



Federal Ministry  
of Transport and  
Digital Infrastructure

Informal document **GRRF-85-06**  
85th GRRF, 11 December 2017  
Agenda item 2

# Informal Working Group ACSF

## ACSF of Category C

# Activities of the IWG ACSF

3 meetings for ACSF of category C since the 84<sup>th</sup> session of GRRF

- 24<sup>th</sup> Oct. 2017 Meeting in Solihull, UK  
(only Contracting Parties)
- 17<sup>th</sup> Nov. 2017 Webex Conference
- 22<sup>nd</sup> – 24<sup>th</sup> Nov. 2017 IWG ACSF Meeting in Bonn, GER

# Activities of the IWG ACSF

Following major issues have been solved within the IWG ACSF:

## a) reaction time value

- minimum distance ( $S_{\text{rear}}$ )
- minimum operation speed ( $V_{\text{smin}}$ )
- critical situation ( $S_{\text{critical}}$ )

## b) Test target (L3e vehicle)

## c) Type approval test requirements



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a) reaction time value

# a) reaction time value

## - State of discussion

- Already in 84<sup>th</sup> session of GRRF the IWG had a fundamental consensus regarding the principles of
  - minimum distance ( $S_{\text{rear}}$ )
  - minimum operation speed ( $V_{\text{smin}}$ )
  - critical situation ( $S_{\text{critical}}$ )
- The remaining discussion points were:
  - When will the reaction of the driver in the rear vehicle start (somewhere between activation of the direction indicators and the start of the lane change manoeuvre)?
  - Which reaction time component value shall be take into the calculation (0.4 or 1.2 s after start of the lane change manoeuvre)?

## a) reaction time value

- Simulation on test track done by BASt

$$V_{\text{ACSF}} = 80 \text{ km/h}$$

$$V_{\text{rear}} = 130 \text{ km/h}$$

$$S \sim 60\text{m} (S_{\text{critical}})$$



- Braking starts 0.4 s after start of LCM with  $3 \text{ m/s}^2$
- Remaining safety gap = 1 s

## a) reaction time value

### - continuous lateral movement

- The driver in the rear vehicle can see the flashing direction indicators of the ACSF car at least 3 s before the start of the lane change manoeuvre
- The IWG ACSF came to the conclusion, that the lateral movement of the ACSF car to the lane marking in combination with the flashing direction indicators is a clear signal to the driver in the rear vehicle that the ACSF vehicle will change the lane
- To have a clear visible lateral movement it is important, that the ACSF vehicle is not already driving closed to the lane marking at the beginning of the lane change procedure
- Therefore requirements for a continuous lateral movement and lane centering were added

