
**Electrically propelled road vehicles —
Safety specifications —**

**Part 1:
Rechargeable energy storage system
(RESS)**

iTeh STANDARD PREVIEW
*Véhicules routiers électriques — Spécifications de sécurité —
Partie 1: Système de stockage d'énergie rechargeable (RESS)*
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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. 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. 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 third edition cancels and replaces the second edition (ISO 6469-1:2009) and ISO 12405-3:2014, which have been technically revised.

The main changes compared to ISO 6469-1:2009 and ISO 12405-3:2014 are as follows:

- test descriptions and requirements were reworked to include specific characteristics for lithium-ion based battery systems;
- document was reworked to become a general safety standard for all RESS types; and
- almost all test procedures and descriptions as given in the previous versions of both documents have been adapted to the latest technical developments.

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.

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Electrically propelled road vehicles — Safety specifications —

Part 1: Rechargeable energy storage system (RESS)

1 Scope

This document specifies safety requirements for rechargeable energy storage systems (RESS) of electrically propelled road vehicles for the protection of persons.

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

NOTE 1 Requirements for motorcycles and mopeds are specified in ISO 13063 and ISO 18243.

NOTE 2 Additional safety requirements can apply for RESS that can be recharged by means different from supplying electric energy (e.g. redox flow battery).

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 6469-3, *Electrically propelled road vehicles — Safety specifications — Part 3: Electrical safety*

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

IEC 60068-2-27, *Environmental testing - Part 2-27: Tests — Test Ea and guidance: Shock*

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:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

bus

<vehicle type> vehicle designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass exceeding 5 t

3.2

capacity

total number of ampere-hours that can be withdrawn from a fully charged RESS (3.22) under specified operating

3.3

clearance

shortest distance in air between two *conductive parts* (3.4)

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

3.4

conductive part

part which can carry electric current

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

3.5

creepage distance

shortest distance along a surface of a solid insulating material between two *conductive parts* (3.4)

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

3.6

customer

party that is interested in using the *RESS* (3.22) or *RESS subsystem* (3.24) and therefore, orders or performs the test

EXAMPLE Vehicle manufacturers.

[SOURCE: ISO PAS 19295:2016, modified — “voltage class B component or system” replaced by “RESS or RESS subsystems and therefore, orders or performs the test”, EXAMPLE added]

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3.7

electric chassis

conductive parts (3.4) of a vehicle that are electrically connected and whose potential is taken as reference

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[SOURCE: ISO 6469-3:2018, 3.12]

3.8

electric drive

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

[SOURCE: ISO 6469-3:2018, 3.13]

3.9

electrically propelled vehicle

vehicle with one or more *electric drive(s)* (3.8) for vehicle propulsion

[SOURCE: ISO 6469-3:2018, 3.15]

3.10

explosion

sudden release of energy sufficient to cause pressure waves and/or projectiles that can cause structural and/or physical damage to the surrounding area

3.11

flammable electrolyte

electrolyte having a flash point of not more than 93 °C

Note 1 to entry: The determination of flash point is based on ISO 2592.

3.12

heavy-duty truck

vehicle designed and constructed for the carriage of goods and having a maximum mass exceeding 12 t

3.13**isolation resistance
insulation resistance**

resistance between *live parts* (3.16) of an electric circuit and the *electric chassis* (3.7) as well as other electric circuits which are insulated from this electric circuit

[SOURCE: ISO 6469-3:2018, 3.23]

3.14**isolation resistance monitoring system**

system that periodically or continuously monitors the *isolation resistance* (3.13) between *live parts* (3.16) and the *electric chassis* (3.7)

[SOURCE: ISO 6469-3:2018, 3.24]

3.15**leakage**

escape of liquid or gas except for *venting* (3.28)

3.16**live part**

conductor or *conductive part* (3.4) intended to be energized in normal use, but by convention, not the *electric chassis* (3.7)

[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”]

3.17**maximum operating temperature**

highest value of the temperature at which the systems/components can be operated continuously

3.18**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

[SOURCE: ISO 6469-3:2018, 3.26]

3.19**medium-duty truck**

vehicle designed and constructed for the carriage of goods and having a maximum mass exceeding 3,5 t but not exceeding 12 t

3.20**midi bus**

vehicle designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5 t

3.21**overcurrent protection**

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

[SOURCE: IEC 60050-195:1998, 448-14-26]

3.22**rechargeable energy storage system****RESS**

rechargeable system that stores energy for delivery of electric energy for the *electric drive* (3.8)

EXAMPLE Battery, capacitor, flywheel.

3.23

RESS control unit

electronic device that controls functions of the RESS (3.22) and that provides communication between the RESS (3.22) and other vehicle controllers

EXAMPLE Battery control unit.

3.24

RESS subsystem

any assembly of RESS (3.22) components which stores energy

3.25

rupture

loss of mechanical integrity of an enclosure resulting in openings not fulfilling protection degree IPXXB according to ISO 20653

Note 1 to entry: Predetermined openings for venting are not considered as rupture.

3.26

state of charge

SOC

available capacity (3.2) of an RESS (3.22) or RESS subsystem (3.24) expressed as a percentage of rated capacity (3.2)

3.27

supplier

party that provides RESS (3.22) or RESS subsystem (3.24)

EXAMPLE RESS manufacturers.

