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Informal document **GRSG-112-36**
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agenda item 16.)

**Draft Regulation on Driver Assist Systems
to Avoid Blind Spot Accidents**
Proposal for Regulation Text

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Structure


- Summary of previous work
 - Accidentology
 - Relevant Parameters
 - Derivation of Test Cases
 - Test Tools & Conduction
- Regulation
 - Test Setup
 - Test Cases
 - Excerpt: relevant text

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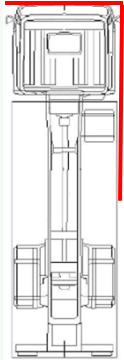
SUMMARY

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In depth accident analysis - results

- Daytime about 90 %
- 90 % dry weather
- Truck drivers sight O.K.; obstruction in only 9 %
- Only 22 % of the cases after previous halt of the truck
- In 90 % of the cases truck did not brake
- In 90 % of the cases bicycle moved
- Impact point at frontal part of the truck (up to 6 m towards the rear)
- 90 % of fatalities with trucks above 7.5 t
- 6x more Bicycles than Pedestrians
- Traffic lights do not play any role




60-80%

(UDB / DEKRA)

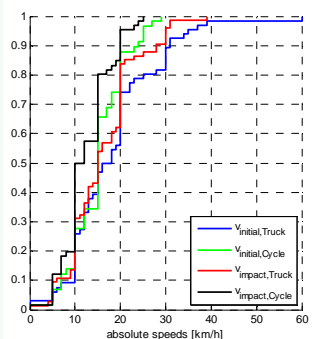
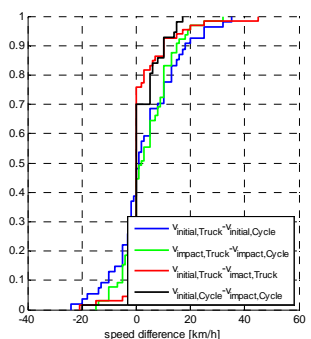
	Cycl.	Ped.
accidents	640	55
seriously injured	118	16
fatalities	23	4

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In depth accident analysis - results

Speeds:

- Bicycle and truck did not change their speeds during the accident in about two thirds of all cases
- Truck speeds are below 30 km/h in more than 90% of all cases
- Bicycle speeds are below 20 km/h in more than 80% of all cases

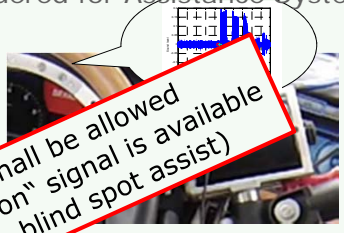
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Difference between Warning and Information

- Warning
 - High intensity
 - If issued right, good effects in steering driver's attention
 - High annoyance if issued too often → risk of deactivation


Not Considered for Assistance System




Additional „warning“ shall be allowed as long as initial „information“ signal is available (= as it is in today's M₁ blind spot assist)

- Information
 - Low intensity
 - Low annoyance if issued too often → low risk of deactivation
 - Lesser effect in steering driver's attention

Considered for Assistance System

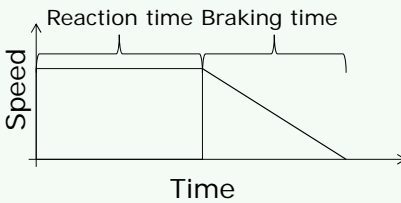


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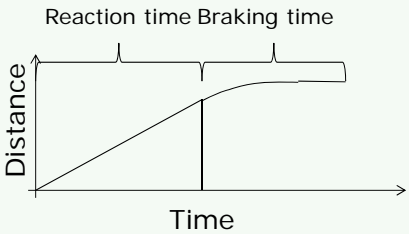


Last Point of Information LPI

- Stopping distance depends on driver reaction time and deceleration




Speed vs Time graph. The y-axis is labeled 'Speed' and the x-axis is 'Time'. A horizontal line represents constant speed during the 'Reaction time' period. After this period, the speed decreases linearly during the 'Braking time' period until it reaches zero.



