## Explanation of the color code of the document:

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| Words in red color | = | proposed wording by IMMA out of the 7. RESS Meeting |
| Words in blue color | = | amendments / justification / questions from IMMA and the Secretary of the group for the 8. RESS Meeting |
| Words in grey | = | accepted wording by IMMA |
| Words in red with yellow background | = | Outcome of 8. RESS |

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| 1.1 | **PART I:** safety requirements with respect to the electric power train of road vehicles of categories M and N, with a maximum design speed exceeding 25 km/h, equipped with one or more traction motor(s) operated by electric power and not permanently connected to the grid, as well as their high voltage components and systems which are galvanically connected to the high voltage bus of the electric power train.<br><br>**PART I of this** Regulation does not cover post-crash safety requirements of road vehicles; | **PART I:** safety requirements with respect to the electric power train of road vehicles of categories M and N, with a maximum design speed exceeding 25 km/h **and vehicles of categories L,** equipped with one or more traction motor(s) operated by electric power and not permanently connected to the grid, as well as their high voltage components and systems which are galvanically connected to the high voltage bus of the electric power train.<br><br>**PART I of this** Regulation does not cover post-crash safety requirements of road vehicles; | **PART I:** safety requirements with respect to the electric power train of road vehicles of categories M and N, with a maximum design speed exceeding 25 km/h **and vehicles of categories L [with a maximum design speed exceeding 6 km/h],** equipped with one or more traction motor(s) operated by electric power and not permanently connected to the grid, as well as their high voltage components and systems which are galvanically connected to the high voltage bus of the electric power train.<br><br>**PART I of this** Regulation does not cover post-crash safety requirements of road vehicles; | The text in the brackets has to be checked by the REESS members.<br><br>RESS agreed to delete the brackets.<br><br>Explanation by IMMA:<br>IMMA to date has only considered L1-L5 aspects.<br><br>L6/L7 Aspects will be considered in a later phase.<br><br>✓ |

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| 2.1 | "**Active driving possible mode"** means the vehicle mode when application of pressure to the accelerator pedal (or activation of an equivalent control) or release of the brake system will cause the electric power train to move the vehicle. | | **"Active driving possible mode"** means the vehicle mode when application of pressure to the accelerator pedal (or activation of an equivalent control) or release of the brake system will cause the electric power train to move the vehicle. | ✓ |
| 2.2 | **"Barrier"** means the part providing protection against direct contact to the live parts from any direction of access. | | **"Barrier"** means the part providing protection against direct contact to the live parts from any direction of access. | ✓ |
| | | ~~[“Basic insulation” means the insulation applied to live parts for protection against direct contact under fault-free conditions.]~~ | | See the comment to § 2.7 and § 5.1.2.3.<br><br>Explanation from Secretary: Because of new wording for § 5.1.2.3 the definition is no longer necessary. |

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| | | ~~**“Battery pack” means the single mechanical assembly comprising battery cells and retaining frames or trays and possibly components for battery management**~~ | | ✓ |
| 2.4 | **"Conductive connection"** means the connection using connectors to an external power supply when the rechargeable energy storage system (REESS) is charged. | | **"Conductive connection"** means the connection using connectors to an external power supply when the rechargeable energy storage system (REESS) is charged. | ✓ |
| 2.5 | **"Coupling system for charging the rechargeable energy storage system (REESS)"** means the electrical circuit used for charging the REESS from an external electric power supply including the vehicle inlet. | | **"Coupling system for charging the rechargeable energy storage system (REESS)"** means the electrical circuit used for charging the REESS from an external electric power supply including the vehicle inlet. | ✓ |
| 2.7 | **"Direct contact"** means the contact of persons with live parts. | | **"Direct contact"** means the contact of persons with live parts. | ✓ |

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| | | ~~[“Double insulation” means the insulation system comprising both basic insulation and supplementary insulation]~~ | | See the comment to 5.1.2.3.<br><br>If such wording is necessary it has to be checked by IMMA whether the following existing wording out of § 5.1.3.2: “*double or more layers of solid insulators, barriers or enclosures that meet the requirement in Paragraph 5.1.1. independently, for example wiring harness*;” can be used.<br><br>Explanation from Secretary: Because of new wording for § 5.1.2.3 the definition is no longer necessary. |
| | | ~~“Drive direction control” means the device that is physically actuated by the driver rider for selecting the driving direction of the road vehicle (forward or backward)~~ | | ✓ |

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| 2.8 | **"Electrical chassis"** means a set made of conductive parts electrically linked together, whose potential is taken as reference. | | **"Electrical chassis"** means a set made of conductive parts electrically linked together, whose potential is taken as reference. |  |
| 2.9 | **"Electrical circuit"** means an assembly of connected live parts which is designed to be electrically energized in normal operation. | | **"Electrical circuit"** means an assembly of connected live parts which is designed to be electrically energized in normal operation. |  |
| 2.10 | **"Electric energy conversion system"** means a system that generates and provides electric energy for electric propulsion. | | **"Electric energy conversion system"** means a system that generates and provides electric energy for electric propulsion. |  |
| 2.11 | **"Electric power train"** means the electrical circuit which includes the traction motor(s), and may include the REESS, the electric energy conversion system, the electronic converters, the associated wiring harness and connectors, and the coupling system for charging the REESS. | | **"Electric power train"** means the electrical circuit which includes the traction motor(s), and may include the REESS, the electric energy conversion system, the electronic converters, the associated wiring harness and connectors, and the coupling system for charging the REESS. |  |

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| | | ~~**“Electrical shock” means the physiological effect resulting from an electric current passing through a human body.**~~ | | ✓ |
| 2.12 | **"Electronic converter"** means a device capable of controlling and/or converting electric power for electric propulsion. | | **"Electronic converter"** means a device capable of controlling and/or converting electric power for electric propulsion. | ✓ |
| 2.13 | **"Enclosure"** means the part enclosing the internal units and providing protection against direct contact from any direction of access. | | **"Enclosure"** means the part enclosing the internal units and providing protection against direct contact from any direction of access. | ✓ |
| 2.15 | **"Exposed conductive part"** means the conductive part which can be touched under the provisions of the protection degree IPXXB, and which becomes electrically energized under isolation failure conditions. This includes parts under a cover that can be removed without using tools. | | **"Exposed conductive part"** means the conductive part which can be touched under the provisions of the protection degree IPXXB, and which becomes electrically energized under isolation failure conditions. This includes parts under a cover that can be removed without using tools. | ✓ |

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| 2.16 | **"External electric power supply"** means an alternating current (AC) or direct current (DC) electric power supply outside of the vehicle. | | **"External electric power supply"** means an alternating current (AC) or direct current (DC) electric power supply outside of the vehicle. | ✓ |
| 2.19 | **"High Voltage"** means the classification of an electric component or circuit, if its working voltage is > 60 V and ≤ 1500 V DC or > 30 V and ≤ 1000 V AC root mean square (rms). | | **"High Voltage"** means the classification of an electric component or circuit, if its working voltage is > 60 V and ≤ 1500 V DC or > 30 V and ≤ 1000 V AC root mean square (rms). | ✓ |
| 2.20 | **"High voltage bus"** means the electrical circuit, including the coupling system for charging the REESS that operates on high voltage. | | **"High voltage bus"** means the electrical circuit, including the coupling system for charging the REESS that operates on high voltage. | ✓ |
| 2.21 | **"Indirect contact"** means the contact of persons with exposed conductive parts. | | **"Indirect contact"** means the contact of persons with exposed conductive parts. | ✓ |

