
Electric road vehicles — Reference energy consumption and range — Test procedures for passenger cars and light commercial vehicles

Véhicules routiers électriques — Consommation d'énergie de référence et autonomie de référence — Modes opératoires d'essai pour voitures particulières et véhicules utilitaires légers

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 8714 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 21, *Electric road vehicles*.

Annexes A, B and C form a normative part of this International Standard.

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Electric road vehicles — Reference energy consumption and range — Test procedures for passenger cars and light commercial vehicles

1 Scope

This International Standard specifies test procedures for measuring the reference energy consumption and reference range of purely electrically propelled passenger cars and commercial vehicles of a maximum authorized total mass (in accordance with ISO 1176) of 3 500 kg and a maximum speed of 70 km/h or more.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 1176:1990, *Road vehicles — Masses — Vocabulary and codes*

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ISO 8713:2002, *Electric road vehicles — Vocabulary*

ISO 8715:2001, *Electric road vehicles — Road operating characteristics*

ISO 10521:1992, *Motor vehicle road load — Determination under reference atmospheric conditions and reproduction on chassis dynamometer*

IEC 60687:1992, *Alternating current static watt-hour meters for active energy (classes 0,2 S and 0,5 S)*

United Nations Regulation No. 83, *Uniform provisions concerning the approval of vehicles with regard to the emission of pollutants according to engine fuel requirements*

United States Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 86, *Control of air pollution from new and in-use motor vehicles and new and in-use motor vehicle engines: Certification and test procedures*, Appendix I

United States Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 600, *Fuel Economy of Motor Vehicles*, Appendix I

TRIAS 5-3-1996, *Fuel consumption test method of gasoline engine vehicle on 10 · 15 mode driving cycles*

3 Terms and definitions

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

3.1

complete electric vehicle kerb mass

mass of the electric vehicle including traction batteries, without occupants or load, but with fuel, cooling liquid, window-washer fluid, lubricating oil, tools and spare wheel, and on-board charger and portable charger or part of it, if provided as standard equipment by the vehicle manufacturer

[ISO 8713:2002, definition 3.13]

3.2

test mass of an electric vehicle

sum of the complete electric vehicle kerb mass plus an additional mass

[ISO 8713:2002, definition 3.54]

3.3

reference energy consumption

quantity of electrical energy from the mains needed to recharge the traction battery, divided by the distance covered, after the vehicle has been driven through a specified test sequence

[ISO 8713:2002, definition 3.48]

NOTE The reference energy consumption is usually expressed in watt-hours per kilometre (W-h/km).

3.4

reference range

distance covered by an electric vehicle over a designated test sequence on a fully charged traction battery, to the end of the test sequence as defined by the end of test sequence criteria

[ISO 8713:2002, definition 3.49]

See clause 6.

NOTE The reference range is usually expressed in kilometres (km).

4 Test sequence

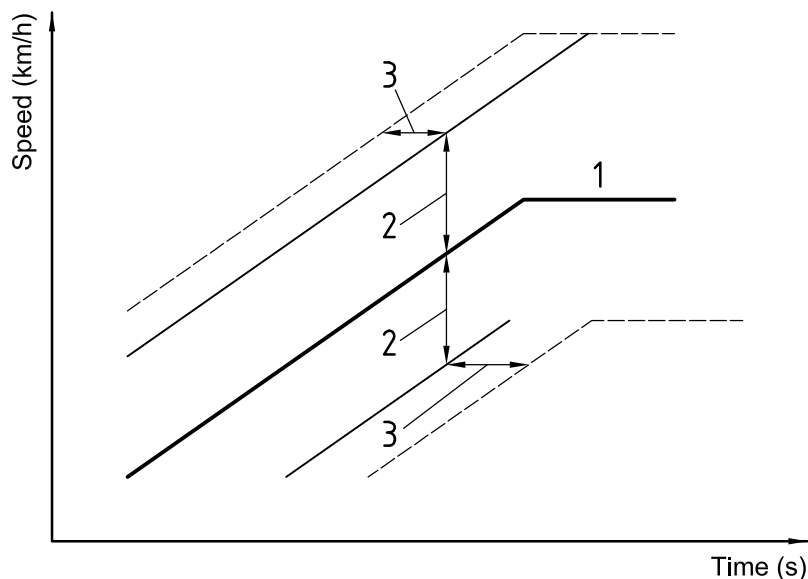
Choose one of the following annexes of this International Standard for the definition of the test sequence:

- annex A for the European driving cycle;
- annex B for the USA driving cycle;
- annex C for the Japanese driving cycle.

The same test sequence shall be used to define energy consumption and range. Every effort shall be made to conduct the tests by following the reference curve within the tolerances given in clause 5.

5 Tolerances

Tolerances on speed and time in the test sequence shall be as shown in Figure 1.



Key

- 1 Reference curve
- 2 Tolerance of speed, in kilometres per hour (km/h)
- 3 Tolerance of time, in seconds (s)

Figure 1 — Reference curve and tolerances
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A tolerance on speed of ± 2 km/h and a tolerance on time of ± 1 s shall be geometrically combined at each point as in Figure 1.

One deviation of up to 4 s beyond these tolerances is permitted in any drive cycle. This exception shall not be allowed to delay the determination of the end of the test sequence.

The total time-out of tolerances shall be mentioned in the test report.

6 End of test sequence criterion

The criterion for the end of the test sequence shall be as specified in annex A, B or C, or shall be an indication from the on-board instrumentation, given to the driver, to stop the vehicle.

7 Measurement of range and energy consumption

7.1 General

The following test method permits measurement of the range in kilometres and the electric energy consumption at the mains in watt-hours per kilometre.

7.2 Parameters, units and accuracy of measurements

Table 1 specifies parameters and their units, accuracy and resolution.

Table 1 — Parameters, units and accuracy of measurements

Parameter	Unit	Accuracy	Resolution
Time	s	± 0,1 s	0,1 s
Distance	m	± 0,1 %	1 m
Temperature	°C	± 1 K	1 K
Speed	km/h	± 1 %	0,2 km/h
Mass	kg	± 0,5 %	1 kg
Energy	W·h	According to IEC 60687 class 0,2 S	According to IEC 60687 class 0,2 S

7.3 Test conditions

7.3.1 Vehicle conditions

The vehicle shall be loaded according to specification for each test.

The vehicle tyres shall be inflated to the pressure specified by the vehicle manufacturer according to the test chosen (track or chassis dynamometer) when the tyres are at ambient temperature.

The viscosity of oils used for the lubrication of mechanical moving parts shall conform to the specifications of the vehicle manufacturer.

The lighting and light signalling and auxiliary devices shall be off, except those required for testing and usual day-time operation of the vehicle.

All energy-storage systems available for other than traction purposes (electric, hydraulic, pneumatic, etc.) shall be in the operating range specified by the vehicle manufacturer.

For the traction battery conditioning, the test driver shall follow the procedure recommended by the vehicle manufacturer for keeping the temperature of the battery in the normal operating range.

The vehicle shall be driven at least 300 km before the test with those batteries that are installed in the test vehicle.

The mass of the vehicle used in the test shall be the test mass of an electric vehicle in accordance with ISO 8713.

7.3.2 Ambient temperature conditions

Outdoor test steps shall be carried out at an ambient temperature between 5 °C and 32 °C.

Indoor test steps shall be carried out at room temperature between 20 °C and 30 °C.

7.4 Test procedure

7.4.1 General

The test procedure consists of the following four steps:

- a) initial charging of the traction battery (see 7.4.2);
- b) application of the appropriate test sequence, and measurement of the reference range and consumption at the mains (see 7.4.3);
- c) charging of the traction battery and measurement of the energy consumption at the mains (see 7.4.4);
- d) calculation of the reference energy consumption (see 7.4.5).

