Safety

ABS
(Anti-Blocking System)

By preventing wheel locking in the event of emergency braking, ABS (which stands for Anti-Blocking System) lets **the tyres retain their ability to steer the car**. The driver therefore remains in control of the vehicle's trajectory.

RENAULT COMMUNICATION

BASIC FACTS

Contrary to a generally accepted idea, ABS does not reduce braking distances – it optimises them, whatever the level of adherence between the tyre and the ground. It also allows the driver to retain control of the trajectory of the car and maintain its stability. When a tyre grips the roadway under normal conditions, this ensures the car can be steered correctly. Conversely, when a wheel is blocked following too-sharp braking, the tyre loses its directional ability and the trajectory of the car becomes uncontrollable. By preventing wheel blocking, ABS avoids the appearance of this phenomenon.

IN SHORT
ABS detects the start of wheel blocking. It then reduces the pressure in the braking system so that the tyre can recover its grip. It restores the pressure immediately so that braking can continue.

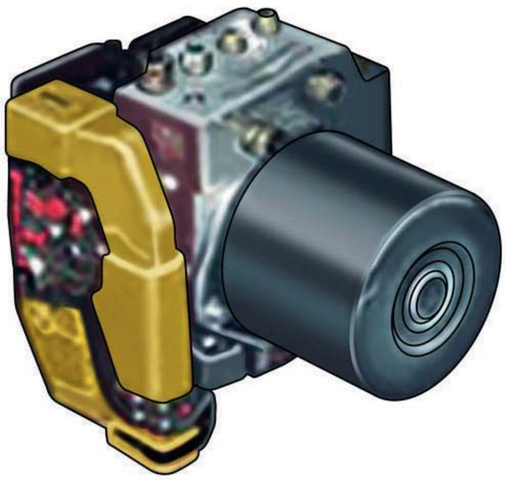
HOW DOES IT WORK?

1 TRAJECTORY CONTROL

Each wheel of the car has a tachometer – a device capable of measuring rotation speed. It consists of a disk with a notched periphery that is connected directly to the wheel and an electro-magnetic sensor. When the wheel turns, the sensor delivers a pulse each time a notch of the disk passes in front of it. The frequency of the pulses is therefore proportional to the number of revolutions of the wheel. When braking occurs, as long as the wheel does not block, the frequency at which the sensor delivers the pulse gradually declines, until the car stops. On the other hand, any onset of blocking is signalled by an abrupt fall-off in the frequency of the sensor output. The ABS computer detects the break in the regularity of the fall-off, signifying that slip between the tyre and the ground is starting to occur. Through the activation of a solenoid valve, the system starts to resist an additional increase of pressure in the braking circuit. If the onset of blocking persists, the computer acts again on the solenoid valve to bring about a drop in pressure. As soon as it detects that the tyre has found its grip, which is apparent from an increase in the speed of wheel rotation and thus of the pulse frequency delivered by the sensor, it acts again on the solenoid to restore the pressure in the braking system. This operation can be repeated numerous times, at very short intervals.

2 ARCHITECTURE
ABS is the cornerstone of many other systems

The ABS computer has taken on major importance within car on-board electronics architecture. ESP, emergency brake assist, ASR, traction control (see sheet), and also cruise control, tyre pressure monitor and many other systems, either base their operation on information which it delivers, or make direct use of the ABS computer to perform their task.



RENAULT COMMUNICATION

Active anti-submarining system

In the event of a frontal impact, it can happen that the occupant's pelvis slips under the lap strap of the safety belt: this is called submarining. The belt strap no longer rests on the pelvic bones, which are highly resistant, but on the much more fragile stomach. This situation can produce serious injuries. Active anti-submarining counter-acts this phenomenon.

BASIC FACTS

The shape of car seats is already designed to attempt to counteract submarining. However, giving seats a form and sufficient firmness to be able to completely reach such a point is not compatible with the comfort that is expected of them. Pretensioner systems make it possible to limit, and even provide a solution to, the problem of submarining. Unfortunately, they cannot be adapted to all types of vehicles. On convertibles, among other models, the installation of multiple pretensioners is not feasible for both technical and ergonomic reasons. To compensate for this deficiency and ensure that they have a level of safety equivalent to that of other models, Renault has developed the concept of active anti-submarining, based on a specific airbag integrated in the base of the seat.

IN SHORT
A specific airbag placed in the base of the seat inflates in a frontal impact to stabilise the pelvis of the occupant and eliminate the phenomenon of submarining.

HOW DOES IT WORK?

1 AS A COMPLEMENT TO THE SAFETY BELT

The base of the seats contains an airbag of a very particular type. It is composed of a sandwich of two very thin metal sheets welded together all around their edges. This structure, which resembles a simple sheet of pressed steel, is therefore very thin. Hidden in the upholstery foam of the seats, it is imperceptible both visually and in terms of comfort. However, like a traditional airbag, this sandwich contains a gas canister. In the event of an impact, it is triggered, which causes an instantaneous inflation of the metal sandwich. It then plays a double role. Initially, thanks to the additional curvature that it gives to the seat, it is an efficient barrier to submarining. In addition, the metal sheets that make up this airbag are deformable. It thus acts as a supplementary energy absorber, supplementing the work of the safety belt.

2 THOROUGHLY TRIED AND TESTED

Before being installed as standard, this airbag underwent many tests to ensure that it did not present any type of risk. Specific studies were undertaken involving children, who sometimes place their heads on seats.

Additional cornering lights

On winding roads, the **inside of bends are not illuminated by headlights** and remain in darkness. A problem which additional cornering lights eliminate...

RENAULT COMMUNICATION

BASIC FACTS

On winding roads, the inside of bends can conceal obstacles that are barely visible to the driver because of the directionality of traditional headlights. Their beam of light is emitted in line with the axis of the car and so is cast tangentially to the curve of the road. The inside of the bend therefore remains in half-light.

IN SHORT

Additional cornering lights, directed at an angle of 40° to the axis of the car, light up the inside of a bend. They are automatically deactivated at high speed or in reverse gear.

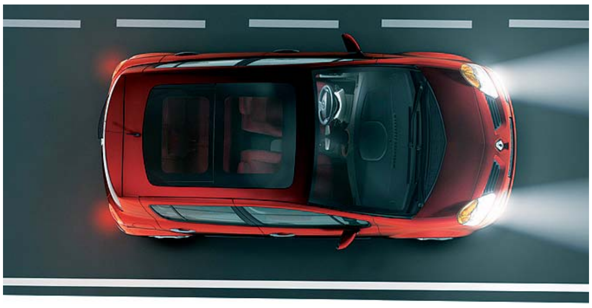
HOW DOES IT WORK?

1 ACTIVATION

A specific computer compares and exploits data from several sources. An angular steering wheel position sensor indicates the driver's actions to the computer and, in particular, the direction of the bend – a right-hand or left-hand bend. The wheel tachometers supply the speed of the car. This data comes from the ABS computer. The computer also takes account of the position of the lighting controls. While making use of all of this information, the calculator gradually illuminates either the right or left additional light. Its beam, directed at an angle of 40° compared to the axis of the car, illuminates the inside of the bend.

At high speed, the feature does not function since it is no longer a question of bends but of broad curves. The normal light coming from the headlights is therefore sufficient to illuminate them completely. As a result, once a certain speed threshold is reached, the computer automatically inhibits the additional cornering lights and reactivates them as soon as speed decreases again.

2 ADAPTATION
Avoiding the traps of winding roads



Because of their fixed direction, traditional headlights cannot illuminate the inside of bends on winding roads. For the driver, certain obstacles may not be seen. By delivering a complementary source of light directed towards the interior of the bend, additional cornering lights eliminate these traps. The additional cornering lights on Modus were awarded the EPCOS-SIA 2005 innovation trophy.

RENAULT COMMUNICATION

Airbags

Airbags are responsible for the **final deadening of an impact**, after the safety belts have absorbed most of the energy released by the occupant. A pyrotechnic gas generator managed by a computer ensures their inflation.

