

Submitted by the leadership of SIG UNR157

UNR157-10-04

The text reproduced reflects the state of play of the discussion in the SIG UNR157 up to its 9th meeting for adding the lane change capability of ALKS.

Modifications to the existing text of UN-Regulation No. 157 (incl. suppl. 02 to 00 series) are marked in **black bold** for new or ~~strike through~~ for deleted characters.

Comments:

- Agreements and group conclusions highlighted in *grey*.
- Open points of discussions highlighted in *yellow*. In particular: **Homework**

Amendments by OICA/CLEPA in blue

I. Proposal

Group conclusion on para. 2.21 to 2.27, agreed (reminder: may need renumbering if merged with speed increase proposal). Point of discussion in 2.25: to be confirmed if "combination" should be included as a follow-up of the recent adoption of commercial vehicles requirements.

Paragraphs 2.21. to 2.27., 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, emergency refuge area or beside the road.
- 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 [or combination] have fully crossed the lane marking ~~{or combination}~~.
- 2.26. **"Target stop area"** means a potential stopping area (e.g. emergency lane, hard shoulder, beside the road, slowest lane of traffic, own lane of travel).
- ~~2.27. "Beside the road" means the area of road surface beyond the boundaries of the carriageway which is not a hard shoulder or emergency refuge area.~~

Point of discussion on 2.28 and 2.29: Proposal from industry for definitions of MRM and Regular lane changes to be confirmed

~~[2.28. "MRM lane change" is a lane change performed by the ALKS during a minimum risk manoeuvre.]~~

Kommentiert [KT(1)]: Might not be needed if the corresponding requirement is adapted to be applicable to a shoulder as well.

Kommentiert [SR(2)]: Industry sees no need to differentiate in the definition section between the different types of lane changes / manoeuvres. Splitting up the requirement section into generic and additional specific requirements does the job sufficiently. **2.28. – 2.31. are not needed** therefore.

[2.29. ~~“Regular lane change” is any lane change performed by the ALKS that is not an MRM lane change.~~]

Point of discussion on 2.30: JP proposal (UNR157-06-05) for definition of evasive lane change to be confirmed (Reminder: may need renumbering if merged with speed increase proposal.)

[2.30. ~~An “Evasive Lane Change” is a steering manoeuvre when the ALKS vehicle cannot avoid collision by its full braking performance.”]~~

Point of discussion on 2.31: JP proposal (UNR157-07-12) for definitions of MRM lane change procedure to be confirmed (Reminder: may need renumbering if merged with speed increase proposal.)

[2.31. ~~A “Minimum Risk Manoeuvre Lane Change Procedure (MRMLCP)” starts when the direction indicator lamps are activated and ends when the hazard warning lamps are activated 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 towards the target stop area in target lane;~~
- ~~(e) — Stop the vehicle when arrive target stop area.~~
- ~~(f) — Deactivation of direction indicator lamps and activation of hazard lamps.]~~

Point of discussion for para. 2.8: Homework: New text expected from industry to address comments from the 6th meeting (clear distinction between regular Lane Changes and Lane Changes during EM).

Paragraph 2.8., amend to read

2.8. “Emergency Manoeuvre (EM)” is a manoeuvre performed by the system in case of an event in which the vehicle is at ~~imminent~~ imminent collision risk and has the purpose of avoiding or mitigating a collision. ~~[This includes manoeuvres when a collision is already imminent as well as those where evasive steering needs to be performed by the system in order to keep the risk of a collision at a low level / evasive steering manoeuvres that aim to avoid a collision to become imminent.]~~

Group conclusion on 5.1.6.: Proposal agreed.

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**).

Group conclusion on 5.2.1.: Proposal agreed.

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.

When intentionally crossing lane markings other than during an LCP (e.g. when forming an access corridor for emergency vehicles or slightly crossing lane markings in order to pass an obstacle partly blocking the

Kommentiert [SR(3)]: 2.30 is not needed at all (see above). However, this is also against the understanding from previous discussions. If introduced this must be linked to the threshold of what is considered to be an EM which is 5 m/s² (see Par. 5.3.1.1) and not to the full braking performance of the vehicle.

