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NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA

ICS 43.140

T 80

GB 20073-2018

Replacing GB 20073-2006

**Performance and Measurement Method for Braking of
Motorcycles and Mopeds**

摩托车和轻便摩托车制动性能要求及试验方法

Issued on: February 06, 2018

Implemented on: July 01, 2018

**Issued by: General Administration of Quality Supervision, Inspection and
Quarantine;**

Standardization Administration of the People's Republic of China.

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Performance and Measurement Method for Braking of Motorcycles and Mopeds

1 Scope

This Standard specifies the braking performance requirements and test methods for motorcycles and mopeds.

This Standard applies to motorcycles and mopeds.

This Standard does not apply to the carriages for disabled persons.

2 Normative References

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this document.

GB/T 5359.4 Term for Motorcycles and Mopeds - Part 4: Mass of Vehicle with Two and Three Wheels

GB/T 5378 Methods of Road Test for Motorcycles and Mopeds

GB/T 15089-2001 Classification of Power-Driven Vehicles and Trailers

ASTM E867 Terminology Relating to Vehicle-Pavement Systems

ASTM E1136 Specification for A Radial Standard Reference Test Tire

ASTM F408 Test Method for Tires for Wet Traction in Straight-Ahead Braking, using a Towed Trailer

ASTM F457 Test Method for Speed and Distance Calibration of Fifth Wheel Equipped with Either Analog or Digital Instrumentation

3 Terms and Definitions

For the purposes of this Document, the Category-L vehicle defined in GB/T 15089-2001 and

the following terms and definitions apply.

3.1 Brake system

A component combination that gradually slows down or stops a moving vehicle, or keeps a stopped vehicle stationary. The device consists of a control, a transmission and a brake, but does not include an engine.

3.2 Control

A component that is directly operated by the driver to provide the transmission with the energy required for braking or controlling.

3.3 Transmission

The combination of components between the control and the brake that connects their functions.

3.4 Brake

A component in a brake system that produces forces to prevent vehicle movement.

3.5 Service brake system

A brake system that slows down a moving vehicle.

3.6 Secondary brake system

The second set of service brake systems that are installed on vehicles equipped with a combined brake system.

3.7 Single brake system

A brake system that only acts on one axle.

3.8 Combined brake system; CBS

- a) For two-wheeled mopeds (Category-L₁) and two-wheeled motorcycles (Category-L₃), a set of service brake system that operates a single control can jointly control at least two brakes on different wheels;
- b) For three-wheeled mopeds (Category-L₂) and right three-wheeled motorcycles (Category-L₅), a set of service brake system that operates a single control can jointly control the brakes on all wheels;
- c) For motorcycle with sidecar (Category-L₄), a set of service brake system that operates a single control can control at least brakes on the front and rear wheels. A brake system that controls both the rear and side wheels shall be considered a rear brake.

3.9 Split service brake system; SSBS

A brake system that controls the brakes on all wheels, where a single control controls two or more subsystems. The failure of any one subsystem (such as system failure caused by hydraulic pipeline leakage) cannot affect the function of other subsystems.

3.10 Power-assisted braking system

A brake system in which the driver's physical force is assisted by one or more energy supply devices to apply the braking force. Such as vacuum booster brake system (with vacuum booster).

3.11 Antilock brake system; ABS

A system that can determine the degree of wheel slip relative to the ground, and can automatically adjust the braking force of the wheel, thereby limiting the degree of wheel slip relative to the ground.

3.12 Wheel lock

The case when the wheel slip is 1.00.

3.13 Peak braking coefficient; PBC

The coefficient of friction between the tire and the road surface that is measured based on the maximum deceleration of the rolling tire.

3.14 $V_{\max}$

The maximum speed that is measured according to the test method specified in GB/T 5378.

3.15 Engine disconnected

The engine is disconnected from the drive wheels.

3.16 Initial brake system

The temperature of the brakes before any braking is applied. If multiple brakes are controlled at the same time, select the temperature of the brake with the highest temperature.

3.17 Laden

Load the vehicle to its factory-set maximum gross mass (as per GB/T 5359.4).

3.18 Lightly loaded

It is whichever is the lesser BETWEEN the sum of vehicle curb weight (as per GB/T 5359.4) plus the driver's mass (75kg) plus the test equipment mass (15kg) AND the laden mass.

When the antilock brake system test is carried out on the road with low friction coefficient, the mass of the test equipment (including the protective bracket) is 30kg.

