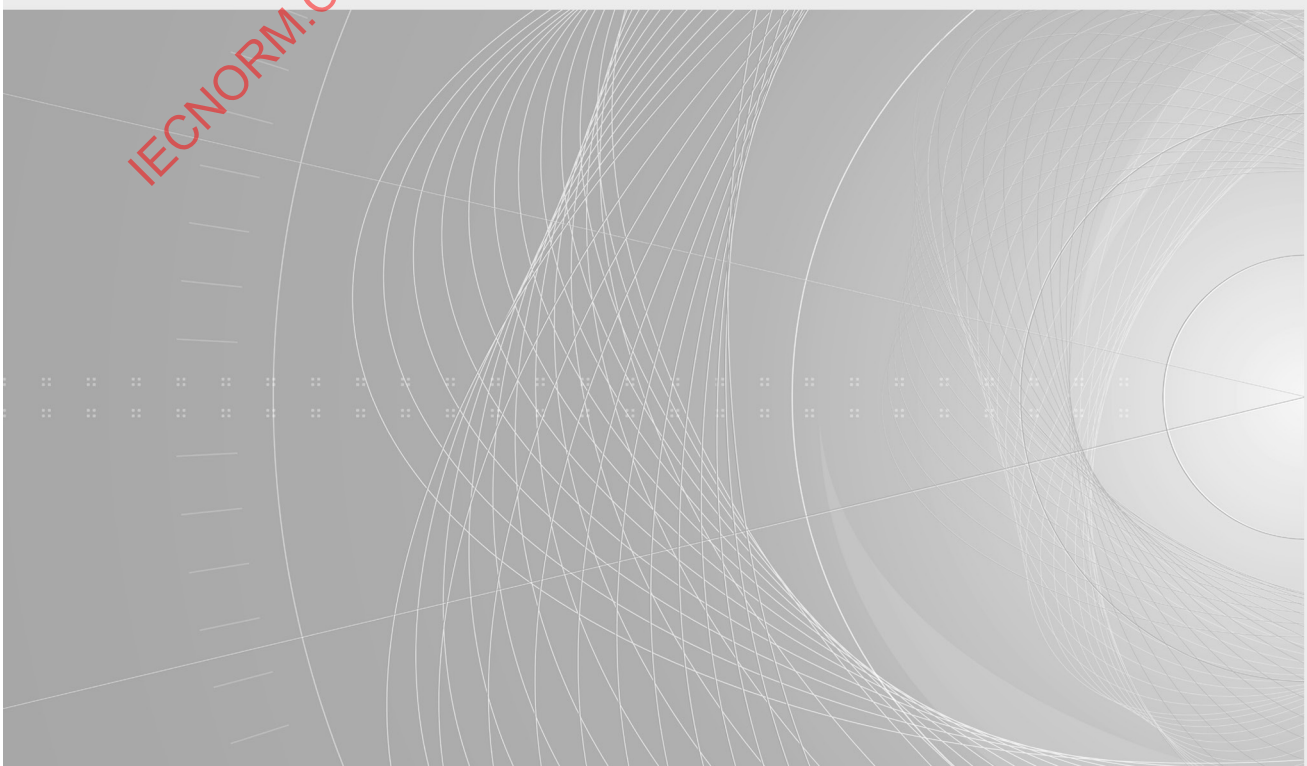
IEC TS 61851-3-1

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**



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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

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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- withdrawn,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

Note 1 to entry: The vehicle inlet can be on the EV or on the RESS.

3.5.10
connecting point
point where the electric vehicle is connected to the fixed installation

Note 1 to entry: The connecting point is a socket outlet or a vehicle connector.

3.5.11
A/B coupler
means enabling the connection and disconnection of RESS to an EV

4 Symbols and abbreviated terms

AC	alternating current	MCU	motor control unit
BMS	battery management system	MSN	message number
C. param.	communication parameter	NMT	network management
Const.	constant	PDO	process data object
DC	direct current	RPDO	receive PDOs
DRI	double or reinforced insulation	ro	read only
EMCY	emergency	rw	read write
EMS	energy management system	SDO	service data object
EMSC	energy management system controller	SOC	state of charge
FSA	finite-state automaton	SOH	state of health
GAO	general application objects	TPDO	transmit PDOs
HMI	human machine interface	VCU	voltage converter unit
IMD	insulation monitoring device	VD	virtual device
LSS	layer setting services	VDN	virtual device number
M_param.	mapping parameter		

5 General requirements

The double or reinforced insulated (DRI) EV supply equipment shall be so constructed that

- the EV can be connected to the DRI EV supply equipment in normal conditions of use,
- the energy transfer operates safely, and its performance is reliable, and
- it minimises the risk of danger to the user or surroundings.

In general, this principle is achieved by fulfilling the relevant requirements specified in this document.

The DRI EV supply equipment may have one or more "connecting points" according to IEC 60364-7-722:2018 that are used for energy supply to electric vehicle. This includes socket-outlets (case A or case B) and/or cord sets attached with vehicle connectors (case C). Each connecting point shall have its own dedicated protection means.

Each connecting point shall be supplied by its own safety isolating transformer according to 7.1.1.

EV supply system configuration type A, B and D according to 6.7 is considered to be portable or mobile equipment according to 6.6 b).

NOTE 1 For EV supply system configuration type A, the DRI EV supply equipment is free standing and not considered to be part of the vehicle.

EV supply system configuration type C, E and F according to 6.7 is considered to be stationary equipment according to 6.6 a).

The DRI EV supply equipment shall be rated for one or a range of standard nominal voltages as given in IEC 60038.

NOTE 2 In the following countries, standard nominal voltages are given in CSA C235:19: CA.

General conditions for tests shall be in accordance with IEC TS 61851-3-2:2023, Clause 5 and Table DD.1.

For extreme environment or other special service conditions, see IEC 61439-7:2022.

Unless otherwise specified, the tests shall be carried out in a draught-free location and at an ambient temperature of 20 °C ± 5 °C.

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

NOTE 3 In the following countries, there are other requirements to be met for DRI EV supply equipment: JP, US.

Compliance is checked by meeting all of the relevant requirements of the IEC 61851-3 series, and the tests specified.

All tests indicated in this document are type tests unless otherwise mentioned.

Unless otherwise specified, all tests shall be carried out in the order of the clauses and subclauses in this document.

Assemblies for stationary DRI EV supply equipment shall comply with IEC 61439-7:2022 with the specific exceptions or additions as indicated in Clause 12.

6 Classification

6.1 Characteristics of supply network

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

- AC supply network;
- DC supply network.

