INTERNATIONAL STANDARD

ISO 11452-3

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

Part 3: Transverse electromagnetic (TEM) cell

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

Partie 3: Cellule à mode électromagnétique transverse (TEM)

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 11452 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11452-3 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This second edition cancels and replaces the first edition (ISO 11452-3:1995), which has been technically revised.

ISO 11452 consists of the following parts, under the general title *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy*:

— *Part 1: General and definitions*

— *Part 2: Absorber-lined shielded enclosure*

— *Part 3: Transverse electromagnetic (TEM) cell*

— *Part 4: Bulk current injection (BCI)*

— *Part 5: Stripline*

— *Part 6: Parallel plate antenna*

— *Part 7: Direct radio frequency (RF) power injection*

Annexes A to D of this part of ISO 11452 are for information only.

Introduction

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

The TEM cell method has the major advantage of not radiating energy into the surrounding environment. The method can be used for testing either the immunity of a component with the field coupling to the wiring harness or the immunity of the component alone with minimum exposure to the wiring harness.

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

Part 3: Transverse electromagnetic (TEM) cell

1 Scope

This part of ISO 11452 specifies transverse electromagnetic (TEM) cell tests for determining the immunity of electronic components of passenger cars and commercial vehicles to electrical disturbances from narrowband radiated electromagnetic energy, regardless of the vehicle propulsion system (e.g. spark-ignition engine, diesel engine, electric motor).

The electromagnetic disturbances considered are limited to continuous narrowband electromagnetic fields.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this part of ISO 11452. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 11452 are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 11452-1, *Road vehicles — Component test methods for electrical disturbances by narrowband radiated electromagnetic energy — Part 1: General and definitions*.

3 Terms and definitions

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

4 Test conditions

The upper frequency range limit of the TEM cell is a direct function of the TEM cell dimensions.

For testing automotive electronic systems, a 0,01 MHz to 200 MHz TEM cell should be used. See annex A for suggested cell dimensions.

The user shall specify the test severity level or levels over the frequency range. See annex D for suggested test severity levels.

Standard test conditions shall be those given in ISO 11452-1 for the following:

— test temperature;

— supply voltage;

— modulation;

— dwell time;

— frequency step sizes;

— definition of test severity levels;

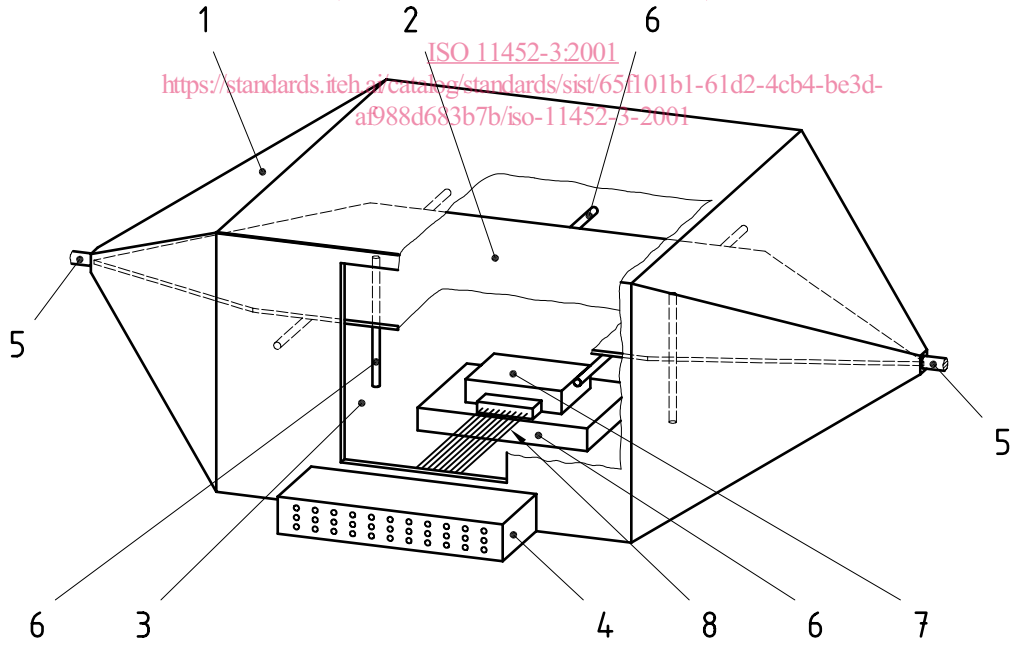
— test-signal quality.

5 Test apparatus

5.1 TEM cell

The TEM cell used for this test is a rectangular coaxial line with a 50 Ω characteristic impedance (see Figure 1). The device under test is exposed to a uniform TEM field.

The TEM cell is a laboratory measurement system which can be used to generate test fields within 2 dB of the theoretical value if the device under test does not occupy an excessive portion of the test volume (see 5.3).



