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**Electrically propelled road vehicles —  
Connection to an external electric  
power supply — Safety requirements**

*Véhicules routiers à propulsion électrique — Connexion à une borne  
d'alimentation électrique externe — Exigences de sécurité*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#).

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 37, *Electrically propelled vehicles*.

This corrected version of ISO 17409:2015 incorporates the following corrections.

6.1.2 and 6.1.3: The phrase 'overload protection' has been replaced with 'short-circuit protection' in four places.

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# Electrically propelled road vehicles — Connection to an external electric power supply — Safety requirements

## 1 Scope

This International Standard specifies electric safety requirements for conductive connections of electrically propelled road vehicles to an external electric power supply using a plug or vehicle inlet.

It applies to electrically propelled road vehicles with voltage class B electric circuits. In general, it may apply to motorcycles and mopeds if no dedicated standards for these vehicles exist.

It applies only to vehicle power supply circuits. It applies also to dedicated power supply control functions used for the connection of the vehicle to an external electric power supply.

It does not provide requirements regarding the connection to a non-isolated d.c. charging station.

It does not provide comprehensive safety information for manufacturing, maintenance, and repair personnel.

The requirements when the vehicle is not connected to the external electric power supply are specified in ISO 6469-3.

NOTE 1 This International Standard does not contain requirements for vehicle power supply circuits using protection by class II or double/reinforced insulation but it is not the intention to exclude such vehicle applications.

NOTE 2 Requirements for EV supply equipment are specified in IEC 61851.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6469-1, *Electrically propelled road vehicles — Safety specifications — Part 1: On-board rechargeable energy storage system (RESS)*

ISO 6469-3, *Electrically propelled road vehicles — Safety specifications — Part 3: Protection of persons against electric shock*

ISO 13849 (all parts), *Safety of machinery — Safety-related parts of control systems*

ISO 20653, *Road vehicles — Degrees of protection (IP code) — Protection of electrical equipment against foreign objects, water and access*

ISO 26262 (all parts), *Road vehicles — Functional safety*

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 60364-4-43, *Electrical installations of buildings — Part 4-43: Protection for safety — Protection against overcurrent*

IEC 60364-5-54, *Low-voltage electrical installations — Part 5-54: Selection and erection of electrical equipment — Earthing arrangements and protective conductors*

IEC 60364-6, *Low-voltage electrical installations — Part 6: Verification*

IEC 60664 (all parts), *Insulation coordination for equipment within low-voltage systems*

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

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

IEC 61851-23, *Electric vehicle conductive charging system — Part 23: D.C. electric vehicle charging station*

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

IEC 62196-2, *Plugs, socket-outlets, vehicle connectors and vehicle inlets — Conductive charging of electric vehicles — Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories*

IEC 62196-3, *Plugs, socket-outlets, vehicle connectors and vehicle inlets — conductive charging of electric vehicles — Part 3: Dimensional compatibility and interchangeability requirements for dedicated d.c. and combined a.c./d.c. pin and contact-tube vehicle couplers*

ISO/IEC 15118 (all parts), *Road vehicles — Vehicle to grid communication interface*

### 3 Terms and definitions

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

#### 3.1 balance of electric power system

remaining portion of a voltage class B electric circuit when all RESS and fuel cell stacks are disconnected

#### 3.2 barrier

part providing protection against direct contact from any usual direction of access

#### 3.3 basic insulation

insulation of hazardous-live-parts which provides basic protection

#### 3.4 case A

connection of an EV to the a.c. supply network (mains) utilizing a supply cable and plug permanently attached to the EV

#### 3.5 case B

connection of an EV to the a.c. supply network (mains) utilizing a detachable cable assembly with a vehicle connector and a.c. EV supply equipment

#### 3.6 case C

connection of an EV to the a.c. supply network (mains) utilizing a supply cable and vehicle connector permanently attached to the EV supply equipment.

Note 1 to entry: Only case C is applicable for mode 4 (see IEC 61851-1).

#### 3.7 charger

power converter at the vehicle power supply circuit which supplies electric power, e.g. for charging a RESS



**3.8****conductive part**

part capable of conducting electric current

**3.9****control pilot circuit**

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

**3.10****control pilot conductor**

insulated conductor incorporated in an EV cable assembly that creates, together with the protective conductor, the control pilot circuit

**3.11****control pilot function**

functionality used to monitor and control the interaction between the electric vehicle and the supply equipment

**3.12****d.c. EV charging station**

EV supply equipment intended to supply d.c. current to an EV

**3.13****direct contact**

contact of persons with live parts

**3.14****distortion power factor**

product of the displacement power factor and the total harmonic distortion up to the 40th harmonics of the load current

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**3.15****displacement power factor**

power factor due to the phase shift between voltage and current at the fundamental line frequency

**3.16****double insulation**

insulation comprising both basic insulation and supplementary insulation

**3.17****electric chassis**

conductive parts of a vehicle that are electrically connected and whose potential is taken as reference