Kommentiert [KT(4)]: As consensus during the last SIG discussion seemed to be that the direction indicator would be deactivated once the target lane was reached and the hazard warning lights would then come back on, there is no need for a special “MRMLCP”, as the steps are identical to the LCP above.

current lane of travel), this manoeuvre shall not endanger the safety of the vehicle or any other road user and shall ensure sufficient lateral distance to road boundaries and other road users.

Group conclusion on para. 5.2.6 to 5.2.6.3.: Proposal agreed.

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 fitted capable 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. LCPs shall only be performed in an uncritical way as described in paragraphs 5.2.6.1.1. and 5.2.6.1.2.
- 5.2.6.1.1. The intervention shall not cause a collision with another vehicle or road user in the predicted path of the vehicle during a lane change.
- 5.2.6.1.2. A lane change procedure shall be predictable and manageable for other road users.
- 5.2.6.2. A LCP shall be completed without undue delay.
- 5.2.6.3. The system may perform a single or multiple lane change(s) across regular lanes of traffic and/or to the hard shoulder in accordance with national traffic rules in the country of operation.

Group conclusion on (old) para. 5.2.6.4.: Agreed to delete.

~~[5.2.6.4. — A lane change shall not be performed towards a lane intended for traffic moving in the opposite direction.]~~

Group conclusion on (new) para. 5.2.6.4: agreed.

- 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.

Group conclusion on para 5.2.6.5: Grey highlighted text agreed.

Points of discussion: can [] in a) be removed? Comments collected in 9th SIG to b): Come back, may not be needed since sufficiently covered by para. 5.1.6.; d): Improve wording (capture scenario of three lanes), can [] be removed?; e)-g): need do come back, no agreement yet.

5.2.6.5. The activated system may ~~shall only~~ undertake a LCP in compliance with Paragraph 5.1.2, and only if all of the following requirements conditions are fulfilled:

(a) The vehicle is equipped with a sensing system capable of fulfilling the front, side and rearward detection range requirements as defined in paragraph 7.1., ~~[7.1.1.1. and 7.1.2.1.]~~ and subparagraph 7.1.3.;

[(b) All system self-checks, as defined in paragraph 5.1.6. is positively confirmed;]

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

~~[(d) There is no other vehicle which is activating direction indicator to come to the target lane (except following vehicles at and near merging and departing lanes).]~~

Kommentiert [KT(5): As 5.2.6.5. is the general section on LCP, 5.2.6.5.1. specific to a regular LCP and 5.2.6.5.2. specific to MRM LCP the items need to be matched differently, because there currently is a mismatch/duplication.

Kommentiert [KT(6): See proposal for alternative requirement after 5.2.6.6.1.

~~(e) The RLCP 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 (e.g. due to the surrounding traffic), it should shall at the next available opportunity either complete the RLCP or return to its original lane.~~

Kommentiert [KT(7): Is specific to a LCP during a regular LC, therefore deleted here.

~~(f) The target lane is a regular lane of travel, or hard shoulder temporarily opened up as a regular lane of travel.~~

Kommentiert [KT(8): Is specific to a LCP during a regular LC, therefore deleted here.

~~(g) There is a reason for a lane change (e.g. when operation cannot be continued in the current lane, to overtake a slower moving vehicle, or to prevent violation of the obligation to drive in the slowest lane when possible, for a LCP is being undertaken as part of a MRM as a follow up of a severe failure).~~

Kommentiert [KT(9): Is specific to a LCP during a regular LC, therefore deleted here.

Group conclusion on paras 5.2.6.5.1: agreed

5.2.6.5.1. Lane Change Procedure: Additional specific requirements for regular lane changes

The activated system shall only initiate a regular LCP if the following conditions are fulfilled:

- (a) 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 (e.g. due to the surrounding traffic), it should at the next available opportunity either complete the LCP or return to its original lane.
- (b) The target lane is a regular lane of travel, or hard shoulder temporarily opened up as a regular lane of travel.
- (c) There is a reason for a lane change (e.g. Operation cannot be continued in the current lane, for the purpose of overtaking a slower moving vehicle, to prevent violation of the obligation to drive in the slowest lane when possible, for a LCP is being undertaken as part of a MRM as a follow up of a severe failure).