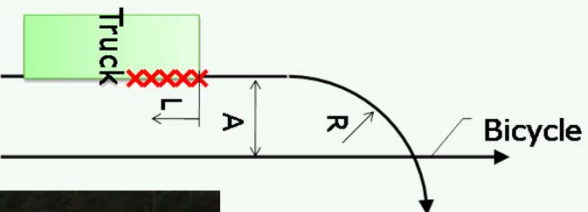
Distance vs Time graph. The y-axis is labeled 'Distance' and the x-axis is 'Time'. The distance increases linearly during the 'Reaction time' period. During the 'Braking time' period, the distance increases at a decreasing rate, following a parabolic curve, until the vehicle stops.

- Information should be given at a point when the vehicle driver can still comfortably come to a full stop BEFORE crossing the bicycle line of movement
- This point is the „Last Point of Information“ (LPI)

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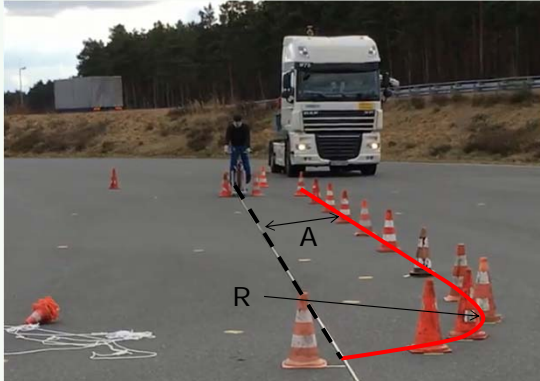


Test Setup



Schematic diagram showing a truck on the left and a bicycle on the right. A red dashed line indicates the impact location L from the front of the truck. A vertical double-headed arrow indicates the initial lateral separation A . A curved arrow indicates the turning radius R of the truck.

- L – Impact location from front of truck
- A – Initial lateral separation of HGV and Bicycle
- R – Turning Radius of HGV




Photograph of the test setup on a road. A white truck is positioned on the left, and a person on a bicycle is on the right. Orange traffic cones are used to mark the impact location L , the initial lateral separation A , and the turning radius R .

- L – Impact location from front of truck
- A – Initial lateral separation of HGV and Bicycle
- R – Turning Radius of HGV

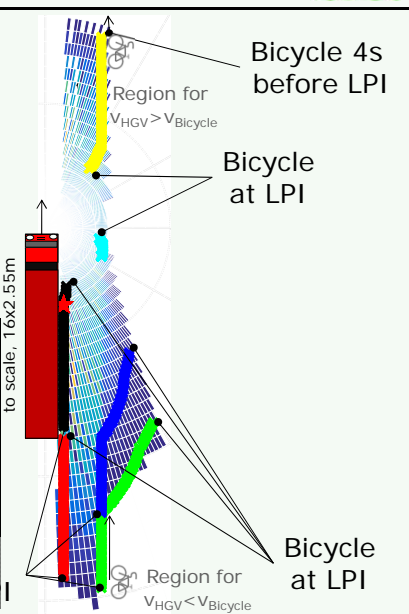
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Original Test Cases




- Information MUST be given at or before Last Point of Information (LPI)
- Exact timing defined by manufacturer
- Tests will simulate at least 8s before LPI

ID	v_{Truck} [km/h]	v_{Cycle} km/h]	R [m]	Initial lateral separation [m]	Impact location with respect to front of truck [m]
1	10	20	5	1,5	6
2	10	20	10	4,5	6
3	10	20	10	4,5	3
4	10	20	10	1,5	0
5	10	10	5	4,5	0
6	20	10	25	4,5	0
7★	20	20	25	1,5	6




