
**Road transport and traffic telematics —
Electronic fee collection — Test
procedures for user and fixed
equipment —**

**Part 1:
Description of test procedures**

*Télématique de la circulation et du transport routier — Perception du
télépéage — Modes opératoires relatifs aux équipements embarqués et
aux équipements fixes —*

Partie 1: Description des modes opératoires



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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.org
Web 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.

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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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/TS 14907-1 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 278, *Road transport and traffic telematics*, in collaboration with ISO Technical Committee TC 204, *Intelligent transport systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO/TS 14907-1:2005), which has been technically revised.

ISO/TS 14907 consists of the following parts, under the general title *Electronic fee collection — Test procedures for user and fixed equipment*:

- *Part 1: Description of test procedures*
- *Part 2: Conformance test for the onboard unit application interface*

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.

There are complete EFC-systems available, including documentation and approvals, and these could already be in operation in some European countries. This part of ISO/TS 14907 provides a toolbox of tests and procedures for the assessment and proof of such EFC-systems that they are suitable for specified EFC applications under specific operational conditions. Dependent on a system to be tested, and based on the available documentation and the status of previously performed approvals, this part of ISO/TS 14907 enables parties involved, e.g. system provider, operators and test houses, to take into consideration already proven references and to identify such parameters which still have to be tested according to the specified applications.

At the time of publication of this part of ISO/TS 14907, the determination of common system requirements for Europe (or any other region) has not been agreed. For this reason, this part of ISO/TS 14907 does not specify any particular performance requirements, unless these are already determined elsewhere (such as safety or radio regulations), but rather identifies the key parameters which will comprise such requirements. Where reference to an existing test is available, this part of ISO/TS 14907 provides that reference. This part of ISO/TS 14907 defines only the test and test procedures, not the benchmark figures that these are to be measured against. Benchmark figures which the systems or components under test can be compared with and validated against, might form the subject of a future part of this Technical Specification.

This part of ISO/TS 14907 is furthermore limited to automated (electronic) payment using a standardized dedicated short-range communication (DSRC). The scope of this part of ISO/TS 14907 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.

This part of ISO/TS 14907 enables groups of operators to determine common specific performance levels and operating conditions, and to enable regional variation where appropriate. It provides operating and environmental parameters (or classes of operating and environmental parameters) within which such systems shall successfully function without impairing interoperability to ensure that the person who specified the system can state their requirements clearly to implementation designers and integrators, and to enable the measurement of the performance of such systems.

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

- reference as far as possible to existing standardized test procedures;
- focusing on those tests that are essential to ensure that EFC equipment is able to exchange information and mutually use the exchanged information.

A brief guide describing how to use this part of ISO/TS 14907 is provided by Annex A.

Whilst this part of ISO/TS 14907 relates to general test procedures, certain provisions relate specifically to test procedures for certification purposes. Many features of this part of ISO/TS 14907 are relevant internationally; it is recognized that due to different regulatory requirements outside Europe, extension will be required to make its applicability as comprehensive in non-EU countries, before this document can be reviewed for acceptance as an International Standard.

Road transport and traffic telematics — Electronic fee collection — Test procedures for user and fixed equipment —

Part 1: Description of test procedures

1 Scope

This part of ISO/TS 14907 specifies the test procedures of EFC roadside equipment (RSE) and on-board equipment (OBE) with regard to the conformance to standards and requirements for type approval and acceptance testing which is within the realm of EFC application specifically.

The scope of this part of ISO/TS 14907 is restricted to systems operating within the radio emission, EMC regulations, traffic and other regulations of the countries in which they are operated and it is therefore a requirement that all required equipment approvals from an authenticated and accredited test house have been obtained in order to claim compliance.

This part of ISO/TS 14907 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.

An overview of the tests and parameters provided by this part of ISO/TS 14907 is given in 5.1 and 5.2. OBU conformance testing relative to ISO 14906 (EFC — Application interface definition for DSRC) is covered by ISO/TS 14907-2.

This part of ISO/TS 14907 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 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 here. All tests in this part of ISO/TS 14907 provide instructions to evaluate the test results.

The test procedures can be used for prototype testing, type approvals, test of installations and periodic inspections. Thus this Part 1 is a document that defines only the test and test procedures, not the benchmark figures that these are to be measured against.

Related to a conceptual model of an EFC-system, this part of ISO/TS 14907 relates only to the equipment of the user and the service provider as illustrated in Figure 1. Any other entities are outside the scope of this part of ISO/TS 14907.