4.2.3.2 The parking brake system shall:

- a) Contains a control and is separate from the control of the service brake system;
- b) Only use purely mechanical means to lock the working parts.

4.2.3.3 It shall be ensured that the driver can operate the parking brake system from the normal driving position.

4.2.3.4 The parking brake systems installed on three-wheeled mopeds (Category-L₂), motorcycles with sidecars (Category-L₄) and right three-wheeled motorcycles (Category-L₅) shall be tested in accordance with A.3.5 in Appendix A and meet the requirements of performance requirements.

4.3 Characteristics of the brake system

4.3.1 Two-wheeled mopeds (Category-L₁) and two-wheeled motorcycles (Category-L₃) shall be equipped with two sets of independent service brake systems, or a set of split service brake system, in which at least one brake controls the front wheel, another brake controls the rear wheel.

4.3.2 Special requirements for two-wheeled motorcycles (Category-L₃):

- a) Two-wheeled motorcycles (Category-L₃) with an actual engine displacement greater than 150mL and less than or equal to 250mL shall be equipped with an antilock brake system or a combined brake system;
- b) For two-wheeled motorcycles (Category-L₃) with actual engine displacement greater than 250mL, antilock brake system shall be installed on both front and rear wheels.

4.3.3 Motorcycles with sidecars (Category-L₄) shall comply with the provisions of 4.3.1. If the performance requirements specified in each test can be met, the sidecar does not need to be equipped with brake.

4.3.4 Three-wheeled mopeds (Category-L₂) shall be equipped with a parking brake system and one of the following brake systems:

- two sets of independent service brake systems (except combined brake systems), which can control the brakes on all wheels when operated simultaneously, or;
- a set of split service brake system, or;
- A set of combined brake systems capable of controlling the brakes on all wheels and a secondary brake system, which may be a parking brake system.

4.3.5 Right three-wheeled motorcycle (Category-L₅) shall be equipped with a parking brake system and a foot-operated service brake system that controls the brakes on all wheels. The foot-operated service brake system is:

- a set of split service brake system, or;
- a set of combined brake system and a set of secondary brake system, the secondary brake system may be a parking brake system.

4.3.6 If the requirements for the failure test of the combined brake system can be met, two sets of independent service brake systems may share the same brake and transmission.

4.4 Brake master cylinder

For vehicles using hydraulic transmission, the brake master cylinder shall meet the following requirements:

- Each brake system shall have an independent, sealed, covered reservoir;
- The minimum volume of the reservoir shall be 1.5 times the liquid volume required for the brake to adjust from the new friction lining state to the completely worn state of the friction lining;
- The liquid level shall be checked without opening the reservoir.

4.5 Warning lights

4.5.1 The position of the warning light of brake system shall be convenient for the driver in the normal operating position to observe and identify.

4.5.2 Vehicles equipped with an antilock brake system shall be equipped with a yellow warning light:

- a) The warning light shall be lit when the vehicle ignition switch is turned on, and shall be extinguished after the function check is completed;
- b) When the antilock brake system fails and affects the generation and transmission of system signals, the warning light shall indicate. The warning light shall remain on as long as the failure exists and the ignition switch is in the "on" position.

4.5.3 Vehicles equipped with split service brake systems shall be equipped with a red warning light:

- a) The warning light shall be lit when the vehicle ignition switch is turned on, and shall be extinguished after the function check is completed;
- b) Warning lights shall be indicated in the following situations:
 - Hydraulic failure occurs when the control force acting on the control is no greater than 90 N, or;
 - When the control is not operated, the liquid level of the reservoir of brake master

shall be no more than 1%.

5.1.1.1.2 Unless there are other special requirements, the peak braking coefficient (PBC) of the test pavement is 0.9 ± 0.1 .

5.1.1.1.3 See Appendix F for the test method of peak braking coefficient (PBC) on pavement with high friction coefficient.

5.1.1.2 Pavement with low friction coefficient

5.1.1.2.1 The test area shall be kept clean, the test pavement should be level, and the slope shall be no more than 1%.

5.1.1.2.2 The peak braking coefficient (PBC) of the test pavement shall be no greater than 0.45.

5.1.1.2.3 See Appendix F for the test method of peak braking coefficient (PBC) on pavement with low friction coefficient.

5.1.1.3 Parking brake system test ramp

The parking brake system test ramp shall be a test plane with a gradient of 18%, and the test plane shall be clean, dry, and not deformed under the weight of the test vehicle.

