BRITISH STANDARD

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Truck and bus tyres — Methods of measuring tyre rolling circumference — Loaded new tyres

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BSI
British Standards

National foreword

This British Standard is the UK implementation of ISO 9112:2008. It supersedes BS AU 50-1.2.2:1991 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AUE/4, Tyres and wheels for motor vehicles.

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

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Truck and bus tyres — Methods of measuring tyre rolling circumference — Loaded new tyres

Pneumatiques pour véhicules utilitaires et autobus — Méthodes de mesure de la circonférence de roulement — Pneumatiques neufs en charge

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Foreword

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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 9112 was prepared by Technical Committee ISO/TC 31, *Tyres, rims and valves*, Subcommittee SC 4, *Truck and bus tyres and rims*.

This second edition cancels and replaces the first edition (ISO 9112:1991), which has been technically revised.

Introduction

The distance covered by a vehicle in a straight line in one wheel revolution is information that is increasingly used by the electronic systems in vehicles. One reason is that it makes it possible to indicate the instantaneous vehicle speed to the driver. Its evaluation uses the rolling circumference of the tyre in normal usage conditions: tyre deflected by the carried load and inflated to an adapted pressure level.

A standardized measuring method is necessary because some parameters, such as tyre load and pressure, can cause the rolling circumference to change. This International Standard contributes to tyres being interchangeable for a given vehicle. Its application by tyre manufacturers allows confidence to be maintained in the information provided to the driver, especially concerning speed and distance travelled.

Truck and bus tyres — Methods of measuring tyre rolling circumference — Loaded new tyres

1 Scope

This International Standard specifies two methods for measuring the rolling circumference and the number of revolutions per unit distance (kilometre) of new commercial vehicle tyres, under loaded conditions, for use on trucks and buses.

The first method is a drum method consisting of loading a test tyre mounted on a free axle against a driven road wheel (or drum) of specified diameter. The second method involves a vehicle whose drive axle is equipped with the test tyres driven on a straight, paved road. The values thus obtained are not intended for use as levels of performance or quality.

This International Standard applies to all truck and bus tyres.

NOTE This International Standard applies not only to large truck and bus tyres, but also to small truck and bus tyres, which are called “light truck tyres” in some countries.

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

3 Terms and definitions

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

3.1

revolutions per unit distance

number of tyre revolutions (and portions thereof) that occur when the (axle) centre of the tyre is moved exactly the unit distance of 1 km, under the conditions specified in this International Standard

3.2

rolling circumference of tyre

distance that the (axle) centre of the tyre moves in one revolution of the tyre, under the conditions specified in this International Standard

3.3

reference speed

speed at which the test is intended to be performed and which is related to the delivered value of the rolling circumference

4 Drum method

4.1 Principle

A test tyre mounted on a free axle is loaded against a driven road wheel (drum) of specified diameter. The value of the rolling circumference is determined for a specified speed; the tyre and drum revolutions are counted and used in the formula to determine the tyre's rolling circumference.

4.2 Test drum specifications

4.2.1 Diameter

The test drum shall have a diameter of at least 1,7 m, with a free axle capable of holding and loading a tyre against the driven drum. Care shall be taken to avoid low frequency bouncing.

4.2.2 Surface

The surface of the drum should preferably be of smooth steel. In cases where a textured drum surface is used, this shall be noted in the test report. The surface of the drum shall be kept clean.

4.2.3 Width

The width of the drum surface shall exceed that of the test tyre tread.

4.3 Thermal environment

The test should preferably be carried out at a reference room temperature of 25 °C. However, it may be performed in the range 20 °C to 30 °C. No temperature correction is required.

4.4 Test speed

4.4.1 Test speed for load index 122 and above

In order to establish a basic reference for rolling circumference for all tyres, the rolling circumference shall be given for a drum speed of 80 km/h for tyres with speed symbols K to M inclusive, and for a drum speed of 60 km/h for tyres with speed symbols F to J.

For tyres that bear the mandatory marking “max. speed 55 mph/88 km/h” or “max. speed 50 mph/80 km/h”, and for tyres not marked with a speed symbol, the drum speed shall be 60 km/h.

For radial tyres, the measurements can be performed within the speed interval from 30 km/h to 130 km/h, and the end result may be calculated by linear interpolation.

4.4.2 Test speed for load index 121 and below

In order to establish a basic reference for rolling circumference for all tyres, the rolling circumference shall be given for a drum speed of 80 km/h.

NOTE This also applies to tyres without speed symbol on the sidewall.

For radial tyres, the measurements can be performed within the speed interval from 30 km/h to 130 km/h, and the end result may be calculated by linear interpolation.

