INTERNATIONAL STANDARD

ISO 9043

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Mopeds — Measurement method for moments of inertia

Cyclomoteurs — Méthode de mesure des moments d'inertie

Reference number
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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.

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.

International Standard ISO 9043 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Sub-Committee SC 23, *Mopeds*.

Annex A forms an integral part of this International Standard.

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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 the 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 to be 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.

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Mopeds — Measurement method for moments of inertia

1 Scope

This International Standard specifies a measurement method for determining the moments of inertia of the moped and of the moped/rider combination.

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

The measurement results obtained by the method given in this International Standard alone (see annex A) cannot be used for an evaluation of the vehicle stability because they deal with only one aspect of this very complex phenomenon.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3779:1983, *Road vehicles — Vehicle identification number (VIN) — Content and structure.*

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

3 Equipment

3.1 The moped shall be placed on a platform that is as light as possible, while being sufficiently rigid.

3.2 The moped shall be fixed on the platform in such a way that the sprung mass keeps the position obtained under the condition quoted in item 1.11 in annex A, when the moped mounted on the platform is swung about the pivots.

3.3 The rider shall be simulated by an anthropomorphic test dummy[1].

3.4 The dummy shall be fixed on the moped by means of a rigid restraint jig.

4 Definition of axis systems

4.1 The moped axis system (x, y, z) is a 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. The y-axis points to the rider's left side and the z-axis points upwards.

4.2 The earth-fixed axis system (X, Y, Z) is a right-hand orthogonal axis system fixed on the Earth. The X- and Y-axes are in a horizontal plane and the Z-axis points upwards.

5 Position of dummy

5.1 The hands of the dummy shall be on the steering handlebar grips and the feet shall be on the footrests in such a way that the front part of the heel touches the footrest and the foot is at 90° ± 5° to the lower leg.

In the case of a moped with platform, the position of the feet shall be in accordance with the requirements of the manufacturer.

1) Test dummy as specified in 49 CFR Part 572, subpart B, or equivalent.

5.2 The projection of the position of the dummy on the *xz* plane shall be defined by

— measuring the angle *A* between the *x*-axis and the line drawn from the knee pivot to the bottom of the heel;

— measuring the angle *B* between the *x*-axis and the line drawn from the shoulder pivot to the H-point.

6 Position of moped

The roll angle of the moped in relation to the platform shall be zero with a tolerance of ± 0,5°.

7 Measuring procedure

7.1 Abbreviations and symbols

The following abbreviations and symbols are used in 7.2 to 7.4:

RMP	Rider/Moped/Platform combination
MP	Moped/Platform combination
P	Platform
RM	Rider/Moped combination
M	Moped
m	Mass, in kilograms
T	Period, in seconds
i	RMP, MP, P, as appropriate
j	RM, M, as appropriate
g	acceleration due to gravity, in metres per second squared

NOTE 1 Further symbols are explained in the respective figures.

7.2 Roll moment of inertia about *x*-axis

The roll moment of inertia, I, in kilograms metre squared, about the *x*-axis may be calculated from the following equation (see figure 1):

$$I_{xxj} = \left(\frac{T_{jP}}{2\pi}\right)^2 \sqrt{c'^2_{jP} + d'^2_{jP}}\; m_{jP} g - \left(\frac{T_P}{2\pi}\right)^2 \sqrt{c'^2_P + d'^2_P}\; m_P g - m_j\left(c'^2_j + d'^2_j\right)$$

7.3 Pitch moment of inertia about *y*-axis

The pitch moment of inertia, I, in kilograms metre squared, about the *y*-axis may be calculated from the following equation (see figure 2):

$$I_{yyj} = \left(\frac{T_{jP}}{2\pi}\right)^2 \sqrt{c^2_{jP} + d^2_{jP}}\; m_{jP} g - \left(\frac{T_P}{2\pi}\right)^2 \sqrt{c^2_P + d^2_P}\; m_P g - m_j\left(c^2_j + d^2_j\right)$$

