

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 It also gives information on projects, replaced and withdrawn publications.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 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	Contactor	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	Degrees of protection against solid foreign objects and water for the enclosures	43
12.4.2	Degrees 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 values 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 using 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	56
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

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

3.1.7

AC EV charging station

EV charging station that supplies alternating current to an EV

3.1.8

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

3.1.9

charging mode

method for connection of an EV to the supply network to supply energy to the vehicle

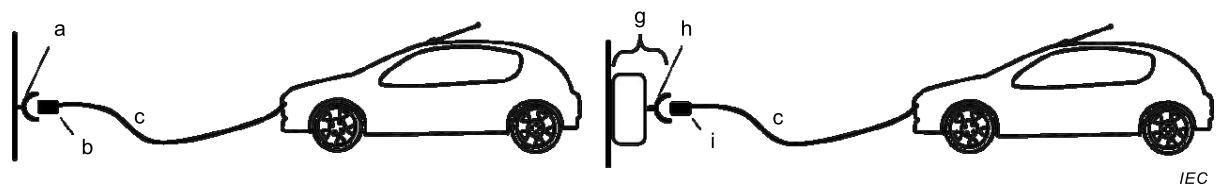
Note 1 to entry: Mode 1, mode 2, mode 3 and mode 4 are described in Clause 6.

3.1.10

case A

connection of an EV to the supply network with a plug and cable permanently attached to the EV

SEE: Figure 1



Note 1 to entry: The cable assembly is part of the vehicle.

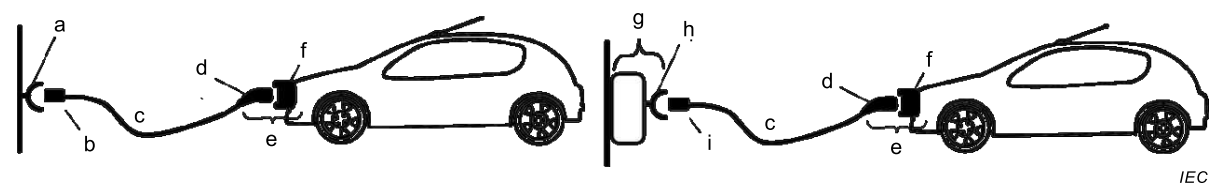
Figure 1 – Case A connection

3.1.11

case B

connection of an EV to a supply network with a cable assembly detachable at both ends

SEE: Figure 2



Note 1 to entry: The detachable cable assembly is not part of the vehicle or the charging station.

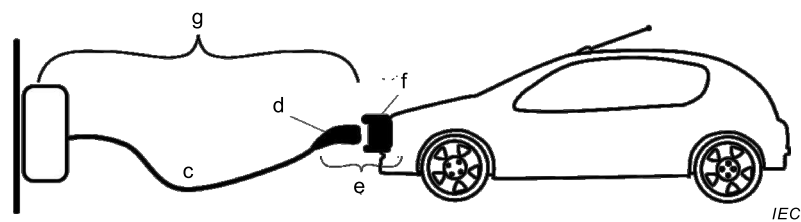
Figure 2 – Case B connection

3.1.12

case C

connection of an EV to a supply network utilizing a cable and vehicle connector permanently attached to the EV charging station.

SEE: Figure 3



Note 1 to entry: The cable assembly is part of the EV charging station.

Figure 3 – Case C connection

Key for Figures 1 to 3

- | | |
|-----------------------|----------------------|
| (a) Socket-outlet | (f) Vehicle inlet |
| (b) Plug | (g) Charging station |
| (c) Cable | (h) EV socket-outlet |
| (d) Vehicle connector | (i) EV plug |
| (e) Vehicle coupler | |

3.2 Insulation

3.2.1

basic insulation

insulation of hazardous-live-parts which provides basic protection

[SOURCE: IEC 60050-826:2004, 826-12-14]

3.2.2

direct contact

electrical contact of persons or animals with live parts

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

3.2.3

double insulation

insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60050-826:2004, 826-12-16]

3.2.4

conductive part

part which can carry electric current

[SOURCE: IEC 60050-195:1998, 195-01-06]

3.2.5

exposed conductive part

conductive part of electrical equipment, which can be touched and which is not normally live, but which can become live when basic insulation fails

Note 1 to entry: A conductive part of electrical equipment which can only become live through contact with an exposed-conductive-part which has become live is not considered to be an exposed-conductive-part itself.

[SOURCE: IEC 60050-441:1998, 442-01-21]

3.2.6

hazardous-live-part

live part which, under certain conditions, can give a harmful electric shock

[SOURCE: IEC 60050-195:1998, 195-06-05]

3.2.7

fault protection

protection against shock under single-fault conditions

[SOURCE: IEC 60050-195:1998/AMD1:2001, 195-06-02]

3.2.8

insulation

all the materials and parts used to insulate conductive elements of a device, or a set of properties which characterize the ability of insulation to provide its function

[SOURCE: IEC 60050-151:2001, 151-15-41, modified and 151-15-42, modified]

3.2.9

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

Note 1 to entry: This concept does not necessarily imply a risk of electric shock.

[SOURCE: IEC 60050-195:1998, 195-02-19]

3.2.10

reinforced insulation

insulation of hazardous-live-parts which provides a degree of protection against electric shock equivalent to double insulation

Note 1 to entry: Reinforced insulation may comprise several layers which cannot be tested singly as basic insulation or supplementary insulation.

[SOURCE: IEC 60050-195:1998, 195-06-09]

3.2.11

supplementary insulation

independent insulation applied in addition to basic insulation for fault protection

[SOURCE: IEC 60050-826:2004, 826-12-15]

3.3 Functions

3.3.1

control pilot conductor

insulated conductor incorporated in a cable assembly, which, together with the protective conductor, is part of the control pilot circuit

3.3.2

control pilot circuit

circuit designed for the transmission of signals or communication between the EV and the EV supply equipment

Note 1 to entry: for Mode 2 it is between the EV and the ICCB or IC-CPD.

