INTERNATIONAL STANDARD

ISO 11452-4

Second edition
2001-02-01

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

Part 4: Bulk current injection (BCI)

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

Partie 4: Méthodes d'injection de courant (BCI)

Reference number
ISO 11452-4:2001(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

Page

Foreword iv
Introduction v
1 Scope 1
2 Normative reference 1
3 Terms and definitions 1
4 Test conditions 1
5 Test apparatus 2
6 Test procedure 5
Annex A (normative) **Current-injection probe calibration** 8
Annex B (normative) **Current monitoring probe calibration** 10
Annex C (normative) **Optimization of the injection probe position** 11
Annex D (informative) **Function performance status classification (FPSC)** 12
Annex E (informative) **Artificial network (AN) schematic** 13

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 11452-4 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 11452-4:1995), 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 C form a normative part of this part of ISO 11452. Annexes D and E 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.

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

Part 4:
Bulk current injection (BCI)

1 Scope

This part of ISO 11452 specifies bulk current injection (BCI) 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 from 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 frequency range of the BCI test method is a direct function of the current probe characteristic. More than one type of current probe may be necessary.

For testing automotive electronic systems, the applicable frequency range of the BCI test method is 1 MHz to 400 MHz.

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.

For the calibrated injection probe method (6.2.2), the test signal quality criteria from ISO 11452-1 shall apply.

For the current monitoring probe method (6.2.3), none of the first five harmonics (up to 400 MHz) shall exceed – 9 dB relative to the carrier wave when a deviation of the device under test is observed. If this limit is exceeded, it shall be noted in the test report.

5 Test apparatus

5.1 BCI system

Bulk current injection is a method of carrying out immunity tests by inducing disturbance signals directly into the wiring harness by means of a current injection probe. The injection probe is a current transformer through which the wiring harnesses of the device under test are passed. Immunity tests are carried out by varying the test severity level and the frequency of the induced disturbance.

