Truck and bus - Service brake structural integrity test procedure

1. Scope

This standard specifies the test procedures for evaluating the structural integrity of normally operated service brakes of trucks and buses.
Trucks include tractors, but not trailers.

2. Normative reference

The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard.
If the indication of the year of coming into effect is given to these referred standards, only the edition of indicated year constitutes the provision 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

Definitions of main terms used in this standard shall be as follows, in addition to those defined in **2.** (Definitions) of **JIS D0210**.

3.1 Brake temperature before brake is applied

Brake temperature read at a point in time within 15s before the start of braking. If there is any specification about the brake temperature, it represents the highest value among the average values of the brake temperature taken of each wheel.

3.2 Spike stop

A particularly powerful braking operation performed for the purpose of testing structural integrity of the brake, and its pedal force-time characteristics meeting the following requirements (see **Attached Figure 1**).

a) The pedal force rising gradient shall be targeted at 10 kN/s and should range between 5 and 20 kN/s. The range of up to a pedal force of 0.3 kN within 0.03 s after the rise of the pedal force is not, however, covered. The pedal force rising gradient α may be given by equation (1).

$$\alpha = F/t \quad \cdots\cdots (1)$$

where, α: pedal force rising gradient (kN/s)
F: pedal force (kN)
t : elapsed time after the start of pedal force rise (s)

b) Having the target to reach 1 kN (0.7 kN) within the abovementioned gradient range, the pedal force must reach a point that falls within the range of 0.8 to 1.2 kN (0.5 to 0.9 kN). That pedal force is thereafter maintained up to a complete stop. The pedal force may, however, be decreased as long as a condition is maintained, in which a wheel lock exists or the ABS (anti-lock brake system) is being activated.
The maximum pedal force value should not exceed 1.2 kN (0.9 kN) throughout the entire range.

Remark: The values not indicated in parentheses are applied during the forward motion, while those indicated in parentheses are applied during the backward motion.

c) With the air brake (including the combined brake), the brake pedal is to be depressed to make a full-stroke motion within 0.2 s.

3.3 Brake line pressure

Fluid pressure or air pressure measured at a point near the wheel cylinder or brake chamber

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4. Test conditions

4.1 Vehicle classification

Test vehicles shall be classified into the following categories according to the riding capacity and gross vehicle mass.

Each of these categories is designated as follows. Given in parentheses for reference are the names used in the technical regulations for braking equipment of trucks and buses.

Category M2 (Class 1 buses): Buses with a riding capacity of 10 persons or more and a gross vehicle mass of 5 t or less

Category M3 (Class 2 buses): Buses with a riding capacity of 10 persons or more and a gross vehicle mass of more than 5 t

Category N1 (Class 1 trucks): Trucks with a gross vehicle mass of 3.5 t or less

Category N2 (Class 2 trucks): Trucks with a gross vehicle mass of more than 3.5 t and less than 12 t

Category N3 (Class 3 trucks): Trucks with a gross vehicle mass of more than 12 t

4.2 Vehicle conditions

The test vehicles during the test shall comply with the following requirements, in addition to the conditions as specified in **4.1** (Vehicle conditions) of **JIS D 0210**.

a) The following measuring instruments shall be mounted in principle. They must be properly calibrated.

Thermometer
Deceleration meter
Pedal force-time recorder (capable of measuring more than 30 Hz)

b) For the air brake, pedal switch A (actuated simultaneously with the start of depression of the pedal) and pedal switch B (actuated simultaneously with the full-stroke motion of the pedal) shall be installed.

c) If the vehicle manufacturer specifies several different types of tyres for use in ordinary running, one having the greatest moment of inertia should be selected. Completely new or fairly new tyres developing no abnormal wear shall be mounted.

d) Wheel alignment should be adjusted according to the instructions given by the vehicle manufacturer at the start of the test. The adjusted values must be recorded.

4.3 Conditions of brake parts

The conditions of each of different brake parts at the time of testing shall comply with **4.3** (Conditions of brake parts) of **JIS D 0210**.