6.2 Method of connection

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

- plug and cable connected;
- permanently connected.

6.3 Normal environmental conditions

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

- indoor use;
- outdoor use.

6.4 Special environmental conditions

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

Where any special service conditions specified by the client exist, a special agreement regarding testing shall be made between the DRI EV supply equipment manufacturer and the client.

6.5 Access

The DRI EV supply equipment shall be classified according to the access it is intended for:

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

6.6 Mounting method

The DRI 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;

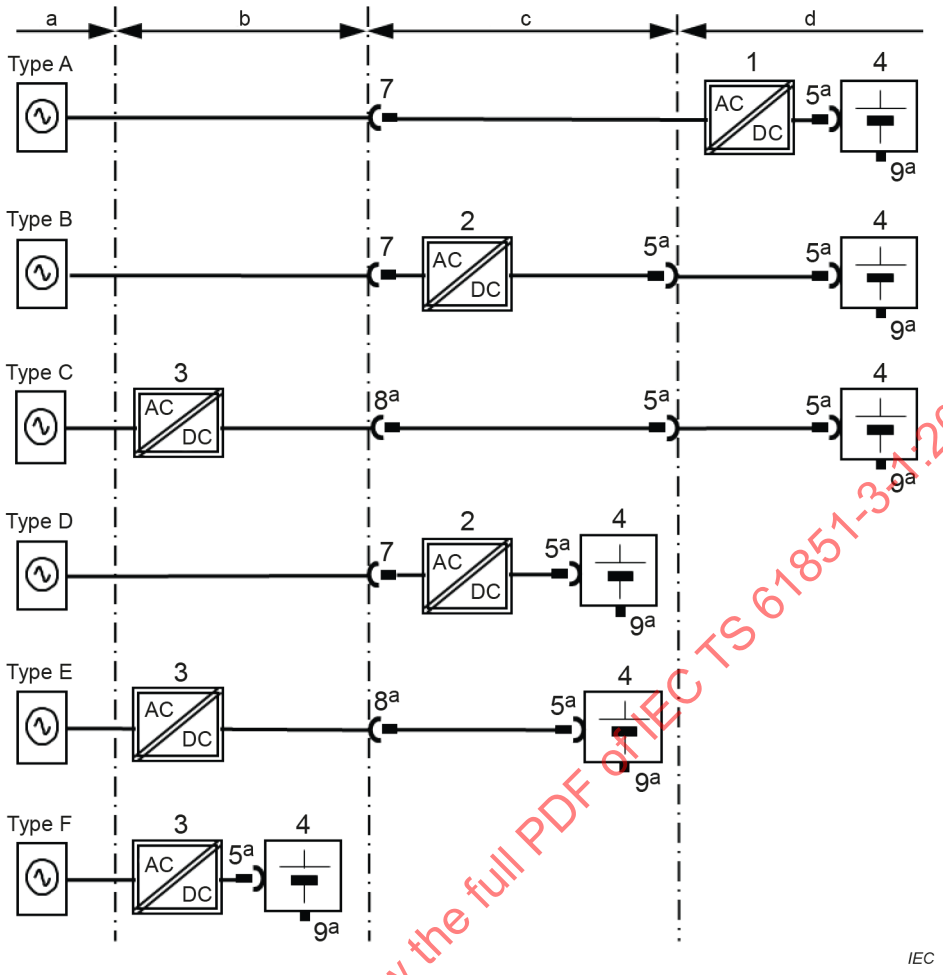
b) non-stationary equipment
   - portable equipment;
   - mobile equipment.

NOTE More than one classification can apply.

6.7 EV supply system configuration

The DRI EV supply equipment shall be classified according to the EV supply system configuration (see Figure 1):

- EV supply system configuration type A;
- EV supply system configuration type B;
- EV supply system configuration type C (see Table 1 as reference in ISO 18246);
- EV supply system configuration type D (see Table 1 as reference in ISO 18246);
- EV supply system configuration type E (see Table 1 as reference in ISO 18246);
- EV supply system configuration type F (see Table 1 as reference in ISO 18246).



Key

a supply network (AC or DC), and fixed installation (according to the IEC 60364 series)

b stationary equipment (see 6.6 a))

c portable or mobile equipment (see 6.6 b))

d EV (located inside of the electric vehicle)

1 portable or mobile DRI EV supply equipment (not permanently fixed to the EV)

2 portable or mobile DRI EV supply equipment

3 stationary DRI EV supply equipment

4 removable or non-removable RESS (battery system)

5 vehicle coupler, DC (according to IEC TS 62196-4)

7 standard plug and socket-outlet (AC) (according to the IEC 60884 series or the IEC 60309 series)

8 dedicated plug and socket-outlet (DC) (according to IEC TS 62196-4)

9 A/B coupler (manufacturer specific)

NOTE 1 See Clause 7 for details.

NOTE 2 Vehicle parts are out of the scope of the document.

NOTE 3 Key "a" can include on site storage system.

[a] One or two can be optional.

Figure 1 – EV supply system configuration

Table 1 – Corresponding type designations to ISO 18246

IEC TS 61851-3-1, IEC TS 61851-3-2 and IEC TS 61851-3-4	Corresponding ISO 18246
EV supply system configuration type A	Charging type A
EV supply system configuration type B	Charging type B
EV supply system configuration type C	
EV supply system configuration type D	Charging type C
EV supply system configuration type E	
EV supply system configuration type F	

7 General EV supply system requirements

7.1 EV supply system requirements

7.1.1 General

The EV supply systems shall meet the following requirements.

- Safety isolating transformer according to IEC 61558-2-6 shall be used.
- Double or reinforced insulation of construction of DRI EV supply equipment according to IEC TS 61851-3-2:2023, Clause 13 or Clause 16 and Table DD.1.
- IP degree according to 9.1 and 12.3.
- EV supply systems according to the IEC 61851-3 series shall use DC plug and socket-outlet and/or vehicle coupler according to IEC TS 62196-4:2022.
- For DC (Figure 1, key 5 and key 8), up to 120 V, dedicated accessories according to IEC TS 62196-4:2022 shall be used only.
- For AC (Figure 1, key 7), up to 8 A standard plug and standard socket-outlets according to IEC 60884-1:2022 or IEC 60309-2:2021 shall be used only.
- For AC (Figure 1, key 7), over 8 A or for three phase applications, standard plug and standard socket-outlets according to IEC 60309-2:2021 shall be used only.
- Accessories according to the IEC 60320 series shall not be used.
- In each active device, the conductor DC +60 V and DC –120 V shall be equipped with a mechanical switching device according to 12.1.
- The simultaneous supply of DC +60 V and DC –120 V shall be avoided by an interlocking switch.

