

the two thermocouples recording the highest temperatures over a 60 second interval:

$$\frac{1}{2} \left[\left(\frac{T_{\text{High 1}} + T_{\text{High 2}}}{2} \right)_{@ \text{ time 30 sec}} + \left(\frac{T_{\text{High 1}} + T_{\text{High 2}}}{2} \right)_{@ \text{ time 60 sec}} \right] \geq 430 \text{ } ^\circ\text{C}$$

If the pressure relief device releases before the end of the fifth minute after ignition, then the minimum temperature requirement does not apply.

S8.3.6 *Recording data.* Record time, temperature, and pressure readings at 30 second intervals, beginning when the fire is ignited and continuing until the pressure release device releases.

S8.3.7 *Duration of exposure to fire source.* The CNG fuel container is exposed to the fire source for 20 minutes after ignition or until the pressure release device releases, whichever period is shorter.

S8.3.8 *Number of tests per container.* A single CNG fuel container is not subjected to more than one bonfire test.

S8.3.9 *Wind velocity.* The average ambient wind velocity at the CNG fuel container during the period specified in S8.3.6 of this standard is not to exceed 2.24 meters/second (5 mph).

S8.3.10 The average wind velocity at the container is any velocity up to and including 2.24 meters/second (5 mph).

[59 FR 49021, Sept. 26, 1994; 59 FR 66776, Dec. 28, 1994; 60 FR 37843, July 24, 1995; 60 FR 57948, Nov. 24, 1995; 61 FR 19204, May 1, 1996; 61 FR 47089, Sept. 6, 1996; 63 FR 66765, Dec. 3, 1998; 65 FR 51772, Aug. 25, 2000; 65 FR 64626, Oct. 30, 2000]

§ 571.305 Standard No. 305; Electric-powered vehicles: electrolyte spillage and electrical shock protection.

S1. *Scope.* This standard specifies requirements for limitation of electrolyte spillage, retention of propulsion batteries during a crash, and electrical isolation of the chassis from the high-voltage system, to be met by vehicles that use electricity as propulsion power .

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries during a crash which occur because of electrolyte spillage from propulsion

batteries, intrusion of propulsion battery system components into the occupant compartment, and electrical shock.

S3 *Application.* This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks and buses with a GVWR of 4536 kg or less, that use more than 48 nominal volts of electricity as propulsion power and whose speed attainable in 1.6 km on a paved level surface is more than 40 km/h.

S4. *Definition.*

Battery system component means any part of a battery module, interconnect, venting system, battery restraint device, and battery box or container which holds the individual battery modules.

Dummy means a 50th percentile male test dummy as specified in subpart F of part 572 of this chapter.

S5. *General requirements.* Each vehicle to which this standard applies, when tested according to S6 under the conditions of S7, must meet the requirements of S5.1, S5.2, and S5.3.

S5.1 *Electrolyte spillage from propulsion batteries.* Not more than 5.0 liters of electrolyte from propulsion batteries shall spill outside the passenger compartment, and no visible trace of electrolyte shall spill into the passenger compartment. Spillage is measured from the time the vehicle ceases motion after a barrier impact test until 30 minutes thereafter, and throughout any static rollover after a barrier impact test.

S5.2 *Battery Retention.* Battery modules located inside the passenger compartment must remain in the location in which they are installed. No part of any battery system component that is located outside the passenger compartment shall enter the passenger compartment during the test procedures of

S6 of this standard, as determined by visual inspection.

S5.3 *Electrical isolation*. Electrical isolation between the battery system and the vehicle electricity-conducting structure after each test must be not less than 500 ohms/volt.

S6. *Test requirements*. Each vehicle to which this standard applies, under the conditions of S7, must be capable of meeting the requirements of any applicable single barrier crash/static rollover test sequence, without alteration of the vehicle during the test sequence. A particular vehicle need not meet further test requirements after having been subjected to a single barrier crash/static rollover test sequence.

S6.1 *Frontal barrier crash*. The vehicle must meet the requirements of S5.1, S5.2 and S5.3 when it is traveling longitudinally forward at any speed, up to and including 48 km/h, and impacts a fixed collision barrier that is perpendicular to the line of travel of the vehicle, or at any angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle.

