IEC TS 61851-3-1

Edition 1.0 2023-07

TECHNICAL SPECIFICATION

Electric vehicle conductive charging system –
Part 3-1: DC EV supply equipment where protection relies on double or reinforced insulation – General rules and requirements for stationary equipment



IEC TS 61851-3-1:2023-07(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –

Part 3-1: DC EV supply equipment where protection relies on double or reinforced insulation – General rules and requirements for stationary equipment

FOREWORD

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IEC TS 61851-3-1 has been prepared by IEC technical committee 69: Electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks. It is a Technical Specification.

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

Draft	Report on voting
69/845/DTS	69/882/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

In this document, the following print types are used:

– requirements: in roman type;

– *test specifications: in italic type*;

– notes: in small roman type.

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- withdrawn,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

INTRODUCTION

This document is published in separate parts according to the following structure:

IEC TS 61851-3-1, *Electric vehicle conductive charging system – Part 3-1: DC EV supply equipment where protection relies on double or reinforced insulation – General rules and requirements for stationary equipment*

IEC TS 61851-3-2, *Electric vehicle conductive charging system – Part 3-2: DC EV supply equipment where protection relies on double or reinforced insulation – Particular requirements for portable and mobile equipment*

IEC TS 61851-3-4, *Electric vehicle conductive charging system – Part 3-4: DC EV supply equipment where protection relies on double or reinforced insulation – General definitions and requirements for CANopen communication*

IEC TS 61851-3-5, *Electric vehicle conductive charging system – Part 3-5: DC EV supply equipment where protection relies on double or reinforced insulation – Pre-defined communication parameters and general application objects*

IEC TS 61851-3-6, *Electric vehicle conductive charging system – Part 3-6: DC EV supply equipment where protection relies on double or reinforced insulation – Voltage converter unit communication*

IEC TS 61851-3-7, *Electric vehicle conductive charging system – Part 3-7: DC EV supply equipment where protection relies on double or reinforced insulation – Battery system communication*

ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –

Part 3-1: DC EV supply equipment where protection relies on double or reinforced insulation – General rules and requirements for stationary equipment

1 Scope

This part of IEC 61851, which is a Technical Specification, applies to the equipment, including stationary equipment

- for the conductive transfer of electric power between the supply network and
  - an electric road vehicle, or
  - a removable rechargeable energy storage system (RESS), or
  - an on-board RESS of an electric road vehicle,
- when the equipment is connected to the supply network having a supply voltage up to 480 V AC or up to 400 V DC and a rated output voltage up to 120 V DC, and
- where the protection against electric shock relies on double or reinforced insulation, and with double or reinforced insulation between all AC and DC inputs and outputs.

NOTE 1 In the following countries, the acceptable nominal supply voltage is up to 600 V AC: CA, US.

Particular requirements for portable and mobile DRI EV supply equipment are covered by IEC TS 61851-3-2023.

Equipment for the conductive transfer of electric power between the supply network and an electric road vehicle/RESS according to the IEC TS 61851-3 series is intended to be connected to vehicles where the vehicle power supply circuit is protected against electric shock by double or reinforced insulation.

NOTE 2 For information regarding protection against electric shock by double or reinforced insulation of the EV or of the vehicle power supply circuit, see ISO 18246:2023, 6.1.1 b) and Table 3.

Requirements for bidirectional energy transfer DC to AC are under consideration and are not part of this document.

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

This document applies to VCUs intended to be a part of DRI EV supply equipment specified in this document.

This document applies to equipment for the conductive transfer of electric power between the supply network and an electric road vehicle/RESS intended to be installed and/or used at an altitude of up to 2 000 m.

The aspects covered in this document include

- the connection to the vehicle,
- characteristics to be complied with by the vehicle with respect to the AC or DC,
- the specification for required level of electrical safety for the double or reinforced insulated (DRI) EV supply equipment,

- operators and third-party electrical safety,
- requirements for command and control communication for safety and process matters, if required,
- requirements for bidirectional power transfer DC to DC, and
- the connection to installations according to IEC 60364-7-722.

NOTE 3 In the following countries, electrical installation codes other than those from IEC 60364-7-722 are used: CA, US.

