INTERNATIONAL STANDARD

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Electric road vehicles — Safety specifications —

Part 3: Protection of persons against electric hazards

Véhicules routiers électriques — Spécifications de sécurité —
Partie 3: Protection des personnes contre les dangers électriques

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 6469 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 6469-3 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 21, *Electric road vehicles*.

ISO 6469 consists of the following parts, under the general title *Electric road vehicles — Safety specifications*:

— *Part 1: On-board electrical energy storage*

— *Part 2: Functional safety means and protection against failures*

— *Part 3: Protection of persons against electric hazards*

Annexes A and B form a normative part of this part of ISO 6469.

Electric road vehicles — Safety specifications —

Part 3:
Protection of persons against electric hazards

1 Scope

This part of ISO 6469 specifies requirements for the protection of persons against electrical hazards on exclusively battery-powered electric road vehicles (passenger cars and light commercial vehicles) when the vehicles are not connected to an external power supply.

It is applicable only if the maximum working voltage of an on-board electrical circuit is lower than 1 000 V a.c., or 1 500 V d.c. or lower, according to national standards or regulations (e.g. for qualification of service personnel). It does not necessarily apply to assembly, maintenance and repair of these vehicles.

NOTE Requirements for electric road vehicles connected to an external power supply are specified in IEC 61851-21.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 6469. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 6469 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3864:1984, *Safety colours and safety signs*

ISO 6469-1:2001, *Electric road vehicles — Safety specifications — Part 1: On-board electrical energy storage*

ISO 6469-2:2001, *Electric road vehicles — Safety specifications — Part 2: Functional safety means and protection against failures*

ISO 8713:—[1)], *Electric road vehicles — Terminology*

IEC 60417-1:2000, *Graphical symbols for used on equipment — Part 1: Overview and application*

IEC 60417-2:1998, *Graphical symbols for used on equipment — Part 2: Symbol originals*

IEC 60529:1989, *Degree of protection provided by enclosures (IP code)*

IEC 61851-21:—[2)], *Electric vehicle conductive charging system — Part 21: Electric vehicle requirements for conductive connection to an AC/DC supply*

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1) To be published.

2) To be published.

3 Terms and definitions

For the purposes of this part of ISO 6469, the following terms and definitions apply.

3.1
conductive part
part capable of conducting electric current

[ISO 8713]

NOTE Although not necessarily electrically energized in normal operating conditions, it may become electrically energized under fault conditions of the basic insulation (see 3.3).

3.2
exposed conductive part
conductive part which can be touched by a test finger according to IPXXB (IEC protection code) as specified in IEC 60529

[ISO 8713]

NOTE This concept is relative to a specific electrical circuit: a live part in one circuit may be an exposed conductive part in another (e.g. the body of a passenger car may be a live part of the auxiliary network but an exposed conductive part of the power circuit).

3.3
live part
conductor or conductive part intended to be electrically energized in normal use

[ISO 8713]

3.4
electrical circuit
collection of connected live parts through which electrical current is intended to flow

[ISO 8713]

3.5
auxiliary electrical circuit
electrical circuit supplying vehicle functions other than for propulsion, such as lamps, windscreen- (windshield-) wiper motors and radios

[ISO 8713]

3.6
electrical chassis
conductive parts galvanically connected, whose potential is taken as a reference

[ISO 8713]

3.7
nominal voltage
value of the voltage used to name an electrical system and to which its characteristics are referred

[ISO 8713]

3.8
working voltage
highest value of a.c. voltage (rms) or d.c. voltage which may occur in an electrical system under any normal operating conditions, transients being disregarded

[ISO 8713]

3.9
power unit
combination of power control and electric motor

[ISO 8713]

3.10
power system
combination of power unit and the on-board energy source

[ISO 8713]

3.11
direct contact
contact of persons to live parts

[ISO 8713]

3.12
indirect contact
contact of persons to exposed conductive parts made live by a fault in the basic insulation of live parts

[ISO 8713]

3.13
basic insulation
insulation of live parts necessary to provide protection against direct contact (in a no-fault condition)

[ISO 8713]

NOTE Basic insulation does not necessarily include insulation used exclusively for a functional purpose.

