International Standard

ISO 14907-1

Electronic fee collection — Test procedures for user and fixed equipment —

Part 1: Description of test procedures

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ISO copyright office
CP 401 • CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 278, *Intelligent Transport Systems,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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This second edition cancels and replaces the first edition of ISO 14907-1:2020, which has been technically revised.

The main changes are as follows:

— the presentation of the different test groups has been modified to consistently reflect their typical sequence (i.e. pre-, functionality- and quality-related tests);

— terms and definitions have been updated and ISO 17573-2 has been included as the primary source for harmonized terminology across electronic fee collection (EFC) standards;

— the references have been revised.

A list of all parts in the ISO 14907 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

For an electronic fee collection (EFC) system, approvals and tests are required to determine whether the system (or individual components of the system) conforms to standards and application requirements and to enable parameters such as quality, availability, and maintainability to be measured.

This document provides a toolbox of tests and procedures for the assessment and proof of EFC systems that they are suitable for specified EFC applications under specific operational conditions. Depending on the system to be tested and based on available documentation and the status of previous approvals, this document helps interested parties, such as system suppliers, operators and testing institutes, make use of already proven references and identify parameters that still need to be tested according to the specified intended use.

At the time of publication of this document, the determination of common system requirements for Europe (or any other region) has not been agreed. For this reason, no specific performance requirements are set out in this document, unless these are already determined elsewhere (such as safety or radio regulations), but instead the most important parameters that should be included in such requirements specifications are stated. Where reference to an existing test is available, this document provides that reference. This document defines only the test and test procedures, not the benchmark figures that these intend to be measured against. Benchmark figures which the systems or components under test can be compared with and validated against will potentially form the subject of a future part of the ISO 14907 series. Within the framework of the European Electronic Toll Service (EETS), this document can provide a basis for the certification of the various systems' part of the EETS, in particular for assessing their suitability for use.

This document is furthermore limited to automated (electronic) payment using a standardized dedicated short-range communication (DSRC). The scope of this document does not include manual payment, conventional money transaction, nor payment by means of sticker, vignettes, tickets, or magnetic-stripe cards, etc. The applications to which EFC is related are toll collection, road pricing, parking, and individual traffic information.

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This document supports groups of operators to determine common specific performance levels and operating conditions, while allowing for regional variation where needed. It provides operating and environmental parameters (or classes of operating and environmental parameters) within which such systems operate without impairing interoperability.

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The following guidelines have been followed when selecting the test procedures for test parameters:

— as far as possible, reference is made to existing standardized test procedures;

— the focus is placed on those tests that are essential to ensuring that EFC equipment can exchange information and mutually use the exchanged information.

An overview of the tests and parameters provided by this document is given in 5.1 and 5.2.

A brief guide describing how to use this document is provided by Annex A.

While this document relates to general test procedures, some provisions relate specifically to test procedures for certification purposes. Many parts of this document are relevant internationally, but adaptations can be necessary to meet regulations outside Europe Economic Area (EEA).

ISO/TS 37444 provides an examination framework for EFC charging performance.

This document relates only to the equipment of the user and the service provider as illustrated in Figure 1.

