INTERNATIONAL STANDARD

ISO 13326

First edition
1998-12-15

Test methods for measuring tyre uniformity

Méthodes de mesure de l'uniformité du pneumatique

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

Reference number
ISO 13326:1998(E)

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*.

Annex A of this International Standard is for information only.

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

© ISO 1998

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed in Switzerland

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.

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

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.

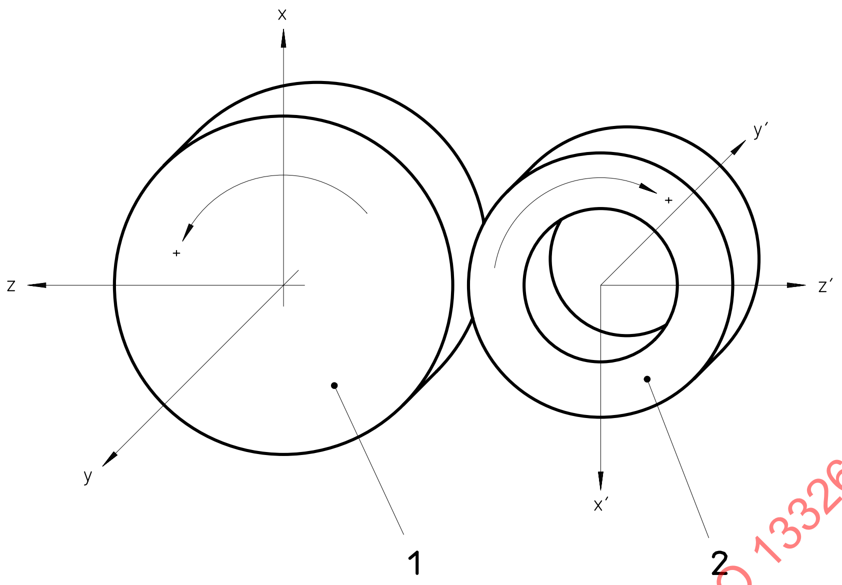
3.2
peak to peak (total)
difference between the maximum and the minimum values of measurement signal, within a specified bandwidth, during one revolution

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

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998



Key

1 Drum

2 Tyre

Figure 1 — Reference axis system for forces

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

3.5 Forces

3.5.1
radial force variation
ΔF_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
ΔF_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
$\overline{F}_L$
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
ΔF_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.

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

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 ω, 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 ω.

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 α between the tyre main inertia axis and the tyre rotation axis, measured on a tyre running freely, expressed in gram square millimetres

NOTES

1 When the tyre is spun at a constant angular velocity ω, the dynamic unbalance generates a bending moment M, perpendicular to the rotation axis given by:

$$M = (I_a - I_d) \times \sin\alpha \times \omega^2$$

where $\sin\alpha$ is approximated by α.

2 A pneumatic tyre is actually a deformable solid, which means that I_a and I_d, and therefore the relative positions of their axes in space, may vary with the rotational speed. In practical terms it should be assumed that I_a and I_d are functions of ω.

3.8
phase
angular orientation of the tyre related to a reference point

3.9
direction of rotation
direction of rotation as perceived from the operating position

See figure 1.

NOTE — Positive rotation of the drum is assumed to be a rotation around the Y axis, when the Z axis moves clockwise onto the X axis.

3.10
test drum
rotating cylindrical flywheel

4 Test equipment and its requirements

4.1 Apparatus for measurement of forces and geometry

4.1.1 General

4.1.1.1 The equipment for the measurement of forces and geometry shall include

- an axle or spindle supporting a rim on which the tyre may be readily mounted,
- a test drum, the axis of which is parallel to said axle,
- a means for loading the tyre against the drum (or pushing the drum against the tyre) at a specified force and/or for holding a fixed tyre-to-drum axis distance during measurements,
- equipment to measure the force components in the radial (Z axis) and lateral (Y axis) directions while the tyre and the drum are rotated at prescribed speed, and
- optionally, means for rapid inflation and deflation of the tyre and for control of inflation pressure during rotation.

