Proposal for amendments to ECE/TRANS/WP.29/GRVA/2021/03

(Proposal for amendments to UN Regulation No. 157 (Automated Lane Keeping System)).

This document reflects the outcomes of the discussions during the Special Interest Group ALKS with regard to the scope extension to commercial vehicles. The changes proposed to document GRVA/2021/03 are marked in **bold** for new or ~~strikethrough~~ for deleted characters.

I. Proposal

Introduction., amend to read:

Introduction

The intention of the Regulation is to establish uniform provisions concerning the approval of vehicles with regard to Automated Lane Keeping Systems (ALKS).

ALKS controls the lateral and longitudinal movement of the vehicle for extended periods without further driver command. ALKS is a system whereby the activated system is in primary control of the vehicle.

This UN Regulation is the first regulatory step for an automated driving system (as defined in ECE/TRANS/WP.29/1140) in traffic and it therefore provides innovative provisions aimed at addressing the complexity related to the evaluation of the system safety. It contains administrative provisions suitable for type approval, technical requirements, audit and reporting provisions and testing provisions.

ALKS can be activated under certain conditions on roads where pedestrians and cyclists are prohibited and which, by design, are equipped with a physical separation that divides the traffic moving in opposite directions and prevent traffic from cutting across the path of the vehicle. In a first step, the original text of this UN Regulation limits the operational speed to 60 km/h maximum ~~and passenger cars (M_1 vehicles)~~**.**

This UN Regulation includes general requirements regarding the system safety and the failsafe response. When the ALKS is activated, it shall perform the driving task instead of the driver, i.e. manage all situations including failures, and shall not endanger the safety of the vehicle occupants or any other road users. There is however always the possibility for the driver to override the system, at any time.

The Regulation also lays down requirements on how the driving task shall be safely handed over from the ALKS to the driver including the capability for the system to come to a stop in case the driver does not reply appropriately.

Finally, the Regulation includes requirements on the Human-Machine Interface (HMI) to prevent misunderstanding or misuse by the driver. The Regulation for instance requires that on-board displays used by the driver for other activities than driving when the ALKS is activated, shall be automatically suspended as soon as the system issues a transition demand. These measures are without prejudice to driver behaviour rules on how to use these systems in the Contracting Parties as currently being discussed by the Global Forum for Road Traffic Safety (WP.1) at the time of drafting this document (See e.g. Informal Document 4 Revision 1 of the seventy-eight session of WP.1).

Paragraph 1.1., amend to read:

1.1. This Regulation applies to the type approval of vehicles of Categories ~~M1~~ **M and N**[1] with regards to their Automated Lane Keeping System.

Paragraph 5.2.3.3., amend to read:

5.2.3.3. The activated system shall detect the distance to the next vehicle in front as defined in paragraph 7.1.1. and shall adapt the vehicle speed in order to avoid collision.

While the ALKS vehicle is not at standstill, the system shall adapt the speed to adjust the distance to a vehicle in front in the same lane to be equal or greater than the minimum following distance.

In case the minimum time gap cannot be respected temporarily because of other road users (e.g. vehicle is cutting in, decelerating lead vehicle, etc.), the vehicle shall readjust the minimum following distance at the next available opportunity without any harsh braking unless an emergency manoeuvre would become necessary.

The minimum following distance shall be calculated using the formula:

$d_{min} = v_{ALKS} * t_{front}$

Where:

d_{min} = the minimum following distance

v_{ALKS} = the present speed of the ALKS vehicle in m/s

t_{front} = minimum time gap in seconds between the ALKS vehicle and a leading vehicle in front as per the table below:

Present speed of the ALKS vehicle		*Minimum time gap* ***M1/N1***	*Minimum following distance* ***M1/N1***	***Minimum time gap*** ***M2/M3//N2/N3***	***Minimum following distance*** ***M2/M3//N2/N3***
(km/h)	(m/s)	(s)	(m)	**(s)**	**(m)**
7.2	2.0	1.0	2.0	**1.2**	**2.4**
10	2.78	1.1	3.1	**1.4**	**3.9**
20	5.56	1.2	6.7	**1.6**	**8.9**
30	8.33	1.3	10.8	**1.8**	**15.0**
40	11.11	1.4	15.6	**2.0**	**22.2**
50	13.89	1.5	20.8	**2.2**	**30.6**
60	16.67	1.6	26.7	**2.4**	**40.0**

For speed values not mentioned in the table, linear interpolation shall be applied.

Notwithstanding the result of the formula above for present speeds below 2 m/s the minimum following distance shall never be less than 2 m.