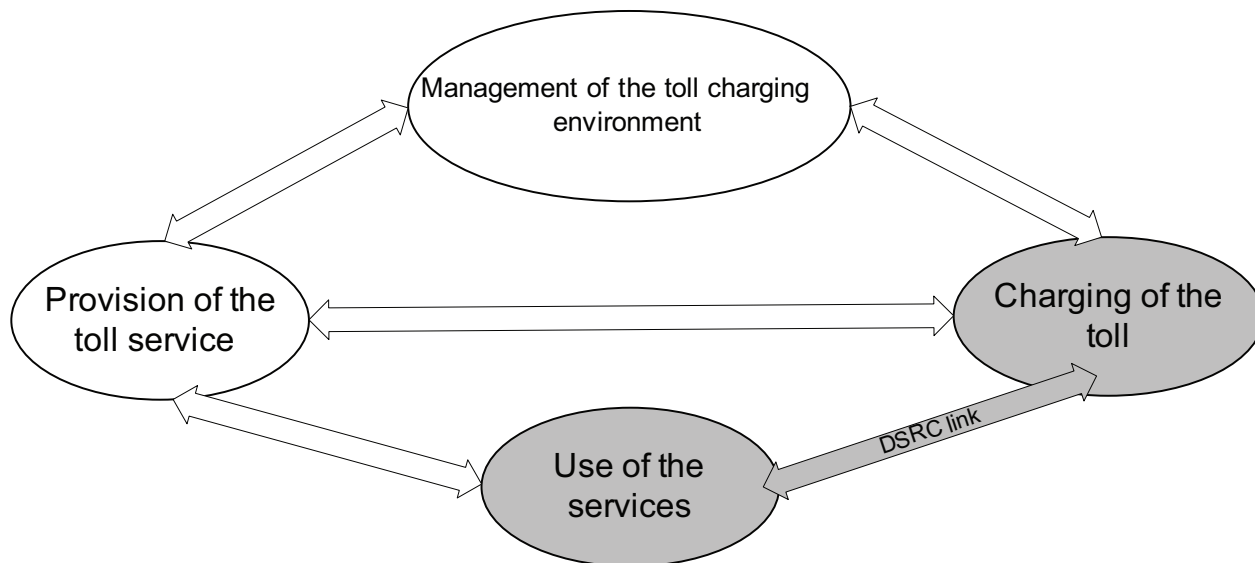


Figure 1 — Conceptual model of EFC

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:

- on-board equipment (OBE) within a vehicle;
- on-board unit containing the communications and computing sub-functions;
- optional integrated circuit card which may carry electronic money, service rights and other secured information;
- communication between OBE and RSE based on DSRC;
- equipment for the fee collection at the roadside (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 part of ISO/TS 14907 relates solely to OBE and RSE and the DSRC interface between OBE and RSE including its functions to perform the fee collection as illustrated by Figure 2. All the equipment used for enforcement (e.g. detection, classification, localization and registration) and central equipment are outside the scope of this part of ISO/TS 14907.

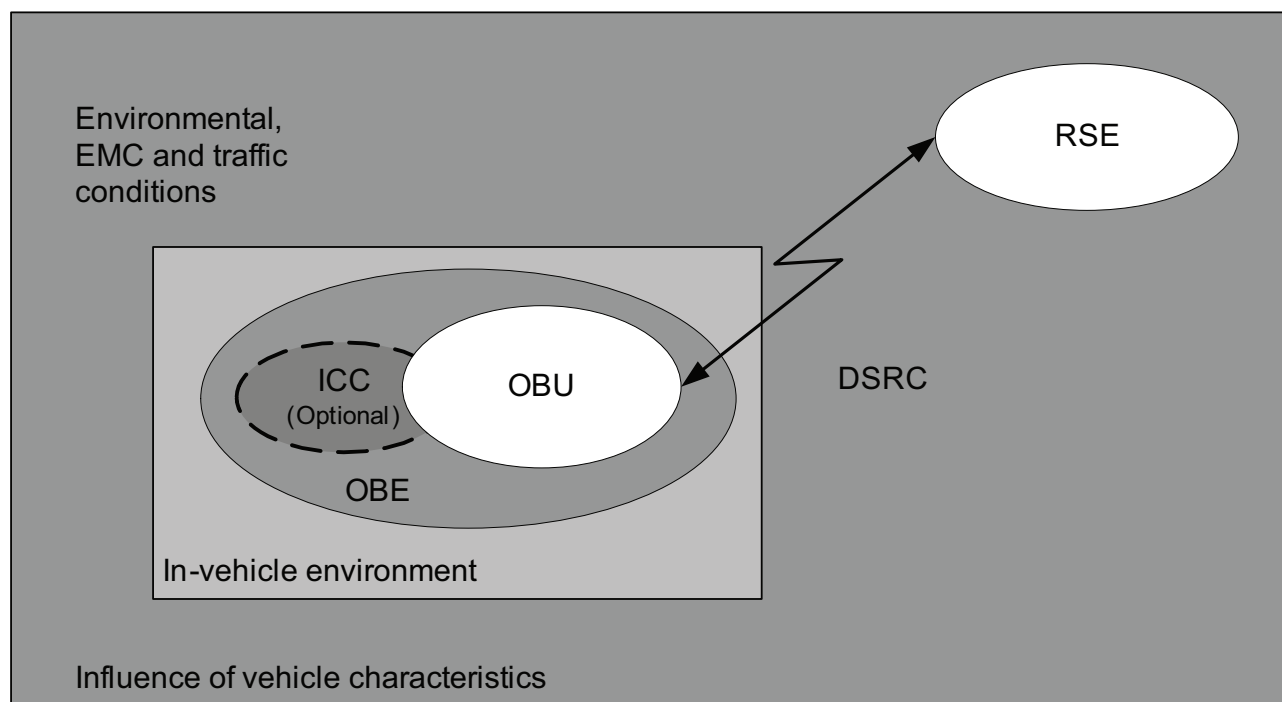


Figure 2 — OBE/RSE interface and associated environments

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/IEC Guide 65, *General requirements for bodies operating product certification systems*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

3 Terms and definitions

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

3.1

acceptance testing

examination that a duly identified product, process or service is in conformity with the system specification

3.2

availability

probability that a unit at a random point in time within a given interval is in a certain degree of preparedness to function or functioning under given running, environmental and maintenance conditions

3.3

certification

procedure by which a third party gives written assurance that a product, process or service conforms to specified requirements

3.4

compatibility

suitability of products, processes or services for use together under specific conditions to fulfil relevant requirements without causing unacceptable interactions

3.5

EFC equipment

equipment comprising roadside equipment (RSE) and on-board equipment (OBE)

3.6

EFC-system

system that enables electronic debiting, i.e. paying for a transport service, without any action from the user at the moment of the use of the service

3.7

evaluation

systematic examination of the extent to which an entity (such as a system, process or product) or a unit is capable of fulfilling specified requirements

3.8

field test

test that is performed under real-life conditions

3.9

functionality

group of parameters which are able to measure the performance of an EFC-system

NOTE Functionality parameters can include communication, application, and vehicle and traffic characteristics.

