45-2 The protection of the occupants in the event of a lateral collision: Effective date from 2017/1/1

Refer to: R95 03-S5

45-2.1 Effective Date and Scope:

45-2.1.1 Effective date from 2017/1/1, the new vehicle variants of category symbols M1 and N1, where the R point of the lowest seat is not more than 700 mm from ground level, and from 2019/1/1 all vehicle variants of category symbols M1 and N1, where the R point of the lowest seat is not more than 700 mm from ground level, the protection of the occupants in the event of a lateral collision shall comply with this regulation.

45-2.1.2 For the vehicle is not equipped with automatically activated door locking systems, and with "451 The protection of the occupants in the event of a lateral collision" approval documents, it could be deemed to comply with this regulation.

45-2.1.3 Except for child-only vehicle, application for low volume or vehicle-by-vehicle safety approval may be exempt from this regulation.

45-2.2 Definitions

45-2.2.1 Passenger compartment:

45-2.2.1.1 "Passenger compartment with regard to occupant protection" means the space for occupant accommodation, bounded by the roof, floor, side walls, doors, outside glazing and front bulkhead and the plane of the rear compartment bulkhead or the plane of the rear-seat back support.

45-2.2.1.2 "Passenger compartment for electric safety assessment" means the space for occupant accommodation, bounded by the roof, floor, side walls, doors, outside glazing, front bulkhead and rear bulkhead, or rear gate, as well as by the electrical protection barriers and enclosures provided for protecting the occupants from direct contact with high voltage live parts.

45-2.2.2 "High Voltage" means the classification of an electric component or circuit, if its working voltage is > 60 V and $\leqq$ 1,500 V direct current (DC) or > 30 V and $\leqq$ 1,000 V alternating current (AC) root - mean - square (rms);

45-2.2.3 "Rechargeable energy storage system (REESS)" means the rechargeable energy storage system which provides electrical energy

for propulsion;

45-2.2.4　"Electrical Protection Barrier" means the part providing protection against any direct contact to the high voltage live parts;

45-2.2.5　"Electrical power train" means the electrical circuit which includes the traction motor(s), and may also include the REESS, the electrical energy conversion system, the electronic converters, the associated wiring harness and connectors, and the coupling system for charging the REESS;

45-2.2.6　"Live parts" means conductive part(s) intended to be electrically energized in normal use;

45-2.2.7　"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.

45-2.2.8　"Direct contact" means the contact of persons with high voltage live parts;

45-2.2.9　"Indirect contact" means the contact of persons with exposed conductive parts;

45-2.2.10　"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 paragraph 45-2.8.4.;

45-2.2.11　"Working voltage" means the highest value of an electrical circuit voltage root-meansquare (rms), specified by the manufacturer, 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;

45-2.2.12　"Coupling system for charging the rechargeable energy storage system (REESS)" means the electrical circuit used for charging the RESS from an external electrical power supply including the vehicle inlet;

45-2.2.13　"Electrical chassis" means a set made of conductive parts electrically linked together, whose electrical potential is taken as reference;

45-2.2.14　"Electrical circuit" means an assembly of connected high voltage live parts which is designed to be electrically energized in normal

operation;

45-2.2.15 "Electrical energy conversion system" means a system (e.g. fuel cell) that generates and provides electrical energy for electrical propulsion;

45-2.2.16 "Electronic converter" means a device capable of controlling and/or converting electrical power for electrical propulsion;

45-2.2.17 "Enclosure" means the part enclosing the internal units and providing protection against any direct contact;

45-2.2.18 "High Voltage Bus" means the electrical circuit, including the coupling system for charging the REESS that operates on a high voltage;

45-2.2.19 "Solid insulator" means the insulating coating of wiring harnesses, provided in order to cover and prevent the high voltage live parts from any direct contact. This includes covers for insulating the high voltage live parts of connectors and varnish or paint for the purpose of insulation;

45-2.2.20 "Automatic disconnect" means a device that when triggered, galvanically separates the electrical energy sources from the rest of the high voltage circuit of the electrical power train;

45-2.2.21 "Open type traction battery" means a type of battery requiring liquid and generating hydrogen gas released to the atmosphere.

