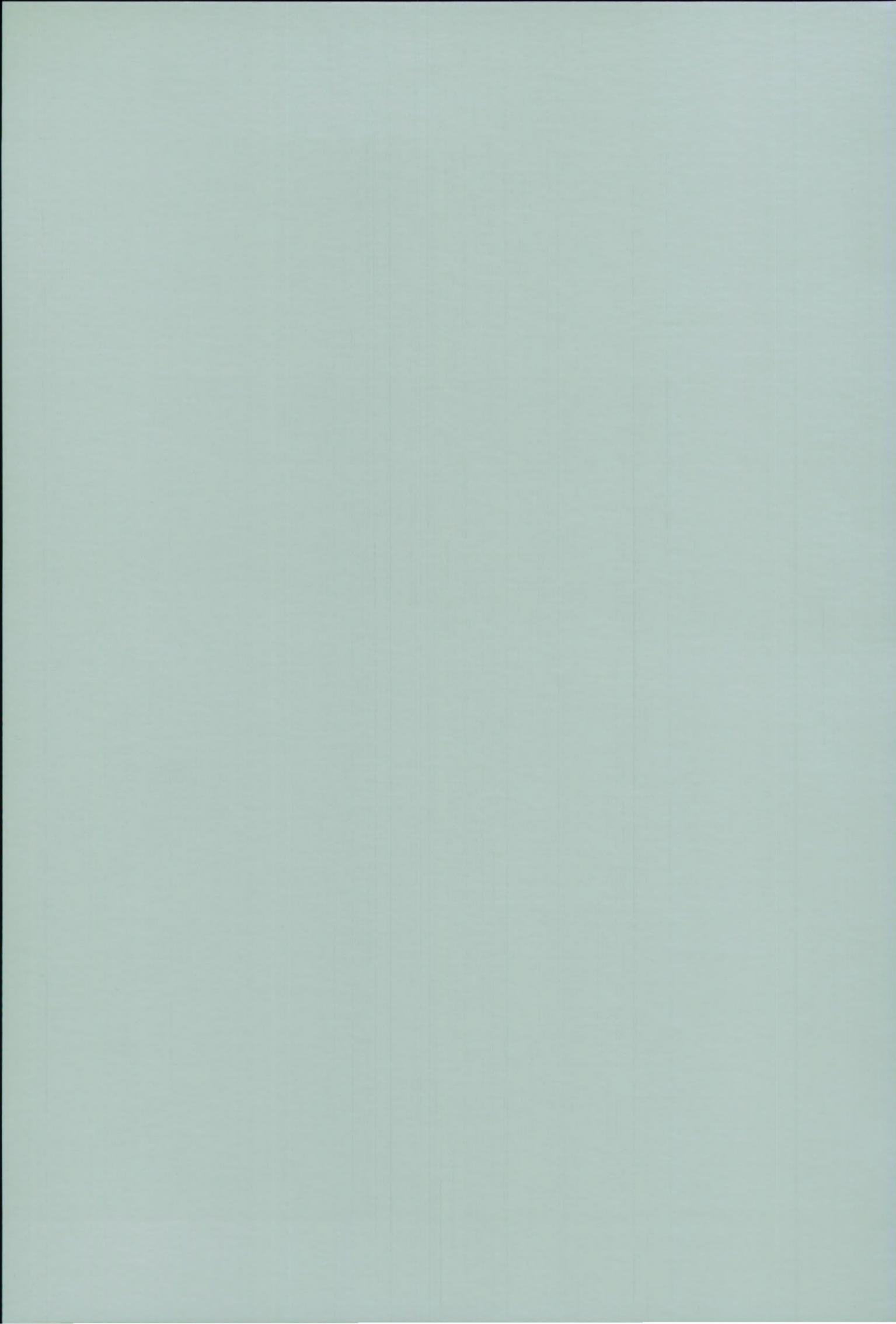


VOLVO S80

TECHNICAL PRESENTATION



VOLVO



EXCITINGLY SAFE

A TECHNICAL
PRESENTATION



V O L V O S 8 0



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LUK 456

Innovative technology in everyone's best interests – when it comes to both products and processes.

These are words that very definitely characterise the new Volvo car project, the Volvo S80. A car that perhaps more than any other previous Volvo model represents a break with tradition and the proud continuation of the Volvo heritage into the next millennium. Exciting and different in the eye of the observer, yet recognisable as a Volvo from most angles.

The Volvo S80 is the first car to be built on the new large platform, one of the two platforms which will be used for future Volvo cars. One large, one smaller.

This is a major step forward in car technology – in a package characterised by bold design, fine handling and driving properties, superb comfort and an impressive presence.

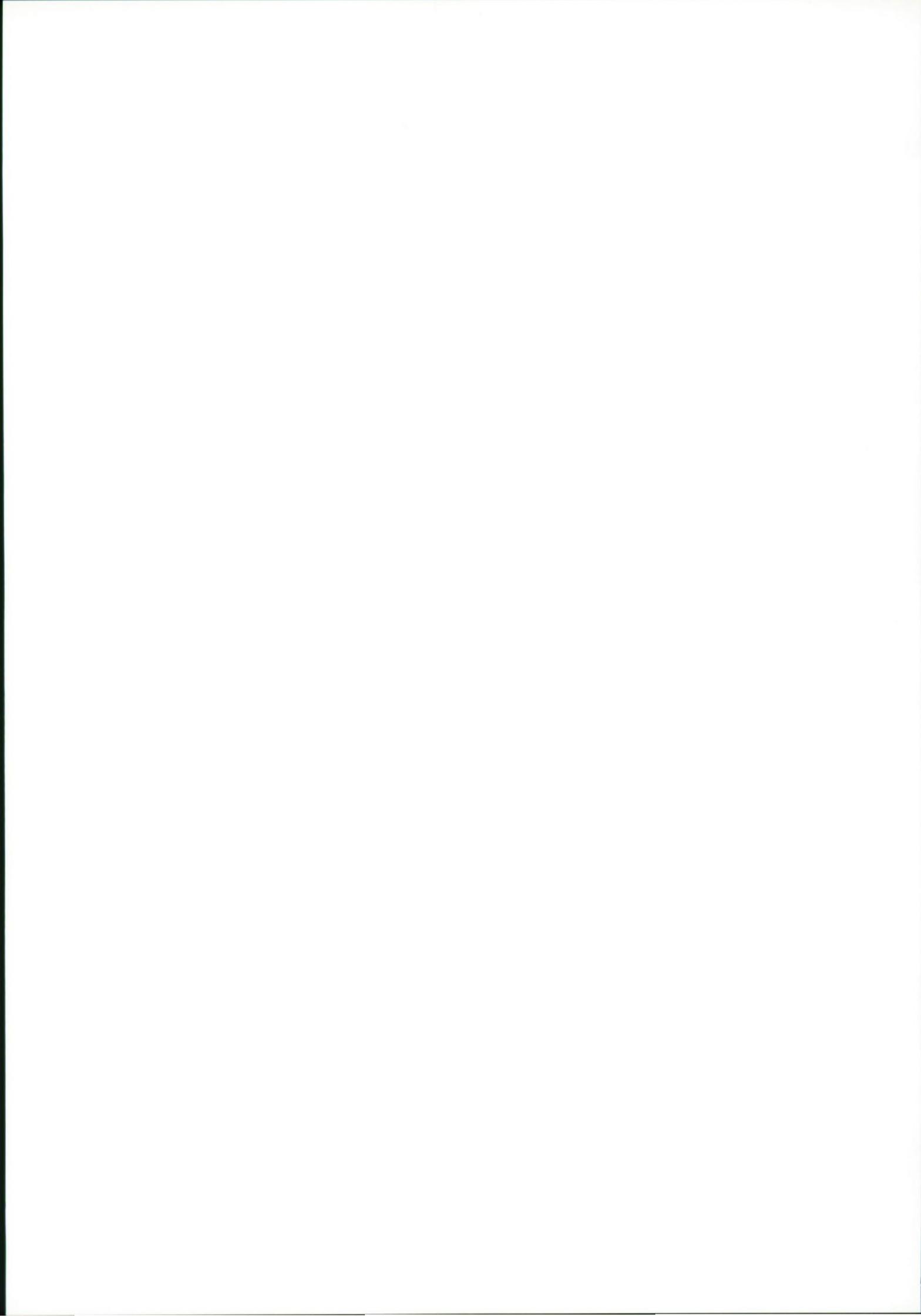
Six major new technical features

The Volvo S80 includes six major new and innovative technical features all of which symbolise Volvo's technological level, both as a car and as a company.

- A transverse, in-line, six-cylinder engine and the world's shortest gearbox. Page 9
- The Multiplex electrical system. Page 18
- WHIPS, the Whiplash Protection System. Page 32
- IC, the Inflatable Curtain. Page 34
- An integrated GSM telephone. Page 41
- An environmental product declaration for the customer. Page 51

We have chosen to divide the Volvo S80 into six areas, all of which combine to create the exciting overall experience that is pure Volvo S80.

- Driving experience. Page 7
- Active safety. Page 21
- Passive safety. Page 29
- Comfort. Page 37
- Security. Page 45
- Environment. Page 51



DRIVING
EXPERIENCE

V O L V O S 8 0



Driving pleasure and sophisticated road behaviour come from within and are multi-faceted in nature. Although this is a very individual experience, some criteria for a positive driving experience are rock-solid facts.

The driver's input must be transformed into the required response in an instant. Quick response, generous amounts of power and torque in an engine that is both quiet and smooth result in good fuel economy. A low-emission engine should be the result of this equation. Difficult to achieve, but not impossible.

A large car must have a large engine. This is correct in principle, but size can be compensated for. The Volvo S80 has relatively large engines, up to 2.9 litres, but sheer size has been replaced by smart technology in order to create the perfect combination – for each specific engine variant.

Large, yet small

Engines with a “large” feeling in terms of performance and comfort; engines with a “small” feeling in terms of emissions and running costs.

The Volvo S80 can be specified with different versions of the RN generation of engines. RN stands for Revised N. The N series – Volvo's modular engine family comprising four-, five- and six-cylinder all-aluminium engines – has now been extensively upgraded and improved in order to comply with 21st century fuel efficiency and performance requirements, hence the R.

Strong, Light, In-Line, Multi-valve

One decisive component in Volvo's engine philosophy is to offer a wide performance range, which is achieved by turbocharging. In this context, in-line engines offer another decisive customer benefit compared with V engines.

Volvo calls this philosophy SLIM, Strong, Light, Inline, Multi-valve engines – and it offers customers a great many benefits.

These transverse, in-line engines are now fitted in every Volvo car, from the 4-cylinder engines in the Volvo S40 and V40, to the five-cylinder versions in the Volvo S70, V70 and C70 and the five- and six-cylinder engine concepts in the Volvo S80.

The Volvo N series of engines has been very highly acclaimed for this combination and for its characteristics.

With the introduction of the Volvo S80, this has been taken one, or perhaps several, steps further.

In the case of the six-cylinder engine, some 90 per cent of the main components are new, whereas the corresponding figure for the five-cylinder engine is 50–90 per cent, depending on the engine version.

The fact that the six-cylinder engine has been turned 90 degrees in order

to enable it to be installed transversely, has necessitated many new solutions. Moving components and small details are not the only things to have been changed. The cylinder block and the cylinder head are two of the main parts that have also been redesigned.

The five-cylinder engine variants have always been installed transversely. However, this is the first time a six-cylinder Volvo engine has been installed in such a manner. In fact, this is the first time an in-line six-cylinder with a side-mounted gearbox has been installed transversely in a production car.

Automotive history has previously seen small transverse straight six-cylinders with the gearbox behind and below the engine, but the Volvo S80 features the most complex installation, as well as perhaps both the neatest and most compact – and definitely the most powerful yet!

In order to retain the excellent manoeuvrability, stability and balance which has become the hallmark of front-wheel drive Volvos, the engineers invented several design solutions to make it work, not least the very compact transmissions.

This is also the first time a new Volvo has been introduced with such a wide range of engine versions from the beginning. No matter which engine is chosen, they all have generous power and torque and are very fuel efficient in relation to their size and capability.

Six-cylinder engines

For the combination of smoothness, torque and effortless cruising, few other engines can match an in-line, six-cylinder. This is a fully-balanced and very effective design with one cold side and one hot side, smooth, light in weight and quiet in operation.

