

# Truck and bus – Braking device – Dynamometer test procedures

## 1. Scope

This Standard specifies the test procedures for the dynamometer performance of normally operated service brake devices used in trucks and buses.

## 2. Applicable Publications

The following publication forms a part of this Standard to the extent specified herein. The latest edition of all publications shall apply.

**JIS D0210** General Rules of Brake Test Methods for Automobiles and Motorcycles

## 3. Definitions

Definitions of major terms used herein are specified in **Item 2** of **JIS D0210**.

## 4. Test Conditions

### 4.1 Vehicle Classification

Test vehicles shall be classified in accordance with passenger capacity and total vehicle mass as specified below. The specific vehicle class is shown in brackets ( ) for reference.

Category	Passenger capacity	Total vehicle mass
M2 (Class 1 bus)	10 persons or more	5 tons or less
M3 (Class 2 bus)	10 persons or more	Exceeding 5 tons
N1 (Class 1 truck)	n/a	3.5 tons or less
N2 (Class 2 truck)	n/a	Exceeding 3.5 tons up to 12 tons
N3 (Class 3 truck)	n/a	Exceeding 12 tons

### 4.2 Condition of Brake Parts

The condition of each part of brake devices used in testing shall conform to **Item 4.3** of **JIS D0210** (Condition of Brake Parts).

### 4.3 Inertia

Inertia shall be calculated as specified in **Item 7** of **JIS D0210** (Calculation Equation). Test loads, however, shall be as follows to accommodate specific test procedures and test equipment such as single or dual dynamometers.

- a) Front-and-rear combination tests using a dual dynamometer:  
1/2 of the total vehicle load
- b) Right-left combination tests:  
1/2 of the total vehicle load (single dynamometer) or total vehicle load (dual dynamometer) divided by the ratio of the front and rear wheel braking forces at a braking deceleration of  $4.5 \text{ m/s}^2$  (N1 vehicles) or  $3.0 \text{ m/s}^2$  (N2, N3, M2 and M3 vehicles).

### 4.4 Breaking Torque

Breaking torque shall be calculated as specified in **Item 7** (Calculation Equation) of **JIS D0210** and shall be entered on the test record (Performance Summary Table).

Temperature shall be measured on the fixed side as specified in **Item 6** (Temperature Measurement) of **JIS D0210**.

**Remarks:** Any deviation from the above shall be noted in the test record.

#### 4.5 Temperature Measurement

Temperature shall be measured on the fixed side as specified in **Item 6** (Temperature Measurement) of **JIS D0210**.

**Remarks:** Any deviation from the above shall be noted in the test record.

#### 4.6 Cooling Wind

Cooling wind shall be at room temperature, shall be applied at a velocity of 11 m/s, and shall be directed to blow uniformly and continuously against the projected surface of the brake device.

**Remarks:** Any deviation from the above shall be noted in the test record.

#### 4.7 Temperature Adjustment

When adjustments are required to achieve a specified initial brake temperature refer to **Item 5.2.d** Burnish conditions.

### 5. Test Procedures

#### 5.1 Preparation

The brake device shall be inspected to confirm that there are no abnormalities before being installed on the test equipment. Any foreign matter including grease and paint shall be removed from the surface of the friction material. Specific measuring points on the pad and lining shall be determined prior to testing in order to assure accurate measurement of wear on the friction material. Linings shall be measured at 8 to 12 points, 4 to 6 points on each side. Pads shall be measured at 6 to 8 points, as a rule. The friction surface of the drum or disc shall be clean. A thermocouple shall be installed at a specified location on the lining or pad. The brake device shall be installed and centered on the test equipment. Any deflection of the drum or disc shall be recorded.

**Remarks:** Any deviation from the above shall be noted in the test record.

#### 5.2 Test Items and Sequence

Test items and sequence of the test are specified below and in **Attached Table 1**. In vehicles where the specified braking temperature cannot be readily achieved, the initial brake temperature may be adjusted from 90°C to 65°C, or from 120°C to 80°C, and 150°C to 100°C, respectively.

##### a) Initial measurement

Lining or pad thickness and other brake part dimensions shall be measured and recorded as required.

