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Introduction: Modifications to UN R131 AEBS for Heavy Vehicles

Ad-Hoc Drafting Group on Regulation No. 131
Geneva, November 14, 2018

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Structure of Presentation

- Justification for increase in performance (accidentology, technology, economy)
- Justification and explanation for change in warning requirements
- AEBS Deactivation
- Summary

Quick summary – some severe German accidents since July 2018

- *October 22*, truck cuts through traffic, causing an accident with in total 3 collisions, 1 driver dies
- *October 16*, tanker collides with slowly travelling truck, driver dies
- *August 13*, 3 killed in a series of accidents with stationary vehicles involving 6 trucks and 1 transporter
- *July 10*, truck runs into end of traffic jam, driver dies

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Accidentology for Germany, 2015

	Accidents with Injuries	Percent	Fatalities	Percent
All Rear-End Accidents	45,635	100%	249 (5,5 per 1000 acc.)	100%
Rear-End involving HGV	2,800	6,1%	128	51,4%
Rear-End caused by HGV*	1,571	3,4%	58 (36 per 1000 acc.)	23,3% **AEBS – R131**
Rear-End not caused by HGV	1,229	2,7%	70	28,1%

Rear-End caused by HGV: about 1/30 of all rear-end accidents w/personal injury, but about 1/5 of all fatalities!

* Official cause: 50%-50% Distance not sufficient – Speed too high

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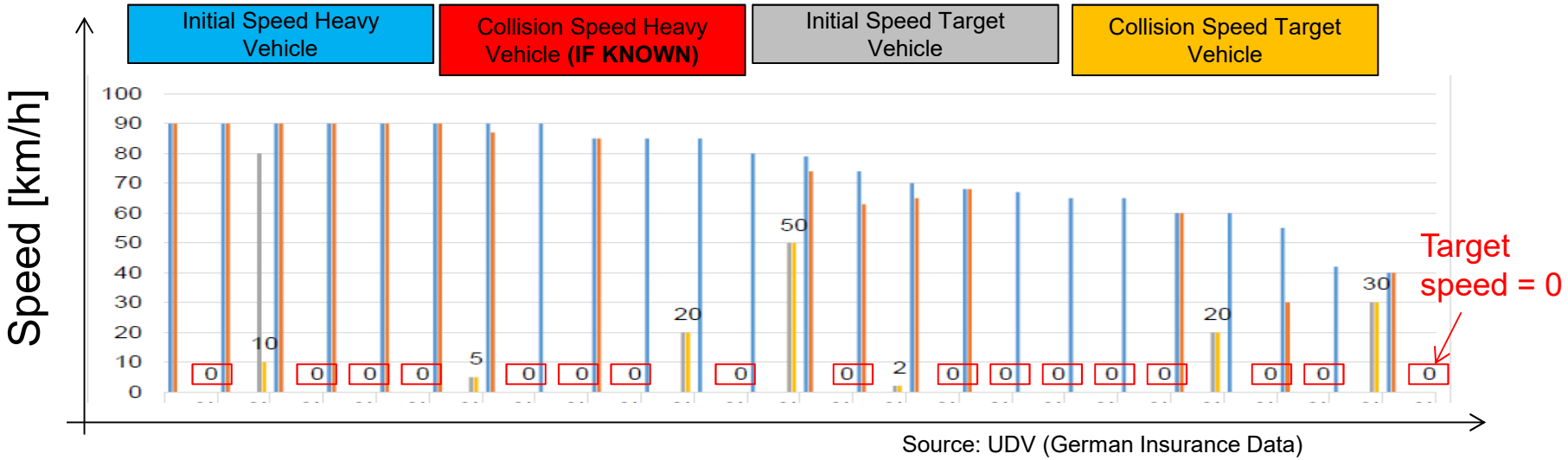
Other Sources: Insurer‘s Database



