Annex A.1

China Intelligent-connected Car Assessment Programme

China Intelligent-connected Car Assessment Programme (C-ICAP)

(Version 1.1)

Detailed Rules for Assessment of Basic Driving Assistance

C-ICAP

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1 Assessment Method

The test objects of this assessment method include adaptive cruise system, lane centering control system and combined driving assistance system. When the score obtained for system prompt and hands off detection (HOD) test is full score, then the pilot driving assistance test specified in A.2 may be carried out,

1.1 Indicator System

The indicators for basic driving assistance are detailed in Table 1-1.

Table 1- 1 Indicator System for Basic Driving Assistance

	level-1 indicator	**level-2 indicator**
Basic driving assistance	Following Ability	Front Vehicle Static State Identification and Response
		Front Vehicle Low-speed Identification and Response
		Front Vehicle Deceleration Identification and Response
		Front Vehicle Cut-in Identification and Response
		Front Vehicle Cut-out Identification and Response
		Start/Stop Following Front Vehicle
	Combined Control Ability	Lane centering control
		Low-speed Combined Control
		High-speed Combined Control
		Driver-confirmed lane changing ability (bonus item)
	Collision Avoidance Ability	Pedestrian and Two-wheeled Vehicle Crossing
		Traffic Accidents
		Road Construction
		Simulated dangerous scenario (bonus item)
	Driver Engagement	System prompt
		Driver monitoring

1.2 Allocation of Weight to Indicators

1.2.1 Allocation of Weight to Level-1 Indicators

There are four level-1 indicators for basic driving assist: following ability, combined control ability, collision avoidance ability and driver engagement. The weight of each level-1 indicator is shown in Table

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1-2.

Table 1- 2 Weights of Level-1 Indicators for Basic Driving Assist

	No.	level-1 indicator	Weight
Basic driving assistance	1	Following Ability	50%
	2	Combined Control Ability	20%
	3	Collision Avoidance Ability	10%
	4	driver engagement	20%

1.2.2 Allocation of Weight to Level-Indicators

1.2.2.1 Allocation of Weight to Vehicle Following Ability

For the following ability, there are six level-2 indicators: front vehicle static state identification and response, front vehicle low speed identification and response, front vehicle deceleration identification and response, front vehicle cut-in identification and response, front vehicle cut-out identification and response, and start/stop following front vehicle. The weight of each level-2 indicator is shown in Table 1-3.

Table 1- 3 Weights of Level-2 Indicators for Following Ability

level-1 indicator	No.	level-2 indicator	Weight
Following Ability	1	Front Vehicle Static State Identification and Response	20%
	2	Front Vehicle Low-speed Identification and Response	30%
	3	Front Vehicle Deceleration Identification and Response	20%
	4	Front Vehicle Cut-in Identification and Response	15%
	5	Front Vehicle Cut-out Identification and Response	10%
	6	Start/Stop Following Front Vehicle	5%

1.2.2.2 Allocation of Weight to Combined Control Ability

For the combined control ability, there are four level-2 indicators: lane centering control, low-speed combined control, high-speed combined control and driver-confirmed lane changing ability (bonus item). The weight of each level-2 indicator is shown in Table 1-4.

Table 1- 4 Weight of Level-2 Indicators for Combined Control Ability

level-1 indicator	No.	level-2 indicator	Weight
Combined Control Ability	1	Lane centering control	40%
	2	Low-speed Combined Control	40%
	3	High-speed Combined Control	20%
	4	Driver-confirmed lane changing ability (bonus item)	+10%

1.2.2.3 Allocation of Weight to Collision Avoidance Ability

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For the collision avoidance ability, there are four level-2 indicators: pedestrian and two wheeled vehicle crossing, traffic accident, road construction and simulated dangerous scenario (bonus item). The weight of each level-2 indicator is shown in Table 1-5.

Table 1- 5 Weights of Level-2 Indicators for Collision Avoidance Ability

level-1 indicator	No.	level-2 indicator	Weight
Collision Avoidance Ability	1	Pedestrian and Two-wheeled Vehicle Crossing	50%
	2	Traffic Accidents	30%
	3	Road Construction	20%
	4	Simulated dangerous scenario (bonus item)	+10%

1.2.2.4 Allocation of Weight to Driver Engagement

For the driver engagement, there are two level-2 indicators: system prompt and driver monitoring. The weight of each level-2 indicator is shown in Table 1-6.

Table 1- 6 Weights of Level-2 Indicators for Driver Engagement

level-1 indicator	No.	level-2 indicator	Weight
Driver Engagement	1	System prompt	30%
	2	Driver monitoring	70%

1.2.3 Allocation of Weight to Level-3Indicators

1.2.3.1 Allocation of Weight to Vehicle Following Ability

The weight of level-3 indicators for following ability is shown in Table 1-7.

Table 1- 7 Weights of Level-3 Indicators for Following Ability

level-1 indicator	level-2 indicator	No.	Level-3 indicator	Weight
Following Ability	Front Vehicle Static State Identification and Response	1	The set speed of the VUT is 60km/h, and the VT is on the right side of the road.	25%
		2	The set speed of the VUT is 60km/h, and VT is in the middle of the road.	25%
		3	The set speed of the VUT is 80km/h, and the VT is on the left side of the road.	25%
		4	The set speed of the VUT is 80km/h, and VT is in the middle of the road.	25%
	Front Vehicle Low-speed Identification and Response	1	The set speed of the VUT is 60km/h. The VT running at 20km/hon the right side of the road.	20%
		2	The set speed of the VUT is 60km/h. The VT is running 20km/h in the middle of the road.	20%

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level-1 indicator	level-2 indicator	No.	Level-3 indicator	Weight
		3	The set speed of the VUT is 120km/h. The VT is running at 60km/h on the left side of the road.	20%
		4	The set speed of the VUT is 120km/h. The VT is running 60km/h in the middle of the road.	20%
		5	The set speed of the VUT is 80km/h. The motorcycle target is running at 30km/h in the middle of the road.	10%
		6	The set speed of the VUT is 80km/h. The motorcycle target is running at 30km/h on the right side of the road.	10%
	Front Vehicle Deceleration Identification and Response	1	The set speed of the VUT is 60km/h, the speed of the VT is 50km/h, and the deceleration is3m/s^2	100%
	Front Vehicle Cut-in Identification and Response	1	The set speed of the VUT is 40km/h, and the speed of the VT is 20km/h.	50%
		2	The set speed of the VUT is 80km/h, and the speed of the VT is 60km/h.	50%
	Front Vehicle Cut-out Identification and Response	1	The set speed of the VUT is 50km/h, and the speed of the VT is 40km/h.	50%
		2	The set speed of the VUT is 70km/h, and the speed of the VT is 60km/h.	50%
	Start/Stop Following Front Vehicle	1	The set speed of the VUT is 30km/h, and the speed of the VT is 20km/h.	100%

1.2.3.2 Allocation of Weight to Combined Control Ability

The weight of each level-3 indicator for combined control ability is shown in Table 1-8.

Table 1- 8 Weight of Level-3 Indicators for Combined Control Ability

level-1 indicator	level-2 indicator	No.	Level-3 indicator	Weight
Combined Control Ability	Lane centering control	1	The speed is 60km/h, and the turning radius is 250m	50%
		2	The speed is 80km/h, and the turning radius is 500m	50%
	Low-speed Combined Control	1	the set speed of the VUT is 40km/h	100%

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	High-speed Combined Control	1	the set speed of the VUT is 80km/h	100%
	Driver-confirmed Lane Changing Ability	1	Interference-free Lane Changing	50%
		2	Interfered Lane Changing	50%

1.2.3.3 Weight of Collision Avoidance Ability

The weight of each level-3 indicator for collision avoidance ability is shown in Table 1-9.

Table 1- 9 Weights of Level-3 Indicators for Collision Avoidance Ability

level-1 indicator	level-2 indicator	No.	Level-3 indicator	Weight
Collision Avoidance Ability	Pedestrian and Two-wheeled Vehicle Crossing	1	Pedestrian Crossing with Shelter	25%
		2	Pedestrian Crossing at Night	25%
		3	Two-wheeled Vehicle Crossing	25%
		4	Electrical Two-wheeled Vehicle Crossing	25%
	Traffic Accidents	1	Accident Vehicle Identification and Response	100%
	Road Construction	1	Conical Barrel Identification and Response	100%
	Simulated dangerous scenario (bonus item)	1	Process Compliance Audit	30%
		2	Emergency Avoidance of Front Vehicle on Expressway	14%
		3	Slow Moving Heavy Truck	14%
		4	Front Vehicle Cut-in at Tunnel Entrance	14%
		5	Fuzzy Lane Changing	14%
		6	Speed Limit Sign Identification	14%

1.2.3.4 Weight of Driver Engagement

The weight of each level-3 indicator for driver engagement is shown in Table 1-10.

Table 1- 10 Weights of Level-3 Indicators for Driver Engagement

level-1 indicator	level-2 indicator	No.	Level-3 indicator	Weig ht
Driver Engagement	System prompt	1	Definition of system	15%
		2	Description of driver's responsibilities	15%
		3	Description of use conditions of system	15%
		4	Description of driver state monitoring	15%

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		5	On, off and activated states	40%
	Driver monitoring	1	Hands off detection	48%
		2	Minimum risk maneuver test	12%
		3	Eye closure detection	20%
		4	Head bowing detection	20%

1.3 Scoring Method

The total score of basic driving assistance shall be calculated on the basis of the scores and weights of level-1 indicators, with two decimal places reserved. The calculation method is as shown in Formula 1-1.

$$S = \sum_{i=1}^{4} S_i \times b_i \tag{1-1}$$

Where: S is the total score of basic driving assistant, and i is the serial number of level-1 indicator. S_i and b_i are the score and weight of the level-1 indicator with the serial number of i.

1.3.1 Scoring Method for Level-1 Indicators

The score of each level-1 indicator shall be calculated on the basis of the scores and weights of level-2 indicators, with two decimal places reserved. The calculation method is as shown in Formula 1-2.

$$S_i = \sum_{j=1}^{n_i} S_{ij} \times b_{ij} \tag{1-2}$$

Where: S_i is the score of level-1 indicator, i is the serial number of level-1 indicator, j is the serial number of level-2 indicator, and n_i is the number of level-2 indicators. $S_{ij}$and b_{ij} are the score of level-2 indicator and the weight of the corresponding level-2 indicator respectively.

1.3.2 Scoring Method for Level-2 Indicators

The score of each level-2 indicator shall be calculated on the basis of the scores and weights of level-3 indicators, with two decimal places reserved. The calculation method is as shown in Formula 1-3.

$$S_{ij} = \sum_{z=1}^{n_{ij}} s_{ijz} \times b_{ijz} \tag{1-3}$$

Where: S_{ij} is the score of level-2 indicator. i is the serial number of level-1 indicator, j is the serial number of level-2 indicator, z is the serial number of level-3 indicator, and n_{ij} is the number of level-3 indicators. S_{ijz} and b_{ijz} are the score of level-3 indicator and the weight of the corresponding level-3 indicator respectively.