4.4 Conditions of road surface and weather

The conditions of the road surface and weather shall comply with **4.2** (Conditions of road surface and weather) of **JIS D 0210**.

4.5 Temperature measurement method

Measurement of brake temperature shall comply with **6** (Temperature measurement method) of **JIS D 0210**.

5. Test procedures

5.1 Test items and test order

Test items and test order shall comply with the following (see **Reference Table**).

a) Check before burnishing

Initial speed:	50 km/h
Gearshift position at braking:	Neutral; drive range for the vehicle with the automatic transmission
Brake temperature:	90 °C max
Braking operation:	Braking deceleration at 3.0 m/s^2 constant, complete stop
Number of braking operations:	10 times max
Record:	Pedal force or brake line pressure and brake temperature

Remark: It is allowed to proceed directly to the next test item, if the test equipment, brake, and the vehicle remain fully operational throughout this test.

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b) Spike stop test before burnishing

Initial speed: 50 km/h for N1 vehicle; 30 km/h for M2, M3, N2, and N3 vehicles
Gearshift position at braking: Neutral; drive range for the vehicle with the automatic transmission
Brake temperature: 90 °C
Braking operation: Forward spike stop, complete stop
Brake interval: Not specified, but the above temperature condition must be met as a rule.
Number of braking operations: Twice
Record: Pedal force-time characteristics (time for the brake pedal to make a full-stroke motion with the air brake) and brake temperature

c) Functional check before burnishing

Initial speed: 50 km/h
Gearshift position at braking: Neutral; drive range for the vehicle with the automatic transmission
Brake temperature: 90 °C
Braking operation: Braking deceleration at 3.0 m/s^2 constant, complete stop
Number of braking operations: Twice
Record: Pedal force or brake line pressure, abnormal condition of brake (operation feeling, performance, directional stability, noise, etc.)

d) Burnishing

Initial speed: 60 km/h
Gearshift position at braking: Ordinary drive position
Brake temperature: 120 °C for N1 vehicle; 150 °C for M2, M3, N2, and N3 vehicles (If the brake temperature falls short of the specified value, apply brake immediately and continuously.)
Braking operation: Braking deceleration at 3.0 m/s^2 constant, complete stop
Cooling speed: 60 km/h
Acceleration conditions: Ordinary acceleration
Number of braking operations: 200 times for N1 vehicle; 300 times for M2, M3, N2, and N3 vehicles
Record: Pedal force or brake line pressure, braking deceleration and brake temperature (optional) (for every first and 20th braking)

Remark 1: A break may be taken in the middle of the test; however, it is desirable that the number of consecutive braking operations be 40 times or more.

Remark 2: The number of braking operations performed before the brake temperature reaches the specified level should not be included in the number of burnishing operations.

e) Brake adjustment

The clearance between the brake lining (or pad) and the drum (or disc) shall be as specified in the maintenance manual or technical manual of the vehicle in question (but not required for a system with an auto adjuster).

f) Functional check after burnishing

Repeat of **c) of 5.1**

g) Spike stop test after burnishing

Initial speed: Forward 50 km/h and reverse 10 to 20 km/h for N1 vehicle; forward 30 km/h and reverse 10 to 20 km/h for M2, M3, N2, and N3 vehicles
Gearshift position at braking: Neutral; drive range for the vehicle with the automatic transmission
Brake temperature: 90 °C
Braking operation: Alternately perform forward spike stop and reverse spike stop.
Brake interval: Not specified, but the above temperature condition must be met as a rule.
Number of braking operations: Forward 10 times and reverse 10 times for N1 vehicle; forward 40 times and reverse 40 times for M2, M3, N2, and N3 vehicles

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Record: Pedal force-time characteristics (time for the brake pedal to make a full-stroke motion with the air brake) and brake temperature

h) Final functional check

Repeat of **c) of 5.1**

i) Inspection

Check each of the following parts for possible deformation, damage, looseness, fluid leak (air leak), abnormal brake drag or contact, or any other abnormal symptom and record if any.

