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Road vehicles - Brake lining friction materials - Test method for brake wear particle emission

道路车辆 制动衬片摩擦材料 磨损颗粒物排放量测试方法

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Table of Contents

1 Scope

This document describes the NEDC brake cycle test method and the WLTP brake cycle test method for testing the particulate matter emission from the wear of brake lining friction materials of road vehicles.

This document applies to the brake linings for Category-M1 and Category-N1 vehicles. Brake linings for other types of vehicles may refer to this document for further information.

2 Normative References

GB/T 5620

GB/T 13554-2020

GB/T 15089

GB/T 29064

3 Terms and Definitions

The terms and definitions defined in GB/T 5620 and GB/T 15089 and the following are applicable to this document.

3.1 NEDC brake cycle

The New European Driving Cycle brake cycle.

One cycle consists of four urban road modes and one expressway mode.

3.2 WLTP brake cycle

The World Light Vehicle Test Procedure brake cycle.

One cycle consists of 10 stages and 303 braking maneuvers, and a driving cycle of a total duration of 15,826 seconds.

3.3 Particulate size

The diameter of a spherical particle in aerodynamics that is equivalent to a density of 1,000 kg/m3.

3.4 Particulate concentration

The mass of suspended particulate matter per unit volume under the capture temperature and pressure conditions.

NOTE. generally, it is expressed as the quantity or mass of fine particles per unit volume or mass of gas or suspended in a liquid, depending on the type and size of the particulate matter.

3.5 Cascade impactor

A device that blows sample gas from a fine nozzle or slit towards a flat plate, causing particles to deposit on the flat plate through inertial force.

3.6 Brake emissions family

A collection of brakes designed to have similar emission characteristics, taking into account calipers, brake discs (drums), brake linings and other vehicle parameters.

3.7 Mass in running order

The total mass of the vehicle and its fuel tank when filled to at least 90% capacity, including the mass of the driver, fuel and fluids. With standard equipment installed in accordance with the manufacturer's specifications, it also includes the mass of the vehicle body, driving cab,

transmission, spare tire, and tools.

3.8 Aerosol

A dispersed system consisting of solid and/or liquid particles suspended in air.

3.9 Response time

The time difference between the start of a change in the measured value at a datum point and the measurement system response reaching 90% of the final reading.

NOTE. system response time (t90) consists of system delay time and system rise time. In this document, the inlet of the sampling nozzle is defined as the datum point.

3.10 Friction braking share coefficient

During a driving cycle, the ratio of the total energy absorbed by the full friction braking system to the change in the vehicle's total kinetic energy during braking events (excluding road loads) in the same driving cycle.

3.11 Standard conditions

Conditions with a pressure of 101.325 kPa and a temperature of 273.15 K (i.e., 0 ?C).

3.12 Specific friction work

During a brake emission test, under a specified deceleration event, the actual friction work applied to the test brake.

4 Abbreviations

The following abbreviations apply to this document (see Table 1).

5.2.2.2 Running-in

5.2.2.2.1 The final running-in speed is equivalent to full braking.

5.2.2.2.2 After running-in, use blast air to thoroughly remove wear particles from the brake linings and brake discs (drums), then, measure the thickness and mass.

5.2.2.2.3 After running-in, use air to purge the brake calipers and clamping tools to thoroughly remove wear particles. Simultaneously, use a waste cloth to remove wear particles inside the main duct of the wear particle capture device.

5.2.2.3 Wear particle measurement mode

5.2.2.3.1 One cycle of the wear particle measurement mode is shown in Table 3 (an

equivalent mileage of 11 km), for a total of 30 cycles.

5.2.2.3.2 Replace one filter element every 10 cycles and measure the mass of the filter element.

If the mass of the filter element or the wear of the brake linings and brake discs (drums) is insufficient, the cycle shall be continued, until sufficient wear is achieved.

5.2.3.1 Filtration mass method

5.2.3.1.1 For the filtration mass method, a cascade impactor capable of achieving the fraction of particulate matter (PM10, PM2.5) is used. The diameter of the filter element shall be ? 47 mm (effective diameter 37 mm).

5.2.3.1.2 The PM2.5 emission (Ma) per 1 km per wheel travel is calculated by measuring the increment in filter element mass before and after the test. Ma is calculated in accordance with Formula (2). Where, Ma---the PM2.5 emission per 1 km per wheel travel, expressed in (mg/km);

Mb---the increment in filter element mass before and after the test, expressed in (mg);

Q2---the air suction volume of the capture device, expressed in (m3/min);

Q1---the flow rate in the main duct, expressed in (m3/min);

L---the total mileage under the wear particle measurement mode, expressed in (km).

5.2.3.1.3 The weighing range of the balance used to weigh the filter element shall be 0.1 ?g ~ 10 ?g. The appropriate accuracy shall be selected based on the amount of wear particle emission.

5.2.3.2 Light scattering particle mass concentration method

5.2.3.2.1 Although the light scattering particle mass concentration meter can measure particle mass concentration in real time, its accuracy varies depending on the type of particles measured.

Therefore, it needs to be used simultaneously with the filtration mass method. In this case, the measurement time needs to be matched with the filtration mass method, and a cascade impactor shall be installed during measurement.

5.2.3.2.2 The PM2.5 emission (Mc) obtained from the mass concentration is calculated using Formula (3). Where, Mc---the PM2.5 emission calculated based on mass concentration, expressed in (mg);

ts---the measurement start time;

te---the measurement end time;