3.14
supplementary insulation
independent insulation applied in addition to basic insulation, in order to provide protection against electric shock in the event of a failure of the basic insulation

[ISO 8713]

3.15
double insulation
insulation comprising both basic and supplementary insulation

[ISO 8713]

3.16
reinforced insulation
insulation system applied to live parts which provides protection against direct contact equivalent to double insulation

[ISO 8713]

NOTE The term “insulation system” does not imply that the insulation shall be a homogeneous piece. It may comprise several layers which cannot be tested individually as supplementary or basic insulation.

3.17
protection degree
protection related to the contact to live parts of a test finger (IPXXB), a test rod (IPXXC), or a test wire (IPXXD), as defined in IEC 60529

[ISO 8713]

NOTE IEC 60529 also defines protection degrees related to the ingress of water through enclosures (e.g. IPX3 by spray water, or IPX5 by a water jet).

3.18
class I equipment
equipment in which protection against direct contact is ensured by using basic insulation over live parts and connecting together the exposed conductive parts of this equipment using a protective conductor

[ISO 8713]

3.19
class II equipment
equipment in which protection against direct contact is ensured by using double insulation or reinforced insulation

[ISO 8713]

3.20
opening part
part of an electric road vehicle such as door, bonnet (hood), boot (trunk), access lid (e.g. charging inlet cover or fuel tank opening), sun roof or hardtop

[ISO 8713]

3.21
potential equalization
galvanical connection of exposed conductive parts of the electrical equipment

[ISO 8713]

3.22
insulation resistance monitoring system
system which monitors periodically or permanently the insulation resistance between traction battery and vehicle chassis

[ISO 8713]

4 Voltage classes of an electric circuit

Depending on its working voltage, U, an electrical circuit will belong to one of the voltage classes specified in Table 1.

5 Protection against electrical hazards

5.1 General

Protection against electrical hazards shall comprise protection against direct contact to live parts and protection under fault condition of basic insulation of live parts.

For voltage class A electrical circuits no specific protection means against electrical hazards are required.

Table 1 — Voltage classes of electric circuits

Voltage class	Working voltage	
	d.c. systems V	**a.c. systems** (15 Hz to 150 Hz) V(rms)
A	$0 < U \leqslant 60$	$0 < U \leqslant 25$
B	$60 < U \leqslant 1\,500$	$25 < U \leqslant 1\,000$

NOTE 1 The value 60 V d.c. or 25 V a.c. is selected taking into account humid weather conditions. For non a.c. but repetitive pulse voltages, if peak duration is above 10 ms, the considered working voltage is then the maximum peak value. If the peak duration is less than 10 ms, the working voltage is then the rms value. The reported a.c. voltage values are the most critical within the specified frequency range.

NOTE 2 d.c. voltage with $\leqslant$ 10 %: ripple voltage (rms).

NOTE 3 The upper voltage of class B can be lower in accordance with national standards or regulations (see also clause 1).

NOTE For functional reasons, means similar to those specified in 5.2 and 5.3 can also be provided for voltage class A electrical circuits. Such means are not covered by this part of ISO 6469.

5.2 Protection against direct contact

Persons shall be protected against any electrical hazard resulting from direct contact to live parts of any voltage class B electrical circuits.

Protection against direct contact shall be provided either by basic insulation of live parts, or by barriers/enclosures, or by a combination of both, in accordance with the requirements of 6.2 and 6.3.

5.3 Protection under fault condition of basic insulation

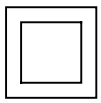
Persons shall be protected against any electrical hazard resulting from contact to exposed conductive parts in case of a fault condition of the basic insulation of live parts of any class B electrical circuits.

Protection under fault conditions shall be provided using either class I or class II equipment or by a combination of both.

Supplementary, double or reinforced insulation of class II equipment shall comply with the requirements given in 6.2.

The potential equalization of class I equipment shall comply with the requirements given in 6.4.

Class II equipment shall be identified by the following symbol, according to IEC 60417:



6 Requirements for protection against electrical hazards

6.1 General

Verification of the means of protection according to 5.2 and 5.3 shall be performed on each voltage class B electrical circuit on the vehicle.

If the safety aspects in relation to the whole vehicle are not affected, the tests may instead be performed on individual components.