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U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

LABORATORY TEST PROCEDURE

FOR

FMVSS 305, ELECTRIC POWERED VEHICLES: ELECTROLYTE SPILLAGE AND ELECTRICAL SHOCK PROTECTION

ENFORCEMENT
Office of Vehicle Safety Compliance
Mail Code: NEF-220
1200 New Jersey Avenue, SE
Washington, DC 20590

REVISION CONTROL LOG
FOR OVSC LABORATORY
TEST PROCEDURES

TP-305
ELECTRIC POWERED VEHICLES: ELECTROLYTE SPILLAGE AND ELECTRICAL SHOCK PROTECTION

TEST PROCEDURE		FMVSS 305		DESCRIPTION
REV. No.	DATE	AMENDMENT	EFFECTIVE DATE	
00	12/29/2005	65 FR 57988 66 FR 60160 69 FR 51399	12/01/2001	Final Rule and Amendments
01	09/11/2008			Added note for a zero-voltage condition when calculating electrical isolation
02	05/24/2022	82 FR 44945	08/23/2019	Added pre-crash test procedures, post-crash test options, and other items as amended.
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1. PURPOSE AND APPLICATION

This document is a laboratory test procedure provided by the National Highway Traffic Safety Administration (NHTSA), Office of Vehicle Safety Compliance (OVSC) for the purpose of presenting guidelines for a uniform testing data and information recording format, and providing suggestions for the use of specific equipment and procedures for contracted testing laboratories. The data correspond to specific requirements of the Federal Motor Vehicle Safety Standard(s) (FMVSS). The OVSC test procedures include requirements that are general in scope to provide flexibility for contracted laboratories to perform compliance testing and are not intended to limit or restrain a contractor from developing or utilizing any testing techniques or equipment which will assist in procuring the required compliance test data.

These test procedures do not constitute an endorsement or recommendation for use of any particular product or testing method.

Prior to conducting compliance testing, contracted laboratories are required to submit a detailed test procedure to the Contracting Officer's Representative (COR)COR to demonstrate concurrence with the OVSC laboratory test procedure and the applicable FMVSS. If any contractor views any part of an OVSC laboratory test procedure to be in conflict with a FMVSS or observes deficiencies in a laboratory test procedure, the contractor is required to advise the COR and resolve the discrepancy prior to the start of compliance testing or as soon as practicable. The contractor's test procedure must include a step-by-step description of the methodology and detailed check-off sheets. Detailed check-off sheets shall also be provided for the testing instrumentation including a complete listing of the test equipment with make and model numbers. The list of test equipment shall include instrument accuracy and calibration dates. All equipment shall be calibrated in accordance with the manufacturer's instructions. There shall be no contradictions between the laboratory test procedure and the contractor's in-house test procedure. Written approval of the in-house test procedures shall be obtained from the COR before initiating the compliance test program.

NOTE: The OVSC Laboratory Test Procedures, prepared for the limited purpose of use by independent laboratories under contract to conduct compliance tests for the OVSC, are not rules, regulations or NHTSA interpretations regarding the meaning of a FMVSS. The laboratory test procedures are not intended to limit the requirements of the applicable FMVSS(s). In some cases, the OVSC laboratory test procedures do not include all of the various FMVSS minimum performance requirements. Recognizing applicable test tolerances, the laboratory test procedures may specify test conditions that are less severe than the minimum requirements of the standard. In addition, the laboratory test procedures may be modified by the OVSC at any time without notice, and the COR may direct or authorize contractors to deviate from these procedures, as long as the tests are performed in a manner consistent with the standard itself and within the scope of the contract. Laboratory test procedures may not be relied upon to create any right or benefit in any person. Therefore, compliance of a vehicle or item of motor vehicle equipment is not necessarily guaranteed if the manufacturer limits its certification tests to those described in the OVSC laboratory test procedures.

2. GENERAL REQUIREMENTS

FMVSS No. 305 specifies performance requirements for limitation of electrolyte spillage, retention of propulsion batteries, and electrical isolation of the chassis from the high-voltage system during the crash event. This standard applies to vehicles that use electricity as propulsion power.

APPLICABILITY
The standard is applicable to passenger cars, multipurpose passenger vehicles, trucks and buses with a gross vehicle weight rating (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.

STANDARD REQUIREMENTS
When tested to the procedures contained herein, each vehicle to which the standard applies shall not:

- Spill more than 5.0 liters of propulsion battery electrolyte 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 crash test impact test until 30 minutes thereafter, and throughout any static rollover after a crash test impact test.
- Have any propulsion battery system component located inside the passenger compartment move from the location in which they are installed
- Have any propulsion battery system component located outside the passenger compartment enter the passenger compartment
- Fail to maintain an electrical isolation of no less than 500 ohms/volt between the propulsion battery system and the vehicle's electricity-conducting structure

APPLICABLE CRASH TESTS
Vehicles will be tested to the requirements of FMVSS 305 and perform applicable crash tests. The governing crash tests are utilized when testing to other dynamic standards. The vehicle must be able to meet the requirements of any of the governing crash tests. Also, the test facility must be adequate to conduct the governing crash tests prescribed in dynamic testing. The facility must meet the minimum requirements regarding weighing capability, speed measurement systems, test surface, tow-road, abort system, barriers, and all other requirements.

NOTE: The methodology for rounding measurement in the test reports shall be made in accordance with ASTM E29-06b, "Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications."

3. SECURITY

The contractor shall provide appropriate security measures to protect the OVSC test vehicles and Government Furnished Property (GFP) from unauthorized personnel during the entire compliance testing program. The contractor is financially responsible for any acts of theft and/or vandalism which occur during the storage of test vehicles and GFP. Any security problems which arise shall be reported by telephone to the Property Management team within the Office of Administrative and Management Services, within two working days after the incident. A letter containing specific details of the security problem shall be sent to the IPM (with copy to the COR) within 48 hours.

The contractor shall protect and segregate the data that evolves from compliance testing before and after each vehicle test. No information concerning the vehicle safety compliance testing program shall be released to anyone except the COR, unless specifically authorized by the COR or the COR's Division Chief.

NOTE: No individuals, other than contractor personnel directly involved in the compliance testing program or OVSC personnel, shall be allowed to witness any vehicle or equipment item compliance test or test dummy calibration unless specifically authorized by the COR.

4. GOOD HOUSEKEEPING

Contractors shall maintain the entire vehicle compliance testing area, fixtures, and instrumentation in a neat, clean and painted condition with test instruments arranged in an orderly manner consistent with good test laboratory housekeeping practices.

5. TEST SCHEDULING AND MONITORING

The contractor shall submit a test schedule to the COR prior to conducting the first compliance test. Tests shall be completed at intervals as required in the contract. If not specified, the first test shall be conducted within 6 weeks after receiving the first delivered unit. Subsequent tests shall be completed in no longer that 1-week intervals unless otherwise specified by the COR.

Scheduling of tests shall be adjusted to permit vehicles (or equipment, whichever applies) to be tested to other FMVSSs as may be required by the OVSC. All compliance testing shall be coordinated with the COR in order to allow monitoring by the COR and/or other OVSC personnel if desired. The contractor shall submit a monthly test status report and a vehicle status report (if applicable) to the COR. The vehicle status report shall be submitted until all vehicles are disposed of. The status report forms are provided in the forms section.

6. TEST DATA DISPOSITION

The Contractor shall make all preliminary compliance test data available to the COR on location within 30 minutes after the test (or within four hours for equipment testing). Final test data, including digital printouts and computer-generated plots (if applicable), shall be available to the COR in accordance with the contract schedule or if not specified within two working days. Additionally, the Contractor shall analyze the preliminary test results as directed by the COR.

All backup data sheets, strip charts, recordings, plots, technicians' notes, etc., shall be either sent to the COR or destroyed at the conclusion of each delivery order, purchase order, etc.

The contractor shall protect and segregate the data that evolves from compliance testing before and after each test.

TEST DATA LOSS

A. INVALID TEST DESCRIPTION

An invalid compliance test is one, which does not conform precisely to all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test.

B. INVALID TEST NOTIFICATION

The Contractor shall notify NHTSA of any test not meeting all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test, by telephone, within 24 hours of the test and send written notice to the COR within 48 hours or the test completion.

C. RETEST NOTIFICATION

The Contracting Officer (CO) of NHTSA is the only NHTSA official authorized to notify the Contractor that a retest is required. The retest shall be completed within 2 weeks after receipt of notification by the Contracting Officer that a retest is required.

D. WAIVER OF RETEST

NHTSA, in its sole discretion, reserves the right to waive the retest requirement. This provision shall not constitute a basis for dispute over the NHTSA's waiving or not waiving any requirement.

E. TEST VEHICLE (ONLY IF APPLICABLE)

NHTSA shall furnish only one vehicle for each test ordered. The Contractor shall furnish the test vehicle required for the retest. The retest vehicle shall be equipped as the original vehicle. The original vehicle used in the invalid test shall remain the property of NHTSA, and the retest vehicle shall remain the property of the Contractor. The Contractor shall retain the retest vehicle for a period not exceeding 180 days if it fails the test. If the retest vehicle passes the test, the Contractor may dispose of it upon notification from the COR that the test report has been accepted.

F. TEST REPORT

No test report is required for any test that is determined to be invalid unless NHTSA specifically decides, in writing, to require the Contractor to submit such report. The test data from the invalid test must be safeguarded until the data from the retest has been accepted by the COR. The report and other required deliverables for the retest vehicle are required to be submitted to the COR within 3 weeks after completion of the retest.

G. DEFAULT

The Contractor is subject to the default and subsequent reprocurement costs for nondelivery of valid or conforming test (pursuant to the Termination For Default clause in the contract).

H. NHTSA'S RIGHTS

None of the requirements herein stated shall diminish or modify the rights of NHTSA to determine that any test submitted by the Contractor does not conform precisely to all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test.

GFP consist of test vehicles, test equipment and instrumentation. The GFP is authorized by contractual agreement. The contractor is responsible for the following.

A. ACCEPTANCE OF TEST VEHICLES

The Contractor has the responsibility of accepting each GFP test vehicle whether delivered by a new vehicle dealership or another vehicle transporter. In both instances, the contractor acts on behalf of the OVSC when signing an acceptance of the GFP test vehicle delivery order. When a GFP vehicle is delivered, the Contractor must verify:

1. All options listed on the "window sticker" are present on the test vehicle.

2. Tires and wheel rims are new and the same as listed.

3. There are no dents or other interior or exterior flaws in the vehicle body.

4. The vehicle has been properly prepared and is in running condition.

5. The glove box contains an owner's manual, warranty document, consumer information, and extra set of keys.

6. Proper fuel filler cap is supplied on the test vehicle.

7. Spare tire, jack, lug wrench and tool kit (if applicable) is located in the vehicle cargo area.

8. The VIN (vehicle identification number) on the vehicle condition report matches the VIN on the vehicle.

9. The vehicle is equipped as specified by the COR.

A Vehicle Condition form will be supplied to the Contractor by the COR when the test vehicle is transferred from a new vehicle dealership or between test contracts. The upper half of the form is used to describe the vehicle as initially accepted. The lower half of the Vehicle Condition form provides space for a detailed description of the post-test condition. The contractor must complete a Vehicle Condition form for each vehicle and deliver it to the CORCOR with the Final Test Report or the report will NOT be accepted for payment.

If the test vehicle is delivered by a government contracted transporter, the Contractor should check for damage which may have occurred during transit. GFP vehicle(s) shall not be driven by the Contractor on public roadways unless authorized by the COR.

B. TEST EQUIPMENT AND INSTRUMENTATION

The Contractor has the responsibility of accepting GFP test equipment and instrumentation delivered to the Contractor. The Contractor acts on behalf of the OVSC when signing an acceptance of the GFP test equipment and instrumentation delivery order. When GFP test equipment and instrumentation is delivered, the Contractor must:

1. Verify all partial and sub-component quantities as per the packaging document

2. Verify physical condition of all equipment and instrumentation (inspect for damage)

3. Verify functional condition of all equipment and instrumentation

4. Store in a clean, organized, secure, and environmentally controlled area

C. NOTIFICATION OF COR

The COR must be notified within 24 hours after a vehicle (and/or equipment item) has been delivered. In addition, if any discrepancy or damage is found at the time of delivery, a copy of the Vehicle Condition form shall be sent to the COR immediately

7. CALIBRATION OF TEST INSTRUMENTS

Before the Contractor initiates the vehicle safety compliance test program, a test instrumentation calibration system must be implemented and maintained in accordance with established calibration practices. The calibration system shall include the following as a minimum:

A. Standards for calibrating the measuring and test equipment shall be stored and used under appropriate environmental conditions to assure their accuracy and stability.

B. All measuring instruments and standards shall be calibrated by the Contractor, or a commercial facility, against a higher order standard at periodic intervals not exceeding 12 months for instruments and 12 months for the calibration standards except for static types of measuring devices such as rulers, weights, etc., which shall be calibrated at periodic intervals not to exceed two years. Records, showing the calibration traceability to the National Institute of Standards and Technology (NIST), shall be maintained for all measuring and test equipment. Accelerometers shall be calibrated every twelve months or after a test failure or after any indication from calibration checks that there may be a problem with the accelerometer whichever occurs sooner.

C. All measuring and test equipment and measuring standards shall be labeled with the following information:

1. Date of calibration

2. Date of next scheduled calibration

3. Name of the technician who calibrated the equipment

D. A written calibration procedure shall be provided by the Contractor, which includes as a minimum the following information for all measurement and test equipment:

1. Type of equipment, manufacturer, model number, etc.
2. Measurement range
3. Accuracy
4. Calibration interval
5. Type of standard used to calibrate the equipment (calibration traceability of the standard must be evident).
6. The actual procedures and forms used to perform the calibrations

E. Records of calibration for all test instrumentation shall be kept by the Contractor in a manner that assures the maintenance of established calibration schedules

F. All such records shall be readily available for inspection when requested by the COR. The calibration system shall need the acceptance of the COR before vehicle safety compliance testing commences.

