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**Performance requirements and test methods for
advanced emergency braking system (AEBS) of
passenger cars**

乘用车自动紧急制动系统(AEBS)性能要求及试验方法

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Performance requirements and test methods for advanced emergency braking system (AEBS) of passenger cars

1 Scope

This Standard specifies terms and definitions, technical requirements and test methods for advanced emergency braking system (AEBS) of passenger cars.

This Standard is applicable to category M₁ cars equipped with advanced emergency braking system (AEBS).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB 4094-2016, *Motor vehicles - Symbols for controls, indicators and tell-tales*

GB/T 5620, *Road vehicles - Vocabulary and definition for braking of automotive vehicles and their trailers*

GB 21670-2008, *Technical requirements and testing methods for passenger car braking systems*

GB/T 34590.1~34590.10-2017, *Road vehicles - Functional safety*

GB 34660, *Road vehicles - Requirements and test methods of electromagnetic compatibility*

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 5620 as well as the followings apply.

3.1 advanced emergency braking system; AEBS

a system that monitors the driving environment in front of the vehicle in real time, and automatically activates the vehicle braking system to slow the vehicle when a collision risk may occur, so as to avoid collisions or reduce collisions

3.2 subject vehicle

a vehicle tested in accordance with the relevant requirements of AEBS of passenger car

3.3 target

a mass-produced ordinary passenger car as defined in GB/T 3730.1 OR representative object that the detection parameters can represent the above vehicle and is suitable for AEBS sensing detection characteristics

3.4 stationary target

a target that keeps still in the center of the same lane in front of the subject vehicle

3.5 moving target

a target that is moving in the same direction at a constant speed in the center of the same lane in front of the subject vehicle

3.6 braking target

a target that is directly in front of the center of the driving route of the subject vehicle, that originally drove at a constant speed in the same direction as the subject vehicle and then started to decelerate

3.7 emergency braking phase

a phase that under the control of AEBS, the subject vehicle decelerates with a deceleration of at least 4m/s^2

3.8 common space

an area where two or more kinds of information (such as signs) can be displayed asynchronously

[GB 4094-2016, definition 3.6]

3.9 time to collision; TTC

the distance between the subject vehicle and the target divided by the instantaneous relative speed of the subject vehicle and the target

way.

4.2.5 The failure warning signal shall be a yellow warning signal that is always bright. It can be expressed in text or graphics. This requirement does not apply to warning signs displayed in the common space.

4.2.6 When the ignition (start) switch is in the "on" (running) state or the ignition (start) switch is between "on" (running) and "start", when the manufacturer specifies the position for inspection, every optical warning signal shall start to light up. This requirement does not apply to warning signals displayed in the common space.

4.2.7 The optical warning signal shall be clearly visible even during the day so that it is convenient for the driver to check the signal status in the normal driving position.

4.3 Performance requirements

4.3.1 Basic performance

AEBS shall meet the following requirements during normal operation:

- a) With early warning and emergency braking functions.
- b) Except for the conditions specified in 4.5, the system shall operate normally between the vehicle speed of 15km/h and the maximum operating speed of the AEBS system under all load conditions of the vehicle.
- c) If it encounters working conditions such as the sudden insertion of the vehicle in front, the collision cannot be predicted in time, and the collision warning signal cannot be issued 1s before the emergency braking, then the collision warning signal shall be issued no later than the emergency braking phase.

4.3.2 Early warning and starting performance under stationary target conditions

4.3.2.1 Test according to 5.3. The subject vehicle shall use at least two modes of acoustic, tactile and optical early warnings 1s before the start of the emergency braking phase at the latest. The speed drop in the early warning phase shall not exceed 15km/h or 30% of the speed of the subject vehicle. Whichever is higher.

4.3.2.2 The subject vehicle shall not collide with the stationary target.

4.3.2.3 The emergency braking phase shall not start 3s before the estimated

collision time.

4.3.2.4 At least 3 of 5 tests shall meet the requirements of 4.3.2.1~4.3.2.3.

4.3.3 Early warning and start performance under moving target conditions

4.3.3.1 Test according to 5.4. The subject vehicle shall use at least two modes of acoustic, tactile and optical early warnings 1s before the start of the emergency braking phase at the latest. The speed drop in the early warning phase shall not exceed 15km/h or 30% of the speed of the subject vehicle. Whichever is higher.

