

Automobile parts - Brake lining and disc brake pad - Wear test procedure on inertia dynamometer

1 Scope

This standard specifies the dynamometer test procedure for the measurement of wear of brake linings and pads to be used in the service brakes of automobiles¹⁾.

Note:¹⁾

Special motor vehicles and motorcycles are excluded from the scope of this standard. Trailers with a nominal gross coupled weight (GCW) exceeding 40 tons are also excluded from the scope of this standard.

2 Normative reference

The following standards, when referenced in this standard, constitute provisions of this standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS D0106	Road vehicles - Brake types, braking mechanics and brake operation - Vocabulary
JIS D0107	Road vehicles - Braking equipment - Vocabulary
JIS D0210	General rules of brake test method of automobiles and motor cycles

3 Definitions

Definitions of main terms used in this standard shall be based on **JIS D0106**, **JIS D0107** and as follows.

3.1

Initial speed

Speed when brake application is initiated and read on a calibrated speed indicator.

3.2

Braking deceleration

Braking deceleration kept almost constant during the brake application by brake lever control force, pedal effort, a pressure control device or the like, except under transient conditions. In a practical test, the value shall be converted into the braking torque calculated in 7 of **JIS D0210**.

3.3

Initial brake temperature

Temperature of drum(s) or disc(s) when brake application is initiated. Where more than one brake is used and tested at the same time, the initial brake temperature shall be the highest of all the brakes.

4 Test conditions

4.1 Condition of each element of braking devices

The condition of each element of braking devices shall be as follows.

- a) The brake linings or pads, the drum(s) or disc(s), and the brake fluid to be used in the test shall be genuine new products at the beginning of the test.
- b) The brake mechanism and the braking devices shall be assembled with genuine parts with normal specifications and functions, and if necessary, shall be suitably adjusted.

4.2 Inertia

Inertia shall be calculated in accordance with 7 in **JIS D0210**. If not following the specified method, indicate so in the recording sheet. The test mass W according to the type of test equipment such as a dual or single dynamometer and test methods shall be the value obtained by distributing the gross vehicle mass by the braking force ratio of each wheel at a braking deceleration of 2.9 m/s^2 .

4.3 Braking torque

Braking torque shall be calculated in accordance with 7 in **JIS D0210**. If not following the specified method, indicate so in the recording sheet. The test mass W shall be the value obtained by distributing the gross vehicle mass by the braking force ratio of each wheel at a braking deceleration of 2.9 m/s^2 .

4.4 Measurement of temperature

The temperature measuring point shall be generally on the rotating side (of drum(s) or disc(s)) and measured in accordance with 6 in **JIS D0210**. If not following the specified method, indicate so in the recording sheet.

4.5 Cooling air

The air velocity shall be, as a rule, 11 m/s , which shall be adjusted so that the air blows uniformly and continuously against the projected area of the brake. The air temperature shall be set to the room temperature. If the initial brake temperature does not reach the target value, the air velocity may be adjusted arbitrary, but it shall be mentioned in the recording sheet.

5 Test procedure

5.1 Preparation for test

Preparation for the test shall be as follows.

- a) Make sure that no abnormalities are found on the brake before installing it on the test equipment. Make also sure that grease, paint, or any other foreign matter is not adhered onto the linings or pads.
- b) Thermocouples shall be attached to the specified locations on the drum(s) or disc(s), and the friction surface shall be cleaned using degreasing agents.
- c) The brake shall be attached onto the test equipment and centred. Drum or disc deflection shall be recorded.

5.2 Test items and test sequence

A list of test items is shown in **Annex A**.

5.2.1 General wear tests

General wear tests shall be as follows.

a) Burnish

Burnish shall be performed as shown in **Table 1**.

Table 1 Burnish conditions

Test item	Braking deceleration (m/s ²)	Initial speed (km/h)	Initial brake temperature (°C)		Number of brake applications
			Drum	Disc	
Burnish	2.9	50	100		200
If the contact of the friction surface is not adequate after the specified number of brake applications, the braking shall be repeated until a sufficient contact is attained.					

b) Wear test

The wear test shall be performed as shown in **Table 2**.

Table 2 Wear test conditions

Test item	Braking deceleration ^{a)} (m/s ²)	Initial speed (km/h)	Initial brake temperature ^{b)} (°C)		Number of brake applications ^{c)}
			Drum	Disc	
Wear test	2.9	50	100	100	1000
			200	200	
			250	250	
			300 (350)	300 350	500
			-	400 (450) (500)	200

Measurement and recording shall be carried out based on **6** and **7** for each temperature.

Remark: Temperature conditions below 100°C may be added to the test if the initial brake temperature is likely to decline due to increased brake size with respect to the vehicle mass and the like.

Note:^{a)}

The output shall be generally kept constant when braking. If the input is kept constant, the pressure shall also be kept constant at a level allowing a braking deceleration equivalent to 2.9 m/s².

Note:^{b)}

Initial brake temperatures in parentheses may be omitted as optional items. If the initial brake temperature does not reach the target value, the conditions may be omitted.