G. Test equipment shall receive a system functional check out using a known test input immediately before and after the test. This check shall be recorded by the test technician(s) and submitted with the final report.

H. The Contractor may be directed by NHTSA to evaluate its data acquisition system.

Further guidance is provided in the International Standard ISO 10012-1, "Quality Assurance Requirements for Measuring Equipment" and American National Standard ANSI/NCSL Z540-1, "Calibration Laboratories and Measuring and Test Equipment General Requirements."

NOTE: In the event of a failure to meet the standard's minimum performance requirements additional calibration checks of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration will be at the COR's discretion and shall be performed without additional cost.

8. SUGGESTED TEST EQUIPMENT

ELECTRICAL ISOLATION

MEASUREMENT Voltage Measurement

Device and Interface

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

Voltage measurements throughout this test must be made quickly and safely. To ensure these requirements are met, the testing lab must devise, for COR approval, a test interface port or other device to facilitate these voltage measurements. All voltage measurements shall be immediate upon connection to the interface port. This test interface port equipment shall be easily accessible from the exterior of the vehicle and connected to the appropriate propulsion system and battery components via laboratory installed wires. The external mounting of this test interface port shall be configured such that no movement, interference, or damage will result to it from a crash test. The test interface port shall incorporate a fusible link and any other necessary safety device or usage procedure to protect the data measurement and recording equipment from damage, and the test technicians from electrical shock.

A terminal block or circuit board is recommended as a means to providing an external interface.

The following is an example quoted from Transport Canada document, "Test Procedures, Frontal Impact 208-212-301F-305F, No. 03-002"

"This kit is composed of a PVC box compliant with the electrical code and containing insulated banana connectors that allow the measuring equipment to be connected for the verification of the standard. A warning light indicates the presence of voltage inside the box. A shielded cable with three conductors, 20 feet in length and capable of supporting 600 volts, connects the box to the vehicle's electrical system. This cable is covered with orange-coloured mechanical protection (similar to the Hybrid vehicle high-voltage identification code). The box is protected by a 0.5-amp fuse."

Electric shock protection during charging

For motor vehicles with an electric energy storage device that can be charged through a conductive connection with a grounded external electric power supply, a device to enable conductive connection of the electrical chassis to the earth ground shall be provided. This device shall enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is removed from the vehicle.

Test equipment to evaluate protection from direct contact with high voltage sources

A. Any parts surrounding the high voltage components are opened, disassembled, or removed without the use of tools.
B. Probes to insert into any gaps or openings: IPXXB probe or IPXXD probe
C. A low voltage supply (of not less than 40 V and not more than 50 V)
D. A mirror or fiberscope
E. Voltmeter
F. Ammeter
G. Resistance Tester (a resistance tester that can measure current levels of at least 0.2 Amperes with a resolution of 0.01 ohms or less

STATIC ROLLOVER AND ELECTROLYTE COLLECTION

Static Rollover Machine

The rollover machine must be capable of rotating, and holding in place, the crash test vehicle up to 5443 kg about its longitudinal axis with the axis kept horizontal, to each successive increment of 90^o, 180^o, and 270^o at a uniform rate, with 90^o of rotation taking place in any time interval from 1 to 3 minutes. Leakage will be collected for the 5-minute period from the beginning of rotation plus any additional 1-minute collection periods that are required. Voltage measurements shall be able to be made continuously throughout the rollover test.

STODDARD AND ELECTROLYTE COLLECTION CONTAINERS

Containers for the collection of Stoddard solvent and propulsion battery electrolyte and a stopwatch for timing the fluid collection intervals are required. Containers for each fluid collected must be labeled before they are photographed. For containers containing both Stoddard and electrolyte, the fluids shall be allowed to separate by specific gravity then measured and photographed.

OTHER INSTRUMENTATION

The Contractor shall provide the necessary equipment to permanently record and display data. The data shall be included in the final test report and on the electronic data media.

TEST DUMMIES

As required by the governing crash test procedure. No dummy instrumentation is necessary unless required by additional contract obligations.

10. PHOTOGRAPHIC DOCUMENTATION

DIGITAL PHOTOGRAPHS

The Contractor shall take digital photographs of the test execution procedures. Photographs shall be taken in color and contain clear images. A tag, label or placard identifying the test item, NHTSA number (if applicable) and date shall appear in each photograph and must be legible. Each photograph shall be labeled as to the subject matter. The required resolution for digital photographs is a minimum of 1,600 x 1,200 pixels. Digital photographs are required to be created in color and in a JPG format. Glare or light from any illuminated or reflective surface shall be minimized while taking photographs.

The test reports shall include enough photographs to describe the testing in detail and shall be organized in a logical succession of consecutive pictures. The digital photographs should be included in the test report as 203 mm x 254 mm or 215.9 mm x 279 mm (8 x 10 or 8½ x 11 inch) pictures (or for equipment testing -- 125 mm x 175 mm (5 x 7 inch) pictures). All photographs are required to be included in the test report in the event of a test failure. Any failure must be photographed at various angles to assure complete coverage. Upon request, the photographs should be sent to the COR on a CD or DVD and saved in a "read only" format to ensure that the digital photographs are the exact pictures taken during testing and have not been altered from the original condition.

PHOTOGRAPHIC VIEWS

As a minimum, the following test photographs shall be included in each vehicle final test report, submitted by the Contractor:

A. Propulsion battery module(s)
B. High voltage interconnect(s)
C. Propulsion battery venting system(s)
D. Battery box(s) or container(s) which holds the individual battery modules
E. Other visible electrical propulsion components.
F. Pretest view of the propulsion battery, if any part of it is visible. DO NOT disassemble any parts other than carpet, seats, and other interior pieces to take these photographs.

G. Pretest and post-test view of the electric propulsion drive. Take the best photographs possible without removing any parts. Use mirrors to view any hidden components where possible.
H. Pretest view of the installed Test Interface Port and other test devices.
I. Post-test propulsion battery electrolyte spillage location view when leakage occurs.
J. Post-test indication of battery module movement, or retention loss. Apply paint or other

highly visible finish, such as machinist blue, to all attachment fasteners or means (welds), pretest, to indicate component movement or retention loss.

K. Post-test battery component intrusion, when intrusion occurs. Disassembly and removal of parts may be necessary to take these photographs. DO NOT disassemble without OVSC representative present.
L. Post-test views of test vehicle while vehicle is on static rollover machine at 90°, 180°, 270°, and 360°, highlighting propulsion battery location.
M. Photographs of propulsion battery system mounting and/or intrusion failures.
N. Pretest and post-test of the vehicle passenger compartment to show any vehicle areas at which intrusion/spillage may occur.

O. Post-test view of the propulsion battery box(s) or container(s) that hold the individual battery modules. Disassembly and removal of parts may be necessary to take these photographs. DO NOT disassemble without OVSC representative present.
P. Photographs of all labels on the vehicle related to the electrical propulsion system.
Q. Other photographs requested by COR.

CAMERA COVERAGE

<u>High-speed photographic coverage:</u>

All High-speed photographic coverage required by the governing crash test procedure shall be included in this test.

<u>Real-time photographic coverage:</u>

The Contractor shall use a "real time" color digital and/or color motion picture camera with at least 24 frames per second (fps) to record the condition of the passenger compartment interior area of the vehicle, and locations of propulsion battery components, pre- and post-test. All real-time photographic coverage required by the governing crash test procedure shall be included in the final film submission.

A real-time camera shall be used to record any propulsion battery electrolyte spillage from, or into the interior compartment of, the test vehicle after the impact event or during the static rollover test.

The video footage shall be transferred to a compact disc (CD) or DVD as AVI or MPEG files with any standard or generally available “codec” compatible to Microsoft Windows. All video footage should be saved in a “read only” format before sending to the COR to verify that the evidence has not been altered from its original condition. Video footage may only be saved using other types of file formats if approved by the COR.

11. DEFINITIONS

AUTOMATIC DISCONNECT
A device that when triggered, conductively separates a high voltage source from the electric power train or the rest of the electric power train

PROPULSION BATTERY SYSTEM COMPONENT

1\. Any part of a propulsion battery module, interconnect, venting system, battery restraint device, and battery box or container that holds the individual battery modules used for propulsion.

CHARGE CONNECTOR
A conductive device that, by insertion into a vehicle charge inlet, establishes an electrical connection of the vehicle to the external electric power supply for the purpose of transferring energy and exchanging information.

CONNECTOR
A device providing mechanical connection and disconnection of high voltage electrical conductors to a suitable mating component, including its housing.

DIRECT CONTACT
The contact of persons with high voltage live parts.

DUMMY
Use definitions for test dummies as specified in FMVSS Nos. 208, 214D, and/or 301.

ELECTRIC ENERGY STORAGE DEVICE
A high voltage source that stores energy for vehicle propulsion. This includes, but is not limited to, a high voltage battery or battery pack, rechargeable energy storage device, and capacitor module.

ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM
An assembly of electrical components that stores or converts electrical energy for vehicle propulsion. This includes, but is not limited to, high voltage batteries or battery packs, fuel cell stacks, rechargeable energy storage systems, capacitor modules, inverters, interconnects, and venting systems

ELECTRICAL ISOLATION
A high voltage source in the vehicle means the electrical resistance between the high voltage source and any of the vehicle's electrical chassis divided by the working voltage of the high voltage source.

ELECTRIC POWER TRAIN
An assembly of electrically connected components which includes, but is not limited to, electric energy storage/conversion systems and propulsion systems

ELECTRICAL CHASSIS
Conductive parts of the vehicle whose electrical potential is taken as reference and which are: (1) conductively linked together, and (2) not high voltage sources during normal vehicle operation

ELECTRICAL PROTECTION BARRIER
The part providing protection against direct contact with high voltage live parts from any direction of access.

ELECTROLYTE SPILLAGE

2.

The fall, flow, or run of propulsion battery electrolyte in, on, or from the vehicle, including wetness resulting from capillary action.

ELECTRICAL ISOLATION
A high voltage source in the vehicle means the electrical resistance between the high voltage source and any of the vehicle's electrical chassis divided by the working voltage of the high voltage source

EXPOSED CONDUCTIVE PART
The conductive part that can be touched under the provisions of the IPXXB protection degree and that is not normally energized, but that can become electrically energized under isolation fault conditions. This includes parts under a cover, if the cover can be removed without using tools.

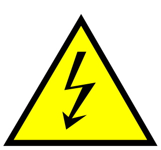
EXTERNAL ELECTRIC POWER SUPPLY
A power supply external to the vehicle that provides electric power to charge the propulsion battery in the vehicle.

FUEL CELL SYSTEM
A system containing the fuel cell stack(s), air processing system, fuel flow control system, exhaust system, thermal management system, and water management system.

GOVERNING CRASH TEST PROCEDURE
The OVSC Test Procedures, each of these is available on the agency website:
https://one.nhtsa.gov/Vehicle-Safety/Test-Procedures

GROSS VEHICLE WEIGHT RATING OR GVWR
The value specified by the manufacturer as the loaded weight of a single vehicle. (571.3)

HIGH VOLTAGE SOURCE
Any electric component which is contained in the electric power train or conductively connected to the electric power train and has a working voltage greater than 30 VAC or 60 VDC.



High Voltage Equipment

INDIRECT CONTACT
The contact of persons with exposed conductive parts.

LIVE PART
A conductive part of the vehicle that is electrically energized under normal vehicle operation.

2.

LUGGAGE COMPARTMENT
The space in the vehicle for luggage accommodation, separated from the passenger compartment by the front or rear bulkhead and bounded by a roof, hood or trunk lid, floor, and side walls, as well as by electrical protection barriers provided for protecting the occupants from direct contact with high voltage live parts.

LONGITUDINAL OR LONGITUDINALLY
Parallel to the longitudinal centerline of the vehicle. (571.3) OUTBOARD DESIGNATED

LUGGAGE COMPARTMENT
The space in the vehicle for luggage accommodation, separated from the passenger compartment by the front or rear bulkhead and bounded by a roof, hood or trunk lid, floor, and side walls, as well as by electrical protection barriers provided for protecting the occupants from direct contact with high voltage live parts.

PASSENGER COMPARTMENT
The space for occupant accommodation that is bounded by the roof, floor, side walls, doors, outside glazing, front bulkhead and rear bulkhead or rear gate, as well as electrical protection barriers provided for protecting the occupants from direct contact with high voltage live parts.

PASSIVE ACTIVE DRIVING MODE
The vehicle mode when application of pressure to the accelerator pedal (or activation of an equivalent control) or release of the brake system causes the electric power train to move the vehicle.

POSSIBLE ACTIVE DRIVING MODE
The vehicle mode when application of pressure to the accelerator pedal (or activation of an equivalent control) or release of the brake system causes the electric power train to move the vehicle.

PROPULSION SYSTEM
An assembly of electric or electro-mechanical components or circuits that propel the vehicle using the energy that is supplied by a high voltage source. This includes, but is not limited to, electric motors, inverters/converters, and electronic controllers.

PROTECTION DEGREE IPXXB
Protection from contact with high voltage live parts. It is tested by probing electrical protection barriers with the jointed test finger probe, IPXXB, in Figure-A.

3.