# a) reaction time value

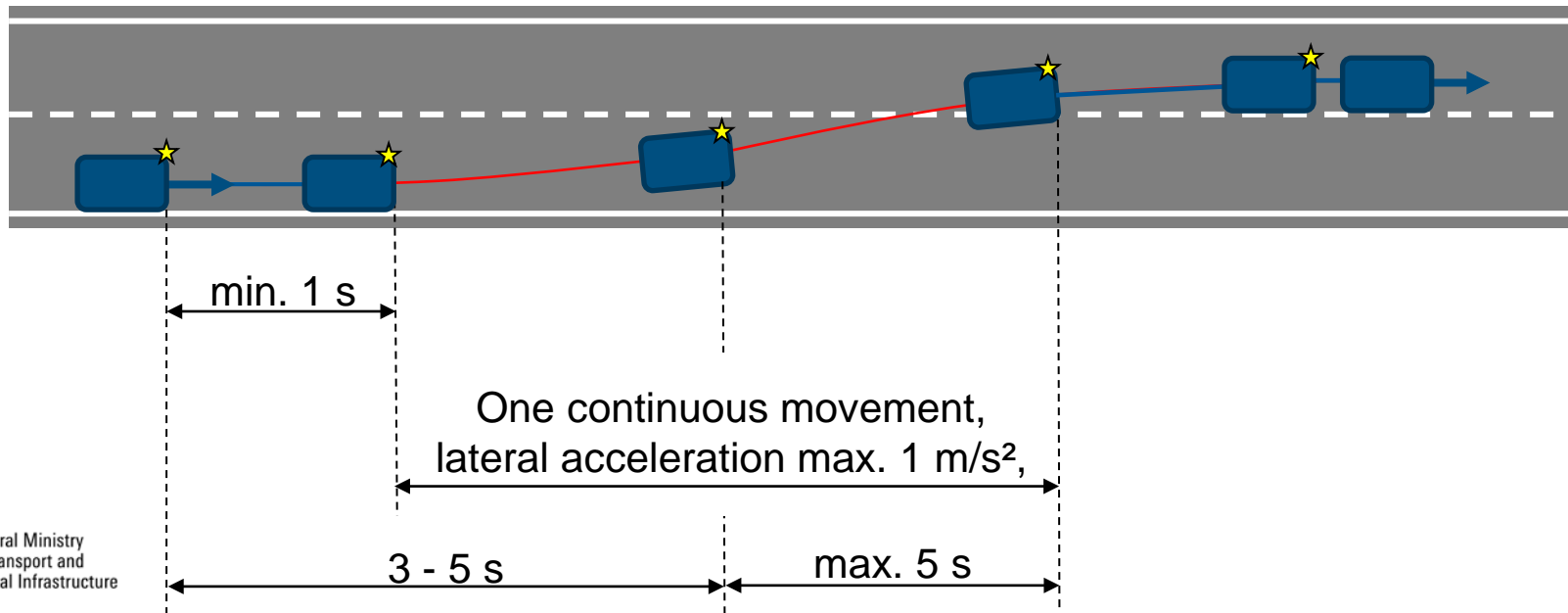
## - continuous lateral movement

- **new § 5.6.4.6.4.**

The lateral movement of the vehicle towards the intended lane shall not start earlier than 1 s after the start of the lane change procedure. Additionally the lateral movement to approach the lane marking and the lateral movement necessary to complete the lane change manoeuvre, shall be completed as one continuous movement.

- **new § 5.6.4.1.2.**

When the ACSF of Cat. C is activated (stand by) the system shall aim to center the vehicle in the lane. [...]

