

Passenger car – 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 passenger cars. Test procedures for two-wheeled vehicles are not included in this Standard.

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**, and include such terms as initial braking speed, braking interval, and initial brake temperature.

4. Test Conditions

4.1 Vehicle Classification

Test vehicles are classified into the following categories by nominal maximum speed as specified below in accordance with the provisions of **JIS D0210**.

- P1: Exceeding 140 km/h
- P2: Exceeding 110 km/h up to 140 km/h
- P3: Exceeding 90 km/h up to 110 km/h
- P4: 90 km/h or less

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).

a) Inertia

Inertia shall be determined by the calculation equation 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 dual or single dynamometers.

- 1) Front-and-rear combination tests using a dual dynamometer: 1/2 of the total vehicle load
- 2) 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 m/s^2

4.3 Temperature Measurement

A thermocouple shall be installed on the fixed side as specified in **Item 6** (Temperature Measurement) of **JIS D0210**, as a rule.

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

4.4 Cooling Wind

Cooling wind shall be at room temperature, shall be applied at a velocity of 11 m/s, as a rule, 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.

4.5 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 10 points, 5 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**.

The vehicle shall be brought to a complete stop with each brake application.

In vehicles where the specified braking temperature cannot be readily achieved, the initial brake temperature may be adjusted from 80oC to 60oC, or from 120oC to 80oC, 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/s²
 Initial brake temperature: 80oC max. - front
 60oC max. - rear
 Repetitions: 10

c) First (pre burnish) effectiveness test

Initial braking speed: 50 km/h & 100 km/h - P1 & P2 vehicles
 50 km/h & 80 km/h - P3 vehicles
 50 km/h & 65 km/h - P4 vehicles
 Braking deceleration: 1.0 m/s² to 10.0 m/s²
 Initial brake temperature: 80°C - front
 60°C - rear
 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: 65 km/h
 Braking deceleration: 3.5 km/s²
 Initial brake temperature: 120°C - front
 100°C - rear
 Repetitions: 200

e) Second effectiveness test

1) Low Temperature effectiveness test

Initial braking speed: 50 km/h
 Braking deceleration: 1.0 m/s² to 10.0 m/s²
 Initial brake temperature: 50°C max. - front/rear
 Repetitions: Repeat until measurements for 4 or more points are as equal as possible, within total deceleration range.

2) Normal temperature effectiveness test

The first effectiveness test specified in **Item 5.2c** above, shall be repeated. The initial braking speeds, however, shall be as follows.

Initial braking speed: 50 km/h, 100 km/h & 130 km/h - P1 vehicles
 50 km/h, 80 km/h & 100 km/h - P2 vehicles
 50 km/h & 80 km/h - P3 vehicles
 50 km/h & 65 km/h - P4 vehicles

f) First rebrinish test

The first effectiveness test specified in **Item 5.2d** shall be repeated. Repetitions shall be 35.

g) Light load effectiveness test (Optional):

The first effectiveness test specified in **Item 5.2c** shall be repeated. Upon completion of the test, the burnish test specified in **Item 5.2d** shall be repeated. Repetitions shall be 35.

h) Emergency brake test (Optional)

Initial braking speed: 100 km/h - P1 vehicles
 100 km/h - P2 vehicles
 65 km/h - P3 vehicles
 50 km/h - P4 vehicles

Braking deceleration: 1.0 m/s² to 6.0 m/s²

Initial brake temperature: 80°C - front
 60°C - rear

Repetitions: Repeat until measurements for 4 or more points are as equal 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 rebrinish test specified in **Item 5.2f**, then proceed to the next test. When the specified braking deceleration is inadequate, the test shall be performed at braking a deceleration of 1.0 m/s² to 2.5 m/s².

i) First fade recovery test

1) Baseline check:

Initial braking speed: $V \max. \begin{smallmatrix} +0 \\ -20 \end{smallmatrix} \text{ km/h} \leq 100 \text{ km/h}$
 Braking deceleration: 5.0 m/s² constant or a constant input that allows that deceleration
 Initial brake temperature: 80°C - front
 60°C - rear
 Repetitions: 3

Remarks: 1- When a constant input is required, select an appropriate pressure in advance to obtain deceleration of 5.0 m/s²

2- When the initial brake temperature must be increased to a specified degree in the fade recovery test, refer to the burnish conditions specified in **Item 5.2d**.