~~**When the system is active, the vehicle shall comply with the minimum following distances per the local traffic rules of Contracting Party regions, as declared by the vehicle manufacturer in the Appendix of Annex 1, for vehicles of categories M2, N2, M3, N3.**~~

Paragraph 5.2.5.2., amend to read:

[1] As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.6, para. 2 - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

5.2.5.2. The activated system shall avoid a collision with a cutting-in vehicle,

(a) Provided the cutting in vehicle maintains its longitudinal speed which is lower than the longitudinal speed of the ALKS vehicle and

(b) Provided that the lateral movement of the cutting in vehicle has been visible for a time of at least 0.72 seconds before the reference point for *TTCLaneIntrusion* is reached,

(c) When the distance between the vehicle's front and the cutting in vehicle's rear corresponds to a TTC calculated by the following equation:

$TTCLaneIntrusion > vrel/(2 \cdot$ ~~X 6m/s²~~ **6m/s²**$) + 0.35s$

Where:

~~**X = 6m/s² for M_1, N_1 and 5m/s² for M_2, M_3, N_2, N_3**~~

Vrel = relative velocity between both vehicles, positive for vehicle being faster than the cutting in vehicle

TTCLaneIntrusion = The TTC value**,** when the outside of the tyre of the intruding vehicle's front wheel closest to the lane markings crosses a line 0.3 m beyond the outside edge of the visible lane marking to which the intruding vehicle is being drifted."

Paragraph 5.3.4., amend to read:

5.3.4. The vehicle shall implement a logic signal indicating emergency braking as specified in UN Regulation No. 13-H **or 13, as appropriate**.

Paragraph 7.1. and 7.1.2., amend to read:

7.1. Sensing requirements

The fulfilment of the provisions of this paragraph shall be demonstrated by the manufacturer to the technical service during the inspection of the safety approach as part of the assessment to Annex 4 and according to the relevant tests in Annex 5.

The ALKS vehicle shall be equipped with a sensing system such that, it can at least determine the driving environment (e.g. road geometry ahead, lane markings) and the traffic dynamics:

(a) Across the full width of its own traffic lane, the full width of the traffic lanes immediately to its left and to its right, up to the limit of the forward detection range;

(b) Along the full length of the vehicle **or combination** and up to the limit of the lateral detection range.

The requirements of this paragraph are without prejudice to other requirements in this Regulation, most notably paragraph 5.1.1. **and 5.1.2.**

7.1.2. Lateral detection range

The manufacturer shall declare the lateral detection range. The declared range shall be sufficient to cover the full width of the lane immediately to the left and of the lane immediately to the right of the vehicle **or combination**.

The Technical Service shall verify that the vehicle sensing system detects vehicles during the relevant test in Annex 5. This range shall be equal or greater than the declared range.

Paragraph 8.4.3., delete and replace by new heading with subparagraphs to read:

8.4.3. ~~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 DSSAD, as required by national and regional law.~~

Retrievability of data

8.4.3.1. For vehicles of category M1 and N1 the data shall be retrievable even after an impact of a severity level set by UN Regulations Nos. 94, 95 or 137 as applicable.

8.4.3.2. For vehicles of categories M2, M3, N2 and N3, the following applies.

Either:

- **the data shall be retrievable even after a mechanical shock of a severity level as specified in the component test of Annex 9C of the 03 series of amendment to UN Regulation No. 100, and**
- **the DSSAD shall be mounted in a position such as to be protected against mechanical damage resulting from a typical vehicle crash (e.g. frontal impact). This shall be demonstrated to the technical service together with appropriate documentation (e.g. calculations or simulations);**

or Alternatively,

sufficient crash protection may be demonstrated by the manufacturer by fulfilling the requirements of paragraph 8.4.3.1. (e.g. for M2 / N2 vehicles derived from M1 / N1).

8.4.3.3. If the main on-board vehicle power supply is not available, it shall still be possible to retrieve all data recorded on the DSSAD, as required by national and regional law.

II. Justification

1. The overall objective of the former Informal Working Group (IWG) on Automatically Commanded Steering Function (ACSF) has been to develop technical requirements for Automated Lane Keeping Systems (ALKS). The limitation to passenger cars (M1 category vehicles) was agreed in order to deliver within the given timeline. After having successfully accomplished the work for the system in a first step, the automotive industry has now reviewed and examined the existing requirements under the premise of including all vehicle categories M and N.

2. Minimum Following Distance:

Suggestion to add a special column for M2/M3/N2/N3 in the table based on the following approach:

- **Using a deceleration value of 5 m/s² (minimum performance of the service brakes in R13) for each speed value for the calculation**
- **Using a brake delay of 0.4s (linear increase up to full brake performance --> 0.8s/2) for each speed value for the calculation**
- **Ensuring that the minimum following distance is always greater than the calculated braking distance**

This conservative approach by using the minimum requirement for the service brake defined in Regulation 13 will lead to higher brake distances and therefore to higher minimum following distances.

~~3. The proposal in paragraph 5.2.5.2. reflects the mandatory minimum performance for service braking systems (5 m/s²) as required in the 11 series of amendments to UN Regulation No. 13, for vehicles of the Categories M2, M3, N2 and N3.~~

4. Sensing Requirements:

Suggestion to add the term "combination" to the paragraphs 7.1. and 7.1.2. This will lead to an extension of the lateral detection range to the whole combination.

Suggestion to add the reference to paragraph 5.1.2 to paragraph 7.1 for an additional clarification, that the local traffic rules should be considered regarding the sensing requirements, e.g. to ensure the 50m minimum following distance above 50km/h in Germany for M2/M3 and N2/N3.

5. Retrievability of data for DSSAD:

As UNECE Reg. 94, 95 or 137 cannot be applied to all other vehicle categories, we suggest to split the paragraph 8.4.3. and add in paragraph 8.4.3.2 an alternative approach for the retrievability of the data of the DSSAD.