1.3.3 Scoring Method for Level-3Indicators

1.3.3.1 Explanation on Scoring for Following Ability

Each test item shall be repeated for 3 times, and the worst one shall be taken as the final score.

1.3.3.1.1 Explanation on Scoring for Front Vehicle Static State Identification and Response

1) If the VUT does not collide with the target and the maximum deceleration during braking operation does not exceed 5m/s^2, then 100 points will be obtained;

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2) If the VUT does not collide with the target and the maximum deceleration during braking operationexceeds5m/s^2, then 70 points will be obtained;

3) If the VUT collides with the target, then the score shall be calculated according to the Formula 1-4 below:

$$\text{Score} = 70 \times \frac{Vrel,test - Vrel,impact}{Vrel,test} \tag{1-4}$$

Where: Vrel,test: the relative speed of the VUT and the VT at the beginning of the test.

Vrel,impact: the relative speed of the VUT and the VT when they collide with each other, which shall be calculated by subtracting the longitudinal speed of the VT from the speed of the VUT at the time of collision.

If the reduction effect of the system on vehicle speed at a certain test speed point is less than 5km/h, or V impact (the speed when the VUT collides with the GVT) is more than 50km/h, then the test under this scenario shall be stopped

1.3.3.1.2 Explanation on Scoring for Front Vehicle Low Speed Identification and Response

1) If the VUT does not collide with the target, it can follow the target steadily, and the maximum deceleration during braking operation does not exceed 5m/s^2, then 100 points will be obtained;

2) If the VUT does not collide with the target, but it cannot follow the target steadily or the maximum deceleration during braking operation exceeds5m/s^2, then 70 points will be obtained

3) If the VUT collides with the target, then the score shall be calculated according to the Formula 1-5 below:

$$\text{Score} = 70 \times \frac{Vrel,test - Vrel,impact}{Vrel,test} \tag{1-5}$$

Where: Vrel,test: the relative speed of the VUT and the VT at the beginning of the test.

Vrel,impact: the relative speed of the VUT and the VT when they collide with each other, which shall be calculated by subtracting the longitudinal speed of the VT from the speed of the VUT at the time of collision.

If the reduction effect of the system on vehicle speed at a certain test speed point is less than 5km/h, or V impact (the speed when the VUT collides with the GVT) is more than 50km/h, then the test under this scenario shall be stopped

1.3.3.1.3 Explanation on Scoring for Front Vehicle Deceleration Identification and Response

1) If the VUT does not collide with the target and the maximum deceleration during braking operation does not exceed 5m/s^2, then 100 points will be obtained;

2) If the VUT does not collide with the target and the maximum deceleration during braking operationexceeds5m/s^2, then 70 points will be obtained;

3) If the VUT collides with the target, then the score shall be calculated according to the Formula 1-6 below:

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$$\text{Score} = 70 \times \frac{Vrel,test - Vrel,impact}{Vrel,test} \quad (1\text{-}6)$$

Where: Vrel,test: the running speed of the VUT at the beginning of the test;

Vrel,impact: the speed of the VUT when it collides with the VT.

If the reduction effect of the system on vehicle speed at a certain test speed point is less than 5km/h, or V impact (the speed when the VUT collides with the GVT) is more than 50km/h, then the test under this scenario shall be stopped

1.3.3.1.4 Explanation on Scoring for Front Vehicle Cut-in Identification and Response

The score shall be calculated by reference to 1.3.3.1.2.

1.3.3.1.5 Explanation on Scoring for Front Vehicle Cut-out Identification and Response

The score shall be calculated by reference to 1.3.3.1.1.

1.3.3.1.6 Explanation on Scoring for Start/Stop Following Front Vehicle

If the VUT does not collide with the target, and after the target starts again, the VUT can automatically start and resume the set speed or follow the target steadily, and the deceleration during braking operation is less than $5m/s^2$, then 100 points will be obtained.

1.3.3.2 Explanation on Scoring for Combined Control Ability

1.3.3.2.1 Explanation on Scoring for Lane Centering Control

If the outer edge of the front wheel of the VUT does not contact the inner edge of the lane line, then 100 points will be obtained.

1.3.3.2.2 Explanation on Scoring for Low-speed Combined Control

1) If the outer edge of the front wheel of the VUT does not contact the inner edge of the lane line, the VUT does not collide with the target, and the maximum deceleration during braking operation does not exceed $5m/s^2$, then 100 points will be obtained;
2) If the outer edge of the front wheel of the VUT does not contact the inner edge of the lane line, the VUT does not collide with the target, and the maximum deceleration during braking operation exceeds $5m/s^2$, then 70 points will be obtained;
3) If the outer edge of the front wheel of the VUT does not contact the inner edge of the lane line and the VUT collides with the target, then the score shall be calculated according to the Formula 1-7 below:

$$\text{Score} = 70 \times \frac{Vrel,test - Vrel,impact}{Vrel,test} \quad (1\text{-}7)$$

Where: Vrel,test: the speed of the VUT at the beginning of the test.

Vrel,impact: the relative speed of the VUT and the VT when they collide with each other, which shall be calculated by subtracting the longitudinal speed of the VT from the speed of the VUTat the time of collision.

1.3.3.2.3 Explanation on Scoring for High-speed Combined Control

The score shall be calculated by reference to 1.3.3.2.2.

1.3.3.2.4 Explanation on Scoring for Driver-confirmed Lane Changing Ability

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1.3.3.2.4.1 Explanation on Scoring for Interference-free Lane Changing

If the VUT can correctly turn on the turn lamps and successfully complete the lane-changing action during the interference-free lane changing test, then 100 points will be obtained;

1.3.3.2.4.2 Explanation on Scoring for Interfered Lane Changing

If the system cancels the lane changing operation or completes the lane changing operation successfully by adjusting the vehicle speed during the interfered lane changing test, then 100 points will be obtained.

1.3.3.3 Explanation on Scoring for Emergency Avoidance

1.3.3.3.1 Explanation on Scoring for Pedestrian and Two-wheeled Vehicle Crossing

1.3.3.3.1.1 Explanation on Scoring for Pedestrian Crossing with Shelter

If the collision is completely avoided during the test, full score shall be obtained for this test speed point; if the collision is not completely avoided during the test, the linear interpolation method shall be used to calculate the score of the corresponding test point.

The score shall be calculated according to the Formula 1-8 below:

$$\text{Score} = \frac{Vrel,test - Vrel,impact}{Vrel,test} \tag{1-8}$$

Where: Vrel,test - the speed of the VUT at the beginning of the test, in kilometers per hour (km/h);

$V_{rel,impact}$ - the speed of the VUT at the time of collision, in kilometers per hour (km/h)

1.3.3.3.1.2 Explanation on Scoring for Pedestrian Crossing at Night

The score shall be calculated by reference to 1.3.3.3.1.1.

1.3.3.3.1.3 Explanation on Scoring for Two-wheeled Vehicle Crossing

The score shall be calculated by reference to 1.3.3.3.1.1.

1.3.3.3.1.4 Explanation on Scoring for Electric Two-wheeled Vehicle Crossing

The score shall be calculated by reference to 1.3.3.3.1.1.

1.3.3.3.2 Explanation on Scoring for Accident Vehicle Identification and Response

The score shall be calculated by reference to 1.3.3.3.1.1.

1.3.3.3.3 Explanation on Scoring for Conical Barrel Identification and Response

The score shall be calculated by reference to 1.3.3.3.1.1.

1.3.3.3.4 Explanation on Scoring for Simulated Dangerous Scenario

1.3.3.3.4.1 Explanation on Scoring for Process Compliance Audit

The manufacturer shall be able to provide the proof of compliance of simulation test process, and shall state the key information by reference to the test process audit report template.

The test process audit report shall include four parts: the core software and hardware used, the comparison of vehicle dynamics calibration results, the equipment tested, and the signal flow diagram. The full score for each part shall be 25 points, and the comprehensive assessment shall be based on the integrity, rationality and authenticity of the contents.

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If all the above materials are provided and meet the requirements, then 100 points will be obtained for this test item.

1.3.3.3.4.2 Explanation on Scoring for Emergency Avoidance of High-speed Front Vehicle

1) If the VUT does not collide with the obstacle and the maximum deceleration during braking operation does not exceed 5m/ s^2, then 100 points will be obtained;

2) If the VUT does not collide with the obstacle and the maximum deceleration during braking operation exceeds 5m/s^2, then 70 points will be obtained;

3) If the VUT collides with the obstacle, then no point will be obtained.

1.3.3.3.4.3 Explanation on Scoring for Running/Stop of Low-speed Heavy Truck

1) If the VUT does not collide with the VT, and after the VT starts again, the VUT can automatically start and resume the set speed or follow the VT steadily, and the deceleration during braking operation is less than 5m/s^2, then 100 points will be obtained;

2) If the VUT does not collide with the VT, and after the VT starts again, the VUT can automatically start and resume the set speed or follow the VT steadily, and the deceleration during braking operation is less than exceeds 5m/s^2, then 70 points will be obtained;

3) If the VUT collides with the VT, then no point will be obtained.

1.3.3.3.4.4 Explanation on Scoring for Front Vehicle Cut-in at Tunnel Entrance

1) If the VUT does not collide with the VT and the maximum deceleration during braking operation does not exceed 5m/s^2, then 100 points will be obtained;

2) If the VUT does not collide with the VT and the maximum deceleration during braking operation exceeds 5m/s^2, then 70 points will be obtained;

3) If the VUT collides with the VT, then no point will be obtained.

1.3.3.3.4.5 Explanation on Scoring for Fuzzy Lane Changin

1) If the VUT does not collide with the VT and the outer edge of its front wheel goes beyond the outer edge of the lane line by no more than 0.2m, then 100 points will be obtained.

2) If the VUT does not collide with the VT and the outer edge of its front wheel goes beyond the outer edge of the lane line by more than 0.2m, then 70 points will be obtained.

3) If the VUT collides with the VT, then no point will be obtained.

1.3.3.3.4.6 Explanation on Scoring for Speed Limit Sign Identification

1) If the VUT can accurately obtain the speed limit information for road section ahead (There is no restriction on the specific implementation method, such as perception by camera, display of on-board map or interaction with mobile device), issue the warnings and stabilize the speed within the range of 50-70km/h in front of the speed limit plate, then 100 points will be obtained;

2) If the VUT can accurately obtain the speed limit information for road section ahead (There is no restriction on the specific implementation method, such as perception by camera, display of on-board map or interaction with mobile device) and issue the warnings, but cannot stabilize the speed within the range of 50-70km/h in front of the speed limit plate, then 70 points will be obtained;

3) If the VUT cannot accurately obtain the speed limit information for road section ahead (There is no

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restriction on the specific implementation method, such as perception by camera, display of on-board map or interaction with mobile device), then no point will be obtained;

1.3.3.4 Explanation on Scoring for Driver Engagement

1.3.3.4.1 Explanation on Scoring for System Prompt Ability

The user manual of the VUT shall be reviewed:

1) Description of system functions: If the manual clearly indicates that the system is a basic driving assistance system and clearly describes its functions, 100 points will be obtained;
2) Description of driver's responsibilities: If the manual clearly states that the driver bears all responsibilities, 100 points will be obtained;
3) Description of use conditions: If the manual clearly describes the use conditions of the system, at least including the use area, weather conditions and lane line requirements, 100 points will be obtained;
4) Description of driver state monitoring: If the manual describes the behaviors that can cause alarm from driver monitoring system as well as the corresponding alarm forms, 100 points will be obtained.
5) If the vehicle can clearly indicate the off, on and active state of the system after it is started, 100 points will be obtained.