- Source: Insurance Cases, speeds from tachograph if possible
- 24 cases with known speed of struck vehicle
- Collision present in all cases; collision speed of striking vehicle not in all cases known
- In 75%, struck vehicle is stationary

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Other Sources: Lower Saxony, 2017

- Detailed investigation of **57** severe rear-end accidents (at least 1 severely injured) on highways in Lower Saxony
- Investigation performed by "*Landesverkehrswacht Niedersachsen e.V.*" (Dr. Petersen) in close collaboration with the Lower Saxony police and authorities

n=57	Target moving	Target decelerating	Target stationary
All vehicles	11 (19%)	14 (24%)	32 (56%)
With AEBS	2 (13% w/ AEBS)	4 (25% w/ AEBS)	10 (62% w/ AEBS) !
Without AEBS	8 (21% no AEBS)	10 (26% no AEBS)	20 (53% no AEBS)

- AEBS seems to be effective with moving targets
- **AEBS seems to be less effective with stationary targets**

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Other Sources - GIDAS

GIDAS, German In-Depth Accident Study
Selection: 2005-2017, Truck vs. other Vehicle, all severities, Highway

Update	Target moving	Target decelerating	Target stationary
All vehicles (GIDAS, N=84)	18 (21%)	29 (35%)	37 (44%)
All vehicles (Petersen, N=57)	11 (19%)	14 (24%)	32 (56%)

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Observations and Conclusion

Observations

1. Accident severity in rear-end accidents is much higher when these accidents involve trucks
2. In particular, rear-end accidents caused by trucks result in 36 fatalities per 1000 accidents (all rear-end: 5.5 per 1000)
3. In a large share of all truck-caused accidents, the struck vehicle is stationary (75%, UDV, 56%, Lower Saxony statistics)
4. AEBS seems to be highly effective for moving struck vehicles, but not for stationary (and stopped) struck vehicles

Conclusion

1. Accidents caused by trucks striking a stationary vehicle are highly important
2. AEBS Requirements for speed reduction on stationary vehicles are not sufficient
3. Requirements need to be increased if possible

