Submitted by Germany	Informal Document: ACSF-06-28

Based on document ACSF-06-05 after the 6th meeting

- Current Text is discussion is marked in black.
- Explicit confirmed paragraphes at the 6th session are marked in **green**.
- Confirmed text at 5th session (and not amended in 6th session) are marked in purple
- Homework can be found on the right margin

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Consolidated Document

Proposal for amendments to Regulation No. 79 to include ACSF > 10 km/h

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Amend paragraph 2.3.4.1. to read:

2.3.4.1. "Automatically commanded steering function" (ACSF) means the function within a complex electronic control system where actuation of the steering system can result from automatic evaluation of signals initiated on-board the vehicle, possibly in conjunction with passive infrastructure features, to generate continuous control action in order to assist the driver.

2.3.4.1.1. Category A ACSF means, a function that operates at a speed no greater than 10 km/h to assist the driver, on demand, in low speed lateral manoeuvring or lateral parking operations.

2.3.4.1.2. ACSF Category B1 means a function [which is initiated/activated by the driver and] which continuously assists the driver in keeping the vehicle within the chosen lane, by influencing the lateral movement of the vehicle.

2.3.4.1.3. "ACSF Category B2 means a function which is initiated/activated by the driver and which keeps the vehicle within its lane by influencing the lateral movement of the vehicle for extended periods without further driver command/confirmation

[2.3.4.1.4. Category C ACSF means, a function which is initiated/activated by the driver and which can perform a single lateral manoeuver (e.g. lane change) when commanded by the driver.

2.3.4.1.5. Category D ACSF means, a function which is initiated/activated by the driver and which can indicate the possibility of a single lateral manoeuvre (e.g. lane change) but performs that function only following a confirmation by the driver.]

2.3.4.1.6. Category E ACSF means, a function which is [initiated/activated] by the driver and which can continuously determine the possibility of a manoeuvre (e.g. lane change) and complete these manoeuvers for extended periods without further driver command/confirmation.

[2.3.4.2 **"Corrective steering function" means the discontinuous control function within a complex electronic control system whereby, for a limited duration, changes to the steering angle of one or more wheels may result from the automatic evaluation of signals initiated on-board the vehicle, in order to maintain the basic desired path of the vehicle or to influence the vehicle's dynamic behaviour. Any system for avoiding the lane departure or for keeping within the lane shall be considered ACSF according. 2.3.4.1]**

Insert new paragraph 2.4.8. to read

2.4.8. **For Automatically commanded steering functions**

2.4.8.1. **"Lane" means one of the longitudinal strips into which a roadway is divided.**

2.4.8.2. **"Visible Lane markings" means delineators intentionally placed on the borderline of the lane that are directly visible by the driver while driving (e.g. not covered by snow, etc.).**

2.4.8.3. **"Lead vehicle" means a vehicle driving in front of the vehicle equipped with ACSF.**

2.4.8.4. **"Lane change manoeuvre" means a manoeuvre in which the vehicle changes from its initial lane to an adjacent lane**

2.4.8.5. **"Specified maximum speed V_{smax}" means the maximum speed up to which an ACSF is designed to operate under normal operating conditions.**

2.4.8.6. **"Specified minimum speed V_{smin}" means the minimum speed down to which an ACSF is designed to operate under normal operating conditions.**

2.4.8.7. **"Specified maximum lateral acceleration ay_{smax}" means the maximum lateral acceleration up to which an ACSF is designed to operate under normal operating conditions.**

2.4.8.8. **"Normal operating conditions" mean that the ACSF system is active and does neither carry out a transition procedure nor a Minimal Risk Manoeuvre nor an Emergency Manoeuvre.**

2.4.8.9. **"Transition demand " means an instruction from the ACSF that the driver has to take over control of the steering task again.**

2.4.8.10. **"Transition procedure" means the sequence of providing a transition demand by the system, taking over steering control by the driver and deactivation of the ACSF.**

2.4.8.11. **"Conditions for operation" mean circumstances like traffic situation, road category, quality of lane markings, vehicle speed, curvature of the road, lighting, sensor capabilities etc. specified by the vehicle manufacturer, where the system is designed to operate.**

2.4.8.12. **"System boundaries" mean all circumstances from which on the conditions for operation are not fulfilled anymore.**

Homework:
UK to improve wording

2.4.8.13. "ACSF status" means any distinct operational mode of the ACSF like "switched off" "switched on", "available to be activated", "activated" etc.

2.4.8.14. “Driver availability recognition [system/function]” means a function able to assess driver’s physical availability to respond to a transition demand from an ACSF system.

2.4.8.15. "Minimal risk manoeuvre" means a procedure aimed at minimizing risks in traffic, which is automatically performed by the system, e.g. when the driver does not respond to a transition demand

2.4.8.16. "Emergency Manoeuvre" is a manoeuvre performed by the system in case of a sudden unexpected event in which the vehicle is in imminent danger to collide with another object, with the purpose to avoid or mitigate a collision.

2.4.8.17. "Protective braking" means an application of the brakes of the vehicle by the system in order to decelerate the vehicle with the purpose of avoiding or mitigating a collision.

[2.4.8.18. " Data Storage System for ACSF (DSSA)“ means a data recording medium to record ACSF system operation data including data of Driver availability Recognition System.]

2.4.8.19 An ACSF is in “off mode” (or “switched off”) when prevented from controlling the steering system.

2.4.8.20 An ACSF is in “standby mode” when the function is switched on but the conditions for being active are not all met. In this mode, the system does not control the steering system.

2.4.8.21 An ACSF is in “active mode” (or “active”) when the function is switched on and the conditions for being active are met. In this mode, the system [continuously or discontinuously] controls the steering system.

2.4.8.22 An ACSF is in “failure mode” when the system has detected a failure.

5.1.6.1. Whenever an Automatically Commanded Steering function becomes active, this shall be indicated to the driver. Any termination of control shall produce a warning in accordance with the requirements of paragraph 5.4.3.

5.4.3. Special Warning Provisions for Automatically Commanded Steering Functions

5.4.3.1 Any termination of control initiated by the system (i.e. when the active mode is automatically deactivated by the system), other than specified in 5.6.1.4.7 shall produce a distinctive driver warning including visual warning and either an acoustic warning or an haptic warning until the driver has resumed steering control or the vehicle is at standstill. The same warning as for a transition demand maybe used. In the case of ACSF category A, a short [but distinctive] warning is deemed to fulfill the warning requirement above. In the case of ACSF category B1, no warning is necessary.

Amend paragraph 5.5.2. to read:

5.5.2. It shall be possible to verify in a simple way the correct operational status of those Complex Electronic Systems, which have control over steering. If special information is needed, this shall be made freely available. **[It shall be possible to verify the correct operational status of those Electronic Systems by a visible observation of the failure warning signal status, following a "power-ON" and any bulb check.**

In the case of the failure warning signal being in a common space, the common space must be observed to be functional prior to the failure warning signal status check.

In the case of an ACSF system able to operate at higher speed than 10km/h, it shall be possible to confirm the failure warning signal status via the use of an electronic communication interface.]

In the case of an ACSF system it shall be possible to confirm the valid software version of the system via the use of an electronic communication interface.

Amend paragraph 5.5.2.1. to read:

5.5.2.1. At the time of Type Approval the means implemented to protect against simple unauthorized modification to the operation of the verification means chosen by the manufacturer (e.g. warning signal) shall be confidentially outlined.

Alternatively this protection requirement is fulfilled when a secondary means of checking the correct operational status is available, e.g. by using an electronic communication interface.

Insert new paragraph 5.6

5.6 **Special Provisions for Automatically Commanded Steering Functions**

Information about the transition procedure and the consequences of delayed or omitted take over of the steering shall be provided to the users of the vehicle, at least in the owners manual.

5.6.1. **Special Provisions for Category E ACSF**

Any system of Category E ACSF shall fulfill the following requirements.

5.6.1.1. **General**

Rem: including B2 necessary

5.6.1.1.1. **[The system shall be active (deliver automatic steering) only after a deliberate action of the driver and if the conditions for operation of the system are fulfilled (all associated functions – e.g. brakes, accelerator, steering, camera/radar/lidar etc. are working properly).]**

Proposal: "Any safety system, other than ACSF, which is installed in the vehicle shall not be affected by activation or deactivation of the ACSF system."

