

~~Base document for ALKS for low speed application prepared by co-chairs~~

~~Unchanged text (compared to ACSF-23-02r3) in black — just without all the colours.~~

Proposal for Technical Requirements for an Automated Lane Keeping System

~~*** SPECIFIC REQUIREMENTS ***~~

2.1 Scope

~~— The following set of requirements applies to “Automated Lane Keeping System (ALKS) for low speed application”, a system which is initiated/activated by the driver and which keeps the vehicle within its lane by influencing the lateral movement of the vehicle and controls the longitudinal movement of the vehicle for extended periods without further driver command/confirmation at the speed of [60] km/h or below.~~

2.1.1. ~~—~~ This ~~system~~ Regulation applies to vehicles of categories M₁.

2.2. Definitions

~~2.2.0. — “Automated Lane Keeping System (ALKS)” for low speed application is a system which is activated by the driver and which keeps the vehicle within its lane by influencing the lateral movement of the vehicle and controls the longitudinal movement of the vehicle for extended periods without further driver command.~~

~~Within this Regulation ALKS is also referred to as “the system”.~~

2.2.1. “*Transition demand*” is a logical and intuitive procedure to transfer the dynamic driving task from automated control by the system to human driver control. This request given from the system to the human driver indicates the transition phase.

2.2.2. “*Transition phase*” means the duration of the transition demand.

~~2.2.3. — “Planned event” is a situation which is known in advance, e.g. at the time of activation such as a journey point (e.g. exit of a highway) etc. and which requires a transition demand.~~

~~2.2.4. — “Unplanned event” is a situation which is unknown in advance, but assumed as very likely in happening, e.g. [road construction, inclement weather, approaching emergency vehicle, missing lane marking, load falling from truck (collision)] and which requires a transition demand.~~

2.2.5. “*Imminent collision risk*” describes a situation or an event which leads to a collision of the vehicle with another road user or an obstacle unless an emergency manoeuvre is executed.

2.2.6. Minimum Risk Manoeuvres

2.2.6.1. “*Minimum risk manoeuvre*” means a ~~procedure—manoeuvre aimed at minimising risks in traffic, which is automatically~~ performed by the system after ~~the end of a transition demand phase as risk mitigation strategy in case the human driver has not resumed manual control of the vehicle.~~

~~2.2.6.2. “Severe failure minimum risk manoeuvre” means a manoeuvre performed by the system as risk mitigation strategy in case of a severe ALKS or severe vehicle failure.~~

2.2.7. “*Emergency Manoeuvre*” is a manoeuvre performed by the system in case of ~~an sudden unplanned~~ event in which the vehicle is at imminent risk of a collision ~~[and in case of insufficient lead time to transition the control back to the driver,]~~ with the purpose of avoiding or mitigating a collision.

~~2.2.8. “Operational speed” is the maximum vehicle speed at which the system may be active [and shall be determined by the capability of the system’s sensing technology].~~

2.2.8. Speed

~~2.2.8.1 “Specified maximum speed” is the speed declared by the manufacturer up to which the system operates under optimum conditions.~~

~~2.2.8.2 “Maximum operational speed” is the speed selected by the system up to which the system operates under current environmental and sensor conditions. It is the maximum vehicle speed at which the system may be active and shall be determined by the capability of the sensing system.~~

~~2.2.8.3. “Present speed” or “speed” is the current speed selected by the system due to traffic.~~

~~2.2.8.4 “Set speed” is the speed selected by the driver for the active ALKS system, which defines an upper limit for the present speed.~~

2.2.9. “*Detection range*” of the sensing system is the distance at which the system can reliably recognise a target and generate an appropriate control signal.

~~{2.2.10. “Operating range” shall be determined from the value of the verified detection range after taking account of the deterioration of components of the sensing system due to time and usage throughout the normal life of a vehicle.}~~

~~{2.2.11. “Normal life” of a vehicle is understood to be [10] years or [160 000] kilometres.}~~

~~Comment from SDG to 2.2.11: Can be deleted [definition “normal life”] when sensor self test is introduced. See paragraph 2.4.3.last bullet point for a first proposal~~

2.2.10. Failures

~~{2.2.10.12. A “severe ALKS failure” is a failure specific to the operation of the ALKS that affects the safe operation of the system with an acceptable occurrence. Single sensors failures are only considered as such ~~or~~ when accompanied by another influence affecting the safe operation of the system, e.g. unsuitable~~

~~environmental conditions, a second failure of the ALKS or of another component in the vehicle.}~~

~~The occurrence of a severe ALKS failure is deemed acceptable if it is comparable to similar failures in other well established and well trusted safety systems (e.g. braking or steering systems).~~

~~{2.2.10.2.13. A “severe vehicle failure” is any failure in-of the vehicle (e.g. electrical, mechanical) that affects the dynamic driving task {and would also leave the manually driven vehicle in a state unfit to drive} (e.g. loss of power supply, failure of the braking system, sudden loss of tire pressure).}~~

~~2.2.11. “Self-check” means an integrated function that checks for a system failure and for a change in detection range of the sensing system on a continuous basis.~~

~~2.2.12.14. A “system-Override” means an action of by the driver means a situation when the driver provides an input to a control elements of the vehicle which has-have priority over the longitudinal or lateral movement of the vehicle control of the system, while the system is still active.~~

~~{2.2.13.15. The “Dynamic Driving task” is the physical means the control and execution of all longitudinal and lateral movements of the vehicle.}~~

~~Alternative German proposal covering also 2.2.8~~

~~2.2.x — Speeds~~

~~2.2.x.1 — “Specified maximum speed” is the speed declared by the manufacturer up to which the system operates under optimum conditions ($v_{s,max}$).~~

~~2.2.x.2 — “Maximum operational speed” is the speed selected by the system up to which the system operates under current environmental and sensor conditions ($v_{now,max}$). It is the maximum vehicle speed at which the system may be active and shall be determined by the capability of the sensing system.~~

~~2.2.x.3. — “Set speed” is the speed selected by the driver for the active ALKS system, which defines an upper limit for v_{now} (v_{set}).~~

~~2.2.x.4 — “Present speed” is the current speed selected by the system due to traffic (v_{now}).~~

~~2.2.14. “Data Storage System for Automated Driving (DSSAD)” enables the determination of interactions between the automated driving function and the human driver, who may engage and disengage in it.¹~~

2.3. General Requirements

~~Comment to 2.3: Section re-introduced, to be checked for completeness.~~

~~2.3.1 The system shall have the capability to detect failures affecting the safe operation or the functionality of the ALKS and/or implement safe strategies until the detection is completed.~~

¹ To be revised in accordance with IWG EDR/DSSAD.