4.1.1.2 The parallelism of the two axes of rotation shall be kept below

0,25 mm/m when loaded with a radial force (Z axis) of 10 kN and a lateral force of 500 N if the apparatus is equipped with a test drum of type A (preferred outer diameter 854 mm),

0,5 mm/m when loaded with a radial force (Z axis) of 40 kN and a lateral force of 2 kN if the apparatus is equipped with a test drum of type B (preferred outer diameter 1 600 mm).

NOTE — It is desirable that the parallelism between drum and tyre axes be 0,17 mm/m maximum under no load, when the absolute values of lateral force offset are made equal, by adjusting the fitting angle detectors, in order to correct the errors caused by axis parallelism, interference and fitting accuracy of the detectors. The outer surface of the drum may be used as reference in place of the drum axis.

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

4.1.1.3 Rotational torque should preferably be applied from the tyre axis; alternatively it may be from the drum axis.

There should be provisions for both clockwise and counter clockwise directions of rotation.

4.1.1.4 The equipment shall be capable of rotating tyres at a rotational frequency of at least 10 r/min and not higher than 250 r/min during the measuring operations.

4.1.2 Structural resonant frequencies

The supporting structure and components of the machine shall be so designed that the influence of natural frequencies, within the measurement frequency range, does not alter the measured parameters more than 10 %.

4.1.3 External vibrations

Sufficient isolation of the equipment shall be provided in order to minimise the influence of the environment on measured parameters.

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

4.2 Test drum

4.2.1 The preferred outer diameters of the drum are:

854 mm for type A, and

1 600 mm for type B.

NOTE — The actual specified outer diameter can be comprised between:

830 mm and 1 000 mm (reference being 854 mm) for type A, and

1 520 mm and 1 710 mm (reference being 1 600 mm) for type B .

If other drum diameters are used, their correlation with the preferred diameters is to be checked.

4.2.2 The run-out of the outer surface of the drum, as measured at a reference band, shall be less than

0,05 mm when using type A test drum, and

0,1 mm when using type B test drum.

4.2.3 The unbalance of the test drum, which is critical in case forces are measured at the drum axis, shall remain less than the values given in table 1.

Table 1

Test drum	Residual unbalance of the test drum	
	Static, kg·mm	**Dynamic**, kg·mm²
Type A	< 5	< 500
Type B	< 50	< 5 000

4.2.4 The width of the drum surface shall be greater than the footprint of the tyre tested.

4.2.5 The drum shall be provided with a high-friction coarse-textured outer surface in order to prevent lateral forces generated during the measurement from causing the tyre to skid on the drum.

4.3 Test rim

4.3.1 The rim width shall be equal to that of one of the rims permitted by 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, and preferably equal to the measuring rim width.

4.3.2 The specified diameter and the inner contour of the test rim for the measurement of forces and/or geometry shall generally conform to the standard diameter and contour, but some modifications of the contour may be required to facilitate mounting, dismounting and proper seating of the tyre beads for repeatable data.

Wheels having special contours for bead retention (e.g. humps, etc.) shall be avoided.

4.3.3 The rims shall be sufficiently rigid to ensure that deflection in any direction at the bead seat, when operating under load, is less than 0,125 mm.

4.3.4 The rims shall have a peak-to-peak run-out at the bead seats, in both radial (bead seat portion) and axial (inner surface of flange) directions, when installed with normal piloting on the apparatus, less than the values given in table 2.

Table 2

Equipment	Peak-to-peak run-out mm
Type A drum	≤ 0,05
Type B drum	< 0,1

4.3.5 The difference in diameter on the two bead seats of the test rim shall not exceed the values given in table 3.

Table 3

Equipment	Difference in diameter mm
Type A drum	< 0,1
Type B drum	< 0,2

4.3.6 The bead seats shall be turned and polished; the two surfaces shall be symmetrical with respect to the equatorial plane of the wheel within the values given in table 4.

