Submitted by the 'task force on testing' lead by JRC/EC

UNR157-10-09

Proposal for amendments to

ECE/TRANS/WP.29/2020/81

The text reproduced below was prepared by the experts from the EC. The proposal is aimed at modifying the text of document ECE/TRANS/WP.29/2020/81 (Regulation 157 on ALKS). This document proposes a new annex (Annex 6) to amend Regulation 157, although it contains Section 5.4 in Annex 5 from the original text, which is given without highlighting. All modifications to ECE/TRANS/WP.29/2020/81 are given in **blue** text.

General comments:

1. *It was suggested to discuss on reference to Technical service vs Type Approval Authority;*
2. *It was suggested to discuss the opportunity to use other terms than ALKS (e.g. ALKS+(LC), highway chauffeur etc.) to refer to the new system with lane change capabilities;*

Pending items:

- *Discuss wording for defining the purpose of public road testing;*
- *Discuss the updated list of scenarios to be covered and whether they should be mandatory or recommended;*
- *Discuss requirements for minimum test duration;*
- *Finalize section 7.3 on test duration with input form industry.*

I. Proposal

Annex 6, amend to read:

Specification for public road testing of ADSs

1. Introduction

This annex defines **public road** tests on ALKS. The purpose of this test is to **assess the behaviour** of the system, in a fault-free condition, in its operating environment and to complement the assessment of the documentation provided under Annex 4. **The test parameters covered in the test shall be recorded in the test report in such a manner that allows traceability.**

Together, the assessment of Annex 4 and the **public road** test shall enable the **approval authority** to identify areas of system performance that may require further assessment, either through testing or further review of Annex 4.

Pass- and Fail-Criteria for tests are derived solely from the technical requirements in paragraphs 5 to 7 of the Regulation. These requirements are worded in a way that they allow the derivation of pass-fail-criteria but for any combination of parameters in which the system is designed to work (e.g. operating speed range, operating lateral acceleration range, curvature range as contained in the system boundaries).

The **scenarios specified** in this document **shall be intended as** a minimum**.** The **approval authorities** may perform **additional** test**s** within the system **ODD** and compare the measured results against the requirements.

The **public road** test **shall be** undertaken once the system has passed the tests **under the provisions** outlined **in paragraphs 3 to 4.11 and paragraph 5 to Annex 5** and upon completion of a risk assessment by the **approval authority**.

2. **Definitions**

for the purposes of this Annex

2.1. ***"Emergency operation"*** **means the operation outside the operational limits specified by the manufacturer, when safety systems come into action in order to prevent or mitigate possible damage.**

2.2. ***"Normal operation"*** **means the operation within specified operational limits and conditions to perform the designed activity, including actions to ensure that the system stays within its operational limits.**

2.3. **"*Dense traffic conditions*" means that ADS operations have the main objective to maintain a safe distance from the surrounding vehicles. In this case the average speed shall be greater than or equal to 15 km/h and lower than or equal to [55] km/h.**

2.4. **"*Free flow traffic conditions*" means that ADS operations are not heavily affected on a continuous basis by the behaviour of the surrounding vehicles. In this case the average speed shall be greater than to [90] km/h and lower than or equal to either the system maximum speed or the road maximum allowed, whichever lowest.**

2.5. **"*Congested traffic conditions*" means that ADS operations are affected on a continuous basis by the behaviour of the surrounding vehicles. In this case the vehicle average speed shall be greater than [55] km/h to and lower than or equal to [90] km/h.**

3. **General Principles**

3.1. **The public road test shall primarily verify the ADS normal operation within (but including coming close to) the system boundaries. The manufacturer shall declare the system boundaries to the authority in accordance with Annex 4.**

3.2. **For the public road test the authority shall assess the system in a fault-free condition of the vehicle and its ADS system. The systems carrying out the DDT shall not be modified for this test or set of tests; but additional system monitoring functions may be activated.**

3.3. **A public road test is always a test with other naïve traffic participants. A test on public roads that are closed to other traffic shall be considered a test corresponding to Annex 5.**

4. **Test conditions**

4.1. The tests shall be performed under **starting** conditions (e.g. environmental, road geometry) that allow the activation of the **ADS (excluding scenarios according to paragraph 5.7).**

4.2. **If applicable to the system's ODD, the composition of the public road test shall allow the verification of the system on motorway free-flow condition and on motorway congested conditions.**

4.3. The location and selection of the test route**s**, time-of-day and environmental conditions shall be determined by the **approval authority**. **Such tests shall cover different time-of-day and light intensity. They shall include scenarios in which the ADS is expected to experience challenging scenarios (e.g. tight curvatures, speed changes caused by variable infrastructural or traffic conditions, merging situations) and to approach the limits of its declared ODD during ADS operation (changes in visibility or road conditions, planned or sudden end of ODD).**

5. **Test scenarios to assess the behaviour of the system under normal operation on public roads**

Public road testing shall include the following test scenarios to assess the behaviour of the system with regard to the DDT during a public road test under normal operating conditions.

Test scenarios shall be selected depending on the Operational Design Domain (ODD).