RENAULT COMMUNICATION

BASIC FACTS

Today, all vehicles are equipped with 2 frontal airbags. The first, integrated in the steering wheel, protects the driver; the second, in the instrument panel, protects the passenger. Their volume can vary from one model of car to another but, on average, it is around 60 litres for the driver airbag and approximately 150 litres for the passenger airbag. This variation of volume is explained by the presence of the steering wheel, which reduces the distance separating the driver from the cockpit elements. It has been shown that in the event of a frontal impact, the action of the airbags, combined with that of the safety belts, decreases the number of drivers killed by 25% and of passengers by 15%. In the same way, in both cases, it decreases the number of serious thoracic injuries by 65% and that of head injuries by 75%.

IN SHORT

The airbags inflate in 30 thousandths of a second to supplement the action of the safety belt during the final phase of impact deadening. They reduce the risk of serious head injuries by 75%.

HOW DOES IT WORK?

1 HIGH PROTECTION

A computer, also known as an ECU, for Electronic Control Unit, permanently measures vehicle accelerations – an impact is in fact read as a very violent acceleration. To do this the ECU, which is generally installed in the middle of the vehicle at the front of the cabin, analyses information delivered by the accelerometers. These sensors provide the ECU microprocessor with data on the car's acceleration and deceleration, both longitudinal and latitudinal. When an impact is detected, specifically because a value of the acceleration parameters is exceeded, the ECU determines its direction and intensity. As soon as these are above a threshold considered critical, the ECU triggers inflation of the airbags. It does this by sending a pulse to a pyrotechnic air pump. This firing causes a strong, almost instantaneous release of gas, obtained by a chemical reaction based on solid fuels, which inflates the airbag in 30 thousandths of a second. Vents – calibrated slits made in the fabric of the bag – allow it to deflate rapidly (in 0.2 seconds) following the impact, to control the amount of pressure applied to the occupant.

In addition, as the ECU can compute the direction of the impact, it can selectively trigger either the frontal airbags or the side airbags, or both jointly. It should be noted that, to ensure correct deployment of the airbags even in the event of destruction of the battery at the time of the impact, the computer is equipped with condensers. Those give it enough "back up" electrical power, even when it ceases being powered normally by the battery.

2 BEYOND TECHNIQUE

A correct driving position helps the action of the airbags

RENAULT COMMUNICATION

So that the airbag can fully play its part, the driving position must be correct. If the driver is too close to the steering-wheel, the deployment of the airbag can cause burns; too far away and it loses efficiency. To check that the driving position is correct, the driver should be able to touch the steering wheel with his wrists when stretching out his arms.

Lastly, and most importantly, a child safety seat must never be installed on the front passenger sear unless the passenger airbag has first been disabled.

ASR active traction control system

To guarantee that the vehicle starts perfectly on a surface offering poor grip, in conditions of ice or snow, for instance, ASR traction control **adjusts the distribution of torque between the drive wheels.**

RENAULT COMMUNICATION

BASIC FACTS

Because of the presence of the differential, if one of the drive wheels spins on starting, the available torque is reduced accordingly. In addition to starting on snow or ice, a similar situation arises when trying to get out of a rut. If one of the drive wheels spins, the other wheel only has very low adherence, insufficient to get the car out of the rut. To resolve this problem, ASR applies braking pressure to the wheel that is spinning, thereby ensuring that all the engine torque is transferred to the wheel with good grip.

IN SHORT

On starting, ASR lowers the torque applied to a wheel that is starting to spin and applies it to the other drive wheel. This delivers improved starting on snow, ice and, in general on any surface with low adherence.

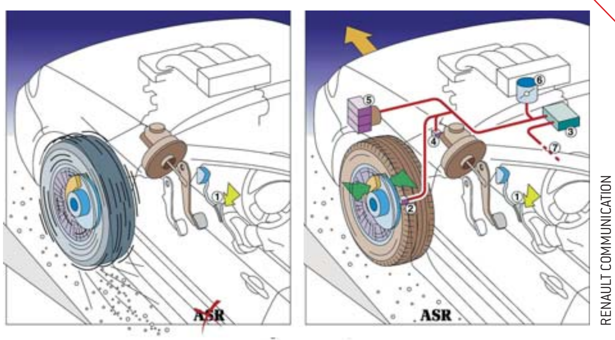
HOW DOES IT WORK?

To some extent ASR traction control behaves inversely to ABS. Here, the computer does not detect blocking but, conversely, a rise in the number of abnormal revolutions of the wheel. To do this, the computer constantly analyses the evolution of the frequency of the impulses that the wheel tachometers deliver. When starting with no slip, the frequency coming from each wheel increases progressively. On the other hand, a sharp increase in this frequency signals the start of wheel spin on one of the wheels. Moreover, this increase in frequency is incoherent compared to that delivered by the other wheel tachometers: the increase in the number of revolutions of the wheel concerned is incompatible with the real acceleration rate of the car. By detecting this anomaly, the ASR computer detects the wheel that is spinning and actuates its brake calliper to bring it back to a normal number of revolutions. This braking torque that the system applies to the wheel that has lost grip is transferred, via the differential, to the wheel with normal adherence, in order to give the car the maximum level of traction. However, it can happen that, on ice, for example, the wheel that had traction in its turn loses adherence. This phenomenon, as previously, is signalled by the abrupt rise in the frequency of the impulses of its tachometer. The computer then adopts a new strategy, as it would be useless to try to apply braking. It acts on the engine torque while directly communicating with the injection control unit. By reducing the power that the engine delivers, it enables the drive wheels to find adherence. From now on it will maintain this power at the limits of the wheel slip threshold during the entire starting phase.

Not only does this mode of functioning allow improved starting under the worst driving conditions, it ensures the vehicle will remain steerable by constantly maintaining wheel adherence. Lastly, ASR does not just function during starting or in a straight line. At any moment, and no matter what the topography of the road, it is able to compensate for a loss of adherence caused, for example, by a patch of oil or black ice.

A supplement to ABS and ESP

The ASR control unit is an integral part of the ESP control system. It is in fact a “module”, a bundle of software functions, able to communicate and interact with ESP and ABS (see sheet), in order to respond to the features of ASR.



1. Accelerator pedal
2. Wheel speed sensor
3. Engine management unit
4. Brake pressure sensor
5. ABS control unit
6. Butterfly valve actuator control unit/injection pump
7. CAN

Automated headlights and windscreen-wiper activation

These systems aim to relieve the driver of routine tasks so that he can **give his attention to the road** or avoid him forgetting to put on his headlights when driving conditions require it.

RENAULT COMMUNICATION

BASIC FACTS

The driving station of a current vehicle comprises an average of about thirty controls. However, as soon as the driver has to act on one of them, his attention is distracted from the road. Even if he is not aware of it and the fall-off in alertness is only very temporary, it is no less present. One must not lose sight of the fact that in only one second a car going at 90 kph travels 25 meters. At a speed of 130 kph, the distance in question is more than 36 meters. Each second lost can thus have serious repercussions during critical situations. Relieving the driver of performing operations that can be managed automatically to allow him to focus exclusively on driving therefore contributes to safety.

> HOW DOES IT WORK?

RAIN SENSOR

LIGHT SENSOR

RENAULT COMMUNICATION

The rain sensor, placed behind the rear-view mirror, is based on the reflection of infra-red beams in the windscreen itself. To achieve this, two electro-luminescent diodes emit infra-red beams that penetrate the glass of the windscreen and are reflected on its external surface. These beams are emitted at an angle such that when reflected, they reach two photodiodes which measure their intensity. When the windscreen is dry, reflection is maximum. On the other hand, the presence of water decreases it because of the phenomena of infra-red diffraction within the drops. Furthermore, this loss of reflection is proportional to the quantity of water present on the surface of the windscreen. Thus, by measuring, through the photodiodes, modifications in reflection, the device computer determines not only if the windscreen is dry or wet, but also the quantity of water to be eliminated. It commands the activation of the windscreen wipers and their speed, according to the intensity of the rain.