Note:^{c)}

The temperature shall be generally raised without any air when changing the test conditions, and the number of brake applications required to raise the temperature shall be handled as the number of brake applications after the temperature rise.

If adequate wear for measurement is not obtained with the number of specified brake applications, the test frequency may be increased.

c) Second wear test

The second wear test shall be performed as shown in **Table 3**.

Table 3 Second wear test conditions

Test item	Braking deceleration ^{a)} (m/s ²)	Initial speed (km/h)	Initial brake temperature ^{b)} (°C)		Number of brake applications ^{c)}
			Drum	Disc	
Second wear test	2.9	50	100	100	500
			200 (250)	200 (250)	
			(300)	(300)	250
			-	(400)	100
Measurement and recording shall be carried out based on 6 and 7 for each temperature. Remark: Temperature conditions below 100°C may be added to the test if the initial brake temperature is likely to decline due to increased brake size with respect to the vehicle mass and the like. See Note: ^{a)} to ^{c)} in Table 2 for Note: ^{a)} to ^{c)} .					

5.2.2 High speed wear test

It is recommended to refer to **Annex D** for the high speed wear test.

6 Measuring procedure**6.1 Measurement of wear thickness**

The measurement of brake lining or pad wear thickness shall be performed as follows.

a) Measuring instrument

A micrometer or equivalent instruments shall be used.

b) Measuring locations

In order to ensure accurate measurement of brake lining or pad wear, 4 to 6 points on each side (8 to 12 points in total) shall be measured for each lining. For pads, 4 to 8 points shall be selected for the measurement. (See **Annex C**.)

c) Measuring accuracy

The thickness of brake linings or pads shall be measured for each specified test temperature with an accuracy of 0.01 mm under room temperature conditions.

6.2 Measurement of wear mass

It is recommended to measure the mass of brake linings or pads. The method shall be as follows.

a) Measuring instrument

A balance or other equivalent instruments shall be used.

b) Measuring accuracy

The mass of brake linings or pads shall be measured for each specified temperature an accuracy of 0.01 g under room temperature conditions.

If the mass of the brake linings or pads exceeds 1 kg, the accuracy may be 0.1 g.

Remark: It is recommended to measure and record the surface conditions or dimensions of the drum(s) or disc(s).

7 Recording

The recording procedure shall be as follows.

- a) The thickness wear amount shall be expressed as a mean value by averaging all values of the 1000 brake applications. It is also recommended to record the maximum and minimum values for reference.
- b) The wear mass shall be expressed as a mean value by averaging all values of the 1000 brake applications.
- c) It is recommended to calculate the wear rate using the following equation and record the rate.

$$V = \frac{T \cdot A}{E_k}$$

$$E_k = \frac{I \cdot \omega^2 \cdot N}{2}$$

where, V : wear rate ($10^{-7} \text{ cm}^3/\text{N} \cdot \text{m}$)

E_k : total work ($\text{N} \cdot \text{m}$)

I : inertia ($\text{kg} \cdot \text{m}^2$)

T : thickness of wear (cm)

A : area of linings or pads (cm^2)

ω : angular velocity (rad/s)

N : number of brake applications

- d) The temperature, initial speed, number of brake applications, and number of times when the specified temperature was attained during the test shall be recorded.
- e) It is recommended to measure the pressure and braking torque (torque waveform) of brake application intervals of 100 times or less.
- f) The room temperature at the time of the test shall be recorded.
- g) If any abnormalities such as noise, vibration, etc. are found during the test, such abnormalities shall be recorded.
- h) The recording sheets shall be in accordance with **Annex B**.

Remark: It is recommended to record the amount of wear of each brake lining individually for some types of brakes.

Annex A (informative) List of test items

A.1 List of test items

Table A.1 shows the list of test items.

Table A.1 List of test items

Test item		Braking deceleration ^{a)} (m/s ²)	Initial speed (km/h)	Initial brake temperature ^{b)} (°C)		Number of brake applications ^{c)}
				Drum	Disc	
General wear test	Burnish	2.9	50	100		200
	Wear test	2.9	50	100	100	1000
				200	200	
				250	250	
				300 (350)	300 350	500
				-	400 (450) (500)	200
	Second wear test	2.9	50	100	100	500
				200 (250)	200 (250)	
				(300)	(300)	250
-	(400)	100				
High speed wear test	Burnish	2.9	50	100		200
	High speed wear test	2.9	100 ^{d)}	100		100

Note:^{a)}

The output shall be generally kept constant when braking. If the input is kept constant, the pressure shall also be kept constant at a level allowing a braking deceleration equivalent to 2.9 m/s².

Note:^{b)}

Initial brake temperatures in parentheses may be omitted as optional items. If the initial brake temperature does not reach the target value, the conditions may be omitted.

Note:^{c)}

The temperature shall be generally raised without any air when changing the test conditions, and the number of brake applications required to raise the temperature shall be handled as the number of brake applications after the temperature rise.

If adequate wear for measurement is not obtained with the number of specified brake applications, the test frequency may be increased.

Note:^{d)}

If the nominal maximum speed of the test vehicle is below 100 km/h, the test shall be conducted at the nominal maximum speed.