

Submitted by the expert from Germany

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

The modifications to the Regulation are marked in blue bold and strikethrough characters.

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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 ~~in following a particular path, in low speed manoeuvring or parking operations.~~
- 2.3.4.1.1. Category 1 ACSF means, a function that operates at a speed no greater than 10 km/h to assist the driver, on demand, in low speed manoeuvring or parking operations.**
- 2.3.4.1.2. Category 2 ACSF means, a function that operates at a speed no greater than [130 km/h] and which can perform a single manoeuvre (e.g. lane change) when commanded by the driver.**
- 2.3.4.1.3. Category 3 ACSF means, a function that operates at a speed no greater than [130 km/h] and which can indicate the possibility of a single manoeuvre (e.g. lane change) but performs that function only following a command by the driver.**
- 2.3.4.1.3. Category 4 ACSF means, a function that operates at a speed no greater than [130 km/h], which is commanded by the driver and which can continuously determine the possibility of a manoeuvre (e.g. lane change) and complete these manoeuvres for extended periods without further driver command.**

*Insert new paragraph 2.4.8. to read*

- 2.4.8. For Automatically commanded steering functions**
- 2.4.8.1 "Motorway" means, a road section, dedicated exclusively to motor vehicles, having at least two traffic lanes for each direction of travel and having a physical separation of traffic moving in opposite directions.**
- 2.4.8.2 "Lane" means one of the longitudinal strips into which a roadway is divided.**
- 2.4.8.3 "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.).**

- 2.4.8.4 "Lead vehicle" means a vehicle driving in front of the vehicle equipped with ACSF.
- 2.4.8.5 "Lane change manoeuvre" means a manoeuvre in which the vehicle changes from its initial travel lane to an adjacent lane
- 2.4.8.6 "Specified maximum speed  $V_{smax}$ " means the maximum speed up to which an ACSF is designed to work.
- 2.4.8.7 "Specified minimum speed  $V_{smin}$ " means the minimum speed up to which an ACSF is designed to work.
- 2.4.8.8 "Transition request" means a request to the driver that the driver has to take over manual control of the steering task again.
- 2.4.8.9 "Transition procedure" means the sequence of providing a transition request by the ACSF, taking over manual steering control by the driver and deactivation of the ACSF since manual control was detected by the ACSF.
- 2.4.8.10 "Conditions for safe operation" mean all circumstances like traffic situation, road category, quality of lane markings, vehicle speed, curvature of the road, lighting, sensor capacities etc. specified by the vehicle manufacturer that have to be fulfilled when an ACSF shall be able to be activated by a driver.
- 2.4.8.11 "System boundaries" mean all circumstances from which on the conditions for safe operation are not fulfilled anymore, that cannot be dealt with by an activated ACSF anymore and thus request a take-over of manual steering control by the driver.
- 2.4.8.12 "ACSF status" means any distinct operational mode of the ACSF like "switched off", "switched on", "available to be activated", "activated" etc.
- 2.4.8.13 "Attention recognition system" means a device to detect if the driver is vigilant, is attentive, is aware of the traffic situation
- 2.4.8.14 "Minimum risk manoeuvre" means a strategy for the [longitudinal and] lateral control of the vehicle to reach a status with as little risk as possible in the given traffic situation when the driver is detected by the ACSF not to be available.

*Amend paragraph 5.1.6.1. to read:*

5.1.6.1. Whenever the **an** Automatically Commanded Steering function becomes operational, this shall be indicated to the driver. ~~and the control action shall be automatically disabled if the vehicle speed exceeds the set limit of 10 km/h by more than 20 per cent or the signals to be evaluated are no longer being received.~~ Any termination of control shall produce a ~~short but distinctive driver warning~~ **in accordance with the requirements of paragraph 5.4.3.** ~~by a visual signal and either an acoustic signal or by imposing a tactile warning signal on the steering control.~~

*Insert new paragraph 5.4.3. Renumber paragraph 5.4.3. as 5.4.4.*

#### **5.4.3. Special Warning Provisions for Automatically Commanded Steering Functions**

**5.4.3.1 Any termination of control shall produce a distinctive driver warning by a [yellow] visual signal and either an acoustic signal or by imposing a haptic warning signal. This warning shall be provided before the system (function) becomes in-operational, if the termination is not intended by the driver.**

