

Proposal for amendments regarding WP.29/2022/59

Modifications to the existing text of UN-Regulation No. 157 are in **bold** for new or ~~striketrough~~ for deleted characters.

Modifications to WP.29/2022/59 are in **green bold** for new or ~~green striketrough~~ for deleted characters.

Modifications since UNR157-14-03 and UNR157-14-04 are highlighted in tracked changes.

Amendments **highlighted yellow** are still to be confirmed.

I. Proposal

Paragraph 2.26., amended to read:

- 2.26.** 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 ~~for combination~~.

Paragraph 2.32., amended to read:

- 2.32.** "Potential Vehicle Presence Area (PVPA)" is the **area** in which another vehicle could be relevant to the ALKS when performing a lane change and that is enclosed by the following:
- (a)** a line to the front of the vehicle, perpendicular to the direction of travel at the minimum following distance specified in paragraph 5.2.3.3. measured from the forward most point of the vehicle;
 - (b)** a line to the rear of the vehicle, perpendicular to the direction of travel at the critical distance established by paragraph 5.2.6.7.2.~~3.12~~.
 - (c)** a line parallel to the direction of travel along the side of the vehicle that is not adjacent to the target lane; and
 - (d)** a line parallel to the direction of travel along the furthest lane marking of the lane beyond to the target lane or of the target lane if there is not one beyond it.

Lines (a) and (b) change according to the speed at which the ALKS vehicle travels.

Insert new paragraph 2.33., to read:

- 2.33.** A "vehicle" means a single **power-driven vehicle or a combination of ~~vehicles~~a power-driven vehicle and trailer(s) if they are operated in combination.**

Paragraph 4.4.2., amended to read:

- 4.4.2.** The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in paragraph 4.4.1. ~~above~~;

Insert new paragraph 4.4.3., to read:

- 4.4.3.** An additional symbol after the letter "R" prescribed in paragraph 4.4.2. (if applicable):
- 4.4.3.1.** "LC" in the case of a ALKS capable of a LCP.

Paragraph 5.1.1., amended to read:

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.

The activated system shall not cause any collisions that are reasonably foreseeable and preventable. If a collision can be safely avoided without causing another one, it shall be avoided. ~~When the vehicle is involved in a detectable collision the vehicle shall be brought to a standstill.~~

Renumber original paragraph 5.1.1.1. to 5.1.1.2. and insert a new paragraph 5.1.1.1., to read:

5.1.1.1. The ALKS shall respond whilst active to any collision which requires a response according to national traffic rules (e.g. bringing the vehicle to standstill) and which could be expected to be recognised by a competent and careful human driver. In the case of such a collision and without prejudice to paragraph 5.4.4.1.1., a transition demand shall be given, unless one is already being given.

Paragraphs 5.2.1.1. to 5.2.1.5., amended to read:

5.2.1.1. A vehicle with ALKS enabled, and equipped with a sensing system to the front, side and rear that is sufficient to assess the criticality of crossing into another lane, is permitted to intentionally cross lane markings when:

- (a) performing a LCP according to paragraph 5.2.6.;
- (b) performing an evasive lane crossing during an EM according to paragraph 5.3.;
- (c) forming ~~an access~~ an access corridor for emergency and enforcement vehicles according to paragraph 5.2.1.2.;
- (d) partly entering into the adjacent lane according to paragraph 5.2.1.3. in order to drive around an obstacle partly blocking the lane.

5.2.1.2. Forming an access corridor for emergency and enforcement vehicles

The ALKS shall only leave its current lane of travel to form an access corridor for emergency and enforcement vehicles where this is required according to national traffic rules or common practise by other road users.

The ALKS shall ensure sufficient lateral and longitudinal distance to road boundaries, vehicles and other road users.

The vehicle shall return completely to its original lane of travel once the situation that required this access corridor has passed.

5.2.1.3. Crossing lane markings in order to drive around an obstacle

5.2.1.3.1. The ALKS shall only respond to an obstacle by entering partly into the adjacent lane if a regular lane change out of its current lane of travel is not possible, e.g. due to the traffic situation or an adjacent lane not being available and if this behaviour can be considered not to increase the risk to the vehicle occupants and other road users.

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

5.2.1.3.3 These manoeuvres shall not endanger the safety of the vehicle occupants or any other road user by:

- (a) ensuring sufficient lateral and longitudinal distance to road boundaries, vehicle and other road users;
- (b) the lateral acceleration not exceeding ~~{1.0}~~ m/s²; and
- (c) complying with the assessment of the target lane according to paragraph 5.2.6.7.2. and its sub-paragraphs when

crossing the lane marking by more than ~~[half/a third]~~ of the vehicle's width 1.0 m.

- 5.2.1.4. The manufacturer shall demonstrate to the Technical Service how the system fulfils the requirements of paragraphs 5.2.1.2. and 5.2.1.3. if the system is capable of performing any of the manoeuvres described therein.

Paragraph 5.2.3.1., amended to read:

5.2.3.1. Speed

The manufacturer shall declare the specified maximum speed based on the forward detection range of the system as described in paragraph 7.1.1.

The maximum speed up to which the system is permitted to operate is ~~60~~ **130** km/h.