The light sensor comprises three lenses that focus the light onto three photo-electric cells. This configuration makes it possible to divide "the luminous space" surrounding the vehicle into several zones through the directivity of each basic lens-cell pair. One pair measures the total ambient light, the second intercepts the frontal sources of light and the third makes it possible to distinguish a tunnel from a country road at night. By comparing the information gathered by these three devices, the system computer determines the situation with which the vehicle is confronted and commands the headlights in consequence. Furthermore, this "multi-sensor" configuration makes it possible for the computer to better manage transitions between zones of shade and zones of light.

The two systems interact. In night driving, for example, the threshold of windscreen-wiper activation is lowered. The driver remains in control of the system, of course, and can choose whether or not to activate it and can override it at any moment.

IN SHORT >>>
Windscreen wipers
Automatic activation of the windscreen wipers is controlled by an active infra-red sensor which detects the presence of water droplets on the windscreen by the modifications in reflection that they induce.

IN SHORT >>>
Lighting
Automatic lighting of the headlights is controlled by a passive light sensor. It measures available light using a set of photo-electric cells.

Automatic roll bars
for coupé-cabriolets

Because of the absence of a roof, **the rear-seat passengers of convertibles are particularly exposed in the event of a rollover**. To protect them effectively, while preserving the convertible aspect of the car, Renault has developed automatic roll bars that deploy at the start of a rollover.

RENAULT COMMUNICATION

BASIC FACTS

In a convertible, the safety area in a rollover is materialised, on the one hand, by the leading edge of the windscreen and in addition, by the roll bars placed behind the rear seats. Their height is thus of primary importance to ensure rear-seat passengers an adequate level of safety. Unfortunately, endowing these elements with sufficient height is incompatible with the elegant style of a convertible. To combine appearance and safety, Renault turned to the development of automatic, retractable roll bars. Retracted, their appearance is identical to that of head-restraints, which is indeed their purpose in the event of a rear collision. On the other hand, as soon as their control unit detects the start of rollover, they are deployed to ensure protection of the passengers.

IN SHORT

As soon as the start of rollover is detected, the roll bars deploy to increase the safety zone. In the event of accidental deployment, no risk to the passengers is entailed, and a manual reset can be performed.

HOW DOES IT WORK?

1 THE COMPUTER

A computer analyses the rolling and pitching movements of the car. As soon as its angle of incline exceeds 50° along its lateral axis, or 67° longitudinally, the computer commands deployment of the roll bars; their travel is 130 mm. To do this, it activates an electromagnet which in turn releases the springs. The time required for deployment of the roll bars is considerably longer than that of an airbag, for example, since it is half a second. However, this duration is fully adapted to the situation because the rollover movement of a car is relatively slow and always much greater than this lapse of time. Moreover, the use of electromechanical and not pyrotechnic mechanisms has additional advantages. On the one hand, deployment of the roll bars is carried out in a relatively gradual manner which consequently carries no risk for the occupants of the car. Additionally, this solution allows for a manual reset of the system in the event of accidental deployment: a situation that can occur in certain cases of extreme driving where the computer may interpret strong rolling or strong pitching as the start of vehicle rollover. Lastly, if the roof of the convertible is up, this does not prevent deployment of the roll bars. However, in this case, they do not reach their position of full deployment, but stop once they are almost touching the roof. This ability to adapt to the situation is made possible by the choice of the electromechanical system.

2 TESTS

To test the system's effectiveness, the convertible is sent down a sloping ramp which occupies only half of the roadway. This causes the car to roll over. During this test, known as the "corkscrew test", the deformation of various elements (windscreen and roll bars) are analysed to check that the roll bars deliver the correct level of protection to the occupants of the car.

RENAULT COMMUNICATION

Child safety equipment

A child's body is not a small-scale version of an adult's body. Moreover, it is very different in terms of flexibility. Until 10 years old, a child must be seated in a **specific safety device** adapted to his anatomy. The safety of children is therefore a specific safety topic. It is the subject of very advanced research at Renault.

RENAULT COMMUNICATION

BASIC FACTS

The fundamental rule is that all the children must be systematically attached with safety devices adapted to their age. Statistics show that 30% of rear passengers involved in an accident are children younger than 10. In 22% of cases, serious injury could have been avoided by an adapted protection system. To meet this need, since 1998 Renault has fitted its cars with Isofix anchoring systems that are specifically adapted to the fixing of child seats. So that its protection is effective, a child seat or booster must be completely anchored to the vehicle seat. The ISO (International Standards Organisation) worked on this problem and produced the Isofix fixing system standard.

IN SHORT

Isofix is a standard child safety seat fixing system that ensures they remain effective in an impact.

HOW DOES IT WORK?

1 STANDARDS

The Isofix standard seeks to prevent incorrect fitting of universal child seats in cars, and thereby minimise the risk of injury under collision conditions. Isofix introduces a standardised interface between the child seat and the vehicle, with two anchor rings at the junction between the seat back and bottom, and a third "tip-proof" anchor point for forward-facing seats. In addition to these fastenings, Renault includes an extra anchor point to provide better stability for backward-facing seats. Because a child's morphology changes very fast, Isofix specifies three age-ranges, each calling for a specific protection system:

Up to 2 years. Very young children need special neck protection. Because the head accounts for half of a baby's total weight, the neck is very vulnerable. To minimise the risk of neck injury and improve thorax and stomach protection, the child should be seated facing backwards, in a special baby car seat. This can be fitted on the front passenger seat provided the passenger-seat airbag is disabled.

2 to 4 years. At this age, the priority is head protection. To prevent the head from impacting against the back of the front seat in the event of frontal collision, the child should be strapped into a suitable forward-facing seat properly attached to the car seat.

4 to 10 years. Children under the age of about 10 are not adequately protected by the regular car seat belt. Without a booster seat, the child is too low down, and risks stomach injury when the belt tightens under impact. A solidly anchored booster seat will hold the three-point seat belt against the pelvis to reduce the risk of serious injury. And a booster seat with back will improve the fit of the belt against the shoulder and minimise the risk of slipping.

RENAULT COMMUNICATION

2 FIGURES

60,000
children in Europe are injured each year in accidents, often because of the lack of a child seat or the use of an inappropriate child seat.

30%
of rear passengers involved in an accident in Europe are children.

88%
of young children correctly attached in rear-facing child seats are unscathed in an accident.

MORE INFORMATION www.iso.org/iso/fr/prods-services/popstds/isofix.html

Emergency Brake Assist

Studies show that, in the event of emergency, **less than 30% of drivers fully use the braking capacities of their car**. Out of fear of wheel locking, they apply insufficient pressure to the pedal at the start of braking. Emergency Brake Assist compensates for this reluctance by demanding the maximum from the hydraulic system resources at the start of braking.

RENAULT COMMUNICATION

BASIC FACTS

When they are confronted with an emergency braking situation, most drivers do not dare to press hard enough on the break pedal for fear of blocking the wheels. In addition, drivers frequently have a tendency to release the pressure on the pedal prematurely, well before the car has sufficiently slowed down. Both these points considerable lengthen the car's braking distances. The Emergency Brake Assist system is designed to compensate for them.

IN SHORT
This complement to the ABS system detects emergency braking and then acts on the hydraulic system to increase its effectiveness by applying maximum pressure to the brakes at the start of braking.

