INTERNATIONAL STANDARD

ISO 11451-2

First edition
1995-12-01

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

Part 2: Off-vehicle radiation source

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

Partie 2: Irradiation par source externe

Reference number
ISO 11451-2:1995(E)

Contents

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland

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 11451-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 11451 consists of the following parts, under the general title *Road vehicles — Electrical disturbances by narrowband radiated electromagnetic energy — Vehicle test methods*:

— *Part 1: General and definitions*

— *Part 2: Off-vehicle radiation source*

— *Part 3: On-board transmitter simulation*

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

Annex A forms an integral part of this part of ISO 11451.

This page intentionally left blank

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

Part 2:
Off-vehicle radiation source

1 Scope

This part of ISO 11451 specifies off-vehicle radiation source test methods and procedures for testing passenger cars and commercial vehicles regardless of the propulsion system (e.g. spark-ignition engine, diesel engine, electric motor). The electromagnetic disturbances considered in this part of ISO 11451 are limited to continuous narrowband electromagnetic fields.

Two methods for calibrating electromagnetic fields are defined in this part of ISO 11451: a substitution method and a closed-loop method. The substitution method is the method most commonly used.

Part 1 of ISO 11451 gives 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 11451. 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 11451 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 11451-1:1995, *Road vehicles — Electrical disturbances by narrowband radiated electromagnetic energy — Vehicle test methods — Part 1: General and definitions.*

3 Test conditions

3.1 Test temperature and supply voltage

Heat is generated in the test chamber when the vehicle is operated during the test. Sufficient cooling shall be provided to ensure that the engine does not overheat (see 4.1).

The ambient temperature in the test chamber shall be recorded if it is outside the range of (23 ± 5) °C.

For tests that require the vehicle engine to be running, the electrical charging system shall be functional. For tests where the vehicle engine is not required to be running, the battery voltage shall be maintained above 12,2 V and 24,4 V for 12 V and 24 V systems respectively.

3.2 Frequency range

The applicable frequency range of this test method is 0,1 MHz to 18 000 MHz. Testing over the full frequency range may require different field generating devices. This does not imply that testing of overlapping frequency ranges is required.

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 11451, 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 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
>0,1 to ⩽1	0,1
>1 to ⩽10	1
>10 to ⩽200	2
>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 11451, 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

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

The user shall specify the test severity level(s) 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.

4 Test instrument description and specification

The test consists of generating radiated electromagnetic fields 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 vehicle operation 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. An example of a rectangular chamber is shown in figure 1. The chamber shape is a function of the types of tests to be performed, the size of vehicle 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, with the optional exception of 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 needed between them and the largest vehicle 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.

A frequency range of 20 MHz to 18 000 MHz has been achieved in some chambers but because of absorber material sizes required for a 20 MHz cut-off, several absorber-lined facilities have been designed

with cut-off frequencies of 200 MHz or greater. Testing below cut-off is then accomplished using customized antennas and specialized methods (see 4.2.1).

The vehicle is operated during the performance of this test, generating heat in the enclosed chamber. Sufficient cooling shall be provided through chamber air-conditioning and cooling of the radiator to ensure that the engine does not overheat.

