

Industry input to ACSF-18 meeting, June 6-8, 2018 – The Hague Homework from ACSF-17

Proposal for Requirements related to the Dynamic Driving Tasks / Headway Control/ MRM of Category B2

Definitions already implemented in 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 (taken - and modified - from document ACSF-06-28):

- 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" 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 of avoiding or mitigating a collision.
- 2.4.x.** "Protective deceleration" means a deceleration of the vehicle automatically initiated by an ACSF (e.g. by braking) with the purpose of avoiding or mitigating a collision.

5.6.3. Special Provisions for ACSF of Category B2

Any ACSF of Category B2 shall fulfil the following requirements

5.6.3.1. General system classification (Activation / Operation)

5.6.3.2. Dynamic Driving Task and Headway Control

5.6.3.2.x 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.

Lateral Control

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

5.6.3.2.x The activated system shall be able to detect a vehicle driving beside and initiate an emergency manoeuvre as specified in paragraph 5.6.3.7.x if the vehicle is in imminent danger to collide with the vehicle beside.

Longitudinal / Headway Control

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

5.6.3.2.x The activated system shall adapt the speed according to any curve radius, in particular to fulfil the requirement of paragraph 5.6.3.2.x. This shall be tested according to the relevant test in Annex 8.

5.6.3.2.x Once the system of category B2 is activated, it shall detect the distance to another road user in front (e.g. to detect a front vehicle slowing down or cutting-in), and adapt the speed to maintain the distance equal to or greater than the critical distance specified in paragraph 5.6.3.2.x.

5.6.3.2.x The activated system of category B2 shall be able to bring the vehicle to a complete stop in front of a stationary vehicle blocking 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.x., and tested according to the relevant test in Annex 8.

5.6.3.2.x The system shall upon activation detect that due to a sudden unexpected event the vehicle is in imminent danger to collide with another road user in front 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.

Once such an event is detected, the system shall perform an emergency manoeuvre.

This shall be tested with a lead vehicle performing an emergency braking and a cutting in vehicle according to the relevant tests in Annex 8.

5.6.3.2.x Critical distance to the front

The distance to a vehicle in front is deemed to be critical when the distance the ACSF vehicle travels in [x.x] seconds is greater than the distance to the vehicle in front.

The critical distance shall be calculated using the following formula:

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

Where:

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

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

5.6.3.2.x. Maximum operational speed

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

The distance $S_{\text{front-B2}}$ shall be declared by the manufacturer. The declared value under ideal conditions (dry road surface, good visibility) shall not be less than [46] m.

The declared distance shall be tested according to the relevant Test in Annex 8 using a two-wheeled motor vehicle of category L3 as the vehicle in front.

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

$$v_{\text{max-B2}} = +\sqrt{2 * a_{\text{ACSF}} * (S_{\text{front-B2}} - (v_{\text{max-B2}} * t_{\text{System}}))}$$

=>

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

Where:

a_{ACSF} = [3,7] m/s² = feasible deceleration under wet conditions¹;

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

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

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

Notwithstanding the result of the formula above the maximal operational speed is also restricted to [130] km/h by paragraph 5.6.3.2.x

5.6.3.3. Human Driver Priority

5.6.3.4. Driving Control Transition

5.6.3.5. System Redundancy

5.6.3.6. Information to the Driver

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

5.6.3.7. Minimal Risk Manoeuvre and Emergency Manoeuvre

5.6.3.7.x 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.x.. If the driver did not resume manual control, a minimal risk manoeuvre shall immediately be initiated.

The minimal risk manoeuvre shall automatically perform at least one of the following actions:

- Slow down the vehicle inside the lane with a deceleration not greater than [4] m/s². Higher deceleration values are permissible for very short durations, e.g. in order to stimulate the driver's attention. Additionally, it shall activate the hazard warning lights not later than [4] seconds after the start of the minimum risk manoeuvre and latest when the vehicle comes to standstill to warn the following traffic and it may provide an acoustic signal to warn other road users,

OR

- 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 flashing the hazard warning lights. Additionally an acoustic warning may be provided to warn other road users. In order to not endanger the other road users, the vehicle shall perform all necessary lane changes across regular driving lanes only if the situation is not critical as defined in Paragraph 5.6.4.7 for the ACSF of Category C.

Each 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.x Emergency Manoeuvre

The activated system shall detect if due to a sudden unexpected event the vehicle is in imminent danger to collide with e.g. another road user ahead or beside the vehicle. If the time for a safe transition of the control back to the driver [as defined in paragraph 5.6.3.x. "Driving Control Transition"] is too short an emergency manoeuvre shall be automatically initiated.

In order to avoid or mitigate the imminent collision the emergency manoeuvre shall

- perform a protective deceleration up to the full braking performance of the vehicle to achieve the maximum possible deceleration 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.

whatever is appropriate.

Tests to be added into Annex 8

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

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