

Proposal for amending the list of tests (based on ACSF-23-02) after a first revision.

For each paragraph of this tests proposal, it is indicated in parenthesis the paragraph of technical requirements from informal document ACSF-22-03

3 TESTS

3.1 FUNCTIONNAL TESTS

3.1.1 (§ 2.4.1) The vehicle shall be equipped with means for the driver to activate (active mode) and deactivate (off mode) the system.

- **Pass/Fail criteria: OK/NOK**

3.1.2 (§ 2.4.2) The default status of the system shall be in off mode 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.

- **Pass/Fail criteria: OK/NOK**

3.1.3. (§ 2.4.3.) The system shall be active only after a deliberate action by the driver.

The activation of the system shall be possible only if:

- The driver is in the driver seat and the seatbelt is fastened

- **Pass/Fail criteria: OK/NOK**

- the driver is detected to ready to take over control on request,

- **Pass/Fail criteria:**

- all functions needed for the operation are working properly

- **Pass/Fail criteria:**

- the vehicle is 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.

- **Pass/Fail criteria:**

3.1.3. (§ 2.4.4.) It shall be possible to deactivate (off-mode) the system at any time by a single deliberate action of the driver using the same control as indicated in paragraph 2.4.3 above.

To be completed with all functionalities requirements and for manufacturer ODD

3.2 DRIVING TESTS

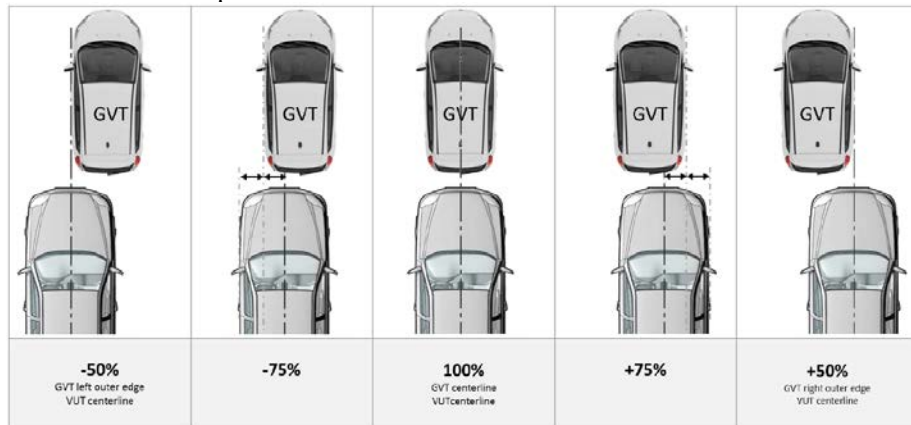
The width of a traffic lane shall be considered to be [3.50m +/- 0.2m].

The vehicle shall be driven with the ALKS activated without any force applied by the driver on the steering control (e.g. by removing the hands from the steering control) and foot on the pedals. The test conditions and the vehicle speeds shall be within the operating range of the system as declared by the manufacturer.

Authorised road

Target vehicle to define (GST and launch pad)

Definition of overlap:

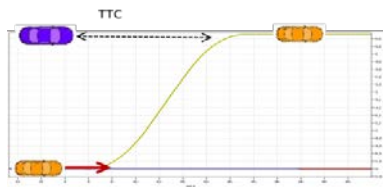


Definition of offset:

0% offset = External point on left front side of the ego vehicle aligned with center longitudinal axis of PTW position

100% offset = External point on right front side of the ego vehicle aligned with center longitudinal axis of PTW position

Definition of TTC:



3.2.1. (§2.4.5) Overriding test

3.2.1.1. The vehicle speed shall be conducted at $V_{max-alks}$.

The vehicle shall be driven with a constant speed on a curved track with lane markings at each side.

The radius of the curve shall be chosen with the minimum radius bend declared by manufacturer, or radius of [200m +/- 100m].

The driver shall then apply a force on the steering control to override the system intervention and leave the lane.

The force applied by the driver on the steering control during the overriding manoeuvre shall be recorded.

