Rethinking Safety: Four Advanced Airbags Protect Comfort Seating Positions

- **New airbag concept from ZF LIFETEC enhances protection in highly reclined seating positions – four airbags protect the head, pelvis and legs while reducing the risk of submarining under the seatbelt**
- **All modules will be series-ready as of 2028**
- **"With intelligently networked airbag systems, we stabilize occupant motion and specifically reduce the risk of submarining in the unlikely event of an accident," says Harald Lutz, Senior Vice President Engineering at ZF LIFETEC**
- **Company presents the occupant protection concept at the leading event AIRBAG 2026 from December 8th to 10th in Mannheim, Germany**

Alfdorf, June 25th, 2026 +++ ZF LIFETEC, a global leader in passive safety systems for passenger cars, has developed an advanced airbag concept designed for comfort-oriented seating positions with increased seatback recline. The system combines four airbags to protect the head, pelvis, and legs and can also significantly reduce the risk of the so-called "submarining" (the occupant sliding under the seatbelt). All modules are scheduled to be ready for series production in 2028 and will contribute to enhanced safety in both automated and conventional driving.

Conventional seating positions are based on an upright posture. However, with increasing vehicle automation and rising comfort expectations, strongly reclined seating positions are becoming more important. These positions alter occupant motion during a crash and create new requirements for restraint systems. "Comfort seating positions fundamentally change occupant biomechanics in a crash. Our holistic protection concept addresses these changes directly. With intelligently networked airbags, we stabilize occupant motion and specifically

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reduce the risk of submarining in the unlikely event of an accident," says Harald Lutz, Senior Vice President Engineering at ZF LIFETEC.

Holistic Protection for Comfort Positions

A key role in preventing submarining is played by the **Seat Ramp Airbag**, integrated beneath the seat cushion. In the event of a crash, it limits pelvis forward travel, effectively reducing the likelihood of the occupant sliding under the seatbelt.

The **Dual Contour Knee Airbag**, positioned in front of the knees, deploys almost simultaneously and guides the knees and thighs to stabilize occupant position. Its deployment volume adapts to seat position and seatback angle – smaller in standard seating, significantly larger in comfort or relaxed positions. This additional support helps control pelvis positioning and enhances the effectiveness of the front airbag.

The **Active Heel Airbag**, located in the footwell, improves foot coupling to the vehicle floor, especially at greater distances in comfort or relaxed seating. It provides a stable support point for the heels and prevents the legs from sliding forward or upward in a crash. As a result, knee positioning is stabilized, the risk of submarining is reduced, and the likelihood of foot and ankle injuries, such as impacts with pedal structures, is minimized.

The **Dual Contour Airbag**, integrated into the steering wheel and instrument panel for driver and passenger, adapts its volume to the upper body position. At larger distances, such as in comfort seating positions, it deploys with greater volume to ensure optimized energy absorption and support, improving protection for the head and upper body.

Together, these four airbags address a wide range of injury mechanisms, from pelvis instability and leg guidance to head and upper body loads. As part of a holistic occupant

protection concept, they are complemented by adaptive seatbelt systems, enabling coordinated protection performance, particularly in comfort and relaxed seating positions.

Adaptive Safety Through Intelligent Sensor Technology

Deployment and control of the airbag systems can be managed by a smart safety algorithm using camera-based occupant sensing, seatbelt webbing extraction sensor, seat angle detection, seat adjustment data, or a comfort mode switch – depending on availability and vehicle specific use case definition. This enables an adaptive airbag deployment strategy for both driver and passenger.

“Submarining”: When Comfort Seating Changes Everything

In upright seating positions, the seatbelt fits closely to the upper body and pelvis. In a crash, the pyrotechnic belt pretensioner tightens the slack in the lap belt. At the same time, the retractor locks the belt, preventing further payout. This ensures controlled restraint of the upper body. In a frontal crash, the occupant is then transferred in a controlled manner to the front and knee airbags.

In comfort seating positions, the seatback is significantly reclined and the legs are extended into the footwell. In an accident, both force distribution and occupant motion change significantly. The seatbelt often no longer fits optimally across the chest and pelvis. Reduced fixation of the pelvic bone increases the risk of abdominal and pelvic injuries, as the belt may slide into the abdominal area.

At the same time, airbag effectiveness is delayed because the upper body and head are positioned farther away from the airbag modules and make contact later.
The lack of stable foot support on the vehicle floor additionally increases the likelihood of uncontrolled leg movement, raising the risk of knee and ankle injuries.

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To address these biomechanical challenges, ZF LIFETEC has developed advanced safety systems, which enable improved occupant protection even in comfort seating positions – including the Seat Ramp Airbag, Active Heel Airbag, Dual Contour Knee Airbag, and Dual Contour Airbags for driver and passenger.

Presentation at AIRBAG 2026

The occupant protection concept, comprising the Dual Contour Airbag for driver and passenger, Seat Ramp Airbag, Dual Contour Knee Airbag, and Active Heel Airbag, is part of the innovation portfolio that ZF LIFETEC will present at AIRBAG 2026 (December 8–10, 2026 in Mannheim, Germany). The international event is a key platform for passive safety, bringing together car manufacturers, suppliers, research institutions, and regulatory bodies.

Caption:

3D simulation: In comfort seating positions, the risk of sliding under the seatbelt in a crash increases. ZF LIFETEC's four coordinated airbags stabilize the occupant and significantly reduce the risk of severe injury.

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About ZF LIFETEC

ZF LIFETEC is a leading passive safety technology provider for the enhanced protection of vehicle occupants. Employing around 34,000 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 48 locations across 21 countries. In 2025, the Group generated sales of EUR 4.7 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 the 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.

Learn more at www.zf-lifetec.com

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