
**Electrically propelled road vehicles —
Determination of power for
propulsion of hybrid electric vehicle**

*Véhicules routiers à propulsion électrique — Détermination de la
puissance de propulsion des véhicules hybrides*

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Foreword

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Introduction

It is necessary for vehicle manufacturers to show the reasonable value of the power of hybrid-electric vehicle (HEV) system and compare it with the value of the internal combustion engine (ICE) power measured in the existing test methods such as ISO 1585 and UN Regulation No. 85. But at present, there is no international evaluation method for the power of HEV systems available. Vehicle manufacturers indicate the power of HEVs in their catalogues based on their individual calculation method. With the method in this document, it is possible to measure and compare the power of any HEV topology with those of internal combustion engine vehicles (ICEV).

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Electrically propelled road vehicles — Determination of power for propulsion of hybrid electric vehicle

1 Scope

This document specifies measurement methods for the maximum system propulsion power of hybrid-electric vehicles (HEV).

The results can be compared with the data of internal combustion engine vehicles (ICEV) power measured with the relevant current method.

NOTE ISO 1585 and UN Regulation No. 85, for example.

This document applies only to the vehicles with the following characteristics:

- HEVs with an internal combustion engine (ICE) and one or more electric motors powered by one or more rechargeable energy storage systems (RESS) for propulsion;
- vehicles classified as passenger cars or light duty trucks.

This document does not apply to fuel cell vehicles.

2 Normative references (standards.iteh.ai)

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 1585, *Road vehicles — Engine test code — Net power*

ISO 23274 (all parts), *Hybrid-electric road vehicles — Exhaust emissions and fuel consumption measurements*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1585, ISO 23274 (all parts), ISO/TR 8713 and the following apply.

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

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

3.1

hybrid-electric vehicle

HEV

vehicle with both a *rechargeable energy storage system* (3.3) and a fuelled power source for propulsion

3.2

externally chargeable HEV

hybrid-electric vehicle (3.1) with a *rechargeable energy storage system* (3.3) that is intended to be charged from an external electric energy source

Note 1 to entry: External charge for the purpose of conditioning of the RESS is not included.

Note 2 to entry: Externally chargeable HEVs are widely known as plug-in HEVs (PHEVs).

3.3

rechargeable energy storage system

RESS

system that stores energy for delivery of electric power and which is rechargeable

EXAMPLE Batteries or capacitors.

4 Symbols and abbreviated terms

AWD all wheel drive

ICE internal combustion engine

ICEV internal combustion engine vehicle

SOC state of charge

UN United Nations

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5 Test condition

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5.1 Test instrumentation

5.1.1 Chassis dynamometer

The chassis dynamometer shall have the absorption capacity for the vehicle propulsion power by fixed speed control.

5.1.2 Test room

Conditions of the test room shall be adjusted as follows:

- reference temperature: $298 \text{ K} \pm 10 \text{ K}$ ($25 \text{ °C} \pm 10 \text{ °C}$);
- test atmospheric conditions, P_d : $80 \text{ kPa} < P_d < 110 \text{ kPa}$.

5.1.3 Cooling fan

Fans shall be used to cool the vehicle to maintain the proper operating temperature. However, excessive cooling is prohibited. Air speed in front of the vehicle shall not be higher than the vehicle speed.

5.2 Measurement

5.2.1 Measurement items and accuracy

Table 1 — List of items

Items	Unit	Accuracy	Remark
Engine speed	min ⁻¹	±10 min ⁻¹ or ±0,5 % of measured value whichever is greater	
Intake manifold pressure	Pa	±50 Pa	Intake manifold pressure means inlet depression as used in ISO 1585.
Atmospheric pressure	Pa	±100 Pa	
Fuel flow rate	g/s	±3 %	At least used for compression-ignition engines, and for ICEs if the confirmation of air fuel ratio according to ISO 1585 is necessary.
Voltage	V	±0,5 %	
Current	A	±0,5 %	The current transducer shall have a minimum accuracy of 0,5 % of the measured value or 0,1 % of the maximum value of the scale.
Room temperature	K	±2 K	
Chassis dynamometer roller speed	km/h	±0,5 km/h or ±1 %, whichever is greater	
Time	s	±0,01 s	
Drive shaft or wheel rotational speed	s ⁻¹	±0,05 s ⁻¹ or ±1 %, whichever is greater	
Drive shaft or wheel torque	Nm	±6 Nm or ±0,5 %, whichever is greater	

Measurement devices shall be of certified accuracy, traceable to an approved regional or international standard.

5.2.2 Measurement frequency

All the items in [Table 1](#), except atmospheric pressure and room temperature, shall be measured and recorded at a frequency of not less than 10 Hz.

The items atmospheric pressure and room temperature shall be at least recorded as single measurement activity at start of vehicle operation (see [6.8.4](#)) and after end of vehicle running (see [6.8.6](#)).