Pedal, pedal bracket
Master cylinder, servo unit, or brake valve
Pressure line
Wheel brake
Wheel alignment

5.2 Permissible range of changes made in test conditions

a) Test braking may be initiated if the reading taken on the calibrated measuring instruments with respect to the specified conditions falls within the following range for each of the following items.

1) For initial speed, the range of ±3 km/h with respect to the specified initial speed. This range is not, however, applied to reverse spike stop. Further, if the speed equivalent to 80 % of the nominal maximum speed is smaller than the specified initial speed value, the specified initial speed is replaced by 80 % of the nominal maximum speed.

2) For brake temperature, the range of ±10 °C with respect to the specified brake temperature. In a vehicle in which it is particularly difficult to raise the brake temperature, however, the test may be conducted by changing the brake temperature to 65 °C for 90 °C, 80 °C for 120 °C, and 100 °C for 150 °C. If the brake temperature is changed, record that value.

b) Tests are conducted for the following items by keeping the reading taken on the calibrated measuring instruments as close as possible to a target value that falls within the following range with respect to the specified conditions.

1) For braking deceleration, it shall be in the range of +0.5/0 m/s^2 with respect to the specified braking deceleration. If a specific value falling within this range is selected as the target value, record that value.

5.3 Braking operations for purposes other than testing

Braking operations performed for purposes other than testing should be avoided as much as feasible. If it is necessary to heat the brake to a specified temperature, however, carry out braking operations with the initial speed and braking deceleration set according to the burnishing conditions.

5.4 Change of applicable vehicle category

If a test is necessary for vehicle categories other than the specified ones, tests may be conducted by changing the vehicle categories.

6. Record

6.1 Recording procedure

The following procedure applies for recording the tests.

a) Throughout the test period, take note of all abnormal braking performance, noise, vibration, and other unusual phenomena and record the specific details of the phenomena.

b) If a wheel lock occurs at any time during the test period, record the position of the wheel at which the wheel lock occurs, the conditions, in which the wheel lock occurs, and associated information.
If the ABS is activated during the time, record the activation of the ABS.

c) The sequence, in which the brake temperatures of wheels are read, should be the same throughout the entire test period.

d) For the pedal force-time characteristics in spike stop, read and record each of the following values based on the waveform on the recorder. In this case, time should start with the start of a pedal force rise.

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1) Elapsed time until a pedal force of 0.8 kN is first reached in forward spike stop and a pedal force of 0.5 kN is first reached in reverse spike stop.

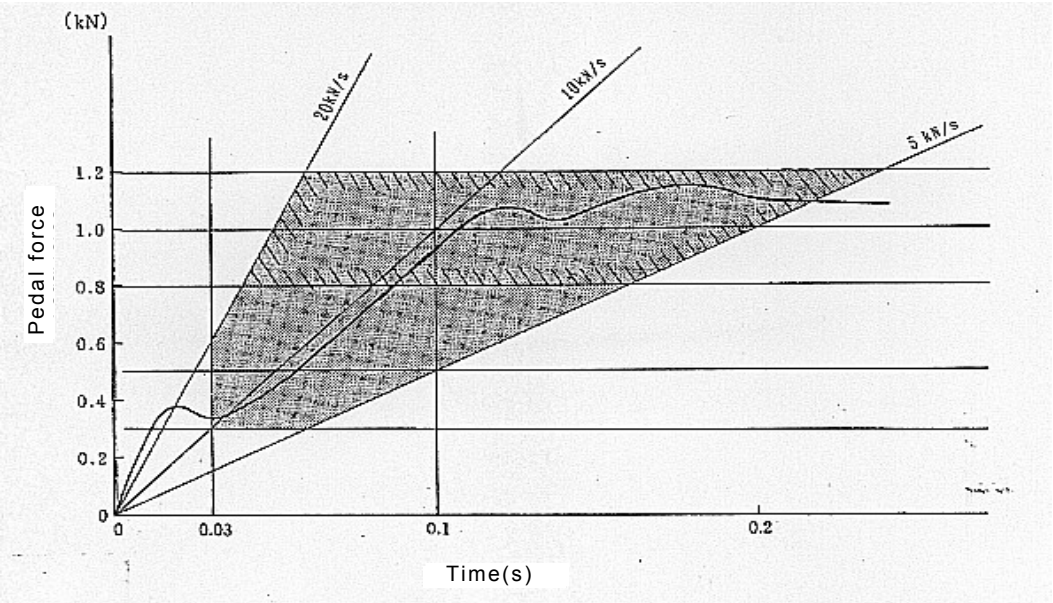
2) The maximum pedal force during braking and the elapsed time until it is reached

