Mercedes-Benz

TecDay Real Life Safety

Press Information

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The descriptions and data contained in this press kit apply to the international model range of Mercedes-Benz. Country-specific variations are possible.

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Mercedes-Benz – A Daimler Brand

Synergy of sophisticated safety technologies makes new Mercedes models part of the "thinking" process

Leipzig – By introducing around a dozen new or modified systems, Mercedes-Benz is adding a new chapter to its long history of passenger-car safety. Following on from their successes achieved in the domain of occupant protection, the Mercedes experts will be focussing more than ever on avoiding traffic accidents and reducing accident severity, with the driver assistance systems being unveiled in the new E-Class and the model year 2009 S-Class from spring 2009 onwards set to play a crucial role. Mercedes-Benz is implementing a globally unique synergy of sophisticated safety technologies to give its cars extra "senses" and added intelligence. All of which makes Mercedes models part of the "thinking" process – cars that can see, sense and act autonomously. In addition to this, the Mercedes saloons show the way ahead when it comes to occupant protection and set new standards with their "electronic" crumple zones.

Like tried-and-trusted Mercedes inventions such as ABS, ESP®, Brake Assist and PRE-SAFE®, the new assistance systems have been adapted based on real-life accident findings. The aim behind their development was to prevent extremely frequent types of collision and collisions with serious consequences by focussing on the **causes of accidents**: distance to other vehicles, speed, drowsiness, darkness and lane departure.

To this end, Mercedes-Benz is for the first time using **cameras** alongside **radar sensors**. These long-range cameras monitor the area around the car and are able to interpret critical situations. By way of example, new camera-based assistance systems help the driver by keeping the car safely on track, detecting speed-limit signs, controlling the headlamps in line with the current driving situation and enhancing visibility in the dark.

The new E-Class will be the world's first car to feature headlamps that adapt automatically in line with the current driving situation. **Adaptive Highbeam Assist** detects oncoming vehicles or moving vehicles in front with their lights on and adjusts the headlamps continuously so as to always provide the best possible headlamp range – without dazzling other motorists. In this way, the low-beam range can be increased from its current level of 65 metres to up to 300 metres. If the road ahead is clear, the system switches to high beam with a minimum of fuss. This Mercedes development is therefore fundamentally different to conventional systems of this type, since the latter merely switch between low beam and high beam.

Adaptive Highbeam Assist: the best possible light in any traffic situation

Tests show that motorists who use Adaptive Highbeam Assist are safer on the road in the dark because they see pedestrians, cyclists or obstacles on the road up to 150 metres earlier than is the case with conventional low beam. What's more, the system helps to **relieve driver stress** as there is no longer any need to repeatedly flick the stalk on the steering wheel. So the driver can concentrate more on actually driving the car. Once activated, Adaptive Highbeam Assist always provides the best possible headlamp range.

At the heart of the system is a camera, located on the inside of the windscreen, which sends new data every 40 milliseconds so that the range of the variable-control bi-xenon headlamps can be adjusted.

Mercedes-Benz has further developed its **Night View Assist** system, which illuminates a long stretch of the road ahead using invisible infrared light. The second generation of this system features a special pedestrian detection function: as soon as the system detects pedestrians ahead of the car, they are highlighted on the display.

Lane Keeping Assist: warning if the car leaves its lane

Another new assistance system developed by Mercedes can prevent accidents caused by the car **leaving its lane.** More than a third of all road users killed in Germany are involved in this type of accident. This is why Mercedes-Benz has developed a "forward-looking" system for safe motoring called Lane Keeping Assist. Its camera monitors the line taken by the car and the driver's control inputs on a permanent basis, allowing the system to detect when the car leaves its lane unintentionally and if there is a risk of an accident. If this is the case, the system warns the driver in plenty of time, prompting them to counter-steer by making the **steering wheel vibrate** with a series of short, clearly discernable pulses.

Unlike conventional systems of this type, the Mercedes assistance system also assesses the driver's actions and, by doing so, can ascertain reliably whether the car has left its lane intentionally or unintentionally. There is therefore no warning if, for example, the driver accelerates before overtaking or joining a motorway, brakes heavily or steers into a bend.

If the system detects that the car is leaving its lane unintentionally, it activates an electric motor in the steering wheel, causing the steering wheel to vibrate. The timing of the warning depends on the width of the road and the type of lane markings. If the car crosses over a continuous line marking on the road, as opposed to a broken line, the system emits its warning earlier.

Speed Limit Assist: a camera with an eye for traffic signs

A further new assistance system reminds the driver of the current **speed limit** in force: the camera on the windscreen detects speed-limit signs as the car drives past them and then indicates the speed limit on the display in the speedometer. The driver therefore remains fully aware of the current speed limit, enabling them to adapt the car's speed accordingly. The display goes out as soon as the speed limit is lifted.

Thanks to the huge strides forward made in image-processing technology, Speed Limit Assist is able to work in **real time**, analysing the images within a fraction of a second – as the car drives past – and providing the driver with the required information instantaneously. Plus it makes no difference whether the speed-limit sign is at the side of the road or on a gantry above the road.

Furthermore, Speed Limit Assist evaluates the data provided by the **navigation system's** digital map, allowing it to check the plausibility of the camera image. By way of example, the last speed limit detected disappears from the display as soon as the navigation system detects that the car has entered a built-up area.

ATTENTION ASSIST: drowsiness detection system fitted as standard in the E-Class and S-Class

Thanks to a new technology, future Mercedes models will have a keen sense of their drivers' awareness. The aim is to detect driver drowsiness in plenty of time so as to warn them before they fall asleep momentarily. According to scientific studies, around a quarter of all serious motorway accidents are caused by driver drowsiness.

The new ATTENTION ASSIST system is equipped with highly sensitive sensors which monitor the driver's behaviour, the current driving situation and over 70 other parameters. By doing this, the system is able to detect when the driver's concentration starts to slip. This permanent form of monitoring is important for detecting the floating transition from awakeness to drowsiness and for warning the driver at an early stage. In addition to the speed, lateral acceleration and longitudinal acceleration, the system also detects use of the turn indicators and pedals as well as certain control inputs and external influences such as side winds or road unevenness, for example.

Observation of **steering behaviour** has proven to be extremely meaningful. Field tests carried out by the Mercedes engineers over a period of several years, involving over 550 participants to date, show that drowsy drivers make minor steering errors that are often corrected quickly and abruptly. These are detected

by a highly sensitive **steering wheel angle sensor**. If ATTENTION ASSIST detects typical indicators of drowsiness based on these and other data, it warns the driver by emitting an audible signal and flashing up a message on the display: "ATTENTION ASSIST. Break!"

ATTENTION ASSIST will be specified as standard for the new E-Class and the model year 2009 S-Class.

PRE-SAFE®: tensioning of the seat belts before an unavoidable accident

Further standard equipment Mercedes-Benz offers for these models includes the PRE-SAFE® **anticipatory occupant protection system.** Based on information received from sensors, it identifies situations that might turn into accidents and instinctively activates preventive occupant-protection measures, allowing the seat belts and airbags to deploy with maximum effect in the event of an impact. PRE-SAFE® therefore bridges the gap between active safety and passive safety; it is networked to Brake Assist and the Electronic Stability Program (ESP®), whose sensors recognise potentially dangerous driving situations and then transmit this information to the electronic control units within milliseconds.

