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**Intelligent and connected vehicle - General technical
requirements for automated driving system**

智能网联汽车 自动驾驶系统通用技术要求

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Intelligent and connected vehicle - General technical requirements for automated driving system

1 Scope

This document specifies the overall requirements, dynamic driving task execution requirements, dynamic driving task backup requirements, human-machine interaction requirements, etc. for automated driving system.

This document applies to M-category and N-category vehicles equipped with automated driving system.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 34590.1, Road vehicles - Functional safety - Part 1: Vocabulary

GB/T 34590.3-2022, Road vehicles - Functional safety - Part 3: Concept phase

GB/T 40429-2021, Taxonomy of driving automation for vehicles

GB/T 41798, Intelligent and connected vehicles - Track testing methods and requirements for automated driving functions

GB/T 43267-2023, Road vehicles - Safety of the intended functionality

GB/T 44298-2024, Intelligent and connected vehicles - Symbols for controls, indicators and tell-tales

GB/T 44373-2024, Intelligent and connected vehicle - Terms and definitions

GB/T 44719, Intelligent and connected vehicle - Methods and requirements of road test for automated driving functions

4.7 In active state, ADS shall perform all dynamic driving tasks (DDT) and shall not cause unreasonable safety risks.

4.8 In active state, when ADS performs dynamic driving tasks (DDT), it shall comply with road traffic regulations.

4.9 In active state, when ADS performs dynamic driving tasks (DDT), it shall comply with reasonable expectations of other road users.

4.10 When ADS is in active state, for any device or system required to support the driver in resuming manual driving, it shall be confirmed whether the device or system is in an operational state suitable for manual driving. If the relevant device or system is in an inappropriate operational state, ADS shall implement reasonable control strategies.

Note: Required devices or systems include defogger, windshield wipers, lighting devices, etc.

4.11 In active state, ADS shall not cause any reasonably foreseeable and preventable collision.

4.12 When ADS is in active state and a collision is unavoidable, reasonable control strategies shall be implemented to reduce accident injuries or losses.

4.13 When ADS is in active state and a vehicle collision is detected, the vehicle shall be brought to a standstill unless otherwise stated by the vehicle manufacturer.

4.14 When ADS is in active state, and the operational design conditions (ODC) are about to be not met or have been not met, a reasonable control strategy shall be implemented.

4.15 In active state, ADS shall effectively exchange information with other road users.

Note: Information interaction methods include turn signals, brake lights, etc.

4.16 In active state, ADS shall not disrupt normal traffic flow and thus reduce overall traffic efficiency.

4.17 ADS shall not present unreasonable risks due to hazards caused by abnormal functional performance and shall comply with Appendix A.

4.18 ADS shall not present unreasonable risks due to hazards caused by intended functions or insufficient implementation of its functions, and shall comply with Appendix A.

4.19 Vehicles equipped with ADS shall be equipped with a data storage system for automated driving (DSSAD).

4.20 Based on the review of the ADS development and design process and materials, test methods such as simulation test, track test, and road test shall be reasonably selected to verify that ADS meets the requirements of this document. The test type can be selected by referring to Appendix B.

4.21 For ADS whose operational design domain (ODD) includes highways or urban roads, the track test, if carried out, shall at least be in accordance with GB/T 41798; the road test, if carried out, shall at least be in accordance with GB/T 44719; and the simulation test, if carried out, shall at least be in accordance with the relevant national standards for simulation test methods for automated driving functions.

5 Dynamic driving task execution

5.1 ADS shall be able to continuously identify whether its operational design conditions (ODC) are met.

5.2 The perception system of ADS shall have a detection range that is compatible with the ODC of ADS.

5.3 ADS shall be able to determine the vehicle's position and detect objects and events in the surrounding environment.

Note: Common objects include roads (including road type, road surface conditions, road geometry, lane characteristics, road edges, etc.), road facilities (including traffic signs, traffic lights, etc.), targets (including motor vehicles, non-motor vehicles, pedestrians, obstacles, etc.), weather environment (including weather, lighting conditions, etc.), and digital information environment (including wireless communication, location signals, etc.).

