TECHNICAL REPORT

ISO TR 10605

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Road vehicles — Electrical disturbances from electrostatic discharges

Véhicules routiers — Perturbations électriques dues aux décharges électrostatiques

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Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 10605, which is a Technical Report of type 2, was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This document is being issued in the Technical Report (type 2) series of publications (according to subclause G.4.2.2 of part 1 of the IEC/ISO Directives) as a "prospective standard for provisional application" in the field of electrostatic discharge testing of electrical and electronic devices applied in road vehicles, because there is an urgent need for guidance on how standards in this field should be used to meet an identified need.

This document is not to be regarded as an "International Standard". It is proposed for previsional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the ISO Central Secretariat.

A review of this Technical Report (type 2) will be carried out not later than three years after its publication with the options of: extension for another three years; conversion into an International Standard; or withdrawal.

Annexes A and B form an integral part of this Technical Report.

Introduction

The familiar static charge generated and discharged when moving about inside a vehicle or getting out of it has assumed greater significance with the increase of vehicle electronic modules. Tests simulating the electrostatic discharge of humans, in common use by various industries, were examined and it was determined that they were not applicable to the automotive environment. As a consequence, tests tailored to the automotive environment were developed.

Tests that simulate an electrostatic discharge (ESD) into a vehicle electrical system are based on the human ESD model. The ESD model consists essentially of a capacitor formed by a person to his surroundings and discharged through a path that includes the person's resistance. Sensitive electrical devices can be adversely affected by energy either coupled or radiated from electrostatic discharges. This Technical Report describes ESD tests that are applicable to both automotive electronic modules and vehicles.

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Road vehicles — Electrical disturbances from electrostatic discharges

1 Scope

This Technical Report specifies the electrostatic discharge (ESD) test methods necessary to evaluate electronic modules intended for vehicle use. It describes test procedures for evaluating both electronic modules on the bench and complete vehicles.

It applies to all types of road vehicles regardless of the propulsion system (e.g. spark-ignition engine, diesel engine, electric motor).

A procedure for calibrating the simulator that is used to generate the electrostatic discharges is given in annex A.

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

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this Technical Report. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this Technical Report are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 801-2:1991, *Electromagnetic compatibility for industrial-process measurement and control equipment — Part 2: Electrostatic discharge requirements.*

3 Definitions

For the purposes of this Technical Report, the following definitions apply.

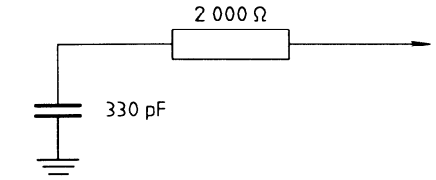
3.1 electrostatic discharge (ESD): Transfer of electrostatic charge between bodies at different potentials occurring prior to contact or induced by an electrostatic field.

3.2 human ESD model for vehicle occupants: Capacity, voltage and resistance that characterize a person as a source of an electrostatic charge for automobile conditions.

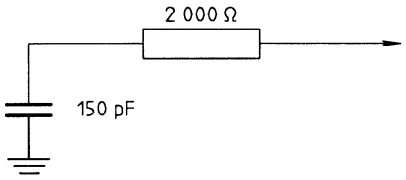
Figure 1 defines the capacitance/resistance parameters for an occupant inside and outside a vehicle. Figure 1a) is also applicable for component tests.

3.3 ground plane: Metal sheet or plate used as a common reference point for the device under test, ESD simulator and auxiliary equipment.

3.4 ESD simulator: Instrument that simulates the human ESD model for vehicle occupants.



a) Inside vehicle and electronic module parameters



b) Outside vehicle parameters

Figure 1 — Human ESD models

4 Test equipment

This test equipment applies to all parts of this test procedure, including annex A.

Test equipment used to verify the functional and parametric requirements of the device under test shall not be sensitive to ESD.

4.1 ESD simulator with the following characteristics:

Voltage range: variable from − 25 kV to + 25 kV

Capacitance: 330 pF ± 10 %, 150 pF ± 10 % (two probes)

Resistance: 2 000 Ω ± 10 %

Risetime:

direct contact: 0,7 ns to 1 ns (at a 2 Ω load)

air discharge: ⩽ 5 ns (at a 2 Ω load)

Tip shapes: in accordance with IEC 801-2, figure 2.