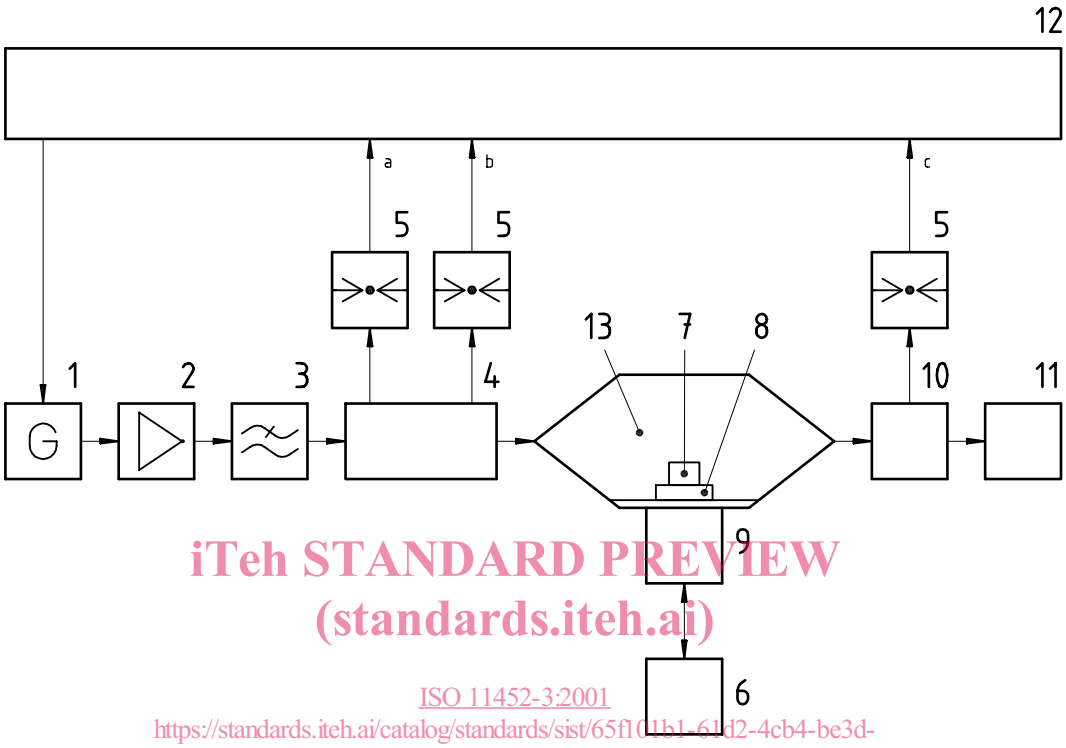
Key

1 Outer conductor (shield)
2 Septum (inner conductor)
3 Access door
4 Connector panel (optional)
5 Coaxial connectors
6 Dielectric support (relative permittivity $\varepsilon_r \leqslant 1{,}4$)
7 Device under test
8 Input/output leads

Figure 1 — TEM cell

5.2 Instrumentation

Figure 2 shows an example of a TEM cell test set-up. The TEM cell has high resonances in the region greater than the recommended upper frequency limit. A low pass filter with an attenuation of at least 60 dB at frequencies above 1,5 times the cut-off frequency of the TEM cell shall be installed (e.g. 200 MHz TEM cell: 60 dB for frequencies above 300 MHz).



Key

1 Signal generator
2 Broadband amplifier
3 Low pass filter
4 Dual-directional coupler (30 dB decoupling ratio minimum)
5 RF-power meter
6 Peripheral
7 Device under test
8 Dielectric support
9 Low pass filters/connector panel
10 Coupler
11 High power load (50 Ω)
12 Controller
13 TEM cell

a $P_{\text{reflected}}$ (reflected power).

b P_{forward} (forward power).

c P_{output} (output power).

Figure 2 — Example TEM cell configuration

5.3 Test set-up

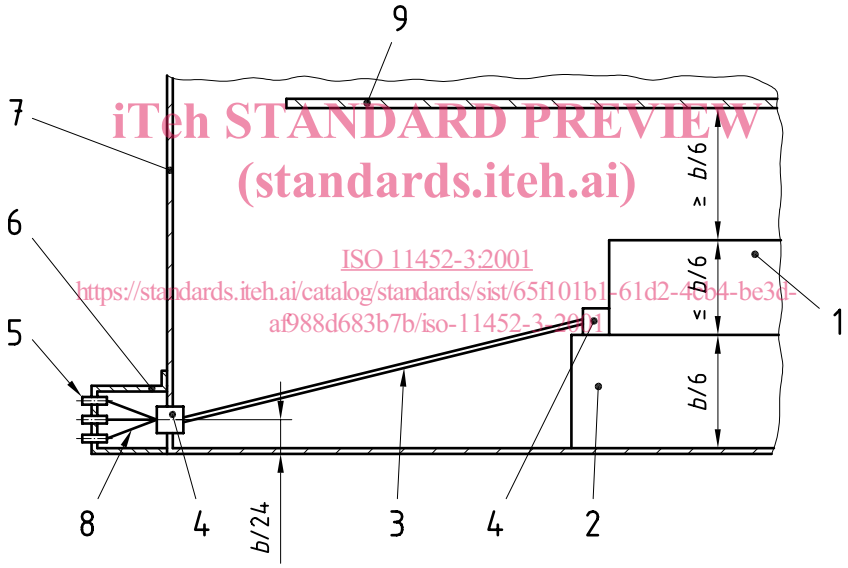
5.3.1 General

In order to maintain the homogeneous field in the TEM cell and obtain reproducible measurement results, the device under test shall be no larger than one-sixth of the cell (inside) height, b (see Figure 3 and Figure A.1). The device under test should be placed in the centre of the cell on a dielectric equipment support.