1.3.3.4.2 Explanation on Scoring for Driver Monitoring Ability

1.3.3.4.2.1 Explanation on Scoring for Hands Off Detection

The time interval between the moment when the driver's hands leave the steering wheel and the moment when the visual alarm is given shall not exceed 15s; the time interval between the moment when the driver's hands leave the steering wheel and the moment when the audible alarm is given shall not exceed 30s, and the alarm shall last until the function exits. If the function is turned off or enters the minimum risk maneuver (MRM) state within 30s after the audible alarm is given, accompanied by a rapid audible alarm for at least 5s, then 100 points will be obtained;

1.3.3.4.2.2 Explanation on Scoring for Minimum Risk Manoeuvre Test

During the test in 1.3.3.4.2.1, if the system enters the minimum risk manoeuvre and has the horizontal control, then 100 points will be obtained.

1.3.3.4.2.3 Explanation on Scoring for Eye Closure Detection

If the voice alarm or the audible alarm (accompanied by visual or tactile signal) is sent out within 4s after the driver closes his eyes, then 100 points will be obtained.

1.3.3.4.2.4 Explanation on Scoring for Head Bowing Detection

If the voice alarm or the audible alarm (accompanied by visual or tactile signal) is sent out within 5s after the driver bows his head, then 100 points will be obtained.

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2 Test Method

2.1 Scope of Application

This Specification is applicable to M_1 passenger vehicles.

2.2 Normative References

The terms and conditions in the following documents constitute the terms and conditions of this Specification through reference in this Specification. For dated references, all subsequent amendments (excluding corrections) or revisions are not applicable to this Specification. For undated references, the latest edition is applicable to this Specification.

ISO 15622-2018 《 Intelligent transport systems — Adaptive Cruise Control systems — Performance requirements and test procedures》

ISO 22178-2009《Intelligent transport systems — Low speed following (LSF) systems — Performance requirements and test procedures》

ISO 11270-2010 《 Intelligent transport systems — Lane keeping assistance systems (LKAS) — Performance requirements and test procedures》

ECE R79 《 Uniform provisions concerning the approval of vehicles with regard to steering equipment》

ECE R157 《 Uniform provisions concerning the approval of vehicles with regard to Automated Lane Keeping Systems》

GB/T 20608-2006 Intelligent Transportation System - Adaptive Cruise Control System - Performance Requirements and Test Procedures

GB 5768.3 Road Traffic Signs and Markings - Part 3: Road Traffic Markings

ISO 8855-1991 《Road vehicles - Vehicle dynamics and road-holding ability - Vocabulary》

2.3 Definitions

Vehicle Under Test (VUT)

The vehicle that can continuously control both transversal and longitudinal movements and will be tested in accordance with these Rules.

Vehicle Target (VT)

Vehicle target specified in these Rules.

Time To Collision

The time required for the VUT to collide with VT, adult dummy target, bicycle target or pedal motorcycle target while maintaining the current motion state.

Time Gap

The time required for the VUT to arrive at the position of the target at the current speed.

Set Speed

The expected speed (meter-indicated speed) of the vehicle when the driving assistance system is activated.

Desired Speed

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The maximum stable speed that the system can reach after setting the vehicle speed.

Minimum Risk Manoeuvre

The control strategy adopted by the system to reduce risks when the driver fails to take over the control for a long time after the system sends a takeover request. In this state, the system shall at least maintain the transversal control over the vehicle.

2.4 General Provisions

This section describes the test methods for basic driving assistance.

2.5 Test Conditions

2.5.1 Site Conditions

1) The test road surface shall be dry, flat and solid, without visible moisture, and the peak braking force coefficient shall be greater than 0.9;
2) The test road surface shall be compacted and free of irregularities (such as large inclination, cracks, well covers or reflective bolts) that may cause abnormal operation of the sensor;
3) The lane width shall be 3.75m, and the lane lines shall be white solid lines or white dotted lines. If they are white dotted lines, the blank-line ratio shall be 6/9.

2.5.2 Weather Conditions

1) The weather shall be dry without precipitation and snowfall;
2) The visibility in the horizontal direction shall not be less than 1km;
3) The wind speed shall not be greater than 10m/s;
4) For the test conducted under natural light conditions, the lighting conditions in the whole test area shall be consistent, and the light intensity shall not be less than 2,000lux. Except for the impact caused by the VUT and the VT, there shall be no obvious shadow area in the whole area. The test shall not be conducted in the direction towards or away from direct sunlight.

2.5.3 Equipment Requirements

2.5.3.1 The test equipment shall meet the requirements of sampling and storage of dynamic data, and the sampling and storage frequency shall at least be 100Hz. The DGPS time shall be used for data synchronization between the VT and the VUT.

2.5.3.2 Data Acquisition and Target Control Accuracy

The data acquisition accuracy of the VT and the VUT during the test shall at least meet the following requirements:

1) Speed accuracy: 0.1km/h;
2) Accuracy of transversal and longitudinal position: 0.03m;
3) Accuracy of longitudinal acceleration: 0.1m/ s^2;
4) Accuracy of angular velocity of steering wheel: 1.0°/s

Target control accuracy:

1) Position accuracy: 0.05m;

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2) Speed accuracy: 2km/h;

3) Acceleration accuracy: 0.25m/ s^2;

2.5.3.3 Filtering Requirements

2.5.3.3.1 The original data shall be used for position and speed, without filtering;

2.5.3.3.2 The acceleration shall be filtered by a 12-pole stepless Butterworth filter, with the cut-off frequency being 10Hz;

2.5.3.3.3 Requirements on VT

As shown in Figure 2-1, the VT shall be a M_1 passenger vehicle or a soft target used to replace the actual M_1 passenger vehicle. Such soft target shall be used to replace the real vehicle (including visual, radar, lidar and PMD attributes). For the requirements on specifications of soft target, please refer to ISO19206.

Figure 2- 1 Appearance Diagram of Soft Vehicle Target

2.5.3.3.4 Requirements on Adult Dummy Target

As shown in Figure 2-2, the dummy target shall be used to replace the pedestrian target (including visual, radar, lidar and PMD attributes). For the requirements on specifications of dummy, please refer to ISO 19206.

Figure 2-2 Appearance Diagram of Pedestrian Target

2.5.3.3.5 Requirements on Child Dummy Target

As shown in Figure 2-3, the child dummy target shall be used to replace the child target (including visual, radar, lidar and PMD attributes). For the requirements on specifications of child dummy, please refer to ISO 19206.

Figure 2-3 Appearance Diagram of Child Dummy Target

2.5.3.3.6 Requirements on Two-wheeled Vehicle Target

As shown in Figure 2-4, the two-wheeled target shall be used to replace the bicycle (including visual, radar, lidar and PMD attributes). For the requirements on specifications of two-wheeled vehicle target, please refer to ISO 19206.

Figure 2-4 Appearance Diagram of Two-wheeled Vehicle Target

2.5.3.3.7 Requirements on Motorcycle Target

The two-wheeled vehicle target shall be used to replace the real two-wheeled vehicle target (including visual, radar, lidar and PMD attributes). The specifications of motorcycle target are shown in Figure 2-5.

Figure 2-5 Appearance Diagram of Motorcycle Target

2.5.4 Test Procedures

2.5.4.1 Preparation of VUT

2.5.4.1.1 Confirmation on Tyre Conditions

The test shall be conducted with the brand new and genuine tyres consistent with the tyre configuration (supplier, model, size, speed and load class) specified by the manufacturer. To the extent that the tyre configuration (supplier, model, size, speed and load grade) is consistent with that specified by the manufacturer, the replacement tyre provided by the manufacturer or the agent designated by the manufacturer may be used. The tyres shall be inflated to the standard cold air pressure recommended by the manufacturer, which shall be at least suitable for normal load conditions.

2.5.4.1.2 Confirmation on Vehicle Conditions

2.5.4.1.2.1 It shall be ensured that the spare wheel (if equipped) and on-board tools are loaded on the VUT. There shall be no other objects on the VUT.

2.5.4.1.2.2 It shall be ensured that all tyres are inflated to the manufacturer's recommended tyre pressures for the current load state.

2.5.4.1.2.3 Measure the front and rear axle loads of the vehicle, calculate the total vehicle mass, which shall be regarded as the curb weight of the vehicle and recorded.

2.5.4.1.3 Equipment Installation and Loading

2.2.4.1.3.1 Install the instruments and equipment for the test.

2.5.4.1.3.2 Load the vehicle according to the weight requirements (200kg minus the weight of test driver and test equipment), and fix the load securely.

2.5.4.1.3.3 With the driver included, measure the front and rear axle loads of the vehicle.

2.5.4.1.3.4 Compare it with the curb weight of the vehicle.

2.5.4.1.3.5 The difference between the total vehicle mass measured and the curb weight +200kg shall be within ±1%, and the difference between the front and rear axle load distribution and the axle load distribution of the vehicle with full oil and no load shall be less than 5%. If the actual situation of the vehicle fails to meet this requirement, the load shall be adjusted without affecting the performance of the vehicle, and shall be firmly fixed after the adjustment.

2.5.4.1.3.6 The operations in 2.5.4.1.3.3 through 2.5.4.1.3.5 shall be repeated until the front/rear axle load and the total mass of the vehicle can meet the requirements. The load shall be carefully adjusted until it is as close as possible to the original property of the vehicle, and the final axle load shall be recorded.

2.5.4.2 Preparation for Test

2.5.4.2.1 Requirements on Vehicle Conditions

1) It shall be ensured that the spare wheel (if equipped) and on-board tools are loaded on the VUT. There shall be no other objects on the VUT.

2) It shall be ensured that all tyres are inflated to the manufacturer's recommended tyre pressures for the current load state.

2.5.4.2.2 Function Setting

It shall be ensured that the automatic emergency braking system (AEB) is turned on. For systems with different following distances and alarm levels, the following distance and alarm level shall be set to the

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intermediate level or the level immediately above the intermediate level (i.e., the following distance will be shorter and the alarm will be given later under the same conditions) before the test starts. The configuration diagrams are shown in Figure 2-6 and Figure 2-7.

