Submitted by Industry

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Proposal for Requirements related to systems able to keep the vehicle in the lane without any driver command on the steering control (B2)

This document is based on Document ACSF-18-05, reflects the comments received during ACSF 18 in The Hague and includes various additions in all of the following sections:

5.6.3. **Special Provisions for ACSF of Category B2**
5.6.3.1. **General system requirements**
5.6.3.2. **Dynamic Driving Task and Headway Control**
5.6.3.3. **Human Driver Priority**
5.6.3.4. **Driving Control Transition**

5.6.3.6. **Information to the Driver**
5.6.3.7. **Minimal Risk Manoeuvre and Emergency Manoeuvre**
5.6.3.8 **System information Data**

Modifications to the text of document ACSF-18-05 are indicated in purple

Definitions from R79

2.3.4. "Advanced Driver Assistance Steering System" means a system, additional to the main steering system, that provides assistance to the driver in steering the vehicle but in which the driver remains at all times in primary control of the vehicle **[or is expected to take over primary control upon request]**. It comprises one or more of the following functions:

2.3.4.1.3 "ACSF of 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.

Additional definitions:

2.4.x. **"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.x. **"Emergency Manoeuvre" means a manoeuvre performed by the system either in case the driver has not taken over manual control during or after a Minimal Risk Manoeuvre or in case of an imminent collision, with the purpose of collision avoidance or mitigation.**

2.4.x. **"Transition demand" means an instruction from the system that the driver has to take over manual control of the steering task again.**

5.6.3. **Special Provisions for ACSF of Category B2 (the system).**

Any such system [shall only be approved in accordance with this regulation where the function does not cause any deterioration in the performance of the basic steering system and] shall fulfil the following requirements

5.6.3.1. General system classification, activation and operation

5.6.3.1.1. Any vehicle fitted with such system shall be equipped with means to monitor the driving environment (e.g. road signs, lane markings, road edge, other road users). These means shall monitor the driving environment any time the system is active.

5.6.3.1.2. The activated system shall be able to cope with all [dynamic] driving tasks either by continuing the operation or by initiating a transition demand.

5.6.3.1.3. The activated system shall follow all applicable traffic rules in the country of operation (e.g. speed limits including sub signs, following distance, provide space for cutting in vehicles, overtaking, priority for emergency vehicles …).

5.6.3.1.4. The activated system shall have a predictable behaviour (e.g. not swerving inside the lane, no harsh braking manoeuvres without imminent collision risk, no very slow driving without an obvious reason like traffic jam).

Comment: This paragraph would find a better place in the introduction.

5.6.3.1.5. The default status of the system shall be off at the initiation of each new engine start/run cycle. This requirement does not apply when a new engine start/run cycle is performed automatically, e.g. by the operation of a stop/start system.

5.6.3.1.6. The vehicle shall be equipped with a means for the driver to activate and deactivate the system. Deactivation must always be possible with a single action of the driver. The same means as for an ACSF of Category B1 may be used.

5.6.3.1.7. The system shall only be active after a deliberate action by the driver.

Operation of the system shall only be possible on roads where pedestrians and cyclists are prohibited and which, by design, are equipped with a physical separation that divides the traffic moving in opposite directions. These conditions shall be ensured by the use of at least two independent means.

Operation of the system shall only be possible if all functions (e.g. brakes, accelerator steering, sensors) needed for the operation are working properly and when the system has detected that the driver is able to take over control on request.

5.6.3.1.8. The system shall be deactivated automatically when the driver takes over manual control following a transition demand.

5.6.3.2. Dynamic Driving Task and Headway Control

5.6.3.2.1. ~~**The activated system shall be able to cope with all dynamic driving tasks [inside the domain] described in Paragraph [5.6.3.1.] Upon activation the system shall detect those situations in which it cannot deliver any longer a safe operation (e.g. inclement weather conditions, obstructed lane, necessary lane change or persons controlling the traffic flow), and transition the control back to the driver [as defined in Paragraph 5.6.3.x..]**~~

~~**The situations in which the vehicle will generate a transition demand to the driver shall be declared by the vehicle manufacturer during type approval according to Annex 6.**~~

The activated system shall keep the vehicle inside its lane of travel and ensure that the vehicle does not cross any lane marking. The system shall aim to keep the vehicle in a stable lateral position inside the lane of travel [to avoid confusing other road users].

5.6.3.2.2. **The activated system shall be able to detect a vehicle driving beside and if necessary adjust speed and/or the lateral position of the vehicle within its lane as appropriate.**

5.6.3.2.3. **The activated system shall be able to control the longitudinal speed of the vehicle.**

5.6.3.2.4. **The activated system shall adapt the longitudinal vehicle speed to infrastructural and environmental conditions (e.g. small curve radius, inclement weather).**

5.6.3.2.5 **The activated system shall continuously detect the distance to a leading vehicle in front in the same lane and adapt the speed to maintain or readjust the distance to be equal or greater than the critical distance calculated using the formula**

$$S_{Critical\text{-}Front} = v_{ACSF} * t_{front}$$

Where:

v_{ACSF} = **the actual speed of the ACSF vehicle in [m/s];**

t_{front} = **time gap of [2] seconds between the ACSF vehicle and the lead vehicle.**

The above shall also be ensured for lead vehicles slowing down or cutting-in.

