

**Economic and Social Council**Distr.: General  
9 July 2020

Original: English

---

**Economic Commission for Europe**

Inland Transport Committee

**World Forum for Harmonization of Vehicle Regulations****Working Party on Automated/Autonomous and Connected Vehicles****Seventh session**

Geneva, 21-25 September 2020

Item 4 (d) of the provisional agenda

**Automated/autonomous and Connected vehicles:****UN Regulation on Automated Lane Keeping System****Proposal for amendments to UN Regulation on Automated Lane Keeping System (ALKS)****Submitted by the expert Germany \***

The text reproduced below was prepared by the expert from Germany. The proposal is aimed at inserting additional requirements for a lane change functionality. The modifications to the existing text of the Regulation are marked in bold for new or strikethrough for deleted characters.

---

\* In accordance with the programme of work of the Inland Transport Committee for 2020 as outlined in proposed programme budget for 2020 (A/74/6 (part V sect. 20) para 20.37), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.



## I. Proposal

Paragraphs 2.21. to 2.25., insert to read:

- 2.21. **“Starting lane” is the lane out of which the ALKS vehicle intends to manoeuvre.**
- 2.22. **“Target lane” is the lane into which the ALKS vehicle intends to manoeuvre. The target lane can be a regular lane of travel, an enter lane, an exit lane or a hard shoulder.**
- 2.24. **A “Lane Change Procedure (LCP)” starts when the direction indicator lamps are activated and ends when the direction indicator lamps are deactivated by the system. It comprises the following operations:**
- (a) **Activation of the direction indicator lamps;**
  - (b) **Temporary suspension of the mandatory lane keeping functionality of the ALKS;**
  - (c) **Lateral movement of the vehicle towards the lane boundary;**
  - (d) **Lane Change Manoeuvre;**
  - (e) **Resumption of the mandatory lane keeping function of the ALKS;**
  - (f) **Deactivation of direction indicator lamps.**
- 2.25. **A “Lane Change Manoeuvre (LCM)” is part of the LCP and**
- (a) **Starts when the outside edge of the tyre tread of the vehicle’s front wheel closest to the lane markings crosses the outside edge of the lane marking to which the vehicle is being manoeuvred and**
  - (b) **Ends when the rear wheels of the vehicle have fully crossed the lane marking.**

Paragraph 5.1.6., amend to read:

- 5.1.6. The system shall perform self-checks to detect the occurrence of failures and to confirm system performance at all times (e.g. after vehicle start the system has at least once detected an object at the same or a higher distance than that declared as detection ranges according to paragraph 7.1. **and its subparagraphs**).

Paragraph 5.2.6. and subparagraphs, insert to read:

### **5.2.6. Lane Change Procedure**

**The requirements of this paragraph and its subparagraphs apply to the system, if additionally fitted to perform a LCP.**

**The fulfilment of the provisions of this paragraph and its subparagraphs shall be demonstrated by the manufacturer to the satisfaction of the technical services during the assessment of Annex 4 and according to the relevant tests in Annex 5.**

- 5.2.6.1. **A LCP shall not cause a risk to safety of the vehicle occupants and other road users.**
- 5.2.6.2. **The activated system shall only undertake a LCP if the following requirements are fulfilled:**
- (a) **The vehicle is equipped with a sensing system capable of fulfilling the rearward detection range requirements as defined in paragraph 7.1. and subparagraph 7.1.3.;**
  - (b) **The system self-check as defined in paragraph 5.1.6. is positively confirmed;**
  - (c) **The assessment of the target lane as defined in paragraph 5.2.6.6. and its subparagraphs is positively confirmed;**

(d) The LCP is anticipated to be completed before the ALKS vehicle comes to standstill (i.e. in order to avoid coming to standstill while in the middle of two regular lanes due to stopped traffic ahead). In case the ALKS vehicle becomes stationary between two regular lanes during the LCM nonetheless (e.g. due to the surrounding traffic), it should at the next available opportunity either complete the LCP or return to its original lane.

5.2.6.3. In compliance with paragraph 5.1.2. in particular, the activated system may undertake a LCP if:

(a) Operation cannot be continued in the current lane (e.g. due to a blocked lane ahead, ending lane ahead), for the purpose of overtaking a slower moving vehicle or to prevent violation of the obligation to drive in the slowest lane when possible;

(b) A gap allowing a LCM is already present or expected to open up shortly.

5.2.6.4. A LCP shall be completed without undue delay.

The system shall generate the signal to activate and deactivate the direction indicator signal. The direction indicator shall remain active throughout the whole period of the LCP and shall be deactivated by the system in a timely manner once the lane keeping functionality is resumed.

5.2.6.5. Specific requirements for LCM

The lateral movement to approach the lane marking in the starting lane and the lateral movement necessary to complete the LCM shall aim to be one continuous movement.

The LCM shall not be initiated before a period of 3.0 seconds and not later than 7.0 seconds after activation of the direction indicator lamps.

The LCM may be terminated before being completed if the situation requires it. In this case the ALKS vehicle has to be steered back into the starting lane.

The ALKS vehicle shall be in a single lane of travel at the end of the LCM.

5.2.6.6. Assessment of the target lane

A LCP shall only be initiated if an approaching vehicle in the target lane is not forced to unmanageably decelerate due to the lane change of the ALKS vehicle.