3.2.1.2. The test requirements are fulfilled if the force applied by the driver on the steering control during the overriding manoeuvre for deactivate ALKS is less than [50N] and more than [10N] during more than [1s].

3.2.1.3 The manufacturer shall demonstrate through appropriate documentation that this condition is fulfilled throughout the ALKS operation range and all ODD.
This may be achieved on the basis of appropriate documentation appended to the test report.

3.2.2. (§2.5.2) Lane Keeping Functionality Test

3.2.2.1. Swerving Test on straight line

3.2.2.1.1 The vehicle speed shall be conducted at $V_{max-alks}$.
The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side and without any vehicle around.

3.2.2.1.2. The test requirements are fulfilled if:
The variation of the lateral position of the vehicle around the mean value measuring during at least [20s] is no more [$\pm 20\text{cm}$] after a time for center the vehicle inside the line of [10s] after activating ALKS with a frequency below [0,1Hz]
The moving average over half a second of the lateral jerk does not exceed [5 m/s^3].

3.2.2.2. Lane keeping Test on a curve

3.2.2.2.1 The vehicle speed shall be conducted at $V_{max-alks}$.
The vehicle shall be driven with a constant speed on a track with lane markings at each side and with the minimum radius bend declared by manufacturer or with the curve of [200m/+100m] and without any vehicle around.

3.2.2.2.2 The test requirements are fulfilled if:
The vehicle stays in its lane no more than [0.50m] to the lane markings.
The moving average over half a second of the lateral jerk does not exceed [5 m/s^3],

3.2.2.3. Detection object Test for (idem ESF Type b)

3.2.2.3.1 The vehicle speed shall be conducted at $V_{max-alks}$.
The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side and shall approach an object positioned within its trajectory.
The object shall be of such size [$118*78*80 \text{ cm } \pm 10\text{cm}$] and positioned in a way that the vehicle can pass the object without crossing the lane markings.

3.2.2.3.2 The test requirements are fulfilled if:
The ALKS intervention avoids the collision with the object, and does not lead the vehicle to cross the lane markings.

3.2.2.3.3 False reaction test (idem ESF Type b)

The vehicle under test shall approach a plastic sheet having a colour contrast to the road surface, a thickness less than 3 mm, a width of 0.8 m and a length of 2 m positioned between the lane markings in the trajectory of the vehicle. The plastic sheet shall be positioned in a way that the vehicle could pass the sheet without crossing the lane markings.

3.2.2.3.4 The test requirements are fulfilled if:
The ALKS does not start any intervention.

3.2.2.4. The manufacturer shall demonstrate through appropriate documentation that these conditions are fulfilled throughout the ALKS operation range and all ODD.
This may be achieved on the basis of appropriate documentation appended to the test report.

3.2.3. (§2.5.4) Following distance Test

3.2.3.1. Following distance Test on straight line

3.2.3.1.1 The vehicle speed shall be conducted at $V_{test} = V_{max-alks}$ and at 10kph.
The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side and with a front vehicle at $V_{test} - [10kph]$ with 100% overlap and with $[-50\%]$ and $[+50\%]$ overlap.

3.2.3.1.2. The test requirements are fulfilled if:

The t_{front} with S value is more than [2s]

The variation of the lateral position of the vehicle around the mean value measuring during the following distance test is no more $[+/- 20cm]$

The moving average over half a second of the lateral jerk does not exceed $[5 m/s^3]$,
longitudinal acceleration below $4m/s^2$ and longitudinal jerk does not exceed $[5m/s^3]$.

3.2.3.1.3 The vehicle speed shall be conducted at $V_{test} = V_{max-alks}$ and at 10kph.

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side and with a front PTW at $V_{test} - [10kph]$ with 50% offset and with $[+10\%]$ and $[+90\%]$ offset.

3.2.3.1.4. The test requirements are fulfilled if:

The t_{front} with S value is more than [2s]

The variation of the lateral position of the vehicle around the mean value measuring during the following distance test is no more $[+/- 20cm]$

The moving average over half a second of the lateral jerk does not exceed $[5 m/s^3]$,
longitudinal acceleration below $4m/s^2$ and longitudinal jerk does not exceed $[5m/s^3]$.