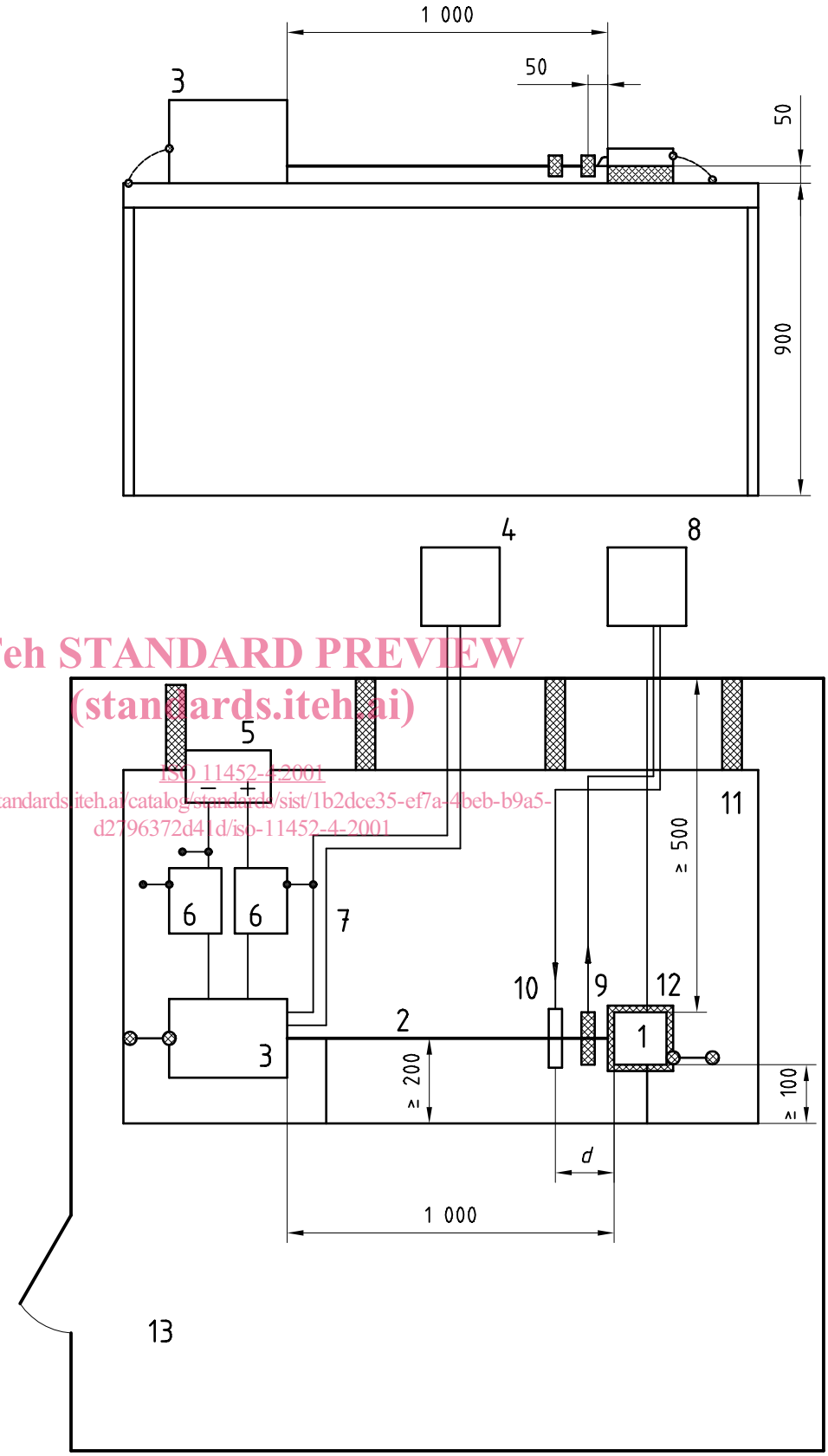
5.2 Instrumentation

Figure 1 shows an example of a BCI measurement system set-up. When a battery is used, a charging source may be needed to achieve the specified test voltage.

An injection probe, or a set of such probes, capable of operating over the test frequency range, is required to couple the test equipment to the device under test. The probe or probes shall be capable of withstanding a continuous input power over the test frequency range regardless of the system loading.

The monitoring probe, or set of probes, shall be capable of operating over the test frequency range and shall be terminated in the load impedance at which it was calibrated.

Dimensions in millimetres



Key

1 Device under test (bonded to ground plane if necessary)
2 Wiring harness
3 Load simulator(s) (bonded to ground plane if necessary)
4 Device under test stimulator and monitoring system
5 Power supply
6 Artificial network(s)
7 Optical fibre
8 RF instrumentation
9 RF monitor probe
10 RF injection probe
11 Ground plane test bench
12 Insulator
13 Shielded room (absorber-lined shielded enclosure)

d Distance from device under test connector to centre of injection probe

NOTE Not drawn to scale.

Figure 1 — Example BCI test configuration

5.3 Test set-up

5.3.1 General

The test shall be performed inside a shielded enclosure.

5.3.2 Test bench

The test bench shall have a ground plane made of copper, brass or galvanized steel, and have the following dimensions:

— thickness: 0,5 mm min.;

— length: 2 000 mm min. or that of the entire equipment plus 500 mm, whichever is larger;

— width: that of the equipment plus 200 mm on each side.

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

5.3.3 Installation of the device under test

See Figure 1 for example.

The device under test with associated test wiring harness and actual or simulated loads shall be tested. The length of the harness (between the device under test and load simulator) shall be (1 ± 0,1) m. The device under test, test harness and other peripherals which are part of the test shall be placed and arranged on the grounded test bench and connected to it according to its intended use in the vehicle. If no requirements are specified in the test plan, then the device under test shall be placed on a non-conductive material $\left(50^{+10}_{0}\right)$ mm above the metallic surface of the table.

The front of the device under test shall be located at a minimum of 100 mm from the edge of the ground plane. The test harness shall be located at a minimum of 200 mm from the edge of the ground plane and placed on non-conductive supports $\left(50^{+10}_{0}\right)$ mm above the ground plane. The harness shall pass concentrically through the centre of the current injection probe and all wires in the harness shall be terminated. When possible, the actual loads and actuators shall be used. If the return lead is remotely grounded, it shall be included in the coupling harness.

The distance between the device under test and all other conductive structures, such as shielded-room walls, with the exception of the ground plane underneath the device under test, shall be a minimum of 0,5 m.

The artificial network (AN) or networks (see annex E for schematic) and the load simulator shall be placed directly on the ground plane. The AN case or cases shall be bonded to the ground plane. The load simulator case may be connected to the ground plane if called for in the test plan.

Power shall be applied to the device under test using a 5 µH/50 Ω AN. The grounding of the device under test will depend on its intended installation in the vehicle.

— If the device under test is remotely grounded (power return line longer than 200 mm), two artificial networks are required, one for the positive supply line and the other for the power return line.

— If the device under test is locally grounded (power return line 200 mm or shorter), only one AN is required for the positive supply line.

The artificial-network measuring port or ports shall be terminated with a 50 Ω load. The power supply return shall be connected to the test bench ground plane (between power supply and AN or ANs).

5.3.4 Device under test control actuation

The device under test shall be operated according to the test plan by actuators having a minimum effect on the electromagnetic characteristics (e.g. plastics blocks on the push-buttons, pneumatic actuators with plastic 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.

6 Test procedure

6.1 Test plan

Prior to performing the tests, a test plan shall be generated which shall cover the following:

— test set-up;

— frequency range;

— modulation;

— test method [calibrated injection (6.2.2) or current monitoring (6.2.3) probe];

— fixed or optimized position for current monitoring probe;

— device under test mode of operation;

— device under test acceptance criteria;

— definition of test severity levels;

— device under test monitoring conditions;

— device under test orientation;

— test report content (see 6.3);

— maximum forward power (for closed loop method only);

— any special instructions and changes from the standard test.

Each device under test shall be tested under the most significant situations: i.e. at least in stand-by mode and in a mode where all the actuators can be excited.

6.2 Test methods

6.2.1 General

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.

Two BCI test methods are specified: the calibrated injection (substitution) and current monitoring (closed-loop) probe methods. For both, the test equipment shall be connected in a manner similar to that shown in Figure 1.