4.5 Accuracy

The minimum number of impulses (N_i) per revolution of both the tyre and the drum shall be 10. The total number of impulses during the time of measurement should be greater than 1 000.

4.6 Test tyre parameters

4.6.1 Load

The standard test load shall be 85 % of the maximum single load capacity of the tyre.

4.6.2 Alignment

The specific values are shown in Annex A.

4.6.3 Inflation pressure

The inflation pressure of the test tyre at ambient temperature shall be the inflation pressure, specified by the tyre manufacturer concerned, corresponding to the maximum single tyre load capacity. The pressure shall be capped.

4.7 Rims

The rims used in the test should be of a size and type approved by the tyre manufacturer for use with the test tyre. If such rims are not available, or if the information is unknown, a standard measuring rim, or the rim nearest in size and type to it, shall be used in the test.

4.8 Procedure

4.8.1 To ensure repeatability of measurements, an initial break-in and cooling period can be necessary prior to the start of the test. Such a break-in should be carried out on a test drum of at least 1,7 m in diameter, for a period of at least 1 h, at the reference test speed of 60 km/h or 80 km/h, whichever applies in accordance with 4.4, with the load and inflation pressure as specified in 4.6.1 and 4.6.3 respectively.

4.8.2 For future comparisons, record the overall diameter of the new tyre after the break-in.

4.8.3 Allow the tyre to stand, inflated, in the test area thermal environment in order for it to achieve thermal equilibrium, generally reached after 6 h.

4.8.4 Adjust the inflation pressure to that specified in 4.6.3. After about 10 min, verify that the load is as specified in 4.6.1.

4.8.5 Rotate the drum at the test speed for at least 90 min, in order to warm up the tyre and reach thermal equilibrium. After warm-up, the inflation pressure may not be readjusted under capped-pressure conditions, and the test shall be run with pressure build-up to simulate normal service conditions. The values obtained under regulated pressure conditions will be similar to those obtained using capped pressure.

4.8.6 Record the number of revolutions (and portions thereof) of both tyre and drum that occur during a time duration, T. For tyre as well as for drum, the total number of impulses during the time T should be greater than 1 000.

4.9 Calculation

Calculate the rolling circumference of the test tyre, C_r, in millimetres, as follows:

$$C_r = 2\pi \, (N_d/N_t) \, R$$

where

N_d is the number of revolutions of the drum;

N_t is the number of revolutions of the tyre;

R is the radius of the drum, in millimetres.

5 Test method using vehicle

5.1 Principle

This method consists of driving a typical vehicle equipped with the test tyres on the drive axle, on a straight, level, paved road at a constant speed, and counting the number of tyre revolutions (or portions thereof) that occur while traversing an accurately measured distance.

5.2 Test course

The test course shall be a level, straight section of smooth, dry road surfaced with either asphalt or concrete pavement of medium roughness. The longitudinal and transverse gradient of the road shall be at most 1 %. The length of the course should be 500 m or longer, depending on the accuracy of the test equipment as specified in 5.5.

The length of the test course, expressed in metres, shall be measured to within 0,1 %.

5.3 Test temperature and wind speed

The ambient temperature shall be between 5 °C and 30 °C. However, an asphalt surface shall be sufficiently cool so that the surface is not tacky. The wind speed shall not exceed 3 m/s.

5.4 Test speed

5.4.1 Test speed for load index 122 and above

The speed shall be 80 km/h $\pm$ 2 km/h for tyres with speed symbols K to M inclusive, and 60 km/h $\pm$ 2 km/h for speed symbols F to J inclusive.

For tyres that bear the mandatory marking “max. speed 55 mph/88 km/h” or “max. speed 50 mph/80 km/h”, and for tyres not marked with a speed symbol, the test speed shall be 60 km/h $\pm$ 2 km/h.

5.4.2 Test speed for load index 121 and below

The test speed shall be 80 km/h $\pm$ 2 km/h.

NOTE This also applies to tyres without a speed symbol on the sidewall.

5.5 Accuracy

The minimum number of impulses per revolution shall be 16. The overall error in the revolution-counting equipment, including start and stop errors, shall not exceed 0,1 %.

5.6 Vehicle for measurements

5.6.1 Test vehicle and tyre positions

The test vehicle shall be representative of the type used with the tyre size being tested.

The test vehicle shall have only two axles. Since most speedometers and odometers are actuated from the drive-shaft, the test tyres shall be fitted to the drive axle. For four-wheel drive vehicles, one axle shall be disengaged.

Tyre sizes that are normally used as duals on drive axles shall be tested as duals.

5.6.2 Test load

The load on the drive axle shall be 85 % of the maximum rated tyre load (85 % of maximum dual load rating for tyre sizes normally used as duals on drive axles) multiplied by the number of tyres on the axle, within $\pm$ 2 %.

