Passenger cars - Service brake - Structural integrity dynamometer test procedure

1 Scope

This standard sets forth strength test methods on service brakes that normally operate in passenger car, through the use of an inertial dynamometer.

2 Normative reference

The following standards contain which, thorough reference in this Standard, constitute provisions of this Standard. Only the edition of indicated year constitutes the provisions of this Standard but the revision and amendment made thereafter are not applied.

JIS D 0210:1995 General rules of brake test method of automobiles and motor cycles

3 Definitions

The principal terms used in this standard, in addition to those defined in **2** of **JIS D 0210**:1995, are as follows:

3.1

Deceleration 7.8 m/s^2 equivalent torque (ideal allocation: 80 % equivalent torque)

The term applies to the torque required per brake wheel when a vehicle comes to a halt at a 7.8 m/s^2 deceleration, by taking any shift in load into consideration. This torque is calculated according to the following equations:

a) For forward direction control

Front wheel $$T_{ff} = \frac{0.8}{2}\left(W_f + 0.8\frac{H}{L}W\right)r_f$$

Rear wheel $$T_{rf} = \frac{0.8}{2}\left(W_r - 0.8\frac{H}{L}W\right)r_r$$

b) For backward direction control

Front wheel $$T_{fr} = \frac{0.8}{2}\left(W_f - 0.8\frac{H}{L}W\right)r_f$$

Rear wheel $$T_{rr} = \frac{0.8}{2}\left(W_r + 0.8\frac{H}{L}W\right)r_r$$

where,

T_{ff}: Torque per front wheel during forward direction control (N•m)

T_{rf}: Torque per rear wheel during forward direction control (N•m)

T_{fr}: Torque per front wheel during backward direction control (N•m)

T_{rr}: Torque per rear wheel during backward direction control (N•m)

W: Load equivalent to the total mass of the vehicle (N)

W_f: Load equivalent to the mass of the front wheels when the vehicle is loaded (N)

W_r: Load equivalent to the t mass of the rear wheels when the vehicle is loaded (N)

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H: Height of the center of gravity (m)

L: Wheel base (m)

r_f: Front wheel tyre moving load radius (m)

r_r: Rear wheel tyre moving load radius (m)

4 Tests

4.1 Breaking strength test

A test that examines the yielding state or breakage while tracking the process of permanent deformation of a given brake.

In this context, "breakage" refers to a condition in which abnormalities have occurred such as deformations or fractures that adversely affect the functionality of a given brake.

4.2 Durability strength test

A test designed to determine the durability of a given vehicle by employing conditions that are more stringent than normal conditions.

Remarks Both tests **4.1** and **4.2** include forward and backward tests.

5 Requirements

At the time of testing, the components of a brake apparatus must in principle be in the condition provided in **4.3** of **JIS D 0210**:1995.

6 Test methods

6.1 Breaking strength test

6.1.1 Test conditions

The following test conditions must be employed:

6.1.1.1 Inertia

Calculate the inertia according to the following equations, select the closest value from the inertia combinations of the test machine, and set that value:

a) Forward motion

Front wheel $$I_{ff} = \frac{1}{2}\left(W_f + 0.8\frac{H}{L}W\right)\frac{r_f^2}{g}$$

Rear wheel $$I_{rf} = \frac{1}{2}\left(W_r - 0.8\frac{H}{L}W\right)\frac{r_r^2}{g}$$

b) Backward motion

Front wheel $$I_{fr} = \frac{1}{2}\left(W_f - 0.8\frac{H}{L}W\right)\frac{r_f^2}{g}$$

Rear wheel $$I_{rr} = \frac{1}{2}\left(W_r + 0.8\frac{H}{L}W\right)\frac{r_r^2}{g}$$

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where,

I_{ff}: Inertia per front wheel in forward direction (kg•m^2)

I_{rf}: Inertia per rear wheel in forward direction (kg•m^2)

I_{fr}: Inertia per front wheel in backward direction (kg•m^2)

I_{rr}: Inertia per rear wheel in backward direction (kg•m^2)

g: Acceleration due to gravity (9.8 m/s^2)

6.1.1.2 Temperature measurement

Attach a thermocouple according to **6** of **JIS D 0210**:1995 to the fixed side in principle.