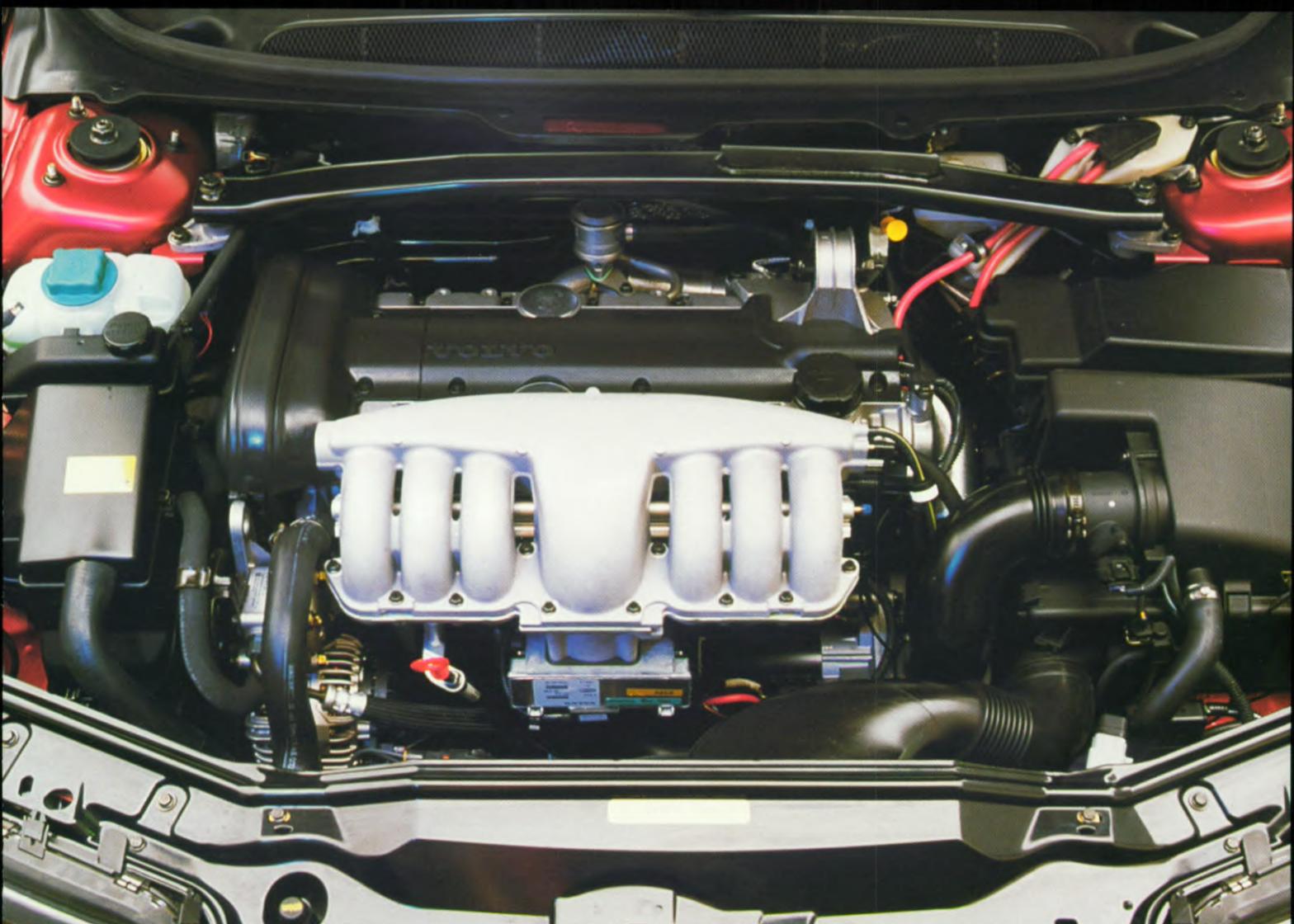
The Volvo S80 comes with two different six-cylinder engines, one normally aspirated and one high-performance version with twin turbos, the T6.

Volvo S80 2.9 – 6-cyl, 2.9-litre

The normally-aspirated engine is known as the B6304S and has a capacity of 2,922 cc. It has a power output of 204 BHP (150 kW) at 6,000 RPM, with maximum torque of 280 NM at 4,300 RPM. The fuel consumption according to EU COMB is 9.7 litres for the manual version and 10.1 for the automatic. This engine is the revised version of the ultra-smooth, three-litre, six-cylinder which has already proved itself to be a pleasant companion on the road, longitudinally installed, one may add.

Volvo S80 T6 – 6-cyl, 2.8-litre twin-turbo

The twin-turbo engine, the B6284T, develops some 272 BHP (200 kW) at





5,400 RPM and has maximum torque of 380 NM between 2,000 and 5,000 RPM. This high-performance Volvo S80 is known as the T6, continuing the Volvo tradition of the fast and sporty turbocharged T5s and T4s. The fuel consumption figure for the T6 (EU COMB) is 10.9 litres.

The aim when the T6 was developed was to combine the advantages of a relatively small engine – in terms of fuel consumption and environmental load – with the characteristics and performance of a much larger engine, in an appealing and advantageous manner.

The turbocharging is of the parallel type – in other words, two small yet efficient turbochargers are each driven by and feed three cylinders. The system has previously been tested by Volvo on a high-performance engine and it is now being applied in standard form.

The T6 engine reaches its full torque far more quickly with twin turbos compared with an engine with one large turbocharger, as there is less inertia in the blades in smaller compressors.

The fact that the ignition sequence and the valve timing in an in-line, six-cylinder are perfectly suited to a turbo concept of this, is clearly demonstrated by the torque curve. This was also the order of priority when the engine was developed. Outstanding torque and flexibility rather than just a high power output. It is torque that matters in everyday driving.

Five-cylinder engines

In order to enable customers to choose from a wide and attractive model range, the Volvo S80 will be available with five different five-cylinder engines two available directly from the start and another three within a year.

The first two versions to be introduced are both turbocharged engines.

Volvo S80 T5 – 5-cyl, 2-litre high-pressure turbo

A high-pressure version, the B5204T3, with a capacity of 1,984 cc, yields 226 BHP (166 kW) at 5,500 RPM of power and 310 NM between 2,700 and 5,000 RPM of torque. The fuel consumption according to EU COMB is 9.6 for the manual, 10.0 for the automatic.

Volvo S80 T – 5-cyl, 2-litre light-pressure turbo

The light-pressure version, the B5204T4, is also a two-litre engine (1,984 cc) and develops 163 BHP (120 kW) at 5,100 RPM and 230 NM of torque between 1,800 and 5,000 RPM. Fuel consumption according to EU COMB is 9.5 litres for the manual version and 9.9 for the automatic.

The other three variants which are due later are as follows.

Volvo S80 2.4 – 5-cyl, 2.4-litre 170 bhp

The largest normally-aspirated five-cylinder, the B5244S, has a capacity of 2,435 cc. The power output is 170 BHP (125 kW) at 5,700 RPM, while maximum torque is 240 NM at 4,500 RPM. Fuel consumption: 9.2 litres in the manual version according to EU COMB.

Volvo S80 – 5 cyl, 2.4 litre 140 bhp

The other normally-aspirated version, the B5244S2, has a capacity of 2,435 cc. The power output is 140 BHP (103 kW), while maximum torque is 220 NM at 3,000 RPM. Fuel consumption according to EU COMB is a mere 8.6 litres in the manual version.

Volvo S80 2.5D – 5-cyl, 2.5-litre turbodiesel

The direct-injection turbodiesel, the D5252T, which has already been used in the Volvo S70 and V70 for some time is also being used in the Volvo S80. The power output is 140 BHP (103 kW) at 4,000 RPM, while torque is 290 NM at 1,900 RPM. Fuel consumption according to EU COMB is only 6.5 litres.

Development of bi-fuel technology

Volvo has also developed a special version, an S80 powered by natural gas, a very sensible variant, which runs on natural gas but can also be run on petrol.

This version is also due within a year.

RN engines – joint technical solutions

The opportunity to offer so many variants is a result of the design of the modular engine. The basic RN engine concept for all the petrol engines is the same. It consists of five main parts. These main parts are all made of cast aluminium for low weight and high efficiency.

The methods used for design and manufacture ensure very compact and rigid engines, featuring extremely low noise and vibration emissions. The high precision of the cast main engine parts makes conventional gaskets superfluous; liquid gaskets are used and the parts are then joined together with yield-point tightening bolts during final assembly.

This basic concept can be expanded or reduced depending on the requirements. In technical terms, the four-cylinder engine is more or less the same as the six-cylinder, but it has two fewer cylinders.

Starting from the bottom, there is the oil sump, made of high-pressure, die-cast aluminium and of a new design compared with that of the N series. On engines with an oil cooler, the sump is integrated in the engine.

The lower crankcase and cylinder block are also made of high-pressure,

die-cast aluminium and they both form a very compact and rigid unit. Both have reinforcing ribbed structures in order to reduce panel vibration and the transmission of noise.

In the six-cylinder engine, the crankshaft runs in seven main bearings, whereas in the five-cylinder it runs in six.

The crankshafts are made of forged vanadium steel. All the oil channels and cooling ducts are cast in during production and require no subsequent machining.

The grey-iron cylinder liners in the block are also cast in during the high-pressure process. These liners offer high wear resistance and reduce the risk of leakage.

The slots between the cylinders at the upper edge of the block are specially machined to minimise the risk of ovality in the cylinders as a result of thermal expansion. The cylinders are very narrowly spaced, giving every engine variant a small overall length.

On top of the lower crankcase/cylinder block assembly sits the cylinder head. It is made of chill-cast aluminium to ensure a homogeneous material.

Efficient gasflow

The combustion chambers are of the pent-roof type, with four large area valves per cylinder, set at a relative angle of 58 degrees. The valve diameters are 32 mm for the inlet valves on the six-cylinder normally aspirated engines and 31 mm on all other engines and 27 for the exhaust valves. The spark plug is located in the centre.

The choice of pent-roof combustion chambers permits the use of large-diameter valves and the shape of the chamber helps to create a tumbling motion in the mixture during the intake stroke, thereby making the combustion process more efficient. The tumbling motion helps to create good fuel economy, high part-load stability, high specific performance and low exhaust emissions.

The strength and velocity of the tumbling motion have been carefully determined by the engineers in single-cylinder test rigs using PTV (Particle Tracking Velocimetry), in order to optimise the combination of properties.

The camshaft bearing housing, which is also made of chill-cast aluminium, has integrated upper bearing halves and forms the top part of the cylinder head. The lower bearing halves are integrated in the cylinder head.

CVVT – Continuously Variable Valve Timing

The double overhead camshafts feature CVVT – Continuously Variable Valve Timing – in order to optimise combustion and improve emission levels. This means that both the cylinder head and the camshaft bearing housing have been redesigned for CVVT.

The CVVT system is used in two different ways.

On the normally-aspirated engine versions, it works on the inlet cam in order to improve low-end torque and driving characteristics.

On the Volvo S80 T6 version, it operates on the exhaust cam in order to cut emission levels still further, especially during cold starts.

CVVT is based on the principle, using the engine oil flow, that the engine changes the position of the camshafts relative to the valves with the aid of an hydraulic control valve.

The opening and closing of the valves is adjusted depending on the situation (engine load, engine speed and so on). No matter whether it is intended to control the inlet valve timing or discharge the exhaust gases at exactly the right moment in the combustion process in order to reduce the HC content, CVVT improves the overall characteristics of the engine by improving driving characteristics and reducing emissions.

While we are on the subject of emissions, the emission control system in the six cylinder engines features twin catalytic converters, one for each set of three cylinders. Each of these catalytic converters has twin oxygen (Lambda) sensors.

One of them is located in front of the catalytic converter to provide information about the oxygen content of the exhaust fumes. The other is positioned behind the catalytic converter, thereby making it possible to control the emissions with greater precision.

The cams are driven by toothed belts for a long and trouble-free service life with accurate and quiet operation. They have plastic covers with rubber cushioning between them to counteract noise emissions and prevent the covers from rattling.

Computer-controlled electronic throttle

The engine management system is Volvo-specific, software-based and is part of the multiplex system (described later on). Apart from being very sophisticated with a multitude of functions, it is also insensitive to external interference, such as electromagnetic currents (EMC), and is designed with back-up, should a malfunction nonetheless occur.

All the Volvo S80 engines have a computer-controlled electronic throttle, i. e. no physical connection between the pedal and the throttle plate. Instead, the pedal has a sensor that communicates directly with the engine management system.

There are several advantages to this system. Driver input is handled more effectively by the engine, thereby resulting in smoother operation. This is reflected in lower fuel consumption and emissions. Not only does the electronic throttle control engine speed when driving, it also handles the idling speed function and cruise control, among other things. The result is rationalisation, the more effective use of functions and greater reliability.

