INTERNATIONAL RECOMMENDATION

OIML R 21

Edition 2007 (E)

Taximeters

Metrological and technical requirements, test procedures and test report format

Taximètres

Exigences métrologiques et techniques, procédures d'essais et format du rapport d'essais

OIML R 21 Edition 2007 (E)

ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE

INTERNATIONAL ORGANIZATION OF LEGAL METROLOGY

Contents

Foreword

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Taximeters

1 SCOPE

This International Recommendation specifies the metrological and technical requirements and test procedures for taximeters that are subject to national metrological control.

It is intended to provide standardized requirements and testing procedures to evaluate the metrological and technical characteristics in a uniform and traceable way.

1.1 Application

This Recommendation applies to taximeters that calculate fares charged for journeys according to defined tariffs.

This Recommendation does not apply to mechanical taximeters.

1.2 Principle of operation

A distance measurement transducer (2.2.4) installed in the taxi provides the taximeter with distance information. The taximeter receives the output signal(s) from the distance measurement transducer and the time measuring signal, analyses and converts the signal(s) into the distance measurement signal. Together with the time measuring signal the taximeter calculates the fare, totalizes, displays and possibly records the results due for a taxi journey based on specified tariffs and/or the length and/or the duration of the journey.

2 TERMINOLOGY

The terminology used in this Recommendation conforms to the International Vocabulary of Basic and General Terms in Metrology [1], the International Vocabulary of Terms in Legal Metrology [2], the OIML Certificate System for Measuring Instruments [3], and the OIML International Document General requirements for Electronic Measuring Instruments [4]. In addition, for the purposes of this Recommendation, the following definitions apply.

2.1 General

2.1.1 Taximeter

Instrument intended to measure duration and distance on the basis of a signal delivered by a distance measurement transducer, and to calculate and indicate the fare to be paid on the basis of the measured distance and/or duration.

2.1.2 Taxi

Vehicle, typically a car controlled by a driver, that takes passengers on a journey in exchange for a fare.

2.1.3 Metrological authority

Legal entity (i.e. the verification, issuing authority, accredited body, etc), designated or formally accepted by the government to be responsible for ascertaining that the instrument satisfies all or some specific requirements of this Recommendation.

2.1.4 Metrologically relevant

Any device, instrument, function or software (of a taximeter) that influences the measurement result or any other primary indication is considered as metrologically relevant.

2.1.5 Legally relevant

Part of a measuring instrument, device or software subject to legal control.

2.2 Construction

2.2.1 Device

In this Recommendation the term "device" is used for any means by which a specific function is performed irrespective of the physical realization e.g. by a mechanism or a key initiating an operation; the device may be a small part or a major portion of an instrument.

2.2.2 Real-time clock

Device incorporated into the taximeter that tracks the current time and date.

2.2.3 Event-counter

Non-resettable counter device that increments each time device-specific parameters (2.2.8.3) are changed. The reference number of the counter at the time of initial or subsequent verification is fixed and secured by appropriate hardware or software means.

2.2.4 Distance measurement transducer

Device installed in a taxi that converts the distance to be measured into pulses or digital data which are passed to the taximeter.

2.2.5 Interface

Electronic, optical, radio or other hardware and software connection means that enables information to be automatically passed between several measuring instruments or devices or between several different software modules.

2.2.6 User interface

Interface that enables information to be interchanged between a human user and the measuring instrument or its hardware or software components, e.g. switches, keyboard, mouse, display, monitor, printer, touch-screen, or a window on a screen including the software that generates it.

2.2.7 Protective interface

Interface which only allows the introduction of data into the data processing device of the taximeter, which cannot:

- display data that are not clearly defined and which could be taken as being a measurement result;
- falsify displayed, processed or stored measurement results or primary indications;
- adjust the instrument or change any adjustment factor.

2.2.8 Software

2.2.8.1 Legally relevant software

Programs, data, type-specific and device-specific parameters that belong to the taximeter, and define or fulfill functions that are subject to legal control.

2.2.8.2 Type-specific parameter

Legally relevant parameter with a value that depends on the type of taximeter only. They are fixed at type approval of the taximeter. Examples of type-specific parameters include software identification and parameters used for fare calculation and rounding.

2.2.8.3 Device-specific parameter

Legally relevant parameter that depends on the individual taximeter. Such parameters comprise adjustment and configuration parameters. They are adjustable or selectable only in a service mode of the taximeter and may be classified as those that should be secured and those that may be accessed (settable parameters).

2.2.8.4 Software identification

Sequence of readable characters of software, and that is inextricably linked to the software (e.g. version number, checksum).

2.2.8.5 Software protection

Securing of measuring instrument software by a hardware or software implemented seal which has to be removed, damaged or broken to obtain access to change software.

2.2.8.6 Software separation

Software in measuring devices can be divided into a legally relevant part and a legally irrelevant part. These parts communicate via an interface.

2.2.8.7 Data storage device

Storage on the instrument or external storage device used for keeping measurement data ready after completion of the measurement for subsequent legally relevant purposes.

2.2.9 Taxi identification number

Numbers and/or letters identifying the taxi or the national registration number specified for the taxi.

2.2.10 Printing device (printer)

Device used to produce hardcopies (printouts) of the measurement results.

2.2.11 Operating position device

Device to switch the taximeter into specific operating positions (see 2.3.3).

The operating position device may, for example, consist of specific keys and switches for specific functions.

2.3 Metrological characteristics

2.3.1 Measurement data

2.3.1.1 Fare

Monetary amount calculated, indicated and displayed as a fare by the taximeter, due for a taxi journey based on a fixed initial fee (excluding any supplementary charges) and/or the length and/or the duration of the journey.

2.3.1.1.1 Supplementary charges

Additional monetary amount for an extra service, entered on manual command, suitably identified, indicated and displayed separately from the fare in "Hired" (occupied) and in "Stopped" (To Pay) operating positions, with the possibility to temporarily add to the fare and display the total value of the fare including the supplementary charge at the end of the journey.

2.3.1.1.2 Initial hire fee (or initial charge)

First increment of fare indication upon activation of the taximeter.

2.3.1.1.3 Fare increment step

Smallest amount of money by which the fare may be incremented in equal steps in "Hired" (Occupied) operating position in accordance with the national regulations.

2.3.1.2 Cross-over speed

Speed of the taxi (km/h) at which the time-counting and distance-counting methods operate the taximeter at the same rate. The speed value is determined by division of the time tariff value by the applicable distance tariff value.

The cross-over speed is calculated as:

$$\frac{\text{Time tariff [amount/h]}}{\text{Distance tariff [amount/km]}}$$

For example:

Time tariff: $ 60.00/h

Distance tariff: $ 3.00/km

Cross-over speed [km/h]: $\frac{\$\ 60.00/\text{h}}{\$\ 3.00/\text{km}} = 20$ km/h

2.3.1.3 Fare calculation method

2.3.1.3.1 Normal calculation method, S (single application of tariff)

Fare calculation based on application of the time tariff below the cross-over speed and application of the distance tariff above the cross-over speed.

2.3.1.3.2 Normal calculation method, D (double application of tariff)

Fare calculation based on the combined application of time tariff and distance tariff over the whole journey.

2.3.1.4 Taximeter constant, *k*

Constant expressed in pulses per kilometre which represents the number of pulses the taximeter must receive in order to correctly indicate a distance traveled of one kilometre.

2.3.1.5 Initial distance

Distance which can be traveled according to the tariff for the initial hire fee, considering distance-counting only.

2.3.1.6 Initial time

Period during which the taxi can be used for the initial hire fee, considering time-counting only.

2.3.1.7 Time-counting

Time-counting is the calculation method in which the fare increases in proportion to the duration of the journey.

2.3.1.8 Distance-counting

Distance-counting is the calculation method in which the fare increases in proportion to the distance traveled.

2.3.1.9 Time-distance counting

Time-distance counting is the calculation method in which two components of the fare increase concurrently, one in proportion to the duration of the journey and the other in proportion to the distance traveled.

2.3.1.10 Distance measuring signal

Signal supplied by the distance measurement transducer to the taximeter, in proportion to the distance traveled.

2.3.1.11 Time measuring signal

Signal supplied by a clock incorporated in the taximeter, in proportion to the duration of the journey.

2.3.1.12 Reference number of pulses

Theoretical number of pulses from a distance and/or time measuring signal, which can be calculated using the tariff data and the taximeter constant, *k*, which should lead to a certain change in the fare indication.

2.3.1.13 Tariff

Set of tariff values (including initial time / initial distance) that represents a schedule of charges or rates which will be operative in the taximeter in a specified tariff position.

2.3.1.14 Tariff values

Values from which the taximeter calculates the fare.

2.3.1.15 Distance tariff value

Tariff value expressed as an amount of money for a given distance.

2.3.1.16 Time tariff value

Tariff value expressed as an amount of money for a given period of time.

2.3.1.17 Tariff position

Position to which the taximeter can be adjusted in the "Hired" (Occupied) operating position.

2.3.2 Tariff regulation

Regulation, establishing which tariffs and supplements are to be applied under specified conditions.

2.3.3 Operating position

Specific operating position in which a taximeter fulfils different parts of its functioning.

2.3.3.1 "For Hire" (Free) operating position

Operating position in which the taximeter is not calculating a fare and no paying customer is making a taxi journey.

2.3.3.2 "Hired" (Occupied) operating position

Operating position in which the taximeter is indicating and calculating a fare which is based on a possible initial hire fee and a tariff for the time of the journey and/or distance traveled.

2.3.3.3 "Stopped" (To Pay) operating position

Operating position in which the taximeter is indicating a fare at the end of a fare-paying journey.

2.3.3.4 "Measure" operating position

Operating position in which the total distance and duration of the journey are measured and indicated.

2.3.4 Repeatability [VIM:1993, 3.6 [1]]

Ability of a taximeter to provide results that agree one with the other under the same operating conditions of measurement.

2.3.5 Durability

Ability of a taximeter to maintain its performance characteristics over a period of use.

2.3.6 Audit trail

Continuous data file containing an information record or event-counter (2.2.3) of the changes to the values of device-specific parameters, of software updates or other activities or events that are legally relevant and which may influence the metrological characteristics. Every log entry has a unique time and date stamp.

2.3.7 Operational mode

Mode in which the taximeter is fully operational and implements all functions, including security functions.

2.3.8 Service mode

Mode for updating or confirming the taximeter parameters to be held in the memory storage.

2.4 Indications and errors

2.4.1 Indications of an instrument

Value of a quantity provided by a measuring instrument.

Note: "Indication", "indicate" or "indicating" includes both displaying and/or printing.

2.4.2 Digital indication [VIM:1993, 4.11 [1]]

Indication in which the output or display of the measurement results is digitized.

Note: The term "digitized" relates to the form of presentation of the output or display, not to the principle of operation of the instrument.

2.4.3 Primary indications

Indications, signals and symbols designed to or which may be used to display the fare, that are subject to requirements of this Recommendation.

2.4.4 Totalization indication

Indication mode to display the totalized values, clearly different from other values.

2.4.5 Errors

2.4.5.1 Error (of indication) [VIM:1993, 5.20 [1]]

Indication of an instrument minus a true value of the corresponding input quantity.

2.4.5.2 Intrinsic error [VIM:1993, 5.24 [1]]

Error of an instrument determined under reference conditions.

2.4.5.3 Initial intrinsic error

Intrinsic error of an instrument as determined prior to performance tests.

2.4.5.4 Maximum permissible error, MPE [VIM:1993, 5.21 [1]]

Extreme value of an error permitted by specifications, regulations, etc., for a given instrument.

2.4.5.5 Fault

Difference between the error of indication and the intrinsic error of a taximeter.

Note: Principally, a fault is the result of an undesired change of data contained in or flowing through the measuring instrument. In this Recommendation, a "fault" is a numerical value.

2.4.5.6 Significant fault

Fault, the magnitude of which is greater than the maximum permissible error of the taximeter.

The following are not considered to be significant faults:

- faults that result from simultaneous and mutually independent causes in the instrument;
- faults that make it impossible to perform any measurement;
- transitory faults that are momentary variations in the indications which cannot be interpreted; memorized or transmitted as a measurement result;
- faults that are so serious that they will inevitably be noticed by those interested in the measurement.

2.5 Test conditions

2.5.1 Equipment under test (EUT)

Taximeter or device subjected to performance tests.

2.5.2 Influence quantity [VIM:1993, 2.7 [1]]

Quantity that is not the measurand but which affects the result of the measurement.

2.5.3 Influence factor

Influence quantity having a value within the specified rated operating conditions of the EUT.

2.5.4 Disturbance

Influence quantity having a value within the limits specified in this Recommendation, but outside the specified rated operating conditions of the EUT.

2.5.5 Rated operating conditions [VIM:1993, 5.5 [1]]

Conditions of use (e.g. reference conditions applicable in the IEC Standard) giving the range of values of the influence factors, for which the errors (of indication) of the EUT are required to be within the maximum permissible errors.

2.5.6 Reference conditions [based on VIM:1993, 5.7 [1]]

Set of reference values, or reference ranges of influence quantities prescribed for testing the performance of the EUT, or the inter-comparison of the results of measurements.

2.5.7 Preconditioning

Treatment of the EUT, with the object of removing, or partly counteracting, the effects of its previous history. Where called for, it is the first process in the test procedure.

2.5.8 Conditioning

Exposure of the EUT to an environmental condition (influence factor or disturbance) in order to determine the effect of such a condition on it.

2.5.9 Recovery

Treatment of the EUT, after conditioning, in order that the properties of the EUT may be stabilized before measurement.

2.5.10 Performance test

Test intended to verify whether the EUT is capable of accomplishing its intended functions.

2.5.11 Function test

Test conducted at ambient environmental conditions of the type evaluation test to check the distance and time accuracy and functionality of the taximeter.

2.5.12 Function control test

Test conducted during and/or after each influence factor and disturbance test to check the distance and time accuracy of the taximeter.

2.6 Symbols, units and abbreviations

I	Indication
MPE	Maximum permissible error
EUT	Equipment Under Test
sf	Significant fault
k	Number of pulses per kilometre traveled received by a taximeter
U_{nom}	Nominal voltage value marked on the instrument
U_{max}	Highest value of a voltage range marked on the instrument
U_{min}	Lowest value of a voltage range marked on the instrument
e.m.f	Electromotive force
I/O	Input / Output ports
RF	Radio frequency
V/m	Volts per metre
kV	kilovolt
DC	Direct current
MHz	Megahertz
Pulses/km	Pulses per kilometre
ASD	Acceleration spectral density

3 METROLOGICAL REQUIREMENTS

3.1 Main function of the taximeter

A taximeter shall be designed to measure the duration, and calculate the distance of a fare-paying journey based on a signal delivered by a distance measurement transducer.

A taximeter displays the fare to be paid on the basis of the initial fare registered on the taximeter before distance is traveled and the fare incrementing with fixed intervals after the appertaining distance and/or time is delivered.

3.2 Maximum permissible errors (MPE)

3.2.1 Initial verification

The maximum permissible errors, plus or minus, on initial verification:

3.2.1.1 For a taximeter not installed in the vehicle:

(a) For the elapsed time, 0.2 s or 0.1 % whichever is greater;
(b) For the distance traveled, 4 m or 0.2 % whichever is greater;
(c) For the fare calculated, 0.1 %. Allowance shall be made for the rounding of the least significant digit of the fare indication.

3.2.1.2 For a taximeter installed in the vehicle:

(a) For the elapsed time, 0.2 %;
(b) For the distance traveled, 2 %;

(c) Adjust the taximeter constant, *k*, to the vehicle on which the taximeter is mounted as close as possible to zero error where applicable compensating for wear and tear of the tires of the vehicle.

3.2.2 In-service verification

The maximum permissible errors on in-service verification of a taximeter shall be as specified in 3.2.1.2 for vehicle-installed taximeters.

3.3 Taximeter accuracy conformance over time

A taximeter system shall be designed so that it can conform to the maximum permissible errors without adjustment for a period of not less than one year of normal use and in accordance with national regulations. Any malfunction of the taximeter arising from significant faults shall be automatically and clearly indicated (e.g. by a visible or audible fault indication or by automatic switch off). The documentation submitted by the manufacturer (6.2.1) shall include a description of how this requirement is met.

3.4 Units of measurement

The units of measurement to be used on a taximeter are:

- time, in seconds, minutes and hours;
- distance, in metres (m) or kilometres (km), or as specified in national regulations;
- the fare with the monetary unit, as specified in national regulations.

3.5 Variations due to influence quantities

An instrument shall comply, unless otherwise specified and as far as applicable, with 3.2 and 3.3 under the conditions of 3.5. If not otherwise specified, tests shall not be combined.

3.5.1 Temperature

A taximeter shall maintain its metrological properties within a nominal temperature range of – 25 °C to + 55 °C. There shall be a minimum temperature range of 80 °C with values to be chosen from lower limits of – 40 °C, – 25 °C, or – 10 °C, and upper limits of + 40 °C, + 55 °C, or + 70 °C.

3.5.2 DC voltage supply

A taximeter shall maintain its metrological and technical requirements if the supply voltage varies from the lower and upper limits (U_{min}, U_{max}) of the nominal voltage supply for:

(a) 12 V road vehicle battery voltage supply: lower limit is 9 V, upper limit is 16 V,
(b) Other battery voltage supply specified by manufacturer with given lower and upper limits.

A taximeter shall either continue to function correctly if there is a temporary voltage drop below the lower operating voltage limit or abort an existing measurement if the voltage drop is for a longer period (5.2.5).

3.6 Taximeter constant, *k*

It shall be possible to adjust the taximeter constant, *k*, to the vehicle within the maximum permissible error of 3.2.1.1 (c). It shall be possible to display the taximeter constant, *k*, on the taximeter as a readily accessible decimal number. Every change of the taximeter constant, *k*, shall be secured in accordance with 4.2.5. The use of the taximeter shall not be possible when the change registration capacity is exceeded. That capacity will be defined by the manufacturer.

3.7 Real-time clock

The real-time clock shall keep track of the time of the day and the date. One or both values may be used for the automatic change of tariffs. The following requirements apply:

(a) The timekeeping accuracy shall be 0.02 % of the time;
(b) The correction possibility of the clock shall be not more than 2 minutes per week. Correction for summer and winter time shall be performed automatically in applicable countries and shall be secured in accordance with 4.2.5;
(c) Other time corrections, automatic or manual, shall be prevented during a journey, unless conducted during a verification process.

In the event of an interruption of the power, the real time clock shall continue to function correctly, and retain the correct time and date in the taximeter for at least one year, unless otherwise specified in national regulations.

4 TECHNICAL REQUIREMENTS

4.1 Suitability for use

A taximeter shall be designed to suit the method of operation and vehicles for which it is intended. It shall be of adequately robust construction in order that it maintains its metrological characteristics.

4.2 Security of operation

4.2.1 Fraudulent use

A taximeter shall have no characteristics likely to facilitate its fraudulent use.