~~Specified A specified maximum speeds of more than 60 km/h shall only be permissible permitted only if the ALKS is capable of performing bringing the vehicle to standstill on the hard shoulder during an MRM lane change according to paragraph 5.2.6. [x].~~

~~[Operational speeds of more than [60 km/h] are permitted either:~~

~~(a) Up to [90]km/h exclusively in the slowest lane of travel, provided there is surrounding traffic travelling at a similar speed (e.g. dense traffic or following a lead vehicle); or~~

~~(b) In all lanes of travel, if the ALKS is capable of changing lanes to bring the vehicle to a standstill outside of the regular lanes of travel during an MRM according to paragraph [X].~~

~~Systems that operate above 60 km/h up to [90]km/h without lane change capability shall implement strategies to minimize the risk of stopping in lane to the vehicle occupants and other road users, e.g. adapted deceleration strategy, operation only under good visibility.]~~

Paragraphs 5.2.6.1.1. and 5.2.6.1.2., amend to read:

- 5.2.6.1.1. The intervention shall not cause a collision with ~~an~~ other vehicles or other road users 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 vehicles or other road users.

Renumber following footnotes accordingly and Paragraph 5.2.6.5.1., amended to read:

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

The activated system shall only initiate³ a regular lane change LCP if the following conditions are fulfilled:

- (a) 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, where a lane change is required by national traffic rules).
- (b) The target lane is a regular lane of travel, or hard shoulder temporarily opened up as a regular lane of travel.
- (c) 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.

~~(d) — There is no other vehicle in the PVPA, whose priority resulting from its active direction indicators, would prevent a LCP by the ALKS according to national traffic rules.~~

³ Initiation of a regular lane change shall only be permitted for a vehicle of Category M₁ or N₁.

Paragraph 5.2.6.5.2.3., amended to read:

5.2.6.5.2.3. A lane change procedure shall not start within the first 3 seconds following the start of the MRM intervention, unless an **earlier sooner** initiation is required either in order to reach a minimal risk target stop area (e.g. when the hard shoulder is ending ahead or in case of failure) or if the lane change manoeuvre can be performed with a criticality equal to that of a regular lane change.

Paragraph 5.2.6.6.1., amended to read:

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.

Paragraph 5.1.6.6.4., renumbered to 5.2.6.6.4.

5.2.6.6.4. 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 following traffic.

Paragraphs 5.2.6.6.5.1.1. and 5.2.6.6.5.1.2., amend to read:

5.2.6.6.5.1.1. Another vehicle's potential for changing into the target lane on a conflicting trajectory shall be assessed, based on **aspects such as:** its direction indicator status, **the vehicle's** dynamics, ~~and~~ the surrounding traffic.

5.2.6.6.5.1.2. If there is an area in the PVPA where the system is not able to assess the status of the direction indicator on another vehicle on the basis of the declaration in 7.1.4., a LCM shall not be initiated if there is another vehicle in that part of the PVPA, except whose movement can be assessed not to conflict with the trajectory of the ALKS vehicle, ~~except and~~ for following vehicles at and near merging and departing lanes. In such circumstances, an approaching vehicle in the lane next to the target lane shall be treated like an approaching vehicle in the target lane.

Paragraphs 5.1.6.6.6.1., 5.1.6.6.2. and 5.1.6.6.6.3., renumbered to 5.2.6.6.6.1, 5.2.6.6.6.2. and 5.2.6.6.6.3.

5.2.6.6.6.1. 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.

5.2.6.6.6.2. 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.

5.2.6.6.6.3. 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 marking.

Paragraph 5.2.6.7.2.1., amended to read:

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 **aim not to** make an approaching vehicle in the

target lane decelerate, particularly in the case where the lane change is not urgent (e.g. for the purpose of overtaking a slower moving vehicle). But where this is necessary due to the traffic situation, in the absence of more specific traffic rules, the ~~approaching vehicle shall not have to~~ **ALKS vehicle shall not make an approaching vehicle in the target lane** decelerate at a higher level than A m/s², B seconds after the ALKS vehicle starts, to ensure the distance between the two vehicles is never less than that which the ALKS vehicle travels in C seconds.

...

Paragraph 5.2.6.7.2.2., deleted:

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

Paragraph 5.2.6.7.2.3. (first), renumbered to 5.2.6.7.2.2.

5.2.6.7.2.3.2. When there is no vehicle detected

If no approaching vehicle is detected by the system in the target lane, the assessment shall be calculated as per 5.2.6.7.2.1. with the assumption that:

- (a) the approaching vehicle in the target lane is at a distance from the ALKS vehicle equal to the actual rearward detection range;
- (b) the approaching vehicle in the target lane is travelling with the allowed maximum speed + 30km/h or 160km/h, whichever is lower; and
- (c) the full width of the approaching vehicle is detected by the ALKS vehicle during its lateral movement for at least 1 second.

Paragraph 5.2.6.7.2.3. (second), amended to read:

5.2.6.7.2.3. 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 distance which the following vehicle in **the** target lane travels in 1.0 **second**.

Paragraph 5.2.6.7.3.1., amended to read:

5.2.6.7.3.1. When there is an approaching vehicle

In the absence of more specific traffic rules, ~~an approaching vehicle in the target lane should not have to~~ **the ALKS vehicle shall aim not make to an approaching vehicle in the target lane** decelerate at a higher level than A m/s², B seconds after the ALKS vehicle starts

...

Paragraph 5.2.6.7.3.3., amend to read:

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 distance which the following vehicle in **the** target lane travels in 0.7 **seconds**.

Paragraphs 5.2.6.7.4. and 5.2.6.7.5., amended to read

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~~.

5.2.6.7.5. 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 **demand** shall not exceed 2 m/s², except for the purpose of avoiding or mitigating the risk of an imminent collision 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.