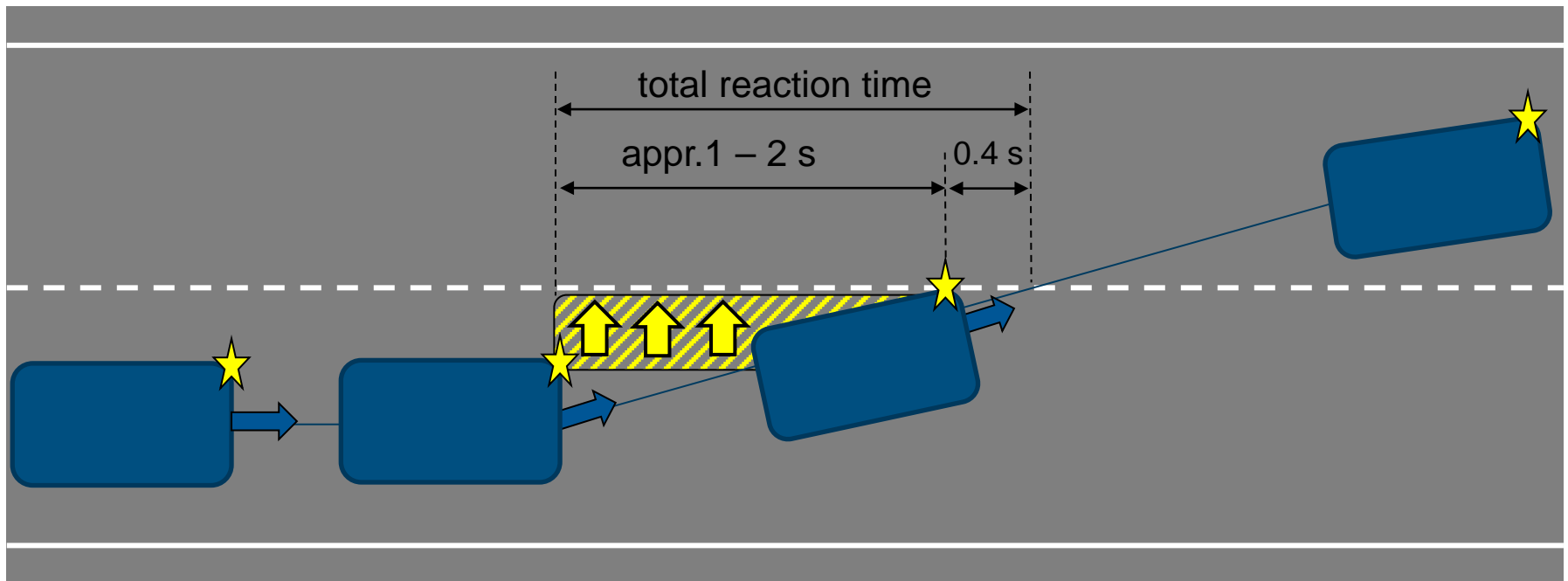




## a) reaction time value

- continuous lateral movement

- The mandatory continuous lateral movement achieves that we have a total reaction time of at least 1.4 s, which is comparable to the AEBS reaction time (approximately 1 – 2 s before LCM + 0.4 s after LCM).



## a) reaction time value

### - conclusion

- In summary the IWG ACSF came to the conclusion that due to the mandatory continuous lateral movement a value of 0.4 s as the reaction time component after the lane change manoeuvre has started is a reasonable value.

➤ **0.4 s shall be used in the formula as  $t_B$**

$$S_{critical} = (V_{rear} - V_{ACSF}) \cdot t_B + \frac{(v_{rear} - v_{ACSF})^2}{2 \cdot a} + V_{ACSF} \cdot t_G$$

$$V_{smin} = a \cdot (t_B - t_G) + V_{app} - \sqrt{a^2 \cdot (t_B - t_G)^2 - 2 \cdot a \cdot (V_{app} \cdot t_G - S_{rear})}$$



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## b) Test target (L3e vehicle)

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- continuous lateral movement

- Sensor performance shall be tested at the worst case scenario, which is a motorcycle (L3e) coming from the rear
- Unfortunately no standardized test target for L3e vehicle is available
- IWG ACSF agreed to following solution:

### **new Annex 8, § 3.5.5.1**

*For the approaching vehicle in the test a type approved high volume series production L3 motorcycle with an engine capacity not exceeding 600 ccm without front fairing nor windscreen shall be used.*

(until a standardized test target is defined)



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## c) Type approval test requirements

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### - Test overview (7 tests)

- 1) Lane change functional test
- 2) Minimum activation speed test  $V_{\text{smin}}$
- 3) Overriding test
- 4) Lane change procedure suppression test
- 5) Sensor performance test
- 6) Sensor blindness test
- 7) Engine start/ run cycle test

## c) Type approval test requirements

### - General test requirements

- Straight test track with
  - at least two lanes,
  - same direction of travel,
  - road markings on each side of the lanes
- Vehicle test speed defined in each test as  $V_{\text{test}}$ 
  - Based on minimum specified speed  $V_{\text{smin}}$
  - Assumed max. speed of approaching vehicle  $V_{\text{app}} = 130 \text{ km/h}$  (\*)
- Test requirements must be fulfilled in whole speed range
  - Demonstration to satisfaction of technical service (appropriate documentation)

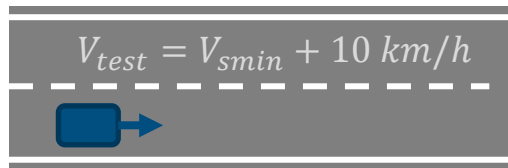
# c) Type approval test requirements

## - (1) Lane change functional test

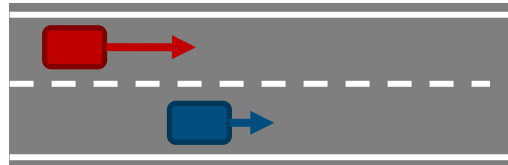
Objective

Verification lane change procedure

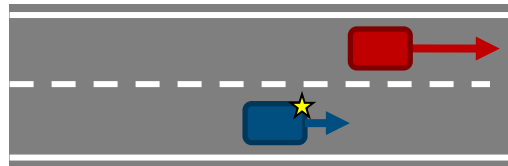
### Test procedure



Activation ACSF of Category C (standby mode) by driver



Approaching vehicle passes vehicle under test entirely



Lane change procedure initiated by driver (indicator)