##### b) Pre burnish check

Initial braking speed:	50 km/h
Braking deceleration:	3.0 m/s <sup>2</sup>
Initial brake temperature:	90°C max.
Repetitions:	10

##### c) First (Pre burnish) effectiveness test

Initial braking speed:	60 km/h & 80 km/h - N1 vehicles 60 km/h - M2, M3, N2 & N3 vehicles
Braking deceleration:	1.0 m/s <sup>2</sup> to 7.0 m/s <sup>2</sup>
Initial brake temperature:	90°C
Repetitions:	Repeat until measurements for 6 or more points are as equal as possible, within total deceleration range

**Remarks:**

- 1- The lower values for initial braking speed and deceleration shall be applied first, as a rule, prior to applying the higher deceleration.
- 2- Constant braking input/output shall be maintained. Any occurrence of inconstant braking shall be noted in the test record.

**d) Burnish**

Initial braking speed: 60 km/h  
 Braking deceleration: 3.0 km/s<sup>2</sup>  
 Initial brake temperature: 120°C - N1 vehicles  
 150°C - M2, M3, N2 & N3 vehicles  
 Repetitions: 200 - N1 vehicles  
 300 - M2, M3, N2 & N3 vehicles

**e) Second effectiveness test**

**1) Low Temperature effectiveness test**

Initial braking speed: 60 km/h  
 Braking deceleration: 1.0 m/s<sup>2</sup> to 7.0 m/s<sup>2</sup>  
 Initial brake temperature: 50°C max.  
 Repetitions: Repeat until measurements for 3 or more points are as equal as possible, within total deceleration range

**2) Normal temperature effectiveness test**

Initial braking speed: 60 km/h, 80 km/h & 120 km/h- N1 vehicles  
 60 km/h & 100 km/h - M2 & N2 vehicles  
 60 km/h & 90 km/h - M3 & N3 vehicles  
 Braking deceleration: 1.0 to 7.0m/s<sup>2</sup>  
 However, it shall be between 1.0 m/s<sup>2</sup> and 5.0 m/s<sup>2</sup> for the following initial braking speeds:  
 100 km/h - M2 & N2 vehicles  
 90 km/h – M3 & N3 vehicles  
 Initial brake temperature : 90°C  
 Repetitions: Repeat until recording 6 or more measuring points that are as equal as possible, within total deceleration range. However, it shall be 5 or more for the following initial braking speeds:  
 100 km/h - M2 & N2 vehicles  
 90 km/h – M3 & N3 vehicles

**Remarks:** If the specified speed exceeds the nominal maximum speed, the test shall be conducted up to the respective maximum speed. Any such changes shall be noted in the test record.

**f) First reburnish test**

Repeat burnish specified in **Item 5.2d**. Repetitions shall be 35.

**g) Light load effectiveness test (Optional)**

The second effectiveness test specified in **Item 5.2c** shall be repeated with the exception of the low temperature effective test.

**Remarks:** 1- The inertia shall be adjusted to Light-load prior to performing the test.  
 2- Upon completion, repeat first reburnish test specified in **Item 5.2f** then proceed to the next test.

**h) Emergency brake test (Optional)**

Initial braking speed: 70 km/h - N1 vehicles  
 60 km/h - M2 & M3 vehicles  
 50 km/h - N2 vehicles  
 40 km/h - N3 vehicles

Braking deceleration: 1.0 m/s<sup>2</sup> to 2.5 m/s<sup>2</sup>  
 Initial brake temperature: 90°C  
 Repetitions: Repeat until 4 or more measuring points are recorded as equally as possible, within total deceleration range.

**Remarks:** 1- For four-wheel and dual dynamometers, the test shall be conducted in response to each system failure. For single dynamometers, the moment of inertia corresponding to the failure shall be added in the test.  
 2- Upon completion, repeat the first rebrake test specified in **Item 5.2f**, then proceed to the next test.

**i) First fade recovery test**

**1) Baseline check**

Initial braking speed: 80 km/h - N1 vehicles  
 60 km/h - M2, M3, N2 & N3 vehicles  
 Braking deceleration: 3.0 km/s<sup>2</sup> and 5.0m/s<sup>2</sup> constant or a constant input that allows that deceleration  
 Initial brake temperature: 90°C  
 Repetitions: 3 at each braking deceleration

**Remarks:** When a constant input is required, select an appropriate pressure in advance to obtain deceleration of 3.0 m/s<sup>2</sup> and 5.0 m/s<sup>2</sup>.

