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Intelligent & Connected Vehicle Autonomous Driving Functionality Test Regulations (For Trial Implementation)

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Intelligent & Connected Vehicle Autonomous Driving Functionality Test Regulations

1 General

This document specifies test scenario, test method and pass criteria for intelligent & connected vehicle autonomous driving functionality test items.

This document is applicable to passenger car and commercial vehicle which apply to perform intelligent & connected vehicle road test.

This document is not applicable to low speed vehicle and motorcycle.

2 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

2.1 Intelligent & Connected Vehicle (ICV)

New generation of motor vehicle which is installed with advanced devices such as on-board sensor, controller and actuator, and combines modern communication and network technology, realizes intelligent information exchange and sharing between vehicle and X (human, vehicle, infrastructure, cloud-side and so on), features functionalities such as complicated environment perception, intelligent decision-making and collaboration control, realizes “safe, efficient, comfortable and energy saving” driving, and ultimately to achieve a replacement for the operation of human.

2.2 Vehicle Under Test (VUT)

Vehicle which applies for intelligent & connected vehicle road test and will be subjected to autonomous driving functionality test to be performed as per the requirements of this document.

2.3 Vehicle Target (VT)

Mass production passenger car and commercial vehicle which are used for establishment of test scenario, or flexible target which features perception attributes for sensors such as laser radar, millimeter-wave radar, ultrasonic radar and camera and can replace the above mentioned vehicles.

2.4 Two-Wheeler

Combination of mass production bicycle, motorized bicycle, motorcycle and

rider used for establishment of test scenario, or substitute target featuring perception attributes of the above mentioned combination.

2.5 On Board Unit (OBU)

Hardware unit which is installed on vehicle under test and used for realization of networking communication between vehicle and the outside (i.e., V-X, including vehicle-vehicle, vehicle-infrastructure, vehicle-human and vehicle-cloud side, etc).

2.6 Road Side Unit (RSU)

Hardware unit which is installed at roadside of test site and is used for networking communication between vehicle and the outside (i.e., V-X, including vehicle-vehicle, vehicle-infrastructure, vehicle-human and vehicle-cloud side, etc).

2.7 Vehicle-to-Vehicle (V2V)

Information communication between vehicle under test and vehicle target which is completed by data pack transmission and receiving through on board unit.

2.8 Vehicle-to-Infrastructure (V2I)

Information communication between vehicle under test and road infrastructure which is completed by data pack transmission and receiving through on board unit and roadside unit.

2.9 Test Scenario

Combination of elements such as geographical environment in which vehicle is tested, weather, road, traffic conditions as well as vehicle status and time.

2.11 Dynamic Driving Task

Complete perception, decision-making and operation required for vehicle driving, including but not limited to:

- Control lateral vehicle motion;
- Control longitudinal vehicle motion;
- Object and event detection and response;
- Driving plan;
- Control vehicle lighting and signaling device.

Note: Excluding tasks such as drive distance plan, destination and route selection, etc.

2.12 Dynamic Driving Task Fallback

In case of exceeding of operational design domain or failure of relevant system of dynamic driving task, user implements dynamic driving tasks; if user has not intervened, the system shall feature the capability to enable it to reach minimal risk condition.

2.13 Autonomous Driving System

System which is able to continuously implement partial or all dynamic driving tasks and/or execute dynamic driving task fallback and consists of hardware and software.

2.14 Operational Design Domain (ODD)

The operating conditions of autonomous driving functionality determined during design (such as road, weather, traffic, velocity, time and etc.).

2.15 Failure

Error or malfunction that occurs in autonomous driving system or other complete vehicle system, making it impossible for autonomous driving system to reliably implement partial or all dynamic driving tasks.

2.16 Minimal Risk Condition

When autonomous driving system cannot complete the drive distance planned in advance due to failure of relevant system or exceeding of operational design domain, user or driving automation system implements dynamic driving task fallback, and finally reduces the accident risk to the minimum condition.

2.17 Request to Intervene

The notice which is used by autonomous driving system to request user to implement dynamic driving task fallback quickly.

2.18 Vehicle Control Authority

Control authority for systems such as vehicle steering, acceleration, braking, lighting and rain wiper, etc.

2.19 Platooning

A traveling state under which multiple vehicles under test are arranged in

platoon at small space; in which, the 1st vehicle is manually manipulated, and other vehicles starting from the 2nd vehicle are under autonomous driving.

2.20 Instruction

Driver's input signal and signal sent independently by vehicle under test through perception, map and other information.

For example, in lane-changing scenario, vehicle under test implements lane-changing action after receiving instruction; at the moment, the instruction can be execution signal sent by direction indicator lamp manipulated by driver or the execution signal sent by vehicle under test based on perception and independent decision-making.

2.21 Time to Collision (TTC)

Time to collision with target when vehicle under test maintains the movement conditions of the current instant.

2.22 Time Gap

Time taken for vehicle under test to run through certain distance at the current vehicle velocity.

2.23 Maximum autonomous driving velocity V_{max}

The maximum stable vehicle velocity of vehicle under test which can be maintained under autonomous driving mode.

3 Test Items

As shown in Table 1, this document specifies relevant test scenario, test method and requirement respectively regarding the intelligent & connected vehicle autonomous driving functionality test items listed in appendix 1 of *Administrative Specifications for Intelligent & Connected Vehicle Road Test (For Trial Implementation)*.

Vehicle that applies for intelligent & connected vehicle road test shall be subjected to autonomous driving functionality test verification as per this document.

For the optional test items listed in appendix 1 of *Administrative Specifications for Intelligent & Connected Vehicle Road Test (For Trial Implementation)* (marked with * in Table 1), where enterprise makes statement that its vehicle

features relevant functionality or test road segment involves relevant scenario, it is necessary to perform test of relevant items.

Table 1 Test item and test scenario of intelligent & connected vehicle autonomous driving functionality

| No. | Test Item | Test Scenario |
|-----|---|---|
| 1 | Identification and response to traffic signs and markings | Identification and response to velocity limit signs |
| | | Identification and response to stop signs and markings |
| | | Identification and response to lane dividing lines |
| | | Identification and response to crosswalk lines |
| 2 | Identification and response to traffic signal lamps * | Identification and response to power-driven vehicle signal lamps |
| | | Identification and response to direction indication signal lamps |
| 3 | Identification and response to driving status of the front vehicle | Identification and response to vehicle running in |
| | | Identification and response to opposite vehicle borrowing lane of the subject vehicle |
| 4 | Identification and response to obstacles | Obstacle test |
| | | Misuse test |
| 5 | Identification and avoidance to pedestrians and non-power-driven vehicles * | Pedestrian passing across street |
| | | Pedestrian walking along road |
| | | Two-wheeler passing cross street |
| | | Two-wheeler running along road |
| 6 | Vehicle-following driving | Stable vehicle-following driving |
| | | Stop-go functionality |
| 7 | Road-side parking | Emergency stop along roadside |
| 8 | Overtaking | Stop along roadside in the rightmost lane |
| | | Overtaking |
| 9 | Lane-changing | Change into adjacent lane without vehicle |
| | | Change into adjacent lane with vehicle |
| | | Decrease of number of forward lanes |
| 10 | Intersection driving * | Traffic in conflict with vehicle running straight |
| | | Traffic in conflict with vehicle turning right |
| | | Traffic in conflict with vehicle turning left |
| 11 | Traffic circle driving * | Traffic circle driving |
| 12 | Autonomous emergency braking | Forward vehicle is stationary |
| | | Forward vehicle applies brake |
| | | Pedestrian passes across |
| 13 | Manual operation intervention | Manual operation intervention |
| 14 | Networking communication * | Vehicle-to-vehicle on long straight road segment |
| | | Vehicle-to-infrastructure on long straight road segment |
| | | Vehicle-to-vehicle at intersection |
| | | Platooning test |

4 General Requirements

4.1 General requirements of vehicle under test

4.1.1 Vehicle under test shall be in compliance with the stipulations of article 7 (1) to (4) of *Administrative Specifications for Intelligent & Connected Vehicle Road Test (For Trial Implementation)*.

4.1.2 Vehicle under test shall provide material shown hereunder:

- 1) For homemade power-driven vehicle, delivery qualification certificate of complete vehicle shall be provided. For the vehicle type that is not listed in the announcement, delivery qualification certificate and compulsory inspection report of the vehicle type that is issued by a third party test lab

authorized by state shall be provided; for imported power-driven vehicle, compulsory product certification of imported power-driven vehicle, vehicle-carried inspection sheet and goods import certificate shall be provided;

- 2) Autonomous driving functionality introduction and certificate of failing to reduce vehicle safety performance;
- 3) Qualification certificate of power-driven vehicle safety technology inspection;
- 4) Certificates for the test subject conducting real vehicle test in the specific area such as a closed road or site.

4.1.3 Vehicle under test adopting networking communication technology shall be subjected to further test verification as per the test items selected in annex A on the basis of test in 6.14.

4.1.4 Vehicle under test adopting high accuracy map technology shall be subjected to test verification of the functionality as per the test items selected in annex A.

4.1.5 Autonomous driving system of vehicle under test shall ensure that under occurrence of emergency, driver is able to perform manual operation intervention. When autonomous driving system fails or operational design domain is exceeded, vehicle under test shall timely send request to manually intervene, and remind driver to intervene in vehicle under test.

4.1.6 Vehicle under test shall display the current driving mode at prominent position, i.e., autonomous driving mode or manual operation mode.

4.2 General requirements of test scenario

4.2.1 The test road shall be flat and dry bitumen or concrete road surface; single lane width shall be 3.5m to 3.75m.

4.2.2 Test environment shall be excellent and free from severe weather conditions such as rain, snow and hail, and horizontal visibility shall be not less than 500m.

4.2.3 Connection communication functionality test shall be performed under the condition that electromagnetic environment will not cause prominent influence upon test results.

4.2.4 Traffic signs and markings of test scenario shall be clear and visible and shall meet the requirements of GB 5768-2017 *Road traffic signs and markings*.

4.3 Requirements of test process

4.3.1 Test subject shall fill in and submit parameter table of vehicle under test when applying for test, see the parameter table format as per annex A. Prior to test, third party test institutions shall perform vehicle conformity inspection as per the parameter table of vehicle under test.

4.3.2 In accordance with test route scenario arrangement, partial scenarios can be combined for test; see the recommended program for combination test as per annex B.

4.3.3 If test subject proposes special weather (natural conditions such as rain, snow, fog, mist and nighttime, etc) test requirements, third party test institutions may configure relevant natural environment as per requirements and arrange relevant test.

4.3.4 Vehicle applying for test shall be subjected to tests of all specified scenarios in one time. During test period, perform one round of tests only for each test scenario as per test method stipulation, and terminate test if vehicle under test does not meet any requirements on any test scenario.

4.3.5 Record contents during test process shall include:

- a) Vehicle control mode;
- b) Vehicle velocity, acceleration and other motion status;
- c) Environmental perception and response status;
- d) Vehicle lighting and signal real-time status;
- e) 360° video monitor situations outside vehicle;
- f) Vehicle interior video and speech sound monitoring situations of test driver and human-machine interaction.

4.3.6 Requirements of test accuracy:

- a) Velocity of vehicle under test and vehicle target: $0\pm 2\text{km/h}$;
- b) Acceleration of vehicle under test and vehicle target: $0\pm 0.5\text{m/s}^2$;
- c) Relative lateral distance of vehicle under test and vehicle target: $0\pm 0.1\text{m}$;
- d) Relative longitudinal distance of vehicle under test and vehicle target: $0\pm 0.1\text{m}$.

4.4 Requirements of test instruments and equipment

Test instruments and equipment shall meet the following requirements:

- a) Dynamic data sampling and storing frequency shall be at least 100Hz.
- b) Accuracy requirements:
 - Velocity accuracy 0.1km/h;
 - Lateral and longitudinal position accuracy 0.03m;
 - Accelerate accuracy 0.1m/s².

