# INTERNATIONAL STANDARD

## ISO
## 18580

First edition
2015-11-15

# Motorcycles — Verification of total running resistance force during mode running on a chassis dynamometer

*Motocycles — Vérification de la force totale de résistance à l'avancement durant les essais sur un banc dynamométrique en mode roulage*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

**COPYRIGHT PROTECTED DOCUMENT**

# Contents

Page

# 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).

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).

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 meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 38, *Motorcycles and mopeds*.

## Introduction

The ordinary chassis dynamometer has the mechanical inertia system where the running resistance is set on the chassis dynamometer in accordance with ISO 11486 and the verification of force generated by the inertia mass is not necessary because the equivalent inertia mass is mechanically set by a flywheel. A chassis dynamometer using the electric inertia function is not equipped with such a mechanical flywheel equivalent to inertia mass system and the inertia force is electrically set in the same way of the running resistance force control. The inertia force is generated by the acceleration and/or deceleration, therefore, it is necessary to check the performance of electric inertia function during the mode running test and this International Standard specifies the method to verify the chassis dynamometer operated normally. The verification method specified in this International Standard can be applicable not only for the total running resistance check during the exhaust gas and/or fuel consumption mode test but also the system installation and the periodical performance check. The accurate verification can be achieved when this method is applied to the ordinary mechanical inertia system chassis dynamometer.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

# Motorcycles — Verification of total running resistance force during mode running on a chassis dynamometer

## 1 Scope

This International Standard specifies the verification method of total running resistance force when the exhaust gas emissions and/or fuel consumption of motorcycles are measured during mode running on a chassis dynamometer. The performance of chassis dynamometer is verified by comparing the measured total running resistance force (measured by a chassis dynamometer absorption force) and the target total running resistance force (calculated from velocity, acceleration and/or deceleration). This International Standard is applicable when the running resistance force of a chassis dynamometer is set in accordance with ISO 11486.

## 2 Terms and definitions

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

**2.1**
**equivalent inertia mass of motorcycle**
$m_i$
mass obtained by adding the rotating mass of the front wheel to the total mass of the motorcycle, rider and instruments

**2.2**
**mechanical equivalent inertia mass of chassis dynamometer**
$m_b$
equivalent inertia mass of mechanical rotating parts of chassis dynamometer, e.g. roller and shaft and/or fly wheel

**2.3**
**chassis dynamometer absorption force**
$F_{dy}$
tangential force acted on the roller surface which is calculated from a roller shaft or motor cradling torque and roller radius

Note 1 to entry: The chassis dynamometer absorption force is the running resistance force for a chassis dynamometer equipped with a mechanical flywheel equivalent inertia mass system and is sum of running resistance force and inertia force generated by motorcycles for a chassis dynamometer using the electric inertia function.

**2.4**
**total friction loss of a chassis dynamometer**
$F_f$
friction and aerodynamic loss of rotating parts of chassis dynamometer, e.g. bearings and roller(s)

**2.5**
**running resistance force**
rolling resistance and aerodynamic loss of motorcycle on flat surface

**2.6**
**inertia force**
force generated by inertia mass of motorcycle or chassis dynamometer during acceleration and/or deceleration

**2.7**
**total running resistance force**
sum of running resistance force and inertia force of motorcycle

**2.8**
**target total running resistance force**
$F_{tg}$
total running resistance force calculated in accordance with equivalent inertia mass of motorcycle, velocity, acceleration and/or deceleration

**2.9**
**measured total running resistance force**
$F_m$
sum of the chassis dynamometer absorption force, total friction loss of chassis dynamometer and an inertia force generated by the mechanical equivalent inertia mass of chassis dynamometer

**2.10**
**target integral work**
$W_{tg}$
integral work calculated in accordance with measured velocity and $F_{tg}$ during test mode running, in kilo joule

**2.11**
**measured integral work**
$W_m$
integral work calculated in accordance with measured velocity and $F_m$ during test mode running, in kilo joule

