

INTERNATIONAL STANDARD

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

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

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX



ICS 43.120

ISBN 978-2-88912-222-6

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ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –**Part 1: General requirements**

FOREWORD

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

This second edition cancels and replaces the first edition published in 2001. It constitutes a technical revision.

The main changes with respect to the first edition of this standard are the following:

- revision of connector definitions and current levels (Clause 8);
- modification definition of pilot wire to pilot function;
- division of Clause 9 to create Clauses 9 and 11;
- Clause 9: specific requirements for inlet, plug and socket–outlet;
- Clause 11: EVSE requirements: the basic generic requirements for charging stations;
- renumbering of annexes;

- deletion of previous Annex A and integration of charging cable requirements into new Clause 10;
- Annex B becomes Annex A and is normative for all systems using a PWM pilot function with a pilot wire;
- Annex C becomes Annex B;
- replacement of previous Annex D (coding tables for power indicator) with B.4 in Annex B using new values;
- new informative Annex C describing an alternative pilot function system.

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

FDIS	Report on voting
69/173/FDIS	69/179/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.

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.

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

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ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –

Part 1: General requirements

1 Scope

This part of IEC 61851 applies to on-board and off-board equipment for charging electric road vehicles at standard a.c. supply voltages (as per IEC 60038) up to 1 000 V and at d.c. voltages up to 1 500 V, and for providing electrical power for any additional services on the vehicle if required when connected to the supply network.

Electric road vehicles (EV) implies all road vehicles, including plug in hybrid road vehicles (PHEV), that derive all or part of their energy from on-board batteries.

The aspects covered include characteristics and operating conditions of the supply device and the connection to the vehicle; operators and third party electrical safety, and the characteristics to be complied with by the vehicle with respect to the a.c./d.c. EVSE, only when the EV is earthed.

NOTE 1 Class II vehicles are not defined, but the lack of information for this type of vehicle means that the requirements for the standard are under consideration.

NOTE 2 This standard also applies to EVSE with on-site storage capability.

Requirements for specific inlet, connector, plug and socket-outlets for EVs are contained in IEC 62196-1:2003. Standard sheets for the vehicle connector and inlet are also under consideration. They will be incorporated in a separate part of standard IEC 62196.

This standard does not cover all safety aspects related to maintenance.

This standard is not applicable to trolley buses, rail vehicles, industrial trucks and vehicles designed primarily for use off-road.

2 Normative references

The following referenced documents are indispensable for the application 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 60038:2009, *IEC standard voltages*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 + 12 h cycle)*

IEC 60068-2-75:1997, *Environmental testing – Part 2: Tests – Test Eh: Hammer tests*

IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60276, *Definitions and nomenclature for carbon brushes, brush-holders, commutators and slip-rings*

IEC 60309-1:1999, *Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements*

IEC 60309-2:1999, *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

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

IEC 60529:1989, *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/TR 60755:2008, *General requirements for residual current operated protective devices*

IEC 60884-1:2002, *Plugs and socket-outlets for household and similar purposes – Part 1: General requirements*

IEC 60884-2-5:1995, *Plugs and socket-outlets for household and similar purposes – Part 2 particular requirements for adaptors*

IEC 60947-3:2008, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

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

IEC 60990:1999, *Methods of measurement of touch current and protective conductor current*

IEC 61000-6-1:2005, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments*

IEC 61000-6-3:2006, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*

IEC 61008-1:2010, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – General rules*

IEC 61009-1:2010, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – General rules*

IEC 61180-1:1992, *High-voltage test techniques for low-voltage equipment – Part 1: definitions, test and procedure requirements*

IEC 62196-1:2003, *Plugs, socket-outlets, vehicle couplers and vehicle inlets – Conductive charging of electric vehicles – Part 1: Charging of electric vehicles up to 250 A a.c. and 400 A d.c.*

ISO 6469-2:2009, *Electrically propelled road vehicles – Safety specifications – Part 2: Vehicle operational safety means and protection against failures*