Between each step, if the vehicle moves, it shall be pushed to the next test area (without regenerative recharging).

7.4.2 Initial charging of the traction battery

7.4.2.1 General

Unless otherwise prescribed by the vehicle manufacturer or the traction battery manufacturer, the initial charge of the traction battery shall be performed as follows.

The phrase “initial charging of the traction battery” applies to the first charge up of the traction battery at reception of the vehicle. In the case of several combined tests or measurements carried out consecutively, the first charge up carried out shall be an initial charging of the traction battery, in accordance with the procedure given in 7.4.2.2 and 7.4.2.3, while the following charge ups shall be carried out in accordance with the normal overnight charging procedure specified in 7.1.1 of ISO 8715:2001.

7.4.2.2 Discharging the traction battery

Start the procedure by discharging the traction battery while driving (on a loop track or chassis dynamometer) at a steady speed of $70\% \pm 5\%$ of the maximum thirty-minutes speed of the vehicle (see ISO 8715).

Stop the discharge

- when the vehicle is unable to run at 65% of the maximum thirty-minutes speed, or
- when an indication to stop the vehicle is given to the driver by the on-board instrumentation fitted as standard by the vehicle manufacturer.

7.4.2.3 Application of a normal charge

Charge the vehicle in accordance with the normal overnight charging procedure (see ISO 8715).

7.4.3 Application of the designated test sequence and distance measuring

The time t_0 at which charging of traction battery is terminated shall be recorded. Starting within 4 h of t_0 , the test sequence designated shall be applied. If the test is applied on a chassis dynamometer, the determination of vehicle road load and the reproduction on the chassis dynamometer shall be applied in accordance with ISO 10521.

The test sequence shall continue until the end of test sequence criterion is reached (see clause 6), at which point the vehicle shall be braked until stopped.

Unless otherwise specified in annex A, B or C, up to three interruptions of no longer than 15 min in total are permitted between test sequences, out of respect for human needs.

At the end of the test sequence only, the covered distance, d , in kilometres is taken as the range of the vehicle tested. The value measured shall be rounded to the nearest whole number. It shall be given together with the driving time in hours and minutes.

The average and maximum speeds reached during the test cycle, and the driving time (in hours and minutes), shall be reported.

7.4.4 Charging the traction battery and measuring energy

The vehicle shall be physically reconnected to the mains within 2 h following completion of the appropriate test sequence. The vehicle traction battery shall then be fully charged in accordance with the normal overnight charging procedure (see ISO 8715). The energy-measuring equipment, placed between the mains and the vehicle charger, shall be used to measure the energy, E , in watt-hours, delivered from the mains, as well as the charging duration. The vehicle shall be physically disconnected from the mains after 24 h from the plug-in time.

In the case of a mains power interruption, the 24 h period shall be lengthened according to the duration of the interruption. The validity of the charge shall be agreed between the technical services of the approval laboratory and the vehicle manufacturer.

7.4.5 Calculation of reference energy consumption, C

The reference energy consumption, C , shall be calculated using the formula

$$C = \frac{E}{D}$$

expressed in watt-hours per kilometre (W·h/km), rounded to the nearest whole number.

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Annex A (normative)

European driving cycle and end of test criterion

A.1 General

This annex specifies the European driving cycle, thus giving the test sequence to be applied with the reference curve. It is in accordance with UN Regulation No. 83.