Group conclusion on paras 5.2.6.5.2 to 5.2.6.5.2.2: agreed.

5.2.6.5.2. Lane Change Procedure: Additional specific requirements during an MRM

5.2.6.5.2.1. Lane changes during a MRM shall be made only if under the traffic situation these lane changes can be considered to minimize the risk to safety of the vehicle occupants and other road users.

5.2.6.5.2.2. Before initiating a lane change procedure, the system shall, if deemed appropriate, reduce the vehicle speed to minimize the risk related to that lane change (e.g. by adapting the speed of the vehicle to that of other vehicles in the target lane).

Point of discussion on 5.2.6.5.2.3.: Requirement coming from RMF (UNR79) needed?

~~[5.2.6.5.2.3. A lane change procedure shall not start within the first 5s following the start of the MRM intervention.]~~

Kommentiert [KT(10): These 5s were introduced for RMF to ensure sufficient warning to the driver of the RMF vehicle before the start of the LCP. This is ensured by 10s transition phase of ALKS.

[5.2.6.5.2.4. In case the target stop area cannot be reached in an uncritical way the system shall aim to keep the vehicle within its current lane of travel while the vehicle is stopping.]

Additionally, if this provision was aiming to alert surrounding traffic through activation of the hazard warning lights, the provisions on assumed reaction times, maximum deceleration and delay on increase of deceleration could be deleted, as the driver of the following vehicle would already be ready to respond.

Group conclusion on para. 5.2.6.6.: Agreed.

5.2.6.6. Lane change manoeuvre (LCM)

5.2.6.6.1. 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

Kommentiert [SR(11): This provision is not really needed and somehow in contradiction with the definition of the target stop area which includes the own lane of travel as well.

one continuous movement. During the lane change manoeuvre, the system shall aim to avoid a lateral acceleration of more than 1 m/s² in addition to the lateral acceleration generated by the lane curvature.

The duration between initiation of the LCP and start of the LCM shall be in compliance with traffic rules in the country of operation.

General reminder: Is wording/explicit requirement needed to capture: Vehicle need to adapt to (local) driving style meaning behavioural law, when there is no explicit value, e.g. for front distance etc. in the traffic rules?

x.x.x. A LCM shall only be initiated when the relevant area of the target lane is expected to remain unoccupied throughout the manoeuvre (e.g. there is no other vehicle in the second to next lane expected to change on a conflicting trajectory).

Kommentiert [KT(12): Introduced to address a potential safety concern when two vehicles would try to change into the same lane at the same time.

5.2.6.6.2. The LCM may be abandoned before being completed if the situation requires it. In this case the LCM shall be completed by steering the ALKS vehicle back into the starting lane if traffic conditions allow it.

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

5.1.6.6.3. When several consecutive lane changes are performed, the direction indicator may remain active throughout these lane changes while the lateral behaviour shall ensure that each lane change manoeuvre can be perceived as an individual manoeuvre by when there is following traffic.

Point of discussion para. 5.2.6.6.4.: Need to confirm signalling sequence and whether beside the road is sufficient if vehicle can't fit on the hard shoulder.

5.2.6.6.4 Lane change manoeuvre: Additional specific requirements in MRM

5.1.6.6.4.1. A lane change manoeuvre during MRM shall be indicated in advance to other road users by activating the appropriate direction indicator lamps instead of the hazard warning lights.

5.1.6.6.4.2. Once the lane change manoeuvre is completed the direction indicator lamps shall be deactivated in a timely manner, and the hazard warning lights shall become active again.

5.1.6.6.4.3. Upon termination of the LCM the ALKS shall aim to bring the vehicle in a position that reduces the risk to the vehicle occupants and other road users.

Kommentiert [KT(13): 5.1.6.6.4.3. and 5.1.6.6.4.4. are addressing the same thing, but per definition "beside the road" does not include the hard shoulder.

5.1.6.6.4.4. The following additional requirements are to be fulfilled When bringing the vehicle to a safe stop beside the road or on a hard shoulder not wide enough to fit the entire vehicle, the vehicle may come to a standstill on the lane mark beside the road.