Access probe

(Dimensions in mm)

IPXXB

Jointed test finger

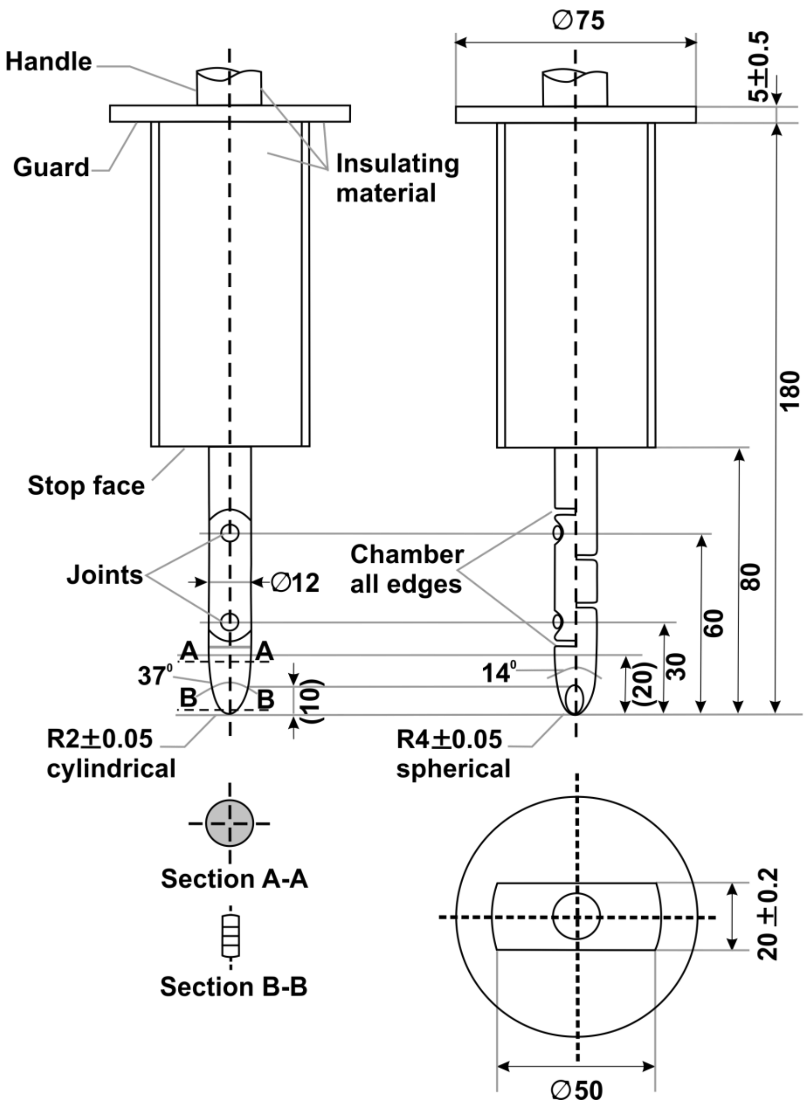


Figure-A Jointed test finger IPXXB

- Material: metal, except where otherwise specified
- Linear dimensions in millimeters
- Tolerances on dimensions without specific tolerance:

  on angles, 0/10 degrees
  on linear dimensions:
  up to 25 mm: 0/-0.05 mm
  over 25 mm: ± 0.2 mm

4.

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

PROTECTION DEGREE IPXXD
Protection from contact with high voltage live parts. It is tested by probing electrical protection barriers with the test wire probe, IPXXD, in Figure-B.

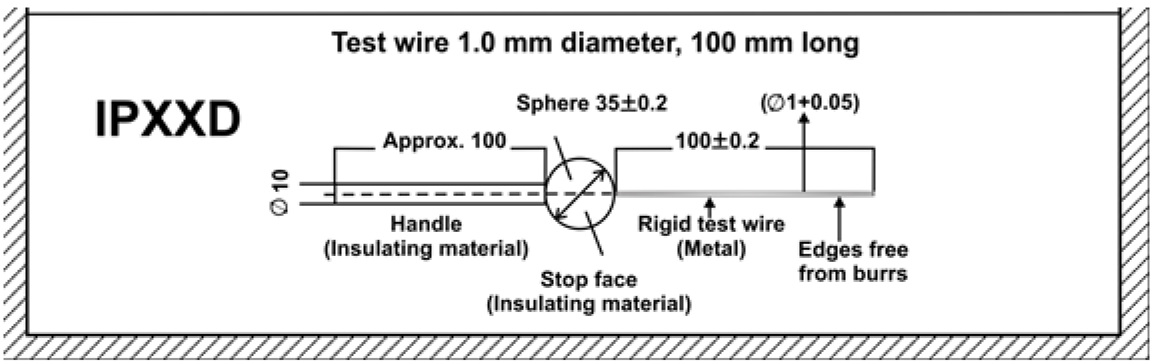
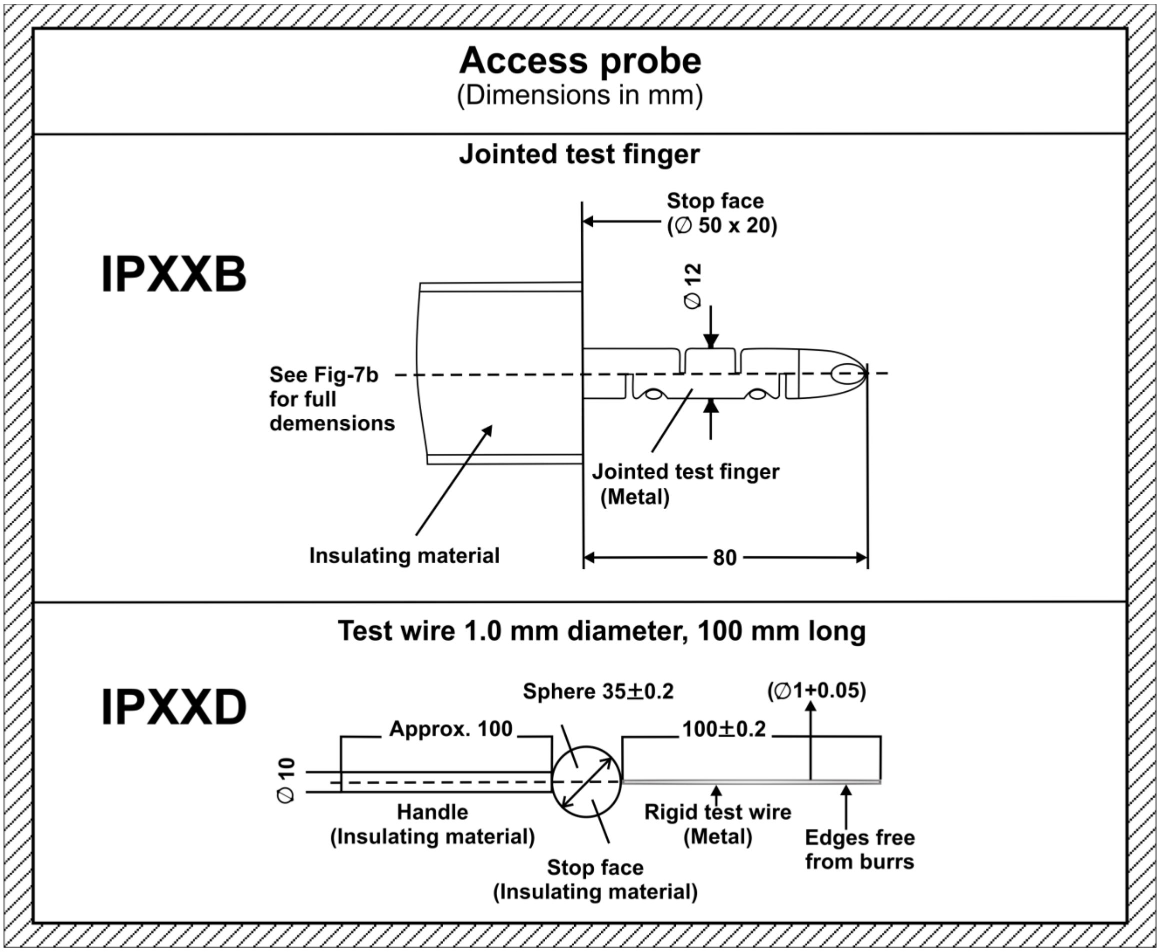


Figure-B Access probes for the tests of direct contact protection. Access probe IPXXD



Access probes for the tests of direct contact protection. Access probe IPXXB (top) and Access probe IPXXD (bottom).

SEATING POSITION

A designated seating position where a longitudinal vertical plane tangent to the outboard side of the seat cushion is less than 12 inches from the innermost point on the inside surface of the vehicle at a height between the design H-point and the shoulder reference point (as shown in fig. 1 of Federal Motor Vehicle Safety Standard No. 210) and longitudinally between the front and rear edges of the seat cushion. (571.3)

SERVICE DISCONNECT

The device for deactivation of an electrical circuit when conducting checks and services of the vehicle electrical propulsion system.

RATED CARGO AND LUGGAGE CAPACITY WEIGHT (RCLW)

RCLW = vehicle capacity weight – (68 kg x designated seating capacity).

Maximum RCLW used in testing a truck, MPV, or bus is 136 kg.

RCLW for school buses will follow the calculation contained within the governing crash test procedure.

5.

TELLTALE
A display that indicates the actuation of a device, a correct or defective functioning or condition, or a failure to function. (571.101, S4)

UNLOADED VEHICLE WEIGHT (UVW)
The weight of a vehicle with maximum capacity of all fluids necessary for operation of the vehicle, but without cargo, occupants, or accessories that are ordinarily removed from the vehicle when they are not in use. (571.3)

VAC – VOLTAGE ALTERNATING CURRENT
volts of alternating current (AC) expressed using the root mean square value.

VCW for school buses will follow the calculation contained within the governing crash test procedure.

VDC- VOLTAGE DIRECT CURRENT
means volts of direct current (DC).

VEHICLE CAPACITY WEIGHT (VCW)
The rated cargo and luggage load plus 68 kilograms times the vehicle's designated seating capacity (571.110, S3).

VCW for school buses will follow the calculation contained within the governing crash test procedure.

VEHICLE CHARGE INLET
The device on the electric vehicle into which the charge connector is inserted for the purpose of transferring energy and exchanging information from an external electric power supply.

WORKING VOLTAGE
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

12. PRETEST REQUIREMENTS

12.1 Prior to conducting a compliance test, the contractor shall:

A. Verify COR approval of Contractor’s in-house test procedure,

B. Verify the training of technicians for performance of this test,

C. Verify the calibration status of test equipment,

D. Perform required crash tests

E. Review vehicle Owner’s Manual (or equipment mfg. instructions), and

F. Set cold tire pressures according to the vehicle manufacturer’s recommendations (where applicable).

12.2 DETAILED TEST AND QUALITY CONTROL PROCEDURES REQUIRED

Prior to conducting any compliance test, Contractors are required to submit a detailed in-house compliance test procedure to the COR which includes:

A. A step-by-step description of the methodology to be used.

B. A written Quality Control (QC) Procedure which shall include calibrations, the data review process, report review, and the people assigned to perform QC on each task.

C. A complete listing of test equipment with instrument accuracy and calibration dates.

D. Detailed check off lists to be used during the test and during data review. These lists shall include all test procedure requirements and FMVSS requirements pertaining to the safety standard for which testing is being performed. Each separate check off sheet shall identify the lab, test date, vehicle, and test technicians. These check sheets shall be used to document that all requirements and procedures have been complied with. These sheets shall be submitted with the test report.

E. There shall be no contradiction between the OVSC Laboratory Test Procedure and the Contractor's in-house test procedure. The procedures shall cover all aspects of testing from vehicle receipt to submission of the final report. Written approval of the procedures must be obtained from the COR before initiating the compliance test program.

12.3 DATA COLLECTION SET-UP

A. Remove the key from the keylock and ensure the vehicle is not powered.

B. Remove barriers to access the propulsion battery module (e.g. seat backs, carpet, covers).

C. Wear high-voltage protection gloves, nonconductive shoes, eye protection and any other safety equipment deemed necessary to safely prepare the vehicle and conduct the test.

D. Set the propulsion battery module switch, service plug, or otherwise to the “OFF” or de- powered, position (See examples below). Follow any Manufacturer instructions provided by the COR.


Service Plug-Toyota Prius


Service Switch-Ford Escape

Service Switch-Honda Civic

Wait 5 Minutes.

E. Set the propulsion battery module switch, service plug, or otherwise to the “OFF” or de- powered, position (See examples below). Follow any Manufacturer instructions provided by the COR

F. Remove propulsion battery module service cover, or cover that closes the battery compartment.

G. Measure the voltage across the propulsion battery at the appropriate terminals, and verify 0 volts.

H. Measure the voltage between the positive terminal of the propulsion battery and the vehicle body, and verify 0 volts.

I. Measure the voltage between the negative terminal of the propulsion battery and the vehicle body, and verify 0 volts.

J. If any voltage measurements differ from 0 volts, **STOP**, quarantine vehicle, document incident and contact the COR.

K. Attach test leads from the propulsion battery, propulsion system, automatic propulsion battery disconnect, ground points, and any other points necessary on the vehicle such that immediate retrieval of data is possible after an impact event and at all times during the static rollover test

L. Telltale indicator of drive mode when leaving vehicle and telltale indicator of active driving mode at start up

M. Prevent drive -away during charging: when an on-board electric energy storage device can be externally charged, vehicle movement by its own propulsion system shall not be possible. When an external electric power supply is physically connected to the vehicle charge inlet the vehicle shall not be able to move

NOTE: If vehicle is equipped with an automatic disconnect physically contained within the battery pack system, all voltage measurements **after impact** will be taken from the traction 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, all post-impact voltage measurements are to be made from the battery side of the automatic disconnect. Automatic disconnect presence, location, and set-up instruction are vehicle specific and is available from the COR.

