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**Electric road vehicles — Safety  
specifications —**

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

*Véhicules routiers électriques — Spécifications de sécurité —*

*Partie 2: Mesures de sécurité fonctionnelle et protection contre les  
défaillances*



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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 6469-2 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*

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# Electric road vehicles — Safety specifications —

## Part 2:

# Functional safety means and protection against failures

## 1 Scope

This part of ISO 6469 specifies requirements for functional safety means and protection against failures related to the specific hazard of the electrical propulsion of exclusively battery powered electric road vehicles (passenger cars and light commercial vehicles).

It is applicable only if the maximum working voltage of the 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 the protection of service personnel). It does not necessarily apply to assembly, maintenance and repair of these vehicles.

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

ISO 6469-3:2001, *Electric road vehicles — Safety specifications — Part 3: Protection of persons against electric hazards*

ISO 8713:—<sup>1)</sup>, *Electric road vehicles — Terminology*

ISO 11451-2:2001, *Road vehicles — Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 2: Off-vehicle radiation sources*

## 3 Terms and definitions

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

### 3.1

#### power unit

combination of power control and electrical motor

[ISO 8713]

1) To be published.

**3.2**  
**drive direction control**  
device physically actuated by the driver to select the driving direction of the road vehicle (forward or backward)

[ISO 8713]

EXAMPLE A lever or push-button switch.

**3.3**  
**auxiliary electrical circuit**  
electrical circuit supplying vehicle functions other than for propulsion, such as lamps, windscreen- (windshield-) wiper motors and radios

[ISO 8713]

**3.4**  
**power system**  
combination of power unit and the on-board energy source

[ISO 8713]

## 4 Environmental and operational conditions

The requirements given in this part of ISO 6469 shall be met across the range of environmental and operational conditions for which the electric vehicle is designed to operate, as specified by the vehicle manufacturer.

## 5 Operational safety

### 5.1 Propulsion system, power-on procedure

At least two deliberate, distinct actions shall be performed in order to go from the "power-off" mode to the "driving enabled" mode.

- a) Power-off: the propulsion system is off; no active driving of the vehicle is possible in this mode.
- b) Driving enabled: only in this mode will the vehicle move when the accelerator device is applied.

Vehicle movement by its own propulsion system shall be impossible when the vehicle is physically connected to an external electrical network (e.g. mains, off-board charger).

After an automatic or manual turn-off of the propulsion system, it shall only be possible to reactivate the system by the specified power-on procedure.

An obvious device (e.g. a visual or audible signal) shall indicate permanently or temporarily that the propulsion system is ready for driving.

### 5.2 Driving

#### 5.2.1 Indication of reduced power

If the power is automatically reduced to a significant extent (e.g. by high temperature of the power unit or of the energy source component), this shall be indicated to the driver by an obvious device such as a visual or audible signal.

### 5.2.2 Indication of low state of charge of the traction battery

A low state of charge of the traction battery shall be indicated to the driver by an obvious device, (e.g. a visual or audible signal). At the indicated low state of charge specified by the vehicle manufacturer, the vehicle shall meet the following requirements.

- a) It shall be possible to move the vehicle out of the traffic area by its own propulsion system.
- b) A minimum energy reserve shall still be available for the lighting system as required by national and/or international standards or regulations, when there is no independent energy storage for the auxiliary electrical circuit.

### 5.2.3 Decelerating by releasing the accelerator pedal

Release of the accelerator pedal during driving should not result in a deceleration rate greater than that of a comparable internal combustion (IC) engine-powered road vehicle.

### 5.3 Driving backwards

If driving backwards is achieved by reversing the rotational direction of the electric motor, the following requirements shall be met to prevent unintentional switching into reverse when the vehicle is in motion:

- a) switching between the forward and backward (reverse) directions shall require either two separate actions by the driver, or
- b) if only one driver action is required, a safety device shall allow the transition only when the vehicle is stationary or moving slowly.

The maximum reverse speed shall be limited (according to the manufacturer's specification).

If driving backwards is not achieved by reversing the rotational direction of the electric motor, national and/or international regulations for driving vehicles propelled by IC engines in reverse shall apply to the electrical road vehicle.

### 5.4 Parking

When leaving the vehicle, the driver shall be informed by an obvious device (e.g. a visual or audible signal) if the propulsion system is still in the driving enabled mode.

If the electric motor continues to rotate when the vehicle is stationary, no unintended movement of the vehicle shall be possible after switching to the power-off mode.

### 5.5 Main switch

A main switch shall make it possible to disconnect at least one pole of the on-board electrical energy source (e.g. traction battery).

The main switch shall be activated (on and off) by a manual device positioned within the driver's hand reach. This disconnect device may be the same device as that used for the power-on procedure specified in 5.1. A different or additional disconnect device may also be provided.

After each disconnection, it shall be possible to reactivate the propulsion system only by using the normal power-on procedure.

## 5.6 Electromagnetic compatibility

### 5.6.1 Susceptibility

The electric road vehicle shall be tested for susceptibility according to ISO 11451-2. The reference field strength shall be a minimum of 30 V/m rms or according to national standards or regulations.

### 5.6.2 Emissions

Care shall be taken to minimize electromagnetic emissions from the electric road vehicle, taking into account national standards or regulations and international standards such as CISPR 22<sup>[1]</sup>.

## 5.7 Vehicle functions supplied by auxiliary electrical circuits

Vehicle functions enabled by the auxiliary circuits shall meet the relevant national and/or international standards or regulations during operation of the vehicle, particularly those related to lighting, signalling and safety functions.

## 6 Protection against failures

### 6.1 General

This clause specifies safety measures for avoiding the hazardous effects of failures in systems and components specific to electric road vehicles. Other systems and components shall be dealt with as for IC engine-propelled vehicles.

In particular, the following potential hazards shall be avoided.

### 6.2 Unintentional vehicle behaviour

Unintentional acceleration, deceleration and reversal of the propulsion system shall be prevented. In the event of a single failure (e.g. in the power control unit) of a stationary, unbraked vehicle, the propulsion shall be cut off to prevent unintended vehicle movement.

Unintended steering effects from different torques while driving or braking that are greater than those of IC engine-propelled vehicles shall not occur.

### 6.3 Electrical connections

Any unexpected disconnection of electrical connectors shall not result in hazardous behaviour of the vehicle.

### 6.4 Auxiliary electrical circuits

The auxiliary electrical circuits shall be protected against over-voltages when not galvanically isolated from the power system.

### 6.5 Over-current cut-off device

A circuit breaker, cut-off device or fuse shall switch off at least one pole of the on-board electric energy source (e.g. traction battery) in the case of over-current. This device may be the main switch specified in 5.5, or the battery over-current interruption device according to ISO 6469-1:2001, clause 8.

It shall be possible to reactivate the propulsion system only by the normal power-on procedure after the fault condition has been cleared.

## 7 Owner's manual

Special attention shall be given in the owner's manual to aspects specific to electric road vehicles.

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