

Amendment of UN ECE R100 regarding „in-use “requirements for vehicles of category L

Status: 25.03.2013

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1.	Scope
	<p>The following prescription apply to 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.</p> <p>This Regulation does not cover post-crash safety requirements of road vehicles.</p>
2.	Definitions
	<p>For the purpose of this regulation the following definitions apply:</p>
2.1.	<p>"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.</p>
2.2.	<p>"Barrier" means the part providing protection against direct contact to the live parts from any direction of access.</p>
2.3.	<p>"Conductive connection" means the connection using connectors to an external power supply when the rechargeable energy storage system (REESS) is charged.</p>
2.4.	<p>"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.</p>
2.5.	<p>"Direct contact" means the contact of persons with live parts.</p>
2.6.	<p>"Electrical chassis" means a set made of conductive parts electrically linked together, whose potential is taken as reference.</p>
2.7.	<p>"Electrical circuit" means an assembly of connected live parts which is designed to be electrically energized in normal operation.</p>
2.8.	<p>"Electric energy conversion system" means a system that generates and provides electric energy for electric propulsion.</p>

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2.9.	" 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.
2.10.	" Electronic converter " means a device capable of controlling and/or converting electric power for electric propulsion.
2.11.	" Enclosure " means the part enclosing the internal units and providing protection against direct contact from any direction of access.
2.12.	" 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.
2.13.	" External electric power supply " means an alternating current (AC) or direct current (DC) electric power supply outside of the vehicle.
2.14.	" 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).
2.15.	" High voltage bus " means the electrical circuit, including the coupling system for charging the REESS that operates on high voltage.
2.16.	" Indirect contact " means the contact of persons with exposed conductive parts.
2.17.	" Live parts " means conductive part(s) intended to be electrically energized in normal use.
2.18.	" Luggage compartment " <ul style="list-style-type: none"> ● 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. ● of category L1 to L7 vehicles means the enclosed space in the vehicle intended for luggage accommodation.
2.19.	" On-board isolation resistance monitoring system " means the device which monitors the isolation resistance between the high voltage buses and the electrical chassis.
2.20.	" 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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2.21.	<p>"Passenger compartment"</p> <ul style="list-style-type: none"> • 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. • for L1 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.
2.22.	<p>"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.</p>
2.23.	<p>"Rechargeable energy storage system (REESS)" means the rechargeable energy storage system that provides electric energy for electrical propulsion.</p>
2.24.	<p>"Service disconnect" means the device for deactivation of the electrical circuit when conducting checks and services of the REESS, fuel cell stack, etc.</p>
2.25.	<p>"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.</p>
2.26.	<p>"Vehicle type" means vehicles which do not differ in such essential aspects as:</p> <ol style="list-style-type: none"> (a) Installation of the electric power train and the galvanically connected high voltage bus. (b) Nature and type of electric power train and the galvanically connected high voltage components.
2.27.	<p>"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.</p>
3.1.	Application for approval
3.1.	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.
3..2.	It shall be accompanied by the under-mentioned documents in triplicate and following particulars:
3.2.1.	Detailed description of the vehicle type as regards the electric power train and the galvanically connected high voltage bus.

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3.3.	A vehicle representative of the vehicle type to be approved shall be submitted to the Technical Service responsible for conducting the approval tests
3.4	The competent Authority shall verify the existence of satisfactory arrangements for ensuring effective control of the conformity of production before type approval is granted.
4.	Approval
4.1.	If the vehicle submitted for approval pursuant to this Regulation meets the requirements of Paragraph 5 below and Annexes 3, 4, 5 and 7 to this Regulation, approval of this vehicle type shall be granted.
4.2	An approval number shall be assigned to each type approved. Its first two digits (at present 01 for the Regulation in its form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to another vehicle type.
4.3	Notice of approval or of refusal or of extension or withdrawal of approval or production definitely discontinued of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the Agreement applying this Regulation, by means of a form conforming to the model in Annex 1 to this Regulation.
4.4	There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation an international approval mark consisting of:
4.4.1.	A circle surrounding the Letter "E" followed by the distinguishing number of the country which has granted approval ⁽¹⁾ .
4.4.2.	The number of this Regulation, followed by the Letter "R", a dash and the approval number to the right of the circle described in Paragraph 4.4.1.
4.5	If the vehicle conforms to a vehicle type approved under one or more other Regulations annexed to the Agreement in the country which has granted approval under this Regulation, the symbol prescribed in Paragraph 4.4.1. need not be repeated; in this case the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in Paragraph 4.4.1.
4.6.	The approval mark shall be clearly legible and shall be indelible.
4.7.	The approval mark shall be placed on or close to the vehicle data plate affixed by the Manufacturer.
4.8.	Annex 2 to this Regulation gives examples of the arrangements of the approval mark.