~~2.3.2. The activated system shall cope with all dynamic driving tasks and with any situation or shall otherwise transition the control back to the driver offering sufficient lead time.~~

~~Any type of situation in which the vehicle will generate a transition demand to the driver shall be declared by the vehicle manufacturer and explained by documentation shall be provided together with the documentation package required in Annex [X] [CEL].~~

~~Comment to 2.3.2.: Previously this was paragraph 2.5.1. Slight change in the wording at the end of the sentence for clarification.~~

~~UK proposal 1~~

~~2.3. General 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 X [CEL] and according to the relevant tests in Annex X.~~

~~2.3.1 The activated system shall cope with all dynamic driving tasks and situations including failures, and shall maintain-not endanger the safety of the vehicle occupants and all other road users ~~until the human driver has fully resumed manual control.~~~~

~~2.3.2. The activated system shall comply with all relevant traffic rules in the country of operation and as appropriate in the current situation.~~

~~2.3.3. The system shall have the capability to detect failures affecting the safe operation or the functionality of the ALKS, and ~~inhibit activation if necessary to maintain safety~~ implement safe strategies until the detection is completed.~~

~~The occurrence of a severe ALKS failure is deemed acceptable if it is comparable to similar failures in other well-established and well trusted safety systems (e.g. braking or steering systems).~~

~~2.3.4. The activated system shall maximize driver controllability (e.g. wipers on in case of rain, headlamps on in case of darkness) in the way of safety due to the fact that system and driver have not the same needs to assure a safe driving.~~

~~2.3.5. If determined necessary, by the activated system, it shall issue a transition demand with sufficient lead time and ensure-not endanger the safety of vehicle occupants and all other road users ~~until the human driver has fully resumed manual control.~~~~

~~Types of Situations in which the vehicle will generate a transition demand to the driver shall be declared by the vehicle manufacturer and included in the documentation package required in Annex [X] [CEL].~~

~~Remark : UK and Industry will draft better wording for 2.3.1. and 2.3.2.~~

~~Remark : add text with regard to the point « the vehicle configuration shall maximize driver controllability (e.g. wipers ON in case of rain, headlamps ON by night).”~~

~~Comment to remark above: In the way of safety due to the fact that system and driver have not the same needs to assure a safe driving.~~

~~2.3.3. The activated system shall comply with all applicable relevant traffic rules in the country of operation~~

~~Remark: insert a text or a footnote “unless the only way to avoid an collision is to not respect the traffic rules” ask WP.1 for guidance on non-compliance with traffic rules in certain~~

~~2.3.6. The system shall continuously perform a self-check (e.g. after ignition the system has at least once detected an object at the same or a higher distance than that declared as detection range according to paragraph 2.5.6.2.).~~

~~2.3.7. The effectiveness of the system shall not be adversely affected by magnetic or electrical fields. This shall be demonstrated by compliance with Regulation No. 10, 05 Series of amendments to the Regulation.~~

~~2.3.8. Conformity with the safety aspects of electronic control systems shall be shown by meeting the requirements of Annex [X] [CEL].~~

2.4. Activation, Deactivation and Driver Input

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 X [CEL] and according to the relevant tests in Annex X.

2.4.1. The vehicle shall be equipped with ~~a~~dedicated means for the driver to activate (active mode) and deactivate (off mode) the system.

2.4.2. The default status of the system shall be the off mode at the initiation of each new engine start/run cycle.

This requirement does not apply when a new engine start/run cycle is performed automatically, e.g. by the operation of a stop/start system.

2.4.3. The system shall become active only upon a deliberate action by the driver and if all the following conditions are met:

~~Activation of the system shall only be possible if all the following condition are met:~~

- The driver is in the driver seat and ~~his~~the driver's ~~safety belt~~safety belt seat belt is fastened according to paragraph 2.6.,
- the driver is ~~detected to be~~ available to take over control of the dynamic driving task according to paragraph 2.6.,
- ~~the system has ensures that~~ no failure affecting the safe operation or the functionality of the ALKS is present,
- DSSAD is operational,
- the ~~actual~~ environmental and infrastructural conditions allow the operation, ~~and~~

positive confirmation of system self-check and

- the vehicle is on roads where pedestrians and cyclists are prohibited and which, by design, are equipped with a physical separation that divides the traffic moving in opposite directions-

~~[after ignition on the system has at least once detected an object at the same or a higher distance than that declared as detection range according to paragraph 2.5.6.2.~~

Comment to last bullet point: Proposal for a sensor self test based on the principle from ACSF Cat C. First draft from Roland Schaefer to address the comment from the SDG to paragraph 2.5.6.2. An addition like “This provision does not apply when a lead vehicle is detected in a distance shorter than the detection range directly upon a new ignition run cycle e.g. in a traffic jam.” could help to address initial responses received.

Remark: to be discussed together with paragraph 2.5.6.2.

~~2.4.4. Manual Deactivation~~

~~It shall be possible to manually deactivate (off mode) the system by a deliberate action of the driver using the same means as to activate per paragraph 2.4.1.~~

~~The system shall provide protection against unintentional manual deactivation. A manual deactivation by the driver is deemed intentional either if it requires a single action exceeding a certain threshold for a reasonable amount of time or if it requires two independent actions.~~

Remark : UK and industry will draft better wording for 2.4.4.