The device under test and the wiring harness may be positioned in either of two arrangements, depending on whether the exposure of the device under test and the wiring harness (5.3.2) or that of the device alone (5.3.3) is being tested.

5.3.2 Exposure of device under test and wiring harness (for major field coupling to the harness)

The height of the dielectric support is one sixth of cell height b (see Figure 3). In order to obtain reproducible measurement results, the device under test together with its wiring harness or printed circuit board shall be placed in the same position in the TEM cell for each measurement. In addition to the direct RF-field coupling to the device under test, the use of an unshielded harness or printed circuit board will result in a common mode electrical field coupling and a differential mode magnetic field coupling, depending on the inclination and the width of the harness or circuit board.

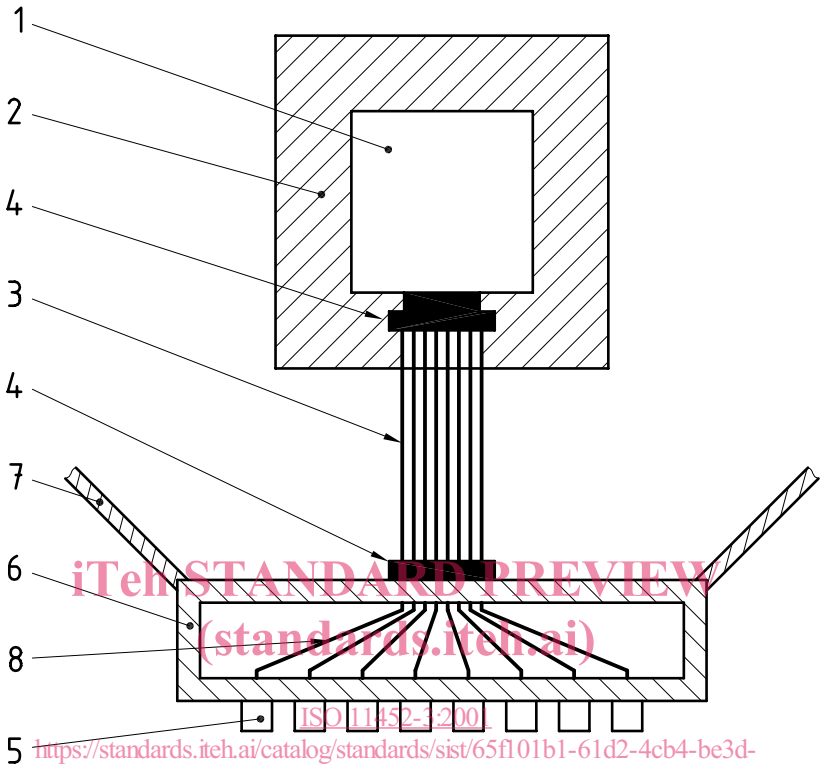


Key

1 Device under test
2 Dielectric support (relative permittivity $\varepsilon_r \leqslant 1{,}4$)
3 Printed circuit board (no ground plane) or wiring harness, unshielded
4 Connector
5 Coaxial connectors
6 Connector panel
7 TEM cell wall
8 Cables
9 Septum
b TEM cell height (see annex A)

Figure 3 — Example test set-up — Major field coupling to wiring harness (side view)

The connector panel should be attached to the TEM cell as close as possible to the printed lead system. The supply and signal leads from the connector in the cell wall are directly connected to the device under test using either a printed circuit board of length suitable for positioning the device under test in the allowed working region of the TEM cell, or a set of leads secured to a rigid support (see Figure 3 and Figure 4). The printed circuit board or supported wiring harness between the connector and the device under test will yield reproducible measurement results if the position of the leads and the device under test in the TEM cell are fixed.



Key

1 Device under test
2 Dielectric support (relative permittivity $\varepsilon_r \leqslant 1{,}4$)
3 Printed circuit board or wiring harness
4 Connector
5 Coaxial connectors
6 Connector panel
7 TEM cell wall
8 Cables

NOTE RF filters can be connected to the coaxial connectors in the connector panel or directly to the connector in the TEM cell wall.

Figure 4 — Example test set-up — Major field coupling to wiring harness (top view)

5.3.3 Exposure of device under test alone (for major field coupling to that device)

The height of the dielectric support is 50 mm (see Figure 5). In order to obtain reproducible measurement results, the device under test shall be placed in the same position in the TEM cell for each measurement.