S6.2 *Rear moving barrier impact*. The vehicle must meet the requirements of S5.1, S5.2, and S5.3, when:

(a) it is impacted from the rear by a barrier moving at any speed up to and including 48 km/h, with a dummy at each front outboard designated seating position, or

(b) at the manufacturer's option (with said option irrevocably selected prior to, or at the time of, certification of the vehicle), it is impacted at 80 ± 1.0 km/h with 50th percentile test dummies as specified in part 572 of this chapter at each front outboard designated seating position under the conditions specified in S7.3(b) of FMVSS No. 301 and S7 of this section as applicable.

S6.3 *Side moving deformable barrier impact*. The vehicle must meet the requirements of S5.1, S5.2 and S5.3 when it is impacted from the side by a barrier that conforms to part 587 of this chapter that is moving at any speed up to and including 54 km/h, with the appropriate 49 CFR part 572 test dummies specified in 571.214 of this chapter.

S6.4 *Post-impact test static rollover*. The vehicle must meet the requirements of S5.1, S5.2, and S5.3, after

being rotated on its longitudinal axis to each successive increment of 90 degrees after each impact test specified in S6.1, S6.2, and S6.3.

S7. *Test conditions*. When the vehicle is tested according to S6, the requirements of S5 must be met under the conditions in S7.1 through S7.6.7. Where a range is specified, the vehicle must be capable of meeting the requirements at all points within the range.

S7.1 *Battery state of charge*. The battery system is at the level specified in the following paragraph (a), (b), or (c), as appropriate:

(a) At the maximum state of charge recommended by the manufacturer, as stated in the vehicle operator's manual or on a label that is permanently affixed to the vehicle;

(b) If the manufacturer has made no recommendation, at a state of charge of not less than 95 percent of the maximum capacity of the battery system; or

(c) If the batteries are rechargeable only by an energy source on the vehicle, at any state of charge within the normal operating voltage, as defined by the vehicle manufacturer.

S7.2 *Vehicle conditions*. The switch or device that provides power from the propulsion batteries to the propulsion motor(s) is in the activated position or the ready-to-drive position.

S7.2.1 The parking brake is disengaged and the transmission, if any, is in the neutral position. In a test conducted under S6.3, the parking brake is set.

S7.2.2 Tires are inflated to the manufacturer's specifications.

S7.2.3 The vehicle, including test devices and instrumentation, is loaded as follows:

(a) A passenger car is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus the necessary test dummies as specified in S6, restrained only by means that are installed in the vehicle for protection at its seating position.

(b) A multipurpose passenger vehicle, truck, or bus with a GVWR of 4536 kg or less is loaded to its unloaded vehicle weight plus the necessary dummies, as specified in S6, plus 136 kg or its rated

cargo and luggage capacity weight, whichever is less. Each dummy is restrained only by means that are installed in the vehicle for protection at its seating position.

S7.3 Static rollover test conditions. In addition to the conditions of S7.1 and S7.2, the conditions of S7.4 of Sec. 571.301 of this chapter apply to the conduct of static rollover tests specified in S6.4.

S7.4 Rear moving barrier impact test conditions. In addition to the conditions of S7.1 and S7.2, the rear moving barrier test conditions for S6.2(a) are those specified in S8.2 of Standard No. 208 (49 CFR 571.208), except for the positioning of the barrier and the vehicle. The rear moving barrier is described in S8.2 of Standard No. 208 of this chapter. The barrier and test vehicle are positioned so that at impact—

- (a) The vehicle is at rest in its normal attitude;
- (b) The barrier is traveling at 48 km/h with its face perpendicular to the longitudinal centerline of the vehicle; and
- (c) A vertical plane through the geometric center of the barrier impact surface and perpendicular to that surface coincides with the longitudinal centerline of the vehicle.

S7.5 Side moving deformable barrier impact test conditions. In addition to the conditions of S7.1 and S7.2, the conditions of S8.9, S8.10, and S8.11 of 571.214 of this chapter apply to the conduct of the side moving deformable barrier impact test specified in S6.3.