4.3.3.2 The subject vehicle shall not collide with the moving target.

4.3.3.3 The emergency braking phase shall not start 3s before the estimated collision time.

4.3.3.4 At least 3 of 5 tests shall meet the requirements of 4.3.3.1~4.3.3.3.

4.3.4 Early warning and start performance under braking target conditions

4.3.4.1 Test according to 5.5. The subject vehicle shall use at least two modes of acoustic, tactile and optical early warnings 1s before the start of the emergency braking phase at the latest. The speed drop in the early warning phase shall not exceed 15km/h or 30% of the speed of the subject vehicle. Whichever is higher.

4.3.4.2 The subject vehicle shall not collide with the braking target.

4.3.4.3 The emergency braking phase shall not start 3s before the estimated collision time.

4.3.4.4 At least 3 of 5 tests shall meet the requirements of 4.3.4.1~4.3.4.3.

4.4 Warning signal after system failure

Test according to 5.6. The always-on optical warning signal that meets the requirements of GB 4094-2016 shall be activated when the vehicle is driving at a speed greater than 15km/h for 10s at the latest. As long as the failure still exists and the vehicle is at a standstill after turning off the ignition switch and then turning it on again, the failure warning signal shall be re-illuminated immediately.

4.5 Driver intervention performance

4.5.1 AEBS allows the driver to interrupt the early warning phase.

4.5.2 AEBS shall ensure that the driver can interrupt the emergency braking

shall be the cold inflation pressure recommended by the vehicle manufacturer.

5.2.3 Brakes

The subject vehicle shall run-in the brakes in accordance with the requirements of Chapter 7 in GB 21670-2008.

5.3 Early warning and start-up test under stationary target conditions

5.3.1 The subject vehicle shall drive toward the stationary target in a straight line at least 2s before the start of the test. The deviation between the subject vehicle and the target centerline does not exceed 0.5m.

5.3.2 The test shall start when the subject vehicle is traveling at a speed of (30 ± 2) km/h and is at least 60m away from the target.

5.3.3 In addition to slight adjustments to the steering to prevent the vehicle's direction from shifting, from the beginning of the test until the subject vehicle stops, the driver shall not make any adjustments to the subject vehicle.

5.4 Early warning and start-up test under moving target conditions

5.4.1 The subject vehicle and the moving target shall drive in the same direction in a straight line for at least 2s before the test. The deviation between the subject vehicle and the target centerline does not exceed 0.5m.

5.4.2 The test shall start when the subject vehicle is traveling at a speed of (50 ± 2) km/h, the moving target is traveling at a speed of (20 ± 2) km/h, and the distance between the two is at least 120m.

5.4.3 In addition to slight adjustments to the steering to prevent the vehicle's direction from shifting, from the beginning of the test until the speed of the subject vehicle is equal to the target speed, the driver shall not make any adjustments to the subject vehicle.

5.5 Early warning and start-up test under braking target conditions

5.5.1 The subject vehicle and the braking target shall drive in the same direction in a straight line for at least 2s before the test. The deviation between the subject vehicle and the target centerline does not exceed 0.5m.

5.5.2 The test shall be driven by the subject vehicle at a speed of (50 ± 2) km/h. The braking target starts at a speed of (50 ± 2) km/h, a deceleration of (-4 ± 0.25) m/s², and a distance of (40 ± 1) m between the two.

5.5.3 In addition to slight adjustments to the steering to prevent the vehicle's direction from shifting, from the beginning of the test until the speed of the subject vehicle is equal to the target speed, the driver shall not make any

adjustments to the subject vehicle.

5.6 Warning signal detection test after system failure

5.6.1 Simulate circuit failure by disconnecting the power of AEBS components or the circuit connection between AEBS components. When simulating the AEBS failure, the circuit connection of the driver warning signal specified in 4.2.1 and the AEBS manual function shutdown control device specified in 4.5 shall not be cut off.

5.6.2 Start and gradually accelerate the subject vehicle. Observe and record the failure warning device signal, the vehicle speed and time when the warning signal is first issued. After parking, after the vehicle is at a standstill and the ignition switch is turned off and then turned on again, the failure warning signal shall be re-illuminated immediately.

5.7 Driver intervention performance test

5.7.1 Test according to one of the methods specified in 5.3, 5.4 or 5.5. In the early warning phase, through active actions such as the driver stepping on the accelerator pedal, turning on the turn signal, and other methods specified by the manufacturer, check whether the response of the system can be interrupted by the driver's active actions.

