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## 25 years of Bosch ESP®: no more skidding Breakthrough for road safety

May 19, 2020

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- ▶ In the EU alone, the electronic stability program has saved some 15,000 lives.
- ▶ Worldwide, 82 percent of all new passenger cars feature the anti-skid system.
- ▶ Harald Kroeger: “The development of ESP® was a milestone on the path to our ‘vision zero’ of no more road deaths.”

Stuttgart, Germany – A wet road and a sudden evasive maneuver: there was a time when such a situation would frequently have ended in a ditch or against a crash barrier, and not rarely with fatalities or severe injuries. Almost 25 years ago to the day, a remedy was finally provided in the shape of a pioneering invention – the ESP® electronic stability program that Bosch and Daimler-Benz first launched in S-class vehicles in 1995. Since then, ESP® has been keeping vehicles safely on track, also in critical situations. Bosch accident researchers estimate that in the EU alone, the anti-skid system has saved some 15,000 lives over the past 25 years, as well as preventing just under half a million accidents involving personal injury. Together with the seatbelt and airbag, ESP® is one of the most important life-savers in a vehicle. “The development of the electronic stability program was a milestone on the path to our ‘vision zero’ of no more road deaths,” says the Bosch board of management member Harald Kroeger. “ESP® is an outstanding example of what we mean by ‘Invented for life.’” The innovation may be from 1995, but there is nothing dated about it: Bosch has continuously improved its anti-skid system, and produced more than 250 million ESP® systems to date. Modern cars are inconceivable without this electronic guardian angel. Worldwide, 82 percent of all new vehicles are equipped with ESP®. In 2016, this figure was 64 percent.

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### **ESP® can prevent up to 80 percent of all skidding accidents**

Especially when roads are wet or icy, when evading unexpected obstacles such as animals on the road, and also when driving into a bend too fast, the electronic stability program intervenes. With ESP® on board, up to 80 percent of all skidding accidents can be prevented. It combines the functions of the ABS antilock braking system and the TCS traction control system, but can do considerably more. It also detects vehicle skidding movements, and actively counteracts them.

The anti-skid system uses information about vehicle dynamics to detect whether the car is heading in the direction the driver is steering. If there is a discrepancy between these two factors, ESP® intervenes. This may sound simple, but is in fact a complex process. Smart sensors help compare steering angle and vehicle trajectory 25 times a second. If the two diverge, ESP® reduces engine torque and brakes individual wheels. In this way, the system helps the driver prevent the vehicle from breaking away or skidding – effectively nipping many accidents in the bud.

### **Breakthrough following the elk test**

The story behind this achievement is a long one. It started in the 1980s with initially independent efforts by Bosch and Daimler-Benz to achieve more vehicle stability. From 1992 until market launch, experts from the two companies worked together in a project unit. The legendary elk test of 1997 helped the system achieve a breakthrough: during tests for a Swedish automotive magazine, a Mercedes Benz A-class tipped over when making an abrupt evasive maneuver. Mercedes-Benz responded by making ESP® standard equipment. Since that time, more and more vehicles of many different automakers have adopted the anti-skid system.

Fewer accidents, fewer injuries, fewer fatalities – legislators have also recognized the benefits of ESP® and made it a mandatory feature of vehicles in many parts of the world. In the EU, the mandating process was gradual. From November 2011, it was initially mandatory for new passenger-car and commercial-vehicle types, and from November 1, 2014, for all newly registered passenger cars and commercial vehicles. And also in Argentina, Australia, Brazil, Canada, China, Ecuador, Israel, Japan, Malaysia, New Zealand, Russia, South Korea, Turkey, and the United States, the anti-skid system is either legally mandated or a self-imposed commitment. Experience from Europe shows that if the proportion of vehicles featuring the system rises, accident numbers fall.

## **Basis for automated driving**

“ESP® has taken road safety to a new level,” Kroeger says. And it has done so across a diverse range of vehicle types. Bosch offers customized ESP® systems for all powertrain types, from combustion engines to electric motors, and for vehicles of all kinds, from micro cars to commercial vehicles. Even for motorized two-wheelers, the company has developed a kind of ESP®. The MSC motorcycle stability control that Bosch launched in 2013 ensures the best possible stability in all riding situations, and is a further pioneering road-safety achievement.