45-2.2.22 "Automatically activated door locking system" means a system that locks the doors automatically at a pre-set speed or under any other condition as defined by the manufacturer.

45-2.2.23 "Reference mass" means the unladen mass of the vehicle increased by a mass of 100 kg (that is the mass of the side impact dummy and its instrumentation).

45-2.2.24 "Unladen mass" means the mass of the vehicle in running order without driver, passengers or load, but with the fuel tank filled to 90 per cent of its capacity and the usual set of tools and spare wheel on board, where applicable.

45-2.3 The protection of the occupants in the event of a lateral collision shall according to suitable types and range of principle are as below：

45-2.3.1 Vehicle powered by internal combustion engine:

45-2.3.1.1 The same vehicle category symbol.

45-2.3.1.2 The same axle set type.

45-2.3.1.3 The same brand and vehicle type series.

45-2.3.1.4 The chassis vehicle have had same axle set type.

45-2.3.1.5 The same chassis brand.

45-2.3.1.6 Chassis manufacturers announced that the same chassis vehicle type series.

45-2.3.2   Vehicle powered by pure electric motor:

45-2.3.2.1 The same vehicle category.

45-2.3.2.2 The same axle set variant.

45-2.3.2.3 The same brand and vehicle type.

45-2.3.2.4 The chassis vehicle have had same axle set variant.

45-2.3.2.5 The same chassis brand.

45-2.3.2.6 Chassis manufacturers announced that the same chassis vehicle type.

45-2.3.2.7 The same place of the components of the propulsion system.

45-2.3.2.8 The same place of the battery or of the parts of propulsion battery.

45-2.3.3   Vehicle powered by hybrid:

45-2.3.3.1 The same vehicle category.

45-2.3.3.2 The same axle set variant.

45-2.3.3.3 The same brand and vehicle type.

45-2.3.3.4 The chassis vehicle have had same axle set variant.

45-2.3.3.5 The same chassis brand.

45-2.3.3.6 Chassis manufacturers announced that the same chassis vehicle type.

45-2.3.3.7 The same place of the components of the propulsion system.

45-2.3.3.8 The same place of the battery or of the parts of propulsion battery.

45-2.4　Test conditions, state of the vehicle and preparation of the vehicle:

45-2.4.1 The vehicle to be tested shall be stationary.

45-2.4.2 The unladen mass of the vehicle is increased by a mass of 100 kg (that is the mass of the side impact dummy and its instrumentation). The fuel tank shall be filled with water to a mass equal to 90 % with a tolerance of +/- 1 per cent. of the mass of a full load of fuel.

It shall be allowed by agreement between manufacturer and Technical Service 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. This requirement does not apply to Hydrogen fuel tanks.

45-2.4.3 The mass of the measuring apparatus shall not change each axle reference load by more than 5 %, each variation not exceeding 20 kg.

45-2.4.4 The doors shall be closed, but not locked. The transmission shall be placed in neutral and the parking brake disengaged.

45-2.4.4.1 However, in the case of vehicles equipped with an automatically activated door locking system, it shall be ensured that all the side doors are locked before the test.

45-2.4.4.2 In the case of vehicles equipped with an automatically activated door locking system, which is installed optionally and/or which can be de-activated by the driver, one of the following two procedures shall be used at the choice of the manufacturer:

45-2.4.4.2.1　All the side doors shall be locked manually before the start of the test.

45-2.4.4.2.2　It shall be ensured that the side doors on the struck side are unlocked and the side doors on the non-struck side locked before the impact; the automatically activated door-locking system may be overridden for this test.