Re-Install the propulsion battery module service cover, or otherwise close the battery compartment. Take great care to preserve the integrity of the connection wiring and propulsion battery hold-downs.

12.4 TEST VEHICLE PREPARATION

A. Apply paint or other highly visible finish, such as machinist blue, to all battery system component attachment fasteners or attachment means (e.g., welds), to indicate component movement or separation, post-test.

B. If the vehicle is equipped with a liquid cooling system, assure that the coolant is a different color than the Stoddard solvent in use as specified in FMVSS Nos. 208, 214D and 301.

C. Reset the propulsion battery module switch, service plug, or otherwise to the "ON", or powered, position. Verify proper function of propulsion system.

D. Charge the propulsion battery system to the level specified in (1), (2), or (3) below:

1. The voltage corresponding to the maximum state of charge recommended by the manufacturer, as stated in the vehicles owner's manual or on a label that is permanently affixed to the vehicle;

   OR

2. If the manufacturer has made no recommendation, a voltage corresponding to a state of charge of not less than 95 percent of the maximum capacity of the battery system. Verify the charge level with the COR.

   OR

3. If the batteries are rechargeable only by an energy source on the vehicle, upon approval from the COR, operate the vehicle such that the maximum practicable state of charge within the normal operating range, as specified by the manufacturer, is reached as indicated by the vehicle's instrumentation, if installed, or using other measurement methods as directed by the COR.

E. Complete Data Sheet 1—Test Vehicle Specifications and Data Sheet 2– Pre-test Data.

F. Indicator signal for driver that vehicle is in active driving mode: A momentary indication shall be given to the driver when the vehicle is in possible active driving mode.

G. Indicator signal for driver when driver is leaving the vehicle and vehicle is in active driving mode: when leaving the vehicle, the driver shall be informed by an audible or visual signal if the vehicle is still in the possible active drive mode.

H. Prevent drive away during charging: if the on-board electric energy storage device can be externally charged, vehicle movement by its own propulsion system shall not be possible as long as the charge connector of the external electric power supply is physically connected to the vehicle charge inlet.

I. Prepare the test vehicle per the test procedure of the applicable governing crash tests

J. Document and photograph test vehicle per the FMVSS 305 test procedure, and record in Data Sheet 6.

K. A passenger car (or Multipurpose Vehicle, truck) 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

L. Tires are inflated to the manufacturer's specifications

12.5 ELECTRICAL ISOLATION MONITORING

Each DC high voltage sources of vehicles with a fuel cell system shall be monitored by an electrical isolation monitoring system that displays a warning for loss of isolation when tested according to the instructions listed below of this section. The system must monitor its own readiness and the warning display must be visible to the driver seated in the driver's designated seating position.

A. The electric energy storage device is at the state-of-charge
B. The switch or device that provides power from the electric energy storage/conversion system to the propulsion system is in the activated position or the ready-to-drive position

C. Determine the isolation resistance, Ri, of the high voltage source with the electrical isolation monitoring system using the procedure outlined in below:

A. The voltmeter used in this test has an internal resistance of at least 10 MΩ.
B. The voltage(s) is/are measured as shown in Figure 1 and the high voltage source voltage(s) (Vb) is/are recorded.
C. Before any vehicle impact test, Vb is equal to or greater than the nominal operating voltage as specified by the vehicle manufacturer.
D. The voltage V1 between the negative side of the high voltage source and the electrical chassis is measured as shown in Figure 2.
E. The voltage V2 between the positive side of the high voltage source and the electrical chassis is measured as shown in Figure 3.
F. 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 electrical chassis. With the Ro installed, measure the voltage (V1′) as shown in Figure 4 between the negative side of the high voltage source and the electrical chassis. 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).
G. If V2 is greater than V1, insert a known resistance (Ro) between the positive side of the high voltage source and the electrical chassis.
H. With the Ro installed, measure the voltage (V2′) as shown in Figure 5 between the positive side of the high voltage source and the electrical chassis. Calculate the electrical isolation resistance (Ri) according to the formula shown.
I. Divide Ri (in ohms) by the working voltage of the high voltage source (in volts) to obtain the electrical isolation (in ohms/volt).

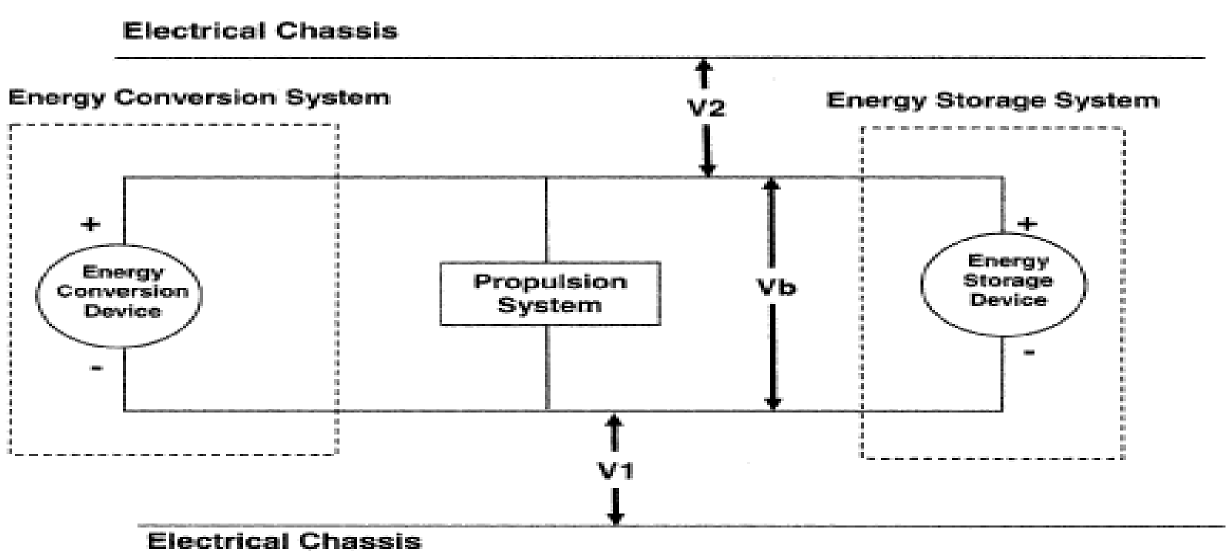


Figure 1. S7.6.3 and S7.7 Voltage Measurements of the High Voltage Source

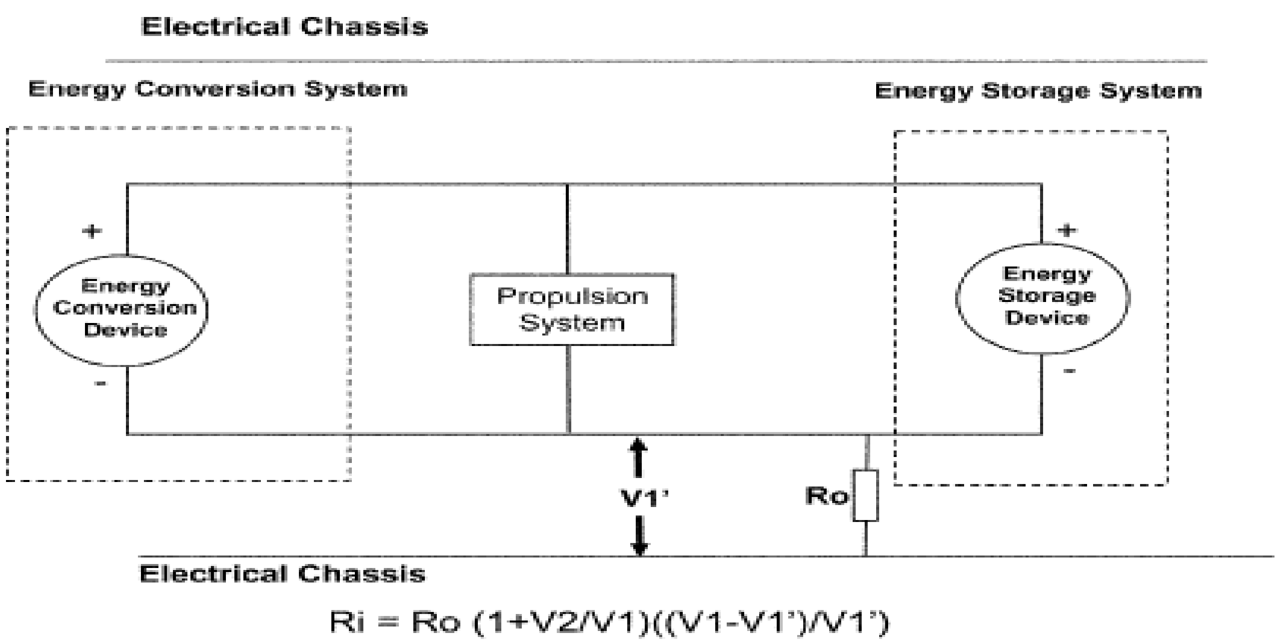


Figure 4. S7.6.6 Measurement for V1' Voltage across Resistor between Negative Side of the High Voltage Source and Electrical Chassis

(1) Measurement for V1` voltage across resistor between negative side of high voltage and electrical chassis.
(2) Measurement for V2` voltage across resistor between positive side of high voltage source and electrical chassis.
(3) Insert a resistor with resistance Ro equal to or greater than 1/(1/(95 times the working voltage of the high voltage source)−1/Ri) and less than 1/(1/(100 times the working voltage of the high voltage source)−1/Ri) between the positive terminal of the high voltage source and the electrical chassis.
(4) The electrical isolation monitoring system indicator shall display a warning visible to the driver seated in the driver's designated seating position.

12.6 ELECTRIC SHOCK PROTECTION DURING CHARGING

For motor vehicles with an electric energy storage device that can be charged through a conductive connection with a grounded external electric power supply, a device to enable conductive connection of the electrical chassis to the earth ground shall be provided. This device shall enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is removed from the vehicle.

12.7 INDICATOR OF POSSIBLE ACTIVE DRIVING MODE AT START UP

At least a momentary indication shall be given to the driver when the vehicle is in possible active driving mode. This requirement does not apply under conditions where an internal combustion engine provides directly or indirectly the vehicle's propulsion power upon start up.

12.8 INDICATOR OF POSSIBLE ACTIVE DRIVING MODE WHEN LEAVING THE VEHICLE

When leaving the vehicle, the driver shall be informed by an audible or visual signal if the vehicle is still in the possible active driving mode.

12.9 PREVENT DRIVE-AWAY DURING CHARGING

If the on-board electric energy storage device can be externally charged, vehicle movement by its own propulsion system shall not be possible as long as the charge connector of the external electric power supply is physically connected to the vehicle charge inlet.

12.10 ELECTRICAL ISOLATION BASELINE MEASUREMENT

NOTE: The following measurements are to be made immediately prior to crash test, and should be completed within 15 minutes.

A. Check that the battery system is connected to the vehicle's propulsion system, and the vehicle is in the "ready-to-drive" (propulsion motor(s) activated) position. Start Data Sheets 4-6 – Pre-Impact Electrical Isolation Measurements & Calculations.
B. Measure the voltage of the propulsion battery as shown in Figure 1 below. Before any vehicle impact test, verify that V_b is equal to or greater than the nominal operating voltage as specified by the vehicle manufacturer, or as supplied by the COR. If V_b is not equal to

or greater than the nominal operating voltage as specified by the vehicle manufacturer, or as supplied by the COR, repeat the propulsion battery charging step of Test Vehicle.

Preparation and promptly call COR for guidance. The voltmeter used in this test measures direct current values and has an internal impedance of at least 10MΩ. Record the voltage measurement as V_b in Data Sheet 3. Make certain all voltages are DC. If there is AC voltage on the traction side connection, consult the COR for additional guidance.

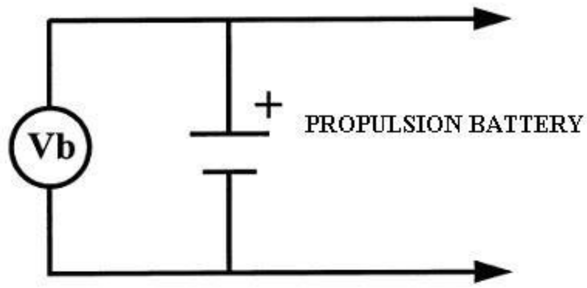


FIGURE 1

C. Measure the voltage (***V_1***) from the negative side of the propulsion battery to the vehicle chassis point(s) as shown in Figure 2 below. Record the voltage measurement as ***V_1***, in Data Sheet 3.

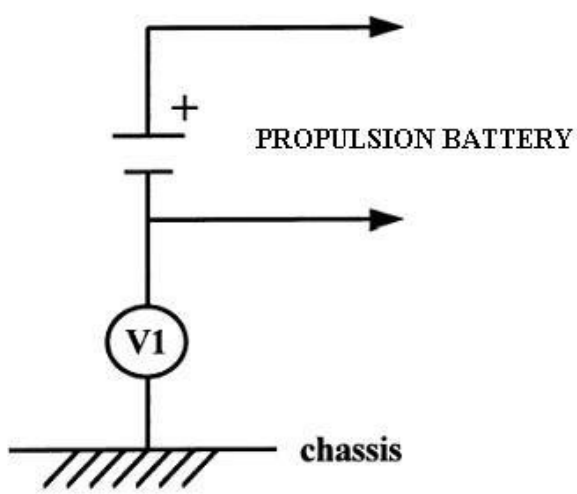


FIGURE 2

D. Measure the voltage (***V_2***) from the positive side of the propulsion battery to the vehicle chassis point(s) as shown in Figure 3 below. Record the voltage measurement as ***V_2***, in Data Sheet 3.