5.6.3.2.6 **The activated system shall be able to brake such to avoid a collision with a stationary vehicle in its lane of travel. This shall be ensured up to the maximum operational speed of the system, as defined in Paragraph 5.6.3.2.8.**

5.6.3.2.7 **The activated system shall detect the risk of an imminent collision e.g. due to a decelerating lead vehicle, a cutting in vehicle or a suddenly appearing obstacle after a lane change of a leading vehicle and shall automatically perform an appropriate emergency manoeuver as defined in Paragraph 5.6.3.7.**

5.6.3.2.8. **Operational speed and lead vehicle detection**

The system shall be able to detect vehicles driving in front up to a distance of $S_{front\text{-}B2}$ as specified below.

The distance $S_{front\text{-}B2}$ shall be declared by the manufacturer. This value shall not be less than [46] m and shall be less or equal than that value to be recorded during the relevant test described in Annex [X] using a two wheeled motor vehicle of category L3 as the leading vehicle.

The maximum speed $v_{max\text{-}B2}$ of the system up to which the ACSF of category B2 is permitted to operate shall be calculated with the distance $S_{front\text{-}B2}$ using the formula below:

$$V_{max-B2} = -a_{ACSF} * t_{System} + \sqrt{(a_{ACSF} * t_{System})^2 + 2a_{ACSF} * s_{front-B2}}$$

Where:

a_{ACSF} = **[3,7] m/s² = feasible deceleration under wet conditions[1];**

$s_{front\text{-}B2}$ = **Distance in [m] declared by the manufacturer.**

$v_{max\text{-}B2}$ = **Resulting maximal operational speed of the category B2.**

t_{system} = **System delay [0.5] seconds until deceleration level is reached.**

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

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

Notwithstanding the result of the formula above the maximal operational speed is restricted to [130] km/h.

5.6.3.2.9. **The fulfilment of the provisions of paragraph 5.6.3.2 and its subparagraphs shall be demonstrated to the technical service and tested according to the relevant tests in Annex [X].**

5.6.3.3. Human Driver Priority

5.6.3.3.1. **The system shall be designed such that the driver may at any time override its operation by a deliberate action. The system design shall include protection against effect of unintentional driver action on the system controls (e.g. driver motion due to a braking intervention of the system).**

5.6.3.3.2. **Driver override on the steering control shall override the steering function of the system. The steering control effort necessary to override the directional control provided by the system shall not exceed 50 N.**

5.6.3.3.3. **Driver override by braking shall override the longitudinal control of the system.**

5.6.3.3.4. **Driver action on the accelerator control may override the longitudinal control of the system. In case the driver is not holding the steering control during this override, the system shall initiate a transition demand or a hands-on warning as specified in paragraph 5.6.3.6.3.**

5.6.3.4. Driving Control Transition

5.6.3.4.1. **The activated system shall detect those situations in which it cannot continue the operation (e.g. inclement weather conditions, obstructed lane, necessary lane change or persons controlling the traffic flow).**

5.6.3.4.2. **The transition demand shall consist at least of an optical and additionally of an acoustic or haptic signal.**

5.6.3.4.3. **As soon as the activated system has detected that it will no longer be able to continue the operation, it shall immediately issue a transition demand. However, in respect to foreseeable [planned] transitions, the transition demand is not required to be given earlier than [15] seconds upfront.**

5.6.3.4.4. **Following the transition demand a minimum risk manoeuvre as defined in Paragraph 5.6.3.7 shall be initiated latest when the demand continues**

- **for 15s or [2]**
- **up to the point where the system cannot continue to operate any longer.**

In respect to a planned transition demand (e.g. end of the motorway or end of the lane), the minimum risk manoeuvre shall start early enough to bring the vehicle to standstill before the system is no longer able to operate.

5.6.3.4.5. **The activated system shall be able to detect if the driver is available, i.e. present in the seat and awake, to take over control on demand.**

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[2] Early information to the driver indicating the need to take over control soon but not immediately does not need to be followed by a minimum risk manoeuvre after 15 seconds.

As soon as the driver is detected to be unavailable, the system shall issue an optical and an acoustic or haptic warning. If this warning continues for [15] seconds, a transition demand shall be initiated together with a minimal risk manoeuvre.

The warning above may be terminated as soon as the system has detected that the driver is available again.