Recording lateral acceleration & lateral jerk

Repetition of test: 2x



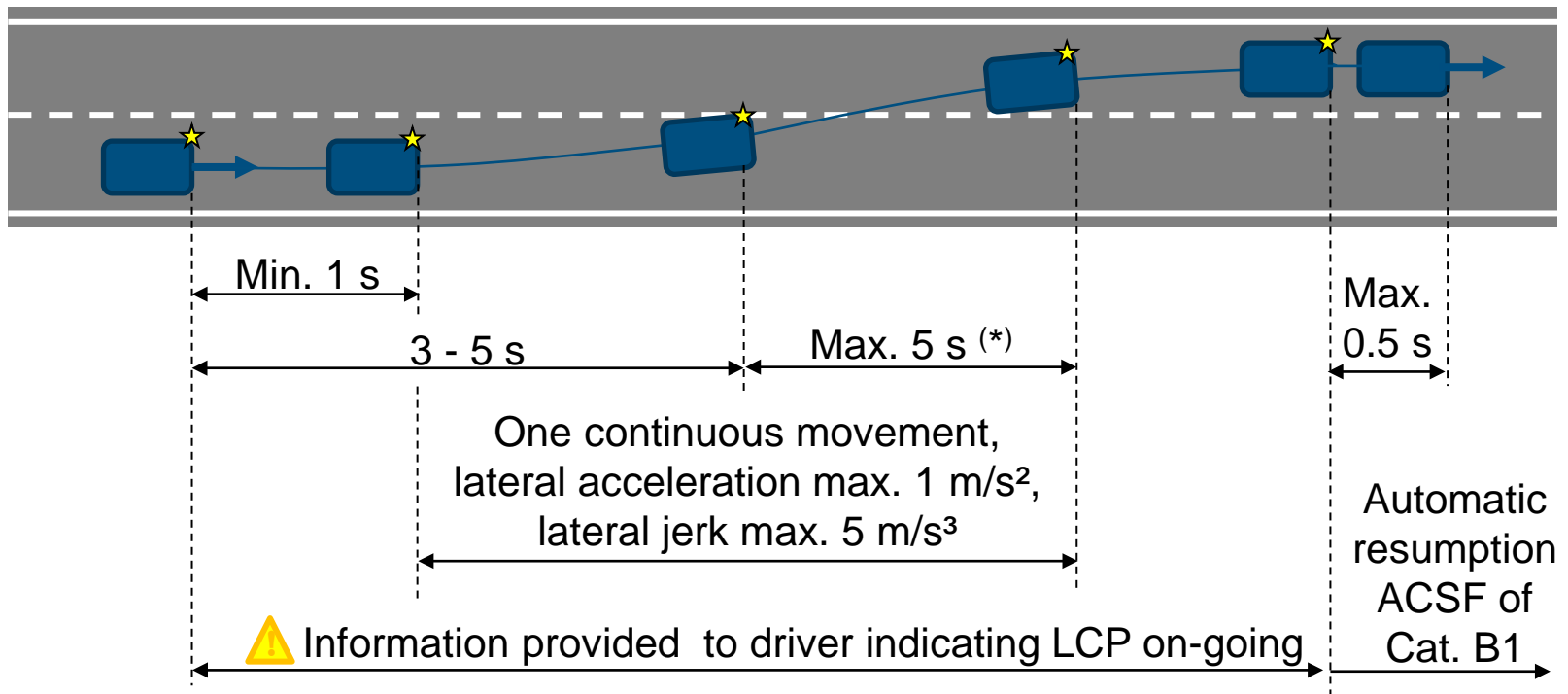
# c) Type approval test requirements

## - (1) Lane change functional test

Objective

Verification lane change procedure

Test fulfilled:



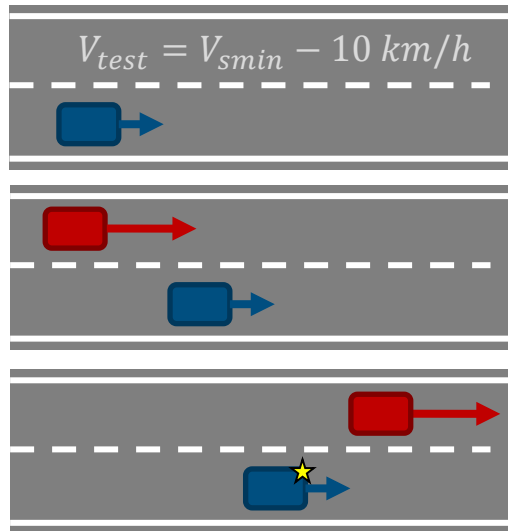
# c) Type approval test requirements

## - (2) Minimum activation speed test $V_{smin}$

### Objective

Verification no system activation below specified minimum speed

### Test procedure



Activation ACSF of Cat. C (standby mode) by driver

Approaching vehicle passes vehicle under test entirely

Lane change procedure initiated by driver (indicator)



Test fulfilled

Lane change manoeuvre is not performed.

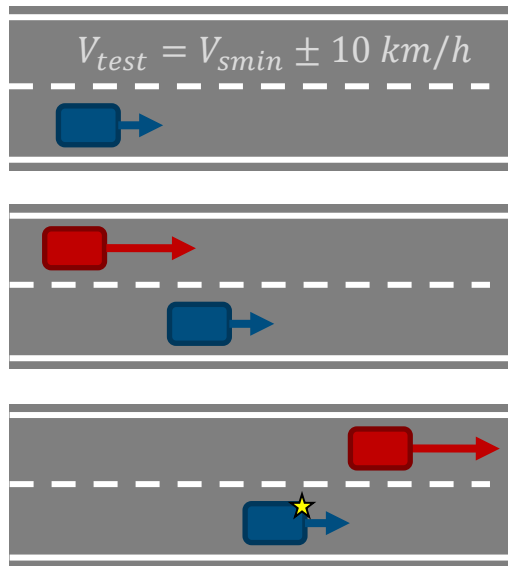
# c) Type approval test requirements

## - (2) Minimum activation speed test $V_{smin}$

### Objective

Verification no system activation below specified minimum speed

### Test procedure



### Additional testing

In case  $V_{smin}$  is calculated based on country specific general maximum speed other than 130 km/h:

- In addition test procedure with  $V_{test} = V_{smin} - 10 \text{ km/h}$   
**Test fulfilled:** Lane change procedure is not performed.
- In addition test procedure with  $V_{test} = V_{smin} + 10 \text{ km/h}$   
**Test fulfilled:** Lane change procedure is performed.

Simulation country of operation allowed.

Detection country of operation and knowledge of country specific general maximum speed limit shall be demonstrated to technical service.

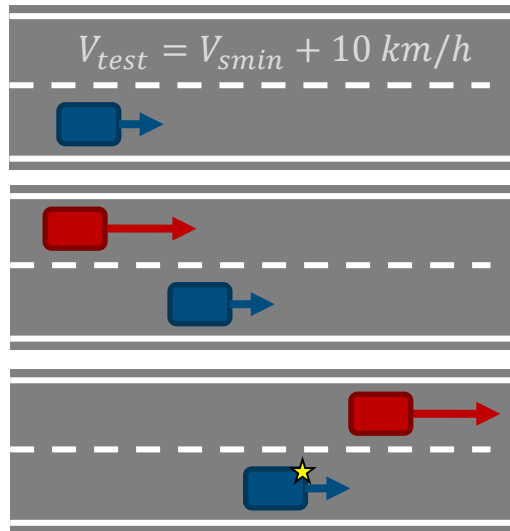
# c) Type approval test requirements

## - (3) Overriding test

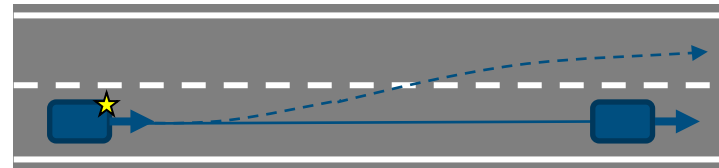
Objective

Verification overriding force needed by driver

### Test procedure



Driver firmly maintains steering control in straight direction



- Measurement force applied by driver on steering control
- Repetition of test: 2x