Equipment covered by this document is not intended to be located in hazardous areas where flammable gas or vapour and/or combustible materials, fuels or other combustible or explosive materials are present. Additional requirements can apply to these locations.

This document does not apply to

- aspects related to maintenance,
- electrical devices and components, which are covered by their specific product standards,
- trolley buses and rail vehicles,
- vehicle power supply circuit, which is covered by ISO 18246, and
- EMC requirements for on-board equipment while connected to the supply, which are covered by IEC 61851-21-1.

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 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-11:2021, *Environmental testing – Part 2-11: Tests – Test Ka: Salt mist*

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

IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60269 (all parts), *Low-voltage fuses*

IEC 60309-2:2021, *Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes – Part 2: Dimensional compatibility requirements for pin and contact-tube accessories*

IEC 60320 (all parts), *Appliance couplers for household and similar general purposes*

IEC 60335-1:2020, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*
IEC 60364-4-41:2005/AMD1:2017

IEC 60364-7-722:2018, *Low-voltage electrical installations – Part 7-722: Requirements for special installations or locations – Supplies for electric vehicles*

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

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60884-1:2022, *Plugs and socket-outlets for household and similar purposes – Part 2: General requirements*

IEC 60898 (all parts), *Electrical accessories – 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 60947-3:2020, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

IEC 60947-4-1:2018, *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 60950-1:2005/AMD1:2009
IEC 60950-1:2005/AMD2:2013

IEC 60990:2016, *Methods of measurement of touch current and protective conductor current*

IEC 61009-1:2010, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*
IEC 61009-1:2010/AMD1:2012
IEC 61009-1:2010/AMD2:2013

IEC 61180:2016, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*

IEC 61439-7:2022, *Low-voltage switchgear and controlgear assemblies – Part 7: Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicles charging stations*

IEC 61558-2-6, *Safety of transformers, reactors, power supply units and combinations thereof – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers for general applications*

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

IEC 61851-1:2017, *Electric vehicle conductive charging system – Part 1: General requirements*

IEC 61851-3 (all parts), *Electric vehicle conductive charging system – Part 3: DC EV supply equipment where protection relies on double or reinforced insulation*

IEC TS 61851-3-2:2023, *Electric vehicle conductive charging system – Part 3-2: DC EV supply equipment where protection relies on double or reinforced insulation – Particular requirements for portable and mobile equipment*

IEC TS 61851-3-4:2023, *Electric vehicle conductive charging system – Part 3-4: DC EV supply equipment where protection relies on double or reinforced insulation – General definitions and requirements for CANopen communication*

IEC TS 61851-3-5:2023, *Electric vehicle conductive charging system – Part 3-5: DC EV supply equipment where protection relies on double or reinforced insulation – Pre-defined communication parameters and general application objects*

IEC 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

IEC 62196-1:2022, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 1: General requirements*

IEC TS 62196-4:2022, *Plugs, socket-outlets, vehicle connectors and vehicles inlets – Conductive charging of electric vehicles – Part 4: Dimensional compatibility and interchangeability requirements for DC pin and contact-tube accessories for class II or class III applications*

IEC 62477-1:2022, *Safety requirements for power electronic converter systems and equipment – Part 1: General*

IEC PAS 62840-3:2021, *Electric vehicle battery swap system – Part 3: Particular safety and interoperability requirements for battery swap systems operating with removable RESS/battery systems*

ISO 11898-1:2015, *Road vehicles – Controller area network (CAN) – Part 1: Data link layer and physical signalling*

EN 50325-4:2002, *Industrial communications subsystem based on ISO 11898 (CAN) for controller-device interfaces – Part 4: CANopen*

EN 50604-1:2016, *Secondary lithium batteries for light EV (electric vehicle) applications – Part 1: General safety requirements and test methods*
EN 50604-1:2016/AMD1:2021

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61851-1:2017, IEC TS 61851-3-4:2023 and the following 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
double or reinforced insulated EV supply equipment
DRI EV supply equipment
class II EV supply equipment
EV supply equipment in which protection against electric shock relies on double insulation or reinforced insulation, there being no provision for protective earthing or reliance upon installation conditions.

Note 1 to entry: DRI EV supply equipment intended to use in case C includes supply cable and vehicle connector.

Note 2 to entry: IEC 61851-1:2017, 3.1.1, Examples 1 and 2, are not applicable.