3.10

inspection

conformity evaluation by observation and judgement accompanied, as appropriate, by measurement, testing or gauging

3.11

interoperability

ability of systems to provide services to, and accept services from, other systems and to use the services so exchanged to enable them to operate effectively together

3.12

laboratory tests

tests which are performed in a laboratory under specified conditions

3.13

maintainability

ability of a device to be maintained or restored to specified conditions within a given period of time

3.14

on-board equipment

OBE

equipment located within the vehicle and supporting the information exchange across the interfaces of its sub-units

NOTE OBE is composed of the on-board unit (OBU) and other sub-units whose presence is considered optional for the execution of the DSRC interface

3.15**quality**

degree to which a set of inherent characteristics fulfils requirements

[ISO 9000:2005, definition 3.1.1]

NOTE User requirements can include ease of use, safety, availability, reliability, sturdiness, economy and environmental safety. Such requirements can be explicit or implicit.

3.16**quality of EFC equipment**

quality of EFC equipment expressed by qualitative and quantitative means using a group of parameters such as reliability, availability and maintainability

3.17**reliability**

ability of a device to perform its intended function under given conditions of use for a specified period of time

3.18**roadside equipment****RSE**

equipment located at a fixed position along the road transport network that enables communication and data exchange with on-board equipment

3.19**simulation**

representation of selected behavioural characteristics of one physical or abstract system by another system

[ISO 2382-1:1993, definition 01.06.01]

3.20**simulation of an EFC-system**

simulation of a DSRC-based EFC-system, where selected behavioural characteristics of the EFC-system are represented by a computer model to enable testing of the EFC equipment in a realistically modelled environment

3.21**test**

technical operation that consists of the determination of one or more characteristics of a given product, process or device according to a specified procedure

3.22**test parameter**

parameter that specifies one or more characteristics of an EFC-system

3.23**test procedure**

specific procedure for performing a test

3.24**test status**

indication of the nature of a test

NOTE 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.

3.25**test type**

kind of test, such as inspection, simulation, lab test and field test

3.26

test house

third party (person or body) that is recognized as being independent of the parties involved, as concerns the issue in question

3.27

type approval

approval based on conformity testing on the basis of one or more specimens of a product representative of the production

3.28

validation

confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled

3.29

verification

confirmation by examination and provision of objective evidence that specified requirements have been fulfilled

4 Abbreviated terms

ARIB	Association of Radio Industries and Businesses
DSRC	dedicated short range communication
EFC	electronic fee collection
EIRP	equivalent isotropically radiated power
EMC	electromagnetic compatibility
ETSI	European Telecommunications Standards Institute
ICC	integrated circuit card
IEC	International Electrotechnical Commission
IUT	implementation under test
MMI	man machine interface
MTBF	mean time between failure
MTTF	mean time to failure
MTTR	mean time to repair
OBE	onboard equipment
OBUE	onboard unit
RSE	roadside equipment
SUT	system under test
tbd	to be determined

5 Test parameters and test procedures for EFC

5.1 Tests overview

5.1.1 Introduction

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

- a) functionality tests;
- b) quality tests;
- c) referenced pre-tests.

Figure 3 shows the general structure of all test parameter groups relevant for EFC-systems and those which are relevant to this part of ISO/TS 14907. The test parameters for pre-tests are referenced from sources other than this part of ISO/TS 14907. 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 take into account those pre-tests that have already been passed, i.e. for EMC, DSRC and environment.