At the same time, ESP® is the basic technology for many driver assistance systems, as well as for the automated driving with which Bosch is pursuing its vision zero. “Whether new or tried and tested, Bosch technologies alert and support drivers in critical situations. And increasingly, they are in a position to assume monotonous and fatiguing tasks. This gives us an opportunity to further reduce the number of accidents and road deaths,” Kroeger says. Whether with or without a driver at the wheel, Bosch will be nipping accidents in the bud in the future as well.

**Press photos:** #2978892, #2978893, #2978894, #2982730, #2978896, #2978897

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## Staying on track

### Milestones from 25 years of ESP® at Bosch

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Just under half a million accidents involving personal injury avoided and 15,000 lives saved in the EU alone – this is the track record of ESP®, first launched in 1995. The story behind this achievement is one that began more than 25 years ago. The following text present the milestones in the development of the electronic stability program at Bosch:

**1983:** Bosch researchers float some first ideas about how to improve stability when braking hard in bends. They base their ideas on the ABS antilock braking system launched in 1978. An initial proposal is to flexibly adapt each wheel's slip to improve control over the vehicles when braking in bends.

**1984:** Effective July 1, a development team is set up. Its task is to use ABS as the basis for developing a brake control system offering improved vehicle control when skidding is imminent in a bend. In such a situation, the vehicle has to remain stable and steerable as far as the laws of physics will allow.

**1992:** A joint project unit is set up near the Bosch location in Schwieberdingen. It is made up of engineering experts from Bosch and the automaker Daimler-Benz, which is subsequently the first to install the system. An agreement is made to develop a system for production in 36 months.

**1995:** ESP® has its press debut in a Mercedes-Benz S-class coupé in May, and its market launch in the coupé and sedan in September (as an extra, standard feature only with the most powerful, 12-cylinder engine).

**1997:** A Mercedes-Benz A-class vehicle rolls over while performing an extreme swerving maneuver during testing. The model was only recently launched. Following this “elk test” for a Swedish automotive magazine, the automaker decides to make ESP® a standard feature. Other automakers soon follow suit.

**1998:** For the first time, the yaw-rate sensor that is at the heart of the ESP® is produced as a micromechanical sensor. Bosch has been mass-producing these sensors with microscopically small movable structures since 1995. This means ESP® can be smaller, while at the same time longer-lasting, less sensitive, more reliable, and less expensive.

**2003:** Bosch celebrates the delivery of its 10 millionth ESP® system. The technology has now been in the market for ten years. In the years that follow, increasing volumes pave the way for this lifesaver to become established in the compact class.

**2011:** Traffic experts and policymakers increasingly acknowledge the benefits of ESP®. The anti-skid system is mandated in various countries, including EU member states. In the EU, the mandating process is gradual. From November 2011, it is initially mandatory for new passenger-car and commercial-vehicle types, and from November 1, 2014, for all newly registered passenger cars and commercial vehicles.

**2016:** In the Life Achievement category, the European Patents Office confers its European Inventor Award on Anton van Zanten. Born in the Netherlands, van Zanten headed up the 35-strong group of ESP® developers at Bosch.

**2020:** ESP® turns 25. Over the past quarter of a century, Bosch has continuously improved its anti-skid system, producing more than 250 million ESP® systems to date.

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## **From windshield wiper to e-bike ABS** Twelve Bosch innovations for more road safety

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ESP® – three letters that make all the difference. Since its debut in 1995, the electronic stability program has prevented skidding accidents and saved lives – year in and year out. With innovations such as ESP®, Bosch has been enhancing road safety for decades. Here, we present a selection:

### **1926: Windshield wiper**

Goodbye to poor visibility: comprising an electric motor that drove a rubber-coated arm via a worm screw and gear, the Bosch electric windshield wiper finally gave drivers a clear view of the road ahead. It was followed in 1959 by an electric windshield washer system. Activated at the push of a button, an electric pump precisely sprayed water on to the windshield through one or several nozzles that were mounted on the hood.

### **1927: Power-assisted brake for commercial vehicles**

In the years after 1900, vehicles became increasingly fast and powerful, but braking force was unable to keep up. This prompted Bosch to develop a pneumatic brake booster for heavy trucks, whose heavy loads meant especially long braking distances. The system used the vacuum that arises in the induction tract of the engine, so that only one-third as much pressure now had to be applied to the brakes.

### **1928: Bosch brake assistant**

Bosch also used this innovative brake technology, premiered in 1927, in passenger cars. There were two challenges: to achieve a compact design that would allow it to be installed in the tight space available in the engine compartment, and to make it more affordable. The technology became established as standard equipment. As in the case of the Bosch brake for trucks, drivers now only had to apply one-third of the pedal pressure, and braking distance was also reduced by one-third.