3) With the air brake, the elapsed time that begins when pedal switch A is actuated and ends when pedal switch B is actuated

6.2 Record format

a) The format for the record shall comply with "Service brake specifications & summary sheet of structural integrity test results (**Attached Table 1**).

b) Attached Tables 2 and **3** show, for reference, the formats of test results according to the test items.



Attached Figure 1 Example of pedal force-time characteristics in forward spike stop

Reference Standards and Regulations:

JASO C 404	Truck and bus - Service brake road test procedure
JASO C 417	Service brake structural integrity test procedure passenger car
SAE J294	Service brake structural integrity test procedure - vehicles over 4500 kg (10 000 lb) GVWR

Technical Regulations for truck and bus braking equipment (December 20, 1996)

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Attached Table 1 Service brake specifications & data sheet of structural integrity test results (trucks and buses)

Test no. _____
Date _____
Test site _____
Tested by _____

Vehicle specifications

Vehicle name_____Model_____Chassis no._____Year of manufacture_____

Axle arrangement_____Engine model_____Total displacement_____cm^3

Nominal maximum speed_____km/h Vehicle category_____

Gross vehicle mass_____kg

Nominal axial load 1st axle____kN 2nd axle____kN 3rd axle____kN 4th axle____kN Total____kN

Test load 1st axle____kN 2nd axle____kN 3rd axle____kN 4th axle____kN Total____kN

Overall length_____mm Overall width_____mm Overall height_____mm Wheelbase_____mm

Tyre size 1st axle_____ 2nd axle_____ 3rd axle_____ 4th axle_____

Tyre dynamic load radius 1st axle_____mm 2nd axle_____mm 3rd axle_____mm 4th axle_____mm

Brake specifications

Brake system type: air, hydraulic, others _____

Pedal ratio_____Master cylinder diameter(mm)_____Master cylinder type_____

	1st axle	2nd axle	3rd axle	4th axle
Brake type				
Drum diameter mm				
Disc O.D. × effective diameter × thickness mm				
Wheel cylinder diameter mm				
Lining width × thickness ×length mm				
Friction material				
Friction surface area (both wheels) mm^2				
Chamber size				

		Before burnishing		After burnishing (forward)			After burnishing (reverse)		
		1st	2nd	Max	Min	Average	Max	Min	Average
Spike stop test	Pedal force rising gradient kN/s								
	Maximum pedal force value kN								
	Pedal stroke time sec								
	Evaluation								

Functional check	Pedal pressure or brake line pressure kN or MPa	☐Normal	☐Abnormal
	Brake operation feeling	☐Normal	☐Abnormal
	Braking performance	☐Normal	☐Abnormal
	Directional stability during braking	☐Normal	☐Abnormal
	Noise during running or braking	☐Normal	☐Abnormal
	Other observations	☐Normal	☐Abnormal

Observations during inspection	Pedal, pedal bracket	☐Normal	☐Abnormal
	Master cylinder, servo unit, or brake valve	☐Normal	☐Abnormal
	Brake line pressure	☐Normal	☐Abnormal
	Wheel brake(front wheel)	☐Normal	☐Abnormal
	Wheel brake(rear wheel)	☐Normal	☐Abnormal
	Wheel alignment	☐Normal	☐Abnormal
	Other observations	☐Normal	☐Abnormal

General observations_____

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