Homework: everybody to think about this until next meeting

5.6.1.1.2. **The vehicle shall be equipped with a means for the driver to activate and deactivate the system. The deactivation shall be possible at any time.**
The activation of the system shall not be possible if the driver is not in the driver seat or if the seatbelt is not fastened.

5.6.1.1.3. **[Deliberate braking operation by the driver shall take priority over a demand for longitudinal movement by the ACSF system.**
Deliberate Accelerating operation by the driver shall take priority over a demand for longitudinal movement by the ACSF system.
Deliberate Steering operation by the driver shall take priority over a demand for steering by the ACSF system.
The system may remain active provided that priority is given to the driver during the overriding period. The means to override the ACSF shall be indicated in the system information data. A transition demand may be issued at the discretion of the vehicle manufacturer to request the driver for [an orderly] takeover.]

Homework: UK to improve wording

5.6.1.1.4 **The specified maximum speed V_{smax} shall not have a value of more than 130 km/h**

5.6.1.1.5. **The specified maximum lateral acceleration ay_{smax} shall not have a value of more than 3 m/s² and, if V_{smax} is > 60 km/h of less than 1 m/s².**

5.6.1.1.6. **The activated system shall at any time control the movement of the vehicle in such a way that the vehicle does not induce any safety critical situations and that the movements of the vehicle are clear to other road users.**

5.6.1.1.7. **The system status shall be indicated to the driver by a visual signal. The indication shall [at least] distinguish between stand-by, active and failure Mode. The indication shall be present as long as the relevant system status persists.**

5.6.1.1.8. **The vehicle shall be equipped with means to monitor at any time when ACSF is active a minimum range to the front (s_{Front}), to the right (s_{side}), and to the left side (s_{side}) and behind (s_{Rear}) the vehicle with the purpose to avoid or to mitigate collisions.**

5.6.1.1.8.1. **The minimal range in front (s_{Front}) of the ACSF vehicle shall be calculated according to the following formula:**

$$s_{Front} = v_{ACSF}^2 / (2 \cdot a_{ACSF})$$

where:

s_{Front} = ***relative distance between the vehicle equipped with ACSF and the vehicle driving in front, measured in meters from the front edge of the vehicle equipped with ACSF to the rear end of the vehicle driving in front.***

v_{ACSF} = ***speed of the vehicle equipped with ACSF measured in m/s***

a_{ACSF} = ***3,7 m/s² = feasible deceleration under wet conditions***

5.6.1.1.8.2. **The minimal range to the rear (S_{Rear}) of the ACSF vehicle shall be calculated according to the following formula:**

$$S_{Rear} = d_{reaction,\,rear} + d_{brake,rear} + d_{safety,rear}$$

with:

$$d_{reaction,rear} = (v_{rear} - v_{VUT}) * t_{reaction}$$

$$d_{brake,rear} = \frac{(v_{rear} - v_{ACSF})^2}{2 * a_{brake}}$$

$$d_{safety,rear} = v_{ACSF} * t_d$$

where:

S_{Rear} = ***relative distance between the vehicle equipped with ACSF and the vehicle behind, measured in meters from the rear edge of the vehicle equipped with ACSF to the front end of the vehicle behind.***

$d_{reaction,\,rear}$ = ***relative distance of the vehicle driving behind the vehicle equipped with ACSF caused by the reaction of the driver to brake, measured in meters***

$t_{reaction}$ = ***1,2 s = reaction time of the driver driving the vehicle behind the vehicle equipped with ACSF needed to execute the braking and to built up the full braking force, measured in seconds***

$d_{brake, rear}$ = *braking distance of the vehicle driving behind the vehicle equipped with ACSF, measured in meters*

$d_{safety, rear}$ = *safety distance between the vehicle equipped with ACSF and the vehicle driving behind, measured in meters*

t_d = *1,0 s = safety time gap to vehicle equipped with ACSF after braking, measured in seconds*

v_{rear} = *[36,1 m/s] speed of the vehicle driving behind the vehicle equipped with ACSF, measured in m/s.*

v_{VUT} = *speed of the vehicle equipped with ACSF, measured in m/s.*

a_{brake} = *3 m/s² = admissible deceleration of the vehicle driving behind the vehicle equipped with ACSF*

5.6.1.1.8.3. **The minimal range to the left and to the right (side) shall be at least 7 m (measured from the medium longitudinal centerline of the vehicle *equipped with ACSF*)**

[5.6.1.1.9 **The vehicle shall have a means to detect whether the rule of the road is left or right hand traffic, and shall behave accordingly, keeping left or right as far as possible. It shall overtake on the lane outside slower traffic and returning to the original lane, once a suitable distance ahead of the overtaken traffic.]**

5.6.1.1.10. **The vehicle shall fulfill the tests for Category E as specified in Annex 7.**

[5.6.1.1.x **The vehicle shall detect the max. speed limit of the country, where it is used and shall not activate the ACSF system (CAT E) above this speed limit.]**
Remark: to be confirmed in the next meeting!

Trailer towing issue is considered by an other §

5.6.1.2. Operation of ACSF

5.6.1.2.1. Any lane change manoeuvre shall be initiated only if:

- the vehicle is travelling on a road section which is not dedicated to pedestrians or cyclists and which has a [physical or constructional] separation of traffic moving in opposite directions and which has at least two lanes for the direction the vehicle is driving and

- any traffic that can affect the safe manoeuvre is identified by equipment installed on the vehicle and

- the vehicle equipment can analyze speed and distance of the identified traffic to ensure a safe manoeuvre (e.g. does not cause a deviation to the flow, direction of other traffic or considering left- or right-hand traffic).

5.6.1.2.2. If a lane change manoeuvre is carried out, the correspondent direction indicator lamps shall automatically flash minimum 3 times prior the outside of the tyre of the vehicle's front wheel closest to the lane markings has touched the inside edge of the visible lane marking to which the vehicle is being drifted.

Homework: UK to harmonize 5.6.1.2.1; 5.6.2.1.2 in the D, UK and EC proposal

Reminder: detection of the road necessary

5.6.1.2.3. The lane change manoeuvre shall be completed, except the system detects an imminent critical situation or the system is overridden by the steering of the driver.

5.6.1.2.4. The activated system shall prior and after a lane change manoeuvre ensure that the vehicle does not cross any lane marking.

5.6.1.2.5. The system shall detect if the driver's seatbelt is unfastened. When the driver's seatbelt is detected to be unfastened a transition demand shall be initiated according to 5.6.1.4.4.

5.6.1.2.6. Driver availability recognition system

The system shall comprise a driver availability recognition system that is active whenever the ACSF system is active.

The driver availability recognition system shall detect that the driver is present in the driver seat and that he is available to take over the steering.

5.6.1.2.6.1. Driver not present in the driver seat

When the driver is not present in the driver seat the system shall provide a distinctive warning until the driver is detected to be back in the driver seat or until a transition demand is initiated.

When the driver is not back in the driver seat during the distinctive accoustic warning with a max. duration of [15 s] a transition demand shall be initiated according to 5.6.1.4.3.

5.6.1.2.6.2. Driver not available to take over the steering

The system shall check if the driver is available to take over the steering by permanently evaluating driver's activity. The means to detect driver's activity [(e.g. head and/or eye movement and/or input to any control element of the vehicle)] shall be selected by the manufacturer.

When the driver does not show any activity for a time span of maximum [3] min the system shall provide a distinctive accoustic warning until appropriate actions of the driver are detected (e.g. the driver resumes manual control) or until a transition demand is initiated.

When the system does not detect appropriate actions from the driver during the distinctive accoustic warning with a max. duration of [15 s] a transition demand shall be initiated according to 5.6.1.4.3.

Homework: UK to harmonize 5.6.1.2.6

5.6.1.3. System information data Remark: Move to the end of the paragraph

5.6.1.3.1. Following data shall be provided together with the documentation package required in Annex 6 of this regulation to the Technical Service at the time of type approval

5.6.1.3.1.1. The values for V_{smax} , V_{smin} and $ay_{smax.}$

5.6.1.3.1.2. The conditions under which the system can be activated, i. e. when the conditions for operation of the system are fulfilled.

5.6.1.3.1.3. Information about system boundaries at which the activated system shall issue a transition demand.

5.6.1.3.1.4. The specific values for time according to 5.6.1.4.2 which are foreseen for safe transition to manual steering under different circumstances.

5.6.1.3.1.5. Documentation about the chosen strategies regarding the minimal risk manoeuvre which is foreseen depending on the given traffic situation.