Transmissions

One undeniable fact or which affects the driving experience is the way the transmission deals with engine power and torque and what the transmission is like to handle.

A dynamic car must have the option of a manual gearbox, even if most buyers prefer an automatic.

Although the automatic of today is very active and features a great many functions, the manual gearbox is still the ultimate sign of absolute control. Perhaps this is why sporty cars for active driving are supposed to have a clutch.

In order to offer a selection of transmissions to suit all tastes, the Volvo S80 comes with a manual gearbox or an automatic, or both. The Volvo S80 offers all three types. There is an attractive alternative for every buyer.

Manual gearboxes

Since a transverse, in-line engine installation – especially a six-cylinder – requires a great deal of space and the width of the car must remain within moderate limits, solutions for extremely compact transmissions had to be found. Even if there are other ways to design and install a gearbox for a transverse engine, Volvo prefers the design with the transmission at the side.

When designing the M56 for the 850, the need for a small gearbox called for something unorthodox. Volvo's engineers came up with a three-shaft (one input and two layshafts) solution – instead of a conventional two-shaft (one input, one layshaft) system.

This time, the need for a compact box was even greater because of the larger six-cylinder engine. However, not only did it have to be small, it also had to be able to handle even more power and torque than the M56 was capable of doing.

Once again, Volvo's technicians opted for multi-shaft technology – successfully applied in the M56 box for the 850.

The result, the M65, is a technical marvel; the world's shortest manual gear-box for a car and yet one of the most robust, capable of transmitting 380 NM of torque to the front wheels!

It is only 297 mm long as a result of the multi-shaft solution, this time with not three but four shafts!

This makes the driveline installation in the Volvo S80 the most compact in the world in relation to its capacity and capability.

The compact design with short, sturdy shafts produces extreme torsional stiffness and minimises the risk of deflection even at high loads and the resulting poor meshing of the gears.

As with the M56, the M65 has an integrated final drive and the entire assembly is housed in an aluminium casing and bolted to the end of the engine on the left side of the car.

In order to prevent reverse gear being engaged unintentionally, there is a speed-sensitive blocking device which prevents reverse being selected at speeds of above 25 KPH.

The choice of transmission alternatives for the Volvo S80 is:
M65, the manual five-speed for six-cylinder cars
M56, the manual five-speed for five-cylinder cars

Automatic transmissions

When the Volvo 960 was introduced back in 1990, Volvo also introduced the first generation of automatic transmissions that had been developed by Volvo in co-operation with Aisin AW in Japan. Electronic control went on to play a major part in the different functions and electronics brought with it the opportunity to refine and improve the characteristics, to tailor the transmission according to the specific needs of every single model.

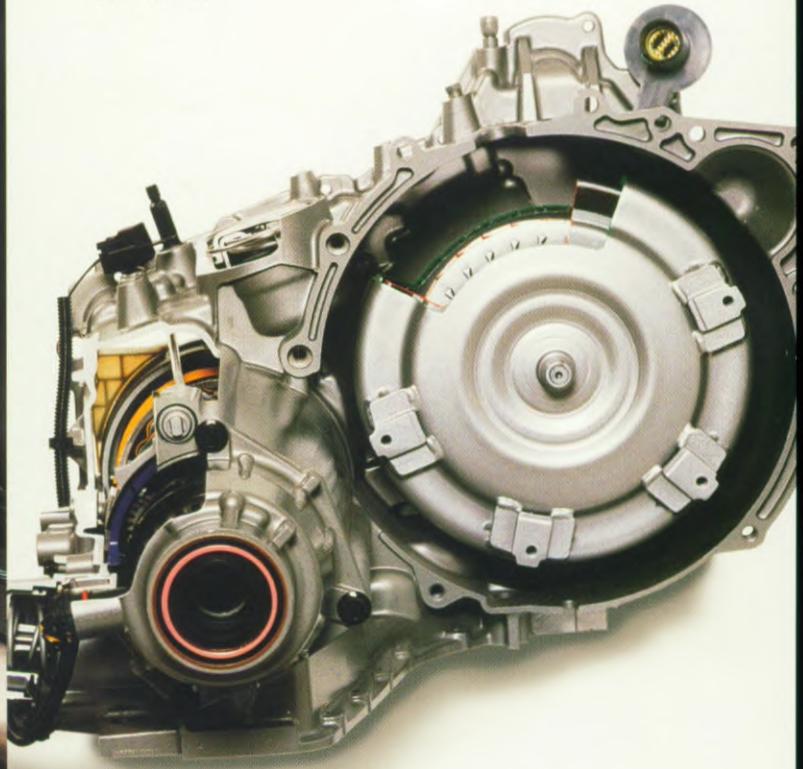
The ingenious design of the four-speed, electronically-controlled AW50-42 LE transmission for the front-wheel drive Volvo 850 was the equally smart automatic counterpart of the three-shaft M56 manual box.

For the Volvo S80, this design has been taken still further and incorporates more features, in spite of being smaller than its predecessor.

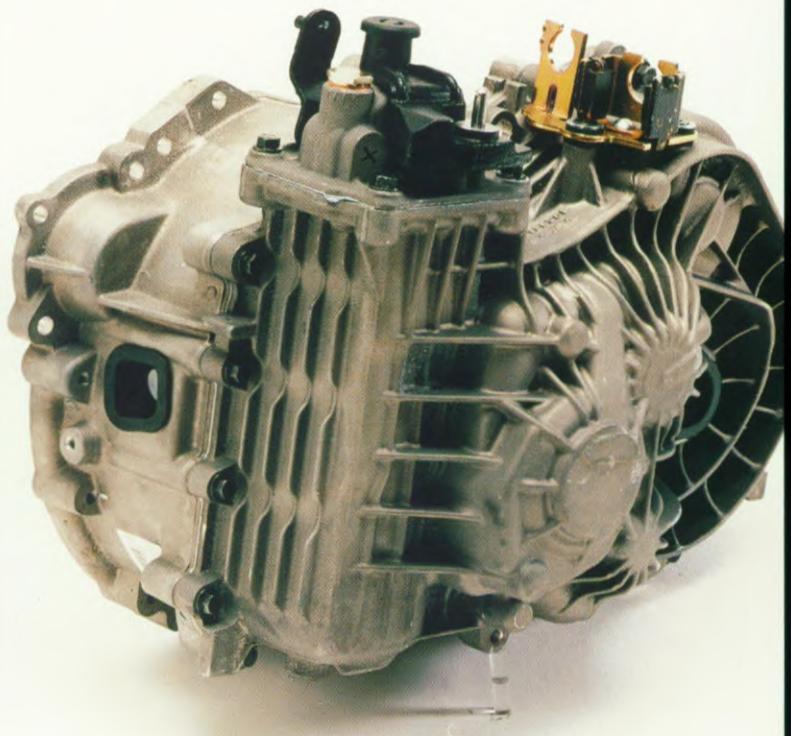
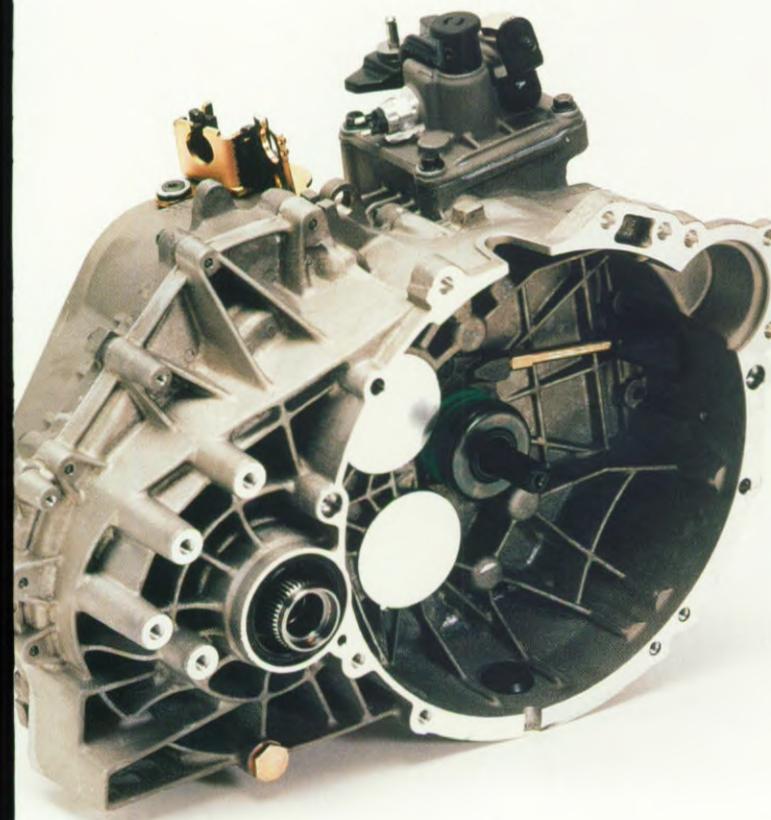
However, two manufacturers have worked with Volvo on the Volvo S80 automatics, General Motors and Aisin Warner.



Geartronic



M65





Although they are similar in visual design and size, the two types differ slightly depending on their task. The GM transmissions are used for the six-cylinder cars, whereas the five-cylinder versions have AW transmissions:

- GM4T65EV four-speed automatic for six-cylinder cars
- GM4T65EV/GT four-speed automatic with optional Geartronic for the Volvo S80 T6 and later on the Volvo S80 2.9
- AW50-42LE four-speed automatic for five-cylinder cars with turbo engines
- AW55-50SN five-speed automatic for five-cylinder, normally-aspirated engines (under development).

All these transmissions have adaptive gear patterns, replacing the need for the separate E and S driving modes.

The automatic transmission with the Geartronic function combines two transmissions in one. By moving the gear selector lever to the left and locking it in the gate, the Tip mode is activated. The transmission is now like a manual gearbox to operate, albeit without a clutch.

In this manual position, it is operated like a sequential gearbox, i.e. the gears are positioned in a sequence as they are in a racing car (pull/push); push the lever for a higher gear, pull it to change down.

Geartronic also features a slipping lock-up for improved fuel economy and torque-controlled pressure regulation for improved gear-changing characteristics.

Another important feature of this transmission is what is known as driver adaptation – the transmission adapts itself to the driving style of the driver, varying the gear pattern and points of gear change, depending on how the car is being driven. This eliminates the need for selective driving modes, as this is automatically taken care of by the transmission.

However, it still features a winter mode, marked “w” on the selector gate, for safer take-off and driving on slippery surfaces. In the w mode, the car starts in third gear to prevent the wheels from spinning or making sudden movements.

In order to transfer all 272 BHP and 380 NM of torque to the ground, the Volvo S80 T6 also features a viscous clutch to distribute the power between the driving wheels. The wheel with the best grip on the road surface receives more power than the other wheel and this continues if the conditions change. The car therefore feels more stable and well-controlled at high speeds on twisting roads, with a noticeable increase in pulling power when cornering.

Steer and stop

A third decisive factor when it comes to the driving experience is the way a car responds to steering input and the way it stops, i. e. steering and brakes.

The very responsive rack-and-pinion steering has optional speed-adaptive power assistance which maintains road feedback and stability at higher speeds and makes it very light at low speeds, when parking or manoeuvring in tight spaces, for example.

Large-diameter, powerful disc brakes all round with ABS and electronic braking force distribution provide for safe stopping from any speed. The general feel of the brake pedal at any speed is just as important as the braking performance. The system must respond to driver's input in such a way that the driver really feels that the pedal is an extension of his/her right foot, rather than being something separate that has to be manipulated. This is important to enable the driver to precision-adapt the braking force.

The general body and chassis design, the position of the driveline and the battery in the boot all give the car very good weight distribution with a 57/43 ratio. This makes an important contribution to the fine handling characteristics.

The chassis layout of the Volvo S80 with all its components and features, the STC, DSTC and EBD systems are described in greater detail under the heading ACTIVE SAFETY.

