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Mopeds — Methods for setting the running resistance on a chassis dynamometer

Cyclomoteurs — Méthodes pour fixer la résistance à l'avancement sur un banc dynamométrique

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Contents

Page

Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 28981 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 23, *Mopeds*.

Introduction

This International Standard is based on ISO 11486:2006[6], which specifies the measurement method(s) for determining motorcycle running resistance on the road, but adapted to the different vehicle category of mopeds. The most significant difference between this International Standard and ISO 11486:2006[6] is that use of chassis dynamometers with a fixed load curve is permitted and a specific verification method is specified.

Mopeds — Methods for setting the running resistance on a chassis dynamometer

1 Scope

This International Standard specifies the measurement method for determining the moped running resistance on the road, and two methods of setting the chassis dynamometer with the moped running resistance. It is applicable to mopeds as defined in ISO 3833.

2 Normative references

The following referenced documents are indispensable for the application 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 3833, *Road vehicles — Types — Terms and definitions*

ISO 7116, *Mopeds — Measurement method for maximum speed*

3 Terms and definitions

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

3.1
running resistance
F
total force resistant to a running moped which, when measured by the coastdown method, includes the friction forces in the drive-train

3.2
reference speed
v_0
moped speed at which the running resistance of the moped is calculated and then used for setting the chassis dynamometer

3.3
specified speed
v
moped speed at which the running resistance on the road is measured to determine the running resistance curve

3.4
moped kerb mass
m_k
moped dry mass to which is added the mass of the following:

— fuel: tank filled at least to 90 % of the capacity specified by the manufacturer;

— oils and coolant: filled as specified by the manufacturer;

— auxiliary equipment usually supplied by the manufacturer in addition to that necessary for normal operation [tool-kit, carrier(s), windscreen(s), protective equipment, etc.]

3.5
moped reference mass
m_{ref}
kerb mass of the moped increased by a uniform figure of 75 kg which represents the mass of a rider

4 Symbols

For the purposes of this document, the symbols in Table 1 apply.

Table 1 — Symbols

Symbols	Definition	Unit
a	The coefficient of polygonal function	—
b	The coefficient of polygonal function	—
c	The coefficient of polygonal function	—
a_T	The rolling resistance force of front wheel	N
b_T	The coefficient of aerodynamic	N/(km/h)^2
d_T	The relative air density under test conditions	—
d_0	The standard ambient relative air density	—
F	The running resistance force	N
F_E	The set running resistance force on the chassis dynamometer	N
$F_E(v_0)$	The set running resistance force at the reference speed on the chassis dynamometer	N
$F_E(v_i)$	The set running resistance force at the specified speed on the chassis dynamometer	N
F_f	The total friction loss	N
$F_f(v_0)$	The total friction loss at the reference speed	N
F_j	The running resistance force	N
$F_j(v_0)$	The running resistance force at the reference speed	N
F_{pau}	The braking force of the power absorbing unit	N
$F_{pau}(v_j)$	The braking force of the power absorbing unit at the specified speed	N
$F_{pau}(v_0)$	The braking force of the power absorbing unit at the reference speed	N
F_T	The running resistance force obtained from the running resistance table	N
F^*	The target running resistance force	N
F^*_j	The target running resistance force at the specified speed	N
$F^*(v_0)$	The target running resistance force at the reference speed on the chassis dynamometer	N
$F^*(v_i)$	The target running resistance force at the specified speed on the chassis dynamometer	N
f_0	The rolling resistance	N
f^*_0	The corrected rolling resistance in the standard ambient conditions	N
f_2	The coefficient of aerodynamic drag	N/(km/h)^2
f^*_2	The corrected coefficient of aerodynamic drag in the standard ambient conditions	N/(km/h)^2
K_0	The temperature correction factor for rolling resistance	—

Table 1 (*continued*)