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| | | ~~**[“Isolation resistance” means the resistance between live parts of voltage class B electric circuit and the electric chassis or exposed conductive parts as well as the voltage class A system]**~~<br><br>**"~~Isolation resistance~~"**<br>~~The insulation resistance between two electrodes which are in contact with, or embedded in, a specimen, is the ratio of the direct voltage applied to the electrodes to the total current between them at a given time after the application of that voltage. It is dependent upon both the volume and surface resistance of the specimen~~ | | Only to add this definition to UN ECE R100 does not work. There may be an amendment of § 5 necessary.<br>Proposal will developed by VDE, TÜV SGS and IMMA.<br>The proposal has also to be discussed with OICA.<br><br>IMMA suggestion:<br>Adding in paragraph 5.1.3.1. this sentence:<br><br>If AC high voltage buses and DC **not high voltage** buses are galvanically isolated from each other, isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 500 Ω/volt of the working voltage for AC buses.<br><br>VDE suggestion<br>Definition of isolation resistance based on IEC 60167<br><br>RESS decided that there is no necessity for a definition of “isolation resistance” |

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| 2.22 | **"Live parts"** means conductive part(s) intended to be electrically energized in normal use. | | **"Live parts"** means conductive part(s) intended to be electrically energized in normal use. | ✓ |
| 2.23 | "**Luggage compartment**" means 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. | "**Luggage compartment**" means the **closed** 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..~~ | "**Luggage compartment**"<br>• of category M and N vehicles means 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.<br>• of category L1 to L5 [to L7] vehicles means the **en**closed space in the vehicle **intended** for luggage accommodation. | The definition has to be checked by IMMA whether it will fit also for vehicles of categories L.<br><br>Explanation by IMMA:<br>The luggage compartment of many electrical motorcycles doesn't have roof or hood.<br><br>There is an applicable part in L1-L5 such as tool box, luggage box under seat, accessory box, or Cowl pocket on front cowl.<br><br>A new and separate definition may be proposed by IMMA for L6/L7 in a later phase.<br><br>Question by IMMA:<br>Need to be checked whether it will fit also for vehicles of categories M or if different definitions should define for different vehicle categories.<br><br>✓ |

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| | | ~~“Maximum working voltage” means the highest value of a.c. voltage (rms) or of d.c. voltage which may occur in an electric system under any normal operating conditions according to manufacturer’s specifications, disregarding transients~~ | | ✓ |
| 2.25 | **"On-board isolation resistance monitoring system"** means the device which monitors the isolation resistance between the high voltage buses and the electrical chassis. | | **"On-board isolation resistance monitoring system"** means the device which monitors the isolation resistance between the high voltage buses and the electrical chassis. | ✓ |
| 2.26 | **“Open type traction battery"** means a liquid type battery requiring refilling with water and generating hydrogen gas released to the atmosphere. | | **“Open type traction battery"** means a liquid type battery requiring refilling with water and generating hydrogen gas released to the atmosphere. | ✓ |

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| 2.27 | **"Passenger compartment"** means 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. | **"Passenger compartment"**<br>• for M and N category means 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.<br>• for **L1 to L5 [to L7]** category means the passenger compartment is bounded by at least 4 of the following elements: 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. | **"Passenger compartment"**<br>• for M and N category means 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.<br>for **L1 to L5 [to L7]** category means the passenger compartment is bounded by at least 4 of the following elements: 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. | **The definition has to be checked by IMMA whether it will fit also for vehicles of categories L.**<br><br>IMMA explanation:<br>L1, L3, L5 have few examples for a passenger compartment. An applicable case exists also for L2 and L4 in the sidecar.<br><br>It may also be possible to introduce ‘bodied vehicle’: definition exists in Directive 97/24/EC chapter 12):<br><br>An embodied L category vehicle is a vehicle of which the passenger compartment is bounded by at least 4 of the following elements: windscreen, floor, roof, lateral or rear closures or doors.<br><br>IMMA question:<br>L6, L7 vehicles also may have Passenger compartment.<br><br>✓ |

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| | | “~~**Power-off mode” means that the propulsion system is off; no active driving of the vehicle is possible in this mode.**~~ | | ✓ |
| 2.28 | **"Protection degree"** means the 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 Annex 3. | | **"Protection degree"** means the 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 Annex 3. | ✓ |
| 2.29 | **"Rechargeable energy storage system (REESS)"** means the rechargeable energy storage system that provides electric energy for electrical propulsion. | | **"Rechargeable energy storage system (REESS)"** means the rechargeable energy storage system that provides electric energy for electrical propulsion. | ✓ |

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| | | **~~[“Reinforced insulation” means the insulation of live parts for protection against electric shock equivalent to double insulation.]~~** | | **See the comment to 5.1.2.3.**<br><br>**If such wording is necessary it has to be checked by IMMA whether the following existing wording out of § 5.1.3.2: “*double or more layers of solid insulators, barriers or enclosures that meet the requirement in Paragraph 5.1.1. independently, for example wiring harness;”* can be used.**<br><br>Explanation from Secretary: Because of new wording for § 5.1.2.3 the definition is no longer necessary. |
| | | **["Removable REESS ~~battery~~ for driving" means that the battery which the driver ~~rider~~ charges or replaces without using tools, and could be easily put on and taken off.]** | | May be discussed when REESS requirements for category L vehicles will be discussed. |

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| 2.31 | **"Service disconnect"** means the device for deactivation of the electrical circuit when conducting checks and services of the REESS, fuel cell stack, etc. | | **"Service disconnect"** means the device for deactivation of the electrical circuit when conducting checks and services of the REESS, fuel cell stack, etc. | ✓ |
| 2.33 | **"Solid insulator"** means the 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. | | **"Solid insulator"** means the 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. | ✓ |
| | | ~~**“Traction battery / battery” means the collection of all battery packs, which are electrically connected, for the supply of electric power to the electric drive and conductively connected auxiliary system, if any**~~ | | ✓ |

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| 2.37 | **"Vehicle type"** means vehicles which do not differ in such essential aspects as:<br>(a) Installation of the electric power train and the galvanically connected high voltage bus.<br>(b) Nature and type of electric power train and the galvanically connected high voltage components. | | **"Vehicle type"** means vehicles which do not differ in such essential aspects as:<br>(a) Installation of the electric power train and the galvanically connected high voltage bus.<br>(b) Nature and type of electric power train and the galvanically connected high voltage components. | ✓ |
| | | ~~**“Voltage class B” means the classification of an electric component or circuit as belonging to voltage class B, if its maximum working voltage is (> 30 and ≤ 1000) V a.c. or (> 60 and ≤ 1500) V d.c. respectively**~~ | | ✓ |

