INTERNATIONAL STANDARD

ISO 7637-3

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Road vehicles — Electrical disturbances from conduction and coupling —

Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines

Véhicules routiers — Perturbations électriques par conduction et par couplage —

Partie 3: Transmission des perturbations électriques par couplage capacitif ou inductif le long des lignes autres que les lignes d'alimentation

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 7637-3 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 7637-3:1995), which has been technically revised. It also incorporates the Technical Corrigendum ISO 7637-3:1995/Cor.1:1995.

ISO 7637 consists of the following parts, under the general title *Road vehicles — Electrical disturbances from conduction and coupling*:

— *Part 1: Definitions and general considerations*

— *Part 2: Electrical transient conduction along supply lines only*

— *Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines*

Introduction

Experience collected over a long period of immunity testing of instruments, equipment and devices under test (DUTs) shows that a test simulating transient coupling phenomena is needed for a sufficient coverage of the wide range of electric and electromagnetic interferences. The knowledge of these facts is common among electomagnetic conductivity (EMC) experts, and many companies have developed such coupling tests.

The fast transient test uses bursts composed of a number of fast transients, which are coupled into lines of electronic equipment, in particular input/output (I/O) lines. The fast rise time, the repetition rate and the low energy of the fast transient bursts are significant to the test.

The slow transient test uses a single pulse similar to that used for conducted transient, applied a number of times to the DUT.

During system development, the production wiring harness is not available and the vehicle's electrical noises are not known. The test shall therefore be performed with the worst case situation, which is represented by the capacitive and inductive coupling described in this part of ISO 7637.

Road vehicles — Electrical disturbances from conduction and coupling —

Part 3:
Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines

1 Scope

This part of ISO 7637 establishes a bench top test for the evaluation of the immunity of devices under test (DUTs) to transient transmission by coupling via lines other than supply lines. The test transient pulses simulate both fast and slow transient disturbances, such as those caused by the switching of inductive loads and relay contact bounce.

Three test methods are described in this part of ISO 7637:

— the capacitive coupling clamp (CCC) method;

— the direct capacitive coupling (DCC) method; and

— the inductive coupling clamp (ICC) method.

NOTE The applicability of the three test methods is shown in Table 1.

Only one test method need be selected for slow transients and only one method need be selected for fast transients.

This part of ISO 7637 applies to road vehicles fitted with nominal 12 V, 24 V or 42 V electrical systems.

For transient immunity, Annex B provides recommended test severity levels in line with the functional performance status classification (FPSC) principle described in ISO 7637-1.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7637-2, *Road vehicles — Electrical disturbances from conduction and coupling — Part 2: Electrical transient conduction along supply lines only*

3 Test methods

3.1 General

This clause describes methods for testing the immunity of electrical system components or devices under test (DUTs) against coupled transients. These tests shall be performed in the laboratory.

The test pulse severity levels should be mutually agreed upon between the vehicle manufacturer and the supplier prior to the test.

The test pulses defined are typical pulses which represent the characteristics of most of the actual transients which may occur in the vehicle.

In special cases, it may be necessary to apply additional test pulses. Some test pulses may be omitted if a device, depending on its function or its configuration, is not influenced by comparable transients in the vehicle. It is part of the vehicle manufacturer's responsibility to define the test pulses needed for specific components.

A test plan shall be written to define

— the test methods to be used,

— the test pulses to be applied,

— the test pulse amplitudes,

— the number of pulses to be applied,

— the DUT operating modes,

— the wiring harness (test versus production),

— the leads to be included in the capacitive coupling clamp, if used,

— the leads to be tested using the direct coupling capacitor method, if used,

— the capacitance values to be used, if the direct coupling capacitor method is used,

— the leads to be included in the inductive coupling clamp, if used,

— the type of inductive coupling clamp, if the inductive coupling method is used.

Suggested values for the evaluation of immunity of DUTs can be chosen from Tables B.1, B.2, B.3 and B.4.

The applicability of the three different test methods is indicated in Table 1. Only one test method need be selected for slow transients and only one method need be selected for fast transients.

Table 1 — Test method applicability

Transient type	CCC method	DCC method	ICC method
Slow pulses of 4.3.3	Not applicable	Applicable	Applicable
Fast pulses a and b of 4.3.2	Applicable	Applicable	Not applicable

3.2 Standard test conditions

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

Unless otherwise defined in this part of ISO 7637, the tolerance on time, resistance and capacitance is ± 10 %.

Unless otherwise defined in this part of ISO 7637, the tolerance on voltage is $\begin{pmatrix} +10 \\ 0 \end{pmatrix}$ %.

The supply voltage shall be as shown in Table 2 unless other values are agreed upon by the users of this part of ISO 7637, in which case such values shall be documented in the test reports.

Table 2 — Test voltages

Nominal system voltage V	Test voltage V
12	13,5 ± 0,5
24	27 ± 1
42	42 ± 1,5

3.3 Ground plane

The ground plane shall be a metallic sheet (e.g. copper, brass or galvanized steel) with a minimum thickness of 1 mm. The minimum size of the ground plane shall be 2 m × 1 m; however, the final size depends on the dimensions of the DUT and the test harness. The ground plane shall be connected to the facility earth ground.