Symbols	Definition	Unit
m	The test moped mass	kg
m_a	The actual mass of the test moped	kg
m_i	The equivalent inertia mass	kg
m_{fi}	The flywheel equivalent inertia mass	kg
m_k	The moped kerb mass	kg
m_r	The equivalent inertia mass of all the wheels	kg
m_{ref}	The moped reference mass	kg
m_{rid}	The rider mass	kg
m_{rf}	The rotating mass of the front wheel	kg
m_{r1}	The equivalent inertia mass of the rear wheel and the moped parts rotating with the wheel	kg
p_0	The standard ambient pressure	kPa
p_T	The mean ambient pressure during the test	kPa
T_T	The mean ambient temperature during the test	K
T_0	The standard ambient temperature	K
v	The specified speed	km/h
v_j	The specified speeds which are selected for coastdown time measurement	km/h
v_0	The reference speed	km/h
v_1	The speed at which the measurement of the coastdown time begins	km/h
v_2	The speed at which the measurement of the coastdown time ends	km/h
ΔT_E	The corrected coastdown time at the inertia mass ($m_i + m_{r1}$)	s
ΔT_i	The average coastdown time at the specified speed	s
ΔT_j	The average coastdown time of the two tests	s
ΔT_{road}	The target coastdown time	s
Δt	The coastdown time	s
$\overline{\Delta t}$	The mean coastdown time on the chassis dynamometer without absorption	s
Δt_E	The mean coastdown time on the chassis dynamometer at the reference speed	s
Δt_{ai}	The coastdown time measured during the first road test	s
Δt_{bi}	The coastdown time measured during the second road test	s
Δt_i	The coastdown time corresponding to the reference speed	s
Δv	The coastdown speed interval ($2\Delta v = v_1 - v_2$)	km/h
ε	The chassis dynamometer setting error	—
ρ_0	The standard relative ambient air volumetric mass	kg/m^3

5 Test moped, chassis dynamometer and instruments

A full description of the moped shall be provided in accordance with Annex A.

A full description of the chassis dynamometer and instruments shall be provided in accordance with Annex B.

6 Required accuracy of measurements

Measurements shall be made to the accuracies as specified in Table 2.

Table 2 — Required accuracy of measurements

Parameter	At measured value	Resolution
a) Running resistance force, F	+ 2 %	—
b) Moped speed (v_1, v_2)	± 1 %	0,45 km/h
c) Coastdown speed interval [$2\Delta v = v_1 - v_2$]	± 1 %	0,10 km/h
d) Coastdown time (Δt)	± 0,5 %	0,01 s
e) Total moped mass [$m_k + m_{rid}$]	± 1,0 %	1,4 kg
f) Wind speed	± 10 %	0,1 m/s
g) Wind direction	—	5°
h) Ambient temperature	—	2 K
i) Barometric pressure	—	0,2 kPa

7 Road test

7.1 Requirement for road

The test road shall be flat, level, straight and smoothly paved. The road surface shall be dry and free of obstacles or wind barriers that might impede the measurement of the running resistance. The slope of the surface shall not exceed 0,5 % between any two points at least 2 m apart.

7.2 Ambient conditions for the road test

During data collecting periods, the wind shall be steady. The wind speed and the direction of the wind shall be measured continuously or with adequate frequency at a location where the wind force during coastdown is representative.

The ambient conditions shall be within the following limits:

— maximum wind speed: 3 m/s;

— maximum wind speed for gusts: 5 m/s;

— average wind speed, parallel: 3 m/s;

— average wind speed, perpendicular: 2 m/s;

— maximum relative humidity: 95 %;

— air temperature: 278 K to 308 K.

Standard ambient conditions shall be as follows:

— pressure, p_0: 100 kPa;

— temperature, T_0: 293 K;

— relative air density, d_T: 0,919 7;

— air volumetric mass, ρ_0: 1,189 kg/m^3.

The relative air density when the moped is tested, calculated in accordance with the formula below, shall not differ by more than 7,5 % from the air density under the standard conditions.

The relative air density, d_T, shall be calculated by the following formula:

$$d_T = d_0 \times \frac{p_T}{p_0} \times \frac{T_0}{T_T} \quad (1)$$

7.3 Reference speed

The reference speed or speeds shall be as defined in the test cycle.

7.4 Specified speed

The specified speed, v, is required to prepare the running resistance curve. To determine the running resistance as a function of moped speed in the vicinity of the reference speed, v_0, running resistances shall be measured using at least four specified speeds, including the reference speed(s). The range of specified speed points (the interval between the maximum and minimum points) shall extend either side of the reference speed or the reference speed range, if there is more than one reference speed, by at least Δv, as defined in 7.6. The specified speed points, including the reference speed point(s), shall be no greater than 20 km/h apart and the interval of specified speeds should be the same. From the running resistance curve, the running resistance at the reference speed(s) can be calculated.