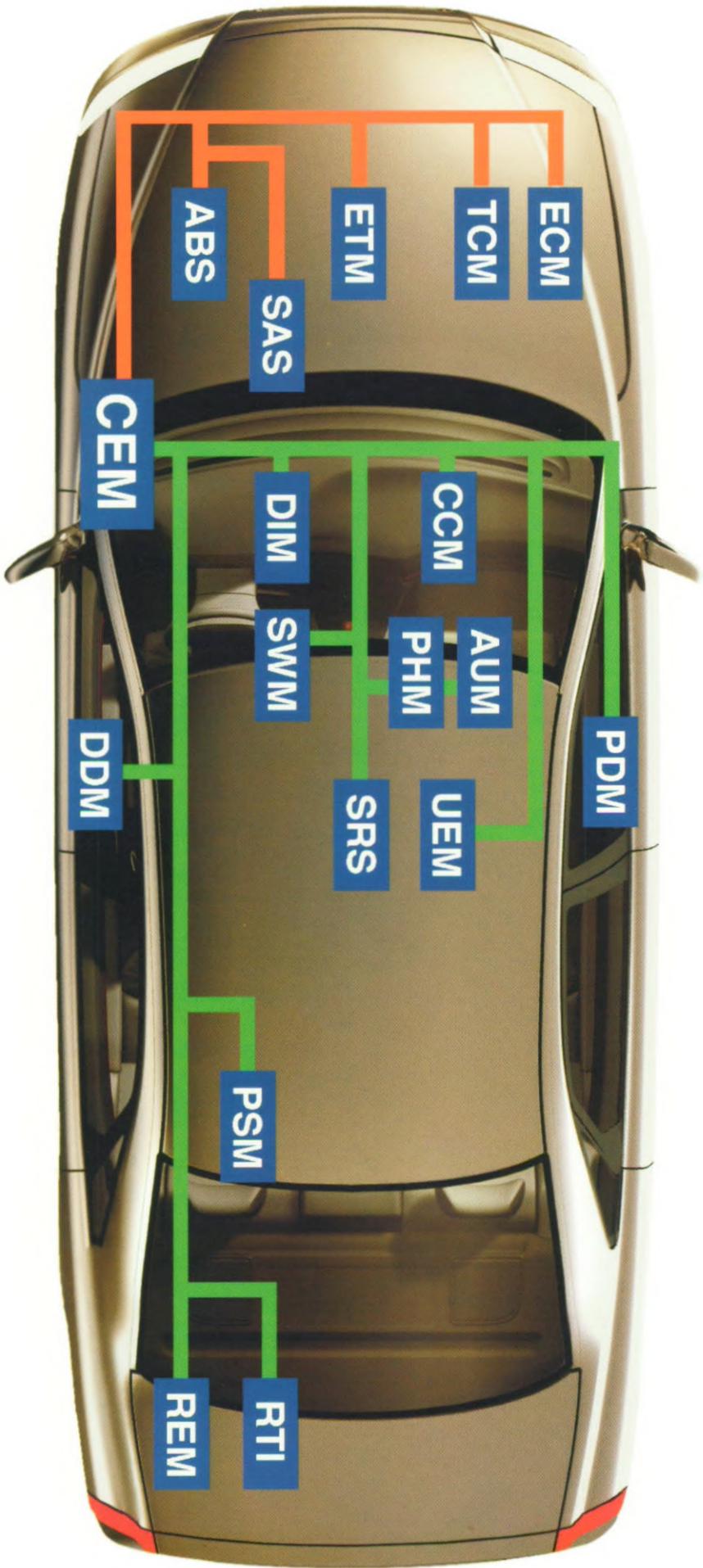
The smart electrical system of the future

Although a car is not primarily experienced through its electrical system, the revolutionary new electrical system in the Volvo S80 has a natural position alongside engines, transmissions and chassis performance.

To give you an idea of what has happened to the electrical system in cars over the years, the first Volvo back in 1927 had four fuses, protecting a mere 30 m of electrical cable.

Seventy years later, the Volvo of 1997 had 54 fuses for 1,200 m of cables and a host of functions, which were totally unknown in 1927. For example, the total computer power in the car is more than 6 MB.

By tradition, each function has had its own system and each system has had one supplier. The capacity of the electrical system was measured in terms of the sum of the number of components





However this simply could not continue; the need for a radical change was pressing.

A new totality was needed, one system that could handle everything. All the components had to be able to communicate, "understand" one another's language, integrated within this one system. One specification, one supplier.

The Volvo S80 not only has a new electrical system – many cars have advanced electrical systems, the Volvo S80 features the multiplex system which is a new method for signal communications.

The electrical system is designed as a communication network of 18 computers with central control units and no fewer than 24 modules for most electrical functions. These modules function like computers and control the electrical functions in the car whenever necessary.

Multiplex technology involves only two cables. One of them is able to carry all the signals in the system at the same time. The other is the electrical cable which carries the necessary power. These cables run around the entire car and are known as the databus.

The information travels in digital packages. All the small network modules are able to recognise "their" signal for action and do as they are told.

When the signal "open left front window" arrives, for example, only one module (in the front door) reacts to it, receives it and transmits an "order" to the electric motor to lower the window.

Signals are able continuously to alert and activate the different modules as a result of the capacity of the system, which also operates at two speeds depending on the function. The engine and transmission management uses a high-speed databus, whereas all the other functions use a slightly slower databus.

The benefits of the multiplex system are considerably fewer cables and connections in the car, improved reliability, communication between all the components and software adaptations, easier and improved opportunities for the retro-installation of electrical functions and so on.

The system also has the benefit of self-diagnosis for all functions, including engine management, making the OBD (On Board Diagnostics) unit even more important than before. Diagnosis is easier, as is servicing. Any information about a fault or malfunction is passed on to the driver by indicator lamps and a message display in the instrument cluster.

All the cables in the system are fitted in well-protected cable ducts.

The multiplex system in each car is programmed according to model specifications and fitted options.

So much for hardware and function. There is, however, something else that is very important in order to create a positive driving experience.

How you sit and feel behind the wheel

No matter how much power you have under your right foot or how quick and nippy the steering is, if you cannot sit in comfort you do not feel good and the driving experience is negative. Physical well-being behind the wheel instantly transforms itself into mental well-being as well. A state of mind that is necessary in order to be a good, safe and alert driver.

The driver's environment must be the optimum combination of correct ergonomics, comfort and pleasure, with harmonious colours and materials. Function and feeling must be well-balanced. Everything must radiate a feeling of high quality. In order to really experience a car and have the best chance of doing so, you have to sit correctly. A fact that is all too often neglected.

For many years, Volvo has had a reputation for very good seat comfort.

In addition to the shape and design, a Volvo seat can be adjusted in all directions for the best possible support and comfort.

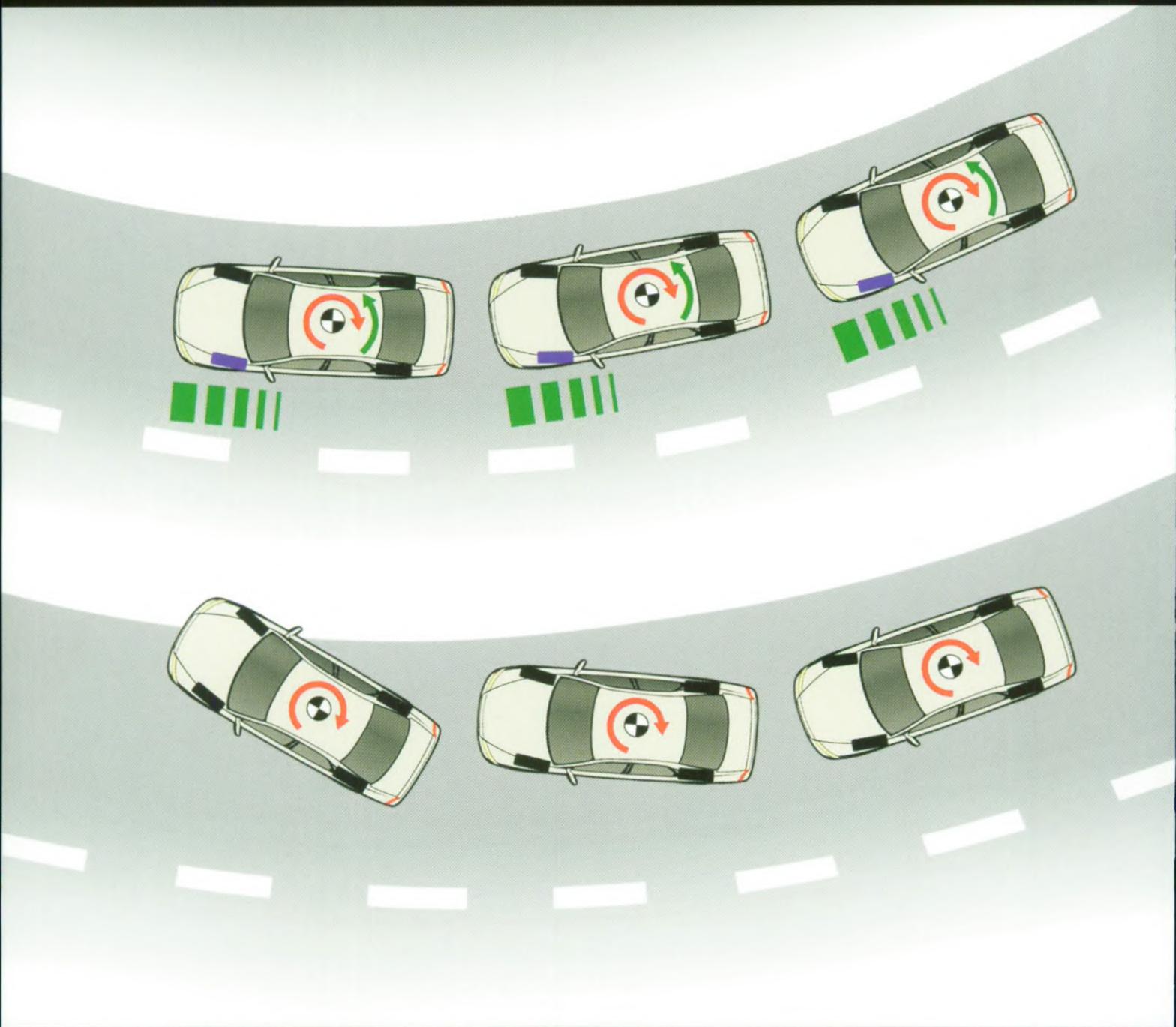
The front seats can easily be adjusted for height at both the front and rear and they also feature an adjustable lumbar support. The fore-aft adjustment is even more generous than usual.

In addition, the seats feature the WHIPS system which is described later on under a separate heading. The steering wheel must be comfortable to grip and hold for a long time. It must also be adjustable. In the Volvo S80, the steering wheel is adjustable for both rake and range in order to give every driver the best possible chance to find her or his ideal position. To be able to be at one with the car. Add to this gauges that are clear and easy to read, controls that are easy to reach and pleasant to handle, a cosy feeling in general and a pleasant smell and the driving experience will be one of joy and pleasure.

ACTIVE SAFETY
MAKES DRIVING
BOTH MORE FUN
AND SAFER



V O L V O S 8 0



A rigid body is a prerequisite for stability, safety and comfort. The front and rear suspensions must be rigidly connected to one another through the body in order to achieve top-class road characteristics.

Almost half the strong Volvo S80 body structure is made of high strength steel (HSS). The choice of HSS and the actual design of the body both help to make it extremely rigid. All the substructures have therefore also been designed to be very strong.

By working in an integrated way and consistently using computer-aided design engineering coupled with advanced calculation analyses (Finite Element Method), the body of the new Volvo S80 is the most torsionally-rigid Volvo to date. At the same time, it has also been possible to reduce the weight of the body.

In figures, this results in torsional stiffness of 18.6 kNm/degree, or, in layman's terms, the equivalent of this hypothesis.

If another Volvo S80 (approx. 1,500 kg) were suspended on a wire from one of the front wheels of a Volvo S80, the body would turn itself less than one degree around its own longitudinal axis. One degree, which is not visible to the naked eye or hardly noticeable when examining the car.

The torsional stiffness of a four-door car body usually lies within the range of 6–14 kNm/degree; this clearly demonstrates the extreme rigidity of the Volvo S80. This is also an extraordinary figure, bearing in mind that the car features a split rear seat, since the rear seat frame plays an important role in this case.

This very high degree of torsional stiffness makes an important contribution to the fine driving characteristics, especially when cornering, and provides benefits in terms of improved safety and lower noise.

The chassis geometry of the Volvo S80 has been carefully developed using both new knowledge and old skills. The experience acquired from the high-performance versions of the Volvo 850 and subsequently the S70 and V70 has played a major role in the development of single suspension components and the tuning of the suspension.

The Volvo S80 features a choice of two optional active chassis systems – STC and DSTC – both of which actively assist the driver by maintaining stability and traction.

