BS ISO 7116:2011

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Mopeds — Measurement method for determining maximum speed

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National foreword

This British Standard is the UK implementation of ISO 7116:2011.

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

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Mopeds — Measurement method for determining maximum speed

Cyclomoteurs — Méthode de mesure pour déterminer la vitesse maximale

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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.

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 7116 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 23, *Mopeds*.

This third edition cancels and replaces the second edition (ISO 7116:1995), which has been technically revised.

Introduction

In this third edition of ISO 7116, all the test methods and conditions, such as accuracy of measuring system and climatic conditions, are reviewed and updated for the purpose of obtaining measurement results with higher accuracy.

The test method and conditions on circle type test tracks, which are used in several regions, are also revised substantially in view of the similarity with testing results on straight test tracks.

Mopeds — Measurement method for determining maximum speed

1 Scope

This International Standard specifies a method for determining the maximum speed of a moped 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 6726, *Mopeds and motorcycles with two wheels — Masses — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO 6726 and the following apply.

3.1
maximum speed
v_{max}
highest steady speed of test moped

3.2
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;

— auxiliary equipment usually supplied by the manufacturer in addition to that necessary for normal operation

EXAMPLES Tool-kit, carrier(s), windscreen(s), protective equipment, etc.

4 Symbols

Table 1 — Symbols

Symbols	Definition	Unit
A_{len}	accuracy of measurement equipment of the measurement section length	m
A_{speed}	resultant accuracy of speed measurement	%
A_{time}	accuracy of time measurement equipment	s
d_T	relative air density during the test	—
d_0	relative air density at the standard reference conditions	—
e_{speed}	resultant speed measurement error of system	km/h
L_{st}	length of the measurement section of type 1, type 3 and type 5 test tracks	m
L_{st1}	length of the measurement section 1 of type 2 and type 4 test tracks	m
L_{st2}	length of the measurement section 2 of type 2 and type 4 test tracks	m
p_T	total barometric pressure during test	kPa
p_0	total barometric pressure at standard reference conditions	kPa
T_T	air temperature during test	K
T_0	air temperature at standard reference conditions	K
t	time to run the measurement section	s
t_a	time to run the measurement section in direction a	s
t_b	time to run the measurement section in direction b	s
t_i	time to run the measurement section test run i	s
v	moped speed	km/h
v_{ave}	average speed of moped of two-direction tests	km/h
v_i	moped speed test run i	km/h
v_{max}	maximum speed of test moped	km/h
ρ_0	air volumetric mass	kg/m^3

5 Standard reference conditions

The standard reference conditions shall be as follows:

a) total barometric pressure, p_0: 101,325 kPa;

b) air temperature, T_0: 293,15 K;

c) relative humidity, H_0: 65 %;

d) air volumetric mass, ρ_0: 1,205 kg/m^3;

e) relative air density, d_0: 0,931 9.

6 Preparation of test moped

6.1 The moped shall conform in all its parts and components with the production series or, if different, a full description of such differences shall be included in the test report.

6.2 The fuel feed, ignition devices and the viscosity of the oils for the moving mechanical parts shall be in accordance with the instructions given by the moped manufacturer.

6.3 The lubricants shall be those prescribed by the manufacturer; the fuel shall be the commercial grade for the type of moped tested.

6.4 The moped engine and transmission shall be properly run in, according to the manufacturer's instructions.

6.5 Before the test, all moped parts shall be stabilized at the normal temperature for the moped in use.

6.6 The test moped mass shall be the moped kerb mass.

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

6.8 When installing the measurement instruments on the moped, care shall be taken to minimize their effects on the distribution of the load between the wheels and the additional aerodynamic loss.

6.9 Tyres shall be inflated to the pressure specified by the manufacturer.

7 Rider and riding position

7.1 The rider shall wear a close-fitting suit, a protective helmet, eye protection, boots and gloves.

7.2 The rider in the conditions given in 7.1 shall have a mass of 75 kg $\pm$ 2 kg and be 1,75 m $\pm$ 0,02 m tall.

7.3 The rider shall take the normal and safe riding position which is appropriate for attaining the maximum speed of the moped to be tested. The position shall allow the rider at all times to have proper control of the moped during the test. The position of the rider shall remain as stable as possible in order to avoid any influence on the test results. The description of the position shall be given in the test report or may be replaced with photographs (either during motion or in a static position).