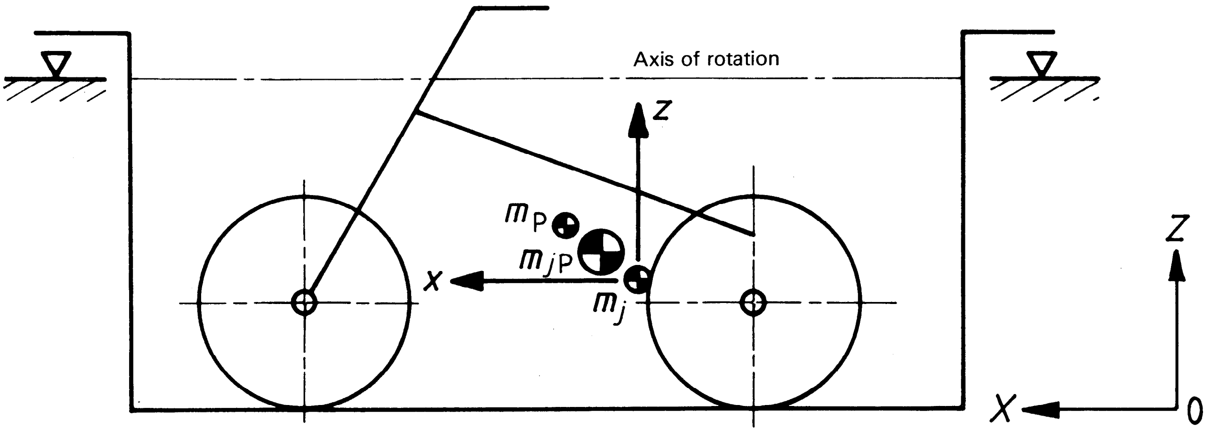
7.4 Yaw moment of inertia about *z*-axis

The yaw moment of inertia, I, in kilograms metre squared, about the *z*-axis may be calculated from the following equation (see figure 3):

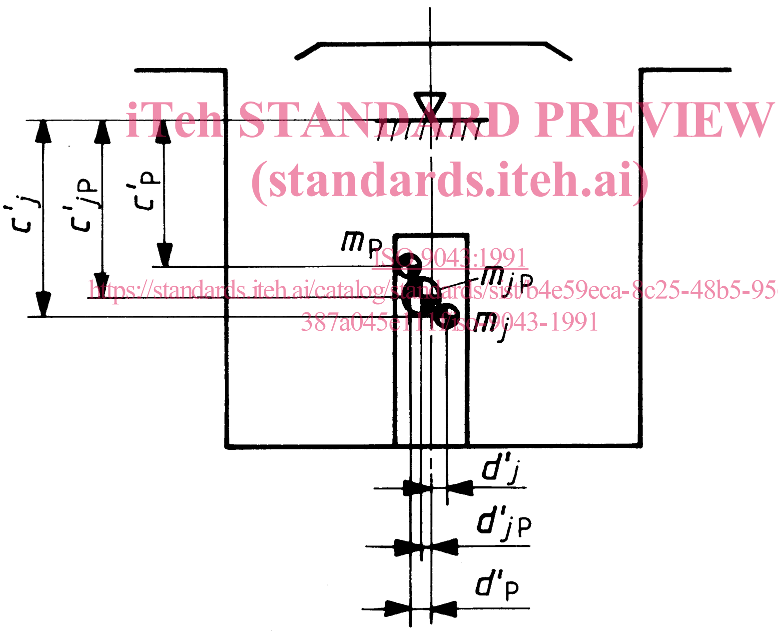
$$I_{zzj} = \left(\frac{T_{jP}}{2\pi}\right)^2 \frac{m_{jP} g a_{jP1} a_{jP2}}{l} + m_{jP} d'^2_j - \left(\frac{T_P}{2\pi}\right)^2 \times \frac{m_P g (a_{jP1} - d'_P)(a_{jP2} + d'_P)}{l} - m_P (d'_P + d'_j)^2$$

8 Test results

Test results shall be presented as indicated in annex A.

