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**Electrically propelled mopeds  
and motorcycles — Test method  
for evaluating performance of  
regenerative braking systems**

*À propulsion électrique cyclomoteurs et des motocycles — Méthode  
d'essai pour évaluer l'efficacité du système de freinage régénératif*

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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](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

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

For an explanation on 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 the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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

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# Electrically propelled mopeds and motorcycles — Test method for evaluating performance of regenerative braking systems

## 1 Scope

This document specifies test procedures for measuring performance of regenerative braking systems used for electric motorcycles and mopeds that are propelled by traction motors with electric batteries. Performance of regenerative braking systems is dealt with two perspectives: first, how much a regenerative braking system can extend range of a motorcycle or moped or reduce energy consumption, and second, the efficiency of the driving motor system when working as generator in regenerative braking mode.

## 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 13064-1:2012, *Battery-electric mopeds and motorcycles — Performance — Part 1: Reference energy consumption and range*

ISO 13064-2:2012, *Battery-electric mopeds and motorcycles — Performance — Part 2: Road operating characteristics*

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 terminological databases for use in standardization at the following addresses:

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

### 3.1

#### load motor

electric motor that can simulate road load, as well as braking torque, when testing a *test motor system* (3.11) of electric mopeds and motorcycles

Note 1 to entry: During test, both rotational speed and torque of load motor shall be controllable within a specified range.

### 3.2

#### load motor system

combination of a *load motor* (3.1) and its inverter

### 3.3

#### **reference energy consumption**

quantity of electric energy from the mains needed to charge the traction battery, divided by the distance covered after an electric motorcycle or moped has been driven through the specified test sequence

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

[SOURCE: ISO/TR 8713:2012, 2.62, modified — “the vehicle” has been replaced by “an electric motorcycle or moped”.]

### 3.4

#### **reference energy consumption gain**

ratio of *reference energy consumption* (3.3) to change in reference energy consumption due to regenerative braking system

Note 1 to entry: Gain is positive when reference energy consumption is decreased by regenerative braking system.

### 3.5

#### **reference range**

distance covered by an electrically propelled motorcycle or moped 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

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

[SOURCE: ISO/TR 8713:2012, 2.63, modified — “vehicle” has been replaced by “motorcycle or moped”.]

### 3.6

#### **reference range gain**

ratio of *reference range* (3.5) to change in reference range due to *regenerative braking system* (3.7)

Note 1 to entry: Gain is positive when reference range is increased by regenerative braking system.

### 3.7

#### **regenerative braking system**

brake system which, during deceleration, provides for the conversion of kinetic energy into electrical energy

### 3.8

#### **regenerative braking efficiency of traction motor system**

efficiency of a traction motor system when working as a generator in regenerative braking mode, which is the ratio of mechanical power input to electrical power output

### 3.9

#### **state of charge**

#### **SOC**

actual capacity of a battery pack or system, indicated as percentage of the rated capacity

### 3.10

#### **test motor**

motor under test that is used as a main traction motor for electric mopeds and motorcycles, which generates traction torque as well as regenerative electric energy during braking

### 3.11

#### **test motor system**

combination of *test motor* (3.10) and its inverter

## 4 Principles

Performance of a regenerative system is affected by various elements, i.e. motor and inverter, battery SOC, temperature, brake control strategy, road load, traffic situation, driving behaviour of drivers, etc.