4.1.1 The simulator shall be designed so that the discharge capacitance is fully charged to the desired voltage before the energy is switched to the device under test.

4.1.2 The construction of the ESD simulator shall be such that the high voltage ground and the chassis ground are electrically isolated from each other.

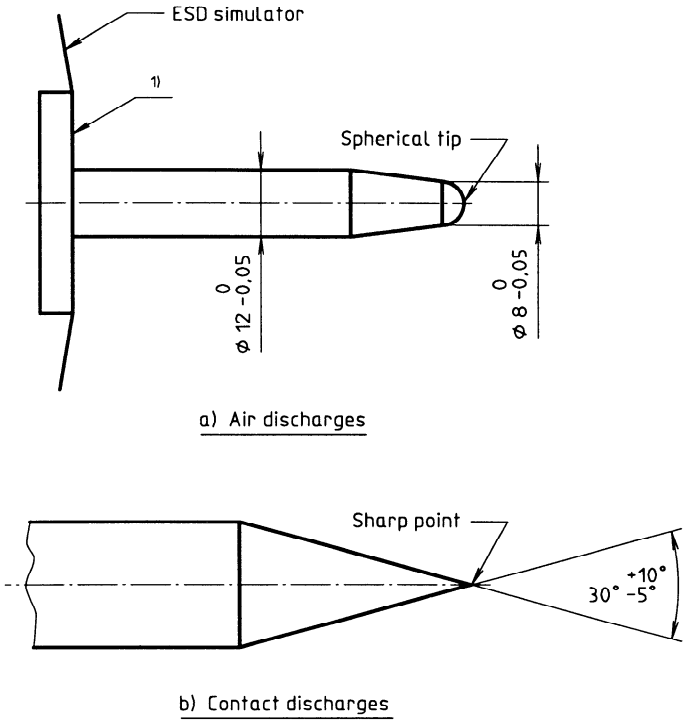
4.1.3 Simulator equipment used shall be of a type that is commercially available.

4.2 Ground plane, a conductive metallic sheet (e.g. copper, brass or galvanized steel) with a minimum thickness of 1 mm and an area of at least 1 m^2, ensuring that it projects beyond the device under test by at least 100 mm on all sides. The ground plane shall be connected to the facility earth ground by a ground strap less than 1 m long and at least 5 mm wide. The inductance of the ground strap shall be ⩽ 2 µH.

4.3 Insulation blocks, if used, shall be constructed of clean, dry Delrin[1] or a similar material. The blocks shall be (25 ± 2,5) mm in height and project beyond the device under test by at least 20 mm on all sides.

1) Delrin is a trade-name. This information is given for the convenience of users of this Technical Report and does not constitute an endorsement by ISO of the product named.

Dimensions in millimetres



1) The discharge switch (e.g. vacuum relay) shall be mounted as close as possible to the tip of the discharge electrode.