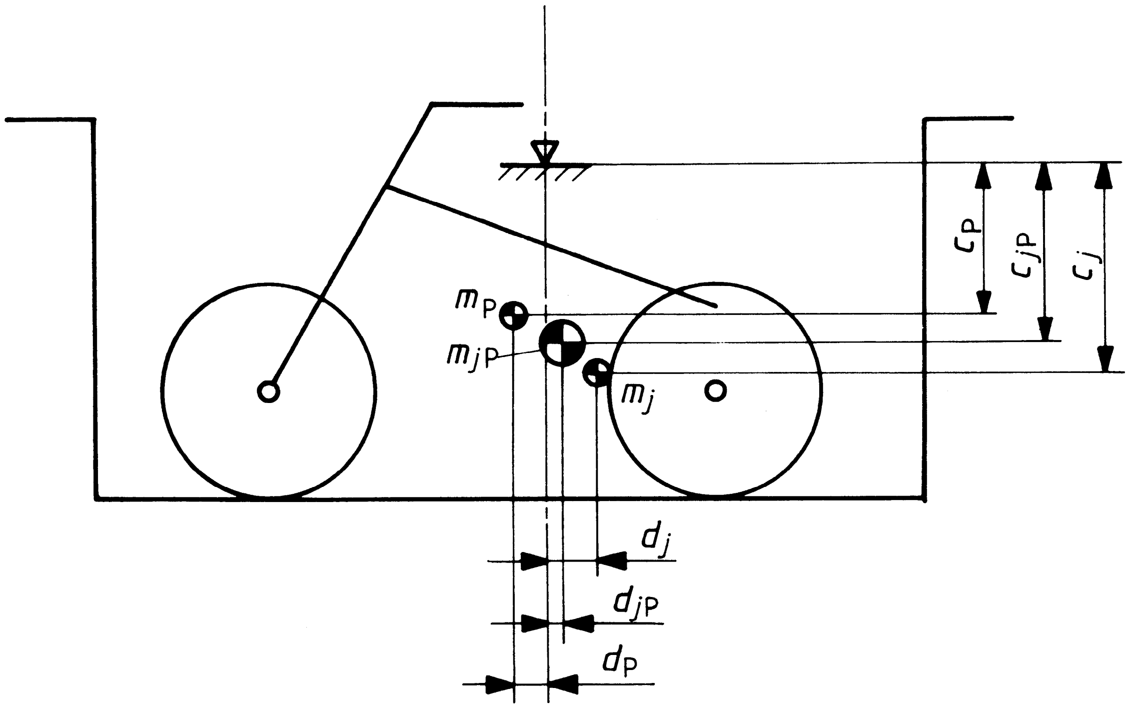


a) Side view

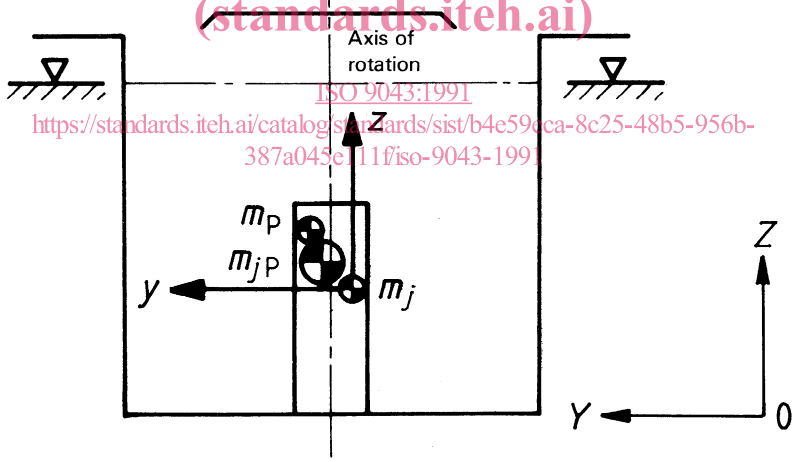


b) Rear view

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



a) Side view



b) Rear view

Figure 2 — Measurement procedure for pitch moment of inertia (procedure with physical pendulum principle using platform)