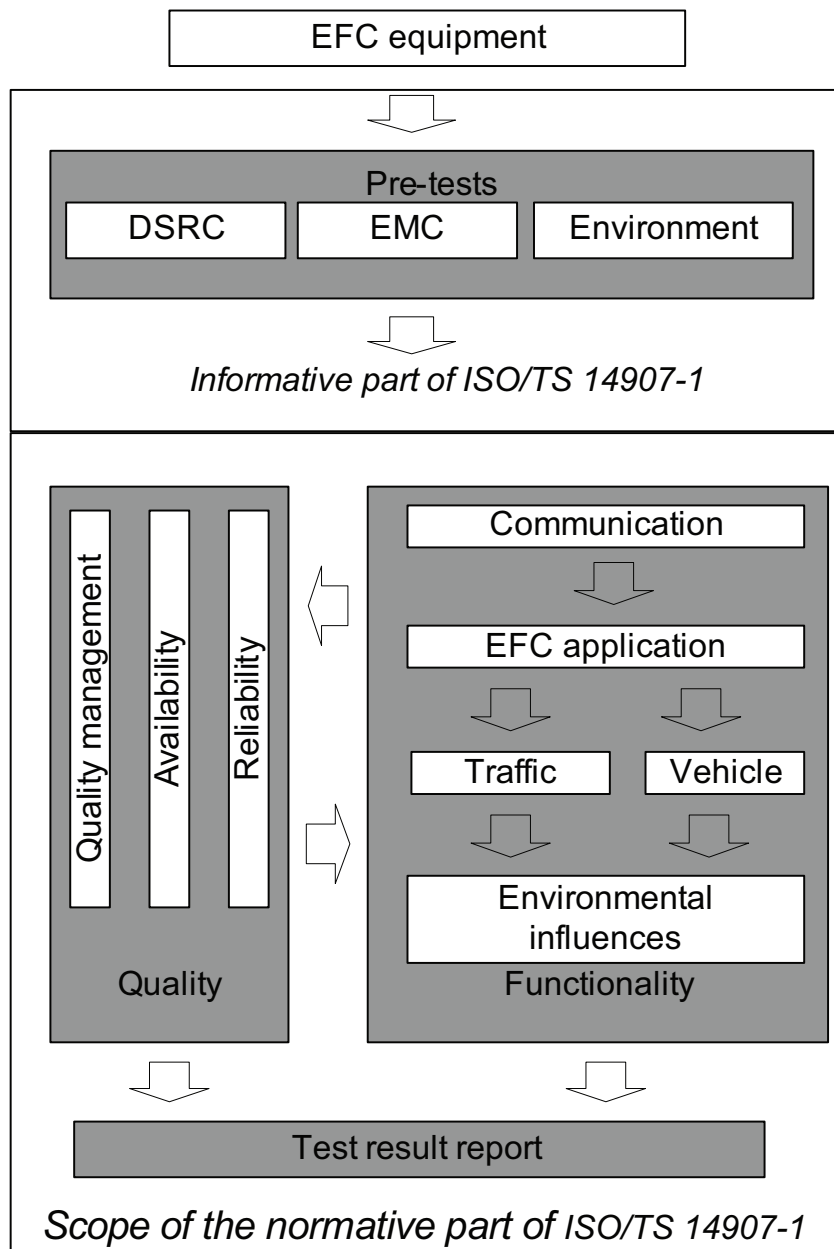


Figure 3 — Test plan — Interdependencies

5.1.2 Functionality tests

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

The functionality tests are related to the essential test parameters that need to 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.

5.1.3 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.

For some of these test parameters, there are some existing test procedures available, which are referenced.

These tests are described in 6.2 and Annex C.

5.1.4 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 part of ISO/TS 14907. The parameters that are relevant can be assigned to the following groups:

- DSRC;
- EMC;
- environment.

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, namely functionality, quality and referenced pre-tests. 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 an overview of the parameters for which tests are defined in this part of ISO/TS 14907 to measure the performance and assess the level of conformance of an EFC-system or components under test.

Table 2 provides a list of the quality tests.

Table 3 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.

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 part of ISO/TS 14907, 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”.

Table 1 — 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	6.1.1	B	—	p	o	o
	F1	Validation of the specification	6.1.2	B	p	—	—	—
	F2	Implementation test	6.1.2	B	p	o	o	o
	F3	Functionality tests	6.1.2	B	p	o	o	p
Traffic conditions	T1	Longitudinal distance between vehicles	6.1.3, B.2	B	—	—	o	p
	T2	Lateral distance between vehicles	6.1.3, B.2	C	—	—	o	o
	T3	Lateral distance between OBES	6.1.3, B.2	C	—	—	o	o
	T4	Speed of vehicles	6.1.3, B.2	C	—	—	o	o
	T5	Driving angle	6.1.3, B.2	C	—	—	o	o
	T6	Lane changing	6.1.3, B.2	C	—	—	o	o
	T7	Shadowing	6.1.3, B.2	B	—	—	o	p
	T8	Traffic scenarios — free flow	6.1.3, B.2	C	—	—	o	o
	T9	Traffic scenarios — restricted flow	6.1.3, B.2	C	—	—	o	o
	T10	Traffic volume	6.1.3, B.2	C	—	—	o	o

Table 1 (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
Category 2								
Vehicle characteristics	V1	Length of vehicle	6.1.4, B.3	C	—	—	o	o
	V2	Height of vehicle	6.1.4, B.3	C	—	—	o	o
	V3	Width of vehicle	6.1.4, B.3	C	—	—	o	o
	V4	Length of bonnet	6.1.4, B.3	C	—	—	o	o
	V5	Other vehicle features, weight, number of axles, volume, shape, paintwork, colour, air conditioner, mobile communication equipment	6.1.4, B.2	C	—	—	o	o
	V6	Constructive elements, superstructures in the windscreen area, lorries with external sun visors, car transporters with projecting loading surface sun roof (open/closed)/roof mountings	6.1.4, B.3	C	—	—	o	o
	V7	Attenuation of windscreen, caused by e.g. metallized, coated, heated or dirty windscreen	6.1.4, B.3	C	—	o	o	o
	V8	Angle of windscreens, horizontal plane cars, small trucks and vans, trucks, buses and touring coaches	6.1.4, B.3	C	—	o	o	o
	V9	Angle of windscreens, vertical plane location in the outer curve area	6.1.4, B.3	C	—	o	o	o
	V10	Mounting height of OBE antenna	6.1.4, B.3	C	—	o	o	o
	V11	Lateral mounting of OBE antenna from middle of windscreen	6.1.4, B.3	C	—	o	o	o
	V12	OBE behaviour, variation of supply voltage, operational state of OBE, fixing of OBE, ICC behaviour	6.1.4, B.3	C	—	o	o	o

Table 1 (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
Category 3								
Environmental influences	I1	Width of pavement	6.1.5, B.4	C	o	—	o	o
	I2	Number of lanes	6.1.5, B.4	C	o	—	o	o
	I3	Other topographical influences	6.1.5, B.4	C	o	o	o	o
	I4	Water and dust	6.1.5, B.4	C	—	o	o	o
	I5	Temperature, humidity and daylight	6.1.5, B.4	C	—	o	o	o
	I6	Other weather conditions	6.1.5, B.4	C	—	o	o	o
^a Test only to be applied if function or item is specified.								