2) Fade test

Initial braking speed: $\sqrt{(80\%V \max.)^2 - (40\%V \max.)^2} \text{ km/h} \leq 100 \text{ km/h}$
 Braking deceleration: 3.0 km/s² constant or a constant input that allows that deceleration
 Initial brake temperature: 60°C front/rear
 Braking interval: 35 seconds - P1 vehicles
 40 seconds - P2 vehicles
 45 seconds - P3 & P4 vehicles

Repetitions: 10

- Remarks:**
- 1- When a constant input is required, select in advance an appropriate pressure for the initial brake application to obtain deceleration equivalent to 3.0 m/s² upon completion of the baseline check. Repetitions shall be increased by 3.
 - 2- When any of the braking intervals above are inadequate, the time cycle may be extended to 45 or 60 s. The adjusted braking interval shall be noted in the test record.
 - 3- Upon completion, proceed immediately to the high temperature effectiveness test. The interval between the two tests shall be 15 seconds, as a rule. This may be extended to a maximum of 35 seconds. Any interval extension shall be noted in the test record.

3) High temperature effectiveness test

Initial braking speed: $V \max. \begin{matrix} +0 \\ -20 \end{matrix} \text{ km/h} \leq 100 \text{ km/h}$

Braking deceleration: 5.0 km/s² constant or a constant input that allows that deceleration

Repetitions: 1

- Remarks:** Vehicle stop/restart interval shall be as short as possible. Upon completion, proceed immediately to the cooling effectiveness test. The braking interval between completion of the first test and first braking of the second test shall be 120 seconds.

4) Cooling effectiveness test

Initial braking speed: 50 km/h

Braking deceleration: 3.0 m/s² constant or a constant input that allows that deceleration

Braking interval: 120 seconds

Repetitions: 4

- Remarks:**
- 1- When a constant input is required, select in advance an appropriate pressure to obtain deceleration of 3.0 m/s².
 - 2- Vehicle stop/restart interval shall be as short as possible. Upon completion, proceed immediately to the recovery test. The braking interval between completion of the first test and first braking of the second test shall be 120 seconds.

5) Recovery test

Initial braking speed: $V \max. \begin{matrix} +0 \\ -20 \end{matrix} \text{ km/h} \leq 100 \text{ km/h}$

Braking deceleration: 5.0 m/s² constant or a constant input obtained by baseline check

Braking interval: 120 seconds

Repetitions: 1

6) Effectiveness spot check (Optional)

Initial braking speed: Same as in 2) Fade test

Braking deceleration: Same as in 2) Fade test

Initial brake temperature: 80°C - front 60°C - rear

Repetitions: 2

- Remarks:** When a constant input is required, select in advance an appropriate pressure to obtain deceleration of 5.0 m/s².

j) Second reburnish Repeat the first reburnish specified in Item 5.2f.

k) Second fade recovery test

1) Base line check

Initial braking speed: 50 km/h

Braking deceleration: 5.0 km/s² constant or a constant input that allows that deceleration

Initial brake temperature: 80°C - front 60°C - rear

Repetitions: 3

- Remarks:**
- 1- When a constant input is required, select in advance an appropriate pressure to obtain deceleration of 5.0 m/s².
 - 2- When the initial brake temperature must be increased to a specified degree in the fade recovery test, refer to the burnish conditions specified in **Item 5.2d**.

2) Fade test

Initial braking speed: $\sqrt{(80\%V \text{ max.})^2 - (40\%V \text{ max.})^2} \text{ km/h} \leq 100 \text{ km/h}$
 Braking deceleration: 5.0 km/s² constant or a constant input that allows that deceleration
 Initial brake temperature: front /rear brake: 60°C first application
 Braking interval: 35 seconds - P1 vehicles
 40 seconds - P2 vehicles
 45 seconds - P3 and P4 vehicles
 Repetitions: 15

- Remarks:**
- 1- When a constant input is required, select in advance an appropriate pressure in the first brake application to obtain deceleration of 5.0 m/s² upon completion of the base line check. Repetitions shall be increased by three.
 - 2- When any of the braking intervals above are inadequate, the time cycle may be extended to 45 or 60 seconds. The adjusted braking interval shall be noted in the test record.
 - 3- Upon completion, proceed immediately to the high temperature effectiveness test. The interval between the two tests shall be 15 seconds, as a rule. This may be extended to a maximum of 35 seconds. Any interval extension shall be noted in the test record.

