ELECTRICAL SAFETY PROVISIONS FOR VEHICLES Post Crash

1.   General

This module shall apply to the electric power train of electric vehicles, hybrid vehicles and fuel cell vehicles, and the high voltage components and systems which are ~~galvanically~~ conductively connected to the high voltage bus of the electric power train following vehicle crash test(s). The crash test(s) to be used for purposes of evaluating compliance to these requirements are those specified within existing regulations of the contracting parties.

2.   Definitions

For the purposes of this regulation the following definitions apply.

2-1~~24~~   Automatic disconnect
means a device that when triggered, conductively ~~galvanically~~ separates the electrical energy sources from the rest of the high voltage circuit of the electrical power train.

2-2~~5~~   Coupling system for charging the rechargeable energy storage system (RESS)
means the electrical circuit used for charging the RESS from an external electric power supply ~~(AC or DC electric power supply outside of the vehicle)~~ including the vehicle inlet

2–3~~9~~ Direct contact
means the contact of persons with high voltage live parts.

2–4~~16~~Electrical chassis
means a set made of conductive parts electrically linked together, whose electrical potential is taken as reference.

2–5~~14~~Electrical circuit
means an assembly of connected high voltage live parts which is designed to be electrically energized in normal operation.

2-6~~26~~ Electrical isolation
means the electrical resistance between the vehicle high voltage bus ~~source~~ and any vehicle conductive structure.

2–7~~18~~Electrical Protection Barrier
means the part providing protection against any direct contact to the high voltage live parts ~~from any direction of access.~~

2-8~~3~~ Electrical energy conversion system
means a system (e.g. fuel cell) that generates and provides electrical energy for vehicle ~~electrical~~ propulsion.

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2-~~9~~1   Electric power train

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

Propulsion system

~~means the components or electric circuit to propel the vehicle using the energy that is supplied by a high voltage source. These include, but are not limited to, the propulsion motor, electric converter, and associated wire harnesses and connectors, and coupling systems for charging rechargeable energy storage systems.~~

~~Electric energy storage/conversion/power generating system~~

~~means the components comprising, but not limited to, the vehicle's high voltage battery system, capacitor system, or fuel cell system, and rechargeable energy storage systems. These include, but are not limited to, the battery or capacitor modules, interconnects, venting systems, battery or capacitor restraint devices, and electric energy storage boxes or containers that hold the individual battery or capacitor modules. Hydrogen system components of fuel cell vehicles, such as the hydrogen tanks and hydrogen tubes, are not included in the electric energy storage/conversion system.~~

2-10   Electronic converter

means a device capable of controlling and/or converting electrical power for ~~electrical~~ propulsion.

2–11~~10~~Enclosure

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

2-12~~13~~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.

2-13~~22~~High Voltage

means the classification of an electric component or circuit, if its maximum working voltage is > 60 V and ≤ 1500 V direct current (DC) ~~d.c.~~ or > 30 V and ≤ 1000 V alternating current   (AC) ~~a.c.~~ root – mean – square (rms)

~~High voltage source means~~

~~any electric component that has a working voltage greater than 30 VAC or 60 VDC.~~

2-14~~23~~High Voltage Bus

means the electrical circuit, including the coupling system for charging the RESS, that operates on high voltage

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2–15~~11~~Indirect contact

means the contact of persons with exposed conductive parts.

2–16~~10~~Live parts

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

~~2–8   Luggage compartment~~

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

2-17~~25~~ Open type traction battery

means a type of battery requiring liquid and generating hydrogen gas released to the atmosphere.

2–18~~7~~Passenger compartment for electric safety assessment means

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

~~2–12 Protection degree~~

~~Protection provided by a barrier/enclosure related to the contact with live parts by a test probe, such as a test finger (IPXXB) or a test wire (IPXXD) as defined in Attached Sheet 1~~

2-12   Protection IPXXB

means protection from contact with high voltage live parts provided by either an electrical protection barrier or an enclosure and tested using a Jointed Test Finger (IPXXB) as described in Attached Sheet 1.

2-19~~2~~ "Rechargeable energy storage system (RESS)"

means the rechargeable energy storage system which ~~that~~ provides the electrical energy for propulsion

~~Electric energy storage device~~

~~means a high voltage source that can store energy, such as a battery or capacitor modules.~~

2–20~~17~~Solid insulator

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

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2–2145Working voltage

means the highest value of an electrical circuit voltage root-mean-square (rms), specified by the manufacturer or determined by measurement, which may occur between any conductive parts in open circuit conditions or under normal operating conditions. If the electrical circuit is divided by galvanic isolation, the working voltage is defined for each divided circuit, respectively.