5.1.1.4 Width of test road

5.1.1.4.1 For two-wheeled mopeds (Category-L₁) and two-wheeled motorcycles (Category-L₃), the width of the test road is 2.5m.

5.1.1.4.2 For three-wheeled mopeds (Category-L₂), motorcycles with sidecars (Category-L₄) and right three-wheeled motorcycles (Category-L₅), the width of the test road is 2.5m plus the vehicle width.

5.1.2 Requirements for environmental condition

5.1.2.1 During the test, the ambient temperature shall be between 4°C and 45°C.

5.1.2.2 During the test, the average wind speed shall not exceed 3m/s, and the instantaneous wind speed shall not exceed 5m/s.

5.1.3 Requirements for test speed

The error range of the test speed is ± 5 km/h. If the actual test speed deviates from the specified test speed, the actual stopping distance shall be corrected according to the formula in Appendix A.1.3.

5.1.4 Requirements for automatic transmission

5.1.4.1 Regardless of whether the test conditions require "engine disconnected" or "engine connected", a vehicle equipped with an automatic transmission shall complete all brake

A.3.6.1 Overview of test

A.3.6.1.1 It is applicable to Categories-L₃, L₄ and L₅ vehicles.

A.3.6.1.2 It is not applicable to the parking brake system and secondary brake system.

A.3.6.1.3 For each brake system, the following three parts of the test shall be carried out continuously:

- a) According to the requirements of A.3.1, the dry braking test of single-operated brake control shall be taken as the baseline test;
- b) Conduct a thermal decay process with a series of repeated braking;
- c) According to the requirements of A.3.1, the dry braking test of single-operated brake control is taken as the residual performance test; and measure the residual performance of the brake after the thermal decay process.

A.3.6.1.4 All tests shall be carried out on the vehicle under laden state.

A.3.6.1.5 During the thermal decay process, the test vehicle shall be installed with a device that can continuously record the brake controlling force and vehicle deceleration. Mean fully developed deceleration and stopping distance do not apply to thermal decay processes. The baseline test and the residual brake performance test shall measure the mean fully developed deceleration or stopping distance.

A.3.6.2 Baseline test**A.3.6.2.1 Vehicle status**

Engine disconnected.

A.3.6.2.2 Test conditions and procedures

A.3.6.2.2.1 Initial brake temperature: $\geq 55^{\circ}\text{C}$ and $\leq 100^{\circ}\text{C}$.

A.3.6.2.2.2 Specified test speed: Whichever is less between 60km/h and $0.9V_{\text{max}}$.

A.3.6.2.2.3 Implementation of brake system: Each control of service brake system is implemented separately.

A.3.6.2.2.4 Brake controlling force:

Hand control: $\leq 200\text{N}$;

Foot control: $\leq 350\text{N}$ (Categories-L₃ and L₄);

$\leq 500\text{N}$ (Category-L₅).

A.3.6.2.2.5 Accelerate the vehicle to the specified test speed; implement braking according to the specified conditions; and record the controlling force that enables the vehicle to achieve the specified brake performance corresponding to the vehicle categories in Tables A.1 to A.4.

A.3.6.3 Thermal decay process

A.3.6.3.1 Vehicle status

From the specified test speed to 50% of the specified test speed, combined with the engine, select the highest gear that can ensure that the engine speed is higher than the idle speed specified by the manufacturer. From 50% of the specified test speed to the complete stop of the vehicle, disconnect the engine.

A.3.6.3.2 Test conditions and procedures

A.3.6.3.2.1 The initial brake temperature before the first brake: $\geq 55^{\circ}\text{C}$ and $\leq 100^{\circ}\text{C}$.

A.3.6.3.2.2 Specified test speed:

Independent front brake system: Whichever is less between 100km/h or $0.7V_{\max}$;

Independent rear brake system: Whichever is less between 80km/h or $0.7V_{\max}$;

Combined brake system or split service brake system: Whichever is less between 100km/h and $0.7V_{\max}$.

A.3.6.3.2.3 Implementation of brake system: The control of each service brake system is implemented separately.

A.3.6.3.2.4 Brake controlling force:

- a) First braking: Apply a constant controlling force to decelerate the vehicle from 80% of the specified test speed to 10% of the specified test speed and achieve $3.0\text{m/s}^2 \sim 3.5\text{m/s}^2$. If the vehicle cannot meet this requirement, it shall reach the specified deceleration corresponding to the vehicle categories in Tables A.1 ~ A.4;
- b) The rest of the repeated braking process: Use the same controlling force as the first braking, continuous braking for 10 times; the distance between two adjacent braking is 1000m.