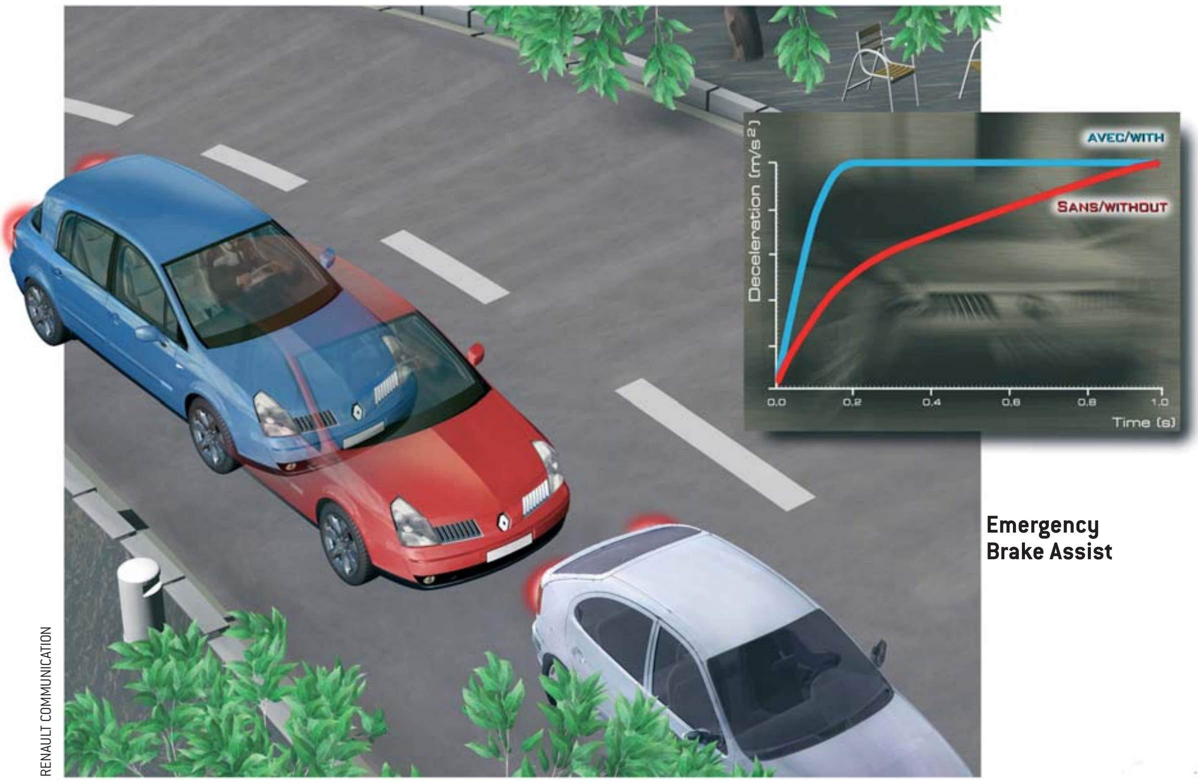
HOW DOES IT WORK?

1 DETECTING AN EMERGENCY

The speed with which the driver presses on the brake pedal is detected: even if he does not exert sufficient pressure, under the impact of surprise, the movement will be fast. This behaviour permits the Emergency Brake Assist to detect an emergency situation. Consequently, it invokes an excess of pressure in the hydraulic circuit of the braking system and maintains it until the threshold that triggers ABS. The braking capacities of the car are thus fully exploited as of the first meter. In addition, this maximum pressure in the hydraulic circuit is maintained until the driver has largely slackened pressure on the brake pedal. The system interprets this action as signalling the end of the emergency situation. It is then deactivated to allow a return to gradual, gentle braking as in normal use.

2 CONTROLLING BRAKING

Emergency Brake Assist offers all drivers an identical level of safety

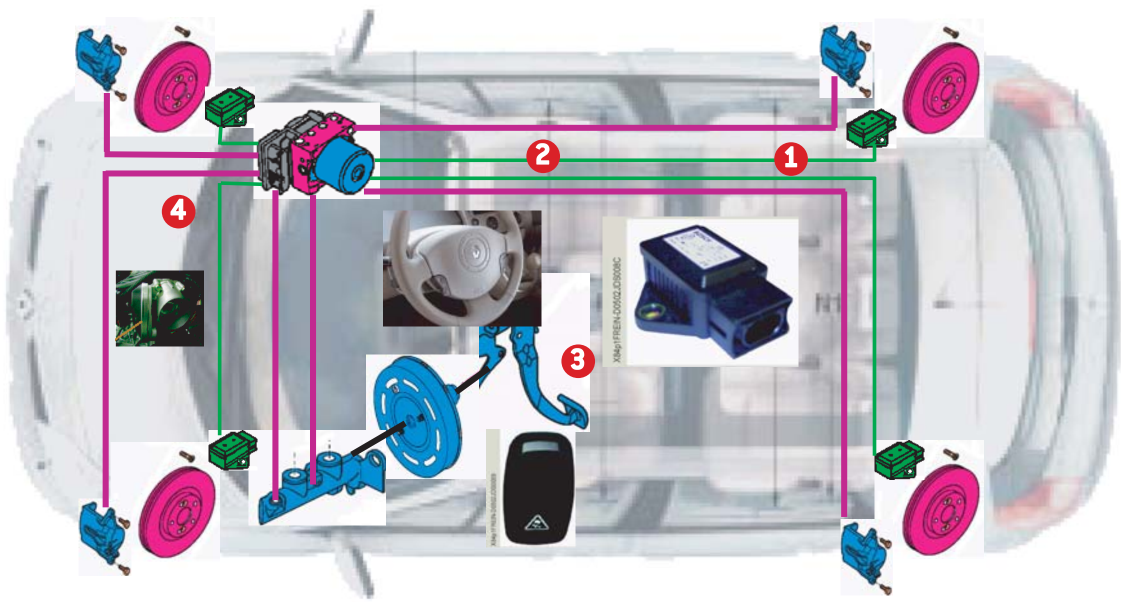


Emergency Brake Assist

To have perfect control of braking requires a lengthy apprenticeship and excellent knowledge of the capacities of the vehicle. An occasional driver, out of lack of experience or practice, will not be able to fully exploit the braking capacity of his car. Emergency Brake Assist compensates for this weakness by interpreting and supplementing his actions.

ESP (Electronic Stability Program)

Dynamic trajectory control, also known as ESP (Electronic Stability Program), assists the driver to **retain control of his vehicle** in the event of a loss of grip. Traction control operates alongside ESP.



Hydraulic link
Electric link

Components of the ESP system include:

1 | a sensor which combines two piece of information: lateral acceleration and rate of yaw
2 | a steering wheel angle sensor
3 | a disconnection switch
4 | specific management of engine torque

BASIC FACTS

The aim of ESP is to maintain the trajectory of the vehicle as the driver wishes it to be in turning the steering wheel. An abrupt emergency manœuvre, a bend taken too fast and even a damaged road surface can result in a loss of tyre grip, meaning that the driver is barely, if at all, in control of his trajectory. By detecting the warning signs of such phenomena, ESP helps the driver by attempting to correct the trajectory.

IN SHORT
Using data supplied by seven sensors, the ESP computer acts selectively on the wheels so that the car returns to the intended trajectory. It does this by working in close conjunction with the ABS system.

HOW DOES IT WORK?

1 THE COMPUTER

To avoid sudden loss of adherence, ESP works selectively on each wheel and, if necessary, on engine torque. Take the case of a right-hand bend. If the car is tending to go straight on or is in understeer, ESP will force it to take the bend by applying braking pressure to the right rear wheel, and possibly the right front wheel. This creates a fulcrum which forces the car to take the bend (figure 1). In the same right-hand bend, if the car is tending to go into a spin or is in oversteer, ESP then acts on the front left wheel. By applying brake pressure to it, it creates purchase which forces the car to rectify its trajectory (figure 2).

To perform these operations, ESP analyses the data provided by seven sensors and compares them with a reference model of the vehicle's behaviour stored in its memory. The first sensor transmits the angle of the steering wheel. To verify whether the real trajectory of the car is complying with that desired by the driver, it processes the information fed to it by the other six sensors.

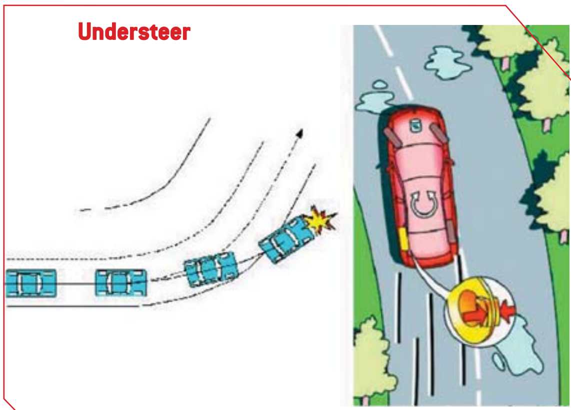
First of all, the computer determines the speed of the vehicle by analysing the data provided by each wheel's tachometers (those of the ABS). The computer also checks that the difference in speed of rotation between the right and left wheels conforms to the bend that the vehicle is negotiating. The analysis is further refined by data supplied by a sixth sensor, a gyrometer, which detects the vehicle's rotational movements around its vertical axis, also known as the rate of yaw. Finally, an accelerometer enables it to detect the onset of lateral slipping. Any discrepancy detected by the computer results from a deviation between the car's real trajectory and that desired by the driver.