Category	Type of scenario		Mandatory / Recommended
Prevention of activation when the system is outside of its technical boundaries	On a section of highway that is not suitable		Mandatory
	In an urban environment		Mandatory
	On a normally suitable road when other conditions (e.g. weather/time of day) are not met		Recommended
System override by the driver	Intervention made by the steering wheel		Mandatory
	Intervention made by the acceleration pedal		Mandatory
	Intervention made by the brake pedal		Mandatory
No violation of traffic rules	Adheres to speed limits		Mandatory
	Repeated changes in speed limit above 60 km/h		Mandatory
	Exposure to different road signs which require system reaction (at least [3] different times)		Mandatory
	Sufficient distance to vehicle in front		Mandatory
	Does not cross solid lane markings where lane change is prohibited		Recommended
Response to road events	Tunnel		Recommended
	End of motorway		Recommended
	Work zone		Recommended
	Toll station		Recommended
	Reacts to closed lane		Recommended
	Emergency vehicle approaching		Recommended
	Change in environmental conditions		Recommended
Response to other road users within the frontal and lateral detection range	Response to the acceleration and deceleration of a lead vehicle		Mandatory
	PTW as lead vehicle		Recommended
	HDV as lead vehicle		Mandatory
	Another vehicle merging at an entry lane		Mandatory
	Another vehicle merging at an ending lane	Free flow and dense traffic conditions	Mandatory
		Congested traffic conditions (repetition of at least [10] times)	Recommended
	Another vehicle merging with little longitudinal distance between the vehicles		Recommended
	Cut-out of another vehicle (e.g. at highway exit)		Mandatory
	The ALKS approaching stop and go traffic situations with different initial speeds (at least [10] situations)		Mandatory

Lane Keeping	Lane keeping on roads with different lane curvature		Mandatory
	Another vehicle driving close beside in the adjacent lane		Recommended
Lane changing performed by the system	The ALKS vehicle performing lane change in the adjacent (target) lane with and without surrounding traffic		Mandatory
	Merging at motorway entry		Mandatory
	Merging at lane end	Free flow and dense traffic conditions	Mandatory
		Congested traffic conditions (repetition of at least [10] times)	Mandatory

*Recommended scenarios shall be understood as those scenarios that although strived during the public road testing effort, they have not been achieved under the provisions indicated in Paragraph 6 to this Annex.

6. Test duration

The test, or combination of tests, shall be such that allows recording the ADS operation including:

- at least [5] hours of dense traffic conditions
- and, if applicable to the system's ODD, at least [10] hours of free-flow traffic condition, including congested traffic conditions.

Test duration is deemed to be sufficient when all mandatory scenarios have been covered and either

- the durations prescribed above are met, or
- testing has commenced for at least two days.

While test scheduling and route planning shall aim to achieve as much system operation time as possible for the public road test, any recommended scenarios that could not be achieved within two days of testing, shall be provided from the manufacturer's internal system validation tests.

7. Data collection

7.1. Minimum data channels

To verify the performance of the system with regard to the dynamic driving task of the ADS during normal operation on the test scenarios prescribed in paragraph 5, the minimum data to be recorded during the public road test, or series of tests, shall include:

(a) ADS Vehicle longitudinal acceleration;

(b) ADS Vehicle lateral acceleration;

(c) ADS Vehicle longitudinal velocity;

(d) ADS Vehicle lateral velocity;

(e) ADS Vehicle position;

(f) ADS Vehicle distance to leading vehicle;

(g) Leading vehicle relative speed;

(h) Relative position of the ADS vehicle from lane markings;

(i) Traffic signs recognition along with their geo-localization;

(j) Follower vehicle's position to ADS vehicle;

(k) Follower vehicle's velocity to ADS vehicle;

(l) Position of the vehicle/s in the adjacent (target) lane;

(m) Velocity of the vehicle/s in the adjacent (target) lane.

Data from the test, or combination of tests, shall be recorded and the test vehicle instrumented with non-perturbing equipment.

Where data cannot be generated without external measurement equipment, internal measurement data may be used, provided its tolerances have been assessed.

Data from the test, or combination of tests, shall not be modified or be removed from the assessed test.

7.2. Further data channels

The parameters listed in paragraph 7.1 are meant to be a minimum set of parameters. Any data channels used or generated by the system as deemed necessary for post-test evaluation by the authority shall be logged. Relevant warning signals received (via communication/life HD map) or identified otherwise by the ADS (acoustical or optical emergency vehicle recognition) shall be logged.

7.3. Data evaluation

Kommentiert [RSB1]: OICA/CLEPA will provide comments but agrees on reconsider including the section

7.3.1. The data recorded from activated system shall be assessed for the sections falling within the declared ODD including those sections when the system has left the ODD inadvertently without correctly ending its operation.

7.3.2. If a collision or emergency manoeuvre cannot be avoided during the public road testing, the collected data will not be part of the verification under normal operation. The data collected under emergency operating conditions will be evaluated as part of the critical traffic scenarios assessment (see Annex 5).

7.3.3. During the test, or combination of tests, a qualified expert (or in case use new tools appear for automatic evaluation, they can be used as well) shall evaluate that the ADS:

a) Respects the traffic rules;

b) Adapts its operations to environmental conditions;

c) Does not show an unpredictable behaviour creating a danger to surrounding traffic;

d) Shows reasonable cooperative behaviour in relevant situations (i.e. merging in dense traffic).

7.3.4. Time gap to leading vehicle, time gap left to the upcoming vehicle in the target lane in case of lane-change and lateral position deviation shall be quantitatively evaluated according to the technical requirements in paragraph 5 in this Regulation.

7.4. Test report

A test report shall be prepared in accordance with a Data Reporting File and shall be made available to the relevant authorities.