
**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*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 8714:2023

<https://standards.iteh.ai/catalog/standards/sist/d22c8f45-0620-45f5-a66b-435cdb8e73e3/iso-8714-2023>



iTeh STANDARD PREVIEW (standards.iteh.ai)

ISO 8714:2023

<https://standards.iteh.ai/catalog/standards/sist/d22c8f45-0620-45f5-a66b-435cdb8e73e3/iso-8714-2023>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2023

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword.....	iv
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	1
4 Abbreviated terms.....	2
5 Test sequence.....	2
5.1 General.....	2
5.2 Selection of ADT cycle.....	2
5.3 Deviations in speed trace for vehicles with less maximum speed than the maximum speed of the selected ADT cycle.....	2
5.4 Selection of the number of ADT cycles for the shortened test.....	3
5.5 Speed determination and procedure for running a CSS.....	3
6 Tolerances.....	3
7 End-of-test criteria.....	4
8 Measurement of range and energy consumption.....	5
8.1 General.....	5
8.2 Parameters, units and accuracy of measurements.....	5
8.3 Test conditions.....	6
8.3.1 Vehicle conditions.....	6
8.3.2 Ambient temperature conditions.....	6
8.4 Test procedure.....	6
8.4.1 General.....	6
8.4.2 Charging of the RESS.....	7
8.4.3 Application of the designated test sequence and calculation for results.....	8
8.4.4 Test procedure overviews.....	11
9 Presentation of results.....	11
Annex A (informative) Test results of reference energy consumption and range of test vehicle.....	12
Annex B (normative) Determination of CSS speed.....	14
Bibliography.....	18

Foreword

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

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

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 37, *Electrically propelled vehicles*.

This second edition cancels and replaces the first edition (ISO 8714:2002), which has been technically revised.

The main changes are as follows:

- addition of shortened test;
- deletion of the former Annexes A, B and C (regional tests) because their information is obsolete.

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

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

1 Scope

This document 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 documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TR 8713, *Electrically propelled road vehicles — Vocabulary*

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

ISO 10521 (all parts), *Road vehicles — Road load*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 8713 and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

complete electric vehicle kerb mass

mass of the electric vehicle including the rechargeable energy storage system (RESS), without occupants or load, but with combustion heater 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

Note 1 to entry: Adapted from ISO 8715.

3.2

reference energy consumption

quantity of electrical energy from the external AC electric power source needed to recharge the rechargeable energy storage system (RESS), divided by the distance covered or calculated, after the vehicle has been driven through a specified test sequence

Note 1 to entry: The reference energy consumption is usually expressed in watt-hours per kilometre (Wh/km).

3.3

reference range

distance covered by or calculated for an electric vehicle over a designated test sequence on a fully charged rechargeable energy storage system (RESS), to the end of the test sequence as defined by the end-of-test criteria

Note 1 to entry: The reference range is usually expressed in kilometres (km).

3.4

test mass

sum of the *complete electric vehicle kerb mass* (3.1) plus the maximum authorized pay mass (including driver) if it is equal or less than 180 kg; 180 kg, if the maximum authorized pay mass exceeds 180 kg but is less than or equal to 360 kg; half of the maximum authorized pay mass if this pay mass exceeds 360 kg

4 Abbreviated terms

ADT	applicable driving test
CCT	consecutive cycle test
CSS	constant speed segment
RESS	rechargeable energy storage system

5 Test sequence

5.1 General

There are two test methods for measuring the reference energy consumption and reference range of purely electrically propelled vehicles on a chassis dynamometer, the consecutive cycle test (CCT) (see 8.4.3.2) and the shortened test (see 8.4.3.3). The CCT repeats the selected applicable driving test (ADT) cycle (see 5.2) as a test sequence until the end-of-test criterion is reached (see Clause 7). The test sequence of the shortened test consists of a selected number of ADT cycles (see 5.2 and 5.4) followed by a constant speed segment (CSS) (see 5.5). The CSS is performed for discharging the RESS by a higher electrical load than the average ADT cycle load in order to shorten the overall test duration.