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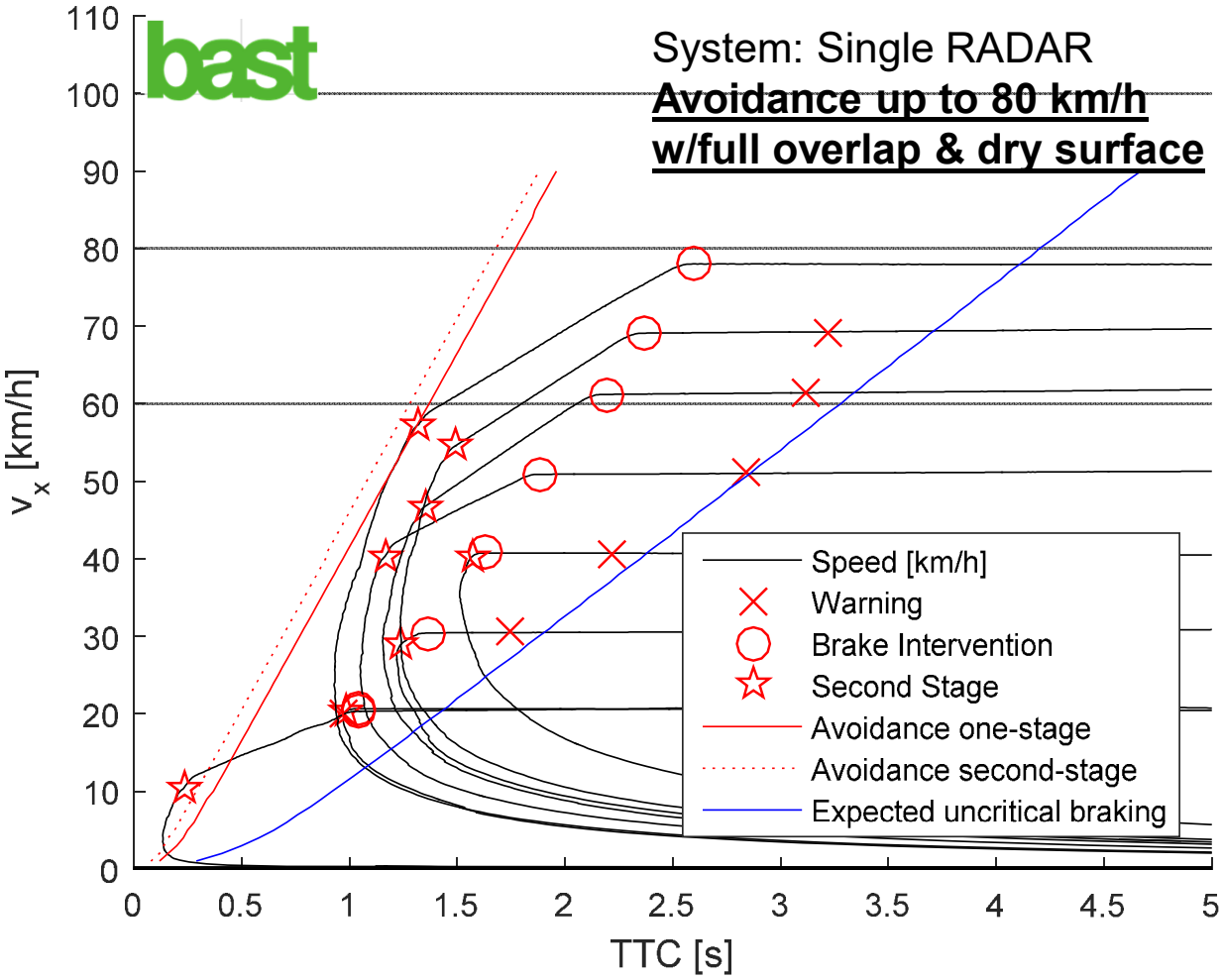
Speed Reduction on Stationary Targets



Other Data:

- **ADAC (2017)**
- 3 trucks from independent companies
- Trucks fully loaded
- Speed reduction: ≥ 70 km/h on stationary target
- 3 of 5 truck corporations with > 50% market share in Western Europe
- *VM technical publications*

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Cost-Benefit (2010 ACEA-TRL Study)

Assumption for AEBS performance from 2010…

Accident and casualty type		Estimated total casualties (EU-25) 2005		Predicted reduction in casualty numbers (fatal/serious 25%/75%, slight injuries (0%/10%)		Cost per vehicle (€) sustainable for a benefit/cost ratio of 1	
		Upper	Lower	Upper	Lower	Upper	Lower
All casualties from two-vehicle accidents where the front of an M1 vehicle collides with the rear of any other vehicle excluding motorcycles	Fatal	709	580	532	145		
	Serious	12,453	10,189	8,808	2,402		
	Slight	506,805	414,659	41,873	-2,402		
M1 Total						**136**	**15**
All casualties from two-vehicle accidents where the front of an M2/M3 vehicle collides with the rear of any other vehicle excluding motorcycles	Fatal	18	15	14	4		
	Serious	496	406	358	98		
	Slight	17,134	14,018	1,355	-98		
M2/M3Total						**1,450**	**162**
All casualties from two-vehicle accidents where the front of an N1 vehicle collides with the rear of any other vehicle excluding motorcycles	Fatal	156	128	117	32		
	Serious	1,674	1,369	1,138	310		
	Slight	44,536	36,439	3,315	-310		
N1 Total						**144**	**20**
All casualties from two-vehicle accidents where the front of an N2/N3 vehicle collides with the rear of any other vehicle excluding motorcycles	Fatal	468	383	351	96		
	Serious	2,340	1,915	1,404	383		
	Slight	31,913	26,111	1,787	-383		
N2/N3 Total						1,343	286