In another first, Mercedes-Benz will also be using the information provided by the **short-range radar** to trigger the seat belt tensioners at the very last moment before an unavoidable collision, thus greatly reducing the forces exerted on the driver and front passenger during the crash.

Radar technology: sensor with medium-range detection capability and greater range

DISTRONIC PLUS and Brake Assist PLUS – Mercedes assistance systems based on sophisticated radar technology – are highly effective at helping to prevent accidents. Analysis of accident-research data has shown that this technology can prevent a fifth of all **head-to-tail crashes** in Germany on average. On motorways, the accident rate can be reduced by as much as 36 percent.

Mercedes-Benz has further enhanced the radar technology for the new E-Class and the model year 2009 S-Class. The newly developed **long-range radar sensor** will have a range of 200 metres instead of 150 metres as previously. In addition, the sensor now has **medium-range detection capability**, allowing monitoring of the area up to around 60 metres ahead of the car with a 60-degree beam width. This new technology enables even more accurate monitoring of the traffic situation in front of the car and even better detection of dynamic events such as a car in front swerving suddenly. The two wide-beam short-range radar sensors (80-degree beam width) with a range of around 30 metres are still employed.

PRE-SAFE® Brake: autonomous emergency braking as "electronic" crumple zone

As well as warning drivers in the new E-Class and the S-Class of an imminent head-to-tail crash, radar technology can also assist with emergency braking. The sensors are networked with **Brake Assist PLUS**, which automatically calculates the brake pressure required to prevent an imminent collision. This braking assistance, available as soon as the driver hits the brake pedal, allows controlled, targeted braking or – if necessary – emergency braking, depending on the car's speed and the distance to the vehicle in front.

If the driver fails to react to the warnings given by Brake Assist PLUS, the PRE-SAFE® Brake intervenes and brakes the car autonomously: around 1.6 seconds before the calculated impact point, the system initiates **autonomous partial braking** and decelerates the car with around 40 percent of the maximum braking power.

In the new E-Class and the model year 2009 S-Class, this safety system provides a further function: if the driver still fails to act after automatic partial braking, the PRE-SAFE® Brake activates the **maximum braking power** around 0.6 seconds before the now unavoidable impact and, as a consequence, can greatly reduce the severity of the accident. The system therefore acts like an "electronic crumple zone", offering the car occupants even greater protection.

Occupant protection: over 150 crash tests for the highest possible level of Mercedes safety

During the course of its development to date, the new E-Class has successfully come through over 150 high-speed crash tests and more than 17,000 realistic crash simulations, including around 40 different crash tests which the saloon had to pass in order to gain world-wide approval and nine extremely demanding, in-house impact tests, some of which go well beyond the statutory requirements.

The Sindelfingen-based engineers have continued to perfect the crumple-zone principle invented by Mercedes safety pioneer Béla Barényi. The front deformation zones of the latest Mercedes passengers cars work on several levels – making them even more effective as the impact forces are distributed over a wide area and can be made to bypass the passenger cell. Likewise the increased use of ultra-high-strength steel alloys helps the bodyshell to withstand high impact loads. These steel grades offer maximum strength whilst minimising weight. Around 72 percent of all the bodyshell panels for the new E-Class are made from sophisticated high-tech steel grades – a new record in passenger-car development.

With a total of seven airbags fitted as standard, not to mention seat-belt tensioners, belt force limiters and NECK-PRO crash-responsive head restraints, the new E-Class will offer an even more extensive package of safety equipment than its predecessor. **Self-adaptive belt-force limiters** in the rear, which adapt automatically to suit the size of the rear passengers, will be introduced for the first time in autumn 2009.

Mercedes-Benz is continuing its long-standing and very successful commitment to protecting those road users who are most at risk. Standard equipment for the new E-Class includes an active bonnet, which greatly reduces the risk of injury to pedestrians. In the event of an accident, a **system of springs** raises the rear section of the bonnet by 50 millimetres within milliseconds, thus enlarging the deformation zone. One special feature of this Mercedes system is its reversibility: drivers can reset the active bonnet themselves without having to visit a workshop.

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Adaptive Highbeam Assist selects the optimum light settings automatically

➢ **Driving a car at night will be even safer in future. Mercedes-Benz is unveiling an innovative system which adjusts the range of the headlamps automatically based on the distance to oncoming vehicles or moving vehicles in front with their lights on. Consequently, the best possible headlamp range is always selected, allowing the driver to see the course of the road, pedestrians or danger spots at an earlier stage. From spring 2009, the new E-Class and the S-Class will feature the world's most powerful headlamp technology in the shape of the Intelligent Light System and Adaptive Highbeam Assist. What's more, Mercedes-Benz has further developed the tried-and-tested Night View Assist system, which illuminates the road ahead of the vehicle with non-reflective infrared light. As soon as the system detects pedestrians up ahead, they are highlighted on the display in the cockpit.**

In contrast to conventional systems, which merely switch between low beam and high beam, the new Adaptive Highbeam Assist system adapts itself in line with the current conditions on the road, controlling the light distribution as the situation allows. The low-beam range can therefore be increased from 65 to up to 300 metres – without dazzling other motorists. If the system detects oncoming vehicles or vehicles in front, it adapts the headlamp range continuously, based on the distance to these vehicles, so that the cone of light emitted by the headlamps ends before it reaches these vehicles. In addition, Adaptive Highbeam Assist takes into account the steering angle in order to dim the headlamps on tight bends. If the road ahead is clear, the system switches to high beam with a minimum of fuss.

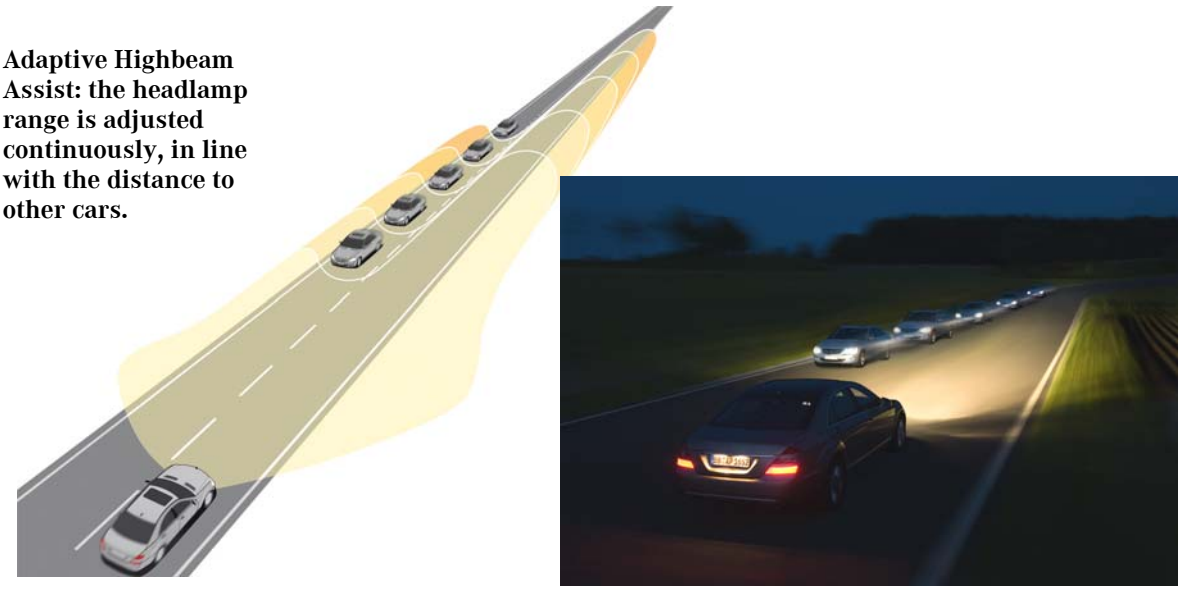
Realistic tests confirm that motorists who use Adaptive Highbeam Assist are safer on the road in the dark: dummies placed at the side of the road to simulate pedestrians were detected from a distance of around 260 metres – around

