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Road vehicles - Brake linings - Effects of heat on dimensions and form of disc brake pads test method

道路车辆　制动衬片　盘式制动衬块受热膨胀量试验方法

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1 Scope

This document describes two methods for measuring the thermal expansion of disc brake pads: the heating plate method and the oven method to determine the dimensional change as a function of temperature, as well as its heat conduction.

Dimensions include:

-- thickness;

-- certain profile dimensions of a disc brake pad whose variations may cause brake failure.

This document applies to molded or bonded disc brake pads with a solid backplate and with a width not greater than 120 mm, a height not greater than 80 mm, and a thickness not greater than 20 mm.

2 Normative references

The provisions in the following documents become the essential provisions of this document through normative reference in 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/T 5620 Road vehicles - Vocabulary and definition for braking of automotive vehicles and their trailers

3 Terms and definitions

The terms and definitions defined in GB/T 5620 and the following apply to this document.

3.1 growth

The permanent changes in the external dimensions of a friction material that occurs when it undergoes high-temperature cycles and then cools to room temperature.

The temperature is measured at the center of the heating plate by a thermocouple installed in a small hole, which is parallel to the contact surface and 5 mm away from the contact surface (see Figure 2). If the disc brake pad is previously equipped with a silencer, place a 4 mm×80 mm×100 mm heat transfer plate between the disc brake pad and the fixture to measure heat conduction. The temperature of the heat transfer plate is measured with a thermocouple installed in a small hole extending to the center of the heat transfer plate (see Figure 2).

The fixture holding the disc brake pad shall be able to exert a force of 20 N~200 N. A movement meter on the same side can measure the movement of the backplate or intermediate plate.

5.1.5 Test procedures

5.1.5.1 Place the disc brake pad that had been treated according to 5.1.1 between the heating plate and the fixture, with the friction surface facing the heating plate. The pressure on the surface of the disc brake pad is approximately 0.02 N/mm^2.

5.1.5.2 Start heating so that the heating plate reaches the final temperature of 400 °C at the end of 10 minutes of heating.

5.1.5.3 According to the test device used, measure the changes in disc brake pad thickness, heating plate temperature, temperature of the friction material and backplate or intermediate plate during heating and cooling. If the recorder is not used for automatic recording, the test person shall manually record once every 25°C during the heating plate temperature within the range of 50 °C~400 °C.

5.1.5.4 After the final temperature is reached, turn off the heat source and start cooling. During the cooling period, the test device undergoes natural cooling and cold air shall not be blown to the heating plate to cool down.

5.1.5.5 When the heating plate cools to 50 °C, immediately start the heat source again and repeat steps 5.1.5.2~5.1.5.4. During the second heating period, no adjustments shall be made under any circumstances.

5.1.5.6 After the test, measure the disc brake pad profile dimension at room temperature, and its value is d_{Bi}.

5.1.6 Test data processing

5.1.6.1 If a recorder is used, the recorded data shall be processed appropriately so that changes in disc brake pad thickness, heating plate temperature, disc brake pad temperature, and backplate or intermediate plate temperature accurately correspond to the relevant factors. If the coordinate system of x, y_1, y_2, and y_3 is used, the heating plate temperature is used to control the horizontal axis of the coordinates.

5.1.6.2 If these data are read, the changes in the temperature of the disc brake pad and its backplate or intermediate plate and the thickness change of the disc brake pad shall be filled in on millimeter paper and contrasted with the temperature of the heating plate. The curve shall also be verified to ensure it is correct. If necessary, calculate its change according to formula (1):

$$\Delta d_i = d_{Bi} - d_{Ai} \quad \cdots\cdots (1)$$

5.1.7 Test report

The test report shall contain the following content:

a) The model, batch number, and supplier of the disc brake pad;

b) The average thickness d_m of the disc brake pad at the beginning of the test;

c) The maximum value of the corresponding change in disc brake pad thickness in relation to temperature and test stage;

d) Changes in disc brake pad thickness at maximum temperature during the first and second heating periods;

e) Residual changes in the thickness and dimensions of the disc brake pad from cooling to room temperature (after the test);

f) The temperature of the disc brake pad backplate or intermediate plate when the heating plate reaches the maximum temperature during the first and second heating periods;

g) The appearance of the disc brake pad after the test, especially the situation including the cracking, blistering, peeling, delamination of the friction material, and separation from the backplate.

5.2 Oven method

5.2.1 Sampling

Take out a disc brake pad from the finished product warehouse and remove the silencer and other accessories.

5.2.2 Instruments and equipment

5.2.2.1 Oven with circulating air.

5.2.2.2 Thickness gauge or micrometer with an accuracy of not less than 0.02 mm.

5.2.2.3 Thermometer.

5.2.2.4 Timers.

5.2.3 Test procedures

5.2.3.1 Swell and growth test

5.2.3.1.1 At room temperature, select 6 measuring points 12 mm~18 mm away from the edge of the disc brake pad, measure their thickness, and mark them.

5.2.3.1.2 At room temperature, place the disc brake pad as far as possible in the center of the oven so that the ventilation airflow is parallel to the surface of the disc brake pad, and heat the oven to 200 °C within 30 to 60 minutes. This temperature is measured at the center of the oven close to the disc brake pad, and the disc brake pad is kept at this temperature for 30 minutes. If multiple disc brake pads are tested at the same time, the minimum distance between disc brake pads shall be 50 mm, and the minimum distance between the disc brake pads and the oven wall shall be 100 mm.

5.2.3.1.3 Take the disc brake pad out of the oven, measure the thickness at 6 marked points within 3 minutes, and record the thickness change as the swell.

5.2.3.1.4 After the disc brake pads naturally cool to room temperature in a windless environment, measure the thickness at the 6 marked points again, and record the thickness change as growth.

NOTE: If required, the dimensional stability test can be performed simultaneously with the swell and growth tests on the same disc brake pad.

5.2.3.2 Dimensional stability test

5.2.3.2.1 Place the disc brake pad on a piece of paper at room temperature, draw its outline, and record the outer arc length.

5.2.3.2.2 Carry out the test according to the provisions of 5.2.3.1.2.

5.2.3.2.3 Let the disc brake pad naturally cool to room temperature in a windless environment and place it on the paper again so that the center of the disc brake pad can match the initial contour, and both ends and the initial outline have approximately equal offset distances. Repeat draw the appearance outline of the disc brake pad and compare it with the initial outline to obtain the corresponding changes in dimensions.

5.2.4 Precautions

5.2.4.1 Record and report any bubbles and surface anomalies at each measurement point.

5.2.4.2 Be careful when moving the disc brake pad so as not to affect the results.

5.2.4.3 The room temperature for the test shall be (23±5) ℃.

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