Kommentiert [KT(14): Alternatively we could say "outside of a regular lane of traffic"

5.2.6.9.4.4.1. All provisions of paragraph 5.2.6. shall be applied except [5.2.6.5.1 item a].

Group conclusion on para. 5.2.6.6.4.5. and 5.2.6.6.4.6.: Agreed to delete.

~~[5.2.6.6.4.5. In addition to the provisions of paragraph 5.1.6.6.4.1, an acoustic warning may be given as warning to other road users unless traffic rules in the country prohibits using an acoustic warning.]~~

~~5.2.6.6.4.6. When bringing the vehicle to a stop beside the road the vehicle speed shall not exceed 10 km/h.]~~

Point of discussion for para. 5.2.6.7.1.: Can revised text be agreed?

5.2.6.7. Assessment of the target lane

5.2.6.7.1. A LCP shall only be initiated if [the ALKS vehicle would be able to keep a safe distance from a lead vehicle or any other obstacle in the target lane according with the provisions of paragraph 5.2.3.3. and if] the lane change of the ALKS vehicle does not disturb surrounding traffic flow an

approaching vehicle in the target lane is not forced to unreasonably decelerate due to the lane change of the ALKS vehicle.

Point of discussion on para 5.2.6.7.2. and subparagraphs: Revised wording (~~strikethrough~~ and new text underlined) to be agreed as well as values.

5.2.6.7.2. Additional assessment of the target lane for a regular lane change

A regular LCP shall only be initiated if the ALKS vehicle is able to fulfil the requirements of par. 5.2.4. and 5.2.5. also with respect to the target lane.

5.2.6.7.2.1. When there is an approaching vehicle

An approaching vehicle in the target lane should not have to decelerate but where this is reasonable it shall not be at a higher level than A m/s², B seconds after the ALKS vehicle starts ~~crossing a lane marking~~ the lane change manoeuvre, to ensure the distance between the two vehicles is never less than that which the lane change ALKS vehicle travels in C seconds.

With:

- (a) A equal to 3.0 m/s²
- (b) B equal to:
 - (i) 0.4 seconds after the ~~outside edge of the tyre tread of the vehicle's front wheel closest to the lane marking crosses the outside edge of the lane marking~~ start of the lane change manoeuvre, provided there was at least 1.0 s lateral movement of the ALKS vehicle within the starting lane ~~that was in principle visible to an~~ the approaching vehicle from the rear without an obstruction before the LCM starts; or
 - (ii) 1.4 seconds after the ~~outside edge of the tyre tread of the vehicle's front wheel closest to the lane marking crosses the outside edge of the lane marking~~ start of the lane change manoeuvre for all other cases, 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 1.0 second.

5.2.6.7.2.2. Determination of whether a situation is critical shall consider any deceleration or acceleration of the ALKS vehicle.

Point of discussion for 5.2.6.7.2.3.: Come back: can [] be removed?

5.2.6.7.2.3. When there is no vehicle detected

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

- a) the approaching vehicle in the target lane is at a distance from the ALKS vehicle equal to rearward detection range and
- b) the approaching vehicle in the target lane is travelling ~~[with the allowed maximum speed + 30km/h or 130km/h whichever is lower].~~

Point of discussion for 5.2.6.7.2.3: Confirm tentative agreement.

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

At the beginning of the LCM, the distance between the rear of the ALKS vehicle and the front of a vehicle following behind in the target lane at equal or lower longitudinal speed shall never be less than the speed distance which the following vehicle in target lane travels in 1.0s.

Kommentiert [KT(15)]: Shouldn't 5.2.6.7.2. and 5.2.6.7.3. be sub-paragraphs to 5.2.6.7.1., as they detail what is meant with "unreasonably decelerate"

Kommentiert [KT(16)]: How is it reflected now that the ALKS vehicle cannot have knowledge of whether it was actually visible to the approaching vehicle.

Point of discussion for para. 5.2.6.7.3 and subparagraphs: Confirm tentative agreement with revised wording (~~strike through~~ and new text underlined) to align with para. 5.2.6.7.2.1. New para numbers to split MRM and regular lane changes. Text in [] to be confirmed

5.2.6.7.3. **Additional assessment of the target lane for an MRM lane change**

5.2.6.7.3.1. 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~~ the lane change manoeuvre, to ensure the distance between the two vehicles is never less than that which the ~~lane change~~ ALKS vehicle travels in C seconds.

