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JIS

JAPANESE INDUSTRIAL STANDARD

General rules of brake test method of automobiles and motor cycles

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In the event of any doubt arising,
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General rules of brake test method of automobiles and motor cycles

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1. Scope This Japanese Industrial Standard specifies difinitions, vehicle division, test conditions, braking speed measuring method, temperature measuring method and calculation formula to be used in common to the brake test method of automobiles.

Remarks: The following standards are cited in this Standard:

JIS C 1602 Thermocouples

JIS D 0106 Road vehicles – Brake types, braking mechanics and brake operation – Vocabulary

JIS D 0107 Glossary of terms relating to braking equipments of automobiles

2. Definitions For the purposes of this Standard, the definitions given in JIS D 0106 and JIS D 0107, and the following definitions apply.

(1) cooling running velocity A definite velocity to run for the purposes of brake cooling and of entrance running for the following braking.

(2) brake temperature before braking The brake temperature read-out according to the specification before starting of braking.

(3) difinite braking deceleration The braking deceleration to be kept at approximately constant during braking according to lever control force and adjustment of pedal pressure, excepting transient state.

(4) definite pedal pressure or definite control force The pedal pressue or control force kept approximately constant during braking, excepting the transient state.

(5) braking interval In repetition of braking operation, the lapse of time or the lapse of distance from a starting time of braking operation until the next starting time of braking operation.

(6) heat-fade test requiring time The lapse of time from the first starting time of braking operation till the final starting time of braking operation in the heat-fade test.

(7) normal driving position The state at the maximum speed change stage at which the speed change gear can be maintained at a specified braking initial speed, excepting overdrive.

(8) neutral position The state where the speed change gear is placed at a neutral position or the clutch is cut, prior to starting the braking operation.

(9) spike braking A specially strong force braking operation, the pedal pressure-time characteristics of which satisfy the following specifications. However, it does not apply to two-wheeled vehicle.

(a) The pedal pressure build-up time grade shall be aimed at 10 kN/s and be within the range of 5 kN/s to 20 kN/s. However, the range of within 0.03 s from the time point of pedal pressure build-up time and the range of pedal pressure of 0.3 kN or less are not the object of the specification.

The pedal pressure build-up time grade (a) can be calculated by the following formula (1):

$$a=\frac{F}{t} \quad \cdots\cdots (1)$$

where, a : pedal pressure build-up time grade (kN/s)
F : pedal pressure (kN)
t : lapse of time from start of pedal pressure build-up (s)

(b) The pedal pressure shall be aimed at reaching 1 kN (0.7 kN) in the range of abovementioned grade, and shall be reached to the range of 0.8 kN[0.5 kN to 1.2 kN(0.9 kN)]. Thereafter, the pedal pressure shall be maintained until complete stopping. However, as far as the wheel lock state or the state of antilock device actuating is maintained, the pedal pressure may be lowered.

Furthermore, the maximum value of pedal pressure shall not exceed 1.2 kN (0.9 kN) over the whole range.

Remarks: The value without parentheses ( ) applies to advancing time, and the value given in ( ), to retreating time.

(c) In the air brake (including double brake), the brake pedal shall be trodden so that the whole stroke is reached within 0.2 s.

3. Vehicle division In the case where the test vehicles are divided according to the maximum velocity, those shall be divided by the following velocity:

Division 1 Those exceeding 140 km/h in maximum velocity.

Division 2 Those exceeding 110 km/h up to and including 140 km/h in maximum velocity.

Division 3 Those exceeding 90 km/h up to and including 110 km/h in maximum velocity.

Division 4 Those exceeding 60 km/h up to and including 90 km/h in maximum velocity.

Division 5 Those of 60 km/h or less in maximum velocity.

4. Test conditions

4.1 Vehicle condition The vehicle condition at the testing time shall be as follows:

(1) The distributed load at the testing time of vehicle for test shall be the state as near the distributed load at fully laden condition as possible in the state of containing testing person and test appliances, excepting following (2).

In the case of connected vehicle, the gross mass of test trailer at the time of test and the distributed load at the time of connection shall be as near as possible to the specified value of the maker.

(2) The vehicle condition at lightly laden time shall be the condition as near as possible to the distributed load when two persons are ridden on the front seat of vehicle at distributed load in unladen condition in the state including testing persons and test appliances. However, this does not apply to two-wheeled vehicles.