45-2.4.5 The longitudinal adjustment device shall be placed with the locking device engaged in the position that is nearest to midway. The head restraint shall be adjusted such that its top surface is level with the centre of gravity of the dummy's head; if this is not possible, the head restraint shall be in the uppermost position. Unless otherwise specified by the manufacturer, the seat-back shall be set such that the torso reference line of the three-dimensional H point machine is set at an angle of 25 +/- 1 degree towards the rear. All other seat adjustments shall be at the mid-point of available travel; however, height adjustment shall be at the position corresponding to the fixed seat, if the vehicle type is available with adjustable and fixed seats. If the steering wheel is adjustable, all adjustments are positioned to their mid-travel locations.

45-2.4.6 The side impact dummy EuroSID shall be installed in the front seat on the impact side. The safety-belts or other restraint systems, which are specified for the vehicle, shall be used. Belts should be of an approved type, conforming to the Regulation of the "Standards" and mounted on anchorages conforming to the Regulation of this "Standards".

45-2.4.7 Electrical power train adjustment

45-2.4.7.1 The REESS shall be at any state of charge, which allows the normal operation of the power train as recommended by the manufacturer.

45-2.4.7.2 The electrical power train shall be energized with or without the operation of the original electrical energy sources (e.g. engine-generator, REESS or electric energy conversion system), however:

45-2.4.7.2.1　By the agreement between Technical Service and manufacturer 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.

45-2.4.7.2.2　In the case where 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 galvanic separation considering the conditions as seen during the impact.

45-2.5   Test method: The longitudinal vertical median plane of the mobile deformable barrier shall be coincident within +/- 25 mm with a transverse vertical plane passing through the R point of the front seat adjacent to the struck side of the tested vehicle. The mobile deformable barrier speed at the moment of impact shall be 50 +/- 1 km/h. The trajectory of the mobile deformable barrier longitudinal median vertical plane shall be perpendicular to the longitudinal median vertical plane of the impacted vehicle.

45-2.6   Specifications

45-2.6.1   The vehicle shall undergo a test in accordance with paragraph 45-2.4 to this Regulation.

45-2.6.1.1 The test will be carried out on the driver's side unless asymmetric side structures, if any, are so different as to affect the performance in a side impact. In that case either of the alternatives in paragraph 45-2.6.1.1.1. or 45-2.6.1.1.2. may be used by agreement between the manufacturer and technical service.

45-2.6.1.1.1   The manufacturer will provide the authority responsible for approval with information regarding the compatibility of performances in comparison with the driver's side when the test is being carried out on that side.

45-2.6.1.1.2   The technical service, if concerned as to the construction of the vehicle, will decide to have the test performed on the side opposite the driver, this being considered the least favourable.

45-2.7   Inspection standard:

Additionally, vehicles equipped with electric power train shall meet the requirements of paragraph 45-2.7.5. This can be met by a separate impact test at the request of the manufacturer and after validation by the Technical Service, provided that the electrical components do not influence the occupant protection performance of the vehicle type as defined in paragraphs 45-2.7.1. to 45-2.7.4.3. of this Regulation. In case of this condition the requirements of paragraph 45-2.7.5. shall be checked in accordance with the methods set out in paragraph 45-2.4. to this Regulation. But the side-impact dummy shall be installed in the front seat on the impact side.

45-2.7.1 The performance criteria, as determined for the collision test shall meet the following conditions:

45-2.7.1.1 The head performance criterion (HPC) shall be less than or equal to 1,000; when there is no head contact, then the HPC shall not be measured or calculated but recorded as "No Head Contact."

45-2.7.1.2 The thorax performance criteria shall be:

45-2.7.1.2.1   Rib Deflection Criterion (RDC) less than or equal to 42 mm.

45-2.7.1.2.2   Soft Tissue Criterion (VC) less or equal to 1.0 m/sec.

45-2.7.1.3 The abdomen performance criterion shall be: Abdominal Peak Force (APF) less than or equal to 2.5 kN internal force.

