

The proposal is based on document ACSF 04-20

Modifications to the Regulation are marked in **red bold** and strikethrough characters.

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

The modifications to the Regulation are marked in 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 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 manoeuvring or parking operations.**
- 2.3.4.1.2. [“ACSF Category B 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.]
- [2.3.4.1.3. **Category C ACSF means, a Category B-System including a function which can perform a single manoeuvre (e.g. lane change) when commanded by the driver.**
- 2.3.4.1.4. **Category D ACSF means, a Category B-System including a function which can indicate the possibility of a single manoeuvre (e.g. lane change) but performs that function only following a confirmation by the driver.**
- 2.3.4.1.5. **Category E ACSF means, a Category B-System including 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 manoeuvres for extended periods without further driver command/confirmation.]**

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 [a speed limit of more than 100 km/h and] at least two traffic lanes for each direction of travel and having a physical separation of traffic moving in opposite directions.]~~

Justification: The area of use will be defined in 5.6.1.2.1 for Cat E and in 5.6.xxx for the other categories

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 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 operate**.

2.4.8.7 "Specified minimum speed V_{smin} " means the minimum speed up to which an ACSF is designed to **work operate**.

2.4.8.xx "Specified maximum lateral acceleration a_{ysmax} " means the maximum lateral acceleration up to which an ACSF is designed to work.

2.4.8.8 "Transition demand" means an instruction from the ACSF ~~they have~~ the driver has to take over ~~manual~~ manual control of the steering task again.

2.4.8.9 "Transition procedure" means the sequence of providing a transition demand by the system, taking over ~~manual~~ manual steering control by the driver and deactivation of 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 capabilities etc. specified by the vehicle manufacturer that have to be fulfilled when an ACSF shall be able to be activated by a driver.]~~ (put it in the requirements?) 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.

[2.4.8.11 "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.~~

Justification: to condider the proposal of OICA "ACSF-04-13"

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 "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, ~~based e.g. on the monitoring of driver activity and presence in driver's seat etc.~~
- 2.4.8.14 "Minimal risk manoeuvre" means a procedure aimed at ~~reducing~~ minimizing risks in traffic, which is automatically performed by the system, e.g. when the driver does not respond to a transition demand ~~(e.g. by reducing vehicle speed).~~
- 2.4.8.15 "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, ~~in order~~ with the purpose to avoid or mitigate a collision. ~~]~~
- 2.4.8.16 "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.

Justification: see Doc. ACSF-04-04

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

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.~~ **[especially, in case of category E termination of control is described]** 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 other than in 5.4.3.2 or a transition demand (acc. to 5.6.1.5) shall produce a distinctive driver warning by a [yellow or red] 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. If the driver does not take over manual control 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.~~

Any termination of control initiated by the system other than specified in 5.6.1.4.7 shall produce a distinctive driver warning including a ~~{visual signal /~~ **optical-visual** warning} and either an acoustic ~~{signal /~~ warning] or an haptic ~~{signal /~~ warning] {until the driver has resumed ~~manual~~ steering control }.

Justification: using the wording of AEBS-Regulation

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

Comment: moved to 5.6.1.1.7

[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.]

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

5.6.1. Special Provisions for Category E ACSF

5.6.1.1. General

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 safe operation of the system are fulfilled (all associated functions – e.g. brakes, accelerator, steering, camera/radar/lidar etc. are working proper).

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.

5.6.1.1.3. If ~~the driver is steering~~ the driver is overriding the ACSF by steering manually, ACSF shall be deactivated automatically.

5.6.1.1.3.1 The specified maximum speed V_{smax} shall not have a value of more than 130 km/h (+5 km/h)

Comment: to be renumbered after the discussion

5.6.1.1.4. The system shall not induce in normal driving situations a lateral acceleration of more than 3 m/s².

5.6.1.1.4.1 The specified maximum lateral acceleration a_{ysmax} shall not have a value of more than 3 m/s² and of less than [1 m/s²].

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

5.6.1.1.6. The activated system 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 is clear to other road users.

Comment: Add example situations ?

5.6.1.1.7. ~~The system shall at any time give a noticeable and distinctive signalization to the driver about the system status. This signalization shall be at least a visual signal. Any change in system status shall be indicated by an optical and [, if not initiated by the driver,] either an acoustic or haptic signal.~~

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

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

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

When the system is **manually** switched off by the driver, the indication of **manual stand-by Mmode** and failure **Mmode** may be suppressed.

