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COMMISSION

Brussels, **XXX**  
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ANNEXES 1 to 2

## **ANNEXES**

to the

**Commission Implementing Regulation (EU) .../... of XXX**

**laying down rules for the application of Regulation (EU) 2019/2144 of the European Parliament and of the Council as regards uniform procedures and technical specifications for the type-approval of motor vehicles with regard to their automated driving system (ADS)**

## ANNEX I

### **Information document for EU type-approval of fully automated vehicles with regard to their automated driving system**

#### MODEL

Information document No ... relating to the EU type-approval of a type of vehicle with regard to the automated driving system.

The following information shall be supplied in triplicate and include a list of contents. Any drawings or pictures shall be supplied in appropriate scale and in sufficient detail on size A4 or on a folder of A4 format. Photographs, if any, shall show sufficient detail.

If the systems, referred to in this information document have electronic controls, information concerning their performance shall be supplied.

- 0. GENERAL
  - 0.1. Make (trade name of manufacturer):
  - 0.2. Type:
    - 0.2.1. Commercial name(s) (if available):
  - 0.3. Means of identification of type, if marked on the vehicle / component / separate technical unit:
    - 0.3.1. Location of that marking:
  - 0.4. Category of vehicle:
  - 0.5. Company name and address of manufacturer:
  - 0.8. Name(s) and address(es) of assembly plant(s):
  - 0.9. Name and address of the manufacturer's representative (if any):
- 1. GENERAL CONSTRUCTION CHARACTERISTICS
  - 1.1. Operational Design Domain (Maximum speed, road type, country, Environment, Road conditions, etc)/ Boundary conditions/ Main conditions for Minimum risk manoeuvres and transition demands
    - 1.1.1 Member States and local areas where the vehicle is expected to be operated
  - 1.2. Basic Performance (e.g. Object and Event Detection and Response (OEDR) ...)
  - 1.3. The means to activate, override or deactivate the system.
- 2. Description of the functions of "The System" including control strategies
  - 2.1. Main automated Driving Functions (functional architecture, environmental perception).

- 2.1.1. Vehicle-internal
- 2.1.2. Vehicle-external (e.g. backend)
- 3. Overview major components (units) of "The System"
  - 3.1. Control Units
  - 3.2. Sensors
  - 3.3. Maps/Positioning
- 4. System layout and schematics
  - 4.1. Schematic system layout including sensors for the environmental perception (e.g. block diagram)
  - 4.2. List and schematic overview of interconnections (e.g. block diagram)
- 5. Specifications
  - 5.1. Means to check the correct operational status of the system
  - 5.2. Means implemented to protect against simple unauthorized activation/operation and interventions into the system
- 3.2. Sensors
- 3.3. Maps/Positioning
- 4. System layout and schematics
  - 4.1. Schematic system layout including sensors for the environmental perception (e.g. block diagram)
  - 4.2. List and schematic overview of interconnections (e.g. block diagram)
- 5. Specifications
  - 5.1. Means to check the correct operational status of the system
  - 5.2. Means implemented to protect against simple unauthorized activation/operation and interventions into the system
- 6. Safety Concept
  - 6.1. Safe Operation – Vehicle Manufacturer Statement
  - 6.2. Outline software architecture (e.g. block diagram)
  - 6.3. Means by which the realization of the system logic is determined
  - 6.4. General explanation of the main design provisions built into "The System" so as to generate safe operation and interaction with other road users under fault conditions, under operational disturbances and the occurrence of planned/unplanned conditions that would exceed the ODD.
  - 6.5. General description of failure handling main principles, fall-back level strategy

including risk mitigation strategy (minimum risk manoeuvre)

- 6.6. Driver, vehicle occupants and other road users' interaction including warning signals and transition demands to be given to driver.
- 6.7. Validation by the manufacturer for the performance requirements specified elsewhere in the regulation including the OEDR, the HMI, the respect of traffic rules and the conclusion that that the system is designed in such a way that it is free from unreasonable risks for the driver, vehicle occupants and other road users.
- 8. Data Storage System
  - 8.1. Type of Data stored
  - 8.2. Storage location
  - 8.3. Recorded occurrences and data elements means to ensure data security and data protection
  - 8.4. Means to access the data
- 9. Cyber security (cross reference to the cyber regulation is possible)
  - 9.1. General description of the cyber security and software update management scheme
    - 9.1.1. Installation of the ADS sensing system:
  - 9.2. General description of the different risks and measures put in place to mitigate these risks.
    - 9.2.1. Software Identification of the ADS:
    - 9.2.2. Cyber Security Type Approval Number (if applicable):
  - 9.3. General description of the update procedure.
    - 9.3.1. Software Update Type approval number (if applicable):
- 10. Information provisions to users/operator
  - 10.1. Model of the information provided to users
  - 10.2. Extract of the relevant part of the operator manual
    - 10.2.1. A role rights obligation concept for the activities needed to operate;
    - 10.2.2. Definition of the skills required to carry out the activities necessary to operate;
    - 10.2.3. The extent, timing and frequency of maintenance operations;
    - 10.2.4. Precautionary statements in the sense of compliance with limit values for the technical functions;
    - 10.2.5. Disturbances or safety measures to be taken in the event of malfunctioning of the operation;

- 10.2.6. Documents for maintenance and repair, including the necessary templates;
- 10.2.7. Presentation of data protection and data security functionalities.
- 11. Human supervision
  - 11.1 Means to monitor the inside of the vehicle
  - 11.2. Written description of the role of remote supervision and remote monitoring by a remote supervision centre

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*Explanatory note*

This information document comprises the information relevant for the automated driving system and shall be completed in accordance with the template laid down in Annex I to Commission Implementing Regulation (EU) 2020/683.

## ANNEX II

### **Performance requirements**

#### **1. Definitions**

In addition to the definitions in Regulation (EU) 858/2018 and Regulation (EU) 2144/2019, for the purpose of the Annexes, the following definitions shall apply:

x.x. “Automated driving system (ADS)” means the set of hardware and software...

ODD elements: type of roads, weather conditions

..[To be completed later]

#### **2. General requirements**

x.x The effectiveness of the system shall not be adversely affected by magnetic or electrical fields. This shall be demonstrated by compliance with the 05 or later series of amendments to UN Regulation No. 10.

#### **3 Expected vehicle behaviour regarding the Dynamic Driving Task (DDT) under normal driving conditions**

x.x. In the ODD, the ADS shall perform the DDT safely and dynamically by appropriate choice of trajectory and speed and shall manage all normal driving situations reasonably expected in the ODD.

x.x.x. The ADS shall be able to perform appropriate manoeuvres expected in the ODD (lane keeping, lane change, intersections, runabout, etc.)

x.x.x. The ADS shall be able to leave sufficient space with the vehicle in front to avoid a collision. In case this cannot be respected temporarily because of other road users (e.g. vehicle is cutting in, decelerating lead vehicle, etc.), the vehicle shall readjust the following distance at the next available opportunity.

x.x.x. When travelling on its lane the ADS shall be able to leave sufficient time and space for others in lateral manoeuvres as appropriate.

x.x.x. The ADS shall be cautious with right of way at intersections.

x.x.x. The ADS shall drive in a predictable manner for other road users and shall avoid any harsh braking/steering unless an emergency manoeuvre would become necessary.