5.6.1.3.1.6. Documentation about the chosen strategies regarding the emergency manoeuvre which is foreseen in different sudden critical events.

5.6.1.3.1.7 Information about the driver availability recognition system:
- how it detects the presence of the driver in the seat and
- how it detects driver availability to take over the steering and
- how it evaluates driver's activity and
- how it detects appropriate driver activities after a distinctive warning

5.6.1.3.1.8 Information about how the failure warning signal status and the confirmation of the valid software version can be checked via the use of an electronic communication interface.

5.6.1.3.1.9 Documentation about which system software version is valid. This documentation shall be updated whenever a software version was amended.

5.6.1.4. Transition demand and system operation during transition

5.6.1.4.1. If the system detects that its boundaries are reached or will be reached shortly or in case of a system failure it shall provide a transition demand.

5.6.1.4.2. The timing of the transition demand shall be such that sufficient time is provided for a safe transition to manual steering.

5.6.1.4.2.1. In case of normal operating conditions and in case that the system anticipates that system boundaries will be reached a transition demand shall be given not later than 4 s before system boundaries are reached.

5.6.1.4.2.2. In case of a sudden unexpected event with imminent danger of a collision a transition demand shall be given immediately and an emergency manoeuvre shall be initiated. Remark: is this still necessary ? -> see: 5.6.1.6.

5.6.1.4.2.3. In case of a sudden unexpected event without imminent danger of a collision a transition demand shall be given immediately and the system shall follow the [system/basic]* desired path for at least 4 s after the transition demand, at least in the following cases

- if the speed of the vehicle with activated ACSF exceeds v_{smax}, or

- if the vehicle with activated ACSF and a specified Vsmax > 60 km/h, reaches a lateral acceleration of more than ay_{smax} , or

- if a system boundary is reached due to a missing lane marking, or

- if a single sensor failure occurs.

Homework:
*: for UK + J to clarify

5.6.1.4.3. If a transition demand is given because a driver availability recognition system according 5.6.1.6, the system shall follow the [system/basic]* desired path for at least 4 s after the transition demand has started.

5.6.1.4.4. The system shall provide a transition demand if the driver's seatbelt is unfastened or if the driver's seat is left by the driver. In this case the system shall follow the initial path at least [4 s] after the transition demand.

5.6.1.4.5. In case of other failures than a single sensor failure a transition demand shall be given immediately and the system shall initiate the fail-safe strategy as declared by the manufacturer in Annex 6 of this regulation, as soon as the failure is detected.

5.6.1.4.6. In case the vehicle is fitted with a built-in infotainment system, content visible to the driver, which is not relevant for driving, shall be deactivated as long as a transition demand is issued.

5.6.1.4.7. The transition demand shall be provided by a visual warning signal and either an acoustic warning signal or by imposing a haptic warning signal. The warning shall

be escalating with time in terms of enlarging the intensity of the warning and/or in terms of adding and/or changing the warning means, or start immediately with the highest intensity level.

5.6.1.5. Minimal Risk Manoeuvre

5.6.1.5.1. If the system detects that after a transition demand the driver does not take over manual control of the steering again the vehicle shall carry out a minimal risk manoeuvre not later than 4 s after the start of the transition demand

5.6.1.5.2. It shall at any time be possible to override the minimal risk manoeuvre by the driver. The system may be designed to exclude unintended override.

5.6.1.5.3. The hazard lights shall be activated automatically not later than 10 s after the start of the minimal risk manoeuvre. Additionally, an audible warning device may be permitted to warn the other road users.

Homework: OICA to propose new wording only if really neccesary

5.6.1.6. Emergency Manoeuvre

5.6.1.6.1. If the activated ACSF detects that due to a sudden unexpected event the vehicle is in imminent danger of a collision and that the time for a safe transition procedure is too short, an emergency manoeuvre shall be carried out (e.g. by braking the vehicle and/or by steering).

Homework: EC to make a new proposal

5.6.1.7. Longitudinal control and protective deceleration

5.6.1.7.1. Any vehicle equipped with an ACSF of category E shall be able to control the longitudinal speed of the vehicle

5.6.1.7.1.1. If the activated system detects that the distance to other road users in front is less or will shortly be less than the foreseen safety distance a protective deceleration shall be carried out until the foreseen safety distance is reached again.

5.6.1.7.1.2. If the activated system detects that due to a sudden unexpected event the vehicle is in imminent danger to collide with another road user in front and that the time for a safe transition procedure is too short, a protective deceleration as emergency manoeuvre shall be carried out. Only in case a lane change can be carried out safely, alternatively a lane change manoeuvre can be carried out to prevent the collision.

5.6.1.7.1.3. The protective deceleration must be able to deliver full braking force of the vehicle in order to achieve a maximum deceleration.

Homework: OICA to prepare a presentation w.r.t. safety distance

5.6.1.8. **Data Storage System for ACSF (DSSA)**

[5.6.1.8.1. **The DSSA shall record and store the data during the operation of the ACSF in order to demonstrate ~~that~~ if the ACSF had operated properly in align with the relevant requirements in case of a road accident The DSSA shall be fitted in the vehicle and should not contain any radio interface. The DSA shall be designed to ensure data security and data protection and shall be protected against tampering and misuse. The driver and the passengers of the vehicle have to be adequately informed about the data capture. Principally, they shall be enabled to decide by themselves by several options about the processing of the data.**

5.6.1.8.2 **The DSSA shall record and store following data:**

- **GPS-time**
- **GPS Location**
- **Information about the ACSF status**
- **Information about failures**
- **Information about transition demands**
- **Information about minimal risk maneuvre**
- **Takeover of the steering by the driver**

5.6.1.8.3. **The recorded data shall not be deletable and not be volatilized in the DSSA without any deterioration [for at least [6] month].**

5.6.1.8.4. **If special tools are necessary to get access to recorded data, the tools shall be made available by the manufacturer to the authorities, the driver and the passengers of the vehicle and the vehicle owner.**

5.6.1.8.5. **The DSSA shall record at least for [30] seconds prior to and [10] seconds after an accident.]**

End of the discussion at the 6th session

The following text is still the original of ACSF-06-05
(including the comments of Germany) and was not discussed in the 6th session

5.6.2. Special Provisions for ACSF of Category D

Any system of Category D ACSF shall fulfill the following requirements.

5.6.2.1. General

5.6.2.1.1. The system shall be active (deliver automatic steering) only after a deliberate action of the driver and if the conditions for operation of the system are fulfilled (all associated functions – e.g. brakes, accelerator, steering, camera/radar/lidar etc. are working properly).

5.6.2.1.2. The vehicle shall be equipped with a means for the driver to activate and deactivate the system. The deactivation shall be possible at any time.

5.6.2.1.3. Steering by the driver shall override steering by the system. Braking or accelerating by the driver shall override speed selection by the system.

5.6.2.1.4 The specified maximum speed $\underline{V_{smax}}$ shall not have a value of more than 130 km/h

5.6.2.1.5 The specified maximum lateral acceleration ay_{smax} shall not have a value of more than 3 m/s^2 and of less than 1 m/s^2.

5.6.2.1.6. The activated system shall at any time control the movement of the vehicle in such a way that the vehicle does not induce any safety critical situations and that the movements of the vehicle are clear to other road users.

5.6.2.1.7. The system status shall be indicated to the driver by a visual signal.

The indication shall [at least] distinguish between the system status stand-by Mode, active Mode and failure Mode.

The indication shall be present as long as the relevant system status persists.

When the system is switched off by the driver, the indication of stand-by Mode and failure Mode may be suppressed.

Any change in system status shall be indicated by a visual and either an acoustic or haptic signal.

5.6.2.1.8. The vehicle shall be equipped with means to monitor at any time when ACSF is active a minimum range to the front (s_{Front}), to the right (s_{side}), and to the left side (s_{side}) and behind (s_{Rear}) the vehicle with the purpose to avoid or to mitigate collisions.