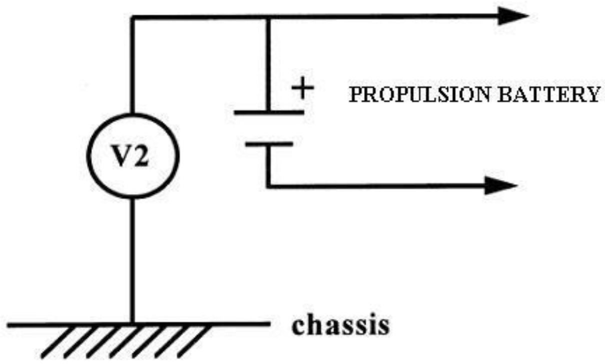


FIGURE 3

E. Insert a resistor (**R_o**) of a known resistance (in ohms) approximately 500 times the nominal operating voltage of the vehicle (in volts) per SAE J1766, between the negative side of the propulsion battery and the vehicle chassis. With **R_o** installed, measure and record the voltage (***V_1***') as shown in Figure 4 between the negative side of the propulsion battery and the vehicle chassis point(s). Calculate the electrical isolation value (in ohms) as shown in Figure 4 below. Record electrical isolation value as **R_{i1}** in Data Sheet 3.

NOTE--R_o is not required to be precisely this value since the equations are valid for any R_o; however, an R_o value in this range should provide good resolution for the voltage measurements.[1]

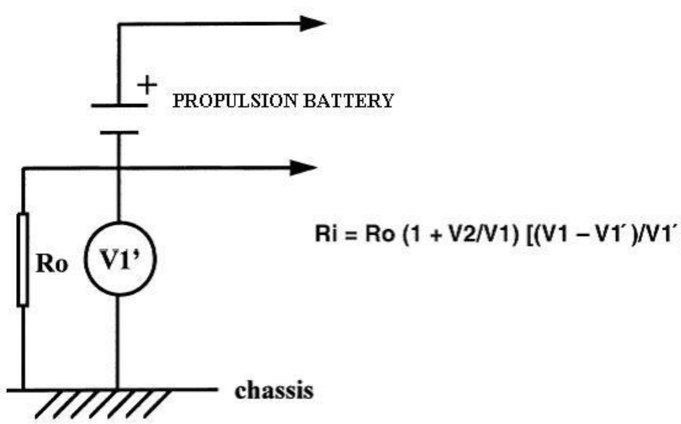


FIGURE 4

F. With **R_o** installed, measure and record the voltage (***V_2***') as shown in Figure 5 between the positive side of the propulsion battery and the vehicle chassis point(s). Calculate the electrical isolation value (in ohms) as shown in Figure 5 below.

[1] SAE J1766-rev. June 1998- recommended practice for electric and hybrid electric vehicle battery systems crash integrity testing

NOTE: If measured voltage is zero and results in a division by zero in the electrical isolation calculation, record "Zero Volts." This "zero voltage" condition is considered as being compliant.

Record electrical isolation value as $\mathbf{R_{i2}}$ in Data Sheet 3.

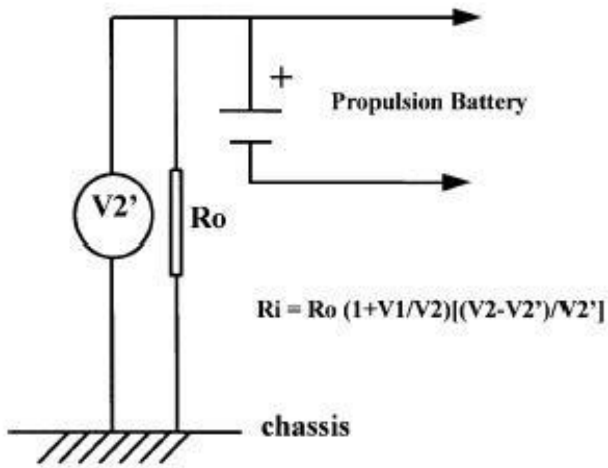


Figure 5

NOTE: Exact location of measurement will vary depending on the location of the disconnect(s) for the system.

G. If $\mathbf{R_{i1}}$ is less than $\mathbf{R_{i2}}$ then, divide $\mathbf{R_{i1}}$ by the nominal operating voltage of the propulsion battery (***V_b***) shown in Figure 4. **Note: If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant.** Record this value as $\mathbf{R_i}$ / ***V_b***, in Data Sheet 3. This value must be equal to or greater than 500. If this value is less than 500, a test failure has occurred.

H. If $\mathbf{R_{i2}}$ is less than $\mathbf{R_{i1}}$ then, divide $\mathbf{R_{i2}}$ by the nominal operating voltage of the propulsion battery (***V_b***) shown in Figure 4. **Note: If measured voltage is zero and results in a division by zero record "Zero Volts." This "zero voltage" condition is considered as being compliant.** Record this value as $\mathbf{R_i}$ / ***V_b***, in Data Sheet 3. This value must be equal to or greater than 500. If this value is less than 500, a test failure has occurred.

I. Recheck that the battery system is connected to the vehicle's propulsion system, and the vehicle in the "ready-to-drive" (propulsion motor(s) activated) position.

J. Verify that the parking brake is disengaged and the transmission, is in the neutral position

12.11 ELECTRIC ENERGY STORAGE DEVICE STATE-OF-CHARGE

The electric energy storage device shall be at the state-of-charge specified in either subparagraph A, B or C:

A. At the maximum state-of-charge in accordance with the vehicle manufacturer's recommended charging procedures, as stated in the vehicle owner's manual or on a label that is permanently affixed to the vehicle; or
B. If the manufacturer has made no recommendation for charging procedures 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 manufacture

13 COMPLIANCE TEST EXECUTION

13.1 GOVERNING CRASH TEST

Perform applicable governing crash testing.

NOTE: If vehicle is equipped with an automatic disconnect physically contained within the battery pack system, all voltage measurements **after impact** will be taken from the traction 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, all post-impact voltage measurements are to be made from the battery side of the automatic disconnect. Automatic disconnect presence, location, and set-up instruction are vehicle specific and must be obtained from the COR

13.2 TEST METHOD TO DETERMINE VOLTAGE BETWEEN EXPOSED CONDUCTIVE PARTS OF ELECTRICAL PROTECTION BARRIERS AND THE ELECTRICAL CHASSIS AND BETWEEN EXPOSED CONDUCTIVE PARTS OF ELECTRICAL PROTECTION BARRIERS

A. Connect the voltmeter to the measuring points (exposed conductive part of an electrical protection barrier and the electrical chassis or any two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other).
B. Measure the voltage.
C. The voltage between two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other may be calculated using the separately measured voltages between the relevant electrical protection barriers and the electrical chassis.

13.3 ELECTRICAL ISOLATION OF HIGH VOLTAGE SOURCES FOR CHARGING THE ELECTRIC ENERGY STORAGE DEVICE

For the vehicle charge inlet intended to be conductively connected to the AC external electric power supply, the electric isolation between the electrical chassis and the high voltage sources that are conductively connected to the vehicle charge inlet during charging of the electric energy storage device shall be:

A. Greater than or equal to 500 ohms/volt when the charge connector is disconnected, for an AC high voltage source.
B. If AC high voltage meets the physical barrier protection requirements: the electric energy storage device shall be greater than or equal to 100 ohms/volt when the charge connector is disconnected, for an AC high voltage source.
C. Electrical isolation for 100 ohms/ volt for a DC high voltage source.
D. The electrical isolation is measured at the high voltage live parts of the vehicle charge inlet and determined in accordance with the electrical isolation test procedure. During the measurement, the rechargeable electric energy storage system may be disconnected.

13.4 ELECTRICAL ISOLATION MONITORING

DC high voltage sources of vehicles with a fuel cell system shall be monitored by an electrical isolation monitoring system that displays a warning for loss of isolation when tested according to the test procedure for on-board electrical isolation monitoring system. The system must monitor its own readiness and the warning display must be visible to the driver seated in the driver's designated seating position.

13.5 ELECTRIC SHOCK PROTECTION DURING CHARGING

For motor vehicles with an electric energy storage device that can be charged through a conductive connection with a grounded external electric power supply, a device to enable conductive connection of the electrical chassis to the earth ground shall be provided. This device shall enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is removed from the vehicle.

13.6 TEST METHOD TO EVALUATE PROTECTION FROM DIRECT CONTACT WITH HIGH VOLTAGE SOURCES

A. Any parts surrounding the high voltage components are opened, disassembled, or removed without the use of tools.
B. For the purpose of determining the voltage level of the high voltage source, voltage is measured as shown in the Figure below. Voltage Vb is measured across the two terminals of the voltage source. Voltages V1 and V2 are measured between the source and the electrical chassis. V1, V2 and Vb measurements must be less than or equal to 30 volts AC for AC components. For DC components measurements V1, V2 and Vb must measure 60 volts (DC) or less. For a high voltage source that has an automatic disconnect that is physically contained within itself, the voltage measurement after the test is made from the side of the automatic disconnect connected to the electric power train or to the rest of the electric power train if the high voltage source is a component contained in the power train. For a high voltage source that has an automatic disconnect that is not physically contained within itself, the voltage measurement after the test is made from both the high voltage source side of the automatic disconnect and from the side of the automatic disconnect connected to the electric power train or to the rest of the electric power train if the high voltage source is a component contained in the power train.

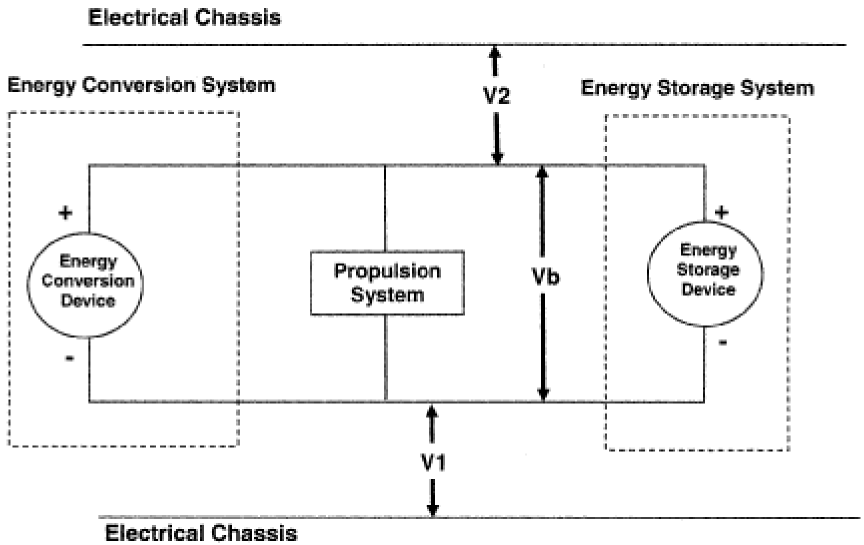


Figure 1. S7.6.3 and S7.7 Voltage Measurements of the High Voltage Source

C. The selected access probe is inserted into any gaps or openings of the electrical protection barrier with a test force of 10 N ± 1 N with the IPXXB probe or 1 to 2 N with the IPXXD probe. If the probe partly or fully penetrates into the electrical protection barrier, it is placed in every possible position to evaluate contact with high voltage live parts. If partial or full penetration into the electrical protection barrier occurs with the IPXXB probe, the IPXXB probe shall be placed as follows: starting from the straight position, both joints of the test finger are rotated progressively through an angle of up to 90 degrees with respect to the axis of the adjoining section of the test finger and are placed in every possible position.
D. A low voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp may be connected between the access probe and any high voltage live parts inside the electrical protection barrier to indicate whether high voltage live parts were contacted.
E. A mirror or fiberscope may be used to inspect whether the access probe touches high voltage live parts inside the electrical protection barrier.

13.7 PASS/ FAIL REQUIREMENT TO INDICATE CONTACT WITH HIGH VOLTAGE PARTS

Protection degree IPXXD or IPXXB is verified when the following conditions are met:
A. The access probe does not touch high voltage live parts. The IPXXB access probe will be penetrated into the electrical protection barrier, it is placed in every possible position to evaluate contact with high voltage live parts.
B. A low voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp may be connected between the access probe and any high voltage live parts inside the electrical protection barrier to indicate whether high voltage live parts were contacted.
C. A mirror or fiberscope may be used to inspect whether the access probe touches high voltage live parts inside the electrical protection barrier. When using the access

probe to verify protection degree IPXXB or IPXXD, the lamp shall not light up. The stop face of the access probe does not fully penetrate the electrical protection barrier.