The tyre maximum load capacity is the value corresponding to the load index moulded on the sidewall of the tyre.

NOTE When the tyre is not marked in this way, it is advisable that the literature provided by the tyre manufacturer be consulted for the maximum load capacity at the speed indicated by the speed symbol rating of the tyre.

The load on the other axle should be as obtained with normal load distribution.

5.7 Tyres and rims

5.7.1 Test tyres

The test tyres shall be a matched set of the same size designation, type and brand having inflated unloaded overall diameters within 0,5 % of each other.

For future comparisons with other tyres, record the overall diameter of the new tyres. This shall be measured as specified in ISO 4209-1.

5.7.2 Tyre inflation pressure

The inflation pressure of the test tyres at ambient temperature shall be that pressure corresponding to the maximum load capacity (maximum dual load capacity for tyre sizes normally used as duals on drive axles) specified by the manufacturer.

5.7.3 Test rims

The rims shall be of the size and type approved by the tyre manufacturer for use with the test tyre in highway service. In the absence of such information, the rim nearest or equivalent to the size and type of the standardized measuring rim shall be chosen.

5.7.4 Tyre break-in

Prior to the test, the test tyres shall be conditioned by running at least 1 h, at the reference test speed of 60 km/h or 80 km/h as applicable, with the load and inflation given in 5.6.2 and 5.7.2 respectively.

After break-in, the tyres shall not have more than 10 % loss of tread depth.

5.8 Procedure

5.8.1 After the tyres have been broken in as specified in 5.7.4, allow the tyres to stand inflated at the ambient temperature of the test area for at least 3 h. During this time, the tyre and wheel assembly may be installed on the test vehicle.

5.8.2 Adjust the inflation to the pressure specified in 5.7.2. The load shall be that specified in 5.6.2.

5.8.3 Drive the vehicle at the test speed for at least 90 min to warm up the tyres. After warm-up, the inflation pressure shall not be readjusted; the test is run with pressure build-up to simulate normal service conditions.

5.8.4 Run the test immediately at the test speed specified in 5.4 over the test course specified in 5.2. This requires an approach road at both ends of the test course in order to allow the course to be entered at the test speed.

Acceleration, braking and steering shall be kept to an absolute minimum during the measurements.

5.8.5 Record the number of revolutions (and portions thereof) of the right test wheel and left test wheel that occur over the test course.

5.8.6 Repeat the test such that the course is traversed twice in each direction.

5.8.7 If the number of revolutions for each wheel on the second run differs from the first run in the same direction by more than 0,2 %, repeat the test until two runs are obtained in each direction with the number of revolutions within 0,2 % for each wheel.

5.9 Calculations

5.9.1 Accuracy

A calculation is made for each of the eight readings (i.e. four runs for each drive wheel) that comply with the accuracy requirements of 5.8.7.

The eight calculated figures are then averaged to obtain the rated value. The revolutions per unit distance (see 5.9.2) and the rolling circumference (see 5.9.3) are then rounded to the nearest unit.

5.9.2 Revolutions per unit distance

The number of tyre revolutions per unit distance is determined by dividing the measured revolutions (and portions thereof) by the measured distance traversed in the test. Thus the number of revolutions per kilometre is given by:

$$(N/L) \times 10^3$$

where

N is the number of measured revolutions;

L is the test course length, in metres.

5.9.3 Rolling circumference

The rolling circumference is determined by dividing the length of the test course by the number of revolutions. Thus the rolling circumference, in millimetres, is given by:

$$(L/N) \times 10^3$$

Annex A
(informative)

Test equipment tolerances for the drum method

A.1 Purpose

These limits are given in order to achieve suitable levels of repeatable test results that can be correlated among various test laboratories. The tolerances are not intended to represent a complete set of engineering specifications for test equipment, but to serve as guidelines for achieving reliable test results.

A.2 Alignment

A.2.1 Load application

Load application shall be kept normal to the test surface and shall pass through the wheel centre within 5 mrad.

A.2.2 Camber angle

The plane of the wheel shall be normal, within 10 mrad, to the test surface.

A.2.3 Slip angle

The plane of the tyre shall be parallel, within 3 mrad, to the direction of the test surface motion.

A.3 General accuracy

Excluding perturbations induced by non-uniform tyres and rims, the test equipment should be capable of checking the test variables within the following limits:

— tyre loading: $\pm$ 100 N;

— inflation pressure: $\pm$ 5 kPa;

— surface velocity: $\pm$ 1 km/h;

— drum measurement accuracy: $\pm$ 1 mm.

Bibliography

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

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