Test fulfilled: Measured overriding force  $\leq 50 \text{ N}$

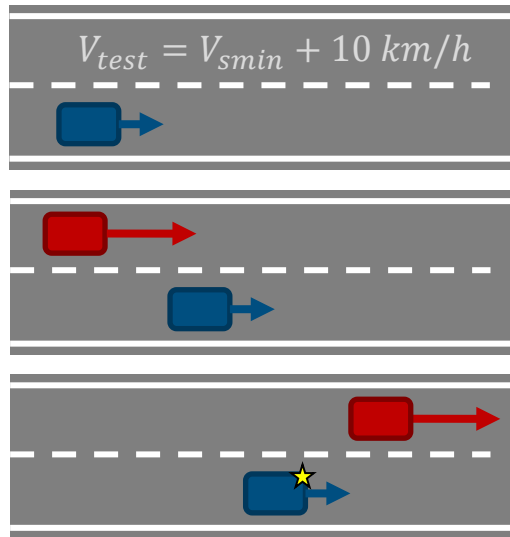
# c) Type approval test requirements

## - (4) Lane change procedure suppression test

### Objective

Verification conditions to suppress lane change procedure

### Test procedure



Test repeated for following conditions, which shall occur before lane change manoeuvre has started:

- Driver's actions:
  - removed hands from steering control and hands-off warning initiated
  - manual deactivation direction indicator lamps
  - overrides system
  - switches system off
- Vehicle speed reduced to  $V \leq V_{min} - 10 \text{ km/h}$
- Begin lane change manoeuvre  $\geq 5 \text{ s}$

**Test fulfilled:** Suppression lane change procedure in each test case above

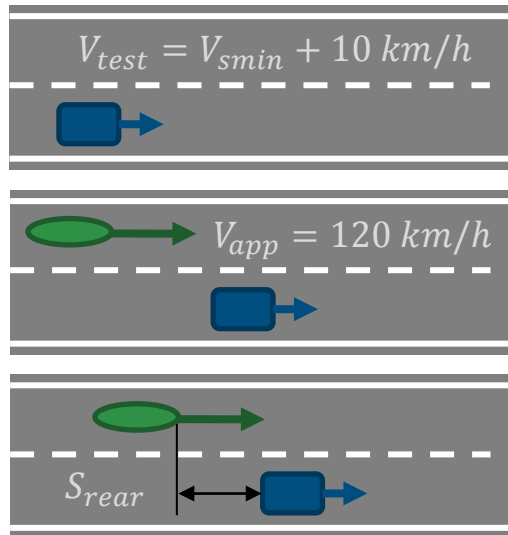
# c) Type approval test requirements

## - (5) Sensor performance test

### Objective

Verification of minimum distance  $S_{rear}$  declared by manufacturer

### Test procedure



Approaching vehicle

- Type approved high volume series production L3 motorcycle
- Engine capacity  $\leq 600 \text{ cm}^3$
- w/o front fairing nor windscreen
- Shall aim to drive middle of lane

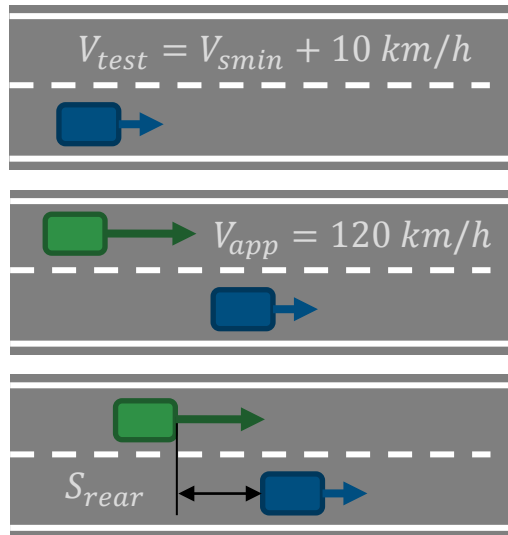
# c) Type approval test requirements

## - (5) Sensor performance test

Objective

Verification of minimum distance  $S_{rear}$  declared by manufacturer

### Test procedure



Distance measured

- Distance rear end test vehicle and front end of approaching vehicle measured (e.g. differential GPS)
- Value the system detects approaching vehicle noted