5 Pass Criteria

5.1 With the exception of the test scenario of autonomous emergency braking and manual operation intervention, all tests shall be completed under autonomous driving state of vehicle under test and meet the following pass criteria:

- a) Vehicle under test shall be subjected to test of each scenario as per stipulations and meet the requirements;
- b) Vehicle under test shall pass test of all the specified required items and optional test items in one test application;
- c) No change adjustment of software/hardware shall be made during test period.

5.2 Furthermore, the following conditions shall be met:

- a) With the exception of hazard avoidance driving mode conditions, autonomous driving vehicle under test shall not violate traffic regulations;
- b) Autonomous driving vehicle under test shall be able to use functionalities such as lighting and rain wiper normally;
- c) Autonomous driving vehicle under test shall timely send warning remind in case of occurrence of malfunction;
- d) The traveling direction control of autonomous driving vehicle under test shall be accurate and free from swinging or deviation.

6 Test Regulations

6.1 Identification and response to traffic signs and markings

6.1.1 General

This test item aims to test the identification and response to autonomous driving system to traffic signs and markings and assess the capability of vehicle under test to comply with traffic regulations.

This test item shall include test of four types of signs and markings scenarios such as velocity limit sign, stop signs and markings, lane dividing line and crosswalk line.

Third party test institutions may add relevant ban/prohibition, warning and indicative signs and markings tests as per the actual test road situations.

6.1.2 Identification and response to velocity limit signs

6.1.2.1 Test scenarios

Test road shall be long straight road containing one lane at least, and velocity limit sign board shall be configured on the road segment, vehicle under test shall run towards the sign board at velocity higher than the velocity shown on velocity limit sign board. As shown in Figure 6.1.

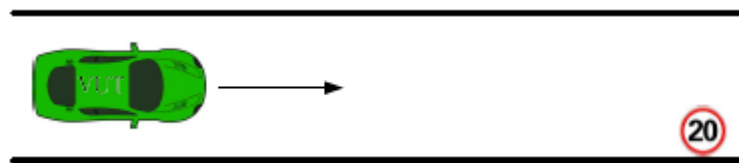


Figure 6.1 Schematic diagram of test scenario of identification and response to velocity limit signs

6.1.2.2 Test methods

Under autonomous driving mode, vehicle under test shall reach 1.2 times of the velocity shown on velocity limit sign at a position 100m ahead of velocity limit sign, and run towards velocity limit sign at constant velocity along lane center.

6.1.2.3 Requirements

When vehicle under test reaches velocity limit sign, the vehicle velocity shall be not more than the velocity shown on the velocity limit sign.

6.1.3 Identification and response to stop signs and markings

6.1.3.1 Test scenarios

Test road shall be long straight road containing one lane at least, stop sign board and stop line shall be configured on the road segment, and vehicle under test shall run towards stop line at constant velocity. As shown in Figure 6.2.

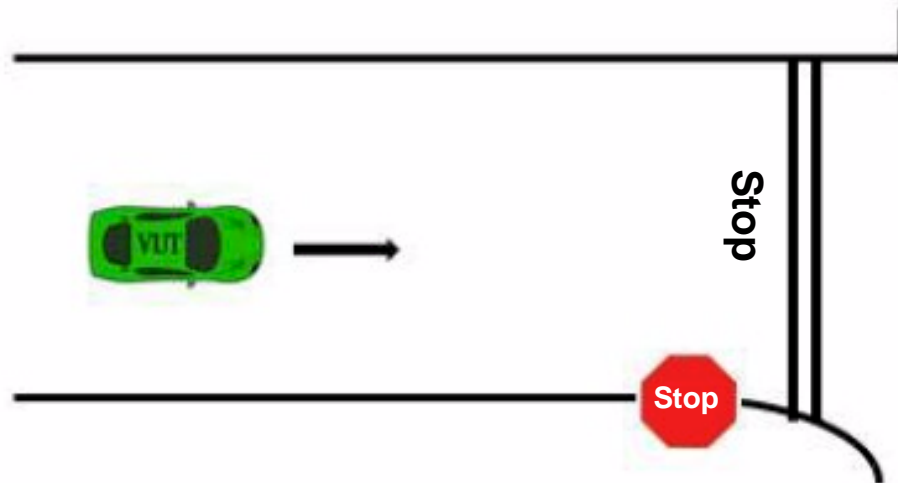


Figure 6.2 Schematic diagram of test scenario of identification and response to stop signs and markings

6.1.3.2 Test methods

Under autonomous driving mode, vehicle under test shall reach the vehicle velocity of 30km/h at a position 100m ahead of stop line, and run towards stop line at constant velocity along lane center. In test, there shall be no vehicle or pedestrian in front of stop line.

6.1.3.3 Requirements

- a) Vehicle under test shall stop in front of stop line;
- b) The stop time of vehicle under test shall not exceed 3s.

6.1.4 Identification and response to lane dividing lines

6.1.4.1 Test scenarios

The test road shall be a combination of a straight long road and curve road of radius not more than 500m, the length of curve road shall be more than 100m, and lane dividing lines at two sides shall be white dotted line or solid line. As shown in Figure 6.3.

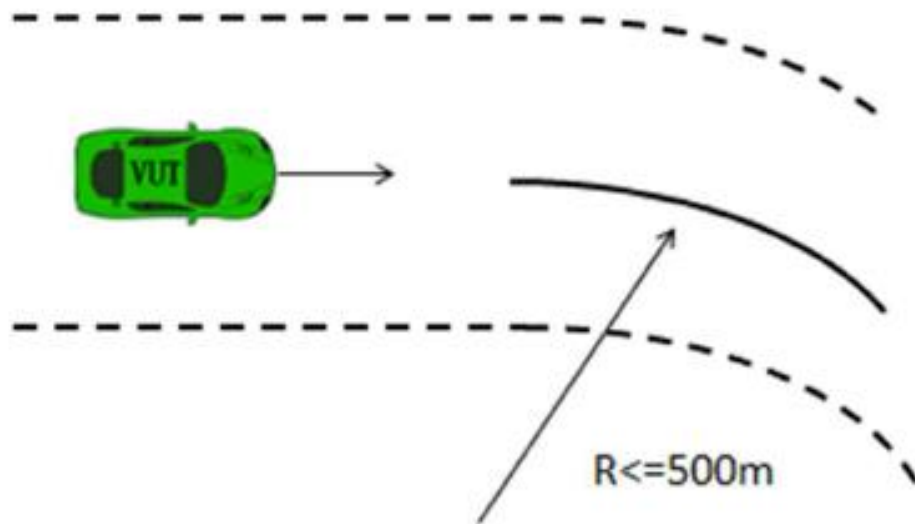


Figure 6.3 Schematic diagram of test scenario of identification and response to lane dividing lines

6.1.4.2 Test methods

Under autonomous driving mode, vehicle under test shall reach vehicle velocity of 30km/h at a position 100m ahead of curve road and run at constant velocity along lane center; if the maximum autonomous driving velocity V_{max} is more than 60km/h, then set test velocity as 60km/h.

6.1.4.3 Requirements

- a) Vehicle under test shall always maintain running within test lane dividing line, direction shall be controlled accurately and shall not deviate from the correct traveling direction;
- b) Wheels of vehicle under test shall not run into the inner side of lane border line;
- c) Vehicle under test shall run into curve road smoothly without prominent swinging.

6.1.5 Identification and response to crosswalk lines

6.1.5.1 Test scenarios

Test road shall be long straight road containing one lane at least, crosswalk line shall be configured inside road segment, and vehicle under test shall run towards crosswalk line along test road. As shown in Figure 6.4.



Figure 6.4 Schematic diagram of test scenario of identification and response to crosswalk lines

6.1.5.2 Test methods

Under autonomous driving mode, vehicle under test shall reach vehicle velocity of 40km/h at a position 100m ahead of stop line and run at constant velocity along lane center towards stop line. During the test, crosswalk line shall be free from pedestrian and non-power-driven vehicle, etc.

6.1.5.3 Requirements

- a) Vehicle under test shall be able to decelerate and pass through crosswalk line at low velocity;
- b) Vehicle under test is allowed to stop in front of stop line for a short time, but the stop time shall not exceed 3s.

6.2 Identification and response to traffic signal lamps

6.2.1 General

This test item aims to test the identification and response to autonomous driving system to traffic signal lamp and assess the capability of vehicle under test to comply with traffic signal lamp instruction.

This test item shall include power-driven vehicle signal lamp and direction indication signal lamp (if included in the test road segment) scenario test.

Third party test institutions may add test of scenarios such as relevant direction indication signal lamp, non-power-driven vehicle signal lamp, crosswalk signal lamp, lane signal lamp, flash warning signal lamp, and signal lamp for level intersection of road and railway as per the actual test road segment situations.

6.2.2 Identification and response to power-driven vehicle signal lamps

6.2.2.1 Test scenarios

Test road shall be long straight road containing one lane at least, and power-driven vehicle signal lamp shall be configured in the road segment, type of signal lamp can be selected as per the actual test road situations. As shown in Figure 6.5.

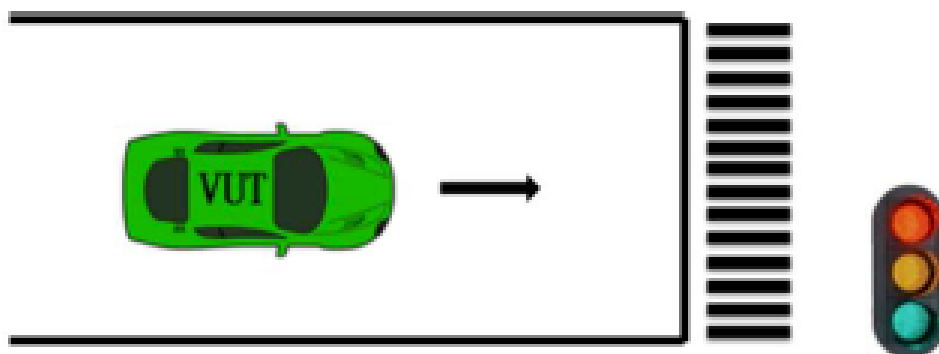


Figure 6.5 Schematic diagram of test scenario of identification and response to power-driven vehicle signal lamps

6.2.2.2 Test methods

Under autonomous driving mode, vehicle under test shall reach the vehicle velocity of 30km/h at a position 100m ahead of stop line, and run towards power-driven vehicle signal lamp at constant velocity along lane center. The initial state of power-driven vehicle signal lamp is red, and the power-driven vehicle signal lamp turns from red light to green light after vehicle under test stops stably.

6.2.2.3 Requirements

- a) Vehicle under test shall stop and wait during red light period, and shall not exceed stop line;
- b) After the power-driven vehicle signal lamp turns from red light to green light, vehicle under test shall timely start up and go ahead, and startup time shall not exceed 5s.

6.2.3 Identification and response to direction indication signal lamps (if included in the test road segment)

6.2.3.1 Test scenarios

Test road shall be intersection containing 2-way two lanes at least. Intersection shall be configured with direction indication signal lamp. Vehicle under test shall run towards signal lamp at constant velocity. As shown in Figure 6.6.