They cannot, however, overcome the limits set by road friction and should not be regarded as speed boosters, but they will most certainly help to give the car reliable, safe behaviour in situations in which many other cars abandon their drivers.

STC

Stability and Traction Control (STC) can be described as a combination of two existing Volvo systems, the low-speed, brake-activating TRACS system in the Volvo S70/V70/C70 models and the speed-independent, torque-limiting DSA system in the Volvo S40 and V40.

STC is designed to prevent the driving wheels from spinning when starting and accelerating, as well as counteracting wheel spin if the driving wheels hit slippery patches when driving.

The system improves tyre grip on slippery surfaces and provides the optimum combination of traction and side stability which in turn enhances the high level of active safety.

The traction function works at lower speeds, up to 40 KPH, by transferring the engine power to the wheel with the best grip from the one with the poorest grip. This is done using the ABC sensors and the brake system.

The stability function reduces engine torque, by cutting down on the fuel supply, if one of the driving wheels starts to lose its grip on the road, both during acceleration and when driving on a slippery road. This minimises wheel spin and brings the car back to full stability.

The system reacts and is activated within milliseconds and driving characteristics are never affected. An indicator lamp on the dashboard flashes if and when STC is engaged.

STC is a standard feature on the Volvo S80 T6 and is available as an option on both six- and five-cylinder cars.

DSTC

Dynamic Stability and Traction Control (DSTC) is an even more sophisticated stability system to improve active safety by also intervening and counteracting any tendency to skid.

If the car makes a sudden movement and loses its directional line, or enters a corner too fast and the rear end starts to turn the car inwards, DSTC gently returns it to the right line. This is done by applying the brakes on one or more wheels.

DSTC works through the ABS system, which has been further developed.

A number of sensors monitor the rotational speed of all four wheels, the steering wheel angle and the directional behaviour of the car.

The DSTC processor receives the signals and compares the actual behaviour of the car with the desired behaviour. Any deviation from the norm, such as the rear wheels starting to break away, and the system intervenes and makes

corrections, activating the brakes on the wheel that will bring the car back in line. If necessary, the system also reduces engine torque, like STC.

In a way, it would be true to say that DSTC is able to compensate for the driver's mistakes up to a certain point, as it counteracts and prevents skidding when the driver has already started to lose control.

The system is particularly effective if the driver has to brake hard and steer away at the same time, like the well-known elk test. The system counteracts any tendencies to skid and returns the car to its original course.

DSTC works through the ABS system which has been further developed to incorporate this system. In addition to more relief valves and a more powerful microprocessor, a brake reinforcement unit with electronic activation, sensors for side acceleration, yaw rate and steering wheel angle have been added.

The DSTC system will initially only be available on six-cylinder cars, The Volvo S80 T6 and Volvo S80 2.9.

Brakes

Needless to say, the brake system is also both powerful and sophisticated, performing as it does so many more functions than simply stopping the car safely depending on driver input. Brake pedal feel has been further improved to provide a distinct yet comfortable feeling at all speeds and the pulsating ABS action is less pronounced. The stability and feeling of being in full control when braking on uneven surfaces is top-class, especially if there is a difference in friction between the left and the right sides.

The system features large-diameter discs, 286 mm with 15" wheels and 305 mm with 16" wheels with ventilation at the front and 288 mm at the rear. All the wheels also feature sliding calipers.

Full use of the braking system is always possible as a result of Electronic Brake Force Distribution, EBD. The brake systems in modern cars are usually of two types. Either the front brakes are much more powerful than the rear ones or the braking force of the rear brakes is reduced by pressure-limiting valves to keep the force down to a certain level.

EBD, on the other hand, carefully monitors the behaviour of the rear wheels in relation to the front wheels and regulates the braking force electronically to match the degree of braking and load. In this way, perfect balance is always maintained by making the most effective use of the available braking force. Even when the driver brakes very hard, full directional stability and steering ability are maintained. The system is particularly effective when driving with heavy loads.

EBD permits far more braking force to be applied to the rear wheels as it always ensures full braking stability by regulating the pressure at an early stage of the braking process.

The entire EBD function is integrated in the ABS system, thereby enabling the function of the system to be monitored. Moreover, possible faults can be indicated by a warning lamp, as different from conventional pressure-limiting systems.

Should a defect occur in the ABS/EBD systems and be indicated to the driver, the system automatically changes to passive function. The car still has a normal braking system but without the ABS or EBD functions.

The most vulnerable part of a brake system is the brake lines. In order to minimise the risk of corrosion and brake circuit failure, the pipes are made of heavy-duty, long-life cu-ni-fer (copper-nickel-iron) alloy.

Front suspension

The design and geometry of the front suspension play a vital part in giving a powerful front-wheel drive car like the Volvo S80 the best possible dynamic properties. Here, too, it is a question of combining space and function in the optimum manner.

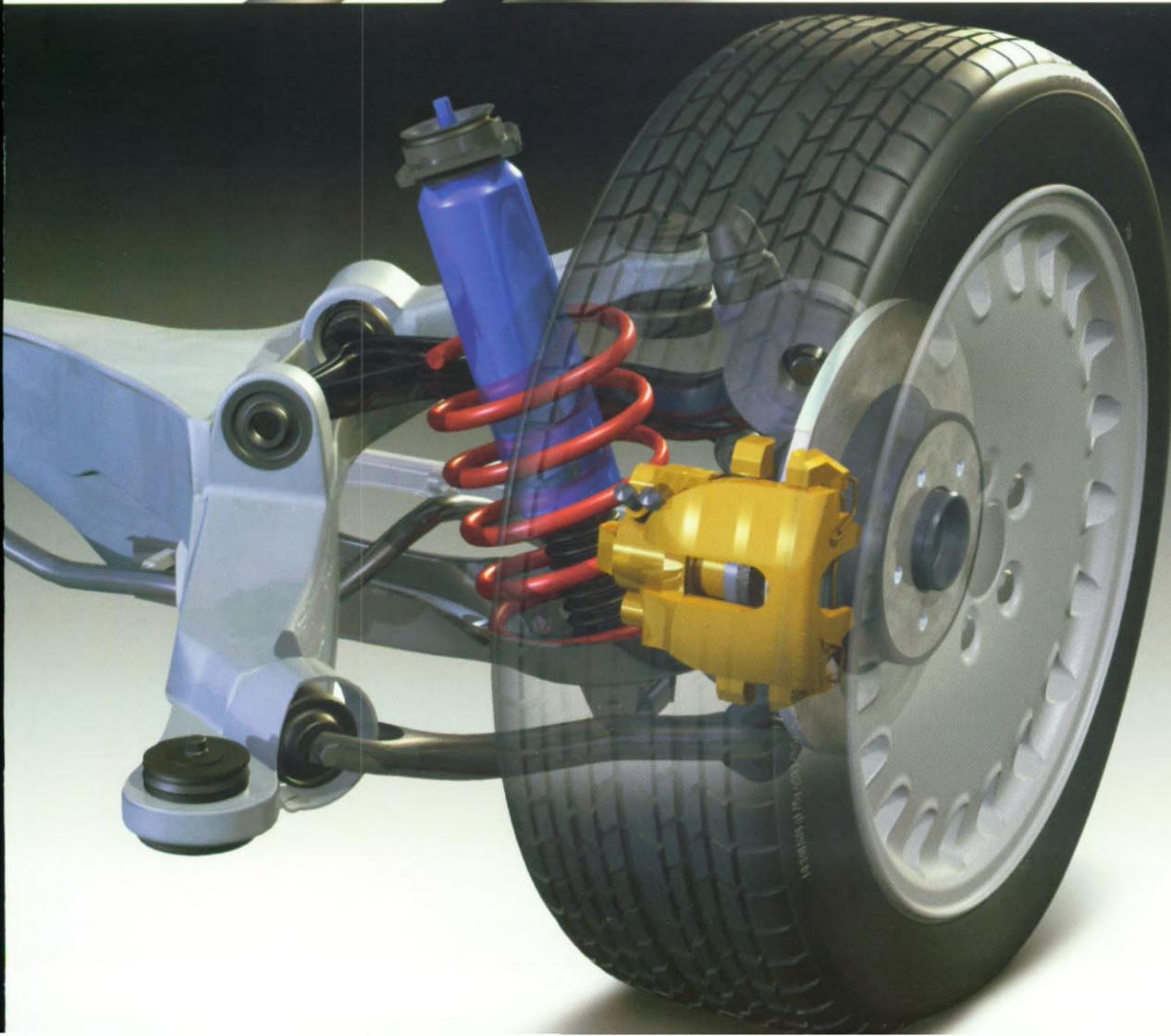
The front suspension features spring struts of the same design as the ones in the Volvo S70/V70/C70 but with modified geometry. The shock absorbers and coil springs are one unit and are asymmetrically positioned in relation to the strut.

Below the springs struts, there are triangular lower links and an anti-roll bar is directly attached to the spring struts via a link. This design produces very good directional stability when accelerating and braking on uneven surfaces. The suspension is supported by both anti-lift and anti-dive functions to prevent lifting tendencies when accelerating and diving tendencies when braking. It is important that the car maintains a horizontal position whenever possible for both safety and comfort reasons.

A small offset makes the front end less sensitive to acceleration forces and vibrations from the wheels. So a small front-wheel centre offset has been chosen, only 43 mm with wider tyres, 49 mm for the others.

Rear suspension

The rear end plays an important role in a front-wheel drive car. In a car with a pronounced orientation towards dynamism and comfort, the need for a first-class rear suspension was obvious.





The independent rear suspension is of the multi-link type and is mounted in a chill-cast aluminium subframe which is attached to the car at four points by means of insulating rubber bushings to keep noise and vibration to an absolute minimum.

The choice of aluminium gives the installation low weight and the low design enables the subframe to be installed without encroaching on the passenger compartment or luggage space.

The movements of the wheels are controlled by four links on each side (multi-link) – two trailing arms, upper and lower links, a track rod and an anti-roll bar.

This system permits a certain degree of rear wheel steer when cornering, as it provides assistance and helps to stabilise the car when braking.

The multi-link design combines a very high level of comfort with fine handling and controlled behaviour. There is also a safety aspect; the subframe is part of the rear impact protection system, protecting the fuel tank and creating the space for the spare wheel to lie flat, on top of the frame but in the boot, as it absorbs and helps to dissipate the impact forces.

The coil springs and shock absorbers are integrated to form one compact unit. There is also the option of an automatic levelling system, Nivomat. This system keeps the car horizontal and stable even when it is heavily laden. This also results in improved rear visibility and reduces the risk of dazzling oncoming motorists in the dark.

The steering is based on the rack-and-pinion principle which is the most space-efficient and precise way of moving the wheels. The system has a very direct response and does not transmit any vibration or torque force. The power steering is available in a speed-sensitive version which adjusts the degree of amplification to match the speed and needs of the driver – light steering at low speed, more stable steering at higher speeds.

The nimble steering, which responds even to low input from the driver, has only three turns of the wheel, lock to lock.

Optimal optics

Active safety also includes seeing and being seen in poor visibility or at night. The light provided by the headlights is a very important safety factor. Being able to see along a long stretch of the road ahead could be a decisive factor in certain situations, just like being detected from the rear from far away. The Volvo S80 has very effective headlights and large tail-lights.

The headlights, double, so-called free-form headlights for both full and dipped beam, are equipped with wipers/washers and can also be supplemented with elegantly integrated foglamps.

When full beam is applied, the dipped beam function remains in operation, thereby generating a very powerful beam and considerably increasing the driver's field of vision in terms of both length and width.

The purpose of a headlight is to compress the light to obtain maximum effect and then to distribute the light to achieve the desired light image. In a conventional headlight, the reflector performs the former function and the optical pattern of the glass the latter.

In free-form headlights, the reflector is designed to perform both these functions and thus permits the use of clear glass without optical patterns. In other words, it is not the actual glass that forms the light image. The light is collected and distributed directly through the reflector surfaces which are designed in such a way that they produce the final light image.

As the surface of the reflector has a number of orientation points which no longer comply with any simple mathematical formula for the condition of the surface, they are called free-form surfaces - hence the name free-form headlights. As a result, the size and shape of the headlight opening is less important. The pure appearance of the free-form headlights helps to give the front of the Volvo S80 its very characteristic appearance.

Characteristic in appearance is almost an understatement when it comes to the large tail-lights. Clearly recognisable from the ECC environmental concept car, the light clusters are not simply aesthetic. They each house twin tail-lights. So, if one bulb blows, there is still one left.

