

## Proposal for amendments to ECE/TRANS/WP.29/GRVA/2020/33

The text reproduced below was prepared by the expert from the UK. The proposal is aimed at modifying the text of document ECE/TRANS/WP.29/GRVA/2020/33 to only allow lane changes for ALKS systems during minimum risk manoeuvres. All modifications to ECE/TRANS/WP.29/GRVA/2020/33 are given in **red** text. Modifications to the original text of ECE/TRANS/WP.29/2020/81 (Regulation 157 on ALKS) are given in **bold**. Deletions are indicated by ~~strike through~~ text.

### 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 or emergency refuge area.**
- 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 in the given order:**
- (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 5.2.1., amend to read:*

- 5.2.1. The activated system shall keep the vehicle inside its lane of travel and ensure that the vehicle does not cross any lane marking (outer edge of the front tyre to outer edge of the lane marking), **except during a Lane Change**

**Manoeuvre, as part of a Lane Change Procedure.** The system shall aim to keep the vehicle in a stable lateral position inside the lane of travel to avoid confusing other road users.

*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 **in compliance with Paragraph 5.1.2, and** 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~~ **All** system self-checks, 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.

**(e) The target lane is a regular lane of travel, or hard shoulder temporarily opened up as a regular lane of travel, or;**

**If the LCP is being undertaken as part of a MRM, the target lane may additionally be a hard shoulder, emergency refuge area, or other emergency lane, providing there is no other vehicle travelling in that lane within the rear detection range of the ALKS vehicle.**

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

~~(af) 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, or;~~

~~**The LCP is being undertaken as part of a MRM**~~

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

**5.2.6.43.** A LCP shall be completed without undue delay.

**5.2.6.4.** 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~~ ~~abandoned~~ before being completed if the situation requires it. In this case the LCM shall be completed by steering 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~~ LCM shall only be initiated if an approaching vehicle in the target lane ~~is not~~ ~~would not be~~ 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. Determination of whether a situation is critical shall consider any deceleration or acceleration of the ALKS vehicle after it has crossed the lane marking.

#### 5.2.6.6.23. If no approaching vehicle is detected by the system in the target lane, the ~~minimal~~-minimum 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~~ entry lanes) is travelling with at least the allowed ~~or the advised~~ maximum speed ~~whichever is lower~~ or, on roads where no speed limit applies, at least the advised maximum speed, or;

b) an approaching vehicle on a target lane intended for slower traffic (including exit lanes and ~~hard~~ shoulders temporarily opened for regular traffic) is

travelling with a ~~maximum~~-speed difference of at least [20] km/h at the beginning of the LCM ~~or while not exceeding the allowed or advised maximum speed or advised maximum speed~~

is travelling with at least the allowed maximum speed or, on roads where no speed limit applies, at least the 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.

#### 5.2.6.8. For the duration of the lane change manoeuvre, the lane change vehicle shall observe the minimum following distance requirements in accordance

**with 5.2.3.3 for any lead vehicle(s) or road user(s) in the target lane of travel or the initial lane of travel.**

**The strategy shall be clearly documented to ensure that this requirement is met, whilst ensuring that all lane changes can be completed and forward collisions avoided.**

- 5.2.6.9 In the case that, in the target lane, no obstacle or road user is present within the forward detection range, the speed of the ALKS vehicle, prior to beginning the lane change manoeuvre, shall be such that the lane change manoeuvre can complete and the vehicle can be brought to a complete stop within a distance equal to the forward detection range less 2m.**

*Paragraph 5.4.2.4., insert to read:*

- 5.4.2.4. In case a system is fitted to perform a 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.**

*Paragraphs 5.5.1-5.5.2., amended to read:*

- 5.5.1. During the minimum risk manoeuvre the vehicle shall be slowed down inside the lane or, in case the lane markings are not visible, remain on an appropriate trajectory taking into account surrounding traffic and road infrastructure, with an aim of achieving a deceleration demand not greater than 4.0 m/s<sup>2</sup>.

Higher deceleration demand values are permissible for very short durations, e.g. as haptic warning to stimulate the driver's attention, or in case of a severe ALKS or severe vehicle failure.

**In the case of a system that can perform a lane change, the system may choose to perform one or more lane change procedures during a minimum risk manoeuvre.**

~~Additionally, the~~ **The** signal to activate the hazard warning lights shall be generated with the start of the minimum risk manoeuvre.

**In the case of a lane change procedure being undertaken during a minimum risk manoeuvre, the hazard warning lamps shall be deactivated immediately prior to the lane change procedure being initiated; the hazard warning lamps shall be reactivated without delay upon completion of the lane change procedure.**

5.5.4.3....\_\_\_\_\_

*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.

## II. Justification

1. This document proposes an amendment to ECE/TRANS/WP29/GRVA/2020/33, submitted by Germany to amend UN Regulation on ALKS (ECE/TRANS/WP.29/2020/81), lane change capability to the system.
2. This proposal aims to amend and clarify some aspects of the original proposal, and to also make explicit provisions for undertaking a lane change during a minimum risk manoeuvre. Specifically, this document:
  - a. Includes emergency refuge areas;

- b. Removes the upper limit on indicator times;
- c. Allows the system to account for acceleration or deceleration of the ego vehicle when assessing the critical situation;
- d. Places [] around the minimum assumed speed differential of 20 km/h when changing into a slower lane. [] indicate a discussion point;
- e. Introduces forward distance requirements to vehicles in the target lane, based upon the following distance requirements of the ALKS regulation;
- f. Removes the requirement of 7.1.3 to demonstrate the effects of wear and age on sensor system performance as this requirement is a duplication of that of paragraph 7.1.4. of the core ALKS regulatory text.