4.2.2 Accidental breakdown and maladjustment

A taximeter shall be so constructed that an accidental breakdown or maladjustment of devices likely to disturb its correct functioning cannot take place without its effect being evident (e.g. by appropriate securing, visible or audible fault indication or automatic switch off).

If required by national regulations, the absence or improper functioning of connected instruments shall automatically prevent the operation of the taximeter. This setting of the taximeter shall be secured in accordance with 4.2.5.

4.2.3 Inspection and adjustment

A taximeter shall be designed in such a way as to permit easy inspection and adjustments of the taximeter in order to assess its functionality and to conform to changes in its functions imposed by national regulations. Access to inspection and adjustment functions shall be secured in accordance with appropriate parts of 4.2.5.

4.2.4 Controls and keys

Controls and keys on taximeters effecting measurements shall be so designed that they cannot normally come to rest in positions other than those intended by design, unless during the manoeuvre all indication is made impossible. Keys shall be marked unambiguously. Controls shall be secured in accordance with appropriate parts of 4.2.5.

4.2.5 Securing of functions, hardware, software and pre-set controls

Means shall be provided for securing taximeter functions, measurement data, hardware, software and pre-set controls, to which access, adjustment or removal is prohibited. Security should be provided on all parts of the measuring system which cannot be sealed in any other way against operations liable to affect the measurement accuracy.

In accordance with national regulations there shall be adequate security to ensure that:

(a) Any device for changing the parameters of legally relevant measurement data, particularly for correction and adjustment, shall be secured by appropriate hardware or software means against unintentional and accidental changes;
(b) Access to legally relevant functions shall be restricted to the metrological authority, e.g. by hardware and/or software means such as a special device (hard key, identity scanner, etc.);
(c) It shall be possible for the interventions to be recorded by means of an audit trail (2.3.6) or an event counter (2.2.3) and it shall be possible to access and display this information; the records shall include the date and a means of identifying the authorized person making the intervention (see b) above); the traceability of the interventions shall be assured for at least the period of time in between periodical verifications depending on national regulations;
(d) Records may not be overwritten, and if the storage capacities for records is exhausted, no further intervention shall be possible without breaking a physical seal;
(e) Software protection (2.2.8.5) against intentional, unintentional and accidental changes shall be provided in accordance with the requirements of 4.11;
(f) Means of detecting physical tampering or removal of taximeter hardware shall be provided;
(g) Transmission and updating of legally relevant measurement data and software shall be secured against intentional, unintentional and accidental changes in accordance with the appropriate requirements of 4.10, 4.11 and 5.2.3 respectively;
(h) The securing possibilities available in a taximeter shall be such that separate securing of tariff data is possible;
(i) The securing possibilities available in a taximeter may be such that separate securing of the settings is possible.

4.3 Fare calculation

The interval of fare to pay, the fare calculation method in use, and the monetary symbols shall comply with national regulations.

A taximeter shall be able to calculate the fare by both of the following calculation methods, with the possibility to choose between these calculation methods by a secured setting:

(a) Normal calculation method S (single application of tariff)

The fare is calculated from time-counting below the cross-over speed and from distance-counting above the cross-over speed in accordance with the selected tariff.

(b) Normal calculation method D (double application of tariff)

The fare is calculated from combined time-counting and distance-counting in accordance with the selected tariff.

The indications for fare calculation shall comply with the requirements of 4.9.1.

4.4 Tariff programming

4.4.1 Tariffs

Each allocated tariff includes the following values:

- initial hire fee;
- initial time;
- initial distance;
- time-tariff value;
- distance-tariff value;
- supplementary charge increment, if appropriate.

4.4.2 Input of tariffs

It shall be possible to secure the access to the level at which tariffs can be changed in accordance with 4.2.5.

The tariffs may be entered individually via appropriate protective user interface(s).

Unauthorized or unintentional tariff re-programming due to interfacing with other equipment shall be secured in accordance with 4.2.5.

If the taximeter is capable of having its tariffs re-programmed in advance of the effective date, those tariffs shall not become effective until that date.

Where applicable, the tariffs shall have identifications and signatures of the corresponding tariff parameters.

4.5 Operating position device

The operating position device (2.2.11) is used to bring the taximeter into the operating positions specified below for the tariff based measurement results allocated to individual registers in the taximeter.

4.5.1 "For Hire" (Free) operating position

In the "For Hire" (Free) operating position the fare calculation is disabled (i.e. time-counting and distance-counting are inactive).

In switching to the "For Hire" (Free) operating position, the fare indication and the supplement indication shall be cleared.

In the "For Hire" (Free) operating position it shall be possible to display, when relevant, the following information:

(a) All elements of the indicator display;
(b) The contents of totalizers (see 4.7);
(c) The taximeter constant, *k*, expressed in pulses per kilometre;
(d) The contents of the event counters (see 4.2.5, 4.11.2);
(e) The values of each allocated tariff (see 4.4.1);
(f) Signatures of the corresponding tariff values;
(g) Date and time;
(h) Software version number and/or checksum (see 4.11.1).

The above information shall not be displayed for more than 10 seconds when the taxi is moving, they shall not be interpreted as fare or supplement indication; and their use shall comply with the security of operation requirements of 4.2.

Other indications in the "For Hire" (Free) operating position are permitted provided that they are in accordance with national regulation, they shall not be interpreted as fare or supplement indication and their use is subject to the requirements of 4.2.

4.5.2 "Hired" (Occupied) operating position

In the "Hired" (Occupied) operating position the fare calculation takes place on the basis of a possible initial charge and a tariff for distance traveled and/or duration of the journey (i.e. time-counting and distance-counting are active).

The indications in the "Hired" (Occupied) operating position at the beginning of the journey shall be in the following order:

(a) The initial charge;
(b) The first fare indication, followed by subsequent fare indication changes corresponding to the initial and then successive equal time intervals or distances specified in the applied tariff.

Indications in "Hired" (Occupied) operating position may also include the distance and time displays, provided that they comply with the quality of indication requirements of 4.9.1 and, where appropriate, comply with national regulations.

4.5.3 "Stopped" (To Pay) operating position

In the "Stopped" (To Pay) operating position the fare calculation based on time is disabled (i.e. time-counting is inactive). The indications in "Stopped" (To Pay) operating position shall include the following:

(a) The fare to be paid for the journey; or
(b) If there is a supplementary charge for an extra service, entered by manual command, this shall be displayed separately from the indicated fare. However, in this case a taximeter may temporarily indicate the value of the fare including the supplementary charge.

In the case of b) the indication of the supplement shall be made by figures with a height not more than that of the figures indicating the fare.

The indications in the "Stopped" operating position shall comply with the requirements of 4.9.1.

4.5.4 "Measure" operating position for the normal calculation method D (double application of tariff) system

If the fare calculation is according to the normal calculation method D, the taximeter may be equipped with the "Measure" operating position in which the distance and duration of the journey are measured and displayed in real time on a separate indicator as follows:

(a) Time measured in hours with the smallest increment of 30 seconds;
(b) Distance measured shall have a resolution better than or equal to 0.1 km;
(c) Readings for both time and duration may be given at the same time, or may be recalled one after the other by means of the operating position device;
(d) The period of use shall be shown as hh:mm:ss and the indicated unit of measurement shall comply with the requirements of 4.9.1 so that there can be no confusion as to the quantity indicated.

4.6 Additional requirements for the operating position device

The operating position device is subject to the following requirements:

(a) In the "Stopped" (To Pay) operating position, the indication of the fare shall be readable for at least 10 seconds. During this period it shall not be possible to change to the "For Hire" (Free) operating position;
(b) The design and setting of the operating position device shall ensure that any change in operating positions and their indications comply with the appropriate securing requirements of 4.2.5 and 4.9.1;
(c) It shall not be possible to switch the operating position device to any other operating positions other than those mentioned above, unless otherwise specified in national regulations.

4.7 Totalizers

A taximeter shall be fitted with non-resettable totalizers which can clearly and unambiguously display all of the following values:

(a) Total distance traveled by the taxi;
(b) Total distance traveled when hired;
(c) Total number of journeys;
(d) Total amount of money charged as supplements;
(e) Total amount of money charged as fare.

Other data may be totalized and indicated provided that they comply with national regulations and with the requirements of 4.9.1 for quality of indication to prevent the display of totalized values being used to deceive passengers.

Values saved under conditions of power loss shall be included in the total and shall be stored for at least one year for subsequent use or for a period in accordance with national regulations. In all cases the requirements for data storage given in 4.10 apply.

Totalized values shall be displayed for a maximum of 10 seconds, or for a time specified in accordance with national regulations.

Totalizers shall have a minimum number of digits (e.g. 8 digits) in accordance with national regulations.

4.8 Automatic change of tariffs

The automatic change of tariffs may be triggered by the:

(a) Distance of the journey;
(b) Duration of the journey;
(c) Time of day;
(d) Date;
(e) Day of the week; or
(f) Other data specified in accordance with national regulation.

Any alteration of tariff values shall be secured in accordance with 4.2.5.

4.9 Indicating and printing

4.9.1 Quality of reading

The primary indications shall be by means of a display. Reading of the primary indications (2.4.3) shall be reliable, easy and unambiguous under conditions of normal use including in daylight and at night, and the figures forming the indications shall be of a height equal to or higher than 10 mm or of a size in accordance with nation regulations, and of a shape and clarity that permits easy reading.

Primary indications shall contain names or symbols of the units of measurement and comply with the

requirements of 3.4.

The indicator display shall be so designed that the indications of interest to the passenger are sufficient for a particular application, suitably identified and readable from a distance of at least 2 metres.

A digital indication shall show at least one figure beginning at the extreme right to adequately differentiate subordinate digits.

A decimal fraction value shall be separated from its integer by a decimal sign (comma or dot), with the indication showing at least one figure to the left of the decimal sign and all figures to the right of the decimal sign.

4.9.2 Printing

In accordance with national regulations, a printer may be used to obtain a hard copy, e.g. of the results at the end of the measurement, audit trail record of changes to measurement features and parameters, etc. Printing shall be clear and permanent for the intended use. Printed figures shall be at least 2 mm in height, clear, legible and unambiguous.

If printing takes place, the name or the symbol of the unit of measurement shall be either to the right of the value or above a column of values, or placed in accordance with national regulation.

Multiple copies of the print-out containing the same data must be marked “copy” or “duplicate”.

The minimum printout resulting from each measurement operation shall be dependent upon the application of the taximeter in accordance with national regulations. In general the printout information may include the following:

- tariff identification;
- fare;
- supplementary charge;
- distance and duration of the journey;
- date and the time of the journey;
- taxi identification number.

4.10 Data storage

Legally relevant data stored in a memory of the taximeter or on external storage (e.g. hard-drive) for subsequent legal use shall be adequately protected against intentional and unintentional changes during the storage and data transmission process.

In accordance with national regulations there shall be adequate security to ensure that:

(a) Securing of legally relevant software stored or transmitted between storage devices comply with the appropriate requirements of 4.11;
(b) The legally relevant measurement data stored or transmitted shall be accompanied by all relevant information necessary to reconstruct an earlier measurement for future legally relevant use;
(c) External storage device identification and security attributes shall be verified to ensure integrity and authenticity;
(d) Exchangeable storage media is sealed against unauthorized removal in accordance with 4.2.5;
(e) For long term storage of legally relevant data, the data must be stored automatically when the measurement is concluded. The long-term storage must have a capacity which is sufficient for the intended use;
(f) When the storage is full, new data may replace oldest data provided that the owner of the old data has given authority to overwrite the old data and it complies with the appropriate requirements of 4.2.5 and 4.11.

4.11 Software

There shall be a distinct separation between the legally relevant and non-relevant software (2.2.8.6) in a taximeter. The legally relevant software of a taximeter shall be identified by the manufacturer, i.e. the software that is critical for measurement characteristics, measurement data and metrologically important parameters, stored or transmitted, and software programmed to detect system faults (software and hardware), is considered as an essential part of a taximeter and shall meet the requirements for securing software specified below. National regulations may specify the security that is required.

4.11.1 In accordance with national regulations software documentation submitted with the instrument shall include:

(a) A description of the legally relevant software;
(b) A description of the accuracy of the measuring algorithms (e.g. rounding algorithm when calculating the distance or price);
(c) A description of the user interface, menus and dialogues;
(d) The unambiguous software identification;
(e) An overview of the software system;
(f) Means of securing software;
(g) The operating manual;
(h) Other information relevant to the software characteristics of the taximeter.

4.11.2 In accordance with national regulations there shall be adequate security to ensure that:

(a) The legally relevant software shall be adequately protected against accidental or intentional changes by means of an audit trail (2.3.6) or an event counter (2.2.3) providing information record of the changes to the software;
(b) The legally relevant software shall be assigned with a software identification (2.2.8.4) which shall be adapted in the case of every software change that may affect the functions and accuracy of the taximeter. Software identification shall be easily provided by the taximeter;
(c) The transmission, changing and updating of the legally relevant software shall be secured, e.g. through the use of protective interfaces connected to the taximeter, and comply with the relevant requirements and conditions of 5.2.3;
(d) It shall be possible to access and display the information in the audit trail records; the records shall include the date and a means of identifying the authorized person making the intervention (see (a) above); the traceability of the interventions shall be assured for at least the period of time in between periodical verifications depending on national legislation. Legally relevant records may not be overwritten, and if the storage capacities for legally relevant records are exhausted, no further intervention shall be possible without breaking a physical seal.

4.12 Descriptive markings

Taximeters shall bear the following markings, variable according to national regulations:

- name or identification mark of manufacturer;
- name or identification mark of the importer (if applicable);
- serial number of the taximeter (if applicable);
- type approval sign and/or number of type examination certificate;
- relevant data in respect of the conditions of use;
- year of manufacture;
- specified range of the taximeter constant, *k*, (if applicable) in pulses per kilometre;
- software identification (if applicable).

4.12.1 Supplementary markings

Depending upon the particular use of the taximeter, one or more supplementary markings may be required, e.g.:

- relevant data in respect of the conditions of use;
- where a particular taximeter is verified using a particular type of vehicle (i.e. air suspension systems only).

4.12.2 Presentation of descriptive markings

Descriptive markings shall be indelible and of a size, shape and clarity that permit legibility under normal conditions of use of the instrument. Markings shall be grouped together in a clearly visible place on the instrument, either on a descriptive plate fixed near the indicating device or on the indicating device itself. It shall be possible to seal the plate bearing the markings, unless it cannot be removed without being destroyed.

These additional markings may be either in the national language or in form of adequate, internationally agreed and published pictograms or signs.

The descriptive markings in 4.12 may be simultaneously displayed by a software solution, either permanently or on manual command. In this case the markings are considered as device-specific parameters (see 2.2.8.3), and the following shall apply:

- the taximeter constant, *k*, and the date shall be displayed as long as the taximeter is switched on;
- the other markings may be accessed and displayed by a simple manual command (e.g. a specific keystroke);
- it shall be described in the type approval certificate;
- such markings shall be secured in accordance with the securing requirements given in 4.2.5 and 4.11.2.

The software controlled display markings need not be repeated on the data plate, if they are shown on or indicated near the display of the measurement result, with the exception of the following markings which shall be shown on the data plate:

- *k* and the date shall be shown on the display;
- type approval sign in accordance with national requirements;
- name or identification mark of the manufacturer.

4.13 Verification marks

According to national regulations, initial verification may be testified by verification marks, e.g.:

- verification authority identification;
- date of verification;
- other verification markings specified in accordance with national regulations (e.g. actual value of the taximeter constant, *k*, in pulses per kilometre, vehicle registration, taximeter serial number).

After every subsequent verification new marks shall replace the old marks where necessary to reflect new information.

4.13.1 Position of verification marks

A place shall be provided for the application of verification marks. This place shall:

- be such that the part on which the marks are located cannot be removed from the taximeter without damaging the marks;

- permit the easy application of the marks without changing the metrological qualities of the taximeter;
- be clearly and visibly marked on, in or near the fare indicating device when the taximeter is in service.

4.14 Installation and test conditions

4.14.1 General

Taximeters shall be manufactured, tested and installed so as to minimize any adverse effects of the testing and installation environment. If the correct testing or operation of the taximeter is likely to be affected by the properties of other connected equipment and the vehicle in which it is installed, then the taximeter shall be provided with a means to secure the correct testing and operation of the taximeter (e.g. a test connector interface as specified in 5.2.3 for testing purposes). Where particular details of installation have an effect on the accuracy of the taximeter these details shall be recorded in the test report (e.g. influence of the vehicle) and in the operating and installation manual of the taximeter.

4.14.2 Taximeter operation

After installation the taximeter shall comply with the appropriate requirements of this Recommendation.

All settings that can influence the taximeter compliance with the requirements of this Recommendation shall be secured (see 4.2.5), with access possible only through a special secure mode, e.g. a service mode (2.3.8). Other settings not subject to legal control shall have appropriate protected access (see 4.2.5) through e.g. an operational mode (2.3.7).

5 ELECTRONIC REQUIREMENTS

5.1 General requirements

Taximeters shall comply with the following requirements in addition to the applicable requirements of all other clauses of this Recommendation.

5.1.1 Rated operating conditions

Taximeters shall be so designed and manufactured that they do not exceed the maximum permissible errors under rated operating conditions.

5.1.2 Influence quantities

In addition to 3.5, an electronic instrument shall comply with the requirements under a relative humidity above 93 % when combined with cyclic temperature changes and condensation.

5.1.3 Disturbances

Taximeters shall be so designed and manufactured that when exposed to disturbances, either:

(a) Significant faults do not occur (i.e. the difference between the indication due to the disturbance and the indication without the disturbance (intrinsic error), either shall not exceed the value given in 2.4.5.6; or
(b) Significant faults are detected and acted upon. The indication of significant faults in the display should not be confusing with other messages that appear in the display.

5.1.4 Durability

The requirements of 5.1.1, 5.1.2 and 5.1.3 shall be met durably in accordance with the intended use of the instrument.

5.1.5 Evaluation for compliance

A type of a taximeter is presumed to comply with the requirements of 5.1.1, 5.1.2, 5.1.3 if it passes the examination and tests specified in Annex A.

5.1.6 Application

The requirements of 5.1.3 may be applied separately to each:

(a) Individual cause of significant fault; and/or
(b) Part of the measuring instrument.

The choice of whether 5.1.3 (a) or (b) is applied is left to the manufacturer.

5.2 Functional requirements

5.2.1 Indicator display test

Upon switch-on (of indication), a display test procedure shall be performed that shows all relevant signs of the indicator in their active and non-active state sufficiently long to be checked by the operator. This is not applicable for non-segmented displays, on which failures become evident, for example, screen-displays, matrix-displays, etc.

5.2.2 Acting upon significant faults

When a significant fault has occurred, either the taximeter shall be made inoperative automatically, or a visual or audible indication shall be provided automatically and shall continue until the user takes action or the fault disappears.

5.2.3 Interfaces

A taximeter shall be equipped with interfaces (see 2.2.5) permitting the coupling of the taximeter to any other instruments or the vehicle for automatic transmission of information, and a user interface (2.2.6) permitting the exchange of information between a human user and the taximeter.