The RESS discharging in the shortened test shall be performed by running the vehicle in a CSS or optionally with a constant power discharge via the DC fast charging port (see 5.5).

5.2 Selection of ADT cycle

Select a relevant regional ADT cycle for the definition of the test sequence. The selected ADT cycle applies to either CCT in 8.4.3.2 or shortened test in 8.4.3.3.

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 6, see Figure 1.

5.3 Deviations in speed trace for vehicles with less maximum speed than the maximum speed of the selected ADT cycle

Vehicles with a maximum speed capability that is less than the maximum speed of the selected ADT cycle shall be operated at fully activated accelerator control when the speed trace cannot be followed.

Speed trace violations according to [Clause 6](#) under these circumstances shall not void a test, if the vehicle speed is higher than 70 km/h. Deviations from the driving cycle shall be recorded.

NOTE If the relevant regional ADT standard, where the selected regional ADT cycle belongs to, includes requirements for a reduced test procedure for vehicles which cannot follow the target speed curve, these requirements for a reduced speed curve are taken into account.

5.4 Selection of the number of ADT cycles for the shortened test

In the shortened test, the selected ADT cycle shall be continued consecutively until an additional cycle after the total range at the cycle end exceeds 40 km to warm-up the relevant drive train components. In the additional ADT cycle test, the energy consumption and range shall be measured under the assumed conditions of a fully warmed-up drive train. The total number of these ADTs, N , is defined as the number of ADTs for the shortened test prior to the CSS.

5.5 Speed determination and procedure for running a CSS

As the second part of the shortened test, a CSS is performed following the required number of ADT cycles as described in [5.4](#). A CSS is also performed in order to discharge the RESS for preconditioning before the normal charging, see [8.4.2](#).

A relevant CSS running speed value for the selected ADT cycle shall be determined by choosing one of the two methods described in [Annex B](#), see [Clauses B.2](#) and [B.3](#). If a shortened test method with a CSS for the selected ADT cycle is available in the relevant regional ADT standard, then this CSS speed value can be used.

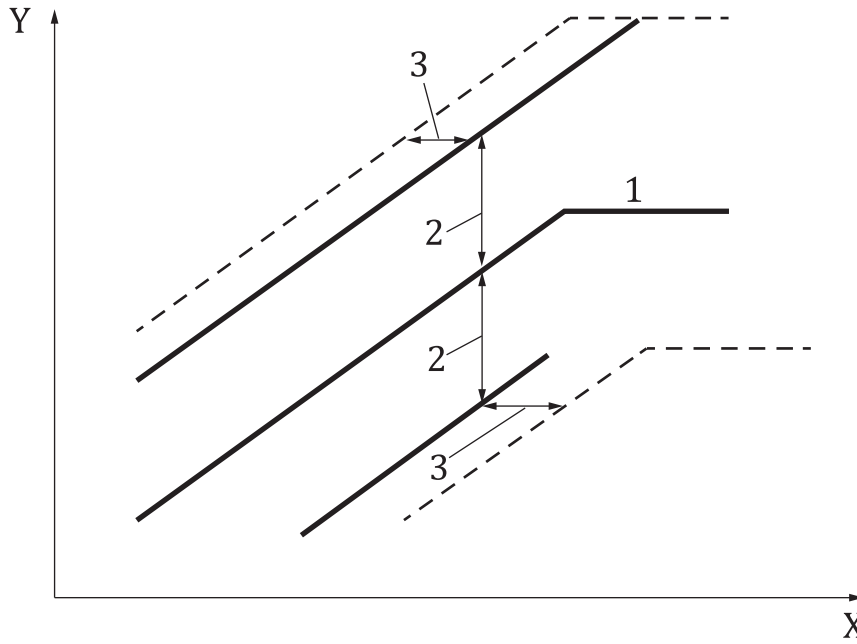
Optionally, the RESS discharging can be performed with a constant power discharge via the DC fast charging port. The determination of the value for power for the RESS discharging and some information necessary for the test are described in [Annex B](#), see [Clause B.4](#).