Paragraph 5.3.5.1. and 5.3.5.2., amended to read:

{5.3.5.1. An ALKS shall aim to avoid an evasive lane crossing ~~shall only be performed by the ALKS~~ when the imminent collision risk was ~~not~~ present or occurring within the detection ranges declared by paragraph 7.1. before it became an imminent collision risk.}

5.3.5.2. If utilising an evasive lane crossing as part of an emergency manoeuvre, the ALKS shall ensure that it is **as at least as safe to the vehicle occupants and other road users as avoiding the imminent collision risk ~~with the vehicle's full~~ by braking **performance**.**

Paragraph 5.3.5.5., amended to read:

{5.3.5.5. The vehicle shall only perform an evasive lane crossing if another vehicle in the evading lane is not forced to unmanageably decelerate due to that manoeuvre.}

Paragraph 5.4.2.1., amended to read:

5.4.2.1. In case of a planned event that would prevent the ALKS from continuing the operation, a transition demand shall be given early enough to ensure the minimal risk ~~manoeuvre~~ **manoeuvre**, in case the driver would not resume control, would bring the vehicle to standstill before the planned event occurs.

Paragraph 5.5.1 (renumbered), amended to read:

5.5.2.1. The minimum risk manoeuvre shall bring the vehicle to standstill unless the system is deactivated by the driver during the manoeuvre.

This shall be in a target stop area considered to be the greatest minimising minimisation of risk achievable under the given circumstances (e.g. traffic situation, environmental conditions, system failures), performed according to paragraph 5.2.6., if a lane change is required to reach the target stop area and the ALKS is capable of performing a MRM lane change during an MRM.

Otherwise, within its current lane, or in the case the lane markings are not visible, following an appropriate trajectory taking into account surrounding traffic and road infrastructure.

Paragraph 5.5.2. (second), to be deleted:

~~5.5.2. The minimum risk manoeuvre shall bring the vehicle to standstill unless the system is deactivated by the driver during the manoeuvre.~~

Renumber paragraphs 6.3.5. and 6.3.6. to 6.3.6. and 6.3.7.

Insert new paragraph 6.3.5. to read:

6.3.5. Any driver activation of the direction indicator shall immediately initiate a transition demand as specified in paragraph 5.4., when the input exceeds a reasonable threshold designed to prevent unintentional activation.

Paragraph 6.4.3. and its sub-paragraphs, amended to read:

6.4.3. Transition phase and minimum risk manoeuvre

6.4.3.1. During the transition phase and the MRM, the system shall instruct the driver in an intuitive and unambiguous way to take over manual control of the vehicle. The instruction shall include ...

Paragraphs 7., 7.1., 7.1.1., and 7.1.1.1., amended to read:

7. Object and Event Detection and Response (OEDR)

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.

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 ~~or combination~~ and up to the limit of the lateral detection range.

If the ALKS is capable of performing a LCP, in addition to above, a sensing system shall ...

7.1.1. Forward detection range

The manufacturer shall ...

A specified maximum speed above 60 km/h shall only be declared by the manufacturer, if the declared forward detection range fulfils the corresponding minimum value according the following table based on a deceleration of 5m/s²:

...

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

The declared range in paragraph 7.1.1. shall be sufficient to cover at least an area 9m to the side(s) to which the ALKS performs a LCP measured from the centreline of the ALKS vehicle.

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

Paragraphs 7.1.2. and 7.1.2.1., amended to read:

7.1.2. Lateral detection range

The manufacturer shall declare the lateral detection range. The declared range shall be sufficient to cover the full width of the lane immediately to the left and of the lane immediately to the right of the vehicle ~~or combination~~.

The Technical Service shall verify that the vehicle sensing system detects vehicles during the relevant test in Annex 5. This range shall be equal or greater than the declared range.

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 also declare the lateral detection range that shall be sufficient to cover at least an area 9m to the side(s) to which the ALKS performs a LCP measured from the centreline of the ALKS vehicle.

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

Paragraph 7.1.3., amended 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 rearward detection range measured from the most rearward point of the vehicle. This declared range shall be sufficient to cover at least an area 9m to the side(s) to which the ALKS performs a LCP measured from the **centreline** of the ALKS vehicle.

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

Paragraph 7.1.4., amended to read:

7.1.4. Direction indicator status detection area

The manufacturer shall declare the area, **if any**, within the PVPA in which the system is able to assess the status of other vehicle's direction indicators. This shall account for the different direction indicator positions ~~of~~ **on** vehicles which are normally operated in the PVPA in the system's countries of operation.

The Technical Service shall verify this area during the relevant test in Annex 5.

Paragraph 7.1.6., amended to read:

7.1.6. 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 values** specified in paragraph 7.1. over the lifetime of the system.

Paragraph 7.1.7., amended to read:

7.1.7. The fulfilment of the provisions of paragraph 7.1. and its subparagraphs shall be demonstrated to the technical service and tested according to the relevant tests in Annex 5.

Where the ALKS can operate **with in** a vehicle combination, the manufacturer shall demonstrate to the Technical Service at the time of type approval the strategies implemented to ensure that the sensing capability is always sufficient for the length of trailer attached.

Paragraph 8.2.1., amended to read:

8.2.1. Each vehicle equipped with a DSSAD shall at least record an entry for each of the following occurrences upon activation of the system:

...

- (e) Start of Emergency Manoeuvre;
- (f) End of Emergency Manoeuvre;
 - (i) **Vehicle has remained in lane;**
 - (ii) **Vehicle has crossed into evading lane.**
- (g) Event Data Recorder (EDR) trigger input;
- (h) Involved in a detected collision;
- (i) Minimum Risk Manoeuvre engagement by the system;
- (j) Severe ALKS failure;
- (k) Severe vehicle failure;
- (l) **Start of Lane Change Procedure;**
- (m) **End of Lane Change Procedure;**
- (n) **Aborted Lane Change Procedure;**

- (o) Start of intentional lane crossing (not LCP);
- (p) End of intentional lane crossing (not LCP).