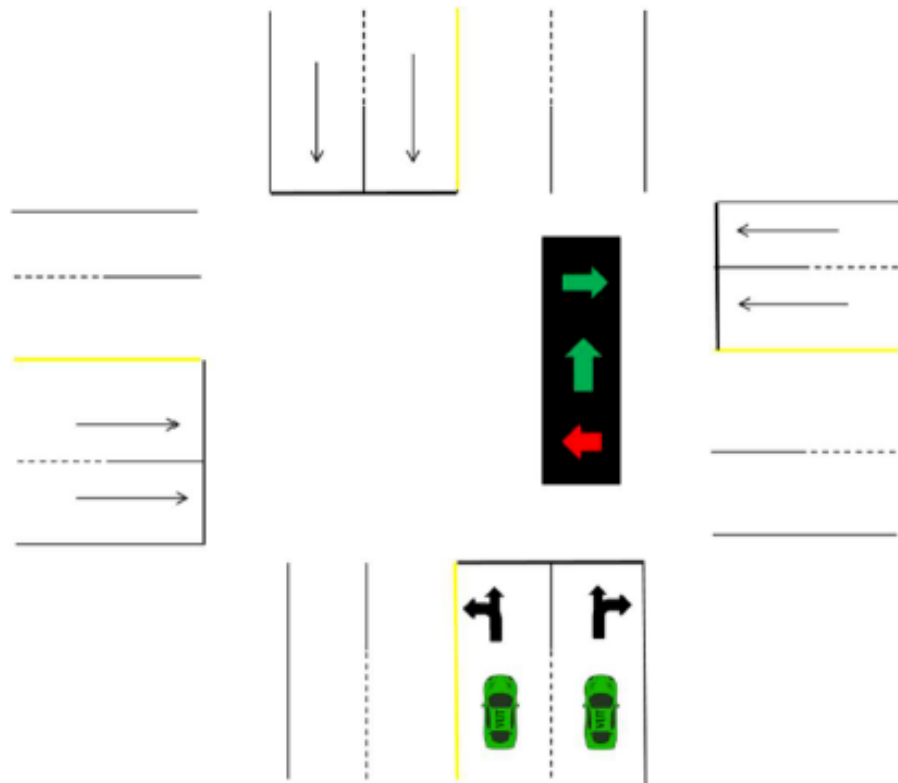


Figure 6.6 Schematic diagram of test scenario of identification and response to direction indication signal lamps

6.2.3.2 Test methods

Under autonomous driving mode, vehicle under test shall reach the vehicle velocity of 30km/h at a position 100m ahead of stop line, and run towards direction indication signal lamp along lane center. The initial state of direction indication signal lamp corresponding to vehicle under test running direction is red, and the signal lamp turns from red light to green light after vehicle under test stops stably. The identification and response capability of direction indication signal lamps under the scenario shall be tested respectively.

6.2.3.3 Requirements

- a) Vehicle under test shall stop and wait during red light period, and shall not exceed stop line;

- b) After the power-driven vehicle signal lamp turns from red light to green light, vehicle under test shall timely start up and go ahead, and startup time shall not exceed 5s;
- c) When vehicle under test makes left turn or right turn, it shall be possible to turn on the corresponding direction indicator lamp correctly.

6.3 Identification and response to driving status of the front vehicle

6.3.1 General

This test item aims to test the identification and response to autonomous driving system to the forward vehicle traveling state and assess the capability of vehicle under test to perceive, predicate and respond to the forward vehicle.

This test item shall include test of two scenarios where vehicle runs in or opposite vehicle borrows lane of the subject vehicle.

Third party test institutions may add relevant scenario as per the actual test road segment situations.

6.3.2 Identification and response to vehicle running in

6.3.2.1 Test scenarios

Test road shall be long straight road containing two lanes at least, the central lane dividing line is white dotted line. Vehicle under test and vehicle target run at constant velocity in respective lanes, and vehicle target runs into the lane of vehicle under test in the process when vehicle under test approaches vehicle target. As shown in Figure 6.7.

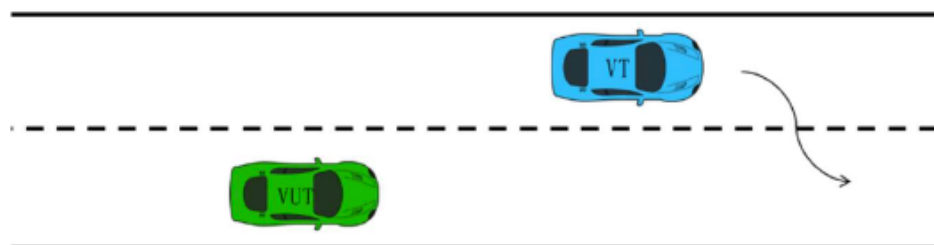


Figure 6.7 Schematic diagram of test scenario of identification and response to vehicle target running in

6.3.2.2 Test methods

Vehicle under test runs at constant velocity of 30km/h along lane center under autonomous driving mode, vehicle target runs in the same direction at constant velocity of 20km/h along adjacent lane center. When the time gap between the two vehicles is not more than 1.5s, vehicle target cuts into the lane of vehicle under test.

6.3.2.3 Requirements

- a) Vehicle under test shall be able to adjust its own velocity adaptively as per the vehicle target cut-in distance and velocity;
- b) Vehicle under test shall keep safe distance from vehicle target to prevent collision;
- c) Vehicle under test shall stably follow vehicle target after cut-in of vehicle target.

6.3.3 Identification and response to opposite vehicle borrowing lane of subject vehicle

6.3.3.1 Test scenarios

Test road shall be long straight road containing 2-way two lanes at least, and the central lane dividing line shall be yellow dotted line. Vehicle under test runs at constant velocity along lane center, meanwhile, vehicle target of the opposite direction runs at constant velocity over yellow dotted line. As shown in Figure 6.8.

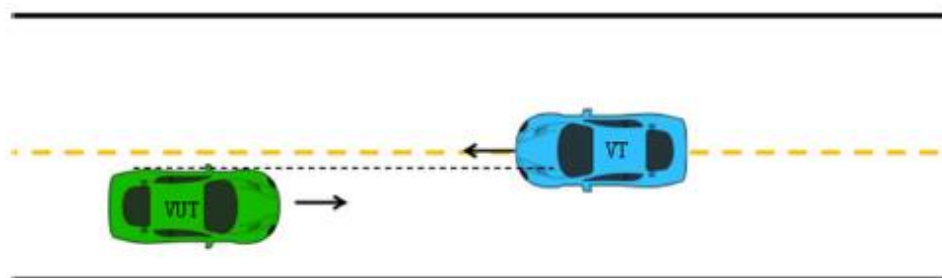


Figure 6.8 Schematic diagram of test scenario of identification and response to opposite vehicle borrowing lane of subject vehicle

6.3.3.2 Test methods

Vehicle under test runs at constant velocity of 30km/h under autonomous driving mode, and the vehicle target of the opposite direction approaches vehicle under test at the same velocity over yellow dotted line, the initial longitudinal distance

after the two vehicle get stable shall be not less than 100m and lateral overlap rate shall be not less than 10%.

6.3.3.3 Requirements

Vehicle under test shall dodge in its own lane during test to avoid collision with vehicle target.

6.4 Identification and response to obstacles

6.4.1 General

This test item aims to test the identification and response to autonomous driving system to obstacle and assess the capability of vehicle under test to perceive forward obstacle, make decisions and execute.

This test item shall include test of two scenarios of obstacle and misuse.

Third party test institutions may add relevant obstacle category as per the actual test road segment situations.

6.4.2 Obstacle test

6.4.2.1 Test scenarios

Test road shall be long straight road containing one lane at least, place conical traffic road marker (recommended dimension: 50cm*35cm) and median barrier (recommended dimension: 70cm*200cm) at the center of lane, vehicle under test runs at constant velocity towards forward obstacle. As shown in Figure 6.9.

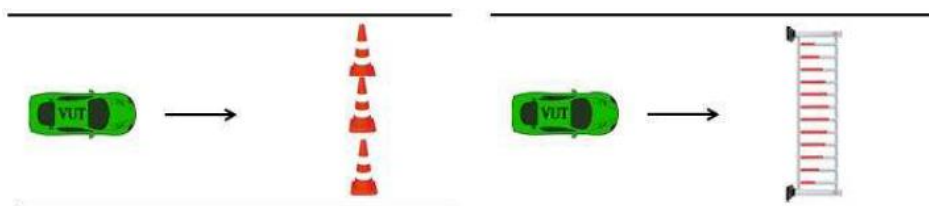


Figure 6.9 Schematic diagram of test scenario of obstacles

6.4.2.2 Test methods

Under autonomous driving mode, vehicle under test shall reach the vehicle velocity of 30km/h at a position 100m ahead of obstacles, and run towards forward obstacle at constant velocity along lane center. The obstacles are 3 conical road markers or 1 median barrier placed perpendicular to road direction in parallel separately in test road. Tests shall be performed respectively.

6.4.2.3 Requirements

Vehicle under test shall be able to avoid collision with the above obstacle through braking, steering or combination method.

6.4.3 Misuse test

6.4.3.1 Test scenarios

Test road shall be long straight road containing one lane at least, place any targets such as manhole cover, iron plate or deceleration strip at the center of lane, vehicle under test runs towards the target at constant velocity. As shown in Figure 6.10.



Figure 6.10 Schematic diagram of test scenario of misuse

6.4.3.2 Test methods

Under autonomous driving mode, vehicle under test shall reach the vehicle velocity of 30km/h at a position 100m ahead of forward target and run towards the target at constant velocity along lane center.

6.4.3.3 Requirements

Vehicle under test shall be able to pass by the above target through run-over or dodging method, and shall not directly apply brake to stop.

6.5 Identification and avoidance to pedestrians and non-power-driven vehicles *

6.5.1 General

This test item aims to test the identification and response to autonomous driving system to pedestrian and non-power-driven vehicle and assess capability of vehicle under test to perceive forward pedestrian and non-power-driven vehicle, predict behavior and make response.

This test item shall include test of four scenarios of pedestrian passing cross street, pedestrian walking along road, two-wheeler passing cross street and two-wheeler running along road.

Third party test institutions may add relevant scenario as per the actual test road segment situations.

6.5.2 Pedestrian passing across street

6.5.2.1 Test scenarios

Test road shall be long straight road containing two lanes at least, and crosswalk line shall be configured inside road segment. Vehicle under test runs at constant velocity towards crosswalk line, and pedestrian crosses street along crosswalk line at the same time, collision risk exists between vehicle under test and pedestrian. As shown in Figure 6.11.

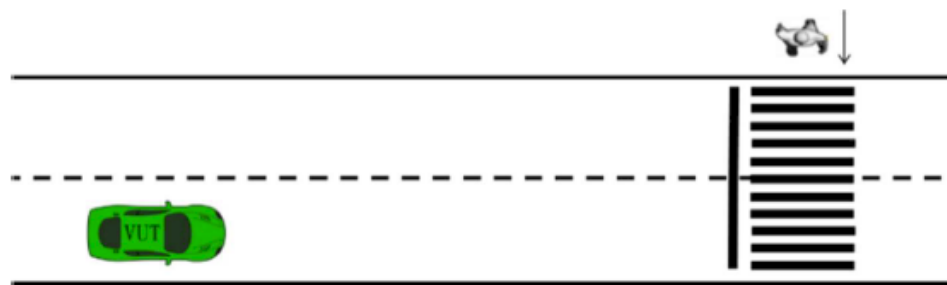


Figure 6.11 Schematic diagram of test scenario of pedestrian passing across street

6.5.2.2 Test methods

Under autonomous driving mode, vehicle under test shall run at constant velocity of 30km/h, when it takes 3.5s for vehicle under test to reach crosswalk line, pedestrian starts to walk from the left side of vehicle on roadside and passes crosswalk line at velocity of 5km/h to 6.5km/h.

6.5.2.3 Requirements

- Vehicle under test shall be able to decelerate in advance and ensure that pedestrian gets across lane of vehicle safely;
- When vehicle under test is stopped in front of crosswalk line, after pedestrian gets across lane of vehicle under test, vehicle shall be able to automatically start and continue to run, startup time shall not exceed 5s.

6.5.3 Pedestrian walking along road

6.5.3.1 Test scenarios

Test road shall be long straight road containing two lanes at least, the central lane dividing line is white dotted line. Vehicle under test runs at constant velocity along lane center, meanwhile, pedestrian walks forward along lane in front of vehicle. As shown in Figure 6.12.