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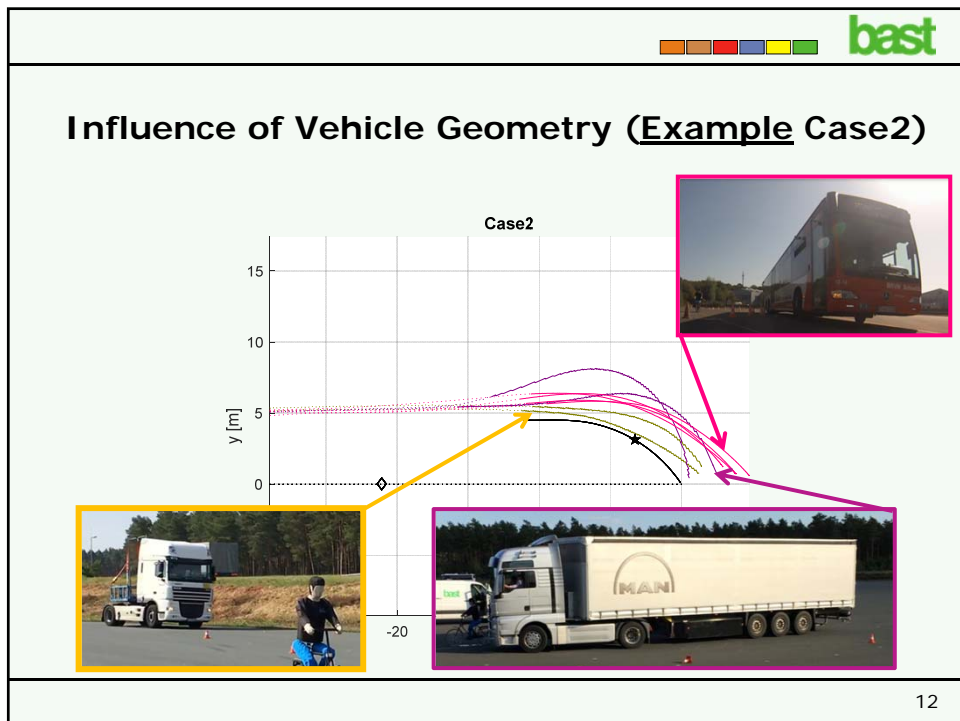
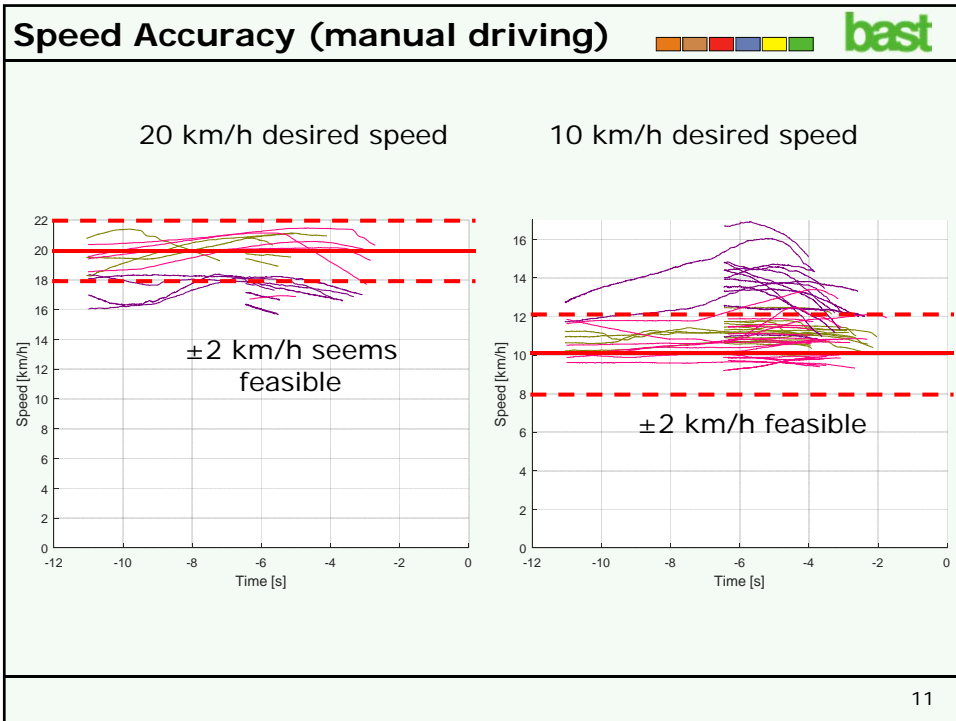
Possible Test Equipment




- Vehicle
 - Truck, manually driven, without trailer
 - Position estimation: GeneSys DGPS
 - Position transmitted to dummy propulsion system
- Dummy
 - Standard impactable bicycle dummy
 - Draft dummy specs included in Regulation
- Dummy Propulsion
 - 4a „Surfboard“ commercial Dummy Propulsion
 - Synchronisation of triggering time

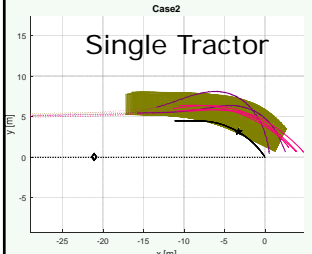


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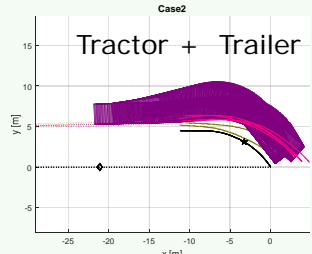