With:

(b) A equal to 3.7 m/s²

(b) B equal to:

- (i) 0.0 second, if ~~during a minimal risk manoeuvre~~ the lateral movement of the ALKS vehicle continued for at least 1 second while the vehicle had not yet crossed the lane marking and the direction indicator had been active for at least 3.0 seconds prior to ~~crossing of the lane markings the start of the lane change manoeuvre~~ while a vehicle approaching from the rear was detected by the sensing system;
- (i) 0.4 seconds after the ~~ALKS vehicle has crossed the lane marking start of the lane change manoeuvre~~, provided there was at least 1.0 s lateral movement of the ALKS vehicle within the starting lane ~~in principle that was visible to an the~~ 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 start of the lane change manoeuvre~~, 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.

(ci) C equal to:

- (i) 0.5 second, if the lane change is performed towards a lane intended for slower traffic or towards the hard shoulder ~~during a minimal risk manoeuvre~~;
- (ii) 1.0 second for all other conditions.

5.2.6.7.3.2. When there is no vehicle detected

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

- a) the approaching vehicle in the target lane is at a distance from the ALKS vehicle equal to rearward detection distance and
- b) the approaching vehicle in the target lane is travelling ~~[with the allowed maximum speed +30 km/h or 130km/h whichever is lower]~~ and
- c) the approaching vehicle on a hard shoulder is travelling ~~[at a maximum speed of 80 km/h and a maximum speed difference to the ALKS vehicle at the start of the LCM of 40 km/h]~~.

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

At the beginning of the LCM, the distance between the rear of the ALKS vehicle and the front of a vehicle following behind in the target lane at

Kommentiert [KT(17)]: We should use "while a vehicle approaching from the rear was detected by the sensing system" anywhere we originally used "in principle visible to a vehicle approaching from the rear", as this is the only condition that can actually be confirmed by the system.

equal or lower longitudinal speed shall never be less than the **speed distance** which the following vehicle in target lane travels in 0.7s.

Group conclusion on para 5.2.6.7.4.: Agreement to delete reference to crossing lane marking since it should be considered at all times.

5.2.6.7.4. Determination of whether a situation is critical shall consider any deceleration or acceleration of the ALKS vehicle ~~after it has crossed the lane marking.~~

Group conclusion on para 5.2.6.7.5. and 5.2.6.7.6.: Agreement to delete since covered with new 5.2.6.7.1.

~~[5.2.6.7.5. 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.]~~

Reminder for para 5.2.6.7.6: Move to MRM LC or consider removing entirely at later stage, if covered already and therefore not needed.

~~[5.2.6.7.6. 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.]~~

Reminder for para 5.2.6.7.7.: Keep for "regular lane change" and MRM LC. Point of discussion: Consider if [] can be removed and finalize text.

Homework: Industry to provide text to cover circumstances when there could be an exemption to this and to 5.2.6.7.8.

5.2.6.7.7. In case the ALKS decelerates the vehicle during a lane change procedure into a **regular lane of traffic**, this deceleration shall be factored in when assessing the distance to a vehicle approaching from the rear, and the deceleration shall [not exceed 2m/s², except for the purpose of avoiding or mitigating the risk of an imminent collision ~~/be manageable for the vehicle approaching from the rear~~] or when required to ensure reaching the target stop area during an MRM.

How the provisions of this paragraph are implemented in the system design shall be demonstrated to the Technical Service during type approval.

Reminder for para 5.2.6.7.7.: Keep for "regular lane change" and MRM LC. Point of discussion: Can OICA proposal in red (coming from UNR157-08-13) be agreed? Consider if [] can be removed and finalize text.

5.2.6.7.8. Where there is not sufficient headway time for the vehicle behind at the end of the lane change procedure, the ALKS shall not increase the rate of deceleration for [at least 2 seconds ~~/a certain period of time~~] after the completion of the lane change procedure except for the purpose of avoiding or mitigating the risk of an imminent collision **or when required to fulfil other requirements of this regulation (e.g. to adapt to changing speed limits, maintain sufficient following distance) or to ensure reaching the target stop area during an MRM.**

How the provisions of this paragraph are implemented in the system design shall be demonstrated to the Technical Service during type approval.