A taximeter shall be able to transmit the following data through appropriate protective interfaces:

- operation position: “For Hire”, “Hired” or “Stopped”;
- totalizer data according to 4.7;
- general information: constant of the distance measurement transducer, date of securing, vehicle identification, real time, tariff identification;
- fare information for a journey: total charged, fare, calculation of the fare, supplement charge, date, start time, finish time, distance traveled;
- appropriate tariff(s) information: parameters of tariff(s).

5.2.3.1 In accordance with national regulations documentation on interface submitted with the instrument shall include:

(a) Description of the interface and identification (e.g. RS232, USB, interface number or label, etc.);
(b) A list of all commands (e.g. menu items in case of a user interface or commands accepted by the software of the device, received via each communication interface);

(c) A brief description of their meaning and their effect on the functions and data of the measuring instrument;
(d) Other relevant information regarding the interface characteristics of the taximeter.

5.2.3.2 Securing of interfaces

An interface through which the functions mentioned in 5.2.3 cannot be performed or initiated, need not be secured.

For other interfaces and in accordance with national regulations there shall be adequate security to ensure that:

(a) Interfaces shall not allow the metrological functions of the taximeter and its legally relevant software and data to be inadmissibly influenced by other interconnected instruments, or by disturbances acting on the interface;
(b) The legally relevant data and metrological functions are protected against accidental or intentional changes by a protective interface;
(c) The legally relevant functions in the taximeter's interfaces shall be subject to the appropriate requirements for securing hardware in 4.2.5 and software in 4.11;
(d) The legally relevant parts of the connected instrument, and functions performed or initiated by the connected instrument shall be included in the initial or subsequent verification;
(e) It shall be easily possible to verify the authenticity and integrity of data transmitted to and/or from the taximeter and the connected instrument.

5.2.4 Taximeter test connector

Where the accuracy of the taximeter is to be determined through the functional testing described in A.4, the taximeter shall have a test connecter that is capable of processing at least the signals in Table 1. The functioning of this test connector shall be checked once to ensure that it is capable of processing the signals in Table 1.

Table 1 – Taximeter test connection signals

Input:	Output:
Distance pulses at a rate equivalent to a speed of up to 200 km/h	Distance pulses
Time pulses at a rate equivalent of up to 10 times real time	Time pulses
Signal to block time counting	A signal to indicate fare increments.
The electrical data of the signals must be compatible with the following:	
Signal LOW (logic 0) – 12 V < U_I < 0.8 V	Signal LOW (logic 0) 0 V< U_I < 1 V (1)
Signal HIGH (logic 1) 3 V < U_h < 12 V	Signal HIGH (logic 1) 3 V< U_h < 5 V (1)
Input resistance, R > 4.7 kΩ	Source resistance, R_s < 10 kΩ(1)
Notes: (1) No load at test pin. (2) Signals are referred to ground on the test connector, normally the negative line of the taximeter supply voltage. (3) All signals shall be of rectangular shape with a pulse width of at least 25 μs and a rise and fall time of a maximum of 20 % of the pulse width.	

The taximeter test connector shall be easily accessible after installation in a vehicle provided that it is secured against unauthorized access in accordance with 4.2.5.

If the taximeter is connected to a network in the car (e.g. CAN bus), there shall be the possibility for an input and output for the distance information. In that case the taximeter does not work with pulses but with digital distance information.

5.2.5 Voltage drop below the lower operating voltage limit (3.5.2)

In case of a voltage drop below the lower operating voltage limit, the taximeter shall automatically:

(a) Continue to function correctly or resume its correct functioning without loss of data available before the voltage drop if the voltage drop is temporary (e.g. less than 20 seconds), for example due to restarting the vehicle engine;
(b) Abort an existing measurement and return to the "For Hire" (Free) operating position if the voltage drop is for a longer period (e.g. greater than 20 seconds). In this case, the taximeter shall resume its correct functioning and the stored measurement data concerning the aborted journey must be correct;
(c) Show a significant fault or is automatically put out of service if the voltage drop is for a lengthy period.

If disconnected from the supply voltage, a taximeter shall store the totalized values for at least one year or for a period set in accordance with national regulations.

5.2.6 Repeatability

The application of the same taximeter under the same conditions of measurement shall result in the close agreement of successive measurements. The difference between the successive measurement results shall be less than the appropriate maximum permissible error in 3.2.

5.3 Examination and tests

The examination and testing of a taximeter and any devices having metrological influence is intended to verify compliance with the applicable requirements of this Recommendation.

5.3.1 Examination

A taximeter having metrological influence shall be examined to obtain a general appraisal of the design and construction.

Devices may be examined and tested only once while being connected to a taximeter, and may be declared as suitable for connection to any verified taximeter having an appropriate and protective interface.

A description of the operation and type of devices fitted to the taximeter shall be included in the type approval certificate.

5.3.2 Performance tests

A taximeter shall be tested as specified in Clause 7 and Annex A to determine the correct functioning of the equipment.

Susceptibility that would result from the use of electronic interfaces to other equipment shall be determined in the tests.

5.3.3 Metrological features to be considered

All metrologically relevant features and functions (see 3, 4 and 5) have to be tested at least once in a taximeter as far as applicable and as many as possible in the same taximeter. Variations in metrologically relevant features and functions such as different housings, temperature and humidity ranges, instrument functions, indications, etc. may require additional partial testing of those factors which are influenced by that feature. These additional tests should preferably be carried out on the same taximeter, but if this is not possible, tests on one or more additional taximeter may be performed under the responsibility of the testing authority.

6 METROLOGICAL CONTROLS

6.1 General

The metrological controls of taximeters shall, in agreement with national regulations, consist of:

- type approval;
- initial verification;
- subsequent verification;
- in-service inspection.

Tests should be applied uniformly by the legal metrology services and should form a uniform program. Guidance for the conduct of type approval and initial verification is provided in OIML International Documents D 19 [5] and D 20 [6] respectively.

6.2 Type approval

6.2.1 Documentation

The application for type approval shall include the submission to the metrological authority of the following information and documents, as far as applicable and in accordance with national regulations:

- metrological characteristics of the taximeter (3);
- technical and electronic specifications (4, 5);
- functional description of the taximeter and its devices (2.3, 3.1, 5.2);
- drawings, diagrams, and photos of the instrument explaining its construction and operation;
- description and application of securing components, controls, fault indication function, etc. (3.2, 4.10, 5.2);
- interfaces (types, intended use, immunity to external influences instructions (4.2.5, 5.2.3);
- general software information (4.11, 4.12.2);
- printing devices (4.9.2);
- data storage devices (4.10);
- drawing or photo of the instrument showing the principle and the location of control marks, securing marks, descriptive and verification marks (4.2.5, 4.12);
- list of tariffs provided on the taximeter (4.4);
- any document or other evidence that the design and construction of the taximeter and devices comply with the requirements of this Recommendation;
- operating instructions, operating manual.

Note: Adherence to requirements for which no test is available, such as software-based operations, may be demonstrated by a specific declaration of the manufacturer (e.g. for interfaces as per 5.2.3, and for protected access to setup and adjustment operations as per 4.2.5.

6.2.2 Type evaluation

Type evaluation shall be carried out on one or more taximeters submitted in a form suitable for laboratory tests. The submitted documents shall be examined and tests carried out to verify that the taximeter complies with the:

(a) Metrological requirements in Clause 3, particularly with reference to the appropriate limits of error and the operating conditions specified by the manufacturer;
(b) Technical requirements in Clause 4; and
(c) Electronic requirements in Clause 5.

The appropriate metrological authority shall conduct the tests in a manner that prevents an unnecessary commitment of resources, and that permits the results of the tests to be assessed for initial verification.

The appropriate metrological authority may:

(a) Conduct other appropriate tests in accordance with national regulations to verify compliance with the metrological and technical requirements of this Recommendation;
(b) Accept, with the consent of the applicant, test data obtained from other metrological authorities without repeating tests.

6.2.2.1 Type evaluation tests

Type evaluation tests shall be performed under the normal rated operating conditions for which the taximeter is intended. The functioning of the taximeter shall be determined as specified in Clause 7 and Annex A, and influence factors shall be applied to the taximeter as specified in 3.5 and Annex A.

Type evaluation tests shall be performed either on the premises of the metrological authority to which the application has been submitted, or in any other suitable place agreed between the metrological authority concerned and the applicant.

The metrological authority may require the applicant to supply equipment and personnel to perform the tests.

6.2.2.2 Type approval certificate

The following information shall appear on the type approval certificate:

- name and address of the recipient of the certificate;
- name and address of the manufacturer, if not the recipient;
- type of the instrument and number of the certificate number;
- metrological and technical characteristics;
- type approval mark;
- information on the location of marks for type approval, initial verification and securing;
- list of documents accompanying the type approval certificate; and
- specific remarks.

If applicable, the version of the metrological part of the evaluated software shall be indicated in the type approval certificate or its annexes.

6.2.2.3 Determination of accuracy requirements

Accuracy requirements shall be determined in accordance with the appropriate parts of 3.2.1 by compliance with the metrological requirements at initial verification of the taximeter.

6.3 Initial verification

6.3.1 General requirements

Initial verification tests shall be carried out in accordance with national regulations by the appropriate metrological authority.

The appropriate metrological authority shall conduct the tests in a manner that prevents an unnecessary commitment of resources. In appropriate situations and to avoid duplicating tests previously performed on the taximeter for type evaluation under 6.2.2, the authority may use the results of observed tests for type evaluation.

The metrological authority may require the applicant to supply equipment and personnel to perform the tests.

6.3.2 Initial verification tests

Initial verification shall not be performed unless conformity of the taximeter to the approved type and/or the requirements of OIML R 21 is established.

Initial verification tests shall be carried out to verify compliance with the following:

- appropriate maximum permissible errors in 3.2.1;
- correct functioning of all devices, e.g. distance transducer, taximeter, real-time clock;
- construction material and design, as far as they are of metrological relevance;
- if appropriate, a list of the tests performed;
- secured tariffs (if applicable, depending on national regulations).

Tests shall be performed on the taximeter, including all devices which form the assembly as intended for normal operational use, and the verification procedure may be carried out in two stages, where the first stage shall allow for easy examination of the tariff parameters and distance measurement without the influence of the vehicle, and the second stage shall comprise all examinations of which the outcome is dependent on tests of a vehicle-installed taximeter.

6.3.3 Visual inspection

Before testing, the taximeter shall be visually inspected for:

- physical metrological characteristics, i.e. measurement units, real-time clock;
- identification of software, if applicable;
- prescribed markings and positions for verification and control marks.

If the location and conditions of use of the instrument are known, it should be considered whether they are appropriate.

6.3.4 Marking and securing

According to national regulations, initial verification may be testified by verification marks as specified in 4.13. National regulations may also require securing of devices whose dismantling or maladjustment might alter the metrological characteristics of the taximeter without the alterations being clearly visible. The provisions of 4.2.5 and 4.13 shall be observed.

6.4 Subsequent metrological control

Subsequent metrological control may be performed by the metrological authority according to national regulations.

6.4.1 Subsequent verification

Subsequent verification shall be carried out in accordance with the same provisions as in 6.3 for initial verification with the error limits being those in 3.2.1.2 for a taximeter installed in a vehicle. Marking and securing may take place according to 6.3.4, the date being that of the subsequent verification.

6.4.2 In-service inspection

In-service inspection shall be carried out in accordance with the same provisions as in 6.3 for initial verification with the exception that the in-service maximum permissible errors in 3.2.1.2 shall be applied. Marking and securing may remain unchanged, or renewed as per 6.4.1.

7 TEST METHOD

7.1 General

A taximeter shall undergo type approval in accordance with the requirements of A.1. All the relevant test information, indications and functional performance shall be recorded for the tests. Other tests or test data in accordance with 6.2.2 may be used to verify the performance of the taximeter to the requirements of this Recommendation.

Initial verification of a taximeter, including all devices which form the assembly as intended for normal operational use, shall include checks for conformity to the approved type, and verification of the metrological and technical requirements in accordance with A.2 in appropriate situations and to avoid duplicating tests previously performed on the taximeter under type approval.

7.2 Functional tests according to the featured calculation method (A.4)

The following functional tests are performed according to the featured calculation methods S and D in the taximeter and conducted in accordance with the test program in Table 2:

(a) Function test in 7.2.1;
(b) Function control test in 7.2.2;
(c) Visual examination in 7.3; and
(d) Test report format in 7.4.

7.2.1 Function test (A.4.3)

The function test for the featured calculation method S and D in the taximeter consists of an initial check of the taximeter's accuracy and is performed at the beginning of the test program (see Table 2) at ambient conditions and in accordance with A.4.3 for the following parameters:

(a) Test of initial distance and initial time;
(b) Lowest, middle and highest values of:
    (1) the specified pulse frequency range (from 5 km/h up to a maximum speed of at least 200 km/h as specified by the manufacturer);
    (2) pulse voltage levels;
    (3) three or more *k* values shall be tested (each with a minimum and maximum number of pulses per kilometre specified by the manufacturer);
(c) Selection of automatic changes, if applicable (see 4.8);
(d) Supply voltage variations.

The start and end times, the date of the function test and the checklist for the taximeter's operation and tasks (see Annex C) shall be completed during the function test.

7.2.2 Function control test during and after influences or disturbances (A.4.4)

Function control tests for the featured calculation method S and D in the taximeter are conducted to check the taximeter's accuracy for a suitable tariff during and/or after influence or disturbance conditions as specified in Table 2 and A.4.4.

7.3 Visual examination (A.4.2)

The EUT shall be carefully checked for any visible deterioration before and after each test. Details of observations shall be noted and recorded.

7.4 Test report format

The results of the tests shall be recorded in the test report format given in Annex C.

7.5 Program of functional tests

Table 2 –Test program

Test category	Test	Test reference	Notes
1	Initial visual examination and function test.	A.4.3	Initial check of taximeter accuracy at ambient conditions.
2	(a) Static temperatures function control tests.	A.5.4.1	Function control during dry heat and cold tests.
	(b) Damp heat cyclic (condensing) function control tests.	A.5.4.2	Function control during damp heat cyclic tests.
	(c) Visual examination and function control test.	A.4.4	Repeat the function control test at ambient conditions after completion of the damp heat cyclic test. Check the recorded information.
3	(a) Voltage supply variations function control test.	A.5.4.3	Function control test during voltage variations test.
	(b) Function control and visual examination.	A.4.4	Repeat the function control test at ambient conditions after completion of the voltage variations test. Check the recorded information.
4	(a) Random or sinusoidal vibration function control test.	A.5.4.4.1 or A.5.4.4.2	Function control during vibration test.
	(b) Function control and visual examination.	A.4.4	Repeat the function control test at ambient conditions after completion of the random or sinusoidal vibrations test. Check the recorded information.
5	(a) Immunity to radiated electromagnetic fields.	A.5.4.5.1	Repeat the function control test at ambient environmental conditions after completion of the electrostatic discharges tests. Check the recorded information.
	(b) Immunity to conducted electromagnetic fields.	A.5.4.5.2	
	(c) Electrostatic discharge test.	A.5.4.6	
	(d) Visual examination and function control test.	A.4.4	
6	(a) Electrical transient conduction along supply lines.	A.5.4.7.1	Repeat the function control test at ambient conditions after completion of the test for electrical transient conduction via other supply lines. Check the recorded information.
	(b) Electrical transient conduction via lines other than supply lines.	A.5.4.7.2	
	(c) Function control and visual examination.	A.4.4	

Annex A (Mandatory)

Test procedures for taximeters

A.1 Examination for type approval (6.2)

The following shall normally be applied for type evaluation:

(a) Review the documentation submitted to determine whether it is adequate and correct. Consider the operational manual. For type approval the documentation shall be as specified in 6.2.1;
(b) Compare construction with documentation and examine the various devices of the taximeter to ensure compliance with the documentation specified in 6.2.1;
(c) Note the metrological characteristics using the checklist given in the test report format in Annex C;
(d) Examine the taximeter for conformity with the technical requirements in Clause 4, in accordance with 6.2.2 and using the checklist given in the test report format in Annex C;
(e) Examine the taximeter for conformity with the requirements of 5.1, 4.2 and 5.3, in accordance with 6.2.2 and using the checklist given in the test report format in Annex C.

A.2 Examination for initial verification (6.3)

(a) Examine the taximeter for conformity with the approved type and/or the requirements of this Recommendation in accordance with 6.3;
(b) Check the descriptive markings in accordance with 4.12 using the checklist given in the test report format in Annex C;
(c) Check the arrangement for verification marks and securing in accordance with 6.3.5 using the checklist given in the test report format in Annex C.

A.3 General test requirements

A.3.1 Supply voltage (3.5.2)

Power up the EUT and maintain the EUT energized for the duration of each test, unless otherwise specified in the test.

A.3.2 Temperature (3.5.1)

The tests shall be performed at a steady ambient temperature unless otherwise specified.

There shall be no condensation of water on the EUT unless otherwise specified for each test.

A.3.3 Recovery

After each test the EUT shall be allowed to recover sufficiently before the next test.

A.4 Functional tests (7.2)

A.4.1 General

The taximeter shall be connected through its test connector to a calibrated pulse counter and a calibrated timer as appropriate for the functional tests. Refer to Table 1 for test connection signals information.

The functional tests shall be conducted at rated operating voltage of 12 V DC for 12 V systems.

For other voltage systems the functional tests shall be conducted at the appropriate operating voltage, e.g. at 24 V DC for 24 V systems.

A.4.2 Visual examination (7.3)

The EUT shall be inspected visually before and after each functional test in the test program in Table 2. The registered results from the tests shall be checked.

A.4.3 Function test (7.2.1)

This is the first test conducted at the beginning of the test program in Table 2 to check the accuracy of the time (if applicable) and the distance measurement as specified in 7.2.1 and in accordance with Table 3.

Table 3 - Summary of the function test

<table>
<tr><th>Test conditions</th><th colspan="2">Measuring parameters</th><th>Error allowance</th></tr>
<tr><td rowspan="6">12 V DC under reference ambient conditions</td><td colspan="2">Accuracy of the time (if applicable) and the distance measurement:</td><td rowspan="6">maximum permissible error
(see 3.2.1)</td></tr>
<tr><td colspan="2">(a) at voltages of 9 V and 16 V</td></tr>
<tr><td colspan="2">(b) for the featured calculation method S or D</td></tr>
<tr><td rowspan="3">(c) Lowest, medium and highest values of:</td><td>pulse frequency levels</td></tr>
<tr><td>pulse voltage levels</td></tr>
<tr><td>specified k values</td></tr>
<tr><td></td><td colspan="2">(d) Selection of automatic changes (if applicable)
(e) The time and date of the test (e.g. at the beginning and end of tests) and checklist for operation and tasks</td><td>4.8
Test report format
(see Annex C)</td></tr>
<tr><td>Visual examination</td><td colspan="2">Check recorded information and examine the taximeter for visual defects</td><td>A.4.2</td></tr>
</table>

A.4.4 Function control test (7.2.2)

These are subsequent tests to check the accuracy of the time (if applicable) and the distance measurement during and after the application of influence factors and/or disturbances as specified in 7.2.2 and in accordance with Table 4.