x.x.x. The ADS shall signal unambiguously its intention to road users

- x.x.x Vehicles with ADS intended to carry standing or unrestrained passengers shall not exceed a combined horizontal acceleration of  $2.4 \text{ m/s}^2$  in normal operation.
- x.x The ADS shall comply with the traffic rules in the country of operation in particular speed limits, responding to enforcement authority instruction and giving priorities to emergency vehicles.
- x.x.x The safety of all road users and passengers must be given the highest priority in fulfilling the driving task.
- x.x Specific requirements regarding the Lane Change Procedure (LCP)
- x.x.x The ADS may undertake a LCP if:
  - x.x.x.x the vehicle with the ADS would be able to keep a safe distance from a lead vehicle or any other obstacle in the target lane and if an approaching vehicle in the target lane is not forced to unmanageably decelerate due to the lane change of the vehicle with automated driving function.;
  - x.x.x.x.x An approaching vehicle in the target lane should always have a TTC to the vehicle with automated driving function of at least [4] seconds at the end of the LCM.
  - x.x.x.x.x If no approaching vehicle is detected by ADS in the target lane, the ADS shall assume that the approaching vehicle in the target lane is at a distance equal to rearward detection distance and the approaching vehicle in the target lane is travelling with the allowed or the advised maximum speed whichever is higher.
- x.x.x At the beginning of the LCM, the distance between the rear of the vehicle with automated driving function and the front of a vehicle following behind in the target lane at equal or lower longitudinal speed shall never be less than the speed which the following vehicle in target lane travels in 1 second.
- x.x Specific requirements regarding turning and crossings

The following requirements shall be taken into account with regard to interaction with other road users involved in the movement when turning and crossing (see Figure 1).
- x.x.x In the case of the turning manoeuvre crosses the opposite track, when considering oncoming traffic, it must be ensured — in addition to the distance from the subsequent traffic on the target road — that the TTC of the privileged opposite traffic to the fictitious collision point (point of intersection of the trajectories) never falls below 4 seconds. (case (b) in Figure 1)

The same applies to cross with privileged traffic (case (c) in Figure 1): The TTC of privileged traffic to the imaginary collision point (point of intersection of the

trajectories) shall be greater than 4 seconds.

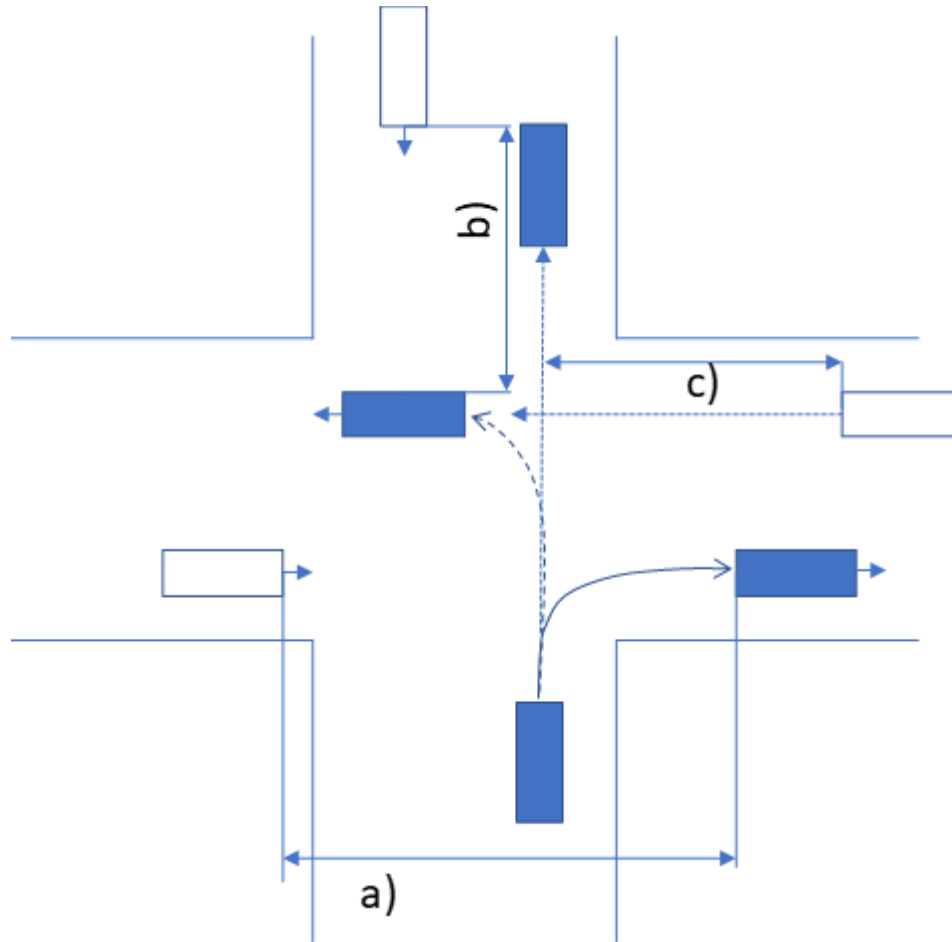


Figure1: Visualization of the distances during turning and crossings. Case (a): Distance to the following traffic to be observed during turning-in. Case (b): Additional distance to reverse traffic to be observed when turning as a result of reverse traffic. Case (c): distance to the privileged crossing traffic to be respected when crossing.

x.x.. The ADS shall be able to handle in a safe way the presence in the same lane of a stationary vehicle, a road user, a passable or unpassable obstacle [debris, lost cargo, etc.], or a blocked lane of travel.

#### 4. Expected vehicle traffic behaviour in emergency conditions.

x.x Within the ODD, the ADS shall perform the DDT for all reasonably expected emergency driving conditions in the ODD.

x.x. The ADS shall be able detect the risk of collision in particular with a decelerating lead vehicle, a cutting in vehicle/cyclist which travel in the same direction, a vehicle proceeding in the opposite direction or a suddenly appearing obstacle (debris, lost load) and shall automatically perform appropriate emergency manoeuvres (braking, evasive) to minimize risks to safety of the vehicle occupants and other road users.



X.X.X. The ADS shall avoid a collision with a leading vehicle which decelerates up to its full braking performance provided that there was no undercut by another vehicle.

X.X.X. Collisions with cutting in vehicles and cyclists which travel in the same direction shall be avoided at least within the conditions determined by the following equation. The compliance with this equation is required only for road users cutting in, and only if the inserting road users were visible at least 0,72 seconds before cut-in:

$$TTC \geq \frac{v_{rel}}{2a} + \frac{1}{2}\tau + \tau_{Reaction}$$

TTC	Time to-collision at the moment of the cut-in of the vehicle or cyclist by more than 30 cm in the lane of the vehicle equipped with an ADS	
$v_{rel}$	Relative velocity in meters per second [m/s]. Positive if the vehicle with ADS is driving towards a slower intruding vehicle.	
$\tau$	Time in seconds [s] to reach deceleration (a) in meters per square second [m/s <sup>2</sup> ].	Typical values are 0,5 s up to 10 m/s <sup>2</sup> . possible vehicle decelerations shall be scaled accordingly. Therefore, for 6 m/s <sup>2</sup> , this deceleration is assumed to be achieved in 0,3 seconds, 2.4 m/s <sup>2</sup> in 0,12 seconds.
$\tau_{Reaction}$	Time in seconds [s] necessary to initiate a brake response.	0,1 s

a	Deceleration in meters per square second [m/s <sup>2</sup> ]	2.4 m/s <sup>2</sup> for vehicles transporting standing or not fastened passengers; 6m/s <sup>2</sup> for other vehicles.
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This results in a required collision avoidance when another road user enters ego lane above the following TTC values (for example shown for speeds in 10 km/h steps). These requirements are to be met independently of environmental conditions and should be taken into account in the derivation of the existence criteria.

V <sub>TGL</sub> [km/h]	TTC <sub>LaneChange</sub> [s] for vehicles with standing passengers	TTC <sub>LaneChange</sub> [s] for other vehicles
10	0,74	0,48
20	1,32	0,71
30	1,9	0,94
40	2,47	1,18
50	3,05	1,41
60	3,63	1,64

If a lane change with a lower TTC is carried out to the lane of the vehicle with ADS, it can no longer be assumed that there will be no collision avoidance. (The control strategy of the system may change between collision avoidance and mitigation only by prioritizing braking over an unsuccessful alternative manoeuvre.)

