INTERNATIONAL STANDARD

ISO 11452-7

First edition
1995-12-01

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

Part 7:
Direct radio frequency (RF) power injection

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

Partie 7: Injection directe de puissance à fréquence radio (FR)

INTERNATIONAL ISO

Reference number
ISO 11452-7:1995(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 11452-7 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 forms an integral part of this part of ISO 11452. Annexes B and C are for information only.

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

Part 7:
Direct radio frequency (RF) power injection

1 Scope

This part of ISO 11452 specifies direct RF power injection tests for electromagnetic immunity of electronic components of passenger cars and commercial vehicles, regardless of the propulsion system (e.g. spark-ignition engine, diesel engine, electric motor). The electromagnetic disturbance considered in this part of ISO 11452 is limited to continuous narrowband electromagnetic fields.

Immunity measurements of complete vehicles are generally only possible by the vehicle manufacturer, because, for example, of the high costs of an absorber-lined room, 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.

ISO 11452-1 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 11452. 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 11452 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 7637-1:1990, *Road vehicles — Electrical disturbance by conduction and coupling — Part 1: Passenger cars and light commercial vehicles with nominal 12 V supply voltage — Electrical transient conduction along supply lines only.*

ISO 7637-2:1990, *Road vehicles — Electrical disturbance by conduction and coupling — Part 2: Commercial vehicles with nominal 24 V supply voltage — Electrical transient conduction along supply lines only.*

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 to by the users of this part of ISO 11452, the values shall be documented in the test report.

3.2 Frequency range

The upper limit of the test is limited by resonances in the broadband artificial network (BAN). By using an appropriate BAN, a useful frequency range of 0,25 MHz to 400 MHz can readily be achieved.

3.3 Modulation

The test determines the type and frequency of the 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 frequency step sizes not greater than those shown in table 1.

Table 1 — Frequency step sizes

Frequency band MHz	Maximum frequency step size MHz
>0,25 to ⩽1	0,01
>1 to ⩽10	1
>10 to ⩽200	2
>200 to ⩽400	20

Alternatively, logarithmic frequency steps, with the same minimum number of frequency step 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 to find the minimum susceptibility thresholds.

3.6 Test severity levels

The user should specify the test severity levels over the frequency range. Suggested severity levels are included in annex C.

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

The power level is measured at the output of the 10 dB attenuator in figure 1.

4 Test instrument description and specification

4.1 Power injection system

Direct RF power injection is a technique which couples quantifiable RF power into the operating device under test, while eliminating variables related to wiring harness length and routing. RF is coupled into the device under test directly at its connector pins.

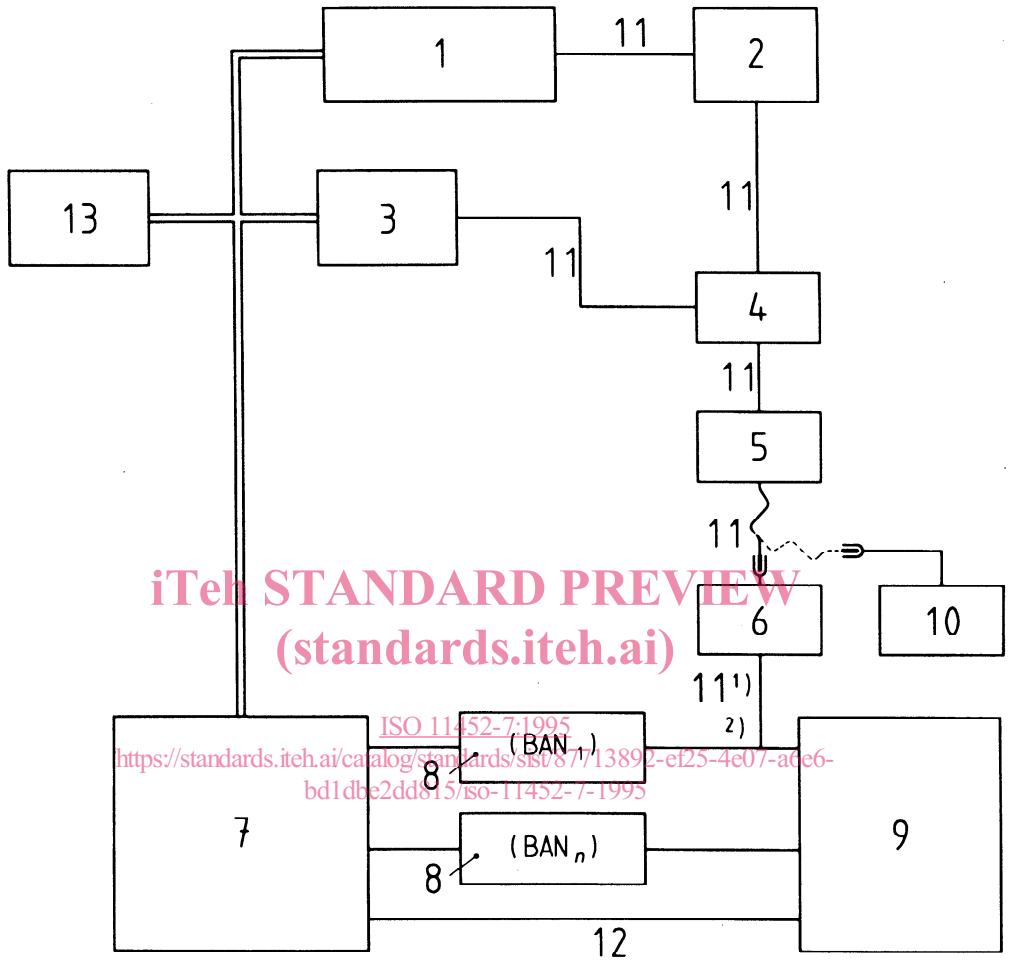
The device under test is connected in the test set-up to perform its designated functions with only the necessary connections made through broadband artificial networks (BANs). The BAN is a device that presents a controlled impedance to the device under test over a specified frequency range while allowing the device under test to be interfaced to its sensors and loads.