Table 4 - Summary of the function control test

<table>
<tr><th>Test conditions</th><th>Measuring parameters</th><th>Error allowance</th></tr>
<tr><td>12 V DC under conditions of influences and disturbances</td><td>Time (A.4.5.2) and distance (A.4.5.1) accuracy for calculation method S and D during influences and/or disturbances (see Table 2).</td><td rowspan="3">Maximum permissible error
(see 3.2.1)</td></tr>
<tr><td rowspan="2">12 V DC under ambient conditions</td><td>After application of influences and/or disturbances (see Table 2):
(a) Time and distance accuracy for calculation method S and D, and</td></tr>
<tr><td>(b) Visual inspection - check recorded information and examine taximeter for visual defects</td><td>A.4.2</td></tr>
</table>

A.4.5 Function control test for calculation method S (single application of tariff)

A.4.5.1 Distance measurement

To eliminate the influence of time from the distance test the use of the test connection input "signal to block time counting" (see Table 1) is recommended for this test so that the time and distance can be examined separately.

A.4.5.1.1 Test of the initial distance

The test of the initial distance is conducted as follows: Beginning with the taximeter set to the "For Hire" (Free) operating position, use the pulse counter to measure the number of pulses generated between switching the taximeter to the "Hired" (Occupied) operating position and one fare increment step. The difference between this number of pulses (actual) and the number expected (reference) according to the programmed tariff is checked for compliance with the applicable initial verification maximum permissible error limits in 3.2.1 taking into consideration the distance represented by each pulse.

A.4.5.1.2 Test of distance counting accuracy

The test of distance counting accuracy can be done at a simulated speed of up to 200 km/h. When using this speed, it should be at least 10 fare increments. With the taximeter set to the "Hired" (Occupied) operating position, the two test possibilities are given below:

(a) Use the pulse counter to measure the time elapsed for switching the taximeter for a specified number of fare increments. This time (actual) is then compared to the time expected (reference) according to the programmed tariff, and the taximeter constant, *k*;

(b) A predetermined number of distance pulses calculated for a number of fare increments at the pulse input of the taximeter to recognize whether the taximeter displays the corresponding number of fare increments. Compare this number of pulses to the number of expected fare increment steps according to the programmed tariff and the taximeter constant, *k*.

A.4.5.2 Time measurement

A.4.5.2.1 Test of the initial time

The test of the initial time is conducted as follows: Beginning with the taximeter set to the "For Hire" (Free) operating position, the timer is used to measure the number time pulses elapsed between switching the taximeter to the "Hired" (Occupied) operating position and one fare increment step. The difference between the measured time (actual) and time expected (reference) according to the programmed tariff is checked for compliance with the applicable initial verification maximum permissible error limits in 3.2.1.

A.4.5.2.2 Test of time counting accuracy

The test of time counting accuracy is conducted as follows: With the taximeter set to the "Hired" (Occupied) operating position, the pulse counter is used to measure time pulses at 10 times higher frequency (see Table 1) for a number of fare increments. The measured time is compared to the time expected according to the programmed tariff, and checked for compliance with the applicable initial verification maximum permissible errors in 3.2.1.

A.4.6 Function control test for calculation method D (double application of tariff)

The pulse counter is used to measure the number of distance pulses generated between switching the taximeter to the "Hired" (Occupied) operating position and one fare increment step, and at the same

time the timer is used to measure the time elapsed between switching the taximeter to the "Hired" (Occupied) operating position and one fare increment step.

The difference between the number of pulses (actual) counted and the number expected (reference) according to the programmed tariff, and the difference between the time measured (actual) and the time expected (reference) according to the programmed tariff are checked for compliance with the applicable initial verification maximum permissible error limits in 3.2.1, taking into consideration the distance represented by each pulse.

A.5 Performance tests

A.5.1 General test conditions

Metrological performance tests are intended to verify that taximeters can function as intended in the climatic, mechanical and electromagnetic environments and under the conditions specified. Each test indicates, where appropriate, the reference condition under which the intrinsic error is determined.

Where possible, tests shall be carried out on a taximeter in its normal operational state under laboratory conditions. The permissible effects of the influence factors or disturbances, under these laboratory conditions, are specified for each test in Annex A.

When the effect of one influence factor is being evaluated, all other factors are to be held relatively constant, at a value close to normal. After each test, the taximeter shall be subjected to the recovery condition as specified in A.3.3. The operational status of the taximeter shall be recorded for each test.

When a taximeter is connected in other than a normal configuration, the procedure shall be mutually agreed on by the metrological authority and the applicant.

The tests in Annex A are conducted at the rated operating voltage of 12 V DC unless otherwise specified.

A.5.2 Interfaces (4.2.3)

Susceptibility that would result from the use of interfaces to other equipment shall be determined in the tests.

A.5.3 Documentation

Simulators shall be defined in terms of hardware and functionality by reference to the EUT, and by any other documentation necessary to ensure reproducible test conditions. This information shall be attached to, or traceable from, the test report.

A.5.4 Influence factor and disturbance tests (3.5, 5.1.1)

Table 5- Summary of tests

Test	Characteristic under test	Criterion	§
Static temperatures (dry heat and cold)	influence	MPE	A.5.4.1
Damp heat (condensing)	disturbance	sf	A.5.4.2
Supply voltage variations	influence	MPE	A.5.4.3
Vibration (random or sinusoidal)	influence	MPE	A.5.4.4
Immunity to electromagnetic fields	disturbance	MPE	A.5.4.5
Electrostatic discharge	disturbance	MPE	A.5.4.6
Electrical transient conduction on voltage supply lines or via lines other than supply lines	disturbance	MPE	A.5.4.7
Note: MPE = maximum permissible error (3.2.1), sf = significant fault (2.4.5.6)			

A.5.4.1 Static temperatures (Dry heat and cold) (3.5.1)

Static temperature tests are carried out according to basic standard IEC 60068-2-1 [7], IEC 60068-2-2 [8], IEC 60068-3-1 [9], and according to Table 6.

Table 6 - Dry heat (non-condensing) and cold

Environmental phenomenon	Test specification			Test setup
Static temperatures (Dry heat and cold)	Minimum temperature range of 80 °C	16 hours at lower limit of temperature range (see 3.5.1)	16 hours at upper limit of temperature range (see 3.5.1)	IEC 60068-2-2 IEC 60068-2-1 IEC 60068-3-1
		Function control at low operating temperature	Function control at high operating temperature	
Note: Use IEC 60068-3-1 for background information.				

Supplementary information to the IEC test procedures:	
Object of the test:	To verify compliance with the provisions in 5.1.1 under conditions of dry heat (non-condensing) and cold tests conducted separately.
Pre-condition:	None required.
Condition of the EUT:	Supply voltage (12 V DC) is on for 16 hours at upper temperature limit, and off for 16 hours at the lower temperature limit, with the exception that voltage shall be switched on during the function control test (A.4.4) at the low operating temperature. There shall be sufficient temperature stabilization after each test.
Test sequence:	The test consists of exposure of the EUT to the upper and lower limits of the specified temperature range for 16 hours each. At the end of each temperature test, function control shall then be conducted at each specified operating temperature after sufficient temperature stabilization has occurred. (a) The EUT is exposed to the high temperature range limit for 16 hours, with the voltage on. At the end of the 16 hours after sufficient temperature stabilization the function control test (A.4.4) shall then be conducted at the specified high operating temperature, with the voltage supply on; (b) The EUT is exposed to the low temperature range limit for 16 hours, with the voltage off. At the end of the 16 hours after sufficient temperature stabilization the function control test (A.4.4) shall then be conducted at the specified low operating temperature, with the voltage supply switched on.
Number of test cycles:	At least one cycle.
Test information:	After sufficient temperature stabilization record the following: (a) date and time; (b) temperature; (c) relative humidity; (d) supply voltage; (e) pulse voltage levels; (f) frequency levels; (g) errors; (h) functional performance; (i) indications (as applicable). The change of temperature shall not exceed 1 °C/min during heating and cooling.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 3.2.1 for initial verification.
Note:	Repeat the function control test at ambient environmental conditions after completion of the static temperatures test. Check the recorded information.

A.5.4.2 Damp heat cyclic (condensing) test (5.1.2)

Damp heat, cyclic tests are carried out according to basic standard IEC 60068-3-4 [10], IEC 60068-2-30 [11], and according to Table 7.

Table 7 - Damp heat cyclic test

Environmental phenomenon	Test specification	Test setup
Damp heat, cyclic	24 hour cycle temperature variations between + 25 °C and + 55 °C, maintaining the relative humidity above 95 % during the temperature change and low temperature phases (the first 12 hours), and at 93 % at the upper temperature phases (next 12 hours).	IEC 60068-2-30 IEC 60068-3-4

Supplementary information to the IEC test procedures:	
Object of the test:	To verify compliance with the provisions in 5.1.2 after conditions of high humidity and cyclic temperature changes.
Pre-condition:	Pre-condition: After a visual inspection and functional test, the EUT shall be introduced in the humidity chamber in an unpacked, switched off, ready-for-use state and left at 25 °C, 65% R.H. for at least 1 hour before starting the first cycle.
Condition of the EUT:	Supply voltage (12 V DC) is switched off for the duration of the test. The handling of the EUT shall be such that condensation should occur on the EUT during the temperature rise. All parts of the EUT are within 3 °C of their final temperature.
Test sequence:	24 hour cycle sequence: (a) First 3 hours – temperature rise from the specified low; (b) Temperature maintained at the specified high until 12 hours from start of the cycle; (c) Temperature lowered from the specified high to the specified low within the next 3-6 hours; (d) Temperature maintained at the specified low until the 24-hour cycle is completed.
Number of test cycles:	At least two cycles.
Test information:	After sufficient temperature stabilization record the following: (a) date and time; (b) temperature; (c) relative humidity; (d) supply voltage; (e) pulse voltage levels; (f) frequency levels; (g) errors; (h) functional performance; (i) indications (as applicable).
Maximum allowable variations:	After the disturbance, no significant fault shall occur.

Note:	Conduct the function control test (A.4.4) at ambient environmental conditions after completion of the damp heat cyclic tests. Check the recorded information.

A.5.4.3 Supply voltage variations (3.5.2)

A.5.4.3.1 DC voltage supply test

Supply voltage limit variations tests are carried out according to ISO 16750-2 [12], and in accordance with Table 8.

Table 8 – Supply voltage variations

Environmental phenomenon	Test specification			Test setup
DC voltage variations	U_{nom} = 12 V	U_{max} =16 V	U_{min} = 9 V	ISO 16750-2
Notes: (1) For a 12 V battery, the nominal voltage (U_{nom}) of the electrical system in road vehicles is usually 12 V DC, but the voltage at the battery-terminal points can vary considerably. (2) For other battery voltage systems, the appropriate corresponding voltages shall be applied.				

Supplementary information to the ISO test procedures:	
Object of the test:	To verify compliance with the provisions in 5.1.1 of voltage variations at the lower and upper limits of the voltage range.
Preconditioning:	None.
Condition of the EUT:	Supply voltage (12 V DC) is switched on for the duration of the test.
Test sequence:	The test consists of exposure to the specified battery condition for a period sufficient for achieving temperature stability and for performing the required measurements.
Number of test cycles:	At least one cycle.
Test information:	After stabilization of the EUT at the nominal voltage and at ambient conditions conduct the function test in A.4.3 at the upper (16 V DC) and lower (9 V DC) limits and record: (a) date and time; (b) temperature; (c) relative humidity; (d) supply voltage; (e) pulse voltage levels; (f) frequency levels; (g) errors; (h) functional performance; (i) indications (as applicable).
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 3.2.1 for initial verification.

A.5.4.3.2 Voltage drop below lower operating voltage limit (5.2.5)

There is no reference to standards for this test. Refer to Table 9 for the test conditions.

Table 9 – Voltage reductions below lower operating limit

<table>
<tr><td>Environmental phenomenon</td><td colspan="3">Test specification</td><td>Test setup</td></tr>
<tr><td rowspan="4">Slow dips below the lower operating voltage limit</td><td>% of lower value of voltage reduction, V_L</td><td>Width of reduction (seconds)</td><td>Requirement</td><td rowspan="4">No reference to standards at present</td></tr>
<tr><td rowspan="3">90, 40, 0</td><td>7, 14</td><td>Taximeter should show the previously indicated fare</td></tr>
<tr><td>15, 17.5 20</td><td>Taximeter should show the previously indicated fare or switch to the “For Hire” (Free) operating position</td></tr>
<tr><td>21, 30</td><td>Taximeter should switch to the “For Hire” operating position</td></tr>
<tr><td>Note:</td><td colspan="4">For specifications of the supply voltage used during the test to simulate the battery, refer to ISO 7637-2 [20], clause 4.4 [8].</td></tr>
</table>

Supplementary information:	
Object of the test:	To verify compliance with the provisions in 5.1.1 under conditions of slow battery voltage dips.
Pre-condition:	None.
Condition of the EUT:	Before any test stabilize the EUT under constant environmental conditions.
Test sequence:	The test consists of exposure of the supply voltage to the specified conditions in Table 9, observing the behavior of the taximeter. Manually apply slow voltage reductions below the lower voltage limit for the varying amounts of time listed in Table 9. Additionally, reverse (incorrect) polarity shall be applied for 30 seconds. This shall cause no detectable change in registered information. If a standard supply voltage (with sufficient current capacity) is used in bench testing to simulate the battery, the low internal impedance of the battery shall also be simulated. The continuous supply source shall have an internal resistance R_i less than 0.01 Ω and an internal impedance $Z_i = R_i$ for frequencies less than 400 Hz.
Test information:	The function control test in A.4.4 shall run during the application of the dips. Record: (a) date and time; (b) temperature; (c) relative humidity; (d) supply voltage; (e) indications (as applicable); (f) errors; (g) functional performance.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 3.2.1 for initial verification.
Notes:	Repeat the function control test (A.4.4) at ambient environmental conditions after completion of the voltage variations test. Check the recorded information.

A.5.4.4 Vibration (random or sinusoidal)

Two different vibration tests (random or sinusoidal) are described below. In general, the random vibration test is recommended. The sinusoidal vibration test may be applied if specified by national regulations. Guidance for the selection amongst both the tests can be found in IEC 60068-3-8 [13].

A.5.4.4.1 Vibration (random)

Vibration (random) tests are carried out according to basic standard IEC 60068-2-64 [14], IEC 60068-2-47 [15], IEC 60068-3-8 [13], and according to Table 10.

Table 10 - Vibration (random) test

Environmental phenomenon	Test specification		Test setup
Random vibrations	Frequency range:	10 Hz to 150 Hz	IEC 60068-2-64 IEC 60068-2-47 IEC 60068-3-8
	Total RMS level:	7 ms^{-2}	
	ASD level 10 Hz – 20 Hz:	1 m^2s^{-3}	
	ASD level 20 Hz – 150 Hz:	– 3 dB/octave	
	Number of axes:	3	
	Duration per axis:	At least 30 minutes	

Supplementary information to the IEC test procedures:	
Object of the test:	To verify that the EUT complies with the provisions in 5.1.1 under conditions of random vibrations.
Pre-condition:	None required.
Condition of the EUT:	Supply voltage is switched on for the duration of the test. Mount the EUT on a rigid fixture by its normal mounting means, such that the gravitational force acts in the same direction as it would in normal use. Where the effect of gravitational force is not important, the EUT may be mounted in any position.
Test sequence:	In accordance with the specifications in Table 10, apply random vibrations, over the specified frequency range, to the EUT, in three mutually perpendicular axes (2 horizontal and 1 vertical) in turn, for 30 minutes per axis.
Number of test cycles:	At least one cycle.
Test information:	Conduct the function control test (A.4.3) and record: (a) date and time; (b) temperature; (c) supply voltage; (d) frequency range; (e) total RMS; (f) ASD levels; (g) number of axes and duration per axis; (h) pulse levels; (i) frequency levels; (j) errors; (k) functional performance; (l) indications (as applicable).
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 3.2.1 for initial verification.
Note:	Repeat the function control test at ambient environmental conditions after completion of the random vibrations test. Check the recorded information.

A.5.4.4.2 Vibration (sinusoidal)

Vibration (sinusoidal) tests are carried out according to basic standard IEC 60068-2-6 [16], IEC 60068-2-47 [15], IEC 60068-3-8 [13], and according to Table 11.

Table 11 - Vibration (sinusoidal) test

Environmental phenomenon	Test specification		Test setup
Sinusoidal vibrations	Frequency range:	10 Hz to 150 Hz	IEC 60068-2-6 IEC 60068-2-47 IEC 60068-3-8
	Max acceleration level:	10 ms^{-2}	
	Number of axes:	3	
	Number of sweeps per axis:	20	

Supplementary information to the IEC test procedures:	
Object of the test:	To verify that the EUT complies with the provisions in 5.1.1 under conditions of sinusoidal vibrations.
Pre-condition:	None required.
Condition of the EUT:	Normal voltage is switched on for the duration of the test. Mount the EUT on a rigid fixture by its normal mounting means, such that the gravitational force acts in the same direction as it would in normal use. Where the effect of gravitational force is not important, the EUT may be mounted in any position.
Test sequence:	In accordance with the specifications in Table 11, apply sinusoidal vibrations, over the specified frequency range, at 1 octave/min, at the specified acceleration level with a specified number of sweep per axis, in three mutually perpendicular main axes (2 horizontal and 1 vertical) of the rigidly mounted EUT.
Number of test cycles:	At least one cycle.
Test information:	Conduct the function control test (A.4.3) and record: (a) date and time; (b) temperature; (c) frequency range; (d) acceleration level; (e) sweep per axis; (f) number of axes and duration per axis; (g) pulse levels; (h) frequency levels; (i) errors; (j) functional performance; (k) indications (as applicable).
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in 3.2.1 for initial verification.
Note:	Repeat the function control test at ambient environmental conditions after completion of the sinusoidal vibration test. Check the recorded information.

A.5.4.5 Immunity to electromagnetic fields

A.5.4.5.1 Immunity to radiated electromagnetic fields

Radiated, radio frequency, electromagnetic field immunity tests are carried out in accordance with IEC 61000-4-3 [17], and according to Table 12.

The unmodulated carrier of the test signal is adjusted to the indicated test value. To perform the test the carrier is in addition modulated as specified.