5.6.2.1.8.1. The minimal range in front (s_{Front}) of the ACSF vehicle shall be calculated according to the following formula:

$s_{Front} = v_{ACSF}^2 / (2 \cdot a_{ACSF})$

where:

s_{Front} = *relative distance between the vehicle equipped with ACSF and the vehicle driving in front, measured in meters from the front edge of the vehicle equipped with ACSF to the rear end of the vehicle driving in front.*

v_{ACSF} = *speed of the vehicle equipped with ACSF measured in m/s*

a_{ACSF} = *3,7 m/s² = feasible deceleration under wet conditions*

5.6.2.1.8.2. The minimal range to the rear (S_{Rear}) of the ACSF vehicle shall be calculated according to the following formula:

$S_{Rear} = d_{reaction,\,rear} + d_{brake,rear} + d_{safety,rear}$

with:

$$d_{reaction,rear} = (v_{rear} - v_{VUT}) * t_{reaction}$$

$$d_{brake,rear} = \frac{(v_{rear} - v_{ACSF})^2}{2 * a_{brake}}$$

$d_{safety,rear} = v_{ACSF} * t_d$

where:

S_{Rear} = *relative distance between the vehicle equipped with ACSF and the vehicle behind, measured in meters from the rear edge of the vehicle equipped with ACSF to the front end of the vehicle behind.*

$d_{reaction,\,rear}$ = *relative distance of the vehicle driving behind the vehicle equipped with ACSF caused by the reaction of the driver to brake, measured in meters*

$t_{reaction}$ = *1,2 s = reaction time of the driver driving the vehicle behind the vehicle equipped with ACSF needed to execute the braking and to built up the full braking force, measured in seconds*

$d_{brake,\,rear}$ = *braking distance of the vehicle driving behind the vehicle equipped with ACSF, measured in meters*

$d_{safety,\,rear}$ = *safety distance between the vehicle equipped with ACSF and the vehicle driving behind, measured in meters*

t_d = *1,0 s = safety time gap to vehicle equipped with ACSF after braking, measured in seconds*

v_{rear} = *[36,1 m/s] speed of the vehicle driving behind the vehicle equipped with ACSF, measured in m/s.*

v_{VUT} = *speed of the vehicle equipped with ACSF, measured in m/s.*

a_{brake} = *3 m/s² = admissible deceleration of the vehicle driving behind the vehicle equipped with ACSF*

5.6.2.1.8.3. **The minimal range to the left and to the right (side) shall be at least 7 m (measured from the medium longitudinal centerline of the vehicle *equipped with ACSF*)**

5.6.1.1.9. **The vehicle shall fulfill the tests for Category D, i.e. FU1, FU2, FU3, TR1, TR2, TR3, TR4, TR5, EM1 and EM2, as specified in Annex 7.**

5.6.2.2. **Operation of ACSF**

5.6.2.2.1. **Any lane change manoeuvre shall be indicated only if:**

- the vehicle is travelling on a road section which is not dedicated to pedestrians or bicyclists and which has a [physical or constructional] separation of traffic moving in opposite directions and which has at least two lanes for the direction the vehicle is driving and

- any traffic that can affect the safe manoeuvre is identified by equipment installed on the vehicle and

- the vehicle equipment can analyze speed and distance of the identified traffic to ensure a safe manoeuvre (e.g. does not cause a deviation to the flow, direction of other traffic or considering left- or right-hand traffic).

5.6.2.2.2. **If a lane change manoeuvre is carried out, the correspondent direction indicator lamps shall be automatically activated minimum 3 s**
a) prior to the start of the lane change manoeuvre or
b) prior the vehicle has touched the lane markings

5.6.2.2.3. **The lane change manoeuvre shall be completed, except the system detects an imminent critical situation or the system is overridden by the steering of the driver.**

5.6.2.2.4 **The activated system shall prior and after a lane change manoeuvre ensure that the vehicle does not cross any lane marking.**

5.6.2.2.5 **Detection of unfastening seatbelt**

The system shall detect if the driver's seatbelt is unfastened. When the driver's seatbelt is detected to be unfastened a transition demand shall be initiated according to 5.6.1.4.4.

5.6.2.2.6 **Driver availability recognition system**

The system shall comprise a driver availability recognition system that is active whenever the ACSF system is active.

The driver availability recognition system shall detect that the driver is present in the driver seat and that he is available to take over the steering.

5.6.2.2.6.1 **Driver not present in the driver seat**

When the driver is not present in the driver seat the system shall provide a distinctive warning until the driver is detected to be back in the driver seat or until a transition demand is initiated.

When the driver is not back in the driver seat during the distinctive warning with a max. duration of [15 s] a transition demand shall be initiated according to 5.6.1.4.3.

5.6.2.2.6.2 **Driver not available to take over the steering**

The system shall check if the driver is available to take over the steering by permanently evaluating driver's activity. The means to detect driver's activity [(e.g. head and/or eye movement and/or input to any control element of the vehicle)] shall be selected by the manufacturer.

When the driver does not show any activity for a time span of maximum [15] min the system shall provide a distinctive warning until appropriate actions of the driver are detected (e.g. the driver resumes manual control) or until a transition demand is initiated.

When the system does not detect appropriate actions from the driver during the distinctive warning with a max. duration of [15 s] a transition demand shall be initiated according to 5.6.1.4.3.

5.6.2.3. **System information data**

5.6.2.3.1. **Following data shall be provided together with the documentation package required in Annex 6 of this regulation to the Technical Service at the time of type approval**

5.6.2.3.1.1. **The values for V_{smax} , V_{smin} and $ay_{smax.}$**

5.6.2.3.1.2. **The conditions under which the system can be activated, i. e. when the conditions for operation of the system are fulfilled.**

5.6.2.3.1.3. **Information about system boundaries at which the activated system shall issue a transition demand.**

5.6.2.3.1.4. **The specific values for time according to 5.6.1.4.2 which are foreseen for safe transition to manual steering under different circumstances.**

5.6.2.3.1.5. **Documentation about the chosen strategies regarding the minimal risk manoeuvre which is foreseen depending on the given traffic situation.**

5.6.2.3.1.6. Documentation about the chosen strategies regarding the emergency manoeuvre which is foreseen in different sudden critical events.

5.6.2.3.1.7 Information about the driver availability recognition system:
- how it detects the presence of the driver in the seat and
- how it detects driver availability to take over the steering and
- how it evaluates driver's activity and
- how it detects appropriate driver activities after a distinctive warning

5.6.2.3.1.8 Information about how the failure warning signal status and the confirmation of the valid software version can be checked via the use of an electronic communication interface.

5.6.2.3.1.9 Documentation about which system software version is valid. This documentation shall be updated whenever a software version was amended.

5.6.2.4. Transition demand and system operation during transition

5.6.2.4.1. If the system detects that its boundaries are reached or will be reached shortly or in case of a system failure it shall provide a transition demand.

5.6.2.4.2. The timing of the transition demand shall be such that sufficient time is provided for a safe transition to manual steering.

5.6.2.4.2.1 In case of normal operating conditions and in case that the system has the information that system boundaries will be reached a transition demand shall be given not later than 4 s before system boundaries are reached.

5.6.2.4.2.2 In case of a sudden unexpected event with imminent danger of a collision a transition demand shall be given immediately and an emergency manoeuvre shall be initiated.

5.6.2.4.2.3 In case of a sudden unexpected event without imminent danger of a collision a transition demand shall be given immediately and the system shall follow the initial path for at least [4 s] after the transition demand, in the following cases

- if the speed of the vehicle with activated ACSF exceeds v_{smax}, or
- if the vehicle with activated ACSF reaches a lateral acceleration of more than ay_{smax} , or
- if a system boundary is reached due to a missing lane marking, or
- if a single sensor failure occurs.

5.6.2.4.3. If a transition demand is given because a driver availability recognition system has detecteds that the driver is not present in his seat and/or is not available to take over the steering, the system shall not cross any lane marking for at least [4 s] after the transition demand.

5.6.2.4.4. The system shall provide a transition demand if the driver's seatbelt is unfastened. In this case the system shall not cross any lane marking for at least [4 s] after the transition demand.

5.6.2.4.5. In case of other failures than a single sensor failure a transition demand shall be given immediately and the system shall initiate the fail-safe strategy as declared by the manufacturer in Annex 6 of this regulation, as soon as the failure is detected.

5.6.2.4.6. In case the vehicle is fitted with a built-in infotainment system, content visible to the driver, which is not relevant for driving, shall be deactivated as long as a transition demand is issued.

5.6.2.4.7. The transition demand shall be provided by a visual warning signal and either an acoustic warning signal or by imposing a haptic warning signal. The warning shall be escalating with time in terms of enlarging the intensity of the warning and/or in terms of adding and/or changing the warning means, or start immediately with the highest intensity level.

