INTERNATIONAL STANDARD

ISO 11451-1

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

Part 1: General principles and terminology

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

Partie 1:Principes généraux et terminologie

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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 11451-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This third edition cancels and replaces the second edition (ISO 11451-1:2001), which has been technically revised.

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

— *Part 1: General principles and terminology*

— *Part 2: Off-vehicle radiation source*

— *Part 3: On-board transmitter simulation*

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

Introduction

In recent years, an increasing number of electronic devices for controlling, monitoring and displaying a variety of functions have been introduced into vehicle designs. It is necessary to consider the electrical and electromagnetic environment in which these devices operate.

Electrical and radio-frequency disturbances occur during the normal operation of many items of motor vehicle equipment. They are generated over a wide frequency range with various electrical characteristics and can be distributed to on-board electronic devices and systems by conduction, radiation or both. Narrowband signals generated from sources on or off the vehicle can also be coupled into the electrical and electronic system, affecting the normal performance of electronic devices. Such sources of narrowband electromagnetic disturbances include mobile radios and broadcast transmitters.

The characteristics of the immunity of a vehicle to radiated disturbances have to be established. ISO 11451 provides various test methods for the evaluation of vehicle immunity characteristics. Not all methods need be used for a given vehicle.

ISO 11451 is not intended as a product specification and cannot function as one (see A.1). Therefore, no specific values for the test severity level are given.

Annex A of this part of ISO 11451 specifies a general method for function performance status classification (FPSC), while Annex B explains the principle of constant peak test level. Typical severity levels are included in an annex of each of the other parts of ISO 11451.

Protection from potential disturbances needs to be considered in a total system validation, and this can be achieved using the various parts of ISO 11451.

NOTE Immunity measurements of complete 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. ISO 11452 specifies test methods for the analysis of component immunity, which are better suited for supplier use.

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

Part 1: General principles and terminology

1 Scope

This part of ISO 11451 specifies general conditions, defines terms, gives practical guidelines and establishes the basic principles of the vehicle tests used in the other parts of ISO 11451 for determining the immunity 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. A wide frequency range (0,01 MHz to 18 000 MHz) is allowed for the immunity testing in this and the other parts of ISO 11451.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
absorber-lined shielded enclosure
shielded enclosure/screened room with radio frequency-absorbing material on its internal ceiling and walls

NOTE The common practice is for the room to have a metallic floor, but absorbing material may also be used on the floor.

2.2
amplitude modulation
AM
process by which the amplitude of a carrier wave is varied following a specified law, resulting in an AM signal

2.3
bulk current
total amount of common mode current in a harness

2.4
compression point
input signal level at which the measurement system becomes non-linear, when the output value will deviate from the value given by an ideal linear system

2.5
coupling
means or device for transferring power between systems

NOTE Adapted from IEC 60050-726.

2.6
current injection probe
device for injecting current in a conductor without interrupting the conductor and without introducing significant impedance into the associated circuits

2.7
current (measuring) probe
device for measuring the current in a conductor without interrupting the conductor and without introducing significant impedance into the associated circuits

[IEC 60050-161]

2.8
degradation (of performance)
undesired departure in the operational performance of any device, equipment or system from its intended performance

NOTE The term “degradation” can apply to temporary or permanent failure.

[IEC 60050-161]

2.9
dual directional coupler
four-port device consisting of two transmission lines coupled together in such a manner that a single travelling wave in any one transmission line will induce a single travelling wave in the other, the direction of propagation of the latter wave being dependent upon that of the former

NOTE Adapted from IEC 60050-726.

2.10
electromagnetic compatibility
EMC
ability of equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbance to anything in that environment

[IEC 60050-161]

2.11
electromagnetic disturbance
any electromagnetic phenomenon which may degrade the performance of a device, equipment or system, or adversely affect living or inert matter

EXAMPLE An electromagnetic disturbance may be an electromagnetic noise, an unwanted signal or a change in the propagation medium itself.

[IEC 60050-161]

2.12
electromagnetic interference
EMI
degradation of the performance of equipment, transmission channel or system caused by electromagnetic disturbance

NOTE The English words “interference” and “disturbance” are often used indiscriminately.