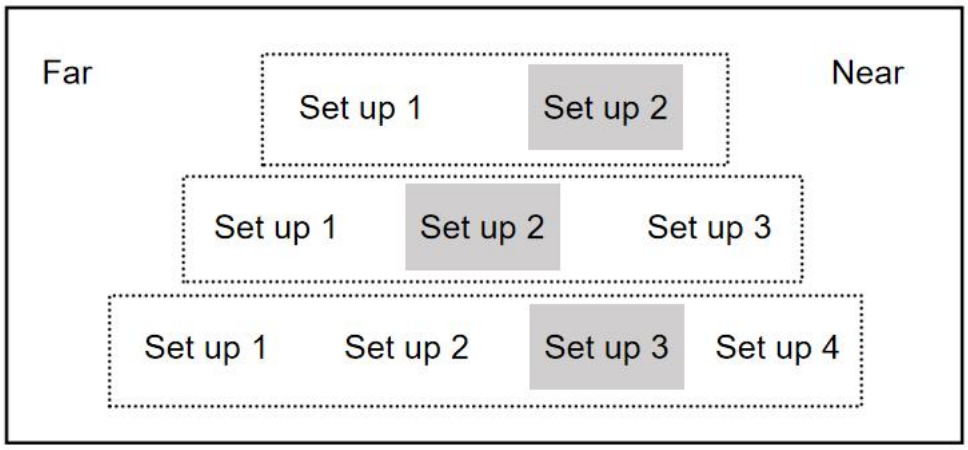

Figure 2-6 Schematic Diagram of Following Distance Setting

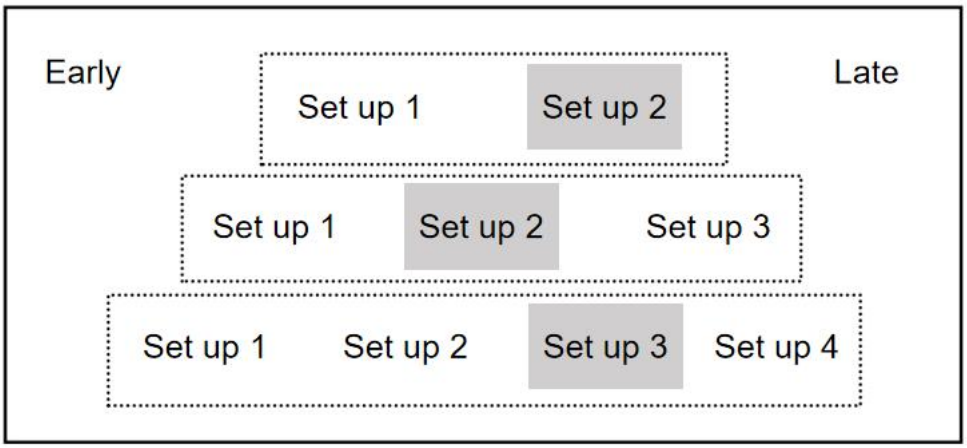

Figure 2-7 Schematic Diagram of Alarm Time Setting

2.5.4.2.3 Active hood system

If the failure of the vehicle's active hood system will not affect the normal operation of the system, the system shall be disabled before the test.

2.5.4.2.4 Airbag system

If the failure of the vehicle's airbag system will not affect the normal operation of the system, the system shall be disabled before the test.

2.6 Test Items

2.6.1 Following Ability

2.6.1.1 Front Vehicle Static State Identification and Response

(1) Test Scenarios

As shown in Figure 2-8, the test road shall be a long straight road with at least one lane, and the VUT shall run towards the front static VT.

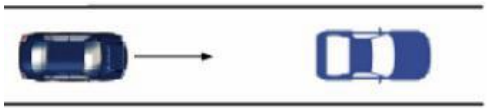

Figure 2-8 Schematic Diagram of Test Scenario for Front Vehicle Static State Identification and Response

(2) Test Method

After the system is activated, the vehicle speed shall be set from low to high for test. The VUT shall reach the expected speed before it is only 200m away from the VT, and shall approach the static VT ahead in a stable state. The driver shall hold the steering wheel with both hands and shall not interfere with the normal operation of the system. The set speed of the VUT and the placement position of the VT are shown in Table 2-1.

VT placed on the left side of the road shall mean that the outer edges of the left wheels of the VT coincide with the inner side of the left lane line.

VT placed on the right side of the road shall mean that the outer edges of the right wheels of the VT coincide with the inner side of the right lane line.

Table 2 -1 Table of Test Parameters for Front Vehicle Static State Identification and Response

Set speed of the VUT (km/h)	Position and posture of the VT
60	On right side of the road
	In the middle of the road
80	On left side of the road
	In the middle of the road

(3) Exit Conditions

The test shall exit when the following conditions are met:

1) If the vehicle speed is zero or a collision occurs during a single test, the single test shall be terminated.

2) If the speed of the VUT is greater than 50km/h when the collision occurs, the test of this item shall be terminated.

3) If the speed reduction of the VUT is less than 5km/h, the test of this item shall be terminated.

2.6.1.2 Front Vehicle Low-speed Identification and Response

(1) Test Scenarios

As shown in Figure 2-9, the test road shall be a long straight road with at least one lane, and the VUT shall run towards the front slow-moving VT.

Figure 2-9 Schematic Diagram of Test Scenario for Front Vehicle Low-speed Identification and Response

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(2) Test Method

After the system is activated, the vehicle speed shall be set from low to high for test. The VUT shall reach the expected speed before it is only 200m away from the VT, and shall approach the low-speed VT ahead in a stable state. The driver shall hold the steering wheel with both hands and shall not interfere with the normal operation of the system. The set speed of the VUT and the placement position of the VT are shown in Table 2-2.

VT placed on the left side of the road shall mean that the outer edges of the left wheels of the VT coincide with the inner side of the left lane line.

VT placed on the right side of the road shall mean that the outer edges of the right wheels of the VT coincide with the inner side of the right lane line.

Table 2 -2 Table of Test Parameters for Front Vehicle Low-speed Identification and Response

Set speed of the VUT (km/h)	Speed of VT (km/h)	Position of VT
60	20 (vehicle)	On right side of the road
		In the middle of the road
120	60 (vehicle)	On left side of the road
		In the middle of the road
80	30 (motorcycle)	In the middle of the road
		0.5m to the right in the middle of the road

(3) Exit Conditions

The test shall exit when the following conditions are met:

1) For any single test, if the speed of the VUT is less than the speed of the VT or a collision occurs, the test shall be terminated.

2) If the speed of the VUT is greater than 50km/h when the collision occurs, the test of this item shall be terminated.

3) If the speed reduction of the VUT is less than 5km/h, the test of this item shall be terminated.

2.6.1.3 Front Vehicle Deceleration Identification and Response

(1) Test Scenarios

As shown in Figure 2-10, the test road shall be a long straight road with at least one lane, and the VUT shall run towards the front slow-moving VT.

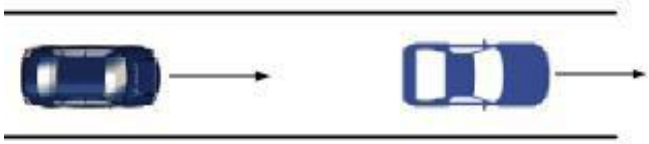

Figure 2-10 Schematic Diagram of Test Scenario for Front Vehicle Deceleration Identification and Response

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(2) Test Method

After the system is activated, the vehicle speed shall be set from low to high for test. The VUT shall follow VT at a relatively stable following distance, and then the front vehicle shall apply a deceleration of 3m/s^2. During the process, the driver shall hold the steering wheel with both hands and shall not interfere with the normal operation of the system. The set speed of the VUT and the placement position of the VT are shown in Table 2-3.

Table 2 -3 Table of Test Parameters for Front Vehicle Deceleration Identification and Response

Set speed of the VUT (km/h)	Speed of VT (km/h)	Deceleration of the VT
60	50	3m/s^2

(3) Exit Conditions

The test shall exit when the following conditions are met:

1) For any single test, if the speed of the VUT is less than the speed of the VT or a collision occurs, the test shall be terminated.

2) If the speed of the VUT is greater than 50km/h when the collision occurs, the test of this item shall be terminated.

3) If the speed reduction of the VUT is less than 5km/h, the test of this item shall be terminated.

2.6.1.4 Front Vehicle Cut-in Identification and Response

(1) Test Scenarios

As shown in Figure 2-11, the test road shall be a long straight road with at least two lanes, the middle lane line shall be a white dotted line, and the lane width shall be 3.75m. The VUT and VT shall run in their respective lanes. When the VUT approaches the VT, the VT shall cut into the lane where the VUT is located.

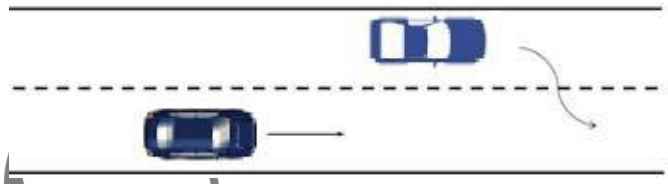

Figure 2-11 Schematic Diagram of Test Scenario for Front Vehicle Cut-in Identification and Response

(2) Test Method

After the system is activated, the vehicle speed shall be set from low to high for test. The VUT shall reach the expected speed before it is only 200m away from the VT, and shall run steadily in the lane. The VT shall run at a constant speed along the middle of the adjacent lane in the same direction, quickly cut into the lane where the VUT is located, and then run along the middle of the lane. During this process, the driver shall hold the steering wheel with both hands and shall not interfere with the normal operation of the system. The set speed of the VUT, the speed of the VT, the distance between the VT and the VUT when the VT cuts in the lane, and the duration of the cut-in operation of the VT are shown in Table 2-4.

Table 2 -4 Table of Test Parameters for Front Vehicle Cut-in Identification and Response

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Set speed of the VUT (km/h)	Speed of VT (km/h)	Time gap between front end and the rear end of VT (s)	Duration of cut-in operation (s)
40	20	1.5	2.2
80	60		

(3) Exit Conditions

For any single test, if the speed of the VUT is less than the speed of the VT or a collision occurs, the test shall be terminated.

2.6.1.5 Front Vehicle Cut-out Identification and Response

(1) Test Scenarios

As shown in Figure 2-12, the test road shall be a long straight road with at least two lanes, the middle lane line shall be a white dotted line, and the lane width shall be 3.75m. The VUT shall run in any lane, and there shall be the VT in front of the VUT.

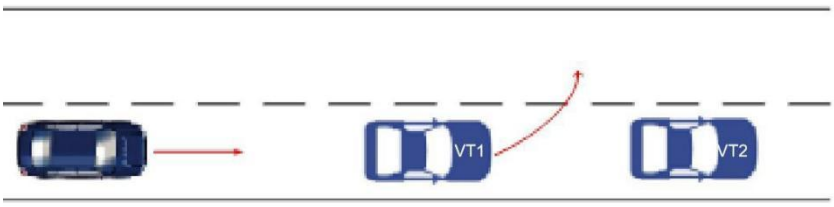

Figure 2-12 Schematic Diagram of Test Scenario for Front Vehicle Cut-out Identification and Response

(2) Test Method

After the system is activated, the vehicle speed shall be set from low to high for test. The VT1 shall run along the middle of the lane, and the VUT shall follow the VT1 ahead with a relatively stable following distance. The VT1 shall cut out of the lane when approaching the VT2, and then run along the middle of the adjacent lane. During the process, the driver shall hold the steering wheel with both hands and shall not interfere with the normal operation of the system. The speed of VT, the distance between the VT1 and the VT2 when the VT1 cuts out of the lane, and the duration of cut-out process of the VT1 are shown in Table 2-5.