Table 4

Equipment	Surface symmetry limits mm
Type A drum	± 0,05
Type B drum	± 0,1

4.3.7 The unbalance of the test rim, which is critical in case forces are measured at the rim axis, shall remain below the values given in table 5.

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

Table 5

Test drum	Residual unbalance of the test rim	
	Static, kg·mm	**Dynamic**, kg·mm^2
Type A	< 1	< 100
Type B	< 10	< 1000

4.4 Measuring system

4.4.1 A system of appropriate design, which includes transducers for the development of output signals, is required to isolate and detect the components of the various uniformity characteristics of tyres.

4.4.2 The transducers may be placed either between the structure supporting the tyre and the tyre (on the test rim axis) or between the structure supporting the drum and the drum (on the drum axis).

4.4.3 A matching calibration system is required for calibration of force and geometry measuring systems.

4.4.4 The measuring system may contain a position marker to indicate the angular orientation of the tyre relative to the force signals that it produces.

4.4.5 The measuring system shall be capable of measuring, in the Y and Z main directions, the force variation ranges given in table 6.

Table 6

Equipment	Force variation range N
Type A drum	⩾1000
Type B drum	⩾3000

4.5 Tyre inflation and deflation

The equipment may include means for rapid inflation and deflation of the tyre and for control of the inflation pressure during the rotation of the equipment.

4.6 Optional instrumentation

Optional instrumentation may include equipment for

— indicating peak-to-peak values of the components of force variations,

— measuring the amplitude and phase of the first ten harmonics of the components of force variations,

— tyre inflation pressure monitoring and control.

4.7 Ambient conditions

Temperature, pressure and humidity shall be in accordance with category B2 of IEC 60654-1. Acceleration of gravity shall be known with the required accuracy in case the calibration process of the apparatus requires weights.

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

5 Testing

NOTE — The following operations are not intended to be an operational guide. All operations are not compulsory, and their order may be changed.

5.1 Preparation of the tyre for measurement

5.1.1 Room temperature shall be controlled between 5 °C and 40 °C. If the tyre temperature is not within the 5 °C to 40 °C range, leave the tyre in the ambient until its temperature falls between the above values.

5.1.2 Mount the tyre on the test rim (preferably having the same width as the measuring rim standardized for the tyre size designation) and inflate it to the pressure specified for the test.

5.1.3 Suitable mounting methods shall be applied in order to ensure proper bead seating. Such methods may require that a suitable lubricant be applied onto the tyre, or onto the rim or both, prior to assembling the tyre and the rim.

5.1.4 Care should be taken that both the tyre and the drum are free of surface contamination such as oil and dirt.

5.1.5 If needed, a suitable warm-up procedure shall be followed to ensure that local distortions in the structure of the tyre due to packaging and shipping are reduced to an acceptable level.

5.2 Measurement of forces

5.2.1 The apparatus shall be equipped with an appropriate test drum, depending on the type of tyre to be measured, in accordance with table 7.

Table 7

Type of tyre	Test drum
Tyres for motorcycles	type A
Tyres for passenger cars	type A
Tyres for commercial vehicles having load capacity index for single application ⩽ 121	type A or type B
Tyres for commercial vehicles having load capacity index for single application ⩾ 122	type B[1)]

1) A type A test drum may also be used provided that the measuring system is capable of measuring force variations of at least 3000 N (see table 6).

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

5.2.2 Prepare and mount the tyre on the test rim.

5.2.3 Inflate the tyre and adjust the inflation pressure of the tyre to the prescribed value, depending on the type of tyre, in accordance with table 8.