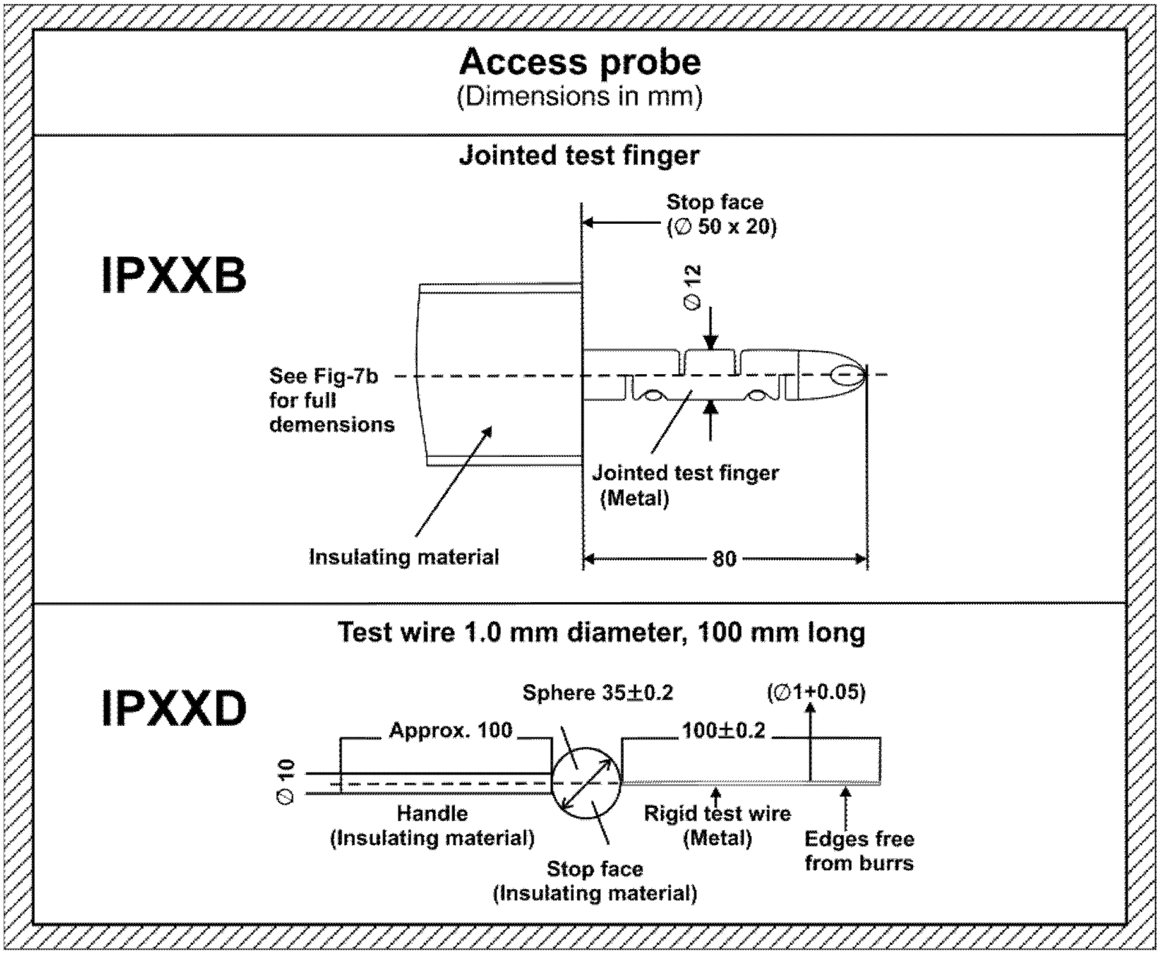


Figure 7a. Access Probes for the Tests of Direct Contact Protection

13.8 TEST METHOD USING A RESISTANCE TESTER

The resistance tester is connected to the measuring points (the electrical chassis and any exposed conductive part of electrical protection barriers or any two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other), and the resistance is measured using a resistance tester that can measure current levels of at least 0.2 Amperes with a resolution of 0.01 ohms or less. The resistance between two exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other may be calculated using the separately measured resistances of the relevant parts of the electric path.

13.9 TEST METHOD USING A DC POWER SUPPLY, VOLTMETER AND AMMETER

A. Connect the DC power supply, voltmeter and ammeter to the measuring points (the electrical chassis and any exposed conductive part or any two simultaneously reachable exposed conductive parts that are less than 2.5 meters from each other) as shown in Figure-C.
B. Adjust the voltage of the DC power supply so that the current flow becomes more than 0.2 Amperes.

C. Measure the current I and the voltage V shown in Figure-C.
D. Calculate the resistance R according to the formula, R=V/I.
E. The resistance between two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other may be calculated using the separately measured resistances of the relevant parts of the electric path.

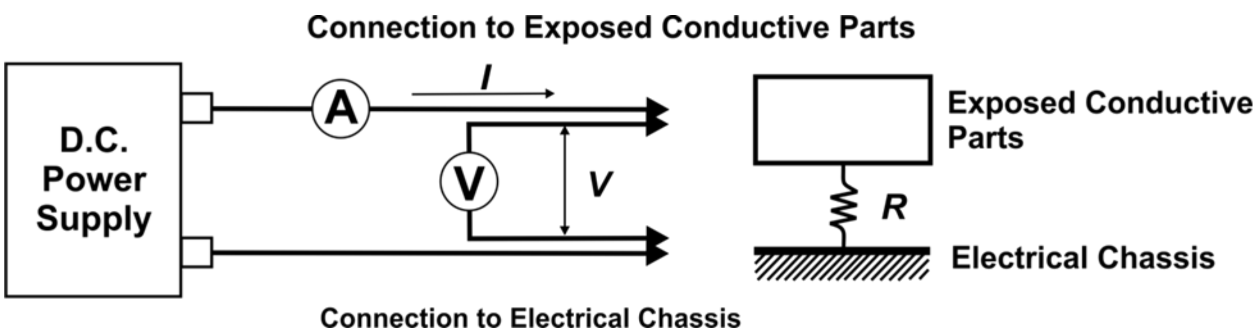


Figure-C Connection to determine resistance between exposed conductive parts of electrical protection barrier and electrical chassis

13.10 ELECTRICAL ISOLATION COMPLIANCE MEASUREMENT

NOTE: All voltage measurements shall be recorded immediately after the crash test, and at the start of each increment of 90º, 180º, 270º, and 360º of the static rollover test.

NOTE: If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant.

A. Immediately following the crash test, measure V_1, V_2, V_1', and V_2' voltages per Figures 2-5 with R_o installed and record the values in Data Sheet 4, Post-Impact Data.

B. Calculate the electrical isolation value (in ohms) as shown in Figure 4. Record electrical isolation value as Ri1 in Data Sheet 4.

C. Calculate the electrical isolation value (in ohms) as shown in Figure 5. Record electrical isolation value as Ri2 in Data Sheet 4.

1) If R_{i1} is less than R_{i2} then, divide R_{i1} by the nominal operating voltage of the propulsion battery (V_b) shown in Figure 4. Record this value as R_i / V_b, in Data Sheet 4. This value must be equal to or greater than 500. If this value is less than 500, a test failure has occurred.

2) If R_{i2} is less than R_{i1} then, divide R_{i2} by the nominal operating voltage of the propulsion battery (V_b) shown in Figure 4. Record this value as R_i / V_b, in Data Sheet 4. This value must be equal to or greater than 500. If this value is less than 500, a test failure has occurred.

D. Visually inspect for electrolyte leakage in the passenger compartment and record and photograph findings in Data Sheet 4 & Data Sheet 6.

E. Visually inspect for external battery component entry into the occupant compartment and record and photograph findings in Data Sheet 4 & Data Sheet 6.

Visually inspect for internal battery component movement in the occupant compartment and record and photograph findings in Data Sheet 4 & Data Sheet 6.

Document and photograph test vehicle per prescribed governing crash test procedure and record findings in Data Sheet 6.

Prepare the vehicle for the Static Rollover Test

14. POST TEST REQUIREMENTS

After the required tests are completed, the contractor shall:

A. Verify all data sheets complete and photographs taken,

B. Complete the Vehicle Condition report form including a word description of its post test condition,

C. Copy applicable pages of the vehicle Owner's Manual for attachment to the final test report,

D. Remove all instrumentation from vehicle. Return vehicle to its pretest condition.

E. Move the test vehicle to a secure area,

F. Place all original records in a secure and organized file awaiting test data disposition

15. Reports

15.1 MONTHLY STATUS REPORTS

The contractor shall submit a monthly Test Status Report and a Vehicle Status Report to the COR. The Vehicle Status report shall be submitted until all vehicles are disposed of. Samples of the required reports are found in the report forms section.

15.2 APPARENT NONCOMPLIANCE

Within 4 hours of a test failure, the Contractor shall provide summary notification of that failure to the COR. This summary notification may be transmitted via telephone, e-mail, or facsimile. It may be handwritten.

Within 24 hours of a test failure, the Contractor shall provide the COR with a written notification that includes the following information: FMVSS, test date, laboratory, contract number, project engineer's name, vehicle make, vehicle model, vehicle model year, NHTSA number, VIN, vehicle build date, test failure description, relevant data (plots, values, etc.) section of the standard failed, date of notification of COR, and the name of the individual that notified the COR. A sample form will be provided, upon request, by the COR.

15.3 FINAL TEST REPORTS

15.3.1 COPIES

The Contractor shall submit up to three (3) CD-ROM or DVD discs of the final report, three (3) copies of all photographs and video including high-speed video, and two (2) copies of the electronic data for each test performed under this contract in both Word and pdf formats. The Final Test Report shall be submitted to the COR for acceptance within three weeks of test completion. The Final Test Report format to be used by all Contractors can be found in the "Report Section".

Where there has been no indication of an apparent noncompliance, three paper copies and electronic copies in both Word and pdf formats of each Final Test Report shall be submitted to the COR for acceptance within three weeks of test completion. No payment of contractor's invoices for conducting compliance tests will be made prior to the Final Test Report acceptance by the COR. Contractors are requested to NOT submit invoices before the COR is provided with copies of the Final Test Report.

Contractors are required to submit the first Final Test Report in draft form within one week after the compliance test is conducted. The Contractor and the COR will then be able to discuss the details of both test conduct and report content early in the compliance test program.

Contractors are required to PROOF READ all Final Test Reports before submittal to the COR. The OVSC will not act as a report quality control office for contractors. Reports containing a significant number of errors will be returned to the Contractor for correction, and a "hold" will be placed on invoice payment for the particular test.

15.3.2 REQUIREMENTS

The Final Test Report and associated documentation (including photographs) are relied upon as the chronicle of the compliance test. The Final Test Report will be released to the public domain after review and acceptance by the COR.

For these reasons, each final report must be a complete document capable of standing by itself. The contractor should use DETAILED descriptions of all compliance test events. Any events that are not directly associated with the standard but are of technical interest should also be included. The Contractor should include as much DETAIL as possible in the report. Instructions for the preparation of the first three pages of the final test report are provided for standardization.

15.3.3 FIRST THREE PAGES

A. FRONT COVER

A heavy paperback cover (or transparency) shall be provided for the protection of the final report. The information required on the cover is as follows:

(1) Final Report Number such as 305-ABC-XX-001, where –

305 is the FMVSS tested
ABC are the initials for the laboratory
XX is the last two numbers of the Fiscal Year of the test program
001 is the Group Number (001 for the 1st test
002 for the 2nd test, etc.)

(2) Final Report Title and Subtitle such as

SAFETY COMPLIANCE TESTING FOR FMVSS
305
Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection
* * * * * * * * * * * * * * *
* ABC Motor Company
20XX Saferider 4-door sedan

NHTSA No. CX0401

(3) Contractor's Name and Address such as

COMPLIANCE TESTING LABORATORIES,

INC.

4335 West Dearborn Street
Detroit, Michigan 48090-
1234

NOTE: DOT SYMBOL SHALL BE PLACED BETWEEN ITEMS (3) AND (4)

(4) Date of Final Report completion

(5) The words "FINAL REPORT"

(6) The sponsoring agency's name and address as follows

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety
Compliance Mail Code: NVS-220
1200 New Jersey Avenue,
SE Washington, DC 20590

B. FIRST PAGE AFTER FRONT COVER

When a contract test laboratory is reporting, a disclaimer statement and an acceptance signature block for the COR shall be provided as follows:

This publication is distributed by the National Highway Traffic Safety Administration in the interest of information exchange. Opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof.

If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement.

Prepared By: ________________________________

Approved By: ________________________________*

Approval Date: ________________________________*

FINAL REPORT ACCEPTANCE BY OVSC:*

Accepted By: ________________________________

Acceptance Date: _____________________________

*	These lines not required when OVSC staff writes the Test Report

C. SECOND PAGE AFTER FRONT COVER

A completed Technical Report Documentation Page (Form DOT F1700.7) shall be completed for those items that are applicable with the other spaces left blank. Sample data for the applicable block numbers of the title page follows.

Block 1 — REPORT

NUMBER 305-ABC-

XX-001

Block 2 — GOVERNMENT ACCESSION NUMBER

Leave blank

Block 3 — RECIPIENT'S CATALOG NUMBER

Leave blank

Block 4 — TITLE AND SUBTITLE

Final Report of FMVSS 305 Compliance Testing of 20XX Saferider 4-door sedan, NHTSA No. CX0401

Block 5 — REPORT DATE

Month Day, 20XX

Block 6 — PERFORMING ORGANIZATION CODE

ABC

Block 7 — AUTHOR(S)

John Smith, Project Manager
Bill Doe, Project Engineer

Block 8 — PERFORMING ORGANIZATION REPORT

NUMBER ABC-DOT-XXX-00

Block 9 — PERFORMING ORGANIZATION NAME AND ADDRESS

ABC Laboratories 405
Main Street
Detroit, MI 48070-1234 Block

10 — WORK UNIT NUMBER

Leave blank

Block 11 — CONTRACT OR GRANT NUMBER

DTNH22-XX-D-12345

Block 12 — SPONSORING AGENCY NAME AND ADDRESS

United States Department of Transportation
National Highway Traffic Safety Administration
Office of Vehicle Safety Compliance
Mail Code: NEF-240
1200 New Jersey Avenue, SE Washington, DC 20590

Block 13 — TYPE OF REPORT AND PERIOD COVERED

Final Test Report
Month Day to Month Day, 20XX

Block 14 — SPONSORING AGENCY CODE

NEF-240

Block 15 — SUPPLEMENTARY NOTES

Leave blank

Block 16 — ABSTRACT

Compliance tests were conducted on the subject 200X Saferider 4-door sedan in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-305-0X for the determination of FMVSS 305 compliance. Test failures identified were as follows:

None

NOTE: Above wording must be shown with appropriate changes made for a particular compliance test. Any questions should be resolved with the COR.