ISO 6469-3:2001, *Electric road vehicles – Safety specifications – Part 3: Protection of persons against electric hazards*

EN 50065-1:2001, *Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz – Part 1: General requirements, frequency bands and electromagnetic disturbances*

SAE J1772:2010, *Recommended practices: SAE Electric Vehicle and Plug In Hybrid Electric Vehicle Conductive Charge Coupler*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

basic insulation

insulation of hazardous-live-parts which provides basic protection

3.2

cable assembly

piece of equipment used to establish the connection between the EV and socket-outlet (in case A and case B) or to the fixed charger (in case C)

NOTE 1 It may be either fixed or be included in the vehicle or the EVSE, or detachable.

NOTE 2 It includes the flexible cable and the connector and/or plug that are required for proper connection.

NOTE 3 See Figures 1 to 3 for description of cases A, B and C.

NOTE 4 A detachable cable assembly is not considered as a part of the fixed installation.

3.3

charger

power converter that performs the necessary functions for charging a battery

3.3.1

class I charger

charger with basic insulation as provision for basic protection and protective bonding as provision for fault protection

NOTE Protective bonding consists of connection of all exposed conductive parts to the charger earth terminal.

3.3.2

class II charger

charger with

- basic insulation as provision for basic protection, and
 - supplementary insulation as provision for fault protection,
- or in which
- basic and fault protection are provided by reinforced insulation

3.3.3

off-board charger

charger connected to the premises wiring of the a.c. supply network (mains) and designed to operate entirely off the vehicle. In this case, direct current electrical power is delivered to the vehicle

3.3.3.1

dedicated off-board charger

off-board charger designed to be used only by a specific type of EV, which may have control charging functions and/or communication

3.3.4

on-board charger

charger mounted on the vehicle and designed to operate only on the vehicle

**3.4
charging**

all functions necessary to condition standard voltage and frequency a.c. supply current to a regulated voltage/current level to assure proper charging of the EV traction battery and/or supply of energy to the EV traction battery bus, for operating on-board electrical equipment in a controlled manner to assure proper energy transfer

**3.5
connection**

single conductive path

**3.6
control pilot**

the control conductor in the cable assembly connecting the in-cable control box or the fixed part of the EVSE, and the EV earth through the control circuitry on the vehicle. It may be used to perform several functions

**3.7
earth terminal**

accessible connection point for all exposed conductive parts electrically bound together

NOTE In the U.S.A., the term "ground" is used instead of "earth".

**3.8
electric vehicle
EV**

electric road vehicle (ISO)

any vehicle propelled by an electric motor drawing current from a rechargeable storage battery or from other portable energy storage devices (rechargeable, using energy from a source off the vehicle such as a residential or public electric service), which is manufactured primarily for use on public streets, roads or highways

**3.8.1
class I EV**

an EV with basic insulation as provision for basic protection and protective bonding as provision for fault protection

NOTE This consists of connection of all exposed conductive parts to the EV earth terminal.

**3.8.2
class II EV**

EV in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions, such as double insulation or reinforced insulation, are provided, there being no provision for protective earthing or reliance upon installation conditions

**3.9
EV supply equipment
EVSE**

conductors, including the phase, neutral and protective earth conductors, the EV couplers, attachment plugs, and all other accessories, devices, power outlets or apparatuses installed specifically for the purpose of delivering energy from the premises wiring to the EV and allowing communication between them if required

**3.9.1
a.c. EV charging station**

all equipment for delivering a.c. current to EVs, installed in an enclosure(s) and with special control functions

3.9.2**d.c. EV charging station**

all equipment for delivering d.c. current to EVs, installed in an enclosure(s), with special control functions and communication and located off the vehicle

NOTE DC charging includes pulse mode charging.

