Deutscher
Verkehrssicherheitsrat

Statement on UNECE Regulation No. 131 concerning advanced emergency braking systems (AEBS) in goods road transport vehicles and buses

(As at 30/08/2021)

In a resolution of the Board of Directors from 09/09/2016, the German Road Safety Council (DVR) expressed its position in relation to the then-current situation concerning Advanced Emergency Braking Systems (AEBS). On the basis of various analyses of accidents involving heavy commercial vehicles on motorways in Lower Saxony, several recommendations were formulated to improve advanced emergency braking systems and adapt the UNECE and EU requirements to the state of the art (UNECE Regulation No. 131 and EU Commission Regulation No. 347/2012/EC).

Corresponding recommendations were supported by several associations (Federal Association of Road Haulage, Logistics and Disposal – BGL, German Social Accident Insurance Institution for Commercial Transport, Postal Logistics and Telecommunication – BG Verkehr, General German Automobile Club – ADAC, etc.) and subsequently by the Conference of Ministers of Transport and the Federal Council.
Based on these recommendations and the findings from Federal Highway Research Institute (BASt) report F 133[1], in 2018 Germany submitted a comprehensive and detailed application to the UNECE Working Party on Automated/Autonomous and Connected Vehicles (GRVA) in Geneva[2] to amend UNECE Regulation No. 131. The processing of this submission in the GRVA was initially postponed in favour of the new UNECE Regulation No. 152 for lightweight goods road transport vehicles and passenger cars, which is currently being drafted. In September 2020, under the leadership of the Federal Ministry of Transport and Digital Infrastructure (BMVI), the UNECE AEBS-HDV working group was enlisted to amend the previous requirements of UNECE Regulation No. 131 in line with the current findings from technology and accident research. As of now, this working group has held multiple meetings – some of which have been in relation to Regulation No. 152 aimed at M1/N1 vehicle categories – and has discussed and developed a wide range of proposed amendments and addenda for Regulation No. 131[3].

The DVR recognises the efforts made by the German government and the other countries involved in the AEBS-HDV working group, associations and the industry to refine the way Regulation No. 131 deals with

[1] BASt report F 133, advanced emergency braking systems for trucks

[2] https://www.unece.org/fileadmin/DAM/trans/doc/2018/wp29grva/ECE-TRANS-WP29-GRVA-2018-04e.pdf - 16.07.2018

[3] https://wiki.unece.org/display/trans/AEBS-HDV

“vehicle to vehicle” scenarios and to take crossing pedestrians and cyclists into account in the accident prevention requirements in urban environments. The DVR welcomes the fact that features to increase safety are already being taken into account by the UNECE working group in the current amendment, states its position on certain points – primarily “vehicle to vehicle” scenarios – and requests that its recommendations be taken into account.

Comments and recommendations from the DVR for current changes to UNECE Regulation No. 131

The DVR welcomes and supports:

1. The extension of the requirements across the complete range of speeds up to 100 km/h; see Table 1.

2. Efforts to grant a higher level of flexibility with regard to the requirements for warning phases. In this way, with the appropriate configuration, drivers of vehicles can receive advanced warnings in critical driving situations so that they can take early actions themselves (braking or swerving) to avoid imminent forward collisions.

3. The removal of the currently defined limitation of decelerations in the warning phases before the AEBS emergency braking intervention. The DVR expressly welcomes and supports this change, because if the AEBS identifies a collision-relevant vehicle in front that is braking heavily – for example in a traffic jam or an accident situation – the AEBS should be permitted to apply the full emergency braking force “immediately” if required in accordance with Regulation No. 131.

4. The fact that, thanks to development of the technologies by manufacturers, the ability to avoid collisions with stationary vehicles is being increased to the level that already exists for collisions with moving vehicles, and now speed differences of at least ≥70 km/h are stipulated as part of a UNECE-wide requirement.

In addition, the DVR recommends the following:

5. Due to the high percentage of accidents involving trucks driving into the back of stationary vehicles in front of them and the dramatic level of personal injury and economic damage associated with such accidents, with a view to Vision Zero, the development goal of the industry

and legislators for future advanced emergency braking systems – at least for the air-braked N2/N3 and M2/M3 vehicles that are commonly used in Europe – should be to adapt the minimum requirements for the prevention of such collisions in "vehicle to vehicle" scenarios in line with the maximum speeds that are actually driven and technically possible (configuration of the speed limiter) in the relevant vehicle types (N2/N3: almost 90 km/h; M2/M3 buses: 100 km/h). Furthermore, the AEBS emergency braking should intervene in good time before the "Last Point to Steer" and the intervention should continue until the vehicle is stationary; see explanations below and Table 2.