Note 3 to entry: See also Figure 1.

[SOURCE: IEC 60335-1:2020, 3.3.10, modified – Adapted for EV supply equipment.]

3.1.2
EV supply system
complete system including the DRI EV supply equipment and the EV/RESS functions that are required to transfer power between the fixed installation/supply network and the EV/RESS

3.1.3
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

[SOURCE: IEC 61851-1:2017, 3.1.8]

3.1.4
case A
connection of an EV to the supply network with a plug and cable permanently attached to the EV

[SOURCE: IEC 61851-1:2017, 3.1.10, modified – The figure has been deleted.]

3.1.5
case B
connection of an EV to a supply network with a cable assembly detachable at both ends

[SOURCE: IEC 61851-1:2017, 3.1.11, modified – The figure has been deleted.]

3.1.6
case C
connection of an EV to a supply network utilizing a cable and vehicle connector permanently attached to the DRI EV supply equipment

[SOURCE: IEC 61851-1:2017, 3.1.12, modified – The words "EV charging station" has been replaced with "DRI EV supply equipment", and the figure has been deleted.]

3.1.7
voltage converter
set of equipment to convert one type of electric current to another type different in nature, voltage and/or frequency

[SOURCE: IEC 60050-811:2017, 811-19-01, modified – The word "voltage" has been added to the term, and the words "static or rotating" has been deleted from the definition.]

3.1.8
voltage converter unit
VCU
voltage converter with local EMS and communication interface

3.1.9
built-in voltage converter unit
built-in VCU
fixed VCU intended to be installed in a cabinet, in a prepared recess in a wall or in a similar location

[SOURCE: IEC 60335-1:2020, 3.5.5, modified – The word "appliance" has been replaced with "voltage converter unit" in the term and in the definition.]

3.1.10
AUX supply circuit
independent power supply that provides energy to a part of the components in EV supply equipment or the EV

Note 1 to entry: AUX supply circuit is used for supplying the logic controller of active and passive devices.

3.1.11
DC power circuit
circuit for DC conductive power transfer

3.2 Insulation

3.2.1
basic insulation
insulation of hazardous-live-parts which provides basic protection

[SOURCE: IEC 60050-851:2008, 851-15-04]

3.2.2
direct contact
electric contact of persons or animals with live parts

[SOURCE: IEC 60050-195:2021, 195-06-03, modified – The words "human beings" and "livestock" have been replaced with "persons" and "animals" respectively.]

3.2.3
double insulation
insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60050-851:2008, 851-15-06]

3.2.4
conductive part
part which can carry electric current

[SOURCE: IEC 60050-195:2021, 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

[SOURCE: IEC 60050-442:1998, 442-01-21, modified – The note has been deleted.]

3.2.6
hazardous-live-part
live part which, under certain conditions, can give a harmful electric shock

[SOURCE: IEC 60050-195:2021, 195-06-05, modified – The note to entry has been deleted.]

3.2.7
insulation
materials and parts used to insulate conductive elements of a device, or a set of properties which characterize the ability of an insulation to provide its function

[SOURCE: IEC 60050-151:2001, 151-15-41, modified – The end of the definition starting by "or a set…" has been added.]

3.2.8
live part
conductive part intended to be energized under normal operating conditions, including a neutral conductor, but by convention not a PEN conductor, PEM conductor or PEL conductor

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

[SOURCE: IEC 61851-1:2017, 3.2.9, modified – The words "conductor or" has been deleted from the definition, and "operation" replaced with "operating conditions".]

3.2.9
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 60050-195:2021, 195-06-09, modified – The words "of hazardous-live-parts" have been added.]

3.2.10
supplementary insulation
independent insulation applied in addition to basic insulation for fault protection

[SOURCE: IEC 60050-851:2008, 851-15-05]

3.3 Functions

3.3.1
CAN circuit
circuit and associate wiring used for communication according to ISO 11898-1:2015

3.3.2
gateway
functional unit that connects two networks with different network architectures and protocols

[SOURCE: IEC 60050-732:2010, 732-01-17, modified – The words "computer networks" have been replaced with "networks" in the definition, and Note 1 and 2 have been deleted.]