- x.x.x. The ADS shall avoid a collision with an unobstructed crossing pedestrian in front of the vehicle. **[requirements to be adapted from R152]**
- x.x.x. If a crash can be safely avoided without causing another one, it shall be avoided.
- x.x.x. After the evasive manoeuvre the vehicle shall aim at resuming a stable motion.
- x.x.x. If the emergency manoeuvre results in the vehicle being at standstill, the signal to activate the hazard warning lights shall be generated. If the vehicle automatically drives off again, the signal to deactivate the hazard warning lights shall be generated automatically.
- x.x.x. The vehicle shall implement a logic signal indicating emergency braking as specified in UN Regulation No. 13-H.

**5. Fail safe strategy: System boundaries, failures, system performance degradation and minimum Risk Manoeuvre (MRM)**

- x.x The ADS shall detect ODD boundaries, ADS performance degradation at all times, in particular due failures or perception problems, and shall perform a minimum risk manoeuvre in case of the ODD boundaries are reached, or in case the ADS performances in accordance with this regulation cannot be guaranteed anymore.
- x.x. During the minimum risk manoeuvre the vehicle shall be slowed down and be brought to a minimal risk state taking into account surrounding traffic and road infrastructure activating the hazard warning lights and bringing the vehicle to a halt in the safest possible place.
- x.x. In case another vehicle crashed into the vehicle equipped with an ADS, the control strategy should bring the vehicle equipped with an ADS to a stop.
- x.x. If failures are affecting the braking or steering performance of the system, the manoeuvre shall be carried out with consideration for the remaining performance.

**6. Specific requirements regarding the Human Machine Interface (HMI)**

- x.x. The ADS shall:
  - x.x.x. indicate its status to passengers
  - x.x.x. shall provide passengers with the possibility to call a remote supervision centre in case of urgency through an acoustic and optic interface.
  - x.x.x. Shall provide an emergency button to allow passengers to stop the vehicle in case of emergency.

**7. Human supervision of the ADS**

- x.x. The ADS shall provide means for human supervision, e.g. the possibility for a remote supervision centre to give orders to the ADS to perform a specific manoeuvre in case of an unclear driving situation and to respond to request to passengers.
- x.x. The ADS shall provide means for a human supervision of what is happening inside the vehicle in case of transport of passengers.

**8. Functional and operational safety during the ADS lifecycle**

- x.x. The manufacturer shall demonstrate that an acceptable consideration of functional and operational safety for the automated driving system has been done during the design and development processes of the ADS and that the technical and operational measures put in place will guarantee that the ADS complies with the requirements of this Regulation and that the ADS was designed and developed to operate in such a way that it is free of unreasonable safety risks to passengers and other road users during the vehicle lifecycle (design, development, production, field operation, decommissioning).

- x.x. The manufacturer shall in particular take measures to :
- x.x.x.x Ensure that the ADS manages all traffic situations that may happen in the ODD.
- x.x.x. Ensure that the vehicle is able to detect and react safely to failures, perception problems.
- x.x.x. Minimize reasonably foreseeable misuse/confusion by passengers and other road users and tampering of the ADS.
- x.x.x. Manage the safety and continued compliance of the vehicles with automated driving function system over lifetime (wear and tear especially for sensors, new traffic scenarios, etc.).
- x.x.x. The ODS shall overall be free of unreasonable risks for the vehicle occupants or any other road users and shall ensure a higher level of safety than the level of safety of vehicles driven by persons (indicative target: 10<sup>-9</sup> fatality per hour of operation).

## **9. Specific requirements regarding Cybersecurity and Software-Updates**

- x.x. Cyber security and cyber security management system

The effectiveness of the system shall not be adversely affected by cyber-attacks, cyber threats and vulnerabilities. The effectiveness of the security measures shall be demonstrated by compliance with UN Regulation No. 155.

- x.x. Software update and software updates management system

If the system permits software updates, the effectiveness of the software update procedures and processes shall be demonstrated by compliance with UN Regulation No. 156.

- x.x. Requirements for software identification

- x.x.x. For the purpose of ensuring the software of the system can be identified, an R<sub>x</sub>SWIN may be implemented by the vehicle manufacturer. If R<sub>x</sub>SWIN is not implemented, an alternative software identification system (i.e. software version) shall be implemented.

- x.x.x. If the manufacturer implements an R<sub>x</sub>SWIN the following shall apply:

- x.x.x.x The vehicle manufacturer shall have a valid approval according to UN Regulation No. 156 (Software Update Regulation).

- x.x.x.x The vehicle manufacturer shall provide the following information in the attached to the information document of this Regulation:

- x.x.x.x.x The R<sub>x</sub>SWIN

How to read the R<sub>x</sub>SWIN or software version(s) in case the R15X7SWIN is not held on the vehicle

x.x.x.x. The vehicle manufacturer may provide in the communication form of this Regulation a list of the relevant parameters that will allow the identification of those vehicles that can be updated with the software represented by the RxSWIN. The information provided shall be declared by the vehicle manufacturer and may not be verified by an Approval Authority.

The vehicle manufacturer may obtain a new vehicle approval for the purpose of differentiating software versions intended to be used on vehicles already registered in the market from the software versions that are used on new vehicles. This may cover the situations where type approval regulations are updated or hardware changes are made to vehicles in series production. In agreement with the testing agency, duplication of tests shall be avoided where possible.

## **10. Specific requirements regarding data recorder for ADS**

x.x. Each vehicle equipped with an ADS shall be fitted with a data recorder that meets the requirements specified below.

x.x. Recorded occurrences

x.x.x. Each vehicle equipped with a data recorder shall at least record an entry for each of the following occurrences upon activation of the system:

x.x.x.x. Activation of the system

x.x.x.x. deactivation of the system

x.x.x.x. Start of Emergency Manoeuvre

x.x.x.x. End of Emergency Manoeuvre

x.x.x.x. Involved in a detected collision

x.x.x.x. Minimum Risk Manoeuvre engagement by the system

x.x.x.x. ADS failure

x.x. Data elements

x.x.x For each event listed in paragraph 8.2., the data recorder shall at least record the following data elements in a clearly identifiable way:

x.x.x.x The recorded occurrence flag

x.x.x.x Reason for the occurrence, as appropriate,

x.x.x.x Date (Resolution: yyyy/mm/dd);

- x.x.x.x     Timestamp:
- x.x.x.x     Resolution: hh/mm/ss timezone e.g. 12:59:59 UTC
- x.x.x.x     Accuracy: +/- 1.0 s.
- x.x.x.     For each Recorded occurrence, the RXSWIN, or the software versions, indicating the software that was present at the time when the event occurred, shall be clearly identifiable.
- x.x.x.     A single timestamp may be allowed for multiple elements recorded simultaneously within the timing resolution of the specific data elements. If more than one element is recorded with the same timestamp, the information from the individual elements shall indicate the chronological order.
- x.x.        Data availability
- x.x.x.     The data of the data recorder shall be available subject to requirements of national and regional law.<sup>1</sup>
- x.x.x.     Once the storage limits of the data recorder are achieved, existing data shall only be overwritten following a first in first out procedure with the principle of respecting the relevant requirements for data availability.  
  
Documented evidence regarding the storage capacity shall be provided by the vehicle manufacturer.
- x.x.x.     The data shall be retrievable even after an impact of a severity level set by UN Regulations Nos. 94, 95 or 137. If the main on-board vehicle power supply is not available, it shall still be possible to retrieve all data recorded on the data recorder.
- x.x.x.     Data stored in the data recorder shall be easily readable in a standardized way via the use of an electronic communication interface, at least through the standard interface (OBD port).
- x.x.x.     Instructions from the manufacturer shall be provided on how to access the data.
- x.x.        Protection against manipulation
- x.x.x.     It shall be ensured that there is adequate protection against manipulation (e.g. data erasure) of stored data such as anti-tampering design
- x.x.        Availability of the data recorder  
  
The data recorder shall be able to communicate with the ADS to inform that the data recorder is operational.

