Proposal for amendments to

ECE/TRANS/WP.29/2020/81

The text reproduced below was prepared by the experts from the 'task force on testing' lead by JRC/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. Deletions are indicated by ~~red strikethrough~~ text.

General comments:

1. *It was suggested to discuss on reference to Technical service vs Type Approval Authority;* ***ADDRESSED (same as Annex 4)***
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;* ***ADDRESSED***
- *Discuss the updated list of scenarios to be covered and whether they should be mandatory or recommended;* ***ADDRESSED***
- *Discuss requirements for minimum test duration;* ***ADDRESSED***
- *Finalize section 7.3 on data evaluation with input from industry.* ***ADDRESSED***

I. Proposal

Annex 6, amend to read:

Specification for public road testing of ALKS

1. Introduction

This annex defines ~~real world~~ **public road** tests ~~with the purpose to verify the technical requirements~~ on ALKS. ~~The Technical Service shall conduct, or shall witness, an assessment of the system is functional and complies with the minimum performance requirements.~~ The purpose of this test is to ~~support the Technical Service in understanding~~ **assess the behaviour** of the system, in a fault-free condition, ~~in the presence of traffic~~ ~~(a 'real world' test)~~ 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.**

~~Until such time that specific test provisions have been agreed, the Technical Service shall ensure that the ALKS is subject to at least the tests outlined in Annex 5. The specific test parameters for each test shall be selected by the Technical Service and shall be recorded in the test report in such a manner that allows traceability and repeatability of the test setup.~~

Together, the assessment of Annex 4 and the ~~real-world~~ **public road** test shall enable the ~~Technical Service~~ **the type-approval authority or the technical service acting on its behalf (hereafter referred as type-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 ~~not only for a given set of test parameters,~~ 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 ~~specifications~~ **specified** in this document ~~are meant to be~~ **shall be intended as** a minimum**.** The ~~technical service~~ **type-approval authorities** may perform ~~any other~~ **additional** test**s** within the system **ODD** ~~boundaries~~ and ~~may then~~ compare the measured results against the requirements.

~~It is recommended that~~ **T**he ~~real-world~~ **public road** test ~~is~~ **shall be** undertaken once the system has passed ~~all of~~ the tests **under the provisions** outlined **in paragraphs 3 to 4.11 and paragraph 5 to** ~~this~~ **Annex 5** and upon completion of a risk assessment by the ~~Technical Service~~ **type-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 ALKS 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 ALKS 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 ALKS 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 ALKS normal operation within (but including coming close to) the system boundaries. The manufacturer shall declare the system boundaries to the type-approval authority in accordance with Annex 4.

3.2. For the public road test the type-approval authority shall assess the system in a fault-free condition of the vehicle and its ALKS 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.

3.4. Modifications to the external appearance of the test vehicle (e.g. sensors, cameras, camouflage) may be made in agreement with the type approval

authority; however, such modifications shall be minimised in order to reduce the likelihood of other road users modifying their behaviour as a result of being aware the vehicle is being tested.4. Test conditions

4.1. The tests shall be performed under **starting** conditions (e.g. environmental, road geometry) that allow the activation of the **ALKS (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 ~~Technical Service~~ **type-approval authority**. **Such tests shall cover different time-of-day and light intensity. They shall include scenarios in which the ALKS 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 ALKS 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**

~~During the real-world assessment, the Technical Service shall assess at least:~~

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).

Table A6/1

Public road scenarios

Category	**Type of scenario**	**Mandatory / Recommended**	**Main reference requirements (non-exhaustive list)**
Prevention of activation when the system is outside of its technical boundaries~~/requirements for ALKS~~	**On a section of highway that is not suitable**	**Mandatory**	**6.2.3.**
	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**	**6.3.1.**
	Intervention made by the acceleration pedal	**Mandatory**	**6.3.3. and 6.3.4.**
	Intervention made by the brake pedal	**Mandatory**	**6.3.2. and 6.3.4.**
No violation of traffic rules	**Adheres to speed limits**	**Mandatory**	**5.1.2**
	Repeated changes in speed limit above 60 km/h	**Mandatory**	**5.1.2 and 5.2.3**
	Exposure to different road signs which require system reaction (at least [3] different times)	**Mandatory**	

	Sufficient distance to vehicle in front		**Mandatory**	**5.2.3.3**
	Does not cross solid lane markings where lane change is prohibited		**Recommended**	**5.1.2 and 5.2.1**
Response to **road** events ~~Response to a planned event~~ ~~Response to an unplanned event~~	**Tunnel**		**Recommended**	**5.4.2.1**
	End of motorway		**Recommended**	
	Work zone		**Recommended**	**§ 5.4.2.1 or 5.4.2.2**
	Toll station		**Recommended**	**5.4.2.1**
	Reacts to closed lane		**Recommended**	**5.4.2.1 or 5.4.2.2**
	Emergency vehicle approaching		**Recommended**	**5.4.2.2**
	Change in environmental conditions		**Recommended**	
~~Detection of the presence~~ **Response to** other road users within the frontal and lateral detection range ~~Vehicle behaviour in response to other road users (following distance, cut-in scenario, cut-out scenario etc).~~	**Response to the acceleration and deceleration of a lead vehicle**		**Mandatory**	**5.2.5**
	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**	**5.2.5 and 5.2.3.3**
	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**	**5.2.1**
	Another vehicle driving close beside in the adjacent lane		**Recommended**	**5.2.2**
Lane changing performed by the system	**The ALKS performing lane change in the adjacent (target) lane with and without surrounding traffic**		**Mandatory**	**5.2.6**
	Merging at motorway entry		**Mandatory**	
	Merging at lane end	**Free flow and dense traffic conditions**	**Mandatory**	
		Congested traffic conditions	**Mandatory**	

		(repetition of at least [10] times)		

***Recommended scenarios shall be understood as those scenarios that shall be covered during the public road testing effort, but although strive, they have not been achieved under the provisions indicated in Paragraph 6 to this Annex or are not available in the country where the AKLS is under test.**

6. Test duration

The test, or combination of tests, shall be such that allows recording the ALKS 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.**

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 continued for at least 16 hours.**

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 encountered within 16 hours 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 ALKS 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) ALKS longitudinal acceleration;

(b) ALKS lateral acceleration;

(c) ALKS longitudinal velocity;

(d) ALKS lateral velocity;

(e) ALKS position;

(f) ALKS distance to leading vehicle;

(g) Leading vehicle relative speed;

(h) Relative position of the ALKS from lane markings;

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

(j) Follower vehicle's position to ALKS;

(k) Follower vehicle's velocity to ALKS;

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

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

~~The test drive~~ **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. ~~The Technical Service may log, or request logs of~~ **A**ny data channels used or generated by the system as deemed necessary for post-test evaluation **by the type-approval authority shall be logged. Relevant warning signals received (via communication/life HD map) or identified otherwise by the ALKS (acoustical or optical emergency vehicle recognition) shall be logged.**

7.3. **Data evaluation**

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. **Even if a collision or emergency manoeuvre cannot be avoided during the public road testing, the collected data shall be used for the verification.**

7.3.3. **During the test, or combination of tests, it shall be evaluated at least qualitatively that the ALKS complies with requirements of the Regulation including:**

a) Complies with the traffic rules;

b) Adapts its operations to environmental conditions;

And that the ALKS:

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

b) 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 type-approval authorities.