Table 2 — Quality

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
Quality management	Q1	Design, development, production, installation and servicing	6.2.1	B	p	—	—	—
Reliability/ availability	R1	Components, equipment, system	6.2.2, C.1	B	p	o	o	o
	R2	Transaction-level reliability	6.2.2, C.2	B	p	o	o	o
	R3	OBE life duration	6.2.2, C.2	B	p	o	o	o
	R4	OBE battery duration	6.2.2, C.2	B	p	o	o	o
	R5	OBE smart card life duration	6.2.2, C.2	B	p	o	o	o
^a Test only to be applied if function or item is specified.								

Table 3 — Referenced pre-tests

Parameter	Tests		Location Reference to subclause	Test status Basic/ conditional ^a	Test type (R = refer to standards/regulations which specify these pre-tests)
	Item	Name			
DSRC	D1	Layer 1	6.3.1, F.1	B	R
	D2	Layer 2	6.3.1, F.1	B	R
	D3	Layer 7	6.3.1, F.1	B	R
Environment	ET1	Basic parameter	6.3.2, F.2	B	R
	ET2	Mechanical	6.3.2, F.2	B	R
	ET3	Electrical	6.3.2, F.2	B	R
	ET4	Chemical/biological	6.3.2, F.2	B	R
	ET5	Safety	6.3.2, F.2	B	R
EMC	E1.1	Emission	6.3.3, F.3	B	R
	E1.2	Immunity	6.3.3, F.3	B	R
^a Test only to be applied if function or item is specified.					

5.3 Test plan

The test house carrying out the type approval or acceptance testing shall devise an individual test plan for each tested EFC-system or EFC component, in accordance with Figure 3, taking into account the system-specific characteristics of the EFC application. With respect to *type approval*, the requirements of applicable standards or other normative and referenced documents shall be tested by an accredited test house.

With respect to *acceptance tests*, only the features that are specified or implicit in the system specification shall be tested. Where additional features are provided for contingent use at some future date, these shall be tested only if such contingency is included in the system specification. Where additional features are present in products supplied, but are neither used nor included in the system specification or implementation, there is no requirement that they shall be tested unless they have an effect on the operation of the system.

Results of pre-tests that have already been passed shall be compared with the application-specific requirements. If deviations are detected, additional tests will need to be carried out. The test plan shall make references to each listed test parameter with respect to the following details:

- identification of test parameter and item;
- reference of the related requirements/severity of the test;
- required equipment and documentation;
- selected test type;
- required test equipment, measurement equipment, interfaces and tools;
- required test environment;
- department carrying out the test;
- required documentation of the tests and the results (see G.5).

Interdependencies between the results of the different tests are anticipated and shall be taken into account by the test house. An example test protocol form is given in G.5.

5.4 Required documentation

The following listed documentation shall be supplied by the manufacturer to carry out the tests defined by a test plan:

- system description (overview, block diagrams);
- system specification including functions, timing, operational data on a detailed level;
- safety and security concept (threat analysis, implemented measures to detect and control failures, threats and manipulations);
- user documentation (service provider and user);
- specification of ambient conditions;
- operational directives;
- quality assurance directives, development rules;
- maintenance and installation directives;
- list of all available documents from the manufacturer relating to the EFC-system under test created during the design and manufacture of the equipment.

6 Inspection and tests

6.1 Functionality tests

6.1.1 Communication

The test specifications with regard to communication are defined in ISO/TS 14907-2. It specifies the tests that verify OBU conformance of implemented communication (transaction) protocols to conform with the specifications given in ISO 14906 to be used for EFC applications.

NOTE ISO/TS 14907-2 can also be used as a source of inspiration for roadside equipment testing in accordance with ISO 14906.

ISO/TS 14907-2 describes general requirements for conformance testing and specific test procedures for:

- basic DSRC L7 functionality;
- EFC application functions;
- EFC attributes;
- addressing procedures of EFC attributes and (hardware) components (e.g. ICC and MMI);
- EFC transaction model;
- behaviour of the interface.

6.1.2 EFC application

6.1.2.1 General

The tests are related to components or to a complete EFC-system consisting of an OBE, RSE or both and RSE/OBE in combination. The objective of the tests is to validate that the equipment to be tested fulfils the functional and technical requirements of the specification. The proof consists of inspections, simulations and tests which are to ensure that the system specifications and the equipment of EFC are in conformance with the EFC requirements based on standards and regulations, national requirements and other requirements.

Subclauses 6.1.2.2 and 6.1.2.3 describe a set of tests (see also Annex B); which of those tests are relevant and sufficient to prove the performance of an EFC-system or its components shall be defined by a test plan (see 5.3).

The EFC application test is divided into two sections:

- a) validation of the EFC specification;
- b) inspection and test of the EFC-system or component under test (SUT).

The relationship between the test sections is shown in Figure 4.