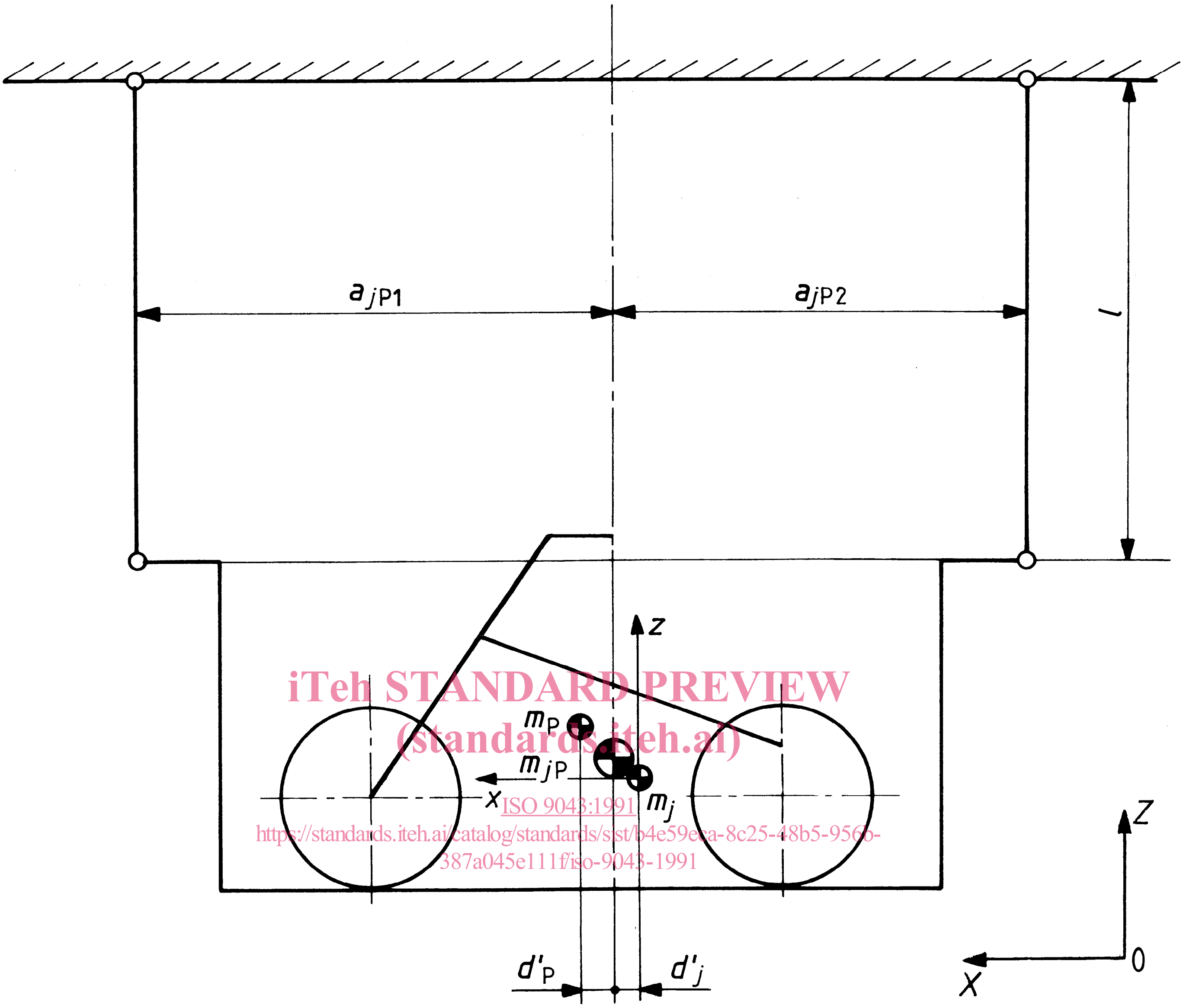


Figure 3 — Measurement procedure for yaw moment of inertia (procedure with bifilar pendulum principle using platform) — Side view