INTERNATIONAL STANDARD

ISO 11452-2

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Road vehicles — Electrical disturbances by narrowband radiated electromagnetic energy — Component test methods —

Part 2:
Absorber-lined chamber

Véhicules routiers — Perturbations électriques par rayonnement d'énergie électromagnétique en bande étroite — Méthodes d'essai d'un composant —

Partie 2: Chambre anéchoïque

Reference number
ISO 11452-2:1995(E)

Contents

Annex

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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.

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.

International Standard ISO 11452-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

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

- *Part 1: General and definitions*
- *Part 2: Absorber-lined chamber*
- *Part 3: Transverse electromagnetic mode (TEM) cell*
- *Part 4: Bulk current injection (BCI)*
- *Part 5: Stripline*
- *Part 6: Parallel plate antenna*
- *Part 7: Direct radio frequency (RF) power injection*

Annex A of this part of ISO 11452 is for information only.

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Road vehicles — Electrical disturbances by narrowband radiated electromagnetic energy — Component test methods —

Part 2:
Absorber-lined chamber

1 Scope

This part of ISO 11452 specifies test methods and procedures for testing electromagnetic immunity (off-vehicle radiation sources) of electronic components for passenger cars and commercial vehicles regardless of the propulsion system (e.g. spark-ignition engine, diesel engine, electric motor). To perform this test method, the electronic module along with the wiring harness (prototype or standard test harness) and peripheral devices are subjected to the electromagnetic disturbance generated inside an absorber-lined chamber. The electromagnetic disturbances considered in this part of ISO 11452 are limited to continuous narrowband electromagnetic fields.

Immunity measurements of complete vehicles are generally only possible by the vehicle manufacturer. The reasons, for example, are the high costs of an absorber-lined chamber, preserving the secrecy of prototypes, or the large number of different vehicle models. Therefore, for research, development and quality control, a laboratory measuring method is used by the manufacturer.

Part 1 of ISO 11452 gives general information, definitions, practical use and basic principles of the test procedure.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 11452. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 11452 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.

ISO 11452-1:1995, *Road vehicles — Electrical disturbances by narrowband radiated electromagnetic energy — Component test methods — Part 1: General and definitions.*

3 Test conditions

3.1 Test temperature and supply voltage

The ambient temperature during the test shall be (23 ± 5) °C.

The supply voltage during the test shall be (13,5 ± 0,5) V for 12 V electrical systems and (27 ± 1) V for 24 V electrical systems.

If other values are agreed by the users of this part of ISO 11452, the values shall be documented in the test report.

3.2 Frequency range

The applicable frequency range of the test method is 200 MHz to 18 000 MHz.

3.3 Modulation

The device under test determines the type and frequency of modulation. If no values are agreed between the users of this part of ISO 11452, the following shall be used:

— no modulation (CW);

— 1 kHz sine-wave amplitude modulation (AM) of 80 %.

3.4 Dwell time

At each frequency, the device under test shall be exposed to the test level for the minimum response time needed to control it. In all cases, this minimum time of exposure shall not be less than 2 s.

3.5 Frequency step sizes

All tests in this part of ISO 11452 shall be conducted with linear frequency step sizes not greater than those specified in table 1.

Table 1 — Frequency step sizes

Frequency band MHz	**Maximum frequency step size** MHz
>200 to ≤1 000	20
>1 000 to ≤18 000	200

Alternatively, logarithmic frequency steps, with the same minimum number of frequency steps in each frequency band, may be used. The values, as agreed by the users of this part of ISO 11452 shall be documented in the test report.

If it appears that the susceptibility thresholds of the device under test are very near the chosen test level, these frequency step sizes should be reduced in the frequency range concerned in order to find the minimum susceptibility thresholds.

3.6 Test severity levels

The user should specify the test severity level(s) for the field strength over the frequency range. Suggested test severity levels are given in annex A.

These test severity levels are expressed in terms of the equivalent root-mean-square value of the unmodulated wave.

Tests are generally performed in both horizontal and vertical polarizations over the test frequency range. Any exceptions to this practice shall be specified in the test plan.