**1957: Asymmetric low-beam headlights**

In 1913, Bosch started production of a new automotive lighting system. The system comprised a generator, headlights, a battery, and a regulator. And while these lighting systems were continuously improved, they still had one disadvantage: they dazzled oncoming vehicles. The more cars there were on the roads, the more inconvenient and dangerous the situation became. In 1957, Bosch premiered asymmetric low-beam headlights. This system causes less dazzle for oncoming traffic and illuminates the driver's own side of the road better.

**1978: ABS antilock braking system**

Following nine years of development work, 1978 marked the start of the success story of ABS, the electronically controlled antilock braking system for four-wheeler passenger cars. If the wheels lock up, ABS reduces brake pressure then increases it again – up to 40 times a second. This keeps braking distances short, even on slippery surfaces, and the vehicle remains steerable. For motorcycles, the EU mandated the system for all new type approvals from 2016.

**1980: Electronic airbag control**

In 1980, Bosch was the first European company to manufacture electronic triggering units for passive safety systems. This set the standard in road safety. The triggering unit comprised three components made up of some 170 individual parts, and controlled the driver airbag. It was first installed in the Mercedes-Benz S-class. Up to nine airbags are installed in today's vehicles. They are deployed individually, depending on the accident scenario.

**1986: TCS traction control system**

The TCS traction control system prevents the driven wheels from spinning. The electronic control unit reduces the speed of the spinning wheels until they recover their grip. TCS is an early example of networking diverse automotive electronic systems. When traction control is activated, it intervenes in the engine management or brake control system. Despite actuation of the accelerator, engine power is continuously lowered, or the brake is actuated, until the wheels recover their grip. Traction control can also brake a wheel individually in order to divert engine power to another drive wheel if the latter offers better traction.

**1995: MEMS in mass production**

In the 1980s, Bosch worked on making sensors smaller, more reliable, and more energy efficient, as a way of providing ever more sensor data in cars. Following the start of mass production in 1995, these miniature helpers became ever more prevalent, furnishing control units with data about when the car brakes or

accelerates, as well as about the direction the car is traveling. Information such as this is important for safety systems such as ESP®.

### **1995: ESP® electronic stability program**

Using smart sensors, ESP® compares 25 times per second whether the car is actually moving in the direction that the driver is steering it in. If it is not, the system intervenes. By reducing engine torque and deliberately braking each wheel individually, the system helps the driver stabilize the vehicle and prevent skidding accidents. Since its market launch in 1995, ESP® has prevented just under half a million accidents and saved more than 15,000 lives in the EU alone. Bosch celebrates a milestone this year: it has sold 250 million ESP® systems since production began 25 years ago.

### **2010: Predictive emergency braking system**

Ever more sensors in cars, sharing information with each other, make completely new applications possible: the emergency braking system that went into production in 2010 makes use of the information radar and video sensors share with the ESP®. If there is a threat of collision, it offers drivers multi-stage support. First, it alerts to the need to brake hard. If this alert is not heeded, the system initiates partial braking, and if the driver still does not react, it triggers emergency braking.

### **2013: MSC motorcycle stability control**

In 2013, Bosch took its ESP® success story, which began in 1995, and applied it to two-wheelers. In all riding situations, MSC motorcycle stability control ensures maximum stability: when braking and accelerating, on straight stretches and in bends. Wheel sensors measure wheel speed, and a further sensor measures lean and pitch angles. If the system detects a wheel on the verge of locking up, braking pressure is lowered and built up again within a fraction of a second, ensuring that the correct amount of pressure is constantly applied to prevent each wheel from locking up. This can save motorcyclists' lives.

### **2018: eBike ABS**

Bosch has been manufacturing antilock braking systems for cars since 1978, and for motorcycles since 1995. They were joined in 2018 by an ABS for eBikes, which Bosch developed in collaboration with the brake manufacturer Magura. The world's first production antilock braking system for pedelecs reduces the risk of becoming unseated in critical situations. In this front-wheel ABS, the hydraulic brakes and electronic brake system are perfectly tuned to each other. Wheel-speed sensors monitor the speed of both wheels. As soon as the front wheel threatens to lock up, the system regulates brake pressure to optimize riding

stability. This is a huge added boost to rider safety. In addition, the rear wheel lift control function reduces the risk of a head-over-heels accident. If far too much brake force is applied, the ABS regulates the pressure applied to the front wheel, so that the rear wheel can quickly regain traction.