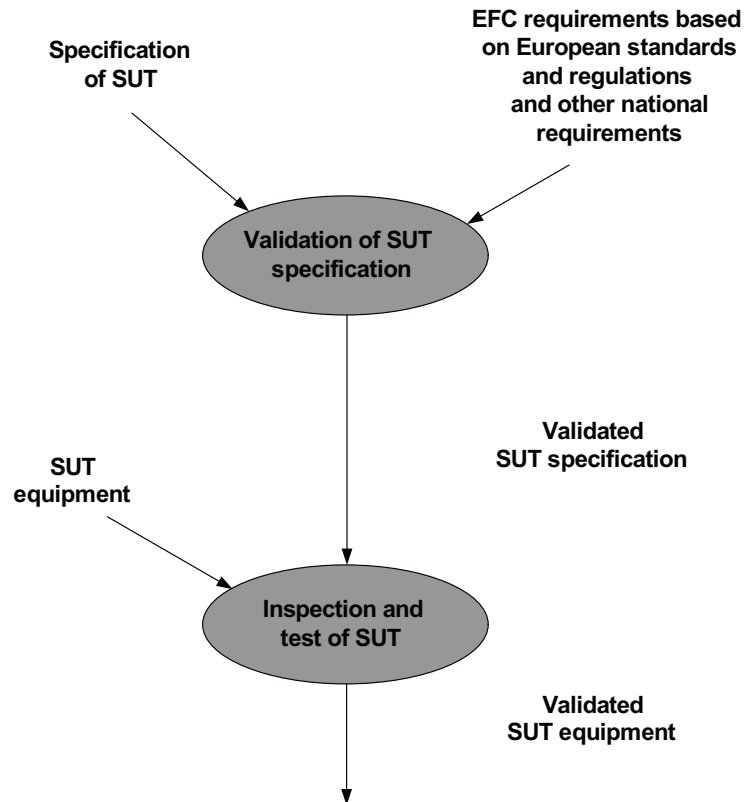


Figure 4 — Structure of application tests

Subclause 6.1.2.2 addresses the validation of the EFC-system specification with respect to the design specification. The objective is a validation of the system specification to verify that it is in conformance with the EFC requirements based on standards and regulations, national requirements and other requirements. The activity consists of inspection and analysis of the referenced documentation. The output of this phase is an authorized and valid system specification of the SUT which meets the requirements of the selected standards and regulations. Additionally a test plan will be specified which identifies the required test steps to prove the performance of the SUT.

Subclause 6.1.2.3 addresses EFC equipment that is designed according to a validated system specification. The activities of this section are inspections, simulations and tests. Before the functionality test can start, an implementation test (pre-test after installation) is carried out to ensure the principal performance of the system. The implementation includes the activities of installation and commissioning. The objective of the tests is to validate the conformity of the equipment with the specification and compliance with the EFC requirements of standards and regulations, national requirements and other requirements.

The inspection and test shall take into consideration results of tests that have been previously performed, for example, quality tests and reference tests, and shall be detailed by a test plan (see 5.3). Annex B contains a list of tests that are related to traffic conditions, vehicle characteristics and other environment influences. Annex H provides examples of EFC scenarios as part of a functionality test.

6.1.2.2 Validation of the SUT specification

EFC application test		
Name:	Validation of the specification (F1)	
Group:	EFC application	
Purpose:	To ensure that the specification of the SUT or component is in conformance with the EFC requirements of standards and regulations, national requirements and user requirements.	
Requirement reference:	— National requirements for EFC. — EFC requirements for a DSRC communication. — User requirements of the specified EFC application.	
Default:	All specifications to be inspected shall be in conformance regarding the DSRC regulations and DSRC standards applicable in the countries and regions in which the system or component will be operated.	
Test configuration:	A set of documentation as listed in 5.4 is required.	
Behaviour description:	The task consists of inspection and analysis (Annex G) of the provided documentation. The details of the system specification of the SUT are compared with the requirements of the EFC standards and regulations, national requirements and user requirements. The documentation is inspected concerning completeness, validity, unambiguity, consistency and understandability. The analysis is carried out to evaluate the system structure, reliability figures, measures to detect and control failures, timing behaviour, security and safety, maintenance, and other technical and non-technical measures concerning system performance.	
Constraints reference:	None	
Verdict:	Test result Authorized and valid system specification of the SUT. Test plan for the performance proof. The system specification does not conform to the requirements. List of discovered deviations.	Verdict Pass Fail
Comments:		

6.1.2.3 Inspection and test of SUT

EFC application test		
Name:	Implementation test (F2)	
Group:	EFC application	
Purpose:	The objective of this test is to verify that the specified EFC-system (SUT) or component is in conformance with the fundamental requirements of the EFC application.	
Requirement reference:	Validated system specification of the SUT	
Default:	Certified DSRC equipment according to the requirements of DSRC regulations and DSRC standards applicable in the countries and regions in which the system or component will be operated.	
Test configuration:	— Documentation and equipment according to test plan. — Test facilities according to test plan.	
Behaviour description:	The SUT or component shall be tested according to the specified requirements. Prerequisite for the inspection and test is a validation of the system specification, certified DSRC equipment according to the DSRC standards and a qualification of the SUT in accordance with other fundamental requirements. Tests which are vacant have to be carried out within this phase. The qualification of this phase consists of inspection, test and simulation. The work is separated into the following steps: — Verification of the quality items of 6.2 and Annex C. — Inspection of the hardware and software to confirm that the system requirements (validated SUT specification) are implemented in the SUT. — Inspection of housing protection, electrical safety, shielding and earthing of installed equipment. — Test of range of electromagnetic emissions, EMC interference and environmental conditions. — Simulation of functions of the SUT to verify its ability to meet the functionality tests (traffic, vehicle, environment and communication requirements). The simulations are carried out according to the specifications of Annex G (simulation). — Test of the basic functions and adjustment of RSE-transmitter/receiver (communication zone) and determination of the footprint range (static test without vehicle). — Test of basic communication functions between RSE and OBE in relation to the determined footprint range of the antenna (static test without vehicle). — Test of subsystems (OBE, chipcard and RSE) to perform the functions as specified in the SUT documentation.	
Constraints reference:	The requirements of the tests are according to the details of the documents identified under "requirement reference".	
Verdict:	Test result The results are stating the SUT ability to meet principal requirements under specific conditions. The SUT does not meet the principal requirements.	Verdict Pass Fail
Comments:		