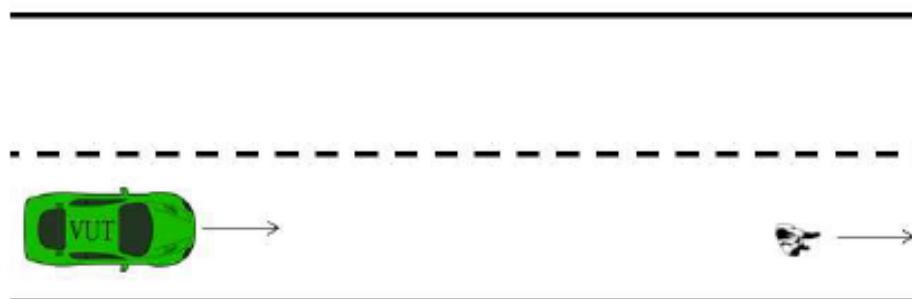


Figure 6.12 Schematic diagram of test scenario of pedestrian walking along road

6.5.3.2 Test methods

Under autonomous driving mode, reach the vehicle velocity of 30km/h at a position 100m ahead of pedestrian, and run towards pedestrian at constant velocity along lane center. The pedestrian velocity is 5km/h.

6.5.3.3 Requirements

Vehicle under test shall be able to dodge pedestrian through braking, steering or combination method.

6.5.4 Two-wheeler passing cross street

6.5.4.1 Test scenarios

Test road shall be long straight road containing two lanes at least, and crosswalk line shall be configured inside road segment. Vehicle under test runs at constant velocity towards crosswalk line, meanwhile, two-wheeler crosses street along crosswalk line, collision risks exist between the two of them. As shown in Figure 6.13.

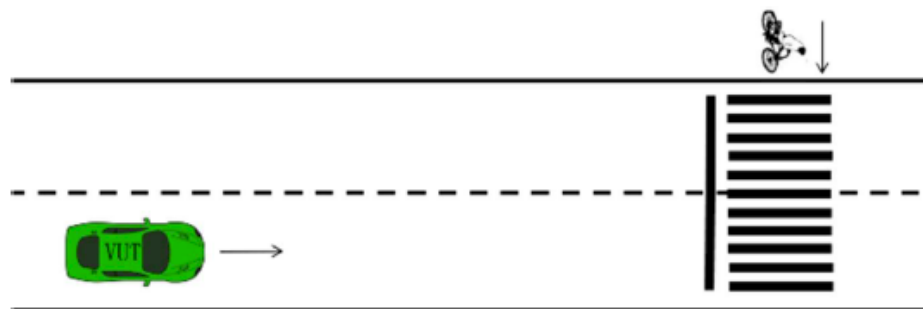


Figure 6.13 Schematic diagram of test scenario of two-wheeler passing cross street

6.5.4.2 Test methods

Under autonomous driving mode, vehicle under test shall run at constant velocity of 30km/h, when it takes 1.5s for vehicle under test to reach crosswalk line, two-wheeler starts to cross street at 15km/h from the left side of vehicle on roadside.

6.5.4.3 Requirements

- a) Vehicle under test shall be able to decelerate in advance and ensure that two-wheeler gets across lane of vehicle safely;
- b) When vehicle under test is stopped in front of crosswalk line, after two-wheeler gets across lane of vehicle under test, vehicle shall be able to automatically start and continue to run, startup time shall not exceed 5s.

6.5.5 Two-wheeler running along road

6.5.5.1 Test scenarios

Test road shall be long straight road containing two lanes at least, the central lane dividing line is white dotted line. Vehicle under test runs at constant velocity along lane center, meanwhile, two-wheeler runs forward along the lane ahead of the subject vehicle. As shown in Figure 6.14.

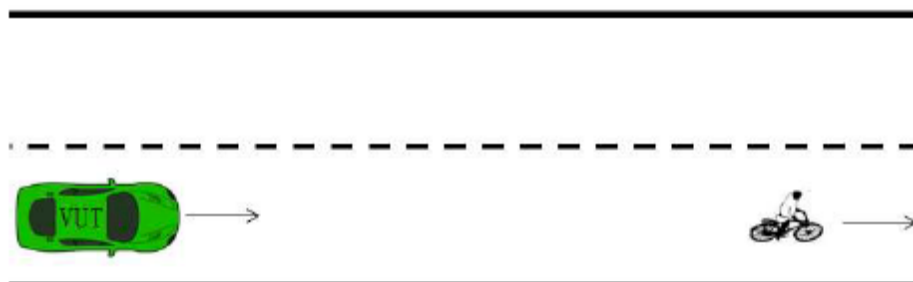


Figure 6.14 Schematic diagram of test scenario of two-wheeler running along road

6.5.5.2 Test methods

Under autonomous driving mode, reach the vehicle velocity of 30km/h at a position 100m ahead of two-wheeler, and run towards two-wheeler at constant velocity along lane center. The two-wheeler velocity is 20km/h.

6.5.5.3 Requirements

Vehicle under test shall be able to dodge two-wheeler through braking, steering or combination method.

6.6 Vehicle-following driving

6.6.1 General

This test item aims to test the capability of autonomous driving system to follow the forward vehicle.

This test item shall include stable vehicle-following driving and stop-go functionality test; if vehicle under test features platooning functionality, platooning test shall be performed.

Third party test institutions may add relevant scenario as per the actual test road segment situations.

6.6.2 Stable vehicle-following driving

6.6.2.1 Test scenarios

Test road shall be long straight road of which lane dividing lines on both sides are solid line. Vehicle under test approaches vehicle target running at constant velocity in the front. As shown in Figure 6.15.



Figure 6.15 Schematic diagram of test scenario of stable vehicle-following driving

6.6.2.2 Test methods

Under autonomous driving mode, vehicle under test approaches vehicle target at constant velocity of 30km/h along lane center, and vehicle target runs at constant velocity of 20km/h.

6.6.2.3 Requirements

Vehicle under test shall be able to identify vehicle target and feature self-adaptive adjustment of vehicle velocity, and realize stable follow-up of vehicle target.

6.6.3 Stop-go functionality

6.6.3.1 Test scenarios

Test road shall be long straight road of which lane dividing lines on both sides are solid line. Vehicle under test shall stably follow vehicle target, vehicle target shall apply brake until stop, and vehicle target starts and accelerates after a certain period of time. As shown in Figure 6.16.

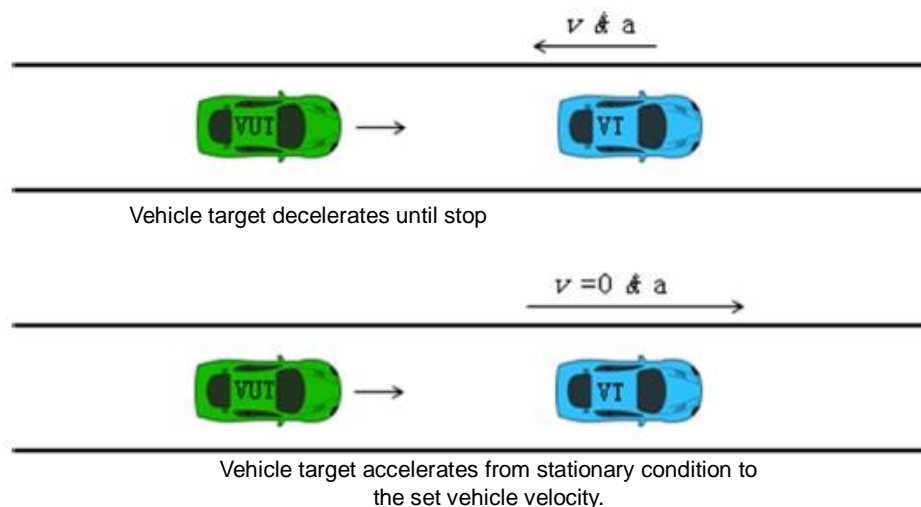


Figure 6.16 Schematic diagram of test scenario of stop-go functionality

6.6.3.2 Test methods

Under autonomous driving mode, vehicle under test follows the forward vehicle target, vehicle target runs at constant velocity of 30km/h. During test, two vehicles runs at lane center, after vehicle under test stably follows vehicle target for 3s at least, vehicle target decelerates until stop. After vehicle under test stops for at least 3s, vehicle target starts up and accelerates to resume 30km/h.

6.6.3.3 Requirements

- a) After vehicle target decelerates until stop, vehicle under test shall be able to stop along with vehicle target without collision with vehicle target;
- b) When vehicle target is restarted, vehicle under test shall restart along with it within 5s;
- c) After restart, vehicle under test shall be able to run stably along with vehicle target.

6.7 Road-side parking

6.7.1 General

This test item aims to test the functionality of autonomous driving system to stop along roadside when encountering driving risk, and assess the capability of realization of minimal risk condition of vehicle under test.

This test item shall include test of two scenarios of emergency stop along roadside and stop along roadside in the rightmost lane.

Third party test institutions may add relevant scenario of stop along roadside as per the actual test road segment situations.

6.7.2 Emergency stop along roadside

6.7.2.1 Test scenarios

Test road shall at least contain one traffic lane and one emergency lane, and vehicle under test runs at constant velocity in the traffic lane. As shown in Figure 6.17.

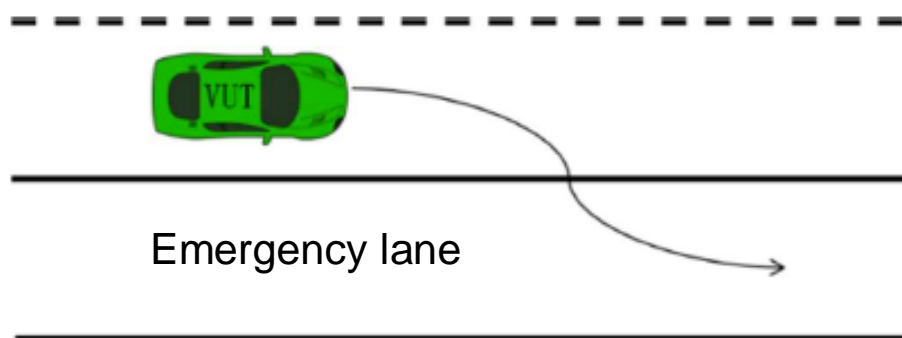


Figure 6.17 Schematic diagram of test scenario of emergency lane parking

6.7.2.2 Test methods

Vehicle under test runs at constant velocity of 60km/h along lane center under autonomous driving mode, and sends instruction of stop along roadside to vehicle under test through appropriate method.

If the maximum autonomous driving velocity V_{max} of vehicle under test is less than 60km/h, then perform test as per the maximum autonomous driving velocity V_{max} .

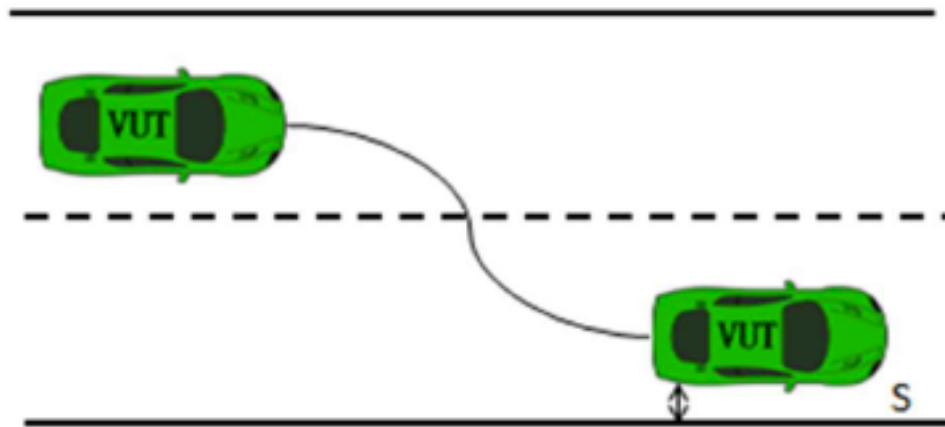
6.7.2.3 Requirements

- a) Vehicle under test shall be able to turn on right direction indicator lamp automatically, realize lane-changing and stop in emergency lane;
- b) Vehicle under test shall be able to turn on hazard warning signal lamp correctly after entering emergency lane;
- c) After vehicle under test stops completely, any position of it shall not protrude beyond emergency lane.