8 Measurement equipment and accuracies

8.1 Measurement equipment

Test equipment to measure the moped speed and the ambient atmospheric conditions shall be as follows:

a) electronic time counter or equivalent time measurement system;

b) photoelectric cell or equivalent sensor;

c) measurement equipment for the distance between photoelectric cells;

d) thermometer;

e) barometer;

f) humidity meter;

g) anemometer.

The photoelectric cell and electronic time counter system, or the equivalent system, shall be used to measure the moped speed. Care shall be taken with the set-up adjustment of photoelectric cells or equivalent sensors (e.g. height of the sensors and the crossing point of the photo-beam and the moped) so that the required accuracy of the length of measurement section is secured. The details of the system shall be given in the test report if the equivalent system is used.

The function and accuracy of the test equipment shall be checked before use in the test.

8.2 Measurement accuracies

8.2.1 Accuracy of speed measurement system

The error of measured moped speed is influenced by the total time to run the measurement section(s), t, the length of the measurement section(s), L_{st}, the accuracy of the time measurement equipment, A_{time}, and the accuracy of measurement equipment of the measurement section length, A_{len}.

The length of the measurement section shall be chosen with reference to instrument accuracy and to the method of determining the running time, such that the actual speed is measured to an accuracy of ±1 %.

The accuracy of measurement equipment (e.g. the tape measure or the surveying instrument) of the measurement section(s) length, A_{len}, shall be given in the test report.

The accuracy of time measurement equipment, A_{time}, is determined by the accuracy of the electronic time counter system itself and the response time of the photoelectric cell sensor. A_{time} shall be given in the test report.

8.2.2 Measurement accuracy of ambient atmospheric conditions

The accuracies of equipment used to measure the ambient atmospheric conditions shall be in accordance with Table 2.

Table 2 — Accuracy

Parameter	At measured value	Resolution
Wind speed	±10 %	0,1 m/s
Wind direction	—	5°
Ambient temperature	—	1 K
Barometric pressure	—	0,2 kPa
Humidity	±5 %	1 %

9 Test tracks

9.1 General requirements

The test shall be carried out on a roadway that allows the maximum speed to be maintained over a measurement section(s) as defined in 9.2. The entry section of the measurement section shall have the same surface and longitudinal profile as the measurement section and be long enough to permit the moped to attain its maximum speed.

The test track shall be flat, level and smoothly paved. The road surface shall be dry and free of obstacles or wind barriers that might impede the measurement of the maximum speed. The test track shall have not more than 0,5 % longitudinal slope and not more than 3 % transverse slope, excluding the deceleration section(s).

The difference in altitude between any two points on the measurement section shall not exceed 1 m. However, the slope to compensate the centrifugal force of loop type and circle type test tracks may be allowed.

The shape and dimensions of the test track and the location of the measurement section(s) shall be given in the test report or replaced by the figure.

9.2 Composition

The test track shall consist of the following sections:

a) the acceleration section to reach maximum speed;

b) the maximum speed measurement section;

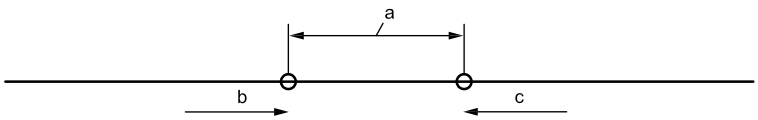
c) the deceleration section to safely stop the test moped.

9.3 Possible shapes and specific requirements

9.3.1 The straight type test track

9.3.1.1 Type 1

The measurement section as shown in Figure 1 shall be located on the straight track. The acceleration sections to the left and right of the measurement section shall be long enough to enable maximum speed to be attained at the measurement section.

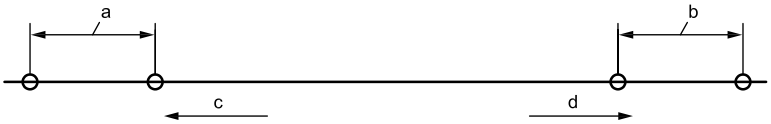


a Measurement section.
b Direction of moped, a.
c Direction of moped, b.