  NOTE 1 See S1a and S1b switches specified in Figure D.1 for example.

  NOTE 2 DRI EV supply equipment with output voltages over 60 V DC can provide an insulation monitoring device (IMD) according to IEC 61557-8:2014.

- EV supply system configuration type A to type C shall only be connected to the part of the vehicle power supply circuits or the RESS (battery system) over a vehicle coupler according to IEC TS 62196-4:2022, where protection against electric shock is provided by double or reinforced insulation.
- EV supply system configuration type D to type F shall only be connected to removable RESS (battery system) according to EN 50604:2016 and EN 50604:2016/AMD1:2021.
- The circuits of voltage class A and of voltage class B in vehicle power supply circuits of EV supply equipment side shall be separated by double or reinforced insulation.

Compliance is checked by inspection and test according to the referenced clause(s).

Examples of possible positions and installations of socket-outlets according to IEC TS 62196-4:2022 are given in Annex B.

For signalling of the operational status of the socket-outlet or vehicle inlet according to IEC TS 62196-4:2022 to customers, additional information are given in Annex A.

Compliance is checked by inspection and by test.

7.1.2 EV supply system configuration type A

A removable or non-removable RESS and the EV are supplied with energy using a portable or mobile DRI EV supply equipment connected to the supply network over a standard plug and socket-outlet. DRI EV supply equipment, type A, is not permanently fixed to the EV and not part of the EV.

NOTE If DRI EV supply equipment is permanently fixed to vehicle according to type A, it is not covered by this document.

7.1.3 EV supply system configuration type B

A removable or non-removable RESS and the EV are supplied with energy over a vehicle coupler using a portable DRI EV supply equipment connected to the supply network over a standard plug and socket-outlet (case B).

For type B: the vehicle inlet can be on the EV or on the RESS. In this case, one of the two does not exist.

7.1.4 EV supply system configuration type C

A removable or non-removable RESS and the EV are supplied with power over a vehicle coupler using fixed installed DRI EV supply equipment connected to the supply network.

For type C:

- the vehicle inlet can be on the EV or on the RESS. In this case, one of the two does not exist;
- the socket-outlet (DC, Figure 1, key 8) can be replaced by a fixed cable on installation side case C.

7.1.5 EV supply system configuration type D

A removed RESS is supplied with power using portable DRI EV supply equipment connected to the supply network over a standard plug and socket-outlet.

7.1.6 EV supply system configuration type E

A removed RESS is supplied with power using fixed installed DRI EV supply equipment connected to the supply network.

For type E: the socket-outlet (DC, Figure 1, key 8) can be replaced by a fixed cable on installation side: case C.

7.1.7 EV supply system configuration type F

A removed RESS is supplied with power using a battery swap system according to IEC PAS 62840-3:2021 connected to the supply network.

7.1.8 Conversion device

For further information, see Annex C.

7.2 Voltages and currents

7.2.1 Rated voltages and currents

AC input voltage of the EV supply system shall not exceed 250 V AC single-phase or 480 V AC three-phase. The AC input current for cord and plug connected EV supply system shall not exceed 32 A.

NOTE 1 See 9.1.1 for current limitations of connecting accessories.

NOTE 2 See IEC 61851-1:2017, 6.2.1 and 6.2.2, for the deviation of the AC input current in each country.

The output current shall not exceed 60 A DC.

Standard ratings for DRI EV supply equipment according to the IEC 61851-3 series are as follows:

- for system input voltages from the supply network, see Table 2;
- for system output voltages, see Table 3.

Table 2 – Rated system input voltages

V	AC	DC	ISO voltage-class
250	X		B
400	X		B
480	X		B
400		X	B

NOTE 3 In the following countries, the acceptable rated supply voltage is up to 600 V AC: CA, US.

Table 3 – System output voltages class

Nominal output voltage	Maximum output voltage	DC	ISO voltage-class
48	60	X	A
96	120	X	B
NOTE Maximum system voltages for DC systems means the absolute highest voltage in the system.			

NOTE 4 The voltage range definitions for EMS are provided in object 6000_h according to IEC TS 61851-3-5:2023.

Compliance is checked by inspection.

7.2.2 Current and voltage regulation

The DC output current of the DRI EV supply equipment shall not exceed the set current value sent by the EV/RESS by more than 5 % and not exceed the maximum rated current.

Compliance is tested by simulation of fault conditions.

The DC output voltage of the DRI EV supply equipment shall not exceed the set voltage value sent by the EV/RESS by more than 2 % and not exceed the maximum voltage.

The DC power circuit shall be opened if these conditions are not met (see IEC 61851-3-4:2023, 7.4).

Compliance is tested by simulation of fault conditions.

For details of voltage and current regulation, see IEC TS 61851-3-2:2023, Annex CC.

7.2.3 AUX supply circuit

AUX supply circuit consists of two conductive wires, AUX +12 V and AUX 0 V.

The nominal voltage at AUX supply circuit shall be 12 V, max. 2 A.

The voltage at the AUX supply circuit, if available at the vehicle coupler, shall be 12 V ± 0,6 V up to 2 A and shall be less than 3 A for short circuit.

It is recommended that, if AUX 0 V and DC 0 V conductors are connected in the vehicle system, the voltage difference between AUX 0 V and DC 0 V shall not exceed 5 V.

Devices requiring connection to AUX supply circuit shall have an input voltage range of 9 V to 15 V.

The auxiliary voltage can be generated by different active devices, for example the battery system or the VCU.

Compliance shall be tested by measurement at maximum rated current on the DC power circuit.

AUX supply circuit and CAN circuit shall be separated from other circuits with voltages over 30 V AC or 60 V DC by double or reinforced insulation.

See IEC TS 61851-3-2:2023, Clause 23, for internal wiring.

Compliance shall be tested according to IEC TS 61851-3-2:2023, Clause 29.

The VCU for multiple supply shall provide at least 1,3 A for each AUX supply circuit output, for example see IEC PAS 62840-3:2021, Figure B.3.

Compliance shall be tested by measurement.

During wake up by the EV/RESS, the AUX supply circuit of the DRI EV supply equipment may require wake-up current. The following list gives recommended maximum current absorption for consumers within the EV supply system:

- EMSC up to 0,4 A;
- battery system up to 0,4 A;
- security unit up to 0,2 A;
- gateway unit up to 0,2 A;
- sensor units and HMI may consume up to 0,4 A (optional);
- in sleep mode, 100 µA.