Table 12 - Radiated electromagnetic field

<table>
<tr><td colspan="4">Test specification</td></tr>
<tr><td>Environmental phenomenon</td><td>Frequency ranges (MHz)</td><td>Field strength (V/m)</td><td>Test setup</td></tr>
<tr><td rowspan="2">Radiated electromagnetic field</td><td>80 to 2000(1)</td><td rowspan="2">24(3)</td><td rowspan="2">IEC 61000-4-3</td></tr>
<tr><td>26 to 80(2)</td></tr>
<tr><td>Modulation</td><td colspan="3">80 % AM, 1 kHz sine wave</td></tr>
<tr><td>Notes:</td><td colspan="3">(1) IEC 61000-4-3 only specifies test levels above 80 MHz. For frequencies in the lower range the test methods for conducted radio frequency disturbances are recommended (A.5.4.2.2);
(2) For EUT having no I/O ports available so that the test according to A.5.4.5.2 cannot be applied, the lower limit of the radiation test is 26 MHz;
(3) 24 V/m is the recommended severity level concerning electronic sub assemblies installed in motor vehicles [see the Automotive EMC Directive (2004/104/EC)]. However, in accordance with national regulations a severity level of 10 V/m may be applied.</td></tr>
</table>

Supplementary information to the IEC test procedures:	
Object of the test:	To verify compliance with the provisions in 5.1.3 under conditions of specified electromagnetic fields applied to the taximeter.
Pre-condition:	None required.
Condition of the EUT:	Before any test stabilize the EUT under constant environmental conditions. The electromagnetic field can be generated in different facilities, the use of which is limited by the dimensions of the EUT and the frequency range of the facility.
Test sequence:	The EUT shall be exposed to electromagnetic field strength as specified in Table 12. When using an electronic pulse generator to simulate the pulses produced by a typical distance measurement transducer, care should also be taken not to let the pulse generator be affected by the electromagnetic waves by using a suitable method of electromagnetic isolation. Alternatively a mechanically driven pulse generator may be used.
Test information:	Record: (a) date and time; (b) temperature; (c) supply voltage; (d) test setup information; (e) supply voltage; (f) indications (as applicable); (g) errors; (h) functional performance.
Maximum allowable variations:	All errors shall be within the maximum permissible errors specified in 3.2.1 for initial verification.

A.5.4.5.2 Immunity to conducted radio-frequency, electromagnetic fields

Conducted electromagnetic field immunity tests (radio-frequency electromagnetic fields lower than 80 MHz) are carried out in accordance with IEC 61000-4-6 [18], and according to Table 13.

Table 13 - Immunity to conducted radio-frequency, electromagnetic

Test specification			
Environmental phenomenon	Frequency range (MHz)	RF amplitude (50 Ω) (V e.m.f)	Test setup
Conducted electromagnetic field	0.15 to 80	24[(2)] V	IEC 61000-4-6
Modulation	80 % AM, 1 kHz sine wave		
Notes:	(1) This test shall only be performed when the cable length connected to the taximeter exceeds 3 m; (2) 24 V is the recommended severity level concerning electronic sub assemblies installed in motor vehicles (see the Automotive EMC Directive (2004/104/EC)). However, in accordance with national regulations a severity level of 10 V may be applied.		

Supplementary information to the IEC test procedures:	
Object of the test:	To verify compliance with the provisions in 5.1.3 under conditions of specified conducted electromagnetic fields.
Pre-condition:	The performance of the test equipment, consisting of an RF generator, RF amplifiers, (de-)coupling devices, attenuators, etc., shall be verified before testing commences.
Condition of the EUT:	Before any test, stabilize the EUT under constant environmental conditions.
Test sequence:	The EUT shall be exposed to electromagnetic field strength as specified in Table 13. Radio frequency electromagnetic current, simulating the influence of electromagnetic fields on conductors, shall be coupled or injected into EUT ports for voltage, inputs, and outputs using coupling/decoupling devices as defined in the referred standard.
Test information:	Record: (a) date and time; (b) temperature; (c) test setup information; (d) supply voltage; (e) indications (as applicable); (f) errors; (g) functional performance.
Maximum allowable variations:	All errors shall be within the maximum permissible errors specified in 3.2.1 for initial verification.

A.5.4.6 Electrostatic discharge tests

Electrostatic discharge tests are carried out in accordance with IEC 61000-4-2 [19], and according to Table 14.

Table 14 - Electrostatic discharge tests

<table>
<tr><td>Environmental phenomenon</td><td colspan="2">Test specification</td><td>Test setup</td></tr>
<tr><td rowspan="3">Electrostatic discharge</td><td>Test voltage</td><td>Levels</td><td rowspan="3">IEC 61000-4-2</td></tr>
<tr><td>contact discharge</td><td>6 kV(1) (2)</td></tr>
<tr><td>air discharge</td><td>8 kV(1)</td></tr>
<tr><td>Notes:</td><td colspan="3">(1) Tests shall also be performed at the specified lower voltage levels in the IEC 61000-4-2 standard up to and including the levels specified above;
(2) 6 kV is the recommended maximum contact discharge level and shall be applied to conductive accessible parts. Metallic contacts, e.g. in battery compartments or in socket outlets are excluded from this requirement. However, in accordance with national regulations a lower maximum contact discharge level of 4 kV may be applied.</td></tr>
</table>

Supplementary information to the IEC test procedures:	
Object of the test:	To verify compliance with the provisions in 5.1.3 under conditions where direct and indirect electrostatic discharges are applied.
Pre-condition:	Before starting the tests, the performance of the electrostatic discharge generator as defined in IEC 61000-4-2 shall be verified.
Condition of the EUT:	Before any test stabilize the EUT under constant environmental conditions.
Test sequence:	The EUT shall be exposed to electrostatic discharge tests as specified in Table 14. The taximeter and any relevant devices shall be operational during this test. At least 10 discharges shall be applied. The time interval between successive discharges shall be at least 10 seconds. For EUT not equipped with a ground terminal, the EUT shall be fully discharged between discharges. Contact discharge is the preferred test method. Air discharge shall be used were contact discharge cannot be applied. Direct application: In the contact discharge mode to be carried out on conductive surfaces, the electrode shall be in contact with the EUT. In the air discharge mode on insulated surfaces, the electrode is approached to the EUT and the discharge occurs by spark. Indirect application: The discharges are applied in the contact mode to coupling planes mounted near the EUT.
Test information:	Record: (a) date and time; (b) temperature; (c) test setup information; (d) supply voltage; (e) indications (as applicable); (f) errors; (g) functional performance.
Maximum allowable variations:	All errors shall be within the maximum permissible errors specified in 3.2.1 for initial verification.
Note:	Repeat the function control test at ambient environmental conditions after completion of the electrostatic discharge test. Check the recorded information.

A.5.4.7 Electrical transient conduction

A.5.4.7.1 Conduction along supply lines of external 12 V road vehicle battery

For this test refer to ISO 7637-2 [20], and to Table 15.

Table 15 - Electrical transient conduction on 12 V supply lines

Environmental phenomenon	Test specification		Test setup
Electrical transient conduction on supply lines	Test pulse	Pulse voltage, U_s	ISO 7637-2
		U_{nom} = 12 V	
	1	– 100 V	
	2a	+ 50 V	
	2b	+ 10 V	
	3a	– 150 V	
	3b	+ 100 V	
	4	– 7 V	
Notes:	(1) Test pulse 2b is only applicable if the instrument is connected to the battery via the main (ignition) switch of the car, i.e. if the manufacturer has not specified that the instrument is to be connected directly (or by its own main switch) to the battery; (2) No reference has been made to test pulses 5a and 5b.		

Supplementary information to the ISO test procedures:		
Applicable standards:	ISO 7637-2	§ 5.6.1: Test pulse 1 § 5.6.2: Test pulse 2a + b § 5.6.3: Test pulse 3a + 3b § 5.6.4: Test pulse 4
Object of the test:	To verify compliance with the provisions in 5.1.3 under the following conditions: ▪ transients on the supply lines due to supply disconnection from inductive loads (pulse 1); ▪ transients due to a sudden interruption of currents in a device connected in parallel with the device under test due to the inductance of the wiring harness (pulse 2a); ▪ transients from DC motors acting as generators after the ignition is switched off (pulse 2b); ▪ transients on the supply lines, which occur as a result of the switching processes (pulses 3a and 3b); ▪ voltage reductions caused by energizing the starter-motor circuits of internal combustion engines (pulse 4).	
Preconditioning:	None	
Condition of the EUT:	Before any test, stabilize the EUT under constant environmental conditions.	
Test sequence:	The test consists of exposure to conducted disturbances on the supply voltage by direct brief coupling onto supply lines of the strength and character as specified in Table 15 while the taximeter is switched on.	
Test information:	Record: (a) date and time; (b) temperature; (c) test setup information; (d) supply voltage; (e) indications (as applicable); (f) errors; (g) functional performance.	
Maximum allowable variations:	No significant error during the disturbance, except for test 2b. For test 2b, no significant error after the disturbance.	

A.5.4.7.2 Electrical transient conduction via lines other than supply lines of 12 V road vehicle battery

Electrical conduction by capacitive and inductive coupling on signal lines is carried out in accordance with ISO 7637-3 [21], and according to Table 16.

Table 16 – Electrical transient conduction via lines other than supply lines

Environmental phenomenon	Test specification		Test setup
Electrical transient conduction via lines other than supply lines	Test pulse	Pulse voltage, U_s	ISO 7637-3
		U_{nom} = 12 V	
	a	– 60 V	
	b	+ 40 V	

Supplementary information to the ISO test procedures:	
Object of the test:	To verify compliance with the provisions in 5.1.3 under conditions of transients which occur via lines other than supply lines because of the switching processes (pulses a, and b).
Preconditioning:	None.
Condition of the EUT:	Before any test stabilize the EUT under constant environmental conditions.
Test sequence:	The test consists of exposure of the EUT to conducted disturbances (bursts of voltage spikes by capacitive and inductive coupling on signal lines) of the strength and character as specified in Table 16 while the taximeter is switched on.
Test information:	Apply the test pulses and record the following: (a) date and time; (b) temperature; (c) test setup information; (d) supply voltage; (e) indications (as applicable); (f) errors; (g) functional performance. Repeat the test for the defined pulses and record the indications.
Maximum allowable variations:	No significant error during the disturbance.
Note:	Repeat the function control test at ambient conditions after completion of the transient conduction via supply lines test. Check the recorded information.

Annex B

(Informative)

General information on the conditions for the compatibility between a taximeter and a distance measurement transducer

B Compatibility for use with distance measurement generator

The conditions for the compatibility between the taximeter and the distance measurement generator shall be specified by the manufacturer of the taximeter and checked in accordance with the appropriate parts of OIML R 21.

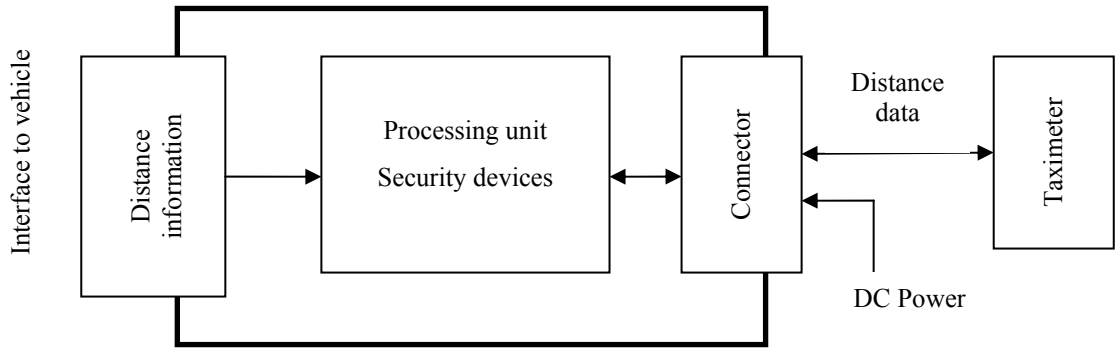
B.1 Description and purpose

The distance measurement transducer is installed in the taxi and its purpose is to provide a taximeter with secured distance information representative of the distance traveled by the taxi. The transducer is interfaced to a moving part of the taxi and it may be located in any part of the taxi. In its operational mode, the distance measurement transducer is connected to a taximeter. There are two principles of operation:

(a) An analog transducer sends electrical impulses with a frequency proportional to the velocity to the taximeter.
(b) A software controlled transducer calculates the velocity and transmits the value of the quantity in a datagram via a fieldbus to the taximeter.

A typical distance measurement transducer is described in Figure A.

Figure A - Typical distance measurement transducer



B.2 Suitability and security of operation

The design of the distance measurement transducer shall suit the method of operation and vehicle for which it is intended. The distance measurement transducer shall be capable of providing the following functions:

- give a stable signal at every speed traveled;
- have defined characteristics regarding voltage level, pulse width and the relation of speed and frequency;

- be able to establish and authenticate, for any interaction, the identity of any device that it is connected to, at connection and at power supply recovery;
- ensure that motion information may only be processed and derived from the transducer interface;
- exchange distance information with associated security attributes to ensure integrity and authenticity of measurement data;
- any change in the instrument characteristics or software shall only be possible by breaking seals.

The distance measuring transducer may incorporate capabilities for the secure processing, transmission and storage of information pertaining to the transducer identification and connected device identity.

B.3 Metrological characteristics of the transducer

The documentation provided by the manufacturer of the distance measurement transducer shall include the following:

- name and address of the manufacturer;
- approval of the transducer and/or interconnected devices if applicable;
- technical specifications;
- metrological characteristics of the transducer;
- functional description of the transducer;
- description of securing;
- software information (if applicable);
- drawings, diagrams and general information explaining the construction and operation;
- any document or other evidence that the design and construction of the transducer conforms to appropriate international standards.

Annex C
(Mandatory)
Test report format

Explanatory notes on the Test report format

This "Test report format" aims at presenting, in a standardized format, the results of the various tests and examinations to which a type of a taximeter shall be submitted with a view to its approval.

The Test report format consists of two parts, a "checklist" and the "test report" itself:

- The checklist is a summary of the examinations carried out on the instrument. It includes the conclusions of the results of the test performed, experimental or visual checks based on the requirements of R 21.
- The test report is a record of the results of the tests carried out on the instrument. The "test report" forms have been produced based on the tests detailed in Annex A of this International Recommendation.

It is recommended that all metrology services or laboratories evaluating types of taximeter according to R 21 or to national or regional regulations based on this OIML Recommendation use this Test report format, directly or after translation into a language other than English.

It is also recommended that this Test report format be transmitted by the country performing these tests to the relevant authorities of another country, under bi- or multilateral cooperation agreements.

In the framework of the *OIML Certificate System for measuring instruments*, use of this Test report format is mandatory.

The "information concerning the test equipment used for type evaluation" shall cover all test equipment which has been used in determining the test results given in a report. The information may be a short list containing only essential data (name, type, reference number for the purpose of traceability). For example:

- Verification standards (accuracy, or accuracy class, and number);
- Simulator for testing of devices (name, type, traceability and number);
- Climatic test and static temperature chamber (name, type and number);
- Electrical tests, bursts (name of the instrument, type and number);
- Description of the procedure of field calibration for the test of immunity to radiated electromagnetic fields.

Note concerning the numbering of the following pages

A special place is left at the top of each page (starting with the following page) for numbering the pages of reports established following this model. In particular, some tests (e.g. metrological performance tests) shall be repeated several times, each test being reported individually on a separate page following the relevant format.

For a given report, it is advisable to complete the sequential numbering of each page by the indication of the total number of pages of the report.

TAXIMETER
TYPE EVALUATION REPORT

EXPLANATORY NOTES

Symbols, units and abbreviations:

I	Indication
Res.	Resolution
MPE	Maximum permissible error
EUT	Equipment Under Test
sf	Significant fault
k	Number of pulses per kilometre traveled received by a taximeter
Temp	Temperature
Ref.	Reference (values)
U_{nom}	Nominal voltage value marked on the instrument
U_{max}	Highest value of a voltage range marked on the instrument
U_{min}	Lowest value of a voltage range marked on the instrument
e.m.f	Electromotive force
I/O	Input / Output ports
RF	Radio frequency
V/m	Volts per metre
kV	Kilovolt
DC	Direct current
Hz	Hertz, cycles per second (unit of frequency measurement)
MHz	Megahertz
ms^{-2}	Metres per second per second
Pulses/km	Pulses per kilometre
ASD	Acceleration spectral density
RMS	Root-mean-square acceleration

The name(s) or symbol(s) of the unit(s) used to express test results shall be specified in each test form.

For each test, the "SUMMARY OF TYPE EVALUATION" and the "CHECKLIST" shall be completed according to this example:

	P	F
when the instrument has passed the test:	X	
when the instrument has failed the test:		X
when the test is not applicable:	—	—

P = Passed
F = Failed

The blank spaces in boxes in the headings of the report should always be filled in according to the following example:

	At start	At end	
Temp:	20.5	21.1	°C
Rel. h.:			%
Date:	2006-01-29	2006-01-30	yyyy-mm-dd
Time:	16:00:05	16:30:25	hh:mm:ss

"Date" in the test report(s) refers to the date on which the test was performed.

In the disturbance tests, faults greater than the value specified in 2.4.5.6 are acceptable provided that they are detected and acted upon, or that they result from circumstances such that these faults shall not be considered as significant; an appropriate explanation shall be given in the column "Yes (remarks)".

Section numbers in brackets refer to the corresponding subclauses of R 21.

GENERAL INFORMATION CONCERNING THE TYPE

Application no.:……	Manufacturer's name and address:…….		
Applicant:……..	Date instrument submitted:……		
Type designation:…….	Evaluation period:	Start:…….	End:……...
Report date:……..	Observer:……		
Issuing Institute name and address:……			

Testing on: ☐ Taximeter ☐ Device[1]

Characteristic values:

Fare increment step (I)	Time tariff (I/h)			Distance tariff (I/km)			Taximeter constant, k (pulses/km)			Measuring range	
	Min	Max	Res.	Min	Max	Res.	Min	Max	Res.	Distance (km)	Time (h)

Battery voltage[2]: ☐ 12 V ☐ Other battery power supply: ……

U_{nom} = ☐ V U_{min} = ☐ V U_{max} = ☐ V

Printer: ☐ Built-in ☐ Connected ☐ Not present but connectable ☐ No connection

Temperature range: ☐ °C Min: ☐ °C Max: ☐ °C

Software identification of the type: ☐

[1] The test equipment connected to the taximeter shall be defined in the test form(s) used.

[2] The rated operating voltage is 12 V DC. For other voltage systems, e.g. 24 V DC, the appropriate corresponding voltages shall be applied for the tests.

Additional remarks:

Use this space to indicate additional remarks and/or information: other connected devices and interfaces, choice of the manufacturer regarding protection against disturbances, etc.

IDENTIFICATION OF THE INSTRUMENT

Application no.:	…….
Report date:	…….
Type designation:	…….
Manufacturer:	……..
Serial no.:	……..

Manufacturing documentation:

(Record as necessary to identify the equipment under test)

System or device name	Drawing number or software identification	Issue or reference level	Serial or reference no.
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….
…….	…….	…….	…….

Description or other information pertaining to identification of the instrument:

(*attach photograph here if available*)

INFORMATION CONCERNING THE TEST EQUIPMENT[3] USED FOR TYPE EVALUATION

TEST EQUIPMENT

Application no.:	…….
Report date:	…….
Type designation:	…….
Manufacturer:	……..