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| 2.38 | **"Working voltage"** means the highest value of an electrical circuit voltage root-mean-square (rms), specified by the manufacturer, which may occur between any conductive parts in open circuit conditions or under normal operating condition. If the electrical circuit is divided by galvanic isolation, the working voltage is defined for each divided circuit, respectively. | | **"Working voltage"** means the highest value of an electrical circuit voltage root-mean-square (rms), specified by the manufacturer, which may occur between any conductive parts in open circuit conditions or under normal operating condition. If the electrical circuit is divided by galvanic isolation, the working voltage is defined for each divided circuit, respectively. | ✓ |
| 3.1. | **PART I: APPROVAL OF A VEHICLE TYPE WITH REGARD TO THE HIGH VOLTAGE SYSTEM** | | **PART I: APPROVAL OF A VEHICLE TYPE WITH REGARD TO ~~THE HIGH VOLTAGE SYSTEM~~ ELECTRICAL SAFETY, INCLUDING HIGH VOLTAGE SYSTEM** | ✓ |
| 3.1.1. | The application for approval of a vehicle type with regard to specific requirements for the electric power train shall be submitted by the vehicle manufacturer or by his duly accredited representative. | | The application for approval of a vehicle type with regard to specific requirements for the electric power train shall be submitted by the vehicle manufacturer or by his duly accredited representative. | ✓ |

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| 3.1.2. | It shall be accompanied by the under-mentioned documents in triplicate and following particulars: | | It shall be accompanied by the under-mentioned documents in triplicate and following particulars: | **Because of lack of time not discussed.** ✓ |
| 3.1.2.1. | Detailed description of the vehicle type as regards the electric power train and the galvanically connected high voltage bus. | | Detailed description of the vehicle type as regards the electric power train and the galvanically connected high voltage bus. | **Because of lack of time not discussed.** ✓ |
| 3.1.3. | A vehicle representative of the vehicle type to be approved shall be submitted to the Technical Service responsible for conducting the approval tests | | A vehicle representative of the vehicle type to be approved shall be submitted to the Technical Service responsible for conducting the approval tests | **Because of lack of time not discussed.** ✓ |
| 5. | **REQUIREMENTS OF A VEHICLE WITH REGARD TO ITS ELECTRICAL SAFETY** | | **REQUIREMENTS OF A VEHICLE WITH REGARD TO ITS ELECTRICAL SAFETY** | ✓ |

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| 5.1 | **Protection against electrical shock**<br><br>These electrical safety requirements apply to high voltage buses under conditions where they are not connected to external high voltage power supplies. | | **Protection against electrical shock**<br><br>These electrical safety requirements apply to high voltage buses under conditions where they are not connected to external high voltage power supplies. | ✓ |
| 5.1.1. | **Protection against direct contact**<br><br>The protection against direct contact with live parts shall comply with Paragraphs 5.1.1.1. and 5.1.1.2.<br>These protections (solid insulator, barrier, enclosure, etc.) shall not be able to be opened, disassembled or removed without the use of tools. | | **Protection against direct contact**<br><br>The protection against direct contact with live parts shall comply with Paragraphs 5.1.1.1. and 5.1.1.2.<br>These protections (solid insulator, barrier, enclosure, etc.) shall not be able to be opened, disassembled or removed without the use of tools. | ✓ |

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| 5.1.1.1. | For protection of live parts inside the passenger compartment or luggage compartment, the protection degree IPXXD shall be provided. | | For protection of live parts inside the passenger compartment or luggage compartment, the protection degree IPXXD shall be provided. | ✓ |
| 5.1.1.2. | For protection of live parts in areas other than the passenger compartment or luggage compartment, the protection degree IPXXB shall be satisfied. | | For protection of live parts in areas other than the passenger compartment or luggage compartment, the protection degree IPXXB shall be satisfied. | ✓ |

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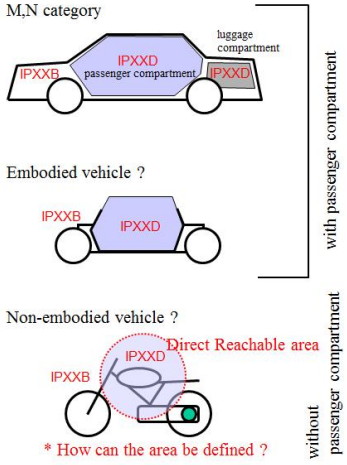
| **5.1.1.3** | | [For vehicles where no passenger compartment is ~~defined~~ present, for all areas within direct reach of driver and passenger **(**by the hands when the driver or passenger is on the seat) protection degree IPXXD shall be provided. **For all other parts IPPXB has to be fulfilled.]** | Is there an R-point definition for category L vehicles ?<br>  <br> | New paragraph.<br><br>Wording has to be checked by IMMA.<br><br>Explanation IMMA:<br><br>"Luggage compartment" can be used in the way as it is now, because all of M/N/L can have it.<br><br>Question by IMMA:<br>“The area within direct reach of driver and passenger” in the text, is it well defined and unambiguously?<br><br>IMMA has to come up with an improved wording for § 5.1.1.3. It has to be considered how an possible R-point could be introduced and which protection degree should be required for L vehicles.<br><br>Deadline 18. March 2013 |

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| 5.1.1.3. | Connectors (including vehicle inlet) are deemed to meet this requirement if:<br><br>(a) they comply with 5.1.1.1. and 5.1.1.2. when separated without the use of tools, or<br><br>(b) they are located underneath the floor and are provided with a locking mechanism, or<br><br>(c) they are provided with a locking mechanism and other components shall be removed with the use of tools in order to separate the connector, or<br><br>(d) the voltage of the live parts becomes equal or below DC 60V or equal or below AC 30V (rms) within one second after the connector is separated. | | Connectors (including vehicle inlet) are deemed to meet this requirement if:<br><br>(a) they comply with 5.1.1.1. and 5.1.1.2. when separated without the use of tools, or<br><br>(b) they are located underneath the floor and are provided with a locking mechanism, or<br><br>(c) they are provided with a locking mechanism and other components shall be removed with the use of tools in order to separate the connector, or<br><br>(d) the voltage of the live parts becomes equal or below DC 60V or equal or below AC 30V (rms) within one second after the connector is separated. | ✓ |

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| | | ~~(e) If vehicles of category L are equipped with removable REESS, the protection degree IPXXB shall be applicable to the interface between the vehicle and the REESS, except when the voltage at the interface between the vehicle and the REESS is ≤ 60 V d.c. within a second.~~ | | This requirement is not necessary because it is already captured in 5.1.1.3. (d). ✓ |
| 5.1.1.4. | **Service disconnect**<br><br>For a service disconnect 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. | | **Service disconnect**<br><br>For a service disconnect 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. | ✓ |

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| 5.1.1.5. | **Marking** | | **Marking** | ✓ |
| 5.1.1.5.1. | In the case of a REESS having high voltage capability the symbol shown in Figure 1 shall appear on or near the REESS. The symbol background shall be yellow, the bordering and the arrow shall be black. | | In the case of a REESS having high voltage capability the symbol shown in Figure 1 shall appear on or near the REESS. The symbol background shall be yellow, the bordering and the arrow shall be black. | ✓ |
| |  | |  | ✓ |
| | Figure 1 - Marking of high voltage equipment | | Figure 1 - Marking of high voltage equipment | ✓ |