6.1.1.3 Cooling air

In principle, employ an airflow velocity of 11 m/s, and adjust so that the air blows uniformly and continuously onto the projection face of the brake.

The temperature of the airflow shall be room temperature.

6.1.2 Test method

The following test method is employed:

6.1.2.1 Preparations

Before attaching a brake to the test machine, make sure there are no abnormalities, and there are no foreign matter, such as grease or paint, is attached to the disc brake pad and the lining face of the drum brake shoe assembly. Clean the drum or disc frictional surface with acetone. Attach thermocouples to prescribed positions on the drum or disc. Attach the brake to the test machine, center it, and record any vibration of the drum or disc.

6.1.2.2 Test items and test sequence

Employ the test items and test sequence given below, and perform forward and backward motions using different brakes (**Table 1**).

On each control, come to a complete stop.

6.1.2.2.1 Initial measurement

Measure and record the dimensions of each brake component.

6.1.2.2.2 Burnishing

1) Direction of turn: Perform a forward test in the forward rotation direction; perform a backward test in the backward rotation direction.

2) Damping initial speed: 65 km/h

3) Damping deceleration speed: 3.5 m/s^2

4) Pre-damping brake temperature: front wheel 120 °C, rear wheel 100 °C

5) Number of damping operations: 200 times. If the braking becomes stable before 200 operations, move to the next test.

6.1.2.2.3 Adjusting the brake

In the case of a drum brake, adjust the gap between the brake lining and the drum according to instructions provided by the car manufacturer.

6.1.2.2.4 Breaking strength test

a) Forward direction

1) Damping initial speed: 50 km/h

2) Pre-damping brake temperature: 80 °C

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3) Assigned torque: Increase the torque in steps from 1/2 the torque equivalent to a 7.8 m/s^2 deceleration to 1/4 the torque equivalent to 7.8 m/s^2. In principle, increase it until the brake breaks.

4) Damping operations: For each set torque, 5 times.

b) Backward direction

Perform a backward direction test only when deemed necessary, according to the load status on the brake mechanism and when the brake is mounted on a real car.

1) Damping initial speed: 20 km/h

2) Pre-damping brake temperature: 80 °C

3) Assigned torque: Increase the torque in steps from 1/2 the torque equivalent to a 7.8 m/s^2 deceleration to 1/4 the torque equivalent to 7.8 m/s^2. In principle, increase it until the brake breaks.

4) Damping operations: For each set torque, 5 times.

6.1.2.2.5 Inspection

The following specifications are intended as an example. For individual items including intermediate inspections and final inspections, make decisions through consultation with the car manufacturer, by taking the type of brake involved into consideration.

a) Drum brake

1) Deformation of the anchor

2) Deformation and crushing of the shoe web

3) Deformation of the backing plate

4) Deformation and loosening of attachments

b) Disc brake

1) Any opening of the pad insertion unit

2) Any opening of the caliper

3) Deformation and loosening of the pad

6.1.2.3 Recording

Record test results as follows:

a) For each torque setting, record any strange noise, abnormal dragging or contact, liquid leakage, or other abnormalities that are noted.

b) The pressure required to set each torque level.

c) The number of actual damping operations and the torque that were required until the brake broke down.

d) With regard to the inspection provided in **6.1.2.2.5**, inspect the brake and record the results after performing 5 damping operations at each torque setting at least 1.5 times greater than the torque equivalent to 7.8 m/s^2.

e) Use the types of recording forms given in **Tables 2** and **3**.

6.2 Durability strength test

6.2.1 Test conditions

Employ the following test conditions:

6.2.1.1 Inertia

See **6.1.1.1**.

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