**3.18****electric shock**

physiological effect resulting from an electric current passing through a human body

**3.19****electric vehicle****electric road vehicle****EV**

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

**3.20****enclosure**

part providing protection of equipment against direct contact from any direction

**3.21**

**EV supply equipment**

equipment or combined equipment providing dedicated functions for an electric power supply from a fixed installation to an EV for the purpose of charging for all dedicated charging modes and cases of connection

**3.22**

**exposed conductive part**

conductive part of the electric equipment, which can be touched by a test finger according to IPXXB (see ISO 20653) after removing barriers/enclosures which can be removed without using tools and which is not normally live, but which can become live under fault conditions

**3.23**

**external electric power supply**

electric power source that is not part of the vehicle for supplying electric energy to an EV using an EV supply equipment

**3.24**

**hazard**

potential source of harm

**3.25**

**isolation resistance**

resistance between live parts of voltage class B electric circuit and the electric chassis, as well as the voltage class A system

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**3.26**

**live conductor (line and neutral) ([standards.iteh.ai](https://standards.iteh.ai))**

conductor which is energized in normal operation and capable of contributing to the transmission or distribution of electric energy

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**3.27**

**live part**

conductor or conductive part intended to be electrically energized in normal operation

**3.28**

**maximum working voltage**

highest value of a.c. voltage (rms) or of d.c. voltage which can occur in an electric system under any normal operating conditions according to manufacturer's specifications, disregarding transients

**3.29**

**mode 1**

connection of the EV to the a.c. supply network (mains) utilizing a cable and plug, that is not fitted with any supplementary pilot or auxiliary contacts, and connects to a standard socket-outlet

**3.30**

**mode 2**

connection of the EV to the a.c. supply network (mains) utilizing a cable and plug connected to a standard socket-outlet, with a control pilot function and system for personal protection against electric shock placed between the EV and the socket outlet

**3.31**

**mode 3**

connection of the EV utilizing EV supply equipment permanently connected to the a.c. supply network (mains) and where the control pilot function extends to control equipment in the EV supply equipment

Note 1 to entry: Mode 3 includes the use of cable assembly not permanently connected to the a.c supply network (case A and case B).

### 3.32 mode 4

connection of the EV to the a.c. or d.c. supply network (mains) utilizing a d.c. EV supply equipment or d.c. EV charging station using a control pilot function

### 3.33 non-isolated d.c. EV charging station

d.c. EV charging station with d.c. circuit on output side which is not electrically separated by at least basic insulation from the supply system

### 3.34 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

### 3.35 protective conductor (PE)

conductor provided for purposes of safety, for example protection against electric shock

### 3.36 rechargeable energy storage system RESS

system that stores energy for delivery of electric energy and which is rechargeable

EXAMPLE Batteries and capacitors.

### 3.37 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. <https://www.iso.org/standard/52776845642/iso-17409-2015>

### 3.38 residual current device RCD

mechanical switching device or association of devices designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions

Note 1 to entry: A residual current device can be a combination of various separate elements designed to detect and evaluate the residual current and to make and break current.

### 3.39 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

### 3.40 standard plug and socket-outlet

plug and socket-outlet which meets the requirements of any IEC and/or 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 standards IEC 60309-1, IEC 60309-2, and IEC 60884-1 define standard plugs and socket-outlets.

### 3.41 supplementary insulation

independent insulation applied in addition to basic insulation for fault protection

**3.42**

**touch current**

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

**3.43**

**vehicle connector**

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

**3.44**

**vehicle coupler**

means of enabling the manual connection of a flexible cable to an EV for the purpose of supplying electric energy to an EV

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

**3.45**

**vehicle inlet**

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

**3.46**

**vehicle isolation resistance monitoring system**

system which periodically or continuously monitors the isolation resistance between live parts of voltage class B electric circuits and the electric chassis

**3.47**

**vehicle power supply circuit**

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

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**3.48**

**voltage class A**

classification of an electric component or circuit as belonging to voltage class A, if its maximum working voltage is  $\leq 30$  V a.c. (rms) or  $\leq 60$  V d.c., respectively

**3.49**

**voltage class B**

classification of an electric component or circuit as belonging to voltage class B, if its maximum working voltage is ( $>30$  V and  $\leq 1\ 000$ ) V a.c. (rms) or ( $>60$  V and  $\leq 1\ 500$ ) V d.c., respectively

## 4 Environmental conditions

The requirements given in this International Standard shall be met across the range of environmental conditions for which the electric vehicle is designed to operate when connected to an external electric power supply, as specified by the vehicle manufacturer.

NOTE See ISO 16750-4 for guidance.

## 5 Requirements for protection of persons against electric shock

### 5.1 Basic protection

In this Clause, requirements for protection against direct contact at the vehicle inlet (case B and C) and at the plug (case A) are specified.

Standard plug mated with standard socket-outlet (case A) shall comply with the requirements of relevant standards and the national requirements of the country where the product is placed on the market.