

Submitted by the leadership of SIG UNR157

UNR157-11-04

The text reproduced reflects the state of play of the discussion in the SIG UNR157 up to its 10th 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 ~~struck through~~ for deleted characters.

Comments:

- Agreements and group conclusions highlighted in **grey** with changes from UNR157-10-04 highlighted in **blue**.
- Open points of discussions highlighted in **yellow**. In particular: **Homework**

OICA/CLEPA comments to SIG ALKS-11

I. Proposal

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 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 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.]

[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.]

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~~ **what is** declared as detection ranges according to paragraph 7.1. **and its** subparagraphs).

Point of discussion on 5.2.1.: Can new proposal from industry (UNR157-10-05) in [] be agreed to? Concerns raised by JP and SE. Consider moving proposed new text to new, separate paragraph.

Homework: Industry to come with new proposal addressing the raised concerns.

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 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.]~~

~~[When necessary to follow applicable traffic rules or to avoid disruptions in the traffic flow, the ALKS vehicle is permitted to intentionally cross lane markings (e.g. forming an access corridor for emergency vehicles or passing an obstacle partly blocking the lane of travel). Such lane crossings are not considered to be a lane change as defined in Par 5.2.6 or 5.3 [as long as the vehicle remains partly in its original lane of travel].~~

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

~~The manufacturer shall demonstrate to the Technical Service the strategies implemented in the system to ensure that these manoeuvres do not endanger the safety of the vehicle or any other road user.~~

Kommentiert [KT(1): Proposal for alternative wording to the text above in order to address the concerns raised during the last session:

- Better description of what triggers this behavior
- A clear distinction from an actual lane change
- An assessment of the strategies by the Technical Service

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 to capable of performing** 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 (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.

Points of discussion (new): Can new proposal by industry (UNR157-10-06) be agreed to and, if so, is the suggested location correct? JP asked to come back to discussion when their results of internal study on detection range can be presented.

Homework: JP to present study on detection range.

- [5.2.6.5. (?) 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 lanes on a conflicting trajectory).]

Group conclusion on para 5.2.6.5: Grey highlighted text agreed;

Points of discussion: Come back to a) and decide if [] can be removed, and whether d) should be deleted, when JP provides data on their scenario validation study. Come back to b) and decide, if subpara. needed (may not be needed since sufficiently covered by para. 5.1.6.); e)-g): are placed under regular LC requirements (see para. 5.2.6.5.1.).

Homework: JP to present scenario validation study (for a and d)).

- 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).]~~

~~(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.~~

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

~~(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).~~

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.

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?

Homework: JP to come with additional justification to include 5s-requirement.

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

Point of discussion on 5.2.6.5.2.4.: Come back and decide if amendments are needed to improve wording and if [] can then be removed.

Homework: Industry to come with new wording to factor in there might be conditions leading to situations where stopping in lane is more preferable than changing lanes and then stopping outside the lane of travel.

[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.]

Point of discussion on 5.2.6.5.2.5. (new): Is it agreed that proposal from JP (UNR157-10-11) is not necessary given the provisions in para. 5.5.1.?

[5.2.6.5.2.5. ~~The system shall generate the hazard warning lights to activate. The hazard warning lights shall remain active throughout stay in the target stop area.]~~

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 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.

Group conclusion on para. 5.2.6.6.2. and 5.2.6.6.3.: Agreed.

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 expected to change into the same lane on a conflicting trajectory).

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.

5.2.6.6.3. When several consecutive lane changes are performed, the direction indicator may remain active throughout these lane changes while the

Kommentiert [KT(2): Introduced to address a potential safety concern when two vehicles would try to change into the same lane at the same time. This comes together with the proposed amendments to the field of view, requiring 6m to the side in order to ensure proper detection and assessment of the behavior of other vehicles.

lateral behaviour shall ensure that each lane change manoeuvre can be perceived as an individual manoeuvre by 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

5.2.6.6.4.1. 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.

5.2.6.6.4.2. 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.

Point of discussion para. 5.2.6.6.4.3. and 5.2.6.6.4.4.: Industry proposes to delete para. 5.2.6.6.4.3. and amend para. 5.2.6.6.4.4. as below (see UNR157-10-05), since both para. are addressing the same thing. Can this be agreed to by the group?.

~~**5.2.6.6.4.3.** 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.~~

~~**5.2.6.6.4.4** 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.~~

Group conclusion on 5.2.6.7.1.: 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. JP asked to come back in next meeting and keep [] for the moment, since they are conducting study.

Homework:

~~- JP to come with scenario validation study.~~

~~- UK to come with alternative wording for 'in principle visible' in b) (i).~~

5.2.6.7.2. 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~~ The ALKS vehicle shall not make an approaching vehicle in target lane 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~~, 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.

Group conclusion on para. 5.2.6.7.2.3.: Agreed.

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 160km/h, whichever is lower.

Group conclusion on para. 5.2.6.7.2.4. (renumbered): Agreed

5.2.6.7.2.4. 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 which the following vehicle in target lane travels in 1.0s.

Point of discussion for para. 5.2.6.7.3 and subparagraphs: Confirm tentative agreement with revised wording (~~struck through~~ and new text underlined) to align with para. 5.2.6.7.2.1 .

5.2.6.7.3. 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:

- (a) 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 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 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.~~

(c) 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.

Para. 5.2.6.7.3.2.: Additional wording needed to make sure hard shoulder is not being used as regular lane, but as emergency refuge area. Text in [] to be confirmed.

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 160km/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 equal or lower longitudinal speed shall never be less than the speed which the following vehicle in target lane travels in 0.7s.