4 Test instrument description and specifications

For the test, radiated electromagnetic fields are generated by using antenna sets with radio frequency (RF) sources capable of producing the desired field strengths over the range of test frequencies. The fields are monitored with small probes to ensure proper test levels. To reduce test error, the operation of the device under test is usually monitored by optical couplers.

4.1 Absorber-lined chamber

The objective of an absorber-lined chamber is to create an indoor electromagnetic compatibility test facility which simulates open field testing. The chamber is lined with absorbing material on as many surfaces in the chamber as possible to minimize reflections and resonances. The design objective is to reduce the reflectivity in the test area to − 10 dB or less.

The size, shape and construction of an absorber-lined chamber can vary considerably. The chamber shape is a function of the types of tests to be performed, the size of the device to be tested and the frequency range to be covered. Basically, an absorber-lined chamber consists of a shielded room with absorbing material on its internal reflective surfaces, optionally excluding the floor. The minimum size of the room is determined by the size of the test region needed, the size of the field generation device and the clearances required between them and the largest device that is to be tested. To create the test region, the absorber, field generation system, and chamber shape are selected to reduce the amount of extraneous energy in the test region below a minimum value which will give the desired measurement accuracy.

4.2 Instrumentation

4.2.1 Field generating device

The field generating device shall be an antenna. Any commercially available antenna set (including high power baluns if appropriate) which is capable of radiating the specified field strengths at the device under test 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.

4.2.2 Monitoring of the device under test

Test equipment, appropriate to the test power levels, required to monitor the operation of the device under test shall be coupled to the control centre by fibre-optic links or high resistance leads.

Any electrical connection of a monitoring device to the device under test may cause malfunctions of the device under test. Extreme care shall be taken to avoid such an effect.

4.2.3 Field probes

Field probes should be isotropic. The transmission lines from the probes should be either very high resistance or fibre-optic links.

4.3 Test set-up

4.3.1 Installation of the device under test

Examples of the test configuration are shown in figures 1 to 3. The device under test with standard test wiring harness and actual or simulated loads shall be used in the test. The device under test, test harness and other peripherals which are part of the test are placed on a test bench. The length of the test harness shall be (1,5 ± 0,075) m. The wiring type is defined by the actual system application and requirement.

The faces of the device under test shall be located at a minimum distance of 100 mm from the edge of the ground plane. All leads and cables shall be a minimum of 100 mm from the edge of the ground plane and the distance to the ground plane (from the lowest point of the harness) shall be $(50\ ^{+10}_{\ 0})$ mm above the ground plane.

The device under test shall be placed at (100 ± 5) mm from the longitudinal line of the wiring harness (see figure 1).

Power shall be applied to the device under test via a 5 µH/50 Ω artificial network.

4.3.2 Location of field generating device

The phase centre of any antenna shall be 1 m above the floor. No part of any antenna radiating elements shall be closer than 0,25 m to the floor.

The radiating elements of the field generating devices shall not be closer than 0,5 m to any absorbent material and shall not be closer than 1,5 m to the wall of the chamber.

The distance between the antenna and the wiring harness shall be (1 ± 0,01) m. This distance is measured from

— the phase centre of the biconical antenna;

— the nearest part of the log periodic antenna;

— the nearest part of the horn antenna.

The phase centre of the antenna shall be in line with the centre of the wiring harness.

4.3.3 Test bench description

The test shall be performed inside an absorber-lined chamber on a table with either non-metallic or metallic surface (see 4.3.3.1 and 4.3.3.2 respectively).

The use of non-metallic or metallic table may induce significant differences in test results. The type of test bench shall be specified in the test plan and recorded in the test report.

4.3.3.1 Non-metallic table

The table shall be constructed of non-metallic material 0,9 m above the floor (either metallic or absorber-lined). The system under test shall not be connected to the chamber ground.