~~Industry proposal for 2.4.4.~~

2.4.4. Manual Deactivation

It shall be possible to manually deactivate (off-mode) the system by an intentional action of the driver using the same means as to activate the system, as mentioned in paragraph 2.4.1.

The means of deactivating shall provide protection against unintentional manual deactivation for example by requiring a single input exceeding a certain threshold of time or a double press, or two separate but simultaneous inputs.

Additionally, it shall be ensured the driver is in lateral control of the vehicle at the time of the deactivation, by e.g. placing the deactivation means on the steering control or confirming the driver is holding the steering control.

~~2.4.5. Automatic Deactivation “due to driver input”~~

~~The system shall be deactivated automatically when at least one of the following conditions is met:~~

- ~~— The driver maintains the vehicle in standstill for at least [1] s by any braking system.~~
- ~~— The driver overrides the system by steering and this override is not suppressed, as specified in paragraph 2.4.8.~~
- ~~— The driver is holding the steering control and overrides the system by braking or accelerating, as specified in paragraph of 2.4.8.~~

~~{In case of an on-going transition demand, before deactivating, the system {shall/may} at least confirm that the driver has responded to the transition demand by taking hold and then continue to hold the steering control for at least [1]s.}~~

~~–be deactivated automatically once the driver has responded to the transition demand by taking hold and then continue to hold the steering control for at least [1]s.~~

~~The system shall not be automatically deactivated as long as none of the conditions above in this paragraph is met.~~

Remark: Industry proposal

~~2.4.5. Automatic Deactivation~~

~~The system shall be deactivated automatically when at least one of the following conditions is met:~~

- ~~— [The driver maintains the vehicle in standstill for at least [1] s by any braking system.]~~
- ~~— The driver overrides the system by steering, while holding the steering control, and this override is not suppressed, as specified in paragraph 2.4.8.~~
- ~~— The driver is holding the steering control and overrides the system by braking or accelerating, as specified in paragraph of 2.4.8.~~

~~In case of an on going transition demand, the system [shall/may] be deactivated automatically once the driver has responded to the transition demand by taking hold and then continue to hold the steering control for at least [1]s.~~

~~As an alternative to the above, and only in the case where a transition demand [initiated by either the driver or the system] is on going, the system may be deactivated automatically upon detection that the driver has taken hold of the steering control [as a response to the transition demand], provided the driver monitoring system confirms the driver is directing their gaze to relevant directions for performing the driving task (e.g. the road forward, the blind spot, the rearview mirrors/devices, the instrument cluster).~~

~~The system shall not be automatically deactivated by any driver input as long as none of the conditions above in this paragraph is met.~~

~~2.4.8.6. Any system override due to driver input to the accelerator or brake control shall immediately initiate a transition demand as specified in paragraph 2.7.~~

Remark: revised text drafted by France/NL/UK/Germany during lunch break 2019/08/01

2.4.5. Automatic Deactivation

The system shall not be automatically deactivated by any driver input other than those described below in paragraphs 2.4.5.1 and 2.4.5.2, ~~as long as none of the conditions above in this paragraph is met.~~

2.4.5.1. Deactivation by input to driving controls

The system shall be deactivated automatically when at least one of the following conditions is met:

- ~~—~~
- ~~— The driver maintains the vehicle in standstill for at least [1] s by any braking system~~
- ~~— The driver overrides the system by steering, while holding the steering control, and this override is not suppressed, as specified in paragraph 2.4.8~~ or

~~- The driver is holding the steering control and overrides the system by braking or accelerating, as specified in paragraph 2.4.8.~~

~~- In case of an on-going transition demand, the system [shall/may] be deactivated automatically once the driver has responded to the transition demand by taking hold and then continue to hold the steering control for at least [1]s.~~

2.4.5.2. Deactivation during an ongoing transition demand

~~As an alternative to the above, and only In the case where a transition demand [initiated by either the driver or the system] is on-going, the system may shall only be deactivated automatically~~

~~- as defined in paragraph 2.4.5.1. or~~

~~- upon detection that the driver has taken hold of the steering control [as a response to the transition demand], and provided the system confirms the driver is attentive as per defined in paragraph 2.6.3.4.8. driver is directing their gaze to relevant directions for performing the driving task (e.g. the road forward, the blind spot, the rearview mirrors/devices, the instrument cluster).~~

2.4.5.3. Deactivation during an ongoing emergency manoeuvre

In case of an ongoing emergency manoeuvre, the deactivation of the system may be delayed until the collision risk disappeared.

2.4.5.4. Deactivation in case of a severe vehicle failure or a severe ALKS failure

It is recognized that in case of a severe vehicle failure or a severe ALKS failure the ALKS may employ different strategies with regard to deactivation. These different strategies shall be declared by the manufacturer and their efficiency with regard to ensuring a safe transition of control back to the driver shall be assessed by the Technical Service.

~~[2.4.8.1. A driver input to the steering control shall override the lateral control function of the system when the input exceeds a reasonable threshold (e.g. based on force and duration) designed to prevent unintentional override.~~

~~This threshold shall include a specified force and duration and vary depending on parameters that include criteria used for driver attentiveness. These thresholds shall be defined to the Technical Service during the assessment according to Annex X (CEL).]~~

~~— This threshold including a possible variation depending on parameters like speed, gaze direction of the driver, or a second deliberate action (e.g. the use of the turn indicator accompanying the steering input) and the rationale for the variation shall be provided to the Technical Service during the assessment according to Annex X (CEL).]~~

~~2.4.8.2. A driver input to the braking control resulting in a higher deceleration than that induced by the system, or maintaining the vehicle in standstill for at least [1] s by any braking system, shall override the longitudinal control function of the system.~~

~~Driver attentiveness shall be confirmed by at least one of the following criteria:~~

~~—Driver gaze direction is being confirmed as primarily looking at the road ahead~~

~~—Driver head movement is being confirmed as primarily directed towards the road ahead~~

~~{Or alternative criteria to be defined by industry}~~

~~The specification for confirming these criteria must be declared by the manufacturer and supported by documented evidence. This shall be assessed by the technical service according to Annex X (CEL).~~

~~2.4.6. Following a deactivation, the driver may only be supported in his driving task by any driver assistance function which was active at the time of the activation of the ALKS or which was activated during the operation of the ALKS, [except such driver assistance functions which allow the driver make his/her hands be off from the steering control, or his/her foot be off from both the accelerator control and the braking control].~~

~~— [The manufacturer shall provide evidence that suitable information is provided to the driver to ensure mode awareness when changing from ALKS to assisted driving mode.]~~

~~— [Any longitudinal control that will be active after the deactivation of the ALKS shall not exceed upon [automatic] activation the speed limit valid at the time of deactivation of the ALKS.]~~

~~ALTERNATIVE from Germany for paragraph 2.4.6~~

2.4.6. When deactivated (off mode) the system shall not provide any continuous control of either longitudinal or lateral movement of the vehicle.