Kommentiert [KT(18): This requirement is not needed, because the aim of collision avoidance should be addressed by:
"5.2.6.1. A LCP shall not cause an unreasonable risk to safety of the vehicle occupants and other road users. LCPs shall only be performed in an uncritical way as described in paragraphs 5.2.6.1.1. and 5.2.6.1.2."

"5.2.6.1.1. The intervention shall not cause a collision with another vehicle or road user in the predicted path of the vehicle during a lane change."

"5.2.6.7.2. A regular LCP shall only be initiated if the ALKS vehicle is able to fulfil the requirements of par. 5.2.4. and 5.2.5. also with respect to the target lane."

Note: Para. 5.3. was not discussed in 9th SIG meeting.

Point of discussion on para. 5.3. and subparagraphs from previous SIG meetings: text proposed by industry in (UN157-05-11) needs to be confirmed. Tentative feedback from JP not to support text in [] in para. 5.3.1.

Homework: Industry was asked to come with new text to narrow down the concept of emergency lane change to ensure this will only be used in case of emergency situations. Furthermore, industry to provide explanation where the 0.5 s in para. 5.3.5.3.1. come from and to clarify if the two conditions must be fulfilled (decision needed: 'add' or 'or correct')? Value of 4 m/2 (and not 3.7 m/s²) to be explained in para. 5.3.5.3.2.

Paragraph 5.3., amend to read

“5.3. Emergency Manoeuvre (EM)

5.3.1. An Emergency Manoeuvre shall be carried out in case of an imminent collision risk ~~[or when the vehicle needs to cross lane markings to mitigate the risk of a collision].~~

5.3.1.1. Any longitudinal deceleration demand of more than 5.0 m/s² of the system shall be considered to be an emergency manoeuvre.

[5.3.1.2. Any evasive lateral manoeuvre that leads the ALKS vehicle to cross lane markings in response to an imminent risk of collision and that is not considered a lane change according to paragraph 5.2.6. shall be considered to be an emergency manoeuvre.]

5.3.2. This manoeuvre shall decelerate the vehicle up to its full braking performance if necessary and/or may perform an automatic evasive manoeuvre, when appropriate.

If failures are affecting the braking or steering performance of the system, the manoeuvre shall be carried out with consideration for the remaining performance.

During the evasive manoeuvre the ALKS vehicle shall not cross the lane marking (outer edge of the front tyre to outer edge of the lane marking) [unless the system is capable of fulfilling the provisions of paragraph 5.3.5.]

After the evasive manoeuvre the vehicle shall aim at resuming a stable position.

[5.3.5. Lateral Evasive manoeuvre crossing lane markings [to minimize the risk of a collision.]

[5.3.5.1. The vehicle shall only cross lane markings in response to a risk of collision if the system has sufficient information about its surrounding to the front and side (as defined in paragraph 7.1.) and to the rear (according to the following paragraphs) in order to assess the criticality of crossing the lane markings.]

[5.3.5.2. The activated system shall not cause a collision with another vehicle or road user in the predicted path of the vehicle when crossing lane markings in response to a risk of collision.]

~~[5.3.5.3. The vehicle shall only cross lane markings in response to a risk of collision if another vehicle in the evasive lane is not forced to unmanageably decelerate due to that manoeuvre.]~~

~~[5.3.5.3.1. When crossing the lane markings by not more than [30] cm, it shall be ensured that~~

- ~~• the distance to a vehicle following behind in the evasive lane at equal or lower speed is greater than that which the following vehicle travels in 0.5s. [and/or]~~
- ~~• a minimum lateral distance of 1m to vehicles travelling in the evasive lane is ensured.]~~

~~[5.3.5.3.2. When crossing the lane markings by more than [30] cm up to [half the vehicle's width], it shall be ensured that~~

- ~~• an approaching vehicle in the evasive lane shall not have to decelerate at a higher level than 4 m/s², 0,4 seconds after the ALKS vehicle starts crossing the lane markings, to ensure collision avoidance between the two vehicles, and~~
- ~~• the distance to a vehicle following behind in the evasive lane at equal or lower speed is greater than that which the following vehicle travels in 0.5s, and~~
- ~~• the evasive lane is unoccupied across the length of the ALKS vehicle.]~~

~~[5.3.5.3.3. When crossing the lane markings by more than [half the vehicle's width], the criticality of the situation shall be assessed according to the corresponding provisions for a LCP provisions in paragraphs 5.2.6.]~~

[5.3.5.4. The vehicle shall aim at returning to its original lane of travel once the situation that required the lateral manoeuvre has passed.]