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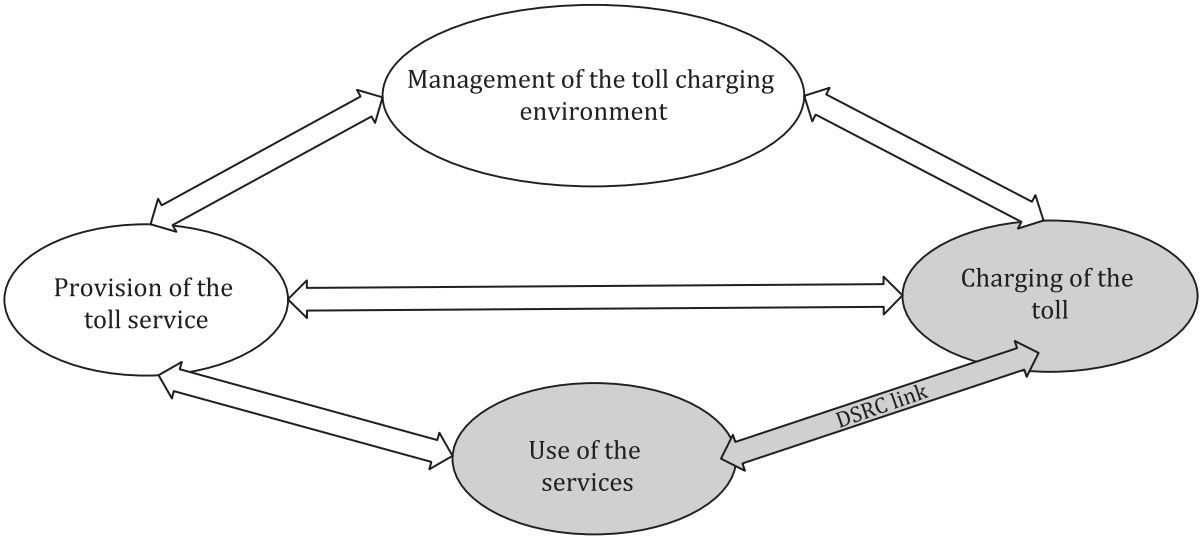


Figure 1 — Conceptual model of EFC

The scope of this document relates solely to on-board equipment (OBE) and roadside equipment (RSE), and the DSRC interface between OBE and RSE including its functions to perform the fee collection as illustrated by Figure 2.

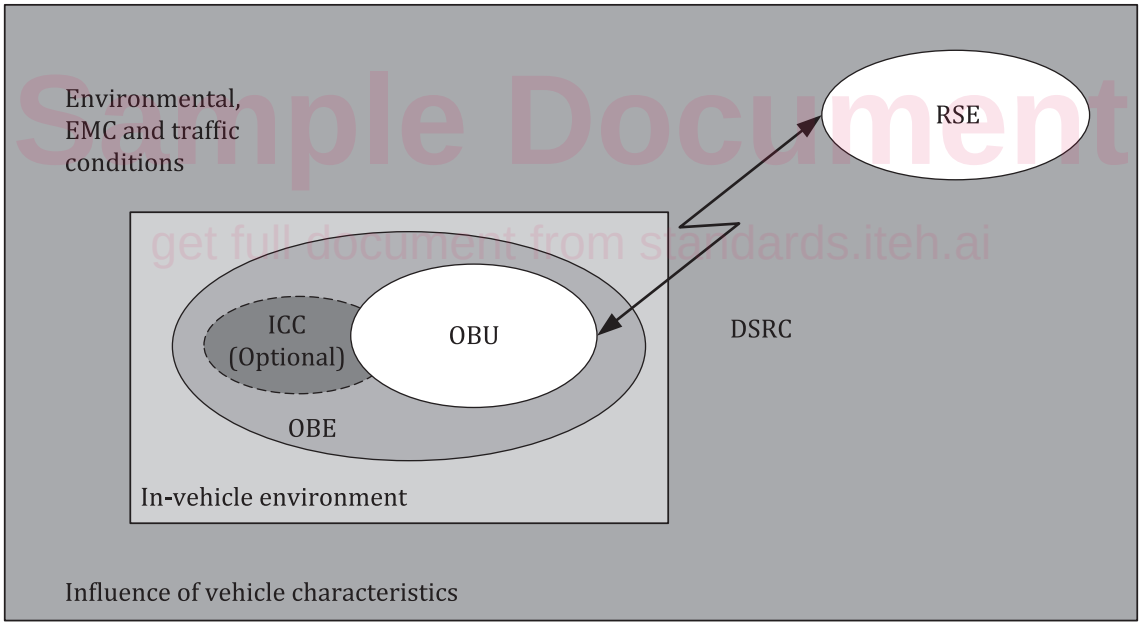


Figure 2 — OBE/RSE interface and associated environments

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Electronic fee collection — Test procedures for user and fixed equipment —

Part 1: Description of test procedures

1 Scope

This document specifies the test procedures for roadside equipment (RSE and on-board equipment (OBE for electronic fee collection (EFC) with regard to conformance to standards and requirements for type approval and acceptance testing.