(3) The test vehicle shall be under the normal maintained condition.

The wheel alignment, tire air pressure, tire wearing condition and the condition of parts concerning the test shall be adequate condition throughout the whole test period.

4.2 Condition of road surface and weather The condition of road surface and weather shall be as follows:

(1) Test road surface The road surface for carrying out the test braking operation shall be a flat and hard paved road surface of dry concrete using dry Portland cement or that having equivalent friction coefficient. The gradient of road surface for braking operation to be carried in the case specially specified shall be ±1% or less.

(2) Atmospheric temperature The atmospheric temperature at the time of carrying out the test shall be in the range where the performance is not remarkably influenced, and that at the time of carrying out heat-fade recovery test should preferably be 4°C up to and including 35°C.

(3) Wind velocity The wind velocity at the time of carrying out the test shall be in the range where the performance is not remarkably influenced, and usually it is desirable that the wind velocity is not more than 5 m/s.

4.3 Condition of each part of braking device The condition of each part of braking device at the time of testing shall, as a rule, be as follows:

(1) For brake lining or pad, drum or disc and brake liquid, the normal new products shall be used to start the test.

(2) The braking device shall be of normal specifications, be assembled with parts having normal performance and be adjusted adequately as required.

5. Measuring method of braking speed The measurement of initial braking speed and the final braking speed shall be carried out as follows:

(1) Initial braking speed The speed directly before starting of braking operation shall be read out according to the calibrated speedometer.

(2) Final braking speed The speed directly after completion of braking operation shall be read out according to the calibrated speedometer.

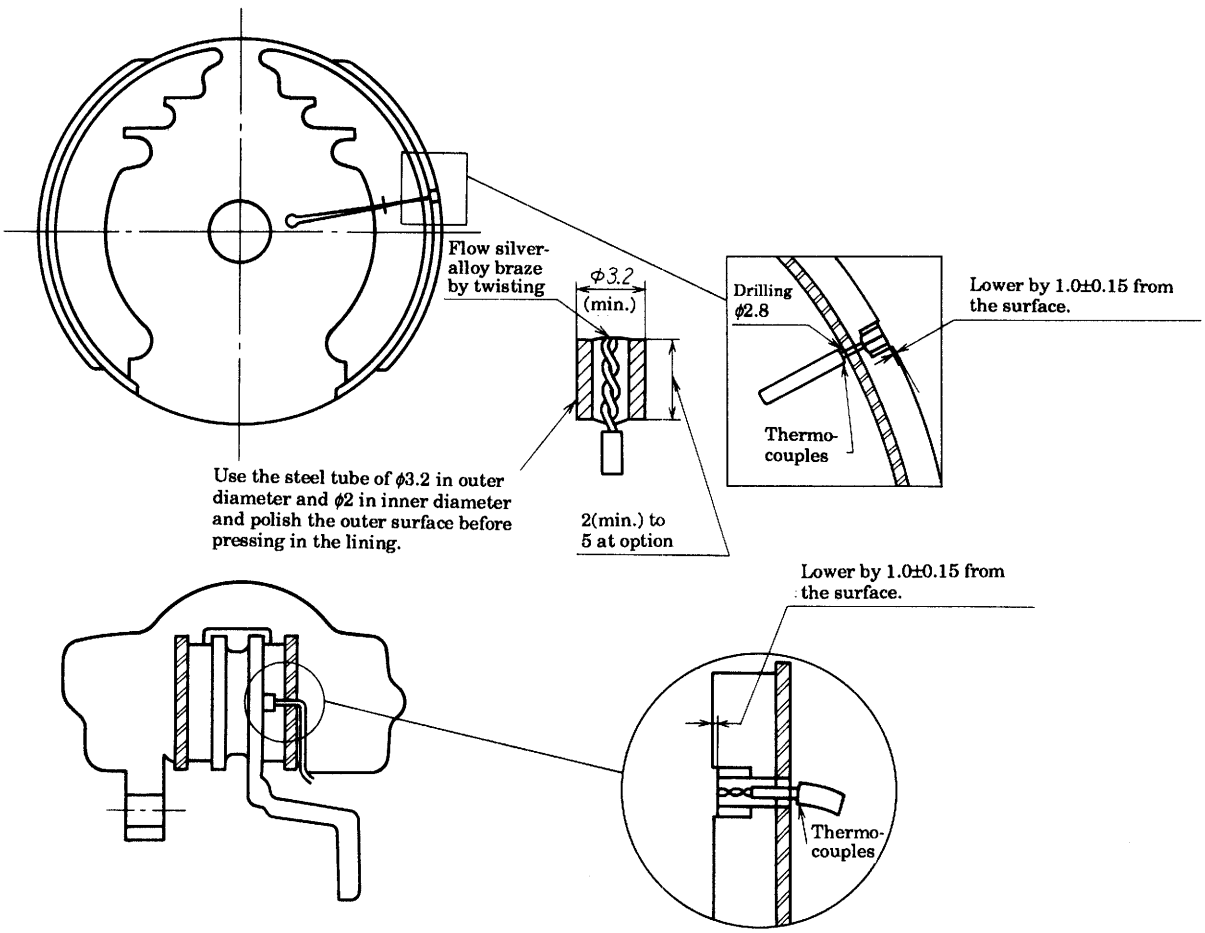
6. Temperature measuring method The measurement of brake temperature shall, as a rule, be carried out as follows:

Remarks: As for the thermocouples, see JIS C 1602.

(1) In the case of measuring on fixed side (see Fig. 1) For each brake, attach the thermocouples at approximately middle of brake lining at maximum load or of friction surface of pad, and also at a position apart by 1 mm from the surface.

Fig. 1

Unit: mm



(2) In the case of measuring on rotary side (see Fig. 2)

In the case of drum Attach the thermocouples at approximately middle of sliding surface of lining and at a position 2 mm to 3 mm from inner surface of drum.

In the case of disc Attach the thermocouples at approximately effective radius of disc and at approximately middle of thickness of disc.

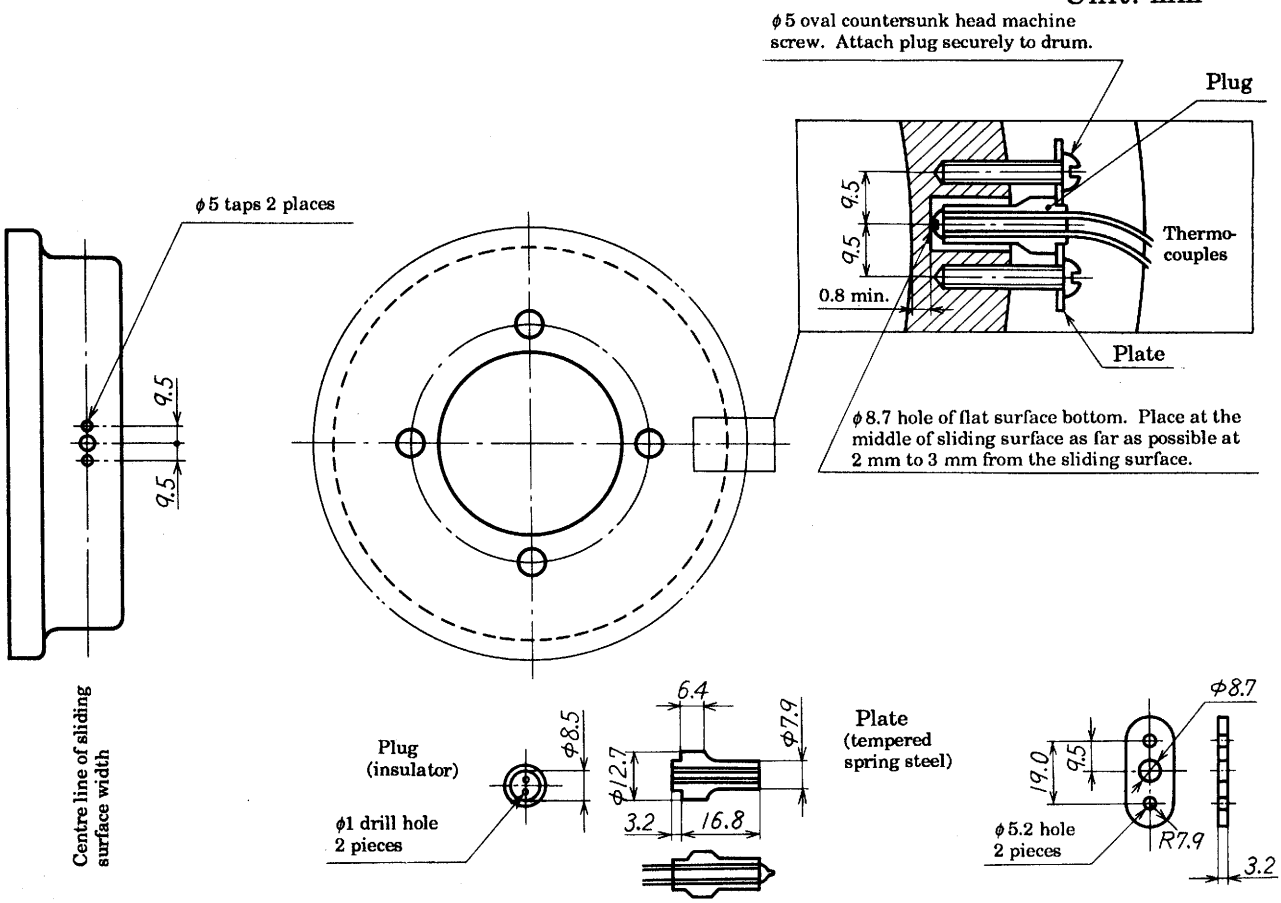
Further, where the disc is extremely thick, attach at a position of 5 mm from the surface.