The computer then acts selectively, applying brakes to one or more wheels. Here again, the system employs ABS circuits, and the selective braking of wheels is made possible by a constant dialogue between ESP and ABS functions. If the selective braking of wheels is insufficient to force the vehicle to adopt the correct trajectory, the computer then acts on engine torque by way of the throttle, injection or ignition.

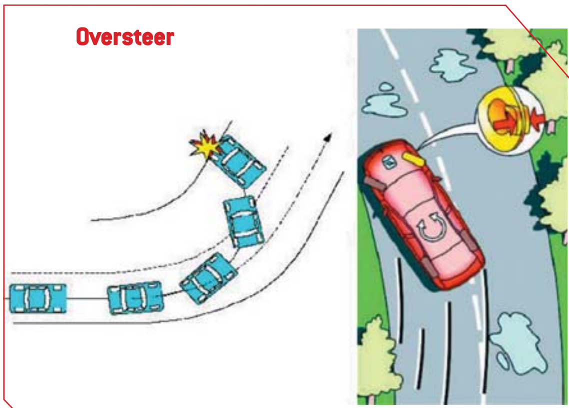
2 UNDERSTEER CONTROL STRENGTHENS THE ACTION OF ESP

On Renault vehicles, the use of CSV Understeer Control further improves the action of ESP. Understeer Control can act on all four wheels at the same time. In view of the fact that, in certain extreme situations, this can lead to a sharp deceleration of the car, the hazard warning lights are automatically activated to alert other drivers.

Understeer



Oversteer



RENAULT COMMUNICATION

Euro NCAP:
safety beyond the standard

Euro NCAP is a Brussels-based association whose purpose is to conduct **very detailed studies of the consequences of car accidents on driver and passengers**. An independent organisation, Euro NCAP is co-financed by the FIA, the European Union, the governments of five countries (the UK, France, Germany, the Netherlands and Sweden) and three associations: the ICRT, the ADAC and the AIT. Euro NCAP employs its annual budget of approximately €6 million on acquiring about thirty new vehicles and subjecting them to crash tests.

RENAULT COMMUNICATION

TEST PROTOCOLS

New cars face a series of four crash tests: front impact, side impact, the pole test and pedestrian impact. Dummies are covered in sensors that make it possible to evaluate the degree of possible trauma which each part of car occupants' or pedestrians' bodies may undergo. Each measurement gives rise to a corresponding score. After reformulation and weighting, an overall assessment of the vehicle is delivered in the form of stars, with a maximum attribution of five. To date, eight Renault vehicles have obtained the maximum score: Espace IV, Vel Satis, Laguna II, Scenic II, Modus, Clio III, Mégane II and Mégane Coupé-Convertible. The last of these is the world's first coupé-convertible to have obtained the maximum score, at the same time as the Saab 9-3 coupé-convertible.

IN SHORT
An independent association, Euro NCAP carries out crash tests every year. The results are interpreted in the form of stars (5 is the maximum) which quantify a car's level of safety.

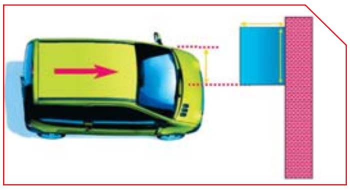
MORE INFORMATION

www.euroncap.com In addition to a detailed presentation of its measurement methodology, there is a list of the results obtained by many vehicles, classified by type and make.

HOW DOES IT WORK?

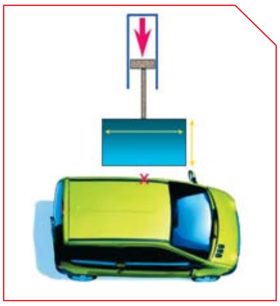
1 PROTOCOL

Front impact



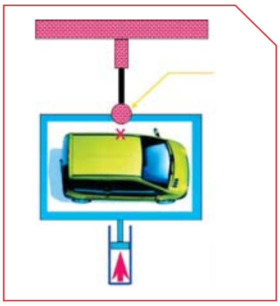
Travelling at 64 kph (against 56 kph as stipulated in the European directive), the car impacts a deformable metal barrier, which simulates a motorway safety barrier. To accentuate the effect of the impact still further, the barrier only covers 40% of the width of the car, driver side. This test is scored out of 16.

Side impact



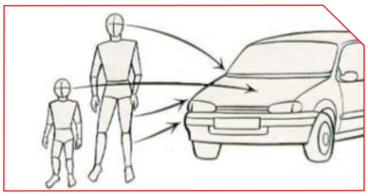
This simulates an accident with another vehicle. A trolley is towed into the driver's side of the car at 50 kph. This test is scored out of 16.

Pole test



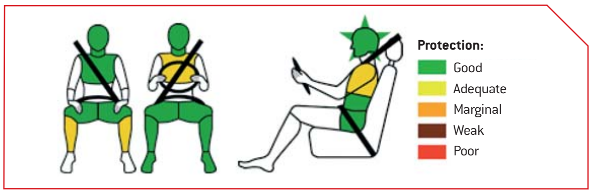
The car is propelled sideways into a rigid pole on the driver's side. Success in this test earns up to 2 bonus points.

Pedestrian impact test



This test evaluates dangerousness in an impact with a pedestrian. Impact occurs at 40 kph. This test is scored separately.

Dummies



Dummies packed with sensors are used to evaluate traumas suffered by each part of the body. Colour-coding denotes the degree of gravity for each zone. Here, results obtained by the Mégane Coupé-Convertible in front and side impact tests.

IN SHORT

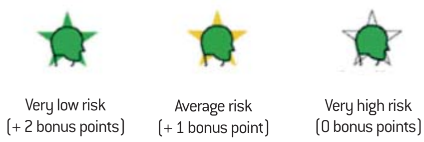
The Euro NCAP evaluation protocol consists of four crash tests that aim to simulate real accident conditions. The tests are extremely stringent and surpass the measurements standards stipulated by the European directive.

2 SCORING SYSTEM: THE COVETED EURO NCAP STARS

Calculating the score

Each impact gives rise to a score, according to the level of safety that is offered by the car. The front impact test is worth up to 16 points, as is the side impact test. The pole test can provide up to 2 bonus points. The total score is thus awarded on the basis of 34 points: 16 points (front impact) + 16 points (side impact) + 2 bonus points. Note that the front impact test has some specific marking criteria. They are based on the measurements carried out on the driver dummy, unless the trauma sustained by the passenger dummy is greater. In this case, the less favourable of the two scores is taken into account.

The side impact test against a pole gives rise to a specific evaluation:



Synthesis of results

The results are synthesised in the form of stars.
The number of stars qualifies the overall level of protection.

excellent
very good
good
poor
very poor

IN SHORT

The tests deliver a score based on 34 points: 16 points for front impact, 16 points for side impact, 2 bonus points for the pole test. According to this score, a rating of between one and five stars is awarded to the vehicle, reflecting its overall level of safety.

Head-restraints

In the event of a rear impact, the head of a vehicle's occupant is first propelled violently backwards and then forwards. If head restraints do not **absorb this brutal movement** correctly, trauma of the neck vertebrae, known as "whiplash injury", can occur.