Table 2 -5 Table of Test Parameters for Front Vehicle Cut-out Identification and Response

Set speed of the VUT (km/h)	Speed of the VT1 (km/h)	Speed of the VT1 (km/h)	Distance between the VT1 and the VT2 (m)	Duration of cut-out operation of the VT (s)
50	40	0	25	2.2
70	60	0	37	2.2

(3) Exit Conditions

1) For any single test, if the speed of the VUT is less than the speed of the VT or a collision occurs, the test shall be terminated.

2) If the speed of the VUT is greater than 50km/h when the collision occurs, the test of this item

shall be terminated.

3) If the speed reduction of the VUT is less than 5km/h, the test of this item shall be terminated.

2.6.1.6 Start/Stop Following Front Vehicle

(1) Test Scenarios

As shown in Figure 2-13, the test road shall be a long straight road with at least one lane. The VUT shall follow the VT steadily in the same lane, and the VT shall brake until it stops. After a certain time, the VT shall start and accelerate.

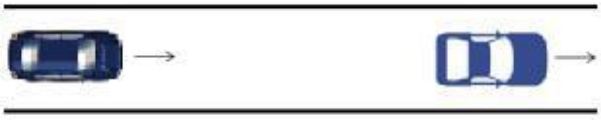

Figure 2-13 Schematic Diagram of Test Scenario for Start/Stop Following Front Vehicle

(2) Test Method

After the system is activated, the VUT shall follow the VT ahead at a constant speed of 20km/h in the middle of the lane. After the VUT has followed the VT at a relatively stable following distance for at least 3s, the VT shall decelerate at a deceleration of 2m/s^2 until it stops. The VUT shall stop within 3s. Thereafter, the VT shall start and accelerate to the initial speed, with the acceleration of 2m/s^2. In this process, the driver shall hold the steering wheel with both hands and shall not interfere with the normal operation of the system.

(3) Exit Conditions

The test shall exit when the following conditions are met:

1) The VUT collides with the VT.

2) The VUT runs stably.

2.6.2 Combined Control Ability

2.6.2.1 Lane Centering Control

(1) Test Scenarios

As shown in Figure 2-14, the test road shall be a combination of a long straight road and a curved road, with smooth transition at the junction. The length of the curved road shall meet the requirements that the running time of vehicle is more than 5s. The lane lines on both sides shall be white dotted lines or solid lines, and there shall be no other traffic participants. The VUT shall run from the long straight road to the curved road.

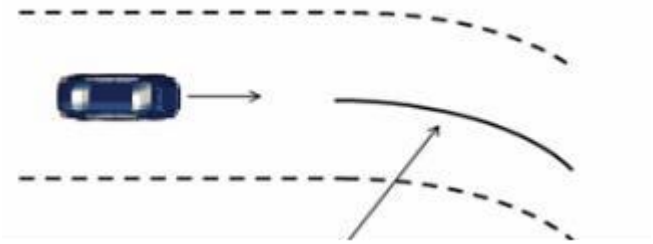

Figure 2-14 Schematic Diagram of Test Scenario for Lane Centering Control

(2) Test Method

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The test shall be carried out at the set speed of 60km/h and 80km/h respectively. The turning radius corresponding to different set speeds is shown in Table 2-6. After the system is activated, the driver shall hold the steering wheel with both hands. The vehicle shall reach a stable running state before entering the curved road.

Table 2 -6 Table of Test Parameters for Lane Keeping Ability

Turning radius (m)	250	500
Set speed of the VUT (km/h)	60	80

(3) Exit Conditions

The outer edge of the front wheel of the VUT contacts the inner edge of the lane line, or the vehicle runs stably in the lane.

2.6.2.2 Low-speed Combined Control

(1) Test Scenarios

As shown in Figure 2-15, the test road shall be a combination of a long straight road and a curved road, with smooth transition at the junction. The length of straight road shall not be less than 150m, the length of curved road shall not be less than 200m, and the turning radius on the curved road shall be 500m at the end of curved road.

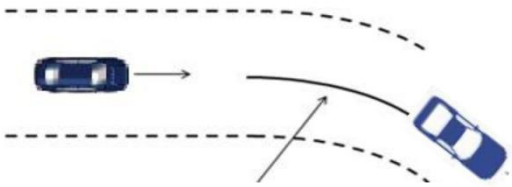

Figure 2-15 Schematic Diagram of Low-speed Combined Control

(2) Test Method

After the system is activated, the vehicle speed shall be set to 40km/h. The VUT shall run towards the front static VT in a stable state. The driver shall hold the steering wheel with both hands and shall not interfere with the normal operation of the system.

(3) Exit Conditions

The test shall exit when the following conditions are met:

1) For any single test, if the speed of the VUT is less than the speed of the VT or a collision occurs, the test shall be terminated.

2.6.2.3 High-speed Combined Control

(1) Test Scenarios

As shown in Figure 2-16, the test road shall be a combination of a long straight road and a curved road, with smooth transition at the junction. The length of straight road shall not be less than 150m, the length of curved road shall not be less than 200m, the final turning radius on the curved road shall be 500m, and the static VT shall be placed at the end of curved road.

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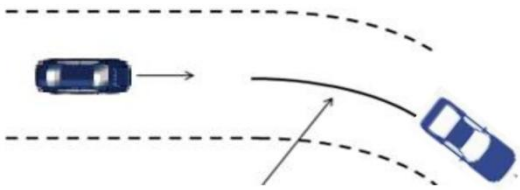

Figure 2-16 Schematic Diagram of High-speed Combined Control

(2) Test Method

After the system is activated, the vehicle speed shall be set to 80km/h. The VUT shall run towards the front static VT in a stable state. The driver shall hold the steering wheel with both hands and shall not interfere with the normal operation of the system.

(3) Exit Conditions

The test shall exit when the following conditions are met:

1) For any single test, if the speed of the VUT is less than the speed of the VT or a collision occurs, the test shall be terminated.

2.6.2.4 Driver-confirmed Lane Changing Ability

2.6.2.4.1 Interference-free Lane Changing

(1) Test Scenarios

As shown in Figure 2-17, the test road shall be a long straight road with at least two lanes. The VUT shall run at a constant speed and there shall be no interfering vehicle on the adjacent lane.

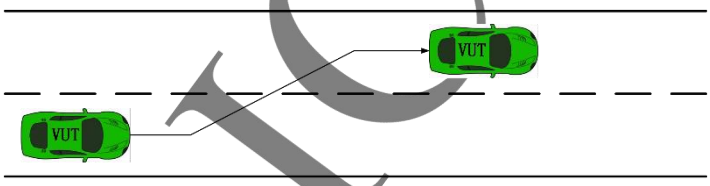

Figure 2-17 Schematic Diagram of Test Scenario for Interference-free Lane Changing

(2) Test Method

The speed of the VUT shall be set at the minimum speed which can activate the lane changing function. After the vehicle runs stably, the lane changing action shall be triggered.

(3) Exit Conditions

The VUT has completed the lane changing action or the VUT has run in the lane for more than 10s.

2.6.2.4.2 Interfered Lane Changing

(1) Test Scenarios

As shown in Figure 2-18, the test road shall be a long straight road with at least two lanes, the VUT shall run at a constant speed, and the VT shall exist in the adjacent lane and run at the same speed.

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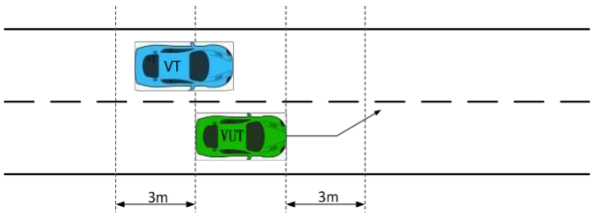


Figure 2-18 Schematic Diagram of Test Scenario for Interfered Lane Changing

(2) Test Method

The speed of the VUT shall be set at the minimum speed which can activate the lane changing function. The VT in the adjacent lane shall run in the same direction at the same speed and its position shall always be within the range from 3m in front of the VUT to 3m behind the VUT. After the vehicle runs stably, the driver shall move the steering lever to trigger the lane changing action.

(3) Exit Conditions

The VUT has triggered the lane changing action or the VUT has run in the lane for more than 10s.

2.6.3 Emergency Avoidance

2.6.3.1 Pedestrian and Two-wheeled Vehicle Crossing

2.6.3.1.1 Pedestrian Crossing with Shelter

(1) Test Scenarios

The test road shall be a long straight road with at least one lane. The layout of the scenario is shown in Figure 2-19.

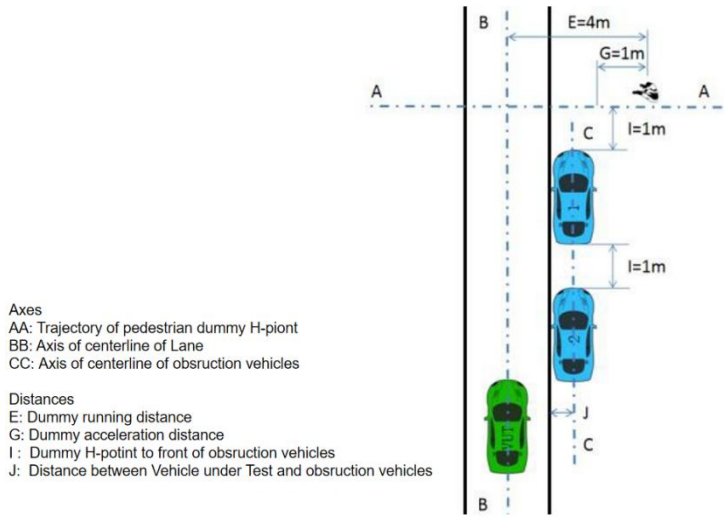


Figure 2-19 Schematic Diagram of Test Scenario for Pedestrian Crossing with Shelter

(2) Test Method

After the system is activated, the speed of the VUT shall be set at 40km/h, and the expected speed shall be reached before the VUT is 100m away from the moving track of the pedestrian, and the VUT shall run forward at a constant speed. The pedestrian shall move at a constant speed of 5km/h, and the expected collision point shall be in the middle of the road.

(3) Exit Conditions

1) If, in a single test, the VUT collides with the pedestrians or avoids the collision, the test shall be terminated.

2) If the speed reduction of the VUT is less than 5km/h, the test of this item shall be terminated.

(4) Size of Obstacle Vehicle

Length of vehicle	Width of vehicle	Height of vehicle
4100mm-4700mm	1700mm-1900mm	1300mm-1800mm

2.6.3.1.2 Pedestrian Crossing at Night

2.6.3.1.2.1 Background Light Intensity

The value of background light intensity measured at the intersection of vehicle's running track and the pedestrian's moving track shall be selected, and all lamps (including vehicle lamps) shall be turned off during the measurement of background light intensity. The background light intensity shall meet the following condition: I_{EB}<1lux.