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| 5.1.1.5.2. | The symbol shall also be visible on enclosures and barriers, which, when removed expose live parts of high voltage circuits. This provision is optional to any connector for high voltage buses. This provision shall not apply to any of the following cases:<br>(a) where barriers or enclosures cannot be physically accessed, opened, or removed; unless other vehicle components are removed with the use of tools<br><br>(b) where barriers or enclosures are located underneath the vehicle floor. | | The symbol shall also be visible on enclosures and barriers, which, when removed expose live parts of high voltage circuits. This provision is optional to any connector for high voltage buses. This provision shall not apply to any of the following cases:<br>(a) where barriers or enclosures cannot be physically accessed, opened, or removed; unless other vehicle components are removed with the use of tools<br><br>(b) where barriers or enclosures are located underneath the vehicle floor. | ✓ |
| 5.1.1.5.3. | Cables for high voltage buses which are not located within enclosures shall be identified by having an outer covering with the colour orange. | | Cables for high voltage buses which are not located within enclosures shall be identified by having an outer covering with the colour orange. | ✓ |

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| 5.1.2. | **Protection against indirect contact** | | **Protection against indirect contact** | ✓ |
| 5.1.2.1. | 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. | | 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. | ✓ |
| 5.1.2.2. | 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. | | 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. | ✓ |

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| 5.1.2.3. | In the case of motor vehicles which are intended to be connected to the grounded external electric power supply through the conductive connection, a device to enable the galvanical connection of the electrical chassis to the earth ground shall be provided. | In the case of motor vehicles which are intended to be connected to the grounded external electric power supply through the conductive connection, a device to enable the galvanical connection of the electrical chassis to the earth ground shall be provided.<br><br>~~[In case of motor vehicles which are not intended to be connected to the grounded external electric power supply through the conductive connection, example: motor vehicles with **double insulation** or reinforced insulation, or motor vehicle connected to outside battery charger with double insulation or reinforced insulation, a device to enable galvanical connection of electrical chassis to the earth ground need not be provided]~~ | | **IMMA has to check whether this amendment is necessary.** |

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| | | [In the following cases a galvanical connection of electrical chassis to the earth ground need not be provided:<br><br>a) the vehicle which uses only a dedicated charger that is protected when a fault to a basic isolation arises<br>b) the vehicle whose whole vehicle metallic body is protected when a fault to a basic isolation arises<br>**c)** the vehicle which cannot be charged without removing the traction battery pack from the vehicle]. | | Explanation by IMMA:<br>The purpose of this requirement is protection of the user from electric shock when a fault to a basic isolation arises in case an external power supply is in class II (double or reinforced insulation is used and the ground connection must not be provided).<br><br>Text still in brackets. 4 weeks’ time for VDE, TÜV SGS and IMMA to check and may improve if necessary.<br><br>Deadline 18. March 2013 |

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| | The device should enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is removed from the vehicle.<br><br>Compliance to this requirement may be demonstrated either by using the connector specified by the car manufacturer, or by analysis. | The device should enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is removed from the vehicle.<br><br>Compliance to this requirement may be demonstrated either by using the connector specified by the car manufacturer, or by analysis. | The device should enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is removed from the vehicle.<br><br>Compliance to this requirement may be demonstrated either by using the connector specified by the car manufacturer, or by analysis. |  |

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| 5.1.3. | Isolation resistance | | Isolation resistance | ✓ |
| 5.1.3.1. | **Electric power train consisting of separate Direct Current- or Alternating Current-buses**<br><br>If AC high voltage buses and DC high voltage buses are galvanically isolated from each other, isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 100 Ω/volt of the working voltage for DC buses, and a minimum value of 500 Ω/volt of the working voltage for AC buses. | | **Electric power train consisting of separate Direct Current- or Alternating Current-buses**<br><br>If AC **[~~high voltage~~]** buses and DC **[~~high voltage~~]** buses are galvanically isolated from each other, isolation resistance between **[~~the~~ all]** high voltage bus**es** and the electrical chassis shall have a minimum value of 100 Ω/volt of the working voltage for DC buses, and a minimum value of 500 Ω/volt of the working voltage for AC buses. | Amendment has to be checked by the experts of OICA<br><br>Deadline 18. March 2013 |

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| | The measurement shall be conducted according to Annex 4A"Isolation resistance measurement method for vehicle based tests. | | ~~If AC high voltage buses and DC~~ **~~not high voltage~~** ~~buses are galvanically isolated from each other, isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 500 Ω/volt of the working voltage for AC buses.~~<br>The measurement shall be conducted according to Annex 4A"Isolation resistance measurement method for vehicle based tests. | Proposal from IMMA:<br>Proposal from IMMA instead of a definition of isolation resistance. |

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| 5.1.3.2. | **Electric power train consisting of combined DC- and AC-buses**<br><br>If AC high voltage buses and DC high voltage buses are galvanically connected isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 500 Ω/volt of the working voltage.<br><br>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 Ω/V of the working voltage: | | **Electric power train consisting of combined DC- and AC-buses**<br><br>If AC **[~~high voltage~~]** buses and DC **[~~high voltage~~]** buses are galvanically connected isolation resistance between **[~~he~~ all]** high voltage bus and the electrical chassis shall have a minimum value of 500 Ω/volt of the working voltage.<br><br>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 Ω/V of the working voltage: | Amendment has to be checked by the experts of OICA<br><br>Deadline 18. March 2013 |

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| | (a) double or more layers of solid insulators, barriers or enclosures that meet the requirement in Paragraph 5.1.1. independently, for example wiring harness;<br><br>(b) mechanically robust protections that have sufficient durability over vehicle service life such as motor housings, electronic converter cases or connectors;<br>The isolation resistance between the high voltage bus and the electrical chassis may be demonstrated by calculation, measurement or a combination of both.<br><br>The measurement shall be conducted according to Annex 4A "Isolation resistance measurement method for vehicle based tests. | | a) double or more layers of solid insulators, barriers or enclosures that meet the requirement in Paragraph 5.1.1. independently, for example wiring harness;<br><br>(b) mechanically robust protections that have sufficient durability over vehicle service life such as motor housings, electronic converter cases or connectors;<br>The isolation resistance between the high voltage bus and the electrical chassis may be demonstrated by calculation, measurement or a combination of both.<br><br>The measurement shall be conducted according to Annex 4A "Isolation resistance measurement method for vehicle based tests. | ✓ |

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| 5.1.3.3. | **Fuel cell vehicles**<br><br>If the minimum isolation resistance requirement cannot be maintained over time, then protection shall be achieved by any of the following:<br><br>(a) double or more layers of solid insulators, barriers or enclosures that meet the requirement in Paragraph 5.1.1 independently; | | **Fuel cell vehicles**<br><br>If the minimum isolation resistance requirement cannot be maintained over time, then protection shall be achieved by any of the following:<br><br>(a) double or more layers of solid insulators, barriers or enclosures that meet the requirement in Paragraph 5.1.1 independently; | |

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| | (b) on-board 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 REESS, which is not energized besides during charging the REESS, and the electrical chassis need not be monitored. The function of the on-board isolation resistance monitoring system shall be confirmed as described in Annex 5. | | (b) on-board 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 REESS, which is not energized besides during charging the REESS, and the electrical chassis need not be monitored. The function of the on-board isolation resistance monitoring system shall be confirmed as described in Annex 5. | **IMMA may check whether to use driver is OK.**<br><br>Definition of a rider has to be proposed by IMMA. |