List all test equipment used in this report:

Equipment name or description	Manufacturer	Type or reference no.	Serial or identification no.	Calibration date	Measurement uncertainty (if applicable)	Used for (test references)
Power supply	……...	……...	……...	……...	……...	……...
Pulse counter	……...	……...	……...	……...	……...	……...
Timer	……...	……...	……...	……...	……...	……...
Electrostatic discharge generator	……...	……...	……...	……...	……...	……...
Pulse generator	……...	……...	……...	……...	……...	……...
EMC chamber	……...	……...	……...	……...	……...	……...
Climatic chamber	……...	……...	……...	……...	……...	……...
	……...	……...	……...	……...	……...	……...
	……...	……...	……...	……...	……...	……...
	……...	……...	……...	……...	……...	……...
	……...	……...	……...	……...	……...	……...
	……...	……...	……...	……...	……...	……...
	……...	……...	……...	……...	……...	……...
	……...	……...	……...	……...	……...	……...
	……...	……...	……...	……...	……...	……...

[3] For traceability, test equipment with traceable calibration to national and international standards shall be used to perform the measurements.

CONFIGURATION FOR TEST

Provide additional information relating to equipment configuration, interfaces, data rates, EMC protection options, etc., for the instrument and/or simulator.

Test connector:

– Input signals:

Distance pulses:

Low-high:	
High-low:	
Max. freq. (Hz):	

Time pulses:

Low-high:	
High-low:	
Min. freq. (Hz):	
Max. freq. (Hz):	

Signal to block time-counting when:

Signal is low:	
Signal is high:	

Output signals:

Distance pulses:

Low-high:	
High-low:	

Time pulses:

Low-high:	
High-low:	
Internal clock freq. (Hz):	

Signal to indicate fare increment:

Low-high signal:	
High-low signal:	

Distance sensor interface:

Low voltage:	
High voltage:	
Trigger:	
Low-high:	

Use this space for additional information relating to equipment configuration.

SUMMARY OF TYPE TEST REPORT

Application no.:	…….
Report date:	…….
Type designation:	…….

Test category	Annex C	Test	Test reference	Report page	Passed	Failed	Remarks
1	C.1	Initial examination and function test	A.4.3				
2	C.2.1	Static temperatures - Dry heat and cold function control	A.5.4.1				
	C.2.2	Damp heat cyclic (condensing) function control	A.5.4.2				
	C.2.3	Function control test after static temperatures and damp heat cyclic test	A.4.4				
3	C.2.4	Voltage drop below lower limit function control	A.5.4.3				
	C.2.4.1	Function control after voltage variations test	A.4.4				
4	C.2.5	Random vibration function control, or	A.5.4.4.1				
	C.2.5.1	Sinusoidal vibration function control	A.5.4.4.2				
	C.2.5.2	Function control after vibrations test	A.4.4				
5	C.2.6.1	Immunity to radiated electromagnetic fields	A.5.4.5.1				
	C.2.6.2	Immunity to conducted electromagnetic fields	A.5.4.5.2				
	C.2.6.3	Electrostatic discharge test	A.5.4.6				
	C.2.6.4	Function control after electromagnetic fields and electrostatic discharge tests	A.4.4				
6	C.2.7.1	Electrical transient conduction along supply lines	A.5.4.7.1				
	C.2.7.2	Electrical transient conduction via lines other lines than supply lines	A.5.4.7.2				
	C.2.7.3	Function control after transient conduction tests	A.4.4				
7	C.3	Examination of the construction					
		Checklist					

C.1 Function test at the beginning of the test program (7.2.1, A.4.3)

			At start	At end	
Application no.:	.....	Temp:			°C
Type designation:	.....	Rel. h.:			%
Observer:	.....	Date:			yyyy-mm-dd
		Time:			hh:mm:ss

C.1.1 Initial examination at reference (ambient) conditions

C.1.1.1 Voltage supply variations test (3.5.2, A.5.4.3.1)

Battery voltage (DC): ☐ 12 V ☐ Other battery power supply

U_{nom} = ☐ V U_{min} = ☐ V U_{max} = ☐ V

Time measurement

12 V DC voltage supply[4]	Time signal (Hz)		Number of test pulses		Indication, *I*		Time tariff (*I*/h)	Time signal error		Test pulses error		MPE %
	Actual	Ref.	Actual	Ref.	Start	End		Hz	%	Pulses	%	
9 V												
16 V												

Distance measurement

12 V DC voltage supply	Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses error		MPE %
	Actual	Ref.	Start	End			Pulses	%	
9 V									
16 V									

☐ Passed ☐ Failed

Remarks:

[4] Rated operating voltage is 12 V DC (see A.4.1). For other voltage systems the appropriate corresponding voltages shall be applied.

C.1.1.2 Pulse frequency levels[5]

Distance measurement

DC voltage supply	Pulse frequency[6] (Hz)		Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses error		MPE %
			Actual	Ref.	Start	End			Pulses	%	
12 V	Lowest										
	Medium										
	Highest										

☐ Passed ☐ Failed

Remarks:

C.1 Function test (continued)

C.1.1.3 Pulse voltage levels[7]

Distance measurement

DC voltage supply	Pulse voltage (V)		Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses error		MPE %
			Actual	Ref.	Start	End			Pulses	%	
12 V	Lowest										
	Medium										
	Highest										

☐ Passed ☐ Failed

Remarks:

[5] By testing different pulse frequencies, time measurement is dispensable.

[6] At least 10 fare increments at simulated speed of up to 200 km/h (7.2.1, A.4.5.1.2).

[7] By variation of pulse voltage levels, time measurement is dispensable.

C.1.1.4 Specified *k* values[8]

Distance measurement

DC voltage supply	Taximeter constant, *k* (pulses/km)		Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses error		MPE %
			Actual	Ref.	Start	End			Pulses	%	
12 V	Lowest										
	Medium										
	Highest										

☐ Passed ☐ Failed

Remarks:

[8] *k* values (see 2.6). By variation of k values, time measurement is dispensable.

C.1 Function test (continued)

C.1.1.5 Featured calculation method

Time measurement

DC voltage supply	Calculation method S or D	Time signal (Hz)		Number of test pulses		Indication, *I*		Time tariff (*I*/h)	Time signal error		Test pulses error		MPE %
		Actual	Ref.	Actual	Ref.	Start	End		Hz	%	Pulses	%	
12 V													

Distance measurement

DC voltage supply	Calculation method S or D	Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses error		MPE %
		Actual	Ref.	Start	End			Pulses	%	
12 V										

☐ Passed ☐ Failed

Remarks:

C.1.1.6 Programmed tariff (including automatic changes, if applicable) [9]

Time measurement													
DC voltage supply	Tariffs	Time measuring signal (Hz)		Number of test pulses		Indication, *I*		Time tariff (*I*/h)	Time signal error		Test pulses error		MPE %
		Actual	Ref.	Actual	Ref.	Start	End		Hz	%	Pulses	%	
12 V													

Distance measurement										
DC voltage supply	Tariffs	Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses error		MPE %
		Actual	Ref.	Start	End			Pulses	%	
12 V										

☐ Passed ☐ Failed

Remarks:

[9] Tests shall are performed for a selection of the available programming modes and/or tariffs (including automatic changes, if applicable and only testing relevant measurement data).

C.2 Function control tests during and/or after exposure to influences and/or disturbances (7.2.2, A.4.4)

Tests are conducted in accordance with the test program in Table 2 and the summary in Table 4. All registered information shall be checked.

			At start	At end	
Application no.:	.....	Temp:			°C
Type designation:	.....	Rel. h.:			%
Observer:	.....	Date:			yyyy-mm-dd
		Time:			hh:mm:ss

C.2.1 Dry heat (non-condensing) and cold tests[10] (3.5.1, A.5.4.1)

Time measurement													
DC Voltage supply	Operating temperature	Time measuring signal (Hz)		Test pulses		Indication, *I*		Time tariff (*I*/h)	Time signal error		Test pulses error		MPE %
		Actual	Ref.	Actual	Ref.	Start	End		Hz	%	Pulses	%	
12 V	Specified high (dry heat)												
	Specified low (cold test)												

Distance measurement										
DC voltage supply	Operating temperature	Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses error		MPE %
		Actual	Ref.	Start	End			Pulses	%	
12 V	Specified high (dry heat)									
	Specified low (cold test)									

☐ Passed ☐ Failed

Remarks:

[10] Function control tests are conducted at the specified temperatures after 16 hours exposure at each temperature limit. The test is performed after sufficient temperature stabilization has occurred. The change of temperature shall not exceed 1 °C/min during heating and cooling down.

C.2.2 Damp heat cyclic (condensing) test (5.1.2, 5.1.3, A.5.4.2)

			At start	After 3 h	After 12 h	At end	
Application no.:	.....	Temp:					°C
Observer:	.....	Time:					hh:mm:ss

Test		Result		
Temperature/humidity sequence[11]	24 h period	Indication *I*		Significant fault
			Yes	Yes (remarks)[12]
Temperature rise from reference at 95 % Rel. h.	0 to 3			
Specified high temperature at 93 % Rel. h.	3 to 12			
Temperature drop to reference at 95 % Rel. h.	18 to 24			

☐ Passed ☐ Failed

Remarks:

[11] All parts of the EUT are within 3 °C of their final temperature.

[12] Functional status of the instrument during and after exposure to disturbances.

C.2.3 Function control and visual examination at ambient environmental conditions after static temperatures and damp heat test (7.2.2, A.4.4)

Time measurement

DC voltage supply	Time measuring signal (Hz)		Test pulses		Indication, *I*		Time tariff (*I*/h)	Time signal error		Test pulses error		MPE %
	Actual	Ref.	Actual	Ref.	Start	End		Hz	%	Pulses	%	
12 V												

Distance measurement

DC voltage supply	Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/km)	Distance tariff (*I*/km)	Test pulses error		MPE %
	Actual	Ref.	Start	End			Pulses	%	
12 V									

Visible deterioration detected: ☐ Yes ☐ No

Result: ☐ Passed ☐ Failed

Remarks:

C.2.4 Voltage drop below the lower voltage limit of 9 V DC (5.2.5, A.5.4.3.2)

The results of the supply voltage limits variation test in C.1.1.1 shall be referred to and recorded with this test.

			At start	At end	
Application no.:	.....	Temp:			°C
Type designation:	.....	Rel. h.:			%
Observer:	.....	Date:			yyyy-mm-dd
		Time:			hh:mm:ss

Battery voltage (DC): ☐ 12 V ☐ Other battery power supply

U_{nom} = ☐ V U_{min} = ☐ V U_{max} = ☐ V

% of lower value of voltage reduction, V_L	Width of reduction (seconds)	Passed	Failed	Remarks
80	7			
	14			
	15			
	17.5			
	20			
	21			
	30			
40	7			
	14			
	15			
	17.5			
	20			
	21			
	30			
0	7			
	14			
	15			
	17.5			
	20			
	21			
	30			

☐ Passed ☐ Failed

Remarks:

Polarity change: ± 12 V DC	Duration of polarity change (seconds)	Registered information complies	Registered information does not comply

☐ Passed ☐ Failed

Remarks:

C.2.4.1 Function control and visual examination at ambient environmental conditions after voltage variation test (7.2.2, A.4.4)

Time measurement												
DC voltage supply	Time measuring signal (Hz)		Test pulses		Indication, *I*		Time tariff (*I*/h)	Time signal error		Test pulses error		MPE %
	Actual	Ref.	Actual	Ref.	Start	End		Hz	%	Pulses	%	
12 V												

Distance measurement									
DC Voltage supply	Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses error		MPE %
	Actual	Ref.	Start	End			Pulses	%	
12 V									

Visible deterioration detected: ☐ Yes ☐ No

Result: ☐ Passed ☐ Failed

Remarks:

C.2.5 Vibrations test (A.5.4.4)

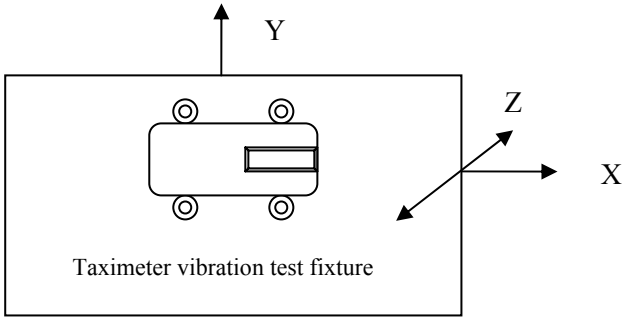


Figure B.1 - Set up for Z axis vibration: Direction of motion is in and out of page.

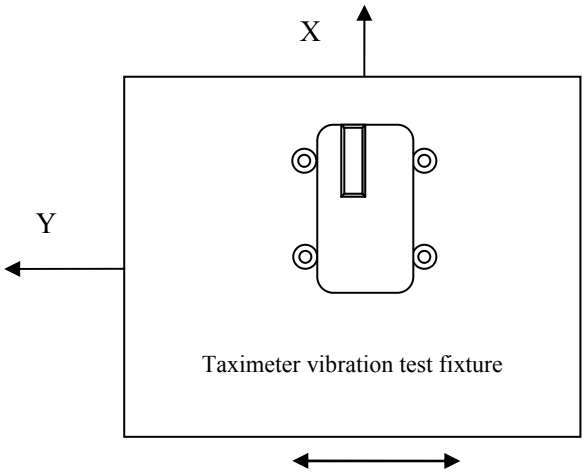


Figure B.2 - Set up for Y axis vibration

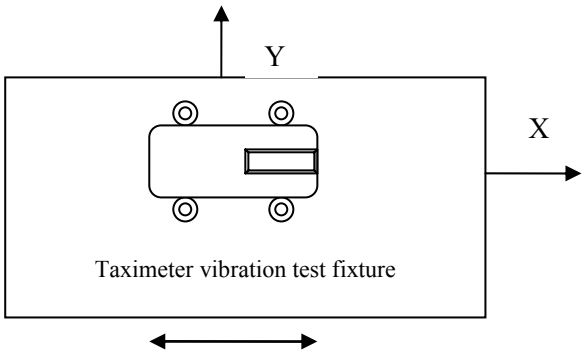


Figure B.3 - Set up for X axis vibration

C.2.5 Vibrations test (A.5.4.4)

Two different vibration tests (random or sinusoidal) are described below. In general, the random vibration test is recommended. The sinusoidal vibration test may be applied if specified by the manufacturer.

C.2.5.1 Random vibrations in three mutually perpendicular axes (A.5.4.4.1)

			At start	At end	
Application no.:	.....	Temp:			°C
Type designation:	.....	Rel. h.:			%
Observer:	.....	Date:			yyyy-mm-dd
		Time:			hh:mm:ss

Time measurement

DC Voltage supply	In three axes[13]	Time measuring signal (Hz)		Number of test pulses		Indication, *I*		Time tariff (*I*/h)	Time signal error		Test pulses error		MPE %
		Actual	Ref.	Actual	Ref.	Start	End		Hz	%	Pulses	%	
12 V	First axis												
	Second axis												
	Third axis												

Distance measurement

DC Voltage supply	In three axes	Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses Error		MPE %
		Actual	Ref.	Start	End			Pulses	%	
12 V	First axis									
	Second axis									
	Third axis									

☐ Passed ☐ Failed

Remarks:

[13] In accordance with the specifications in Table 10, apply random vibrations, over a frequency range of 10-150 Hz, to the EUT, at the specified ASD level, in three mutually perpendicular axes in turn, for 30 minutes per axis in each functional mode.

C.2.5.2 Sinusoidal vibration in three mutually perpendicular axes (A.5.4.4.2)

			At start	At end	
Application no.:	.....	Temp:			°C
Type designation:	.....	Rel. h.:			%
Observer:	.....	Date:			yyyy-mm-dd
		Time:			hh:mm:ss

Time measurement

DC Voltage supply	In three axes[14]	Time measuring signal (Hz)		Number of test pulses		Indication, *I*		Time tariff (*I*/h)	Time signal error		Test pulses error		MPE %
		Actual	Ref.	Actual	Ref.	Start	End		Hz	%	Pulses	%	
12 V	First axis												
	Second axis												
	Third axis												

Distance measurement

DC Voltage supply	In three axes	Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses error		MPE %
		Actual	Ref.	Start	End			Pulses	%	
12 V	First axis									
	Second axis									
	Third axis									

☐ Passed ☐ Failed

Remarks:

[14] In accordance with the specifications in Table 11, apply sinusoidal vibrations, over a frequency range of 10-150 Hz, at 1 octave/min, and at 10 ms^{-2} maximum acceleration level with 20 sweep cycles per axis, in three mutually perpendicular main axes of the rigidly mounted EUT

C.2.5.3 Function control and visual examination at ambient environmental conditions after vibration test (7.2.2, A.4.4)

Time measurement

DC Voltage supply	Time measuring signal (Hz)		Number of test pulses		Indication, *I*		Time tariff (*I*/h)	Time signal error		Test pulses error		MPE %
	Actual	Ref.	Actual	Ref.	Start	End		Hz	%	Pulses	%	
12 V												

Distance measurement

DC Voltage supply	Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses error		MPE %
	Actual	Ref.	Start	End			Pulses	%	
12 V									

Visible deterioration detected ☐ Yes ☐ No

Result: ☐ Passed ☐ Failed

Remarks:

C.2.6 Immunity to electromagnetic fields

C.2.6.1 Immunity to radiated electromagnetic fields test (A.5.4.5.1)

			At start	At end	
Application no.:	.....	Temp:			°C
Type designation:	.....	Rel. h.:			%
Observer:	.....	Date:			yyyy-mm-dd
		Time:			hh:mm:ss

Disturbances			MPE compliance		Remarks
Frequency range (MHz)	Polarization	Facing EUT	Yes	No	
without disturbance					
26 – 80	Vertical	Front			
		Right			
		Left			
		Rear			
	Horizontal	Front			
		Right			
		Left			
		Rear			
80 - 2000	Vertical	Front			
		Right			
		Left			
		Rear			
	Horizontal	Front			
		Right			
		Left			
		Rear			

Test severity

Frequency range:	80 MHz [(1)] to 2000 MHz
RF amplitude (50 Ω):	24 V/m
Modulation:	80 % AM, 1 kHz, sine wave

Notes:

(1) Lower limit is 26 MHz if the test according to A.5.4.5.2 cannot be applied due to lack of I/O ports;

(2) 24 V/m is the recommended severity level concerning electronic sub assemblies installed in motor vehicles (see the Automotive EMC Directive (2004/104/EC)). However, in accordance with national regulations a lower severity level of 12 V/m may be applied.

Note: If EUT fails, the frequency and field strength at which this occurs must be recorded.

☐ Passed ☐ Failed

Remarks:

C.2.6.2 Immunity to conducted electromagnetic fields test (A.5.4.5.2)

			At start	At end	
Application no.:	.....	Temp:			°C
Type designation:	.....	Rel. h.:			%
Observer:	.....	Date:			yyyy-mm-dd
		Time:			hh:mm:ss

Frequency Range (MHz)	Cable/Interface	Level (Volts RMS)	MPE compliance		Remarks[15]
			Yes	No	
without disturbance					
without disturbance					
without disturbance					
without disturbance					
without disturbance					
without disturbance					

[15] Functional status of the instrument during and after exposure to disturbances. If the EUT fails, the frequency and field strength at which this occurs must be recorded.