Working voltage

means the highest root mean square voltage of the voltage source, which may occur across its terminals or between its terminals and any conductive parts in open circuit conditions or under normal operating conditions.

?? VAC

means volts of alternating current (AC).

?? VDC

means volts of direct current (DC).

3. Requirements

3-1 General

Vehicles equipped with electric power train shall meet the requirements of paragraph 3-2 through 3-4. This can be met by a separate impact test provided that the electrical components do not influence the occupant protection performance of the vehicle type as defined in the impact regulation. In case of this condition the requirements of paragraph 3-2 through 3-4 shall be checked in accordance with the methods set out in Attached Sheet 0.

3-2 Protection against electrical shock

After the impact at least one of the three criteria specified in paragraph 3-2-1 through paragraph 3-2-3 shall be met. However Contracting Parties under the 1998 Agreement can choose to adopt Paragraph 3-2-4 "Low electrical energy" as additional criteria.

If the vehicle has an automatic disconnect function, or device(s) that galvanically conductively divide the electric power train circuit during driving condition, at least one of the following criteria shall apply to the disconnected circuit or to each divided circuit individually after the disconnect function is activated.

However criteria defined in 3-2-2 shall not apply if more than a single potential of a part of the high voltage bus is not protected under the conditions of protection IPXXB.

In the case that the test is performed under the condition that part(s) of the high voltage system are not energized, the protection against electrical shock shall be proved by either 3-2-2 or [3-2-3] for the relevant part(s).

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~~A) Requirements for protection against electrical shock described in § 3-2-1 through 3-2-3 have to be transferred into national legislation by the Contracting Parties of the 1998 Agreement~~

3-2-1   Absence of high voltage

The voltages Vb, V1 and V2 of the high voltage buses shall be equal or less than 30 VAC or 60 VDC within 60 seconds after the impact as specified in Attached Sheet 0 paragraph 2.

~~The voltage of the voltage source must be less than or equal to 30 VAC for AC components or 60 VDC for DC components.~~

3-2-2   Isolation resistance

The criteria specified in the paragraphs 3-2-2-1 and 3-2-2-2 below shall be met.

The measurement shall be conducted in accordance with paragraph 3 of Attached Sheet 0.

3-2-2-1   Electrical power train consisting of separate DC- or AC-buses

If the AC high voltage buses and the DC high voltage buses are ~~galvanically~~ conductively isolated from each other, isolation resistance between the high voltage bus and the electrical chassis (Ri, as defined in paragraph 3 of Attached Sheet 0) 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.

3-2-2-2   Electrical power train consisting of combined DC- and AC-buses

If the AC high voltage buses and the DC high voltage buses are conductively ~~galvanically~~ connected they shall meet one of the following requirements:

(a) isolation resistance between the high voltage bus and the electrical chassis (Ri, as defined in paragraph 3 of Attached Sheet 0) shall have a minimum value of 500 Ω/volt of the working voltage.

(b) isolation resistance between the high voltage bus and the electrical chassis (Ri, as defined in paragraph 3 of Attached Sheet 0) shall have a minimum value of 100 Ω/volt of the working voltage and the AC bus meets the physical protection as described in 3-2-3.

(c) isolation resistance between the high voltage bus and the electrical chassis (Ri, as defined in paragraph 3 of Attached Sheet 0) 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 3-2-1.

~~The electric isolation between each high voltage source and the vehicle chassis electricity-conducting structure must meet one of the following:~~

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(1) Electrical isolation must be greater than or equal to 500 ohms/volt for all DC high voltage sources without continuous monitoring of electrical isolation during vehicle operation and for all AC high voltage sources; or

(2) Electrical isolation must be greater than or equal to 100 ohms/volt for all DC high voltage sources with continuous monitoring of electrical isolation, in accordance with the requirements of S5.4, during vehicle operation.

S5.4 *Electrical isolation monitoring.*

For each continuously monitored DC high voltage source, the continuous monitoring of electrical isolation during vehicle operation referred to in S5.3(a)(2) must be achieved through an electrical isolation monitoring system that displays a warning for loss of isolation when tested according to S8. The system must monitor its own readiness and the warning display must be clearly visible from the driver's designated seating position.

[3-2-3   Physical Protection

For protection against direct contact with high voltage live parts, the protection IPXXB shall be provided.

In addition, for protection against electrical shock which could arise from indirect contact, the resistance between all exposed conductive parts and electric 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. In case of doubts a measurement shall be made.]