6. The AEBS function should be permanently available wherever possible. Case-by-case deactivation of the AEBS functionality by drivers should be heavily restricted and the functionality should be quickly reactivated, either automatically or manually.

7. Only "positive actions" by the driver should be permitted as a means of overriding (interrupting) emergency braking interventions that are perceived as incorrect/unnecessary by the driver. For fast motorway driving, the kick-down of the accelerator pedal should be listed as an example of a "positive action" in Regulation No. 131. Manufacturers may also want to implement a helpful and appropriate steering intervention before reaching the "Last Point to Steer" as a positive action, if the validity of such an intervention is verified. Interruptions of the AEBS through steering movements that are less positive or "actuation of the direction indicator" should only be allowed at low speeds in urban traffic and should be standardised by manufacturers as much as possible.

Findings from accident statistics and justification for the recommendations

Through a statistical evaluation of the accidents caused by goods road transport vehicles and buses registered in Germany involving personal injury and significant property damage on federal motorways between 2009 and 2018, the BASt research report 13/21 shows a significant sta-

tistical effect of approximately 37% for the new vehicles registered between 2016 and 2018, i.e. the vehicles equipped with early AEBS as standard, in relation to the number of forward collisions.[4]

According to relevant media research performed by specialist journalist Jan Bergrath, 45 truck drivers died in forward collisions involving goods transport road vehicles in 2019, 48 died in 2020 and 44 have already died in the first half of 2021. These figures include vehicles with and without AEBS functionality.[5]

In collaboration with the Lower Saxony Ministry of the Interior, the Regional Road Safety Association performed single-case analyses of accidents on motorways in Lower Saxony involving goods road transport vehicles registered in Germany and overseas with a maximum authorised mass (MAM) >7.5 tonnes between 2015 and 2020 in which serious personal injury (death/serious injury) occurred. These analyses showed a significantly subproportional rate of forward collisions among goods road transport vehicles equipped with AEBS functionality compared to older goods road transport vehicles without AEBS functionality.[6] This points towards a significant reduction in serious forward collisions.
Nevertheless, despite more vehicles being equipped with AEBS, the percentage of accidents involving a goods road transport vehicle driving into the back of another vehicle did not decrease, but rather remained at about the same level (40% in 2015, 38% in 2020). The absolute number of such forward collisions increased up to 2018 and only began to decrease in 2019 and 2020.
The percentage of forward collisions involving vehicles with AEBS functionality increased from 11% in 2016 to 35% in 2020 as more vehicles were equipped with AEBS; see Figure 1. This includes one to four deaths and seven to 24 serious injuries.

The 51 forward collisions involving trucks (38% of 133 serious accidents) from 2020 that were subjected to an in-depth analysis – 18 of which (35% of 51) involved trucks that were proven to be fitted with AEBS as standard – have the following characteristics:

- Disproportionately large percentage of deaths with 45% vs 38%
- More than 65% of the vehicles that were crashed into (1.) were heavy articulated trucks

[4] BASt research report 13/21: Fewer forward collisions on federal motorways thanks to advanced emergency braking systems in trucks

[5] Jan Bergrath, Dieter Schäfer: https://www.bghw.de/e-magazin/bewusstsein-fuers-risiko?fbclid=IwAR0oA-iEXsNIjrI5Mx2-R6KhRQoSwByFa2AgBrrAs-TIz3iCFgDDkV2FDh2I, June 2021

[6] Petersen et.al.: Notbremsassistenzsysteme im Lkw – eine Analyse niedersächsischer Autobahnunfälle in den Jahren 2015 bis 2019 und der Einfluss aktueller Systeme (Advanced emergency braking systems for trucks – An analysis of truck accidents on Lower Saxony's motorways from 2015 to 2019 and the influence of current systems). ZVS 04-2020, and an as yet unpublished analysis of accidents on federal motorways in 2020

- 39% of the vehicles that were crashed into from behind were still moving when the collision occurred, and two thirds of these (25%) had braked heavily – mostly due to traffic with lots of goods road transport vehicles
- More than 50% of the vehicles that were crashed into were already stationary and at the back of a traffic jam or similar
- An additional 10% were stationary vehicles that had broken down or construction/service vehicles
- 14% of the accidents involved a goods road transport vehicle driving into the back of a stationary vehicle without braking, 8% with AEBS.

Goods road transport vehicles from all vehicle brands were involved in the forward collisions involving goods road transport vehicles with AEBS in 2018, 2019 and 2020. The percentages from 2019/2020 displayed positive effects compared to earlier years resulting from improved AEBS generations and decisions to equip vehicles with more effective AEBS.