### Test fulfilled:

System detects approaching vehicle latest at distance declared by manufacturer  $S_{rear}$

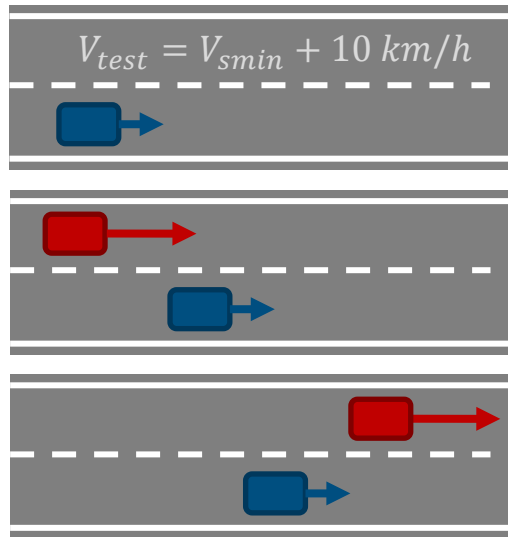
# c) Type approval test requirements

## - (6) Sensor blindness test

Objective

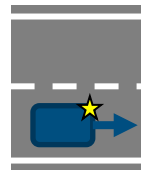
Verification system detection sensor blindness

### Test procedure



Making rear sensor(s) blind

- Means agreed between vehicle manufacturer and technical service (documented in report)
- Standstill (no new engine start/ run cycle!)



Continued test procedure

- Vehicle speed  $V_{test} = V_{smin} + 10 \text{ km/h}$
- Initiation lane change procedure



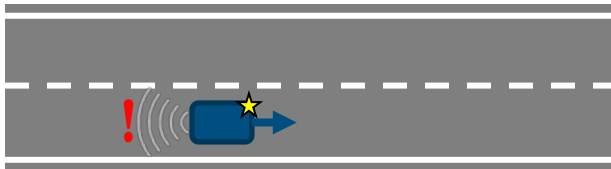
## c) Type approval test requirements

### - (6) Sensor blindness test

Objective

Verification system detection sensor blindness

Test fulfilled



- System detects sensor blindness
- System provides warning to driver
- Lane change manoeuvre is not performed

#### Additionally

Vehicle manufacturer demonstrates to satisfaction of technical service requirements also fulfilled under different driving scenarios. May be achieved by documentation.

# c) Type approval test requirements

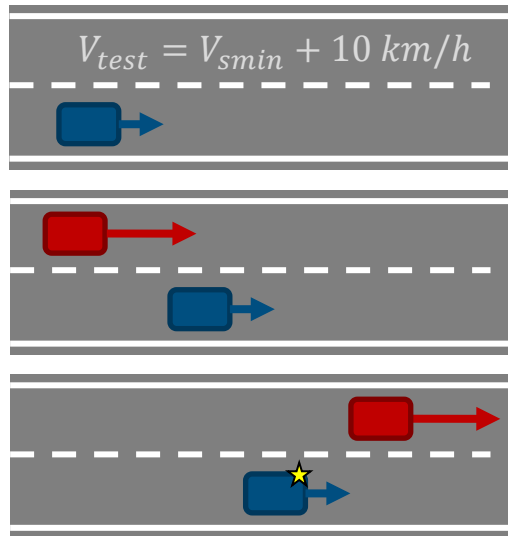
## - (7) Engine start/ run cycle test – Phase I

Objective

Verification default-off status

### Test procedure

Engine start/ run cycle



**No** activation ACSF of Cat. C (off mode) by driver

Approaching vehicle passes vehicle under test entirely

Lane change procedure initiated by driver (indicator)

Test fulfilled

Lane change manoeuvre is not performed.