*Point of discussion 5.4.2.4.: Text from JRC/EC (UNR157-03-06) to be confirmed (Reminder: definition for 'regular LCP' might need to be introduced, if inserted here as (new) term.)
New text proposal by leadership: ~~strikethrough~~ and underlined.*

Homework 9th SIG: JP to come with new text.

Paragraph 5.4.2.4., insert to read:

[5.4.2.4. In case the ALKS is capable to perform [a regular] LCP, it shall be aimed that [a regular] LCP is not part of the transition phase, meaning that a LCP shall not be started when a the transition demand is known to occur during the procedure not given shortly before or during a LCP, unless the LC is required because operation cannot be continued in the current lane (e.g. due to a lane ending ahead) or when a transition demand is required to be given according to the provisions of this regulation (e.g. due to driver unavailability or an unplanned event).].]

Note: Para. 5.5.1. was not discussed in 9th SIG meeting.

Point of discussion for para.5.5.1. from previous SIG meeting: Can the proposed amendments from industry be agreed and added?

Paragraphs 5.5.1., 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/s².

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. [The ALKS shall either:

- (a) **Keep the vehicle 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; or,**
- (b) **Bring the vehicle to a safe stop outside of its lane of travel, when:**
 - (i) **ALKS is capable of performing a lane change according to paragraph 5.2.6.; and**
 - (ii) **A lane change can be safely performed under the current conditions to bring the vehicle to a safe stop outside its lane of travel.]**

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

[If a lane change procedure is performed during the minimal risk manoeuvre, the signal to activate the hazard warning lights shall be generated again once the vehicle has reached its target lane.]

Group conclusion on para 6.4.1: Proposal agreed.

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 the ALKS is capable of performing 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.”

Point of discussion for para. 7.1: Can proposed amendment in c) be agreed? Underlined text based on suggestion from JP in 7th SIG meeting.

Homework: Industry to come with drawings for c).

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 ~~including the activation of direction indicator in other vehicle:~~

- (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, the full width of the lane next to the target lane, up to the limit of the forward side and rearward 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.

NOTE: The following was not discussed in 9th SIG due to time constraints!

Point of discussion for new para. 7.1.1.1. and 7.1.2.1.: Can the text proposed by Japan (UNR157-07-11) be agreed and added?

Paragraph 7.1.1.1., insert to read:

~~[7.1.1.1. The requirements of this paragraph apply to the system, if the ALKS is capable to perform a LCP.~~

~~———— The manufacturer shall declare the forward detection range measured from the most forward point of the vehicle. This declared range shall be sufficient to cover at least the target lane and the lane next to the target lane.~~

~~———— 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 7.1.2.1., insert to read:

~~[7.1.2.1. The requirements of this paragraph apply to the system, if the ALKS is capable to perform a LCP.~~

~~———— The manufacturer shall declare the lateral detection range. This declared range shall be sufficient to cover at least the target lane and the lane next to the target lane.~~

~~———— 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.]~~

Point of discussion for para.7.1.3.: Can the text be confirmed? (Most recent amendment proposed by JP (underlined text, UNR157-07-11) in 7th SIG to align with proposal for para. 7.1.)

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 the ALKS is capable to perform a LCP.

The manufacturer shall declare the rear detection range measured from the most rearward point of the vehicle. This declared range shall be sufficient to cover at least the target lane and the lane next to the target lane.

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.]

Point of discussion for 7.1.5.: Can proposed amendments be confirmed?

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].

Point of discussion Annex 5, para.4.6.: Can proposed amendments be confirmed? (Most recent amendment proposed by JP (underlined text, UNR157-07-11) in 7th SIG to align with proposal for para. 7.1.)

Annex 5, Tests, 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

Kommentiert [KT(19)]: As agreed when adopting the first supplement to UN-R157.