A.2 Test sequence

A.2.1 General

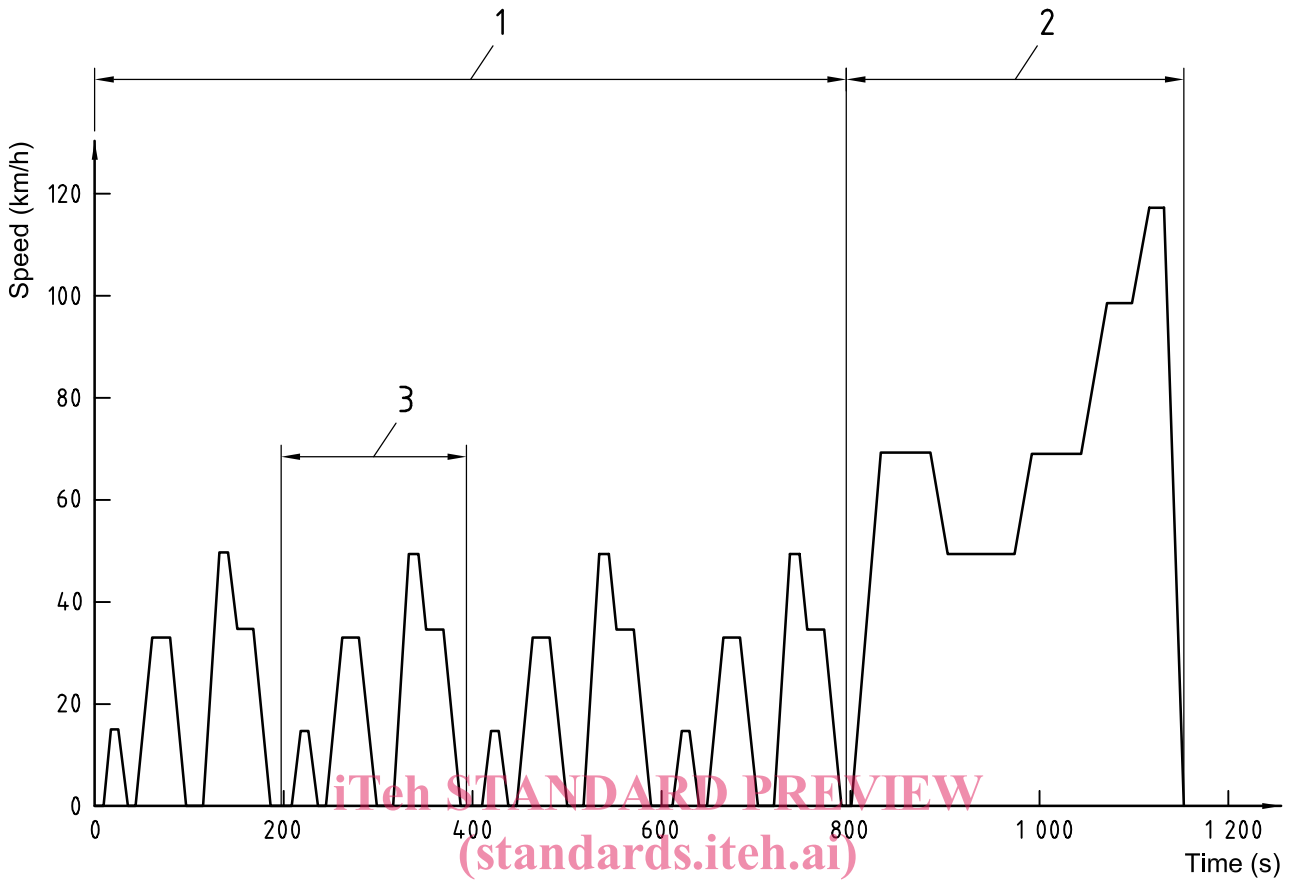
The test sequence to be applied shall consist of an urban sequence, consisting of four basic urban cycles, plus an extra-urban sequence, consisting of a single extra-urban cycle, thus leading to a theoretical target test distance of 11,022 km and a duration of 19 min 40 s. Additionally, a test sequence comprising only the urban sequence is allowed.

Figure A.1 shows the composition of the test sequence.

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Key

- 1 Urban sequence
- 2 Extra-urban sequence cycle
- 3 Basic urban cycle

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Figure A.1 — Test sequence composition