Figure 1 — Test track type 1

9.3.1.2 Type 2

The two measurement sections, 1 and 2, whose lengths may be different, as shown in Figure 2, shall be located at each end of the straight test track, and in a virtually straight line.



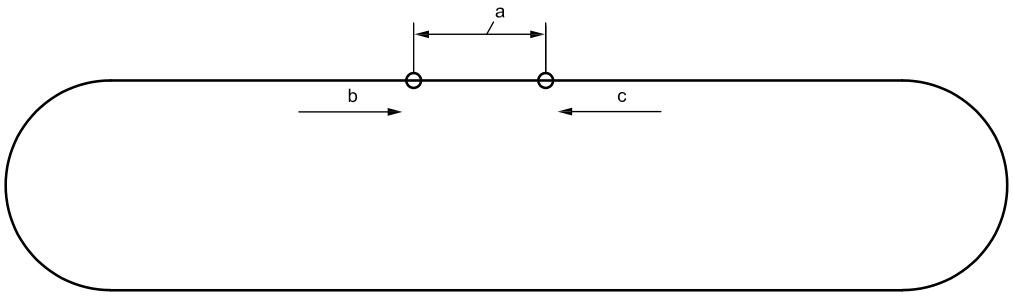
a Measurement section 1.
b Measurement section 2.
c Direction of moped, a.
d Direction of moped, b.

Figure 2 — Test track type 2

9.3.2 The loop type test track

9.3.2.1 Type 3

The measurement section as shown in Figure 3 shall be located on the straight part of the loop track. The straight track lengths to the left and right of the measurement section shall be long enough to enable maximum speed to be attained at the measurement section.



a Measurement section.

b Direction of moped, a.

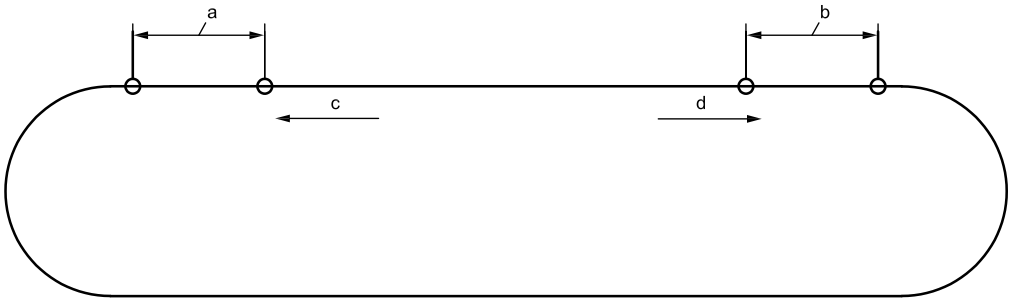
c Direction of moped, b.

Figure 3 — Test track type 3

9.3.2.2 Type 4

The two measurement sections, 1 and 2, whose lengths may be different, as shown in Figure 4, shall be located at each end of the straight test part, and in a virtually straight line.

The straight part before the measurement section shall be long enough to enable maximum speed to be attained at the measurement section.



a Measurement section 1.

b Measurement section 2.

c Direction of moped, a.

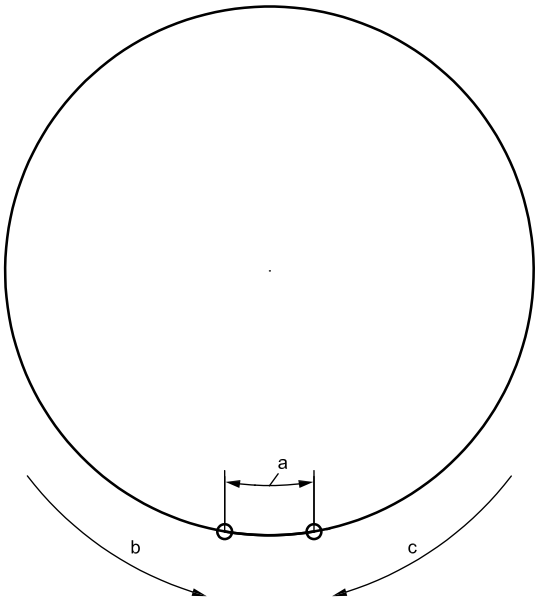
d Direction of moped, b.