3.9.3**exposed conductive part**

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

3.9.4**direct contact**

contact of persons with live parts

3.9.5**indirect contact**

contact of persons with exposed conductive parts made live by an insulation failure

3.10**live part**

any conductor or conductive part intended to be electrically energized in normal use

3.10.1**hazardous live part**

live part, which under certain conditions, can result in an electric shock

3.11**in-cable control box**

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

NOTE The in-cable control box is located in a detachable cable assembly or plug that is not part of the fixed installation.

3.12**plug and socket-outlet**

means of enabling the manual connection of a flexible cable to fixed wiring

NOTE It consists of two parts: a socket-outlet and a plug.

3.12.1**plug**

part of a plug and socket-outlet integral with or intended to be attached to the flexible cable connected to the socket-outlet

3.12.2**socket-outlet**

part of a plug and socket-outlet intended to be installed with the fixed wiring

3.13**power indicator**

resistor value identifying supply rating recognition by the vehicle

3.14**retaining device**

mechanical arrangement which holds a plug or connector in position when it is in proper engagement, and prevents unintentional withdrawal of the plug or connector

NOTE The retaining device can be electrically or mechanically operated.

3.15
vehicle coupler

means of enabling the manual connection of a flexible cable to an EV for the purpose of charging the traction batteries

NOTE It consists of two parts: a vehicle connector and a vehicle inlet.

3.15.1
vehicle connector

part of a vehicle coupler integral with, or intended to be attached to, the flexible cable connected to the a.c. supply network (mains)

3.15.2
vehicle inlet

part of a vehicle coupler incorporated in, or fixed to, the EV or intended to be fixed to it

3.16
function

any means, electronic or mechanical, that insure that the conditions related to the safety or the transmission of data required for the mode of operation are respected

3.17
pilot function

any means, electronic or mechanical, that insures the conditions related to the safety or the transmission of data required for the mode of operation

3.18
proximity function

a means, electrical or mechanical, in a coupler to indicate the presence of the vehicle connector to the vehicle

3.19
standardized socket-outlet

socket-outlet which meets the requirements of any IEC and/or national standard

3.20
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 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.

NOTE 2 In the following countries an RCD may be either electrical, electronic, mechanical or a combination thereof: US, JP, UK.

[IEC 60050-44:1998, 442-05-02]

3.21
pulse mode charging

charging of storage batteries using modulated direct current

3.22
standard interface

interface that is defined by any of the following standards IEC 60309-1, IEC 60309-2, or IEC 60884-1 and/or national standard having an equivalent scope, and is not fitted with any supplementary pilot or auxiliary contacts

**3.23
basic interface**

interface as defined by the IEC 62196-1 and for which a functional description is given in 8.4

**3.24
universal interface**

interface as defined by the IEC 62196-1 and for which a functional description is given in 8.5

**3.25
plug in hybrid electric road vehicle
PHEV**

any electrical vehicle that can charge the rechargeable electrical energy storage device from an external electric source and also derives part of its energy from an other source

**3.26
cord extension set**

assembly consisting of a flexible cable or cord fitted with both a plug and a connector of a standard interface type

NOTE A mode 2 or a mode 1 cable assembly is not considered as a cord extension set.

**3.27
adaptor**

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

NOTE The socket-outlet may accept different configurations and ratings.

**3.28
indoor use**

equipment designed to be exclusively used in a weather protected locations

**3.29
outdoor use**

equipment designed to be allowed to be used in non weather protected locations

4 General requirements

The EV shall be connected to the EVSE so that in normal conditions of use, the conductive energy transfer function operates safely.

In general, this principle is achieved by fulfilling the relevant requirements specified in this standard, and compliance is checked by carrying out all relevant tests.

5 Rating of the supply a.c. voltage

The rated value of the a.c. supplied voltage for the charging equipment is up to 1 000 V. The equipment shall operate correctly within $\pm 10\%$ of the standard nominal voltage. The rated value of the frequency is $50\text{ Hz} \pm 1\%$ or $60\text{ Hz} \pm 1\%$.

NOTE Nominal voltage values can be found in IEC 60038.