3.3.3**control pilot function**

function used to monitor and control the interaction between the EV and the EV supply equipment

3.3.4**control pilot function controller
CPFC**

device in the EV supply equipment and the EV responsible for the control pilot function and the generation of the PWM signal

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

3.3.5**proximity function**

electrical or mechanical means to indicate the insertion state of the vehicle connector in the vehicle inlet to the EV and/or to indicate the insertion state of the plug in the socket-outlet of the EV charging station

3.4 Vehicle**3.4.1****electric vehicle
EV****(electric road vehicle)**

any vehicle propelled by an electric motor drawing current from an RESS, intended primarily for use on public roads

Note 1 to entry: In this standard, these terms refer only to those vehicles that can be charged from an external electrical source.

[SOURCE: ISO 17409]

3.4.2**plug in hybrid electric road vehicle
PHEV**

electrical vehicle that can charge the rechargeable electrical energy storage device from an external electric source and also derives part of its energy from another on-board source

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

3.4.3**rechargeable energy storage system
RESS**

system that stores energy for delivery of electric energy and which is rechargeable

EXAMPLE: batteries, capacitors

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

[SOURCE: ISO 17409]

3.5 Cords, cables and connection means**3.5.1****adaptor**

portable accessory constructed as an integral unit incorporating both a plug portion and one socket-outlet portion

[SOURCE: IEC 60050-442:1998, 442-03-19, modified]

3.5.2

cable assembly

assembly consisting of flexible cable or cord fitted with a plug and/or a vehicle connector, that is used to establish the connection between the EV and the supply network or an EV charging station

Note 1 to entry: A cable assembly can be detachable or be a part of the EV or the EV charging station.

Note 2 to entry: A cable assembly can include one or more cables, with or without a fixed jacket, which can be in a flexible tube, conduit or wire way.

[SOURCE: IEC 62196-1:2014, 3.1, modified]

3.5.3

cable management system

one or more devices that is intended to protect a cable assembly from mechanical damage and/or to facilitate its handling

EXAMPLE: Cable suspension device.

3.5.4

cord extension set

assembly consisting of a flexible cable or cord fitted with plug and a portable socket-outlet or connector which can match each other

Note 1 to entry: The cord is called an “adapter cord” when the plug and socket-outlet do not match.

Note 2 to entry: A Mode 1, Mode 2 or Mode 3 cable assembly is not considered as a cord extension set.

[SOURCE: IEC 60050-461:2008, 461-06-17, modified]

3.5.5

in-cable control box

ICCB

device incorporated in the Mode 2 cable assembly, which performs control functions and safety functions

Note 1 to entry: The “ICCB” is called “function box” in IEC 62752.

Note 2 to entry: This note applies to the French language only.

3.5.6

IC-CPD

Mode 2 cable assembly that complies with IEC 62752

3.5.7

EV socket-outlet

specific socket-outlet intended to be used as part of EV supply equipment and defined in the IEC 62196 series

3.5.8

EV plug

specific plug intended to be used as part of EV supply equipment and defined in the IEC 62196 series

3.5.9

plug

accessory having contacts designed to engage with the contacts of a socket-outlet, also incorporating means for the electrical connection and mechanical retention of flexible cables or cords

[SOURCE: IEC 60050-442:1998, 442-03-01, modified – The word "pins" has been replaced by "contacts" in the definition.]

3.5.10

socket-outlet

accessory having socket-contacts designed to engage with the contacts of a plug and having terminals for the connection of cables or cords

[SOURCE: IEC 60050-442:1998, 442-03-02, modified – The word "pins" has been replaced by "contacts" in the definition.]

3.5.11

standard plug and socket-outlet

plug and socket-outlet which meets the requirements of any IEC and/or any national standard that provides interchangeability by standard sheets, excluding the specific EV accessories as defined in the IEC 62196 series

Note 1 to entry: The IEC 60309-1, IEC 60309-2 and IEC 60884-1 and IEC TR 60083, define standard plugs and socket-outlets.

3.5.12

vehicle coupler

electric vehicle coupler

means of enabling the connection at will of a flexible cable to an electric vehicle

Note 1 to entry: It consists of two parts: a vehicle connector and a vehicle inlet.

[SOURCE: IEC 62196-1:2014, 3.3]

3.5.13

vehicle connector

electric vehicle connector

part of a vehicle coupler integral with, or intended to be attached to the cable assembly

[SOURCE: IEC 62196-1:2014, 3.3.1]

3.5.14

vehicle inlet

electric vehicle inlet

part of a vehicle coupler incorporated in, or fixed to, the electric vehicle

[SOURCE: IEC 62196-1:2014, 3.3.2]

3.5.15

connecting point

point where one electric vehicle is connected to the fixed installation

Note 1 to entry: The connecting point for Modes 1 and 2 is the point where one electric vehicle is connected to the fixed installation or supply network.

Note 2 to entry: The connecting point for Modes 3 and 4 is the point where one electric vehicle is connected to the EV charging station

Note 3 to entry: The connecting point for Mode 1, Mode 2 and Mode 4, connected by a cable and plug is the standard socket-outlet.

Note 4 to entry: The connecting point for Mode 3 and permanently connected Mode 4 is the EV socket-outlet (case A and case B) or the EV connector (case C).

3.5.16

interlock

device or combination of devices that prevents the power contacts of a socket-outlet/vehicle connector from becoming live before it is in proper engagement with a plug/vehicle inlet, and which either prevents the plug/vehicle connector from being withdrawn while its power contacts are live or makes the power contacts dead before separation

3.5.17

retaining means

device (e.g. mechanical or electromechanical) that holds a plug or vehicle connector in position when it is in proper engagement, and prevents its unintentional withdrawal

[SOURCE: IEC 62196-1:2014, 3.9]

3.5.18

latching device

part of the interlock mechanism provided to hold a plug in the socket-outlet or vehicle connector in the vehicle inlet to prevent its intentional or unintentional withdrawal

EXAMPLE See standard sheets 2-II and 2-IIId in IEC 62196-2:2014 and 3-IIId in IEC 62196-3:2014.