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5.	Specifications and Tests
5.1	Protection against electrical shock 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 The protection against direct contact with live parts shall comply with Paragraphs 5.1.1.1. and 5.1.1.2. and 5.1.1.3 These protections (solid insulator, barrier, enclosure, etc.) shall not be able to be opened, disassembled or removed without the use of tools.
5.1.1.1.	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.
5.1.1.3	<i>For vehicles of category L without passenger compartment, for protection of live parts, the protection degree IPXXD shall be provided.</i>
5.1.1.4.	Connectors (including vehicle inlet) are deemed to meet this requirement if: a) they comply with 5.1.1.1. and 5.1.1.2. when separated without the use of tools, or b) they are located underneath the floor and are provided with a locking mechanism, or 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 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.
5.1.1.5.	Service disconnect 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.

Kommentar [Gld1]:
It may need to be clarified that this concerns only for vehicles that have a passenger compartment

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5.1.1.6.	Marking
5.1.1.6.1.	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.
	
	Figure 1 - Marking of high voltage equipment
5.1.1.6.2.	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: (a) where barriers or enclosures cannot be physically accessed, opened, or removed; unless other vehicle components are removed with the use of tools (b) where barriers or enclosures are located underneath the vehicle floor.
5.1.1.6.3.	Cables for high voltage buses which are not located within enclosures shall be identified by having an outer covering with the colour orange.
5.1.2.	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.
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.

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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.
	<p>[In the following cases a galvanical connection of electrical chassis to the earth ground need not be provided:</p> <p>a) the vehicle which uses only a dedicated charger that is protected when a fault to a basic isolation arises</p> <p>b) the vehicle whose whole vehicle metallic body is protected when a fault to a basic isolation arises</p> <p>c) the vehicle which cannot be charged without removing the traction battery pack from the vehicle].</p>
	<p>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.</p> <p>Compliance to this requirement may be demonstrated either by using the connector specified by the car manufacturer, or by analysis.</p>
5.1.3.	Isolation resistance
5.1.3.1.	<p>Electric power train consisting of separate Direct Current- or Alternating Current-buses</p> <p>If AC high-voltage buses and DC high-voltage buses are galvanically isolated from each other, isolation resistance between the all high voltage buses 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.</p> <p>The measurement shall be conducted according to Annex 4 "Isolation resistance measurement method".</p>

Kommentar [Gld2]:
Final requirements still to be agreed in RESS IG
IMMA is waiting for the opinion from the RESS IG.

<p>5.1.3.2.</p>	<p>Electric power train consisting of combined DC- and AC-buses</p> <p>If AC high voltage buses and DC high voltage buses are galvanically connected isolation resistance between the all high voltage bus and the electrical chassis shall have a minimum value of 500 Ω/volt of the working voltage.</p> <p>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:</p> <p>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;</p> <p>(b) mechanically robust protections that have sufficient durability over vehicle service life such as motor housings, electronic converter cases or connectors;</p> <p>The isolation resistance between the high voltage bus and the electrical chassis may be demonstrated by calculation, measurement or a combination of both.</p> <p>The measurement shall be conducted according to Annex 4A "Isolation resistance measurement method for vehicle based tests.</p>
<p>5.1.3.3.</p>	<p>Fuel cell vehicles</p> <p>If the minimum isolation resistance requirement cannot be maintained over time, then protection shall be achieved by any of the following:</p> <p>a) double or more layers of solid insulators, barriers or enclosures that meet the requirement in Paragraph 5.1.1 independently;</p> <p>b) on-board isolation resistance monitoring system together with a warning to the driver/rider as applicable 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.</p>

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5.1.3.4.	<p>Isolation resistance requirement for the coupling system for charging the REESS</p> <p>For the vehicle inlet, in addition to 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.</p>
5.2.	<p>Rechargeable energy storage system (REESS)</p>
5.2.1.	<p>Protection against Excessive Current</p> <p>The RESS shall not overheat.</p> <p>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.</p> <p>However, the requirement may not apply if the manufacturer supplies data that ensure that overheating from excessive current is prevented without the protective device.</p>
5.2.2.	<p>Accumulation of gas</p> <p>Places for containing open type traction batteries that may produce hydrogen gas shall be provided with a ventilation fan or a ventilation duct or any other suitable means to prevent the accumulation of hydrogen gas.</p> <p>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.</p>
5.2.3	<p>Protection against electrolyte spills (L-category vehicles only)</p> <p>L category vehicles shall foresee that no spilled electrolyte from the REESS and its components shall reach the driver/rider as applicable nor any person around the vehicle during normal condition of use and/or functional operation.</p>

Kommentar [Gld3]:
 This paragraph has to be considered again when the REESS requirements for category L vehicles will be discussed.