A.3.6.3.2.5 After each stop by braking, the vehicle shall be immediately accelerated at maximum to the specified test speed, and such speed is maintained to the beginning of the next braking.

A.3.6.4 Remaining performance test

After completing the thermal decay process, the brake system is subjected to a separate brake within 1 min according to the baseline test conditions; and the used controlling force is less

B.5.1.7 Braking times: the braking is performed for a maximum of 3 times, and it is ok for only 1 time can meet the performance requirements.

B.5.1.8 For each braking, the vehicle is accelerated to the specified test speed and braked under specified conditions.

B.5.2 Performance requirements

When the vehicle is tested in accordance with the requirements of B.5.1, the performance requirements are as follows:

The wheels did not lock up, and the wheels did not deviate from the test road.

B.6 Wheel lock inspection when transitioning on the pavement with high to low friction coefficient

B.6.1 Test conditions and procedures

B.6.1.1 Test pavement: The test pavement with high friction coefficient is immediately followed by the test pavement with low friction coefficient.

B.6.1.2 Initial brake temperature: $\geq 55^{\circ}\text{C}$ and $\leq 100^{\circ}\text{C}$.

B.6.1.3 Passing speed: The passing speed when the vehicle reaches the connection point of the pavements with two friction coefficients is whichever is less between 50km/h and $0.5V_{\max}$.

B.6.1.4 Implementation of brake system: The control of each service brake system is implemented separately. If all wheels are equipped with an antilock brake system, the control of each service brake system shall be implemented simultaneously.

B.6.1.5 Brake controlling force: Sufficient controlling force shall be applied to ensure that the antilock brake system is in a fully cycling state during each braking process until the vehicle speed drops below 10km/h.

B.6.1.6 Braking times: The braking is performed for a maximum of 3 times, and it is ok for only 1 time can meet the performance requirements.

B.6.1.7 Every time the vehicle is braked, the vehicle is accelerated to an appropriate speed; and the brake is applied before the connection point of the pavements with two friction coefficient.

B.6.2 Performance requirements

When the vehicle is tested in accordance with the requirements of B.6.1, the performance requirements are as follows:

The wheels did not lock up, and the wheels did not deviate from the test road.

B.7 Wheel lock inspection when transitioning on the pavement with low to high friction

coefficient**B.7.1 Test conditions and procedures**

B.7.1.1 Test pavement: The test pavement with low friction coefficient is next to the test pavement with high friction coefficient and with PBC no less than 0.8.

B.7.1.2 Initial brake temperature: $\geq 55^{\circ}\text{C}$ and $\leq 100^{\circ}\text{C}$.

B.7.1.3 Passing speed: The passing speed when the vehicle reaches the connection point of the pavements with two friction coefficients is whichever is less between 50km/h and $0.5V_{\max}$.

B.7.1.4 Implementation of brake system: The control of each service brake system is implemented separately; if all wheels are equipped with an antilock brake system, the control of each service brake system shall also be implemented simultaneously.

B.7.1.5 Brake controlling force: Sufficient controlling force shall be applied to ensure that the antilock brake system is in a fully cycling state during each braking process until the vehicle speed drops below 10km/h.

B.7.1.6 Braking times: the braking is performed for a maximum of 3 times, and it is ok for only 1 time can meet the performance requirements.

B.7.1.7 Every time the vehicle is braked, the vehicle is accelerated to an appropriate speed; and the brake is applied before the connection point of the pavements with two friction coefficients.

B.7.1.8 Record the continuous deceleration of the vehicle.

B.7.2 Performance requirements

When the vehicle is tested in accordance with the requirements of B.7.1, the performance requirements are as follows:

- a) The wheels do not lock up, and the wheels do not deviate from the test road;
- b) Within 1s after the rear wheel of the vehicle reaches the connection point of the pavements with two friction coefficients, the deceleration of the vehicle shall increase.

B.8 Braking performance after electrical failure of the antilock brake system**B.8.1 Test conditions and procedures**

In the case of an electrical failure of the antilock brake system, a dry braking test of the single-operated brake control shall be carried out according to the requirements of A.3.1.

B.8.2 Performance requirements

When the vehicle is tested in accordance with the requirements of B.8.1, the performance requirements are as follows:

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