Remarks: However, in case where it is not in accordance with the above-mentioned, the effect shall be recorded.

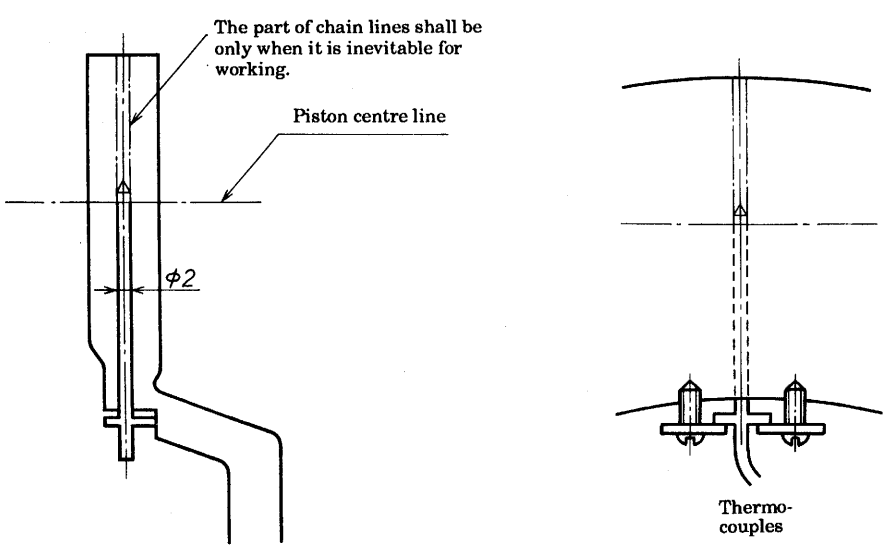
Fig. 2

In the case of drum

Unit: mm



In the case of disc



Remarks: In case where it is impossible to make as the above described owing to the shape of disc (for example, ventilated disc), let it approach to the above position as far as possible.

7. Calculation formulae The calculation formulae to obtain the moment of inertia, braking torque and braking factor shall be as follows: However, these shall not be applied to two-wheeled vehicles.

(1) The moment of inertia and braking torque when tested with ordinary brake specifications:

$$I = m \cdot r^2 = \frac{W \cdot r^2}{g}$$

$$T = m \cdot r \cdot b = \frac{W \cdot r}{g} b \quad \text{or} \quad T' = \frac{I'}{r} b$$

Further, according to the using testing machine such as dual dynamometer, single dynamometer, etc. and the test method, W (test load) shall be taken as the following values:

(1.1) In the case where the front-rear combination test is carried out with dual dynamometer:

$$W = \frac{1}{2} \cdot W_T$$

(1.2) In the case where the right-left combination test is carried out with dual dynamometer:

(a) The value of load equivalent to gross mass of automobile distributed by braking force distribution of front and rear wheels at the specified braking deceleration:

Front wheel $\quad W = W_T \cdot \frac{Bf}{Bf + Br}$

Rear wheel $\quad W = W_T \cdot \frac{Br}{Bf + Br}$

(b) The value of load equivalent to gross mass of automobile distributed by taking into consideration the load traveling caused by specified braking deceleration:

Front wheel

At advancing $\quad W = Wf + W_T \cdot A \cdot \frac{H}{L}$

At retreating $\quad W = Wf - W_T \cdot A \cdot \frac{H}{L}$

Rear wheel

At advancing $\quad W = Wr - W_T \cdot A \cdot \frac{H}{L}$

At retreating $\quad W = Wr + W_T \cdot A \cdot \frac{H}{L}$

(1.3) In the case where the test is carried out with a single dynamometer.