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| 5.1.3.4. | **Isolation resistance requirement for the coupling system for charging the REESS**<br><br>For the vehicle inlet intended to be conductively connected to the grounded external AC power supply and the electrical circuit that is galvanically connected to the vehicle inlet during charging of the REESS, the isolation resistance between the high voltage bus and the electrical chassis shall be at least 1 MΩ when the charger coupler is disconnected. During the measurement, the traction battery may be disconnected. | **Isolation resistance requirement for the coupling system for charging the REESS**<br><br>~~For the vehicle inlet and, only for L-category vehicle having a flexible recharge cable to direct connect to AC power supply, for the cable intended to be conductively connected to the grounded external AC power supply and the electrical circuit that is galvanically connected to the vehicle inlet or to the recharge cable during charging of the REESS, the isolation resistance between the high voltage bus and the electrical chassis shall be at least 1 MΩ when the charger coupler is disconnected. During the measurement, the traction battery may be disconnected.~~ | **Isolation resistance requirement for the coupling system for charging the REESS**<br><br>For the vehicle inlet **and for a recharge cable if permanently connected to the vehicle of cat L,** intended to be conductively connected to the grounded external AC power supply and the electrical circuit that is galvanically connected to the vehicle inlet **or to the recharge cable** during charging of the REESS, the isolation resistance between the high voltage bus and the electrical chassis shall be at least 1 MΩ when the charger coupler is disconnected. During the measurement, the traction battery may be disconnected. | ~~**IMMA together with OICA has to define “vehicle inlet”.**~~<br><br>Explanation by IMMA:<br>IMMA believes it is not necessary.<br><br>L1-5 category vehicle can have a cable-type power receiving part.<br><br>The text only for "cable-type L category vehicle" should be added, together with the original text of R100 for the "vehicle inlet".<br><br>To take into account the case when the cable is permanently connected to the vehicle.<br><br>  |

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| 5.2 | **Rechargeable energy storage system (REESS)** | | **Rechargeable energy storage system (REESS)** | |
| 5.2.1. | **Protection against Excessive Current**<br><br>The RESS shall not overheat.<br><br>If the REESS is subject to overheating due to excessive current, it shall be equipped with a protective device such as fuses, circuit breakers or main contactors.<br><br>However, the requirement may not apply if the manufacturer supplies data that ensure that overheating from excessive current is prevented without the protective device. | | **Protection against Excessive Current**<br><br>The RESS shall not overheat.<br><br>If the REESS is subject to overheating due to excessive current, it shall be equipped with a protective device such as fuses, circuit breakers or main contactors.<br><br>However, the requirement may not apply if the manufacturer supplies data that ensure that overheating from excessive current is prevented without the protective device. | **This paragraph has to be considered again when the REESS requirements for category L vehicles will be discussed.** |

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| 5.2.2. | **Accumulation of gas**<br><br>Places for containing open type traction batteries that may produce hydrogen gas shall be provided with a ventilation fan or a ventilation duct to prevent the accumulation of hydrogen gas. | **L Category vehicles shall have a structure of framework to scavenge hydrogen gas.** | **Accumulation of gas**<br><br>Places for containing open type traction batteries that may produce hydrogen gas shall be provided with a ventilation fan or a ventilation duct to prevent the accumulation of hydrogen gas.<br><br>**Vehicles with open type framework that do not allow accumulation of hydrogen gas at such places are not required to have a ventilation fan or a ventilation duct.** | ✓ |

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| 5.2.3 | | Protection against electrolyte spills (L-category vehicles only)<br><br>L category vehicles shall foresee that no spilled electrolyte from the REESS and its components shall reach the driver nor any person around the ~~motorcycle and/or moped~~ vehicle during normal condition of use and/or functional operation.<br><br>Also, L category vehicles shall foresee that electrolyte shall not spill from the vehicle when the vehicle is tilted to the ground ~~and~~ or when the REESS is put upside-down. | Protection against electrolyte spills (L-category vehicles only)<br><br>L category vehicles shall foresee that no spilled electrolyte from the REESS and its components shall reach the driver nor any person around the ~~motorcycle and/or moped~~ vehicle during normal condition of use and/or functional operation.<br><br>Also, L category vehicles shall foresee that electrolyte shall not spill from the vehicle when the vehicle is tilted to the ground ~~and~~ or when the REESS is put upside-down. | ✓ |

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| 5.2.4 | | Accidental ejection (L-category vehicles only)<br><br>The REESS and its components in L-category vehicles shall be capped in their position by the securing devices ~~not be ejected during normal condition of use and/or functional operation the active driving possible mode~~.<br><br>The REESS and its components in L-category vehicles shall not be ejected when the vehicle is tilted to the ground ~~and~~ or when the REESS is put upside-down. | Accidental or unintentional ~~ejection~~ detachment (L-category vehicles only)<br><br>The REESS and its components shall be installed in the vehicle in such a way so as to preclude the possibility of inadvertent or unintentional ~~ejection~~ detachment of the REESS.<br><br>The REESS and its components in L-category vehicles shall not be ejected when the vehicle is tilted to the ground ~~and~~ or when the REESS is put upside-down. | Peter Davis will improve the wording. => Done<br><br>The use of ejection has to be checked by IMMA. |

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| 5.3. | **Functional safety**<br><br>At least a momentary indication shall be given to the driver when the vehicle is in "active driving possible mode".<br><br>However, this provision does not apply under conditions where an internal combustion engine provides directly or indirectly the vehicle´s propulsion power.<br><br>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. | | **Functional safety**<br><br>At least a momentary indication shall be given to the driver when the vehicle is in "active driving possible mode".<br><br>However, this provision does not apply under conditions where an internal combustion engine provides directly or indirectly the vehicle´s propulsion power.<br><br>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. | ✓<br><br>**Has to be discussed in the afternoon of 02.10.2012.**<br>**=> Not been done** |

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| | If the on-board REESS 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. | ~~**If the charging cable is permanently connected to the L-category vehicles they are exempted from this requirement in the case when the vehicle detects the voltage is off.**~~<br><br>~~**or when the position of the cable prevents the normal use of the vehicle.**~~ | If the on-board REESS 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.<br>**For an L-cat vehicle, with a permanently connected charge cable, the requirement above is not applicable if using the cable to charge the vehicle prevents the use of the vehicle (e.g. seat cannot be closed, cable disturb the rider to sit, cable disturb the rider to step-in)** | ✓<br><br>**This requirement has to be discussed again.**<br>**The wording has to be approved (Peter Davis).**<br>**IMMA has to deliver good justification.**<br><br>Justification by IMMA:<br>When the charging cable during charging prevents the use of the vehicle, (e.g., cable layout can prevent the normal use of the vehicle) regardless of the mechanical or electrical way, the requirement is not necessary<br><br>In the original text, it is limited for the case with traction system. However it is possible to prevent normal use with a structural method too: |
| | This requirement shall be demonstrated by using the connector specified by the car manufacturer. | This requirement shall be demonstrated by using the connector specified by the ~~**car**~~ manufacturer. | This requirement shall be demonstrated by using the connector specified by the ~~**car**~~ **vehicle** manufacturer. | |

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| | | | | when the vehicle is connected to the power outlet (or the cable is not stored in the right position),<br><br>1. Prevent the riding<br>➢ seat cannot be closed<br>➢ cable disturb the rider to sit<br>➢ cable disturb the rider to step-in<br>➢ cable cannot be taken out without locking the seat in the open position (cable storage lid is the seat stopper)<br><br>2. Prevent the vehicle movement<br>➢ stand cannot be released up<br>➢ main or starter switch cannot be ON<br>➢ parking lock cannot be released<br>➢ charging cable cannot be taken out without locking the main stand (side stand) in the parking position<br>➢ (cable lid is the stand locking knob)<br>➢ wheel is locked when the cable is taken out<br>➢ handle lock cannot be released without storing the charging cable in the right position |

