EVS-03-06

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| **Clause** | **Questions** (in red) | **Comments** (relevant comments or proposal highlighted in yellow) |
| **3.9** | "Electric power train" means the electrical circuits which includes the traction motor(s), and may also 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.Need for a definition of a traction motor? | The term 'traction motor' is used in the definition for clause 3.9 only.Conclusion:A new definition is not necessary, but it makes sense to substitute 'traction motor' by'electric traction motor' to clarify the description for the component meant. |
| **5.1.1.2.4.2.** | **Electric power train consisting of combined DC- and AC-buses**If AC high voltage buses and DC high voltage buses are conductively 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. However, if all AC high voltage buses are protected by one of the two following measures, isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 100 ohms/volt of the working voltage.Note FMVSS 305 requires the isolation monitoring system in the case where the lower level of isolation resistance is used1. at least two or more layers of solid insulators, electrical protection barriers or enclosures that meet the requirement in paragraph 5.1.1.1. independently, for example wiring harness;
2. mechanically robust protections that have sufficient durability over vehicle service life such as motor housings, electronic converter cases or connectors.

The isolation resistance between the high voltage bus and the electrical chassis may be demonstrated by calculation, measurement or a combination of both.The measurement shall be conducted according to paragraph 7.1.1. | **The FMVSS 305 request an isolation monitoring system**, if the isolation resistance design for DC high voltage circuits is lower than 500 ohms/volt and at least 100 ohms/volt.**The ECE-R 100** request for fuel cell vehicles, if the minimum isolation resistance requirement cannot be maintained over time, one of the two following measures:- double or more layers of solid insulators, barriers or enclosures with specific requirements- an **isolation monitoring system** together with a warning to the driver if the isolation resistance drops below the minimum required value Proposal:Discuss to request for all DC circuits with the 100 ohms/volt requirement (not only for fuel cell vehicles) the following additional requirement:If the minimum isolation resistance requirement of 100 ohms/volt cannot be maintained over vehicle service life, one of the two following measures:- double or more layers of solid insulators, barriers or enclosures with specific requirements- an **isolation monitoring system** together with a warning to the driver if the isolation resistance drops below the minimum required value |
| **5.2.2.4.2.** | **Electrical power train consisting of combined DC- and AC-buses**If the AC high voltage buses and the DC high voltage buses are conductively connected they shall meet one of the following requirements:1. isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 500 Ω/volt of the working voltage.
2. isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 100 Ω/volt of the working voltage and the AC bus meets the physical protection as described in paragraph 5.2.2.3.
3. isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 100 Ω/volt of the working voltage and the AC bus meets the absence of high voltage as described in paragraph 5.2.2.1.