Group conclusion on para 5.2.6.7.4 and 5.2.6.7.6.: Agreed. (Consider renumbering of following paragraphs at later stage.)

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

~~[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.]~~

Group conclusion on para 5.2.6.7.7.: Agreed.

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/s^2 , 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.

Group conclusion on para 5.2.6.7.8.: Agreed.

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 fulfill 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.

Group conclusion on para 5.3.1 and subparagraphs: Agreed.

Point of discussion for para. 5.3.2 and 5.3.3. (with subparagraphs).: Can [] be deleted? Is para.5.3.3. for emergency situation only?

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 lateral manoeuvre that leads the ALKS vehicle to cross lane markings in response to a 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.

~~[5.3.3. Lateral Evasive manoeuvre crossing lane crossing markings to minimize the risk of a collision.]~~

[5.3.3.1. The vehicle shall only cross lane markings in response to a risk of imminent 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.]

- [5.3.3.2. 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 imminent collision.]
- [5.3.3.3. The vehicle shall only cross lane markings in response to a risk of imminent collision if another vehicle in the evasive lane is not forced to unmanageably decelerate due to that manoeuvre.]
- [5.3.3.3.1. 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.]
- [5.3.3.3.2. 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.]
- [5.3.3.3.3. 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.]
- [5.3.3.4. 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 for para. 5.3.3.5.: New proposal from JP (UNR157-10-11) in 9th SIG, need to come back in next SIG meeting.

- [5.3.3.5. ~~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 crossing the lane markings and shall be deactivated by the system in a timely manner once the lane keeping functionality is resumed.~~

~~When initiating an evasive manoeuvre that intends to cross into the adjacent lane by more than [30cm], the system shall indicate its intention to change into the adjacent lane by generating the signal to activate the direction indicator.]~~

Kommentiert [KT(3): Alternative wording to the text above, reflecting that minor crossing could go without indication in order avoid confusing other road users.

Point of discussion 5.4.2.4.: Can proposed text be agreed and [] removed?

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 transition demand is known to occur during the procedure.~~

~~When a LCP is required to be performed during the transition phase (e.g. when the lane is ending ahead), the system shall implement appropriate strategies to ensure the driver can resume control safely even during this maneuver (e.g. appropriate HMI, adapted overriding thresholds, limiting the max. lateral acceleration).~~

Kommentiert [KT(4): Alternative wording to the text above picking up on the proposal to reflect the actual safety goal without prohibiting the behavior altogether.

Point of discussion for para.5.5.1.: Can the proposed amendments from industry (UNR157-10-12) be agreed and [] removed?

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, preferably outside of the regular lanes of travel, when:**
 - (i) **the 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.]~~ this target stop area can be considered minimizing the risk under the given circumstances (e.g. traffic situation, environmental conditions, system failures); or else,]**

Additionally, the signal to activate the hazard warning lights shall be generated with the start of the minimum risk manoeuvre **but suspended during a LCP.**

~~**[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 stop area.]**~~

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."

Kommentiert [KT(5): This sentence should not be needed anymore with the addition of "but suspended during a LCP" in the previous sentence.

Point of discussion for para. 7.1: Can the proposed amendments be agreed to? In 9th SIG OICA/CLEPA proposed to delete reference to direction indicator and indicated they could then agree to remove [] in c). Come back and finalize discussion when JP has presented study.

Homework: JP to come with scenario validation study.

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, At least up to 6m to each side measured from the center of the ALKS vehicle 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.

Point of discussion for new para. 7.1.1.1., 7.1.2.1 and 7.1.3.: Can the text proposed by Japan (UNR157-07-11) be agreed and added? Come back and finalize discussion when JP has presented study on detection range.

Homework: JP to come with study on detection range.

Paragraph 7.1.1.1., insert to read:

[7.1.1.1. The requirements of this paragraph additionally 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~~ an area 6m to the side(s) to which the ALKS performs a LCP measured from the center of the ALKS vehicle.

The Technical Service shall verify that the distance at which the vehicle sensing system detects a ~~road-user~~ vehicle 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 additionally 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~~ an area 6m to the side(s) to which the ALKS performs a LCP measured from the center of the ALKS vehicle.

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

Kommentiert [KT(6): In order to align with similar requirements in other regulations, OICA/CLEPA propose to refer to an actual distance to the side instead of naming the lanes.

Kommentiert [KT(7): OICA/CLEPA can agree to this requirement provided we clarify that this applies to vehicles. As this requirement originates from the concern that another vehicle (incl. PTW) could change into the same lane, there is no need to apply this to pedestrians.

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~~ an area 6m to the side(s) to which the ALKS performs a LCP measured from the center of the ALKS vehicle.

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

Group conclusion on para 7.1.5.: Agreed. ("Vehicle" deleted to be line with latest UNR 157 version (=suppl.1 to 00 series))

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.

Note: Following paragraphs for Annex 5 not discussed in 10th SIG.

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 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 within an area 6m to the side(s) to which the ALKS performs a LCP measured from the center of the ALKS vehicle.]**

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 6m to the side(s) to which the ALKS performs a LCP from the center of the ALKS vehicle;

(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 left side;

(b) With a motorcycle target approaching the ALKS vehicle from the left target lane and the lane next to the target lane right side.

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 rear in the left adjacent lane target lane and the lane next to the target lane within an area 6m to the left measured from the center of the ALKS vehicle;

(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 within an area 6m to the right measured from the center of the ALKS vehicle.]

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

Annex 5, Tests, 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;

(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