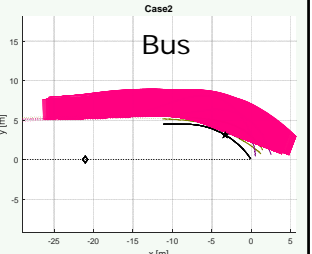
Case 2: Overview



Single Tractor




Tractor + Trailer



Bus

- Different vehicle types show different cornering styles
- **Corridors** for test conduction need to be adjusted to take this into account


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False Positive Tests

- System must not react to trees, cones and other road clutter
- Tests will always be carried out using cones
 - Information should only be given when approaching the bicycle
- Generic local road sign should be placed
 - No information should be given when entering the corridor
 - Additionally road sign positioned at entry of corridor

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Summary

- Accident data shows:
 - Bicycles, daytime, no obstruction of sight
 - Impact on right side of heavy trucks
 - In majority of cases no starting or stopping
 - Speed ranges below 20 km/h (bicycle), below 30 km/h (truck)
- Concept for assistance system
 - Information signal (comparable to M1 blind spot assist systems)
 - 7 draft test cases had been defined
 - Test procedure can be conducted with current test tools
 - Possible accuracies for speed and position (corridor) have been defined

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REGULATION

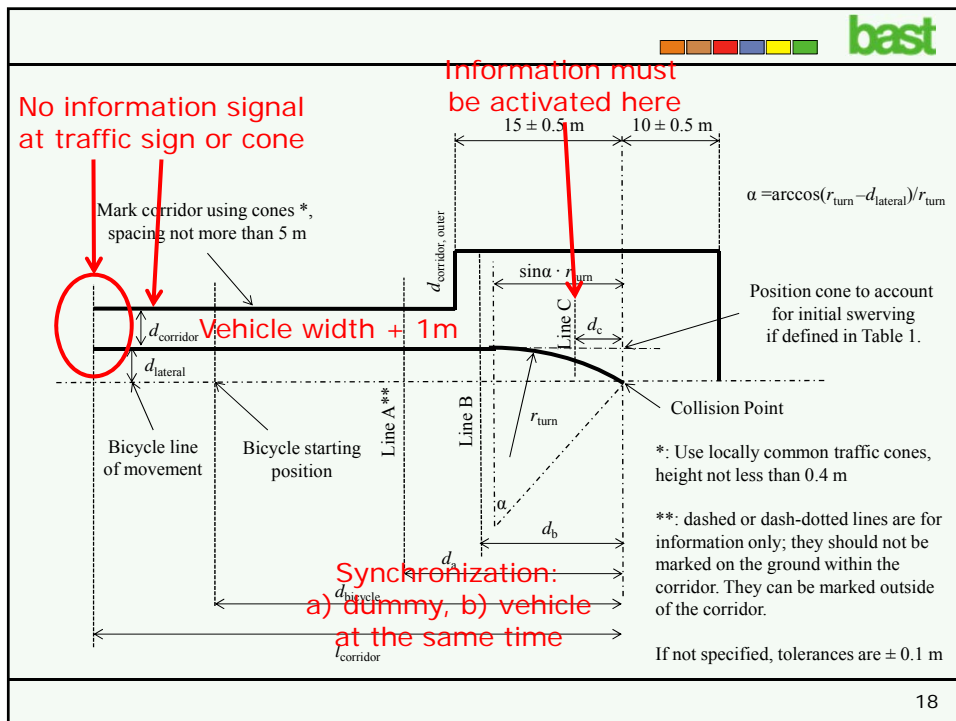
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Performance Requirements