7.3 Functions provided

7.3.1 Mandatory functions for power transfer

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

- verification that the EV is properly connected (proximity function), according to IEC TS 62196-4:2022, 10.3;
- compatibility check according to IEC TS 61851-3-4:2023, 8.2.3.4, to verify the objects according to 7.3.3;
- start power transfer (switch on active device) of the system, according to IEC TS 61851-3-4:2023, 8.2.3;
- stop power transfer (switch off active device) of the system, according to IEC TS 61851-3-4:2023, 8.2.3;
- selection of the maximum applicable current, according to 7.2.2;
- selection of the voltage, according to 7.2.2;
- verification that open DC contacts are not live according to IEC TS 61851-3-4:2023, 8.2.3.4;
- latching of the accessories rated above 5 A DC and 60 V DC according to IEC TS 62196-4:2022 (see 11.4).

  NOTE Latching device can be used to provide the proximity function to the EV and the DRI EV supply equipment. Object 6311_h according to IEC TS 61851-3-5:2023 describes the function. "Device is latched" can be used for proximity function.

If the DRI EV supply equipment can supply more than one connecting point simultaneously, the above functions shall be performed independently for each connecting point.

Compliance is checked by inspection and test where applicable.

7.3.2 Optional functions for power transfer

The following functions may be provided by the DRI EV supply equipment:

- indication of the real time available load current of the DRI EV supply equipment;
- control for bi-directional power flow.

NOTE Ventilation requirements can be subject to national or regional regulations or standards.

If applicable, compliance is checked by meeting all of the relevant requirements of IEC TS 61851-3-4:2023, 8.2.3.4.

7.3.3 Objects for compatibility check

The following objects of each active device shall be confirmed by compatibility check:

– device type, according to IEC TS 61851-3-5:2023, 5.1.1;
– supported functionality, according to IEC TS 61851-3-5:2023, 6.2.2;
– device manufacturer or responsible vendor (one of them), according to IEC TS 61851-3-5:2023, 5.1.9 (EN 50325-4:2002, B.5.3, Object $100A_h$):
  - vendor ID;
  - product code;
  - revision number;
  - serial number;
– software version, according to EN 50325-4:2002, B.5.3, Object $100A_h$;

– hardware version, according to EN 50325-4:2002, B.5.3, Object 1009_h;
– node-ID, according to EN 50325-4:2002, 3.2;
– minimum voltage, according to IEC TS 61851-3-5:2023, 6.2.21;
– maximum voltage, according to IEC TS 61851-3-5:2023, 6.2.18;
– max. continuous input current, according to IEC TS 61851-3-5:2023, 6.2.18;
– max. continuous output current, according to IEC TS 61851-3-5:2023, 6.2.19.

7.4 Requirements for AC/DC or DC/DC VCU for stationery DRI EV supply equipment

7.4.1 General

Subclause 7.4 covers requirements for VCUs for AC/DC or DC/DC conversion of electric power used within stationary DRI EV supply equipment.

Any simultaneous supply of DC +60 V and DC –120 V shall be avoided by an interlocking switch.

NOTE See S1a/S1b switch specified in Figure D.1 for example.

CAN circuit shall be separated from other circuits with voltages over 30 V AC or 60 V DC by double or reinforced insulation.

See Annex D and IEC TS 61851-3-2:2023, Clause 23, for internal wiring.

7.4.2 Built-in AC/DC VCU for stationary DRI EV supply equipment

Built-in AC/DC VCUs for stationary DRI EV supply equipment provides at least one of the following DC power circuits:

- maximum system output voltage of +60 V DC to the DC power circuits on side B by the following terminals:
  – DC +60 V;
  – DC 0 V.
- maximum system output voltage of –120 V DC to the DC power circuits on side B by the following terminals:
  – DC –120 V;
  – DC 0 V.

NOTE Example for wiring and insulation of built-in AC/DC VCU for stationary DRI EV supply equipment are shown in Figure D.1, Figure D.2 and Figure D.3. For additional information, see also IEC TS 61851-3-2:2023, Annex AA.

7.4.3 Built-in DC/DC VCU for stationary DRI EV supply equipment

The built-in DC/DC VCU for stationary DRI EV supply equipment provides DC input voltage (side A) according to Table 2 and DC output voltages (side B) according to Table 3.

Portable and mobile DC/DC VCUs are not supported by 7.4.3.

DC/DC VCUs provides AUX voltage for AUX supply circuit at side B or side A.

NOTE Example for wiring and insulation of built-in DC/DC VCU for stationary DRI EV supply equipment is shown in Figure D.3. For additional information, see also IEC 61851-3-2:2023, Annex AA.

7.4.4 Protection against access to live parts of built-in VCUs

Live parts of built-in VCUs shall be protected at least by basic insulation before integrating into DRI EV supply equipment and are tested as a complete assembly.

8 Communications

8.1 Command and control communication (mandatory)

The command and control communication between the DRI EV supply equipment and the EV exchanges information (mandatory functions) to start, control and terminate the process of power transfer from/to the EV as covered by 7.3.1. This command and control communication shall be in accordance with IEC TS 61851-3-4:2023.

The use of a gateway is recommended to separate the CANopen EMS communication from external influences. For further information, see IEC TS 61851-3-4:2023, 8.4.3 and Annex A.

8.2 Optional communication

Exchange of information, other than information covered by 8.1, between the DRI EV supply equipment and the EV are covered by 7.3.2 and IEC TS 61851-3-4:2023, Annex A.

The use cases and system architecture are specified in IEC TS 61851-3-4:2023, Annex A.

8.3 Communication circuit from the DRI EV supply equipment to the telecommunication networks

Telecommunication network or telecommunication port of the DRI EV supply equipment, connected to the telecommunication networks, if any, shall comply with the requirements for connection to telecommunication networks of IEC 60950-1:2005, IEC 60950-1:2005/AMD1:2009 and IEC 60950-1:2005/AMD2:2013, Clause 6.

Compliance is checked by inspection.

9 Protection against electric shock

9.1 Protection against direct contact

9.1.1 General

Protection against direct contact shall consist of one or more provisions that, under normal conditions, prevent contact with hazardous-live-parts according to IEC TS 61851-3-2:2023, Clause 8 and Table DD.1.

Compliance is checked by inspection and measurement according to IEC TS 61851-3-2:2023, Clause 8 and Table DD.1.

Power contacts of accessories according to IEC TS 62196-4:2022 shall only be live if

- latching according to IEC TS 62196-4:2022 is completed for accessories rated above 5 A and 60 V DC, and
- compatibility check according to IEC TS 61851-3-4:2023, 8.2.3.4, is successfully completed.

NOTE 1 Latching is not required for accessories having both a rated voltage 60 V or less and a rated current 5 A or less.

Immediately after the following events, all active devices shall be disconnected from the DC power circuit within 100 ms:

- latching is opened or lost for accessories rated above 5 A and 60 V DC;
- communication is lost (detected by a missing heartbeat according IEC TS 61851-3-5:2023, 5.1.7 and 5.1.8);
- request to power off the device (according to IEC TS 61851-3-4:2023, 9.2.2);

Compliance is checked by inspection and, if necessary, by a test on the sample wired as in normal use and an externally generated test sequence that simulates the fault conditions.

Accessories rated above 5 A and 60 V DC shall only be live if all vehicle connectors or plugs are fully engaged (proximity function or connection switch according to IEC TS 62196-4:2022, 10.3).

Compliance is checked by inspection.

9.1.2 IP ratings for protection against electric shock

IP ratings for enclosures shall be at least IPXXC.

For all other applications, the minimum IP rating is covered by Table 4.

Table 4 – IP ratings

	60 V DC	120 V DC	Mated	Not mated	IPXX [a]
For any accessory in mated condition			X		D
For dedicated DC accessories (IEC TS 62196-4)	X			X	B
		X		X	B
NOTE For standard accessories (IEC 60884 series, IEC 60309 series), the IP rating of their product standard applies. [a] In the following countries, IPXXD is not required: SE, CH.					

Compliance is checked by test in accordance with IEC 60529.

NOTE In the following countries, as exception to IEC 61439-7:2022, 10.2.701, the product must fulfil a minimum requirement of IPXXB after the test: SE, CH.

9.2 Stored energy – Discharge of capacitors

9.2.1 Disconnection of plug connected EV supply equipment

For plug and cable 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 IEC 60950-1:2005 and IEC 60950-1:2005/AMD1:2009, 2.1.1.5.

NOTE Requirements for the EV are specified in ISO 18246.

9.2.2 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 s after disconnecting the supply network 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 IEC 60950-1:2005 and IEC 60950-1:2005/AMD1:2009, 2.1.1.7.

9.3 Fault protection

Fault protection shall consist of the following protective measures according to IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017: double or reinforced insulation.

Compliance is checked by inspection and tests according to 7.1.

9.4 DC leakage currents

The following requirement shall be fulfilled to ensure a proper function of an RCD in the fixed electrical installation.

The DRI EV supply equipment shall ensure by its design that a DC leakage current does not exceed the values specified in IEC TS 61851-3-2:2023, Clause 13 or Clause 16.

Compliance shall be tested in accordance with IEC TS 61851-3-2:2023, Clause 13 or Clause 16.

9.5 Y capacitors

The Y capacitors shall comply with IEC TS 61851-3-2:2023, Clause 22.

Compliance shall be tested by tests according to IEC TS 61851-3-2:2023, Clause 22.

10 Specific requirements for accessories

10.1 General requirements

Accessories used to connect DRI EV supply equipment to the supply network or to the EV/RESS shall be in accordance with the requirements specified in 7.1.1.

Compliance is checked by inspection.

NOTE In the following countries, national requirements apply for the standard plug and socket-outlets: US, CA, JP, DE, FR, CH.

10.2 Adaptors

Adaptors shall not be used to connect a vehicle connector to a vehicle inlet or a plug to a socket-outlet.

10.3 Latching device

Interlocking (may be provided by a latching device) of the accessories is mandatory for accessories rated above 5 A and 60 V DC to prevent them from unintentional separation and breaking under load. The interlocking shall insure that the power transfer is stopped before separation. See also 7.1.1.

The plug or vehicle connector, if in the latched state, shall only be unlatched automatically under one of the following conditions:

– a specific customer action is taken on the DRI EV supply equipment to disconnect the supply network by request to power off the device (according to IEC TS 61851-3-4:2023, 9.2.2);
– request to power off the device (according to IEC TS 61851-3-4:2023, 9.2.2);
– loss of power supply to the DRI EV supply equipment;
– communication is lost (missing heartbeat according to IEC TS 61851-3-5:2023, 5.1.7 and 5.1.8).

Latching device is tested according to IEC 62196-1:2022, 14.1.

10.4 Contact sequencing of accessories

The contact sequencing during mating and un-mating shall be in accordance with IEC TS 62196-4:2022, 6.406.

Compliance is checked by inspection.

11 Cable assembly requirements

11.1 General

The cable assembly shall be provided with cables that are suitable for the application.

NOTE The IEC 62893 series covers some types of cables for the DRI EV supply equipment.

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

Compliance is checked by inspection.

11.2 Electrical rating

For types B and D, the voltage and current ratings of the cable assembly shall be compatible with the rating of the related contact of the accessories according to IEC TS 62196-4:2022. See also 7.1.1.

For types A, C and E, the voltage and current ratings of the cable assembly shall comply with IEC TS 61851-3-2:2023, Clause 25.

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

Compliance is checked by inspection and tests according to IEC TS 61851-3-2:2023, Clause 25.

11.3 Mechanical characteristics

The mechanical characteristics of the cable should be equivalent or superior to those of IEC 60245-4 cable, as well as for fire resistance, chemical withstand, UV resistance. For EVs, see the IEC 62893 series.

NOTE 1 In the following countries, other cable types are required by national regulations: US (type cable EV, EVJ families), JP (VCT, etc.).

NOTE 2 In the following county, cable types G, SEO, SO, STO, SJEO, SJO, SJTO, or W, or a cord that is equally serviceable in accordance with CSA C22.2 No. 49, are required: CA.

For type B and type D, the length of the cable from the plug to the portable or mobile DRI EV supply equipment or from the portable or mobile DRI EV supply equipment to the vehicle connector shall be at least 0,5 m and not more than 2 m each.

For type C and type E, the length of the cable from the plug to the vehicle connector shall be at least 1 m and not more than 4 m.

For case C, the length of the cable from the DRI EV supply equipment to the vehicle connector shall be limited to 2 m.

Compliance is checked by inspection.

11.4 Storage means for case C

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

Compliance is checked by inspection.

11.5 Strain relief

Strain relief shall be in accordance with IEC 61851-1:2017, 11.6.

12 DRI EV supply equipment constructional requirements and tests

12.1 Characteristics of mechanical switching devices

12.1.1 General

Switching devices within DRI EV supply equipment on DC power circuit shall comply with their relevant standards, with at least the characteristics as given in 12.1.2.

12.1.2 Switch and switch-disconnector

Switches and switch-disconnectors shall comply with IEC 60947-3:2020.

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.

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

Compliance is checked by inspection.

12.1.3 Contactor

Contactors shall comply with IEC 60947-4-1:2018.

For AC applications, contactors shall have a rated current, at a utilization category of at least AC-1, not less than the rated current of the circuit that they are intended to operate in.

For DC applications, contactors shall have a rated current, at a utilization category of at least DC-1, not less than the rated current of the circuit that they are intended to operate in.

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

Compliance is checked by inspection.

12.1.4 Circuit-breaker

Circuit breakers, if any, shall comply with IEC 60898-1 or IEC 60947-2 or IEC 61009-1.

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

Compliance is checked by inspection.

12.1.5 Relays

Relays used to switch the main current path shall comply with IEC 61810-1, with the following minimum characteristics:

– 50 000 cycles;
– contact category: CC 2.

12.1.6 Switch-on peak current

It is recommended that the maximum sum of all directly connected capacities does not exceed 1 000 µF at DC power circuit.

Each active device (e.g., DRI EV supply equipment) shall be protected against inrush currents resulting from switch-on capacitive loads up to 1 000 µF.

Compliance is tested by applying a capacity of 1 000 µF or a capacity according to manufacturer request to the DC power circuit and then start power transfer.

If power transfer continues for at least 60 s, the DRI EV supply equipment is deemed to pass the test.

12.2 Clearances and creepage distances

The clearances and creepage distances in the DRI EV supply equipment, installed as intended by the manufacturer, shall be in accordance with the requirements specified in IEC TS 61851-3-2:2023, Clause 29.

– For stationary DRI EV supply equipment providing IP 55 or higher, pollution degree 2 applies.
– For all other stationary DRI EV supply equipment, pollution degree 3 applies.

Parts of the DRI EV supply equipment directly connected to the AC supply network shall be designed according to overvoltage category IV.

Compliance is checked by inspection, by measurement and by tests.

Permanently connected DRI EV supply equipment shall be designed according to a minimum overvoltage category III, except for the vehicle connector in case C where a minimum overvoltage category II applies.

Compliance is checked by inspection, by measurement and by tests.

DRI EV supply equipment supplied through a cable and plug shall be designed according to IEC TS 61851-3-2:2023, Clause 29, by a minimum overvoltage category II. Tests shall be performed according to IEC TS 61851-3-2:2023, Clause 29 and Table DD.1.

Compliance is checked by inspection, measurement and tests according to IEC TS 61851-3-2:2023, Clause 29 and Table DD.1.

Equipment that is intended to be used under the conditions of a higher overvoltage category shall include an appropriate overvoltage protective device (see IEC 60664-1:2020, 4.2.2.5).

Compliance is checked by inspection.

NOTE Additional information is given in 12.6.2.

12.3 IP degrees

12.3.1 Degrees of protection against solid foreign objects and water for the enclosure

Enclosures of the DRI EV supply equipment shall have an IP degree according to IEC 60529 as follows:

– indoor use: at least IP 21;
– outdoor use: IP44;
– portable or mobile DRI EV supply equipment: at least IP 55.
– for built-in VCUs, IPX1.

IPX4 may be obtained by the combination of the socket-outlet or connector and the lid or cap, DRI EV supply equipment enclosure or EV enclosure.

Compliance is checked by test in accordance with IEC 60529.

12.3.2 Degrees of protection against solid foreign objects and water for accessories

The minimum IP degree for plug, socket-outlets and the vehicle connectors shall be in accordance with their appropriate standards.

The minimum IP degrees of accessories according to IEC TS 62196-4:2022 shall be as follows.

– Indoor use:
  - vehicle connector mated with vehicle inlet: IP21;
  - plug mated with socket-outlet: IP21;
  - vehicle connector for case C when not mated: IP24.
– Outdoor use:
  - vehicle connector mated with vehicle inlet: IP44;
  - plug mated with socket-outlet: IP44;
  - vehicle connector when not mated: IP24;
  - socket-outlet when not mated: IP24.

Compliance is checked by test in accordance with IEC 60529.

IPX4 may be obtained by the combination of the socket-outlet or vehicle connector and the lid or cap, DRI EV supply equipment enclosure, or EV enclosure.

NOTE In the following country, the UL articulated finger probe is used according to national regulations: US.

12.4 Insulation resistance

The insulation resistance is measured with a 500 V DC voltage applied between all inputs/outputs connected together (power source included), and the accessible parts shall be $R > 7$ MΩ.

The measurement of insulation resistance shall be carried out after applying the test voltage during 1 min and immediately after the damp heat continuous test of IEC 60068-2-78:2012, test Cab, at 40 °C ± 2 °C and 93 % relative humidity for four days.

Test shall be conducted according to IEC TS 61851-3-2:2023, Clause 13 and/or Clause 16 and Table DD.1.

Compliance is tested according to IEC TS 61851-3-2:2023, Clause 13 and/or Clause 16 and Table DD.1.

12.5 Touch current

The touch current between any AC supply network live parts and the accessible metal parts connected with each other and with a metal foil covering insulated external parts shall be measured in accordance with IEC 62477-1:2022, 5.2.3.7, and shall not exceed the values indicated in Table 5.

The touch current shall be measured within one hour after the damp heat continuous test of IEC 60068-2-78:2012, test Cab, at 40 °C ± 2 °C and 93 % relative humidity for four days, with the DRI EV supply equipment connected to AC supply network in accordance with IEC 60990:2016, Clause 6.

The supply voltage shall be 1,1 times the nominal rated voltage for this measurement.

Table 5 – Touch current limits

	Class I mA	Class II mA
Between any live parts and the accessible metal parts connected with each other and a metal foil covering insulated external parts	3,5	0,25
Between any live parts and the metal inaccessible parts normally non-activated (in the case of double insulation)	Not applicable	3,5
Between inaccessible and accessible parts connected with each other and a metal foil covering insulated external parts (additional insulation)	Not applicable	0,5

This test shall be made when the DRI EV supply equipment is functioning with a resistive load at rated output power.

The equipment is fed through an isolating transformer or installed in such a manner that it is isolated from the earth.

12.6 Dielectric withstand voltage

12.6.1 AC withstand voltage

The dielectric withstand voltage at power frequency (50 Hz or 60 Hz) shall be applied for 1 min as follows.

1) For basic insulation

   U_n + 1 200 V (RMS) in common mode (all circuits in relation to the inaccessible conductive parts) and differential mode (between each electrically independent circuit and all other conductive parts or circuits) as specified in IEC 60664-1:2020, 5.4.3.

   NOTE U_n is the nominal line to neutral voltage of the neutral-earthed supply system.

2) For a DRI EV supply equipment

   2 × (U_n + 1 200 V) (RMS) in common mode (all circuits in relation to the exposed conductive parts) and differential mode (between each electrically independent circuit and all other exposed conductive parts or circuits) as specified in IEC 60664-1:2020, 5.4.3.2.

3) For DRI EV supply equipment where the insulation between the AC or DC supply network and the DC output circuit is double or reinforced insulation, 2 × (U_n + 1 200 V) (RMS) shall be applied to the insulation.

   Alternatively, the test can be carried out using a DC voltage equal to the AC peak values.

For this test, all the electrical equipment shall be connected, except those items of apparatus which, according to the relevant specifications, are designed for a lower test voltage; current-consuming apparatus (e.g. windings, measuring instruments, voltage surge suppression devices) in which the application of the test voltage would cause the flow of a current shall be disconnected. Such apparatus shall be disconnected at one of their terminals unless they are not designed to withstand the full test voltage, in which case all terminals may be disconnected.

For test voltage tolerances and the selection of test equipment, see IEC 61180:2016.

12.6.2 Impulse dielectric withstand (1,2/50 µs)

The dielectric withstand of the power circuits at impulse shall be checked using values in accordance with appropriate over-voltage category as indicated in IEC 60664-1:2020, Table F.1.

The impulse voltage shall be applied to live parts and exposed conductive parts.

The test shall be carried out in accordance with the requirements of IEC 61180:2016.

Compliance is tested according to IEC 61180:2016.

Overvoltage categories are specified in 12.2.

NOTE For an explanation of the overvoltage categories, see IEC 60664-1:2020, 4.3.2.

12.7 Temperature rise

Assemblies for DRI EV supply equipment shall comply with IEC 61439-7:2022.

12.8 Damp heat functional test

Immediately after the conditioning defined below, the DRI EV supply equipment shall process compatibility check according to 7.3.3.

Conditioning:

– for indoor units: 6 cycles of 24 h each to a damp heat cycling test according to IEC 60068-2-30:2005 (test Db) at (40 ± 3) °C and relative humidity of 95 %;
– for outdoor units: two identical 12-day periods. Each 12-day period comprises
  - 5 cycles of 24 h each to a damp heat cycling test according to IEC 60068-2-30:2005 (test Db) at (40±3) °C and relative humidity of 95 %, and
  - 7 cycles of 24 h each to salt mist test according to IEC 60068-2-11:2021 (test Ka: salt mist), at a temperature of (35 ± 2) °C.

Conformity is checked by a successfully completion of a compatibility check according of 7.3.3.

12.9 Minimum temperature functional test

The DRI EV supply equipment shall be pre-conditioned in accordance with IEC 60068-2-1:2007, test Ab, at the minimum operating temperature (either –5 °C for indoor, –25 °C outdoor or lower values declared by the manufacturer ±3 K) for (16 ± 1) h.

The DRI EV supply equipment shall process compatibility check according to 7.3.3, while at the minimum operating temperature.

Conformity is checked by a successfully completion of a compatibility check according of 7.3.3.

12.10 Mechanical strength

DRI EV supply equipment shall be constructed of materials capable of withstanding the mechanical strength that are likely to be encountered in specified service conditions.

NOTE 1 In the following country, national standards or regulations provide the different requirements: JP.

IEC 61439-7:2022, 10.2.701, is applicable with the following addition: the minimum degree of protection against mechanical impact provided by the enclosure shall be IK10 according to IEC 62262.

NOTE 2 In the following country, the product must fulfil a minimum requirement of IPXXB after the test: SE.

Compliance is checked by inspection, by measurement and by tests.

13 Overload and short-circuit protection

Where connecting points can be used simultaneously and are intended to be supplied from the same input line, they shall have individual protection incorporated in the DRI EV supply equipment.

Such over-current protective devices shall comply with IEC 60947-2, IEC 60947-6-2, or IEC 61009-1 or with the relevant parts of the IEC 60898 series or IEC 60269 series.

NOTE 1 In the following country, the methods of protection against over-current and overvoltage are in accordance with national codes: CA.

NOTE 2 In the following countries, the branch circuit over-current protection is based upon 125 % of the equipment rating: US, CA.

Stationary DRI EV supply equipment shall provide over current protective device for the DC power circuit.

Protective devices against over-currents or short circuits of DRI EV supply equipment shall be coordinated with those of the supply network.

NOTE 3 Protection against short-circuit can be provided in the fixed installation, the DRI EV supply equipment, or both.

Compliance is checked by inspection.

14 Emergency switching or disconnect (optional)

Emergency switching or disconnect equipment shall be used to disconnect the supply network from stationary DRI EV supply equipment (EV supply system configuration type C, E and F if applicable).

Such equipment can be subject to national rules.

Such equipment may be part of the supply network or the stationary DRI EV supply equipment.

Compliance is checked by inspection.

15 Marking and instructions

15.1 Installation manual

Instructions for the connection of the EV to the DRI EV supply equipment shall be provided within the DRI EV supply equipment user's manual (instructions) and in the manufacturer's technical documentation supplied with the equipment.

The DRI EV supply equipment manufacturer shall state in the manual, where applicable, the interface characteristics specified in IEC 61439-7:2022, Clause 5. Wiring instructions shall be provided.

If protective devices are included in the DRI EV supply equipment, the manual shall indicate the characteristics of those protection devices explicitly describing the type and rating. The information may be provided in a detailed electric diagram.

If the protective devices are not in the DRI EV supply equipment, the manual shall indicate all information necessary for the installation of external protection explicitly describing the type and rating of the devices to be used.

It is recommended that the installation manual be made available to future customers.

The installation manual shall indicate if the optional function for ventilation is supported.

The installation manual shall indicate ratings or other information that denote special (severe or unusual) environmental conditions of use (see 6.4).

The installation manual of DRI EV supply equipment shall indicate the classifications as given in Clause 6.

Compliance is checked by inspection.

15.2 User manual (instructions) for DRI EV supply equipment

User information shall be provided by the manufacturer on the DRI EV supply equipment or in a user's manual.

Such information shall state the following:

– adaptors or conversion adapters are not allowed to be used;
– cord extension sets are not allowed to be used;
– a cord extension set, or a second cable assembly shall not be used in addition to the cable assembly for the connection of the EV to the DRI EV supply equipment;
– use only with vehicle classified for the use with DRI EV supply equipment;
– relevant information about usage of class II equipment as covered by IEC TS 61851-3-2:2023, Table DD.1, and according to IEC 60335-1:2020, 7.12.

The user manual shall include information about national usage restrictions.

Compliance is checked by inspection.

15.3 Marking of DRI EV supply equipment type A to type F

The DRI EV supply equipment manufacturer shall provide each DRI EV supply equipment with one or more labels, marked in a durable manner and located in a place such that they are visible and legible, during installation and maintenance:

– name, initials, trademark or distinctive marking to identify the manufacturer;
– part number;
– serial number or production lot;
– date of manufacture;
– rated voltage in V (input and output) according to 7.1;
– rated frequency in Hz;
– rated current in A (input and output) and the ambient temperature used to determine the rated current according to 7.1;
– number of phases;
– degree of protection (see 9.1 and 12.3);
– all necessary information relating to the other declared classifications according to Clause 6, characteristics and diversity factor(s) – see also IEC TS 61851-3-2:2023, Table DD.1, and IEC 60335-1:2020, 7.1;
– minimal contact information (phone number, address of contractor, installer or manufacturer), only applicable for built-in equipment.

NOTE 1 In the following country, all DRI EV supply equipment must be marked with the words "For use with electric vehicles", which must be visible during intended use: CA.

NOTE 2 In the following country, the special environmental or ventilation conditions must be marked: CA.

Compliance is checked by inspection and test of 15.5.

15.4 Marking of cable assemblies type C and type E

The cable assembly for type C and type E according to Figure 1 shall be marked in a durable manner by a label or equivalent means with the following information:

– name, initials, trademark or distinctive marking to identify the manufacturer;
– type designation or identification number or any other means of identification, making it possible to obtain relevant information from the manufacturer;
– rated voltage in V according to 7.1;
– rated current in A according to 7.1;.
– degree of protection according to 9.1 and 12.3;
– number of phases.

Compliance is checked by inspection and test of 15.5.

15.5 Durability test for marking

Marking made by moulding, pressing, engraving or similar, including labels with a laminated plastic covering, shall not be submitted to the following test.

The markings required by this document shall be legible with corrected vision, durable and visible during use.

Compliance is checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.

NOTE The petroleum spirit is defined as a solvent hexane with a content of aromatics of maximum 0,1 % in volume, a kauri-butanol value of 29, an initial boiling point of 65 °C, a final boiling point of 69 °C and a density of approximately 0,68 g/cm^3.

After the test, the marking shall be legible to normal or corrected vision without additional magnification. It shall not be easily possible to remove marking plates and they shall show no curling.

Annex A
(informative)

Acoustical and optical signalling

A.1 General

Signalling may be provided by optical and/or acoustical devices.

A.2 Optical signalling

For optical signalling, two or more lights shall be used. One "latching light" and one "power light". Consumption of all luminous elements shall be less than 0,5 W.

The following information shall be provided by the following recommended signals:

– ready: "latching light" illuminates blue;
– wait: alternating blinking of both lights in blue, max. 5 s;
– failure: synchronous blinking of both lights in orange, max. 5 s;
– latch successful: "latching light" illuminates green;
– power transfer: "power light" illuminates green;
– not ready (reserved or defect): no light illuminates.

A.3 Acoustical signalling

The following information may be provided by the optical and/or acoustical signal:

– ready: no signal;
– wait: no signal;
– failure: continuing acoustical signal min. 2 s max. 5 s;
– latching successful: one bleep max. 0,5 s;
– power transfer: no signal;
– not ready (reserved or defect): no signal.

Annex B
(informative)

Example of position for socket outlets

Figure B.1 and Figure B.2 show examples of position for socket outlets.

Dimensions in millimetres

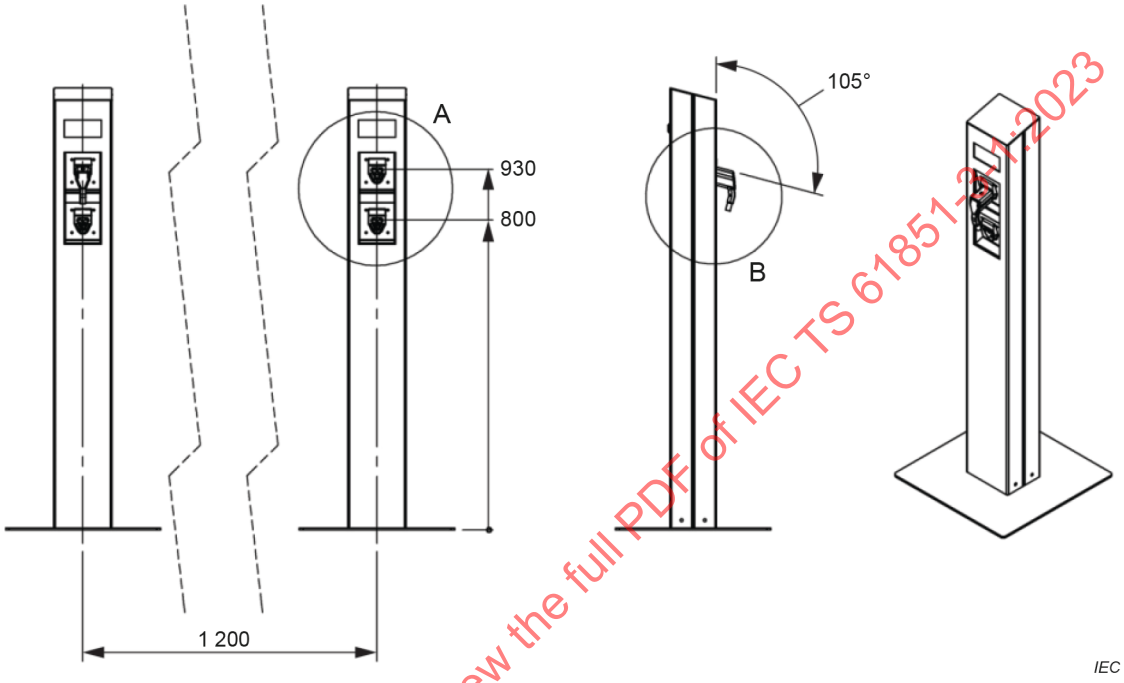


Figure B.1 – Example of position of the socket-outlet overview