



SURFACE VEHICLE RECOMMENDED PRACTICE

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Vehicle Electromagnetic Immunity - Electrostatic Discharge (ESD)

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

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1. SCOPE

This SAE Standard specifies the ESD test methods and procedures necessary to evaluate electronic modules intended for vehicle use. It describes test procedures for evaluating electronic modules in complete vehicles.

A procedure for verifying the simulator that is used to generate the electrostatic discharges is given in Appendix A.

Functional status classifications for immunity to ESD are given in Appendix B.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 IEC Publication

Copies of these documents are available online at <http://webstore.ansi.org/>

IEC 61000-4-2 (2001-04) Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test

2.1.2 ISO Publication

Copies of these documents are available online at <http://webstore.ansi.org/>

ISO 10605 Road Vehicles - Test Methods for Electrical Disturbances from Electrostatic Discharge

3. DEFINITIONS

3.1 ELECTROSTATIC DISCHARGE (ESD)

A transfer of electrostatic charge between bodies at different potentials occurring prior to contact or induced by an electrostatic field.

3.2 HUMAN ESD MODEL FOR VEHICLE OCCUPANTS

The capacity, voltage, and resistance that characterize a person as a source of an electrostatic charge for automobile conditions. Figure 1 defines the model of capacitance and resistance network. The resistances are 330 Ohm or 2000 Ohm. The capacitance is 150 pF for an occupant outside vehicle. The capacitance is 330 pF for an occupant inside vehicle.

3.3 DUT

Device under test.

3.4 ESD SIMULATOR

An instrument that simulates the human ESD model for vehicle occupants.

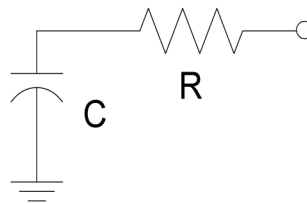


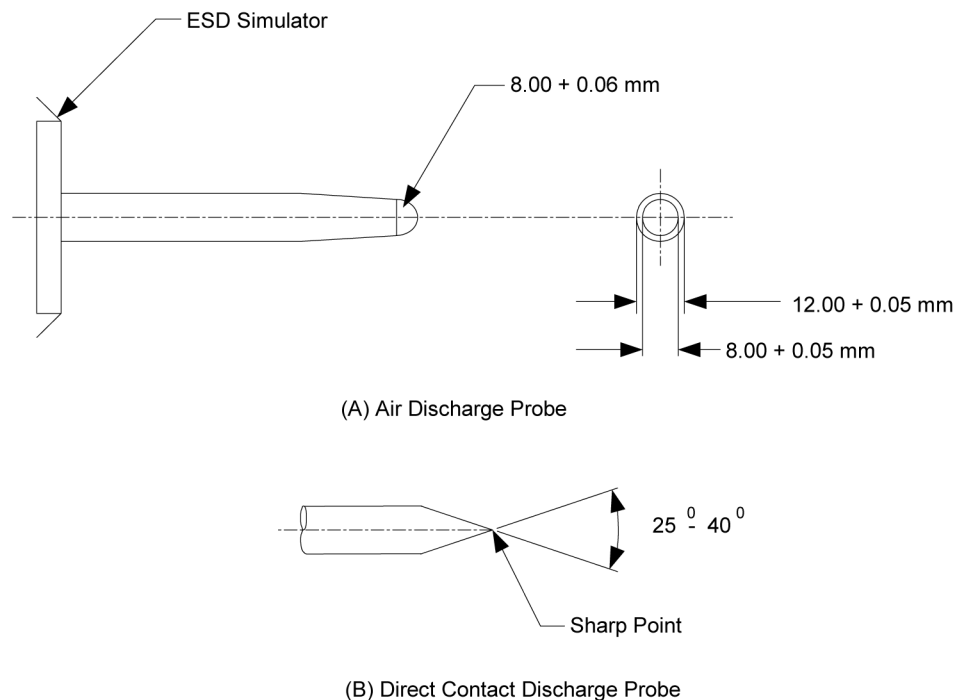
Figure 1 - Human body model

4. TEST EQUIPMENT

This section describes test equipment that is applicable to all parts of this procedure, including Appendix A.

4.1 An ESD simulator that simulates the Human Body ESD model having the following characteristics shall be used:

- a. Voltage Range - Variable from -25 to +25 kV
- b. Capacitance - 330 pF $\pm$ 10%, 150 pF $\pm$ 10%
- c. Resistance - 330 Ohm $\pm$ 10%, 2000 Ohm $\pm$ 10%
- d. Risetime
 1. Direct Contact: 0.7 to 1.0 ns (into a 2 Ohm load)
 2. Air Discharge: less than 20 ns (into a 2 Ohm load)
- e. Tip - (see Figure 2) - IEC 61000-4-2



NOTE 1: The discharge switch (e.g., vacuum relay) shall be mounted as close as possible to the tip of the discharge electrode. Dimensions in millimeters

Figure 2 - ESD Simulator discharge tip probes

4.2 The ESD simulator shall be designed so that the discharge capacitance is fully charged to the desired voltage before the energy can be switched to the device under test and shall not allow bleed-off prior to discharge.