5.4 ADS shall be able to detect the position of targets and the moving speed of dynamic targets.

5.5 ADS shall perform reasonable control strategies to deal with the performance degradation of the perception system.

Note: Performance degradation generally refers to the performance degradation caused by aging of the sensor itself.

5.6 ADS shall perform reasonable control strategies to deal with targets that are detected but cannot be identified.

5.7 ADS shall perform reasonable control strategies to deal with safety risks in undetectable areas.

Note: Undetectable areas include blind spots caused by sensor layout and perception range, blind spots caused by other road users or obstacles, and blind spots caused by road topology or shape.

6.1.3 Monitoring of driver's capability to perform dynamic driving tasks (DDT)

6.1.3.1 For ADS that requires a conventional driver to take over, at least two effective indicators shall be used to determine whether the driver has the capability to perform the dynamic driving task (DDT), and the determination cycle shall be reasonable.

Note: Indicators include specific human-machine interaction actions, eye states, head movements, or body movements.

6.1.3.2 For ADS that requires a conventional driver to take over, when ADS is in active state and the driver is judged to be incapable of performing a dynamic driving task (DDT), ADS shall immediately issue a clear takeover capability deficiency warning signal. Each issued takeover capability deficiency warning signal shall be turned off when any of the following conditions are met:

- a) The driver is detected to have recovered the capability to perform the dynamic driving task (DDT);
- b) ADS issues an intervention request;
- c) ADS implements the Minimum Risk Manoeuvre (MRM);
- d) ADS exits.

6.2 Takeover

6.2.1 General requirements

For ADS that requires a conventional driver to take over, the control strategy for issuing intervention requests and responding to driver takeover shall be safe, reliable and effective, and shall be able to detect in a timely manner whether the driver has taken over.

6.2.2 Issuing an intervention request

6.2.2.1 For ADS that requires a conventional driver to take over, there shall be clear intervention request triggering conditions, and ADS shall be able to identify all situations where an intervention request is required. Except for the special circumstances in 6.2.2.2 c) and 6.2.2.3, when any of the conditions in 7.1.2.1 is not met or the takeover capability is insufficient when the prompt signal reaches the set duration, ADS shall issue an intervention request.

6.2.2.2 The issuing timing of the intervention request shall ensure that the driver has sufficient time to safely take over the vehicle, at least meeting the following requirements.

- a) For planned takeover events, ADS shall initiate an intervention request at an appropriate moment to ensure that the Minimum Risk Manoeuvre (MRM) can

bring the vehicle to a standstill before the planned takeover event occurs, even if the driver does not take over.

- b) For unplanned takeover events, ADS shall issue an intervention request in a timely manner when the event is detected.

Note: Unplanned takeover events refer to events where ADS is not aware of in advance but is required to issue an intervention request, such as temporary road construction, disappearance of lane markings, etc.

- c) For failures that affect the operation of ADS, ADS shall immediately issue an intervention request when the failure is detected. If the failure is a severe ADS failure or a severe vehicle failure, ADS may directly execute the Minimum Risk Manoeuvre (MRM) without issuing an intervention request.

6.2.2.3 If an event occurs in which the driver cannot be guaranteed sufficient time to take over the vehicle, as stated by the vehicle manufacturer, ADS shall not issue an intervention request and immediately implement the Minimum Risk Manoeuvre (MRM).

Example: If the enterprise declares that it cannot guarantee the driver sufficient time to take over the vehicle under “Event X” and proves the rationality of the declaration, then ADS does not need to and cannot issue an intervention request under “Event X”.

6.2.3 Intervention request phase

6.2.3.1 During the process of issuing an intervention request, ADS shall remain active and perform the full dynamic driving task (DDT).

6.2.3.2 Except in special circumstances declared by the vehicle manufacturer, ADS shall not bring the vehicle to a standstill during the process of issuing the intervention request.

6.2.3.3 During the process of issuing an intervention request, the intervention request shall be escalated within a reasonable period of time after issuance and remain in the escalated state until the intervention request is terminated.

6.2.3.4 The time from the issuance of an intervention request to its termination due to the execution of the Minimum Risk Manoeuvre (MRM) shall be no less than 10 seconds, so that the driver has sufficient time to take over the vehicle.

Note: In the case where the driver continues to fail to take over, the timing relationship between the intervention request issuance, escalation and the start of MRM execution is shown in Figure 1.