Block 17 — KEY WORDS

Compliance Testing Safety
Engineering FMVSS 305

Block 18 — DISTRIBUTION STATEMENT

Copies of this report are available from —

National Highway Traffic Safety Administration
U.S. Department of Transportation
NHTSA Technical Information Services (TIS)
Mail Code: NIO-120, Room E-12 -100
1200 New Jersey Avenue, SE Washington, DC
20590

Telephone No. 202-366-4946

Block 19 — SECURITY CLASSIFICATION OF REPORT

Unclassified

Block 20 — SECURITY CLASSIFICATION OF PAGE

Unclassified

Block 21 — NUMBER OF PAGES

Add appropriate number

Block 22 — PRICE

Leave blank

15.3.4 TABLE OF CONTENTS

Final test report Table of Contents shall include the following:

Section 1 — Purpose of Compliance Test

Section 2 — Test Procedure and Discussion of Results Section

3 — Test Data

Section 4 — Test Equipment List and Calibration Information

Section 5 — Photographs

Section 6 — Other Documentation

Section 7 — Notice of Test Failure (if applicable)

15. DATA SHEETS

Data Sheet No. 1
Test Vehicle Specifications

TEST VEHICLE INFORMATION:
Year/Make/Model/Body Style _______________
NHTSA No.:_________; Color:_____________; Date Received: ________
Odometer Reading:_________miles
Selling Dealer: ____

DATA FROM VEHICLE'S CERTIFICATION LABEL:
Vehicle Manufactured By:____
Date of Manufacture:___________
VIN:______________________
GVWR:______kg. ; GAWR-Front:_______kg. ; GAWR-Rear:_______kg.

DATA FROM VEHICLE'S TIRE PLACARD & SIDEWALL:
Location of Placard on Vehicle:_____________________________________
Recommended Tire Size: ____
Recommended Cold Tire Pressure: Front:____kPa; Rear:_______kPa
Size of Tires on Test Vehicle: _______________________________________
Type of Spare Tire: ____

VEHICLE CAPACITY DATA:
Type of Front Seat(s): _______________________________________
Number of Occupants: Front =_____;Rear =_____;Total = _______
A. VEHICLE CAPACITY WEIGHT (VCW) =__________kg.
B. Number of Occupants x 68 kg. =__________kg.
RATED CARGO AND LUGGAGE WEIGHT (RCLW) [A-B]:______kg
Maximum RCLW used in testing a truck, MPV, or bus is 136 kg.
RCLW-School Bus (If Applicable)=_________________kg

ELECTRIC VEHICLE PROPULSION SYSTEM
Type of Electric Vehicle (Electric/Hybrid): ________
Propulsion Battery Type: ______
______________________________ Nominal Voltage:
______________________________V;
Physical Location of Automatic Propulsion Battery Disconnect:
____
Auxiliary Battery Type:____

RECORDED BY:______________________________________DATE: __________
APPROVED BY:______________________________________DATE: _________

Data Sheet No. 2
Pre-Test Data

Vehicle:____________________ NHTSA No.: ________________

CALCULATION OF TARGET TEST WEIGHT (TTW)

1. Unloaded Vehicle Weight (UVW) =_____________________kg.
2. Rated Cargo & Luggage Weight (RCLW) =_______________kg.
3. Weight of_____Part 572 Dummies =________kg.

TARGET TEST WEIGHT = 1 + 2 + 3 = ______kg.

NOTE: The target weight is calculated including tolerances as specified in each vehicle crash test procedure.

<u>As Tested</u>

Test Weight of Vehicle,______Dummies and________kg of Cargo Weight

TOTAL TEST WEIGHT =_________________kg

Measured Cold Tire Pressure @ Total Test Weight:
Front:_______kPa; Rear:_______kPa

PROPULSION BATTERY SYSTEM DATA:
(COR supplied data)

Electrolyte Fluid Type: ________
____ Electrolyte Fluid Specific Gravity: ________________
Electrolyte Fluid Kinematic Viscosity:______________________centistokes
Electrolyte Fluid Color: ____
Propulsion Battery Coolant Type, Color, Specific Gravity (if applicable): _______________

Location of Battery Modules:

☐ Inside Passenger Compartment: ______________

☐ Outside Passenger Compartment: ______________

Measure and Record Battery State of Charge (see page 18): ______________
(**Note**: Check which condition applies and specify the manufacturer's value for the:)

☐ Maximum State of Charge recommended by manufacturer: ______________

OR ☐ Test Voltage (> 95% of Maximum State of Charge): _____________

☐ Test Voltage (Within Normal Operating Voltage Range): _____________

Data Sheet 3

VEHICLE CHASSIS GROUND POINT(S) LOCATION(S):

Details of Vehicle Chassis Ground Point(s) & Location(s) [Supply photographs]:

PROPULSION BATTERY SYSTEM:

Details of Propulsion Battery Components [Supply photographs]:

Comments:

RECORDED BY: DATE:
APPROVED BY: DATE:

Data Sheet No. 4
Pre-Impact Electrical Isolation Measurements & Calculations

Vehicle:____________________ NHTSA No.: ________________

VOLTMETER INFORMATION:

- The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10MΩ
- NOTE: An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles

Make:________________; Model:___________________; S/N: _________
Internal Impedance Value:_________MΩ
Resolution:__________V Last Calibration Date:___________________

PROPULSION BATTERY VOLTAGE:

- Measurement shall be made with propulsion battery connected to the vehicle propulsion system, and the vehicle in the “ready-to-drive” (propulsion motor(s) activated) position
- If voltage measurement is not at the voltage or within the normal operating voltage range specified by the manufacturer, the battery must be charged
- Normal operating voltage range specified by the manufacturer = _____________

Vb =____________V

PROPULSION BATTERY TO VEHICLE CHASSIS

- Vehicle chassis point(s) determined and supplied to contractor by COR

V1 =____________V
V2 =____________V

PROPULSION BATTERY TO VEHICLE CHASSIS ACROSS RESISTOR

- The known resistance Ro (in ohms) should be approximately 500 times the nominal operating voltage of the vehicle (in volts) per SAE J1766.

Ro =___________

Data Sheet No. 5

Electrical Isolation Measurement

Note: If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant.

V1' =___________V
Ri1 = Ro (1 + V2/V1) [(V1-V1')/V1']
Ri1 =___________Ω

V2' =___________V
Ri2 = Ro (1 + V1/V2) [(V2-V2')/V2']
Ri2 =___________Ω

Ri = The lesser of Ri1 and Ri2

Ri =___________Ω Pre-test

Ri/Vb =___________Ω/ V (Electrical Isolation Value)
Minimum Electrical Isolation Value is 500 Ω/ V

- Is the measured Electrical Isolation Value ≥500 Ω/ V?

☐ YES ☐ NO (Fail)

Comments:____

RECORDED BY:____________________________________DATE: __________
APPROVED BY:____________________________________DATE: __________

Data Sheet No. 6
Post-Impact Data

Vehicle:____________________ NHTSA No.: ________________

ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

VOLTMETER INFORMATION:

- The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10MΩ
- NOTE: An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles

Make:________________; Model:___________________; S/N: _________
Internal Impedance Value:_________MΩ
Nominal Propulsion Battery Voltage (Vb):________V

- Record V1, V2, V1’, V2’ voltage measurements immediately after the impacted vehicle **comes to rest**.

V1 =____________V Impact Time:_______minutes________s
V2 =____________V Impact Time:_______minutes________s
V1’ =____________V Impact Time:_______minutes________s
V2’ =____________V Impact Time:_______minutes________s

- Attach complete data acquisition to final test report

Electrical Isolation Measurement

Note: If measured voltage is zero and results in a division by zero, record “Zero Volts.” This “zero voltage” condition is considered as being compliant.

Ri1 = Ro (1 + V2/V1) [(V1-V1’)/V1’]

Ri1 =___________Ω Impact Time:_______minutes________s

Ri2 = Ro (1 + V1/V2) [(V2-V2’)/V2’]

Ri2 =___________Ω Impact Time:_______minutes________s

Ri = The lesser of Ri1 and Ri2

Ri =___________Ω Impact Time:_______minutes________s

Ri/Vb = Electrical Isolation Value/ Nominal Battery Voltage
Minimum Electrical Isolation Value is 500 Ω/ V for AC high voltage
Ri/Vb =___________Ω/V Impact Time:_______minutes________s

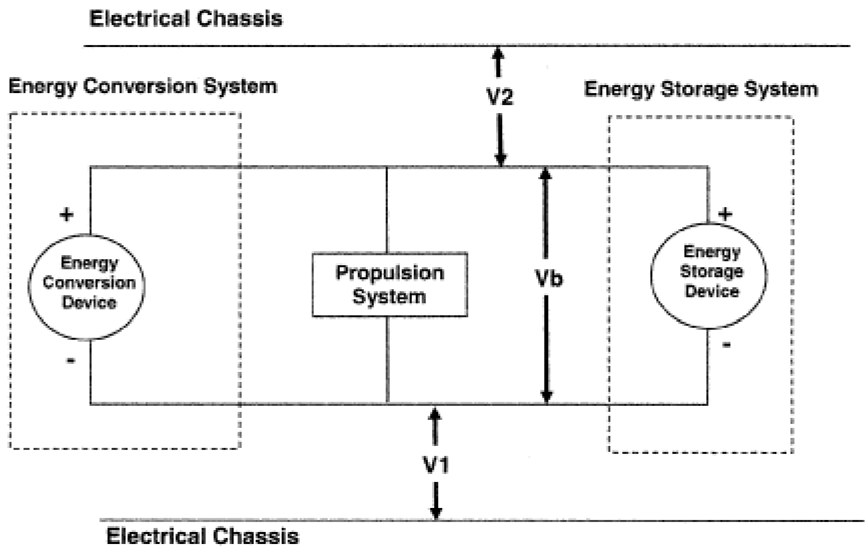
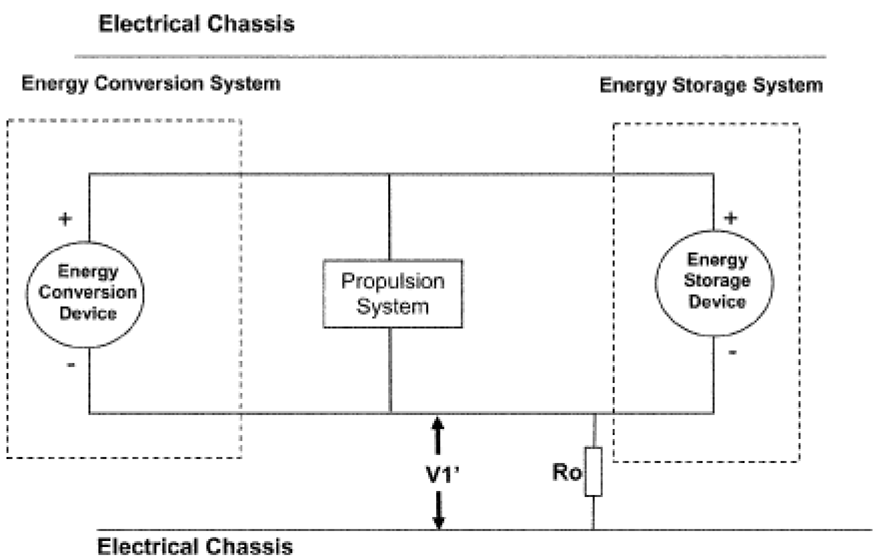


Figure 1. S7.6.3 and S7.7 Voltage Measurements of the High Voltage Source



$$R_i = R_o (1+V2/V1)((V1-V1')/V1')$$

Figure 4. S7.6.6 Measurement for V1' Voltage across Resistor between Negative Side of the High Voltage Source and Electrical Chassis

Data Sheet No.7
Post Impact Data

Vehicle___________________________ NHTSA No_______________________________

ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

VOLTMETER INFORMATION:

- The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10MΩ
- NOTE: An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles

Make:________________; Model:___________________; S/N: _________
Internal Impedance Value:_________MΩ
Nominal Propulsion Battery Voltage (Vb):________V

- Record V1, V2, V1', V2' voltage measurements immediately after the impacted vehicle **comes to rest**.

V1 =____________V Impact Time:_______minutes________s
V2 =____________V Impact Time:_______minutes________s
V1' =____________V Impact Time:_______minutes________s
V2' =____________V Impact Time:_______minutes________s

- Attach complete data acquisition to final test report

Electrical Isolation Measurement

Note: If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant.

Ri1 = Ro (1 + V2/V1) [(V1-V1')/V1']

Ri1 =___________Ω Impact Time:_______minutes________s

Ri2 = Ro (1 + V1/V2) [(V2-V2')/V2']

Ri2 =___________Ω Impact Time:_______minutes________s

Ri = The lesser of Ri1 and Ri2

Ri =___________Ω Impact Time:_______minutes________s

Ri/Vb = Electrical Isolation Value/ Nominal Battery Voltage
Minimum Electrical Isolation Value is 100 Ω/ V for AC high voltage

Ri/Vb =___________Ω/V Impact Time:_______minutes

Data Sheet No. 8
Post Impact Data

Vehicle______________________ NHTSA No___________________________

ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

VOLTMETER INFORMATION:

- The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10MΩ
- NOTE: An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles

Make:_______________; Model:__________________; S/N: _________
Internal Impedance Value:_________MΩ
Nominal Propulsion Battery Voltage (Vb):________V

- Record V1, V2, V1', V2' voltage measurements immediately after the impacted vehicle **comes to rest**.