150 metres earlier than is the case when conventional low beam is used – despite the presence of oncoming traffic. The new Mercedes assistance system therefore offers more than double the safety at night.

What's more, the system relieves driver stress as there is no longer any need to repeatedly flick the stalk on the steering wheel. So the driver can concentrate more on actually driving the car. Once activated, Adaptive Highbeam Assist always provides the best possible headlamp range.

Studies have shown that high beam is currently only switched on for around eight percent of each night journey on average.

Adaptive Highbeam Assist: the headlamp range is adjusted continuously, in line with the distance to other cars.



Data transfer every 40 milliseconds

The newly developed Mercedes technology is based on a camera, located on the inside of the windscreen, which monitors the traffic situation in front of the car. Thanks to an intelligent image-processing algorithm, the camera is able to detect other vehicles and the distance to them. The range of the variable-control bi-xenon headlamps is set based on these findings and adapted continuously depending on the distance to the vehicle in front or the oncoming traffic. The

system operates at lightning speed, sending new data to the headlamps every 40 milliseconds.

Adaptive Highbeam Assist is ready to act at speeds above 55 km/h and operates autonomously once the driver has moved the rotary light switch to the "Auto" position and selected high beam using the multifunction stalk on the steering wheel.

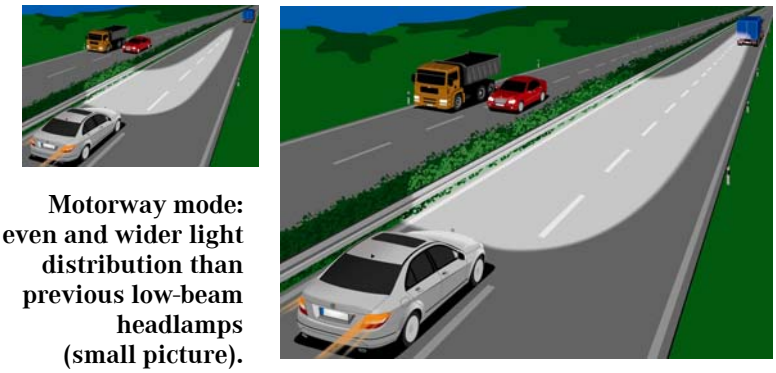
Intelligent Light System increases headlamp range by 50 metres when driving on the motorway

Mercedes-Benz will combine this new development with the Intelligent Light System, which offers five different bi-xenon light functions, each of which is suited to typical driving or weather conditions:

- Country mode
- Motorway mode
- Enhanced fog lamps
- Active light function
- Cornering light function

The light system is based on powerful bi-xenon headlamps. These are variably controllable, and are networked with other electronic control units from which the headlamps obtain information about the current driving situation and distribute their beam patterns accordingly. The familiar low-beam headlamps are replaced by the new **country mode**, which illuminates the driver's-side edge of the road more widely and brightly than before. In the dark, this enables the driver to appraise the situation and respond more rapidly when other road users cross their path.

Motorway mode, which comes on automatically when driving above 90 km/h, increases the driver's range of vision by up to 60 per cent. This lighting function is activated in two stages: the Intelligent Light System first increases the output of the bi-xenon bulbs from 35 to 38 watts, thereby increasing the light intensity and providing noticeably better illumination of the road ahead and the side verges. The second stage of motorway mode is triggered at 110 km/h, when the beam of the bi-xenon module on the driver's side is elevated slightly. Motorway mode has a range of around 120 metres, and the driver is able to see about 50 metres further at the centre of this cone of light than with conventional low-beam headlamps.



Motorway mode: more even and wider light distribution than previous low-beam headlamps (small picture).

With the likewise enhanced fog lamps, Mercedes-Benz improves driver orientation when visibility is poor. The new lighting function is activated at speeds below 70 km/h, as soon as the rear fog lamp is switched on. The variable headlamp technology incorporated in the Intelligent Light System makes it possible to pivot the bi-xenon headlamp on the driver's side outwards by eight degrees, while lowering its beam of light at the same time. This illuminates the inner half of the road more brightly and reduces the degree of glare from light reflected back by the fog.

The Intelligent Light System also includes the active light and cornering light functions. These are switched on automatically: depending on the steering angle, yaw rate and vehicle speed, the active headlamps pivot sideways by up to 15 degrees in fractions of a second, thereby greatly improving road illumination. On an extended bend with a radius of 190 metres, the driver is able to see

25 metres further than with conventional low-beam headlamps thanks to this system. This function operates in both low-beam and high-beam mode.

The **cornering light function** improves safety at crossroads, at T-junctions and on tight bends. It is activated automatically when the driver operates the turn indicators or turns the steering wheel at a speed below 40 km/h. The fog lamps then swivel to illuminate the area diagonally in front of the vehicle for a distance of around 30 metres, with an angle of coverage of 65 degrees.

Night View Assist PLUS with new function for highlighting pedestrians on the display

Mercedes-Benz will be offering Night View Assist – available for the S-Class since 2005 – for the new E-Class. The system uses infrared technology to enhance the driver's range of vision in the dark: two separate headlamps illuminate the road with invisible, non-reflective infrared light. A windscreen-mounted camera designed to pick up precisely this type of light records what happens in front of the car and sends the image to a display on the dashboard. The clear, needle-sharp greyscale image that appears here shows the scene in front of the car, allowing the driver to see pedestrians, cyclists or obstacles on the road at an early stage.

The Sindelfingen-based engineers have further developed Night View Assist and, in future, will be equipping it with a special pedestrian-detection function: as soon as the system detects pedestrians ahead of the car, they are highlighted on the display to make it easier for the driver to see them.

Steering wheel vibrates to warn the driver if the car leaves its lane unintentionally

➢ **A newly developed Mercedes assistance system warns the driver if the car leaves its lane unintentionally. The camera on the inside of the windscreen monitors the road markings and detects when the car leaves its lane. Lane Keeping Assist will be available for the new E-Class and the S-Class from spring 2009.**

Lane departure is the cause of one in six serious accidents on German roads. And more than a third of all road users killed here are involved in this type of accident. This is why Mercedes-Benz has developed this new technology – another "forward-looking" assistance system for even safer motoring. This is made possible by a camera on the inside of the windscreen, which can detect road markings by evaluating the difference in contrast between the road surface and the markings.

