

Submitted by the Experts of Germany and Japan

Informal Document - ACSF-09-04

Submitted by the Experts of OICA/CLEPA

Informal Document - ACSF-09-14

## **Comments of Industry to document ACSF-09-04**

### **Draft Proposal for category C requirements**

#### **Comments and proposals from industry**

The main principle behind ACSF category C is that the driver's duty is to monitor the driving environment and request lane change only if it can be safely performed. Industry is concerned that using category E sensors for an ACSF category C reduces the interest for a category C. Indeed, why should a system able to automatically perform lane changes request a deliberate action from the driver?

However we understand Germany and Japan concerns, and welcome the offer to develop an alternative based on an "enhanced HMI".

As a response to this offer, industry has inserted in this proposal a second option with additional HMI requirements, based on industry document ACSF-09-08. The text now includes 2 alternatives:

- Alternative 1: Use of ACSF E sensors with a single deliberate action to initiate lane change
- Alternative 2: Use of enhanced HMI with 2 deliberate actions (no rear nor side detection sensors required)

#### **Introduction:**

Having being learned by experience on the market, that assistance systems were misused by the driver or misunderstood as automated systems, we need clear technical requirements to prevent dangerous situations in traffic.

This proposal includes sensor performance requirements identical to the requirements of category E.

As a possible alternative for fulfilling the category E requirements for the sensors, it is thinkable to define special additional HMI requirements for category C.

Following points should be considered for the HMI requirements:

- The driver has to be absolutely clear about his responsibility to surveil the traffic. It is not sufficient to submit this information to the driver only via the owner manual. The driver has to get that information in the car e.g. via the display. It is also thinkable that the driver has to confirm a message in the display that he is aware, that he should surveil the traffic and that the system does not (fully) surveil the traffic.

- The initiation/activation of the lane change manoeuvre has to be specified more detailed in the text. Thinkable is a mandatory second confirmation of the lane change.

The draft text below does not include additional HMI requirements as mentioned above yet. These HMI requirements, which should guarantee at least the same safety level, should be developed by OICA/CLEPA as an alternative for the sensor requirements.

## I. Proposal

**2.4.13** A ‘lane change procedure’ starts when the direction indicator lamps are activated and ends when the lane change is completed. It comprises two operations:

- Activation of direction indicator lamps
- Lane change manoeuvre

**2.4.14** A ‘lane change manoeuvre’ is deemed

- to start when the vehicle movement towards the target lane starts or when the front wheel of the vehicle touches the lane marking.
- to end when the vehicle has reached the target lane and drives parallel to the lane markings, or when the rear wheels of the vehicle have crossed the lane marking

*Insert a new paragraph 5.6.3, to read:*

*Reservation for ACSF of category B2.*

*Insert a new paragraph 5.6.4, to read:*

### 5.6.4. Special Provisions for ACSF of Category C

~~Any system of Category C ACSF vehicle fitted with an ACSF of category C complying with the definition in paragraph 2. of this regulation shall fulfill the following requirements.~~

~~The category C shall comprise at least the category B1 specified in paragraph 5.6.2. [or B2 specified in the paragraph 5.6.3.] In this context, any relevant function required in category B1 [or B2] shall be continued to function in case the category C system is activated. However, it is allowed to cross the lane marking at the side to which the lane change is carried out~~

#### 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).]~~

~~The vehicle shall be equipped with [either] an ACSF of category B1 [or of category B2], in accordance with the applicable requirements of this regulation.~~

**Kommentiert [TP1]:** editorial

**Kommentiert [TP2]:** added in 5.6.4.1.1 with improved wording

**Kommentiert [TP3]:** Should it be kept or added only when B2 will be defined?

*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."*

5.6.4.1.2. The vehicle with ACSF Category C 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. The activation of a system of Category C shall be possible only on roads with at least two lanes in the direction of travel.~~

5.6.4.1.4. ~~[Accelerating, braking or steering operation by the driver shall take priority over a demand by the ACSF system.~~

Steering by the driver shall override steering by the system. The steering control effort necessary to override the directional control provided by the system shall not exceed 50 N.

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.]

5.6.4.1.5. ~~The specified maximum lateral acceleration  $a_{y,max}$  shall not have a value of more than 3 m/s<sup>2</sup> and of less than [1.5] m/s<sup>2</sup>.~~

The lateral acceleration induced by the system during the lane change manoeuvre shall not exceed [1 m/s<sup>2</sup>] in addition to the lateral acceleration generated by the lane curve.

However, the lateral acceleration of the vehicle shall not exceed the maximum values defined in the tables of paragraph 5.6.2.1.3.