5.6.2.5. Minimal Risk Manoeuvre

5.6.2.5.1. If the system detects that after a transition demand the driver does not take over manual control of the steering again the vehicle shall carry out a minimum risk manoeuvre not later than 4 s after the start of the transition demand. Alternatively the minimal risk manoeuvre may start at the beginning of the transition demand.

5.6.2.5.2. It shall at any time be possible to override the minimal risk manoeuvre by the driver. The system may be designed to exclude unintended override.

5.6.2.5.3 Not later than 4 s after the start of the minimal risk manoeuvre the hazard lights shall be activated automatically. Additionally, an acoustic warning device may be permitted to warn the other road users.

5.6.2.6. Emergency Manoeuvre

5.6.2.6.1. If the activated ACSF detects that due to a sudden unexpected event the vehicle is in imminent danger to collide with another road user ahead or beside the vehicle and that the time for a safe transition procedure is too short, an emergency manoeuvre shall be carried out (e.g. by braking the vehicle and/or by steering).

5.6.2.7. Longitudinal control and protective deceleration

5.6.2.7.1. Any vehicle equipped with an ACSF of category D shall be able to control the longitudinal speed of the vehicle.

5.6.2.7.1.1. If the activated system detects that the distance to other road users in front is less or will shortly be less than the foreseen safety distance a protective deceleration shall be carried out until the foreseen safety distance is reached again.

5.6.2.7.1.2. If the activated system detects that due to a sudden unexpected event the vehicle is in imminent danger to collide with another road user in front and that the time for a safe transition procedure is too short, a protective deceleration as emergency manoeuvre shall be carried out. Only in case a lane change can be carried out safely, alternatively a lane change manoeuvre can be carried out to prevent the collision.

5.6.2.7.1.3. The protective deceleration must be able to deliver full braking force of the vehicle in order to achieve a maximum deceleration.

5.6.3. Special Provisions for ACSF of Category C

Any system of Category C ACSF shall fulfill the following requirements.

5.6.3.1. General

5.6.3.1.1. The system shall be active (deliver automatic steering) only after a deliberate action of the driver and if the conditions for operation of the system are fulfilled (all associated functions – e.g. brakes, accelerator, steering, camera/radar/lidar etc. are working properly).

5.6.3.1.2. The vehicle shall be equipped with a means for the driver to activate and deactivate the system. The deactivation shall be possible at any time.

5.6.3.1.3. Steering by the driver shall override steering by the system. Braking or accelerating by the driver shall override speed selection by the system.

5.6.3.1.4. The specified maximum lateral acceleration ay_{smax} shall not have a value of more than 3 m/s^2 and of less than 1 m/s^2.

5.6.3.1.5. The activated system shall at any time control the movement of the vehicle in such a way that the vehicle does not induce any safety critical situations and that the movements of the vehicle are clear to other road users.

5.6.3.1.6. The system status shall be indicated to the driver by a visual signal.

The indication shall [at least] distinguish between the system status stand-by Mode, active Mode and failure Mode.

The indication shall be present as long as the relevant system status persists.

When the system is switched off by the driver, the indication of stand-by Mode and failure Mode may be suppressed.

Any change in system status shall be indicated by a visual and either an acoustic or haptic signal.

5.6.3.1.7. The vehicle shall fulfill the tests for Category ~~E~~C, i.e. FU1 and FU3, as specified in Annex 7. The test FU3 shall only be carried out until a single lane change was completed. Returning into the initial lane is not required.

5.6.3.2. Operation of ACSF

5.6.3.2.1. Any lane change manoeuvre shall be initiated only if commanded by a deliberate action of the driver (e.g. by using the direction indicator lever for at least 2 s).

5.6.3.2.2. If a lane change manoeuvre is carried out, the correspondent direction indicator lamps shall be automatically activated minimum 3 s

a) prior to the start of the lane change manoeuvre or
b) prior the vehicle has touched the lane markings

5.6.3.2.3. The lane change manoeuvre shall be completed, except the system detects an imminent critical situation or the system is overridden by the steering of the driver.

5.6.3.2.4. The activated system shall prior and after a lane change manoeuvre ensure that the vehicle does not cross any lane marking.

5.6.3.3. System information data

5.6.3.3.1. Following data shall be provided together with the documentation package required in Annex 6 of this regulation to the Technical Service at the time of type approval

5.6.3.3.1.1. The values for V_{smax} , V_{smin} and $ay_{smax.}$

5.6.3.3.1.2. The conditions under which the system can be activated, i. e. when the conditions for operation of the system are fulfilled.

5.6.3.3.1.3. Information about how the failure warning signal status and the confirmation of the valid software version can be checked via the use of an electronic communication interface.

5.6.3.3.1.4. Documentation about which system software version is valid. This documentation shall be updated whenever a software version was amended.

5.6.4. Special Provisions for ACSF of Category B2

Any system of Category B2 ACSF shall fulfill the following requirements.

5.6.4.1. General

5.6.4.1.1. The system shall be active (deliver automatic steering) only after a deliberate action of the driver and if the conditions for operation of the system are fulfilled (all associated functions – e.g. brakes, accelerator, steering, camera/radar/lidar etc. are working properly).

5.6.4.1.2. The vehicle shall be equipped with a means for the driver to activate and deactivate the system. The deactivation shall be possible at any time.

5.6.4.1.3. Steering by the driver shall override steering by the system. Braking or accelerating by the driver shall override speed selection by the system.

5.6.4.1.4. The specified maximum speed V_{smax} shall not have a value of more than 130 km/h

5.6.4.1.5. The specified maximum lateral acceleration ay_{smax} shall not have a value of more than 3 m/s^2 and of less than 1 m/s^2.

5.6.4.1.6. The activated system shall at any time control the movement of the vehicle in such a way that the vehicle does not induce any safety critical situations and that the movements of the vehicle are clear to other road users.

5.6.4.1.7. **The system status shall be indicated to the driver by a visual signal.**

The indication shall [at least] distinguish between the system status stand-by Mode, active Mode and failure Mode.

The indication shall be present as long as the relevant system status persists.

When the system is switched off by the driver, the indication of stand-by Mode and failure Mode may be suppressed.

Any change in system status shall be indicated by a visual and either an acoustic or haptic signal.

5.6.4.1.8. **The vehicle shall be equipped with means to monitor at any time when ACSF is active a minimum range to the front (s_{Front}), to the right (s_{side}), and to the left side (s_{side}) with the purpose to avoid or to mitigate collisions.**

5.6.4.1.8.1. **The minimal range in front (s_{Front}) of the ACSF vehicle shall be calculated according to the following formula:**

$$s_{Front} = v_{ACSF}^2 / (2 \cdot a_{ACSF})$$

where:

s_{Front} = *relative distance between the vehicle equipped with ACSF and the vehicle driving in front, measured in meters from the front edge of the vehicle equipped with ACSF to the rear end of the vehicle driving in front.*

v_{ACSF} = *speed of the vehicle equipped with ACSF measured in m/s*

a_{ACSF} = $3{,}7\ m/s^2$ = *feasible deceleration under wet conditions*

5.6.4.1.9. **The vehicle shall fulfill the tests for Category B2, i.e. FU1, TR1, TR2, TR3, TR4, TR5, EM1 and EM2, as specified in Annex 7.**

5.6.4.2. **Operation of ACSF**

5.6.4.2.1. **The ACSF system of category B2 shall only operate if:**

- the vehicle is travelling on a road section which is not dedicated to pedestrians or bicyclists and which has a [physical or constructional] separation of traffic moving in opposite directions

- any traffic that can affect the safe keeping of the vehicle in the lane is identified by equipment installed on the vehicle and

- the vehicle equipment can analyze speed and distance of the identified traffic to ensure a safe lane keeping (e.g. does not cause a deviation to the flow, or direction of other traffic.

5.6.4.2.2. The activated system shall at any time ensure that the vehicle does not cross any lane marking.

5.6.4.2.3. The system shall detect if the driver's seatbelt is unfastened. When the driver's seatbelt is detected to be unfastened a transition demand shall be initiated according to 5.6.1.4.4.

5.6.4.2.4. Driver availability recognition system

The system shall comprise a driver availability recognition system that is active whenever the ACSF system is active.

The driver availability recognition system shall detect that the driver is present in the driver seat and that he is available to take over the steering.

5.6.4.2.4.1. When the driver is not present in the driver seat the system shall provide a distinctive warning until the driver is detected to be back in the driver seat or until a transition demand is initiated.

