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Electrically propelled mopeds and motorcycles — Test method for evaluation of energy performance using motor dynamometer

National foreword

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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Electrically propelled mopeds and motorcycles – Test method for evaluation of energy performance using motor dynamometer

*Motocycles et cyclomoteurs à propulsion électrique — Méthode
d'essai pour l'évaluation de la performance énergétique à l'aide
d'un dynamomètre*



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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.

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 documents 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).

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This document was prepared by Technical Committee Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 38, *Mopeds and Motorcycles*.

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.

Electrically propelled mopeds and motorcycles — Test method for evaluation of energy performance using motor dynamometer

1 Scope

This document specifies a test method to evaluate energy performance of electric motorcycles and mopeds by measuring performance of a test motor system (3.4) to be installed to an electric moped or motorcycle under consideration.

The test is carried out on a motor dynamometer test bench where the traction motor system is connected to a load motor system that simulates resistance torque arising from running resistance of vehicle and drive train friction loss and inertia effect.

This method provides estimates of specific energy consumption and range of an electric moped or motorcycle to which the traction motor system is intended to be applied.

This document is only applicable to two-wheeled motorcycles and mopeds.

NOTE This test method is applicable to motorcycle or moped regardless of types of power transmission devices, such as chains, belts, gears, ratio controllable CVTs, shaft drives, direct drives, etc., once gear ratios (ratio of input to output speed) and transmission efficiencies (ratio of input to output torque) are provided.

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 11486](#), *Motorcycles — Methods for setting running resistance on a chassis dynamometer*

[ISO 13064-1](#), *Battery-electric mopeds and motorcycles — Performance — Part 1: Reference energy consumption and range*

[ISO 13064-2](#), *Battery-electric mopeds and motorcycles — Performance — Part 2: Road operating characteristics*

[ISO 28981](#), *Mopeds - Methods for setting the running resistance on a chassis dynamometer*

[IEC 60034-1](#), *Rotating electrical machines — Part 1: Rating and performance*

[IEC 60034-2-1](#), *Rotating electrical machines — Part 2-1: Standard methods for determining losses and efficiency from test (excluding machines for traction vehicles)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in [ISO 13064-2](#), [IEC 60034-1](#), [IEC 60034-2-1](#) 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 driving mode

test mode used for performance evaluation of mopeds and motorcycles such as UDC (urban driving cycle), EUDC (extra-urban driving cycle), WMTC (world motorcycle test cycle)

Note 1 to entry: For reference to UDC, see [ISO 13064-1:2012](#), Annex A for mopeds and Annex B for motorcycles, and EUDC, see [ISO 13064-1:2012](#), Annex B for mopeds, and WMTC, see UN-ECE GTR No.02.

3.2 load motor

electric motor that provides torque control function defined from running resistance, friction loss and inertia effect of the drive train when testing a traction motor system of electrically propelled mopeds and motorcycles

3.3 load motor system

combination of a *load motor* ([3.2](#)) and its pairing inverter

3.4 test motor system

combination of a traction motor and its pairing inverter under test that is used as a main traction motor for electric mopeds or motorcycles

3.5 speed-torque control mode

test mode performed in a *motor dynamometer* ([3.6](#)) where a *test motor system* ([3.4](#)) is speed controlled and *load motor system* ([3.3](#)) is torque controlled

3.6 motor dynamometer

test equipment for measuring *test motor system* ([3.4](#)) energy performance comprising test motor system, *load motor system* ([3.3](#)), DC power supply, transducers, data acquisition and analysing system

4 Principle

This test method specifies a test procedure to evaluate consumed energy ([7.1](#)), travelled distance ([7.2](#)), motor system efficiency ([7.3](#)), and reference energy consumption ([7.4](#)) of electric motorcycles and mopeds with a traction motor system to be fitted to a vehicle under consideration. Instead of chassis dynamometer test that requires a full vehicle, this method is carried out with a traction motor system on a motor dynamometer and provides estimate of energy performance of vehicle with nominal information of the vehicle.