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	<p>Also, L category vehicles shall foresee that electrolyte shall not spill from the vehicle when the vehicle is tilted to the ground or when the REESS is put upside-down.</p>
5.2.4	<p>Accidental or unintentional detachment (L-category vehicles only)</p> <p>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 detachment of the REESS.</p> <p>The REESS and its components in L-category vehicles shall not be ejected when the vehicle is tilted to the ground or when the REESS is put upside-down.</p>
5.3.	<p>Functional safety</p> <p>At least a momentary indication shall be given to the driver/rider as applicable when the vehicle is in "active driving possible mode".</p> <p>However, this provision does not apply under conditions where an internal combustion engine provides directly or indirectly the vehicle’s propulsion power.</p> <p>When leaving the vehicle, the driver/rider as applicable shall be informed by a signal (e.g. optical or audible signal) if the vehicle is still in the active driving possible mode.</p>
	<p>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.</p> <p>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)</p> <p>This requirement shall be demonstrated by using the connector specified by the vehicle manufacturer.</p> <p>If fitted the state of the drive direction control unit shall be identified to the driver/rider as applicable</p>

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5.3.1	Additional functional safety requirements for L-category vehicles.
5.3.1.1.	At the start-up in order to select the active driving possible mode at least two deliberate and distinctive actions shall be performed by the driver.
5.3.1.2.	Only a single action shall be required to deactivate the active driving possible mode.
5.3.1.3.	Driving with reduced power
5.3.1.3.1.	Indication of reduced power 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], shall be indicated to the driver/rider as applicable. The system has to be described in Annex 6.
5.3.1.3.2.	Indication of SOC of REESS 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/rider as applicable. 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.]
5.3.1.4.	Driving or riding backwards It shall not be possible to activate the vehicle reverse control function whilst the vehicle is in forward motion.
5.4.	Determination of hydrogen emissions
5.4.1.	This test shall be carried out on all vehicles equipped with open type traction batteries.
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.
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).

Kommentar [Gld4]:
IMMA could not find an adequate solution to clarify "significant" and relevant impact on vehicle driving performance'.

IMMA proposes alternative text, which is to be confirmed by IMMA

Kommentar [Gld5]:
IMMA could not find an adequate solution to clarify "significant" and ,relevant impact on vehicle driving performance'.

IMMA will propose an updated solution as soon as possible or propose to cancel the text.

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5.4.4.	During a charge carried out by a charger presenting a failure (conditions given in Annex 7), hydrogen emissions shall be below 42 g. Furthermore the charger shall limit this possible failure to 30 minutes.
5.4.5.	All the operations linked to the REESS charging shall be controlled automatically, included the stop for charging.
5.4.6.	It shall not be possible to take a manual control of the charging phases.
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.
5.4.8.	Important charging failures shall be permanently indicated. An important failure is a failure that can lead to a malfunction of the charger during charging later on.
5.4.9.	The manufacturer shall indicate in the owner's manual, the conformity of the vehicle to these requirements.
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.
6.	MODIFICATION AND EXTENSION OF THE TYPE APPROVAL FOR VEHICLE TYPE
	...
7.	Conformity of Production

8.	Penalties for non-conformity of Production
	...
9.	Production definitely discontinued
	...
10.	Names and addresses of Technical Services responsible for conducting approval tests and of administrative Department
	...

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11.	Transitional Provisions
Annex 1	Communication

Annex 2	Arrangements of Approval Marks

Annex 3	Protection against direct contacts of parts under voltage
	...
Annex 4	Isolation Resistance Measurement Method

Annex 5	Confirmation method for function of on-board isolation resistance monitoring system
	...
Annex 6	Essential characteristics of road vehicles or systems

Annex 7	Determination of Hydrogen emissions during the charge procedures of the traction battery
	...

Kommentar [Gld6]:
 Necessity has to be checked when
 the complete amendment of UN R100
 been send to GRSP.