3-2-4   Low electrical energy

The total energy (TE) on the high voltage buses shall be less than 2.0 Joules when measured according to the test procedure as specified in paragraph 5 of Attached Sheet 0 with the formula (a). Alternatively the total energy (TE) may be calculated by the measured voltage Vb of the high voltage bus and the capacitance of the X-capacitors (C_x) specified by the manufacturer or determined by measurement according to formula (b) of paragraph 5 of Attached Sheet 0.

The energy stored in the Y-capacitors (TE_{y1}, TE_{y2}) shall also be less than 2.0 Joules. This shall be calculated by measuring the voltages V1 and V2 of the high voltage buses and the electrical chassis, and the capacitance of the Y-capacitors specified by the manufacturer or determined by measurement according to formulas (c) of paragraph 5 of Attached Sheet 0.

3-3   Electrolyte spillage

In the period from the impact until 30 minutes after no electrolyte from the RESS shall spill into the passenger compartment and no more than 7 per cent of electrolyte shall spill from the RESS except open type traction batteries outside the passenger compartment. For open type traction

batteries no more than 7 per cent with a maximum of 5.0 liters shall spill outside the passenger compartment.

The manufacturer shall demonstrate compliance in accordance with paragraph 6 of Attached Sheet 0.

3-4   **RESS** ~~Traction battery~~ **retention**

RESS located inside the passenger compartment shall remain in the location in which they are installed and RESS components shall remain inside RESS boundaries.

No part of any RESS that is located outside the passenger compartment for electric safety assessment shall enter the passenger compartment during or after the impact test.

The manufacturer shall demonstrate compliance in accordance with paragraph 7 of Attached Sheet 0.

~~S5.2 Electric energy storage/ conversion system retention.~~

~~All components of the electric energy storage/conversion system must be anchored to the vehicle. All component anchorages, including any brackets or structures that transfer loads from the component to the vehicle structure, shall remain attached to the vehicle structure at all attachment locations during and after testing performed pursuant to the procedures of S6 of this standard.~~

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Attached Sheet 0 Test Conditions and Test Procedures

Test Conditions

1   General

The test conditions specified in paragraphs 1 through 4 shall be used.

Where a range is specified, the vehicle shall be capable of meeting the requirements at all points within the range.

~~Where a range is specified, the vehicle must be capable of meeting the requirements at all points within the range.~~

2   Electrical power train adjustment

2-1   The RESS shall be at any state of charge, which allows the normal operation of the power train as recommended by the manufacturer.

2-2   The electrical power train shall be energized with or without the operation of the original electrical energy sources (e.g. engine-generator, RESS or electric energy conversion system), however:

2-2-1   it shall be permissible to perform the test with all or parts of the electrical power train not being energized insofar as there is no negative influence on the test result. For parts of the electrical power train not energized, the protection against electrical shock shall be proved by either physical protection or isolation resistance and appropriate additional evidence.

2-2-2   in the case where the power train is not energized and an automatic disconnect is provided, ~~at the request of the manufacturer~~ it shall be permissible to perform the test with the automatic disconnect being triggered. In this case it shall be demonstrated that the automatic disconnect would have operated during the impact test. This includes the automatic activation signal as well as the conductive ~~galvanic~~ separation considering the conditions as seen during the impact.

~~S7.1 Electric energy storage device state of charge.~~
~~The electric energy storage device is at the state of charge specified in subparagraphs (a), (b), or (c), as appropriate:~~
~~a)   At the maximum state of charge recommended by the manufacturer, as stated in the vehicle owner's manual or on a label that is permanently affixed to the vehicle;~~
~~b)   If the manufacturer has made no recommendation in the owner's manual or on a label permanently affixed to the vehicle, at a state of charge of not less than 95 percent of the maximum capacity of the electric energy storage device; or~~

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c)   If the electric energy storage device(s) is/are rechargeable only by an energy source on the vehicle, at any state of charge within the normal operating voltage defined by the vehicle manufacturer.

[3   It shall be allowed to modify the fuel system so that an appropriate amount of fuel can be used to run the engine or the electrical energy conversion system.]

4   The vehicle conditions other than specified in paragraphs 1through 3 shall be in the crash test protocols of the contracting parties.

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Test Procedures for the protection of the occupants of vehicles operating on electrical power from high voltage and electrolyte spillage

This section describes test procedures to demonstrate compliance to the electrical safety requirements of paragraph 3.

Before the vehicle impact test conducted, the high voltage bus voltage (Vb) (see figure 1) shall be measured and recorded to confirm that it is within the operating voltage of the vehicle as specified by the vehicle manufacturer.