After deactivation, Corrective Steering Function (CSF) may be active with the aim at accustoming the driver to execute the lateral control task by gradually reducing lateral support.

Notwithstanding both paragraphs above, any other safety system delivering longitudinal or lateral support ~~{~~in accident-prone situations ~~(like—e.g. Advanced Emergency Braking System (AEBS), EVSC, Electronic Stability Control (ESC), Brake Assist System (BAS), Emergency Steering Function (ESF))} shall not be deactivated in case of deactivation of ALKS.~~

Remark: Industry will deliver evidence with regard to benefit of o.m. systems

2.4.7. Any ~~automatic~~ deactivation shall be indicated to the driver ~~by an optical and an acoustic signal. The acoustic signal is not required when the deactivation occurs following a transition demand which that contains an acoustic signal as defined in paragraph 2.8.1.1.~~

2.4.8. System override

2.4.8.1. A driver input to the steering control shall override the lateral control function of the system when the input exceeds a reasonable threshold ~~(e.g. based on force and duration)~~ designed to prevent unintentional override.

~~This threshold including a possible variation depending on parameters like speed, gaze direction of the driver, or a second deliberate action (e.g. the use of the turn indicator accompanying the steering input) and the rationale for~~

~~the variation shall be provided to the Technical Service during the assessment according to Annex X (CEL). This threshold shall include a specified force and duration and shall vary depending on parameters that include criteria used for driver attentiveness. These thresholds shall be declared to the Technical Service during the assessment according to Annex X [CEL].~~

2.4.8.2. A driver input to the braking control resulting in a higher deceleration than that induced by the system or maintaining the vehicle in standstill by any braking system, shall override the longitudinal control function of the system.

2.4.8.3. A driver input to the accelerator control may override the longitudinal control function of the system if the driver simultaneously has his hands on the steering wheel. However, such an input shall not cause the system to no longer meet the requirements of this Regulation, ~~unless the driver is holding the steering control [, or the input exceeds [90]% of the maximum accelerator input for more than [1]s (e.g. kick-down)].~~

~~2.4.8.4.~~ Notwithstanding the provisions laid down in paragraphs 2.4.8.1. to 2.4.8.3., the effect of the driver input on any control may be reduced or suppressed by the system in case the system has detected the imminent risk of a collision due to this driver input.

~~2.4.8.5.~~ ~~Notwithstanding the provisions laid down in paragraphs 2.4.8.1. to 2.4.8.3., the driver input may permanently be ignored by the system if the system by design can cope with all dynamic driving tasks by continuing the operation.~~

~~2.4.8.6.~~ ~~Any system override due to driver input to the accelerator or brake control shall immediately initiate a transition demand as specified in paragraph 2.7.~~

2.4.8.5. Any system override due to driver input to the accelerator or brake control shall immediately initiate a transition demand as specified in paragraph 2.7.

~~2.4.8.5.9.~~ It is recognized that in case of a severe vehicle failure or a severe ALKS failure the ALKS may employ different strategies with regard to ~~deactivation and system~~ override. These different strategies shall be declared by the manufacturer and their efficiency with regard to ensuring a safe transition of control back to the driver shall be assessed by the Technical Service.

~~Comment from industry to 2.4.9.: This addition was proposed from industry to describe the required system behaviour during severe failures. The point was just briefly discussed in the SDG but consensus is to be reached in the IWG.~~

2.4.8.6.10. The fulfilment of the provisions in paragraph 2.4 and its subparagraphs shall be demonstrated by the manufacturer to the technical service during the inspection of the safety approach as part of the assessment to Annex X [CEL].

2.5. Dynamic Driving Task, and Sensing Capabilities

2.5.1. The activated system shall keep the vehicle inside its lane of travel and ensure that the vehicle does not cross any 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.

~~2.5.2.~~ The activated system shall detect a vehicle driving beside and if necessary adjust speed and/or the lateral position of the vehicle within its lane as appropriate.

Comment from industry to 2.5.2.: This requirement was mainly drafted to address situations at speed above 60 km/h. The informal group should consider to delete it.

2.5.3. The activated system shall control the ~~longitudinal~~ speed of the vehicle.

2.5.3.1. The activated system shall adapt the vehicle speed to infrastructural and environmental conditions (e.g. narrow curve radii, inclement weather).

Comment from Korea to 2.5.3.2.: Korea indicated to present at ACSF 23 a new concept proposal.

2.5.3.2 The activated system shall detect the distance to another road user in front located within the operating range as defined in paragraph 2.5.6.2.

While the ALKS vehicle is not at standstill, the system shall adapt the speed to adjust the distance to a vehicle in front in the same lane to be equal or greater than the minimum following distance.

In case of a lead vehicle decelerating or cutting in, there shall not be an appreciable time interval between the detection of a following distance below the required minimum distance and the start of the adjustment process.