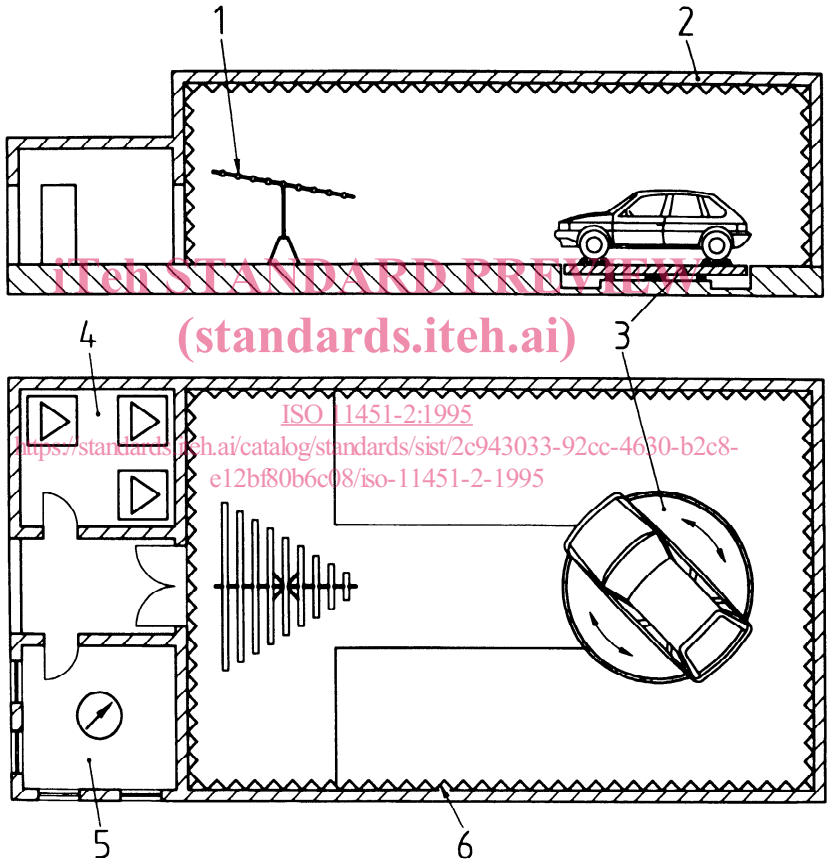
4.2 Instrumentation

4.2.1 Field generating device

The field generating device may be an antenna or a Transmission Line System (TLS).

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.

The TLS generating device may have to be custom-designed. An example of a parallel plate TLS is shown in figure 2. An example of an equipment block diagram for a field generating device is shown in figure 3.