~~S7.6.3 The voltage(s) is/are measured as shown in Figure 1 and the high voltage source voltage(s) (Vb) is/are recorded. Before any vehicle impact test, Vb is equal to or greater than the nominal operating voltage as specified by the vehicle manufacturer.~~

1. **Test setup and equipment**

   If a high voltage disconnect function is used, measurements are to be taken from both sides of the device performing the disconnect function.

   However, if the high voltage disconnect is integral to the RESS or the energy conversion system and the high-voltage bus of the RESS or the energy conversion system is protected according to protection IPXXB following the impact test, measurements may only be taken between the device performing the disconnect function and electrical loads.

   The voltmeter used in this test shall measure DC values and have an internal resistance of at least 10 MΩ.

   ~~S7.6.2 The voltmeter used in this test has an internal resistance of at least10 MΩ.~~

2. **The following instructions may be used if voltage is measured.**

   After the impact test, determine the high voltage bus voltages (Vb, V1, V2) (see figure 1).
   The voltage measurement shall be made not earlier than 5 seconds, but not later than 60 seconds after the impact.

   ~~All measurements for calculating voltage(s) and electrical isolation are made after a minimum of 5 seconds after the vehicle comes to rest in tests specified in S6~~

   This procedure is not applicable if the test is performed under the condition where the electric power train is not energized.

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Voltage measurement. For the purposes of determining low voltage source specified in S5.3(b), voltage is measured as shown in Figure 1. Voltage Vb is measured across the two terminals of the voltage source. Voltages V1 and V2 are measured between the source and the vehicle chassis electricity-conducting structure.
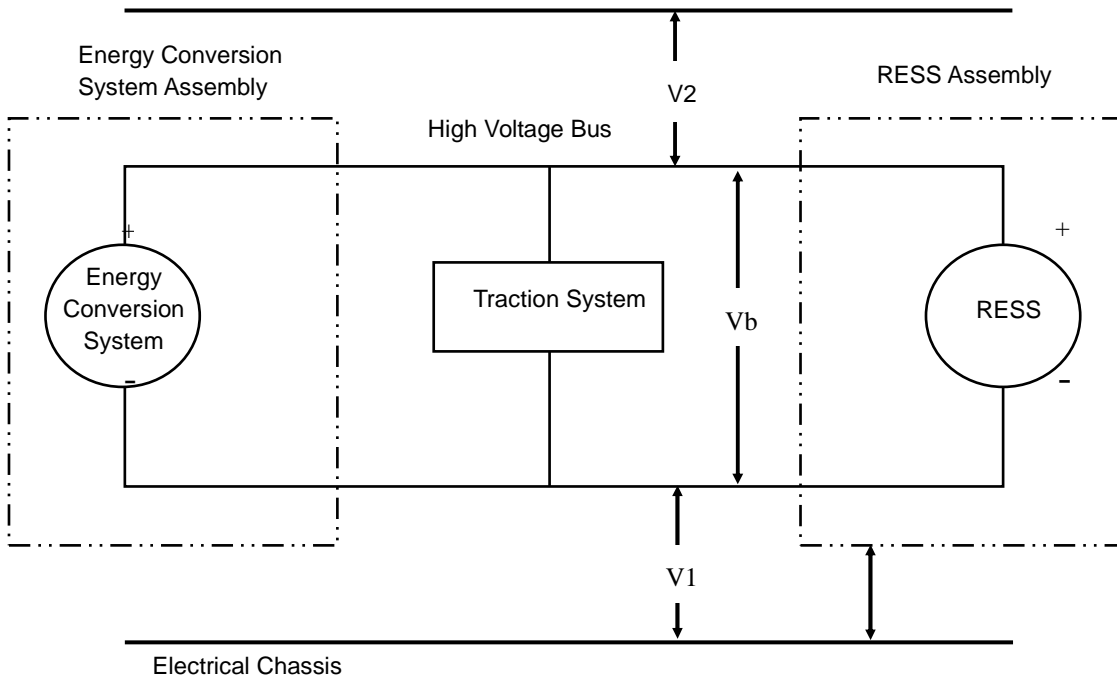
Energy Conversion
System Assembly

RESS Assembly

V2

High Voltage Bus

Energy Conversion System

Traction System

Vb

RESS

V1

Electrical Chassis

Figure 1 Measurement of Vb, V1, V2

3.   Isolation resistance

S7.6.1 Prior to any barrier impact test, the high voltage source is connected to the vehicle's propulsion system, and the vehicle ignition is in the "on" (propulsion system energized) position. Bypass any devices or systems that do not allow the propulsion system to be energized at the time of impact when the vehicle ignition is on and the vehicle is in neutral.