The image-processing system sends data to an electronic control unit, which determines the position of the car and detects when it leaves its lane on the left or right. Unlike conventional systems of this type, the Mercedes assistance system also assesses the driver's actions and, by doing so, reliably ascertains whether the car has left its lane intentionally or unintentionally. There is therefore no warning if, for example, the driver accelerates before overtaking or joining a motorway, brakes heavily or steers into a bend.

If the system determines that the car is leaving its lane unintentionally, it activates an electric motor, causing the steering wheel to vibrate – a discreet yet highly effective way of prompting the driver to countersteer. The timing of the warning depends on the width of the road and the type of lane markings. If the car crosses over a continuous line on the road, as opposed to a broken one, the system emits its warning earlier.

Lane Keeping Assist operates at speeds of between 60 and 250 km/h as soon as the system has detected a lane marking. The steering wheel does not vibrate to warn the driver if the driver ...

- cuts a corner intentionally
- uses the turn indicators
- moves back into the original lane after overtaking

Furthermore, Lane Keeping Assist is deactivated immediately if ABS, ESP®, Brake Assist or another safety system intervenes.

Electronic image processing system detects speed-limit signs as the car drives past them

➢ **A newly developed Speed Limit Assist system detects speed-limit signs in milliseconds, in real time, and reminds the driver of the current speed limit. The system, which will be available for the new E-Class and the model year 2009 S-Class, is based on intelligent, electronic image processing.**

Throughout the world, failure to adjust speed is the root cause of the most road accidents and the road accidents with the gravest consequences. The new Mercedes assistance system can remind drivers of the speed limit currently in force and, in doing so, help them to be safer on the road. The speed limit appears on a display in the instrument cluster and remains visible until the speed restriction is lifted or changed.

Speed Limit Assist: speed display in the instrument cluster

A windscreen-mounted camera monitors the area in front of the car on a permanent basis and has a trained eye for road signs. That's because a computer scans the camera image for round surfaces only and then highlights these. In the next step, a system of algorithms filters out all objects that are round but do not resemble traffic signs. Finally, a comparison with stored patterns eliminates all but those objects which the system is programmed to detect: round traffic signs

indicating the speed limit. The symbols are sent to the cockpit display, meaning that the driver is always aware of the current speed limit and can adjust the car's speed accordingly.

Some of the speed-limit signs in Europe – for example those seen when entering or leaving towns – are rectangular, however. In such cases, the assistance system also scans the data stored on the navigation system's digital map to check the plausibility of the camera image. The last speed limit detected disappears from the display in the instrument cluster as soon as the car enters a built-up area, for example.

Thanks to the huge strides forward made in computer-based image-processing technology, Speed Limit Assist is able to work in real time, analysing the images within a fraction of a second so as to provide the driver with the required information instantaneously. Plus it makes no difference whether the speed-limit sign is at the side of the road or on a gantry above the road.

Drowsiness-detection system warns drivers to prevent them falling asleep momentarily

➢ **Mercedes-Benz accident researchers warn against falling asleep momentarily whilst driving. Drivers who do not take regular breaks when driving long distances run a high risk of becoming drowsy – a state which they often fail to recognise early enough according to the experts. This is why Mercedes-Benz has developed the innovative ATTENTION ASSIST system, which can detect when drivers start to become drowsy and prompt them to take a break before it's too late. The system will be fitted as standard in the new E-Class and the model year 2009 S-Class.**

Scientific studies conclude that around 25 percent of all serious motorway accidents are down to driver drowsiness, meaning that drowsiness causes more road accidents than drink-driving.

The risk of falling asleep momentarily is at its greatest on long-distance journeys in the dark or in unchanging conditions because this is when drivers are most likely to suffer a lapse in attention. The sheer monotony further heightens the risk of falling asleep at the wheel. Studies show that, after just four hours of non-stop driving, drivers' reaction times can be up to 50 percent slower. So the risk of an accident doubles during this time. And the risk increases more than eight-fold after just six hours of non-stop driving!

The newly developed ATTENTION ASSIST system sees Mercedes-Benz continuing to adopt a practically-oriented stance towards accident avoidance. A stance which has already lead to a proven improvement in road safety thanks to developments such as the Electronic Stability Program (ESP®) and Brake Assist.

ATTENTION ASSIST observes the driver's behaviour and, at the start of every trip, produces an individual driver profile that is then continuously compared with current sensor data. This permanent form of monitoring is important for detecting the floating transition from awakeness to drowsiness and for warning the driver in plenty of time. The system is active at speeds of between 80 and 180 km/h.

Steering behaviour as the key indicator of drowsiness

As well as the speed, lateral acceleration and longitudinal acceleration, the Mercedes system also detects steering wheel movements, use of the turn indicators or pedals and certain control inputs, not to mention external influences such as side winds or road unevenness, for example. Observation of steering behaviour has proven to be extremely meaningful as drowsy drivers find it difficult to steer a precise course in their lane. They make minor steering errors that are often corrected quickly and abruptly. Intensive tests carried out by the Mercedes engineers, involving more than 550 drivers, show that this effect occurs at a very early stage when drowsiness kicks in – often before the dangerous situation in which the driver falls asleep momentarily.

ATTENTION ASSIST: how the Mercedes system detects drowsiness

At the heart of this Mercedes system is a highly sensitive sensor which allows extremely precise monitoring of the steering wheel movements and the steering speed.

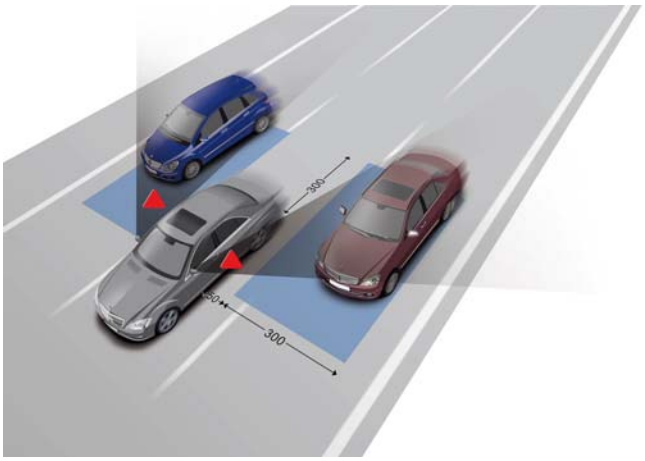
Based on these data, ATTENTION ASSIST calculates an individual behavioural pattern during the first few minutes of every trip. This pattern is then continuously compared with the current steering behaviour and the current driving situation, courtesy of the vehicle's electronic control unit. This process allows the system to detect typical indicators of drowsiness and warn the driver by emitting an audible signal and flashing up an unequivocal instruction on the display in the instrument cluster: "ATTENTION ASSIST. Break!"

Radar sensors monitor the areas directly alongside and behind the car

➢ **Blind Spot Assist, developed by Mercedes-Benz, uses radar technology to monitor the areas directly alongside and behind the car. It warns the driver when changing lanes would be too dangerous.**

Every year, around 9,500 serious road accidents in Germany are caused by motorists who fail to take heed of the traffic behind when changing lanes or cut across in front of another vehicle too soon after overtaking.