6.7.3 Stop along roadside in the rightmost lane

6.7.3.1 Test scenarios

Test road shall be long straight road containing two lanes at least, central lane dividing line is dotted line, vehicle under test runs at constant velocity in left lane. As shown in Figure 6.18.



s: The distance between right wheel of vehicle under test and inner side of lane dividing line.

Figure 6.18 Requirements of urban road test scenario upon parking position

6.7.3.2 Test methods

Vehicle under test runs at constant velocity of 30km/h along lane center under autonomous driving mode, and sends instruction of stop along roadside to vehicle under test through appropriate method.

6.7.3.3 Requirements

- a) Vehicle under test shall be able to turn on right direction indicator lamp automatically, realize lane-changing and stop in emergency lane;
- b) Vehicle under test shall be able to complete parking of vehicle in one time without reversing and other actions;
- c) After parking of vehicle under test, vehicle body shall be basically in parallel with right side lane, and $S \leq 50\text{cm}$;
- d) Vehicle under test shall be able to turn on hazard warning signal lamp correctly after parking.

6.8 Overtaking

6.8.1 General

This test item aims to test the overtaking functionality of autonomous driving system and assess the perception, decision-making and execution capability of vehicle under test.

This test item shall cover three actions such as changing into adjacent lane, overtaking vehicle target and safe returning to original lane.

Third party test institutions may add relevant scenario of overtaking as per the actual test road segment situations.

6.8.2 Test scenarios

Test road shall be long straight road containing two lanes at least, the central lane dividing line is white dotted line. Vehicle under test shall stably follow vehicle target, and send instruction of overtaking to vehicle under test through appropriate method. As shown in Figure 6.19.

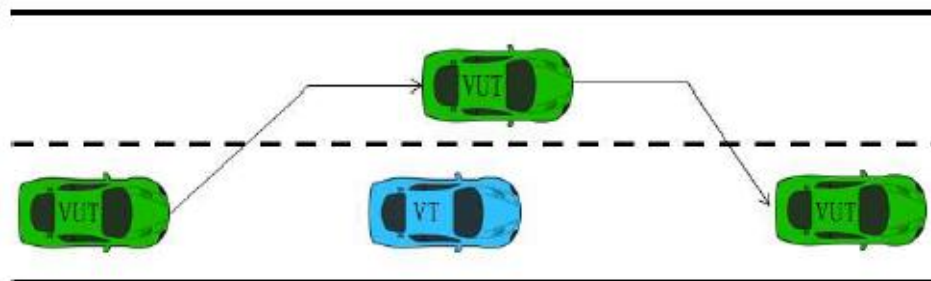


Figure 6.19 Schematic diagram of test scenario of overtaking

6.8.3 Test methods

Vehicle under test approaches vehicle target at velocity of 50km/h under autonomous driving mode, vehicle target runs at constant velocity of 30km/h, and sends instruction of overtaking to vehicle under test through appropriate method.

6.8.4 Requirements

- a) Vehicle under test shall not collide with vehicle target in the overtaking process, and shall not influence the normal running of vehicle target;
- b) Vehicle under test shall complete overtaking action smoothly and keep running at lane center after returning back to its own lane;
- c) Vehicle under test shall be able to turn on the correct direction indicator lamp during the overtaking process.

6.9 Lane-changing

6.9.1 General

This test item aims to test the lane-changing driving capability of autonomous driving system.

This test item shall include test of three scenarios such as change into adjacent lane without vehicle, change into adjacent lane with vehicle and decrease of number of forward lanes.

Third party test institutions may add relevant scenario of lane-changing as per the actual test road segment situations.

6.9.2 Change into adjacent lane without vehicle

6.9.2.1 Test scenarios

Test road shall be long straight road containing two lanes at least, Vehicle under test runs at constant velocity, and there is no interfering vehicle on adjacent lane. As shown in Figure 6.20.

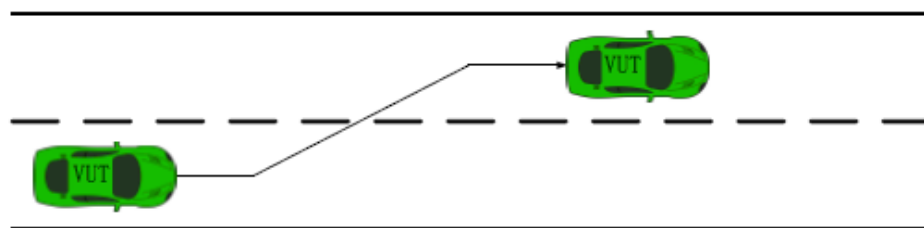


Figure 6.20 Schematic diagram of test scenario of change into adjacent lane without vehicle

6.9.2.2 Test methods

Vehicle under test runs at constant velocity of 30km/h along lane center under autonomous driving mode, and sends instruction of lane-changing to vehicle under test through appropriate method.

6.9.2.3 Requirements

- a) Vehicle under test shall be able to turn on the correct direction indicator lamp, and start to turn at least 3s after activation of direction indicator lamp;
- b) The time from the moment when vehicle under test starts to turn to the moment when vehicle under test changes into adjacent lane shall be not more than 5s.

6.9.3 Change into adjacent lane with vehicle

6.9.3.1 Test scenarios

Test road shall be long straight road containing two lanes at least. Vehicle under test runs at constant velocity, vehicle target exists in adjacent lane, and runs at the same constant velocity. As shown in Figure 6.21.

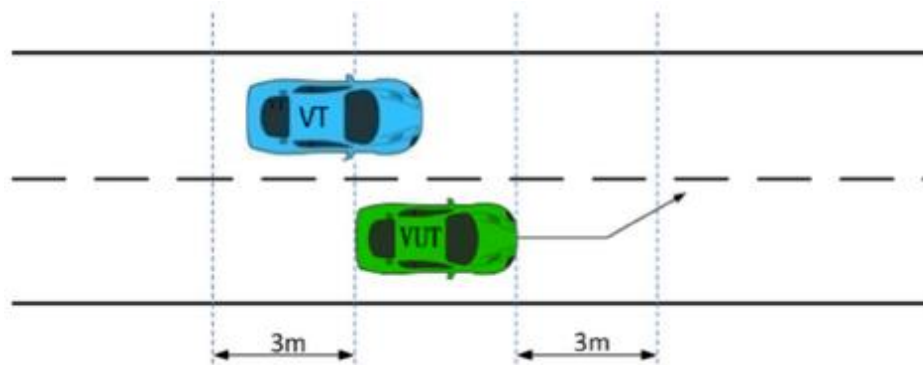


Figure 6.21 Schematic diagram of test scenario of change into adjacent lane with vehicle

6.9.3.2 Test methods

Vehicle under test runs at constant velocity of 30km/h along lane center under autonomous driving mode. Vehicle target runs at the same constant velocity in an area from 3m ahead of vehicle under test to 3m behind vehicle under test in adjacent lane, vehicle under test receives lane-changing instruction.

6.9.3.3 Requirements

Vehicle under test shall be able to keep running on original lane without collision with vehicle target.

6.9.4 Decrease of number of forward lanes

6.9.4.1 Test scenarios

Test road shall be long straight road containing two lanes at least, indication sign board exists 50m ahead of the position where number of lanes decreases. Vehicle under test initially runs in the rightmost lane, vehicle target exists in adjacent lane, and runs at the same constant velocity. As shown in Figure 6.22.

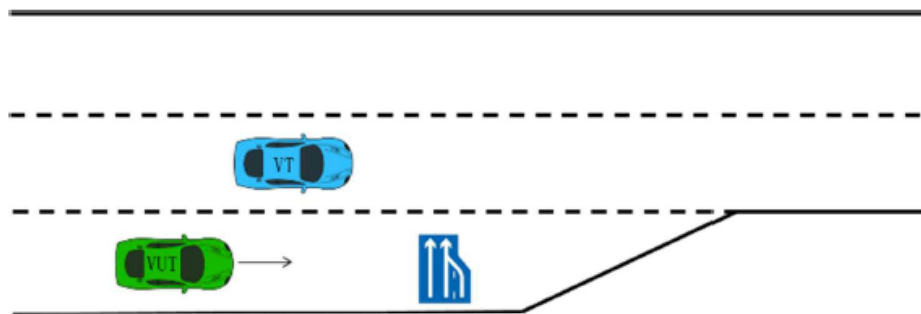


Figure 6.22 Schematic diagram of test scenario of decrease of number of forward lanes

6.9.4.2 Test methods

Under autonomous driving mode, reach the vehicle velocity of 30km/h at a position 100m ahead of the position where number of lanes decreases, and run at constant velocity along lane center towards sign board indicating decrease of number of lanes, vehicle target runs at the same constant velocity in an area from 3m ahead of vehicle under test to 3m behind vehicle under test in adjacent lane, if vehicle under test has no lane-changing operation, then driver shall timely intervene in vehicle.

6.9.4.3 Requirements

- a) Vehicle under test shall be able to turn on the correct direction indicator lamp;
- b) Vehicle under test shall be able to dodge vehicle target through acceleration or deceleration to complete lane-changing operation;
- c) Vehicle under test shall not collide with vehicle target during lane-changing process, and shall not influence normal traveling of vehicle target.

6.10 Passing through intersection

6.10.1 General

This test item aims to test the operation of autonomous driving system at intersection and assess the route planning and navigation capability of vehicle under test.

This test item shall include test of three scenarios of traffic in conflict with vehicle running straight, traffic in conflict with vehicle turning right and traffic in conflict with vehicle turning left.

Third party test institutions may add relevant scenario as per the actual test road segment situations.

6.10.2 Straight running

6.10.2.1 Test scenarios

Test road shall be intersection containing 2-way two lanes at least. Vehicle under test runs straight at constant velocity through the intersection on lane marked with straight running and right turn indication markings, vehicle target runs straight into the intersection at constant velocity from right lateral direction of vehicle under test, the two vehicles are subject to collision risk. As shown in Figure 6.23.

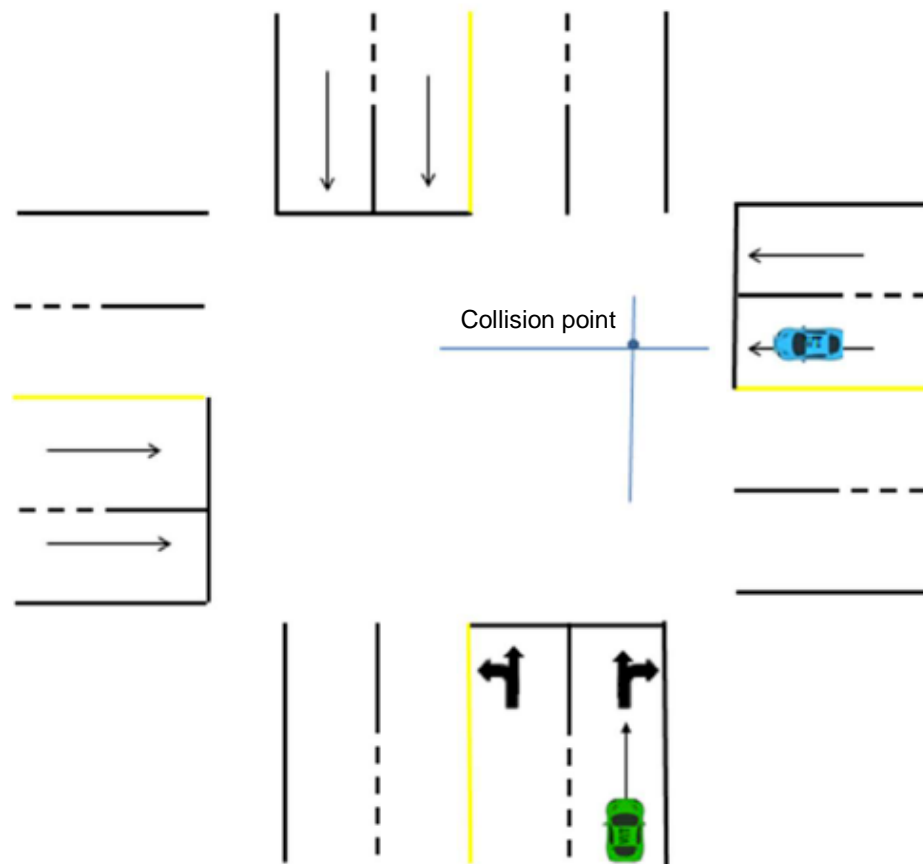


Figure 6.23 Schematic diagram of test scenario of traffic in conflict with vehicle running straight

6.10.2.2 Test methods

Under autonomous driving mode, vehicle under test runs towards intersection at

constant velocity of 30km/h, and vehicle target runs at constant velocity of 20km/h. If vehicle under test maintains the current running state, the two vehicles can reach the collision point at the same time.