A single-case analysis of the forward collisions in 2019 based on the methodology of Research Association for Automotive Technology (FAT) working group 22 predicts that an accident prevention/minimisation potential of around 40% could be achieved if all vehicles used for long-distance transport were fitted with modern AEBS. However, if the future advanced emergency braking systems are improved in line with the recommendations above, the potential could be increased to over 50%.

The accident analysis demonstrates that in addition to the situation involving pedestrians crossing in front of a truck in motion, which is taken into account in the “vehicle to pedestrian” scenario, the situation involving pedestrians crossing directly in front of a stationary truck represents a relevant pedestrian accident scenario in urban areas. This accident situation is addressed in the pending UN Regulation No. 159 with a Moving Off Information System (MOIS). This is a system that issues a warning but does not actively intervene. Against this background, it should be evaluated whether this situation could be incorporated into the “vehicle

to pedestrian” scenario in the new Regulation No. 131 for the development of future emergency braking systems that would prevent the truck from moving off in this situation.[7]

Explanation for points 5 and 7

In accordance with § 3 of the German Road Traffic Regulations, a person operating a vehicle may only travel at a speed that allows them to be in constant control of their vehicle. It also states that their speed must be such that they can stop within their forward range of vision. This requirement for drivers should also serve as a point of orientation for driver assistance systems, in this case, advanced emergency braking systems. This means that an advanced emergency braking system should be able to help a driver who may not be paying attention to bring the vehicle to a stop from the permitted driving speed before colliding with the vehicle in front.

With the UNECE Regulation No. 131 approval regulation – which has been in force for six years and represented the first legislation that made the inclusion of advanced emergency braking systems a legal requirement for N2/N3 and M2/M3 vehicles with MAM of 8 tonnes or more – very conservative requirements were selected for speed reductions when approaching a stationary target, with a figure of ≥20 km/h. The current revision of Regulation No. 131 stipulates an increase to ≥70 km/h for M3 and N3 vehicles in the “vehicle to vehicle” scenario. This means that the same speed differences apply for collision prevention with both stationary and moving vehicles ahead ($\Delta v \geq 70$ km/h).

These newly conceived requirements for deceleration represent minimum requirements with the aim of achieving UNECE-wide technology neutrality and thereby enabling optimum market access for advanced emergency braking systems. This consensus is based on computational considerations of the (time) distance for a “Last Point to Steer” (LPS) and the resulting “Last Point to Brake” (LPB) of the AEBS emergency braking. On this basis, in the case of actual starting speeds of close to 90 km/h (N3) or 100 km/h (M3), very high values of 42 to 54 km/h are calculated for the “permitted” collision speeds; see Table 1.

In contrast to the swerving ability of passenger cars, dynamic swerving manoeuvres on motorways in heavy goods road transport vehicles are very challenging even for professional drivers due to the high centre of gravity and the risk of overturning. In addition, performing such swerving

[7] UDV Compact Accident Research No. 94, 11/2019: Accidents involving trucks colliding with pedestrians or cyclists

manoeuvres on busy motorways poses significant risks for other drivers – who are usually less skilled – in the lane that is being swerved into. Therefore, at high speeds, the reduction of kinetic energy through prompt initiation of emergency braking by the driver or the AEBS is much more effective than attempting to perform a swerving manoeuvre, especially in the heavy traffic situations that are so prevalent in truck forward collision incidents. Therefore, we recommend that heavy braking should be initiated first and then a swerving manoeuvre should only be initiated at low speeds if this is still necessary after heavy braking. Because the relevant goods road transport vehicles are always also equipped with ABS and/or ESP, a braking intervention that has already been initiated by the AEBS can and should be maintained during a swerving manoeuvre at a high speed and should not be interrupted by a steering action alone[8].

However, if the UNECE AEBS-HDV working group chooses to stick to the principle of "emergency braking at the latest when a swerving manoeuvre is no longer possible", then the threshold value calculations for goods road transport vehicles and trains and for buses driven by (untrained) professional drivers should be based on manageable framework conditions (trajectories that are realistic with regard to driving dynamics, for example, a curved sine wave, lane offset in accordance with the width of the truck, etc.). This results in greater distances being calculated and can provide crucial extra metres for a last point to steer, thereby enabling higher speed differences for collision-free AEBS emergency braking; see Table 2.