3.2.3.2. Following distance Test on a curve

3.2.3.2.1 The vehicle speed shall be conducted at $V_{test} = V_{max-alks}$ and at 10kph.

The vehicle shall be driven with a constant speed on a track with lane markings at each side on a curve with a radius of 200m $[+/-100m]$ and with a front vehicle at $V_{test} - [10kph]$ with 100% overlap and with $[-75\%]$ and $[+75\%]$ overlap..

3.2.3.2.2 The test requirements are fulfilled if:

The t_{front} with S value is more than [2s]

The variation of the lateral position of the vehicle around the mean value measuring during the following distance test is no more $[+/- 50cm]$

The moving average over half a second of the lateral jerk does not exceed $[5 m/s^3]$,
longitudinal acceleration below $4m/s^2$ and longitudinal jerk does not exceed $[5m/s^3]$.

3.2.3.3. Following a lead vehicle swerving on straight line

3.2.3.3.1 The vehicle speed shall be conducted at $V_{max-alks}$ and 10kph.

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side following a lead vehicle at the shortest distance allowed by ego vehicle.

Then the lead vehicle changes slowly its trajectory with an angle of $[10^\circ]$ and speed angle of $[1^\circ/s]$

3.2.3.3.2. The test requirements are fulfilled if:

The ego vehicle shall not cross the lane markings and doesn't change more than $[20cm]$ its own trajectory

3.2.3.4. Following a lead vehicle swerving on a curve

3.2.3.4.1 The vehicle speed shall be conducted at $V_{max-alks}$ and 10kph.

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side on a curve with a radius of 200m $[+/-100m]$ following a lead vehicle at the shortest distance allowed by ego vehicle.

Then the lead vehicle changes its trajectory with an angle of $[20^\circ]$ and speed angle of $[2^\circ/s]$

3.2.3.4.2. The test requirements are fulfilled if:

The ego vehicle shall not cross the lane markings and doesn't change more than $[20cm]$ its own trajectory

3.2.3.5. The manufacturer shall demonstrate through appropriate documentation that these conditions are fulfilled throughout the ALKS operation range and all ODD.
This may be achieved on the basis of appropriate documentation appended to the test report.

3.2.4. (§2.5.5) CCRS Test

3.2.4.1. CCRS Test on a straight line

3.2.4.1.1 The vehicle speed shall be conduct at Vmax-alks

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side and with a standstill front vehicle with 100% overlap and with [-50% and -10%] and [+50% and +10%] overlap. (10% it's for example a scenario with a vehicle badly parked on emergency lane)

3.2.4.1.2. The test requirements are fulfilled if:

The ego vehicle shall avoid collision and shall stay inside its lane, and deceleration must be below 4m/s^2

3.2.4.1.3 The vehicle speed shall be conduct at Vmax-alks

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side and with a standstill front PTW with 50% offset and with [+10%] and [+90%] offset.

3.2.4.1.4. The test requirements are fulfilled if:

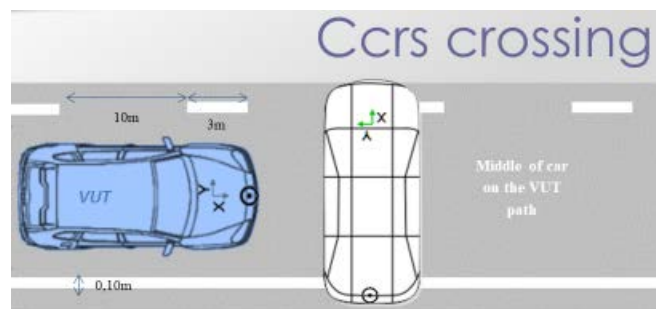
The ego vehicle stop without collide the front vehicle. deceleration must be below 4m/s^2

3.2.4.1.5 The vehicle speed shall be conduct at Vmax-alks

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side and with a standstill front vehicle across the road (90° angle)

3.2.4.1.6. The test requirements are fulfilled if:

The ego vehicle stop without collide the front vehicle.



