

## **Increasing the safety of coach passengers**

### Resolution taken on 6<sup>th</sup> November 2018

based on the recommendation by the Executive Committee  
Vehicle Engineering

#### **Explanation**

For more than 20 years the number of fatalities for bus passengers in Germany has been within a one or two-figure range (see Annex 1). However, this number fluctuates widely and in some years is determined by a single serious coach accident with a large number of victims<sup>1 2</sup>. In the context of Vision Zero, a current aim is to further reduce the number and consequences of severe bus accidents. The number of bus passenger casualties is very constant and in the past two decades was between 5,000 and 6,000, whereby almost all of the victims were due to accidents with local public transport buses, mainly with slight injuries.

In comparison with other means of transport, buses are very safe; fewer average fatalities are only found for rail and air travel<sup>3</sup>.

According to the official statistics<sup>1</sup> passenger cars are the most frequent collision opponents of buses, followed by goods vehicles. Single vehicle accidents with buses involving personal injuries account for 10% of the corresponding bus accidents. The greatest hazard for bus passengers is due to collisions with heavy opponents (e.g. goods vehicles), rigid objects (e.g. walls of buildings) and accidents in which the bus falls on its side or overturns. This is confirmed by many national and international studies<sup>4 5</sup>. Bus accidents end especially tragically if they occur in combination with vehicle fires (e.g. 2017 accident on the A9,

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<sup>1</sup> Statistisches Bundesamt [German Federal Statistical Office] (2016): Unfälle von Bussen im Straßenverkehr 2015. [Bus accidents in road traffic 2015.] Statistisches Bundesamt, Wiesbaden 2016.

<sup>2</sup> A. Berg (2017): Statistische Unfallauswertungen auf der Basis des Statistischen Bundesamtes. [Statistical evaluation of accidents on the basis of statistics from the German Federal Statistical Office].

<sup>3</sup> Vorndran, I.: Unfallstatistik – Verkehrsmittel im Risikovergleich [Accident statistics - risk comparison for means of transport], Statistisches Bundesamt, Wiesbaden 2011.

<sup>4</sup> König, Th., Strzeletz, R., Hummel, Th., Kühn, M., Bende, J. (2012): Untersuchung zur Insassensicherheit und aktiven Sicherheit von Kraftomnibussen auf Basis des Schadensgeschehens der Deutschen Versicherer [Investigation of Passenger safety and active safety of motor buses on the basis of damage claims of German insurers], Forschungsbericht FS 05, Unfallforschung der Versicherer (UDV) [German Insurers Accident Research], Berlin 2012.

<sup>5</sup> ECBOS (2003): European Commission 5<sup>th</sup> Framework Enhanced Coach and Bus Occupant Safety (ECBOS) – Final Published Report, 2003.

2015 accident in Puisseguin, Southern France). However, fires without a previous collision can be a considerable hazard for bus passengers (e.g. 2008 on the A2 near Hannover). There were several fatalities in these coach accidents.

A further topic area is the injury of bus passengers in local public transport as a result of driving manoeuvres (starting, evasive actions, braking) and when alighting or departing, known in the literature as "Non-Collision Events". In the accident research study by the German Insurers Accident Research<sup>4</sup> it was found that the cost of damages for non-collision events was on average approximately the same as for bus accidents involving collisions. However, fatalities are extremely rare in the case of non-collision events.

In addition to technical questions relating to the vehicle, bus accidents include a wide range of other topics, e.g. the safety of unprotected road users in case of collisions with buses, infrastructure measures (e.g. bus stops) behaviour-oriented aspects (e.g. wearing of seat belts by passengers, behaviour of students in school bus transport), etc. However, these do not form the focus of this Board resolution.

Rather, this resolution concentrates on technical measures on and inside coaches, in order to increase passenger safety. To achieve this aim, both active and passive safety measures and combinations of these are necessary. In addition there are measures to prevent fires and for the rapid evacuation after collisions and/or in case of bus fires.

#### Active safety (accident prevention)

In addition to vehicle dynamics control systems (ABS, ASR, ESP) emergency braking assistance systems and lane departure warning systems have the greatest potential for preventing accidents and reducing their consequences<sup>6</sup>. Manually activated distance warning systems and distance regulation systems can help bus drivers to keep a safe distance and to initiate precautionary braking if necessary. Especially as official statistics show that insufficient distance is the most frequent cause of accidents. The legally prescribed emergency braking assistance systems (AEBS) for heavy goods vehicles and buses give a warning and react automatically in case of emergency. The DVR has

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<sup>6</sup> Hummel, Th., Kühn, M., Bende, J., Lang, A. (2011): Fahrerassistenzsysteme – Ermittlung des Sicherheitspotenzials auf Basis des Schadengeschehens der Deutschen Versicherer [*Driver assistance systems - determination of safety potential on the basis of damage claims to German insurance companies*]. Research report FS 03, Unfallforschung der Versicherer [German Insurers Accident Research] (UDV), Berlin 2011.

already formulated a resolution<sup>7</sup> regarding emergency braking assistance systems for trucks and buses, which is again referred to here. In contrast, lane departure warning systems only give a warning and require a response by the driver (Regulation 661/2009/EU and 347/2012/EC as well as UNECE Regulations 130 and 131). For this, it should be noted that their function should be extended to include active lane tracking.