For a vehicle that utilizes an automatic disconnect between the high voltage source and the traction system that is physically contained within the high voltage electric energy storage/conversion/power generating system, the electrical isolation measurement after the test is made from the traction-system side of the automatic disconnect to the vehicle chassis electricity-conducting structure.
For a vehicle that utilizes an automatic disconnect that is not physically contained within the high voltage electric energy storage/conversion/power generating system, the electrical isolation measurement after the test is made from both the high voltage source side and from the traction-system side

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

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The following instructions should be used if the isolation resistance is demonstrated by measurement.

All measurements for calculating voltage(s) and electrical isolation are made after a minimum of 5 seconds after the impact .~~vehicle comes to rest. in tests specified in S6~~

Measure and record the voltage (Vb) between the negative and the positive side of the high voltage bus (see figure 1);

Measure and record the voltage (V1) between the negative side of the high voltage bus and the electrical chassis (see figure 1);

~~The voltage(s) is/are measured as shown in Figure 2, and the voltage(s) (V1) between the negative side of the high voltage source and the vehicle chassis electricity-conducting structure is/are recorded.~~

Measure and record the voltage (V2) between the positive side of the high voltage bus and the electrical chassis (see figure 1);

~~The voltage(s) is/are measured as shown in Figure 3, and the voltage(s) (V2) between the positive side of the high voltage source and the vehicle chassis electricity-conducting structure is/are recorded.~~

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 vehicle electrical chassis (see figure 3). Calculate the isolation resistance (Ri) according to the formula shown below.

$$Ri = Ro*(Vb/V1' - Vb/V1) \quad or \quad Ri = Ro*Vb*(1/V1' - 1/V1)$$

Divide the result Ri, which is the electrical isolation resistance value (in Ω), by the working voltage of the high voltage bus in volt (V).

$$Ri\ \Omega\ /\ V = Ri\ \Omega\ /\ Working\ voltage\ (V)$$

~~S7.6.6 If V1 is greater than or equal to V2, insert a known resistance (Ro) between the negative side of the high voltage source and the vehicle chassis electricity-conducting structure. With the Ro installed, measure the voltage (V1') as shown in Figure 4 between the negative side of the high voltage source and the vehicle chassis electricity-conducting structure. Calculate the electrical isolation resistance (Ri) according to the formula shown. Divide Ri (in ohms) by the working voltage of the high voltage source (in volts) to obtain the electrical isolation (in ohms/volt).~~