[SOURCE: IEC 62196-1:2014, 3.10, modified]

3.5.19

locking mechanism

means intended to reduce the likelihood of tampering with, or an unauthorised removal, of the accessories

[SOURCE: IEC 62196-1:2014, 3.11, modified]

3.5.20

vehicle adaptor

portable accessories constructed as an integral unit incorporating both vehicle inlet portion and vehicle connector portion

3.6 Service and usage

3.6.1

indoor use

intended for operation under normal ambient conditions in a building

[SOURCE: IEC 60050-151:2001, 151-16-06, modified – The term "indoor" has been replaced by "indoor use".]

3.6.2

outdoor use

capable of operating under specific range of outdoor conditions

[SOURCE: IEC 60050-151:2001, 151-16-05, modified – The term "outdoor" has been replaced by "outdoor use".]

3.6.3

equipment for locations with restricted access

equipment accessible to all persons who are authorized to have access to the location (e.g. equipment located in private housing, private parking areas or similar places)

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

3.6.4**equipment for locations with non-restricted access**

equipment accessible for all persons, e.g. access available in a public area

3.6.5**portable equipment**

cord and plug connected equipment, cable assembly, adaptors or other accessories that are capable to be carried by one person and designed and intended to be carried within the EV

3.6.6**mobile equipment**

electric equipment which is moved while in operation or which can easily be moved from one place to another while connected to the supply.

[SOURCE: IEC 60050-826:2004, 826-16-04]

3.6.7**stationary equipment**

equipment or electric equipment not provided with a carrying handle and having such a mass that it cannot easily be moved

Note 1 to entry: Stationary equipment is intended to be either permanently connected to the supply network or connected to the supply network by a cable and plug.

[SOURCE: IEC 60050-826:2004, 826-16-06, modified]

3.6.8**ground mounted**

equipment with a part intended to be embedded or attached to the ground

3.6.9**permanently connected EV supply equipment**

EV supply equipment that can only be connected to, or disconnected from, the AC or DC supply network by the use of a tool

[SOURCE: IEC 60050-151:2001/AMD2:2014, 151-11-29, modified]

3.6.10**user**

party who will specify, purchase, use and/or operate the EV supply equipment, or someone acting on their behalf

[SOURCE: IEC 61439-1:2011, 3.10.3, modified]

3.7 General terms**3.7.1****supply network**

any source of electric energy (eg. mains or electric grid, distributed energy resources (DER), battery bank, PV installation, generator, etc.)

3.7.2**protective conductor**

conductor provided for purposes of safety, for example protection against electric shock

EXAMPLE Examples of a protective conductor include a protective bonding conductor, protective earthing conductor and an earthing conductor when used for protection against electric shock.

[SOURCE: IEC 60050-826:2004, 826-13-22, modified]

3.7.3

protective earthing conductor

protective grounding conductor (US, CA)

equipment grounding conductor (US, CA)

protective conductor provided for protective earthing

Note 1 to entry: In the U.S.A. and in CA, the term "ground" is used instead of "earth".

[SOURCE: IEC 60050-195:1998, 195-02-11, modified – The third term and Note 1 have been added.]

3.7.4

earthing terminal

grounding terminal (US, CA)

terminal provided on equipment or on a device and intended for the electric connection with the earthing arrangement

[SOURCE: IEC 60050-195:1998, 195-02-31]

3.7.5

protective earthing

protective grounding (US, CA)

earthing a point or points in a system or in an installation or in equipment for purposes of electrical safety

[SOURCE: IEC 60050-195:1998/AMD1:2001, 195-01-11]

3.7.6

residual current device

RCD

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

Note 1 to entry: A residual current device can be a combination of various separate elements designed to detect and evaluate the residual current and to make and break current.

[SOURCE: IEC 60050-442:1998, 442-05-02]

3.7.7

leakage current

electric current in an unwanted conductive path under normal operating conditions

[SOURCE: IEC 60050-195:1998, 195-05-15]

3.7.8

switching device

device designed to make or break the current in one or more electric circuits

[SOURCE: IEC 60050-441:1984, 441-14-01]]

3.7.9

mechanical switching device

switching device designed to close and open one or more electric circuits by means of separable contacts

[SOURCE: IEC 60050-441:1984, 441-14-02, modified – The note has been removed.]

3.7.10

touch current

electric current passing through a human body or through an animal body when it touches one or more accessible parts of an electrical installation or electrical equipment

[SOURCE: IEC 60050-826:2004, 826-11-12]

4 General requirements

The EV supply equipment shall be so constructed that an EV can be connected to the EV supply equipment so that in normal conditions of use, the energy transfer operates safely, and its performance is reliable and minimises the risk of danger to the user or surroundings.

Compliance is checked by meeting all of the relevant requirements of the IEC 61851 series.

Unless otherwise stated all tests indicated in this document are type tests.

Unless otherwise stated, all tests required by this standard may be conducted on separate samples. They may be done on the same samples at the manufacturer's agreement.

Unless otherwise stated, each test is conducted once.

Unless otherwise specified, all tests shall be carried out in a draught-free location and at an ambient temperature of $20^{\circ} \pm 5^{\circ} \text{C}$.

The EV supply equipment shall be rated for one or more of standard nominal voltages and frequencies as given in IEC 60038.

NOTE In the following countries, national standards or regulations provide different requirements for frequency: JP.

Assemblies for EV supply equipment shall comply with IEC TS 61439-7 with the exceptions or additions as indicated in Clause 13.

The standard applies to equipment that is designed to be used at an altitude up to 2 000 m.

For equipment designed to be used at altitudes above 2 000 m, it is necessary to take into account the reduction of the dielectric strength and the cooling effect of the air. Electrical equipment intended to operate under these conditions shall be designed or used in accordance with an agreement between manufacturer and user.

5 Classification

5.1 Characteristics of power supply and output

5.1.1 Characteristics of power supply input

The EV supply equipment shall be classified according to the supply network system that it is intended to be connected to:

- EV supply equipment connected to AC supply network;
- EV supply equipment connected to DC supply network.

The EV supply equipment shall be classified according to the electric connection method:

- Plug and cable connected;
- Permanently connected.

5.1.2 Characteristics of power supply output

The EV supply equipment shall be classified according to the type of current the EV supply equipment delivers:

- AC EV supply equipment;
- DC EV supply equipment;
- AC and/or DC EV supply equipment.

5.2 Normal environmental conditions

The EV supply equipment shall be classified according to the environmental conditions and use:

- indoor use;
- outdoor use.