## 11. Provisions for safety during operation

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<sup>1</sup> Note: based on a recent quantitative study of a Contracting Party, GRVA is considering that the text specifies several timestamps specifications of 2500 timestamps to correspond with a period of 6 months of use.

- x.x The manufacturer shall provide the operator of the vehicle equipped with an ADS with the necessary technical and operational measures to be put in place to ensure safety during the vehicle operation:
- x.x.x The limits of the ODD (type of routes, manoeuvre capability, environmental limitation, etc.)
- x.x.x Special off board infrastructure needed for the safe operation of the ADS.
- x.x.x Special arrangement needed on the road infrastructure for the safe operation of the ADS
- x.x.x Special arrangements for the supervision and remote intervention needed for the safe operation of the ADS (e.g. to perform a specific manoeuvre in case of an unclear driving situation, training arrangement for the personnel of the remote supervision centre)
- x.x.x The maintenance plan required for the ADS
- x.x.x. Reporting obligations to competent authorities on the operation of the ADS.

## **12. Provisions for periodic roadworthiness tests**

- x.x. The manufacturer shall ensure the feasibility of periodic roadworthiness testing by taking appropriate measures (e.g.: manual driving, accessibility of brakes). In particular, it shall be able to be tested on brake test benches, it shall have light adjustment positions, etc. for all prescribed tests to be carried out.

## Annex III

### **Assessment and Tests**

Audit on functional and operational safety aspects of the Automated Driving System and tests are defined below to verify compliance with the performance requirements for ADS of Annex II. The overall compliance is based on the audit of the documentation provided by the manufacturer as well as tests performed by the type approval authority (or its technical service). Any requirement in Annex II may be checked by means of tests performed by the type approval authority (or its technical service).

#### **PART 1: Audit on functional and operational safety aspects of the Automated Driving System**

1. General
  - 1.1. The requirements of this part are intended to ensure that an acceptable thorough consideration of functional and operational safety for the automated driving system has been performed by the manufacturer during the design and development processes and will continue to be done throughout the vehicle type lifecycle (design, development, production, field operation, decommissioning).
  - 1.2.. The requirements cover the documentation which must be disclosed by the manufacturer to the type-approval authority or the technical Service acting on its behalf (hereafter referred as type-approval authority), for type approval purposes and verification to be carried out by the type-approval authority.
  - 1.3. This documentation shall demonstrate that the ADS meets the performance requirements specified in Annex II of this Regulation and that the system is designed and developed to operate in such a way that it is free of unreasonable safety risks to the driver, passengers and other road users.
  - 1.3. The type approval authority granting the approval shall verify through targeted spot checks and tests, in particular as specified in part 2 of this annex, that the argumentation provided by the documentation is strong enough and that the design and processes described in documentation are actually implemented by the manufacturer.
  - 1.4. While based on the provided documentation, evidence and the process audit/product assessment carried out to the satisfaction of the type approval authority in accordance with this Regulation, the residual level of risk of the assessed ADS is deemed to be acceptable for the entry into service of the vehicle type, the overall vehicle safety during the ADS lifetime in accordance with the requirements of this regulation remains the responsibility of the manufacturer requesting the type-approval.
2. Definitions
  - 2.1. "The system" or "automated driving system" means a "Higher-Level Electronic Control" system and its electronic control system(s) that provides the automated



driving function. This also includes any transmission links to or from other systems that are outside the scope of this Regulation that acts on the ADS.

- 2.2. "Safety Concept" is a description of the measures designed into the system, for example within the electronic units, so that the vehicle operates in such a way that it is free of unreasonable safety risks to the driver, passengers and other road users under faults and non-fault conditions. The possibility of a fall-back to partial operation or even to a back-up system for vital vehicle functions shall be a part of the safety concept.
- 2.3. "Electronic control system" means a combination of units, designed to co-operate in the production of the stated automated driving function by electronic data processing. Such systems, commonly controlled by software, are built from discrete functional components such as sensors, electronic control units and actuators and connected by transmission links. They may include mechanical, electro-pneumatic or electro-hydraulic elements.
- 2.4. "Higher-Level Electronic Control" systems are those which employ processing and/or sensing provisions to realize the dynamic driving task.
- 2.5. "Units" are the smallest divisions of system components which will be considered in this annex, since these combinations of components will be treated as single entities for purposes of identification, analysis or replacement.
- 2.6. "Transmission links" are the means used for inter-connecting distributed units for the purpose of conveying signals, operating data or an energy supply. This equipment is generally electrical but may, in some part, be mechanical, pneumatic or hydraulic.
- 2.7. "Range of control" refers to an output variable and defines the range over which the system is likely to exercise control.
- 2.8. "*Boundary of functional operation*" defines the boundaries of the external physical limits within which the system is able to perform the dynamic driving tasks (i.e. including the transition demands and minimum risk manoeuvres).
- 2.9. "*Operational Design Domain (ODD)*" of the automated driving system defines the specific operating conditions (e.g. environmental, geographic, time-of-day, traffic, infrastructure, speed range, weather and other conditions) within the boundaries fixed by this regulation under which the automated driving system is designed to operate without any intervention by the driver.
- 2.10. "*Automated Driving Function*" means a function of "The System" that is capable of performing the dynamic driving task of the vehicle.
- 2.12. "*Functional safety*": absence of unreasonable risks under the occurrence of hazards caused by a malfunctioning behaviour of electric/electronic systems (safety hazards resulting from system faults).
- 2.13. "*Fault*": abnormal condition that can cause an element (system, component, software) or an item (system or combination of systems that implement a function of a vehicles) to fail.
- 2.14. "*Failure*" means the termination of an intended behaviour of an element or an item.

- 2.15. *"Operational safety"* means the absence of unreasonable risk under the occurrence of hazards resulting from functional insufficiencies of the intended functionality (e.g. false/missed detection), operational disturbances (e.g. environmental conditions like fog, rain, shadows, sunlight, infrastructure) or by reasonably foreseeable misuse/errors by the driver, passengers and other road users (safety hazards — without system faults).
- 2.16. *"Unreasonable risk"* means the overall level of risk for the driver, vehicle occupants and other road users which is increased compared to a competently and carefully driven manual vehicle.

### 3. Documentation

#### 3.1. Requirements

The manufacturer shall provide a documentation package which gives access to the basic design of "The System" and the means by which it is linked to other vehicle systems or by which it directly controls output variables.

The function(s) of "The System", including the control strategies, and the safety concept, as laid down by the manufacturer, shall be explained.

Documentation shall be brief, yet provide evidence that the design and development has had the benefit of expertise from all the system fields which are involved.

For periodic technical inspections, the documentation shall describe how the current operational status of "The System" can be checked.

Information about how the software version(s) and the failure warning signal status can be readable in a standardized way via the use of an electronic communication interface, at least be the standard interface (OBD port).

The Type-approval authority shall assess the documentation package to show that "The System":

- (a) Is designed and was developed to operate in such a way that it is free from unreasonable risks for the driver, passengers and other road users within the declared ODD and boundaries;
- (b) Respects, under the performance requirements specified elsewhere in this Regulation;
- (c) Was developed according to the development process/method declared by the manufacturer and that this includes at least the steps listed in paragraph 3.4.4.

##### 3.1.1. Documentation shall be made available in three parts:

- (a) Application for type approval: The information document which is submitted to the type approval authority at the time of type approval application shall contain brief information on the items listed **in Appendix 1 to Annex 1**. It will become part of the approval.

(b) The formal documentation package for the approval, containing the material listed in this paragraph 3. (with the exception of that of paragraph 3.4.4.) which shall be supplied to the Type Approval Authority for the purpose of conducting the product assessment / process audit. This documentation package shall be used by the Type Approval Authority as the basic reference for the verification process set out in paragraph 4. of this annex. The Type Approval Authority shall ensure that this documentation package remains available for a period determined of at least 10 years counted from the time when production of the vehicle type is definitely discontinued.