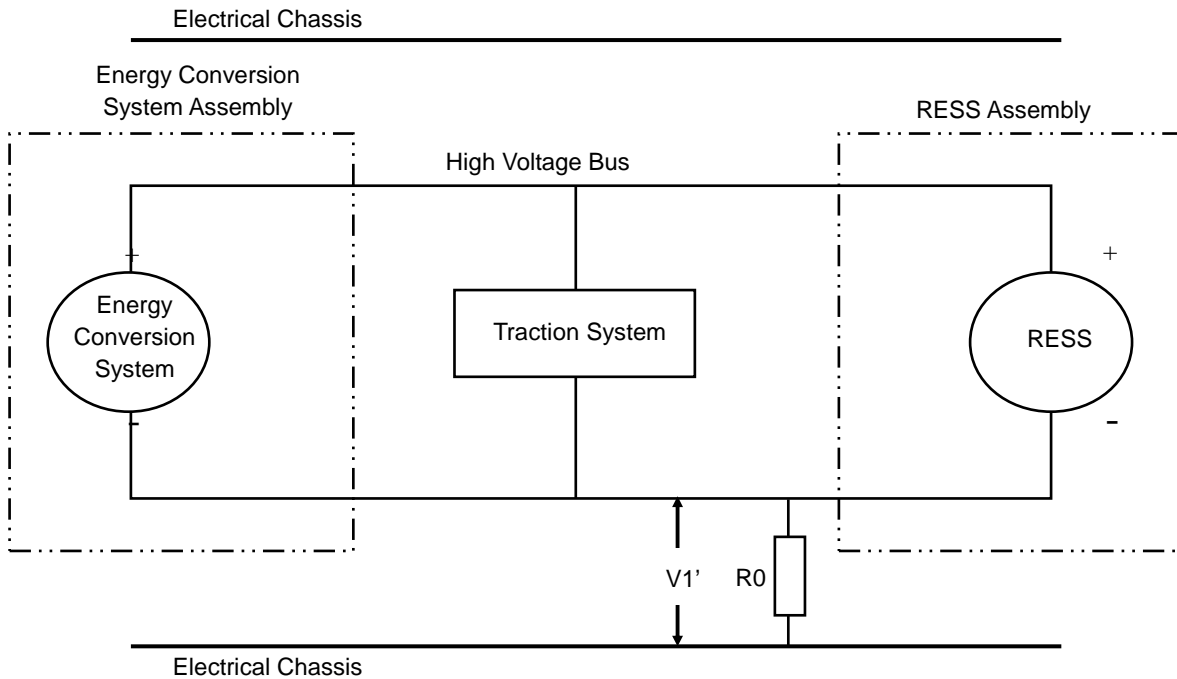**Draft agreed during 8th ELSA Meeting**
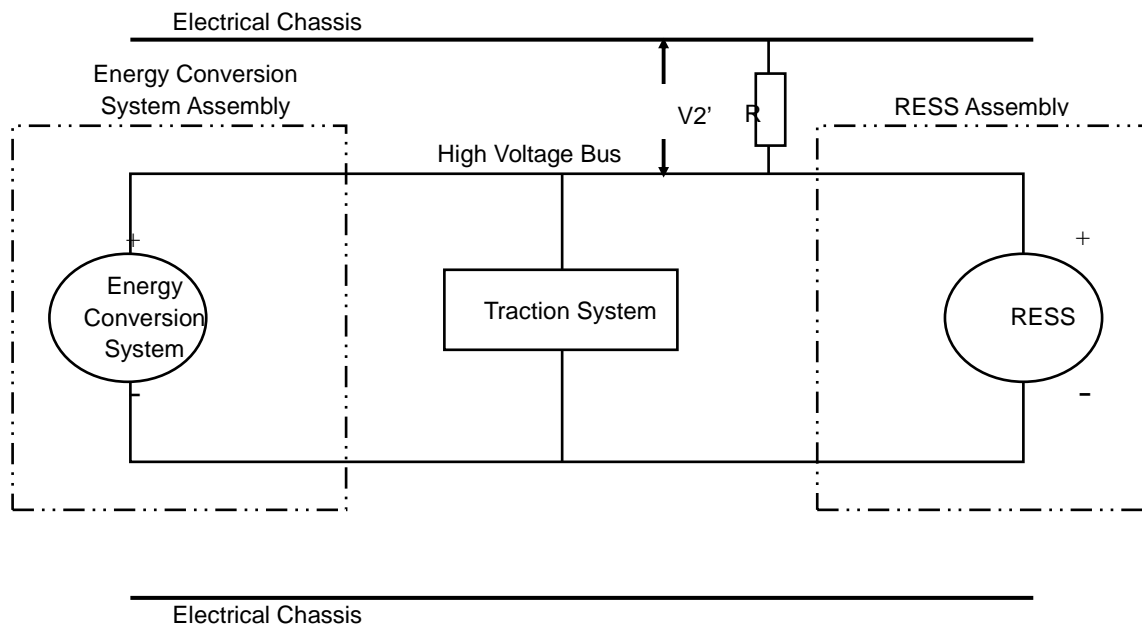

Figure 3: Measurement of V1'

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 4).

Calculate the isolation resistance (Ri) according to the formula shown below.

$$Ri = Ro*(Vb/V2' - Vb/V2) \quad or \quad Ri = Ro*Vb*(1/V2' - 1/V2)$$

Divide the result Ri, which is the electrical isolation resistance value (in Ω), by the working voltage of the high voltage bus in volt (V).

$$Ri\ \Omega\ /\ V = Ri\ \Omega\ /\ Working\ voltage\ V$$

S7.6.7 If V2 is greater than V1, insert a known resistance (Ro) between the positive side of the high voltage source and the vehicle chassis electricity-conducting structure. With the Ro installed, measure the voltage (V2') as shown in Figure 5 between the positive side of the high voltage source and the vehicle chassis electricity-conducting structure. Calculate the electrical isolation resistance (Ri) according to the formula shown. Divide Ri (in ohms) by the working voltage of the high voltage source (in volts) to obtain the electrical isolation (in ohms/volt).

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Electrical Chassis

Figure 4: Measurement of V2'

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 (Volt). Ro is not required to be precisely this value since the equations are valid for any Ro; however, an Ro value in this range should provide a good resolution for the voltage measurements.

For example, megohmmeter or oscilloscope measurements are an appropriate alternative to the procedure described above for measuring isolation resistance. In this case it may be necessary to deactivate the on-board isolation resistance monitoring system.

[4.   Physical Protection

Following the vehicle impact test any parts surrounding the high voltage components shall be, without the use of tools, opened, disassembled or removed. All remaining-surrounding parts shall be considered part of the physical protection.