3.2.4.2. CCRS Test on a curve

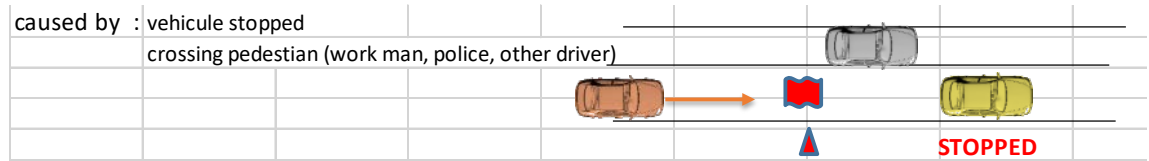
3.2.4.2.1 The vehicle speed shall be conduct at Vmax-alks

The vehicle shall be driven with a constant speed on a track with lane markings at each side on a curve with a radius of 200m [$\pm 100\text{m}$] and with a standstill front vehicle at the output of the curve with 100% overlap and with [-75%] and [+75%] overlap.

3.2.4.2.2. The test requirements are fulfilled if:

No collision with standstill vehicle deceleration must be below 4m/s^2

3.2.4.3. CCRS Test with a pedestrian



3.2.4.3.1 The vehicle speed shall be conduct at [Vmax-alks and 10kph]

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side and with a standstill front vehicle with 100% overlap, then a pedestrian cross at 5kph the lane (impact at 50% if no action)

3.2.4.3.2. The test requirements are fulfilled if:

The vehicle shall not collide the pedestrian.

3.2.4.3.3 The vehicle speed shall be conduct at [Vmax-alks and 30kph]

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side and with a standstill front vehicle with 100% overlap. After the lead vehicle comes to an stop it starts to move again and at this moment a pedestrian cross the lane between the lead vehicle and ego vehicle (impact at 50% if no action)

3.2.4.3.4. The test requirements are fulfilled if:

The vehicle shall not collide the pedestrian.

3.2.4.4. CCRS Test with an object

3.2.4.4.1 The vehicle speed shall be conduct at [Vmax-alks]

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side and with an object on the track [For example work road signs or work barriers]

3.2.4.4.2. The test requirements are fulfilled if:

The vehicle shall not collide the object. deceleration must be below 4m/s^2

3.2.4.5. The manufacturer shall demonstrate through appropriate documentation that these conditions are fulfilled throughout the ALKS operation range and all ODD.

This may be achieved on the basis of appropriate documentation appended to the test report.

3.2.5. (§2.5.6) CCRB, CUT-IN, CUT-OUT Test

3.2.5.1. CCRB Test on straight line

3.2.5.1.1 The vehicle speed shall be conduct at Vmax-alks

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side and following a front vehicle at Vmax-alks with 100% overlap and with [-50%] and [+50%] overlap (idem with 2 standstill vehicles on adjacent lines); then the front vehicle brakes at 4m/s^2

3.2.5.1.2. The test requirements are fulfilled if:

The ego vehicle shall not collide the lead vehicle, and shall brakes at more than 4m/s^2

3.2.5.1.3 The vehicle speed shall be conduct at Vmax-alks

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side and following a front vehicle at Vmax-alks with 100% overlap and with [-50%] and [+50% and] overlap. (idem with 2 standstill vehicles on adjacent lines); then the front vehicle brakes at 6m/s^2

3.2.5.1.4. The test requirements are fulfilled if:

The ego vehicle must stop at more than [1m]. How to take into account that the front vehicle can brake at 10m/s^2 , in that case it stopes 10m before?