45-2.7.1.4 The pelvis performance criterion shall be: Pubic Symphysis Peak Force (PSPF) less than or equal to 6 kN.

45-2.7.2 No door shall open during the test.

45-2.7.2.1 In the case of automatically activated door locking systems which are installed optionally and/or which can be de-activated by the driver, this requirement shall be verified by using one of the following two test procedures, at the choice of the manufacturer:

45-2.7.2.1.1   If testing in accordance with paragraph 45-2.4.4.2.1., the manufacturer shall in addition demonstrate to the satisfaction of the technical service (e.g. manufacturer's in-house data) that, in the absence of the system or when the system is de-activated, no door will open in case of the impact.

45-2.7.2.1.2   If testing in accordance with paragraph 45-2.4.4.2.2, the manufacturer shall in addition demonstrate that the inertial load requirements of "Door latches and retention components" of this direction are met for the unlocked side doors on the non-struck side.

45-2.7.3 After the impact, the side doors on the non-struck side shall be unlocked.

45-2.7.3.1 In the case of vehicles equipped with an automatically activated door locking system, the doors shall be locked before the moment of impact and be unlocked after the impact at least on the non-struck side.

45-2.7.3.2 In the case of automatically activated door locking systems which are installed optionally and/or which can be de-activated by

the driver, this requirement shall be verified by using one of the following two test procedures, at the choice of the manufacturer:

45-2.7.3.2.1   If testing in accordance with paragraph 45-2.4.4.2.1., the manufacturer shall in addition demonstrate to the satisfaction of the technical service (e.g. manufacturer's in-house data) that, in the absence of the system or when the system is de-activated, the side doors on the non-struck side are unlocked after the impact.

45-2.7.3.2.2   If testing in accordance with paragraph 45-2.4.4.2.2., the manufacturer shall in addition demonstrate that when applying the inertial load of "Door latches and retention components" of this direction, the unlocked side doors on the non-struck side remain unlocked.

45-2.7.4   After the impact

45-2.7.4.1 it shall be possible without the use of tools to:

45-2.7.4.1.1   open a sufficient number of doors provided for normal entry and exit of passengers, and if necessary tilt the seat-backs or seats to allow evacuation of all occupants;

45-2.7.4.1.2   release the dummy from the protective system.

45-2.7.4.1.3   remove the dummy from the vehicle

45-2.7.4.2 No interior device or component shall become detached in such a way as noticeably to increase the risk of injury from sharp projections or jagged edges.

45-2.7.4.3 Ruptures, resulting from permanent deformation are acceptable, provided these do not increase the risk of injury;

45-2.7.4.4 If there is continuous leakage of liquid from the fuel-feed installation after the collision, the rate of leakage shall not exceed 30 g/min; if the liquid from the fuel-feed system mixes with liquids from the other systems and the various liquids cannot easily be separated and identified, all the liquids collected shall be taken into account in evaluating the continuous leakage.

45-2.7.5 The electrical power train operating on high voltage, and the high voltage components and systems, which are galvanically

connected to the high voltage bus of the electric power train, shall meet the following requirements:

45-2.7.5.1 Protection against electrical shock

After the impact at least one of the four criteria specified in paragraph 45-2.7.5.1.1. through paragraph 45-2.7.5.1.4.2. shall be met.

If the vehicle has an automatic disconnect function, or device(s) that galvanically 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 45-2.7.5.1.4. 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 degree IPXXB.

If 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 paragraph 45-2.7.5.1.3. or 45-2.7.5.1.4. for the relevant part(s).

For the coupling system for charging the REESS, which is not energized during driving conditions, at least one of the four criteria specified in paragraphs 45-2.7.5.1.1. to 45-2.7.5.1.4. shall be met.

45-2.7.5.1.1   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 as specified in paragraph 45-2.8.2.