A CSS shall be run targeting the CSS speed as follows:

The vehicle on the chassis dynamometer shall be accelerated steadily to the specified CSS speed within 60 s. If the CSS speed cannot be reached within 60 s, the accelerator control shall be fully activated until the CSS speed is reached. When the vehicle reached the CSS speed, the speed shall be maintained until the end-of-test criteria according to [Clause 7](#) are satisfied.

6 Tolerances

Tolerances on speed and time in the test sequence shall be as shown in [Figure 1](#).



Key

- X time [s]
- Y speed [km/h]
- 1 reference speed curve
- 2 tolerance of speed, in km/h
- 3 tolerance of time, in seconds [s]

STANDARD PREVIEW
(standards.iteh.ai)

Figure 1 — Reference curve and tolerances

<https://standards.iteh.ai/catalog/standards/sist/d22c8f45-0620-45f5-a66b->

A tolerance on speed of within $\pm 2,0$ km/h and a tolerance on time of within $\pm 1,0$ 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.

7 End-of-test criteria

The end-of-test criteria are defined as follows.

- a) For vehicles capable of following the speed trace of the selected ADT cycle, the test termination criterion is defined as when the vehicle—due to power limitations—is incapable of maintaining the speed tolerances as defined in [Clause 6](#).
- b) For vehicles with a maximum speed capability that is less than the maximum speed of the selected ADT cycle, it shall be operated at fully activated accelerator control when the speed trace cannot be followed.

If the speed trace is equal or lower than 70 km/h, the test termination criterion is defined as when the vehicle is incapable of maintaining the speed tolerances as defined in [Clause 6](#). If the speed trace is higher than 70 km/h, the test termination criterion is defined as when the vehicle, while operated at fully activated accelerator control is unable to reproduce the best-effort speed versus time relationship established by the vehicle in the first selected ADT cycle. The applicable drive tolerances for the best-effort trace are as defined in [Clause 6](#).

- c) For all vehicles the test termination criterion is defined as when the vehicle is given an indication from the on-board instrumentation to the driver to stop the vehicle, e.g. for safety reasons.

When one of the test termination criteria has occurred, the driver shall immediately apply the brake and the vehicle shall stop within 60 s. At the stop of the vehicle, the test is completed and all measurement activities shall be terminated.

At the shortened test, the DC measurement device additionally shall count the energy values at the test termination point.

NOTE DC measurement is necessary for E_{AC} correction.

8 Measurement of range and energy consumption

8.1 General

The following test method specifies the measurement of the AC electric energy, DC electric energy and the distance, and then the calculation of reference range and reference energy consumption.

8.2 Parameters, units and accuracy of measurements

[Table 1](#) specifies parameters and their units and accuracy of measurements.

Table 1 — Parameters, units and accuracy of measurements

Item	Unit	Accuracy
Time	s	±0,1 s
Distance	m	±0,1 %
Temperature	°C	±1 °C
Speed	km/h	±1 %
Mass	kg	±0,5 %
AC electric energy	Wh	±0,5 %
DC electric energy	Wh	±0,3 % ^a
DC current	A	±0,3 % ^a
DC voltage	V	±0,3 % ^a

^a Any errors in the DC electric energy measurement system shall be less than 1 % of the reading or 0,3 % of the full scale. (Pulsed power electronics measurement needs a wide dynamic range even if it has a small power.)

For the DC energy measurement, wideband meter (power analyser) or wideband ampere-hour meter for pulsed power electronics is required.

The wideband meter (power analyser) is an instrument for processing power and energy in pulsed power electronics by current and voltage inputs. Its bandwidth shall be at least 10 times as high as the switching frequency of the pulsed power electronics, and update period of its outputs shall be 0,05 s or less to get enough time resolution.

Voltage probes and current sensors shall be installed in such a way as to measure voltage at RESS and all current leaving and entering the RESS.

The data of the RESS control unit shall be alternatively applied if the accuracy of the data certifies corresponding accuracy in [Table 1](#).

NOTE If the test vehicle's RESS controller data are not sufficiently accurate, the accuracy of the controller's data are displayed on the data sheet. The accuracy of the resulting specific energy consumption and range can be estimated and are also on the data sheet.

