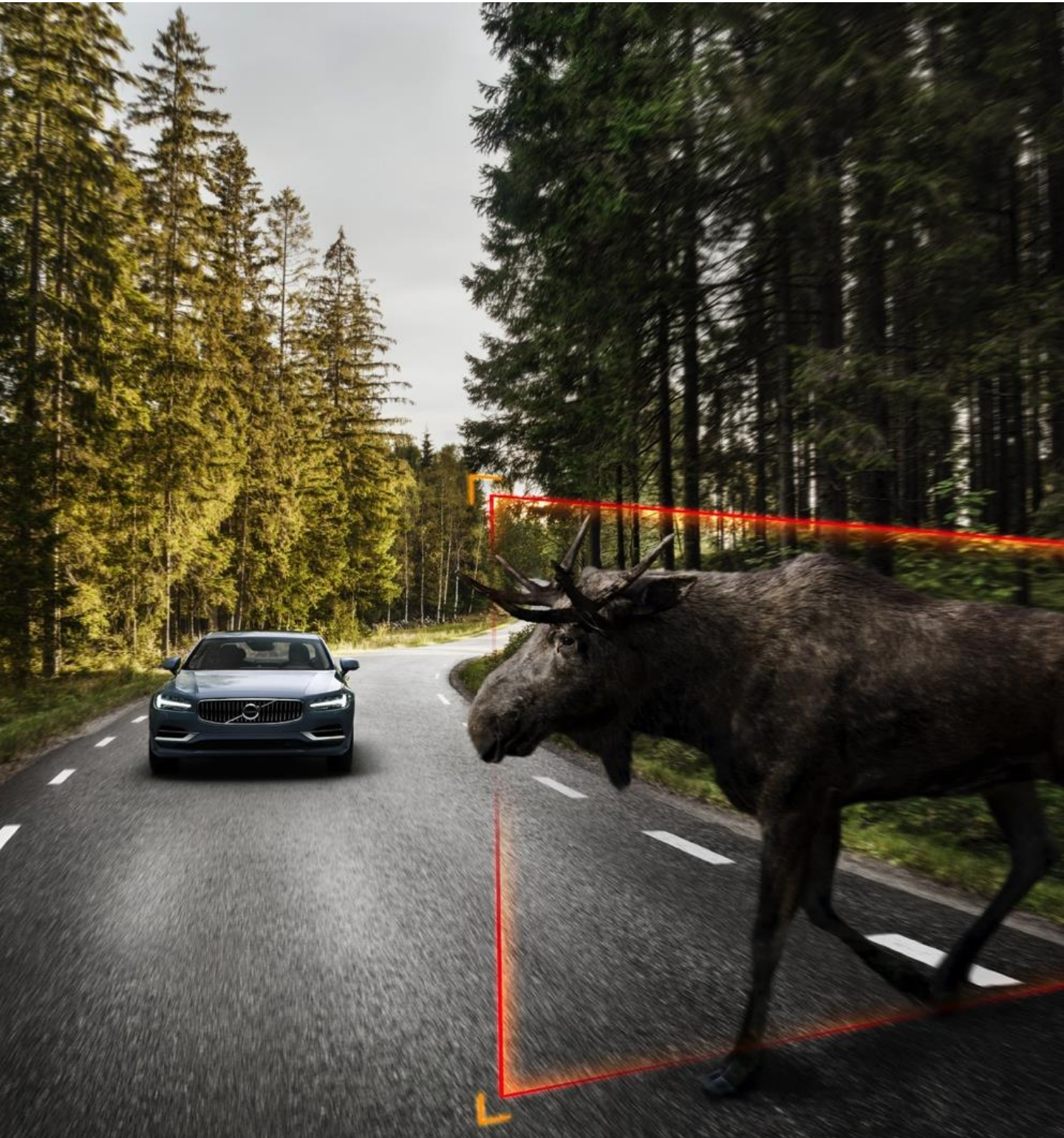




INTELLISAFE

Safety technology in Volvo 90 Series and 60 Series cars





Contents

Volvo Cars' approach to safety	3
City Safety technology	4
• Large animal detection	
• With steering support	
Pilot Assist driver support system	7
Oncoming Mitigation by Braking	8
Oncoming Lane Mitigation	9
Blind Spot Information System (BLIS) with steer assist	10
Lane Keeping Aid	11
Run-off Road	12
Connected Safety	13
Road Sign Information and Speed Limiter	14
Driver Alert Control	15
Rear Collision Warning, Cross Traffic Alert and 360° Camera	16
Park Assist Pilot and Rear Park Assist Camera	17
Automatic Braking and Unlocking after a Collision	18
Seats, airbags and safety belts	19
Swedish steel	20
Child safety	21
Volvo Cars safety innovations	22



Volvo Cars' approach to safety

Industry-leading vehicle safety achieved with unique methods

At Volvo Cars, we always put people and safety first.

We invented the first three-point safety belt in 1959, the first child's booster cushion in 1978, and the Side Impact Protection System (SIPS) in 1991. This 'people and safety' focus started in 1927, when our founders Assar Gabrielsson and Gustaf Larson declared: "Cars are driven by people. The guiding principle behind everything we make at Volvo, therefore is – and must remain – safety."

