

OICA Proposal for ELSA meeting, January 22, 2009**ELECTRICAL SAFETY PROVISIONS FOR VEHICLES IN USE****1. General**

This module shall apply to the electric power train of ~~road vehicles equipped with one or more traction motor(s) operated by electric power~~ ~~electric vehicles, hybrid vehicles and fuel cell vehicles~~, and not permanently connected to the grid and the high voltage components and systems which are galvanically connected to the high voltage bus of the electric power train.

2. Definitions

For the purpose of this regulation the following definitions apply:

2-1 Electric power train

the electrical circuit which ~~includes the traction motor(s), and~~ may include the RESS, the energy conversion system, the electronic converters ~~the traction motors~~, the associated wiring harness and connectors, and the coupling system for charging the RESS.

2-2 "RESS"

rechargeable energy storage system that provides ~~the~~ electric energy for ~~electric~~ propulsion.

2-3 Energy conversion system

system that generates and provides electric energy for ~~electric~~ propulsion.

2-4 Electronic converter

a device capable of controlling or converting electric power ~~for electric propulsion~~.

2-5 Coupling system for charging the RESS

the electrical circuit used for charging the RESS from an external electric power supply including the vehicle inlet.

2-6 External electric power supply

an AC or DC electric power supply outside of the vehicle.

2-7 Passenger compartment

the space for occupant accommodation, bounded by the roof, floor, side walls, doors, window glass, front bulkhead and rear bulkhead, or rear gate, ~~as well as by the barriers and enclosures provided for protecting the power train from direct contact with live parts~~.

2-8 Luggage compartment

the space in the vehicle for luggage accommodation, bounded by the roof, hood, floor, side walls, ~~as well as by the barrier and enclosure provided for protecting the power train from direct contact with live parts~~, being separated from the passenger compartment by the front bulkhead or the rear bulk head.

2-9 Direct contact

the contact of persons with live parts.

2-10 Live parts

conductive part(s) intended to be electrically energized in normal use.

2-11 Indirect contact

the contact of persons with exposed conductive parts.

2-12 Protection degree

Protection provided by a barrier/enclosure related to the contact with live parts by a test probe, such as a test finger (IPXXB) or a test wire (IPXXD), as defined in Attached Sheet 3.

2-13 Exposed conductive part

conductive part which can be touched under the provisions of the protection degree IPXXB and which becomes electrically energized under **isolation** failure conditions.

2-14 Electrical circuit

an assembly of connected live parts which is designed to be electrically energized in normal operation.

2-15 Working voltage

the highest value of an electrical circuit voltage (**r.m.s.**), specified by the manufacturer, which may occur between any conductive parts in open circuit conditions or under normal ~~operation~~ **operating** condition. **If the electrical circuit is divided by galvanic isolation, the working voltage is defined for each divided circuit, respectively.**

2-16 Electrical chassis

a set made of conductive parts electrically linked together, whose potential is taken as reference.

2-17 Solid insulator

insulating coating of wiring harnesses provided in order to cover and protect the live parts against direct contact from any direction of access; covers for insulating the live parts of connectors; and varnish or paint for the purpose of insulation.

2-18 Barrier

the part providing protection against direct contact to the live parts from any direction of access.

2-19 Enclosure

the part enclosing the internal units and providing protection against direct contact from any ~~usual~~ direction of access.

2-20 Service plug

the device for shutting off the electrical circuit when conducting checks and services of the ~~traction battery~~ RESS, fuel cell stack, etc.

2-21 On-board isolation resistance monitoring system

the device which monitors the isolation resistance between the high voltage buses and the electrical chassis.

2-22 High Voltage

classification of an electric component or circuit, if its maximum working voltage is > 60 V and ≤ 1500 V d.c. or > 30 V and ≤ 1000 V a.c.

2-23 High Voltage Bus

electrical circuit, including the ~~vehicle~~ coupling system for charging the RESS, that operates on high voltage.

2-24 Active driving possible mode

vehicle mode when application of pressure to the accelerator pedal (or activation of an equivalent control) will cause the ~~drive~~ electric power train to move the vehicle.

2-25 Open type traction battery

a liquid type battery requiring refilling with water and generating hydrogen gas released to the atmosphere.

2-26 Conductive connection

connection using contactors to an external power supply when the RESS is charged.

3 Requirements for Protection against Electrical Shock

3-1 General

These electrical safety requirements apply to high voltage buses under conditions where they are not connected to external high voltage power supplies.

3-2 Protection against direct contact

The protection against direct contact with live parts shall comply with paragraphs 3-2-1 and 3-2-2. These protections (solid insulator, barrier, enclosure, etc.) shall not be able to be opened, disassembled or removed without the use of tools.

Connectors (including vehicle inlet) are deemed to meet this requirement if:

- they comply with 3-2-1 and 3-2-2 when separated without the use of tools or
- they are located underneath the floor and are provided with a locking mechanism or
- they are provided with a locking mechanism and other components must be removed with the use of tools in order to separate the connector or
- the voltage of the live parts becomes equal or below DC 60V or equal or below AC 30V (r.m.s.) within 1 second after the connector is separated

3-2-1

For protection of live parts inside the passenger compartment or luggage compartment, the protection degree IPXXD shall be provided.

3-2-2

For protection of live parts in areas other than the passenger compartment or luggage compartment, the protection degree IPXXB ~~must~~ shall be satisfied.