S7.6 Electrical isolation test procedure. In addition to the conditions of S7.1 and S7.2, the conditions in S7.6.1 through S7.6.7 apply to the measurement of electrical isolation specified in S5.3.

S7.6.1 Prior to any barrier impact test, the propulsion battery system is connected to the vehicle's propulsion system, and the vehicle ignition is in the "on" (traction (propulsion) system energized) position. If the vehicle utilizes an automatic disconnect between the propulsion battery system and the traction system that is physically contained within the battery pack system, the electrical isolation measurement after the impact is made from the trac-

tion side of the automatic disconnect to the vehicle chassis. If the vehicle utilizes an automatic disconnect that is not physically contained within the battery pack system, the electrical isolation measurement after the impact is made from the battery side of the automatic disconnect to the vehicle chassis.

S7.6.2 The voltmeter used in this test measures direct current values and has an internal resistance of at least 10 MΩ

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

S7.6.4 The voltage is measured as shown in Figure 2, and the voltage (V1) between the negative side of the propulsion battery and the vehicle chassis is recorded.

S7.6.5 The voltage is measured as shown in Figure 3, and the voltage (V2) between the positive side of the propulsion battery and the vehicle chassis is recorded.

S7.6.6 If V1 is greater than or equal to V2, insert a known resistance (Ro) between the negative side of the propulsion battery and the vehicle chassis. With the Ro installed, measure the voltage (V1') as shown in Figure 4 between the negative side of the propulsion battery and the vehicle chassis. Calculate the electrical isolation (Ri) according to the formula shown. This electrical isolation value (in ohms) divided by the nominal operating voltage of the propulsion battery (in volts) must be equal to or greater than 500.

S7.6.7 If V2 is greater than V1, insert a known resistance (Ro) between the positive side of the propulsion battery and the vehicle chassis. With the Ro installed, measure the voltage and record the voltage (V2') between the positive side of the propulsion battery and the vehicle chassis as shown in Figure 5. Calculate the electrical isolation (Ri) according to the formula shown. This electrical isolation value (in ohms) divided by the nominal operating voltage of the propulsion battery (in volts) must be equal to or greater than 500.