NOTE 1 The series impedance of the BAN may affect some input signal waveforms.

The procedure may be used to predict the compatibility of components in the vehicle environment with respect to radiated and conducted RF energy, including conducted transient RF energy. The technique is especially useful as a means of isolating the susceptible circuits within a component and evaluating potential solutions.

4.2 Instrumentation

Figure 1 shows an example of a set-up of the direct RF power injection measurement system. If necessary, this test shall be performed in a shielded room. The spectrum analyser or power meter shall be capable of measuring levels provided by the sampling device with a tolerance of ± 1 dB.



1) Exposed centre conductor lead length 50 mm maximum.
2) Lead length 75 mm maximum from BAN to device under test.

Key

1 RF signal generator
2 RF amplifier(s) (10 to 25 W, typical)
3 Spectrum analyser or RF power meter
4 RF sampling device, 25 W
5 Attenuator 10 dB
6 DC blocking capacitor (impedance less than 5 Ω in the whole frequency range)
7 Peripherals
8 BAN: one in series with each lead except ground
9 Device under test
10 RF power meter (for calibration)
11 Coaxial transmission line (double shielded or equivalent)
12 Ground wire between device under test and peripherals
13 Programmable controller and data acquisition equipment (optional)

Figure 1 — Example of RF power injection test configuration

4.3 Test set-up

At the high frequencies within the range of this test, it is necessary to keep the leads as short as possible.

The RF power is delivered to the device under test through a 50 Ω, 10 dB attenuator in order to minimize the effect of reflections at the injection point. A DC blocking capacitor is inserted at the injection point to prevent damage to the test equipment by the DC voltage on the device lead being tested.

5 Test procedure

5.1 Test plan

Prior to performing the tests, a test plan shall be prepared, specifying the frequencies, power levels, modulation, dwell time, antennas and locations as well as the operation of the vehicle. Each device under test shall be verified under the most significant situations, i.e. at least in stand-by mode 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 humans to RF energy are met.

All power measurements shall be performed using net power.

5.2.1 Before each test, calibrate the test stand (see annex A). Disconnect the injection line from the device under test injection point and connect it to a 50 Ω power meter. Compare the level at the sampling tee output with the level at the injection line (DC block) output. The net difference is the correction factor which shall be factored into the final data. The sampling tee is susceptible to overload which may affect the calibration of the test stand. If the calibration factor exceeds ± 3 dB, the test stand shall be maintained.

5.2.2 All device under test terminals except the ground are injected with RF power individually. The performance requirements of the device under test are determined by the test plan. The RF power into the 10 dB attenuator shall be incremented in steps of 0,1 dB, or as defined in the test plan, from a level of 10 mW or less.

5.2.3 While the RF power is being incremented, operate the device under test in all modes.

5.2.4 Record the terminal identification, frequency, RF power and any interactions that occur during the test.

5.2.5 Increment the frequency and repeat until the entire frequency range has been tested.

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.

Annex A
(normative)

Test set-up calibration procedure

A.1 Disconnect the attenuator (item 5 in figure 1) from the blocking capacitor (item 6) and connect it to the power meter (item 10).

A.2 Determine the calibration value for each test frequency to generate the test level required in the test plan.

A.3 Disconnect the attenuator from the power meter and reconnect it to the blocking capacitor.