**2) Fade Test**

Initial and final speed: 120 km/h to 60 km/h - N1 vehicles  
 100 km/h to 50 km/h - M2 vehicles  
 60 km/h to 30 km/h - M3, N2 & N3 vehicles  
 Braking deceleration: 3.0 km/s<sup>2</sup> constant or a constant input that allows deceleration  
 Braking interval: 55 s - N1, M2 vehicles  
 60 s - M3, N2 & N3 vehicles  
 Initial brake temperature: 90°C - first fade test only  
 Repetitions: 15 - N1 & M2 vehicles  
 20 - M3, N2 & M3 vehicles

**Remarks:**1- When a constant input is required, after the baseline check, select an appropriate pressure prior to the first brake application to obtain the specified deceleration. Repetitions shall be 3 max.  
 2- When 80% of the nominal maximum speed is lower than the specified initial braking speed, the proportion of braking speed to nominal maximum speed shall be: initial 80% final 40%.

**3) High temperature effectiveness test**

Initial braking speed: 80 km/h - N1 vehicles  
 60 km/h - M2, M3, N2 & N3 vehicles  
 Braking deceleration: 5.0 km/s<sup>2</sup> constant or a constant input that allows that deceleration  
 Braking interval: Basic interval between final fade braking and high temperature effectiveness test shall be 25 s expandable to 40 s

Repetitions: 1

**Remarks:** Record braking intervals in **Attached Table 2**  
(Performance Summary table).

#### 4) Recovery test

Initial braking speed: 80 km/h - N1 vehicles  
60 km/h - M2, M3, N2 & N3 vehicles

Braking deceleration: 3.0m/s<sup>2</sup> constant or a constant input obtained by baseline check for that deceleration

Braking interval: 180 s

Repetitions: 20

#### j) Second reburnish

Repeat first reburnish specified in **Item 5.2f**.

#### k) Second fade recovery test

Repeat fade recovery test specified in **Item 5.2i**. Braking interval and repetitions for M3, N2 and N3 vehicles shall be as follows.

Braking interval: 40 s

Repetitions: 30

#### l) Third reburnish

Repeat first reburnish specified in **Item 5.2f**.

#### m) Final effectiveness test

Repeat second effectiveness test specified **Item 5.2fe**.

#### n) Fourth reburnish

Repeat first reburnish specified in **Item 5.2f**.

#### o) Water recovery test

##### 1) Base line check

Initial braking speed: 60 km/h

Braking deceleration: 3.0 m/s<sup>2</sup> constant or a constant input that allows that deceleration

Initial brake temperature: 90°C

Repetitions: 3

**Remarks:** When a constant input is required, select an appropriate pressure in advance to obtain deceleration of 3.0 m/s<sup>2</sup>.

##### 2) Water immersion

With the brake released, thoroughly immerse the friction material surface in water for 120 seconds while rotating the brake slowly at 10 to 30 rpm. Drum brakes may be removed from the brake system before immersion.

**Remarks:** Upon completion, proceed immediately to the recovery test.

##### 3) Recovery test

Initial braking speed: 60 km/h

Braking deceleration: 3.0 m/s<sup>2</sup> constant or constant input obtained in base line check

Braking interval: 60 seconds

Repetitions: 15

**Remarks:** When a constant input is required, select in advance an appropriate pressure to obtain deceleration of 3.0 m/s<sup>2</sup>.

**p) Final measurement and inspection**

The brake shall be inspected and the observed results shall be recorded. Repeat the initial measurement specified in **Item 5.2a**.

**6. Records**

Records shall be maintained as follows.

- a) Any abnormalities such as noise or vibrations observed at any time during the testing shall be recorded.
- b) Values for braking torque, pressure, temperature and initial braking speed (rotational speed) shall be recorded for each test.
- c) Pressure and braking torque shall preferably be measured continuously.
- d) Room temperature and humidity during tests shall be recorded.
- f) Recording forms are specified in **Attached Tables 2 and 3**.

