INTERNATIONAL STANDARD

ISO 11451-3

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

Part 3:
On-board transmitter simulation

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

Partie 3: Rayonnement par émetteur embarqué

Reference number
ISO 11451-3:1994(E)

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 11451-3 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)*

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

Part 3:
On-board transmitter simulation

1 Scope

This part of ISO 11451 specifies on-board transmitter simulation 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.

Part 1 of ISO 11451 specifies general test methods, definitions, practical use and basic principles of the test procedure.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 11451. At the time of publication, the editions indicated were 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 editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 11451-2:—[1], *Road vehicles — Electrical disturbances by narrowband radiated electromagnetic energy — Vehicle test methods — Part 2: Off-vehicle radiation source.*

3 Test conditions

3.1 Test temperature and supply voltage

Heat is generated in the test facility when the vehicle is operated during the performance of the test. Sufficient cooling shall be provided to ensure that the engine does not overheat.

The ambient temperature in the test facility 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 or 24,4 V for 12 V and 24 V systems respectively.

3.2 Frequency range

The frequency range of the test method is 1,8 MHz to 1 300 MHz.

1) To be published.

3.3 Modulation

If a transmitter according to table 2 is used, use the built-in modulation type. If the alternative method in 4.2.1 is used and no values are agreed between the users of this part of ISO 11451, then 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 levels 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 steps

All tests in this part of ISO 11451 shall be conducted with linear frequency step sizes not greater than those specified in table 1.

Table 1 — Frequency step sizes

Frequency band	Maximum frequency step size
1,8 MHz to 10 MHz	1 MHz
10 MHz to 200 MHz	2 MHz
200 MHz to 1 GHz	20 MHz
1 GHz to 1,3 GHz	200 MHz

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.

If the equipment does not allow use of these standard frequency steps, the values used shall be agreed between the users of this part of ISO 11451, and documented in the test plan.

4 Test facility and equipment

This test should typically be performed in a shielded absorber-lined chamber. Where national regulations permit, the test may also be performed at an open area test site (OATS). Where specified in the test plan, the tests shall also be run in a reflective enclosure.

4.1 Test facility specification

4.1.1 Absorber lined chamber

An absorber lined chamber with the characteristics given in ISO 11451-2 is used for this test.

NOTE 1 At frequencies where absorbers are not effective, the reflections in the chamber can affect the exposure of the vehicle.

4.1.2 Open area test site (OATS)

Where national regulations permit the use of an OATS, the OATS should have an area with a radius of 20 m free from large metal structures or objects. Care shall be taken, when performing OATS tests, to ensure that harmonic suppression regulations are met. The test operator shall comply with any regulations.

4.1.3 Reflective enclosure

When required in the testing, a reflective enclosure consisting of a shielded chamber shall be used. Where permitted, this may consist of a building with a metal roof and walls or similar structure such as a bridge with metal superstructure above the road surface.

4.2 Test equipment

4.2.1 Radio frequency (RF) signal sources

Transmitters capable of generating RF power in the frequency ranges with listed output power in table 2 should be considered for the tests.

Table 2 — RF signal sources

Frequency band MHz	Output power W
1,8 to 2	100
3,5 to 4	100
7 to 7,3	100
10,1 to 10,15	100
14 to 14,35	100
18,1 to 18,15	100
21 to 21,45	100
24,89 to 24,99	100
27 to 28	5 [1)]
28 to 29,7	100
30 to 50	120
50 to 54	150
60 to 87	100
120 to 130	100
144 to 148	150
148 to 172	120
220 to 225	150
420 to 470	100
851 to 928	10
1 260 to 1 300	10

1) Maximum legal power allowed.

Handheld transmitters with an output power of 3 W to 8 W may be required as specified in the test plan.

An alternative method of simulating a high-power on-board transmitter is to use the antenna(s) as specified in 4.2.3 and to supply RF power from a broadband amplifier driven by a signal generator.

An RF choke (ferrite or powdered iron toroid, depending on frequency) should be placed around the coaxial cable to the antenna in order to reduce skin currents and more closely simulate a transmitter installed in the vehicle.

4.2.2 RF power and field monitoring equipment

An in-line power meter is required for measuring power to the antenna. Both forward power and reverse power shall be measured and recorded.

An isotropic field probe is required for measuring field strengths inside the vehicle for personnel protection.

4.2.3 Antennas

For the VHF and UHF bands, quarter-wave antennas should be given preference over 5/8 wave antennas, since there are higher skin currents created by quarter-wave antennas.

All antennas should be tuned for minimum voltage standing wave ratio (VSWR) (typically less than 1,5:1), if possible. The resulting VSWR shall be compatible with the design of the RF source.

An exception to tuning the antenna for minimum VSWR is when the test plan calls for testing with a specified VSWR to induce higher radiation within the vehicle resulting from skin currents on the antenna coaxial cable.

The mobile transmitting antenna shall be mounted in the location(s) specified in the test plan.

VSWR is a fixed parameter related to the transmitting monopole: it shall not be adjusted by the test operator when the antenna actually installed on the vehicle is used.

4.2.4 Calibration of test equipment

The power meter shall be calibrated and shall be capable of measuring levels provided by the sampling device with a tolerance of $\pm$ 1 dB.

4.2.5 Test automation

The use of the RF power source specified in 4.2.1 lends itself to automation. Parameters such as frequency, power and time can be controlled and recorded.

5 Test procedure

5.1 Test plan

Prior to performing the tests, generate a test plan which specifies the frequencies, power levels, modulation, length of transmitting time, antennas and locations as well as the operation of the vehicle. The test plan shall also specify the routing of the on-board transmitter harness in the vehicle. When available, the routing shall be in accordance with the vehicle manufacturer specifications.

Verify each device under test under the most significant conditions, i.e. at least in stand-by and in a mode where all the actuators can be excited.

5.2 Test method

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

Place the vehicle in the test area and operate the vehicle according to the test plan.

Actuate the RF source at the levels given in table 2, using the modulation prescribed in the test plan.

Note any event and the corresponding frequency and output power.

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, and any other relevant information regarding the test.