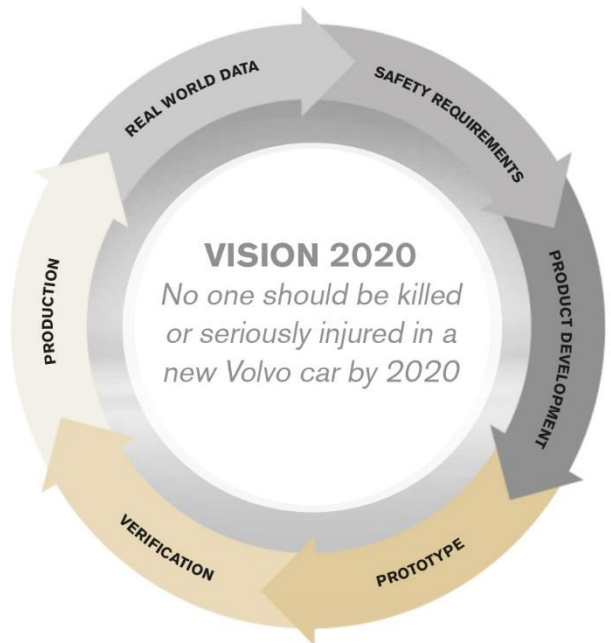
Our in-house Traffic Accident Research Team started in 1970 and continues to be a key component of our unique approach to safety. Each year, this team studies extensive amounts of real-world crash data. This data provides detailed information regarding crash-influencing factors, vehicle technologies and occupant injuries. We have analysed more than 43,000 accidents involving over 72,000 occupants.

Based on this data, our safety engineers set new safety targets and testing protocols, develop technologies and investigate the safety performance of cars in real-world traffic. We call this procedure our Circle of Life.

We follow this unique, systematic, real-life approach because we want to ensure that every new Volvo car is safer than the previous generation.

We are proud that during the past 10 years this procedure has reduced serious injuries for occupants in Volvo cars by 50 per cent.

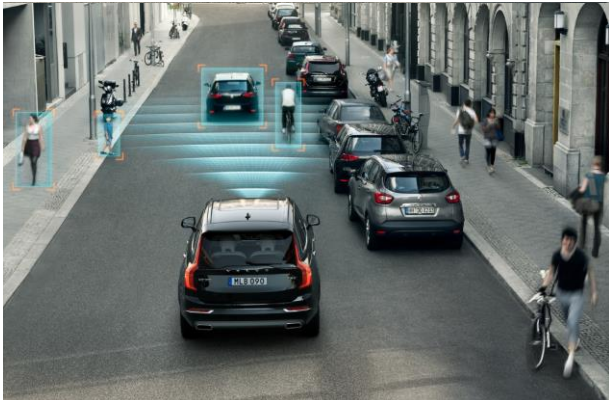
Our vision is that by 2020, no one should be killed or seriously injured in a new Volvo car.



City Safety technology

Driver support for busy traffic

City Safety is the umbrella term for our standard collision avoidance functionalities. All City Safety features are standard and remain active above 4km/h.



Avoiding or mitigating collisions with other vehicles

City Safety first warns the driver and then brakes automatically if the driver does not brake or steer to avoid vehicles (cars, motorcycles, trucks, buses) in front of the car, moving slower in the same direction, braking or not moving. At speed differences up to 60km/h between the car and the vehicle in front, a collision can be avoided when the driver does not react.

At higher speed differences, the collision is mitigated. The driver can take control and brake and/or steer away at any time to avoid the collision. At speeds above 30km/h, the front safety belts tighten to secure the driver's and front seat passenger's position. This automatic safety belt is an option in the 60 Series.

Avoiding or mitigating collisions with cyclists

If a cyclist swerves into or is stationary in the path of the car, the City Safety warns the driver and brakes automatically if the driver does not react. The car's speed can reduce by up to 50km/h to avoid a collision.

Avoiding or mitigating collisions with oncoming vehicles at intersections

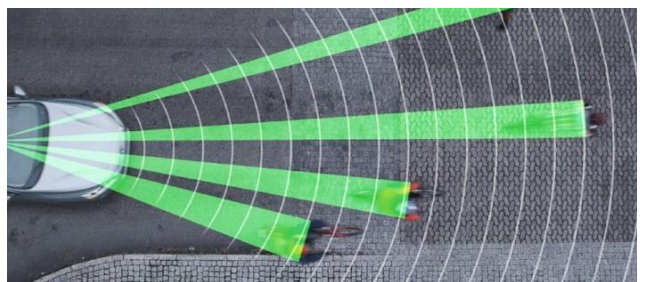
If the driver turns in front of an oncoming vehicle, City Safety can assist by braking automatically, if the driver does not.



If a collision is imminent, at speeds above 10km/h, the front safety belts are tightened (option in 60 Series) to secure the driver's and front seat passengers' position.