**5.4.3.2. Any sudden termination of control caused by a failure of the system physical or functional failure shall produce immediately a short but distinctive driver warning by a [red] visual signal and either an acoustic signal that shall remain operational until the driver has resumed control.**

*Insert new paragraph 5.6*

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

##### **5.6.1. Special Provisions for ACSF of Category 4**

##### **5.6.1.1. General**

**5.6.1.1.1. The vehicle shall be equipped with a means for the driver to activate or deactivate the ACSF at any time.**

**5.6.1.1.2. The ACSF shall be activatable only if the conditions for safe operation of the ACSF are fulfilled [all associated functions – brakes, accelerator, steering, camera/radar/lidar etc. are working proper].**

**5.6.1.1.3. The ACSF shall only activate by deliberate action of the driver.**

**5.6.1.1.4. The ACSF shall be able to detect if the driver controls the steering function manually. If the ACSF detects, that the driver is steering manually , ACSF shall be deactivated.**

**5.6.1.1.5. The ACSF may be operational up to a vehicle lateral acceleration of [3] m/s<sup>2</sup>.**

**5.6.1.1.6. The ACSF shall comprise an attention recognition system that is active whenever the ACSF is active.**

##### **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 motorway as defined in paragraph 2.4.8. and
  - any traffic that can affect the safe manoeuvre shall be identified by equipment installed on the vehicle and
  - the vehicle equipment can analyse speed and distance of the identified traffic to ensure a safe manoeuvre (e.g. does not cause a deviation to the flow or direction of other traffic).
- 5.6.1.2.2. If a lane change manoeuvre is carried out, the correspondent direction indicator lamps shall be automatically activated.
- 5.6.1.2.3. If the ACSF is not overridden by the driver it shall not terminate the lane change until the manoeuvre is safely completed, except for the ACSF detects an imminent critical situation.
- 5.6.1.2.4. The activated ACSF shall at any time control the lateral movements 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.
- 5.6.1.2.5. The activated ACSF shall at any time ensure a safe lateral distance to other road users. The vehicle manufacturer shall provide documentation about how such a safe distance is achieved to the technical service.
- 5.6.1.2.6. The ACSF shall be designed such that safe transition to manual steering is possible at any time.
- 5.6.1.2.7. If the activated ACSF detects that due to a sudden unexpected event the vehicle is in imminent danger to collide with another road user and that the time for a safe transition procedure is too short, an emergency manoeuvre shall be carried out. The vehicle manufacturer shall provide information to the technical service about the safety strategy depending on different circumstances forming a sudden critical event and the foreseen emergency manoeuvres.
- 5.6.1.2.8. If the attention recognition system detects that the driver is inattentive, it shall give a warning to restore attentiveness again. The manufacturer shall provide information to the technical service how the attention recognition systems detects inattentiveness of the driver.
- 5.6.1.3. System boundaries
- 5.6.1.3.1. The vehicle manufacturer shall provide the values for  $V_{smax}$  and  $V_{smin}$  to the technical service.
- 5.6.1.3.2. The vehicle manufacturer shall provide an information to the technical service under which conditions an ACSF can be activated, i. e. when the conditions for safe operation of the ACSF are fulfilled.