When the driver is not back in the driver seat during the distinctive warning with a max. duration of [15 s] a transition demand shall be initiated according to 5.6.1.4.3.

5.6.4.2.4.2 Driver not available to take over the steering

The system shall check if the driver is available to take over the steering by permanently evaluating driver's activity. The means to detect driver's activity [(e.g. head and/or eye movement and/or input to any control element of the vehicle)] shall be selected by the manufacturer.

When the driver does not show any activity for a time span of maximum [15] min the system shall provide a distinctive warning until appropriate actions of the driver are detected (e.g. the driver resumes manual control) or until a transition demand is initiated.

When the system does not detect appropriate actions from the driver during the distinctive warning with a max. duration of [15 s] a transition demand shall be initiated according to 5.6.1.4.3.

5.6.4.3. System information data

5.6.4.3.1. Following data shall be provided together with the documentation package required in Annex 6 of this regulation to the Technical Service at the time of type approval

5.6.4.3.1.1. The values for V_{smax} , V_{smin} and $ay_{smax.}$

5.6.4.1.2. The conditions under which the system can be activated, i. e. when the conditions for operation of the system are fulfilled.

5.6.4.3.1.3. Information about system boundaries at which the activated system shall issue a transition demand.

5.6.4.3.1.4. The specific values for time according to 5.6.1.4.2 which are foreseen for safe transition to manual steering under different circumstances.

5.6.4.3.1.5. Documentation about the chosen strategies regarding the minimal risk manoeuvre which is foreseen depending on the given traffic situation.

5.6.4.3.1.6. Documentation about the chosen strategies regarding the emergency manoeuvre which is foreseen in different sudden critical events.

5.6.4.3.1.7 Information about the driver availability recognition system:
- how it detects the presence of the driver in the seat and
- how it detects driver availability to take over the steering and
- how it evaluates driver's activity and
- how it detects appropriate driver activities after a distinctive warning

5.6.4.3.1.8 Information about how the failure warning signal status and the confirmation of the valid software version can be checked via the use of an electronic communication interface.

5.6.4.3.1.9 Documentation about which system software version is valid. This documentation shall be updated whenever a software version was amended.

5.6.4.4. Transition demand and system operation during transition

5.6.4.4.1. If the system detects that its boundaries are reached or will be reached shortly or in case of a system failure it shall provide a transition demand.

5.6.4.4.2. The timing of the transition demand shall be such that sufficient time is provided for a safe transition to manual steering.

5.6.4.4.2.1 In case of normal operating conditions and in case that the system has the information that system boundaries will be reached a transition demand shall be given not later than 4 s before system boundaries are reached.

5.6.4.4.2.2 In case of a sudden unexpected event with imminent danger of a collision a transition demand shall be given immediately and an emergency manoeuvre shall be initiated.

5.6.4.4.2.3 In case of a sudden unexpected event without imminent danger of a collision a transition demand shall be given immediately and the system shall follow the initial path for at least [4 s] after the transition demand, in the following cases

- if the speed of the vehicle with activated ACSF exceeds v_{smax}, or
- if the vehicle with activated ACSF reaches a lateral acceleration of more than ay_{smax} , or
- if a system boundary is reached due to a missing lane marking, or
- if a single sensor failure occurs.

5.6.4.4.3. If a transition demand is given because a driver availability recognition system has detected that the driver is not present in his seat and/or is not available to take over the steering, the system shall not cross any lane marking for at least [4 s] after

the transition demand.

5.6.4.4.4. **The system shall provide a transition demand if the driver's seatbelt is unfastened. In this case the system shall not cross any lane marking for at least [4 s] after the transition demand.**

5.6.4.4.5. **In case of other failures than a single sensor failure a transition demand shall be given immediately and the system shall initiate the fail-safe strategy as declared by the manufacturer in Annex 6 of this regulation, as soon as the failure is detected.**

5.6.4.4.6. **In case the vehicle is fitted with a built-in infotainment system, content visible to the driver, which is not relevant for driving, shall be deactivated as long as a transition demand is issued.**

5.6.4.4.7. **The transition demand shall be provided by a visual warning signal and either an acoustic warning signal or by imposing a haptic warning signal. The warning shall be escalating with time in terms of enlarging the intensity of the warning and/or in terms of adding and/or changing the warning means, or start immediately with the highest intensity level.**

5.6.4.5. **Minimal Risk Manoeuvre**

5.6.4.5.1. **If the system detects that after a transition demand the driver does not take over manual control of the steering again the vehicle shall carry out a minimum risk manoeuvre not later than 4 s after the start of the transition demand. Alternatively the minimal risk manoeuvre may start at the beginning of the transition demand.**

5.6.4.5.2. **It shall at any time be possible to override the minimal risk manoeuvre by the driver. The system may be designed to exclude unintended override.**

5.6.4.5.3 **Not later than 4 s after the start of the minimal risk manoeuvre the hazard lights shall be activated automatically. Additionally, an acoustic warning device may be permitted to warn the other road users.**

5.6.4.6. **Emergency Manoeuvre**

5.6.4.6.1. **If the activated ACSF detects that due to a sudden unexpected event the vehicle is in imminent danger to collide with another road user ahead or beside the vehicle and that the time for a safe transition procedure is too short, an emergency manoeuvre shall be carried out (e.g. by braking the vehicle and/or by steering within the lane).**

5.6.4.7. **Longitudinal control and protective deceleration**

5.6.4.7.1. **Any vehicle equipped with an ACSF of category B2 shall be able to control the longitudinal speed of the vehicle.**

5.6.4.7.1.1. **If the activated system detects that the distance to other road users in front is less or will shortly be less than the foreseen safety distance a protective deceleration shall be carried out until the foreseen safety distance is reached again.**

5.6.4.7.1.2. **If the activated system detects that due to a sudden unexpected event the vehicle is in imminent danger to collide with another road user in front and that the time for a safe transition procedure is too short, a protective deceleration as emergency manoeuvre shall be carried out.**

5.6.4.7.1.3. **The protective deceleration must be able to deliver full braking force of the vehicle in order to achieve a maximum deceleration.**

5.6.4.8. Data Storage System for ACSF (DSSA)

[5.6.4.8.1. The DSSA shall record and store the data during the operation of the ACSF in order to demonstrate if the ACSF had operated properly in align with the relevant requirements in case of a road accident. The DSSA shall be fitted in the vehicle and should not contain any radio interface. The DSSA shall be designed to ensure data security and data protection and shall be protected against tampering and misuse. The driver and the passengers of the vehicle have to be adequately informed about the data capture. Principally, they shall be enabled to decide by themselves by several options about the processing of the data.

5.6.4.8.2 The DSSA shall record and store following data:

- **GPS-time**
- **GPS Location**
- **Information about the ACSF status**
- **Information about failures**
- **Information about transition demands**
- **Information about minimal risk maneuvre**
- **Takeover of the steering by the driver**

5.6.4.8.3. The recorded data shall not be deletable and not be volatilized in the DSSA without any deterioration [for at least [6] month].

5.6.4.8.4. If special tools are necessary to get access to recorded data, the tools shall be made available by the manufacturer to the authorities, the driver and the passengers of the vehicle and the vehicle owner.

5.6.4.8.5. The DSSA shall record at least for [30] seconds prior to and [10] seconds after an accident.]

5.6.5. Special Provisions for ACSF of Category B1

Any system of Category B1 ACSF shall fulfill the following requirements.

5.6.5.1. General

5.6.5.1.1. The vehicle shall be equipped with a means for the driver to activate and deactivate the system. The deactivation shall be possible at any time.

5.6.5.1.2. The system shall be designed so that excessive intervention of steering control (e.g. an excessive steering torque) is suppressed to ensure the steering operability by the driver and to avoid unexpected vehicle behaviour, during its operation.

The end of the intervention shall be such that the LKAS reduces its directional control to zero in a progressive manner, to ensure easy and safe handling of the vehicle, as defined in paragraph 5.1.1. The directional control fade-out strategy shall be at the discretion of the vehicle manufacturer.

The steering control effort necessary to override the directional control provided by the LKAS shall not exceed the value specified in paragraph 6.2.4.2. for an intact steering equipment.