The scope of this document is restricted to systems operating within the radio emission, electromagnetic compatibility (EMC) regulations, traffic, and other regulations of the regions in which they are operated.

This document identifies a set of suitable parameters and provides test procedures to enable the proof of a complete EFC system, as well as components of an EFC system, e.g. OBE, related to the defined requirements of an application. The defined parameter and tests are assigned to the following groups of parameters:

— functionality;

— quality;

— referenced pre-tests.

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This document describes procedures, methods and tools, and a test plan which shows the relation between all tests and the sequence of these tests. It lists all tests that are required to measure the performance of EFC equipment. It describes which EFC equipment is covered by the test procedures; the values of the parameters to be tested are not included. It also describes how the tests are intended to be performed, and which tools and prerequisites are necessary before this series of tests can be undertaken. It is assumed that the security of the system is inherent in the communications and EFC functionality tests, therefore they are not addressed in this document. All tests in this document provide instructions on how to evaluate the test results.

This document defines only the tests and test procedures, not the benchmark values against which they are intended to be measured. The test procedures defined in this document can be used as input, e.g. by scheme owners, for prototype testing, type approvals, tests of installations and periodic inspections.

Related to a conceptual model of an EFC system, this document relates only to the equipment of the user and the service provider.

EFC systems for DSRC consist, in principle, of a group of technical components, which in combination fulfil the functions required for the collection of fees by electronic automatic means. These components comprise all, or most, of the following:

— OBE within a vehicle;

— OBE containing the communications and computing sub-functions;

— optional integrated circuit card which can carry electronic money, service rights, and other secured information;

— communication between OBE and RSE based on DSRC;

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— equipment for the fee collection at the RSE containing the communications and computing sub-functions;

— equipment for the enforcement at the roadside;

— central equipment for the administration and operation of the system.

The scope of this document relates solely to OBE and RSE and the DSRC interface between OBE and RSE including its functions to perform the fee collection. All the equipment used for enforcement (e.g. detection, classification, localization, and registration) and central equipment are outside the scope of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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/IEC 17025:2017, *General requirements for the competence of testing and calibration laboratories*

ISO/IEC 17065:2012, *Conformity assessment — Requirements for bodies certifying products, processes and services*

ISO 17573-2, *Electronic fee collection — System architecture for vehicle related tolling — Part 2: Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17573-2 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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3.1
decision
conclusion based on the results of review, that fulfilment of specified requirements has or has not been demonstrated

[SOURCE: ISO/IEC 17000:2020, 7.2]

3.2
electronic fee collection equipment
EFC equipment
equipment comprising roadside equipment (RSE) and on-board equipment (OBE)

3.3
review
consideration of the suitability, adequacy and effectiveness of selection and determination activities, and the results of these activities, with regard to fulfilment of specified requirements by an object of conformity assessment

[SOURCE: ISO/IEC 17000:2020, 7.1]

3.4
test status
nature of a test, either basic or conditional

Note 1 to entry: A test labelled “conditional” is performed if, and only if, it is applicable to a feature identified in the specification of the system or component, whereas a test labelled “basic” indicates a highly recommended test as part of a foundation for meaningful evaluation. See 5.2.

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4 Abbreviated terms

ARIB Association of Radio Industries and Businesses

NOTE A Japanese standards development organization.