Insert new paragraph 8.2.2., to read:

8.2.2. Occurrences flags for the start and end of Lane Change Procedure (paragraph (l) and (m)) shall only be recorded if they:

- (a) happen within 60 seconds of an Emergency Manoeuvre or EDR trigger input occurrence;**
- (b) happen within 5 seconds of a system override;**
- (c) are part of a LCP that results in an Aborted Lane Change Procedure occurrence flag; or**
- (d) occur in connection with a Minimum Risk Manoeuvre lane change.**

Paragraph 8.4.5 and its subparagraphs., amended to read:

{8.4.5. Retrieval in conjunction with EDR data

- 8.4.5.1. For vehicles fitted with an EDR in accordance with UN Regulation 160, it shall be possible to retrieve through the standard interface (OBD port) the DSSAD data elements as referred to in paragraphs 8.3.1(a) and 8.3.1.(b) recorded for at least the last 30 seconds before the last setting of the occurrence flag “Event Data Recorder (EDR) trigger input”, alongside the data elements specified in UN Regulation 160, Annex 4 (EDR data).**
- 8.4.5.2. In the absence of any occurrence referred to in paragraph 8.2.1. within the last 30 seconds before the last setting of the occurrence flag “Event Data Recorder (EDR) trigger input”, it shall be possible to retrieve, alongside the EDR data, the data element corresponding to the last occurrences within the same power cycle referred to in paragraphs 8.2.1.(a) and (b), as a minimum.**
- 8.4.5.3. If required by national or regional law, the data elements retrieved in accordance with paragraph 8.4.5.1. or 8.4.5.2. shall not include the date (as referred to in paragraph 8.3.1.(c)) and the timestamp (as referred to in paragraph 8.3.1.(d)) or any other information allowing for identification of the vehicle, its user or owner. Instead the time stamp shall be replaced with information representing the time difference between the occurrence flag “Event Data Recorder (EDR) trigger input” and the occurrence flag of the respective DSSAD data element.}**

Paragraph 12.1., amended to read:

- 12.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 8 11, above are not complied with.**

Paragraph 15. and its subparagraphs, amended to read:

{15. Transitional provisions

- 15.1. As from the official date of entry into force of the 01 series of amendments, no Contracting Party applying this Regulation shall refuse to grant or refuse to accept type approvals under this Regulation as amended by the 01 series of amendments.**
- 15.2. As from 1 September 2023, Contracting Parties applying this Regulation shall not be obliged to accept type approvals to the original version of this Regulation, first issued after 1 September 2023.**
- 15.3. Until 1 September 2024, Contracting Parties applying this Regulation shall accept type approvals to the original version of this Regulation, first issued before 1 September 2023.**

15.4. ~~Contracting Parties applying this Regulation shall not refuse to grant type approvals according to any preceding series of amendments to this Regulation or extensions thereof~~ As from 1 September 2024, Contracting Parties applying this Regulation shall not be obliged to accept type approvals issued to the preceding series of amendments to this Regulation.

15.5 Notwithstanding paragraph 15.4, Contracting Parties applying this Regulation shall continue to accept type approvals issued according to the preceding series of amendments to the Regulation, for vehicles which have no capability to intentionally cross any lane marking as per paragraph 5.2.1.1..

15.6 Contracting Parties applying this Regulation may grant type approvals according to any preceding series of amendments to this Regulation.

15.7 Contracting Parties applying this Regulation shall continue to grant extensions of existing approvals to any preceding series of amendments to this Regulation.

Annex 1 amended to read:

Annex 1

...

6.4. Software Identification of the ALKS (if applicable):

6.5 ALKS capable of: MRM lane change / Regular lane change / Evasive lane crossing / other lane crossing²

7. Written description and/or drawing of the ALKS Human Machine Interface including:

...

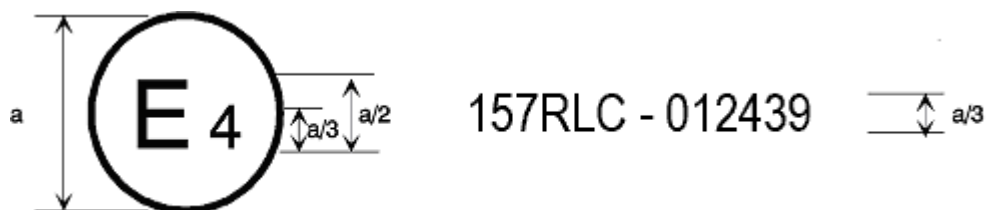
Annex 2, amended to read:

Annex 2

Arrangements of approval marks

Model A

(See paragraph 4.4. of this Regulation)

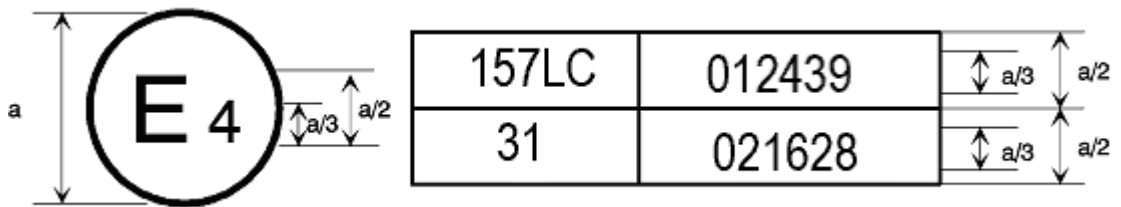


a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to ALKS, been approved in the Netherlands (E 4) pursuant to UN Regulation No. 157 under approval No. ~~002439~~ **012439** and is capable of a lane change procedure. The approval number indicates that the approval was granted in accordance with the requirements of UN Regulation No. 157 ~~in its original version~~ **with the 01 series of amendments incorporated.**

Model B

(See paragraph 4.5. of this Regulation)



a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E 4) pursuant to Regulations Nos. 157 (**capable of a lane change procedure**) and 31.¹ The approval numbers indicate that, at the dates when the respective approvals were given, UN Regulation No. 157 ~~was in its original version~~ **included the 01 series of amendments** and UN Regulation No. 31 included the 02 series of amendments.