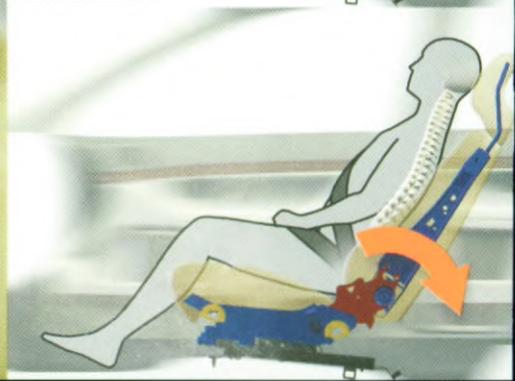
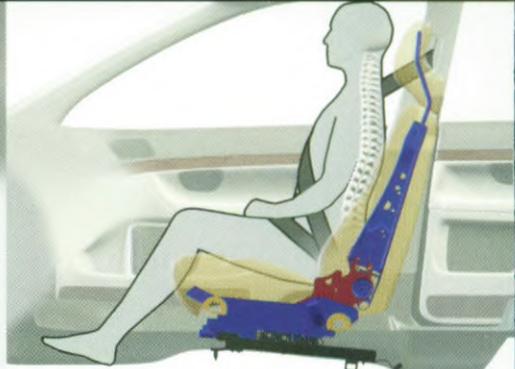
It goes without saying that active safety is far more than this. It is a concept which everyone interprets in different ways. The areas mentioned above are important to Volvo and are just some of the points that are prioritised when developing a car, from concept to finished product.

PASSIVE SAFETY

THE WORLD'S
SAFEST VOLVO



VOLVO S80



Safety is far more than cut-away show cars, with highlighted details painted yellow with black stripes and filled with stuffed airbags. Safety is very much parts of Volvo's soul and, as a result, it is always present, an integral part of the very first design work and a vital part at every stage of the development process.

If the active safety chapter can be summarised as active accident avoidance, passive safety can be summed up in three words: passenger protection priority.

One of Volvo's prerequisites is that every new Volvo has to be safer than the previous one. When it comes to the Volvo S80, this is very much the case.

One of the objectives when designing the Volvo S80 was to further strengthen Volvo's position as the world leader in the field of passenger protection. This aim has been realised.

With two new and important technical features, the level of passenger protection has taken yet another step forward. It would perhaps be no exaggeration to say that the Volvo S80 is the safest passenger car on the market at present.

Although safety developments in the automotive industry have progressed by leaps and bounds in recent years, there is still some truth in the statement that a large car is safer than a small one. Size *is* related to safety. This is part of the laws of nature. A larger, heavier car suffers the least damage in a collision with a smaller, lighter car, thus providing better protection for its occupants. Crumple zones and energy absorption – two vital parameters – can be more effectively designed if there is more space.

A well-designed, rigid body structure is the perfect base on which to build. As mentioned in the chapter on active safety, the Volvo S80 has an extremely rigid body. Almost half of it is made of HSS steel with extremely strong sub-assemblies. Its "core" is the safety cage around which there is a structural network of members. This network is designed to absorb and dissipate crash energy and keep it away from the occupants by interacting and helping to conduct the energy around and away out into the members.

Belts and bags

Volvo has always claimed that the single most important protective feature in a car is the seatbelt. The Volvo S80 has three-point belts on all five seating positions. What is more, they are all equipped with pyrotechnical pretensioners.

The pretensioners automatically tighten the belts in a crash, eliminating the slack which is normal in a belt. The frontseat belts are also equipped with force limiters, which control and regulate the roll speed of the belt webbing

and provide more gentle restraint. The front seatbelts also have automatic belt height adjusters for optimum belt geometry.

Needless to say, the belt system in the Volvo S80 has been integrated with the airbag systems as these systems interact.

So the trigger levels and activation forces are determined in harmony with belt functions, such as the pretensioners and the force limiters.

Passenger airbag

The passenger airbag is invisibly stored under the upper part of the dashboard and is designed to activate in a "friendly" way in order to protect the passenger rather than being a risk.

A belt sensor indicates whether or not the front seat passenger is wearing a seatbelt and adapts the airbag trigger level accordingly. This means that more crash energy is needed to trigger the bag when the passenger is wearing a seatbelt than when he is not.

Back in the 1960s, Volvo pioneered the collapsible steering column, a feature which has been a self-evident part of every Volvo car since then.

In the Volvo S80, this function has been further improved and the steering wheel can be pushed further back, as a result of the collapsing function in both the lower and upper steering shaft which creates additional space for the steering wheel to be kept away from the driver. Belt and bag further protect the driver from contact with the steering wheel.

Two important new features, WHIPS and IC

The Volvo S80 includes two important new safety features. Both of them protect what are perhaps the most vital parts the body, the neck and the sphere that sits on top of it.

WHIPS, Whiplash Protection System

In 1997, the Volvo Car Corporation presented the Whiplash Protection Study, WHIPS, which was an R&D project designed to produce a seat which would reduce the risk of whiplash injuries in rear-end collisions.

The WHIPS system has now been incorporated in the Volvo S80, making it perhaps the safest car on the market in rear-end collisions.

Although they are most frequently caused at low speeds in relatively minor accidents, whiplash injuries are extremely painful, both physically and mentally, for the people who incur them, as well as being difficult to detect and define. They are also perhaps the single most expensive injury in insurance terms.

Since rear-end collisions often occur in city traffic, the Volvo WHIPS system is optimised to be most effective at speeds ranging from 15 KPH (10 MPH) to 30 KPH (20 MPH).

Two-stage operation

The system consists of two elements.

The first element of the WHIPS system is a brand new device that adjusts the angle between the seat cushion and the backrest. The system is activated in two phases.

The first phase allows the backrest of the seat to move backwards together with the occupant, reducing G-forces.

In the second phase the angle of the backrest folds back wards by up to 15 degrees effectively catching the body preventing a catapult effect.

The second element of WHIPS are six modified springs in the backrest with limiters that provide even support of the spine when pressed into the seat.

The fixed head restraint, which remains close to the head, minimises head movement and reduces forces on the neck. So the entire back is pressed against the backrest in a controlled manner.

Tests conducted by Volvo during the development of the system reveal that the WHIPS system can reduce the acceleration forces in the neck by some 50 per cent.

Rear seat passengers are not affected by the movements of the WHIPS front seats in an impact situation as they move rearward as well.

As the WHIPS system is activated at speeds as low as 15 KPH, this means that it must be easy to repair and it is. The mechanical parts that are affected are simple and inexpensive and, in most cases, they can be replaced without needing to replace the entire seat.

Side Impact Protection

Passenger protection in side impacts is perhaps the most difficult area in terms of safety development, because of the lack of space or the minimal crumple zone, only 25–30 cm. Passengers sit very close to the point of impact. This must therefore be compensated for in one way or another.

The SIPS structure has been extensively upgraded and its interacting components consist of the energy-absorbing elements in bottom rails, pillars, cross-members, roof and seats, plus energy-absorbing materials in the doors.

This has been supplemented with more, further improved padding in all the roof pillars and along the edges of the headliner. This material feels hard when it is touched, but it yields in a "friendly" manner and absorbs energy when it is hit in an impact.

The second step in the continued development of the SIPS system was the introduction of the SIPS bags in 1994 – now a standard item on all Volvo cars.

The Volvo side airbag is located in the outer part of the backrest and is

therefore always in the optimum protective position in relation to the occupant.

SIPS further reduces the risk of severe chest and pelvic injuries as its function is to keep the occupant away from the side of the car.

In the Volvo S80, the side airbags are triggered by electronic sensors, one in the B pillar and one behind the rear door. Their position makes the reaction time from moment of impact to triggering the bag very short. A factor which is of vital importance in side impacts.

However, padding and side airbags cannot completely make up for what can happen to the head when the car is hit from the side.

So the time has now come to introduce the second major new safety feature in the Volvo S80. It is also the third stage in the development of side impact protection.

IC, Inflatable Curtain

The Inflatable Curtain, IC, was presented together with WHIPS as an R&D project, in 1997, the first technical system for this type of protection.

The purpose of the system is to reduce further injuries in a side impact by protecting the head and neck of the occupants both in the front and rear seat. The curtains, one on each side, are woven in one piece and hidden inside the roof lining. They cover the upper part of the interior, from the A pillar to the rear side pillar.

The IC is activated by the same sensors as the SIPS bags. They are "slave" sensors to a central sensor which determines where the impact is and which bag should be triggered in order to protect the occupants. If only the rear sensor is affected, the IC is activated but not the SIPS bag.

The curtain is filled within 25 milliseconds and stays inflated about three seconds in order to provide maximum protection in complicated collisions.

The ducts do not cover the entire surface of the curtain. Instead, they are concentrated in the areas which are most likely to be hit by the occupants' heads. As a result, the need for gas is limited and the activation time is minimal.

The ducts act as controlled head restraints and prevent it from hitting the inside of the car. The curtain also prevents the head from impacting collisions obstacles, such as lamp posts and similar objects.

The size of the curtain also supports to keep the passengers inside the car instead of being partially thrown out of the side windows.

The protective capacity of the IC remains the same, regardless of whether the window is open or closed. When the curtain is activated, it hardly touches the side window but expands inwards, moving closer to the heads of the occupants.

Taking all these features into account, it is safe to call the Volvo S80 the best car in the world in terms of side impact protection. In fact, it may very

well be the safest car on the road today.

Folding rear head restraints

The folding rear head restraints may appear to be a feature which is only designed for comfort, but this is only partially true. The rear head restraints fold forwards at the touch of a button in order to improve rear visibility.

However, if they are left folded forwards, it is impossible to travel in the rear seat without folding them back again. This ensures that they once again serve their original purpose as head restraints.

Young passenger protection

It goes without saying that the passenger protection in a Volvo does not simply apply to adult passengers who can sit safely strapped in one of the five seats. Volvo safety also includes the smallest and least protected passengers - children.

The Volvo S80 is naturally equipped for fitting the entire Volvo range of child safety seats.

In order to permit the installation of a rear-facing child seat in the front passenger position, the passenger airbag can be switched on and off using a switch. This switch, which only can be fitted by a Volvo dealer, works via the ignition key. When the ignition is turned on, an indicator lamp on the switch comes on and shows whether or not the passenger airbag is activated. If the switch suffers electronic failure, the SRS lamp comes on, just as it does if any other defect occurs in the SRS system.

Other child safety fittings include the integrated child booster cushion, which can be used with the centre rear seatbelt and adjustable head restraint for children aged four and up (the safest position in a car), and a safety seat fitted behind one of the front seats.

Although the WHIPS function is incorporated in the front seats, it does not interfere with the child seat or the function of the front seats in a rear-end collision.



COMFORT

A MATTER OF
WELL-BEING
- AND SAFETY



V O L V O S 8 0



A long wheelbase and wide track certainly provide plenty of room and a high level of ride comfort, but they also produce size. This need not necessarily be a drawback in terms of manoeuvrability, however. If the car is easy to park and can turn between most kerbs, it has proved the point. The Volvo S80 does so, as previous chapters demonstrate.

A well-tuned chassis and a rigid body on the right wheelbase, sprung and dampened in the optimum manner, create fine ride comfort, which is further enhanced by well-designed seats, an ergonomic interior and good climate comfort. Comfort is something that has to extend to everyone in the car – collectively as well as individually.

As the word comfort includes so many meanings and aspects, Volvo definitely regards it as a matter of safety. The basic requirements in a car are that you should sit in comfort and safety, that you should have quiet, pleasant and enjoyable surroundings, full of smart features to make life more comfortable and enjoyable. The driver of a car like this is far more alert and safe than a driver who has to put up with things that he or she does not like and who is forced constantly to compromise while travelling.

Front seats

For many years, Volvo seats have been developed not only by engineers but also by orthopaedic experts in order to make them more than just something to sit in. Hours of driving should not make the driver – or the passengers – tired. So a great deal of emphasis has been placed on the fact that each and every driver must be able to find her or his perfect position, with good support, especially in the lateral and lumbar regions.

In addition to what was described earlier under the headline of Driving Experience, the front seats also feature:

A backrest which folds forward completely to make it possible to carry long objects (passenger seat).

Seat heating that now operates at two levels. The effect of the heater is pre-adapted according to the type of upholstery in order to work in the optimum way in each specific seat.

Practical storage pockets at the front edge of the seat cushions. Driver's head restraint with built-in loudspeaker for the integrated telephone (described later).

Driver's environment

The driver's environment must be the perfect combination of correct ergonomics, comfort and pleasure, with harmonious colours and quality materials. Function and feeling must be well-balanced. Everything must radiate a sense of quality. It must also be within easy reach.