Figure 4 — Test track type 4

9.3.3 The circle type test track

9.3.3.1 Type 5

The measurement section shall be an arc shape with a constant radius as shown in Figure 5 and the measurement section length, L_{st}, shall be measured along the test moped path or shall be geometrically calculated from the chord length.



a Measurement section.

b Direction of moped, a.

c Direction of moped, b.

Figure 5 — Test track type 5

9.3.3.2 Requirements for type 5 test track

For maximum speed measurement on the circle type test track, track 5, the following conditions shall be met:

a) the radius of the test track shall be large enough to allow the moped to attain the maximum speed;

b) the test moped shall trace a line that enables it to attain its maximum speed without extra weight shift effort by the rider;

c) the maximum speed shall be measured only on one measurement section.

NOTE The measurement section length may be extended to the entire test track circumference provided all applicable tolerances are met. For this lap test, it is strongly advised to pay special attention to ensure that the climatic conditions specified in Clause 10 are satisfied all over the measurement section if wider variation in those conditions is anticipated in each location of the test track.

10 Atmospheric conditions

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 testing is representative.

Atmospheric conditions shall be within the following limits:

a) average wind speed: 3 m/s;

b) maximum wind speed for gusts: 5 m/s;

c) for the single-direction test, except for the lap test on the type 5 test track, the parallel component of wind speed: 1 m/s;

d) maximum relative humidity: 95 %;

e) air temperature: 278 K to 308 K;

f) atmospheric pressure: 90 kPa to 110 kPa.

The relative air density during the test shall not differ by more than 7,5 % from the air density under the standard reference conditions. The relative air density, d_T, shall be calculated using Equation (1).

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

11 Test procedure and calculation of average speed

11.1 General requirements

11.1.1 The gear ratio that allows the moped to attain its maximum speed on the level shall be used. The throttle control shall be held fully open and any manually operated devices for enriching the mixture shall be fully deactivated.

11.1.2 The rider shall maintain the riding position defined in 7.3.

11.1.3 The moped shall have attained its maximum speed by the time it arrives at the measurement section(s). If it is necessary to confirm whether the acceleration section is long enough for the moped to reach the maximum speed or not, the length of the acceleration section shall be verified. Two examples of the verification method are given in Annex A.

11.1.4 The maximum speed measurement shall be made by the two-direction test specified in 11.2. However, in the case where the two-direction runs are not permitted by the test course regulation or for other unavoidable reasons, the single-direction test specified in 11.3 shall be applied.

11.2 Measurement

11.2.1 The moped shall be run in both directions, a and b consecutively, and the times, t_a and t_b, to run the measurement sections in both directions shall be measured.

11.2.2 The time difference between the test run in each direction, $|t_a - t_b|$, shall not differ by more than 5 % of t_a or t_b, whichever is greater.

11.2.3 For type 1, type 3 and type 5 test tracks, the average speed, v_{ave}, of the test run in each direction shall be calculated using Equation (2).

$$v_{ave} = \frac{3{,}6 \times 2L_{st}}{t_a + t_b} \quad (2)$$

For type 2 and type 4 test tracks, v_{ave}, shall be calculated using Equation (3).

$$v_{ave} = \frac{3{,}6 \times \left(L_{st1} + L_{st2}\right)}{t_a + t_b} \tag{3}$$

The calculation result shall be rounded to one decimal place.

11.2.4 For type 1, type 3 and type 5 test tracks, the resultant speed measurement error of system, e_{speed}, shall be calculated using Equation (4).

$$e_{speed} = \frac{3{,}6\left(L_{st} + A_{len}\right)}{\left(\frac{t_a + t_b}{2}\right) - A_{time}} - \frac{3{,}6\left(L_{st} - A_{len}\right)}{\left(\frac{t_a + t_b}{2}\right) + A_{time}} \tag{4}$$

For type 2 and type 4 test tracks, e_{speed} shall be calculated using Equation (5).

$$e_{speed} = \frac{3{,}6\left(L_{st1} + A_{len}\right)}{t_a - A_{time}} - \frac{3{,}6\left(L_{st2} - A_{len}\right)}{t_b + A_{time}} \tag{5}$$

11.2.5 The resultant accuracy of speed measurement, A_{speed}, shall be calculated using Equation (6), and shall be less than 2 %.

$$A_{speed} = \frac{e_{speed}}{v_{ave}} \times 100 \tag{6}$$

11.2.6 At least three average speed data shall be obtained. All data shall be within 1,5 % of the arithmetical average of the average speeds or within 1 km/h, whichever is greater. Additional test(s) shall be conducted until a data set of three average speeds which satisfies the criteria is obtained.