Note – comment about measurement of isolation loss in RESS – diagrams in the test section may not cover this adequately | Paragraph 5.2.2.4. (sub-paragraph of 5.2 Requirements of a vehicle with regard to its electrical safety. Isolations resistance is at least one of the four mentioned criteria that shall be met after post-crash) requests to conduct the isolation resistance in accordance with paragraph 7.1.5.2.5., here you will be directed to paragraph 7.1.1. This paragraph offers two measurement methods for the isolation resistance, 7.1.1.2.1. Measurement method using DC voltage from external and 7.1.1.2.2. Measurement method using the vehicle's own REESS as DC voltage source.The in the question mentioned diagrams are part of paragraph 7.1.1.2.2. Measurement method using the vehicle's own REESS as DC voltage source. The described measurement method delivers an isolation resistance for all parts of the electric circuit, which are in contact with the DC voltage derived from the RESS. This includes the conductively AC circuits, if the power electronic IGBT's are in normal operation and perform an AC voltage output to the AC circuit or if a DC potential is switch to the AC circuit due to a malfunction of the power electronics. If after post-crash the power electronics shut down the IGBT's and therefore doesn't deliver any AC or DC potential to the AC circuit, than the AC circuit is excluded automatically from the isolation resistance measurement because of the fact that at this time there is no conductively connection between DC and AC circuit. This is in line with the electrical safety requirements according to 5.2.. The safety requirements for the AC circuit part are fulfilled because of the fact that the absence of high voltage requirement is fulfilled. In this case it is not requested to fulfill in addition the isolation resistance requirement for an electrical circuit (neither DC nor AC).Conclusion:No change or corrections in test procedure 7.1.1.2.2. necessary.The measurement method using the vehicle's own REESS including the Figures 2 to 4 will deliver an isolation resistance value for the DC electrical circuit and if the AC circuit is conductively connected to the DC circuit a common value for the connected DC and AC circuit. |
| **5.2.3.3.** | Fire hazardFor a period of 1 hour after the crash test, there shall be no evidence of fire or explosion of the REESS.Note – duration of observation period – 1 hr enough or is longer period necessary | The time period of 1 hour after the crash is considered as sufficient to ensure the safe evacuation of the occupants. |
| **5.3.3**. |  Thermal shock and cycling The test shall be conducted in accordance with paragraph 7.2.3.During the test, there shall be no evidence of electrolyte leakage, rupture (applicable to high voltage REESS(s) only), fire or explosion.[what about presence of smoke? – what about heat rise? Observation time interval - 1hr? Longer?The evidence of electrolyte leakage shall be verified by visual inspection without disassembling any part of the Tested-Device.For a high voltage REESS, the isolation resistance measured after the test in accordance with paragraph 7.1.1. shall not be less than 100 Ω/Volt. |  |
| **5.3.4.2** | Mechanical integrity The test shall be conducted in accordance with paragraph 7.2.5.The REESS certified according to this paragraph shall be mounted in a position which is between the two planes; (a) a vertical plane perpendicular to the centre line of the vehicle located 420mm rearward from the front edge of the vehicle, and (b) a vertical plane perpendicular to the centre line of the vehicle located 300mm forward from the rear edge of the vehicle.The crush force specified in paragraph 7.2.5. may be replaced with the value declared by the manufacturer, where the crush force shall be documented in the relevant administration document as a mounting restriction, which shall also be referred to in compliance assessments for the vehicle. In this case, the vehicle manufacture who uses such REESS shall demonstrate that the contact force to the REESS will not exceed the figure declared by the REESS manufacturer. Such force shall be determined by the vehicle manufacturer using test data obtained from either actual or simulated crash tests as specified in the applicable crash regulations in relevant impact directions. Manufacturers may use forces derived from data obtained from alternative crash test procedures, but these forces shall be equal to or greater than the forces that would result from using data in accordance with the applicable crash regulations. Need to address test procedures to be acceptable for self certification environmentDuring the test there shall be no evidence of; electrolyte leakage, fire or explosion. The evidence of electrolyte leakage shall be verified by visual inspection without disassembling any part of the Tested-Device.An appropriate coating shall, if necessary, be applied to the physical protection (casing) in order to confirm if there is any electrolyte leakage from the REESS resulting from the impact test. Unless the manufacturer provides a means to differentiate between the leakage of different liquids, all liquid leakage shall be considered as the electrolyte.For a high voltage REESS, the isolation resistance of the Tested-Device shall ensure at least 100 Ω/Volt for the whole REESS measured in accordance with paragraph 7.1.1., or the protection IPXXB shall be fulfilled for the Tested-Device when assessed in accordance with paragraph 7.1.5.2.4. | From my understanding, the test procedure is always the same, only the crush forces may be replaced with values declared by the manufacturer based on data derived from applicable crash regulations. Conclusion:No change or correction necessary.The wording 'applicable crash regulations' should be replaced by 'applicable regional crash regulations'. |
| **7.1.5.2.6.** | **Electrolyte leakage**Appropriate coating shall be applied,note – what is an appropriate coating? – specification needed? Gas sampling to detect electrolyte vapor? Difficult to measure on vehicle. Treat gas emissions in the environmental restrictions on hazardous substances?if necessary, to the physical protection in order to confirm any electrolyte leakage from the REESS resulting from the crash test.Unless the manufacturer provides the means to differentiate among the leakage of different liquids, all liquid leakage is considered as an electrolyte.How is leakage measured? | If the vehicle or REESS manufacturer cannot offer an appropriate measure to be able to identify electrolyte leakage only, than the requirement is that all liquid leakage is considered as an electrolyte, that the more severe requirement. If possible an necessary to identify electrolyte leakage only, than it is by interest of the manufacturer to propose an appropriate measure.Electrolyte leakage includes from my understanding vapor emissions. The requirement is that 30 minutes after post-crash no electrolyte leakage shall enter the passenger compartment.A REESS is based on cell and module technology, which general abuse behavior and possible emissions of hazardous substances, if one, are familiar due to tests on cell and module level. Therefore it makes no sense to ask for a gas or vapor sampling and analyzing system based on vehicle or REESS tests. Hazardous substances, if any, in the case of an electrolyte leakage can be addressed by results derived from cell and module testing.How to measure a possible amount of electrolyte leakage depends from the arrangement of the REESS in the vehicle. An appropriate measure should be agreed between manufacturer and test authority.Conclusion:No change or modifications necessary. |
| **7.2.2.3.1.** | **General test conditions**The following conditions shall apply to the Tested-Device: (a) the test shall be conducted at an ambient temperature of 20 ± 10 °C. (b) at the beginning of the test, the SOC shall be adjusted to a value in the upper 50% of the normal operating SOC range[note - any justification of why not test at full SOC?]of the Tested-Device.(c) at the beginning of the test, all protection devices which affect the function(s) of the Tested-Device that are relevant to the outcome of the test shall be operational. | At the preparation of the test, the SOC shall be adjusted to a value in the upper 50% of the normal operating SOC range for the tests for which the change of SOC is not aimed. For the testing of REESS without any defects, the SOC will not have significant effect on the safety performance. In addition, the SOC while driving will not be retained at maximum level as the electricity will be consumed for traction. It should also be noted that, in case of vehicle-based tests for vehicles with no external charging capability (e.g. HEV, FCHV), the precise adjustment of the SOC would be quite difficult.Conclusion:No change or modifications necessary. |
| **7.2.2.3.2.2** | **Test procedures**The Tested-Device shall be subjected to a vibration having a sinusoidal waveform with a logarithmic sweep between 7 Hz and 50 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours in the vertical direction of the mounting orientation of the REESS as specified by the manufacturer. The correlation between frequency and acceleration shall be as shown in Table 2:[fix missing data in table below]