(c) Additional confidential material and analysis data (intellectual property) of paragraph 3.4.4. which shall be retained by the manufacturer, but made open for inspection (e.g. on-site in the engineering facilities of the manufacturer) at the time of the product assessment / process audit. The manufacturer shall ensure that this material and analysis data remains available for a period of 10 years counted from the time when production of the vehicle type is definitely discontinued.

### 3.2. Description of the functions of "The System" including control strategies

A description shall be provided which gives a simple explanation of all the functions including control strategies of "The System" and the methods employed to perform the dynamic driving tasks within the ODD and the boundaries under which the automated driving system is designed to operate, including a statement of the mechanism(s) by which control is exercised. The manufacturer shall describe the interactions expected between the system and the driver, vehicle occupants and other road users as well as Human-Machine-Interface (HMI).

Any enabled or disabled automated driving functions for which the hardware and software are present in the vehicle at the time of production, shall be declared and are subject to the requirements of this annex, prior to their use in the vehicle. The manufacturer shall also document the data processing in case of continuous learning algorithms are implemented.

- 3.2.1. A list of all input and sensed variables shall be provided and the working range of these defined, along with a description of how each variable affects system behaviour.
- 3.2.2. A list of all output variables which are controlled by "The System" shall be provided and an explanation given, in each case, of whether the control is direct or via another vehicle system. The range of control (paragraph 2.7.) exercised on each such variable shall be defined.
- 3.2.3. Limits defining the boundaries of functional operation including ODD-limits shall be stated where appropriate to automated driving system performance.
- 3.2.4. Interaction concept with the driver when ODD limits are reached shall be explained including the list of types of situations in which the system will generate a transition demand to the driver.
- 3.2.5. Information shall be provided about the means to activate, override or deactivate the system including the strategy how the system is protected against unintentional deactivation. This shall also include information about how the system detects that the driver is available to take over driving control along with specification and

documented evidence of the used parameter to identify driver attentiveness as well as the influence on the steering thresholds.

### 3.3. System layout and schematics

#### 3.3.1. Inventory of components.

A list shall be provided, collating all the units of "The System" and mentioning the other vehicle systems which are needed to achieve the control function in question.

An outline schematic showing these units in combination, shall be provided with both the equipment distribution and the interconnections made clear.

This outline shall include:

- (a) Perception and objects detection including mapping and positioning
- (b) Characterization of Decision-making
- (c) Remote supervision and remote monitoring by a remote supervision centre (if applicable).
- (d) The data storage system (DSSAD).

#### 3.3.2. Functions of the units

The function of each unit of "The System" shall be outlined and the signals linking it with other units or with other vehicle systems shall be shown. This may be provided by a labelled block diagram or other schematic, or by a description aided by such a diagram.

#### 3.3.3. Interconnections within "The System" shall be shown by a circuit diagram for the electric transmission links, by a piping diagram for pneumatic or hydraulic transmission equipment and by a simplified diagrammatic layout for mechanical linkages. The transmission links both to and from other systems shall also be shown.

#### 3.3.4. There shall be a clear correspondence between transmission links and the signals carried between Units. Priorities of signals on multiplexed data paths shall be stated wherever priority may be an issue affecting performance or safety.

#### 3.3.5. Identification of units

Each unit shall be clearly and unambiguously identifiable (e.g. by marking for hardware, and by marking or software output for software content) to provide corresponding hardware and documentation association. Where software version can be changed without requiring replacement of the marking or component, the software identification must be by software output only.

Where functions are combined within a single unit or indeed within a single computer, but shown in multiple blocks in the block diagram for clarity and ease of

explanation, only a single hardware identification marking shall be used. The manufacturer shall, by the use of this identification, affirm that the equipment supplied conforms to the corresponding document.

3.3.5.1. The identification defines the hardware and software version and, where the latter changes such as to alter the function of the unit as far as this Regulation is concerned, this identification shall also be changed.

3.3.6. Installation of sensing system components

The manufacturer shall provide information regarding the installation options that will be employed for the individual components that comprise the sensing system. These options shall include, but are not limited to, the location of the component in/on the vehicle, the material(s) surrounding the component, the dimensioning and geometry of the material surrounding the component, and the surface finish of the materials surrounding the component, once installed in the vehicle. The information shall also include installation specifications that are critical to the system's performance, e.g. tolerances on installation angle.

Changes to the individual components of the sensing system, or the installation options, shall be notified to the Type Approval Authority and be subject to further assessment.

3.4. Safety concept of the manufacturer

3.4.1. The manufacturer shall provide a statement which affirms that the "The System" is free from unreasonable risks for the driver, passengers and other road users.

3.4.2. In respect of software employed in "The System", the outline architecture shall be explained and the design methods and tools used shall be identified (see 3.5.1). The manufacturer shall show evidence of the means by which they determined the realization of the system logic, during the design and development process.

3.4.3. The manufacturer shall provide the Type Approval Authority with an explanation of the design provisions built into "The System" so as to ensure functional and operational safety. Possible design provisions in "The System" are for example:

- (a) Fall-back to operation using a partial system.
- (b) Redundancy with a separate system.
- (c) Removal of the automated driving function(s).

3.4.3.1. If the chosen provision selects a partial performance mode of operation under certain fault conditions (e.g. in case of severe failures), then these conditions shall be stated (e.g. type of severe failure) and the resulting limits of effectiveness defined (e.g. initiation of a minimum risk manoeuvre immediately) as well as the warning strategy to the driver.

3.4.3.2. If the chosen provision selects a second (back-up) means to realise the performance of the dynamic driving task, the principles of the change-over mechanism, the logic and level of redundancy and any built in back-up checking features shall be

explained and the resulting limits of back-up effectiveness defined.

3.4.3.3. If the chosen provision selects the removal of the automated driving function, this shall be done in compliance with the relevant provisions of this regulation. All the corresponding output control signals associated with this function shall be inhibited.

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, testing with real end users, or any other testing appropriate for validation/verification. Results of validation and verification may be assessed by analysing coverage of the different tests and setting coverage minimal thresholds for various metrics.

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

(i) Issues linked to interactions with other vehicle systems (e.g. braking, steering);

(ii) Failures of the automated driving system and system risk mitigation reactions;

(iii) Situations within the ODD when a system may create unreasonable safety risks for the driver, passengers and other road users due to operational disturbances (e.g. lack of or wrong comprehension of the vehicle environment, lack of understanding of the reaction from the driver, passenger or other road users, inadequate control, challenging scenarios)

(iv) Identification of the relevant scenarios within the boundary conditions and management method used to select scenarios and validation tool chosen.

(v) Decision making process resulting in the performance of the dynamic driving tasks (e.g. emergency manoeuvres), for the interaction with other road users and in compliance with traffic rules

(vi) Reasonably foreseeable misuse by the driver (e.g. driver availability recognition system and an explanation on how the availability criteria were established), mistakes or misunderstanding by the driver (e.g. unintentional override) and intentional tampering of the system.

(viii) Cyber-attacks having an impact on the safety of the vehicle (can be done through the analysis done under the UN Regulation No 157 on Cyber Security and Cyber Security Management System).

The assessment by the approval authority shall consist of spot checks of selected hazards (or cyber threats) to establish that argumentation supporting the safety concept is understandable and logical and implemented in the different functions of the systems. The assessment shall also check that validation plans are robust enough to demonstrate safety (e.g. reasonable coverage of chosen scenarios testing by the validation tool chosen) and have been completed.

It shall demonstrate that the vehicle is free from unreasonable risks for the driver; vehicle occupants and other road users in the operational design domain, i.e. through:

(a) an overall validation target (i.e., validation acceptance criteria) supported by validation results, demonstrating that the entry into service of the automated driving system will overall not increase the level of risk for the driver, vehicle occupants, and other road users compared to a manually driven vehicles; and

(b) A scenario specific approach showing that the system will overall not increase the level of risk for the driver, passengers and other road users compared to a manually driven vehicles for each of the safety relevant scenarios; and

The Type Approval Authority shall perform or shall require performing tests as specified in paragraph 4. to verify the safety concept.

