

Based on document version sent by JRC on Nov. 29<sup>th</sup> 2021

## 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.~~

**Kommentiert [PKT1]:** KBA: Isn't it also to complement the assessment of Annex 5?

Together, the assessment of Annex 4, [Annex 5](#) 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 tests~~ within the system **ODD boundaries** and ~~may then~~ compare the measured results against the requirements.

~~It is recommended that~~ ~~The 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.

## 4. Test conditions

**Kommentiert [PKT2]:** KBA: Use singular meaning “authority”

**Kommentiert [PKT3]:** KBA: 4.11 of Annex 5? Annex 5 only defines tests until 4.8.

**Kommentiert [PKT4]:** KBA: What about the tests defined in Annex 4? Should they not have been conducted before performing the public road test?

**Kommentiert [PKT5]:** KBA: Word “to” should be deleted.

**Kommentiert [PKT6]:** KBA: Word “to” should be deleted.

- 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 routes, 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	<del>Expected behaviour, in</del> <b>Main reference requirements</b>
Prevention of activation when the system is outside of its technical boundaries/ <del>requirements for</del> <b>ALKS</b>	<b>On a section of highway that is not suitable</b>	<b>Mandatory</b>	<del>Prevent system activation until conditions of § 6.2.3. are fulfilled</del>
	<b>In an urban environment</b>	<b>Mandatory</b>	
	<b>On a normally suitable road when other conditions (e.g. weather/time of day) are not met</b>	<b>Recommended</b>	
System override by the driver	<b>Intervention made by the steering wheel</b>	<b>Mandatory</b>	<del>Overriding of the lateral control function according 6.3.1.</del>
	<b>Intervention made by the acceleration pedal</b>	<b>Mandatory</b>	<del>Overriding of the longitudinal function of the system according to § 6.3.3. and initiation of transition demand according to § 6.3.4.</del>
	<b>Intervention made by the brake pedal</b>	<b>Mandatory</b>	<del>Overriding of the longitudinal function of the system according to § 6.3.2. and initiation of transition demand according to § 6.3.4.</del>
<b>No violation of traffic rules</b>	<b>Adheres to speed limits</b>	<b>Mandatory</b>	<del>Comply with local traffic rules according to § 5.1.2</del>

**Kommentiert [PKT7]:** KBA: Unclear whether the TTA (respectively the TS) have to conduct the "public road tests" in each country of operation. Especially, when its required in 5.1.2 that the system shall comply with the traffic rules.

**Kommentiert [HI8]:** Could only refer to "ODD", since this abbreviation has been used above.

**Kommentiert [DPM9]:** The concept is to make a direct link with the main requirements. The list is not exhaustive.

**Kommentiert [DPM10]:** The references of the sections come from the current UNR157. These should be updated as soon as the consolidated version of the new text (including LC and speed increase) would be available.

**Kommentiert [RSB11]:** As agreed during the last meeting only references have been included

**Kommentiert [SP12]:** Who recommends that? What consequence is there if not done when recommended? (true for all cells)

**Kommentiert [PKT13R12]:** KBA: Agree, needs to be defined like "any deviation from this table needs to be explained to the satisfactory of the type approval authority".

	Repeated changes in speed limit above 60 km/h	Mandatory	Comply with local traffic rules and adapt the vehicle speed according to § 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		Respect the minimum following distance and adapt the vehicle speed according to § 5.2.3.3
	Does not cross solid lane markings where lane change is prohibited	Recommended		Comply with local traffic rules and keep the vehicle inside its lane of travel according to § 5.1.2 and § 5.2.1
Response to road events Response to a planned event Response to an unplanned event	Tunnel	Recommended	Respond to a planned event according to § 5.4.2.1	
	End of motorway	Recommended		
	Work zone	Recommended	Respond to a planned or an unplanned event according to § 5.4.2.1 or § 5.4.2.2	
	Toll station	Recommended	Respond to a planned event according to § 5.4.2.1	
	Reacts to closed lane	Recommended	Respond to a planned or an unplanned event according to § 5.4.2.1 or § 5.4.2.2	
	Emergency vehicle approaching	Recommended	Respond to an unplanned event according to § 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	Detect the risk of collision and perform appropriate manoeuvre according to § 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	Detect the risk of collision and the distance to the vehicle in front and perform appropriate action according to § 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	Keep the vehicle inside its lane with a stable lateral position according to § 5.2.1	
	Another vehicle driving close beside in the adjacent lane	Recommended	Detect the vehicle beside and if necessary, adjust the speed or the lateral position according to § 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	Ensure all the requirements of the Lane Change Procedure in § 5.2.6 are verified	
	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 shall be covered during the public road testing effort, but although strive during the public road testing effort, 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, 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 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 achieved encountered within two days 16 hours of testing, shall be provided from the manufacturer's internal system validation tests.

**Kommentiert [HI14]:** What is the reasoning to include provisions for the test duration? Isn't the general understanding that all mandatory tests have to be conducted/assessed, no matter how long they take?

**Kommentiert [PKT15]:** KBA: Would it be allowed to run 5 cars in parallel and therefore performing only 1 hour of testing? Same questions is related to the other timing requirements.

**Kommentiert [RSB16]:** For the sake of clarity.

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~~ Any 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, ~~a qualified expert (or in case use new tools appear for automatic evaluation, they can be used as well) it shall be evaluated at least qualitatively that the ALKS shall comply~~ complies with requirements of the Regulation including:

- a) Complies with the traffic rules;
- b) Adapts its operations to environmental conditions;

And that the ALKS:

**Kommentiert [PKT17]:** KBA: Which position is meant? GPS or the relative position on the road (lane 1, lane 2, lane 3)?

**Kommentiert [PKT18]:** KBA: What about the following vehicle?

**Kommentiert [HI19R18]:** Or is this meant to be covered by (j)?

**Kommentiert [PKT20]:** KBA: What about the following vehicle?

**Kommentiert [HI21R20]:** Or is this meant to be covered by (g)?

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.

**Kommentiert [PKT22]:** KBA: adding "such as phantom-breaks, unreasonable lane-changes etc."

**Kommentiert [PKT23]:** KBA: Use singular meaning "authority"