

# INTERNATIONAL STANDARD

**ISO**  
**13326**

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## Test methods for measuring tyre uniformity

*Méthodes de mesure de l'uniformité du pneumatique*



## 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 13326 was prepared by Technical Committee ISO/TC 31, *Tyres, rims and valves*.

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International Organization for Standardization  
Case postale 56 • CH-1211 Genève 20 • Switzerland  
Internet [iso@iso.ch](mailto:iso@iso.ch)

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# Test methods for measuring tyre uniformity

## 1 Scope

This International Standard specifies test methods carried out under controlled conditions for verifying the uniformity of tyres for passenger cars, commercial vehicles and motorcycles.

NOTE — Lack of uniformity around a tyre produces variations in forces applied by the tyre to the vehicle and this influence is repeated with each revolution of the tyre. At the present state of the art, however, it is impossible to manufacture perfectly uniform tyres. A rigid control of the complete manufacturing process can only minimise the unavoidable imperfections of materials, components and processes affecting uniformity.

Methods for measuring the geometrical run-out of the tyre in both radial and lateral directions are covered, as well as methods for measuring the following parameters:

- radial force variation;
- lateral force variation;
- ply steer;
- conicity.

Not all of these measurements will necessarily be relevant in every situation.

This International Standard does not include methods for measuring the static and the dynamic unbalance nor methods related to tyre-wheel assemblies.

The test methods specified in this International Standard are not intended for the gradation of tyres or the definition of quality levels.

## 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 revisions and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4000-1:1995, *Passenger car tyres and rims — Part 1: Tyres (metric series)*.

ISO 4000-2:1994, *Passenger car tyres and rims — Part 2: Rims*.

ISO 4209-1:1993, *Truck and bus tyres and rims (metric series) — Part 1: Tyres*.

ISO 4209-2:1993, *Truck and bus tyres and rims (metric series) — Part 2: Rims*.

ISO 4223-1:1989, *Definitions of some terms used in the tyre industry — Part 1: Pneumatic tyres*.

ISO 4249-1:1985, *Motorcycle tyres and rims (Code designated series) — Part 1: Tyres*.

ISO 4249-2:1990, *Motorcycle tyres and rims (Code-designated series) — Part 2: Tyre load ratings.*

ISO 4249-3:1997, *Motorcycle tyres and rims (code-designated series) — Part 3: Rims.*

ISO 5751-1:1994, *Motorcycle tyres and rims (metric series) — Part 1: Design guides.*

ISO 5751-2:1994, *Motorcycle tyres and rims (metric series) — Part 2: Tyre dimensions and load-carrying capacities.*

ISO 6054-1:1994, *Motorcycle tyres and rims (code-designated series) — Diameter codes 4 to 12 — Part 1: Tyres.*

ISO 6054-2:1990, *Motorcycle tyres and rims (Code-designated series) — Diameter codes 4 to 12 — Part 2: Rims.*

ISO 8855:1991, *Road vehicles — Vehicle dynamics and road-holding ability — Vocabulary.*

IEC 60654-1:1993, *Industrial-process measurement and control equipment — Operating conditions — Part 1: Climatic conditions.*

VIM:1993, *International vocabulary of basic and general terms in metrology*, BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML.

### 3 Definitions

For the purposes of this International Standard, the definitions given in ISO 4223-1, ISO 8855, VIM and the following apply.

#### NOTES

1 See figure 1 for the axis reference system.

2 Also refer ISO 4000-1, ISO 4000-2, ISO 4209-1, ISO 4209-2, ISO 4249-1, ISO 4249-2, ISO 4249-3, ISO 5751-1, ISO 5751-2, ISO 6054-1 and ISO 6054-2.

#### 3.1 uniformity

state in which any characteristic of the tyre is constant in phase and magnitude in both static and dynamic conditions around the circumference

NOTE — Uniformity is concerned with axis symmetry of mass distribution, geometry and forces generated when the solid is in motion.

Lack of uniformity in a tyre, when it is rotating around its axis, causes variations of forces, which may vary with the angular speed and are applied to the said axis.

#### 3.2 peak to peak (total)

difference between the maximum and the minimum values of measurement signal, within a specified bandwidth, during one revolution

#### 3.3 first harmonic

peak to peak amplitude of the fundamental frequency component of the Fourier transform representing the variation

NOTE — Its frequency is equal to the frequency of rotation.

