

# INTERNATIONAL STANDARD

**IEC**  
**61851-1**

First edition  
2001-01

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## **Electric vehicle conductive charging system –**

### **Part 1: General requirements**

*Dispositif de charge conductive pour véhicules électriques –*

*Partie 1:  
Prescriptions générales*

IEC 61851-1:2001

<https://standards.iteh.ai/catalog/standards/iec/801c2c51-96fd-47af-92c1-31577ddeb347/iec-61851-1-2001>



Reference number  
IEC 61851-1:2001(E)

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Commission Electrotechnique Internationale  
International Electrotechnical Commission  
Международная Электротехническая Комиссия

PRICE CODE

W

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# INTERNATIONAL ELECTROTECHNICAL COMMISSION

## 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.

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

FDIS	Report on voting
69/124/FDIS	69/127/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 3.

Annex A forms an integral part of this standard.

Annexes B, C, D and E are for information only.

The committee has decided that the contents of this publication will remain unchanged until 2005. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

This standard is published in separate parts under the general title *Electric vehicle conductive charging system* and includes:

- Part 1: General requirements
- Part 21: Electric vehicle requirements for conductive connection to an a.c./d.c. supply <sup>1</sup>
- Part 22: AC electric vehicle charging station <sup>1</sup>
- Part 23: DC electric vehicle charging station <sup>1</sup>

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

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<sup>1</sup> To be published.

# ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –

## Part 1: General requirements

### 1 Scope

This part of IEC 61851 applies to equipment for charging electric road vehicles at standard a.c. supply voltages (as per IEC 60038) up to 690 V and at d.c. voltages up to 1 000 V, and for providing electrical power for any additional services on the vehicle if required when connected to the supply network.

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 excluded, but the lack of information on this type of vehicle means that the requirements for the standard are unavailable at present.

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

NOTE 3 Requirements for specific inlet, connector, plug and socket-outlets for EVs are also under consideration. They shall be incorporated in a separate standard (in the IEC 60309 series) when complete.

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 normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61851. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61851 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60038:1983, *IEC standard voltages*

IEC 60245-1:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 1: General requirements*<sup>1</sup>

Amendment 1 (1997)

Amendment 2 (1997)

IEC 60245-2:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 2: Test methods*<sup>2</sup>

Amendment 1 (1997)

Amendment 2 (1997)

<sup>1</sup> There is a consolidated edition 3.2 (1998) that includes IEC 60245-1 (1994) and its amendment 1 (1997) and amendment 2 (1997).

<sup>2</sup> There is a consolidated edition 2.2 (1998) that includes IEC 60245-2 (1994) and its amendment 1 (1997) and amendment 2 (1997).



IEC 60245-3:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 3: Heat resistant silicone rubber insulated cables*  
Amendment 1 (1997)

IEC 60245-4:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables*  
Amendment 1 (1997)

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

IEC 60364-4-41:1999, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 41: Protection against electric shock*<sup>1</sup>

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60950:1999, *Safety of information technology equipment*

### 3 Definitions

For the purpose of this part of IEC 61851, the following definitions apply:

#### 3.1

##### **auxiliary circuit**

electrical circuit supplying the vehicle functions other than for propulsion, such as lamps, windscreen motors and radios

#### 3.2

##### **battery assembly energy store**

assembly consisting of secondary cells or monoblocs, one or several battery trays and such auxiliary appliances as battery fuses, automatic topping-up equipment, intercell connectors, battery monitoring devices

#### 3.3

##### **cable assembly**

piece of equipment which is used to establish the connection between the EV and the EVSE. It may be either fixed and included in one of these devices, or detachable. It includes the flexible cable and the connector and/or plug that are required for proper connection (see figures 1 to 3)

#### 3.4

##### **charger**

power converter that performs the necessary functions for charging a battery

##### 3.4.1

##### **class I charger**

charger having functional (basic) insulation throughout, whose conductive accessible parts are connected to the protective earthing conductor and provided with an earthing terminal or connection to the vehicle

##### 3.4.2

##### **class II charger**

charger having double insulation and/or reinforced insulation throughout. It shall have a lead-through protective conductor for earthing the EV chassis

<sup>1</sup> There is a consolidated edition 3.2 (1999) that includes IEC 60364-4-41 (1992) and its amendment 1 (1996) and amendment 2 (1999).

### 3.4.3

#### **off-board charger**

charger connected to the premise 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

#### 3.4.3.1

##### **dedicated off-board charger**

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

### 3.4.4

#### **on-board charger**

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

### 3.5

#### **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

### 3.6

#### **connection**

means single conductive path

### 3.7

#### **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

### 3.8

#### **earth terminal**

the accessible connection point for all exposed conductive parts electrically bound together

### 3.9

#### **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

#### 3.9.1

##### **class I EV**

an EV the protection of which against electric shocks, when connected to an a.c. supply network (mains), does not rely only on the functional insulation, but includes supplementary safety measures. This shall consist of connecting all exposed conductive parts to the EV earth terminal

#### 3.9.2

##### **class II EV**

an 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

### 3.10

#### **EV supply equipment (EVSE)**

the conductors, including the unearthed, earthed and equipment earthing 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 premise wiring to the EV and allowing communication between them if required

#### 3.10.1

##### **a.c. EV charging station**

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

#### 3.10.2

##### **d.c. EV charging station (d.c. 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

### 3.11

#### **exposed conductive part**

a conductive part of electrical equipment (e.g. an EV) that may be touched and which is not normally energized but which may be so in the case of a fault

#### 3.11.1

##### **direct contact**

contact of persons with live parts

#### 3.11.2

##### **indirect contact**

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

### 3.12

#### **live part**

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

#### 3.12.1

##### **hazardous live part**

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

### 3.13

#### **in-cable control box**

a device which is incorporated in the cable assembly and which performs control functions. It is located within 0,3 m of the plug or the EVSE

### 3.14

#### **plug and socket-outlet**

a means of enabling the manual connection of a flexible cable to fixed wiring. It consists of two parts: a socket-outlet and a plug

#### 3.14.1

##### **plug**

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

#### 3.14.2

##### **socket-outlet**

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

### 3.15

#### **power indicator**

resistor value identifying supply rating recognition by the vehicle

### 3.16

#### **retaining device**

a 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.

### 3.17

#### **vehicle coupler**

a means of enabling the manual connection of a flexible cable to an EV for the purpose of charging the traction batteries. It consists of two parts: a vehicle connector and a vehicle inlet

#### 3.17.1

##### **vehicle connector**

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

#### 3.17.2

##### **vehicle inlet**

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

## 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 voltage

The rated value of the vehicle a.c. supply voltage is up to 690 V. The equipment shall operate correctly within  $\pm 10\%$  of the standard nominal voltage (see IEC 60038). The rated value of the frequency is 50 Hz  $\pm 1\%$  or 60 Hz  $\pm 1\%$ .

## 6 General system requirement and interface

### 6.1 General description

One method for EV charging is to connect the a.c. supply network (mains) to an on-board charger. An alternative method for charging an EV is to use an off-board charger for delivering direct current.

For charging in a short period of time, special charging facilities operating at high power levels could be utilized.

### 6.2 EV charging modes

There are four possible modes of charging, as follows: