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Part 1: General requirements

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

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69/900/CD, 69/968/CC**IEC TC 69 : ELECTRICAL POWER/ENERGY TRANSFER SYSTEMS FOR ELECTRICALLY PROPELLED ROAD VEHICLES AND INDUSTRIAL TRUCKS**

SECRETARIAT:

Belgium

SECRETARY:

Mr Peter Van den Bossche

OF INTEREST TO THE FOLLOWING COMMITTEES:

SC 23E, SC 23H, TC 64

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

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TITLE:

Electric vehicle conductive charging system - Part 1: General requirements

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ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –

Part 1: General requirements

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401

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402

INTRODUCTION

This standard is the first part of the IEC 61851 series of standards that gives the general requirements for the supply¹ of electric energy to electric road vehicles². It is to be noted that the vehicle and the EV supply equipment² make up a complete system that is covered by a number of IEC and ISO standards.

IEC 61851 covers the mechanical, electrical, communications, EMC and performance requirements for EV supply equipment used to charge electric vehicles, including light electric vehicles.

IEC 61851 is divided into several parts as follows:

- *Part 1: General Requirements*,
This document is a system standard that serves as a basis for all the subsequent standards in the series. It is the product standard for Mode 3 EV supply equipment.
 - *Part 21-1: Electric vehicle onboard charger EMC requirements for conductive connection to an AC/DC supply*.
 - *Part 21-2: EMC requirements for OFF board electric vehicle charging systems*. This part covers all requirements for AC and DC EV supply equipment. EMC requirements for wireless power transfer systems (WPT) are not included.
 - *Part 23: DC electric vehicle charging station*. This part covers the requirements for DC charging stations both permanently wired and cable and plug connected.
 - *Part 23-1: DC electric vehicle charging station with an automated connection device (under development)*
 - *Part 23-3: DC electric vehicle supply equipment for Megawatt charging systems (under development)*
 - *Part 24: Digital communication between a d.c. EV charging station and an electric vehicle for control of d.c. charging*. This part provides the requirements for communication between the vehicle and the DC charging stations of Part 23.
 - *Part 25: DC EV supply equipment where protection relies on electrical separation*.
 - *Part 26: EV supply equipment with automated connection of a vehicle coupler located at the underbody of an electric vehicle (under development)*
 - *Part 27: EV supply equipment with automated connection of a vehicle coupler according to IEC 62196-2 or IEC 62196-3 (under development)*
- IEC TS 61851-3 subseries is intended to cover EV supply equipment with a DC output not exceeding 120 V where the protection against electric shock relies on double or reinforced insulation
- *Part 3-1: Electric vehicles 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*
 - *Part 3-2: Electric vehicles 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*

¹ The term “supply of electric energy” is used to designate energy flow to and from the electric vehicle. The term “charging” used in the title is also used to designate such energy flow.

² The reader is advised to refer to the definitions clause 3 for this and all subsequent terms that are used in this document.

- *Part 3-4: Electric vehicles conductive charging system – Part 3-4: DC EV supply equipment where protection relies on double or reinforced insulation – General definitions and requirements for CANopen communications*
- *Part 3-5: Electric vehicles 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*
- *Part 3-6: Electric vehicles conductive charging system – Part 3-6: DC EV supply equipment where protection relies on double or reinforced insulation - Voltage converter unit communication*
- *Part 3-7: Electric vehicles conductive charging system – Part 3-7: DC EV supply equipment where protection relies on double or reinforced insulation – Battery system communication*

Documents directly related to the present document:

- ISO 5474 (all parts), *Electrically propelled road vehicles — Functional and safety requirements for power transfer between vehicle and external electric circuit*
This series of documents gives requirements for electric vehicle that is to be connected to the EV supply equipment. It covers all the classes of vehicles that are in the scope of ISO/TC 22/SC 37.
- IEC 62752, *In-cable control and protection device for mode 2 charging of electric road vehicles (IC-CPD)*.
This product standard gives the requirements for Mode 2 EV supply equipment that includes supplementary protective and control devices that allow the safe connection of a vehicle to a mains socket-outlet of an installation.
- ISO 15118 (all parts), *Road vehicles — Vehicle to grid communication interface*
This series of documents gives the description and the requirements for high level data communication between the EV and the EV supply equipment.

Requirements for wireless power transfer systems are given in IEC 61980 series.

ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –

Part 1: General requirements

1 Scope

This part of IEC 61851 applies to EV supply equipment for charging electric road vehicles, with a rated supply voltage at side A up to 1 000 V AC or up to 1 500 V DC, and a rated voltage at side B up to 1 000 V AC or up to 1 500 V DC.

This document also provides requirements for EV supply equipment enabling bi-directional power transfer (BPT), with reverse voltage at side A up to 1 000 V AC or 1 500 V DC.

Electric road vehicles (EV) cover all road vehicles, including plugin hybrid electric road vehicles (PHEV), that derive all or part of their energy from on-board rechargeable energy storage systems (RESS).

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

The aspects covered in this standard include:

- the characteristics and operating conditions of the EV supply equipment;
- the specification of the connection between the EV supply equipment and the EV;
- the requirements for electrical safety for the EV supply equipment.

Additional requirements may apply to equipment designed for specific environments or conditions, for example:

- EV supply equipment located in hazardous areas where flammable gas or vapour and/or combustible materials, fuels or other combustible, or explosive materials are present;
- EV supply equipment designed to be installed at an altitude of more than 2 000 m;
- EV supply equipment intended to be used on board on ships;

Requirements for electrical devices and components used in EV supply equipment are not included in this standard and are covered by their specific product standards.

EMC requirements for EV supply equipment are covered by IEC 61851-21-2.

Beside definitions and functional requirements given in clause 7 of this standard, all Mode 2 EV supply equipment requirements are covered by IEC 62752.

This standard does not apply to:

- preventive or curative maintenance of the EV supply equipment;
- charging of trolley buses, rail vehicles, and vehicles designed primarily for use off-road;
- equipment on the EV;
- EMC requirements for equipment on the EV while connected, which are covered in IEC 61851-21-1;
- charging RESS off board of the EV;

- DC EV supply equipment that relies specifically on electrical separation with rated side B voltage up to 120 V DC. See IEC 61851-25.
- DC EV supply equipment that relies specifically on double or reinforced insulation with rated side B voltage up to 120V DC. See IEC TS 61851-3 series.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60038, *IEC standard voltages*

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

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

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

IEC 60085:2007, *Electrical insulation - Thermal evaluation and designation*

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

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

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

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

IEC 60364-5-53:2020, *Low-voltage electrical installations – Part 5-53: Selection and erection of electrical equipment - Devices for protection for safety, isolation, switching, control and monitoring*

IEC 60529:2001, *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 60664-3:2016, *Insulation coordination for equipment within low-voltage systems - Part 3: Use of coating, potting or moulding for protection against pollution*

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

IEC 60695-2-10, *Fire hazard testing –Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2021, *Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end products (GWEPT)*

- 546 IEC 60695-2-12:2021, *Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods -*
547 *Glow-wire flammability index (GWFI) test method for materials*
- 548 IEC 60695-10-2:2014, *Fire hazard testing - Part 10-2: Abnormal heat - Ball pressure test*
549 *method*
- 550 IEC 60884-1, *Plugs and socket-outlets for household and similar purposes – Part 1: General*
551 *requirements*
- 552 IEC 60898 (all parts), *Circuit-breakers for overcurrent protection for household and similar*
553 *installations*
- 554 IEC 60947-1:2020, *Low-voltage switchgear and controlgear – Part 1: General requirements*
- 555 IEC 60947-2, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*
- 556 IEC 60947-3, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors,*
557 *switch-disconnectors and fuse-combination units*
- 558 IEC 60947-4-1, *Low voltage switchgear and controlgear – Part 4-1: Contactors and motor-*
559 *starters – Electromechanical contactors and motor-starters*
- 560 IEC 60947-6-2, *Low-voltage switchgear and controlgear – Part 6-2: Multiple function equipment*
561 *– Control and protective switching devices (or equipment) (CPS)*
- 562 IEC 60947-10, *Low-voltage switchgear and controlgear – Part 10: Semiconductor Circuit-*
563 *Breakers*
- 564 IEC 60990, *Methods of measurement of touch current and protective conductor current*
- 565 IEC 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection*
566 *for household and similar uses (RCCBs) – Part 1: General rules*
- 567 IEC 61009-1, *Residual current operated circuit-breakers with integral overcurrent protection for*
568 *household and similar uses (RCBOs) – Part 1: General rules*
- 569 IEC 61180, *High-voltage test techniques for low-voltage equipment – Definitions, test and*
570 *procedure requirements, test equipment*
- 571 IEC 61316:2021, *Industrial cable reels*
- 572 IEC 61439-7:2022, *Low-voltage switchgear and controlgear assemblies – Part 7: Assemblies*
573 *for specific applications such as marinas, camping sites, market squares, electric vehicles*
574 *charging stations*
- 575 IEC 61508-1, *Functional safety of electrical/electronic/programmable electronic safety-related*
576 *systems – Part 1: General requirements*
- 577 IEC 61558-2-4, *Safety of transformers, reactors, power supply units and similar products for*
578 *supply voltages up to 1 100 V – Part 2-4: Particular requirements and tests for isolating*
579 *transformers and power supply units incorporating isolating transformers*
- 580 IEC 61558-2-6, *Safety of transformers, reactors, power supply units and similar products for*
581 *supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating*

- 582 *transformers and power supply units incorporating safety isolating transformers for general*
583 *applications*
- 584 IEC 61558-2-16, *Safety of transformers, reactors, power supply units and similar products for*
585 *supply voltages up to 1 100 V – Part 2-16: Particular requirements and tests for switch mode*
586 *power supply units and transformers for switch mode power supply units*
- 587 IEC 61643-01:2024, *Low-voltage surge protective devices -Part 01: General requirements and test*
588 *methods*
- 589 IEC 61643-11, *Low-voltage surge protective devices -Part 11: Surge protective devices connected to*
590 *low-voltage power systems -Requirements and test methods*
- 591 IEC 61643-21, *Low-voltage surge protective devices -Part 21: Surge protective devices connected to*
592 *telecommunications and signalling networks -Performance requirements and testing methods*
- 593 IEC 61643-311, *Components for low-voltage surge protective devices - Part 311: Performance*
594 *requirements and test circuits for gas discharge tubes (GDT)*
- 595 IEC 61643-321, *Components for low-voltage surge protective devices - Part 321: Specifications for*
596 *avalanche breakdown diode (ABD)*
- 597 IEC 61643-331, *Components for low-voltage surge protection - Part 331: Performance requirements*
598 *and test methods for metal oxide varistors (MOV)*
- 599 IEC 61643-341, *Components for low-voltage surge protection - Part 341: Performance requirements*
600 *and test circuits for thyristor surge suppressors (TSS)*
- 601 IEC 61810-1, *Electromechanical elementary relays – Part 1: General and safety requirements*
- 602 IEC 61851-23:2024, *Electric vehicle conductive charging system – Part 23: DC electric vehicle*
603 *charging station*
- 604 IEC 61851-24, *Electric vehicle conductive charging system – Part 24: Digital communication*
605 *between a d.c. EV charging station and an electric vehicle for control of d.c. charging*
- 606 IEC 62116, *Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention*
607 *measures*
- 608 IEC 62196 (all parts), *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive*
609 *charging of electric vehicles*
- 610 IEC 62196-1:2022, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive*
611 *charging of electric vehicles – Part 1: General requirements*
- 612 IEC 62196-2:2022, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive*
613 *charging of electric vehicles – Part 2: Dimensional compatibility and interchangeability*
614 *requirements for a.c. pin and contact-tube accessories*
- 615 IEC 62196-3:2022, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive*
616 *charging of electric vehicles – Part 3: Dimensional compatibility and interchangeability*
617 *requirements for d.c. and a.c./d.c. pin and contact-tube vehicle couplers*
- 618 IEC TS 62196-3-1:2020, *Plugs, socket-outlets, vehicle connectors and vehicle inlets –*
619 *Conductive charging of electric vehicles – Part 3-1: Vehicle connector, vehicle inlet and cable*
620 *assembly for DC charging intended to be used with a thermal management system*

621 IEC 62368-1:2023, *Audio/video, information and communication technology equipment - Part 1:*
622 *Safety requirements*

623 IEC 62423, *Type F and type B residual current operated circuit-breakers with and without*
624 *integral overcurrent protection for household and similar uses*

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

627 IEC 62752:2024, *In-Cable Control and Protection Device for mode 2 charging of electric road*
628 *vehicles (IC-CPD)*

629 IEC TS 62786:2023, *Distributed energy resources connection with the grid - Part 1: General*
630 *requirements*

631 IEC 62893 (all parts), *Charging cables for electric vehicles*

632 IEC 62955:2018, *Residual direct current detecting device (RDC-DD) to be used for mode 3*
633 *charging of electric vehicles)*

634 **3 Terms and definitions**

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

636 ISO and IEC maintain terminological databases for use in standardization at the following
637 addresses:

- 638 • IEC Electropedia: available at <http://www.electropedia.org/>
- 639 • ISO Online browsing platform: available at <http://www.iso.org/obp>

640 **3.1 Electric supply equipment**

641 **3.1.1**

642 **EV supply equipment**

643 equipment or a combination of equipment, providing dedicated functions to supply electric
644 energy from a fixed electrical installation or supply network to an EV for the purpose of power
645 transfer.

646 EXAMPLE 1: For Mode 3 case B, the EV supply equipment consists of the EV charging station and the cable
647 assembly.

648 EXAMPLE 2: For Mode 3 case C, the EV supply equipment consists of the EV charging station with its cable
649 assembly.

650 Note 1 to entry: EV supply equipment is either permanently connected or connected by a cable and plug to the
651 supply network.

652 **3.1.2**

653 **AC EV supply equipment**

654 EV supply equipment that supplies alternating current to an EV

655 **3.1.3**

656 **DC EV supply equipment**

657 EV supply equipment that supplies direct current to an EV

3.1.4 EV charging system

complete system including the EV supply equipment and the EV functions that are required to supply electric energy to an EV for the purpose of charging

3.1.5**EV charging station**

stationary part of EV supply equipment connected to the supply network

Note 2 to entry: For case C, the cable assembly is part of the EV charging station.

3.1.6**forward power transfer**

forward energy transfer

DEPRECATED: charging

FPT

transfer of electric energy from the electrical installation to an EV

3.1.7**charging mode**

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

3.1.8**charging mode 1****mode 1**

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

3.1.9**charging mode 2****mode 2**

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

3.1.10**charging mode 3****mode 3**

Method for the connection of an EV to an AC EV supply equipment permanently connected to an AC supply network, with a control pilot function that extends from the AC EV supply equipment to the EV

3.1.11**charging mode 4****mode 4**

Method for the connection of an EV to an AC or DC supply network utilizing a DC EV supply equipment, with a control pilot function that extends from the DC EV supply equipment to the EV

Note 1 to entry: Mode 4 EV supply equipment is either permanently connected or connected by a cable and plug to the supply network.

3.1.12**reverse power transfer**

reverse energy transfer

RPT

transfer of electric energy from an EV to the electrical installation

**3.1.13 transfer of electric energy from an EV to the electrical installation
bidirectional power transfer**

bidirectional energy transfer

DEPRECATED: bi-directional power transfer

BPT

combination of forward power transfer (FPT) and reverse power transfer (RPT)

[SOURCE: IEC 61851-23:2024, 3.3.127]

**3.1.14
grid following mode**

mode of reverse power transfer when the energy source follows operational parameters of the electrical installation and operates in parallel either to the electric power network or to a grid forming source.

**3.1.15
grid forming mode**

mode of reverse power transfer when the energy source establishes and maintains both a stable voltage and a stable frequency to supply an electrical installation which is islanded from the electric power network.

Note 1 to entry: There can be only one grid forming source in a microgrid.

**3.1.16
Point of connection**

POC

reference point where the electrical installation is connected to the distribution network

[SOURCE: IEC 60364-8-82, 82.3.17, modified – the term “prosumer” has been deleted]

**3.1.17
Vehicle to grid**

V2G

use-case with reverse power transfer from the EV and the connected EV supply equipment to the electric power network over the point of connection (POC) in grid following mode

**3.1.18
Vehicle to home grid connected**

V2H connected

use case with reverse power transfer from the EV and the connected EV supply equipment to the electrical installation in grid following mode, without reverse power transfer over the point of connection (POC).

NOTE : This use case is sometimes called in other documents “Vehicle to home on grid”.

**3.1.19
Vehicle to home grid islanded**

V2H islanded

use case with reverse power transfer from the EV and the connected EV supply equipment to the electric installation separated from the point of connection (POC) in grid following or grid forming mode.

NOTE : This use case is sometimes called in other documents “Vehicle to home off grid”.

3.1.20

case A

connection of an EV to the supply network with a cable assembly permanently attached to the EV (see: Figure 1)

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

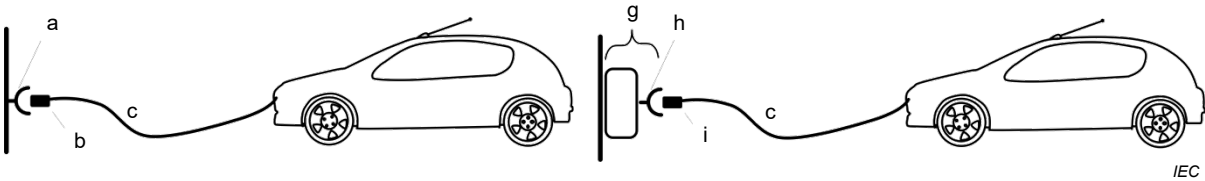


Figure 1 – Case A connection

Key for Figures 1 to 3

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

3.1.21

case B

connection of an EV to a supply network with a cable assembly detachable at both ends (see: Figure 2)

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

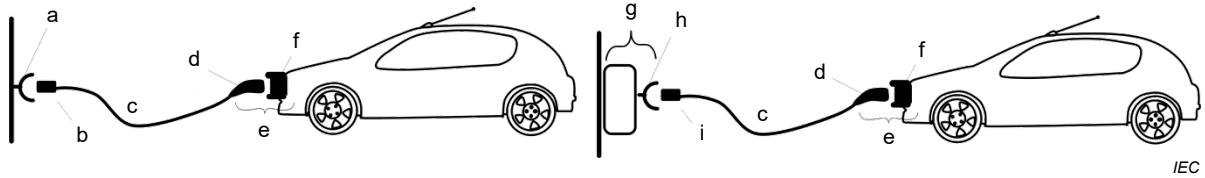


Figure 2 – Case B connection

Key : see Figure 1

3.1.22

case C

connection of an EV to a supply network utilizing a cable assembly permanently attached to the EV charging station (see: Figure 3)

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

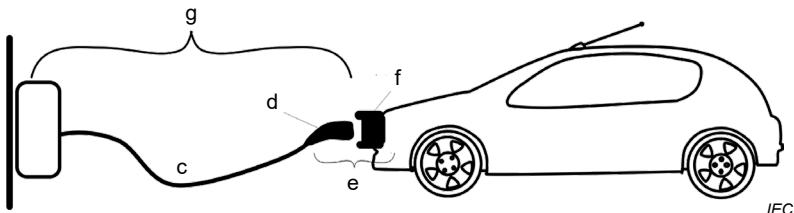


Figure 3 – Case C connection

769 **Key : see Figure 1**

770 **3.2 Insulation**

771 **3.2.1**

772 **basic insulation**

773 insulation that provides basic protection

774 Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes.

775 [SOURCE: IEC 60050-195:2021, 195-06-06]

776 **3.2.2**

777 **basic protection**

778 protection against electric shock under normal conditions

779 [SOURCE: IEC 60050-195:2021, 195-06-01]

780 **3.2.3**

781 **direct contact**

782 electrical contact of human beings or livestock with live parts

783 [SOURCE: IEC 60050-195:2021, 195-06-03]

784 **3.2.4**

785 **double insulation**

786 insulation comprising both basic insulation and supplementary insulation

787 [SOURCE: IEC 60050-826:2004, 195-06-08]

788 **3.2.5**

789 **conductive part**

790 part that can carry electric current

791 [SOURCE: IEC 60050-195:2021, 195-01-06]

792 **3.2.6**

793 **exposed conductive part**

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

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

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

799 **3.2.7**

800 **hazardous-live-part**

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

802 Note 1 to entry: A hazardous voltage can be present on the accessible surface of solid insulation. In such a case,
803 this surface is considered to be a hazardous-live-part

804 [SOURCE: IEC 60050-195:2021, 195-06-05]

3.2.8**fault protection**

protection against electric shock under single-fault conditions

[SOURCE: IEC 60050-195:2021, 195-06-02]

3.2.9**insulation**

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

Note 1 to entry: Examples of relevant properties are: resistance, breakdown voltage.

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

3.2.10**live part <in electrical installations and equipment>**

conductive part intended to be energized under normal operating conditions, including the neutral conductor and mid-point conductor, but excluding the PEN conductor, PEM conductor and PEL conductor

[SOURCE: IEC 60050-195:2021, 195-02-19]

3.2.11**reinforced insulation**

insulation that provides a degree of protection against electric shock equivalent to double insulation

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

[SOURCE: IEC 60050-195:2021, 195-06-09]

3.2.12**supplementary insulation**

independent insulation applied in addition to basic insulation, that provides fault protection

[SOURCE: IEC 60050-195:2021, 195-06-07]

3.3 Functions**3.3.1****control pilot conductor**

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

3.3.2**control pilot circuit**

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

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

3.3.3**control pilot function**

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

3.3.4

control pilot function controller

CPFC

device in the EV supply equipment and the EV responsible for the control pilot function

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

3.3.5

proximity function

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

3.4 Vehicle

3.4.1

electric vehicle

EV

(electric road vehicle)

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

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

[SOURCE: ISO 17409]

3.4.2

plug-in hybrid electric road vehicle

PHEV

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

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

3.4.3

rechargeable energy storage system

RESS

rechargeable system that stores energy for delivery of electric energy, e.g. for the electric drive

EXAMPLE: battery, capacitor, flywheel

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

[SOURCE: ISO 6469-3:2021, 3.11]

3.5 Cords, cables and connection means

3.5.1

adaptor

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

[SOURCE: IEC 60050-442:1998, 442-03-19, modified, “one or more socket-outlet portions” replaced by “one socket outlet portion”]

3.5.2**adapter cord**

assembly consisting of a flexible cable or cord fitted with a plug on the one end and a portable socket-outlet on the other end, and which do not match each other

3.5.3**cable assembly**

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

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

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

3.5.4**cable management system**

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

EXAMPLE: Cable suspension device.

3.5.5**cord extension set**

assembly consisting of a flexible cable or cord fitted with a plug on the one end and a socket-outlet on the other end, and which can match each other

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

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

[SOURCE: IEC 60050-461:2008, 461-06-17, modified adding note 2 to entry]

3.5.6**in-cable control box****ICCB**

device incorporated in the IC-CPD, which performs control functions and safety functions

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

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

3.5.7**In-Cable Control and Protection Device****IC-CPD**

assembly of linked parts or components including cables, plug and vehicle connector for supplying electric vehicles in charging mode 2, which performs control functions and safety functions

[SOURCE: IEC 62752:2024, 3.3.3.2, modification Note deleted]

3.5.8**EV socket-outlet**

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

Note 1 to entry: An EV socket-outlet is not intended to be installed as a standard socket-outlet in building installations and is not intended to connect to standard plugs.

Note 2 to entry: The requirements for EV socket-outlet are defined in the IEC 62196 series.

3.5.9

EV plug

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

Note 1 to entry: An EV plug is not intended to connect directly to standard socket-outlets provided in the building installation.

Note 2 to entry: The requirements for EV plug are defined in the IEC 62196 series.

3.5.10

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 –"pins" replaced by "contacts".]

3.5.11

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 –"pins" replaced by "contacts".]

3.5.12

standard plug

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

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

3.5.13

standard socket-outlet

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

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

3.5.14

vehicle coupler

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

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

3.5.15

vehicle connector

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

[SOURCE: IEC 62196-1:2022, 3.56, modified, "of a vehicle coupler" added, "one flexible cable" replaced by "the cable assembly"]

3.5.16

vehicle inlet

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

974 [SOURCE: IEC 62196-1:2022, 3.57, modified, “of a vehicle coupler” added]

975 **3.5.17**

976 **connecting point**

977 terminating point in the fixed installation where energy is transferred to/from one electric vehicle

978 EXAMPLE A socket-outlet, a vehicle connector or a wireless power transfer device.

979 Note 1 to entry: The connecting point may be part of the fixed installed EV supply equipment.

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

982 Note 3 to entry: The connecting point for Mode 1, Mode 2 and Mode 4, connected by a cable and plug is the point
983 where one electric vehicle is connected to the fixed installation or supply network, means the standard socket-outlet.

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

986 Note 5 to entry: EV supply equipment can have one or more connecting points to supply energy to EVs.

987 [SOURCE : IEC 60364-7-722:2018, 722.3.2, modified note 2 to entry to note 5 to entry added]

988 **3.5.18**

989 **interlock**

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

994 [SOURCE: IEC 62196-1:2022, 3.23]

995 **3.5.19**

996 **retaining means**

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

999 [SOURCE: IEC 62196-1:2022, 3.41]

1000 **3.5.20**

1001 **latching device**

1002 part of the interlock mechanism provided to hold an EV plug in the EV socket-outlet or to hold
1003 a vehicle connector in the vehicle inlet and to prevent its intentional or unintentional withdrawal

1004 EXAMPLE See standard sheets 2-II and 2-IIId in IEC 62196-2:2022 and 3-IIId in IEC 62196-3:2022.

1005 [SOURCE: IEC 62196-1:2022, 3.25]

1006 **3.5.21**

1007 **locking mechanism**

1008 means intended to reduce the likelihood of tampering with, or an unauthorised removal, of the
1009 accessories

1010 [SOURCE: IEC 62196-1:2022, 3.28, modified –note deleted]

1011 **3.5.22**

1012 **vehicle adaptor**

1013 portable accessories constructed as an integral unit incorporating both a vehicle inlet portion
1014 and a vehicle connector portion

- 1015 **3.5.23**
 1016 **vehicle adapter cord**
 1017 assembly consisting of a flexible cable or cord fitted with a vehicle inlet on the one end and a
 1018 vehicle connector on the other end, and which do not match each other
- 1019 **3.6 Service and usage**
- 1020 **3.6.1**
 1021 **indoor use**
 1022 intended for operation under normal ambient conditions in a building
- 1023 [SOURCE: IEC 60050-151:2001, 151-16-06, modified – “indoor” replaced by “indoor use”.]
- 1024 **3.6.2**
 1025 **outdoor use**
 1026 capable of operating under specific range of outdoor conditions
- 1027 [SOURCE: IEC 60050-151:2001, 151-16-05, modified – “outdoor” replaced by “outdoor use”.]
- 1028 **3.6.3**
 1029 **fixed equipment**
 1030 electric equipment fastened to a support or otherwise secured in a specific location
- 1031 [SOURCE: IEC 60050-826:2004, 826-16-07]
- 1032 **3.6.4**
 1033 **stationary equipment**
 1034 equipment that is designed to be fixed as its place of installation, for instance to the floor or to
 1035 a wall, and to be used at this place
- 1036 Note 1 to entry: Stationary equipment is intended to be either permanently connected to the supply network or
 1037 connected to the supply network by a cable and plug.
- 1038 [SOURCE: IEC 61439-7:2022, 3.5.3, modified, “assembly” replaced by “equipment”, note 1 to
 1039 entry added]
- 1040 **3.6.5**
 1041 **ground and floor mounted equipment**
 1042 stationary equipment permanently connected to the supply with a part embedded in the ground
 1043 or intended to be fixed directly on the floor or a base.
- 1044 Note 1 to entry: This type of equipment includes poles and columns..
- 1045 **[SOURCE: IEC 61439-7:2022, 3.5.3.701, modified, “assembly” replaced by “equipment”]**
- 1046 **3.6.6**
 1047 **wall mounted equipment**
 1048 stationary equipment intended to be fixed directly on the wall while being permanently fixed to
 1049 the supply
- 1050 [SOURCE: IEC 61439-7:2022, 3.5.3.702, modified, “assembly” replaced by “equipment”]
- 1051 **3.6.7**
 1052 **transportable equipment**
 1053 equipment intended for use in a place where it is not permanently fixed.
- 1054 Note 1 to entry: When the equipment is to be moved to another place, it is first disconnected from the supply
 1055 network.

1056 [SOURCE: IEC 61439-7:2022, 3.5.702, modified, “assembly” replaced by “equipment”]

1057 **3.6.8**

1058 **portable <equipment>**

1059 cord and plug connected equipment, cable assembly, adaptors or other accessories that are
1060 capable to be carried by one person and designed and intended to be carried within the EV

1061 **3.6.9**

1062 **mobile equipment**

1063 equipment which is capable to be moved while in operation or which can easily be moved from
1064 one place to another while connected to the supply network.

1065 [SOURCE: IEC 61439-7:2022, 3.5.703, modified, “assembly” replaced by “equipment”]

1066 **3.6.10**

1067 **permanently connected EV supply equipment**

1068 EV supply equipment that can only be connected to, or disconnected from, the supply network
1069 by the use of a tool

1070 [SOURCE: IEC 60050-151: 2014, 151-11-29, modified, “equipment” replaced by “EV supply
1071 equipment”, “electric power system” replaced by “supply network”]

1072 **3.6.11**

1073 **user**

1074 party who will specify, purchase, use and/or operate the equipment, or someone acting on their
1075 behalf

1076 [SOURCE: IEC 61439-1:2021, 3.11, modified, “equipment” added]

1077 **3.6.12**

1078 **abnormal operating condition**

1079 temporary operating condition that is not a normal operating condition and is not a single fault
1080 condition of the equipment itself

1081 Note 1 to entry: Abnormal operating conditions are specified in clause B.3 of IEC 62368-1:2023.

1082 Note 2 to entry: An abnormal operating condition may be introduced by the equipment or by a person.

1083 Note 3 to entry: An abnormal operating condition may result in a failure of a component, a device or a safeguard.

1084 [SOURCE: IEC 62368-1:2023, 3.3.7.1]

1085 **3.6.13**

1086 **single fault condition**

1087 condition in which one means for protection against electric shock is defective or one fault is
1088 present which could cause a hazard

1089 Note 1 to entry: If a single fault condition results in one or more other fault conditions, all are considered as one
1090 single fault condition.

1091 [SOURCE: IEC 61140:2016, 3.1.4]

1092 **3.7 General terms**

1093 **3.7.1**

1094 **supply network**

1095 any source of electric energy (eg. Mains or electric grid, distributed energy resources (DER),
1096 battery bank, PV installation, generator, etc.)

- 1097 **3.7.2**
 1098 **protective conductor**
 1099 (identification : PE)
 1100 conductor provided for purposes of safety, for example protection against electric shock
- 1101 EXAMPLE Examples of a protective conductor include a protective bonding conductor, protective earthing
 1102 conductor and an earthing conductor when used for protection against electric shock.
- 1103 [SOURCE: IEC 60050-826:2004, 826-13-22, modified –note deleted.]
- 1104 **3.7.3**
 1105 **protective earthing conductor**
 1106 **protective grounding conductor** (US, CA)
 1107 **equipment grounding conductor** (US, CA)
 1108 protective conductor provided for protective earthing
- 1109 [SOURCE: IEC 60050-826:2004, 826-13-23]
- 1110 **3.7.4**
 1111 **earthing terminal**
 1112 **grounding terminal** (US, CA)
 1113 terminal provided on equipment or on a device and intended for the electric connection with the
 1114 earthing arrangement
- 1115 [SOURCE: IEC 60050-195:1998, 195-02-31]
- 1116 **3.7.5**
 1117 **protective earthing**
 1118 **protective grounding** (US, CA)
 1119 earthing a point or points in a system or in an installation or in equipment for purposes of
 1120 electrical safety
- 1121 [SOURCE: IEC 60050-195:1998/AMD1:2001, 195-01-11]
- 1122 **3.7.6**
 1123 **residual current device**
 1124 **RCD**
 1125 mechanical switching device or association of devices designed to make, carry and break
 1126 currents under normal service conditions and to cause the opening of the contacts when the
 1127 residual current attains a given value under specified conditions
- 1128 Note 1 to entry: A residual current device can be a combination of various separate elements designed to detect
 1129 and evaluate the residual current and to make and break current.
- 1130 Note 2 to entry: Portable residual current devices (PRCDs) are specified in IEC 61540.
- 1131 [SOURCE: IEC 60050-442:1998, 442-05-02]
- 1132 **3.7.7**
 1133 **leakage current**
 1134 electric current in an unintended conductive path under normal conditions
- 1135 [SOURCE: IEC 60050-195:2021, 195-05-15]
- 1136 **3.7.8**
 1137 **switching device**
 1138 device designed to make or break the current in one or more electric circuits

1139 [SOURCE: IEC 60050-441:1984, 441-14-01]]

1140 **3.7.9**

1141 **mechanical switching device**

1142 switching device designed to close and open one or more electric circuits by means of separable
1143 contacts

1144 [SOURCE: IEC 60050-441:1984, 441-14-02, modified –note deleted.]

1145 **3.7.10**

1146 **touch current**

1147 electric current passing through a human body or through an animal body when it touches one
1148 or more accessible parts of an electrical installation or electrical equipment

1149 [SOURCE : IEC 60050-826 :2004, 826-11-12]

1150 **3.7.11**

1151 **surge protective device**

1152 **SPD**

1153 device that contains at least one non-linear component that is intended to limit surge voltages
1154 and divert surge currents

1155 [SOURCE: IEC 61643-11:2011, 3.1.1, modified, note deleted]

1156 **3.7.12**

1157 **side A**

1158 **supply network side**

1159 **DEPRECATED: input**

1160 side of the EV supply equipment connected to the supply network

1161 **3.7.13**

1162 **side B**

1163 **EV side**

1164 **DEPRECATED: output**

1165 side of the EV supply equipment connected to the EV

1166 **3.7.14**

1167 **Electrical Energy Management System**

1168 **EEMS**

1169 system monitoring, operating, controlling and managing energy resources and loads of the
1170 installation

1171 Note 1 to entry: The EEMS can be a dedicated system or part of an integrated system, such as a home and building
1172 electronic system (HBES) or building management system (BMS or BACS) or other similar management system.

1173 [SOURCE: IEC 60364-8-82:2022]

1174 **3.7.15**

1175 **phase balancing function**

1176 electrical (energy) management system ensuring limitation of the power unbalance between
1177 phases.

1178 **3.7.16**

1179 **auxiliary circuit**

1180 all the conductive parts of an equipment included in a circuit (other than the main circuit)
1181 intended to control, measure, signal, regulate and process data, etc.

1182 [SOURCE: IEC 60050-441:1984, 441-13-03, modified – “assembly of switchgear and controlgear”
1183 replaced by “equipment”, “and process data, etc.” added, note deleted]

1184 **3.7.17**

1185 **main circuit**

1186 all the conductive parts of an equipment included in a circuit which is intended to transmit
1187 electrical energy

1188 [SOURCE: IEC 60050-441: 1984, 441-13-02, modified – “assembly” replaced by “equipment”]

1189 **3.7.18**

1190 **class I equipment**

1191 equipment in which protection against electric shock does not rely on basic protection only, but
1192 which includes an additional safety precaution in such a way that means are provided for the
1193 connection of conductive accessible parts to the protective (earthing) conductor in the fixed
1194 wiring of the installation, so that conductive accessible parts cannot become live in the event
1195 of a failure

1196 [SOURCE: IEC 62477:2022, 3.7, modified – “PECS” replaced by “equipment”]

1197 **3.7.19**

1198 **class II equipment**

1199 equipment in which protection against electric shock does not rely on basic protection only, but
1200 in which additional safety precaution are provided, there being no means of connection for the
1201 PE conductor or reliance upon installation conditions

1202 [SOURCE: IEC 62477:2022, 3.8, modified – “PECS” replaced by “equipment”]

1203 **3.7.20**

1204 **class III equipment**

1205 equipment in which protection against electric shock relies on supply at DVC As and in which
1206 voltages higher than those of DVC As are not generated and there is no means for protective
1207 earthing

1208 [SOURCE: IEC 62477:2022, 3.9, modified – “PECS” replaced by “equipment”]

1209 **3.7.21**

1210 **electric power network**

1211 particular installations, substations, lines or cables for the transmission and distribution of
1212 electricity

1213 Note 1 to entry: The boundaries of the different parts of this network are defined by appropriate criteria, such as
1214 geographical situation, ownership, voltage, etc..

1215 [SOURCE: IEC 60050-601:1985, 651-26-01]

1216 **3.7.22**

1217 **coupling session**

1218 **DEPRECATED: charging session**

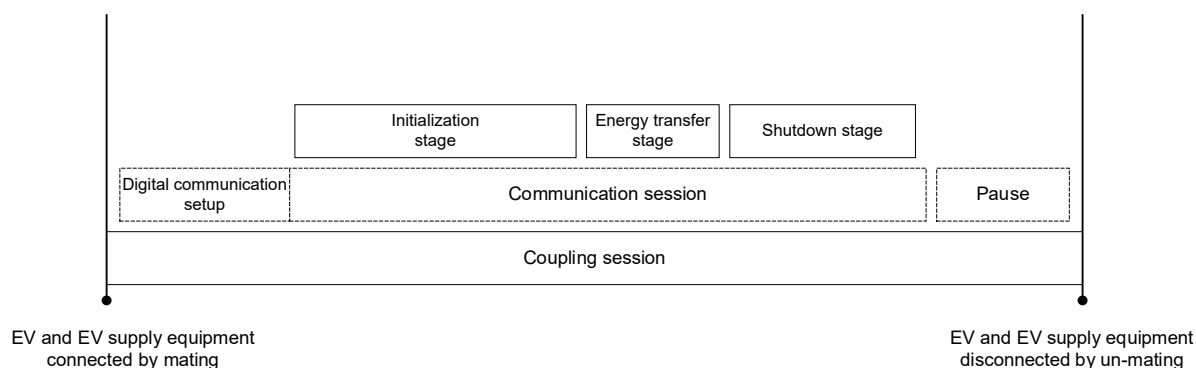
1219 **DEPRECATED: charge session**

1220 **DEPRECATED: supply session**

1221 Session that starts when the EV and EV supply equipment are connected by mating, and
1222 terminates when the EV and EV supply equipment are disconnected by un-mating.

1223 Note 1 to entry: A coupling session can have zero, one or multiple communication sessions.

1224 Note 2 to entry: See Figure 4.



1225
1226 **Figure 4 – Example of a coupling session**

1227 [SOURCE: IEC 61851-23:2024, 3.3.101, modified : ‘vehicle connector is mated to the vehicle inlet’
1228 replaced with ‘EV and EV supply equipment are connected by mating’ and ‘vehicle connector is un-
1229 mated from the vehicle inlet ‘ replaced with ‘EV and EV supply equipment are disconnected by un-
1230 mating’].

1231 3.7.23

1232 communication session

1233 Session that includes the initialization stage, energy transfer stage, and the shutdown stage

1234 Note 1 to entry: Multiple consecutive communication sessions can occur in a coupling session.

1235 Note 2 to entry: A communication session can include only the initialization stage and shutdown stage, if the EV
1236 supply equipment is unable to perform energy transfer.

1237 [SOURCE: IEC 61851-23:2024, 3.3.102]

1238 3.7.24

1239 pause

1240 period of time between communication sessions where the EV supply equipment does not
1241 perform energy transfer

1242 Note 1 to entry: The EV supply equipment and/or the EV may enable sleep mode during a pause.

1243 [SOURCE: IEC 61851-23:2024, 3.3.103]

1244 3.7.25

1245 sleep mode

1246 state of a device or equipment to reduce energy consumption

1247 [SOURCE: IEC 61851-23:2024, 3.3.104]

1248 3.7.26

1249 initialization stage

1250 stage at the beginning of a communication session to set, check and confirm parameters for
1251 the purpose of energy transfer

1252 Note 1 to entry: An initialization stage can be triggered by the user, wake-up/re-initialization triggered by the EV or
1253 EV supply equipment after sleep, a pause or a power outage.

1254 [SOURCE: IEC 61851-23:2024, 3.3.105]

1255 **3.7.27**
 1256 **energy transfer stage**
 1257 stage to perform energy transfer between the EV and the EV supply equipment
 1258 [SOURCE: IEC 61851-23:2024, 3.3.106]

1259 **3.7.28**
 1260 **shutdown stage**
 1261 stage at the end of a communication session to reach a safe state
 1262 EXAMPLE : Normal shutdown, error shutdown and emergency shutdown.
 1263 [SOURCE: IEC 61851-23:2024, 3.3.107]

1264 **4 General requirements**

1265 The EV supply equipment shall be so constructed that an EV can be connected to the EV supply
 1266 equipment so that in normal conditions of use, the energy transfer operates safely, and its
 1267 performance is reliable and minimises the risk of danger to the user or surroundings.

1268 *Compliance is checked by meeting all of the relevant requirements of this standard.*

1269 Electric devices and components that are parts of EV supply equipment shall comply with their
 1270 relevant standards.

1271 NOTE In the following countries, there are other requirements to be met for EV supply equipment: US, GB.

1272 **5 Service conditions**

1273 The service conditions defined in IEC 61439-7:2022, Clause 7 apply.

1274 The EV supply equipment shall be rated for one or more of standard nominal voltages and
 1275 frequencies as given in IEC 60038.

1276 **6 Classification**

1277 **6.1 According to the characteristics of power supply at side A and side B**

1278 **6.1.1 Characteristics of power supply at side A**

1279 The EV supply equipment shall be classified according to the supply network system that it is
 1280 intended to be connected to:

- 1281 – EV supply equipment connected to AC supply network;
- 1282 – EV supply equipment connected to DC supply network.

1283 The EV supply equipment shall be classified according to the electric connection method:

- 1284 – plug and cable connected;
- 1285 – permanently connected.

1286 **6.1.2 Characteristics of power supply at side B**

1287 The EV supply equipment shall be classified according to the type of current the EV supply
 1288 equipment delivers:

- 1289 – AC EV supply equipment;
- 1290 – DC EV supply equipment;
- 1291 – AC and/or DC EV supply equipment.

1292 **6.1.3 Characteristics of power distribution system**

1293 The EV supply equipment shall be classified according to the power distribution system to which
1294 the EV supply equipment is intended to be connected in its final application:

- 1295 – TT system;
- 1296 – TNC or TNS system;
- 1297 – IT system.

1298 **6.2 According to the service conditions**

1299 The EV supply equipment shall be classified according to the service conditions:

- 1300 – climate conditions, indoor use;
- 1301 – climate conditions, outdoor use.
- 1302 – special service conditions

1303 NOTE 1 The conditions that define indoor and outdoor use are given in Table 15 of Clause 7 of IEC 61439-7:2022.

1304 NOTE 2 Specific requirements for the equipment related to installation environment, see IEC 60364-7-722.

1305 **6.3 According to the mounting method**

1306 The EV supply equipment shall be classified according to the type of mounting:

- 1307 a) stationary equipment;
 - 1308 – wall mounted
 - 1309 – pole -mounted
 - 1310 – floor mounted
 - 1311 – ground mounted.
- 1312 b) non stationary equipment
 - 1313 – transportable equipment
 - 1314 – portable equipment
 - 1315 – mobile equipment.

1316 NOTE More than one classification can apply.

1317 **6.4 According to the mechanical resistance**

1318 The EV supply equipment shall be classified according to the mechanical resistance :

- 1319 – medium resistance
- 1320 – high resistance

1321 NOTE Requirements for medium and high resistance are defined in Table 1.

1322 **6.5 According to the charging mode**

1323 The EV supply equipment shall be classified according to 7.2:

- 1324 – Mode 1;
- 1325 – Mode 2;
- 1326 – Mode 3;

1327 – Mode 4.

1328 NOTE EV supply equipment with multiple side B outputs can be classified as supporting more than one mode.

1329 **6.6 According to the protection against electric shock**

1330 The EV supply equipment shall be classified according to the protection against electric shock:

- 1331 – class 1 equipment;
- 1332 – class 2 equipment;
- 1333 – class 3 equipment.

1334 **6.7 According to the ability of RPT**

1335 The EV supply equipment shall be classified according to its ability of supplying electric
1336 power from an EV to an external electric circuit:

- 1337 a) EV supply equipment not suitable for RPT,
- 1338 b) EV supply equipment suitable for RPT in grid following mode only (V2G or V2H
1339 connected),
- 1340 c) EV supply equipment suitable for RPT in grid forming mode only (V2H islanded),
- 1341 d) EV supply equipment suitable for RPT both in grid forming mode and grid following mode
1342 (V2G, V2H connected, and V2H islanded).

1343 If b), c) or d), are declared, Annex F applies.

1344 **7 Charging modes and functions**

1345 **7.1 General**

1346 Clause 7 provides requirements for the different charging modes and describes functions for
1347 energy transfer to EVs.

1348 **7.2 Charging modes**

1349 **7.2.1 Mode 1**

1350 The rated values for current and voltage shall not exceed:

- 1351 – 16 A and 250 V AC, single-phase,
- 1352 – 16 A and 480 V AC, three-phase.

1353 EV supply equipment intended for Mode 1 charging shall provide a protective conductor from
1354 the standard plug to the vehicle connector.

1355 Current limitations are also subject to the standard socket-outlet ratings described in 8.7.3.2.

1356 NOTE 1 In the following countries, Mode 1 charging is prohibited by national codes: US, CN

1357 NOTE 2 In the following countries, for EV supply equipment equipped with a plug for household and similar use,
1358 repeated continuous loads of long duration, shall be limited to 6 A: DK

1359 NOTE 3 In the following countries, NF C 61-314 applies to plugs and socket outlets: FR

1360 NOTE 4 A PRCD as described in IEC 61540 or IEC 62335, can be used to improve protection for connection to
1361 existing AC power supply networks in Mode 1.

7.2.2 Mode 2

The rated values for current and voltage shall not exceed:

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

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

Mode 2 devices shall comply with IEC 62752 as product standard.

NOTE 1 In the following countries, Mode 2 is not allowed in public areas: IT

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

7.2.3 Mode 3

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

NOTE In the following countries, the rated output current of the Mode 3 EV supply equipment is limited to 32 A for single phase and to 63 A for three phase: CN

Secretary note : the term output is deprecated, CN to confirm or modify the country note

7.2.4 Mode 4

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

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

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

NOTE In the following countries for mode 4 EV supply equipment, protective earthing conductors may be switched when required, in accordance with the national wiring regulations: GB.

Secretary's note : the term 'protective earthing conductor' is not used anymore in this clause, GB to confirm or modify the country note.

7.3 Functions provided in Mode 2, 3 and 4**7.3.1 Mandatory functions in Modes 2, 3, and 4****7.3.1.1 General**

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

- Continuous continuity checking of the protective conductor according to clause 7.3.1.2;
- Verification that the EV is properly connected to the EV supply equipment according to clause 7.3.1.3;
- Energization of the power supply to the EV according to clause 7.3.1.4;
- De-energization of the power supply to the EV according to clause 7.3.1.5;
- Maximum allowable current according to clause 7.3.1.6.

Compliance is checked by inspection and tests of Annex A where applicable.



1399 NOTE The control pilot functions can be achieved using a PWM signal and a control pilot as described in Annex A
1400 or by any other non PWM system that provides the same results and is compatible with Annex A. Examples are given
1401 in Annex D or ISO 15118 series.

1402 EV supply equipment designed for Mode 2 or Mode 3, using the control pilot conductor and
1403 utilizing accessories according to IEC 62196-2, shall be provided with a control pilot function
1404 according to Annex A.

1405 The EV supply equipment may provide a control pilot function in accordance with Annex D in
1406 addition to Annex A.

1407 EV supply equipment designed for Mode 4, using the control pilot conductor and utilizing
1408 accessories according to IEC 62196-3, shall be provided with a control pilot function according
1409 to IEC 61851-23.

1410 If EV supply equipment can supply more than one vehicle simultaneously, it shall ensure that
1411 the control pilot function performs the above functions independently at each vehicle connector
1412 or EV socket outlet.

1413 **7.3.1.2 Continuous continuity checking of the protective conductor**

1414 While charging in Mode 2, the electrical continuity of the protective conductor between the ICCB
1415 and the EV shall be continuously monitored by the ICCB.

1416 While charging in Mode 3, the electrical continuity of the protective conductor between the EV
1417 charging station and the EV shall be continuously monitored by the EV supply equipment.

1418 While charging in Mode 4, the electrical continuity of the protective conductor between the EV
1419 charging station and the EV shall be continuously monitored by the EV supply equipment.

1420 In Mode 3 and Mode 4, the function shall include the complete cable assembly.

1421 The EV supply equipment shall de-energize the EV in case any of the following occurs:

- 1422 • loss of electrical continuity of the protective conductor, within 100 ms.
- 1423 • incapacity to verify the continuity of the protective conductor (e.g. short circuit between
1424 control pilot conductor and protective conductor), within 3 s.

1425 **7.3.1.3 Verification that the EV is properly connected to the EV supply equipment**

1426 The EV supply equipment shall be able to determine that the EV is properly connected to the
1427 EV supply equipment.

1428 Proper connection is assumed when the continuity of the control pilot circuit is detected.

1429 **7.3.1.4 Energization of the power supply to the EV**

1430 The EV socket-outlet or the vehicle connector shall not be energized unless the control pilot
1431 function between EV supply equipment and EV has been established correctly with signal states
1432 allowing energization.

1433 The presence of such states does not imply that energy will be transferred between the EV
1434 supply equipment and the EV as this may be subject to other external conditions, e.g. condition
1435 given by an EEMS.

1436 If the EV requests ventilation, the EV supply equipment shall only energize the system if such
1437 ventilation is provided by the installation or the premises, and the ventilation system is

operational. The EV supply equipment shall be interlocked with the ventilation system such that if the ventilation system is inoperative for any reason, the EV supply equipment will not energize its output to the EV when ventilation is requested.

For Mode 2 and Mode 3 EV supply equipment, all the following requirements apply:

- 1) the energization of the EV shall be done by closing a switching device; for Mode 3, see clause 8.7.8; for Mode 2, see IEC 62752;
- 2) EV supply equipment shall react to an appropriate signalling of “EV ready to charge” by the EV within 3 s, by either:
 - energize the power supply to the EV by closing its switching device(s), or,
 - signal to the EV “The EV supply equipment will not deliver the energy” (e.g. control pilot according Annex A change to state x1);
- 3) EV supply equipment shall close all necessary switching device(s) to provide single-phase or three-phase substantially together by using mechanical or electrical coupling;
- 4) the interval time from closing the first live contact to the last live contact shall be limited to 100 ms;
- 5) after closing all intended switching device(s), the EV supply equipment shall not close more switching device(s) for additional phases or shall not open the switching device(s) during state “EV ready to charge”;
- 6) in case of changing supply from the EV supply equipment to an EV from single-phase to three-phase or vice versa, the EV supply equipment shall operate a stop and restart sequence and open the switching device(s) during that stop (for control pilot according Annex A, see chapter A.3.3).

7.3.1.5 De-energization of the power supply to the EV

The EV supply equipment shall de-energize the EV in case the control pilot signal no longer allows energization or the control pilot circuit is interrupted.

For Mode 2 and Mode 3 EV supply equipment, all the following requirements apply:

- 1) the de-energization shall be done by opening a switching device ; for Mode 3, see clause 8.7.8; for Mode 2, see IEC 62752;
- 2) EV supply equipment shall open all switching device(s) together by using mechanical or electrical coupling;
- 3) the interval time from the control pilot state change or interruption to the last live contact opening shall be limited to 100ms.

7.3.1.6 Maximum allowable current

The EV supply equipment shall provide a mean to inform the EV of the value of the maximum current it is allowed to draw. The value of the maximum current permitted shall be transmitted and shall not exceed any of the following:

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

The transmitted value may change, without exceeding the maximum allowed current e.g. for energy management.

The EV supply equipment may request to stop charging or de-energize the EV if the current drawn by the EV exceeds the transmitted value.

7.3.1.7 Intentional and unintentional unmating of the vehicle connector and/or the EV plug for Mode 2, Mode 3 and Mode 4 EV supply equipment

The EV supply equipment shall provide a mechanical or electrical interlock as required by accessories that are classified as “not suitable for making and breaking an electrical circuit under load”, as specified by the product standard of the used accessories.

NOTE 1 For interlock requirements of accessories, see IEC 62196 series or national standards.

NOTE 2 Mechanical and electrical interlock are specified in clause 14.1 of IEC 62196-1:2022.

NOTE 3 In the following countries a means to prevent unintentional unmating of the EV accessories is required: US.

Secretary's note : NC are invited to provide country notes, if specific interlock requirements apply.

7.3.2 Optional functions for Modes 2, 3 and 4

7.3.2.1 General

The optional functions that are implemented shall be indicated in the manual and shall fulfil the requirements of clause 7.3.2.

Other functions can be provided.

Compliance is checked by inspection and test where applicable.

7.3.2.2 Ventilation during supply of energy for Mode 3 and Mode 4 EV supply equipment

The Mode 3 and Mode 4 EV supply equipment can exchange information with installation regarding the request and presence for ventilation.

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

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

NOTE 3 This is mainly a requirement for indoor charging.

7.3.2.3 EV supply equipment using the combined charging interface

The combined vehicle inlet can be used with a basic vehicle connector for AC charging or with a combined vehicle connector for DC charging.

AC and DC charging shall not occur through the combined vehicle inlet at the same time.

The combined interface used for DC charging shall only be used with the “Combined charging System” described in Annex CC of IEC 61851-23:2024.

7.3.2.4 EV supply equipment using a vehicle connector for AC and DC power transfer on the same contacts

EV charging system using an interface for AC and DC power transfer on the same contacts shall be designed such that:

- an EV using this interface for AC charging only does not require any means to be self-protected against DC voltage coming from the EV supply equipment;
- an EV supply equipment using this interface for AC charging only does not require any means to be self-protected against DC voltage coming from the EV.

1518 NOTE 1 Additional requirements for EV using a vehicle inlet with AC and DC power transfer on the same contacts
1519 are described in ISO 5474-3 clause 6.5.

1520 Design of the EV supply equipment using this interface for DC charging shall apply a risk
1521 analysis according to IEC 61508-1 applying a severity level of at least S2 for the function
1522 preventing the risk of unintended DC voltage at side B.

1523 NOTE 2 Such analysis includes the effect of vehicle faults on EV supply equipment.

1524 **7.3.2.5 Phase balancing for Mode 2 and Mode 3 EV supply equipment**

1525 A Mode 2 or Mode 3 EV Supply equipment may integrate a phase balancing function.

1526 The phase balancing function consists of limiting the power unbalance between phases.

1527 NOTE 1 In some countries, DSOs require a limitation of the power unbalance between phases.

1528 Phase balancing function can be achieved by different methods, for example:

1529 a) by a permanent limitation of the maximum allowable current communicated by the EV supply
1530 equipment to the EV. This permanent limitation can prevent the exceedance of the
1531 unbalance limit, regardless the number of phases used by the EV.

1532 b) by a dynamic limitation of the maximum allowable current communicated by the EV supply
1533 equipment to the EV. This dynamic limitation can be achieved:

1534 • In standalone mode, the EV supply equipment detects the current drawn by the EV on
1535 each phase and limits the eventual unbalance by adjusting the maximum allowable
1536 current communicated to the EV.

1537 • In conjunction with an EEMS, which detects the unbalance level and provides the
1538 relevant information to the EV supply equipment which adjusts the maximum allowable
1539 current communicated to the EV.

1540 NOTE 2 This optional function can be implemented either in the charging station or in the electrical installation.

1541 **7.3.2.6 Communications**

1542 **7.3.2.6.1 Digital communication between the EV supply equipment and the EV**

1543 For Modes 1, 2 and 3, digital communication is optional.

1544 For Mode 4, the digital communication as described in IEC 61851-24 shall be provided to allow
1545 the EV to control the EV supply equipment.

1546 NOTE 1 Digital communication as described in ISO 15118 series is also called high level communication.

1547 NOTE 2 Annex D also provides information on digital communication.

1548 **7.3.2.6.2 Digital communication between the EV supply equipment and the** 1549 **management system**

1550 Digital communication between the EV supply equipment and the management system is optional.

1551 **8 Constructional requirements for Mode 3 EV supply equipment**

1552 **8.1 Strength of materials and parts**

1553 **8.1.1 General**

1554 Clause 8.1.1 of IEC 61439-7:2022 applies.

8.1.2 Protection against corrosion

Clause 8.1.2 of IEC 61439-7:2022 applies.

8.1.3 Damp heat resistance

The EV supply equipment shall pass the test defined in clause 10.2.

8.1.4 Properties of insulating materials

8.1.4.1 Thermal Stability

Enclosures or parts of enclosures made of insulating material(s), not already certified to their own product standard, e.g. louvers, meshes, shall be capable of operation at temperatures of at least 70°C. Thermal stability shall be verified according to clause 10.2.3.1 of IEC 61439-7: 2022.

8.1.4.2 Resistance of insulating materials to heat and fire

8.1.4.2.1 General

Parts of insulating material, which can be exposed to thermal stresses due to internal electrical effects, and the deterioration of which can impair the safety of the assembly, shall not be adversely affected by normal (operational) heat, and abnormal heat or fire.

8.1.4.2.2 Resistance of insulating materials to normal heat

The original manufacturer shall select insulating materials which are suitable for the maximum temperatures to which they are exposed in normal operation, in accordance with Clause 8.4. The applied temperature-rise limit for parts of insulating material shall be justified based on, for example, the methods of IEC 60216 (all parts), or thermal class identified in accordance with IEC 60085:2007, or the test procedure reported in IEC 60695-10-2:2014, method A.

NOTE With recognition of the differences to other methods, insulating materials can also be selected based on the relative thermal index (RTI), UL 746B.

8.1.4.2.3 Resistance of insulating materials to abnormal heat and fire due to internal electric effects

8.1.4.2.3.1 General

Parts of insulating materials which may be exposed to thermal stresses due to electrical effects within the equipment and which can impair the safety of EV supply equipment shall not be adversely affected by abnormal heat and by fire.

Parts, components, or devices that meet at least one the following criteria are exempt from clause 8.1.4.2.3 if:

- they are supplied by a limited power source as defined in clause 8.6; or,
- they have already been assessed to their relevant product standard, showing compliance to glow wire and/or flammability category requirements; or,
- it is a mass 2g or less (insignificant mass, in accordance with clause 3.14 of IEC 60695-2-11:2021). For products containing more than one small part, the total mass of non-tested parts located within 3 mm of each other shall be 10g or less.

NOTE The distance of 3 mm is defined in Clause 30.2 of IEC 60335-1:2020

For the purpose of this sub-clause, a protective conductor is not considered as a current-carrying part.

NOTE Fire hazard aspects are detailed in IEC TR 63054.

For each part, the manufacturer shall declare which test method, 8.1.4.2.3.2 or 8.1.4.2.3.3, is to be applied.

1596 If a part made from an identical material, having the same or greater thickness than the reference part
1597 that has already satisfied the requirements of clause 8.1.4.2.3.2 or 8.1.4.2.3.3, then that part does not
1598 need to be assessed again.

1599 **8.1.4.2.3.2 Glow wire testing**

1600 Parts of insulating materials necessary to retain current-carrying parts in position shall conform to the
1601 glow-wire tests at a test temperature of at least 850°C. Manufacturers shall specify the value appropriate
1602 to the product taking into account the Annex A of IEC 60695-2-11: 2021.

1603 Parts of insulating materials other than those specified in the previous paragraph, including parts
1604 necessary to retain the protective conductor, and parts intended to be embedded in and mounted on
1605 walls which are combustion resistant, shall conform to the requirements of the glow-wire test at a
1606 temperature of 650°C.

1607 The suitability of the materials used is verified by:

- 1608 a) making tests on the equipment; or,
- 1609 b) making tests on sections taken from the equipment; or,
- 1610 c) making tests on any parts of identical material having representative thickness; or,
- 1611 d) providing data from the insulating material supplier fulfilling the requirements according to IEC
1612 60695-2-12 for temperatures defined in this sub clause for the relevant parts.

1613 The manufacturer shall indicate which methods, amongst a), b), c), or d) shall be used.

1614 When verification is done by a), b) or c), test shall be made by the glow-wire end-product test of IEC
1615 60695-2-10 and IEC 60695-2-11.

1616 **8.1.4.2.3.3 Test based on flammability category**

1617 For parts of insulating materials, hot wire ignition (HWI) and, where applicable, arc ignition (AI) tests,
1618 shall be made based on flammability category. Arc ignition (AI) is required only if the material is within
1619 13mm of arcing parts or live parts which are subject to loosening of connections.

1620 Tests on materials shall be made in accordance with Annex M of IEC 60947-1:2020. The hot wire ignition
1621 and ignition test value requirements related to the material flammability category shall conform to Table
1622 M.1 or Table M.2 of Annex M of IEC 60947-1:2020.

1623 Alternatively, the manufacturer may provide data from the insulating material supplier fulfilling the
1624 requirements given in Annex M of IEC 60947-1: 2020.

1625 **8.1.5 Resistance to UV radiation**

1626 Clause 8.1.4 of IEC 61439-7:2022 applies.

1627 **8.1.6 Mechanical strength**

1628 Clause 8.1.5 of IEC 61439-7:2022 applies with the following additions.

1629 EV supply equipment shall comply with the severity levels defined in Table 1 and according to
1630 classification 6.4.

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Table 1 – Mechanical requirements and tests for EV supply equipment

Name of the test	Test standard clause	Medium resistance (for normal exposure)		High resistance (for severe exposure)	
		fixed equipment: wall mounted	fixed equipment: ground, floor, pole mounted	fixed equipment: wall mounted	fixed equipment: ground, floor, pole mounted
Mechanical impact	IEC 61439-7 : 2022 clause 10.2.701.2	At least IK08		IK 08 if height higher than 0.9 m, or IK10	At least IK10
Static load	IEC 61439-7 : 2022 clause 10.2.701.3	not required	Vertical load 4500 N/m ² applied for 5 min	not required	Vertical load 8500 N/m ² applied for 5 min
		not required	Lateral force 600 N applied for 5 min in turn	not required	Lateral force 1200 N applied for 5 min in turn
Strength of the doors	IEC 61439-7 : 2022 clause 10.2.701.4	A load of 50 N + load increased to 250 N	A load of 50 N + load increased to 250 N	A load of 50 N + load increased to 450 N	A load of 50 N + load increased to 450 N
Shock load	IEC 61439-7 : 2022 clause 10.2.701.5	not required	not required	not required	Total mass of 15 kg
Torsional test	IEC 61439-7 : 2022 clause 10.2.701.6	not required	not required	not required	2 × 1 000 N applied for 30 s
Shock test	IEC 61439-7 : 2022 clause 10.2.701.7	not required	not required	not required	not required
NOTE 1 : The choice between medium resistance and high resistance to be installed will depend on several factors : national rules, accessibility of the EV supply equipment after installation, mechanical protection in the surroundings of the EV supply equipment, etc. NOTE 2 : These requirements are based on medium and high resistance levels defined in 8.2.1.701, 8.2.1.702 and Table 702 of IEC 61439-7:2022. NOTE 3 : Higher resistance can be also required by national installation rules.					

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1636 Mechanical requirements for mobile and transportable EV supply equipment are under
 1637 consideration. When a mobile or transportable equipment can become a stationary equipment
 1638 by being fixed to the wall, ground, floor, or a pole, the requirements of Table 1 apply to the
 1639 equipment.

1640 *Compliance is checked by the relevant tests defined in clause 10.3.*

1641 **8.1.7 Lifting provisions**

1642 Clause 8.1.6 and 8.701.1 of IEC 61439-7:2022 apply.

1643 **8.2 Clearances and creepage distances**

1644 **8.2.1 General**

1645 The clearances and creepage distances in the EV supply equipment, installed as intended by
 1646 the manufacturer, shall be in accordance with the requirements specified in IEC 60664-1.

1647 Parts of the EV supply equipment directly connected to the electric power network shall be
1648 designed according to overvoltage category IV.

1649 Mode 3 EV supply equipment shall be designed according to a minimum overvoltage category
1650 III except for the EV socket-outlet or the vehicle connector where an overvoltage category II
1651 applies.

1652 Parts or components not complying with these overvoltage categories shall be protected within
1653 the EV supply equipment by appropriate means according to clause 8.7.2.2, in order to
1654 attenuate the transient overvoltage levels.

1655 When SPD (or SPC) according to 8.7.2.2 are implemented in the EV supply equipment, a
1656 reduction of overvoltage categories (OVC) is allowed but limited to one level, e.g. OVC III to
1657 OVC II. In any case, the resulting OVC (after OVC reduction) shall never be lower than OVC II.
1658 In addition,

- 1659 • clearances for basic insulation shall be at minimum equal to the values for case B of Table
1660 F.2 of IEC 60664-1:2020 without applying any OVC reduction and to the values for case A
1661 of Table F.2 of IEC 60664-1:2020 with applying an OVC reduction, whichever is greater
1662 (example, in the case of OVC II after reducing, 1,5 mm is the minimum distance to apply
1663 when measuring distances);
- 1664 • the minimum clearances for double insulation and/or reinforced insulation shall not be lower
1665 than those required for basic insulation according to case A of Table F.2 of IEC 60664-
1666 1:2020 before applying any OVC reduction.

1667 NOTE 1 For this purpose, it is not sufficient to provide means in the upstream installation.

1668 Where SPD (or SPC) according to 8.7.2.2 are implemented in the EV supply equipment for
1669 reducing the OVC, the status of such SPD shall be monitored. When such an SPD or SPC used
1670 for OVC reduction has reached its end of life, the EV supply equipment shall:

- 1671 • de-energize the power supply to the EV,
- 1672 • signal an error state to the EV (i.e. state F according to Annex A), and
- 1673 • alert the user to the error state through the HMI (if any) at the EV supply equipment
1674 according to clause 9.5.

1675 *Compliance is checked by activating the end-of-life status indicating means of the SPD (or SPC)*
1676 *and checking that the behavior of the EV supply equipment is fulfilled.*

1677 The pollution degree outside the EV supply equipment shall be considered as 2 for an indoor
1678 equipment and 3 for an outdoor equipment. Inside the enclosure of an outdoor equipment, the
1679 pollution degree can be reduced to 2 if the enclosure guarantees IP54 as a minimum.

1680 Pollution degree 1 micro-environment is possible when additional means according to IEC
1681 60664-3 are implemented.

1682 NOTE 2 Considerations for the reduction of the pollution degree can be found in Annex B of IEC 62477-1:2022.

1683 For equipment used above 2000 m, the clearances and creepage distances at higher altitude
1684 can be different and shall be considered if the EV supply equipment is declared to be used at
1685 altitudes higher than 2000 m.

1686 For compliance, verification of clearances and creepage distances is done:

- 1687 • by real measurements of the distances directly on the product under test or by design
1688 according to IEC 60664-1:2020, clause 6.8, or
- 1689 • by impulse tests according to 10.14.

8.2.2 Creepages and clearances for inner layers of printed wiring boards

The spacing between the tracks on the same inner layer of multi-layer PCBs shall:

- either meet the full clearance and creepage requirements according IEC 60664-1, or,
- comply with clauses G.13.4 and G.13.5 of IEC 62368-1:2023, or,
- for reduction of spacing, be tested in accordance to IEC 60664-3 for classification as protection type 2 according clause 4.3.

For classification as type 2 protection, the test program according to IEC 60664-3:2016 Annex A, Table A.1 applies.

The tests should be done on three samples of the PCB with the final layout.

After a successful test, minimum required spacing according to table 1 of IEC 60664-3:2016 for type 2 protection can apply.

Over cut edges, through drill holes, etc. the full clearances and creepages of IEC 60664-1 shall be met as delamination of the edges by manufacturing process cannot be excluded.

8.3 Protection against contact with live parts, ingress of solid foreign bodies and water (IP code)

8.3.1 Degrees of protection provided by EV supply equipment enclosures

After installation in accordance with the manufacturer's instructions, enclosures of the EV supply equipment shall have an IP degree, according to IEC 60529 as follows:

- indoor use: at least IP41;
- outdoor use: at least IP44.

Compliance is checked according to clause 10.4.

8.3.2 Degrees of protection provided by basic, combined and DC interfaces

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

Every accessory intended to be connected to the charging interfaces listed, shall be provided with the same protection degree (e.g. adaptor).

The minimum IP degrees for ingress of objects and liquids shall be:

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

1727 – EV socket-outlet when not mated: IP24.

1728 IPX4 may be obtained by the combination of the EV socket-outlet or vehicle connector and the
1729 lid or cap, EV supply equipment enclosure or EV enclosure.

1730 If a lid or cap is used for ensuring the marked degree of protection, the lid or cap shall be fixed
1731 to the vehicle connector.

1732 *Compliance is checked according to clause 10.4.*

1733 NOTE In the following countries, the UL articulated finger probe is used according to national regulations: US.

1734 **8.3.3 Assemblies with water and other fluid systems**

1735 Clause 8.701.2 of IEC 61439-7:2022 applies.

1736 This clause does not apply to a liquid cooled cable assembly according to IEC 62196-3 or IEC
1737 TS 62196-3-1.

1738 **8.4 Temperature rise**

1739 Clause 9.2 of IEC 61439-7:2022 applies.

1740 NOTE 1 For equipment used above 2000 m, the cooling effects at the higher altitude can be different and should
1741 be considered.

1742 NOTE 2 In the following countries, verification of the temperature rise includes measurements for electrical
1743 components, wiring terminals and systems, electrical insulation and materials, conductor and cable insulation and
1744 other parts are verified by type test according to National Standards: US

1745 NOTE 3 In the following countries, the EV supply equipment and its circuits shall be able to carry their maximum
1746 rated currents continuously under specified conditions, see IEC 61439-7, with a reference ambient air temperature
1747 of 25 °C, with adaptation of the temperature rise limits so that the sum of the ambient temperature and the individual
1748 temperature rise limit remains the same: US

1749 **8.5 Operation at low temperatures**

1750 The EV supply equipment shall be operational at low temperatures.

1751 Compliance is checked by tests according to clause 10.5.

1752 **8.6 Resistance to abnormal operating and fault conditions**

1753 The EV supply equipment shall be designed in such a way that a single fault condition or
1754 component failure does not lead to a hazard, unless other means to prevent the hazard are
1755 provided by the installation and are described in the installation manual provided with the EV
1756 supply equipment, see clause 9.1. The requirements in 8.6 also apply to abnormal operating
1757 conditions as applicable.

1758 Protection against the risk of thermal, electric shock and energy hazards in the case of fault
1759 condition of EV supply equipment may be evaluated based on circuit analysis provided by the
1760 manufacturer to identify critical components.

1761 If such analysis is conducted, it shall include situations where a single fault condition in any
1762 component, basic protection would result in:

- 1763 • an impact on the voltage of accessible SELV and PELV circuits and accessible conductive
1764 parts, or
- 1765 • a risk of degradation due to emission of flame, burning particles, molten metal or fire
1766 according to clause 4.6 of IEC 62477-1:2022 or clause 6.4 of IEC 62368-1:2023.

1767 NOTE Clause 4.6.4 of IEC 62477-1:2022 is not to be considered for this analysis as it applies in normal operation.