4.3 Measurement Instrumentation

Verification of the risetime for the ESD simulator requires an analog measurement device with a minimum effective single shot bandwidth of 1 GHz or a digital measurement device with a minimum sampling rate of 4 Gigasamples per second and a single shot bandwidth of 1 GHz. The instrument shall have 50 Ohm input impedance. The use of a Faraday shield, to separate the target from the measurement instrumentation, is highly recommended.

4.4 Voltage Probe (Electrometer)

The ESD simulator charging voltage shall be verified using an electrometer (input resistance 100 G Ohm minimum).

5. TEST PROCEDURE

5.1 Record the pertinent test vehicle information or any specific test conditions in the test report.

5.2 Prior to performing the tests, a test plan shall be generated which shall include all the interface test points and respective test levels for each interface to be tested; the vehicle modes of operation such as drive/idle, cruise; and any special instructions and changes from the standard test.

5.2.1 The discharge points, at a minimum, shall include all accessible points, i.e., electrical switches and controls that can be interfaced by an occupant within the passenger compartment. Also any knobs, levers, or handles which would be actuated in the normal operation of the vehicle should be included.

5.2.2 In a standard test sequence, the vehicle's engine is to be running in idle mode.

5.2.3 Before the application of any discharges to the vehicle, the ESD Simulator Discharge Verification procedure of Appendix A shall be performed.

5.3 Test Environment

5.3.1 Temperature Range

Maintain the ambient temperature during the test at $25\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$.

5.3.2 Relative Humidity

The relative humidity between 20% and 60% (20 °C and 30% relative humidity preferred).

5.4 ESD Operation Test Procedure

WARNING: For the safety of lab personnel, live airbags shall be **DISABLED** (mechanics install **INERT** airbags instead) when performing the test.

5.4.1 The ESD test simulator ground wire shall be electrically connected to the vehicle body inside the passenger compartment (see Figure 3). The steel seat adjustment rail or chassis is recommended. Similar approach may be used for underhood and trunk Locations if required. DC resistance shall be less than 1 Ohm.

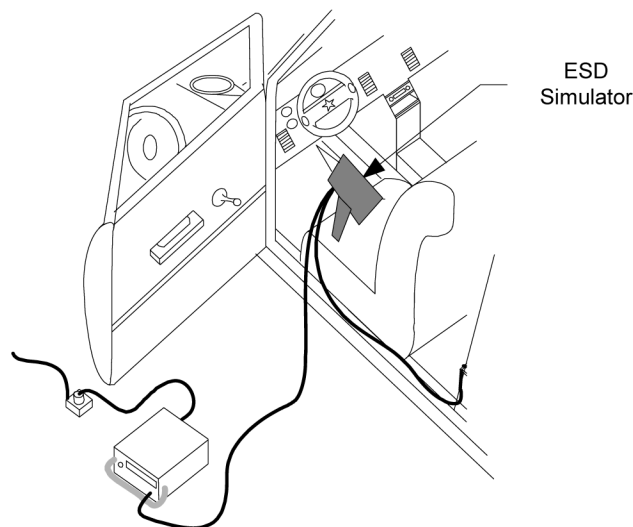


Figure 3 - Vehicle ESD test setup

5.4.2 All discharge points that can be accessed from inside the vehicle shall be tested with the 330 pF 330 Ohm (prefer) or 2000 Ohm probe at ± 4 , ± 8 , and ± 15 kV. Only those discharge points that can be conveniently accessed when standing outside the vehicle (this in effect lowers a person's capacitance) and reaching inside, such as the headlight switch or the ignition switch, shall be additionally tested with the 150 pF 330 Ohm (prefer) or 2000 Ohm probe at ± 25 kV. In this process, the ESD simulator shall be moved towards the discharge point as quickly as possible until either discharge occurs or the electrode touches the discharge point.

NOTE: Should failures occur when testing with air method, re-check by pulling and releasing the gun trigger only when gun is moved at least 0.5 m away from the discharge point. This will avoid any failures due to the radiated transient field induced by the gun relay.

5.4.3 Apply contact discharges to occupant entry or exit discharge locations, specifically the door handles, door window sills and a-pillars with the 330 pF 330 Ohm (prefer) or 2000 Ohm probe at ± 4 , ± 8 , ± 15 and ± 25 kV.