NOTE Reference energy consumption ([7.4](#)) defined in this document is different from those in other standards, such as [ISO/TR 8713](#), ISO 8714, and [ISO 13064-1](#), where reference energy consumption is defined as electric energy required to fully recharge the traction battery from main after completion of a selected driving cycle. While in this document reference energy consumption is ratio of consumed energy ([7.1](#)) to travelled distance ([7.2](#)).

In order to determine resistance torque to the traction motor system, running resistance acting on the driving wheel of a vehicle, in accordance with [ISO 11486](#) for motorcycles and [ISO 28981](#) for mopeds, shall be converted to the resistance torque to the traction motor system, and additionally the inertia effects and friction losses of the drive train of vehicle shall be accounted for.

5 Determination of resistance torque to traction motor system

5.1 Running resistance of vehicle

Running resistance of motorcycle and moped, respectively according to [ISO 11486](#) and [ISO 28981](#), is given as [Formula \(1\)](#):

$$F_w = m_i A + a + b v^2 \quad (1)$$

where

- F_w is the running resistance acting on the driving wheel;
- m_i is the equivalent mass;
- A is the acceleration of vehicle;
- a is the rolling resistance of the front and rear wheel;
- b is the aero dynamic drag coefficient;
- v is the velocity of the vehicle.

While values for m_i and b can be adopted from [ISO 11486](#) and [ISO 28981](#), rolling resistance a shall account for both front and rear wheels for motor dynamometer test. In this document, a is determined by assuming 50:50 weight distribution between front and rear wheels and the same rolling resistance coefficients. Care should be taken for the application of this method to mopeds and motorcycles having extraordinary characteristics. Values m_i , a , and b for motor cycles and mopeds are given in [Annex A](#) and [Annex B](#), respectively.

The accuracy and resolution of associated parameters, such as time, distance, temperature, speed, mass and energy, is in accordance with [ISO 13064-1](#), which is given in [Table 1](#).

Table 1 — Accuracy and resolution of parameters

Parameter	Unit	Accuracy	Resolution
Time	s	±0,1 s	0,1 s
Distance	m	±0,1 %	1,0 m
Temperature	°C	±1,0 K	1,0 K
Speed	km/h	±1,0 %	0,2 km/h
Mass	kg	±0,5 %	1,0 kg
Energy	Wh	class 0,2 S ^a	class 0,2 S ^a
^a According to IEC 62053-22 .			

5.2 Resistance torque for central drive system

A typical configuration for a central drive system is shown in [Figure 1](#), where a chassis mounted traction motor is connected to driving sprocket via gears, and power is transmitted to driven sprocket with a chain or belt. Besides chain, belt and sprocket, other types of transmission devices, such as CVT, gear, shaft drive, direct drive, etc. Resistance torque T_m [N·m] that shall be applied to the traction motor system on a motor dynamometer test setup can be given as (see [Annex C](#) for derivation) [Formula \(2\)](#):

$$T_m = \left(\frac{r}{\eta N} \right) F_w \quad (2)$$

where r is the rear wheel radius, η is overall torque transmission efficiency between traction motor and wheel, and N is overall gear ratio between traction motor and wheel.

NOTE In case of drive configuration given in [Figure 1](#), η is given as $\eta = \eta_g \times \eta_c$, where η_g is the transmission efficiency of gear between traction motor and driving sprocket, and η_c is the transmission efficiency of the chain drive system connected with driving sprocket and driven sprocket (see [Annex C](#)).

If a traction motor system is combined with internal transmission gears to form a single assembly, then the whole assembly is regarded as a traction motor unit. If this is the case, transmission efficiency η_g shall not be taken into consideration, thus, the overall torque transmission efficiency is $\eta = \eta_c$, and the overall gear ratio becomes $N = N_w$.