NOTE The conditions that define indoor and outdoor use are given in 7.1.1 of IEC 61439-1:2011.

5.3 Special environmental conditions

The EV supply equipment may be classified according to their suitability for use in special environmental conditions other than those specified in this document, if declared so by the manufacturer.

5.4 Access

The EV supply equipment shall be classified according to the location they are intended for:

- equipment for locations with restricted access;
- equipment for locations with non-restricted access.

5.5 Mounting method

The EV supply equipment shall be classified according to the type of mounting:

- a) stationary equipment;
 - mounted on walls, poles or equivalent positions:
 - flush mounted;
 - surface mounted.
 - pole/column/pipe-mounted
 - floor mounted
 - ground mounted.
- b) non stationary equipment
 - portable equipment;
 - mobile equipment.

NOTE More than one classification can apply.

5.6 Protection against electric shock

The equipment shall be classified according to the protection against electric shock:

- class I equipment;
- class II equipment;
- class III equipment.

NOTE Class I, Class II and Class III descriptions can be found in IEC 61140:2016, 7.3, 7.4 and 7.5.

5.7 Charging modes

The EV supply equipment shall be classified according to 6.2:

- Mode 1;
- Mode 2;
- Mode 3;
- Mode 4.

NOTE EV supply equipment with multiple outputs can be classified as supporting more than one mode.

6 Charging modes and functions

6.1 General

Clause 6 describes the different charging modes and functions for energy transfer to EVs.

6.2 Charging modes

6.2.1 Mode 1

Mode 1 is a method for the connection of an EV to a standard socket-outlet of an AC supply network, utilizing a cable and plug, both of which are not fitted with any supplementary pilot or auxiliary contacts.

The rated values for current and voltage shall not exceed:

- 16 A and 250 V AC, single-phase,
- 16 A and 480 V AC, three-phase.

EV supply equipment intended for Mode 1 charging shall provide a protective earthing conductor from the standard plug to the vehicle connector.

Current limitations are also subject to the standard socket-outlet ratings described in 9.2.

NOTE 1 In the following countries, Mode 1 charging is prohibited by national codes: US, IL, UK

NOTE 2 In the following countries, Mode 1 charging is prohibited in public areas by national codes: IT

NOTE 3 In the following countries, Mode 1 charging without integral ground fault leakage interruption is not permitted: CA

NOTE 4 In the following countries, plugs and socket-outlets according to IEC 60309-2 are recommended for Mode 1 connections for more than 8 A (2 kVA): CH.

NOTE 5 In the following countries, for EV supply equipment equipped with a plug for household and similar use, repeated continuous loads of long duration, shall be limited to 6 A: DK

NOTE 6 In the following countries, EV supply equipment equipped with a plug for household and similar use, if the charging cycle can exceed 2 hours, the maximum rated current is 10 A: NO

NOTE 7 In the following countries, EV supply equipment equipped with a plug for household and similar use, if the charging cycle can exceed 2 hours, the maximum rated current is 8 A: FR

NOTE 8 In the following countries, Mode 1 cable assembly without PCRD shall not be used but only Mode 1 cables with a PCRD: DE

- (Due to Article 14 in the constitutional law of Germany which frames the preservation of status quo of existing electrical installations it cannot be ensured that fixed electrical installations at all times provide an RCD in Germany).

6.2.2 Mode 2

Mode 2 is a method for the connection of an EV to a standard socket-outlet of an AC supply network utilizing an AC EV supply equipment with a cable and plug, with a control pilot function and system for personal protection against electric shock placed between the standard plug and the EV.

The rated values for current and voltage shall not exceed:

- 32 A and 250 V AC single-phase;
- 32 A and 480 V AC three-phase.

Current limitations are also subject to the standard socket-outlet ratings described in 9.2.

EV supply equipment intended for Mode 2 charging shall provide a protective earthing conductor from the standard plug to the vehicle connector.

Mode 2 equipment that is destined to be mounted on a wall but is detachable by the user, or to be used in a shock resistant enclosure shall use protection equipment as required by IEC 62752.

NOTE 1 In the following countries, Mode 2 charging is limited by national codes to 250 V maximum: US, CA.

NOTE 2 In the following countries, Mode 2 is not allowed in public areas: IT.

NOTE 3 In the following countries, Mode 2 shall not exceed 16 A and not exceed 250 V AC in single phase systems: CH.

NOTE 4 In the following countries, the use of IEC 60309-2 accessories is recommended for Mode 2 connections for more than 8 A (2 kVA): CH.

NOTE 5 In the following countries, for EV supply equipment equipped with a plug for household and similar use, repeated continuous loads of long duration, shall be limited to 6 A: DK

NOTE 6 In the following countries, EV supply equipment equipped with a plug for household and similar use, if the charging cycle can exceed 2 hours, the maximum rated current is 8 A: FR

NOTE 7 In the following countries, EV supply equipment equipped with a plug for household and similar use, if the charging cycle can exceed 2 hours, the maximum rated current is 10 A: NO

NOTE 8 In the following countries, the use of IEC 60309-2 accessories is recommended for Mode 2 connections for more than 10 A: IT

6.2.3 Mode 3

Mode 3 is a method for the connection of an EV to an AC EV supply equipment permanently connected to an AC supply network, with a control pilot function that extends from the AC EV supply equipment to the EV.

EV supply equipment intended for Mode 3 charging shall provide a protective earthing conductor to the EV socket-outlet and/or to the vehicle connector.

6.2.4 Mode 4

Mode 4 is a method for the connection of an EV to an AC or DC supply network utilizing a DC EV supply equipment, with a control pilot function that extends from the DC EV supply equipment to the EV.

Mode 4 equipment may be either permanently connected or connected by a cable and plug to the supply network.

EV supply equipment intended for Mode 4 charging shall provide a protective earthing conductor or protective conductor to the vehicle connector.

Additional requirements for DC EV supply equipment are given in IEC 61851-23.