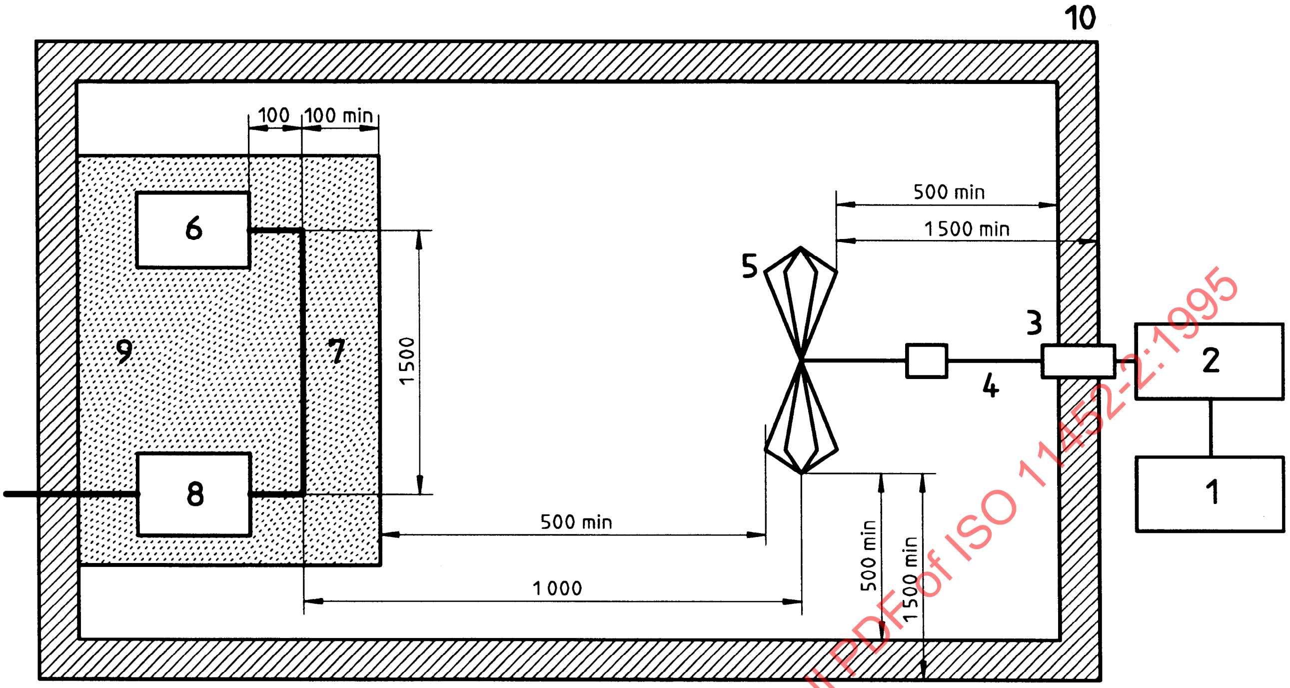
4.3.3.2 Metallic table

The table shall be metallic or a table with a metallic top. The metallic surface shall be constructed from copper, brass or galvanized steel.

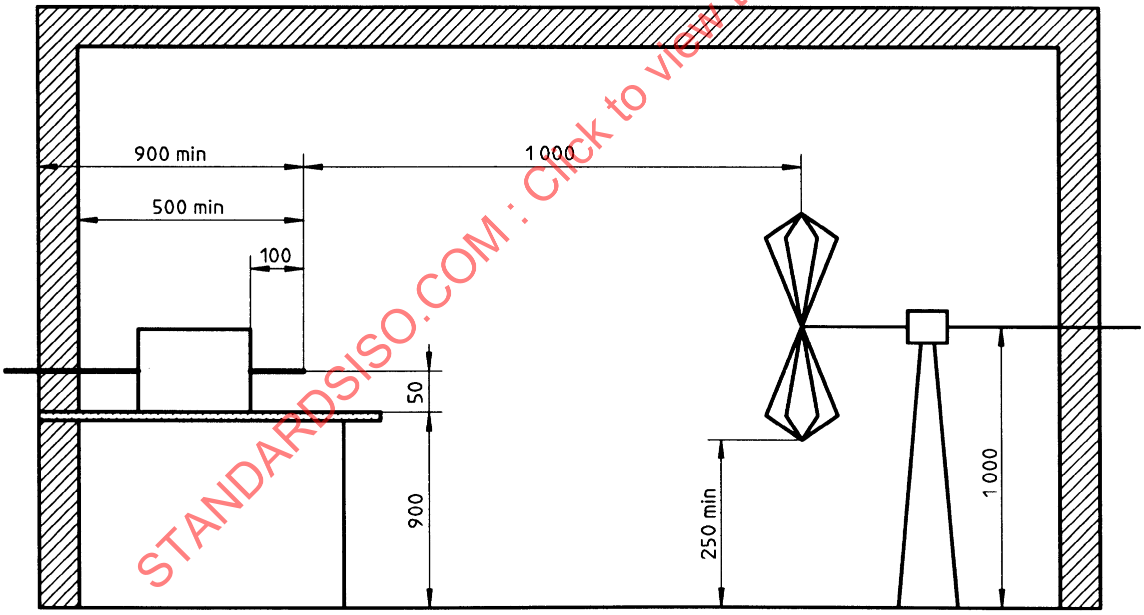
The minimum thickness of the metallic surface shall be 0,5 mm. It shall be 2,25 m^2 or larger in area with the smaller side no less than 0,75 m. The height shall be 0,9 m above the floor of the shielded enclosure.