EFC application test		
Name:	Functionality tests (F3)	
Group:	EFC application	
Purpose:	The objective of this test is to validate that the installed EFC-system (SUT) or component is in accordance with the specifications of the SUT or component.	
Requirement reference:	— Validated system specification of the SUT. — EFC requirements for a DSRC communication. — National requirements for EFC. — User requirements of the specified EFC application.	
Default:	Certified DSRC equipment according to the requirements of DSRC regulations and DSRC standards applicable in the countries and regions in which the system or component will be operated.	
Test configuration:	— Documentation and equipment according to test plan. — Installed EFC equipment according to the manufacturer's instructions. — Test facilities according to the test plan.	
Behaviour description:	The SUT shall be tested according to the specified requirements. Prerequisite for the functionality test is a successful pass of the tests communication, quality and pre-tests. The tests are carried out according to a test plan. The qualification procedure of this section is separated in inspections, tests and simulations. The following steps are required: — Simulation of functions of the SUT to verify its ability to meet traffic, vehicle, environment and communication requirements. The simulations are carried out according to the specifications of Annex G. — Test of the integrated functionality of the selected EFC protocols within the affected communication area including overlapping of different communication units under basic requirements (static and dynamic tests). — EMC interference on realistic applications, e.g. mobile radio, of DSRC functions to verify resistance from outside. — Real-time simulation of traffic and vehicle scenarios (Annex B) to verify the ability of the SUT to meet traffic, vehicle, environment and communication requirements. — Real traffic and vehicle scenarios (Annex B use of vehicles or special constructions) to verify the ability of the SUT to meet traffic, vehicle, environment and communication requirements. — Real traffic and vehicle scenarios (Annex B) based on different EFC transaction profiles to verify compatibility and interoperability characteristics.	
Constraints reference:	The requirements of the tests are according to the details of the documents identified under "requirement reference" and the details of selected classes of performance.	
Verdict:	Test result The results confirm the ability of the SUT to meet functionality, compatibility and interoperability requirements based on the conditions of all carried-out tests. Not in accordance with the specifications.	Verdict Pass Fail
Comments:		

6.1.3 Traffic conditions

Table 4 shows typical traffic conditions, for which individual test case specifications are described in B.2.

Table 4 — Traffic conditions

No.	Traffic conditions
T1	longitudinal distance between vehicles
T2	lateral distance between vehicles
T3	lateral distance between OBEs
T4	speed of vehicle
T5	angle of approach
T6	lane changing
T7	shadowing
T8	traffic scenarios — free flow
T9	traffic scenarios — restricted flow
T10	traffic flow (vehicles/h)

Conditions T1 to T3 and T5 to T7 are shown in Figure 5.

