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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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ISO 17409 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 21, *Electrically propelled road vehicles*.

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

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

1 Scope

This standard specifies electric safety requirements for conductive connection 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 not connected to off-board equipment of the external electric power supply are specified in ISO 6469-3.

NOTE 1 This standard does not contain requirements for class II 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 61851-1.

2 Normative references

The following referenced documents are indispensable for the application 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.

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

ISO 6469-3:2011, *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*

- 32 IEC 60364-5-54, *Electrical installations of buildings - Part 5-54: Selection and erection of electrical equipment*
33 *- Earthing arrangements, protective conductors and equipotential bonding*
- 34 IEC 60664 (all parts), *Insulation coordination for equipment within low-voltage systems – Part 1: Principles,*
35 *requirements and tests*
- 36 IEC 60884-1, *Plugs, socket-outlets and couplers for household and similar purposes – Part 1: General*
37 *requirements*
- 38 IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*
- 39 IEC 60990:1999, *Methods of measurements of touch current and protective conductor current*
- 40 IEC 61851-1, *Electric vehicle conductive charging system – Part 1: General requirements*
- 41 IEC 61851-23, *Electric vehicle conductive charging system – Part 23: D.C. electric vehicle charging station*
42 *(Under development)*
- 43 IEC 62196-1, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – conductive charging of electric*
44 *vehicles – Part 1: General requirements*
- 45 IEC 62196-2, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – conductive charging of electric*
46 *vehicles – Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube*
47 *accessories*
- 48 IEC 62196-3, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – conductive charging of electric*
49 *vehicles – Part 3: Dimensional compatibility and interchangeability requirements for dedicated d.c. and*
50 *combined a.c./d.c. pin and contact-tube vehicle couplers (Under development)*
- 51 ISO/IEC 15118 (all parts), *Road vehicles -- Vehicle to grid communication interface*

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52 **3 Terms and definitions**

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

54 **3.1**
55 **balance of electric power system**
56 remaining portion of a voltage class B electric circuit when all RESS and fuel cell stacks are disconnected

57 **3.2**
58 **barrier**
59 part providing protection against direct contact from any usual direction of access

60 **3.3**
61 **basic insulation**
62 insulation of hazardous-live-parts which provides basic protection

63 **3.4**
64 **case A**
65 connection of an EV to the a.c. supply network (mains) utilizing a supply cable and plug permanently attached
66 to the EV

67 **3.5**
68 **case B**
69 connection of an EV to the a.c. supply network (mains) utilizing a detachable cable assembly with a vehicle
70 connector and a.c. supply equipment

- 71 **3.6**
 72 **case C**
 73 connection of an EV to the a.c. supply network (mains) utilizing a supply cable and vehicle connector
 74 permanently attached to the supply equipment.
- 75 NOTE Case C is the only connection case for mode 4 charging (see IEC 61851-1).
- 76 **3.7**
 77 **charger**
 78 power converter at the vehicle power supply circuit which supplies electric power, e.g. for charging a RESS
- 79 **3.8**
 80 **conductive part**
 81 part capable of conducting electric current
- 82 **3.9**
 83 **control pilot circuit**
 84 a circuit designed for the transmission of signals and/or communication between an EV and an EV supply
 85 equipment
- 86 NOTE: In mode 2, circuit between an EV and an ICCB.
- 87 **3.10**
 88 **control pilot conductor**
 89 insulated conductor incorporated in an EV cable assembly, that creates, together with the protective
 90 conductor, the control pilot circuit.
- 91 **3.11**
 92 **control pilot function**
 93 functionality used to monitor and control the interaction between the electric vehicle and the supply equipment
- 94 **3.12**
 95 **d.c. EV charging station**
 96 EV supply equipment intended to supply DC current to an EV
- 97 **3.13**
 98 **direct contact**
 99 contact of persons with live parts
- 100 **3.14**
 101 **double insulation**
 102 insulation comprising both basic insulation and supplementary insulation
- 103 **3.15**
 104 **electric chassis**
 105 conductive parts of a vehicle that are electrically connected and whose potential is taken as reference
- 106 **3.16**
 107 **electric shock**
 108 physiological effect resulting from an electric current passing through a human body
- 109 **3.17**
 110 **electric vehicle/electric road vehicle (EV)**
 111 any vehicle propelled by an electric motor drawing current from a RESS intended primarily for use on public
 112 roads