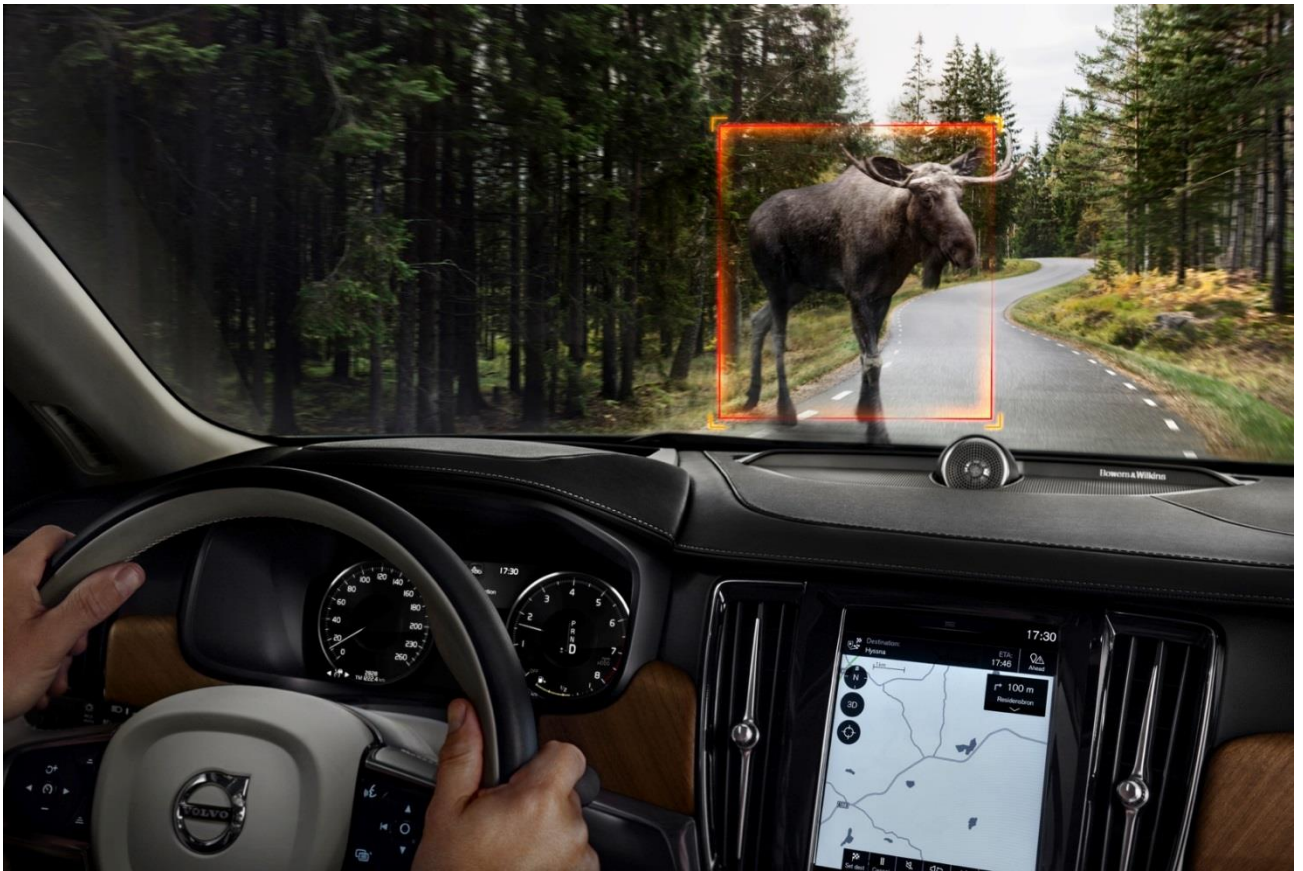
Avoiding or mitigating collisions with pedestrians

If a pedestrian moves into, or crosses the path of the car, or is stationary in the path of the car, City Safety warns and brakes automatically if the driver does not, at speeds up to 80km/h. A collision with a pedestrian can be avoided at speeds up to 45km/h. For speeds between 45 to 80km/h, the collision is mitigated.



City Safety technology

Large animal detection



Avoiding or mitigating collisions with large animals

In addition to detecting vehicles, cyclists and pedestrians, City Safety also detects large animals such as moose, elks and horses.

The radar/camera unit, fitted standard, can detect large animals standing on the road, or slowly moving across it, side-on to the car. The system warns the driver when a large animal is detected. When the driver brakes, additional brake pressure is provided to help avoid a collision when needed.

If the driver does not react, the car applies the brakes to mitigate any impending collision. The car's speed can be reduced by up to 15km/h.

If a collision is imminent, at speeds above 30km/h, the front safety belts tighten to secure the driver's and front seat passenger's position. This safety belt feature is standard in 90 Series cars and optional in the 60 Series cars.

City Safety technology

With steering support



This system helps the driver take evasive action in an emergency situation. If the driver faces a vehicle, a cyclist, a pedestrian, or a large animal in front, braking is not always enough – steering away is sometimes necessary to avoid an accident.

How it works

If steering support detects that the driver is turning the steering wheel to avoid a vehicle, a cyclist, pedestrian, or a large animal in front, it supports the driver in steering away from the threat by:

- braking the inner wheels (during turning) individually to make the turning as effective as possible
- then helping to straighten the direction of travel by braking the outer wheels
- adding to the driver's steering input.

Steering support helps the driver to steer away from the threat as effectively and safely as possible and is always active between 50km/h and 100km/h.

Pilot Assist

Driver support system

Pilot Assist supports the driver with steering, distance and speed control in situations ranging from slow moving traffic jams to free-flowing long distance driving on motorways at speeds up to 130km/h. The system is standard in 90 Series cars and optional for 60 Series cars.

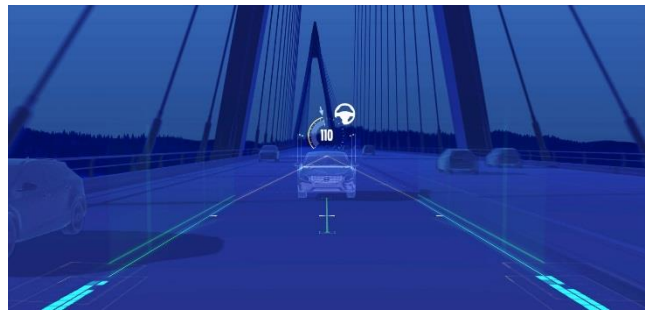
Pilot Assist makes driving safer and more relaxed in monotonous stop-and-go traffic by adding steering assistance to the popular Adaptive Cruise Control.

When Pilot Assist is activated, acceleration, braking and steering assistance helps the driver follow traffic flow within the current lane. This reduces driver strain in tedious situations and increases safety margins.

The system also enhances speed and distance control and achieves a consistent position in the centre of the lane.

Pilot Assist works at speeds up to 130km/h and does not need a lead car, making it useful on long motorway trips where road markings are clear.

Driver support systems operate with restrictions on acceleration, braking and steering. The driver is always responsible for driving the vehicle: hands on the wheel, eyes on the road, mind on driving.



The driver can override the system at any time by using the brake pedal, accelerator pedal or steering wheel. Using the turn indicator will temporarily abort the steering support if the driver wants to change lane.

Pilot Assist alarms and automatically switches off if the driver does not keep a hand on the steering wheel.

Interface

The driver activates Pilot Assist by using the buttons on the left side of the steering wheel. Adaptive Cruise Control settings like time gap and set speed are available and the driver display shows all status information; e.g. steering support on/off.



Oncoming Mitigation by Braking

Auto brake technology for front-to-front collisions

At Volvo Cars, we continue to innovate different safety systems that can operate independently of each other yet work together to improve car occupant safety.