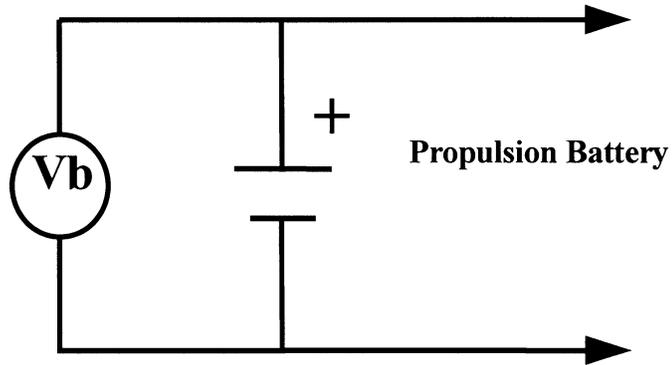


Figure 1. S7.6.3 Measurement Location For Vb Voltage

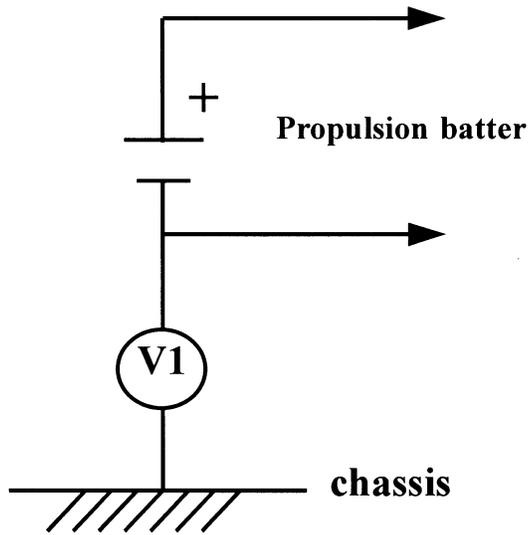


Figure 2. S7.6.4 Measurement Location For V1 Voltage

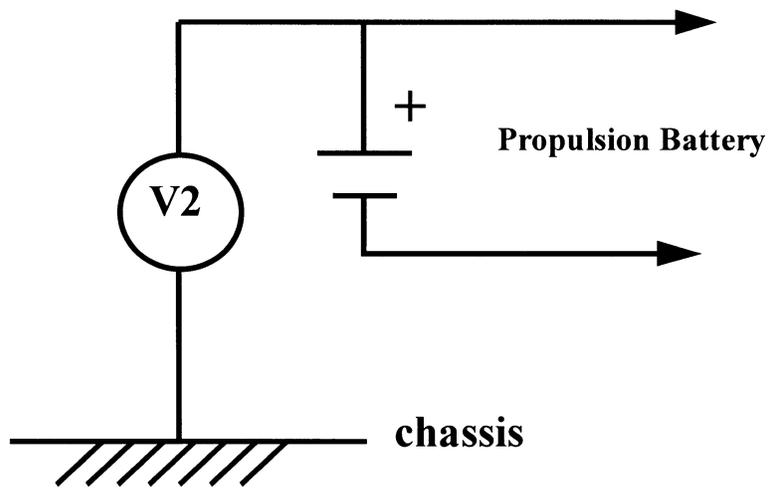


Figure 3. S7.6.5 Measurement Location For V2 Voltage

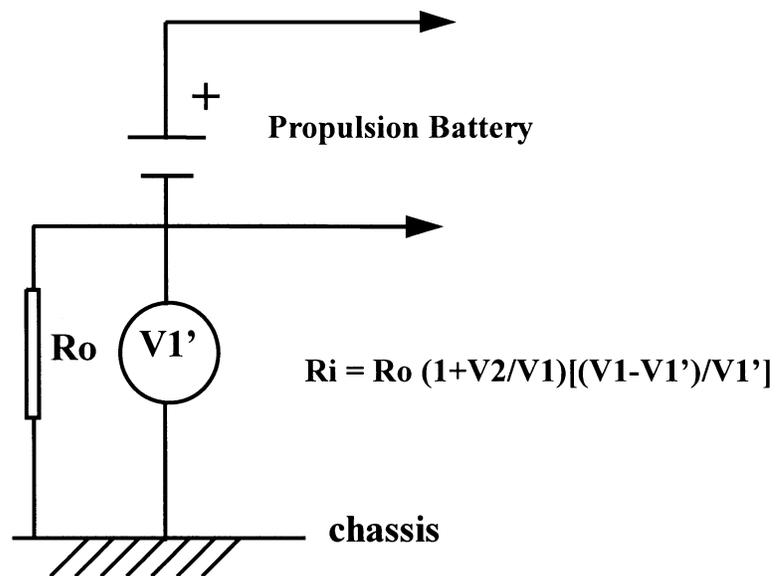


Figure 4. S7.6.6 Measurement Location For V1' Voltage

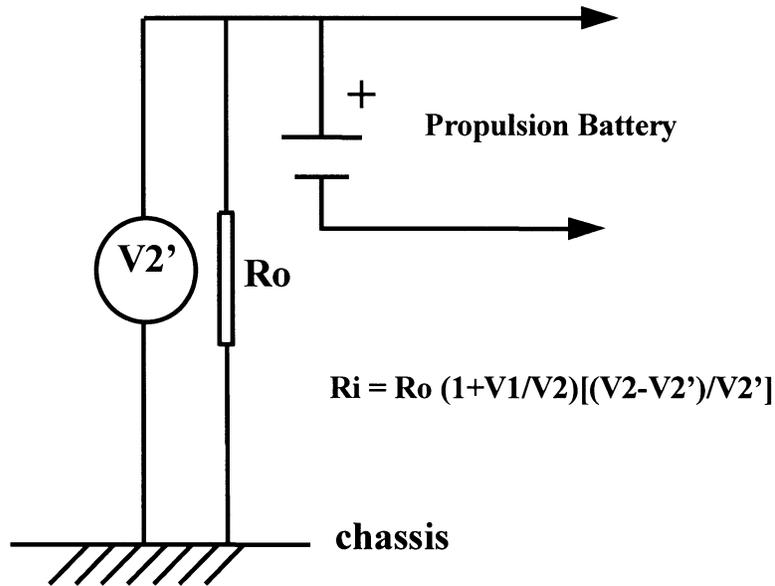


Figure 5. S7.6.7 Measurement Location For V_2' Voltage

[65 FR 57988, Sept. 27, 2000, as amended at 66 FR 60160, Dec. 3, 2001; 69 FR 51399, Aug. 19, 2004; 72 FR 51972, Sept. 11, 2007; 75 FR 12141, Mar. 15, 2010]