6.3 Functions provided in Mode 2, 3 and 4

6.3.1 Mandatory functions in Modes 2, 3, and 4

6.3.1.1 General

The following control pilot functions shall be provided by the EV supply equipment:

- Continuous continuity checking of the protective conductor according to 6.3.1.2;
- Verification that the EV is properly connected to the EV supply equipment according to 6.3.1.3;
- Energization of the power supply to the EV according to 6.3.1.4;
- De-energization of the power supply to the EV according to 6.3.1.5;
- Maximum allowable current according to 6.3.1.6.

Compliance is checked by inspection and test where applicable.

If EV supply equipment can supply more than one vehicle simultaneously, it shall ensure that the control pilot function performs the above functions independently at each connecting point.

NOTE The control pilot functions can be achieved using a PWM signal and a control pilot as described in Annex A or by any other non PWM system that provides the same results and is compatible with Annex A. An example is given in informative Annex D.

EV supply equipment designed for Mode 2 or Mode 3, using the control pilot conductor and utilizing accessories according to IEC 62196-2, shall be provided with control pilot function according to Annex A.

6.3.1.2 Continuous continuity checking of the protective conductor

While charging in Mode 2, the electrical continuity of the protective earthing conductor between the ICCB and the respective EV contact shall be continuously monitored by the ICCB.

While charging in Mode 3, the electrical continuity of the protective earthing conductor between the EV charging station and the respective EV contact shall be continuously monitored by the EV supply equipment.

While charging in Mode 4, the electrical continuity of the protective conductor between the EV charging station and the respective EV contact shall be continuously monitored by the EV supply equipment.

The EV supply equipment shall disconnect the supply to the EV in case of:

- loss of electrical continuity of the protective conductor (i.e. open control pilot circuit), within 100 ms.
- incapacity to verify the continuity of the protective conductor (e.g. short circuit between pilot wire and protective conductor), within 3 s.

6.3.1.3 Verification that the EV is properly connected to the EV supply equipment

The EV supply equipment shall be able to determine that the EV is properly connected to the EV supply equipment.

Proper connection is assumed when the continuity of the control pilot circuit is detected.

6.3.1.4 Energization of the power supply to the EV

The EV socket-outlet or the vehicle connector shall not be energized unless the control pilot function between EV supply equipment and EV has been established correctly with signal states allowing energization.

The presence of such states does not imply that energy will be transferred between the EV supply equipment and the EV as this may be subject to other external conditions, e.g. energy management system.

If the EV requests ventilation, the EV supply equipment shall only energize the system if such ventilation is provided by the installation or the premises.

6.3.1.5 De-energization of the power supply to the EV

If the control pilot signal is interrupted the power supply to the EV shall be interrupted according to 6.3.1.2.

If the control pilot signal status no longer allows energization, the power supply to the EV shall be interrupted but the control pilot signalling may remain in operation.

6.3.1.6 Maximum allowable current

A means shall be provided to inform the EV of the value of the maximum current it is allowed to draw. The value of the maximum current permitted shall be transmitted and shall not exceed any of the following:

- the rated output current of the EV supply equipment,
- the rated current of the cable assembly.

NOTE The cable assembly includes Mode 2 and Mode 3 cable assemblies.

The transmitted value may change, without exceeding the maximum allowed current, to adapt to power limitations, e.g. for load management.

The EV supply equipment may interrupt the energy supply if the current drawn by the EV exceeds the transmitted value.

6.3.2 Optional functions for Modes 2, 3 and 4

6.3.2.1 General

The optional functions that are implemented shall be indicated in the manual and shall fulfil the requirements of 6.3.2.

Other functions can be provided.

Compliance is checked by inspection and test where applicable.

6.3.2.2 Ventilation during supply of energy

EV supply equipment can exchange information with installation regarding the request and presence for ventilation.

NOTE 1 Ventilation requirements might be subject to local or national regulation or standard.

NOTE 2 In the following countries national regulations may require ventilation for some situations for indoor charging under certain conditions: CA.

NOTE 3 This is mainly a requirement for indoor charging.

6.3.2.3 Intentional and unintentional disconnection of the vehicle connector and/or the EV plug

A mechanical or electromechanical means shall be provided to prevent intentional and unintentional disconnection under load of the vehicle connector and/or plug according to IEC 62196-1.

NOTE 1 IEC 62196-1:2014 defines three levels of prevention of disconnection as given in the definitions 3.9, 3.10 and 3.11 in the order of increasing constraints, as follows:

- Unintentional disconnection prevention -> retaining means,
- Unintentional and intentional disconnection prevention -> latching device,
- Unintentional, intentional disconnection and tampering prevention -> locking mechanism.

NOTE 2 In the following countries a means to prevent unintentional disconnect of the EV accessories is required: CA, US.

6.3.2.4 Mode 4 using the combined charging system

The combined charging system as described in Annex CC of IEC 61851-23:2014 and ISO 17409 shall be so designed that:

- AC chargeable EVs with a basic vehicle inlet do not require any means to protect the EV against DC voltage at the inlet.
- AC EV supply equipment does not require any means to be self-protected against DC voltage coming from the EV.

NOTE 1 Standard Sheets for configuration EE and FF of IEC 62196-3 gives dimensions, rating and relevant mechanical functions of the interfaces EE and FF for DC. EV charging system C is described in Annex CC of IEC 61851-23:2014.

For DC charging, digital communication shall be established between the vehicle and the DC EV charging station that validates the DC energy transfer. The DC supply to the vehicle shall not be connected until such complete validation from the vehicle is achieved.

A combined interface extends the use of a basic interface for AC and DC charging.

DC charging can be achieved by using separate and additional DC power contacts to supply DC energy to the EV or by using power contacts placed at the position of the AC power contacts of a basic interface, if the vehicle connector and the vehicle inlet are both suitable for DC.

The basic portion of the combined vehicle inlet can be used with a basic connector for AC charging only or with a combined connector having separate contacts for AC or DC charging.

AC and DC power transfer shall not occur through the combined interface at the same time.

The combined interface used for DC charging shall only be used with the “Combined Charging System” described in Annex CC of IEC 61851-23:2014.

Analysis and design of the EV supply equipment using a basic interface for DC shall apply a risk analysis according to IEC 61508 (all parts) applying a severity level of at least S2 for the function preventing the risk of unintended DC voltage output.

NOTE 2 Such analysis includes the effect of vehicle faults on EV supply equipment.