Test severity

Frequency range: 0.15 MHz to 80 MHz

RF amplitude (EMF): 24 V e.m.f

Modulation: 80 % AM, 1 kHz sine wave

Note: 24 V is the recommended severity level concerning electronic sub assemblies installed in motor vehicles (see the Automotive EMC Directive (2004/104/EC)). However, in accordance with national regulations a lower severity level of 10 V/m may be applied.

☐ Passed ☐ Failed

Remarks:

Include a description of the setup of EUT, e.g. by photos or sketches.

Note: If the EUT fails, the frequency and field strength at which this occurs must be recorded.

Radiated:

Conducted:

C.2.6.3 Electrostatic discharges (A.5.4.6)

			At start	At end	
Application no.:	.....	Temp:			°C
Type designation:	.....	Rel. h.:			%
Observer:	.....	Date:			yyyy-mm-dd
		Time:			hh:mm:ss

☐ Contact discharge ☐ Paint penetration

☐ Air discharges

Polarity[16]: ☐ pos ☐ neg

The EUT shall be in operation during the test.

Direct application						
Type	Discharges			MPE compliance		Remarks[17]
	Test voltage (kV)[18]	Number of discharges ≥ 10	Repetition interval (s)	Yes	No	
	without disturbance					
Contact	2					
Contact	4					
Contact	6					
Air	8					

Indirect application (Horizontal coupling plane)						
Type	Discharges			MPE compliance		Remarks
	Test voltage (kV)	Number of discharges ≥ 10	Repetition interval (s)	Yes	No	
	without disturbance					
Contact	2					
Contact	4					
Contact	6					

[16] IEC 61000-4-2 specifies that the test shall be conducted with the most sensitive polarity.

[17] Functional status of the instrument during and after exposure to disturbances. Significant faults or the test point at which EUT failure occurs shall be recorded.

[18] 6 kV is the recommended maximum level contact discharge. However, in accordance with national regulations a maximum level of 4 kV contact discharge may be applied.

Indirect application (Vertical coupling plane)						
Type	Discharges			MPE compliance		Remarks
	Test voltage (kV)	Number of discharges ≥ 10	Repetition interval(s)	Yes	No	
	without disturbance					
Contact	2					
Contact	4					
Contact	6					

☐ Passed ☐ Failed

Remarks:

Specification of test points of EUT (direct application), e.g. by photos or sketches

a) Direct application

Contact discharges:

Air discharges:

b) Indirect application

C.2.6.4 Function control and visual examination at ambient environmental conditions after electrostatic discharge test (7.2.2, A.4.4)

Time measurement

DC voltage supply	Time measuring signal (Hz)		Number of test pulses		Indication, *I*		Time tariff (*I*/h)	Time signal error		Test pulses error		MPE %
	Actual	Ref.	Actual	Ref.	Start	End		Hz	%	pulses	%	
12 V												

Distance measurement

DC Voltage supply	Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses error		MPE %
	Actual	Ref.	Start	End			Pulses	%	
12 V									

Visible deterioration detected: ☐ Yes ☐ No

Result: ☐ Passed ☐ Failed

Remarks:

C.2.7 Electrical transient conduction (A.5.4.7)

C.2.7.1 Electrical transient conduction along voltage supply lines (A.5.4.7.1)

			At start	At end	
Application no.:	.....	Temp:			°C
Type designation:	.....	Rel. h.:			%
Observer:	.....	Date:			yyyy-mm-dd
		Time:			hh:mm:ss

Exposure of the EUT to disturbances on the DC voltage supply line by direct coupling of pulses**.**

DC voltage	Test pulse	Pulse voltage (V)	MPE compliance		Remarks[19]
			Yes	No	
12 V	1	– 100			
	2a	+ 50			
	2b[20]	+ 10			
	3a	– 150			
	3b	+ 100			
	4	– 7			

☐ Passed ☐ Failed

Remarks:

[19] Functional status of the instrument during and after exposure to test pulses

[20] Test pulse 2b is only applicable if the instrument is connected to the battery via the main (ignition) switch of the car, i.e. if the manufacturer has not specified that the instrument is to be connected directly (or by its own main switch) to the battery.

C.2.7.2 Electrical transient conduction via lines other than voltage supply lines (A.5.4.7.2)

With the applicable voltage supply on, the various signal lines of the EUT are exposed to disturbances by capacitive/inductive coupling.

DC voltage	Test pulse	Pulse voltage, U_s	MPE compliance		Remarks [21]
			Yes	No	
12 V	Cable/interface:				
	a	– 60 V			
	b	+ 40 V			
	Cable/interface:				
	a	– 60 V			
	b	+ 40 V			
	Cable/interface:				
	a	– 60 V			
	b	+ 40 V			
	Cable/interface:				
	a	– 60 V			
	b	+ 40 V			
	Cable/interface:				
	a	– 60 V			
	b	+ 40 V			

☐ Passed ☐ Failed

Remarks:

[21] Functional status of the instrument during and after exposure to test pulses

C.2.7.3 Function control and visual examination at ambient environmental conditions after electrical transient conduction test (7.2.2, A.4.4)

Time measurement

DC Voltage supply	Time measuring signal (Hz)		Number of test pulses		Indication, *I*		Time tariff (*I*/h)	Time signal error		Test pulses error		MPE %
	Actual	Ref.	Actual	Ref.	Start	End		Hz	%	Pulses	%	
12 V												

Distance measurement

DC Voltage supply	Number of test pulses		Indication, *I*		Taximeter constant, *k* (pulses/ km)	Distance tariff (*I*/km)	Test pulses error		MPE %
	Actual	Ref.	Start	End			Pulses	%	
12 V									

Visible deterioration detected: ☐ Yes ☐ No

Result: ☐ Passed ☐ Failed

Remarks:

C.3 EXAMINATION OF THE CONSTRUCTION OF THE INSTRUMENT

Use this page to indicate any description or information pertaining to the instrument, additional to that already contained in this report and in the accompanying national type approval or OIML Certificate. This may include a picture of the complete instrument, a description of its main devices, and any remark which could be useful for authorities responsible for the initial or subsequent verifications of individual instruments built according to the type. It may also include references to the manufacturer's description.

Description:

Remarks:

CHECKLIST

The checklist has been developed based on the following principles.

It is intended to serve as a summary of the results of examinations to be performed and not as a procedure. The items on this checklist are provided to recall the requirements specified in R 21 and they shall not be considered as a substitution for these requirements.

For non-mandatory devices, the checklist provides space to indicate whether or not the device exists and, if appropriate, its type. A cross in the box for "present" indicates that the device exists and that it complies with the definition given in the terminology; when indicating that a device is non-existent, also check the boxes to indicate that the tests are not applicable.

If appropriate, the results stated in this checklist may be supplemented by remarks given on additional pages.

Application no.:	.....	Type designation:	.....

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
3	**A.1**	**METROLOGICAL REQUIREMENTS**			
3.1		**Main function of the taximeter**			
		– Designed to measure the duration, and			
		– To calculate the distance of a journey.			
		Calculates and displays the fare to be paid, on the basis of the initial fare registered on the taximeter before distance is traveled and the fare incrementing with fixed intervals after the appertaining distance and/or time is delivered.			
3.3		**Taximeter accuracy conformance over time**			
		Manufacturer provides documented description of taximeter design for accuracy conformance with the metrological requirements of R 21 for a period of at least one year.			
3.4		**Units of measurement to be used on taximeter are:**			
		– Time, in seconds, minutes and hours;			
		– Distance, in metres (m) or kilometres (km), or as specified in national regulations;			
		– Fare, in accordance with national regulations.			
3.5.1		**Temperature**			
		Minimum temperature range of 80 °C for the climatic environment.			
3.5.2		**DC voltage supply**			
		12 V battery			
		Other supply voltage	Remarks		
3.6		**Taximeter constant, *k***			
		Taximeter constant, *k* is adjustable to the vehicle within the mpes of 3.2.1.1 (b).			
		k can be displayed on the taximeter as a readily accessible decimal number.			
		Every change of *k* is secured in accordance with 4.2.5.			
		The use of the taximeter is not possible when the change registration capacity defined by the manufacturer is exceeded.			
3.7	**A.1**	**Real-time clock**			
		Taximeter is equipped with a real time clock which keeps track of the time of the day and the date.			
		Time and/or the date can be used for the automatic change of tariffs.			

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
		Accuracy shall be 0.02 % of the time.			
		Correction for summer and winter time is performed automatically and complies with the requirements of 4.2.5.			
		Other corrections, automatic or manual, prevented during a journey, unless conducted during a verification process.			
		During interruption to supply voltage, real time clock continues to function correctly, and retains the correct time and date for at least one year and in accordance with national regulations.			
4	**A.1**	**TECHNICAL REQUIREMENTS**			
4.1		**Suitability for use**			
		Taximeter suits the method of operation and vehicles for which it is intended.			
		Taximeter is of robust construction to maintain its metrological characteristics.			
4.2		**Security of operation**			
4.2.1		**Fraudulent use** No characteristics likely to facilitate fraudulent use.			
4.2.2		**Accidental breakdown, maladjustment and inspection**			
		Effect of accidental breakdown or maladjustment is evident.			
		Any malfunction shall be clearly indicated (e.g. by a significant fault indication or by automatic switch off).			
		The absence or improper functioning of connected instruments shall (automatically) prevent the operation of the taximeter. This setting of the taximeter shall be secured.			
4.2.3		**Controls and keys**			
		Controls and keys **c**ome to rest in intended positions and unambiguously marked keys.			
4.2.4		**Inspection and adjustment**			
		Easy inspection and adjustments of the taximeter functions is possible.			
4.2.5	**A.2**	**Securing of functions, hardware, software and pre-set controls**			
		– Means provided for securing taximeter functions, measurement data, hardware, software and pre-set controls, to which access, adjustment or removal is prohibited.			
		– Security provided on all parts of the measuring system which cannot be sealed in any other way against operations liable to affect the measurement accuracy.			
		Other security specified and/or provided in accordance with national regulations to ensure:			
		(a) Any device for changing the parameters of legally relevant measurement data shall be secured by appropriate hard-software means against unintentional and accidental changes			

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
		(b) Access to legally relevant functions only allowed to the metrological authority, e.g. by changeable code (key-word) or of a special device (hard key, etc.);			
		(c) Interventions can be recorded and this information can be accessed and displayed;			
		(d) Recorded information include the date and a means of identifying the authorized person making the intervention (see a) above);			
		(e) Traceability of the interventions shall be assured for at least the period of time in between periodical verifications depending on national regulations;			
		(f) Records may not be overwritten, and if the storage capacities for records is exhausted, no further intervention shall be possible without breaking a physical seal;			
		(g) Protection of software functions against intentional, unintentional and accidental changes is provided in accordance with 4.11;			
		(h) Protection and detection of physical tampering with taximeter hardware is provided (e.g. seals);			
		(i) Transmission and updating of legally relevant data and/or software is protected against intervention in accordance with the requirements of 4.10, 4.11 and 5.2.3;			
		(j) Securing possibilities available in taximeter allows for separate securing of tariff data;			
4.3	**A.1**	**Fare calculation**			
		The interval of fare to pay, the fare calculation method S and D, and the monetary symbols comply with national regulations.	Remarks		
		Taximeter is able to calculate fare by both method S (single application of tariff) and method D (double application of tariff)			
		The option of switching between calculation methods S and D shall be by a secured setting.			
		Indications for fare calculation comply with 4.9.1.			
4.4		**Tariff programming**			
4.4.1		**Each allocated tariff may include following data:**			
		– initial hire fee as an amount of money;			
		– initial time;			
		– initial distance;			
		– time-tariff value as an amount of money per hour;			
		– distance-tariff value as an amount of money per kilometre, or in accordance with national regulations;			
		– supplementary charge increment, if appropriate;			
		– signature of the corresponding tariff data.			

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
4.4.2		**Input of tariff data**			
		It is possible to secure the access to the level where tariff data can be changed in accordance with the requirements of 4.2.5.			
		Tariff data may be entered individually via an appropriately protected interface (5.2.3).			
		Unauthorized or unintentional tariff re-programming due to interfacing with other equipment shall be prevented in accordance with the securing requirements in 4.2.5.			
		If the taximeter is capable of having its tariffs re-programmed in advance of the effective date, those tariffs shall not become effective until that date.			
		Where applicable, the tariffs shall have identifications and signatures of the corresponding tariff parameters.			
4.5	**A.1**	**Operating position device**			
		Indications in the operating positions are as follows:			
4.5.1		**In "For Hire" (Free) operating position**			
		Time-counting and distance-counting shall be inactive.			
		In "For hire" (Free) operating position it is possible to display, when relevant, the following parameters:			
		▪ all elements of the indicator display;			
		▪ the contents of totalizers (see 4.7);			
		▪ the taximeter constant, *k*, expressed in pulses per kilometre;			
		▪ the contents of the event counters (see 4.2.5);			
		▪ the tariff data of each allocated tariff (see 4.4.1);			
		▪ signatures of the corresponding tariff parameters;			
		▪ date and time;			
		▪ software version number and/or checksum.			
		The above parameters shall not be displayed for more than 10 seconds when the vehicle is moving.			
		Other indications in "For Hire" (Free) operating position are permitted in accordance with national regulations, and shall not be interpreted as fare or supplement indication and their use is subject to the requirements of 4.2.			
4.5.2		**In "Hired" (Occupied) operating position**			
		Time-counting and distance-counting shall be activated.			
		Indications in "Hired" (Occupied) operating position shall be in the following order:			
		(a) The initial charge;			
		(b) The first fare indication, followed by subsequent fare indication changes corresponding to the initial and then successive equal time intervals or distances specified in the applied tariff;			
		Indications in "Hired" operating position include the distance and time displays and comply with the quality of indication requirements in 4.9.1 and where appropriate, comply with			

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
		national regulations.			
4.5.3		**In "Stopped" (To Pay) operating position**			
		Fare calculation based on time is disabled (i.e. time-counting is inactive).			
		Indications in "Stopped" (To Pay) operating position are:			
		(a) The fare to be paid for the journey; or			
		(b) Any supplementary charge for an extra service, entered by manual command, is displayed separately from the indicated fare.			
		In the case of b) above:			
		▪ Taximeter may indicate temporarily the value of the fare including the supplementary charge;			
		▪ Indication of the supplement is made by figures with a height not more than that of the figures indicating the fare.			
		Indications in the "Stopped" (To Pay) operating position comply with 4.9.1.			
4.5.4	**A.1**	**In the "Measure" operating position**			
		In calculation method D the distance and duration of the journey are measured and displayed in real time on a separate indicator.			
		Indications in the "Measure" operating position are:			
		(a) Time measured in hours with smallest increment of 30 seconds;			
		(b) Resolution of measured distance is better than or equal to 0.1 km;			
		(c) Both time and duration readings may be given at the same time, or may be recalled one after the other by means of the operating position device;			
		(d) Period of use shown as hh:mm:ss and the indicated unit of measurement shall comply with 3.9.1 to prevent confusion.			
4.6	A.1	**Additional requirements for operating position device**			
		(a) In "Stopped" (To Pay) operating position fare indication is readable for at least 10 seconds and during this time it shall not be possible to change the operating position;			
		(b) Design and setting of the operating position device ensures that any change in operating positions and their indications comply with the appropriate requirements for securing in 4.2.5;			
		(c) It is not possible to place the taximeter in any operating positions other than those mentioned above, unless otherwise specified in national regulations.			
4.7	**A.1**	**Non-resettable totalizers**			
		Clear and unambiguous display of:			
		(a) Total distance traveled by the taxi;			
		(b) Total distance traveled when hired;			
		(c) Total number of journeys;			

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
		(d) Total amount of money charged as supplements;			
		(e) Total amount of money charged as fare.			
		Other data totalled in accordance with national regulations complies with 4.9.1.			
		Values saved under conditions of supply voltage loss are included in the total and shall be stored for at least one year.			
		Totalized values displayed for a maximum of 10 seconds, or for a time in accordance with national regulations.			
		Totalizers have a minimum number of digits (e.g. 8 digits) in accordance with national regulations.			
4.8	A.1	**The tariff data may be triggered by the:**			
		▪ distance of the journey;			
		▪ duration of the journey;			
		▪ time of day;			
		▪ date;			
		▪ day of the week, including special days (e.g. Christmas, ▪ Easter, ...) if relevant;			
		▪ any alteration of tariff data complies with 4.2.5.			
4.9	**A.1**	**Indicating and printing**			
4.9.1		**Quality of reading:**			
		Primary indications shall be by means of a display.			
		Reading of primary indications reliable, easy and unambiguous under conditions of normal use including in daylight and at night.			
		Figures forming the primary indications shall be of a size equal to or higher than 10 mm in height, and of a shape and clarity for easy reading.			
		Primary indications contain names or symbols of the units of measurement and comply with the requirements of 3.4.			
		Indications of interest to the passenger are suitably identified and readable from a distance of at least 2 metres.			
		Digital indication shall display at least one figure beginning at the extreme right.			
		Decimal fraction shall be separated from its integer by a decimal sign (comma or dot), with the indication showing at least one figure to the left of the sign and all figures to the right.			
4.9.2		**Printing device**	Present [ ]		Not present [ ]
		Printing is clear and permanent for the intended use. Printed figures shall be clear, legible and unambiguous.			
		If printing takes place, the name or the symbol of the unit of measurement shall be either to the right of the value or above a column of values, or placed in accordance with national regulations.			