The minimum following distance shall be calculated using the formula:

$$d_{\min} = v_{\text{ALKS}} * t_{\text{front}}$$

Where:

- d_{\min} = the minimum following distance
- v_{ALKS} = the ~~present actual~~ speed of the ALKS vehicle in {m/s};
- t_{front} = minimum time gap in seconds between the ALKS vehicle and ~~the~~ a leading vehicle in front as per the table below:

Present Actual travel speed of the ALKS vehicle is greater than ...		Minimum time gap in seconds
km/h	m/s	{s}
0	0	{1,0}
10	2,78	{1,1}
20	5,56	{1,2}
30	8,33	{1,3}
40	11,11	{1,4}
50	13,89	{1,5}
60	16,67	{1,6}
{70}	{19,44}	{1,7}
{80}	{22,22}	{1,8}
{90}	{25,00}	{1,9}
{100}	{27,78}	{2,0}

For speed values not mentioned in the table, linear interpolation shall be applied.

Notwithstanding the result of the formula above for ~~present actual~~ speeds below 2_m/s the minimum following distance shall never be less than 2 m.

Comment to the table above: The table is derived from the Korean proposal in document 22.09 The values are rounded to ease the understanding and are capped at

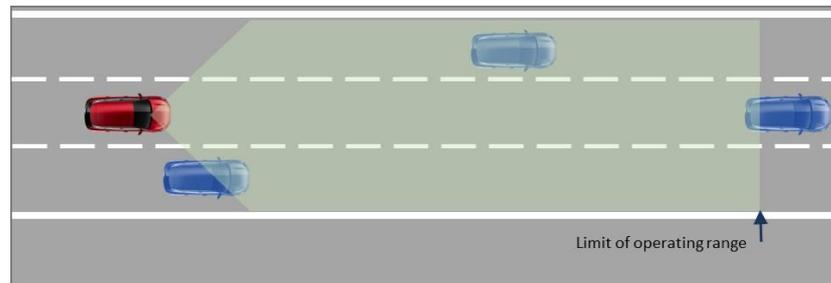
~~2.0 seconds to align with the original proposal from Germany and OICA. For low speed systems the table could end at the corresponding max. operational speed.~~

2.5.4. The activated system shall be able to bring the vehicle to a complete stop behind a stationary vehicle or road user blocking its lane of travel. This shall be ensured up to the maximum operational speed of the system, as defined in paragraph 2.5.7.

2.5.5. The activated system shall detect the risk of an imminent collision ~~e.g. [with another road user ahead or beside the vehicle.]~~ due to a decelerating lead vehicle, a cutting in vehicle or a suddenly appearing obstacle after a lane change of a leading vehicle and shall automatically perform an appropriate ~~emergency manoeuvre as specified in paragraph 2.10~~ collision avoidance manoeuvre.

2.5.6. Sensing system

The ALKS vehicle shall be equipped with a sensing system such that it can determine the driving environment (e.g. road geometry ahead, lane markings) and the traffic dynamics across its own traffic lane, the traffic lane immediately to its left and to its right up to the limit of the operating range.



Schematics of the Sensing System of the ALKS

2.5.6.1 Detection range of the sensing system to the front

The detection range of the sensing system shall be declared by the vehicle manufacturer and shall be at least ~~[46]~~ meters measured from the ~~most~~ forward most point of the ALKS vehicle.

The Technical Service shall verify the distance at which the vehicle sensing system detects a leading vehicle during the relevant test in ~~Par x.x.x in Annex [X], [using a two-wheeled motor vehicle of category L3 as the vehicle in front]~~ and with a standardised pedestrian target. The target used for the pedestrian detection test shall be a adult “articulated soft target” and be representative of the human attributes applicable to the sensor system of the ALKS under test according to ISO 19206-2:2018.

The measured value shall be equal to or higher than the declared value.

~~Comment from SDG to “system to the front”: What about the detection of persons on the road-like road workers in a construction area.~~

~~Comment to value of 46: This would be the result of the below formula if dissolved to D_{range} with 60 km/h as max operational speed.~~

2.5.6.2. The ALKS shall implement strategies to detect and cope with environmental and technical conditions which might reduce the detection range of the

sensing system, e.g. prevent enabling the system, disabling the system and transferring the control back to the driver, reducing the speed when visibility is too low.

These strategies shall be described by the vehicle manufacturer and assessed according to ~~the~~ Annex X (CEL).

Comment from SDG to 2.5.6.2.: We should consider a sensor self test either in section 2.5.6 or in 2.4 on activation. For a draft proposal (not discussed in detail in the SDG) see last bullet under 2.4.3.

2.5.6.3. The vehicle manufacturer shall provide evidence (e.g. test reports) that ~~about~~ how the effect of wear ~~and/or /ageing~~ does not reduce influences the performance of the sensing system ~~below the minimum required value specified in paragraph 2.5.6.1.~~ over the lifetime of the system/vehicle.

2.5.7 ~~Maximum Operational~~ Speed

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

~~Formula approach as~~ ALTERNATIVE 2.5.7.1. Specified maximum speed

The specified maximum speed up to which the system is permitted to operate shall be calculated with the formula below:

$$V_{\max-ALKS} = -a_{ALKS} * t_{system} + \sqrt{(a_{ALKS} * t_{system})^2 + 2a_{ALKS} * D_{range}}$$

Where:

$V_{\max-ALKS}$ = Specified M~~aximum operational~~ speed of the system

a_{ALKS} = ~~{3.7}~~ m/s² = feasible deceleration under wet conditions (unless a higher value is declared by the manufacturer and verified during type approval to the satisfaction of and in agreement with the technical service.)²

t_{system} = System delay of ~~{0.5}~~s until deceleration level is reached

D_{range} = Detection range in {m} determined according to ~~-~~paragraph 2.5.6.1.

The manufacturer shall declare the speed up to which the system will operate. This declared speed shall be less or equal to the value calculated by the formula above.

Notwithstanding the result of the formula above the specified maximum ~~operational~~ speed the manufacturer might declare and the system is permitted to operate is limited to ~~{60}~~ km/h.

~~ALTERNATIVE from GERMANY~~

2.5.7.2. Other S speeds

~~The specified maximum speed shall not be higher than 60 km/h.~~

²Unless a higher value is declared by the manufacturer and verified during type approval to the satisfaction of and in agreement with the technical service.