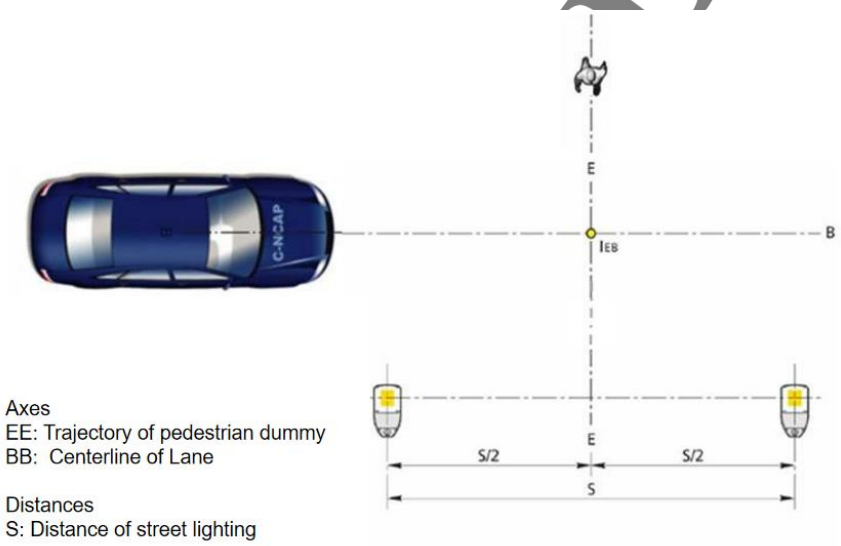


Figure 2-20 Schematic Diagram of Measuring Point of Background Light Intensity

2.6.3.1.2.2 Average Light Intensity of VUT's Path

Average light intensity of VUT's path ($\overline{I\,VUT}$) shall mean the average light intensity of the measuring point on the path of the VUT, namely the average light intensity at the center of the road where the VUT is located. The average light intensity of VUT's path shall be within the following range:

$$\overline{I\,VUT} = \frac{1}{11}\sum_{i=1}^{11} I\,VUTi;\ \ 16lux < \overline{I\,VUT} < 22lux$$

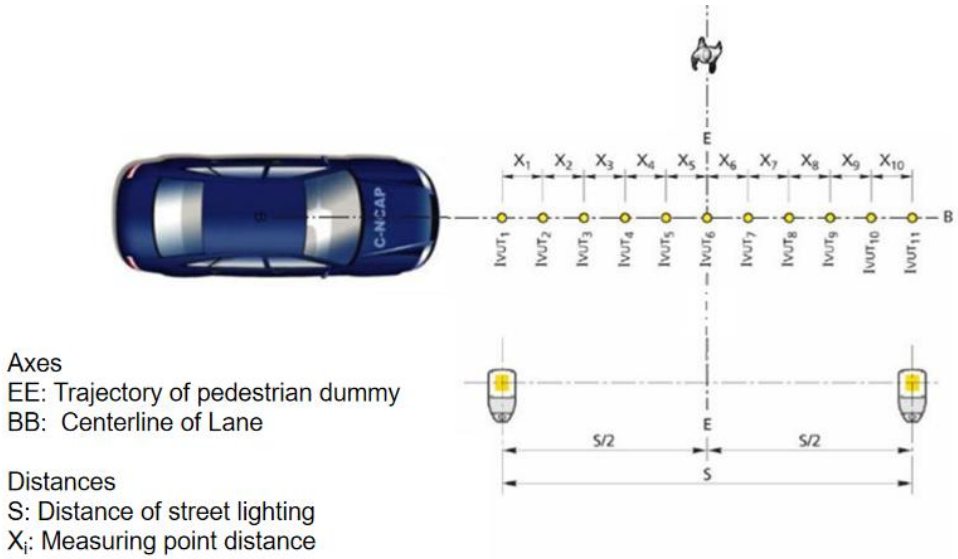


Figure 2-21 Diagram for Measurement of Light Intensity of VUT's Path

2.6.3.1.2.3 Light Intensity of Pedestrian's Path

The minimum light intensity of the measuring point along the pedestrian's path (i.e., the E-E axis in Figure 1-54) shall meet the following condition: I_{PTAi}>5lux.

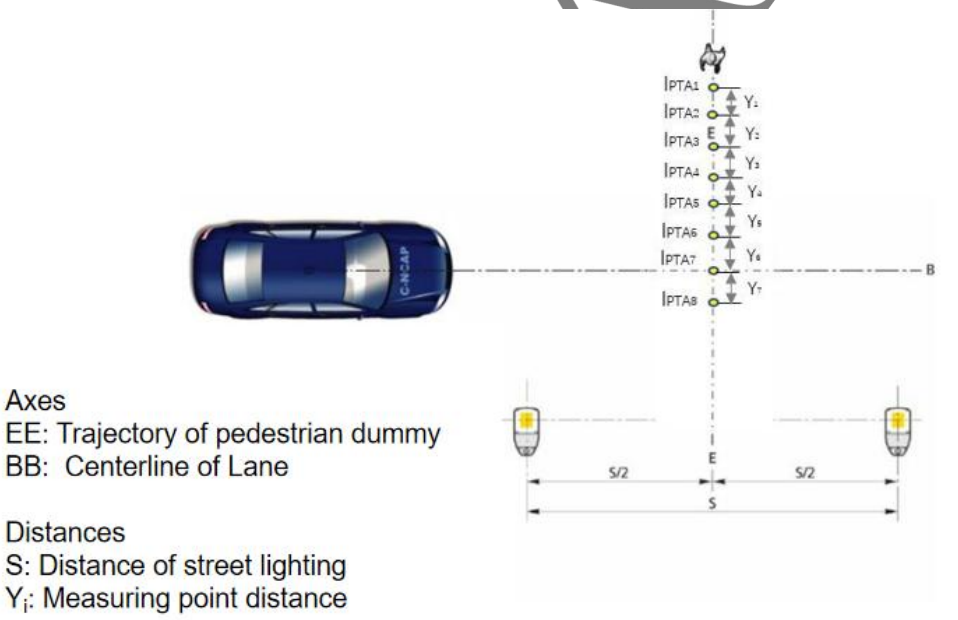
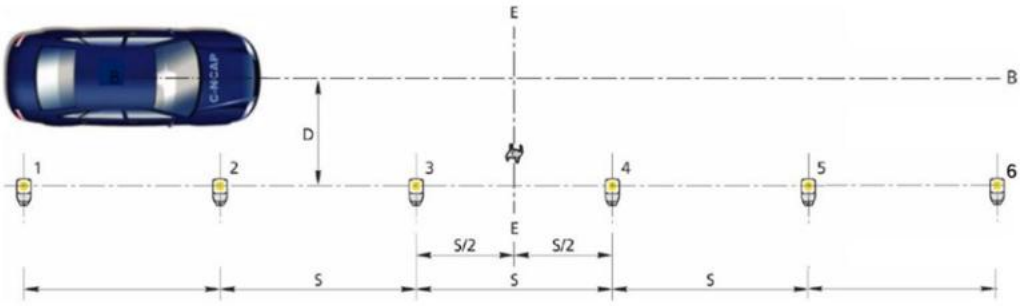


Figure 2-22 Diagram for Measurement of Light Intensity of PTA's Path

2.6.3.1.2.4 Setting of Test Street Lamps

The setting of street lamps in the night pedestrian test is shown in Figure 2-23 below. There shall be six street lamps in the path of the pedestrian, and the crossing path of the pedestrian shall be set between the third lamp and the fourth lamp.



Axes
EE: Trajectory of pedestrian dummy
BB: Centerline of Lane

Distances
S: Distance of street lighting
D: Distance between street lighting and under test vehicle

Figure 2-23 Schematic Diagram of Street Lamp Setting

2.6.3.1.2.5 Test Scenarios

(1) Test Scenarios

The test road shall be a long straight road with at least two lanes. The layout of the scenario is shown in Figure 2-24.

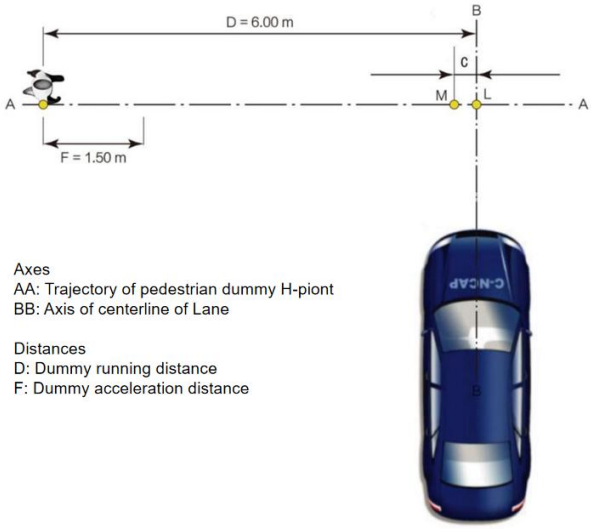


Figure 2-24 Schematic Diagram of Test Scenario for Pedestrian Crossing at Night

(2) Test Method

After the system is activated, the speed of the VUT shall be set at 40km/h, and the expected speed shall be reached before the VUT is 100m away from the moving track of the pedestrian, and the VUT shall run forward at a constant speed. The pedestrian shall move at a constant speed of 6.5km/h, and the expected collision point shall be in the middle of the road.

(3) Exit Conditions

1) If, in a single test, the VUT collides with the pedestrians or avoids the collision, the test shall

be terminated.

2) If the speed reduction of the VUT is less than 5km/h, the test of this item shall be terminated.

2.6.3.1.3 Two-wheeled Vehicle Crossing

(1) Test Scenarios

The test road shall be a long straight road with at least one lane. The layout of the scenario is shown in Figure 2-25.

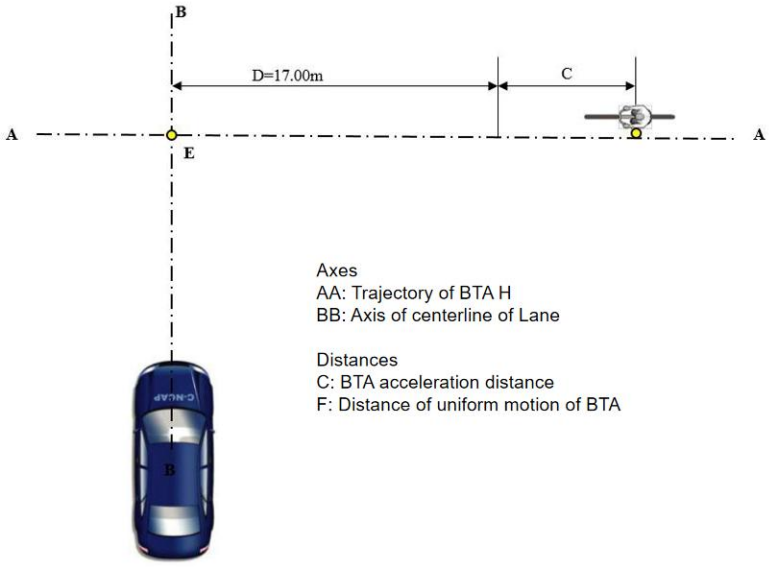


Figure 2-25 Schematic Diagram of Test Scenario for Two-wheeled Vehicle Crossing

(2) Test Method

After the system is activated, the speed of the VUT shall be set at 40km/h, the expected speed shall be reached before the VUT is 100m away from the moving track of the two-wheeled vehicle, and the VUT shall run forward at a constant speed. The two-wheeled vehicle shall run at a constant speed of 15km/h, and the expected collision point shall be in the middle of the road.