45-2.7.5.1.2   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 45-2.8.3. 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 (Cx) specified by the manufacturer according to formula (b) of paragraph 45-2.8.3.

The energy stored in the Y-capacitors (TEy1, TEy2) 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 according to formula (c) of paragraph 45-2.8.3.

45-2.7.5.1.3　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 the electrical chassis shall be lower than 0.1 ohm when there is current flow of at least 0.2 ampere.

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

45-2.7.5.1.4　Isolation resistance

The criteria specified in the paragraphs 45-2.7.5.1.4.1. and 45-2.7.5.1.4.2. below shall be met.

The measurement shall be conducted in accordance with paragraph 45-2.8.5.

45-2.7.5.1.4.1 Electrical power train consisting of separate DC- or AC-buses.

If the AC high voltage buses and the DC high voltage buses are galvanically isolated from each other, isolation resistance between the high voltage bus and the electrical chassis (Ri, as defined in paragraph 45-2.8.5.) shall have a minimum value of 100 omega /V of the working voltage for DC buses, and a minimum value of 500 omega /V of the working voltage for AC buses.

45-2.7.5.1.4.2 Electrical power train consisting of combined DC- and AC-buses

If the AC high voltage buses and the DC high voltage buses are galvanically connected isolation resistance between the high voltage bus and the electrical chassis (Ri, as defined in paragraph 45-2.8.5) shall have a minimum value of 500 omega /V of the working voltage.

However, if the protection IPXXB is satisfied for all AC high voltage buses or the AC voltage is equal or less than 30 V after the vehicle impact, the isolation resistance between the high voltage bus and the electrical chassis (Ri, as defined in paragraph

45-2.8.5) shall have a minimum value of 100 omega /V of the working voltage.

45-2.7.5.2 Electrolyte spillage

In the period from the impact until 30 minutes after no electrolyte from the REESS 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 litters shall spill outside the passenger compartment.

The manufacturer shall demonstrate compliance in accordance with paragraph 45-2.8.6.

45-2.7.5.3 REESS retention

REESS located inside the passenger compartment shall remain in the location in which they are installed and REESS components shall remain inside REESS boundaries. No part of any REESS 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 45-2.8.7.

45-2.8   Test Procedures for the protection of the occupants of vehicles operating on electrical power high voltage and electrolyte spillage

This annex describes test procedures to demonstrate compliance to the electrical safety requirements of paragraph 45-2.7.5. For example, megohmmeter or oscilloscope measurements are an appropriate alternative to the procedure described below for measuring isolation resistance. In this case it may be necessary to deactivate the on-board isolation resistance monitoring system.

Before the vehicle impact test conducted, the high voltage bus voltage (V_b) (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.