3.4.4.1. This documentation shall itemize the parameters being monitored and shall set out, for each failure condition of the type defined in paragraph 3.4.4. of this annex, the warning signal to be given to the driver/vehicle occupants/other road users and/or to service/technical inspection personnel.

3.4.4.2. This documentation shall also describe the measures in place to ensure the "The System" is free from unreasonable risks for the driver, vehicle occupants, and other road users when the performance of "The System" is affected by environmental conditions e.g. climatic, temperature, dust ingress, water ingress, ice packing.

3.5. Safety management system (Process Audit)

3.5.1. In respect of software and hardware employed in "The System", the manufacturer shall demonstrate to the type approval authority in terms of a safety management system that effective processes, methodologies and tools are in place, up to date

and being followed within the organization to manage the safety and continued compliance throughout the product lifecycle (design, development, production, operation including respect of traffic rules, and decommissioning).

- 3.5.2. The design and development process shall be established including safety management system, requirements management, requirements' implementation, testing, failure tracking, remedy and release
- 3.5.3. The manufacturer shall institute and maintain effective communication channels between manufacturer departments responsible for functional/operational safety, cybersecurity and any other relevant disciplines related to the achievement of vehicle safety.
- 3.5.4. The manufacturer shall have processes to monitor safety-relevant incidents/crashes/collisions caused by the engaged automated driving system and a process to manage potential safety-relevant gaps post-registration (closed loop of field monitoring) and to update the vehicles. They shall report critical incidents (e.g. collision with another road users and potential safety-relevant gaps) to the type-approval authorities when critical incidents.
- 3.5.5. The manufacturer shall demonstrate that periodic independent internal process audits are carried out to ensure that the processes established in accordance with paragraphs 3.5.1 to 3.5.4. are implemented consistently.
- 3.5.6. Manufacturers shall put in place suitable arrangements (e.g. contractual arrangements, clear interfaces, quality management system) with suppliers to ensure that the supplier safety management system comply with the requirements of paragraphs 3.5.1. (except for vehicle related aspects like "operation" and "decommissioning"), 3.5.2, 3.5.3 and 3.5.5.

#### 4. Verification and tests

Taking into account the results of the analysis of the manufacturer's documentation package referred to in paragraph 3, the Type Approval Authority shall request the tests to be performed or witnessed by the Technical Service to check specific points arisen from the assessment of the function and the safety concept of the manufacturer.

- 4.1. The functional operation of "The System", as laid out in the documents required in paragraph 3., shall be tested as follows:
  - 4.1.1. Verification of the function of "The System"

The Type approval authority shall verify "The System" under non-failure conditions by testing on a track a number of selected functions from those described by the manufacturer in paragraph 3.2. above, and by checking the overall behaviour of the system in real driving conditions including the compliance with traffic rules.

These tests shall include scenarios whereby the system is overridden by the supervision centre.

These tests can be based on scenarios listed in Part 2 and/or on additional scenarios not covered by part 2.



4.1.1.1. The test results shall correspond with the description, including the control strategies, provided by the manufacturer in paragraph 3.2. and shall comply with the performance requirements of this regulation.

4.1.2. Verification of the safety concept of paragraph 3.4.

The reaction of "The System" shall be checked under the influence of a faults in any individual unit by applying corresponding output signals to electrical units or mechanical elements in order to simulate the effects of internal failure within the unit. The Type approval authority shall conduct this check for at least one individual unit, but shall not check the reaction of "The System" to multiple simultaneous failures of individual units.

The Type Approval Authority shall verify that these tests include aspects that may have an impact on vehicle controllability and user information (HMI aspects e.g. transition scenarios).

4.1.2.1. The Type Approval Authorities shall also check a number of scenarios that are critical for the Object and Event Detection and Response (OEDR) and characterization of the decision-making and HMI functions of the system (e.g. object difficult to detect, when the system reaches the ODD boundaries, traffic disturbance scenarios) as defined in the regulation.

4.1.2.2. The verification results shall correspond with the documented summary of the hazard analysis, to a level of overall effect such that the safety concept and execution are confirmed as being adequate and in compliance with the requirements of this regulation.

4.2. Simulation tool and mathematical models for verification of the safety concept may be used in accordance with Annex VIII to Regulation (EU) 858/2018 8, in particular for scenarios that are difficult on a test track or in real driving conditions. Manufacturers shall demonstrate the scope of the simulation tool, its validity for the scenario concerned as well as the validation performed for the simulation tool chain (correlation of the outcome with physical tests). Simulation shall not be a substitute for physical tests in Part 2 of this Annex.

4.3 Taking into account the results of the analysis of the manufacturer's documentation package referred to in paragraph 3, the Type Approval Authority shall audit specific points from the management system of the manufacturer..

5. Reporting

Reporting of the assessment the vehicle functional operation and safety concept of the ADS as well as the audit of the safety management system of the manufacturer shall be performed in such a manner that allows traceability, e.g. versions of documents inspected are coded and listed in the records of the Technical Service.

An example of a possible layout for the assessment form of the assessment the vehicle functional operation and safety concept of the ADS from the Technical Service to the Type Approval Authority is given in Appendix 1 to this Annex. The listed items in this Appendix are outlined as minimum set of items which need to be covered. **[Layout for the safety management??]**

## 7. Competence of the auditors/assessors

The assessments under this Annex shall only be conducted by auditors/assessors with the technical and administrative knowledge necessary for such purposes. They shall in particular be competent as auditor/assessor for ISO 26262-2018 (Functional Safety - Road Vehicles), and ISO/PAS 21448 (Safety of the Intended Functionality of road vehicles); and shall be able to make the necessary link with cybersecurity aspects in accordance with UN Regulation No 157 and ISO/SAE 21434). This competence should be demonstrated by appropriate qualifications or other equivalent training records.

DRAFT

## Appendix

### Model assessment form for Automated Driving system

Test report No:

1. Identification.
  - 1.1. Vehicle make:
  - 1.2. Type
  - 1.3. Means of identification of type if marked on the vehicle:
  - 1.4. Location of that marking:
  - 1.5. Manufacturer's name and address:
  - 1.6. If applicable, name and address of manufacturer's representative:
  - 1.7. Manufacturer's formal documentation package:

Documentation reference No:

Date of original issue:

Date of latest update:

2. Test vehicle(s)/system(s) description
  - 2.1. General description:
  - 2.2. Description of all the control functions of "The System", and methods of operation:
  - 2.3. Description of the components and diagrams of the interconnections within "The System":
  - 2.4. General description:
  - 2.5. Description of all the control functions of "The System", and methods of operation:
  - 2.6. Description of the components and diagrams of the interconnections within "The System"
3. Manufacturer's safety concept

- 3.1. Description of signal flow and operating data and their priorities:
- 3.2. Manufacturer's declaration:
- The manufacturer(s) ..... affirm(s) that the strategy chosen to achieve "The System" is free of unreasonable safety risks to the driver, passengers and other road users.*
- 3.3. Software outline architecture and the design methods and tools used:
- 3.4. Explanation of design provisions built into "The System" under fault conditions:
- 3.5. Documented analyses of the behaviour of "The System" under individual hazard or fault conditions:
- 3.6. Description of the measures in place for environmental conditions:
- 3.7. Provisions for the periodic roadworthiness test of "The System":
- 3.8. Results of "The System" verification test, referred to in point 4.1.1. of Annex III Part I to Regulation (EU) .../...<sup>(1)</sup> [PO: this Regulation].
- 3.9. Results of safety concept verification test, referred to in point 4.1.2. of Annex III Part I to Regulation (EU) .../...<sup>(1)</sup> [PO: this Regulation].
- 3.10. Results of the audit of the Safety management system (appended to this test report)
- 3.11. Date of assessment/audit
- 3.12. This test has been carried out and the results reported in accordance with Commission Implementing Regulation (EU) .../...<sup>(1)</sup> [PO: this Regulation], as last amended by Regulation (EU) ... /....
- Technical Service carrying out the test  
 Signed: ..... Date: .....
- 3.13. Comments:

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<sup>(1)</sup> [PO: insert full title and OJ reference.]