Table 8

Type of tyre	**Inflation pressure**[1)] kPa
Tyres for motorcycles	200
Tyres for passenger cars	200[2)]
Tyres for commercial vehicles with load capacity index for single application ⩽ 121	200 or 350[3)]
Tyres for commercial vehicles with load capacity index for single application ⩾ 122	450 or 600 or 700

1) The inflation pressure shall be chosen on the basis of the reference pressure assigned for the maximum tyre load carrying capacity and shall be recorded.

2) 207 kPa may also be used.

3) 300 kPa and 320 kPa may also be used.

NOTE — The above test pressures have been arbitrarily selected in order to standardize the measuring procedures. They represent the values currently used by the tyre industry.

5.2.4 Adjust the inflation pressure to one of the prescribed values immediately prior to starting measurements.

5.2.5 Adjust the axis-to-axis spacing of the rolling tyre and drum to provide a predetermined tyre deflection.

This spacing shall lead approximately to the same tyre deflection as on a flat surface of the tyre inflated with the value of inflation pressure corresponding to the maximum tyre load carrying capacity for single applications and loaded with said load carrying capacity.

NOTE — Where expanded load/pressure tables are available the above spacing shall correspond approximately to the deflection on a flat surface of the tyre inflated with the selected prescribed value of test inflation pressure (see 5.2.3) and loaded with the load carrying capacity for single applications corresponding to that inflation pressure.

5.2.6 Rotate the tyre at a constant angular velocity, with zero camber and zero slip angle and record this velocity (in revolutions per minute).

5.2.7 Measure, and record if necessary, the radial and/or lateral force, as a function of phase if necessary, for at least one complete revolution of the tyre.

NOTE — Measurements should not be performed during transient period when signals are stabilizing. Proper stabilization times, depending on the sensors' technology and on the physics of measurement, should be observed before any measurement is recorded.

Figure 2 gives examples of the diagrams of the forces.

5.2.8 Reverse the direction of the tyre rotation and repeat the measurements.

NOTE — Dismounting the tyre from the rim and mounting it again on the rim but showing the other sidewall towards the operator is a permitted alternative.

5.2.9 The following parameters may be recorded, as needed:

— test rim width;

— drum diameter;

— the tyre inflation pressure.