#### Passive safety (reduction of the consequences of accidents)

It does not appear possible to further improve the crash safety of buses in all circumstances (e.g. bus-truck collisions) with justifiable means, in contrast to the case of accidents where the bus tips over. Here, it must be ensured that the survival space of the bus remains intact (UNECE-R 66) and that no passengers can come into contact with the road. In general, passengers wearing seat belts must be held in their seats (UNECE-R 14, 16, 17, 80). Wearing of seatbelts by bus passengers is considerably less than e.g. in cars and must be improved. Older, and therefore possibly no longer up-to-date studies, indicate that only 25% of passengers wear seat belts<sup>8</sup>.

#### Bus fires

In the past, bus fires occurred most frequently (76%) due to fires in the engine compartment<sup>9</sup>. Due to the legislation which has been introduced (smoke alarms in separate compartments, fire alarms, extinguishing systems in engine compartments) above all, the number of engine compartment fires should be reduced. However, bus fires due to collisions must remain in focus. By protection of the fuel tank and safe location of possible sources of ignition (e.g. battery, switchboard) it should be ensured as far as possible that fires do not occur due to collisions.

If a fire occurs in spite of this, it should spread as slowly as possible and it must be largely ensured that during the time which is relevant for evacuation, as few toxic gases as possible and only small amounts of

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<sup>7</sup> DVR Board resolution "Advanced Emergency Braking Assistance Systems for Commercial Vehicles" (09.09.2016)

<sup>8</sup> Bach, P., Bahlmann, N. (2008): Sicherheit von Reisebussen - Strukturfestigkeit des Aufbaus und das Gurtanlegeverhalten der Insassen [*Safety of coaches - Structural strength of the superstructure and seat belt wearing behaviour of passengers*], DEKRA/VDI - Symposium Sicherheit von Nutzfahrzeugen in cooperation with the Vieweg Technology Forum Neumünster (Schleswig-Holstein) 9 and 10 October 2008.

<sup>9</sup> Study on smoke production, development and toxicity in bus fires. Report by the Bundesanstalt für Straßenwesen [*Federal Highway Research Institute*], Fahrzeugtechnik [*Vehicle Technology*], issue F 99

smoke are produced. A DEKRA study commissioned by the BAST<sup>10</sup> shows that fires in the interior of buses are especially dangerous due to the rapid spread of fire and smoke.

On the basis of the fire near Hannover in 2008, various changes were made to the relevant UNECE fire protection regulations, in particular UN-R No. 107 "Uniform provisions concerning the approval of category M<sub>2</sub> or M<sub>3</sub> vehicles with regard to their general construction" and UN-R No. 118 "Uniform technical prescriptions concerning the burning behaviour and/or the capability to repel fuel or lubricant of materials used in the construction of certain categories of motor vehicles", which now form the basis for the design of buses (see Annex 2).

## Resolution

Even now, coaches are a very safe means of transport. However, there are technical possibilities to further improve the present level of passenger safety. The DVR therefore suggests the following measures:

- Robust, highly effective, if possible permanently active emergency braking assistance systems, which could also prevent collisions with stationary vehicles/objects, as standard equipment for coaches.
- Supplementation of equipment standards with an advance distance warning function.
- Equipment of buses with active lane keeping assistant systems and creation of the necessary regulatory framework for this.
- Development of technical systems which prevent bus passengers from coming into contact with the ground (e.g. road) if the bus tips over or overturns.
- Analysis of the present use and optimisation of current passenger restraint systems as well as the development and implementation of technical measures to increase the proportion of wearers.

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<sup>10</sup> Egelhaaf M. et al. (2004): Fire behaviour of coach interiors. Reports, research project commissioned by the BAST (BAST report "Vehicle technology" Volume F 51), ISBN: 978-3-86509-161-1, Verlag für Neue Wissenschaft

- Protection of the fuel tank against damage in collisions and the safe location of possible sources of ignition.
- Updating of the requirements for the flammability of materials and components in bus interiors, in particular the requirements for maximum smoke density and toxicity of combustion gases.
- Further optimisation of evacuation facilities.
- Training of driving personnel with regard to the function, use and limits of technical safety systems.

Signed

Dr. Walter Eichendorf  
President