The Mercedes assistance system can help drivers to change lanes safely: short-range radar sensors housed on both sides of the rear bumper monitor the areas directly alongside and behind the car. This process enables them to see if there is another vehicle in the next lane – in the so-called blind spot. In such situations, the system informs the driver by illuminating a red warning signal in the glass of the exterior mirror. If the driver fails to see this warning and indicates to change lanes, a warning signal sounds as well.



Blind Spot Assist: visual signal and audible warning in the event of high-risk lane changes.

Radar-based assistance systems can prevent 20 percent of all head-to-tail crashes

➢ **DISTRONIC PLUS and Brake Assist PLUS – Mercedes assistance systems based on sophisticated radar technology – are highly effective at helping to prevent accidents. This is one of the findings of an analysis carried out by Mercedes-Benz based on representative accident-research data. This technology can prevent a fifth of all head-to-tail crashes in Germany alone. On motorways, the accident rate can be reduced by as much as around 36 percent. Mercedes-Benz has further enhanced the radar technology for the new E-Class and the model year 2009 S-Class.**

Every year in Germany there are over 50,000 serious head-to-tail crashes, in which some 5700 people are either killed or seriously injured. One in six traffic accidents in which people are injured is down to a head-to-tail crash. The situation is even more serious in the US, where this type of collision accounts for around 30 percent of all serious road accidents.

In developing the DISTRONIC PLUS and Brake Assist PLUS radar-based assistance systems, which have been available for the S-Class since 2005 and the CL-Class since 2006, Mercedes-Benz has made an important contribution towards preventing head-to-tail crashes. This is one of the findings of the latest accident research carried out at Mercedes, based on the reconstruction of over 800 head-to-tail crashes. The representative study focussed on one question in particular: how many accidents of this type could be prevented if all passenger cars were equipped with this Mercedes technology?

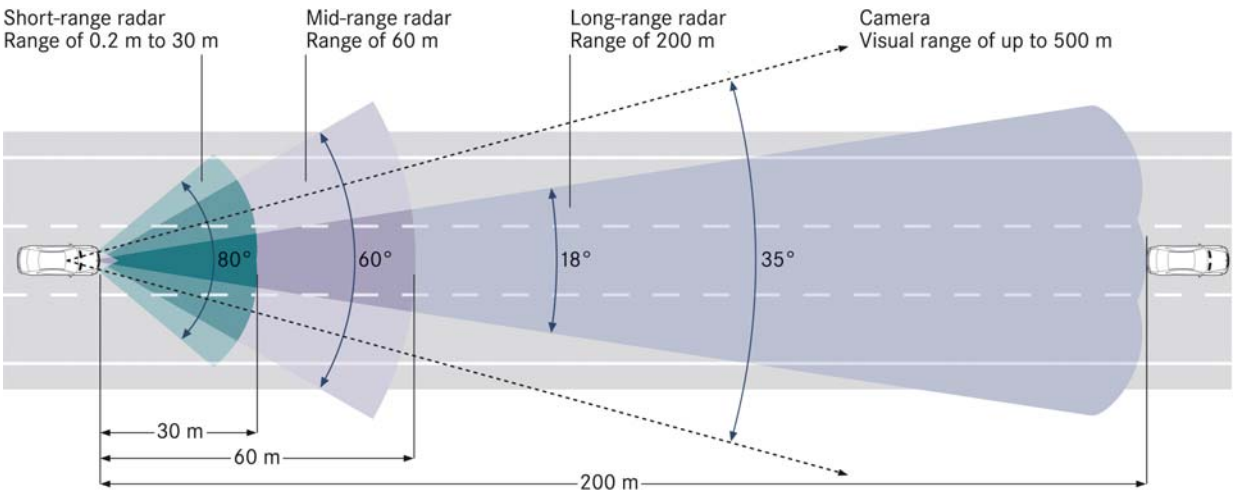
The results confirm the considerable safety-enhancing effect of the assistance systems: DISTRONIC PLUS and Brake Assist PLUS prevent over 20 percent of head-to-tail crashes on average. In another quarter of these collisions, the systems can help to greatly reduce accident severity. This combination of state-of-the-art

radar and brake technology offers the greatest safety potential on motorways, where around 36 percent of all head-to-tail crashes can be prevented.

Warns and assists the driver as well as providing emergency braking

DISTRONIC PLUS proximity control operates at speeds of between 0 and 200 km/h: it keeps the car a set distance behind the vehicle in front, applies the brakes as required and can even bring the car to a complete halt, depending on the traffic situation. If the gap to the vehicle in front narrows too quickly, the system gives the driver an audible warning and, as soon as this first warning signal sounds, automatically calculates the brake pressure required to prevent a collision in this situation.

This technology helps the driver to gauge the level of risk and makes the calculated brake boosting force available instantly, even if the driver does not press the brake pedal forcefully enough. Brake Assist PLUS allows controlled, targeted braking and, if necessary, increases the braking force right up to the point at which an emergency stop is performed, depending on the road speed and the distance to the vehicle in front.



Radar sensors and camera: range of up to 500 metres.

New radar sensor with extended range and medium-range detection capability

When a potential accident situation is recognised, assistance is provided courtesy of two short-range radar sensors behind the front bumper and a long-range radar in the radiator grille. Mercedes-Benz has further enhanced the performance capability of these sensors. In the new E-Class and model year 2009 S-Class, Mercedes-Benz uses a newly developed sensor with a range of 200 metres – instead of 150 metres, as previously – for the long-range radar. In addition, the sensor now also has medium-range detection capability, allowing monitoring of the area up to around 60 metres ahead of the car with a 60-degree beam width. This new technology enables even more precise monitoring of the traffic situation in front of the car and even better detection of dynamic events such as a car in front swerving suddenly. The two wide-beam short-range radar sensors (80-degree beam width) with a range of around 30 metres are still employed.

40 percent of all S-Class saloons are equipped with radar

Mercedes-Benz offers DISTRONIC PLUS in combination with Brake Assist PLUS as an optional extra. Around 40 percent of customers buying new S-Class models in Germany specify this safety technology; in the case of the CL-Class, over 70 percent of customers order DISTRONIC PLUS and Brake Assist PLUS. Since 2005, Mercedes-Benz has supplied customers with over 50,000 cars featuring these innovative systems.