7 Communications

7.1 Digital communication between the EV supply equipment and the EV

Digital communication is optional for Modes 1, 2 and 3.

For Mode 4 the digital communication as described in IEC 61851-24 shall be provided to allow the EV to control the EV supply equipment.

NOTE 1 Digital communication as described in ISO/IEC 15118 series is also called high level communication.

NOTE 2 Annex D also provides information on digital communication.

7.2 Digital communication between the EV supply equipment and the management system

Telecommunication network or telecommunication port of the EV supply equipment, connected to the telecommunication network, if any, shall comply with the requirements for connection to telecommunication networks according to Clause 6 of IEC 60950-1:2005.

8 Protection against electric shock

8.1 Degrees of protection against access to hazardous-live-parts

The different parts of the EV supply equipment as mentioned shall fulfil the following requirements:

- IP ratings for enclosures shall be at least IPXXC;
- vehicle connector when mated with vehicle inlet: IPXXD;
- plug mated with socket-outlet: IPXXD;
- vehicle connector intended for Mode 1 use, not mated: IPXXD;
- vehicle connector intended for Mode 2 use, not mated: IPXXB and fulfilling the following:
Minimum opening of the contact equal to the clearance according to IEC 60664-1 considering overvoltage category 2 (e.g. the value given in IEC 60664-1 for 230 V/400 V is 2,5 kV rated impulse voltage withstand that implies 1,5 mm separation of contacts) and inhibits the charging and warns the user in case of welded contact.
- vehicle connector and EV socket-outlet intended for Mode 3 use, not mated: IPXXB provided it is associated directly upstream with a mechanical switching device (see also 12.3) and fulfilling one of the following:
 - a) minimum opening of the contact equal to the clearance according to IEC 60664-1 considering overvoltage category 3 (e.g. the value given in IEC 60664-1 for 230 V/400 V is 4 kV rated impulse voltage withstand that implies at least 3 mm separation of contacts);
 - b) presence of monitoring of the switching contacts associated with a means to operate another mechanical switching device providing isolating function upstream the above in case of fault of operation of the switching device upstream the accessory;
 - c) presence of shutters on live entry hole of the socket-outlets or connectors for case C.

NOTE 1 In the following countries, IPXXB is required for Mode 1: JP, SE, CH, AT, DE, BE, FI

NOTE 2 In the following countries options a and b are only acceptable if both options are used together: NL, IT

NOTE 3 In the following countries the option b alone is not allowed: BE, CH

NOTE 4 In following countries socket-outlets are equipped with shutters where they are mandatory in residential and public locations: FR, UK

NOTE 5 In following countries standard socket-outlets are equipped with shutters where they are mandatory in residential and public locations: DK

NOTE 6 In the following countries, for installations in dwellings and for 16 A applications, Wiring Rules prescribe the use of socket-outlets with shutters: ES

NOTE 7 In the following countries national regulations require shutters or equivalent protection methods with equivalent safety levels. For example: installation heights, blocking objects against touch ability, interlocking, locking cover etc. SE

NOTE 8 In the following countries the use of software controlled means cannot be used to control isolating devices: UK

Compliance is checked by inspection and measurement.

8.2 Stored energy

8.2.1 Disconnection of plug connected EV supply equipment

For plug connected EV supply equipment, where the connection pins are accessible after unplugging, one second after disconnecting the standard plug from the standard socket-outlet, the voltage between any combination of accessible contacts of the standard plug shall be less than or equal to 60 V DC or the stored charge available shall be less than 50 μC .

Compliance is checked by inspection and by test with the EV disconnected according to 2.1.1.5 of IEC 60950-1:2005.

NOTE Requirements for the EV are specified in ISO 17409.

8.2.2 Loss of supply voltage to permanently connected EV supply equipment

The voltage between power lines or power lines and protective earthing conductor, when measured at the input supply terminals of the EV supply equipment, shall be less than or equal to 60 V DC or the stored energy shall be less than or equal to 0,2 J within 5 seconds after disconnecting the power supply voltage to the EV supply equipment.

Compliance is checked by inspection and by test with no EV connected to the EV supply equipment according to 2.1.1.7 of IEC 60950-1:2005.

8.3 Fault protection

Fault protection shall consist of one or more protective measures as permitted according to IEC 60364-4-41:

- automatic disconnection of supply;
- double or reinforced insulation;
- electrical separation if limited to the supply of one item of current-using equipment;
- extra low-voltage (SELV and PELV).

Electric separation is fulfilled if there is one electrically separated circuit for each EV.

Compliance is checked by inspection.

8.4 Protective conductor

The protective earthing conductor and the protective conductor shall be of sufficient rating in accordance with requirements of IEC TS 61439-7.

NOTE In the following countries, the size and rating of the protective earthing conductor are determined by national codes and regulations: CA, US, JP

For Modes 1, 2 and 3, a protective earthing conductor shall be provided between the AC supply input earthing terminal of the EV supply equipment and the EV.

Mode 4 EV supply equipment shall provide either:

- a) a protective earthing conductor from the input earthing terminal of the AC supply network to the EV
- or

- b) a protective conductor from the EV supply equipment to the EV if fault protection is based on electric separation.

For Modes 3 and 4 permanently connected EV supply equipment, protective earthing conductors shall not be switched.

Compliance is checked by inspection.

8.5 Residual current protective devices

EV supply equipment can have one or more connecting points to supply energy to EVs.

Where connecting points can be used simultaneously and are connected to a common input terminal of the EV supply equipment, they shall have individual protection incorporated in the EV supply equipment.

If the EV supply equipment has more than one connecting point that cannot be used simultaneously then such connecting points can have common protection devices.

EV supply equipment that includes an RCD and that does not use the protective measure of electrical separation shall comply with the following:

- The connecting point of the EV supply equipment shall be protected by an RCD having a rated residual operating current not exceeding 30 mA;
- RCD(s) protecting connecting points shall be at least type A;
- RCDs shall comply with one of the following standards: IEC 61008-1, IEC 61009-1, IEC 60947-2 and IEC 62423;
- RCDs shall disconnect all live conductors.

NOTE 1 This applies to single-phase or three-phase connecting points.

