

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

This document supplements the proposed provisions for an automated lane change per GRVA/2020/33, with the main aim to clarify the proposal. Any amendments to those already proposed in GRVA/2020/33e are marked red in **bold** for new text, and ~~strikethrough~~ for deleted text.

1. 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 5.2.1., 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 **unintentionally** cross any lane marking (outer edge of the front tyre to outer edge of the lane marking). 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 (LCP)**
- 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 an **unreasonable** 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 conditions** 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; A gap allowing a LCM is already present or expected to open up shortly.~~

(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 e) There is a reason for a lane change (e.g. 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~~ LCM shall only be **initiated** started if there is a sufficient gap, so that 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. When there is an approaching vehicle

An approaching vehicle in the target lane should not have to decelerate at a higher level than A m/s², 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/s²;
- (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. When there is no vehicle detected

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 start** of the LCM while not exceeding the allowed or advised maximum speed.

~~5.2.6.7.~~

5.2.6.6.3. When there is an equally fast or slower moving vehicle

The distance to a vehicle following behind in the target lane at equal or lower speed **at the start of the LCM** shall ~~never~~ **not** be less than the **speed distance** 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~~ the ALKS is capable 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 the ALKS is capable 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 the ALKS is capable 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 the ALKS is capable** 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 vehicles** 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.

Annex 5, Paragraph 4.6., amend to read:

4.6. Field of View test

4.6.1. The test shall demonstrate that the ALKS is capable of detecting another road user within the forward detection area up to the declared forward detection range and a vehicle beside within the lateral detection area up

to at least the full width of the adjacent lane. **If the ALKS is capable of performing lane changes, it shall additionally demonstrate that the ALKS is capable of detecting another vehicle within the rear detection range.**

4.6.2. The test for the forward detection ...

4.6.3. The test for the lateral detection range ...

4.6.4. The test for the rear detection range shall be executed at least:

- (a) With a motorcycle approaching the ALKS from the rear in the left adjacent lane;**
- (b) with a motorcycle approaching the ALKS from the rear in the right adjacent lane.**

Annex 5, insert a new paragraph 4.7. to read:

4.7. Lane Change tests (only required if the ALKS is capable of performing lane changes either during an MRM or during regular operation)

The test shall demonstrate that the ALKS, if designed to be capable of performing lane changes, is able to assess the criticality of the situation before starting the LCM.

4.7.1. The test shall be executed at least:

- (a) with different vehicles, including a motorcycle approaching from the rear**
- (b) in a scenario where a LCM in regular operation is possible and executed**
- (c) in a scenario where the LCM in regular operation is not possible due to a vehicle approaching from the rear**
- (d) with an equally fast vehicle following behind in the adjacent lane at a distance of less than that which the following vehicle travels in 1 second preventing a lane change**
- (e) with a vehicle driving beside in the adjacent lane preventing a lane change.**

2. Justifications

A. paragraph 5.2.1. – lane keeping

1. The proposal aims to clarify that intentional lane crossing as part of a lane change maneuver is permitted. Otherwise there would be a contradiction between the provisions for a lane change and the provision in 5.2.1. that the system “does not cross a lane marking”.

B. paragraph 5.2.6.1. - risk to safety of the vehicle occupants and other road users

2. This provision is already covered by par. 5.1.1. (“The activated system shall perform the DDT shall manage all situations including failures, and shall be free of unreasonable risks for the vehicle occupants or any other road users.”), which would

also apply to the ALKS while it is changing lanes. To improve consistency paragraph 5.2.6.1. should therefore be amended to read “unreasonable risk to safety”.

C. paragraphs 5.2.6.2. and 5.2.6.3. – preconditions for a lane change procedure

3. The amendment aims to clarify that this paragraph addresses preconditions for the initiation of a lane change procedure, while preconditions for the lane change maneuver are addressed further down in the text. Therefore while a sufficient gap should be expected to open up, that the gap was already pre-existing should not be a precondition to activate the direction indicator. Otherwise this would prevent lane changes in slow-moving traffic where gaps might only open up upon indication of willingness to change lanes.

D. paragraph 5.2.6.5. – timing of a lane change maneuver

4. The ALKS has to comply with all traffic rules related to the dynamic driving task in the country of operation (par. 5.1.2.), therefore specific requirements on lane change timing derived from the most stringent national traffic rules (“earliest after 3s”) are not needed, to ensure appropriate behaviour of the system. To limit the upper duration is not needed either, because par. 5.2.6.2. already addresses that a lane change procedure should only be initiated when a gap is already present or expected to open up shortly. By relying on the provisions of the national traffic rules instead of defining a specific lane change timing, the system will be able to behave more natural with other vehicles around.

E. paragraph 5.2.6.6. and its sub-paragraphs – criticality of a lane change maneuver

5. The amendment aims to clarify that this paragraph describes preconditions specifically for the Lane Change Maneuver, with the main focus on what would have to be considered a critical situation.

The new sub-headlines aim to clarify that there are provisions for 3 different scenarios (when there is a vehicle approaching in the adjacent lane, when there is no vehicle detected in the adjacent lane and when there is an equally fast or slower moving vehicle in the adjacent lane).

F. paragraph 7.1.3. – rear detection range

6. The amendment aims to use consistent wording (“rear” as in par. 7.1. instead of “rearward”).

Furthermore it aims to clarify that “vehicles” (e.g. cars, trucks, motorcycles) are relevant objects to rear and not pedestrians, who would fall under the current wording of “road user”.

G. Annex 5. – tests

7. The amendment aims to propose test cases for the rear detection range (par. 4.6.) as well as the lane change capabilities (par. 4.7.) in case the vehicle is capable to perform lane changes. The provisions are drafted in a style similar to the existing ALKS test cases, where the main aim was to define relevant circumstances that shall be reflected in the test but leave specific test design up to the Technical Service.
