

New side airbag from ZF LIFETEC can increase the crumple zone in the passenger compartment

- **Increased protection in the event of side collisions**
- **Two-stage side airbag creates additional distance between occupants and door milliseconds before an impending crash**
- **Airbag uses pre-crash sensors from car manufacturers**

A two-stage side airbag from ZF LIFETEC uses the milliseconds before an unavoidable crash to build up valuable distance and better protect the occupants. The Pre-Crash Dual Stage Side Airbag (Dual Stage SAB) triggers its first stage around 200 milliseconds before the collision and pushes the occupants a few centimeters into the vehicle interior, away from the expected impact point. Thanks to this gain in space, the actual side airbag with the second stage can develop its full protective effect during the collision.

According to Euro NCAP, side collisions account for around a quarter of all accidents in Europe. The association also states that side collisions are the second most common cause of death and serious injury. The reason for this is that there is little crumple zone available in the event of a side impact, which can lead to deep intrusions (penetrating deformation of the occupant cabin). Serious injuries to the head and chest are therefore common. Furthermore, side impacts are not necessarily associated with accidents involving two cars; for example, in the pole impact scenario, cars collide with trees, pillars or lamp posts after skidding sideways, can also lead to significant injuries to vehicle occupants.

60 millimeters can save lives

“We are developing the Pre-Crash Dual Stage Side Airbag because we are convinced that in the event of a side impact, the milliseconds before an unavoidable crash are a major safety advantage,” explains Harald Lutz, Senior Vice President Global Engineering at ZF LIFETEC. “Our pre-crash function offers the opportunity to create valuable space that the subsequent side airbag can use for optimum protection.”

For the pre-crash function, ZF LIFETEC uses the vehicle's existing signal acquisition system. This gives vehicle manufacturers the option of integrating the system into their sensor infrastructure. After a corresponding signal detects an unavoidable collision, the first stage of the Dual Stage SAB is triggered 200 milliseconds before the calculated crash scenario. As an additional function of the side airbag, this air cushion pushes the occupants around 60 millimeters towards the inside of the vehicle - i.e., away from the doors - before the second stage of the side airbag and other restraint systems such as airbags and belt tensioners are triggered by

the actual impact. The space created by the first stage of the Dual Stage SAB is used by the second stage with the classic side airbag, which has already positioned itself correctly and now inflates between the occupants and the intruding door.

Two inflators, one cushion

To ensure controlled management of the individual stages, ZF LIFETEC uses two inflators to fill the two-part cushion. A hybrid inflator brings the airbag into position and fills the pre-crash chamber of around 20 liters before the actual impact. The chamber is filled slowly in 30 milliseconds, as it moves people away from the accident as continuously as possible. Another, exclusively pyrotechnic inflator fills the 18-liter second chamber of the airbag within 10 milliseconds shortly after the impact. To avoid a pressure conflict between the two chambers, the pre-crash chamber, which is filled first, is vented again via a trigger flap. The second chamber, which represents the classic side airbag, then has a significantly larger space available and can offer improved protection in the direction of the penetrating vehicle side parts.

The pre-crash chamber is therefore an add-on function that helps to optimize the effect of the side airbag. The system is designed to function like a conventional side airbag in the event of an accident if the car's electronics do not detect a pre-crash signal.

ZF LIFETEC plans to develop the Pre-Crash Dual Stage Side Airbag to application maturity within the next few years. The system has already proven its functionality in several tests, including sled tests, which took a closer look at the complex pole impact scenario. In further development steps, ZF LIFETEC will continue to refine the interaction between the pre-crash and side airbags. The design for different occupant sizes also plays a role here, as does the effect in different seating positions - such as the comfort position during highly automated driving.

The pre-crash dual stage side airbag is integrated into the seat and can be implemented in all vehicle classes, provided the sensor technology required for the pre-crash function is available. "The Euro NCAP Roadmap 2030 already lists pre-crash functionalities. It is foreseeable that cars equipped with our technology will receive a corresponding plus in the rating," said Lutz.

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About ZF LIFETEC

ZF LIFETEC is a leading passive safety technology provider for enhanced protection of vehicle occupants. Employing around 36,000 employees dedicated to the mission of saving lives with a technology driven approach, the company develops, manufactures and distributes a comprehensive product portfolio including airbag, seat belt and steering wheel systems, covering a wide range from small vehicles in the volume segment up to sophisticated luxury vehicles. Featuring a market share exceeding 20 percent in its core product categories, ZF LIFETEC has a worldwide presence at 51 locations across 22 countries. In the fiscal year 2023, the Group generated sales of EUR 4.6 billion. Based on its strong relationships with a diversified customer base of global OEMs, driven by outstanding quality, long-standing R&D collaborations besides a strong global innovation platform, ZF LIFETEC is well positioned for future growth opportunities arising from the automotive megatrends electrification, (semi-) automated driving, smart interior, as well as increasing safety demands and stepped-up safety regulations worldwide.

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