Oncoming mitigation by braking

When the car's sensors detect an impending front-to-front collision with an oncoming vehicle, it will engage auto brake to mitigate the collision by reducing speed by up to 10km/h. The function intervenes late, when the collision is unavoidable.



Oncoming Braking operates independently from the Lane Keeping Aid and uses warnings independent from other functions.



The alert combines a Collision Avoidance warning sound with an indication in the driver display and, where available, also on the head-up display.

The pre-crash safety belt tensioner will engage to secure the driver's and front seat passengers' position before the crash (option in 60 Series).

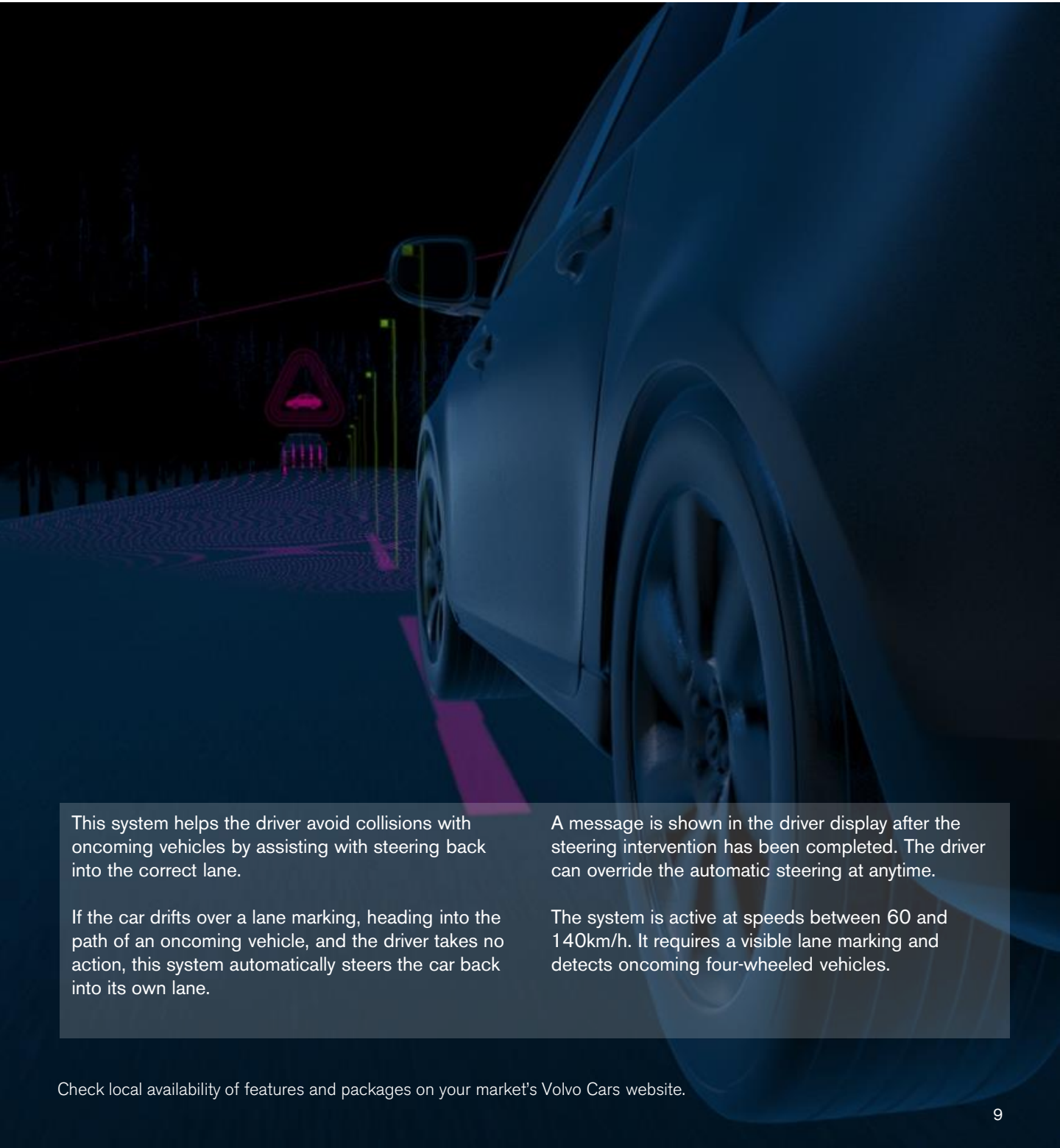
INTELLISAFE

Preventive safety systems



Oncoming Lane Mitigation

Steering out of harm's way



This system helps the driver avoid collisions with oncoming vehicles by assisting with steering back into the correct lane.

