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Common Functional Performance Requirements for Automated and Autonomous Vehicles

This document has been prepared by the Informal Working Group on Functional Requirements for Automated and Autonomous Vehicles (FRAV) to describe functional performance requirements that may be applicable to automated and/or autonomous vehicles. It is based upon ECE/TRANS/WP29/2019/34/Rev.1, WP.29-179-23, and ACSF-24-05.

1. Definitions
 - 1.1. “*Minimal risk condition*” means a condition to which a user or an automated driving system may bring a vehicle in order to reduce the risk of a crash when a given trip cannot or should not be completed.¹
 - 1.2. “*Minimal risk maneuver*” means a procedure automatically performed by the automated driving system to place the vehicle in a minimal risk condition in a manner that minimizes risks in traffic.²
 - 1.3. “*Operational domain*” means the operating conditions which a vehicle can reasonably be expected to encounter when in automated mode. These conditions will be established by the VMAD scenario database.
 - 1.4. “*Operational design domain*” refers to the operating conditions under which a given driving automation system or feature thereof is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics.³ The operational design domain is a subset of the operational domain.

¹ Definition derived from SAE J3016:2016

² Definition derived from ACSF-24-05 (clean); however, the term “minimal” has been substituted for “minimum” and the definition refers to the minimal risk condition for consistency with SAE J3016:2016. The definition omits the ACSF reference to “after a transition demand” under the assumption that such maneuvers could be executed by Level 4/5 vehicles without driver controls or the demand could be skipped if the driver monitoring system detects that a transition to the driver is not appropriate.

³ Definition from SAE J3016:2016

- 1.5. “*Transition demand*” is a logical and intuitive procedure to transfer the dynamic driving task from automated control by the system to human driver control.⁴
- 1.6. “*VMAD*” refers to the GRVA informal working group on Validation Methods for Automated Driving.
- 1.7. “*VMAD scenario*” refers a configuration of traffic variables as defined within the VMAD traffic scenario database.
- 1.8. “*VMAD traffic scenario database*” is the proposed database or catalog of traffic conditions that are reasonably foreseeable under which a vehicle can reasonably be expected to avoid causing an event resulting in injury or death.

2. System Safety
 - 2.1. Activation and use of the vehicle in automated mode shall only be possible within the boundaries of the automated driving system’s operational design domain.
 - 2.2. When in automated driving mode,
 - 2.2.1. The vehicle shall respond to conditions within its operational domain without causing an event resulting in injury or death;
 - 2.2.2. The vehicle shall comply with all applicable road traffic laws except in cases where such compliance would conflict with paragraph 2.2.1.
 - 2.3. [Functional requirements related to overall system design safety (e.g., CEL)?]

3. Operational Design Domain (ODD)
 - 3.1. The vehicle manufacturer shall define the operational design domain of the vehicle, including (at a minimum):⁵
 - 3.1.1. Roadway types
 - 3.1.2. Geographic area
 - 3.1.3. Speed range
 - 3.1.4. Environmental conditions
 - 3.2. The vehicle manufacturer shall identify the conditions defined for the vehicle’s operational domain that fall outside the vehicle’s operational design domain.

⁴ Definition from ACSF-24-05 (clean)

⁵ FRAV will consider ISO/WD 34503: Road vehicles — Taxonomy for operational design domain for automated driving systems

- 4. Execution of Dynamic Driving Tasks
 - 4.1. Object and Event Detection and Response (OEDR)
 - 4.1.1. The automated driving system shall detect and classify objects and events that may be reasonably expected within its operational domain.
 - 4.1.1.1. [Categorical definition of objects/events?]
 - 4.1.2. The automated driving system shall detect conditions within its operational domain that fall outside the boundaries of its operational design domain as defined in paragraph 3.2.
 - 4.2. Normal Driving
 - 4.2.1. The automated driving system shall execute longitudinal and lateral maneuvers in response to objects and events within its operational design domain.
 - 4.2.1.1. The automated driving system shall execute such maneuvers without causing outcomes resulting in injury or death.
 - 4.2.1.2. The automated driving system shall execute such maneuvers without disrupting the normal flow of the surrounding traffic.
 - 4.3. Other Driving
 - 4.3.1. The automated driving system shall execute a failsafe response when the conditions defined for its operational design domain are not satisfied for a duration exceeding [time limit].
 - 4.3.2. The automated driving system shall execute an emergency response when conditions for the execution of a failsafe response are not present.

5. Human-Machine Interface/Operator Information
 - 5.1. Vehicles equipped with automated driving systems that may require driver intervention (e.g., transition demand) shall detect if the driver is available to take over the driving task by continuously monitoring the driver.⁶
 - 5.2. The vehicle shall clearly communicate to the user:
 - 5.2.1. Status of the automated driving system
 - 5.2.1.1. System availability
 - 5.2.1.2. System mode active
 - 5.2.1.3. System malfunction
 - 5.2.2. Critical messages
 - 5.2.3. Transition demand
 - 5.2.4. Initiation of minimal risk maneuver
 - 5.2.5. Status of driver availability
 - 5.3. The vehicle shall signal to other road users:
 - 5.3.1. Intentions to undertake dynamic driving tasks in accordance with applicable traffic laws
 - 5.3.2. Initiation of a minimal risk maneuver
6. Failsafe Response
 - 6.1. When in automated driving mode,
 - 6.1.1. The vehicle shall automatically initiate a failsafe response or sequence of failsafe responses in response to detection of conditions outside its operational design domain for a duration not to exceed [time limit].
 - 6.1.2. Failsafe responses shall only be initiated when conditions permit their completion in compliance with paragraph 2.2.
 - 6.2. Failsafe responses include:
 - 6.2.1. Transition demand
 - 6.2.2. Minimal risk maneuver

⁶ Derived from ACSF-24-05 (clean), para. 2.6.2.