V1 =____________V Impact Time:_______minutes________s
V2 =____________V Impact Time:_______minutes________s
V1' =____________V Impact Time:_______minutes________s
V2' =____________V Impact Time:_______minutes________s

- Attach complete data acquisition to final test report

Electrical Isolation Measurement

Note: If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant.

Ri1 = Ro (1 + V2/V1) [(V1-V1')/V1']

Ri1 =___________Ω Impact Time:_______minutes________s

Ri2 = Ro (1 + V1/V2) [(V2-V2')/V2']

Ri2 =___________Ω Impact Time:_______minutes________s

Ri = The lesser of Ri1 and Ri2

Ri =___________Ω Impact Time:_______minutes________s

Ri/Vb = Electrical Isolation Value/ Nominal Battery Voltage
Minimum Electrical Isolation Value is 100 Ω/ V for DC high voltage

Ri/Vb =___________Ω/V Impact Time:_______minutes

Data Sheet No. 9

- Is the measured Electrical Isolation Value ≥500 Ω/ V?

☐ YES ☐ NO (Fail)

PROPULSION BATTERY SYSTEM COMPONENTS

Describe Propulsion Battery Module movement within the passenger compartment [Supply photographs]:

____
____
____
____
____
____
____
____
____
____
____

- Has the Propulsion Battery Module moved within the passenger compartment?

☐ YES (Fail) ☐ NO

Describe intrusion of an outside Propulsion Battery Component into the passenger compartment [Supply photographs]:

____
____
____
____
____
____
____
____
____

- Has an outside Propulsion Battery Component intruded into the passenger compartment?

☐ YES (Fail) ☐ NO

- Is propulsion battery electrolyte spillage visible in the passenger compartment?

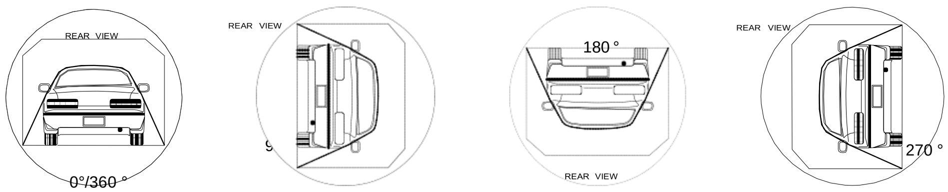
☐ YES (Fail) ☐ NO

RECORDED BY:_________________________________DATE: __________
APPROVED BY:_________________________________DATE: __________

Data Sheet No. 10

STATIC ROLLOVER TEST DATA

Vehicle: ______________________ NHTSA No.:______



I. DETERMINATION OF PROPULSION BATTERY ELECTROLYTE COLLECTION TIME PERIOD:

Rollover Stage	Rotation Time (spec. 1-3 min)				Hold Time		Total Time				Next Whole Minute Interval	
0º-90º		minutes		seconds		minutes		minutes		seconds		minutes
90º-180º		minutes		seconds		minutes		minutes		seconds		minutes
180º-270º		minutes		seconds		minutes		minutes		seconds		minutes
270º-360º		minutes		seconds		minutes		minutes		seconds		minutes

II. ACTUAL TEST VEHICLE PROPULSION BATTERY ELECTROLYTE SPILLAGE:

FMVSS 305 Requirements: Maximum allowable propulsion battery electrolyte spillage is **5.0 Liters**

Rollover Stage	Propulsion Battery Electrolyte Spillage (L)	Spillage Location
0º-90º		
90º-180º		
180º-270º		
270º-360º		

Total Spillage:_______________L

- Is the total spillage of propulsion battery electrolyte greater than 5.0 Liters?

  ☐ YES (Fail) ☐ NO

- Is propulsion battery electrolyte spillage visible in the passenger compartment?

  ☐ YES (Fail) ☐ NO

Data Sheet No. 11

ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

VOLTMETER INFORMATION:

- The voltmeter used in this test shall measure DC values and have an internal resistance of at least 10MΩ
- NOTE: An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles

Make:________________; Model:___________________; S/N: _________
Internal Resistance Value (Ro):_________MΩ
Nominal Propulsion Battery Voltage (Vb):________V

Record V1, V2, V1', V2' voltage measurements at the start of each successive increment of **90º**, **180º**, **270º**, and **360º** of the static rollover test. The increment of rotation for each turn shall be completed within a maximum of 3 minutes.

Electrical Isolation Measurement

V1 =____________V 0º Time:_______minutes________s
V1 =____________V 90º Time:_______minutes________s
V1 =____________V 180º Time:_______minutes________s
V1 =____________V 270º Time:_______minutes________s

V2 =____________V 0º Time:_______minutes________s
V2 =____________V 90º Time:_______minutes________s
V2 =____________V 180º Time:_______minutes________s
V2 =____________V 270º Time:_______minutes________s

V1' =____________V 0º Time:_______minutes________s
V1' =____________V 90º Time:_______minutes________s
V1' =____________V 180º Time:_______minutes________s
V1' =____________V 270º Time:_______minutes________s

V2' =____________V 0º Time:_______minutes________s
V2' =____________V 90º Time:_______minutes________s
V2' =____________V 180º Time:_______minutes________s
V2' =____________V 270º Time:_______minutes________s

- Attach complete data acquisition to final test report of governing crash

Data Sheet No.12

Electrical Isolation Calculation

Note: If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant.

Ri1 = Ro (1 + V2/V1) [(V1-V1')/V1']

Ri1 =___________Ω 90º Time:_______minutes________s
Ri1 =___________Ω 180º Time:_______minutes________s
Ri1 =___________Ω 270º Time:_______minutes________s
Ri1 =___________Ω 360º Time:_______minutes________s

Ri2 = Ro (1 + V1/V2) [(V2-V2')/V2']

Ri2 =___________Ω 90º Time:_______minutes________s
Ri2 =___________Ω 180º Time:_______minutes________s
Ri2 =___________Ω 270º Time:_______minutes________s
Ri2 =___________Ω 360º Time:_______minutes________s

Ri = The lesser of Ri1 and Ri2

Ri =___________Ω 90º Time:________minutes________s
Ri =___________Ω 180º Time:_______minutes________s
Ri =___________Ω 270º Time:_______minutes________s
Ri =___________Ω 360º Time:________minutes________s

Ri/Vb = Electrical Isolation Value/ Nominal Battery Voltage
Minimum Electrical Isolation Value is 500 Ω/ V

Ri/Vb =___________Ω/V 90º Time:_______minutes________s
Ri/Vb =___________Ω/V 180º Time:________minutes________s
Ri/Vb =___________Ω/V 270º Time:________minutes________s
Ri/Vb =___________Ω/V 360º Time:________minutes________s

- Is the measured Electrical Isolation Value ≥500 Ω/ V?

☐ YES ☐ NO (Fail)

COMMENTS:

____
____
____
____

RECORDED BY:____________________________________DATE: __________
APPROVED BY:____________________________________DATE: __________

Data Sheet No. 13
Photograph Data Sheet

Vehicle:____________________ NHTSA No.: ________________

PHOTOGRAPH CHECKLIST

Pre-test	Post-test	
		A. View of the propulsion battery if any part of it is visible. Do NOT disassemble any parts other than carpet, seats and overlay to take these photographs
		B. View of the electric propulsion drive. Take the best photograph possible without removing any parts.
		C. View of the vehicle passenger compartment adjacent to propulsion battery.
		D. Post-test battery module movement, or retention loss, if applicable.
		E. Post-test battery component intrusion.
		F. Post-test view of test vehicle while vehicle is on static rollover machine.
		G. Photographs of propulsion battery system mounting and/or intrusion failures.
		H. Post-test propulsion battery electrolyte spillage location view.
		I. Labels and markings related to propulsion battery system.
		J. Other photographs requested by COR.

COMMENTS:

RECORDED BY:__________________________________DATE: _________
APPROVED BY:__________________________________DATE: _________

Data Sheet No.14

TEST METHOD USING A DC POWER SUPPLY, VOLTMETER AND AMMETER

Connect the DC power supply use the voltmeter and ammeter to measure current and voltage. The electrical chassis and any exposed conductive part or any two exposed conductive parts that are less than 2.5 meters from each other shall be measured. Refer to figure below

Adjust current flow to more than 0.2 amperes.

What is the voltage at 2.5 meters of exposed conductive parts and protection barriers? ___________V

Distance 2.5 meters	Voltage	Current (I)	Resistance (R=V/I)
Location	(volts)	amps	

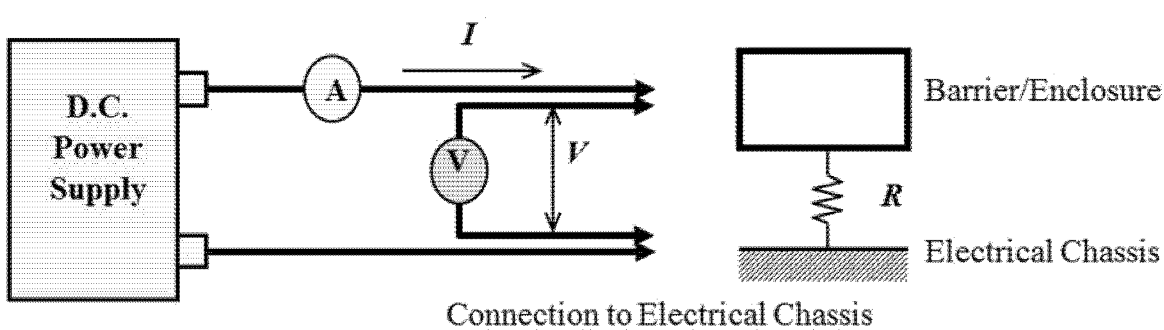


Figure 8. Connection to Determine Resistance between Physical Barrier and Electrical Chassis

Data Sheet No.15

ISOLATION OF HIGH VOLTAGE SOURCES FOR CHARGING THE ELECTRIC ENERGY STORAGE DEVICE

What is the voltage at the high voltage battery source? (It should be 500 volts or more)
___________ volts

Location of Measurement	Required Battery Voltage (500 volts or more) V_b	Measured Battery Voltage (v)

Data Sheet No.16

ELECTRICAL ISOLATION MONITORING

This applies only to Hydrogen Fuel Cell Vehicles:

13.3 Did the dashboard indicator light display “ON”, for loss of isolation of DC high voltage?
Light (______) ON or Light (______) OFF

Remarks ____

____

Data Sheet No.17

ELECTRIC SHOCK PROTECTION DURING CHARGING

An external electrical power supply. This external power supply must have its own ground. Confirm the external power supply is connected to its ground:

YES (   )   NO (   )

Location of external ground:

____

____

Data Sheet No. 18

EVALUATE PROTECTION FROM DIRECT CONTACT WITH HIGH VOLTAGE SOURCES

Determine if any surrounding parts are making contact with high voltage sources, without the use of tools to open or disassemble. Using IPXXB / IPXXD access probe to determine if the electrical protection barrier makes contact with high voltage sources. Insert probe into any gaps or openings. The probe will start from a straight position, both joints of the test finger are rotated progressively through an angle up to 90º and placed in every position. If the IPXXB / IPXXD probe is lit, then high voltage is contacting the surrounding parts.

A low voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp may be connected between the access probe and any high voltage live parts inside the physical barrier to indicate whether live parts were contacted

A mirror or fiberscope may be used to inspect whether the access probe touches high voltage parts inside the physical barrier.

Is the IPXXB / IPXXD access probe lit? YES / NO

Location(s) / Description Vehicle part makes contact with high voltage sources:	Is the IPXXB / IPXXD access probe lit? **YES** IPXXB force 10 Newtons (+/-1) IPXXD force is 1 to 2 Newtons	Is the IPXXB / IPXXD access probe lit? **NO** IPXXB force 10 Newtons (+/-1) IPXXD force is 1 to 2 Newtons

Data Sheet No. 19

ISOLATION OF HIGH VOLTAGE SOURCES FOR CHARGING THE ELECTRIC ENERGY STORAGE DEVICE

Take IPXXD or IPXXB test probe and penetrate the electrical protection barrier. Taking the access probe and place it in every position to evaluate contact with high voltage (500 volts or greater) near its electrical protection barrier. If the technician cannot see inside an opening, a mirror or fiberscope may be used to determine if the indicator light is "ON". The test is a failure, if the probe light is "ON". When the probe is "ON", this indicates high voltage is accessible near its electrical protection barrier.

Check for pass/ fail results. Failed if probe light is "ON"

Location- Place probe into protection barrier, in every position to evaluate contact with high voltage (500 volts or greater)	**PASS**	**FAIL** Failed if probe light is "ON"

Data Sheet No. 20

MEASURE CURRENT BETWEEN EXPOSED CONDUCTIVE PARTS OF ELECTRICAL PROTECTION BARRIERS AND ELECTRICAL CHASSIS

Measure the current of less than 2.5 meters between electrical protection barriers.
Using a voltmeter with a resolution of 0.01 ohms or less

Location of Measurement: Less than 2.5 meters between protection barriers	Measured Current (up to 0.1 amps)

Data Sheet No. 21

MEASURE VOLTAGE BETWEEN EXPOSED CONDUCTIVE PARTS OF ELECTRICAL PROTECTION BARRIERS AND ELECTRICAL CHASSIS

Testing from 12-volt DC battery source from protection barrier, less than 2.5 meters from the battery. Adjust volt meter for current flow to be more than 0.2 amps.

Location of Protection barrier (2.5 m from battery)	Voltage (v)	Current (amps)	Resistance (ohms) Ω