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Laboratory test methods for passenger car tyres capabilities

轿车轮胎性能室内试验方法

(ISO 10191:2021, Passenger car tyres - Verifying tyre capabilities -

Laboratory test methods, MOD)

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Laboratory test methods for passenger car tyres capabilities

1 Scope

This document describes the laboratory test methods for performance testing of passenger car tyres, including test equipment and its precision, test conditions, test procedures, judgment rules and test reports.

This document includes the bead unseating resistance test, strength performance test, high-speed test, endurance test and low-pressure performance test for tyres. Of the test methods proposed, only the applications of some test methods depend on the type of tyre to be tested (tube or tubeless tyres, diagonal tyres or radial tyres, etc.).

The test methods listed in this document are not suitable for grading the performance or quality level of tyre products.

This document is applicable to new passenger car pneumatic tyres and retreaded passenger car pneumatic tyres. Other tyres can be tested with reference to this document after consultation and agreement of relevant parties.

2 Normative references

The following documents contain the provisions which, through normative reference in this document, constitute the essential provisions of this document. For the dated referenced documents, only the versions with the indicated dates are applicable to this document; for the undated referenced documents, only the latest version (including all the amendments) is applicable to this document.

GB/T6326 Tyre terms and definitions (GB/T 6326-2014, ISO 4223-1:2002, NEQ)

GB/T 8170 Rules of rounding off for numerical values & expression and judgment of limiting values

3 Terms and definitions

Terms and definitions defined in GB/T 6326 and the following apply to this document.

3.1 parasitic tread block chunking; PTBC

A defect characterized by rubber pieces separated from the tyre tread or tearing without exposing the tyre reinforcing material (such as carcass ply, belt, etc.).

4.2 Strength testing machine

4.2.1 The testing machine shall be equipped with a sufficiently long cylindrical metal indenter, and the end of the indenter is hemispherical with a diameter of $19\text{ mm}\pm 0.5\text{ mm}$.

4.2.2 The indenter device shall be able to apply force gradually and incrementally, and the accuracy of the force and displacement indicator is $\pm 1\%$ of the full scale.

4.2.3 The accuracy of the displacement velocity of the indenter shall be $\pm 3\%$ of the full scale.

4.3 High-speed and endurance testing machine

4.3.1 The drum diameter of the testing machine shall be $1700\text{ mm}\pm 17\text{ mm}$.

4.3.2 The surface of the test drum of the testing machine shall be a smooth steel surface, and its width shall not be less than the total section width of the test tyre.

4.3.3 The loading capacity of the test loading device shall meet the requirements of the test method, and its accuracy is $\pm 1\%$ of the full scale.

4.3.4 The speed capability of the test machine drum and test equipment shall meet the requirements of the test method, and its accuracy shall be ${}^{+2}_{0}\text{ km/h}$.

4.3.5 The radial runout of the drum of the testing machine shall not exceed 0.25 mm .

4.3.6 The ambient temperature measuring device shall be set within the range of $150\text{ mm}\sim 1000\text{ mm}$ from the test tyre.

4.4 Inflation pressure gauge

The accuracy of the inflation pressure gauge is $\pm 5\text{ kPa}$.

5 Test samples

According to the needs of the test, the test samples are 3 to 5 identical tyres, which are used for bead unseating resistance test and strength test, high-speed test, endurance test and low-pressure performance test respectively. Therein,

- for the bead unseating resistance test and the strength test, the same test sample can be used, or different test samples can be used respectively;
- for the second high-speed test of passenger car tyres whose maximum speed exceeds 300 km/h as specified in 6.3.1.6, the same test sample can be used for the first and second high-speed tests, or different test samples can be used

be noted in the test report that each test point is "not unseated" or "unseated"; if the pressing block for bead unseating slipped or touched the rim, it shall be indicated.

6.2 Strength test

6.2.1 Test conditions and test preparation

6.2.1.1 The test rim should comply with the provisions of GB/T 2978 or relevant industry technical documents on measuring rims.

NOTE: The relevant industry technical documents are only applicable to the specifications of passenger car tyres that are not within the scope of GB/T 2978.

6.2.1.2 Install the test tyre on the test rim and inflate it to the pressure specified in Table 1.

6.2.1.3 The inflated test tyre and rim assembly shall be stood at an ambient temperature of 18 °C to 36 °C for at least 3 hours. If the same set of tyre and rim assembly used for the bead unseating resistance test is used, the test can be continued.

6.2.1.4 Determine 5 roughly equidistant test points along the outer circumferential direction of the tyre, mark and number them one by one.

6.2.2 Test procedures

6.2.2.1 Readjust the pressure of the test tyre that has been stood for the indicated time to the specified value in Table 1.

6.2.2.2 Fix the test tyre and rim assembly after correcting the pressure on the strength testing machine, and conduct the test point by point.

6.2.2.3 The indenter shall be perpendicular to the tread, and press on the pattern block as close as possible to the centerline of the tread circumference, while avoiding pressing into the tread groove.

6.2.2.4 The indenter gradually and incrementally applies force (F) to the tyre crown at a moving speed of 50 mm/min $\pm$ 2.5 mm/min until the tyre crown is pressed through or the minimum breaking energy value specified in Table 9 is reached. Readjust the pressure before moving on to the next test point.