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
		Multiple copies of the print-out containing the same data must be marked "copy" or "duplicate".			
		Minimum printout from each measurement operation shall be dependent upon the application of the taximeter and in accordance with national regulations.			
		In general the printout information may include the programmed tariff, fare, supplementary charge, distance and duration of the journey, date and the time of the journey.			
4.10	**A.1**	**Data storage:**			
		(a) In taximeter memory device;			
		(b) External (removable) storage device.			
		In accordance with national regulations there shall be adequate security to ensure that:			
		(a) Securing of legally relevant software stored or transmitted between storage devices comply with the appropriate requirements of 4.11;			
		(b) The legally relevant measurement data stored or transmitted shall be accompanied by all relevant information necessary to reconstruct an earlier measurement for future legally relevant use;			
		(c) External storage device identification and security attributes shall be verified to ensure integrity and authenticity;			
		(d) Exchangeable storage media is sealed against unauthorized removal in accordance with 4.2.5;			
		(e) For long term storage of legally relevant data, the data must be stored automatically when the measurement is concluded. The long-term storage must have a capacity which is sufficient for the intended use.			
		(f) When the storage is full, new data may replace oldest data provided that the owner of the old data has given authority to overwrite the old data and it complies with the appropriate requirements of 4.2.5 and 4.11.			
4.11	**A.1**	**Software**			
		Distinct separation between the legally relevant and non-relevant software.			
		Legally relevant software is identified by the manufacturer.			
4.11.1		In accordance with national regulations software documentation submitted with the instrument includes:			
		(a) Description of the legally relevant software;			
		(b) Description of the accuracy of the measuring algorithms;			
		(c) Description of the user interface, menus and dialogues;			
		(d) The unambiguous software identification;			
		(e) Overview of the system hardware, e.g. (e.g. rounding algorithm when calculating the distance or price);			
		(f) Means of securing the software;			
		(g) Operating manual;			
		(h) Other relevant information regarding the software characteristics of the taximeter.	Remarks		

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
4.11.2		**Securing of legally relevant software**			
		In accordance with national regulations there shall be adequate security to ensure that:			
		(a) The legally relevant software shall be adequately protected against accidental or intentional changes by means of an audit trail or an event counter providing information record of the changes to the software;			
		(b) The legally relevant software is assigned with a software identification which shall be adapted in the case of every software change that may affect the functions and accuracy of the taximeter. Software identification shall be easily provided by the taximeter;			
		(c) The transmission, changing and updating of the legally relevant software shall be secured and comply with the relevant requirements and conditions of 5.2.3;			
		(d) It shall be possible to access and display the information in the audit trail records; the records shall include the date and a means of identifying the authorized person making the intervention (see a) above); the traceability of the interventions shall be assured for at least the period of time in between periodical verifications depending on national legislation;			
		(e) Legally relevant records may not be overwritten, and if the storage capacities for legally relevant records are exhausted, no further intervention shall be possible without breaking a physical seal.			
4.12	**A.2**	**Descriptive markings:**			
		Taximeters shall bear the following markings, variable according to national regulations:			
		▪ Name or identification mark of manufacturer;			
		▪ Name or identification mark of the importer (if applicable);			
		▪ Serial number and type designation of the instrument (if applicable);			
		▪ Type approval sign and/or number of the type examination certificate;			
		▪ Relevant data in respect of the conditions of use;			
		▪ year of manufacture;			
		▪ Specified range of the taximeter constant, *k* (if applicable) in pulses per kilometre;			
		▪ Software identification (if applicable).			
4.12.1		**Supplementary markings**			
		Are required	Remarks		
4.12.2		**Presentation of descriptive markings**			
		▪ Indelible;			
		▪ Size, shape and clarity that allows easy reading;			
		▪ Grouped together in a clearly visible place;			
		▪ Descriptive plate bearing markings to be sealed, unless it cannot be removed without being destroyed;			
		▪ Shown in national languageor			

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
		▪ Shown in form of adequate internationally agreed and published pictograms and signs;			
		The descriptive markings simultaneously displayed by a software solution either permanently or on manual commend.			
		In the case of software solution:			
		The taximeter constant, *k*, and real-time shall be displayed as long as the taximeter is switched on;			
		The other markings may be accessed and displayed by a simple manual commend (e.g. a specific keystroke);			
		It shall be described in the type approval certificate;			
		Software controlled display markings need not be repeated on the data plate, if they are shown on or indicated near the display of the measurement result, with the exception of the following markings which shall be shown on the data plate: ▪ taximeter constant, *k* and the date shall be shown on the display; ▪ type approval sign in accordance with national requirements; ▪ name or identification mark of the manufacturer.			
4.13	**A.2**	**Verification marks**			
		In accordance with national regulations initial verification markings include:			
		▪ Verification authority identification;			
		▪ Date of verification;			
		▪ Other verification markings specified in accordance with national regulations.			
4.13.1		**Position of verification marks**			
		Part where verification marks are located cannot be removed from the instrument without damaging the marks.			
		Allows easy application of marks without changing the metrological qualities of the instrument.			
		Visible when the instrument is in service.			
5		**ELECTRONIC REQUIREMENTS**			
5.1.3		**Disturbances**			
		Indication of significant faults in the display does not lead to confusion with other messages.			
5.2	**A.1**	**Functional requirements**			
5.2.1		**Indicator display test:**			
		Upon switch-on, all relevant signs of indicator are active and non-active for sufficient time to be checked by operator.			
5.2.2	**A.1**	**Acting upon a significant fault**			
		▪ Either the instrument is made inoperative automatically; or			
		▪ Visual or audible indication is provided automatically and continues until the user takes action or the fault			

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
		disappears.			
5.2.3		**Interface(s):**			
		A taximeter shall be able to supply the following data through appropriate protective interfaces:			
		▪ Operation position: “For Hire”, “Hired” or “Stopped”;			
		▪ Totalizer data according to 4.7;			
		▪ General information: e.g. date of securing, vehicle identification, real time, tariff identification;			
		▪ Fare information for a journey: e.g. total charged, fare, calculation of the fare, supplement charge, date, start time, finish time, distance traveled;			
		▪ Tariff(s) information: e.g. parameters of tariff(s).			
5.2.3.1		In accordance with national regulations documentation on interfaces submitted with the instrument includes:			
		▪ Description of the interface;			
		▪ Identification of the interface (e.g. RS232, USB, interface number or label, etc.);			
		▪ A list of all commands (e.g. menu items in case of a user interface, or commands that are accepted by the software of the device, received via each communication interface);			
		▪ A brief description of their meaning and their effect on the functions and data of the measuring instrument;			
		▪ Other relevant information regarding taximeter interfaces.			
5.2.3.2		Interfaces security:			
		An interface through which the functions mentioned in 5.2.3 cannot be performed or initiated, need not be secured.	Remarks		
		In accordance with national regulations there shall be adequate security to ensure that:			
		(a) Interfaces shall not allow the metrological functions of the taximeter and its legally relevant software and data to be inadmissibly influenced by other interconnected instruments, or by disturbances acting on the interface;			
		(b) The legally relevant data and metrological functions are protected against accidental or intentional changes by a protective interface;			
		(c) The legally relevant functions in the taximeter’s interfaces secured in accordance with the appropriate requirements for securing hardware in 4.2.5 and software in 4.11;			
		(d) The legally relevant parts of the connected instrument, and functions performed or initiated by the connected instrument are included in the initial or subsequent verification;			
		(e) It shall be easily possible to verify the authenticity and integrity of data transmitted to and/or from the taximeter and the connected instrument.			
5.2.4		**Taximeter test connector**			
		For performing the functional tests in A.4 the taximeter is equipped with a test connector, the functioning of which is checked to ensure that it is capable of processing the signals in			

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
		Table 1.			
		Test connector shall be easily accessible after installation in a vehicle provided that it is secured against unauthorized access in accordance with 4.2.5.			
		If the taximeter is connected to a network in the car (e.g. CAN bus), there shall be the possibility for an input and output for the distance information. In that case the taximeter does not work with pulses but with digital distance information.			
5.2.5	**A.1**	**Under conditions of voltage drop below the lower voltage limit:**			
		Taximeter continues to function correctly or resume its correct functioning without loss of data prior to the temporary voltage drop (e.g. less than 20 seconds);			
		Abort an existing measurement and switch to the "For Hire" operating position if the period of voltage drop is greater than 20 seconds; In this case, the taximeter shall resume its correct functioning and retain the correct stored data concerning the journey;			
		Show a significant fault or is automatically put out of service if the voltage drop is for a lengthy period.			
		If disconnected from the supply voltage, the taximeter shall keep the totalized value information for at least one year or for a period set in accordance with national regulations.			
6		**METROLOGICAL CONTROLS**			
6.2		**Type approval**			
		Documentation submitted for type approval includes:			
		▪ Metrological characteristics of the taximeter (3);			
		▪ Technical and electronic specifications (4, 5);			
		▪ Functional description of the taximeter and its devices;			
		▪ Drawings, diagrams, photo of the instrument explaining its construction and operation;			
		▪ Description and application of securing components, controls, fault indication function, etc. (4.2, 4.10, 5.2);			
		▪ Interfaces (types, intended use, immunity to external influences instructions (4.2.5, 5.2.3);			
		▪ General software information (4.11, 4.12.2);			
		▪ Printing devices (4.9.2);			
		▪ Data storage devices (4.10);			
		▪ Drawing or photo of the instrument showing the principle and the location of control marks, securing marks, descriptive and verification marks (4.2.5, 4.12);			
		▪ List of tariffs provided on the taximeter;			
		▪ Any document or other evidence that the design and construction of the taximeter and devices comply with the requirements of this Recommendation;			
		▪ Operating instructions, operating manual.			

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
6.2.2		**Type evaluation**			
		Type evaluation conducted on one or more taximeters submitted in a form suitable for laboratory tests.			
		Submitted documents examined; and tests carried out to verify that the taximeter complies with the:			
		(a) Metrological requirements in Clause 2, with reference to the appropriate mpes and the operating conditions specified by the manufacturer;			
		(b) Technical requirements in Clause 4;			
		(c) Electronic requirements in Clause 5.			
		Tests:			
		▪ Conducted in a manner that prevents an unnecessary commitment of resources, and permit the results of the tests to be assessed for initial verification;			
		▪ Other appropriate tests in accordance with national regulations to verify compliance with R 21;			
		▪ Accept, with the consent of the applicant, test data obtained from other metrological authorities without repeating tests;			
		▪ Under the normal rated operating conditions for which the taximeter is intended;			
		▪ Functioning of the taximeter determined in accordance with Clause 7 and Annex A;			
		▪ Influence factors shall be applied to the taximeter as specified in 3.5 and Annex A;			
		▪ Either on the premises of the metrological authority to which the application has been submitted, or in any other suitable place agreed between the metrological authority concerned and the applicant;			
		▪ With equipment and personnel supplied by the applicant.			
6.3		**Initial verification**			
6.3.1		General			
		▪ Tests conducted in accordance with national regulations;			
		▪ Tests conducted in a manner that prevents an unnecessary commitment of resources, and permits the results of the tests to be assessed for initial verification;			
		▪ Other appropriate tests in accordance with national regulations to verify compliance with the metrological and technical requirements of this Recommendation;			
		▪ Accept, with the consent of the applicant, test data obtained from other metrological authorities without repeating tests.			
6.3.2		To verify compliance with the following:			
		▪ Appropriate maximum permissible errors in 3.2.1;			
		▪ For correct functioning of all devices, e.g. distance transducer, taximeter, real-time clock;			
		▪ For construction material and design, as far as they			

R 21 Clause	Test Clause	Taximeters	Passed	Failed	Remarks
		are of metrological relevance;			
		▪ If appropriate a list of the tests performed;			
		▪ Secured tariffs if applicable (depending on national regulations).			
		Initial verification			
		Tests conducted on the taximeter and including all devices which form the assembly as intended for normal operational use.			
		The verification procedure may be carried out in two stages:			
		▪ where the first stage shall allow for easy examination of the tariff parameters and the distance measurement without the influence of the vehicle; and			
		▪ the second stage shall comprise all examinations of which the outcome is dependent on tests of a vehicle-installed taximeter.			
6.3.3		Visual inspection			
		Before testing, the taximeter shall be visually inspected for: ▪ physical metrological characteristics, i.e. measurement units, real-time clock; ▪ identification of software if applicable; ▪ prescribed markings and positions for verification and control marks.			
		If location and conditions of use of the instrument are known, it should be considered whether they are appropriate.	Remarks		
6.3.4		Marking and securing.			
		According to national legislation, initial verification may be testified by verification marks as specified in 4.13.			

Use this space to detail remarks from the checklist

BIBLIOGRAPHY

Below are references to Publications of the International Electrotechnical Commission (IEC), the International Organization for Standardization (ISO) and the OIML, where mention is made in this Recommendation.

Ref.	Standards and reference documents	Description
[1]	International Vocabulary of Basic and General Terms in Metrology (VIM) (1993)	Vocabulary, prepared by a joint working group consisting of experts appointed by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML.
[2]	International Vocabulary of Terms in Legal Metrology, OIML, Paris (2000)	Vocabulary including only the concepts used in the field of legal metrology. These concepts concern the activities of the legal metrology service, the relevant documents as well as other problems linked with this activity. Also included in this Vocabulary are certain concepts of a general character which have been drawn from the VIM.
[3]	OIML B 3 (2003) OIML Certificate System for Measuring Instruments (formerly OIML P 1)	Provides rules for issuing, registering and using OIML Certificates of conformity.
[4]	OIML D 11 (2004) General requirements for electronic measuring instruments	Provides guidance for establishing appropriate metrological performance testing requirements for influence quantities that may affect the measuring instruments covered by International Recommendations.
[5]	IEC 60068-2-1 (1990-05) with Amendments 1 (1993-02) and 2 (1994-06) Basic environmental testing procedures - Part 2: Tests, Test Ad: Cold, for heat dissipating equipment under test (EUT), with gradual change of temperature.	Concerns cold tests on both non-heat-dissipating and heat dissipating specimens.
[6]	OIML D 19 (1988)	Provides advice, procedures and influencing factors on type evaluation and type approval.
[7]	OIML D 20 (1988) Initial and subsequent verification of measuring instruments and processes	Provides advice, procedures and influencing factors on the choice between alternative approaches to verification and the procedures to be followed in the course of verification.
[8]	IEC 60068-2-2 (1974-01) with Amendments 1 (1993-02) and 2 (1994-05). Environmental testing Part 2: Tests, Test B: Dry heat	Contains test Ba: dry heat for non heat dissipating specimen with sudden change of temperature; test Bb dry heat for non heat dissipating specimen with gradual change of temperature; tests Bc: dry heat for heat dissipating specimen with sudden change of temperature; test Bd: dry heat for heat dissipating specimen with gradual change of temperature.

Ref.	Standards and reference documents	Description
		The 1987 reprint includes IEC no. 62-2-2A
[9]	IEC 60068-3-1 (1974-01) + Supplement A (1978-01): Environmental testing Part 3 Background information, Section 1: Cold and dry heat tests	Gives background information for Tests A: Cold (IEC 68-2-1), and Tests B: Dry heat (IEC 68-2-2). Includes appendices on the effect of: chamber size on the surface temperature of a specimen when no forced air circulation is used; airflow on chamber conditions and on surface temperatures of test specimens; wire termination dimensions and material on surface temperature of a component; measurements of temperature, air velocity and emission coefficient. Supplement A gives additional information for cases where temperature stability is not achieved during the test.
[10]	IEC 60068-3-4 (2001-08) Environmental testing - Part 3-4: Supporting documentation and guidance - Damp heat tests	Provides the necessary information to assist in preparing relevant specifications, such as standards for components or equipment, in order to select appropriate tests and test severities for specific products and, in some cases, specific types of application. The object of damp heat tests is to determine the ability of products to withstand the stresses occurring in a high relative humidity environment, with or without condensation, and with special regard to variations of electrical and mechanical characteristics. Damp heat tests may also be utilized to check the resistance of a specimen to some forms of corrosion attack.
[11]	IEC 60068-2-30 Ed. 3.0 (2005-08) Environmental testing - Part 2: Tests. Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle).	Determines the suitability of components, equipment or other articles for use, transportation and storage under conditions of high humidity - combined with cyclic temperature changes and, in general, producing condensation on the surface of the specimen. If the test is being used to verify the performance of a specimen whilst it is being transported or stored in packaging then the packaging will normally be fitted when the test conditions are being applied. For small, low mass specimens, it may be difficult to produce condensation on the surface of the specimen using this procedure; users should consider the use of an alternative procedure such as that given in IEC 60068-2-38.
[12]	ISO 16750-2 (2003)	Road vehicles – Environmental conditions and testing for electrical and electronic equipment. Part 2: Electrical loads.
[13]	IEC 60068-3-8 (2003-08)	Environmental testing: Supporting documentation and guidance – Selecting amongst vibration tests.

Ref.	Standards and reference documents	Description
[14]	IEC 60068-2-64 Ed. 1.0 (1993-05)	Environmental testing - Part 2: Test methods - Test Fh: Vibration, broad-band random (digital control) and guidance.
[15]	IEC 60068-2-47 Ed. 3.0 (2005-04) Environmental testing - Part 2-47: Test methods - Mounting of components, equipment and other articles for vibration, impact and similar dynamic tests.	This standard provides methods for mounting products, whether packaged or unpackaged, as well as mounting requirements for equipment and other articles, for the series of dynamic tests in IEC 60068-2, that is impact (Test E), vibration (Test F) and acceleration, steady-state (Test G). When they are fastened to the test apparatus and subjected to these tests, whether packaged or unpackaged, they are referred to as specimens.
[16]	IEC 60068-2-6 (1995-03), with Correction 1 (1995-03)	Environmental testing – Part 2: Tests-Test Fc: Vibration (sinusoidal).
[17]	IEC 61000-4-3 Ed. 3.0 (2006-02) Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test.	Is applicable to the immunity requirements of electrical and electronic equipment to radiated electromagnetic energy. It establishes test levels and the required test procedures. The object of this standard is to establish a common reference for evaluating the immunity of electrical and electronic equipment when subjected to radiated, radiofrequency electromagnetic fields. The test method documented in this part of IEC 61000 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon. This part deals with immunity tests related to the protection against RF electromagnetic fields from any source. Particular considerations are devoted to the protection against radio-frequency emissions from digital radiotelephones and other RF emitting devices. It has the status of a basic EMC publication.
[18]	IEC 61000-4-6 (2003-05) with Amendment 2 (2006-03) Consolidated Edition 2.2 (2006-05) Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques. Section 6: Immunity to conducted disturbances, induced by radio-frequency fields	Relates to the conducted immunity requirements of electrical and electronic equipment to electromagnetic disturbances coming from intended radio-frequency (RF) transmitters in the frequency range 9 kHz up to 80 MHz. Equipment not having at least one conducting cable (such as mains supply, signal line or earth connection), which can couple the equipment to the disturbing RF fields is excluded. The object of this standard is to establish a common reference for evaluating the functional immunity of electrical and electronic equipment when subjected to conducted disturbances induced by radio-frequency fields. The test method documented in this part of IEC 61000 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon.

Ref.	Standards and reference documents	Description
[19]	IEC 61000-4-2 (1995-01) with Amendment 1 (1998-01) and Amendment 2 (2000-11) Basic EMC Publication Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 2: Electrostatic discharge immunity test. Consolidated Edition: IEC 61000-4-2 (2001-04) Ed. 1.2	This publication is based on IEC 60801-2 (second edition: 1991). It relates to the immunity requirements and test methods for electrical and electronic equipment subjected to static electricity discharges, from operators directly, and to adjacent objects. It additionally defines ranges of test levels which relate to different environmental and installation conditions and establishes test procedures. The object of this standard is to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment when subjected to electrostatic discharges. In addition, it includes electrostatic discharges which may occur from personnel to objects near vital equipment.
[20]	ISO 7637-2 (2004)	Road vehicles - Electrical disturbance by conduction and coupling - Part 2: Electrical transient conduction along supply lines only.
[21]	ISO 7637-3 (1995) with correction 1, (1995)	Road vehicles - Electrical disturbance by conduction and coupling - Part 3: Passenger cars and light commercial vehicles with nominal 12 V supply voltage and commercial vehicles with 24 V supply voltage - electrical transient transmission by capacitive and inductive coupling via lines other than supply lines.