6.3.2.1 The Minimum Risk Manoeuvre (MRM) shall be terminated only when ADS is exited or the vehicle is stationary by ADS.

6.3.2.2 When the Minimum Risk Manoeuvre (MRM) is terminated due to the vehicle being stationary, the hazard warning signal shall not be turned off due to ADS exit.

7 Human-machine interaction

7.1 Activation and exit

7.1.1 General requirements

7.1.1.1 ADS shall be equipped with a dedicated operating method for the user to activate and exit ADS, which shall prevent reasonably foreseeable user misuse.

Note: Dedicated operating methods include dedicated controls or dedicated operating methods for controls.

7.1.1.2 When ADS is active, at least one means of exiting ADS shall remain visible to the user.

7.1.1.3 Each time the vehicle is ignited (powered on) (except for automatic engine start and stop), ADS shall be in an inactive state.

7.1.2 Activation

7.1.2.1 For ADS that requires a conventional driver to take over, ADS shall only be activated when the driver performs the activation operation and all of the following conditions are met:

- a) The driver is sitting in the driving position and wearing a seat belt;
- b) The driver has the ability to perform dynamic driving tasks (DDT);
- c) There are no failures that affect the operation of ADS;
- d) The data storage system for automated driving (DSSAD) is in a recordable state;
- e) The vehicle is not performing any software upgrade that affects the operation of ADS;
- f) In addition to a) ~ e), other operational design conditions (ODC) declared by the vehicle manufacturer.

7.1.2.2 For ADS that does not require a conventional driver to take over, ADS shall be activated only when the user performs an activation operation and all of the following conditions are met:

- a) There are no failures that affect the operation of ADS;
- b) The data storage system for automated driving (DSSAD) is in a recordable state;
- c) The vehicle is not performing any software upgrade that affects the operation of ADS;
- d) In addition to a) ~ c), other operational design conditions (ODC) declared by the vehicle manufacturer.

7.1.3 Exit

7.1.3.1 ADS shall exit when any of the following conditions are met:

- a) The user exits ADS through a dedicated operation method;
- b) The driver intervenes in lateral motion control in accordance with 7.2.2.1;
- c) The driver intervenes in the longitudinal motion control in accordance with 7.2.3.1 and 7.2.3.2, and the driver holds the steering wheel;
- d) During the intervention request or the implementation of the Minimum Risk Manoeuvre (MRM), in addition to a) ~ c), ADS shall confirm that the driver is holding the steering wheel and focusing on the dynamic driving task (DDT);
- e) Termination of the Minimum Risk Manoeuvre (MRM) due to vehicle stationary condition.

7.1.3.2 In the event of a severe vehicle failure or severe ADS failure, ADS may perform other safe exit control strategies declared by the vehicle manufacturer.

7.1.3.3 Except for 7.1.3.1, 7.1.3.2 and when ADS reaches the intended destination, ADS shall not be exited.

7.1.3.4 ADS may suspend exit only when the exit maneuver performed by the user would result in an imminent risk of collision.

7.1.3.5 The exit of ADS shall not result in:

- a) any emergency auxiliary function automatically shut down;
- b) any partial or combined driver assistance function automatically activated.

7.2 Intervention

7.2.1 General requirements

7.3 System state prompt

7.3.1 General requirements

7.3.1.1 ADS shall continuously provide users with clear and sufficient ADS state information. Each state information shall be easy to distinguish and shall not cause interference to the user.

7.3.1.2 When the ADS state changes, ADS shall provide the user with necessary prompt information in a timely manner.

7.3.2 Not-ready state prompt

If the user fails to activate the system due to ADS in the not-ready state, the user shall be prompted intuitively.

Note: The not-ready state refers to an inactive state in which ADS cannot be activated.

7.3.3 Ready state prompt

When ADS is in the ready state, it should prompt the user, at least by an optical signal, that the system can be activated.

Examples: text information, graphic markings, etc.

7.3.4 Activation state prompt

7.3.4.1 When ADS changes from an inactive state to an active state, it shall prompt the user, at least by a dedicated optical signal, that ADS has been activated.

7.3.4.2 When ADS is in the active state, it shall continuously prompt the user, at least by an optical signal, that ADS is in the active state.