|  |  |
| --- | --- |
| Frequency[Hz] | Acceleration[m/s2] |
|  7 - 18 | 10 |
| 18 - 30 | gradually reduced from 10 to 2 |
| 30 - 50 | 2 |

**Table 2 Frequency and acceleration**At the request of the manufacturer, a higher acceleration level as well as a higher maximum frequency may be used. | The missing frequency value for the table is 7 - 18 Hz, mentioned already in the first sentence of this paragraph.

|  |  |
| --- | --- |
| Frequency[Hz] | Acceleration[m/s2] |
|  7 - 18 | 10 |
| 18 - 30 | gradually reduced from 10 to 2 |
| 30 - 50 | 2 |

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| **7.2.4.3.2.** | **Test procedure**The Tested-Device shall be decelerated or accelerated in compliance with the acceleration corridors which are specified in Figure 9 and Tables 3 or 4. The manufacturer shall decide whether the tests shall be conducted in either the positive or negative direction or both.For each of the test pulses specified, a separate Tested-Device may be used. The test pulse shall be within the minimum and maximum value as specified in Tables 3 or 4. A higher shock level and /or longer duration as described in the maximum value in Tables 3 or 4 can be applied to the Tested-Device if recommended by the manufacturer.**Time****Acceleration**Maximum curveMinimum curve**A****B****C****D****E****F****G****H****Figure 9 Generic description of test pulses**

|  |  |  |
| --- | --- | --- |
| Point | Time (ms) | Acceleration (g)  |
| Longitudinal | Transverse |
| A | 20 | 0 | 0 |
| B | 50 | 20 | 8 |
| C | 65 | 20 | 8 |
| D | 100 | 0 | 0 |
| E | 0 | 10 | 4.5 |
| F | 50 | 28 | 15 |
| G | 80 | 28 | 15 |
| H | 120 | 0 | 0 |

**Table 3 Values for category 1-1 vehicles**May be a challenge to conduct this test for heavy battery systems – subject to test equipment capabilities

|  |  |  |
| --- | --- | --- |
| Point | Time (ms) | Acceleration (g)  |
| Longitudinal | Transverse |
| A | 20 | 0 | 0 |
| B | 50 | 10 | 5 |
| C | 65 | 10 | 5 |
| D | 100 | 0 | 0 |
| E | 0 | 5 | 2.5 |
| F | 50 | 17 | 10 |
| G | 80 | 17 | 10 |
| H | 120 | 0 | 0 |

**Table 4 Values for category 1-2 vehicles**The test shall end with an observation period of 1 h at the ambient temperature conditions of the test environment. | In 7.2.4.2.1. it is already mentioned, that this test shall be conducted either with the complete REESS or with related REESS subsystem(s) including the cells and their electrical connections.Conclusion:No change or modification necessary |
|  | Why determination of hydrogen emissions part, paragraph 5.4 and 6.10, ofR100 is not included in this proposal? (A comment from Japan) | Certain requirements for hydrogen emissions from open-type battery currently exist in UN R100. However, the use of open-type batteries as a REESS will not be expected to expand in the future for globally marketed products. Therefore, no specific test procedure is provided in this gtr as the value to establish a globally harmonised standard is rather limited, while the Contracting Parties concerned may continue to apply its existing requirements for such technologies.Conclusion:No change or modifications necessary. |