Annex 5, paragraph 2.7., amended to read:

- 2.7. A “passable object” is such an object, that may be **rolled driven over without causing an unreasonable risk to the vehicle occupants or other road users regardless of whether the tyre of the ALKS vehicle comes in contact with the object or not.**

Annex 5, insert new paragraph 2.8., to read

- 2.8. **“Operational Design Domain (ODD)” of the automated lane keeping system defines the specific operating conditions (e.g. environmental, geographic, time-of-day, traffic, infrastructure, speed range, weather and other conditions) within the boundaries fixed by this regulation under which the automated lane keeping system is designed to operate without any intervention by the driver.**

Annex 5, paragraph 3.2.3., amended to read:

- 3.2.3. **In order to test the requirements for failure of functions, self-testing and initialization initialisation of the system, and implementation of a minimal risk manoeuvre, errors may be artificially induced and the vehicle may be artificially brought into situations where it reaches the limits of the defined operating range (e.g., environmental conditions).**

It shall be verified, that the condition of the system is according to the intended testing purpose (e.g. in a fault-free condition or with the specific faults to be tested).

Annex 5, paragraph 3.2.5.1., amended to read:

- 3.2.5.1. **Test mass**

The subject vehicle shall be tested in a load condition agreed between the manufacturer and the type-approval authority. No load alteration shall be made once the test procedure has begun. The vehicle manufacturer shall demonstrate, through the use of documentation, that the system works at all load conditions.

Annex 5, paragraph 4., amended to read:

- 4. Test scenarios to assess the performance of the system with regard to the dynamic driving task**

Test scenarios shall be selected depending on the Operational Design Domain (ODD).

At the time of type approval, ~~the Technical Service~~ **type-approval authority** shall conduct or shall witness at least the following tests to assess the behaviour of the ALKS:

~~Test scenarios shall be selected depending on the Operational Design Domain (ODD):~~

Annex 5, paragraph 4.6.1., amended to read:

- 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 as declared in paragraphs 7.1., 7.1.1.1., 7.1.2.1. and 7.1.3., and, if applicable, the direction indicator status of another vehicle within the direction indicator status detection area as declared in paragraph 7.1.4.**

Annex 5, paragraph 4.6.2.2., amended to read:

- 4.6.2.2.** 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 when approaching a PTW target positioned 9m to the side(s) to which the ALKS performs a LCP, measured from the **centreline** of the ALKS vehicle.

Annex 5, paragraph 4.6.3.2., amended to read:

- 4.6.3.2.** 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 with:
- (a) a PTW target approaching the ALKS vehicle 9m to the left side of the ALKS, measured from the **centreline** of the ALKS vehicle;
 - (b) a PTW target approaching the ALKS vehicle 9m to the right side of the ALKS, measured from the **centreline** of the ALKS vehicle.

Annex 5, paragraphs 4.6.4. and 4.6.4.1., amended to read:

- 4.6.4. Reward Rearward detection range**
- 4.6.4.1. The requirements of this paragraph apply to the system, if the ALKS is capable to perform a LCP.
- The test for the rear detection range shall be executed at least with:
- (a) a PTW approaching the ALKS from the rear within an area 9m to the left of the ALKS vehicle, measured from the **centreline** of the ALKS vehicle;
 - (b) a PTW approaching the ALKS from the rear within an area 9m to the right of the ALKS vehicle, measured from the **centreline** of the ALKS vehicle.

Annex 5, paragraphs 4.6.5. and 4.6.5.1., amended to read:

- 4.6.5. Direction indicator status detection range area**
- 4.6.5.1. The provisions of this paragraph apply to the ALKS that has a capability of detecting the direction indicator status of another vehicle.
- The test for the detection area of direction indicator shall be executed at least with:
- (a) an activation of direction indicator of a vehicle positioned at random within the area declared in paragraph 7.1.4. of this Regulation;
 - (b) different types of vehicles, including passenger car and PTW.

Annex 5, Paragraph 5.2 (table), amended to read:

“...
...”

Reference in
main text

Test/Check

...

...

5.1.1.1. System reaction in case of a detectable collision which results in a transition demand

...

...”

Appendix 1 of Annex 6 to be moved to Annex 5 and amended to read:

Appendix 1

Guidance to determine the difficulty of the test

Following data sheets are pictorial examples of simulations, which determines conditions under which ALKS shall avoid a collision, taking into account the combination of every parameter in accordance to the Performance models of Annex 3 4 Appendix 3, at and below the maximum permitted ALKS vehicle speed.

1. In case of performance model 1 in Annex 3 4

Where collision is deemed to be avoidable, three subsets are defined, to differentiate between the parameter sets based on their difficulty in accordance to the Performance model 1 laid down in paragraph 3.3 of Annex 3 4 Appendix 3:

- “Avoidable” conditions are highlighted by green colour,
- “Difficult” conditions are highlighted by blue colour, while
- “Unavoidable” is highlighted by red colour.

...