Figure 2 — ESD simulator discharge tip probes

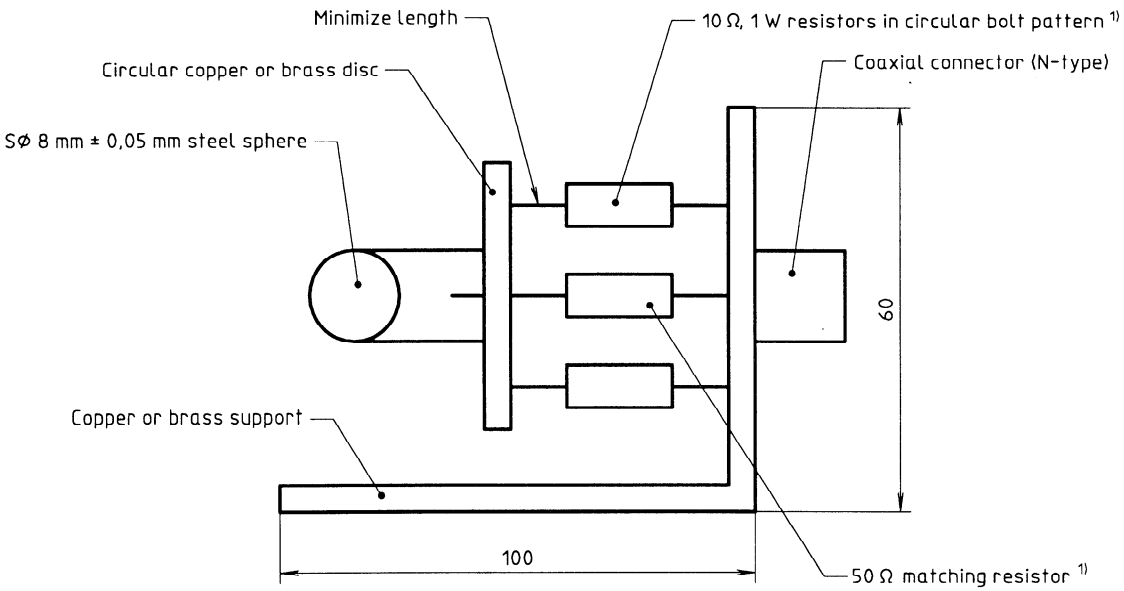
4.4 50 Ω **coaxial target** as shown in figure 3. It is in accordance with IEC 801-2, and available commercially. The target shall be used during the ESD simulator verification in annex A.

4.5 50 Ω, 20 dB **wideband attenuator**, if needed, to be attached to the output of the coaxial target during the simulator verification in annex A.

4.6 **Analog measurement device** with a minimum effective single-shot bandwidth of 1 GHz or **digital measurement device** with a minimum sampling rate of two Giga-samples per second, each with a 50 Ω input impedance, is needed to certify the risetime of the ESD simulator.

4.7 **Electrometer** with a minimum impedance of 100 GΩ, to verify the ESD simulator charging voltage.

Dimensions in millimetres



1) All resistors shall be of high voltage, non-inductive, carbon composite type.

Figure 3 — ESD coaxial target

5 Test procedure for electronic module

5.1 Prior to performing the test, generate a test plan including interface test points, electronic module mode of operation, and any special instructions and changes from the standard test.

5.2 Before applying any discharges to the device under test, perform the ESD simulator discharge verification procedure in annex A.

5.3 Maintain the ambient temperature during the test at (23 ± 5) °C and the relative humidity between 30 % and 60 % unless other values are agreed by the users, in which case such values shall be documented in the test reports.

5.4 Set up the test in accordance with figure 4.

5.5 Connect the ESD simulator high voltage ground directly to the ground plane by a grounding strap as in 4.2.

5.6 Place the device under test at the centre of the ground plane (see figure 4). Place and connect chassis-mounted electronic modules directly to the ground plane. Test electronic modules which will be isolated from ground in normal installation with an insulator between the electronic module and the ground plane using insulation blocks (4.3). Connect all voltage supply pins to an appropriate power source. Provide inputs for all other pins as necessary to put the device under test into a simulated mode of operation.

5.7 Ensure that the device under test is at least in a powered, idling mode.

5.8 Test each exposed shaft, button, switch or surface of the device under test accessible to an occupant inside the vehicle, at each of the voltage levels defined in annex B or as specified in the test plan, in accordance with the methods in 5.8.1 and 5.8.2.

5.8.1 Direct contact discharge: place the ESD simulator in direct contact with all accessible discharge points and test each discharge point to the contact discharge voltage levels in annex B.

5.8.2 Air discharge: place the ESD simulator a minimum of 15 mm away from the device under test. Hold the simulator fingertip probe perpendicular (± 15°) to the discharge location and move it very slowly, i.e. at 5 mm/s or less, towards the device under test until a single discharge is obtained. Test each point to the air discharge voltage levels in annex B.

If no discharge occurs, continue moving the probe towards the device under test until the simulator discharge tip is in contact with the discharge point. If still no discharge occurs, discontinue testing at that voltage level and location.