## PART 2: Tests

### 1. General provisions

Test cases created to assess vehicle safety shall be based on the requirements set out in Annex II. The requirements are defined in such a way that the pass/fail criteria can be derived not only for a specific set of test parameters, but also for all safety-relevant combinations of parameters that may occur in the operating conditions covered by the type approval and the specified operating range (examples: Speed range, longitudinal and transverse acceleration range, radii of curvature, brightness, number of lanes).

These tests shall confirm the functionality of the system and the safety concept of the manufacturer as described in part I of this Annex as well as the minimum performance requirements described in Annex II.

### 2 Test site

The test site shall have its characteristics (example: friction value) that correspond to the specified ODD of the ADS. The intended operational area may act as a test site itself provided that tests can be carried out safely in accordance with the applicable law of the Member State granting the approval.

### 3. Environmental conditions

Tests shall be carried out under different environmental conditions, within the limits of the defined ODD for the ADS. For environmental conditions not tested that may occur within the defined operating range of the vehicle, the vehicle manufacturer shall demonstrate as part of the audit in Part I to the satisfaction of the technical service that the vehicle is safely controlled.

In order to test the requirements for failure of functions, self-testing of the system and initiation and implementation of a manoeuvre to reach a risk imminent condition, errors may be artificially induced and the vehicle may be artificially brought into situations when operating autonomously and exposed to environmental conditions where it reaches the limits of the defined operating range.

### 4. System modifications for testing purposes

If ADS modifications are required in order to allow testing, e.g. road type assessment criteria or road type information (map data), it shall be ensured that these modifications don't have an effect on the test results. These modifications shall in principle be documented and annexed to the test report. The description and the evidence of influence (if any) of these modifications shall be documented and annexed to the test report.

### 5. Subject vehicle conditions

#### 5.1. Test mass

The subject vehicle shall be tested in a load condition agreed between the manufacturer and the Technical Service. No load alteration shall be made once the test procedure has begun. The vehicle manufacturer shall demonstrate, through the

use of documentation, that the system works at all load conditions.

5.2. The subject vehicle shall be tested at the tyre pressure recommended by the vehicle manufacturer.

6. Test tools

In addition to real vehicles, state-of-the-art test tools may be used to carry out the tests, replacing real vehicles and other road users (examples: Soft targets, walk-to-foot attachments, mobile platforms). The replacement test tools shall comply with the characteristics relevant for sensory performance assessment, real vehicles and other traffic participants. Tests must not be carried out in such a way as to endanger experimental personnel.

7 Test parameter variation

As part of the type-approval tests and the verification of compliance with the requirements of the approval, tests may be designed as necessary and the number of tests may be increased as long as they remain within the limits of the defined range of operation of the vehicle to be tested. The vehicle manufacturer shall define the test cases and justify to the technical service why the selected test cases provide sufficient test coverage for all scenarios, test parameters and environmental influences. Adequate robustness of the perceptions systems for the autonomous driving function against input/sensor data malfunction and adverse environmental conditions shall be demonstrated.

8. Tests scenarios to assess the performance of the system with regard to the dynamic driving task.

The scenarios included in the following paragraphs have to be considered a minimum set of conditions under which the vehicle shall be tested. Under the request of the relevant authority, additional scenarios in the ODD of the ADS representative of situations that the vehicle might be reasonably confronted with can be executed.

Depending on the intended operating range (corresponding to an Operational Design Domain (ODD)), test scenarios shall be selected as part of the type test. The selection shall be made on the basis of a **scenario catalogue drawn up by the manufacturer in consultation with the technical service**. Type testing may be carried out on the basis of simulations, manoeuvres on the test track and driving tests on real road traffic. However, it may not be based solely on computer simulations.

8.1. Lane keeping

The test shall demonstrate that the vehicle with automated driving function does not leave its lane and maintains a stable motion inside its lane across the speed range and different curvatures within its system boundaries.

8.1.1 The test shall be executed at least:

- a) With a minimum test duration of 5 minutes;
- b) With a passenger car target as well as a Power Two Wheeler target as the

- other vehicle;
- c) With a lead vehicle swerving in the lane; and
- d) With another vehicle driving close beside in the adjacent lane.

## 8.2. Lane changing manoeuvre (LCM)

The test shall demonstrate that the vehicles with automated driving function does not cause an unreasonable risk to safety of the vehicle occupants and other road users during a Lane Change Procedure, and that the system is able to assess the criticality of the situation before starting the Lane Change Manoeuvre (LCM) throughout the entire operational speed range. These tests are only required if the vehicle with automated driving function is capable of performing lane changes either during a Minimal Risk Manoeuvre or during regular operation.

### 8.2.1. The following tests shall be executed:

- a) With vehicle with automated driving function performing lane change in the adjacent (target) lane;
- b) Merging at lane end;
- c) Merging into an occupied lane.

### 8.2.2. The tests shall be executed at least:

- a) With different vehicles, including a PTW approaching from the rear;
- b) In a scenario where a lane changing manoeuvre in regular operation is possible to be executed;
- c) In a scenario where a lane changing manoeuvre in regular operation is not possible due to a vehicle approaching from the rear;
- d) With an equally fast vehicle following behind in the adjacent lane, preventing a lane change;
- e) With a vehicle driving beside in the adjacent lane preventing a lane change;
- f) In a scenario where a LCM during a minimal risk manoeuvre is possible and executed.
- g) In a scenario where a LCM shall be terminated due to a sudden change in the surrounding conditions, such as, for example, an approaching vehicle in the target lane suddenly accelerating, or a leading vehicle in the target lane suddenly decelerating, or the lane change of another vehicle or another road user into the target lane before the LCM is terminated.

## 8.3. Detect and response to different road geometries

These tests shall ensure, that vehicle with automated driving function detects and adapts to a variation of different road geometries present in the urban environment across its whole speed range.

### 8.3.1. The test shall be executed at least with the list of scenarios below, but based on the ODD of the given system:

- a) T-junctions (3-way intersections) with and without traffic lights, with different rights of way.
- b) Crossroads (4 or more way intersections) with and without traffic lights, with different rights of way.

c) Roundabouts.

8.3.2. Each test shall be executed at least:

- a) Without a lead vehicle;
- b) With a passenger car target as well as a PTW target as the lead vehicle / other vehicle.
- d) Without and with incoming vehicles.

8.4. Detect and response to traffic rules and road furniture

These tests shall ensure that the vehicle with automated driving function respects traffic rules, detects and adapts to a variation of permanent and temporary road furniture in the entire speed range.

8.4.1. The test shall be executed at least with the list of scenarios below, but based on the ODD of the given system:

- a) Different speed limit signs, so that the system has to change its speed according to the indicated values;
- b) Signal lights and/or human traffic controller with situations of going straight, turning left and right;
- c) Pedestrian crossings with and without pedestrians approaching / on the road.
- d) Temporary modifications: e.g., road maintenance operations indicated by traffic signs, cones and other signalization, access restrictions.

8.4.2. Each test shall be executed at least:

- a) Without a lead vehicle;
- e) With a passenger car target as well as a PTW target as the lead vehicle / other vehicle.

8.5. Avoid a collision with a road user or object blocking the lane

The test shall demonstrate that the vehicle with automated driving function avoids a collision with a stationary vehicle, road user or fully or partially blocked lane up to the maximum specified speed of the system.