5.7.2 Test according to one of the methods specified in 5.3, 5.4 or 5.5. During the emergency braking phase, through active actions such as the driver stepping on the accelerator pedal, turning on the turn signal, and other methods specified by the manufacturer, check whether the response of the system can be interrupted by the driver's active actions.

5.7.3 For vehicles equipped with AEBS deactivation device, set the ignition switch to the "ignition" (run) position and release AEBS. Check whether the warning signal is on. Set the ignition switch in the "fire off" (off) position. Then set the ignition switch to the "ignition" (run) position again. Confirm whether the warning signal that has been lit before is lit. If the ignition system is started by a key, the above operations shall be carried out without removing the key all the way.

5.8 Vehicle error response test in adjacent lanes

5.8.1 Two stationary M_1 vehicles are placed as follows:

- a) In the same direction as the subject vehicle.
- b) The distance between the two cars is 3.5m.
- c) The tails of the two vehicles are aligned and 50m away from the head of

Annex A

(normative)

Functional safety requirements

A.1 General rules

When the vehicle safety-related electrical and electronic system malfunctions, it will cause potentially hazardous events (for example, unexpected emergency braking occurs during the normal driving of the vehicle, resulting in a vehicle collision). In accordance with the functional safety requirements of advanced emergency braking system (AEBS) of passenger cars formulated in GB/T 34590.1~34590.10-2017, it clarifies the functional safety requirements that the vehicle safety-related electrical and electronic systems shall meet during the safety life cycle, so as to avoid or reduce the risk caused by system failure.

This appendix specifies the special requirements for the documentation, failure strategies and confirmation tests of advanced emergency braking system (AEBS) of passenger cars in terms of functional safety.

This appendix is not aimed at the nominal performance of AEBS, nor as a specific guide for the development of AEBS functional safety. Rather, it specifies the methods to be followed in the design process and the information that shall be available for system verification and confirmation, so as to prove that the system can ensure the realization of the functional safety concept under normal operation and failure conditions and meet all applicable performance requirements specified in this Standard.

A.2 Documentation

A.2.1 Requirements

Corresponding documents shall be available to explain the functional concept and functional safety concept of AEBS, and meet the following requirements:

- a) Explain the functional concept of AEBS, internal and external interfaces, potential failures, risks and safety measures.
- b) Prove that the AEBS design considers potential failure sources, including random hardware failures and systematic failures, and applies engineering practices in related fields.

Example: Annex E of GB/T 34590.5-2017 gives design practices for random hardware failures.

- c) In order to support the confirmation test, explain how to check the working status of AEBS in normal operation and failure mode.

A.2.2 Definitions of related items

A.2.2.1 The functional concepts of related items shall be described. A functional description list shall be provided.

NOTE 1: In GB/T 34590.1-2017, related items refer to systems or system groups that implement vehicle-level functions or partial functions. For example: Related items of AEBS can include environmental perception system, control system, execution system, driver information interaction system, etc.

NOTE 2: Describe and refine the functions that are perceivable from the vehicle level.

A.2.2.2 The scope of related items shall be defined. Specify the systems and elements belonging to related items. Identify the external system or element with which it interacts.

A.2.2.3 The operating conditions and constraints of related items shall be defined. In view of the corresponding system function, explain the limit of the effective working range.

NOTE: Common operating conditions: power supply, vehicle speed and so on. Common constraints: ambient temperature, humidity, vibration and so on.

A.2.2.4 A schematic diagram (such as module diagram) shall be provided to illustrate the structure of the relevant item and its internal and external interfaces. Indicate related items, components, external interface systems, internal and external interface channels in the schematic diagram. Provide a detailed list, briefly explaining the functions of each component, system and interface in the list.

NOTE: If a component integrates multiple functions, for clarity and ease of explanation, it can be represented by multiple modules in the schematic diagram.

A.2.2.5 Identification mark shall be used to clearly identify each component (including hardware and software) of related items and confirm its consistency with the provided documents. The identification mark shall specify the version of hardware and software. If the version change causes a change in the functions described in this Standard, the identification mark shall be changed accordingly.

A.2.3 Hazard analysis and risk assessment

A.2.3.1 The functional failures of related items shall be analyzed and classified.

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