6.2.2.5 Measure and record the force (F) and pressed depth (the travel is expressed as p) at the moment when the indenter stops moving at each test point.

6.2.2.6 Where the indenter cannot continue moving due to contact with the rim and the tyre has not been punctured, the test point shall be deemed to have passed the test, and shall be indicated in the test report as "rim is touched and tyre isn't punctured".

tyre cool naturally for 15 minutes to 25 minutes, and measure the tyre pressure within the specified time, and then check the appearance of the tyre without disassembly after it has completely cooled.

6.5 Low-pressure performance test

6.5.1 Test conditions and test preparation

6.5.1.1 This test is only applicable to radial tyres (excluding T-type temporary-use spare tyres), and it shall be carried out continuously after the end of the endurance test in 6.4. The same set of tyre and rim assemblies that have passed the endurance test in 6.4 shall be used, and it shall be adjusted to the specified test pressure:

- For standard passenger car radial tyres, the test pressure is 140 kPa;
- For reinforced passenger car radial tyres, the test pressure is 160 kPa.

6.5.1.2 After adjusting the pressure, the test tyre and rim assembly shall be stood at an ambient temperature of $38\text{ }^{\circ}\text{C}\pm 3\text{ }^{\circ}\text{C}$ for at least 2 hours.

6.5.1.3 The setting of test load, speed and time shall meet the following requirements:

- Test load: It is 100% of the load capacity corresponding to the load index of the test tyre, and the unit is kilogram (kg);
- Test speed: 110 km/h for snow tyres, and 120 km/h for other passenger car radial tyres;
- Test time: 90 min.

6.5.1.4 The time for the test drum to start at uniform acceleration and reach the speed specified in 6.5.1.3 shall be within 5 minutes.

6.5.1.5 During the whole test process, the ambient temperature shall be kept within the range of $38\text{ }^{\circ}\text{C}\pm 3\text{ }^{\circ}\text{C}$.

6.5.2 Test procedures

6.5.2.1 Readjust the pressure of the test tyre that has been stood for the indicated time to the specified value in 6.5.1.1.

6.5.2.2 Install the test tyre and rim assembly prepared according to 6.5.2.1 on the high-speed and endurance testing machine, make it perpendicular to the surface of the test drum and apply the load specified in 6.5.1.3.

6.5.2.3 Carry out the test according to the test conditions specified in 6.5.1.3. The whole test process shall be carried out without interruption. The tyre shall not be artificially

After the test is completed according to the requirements of 6.3, if the following conditions are met, the sample is judged as "pass the test"; otherwise, it is judged as "fail the test":

The tyre pressure measured according to the requirements of 6.3.2.5 shall not be lower than 95% of the initial pressure specified in Table 3; there shall be no obvious (tread, sidewall, ply, inner line, belt or breaker, bead) separation, ply cracking, cords break, cords separation, chunking, open splice, chap, and carcass abnormal deformation found in the appearance inspection. Tyres with a maximum speed of 300 km/h and above may have bulges on the tread surface or chunking caused by bulging.

7.4 Endurance performance

After the test is completed according to the requirements of 6.4, if the following conditions are met, the sample is judged as "pass the test"; otherwise, it is judged as "fail the test":

The tyre pressure measured according to the requirements of 6.4.2.4 shall not be lower than 95% of the initial pressure specified in Table 1; there shall be no (tread, sidewall, ply, belt or breaker, bead) separation, ply cracking, cords separation, cords break, chunking (except PTBC of snow tyres), open splice, chap, and carcass abnormal deformation found in the appearance inspection.

7.5 Low-pressure performance

After the test is completed according to the requirements of 6.5, if the following conditions are met, the sample is judged as "pass the test"; otherwise, it is judged as "fail the test":

The tyre pressure measured according to the requirements of 6.5.2.4 shall not be lower than 95% of the initial pressure specified in 6.5.1.1; there shall be no (tread, sidewall, ply, inner line, belt or breaker, bead) separation, ply cracking, cords separation, cords break, chunking (except PTBC of snow tyres), open splice, chap, and carcass abnormal deformation found in the appearance inspection.

8 Test report

The test report shall include the following content:

- a) the manufacturer name, trademark, specification, and production number of the test tyre;
- b) the load index or ply rating, maximum load capacity, speed symbol, material, and structure of the test tyre, etc.;

- c) test rim specifications;
- d) the laboratory ambient temperature;
- e) the document number and test date;
- f) the test pressure and test load;
- g) the test time and test speed at each stage of the test;
- h) the model of the pressing block and the horizontal distance value p for bead unseating test;
- i) the bead unseating resistance of each test point for bead unseating test;
- j) the condition of each test point of the tyre for bead unseating test: "not unseated", "unseated", or "slippage or the rim is touched";
- k) the diameter of the indenter for strength test;
- l) the indenter's force, travel, and breaking energy at each test point of the tyre for strength test;
- m) the condition of each test point of the tyre for strength test: "unpunctured", "punctured", or "the rim is touched and the tyre isn't punctured";
- n) the tyre appearance, tyre pressure, and other conditions after the high-speed, endurance, or low-pressure tests;
- o) records or descriptions of other accidents during the tests;
- p) the conclusion: "pass the test" or "fail the test".

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