For the committee:

Signed

Jürgen Bönninger
Chair of the
Executive Committee for Automotive Engineering

[8] Berg and Petersen: Erweiterte Betrachtungen zum Umgang mit automatischen Notbremssystemen und deren Auslegung (Extended considerations on the handling and design of automatic emergency braking systems). VKU Verkehrsunfall und Fahrzeugtechnik, Oct., Nov., Dec. 2020

Appendices

Figure 1:

Trends of accidents in Lower Saxony on federal motorways involving serious personal injury and goods road transport vehicles since 2008 and forward collisions since 2015 with current AEBS functionality and without AEBS functionality

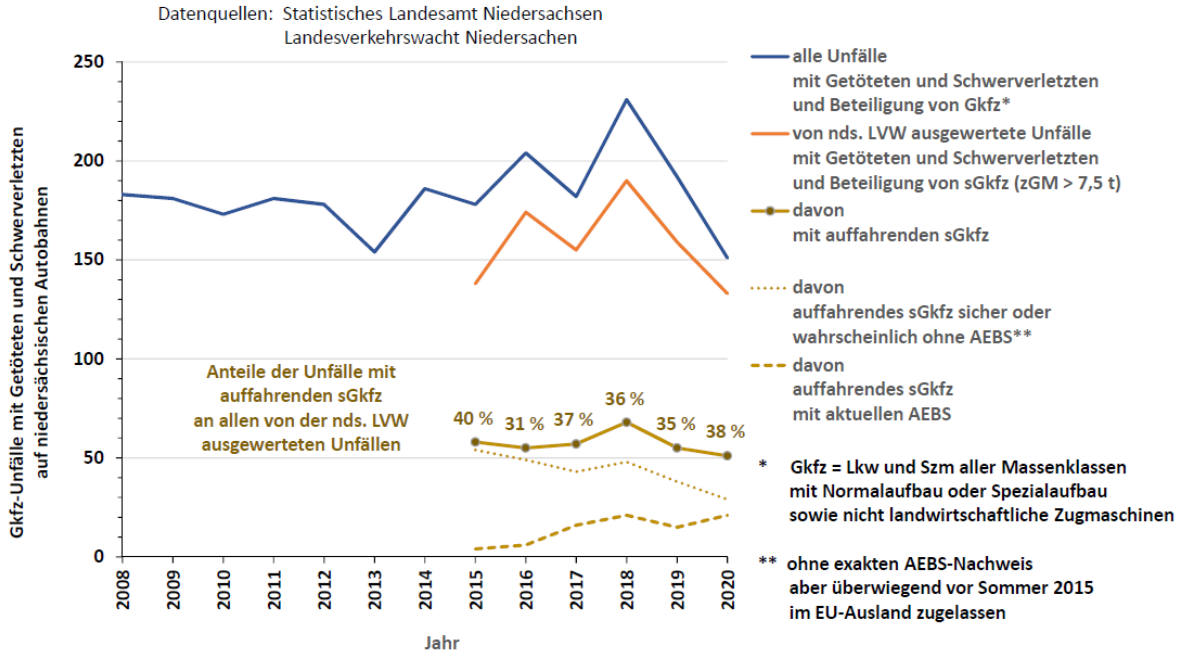

Table 1:

Maximum relative impact speed (km/h)
(not taking into account whether the target was stationary or in motion)

Values according to UNECE proposal from 02/07/2021; values not supported by DVR

Relative speed (km/h)	*M_2 N_2*			*M_3 N_3*
	Vehicle derived from M1/N1	*Vehicle derived from M3/N3 & pneumatic brake*	*Vehicle derived from M3/N3 & hydraulic brake*	*All load conditions **except those specified in paragraph 5.1.8**.*
10	0	0	0	0
20	0	0	0	0
30	0	0	10	0
40	0	0	23	0

50	**0**	0	34	0
60	25	0	45	0
68	35	**0**	53	0
70	37	11	55	**0**
80	49	31	66	28
90	60	44	76	42
100	71	57	86	54

Note: M3/N3 values based on $d_{Braking}$ = -7 m/s² and $TTC_{Braking}$ = 1.73s
Design of the braking deceleration based on the “Shark Fin” curve

Table 2:

Maximum relative impact speed (km/h)
(not taking into account whether the target was stationary or in motion)

DVR recommendation for corresponding table in UNECE Regulation No. 131

Relative speed (km/h)	**M_2 N_2 Vehicle derived from M1/N1 acc. to Reg. No. 152**	**M_3 and M_2 Vehicle derived from M_3 and pneumatic brake**	**N_3 and N_2 Vehicle derived from N_3 and pneumatic brake**
		All load conditions except those specified in paragraph 5.1.8.	
10	0	0	**0**
20	0	0	**0**
30	0	0	**0**
40	0	0	**0**
50	**0**	0	**0**
60	25	0	**0**
68	35	0	**0**
70	37	**0**	**0**
80	49	**0**	**0**
88		**0**	**0**
90	60	**0**	**12**
100	71	**0**	**34**

Note: M3/M2 values based on $d_{Braking}$ = -7 m/s² and TTCBraking = 2.33 s
N3/N2 values based on $d_{Braking}$ = -6 m/s² and TTCBraking = 2.33 s
Design of the braking deceleration based on the “Shark Fin” curve