It shall be bonded to the wall of the shielded room at not more than 300 mm intervals to achieve a bonding resistance less than 2,5 mΩ.

Dimensions in millimetres



a) Top view (horizontal polarization)



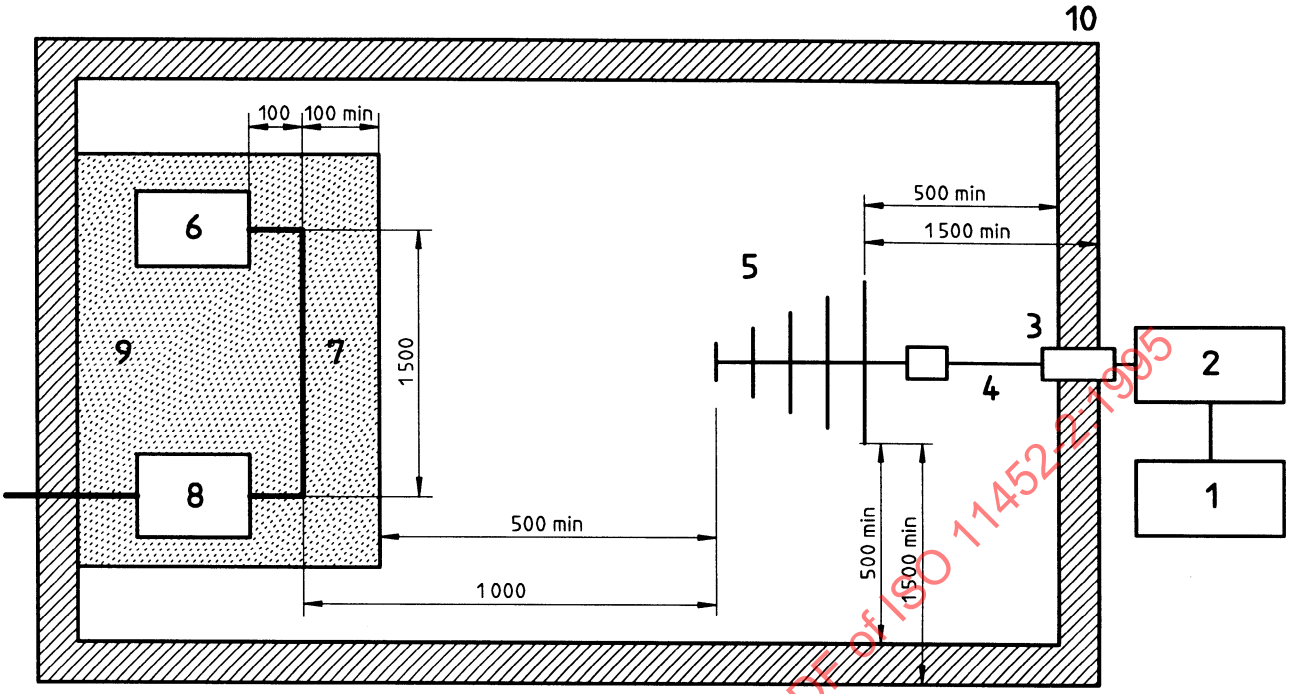
b) Side view (vertical polarization)