3) High temperature effectiveness test (Optional)

Initial braking speed: $V \text{ max. } \begin{matrix} +0 \\ -20 \end{matrix} \text{ km/h} \leq 100 \text{ km/h}$
 Braking deceleration: 5.0 km/s² constant or a constant input that allows that deceleration
 Repetitions: 1

- Remarks:** Vehicle stop/restart interval shall be as short as possible. Upon completion, proceed immediately to the recovery test. The interval between completion of the first test and first braking of the second test shall be 120 seconds.

4) Recovery test

Initial braking speed: 50 km/h
 Braking deceleration: 5.0 m/s² constant or a constant input obtained by base line check
 Braking interval: 120 seconds
 Repetitions: 12

5) Effectiveness spot check (Optional)

Initial braking speed: Same as in **2) Fade test**
 Braking deceleration: Same as in **2) Fade test**
 Initial brake temperature: 80°C - front 60°C - rear
 Repetitions: 2

l) Third reburnish

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

m) Final effectiveness test

Repeat the normal temperature effectiveness test specified in **Item 5.2e2**.

An optional test may be done using the following initial braking speeds.

Initial braking speed: 150 km/h - Vehicles with nominal maximum speeds exceeding 160 km/h and less than 170 km/h

160 km/h - Vehicles with nominal maximum speeds
exceeding 170 km/h

n) Fourth reburnish

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

o) Water recovery test

1) Base line check

Initial braking speed: 50 km/h
Braking deceleration: 3.0 m/s² constant or a constant input that allows that
deceleration
Initial brake temperature: 80°C - front 60°C - rear
Repetitions: 3

Remarks: When a constant input is required, select in advance an appropriate pressure to obtain deceleration of 3.0 m/s².

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: 50 km/h
Braking deceleration: 3.0 m/s² constant or a constant input that allows that
deceleration
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/s².

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) Conditions of wear on pads (lining) or discs (drum) before and after the test shall be recorded.
- e) Room temperature and humidity during tests shall be recorded.
- f) Recording forms are specified in **Attached Tables 2 and 3**.

Reference Standards:

JASO C402 Service Brake Road Test Procedures - Passenger Cars
JASO C407 Braking Device - Dynamometer Test Procedures- Truck and Bus