…and for ideal AEBS

Predicted reduction in casualty numbers (full avoidance)		Cost per vehicle (€) sustainable for a benefit/cost ratio of 1	
Upper	Lower	Upper	Lower
709	580		
12,453	10,189		
506,805	414,659		
		463	**204**
18	15		
496	406		
17,134	14,018		
		4,821	**2,105**
156	128		
1,674	1,369		
44,536	36,439		
		380	**181**
468	383		
2,340	1,915		
31,913	26,111		
		2,570	1,737

AEBS considered to have a ***BCR > 1***
for system price 1,737€ to 2,570€ (2010).
Corresonds to ~ **1,900 € to 2,800 € (2018)**
System cost still > 1,900 €?

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Cost-Benefit

Some Numbers forGermany, relevant for a possible Cost-Benefit-Assessment:

Fatalities: 58, caused by HGV in Rear-End accident

New vehicles p.a.:
12,238 N2
30,305 N3

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Observations and Conclusion

Observations

1. Several AEBS vehicles are already able to avoid accidents purely by AEBS intervention up to 70 km/h differential speed
2. Source: BASt measurements, ADAC measurements, manufacturer publications
3. These vehicles are available from 3 of 5 truck cooperations
4. An industry-sponsored study claims a BCR > 1 for system costs between 1,900 € and 2,800 €
5. System cost is likely << 1,900 € nowadays

Conclusion

1. There is no technical nor economical nor traffic safety reason not to harmonize technical requirements for moving and stationary targets

Warning Requirements

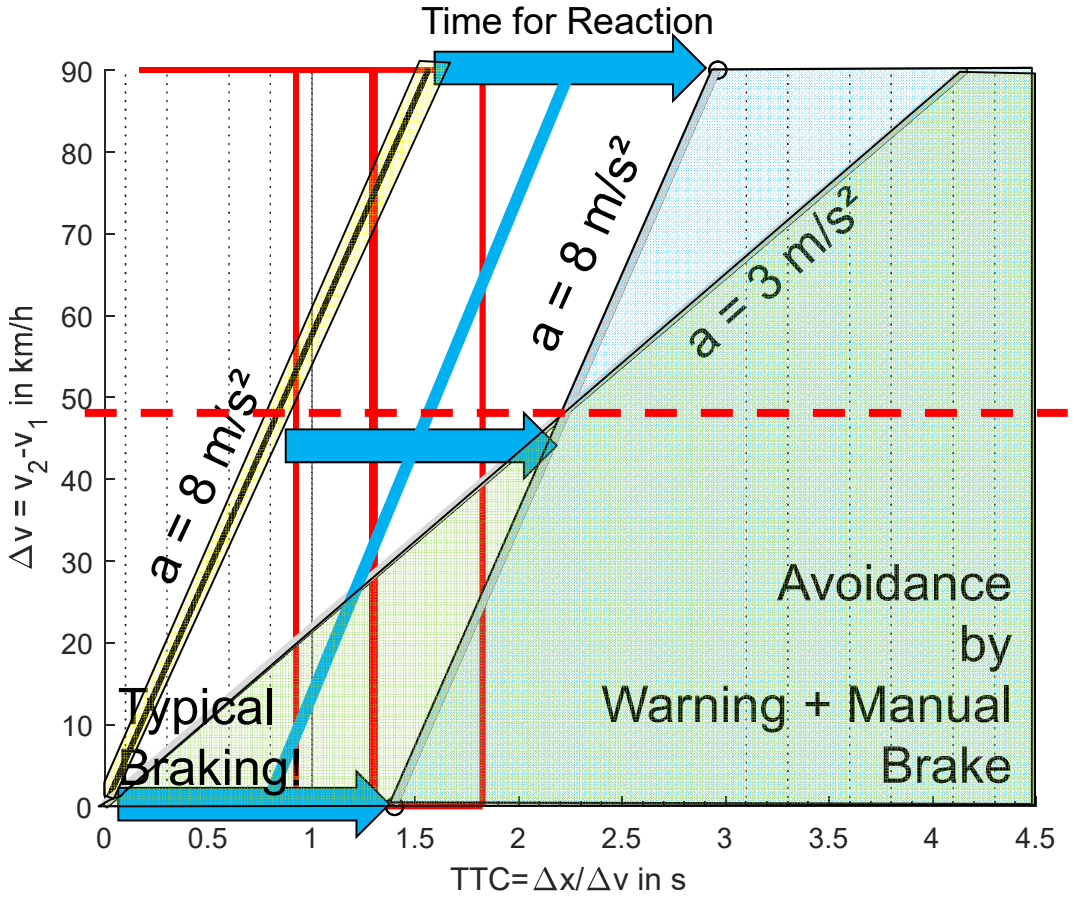
- Current warning requirements are absolutely fine for the foreseen use case (80-12/0, both vehicles with initial constant speeds)

