Informal document **GRVA-05-62**
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Agenda item 4(a)

Submitted by the IWG on VMAD

# Necessity of the traffic critical scenarios drafting at the SG1a group of VMAD IWG

# Basic structure of the DRAFT UN Regulation for ALKS

Regulation

Introduction
1.Scope and purpose
2.Definitions
3.Application for approval
4.Approval

Requirement

5.System Safety and Fail-safe Response
6.Human Machine Interface / Operator Information
7.Object Event Detection and Response

8.Data Storage for Automated Systems

9.Cybersecurity and Software-Updates

10. Modification of vehicle type and extension of approval
11.Conformity of production
12.Penalties for non-conformity of production
13.Production definitively discontinued
14. Names and addresses of Technical Services responsible for conducting approval tests and of Type Approval Authorities

Validation

Annexes to the Reg.

1 Communication
2 Arrangements of approval marks
3 System information data

4 Special requirements to be applied to the safety aspects of electronic control systems [and Audit] (Informal doc. GRVA05-18,19)
*New validation/test method drafted by VMAD IWG*

5 Test Specifications for ALKS
*Conventional test method drafted by ACSF IWG*

(Annex DSSAD (Informal doc.GRVA05-31))
*Drafted by DSSAD/EDR IWG*

New Reg. for CS/SU (Informal doc.GRVA05-05-06)
*Drafted by CS/OTA TF*

# Necessity of boundary of preventable/unpreventable for audit/assessment

Regulation

Requirement

5.System Safety and Fail-safe Response
6.Human Machine Interface / Operator Information
7.Object Event Detection and Response

5.System Safety and Fail-safe Response (Excerpt)

5.1. General Requirements

5.1.1.The activated system shall perform the dynamic driving task~~s~~, manage all situations including failures, and shall not endanger the safety of the vehicle occupants or any other road users.

The activated system shall not cause any collisions that are reasonably foreseeable and preventable. If a collision can be safely avoided without causing another one, it shall be avoided. When the vehicle is involved in a detectable collision, the vehicle shall be brought to a standstill.

To inspect conformity of the vehicle with ALKS to this provision according to Annex 4, boundary of Preventable and unpreventable should be determined.

# Basic structure of DRAFT Annex 4(audit/assessment) ①

Annexes to the Reg.

1 Communication
2 Arrangements of approval marks
3 System information data

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5 Test Specifications for ALKS
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(Annex DSSAD?(Informal doc.GRVA05-?))
*Drafted by DSSAD/EDR IWG*

New Reg.for CS/SU (Informal doc.GRVA05-?)
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Annex 4
Special requirements to be applied to the functional and operational safety aspects of automated driving systems

1. General
2. Definitions
3. Documentation
3.1. Requirements
3.2. Description of the functions of "The System" including control strategies
3.3. System layout and schematics
3.4. Safety concept of the manufacturer
3.5. Safety management system (Process Audit)
4. Verification and tests
5. Reporting by
6. Communication to the other type –approval authorities (See appendix 3- Could also be annexed to the Communication form)
7. Competence of the auditors/assessors

Appendix 1: Model assessment form for automated driving systems
Appendix 2: Information document form for Automated Driving System to be provided by the manufacturer for the approval
(Appendix 3: Communication form?)
(Appendix 4: Traffic critical scenarios)

# Basic structure of DRAFT Annex 4(audit/assessment)②

Annex 4

Special requirements to be applied to the functional and operational safety aspects of automated driving systems

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(Appendix 3: Communication form?)

(Appendix 4: Traffic critical scenarios)

(Excerpt)

3.4.4. The documentation shall be supported, by an analysis which shows, in overall terms, how the system will behave to mitigate or avoid hazards which can have a bearing on the safety of the driver, passengers and other road users.

The chosen analytical approach (es) shall be established and maintained by the Manufacturer and shall be made open for inspection by the Type-approval authority at the time of the type approval.

