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Test method for force and moment of motor vehicle tyres

汽车轮胎力和力矩试验方法

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Test method for force and moment of motor vehicle tyres

1 Scope

This Standard specifies the terms and definitions, test equipment, test conditions and preparations, test procedures, test data processing and test reports for the test method of force and moment of motor vehicle tyres under steady-state conditions.

This Standard applies to pneumatic passenger car tyres and miniature, light truck tyres.

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.

GB/T 6326, Tyre terms and definitions

GB/T 12549, Terms and Definitions for Vehicle Controllability and Stability

HG/T 2177, Appearance quality of tyres

3 Terms and definitions

Terms and definitions determined by GB/T 6326 and GB/T 12549, as well as the following ones, are applicable to this document.

3.1

Free rolling

Rolling of the wheel under the condition of vertical force without driving torque and braking torque.

3.2

Target vertical force

The load that the tyre bears in the free rolling state set according to the tyre load capacity.

4 Test equipment

4.1 Composition and requirements of equipment

4.1.1 Overview

There are two types of test equipment: flat belt and rotary drum. Each type of equipment is mainly composed of four parts: road simulation system, loading and positioning system, measurement system, and data acquisition system.

4.1.2 Road simulation system

4.1.2.1 Flat belt

4.1.2.1.1 The simulated road surface shall be continuous and paved with stable wear-resistant materials.

4.1.2.1.2 The simulated road surface shall be kept clean; the surface shall not have cracks, tears, dents, contamination, or other defects that change friction and flatness.

4.1.2.1.3 The support area of the simulated road surface shall be of sufficient width to support the entire grounding mark.

4.1.2.1.4 The supporting structure shall have sufficient rigidity to ensure that the angular accuracy requirements in 4.1.3.2 can be met.

4.1.2.1.5 The support plate supporting the simulated road surface shall be kept horizontal; the wear amount shall be less than 0.5 mm.

4.1.2.1.6 The drive system can operate the simulated road surface at the specified speed with an accuracy of ±1 km/h.

4.1.2.2 Rotary drum

4.1.2.2.1 The diameter of the rotary drum is not less than 3 m; the surface is continuous, and is laid with stable wear-resistant materials.

4.1.2.2.2 The surface of the rotary drum shall be kept clean, and there shall be no contamination or other defects that change the friction and flatness.

4.1.2.2.3 The drum width shall not be less than the tyre contact width.

4.1.2.2.4 The drum speed control accuracy requirement is ±1 km/h.

4.1.3 Loading and positioning system

4.1.3.1 The loading capacity of the loading device shall meet the test requirements; the setting accuracy of the loading device shall be ±1.0% of the maximum vertical force that can be loaded.

4.1.3.2 The supporting structure of the loading and positioning system shall have sufficient rigidity to ensure that the angular accuracy remains at least ±0.05°.

The interval between the test tyres after vulcanization and before the test is not less than 24 h; the appearance quality shall meet the requirements of HG/T 2177. Before the test, remove all kinds of contaminants (transport labels, stones, etc.) from the tread and tyre bead.

5.3 Test rim

The test rim should be the measurement rim specified in GB/T 2977 or GB/T 2978; there shall be no offset after the rim is installed on the testing machine. Excessive lubricating fluid shall be avoided during installation to prevent slippage between the bead and the rim during the test.

5.4 Test pressure

Inflate the tyre to the air pressure required by the test; the deviation does not exceed ±5 kPa. During inflation, when the tyre is in an unloaded state, record the initial value. The inflated test tyre-rim assembly shall be parked for at least 3 h. Air-holding test or pressure regulating test can be selected.

5.5 Test tyre pre-run

5.5.1 The simulated road speed should be set to 7.2 km/h.

5.5.2 Under the specified test air pressure, set the tyre slip angle and tyre camber angle to 0.00°; load the tyre to 80% of the target vertical force; after the tyre travels 55 m, unload the tyre and leave the simulated road surface.

