
**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

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).

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).

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

For an explanation of 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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This fourth edition cancels and replaces the third edition (ISO 6469-3:2018), which has been technically revised. It also incorporates the Amendment ISO 6469-3:2018/Amd.1:2020.

The main changes are as follows:

- changes from ISO 6469-3:2018/Amd.1:2020 were implemented,
- requirements for equipotential bonding were revised.

A list of all parts in the ISO 6469 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Electrically propelled road vehicles — Safety specifications —

Part 3: Electrical safety

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 19363.

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

ISO 17409, *Electrically propelled road vehicles — Conductive power transfer — 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 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 terminology databases for use in standardization at the following addresses:

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

— IEC Electropedia: available at <https://www.electropedia.org/>

**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* (3.37) that are *energized* (3.16) [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* (3.29) or *protective enclosures* (3.30) to prevent access to live parts in order to achieve basic protection.

[SOURCE: IEC 60050-195:2021, 195-06-06, modified — The phrase “hazardous live parts” and Note 2 to entry were added.]

**3.4
basic protection**

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

[SOURCE: IEC 60050-195:2021, 195-06-01, modified — The phrase “fault-free conditions” replaces “normal conditions”]

**3.5
clearance**

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

[SOURCE: IEC 60050-581:2008, 581-27-76]

**3.6
conductive part**

part which can carry electric current

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

**3.7
conductively connected**

not separated by at least a provision for *basic protection* (3.4)

**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/Amd.1:2013, 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 20653:2013, 3.2, modified — The phrases “or barriers” and “in accordance with ISO 20653”, and the term IP were added.]

3.10**direct contact**

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

[SOURCE: IEC 60050-195:2021, 195-06-03, modified — “persons” replaces “human beings” and “animals” replaces “livestock”.]

3.11**double insulation**

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

[SOURCE: IEC 60050-195:2021, 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 60050-195:2021, 195-01-04, modified — “animal body” replaces “livestock”.]

3.15**electrically propelled vehicle**

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

3.16**energized****live**

at an electric potential different from that of *electric chassis* (3.12) at the worksite and which presents an electrical hazard

Note 1 to entry: A part is energized when it is electrically connected to a source of electric energy. It can also be energized when it is electrically charged and/or under the influence of an electric or magnetic field.

[SOURCE: IEC 60050-651:2014, 651-21-08, modified — “electric chassis” replaces “earth” and the Note 2 to entry was deleted.]

3.17**equipotential bonding**

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

[SOURCE: IEC 60050-195:2021, 195-01-10, modified — “provision” replaces “set”.]

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 60050-442:1998, 442-01-21, modified — “equipment” replaces “electric equipment”.]

3.19

fault protection

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

[SOURCE: IEC 60050-195:2021, 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* (3.14)

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

[SOURCE: IEC 60050-195:2021, 195-06-05, modified — Term changed from “hazardous-live-part” to “hazardous live part” and Note 1 to entry was 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* (3.16) in normal use, but by convention not the *electric chassis* (3.12)

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 60050-195:2021, 195-06-15, modified — “against direct contact” replaces “against contact by a human being or livestock with hazardous-live-parts”.]

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 60050-195:2021, 195-06-14]

3.31**RESS**

rechargeable energy storage system

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* (3.3) or *supplementary insulation* (3.33).

[SOURCE: IEC 60050-581:2008, 581-21-27]

3.33**supplementary insulation**

independent insulation applied in addition to *basic insulation* (3.3), for *fault protection* (3.19)

[SOURCE: IEC 60050-195:2021, 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 17409:2020, 3.57, modified — “cables” replaces “an installation”.]

3.35**vehicle power supply circuit**

voltage class (3.36) B electric circuit which includes all parts that are *conductively connected* (3.7) 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* (3.15) (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 61851-23-1¹⁾.

[SOURCE: ISO 17409:2020, 3.61, modified — Note 1 to entry replaced and Note 2 to entry added.]

3.36**voltage class**

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

1) Under preparation. Stage at the time of publication: IEC/PRVC 61851-23-1:2021.