The moving average over half a second of the lateral jerk generated by the system shall not exceed 5 m/s<sup>3</sup>.

Lane change manoeuvre shall be completed not later than [15]s the time specified below, after the driver's request.

- For M1 N1 vehicle categories: [15s]
- For M2 M3 N2 N3 vehicle categories [30s]

~~5.6.4.1.6. The system status shall be indicated to the driver by a visual signal. The indication shall [at least] distinguish between active and failure Mode. The indication shall be present as long as the relevant system status persists.~~

5.6.4.1.7. The vehicle with ACSF category C shall be equipped with means to monitor the driving environment, recognizing other road users at the side and the rear of the vehicle.

For the calculation of an appropriate range to the side and to the rear which has to be covered when monitoring the driving environment the formulae of 1.2 and 1.3 in Annex 9 shall be used as basic reference material.

5.6.4.1.7.1. The system has to ensure, that under normal operating conditions neither the vehicle itself nor other road users at the side and the rear of the vehicle will be negatively affected by the ACSF operation. In this regard, safety distances to other road users have to be respected.

**Kommentiert [TP4]:**

Other safety systems may be adapted to ACSF (e.g. HMI...). If this requirement should be needed, it should not be specific to ACSF C and be in the general section. (e.g. AEBs warning signals may be modified to fit with „protective braking“ of B2 category (→ a more general discussion is needed considering all ACSF cat's).

**Kommentiert [TP5]:** In this section, the „system“ is ACSF C. However, this does not mean there must be a specific means to deactivate ACSF C (e.g. the means may be shared with ACSF B1 - or B2).

**Kommentiert [TP6]:** This is driver's responsibility.

**Kommentiert [TP7]:** Industry will check the value.

**Kommentiert [TP8]:** Is such a requirement needed at all? What is the intention?

**Kommentiert [TP9]:** Already covered by further requirements

**Kommentiert [TP10]:** Reason for changing vs ACSF-07-05 („may“ becomes „shall“)

5.6.4.1.7.2. In case the system is not capable of recognizing other road users in the entire range of normal driving conditions, the system shall by itself adapt and restrict the boundaries for the selection of speed, accelerations and the execution of certain manoeuvres (e. g. lane change) depending on the presently prevailing conditions for operation (like e. g. weather conditions, actual range for monitoring the driving environment and the detection of obstacles, estimated adhesion, speed of other traffic, speed (difference to other traffic)).

~~5.6.4.1.8. The vehicle with ACSF category C shall identify whether the direction of traffic prescribed in the country (right / left hand traffic).~~

5.6.4.1.98. The vehicle with ACSF category C shall fulfill the tests for Category C as specified paragraph 3.4 in Annex 8. In addition, in order to comply with 5.6.4.1.6.1., 5.6.4.1.6.2., for the driving situations not covered by the tests of Annex 8, the safe operation of the ACSF shall be demonstrated by the vehicle manufacturer on the base of Annex 6.

5.6.4.2. Operation of ACSF category C

5.6.4.2.1 The activation of an ACSF of category C shall only be possible if an ACSF of category B1 [or B2] is active.

5.6.4.2.2. Any single lane change manoeuvre shall be initiated only if commanded by a deliberate action of the driver.

~~5.6.4.2.3. As an alternative to requirements in paragraphs 5.6.4.1.7, 5.6.4.1.8. and 5.6.4.2.2, the system shall fulfill the following requirements:~~

5.6.4.2.3.1 [At the initiation of each new ignition cycle, or at the time of the first system activation, a disclaimer shall be provided to inform the driver of his duty to monitor the traffic and road conditions prior to initiating a lane change maneuver.]

or

[If the vehicle is equipped with a B1 system and a warning has been provided to indicate that the driver is not holding the steering control, a lane change maneuver by the system shall be prohibited.]

5.6.4.2.3.2 Any single lane change manoeuvre shall be initiated only if commanded by two subsequent deliberate actions of the driver, within an interval of [10s]. The lane change maneuver shall start upon the second command.

5.6.4.2.4. The system shall inform the driver on the status of the system during the lane change procedure.

5.6.4.2.5. The lane change manoeuvre shall not be initiated before 3 flashes of the direction indicator lamps.

5.6.4.2.6. Any lane change manoeuvre shall be completed, unless the system detects an imminent critical situation, is overridden by the driver or does not detect the lane markings anymore.

5.6.4.2.7. During the single lateral manoeuvre, ACSF of category B1 [or B2] shall be temporarily suppressed. Once the manoeuvre is completed, ACSF of category B1 [or B2] shall automatically resume.

**Kommentiert [TP11]:** The driver decides the direction of the lane change, to overtake or come back to the original lane.