5.2.6.6.1. An approaching vehicle in the target lane should not have to decelerate at a higher level than A m/s<sup>2</sup>, B seconds after the ALKS vehicle starts crossing a lane marking, to ensure the distance between the two vehicles is never less than that which the lane change vehicle travels in C seconds.

With:

(a) A equal to 3 m/s<sup>2</sup>;

(b) B equal to:

(i) 0.4 seconds after the ALKS vehicle has crossed the lane marking, provided there was at least 1.0 s lateral movement of the ALKS vehicle within the starting lane in principle visible to an approaching vehicle from the rear without an obstruction before the LCM starts; or

(ii) 1.4 seconds after the ALKS vehicle has crossed the lane marking, provided there was not at least 1.0 s lateral movement of the ALKS vehicle within the starting lane in principle visible to an approaching vehicle from the rear before the LCM starts.

(c) C equal to 1 second.

5.2.6.6.2. If no approaching vehicle is detected by the system in the target lane, the minimal gap to the rear shall be calculated under the assumption that:

(a) an approaching vehicle on a target lane intended for faster traffic (including enter lanes) is travelling with the allowed or the advised maximum speed whichever is lower; or

(b) an approaching vehicle on a target lane intended for slower traffic (including exit lanes and shoulders temporarily opened for regular traffic) is travelling with a maximum speed difference of 20 km/h at the beginning of the LCM while not exceeding the allowed or advised maximum speed.

5.2.6.7. The distance to a vehicle following behind in the target lane at equal or lower speed shall never be less than the speed which the following vehicle travels in 1 second.

*Paragraph 5.4.2.4., insert to read:*

5.4.2.4. In case a system is fitted to perform LCP, it shall be aimed that a LCP is not part of the transition phase, meaning that the transition demand is not given shortly before or during a LCP.

*Paragraph 6.4.1., amend to read:*

6.4.1. The following information shall be indicated to the driver:

(a) The system status as defined in paragraph 6.4.2.

(b) Any failure affecting the operation of the system with at least an optical signal unless the system is deactivated (off mode),

(c) Transition demand by at least an optical and in addition an acoustic and/or haptic warning signal.

At the latest 4 s after the initiation of the transition demand, the transition demand shall:

(i) Contain a constant or intermittent haptic warning unless the vehicle is at standstill; and

(ii) Be escalated and remain escalated until the transition demand ends.

(d) Minimum risk manoeuvre by at least an optical signal and in addition an acoustic and/or a haptic warning signal and

(e) Emergency manoeuvre by an optical signal

**(f) A LCP, if fitted to perform a LCP, by at least an optical signal.**

The optical signals above shall be adequate in size and contrast. The acoustic signals above shall be loud and clear.”

*Paragraph 7.1. 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 and up to the limit of the lateral detection range;

**(c) 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 rear detection range, if fitted to perform a LCP.**

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

*Renumber paragraphs 7.1.3. to 7.1.6. into 7.1.4. to 7.1.7.*

*Paragraph 7.1.3., insert to read:*

7.1.3. Rearward detection range

The requirements of this paragraph apply to the system, if additionally fitted to perform a LCP.

The manufacturer shall declare the rearward detection range measured from the rearward most point of the vehicle.

The vehicle manufacturer shall provide evidence that the effects of wear and ageing do not reduce the performance of the sensing system below the minimum required value specified in this paragraph over the lifetime of the system/vehicle.

The Technical Service shall verify that the distance at which the vehicle sensing system detects a road user during the relevant test in Annex 5 is equal or greater than the declared value.

*Paragraph 7.1.5., amend to read:*

7.1.5. The vehicle manufacturer shall provide evidence that the effects of wear and ageing do not reduce the performance of the sensing system below the minimum required values specified in paragraph 7.1. over the lifetime of the system/vehicle.

## II. Justification

1. This document proposes an amendment to UN Regulation on ALKS (ECE/TRANS/WP.29/2020/81), introducing the lane change capability to the system.
2. This proposal, furthermore, goes along with Germany's proposal to expand ALKS to high speed applications (specified maximum speed up to 130 km/h), yet both proposals do not necessarily have to be reviewed simultaneously as they are independent of each other.
3. The proposed amendment for an additional automated lane change enlarges the possible use cases and time in use for ALKS in general, thereby giving automated systems further possibilities to advance their safety benefit potential in road traffic.
4. The proposed requirements for the lane change capability are understood to be "if fitted" requirements: if a vehicle manufacturer chooses to bring such an ALKS to the market, the proposed technical requirements shall be met and fulfilled.
5. The timing and defined minimal gap for an automated lane change procedure ensure a safe lane change procedure without endangering other road users and do not force other vehicles or drivers in "challenging" reactions. The existing detection of vehicles, road users and objects on the road to the front and to the side for the entire ALKS speed range is completed by additional requirements to detect vehicles to the rear and to identify sufficiently large gaps in the neighbouring traffic lane. The requirements ensure that, if the ALKS vehicle performs a regular lane change, no other driver/vehicle has to decelerate with more than  $3 \text{ m/s}^2$  with an acknowledged reaction time of 1.4 s after the clear indication of the lane change intention and an always remaining safety gap of 1 s of traveling with the adjusted speed. The intention to perform a lane change will be always clear and indicated in time to the surrounding traffic.
6. It is understood that appropriate tests in the Annex of UN Regulation for ALKS need to be developed in order to complement the proposed technical requirements.