#### 3.4 second (and higher order) harmonic

peak to peak amplitude of the second (or higher order) frequency component of the Fourier transform representing the variation

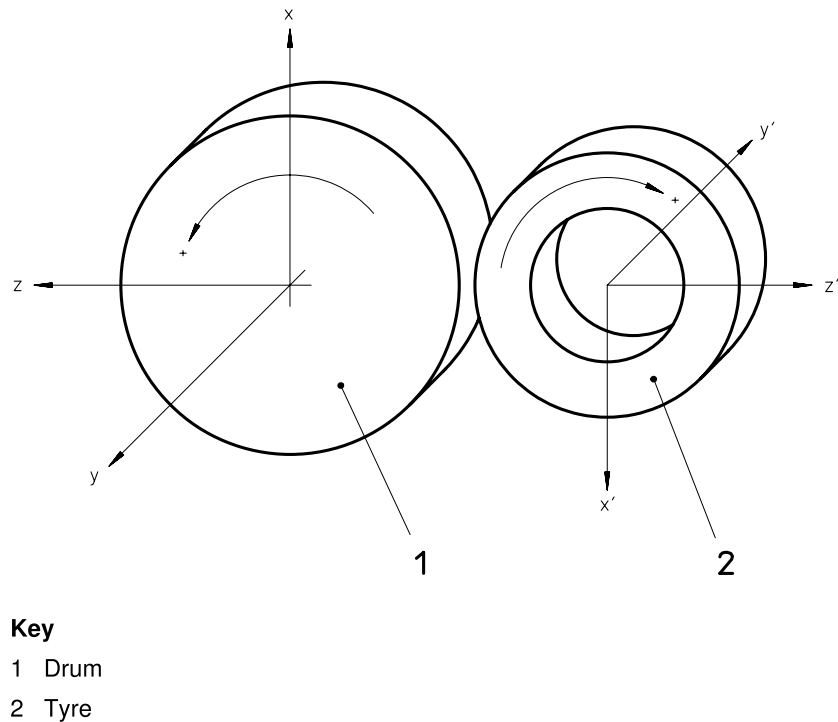


**Figure 1 — Reference axis system for forces**

### 3.5 Forces

#### 3.5.1

##### radial force variation

$$\Delta F_R$$

value of the variation of the force in the radial direction (Z axis) of a loaded tyre which repeats itself for each revolution at a fixed loaded radius and a constant speed, in newtons

#### 3.5.2

##### lateral force variation

$$\Delta F_L$$

value of the variation of the force in the lateral direction (Y axis) of a loaded tyre which repeats itself for each revolution at a fixed loaded radius and a constant speed, in newtons

#### 3.5.3

##### lateral force offset

##### lateral force deviation

$$\bar{F}_L$$

average value of the lateral force of a loaded straight free-rolling tyre, in newtons

#### 3.5.4

##### ply steer

component of the lateral force offset which changes sign with a change in the direction of rotation, in newtons

#### 3.5.5

##### conicity

component of the lateral force offset which does not change sign with a change in the direction of rotation, in newtons

**3.5.6****tangential force variation****tractive force variation**

$$\Delta F_T$$

value of the variation of the force in fore and aft direction (X axis) of a loaded tyre which repeats itself for each revolution at a fixed loaded radius and a constant speed, in newtons

NOTE — Measurement of this parameter is not covered by this International Standard.

**3.6 Geometry****3.6.1****tyre radial run-out**

variation of the tyre radius measured perpendicularly to the spin axis on a circumference along the tread surface, excluding the influence of the various grooves and vents located on the tread, in millimetres

**3.6.2****tyre lateral run-out**

variation of the distance from a fixed reference plane, normal to the spin axis, of a given tyre sidewall at a given distance from said axis, excluding the influence of the lettering and other markings on the sidewall, in millimetres

**3.6.3****test rim radial run-out**

variation of the wheel radius measured perpendicularly to the spin axis on a circumference along the bead seat, in millimetres

NOTE — It is measured separately for each bead seat.

**3.6.4****test rim lateral run-out**

variation of the distance from a fixed reference plane, perpendicular to the spin axis, of the inside vertical portion of the rim flange at a given distance from said axis, in millimetres

NOTE — It is measured separately for each rim flange.

**3.7 Mass distribution****3.7.1****unbalance**

**static unbalance** (3.7.2) or **dynamic unbalance** (3.7.3) or both

**3.7.2****static unbalance**

product ( $m \times e$ ) of the mass  $m$  of the tyre times the eccentricity  $e$  of its centre of gravity, expressed in gram millimetres

**NOTES**

1 When the tyre is spun at an angular velocity  $\omega$ , the static unbalance generates a centrifugal force  $F_z$  normal to the rotational axis, given by:

$$F_z = m \times e \times \omega^2$$

2 A pneumatic tyre is actually a deformable solid, which means that the distribution of mass, and therefore the eccentricity of the centre of gravity, may vary with the rotational speed. Therefore in practice it should be assumed that  $e$  is a function of  $\omega$ .

**3.7.3****dynamic unbalance**

the product  $(I_a - I_d) \times \alpha$  of the axial inertia  $I_a$  minus the diametrical inertia  $I_d$  times the misalignment  $\alpha$  between the tyre main inertia axis and the tyre rotation axis, measured on a tyre running freely, expressed in gram square millimetres