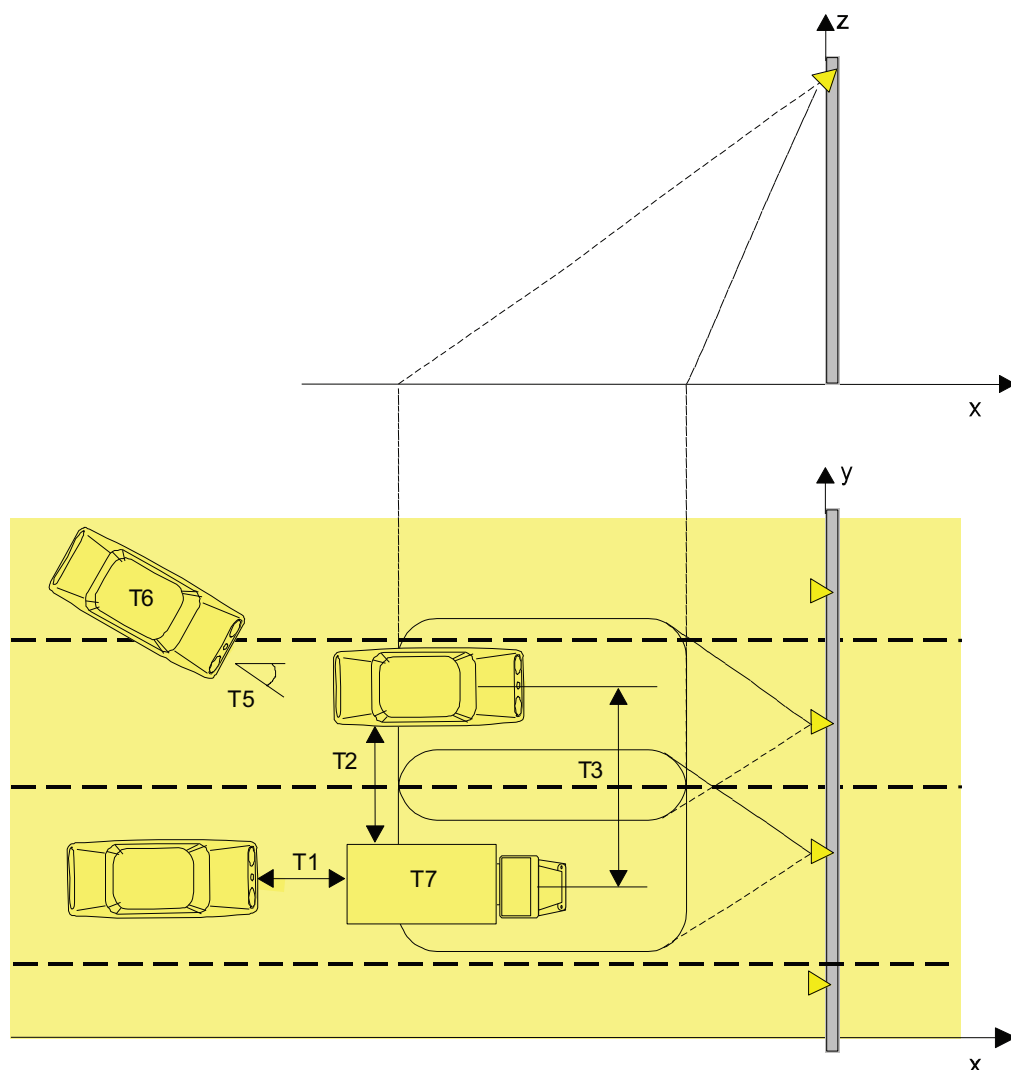


Figure 5 — Traffic conditions

6.1.4 Vehicle characteristics

Table 5 shows typical vehicle characteristics for which individual test case specifications have been described in Annex B.3:

Table 5 — Vehicle characteristics

No.	Vehicle characteristics
V1	length of vehicle
V2	height of vehicle
V3	width of vehicle
V4	length of bonnet
V5	other vehicle features, weight, number of axles, volume, shape, paintwork, colour, air conditioner, mobile communication equipment, trailer
V6	constructive elements, superstructures in the windscreen area, lorries with external sun visors, car transporters with projecting loading surface sun roof (open/closed)/roof mountings
V7	attenuation of windscreen, caused by e.g. metallized, coated, heated, dirty windscreen
V8	angle of windscreens, from horizontal plane cars, small trucks and vans, trucks, buses and touring coaches
V9	angle of windscreens, vertical plane location in the outer curve area
V10	mounting height of OBE antenna
V11	lateral mounting of OBE antenna from middle of windscreen
V12	OBE behaviour, variation of supply voltage, operational state of OBE, fixing of OBE, ICC behaviour

The vehicle characteristics in Table 5 excluding V5 to V7 and V12 are shown in Figure 6.

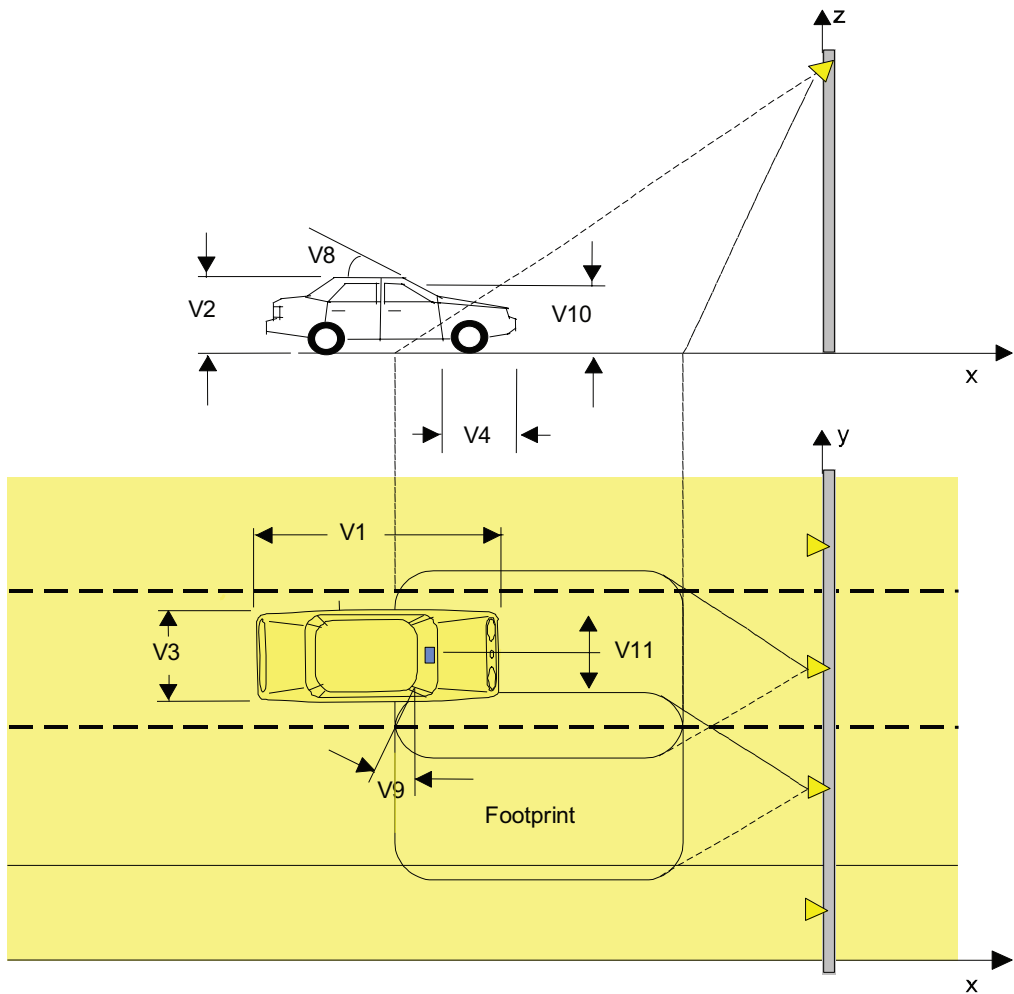


Figure 6 — Vehicle characteristics

6.1.5 Environmental influences

Table 6 lists environmental influences for which individual test case specifications have been described in Annex B.4:

Table 6 — Environmental influences

No.	Environmental influences
I1	width of pavement
I2	number of lanes
I3	other topographical influences
I4	water and dust
I5	temperature, humidity and daylight
I6	other weather conditions