EFFECTIVE DATE NOTE: At 75 FR 33527, June 14, 2010, §571.305 was amended by revising S1, S2, S3, S4, S5, S5.2, S5.3, S6.2, S7, S7.1, S7.2, S7.4, S7.6, S7.6.1, S7.6.2, S7.6.3, S7.6.4, S7.6.5, S7.6.6, S7.6.7, and Figures 1, through Figure 5, and adding S5.4, S7.7, and S8, effective September 1, 2011. For the convenience of the user, the added and revised text is set forth as follows:

§ 571.305 Standard No. 305; Electric-powered vehicles; Electrolyte spillage and electrical shock protection.

S1. *Scope.* This standard specifies requirements for limitation of electrolyte spillage, retention of electric energy storage devices, and protection from harmful electric shock during and after a crash.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries during and after a crash that occur because of electrolyte spillage from electric energy storage devices, intrusion of electric energy storage device components into the occupant compartment, and electrical shock.

S3. *Application.* This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks, and buses that have a GVWR of 4,536 kg or less, that use electrical components with working voltages more than 60 volts direct current (VDC) or 30 volts alternating current (VAC), and whose speed attainable over a distance of 1.6 km on a paved level surface is more than 40 km/h.

S4. *Definitions.*

Electrical isolation means the electrical resistance between the vehicle high voltage source and any vehicle conductive structure.

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.

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

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

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.

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).

S5. *General Requirements.* Each vehicle to which this standard applies, must meet the requirements in S5.1, S5.2, and S5.3 when tested according to S6 under the conditions of S7.

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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.

S5.3 *Electrical safety.* After each test, each high voltage source in a vehicle must meet the electrical isolation requirements of subparagraph (a) or the voltage level requirements of subparagraph (b).

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

(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.

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

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.

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S6.2 *Rear moving barrier impact.* The vehicle must meet the requirements of S5.1, S5.2, and S5.3 when it is impacted from the rear by a barrier that conforms to S7.3(b) of 571.301 of this chapter and that is moving at any speed up to and including 80 km/h (50 mph) with dummies in accordance with S6.2 of 571.301 of this chapter.

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S7. *Test conditions.* When the vehicle is tested according to S6, the requirements of S5.1 through S5.3 must be met under the conditions specified in S7.1 through S7.7. 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. Where a range is specified, the vehicle must be capable of meeting the requirements at all points within the range.

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

(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.

S7.2 *Vehicle conditions.* 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.

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S7.4 *Rear moving barrier impact test conditions.* In addition to the conditions of S7.1 and S7.2, the conditions of S7.3(b) and S7.6 of 571.301 of this chapter apply to the conducting of the rear moving deformable barrier impact test specified in S6.2.

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S7.6 *Electrical isolation test procedure.* In addition to the conditions of S7.1 and S7.2, the conditions in S7.6.1 through S7.6.7 apply to the measuring of electrical isolation specified in S5.3(a).

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 of the automatic disconnect to the vehicle chassis electricity-conducting structure.

S7.6.2 The voltmeter used in this test has an internal resistance of at least 10 MΩ.

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.

S7.6.4 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.

S7.6.5 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.

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).

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).

S7.7 *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.

S8 Test procedure for on-board electrical isolation continuous monitoring system. Prior to any impact test, the requirements of S5.4 for the on-board 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 $R_o = 1/(1/95 \text{ times the working voltage of the high voltage source}) - 1/R_i$ 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.

§ 571.401 Standard No. 401; Interior trunk release.

S1. *Purpose and scope.* This standard establishes the requirement for providing a trunk release mechanism that makes it possible for a person trapped inside the trunk compartment of a passenger car to escape from the compartment.

S2. *Application.* This standard applies to passenger cars that have a trunk