The maximum operational speed shall not exceed the maximum specified speed.

The set speed shall not exceed the maximum operational speed.

The present speed shall not exceed the maximum operational speed and shall not contradict traffic law.

- 2.5.8 The fulfilment of the provisions of paragraph 2.5. and its subparagraphs shall be demonstrated to the technical service and tested according to the relevant tests in Annex [X].

It is recognised that the fulfilment of the requirement in paragraph 2.5.5 may not be fully achieved in other conditions than those for the tests in Annex [X]. However, the system shall not deactivate or unreasonably switch the control strategy in these other conditions. This shall be demonstrated in accordance with Annex [X] [CEL] of this Regulation.

- 2.6. Driver Availability Recognition System

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 X [CEL] and according to the relevant tests in Annex X.

The system shall comprise a driver availability recognition system.

The driver availability recognition system shall detect that the driver is present in the driver seat, the safety belt of the driver is fastened and that the driver is available to take over the driving task.

- 2.6.1. Driver ~~not present~~ presence in the driver seat

~~Whenever the driver is not present in the driver seat or the safety belt of the driver is not fastened while the ALKS is active and the vehicle is not at standstill,~~ the system shall provide a distinctive acoustic warning. For this purpose a given audible signal of the second level warning of the safety-belt reminder according to UN-R16 is deemed to be sufficient.

A transition demand shall be initiated according to paragraph 2.7. if one of the following conditions is met:

- When the driver is detected not to be in the seat for a period of more than {1} second or
- ~~When the driver's safety belt is unbuckled while the vehicle is not at standstill.~~

The second level warning of the safety-belt reminder according to UN-R16 may be used instead of an acoustic warning of the Transition Demand.

~~Comment from SDG: What is exactly meant by "driver not in the seat"~~

~~Homework to the US: rework 2.6.2.~~

2.6.2. Driver availability

The system shall detect if the driver is available to take over the driving task by continuously monitoring the driver. The manufacturer shall declare to the technical service the vehicle's capability to detect that the driver is available to take over the driving task.

2.6.2.1 Criteria for deeming ~~d~~Driver availability

Driver availability shall be assessed based on at least two availability criteria (e.g. input to driver-exclusive vehicle control, eye blinking, eye closure, conscious head and body movement or dedicated confirmation by the driver) to ensure the driver is not falsely detected as available.

The driver shall be considered available by the system when:

The driver is present in the driving seat with safety belt fastened, and at least one of the following conditions are met:

- Input to any driver-exclusive vehicle controls during the last ~~{180}~~30 s.

~~———— [Driver has blinked at least {3/4} times during the last {60}s]~~

- ~~d~~Driver shows conscious head or body movements during the last ~~{30/35}~~s or

~~———— Driver has been talking during the last {30}s~~

- ~~The driver's did not have his~~ eyes have not been continuously closed for the last ~~{30/4}~~s.

Latest when the driver does not show any signs of the above activities, but as soon as the system has detected the driver to no longer be available, the system shall provide a distinctive warning until appropriate actions of the driver are detected or until a transition demand is initiated.

Latest when the system does not detect appropriate actions from the driver during the distinctive warning for a period of more than ~~{15}~~s a transition demand shall be initiated according to paragraph 2.7.

Remark: Industry should provide evidence

2.6.3. Driver attentiveness

The system shall detect if the driver is attentive. The driver is deemed to be attentive when at least one of the following criteria is met:

- Driver gaze direction is confirmed as primarily looking at the road ahead.

- driver gaze direction is being confirmed as looking at the rear view mirrors or
- driver head movement is confirmed as primarily directed towards the driving task.

The specification for confirming these or equally safe criteria must be declared by the manufacturer and supported by documented evidence. This shall be assessed by the technical service according to Annex X (CEL).

- 2.7. Transition Demand and System Operation during Transition phase
- 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 X [CEL] and according to the relevant tests in Annex X.
- 2.7.1. The activated system shall recognise all situations in which it needs to transition the control back to the driver.
- 2.7.2 The timing of the transition demand shall be such that sufficient time is provided for a safe transition to manual driving.
- ~~2.7.2.1. In case of a planned event, a transition demand shall be given latest [15] seconds before the event occurs.~~
- ~~2.7.2.2. In case of an unplanned event, a transition demand shall be given upon detection.~~
- 2.7.2.13 In case of any failure of the system or of any function needed for the operation, the system shall immediately initiate a transition demand upon detection.
- 2.7.3. During the transition phase the system shall continue to operate. The system may reduce the speed of the vehicle to ensure its safe operation but shall not bring it to standstill unless required by the situation (e.g. due to vehicles or obstacles obstructing the path of the vehicle).
- ~~2.7.3.1. Once in standstill the vehicle [may /shall] remain in this condition and shall then activate the hazard warning lights [if the driver has not deactivated the system] latest [5] s after the start of the transition demand.~~
- ~~2.7.3.2. During the transition phase, the transition demand shall be escalated latest after 4 s after the start of the transition demand.~~
- 2.7.4. A transition demand and phase shall only be terminated once the system is deactivated or a minimum risk manoeuvre has started.
- 2.7.4.1. In case the driver is not responding to a transition demand by deactivating the system either manually as per paragraph 2.4.4. or automatically as per paragraph 2.4.5, a minimum risk manoeuvre shall be started automatically, earliest [10 s] after the start of the transition demand.

~~{2.7.4.1.1. Notwithstanding paragraph 2.7.4.1. a severe failure minimum risk manoeuvre MRM may be initiated immediately in case of a severe ALKS or severe vehicle failure. It is recognized that in case of a severe vehicle failure the ALKS may no longer be capable of fulfilling the requirements of this Regulation, but it shall aim at enabling a safe transition of control back to the driver.}~~

~~{2.7.4.1.2. Notwithstanding xxx a MRM may be initiated immediately in case of a severe ALKS failure.}~~

{2.7.4.1.3. The manufacturer shall declare the types of severe vehicle failures and severe ALKS failures that will lead the ALKS to initiate a severe failure MRM immediately.}

~~2.7.5. The system shall be deactivated at the end of any transition phase, unless a minimum risk manoeuvre needs to be performed.~~

~~Comment to 2.7.5.: With the change in 2.7.4.1 this paragraph could be deleted.~~

2.8. Information to the driver

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 X [CEL] and according to the relevant tests in Annex X.