- 5.6.1.3.3. The vehicle manufacturer shall provide information to the technical service about system boundaries at which the activated ACSF must give a transition request.
- 5.6.1.4. Indication of ACSF status
  - 5.6.1.4.1. The ACSF shall at any time give a noticeable and distinctive signalisation to the driver about the ACSF status. This signalisation shall be at least a visual signal. Any change in system status shall be indicated by an optical and either an acoustic or haptic signal.
- 5.6.1.5. Transition request
  - 5.6.1.5.1. If ACSF detects that its system boundaries are reached or will be reached shortly it shall provide a transition request.
  - 5.6.1.5.2. The timing of the transition request shall be such that sufficient time is provided for a safe transition of the steering task from automatically commanded steering to manual steering.
  - 5.6.1.5.3. The vehicle manufacturer shall provide specific values for time intervals to the technical service, which are foreseen for safe transition under different circumstances.
  - 5.6.1.5.4. If the speed of the vehicle with activated ACSF exceeds  $v_{\text{max}}$  a transition request shall be given.
  - 5.6.1.5.5. If the vehicle reaches a lateral acceleration of more than [3] m/s<sup>2</sup> a transition request shall be given.
  - 5.6.1.5.6. If an attention recognition system detects the driver to be inattentive although a warning to restore attentiveness was provided to the driver a transition request shall be given.
  - 5.6.1.5.7. The ACSF shall provide a transition request if the driver's seatbelt is unfastened and/or if the driver's seat is left by the driver.
  - 5.6.1.5.8. The transition request shall be provided by a [yellow] visual signal and either an acoustic signal or by imposing a haptic warning signal.
  - 5.6.1.5.9. If the driver does not take over manual control immediately the transition request 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.
- 5.6.1.5. Minimum Risk Manoeuvre
  - 5.6.1.5.1. If the ACSF detects that after a transition request the driver does not take over manual control of the steering again the vehicle shall carry out a minimum risk manoeuvre. The vehicle manufacturer shall provide information to the technical service about which kind of minimum risk manoeuvres are foreseen depending on the given traffic situation and circumstances at its initiation.

**5.6.2. Special Provisions for ACSF of Category 3**

*- to be developed based on the requirements for a Category 4 system-*

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**5.6.3. Special Provisions for ACSF of Category 2**

*- to be developed based on the requirements for a Category 4 system-*

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**5.6.4. Special Provisions for ACSF of Category 1**

*- to be developed based on the requirements for a Category 4 system-*

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*Insert new Annex 7*

**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 Lead vehicle**

The lead vehicle shall be a high volume series production passenger car of category M1 AA saloon 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.

## 2.4 Pedestrian soft target

A pedestrian soft target is an object representative of a human adult in terms of its detection characteristics 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 \ ASCF category	1	2	3	4
FU1 path following with lead				X
FU2 lane keeping w/o lead				X
TR1 tight curve with lead				X
TR2 tight curve w/o lead				X
TR3 no marking with lead				X
TR4 no marking w/o lead				X
EM1 AEB on braking rabbit				X
EM2 AEB on static pedestrian				X
EM3 abortion of lane change				X

Table 1

### 3.1. Functionality Tests

#### 3.1.1. Functionality Test 1 (FU1)

Drive the vehicle with activated ASCF at least 5 min behind a lead vehicle. If the time gap is not selected by the ASCF, the vehicle shall drive between [2 s] and [3 s] behind the lead vehicle. The lead vehicle shall drive within the lane markings on a track with various curvatures with road markings at each side of the lane at various speeds up to  $v_{smax}$  and down to  $v_{smin}$ . The speed of the lead vehicle shall be selected such that the lateral acceleration is not more than  $1 \text{ m/s}^2$ .

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

#### 3.1.2. Functionality Test 2 (FU2)

Drive the vehicle with activated ASCF at least 5 min without a lead vehicle. The vehicle shall drive on a track with various curvatures with road markings at each side of the lane at various speeds up to  $v_{smax}$  and down to  $v_{smin}$ . The speed shall be selected such that the lateral acceleration is not more than  $1 \text{ m/s}^2$ .

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

### 3.2. Transition Tests

#### 3.2.1 Transition Test 1 (TR1)

Drive the vehicle with activated ACSF at least 1 min behind a lead vehicle. If the time gap is not selected by the ACSF, the vehicle shall drive between [2 s] and [3 s] behind the lead vehicle. The lead vehicle shall drive within the lane markings on a track with road markings at each side of the lane at a speed of 10 km/h below  $v_{smax}$ . After a straight section of at least 200 m the lead vehicle shall enter a curve of more than 90° that demands a lateral vehicle acceleration of more than 3 m/s<sup>2</sup>. The test driver of the vehicle shall not take over manual steering control again.

