

Safety

- **Torsional rigidity improved by 68% compared with previous Volvo S40**
- **Patented zonal front structure controls vehicle deformation**
- **SIPS (Side Impact Protection System) with side airbags and IC (Inflatable Curtain) airbags for front and rear passengers**
- **Twin front 'intelligent' airbags**
- **Five three-point seatbelts with pre-tensioners**
- **Volvo's WHIPS (Whiplash Protection System) fitted as standard**
- **Rear seat belt reminders**
- **Curved front section designed to protect pedestrians and cyclists**
- **Passenger Airbag Cut Off Switch now available**

In brief:

The target for the designers of the Volvo S40 was to match the safety performance of the much larger Volvo S80. Meeting this target meant adopting a new approach to structural design. The torsional rigidity of the new model is 68% greater than that of its predecessor and the front structure of the car is broken up into different deformation zones using different strengths of steel to absorb impact and protect the cabin.

In the event of a front impact, occupants are further protected by "intelligent" airbags and seatbelts with pretensioners.

Volvo's WHIPS (Whiplash Protection System) is standard and reduces the risk of back and neck injuries in a rear impact, and the Volvo SIPS (Side Impact Protection System) includes side airbags and an Inflatable Curtain (IC) that protect both front and rear occupants.

In full:

Volvo's commitment to safety is as old as the company itself. As, Assar Gabrielsson, one of the founders of Volvo declared: "Cars are driven by people. The guiding principle behind everything we make at Volvo therefore, is – and must remain –

safety.” The engineers’ safety target for the new Volvo S40 was as simple as it was challenging – it was to replicate the high level of safety offered by the much larger Volvo S80.

“This was a tough challenge and one that we approached in an entirely new way,” says Ingrid Skogsmo, the head of the industry-leading Volvo Cars Safety Centre. In a compact bodyshell, the deformation must be absorbed in a much shorter distance than in a large car. The torsional rigidity of the new car is 68% greater than it was for the old model which improves its crash-worthiness, but to achieve the desired deformation characteristics, Volvo’s engineers had to adopt a novel and ingenious approach to the design of the frontal structure.

The structure of the all-new Volvo S40 has been divided into different zones and different grades of steel were employed in each area. The outer zones are responsible for most of the deformation, while those closest to the passenger compartment are designed to remain largely intact, protecting the occupants. The zonal system is one of Volvo’s many patented safety designs.

Low speed deformation zone – the front bumper incorporates a rigid crossmember of Boron steel (Ultra High-Strength Steel). This section takes the form of a ‘crash box’ which is capable of absorbing the forces of a low-speed collision without damaging the rest of the body structure. The crash boxes can then be replaced individually, reducing repair costs.

High speed deformation zone – The straight sections of the side members are made of High-Strength Steel, which is optimized for high energy absorption. The addition of upper side members provides significant protection should the vehicle collide with, for example, a truck. This zone accounts for most of the deformation in a collision.

Back-up zone - The section around the A-pillar acts as a barrier for the passenger compartment. Made of extra high-strength steel, this structure is extremely rigid and also helps to prevent the front wheels penetrating the cabin.

Three-way attachment – A rigid cross-member connects the A-pillars and the lower side members. On each side they form a rigid three-way attachment, which helps to maintain the integrity of the cabin in a severe crash.

The Volvo S40's high-tech engines also make a valuable contribution to its crash performance. The five-cylinder units are 200mm slimmer than those found in the larger Volvo saloons and this helps liberate space between the engine and passenger compartment. In a collision, the engine can be pushed 150mm rearwards with many parts, such as the battery, designed to move to pre-destined positions, before the engine block makes contact with the cross-member near the bulkhead.

Many of the advanced interior systems from the Volvo S80 have also been incorporated into the design of the Volvo S40. The steering column deforms by up to 140mm in a horizontal plain, so that the driver's airbag remains in the optimal position. In the event of a severe impact the pedal assembly will also collapse to prevent injury to the driver's lower legs.

The two front airbags are "intelligent" and deploy in two stages according to the severity of the accident, alleviating the risk of facial injuries caused by the occupant's faces impacting with the airbag. They are complemented by three-point safety belts with tensioners, which are fitted for all five occupants. The tensioners activate within a few thousandths of a second in the event of a collision and tighten the belt for maximum protection. The front seat safety belts then release a little so that the driver and passenger are cushioned by the airbags in a controlled manner. A seatbelt reminder system is fitted in the front and rear of the car – and is activated if any of the occupants fail to buckle their seatbelt.

The Volvo S40's side impact protection is no less impressive. The all-new model is 50mm wider than its predecessor, which liberates extra space for deformation in the event of a collision. The dynamics of the Side Impact Protection System (SIPS) are then shared with the larger Volvo S80. A large part of the force of a collision that would otherwise penetrate through the side of the car, is dissipated by SIPS via beams, pillars, the floor, the roof and other parts of the car body.

The side impact airbags then play an important role in protecting the chests of the occupants. They are fitted in the outer edge of the front seats, not in the door, which ensures that they're always securely positioned next to the occupant's side, whatever the position or angle of the seat. They are also larger than they were in the previous generation Volvo S40 to provide more effective hip and chest protection.

Further protection is provided by the IC (Inflatable Curtain) airbag, which sits in the headlining and protects both front and rear occupants. In the event of a side impact, the Curtain inflates in a few thousandths of a second and then remains inflated for about three seconds in order to provide maximum protection throughout complex collision sequences.

The Volvo S80 also debuted the WHIPS (Whiplash Protection System), which is now fitted across the Volvo range and helps prevent neck and back injuries in a rear impact. In the event of an accident, the entire backrest moves rearwards to reduce the strain on the occupant's back and neck. Then, when their back has been safely restrained by the backrest, it inclines backwards in order to reduce the force that would otherwise throw their head forwards. WHIPS reduces acceleration forces on the neck by about a half.

The WHIPS front seats have been made deliberately robust so that they can withstand high loads from items such as unsecured luggage, but they are also capable of yielding in the event of a severe crash, when strength and flexibility are both required. "Our seats are far sturdier than those usually found in the compact segment," says Skogsmo.

Volvo's engineers have also made special provision for protecting the next generation. Both of the outer rear seats can be fitted with integrated child booster cushions for children above three years of age. An optional Passenger Airbag Cut Off Switch is available, which, as its name suggests, means the front passenger airbag can be disabled with a key.

Protection for other road users

The all-new Volvo S40 has been designed to minimise the risk of injury to pedestrians and cyclists in the event of an accident. The smoothly shaped front has an energy absorbing structure ahead of the bumper which serves to reduce the risk of leg injuries. The bonnet and front wings have also been designed to absorb collision energy and the petrol engined models have a generous amount of free space between the top of the cylinder head and the bonnet, which reduces the risk of pedestrian head injuries.