Attached Table 1 General Performance Test - Test item Table

Test items & Sequence		Vehicle Class	Test Conditions					Remarks				
			Initial Braking Speed km/h	Interval s	Initial Temp. °C	Braking Decel. m/s <sup>2</sup>	Repetitions					
a	Initial Measurement	All	—	—	—	—	—	Measurement of lining (pad) thickness, etc.				
b	Preburnish Check	All	50	—	90 or less	3.0	10					
c	First Effect. Check	N1	60 80 -	—	90	1.0 ~ 7.0	6 or more					
		M2, M3, N2, N3	60 - -									
d	Burnish	N1	60	—	120	3.0	200					
		M2, M3, N2, N3			150		300					
e	Second Effect. Test	All	60 - -	—	50 or less	1.0 ~ 7.0	3 or more	Figures in brackets may be adapted when vehicle speed is over 90km/h, except N1 vehicles.				
		N1	60 80 120									
		M2, N2	60 100 -									
		M3, Ns	60 90 -		90	(1.0 ~ 5.0)	(5 or more)					
f	First Reburnish	All	Same as d) burnish				35					
g	(Light Load Effect. Test)	All	Same as c) Second Effect. Test, except low temperature Effect. Test					Optional Item After this test, repeat f) First Reburnish				
h	(Emergency Brake Test)	N1	70	—	90	1.0 ~ 2.5	4 or more	Optional item  Repeat f) First Reburnish after this test				
		M2, M3	60									
		N2	50									
		N3	40									
i	First Fade and Recovery Test	Base Line Check	N1	80	—	90	3.0, 5.0	3 each				
			M2, M3, N2, N3	60								
		Fade Test	N1	120→60					55	(First time only)	3.0	15 15 20
			M2	100→50					55			
			M3, N2, N3	60→30					60			
High Temp. Effect Test	N1	80	*1	—	5.0	1	*1 Basic interval between final braking and High Temp. Effect. Test shall be 25 seconds, expandable to 40 seconds					
	M2, M3, N2, N3	60										
	Recovery Test	N1	80	180	—	3.0	20					
		M2, M3, N2, N3	60									
j	Second Reburnish	All	Same as f) First Reburnish									
k	Second Fade and Recovery Test	All	Same as l) First Fade and Recovery Test, except M3, N2, N3				40	30				
			Fade Recovery Test									
l	Third Reburnish	All	Same as f) First Reburnish									
m	Final Effect. Test	All	Same as e) Effect. Test, except Low Temp. Effect. Test									
n	Fourth Reburnish	All	Same as f) First Reburnish									
o	Water Recovery Test	Base Line Check	All	60	—	90	3.0	3				
		Water immersion	All	Immerse brake thoroughly in water for 120 seconds.								
		Recovery Test	All	60	60	—	3.0	15				
P	Final Measurement and Inspection	All	—	—	—	—	—	Inspect brake and measure lining (pad) thickness etc.				

**Attached Table 2 Service Brake Device - Brake Dynamometer Performance - Summary Table (Truck & Bus)**

Date: \_\_\_\_\_  
 Test Site: \_\_\_\_\_  
 Tested by: \_\_\_\_\_

**Vehicle Specifications**

Vehicle Name \_\_\_\_\_ Type \_\_\_\_\_ Nominal Max Speed \_\_\_\_\_ km/h Vehicle Category \_\_\_\_\_  
 Test Vehicle Mass \_\_\_\_\_ kg No. \_\_\_\_\_ axle load KN No. \_\_\_\_\_ axle load KN No. \_\_\_\_\_ axle load KN No. \_\_\_\_\_ axle load KN  
 Light Loaded Vehicle Mass \_\_\_\_\_ kg No. \_\_\_\_\_ axle load KN No. \_\_\_\_\_ axle load KN No. \_\_\_\_\_ axle load KN No. \_\_\_\_\_ axle load KN  
 Tyre Size Front \_\_\_\_\_ Rear \_\_\_\_\_  
 Dynamic Tire Effective Radius Front \_\_\_\_\_ mm Rear \_\_\_\_\_ mm