6.10.2.3 Requirements

- a) Vehicle under test shall not collide with vehicle target;
- b) Vehicle under test shall comply with the traffic rule that the vehicle coming from right direction shall go first, realize the traffic and enter the corresponding lane.

6.10.3 Turn right driving

6.10.3.1 Test scenarios

Test road shall be intersection containing 2-way two lanes at least. Vehicle under test turns right and passes through the intersection in lane marked with go-straight and turn-right indication markings, meanwhile, vehicle target running at constant velocity straight in lateral left side of intersection towards vehicle under test will enter into lane, the two vehicles are subject to collision risk. As shown in Figure 6.24.

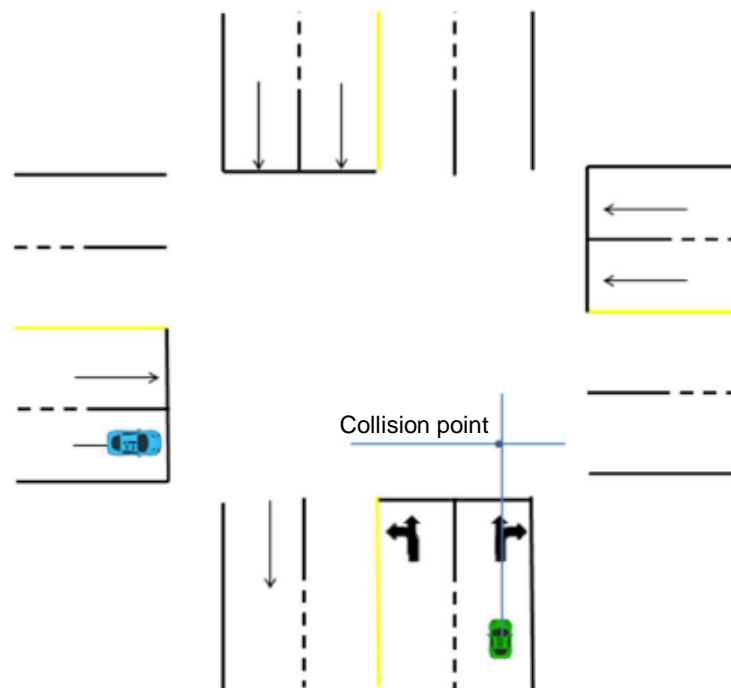


Figure 6.24 Schematic diagram of test scenario of traffic in conflict with right-turning vehicle

6.10.3.2 Test methods

Under autonomous driving mode, vehicle under test runs towards intersection at constant velocity of 30km/h, and vehicle target runs at constant velocity of 20km/h. If vehicle under test maintains the current running state, the two vehicles can reach the collision point at the same time.

6.10.3.3 Requirements

- a) Vehicle under test shall not collide with vehicle target;
- b) Vehicle under test shall be able to turn on the correct direction indicator lamp;
- c) Vehicle under test shall comply with the traffic rule that straight-going vehicle takes precedence, realize turn-right and enter the corresponding lane.

6.10.4 Turn left driving

6.10.4.1 Test scenarios

Test road shall be intersection containing 2-way two lanes at least. Vehicle under test turns left and passes through the intersection in lane marked with go-straight and turn-left indication markings, meanwhile, vehicle target running at constant velocity straight exists in opposite lane. As shown in Figure 6.25.

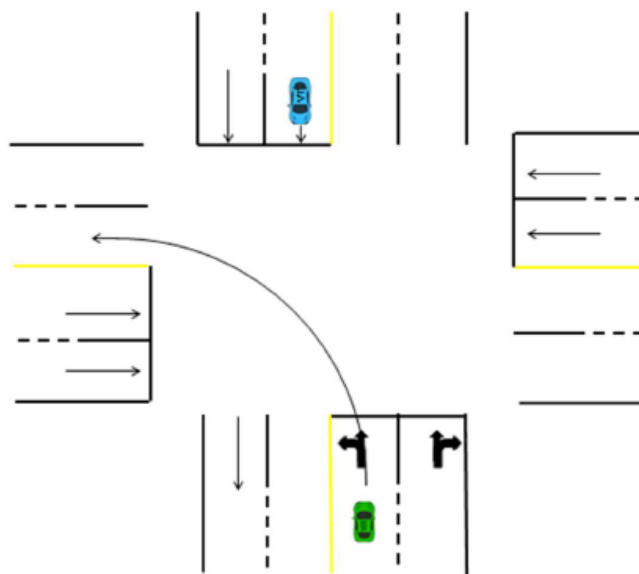


Figure 6.25 Schematic diagram of test scenario of traffic in conflict with left-turning vehicle

6.10.4.2 Test methods

Under autonomous driving mode, vehicle under test runs towards intersection at constant velocity of 30km/h, when the time gap between vehicle under test and intersection is 2s, vehicle target runs out from opposite lane at constant velocity of 20km/h.

6.10.4.3 Requirements

- a) Vehicle under test shall not collide with vehicle target;
- b) Vehicle under test shall be able to turn on the correct direction indicator lamp;
- c) Vehicle under test shall comply with the traffic rule that straight-going vehicle takes precedence, realize turn-left and enter the corresponding lane.

6.11 Traffic circle driving

6.11.1 General

This test item aims to test the driving behavior of autonomous driving system for entry/exit of traffic circle, and assess the capability of vehicle under test route planning and execution.

This test item shall include traffic circle driving scenario test.

Third party test institutions may add relevant scenario as per the actual test road segment situations.

6.11.2 Test scenarios

Test site is traffic circle with not less than 3 entries/exits, and each entry/exit shall be of at least 2-way two lanes. 1 unit of vehicle target exist upstream vehicle under test entry. Vehicle under test runs towards final point of test via traffic circle. As shown in Figure 6.26.

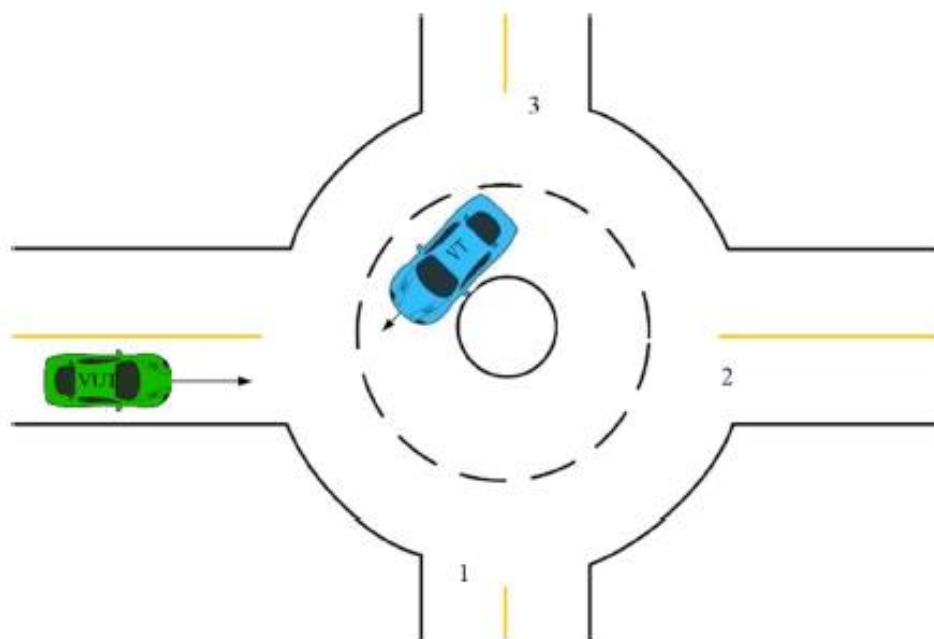


Figure 6.26 Schematic diagram of traffic circle driving

6.11.3 Test methods

Under autonomous driving mode, vehicle under test shall run out of roundabout after passing at least 1 exit. Vehicle under test runs towards traffic circle at velocity of 20km/h, when vehicle under test arrives at entry of roundabout, there is 1 vehicle target emerging from exit 1 upstream entry, and the vehicle target velocity is 20km/h. Record the entire process in which vehicle under test enters into roundabout, runs around roundabout and runs out of roundabout.

6.11.4 Requirements

- a) Vehicle under test shall not collide with vehicle target;
- b) Vehicle under test shall be able to turn on the correct direction indicator lamp when entering/exiting into/from roundabout;
- c) Vehicle under test shall be able to run around roundabout and run out from the correct exit.

6.12 Autonomous emergency braking

6.12.1 General

This test item aims to test the performance of autonomous emergency braking of vehicle under test in case of collision hazard and assess its emergency

collision avoidance capability.

This test item shall include test of three scenarios that forward vehicle is stationary, forward vehicle applies brake and pedestrian passes across.

Third party test institutions may add relevant scenario as per the actual test road segment situations.

6.12.2 Forward vehicle is stationary

6.12.2.1 Test scenarios

Test road shall be long straight road containing one lane at least, vehicle under test approaches forward stationary vehicle target at constant velocity. As shown in Figure 6.27.

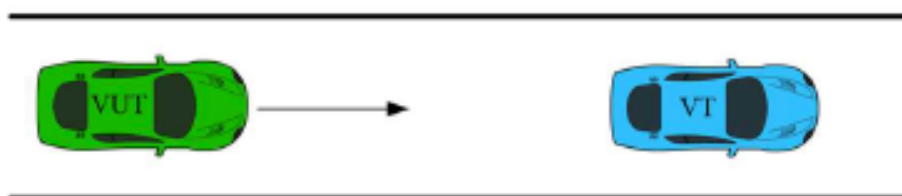


Figure 6.27 Schematic diagram of test scenario that forward vehicle is stationary

6.12.2.2 Test methods

Under manual driving or autonomous driving system failure mode, vehicle under test approaches forward stationary vehicle target at constant velocity of 50km/h along lane center, the lateral distance deviation of vehicle under test center line from vehicle target center line is not exceed 0.5m. During the braking process, test driver shall not turn steering wheel and depress brake pedal.

If vehicle under test is commercial vehicle (with the exception of goods vehicle of which the maximum design total mass is not exceed 3.5t), then the test velocity is selected as 30km/h.

6.12.2.3 Requirements

- a) Vehicle under test shall send alarm information prior to application of brake, including at least optical and acoustic alarm signal;
- b) Vehicle under test does not collide with vehicle target.

6.12.3 Forward vehicle applies brake

6.12.3.1 Test scenarios

Test road shall be long straight road containing one lane at least, vehicle under test follows vehicle target and runs stably at identical vehicle velocity, vehicle target decelerates until stop. As shown in Figure 6.28.



Figure 6.28 Schematic diagram of test scenario that forward vehicle applies brake

6.12.3.2 Test methods

Vehicle under test under manual driving or autonomous driving system failure mode and forward vehicle target run at constant velocity of 50km/h along lane center, the longitudinal space between the two vehicles is kept within the range of $40\text{m}\pm 5\text{m}$, and the lateral distance deviation is not exceed 0.5m. After the state is kept for at least 3s, forward vehicle decelerates at 4m/s^2 until stop. During the braking process, test driver shall not turn steering wheel and depress brake pedal.

If vehicle under test is commercial vehicle (with the exception of goods vehicle of which the maximum design total mass is not exceed 3.5t), then the forward vehicle target decelerates at 2m/s^2 until stop.

