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Electrically propelled road vehicles — Safety specifications —

Part 3: Electrical safety

Véhicules routiers électriques — Spécifications de sécurité —

Partie 3: Sécurité électrique

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Foreword

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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. www.iso.org/directives

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For an explanation on the voluntary nature of standards, 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.

This document was prepared by Technical Committee ISO/TC 22 *Road vehicles*, Subcommittee SC 37, *Electrically propelled vehicles*.

This third edition cancels and replaces the second edition (ISO 6469-3:2011), which has been technically revised.

The main changes compared to the previous edition are as follows:

— extension of pure electric shock protection to all electric safety requirements including those against thermal incidents;

— introduction of definitions and requirements for new voltage classes B1 and B2;

— addition of specific requirements for capacitive discharge;

— new test specification for the isolation resistance monitoring system; and

— new requirements and test for touch current.

Electrically propelled road vehicles — Safety specifications —

Part 3: Electrical safety

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This document specifies electrical safety requirements for voltage class B electric circuits of electric propulsion systems and conductively connected auxiliary electric systems of electrically propelled road vehicles.

It specifies electrical safety requirements for protection of persons against electric shock and thermal incidents.

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

NOTE 1 Electrical safety requirements for post-crash are described in ISO 6469-4.

NOTE 2 Electrical safety requirements for conductive connections of electrically propelled road vehicles to an external electric power supply are described in ISO 17409.

NOTE 3 Specific electrical safety requirements for magnetic field wireless power transfer between an external electric power supply and an electrically propelled vehicle are described in ISO PAS 19363.

NOTE 4 Electrical safety requirements for motorcycles and mopeds are described in ISO 13063.

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.

ISO 7010, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

ISO 17409, *Electrically propelled road vehicles — Connection to an external electric power supply — Safety requirements*

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

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

IEC 60950-1, *Information technology equipment — Safety — Part 1: General requirements*

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

3 Terms and definitions

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

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
auxiliary electric system
vehicle system, other than the propulsion system, that operates on electric energy

3.2
balance of electric circuit
remaining section of an electric circuit when all electric power sources that are energized (e.g. *RESS* (3.31) and *fuel cell stacks* (3.20)) are disconnected

3.3
basic insulation
insulation of *hazardous live parts* (3.22) which provides *basic protection* (3.4)

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

Note 2 to entry: Where insulation is not provided by solid insulation only, it is complemented with protective barriers or protective enclosures to prevent access to live parts in order to achieve basic protection.

[SOURCE: IEC 60050-195:1998, 195-06-06, modified — "hazardous-live-parts" written as "hazardous live parts", Note 2 to entry added]

3.4
basic protection
protection against *electric shock* (3.14) under fault-free conditions

[SOURCE: IEC 60050-195:1998, 195-06-01]

3.5
clearance
shortest distance in air between two *conductive parts* (3.6)

[SOURCE: IEC 60664-1:2007, 3.2]

3.6
conductive part
part which can carry electric current

[SOURCE: IEC 60050-195:1998, 195-01-06]

3.7
conductively connected circuit
two electric circuits are considered conductively connected unless they are separated by at least basic insulation

3.8
creepage distance
shortest distance along the surface of a solid insulating material between two *conductive parts* (3.6)

[SOURCE: IEC 60050-151:2001/AMD1:2013, 151-15-50]

3.9
degree of protection
IP
protection provided by an enclosure or barriers against access, foreign objects and/or water and verified by standardized test methods in accordance with ISO 20653

[SOURCE: ISO 20653, modified — "in accordance with ISO 20653" added]

3.10
direct contact
electric contact of persons or animals with *live parts* (3.25)

[SOURCE: IEC 60050-195:1998, 195-06-03]

3.11
double insulation
insulation comprising both *basic insulation* (3.3) and *supplementary insulation* (3.33)

[SOURCE: IEC 60050-195:1998, 195-06-08]

3.12
electric chassis
conductive parts (3.6) of a vehicle that are electrically connected and whose potential is taken as reference

3.13
electric drive
combination of traction motor, power electronics and their associated controls for the conversion of electric to mechanical power and vice versa

3.14
electric shock
physiological effect resulting from an electric current through a human body or animal body

[SOURCE: IEC 60050-195:1998, 195-01-04]

3.15
electrically propelled vehicle
vehicle with one or more *electric drive*(s) (3.13) for vehicle propulsion

3.16
energized
qualifies a conductive part having an electric potential difference with respect to a relevant reference