RENAULT COMMUNICATION

BASIC FACTS

If the head-restraints of a vehicle are not correctly positioned, "whiplash injury" can occur in the event of a rear impact, even one that is not severe. According to the intensity of the impact, trauma can be of different types. The medical profession distinguishes three levels of gravity in the effects of whiplash injury. The least severe is characterised by some stiffness of the neck, accompanied by barely perceptible pains. If it is more severe, the muscles or skeleton are affected and the neck loses its mobility. In the most serious cases, injuries are caused to the nervous system and these can involve loss of feeling. In the long term, even a relatively benign whiplash injury can be at the origin of serious problems involving the cervical vertebrae, or even the whole spinal column. To avoid this, the head-restraint must be resistant and, particularly, be correctly adjusted, in such a way as to have the head-restraint opposite the head (the top of the head = the top of the head restraint), a requirement that is difficult to ensure when it involves children. To fulfil these conditions, the third-generation Renault System of Protection integrates a head-restraint capable of offering maximum protection for both adults and children.

IN SHORT

The head-restraint plays an essential safety role in the event of a rear collision. Its effectiveness primarily depends on it being correctly positioned in relation to vehicle occupants' heads.

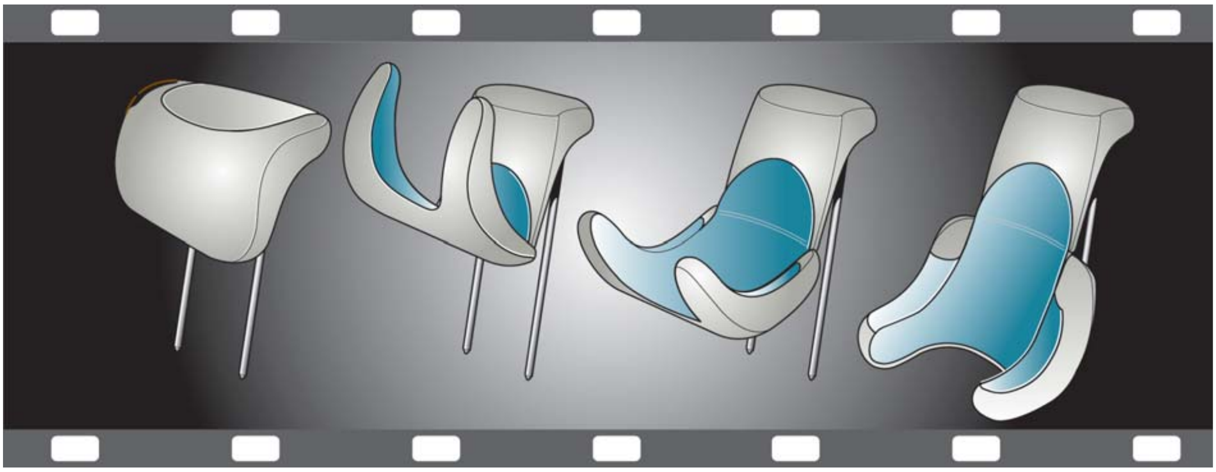
HOW DOES IT WORK?

1 PROTECTION

To guarantee maximum effectiveness of its third-generation protection system head-restraints, Renault has entirely reviewed its design. A complete reworking of the seat-head restraint ensemble also led it to develop a model of head restraint specifically for children. For adults, the characteristic of the new head-restraint lies in the curved support runners, which now slide inside the body of the head-restraint and not the upper part of the seat. This new configuration improves the position of the passenger's back, and support and comfort of the head. It also ensures full adaptability of head-restraint adjustment to the size of the seat occupant. Hence, the head-restraint delivers maximum effectiveness in the event of impact, while improving seat comfort. For children, Renault has specifically designed a "variable geometry" head-restraint adaptable for the rear side seats. In the "child" position, its elements are deployed to form a protective shell around the head of the child passenger sitting on a booster. Folded up, it acts a standard head-restraint and protects an adult passenger.

2 COMPENSATION
Correct adjustment of the head-restraint

The top of the head-restraint must be level with the top of the skull and the distance between the head-restraint and the nape of the neck should not exceed 10 cm.



RENAULT COMMUNICATION

The pre-crash system: preparation for impact

Studies undertaken in the field and close analysis of the conditions that lead up to an accident show that in the moments that precede it, and whatever the reactions of the driver, it is inevitable. In this case, the basic idea of the pre-crash system is to take advantage of this lapse of time to prepare the car and its occupants **to face the collision**.

RENAULT COMMUNICATION

BASIC FACTS

Being able to act even before an impact occurs means that new strategies of protection for car occupants can be envisaged. The pre-crash system opens the way to new systems allowing the violence of the impact to be reduced or to better protect occupants depending on their position, their morphology and the violence of the impact.

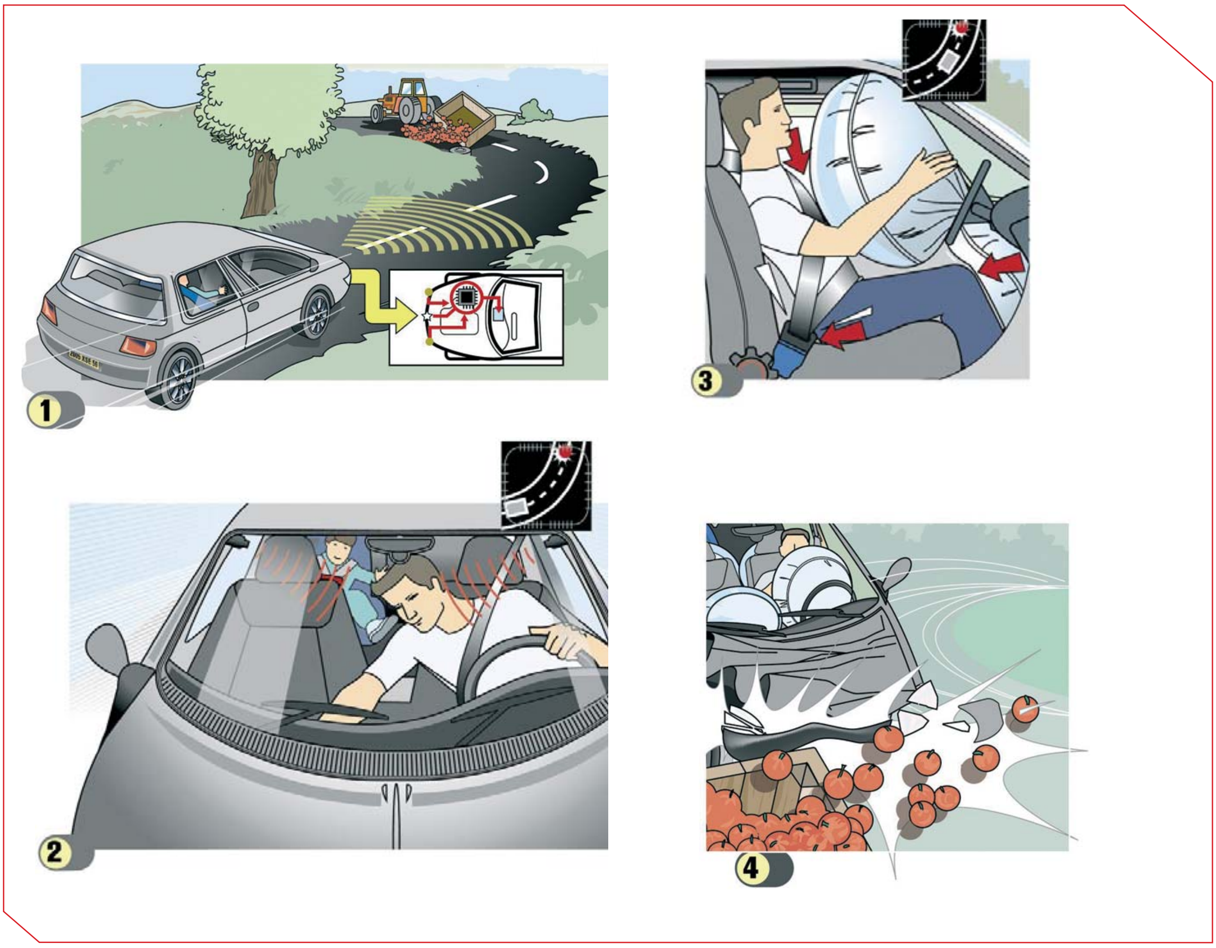
IN SHORT

By using data from specific sensors, such as a video camera and a radar, a computer can detect a situation that will inevitably lead to an impact and prepare the vehicle and its occupants to face it.