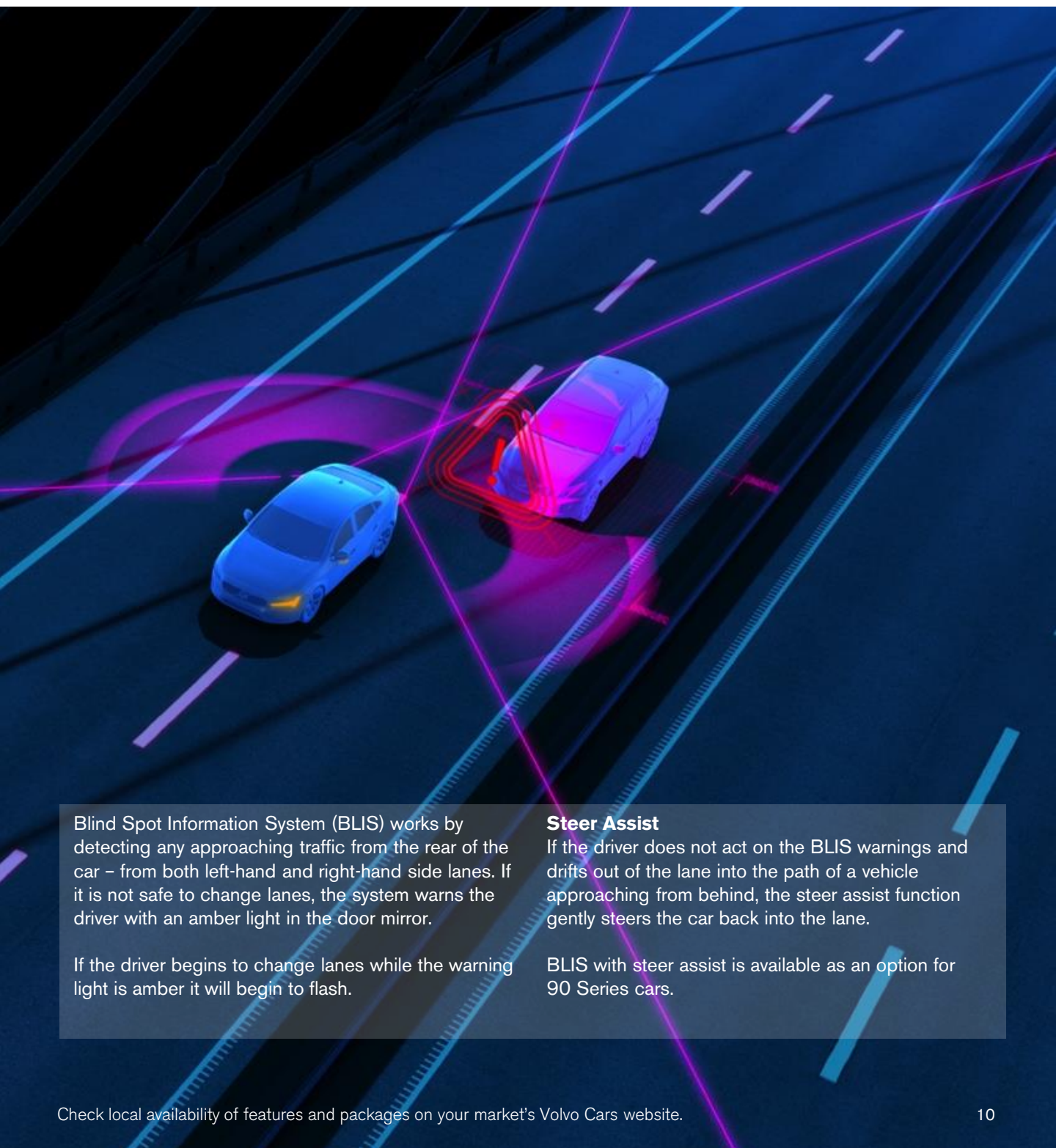
If the car drifts over a lane marking, heading into the path of an oncoming vehicle, and the driver takes no action, this system automatically steers the car back into its own lane.

A message is shown in the driver display after the steering intervention has been completed. The driver can override the automatic steering at anytime.

The system is active at speeds between 60 and 140km/h. It requires a visible lane marking and detects oncoming four-wheeled vehicles.

BLIS with steer assist

Added functionality for the Blind Spot Information System



Blind Spot Information System (BLIS) works by detecting any approaching traffic from the rear of the car – from both left-hand and right-hand side lanes. If it is not safe to change lanes, the system warns the driver with an amber light in the door mirror.

If the driver begins to change lanes while the warning light is amber it will begin to flash.

Steer Assist

If the driver does not act on the BLIS warnings and drifts out of the lane into the path of a vehicle approaching from behind, the steer assist function gently steers the car back into the lane.

BLIS with steer assist is available as an option for 90 Series cars.

INTELLISAFE

Preventive safety systems



Lane Keeping Aid

Staying between the lines

Lane Keeping Aid is a standard-fitted system that helps the driver to keep the car in its lane by gently steering the car back if it is about to cross a lane marking. It activates if the car senses that the driver is not driving actively, for example, not using the indicators.

If the supplied steering intervention is insufficient, the driver is alerted by vibrations in the steering wheel.

The system uses the windscreen-mounted camera and relies on visible lane markings. This system can be switched off in the car settings and feedback can be set to vibration of the steering wheel only, vibration and intervention, or just intervention.

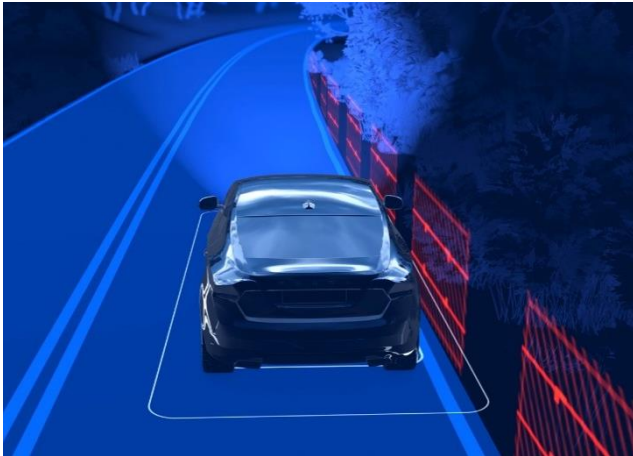
The system is active at speeds of 65 to 200km/h.



Run-off Road

Mitigation and occupant protection

Running off the road is amongst the most common causes of single-vehicle accidents. To combat this, we have developed two systems designed to avoid a run-off road accident occurring, and to protect the car's occupants in the case of an unavoidable road departure.



Run-off Road Mitigation

Run-off Road Mitigation is designed to prevent unintentional road departure at vehicle speeds between 65 and 140km/h.

The causes of run-off road accidents include driver inattentiveness, fatigue or poor weather conditions.

When a potential run-off road situation arises, torque can be applied to the steering to support the driver, along with braking action. The system can always be overridden by the active intervention of the driver.

Run-off Road Protection

The technology uses input from the car's advanced sensor system to detect a run-off road scenario.