Automatic emergency braking can greatly reduce the severity of a head-to-tail crash

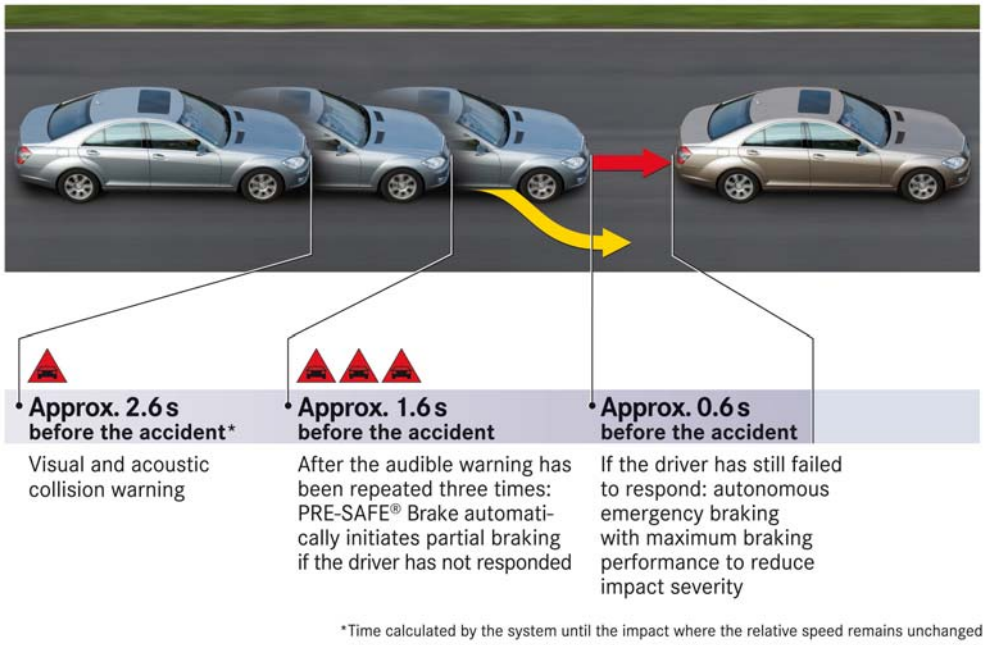
➢ **Mercedes-Benz has continued to further develop the PRE-SAFE® Brake, which was first unveiled in 2006. From spring 2009, a version of the system that activates the maximum braking power automatically if there is an acute risk of an unavoidable accident will be available for the new E-Class and the S-Class. The PRE-SAFE® Brake therefore acts as an electronic crumple zone and can greatly reduce the severity of an impact.**

Accident research shows that drivers do not always react as quickly as necessary at critical moments – for example because they are distracted and therefore do not recognise the immediate threat of a head-to-tail crash, or because they fail to heed the warning signals given by an assistance system. The PRE-SAFE® Brake intervenes in situations such as these by braking the car automatically.

What's more, it does this in two stages: around 1.6 seconds before the calculated impact point – after three audible warning signals – the system initiates partial braking autonomously and decelerates the car with around 40 percent of the maximum braking power (approx four m/s^2). Designed to supplement the visual and audible warnings, autonomous partial braking gives the driver a further, perceptible signal to act. If the driver then brakes immediately, the maximum braking force is made available or, if the driver swerves, the accident can be avoided at the last moment, depending on the driving situation. Mercedes-Benz first unveiled PRE-SAFE® autonomous partial braking in the CL-Class and the S-Class in 2006.

Mercedes will be offering a further enhanced version of this safety system from spring 2009. If the driver fails to react, even after automatic partial braking, the PRE-SAFE® Brake activates the maximum braking power around 0.6 seconds before the now unavoidable collision. This emergency braking can greatly reduce the severity of the impact.

The system therefore acts like an "electronic crumple zone", offering the car occupants even greater protection.



Like Brake Assist PLUS, the PRE-SAFE® Brake uses state-of-the-art radar technology to monitor the situation in front of the car and detect an imminent accident. Two short-range radar sensors with a range of 30 metres and a beam width of 80 degrees are located behind the front bumper covering. The additional long-range radar in the radiator grille has a range of 200 metres.

The PRE-SAFE® Brake greatly reduces the severity of accidents

Mercedes-Benz has tested the operation and effectiveness of the PRE-SAFE® Brake, both on the road and in the road simulator. Around 400 drivers took part in the road tests in Germany and the US, clocking up a total of around one million kilometres in test cars.

Mercedes engineers conducted a series of tests, lasting several weeks and involving 70 drivers, in the road simulator at the Daimler research facility in Berlin. Each of the drivers drove for half an hour and was distracted by an

accident on the other side of the road, whilst at the same time the traffic in front of the car braked suddenly. The results of the test, which reflects an everyday situation on the road, highlight the safety-enhancing effect of the sophisticated assistance systems: a total of 70 percent of these test drives remained accident-free thanks to the fast reactions of the drivers and the assistance provided by BAS PLUS and the PRE-SAFE® Brake. In a third of the simulator tests, those taking part were unable to avoid a crash. In these cases, automatic braking greatly reduced the accident severity.

Realistic tests carried out by the Mercedes engineers have revealed that autonomous PRE-SAFE® emergency braking reduces the impact speed by 16 km/h on average.

The PRE-SAFE® Brake is active at speeds of between 30 and 200 km/h when moving vehicles are detected in front of the car. The system also reacts if the car approaches a stationary queue of traffic, providing its speed is below 70 km/h.

This component is an important part of the PRE-SAFE® anticipatory occupant protection system, which is fitted as standard in many Mercedes models. It uses the otherwise wasted seconds (from an occupant-safety standpoint) between the point at which a potential accident risk is detected and the point at which the protective systems in the interior are activated.

Just like the airbag, seat-belt tensioner, ESP® and other trailblazing Mercedes inventions, the PRE-SAFE® Brake was developed based primarily on real accident situations. When used in combination with Brake Assist PLUS, this technology can make a key contribution towards reducing the high number of head-to-tail crashes or reduce the severity of such collisions. In Germany, over 17 percent of all serious road accidents involve head-to-tail crashes. In the US, meanwhile, one in three road accidents involving deaths or injuries are head-to-tail crashes.

Anticipatory occupant protection system reduces the forces exerted on the occupants during accidents by up 40 percent

➢ **Mercedes-Benz is the world's only car brand to offer an anticipatory occupant protection system that activates protective measures for the car's occupants if there is an imminent risk of an accident. This multi-award-winning technology, called PRE-SAFE®, is fitted as standard in numerous Mercedes model series and has now been further enhanced by Mercedes-Benz.**

The intelligent PRE-SAFE® system takes its lead from nature in that it activates protective measures for the car occupants as a precaution, just as living things react instinctively and search for cover when they are in danger. The aim is to prepare the occupants and the car for an imminent collision so that the seat belts and the airbags can deploy with maximum effect in the event of an impact. What's more, the PRE-SAFE® protective measures are reversible: if the accident is averted, the advance tensioning of the seat belts is halted automatically and the occupants are able to reset the positions of the seats and the sunroof. The anticipatory occupant protection system is then ready for action again straightaway.

Early accident detection is possible because PRE-SAFE® is an intelligent synergy of active and passive safety. It is linked to Brake Assist and the Electronic Stability Program (ESP®), whose sensors detect potentially critical driving situations and send the relevant information to the electronic control units within a matter of milliseconds. PRE-SAFE® also uses these sensor data for anticipatory occupant protection.

PRE-SAFE® celebrated its world premiere in the S-Class in 2002 and has been fitted as standard in the E-Class since 2006.

Like the S-Class, the new E-Class can activate further preventive measures ahead of an imminent accident:

- Whereas PRE-SAFE® previously responded to emergency or panic braking – in other words when the driver hit the brake pedal reflexively – the system in the new E-Class can also be activated if **Brake Assist PLUS** has used the radar system to predict an impending collision and a certain level of deceleration is exceeded when braking. The occupants are prepared for the potential collision by preventive tensioning of the front seat belts and repositioning of the front-passenger seat (if the seat memory function is specified), enabling the seat belts and airbags to offer the best possible protection.

