

SAFETY

In brief:

- Torsional rigidity improved by 68% compared with original Volvo S40.
- Patented zonal front structure controls vehicle deformation.
- Extensively crash tested in Volvo's award winning Safety Centre.
- SIPS (Side Impact Protection System) with side airbags and IC (Inflatable Curtain) airbags for front and rear passengers.
- Twin front 'intelligent' airbags.
- 'Best' class of Thatcham's "2005 Dynamic Seat Assessments".
- Five three-point seatbelts with pre-tensioners.
- Volvo's WHIPS (Whiplash Protection System).
- Rear seat belt reminders.
- Softer, curved front section designed to protect pedestrians and cyclists.
- Passenger Airbag Cut Off Switch available.

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 target for the designers of the Volvo S40 was to match the safety performance of the much larger Volvo S80 saloon. 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. Occupants are further protected by "intelligent" airbags and seatbelts with pretensioners, and if rear seat passengers do not wear a seat belt, a message is displayed on the instrument panel to alert the driver.

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.

All Volvo's car models tested by the International Insurance Whiplash Prevention Group (IIWPG), which includes the UK's Motor Insurance Repair Research Centre

in Thatcham, were found in the top 'best' class of their "2005 Dynamic Seat Assessments". Volvo was the only manufacturer to achieve this result.

"We are very pleased that the Volvo seats have performed in line with our expectations", says Ingrid Skogsmo, Safety Director at Volvo Car Corporation. "Tests only show a part of what happens in real life. However, this is one of several results that confirm Volvo has the right approach to help reduce neck injuries in rear impacts."

In full:

- Torsional rigidity improved by 68% compared with original Volvo S40.
- Patented zonal front structure controls vehicle deformation.
- Extensively crash tested in Volvo's award winning Safety Centre.
- SIPS (Side Impact Protection System) with side airbags and IC (Inflatable Curtain) airbags for front and rear passengers.
- Twin front 'intelligent' airbags.
- 'Best' class of Thatcham's "2005 Dynamic Seat Assessments".
- Five three-point seatbelts with pre-tensioners.
- Volvo's WHIPS (Whiplash Protection System).
- Rear seat belt reminders.
- Softer, curved front section designed to protect pedestrians and cyclists.
- Passenger Airbag Cut Off Switch available.

Volvo's commitment to safety is as old as the company itself. As, Assar Gabriellsson, 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.

Impact protection

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.

The airbags 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 for both front and rear seats – the front alerts the driver with an audio signal, while the system for the rear seats informs the driver via a message on the instrument panel.

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.

WHIPS

All Volvo cars tested by the International Insurance Whiplash Prevention Group (IIWPG), which includes the UK’s Motor Insurance Repair Research Centre in Thatcham, were found in the best class of their “2005 Dynamic Seat Assessments”. Volvo Car Corporation was the only manufacturer to achieve this result.

“We are very pleased that the Volvo seats have performed in line with our expectations”, says Ingrid Skogsmo, Safety Director at Volvo Car Corporation. “Tests only show a part of what

happens in real life. However, this is one of several results that confirm Volvo has the right approach to help reduce neck injuries in rear impacts."

The Volvo S80 showcased the WHIPS (Whiplash Protection System), to help prevent neck and back injuries in a rear impact, and is now fitted across the Volvo range. WHIPS reduces acceleration forces on the neck during a rear-end accident by about a half. In the event of an accident, and works by 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.

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 traffic accident research team compared real-life whiplash injuries from Volvos with and without WHIPS, and the results point to a clear conclusion: WHIPS reduced short term and long term (of more than a year) injuries by 33 per cent and 54 per cent respectively, with whiplash injuries in women these were reduced by as much as 50 per cent and 75 per cent, respectively.

All Volvo car head restraints were placed in the highest category in the 'New Car Whiplash Rating' published by the Thatcham Motor Insurance Repair Research Centre. Static tests were carried out to measure the design and position of head restraints in 500 car models.

"We are very proud of coming out so well," says Volvo Car Corporation's safety engineer and whiplash specialist, Lotta Jakobsson. "Volvo has long understood how important head restraints are, and led the industry in introducing them.

"However, static evaluations of head restraints only show a part of what happens in real life accidents. That is why Volvo has invested over a decade's research into crash testing and analysis of real accidents, and introduced its Whiplash Protection System – 'WHIPS'.

In October 2002, the United States Insurance Institute for Highway Safety (IIHS) compared car seats with and without whiplash protection, and achieved an average injury reduction of 49 per cent.

Like Volvo, the Swedish insurance company, Folksam, also compared real-life accidents, and showed that WHIPS seats reduced whiplash injury by 40 per cent. Folksam also crash tested seats from different 2003 cars and Volvo seats were considered the best, with an overall whiplash injury reduction in the region of 50 per cent possible, if all cars had seats as good as Volvo.

Pedestrian safety

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.

Child Safety

A passenger airbag cut-off switch is now available to enable a child seat to be carried in the front of the car, while in the rear Volvo has also paid special attention to child safety with the option of an integrated booster cushion built into the rear centre armrest designed for children aged between 4 and 10.

In addition, two integrated booster cushions are also available for the rear seats.