5.6.5.2. **Operation of ACSF**

5.6.5.2.1 **The activated system shall at any time ensure that the vehicle does not cross any lane marking.**

5.6.5.2.2 **When the LKAS is temporarily not available, for example due to inclement weather conditions, the system shall clearly inform the driver about the system status, except if the system is in the OFF mode, e.g. switched off. This exception does not affect the required warning in the case of a system failure.**

5.6.5.2.3 **When the system is active (i.e. ready to intervene or intervening), it shall provide a means of detecting that the driver is in control of the vehicle. In the event that the system has detected for a time span of maximum [30] s that the driver is likely to be no longer in control of the vehicle, distinctive warning shall be provided until the driver is detected to be in control of the vehicle again (e.g. via input on the steering wheel, brake pedal actuation) or until the system is deactivated, either automatically or manually.**

In the event that the system has detected for a time span of maximum [60] s that the driver is likely to be no longer in control of the vehicle, the system shall be automatically deactivated.

When the system is automatically deactivated, the system shall clearly inform the driver about the system status.

The warning shall be provided by at least two means out of optical, acoustic and haptic given simultaneously or in a cascade.

5.6.5.3. **System information data**

5.6.5.3.1. **Following data shall be provided together with the documentation package required in Annex 6 of this regulation to the Technical Service at the time of type approval**

5.6.5.3.1.1. **The values for V_{smax} , V_{smin} and $ay_{smax.}$**

5.6.5.3.1.2. **The conditions under which the system can be activated, i. e. when the conditions for operation of the system are fulfilled.**

5.6.5.3.1.3 **Information about the driver availability recognition system:**
- how it detects that the driver is in control of the vehicle

5.6.5.3.1.4 **Information about how the failure warning signal status and the confirmation of the valid software version can be checked via the use of an electronic communication interface.**

5.6.5.3.1.5 **Documentation about which system software version is valid. This documentation shall be updated whenever a software version was amended.**

5.6.6. **Special Provisions for ACSF of Category A**

- to be developed based on the requirements for a Category 5 system-

Annex 7

***Text requirements for* automatically commanded steering functions**

1. General Provisions

Vehicles fitted with ACSF shall fulfill the tests requirements of this annex according to the corresponding category of ACSF specified in Table 1.

2. Test conditions

2.1. The test shall be performed on a flat, dry asphalt or concrete surface delivering good adhesion. The ambient temperature shall be between 0° C and 45° C.

2.2. Lane markings

The lane markings and the width of the lane used in the tests shall be those of one of the Contracting Parties, with the markings being in good condition and of a material conforming to the standard for visible lane markings of that Contracting Party. The lane marking layout used for the testing shall be recorded.

The test shall be performed under visibility conditions that allow safe driving at the required test speed.

2.3. Tolerances

All vehicle speeds specified in the tests shall be met with a tolerance of ± 2 km/h.

2.4. Target vehicle

The target vehicle shall be a high volume series production passenger car of category M1 AA saloon[1] or in the case of a soft target an object representative of such a vehicle in terms of its detection characteristics. A soft target is a target that will suffer minimum damage and cause minimum damage to the subject vehicle in the event of a collision.

3. Tests

Table 1 specifies which tests have to be fulfilled by each ASCF category.

Test \ ACSF category	A	B1	B2	C	D	E
Fu1 Lane keeping		tbd	tbd	tbd	tbd	x
Fu2 Abort of Lane change				tbd	tbd	x
Fu3 Lane change				tbd	tbd	x
Tr1 Lateral acc.		tbd	tbd	tbd	tbd	x

[1] As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.2, para. 2

Tr2 Missing marking		tbd	tbd	tbd	tbd	x
Tr3 Driver ~~not available~~ unfastened		tbd	tbd	tbd	tbd	x
Tr4 Failure		tbd	tbd	tbd	tbd	x
Tr5 Taking over		tbd	tbd	tbd	tbd	x
EM1 Moving target (decel. 6 m/s²)		tbd	tbd	tbd	tbd	x
EM2 Stationary target		tbd	tbd	tbd	tbd	x

Table 1

3.1. Functionality Tests

3.1.1. Functionality Test 1 (FU1): Test for lane keeping

3.1.1.1 Drive the vehicle with activated ACSF ~~at least [5 min]~~ on a track with ~~various~~ curvatur~~e~~s with road markings at each side of the lane at ~~various~~ 2 different lateral accelerations between 0.5 m/s² and 90 % of ay_{smax} ~~test speeds~~ selected by the technical service ~~up to v_{smax} – 10 km/h and down to v_{smin}.~~ Repeat each test case. The ~~curvatures of the track~~ lateral accelerations shall be selected such that the ~~at v_{smax}~~ ~~lateral accelerations~~ vehicle speed remains in the range from v_{smin} up to v_{smax} ~~0,5 m/s² up to 90 % of ay_{smax} are achieved~~.

3.1.1.2 ~~Various curvature test~~ Data for the whole lateral acceleration range

~~If the test track which was used for paragraph 3.1.1.1. has no various curvature,~~ Technical service shall require to manufacturer to deliver data about fulfilling test ~~of the various curvature.~~ for lane keeping capabilities for the whole lateral acceleration range.

3.1.1.3 The requirements of the test are fulfilled if the vehicle does not cross any lane marking.

3.1.2. Functionality Test 2 (FU2): Test for the abort of lane change

3.1.2.1 Drive the vehicle with activated ACSF on a straight track with at least two lanes with road markings at each side of the lane at a test speed of 70 km/h or (V_{smax} - 20 km/h) whatever is lower. Two other vehicles of category M1 or target vehicles shall drive centered in the lane ahead and behind the test vehicle with the same speed. The time gap to the vehicle ahead shall be selected by the test vehicle itself. The time gap to the vehicle behind shall be 1.9 s ±0.1 s. The desired speed of the test vehicle shall then be set such, e.g. 20 km/h higher, that a lane change would be induced to pass the vehicle ahead, however for testing purposes, the execution of the lane change shall be suppressed. The willingness to carry out a lane change ("yes" or "no") shall be recorded. Then a motorcycle of category L3 shall approach from behind on a lane next to the vehicle with a speed of the vehicle test speed plus 50 km/h. The distance ~~time-to-collision (TTC) (calculated as distance divided by relative speed)~~

between the vehicle and the motorcycle shall be recorded. The motorcycle shall drive with a lateral distance to the lane marking between the motorcycle and the vehicle of 1 m ± 0.25 m.

3.1.2.2 The requirements of the test are fulfilled if:

- the willingness to carry out a lane change changes from "yes" to "no" before the distance ~~TTC~~ between the vehicle and the motorcycle falls below 68 m ~~6 s~~ and
- the willingness to carry out a lane change remains "no" until the motorcycle has passed the vehicle completely.

3.1.2.3 In case the willingness to carry out a lane change is “no” at any time of the test described in 3.1.2.1 the test shall be repeated without vehicle behind the test vehicle and the requirements for passing the test given in paragraph 3.1.2.2 shall apply.

3.1.2.4 In case the willingness to carry out a lane change is “no” at any time of the test described in 3.1.2.3 the test shall be repeated without vehicle behind the test vehicle and with a motorcycle speed which is successively reduced by 10 km/h until the willingness to carry out a lane change is “yes” before the functional part of the test. The requirements for passing the test given in paragraph 3.1.2.2 shall apply taking into account the actual motorcycle speed for calculating the appropriate distance value.

Kommentiert [OK1]: Test parameter amended: 1.9 s now (with 70 km/h as test speed) correspond to 37 m

Kommentiert [OK2]: Perhaps stating a distance (now 68 m with 70 km/h as test speed) is more intuitive than a TTC. Calculation is done with the formula of § 5.6.1.1.8.

3.1.3. Functionality Test 3 (FU3): Test for lane change

3.1.3.1 Drive the vehicle with activated ACSF on a straight track with at least two lanes with road markings at each side of the lane at a test speed of 70 km/h or (V_{smax} - 20 km/h) whatever is lower. One vehicle of category M1 or target vehicle shall drive centered in the lane with the same speed. The time gap to the vehicle ahead shall be selected by the test vehicle itself. The desired speed of the test vehicle shall then be set such, e.g. 20 km/h higher, that a lane change would be induced to pass the vehicle ahead.

3.1.3.2. The requirements of the test are fulfilled if:

- the completion of lane change manoeuvre and
- vehicle shall not cross the outer lane marking and
- after the completion of lane change manoeuvre, vehicle shall be back to the initial lane with a time gap of 1.9 s ±0.1 s to the vehicle behind.