When a run-off road situation is unavoidable, the front safety belts automatically tighten to keep the occupants in position. This feature is standard in 90 Series cars and optional in 60 Series cars.

To help to reduce spine injuries, we have designed an energy-absorbing functionality between the seat and seat frame. This design deforms mechanically to cushion the vertical forces that can arise when the car encounters a hard landing.

Connected Safety

Integrating technology to improve driver awareness



At Volvo Cars, we always approach product development from a human-centric perspective. We utilise the best available technologies to integrate useful features and services into Volvo cars, because in-car connectivity can improve safety and peace of mind.

Connected Safety is one example of this. We use the car's internet connection to deliver real-time Connected Safety information to the driver via pop-up icons in the driver display. We are developing a number of systems using this functionality to make driving safer and more enjoyable:

Slippery Road Alert*

Increases the driver's awareness of conditions of the current road and the road ahead.

Road friction is measured during steering, braking and/or acceleration. If the friction is below a certain level, the driver receives a slippery road alert in the driver display.

The cloud sends slippery road alerts to connected Volvo cars approaching a low friction zone.

Hazard Light Alert*

Alerts the driver to vehicles on the road ahead that have activated their hazard lights.

Awareness of vehicles along the road ahead makes it possible for drivers to prepare and adapt their driving style to safely handle the situation.

*Slippery Road Alert and Hazard Light Alert are available as standard in 90 Series and 60 Series cars in Sweden and Norway.

Road Sign Information & Speed Limiter

A reminder to reinforce safe driving

At Volvo, we understand that drivers can have a lot on their minds. So we developed Road Sign Information and Speed Limiter features to help remind drivers of the current speed limit.

Road Sign Information

Nearby road signs are displayed in the lower part of the speedometer, or on the head-up display, if fitted. The system can display European and US speed limit signs – including variable speed limit signs – and supplemental sign information, as well as some of the more important European prohibition signs.

The driver can activate/deactivate a speeding alert in the menu system, including a desired offset speed to the detected speed limit. If speeding alert is activated and the driver exceeds the limit, plus the chosen offset, a speed limit sign icon will flash in the speedometer.

Information about speed cameras is automatically presented when Road Sign Information is activated. If the speeding alert function is activated and the car exceeds the speed limit when approaching a speed camera, a speeding alert warning is issued as described above. No offset speed is considered when approaching speed cameras.

If the car is equipped with Sensus Navigation, speed related information is fetched from the navigation unit in the following cases:

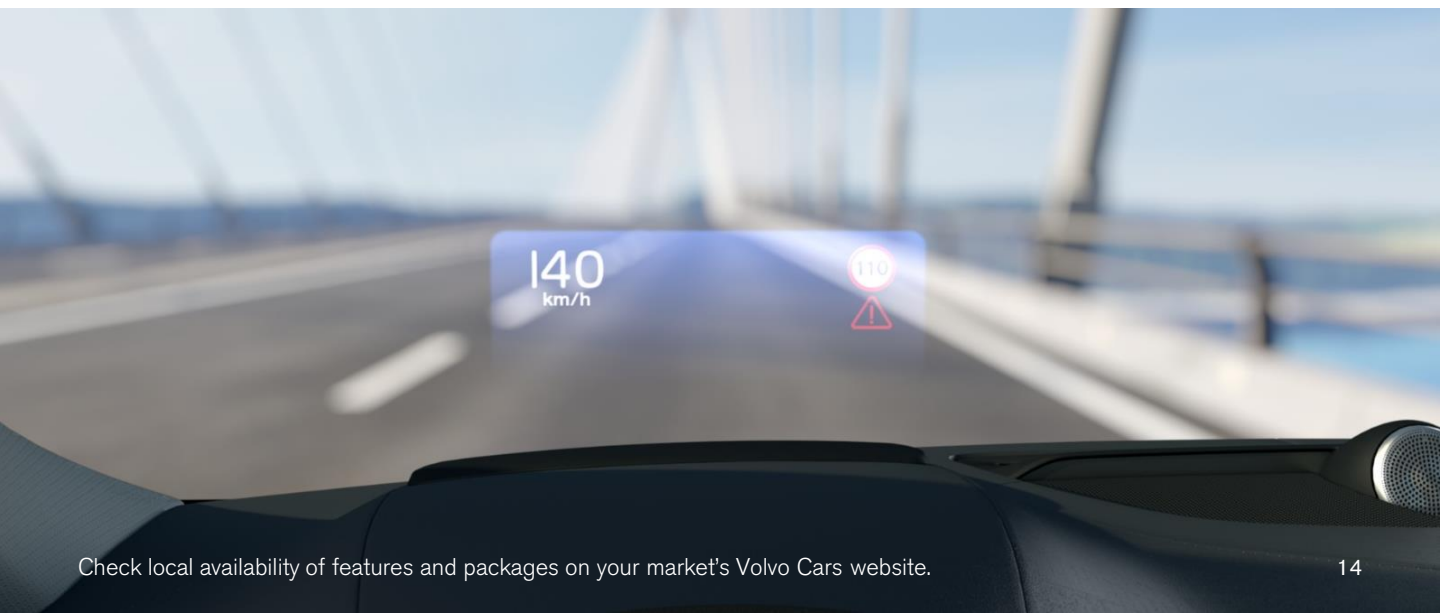
- when passing indirect speed limit signs such as highway, motorway and city signs
- if a previously detected sign is judged not to be valid anymore and no new sign has been passed.

The driver can activate a warning sound for the no-entry sign warnings and speeding alert (disengaged by default).

Speed Limiter

This function limits the speed of the car to that set by the driver, or set automatically with information from the Road Sign Information system.

The driver can exceed the set limit by depressing the accelerator fully for a moment and then choose to drive above the set speed. This is useful for overtaking manoeuvres. When the speed falls below the set speed, the Speed Limiter will resume its function. The set speed is shown in the driver display.



Driver Alert Control

It's time for a break...



Distraction, lack of concentration and falling asleep are major reasons for accidents.