The Jointed Test Finger described in Attached Sheet 1 shall be inserted into any gaps or openings of the physical protection with a test force of 10 N ± 10 per cent for electrical safety assessment. If partial or full penetration into the physical protection by the Jointed Test Finger occurs, the Jointed Test Finger shall be placed in every position as specified below.

Starting from the straight position, both joints of the test finger shall be rotated progressively through an angle of up to 90 degrees with respect to the axis of the adjoining section of the finger and shall be placed in every possible position.

Internal electrical protection barriers are considered part of the enclosure

If appropriate 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, between the Jointed Test Finger and high voltage live parts inside the electrical protection barrier or enclosure

4-1   Acceptance conditions

The requirements of paragraph 3-2-3 shall be considered to be met if the Jointed Test Finger described in Attached Sheet 1 is unable to contact high voltage live parts.
If necessary a mirror or a fiberscope may be used in order to inspect whether the Jointed Test Finger touches the high voltage buses.
If this requirement is verified by a signal circuit between the Jointed Test Finger and high voltage live parts, the lamp shall not light.]

5.   ~~Assessment procedure for~~ Low electrical Energy ~~(if chosen by the Contracting Party)~~

Prior to the impact a switch S1 and a known discharge resistor Re is connected in parallel to the relevant capacitance (ref. figure 2).

Not earlier than 5 seconds and not later than 60 seconds after the impact the switch S1 shall be closed while the voltage Vb and the current Ie are measured and recorded.

~~All measurements for calculating voltage(s) and electrical isolation are made after a minimum of 5 seconds after the vehicle comes to rest in tests specified in S6~~

The product of the voltage Vb and the current Ie shall be integrated over the period of time, starting from the moment when the switch S1 is closed (t_c) until the voltage Vb falls below the high voltage threshold of 60 V DC (t_h). The resulting integration equals the total energy (TE) in joules.

(a)
$$TE = \int_{tc}^{th} V_b \times I_e \, dt$$

When Vb is measured at a point in time between 5 seconds and 60 seconds after the impact and the capacitance of the X-capacitors (C_x) is specified by the manufacturer or determined by measurement total energy (TE) shall be calculated according to the following formula:

(b) $TE = 0.5 \times C_x \times (V_b^2 - 3\,600)$

When V1, V2 (see figure 1) are measured at a point in time between 5 seconds and 60 seconds after the impact and the capacitances of the Y-capacitors (C_{y1}, C_{y2}) are specified by the manufacturer or determined by measurement total energy (TE_{y1}, TE_{y2}) shall be calculated according to the following formulas:

(c) $$TE_{y1} = 0.5 \times C_{y1} \times (V_1{}^2 - 3\,600)$$

$$TE_{y2} = 0.5 \times C_{y2} \times (V_2{}^2 - 3\,600)$$

This procedure is not applicable if the test is performed under the condition where the electric power train is not energized.
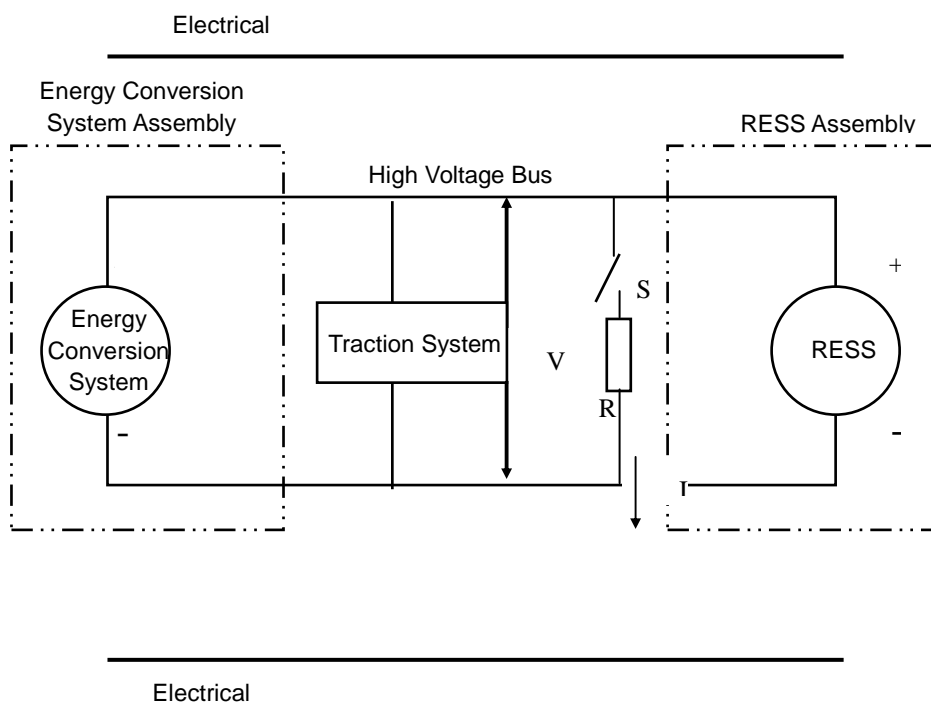