2. In case of performance model 2 of Annex 3 4

Following data sheets are pictorial examples of simulations which determine conditions under which ALKS shall avoid a collision, taking into account the combination of every parameter, at and below the maximum permitted ALKS vehicle speed.

Where collision is deemed to be avoidable, three subsets are defined, to differentiate between the parameter sets based on their difficulty in accordance to the performance model 2 laid down in paragraph 3.4 of Annex 3 4 Appendix 3:

- “Easy” conditions are highlighted by green colour,
- “Medium” conditions are highlighted by yellow colour,
- “Difficult” conditions are highlighted by red colour, while
- “Unavoidable collision” is highlighted by red colour with black “X”.

2.1. Cut in

Classification of difficulty of the scenarios based on the initial parameters is done the following way in accordance to the performance model laid down in paragraph 3.4 of Annex 3 4 Appendix 3:

- Easy: PFS ≤ 0.85 ;
- Medium: PFS > 0.85 and CFS < 0.9 ;
- Difficult: CFS ≥ 0.9 .

Based on these equations the classification may be done for any parameter set; to show some examples, a number of figures are presented below with different ego vehicle speeds.

...

2.2. Cut out

Classification of difficulty of the scenarios based on the initial parameters is done the following way in accordance to the performance model 2 laid down in paragraph 3.4 of Annex 3 4 **Appendix 3:**

- Easy: PFS = 0;
- Medium: PFS > 0 and CFS < 0.5 ;
- Difficult: CFS ≥ 0.5 .

Based on these equations the classification may be done for any parameter set; to show some examples, a number of figures are presented below with different ego vehicle speeds.

...

2.3. Deceleration

Classification of difficulty of the scenarios based on the initial parameters is done the following way in accordance to the performance model laid down in paragraph 3.4 of Annex 3 4 **Appendix 3:**

- Easy: PFS = 0;
- Medium: PFS > 0 and CFS < 0.5 ;
- Difficult: CFS ≥ 0.5 .

Based on these equations the classification may be done for any parameter set. The classification matrix for the different cases is presented below in Fig. 22.

...

Annex 5, paragraph 2 and its sub-paragraphs, amended to read:

2. Definitions

~~for~~ **For** the purposes of this Annex,

- 2.1. ~~“Emergency operation” means the operation outside the operational limits specified by the manufacturer, when safety systems come into action in order to prevent or mitigate possible damage~~ **“Operational Design Domain (ODD)” of the automated lane keeping system defines the specific operating conditions (e.g. environmental, geographic, time-of-day, traffic, infrastructure, speed range, weather and other conditions) within the boundaries fixed by this regulation under which the automated lane keeping system is designed to operate without any intervention by the driver.**
- 2.2. **“Normal operation” means the operation within specified operational limits and conditions to perform the designed activity, including actions to ensure that the system stays within its operational limits.**
- 2.3. ~~“Dense traffic conditions” means that ALKS operations have the main objective to maintain a safe distance from the surrounding vehicles. In this case the average speed shall be greater than or equal to 15 km/h and lower than or equal to [55] km/h.~~

- 2.3.4. “Free flow traffic conditions” means that ALKS operations are not heavily affected on a continuous basis by the behaviour of the surrounding vehicles. ~~In this case the average speed shall be greater than [90] km/h and lower than or equal to either the system maximum speed or the road maximum allowed, whichever lowest.~~
- 2.4.5. ~~“Congested~~ Lightly congested traffic conditions” means that ALKS operations are affected on a continuous basis by the behaviour of the surrounding vehicles (i.e. continuous vehicle following operation). In this case the vehicle average speed shall be greater than {55} km/h ~~and lower than or equal to [90] km/h.~~
- 2.5. “Heavily congested traffic conditions” means that ALKS operations are affected on a continuous basis by the behaviour of the surrounding vehicles and the ALKS is requested to perform frequent decelerations and accelerations, to cope with the perturbations in the surrounding traffic flow. In this case the average speed shall be greater than or equal to 15 km/h and lower than or equal to 55 km/h.

Annex 6, paragraphs 4.1. and 4.2., amended to read:

- 4.1. The tests shall be performed under starting conditions (e.g. environmental, road geometry) that allow the activation of the ALKS (excluding category “Prevention of activation when the system is outside of its ~~technical boundaries~~ ODD” of Table A6/1 ~~scenarios according to paragraph 5.7).~~
- 4.2. If applicable to the system’s ODD, the composition of the public road test shall allow the verification of the system ~~on motorway in free-flow~~ condition, lightly congested traffic and on motorway heavily congested traffic conditions.

Annex 5, Table A6/1, amend to read:

Table A6/1
Public road scenarios

Category	Type of scenario	Mandatory / Recommended	Main reference requirements (non-exhaustive list)
Prevention of activation when the system is outside of its technical boundaries <u>ODD</u>	On a section of highway that is not suitable	Mandatory	6.2.3.
	In an urban environment	Mandatory	
	On a normally suitable road when other conditions (e.g. weather/time of day) are not met	Recommended	
System override by the driver	Intervention made by the steering wheel	Mandatory	6.3.1.
	Intervention made by the acceleration pedal	Mandatory	6.3.3. and 6.3.4.
	Intervention made by the brake pedal	Mandatory	6.3.2. and 6.3.4.
No violation of traffic rules	Adheres to speed limits	Mandatory	5.1.2
	Repeated changes in speed limit above 60 km/h	Mandatory	5.1.2 and 5.2.3
	Exposure to different road signs which require system reaction (at least {3} different times)	Mandatory	
	Sufficient distance to vehicle in front	Mandatory	5.2.3.3
	Does not cross solid lane markings where lane change is prohibited	Recommended	5.1.2 and 5.2.1
	Tunnel	Recommended	5.4.2.1