HOW DOES IT WORK?

Radars and a video camera make it possible to detect the point of no return. The radar detects the obstacle and the video camera specifies the nature of it. By analysing this information, the system computer estimates the speed of approach and the angle of impact and calculates the intensity of the impact and its repercussions.
In addition, sensors placed in the cabin tell the computer the real position of each occupant and indicate his or her morphology. From this data, the computer can undertake several simultaneous actions. On the one hand, it helps the driver get maximum braking power from the vehicle to reduce its speed at the moment of the impact as much as possible. In fact, studies reveal that accidents only are seldom preceded by optimum braking. In addition, at the level of the cabin, the computer is able to command activation of safety-belt pretensioners and airbags at precisely the right moment to achieve perfect synchronisation of their action with the various deceleration phases.

The pre-crash system probably contains many areas of promising progress for improvement of road safety. Currently, the principal barrier to its development resides in the computing power of onboard computers. To perform its task, this type of equipment has call upon complex data-processing operations such as pattern recognition. Nevertheless, the ongoing rapid increase in microprocessor computing power makes it possible to envisage the arrival of operational systems in the medium term.

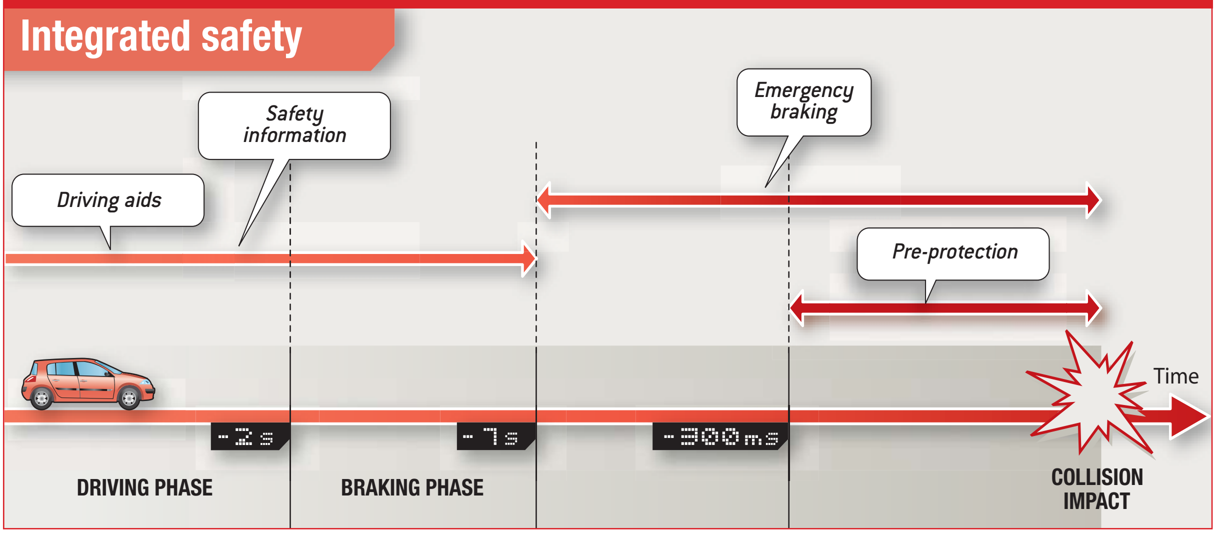


JACQUES PARTOUCHE

1 The radar locates an obstacle, the computer analyses the speed, the angle of approach and calculates the correct speed to best withstand the impact.
2 A battery of sensors indicates the real position of the occupants.
3 The computer commands the firing of the systems and adjusts their power level.
4 The obstacle could not be avoided, the structure of the car deforms, the cabin remains intact, the load limiters enter into action.

Prevention, correction, protection, awareness

Interactivity between the driver and the vehicle must be permanent and be adapted to each situation. **Conscious of the importance of the "man-machine" dialogue**, Renault developed the concept of integrated safety to deliver a global solution.



WAG

BASIC FACTS

Not every situation involves taking the same decisions; this is true for both the driver and the vehicle. To better determine each event and supply an adapted answer to it, the concept of **integrated safety** identifies four different types of situation.

1 PREVENTION

This involves alerting the driver to any type of anomaly likely to lead to a situation of risk. Information, alarms that are communicated in visual or sound form, or even both together encourage the driver to modify his behaviour. Or the solution may involve more traditional equipment being modified, such as giving headlights increased range, to deliver better anticipation of the road ahead at night.

2 CORRECTION

The vehicle makes it possible to react and limit the consequences of an unexpected situation. This may be related to the behaviour of the car or to the inability of the driver to react sufficiently quickly to correct it. Electronic driving aids like Emergency Brake Assist or ESP, which help the driver during this critical phase, illustrate this type of operation perfectly.

3 PROTECTION

If the two preceding strategies have failed and a collision becomes inevitable, the vehicle becomes protective. The car structure and the belt pretensioners, load limiters and airbags form part of the basic safety elements, whose task is to ensure an optimal level of protection to all of the passengers.

4 RAISING AWARENESS

The cause of almost 80% of accidents is of human origin. As a result, Renault is involved in a major programme of making future drivers safety-conscious while they are young. As a car manufacturer and, even more, as a socially responsible corporate citizen, Renault believes that making the ●●●

●●● general public aware of questions of road safety constitutes an integral part of its mission. This is why in 2000 Renault launched the international "Safety for All" programme, with the specific target of training, informing and educating young people in the principles of road safety, and teaching them the correct behaviour to adopt on the road while they are as young as possible.

A large number of initiatives have been developed at local level, supported by the Renault network.

IN SHORT

The Renault concept of integrated safety is articulated around four key concepts: preventing, correcting, protecting, and raising awareness. Each of these deals with a specific context in order to deliver adapted and relevant solutions.

Protection systems for rear-seat passengers

In accordance with its philosophy of "Safety for All", Renault ensures that the passengers in the rear seats of its cars have **a level of safety identical to that of the front seat occupants.**

RENAULT COMMUNICATION

BASIC FACTS

Renault has always wanted to deliver the best possible safety in all seats, including at the rear. In line with this policy, since 2001 Renault has equipped the safety belts of its rear side seats on new vehicles with pretensioners and load limiters.

IN SHORT
In addition to the traditional rear seat anti-submarining bars, the two side seat safety belts also have pretensioners and load limiters.

HOW DOES IT WORK?

1 PROTECTION

Studies carried out by the Renault LAB accident researchers have uncovered a strong tendency of rear-seat passengers to slip under their safety belts at the moment of violent impact. This phenomenon is known as submarining. To prevent this, Renault has equipped the rear seat safety belts of its vehicles with pyrotechnic pretensioners and load limiters, and has designed a hump into the base or the under-seat structure that restrains the occupants.

In addition, the position of the seat-belt fastening points has been re-designed, in such a way that the belts remain perfectly taut at the level of the passengers' thighs and pelvis. This new design, although it is invisible to the user, makes it possible to deliver excellent strapping of the passengers to the seat in the event of an impact.