3.2. Transition Tests

3.2.1. Transition Test 1 (TR1): Transition due to exceeding lateral acceleration

3.2.1.1. Drive the vehicle with activated ACSF on a track with road markings at each side of the lane at a test speed of 80 km/h or 10 km/h below V_{smax} whatever is lower. The track shall comprise a section in which the curvature shall be such that at test speed the lateral acceleration of the vehicle would be more than (ay_{smax} + 0.5) m/s² or 3.5 m/s² whatever is lower for a length of at least 150 m. The test driver of the vehicle shall not take over steering control again until the minimal risk maneuver is finished.

3.2.1.2. The requirements of the test are fulfilled if

3.2.1.2.1. In case transition~~al~~ demand initiated during test

- the transition demand was given not later than ~~at least~~ when the lateral acceleration exceeds ay_{smax} by more than 0.3 m/s² and
- the vehicle does not cross any lane marking for 4 s after the transition demand and
- the minimal risk manoeuvre as specified by the vehicle manufacturer was initiated not later than ~~at least~~ 4 s after the transition demand and
- the hazard lights are activated not later than ~~at least~~ 4 s after the start of the minimal risk manoeuvre ~~transition demand~~.

Kommentiert [OK3]: UK proposed "not later than" instead of "at least" as better wording

Kommentiert [OK4]: see remark in § 5.6.1.5 with regard to excessive flashing

3.2.1.2.2. In case no transition~~al~~ demand during test

- when transition demand was not initiated during test, the vehicle reduces speed by itself so that ay_{smax} was not exceeded for more than 1 s and vehicle shall not cross any lane marking.

3.2.2. Transition Test 2 (TR2): Transition due to missing lane marking

3.2.2.1. Drive the vehicle with activated ACSF on a track with road markings at each side of the lane at a test speed of 80 km/h or 10 km/h below V_{smax} whatever is lower. The track shall comprise

a section with a length of at least 150 m in which the outer side lane marking is missing on one side and in which the curvature shall be such that at test speed the lateral acceleration of the vehicle would be less than ay_{smax} and more than 0.5 m/s^2. The test driver of the vehicle shall not take over steering control again until the minimal risk manoeuvre is finished.

3.2.2.2. The requirements of the test are fulfilled if:

3.2.2.2.1. In case transitional demand initiated during test

- the transition demand was given at the latest when the vehicle entered the section with missing lane marking and
- the vehicle does not cross any lane marking for 4 s after the transition demand and
- the vehicle stays in the initial path for 4 s after the transition demand and
- the minimal risk manoeuvre as specified by the vehicle manufacturer was initiated at the latest 4 s after the transition demand and
- ~~the hazard lights may be are activated initiated at the latest at least 4 s after the transition demand. no later as when the MRM has started.~~
- the hazard lights are activated not later than 4 s after the start of the minimal risk manoeuvre.

Kommentiert [OK5]: moved to § 5.6.1.5.3

3.2.2.2.2. In case no transitional demand during test

The vehicle is following the initial path for the complete section with missing lane marking without crossing the lane marking.]

3.2.3. Transition Tests (TR3): Transition due to unfastening the seat belt

3.2.3.1. Drive the vehicle with activated ACSF ~~at least 1 min~~ on a track with curvatures with road markings at each side of the lane at a speed of v_{smax} – 10 km/h. ~~The curvatures of the track shall be such that at v_{smax} lateral accelerations in the range from 0,5 m/s^2 up to 90 % of ay_{smax} are achieved.~~ Subsequently, the driver shall unfasten the seat belt / or the seat belt sensor shall be cut off at the beginning of driving in the curvature.

Kommentiert [OK6]: kind of curvature does not matter for the transition test due to unfastening

3.2.3.2. The requirements of test for transition demand and minimal risk manoeuvre are fulfilled if :

- the ~~warning signal for~~ transition demand shall be given when the unfastened seat belt was detected according to the paragraph 5.6.1.4.4. The warning signal shall remain exist until the driver operates the steering control and.
- the system shall not cross any lane marking for at least 4 s after the transition demand.
- the vehicle shall initiate one of minimal risk manoeuvre which are described in the system information data not later than 4 s after the start of the transition demand. And the hazard warning signal shall be activated not later than 4 s after the start of the ~~during the control by~~ minimal risk manoeuvre. The minimal risk manoeuvre to be tested is chosen by the car manufacturer and the manoeuvre strategies shall be explained and.

Kommentiert [OK7]: changes in order to make test consistent with § 5.6.1.4.4 and § 5.6.1.5

-When the driver operates the steering control, the minimal risk manoeuvre, activation of hazard warning signal and the warning signal for transition demand shall be deactivated automatically.

Kommentiert [OK8]: Proposal: either delete last bulletpoint here since driver override is tested in TR 5 or include override in TR3 and skip TR 5

3.2.4. Transition Test 4 (TR4): Transition due to failure

3.2.4.1. Drive the vehicle with activated ACSF on a track with road markings at each side of the lane at a test speed of 10 km/h below V_{smax}. The track shall comprise a section with a length of at least 200 m in which the curvature shall be such that at test speed the lateral acceleration of the vehicle would be less than ay_{smax} and more than 0.5 m/s^2. A single sensor failure [e.g. lane marking detection] of the automatic steering function shall be induced that the vehicle is within the first 50 m of this section, when the transition demand initiated.

3.2.4.2. The requirements of the test are fulfilled if:

- the failure warning and the transition demand were given immediately [not later than ~~at least~~ 0.5 s] after the failure was induced and
- the vehicle ~~does~~ shall not cross any lane marking. By way of derogation from this, the vehicle is allowed to cross a lane marking during a minimum risk manoeuvre if the minimum risk manoeuvre described by the manufacturer foresees a lane change depending on the failure type and the traffic situation; ~~until the minimal risk maneuver initiated~~ and
- the minimal risk manoeuvre as specified by the vehicle manufacturer was initiated at the latest ~~at least~~ 4 s after the transition demand; and
- ~~the hazard lights are may be activated during minimal risk manouvre.~~
- the hazard lights are activated not later than 4 s after the start of the minimal risk manoeuvre.

3.2.5. Transition Test 5 (TR5): Driver take over test

3.2.5.1. Drive the vehicle with activated ACSF on a track with road markings at each side of the lane at a test speed of 70 km/h or (V_{smax} - 20 km/h) whatever is lower. The track shall comprise a section with a length of at least 200 m in which the curvature shall be such that at test speed the lateral acceleration of the vehicle would be less than ay_{smax} and more than 0.5 m/s^2. A single sensor failure [e.g. lane marking detection] of the automatic steering function shall be induced that the vehicle is within the first 50 m of this section, when the transition demand initiated. The driver shall override the ACSF by steering after the transitional demand and the minimal risk manoeuvre and the hazard warning lights activation were initiated.

3.2.5.2. The requirements of test are fulfilled if the ACSF is deactivated automatically, the minimal risk manoeuvre is aborted and hazard warning signal is deactivated after the driver override the ACSF by steering.

3.3. Emergency Tests

3.3.1 Emergency Test 1 (EM1): Protective deceleration ~~braking~~ with moving target

3.3.1.1. Drive the vehicle with activated ACSF behind a target vehicle. The vehicle and the target vehicle shall drive within the lane markings on a track with road markings at each side of the lane at a speed of 70 km/h or (V_{smax} - 20 km/h) whatever is lower. The time gap between the test vehicle and the target vehicle shall be selected by the vehicle itself but shall not be more than 2.4 s ~~±0.05 s~~. Then the target vehicle shall decelerate with 6 m/s² ± 0.25 m/s² and with a mean brake jerk of 6 m/s³ ± 0.25 m/s³ in the first second of braking. The vehicle shall not carry out a lane change to avoid a collision. Thus any other lane adjacent to the lane the vehicle is driving in shall be blocked e. g. by other vehicles.

3.3.1.2. The requirements of the test (3.3.1.1.) are fulfilled if the vehicle does not collide with the target vehicle.

3.3.2. Emergency Test 2 (EM2): Protective deceleration ~~braking~~ with stationary target

3.3.2.1. Drive the vehicle with activated ACSF at least 1 min on a track with road markings at each side of the lane at a test speed 10 km/h below V_{smax}. The vehicle shall approach a target vehicle being at standstill and being placed in the center of the lane. The vehicle shall not carry out a lane change to avoid a collision. Thus any other lane adjacent to the lane the vehicle is driving in shall be blocked e. g. by other vehicles next to the target vehicle.

3.3.2.2. The requirements of the test are fulfilled if the vehicle does not collide with the target vehicle.