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Intelligent and connected vehicles - Track testing methods and requirements for automated driving functions

智能网联汽车 自动驾驶功能场地 试验方法及要求

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Table of Contents

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1 Scope

This document specifies the general requirements, test process, pass conditions, and test methods for the field test of the automated driving function of intelligent and connected vehicles.

This document applies to M and N vehicles with automated driving functions. Other vehicle types can refer to this document for the implementation.

2 Normative references

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

GB 5768 (all parts), *Road traffic signs and markings*

GB 14886, *Specifications for road traffic signal setting and installation*

GB 14887, *Road traffic signal lamps*

GB/T 24720, *Traffic cones*

GB/T 24973, *Toll electric barrier*

GB/T 40429, *Taxonomy of driving automation for vehicles*

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 40429 as well as the followings apply.

3.1 automated driving function

A general term for driving automation functions of level 3 and above specified in GB/T 40429, including "conditional automated driving", "highly automated driving" and "full automated driving" functions.

3.2 vehicle under test; VUT

A vehicle for testing the automated driving function.

3.3 object target

Traffic participants and obstacles that are used to construct the testing scenario.

3.4 vehicle target; VT

A production passenger car used to build the testing scenario.

3.5 automated driving mode

A mode in which all dynamic driving tasks are performed by the automated driving system.

3.6 testing scenario

A collection of elements and their states such as roads, traffic signs and markings, and object targets during vehicle testing.

3.7 pre-collision time

The time required for the vehicle under test to maintain the current speed in the preset travel trajectory to reach the pre-collision point with the object target.

3.8 maximum design operational speed; v_{max}

The maximum speed at which the vehicle under test can operate in automated driving mode under its designed operating conditions.

NOTE: The unit is kilometers per hour (km/h).

3.9 testing process

The vehicle under test starts from the first test item and completes the selected test items.

3.10 leading vehicle

In front of the vehicle under test, in the same lane as it, the vehicle that meets the conditions for the activation of the automated driving mode of the vehicle under test.

3.11 stable following

The speed difference between the front and rear vehicles is within ±2km/h and maintained for more than 3s.

3.12 start moving

NOTE: Two-wheeled ordinary motorcycle refers to an ordinary motorcycle with two wheels on the longitudinal center plane of the vehicle. Its length is less than or equal to 2.5m. The width is less than or equal to 1.0m. The height is less than or equal to 1.4m.

4.2.2 Test equipment requirements

The test equipment shall meet the following requirements:

a) The resolution of video capture equipment inside and outside the car is not less than (1920×1080) pixels;

b) The frequency of motion state sampling and storage is not less than 50Hz;

c) The speed acquisition accuracy is not more than 0.1km/h;

d) The horizontal and vertical position acquisition accuracy is not more than 0.1m;

e) The acceleration acquisition accuracy is not greater than 0.1m/s^2.

4.2.3 Test record

The test process record shall include the following:

a) Software and hardware version information about the automated driving system of the vehicle under test;

b) Control mode of the vehicle under test;

c) Motion state parameters of the vehicle under test:

1) Vehicle geometry or mass center point location information;

2) Vehicle longitudinal speed;

3) Vehicle lateral speed;

4) Vehicle longitudinal acceleration;

5) Vehicle lateral acceleration;

d) Lighting and related prompt information state of the vehicle under test;

e) In-vehicle video and voice monitoring that reflects the status of the driver and human-computer interaction;

f) Video information reflecting the driving state of the vehicle under test;

g) Position and motion data of the object target.

4.3 Requirements for vehicle under test

4.3.1 The vehicle under test shall meet the following human-machine interaction requirements:

a) Has an operation mode that facilitates manual activation and deactivation of the automated driving mode;

b) The system state and the prompt information of the man-machine conversion process are clearly visible.