11.3 Single-direction test

11.3.1 The single-direction test may only be applied in the case where the two-direction runs are not permitted by the test course regulation or for other unavoidable reasons.

11.3.2 For the single-direction test, type 1, type 3 and type 5 test tracks may be used.

11.3.3 The moped shall be run in one direction consecutively and times, t_i, to run the measurement section shall be measured at least five consecutive times.

11.3.4 The speed for each run, v_i, shall be calculated using Equation (7) and shall be rounded to one decimal place.

$$v_i = \frac{3{,}6 \times L_{st}}{t_i} \tag{7}$$

11.3.5 The resultant speed measurement error of system, e_{speed}, shall be calculated using Equation (8).

$$e_{speed} = \frac{3{,}6\left(L_{st} + A_{len}\right)}{t_i - A_{time}} - \frac{3{,}6\left(L_{st} - A_{len}\right)}{t_i + A_{time}} \tag{8}$$

11.3.6 The resultant accuracy of speed measurement, A_{speed}, shall be calculated using Equation (9) and shall be less than 2 %.

$$A_{speed} = \frac{e_{speed}}{v_i} \times 100 \tag{9}$$

11.3.7 At least five speed data shall be obtained. All data shall be within 1,5 % of the arithmetical average of the measured speeds or within 1 km/h, whichever is greater. Additional test(s) shall be conducted until a data set of five speeds which satisfies the criteria is obtained.

12 Presentation of results

12.1 The maximum speed

The maximum speed of the moped, v_{max}, shall be the arithmetical average of v_{ave} or v_i measured during the consecutive tests and shall be rounded to the nearest whole number.

12.2 Test report

The presentation of test results shall be as given in Annex B.

Annex A
(informative)

Procedure for determining the acceleration distance

A.1 General

This annex gives two examples to determine an appropriate acceleration distance to ensure that the moped is running at a steady maximum speed. One is the acceleration distance changing method and the other is the continuous speed monitoring method.

A.2 Test conditions

A.2.1 Preparation of test moped

The moped shall be prepared in accordance with Clause 6.

A.2.2 Rider and riding position

The rider and riding position shall be as specified in Clause 7.

A.2.3 Atmospheric conditions

The atmospheric conditions specified in Clause 10 shall be applied.

A.3 Test procedure

A.3.1 The acceleration distance changing method

A.3.1.1 General

In this method, the acceleration distance is increased by an increment length and the moped speed is measured at each acceleration distance until the moped reaches its maximum speed.

A.3.1.2 Measurement equipment and accuracies

The measurement equipment specified in Clause 8 shall be used.