The requirements of the test are fulfilled if the transition request was given at least when the lateral acceleration exceeds [3] m/s<sup>2</sup> and the minimum risk manoeuvre as specified by the manufacturer was initiated. The vehicle shall not cross any lane marking before the minimum risk manoeuvre was initiated.

#### 3.2.2. Transition Test 2 (TR2)

Drive the vehicle with activated ACSF at least 1 min without a lead vehicle. The vehicle shall drive on a track with road markings at each side of the lane at at a speed of 10 km/h below  $v_{smax}$ . After a straight section of at least 200 m the vehicle shall approach a curve of more than 90° that would demand a lateral vehicle acceleration of more than 3 m/s<sup>2</sup>. The test driver of the vehicle shall not take over manual steering control again.

The requirements of the test are fulfilled if the transition request was given at least when the lateral acceleration exceeds [3] m/s<sup>2</sup> and the minimum risk manoeuvre as specified by the manufacturer was initiated. The vehicle shall not cross any lane marking before the minimum risk manoeuvre was initiated.

#### 3.2.3. Transition Test 3 (TR3)

Drive the vehicle with activated ACSF at least 1 min behind a lead vehicle. If the time gap is not selected by the ACSF, the vehicle shall drive between [2 s] and [3 s] behind the lead vehicle. The lead vehicle shall drive within the lane markings on a track with road markings at each side of the lane at a speed of 10 km/h below  $v_{smax}$ . After a straight section of at least 200 m the lead vehicle shall enter a section with a length of 200 m with only one lane marking at the driver's side. The test driver of the vehicle shall not take over manual steering control again.

The requirements of the test are fulfilled if the vehicle does not cross any lane marking and if the transition request was given [0 s] before the vehicle would have entered the section



with missing lane marking and the minimum risk manoeuvre as specified by the manufacturer was initiated.

#### 3.2.4 Transition Test 4 (TR4)

Drive the vehicle with activated ACSF at least 1 min without a lead vehicle. The vehicle shall drive on a track with road markings at each side of the lane at a speed of 10 km/h below  $v_{smax}$ . After a straight section of at least 200 m the vehicle shall approach a section with a length of 200 m with only one lane marking at the driver's side. The test driver of the vehicle shall not take over manual steering control again.

The requirements of the test are fulfilled if the vehicle does not cross any lane marking and if the transition request was given [5 s] before the vehicle would have entered the section with missing lane marking and the minimum risk manoeuvre as specified by the manufacturer was initiated.

### 3.3. Emergency Tests

#### 3.3.1 Emergency Test 1 (EM1)

Drive the vehicle with activated ACSF at least 1 min behind a lead vehicle. If the time gap is not selected by the system, the vehicle shall drive at a gap of 3 s behind the lead vehicle. The lead vehicle shall drive within the lane markings on a track with road markings at each side of the lane at a speed 10 km/h below  $v_{smax}$ . Then the lead vehicle decelerates with  $6 \text{ m/s}^2$  and with a mean brake jerk of  $6 \text{ m/s}^3$  in the first second of braking.

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

#### 3.3.2. Emergency Test 2 (EM2)

Drive the vehicle with activated ACSF at least 1 min on a track with road markings at each side of the lane at a speed 10 km/h below  $v_{smax}$ . The vehicle shall approach a stationary pedestrian soft target being placed in the center of the lane.

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

#### 3.3.3. Emergency Test 3 (EM3)

Drive the vehicle with activated ACSF at least 1 min on a track with road markings at each side of the lane at a speed of [30 km/h] below  $v_{smax}$  or at  $v_{smin}$ , whatever is higher, between two other vehicles. If the time gap is not selected by the system, the vehicle shall drive at a gap of 3 s behind the lead vehicle. Induce by e.g. selecting a higher desired speed a lane change manoeuvre. During the lane change a further overtaking vehicle with a speed of 50 km/h above  $v_{smax}$  shall approach from backwards on the adjacent lane that was intended to

be reached with the lane change. At the point in time when the vehicle is crossing the lane marking the further overtaking vehicle shall be at a TTC of [2 s] behind the vehicle.

The requirements of the test are fulfilled if the vehicle does not collide with the further overtaking vehicle or any other vehicle and aborts the lane change manoeuvre.