3.3.3
energy management system
EMS
system consisting of active and passive devices for controlling the power transfer

3.3.4
active device
device connected to DC power circuit, AUX supply circuit and CAN circuit

3.3.5
passive device
device connected only to AUX supply circuit and CAN circuit

3.3.6
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 DRI EV supply equipment

[SOURCE: IEC 61851-1:2017, 3.3.5, modified – The words "EV charging station" have been replaced with "DRI EV supply equipment".]

3.3.7
human machine interface
HMI
passive device that allows user interaction, interface between operating staff or end user and the instrumentation and computer systems connected to the energy management system (EMS)

EXAMPLE Display or user communication system

[SOURCE: IEC TS 61851-3-4:2023, 3.14, modified – The spelled-out form of "EMS" is given in the definition.]

3.3.8
set current value
parameter transmitted to the DRI EV supply equipment indicating the required current for power transfer

Note 1 to entry: This parameter is defined in IEC 61851-3-5:2023, 6.4.5, for input current, and 6.4.6, for output current.

3.3.9
set voltage value
parameter transmitted to the DRI EV supply equipment indicating the maximum voltage for power transfer

Note 1 to entry: This parameter is defined in IEC 61851-3-5:2023, 6.4.3.

3.4 Vehicle

3.4.1
electric vehicle
EV
electric road vehicle
vehicle with one or more electric drive(s) for vehicle propulsion

[SOURCE: ISO 17409:2020, 3.19, modified – The word "propelled" has been removed from the term, and the equivalent term "electric road vehicle" added.]

3.4.2
rechargeable energy storage system
RESS
rechargeable system that stores energy for delivery of electric energy for the electric drive

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

Note 2 to entry: A battery system can be named in general within the context of the IEC 61851-3 series as an RESS.

[SOURCE: ISO 17409:2020, 3.47, modified – The example has been removed and the notes to entry added.]

3.4.3
removable rechargeable energy storage system
removable RESS
RESS that can be moved/removed from an EV by hand (portable RESS) or with the assistance of an installation/device (mobile RESS)

[SOURCE: EN 50604-1:2016, 3.18]

3.4.4
voltage class
classification of an electric component or circuit according to its maximum working voltage

Note 1 to entry: The classification to the voltage classes A and B is according to ISO 6469-3:2021.

[SOURCE: ISO 17409:2020, 3.62, modified – The date of publication has been updated in the note to entry.]

3.4.5
vehicle power supply circuit
voltage class A or B electric circuit which includes all parts that are conductively connected to the vehicle inlet (case B, case C) or the plug (case A) and that is operational when connected to an external electric circuit

[SOURCE: ISO 17409:2020, 3.61, modified – The words "A or" have been added to the definition, and the words "or part of an autoconnect charging device that is mounted on the electrically propelled vehicle (case D, case E)" have been deleted.]

3.4.6
conversion device
active device which allows the connection of an EV/RESS which does not provide communication according to the IEC 61851-3 series to the energy management system (EMS)

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 61851-1:2017, 3.5.1]

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 a DRI EV supply equipment

Note 1 to entry: A cable assembly can be detachable or be a part of the EV or the DRI EV supply equipment.

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 61851-1:2017, 3.5.2, modified – The words "EV charging station" have been replaced with "DRI EV supply equipment" in the entry.]

3.5.3
cord extension set
assembly consisting of a flexible cable or cord fitted with a plug and a portable socket-outlet which are matched with each other

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

[SOURCE: IEC 60050-461:2008, 461-06-17, modified – The word "non-rewirable" has been removed from the definition.]

3.5.4
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 with "contacts" in the definition.]

3.5.5
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.]

3.5.6
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: IEC 60309-1, IEC 60309-2, IEC 60884-1 and IEC TR 60083 define standard plugs and socket-outlets.

[SOURCE: IEC 61851-1:2017, 3.5.11]

3.5.7
vehicle coupler
electric vehicle coupler
means of enabling the connection at will of a flexible cable to an electric vehicle

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

Note 2 to entry: The vehicle inlet can be on the EV or on the RESS.

3.5.8
vehicle connector
electric vehicle connector
part of a vehicle coupler integral with, or intended to be attached to, the cable assembly

3.5.9
vehicle inlet
electric vehicle inlet
part of a vehicle coupler incorporated in, or fixed to, the electric vehicle