- <u>But: Current warning requirements could lead to too frequent warnings in certain situations</u>
  - Low speeds: Manual brake application in regular situations late
  - Warning required 1.4 seconds before emergency brake phase → long before manual brake application!
- <u>Current warning requirements could prevent effective braking in certain situations</u>
  - Minimum warning time of 1.4 seconds (0.8 s for lighter vehicles)
  - Speed reduction in warning phase is limited
  - Decelerating lead vehicle

Basic Considerations for Driver Warning

Braking for Avoidance:

$$TTC = \frac{v}{2 \cdot a}$$



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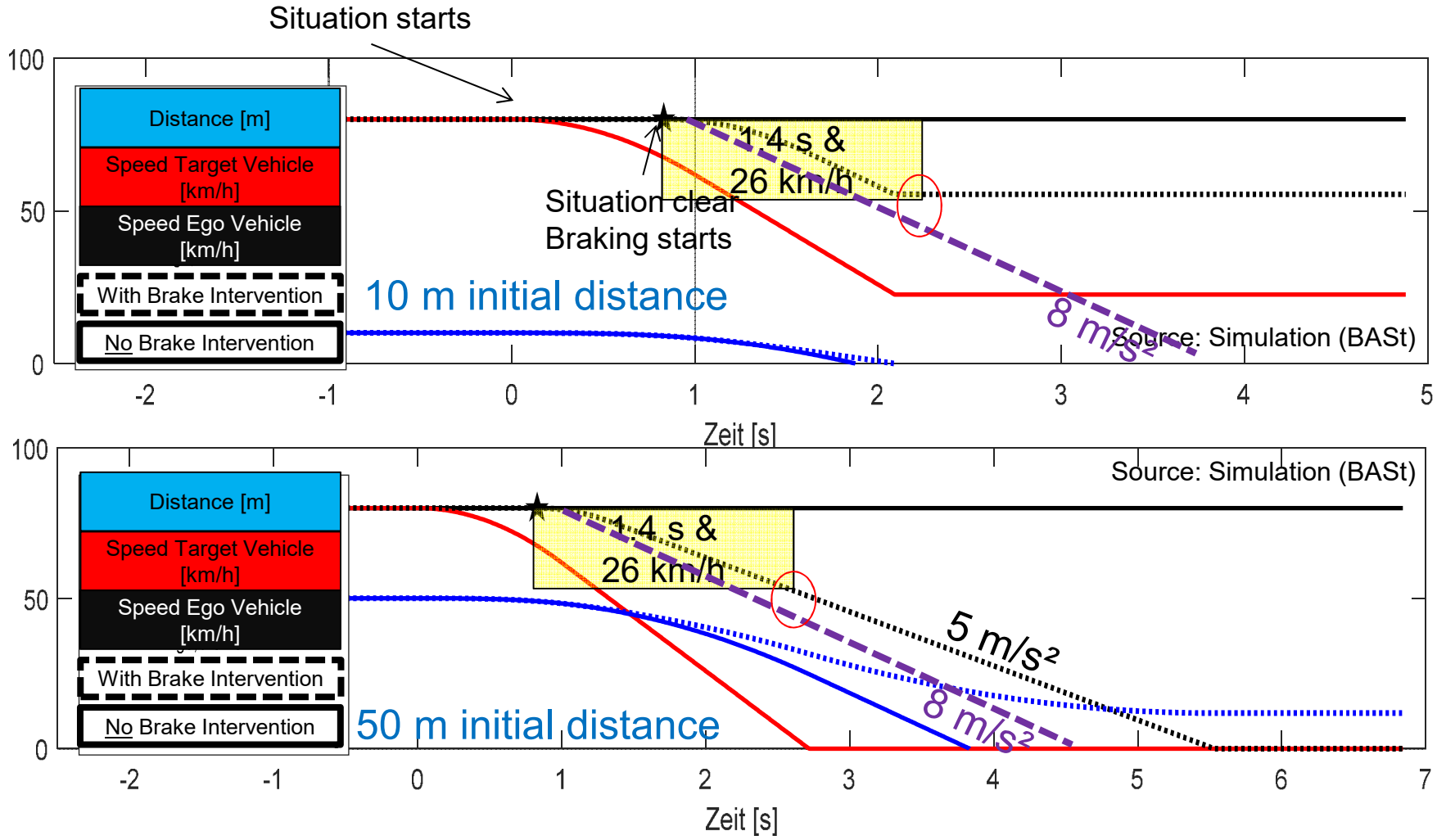
Too Late Braking