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

5.6.1.1.8. The vehicle shall be equipped with means to ~~detect and classify obstacles and other road users at least 176m in front of the vehicle, 8m at the left and right side of the vehicle and 113m behind the vehicle.~~ monitor 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 range in front (S_{Front}) of the ACSF vehicle shall be calculated according to the following formula:

$$S_{Front} = v_{VUT}^2 / (2 \cdot a_{VUT})$$

where:

S_{Front} = relative distance between the vehicle under test (VUT) equipped with ACSF and the vehicle driving in front, measured in meters from the front edge of the VUT to the rear end the vehicle driving in front.

v_{VUT} = speed of the vehicle under test measured in km/h

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

Justification a_{VUT} : ACSF 04-05

5.6.1.1.8.2. The 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:

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

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

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

where:

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

$d_{reaction, rear}$ = relative distance of the vehicle driving behind the VUT 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 VUT 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 VUT, measured in meters

$d_{safety, rear}$ = safety distance between the vehicle under test (VUT) and the vehicle driving behind, measured in meters

t_d = 1,0 s = safety time gap to VUT after braking, measured in seconds

v_{rear} = [36,1 m/s] speed of the vehicle driving behind the vehicle under test (VUT), measured in m/s.

v_{VUT} = speed of the vehicle under test (VUT), measured in m/s.

a_{brake} = 3 m/s² = admissible deceleration of the vehicle driving behind the vehicle under test (VUT)

5.6.1.1.8.3. The range to the left and to the right (s_{side}) shall be calculated according to the following formula:

$$s_{side} = 0,5 w_{VUT} + 1,5 w_{Lane}$$

where:

s_{side} = relative distance to the side of the vehicle equipped with ACSF (VUT), measured in meters from the middle axis of the VUT.

w_{lane} = 3,75 m = typical width of a highway lane, measured in meters

w_{VUT} = width of the vehicle under test (VUT), measured in meters

5.6.1.1.9. The vehicle shall fulfil the tests for Category E as specified in Annex 7.

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 ~~motorway as defined in paragraph 2.4.8.~~ road section which is not dedicated to pedestrians or bicyclists and which has a [physical/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 ~~shall be~~ 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, ~~or~~ 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 be automatically activated minimum [3s] prior to the **steering operation lane change manoeuvre**.

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 **at any time prior and after a lane change manoeuvre** ensure **that** the vehicle does not cross any lane marking. ~~when tested in the conditions defined in Annex 7, paragraph 3.1.1 (FU1 test) 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.~~

5.6.1.2.5. 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 **or by steering**).

5.6.1.2.6 Driver availability recognition system

~~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.~~

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

When the system detects that the driver is not available, ~~e.g. on the monitoring of driver activity or presence in driver's seat~~ it shall provide a distinctive warning until appropriate actions of the driver are detected (e.g. the driver resumes manual control) or a transition demand is initiated.

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

~~If the driver does not respond to the transition demand for more than [y s], a minimal risk manoeuvre shall be initiated.~~

~~The manufacturer shall provide information to the technical service how t if the driver does not respond to the transition demand for more than [y s], a minimal risk manoeuvre shall be initiated. he driver availability recognition system detects appropriate driver activities.~~

moved to 5.6.1.3.1.7

5.6.1.3. System information data

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} , ~~and~~ 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 **safe** 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 ~~intervals acc.~~ **according** to 5.6.1.54.2 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 ~~minimum~~ 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 how the driver availability recognition system detects appropriate driver activities.

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 operation a transition demand shall be given 4 s before system boundaries (e.g. motorway ends, exit) 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.

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 initial path ~~and shall not cross any lane marking~~ for at least [4 s] after the transition demand, in the following cases

- if the speed of the vehicle with activated ACSF exceeds $v_{smax} + 5$ km/h, ~~or a transition demand shall be given immediately and the~~

- if the vehicle with activated ACSF reaches a lateral acceleration of more than $a_{y_{\text{max}}}$, or ~~3 m/s² a transition demand shall be given.~~
- if a system boundary is reached due to a missing lane marking, or
- if a single sensor failure occurs.

5.6.1.4.3. If a driver **availability** recognition system detects ~~that the driver is to be inattentive~~ not available ~~although a warning to restore attentiveness was provided to the driver~~ and if a transition demand ~~shall be~~ is given, the system shall not cross any lane marking for at least [4 s] after the transition demand.

5.6.1.4.64. The system shall provide a transition demand if the driver's seatbelt is unfastened ~~and/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, visual content [/information] 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 ~~[yellow]~~ visual warning signal and either an acoustic warning signal or by imposing a haptic warning signal. The warning ~~may~~ 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. ~~Minimum~~ 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 minimum risk manoeuvre. ~~Alternatively the minimal risk manoeuvre may start at the beginning 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. ~~System may be designed to exclude unintended override.~~

5.6.1.5.3. ~~With 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.~~

5.6.1.6. Protective Braking

- 5.6.1.6.1. Any vehicle equipped with an ACSF of category E shall meet the following requirements for protective braking.**
- 5.6.1.6.1.1. 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 braking shall be carried out.**
- 5.6.1.6.1.2. 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 braking as emergency manoeuvre shall be carried out. Alternatively a lane change manoeuvre can be carried out to prevent the collision.**
- 5.6.1.6.1.3. The protective braking must be able to deliver full braking force of the vehicle in order to achieve a maximum deceleration.**

Comment: unintended Overwriting of the protective braking t.b.d.