(3) Exit Conditions

1) For a single test, if the VUT collides with the two-wheeled vehicle or avoids the collision, the test shall be terminated.

2) If the speed reduction of the VUT is less than 5km/h, the test of this item shall be terminated.

2.6.3.1.4 Electrical Two-wheeled Vehicle Crossing

(1) Test Scenarios

The test road shall be a long straight road with at least one lane. The layout of the scenario is shown in Figure 2-26.

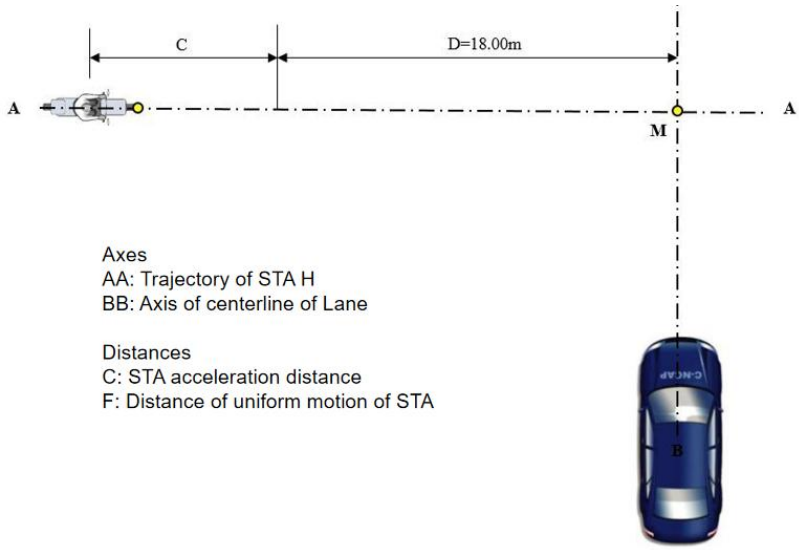


Figure 2-26 Schematic Diagram of Test Scenario for Electrical Two-wheeled Vehicle Crossing

(2) Test Method

After the system is activated, the speed of the VUT shall be set at 40km/h, the expected speed shall be reached before the VUT is 100m away from the moving track of the motorcycle, and the VUT shall run forward at a constant speed. The motorcycle shall run at a constant speed of 20km/h, and the expected collision point shall be in the middle of the road.

(3) Exit Conditions

1) For a single test, if the VUT collides with the motorcycle or avoids the collision, the test shall be terminated.

2) If the speed reduction of the VUT is less than 5km/h, the test of this item shall be terminated.

2.6.3.2 Traffic Accidents

2.6.3.2.1 Accident Vehicle Identification and Response

(1) Test Scenarios

As shown in Figure 2-27, the test road shall be a long straight road with at least two lanes, a static VT shall be placed transversely in the middle of the lane as an obstacle, and the VUT shall run at a constant speed towards the obstacle.

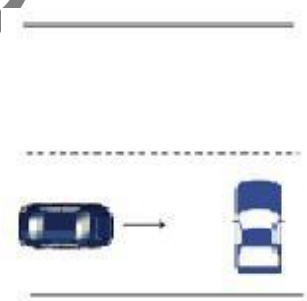


Figure 2-27 Schematic Diagram of Test Scenario for Transversally-placed VT

(2) Test Method

After the system is activated, the speed of the VUT shall be set at 60km/h, the expected speed shall

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be reached before the VUT is 200m away from the target, and the VUT shall run towards the obstacle at a constant speed.

(3) Exit Conditions

1) For any single test, if the speed of the VUT is less than the speed of the VT or a collision occurs, the test shall be terminated.

2) If the speed of the VUT is greater than 50km/h when the collision occurs, the test of this item shall be terminated.

3) If the speed reduction of the VUT is less than 5km/h, the test of this item shall be terminated.

2.6.3.3 Road Construction

2.6.3.3.1 Conical Barrel Identification and Response

(1) Test Scenarios

As shown in Figure 2-28, the test road shall be a long straight road with at least two lanes, and five traffic cones (recommended size: 50cm * 35cm) inclined at an angle of 45 degrees in the road direction shall be placed in the middle of the lane as obstacles, and the VUT shall run at a constant speed towards the obstacle.

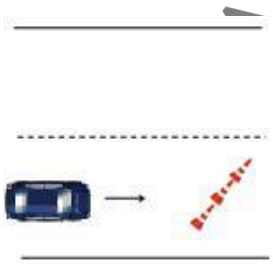

Figure 2-28 Schematic Diagram of Test Scenario for Conical Barrel

(2) Test Method

After the system is activated, the speed of the VUT shall be set at 40km/h, the expected speed shall be reached before the VUT is 200m away from the target, and the VUT shall run towards the obstacle at a constant speed.

(3) Exit Conditions

The VUT collides with the obstacle or avoids the collision.

2.6.3.4 Simulated dangerous scenario

2.6.3.4.1 Simulation Test Implementation Institution and Test Method

The implementation of simulation test shall be completed by the manufacturer itself or a third-party testing and certification institution entrusted by the manufacturer. The specific implementation form shall be reasonably selected by the manufacturer in light of its own situations. In order to ensure the fairness and justice of the results, no matter what method the manufacturer chooses, the test personnel shall conduct the on-site or remote audit on the test environment. As a precondition for scoring, if the submitted report is found to be inconsistent with the actual test environment, the simulation scoring qualification of the relevant model shall be canceled.

The test method shall be flexibly selected in light of the actual situations, including but not limited to hardware-in-the-loop (HIL) and vehicle-in-the-loop (VIL). It is recommended to use the physical-level

sensor signal simulation equipment to improve the test accuracy of simulation, such as video obscure, video injection, millimeter wave radar echo simulator, and ultrasonic radar echo simulator.

2.6.3.4.2 Simulation Test Process Compliance Audit

The simulation test process compliance report mainly inspects whether the actual test environment meets the basic requirements of the simulation, and determines whether the construction of simulated scenario and the overall closed-loop test can be realized. The audit focused on four major parts: core software and hardware, automotive dynamics calibration, equipment under test, and signal flow diagram:

1) Core software: The type and version of scenario simulation software, automotive dynamics simulation software, test management software and automatic test software (if any) shall be described; core hardware: The brand and specific model of real-time simulation system, cabinet, data acquisition board, communication interface board and physical-level sensor signal simulation equipment (if any) shall be described;

2) Comparison of automotive dynamics calibration results: The transverse and longitudinal parameters of vehicle shall be calibrated by reference to GB/T 12544, GB/T12543, GB/T 12676, GB/T 6323 and other recommended standards and in light of the actual test conditions, so as to improve the confidence of simulation;

3) Tested equipment: The design operation domain of driving automation system and the functional specifications that can be released shall be described, and the sensor configuration and main parameters of the system shall also be described, such as lens module, installation position of millimeter wave radar, FOV, maximum/minimum detection distance, acceleration, accuracy, and target information;

4) The signal flow diagram shall describe the overall interaction logic of this test, including the test scenario, the automotive dynamics model, the physical level signal of sensor, and the data flow direction and communication mode of tested object, and shall point out the deployment location and hardware architecture of each software;

2.6.3.4.3 Emergency Avoidance of Front Vehicle on Expressway

1) Test Scenarios

As shown in Figure 2-29, the test road shall have at least three lanes conforming to the definition of Chinese expressway. The VUT shall be located in the first lane on the left, following the VT ahead at a constant speed, and the time gap shall be set at the minimum step. There shall be a road barrier in front of the VT. When the VUT is 200m away from the barrier, it shall change to the second lane.

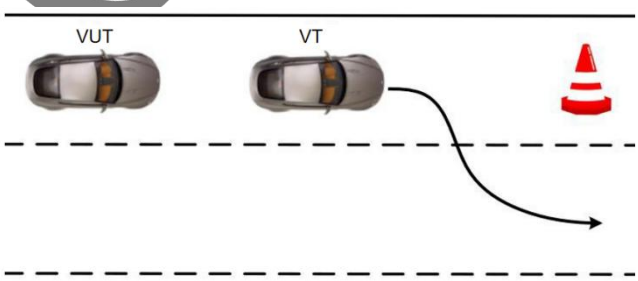

Figure 2-29 Schematic Diagram of Scenario for Emergency Avoidance of Front Vehicle on Expressway

2) Test Method

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After completing the test scenario construction and environment configuration, the system shall be activated and the motion parameters of the VUT and the VT shall be set. The parameters of VUT and traffic flow are shown in Table 2-7.

Table 2 -7 Table of Parameters of Test Scenario for Emergency Avoidance of Front Vehicle on Expressway

Set speed of the VUT	Set speed of VT	Position of VT	Trigger distance of lane changing (VT and obstacle)
90km/h	90km/h	The relative longitudinal distance between the first lane on the left and the main vehicle is the minimum step of time gap	20m

3) Exit Conditions

The test shall exit when the following conditions are met:

i) If the VUT avoids the obstacle or collides with the obstacle, this test shall be terminated.

2.6.3.4.4 Slow Moving Heavy Truck

1) Test Scenarios

As shown in Figure 2-30, the test road shall have at least three lanes conforming to the definition of Chinese urban road, the VUT shall be located in the middle lane, following the VT (heavy truck) ahead at a constant speed, and the time gap shall be set at the minimum step; the interfering vehicles shall be located in the first lane and the third lane on the left side, running at a constant speed. After the system runs stably, the VT shall be accelerated to 10km/h at 3.5m/s^2 after braking for 2s.

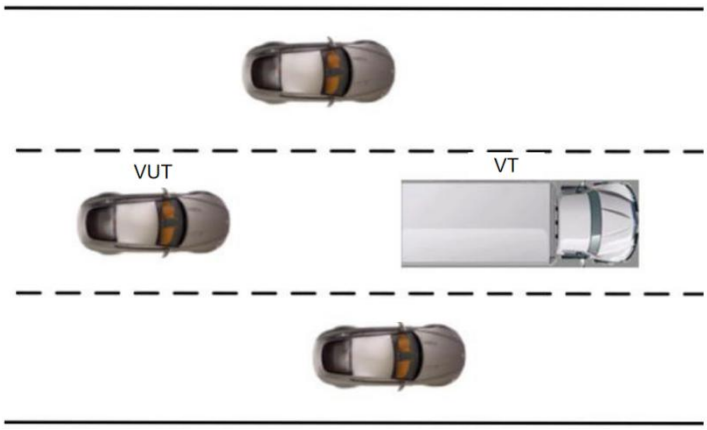

Figure 2-30 Schematic Diagram of Scenario for Slow Moving Heavy Truck

2) Test Method

After completing the test scenario construction and environment configuration, the system shall be activated and the motion parameters of the VUT and the VT shall be set. The parameters of VUT and traffic flow are shown in Table 2-8.