**Brake Specifications**

Type of Brake System \_\_\_\_\_ Full Air \_\_\_\_\_ Air Over Hydraulic \_\_\_\_\_ Hydraulic \_\_\_\_\_ Others \_\_\_\_\_  
 No. \_\_\_\_\_ axle Type Drum Disc \_\_\_\_\_ Cylinder Size \_\_\_\_\_ mm Friction Material \_\_\_\_\_  
 Drum Inside diam. \_\_\_\_\_ mm Disc Effective dia. \_\_\_\_\_ mm X Outside dis. \_\_\_\_\_ mm X Thickness \_\_\_\_\_ mm Sliding area (both wheels) cm<sup>2</sup>  
 Lining (pad) Length (slide direction) \_\_\_\_\_ mm X Width \_\_\_\_\_ mm X Thickness \_\_\_\_\_ mm Sliding area (both wheels) cm<sup>2</sup>  
 No. \_\_\_\_\_ axle Type Drum Disc \_\_\_\_\_ Cylinder Size \_\_\_\_\_ mm Friction Material \_\_\_\_\_  
 Drum Inside diam. \_\_\_\_\_ mm Disc Effective dia. \_\_\_\_\_ mm X Outside dis. \_\_\_\_\_ mm X Thickness \_\_\_\_\_ mm Sliding area (both wheels) cm<sup>2</sup>  
 Lining (pad) Length (slide direction) \_\_\_\_\_ mm X Width \_\_\_\_\_ mm X Thickness \_\_\_\_\_ mm Sliding area (both wheels) cm<sup>2</sup>  
 No. \_\_\_\_\_ axle Type Drum Disc \_\_\_\_\_ Cylinder Size \_\_\_\_\_ mm Friction Material \_\_\_\_\_  
 Drum Inside diam. \_\_\_\_\_ mm Disc Effective dia. \_\_\_\_\_ mm X Outside dis. \_\_\_\_\_ mm X Thickness \_\_\_\_\_ mm Sliding area (both wheels) cm<sup>2</sup>  
 Lining (pad) Length (slide direction) \_\_\_\_\_ mm X Width \_\_\_\_\_ mm X Thickness \_\_\_\_\_ mm Sliding area (both wheels) cm<sup>2</sup>  
 Pedal ratio \_\_\_\_\_ Master Cylinder diam. \_\_\_\_\_ mm Master Cylinder Type \_\_\_\_\_  
 PSPV: Yes/No \_\_\_\_\_ Type \_\_\_\_\_ Other Braking Device: Yes/No \_\_\_\_\_ Type \_\_\_\_\_  
 Area of control pressure for operation energy source \_\_\_\_\_ Mpa

**Brake Dynamometer Test Condition**

Single (Front/Rear), Dual (Front 2 Wheels, Rear 2 Wheels, Front and Rear 1 Wheel each), 4 Wheels  
 Inertia Applied (calculated) \_\_\_\_\_ ( ) kg/m<sup>2</sup>  
 Flywheel rmp/vehicle speed \_\_\_\_\_ rmp/100km/h  
 Temperature Measurement \_\_\_\_\_ Fixed side/Rotate side \_\_\_\_\_  
 Torque/Braking deceleration \_\_\_\_\_ N:m/ \_\_\_\_\_ m/s<sup>2</sup>  From total vehicle mass  From inertia tester Equation \_\_\_\_\_

**Outline of Test Result**

Effectiveness Test  Output constant  Input constant Pedal down or pressure Unit:  Pedal down N  Pressure Mpa

Items	Speed		Km/h		Km/h		Km/h	
	m/s <sup>2</sup>	m/s <sup>2</sup>	m/s <sup>2</sup>	m/s <sup>2</sup>	m/s <sup>2</sup>	m/s <sup>2</sup>	m/s <sup>2</sup>	
First Effect. Test								
Second Effect. Test	Low Temp.							
	High Temp.							
Light Load Effect. Test								
Final Effect. Test								

**Fade Recovery Test**

Output constant (pedal down or pressure)  Input constant (deceleration, torque) Unit: \_\_\_\_\_

Item	Base Line	Fade					High Temp.		Recovery	
	Dece (average) m/s <sup>2</sup>	First	Final	Max.	Min.	Fade ratio	Effect.	Max.	Min.	Recovery Ratio
First Fade	3.0									
Recovery	5.0									
Second Fade	3.0									
recovery	5.0									

Braking interval of high temperature effectiveness test \_\_\_\_\_ second

**Water Recovery Test**

Output constant (pedal down or pressure)  Input constant (deceleration, torque) Unit: \_\_\_\_\_

Item	Base Line	Recovery				
	(Average)	First	Final	Max.	Min.	Recovery ratio
Water Recovery						

**Final Check on each component status**

Friction material \_\_\_\_\_ Drum/Disc \_\_\_\_\_  
 Machine elements \_\_\_\_\_ Hydraulic /Air piping \_\_\_\_\_

**Observations**

\_\_\_\_\_  
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