Response to road events	End of motorway		Recommended	
	Work zone		Recommended	§ 5.4.2.1 or 5.4.2.2
	Toll station		Recommended	5.4.2.1
	Reacts to closed lane		Recommended	5.4.2.1 or 5.4.2.2
	Emergency vehicle approaching		Recommended	5.4.2.2
	Change in environmental conditions		Recommended	
Response to other road users within the frontal and lateral detection range	Response to the acceleration and deceleration of a lead vehicle		Mandatory	5.2.5
	PTW as lead vehicle		Recommended	
	HDV as lead vehicle		Mandatory	
	Another vehicle merging at an entry lane		Mandatory	
	Another vehicle merging at an ending lane	Free flow and dense lightly congested traffic conditions	Mandatory	
		Congested Heavily congested traffic conditions (repetition of at least {10} times)	Recommended	
	Another vehicle merging with little into insufficient longitudinal distance between the <u>ALKS vehicle and a directly preceding vehicle</u> vehicles		Recommended	
	Cut-out of another vehicle (e.g. at highway exit)		Mandatory	5.2.5 and 5.2.3.3
The ALKS approaching stop and go traffic situations with different initial speeds (at least {10} situations)		Mandatory		
Lane Keeping	Lane keeping on roads with different lane curvature		Mandatory	5.2.1
	Another vehicle driving close beside in the adjacent lane		Recommended	5.2.2
Lane changing performed by the system	The ALKS performing lane change in the adjacent (target) lane with and without surrounding traffic		Mandatory	5.2.6
	Merging at motorway entry		Mandatory	
	Merging at lane end	Free flow and dense lightly congested traffic conditions	Mandatory	
		Congested Heavily congested traffic conditions (repetition of at least {10} times)	Mandatory	

* The type approval authority shall aim to cover the ‘recommended’ scenarios during the public road testing. However, if these are not available in the country where the ALKS is tested or do not occur within the duration of the testing, the manufacturer may, in agreement with the type approval authority, provide documentation to demonstrate compliance.

Annex 6, paragraph 6.1., amended to read:

6.1. The test, or combination of tests, shall be such that allows recording the ALKS operation including:

- (a) at least ~~{5}~~ operating hours in **dense heavily congested** traffic conditions; and, if applicable to the system's ODD,
- (b) at least ~~{10}~~ operating hours in free-flow traffic conditions.

Annex 6, paragraph 6.3., amended to read:

6.3 While test scheduling and route planning shall aim to achieve as much system operation time as possible for the public road test, any recommended scenarios that could not be encountered within 16 hours of testing, shall be provided from the manufacturer's internal system validation tests to the satisfactory satisfaction of the type approval authority.

Annex 6, paragraph 7.2., amended to read:

7.2. Further data channels

The parameters listed in paragraph 7.1 are meant to be a minimum set of parameters. Any data channels used or generated by the system as deemed necessary for post-test evaluation by the type-approval authority shall be logged. Relevant warning signals received (e.g., via communication/life—HD—map live maps) or identified otherwise by the ALKS (e.g., acoustical or optical emergency vehicle recognition) shall be logged.

Annex 6, paragraph 7.3.1., amended to read:

7.3.1. The data recorded from **the** activated system shall be assessed for the sections falling within the declared ODD **including as well as** those sections when the system has left the ODD inadvertently without correctly ending its operation.

Annex 6, paragraph 7.3.4., amended to read:

7.3.4. Time gap to leading vehicle, time gap left to the **upcoming approaching** vehicle in the target lane in case of lane-change and lateral position deviation shall be quantitatively evaluated according to the technical requirements in paragraph 5 in this Regulation.

II. Justification

1. Definition of vehicle introduced to included vehicle combinations to make the applicability of provisions clear throughout the text. Reference to “combination” is therefore removed from paragraphs 2.26.(b), 7.1(b) and 7.1.2.
2. Modification to the provision for the approval mark to indicate systems that are capable of performing a LCP by adding paragraph 4.4.3. and modifying Annex 2.
3. New paragraph 5.1.1.1. is to resolve the issues raised by the UK (GRVA-09-33) concerning detectable collision and the table in paragraph 5.2. of Annex 5 is amended accordingly.
4. Paragraphs 5.2.1.1. to 5.2.1.5. have been revised to make clear when a vehicle is allowed to cross the lane markings and the limitations for this when it is not a LCP.
5. The SIG concluded that the for any system operating over 60 km/h it had to be capable of performing a MRM lane change to avoid the risks associated with stopping in lane when traffic is flowing at those higher speeds. The text is

therefore amended in paragraph 5.2.3.1. to reflect that and remove the alternative option that was under consideration.