Attached Table 1 General Performance Test items

JASO C406:2000

Test Conditions		Initial Speed	Intervals	Initial	Braking	Repetitions	Remarks				
Vehicle Class		km/h	(s)	Temperature (°C)	Deceleration (m/s ²)						
Test Items & Sequence											
a	Initial Measurement	All	—	—	—	—	Measurement of lining (pad) thickness, etc.				
b	Preburnish Check	All	50	80 or less: Front 60 or less: Rear	3.0	10					
c	First Effect. Check	P1	50 100	—	80: Front 60: Rear	1.0~10.0 range	6 or more at each initial speed				
		P2	50 100								
		P3	50 80								
		P4	50 65								
d	Burnish	All	65	80: Front 60: Rear	3.5	200					
e	1) Low Temp. Effect. Test	P1 to P4	50	—	50 or less	1.0~10.0 range	3 or more				
	2) Normal Temp. Effect. Test	P1	50 100 130					—	80: Front 60: Rear	1.0~10.0 range	6 or more at each initial speed
		P2	50 80 100								
P3		50 80 —									
P4	50 65 —										
f	First Reburnish	All	Repeat d) burnish, 35 repetitions								
g	(Light Load Effect. Test)	All	Same as c) First Effect. Test					After this test, repeat f)			
h	(Emergency Brake Test)	P1 P2 P3 P4	100 100 65 50	—	80: Front 60: Rear	1.0~6.0 range	4 or more	After this test, repeat f) First Reburnish. In case of difficulty the test may be performed with deceleration speed 1.0m/s ² ~2.5m/s ² .			
i	First Fade & Recovery Test	1) Base Line check	All	$V_{max}^{+0/-20} \leq 100$	—	80: Front, 60: Rear	5.0	3			
		2) Fade Test	P1	35	$\sqrt{(80\%V_{max})^2 - (40\%V_{max})^2} \leq 100$	60: at first brake application	3.0	10			
			P2	40							
			P3	45							
			P4	45							
		3) High Temp. Effect. Test	All	$V_{max}^{+0/-20} \leq 100$	—	—	5.0	1	15 sec. After completion of fade test. Max. 35 sec.		
4) Cooling Effect. Test	All	50	120	—	3.0	4	Cooling interval from the last to the next test is 120 sec.				
5) Recovery Test	All	$V_{max}^{+0/-20} \leq 100$	120	—	5.0	1					
j	Second Reburnish	All Repeat f) first reburnish									
		1) Base Line check	All	50	—	80: Front, 60: Rear	5.0	3			
		2) Fade Test	P1	35	$\sqrt{(80\%V_{max})^2 - (40\%V_{max})^2} \leq 100$	60: at first brake application	5.0	15			
			P2	40							
			P3	45							
P4	45										
3) High Temp. Effect. Test	All	$V_{max}^{+0/-20} \leq 100$	—	—	5.0	1	15 sec. After completion of fade test. Max. 35 sec.				
4) Recovery Test	All	50	120	—	5.0	12	Cooling interval is 120 sec.				
k	Second Fade & Recovery Test	5) Effectiveness Spot Check	P1	—	80: Front, 60: Rear	5.0	2				
			P2	$\sqrt{(80\%V_{max})^2 - (40\%V_{max})^2} \leq 100$							
			P3								
			P4								
l	Third Reburnish	All	Repeat f) first reburnish								
m	Final Effectiveness Test	All	Repeat e2) Normal Effectiveness Test, Optional: Perform additional, final effective test of 150km/h (nominal speed Vmax is 160~170km/h) or 160km/h (nominal speed Vmax is over 70km/h)								
n	Fourth Reburnish	All	Repeat f) first reburnish								
o	Water Recovery Test	1) Base line Check	All	50	—	80: Front, 60: Rear	3.0	3			
		2) Water Immersion	All	Immerse brakes thoroughly in water for 120 seconds (10~30r/m)							
		3) Recovery Test	All	50	60	—	3.0	15			
p	Final Measurement and Inspection	All	—	—	—	—	—	Inspect brake lining (pad) thickness, etc.			

Test items in the bracket are optional items.

Attached Table 3 Braking Device Dynamometer - Performance Report - Summary (Passenger Car)

Test Date: D M Y
 Test Site: _____
 Tested by: _____

1 Test Specifications

Vehicle Name: _____ Type: _____

Test Load Max.nominal load Front: _____ kgm² Rear: _____ kgm² Total: _____ kgm²
 Light Load Front: _____ kgm² Rear: _____ kgm² Total: _____ kgm²
 Tire Size _____ Dynamic tire effective radius _____ mm

Front brake
 Type: _____ Cylinder diameter: _____ mm Effective braking radius: _____ mm
 Friction material: _____ Lot No.: _____
 Disc size specs. Outside dia.: _____ Thickness: _____ Type: ventilated , solid

Rear Brake
 Type: Drum/ Disc _____ Cylinder diameter: _____ mm Effective braking radius: _____ mm
 Friction material: _____ Lot No.: _____
 Disc size specs. Outside dia.: _____ mm Thickness: _____ Type: ventilated , solid
 Drum size specs:(Pitch dia.): _____ mm Outside dis.: _____ mm Thickness: _____ mm Sliding area: _____ cm²
 Lining size Length(slide direction): _____ mm Width: _____ Thickness: _____ Sliding area: _____ cm²

Test Result Record

Test Items		Speed	Deceleration	
		Km/h		
Effectiveness Test	1st Effect.	50		
		100		
		50 (low temp.)		
	2nd Effect.	50		
		100		
		130		
	Final Effect.	50		
		100		
		130		
			Vmax	
Burnish 200 times				
First fade recovery	Fade	First time		
		Max.		
		Min.		
		Max. Temp.		
	Fade ratio			
	High temp. effectiveness			
	Low temp. effectiveness			
Recovery	Max.			
	Min.			
	Recovery ratio			
Second fade recovery	Fade	The first time		
		Max.		
		Min.		
		Max. Temp.		
	Fade ratio			
	Recovery	Max.		
		Min.		
Recovery ratio				
Water fade recovery	Max.			
	Min.			
	Recovery ratio			
Wear of friction material	Inner (mm)			
	Outer (mm)			
Wear of counter materials	Thickness (mm)			
	Weight (g)			
Final check	Changes of Discs			