- 5.3.1. Whenever the system is active, as specified in paragraph 5.3.1.4. below, the BSIS shall inform the driver about bicycles, travelling initially in parallel to the vehicle on the near side of the vehicle, that would be in conflict if the vehicle would start a turn towards the bicycle line of movement.
- 5.3.1.1. The information signal shall be given at a time when the vehicle driver would still be able to avoid a collision, taking into account an appropriate reaction time and an achievable brake deceleration.
- 5.3.1.2. The information signal shall meet the requirements as defined in paragraph 5.4. below.
- 5.3.1.3. The information signal shall be given independently from the activation of turn signals.
- 5.3.1.4. The BSIS shall be operative for all forward vehicle speeds between 1 km/h and 30 km/h.
- 5.3.1.5. The BSIS shall be able to give an information signal for all bicycles moving with a speed between 5 km/h and 20 km/h.
- 5.3.1.6. The BSIS shall not give an information signal for stationary objects that are not pedestrians or cyclists.
- 5.3.1.7. The information signal shall be provided in such a timely manner that the accident is avoided, i.e. the vehicle is stopped before crossing the bicycle trajectory, if there was a driver brake application, resulting in 5 m/s² brake deceleration, and initiated with a reaction time of 1.4 seconds after the information signal. This shall be tested as specified in paragraph 6.5.

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Test Cases													bast	
New Test Case	Orig. Test Case	r_{turn}	$v_{vehicle}$ [km/h]	$v_{Bicycle}$ [km/h]	$d_{lateral}$ [m]	d_a [m]	d_b [m]	d_c [m]	$d_{bicycle}$ [m]	$l_{corridor}$ [m]	$d_{corridor}$ [m]	$d_{corridor,outer}$ [m]	Include cone to account for initial swerving?	
1	1	5	10	20	1.5	44.4	15.8	4.3				5	Yes	
2	4	10	10	20			22	4.4					2	Yes
3	7	25	20	20			38.3	10.7					1	No
4	6	25	20	10	4.5	44.4	43.5	10				1	No	
5	5	5	10	10			19.8	2.4					6	Yes
6	2	10	10	20	4.5	44.4	15.8	4.3	3.4			3	Yes	
7	3	10	10	20	4.5	44.4	15.8	4.3	3.4			2	Yes	
8	1*	5	10	20	1.5	44.4	15.8	4.3				1	No	
9	4*	10	10	20	1.5	44.4	15.8	4.3			No			
10	5*	5	10	10	1.5	44.4	15.8	4.3			No			
11	2*	10	10	20	4.5	44.4	14.7	3.4			No			
12	3*	10	10	20	4.5	44.4	17.7	3.4			No			

Test cases where vehicle initially swerves to the outside

Test cases where vehicle does not swerve to the outside

Test Case No. corresponding to presentations from GRSGs 2016

Test Procedure													bast	
<p>6.5.1. Using cones and the bicycle dummy, form a corridor according to Figure 1, Appendix 1 of this document and the additional dimensions as specified in Table 1, Appendix 1 of this Regulation.</p> <p>6.5.2. Position the bicycle target (as detailed in Annex 3 of this Regulation) at the appropriate starting position as shown in Figure 1, Appendix 1 of this Regulation.</p> <p>6.5.3. Position a local traffic sign corresponding to sign C14 as defined in the Vienna convention on road signs and signals (speed limit 50 km/h) or the local sign closest to this sign in meaning on a pole at the entry of the corridor as shown in Figure 1, Appendix 1 of this Regulation.</p> <p>6.5.4. Drive the vehicle at a speed as shown in Table 1, Appendix 1 of this document with a tolerance of +/- 2 km/h through the corridor.</p> <p>6.5.5. Do not operate the turn lights when initiating the turn towards the bicycle trajectory.</p> <p>6.5.6. Move the bicycle dummy on a straight line as shown in Figure 1, Appendix 1 of this document in way that the dummy position crosses line A (Figure 1, Appendix 1) with a tolerance of +/- 0.5 m at the same time when the vehicle crosses line B (Figure 1, Appendix 1) with a tolerance of +/- 0.5 m (verify e.g. with video or picture). Move the dummy in a way that the dummy moves in a steady state for at least 8 seconds, with the speed as shown in Table 1, Appendix 1 of this document with a tolerance of +/- 0.5 km/h, before reaching the collision point.</p> <p>6.5.7. Verify that the Blind Spot Information signal has been activated before the vehicle crosses line C, Figure 1, Appendix 1 of this document.</p> <p>6.5.8. Verify that the Blind Spot Information signal has not been activated when passing the traffic sign and any cones as long as the bicycle dummy is still stationary.</p>														



Future Improvements

- To clarify: additional warnings can be given after LPI
- Consider how to address approval of stand-alone / retrofit systems
- Erase „original test case“ column from test case table