3.2.5.1.5 The vehicle speed shall be conducted at $V_{max-alks}$

The vehicle shall be driven with a constant speed at $V_{max-alks}$ on a straight line track with lane markings at each side and following a PTW at $V_{max-alks}$ with 50% offset and with [+10%] and [+90%]; then the front vehicle brakes at $4m/s^2$

3.2.5.1.6. The test requirements are fulfilled if:

The ego vehicle shall not collide the lead vehicle

3.2.5.2. CCRB Test on a curve

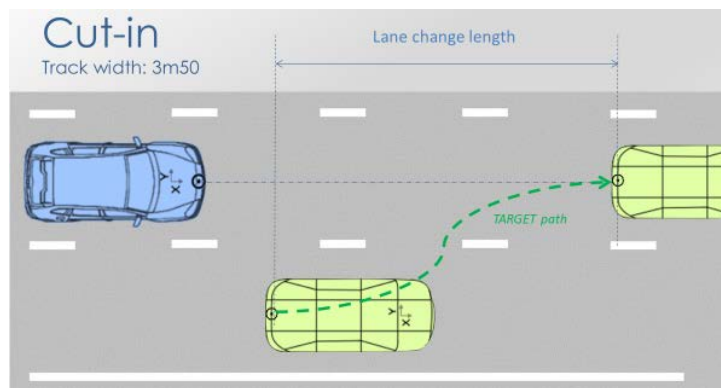
3.2.5.2.1 The vehicle speed shall be conducted at $V_{max-alks}$

The vehicle shall be driven with a constant speed on a track with lane markings at each side on a curve with a radius of 200m [+/-100m] and following a front vehicle at $V_{max-alks}$ with 100% overlap and with [-50%] and [+50%] overlap, then the front vehicle brakes at $6m/s^2$ to stop at the end of the curve.

3.2.5.2.2. The test requirements are fulfilled if:

No collision with standstill vehicle

3.2.5.3. CUT-IN Test on straight line



3.2.5.3.1 The vehicle speed shall be conducted at 50kph [for 60kph it's necessary to adjust the parameters]

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side, then a vehicle suddenly cuts the trajectory at 10kph in front of the ego vehicle, lane change length [14.5m], lateral acceleration [$2m/s^2$], TTC time to collision [-1.5s]

The test must be done with a vehicle cut-in on the right and on the left of the ego vehicle

3.2.5.3.2. The test requirements are fulfilled if:

The ego vehicle doesn't collide with the cut-in vehicle and not cross any lane marking

3.2.5.3.3 The vehicle speed shall be conducted at 50kph [for 60kph it's necessary to adjust the parameters]

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side, then a PTW vehicle suddenly cuts the trajectory at 10kph in front of the ego vehicle, lane change length [14.5m], lateral acceleration [$2m/s^2$], TTC time to collision [-1s]

The test must be done with a vehicle cut-in on the right and on the left of the ego vehicle

3.2.5.3.4. The test requirements are fulfilled if:

The ego vehicle doesn't collide with the cut-in vehicle and not cross any lane marking

[3.2.5.4. CUT-IN Test on a curve

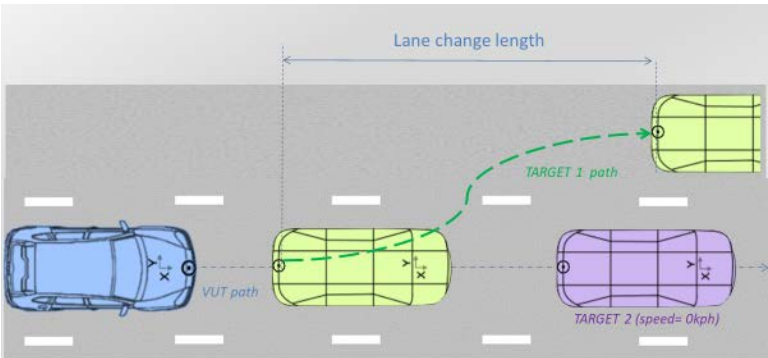
3.2.5.4.1 The vehicle speed shall be conducted at 50kph

The vehicle shall be driven with a constant speed on a track with lane markings at each side on a curve with a radius of 200m [+/-100m]; then a vehicle suddenly cuts the trajectory at 10kph in front of the ego vehicle, lane change length [15m], lateral acceleration [$2m/s^2$], TTC time to collision [-1s]