In 2007, Volvo Cars introduced a world-first technology to combat this danger. Drive Alert Control keeps track of the car's path in relation to lane markings on either side, using the camera in the windscreen.

If the system detects that the car is being driven in an erratic manner, the driver is alerted with an audible signal, plus a driver display text message and coffee cup symbol, to indicate that it is time to take a break.

With Sensus Navigation, the driver is also guided to the next upcoming break stop.

Rear Collision Warning, Cross Traffic Alert and 360° Camera

A protective eye on the city

Rear Collision Warning with braking at standstill

If a vehicle is approaching from behind and the system calculates a risk of a collision, it flashes all indicators at a higher rate than the regular indicator/hazard warning light rate, to alert the driver to the risk of the approaching vehicle..

If the system calculates that a vehicle is about to hit the car from behind, it tensions the safety belts just before the collision. If the car is at a standstill, the system also activates full auto-braking.



Cross Traffic Alert

If reversing with a limited field of view (e.g. parking space) on the rear left and right sides, radar units inside each corner of the rear bumper detect vehicles approaching at distances up to 30m. The system may also under optimal conditions detect smaller objects, such as cyclists and pedestrians, at shorter distances.

The driver is alerted by a directional audible warning from the rear speakers and by a graphic on the centre display. If reversing continues and a collision is imminent, the car auto-brakes to avoid the collision (the brake function is only available in the 60 Series).



360° Camera

With this option, the driver sees a virtual picture bird's-eye view of the car's surroundings, shown on the centre display. Objects close to the car are visualised with graphic elements.

The 360° view is built with information from four cameras around the car. The cameras can be selected separately to support the driver in different parking situations.



Park Assist Pilot and Rear Park Assist Camera

Parking has never been easier

Park Assist Pilot

The Park Assist Pilot facilitates both parallel and perpendicular (bay) parking by taking over and operating the steering wheel while the driver handles the gearbox and controls the car's speed.

The parking manoeuvre is based on information from ultrasonic sensors around the car. When a space for parallel or bay parking is detected, the car will ask the driver for confirmation. The Park Assist Pilot then guides the driver step by step with text and animations in the instrument display until the car is parked.

The function can also assist the driver in manoeuvring out of a parallel park. The steering is returned to the driver once the car has moved out of the parking space.

Rear Park Assist Camera

A rear-view camera is available as an option. It is hidden beside the opening touch-pad for the tailgate.

When the driver engages reverse gear, a wide view behind the car is shown on the centre display. Lines on the display show the path the rear wheels will take according to the steering wheel angle. Dotted lines indicate the exterior dimensions of the car (this can be switched off in the menu system). The camera can also be switched to a zoomed-in view to further assist the driver in viewing the towing area.



Automatic braking and unlocking after a collision

Bringing the car to a safe standstill



Automatic braking

After a collision where the safety belt pre-tensioners and/or one or more airbags have been deployed, and/or a collision with a large animal is detected, the brakes are automatically activated.

Automatic unlocking

If the car's systems sense a frontal, side or rear impact, or rollover, the car is unlocked (if it was already locked manually or automatically).

Seats, airbags and safety belts

Seats

Our current generation seats have strong frames made of different grades of steel, to ensure safety, flexibility and comfort. All seats have anti-submarining protection integrated into the design, for the best possible occupant interaction with the safety belt.

The energy-absorbing functionality between the seat and seat frame helps to reduce spine injuries. It deforms mechanically to cushion the vertical forces that can arise when the car encounters a hard landing. The seats also play a vital role in the event of side impact or rear impact, working with our SIPS and WHIPS technologies.

Whiplash Protection System

Relative movements in the cervical spine can cause pain in the neck, often referred to as whiplash injuries, the most frequent car occupant type. In some cases it can result in long term pain and suffering. Although it can be a result of any crash situation, the highest risk is when hit from behind. Volvo Cars has been the pioneer in this area, introducing head restraints in 1970, designed high in position, rigidly attached and close to the head.

In 1998, we introduced world-first whiplash protection system with integrated functionality in the front seats, called WHIPS. These seats are world-leading in whiplash protection, based on real-world data, and are the benchmark for international test methods (eg. IIHS and EuroNCAP).

Since 2015, the second generation of WHIPS has taken occupant protection in new Volvo cars to another level.

Our whiplash protection system incorporates the design of the whole seat, including the head restraints. If the car is hit from behind, the seats are designed to provide an even support and to absorb the energy, minimising the impact to and the relative movements in the cervical spine.

Airbags

New Volvo cars contain a range of airbags designed to help protect the occupants in the event of a crash. The collision is detected by advanced sensors that will activate the airbags when they are needed. The airbags act as a supplement to the safety belt and other protection systems, and are included where needed.

The **driver airbag** is positioned in the centre of the steering wheel. The airbag is designed together with the safety belt and with the energy absorbing steering column to minimise forces on the driver in the event of a frontal impact.

The **frontal passenger airbag** is incorporated in the dashboard. Together with the safety belt, the airbag is designed to help protect the front seat passenger. In some markets, the airbag can be switched off to accommodate rearward facing children.

Side airbags

Side airbags were pioneered by Volvo in 1994. They are designed to distribute the forces generated in a side impact and to absorb the resulting energy. The side airbags are integrated into the outer sides of the front seat backrests and help protect the front occupants in the event of a crash where there is a lateral component.

Inflatable curtains

Inflatable curtains were a world first introduced by Volvo in 1998. These airbags are integrated in the longitudinal part of the roof above the doors. They inflate from the top down providing added protection for the head for the occupants in all seating rows.

Safety belts

Safety belts are rarely communicated today as they have been standard on all cars for decades. It can be worth remembering, however, that the three-point safety belt was first put into production by Volvo Cars, having been designed by Volvo engineer Nils Bohlin. This was in 1959, years before it would be available on most cars. Volvo also pioneered safety belts in the rear seat and a three-point safety belt on the rear-seat mid-position. The rear safety belts are not only vital for the passengers using them, but also for the occupants in front.