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| | **If fitted** the state of the drive direction control unit shall be identified to the driver | ~~**This shall not apply to vehicles not equipped with a reversing device reverse mode.**~~ | **If a vehicle is equipped with a drive direction control unit the state of this unit shall be identified to the driver.**<br><br>**or as an alternative**<br><br>**If fitted the state of the drive direction control unit shall be identified to the driver** | **Wording has to be checked by Peter Davis.** |
| | | **Paragraph 5.3.1 shall only be applicable to L-category vehicles.** | ~~**Paragraph 5.3.1 shall only be applicable to L-category vehicles.**~~ | Comment from the Secretary: This text has to become the introduction of § 5.3.1 |
| | | **5.3.1. Propulsion system, power-on/power-off procedure** | **5.3.1. Additional functional safety requirements** ~~**Propulsion system, power-on/power-off procedure**~~ **for L-category vehicles.** | **Wording of complete § 5.3.1 with its sup-paragraphs have to be checked by the RESS members.** |

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| | | 5.3.1.1. General<br>For the power-on procedure of the vehicle propulsion system at least two deliberate and distinctive actions shall be performed in order to go from the power-off mode to the active driving possible mode ~~(only in this mode will the vehicle move when the accelerator device is applied).~~ | 5.3.1.1. At the start-up ~~For the power-on procedure of the vehicle propulsion system~~ in order to select the active driving possible mode at least two deliberate and distinctive actions shall be performed by the driver ~~in order to go from the power-off mode to the active driving possible mode~~ | OICA has to check also the wording.<br><br>Deadline 18. March 2013 |

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| | | ~~[The deactivation Only one action is required to deactivate of the active driving possible mode shall only require one action.~~<br>~~A main-switch (a switch intended to start up the vehicle) function shall be an integral part of the power-on/power-off procedure. If the power-on/power-off procedure of the propulsion system is activated by the vehicle key system, it shall be designed according to the operational safety design.~~<br>~~It shall be indicated, continuously or temporarily, to the driver rider, that the propulsion system of the vehicle is ready for driving.~~<br>~~After an intentional power-off of the vehicle, it shall only be possible to reactivate it by the power-on procedure, as described.]~~ | **5.3.1.2. Only a single action shall be required to deactivate the active driving possible mode.** | IMMA explanation:<br>IMMA made amendment by defining main-switch in the text, to avoid any confusion with the safety-switch that physically disconnects the traction battery from the electric motor. |

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| | | ~~5.3.1.2. Automatic turn-off mode~~<br><br>~~An automatic turn-off mode shall be an integral part of the power-on/power-off procedure. If the automatic turn-off mode is activated, the power-off procedure of the propulsion system is activated even without any action on the main switch. Automatic turn-off mode shall be activated when the vehicle is left alone without the driver rider for the period of time specified by the manufacturer, even if the main switch is being kept as turned on.~~<br>~~To go from the automatic turn-off mode to the active driving possible mode, one deliberate action shall be required~~ to intentionally power-off the vehicle. | ~~[5.3.1.2. Automatic turn-off mode~~<br><br>~~An automatic turn-off mode shall be an integral part of the power-on/power-off procedure. If the automatic turn-off mode is activated, the power-off procedure of the propulsion system is activated even without any action on the main switch. Automatic turn-off mode shall be activated when the vehicle is left alone without the driver rider for the period of time specified by the manufacturer, even if the main switch is being kept as turned on.~~<br>~~To go from the automatic turn-off mode to the active driving possible mode, one deliberate action shall be required to intentionally power-off the vehicle.]~~ | **Wording of complete § 5.3.1 with its sup-paragraphs have to be checked by the RESS members.**<br><br>✓ |

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| | | | | |
| | | **5.3.1.3. Driving with reduced power** | **5.3.1.3. Driving with reduced power** | **Wording of complete § 5.3.1 with its sup-paragraphs have to be checked by the RESS members.** |
| | | **5.3.1.3.1. Indication of reduced power**<br><br>**If the electric propulsion system is equipped with a means to automatically reduce the vehicle propulsion power, significant reductions ~~should~~ shall be indicated to the ~~rider~~ driver.** | **5.3.1.3.1. Indication of reduced power**<br><br>**If the electric propulsion system is equipped with a means to automatically reduce the vehicle propulsion power, a reduction that has significant impact on the [acceleration and drivability], [evaluated by the Technical Service together with the manufacturer], ~~should~~ shall be indicated to the ~~rider~~ driver.**<br>**The system has to be described in Annex 6.** | **Wording of complete § 5.3.1 with its sup-paragraphs have to be checked by the RESS members.**<br><br>Evaluation has to be checked by IMMA.<br><br>IMMA will come up with an example and will check whether “safe driving” is the right wording.<br><br>Deadline 18. March 2013. |

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| | | **5.3.1.3.2. Indication of low energy content of REESS**<br><br>**If a low SOC in the REESS has a relevant impact on vehicle driving performance a low energy content of the REESS shall be indicated to the ~~rider~~ driver by an obvious device, (e.g. a visual or audible signal).** | **5.3.1.3.2. Indication of SOC of REESS**<br><br>**When a ~~low~~ SOC ~~in~~ of the REESS has a ~~relevant impact~~ significant impact on the [acceleration and drivability], [evaluated by the Technical Service together with the manufacturer], ~~should~~ shall be indicated to the ~~rider~~ driver. ~~on vehicle driving it performance a low energy content of the REESS shall be indicated to the rider driver~~ by an obvious device, (e.g. a visual or audible signal). [The indicator used for 5.3.1.3.1. may be used.]** | **Wording of complete § 5.3.1 with its sup-paragraphs have to be checked by the RESS members.**<br><br>Wording in brackets has to be checked by IMMA<br><br>Deadline 18. March 2013 |

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| | | ~~At the indicated low state of charge specified by the vehicle manufacturer, the vehicle shall meet the following requirements:~~<br>~~a) It shall be possible to move the vehicle out of the traffic area by its own propulsion system;~~<br>~~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 systems.~~ | | ✓ |

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| | | 5.3.1.4. Driving backwards<br><br>~~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.~~<br><br>~~Switching between the forward and backward (reverse) directions shall require:~~<br>~~a) either two separate actions by the driver rider, or~~<br>~~b) if only one driver rider action is required, a safety device shall allow the transition only when the vehicle is stationary or moving slowly, as specified by the vehicle manufacturer.~~ | 5.3.1.4. Driving backwards<br><br>It shall not be possible to activate the vehicle reverse control function whilst the vehicle is in forward motion | Wording of complete § 5.3.1 with its sup-paragraphs have to be checked by the RESS members.<br><br>✓ |

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| | | ~~If driving backwards is not achieved by reversing the rotational direction of the electric motor, National or International Standards or legal requirements for driving backwards for vehicles propelled by internal combustion engines shall apply.~~ | | ✓ |
| 5.4. | Determination of hydrogen emissions | | Determination of hydrogen emissions | ✓ |
| 5.4.1. | This test shall be carried out on all vehicles equipped with open type traction batteries. | ~~This test shall be omitted for L-category vehicles if the REESS is installed in accordance with Paragraph 5.2.1.3. 5.2.2~~ | This test shall be carried out on all vehicles equipped with open type traction batteries. | ✓ **See last sentence of 5.4.2 “Other analysis methods can be approved if it is proven that they give equivalent results.”** |