# c) Type approval test requirements

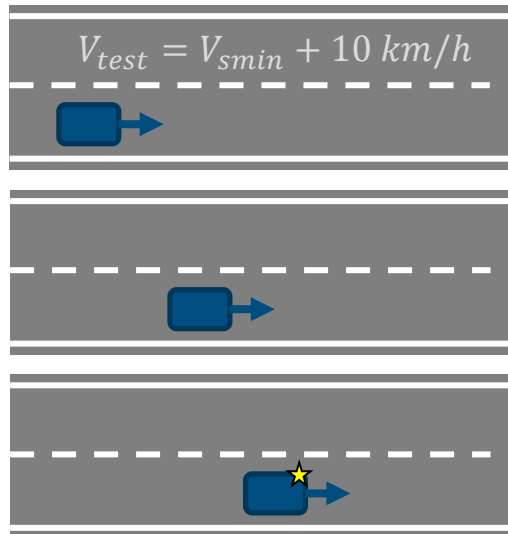
## - (7) Engine start/ run cycle test – Phase II

### Objective

Verification required object detection for system activation

### Test procedure

Engine start/ run cycle



Activation ACSF of Cat. C (standby mode) by driver

**No** approaching vehicle!

Lane change procedure initiated by driver (indicator)

Test fulfilled

Lane change manoeuvre is not performed.

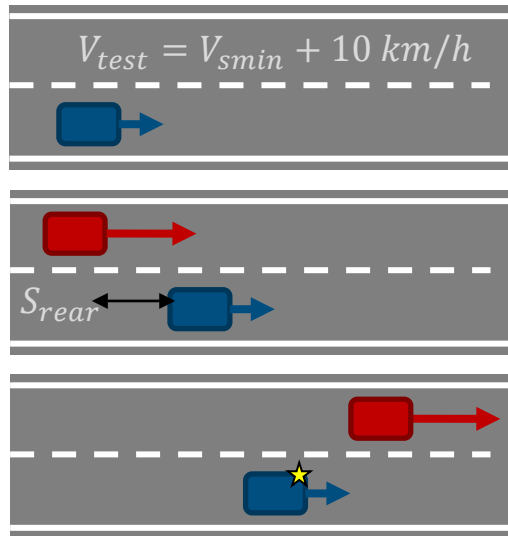
# c) Type approval test requirements

## - (7) Engine start/ run cycle test – Phase III

Objective

Verification lane change enabling conditions

### Test procedure



Approaching vehicle

- Type approved high volume series production vehicle

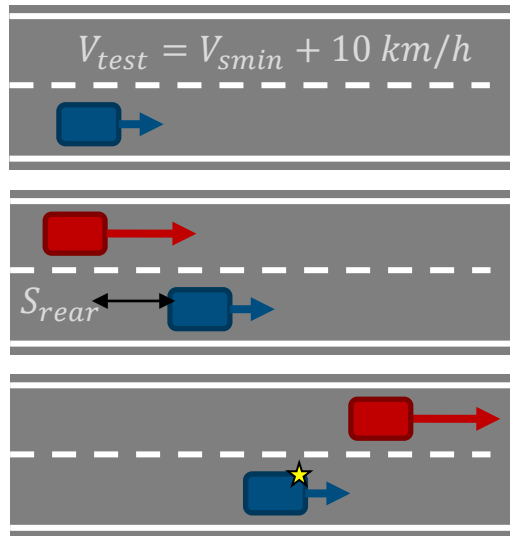
# c) Type approval test requirements

## - Engine start/ run cycle test – Phase III

Objective

Verification lane change enabling conditions

### Test procedure



Distance measured

- Distance rear end test vehicle and front end of approaching vehicle measured (e.g. differential GPS)
- Value the system detects approaching vehicle noted

### Test fulfilled:

System detects approaching vehicle latest at distance declared by manufacturer  $S_{rear}$

Thank you for your attention!

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Invalidenstraße 44  
D-10115 Berlin

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