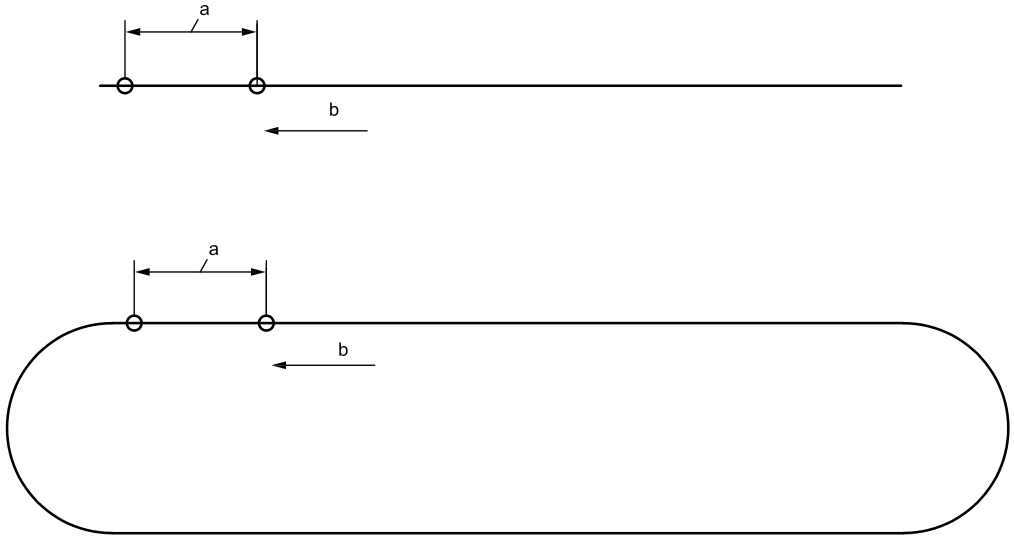
A.3.1.3 Test track

The test track shall be in accordance with 9.3.1 or 9.3.2.

The straight type track shall be used whenever possible. When the loop type track is used for the test, the measurement section shall be located at the end of the straight part of the test track and the corner of the loop track shall be used only for the acceleration and deceleration.

For both test tracks, the length of track shall be long enough to enable maximum speed to be attained.

The measurement section as shown in Figure A.1 shall be located at the end of the straight track or the straight part of the loop track. The length of track shall be determined such as to allow the moped to stop safely after the measurement section.



a Measurement section.

b Direction of moped.

Figure A.1 — Test tracks

A.3.1.4 Determination of the increment length of acceleration distance

The acceleration distance shall be increased by the same increment length. The minimum increment length shall be 50 m.

A.3.1.5 Test procedure for the acceleration distance changing method

A.3.1.5.1 The photoelectric cell and the electronic time counter system or equivalent system shall be set over the measurement section.

A.3.1.5.2 The moped shall be accelerated as quickly as possible.

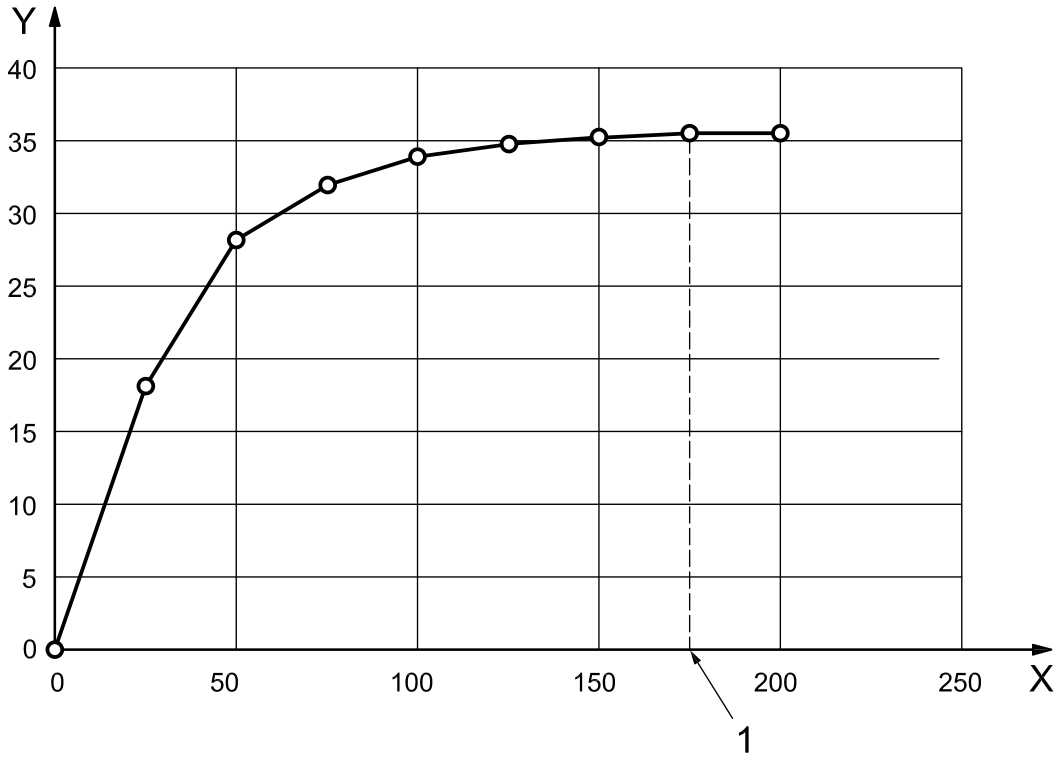
A.3.1.5.3 Time, t, to run the measurement section, L_{st}, shall be measured and the moped speed, v, shall be calculated using Equation (A.1).

$$v = \frac{3{,}6 L_{st}}{t} \tag{A.1}$$

A.3.1.5.4 The acceleration distance shall be increased by the increment length and at least three acceleration distances shall be tested consecutively.