3-2-3 Service plug

For the service plug which can be opened, disassembled or removed without tools, it is acceptable if protection degree IPXXB is satisfied under a condition where it is opened, disassembled or removed without tools.

Protection degrees IPXXB and IPXXD are related respectively, to the contact of a jointed test finger and a test wire with hazardous parts (Annex 3).

3-2-4 Marking

The symbol shown in Figure 1 shall appear near the RESS.

The same symbol shall be visible on enclosures and barriers, which, when removed expose live parts of high voltage circuits.

However, this provision shall not apply to any of the following cases

- where barriers or enclosures cannot be disassembled, opened or removed, unless other components are removed with the use of tools.
- where barriers or enclosures are located underneath the vehicle floor
- where double or more protections are provided by the barrier, enclosure or solid insulator.

The symbol background shall be yellow, the bordering and the arrow shall be black.

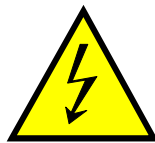


Figure 1 — Marking of high voltage equipment

The outer covering of cables and harness for high voltage buses, not within enclosures or not underneath the vehicle floor shall be identified by orange color or a similar color. This provision shall not apply to any connectors for high voltage buses.

3-3 Protection against indirect contact

3-3-1 ~~Potential Equalization~~

For protection against electrical shock which could arise from indirect contact, the exposed conductive parts, such as the conductive barrier and enclosure, shall be galvanically connected

securely to the electrical chassis by connection with electrical wire or ground cable, or by welding, or by connection using bolts, etc. so that no dangerous potentials are produced.

3-3-2 The resistance between all exposed conductive parts and the electrical chassis shall be lower than 0.1 ohm when there is current flow of at least 0.2 amperes.

This requirement is satisfied if the galvanic connection has been established by welding.

3-3-3 In the case of motor vehicles which are connected to the grounded external electric power supply through the conductive connection, a device to enable the galvanic connection of the electrical chassis to the earth ground shall be provided.

: ~~The vehicle inlet~~ This device shall enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is switched off removed from the vehicle.

Copliance to this requirement may be demonstrated either by using the connector specified by the car manufacturer, or by analysis.

~~3-3-2~~ 3-4 Isolation Resistance

~~3-3-2-1~~ 3-4-1 Electric power train consisting of separate DC- or AC-buses

If AC high voltage buses and DC high voltage buses are galvanically isolated from each other, Electrical isolation resistance between the high voltage bus and the electrical chassis shall be ~~≥ 100 ohms/volt~~ have a minimum value of 100 ohms/volt of the working voltage for DC buses, and ~~≥ 500 ohms/volt~~ a minimum value of 500 ohms/volt of the working voltage for AC buses.

The measurement shall be conducted according to Attached Sheet 1 "Isolation Resistance Measurement Method" or a method equivalent to it.

~~3-3-2-2~~ 3-4-2 Electric power train consisting of combined DC- and AC-buses

If AC high voltage buses and DC high voltage buses are galvanically connected, isolation resistance between the high voltage bus and the electrical chassis ~~when the vehicle is not connected to the external power supply~~ shall have a minimum value of 500 ohms/volt of the working voltage.

However, if all AC high voltage buses are protected by one of the 2 following measures, isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 100 ohms/volt of the working voltage.

- Double or more layers of solid insulators, barriers or enclosures that meet the requirement in paragraph 3.2 independently, for example wiring harness
- Mechanically robust protections that have sufficient durability over vehicle service life such as motor housings, electronic converter cases or connectors.

The isolation resistance between the high voltage bus and the electrical chassis may be demonstrated by calculation, measurement or a combination of both.

The measurement shall be conducted according to Attached Sheet 1 "Isolation Resistance Measurement Method" or a method equivalent to it.

3-4-3 If the minimum isolation resistance requirement cannot be maintained, then protection shall be achieved by any of the following:

- Double or more layers of solid insulators, barriers or enclosures that meet the requirement in paragraph 3.2 independently
- equipping an onboard isolation resistance monitoring system together with a warning to the driver if the isolation resistance drops below the minimum required value. **The isolation resistance between the high voltage bus of the coupling system for charging the RESS, which is not energized besides during charging the RESS, and the electrical chassis need not to be monitored.** The function of the on-board isolation resistance monitoring system shall be confirmed as described in Attached Sheet 2.

4. Requirements for RESS

4-1 Protection against excessive current

The RESS shall be equipped with a protective device (such as fuses or circuit breakers) if necessary in order to prevent overheating from excessive current. ~~This shall be demonstrated by testing or calculation.~~

4-2 Accumulation of Gas

Places for containing open type traction battery that may produce hydrogen gas shall be provided with a ventilation fan or a ventilation duct to prevent the accumulation of hydrogen gas.

5. Requirements for Functional Safety

At least a momentary indication must be given to the driver either

- (a) when the vehicle is in "active driving possible mode" or,
- (b) when one further action is required to place the vehicle in "active driving possible mode".

However, this provision does not apply under conditions where an internal combustion engine provides directly or indirectly the vehicle's propulsion power.

When leaving the vehicle, the driver shall be informed by a signal (e.g. optical or audible signal) if the vehicle is still in the active driving possible mode.

If the on-board RESS can be externally charged by the user, vehicle movement by its own propulsion system shall be impossible as long as the connector of the external electric power supply is physically connected to the vehicle inlet.

This requirement shall be demonstrated by using the connector specified by the car manufacturer.