3.2.5.4.2. The test requirements are fulfilled if:

The ego vehicle doesn't collide with the cut-in vehicle and not cross any lane marking]

3.2.5.5. CUT-OUT Test on straight line



3.2.5.5.1 The vehicle speed shall be conduct at 50kph [for 60kph it's necessary to adjust the parameters]

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side, following a front vehicle at 50kph with 100% overlap then the front vehicle suddenly cuts out the trajectory for avoid a standstill vehicle, lane change length [35m], lateral acceleration [2m/s²], TTC time to collision [2s]

The test must be done with a vehicle cut-out on the right and on the left of the ego vehicle

3.2.5.5.2. The test requirements are fulfilled if:

The ego vehicle doesn't collide with the standstill vehicle and not cross any lane marking

3.2.5.5.3 The vehicle speed shall be conduct at 50kph [for 60kph it's necessary to adjust the parameters]

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side, following a front PTW at 50kph with 50% offset then the front vehicle suddenly cuts out the trajectory for avoid a standstill vehicle, lane change length [35m], lateral acceleration [2m/s²], TTC time to collision [2s]

The test must be done with a PTW cut-out on the right and on the left of the ego vehicle

3.2.5.5.4. The test requirements are fulfilled if:

The ego vehicle doesn't collide with the standstill vehicle and not cross any lane marking

3.2.5.6. CUT-OUT Test on a curve

3.2.5.6.1The vehicle speed shall be conduct at Vmax-alks

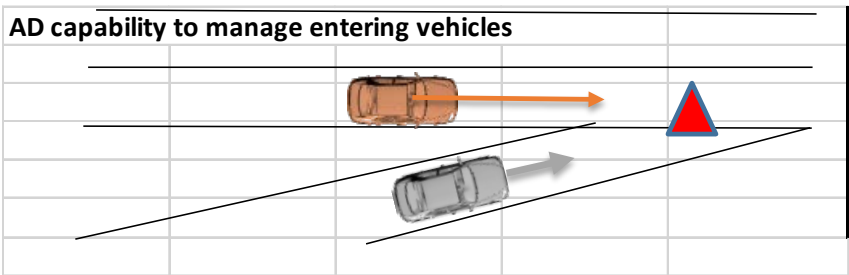
The vehicle shall be driven with a constant speed on a track with lane markings at each side on a curve with a radius of 200m [+/-100m]; following a front vehicle at Vmax-alks with 100% overlap then the front vehicle suddenly cuts out the trajectory for avoid a standstill vehicle, lane change length [35m], lateral acceleration [2m/s²], TTC time to collision [2s]

The test must be done with a vehicle cut-out on the right and on the left of the ego vehicle

3.2.5.6.2. The test requirements are fulfilled if:

The ego vehicle doesn't collide with the cut-in vehicle and not cross any lane markings]

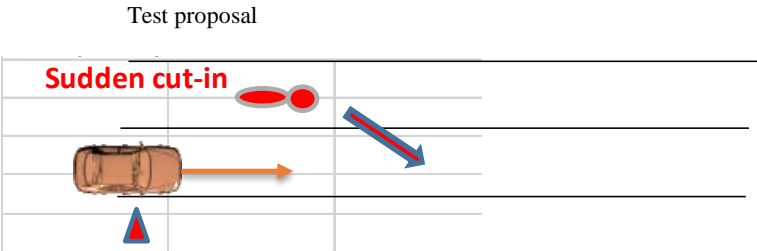
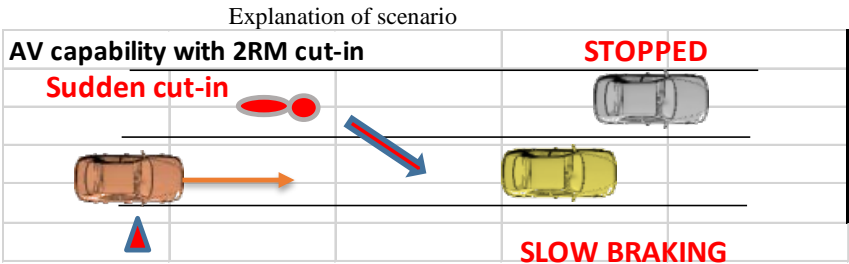
3.2.5.7. Traffic insertion tests



