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Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy —

Part 2:
Absorber-lined shielded enclosure

Véhicules routiers — Méthodes d'essai d'un équipement soumis à des perturbations électriques par rayonnement d'énergie électromagnétique en bande étroite —

Partie 2: Chambre anéchoïque

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 32, *Electric and electronic equipment*.

This third edition cancels and replaces the second edition (ISO 11452-2:2004), which has been technically revised.

The main changes compared to the previous edition are as follows:

a) introduction of reference to additional artificial networks (HV-AN, AMN, AAN) for DUT powered by a shielded power system;

b) precisions for ground plane dimensions;

c) suppression of the minimum distance requirement between rear of horn antenna and absorbers;

d) addition of test set-up descriptions and Figures for DUT powered by a shielded power system;

e) suppression of Annex A relative to artificial networks which are now defined in ISO 11452-1; and

f) update of previous Annex C to be in line with new functional performance status classification (FPSC) format.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Immunity measurements of complete vehicles are generally able to be carried out only by the vehicle manufacturer, owing to, for example, high costs of an absorber-lined shielded enclosure (ALSE), the desire to preserve the secrecy of prototypes or a large number of different vehicles models.

For research, development and quality control, a laboratory measuring method can be used by both vehicle manufacturers and equipment suppliers to test electronic components.

Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy —

Part 2:
Absorber-lined shielded enclosure

1 Scope

This document specifies an absorber-lined shielded enclosure method for testing the immunity (off-vehicle radiation source) of electronic components for passenger cars and commercial vehicles regardless of the propulsion system (e.g. spark-ignition engine, diesel engine, electric motor). The device under test (DUT), together with the wiring harness (prototype or standard test harness), is subjected to an electromagnetic disturbance generated inside an absorber-lined shielded enclosure, with peripheral devices either inside or outside the enclosure. It is applicable only to disturbances from continuous narrowband electromagnetic fields. See ISO 11452-1 for general test conditions.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11452-1:2015, *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 1: General principles and terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11452-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

4 Test conditions

The applicable frequency range of the absorber-lined shielded enclosure test method is 80 MHz to 18 GHz.

The user shall specify the test severity level(s) over the frequency range. Suggested test levels are included in Annex B.

Standard test conditions shall be according to ISO 11452-1 for the following:

— test temperature;

— supply voltage;

— modulation;

— dwell time;

— frequency step sizes;

— definition of test severity levels; and

— test signal quality.

5 Test location

The tests shall be performed in an ALSE.

The purpose of such an enclosure is to create an isolated electromagnetic compatibility test facility which simulates open field testing. Basically, an ALSE consists of a shielded room with absorbing material on its internal reflective surfaces except the floor. However, flat ferrite tiles with a maximum thickness of 25 mm may be optionally applied on the floor.

The same ALSE configuration shall be used for calibration and the DUT test.

The design objective is to attenuate the reflected energy in the test area by at least 10 dB compared to the direct energy.

NOTE In order to achieve this objective, the performance of the absorbing material for the walls and ceiling can be greater than or equal to 6 dB in the frequency range of use. A test method for evaluating absorbing material is described in IEEE STD 1128-1998[1].

6 Test apparatus and instrumentation

6.1 General

Radiated electromagnetic fields are generated using antennas with a radio frequency (RF) energy source capable of producing the desired field strengths. A set of antennas and multiple RF amplifiers could be required to cover the range of test frequencies.

6.2 Measuring equipment

6.2.1 Field-generating device, any available antenna (including high-power baluns, if appropriate) capable of radiating the specified field strength at the DUT with the available power may be used. The construction and orientation of any field-generating device shall be such that the generated field can be polarized in the mode specified in the test plan.

6.2.2 Field probes, shall be electrically small in relation to the wavelength, isotropic and with three orthogonal axes. The communication lines from the probe shall be fibre optic links.

6.2.3 Artificial networks (AN), high voltage artificial networks (HV-AN), artificial mains networks (AMN), and asymmetric artificial networks (AAN), see 7.2 and ISO 11452-1: 2015, Annex B.

6.2.4 RF generator, with internal (or external) modulation capabilities.

6.2.5 High-power amplifier.

6.2.6 Power meter and/or **power sensors** (or equivalent measuring instrument) and dual directional coupler, for measuring forward power and reflected power.

6.3 Stimulation and monitoring of DUT

The device under test (DUT) shall be operated as required in the test plan by actuators that have a minimum effect on the electromagnetic characteristics, e.g. plastic blocks on the push-buttons, pneumatic actuators with plastic tubes.

Connections to equipment monitoring electromagnetic interference reactions of the DUT may be accomplished by using fibre-optics, or high-resistance leads. Other types of lead may be used but require extreme care to minimize interactions. The orientation, length and location of such leads shall be carefully documented to ensure repeatability of test results.