[IEC 60050-161]

2.13
forward power
power supplied by the output of an amplifier or generator

2.14
functional status
performance level agreed between the customer and the supplier which is specified in the test plan

2.15
ground (reference) plane
flat conductive surface whose potential is used as a common reference

[IEC 60050-161]

2.16
immunity (to a disturbance)
ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

[IEC 60050-161]

2.17
immunity level
maximum level of a given electromagnetic disturbance incident on a particular device, equipment or system for which it remains capable of operating at a required degree of performance

[IEC 60050-161]

2.18
narrowband emission
emission which has a bandwidth less than that of a particular measuring apparatus or receiver

[IEC 60050-161]

2.19
polarization
property of sinusoidal electromagnetic wave or field vector defined at a fixed point in space by the direction of the electric field strength vector or of any specified field vector

NOTE 1 When this direction varies with time, the property may be characterized by the locus described by the extremity of the considered field vector.

NOTE 2 Adapted from IEC 60050-726.

2.20
pulse modulation
PM
process by which the amplitude of a carrier wave is varied following a specified law, resulting in an PM signal

2.21
electromagnetic radiation
phenomenon by which energy in the form of electromagnetic waves emanates from a source into space

NOTE By extension, the term “electromagnetic radiation” sometimes also covers induction phenomena.

[IEC 60050-161]

2.22
electromagnetic radiation
energy transferred through space in the form of electromagnetic waves

[IEC 60050-161]

2.23
reflected power
power reflected by the load due to impedance mismatch between RF source and the load

2.24
shielded enclosure
screened room
mesh or sheet metallic housing designed expressly for the purpose of separating electromagnetically the internal and external environment

[IEC 60050-161]

2.25
standing wave ratio
SWR
voltage standing wave ratio
VSWR
ratio, along a transmission line, of a maximum to an adjacent minimum magnitude of a particular field component of a standing wave

NOTE 1 SWR is expressed by the equation:

$$\text{SWR} = \frac{(1+r)}{(1-r)}$$

where r is the absolute value of the coefficient of reflection.

NOTE 2 Adapted from IEC 60050-726.

2.26
(electromagnetic) susceptibility
inability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

NOTE Susceptibility is the lack of immunity.

[IEC 60050-161]

2.27
transmission line system
TLS
field-generating device that works in a similar way to a TEM (transverse electromagnetic) wave generator

EXAMPLE Stripline, TEM cell, parallel plate.

3 General aim and practical use

The test methods, procedures, test instrumentation and levels specified in ISO 11451 are intended to facilitate vehicle specification for electrical disturbances by narrowband radiated electromagnetic energy. A basis is provided for mutual agreement between vehicle manufacturers and component suppliers intended to assist rather than restrict.

Certain devices are particularly susceptible to some characteristics of electromagnetic disturbance, such as frequency, severity level, type of coupling or modulation.

Electronic devices are sometimes more susceptible to modulated, as opposed to unmodulated, radio-frequency (RF) signals. The reason is that high-frequency disturbances may be demodulated by semiconductors. In the case of unmodulated signals, this leads to a continuous shift of, for example, a voltage;

in the case of amplitude-modulated signals, the resulting low-frequency fluctuations may be interpreted as intentional signals (e.g. speed information) and therefore disturb the function of the device under test (DUT) more severely.

A single standard test may not reveal all the needed information about the DUT. It is thus necessary for users of ISO 11451 to anticipate the appropriate test conditions, select applicable parts of ISO 11451 and define function performance objectives. The main characteristics of each test method in ISO 11451-2 to ISO 11451-4 are presented in Table 1.

Table 1 — Main characteristics of test methods in ISO 11451

Part of ISO 11451	Applicable frequency range MHz	Coupling to	Test severity parameter and unit	Provisions
ISO 11451-2 Off-vehicle radiation source	0,01 to 18 000	DUT and wiring harness	Electric field (V/m)	Absorber-lined shielded enclosure required
ISO 11451-3 On-board transmitter simulation	1,8 to 18 000	DUT and wiring harness	Power (W)	Absorber-lined shielded enclosure recommended
ISO 11451-4 Bulk current injection(BCI)	1 to 400	Wiring harness	Current (mA)	Shielded enclosure recommended

4 General test conditions

4.1 General

Unless otherwise specified, the following test conditions are common to all parts of ISO 11451:

— test temperature;

— supply voltage;

— modulation;

— dwell time;

— frequency step sizes;

— definition of test severity level;

— test signal quality.

NOTE The use of the same parameters as for the component test methods given in the corresponding parts of ISO 11452 will achieve better correlation.

Unless otherwise specified, the variables used shall have the following tolerances:

— ± 10 % for durations and distances;

— ± 10 % for resistances and impedances;

— ± 1 dB for power meter;

— ± 3 dB for field probe.