[5.6.1.7. Data Storage System for ACSF (DSSA)

5.6.1.7.1. The DSSA shall record the data for situations of driving, ACSF status, the failure and the driver's operation in order to demonstrate that the ACSF had operated properly in align with the relevant requirements, when a vehicle fitted with Advanced Driver Assistance Steering System having ACSF is involved in a road accident. [A video signal that is monitoring the driver shall be included in the recorded data.]

[5.6.1.7.2. It shall be possible that the drivers may switch off the function of recording video signal by driver's intention.]

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

5.6.1.7.4 The special tools to get access to recorded data shall be specified by the manufacturer.

5.6.1.7.5 The DSSA shall record at least for [5] seconds prior to and [1] second(s) [after an accident.]

5.6.2. Special Provisions for ACSF of Category D

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

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5.6.3. Special Provisions for ACSF of Category C

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

5.6.4. Special Provisions for ACSF of Category B

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

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5.6.5. 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 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.~~

2.3 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 saloon¹ 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.

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

3. Tests

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

Test \ ASCF category	A	B	C	D	E
Fu1 Lane keeping		tbd	tbd	tbd	x
Fu2 Abort of Lane change				tbd	x
Fu3 Lane change			tbd	tbd	x
Tr1 Lateral acc.		tbd	tbd	tbd	x
Tr2 Missing marking		tbd	tbd	tbd	x
Tr3 Driver not available		tbd	tbd	tbd	x
Tr4 Failure		tbd	tbd	tbd	x
Tr5 Taking over		tbd	tbd	tbd	x
EM1 Moving target (decel. 6 m/s ²)		tbd	tbd	tbd	x
EM2 Stationary target		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 ASCF at least [5 min] on a track with various curvatures with road markings at each side of the lane at various test speeds up to v_{smax} – 10 km/h and down to v_{smin} . The curvatures of the track shall be such that at v_{smax} lateral accelerations in the range from 0,5 m/s² up to 90 % of a_{ysmax} are achieved.

3.1.1.2 Various curvature test data

If the test track which was used for paragraph 3.1.1.1. has no various curvature, technical service shall require to manufacture to deliver data about fulfilling test of the various curvature.

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 80 km/h or ($V_{\text{smax}} - 20$ km/h) whatever is lower. Two other vehicles of category M1 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 test speed plus 50 km/h. The 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 $1 \text{ m} \pm 0.25 \text{ m}$.

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 TTC between the vehicle and the motorcycle falls below 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.

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 80 km/h or ($V_{\text{smax}} - 20$ km/h) whatever is lower. One vehicles of category M1 shall drive centered in the lane with a time gap of $1.9 \text{ s} \pm 0.1 \text{ s}$ ahead with the same speed. 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.

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 $(a_{y_{smax}} + 0.5) \text{ m/s}^2$ or 3.5 m/s^2 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 transitional demand initiated during test

- the transition demand was given at least when the lateral acceleration exceeds $a_{y_{smax}}$ by more than 0.3 m/s^2 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 at least 4 s after the transition demand and
- the hazard lights are activated at least 4 s after the transition demand.

3.2.1.2.2. In case no transitional demand during test

- when transition demand was not initiated during test, the vehicle reduces speed by itself so that $a_{y_{smax}}$ 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 10 km/h below V_{smax} . The track shall comprise a section with a length of at least 150 m in which the 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 $a_{y_{smax}}$ 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 immediately after 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 minimal risk manoeuvre as specified by the vehicle manufacturer was initiated at least 4 s after the transition demand and
- the hazard lights are activated at least 4 s after the transition demand.

3.2.2.2. 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 no appropriate reactions from the driver

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 $0,5 \text{ m/s}^2$ 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.

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 vehicle shall initiate one of minimal risk manoeuvre which are described in the system information data. And the hazard warning signal shall be activated 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.
- 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.

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. The driver shall override the ACSF by steering after the transitional demand and minimal risk manoeuvre initiated.

3.2.4.2. The requirements of the test are fulfilled if:

- the failure warning and the transition demand were given immediately [at least 0.5 s] after the failure was induced and

- the vehicle does not cross any lane marking-until the minimal risk maneuver initiated and
- the minimal risk manoeuvre as specified by the vehicle manufacturer was initiated at least 4 s after the transition demand and
- the hazard lights are activated during 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 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 $a_{y_{smax}}$ 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 ~~when the vehicle is driven in~~ the first 50 m of this section, when the transition demand initiated ~~of the track~~. The driver shall override the ACSF by steering after the transitional demand and minimal risk manoeuvre 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 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 80 km/h or 10 km/h below v_{smax} whatever is lower. The time gap between the vehicle and the target vehicle shall be $2.4 \text{ s} \pm 0.05 \text{ s}$. Then the target vehicle shall decelerate with $6 \text{ m/s}^2 \pm 0.25 \text{ m/s}^2$ and with a mean brake jerk of $6 \text{ m/s}^3 \pm 0.25 \text{ m/s}^3$ 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 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_{max} . 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.