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Mopeds — Measurement method for moments of inertia

Cyclomoteurs — Méthode de mesure des moments d'inertie

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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 9043 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 23, *Mopeds*.

This second edition cancels and replaces the first edition (ISO 9043:1991), which has been technically revised.

Introduction

The stability of a moped is a very important element of its active safety. The moped/rider combination and the environment in which this combination is used form a unique closed-loop system. However, the evaluation of moped/rider combination stability is extremely complex because of interaction of the intrinsic moped stability, the influence of the position of the rider and his response to continuously changing conditions.

In the evaluation of moped stability, the determination of the kinetic characteristics of the moped/rider combination is considered an important part of the design parameters of the vehicle itself.

The test procedure described in this International Standard deals with one aspect of the kinetic characteristics: the determination of the moments of inertia of the moped and of the moped/rider combination.

Mopeds — Measurement method for moments of inertia

1 Scope

This International Standard specifies a measuring method for determining the moments of inertia of the moped and of the moped/rider combination. It applies to two-wheeled mopeds.

Other measuring methods can be used if it is demonstrated that the results are equivalent.

Measurement results obtained exclusively by the method described in this International Standard (see Annex A) cannot be used for an evaluation of vehicle stability because they deal with only one aspect of this very complex phenomenon.

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 3779, *Road vehicles — Vehicle identification number (VIN) — Content and structure*

ISO 8705, *Mopeds — Measurement method for location of centre of gravity*

49 CFR Part 572 Subpart B [*Code of Federal Regulations*, issued by the National Highway Traffic Administration (NHTSA)]

3 Terms and definitions

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

3.1
moped-fixed axis system (x, y, z)
right-hand orthogonal axis system fixed in the moped, such that when the moped is moving in a straight line on a level road, the x-axis is substantially horizontal, points forwards and is in the longitudinal plane of symmetry of the moped, the y-axis points to the rider's left side and the z-axis points upwards

NOTE 1 This coordinate system performs translation motion and rotational motion together with the moped.

NOTE 2 Assuming that the moped is fixed to a platform, the coordinate system is also applied to the platform.

3.2
earth-fixed axis system (X, Y, Z)
right-hand orthogonal axis system fixed on the Earth, such that the X-axis and the Y-axis are in a horizontal plane and the Z-axis points upwards

4 Measurement conditions

4.1 Measurement conditions for a moped shall be as follows:

a) the moped shall be quite clean and free from mud and deformation, and shall operate normally;

b) the fuel shall be filled up to the top level specified in the operation manual;

c) lubricating oil and cooling water, for water-cooled engines, shall be filled up to the level specified in the operation manual;

d) tyre pressure shall be as specified in the operation manual;

e) tools shall be provided at the regular storage positions;

f) front and rear suspension systems shall be fixed at a static position;

g) the front wheel shall be positioned along the x-axis.

If the conditions are to be modified depending on the object of measurement, the modified conditions shall be recorded in the measurement results (see Annex A).

4.2 Measurement conditions when a rider is on the moped shall be as follows:

a) measurement conditions of the moped shall be as specified in 4.1;

b) a test dummy as specified in 49 CFR Part 572 Subpart B (or equivalent), with a mass of 73,4 kg, or an equivalent human being, shall be used as the rider;

c) the rider shall be positioned as follows:

1) positioned on the vertical centre surface of the moped;

2) sitting on the seat, holding the handle bar by both hands, with both feet placed on the foot rests;

3) with an angle of posture formed by the line connecting the point S (indicating the centre of rotation of the torso and the arms of the rider) and point H (indicating the centre of rotation of the torso and femoral regions of the rider) and the x-axis;

4) at a seating position that is the distance between the front axle and the point H along the x-axis.

However, if the conditions are to be modified depending on the object of measurement, the modified conditions shall be recorded in the measurement results (see Annex A).

5 Measuring instruments

Measuring instruments to measure the moments of inertia shall be as follows or shall have equivalent functions and accuracy:

a) a precision square level that can measure up to 0,1 mm/1 m (≈20”);

b) a steel tape measure with a tolerance of $\pm [0{,}3 + 0{,}1(L - 1)]$ mm at the length of L m;

c) weighing stands with enough accuracy to weigh the object up to 0,1 kg;

d) a stop watch that can measure up to 0,01 s, used for measuring the oscillation time;

e) a platform with the highest possible rigidity, and of light weight;

f) a knife edge, where the roundness at the edge shall be below 1 mm in radius, and an edge angle below 90 degrees is recommended;

NOTE The roundness at the edge is the form of the edge finished sharply when rounded with the load.

g) weights, to incline the platform.

6 Measuring procedure

6.1 Measurement of location of centre of gravity

Calculate the mass and location of centre of gravity of the platform, moped, and the platform with the moped placed on it, in accordance with ISO 8705.