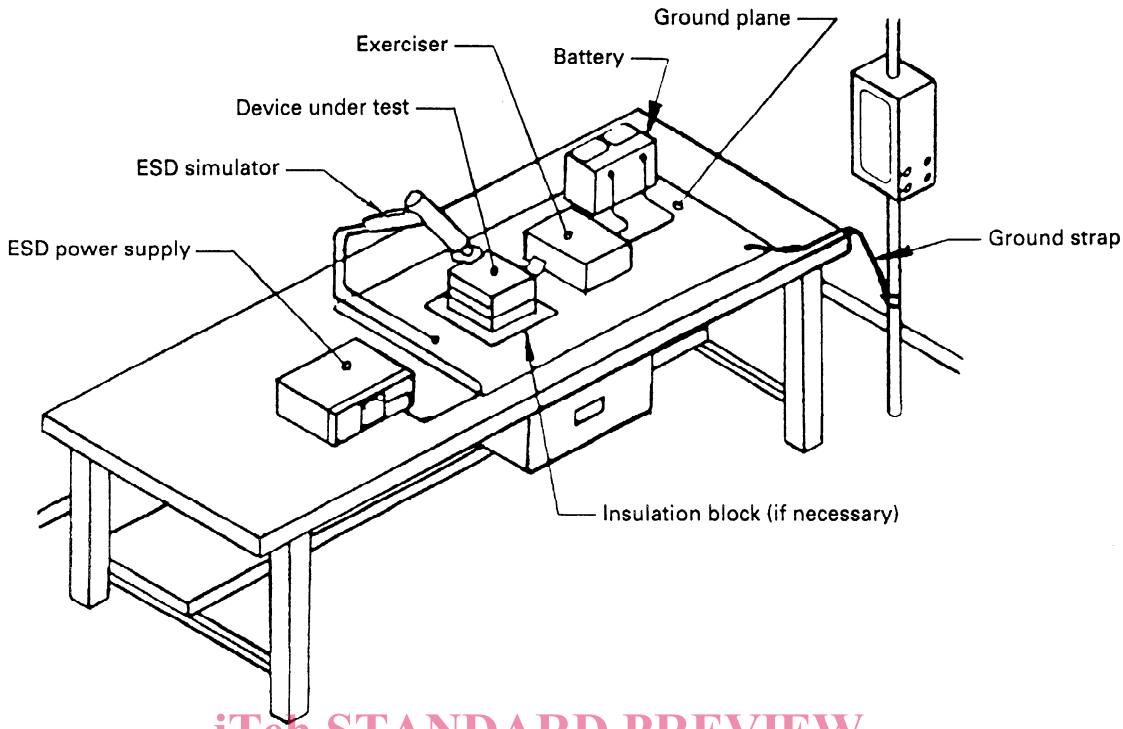


Figure 4 — Electronic module ESD test setup

5.9 Subject each discharge point to a minimum of three positive polarity and three negative polarity discharges at each voltage level, with a minimum time duration between discharges of 5 s.

At each voltage level, all discharge points of a device may be tested first at a single polarity and then with the opposite polarity.

5.10 During and after each series of three discharges, verify that the device under test meets all applicable performance requirements.

5.11 Record all deviations noted (visible, audible, failures, etc.) in the test report.

6 Test procedure for vehicle tests

6.1 Record relevant test vehicle information or any specific test conditions in the test report.

6.2 Prior to performing the test, generate a test plan including all interface test points and their respective test levels for each interface to be tested, vehicle modes of operation such as drive, idle, cruise, and any special instructions and changes from the standard test.

6.3 Include, as the minimum number of discharge points, all electrical switches and controls that can be touched by an occupant of the passenger compartment. Any knobs, levers or handles which are used in the normal operation of the vehicle should also be included.

6.4 In a stardard test sequence, the vehicle's engine is to be running in drive or idle mode. If the test sequence involves tests of systems (e.g. cruise control) at road speeds using a dynamometer, specify the speed in the test plan.

6.5 Before applying any discharges to the vehicle, perform the ESD simulator discharge verification procedure in annex A.

6.6 Connect the ESD test simulator ground cable electrically to the vehicle body inside the passenger compartment (see figure 5). The steel seat adjustment rail or chassis is recommended.