The Type-approval authority shall perform an assessment of the application of the analytical approach (es):

(a) Inspection of the safety approach at the concept (vehicle) level. This approach shall be based on a Hazard / Risk analysis appropriate to system safety.

(b) Inspection of the safety approach at the system level including a top down (from possible hazard to design) and bottom up approach (from design to possible hazards). The safety approach may be based on a Failure Mode and Effect Analysis (FMEA), a Fault Tree Analysis (FTA) and a system-theoretic process analysis (STPA) or any similar process appropriate to system functional and operational safety.

(c) Inspection of the validation/verification plans and results including appropriate acceptance criteria. This shall include validation testing appropriate for validation, for example, Hardware in the Loop (HIL) testing, vehicle on-road operational testing, or any other testing appropriate for validation/verification.

The inspection shall confirm that each of the following items is covered where applicable under (a)-(c):

(i)-(iii) (omitted)

(iv) Identification of the relevant scenarios (including traffic critical scenarios defined in Appendix4) within the ODD and management method used to select scenarios and validation tool chosen

# Appendix 4: Traffic critical scenarios for ALKS① (Under discussion)

This Appendix defines traffic critical scenarios for Annex 4 of the regulation which needs to be divided into preventable and unpreventable, according to the requirement in the regulation which stipulates "The activated system shall not cause any collisions that are reasonably foreseeable and preventable."

Preventable scenarios are those where the validation should prove that ALKS does not result in an accident.

Unpreventable scenarios are those where the validation should prove that collision mitigation strategy of ALKS should be implemented in an accident.

## 1. Traffic critical scenarios

Following three are traffic critical scenarios:

- Cut-in: the 'other vehicle' merges in front of the 'ego vehicle'
- Cut-out: the 'other vehicle' exits the lane of the 'ego vehicle'
- Deceleration: the 'other vehicle' decelerates in front of the 'ego vehicle'

Each of these traffic critical scenarios can be created using the following parameters/elements:

- Road geometry
- Ego vehicle's behavior/ manoeuvre
- Other vehicle's behavior/ manoeuvre

## 2. Performance model of ALKS

Traffic critical scenarios of ALKS are divided into preventable and unpreventable scenarios.
They are determined based on the performance model of the ALKS shown below;

○ Human driver with ADAS model

In low-speed ALKS scenario, the avoidance capability required for the driver model is braking control only. As a result, this driver model is separated into the following three segments: "Risk perceive situation(Risk evaluation time)"; "Delay in time(Time duration from having finished perception until starting deceleration)"; and, "Deceleration degree(Jerking time to full deceleration) and Max. G-force(Full Deceleration)".

# Appendix 4: Traffic critical scenarios for ALKS② (Under discussion)

○ Performance model

To determine whether traffic scenarios are collision preventable or collision unpreventable, performance model factors [Risk perception points, risk evaluation time, Time duration seconds from having finished perception until starting deceleration, jerking time to full deceleration and full deceleration] shown below can be used as the performance model of ALKS considering attentive human behavior .

Merit of this model is that parameters can be set flexibly which is needed for audit/assessment.

- **Performance model factors for vehicles (Under discussion)**

| | | Factors |
|---|---|---|
| ・Risk perception point | lane change (cutting in, cutting out) | Deviation of the center of a vehicle over 0.375m from the center of the driving lane (Derived from research by Japan) |
| | deceleration | Deceleration ratio of preceding vehicle and following distance of ego vehicle |
| ・ Risk evaluation time | | 0.4 seconds (Derived from research by Japan) |
| ・Time duration from having finished perception until starting deceleration, | | 0.75 seconds (Common data in Japan) |
| ・Jerking time to full deceleration | | 0.6 seconds (Derived from experiments by NHTSA and Japan) |
| ・Full deceleration | | 0.774G (Derived from experiments by NHTSA and Japan) |