DSRC dedicated short-range communication

EAL evaluation assurance level

EEA European Economic Area

EFC electronic fee collection

EIRP effective isotropic radiated power

EMC electromagnetic compatibility

ETSI European Telecommunications Standards Institute

ICC integrated circuit(s) card

IEC International Electrotechnical Commission

MMI man-machine interface

MTBF mean time between failure

MTTF mean time to failure

MTTR mean time to repair

OBE on-board equipment

OBU on-board unit

QPSK quadrature phase shift keying

RSE roadside equipment

SUT system under test

tbd to be determined

TOE target of evaluation

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5 Test parameters and test procedures for EFC

5.1 Tests overview

5.1.1 General

The test parameters for EFC systems or components are categorized into three groups as follows:

a) referenced pre-tests;

b) functionality tests;

c) quality tests.

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Figure 3 shows the general structure of all test parameter groups relevant for EFC systems and those which are relevant to this document. The specific test parameters that are ultimately deemed relevant for a specific EFC system shall be identified and listed in the test plan according to 5.3. The individual test plan for type approval or acceptance testing shall consider those pre-tests that have already been passed, i.e. for EMC, DSRC and environment.

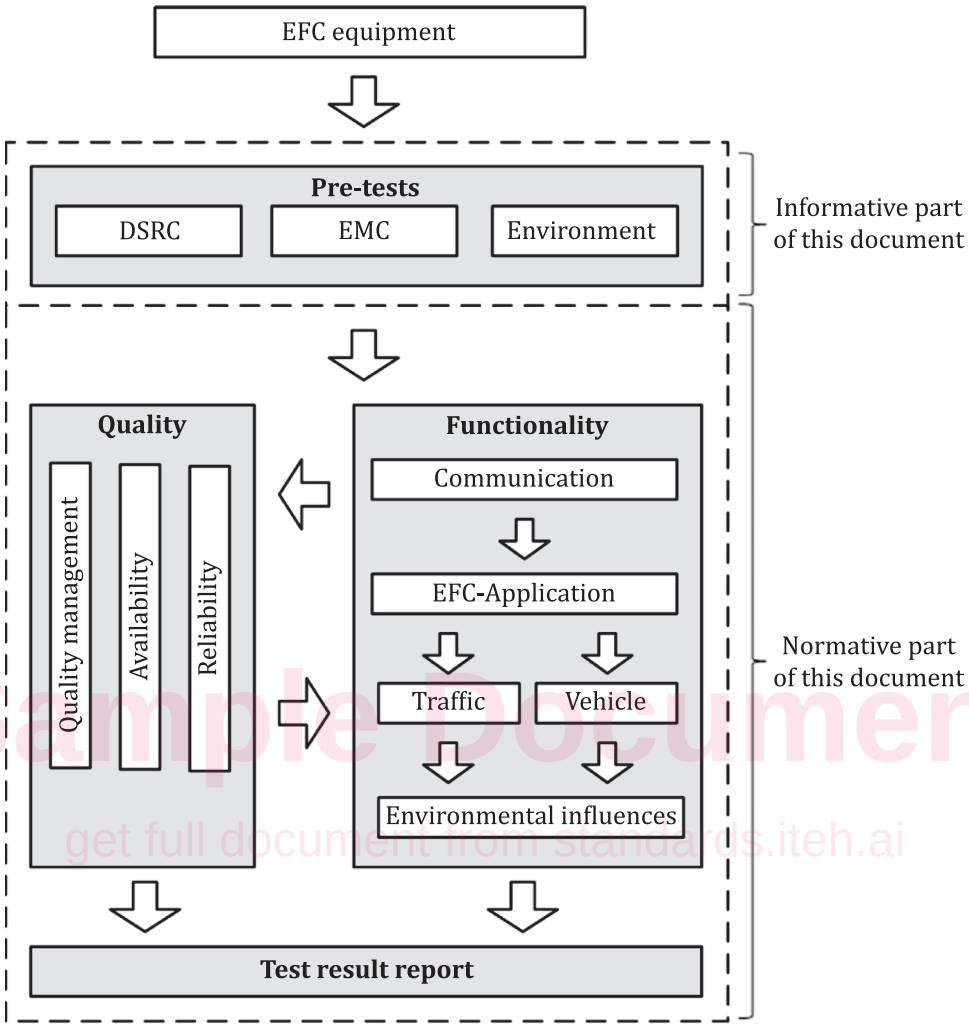


Figure 3 — Test plan — Interdependencies

Annex A provides a brief guide on how to use this document.