2.8.1. The following information shall be indicated to the driver:

- ~~- the system status as defined in paragraph 2.8.2., “active” by at least an optical signal, [containing an unique indication [with a [green] steering wheel or a vehicle with an additional “A” or “AUTO”].]~~
- any failure of the system with at least an optical signal unless the system is manually deactivated (off mode),
- transition demand by at least an optical and in addition an acoustic and/or haptic warning signal. ~~The warning shall be escalated latest [4]s after the initiation [and contain a haptic warning [when the vehicle is moving faster than [20]km/h]].~~
- minimum risk manoeuvre by an optical signal and either an acoustic or a haptic warning signal and
- emergency manoeuvre by an optical signal ~~and either an acoustic or a haptic warning signal.~~

~~ALTERNATIVE section from GERMANY to replace the first bullet point:~~

2.8.2.1. System status

2.8.2.1.1. System unavailability indication

In case activation of the system following the deliberate action of the driver is denied by the system due to system unavailability, this shall be at least visually-optically displayed to the driver.

2.8.2.1.2. System status display when activated

Upon activation the system status (active mode) shall be displayed continuously by an optical signal to the driver.

The optical signal shall be unambiguous and indicate the active system state until the system is deactivated (off mode).

The optical signal shall fulfil the following minimum requirements:

- dedicated colour displayed on the steering control covering at least ~~40~~% of the outer rim perimeter facing towards the driver,
- adequate size (easily readable from permitted seating position),
- colours of indicators contrast adequately from background colour and conform to convention or stereotypes and
- commonly accepted or standardized symbols are used.

Alternative, yet adequate and equally safe requirements for the optical signal may be declared by the manufacturer and shall be supported by documented evidence. This shall be assessed by the technical service according to Annex X (CEL).

2.8.2.3. System status display when deactivated

Upon deactivation, when the system status changes from active mode to (off mode), this shall be indicated to the driver by at least an optical and acoustic signal. As additional optical signal upon deactivation the dedicated colour displayed on the steering control shall switch off.

The optical and acoustical signals shall meet the following minimum requirements:

- adequate size (easily readable from permitted seating position),
- colours of indicators contrast adequately from background colour and conform to convention or stereotypes,
- commonly accepted or standardized symbols are used and
- acoustic signal should raise attention (loud and clear).

2.8.23. During the transition phase and the minimum risk manoeuvre, the system shall instruct the driver in an intuitive and unambiguous way to take over manual control of the vehicle. The instruction shall include ~~a~~-pictorial information showing hands and the steering control and may be accompanied by additional explanatory text or warning symbols, as shown in the example below.



Example 1.



Example 2.



2.8.23.1. During the transition phase, ~~To~~ to visually emphasize and escalate the optical warning symbol, a yellow steering control with moving hands shall be used ~~during the transition phase~~. Additionally, the optical signal shall be accompanied by the blinking/flashing of the dedicated colour displayed on the steering control (only slow blinking/flashing so as not to upset the driver).

2.8.32.2. With the start of the minimum risk ~~manoeuvre~~, the given signal shall change its characteristics to a red flashing steering control with moving hands to emphasize the urgency of an action ~~through by~~ the driver.}]

ALTERNATIVE

~~[With the start of the minimum risk manoeuvre, the given signal shall change its characteristics to emphasize the urgency of an action through the driver and at least the hands or the steering control shall be turned to red.]~~

2.8.43. The warnings of an ALKS during a transition phase, a ~~Minimal~~ minimum Risk M manoeuvre or an ~~e~~ Emergency Manoeuvre manoeuvre may be prioritized over other warnings in the vehicle.

The prioritization of different acoustic and optical warnings during the ALKS operation shall be declared by the manufacturer to the Technical Service during Type Approval.

2.9. Minimum Risk Manoeuvre ~~(as risk mitigation strategy)~~ (MRM)

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 X [CEL] and according to the relevant tests in Annex X.

2.9.1. 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 a deceleration demand not greater than ~~[4]~~ 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 system failure.

Additionally, the hazard warning lights shall be activated ~~not later than [4] seconds after with~~ the start of the minimum risk manoeuvre ~~or once the vehicle comes to standstill whichever is earlier.~~

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

~~2.9.3.~~ In case the ALKS ~~[is designed to / intends to]~~ is capable of performing lane change manoeuvres during the MRM, including to the hard shoulder, this shall only be permitted if the situation is not critical.

Such lane changes are deemed critical either if there is a risk of a collision with another vehicle in the target lane, or if an approaching vehicle in the target lane would have to decelerate at a higher level than 3m/s², 0.4 seconds after the ALKS vehicle has crossed the lane marking, to ensure the distance between the two vehicles is never less than that which the ALKS vehicle travels in 1 ~~second.~~

Any lane change must be indicated to other road users according to traffic law.

The system's safety strategies must be declared and proved with evidence by documentation to the Technical Service.

2.9.4. A minimum risk manoeuvre shall only be terminated once the system is deactivated or the system has brought the vehicle to a standstill.

2.9.5. The system shall be deactivated at the end of any minimum risk manoeuvre.

The hazard warning lights shall remain activated ~~[unless deactivated manually]~~ and the vehicle shall not move away after standstill without manual input.

2.9.6. Reactivation of the system after the end of any minimum risk manoeuvre shall only be possible after each new engine start/run cycle, ~~except when a new engine start/run cycle is performed automatically, e.g. by the operation of a stop/start system.~~

2.10. Emergency Manoeuvre ~~(as collision mitigation strategy)~~ (EM)

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 X [CEL] and according to the relevant tests in Annex X.