7.5 Coastdown starting speed

The coastdown starting speed shall be more than 5 km/h above the highest speed at which coastdown time measurement begins, since sufficient time is required, for example to settle the positions of both the moped and rider and to cut the transmitted engine power off before the speed is reduced to v_1, the speed at which the measurement of the coastdown time is started.

7.6 Coastdown time measurement beginning speed and ending speed

To ensure accuracy in measuring the coastdown time, Δt, and coastdown speed interval, $2\Delta v$, the beginning speed, v_1, and ending speed, v_2, in kilometres per hour, the following requirements shall be met:

$$v_1 = v + \Delta v \quad (2)$$

$$v_2 = v - \Delta v \quad (3)$$

Δv shall be 5 km/h when v is less than 60 km/h, and shall be 10 km/h when v is 60 km/h or more.

7.7 Preparation of test moped

7.7.1 The moped shall conform in all its components with the production series, or, if the moped is different from the production series, a full description shall be given in the test report.

7.7.2 The engine, transmission and moped shall be properly run in, in accordance with the manufacturer's requirements.

7.7.3 The moped shall be adjusted in accordance with the manufacturer's requirements, e.g. the viscosity of the oils, tyre pressures, or, if the moped is different from the production series, a full description shall be given in the test report.

7.7.4 The kerb mass of the moped shall be as defined in 3.4.

7.7.5 The total test mass, including the masses of the rider and the instruments, shall be measured before the beginning of the test.

7.7.6 The distribution of the load between the wheels shall be in conformity with the manufacturer's instructions.

7.7.7 When installing the measuring instruments on the test moped, care shall be taken to minimize their effects on the distribution of the load between the wheels. When installing the speed sensor outside the moped, care shall be taken to minimize the additional aerodynamic loss.

7.8 Rider and riding position

7.8.1 The rider shall wear a close-fitting suit (one-piece) or similar clothing, a protective helmet, eye protection, boots and gloves.

7.8.2 The rider in the conditions given in 7.8.1 shall have a mass of 75 kg ± 2 kg and be 1,75 m ± 0,02 m tall.

7.8.3 The rider shall be seated on the seat provided, with his feet on the footrests and his arms normally extended. This position shall allow the rider at all times to have proper control of the moped during the coastdown test.

The position of the rider shall remain unchanged during the whole measurement period.

7.9 Measurement of coastdown time

7.9.1 After a warm-up period, the moped shall be accelerated to the coastdown starting speed, at which point the coastdown measurement procedure shall be started.

7.9.2 Since it can be dangerous and difficult from the viewpoint of its construction to have the transmission shifted to neutral, the coasting may be performed solely with the clutch disengaged. For those mopeds that have no way of cutting off the transmitted engine power prior to coasting, the moped may be towed until it reaches the coastdown starting speed. When the coastdown test is reproduced on the chassis dynamometer, the transmission and clutch shall be in the same condition as during the road test.

For safety reasons, a quick release device to be operated by the rider of the moped should be provided.

7.9.3 The moped steering shall be altered as little as possible and the brakes shall not be operated until the end of the coastdown measurement period.

7.9.4 The first coastdown time, Δt_{ai}, corresponding to the specified speed, v_j, shall be measured as the elapsed time from the moped speed $v_j + \Delta v$ to $v_j - \Delta v$.

7.9.5 The procedure from 7.9.1 to 7.9.4 shall be repeated in the opposite direction to measure the second coastdown time, Δt_{bi}.

7.9.6 The average ΔT_i of the two coastdown times Δt_{ai} and Δt_{bi} shall be calculated by the following equation:

$$\Delta T_i = \frac{\Delta t_{ai} + \Delta t_{bi}}{2} \tag{4}$$

7.9.7 At least four tests shall be performed and the average coastdown time, ΔT_j, calculated by the following equation:

$$\Delta T_j = \frac{1}{n}\sum_{i=1}^{n} \Delta T_i \tag{5}$$