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Road vehicles - Brake linings - Compressive strain test method

道路车辆 制动衬片 压缩应变试验方法

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Road vehicles - Brake linings - Compressive strain test method

1 Scope

This document specifies the principle, test equipment, technical requirements for test equipment, sample preparation, test methods, deflection compensation of test equipment, verification of test equipment using reference samples and test report for the compressive strain test method of brake linings of road vehicles.

This document applies to the measurement of compressive strain of cut samples of brake lining disc brake pad assemblies, disc or drum friction materials.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 5620, Road vehicles - Vocabulary and definition for braking of automotive vehicles and their trailers

3 Terms and definitions

Terms and definitions determined by GB/T 5620, as well as the following, are applicable to this document.

3.1

compressibility

C

Change of thickness or deflection of the lining caused by uniaxial compressive load in the direction same as the compressive force and perpendicular to the friction surface, when the maximum test pressure is reached in the last loading cycle.

3.2

compressive strain

5 Principle

5.1 General

This test measures:

-- Test method A: compressive strain of friction material sample;

-- Test method B: Compressive deflection of disc brake pad assembly.

According to the type of the sample, choose test method A or test method B for testing, and the two test results shall not be directly compared.

5.2 Test method A – friction material samples

Test method A applies pressure per unit area to the contact interface of the sample. Test method A can be used to evaluate disc or drum friction materials for commercial vehicles, as well as non-back-plate friction materials for research and development purposes.

For larger brake pads used in commercial vehicles, respectively measure the compressive strains of the left and right halves or the compressive strain of the slices in the radial direction. In other cases, the sample size should take into account inhomogeneity of materials. The surface of the friction material sample shall be flat.

Unless otherwise stated, the compressive strain value (ε_{pA}) shall be reported.

5.3 Test method B – Disc brake pad assembly

Test method B simulates a 10 MPa or 16 MPa hydraulic pipeline pressure-loaded disc brake pad assembly.

Note: Test method B is typically used for hydraulic disc brake pad assemblies in passenger cars and light trucks.

Unless otherwise stated, compressive deflection or compressibility (C) shall be reported in microns (μm).

6 Test equipment

The test equipment shall contain the following devices.

a) Compressibility test bench or uniaxial material test load frame: Providing uniform load on the surface of the sample.

b) Loading cylinder for simulation: Including loading indenter for test method A (where the surface shall be larger than the contact surface of the sample) and caliper piston device for test method B.

c) Pressure plate.

d) Devices for applying pressure: Its accuracy is 1% of the full scale of the equipment.

e) Deflection measuring device: Measuring the deflection of the sample as it changes with time; its accuracy is 0.001 mm. It is placed on the loading cylinder or pressure plate, with the center line close to the loading indenter.

f) Recording device or computer: It is used to record the changes in load, pressure, displacement and temperature over time.

g) Heating device: Used to heat the pressure plate to the specified temperature.

h) Thermocouple (recommended diameter 1.5 mm): It is used to measure the temperature of the back plate. The thermocouple is located close to the center line of the back plane and embedded 3 mm below the surface of the back plate.

i) Thermocouple or other device for measuring the sample temperature.

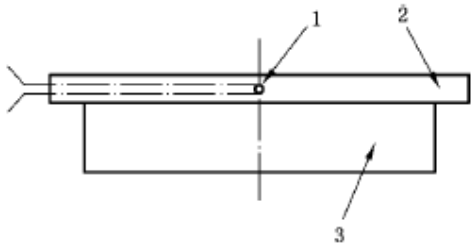
j) Micrometer for measuring the sample thickness.

7 Technical requirements for test device

7.1 Loading

7.1.1 Test method A

Table 2 gives the maximum pressure and loading rate on the contact surface. When determining the actual contact area and contact surface pressure of the sample, all grooves, chamfers and holes shall be removed.



Keys:

1 – thermocouple probe;

2 – back plate;

3 – friction material.

Figure 5 – Thermocouple position for thermal conduction measurement

9.3.2 Remove the sample and the loading indenter adjustment device (piston) from the pressure plate. Preheat the pressure plate surface to (400 ± 10) ℃ and keep it stable for at least 30 min.

9.3.3 Install the loading indenter adjustment device at room temperature.

9.3.4 Immediately after performing 9.3.3, place the sample at room temperature on a heated pressure plate. Record the initial temperature (T_2) of the back plate and apply a preload of 0.5 MPa.

9.3.5 Set the displacement sensor to zero.

9.3.6 Under the test pressure, record the final temperature T_3 of the back plate after 10 min ± 10 s for brake pads of passenger cars, or after 15 min ± 10 s for brake pads of commercial vehicles.

9.3.7 Under the test pressure, record the change in sample thickness after 10 min ± 10 s for brake pads of passenger cars, or after 15 min ± 10 s for brake pads of commercial vehicles.

9.4 Hot compressibility test

9.4.1 If steps 9.3.2 ~ 9.3.7 are performed, perform 9.4.2 directly; if not, perform the above steps 9.3.2 ~ 9.3.7 first.

9.4.2 Reset the displacement sensor to zero.

9.4.3 Perform two compression cycles using the same loading parameters as the normal temperature compressibility test cycle.

9.4.4 Remove the sample from the test equipment and cool it to room temperature.

9.4.5 Measure the thickness of the pad at the position shown in Figure 3 and report the thermal growth (d_G) of the sample as needed.

10 Deflection compensation of test equipment

During the friction material compressibility test, the test equipment itself will change. Therefore, D_{app} shall be subtracted from D_{tot} to determine D. The calculation method is shown in Formula (2):

$$D = D_{tot} - D_{app} \quad \cdots\cdots (2)$$

Where:

D – net deflection of the sample, in micrometers (μm);

D_{tot} – total deflection measured by the equipment, in micrometers (μm);

D_{app} – deflection of the equipment itself, in micrometers (μm).

This compensation can be done automatically or manually. Where the sample is not installed, load the piston indenter to the pressure plate, and measure the functional relationship between D_{app} and pressure.

Note: Use a steel plate of known deflection as a sample to protect the pressure plate.

Then, perform automatic compensation based on the pressure. Alternatively, manually subtract the deflection of the device from the total deflection measured at the maximum pressure for each test.

11 Verification of test equipment using reference samples

Periodic validation shall be performed using reference samples, such as dynamometers or standard calibration springs with appropriate positioning tools and reasonable test conditions (see Examples 1 and 2).

Example 1:

Test conditions for dynamometer:

-- F_B = 1.6 kN;

-- F_P = 50 kN; 60 kN;

-- loading rate = 25 kN/s;

-- 2 cycles.

Example 2:

Test conditions for standard calibration spring:

-- F_B = 3.0 kN;

-- F_P = 59.5 kN;

-- loading rate = 35 kN/s;

-- 3 cycles.

If the difference between the reference sample and its expected value is greater than 5 μm, check the accuracy of the dynamometer, the precision of the displacement sensor and the flatness of the test pressure plate.

12 Test report

See Appendix A for the test report form. Test reports in other formats shall at least contain the following information:

a) Manufacturer and brake lining batch number;

b) Type of sample and additional coatings, silencers, etc.;

c) Sample size (pad area);

d) Number of samples;

e) Thickness of the assembly, accurate to 0.1 mm, thickness of the friction material;

f) Piston size, inner diameter and outer diameter (for discs);

g) If it deviates from the center line position, record the position of the piston deviating from the pad;

h) Test method (A or B) used;

i) Average compressibility or compressive strain of the sample at room temperature;

j) Average hot compressibility or compressive strain of the sample;

k) Room temperature and relative humidity (if required).

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