Figure 2: E.g. measurement of high voltage bus energy stored in X-capacitors

6.   Electrolyte spillage

Appropriate coating shall be applied, if necessary, to the physical protection in order to confirm any electrolyte leakage from the RESS after the impact test.

Unless the manufacturer provides means to differentiate between the leakage of different liquids, all liquid leakage shall be considered as the electrolyte.

7.   RESS retention

Compliance shall be determined by visual inspection

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~~**S8 Test procedure for on-board electrical isolation continuous monitoring system.**~~

~~Prior to any impact test, the requirements of S5.4 for the onboard electrical isolation continuous monitoring system shall be confirmed using the following procedure.~~

~~(1) The electric energy storage device is at the state of charge specified in S7.1.~~

~~(2) The switch or device that provides power from the high voltage system to the propulsion motor(s) is in the activated position or the ready-to-drive position.~~

~~(3) Determine the isolation resistance, Ri, of the high voltage source with the electrical isolation monitoring system using the procedure outlined in S7.6.2 through S7.6.7.~~

~~(4) Insert a resistor with resistance equal to Ro=1/(1/(95 times the working voltage of the high voltage source)—1/Ri) between the positive terminal of the high voltage source and the vehicle chassis electric conducting structure. The electrical isolation monitoring system indicator shall display a warning to the driver.~~

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Attached Sheet 1

JOINTED TEST FINGER (IPXXB)
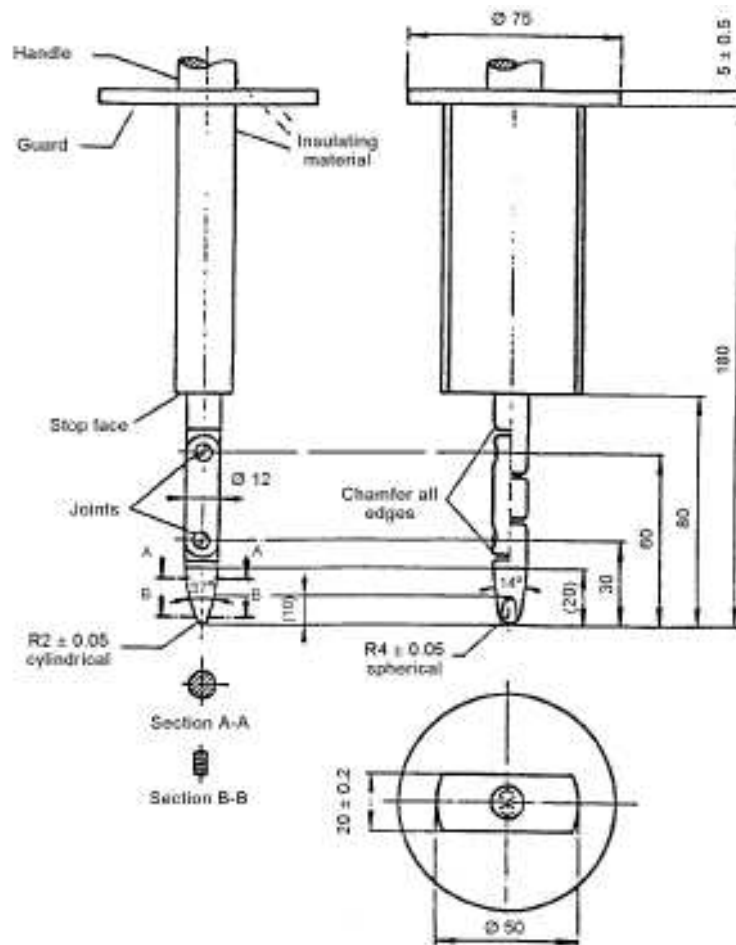
<u>Figure 1</u>: Jointed test finger

Material: metal, except where otherwise specified

Linear dimensions in millimeters

Tolerances on dimensions without specific tolerance:

(a)on angles: 0/-10°

(b)   on linear dimensions: up to 25 mm: 0/-0.05 mm over 25 mm:
       ± 0.2 mm

Both joints shall permit movement in the same plane and the same
direction through an angle of 90° with a 0 to +10° tolerance."