3.4 Test set-up

3.4.1 General

The DUT is arranged and connected according to its requirements. The DUT should be connected to the original operating devices (loads, sensors, etc.) using a test harness or the production wiring harness, as agreed upon between the vehicle manufacturer and the supplier.

If the actual DUT operating signal sources are not available they may be simulated.

The DUT shall be separated from the ground plane by an insulating support having a thickness of 0,05 m to 0,1 m, unless the DUT case is connected to the chassis and has its own ground connection.

The DUT shall be connected to the grounding system according to the manufacturer's installation specification; no additional grounding connections are allowed.

Where possible, all loads, sensors, etc. are connected to the ground plane using the shortest possible lead length.

NOTE To minimize extraneous capacitive coupling to the DUT, it is advisable that the minimum distance between the DUT and all other conductive structures, such as walls of a shielded room (with the exception of the ground plane underneath the test set-up), be more than 0,5 m.

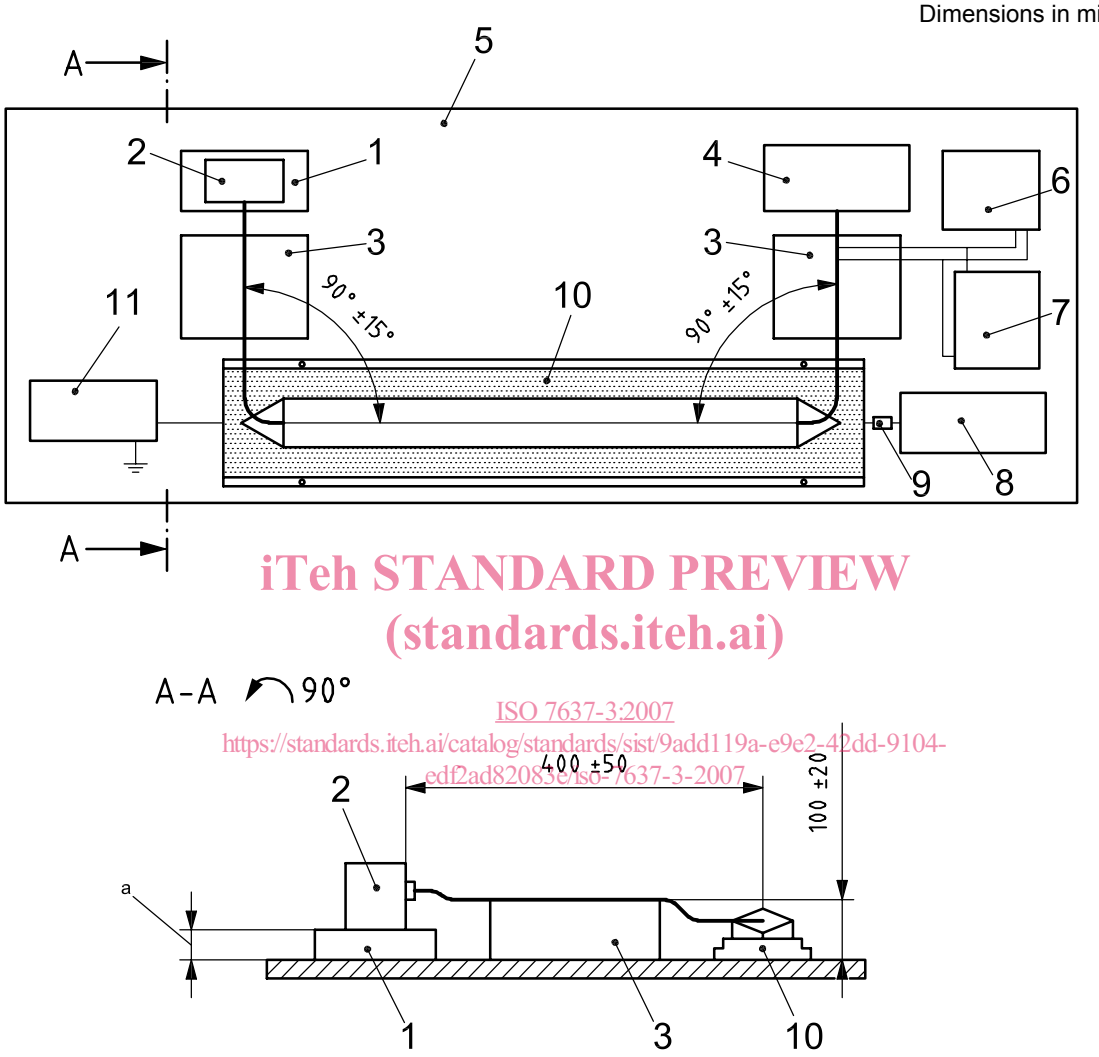
3.4.2 Capacitive coupling clamp (CCC) method

The CCC method is suitable for coupling the fast transient test pulses, particularly for DUTs with a moderate or large number of leads to be tested. It will not couple the slow transient test pulse.