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| 5.4.2. | The test shall be conducted following the method described in Annex 7 to the present Regulation. The hydrogen sampling and analysis shall be the ones prescribed. Other analysis methods can be approved if it is proven that they give equivalent results. | | The test shall be conducted following the method described in Annex 7 to the present Regulation. The hydrogen sampling and analysis shall be the ones prescribed. Other analysis methods can be approved if it is proven that they give equivalent results. | ✓ |
| 5.4.3. | During a normal charge procedure in the conditions given in Annex 7, hydrogen emissions shall be below 125 g during 5 h, or below 25 x $t_2$ g during $t_2$ (in h). | | [During a normal charge procedure in the conditions given in Annex 7, hydrogen emissions shall be below 125 g during 5 h, or below 25 x $t_2$ g during $t_2$ (in h).] | **Requirements have to be checked by IMMA.**<br><br>Explanation by IMMA:<br>The original text of R100 is acceptable<br>✓ |
| 5.4.4. | During a charge carried out by a ~~**on-board**~~ charger presenting a failure (conditions given in Annex 7), hydrogen emissions shall be below 42 g. Furthermore the ~~**on-board**~~ charger shall limit this possible failure to 30 minutes. | | [During a charge carried out by a ~~**on-board**~~ charger presenting a failure (conditions given in Annex 7), hydrogen emissions shall be below 42 g. Furthermore the ~~**on-board**~~ charger shall limit this possible failure to 30 minutes.] | **Requirements have to be checked by IMMA.**<br>Explanation by IMMA:<br>The original text of R100 is acceptable<br>✓ |

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| 5.4.5. | All the operations linked to the **~~battery~~ REESS** charging **~~are~~ shall be** controlled automatically, included the stop for charging. | | [All the operations linked to the **~~battery~~ REESS** charging **~~are~~ shall be** controlled automatically, included the stop for charging.] | **Requirements have to be checked by IMMA.**<br>Explanation by IMMA:<br>The original text of R100 is acceptable<br>✓ |
| 5.4.6. | It shall not be possible to take a manual control of the charging phases. | | [It shall not be possible to take a manual control of the charging phases.] | **Requirements have to be checked by IMMA.**<br>Explanation by IMMA:<br>The original text of R100 is acceptable<br>✓ |
| 5.4.7. | Normal operations of connection and disconnection to the mains or power cuts shall not affect the control system of the charging phases. | | [Normal operations of connection and disconnection to the mains or power cuts shall not affect the control system of the charging phases.] | **Requirements have to be checked by IMMA.**<br>Explanation by IMMA:<br>The original text of R100 is acceptable<br>✓ |

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| 5.4.8. | Important charging failures shall be permanently **indicated** ~~**signaled to the driver.**~~ An important failure is a failure that can lead to a ~~**disfunctioning**~~ **malfunction** of the ~~**on-board**~~ charger during charging later on. | | [Important charging failures shall be permanently **indicated** ~~**signaled to the driver.**~~ An important failure is a failure that can lead to a ~~**disfunctioning**~~ **malfunction** of the ~~**on-board**~~ charger during charging later on.] | **Requirements have to be checked by IMMA.** Explanation by IMMA: The original text of R100 is acceptable ✓ |
| 5.4.9. | The manufacturer shall indicate in the owner's manual, the conformity of the vehicle to these requirements. | | [The manufacturer shall indicate in the owner's manual, the conformity of the vehicle to these requirements.] | **Requirements have to be checked by IMMA.** Explanation by IMMA: The original text of R100 is acceptable ✓ |
| 5.4.10 | The approval granted to a vehicle type relative to hydrogen emissions can be extended to different vehicle types belonging to the same family, in accordance with the definition of the family given in Annex 7, Appendix 2. | | [The approval granted to a vehicle type relative to hydrogen emissions can be extended to different vehicle types belonging to the same family, in accordance with the definition of the family given in Annex 7, Appendix 2.] | **Requirements have to be checked by IMMA.** Explanation by IMMA: The original text of R100 is acceptable ✓ |

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| **Annex 3** | **PROTECTION AGAINST DIRECT CONTACTS OF PARTS UNDER VOLTAGE** | | **PROTECTION AGAINST DIRECT CONTACTS OF PARTS UNDER VOLTAGE** | ✓ |
| 1. | **Access probes** | | **Access probes** | ✓ |
| | Access probes to verify the protection of persons against access to live parts are given in table 1. | | Access probes to verify the protection of persons against access to live parts are given in table 1. | ✓ |
| 2. | **Test conditions** | | **Test conditions** | ✓ |
| | The access probe is pushed against any openings of the enclosure with the force specified in table 1. If it partly or fully penetrates, it is placed in every possible position, but in no case shall the stop face fully penetrate through the opening.<br><br>Internal barriers are considered part of the enclosure | | The access probe is pushed against any openings of the enclosure with the force specified in table 1. If it partly or fully penetrates, it is placed in every possible position, but in no case shall the stop face fully penetrate through the opening.<br><br>Internal barriers are considered part of the enclosure | ✓ |

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| | A low-voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp should be connected, if necessary, between the probe and live parts inside the barrier or enclosure.<br><br>The signal-circuit method should also be applied to the moving live parts of high voltage equipment.<br><br>Internal moving parts may be operated slowly, where this is possible. | | A low-voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp should be connected, if necessary, between the probe and live parts inside the barrier or enclosure.<br><br>The signal-circuit method should also be applied to the moving live parts of high voltage equipment.<br><br>Internal moving parts may be operated slowly, where this is possible. | ✓ |
| **3.** | **Acceptance conditions** | | **Acceptance conditions** | ✓ |
| | The access probe shall not touch live parts.<br><br>If this requirement is verified by a signal circuit between the probe and live parts, the lamp shall not light. | | The access probe shall not touch live parts.<br><br>If this requirement is verified by a signal circuit between the probe and live parts, the lamp shall not light. | ✓ |

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| | In the case of the test for IPXXB, the jointed test finger may penetrate to its 80 mm length, but the stop face (diameter 50 mm x 20 mm) shall not pass through the opening. Starting from the straight position, both joints of the test finger shall be successively bent through an angle of up to 90 degree with respect to the axis of the adjoining section of the finger and shall be placed in every possible position.<br><br>In case of the tests for IPXXD, the access probe may penetrate to its full length, but the stop face shall not fully penetrate through the opening. | | In the case of the test for IPXXB, the jointed test finger may penetrate to its 80 mm length, but the stop face (diameter 50 mm x 20 mm) shall not pass through the opening. Starting from the straight position, both joints of the test finger shall be successively bent through an angle of up to 90 degree with respect to the axis of the adjoining section of the finger and shall be placed in every possible position.<br><br>In case of the tests for IPXXD, the access probe may penetrate to its full length, but the stop face shall not fully penetrate through the opening. | ✓ |