Key

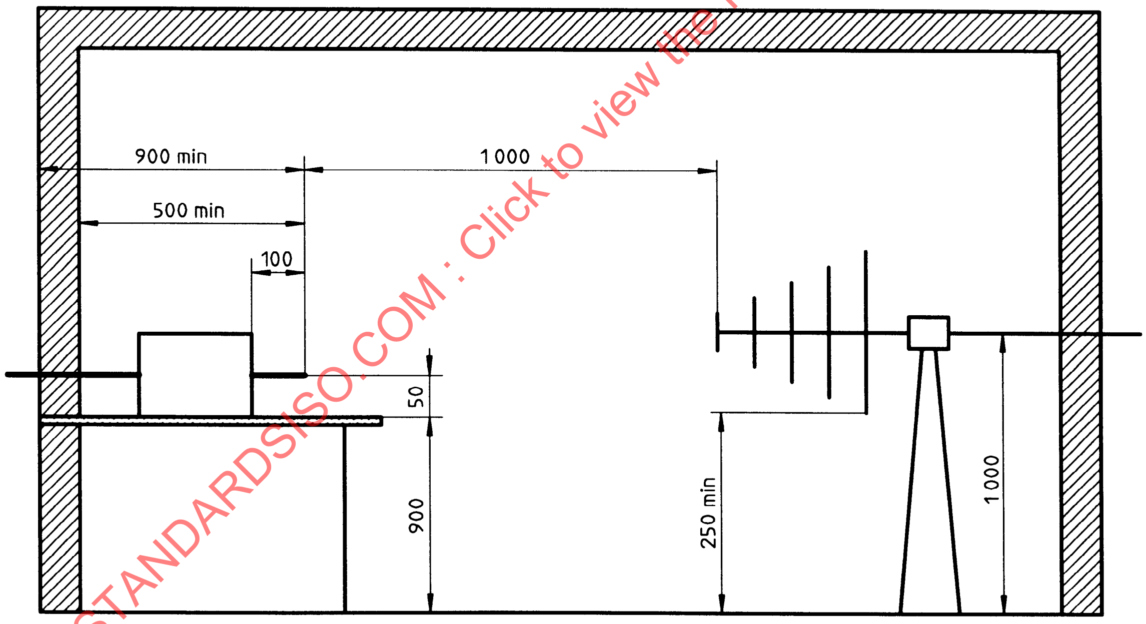
1	Signal generator	6	Device under test
2	Amplifier	7	Wiring harness (power and signal lines)
3	Bulkhead connector	8	Artificial network (power lines)
4	Double shielded coaxial cable	9	Test bench
5	Antenna	10	Typical RF absorber

Figure 1 — Example of test configuration — Biconical antenna

Dimensions in millimetres



a) Top view (horizontal polarization)