(a) The value of $^1/_2$ of the load equivalent to gross mass of automobile distributed by braking force distribution of front and rear wheels at the specified braking deceleration:

Front wheel $W = \frac{W_T}{2} \cdot \frac{Bf}{Bf + Br}$

Rear wheel $W = \frac{W_T}{2} \cdot \frac{Br}{Bf + Br}$

(b) The value of $^1/_2$ of the load equivalent to gross mass of automobile distributed by taking into consideration the load traveling caused by specified braking deceleration:

Front wheel

At advancing $W = \frac{Wf}{2} + \frac{W_T}{2} \cdot A \cdot \frac{H}{L}$

At retreating $W = \frac{Wf}{2} - \frac{W_T}{2} \cdot A \cdot \frac{H}{L}$

Rear wheel

At advancing $W = \frac{Wr}{2} - \frac{W_T}{2} \cdot A \cdot \frac{H}{L}$

At retreating $W = \frac{Wr}{2} + \frac{W_T}{2} \cdot A \cdot \frac{H}{L}$

where, I : moment of inertia when testing at ordinary brake specifications {kg·m^2}

W : test load {N}

r : tire dynamic load radius (m)

g : acceleration of gravity (9.8 m/s^2)

T : braking torque obtained from the load {N·m}

T' : braking torque obtained from moment of inertia {N·m}

I' : moment of inertia at testing {kg·m^2}

b : braking deceleration (m/s^2)

m : test mass (kg)

W_T : load equivalent to gross mass of automobile {N}

Wf : front axle load at laden condition {N}

Wr : rear axle load at laden condition {N}

Bf : front-wheel braking force {N}

Br : rear-wheel braking force {N}

A : ratio of braking deceleration relative to gravity acceleration $\left(\frac{b}{g}\right)$

H : height of centre of gravity (m)

L : wheel base (m)

(2) Moment of inertia and braking torque at testing with parking brake specifications:

$$I_{p1}=\frac{m_T \cdot r^2}{N \cdot f^2}$$

$$T=m_T \cdot r \cdot b \quad \text{or} \quad T'=\frac{I'_{p1} \cdot N \cdot f^2}{r} b$$

where, I_{p1} : moment of inertia at testing with parking brake specifications {kg·m²}

r : tire dynamic load radius (m)

f : final reduction gear ratio (in the case of assembly type, take it as 1)

N : number of brakes at parking braking

T : braking torque obtained from the load {N·m}

T' : braking torque obtained from moment of inertia {N·m}

I'_{p1} : moment of inertia at testing {kg·m²}

b : braking deceleration (m/s²)

m_T : gross mass of automobile (kg)

(3) Braking factor

$$e=\frac{\sum(F_i-f_i)}{(\sum W_j+\sum W_{fj}) \cdot g}=\frac{(F_1-f_1)+(F_2-f_2)+\cdots\cdots+(F_m-f_m)}{(W_1+W_2\cdots\cdots+W_n+W_{f1}+W_{f2}\cdots\cdots+W_{fn}) \cdot g}$$

where, e : braking factor

W_{fj} : mass equivalent to rotary parts (kg)
(however, in the parking brake test, $W_{fj}=0$)
If W_{fj} is not clear, it is assumed as follows:

$W_{fj}=0.05W'_j$ ····· passenger car, small type truck, bus, trailer

$W_{fj}=0.07W'_j$ ····· common truck, tractor

W_j : gross mass of each automobile (kg)

W'_j : mass of each automobile (kg)

F_i : read-out value of test machine for each wheel or each axle {N}

f_i : initial value of each wheel or each axle {N}

g : acceleration of gravity (9.8 m/s²)

Related standards JIS D 1010 General rules of running test method of automobiles

JIS D 1013 Automobiles – Brake test method

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