A.3.1.5.5 When the measured moped speed is equal to or less than the speed of the immediately prior measurement, the acceleration distance of the prior measurement shall be adopted as the necessary minimum distance.

An example of determination procedure is shown in Figure A.2.



Key

X acceleration distance in metres

Y speed in kilometres per hour

1 necessary minimum acceleration distance

Figure A.2 — Example of relationship between moped speed and acceleration distance in the case of an incremental length of 50 m

A.3.2 The continuous speed monitoring method

A.3.2.1 General

In this method, the moped speed is continuously measured until the moped attains its maximum speed in order to obtain the relationship between the moped speed and acceleration distance.

A.3.2.2 Measurement equipment and accuracies

The speed measurement equipment that can measure the moped speed continuously or with sufficient frequency, e.g. GNSS (Global Navigation Satellite System) or a non-contact type speed meter etc., shall be used. The measurement tolerance of speed shall be within 1 km/h.

A.3.2.3 Test track

The test track shall be as specified in 9.3.1 or 9.3.2.

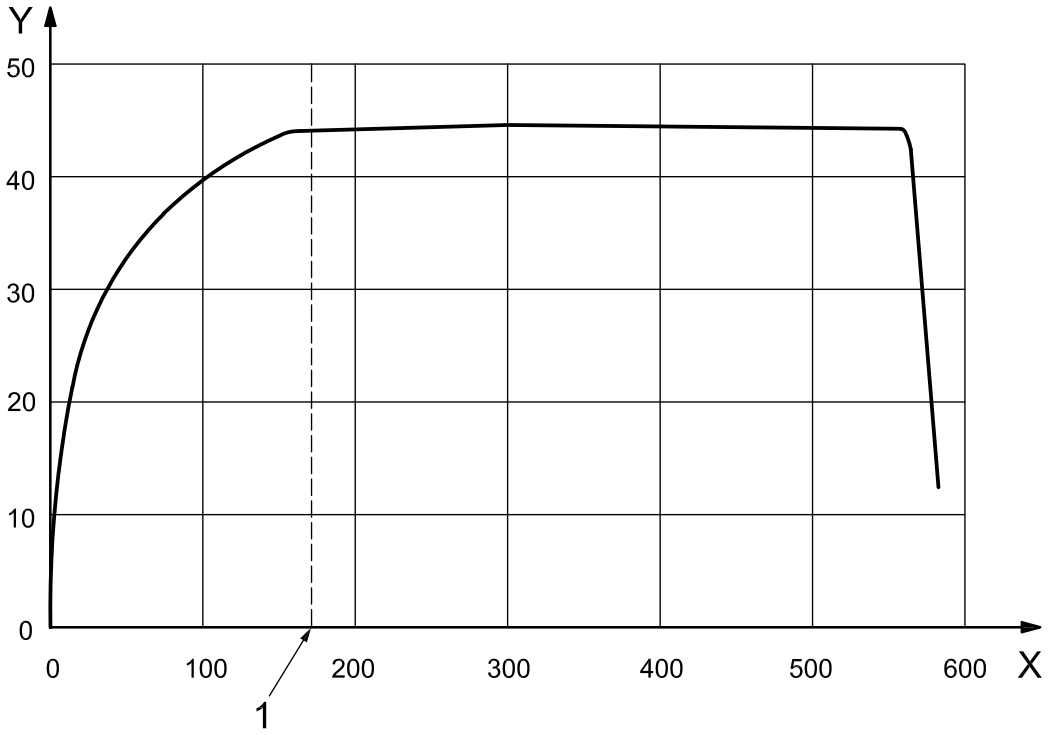
The straight type track shall be used whenever possible. When the loop type track is used for the test, the maximum speed shall be measured in the straight part and the corner part shall be used only for the acceleration and deceleration.