The test method using the CCC is shown in Figure 1. The coupling circuit consists of a CCC through which all lines of the DUT are installed as agreed between the vehicle manufacturer and the supplier (excluding or including the supply lines). The coupling length is 1 m.

The test can be performed either as shown in Figure 1 or with a straight harness as implemented in ISO 11452-4.

Dimensions in millimetres



Key

1 insulation support (if DUT is not to be connected to the ground in the vehicle)
2 DUT
3 insulating supports for test harness
4 peripheral (e.g. sensors, load, accessories), mounted as in the vehicle
5 ground plane
6 power supply
7 battery
8 oscilloscope
9 50 Ω attenuator
10 CCC
11 test pulse generator

[a] The selected dimension is specified in the test plan and documented in the test report.

Figure 1 — Test set-up for CCC method

In the case of the use of a test harness, as specified in this part of ISO 7637, the power supply lines routed outside the coupling clamp shall have a length of 1 m. The distance between the DUT and the CCC, and between peripheral devices and the CCC, shall be (400 ± 50) mm. The portions of the lines being tested which are outside the CCC shall be placed at a distance of (100 ± 20) mm above the ground plane and oriented 90° ± 15° to the longitudinal CCC axis.

The hinged lid of the CCC shall be placed as flat as possible to ensure contact with the test harness which should be positioned as flat as possible.

The DUT shall be placed on the same end of the CCC as the pulse generator.

NOTE It is advisable to limit the length of the harness to 2 m in order to improve the reliability of the results.

If using a production harness with a length exceeding 2 m, the wire length should not be coiled, the wire harness should be positioned as flat as possible and the arrangement shall be specified in the test report. The maximum distance of 0,45 m between DUT and CCC shall be maintained.

3.4.3 Direct capacitor coupling (DCC) method

The DCC method, using the recommended capacitance value, has been shown to couple the same voltage to the DUT lines for the fast transient test pulse.

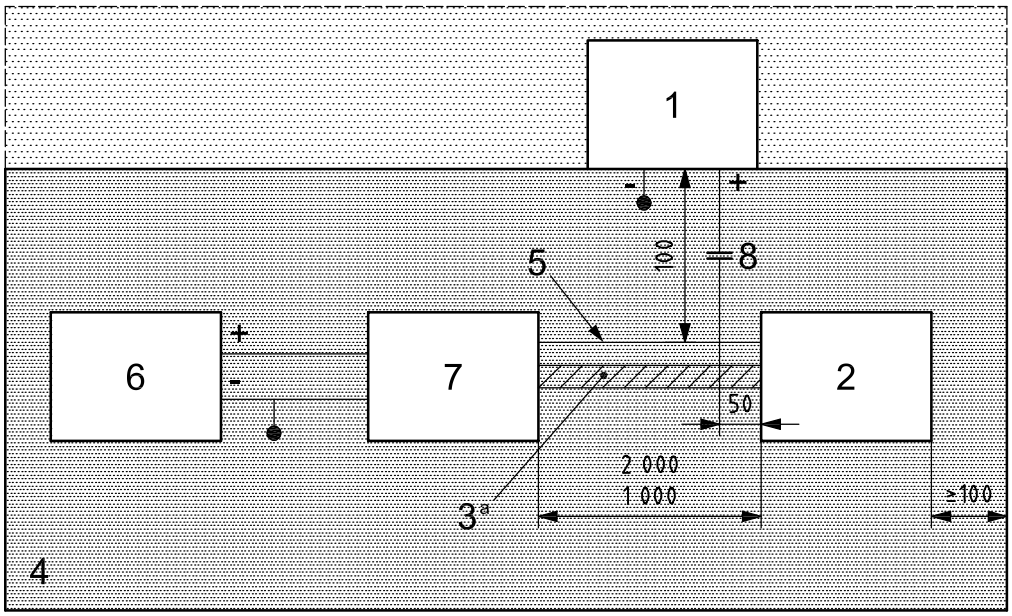
In addition, the DCC method is effective in coupling the slow transient test pulse when the recommended capacitance value is used.

The DCC method is shown schematically in Figure 2. The length of the harness shall be between 1 000 mm and 2 000 mm.

When using the DCC method, care shall be taken to ensure that signals are not unacceptably distorted (e.g. communication on bus systems). The DCC method should not be used on symmetrical lines (e.g. twisted-pair lines) unless care has been taken to excite all lines identically at the same time (see Figure 3).

For the fast transient test, the disadvantage of the DCC method is that each line is tested individually.

Dimensions in millimetres



Key

1 test pulse generator
2 DUT
3 harness
4 ground plane
5 I/O line under test
6 power supply
7 DUT exerciser
8 high-voltage (200 V minimum) ceramic leaded capacitor

NOTE For the value of the capacitor, see Table 3.

a All harnesses are (50 ± 5) mm above ground plane.

Figure 2 — Test set-up for DCC method

Table 3 — Capacitor values for DCC test method

Test pulse	Capacitor value
Fast transient test pulse	100 pF
Slow transient test pulse	0,1 µF