4.3.2 The vehicle under test shall meet the following load requirements:

a) M_1 vehicles (hereinafter collectively referred to as "passenger vehicles"): The mass of the vehicle under test is between the curb mass of the whole vehicle plus the total mass of the driver and test equipment and the maximum allowable total mass. Do not change the load state of the vehicle under test after the start of the test;

b) M_2, M_3, N vehicles (hereinafter referred to as "commercial vehicles"): The vehicle under test is respectively tested under the condition of the curb weight of the whole vehicle plus the total weight of the driver and the test equipment and the maximum allowable total weight. The load state of the vehicle under test is not changed after the start of the test.

5 Test process and pass conditions

5.1 Process management

5.1.1 The test items shall be selected in accordance with Annex B according to the driving area under the designed operating conditions of the vehicle under test.

5.1.2 If the vehicle under test needs a leading vehicle as a condition for the normal activation of the automated driving mode, the leading vehicle shall be set up during the test process and the data of the leading vehicle shall be recorded according to 4.2.3. The leading vehicle shall not have an impact on the test results.

5.1.3 The speed limit setting of the test road shall meet the purpose of the test project.

5.1.4 During the test, the following requirements shall be met:

a) All test items are completed in automated driving mode;

b) The software version and hardware configuration of the automated driving system will not be changed.

According to the requirements of 5.2.1, in this scenario, the vehicle under test shall go straight for 3 times, turn left 3 times and turn right 3 times. In the 3 tests of the same motion trajectory of the vehicle under test, the above two signal light states a) and b) shall appear at least once each.

6.1.4.3 Acceptance requirements

6.1.4.3.1 When conducting right-turn tests at green and red lights, the vehicle under test shall pass through the intersection and enter the corresponding lane. Driving shall not be stopped during this process.

6.1.4.3.2 When deriving straight and turning left at a red light test, the vehicle under test shall meet the following requirements:

a) The vehicle under test stops in front of the stop line at the red light and no part of the vehicle body crosses the stop line;

b) If the vehicle under test is a passenger car, the minimum distance between the front end of the vehicle and the stop line is not more than 2m. After the signal light turns green, the start moving time shall not exceed 3s;

c) If the vehicle under test is a commercial vehicle, the minimum distance between the front end of the vehicle and the stop line is not more than 4m. After the signal light turns green, the start moving time shall not exceed 5s.

6.1.5 Direction indicator lights

6.4.5.1 Testing scenario

The test road is an intersection with at least two lanes in both directions. The intersection settings include direction indicator lights for going straight, turning left, and turning right. The turning radius of the road is not less than 15m. The speed limit is set at 40km/h on this road section, as shown in Figure 5.

6.6.3.2 Test method

The vehicle under test drives to the ordinary platform.

6.6.3.3 Acceptance requirements

The vehicle under test shall meet the following requirements:

a) The vehicle under test enters the ordinary platform at one time and completes docking. There is no reverse adjustment. Ensure the correspondence between the door and the boarding and disembarking areas on the platform;

b) The maximum distance between the outer edge of the step center of the first-level door of the vehicle under test and the inner side of the lane is not greater than 0.3m;

c) The vehicle under test starts to open the door on the same side of the platform within 3 seconds after it stops.

6.7 Dynamic driving task intervention and takeover

6.7.1 Test method

The vehicle under test drives in the long straight in the automated driving mode. The driver intervenes in a manner that enables the vehicle under test to exit the automated driving mode.

6.7.2 Acceptance requirements

The vehicle under test shall hand over the dynamic driving task execution authority to the driver. After handing over the authority, the automated driving system shall not automatically resume the automated driving mode.

6.8 Minimal risk strategy

6.8.1 Test method

During the test of 6.1.6, 6.2.1, 6.2.2, 6.2.4, 6.2.8, 6.2.9, 6.3.2, 6.3.3, 6.4.4, if the vehicle under test sends out a prompt message beyond the design operational range, the driver will not artificially intervene in the driving state of the vehicle under test.

If the vehicle under test does not issue a prompt message beyond the design operational range during all the above-mentioned test items, proceed the supplementary test examples as shown in 6.8.3.

6.8.2 Acceptance requirements

The vehicle under test shall not collide with the object target.

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