- 113 **3.18**
 114 **enclosure**
 115 part providing protection of equipment against direct contact from any direction
- 116 **3.19**
 117 **EV supply equipment**
 118 equipment or combined equipment providing dedicated functions for an electric power supply from a fixed
 119 installation to an EV for the purpose of charging for all dedicated charging modes and cases of connection
- 120 **3.20**
 121 **exposed conductive part**
 122 conductive part of the electric equipment, which can be touched by a test finger according to IPXXB (see ISO
 123 20653) after removing barriers/enclosures which can be removed without using tools and which is not
 124 normally live, but which may become live under fault conditions
- 125 **3.21**
 126 **external electric power supply**
 127 electric power source that is not part of the vehicle for supplying electric energy to an EV using an EV supply
 128 equipment
- 129 **3.22**
 130 **in-cable control box (ICCB)**
 131 device incorporated in the mode 2 cable assembly, which performs control functions and safety functions
- 132 NOTE The in-cable control box is located in a detachable cable assembly or plug that is not part of the fixed
 133 installation.
- 134 **3.23**
 135 **isolation resistance**
 136 resistance between live parts of voltage class B electric circuit and the electric chassis as well as the voltage
 137 class A system
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- 138 **3.24**
 139 **live conductor (line and neutral)**
 140 conductor which is energized in normal operation and capable of contributing to the transmission or
 141 distribution of electric energy
- 142 **3.25**
 143 **live part**
 144 conductor or conductive part intended to be electrically energized in normal use
- 145 **3.26**
 146 **maximum working voltage**
 147 highest value of a.c. voltage (rms) or of d.c. voltage which may occur in an electric system under any normal
 148 operating conditions according to manufacturer's specifications, disregarding transients
- 149 **3.27**
 150 **mode 1**
 151 connection of the EV to the a.c. supply network (mains) utilizing a cable and plug, that is not fitted with any
 152 supplementary pilot or auxiliary contacts, and connects to a standard socket-outlet
- 153 **3.28**
 154 **mode 2**
 155 connection of the EV to the a.c. supply network (mains) utilizing a cable and plug connected to a standard
 156 socket-outlet, with a control pilot function and system for personal protection against electric shock placed
 157 between the EV and the socket outlet

- 158 **3.29**
 159 **mode 3**
 160 connection of the EV utilizing EV supply equipment permanently connected to the a.c. supply network (mains),
 161 and where the control pilot function extends to control equipment in the EV Supply equipment
- 162 **3.30**
 163 **mode 4**
 164 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
 165 charging station using a control pilot function
- 166 **3.31**
 167 **non-isolated d.c. EV charging station**
 168 d.c. EV charging station with d.c. circuit on output side which is not electrically separated by at least basic
 169 isolation from the supply system
- 170 **3.32**
 171 **plug**
 172 accessory having contacts designed to engage with the contacts of a socket-outlet, also incorporating means
 173 for the electrical connection and mechanical retention of flexible cables or cords
- 174 **3.33**
 175 **protective conductor (PE)**
 176 conductor provided for purposes of safety, for example protection against electric shock
- 177 **3.34**
 178 **rechargeable energy storage system / RESS**
 179 system that stores energy for delivery of electric energy and which is rechargeable
- 180 EXAMPLE batteries, capacitors
- 181 **3.35**
 182 **reinforced insulation**
 183 insulation of hazardous-live-parts which provides a degree of protection against electric shock equivalent to
 184 double insulation
- 185 NOTE Reinforced insulation may comprise several layers which cannot be tested singly as basic insulation or
 186 supplementary insulation
- 187 **3.36**
 188 **residual current device (RCD)**
 189 mechanical switching device or association of devices designed to make, carry and break currents under
 190 normal service conditions and to cause the opening of the contacts when the residual current attains a given
 191 value under specified conditions
- 192 NOTE A residual current device can be a combination of various separate elements designed to detect and evaluate
 193 the residual current and to make and break current.
- 194 **3.37**
 195 **socket-outlet**
 196 accessory having socket-contacts designed to engage with the contacts of a plug and having terminals for the
 197 connection of cables or cords
- 198 **3.38**
 199 **standard plug and socket-outlet**
 200 plug and socket-outlet which meets the requirements of any IEC and/or national standard that provides
 201 interchangeability by standard sheets, excluding the specific EV accessories as defined in the IEC 62196
 202 series
- 203 NOTE The standards IEC 60309-1, IEC 60309-2 and IEC 60884-1 define standard plugs and socket-outlets