# 3 Symbols

**Table 1 — Symbols**

| Symbols | Definition | Unit |
|---------|------------|------|
| $A$ | slope of the regression line | — |
| $a$ | rolling resistance of front wheel | N |
| $B$ | intercept of the regression line | — |
| $b$ | coefficient proportional to motorcycle speed | N/(km/h) |
| $c$ | aerodynamic drag coefficient | N/(km/h)$^2$ |
| $e_W$ | integral work error | % |
| $F_{dy}$ | tangential force acted on the roller surface | N |
| $F_f$ | friction and aerodynamic loss of rotating parts of chassis dynamometer | N |
| $F_{tg}$ | target total running resistance force | N |
| $F_{tg,i}$ | the i-th data of $F_{tg}$ data sets | N |
| $F_m$ | measured total running resistance force | N |
| $F_{m,i}$ | the i-th data of $F_m$ data sets | N |
| $m_b$ | equivalent inertia mass of mechanical rotating parts of chassis dynamometer | kg |
| $m_i$ | mass obtained by adding the rotating mass of the front wheel to the total mass of the motorcycle, rider and instruments | kg |
| $T$ | time | s |
| $V$ | roller rotational speed | km/h |
| $W_{tg}$ | target integral work | J |
| $W_m$ | measured integral work | J |

| Symbols | Definition | Unit |
|---|---|---|
| $\gamma$ | correlation coefficient | — |
| $\sigma$ | standard deviation | — |
| $\sigma_{\text{cov}}$ | relative standard deviation (cov: coefficient of variation) | % |

## 4 Verification

### 4.1 Principle

The equivalence between the target and measured total running resistance force is verified by the linear regression statistical analysis. Data combination of target and measured total running force shall be plotted as shown in [Figure 1](#) and the performance of chassis dynamometer shall be evaluated from the slope and intercept of the regression line, correlation coefficient and relative standard deviation.
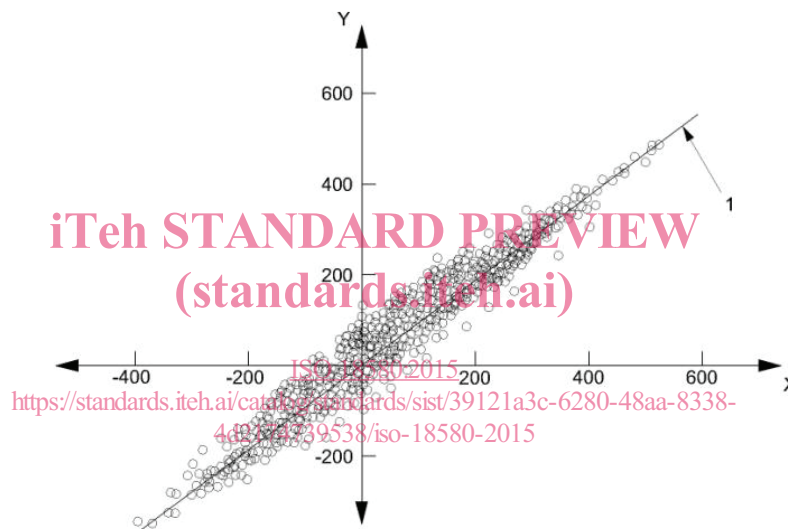


**Key**

1   regression line $A \times F_{\text{tg}} + B$

X   target running resistance force [N]
Y   measured running resistance force [N]

**Figure 1 — Image of relationship between target and measured total running resistance force**

### 4.2 Calculation

**4.2.1**   Data sets of speed, chassis dynamometer absorption force and total friction loss of a chassis dynamometer shall be simultaneously measured during the mode running in a time series. If the total friction loss of a chassis dynamometer cannot be simultaneously measured, the total friction loss shall be determined from the relationship between speed and total friction loss which is obtained prior to the test.

**4.2.2**   Both target and measured total running resistance force shall be calculated from adequate data sets of speed, chassis dynamometer absorption force and total friction loss of a chassis dynamometer by Formulae (1) and (2), respectively.

$$F_{tg} = a + bV + cV^2 + m_i \frac{dV}{dt} \tag{1}$$

$$F_m = F_{dy} + F_f + m_b \frac{dV}{dt} \tag{2}$$

**4.2.3** The relationship between target and measured total running resistance force obtained in 4.2.2 shall be plotted as shown in Figure 1. The slope and intercept of the regression line, correlation coefficient and relative standard deviation shall be calculated in accordance with following formulae using all data sets measured during the mode running.