- A newly developed **multicontour seat** ensures that the driver and front passenger are seated even more securely, thereby limiting dangerous whiplash movements by the upper body. If the PRE-SAFE® control unit detects a critical driving situation, it instantly activates the air chambers in the seat cushions and backrests. These then envelope the seat occupants and give them support. Tests at the Mercedes-Benz Technology Center have shown that this PRE-SAFE® function and preventive belt tensioning increases the distance between the shoulder and the inner door lining by up to 40 millimetres at a lateral acceleration of 0.6 *g*. This enables the sidebag to fulfil its protective function more effectively.

PRE-SAFE® when braking in an emergency	**PRE-SAFE® when there is a risk of skidding**
• Driver and front-passenger seat belts are tensioned	• Bolsters in the seat cushions and backrests of the multicontour front seats* are inflated
• Front-passenger seat* is moved backwards or forwards into the optimum position whilst the cushion angle and backrest inclination are also optimised	• Side windows at the front and rear are closed
	• Sunroof* is closed

* depending on equipment

When installed in combination with DISTRONIC PLUS and Brake Assist PLUS, PRE-SAFE® will also use the information provided by the short-range radar sensors in the front bumper to tension the front seat belts at the very last moment before an unavoidable collision, thus reducing the forces exerted on the driver and front passenger during the crash. This PRE-SAFE® function is literally the "ultima ratio" of anticipatory occupant protection, since the accident occurs around 200 milliseconds later.

Belt tensioning reduces the forces exerted on the occupants by up to 40 percent

Analyses performed during crash tests show just how important and effective anticipatory occupant protection can be. In the case of belt tensioning, for example, the precautionary measures mean that the driver and front passenger are held in their seats in the best possible position and so do not move forwards as much in the event of an impact, thus reducing the load exerted on the head and neck area. These tests showed that the head was subjected to around 30 per cent less stress, while the Mercedes engineers recorded a reduction of around 40 per cent in the neck area.

The crumple zone protects the occupants on four levels in the event of a frontal impact

➢ **Mercedes engineers have continued to perfect the idea patented by their mentor Béla Barényi – through a programme of accident research, crash tests and computer simulations. And with the new E-Class, they have created another masterpiece of passenger-car safety technology. The saloon's front deformation zone works on several levels – making it even more effective as the impact forces are distributed over a wide area and can be made to bypass the passenger cell, With seven airbags fitted as standard, not to mention seat-belt tensioners, belt force limiters and NECK-PRO crash-responsive head restraints, the new E-Class offers an even more extensive package of safety equipment than its predecessor. Adaptive belt force limiters will be installed in the rear for the first time (optional extra).**

The pioneering work carried out by Béla Barényi enabled Mercedes-Benz to develop the basic principles of passenger-car safety in the 1940s and 1950s. And these principles still apply to this day. Barényi's ideas first came to fruition in the "Ponton" (three-box body) Mercedes (model series W 120) exactly 55 years ago in autumn 1953. This precursor to the E-Class was the world's first car to feature a crash-stable floor assembly, which enhanced occupant safety in the event of a frontal or side impact.

This car's successor – model series W 110/111/112 with the distinctive tail fins – provided the next milestone in the field of safety technology. From 1959 onwards, these saloons were the first models into which Mercedes-Benz incorporated front and rear crumple zones. In the event of an accident, these zones absorb energy in a predetermined manner and distribute the impact forces, thus greatly reducing the forces exerted on the occupants.

This Mercedes concept for the safety body still forms the basis for passive safety today; it is part of all modern-day passenger cars, not just those made by Mercedes-Benz.

Béla Barényi's successors at the Mercedes-Benz Technology Centre in Sindelfingen have continued to further develop the concepts devised by their mentor, based on the latest development and calculation methods and the use of state-of-the-art bodyshell materials. The extent of their dedication has reached a new pinnacle with the new E-Class. During the course of its several years of development to date, the saloon has successfully come through over 150 crash tests and more than 17,000 realistic crash test simulations, including around 40 different crash tests which the saloon had to pass in order to gain world-wide approval and nine extremely demanding, in-house impact tests, some of which go well beyond the statutory requirements. Only cars that pass these tests receive the highest accolade in automotive safety: the Mercedes star.

The results of the crash tests prove that Mercedes has pulled off yet another masterstroke in the field of occupant safety.

Large deformation zones are capable of absorbing high forces in the event of an accident

Compared to the previous model series, the Mercedes engineers have enlarged the deformation zones substantially in the front and rear sections as well as improving the energy flows. The front crumple zone has four independently acting impact levels, meaning that the forces can be distributed over a wide area while bypassing the passenger cell.

1) **Sectional panels** above the wheel arches form the upper side-member level. From here, the impact forces are channelled into the A-pillars and, subsequently, into the roof frame.

2) An **aluminium crossmember** connects the forward-extended side members and ensures that the forces are transferred to the side facing

away from the impact. The crossmember and the forward-extended side members form the central impact zone.

3) The **integral support** to which the engine, steering and front axle are attached also serves as an impact level in the event of a frontal collision. It is made of high-strength steel and has been connected to the newly developed floor side members by means of special supporting tubes. As a consequence, the integral support can deform in a predetermined manner and absorb energy in the event of a crash on the one hand and channel high impact forces straight into the vehicle floor on the other.

4) The **side skirts** have been extended forwards to support the wheel and prevent it from entering the footwell in the event of an offset frontal collision. This design also allows the wheel to absorb some of the crash energy. In order to provide specifically targeted front-wheel support and location, Mercedes-Benz has also developed special struts and additional energy-absorbing elements in the wheel arches. The struts are arranged diagonally and prevent the passenger cell from sinking in the event of an impact.

The firewall is a four-part construction. This design enables Mercedes engineers to vary the material thickness according to the level of vulnerability in an accident. As the load acting on the firewall during a frontal crash is greatest in the lower section, the sheet steel used here is more than twice as thick.

Around 72 percent of all the body parts are made from high-strength steel

Key aspects of the safety concept at the heart of the new E-Class include intelligent design and meticulous material selection. More so than ever before, Mercedes-Benz has given preference to ultra-high-strength steel alloys because they offer maximum strength whilst minimising weight and, therefore, are essential for meeting strict Mercedes safety and durability requirements. Around 72 percent of all the bodyshell panels for the new E-Class are made from these grades of steel – a new record in passenger-car development. These ultra-high-

strength, high-tech alloys, which boast three to four times the tensile strength of conventional steel grades, account for around eight percent of the weight. They are used at points where the material can be subjected to very high stresses during an accident – as a material for the B-pillars and roof frame to provide side impact protection, for example, or at the rear to produce a robust crossmember.

If these sophisticated alloys were not used, far more material would be required in order to meet the stringent safety requirements. The B-pillar is a perfect case in point: the body components which have to absorb high forces and transfer these to the body structure in the event of a side impact consist of sheet-metal shells plus an extensive reinforcement which reaches as far as the upper edge of the belt deflector. One of the shells and the reinforcement are made from ultra-high-strength, hot-formed steel. Were they made using conventional sheet steel, however, the B-pillars would be more than a third heavier. In other words, the ultra-high-strength, high-tech alloy enhances safety whilst also reducing weight.