[SOURCE: IEC 60050-151:2001/AMD1:2013, 151-15-58, modified — Note deleted]

3.17
equipotential bonding
provision of electric connections between *conductive parts* (3.6), intended to achieve equipotentiality

[SOURCE: IEC 60050-195:1998, 195-01-10]

3.18
exposed conductive part
conductive part (3.6) of equipment which can be touched and which is not normally live, but which can become live when *basic insulation* (3.3) fails

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

[SOURCE: IEC 61140:2016, 3.6, modified — "exposed conductive part" replaces "exposed-conductive-part" and Note 1 to entry deleted]

3.19
fault protection
protection against *electric shock* (3.14) under single-fault conditions

[SOURCE: IEC 60050-195:1998, 195-06-02]

3.20
fuel cell stack
assembly of two or more fuel cells that are electrically connected

3.21
fuel cell system
system, typically containing the following subsystems: *fuel cell stack* (3.20), air processing, fuel processing, thermal management, water management, and their control

3.22
hazardous live part
live part (3.25) which, under certain conditions, can give a harmful electric shock

Note 1 to entry: For guidance on harmful physiological effects see IEC 61140.

[SOURCE: IEC 60050-195:1995, 448-14-31, modified — term changed from "hazardous-live-part" to "hazardous live part" and Note 1 to entry added]

3.23
isolation resistance
insulation resistance
resistance between *live parts* (3.25) of an electric circuit and the *electric chassis* (3.12) as well as other electric circuits which are insulated from this electric circuit

3.24
isolation resistance monitoring system
system that periodically or continuously monitors the *isolation resistance* (3.23) between *live parts* (3.25) and the *electric chassis* (3.12)

3.25
live part
conductor or *conductive part* (3.6) intended to be energized in normal use, but by convention not the *electric chassis* (3.12)

[SOURCE: IEC 60050-195:1998, 195-02-19, modified — "including a neutral conductor" and Note 1 to entry deleted and "a PEN conductor or PEM conductor or PEL conductor" replaced by "the electric chassis"]

3.26
maximum working voltage
highest value of AC voltage (rms) or of DC voltage that can occur under any normal operating conditions according to the manufacturer's specifications, disregarding transients and ripple

3.27
overload protection
protection intended to operate in the event of overload on the protected section

[SOURCE: IEC 60050-448:1995, 448-14-31]

3.28
overcurrent protection
protection intended to operate when the current is in excess of a predetermined value

[SOURCE: IEC 60050-448:1995, 448-14-26]

3.29
protective barrier
part providing protection against *direct contact* (3.10) from any usual direction of access

[SOURCE: IEC 60050-195:1998, 195-06-15, modified — optional prefix "(electrically)" removed]

3.30
protective enclosure
electrical enclosure surrounding internal parts of equipment to prevent access to *hazardous live parts* (3.22) from any direction

[SOURCE: IEC 60050-195:1998, 195-06-14, modified — optional prefix "(electrically)" removed and "hazardous-live-parts" written as "hazardous live parts"]

3.31
rechargeable energy storage system
RESS
rechargeable system that stores energy for delivery of electric energy for the *electric drive* (3.13)

EXAMPLE Battery, capacitor, flywheel.

3.32
reinforced insulation
insulation of *hazardous live parts* (3.22) which provides protection against *electric shock* (3.14) equivalent to *double insulation* (3.11)

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

[SOURCE: IEC 61140:2016, 3.10.4]

3.33
supplementary insulation
independent insulation applied in addition to *basic insulation* (3.3), for fault protection

[SOURCE: IEC 60050-195:1998, 195-06-07]

3.34
touch current
electric current passing through a human body or through livestock when it touches one or more accessible parts of cables or equipment

[SOURCE: ISO 17409:2017, 3.42, modified — "cables" replaces "an electrical installation"]

3.35
vehicle power supply circuit
voltage class (3.36) B electric circuit which includes all parts that are conductively connected to the vehicle inlet (case B, case C) or the plug (case A) or part of an Autoconnect Charging Device that is mounted on the electrically propelled vehicle (case D, case E) and that is operational when connected to an external electric power supply

Note 1 to entry: Case A, case B, case C are defined in IEC 61851-1.

Note 2 to entry: Case D, case E and Autoconnect Charging Device are defined in IEC 61851-23-1 (under preparation).

[SOURCE: ISO 17409:2017, 3.47, modified — "conductively" replaces "galvanically"]

3.36
voltage class
classification of an electric component or circuit according to its *maximum working voltage* (3.26)