**Press photos:** #1289637, #2978903, #2978904, #2978892, #535658, #1138684

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## European Inventor Award goes to the father of ESP Retired Bosch associate Anton van Zanten honored for his life's work

June 9, 2016

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- ▶ Bosch CEO Dr. Volkmar Denner: "Anton van Zanten and his engineering colleagues are the guardian angels of many drivers."
- ▶ To date, ESP has saved more than 8,500 lives in Europe alone.
- ▶ After the seat belt, ESP is the most important vehicle safety system.
- ▶ Anti-skid protection already features in 64 percent of all new vehicles worldwide.

Stuttgart, Germany/Lisbon, Portugal – Today in Lisbon, Anton van Zanten was honored for his invention of the ESP electronic stability program with the 2016 European Inventor Award. The award, which is conferred by the European Patent Office (EPO), was presented to him in the "Lifetime achievement" category. The Dutch native developed the anti-skid system as the head of a 35-member research group at Bosch, during a career that spanned more than 25 years. The system was first featured as standard equipment in the Mercedes-Benz S600 in 1995. "Anton van Zanten and his engineering colleagues are the guardian angels of many drivers," said Dr. Volkmar Denner, the chairman of the board of management of Robert Bosch GmbH, in praise not only of the award-winner, but also of the team effort behind the innovation. "The invention of ESP stands for our 'Invented for life' ethos like few others," the Bosch CEO said. In Europe alone, ESP has saved more than 8,500 lives and prevented more than a quarter of a million traffic accidents to date. That makes anti-skid protection the most important vehicle safety system after the seat belt – more important even than the airbag.

### **ESP is standard equipment in vehicles in a growing number of countries**

Using smart sensors, ESP compares 25 times per second whether the car is actually moving in the direction that the driver is steering it in. If the measured values do not match, the anti-skid system intervenes, initially reducing engine torque. If that is not sufficient, it additionally brakes individual wheels, generating the counterforce needed to keep a vehicle safely on course. If all vehicles were equipped with the anti-skid system, up to 80 percent of all skidding accidents

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could be prevented. Since November 1, 2014, ESP has been mandatory within the European Union for all newly registered cars and light commercial vehicles weighing up to 3.5 metric tons. In addition to the EU, the anti-skid system is also mandatory in Australia, Canada, Israel, New Zealand, Russia, South Korea, Japan, Turkey, and the United States. Worldwide, 64 percent of all new vehicles are therefore already equipped with ESP. Bosch has manufactured more than 150 million ESP systems to date.

### **Career with many inventions and awards**

By inventing the electronic stability program, Anton van Zanten and his development team at Bosch did more than just lay the foundation for greater road safety. The system is also the basis for today's driver assistance systems and automated driving. Increasing automation presents an opportunity to lower accident rates even further – by up to a third in Germany alone. ESP is Anton van Zanten's greatest success, but by far not his only achievement. The 75-year-old is the very epitome of an inventor. During his career as an automotive engineer, he was responsible for some 180 patent families. Along with ESP, his inventions include electronic rollover mitigation and trailer sway mitigation. Anton van Zanten entered into active retirement in 2003. To this day, he continues to lecture on vehicle systems at universities and act as a consultant for automotive companies. For his contributions to automotive safety, Anton van Zanten has already received numerous awards. However, the European Inventor Award, which pays tribute to his life's work, is of particular significance.

### **Eleventh edition of the European Inventor Award in five categories**

The European Inventor Award has been presented since 2006. It is the EPO's way of honoring researchers, scientists, technicians, and inventors whose inventions have been patented by the EPO and have made an outstanding contribution to scientific, technical, and social progress. What makes it unusual is that any member of the public can nominate an inventor for the award. From the nearly 400 nominees from a total of 13 countries in 2016, an independent, international jury selected the 15 finalists. The jury also decides the winners in the five categories "Industry," "Small and medium-sized enterprises (SMEs)," "Research," "Non-European countries," and "Lifetime achievement." The winners of the European Inventor Award receive a trophy shaped like a sail as a symbol of discovery and human ingenuity. The trophy is crafted with new materials every year.

**Press photos:** 1-BBM-22303, 1-BBM-22304, 1-BBM-22305, 1-BBM-22306

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