Example: Deceleration Lead Vehicle



Observations and Conclusion

Observations

1. Driver warning not effective below approx. 45 km/h (must be far too early if accident avoidance is the goal)
2. Accidents with sudden deceleration of lead vehicle require immediate and full braking
3. Simulations show that current requirements in this scenario sacrifice speed reduction of 10 km/h or more
4. Lead vehicle braking scenarios are relevant (see Slide 6)

Conclusion

1. Warning should not be mandatory for low relative speeds
2. Immediate full braking should be allowed in situations that cannot be anticiptated.
3. These situations are decelerating lead vehicle, cut-in, cut-through

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Deactivation

- Documents ECE/TRANS/WP.29/GRRF/2017/24 and GRRF-86-32 included in the text

- Changes to warning timing (effectively removing mandatory warnings for city speeds)
  → less unjustified warnings in cities! See GRRF-85-21, third bullet point

- While GRRF-86-32 introduced provisions for detecting sensor blocking, it is anticipated that it will be more beneficial to address this problem by exempting the relevant vehicles by national legislation from the requirement to use UN Regulation No. 131.

- Certain N_3 vehicles are available without switch!

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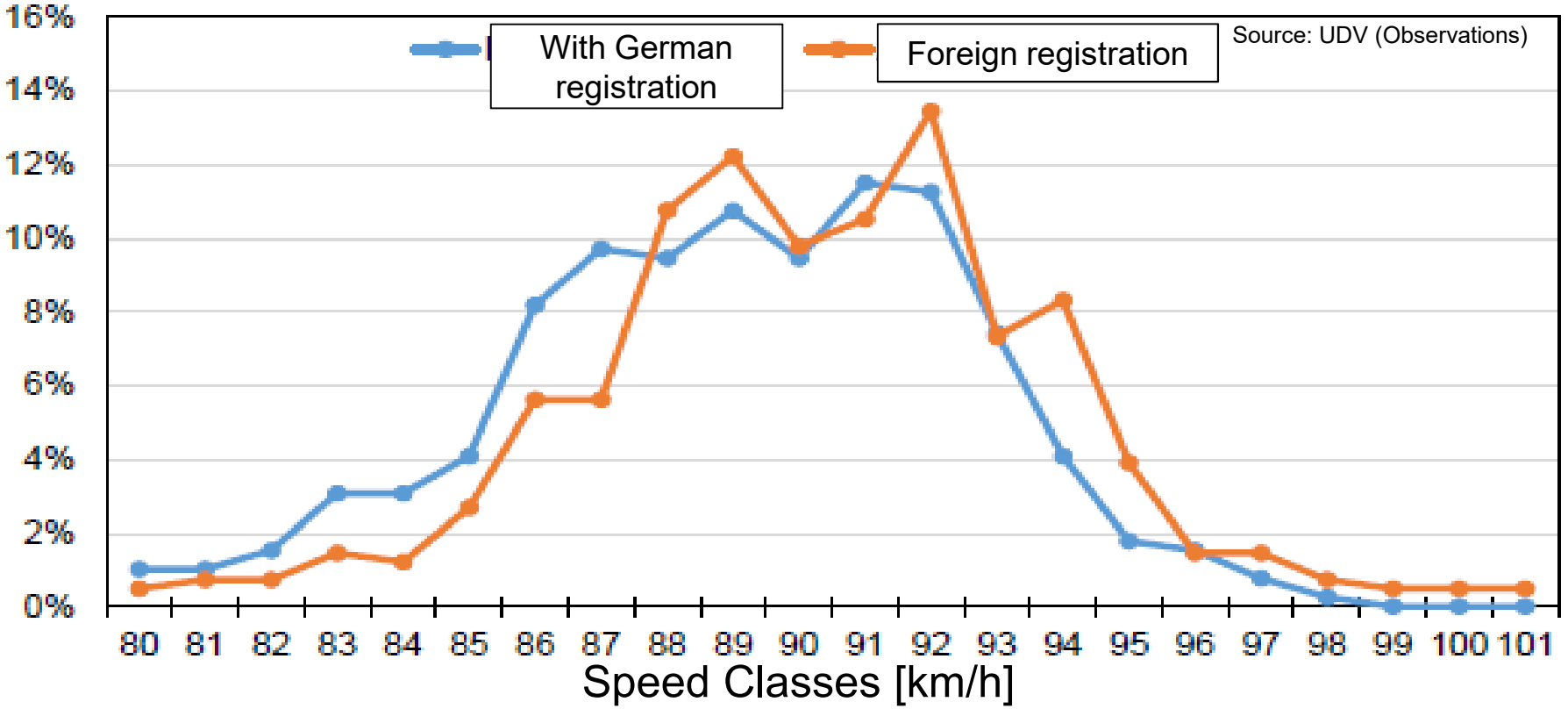
Travelling Speeds in Free Traffic are >> 80 km/h



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Overview: Proposed Requirements

Goal for today: Reach agreement between CPs on contents

Germany proposes the following contents:

1. Equal speed reduction (SR) requirements for brake intervention on moving and stationary targets → SR according to table below
2. Allow suppression of warning signal at low relative speeds
3. Allow immediate braking when situation develops quickly
4. Allow AEBS deactivation only below 30 km/h with automatic reactivation

Relative impact speed on dry roads for N2,3 and M2,3 vehicles:

≤ 70 km/h	→ 0 km/h relative impact speed
80 km/h	→ ≤ 25 km/h relative impact speed
90 km/h	→ ≤ 40 km/h relative impact speed
100 km/h	→ ≤ 55 km/h relative impact speed
110 km/h	→ ≤ 65 km/h relative impact speed

Next steps: Implement contents into document until January

Performance Requirements

Relative Speed [km/h]	Relative Impact Speed (dry) [km/h]	Relative Impact Speed (wet)* [km/h]
10	0	0
20	0	0
30	0	0
40	0	0
50	0	15
60	0	30
70	0	45
80	25	55
90	40	65
100	55	75
110	65	85

* Not tested

Thank you for your attention!

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Robert-Schuman-Platz 1
D-53175 Bonn

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