Where the EV supply equipment is equipped with a socket-outlet or vehicle connector for AC use in accordance with IEC 62196 (all parts), protective measures against DC fault current shall be taken. The appropriate measures shall be:

- RCD type B or
- RCD Type A and appropriate equipment that ensures the disconnection of the supply in case of DC fault current above 6 mA.

NOTE 2 An example of appropriate equipment that ensures the disconnection of the supply in case of DC fault is expected in the future IEC 62955⁷.

NOTE 3 The RCDs or the appropriate equipment that ensure the disconnection of the supply in case of DC fault can be provided inside the EV supply equipment, in the installation or in both places.

NOTE 4 Selectivity can be maintained between the RCD protecting a connecting point and an RCD installed upstream when required for service purposes.

NOTE 5 In the following countries, as the installations are equipped with RCD of Type AC, a means for the protection of fault current with a performance at least equal to Type A in addition to appropriate equipment that ensures the disconnection of the supply in case of DC fault current above 6 mA is provided by the EV supply equipment: JP.

NOTE 6 In the following country, the use of a system of protection is required that is intended to interrupt the electric circuit to the load when:

- a fault current to earth (ground) exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit,
- the earthing (grounding) path becomes open circuited or becomes an excessively high impedance, or a path to earth (ground) is detected on an isolated (ungrounded) system: US, CA.

⁷ Under preparation.

NOTE 7 In the following countries the use of a RCD of type AC for EVs connected by Mode 1 to domestic installations is allowed: JP, SE, UK, CA.

NOTE 8 In some countries, a device which measures leakage current using a frequency sensitive network and trips at predefined levels of leakage current up to 20 mA, based upon the frequency is required: US, CA.

NOTE 9 A PRCD as described in IEC 61540 or IEC 62335, can be used to improve protection for connection to existing AC power supply networks in Mode 1.

8.6 Safety requirements for signalling circuits between the EV supply equipment and the EV

Any circuit for signalling, which extends beyond the EV supply equipment enclosure for connection with the EV (e.g. control pilot circuit), shall be extra low voltage (SELV or PELV) according to IEC 60364-4-41.

8.7 Isolating transformers

Isolating transformers (excluding safety isolating transformers used for signalling) shall comply with the requirements of IEC 61558-1 and IEC 61558-2-4.

Compliance is checked by inspection.

9 Conductive electrical interface requirements

9.1 General

Clause 9 provides a description of the conductive electrical interface requirements.

9.2 Functional description of standard accessories

Standard accessories used for EV supply equipment shall be in accordance with IEC 60309-1, IEC 60309-2 or IEC 60884-1 or the national standard. Standard accessories that are intermateable with interfaces described in the IEC 60320 series shall not be used for EV supply equipment.

Compliance is checked by inspection.

NOTE 1 In the following countries, IEC 60884-1, IEC 60884-2-5 and all other parts of the IEC 60884 series of standards are not indispensable and not applicable. National standards apply to plugs and socket-outlets for household use: UK.

Socket-outlets and plugs designed for household and similar use might not be designed for extended current draw or continuous use at maximum rated currents and might be subject to national regulations and standards for supply of energy to an EV.

NOTE 2 In the following countries the branch circuit overcurrent protection is based on 125 % of the rated current: US, CA.

NOTE 3 In the following countries, specific requirements may apply for the use of such accessories for EV energy supply: US.

NOTE 4 In the following countries EV supply equipment equipped with a plug for household and similar use the maximum rated current is 8 A, if the charging cycle can exceed 2 hours: FR.

NOTE 5 In the following countries, EV supply equipment equipped with a plug for household and similar use, if the charging cycle can exceed 2 hours, the maximum rated current is 10 A: NO.

NOTE 6 In the following countries, for EV supply equipment equipped with a plug for household and similar use, repeated continuous loads of long duration, shall be limited to 6 A: DK.

NOTE 7 In the following countries, plugs and socket-outlets, according to IEC 60309-2 are recommended for Mode 1 and Mode 2 connections for more than 8 A (2 kVA): CH.

NOTE 8 In the following country, 20 A socket-outlet is recommended for AC 200 V: JP.

9.3 Functional description of the basic interface

General requirements and ratings shall be in accordance with the requirements specified in IEC 62196-1.

The basic interface is specified in 6.5 of IEC 62196-1:2014.

The following contacts are indicated:

- up to three phases (L1, L2, L3);
- neutral (N);
- protective conductor (PE);
- control pilot (CP);
- proximity contact (PP).

It may be used either for single-phase or for three-phase or both.

Ratings and requirements for the use of the basic interface shall be in accordance with the requirements specified in IEC 62196-2.

9.4 Functional description of the universal interface

General requirements and ratings shall be in accordance with the requirements specified in IEC 62196-1.

The universal interface is specified in 6.4 and Table 2 of IEC 62196-1:2014.

9.5 Functional description of the DC interface

General requirements and ratings shall be in accordance with the requirements specified in IEC 62196-1.

The DC interface, configurations and ratings are specified in 6.6 and Table 4 of IEC 62196-1:2014.

Ratings and requirements for the use of DC interface shall be in accordance with the requirements specified in IEC 62196-3.

9.6 Functional description of the combined interface

The combined interface is specified in 6.7 and Table 5 of IEC 62196-1:2014.

General requirements and ratings shall be in accordance with the requirements specified in IEC 62196-1.

Ratings and requirements for the use of the combined interface with alternating current shall be in accordance with the requirements specified in IEC 62196-2.

Ratings and requirements for the use of the combined interface with direct current shall be in accordance with the requirements specified in IEC 62196-3.

9.7 Wiring of the neutral conductor

Where accessories according to IEC 62196 are used for three phase supply the neutral conductor shall always be wired to the accessories.

Where accessories according to IEC 62196 are used for single phase supply, the terminals L (L1) and N (Neutral) shall always be wired.

Compliance is checked by inspection.

NOTE In the following countries certain AC supply networks do not provide a neutral conductor: US, BE, IT, CA, JP, CH, NO.

Wiring instructions shall be provided in the manual (see 16.1).

10 Requirements for adaptors

Vehicle adaptors shall not be used to connect a vehicle connector to a vehicle inlet.