3.2.5.7.1 The vehicle speed shall be conduct at $V_{max-alks}$
 The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side following by an insertion path [usual angle]; then a vehicle arrives on right side at $V_{max-alks}$, angle between trajectories [20 - 30°], impact point at the point in which both trajectories cross. (middle front bumper)

3.2.5.7.2. The test requirements are fulfilled if:
 The ego vehicle doesn't collide with the cut-in vehicle and not cross any lane marking and brakes no more than $4m/s^2$

3.2.5.8. CCRB and CUT-IN Braking PTW Test on straight line

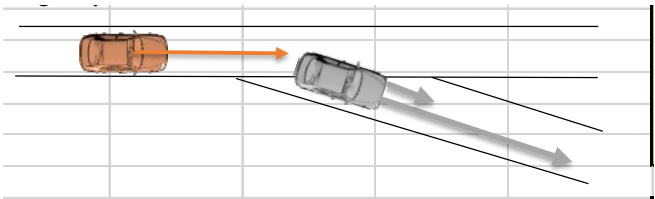


3.2.5.8.1The vehicle speed shall be conduct at 30kph
 The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side; then a PTW vehicle starts to cut in [5m] ahead the trajectory at [$V_{max-alks}$] and brakes at $4m/s^2$ when it is completely inside the lane, lane change length [15m], lateral acceleration [$3m/s^2$]

The test must be done with a vehicle cut-in on the right and on the left side of the ego vehicle

3.2.5.8.2. The test requirements are fulfilled if:
 The ego vehicle doesn't collide with the cut-in vehicle and not cross any lane marking

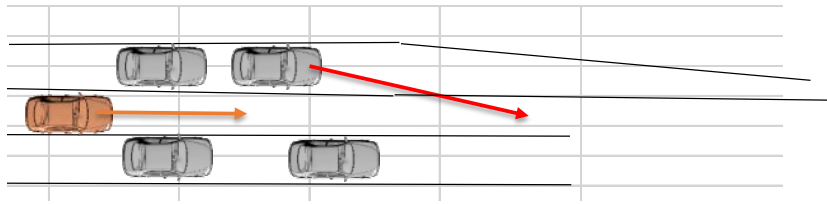
3.2.5.9. Traffic way out tests



3.2.5.9.1 The vehicle speed shall be conduct at $V_{max-alks}$
 The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side following a vehicle; then the lead vehicle exit from the main path [between 20 and 30°] with a little longitudinal deceleration [$1m/s^2$]; lane change length [50m], lateral acceleration [$0,2 m/s^2$]

3.2.5.9.2. The test requirements are fulfilled if:
 The ego vehicle doesn't collide with the cut-out vehicle and not cross any lane marking and brakes no more than $4m/s^2$

3.2.5.10. Reduction lane tests [3 lanes → 2 lanes or 2 lanes → 1 lane] with traffic



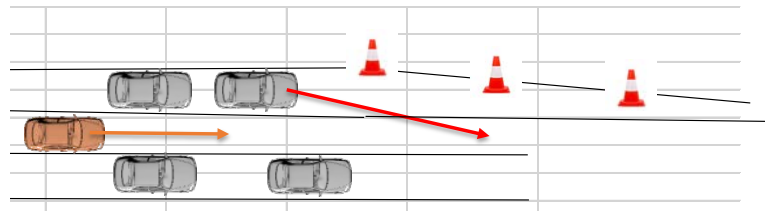
3.2.5.10.1 The vehicle speed shall be conduct at $V_{max-alks}$

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side following by a reduction of number of lanes [with usual angle]; a vehicle arrives on left side at $V_{max-alks}$, angle between trajectories [20 - 30°], impact point at the point in which both trajectories cross (middle front bumper)

3.2.5.10.2. The test requirements are fulfilled if:

The ego vehicle doesn't collide with vehicle on adjacent lanes and brakes no more than [4m/s²]