45-2.8.1   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 REESS or the energy conversion system and the high-voltage bus of the REESS 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 the electrical loads.
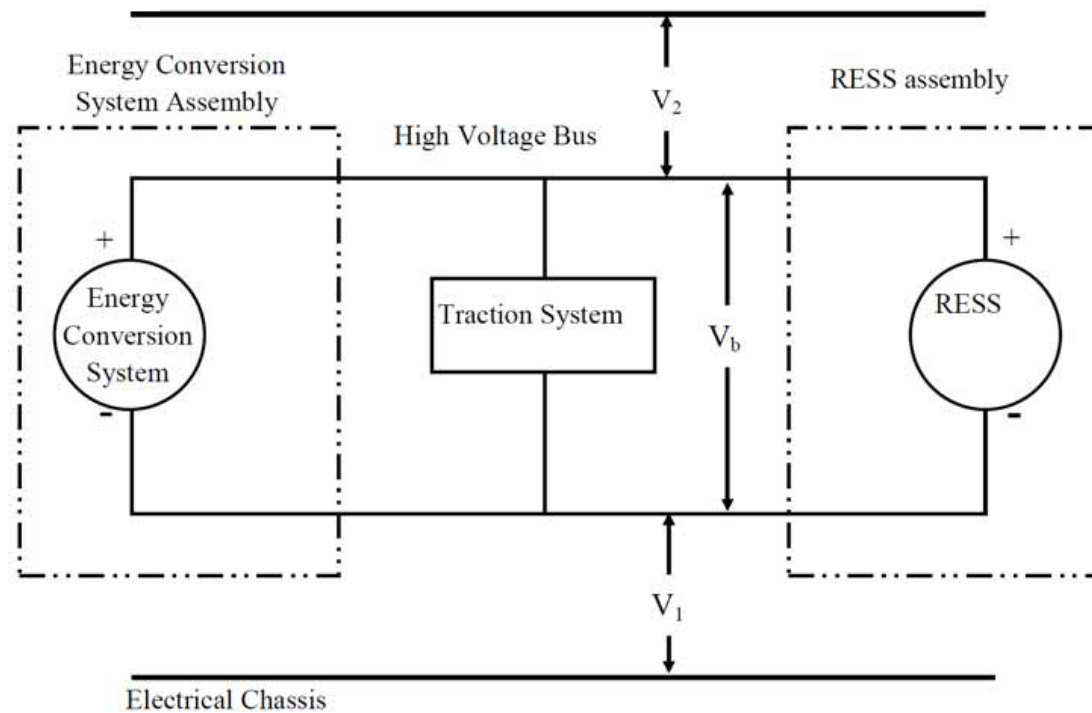
The voltmeter used in this test shall measure DC values and have an internal resistance of at least 10 mega ohms.

45-2.8.2　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.

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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Figure 1: Measurement of Vb, V1, V2

45-2.8.3   Assessment procedure for low electrical Energy

Prior to the impact a switch S1 and a known discharge resistor Re is connected in parallel to the relevant capacitance (see 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. 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 (tc) until the voltage Vb falls below the high voltage threshold of 60 V DC (th). The resulting integration equals the total energy (TE) in joules.

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

(a)

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 (Cx) is specified by the manufacturer, total energy (TE) shall be calculated according to the following formula:

(b) TE = 0.5 x Cx x(Vb² - 3600)

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 (Cy1, Cy2) are specified by the manufacturer, total energy (TEy1, TEy2) shall be calculated according to the following formulas:

(c) TEy^1 = 0.5 x Cy^1 x (V1² - 3600)

  TEy^2 = 0.5 x Cy^2 x (V2² - 3600)

This procedure is not applicable if the test is performed under the condition where the electric power train is not energized.
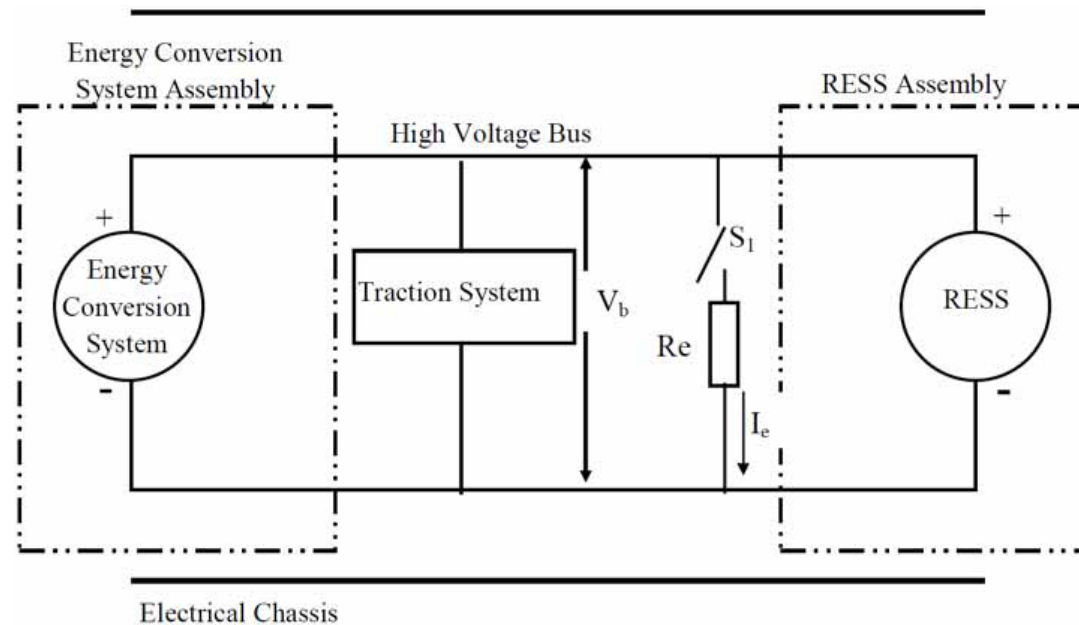
Figure 2: E.g. measurement of high voltage bus energy stored in X-capacitors