Adaptors between the EV socket-outlet and the EV plug shall only be used if specifically designated and approved by the vehicle manufacturer or by the EV supply equipment manufacturer and in accordance with national requirements, if any (see 16.2).

Such adaptors shall comply with the requirements of this standard, and the other relevant standards governing either the EV plug or EV socket-outlet portions of the adaptor. The adaptors shall be marked to indicate the specific conditions of use allowed by the manufacturer, e.g. IEC 62196 series.

Such adaptors shall not allow transitions from one mode to another.

NOTE 1 In the following countries, the use of adaptors from standard socket-outlets to Mode 3 vehicle cable assembly, that maintain the overall safety requirements of this standard is allowed: IT, SE, BE, CH.

NOTE 2 In the following countries, the use of adaptors from standard socket-outlets to cable assembly with a basic or universal interface that maintains the overall safety requirements of this standard is allowed: FR, IT.

NOTE 3 In the following countries, for Mode 1 and Mode 2, a short cord extension set of less than 30 cm in length and with a standard plug and no Mode change, is permitted for use on the EV supply equipment: SE.

NOTE 4 In the following countries, the use of adapter cable assembly with a plug according to IEC 60884 and a socket-outlet according to IEC 60309, with no Mode change, of less than 30 cm and an overcurrent protection of 8 A in the plug portion, is allowed: CH.

11 Cable assembly requirements

11.1 General

The cable assembly shall be provided with a cable that is suitable for the application.

NOTE IEC 62893 (under consideration) is a standard for some types of cables for the EV supply equipment.

Cable assemblies shall not allow transitions from one mode to another. This does not concern Mode 2 cable assemblies that are constructed according to IEC 62752.

11.2 Electrical rating

For case C, the voltage and current ratings of the cable assembly shall be compatible with the rating of the EV supply equipment.

For accessories requiring current coding according to Annex B and IEC 62196-2, the maximum value of the current coding as indicated in Clause B.2 shall be in accordance with the current rating of the cable assembly.

Cables used with accessories according to IEC 62196-2 for Mode 3 case B, shall have a minimum withstand I^2t value of 75 000 A²s.

Compliance is checked by inspection.

NOTE 1 IEC 62893 standard for EV charging cables is under consideration.

NOTE 2 In following countries, specific cable types for cable assemblies are required by national regulations: US (type cable EV, EVJ families), JP (VCT, etc.).

NOTE 3 The I^2t value can be evaluated according to 434.5.2 of IEC 60364-4-43:2008.

11.3 Dielectric withstand characteristics

Dielectric withstand characteristics of the cable assembly shall be as indicated for the EV supply equipment in 12.7.

For Class I equipment: between live part and earth with test voltage for Class I equipment;

For Class II equipment: between live part and exposed conductive parts with test voltage for Class II equipment.

11.4 Construction requirements

A cable assembly shall be so constructed that it cannot be used as a cord extension set.

NOTE As in IEC 62196-1, plugs and connectors are designed not to match each other.

A cable assembly may include one or more cables, which may be in a flexible tube, conduit or wire way.

The cable may be fitted with an earth-connected metal shielding.

The cable insulation shall be wear resistant and maintain flexibility over the full temperature range required by the classification of the EV supply equipment.

Compliance is checked by inspection.

11.5 Cable dimensions

The maximum cable length shall be in accordance with the national codes if any.

NOTE 1 In the following countries, the overall length of the EV supply cable does not exceed 7,5 m unless equipped with a cable management system as required by national codes and regulations: US.

NOTE 2 In the following countries, the overall length of the EV supply cable does not exceed 5 m unless equipped with a cable management system as required by national codes and regulations: CH.

Compliance is checked by inspection.

11.6 Strain relief

The strain relief of the cable in the vehicle connector, EV plug or in the standard plug shall be as specified in the relevant product standard (e.g. IEC 62196-1, IEC 60309-1 or IEC 60884-1).

For case C the strain relief at the EV supply equipment shall be in accordance with the requirements in IEC 62196-1.

11.7 Cable management and storage means for cables assemblies

For case C EV supply equipment, a storage means shall be provided for the vehicle connector when not in use.

For case C EV supply equipment the lowest point of the vehicle connector when stored shall be located at a height between 0,5 m and 1,5 m above ground level.

NOTE In the following countries, requirements related to people with disabilities are covered by national regulations: US.

For case C EV charging stations with cables of more than 7,5 m, a cable management system shall be provided. The free cable length shall not exceed 7,5 m when not in use.

Prevention of overheating of cables or cable assemblies used in stored or partially stored position shall be ensured.

Compliance is checked according to Clause 22 of IEC 61316:1999 for cable reel storage.

12 EV supply equipment constructional requirements and tests

12.1 General

The control means and the protection means in Mode 2 EV supply equipment that is intended to be used both as stationary equipment and as portable equipment shall comply with IEC 61851-1 and with IEC 62752.

For case C EV supply equipment, the output cable assembly is considered part of the assembly for testing purpose.

Electric devices and components of EV supply equipment shall comply with their relevant standards. The tests of devices and components shall be carried out with the specimen, or any movable part of it, placed in the most unfavourable position that can occur in normal use.

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

NOTE 1 In the following countries, there are other requirements to be met for EV supply equipment: JP, US, CA.

NOTE 2 In the following countries, as exception to 10.2.101 and 10.2.102 of IEC TS 61439-7:2014, the product shall fulfil a minimum requirement of IP XXB after the test: SE.

12.2 Characteristics of mechanical switching devices

12.2.1 General

Switching devices within EV supply equipment intended to supply the connecting points shall comply with their relevant standards, with at least the characteristics as given in 12.2.

12.2.2 Switch and switch-disconnector

Switches and switch-disconnectors shall comply with IEC 60947-3.

For AC applications, switches and switch-disconnectors shall have a rated current, at a utilization category of at least AC-22A, not less than the rated current of the circuit that they are intended to operate in.

For DC applications, switches and switch-disconnectors shall have a rated current, at a utilization category of at least DC-21A, not less than the rated current of the circuit that they are intended to operate in.

Compliance is checked by inspection.

NOTE In the following countries, national standards or regulations provide different requirements: JP