A.3.2.4 Test procedure for the continuous speed monitoring method

A.3.2.4.1 The moped shall be accelerated as quickly as possible.

A.3.2.4.2 The moped speed shall be measured continuously and the speed shall be plotted as a function of acceleration distance (see Figure A.3).

A.3.2.4.3 The acceleration distance for the speed saturation point shall be adopted as the necessary minimum distance.



Key

X acceleration distance in metres
Y speed in kilometres per hour
1 necessary minimum acceleration distance

Figure A.3 — Example of test results of the continuous speed monitoring method

Annex B
(normative)

Presentation of results of maximum speed

B.1 Moped

Category: two-wheeler / three-wheeler (*delete as applicable*)

Trade name (-mark): .....

Model: .....

Engine model: .....

Cycle: two-stroke / four-stroke (*delete as applicable*)

Number and layout of cylinders: .....

Engine displacement: ..... cm^3

Gear-box: manual / automatic (*delete as applicable*)

Number of gear ratios (speeds): .....

Drive ratios: — primary: ..... — final: .....

Mileage accumulated at test: ..... km

Moped kerb mass: ..... kg

Onboard instruments mass (if applicable): ..... kg

Others, if there is any alteration: .....

B.2 Test fuel

Test fuel: .....

Mixed with lubrication oil: yes / no (*delete as applicable*)

If yes, the volume ratio of fuel to lubrication oil: .....

B.3 Speed measurement system

Trade name (-mark) of electronic time counter system: .....

Model of electronic time counter system: .....

Trade name (-mark) of photoelectric cells: .....

Model of photoelectric cells: .....

Others: .....

Details of system, if the equivalent system is used: .....

B.4 Test track type

Test track type: type1 / type 2 / type 3 / type 4 / type 5 (*delete as applicable*)

Test procedure: two-direction test / single-diction test (*delete as applicable*)

Description of the shape and dimensions of test track and the location of measurement section(s): .....

.....

B.5 Acceleration distance, measurement section length and accuracies

Acceleration distance: ..... m

Measurement accuracy of acceleration distance: ..... m

Measurement section length: ..... m ..... m

Accuracy of measurement equipment of the measurement section length, A_{len}: ± ..... m

Accuracy of time measurement equipment, A_{time}: ± ..... s

B.6 Rider

Rider height: ..... m

Rider weight: ..... kg

Description or photograph(s) of riding position: .....

B.7 Test conditions

Date: ...../...../.....

Place of the test: .....

Climate: .....

Atmospheric dry-bulb temperature: Start ..... K End ..... K

Atmospheric wet-bulb temperature: Start ..... K End ..... K

Humidity: Start ..... % End ..... %

Atmospheric pressure: Start ..... kPa End ..... kPa

Average wind speed: ..... m/s

Maximum wind speed for gust: ..... m/s

Gear: .....

B.8 Test results

If the test is carried out by the single-direction test, B.8.1 shall be omitted; if the test is carried out by the two-direction test, B.8.2 shall be omitted.

B.8.1 Two-direction test

		Time		Moped speed	
First run	Direction a:	.....	s	.....	km/h
	Direction b:	.....	s	.....	km/h
	Average speed:			.....	km/h
Second run	Direction a:	.....	s	.....	km/h
	Direction b:	.....	s	.....	km/h
	Average speed:			.....	km/h
Third run	Direction a:	.....	s	.....	km/h
	Direction b:	.....	s	.....	km/h
	Average speed:			.....	km/h

B.8.2 Single-direction test

	Time		Moped speed		Parallel component of wind speed	
First run	.....	s	.....	km/h	.....	m/s
Second run	.....	s	.....	km/h	.....	m/s
Third run	.....	s	.....	km/h	.....	m/s
Forth run	.....	s	.....	km/h	.....	m/s
Fifth run	.....	s	.....	km/h	.....	m/s

B.8.3 Maximum speed

Maximum speed: ..... km/h

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[1] ISO 3833, *Road vehicles — Types — Terms and definitions*

[2] ISO 7117, *Motorcycles — Measurement method for determining maximum speed*

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