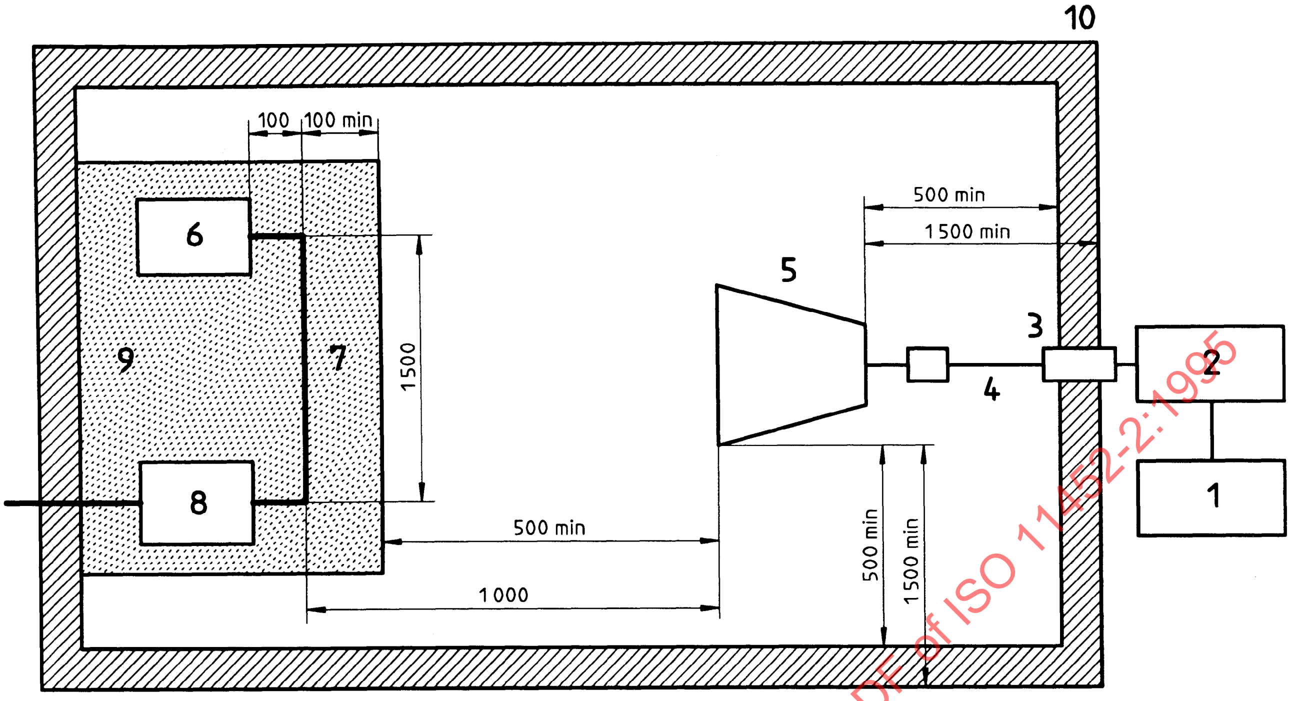
b) Side view (vertical polarization)

Key

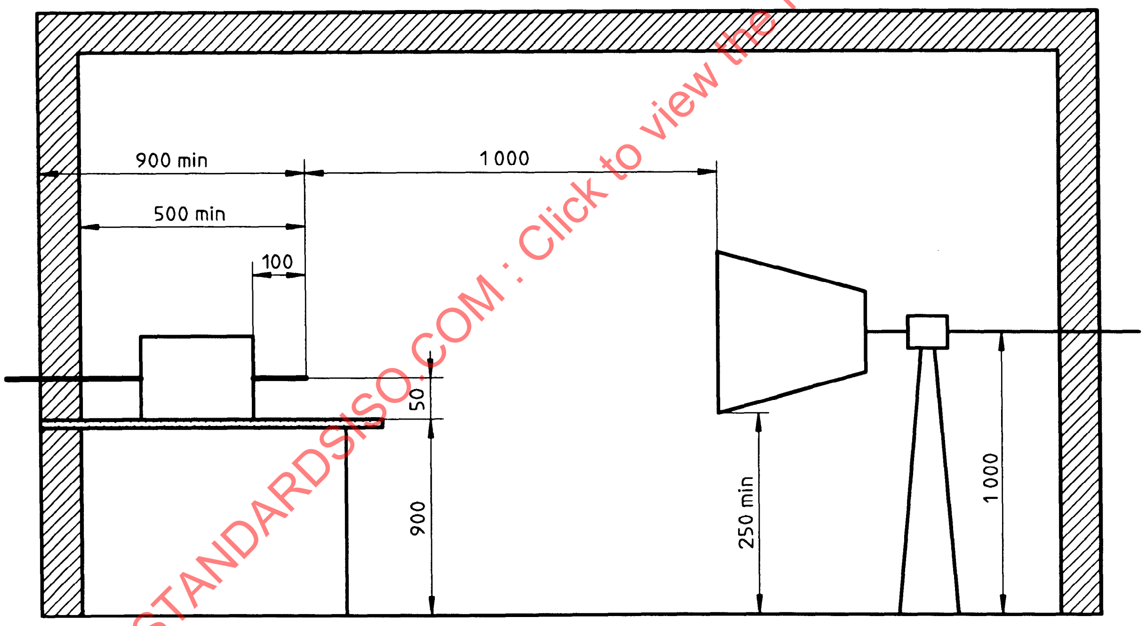
1	Signal generator	6	Device under test
2	Amplifier	7	Wiring harness (power and signal lines)
3	Bulkhead connector	8	Artificial network (power lines)
4	Double shielded coaxial cable	9	Test bench
5	Antenna	10	Typical RF absorber