5.1.2 Referenced pre-tests

The third category of tests is related to test parameters which are fundamental for the performance of EFC equipment. The specific parameters and requirements are not within the scope of this document. The parameters that are relevant can be assigned to the following groups:

— DSRC;

— EMC;

— environment.

5.1.3 Functionality tests

The first category of tests is related to test procedures which aim to verify the functionality of the EFC equipment.

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The functionality tests are related to the essential test parameters that shall be applied to verify the performance and capability of EFC equipment of different vendors and system operators.

The following parameters shall be tested:

— communication;

— EFC application;

— influence of vehicle characteristics;

— influence of traffic characteristics;

— environmental influences.

Communication and EFC application tests are described in 6.1. Tests related to vehicle and traffic characteristics and environmental influences are listed in Annex B.

5.1.4 Quality tests

The second category of tests is related to procedures that aim to determine the quality of the EFC equipment. These are relevant for both operators and users.

The following test parameters shall be tested:

— quality management;

— reliability;

— availability.

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Test procedures are already available for some of these test parameters (see 6.2 and Annex C).

These tests are described in 6.2 and Annex C.

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5.2 Parameter overview

Tables 1 to 3 provide a comprehensive list of the parameters that are relevant for type approval or acceptance testing of a complete EFC system, as well as components of an EFC system. The tables are divided according to the subjects of 5.1.2, 5.1.3, and 5.1.4: pre-tests, functionality and quality. The subclause in which the tests are described or referenced is shown. An indication as to the nature of these tests (basic or conditional) is provided as not all tests are relevant to all operators and their specific operating situations and environment.

As used in Tables 1 to 3,

— “basic” means that the identified tests are highly recommended as part of a foundation for meaningful evaluation, and

— “conditional” means that the test shall be performed if, and only if, it is applicable to a feature identified in the specification of the system or component under evaluation, for example, performing the lane changing test (T6) if the RSE is characterized as multilane.

Table 1 provides a list of parameters that are necessary for pre-tests and whose performance and conformance are tested by reference to existing standards or Technical Specifications.

Table 2 provides an overview of the parameters for which tests are defined in this document to measure the performance and assess the level of conformance of an EFC system or components under test.

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Table 3 provides a list of the quality tests.

NOTE The tests have been categorized into inspection tests, laboratory tests, simulation tests, and field tests. The appropriate test or types of tests are indicated, in the following tables, for each parameter. It is not expected that all the named types of tests for a parameter will be performed on that parameter. Where a set of appropriate tools is available to a test house, it is up to the test house to decide which type of test is most appropriate to meet its specific remit.

Where a particular category of test shall be performed to conform to this document, the test is indicated in the following tables with a “p”. Where a particular category of test is optional, this is indicated with an “o”.

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Table 1 — Referenced pre-tests

Tests			Location	Test status	Test type
Parameter	**Item**	**Name**	**Reference to subclause**	**Basic/ conditional[a]**	**(R = refer to standards/regulations which specify these pre-tests)**
DSRC	D1	Layer 1	6.1.2, F.1	B	R
	D2	Layer 2	6.1.2, F.1	B	R
	D3	Layer 7	6.1.2, F.1	B	R
Environment	ET1	Basic parameter	6.1.3, F.2	B	R
	ET2	Mechanical	6.1.3, F.2	B	R
	ET3	Electrical	6.1.3, F.2	B	R
	ET4	Chemical/biological	6.1.3, F.2	B	R
	ET5	Safety	6.1.3, F.2	B	R
EMC	E1.1	Emission	6.1.4, F.3	B	R
	E1.2	Immunity	6.1.4, F.3	B	R
[a] Test shall only be applied if function or item is specified.					