Any electrical connection of monitoring equipment to the DUT may cause malfunctions of the DUT. Extreme care shall be taken to avoid such an effect.

7 Test set-up for DUT powered by an unshielded power system

7.1 Ground plane

The ground plane shall be made of 0,5 mm thick (minimum) copper, brass or galvanized steel.

The minimum width of the ground plane shall be 1 000 mm, or the width of the entire underneath of the test setup (DUT and associated equipment (e.g. harness including supply lines, load simulator located on the test bench and AN(s)), excluding battery and/or power supply) plus 200 mm, whichever is the larger.

The minimum length of the ground plane shall be 2 000 mm, or the length of the entire underneath of the test setup (DUT and associated equipment (e.g. harness including supply lines, load simulator located on the test bench and AN(s)), excluding battery and/or power supply) plus 200 mm, whichever is the larger.

The height of the ground plane (test bench) shall be (900 ± 100) mm above the floor.

The ground plane shall be bonded to the shielded enclosure such that the DC resistance shall not exceed 2,5 mΩ. The distance from the edge of the ground strap to the edge of the next strap shall not be greater than 300 mm. The maximum length to width ratio for the ground straps shall be 7:1.

7.2 Power supply and AN

Each DUT power supply lead shall be connected to the power supply through an AN.

Power supply is assumed to be negative ground. If the DUT utilizes a positive ground, then the test set-ups shown in the figures shall be adapted accordingly. Power shall be applied to the DUT via a 5 µH/50 Ω AN (see ISO 11452-1:2015, Annex B for the schematic). The number of ANs required depends on the intended DUT installation in the vehicle.

— For a remotely grounded DUT (vehicle power return line longer than 200 mm), two ANs are required: one for the positive supply line and another for the power return line (see Annex A).

— For a locally grounded DUT (vehicle power return line 200 mm or shorter), only one AN is required, for the positive supply (see Annex A).

The AN(s) shall be mounted directly on the ground plane. The case or cases of the AN(s) shall be bonded to the ground plane.

The power supply return shall be connected to the ground plane between the power supply and the AN(s).

The measuring port of each AN shall be terminated with a 50 Ω load.

The length of the power supply lines between the power supply and the load simulator shall be as short as possible and defined in the test plan. Unless otherwise specified, the power supply lines between the power supply and the load simulator shall be placed directly on the ground plane.

7.3 Location of DUT

The DUT shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material ($\varepsilon_r \leq 1{,}4$), at (50 ± 5) mm above the ground plane unless otherwise specified in the test plan.

The case of the DUT shall not be grounded to the ground plane unless it is intended to simulate the actual vehicle configuration.

The front of the DUT shall be located at a distance of (200 ± 10) mm from the edge of the ground plane.

7.4 Location of test harness

The part of the test harness parallel to the front edge of the ground plane shall be (1 500 ± 75) mm.

The total length of the test harness between the DUT and the load simulator (or the RF boundary) shall be $(1\,700\ ^{+300}_{\ \ 0})$ mm. The wiring type is defined by the actual system application and requirement.

The detailed layout of the harness on DUT side between the ground plane front edge and the DUT connector(s) shall be described in the test plan.

The test harness shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material ($\varepsilon_r \leq 1{,}4$), at (50 ± 5) mm above the ground plane.

The part of the test harness parallel to the front edge of the ground plane shall be at a distance of (100 ± 10) mm from the edge of the ground plane.

7.5 Location of load simulator

Unless otherwise specified in the test plan, the load simulator shall be placed directly on the ground plane. If the load simulator has a metallic case, this case shall be bonded to the ground plane.

Alternatively, the load simulator may be located adjacent to the ground plane (with the case of the load simulator bonded to the ground plane) or outside of the test chamber, provided the test harness from the DUT passes through an RF boundary bonded to the ground plane. The layout of the test harness that is connected to the load simulator shall be defined in the test plan and recorded in the test report.

When the load simulator is located on the ground plane, the DC power supply lines of the load simulator shall be connected through the AN(s).

7.6 Location of field generating device (antenna)

The height of the phase centre of the antenna shall be (100 ± 10) mm above the ground plane.

No part of any antenna radiating element shall be closer than 250 mm to the floor. The radiating elements of the antenna, excluding the rear part of the horn antenna, shall not be closer than 500 mm to any absorber material.