**Kommentiert [TP12]:** Alternative 2

5.6.4.2.1. Any lane change manoeuvre shall be initiated / activated only if requested by a deliberate action of the driver. Second lane change in an overtaking manoeuvre shall be separately requested by the driver. The request of the driver (e.g. by pressing [continuously] a button or using [continuously] the direction indicator) shall be persist [until the lane change is half completed (i.e. the center of the vehicle front has crossed the lane marking between the lanes)] [/ for [5] s]. If the driver's request persists [until the lane change is half completed] [/ for [5] s], the lane change manoeuvre shall be completed by the system.

If the driver stops the request [before half of the lane change is completed] [/ for [5] s], the lane change shall be aborted and the vehicle shall return to the initial lane.

~~The vehicle shall not carry out a lane change if a collision with a vehicle at the side or the rear of the vehicle is imminent. The vehicle shall abort an already started lane change manoeuvre and return to the initial lane if a collision with a vehicle at the side or the rear of the vehicle is imminent.~~

~~The vehicle shall indicate to the driver if a vehicle is at the side or the rear of the vehicle in the adjacent lane by an optical signal.~~

~~[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);~~

5.6.4.2.2. 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.

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

5.6.4.2.4. When the system is temporarily not available, for example due to inclement weather conditions, or it reaches its boundary conditions set out in paragraph 5.6.4.1.5., the system shall clearly inform the driver about the system status by an optical signal, except if the system is in the OFF mode, e.g. switched off.

5.6.4.2.5. A system failure shall be signaled to the driver. The optical signal mentioned in paragraph 5.6.4.2.4. of this Regulation may be used for this purpose. However, when the system is manually deactivated by the driver, the indication of failure mode may be suppressed.

5.6.4.2.68. If a system failure occurs during a lane change manoeuvre, the failure shall be signaled to the driver by an optical and an acoustic or haptic warning.

5.6.4.2.9. The above requirements shall be tested in accordance with the relevant vehicle test(s) specified in Annex 8 of this Regulation.

**Kommentiert [TP13]:** In the case of ACSF E sensors, only one deliberate action is needed. However, the requirements here are too design specific. See industry proposal above.

**Kommentiert [TP14]:** This requirement is already covered by 5.6.4.1.7.1.

**Kommentiert [TP15]:** These type of requirements are only valid for alternative 1.

**Kommentiert [TP16]:** This requirement would generate a permanent warning in heavy traffic. Furthermore, 5.6.4.1.7.1. requires the system not to perform a lane change in this case.

**Kommentiert [TP17]:** This is driver's responsibility to use ACSF C only where it is designed for. Furthermore in some way covered by 5.6.4.1.7.1.

**Kommentiert [TP18]:** These requirements are already covered by 5.6.4.1.7.1.

**Kommentiert [TP19]:** See industry proposal in 5.6.4.2.4.

**Kommentiert [TP20]:** See industry proposal in 5.6.4.2.4.

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  $a_{ysmax}$ .

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

5.6.4.3.1.3. The means to override and to abort or cancel

~~5.6.4.3.1.4. Information about how the failure warning signal status and the confirmation of the valid software version related ACSF performance can be checked via the use of an electronic communication interface.~~

~~5.6.4.3.1.5. Documentation about which system software version related ACSF performance is valid. This documentation shall be updated whenever a software version was amended.~~

*Insert new paragraph in Annex 8, to read:*

*Insert a new paragraph 3.3, to read:*

*Reservation for tests of ACSF Category B2 Systems.*

*Insert a new paragraph 3.4, to read:*

3.4. Tests for ACSF Category C Systems

3.4.1. Lane change functional test

3.4.1.1. 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 which is lower than  $V_{smax}$  by the agreement between the manufacturer and the Technical service. The driver shall apply a request of lane change function.

3.4.1.2. The requirements of the test are fulfilled if:

- the lane change manoeuvre was completed and
- the vehicle did not cross the outer lane marking and
- the vehicle did not exceed a lateral acceleration of  $3\text{ m/s}^2$  [ $1\text{ m/s}^2$ ] and
- according to paragraph 5.6.4.2.2, the correspondent direction indicator lamps automatically flashed minimum 3 times prior to the start of the lane change manoeuvre outside of the tyre of the vehicle's front wheel closest to the lane markings had touched the inside edge of the visible lane marking to which the vehicle is being drifted.

3.4.2. Abort of lane change test

3.4.2.1. Drive the vehicle with activated ACSF B1 [or B2] on a straight track with at least two lanes with lane markings at a test speed lower than  $V_{smax}$ . The lane change shall then be commanded by the driver.