8.5.1. This test shall be executed at least:

- a) With a stationary passenger car target;
- b) With a stationary powered two-wheeler target;
- c) With a stationary pedestrian target;
- d) With a pedestrian target crossing the lane with a speed of [5] km/h, also in the presence of other objects (e.g. a ball, a shopping bag, etc.);
- e) With a pedestrian target moving within and partially occupying the lane of the ADS and following the same or the opposite direction of the ADS with a speed of up to [10] km/h;
- f) With a pedestrian target swerving in the same lane of the ADS;
- g) With a target representing a blocked lane;
- h) With a target partially within the lane;
- i) With one or more different types of unpassable objects (e.g. a dustbin, a



fallen bicycle or scooter, a fallen traffic sign, a stationary or moving ball, etc.)

- j) With multiple consecutive obstacles blocking the lane (e.g. in the following order: ego-vehicle -motorcycle - car);
- k) On a curved section of road.

8.6. Avoid unnecessarily braking and maintain a stable motion with a passable object in the lane

- l) The test shall demonstrate that vehicle with automated driving function is not braking without a reason and is able to maintain a stable motion in the presence of a passable object in the lane (e.g., a manhole lid or a small branch) up to the maximum specified speed of the system.

8.6.1. The test shall be executed at least:

- a) Without a lead vehicle;
- b) With a passenger car target as well as a PTW target as the lead vehicle / other vehicle.

8.7. Following a lead vehicle

The test shall demonstrate that the vehicle with automated driving function is able to maintain and restore a stable motion and the required safety distance to a vehicle in front and is able to avoid a collision with a lead vehicle which decelerates up to its maximum deceleration.

8.7.1. This test shall be executed at least:

- a) Across the entire speed range of the vehicle with automated driving function;
- b) Using a passenger car target as well as a PTW target as lead vehicle, provided standardized PTW targets suitable to safely perform the test are available;
- c) For constant and varying lead vehicle velocities (e.g. following a realistic speed profile from existing driving database);
- d) For straight and curved sections of road;
- e) For different lateral positions of lead vehicle in the lane;
- f) With a deceleration of the lead vehicle of at least 6 m/s<sup>2</sup> mean fully developed deceleration until standstill.

8.8. Lane change of another vehicle into lane (cut-in)

The test shall demonstrate that the vehicle with automated driving function is capable of avoiding a collision with a vehicle cutting into the lane of the vehicles with automated driving function Shuttle vehicle up to a certain criticality of the cut-in manoeuvre.

8.8.1. The criticality of the cut-in manoeuvre shall be determined according to the provisions introduced in paragraph x.x.x. and depending on the distance between the rear-most point of the cutting in vehicle and front-most point of the vehicle with automated driving function, the lateral velocity of the cutting-in vehicle and the longitudinal movement of the cutting-in vehicle, as defined in paragraph

X.Y.Z. of this Regulation.

8.8.2. This test shall be executed taking into consideration at least the following conditions:

- a) For different TTC, distance and relative velocity values of the cut-in manoeuvre, covering types of cut-in scenarios in which a collision can be avoided and those in which a collision cannot be avoided;
- b) For cutting-in vehicles travelling at constant longitudinal speed, accelerating and decelerating;
- c) For different lateral velocities, lateral accelerations of the cut-in vehicle;
- d) For passenger car as well as PTW targets as the cutting-in vehicle, provided standardized PTW targets suitable to safely perform the test are available.

8.9. Stationary obstacle after lane change of the lead vehicle (cut-out)

The test shall demonstrate that the vehicle with automated driving function is capable of avoiding a collision with a stationary vehicle, road user or blocked lane that becomes visible after a preceding vehicle avoided a collision by an evasive manoeuvre.

8.9.1. The test shall be executed at least:

- a) With a stationary passenger car target centred in lane;
- b) With a powered two-wheeler target centred in lane;
- c) With a stationary pedestrian target centred in lane;
- d) With a target representing a blocked lane centred in lane;
- e) With multiple consecutive obstacles blocking the lane (e.g. in the following order: ego-vehicle – lane change vehicle – motorcycle – car).

8.10. Field of view test

The test shall demonstrate that the vehicle with automated driving function is capable of detecting another road user within the forward detection area up to the declared forward detection range and a vehicle beside within the lateral detection area up to at least the full width of the adjacent lane. If the vehicle with automated driving function is capable of performing lane changes, it shall additionally demonstrate that the system is capable of detecting another vehicle within the rear detection range.

8.10.1. The test for the forward detection range shall be executed at least:

- a) When approaching a motorcycle target positioned at the outer edge of each adjacent lane;
- b) When approaching a stationary pedestrian target positioned at the outer edge of each adjacent lane;
- c) When approaching a stationary motorcycle target positioned within the ego lane;
- d) When approaching a stationary pedestrian target positioned within the ego lane.

8.10.2. The test for the lateral detection range shall be executed at least:

- a) With a motorcycle target approaching the vehicle with automated driving function from the left adjacent lane;
- b) With a motorcycle target approaching the vehicle with automated driving function from the right adjacent lane.

8.10.3. The test for the rear detection range shall be executed at least:

- a. With a motorcycle approaching the vehicle with automated driving function from the rear outer edge of each adjacent lane;
- b. With a motorcycle target approaching the vehicle with automated driving function from the right adjacent lane.

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## ANNEX IV

### EU TYPE-APPROVAL CERTIFICATE (VEHICLE SYSTEM)

Communication concerning *granting / extension / refusal / withdrawal* <sup>(1)</sup> of type-approval of a type of vehicle with regard to its emergency lane-keeping system in accordance with the requirements laid down in Commission Implementing Regulation (EU) .../...<sup>(2)</sup> [*PO: this Regulation*], as last amended by Regulation (EU) No .../...

Number of the EU type-approval certificate:

Reason for *extension / refusal / withdrawal* <sup>(1)</sup>:

#### SECTION I

- 0.1. Make (trade name of manufacturer):
- 0.2. Type:
  - 0.2.1. Commercial name(s) (if available):
- 0.3. Means of identification of type, if marked on the vehicle:
  - 0.3.1. Location of that marking:
- 0.4. Category of vehicle:
- 0.5. Name and address of manufacturer:
- 0.8. Name(s) and address(es) of assembly plant(s):
- 0.9. Name and address of the manufacturer's representative (if any):

#### SECTION II

1. Additional information (where applicable): see Addendum.
2. Technical service responsible for carrying out the tests:
3. Date of test report:
4. Number of test report:
5. Remarks (if any): see Addendum.
6. Place:
7. Date:
8. Signature:

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<sup>(1)</sup> Delete where not applicable.

(<sup>2</sup>) [PO: insert full title and OJ reference.]

***Addendum***  
**to EU type-approval certificate number**

6. Description and/or drawing of the ads including:
  - 6.1. Specified maximum speed of the ADS declared by the manufacturer:
  - 6.2. Sensing system (incl. components):
  - 6.3. Installation of the ADS sensing system:
  - 6.4. Software Identification of the ADS(if applicable):
7. Written description and/or drawing of the ADS Human supervision system
  - 7.1. Remote supervision and remote monitoring by a remote supervision centre
  - 7.2. Means to activate, deactivate and override the system
  - 7.3. Monitoring in the inside of the vehicle
  - 7.4. Any system limitations due to environmental or road conditions
8. Written description and/or drawing of the information given to passengers and other road users
  - 8.1. System status:
  - 8.2. Transition demand:
  - 8.3. Minimum Risk Manoeuvre:
  - 8.4. Emergency Manoeuvre:
9. Data Storage System for Automated Driving (DSSAD):
  - 9.1. DSSAD performance verified after the tests performed according to Annex 5:
  - 9.2. DSSAD documentation concerning data retrievability, data integrity self-check and protection against manipulation of stored data verified: yes/no
10. Cyber Security and Software updates
  - 10.1. Cyber Security Type Approval Number (if applicable):
  - 10.2. Software Update Type approval number (if applicable):
11. Assessment of the functionality of the automated driving system and the safety concept of the ADS as well as audit of the safety management system of the manufacturer (Annex III-)
12. Annexes

Addendum 1: Information document for automated driving systems (refer to Annex I-Appendix 1 of Regulation XX).”

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