The dashboard is designed according to these precise principles. All the

instruments and gauges are logical and easy to read. In addition to the usual symbols and indicator lamps, there is also a message display window for different functions.

A well-equipped centre console houses the audio system, the climate control and different control buttons, for example. It also contains one of the two folding cup holders – the other is located in the centre armrest which also contains a storage area, a CD rack and a coin holder.

The power windows and power rearview mirrors are easy to operate. The front windows have both auto-down and auto-up functions; one quick touch of the button makes the window go all the way up or down. A built-in crushing guard eliminates the risk of fingers being crushed.

The mirrors, which are heated, have a very useful optional function. They can be folded flat at the touch of a button, a very handy feature in tight spaces. They can also be fitted with a groundlight, which makes it safer and easier to get into and out of the car in the dark.

This is also facilitated by the courtesy lighting; there are courtesy lamps at the doors and in the headliner at the front and rear.

Climate comfort

As Volvo sees it, climate comfort is very definitely a safety factor. Maintaining a pleasant, constant temperature and constantly changing the air are vital in order to stay alert and feel good.

The Volvo S80 offers three different types of climate control, all with newly designed and clear control symbols:

- the standard manual type with a timer function and recirculation but without air conditioning.
- an optional manual climate control – MCC – with the functions mentioned above and with air conditioning
- the optional fully automatic Electronic Climate Control, the very latest version, which makes it possible to set the precise interior temperature that is required, quickly cool down hot air and quickly heat up cold air. Just like the MCC, it contains no CFC.

Cars with air conditioning also have a particle or pollen filter which effectively shuts out unwanted substances and is specially beneficial for people with allergy problems.

All three types of climate control can adjust the passenger compartment temperature on the left and right sides independently of each other. The system has a large number of air outlets which are designed so that the fresh air is distributed around the compartment instead of being blown at high speed as one concentrated stream of air straight into the faces of the driver and passengers.





An outlet in the B-pillars on each side facing the rear seat enable hot or cool air to be directed at rear seat passengers. At the same time, this also helps to keep the rear windows free from mist.

First car with integrated GSM telephone

The climate control units are built into a centre console which also houses the space to fit another Volvo first, a fully integrated GSM telephone, as an option.

Thanks to this well-integrated installation, the telephone can be used both safely and simply, without distracting the driver or jeopardising safety.

The keypad is elegantly integrated in the centre console next to the radio, while the microphone is fitted to the rearview mirror and the loudspeaker is in the driver's seat head restraint.

Using this system, the telephone can be operated hands-free, but, if more privacy is required, there is a handset recessed into the centre armrest.

For extra safety, the telephone can also be operated with the control buttons on the steering wheel; these buttons can also be used to control the radio. They are used to select the menu functions for the telephone, for example.

When the telephone is in use, the audio system is automatically turned off and the message display below the temperature gauge in the instrument cluster provides information about the current telephone number.

The aerial is built into the windscreen, making an outside aerial unnecessary, while the telephone itself is safely placed out of sight in the luggage compartment.

The integrated telephone in the Volvo S80 is the optimum combination of ingenious design, safety and function.

Two other interesting features can also be controlled, safely and very handily, from the steering wheel. Both are optional and built into the centre console – the audio system and RTI.

The audio system

The audio system for the Volvo S80 has been developed alongside the car and is therefore purpose-designed and fully integrated in the centre console. The system, which offers a choice of four different versions with many common functions, consists of a main unit with front panel and display, a cassette recorder and CD player and control knobs.

The top-of-the-line system has the following features: RDS radio with a built-in 4x50 W amplifier, integrated CD player/changer, Mini-Disc player, the Dolby Surround® and Pro Logic® System, control buttons on the steering wheel, nine speakers and a diversity aerial which provides extremely good reception.

The second version consists of an RDS radio with a built-in 4x25 W ampli-

fier, integrated CD and cassette players, a control button for a separate CD changer, control buttons on the steering wheel, eight speakers and a diversity aerial.

The next system has an RDS radio with a built-in 4x15 W amplifier, a cassette recorder, a control button for a separate CD changer, control buttons on the steering wheel, eight speakers and a diversity aerial.

The basic system has an RDS radio with a built-in 4x15 W amplifier, a cassette recorder and six loudspeakers.

The systems can be supplemented with a separate 10-disc CD changer which is one of the smallest on the market. It is safely located in the luggage compartment and controlled from the main unit. The systems also have an automatic volume control that is speed-controlled. It keeps the volume at the same level irrespective of the speed of the car.

The Dolby Surround® Pro Logic® System, which has been used by Volvo for almost two years, produces sound of concert-hall quality in the Volvo S80. The principal property of the system is that it creates a three-dimensional sound pattern, a rare feature in the automotive world.

It comprises a built-in sound processor and an additional loudspeaker in the centre, on top of the dashboard.

The Volvo S80 features twin aerials, the main one in the rear screen and a sub-aerial with amplifier in the rear bumper; the second aerial is necessary for the diversity function. This guarantees extremely good signal reception, even in poor conditions. It is also used by the RTI traffic information system – another option.

Never lost with RTI

RTI has also been used by Volvo with very good results for well over a year. This is an electronic information and route guidance system that helps the driver find any destination and the shortest route to reach it.

The system keeps track of the position of the car using the GPS system and a recorded voice continuously directs the driver, who can then concentrate on the traffic situation. The route is, however, also shown on an electronic road map in the display which is situated on top of the dashboard.

The system is controlled by a multi-function button on the rear of the steering wheel or by a passenger with a remote control.

The RTI system is based on CD-ROMS containing maps with different scales, depending on how detailed the map has to be. The maps also contain the addresses of hotels, airports, hospitals, Volvo dealers and other useful facilities.

The system uses the GPS satellite navigation system in order to establish the position of the car and a built-in gyro senses the direction in which the car is travelling. Signals from the speedometer also keep track of the distance covered along the route.

In the unlikely event of the driver making a mistake along the route, the system automatically selects an alternative route in order to put the car back on track.

Rear seat environment

The passenger environment in the rear seat is often neglected, but it is almost as important to pay attention to the comfort of the people travelling with an alert and comfortable driver.

The rear seat is designed for three adults seated in full comfort, with ample legroom and elbow room, thanks to the width and wheelbase of the car.

The interior door panels are specially designed to make good use of the generous width and all the occupants in the Volvo S80 travel both safely and comfortably.

It goes without saying that all three rear seats have three-point belts, with pretensioners and head restraints. The middle head restraint is adjustable for height in order to work with the optional child booster cushion, which can be specified instead of the standard centre armrest.

The armrest can also be equipped with twin cup holders and covers the luggage compartment hatch which makes it possible to transport long items, like skis.

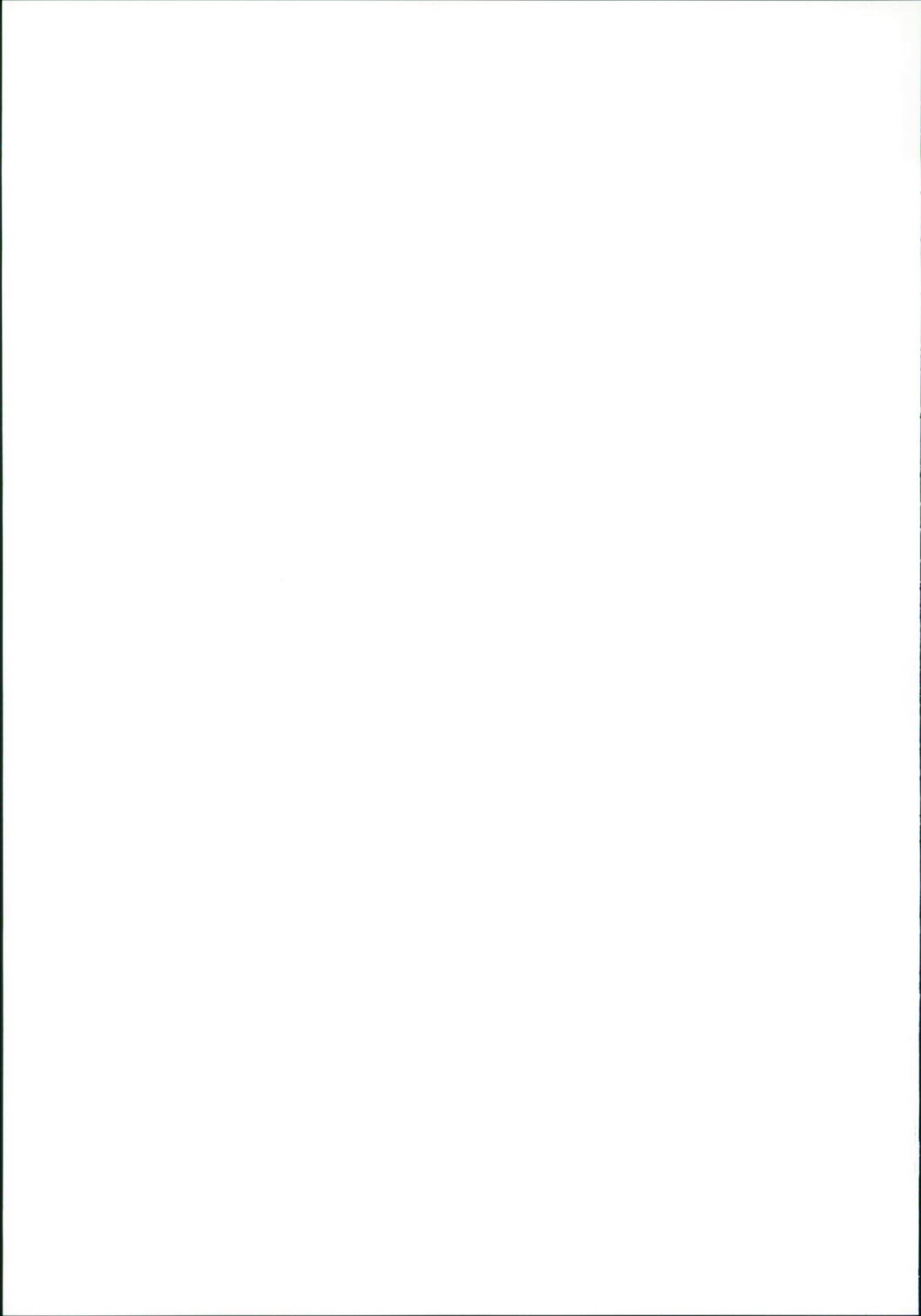
In order to provide even more luggage space, the rear seat can be folded down in a 60/40 split to make the floor behind the driver flat. The folding mechanism is situated on both sides of the luggage compartment for safety reasons. The backrest cannot be folded down from the passenger compartment.

There is also a 12v socket in the rear seat which allows the passengers to use different appliances, like a battery charger.

The luggage compartment is spacious and the boot lid has a very generous opening angle which make the car easy to load. The shape makes it efficient to use and very practical.

The fully-lined compartment has several ingenious details like the extendable load support which keeps carrier bags and other items of baggage safely in position.

Under the boot floor lies the spare wheel, which is part of the crumple zone and energy-absorption network, and beside it there is the battery.



SECURITY

PROTECTION FOR
PROPERTY AND
PEOPLE ALIKE



V O L V O S 8 0



Just like driving characteristics, crash protection and climate comfort are defined as safety areas by Volvo. Security is also a matter of safety for Volvo and something that concerns us every day.

Security is a relatively new area, but this does not make it any less important. At Volvo, security is regarded as part of safety, just like crash protection. Extensive research and development has therefore resulted in a range of features with a very high technology level.

Security can be divided into two areas: personal protection and protection for vehicles/personal belongings or anti-theft systems.

The large number of security features is primarily a result of the new and revolutionary multiplex electrical system. The system allows for easy-to-add-and-install functions at a hitherto unknown level.

The need for personal security has unfortunately increased in recent years and this has led to the development of many ingenious features to increase the sense of security both outside and inside the car, when approaching and leaving it in the dark.

Effective central locking system

A smart and effective central locking system with remote control is one of the basic items in this area. The principle of the central locking system on the Volvo S80 is based on continuously changing control codes to prevent people recording or copying the control signal.

The code is changed every time the lock/unlock buttons are used.

Furthermore, the driver's door has the only lock cylinder in the system.

It is of the free-rotation type which makes entry via the cylinder impossible.

When the car is locked from the outside, the inner locking devices are released and the car cannot be opened from the inside through a broken side window.

There is a hidden emergency lock in the boot lid.