6.12.3.3 Requirements

- a) Vehicle under test shall send alarm information prior to application of brake, including at least optical and acoustic alarm signal;
- b) Vehicle under test does not collide with vehicle target.

6.12.4 Pedestrian passes across

6.12.4.1 Test scenarios

Test road shall be long straight road containing one lane at least, vehicle under test runs at constant velocity, and there is pedestrian passing across street in the front. As shown in Figure 6.29.

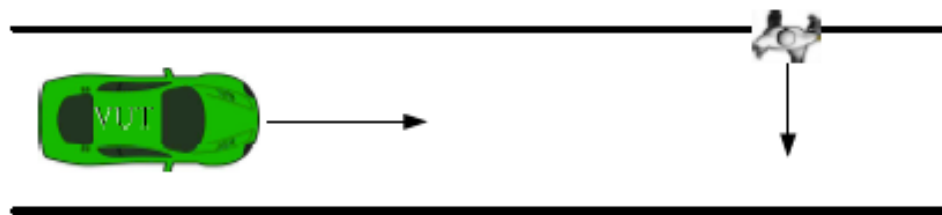


Figure 6.29 Schematic diagram of test scenario that pedestrian passes across

6.12.4.2 Test methods

Vehicle under test under manual driving or autonomous driving system failure mode, runs at constant velocity of 30km/h along lane center, pedestrian passes across street in the front at velocity of 5km/h upon setup instant. If autonomous emergency braking functionality does not intervene, vehicle under test will collide with pedestrian. During the braking process, test driver shall not turn steering wheel and depress brake pedal.

6.12.4.3 Requirements

- a) Vehicle under test shall send alarm information prior to application of brake, including at least optical and acoustic alarm signal;
- b) Vehicle under test does not collide with vehicle target.

6.13 Manual operation intervention

6.13.1 General

This test item aims to test the manual operation intervention functionality of autonomous driving system, and assess the human-machine joint driving capability of vehicle under test to shift between two modes of autonomous driving and manual operation.

This test item shall include test of reminding functionality for request to intervene and intervention functionality.

Third party test institutions may add relevant scenario as per the actual test road segment situations.

6.13.2 Test scenarios

When vehicle under test is under autonomous driving mode, occurrence of the scenario that autonomous driving functionality exceeds operational design

domain shall trigger manual operation intervention request.

6.13.3 Test methods

6.13.3.1 Test of reminding functionality for request to intervene

Under autonomous driving mode, vehicle under test runs straight at constant vehicle velocity (the recommended test vehicle velocity interval is 20km/h to 80km/h). After getting into stable running, send manual operation intervention instruction to vehicle under test through appropriate method, and record the reminding method for manual operation intervention request of vehicle under test.

6.13.3.2 Test of intervention functionality

Manual operation intervention functionality test includes three items, which are respectively intervention in manipulation of brake pedal, intervention in manipulation of steering wheel and intervention in manipulation of button or switch.

a) Intervention in manipulation of brake pedal

Under autonomous driving mode, vehicle under test runs straight at constant velocity, after vehicle under test gets into stable running, driver manipulates brake pedal.

b) Intervention in manipulation of steering wheel

Under autonomous driving mode, vehicle under test runs straight at constant velocity, after vehicle under test gets into stable running, driver turns steering wheel.

c) Intervention in manipulation of button or switch

Under autonomous driving mode, vehicle under test runs straight at constant velocity, after vehicle under test gets into stable running, driver manipulates button or switch.

6.13.4 Requirements

6.13.4.1 Requirements of reminding functionality for request to intervene

Remind when vehicle is reminding manual operation intervention, including at least acoustic and visual reminding. Alarm sound shall be clear and loud, visual warning shall be within the forward visual field of driver, and signaling device

shall be sufficiently bright and prominent after illumination.

6.13.4.2 Requirements of intervention functionality

After manual manipulation of brake, steering, button or switch, driver shall obtain vehicle control authority, and driving automation system cannot resume vehicle control authority.

6.14 Networking communication *

6.14.1 General

This test item aims to test the networking communication of autonomous driving system, and assess the capability of vehicle under test to exchange information with the outside.

This test item shall include test of four scenarios of vehicle-to-vehicle on long straight road segment, vehicle-to-infrastructure on long straight road segment, vehicle-to-vehicle at intersection and platooning.

Third party test institutions may add test of relevant scenario as per the vehicle under test functionality in actual test.

6.14.2 Vehicle-to-vehicle on long straight road segment

6.14.2.1 Test scenarios

Test road shall be long straight road of 2-way two lanes, open and free from barrier, vehicle under test and vehicle target run in opposite direction, and ensure valid test vehicle distance of at least 300m. As shown in Figure 6.30.



Figure 6.30 Schematic diagram of the test scenario of vehicle-to-vehicle on long straight road segment

6.14.2.2 Test methods

Under autonomous driving mode, vehicle under test activates networking communication functionality, vehicle under test and vehicle target run at constant velocity of 30km/h in opposite direction, on board unit terminals of both vehicles respectively transmit information pack to the other vehicle continuously, when the distance between the two vehicles reaches 300m, start to record the receiving/transmission log of vehicle under test and vehicle target until the two vehicles meet each other, and make statistics of the success ratio of information pack delivery of the two vehicles.

6.14.2.3 Requirements

The success ratio of information pack delivery of vehicle under test and vehicle target shall be not less than 90%.

6.14.3 Vehicle-to-infrastructure on long straight road segment

6.14.3.1 Test scenarios

Test road shall be long straight road containing one lane at least, open and free from barrier. Vehicle under test runs towards road side unit, ensure valid test distance of at least 300m. As shown in Figure 6.31.

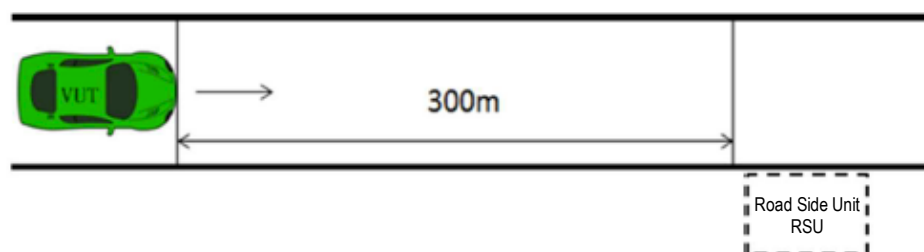


Figure 6.31 Schematic diagram of the test scenario of vehicle-to-infrastructure on long straight road segment

6.14.3.2 Test methods

Under autonomous driving mode, vehicle under test activates networking communication functionality, vehicle under test runs towards roadside equipment at constant velocity of 60km/h, road side unit continuously transmits broadcast information to vehicle under test, when the vehicle reaches the position that is 300m away from roadside equipment, start to record the receiving/transmission log of vehicle under test and roadside equipment until vehicle under test reaches roadside equipment, and make statistics of the success ratio of broadcast information receiving of vehicle under test.

6.14.3.3 Requirements

The success ratio of broadcast information receiving of vehicle under test shall be not less than 90%.

6.14.4 Vehicle-to-vehicle at intersection

6.14.4.1 Test scenarios

Test road shall be intersection of 2-way two lanes, ensure that the valid test distance between vehicle and intersection center line is 50m and the two vehicles run at constant velocity. As shown in Figure 6.32.

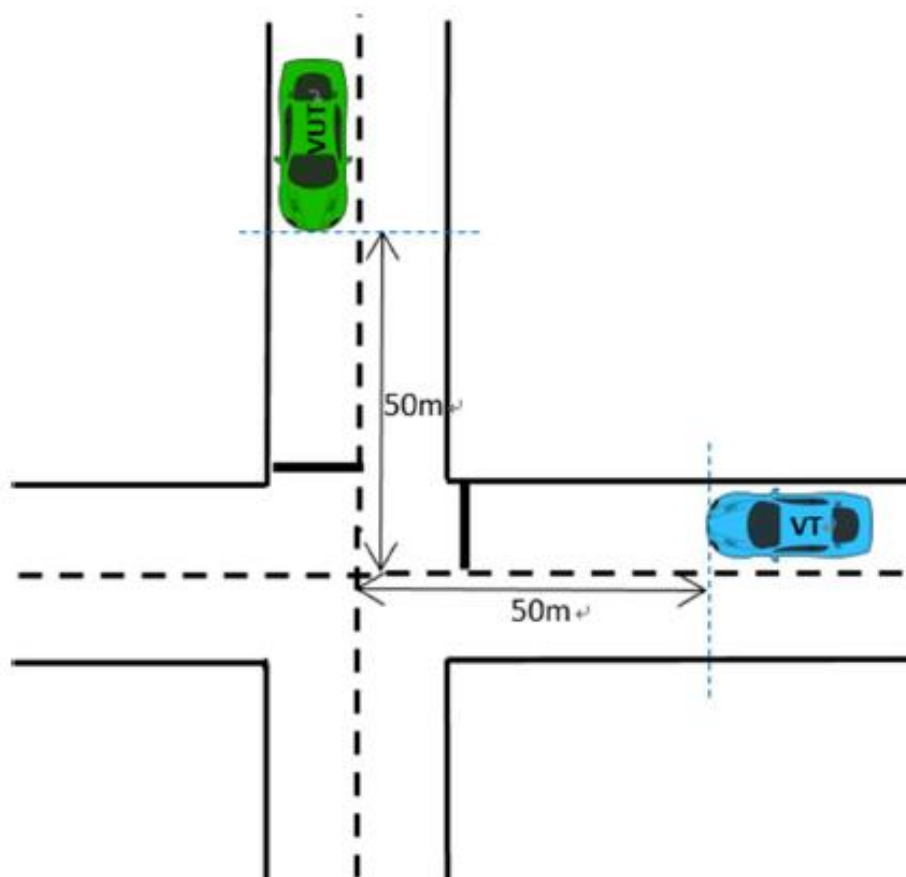


Figure 6.32 Schematic diagram of test scenario of vehicle-to-vehicle at intersection

6.14.4.2 Test methods

Under autonomous driving mode, vehicle under test activates networking communication functionality, vehicle under test and vehicle target run at velocity of 15km/h towards intersection, vehicle under test and vehicle target

respectively transmit information pack continuously to the other vehicle, when the two vehicles respectively reach the position that is 50m from intersection center line, start to record the receiving/transmission log of vehicle under test and vehicle target until the two vehicles reach stop line, and make statistics of the success ratio of information pack delivery of the two vehicles.

6.14.4.3 Requirements

The success ratio of information pack delivery of vehicle under test and vehicle target shall be not less than 90%.

6.14.5 Platooning

6.14.5.1 Platooning acceleration

6.14.5.1.1 Test scenarios

Test road shall be long straight road containing one lane at least, test fleet consists of 3 vehicles under test, vehicle 1 is under manual driving mode, vehicle 2 and vehicle 3 are under autonomous driving mode, and vehicles realize platooning. As shown in Figure 6.33.



Figure 6.33 Schematic diagram of test scenario of platooning acceleration

6.14.5.1.2 Test methods

During test, vehicle 1 is under manual driving mode, vehicle 2 and vehicle 3 are under autonomous driving mode, activate V2V functionality, the 3 vehicles realize platooning connection requirements. Vehicle 1 starts to accelerate from stationary to 60km/h and maintain running at constant velocity.

6.14.5.1.3 Requirements

- a) 3 vehicles under test shall be able to realize platooning;
- b) After platooning, the distance between two vehicles shall be maintained at scope of $\pm 25\%$ of set distance and the maximum distance shall be not more than 20m.

6.14.5.2 Platooning deceleration

6.14.5.2.1 Test scenarios

Test road shall be long straight road containing one lane at least. Test fleet consists of 3 vehicles under test, vehicles under test are under platooning state and run at constant velocity, and vehicle 1 starts to decelerate at a certain instant until stop. As shown in Figure 6.34.