45-2.8.4   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 Figure 5 of this annex 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.

45-2.8.4.1 Acceptance conditions

The requirements of paragraph 45-2.7.5.1.3. shall be considered to be met if the Jointed Test Finger described in Figure 5 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.

45-2.8.5 Isolation resistance

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.

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

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);

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

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.

$R_i = R_o*(V_b/V_1' - V_b/V_1)$ or $R_i = R_o*V_b*(1/V_1' - 1/V_1)$

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

R_i (omega/V) = R_i (omega) / Working voltage (V)

Electrical Chassis

Energy Conversion System Assembly

RESS Assembly

High Voltage Bus

+

Energy Conversion System

Traction System

RESS

+

-

-

V_1'　R_0

Electrical Chassis

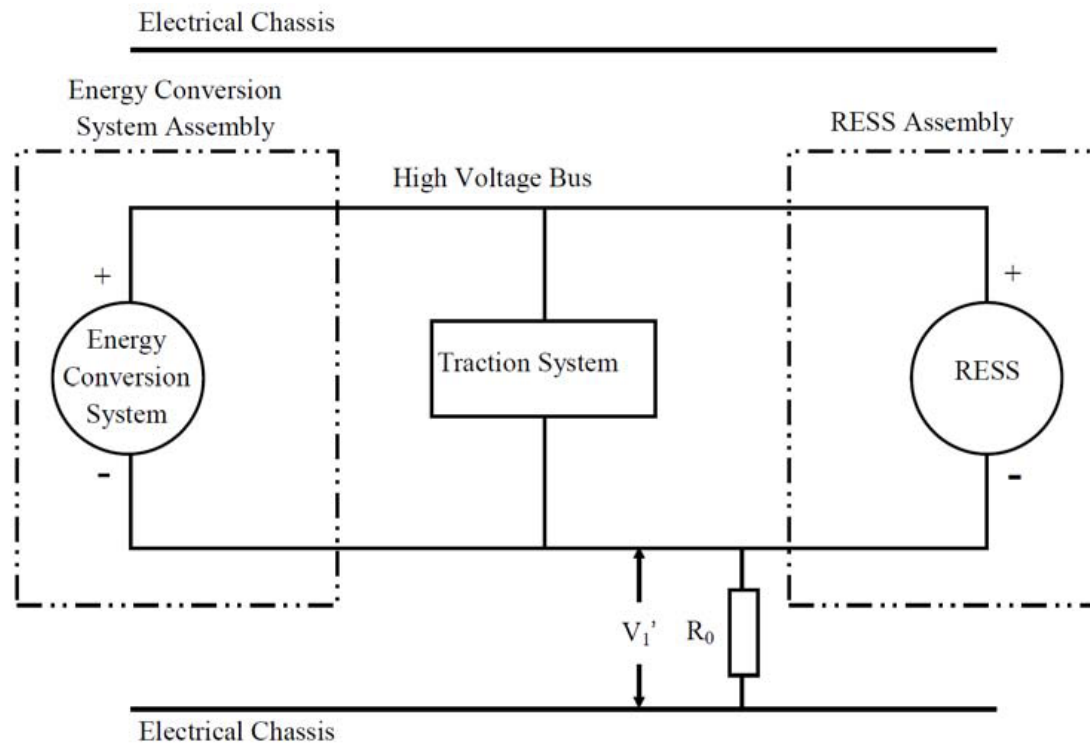45-2 The protection of the occupants in the event of a lateral collision

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.