Figure 2 — Example of test configuration — Log periodic antenna

Dimensions in millimetres



a) Top view (horizontal polarization)



b) Side view (vertical polarization)

Key

1	Signal generator
2	Amplifier
3	Bulkhead connector
4	Double shielded coaxial cable
5	Antenna
6	Device under test
7	Wiring harness (power and signal lines)
8	Artificial network (power lines)
9	Test bench
10	Typical RF absorber

Figure 3 — Example of test configuration — Horn antenna

4.3.4 Test actuators and monitors

The device under test shall be operated as required in the test plan by actuators which have a minimum effect on it, e.g. plastics blocks on the push-buttons, pneumatic actuators with plastics tubes. Connections to equipment monitoring electromagnetic interference reactions of the device under test may be accomplished by using fibre-optics, or high resistance leads. Other types of leads 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.

5 Test procedures

5.1 Test plan

Prior to performing the tests, a test plan shall be prepared; it shall include interface test points, mode of operation for the device under test, acceptance criteria for the device under test, and any special instructions and modifications of the standard test. Each device under test shall be verified under the most significant conditions, i.e. at least in stand-by mode and in a mode where all the actuators can be excited.

5.2 Test methods

CAUTION — Hazardous voltages and fields may exist within the test area. Take care to ensure that the requirements for limiting the exposure of humans to RF energy are met.

The field may be determined according to one of the two methods in 5.2.1 and 5.2.2.

5.2.1 Substitution method

Examples for test configurations are shown in figures 1 to 3.

The substitution method is based upon the use of net power as the reference parameter used for calibration and test.

Measurements using the substitution method can be affected by coupling between the antenna and the device under test as well as by reflected energy. During the test, the net power shall be maintained relative to the calibration point up to a limit of 2 dB increase in forward power.

If the forward power has to be increased by 2 dB or more, this shall be indicated in the test report.

If the standing wave ratio (SWR) in the test system can be demonstrated to be less than 1,2:1, then forward power may be used as the reference parameter to establish the test level.

Electromagnetic field shall be generated, as required, with the specified antenna. Care should be taken that the test equipment is not affected by the test signals.

The specific field strength and polarization shall be calibrated prior to the actual testing by substituting a field measuring device with its sensing element (100 ± 10) mm above the mid-point of the test harness and at (1 000 ± 10) mm from the radiating antenna. The field strength shall be calibrated for both horizontal and vertical polarizations.

After calibration, substitute the field measurement device by the device under test and its associated peripherals. The test is conducted by subjecting the device under test to the test signal based on the calibrated value as predetermined in the test plan. The device under test shall be oriented in each orthogonal plane to determine maximum susceptibility.

5.2.2 Closed-loop levelling method

Examples for test configurations are shown in figures 1 to 3.

This method is different from the substitution method in that during the actual test, the electric field strength measured by the field measurement device is fed back to the signal generator either to increase or to decrease the field strength until the predetermined test severity level is achieved.

Electromagnetic fields shall be generated with the specified antenna according to the configuration specified in 4.3.2.

Placement of the probe is critical to reduce measurement errors. If the probe is placed near a discontinuity, such as a sharp bend or corner of the test bench, or near a resonant cable or component, the resulting measurement could be in error by a substantial amount. Unless otherwise specified by the probe's manufacturer, the probe shall be placed above a flat surface.

Place the device under test and the associated wiring harness and loads in the same configuration as described in 4.3. Place the field measurement device with its sensing element (100 ± 10) mm above the mid-point of the test harness and at (1 000 ± 10) mm from the radiating antenna.

The presence of the device under test may affect the reading of the field probes.

5.3 Test report

When required in the test plan, a test report shall be submitted detailing information regarding the test equipment, test site, systems tested, frequencies, power levels, system interactions, type of table and any other relevant information regarding the test.