5.5.3 Repeat the operations of 5.5.2 in the following order of tyre slip angle:

-- -1.00°, +1.00°, +2.00°, -2.00°, -4.00°, +4.00°.

5.5.4 Set the tyre side slip angle to 0.00°; under the specified test air pressure, set the test load to 2% of the target vertical force of the tyre; then, at a rate of 250 N for every 1 m traveled, load the load linearly to 160% of the target vertical force.

5.5.5 After reaching 160% of the target vertical force, unload the tyre.

5.5.6 Repeat the operations of 5.5.4 and 5.5.5 in the order of tyre slip angle as follows:

-- -1.00°, +1.00°, +2.00°, -2.00°, -4.00°, +4.00°.

6 Test steps

6.1 After completing the pre-run of the test tyre, adjust the tyre pressure to the test pressure when the tyre is not loaded and the testing machine is locked.

6.2 The simulated road speed should be set to 7.2 km/h.

6.3 Set the tyre slip angle to 0.00°; load the tyre from 0 to 20% of the target vertical force; start collecting data after two rotations; after the data collection is completed, unload the tyre and leave the test road.

6.4 Repeat the operations of 6.3 in the following order of test loads:

-- 20%, 40%, 60%, 80%, 100%, 120%, 140%, 160% of the target vertical force.

6.5 Repeat the operations of 6.3 and 6.4 in the following order of tyre slip angle:

-- +1.00°, -1.00°, -2.00°, +2.00°, +4.00°, -4.00°, -6.00°, +6.00°, +8.00°, -8.00°, -10.00°, +10.00°.

6.6 Before starting data collection, the tyre needs to rotate at least two times after each load change. Data acquisition shall be continuous acquisition circle, to obtain 32 or more equally spaced corrected data points. The load and tyre slip angle data reported shall be the average of these data points under the respective conditions.

7 Test data processing

In order to ensure the authenticity and accuracy of the data, the data processing shall correct the influence of the load cell's self-weight, interaction and the transformation of the testing machine to the tyre coordinate system on the data. The tyre coordinate system should be the tyre coordinate system in GB/T 12549; if other coordinate systems are used, it shall be indicated in the test report.

8 Test report

The test report shall at least include the following contents:

a) name and trademark of the manufacturer of the test tyre;

b) test tyre size, load index or level, speed symbol;

c) production number;

d) test rim specification;

e) test environment temperature;

f) test pressure;

g) test load;

h) test speed;

Appendix A

(Normative)

Equipment monitoring

A.1 Control tyre requirements

A.1.1 Control tyre selection

A.1.1.1 Control tyres shall be smooth radial tyres.

A.1.1.2 Select 20 tyres of the same structure from the same batch of the same manufacturer as control tyres. These tyres shall be tested in accordance with the test method for control tyres in A.2. Tabulate the data and analyze to obtain the average lateral force and aligning moment value under each vertical force and tyre slip angle specified in A.2, to obtain the standard deviation. Reserve the 10 tyres with the closest data as a set of control tyres. A control chart shall be prepared for each control tyre.

A.1.1.3 When the basic average drift of this set of tyres reaches 0.5 times the standard deviation, a new set of control tyres needs to be selected.

A.1.2 Control tyre storage

Control tyres shall be stored on tyre racks at a temperature of 24 °C ± 2.5 °C and protected from light.

A.1.3 Use sequence of control tyres

Control tyres shall be used in the following order to reduce drift:

-- 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 1, 2, 3, ...

A.2 Control tyre calibration procedure

The method of shunt calibration shall be used to ensure the normal operation of electronic devices and computer programs under no load conditions. It is recommended to use the control tyres to check the testing machine at least weekly. The control tyre and test method are determined by the test engineer; the following steps are recommended:

a) Tests for control tyres do not require a pre-run.

b) Control tyres shall be temperature-regulated in accordance with 5.1.

c) Control tyres should be inflated to the standard air pressure corresponding to the specified tyre size.

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