6.2 Roll moment of inertia about x-axis (physical pendulum principle)

6.2.1 Roll moment of inertia about AB-axis for empty platform

Inertia moment about the AB-axis for the empty platform shall be measured in the procedure described below (see Figure 1).

a) Place the knife edges A and B on the stay so that they can freely oscillate around the AB-axis.

b) Oscillate the platform gently around the AB-axis. It is desirable to keep total oscillating angle below 5°.

c) Make sure that the platform oscillates in a stable way and measure the time required for the platform to oscillate 50 times by a stop watch. Repeat this process 3 times and obtain the average value of 3 average cycle times. The result shall be the period.

d) Calculate the inertia moment of the platform about the AB-axis, I_{xp}, expressed in kgm^2, using Equation (1):

$$I_{xp} = \left(\frac{T_{xp}}{2\pi}\right)^2 \sqrt{c_p^2 + y_p^2}\, m_p g \tag{1}$$

where

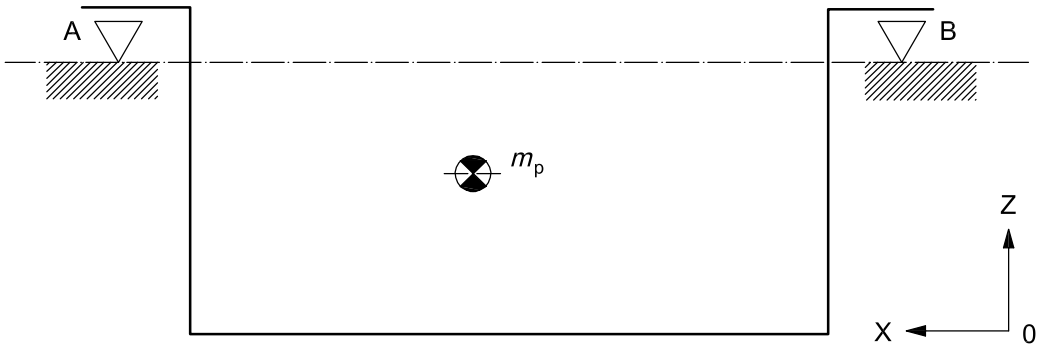
T_{xp} is the period for the platform to oscillate around the AB-axis, in s;

c_p is the distance along the z-axis from the knife edge to the centre of gravity of the platform, in m;

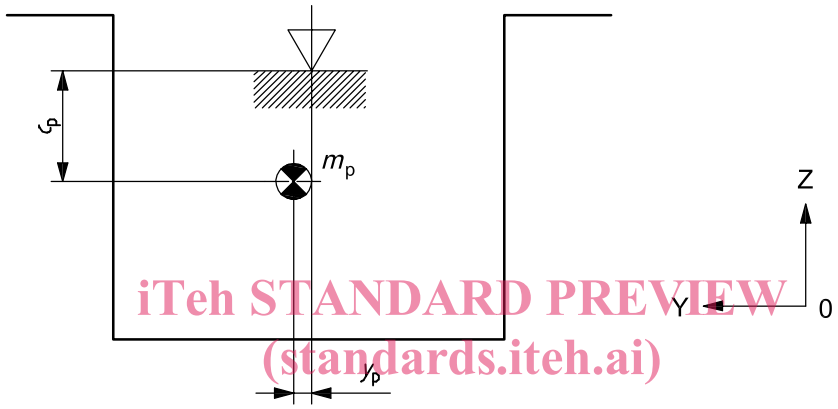
y_p is the distance along the y-axis from the knife edge to the centre of gravity of the platform, in m;

m_p is the mass of the platform, in kg;

g is acceleration due to gravity (9,81 m/s^2).



a) Side view



b) Rear view

Key

c_p distance along the z-axis from the knife edge to the centre of gravity of the platform

m_p mass of platform

y_p distance along the y-axis from the knife edge to the centre of gravity of the platform

Figure 1 — Measurement procedure for roll moment of inertia of empty platform (procedure with physical pendulum principle)

6.2.2 Roll moment of inertia of moped about x-axis

Roll moment of inertia of the moped about the x-axis shall be measured in the procedure described below (see Figure 2).

NOTE This measurement applies to both the empty moped and the moped with a rider.

a) Place the moped on the platform and fix it so that it cannot move. The lateral inclination angle of the moped to the platform shall be 0° ± 0,5°.

b) Place the knife edges A and B on the stay so that they can freely oscillate around the AB-axis.

c) Oscillate the moped/platform combination gently around the AB-axis. It is desirable to keep total oscillating angle below 5°.

d) Make sure that the platform oscillates in a stable way and measure the time required for the platform to oscillate 50 times by a stop watch. Repeat this process 3 times and obtain the average value of 3 average cycle times. The result shall be the period.

e) Calculate the inertia moment of the moped about the x-axis, I_{xm}, expressed in kgm^2, using Equation (2):

$$I_{xm} = \left(\frac{T_{xT}}{2\pi}\right)^2 \sqrt{{c_T}^2 + {y_T}^2}\, m_T g - I_{xp} - m_m \left({c_m}^2 + {y_m}^2\right) \qquad (2)$$

where

T_{xT} is the period for the platform with the moped on it to oscillate around the AB-axis, in s;

c_T is the distance along the z-axis from the knife edge to the centre of gravity of the moped/platform combination, in m;

y_T is the distance along the y-axis from the knife edge to the centre of gravity of the moped/platform combination, in m;

m_T is the mass of moped/platform combination, in kg;

I_{xp} is the inertia moment of the platform about the AB-axis, in kgm^2 [see Equation (1)];

g is acceleration due to gravity (9,81 m/s^2);

m_m is the mass of moped, in kg;

c_m is the distance along the z-axis from the knife edge to the centre of gravity of the moped, in m;

y_m is the distance along the y-axis from the knife edge to the centre of gravity of the moped, in m.