The central locking system can also be operated from inside the car, when driving in city traffic or through less safe neighbourhoods, for example.

Should the driver forget to lock the car when leaving, it will automatically lock itself within two minutes.

Alarm

The central locking system can be combined with an alarm that is fully integrated in the Multiplex system and has been specially developed for the Volvo S80.

The alarm is based on the existing central locking system and its "rolling code" system and is available in different versions depending on market requirements and regulations.

The basic version monitors the bonnet, doors, boot lid and ignition lock. Additional sensors can easily be fitted, including a movement detector for

the passenger compartment or a level sensor which reacts if the car is tilted, lifted or towed away. The interior movement detector can be switched off if a child or dog is left in the car while parked, for example.

Coated side windows

It is much harder to break into the car through the side windows because of the optional side windows made of laminated glass. They are very difficult to break by means of striking or impact.

Should the car nonetheless be broken into, it will be very difficult to start as it has an electronic immobiliser. This immobiliser also uses the "rolling code" which makes the car virtually impossible to start without the right key.

Approach Light

There are several personal security features which make approaching and leaving the car safe in different circumstances. One of them is the optional Approach Light. When approaching the car in the dark, a touch on the button will turn on a number of exterior lights and the interior light, as well as the rearview mirror lights if they have been fitted. This will make it safer to approach the car and increase the sense of security.

Home Safe Lighting

Another personal security function is called "Home Safe Lighting" and is used when leaving the car in the dark, on the owner's driveway, for example. Pulling the full-beam lever ensures that the headlights and a couple of other lights stay on, in order to light up the area in front of the car for about 90 seconds after the car has been locked.

Mayday helps and protects

Another interesting security feature is the Mayday system which offers both personal and vehicle protection. Mayday will be available when there is a reliable service provider in each market.

This is a two-way communication system which identifies the position of the car and is automatically activated in the event of an accident, i.e. when the airbag is triggered, which will then ensure speedy rescue. The driver can also use the system manually and call for help in case of a breakdown or if he or she is in trouble.

The system has a number of back-up functions as it must still work after a serious accident or if the battery goes completely flat.

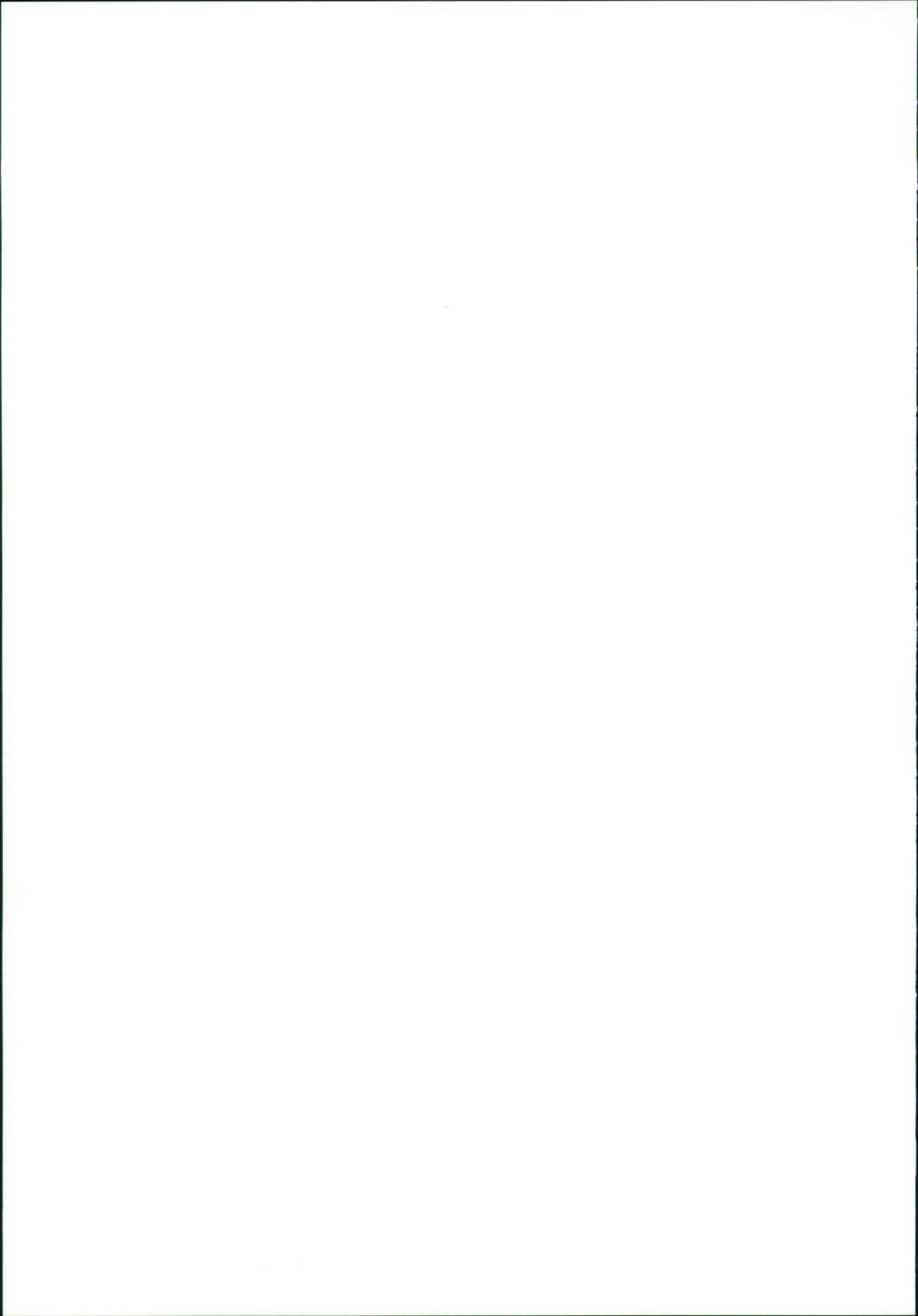
An attempted break-in will automatically be discovered and both the owner and the police will be alerted. If the car is stolen, it will also be possible to identify its position.

Like RTI, Mayday uses GPS (Global Positioning System) and needs the GSM network (PCS in the USA).

The Volvo S80 is not only a safe car in terms of active and passive safety. It also provides a level of personal and vehicle security hitherto unheard of in the automotive world.

Care, innovation and state-of-the-art technology have enabled the car to reach this level.

The same combination applies to the next area.



ENVIRONMENT

FIRST CAR WITH
ENVIRONMENTAL
PRODUCT
DECLARATION



V O L V O S 8 0



DTH 578

Environmental concern is a multi-faceted thing and it begins even before the first computer image of the new car is generated and does not really end with the scrapyard.

Environmental concern must be part of the core of the company. So it comes as no surprise to discover that the Volvo S80 sets a new standard for environmental concern, primarily as a result of Volvo's holistic approach to environmental issues.

First car with environmental product declaration

The Volvo S80 2.9 for the European market is the first car in the world with an environmental product declaration. This declaration covers every phase in the life of the car: production, operation and recycling.

All the data which is used as the basis for the declaration is checked by Lloyd's Register Quality Assurance, an independent inspection institute. This, too, makes this declaration totally unique.

It is Volvo Cars' systematic environmental programme that has made the development of this environmental declaration possible. The complete chain comprises 17 company units, including suppliers and dealers.

All the textile material in the car also has certification in accordance with the international ÖKO-TEX standard.

Volvo is aided in this work by a number of important control and analysis tools that have been developed within the organisation over the years. They include:

VEMS (Volvo Environmental Management System), Volvo's manual for the implementation of eco management systems throughout the Volvo Group, leading to ISO and EMAS environmental certification.

The EPS life cycle analysis (Environmental Priority Strategies in product design) helps engineers during the initial design stages to conduct a complete life cycle analysis of every material, design and process that is chosen.

The ELU (Environmental Load Unit) is a theoretical rating which indicates the environmental load of a certain project and process and therefore permits comparisons between different solutions.

The MOTIV system (Environment and Toxicology within Volvo) is a computer database containing detailed information about some 5,000 chemical products, which enables product and process developers to choose the chemicals that are less harmful to the environment.

A black list specifies the substances which must not be used, while a grey list contains substances whose use should be minimised wherever possible. A white list contains suitable replacement substances and processes that are less harmful to health and the environment. DFR (Designed for Recycling) principles are one of the most recently developed environmental tools and control the design and use of recycled and recyclable components.

In general terms, the environmental load a car imposes is divided into three parts, production, operation and scrapping or destruction.

The production phase

The Volvo S80 is the first car on the market to be produced in a process that has environmental certification according to the ISO 14001 standard for environmental control systems, issued by Lloyd's of London.

Production itself is preceded by product and process development under the strict guidance of the above-mentioned methods – and many others. The production of the S80 at the Volvo Torslanda Plant is second to none in the automotive industry in both environmental and quality terms.

The paintshop uses one of the world's cleanest painting processes in which virtually all the painting is done by robots in sealed-off spaces. Moreover, all hazardous chemicals have been removed from the production process.

All the paint is naturally waterborne, thereby reducing the emission of solvents to a minimum.

The waste-water cleaning process is world class and much of the water that is discharged from the plant is actually cleaner than the water that is brought in from the local waterworks!

Furthermore, energy consumption during the production phase is deliberately kept as low as possible.

The main transition in material usage is taking place within the use of plastics. The percentage of recycled plastics and recyclable plastics is increasing the whole time, in line with Volvo's strategy to make more or less the entire car recyclable.

All the plastic parts weighing more than 50 grams are labelled with international symbols to facilitate sorting and recycling. Recycled plastics currently account for some 10 per cent of the plastic content of the Volvo S80, or more than 33 kilograms in weight.

Of the plastic used in the car, some 25 per cent is recyclable- but the switch-over to other plastics will continuously increase this figure.

The plastics used on the inside of the car have been carefully selected in order to minimise both vapour emissions and fogging. So-called TPO foil on the dashboard and panels has replaced the PVC which was previously used and was largely been responsible for fogging. TPO has several advantages over PVC. It is far better from an environmental point of view and is also more pleasant to touch.

The work of phasing out CFC from plastics and as a coolant from air conditioning systems started back in the 1980s at Volvo. In 1991, the Volvo 850 went on the market as the first CFC-free car in mass production. Needless to say, the Volvo S80 is free not only from CFC but also from mercury, asbestos and cadmium.

The Volvo S80 is the first car on the market to have all its interior fabrics,

not just the upholstery materials, öKO-TEX certified. This standard controls the presence of substances that may be allergenic or harmful to health and only grants certification to materials which comply with its requirements.

Operation phase

During the operational phase of the car, which lasts for perhaps 15 to 20 years, it is important not only to keep all the emissions to a minimum but also to minimise the emission of carbon dioxide, hydrocarbon vapour, particulate matter, fuel consumption and so on.

The use of aluminium in engines not only reduces weight but also helps to cut fuel consumption, together with highly efficient combustion and state-of-the-art engine management.

In some variants, fuel consumption has been reduced by up to seven per cent, thanks to the new generation of engines, good aerodynamics and low roll resistance (cd 0.28).

This is part of Volvo's undertaking to reduce fuel consumption in Volvo cars by an average of 25 per cent by the year 2005.

Fuel in this case means not only petrol and diesel. The Volvo S80 will also be available in environmentally-compatible Bi-Fuel versions. The petrol engine will be able to run on methane, natural gas or biogas, whereas the diesel engine will also be able to run on rape-seed oil.

The emission control in the Volvo S80 – described in detail in the Driving Experience chapter – is the best that is currently available. It produces both a very high level of purification and a very long and efficient service life.

The car easily complies with both the European EU 2000 legislation and the American Low Emission Vehicle (LEV) requirements.

Emissions of hydrocarbons from the fuel system when the car is stationary are effectively dealt with and fed back to the engine using evaporation control – the EVAP system. The scrapping of a car and the re-use of materials must be facilitated in every way. Volvo has carried out in-depth work in this area and it has resulted in a number of achievements.

The Volvo S80 is accompanied by a dismantling manual in order to show the best way of taking it apart when it is scrapped. This must be done in a well-planned, environmentally-sound manner.

A pilot project, ECRIS, has already been in operation for several years, dismantling cars "the environmental way", leaving nothing to waste.

The Volvo S80 has in fact been designed for re-use when it is produced, in order to save raw materials and make the best possible use of plastics, metals, rubber, fabrics and so on. The sources of raw materials are limited and it is both possible and necessary for used materials to be used again. The technology is there – and Volvo is using it.

The Volvo S80 can be driven with a clear environmental conscience.