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

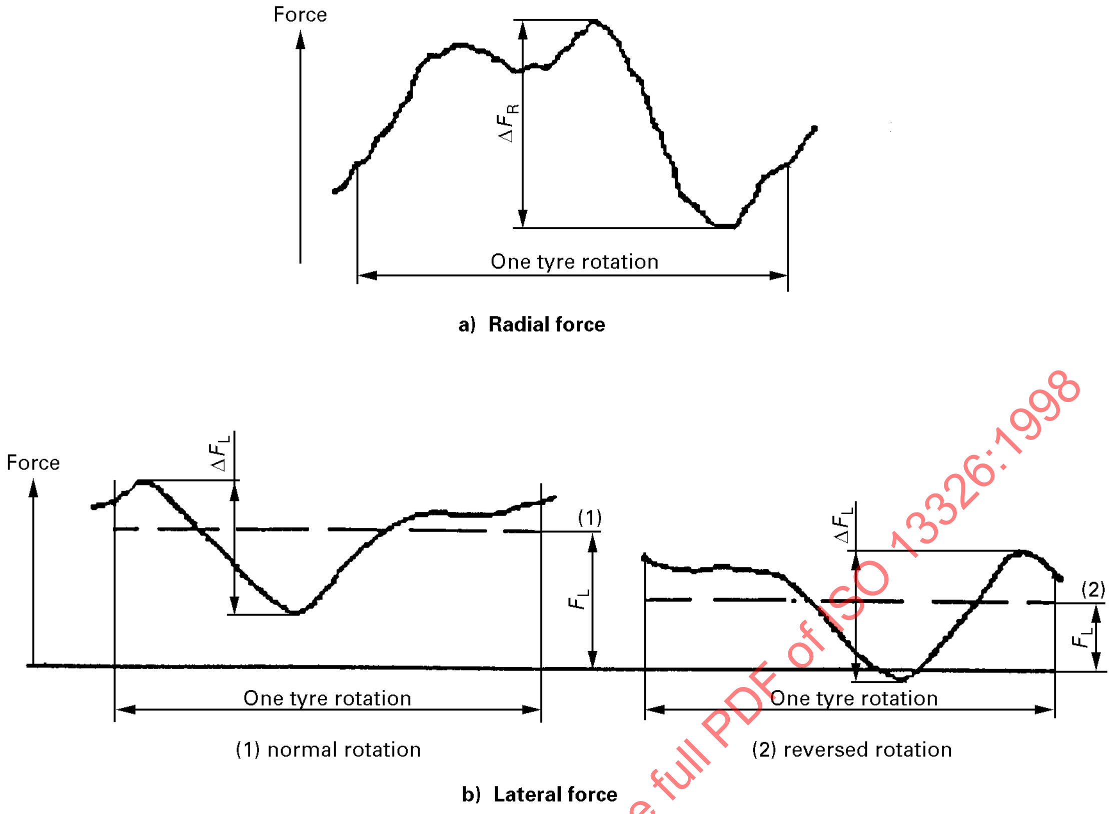


Figure 2 — Examples of wave shapes of forces generated by tyre

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

5.3 Measurement of geometrical parameters

5.3.1 Measurements can be obtained with the tyre in either loaded or unloaded conditions.

If the measurement is done in loaded conditions, the sensors must be located in a position in which tyre deformations due to deflection can be neglected.

5.3.2 Prepare and mount the tyre on the apparatus, which can be the same used for the measurement of forces.

5.3.3 Adjust the inflation pressure and the rotational speed of the tyre to one of the values prescribed for the measurement of forces. Pressure may be raised in order to measure geometrical parameters.

5.3.4 Measurements shall be performed in a plane including the rotation axis of the tyre.

NOTE — In principle three sensors are located over the tyre tread and, when also the lateral run-out is to be measured, two aside the tyre sidewall.

5.3.5 Proceed to the measurement of either or both radial and lateral run-outs, as a function of phase if necessary, for a given position, during one complete tyre rotation.

NOTE — In case the tyre was not previously trimmed, filter also the influence of 'vents' protruding from the surface.

5.3.6 Record the values of run-outs and angular velocity (in revolutions per minute) if necessary.

Proper stabilisation times, depending on the sensors' technology and on the physics of measurement, shall be observed before any measurement is recorded.

NOTES

1 Measurements should not be performed during transient period when signals are stabilizing.

2 One direction of rotation is sufficient.

5.3.7 The following parameters may be recorded, as needed:

— test rim width,

— test mean radial force, in case tyre is measured in loaded conditions, in newtons,

— the tyre inflation pressure.

6 Data interpretation

6.1 Forces

6.1.1 Peak-to-peak (total) value of the variation of the force (radial or lateral), in newtons, is referred to one revolution and is computed, if necessary, for either or both directions of rotation.

NOTE — In case of measurement for both directions of rotation the greater value is to be considered.

6.1.2 Peak-to-peak (total) value of the first harmonic of the variation of the force (radial or lateral), in newtons, is referred to one revolution and is computed, if necessary, for either or both directions of rotation.

NOTE — In case of measurement for both directions of rotation the greater value is to be considered. In addition, components in each higher order harmonic may be computed, if needed.

6.1.3 Lateral force offset (or deviation) ($\overline{F}_L$), in newtons, represents the area mean value of the lateral force during one rotation of the tyre. Lateral force offset values may be recorded, as necessary, for either or both the directions of rotation of the tyre.

The average of the maximum and minimum values of the lateral force in one rotation may be alternatively accepted but shall be registered.

The median value of the lateral force variation may be accepted as an alternative to the mean value of the lateral force variation. It is measured under the same measurement conditions as the lateral force offset and is computed as the average of the maximum and minimum value of the lateral force variation.

NOTE — Lateral force offset is subject to the accuracy (camber and slip components included) of the test apparatus.