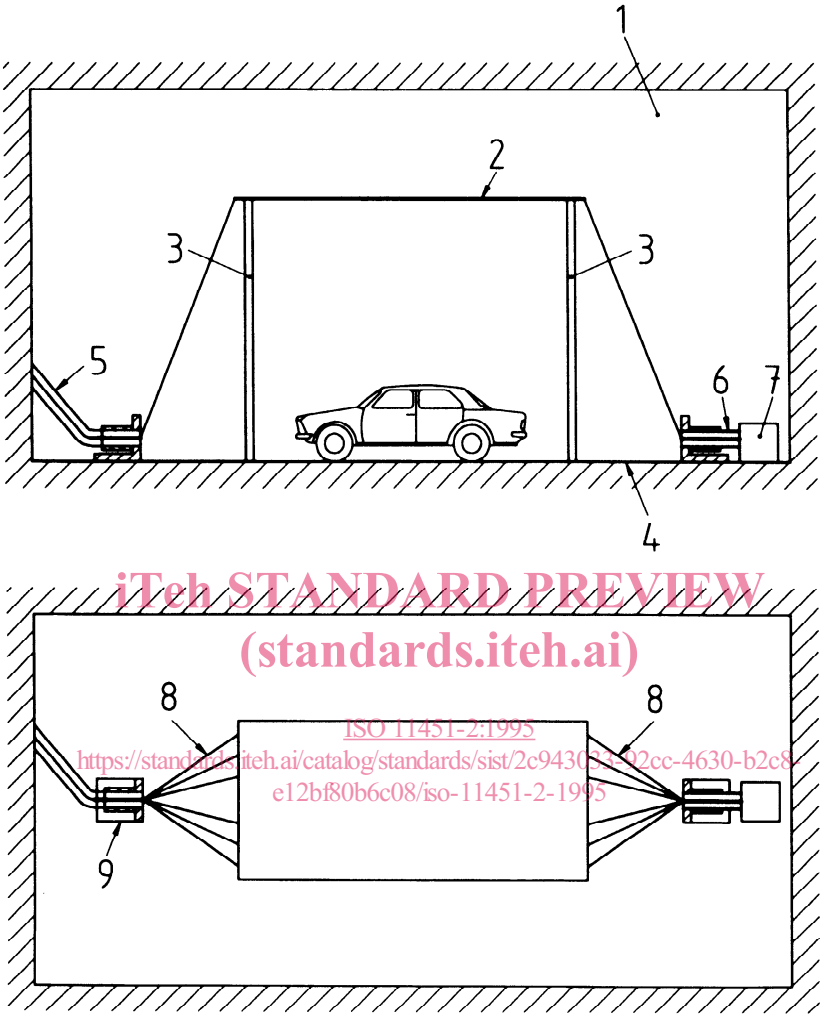
Key

1 Antenna
2 Shielded wall
3 Dynamometer on turntable[1)]
4 Amplifier room
5 Instrumentation room
6 RF absorbers

NOTE — Figure is not to scale.

1) The turntable shown is rotatable through ± 180° with two pairs of variable wheelbase rollers to simulate all vehicle sizes and functions.

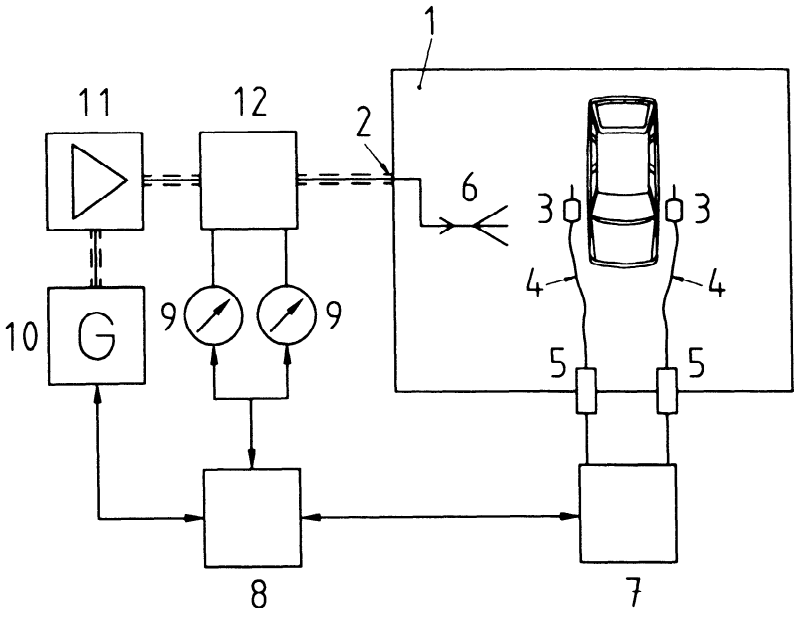
Figure 1 — Example of absorber-lined chamber



Key

1 Shielded room (can be absorber-lined except for floor)
2 Metal plate
3 Non-metallic supports
4 Metal floor
5 Signal source feed line (coaxial)
6 Coaxial
7 Load
8 Metal feed lines
9 Signal source feed connection

Figure 2 — Example of parallel plate TLS



Key

1 Absorber-lined chamber
2 Coaxial penetration
3 Field probe
4 Optical fibre or high resistance leads
5 Waveguide filter
6 Transmitting antenna
7 Field probe output
8 Process controller
9 Power meter
10 RF signal generator(s)
11 Broadband amplifiers
12 Dual directional coupler

Figure 3 — Example of an equipment block diagram for a field generating device

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 a malfunction 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 Vehicle placement

The vehicle shall be placed in the chamber test area. The test area may contain a dynamometer and/or a turntable (see figure 1).

4.3.2 Field generating device location relative to vehicle and chamber

The position(s) of the vehicle relative to the antenna shall be specified in the test plan.

No part of the radiating antenna shall be closer than 0,5 m to the outer body surface of the vehicle.