The distance between the wiring harness and the antenna shall be (1 000 ± 10) mm. This distance is measured from:

— the phase centre (mid-point) of the biconical antenna; or

— the nearest part of the log-periodic antenna; or

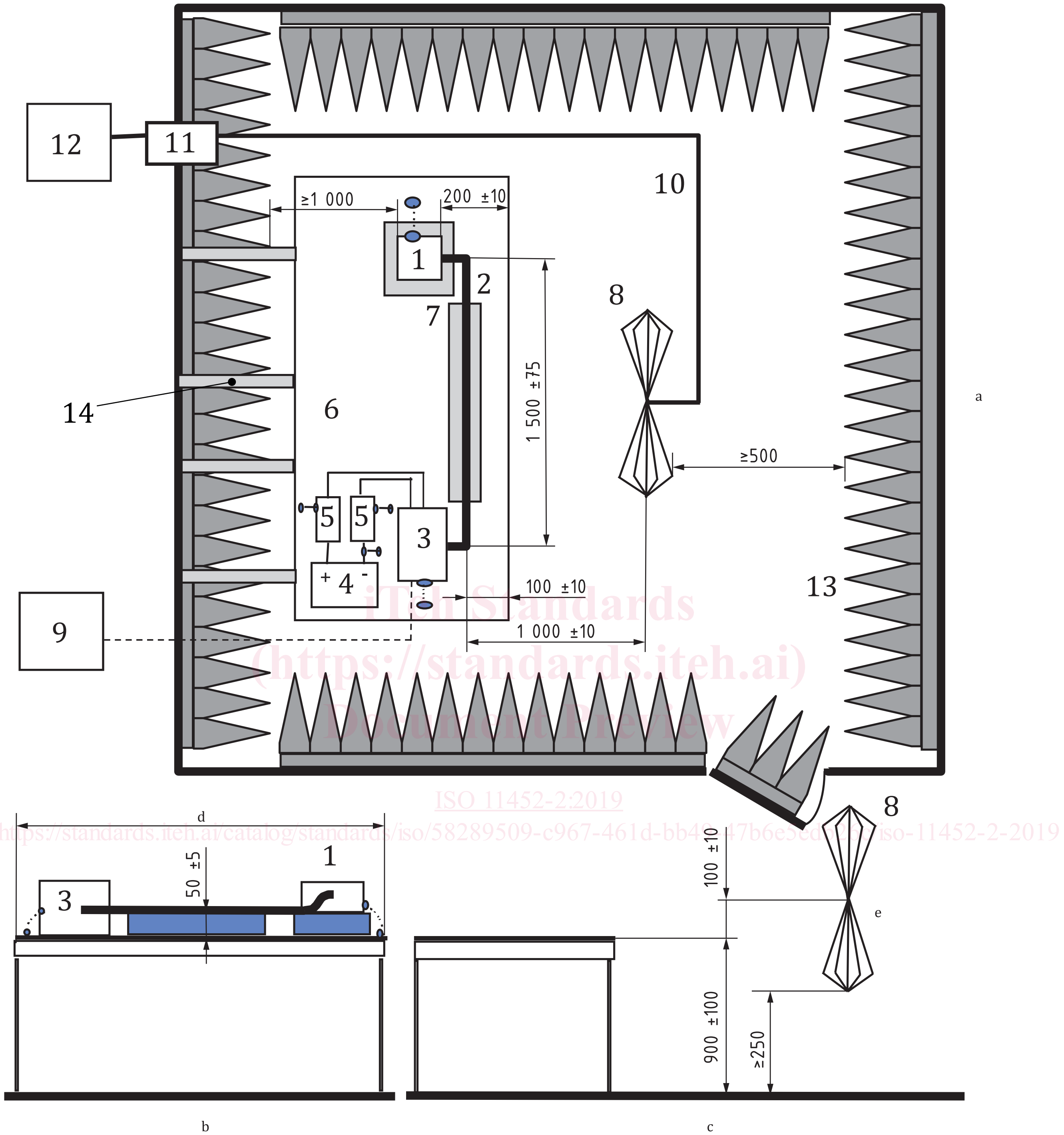
— the nearest part of the horn antenna.

The phase centre of the antenna for frequencies from 80 MHz to 1 000 MHz shall be in line with the centre of the longitudinal part (1 500 mm length) of the wiring harness.

The phase centre of the antenna for frequencies above 1 000 MHz shall be in line with the DUT.

Examples of test set-ups are shown in Figures 1 to 3.

Dimensions in millimetres



Key

1 DUT (grounded locally if required in test plan)
2 test harness
3 load simulator (placement and ground: connection according to 7.5)
4 power supply (location optional)
5 artificial network (AN)
6 ground plane (bonded to shielded enclosure)
a Upper view (horizontal polarisation).
b Front view.
7 low relative permittivity support ($\varepsilon_r \leq 1,4$)
8 biconical antenna
9 stimulation and monitoring system
10 high quality double-shielded coaxial cable (50 Ω)
11 bulkhead connector
12 RF signal generator and amplifier
13 RF absorber material
14 ground straps