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 front, side and rearward detection range at least the target lane and the lane next to the target lane.]**

4.6.2. The test for the forward detection

~~4.6.2.1~~ **The requirements of this paragraph apply to the system, if the ALKS is capable to perform a LCP.**

The test for the forward detection range shall be executed at least:

- (a) — When approaching a motorcycle target positioned at the outer edge of each target lane and the lane next to the target lane;**
- (b) — When approaching a stationary pedestrian target positioned at the outer edge of each target lane and the lane next to the target lane;**

4.6.3. The test for the lateral detection range

~~4.6.3.1~~ **The requirements of this paragraph apply to the system, if the ALKS is capable to perform a LCP.**

The test for the lateral detection range shall be executed at least:

- (a) — With a motorcycle target approaching the ALKS vehicle from the left target lane and the lane next to the target lane;**
- (b) — With a motorcycle target approaching the ALKS vehicle from the right target lane and the lane next to the target lane.**

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~~ target lane and the lane next to the target lane;
- (b) With a motorcycle approaching the ALKS from the rear in the right ~~adjacent lane~~ target lane and the lane next to the target lane.]

Point of discussion for Annex 5, para.4.7.: Can proposed amendments be confirmed?

Annex 5, ~~7~~ests, insert a new paragraphs 4.7., 4.8. and 4.9. to read:

4.7. Lane changing

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

The tests shall demonstrate that the ALKS does not cause an unreasonable risk to safety of the vehicle occupants and other road users during a Lane Change Procedure (LCP), is capable of correctly performing lane changes and 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 1.0 second preventing a lane change;
- (e) With a vehicle driving beside in the adjacent lane preventing a lane change;

Kommentiert [KT(20): What purpose does the information that there is a motorcycle/pedestrian 150m ahead in the second to next lane serve? Pedestrians don't activate direction indicators to change lanes and a motorcycle changing lanes 150m ahead of me is hardly ever causing a safety critical situation.

Kommentiert [KT(21): Instead we should include a test case for LC, were we assess the system's capability to mitigate a risk in a scenario were two vehicles aim to change into the same target area.

Kommentiert [KT(22): To be reviewed when LC requirements are fixed.

- (f) In a scenario where a LCM during a minimal risk manoeuvre is possible and executed.

4.7.2. The following on road-tests shall be executed:

- (a) With the ALKS vehicle performing lane change in the adjacent (target) lane;
- (b) Merging at motorway entry;
- (c) Merging at lane end;
- (d) Merging into an occupied lane.]

Point of discussion for Annex 5, para.4.8.: Can proposed amendments be confirmed?

Homework: Industry to check with para. 5.4. and 5.5. of Annexes 4 and 5.

[4.8 Detect and response to traffic rules and road furniture

4.8.1. These tests shall ensure that the ALKS respects traffic rules, detects and adapts to a variation of permanent and temporary road furniture.

4.8.2. The test shall be executed at least with the list of scenarios below, but based on the ODD of the given system:

- (a) Different speed limit signs, so that the ALKS vehicle has to change its speed according to the indicated values;
- (b) Signal lights of an ending lane. The signal lights are set above the belonging lanes, and the signal lights of adjacent lanes are kept in green state, while the one of the current lane for the ALKS vehicle is kept red.;
- (c) Driving through a tunnel: at least [X]m long section of the road with no sunlight and availability of the positioning system.
- (d) Toll station: a section of the motorway with toll station-, speed limit signs and buildings (ticket machines, barriers, etc.).
- (e) Temporary modifications: e.g., road maintenance operations indicated by traffic signs, cones and other modifications.

4.8.3. Each test shall be executed at least:

- (a) Without a lead vehicle;
- (b) With a passenger car target as well as a PTW target as the lead vehicle / other vehicle.]

Point of discussion for Annex 5, para.4.9.: Can proposed amendments in be confirmed?

[4.9. Avoid braking before a passable object in the lane

4.9.1. The test shall demonstrate that the ALKS vehicle is not braking without a reason before a passable object in the lane (e.g., a manhole lid or a small branch).

4.9.2. The test shall be executed at least:

- (a) Without a lead vehicle;
- (b) With a passenger car target as well as a PTW target as the lead vehicle / other vehicle.]

II. Justification