3.2.5.11. Reduction lane tests [2 lanes → 1 lane] work area with lines materialised with cones



3.2.5.11.1 The vehicle speed shall be conduct at $V_{max-alks}$

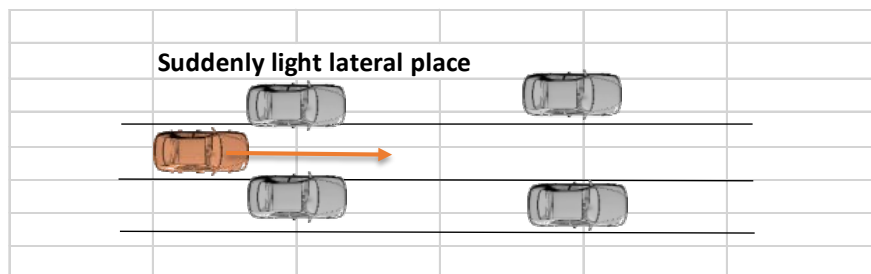
The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side following by a reduction of number of lanes [with usual angle]; a vehicle arrives on left side at $V_{max-alks}$, angle between trajectories [20 and 30°], impact point at the point in which both trajectories cross. (middle front bumper), distance between cones [10m]

3.2.5.11.2. The test requirements are fulfilled if:

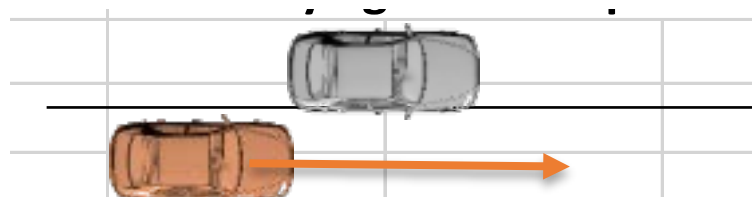
The ego vehicle doesn't collide with vehicle on adjacent lanes and brakes no more than [4m/s²]

3.2.6. (§2.5.7 and §2.5.8) Field of view (with PTW and with truck and trailer)

Explanation of scenario



Test proposal



3.2.6.1 The vehicle speed shall be conducted at $V_{max-alks}$

The vehicle shall be driven with a constant speed on a straight line track with lane markings at each side, the vehicle on left side at $V_{max-alks}$ [-10kph] with a lateral position of [20cm] from ego vehicle

3.2.6.2 The ego vehicle doesn't collide with vehicle on adjacent lanes and doesn't cross any lane marking and brakes no more than $4m/s^2$ and manage a lateral space not less than [0m50] from the other vehicle


3.2.6.3 Test for unintentional lateral manoeuvre (ESF Type a i/ii)

A target vehicle driving in the adjacent lane shall approach the vehicle under test and one of the vehicles shall minimize their lateral separation distance until an ALKS intervention is started.

3.2.6.4 The tests requirements are fulfilled if:

An ALKS intervention is started; and the lateral offset doesn't conduct to cross the lane markings

3.2.7. (§2.9.1) Tests in the absence of lane markings or not visible

transition & minimum risk maneuver if erased lane							
GRRF-ACSF regulation risk (TR2))				← 200m minimum →		← 200m minimum →	
	$V_{max} - 10km/h$						
	after 200m, lateral lane erased						
	transition demand with no driver response					transition demand before erased lane	
	minimum risk maneuver and lane keeping for 5 sec minimum after transition demand.						

[3.2.8. (§2.5.9.2) Tests for special conditions (rain, dazzling sun,.....) and test with low adherence condition)]

[3.2.9. (§2.9.3) MRM Tests]

[3.2.10. (§2.9.3) Road sign Tests (30kph limit, track narrowing, red light on a track,.....)]

[3.2.11. (§2.9.3) Other Sensor performance Tests]

3.2.12. The manufacturer shall demonstrate through appropriate documentation that these conditions are fulfilled throughout the ALKS operation range and all ODD. This may be achieved on the basis of appropriate documentation appended to the test report.