6.1.4 Conicity, in newtons, is computed as the average of the lateral force offset measured for the two directions of rotation of the tyre, or 0,5 × ($\overline{F}_{L,for}$ + $\overline{F}_{L,aft}$)

where

$\overline{F}_{L,for}$ is the lateral force offset, measured

— either with the drum rotating in the clockwise direction, when the direction of rotation is controlled by the operator,

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

— or with the identification mark of the tyre sidewall towards the operator, when the change of direction of rotation is obtained by rotating the tyre on the test rim;

$\overline{F}_{L,aft}$ is the lateral force offset, measured

— either with the drum rotating in the counter-clockwise direction, when the direction of rotation is controlled by the operator,

— or with the identification mark of the tyre sidewall away from the operator, when the change of direction of rotation is obtained by rotating the tyre on the test rim.

6.1.5 Ply steer, in newtons, is computed as half of the difference of the lateral force offset measured for the two directions of rotation of the tyre, or $0{,}5 \times (\overline{F}_{L,for} - \overline{F}_{L,aft})$

where $\overline{F}_{L,for}$ and $\overline{F}_{L,aft}$ are as defined in 6.1.4.

6.2 Geometry

6.2.1 Peak-to-peak values of the radial and of the lateral run-outs, in millimetres, are referred to one complete revolution. The final value may be either the highest value recorded or the average value over a number or individual cycles.

NOTE — The location of the measurement (centre tread, tread shoulders, reference sidewall, sidewall location, etc.) may influence the value.

6.2.2 Values of first harmonic of the various run-outs, in millimetres, are referred to one complete revolution. The final value may be either the highest value recorded or the average value over a number or individual cycles.

7 Accuracy of the instrumentation

The complete apparatus shall be accurate within the range of tolerances specified in 7.1 to 7.3.

7.1 The complete apparatus shall be capable of setting, and measuring, the mean radial force within ± 2 % of the maximum value for which the apparatus is rated.

7.2 The complete apparatus shall be capable of measuring the mean lateral force within ± 2 % of the maximum value for which the apparatus is rated.

7.3 The measuring equipment shall be capable of measuring radial and lateral force variations within:

± 2,5 N in case of type A drum and tyres for motorcycles or tyres for passenger cars;

± 5 N in case of type A drum and tyres for commercial vehicles with load index $\leqslant$ 121;

± 10 N in case of type B drum and tyres for commercial vehicles with load index $\leqslant$ 121;

± 25 N in case of type B drum and tyres for commercial vehicles with load index $\geqslant$ 122.

8 Accuracy of the calibration system

8.1 An appropriate system shall be used for the measurement of forces.

8.2 The calibration system for the measurement of the mean radial force shall be capable to apply forces up to 10 kN ± 50 N, or 0,5 % of the force applied.

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998

Annex A
(informative)

Optional test conditions

A.1 Purpose

Procedures for routine tyre selection in a manufacturing plant may require reduction of the number of variables and provide means for accelerating the measurement process.

In this case, the following options are recommended.

Unless otherwise noted, all aspects of the standard test conditions apply.

A.2 Test wheels

A.2.1 Special divided wheels, which have in any case to guarantee the air retention of the tyre wheel assembly, may be used to permit an accelerated program of mounting and disassembling tyres.

A.2.2 The rim contour may be modified as follows.

A.2.2.1 For rims to be used in conjunction with type A drums, for measurement of passenger car or light truck tyres, the specified rim diameter D_r equals the standardized value D of the specified rim diameter reduced by 1,2 mm (see table A.1).

Table A.1

Nominal rim diameter code	Specified rim diameter, D_r mm $\pm$ 0,3
10	252
12	302,8
13	328,2
14	353,6
15	379
16	404,4
17	435,4
18	460,8
19	486,2
20	511,6

STANDARDSISO.COM : Click to view the full PDF of ISO 13326:1998