*A* shall be calculated in accordance with Formula (3).

$$A = \frac{\sum_{i=1}^{n} F_{tg,i}^2 \times \sum_{i=1}^{n} F_{m,i}^2 - \sum_{i=1}^{n}\left(F_{tg,i} \cdot F_{m,i}\right) \times \sum_{i=1}^{n} F_{tg,i}}{n \times \sum_{i=1}^{n} F_{tg,i}^2 - \left(\sum_{i=1}^{n} F_{tg,i}\right)^2} \tag{3}$$

*B* shall be calculated in accordance with Formula (4).

$$B = \frac{n \times \sum_{i=1}^{n}\left(F_{tg,i} \cdot F_{m,i}\right) - \sum_{i=1}^{n} F_{tg,i} \times \sum_{i=1}^{n} F_{m,i}}{n \times \sum_{i=1}^{n} F_{tg,i}^2 - \left(\sum_{i=1}^{n} F_{tg,i}\right)^2} \tag{4}$$

*γ* shall be calculated in accordance with Formula (5).

$$\gamma = \cos\theta = \frac{\text{cov}\left(F_{tg}, F_m\right)}{\sigma_1 \times \sigma_2} \tag{5}$$

where

$$\sigma_1^2 = \frac{\sum_{i=1}^{n}\left(F_{tg,i} - \overline{F_{tg}}\right)^2}{n} \; ;$$

$$\sigma_2^2 = \frac{\sum_{i=1}^{n}\left(F_{m,i} - \overline{F_m}\right)^2}{n} \; ;$$

$$\text{cov}\left(F_{tg}, F_m\right) = \frac{\sum_{i=1}^{n}\left(F_{tg,i} - \overline{F_{tg}}\right)\left(F_{m,i} - \overline{F_m}\right)}{n}$$

where

$$\overline{F}_{tg} = \frac{1}{n} \sum_{i=1}^{n} F_{tg,i}$$

$$\overline{F}_\text{m} = \frac{1}{\text{n}} \sum_{\text{i}=1}^{\text{n}} F_\text{m,i}$$

$\sigma_\text{cov}$ shall be calculated in accordance with Formula (6).

$$\sigma_\text{cov} = \frac{\sigma}{\overline{F}_\text{m}} \times 100 \tag{6}$$

where

$$\sigma = \sqrt{\frac{\sum_{\text{i}=1}^{\text{n}} \left[ E_\text{m,i} - \overline{E_\text{m}} \right]^2}{\text{n}}}$$

$$E_\text{m,i} = F_\text{m,i} - \left( A \times F_\text{tg,i} + B \right)$$

$$\overline{E}_\text{m} = \frac{1}{\text{n}} \sum_{\text{i}=1}^{\text{n}} E_\text{m,i}$$

**4.2.4** The equivalence between the measured and target total running resistance force shall be evaluated by comparison with tolerances of slope and intercept of the regression line, correlation coefficient and relative standard deviation.

**4.2.5** Both target and measured integral work shall be calculated from adequate data sets of speed, chassis dynamometer absorption force and total friction loss of a chassis dynamometer by Formulae (7) and (8), respectively. The integral work error, $e_\text{w}$, shall be calculated in accordance with Formula (9).

$$W_\text{tg} = \frac{1}{3\,600 \times n_\text{sample}} \sum_{\text{i}=1}^{\text{n}} (F_\text{tg,i} \times V_\text{i}) \tag{7}$$

$$W_\text{m} = \frac{1}{3\,600 \times n_\text{sample}} \sum_{\text{i}=1}^{n} (F_\text{m,i} \times V_\text{i}) \tag{8}$$

$$e_\text{w} = \frac{W_\text{m} - W_\text{tg}}{W_\text{tg}} \times 100 \tag{9}$$

where

$n_\text{sample}$   is the number of data measured in one second.

## 5   Procedure

### 5.1   Tools

#### 5.1.1   Data logger

The data logger shall be capable of sampling and logging the signals of the chassis dynamometer roller speed, chassis dynamometer absorption force and chassis dynamometer friction loss at the frequency of at least 50 ms. If the signal of chassis dynamometer friction loss cannot be logged simultaneously, the functions of speed obtained prior to the test shall be used for the verification. The memory capacity for data logging shall be large enough to store all the data during the test cycle. Data conversion system shall be the A/D conversion. It is desirable to use a stand-alone system, while a built-in system is permissible.