6 Test procedure

6.1 General

The purpose of the following test procedures is to determine the maximum system propulsion power of an HEV (maximum HEV system power) on a chassis dynamometer at fixed speeds. Two optional test procedures are applicable, namely:

- a test procedure via measured RESS power and determined ICE power, consecutively named test procedure option 1 (TP1); and
- a test procedure via torque and speed measurement at the drive shaft(s) or wheel(s), consecutively named test procedure option 2 (TP2).

The test result for the maximum HEV system power shall be stated always in connection with the performed test procedure.

NOTE Depending on the power transfer rate in series and power-split types, the results for the maximum HEV system power differ in TP1 and TP2.

6.2 Preparation of chassis dynamometer

6.2.1 Roller

The chassis dynamometer roller(s) shall be clean, dry and free from foreign material which can cause tire slippage.

6.2.2 Tire slippage

Additional weight may be placed on or in the vehicle to eliminate tire slippage. The use of any additional weight shall be recorded.

6.2.3 Chassis dynamometer warm-up

The chassis dynamometer shall be warmed up in accordance with the dynamometer manufacturer's recommendations, or as appropriate.

6.2.4 Chassis dynamometer control

The chassis dynamometer shall be controlled in fixed speed mode for the power test. Only for the requirements towards vehicle conditioning (6.8.2), the chassis dynamometer shall be controlled in road load mode.

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6.3 Preparation of vehicle

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The tire pressure shall be adjusted in accordance with the vehicle manufacturer's recommendations or the owner's manual. The vehicle lubricants and levels specified by the manufacturer shall be used.

Fuel shall be selected in accordance with the vehicle manufacturer's recommendations. If there are no recommendations, the fuel specified in ISO 1585 shall be used.

6.4 Preparation of measurement devices

The measurement devices shall be installed at suitable position(s) and warmed up as appropriate.

Specifically for TP2, the gearbox output shaft(s) or the driven wheel(s) shall be prepared with appropriate, calibrated torque and rotational speed measurement device(s).

For a driven axle powered via differential and two wheels, it is sufficient to install only one torque and rotational speed measurement device on a drive shaft or wheel. In this case, the measured torque at a drive shaft or wheel shall be multiplied by 2 in order to get the sum of torque per driven axle.

NOTE The torque and rotational speed measurement devices can be substituted by traction force and speed measured by the chassis dynamometer, if the accuracy of this measurement devices fulfil the same requirements as for the drive shaft or wheel measurement devices. If so, it is necessary that the measured values for traction force and speed be transformed, by calculation, to the required values for torque and rotational speed at drive shaft or wheel taken into account the specific data of the tires and the proportional vehicle weight at the wheels used during the test (e.g. rolling friction losses, dynamic rolling radius).

6.5 Initial charge of RESS

The RESS of the vehicle shall be charged to the SOC specified by the vehicle manufacturer.

After the SOC has been set, the current and voltage measurements shall be started.

The SOC shall be adjusted by regenerative braking or by charging from the external electric power supply or by discharging via electric driving.

The SOC adjustment may be carried out during vehicle soak (6.6) in case of externally chargeable HEVs.

6.6 Vehicle soak

The vehicle shall be soaked in accordance with the vehicle manufacturer's recommendations. Unless otherwise specified, the room temperature shall be $298 \text{ K} \pm 10 \text{ K}$ ($25 \text{ °C} \pm 10 \text{ °C}$).

6.7 Vehicle installation

The vehicle shall be installed on the chassis dynamometer roller in accordance with the dynamometer manufacturer's recommendation. During the test, auxiliary systems (for example, air-conditioning and heating) which are not contributing to vehicle propulsion shall be turned off. Auxiliary systems not contributing to vehicle propulsion shall be turned off. If auxiliaries except DC/DC converter cannot be turned off, then the $P_{\text{auxiliary}}$ shall be measured or calculated and finally subtracted from the measured RESS power.

6.8 Test sequence

6.8.1 General

The test shall be carried out in accordance with 6.8.2 to 6.8.6, and 6.9 to 6.10 (see Figure 2). The test shall be stopped immediately if warning indicator(s) with regard to the power train turns on.

NOTE Warnings are coolant temperature and engine check lamp, for example.

6.8.2 Vehicle conditioning

In order to stabilize the vehicle, it shall run at the speed of 60 km/h at the vehicle road load for at least 20 minutes, or with the vehicle manufacturer's recommendations.

When the vehicle conditioning has to be performed due to a measurement loop at various fixed dynamometer speeds (see 6.10), the time to run the vehicle for stabilization in the second or further loop may be shorter than 20 minutes according the vehicle manufacturer's recommendation or if the temperature of components is measured and not higher than before the first test.

6.8.3 RESS adjustment

During vehicle conditioning according to 6.8.2, the SOC shall be monitored and adjusted at the end of vehicle conditioning, according to the requirements specified in 6.5.

6.8.4 Vehicle operation

The measurement devices shall start collecting data. The driving mode switch shall be selected appropriately in order to obtain the maximum HEV power.

Run the vehicle at a fixed speed in accordance with the vehicle manufacturer's recommendations.

To be able to measure the maximum power value, a sufficient number of tests shall be carried out at appropriately varied speeds of chassis dynamometer (see 6.10).