**Kommentiert [TP21]:** These requirements should be added to B2 instead, so that they are applicable to B2, B2+C, B2+D, B2+E. They are not applicable to B1.

**Kommentiert [TP22]:** Valid for alternative 1 and 2

**Kommentiert [TP23]:** Valid for alternative 1 and 2

Once two wheels of the vehicle have crossed the lane marking, the driver shall override the system.

3.4.2.2. The requirements of the test are fulfilled if:

- the lane change is aborted and,
- the force applied by the driver on the steering control during the overriding manoeuvre is less than 50N.

3.4.2. **Abort of lane change test**

Kommentiert [TP24]: Only valid for alternative 1

3.4.2.1 Drive the vehicle with activated ACSF on a straight track with at least two lanes with road markings of the lane at a test speed which is lower than  $V_{\text{smax}}$  by the agreement between the manufacturer and the Technical service. 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  $1.9 \text{ s} \pm 0.1 \text{ s}$ . 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 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  $1 \text{ m} \pm 0.5 \text{ m}$ .

3.4.2.2 The requirements of the test are fulfilled if:

- the willingness to carry out a lane change changes from "yes" to "no" before the distance between the vehicle and the motorcycle falls below the distance calculated by the formula in Annex 9,  $t_{\text{reaction}} = 1.2 \text{ s}$ ,  $t_d = 1 \text{ s}$ ,  $a_{\text{brake}} = 3 \text{ m/s}^2$  shall be used, and
- the willingness to carry out a lane change remains "no" until the motorcycle has passed the vehicle completely.

3.4.2.3 In case the willingness to carry out a lane change is "no" at any time of the test described in 3.4.2.1 the test shall be repeated without vehicle behind the test vehicle and the requirements for passing the test given in paragraph 3.4.2.2 shall apply.

3.4.2.4 In case the willingness to carry out a lane change is "no" at any time of the test described in 3.4.2.3 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 3.4.2.2 shall apply taking into account the actual motorcycle speed for calculating the appropriate distance value according to Annex 9.

[3.4.3. Blind spot test

3.4.3.1 Drive the vehicle with activated ACSF on a straight track with at least two lanes with road markings at each side of the lanes at a test speed which is lower than  $V_{\text{smax}}$  by the agreement between the manufacturer and the Technical service. . Another vehicle of category M1 or target vehicle shall drive centered in the lane at the side of the vehicle equipped with Category C ACSF. The rear end of the other vehicle shall not be ahead of the front of the vehicle equipped with ACSF Category C. The front end of the other

vehicle shall not be behind the rear of the vehicle equipped with ACSF Category C.

Then a lane change shall be requested by the driver to the side of the other vehicle for [10 s].

- 3.4.3.2 The requirements of the test are fulfilled if the vehicle equipped with ACSF Category C did not collide with the other vehicle and is in its initial lane at the end of the test.]

Insert new paragraph in Annex xy, to read:

#### Annex 9

Reference material for the calculation of ranges for monitoring the driving environment

1. Monitoring range to the front ( $s_{Front}$ ), to the right side ( $s_{Side}$ ), to the left side ( $s_{Side}$ ) and to the rear ( $s_{Rear}$ ) of the vehicle shall be calculated basically using the following formulae.

1.1. Range to the front ( $s_{Front}$ )

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

where:

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

$v_{ACSF}$  = speed of the vehicle equipped with ACSF

$a_{ACSF}$  = feasible deceleration of the vehicle equipped with ACSF.

1.2. Range to the rear ( $s_{Rear}$ )

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

with:

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

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

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

$s_{Rear}$  = relative distance between the vehicle equipped with ACSF and the vehicle behind, measured from the rear edge of the vehicle equipped with ACSF to the front end of the vehicle behind

$d_{reaction, rear}$  = relative distance covered by the vehicle driving behind the vehicle equipped with ACSF caused by the reaction of the driver to brake

$t_{reaction}$  = reaction time of the driver driving the vehicle behind the vehicle equipped with ACSF needed to execute the braking and to build up the full braking force

$d_{brake, rear}$  = relative braking distance of the vehicle driving behind the vehicle equipped with ACSF

$d_{safety, rear}$	=	safety distance between the vehicle equipped with ACSF and the vehicle driving behind
$t_d$	=	safety time gap to vehicle equipped with ACSF after braking
$v_{rear}$	=	speed of the vehicle driving behind the vehicle equipped with ACSF
$v_{ACSF}$	=	speed of the vehicle equipped with ACSF
$a_{brake}$	=	admissible deceleration of the vehicle driving behind the vehicle equipped with ACSF.

**1.3. Range to the left and to the right side**

$2 * lane\ width$

measured from the medium longitudinal centerline of the vehicle equipped with ACSF.

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