2.10.1. An emergency manoeuvre shall be carried out only in case of ~~[an imminent collision risk / as described in~~ paragraph 2.5.5].

2.10.2. This manoeuvre shall decelerate the vehicle up to its full braking performance if necessary and/or perform an automatic evasive manoeuvre, whichever is the most appropriate.

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 confirming and has confirmed that no critical situation would result from this manoeuvre].

The situation is deemed critical either if there is a risk of a collision with another vehicle in the evasive path, or if a vehicle approaching from the rear in the evasive lane [with the allowed or advised maximum speed] would be forced to decelerate more than [43] m/s² in order to maintain a safety distance of [1]s to the ALKS vehicle once it has crossed the lane marking.]

After the evasive manoeuvre the vehicle shall aim at resuming a stable position either in its original or the adjacent lane of travel.

The system shall demonstrate its capabilities to assess the criticality of an evasive manoeuvre crossing lane markings according to the relevant test in Annex X.}]

- 2.10.3. An emergency manoeuvre shall only be terminated as soon as the collision risk disappeared {or in case of a system override by the driver}.
- 2.10.3.1 After an ~~E~~emergency ~~m~~Manoeuvre the system shall {continue to operate and /initiate a transition demand}.
- 2.10.3.2 Once the ~~e~~Emergency ~~m~~Manoeuvre has led the vehicle to standstill, the hazard warning lights shall be activated unless the ALKS will drive-off without a manual input. In case the vehicle will not drive off without manual input [a transition demand shall be initiated / an appropriate information shall be given to the driver].
- ~~2.10.4.~~ The vehicle shall implement a logic signal indicating emergency braking as specified in UN R13H {or UN R13 as appropriate}.}
- 2.11. System information data
- 2.11.1. The following data shall be provided, together with the documentation package required in Annex [X] of this UN Regulation, to the Technical Service at the time of type approval.
- 2.11.2. A list of types of situations in which the vehicle may generate a transition demand to the driver.
- 2.11.3. Information about how the system detects that the driver is available to take over the control.
- 2.11.4. The means to monitor the driving environment.
- 2.11.5. The means to activate, override or deactivate the system (~~as relevant~~) including the strategy how the system is protected against unintentional deactivation, the threshold values for a steering override {and how the system assesses that the driver has directed his gaze to the driving task}.
- 2.11.6. Information about how the failure warning signal status and the confirmation of the valid software version related system performance can be checked via the use of an electronic communication interface.*

~~* This paragraph shall be reviewed once the Task Force on Cyber Security and Over the Air issues (TF CS/OTA) reporting to the World Forum for the Harmonization of Vehicle Regulations (WP.29) Informal Working Group on Intelligent Transport Systems / Automated Driving has finalized its work on measures for software identification and, if necessary, amended accordingly.~~

2.11.7. Description of the types of severe vehicle failures and severe ALKS failures that will lead the ALKS to initiate a MRM immediately.

~~2.11.8. Information on the sensor range over lifetime. The sensor range shall be specified in such way that any influence on deterioration of the sensor shall not affect the fulfilment of paragraphs 2.5.6. and 2.5.10. of this Annex.~~

~~Comment from SDG to 2.11.8.: This paragraph can be deleted with the new wording in section 2.5.6. and the sensor self test in 2.4.3.~~

2.11.8. For driving situations not covered by the tests of Annex [X], the safe operation of the system shall be demonstrated by the vehicle manufacturer on the base of Annex X of this Regulation.

2.11.9. Installation

The manufacturer shall provide information regarding the installation options that will be employed for the individual components that comprise the sensing system. These options shall include, but are not limited to, the location of the component in/on the vehicle, the material(s) surrounding the component, the dimensioning and geometry of the material surrounding the component, and the surface finish of the materials surrounding the component, once installed in the vehicle. The information shall also include installation specifications that are critical to the system's performance, e.g. tolerances on installation angle.

Changes to the individual components of the sensing system, or the installation options, shall be notified to the Type Approval Authority and be subject to further assessment.

2.11.10. The system behaviour during a MRM.

~~2.11.11. The system behaviour during a severe failure MRM.~~

~~2.11.12. The system behaviour during an EM.~~

~~2.12. Data Storage System for Automated Driving (DSSAD)³~~

~~2.12.1. Any vehicle with an automated driving function such as ALKS must be equipped with a DSSAD which must fulfil the requirements as specified in [Regulation X or Annex X of this Regulation].~~

~~2.13. Cyber security⁴~~

~~Annex [X] Testing ALKS [To be discussed]~~

~~Annex [X] Complex Electronic Systems⁵~~

³ To be revised in accordance with IWG EDR/DSSAD and subject to GRVA decision.

⁴ To be revised in accordance with TF CS/OTA and subject to GRVA decision.

⁵ To be revised in accordance with IWG VMAD and subject to GRVA decision.

~~*** TESTS ***~~

~~The width of a traffic lane shall be considered to be 3.65m.~~

~~Lane Keeping Functionality Test:~~

- ~~• approach curve with narrow (minimum) radius with the maximum operational speed~~
- ~~• swerving test: stable lateral position in straight lane~~
- ~~• driver availability test: detecting that the driver is not available to take over the control~~

~~Following Distance Test:~~

- ~~• approach a slower lead vehicle which is on constant speed~~
- ~~• follow a leading vehicle which starts slightly decelerating~~

~~Blocked Lane Test:~~

- ~~• approach a stationary target in the lane of travel with the maximum operational speed~~

~~Deceleration Tests~~

- ~~• Lead vehicle performs an emergency braking~~
- ~~• Cutting in vehicle~~
- ~~• Deceleration during minimal risk manoeuvre is below [4m/s²]~~
- ~~• Maximum deceleration during emergency manoeuvre (inclusive full braking performance manually by the driver as a reference)~~

~~Maximum Operational Speed Test~~

- ~~• Sensor performance test~~
- ~~• Maximum speed test (with and without leading vehicle)~~

~~DETAILS TO BE DEFINED ONCE THE REQUIREMENTS ARE AGREED~~