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

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

Ri (omega/V) = Ri (omega) / Working voltage (V)

$Ri = Ro*(Vb/V2' - Vb/V2)$ or $Ri = Ro*Vb*(1/V2' - 1/V2)$
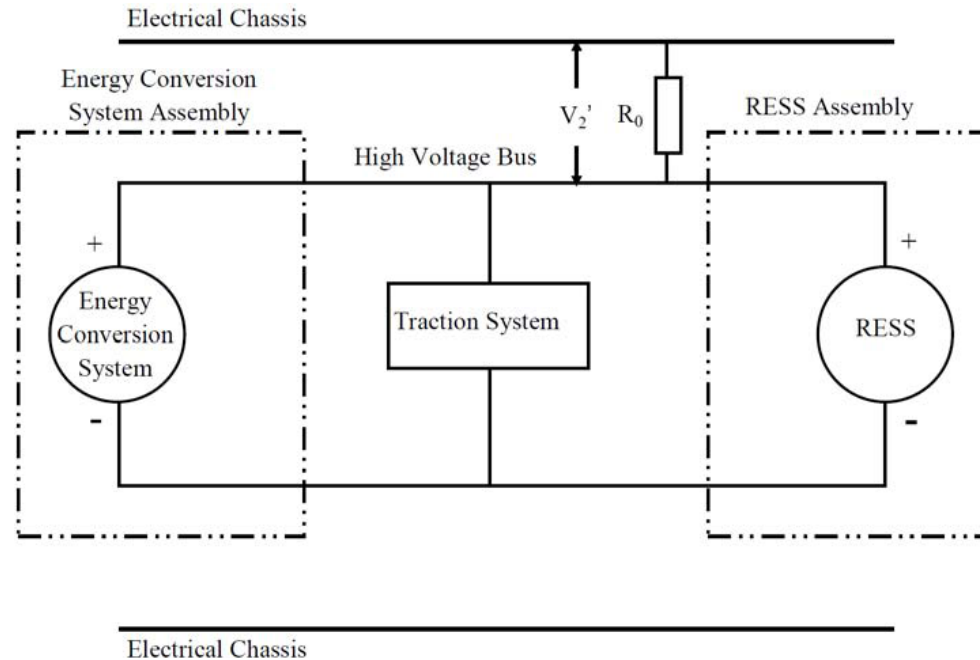
Figure 4: Measurement of V2'

Note 1: The standard known resistance R_0 (in omega) should be the value of the minimum required isolation resistance (in omega/V)

multiplied by the working voltage (in V) of the vehicle plus/minus 20 per cent. R_0 is not required to be precisely this value since the

equations are valid for any R_0; however, a R_0 value in this range should provide a good resolution for the voltage measurements.

45-2.8.6　Electrolyte spillage

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

45-2.8.7　REESS retention : Compliance shall be determined by visual inspection

The official directions are written in Chinese, this English edition is for your reference only.

Figure 5: Jointed test finger (degree IPXXB)

45-2 The protection of the occupants in the event of a lateral collision

Material: metal, except where otherwise specified

Linear dimensions in millimetres

Tolerances on dimensions without specific tolerance:

  (a) On angles: 0/- 10 degrees

  (b) On linear dimensions:

    (i) Up to 25 mm: 0/- 0.05 mm

    (ii) Over 25 mm: +/- 0.2 mm

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

45-2 The protection of the occupants in the event of a lateral collision