7.3.5 Exit prompt

When ADS exits from an activated state to an inactivated state, it shall prompt the user that ADS has exited, by at least two means, including at least an optical signal. If ADS exits due to driver takeover, only optical signals may be used to indicate the situation.

7.3.6 Intervention request

7.3.6.1 The prompt method for non-escalated intervention requests shall include acoustic and/or tactile signals in addition to optical signals. The optical signal shall intuitively and clearly indicate the driver's response to the intervention request, and the sign shall comply with the requirements of No. 5 in Table 1 of GB/T 44298-2024.

7.3.6.2 After the intervention request is escalated in accordance with 6.2.3.3, the escalated intervention request shall at least add continuous or intermittent tactile prompts.

7.3.7 Minimum Risk Manoeuvre (MRM) prompt

7.3.7.1 During the process of ADS executing the Minimum Risk Manoeuvre (MRM), the user shall be given obvious prompts, which shall be in the form of acoustic and/or tactile signals in addition to optical signals.

7.3.7.2 When ADS is in the minimal risk condition (MRC), the user shall be prompted by at least two signals, optical, acoustic or tactile, until ADS is exited.

7.3.7.3 For ADS requiring conventional driver takeover, the prompting signal for the Minimum Risk Manoeuvre (MRM) shall be different from the intervention request.

7.3.8 Failure prompt

When ADS is in the active state, if ADS failure is detected, ADS shall give the user an obvious prompt, including at least an optical prompt signal.

7.3.9 Insufficient takeover capability prompt

The insufficient takeover capability prompt signal shall be clearly distinguishable from other prompt signals of the vehicle when ADS is in active state.

7.3.10 Suspending or suppressing responses to user operation prompt

If ADS suspends or suppresses responses to user operation, this shall be clearly indicated and distinguished from other vehicle prompts when ADS is in active state.

8 Instruction manual

For vehicles equipped with ADS, the product manual shall at least include:

- a) Description of the content such as “This vehicle is equipped with ADS”;
- b) Description of the operational design conditions (ODC) of ADS;
- c) Description of the method and conditions for activating ADS;
- d) Description of the method and conditions for exiting ADS;
- e) Description of the method and result for intervening ADS;
- f) Description of each ADS state prompt signal;
- g) If ADS does not need to be taken over, a statement such as “ADS of this vehicle does not need to be taken over by the driver”;
- h) If ADS needs to be taken over, a statement such as “ADS of this vehicle needs to be taken over by the driver under certain conditions”;

Appendix A

(Normative)

Special requirements for the safety of ADS

A.1 General

This Appendix aims to ensure that vehicle manufacturers give full consideration to functional safety and expected functional safety during the design and development of ADS, and run through the entire vehicle life cycle (development, production, operation, service, and scrapping), so as to avoid unreasonable risks to users and other road users caused by ADS failures and insufficient expected functions, and ensure the safe operation of ADS.

This Appendix specifies the special requirements for ADS in terms of functional safety and intended functional safety.

This Appendix does not target the nominal performance of ADS, nor does it serve as a specific guide for the development of ADS functional safety and intended functional safety. Instead, it specifies the methods to be followed and the information to be available during the design, verification and validation of ADS as a basis for meeting functional safety and intended functional safety.

A.2 General requirements

A.2.1 Vehicle manufacturers shall establish a safety management system and adopt effective processes, methods and tools to manage the safety of ADS throughout the vehicle life cycle (including development, production, operation, service and scrapping), and prove that ADS will not cause unreasonable risks to the user and other road users within the declared operational design conditions (ODC) (including boundaries).

A.2.2 Vehicle manufacturers shall establish a design and development process, including safety management system, requirements management, requirements implementation, testing, failure tracking, maintenance and release.

A.2.3 Vehicle manufacturers shall establish and maintain effective communication channels between departments responsible for the functional safety, expected functional safety, information security and other security aspects of ADS.

A.2.4 Vehicle manufacturers shall have one or more processes to monitor safety-related events caused by ADS, manage potential risks of ADS and be able to upgrade ADS.

A.2.5 Vehicle manufacturers shall conduct independent internal process audits regularly to ensure that the processes established in accordance with A.2.1 ~ A.2.4 are implemented consistently.

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