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[SOURCE: ISO PAS 19295:2016, modified — “voltage class B component or system” replaced by “RESS or RESS subsystems”, EXAMPLE added]

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3.28

venting

release of excessive pressure intended by design

3.29

voltage class

classification of an electric component or circuit according to its *maximum working voltage* (3.18)

Note 1 to entry: The classification to the voltage classes A, B and B2 is according to ISO 6469-3:2018

[SOURCE: ISO 6469-3:2018, 3.35, modified — Note 1 to entry added.]

3.30

water depth

w

water depth level a vehicle is designed for operation according to the vehicle manufacturer's specification

Note 1 to entry: The vehicle manufacturer may consider the local environmental conditions where the vehicle is placed on the market.

4 General requirements

4.1 General electrical requirements

If not otherwise specified in this document, the voltage class B RESS shall fulfil the electrical safety requirements in accordance with ISO 6469-3. These electrical safety requirements may be fulfilled for an RESS on the component or vehicle level.

The voltage class B RESS or the voltage class B RESS subsystem shall be marked in accordance with ISO 6469-3.

NOTE For marking requirements for a voltage class A RESS or RESS subsystem when integrated into a voltage class B circuit see ISO 6469-3.

4.2 General safety requirements

The following requirements are general safety requirements, which apply when cited.

- The RESS shall not exhibit any evidence of leakage.
- The RESS shall not exhibit continuous emission of flames for more than 1 s or explosion.
- The RESS shall not exhibit any evidence of rupture.
- The voltage class B2 RESS shall maintain an isolation resistance according to [5.4.1](#).

Compliance shall be tested in accordance with [6.1.6](#).

5 Technical requirements

5.1 Mechanical requirements

The RESS shall provide the safety performance as specified below under mechanical loads due to vibration and mechanical shock, which an RESS will likely experience during the normal operation of a vehicle over its lifetime.

The general safety requirements in accordance with [4.2](#) shall be fulfilled.

Compliance shall be tested in accordance with [6.2](#).

5.2 Climatic requirements

5.2.1 Thermal shock cycling

The RESS shall provide the safety performance as specified below under a climatic load due to rapid temperature changes, which an RESS will likely experience during the normal operation of a vehicle.

The general safety requirements in accordance with [4.2](#) shall be fulfilled.

Compliance shall be tested in accordance with [6.3.1](#).

5.3 Simulated vehicle accident requirements

5.3.1 Vehicle crash

The RESS shall provide the safety performance at a vehicle crash, which shall comply with [5.3.1.1](#) and [5.3.1.2](#). Testing shall be performed at vehicle level or RESS level.

5.3.1.1 Inertial load at a vehicle crash

The RESS shall provide the safety performance under inertial loads caused by an acceleration which can occur at a vehicle crash. The general safety requirements in accordance with [4.2](#) shall be fulfilled. Compliance shall be tested in accordance with [6.4.1.1.2](#) or [6.4.1.2](#).

5.3.1.2 Contact force at a vehicle crash

The RESS shall provide the safety performance under contact forces which can occur at a vehicle crash. The general safety requirements in accordance with 4.2 shall be fulfilled.

For an RESS intended to be installed in vehicles with a gross mass exceeding 3,5 t, the requirements are deemed to be fulfilled, if the RESS is intended to be installed at a position higher than 700 mm above the ground (distance between the ground and the bottom surface of the RESS).

For an RESS intended to be installed in vehicles with a gross mass exceeding 7,5 t the requirements are deemed to be fulfilled, if the RESS is intended to be installed within a longitudinal chassis frame structure of the vehicle.

Compliance shall be tested in accordance with 6.4.1.1.3 or 6.4.1.2.

5.3.2 Immersion into water

The RESS shall provide the safety performance as specified below when it is exposed to water due to water immersion.

NOTE This requirement does not cover incidents in which the primary hazard for persons is caused by the presence of water, e.g. high flooding, flooded underground parking, flooded underpass.

The requirement is fulfilled if the RESS or RESS subsystem meets one of the following conditions:

- The RESS or RESS subsystem shall be tested in accordance with 6.4.2. During the test and during the post-test observation period of 2 h, the RESS or RESS subsystem shall not exhibit any evidence of continuous emission of flames for more than 1 s, or explosion.
- The RESS or RESS subsystem including all connectors, air ducts and connections for cooling attached is water protected. It shall be tested in accordance with IPX7 in ISO 20653 and no occurrence of water is allowed inside the RESS or RESS subsystem after the exposure to water. The test may be conducted with only the housing of an RESS or RESS subsystem and all connectors, air ducts and connections for cooling attached.

Minimal appearance of water due to the condensation of air humidity is possible and not considered as an occurrence of water. In case of doubt the test may be performed with coloured water.

5.3.3 Exposure to fire

This sub-clause applies to the RESS using flammable electrolyte only.

The RESS shall provide the safety performance as specified below when it is exposed to fire from outside of the vehicle. A thermal load can occur due to a fuel fire underneath the vehicle. Such a fire can be caused by fire from ignited spilled fuel either from the vehicle itself or a nearby vehicle. The intention is to provide time for the driver, passengers, and bystanders to evacuate.

During the test and during the specific post-test observation period for the exposure to fire, the RESS shall not exhibit any evidence of explosion.

Compliance shall be tested in accordance with 6.4.3.

The requirement is deemed to be fulfilled when the RESS is intended to be installed in the vehicle and mounted at a position higher than 1,5 m above the ground (distance between the ground and the bottom surface of the RESS subsystem).