Table 2 -8 Table of Parameters of Test Scenario for Slow Moving Heavy Truck

Set speed of the VUT	Position and set speed of VT	Position and set speed of interfering vehicle	Deceleration of VT during braking operation
10km/h	Middle lane,10km/h	First lane on the left, Third lane on the left, 10km/h	3.5m/s^2

3) Exit Conditions

The test shall exit when the following conditions are met:

i) If the speed of the VUT is less than the speed of the VT or a collision occurs, the test shall be terminated.

2.6.3.4.5 Front Vehicle Cut-in at Tunnel Entrance

1) Test Scenarios

As shown in Figure 2-31, the test road shall have at least three lanes conforming to the definition of Chinese highway tunnel, the VUT shall be located in the middle lane, running along the lane line, and the VT shall be located at the tunnel entrance of the first lane on the left; the interfering vehicle shall be located 20m in front of the VT. When the distance between the VUT and the VT is 15m, the VT and the interfering vehicle shall start to run at a constant speed, and then the VT shall cut in the middle lane.

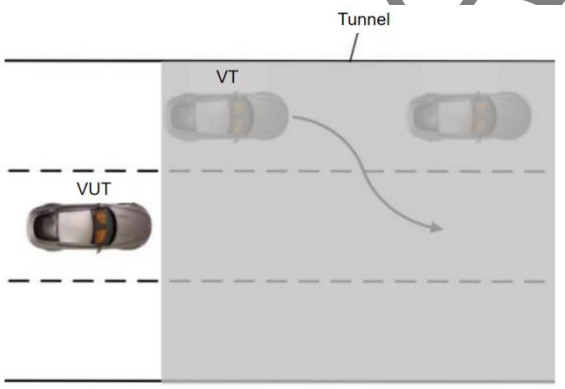

Figure 2-31 Schematic Diagram of Scenario for Front Vehicle Cut-in at Tunnel Entrance

2) Test Method

After completing the test scenario construction and environment configuration, the system shall be activated and the motion parameters of the VUT and the VT shall be set. The parameters of VUT and traffic flow are shown in Table 2-9.

Table 2 -9 Table of Parameters of Test Scenario for Front Vehicle Cut-in at Tunnel Entrance

Set speed of the VUT	Position and set speed of VT	Position and set speed of interfering vehicle	Trigger distance of lane changing (VT and VUT)	Duration of cut-in operation
60km/h	At tunnel entrance in the first lane on the left, 40km	At 20m in front of the VT in the first lane on the left, 30km/h	15m	2s

2) Exit Conditions

The test shall exit when the following conditions are met:

i) If the speed of the VUT is less than the speed of the VT or a collision occurs, the test shall be terminated.

2.6.3.4.6 Fuzzy Lane Changing

1) Test Scenarios

As shown in Figure 2-32, the test road shall have at least two lanes conforming to the definition of Chinese road, the road type shall be curved, and the fade degree of the white dotted line shall be set to 0.5. The VUT shall be located in the first lane on the left, running along the lane line, and the interfering vehicle shall be located in the middle of the two lanes for lane changing.

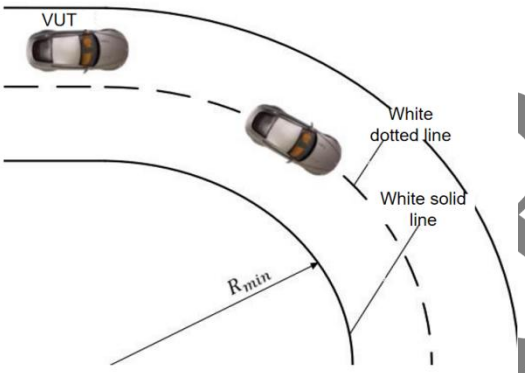

Figure 2-32 Schematic Diagram of Scenario for Fuzzy Lane Changing

2) Test Method

After completing the test scenario construction and environment configuration, the system shall be activated and the motion parameters of the VUT and the VT shall be set. The parameters of VUT and traffic flow are shown in Table 2-10.

Table 2 -10 Table of Parameters of Test Scenario for Fuzzy Lane Changing

Set speed of the VUT	Position of interfering vehicle and set speed of VT	Radius of curved road	Fade degree of white dotted line
60km/h	Running at 30km/h between two lanes	250m	0.5

2) Exit Conditions

The test shall exit when the following conditions are met:

i) If the speed of the VUT is less than the speed of the VT or a collision occurs, the test shall be terminated.

ii) If the outer edge of the front wheel of the VUT in the current lane contacts the inner edge of the lane line, the test shall be terminated.

2.6.3.4.7 Speed Limit Sign Identification

1) Test Scenarios

The test road shall have at least three lanes conforming to the definition of Chinese road. The VUT shall

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run along the line in the middle lane. There shall be a speed limit sign 200m ahead. The minimum speed limit shall be 50km/h and the maximum speed limit shall be 70km/h, as shown in Figure 2-33:

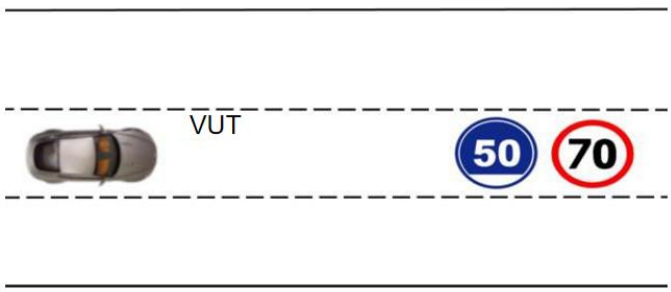

Figure 2-33 Schematic Diagram of Scenario for Speed Limit Sign Identification

2) Test Method

After completing the test scenario construction and environment configuration, the system shall be activated and the motion parameters of the VUT and the VT shall be set. The parameters of VUT and traffic flow are shown in Table 2-11.

Table 2 -11 Table of Parameters of Test Scenario for Speed Limit Sign Identification

Set speed of the VUT	Location of speed limit sign	Minimum speed limit	Maximum speed limit
90km/h	200m in front of the VUT	50km/h	70km/h

3) Exit Conditions

The test shall exit when the following conditions are met:

i) After the VUT passes the signboard for 3s, the test shall be terminated

2.6.4 Driver Engagement

2.6.4.1 System Prompt Ability

1) The user manual shall be reviewed, covering: definition of system, description of driver's responsibilities, description of use condition and description of driver state monitoring.

2) After the vehicle is started, record the system prompt information when the system is turned off;

3) After the vehicle is started, turn on the system, and record the system prompt information under the circumstance that the system is not activated;

4) After the vehicle is started, turn on the system and record the system prompt information under the circumstance that the system is activated.

2.6.4.2 Hands Off Detection and Minimum Risk Maneuver Test

(1) Test Scenarios

The test road shall be a combination of a long straight road and a curved road. The total length of the road shall not be less than 625m. The turning radius of the curved road shall be 500m. The VUT shall run at the lowest allowable speed in the long straight road and the function shall be started.

(2) Test Method

The system shall be turned on, and the driver shall hold the steering wheel with both hands. When

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the vehicle is running stably, the driver shall release the steering wheel, and the steering wheel, instrument and alarm sound shall be recorded. If the VUT has MRM, it shall be ensured that the VUT enters the MRM state in the curved road.

(3) Exit Conditions

The test shall exit when the following conditions are met:

1) The data have been recorded for 1 minute and 15 seconds;

2) The system is turned off or the system enters the MRM.

2.6.4.3 Eye Closure Detection and Head Bowing Detection

(1) Test Scenarios

The test road shall be a long straight road. The total length of the road shall not be less than 300m. The VUT shall run at the lowest allowable speed in the long straight road and the function shall be started.

(2) Test Method

After the system is turned on and the running state of the VUT is stable, the driver shall close his eyes for more than 2s and bow his head for more than 3s respectively, and the instrument and the driver's face, as well as the alarm sound, shall be recorded.

(3) Exit Conditions

The test shall exit when the following conditions are met:

1) The data have been recorded for 1 minute and 30 seconds;

2) The system is turned off or the system enters the MRM.

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Annex 1: Template of on Simulated Dangerous Scenario Test Process Audit Report

Simulated Dangerous Scenario Test Process Audit Report				
No.	Name	Information record		
1	Software and hardware of test bench frame	Software	Scenario simulation software	CarMaker8.0_HIL
			Automotive dynamics software	CarMaker8.0_HIL
			Test management software	Veristand2019
			Automated test software	ECU-Test2020.1
		Hardware	Video black box	Independently developed by ADC
			Real time simulation system	National Instruments
			I/O channel	National Instruments
			Cabinet	Independently developed by ADC
		Key photos of frame		
2	Automotive dynamics calibration	Longitudinal operating condition	Full throttle start	
			Full throttle acceleration	
		Transversal operating condition	Steady-state circumference	
			Double shift line	
3	Tested equipment	Tested object	ADAS domain controller (ADC_Super_V1)	
		Brief description of function	The functions such as AEB, ACC, LKA and TSR can be realized.	
4	Signal flow diagram			
		HIL test was conducted based on video black box.		

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Annex 2: Template of Simulated Dangerous Scenario Test Results Passing Report

Record of Simulated Dangerous Scenario Test Results		
Case name	Emergency Avoidance of Front Vehicle on Expressway	
Case No.	Virtual01	
Test time	19:00, October 27, 2020	
Test location	Tianjin Xiqing District CATARC Intelligent-connected Laboratory	
Testers	Zhang San, and Li Si	
Test conditions		1. The test was carried out on an open two-way three-lane road with clear lines and lane width of 3.75m on a sunny day. 2. With an initial speed of 90km/h, the VUT followed the VT ahead at a constant speed, and the time gap of these two vehicles was set at the minimum step. 3. The VT was located in the first lane on the left, with a relative longitudinal distance of 30m from the VUT, and ran at a constant speed of 90km/h. 4. The trigger distance of lane changing of the VT was 20m.
Test data		
Conclusion	No collision occurred, and the vehicle passed the test.	
Case name	Slow Moving Heavy Truck	
Case No.	Virtual02	
Test time	20:00 , October 27, 2020	
Test location	Tianjin Xiqing District CATARC Intelligent-connected Laboratory	
Testers	Zhang San, and Li Si	
Test conditions		1. The test was carried out on an open two-way three-lane urban road with clear lines and lane width of 3.75m on a sunny day. 2. With an initial speed of 10km/h, the VUT followed the VT ahead at a constant speed, and the time gap of these two vehicles was set at the minimum step. 3. With an initial speed of 10km/h, the interfering vehicle was located in the first/third lane on the left side

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Record of Simulated Dangerous Scenario Test Results		
		and ran at a constant speed; the parking space target ran in the middle lane with the initial speed of 10km/h. 4. The braking was triggered after the VUT followed the front vehicle steadily.
Test data		
Conclusion	No collision occurred, and the vehicle passed the test.	
Case name	Front Vehicle Cut-in at Tunnel Entrance	

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