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Table 2 — Functionality

Tests			Location	Test status	Applicable test type (p = shall be performed, o = optional)			
Parameter	Item	Name	Reference to subclause	Basic/ conditional[a]	Inspection	Laboratory	Simulation	Field test
Category 1								
Communication	C1	Conformance assessment	6.2.1	B	—	p	o	o
EFC application tests	F1	Validation of the specification	6.2.2	B	p	—	—	—
	F2	Implementation test	6.2.2	B	p	o	o	o
	F3	Functionality tests	6.2.2	B	p	o	o	p
Traffic conditions	T1	Longitudinal distance between vehicles	6.2.3, B.2	B	—	—	o	p
	T2	Lateral distance between vehicles	6.2.3, B.2	C	—	—	o	o
	T3	Lateral distance between OBE	6.2.3, B.2	C	—	—	o	o
	T4	Speed of vehicles	6.2.3, B.2	C	—	—	o	o
	T5	Driving angle	6.2.3, B.2	C	—	—	o	o
	T6	Lane changing	6.2.3, B.2	C	—	—	o	o
	T7	Shadowing	6.2.3, B.2	B	—	—	o	p
	T8	Traffic scenarios — free flow	6.2.3, B.2	C	—	—	o	o
	T9	Traffic scenarios — restricted flow	6.2.3, B.2	C	—	—	o	o
	T10	Traffic volume	6.2.3, B.2	C	—	—	o	o
Category 2								
Vehicle characteristics	V1	Length of vehicle	6.2.4, B.3	C	—	—	o	o
	V2	Height of vehicle	6.2.4, B.3	C	—	—	o	o
	V3	Width of vehicle	6.2.4, B.3	C	—	—	o	o
	V4	Length of bonnet	6.2.4, B.3	C	—	—	o	o
	V5	Other vehicle features, weight, number of axles, volume, shape, paintwork, colour, air conditioner, mobile communication equipment	6.2.4, B.2	C	—	—	o	o
	V6	Constructive elements, superstructures in the windscreen area, lorries with external sun visors, car transporters with projecting loading surface sunroof (open/closed)/roof mountings	6.2.4, B.3	C	—	—	o	o

[a] Test shall only be applied if function or item is specified.

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Table 2 *(continued)*

Tests			Location	Test status	Applicable test type (p = shall be performed, o = optional)			
Parameter	**Item**	**Name**	**Reference to subclause**	**Basic/ conditional[a]**	**Inspection**	**Laboratory**	**Simulation**	**Field test**
	V7	Attenuation of windscreen, caused by e.g. metallized or dirty windscreen	6.2.4, B.3	C	—	o	o	o
	V8	Angle of windscreens, horizontal plane cars, small trucks and vans, trucks, buses, and coaches	6.2.4, B.3	C	—	o	o	o
	V9	Angle of windscreens, vertical plane location in the outer curve area	6.2.4, B.3	C	—	o	o	o
	V10	Mounting height of OBE antenna	6.2.4, B.3	C	—	o	o	o
	V11	Lateral mounting of OBE antenna from middle of windscreen	6.2.4, B.3	C	—	o	o	o
	V12	OBE behaviour, variation of supply voltage, operational state of OBE, fixing of OBE, integrated circuit card (ICC) behaviour	6.2.4, B.3	C	—	o	o	o
Category 3								
Environmental influences	I1	Width of pavement	6.2.5, B.4	C	o	—	o	o
	I2	Number of lanes	6.2.5, B.4	C	o	—	o	o
	I3	Other topographical influences	6.2.5, B.4	C	o	o	o	o
	I4	Water and dust	6.2.5, B.4	C	—	o	o	o
	I5	Temperature, humidity, and daylight	6.2.5, B.4	C	—	o	o	o
	I6	Other weather conditions	6.2.5, B.4	C	—	o	o	o

[a] Test shall only be applied if function or item is specified.

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