5.6.3.4.6. **Non driving-related content shall be deactivated from any built-in display, related to driving tasks and visible to the driver, as long as a transition demand is issued.**

5.6.3.4.7. **Any warning or transition demand may be terminated as soon as the systems detects that the driver has taken over manual control of the vehicle.**

5.6.3.5. **System Redundancy**

5.6.3.6. **Information to the Driver**

5.6.3.6.1. **Once activated the system status shall be indicated to the driver by an optical signal.**

5.6.3.6.2. **Any failure of the system or any function needed for the operation shall be indicated to the driver together with a transition demand to the driver. However, when the system is manually deactivated by the driver the indication of the failure may be suppressed.**

5.6.3.6.3. **The optical signal during a transition demand to indicate to the driver to take over manual control of the steering function shall consist of a pictorial information showing hands and the steering control and may be accompanied by additional explanatory text or warning symbols. The same signal as for an ACSF of Category B1 may be used. See examples in paragraph 5.6.2.2.5.**

5.6.3.7. **Minimal Risk Manoeuvre and Emergency Manoeuvre**

5.6.3.7.1. **Minimal Risk Manoeuvre**

The activated system shall detect if the driver resumed manual control after the transition demand has been issued as specified in Paragraph 5.6.3.4. If the driver did not resume manual control, a minimal risk manoeuvre shall immediately be initiated.

During the minimal risk manoeuvre the vehicle shall be slowed down inside the lane of travel where possible or if the vehicle is unable to detect the lane markings remain on an appropriate trajectory taking into account surrounding traffic and road infrastructure with a deceleration not greater than [4] m/s^2. Higher deceleration values are permissible for very short durations, e.g. in order to stimulate the driver's attention. Additionally, the hazard warning lights shall be activated to warn the following traffic not later than [4] seconds after the start of the minimum risk manoeuvre and latest when the vehicle comes to standstill. An acoustic signal to warn other road users may be provided.

Any minimum risk manoeuvre may be terminated as soon as the vehicle detects that the driver took over manual control of the vehicle.

5.6.3.7.2. **Emergency Manoeuvre**

Type I: Bring the vehicle to standstill:

In case the driver has not reacted to a minimal risk manoeuvre by resuming control, the activated system shall aim to bring the vehicle to standstill in any other lane than the fast

lane (e.g. slower lane, hard shoulder, the emergency lane or beside the road). During this the vehicle shall indicate the manoeuvre to the following traffic by activating the hazard warning signal. Additionally, an acoustic warning may be provided to warn other road users. In order to not endanger other road users.

The vehicle shall perform lane changes across regular driving lanes only if the situation is not critical as defined in Paragraph 5.6.4.7 for an ACSF of Category C.

Comment: ***Industry is still of the opinion that this EM type I should be part of the MRM. This would not change the requirement, but only the logic of what a MRM is.***

Type II: Deceleration or Evasion:

The activated system shall detect if the vehicle is in imminent danger to collide with e.g. another road user ahead or beside the vehicle. In case the time to this potential collision is too short for a safe transition of the control back to the driver an emergency manoeuvre shall be initiated automatically.

This manoeuvre shall decelerate the vehicle up to its full braking performance if necessary and / or perform an automatic evasive manoeuvre following the provisions for an Emergency Steering Function, ESF as described in paragraph 5.1.6.2., whichever is appropriate.

Any emergency manoeuvre may be terminated as soon as the vehicle detects that the driver took over manual control of the vehicle.

5.6.3.8 System information Data

5.6.3.8.1. The following data shall be provided, together with the documentation package required in Annex [Y] of this UN Regulation, to the Technical Service at the time of type approval.

5.6.3.8.1.1. A list of situations in which the vehicle may generate a transition demand to the driver.

5.6.3.8.1.2. Information about how the system detects that the driver is available to take over the steering the steering control.

5.6.3.8.1.3. The means to monitor the driving environment.

5.6.3.8.1.4. The means to activate, override and to suppress or cancel the system (as relevant).

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

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

5.6.3.8.1.6. Information on the sensor range over lifetime. The sensor range shall be specified in such way that any influence on deterioration of the sensor shall not affect the fulfilment of paragraphs 5.6.3.2.5. and 5.3.6.2.8. of this UN Regulation.

5.6.3.8.1.7. The vehicle shall be tested in accordance with relevant vehicle test(s) specified in Annex [X] of this UN Regulation. For driving situations not covered by the tests of Annex [X], the safe operation of the system shall be demonstrated by the vehicle manufacturer on the base of Annex 6 of this Regulation.

5.6.3.8.1.8. …

Tests to be added into Annex [X]

3.x.x Tests for ACSF Systems of Cat B2

Lane Keeping Functionality Test

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

Following Distance Test

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

Blocked Lane Test

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

Deceleration Tests

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

Maximum Operational Speed Test

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

DETAILS TO BE DEFINED ONCE THE REQUIREMENTS ARE AGREED