6. Changes in paragraphs 5.2.6.1.1. and 5.2.6.1.2. are editorial improvements to make it clear that the ALKS needs to consider all road traffic and is consistent with drafting elsewhere in the regulation.
7. The footnote in paragraph 5.2.6.5.1. is added to temporarily restrict the performance of a regular lane change to vehicles of category M1 or N1 until such point that there is certainty over the provisions for a LCP and that it can be opened up to all categories. Sub-paragraph is deleted as there are no CPs who have such traffic rules and it could result in uncertainty about when a regular lane change could be performed.
8. The change to paragraph 5.2.6.5.2.3. is editorial to improve the grammar.
9. The change to paragraph 5.2.6.6.1. is editorial to remove an erroneous square bracket.
10. The change to paragraph 5.2.6.6.5.1.1. is editorial to make clear that they are not an exhaustive or absolute list of aspects to be considered in the assessment of the vehicle's potential to change into the target lane.
11. The change to paragraph 5.2.6.6.5.1.2. is editorial to make clear the exemptions that apply to this provision.
12. Paragraphs 5.2.6.7.2.1. and 5.2.6.7.3.1 are amended so that the conditions are on the ALKS vehicle and consistent with drafting used elsewhere.
13. Paragraph 5.2.6.7.2.2. is deleted as it is seen as superfluous given paragraph 5.2.6.7.4.
14. The changes to paragraphs 5.2.6.7.2.3. and 5.2.6.7.3.3 are editorial to improve the grammar.
15. The SIG decided that the determination of the criticality should be done continually and not just after it has crossed the lane therefore paragraph 5.2.6.7.4. is amended accordingly.
16. The change to paragraph 5.2.6.7.5. is so as to be consistent with the terminology used elsewhere as it is only the demand initiated by the system that can be truly assessed.
17. The change to paragraph 5.3.5.1. is so as to not unduly restrict the circumstances under which an evasive lane crossing may occur. Similarly for paragraph 5.3.5.2., where it should not be assessed against the vehicle's full braking performance, merely against braking to avoid the collision risk.
18. Agreement was reached in the SIG on paragraph 5.3.5.5.
19. The change to paragraph 5.4.2.1. is editorial to correct the spelling.
20. A target stop area could be the ALKS's current lane of travel and so an MRM performed according to paragraph 5.2.6. is only necessary if a lane change is required to get to that area. The modifications to paragraph 5.5.1. are designed to make that clear.
21. The second paragraph 5.5.2. is a duplication of what is now in paragraph 5.2.1. so is therefore deleted.
22. In order to prevent ACSF-C being utilised in combination with ALKS, paragraph 6.3.5. has been introduced to require a transition demand to be initiated if the direction indicator is activated.
23. The change to paragraph 7. is to fix a drafting error as the text was incorrectly put under paragraph 7.1. and the change in paragraph 7.1.1. is to fix a grammatical error.
24. "Centre" is changed to "centreline" in paragraphs 7.1.1.1., 7.1.2.1. and 7.1.3. as this is a better technical term to use and will ensure that the distance measurement is performed consistently and accurately. This is also done in paragraphs 4.6.2.2., 4.6.3.2., and 4.6.4.1. of Annex 5.

25. The amendment in paragraph 7.1.4. is to make clear that assessment of direction indicators in the PVPA is voluntary and decision of the manufacturer whether they include that functionality in their system. There is also an editorial change to improve the grammar.
26. The changes to paragraphs 7.1.6. and 7.1.7. are editorial to improve the grammar.
27. The changes to paragraph 8.2.1. are further refinements the data elements that should be recorded to provide data related to lane change and the crossing of lane markings to determine liability of the system and assess its performance. Paragraph 8.2.2. is added to avoid the recording of LCPs that are not related to any incident and have been performed adequately.
28. The provisions related to the retrieval of DSSAD data in conjunction with EDR in paragraph 8.4.5. were agreed between the SIG and the EDR/DSSAD IWG with a few minor additions to clarify that only data related to the current activation should be provided if no occurrence flag has occurred within 30 s of the EDR trigger.
29. Revised transition provisions have been created for paragraph 15. which have been accepted within the SIG and continue to allow systems approved under the original series.
30. Change to the communication document in Annex 1 is to record the lane change capability of the system.
31. The definition of “passable object” in paragraph 2.7. of Annex 5 has been refined to make it clearer as to what is meant and a definition for “ODD” has been added in paragraph 2.8. as it is a term used within Annex 5.
32. The change in paragraph 3.2.3. of Annex 5 is editorial to fix the spelling.
33. The change in paragraph 3.2.5.1. of Annex 5 is editorial to keep consistent terminology.
34. The change in paragraph 4. of Annex 5 is editorial to fix a mistake in the drafting with the order of the paragraphs.
35. The square brackets in paragraphs 4.6.1., 4.6.2.2., and 4.6.3.2. to 4.6.5.1. of Annex 5 are removed as there was consensus within the SIG for those provisions.
36. An additional provision is added to paragraph 4.6.1. of Annex 5 to included testing the direction indicator status detection in the field of view test where a system has such a capability.
37. The change in paragraph 4.6.4. of Annex 5 is editorial to fix the spelling.
38. The change in paragraph 4.6.5. of Annex 5 is editorial to use the correct terminology as it is an area in which the direction indicator is sensed.
39. Appendix 1 of Annex 5 was incorrectly placed under Annex 6 so is moved and there were incorrect cross-references that have been updated.
40. The definitions in Annex 6 under paragraph 2. have been revised to remove the redundant definition of “emergency operation” and add the “ODD” definition. The “traffic conditions” definitions have been revised to use terms that provide a clearer distinction that “dense” and “congested” and the upper limited on the average speed on the previously named “congested traffic conditions” has been removed since it may be problematic for heavy-duty vehicles.
41. Paragraph 4.1. of Annex 6 is amended to correct and editorial issue with an erroneous reference. Paragraph 4.2. is amended to align with the new definitions relating to the traffic conditions.
42. Table A6/1 of Annex 6 is amended to align with the new definitions for traffic conditions and to provide clarity with respect to the categories and scenarios involved. The square brackets have also been removed following consensus within the SIG.

43. The square brackets have been removed from paragraph 6.1. of Annex 6 following consensus within the SIG and sub-paragraph (a) is modified to align with the new definitions for traffic conditions.
 44. The changes in paragraphs 6.3., 7.2., and 7.3.1. of Annex 6 are editorial to improve the grammar.
 45. The change in paragraph 7.3.4. of Annex 6 is editorial to use consistent terminology.
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