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| Table 1 | **- Access probes for the tests for protection of persons against access to hazardous parts** | | **- Access probes for the tests for protection of persons against access to hazardous parts** | ✓ |
| | Drawing see document GRSP-51-11 | | Drawing see document GRSP-51-11 | ✓ |
| Figure 1 | **- Jointed test finger** | | **- Jointed test finger** | ✓ |
| | Drawing see document GRSP-51-11 | | Drawing see document GRSP-51-11 | ✓ |
| | Material: metal, except where otherwise specified<br>Linear dimensions in millimeters<br>Tolerances on dimensions without specific tolerance:<br><br>(a) on angles: 0/-10°<br>(b) on linear dimensions: up to 25 mm: 0/-0.05 mm over 25 mm: ±0.2 mm<br><br>Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a 0 to +10° tolerance. | | Material: metal, except where otherwise specified<br>Linear dimensions in millimeters<br>Tolerances on dimensions without specific tolerance:<br><br>(a) on angles: 0/-10°<br>(b) on linear dimensions: up to 25 mm: 0/-0.05 mm over 25 mm: ±0.2 mm<br><br>Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a 0 to +10° tolerance. | ✓ |

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| Annex 4A | ISOLATION RESISTANCE MEASUREMENT METHOD **FOR VEHICLE BASED TESTS** | | | Content has to be checked by IMMA because of amendment of § 5.1.3.1 and § 5.1.3.2. |
| **1.** | **General** | | | |
| | The isolation resistance for each high voltage bus of the vehicle shall be measured or shall be determined by calculation using measurement values from each part or component unit of a high voltage bus (hereinafter referred to as the "divided measurement"). | | | Feedback at the latest 18. March 2013 |
| **2.** | **Measurement method** | | | |
| | The isolation resistance measurement shall be conducted by selecting an appropriate measurement method from among those listed in Paragraphs 2.1. through 2.2., depending on the electrical charge of the live parts or the isolation resistance, etc. | | | |

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| | The range of the electrical circuit to be measured shall be clarified in advance, using electrical circuit diagrams, etc.<br><br>Moreover, modification necessary for measuring the isolation resistance may be carried out, such as removal of the cover in order to reach the live parts, drawing of measurement lines, change in software, etc.<br><br>In cases where the measured values are not stable due to the operation of the on-board isolation resistance monitoring system, etc., necessary modification for conducting the measurement may be carried out, such as stopping of the operation of the device concerned or | | | |

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| | removing it. Furthermore, when the device is removed, it shall be proven, using drawings, etc., that it will not change the isolation resistance between the live parts and the electrical chassis.<br><br>Utmost care shall be exercised as to short circuit, electric shock, etc., for this confirmation might require direct operations of the high-voltage circuit. | | | |
| 2.1 | Measurement method using ~~**DC**~~ voltage from off-vehicle sources | | | |
| **2.1.1** | **Measurement instrument** | | | |
| | An isolation resistance test instrument capable of applying a DC voltage higher than the working voltage of the high voltage bus shall be used. | | | |

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| **2.1.2** | **Measurement method** | | | |
| | An insulator resistance test instrument shall be connected between the live parts and the electrical chassis. Then, the isolation resistance shall be measured by applying a DC voltage at least half of the working voltage of the high voltage bus.<br><br>If the system has several voltage ranges (e.g. because of boost converter) in galvanically connected circuit and some of the components cannot withstand the working voltage of the entire circuit, the isolation resistance between those components and the electrical chassis can be measured separately by applying at least half of their own working voltage with those component disconnected. | | | |

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| 2.2 | Measurement method using the vehicle's own **REESS** as DC voltage source | | | |
| 2.2.1 | **Test vehicle conditions** | | | |
| | The high voltage-bus shall be energized by the vehicle's own **REESS** and/or energy conversion system and the voltage level of the **REESS** and/or energy conversion system throughout the test shall be at least the nominal operating voltage as specified by the vehicle manufacturer. | | | |
| **2.2.2.** | **Measurement instrument** | | | |
| | The voltmeter used in this test shall measure DC values and shall have an internal resistance of at least 10 MΩ. | | | |
| **2.2.3.** | **Measurement method** | | | |

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| **2.2.3.1.** | **First step** | | | |
| | The voltage is measured as shown in Figure 1 and the high voltage bus voltage (Vb) is recorded. Vb shall be equal to or greater than the nominal operating voltage of the **REESS** and/or energy conversion system as specified by the vehicle manufacturer | | | |
| Figure 1 | **-** Measurement of Vb, V1, V2 | | | |
| | Drawing see document GRSP-51-11 | | | |
| **2.2.3.2.** | **Second step** | | | |
| | Measure and record the voltage (V1) between the negative side of the high voltage bus and the electrical chassis (see Figure 1). | | | |
| **2.2.3.3** | **Third step** | | | |
| | Measure and record the voltage (V2) between the positive side of the high voltage bus and the electrical chassis (see Figure 1). | | | |

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| **2.2.3.4.** | **Fourth step** | | | |
| | If V1 is greater than or equal to V2, insert a standard known resistance (Ro) between the negative side of the high voltage bus and the electrical chassis. With Ro installed, measure the voltage (V1') between the negative side of the high voltage bus and the electrical chassis (see Figure 2).<br>Calculate the electrical isolation (Ri) according to the following formula:<br><br>Ri = Ro*(Vb/V1' – Vb/V1)<br>or Ri = Ro*Vb*(1/V1' – 1/V1) | | | |
| Figure 2 | - Measurement of V1' | | | |
| | Drawing see document GRSP-51-11 | | | |

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| | If V2 is greater than V1, insert a standard known resistance (Ro) between the positive side of the high voltage bus and the electrical chassis. With Ro installed, measure the voltage (V2') between the positive side of the high voltage bus and the electrical chassis (see Figure 3). Calculate the electrical isolation (Ri) according to the formula shown. Divide this electrical isolation value (in Ω) by the nominal operating voltage of the high voltage bus (in volts).<br><br>Calculate the electrical isolation (Ri) according to the following formula:<br><br>Ri = Ro*(Vb/V2' – Vb/V2)<br>or Ri = Ro*Vb*(1/V2' – 1/V2) | | | |
| Figure 3 | - Measurement of V2' | | | |

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| | Drawing see document GRSP-51-11 | | | |
| **2.2.3.5.** | **Fifth step** | | | |
| | The electrical isolation value Ri (in Ω) divided by the working voltage of the high voltage bus (in volts) results in the isolation resistance (in Ω/V).<br>NOTE 1: The standard known resistance Ro (in Ω) should be the value of the minimum required isolation resistance (in Ω/V) multiplied by the working voltage of the vehicle plus/minus 20 per cent (in volts). Ro is not required to be precisely this value since the equations are valid for any Ro; however, a Ro value in this range should provide good resolution for the voltage measurements. | | | |

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| **Annex 5** | **CONFIRMATION METHOD FOR FUNCTIONS OF ON-BOARD ISOLATION RESISTANCE MONITORING SYSTEM** | | | IMMA has to check the content of this Annex.<br><br>Feedback at the latest 18. March 2013 |
| | The function of the on-board isolation resistance monitoring system shall be confirmed by the following method:<br>Insert a resistor that does not cause the isolation resistance between the terminal being monitored and the electrical chassis to drop below the minimum required isolation resistance value. The warning shall be activated. | | | |
| Annex 7 | See document GRSP-51-11 | | | IMMA has to check the content of this Annex.<br><br>Feedback at the latest 18. March 2013 |