8.3 Test conditions

8.3.1 Vehicle conditions

The test mass shall follow the requirements given in ISO 8715. If the requirement for the test mass is given in the relevant regional ADT standard, then it can be used.

The determination of vehicle road load and the reproduction on the chassis dynamometer shall be in accordance with the ISO 10521 series. The same setting on the chassis dynamometer shall be used throughout the test regardless of CCT or shortened test.

The relevant regional ADT standard can be used if it specifies how to determine the vehicle road load.

The vehicle tyres shall be inflated to the pressure specified by the vehicle manufacturer according to the specifications of the 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 RESS conditioning, the test driver shall follow the procedure recommended by the vehicle manufacturer for keeping the temperature of the RESS in the normal operating range.

The vehicle shall be driven at least 300 km before the test with the RESS that is installed in the test vehicle.

8.3.2 Ambient temperature conditions

ISO 8714:2023

<https://standards.iteh.ai/catalog/standards/sist/d22c8f45-0620-45f5-a66b->

Test steps shall be carried out at room temperature between (25 ± 5) °C.

8.4 Test procedure

8.4.1 General

The test procedure consists of the following steps:

- a) charging of the RESS (discharging or charging, preconditioning and normal charging) in accordance with 8.4.2. For shortened test, the energy from the external AC electric power source for charging the RESS ($E_{AC_mes_pre-test}$) can be measured (see 8.4.2.3);
- b) applying the appropriate test sequence (see 5.2), and measuring the range and the DC energy consumption from the RESS, if applicable, and the AC energy from the external AC electric power source for charging the RESS (see 8.4.3);
- c) for CCT, measuring travelled range, the AC energy from the external AC electric power source for charging the RESS after the test and calculation of the reference energy consumption (see 8.4.3.3);
- d) for the shortened test, measuring travelled range, AC energy from the external AC electric power source for charging the RESS after the test, DC energy from the RESS, and calculation of the reference energy consumption and reference range (see 8.4.3.3.2.3).

8.4.2 Charging of the RESS

8.4.2.1 General

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

8.4.2.2 Discharging the RESS

8.4.2.2.1 Setting the remaining RESS level for discharge driving (preconditioning) before full charge

Prior to discharge driving (preconditioning), the remaining state of charge (SOC) of the RESS should be adjusted so that the vehicle can run a distance of up to 50 km at CSS speed. After adjusting the SOC, soak for 9 h or more at the test temperature condition. The soak time can be reduced by agreement between the test institute and customer.

For discharging, a constant power discharge of the RESS via the DC fast charging port can replace running a CSS on a chassis dynamometer (see [Annex B, B.4](#)).

If the SOC level is lower than the requested minimum level, the RESS shall first be charged at least to the requested minimum SOC level before discharging in [8.4.2.2.3](#).

8.4.2.2.2 Vehicle movement

If it is necessary to move the vehicle, push or tow the vehicle so that it does not regenerate or discharge. Exposure to temperatures other than the test environment temperature shall be limited to 30 min.

8.4.2.2.3 Preconditioning (discharge running) for full charge of RESS

Discharging the RESS shall be carried out by driving the vehicle at a constant speed defined by CSS on the chassis dynamometer.

Stop the discharge, if the end-of-test criteria according to [Clause 7](#) are satisfied.

8.4.2.2.4 Application of a normal charge

Soak and charge the vehicle at ambient temperature for 11 h according to [8.4.2.3](#) (normal charging procedure), then start the test within a 1 h period. If charging takes less than 11 h, soaking shall be continued for 11 h. If charging takes more than 11 h, start the test within a 1 h period after charging is completed.

When charging and soaking are completed, push or tow the vehicle onto the chassis dynamometer.

8.4.2.3 Normal charging procedure

8.4.2.3.1 General

The AC energy measurement equipment shall be placed between the external AC electric power source and the vehicle inlet.

The charging of the RESS shall be carried out at an ambient temperature of (25 ± 5) °C. The normal charging procedure shall be in accordance with the vehicle manufacturer's specification for normal operation.

For the normal charging procedure all types of special charging shall be excluded, for example, RESS service charging.

The AC energy shall be measured after the test termination.