The three-point safety belt is seen as one of the most important inventions for mankind and it is definitely the most important protective safety feature in the car. Here are some of the features that now define the latest safety belt technology in Volvo cars:

Comfort is an important part of safety belt design. It ensures the highest possible safety belt usage. This is why Volvo provides height adjusters. The design allows movement and flexibility and keeps the safety belt always taut over the body.

Safety belt reminders: Volvo was the first carmaker to install safety belt reminders back in the 1970s.

Safety belt pre-tensioners: In a collision, pyrotechnical pre-tensioners on all seats automatically tighten the belts across the body to reduce the occupant's movement and help provide maximum protection.

Safety belt load-limiters: Load-limiters absorb energy in a controlled way to reduce forces on the human body during a crash.

Swedish steel

The Volvo Cars safety cage



XC90

To help keep the occupant space inside intact in a crash, the Volvo 90 Series and 60 Series cars are made stronger in every sense. This is achieved with a more extensive use of hot-formed boron steel, the strongest type of steel currently used in the car industry.

The complete safety cage around the occupants is made from hot-formed boron steel and is designed for maximum occupant protection in all types of crash scenarios.








V90

Safety cage with patented front structure:
The hot-formed steel is a significant amount of the total body weight – XC90, 40%; S90, 35%; V90, 35%; V90 Cross Country, 35%; XC60, 34%; V60, 33%.



S90

-  Mild steel
-  High strength steel
-  Very high strength steel
-  Extra high strength steel
-  Ultra high strength steel
-  Aluminium



XC60



V60

Child safety

Protecting what's important

At Volvo Cars, we look at child safety with both the car and child seat in mind, making them work together in the best way to ensure children have a safe journey. In 1978, we introduced the world's first booster cushion for children in cars. This is one example of our long tradition of child safety. Today, we have a wide range of standard and optional features designed with children in mind:

Rearward facing child seats

The safest way of travelling in a car is rearwards. Therefore, babies and young children should travel facing the rear of the car for as long as possible.

Our infant and toddler child seats are pure rearward facing. The child seat can accommodate a child up to 25kg. The child seats are easy to install, adjust and remove thanks to the compact design. The seats are upholstered in the new Volvo material, Wooltextile, which contains 80 per cent wool.

Integrated child seats

A number of models have integrated booster seats available as an option – a very user-friendly form of child restraint.

Booster seat and booster cushion with backrest

Our booster seat and the latest incarnation of our classic booster with backrest have cushions upholstered in the new Volvo material, Wooltextile. They are designed for children aged 4-10 years (up to 36kg).

ISOFIX anchorages

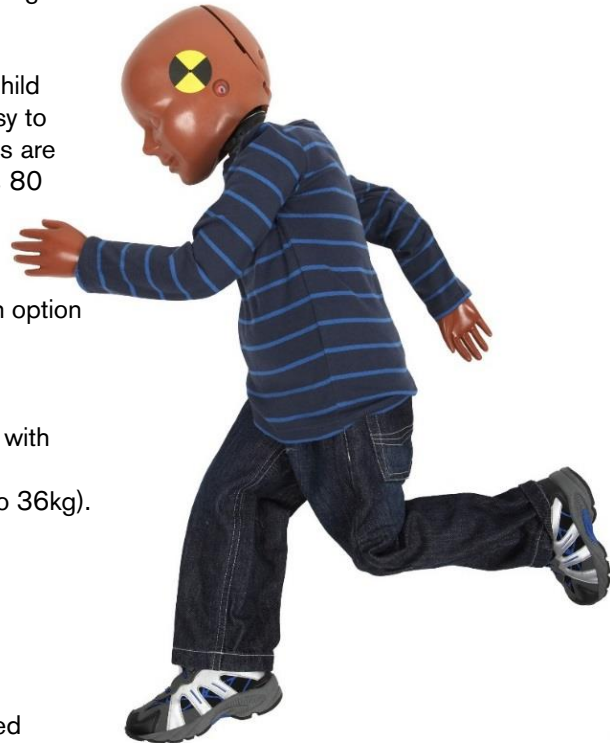
Internationally standardised ISOFIX child seat anchorages are standard-fitted on the two outer second-row seats.

Child safety locks

Manual rear-door child safety locks are standard. They are operated individually for each of the rear doors by opening the door and activating a mechanical locking device in the door end. In locked position, the door cannot be opened from inside.

Power child safety locks

Power-operated child safety locks are available as an option. They are controlled for both of the rear doors with a button on the driver's door. As with the standard-fitted manual child safety locks (which they replace), they lock the interior door handles so the doors cannot be opened from inside.



Volvo Cars safety innovations

A history of world firsts

- 1959** Three-point safety belts introduced as standard equipment in front seats
- 1972** Volvo rearward facing child seat
- 1978** Child safety booster cushion
- 1986** Three-point safety belt introduced in rear centre seat
- 1991** Side Impact Protection System (SIPS)
- 1994** Side Impact Airbags (SIPS-bag)
- 1998** Whiplash Injury Protection System (WHIPS)
- 1998** Inflatable Curtain (IC)
- 2002** Rollover Stability Control (RSC) using gyro sensor and DSTC
- 2003** New patented Front Structure
- 2003** Intelligent Driver Information System (IDIS)
- 2004** Blind Spot Information System (BLIS)
- 2005** Door Mounted Inflatable Curtain (DMIC)
- 2007** Integrated 2-stage booster cushions and safety belts load limiter adapted for children
- 2008** City Safety
- 2012** Pedestrian Airbag Technology
- 2012** SARTRE (Safe Road Trains for The Environment) on public roads (research project)
- 2013** Cyclist Detection with Full Auto Brake
- 2014** Auto brake in intersections
- 2014** Run-off Road Protection
- 2015** Large animal detection
- 2015** Run-off Road Mitigation
- 2018** Oncoming Mitigation by Braking

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V O L V O