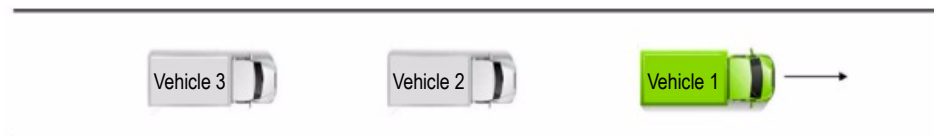


Figure 6.34 Schematic diagram of test scenario of platooning deceleration

6.14.5.2.2 Test methods

During test, vehicles under test are under platooning state and run at constant velocity of 60km/h, vehicle 1 starts to decelerate at a certain instant until stop and the braking deceleration is 2m/s^2 to 4m/s^2 .

6.14.5.2.3 Requirements

There shall be no collision between vehicles under test.

6.14.5.3 Platooning lane change

6.14.5.3.1 Test scenarios

Test road shall be long straight road containing two lanes at least. Test fleet consist of 3 vehicles under test, vehicles under test are under platooning state and run at constant velocity, vehicle 1 is under manual driving mode, vehicle 2 and vehicle 3 are under autonomous driving mode. As shown in Figure 6.35.

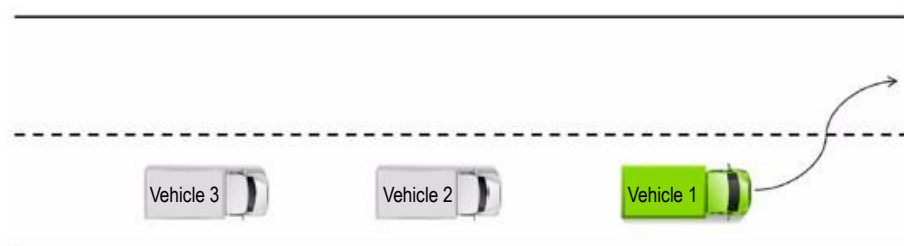


Figure 6.35 Schematic diagram of test scenario of platooning lane change

6.14.5.3.2 Test methods

During test, vehicles under test are already under platooning state and run at constant velocity of 60km/h, vehicle 1 starts to change to adjacent lane at a certain instant.

6.14.5.3.3 Requirements

- a) Vehicle 2 and vehicle 3 shall be able to change lane timely along with vehicle 1;
- b) There shall be no collision between vehicles under test;
- c) After the entire fleet completes lane change, the lateral distance deviation of vehicle 2 and vehicle 3 in relation to vehicle 1 shall be not more than 0.5m.

6.14.5.4 Self-adaptive platooning

6.14.5.4.1 Test scenarios

Test road shall be long straight road containing two lanes at least. Test fleet consists of 3 vehicles under test, vehicles under test are under platooning state and run at constant velocity, vehicle target moves from adjacent lane into a position between vehicle 1 and vehicle 2. As shown in Figure 6.36.

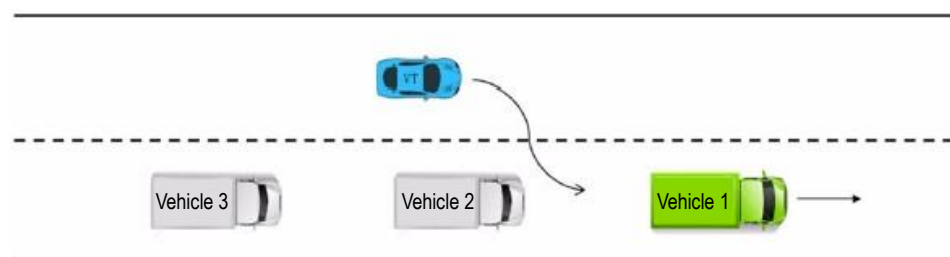


Figure 6.36 Schematic diagram of self-adaptive platooning scenario

6.14.5.4.2 Test methods

During test, vehicle under test are already under platooning state and run at constant velocity of 60km/h, vehicle target starts lane-changing and moves into a position between vehicle 1 and vehicle 2, vehicle target runs at velocity of 60km/h after cut-in along with vehicle 1. Vehicle target is of passenger car type.

6.14.5.4.3 Requirements

- a) Vehicle 2 shall be able to detect vehicle target running in and automatically adjust vehicle velocity;
- b) Vehicle 2 shall be able to keep safe distance from cutting-in vehicle target, and the safe distance shall be not less than 5m;
- c) Vehicle 3 shall be able to adjust vehicle velocity adaptively, keep safe distance from vehicle 2 and meet requirements of platooning.

7 Recommendation for Scenario Combination Test

In actual test, all the test scenarios specified in Chapter 6 can be subjected to combination test of different scenarios as per the principle of single item evaluation and combination test, so as to shorten test cycle and enhance site utilization efficiency; see the recommended combination test program as per annex B.

Annex A
(Normative)

Parameter Table of Vehicle Under Test

Table A.1 Parameter table of vehicle under test

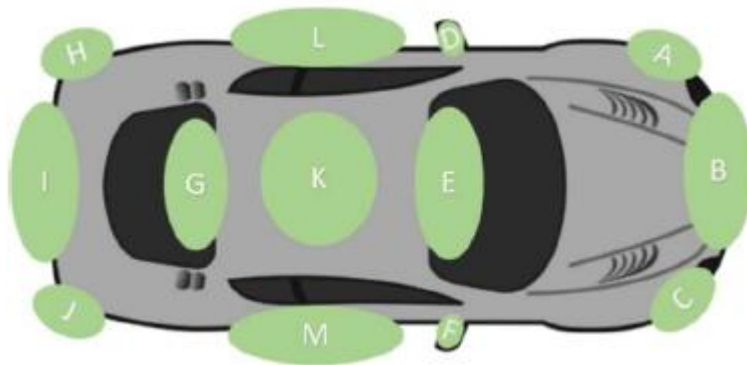
| | | | |
|---|--|--|--|
| Test subject | | | |
| Information of vehicle under test | | | |
| Product trademark | | Product model | |
| Vehicle Identification Number (VIN) | | | |
| The maximum design vehicle velocity under autonomous driving mode | | | |
| Technical route | | | |
| Is connectivity technology adopted | Yes <input type="checkbox"/> | | NO <input type="checkbox"/> |
| Corresponding test item (please make \checkmark mark behind the corresponding items) | 1. Identification and response to traffic signs and markings | | 2. Identification and response to traffic signal lamps * |
| | 3. Identification and response to driving status of the front vehicle | | 4. Identification and response to obstacles |
| | 5. Identification and avoidance to pedestrians and non-power-driven vehicles * | | 6. Vehicle-following driving |
| | 7. Road-side parking | | 8. Overtaking |
| | 9. Lane-changing | | 10. Intersection driving * |
| | 11. Traffic circle driving * | | 12. Autonomous emergency braking |
| | 13. Manual operation intervention | | 14. Networking communication * |
| Is high precision map adopted | Yes <input type="checkbox"/> | | NO <input type="checkbox"/> |
| Corresponding test item (please make \checkmark mark behind the corresponding items) | 1. Identification and response to traffic signs and markings | | 2. Identification and response to traffic signal lamps * |
| | 3. Identification and response to driving status of the front vehicle | | 4. Identification and response to obstacles |
| | 5. Identification and avoidance to pedestrians and non-power-driven vehicles * | | 6. Vehicle-following driving |
| | 7. Road-side parking | | 8. Overtaking |
| | 9. Lane-changing | | 10. Intersection driving * |
| | 11. Traffic circle driving * | | 12. Autonomous emergency braking |
| | 13. Manual operation intervention | | 14. Networking communication * |
| Autonomous driving task input mode (manual or system, it is necessary to make separate statement if different systems adopt different method for one same functionality) | | | |
| 1. Identification and response to traffic signs and markings | | 2. Identification and response to traffic signal lamps * | |
| 3. Identification and response to driving status of the front vehicle | | 4. Identification and response to obstacles | |
| 5. Identification and avoidance to pedestrians and non-power-driven vehicles * | | 6. Vehicle-following driving | |
| 7. Road-side parking | | 8. Overtaking | |
| 9. Lane-changing | | 10. Intersection driving * | |

| | | | |
|-----------------------------------|--|----------------------------------|--|
| 11. Traffic circle driving * | | 12. Autonomous emergency braking | |
| 13. Manual operation intervention | | 14. Networking communication * | |

Environmental perception system

Note: Description of sensor installation position:

A: front left corner area; B: area right ahead; C: front right corner area; D: left rearview mirror and adjacent area; E: front windshield area; F: left rearview mirror and adjacent area; G: rear windshield area; H: rear left corner area; I: area right behind; J: rear right corner area; K: roof area; L: left door area; M: right door area.



Environmental perception system

| Perception Position | Laser radar | | | Millimeter wave radar | | |
|------------------------|--------------|-------|--------|-----------------------|-------|--------|
| | Manufacturer | Model | Number | Manufacturer | Model | Number |
| A | | | | | | |
| B | | | | | | |
| C | | | | | | |
| D | | | | | | |
| E | | | | | | |
| F | | | | | | |
| G | | | | | | |
| H | | | | | | |
| I | | | | | | |
| J | | | | | | |
| K | | | | | | |
| L | | | | | | |
| M | | | | | | |
| Perception Position | Camera | | | Ultrasonic radar | | |
| | Manufacturer | Model | Number | Manufacturer | Model | Number |
| A | | | | | | |
| B | | | | | | |
| C | | | | | | |
| D | | | | | | |
| E | | | | | | |
| F | | | | | | |



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|---|--|--|--|--|--|--|
| G | | | | | | |
| H | | | | | | |
| I | | | | | | |
| G | | | | | | |
| K | | | | | | |
| L | | | | | | |
| M | | | | | | |

Annex B (Informative)

Recommended Program for Test Scenario Combination Test

Test items total 14, including 9 required items, 20 test scenarios; 5 optional items, 14 test scenarios, as shown in Table B.1, in which test scenarios of identical remark content may consider combination test.

Table B.1 Recommended table for test scenario combination

| No. | Test Item | Test Scenario | Remarks |
|-----|---|---|---------|
| 1 | Identification and response to traffic signs and markings | Identification and response to velocity limit signs | A |
| | | Identification and response to stop signs and markings | A |
| | | Identification and response to lane dividing lines | A and F |
| | | Identification and response to crosswalk lines | B |
| 2 | Identification and response to traffic signal lamps * | Identification and response to power-driven vehicle signal lamps | C |
| | | Identification and response to direction indication signal lamps | C |
| 3 | Identification and response to driving status of the front vehicle | Identification and response to vehicle running in | |
| | | Identification and response to opposite vehicle borrowing lane of the subject vehicle | |
| 4 | Identification and response to obstacles | Obstacle test | G |
| | | Misuse test | G |
| 5 | Identification and avoidance to pedestrians and non-power-driven vehicles * | Pedestrian passing across street | B |
| | | Pedestrian walking along road | |
| | | Two-wheeler passing cross street | |
| | | Two-wheeler running along road | |
| 6 | Vehicle-following driving | Stable vehicle-following driving | D and F |
| | | Stop-go functionality | D and F |
| | | | |
| 7 | Road-side parking | Emergency stop along roadside | |
| | | Stop along roadside in the rightmost lane | |
| 8 | Overtaking | Overtaking | E |
| 9 | Lane-changing | Change into adjacent lane without vehicle | E |
| | | Change into adjacent lane with vehicle | |
| | | Decrease of number of forward lanes | |
| 10 | Intersection driving * | Traffic in conflict with vehicle running straight | C |
| | | Traffic in conflict with vehicle turning right | C |
| | | Traffic in conflict with vehicle turning left | C |
| 11 | Traffic circle driving * | Traffic circle driving | |
| 12 | Autonomous emergency braking | Forward vehicle is stationary | |
| | | Forward vehicle applies brake | |



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| | | | |
|----|-------------------------------|---|--|
| | | Pedestrian passes across | |
| 13 | Manual operation intervention | Manual operation intervention | |
| 14 | Networking communication * | Vehicle-to-vehicle on long straight road segment | |
| | | Vehicle-to-infrastructure on long straight road segment | |
| | | Vehicle-to-vehicle at intersection | |
| | | Platooning test | |