Custom-designed floor panels form the robust backbone of the passenger cell

The passenger cell of the new E-Class proves to be a structure which is virtually immune to deformation and which keeps the passengers' survival space intact, even at high impact speeds, regardless of whether the collision is head-on, from the rear or from the side, or whether the vehicle rolls over. The use of high-strength steel and thicker panels plays as important a role here as the installation of additional load-bearing members.

The main floor assembly consists of different sheet-metal plates that either undergo flexible rolling or are welded together by laser beam and subsequently shaped. Flexible means that the ultra-high-strength steel can be processed in such a way that areas with different steel thicknesses can be produced within a single component. The middle blank forms the tunnel – the actual backbone of the passenger cell. Here the thickness of the custom-designed panels varies between 1.4 and 2.0 millimetres, depending on the stresses and loads to which they are subjected.

Other new features which are very important for both occupant protection and the rigidity of the bodyshell include the continuous floor side members, the insides of which are further reinforced with extra sections. Their front faces connect to the side members, thereby lengthening the load-bearing paths along which forces can be distributed in the event of an impact. At the rear, the floor side members extend as far as the crossmember beneath the rear seat unit to stabilise the entire floor structure.

The Mercedes engineers have also incorporated sturdy aluminium transverse sections – known as transmission tunnel braces – into the floor assembly. One is located beneath the transmission, and is designed to direct forces to the opposite side of the vehicle during a lateral impact. The second creates a connection between the two side members. It likewise braces the floor assembly and is able to channel impact forces into the floor structure at an early stage in the event of a side-on collision.

The rear structure has successfully passed the toughest of crash tests

Multi-piece side members and a robust, flexible crossmember made from ultra-high-strength steel form the key components of the rear-end structure. The rear side members are continuous, closed box sections with carefully graduated material thicknesses. These are able to absorb high forces, thereby making a decisive contribution to occupant safety in the event of a rear impact. The bolt-on flexible crossmember is manufactured using a flexible rolling process which likewise allows the material thickness to be varied as required. Accordingly, the material thickness on the outside of the crossmember – where impact loads are highest – is greater than on the inside.

The new E-Class also meets the world's most stringent crash regulations where rear impact protection is concerned, for example the 80-km/h test in the US.

The restraint system for the E-Class includes seven airbags as standard

With seven airbags fitted as standard, not to mention seat-belt tensioners, belt-force limiters and NECK-PRO crash-responsive head restraints, the new E-Class offers an even more extensive package of safety equipment than its predecessor. The airbags, which deploy in a matter of milliseconds in the event of an accident, include two adaptive airbags (for the driver and front passenger), a kneebag for the driver, two sidebags in the front-seat backrests and two large windowbags which extend from the A-pillar to the C-pillar during a side impact. Rear sidebags can be ordered as optional extras.

Three-point inertia-reel seat belts with belt tensioners and belt-force limiters are fitted as standard for the driver, the front passenger and the occupants of the outer seats in the rear. Force limitation is performed on an adaptive basis in the front: after reaching a certain maximum retention, the belt force is reduced to a lower level – the belts are allowed to slacken so that the occupants can sink deeper into the airbags as they deploy, reducing the strain exerted on the torso.

Rear belt-force limiters that adapt to the size of the passengers

From autumn 2009, Mercedes-Benz will be offering adaptive belt-force limiters for the rear seats as an option for the first time. These belt-force limiters adapt to the size of the rear passengers automatically. The newly developed system detects whether the rear occupant is large or small as soon as the seat belt is put on, based on the length of the pulled-out seat belt, and adapts its mode of operation accordingly. The maximum restraint force is activated immediately if the rear passenger is large in size. Only once a certain time has elapsed does the limiter reduce the force. In the case of smaller occupants, the force exerted by the belt is set to a lower level and is not increased continuously until the crash is actually taking place. Hence the protective effect of the seat belt can be adjusted, i.e. further optimised, in line with the occupant's body size.

Crash-responsive head restraints reduce the risk of whiplash injuries

NECK-PRO is the name Mercedes-Benz has given to a crash-responsive head restraint whose development, like that of PRE-SAFE® and other Mercedes innovations, is based on analyses of real accidents. NECK-PRO is an effective means of reducing the risk of whiplash injuries during a rear-end collision. If the sensor system detects a rear-end collision with a defined impact severity, it releases pre-tensioned springs inside the head restraints, causing the head restraints to move forward by about 40 millimetres and upwards by 30 millimetres within a matter of milliseconds. This means that the heads of the driver and front passenger are supported at an early stage.

The standard occupant restraint system for the new E-Class at a glance:

	Front seats	**Rear seats**
Inertia-reel seat belts with height adjustment	•	• Height adjustment for the outer seats
Belt tensioners	•	• for the outer seats
Belt-force limiters	• with adaptive control	• with optional adaptive control for the outer seats from autumn 2009
Head restraints	• with NECK-PRO function	•
Front airbags, two-stage	•	
Sidebags	•	optional
Windowbags	•	•
Kneebag	• on the driver's side	

The bonnet is raised 50 millimetres instantaneously upon impact with a pedestrian

➢ **The Mercedes engineers have continued their long-standing commitment to protecting pedestrians by introducing an active bonnet as standard for the new E-Class. In the event of an accident, a system of springs raises the rear section of the bonnet by 50 millimetres within a matter of milliseconds, thus enlarging the deformation zone. The system is reversible and can be reset manually by the driver.**

The protection of those road users who are most at risk has always been a top priority during the development of Mercedes passenger cars. Smooth-surfaced bodies, energy-absorbing bumpers, flush-mounted door handles, laminated-glass windscreens, folding exterior mirrors and recessed windscreen wipers are pedestrian-protection measures that have been features of Mercedes models for many years. But, as ever, another top priority for the safety engineers is accident prevention. So systems such as Brake Assist, the cornering light function and Night View Assist play crucial roles. Fitting Brake Assist as standard alone has reduced the rate of serious accidents involving collisions between pedestrians and Mercedes passenger cars by 13 percent.

The additional protective measures Mercedes-Benz has introduced for the new E-Class are based on these high standards. Top of the bill is a newly developed, active bonnet, which enlarges the deformation area and thus reduces the risk of injury to pedestrians. This system, fitted as standard, includes three impact sensors in the front section as well as special bonnet hinges pretensioned and arrested by powerful springs. Upon impact with a pedestrian, the sensors send information to the electronic control unit which, in turn, activates two solenoids in the hinges instantaneously. These solenoids release the arresters so that the rear section of the bonnet is pushed upwards by 50 millimetres by means of spring force. It all takes just a fraction of a second.

As well as being extremely fast, the newly developed technology has a further crucial benefit: the active bonnet is reversible. If the bonnet is released in another type of collision, for example, Mercedes customers can reset it to its original position and, therefore, reactivate the system themselves, allowing them to continue driving.

In addition to this, the Mercedes engineers have increased the deformation space between the bonnet and the assemblies beneath it by raising the saloon's exterior contours and lowering the engine, shock absorber towers, reservoirs and control units. Like all the latest Mercedes models, the front bumper on the new E-Class features a flush, foam-filled spoiler lip which provides a pedestrian with uniform support at an early stage in a collision.