2 COMPENSATION

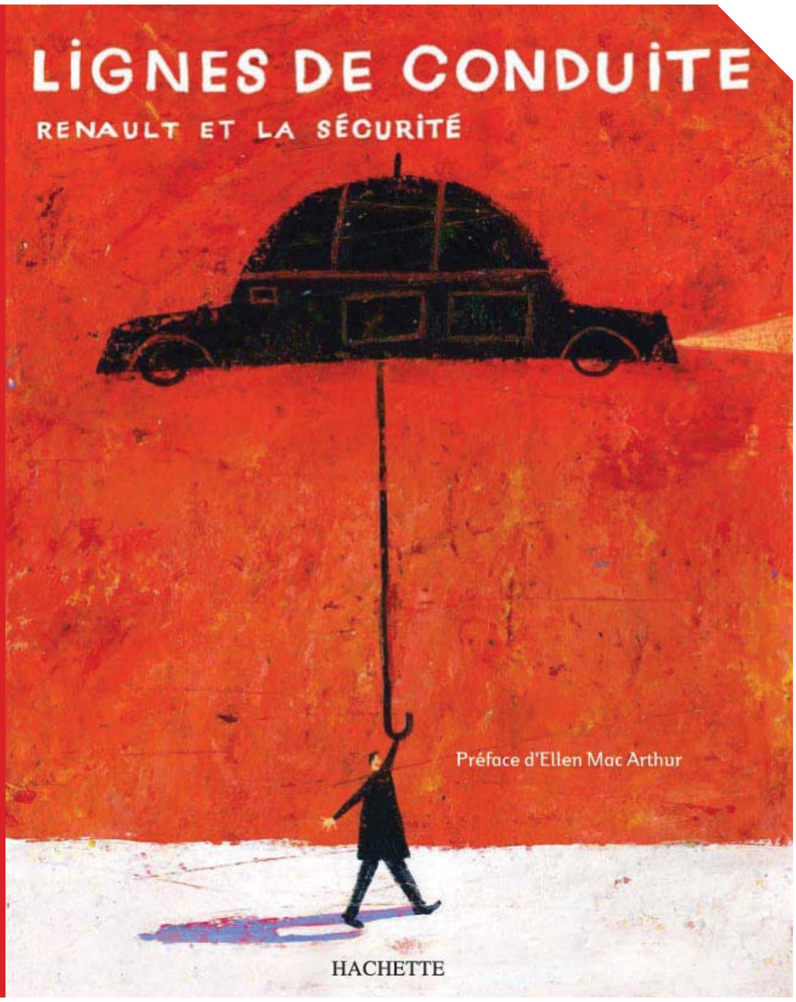
Two items of equipment work together to manage safety belt deployment

The pretensioner, housed at the level of the seat-belt roller, clamps the users of the car to their seats by tautening the belts as soon as an impact is detected.

The load limiter releases the belt gradually after the impact, so that the force that the belt exerts on the body never exceeds a limit beyond which it could cause trauma and injuries.

Road safety:
a priority for Renault

Renault has made automobile safety its priority and adopted a policy to extend it to all, i.e. all occupants of a vehicle and all other road users. In addition, to better determine the nature of the problems raised at each stage of the sequence of situations likely to lead to an accident, Renault has identified these in its concept of "integrated safety". This has led to the association of active and passive safety devices, the aim of which is to offer a very high level of safety on each vehicle.



BASIC FACTS

Road safety cannot be reduced to a piece of equipment or a technology. It involves a global solution that takes into account technical, medical, ergonomic, and social criteria, etc. For more than fifty years, Renault has continually invested in research and development in automobile safety. The problems of safety can be divided into two main types. The first involves upstream action to avoid the accident. Known as active safety, this generally calls upon electronic devices. It works by either providing the driver assistance for better control of his driving, providing early warning of potential risks and assisting him with certain tasks such as illuminating headlight, or else by correcting errors of judgement and poor reflexes when an emergency arises (ABS, ESP dynamic steering control, Emergency Brake Assist), without taking over from him. The second category, called passive safety, has a protective function when an impact is inevitable.

Renault engineers wanted to go even further when working out the "safety for all" approach. They targeted protection for all the occupants of a car, whatever their age, size, seat (front or rear) or vehicle range. Next, the programme also addresses the issue of pedestrian safety and that of other road users. Lastly, to achieve an extremely detailed analysis of every situation, Renault has broken down the sequence of events likely to lead to an accident: this is the concept of integrated safety. Their research has led Renault engineers to combine active safety devices with complementary passive equipment on each vehicle. The equipment has the specific capability to deploy during each phase preceding an accident or, ●●●

••• depending on the sequence of situations likely to cause the accident, make it possible to avoid it entirely. If the accident becomes inevitable, it will then limit the effects on the occupants of the vehicle.

The integrated safety concept

The concept of integrated safety comprises four areas, corresponding to distinct phases that take place during the sequence of events leading to an accident: making aware, preventing, correcting, protecting. In terms of safety, it is always necessary to look at the worst-case scenario, which in this case is an accident. When it occurs, the important thing is to protect the occupants by deploying passive safety resources. Immediately prior to an accident there is still time to assist the driver, without overriding him, to help correct his action in order to avoid the accident or, if inevitable, to attenuate its consequences.
Upstream, before the driver is confronted with an emergency, the best way to improve safety consists of informing him of a possible risk, even when remote (incorrect tyre pressure, for example).
Lastly, a global safety solution cannot neglect making the public aware of road safety issues, because safety is also a question of behaviour and responsibility.

IN SHORT

The Renault concept of integrated safety allows engineers to carry out an extremely detailed analysis of the situations likely to lead to an accident and how they are sequenced.
Engineers are therefore able to deliver technical solutions that are fully adapted to each phase of the concept.

USEFUL INFORMATION

1 KEY DATES

1898: Louis Renault's "voiturette" already comprises rack-and-pinion steering, more reliable and less dangerous than chains or belts.
1909: The compressed-air starter replaces the crank, the cause of many injuries.
1922: The 40 CV gets a hydraulic servo-brake system.
1951: First tests of impact resistance (crash tests of the time) at the Lardy technical centre.
1954: Renault creates the Laboratory of physiology and biomechanics, run by a doctor, which later became the LAB (Laboratory for Accident Research, Biomechanics and Study of Human Behaviour).
1962: R8, the first compact car to be equipped with four disc brakes.
1969: Creation of the LAB (jointly run by Renault and PSA Peugeot Citroën).
1974: BRV (Basic Research Vehicle) prototype with the first integral passive safety system.
1979: EPURE prototype, built on a Renault production base, uses the concept of the non-deformable cabin and takes account of pedestrian impacts.
1985: Appearance of ABS brakes on the R25.
1993: Clio, R19 and Safrane get seat-belt pretensioners and a driver-side airbag.
1995: Appearance of the load limiter on safety belts (SRP1).
1996: Passenger airbag and ABS brakes on all models.
1998: Second generation airbags with controlled vents and head-restraints with close-to-head protection.
2000: Creation of the concept of "Safety for All". Laguna becomes the first car in the world to earn 5 stars from Euro NCAP.
2004: Modus is the first Euro NCAP 5-star car on the B segment.
2005: Renault is clearly the safest manufacturer, with eight 5-star vehicles.

2 KEY FIGURES

100
million euros invested by Renault annually in research and development on safety.

400
real-world crash tests performed annually.

600
people dedicated to improving safety in the LAB.

4,000
digital crash simulations carried out every year.

Safety-awareness

The driver is at the centre of the road safety. Safety systems can only assist him to carry out his task of driving. He remains master on board his car and no device will ever be able to compensate for an inappropriate decision or ignorance of certain safety rules. Conscious of this limitation, Renault is strongly committed to road safety training and raising public road safety awareness.

RENAULT COMMUNICATION

BASIC FACTS

Human error is the cause of almost 80% of accidents. Renault is therefore convinced that progress will come out of training people at an early an age as possible. Since 2000, Renault has been engaged in a vast operation of road safety awareness and education. Intended for teenagers and young adults, the “Safety for All” programme contributes to ensuring that the car remains an instrument of mobility and freedom.

IN SHORT

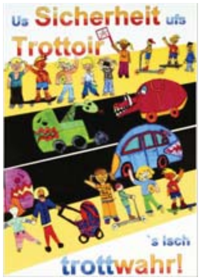
Renault raises road safety-awareness and educates the children and young people of seventeen countries so that their behaviour at the wheel will start to become more responsible.

HOW DOES IT WORK?

RAISING CONSCIOUSNESS AT EVERY AGE

Starting in primary school, for 7-to-11 year olds, the "Safety for All" programme consists of "Kids on the Road", a teaching kit available free-of-charge and already distributed to over 280,000 classes. It is based on an educational and interactive approach to road safety. Its aim is to establish a dialogue with children by discussing topics such as the principal rules of safety, journeys and the road environment.
In parallel with the kit, Renault offers all primary school classes the opportunity to participate in an international competition, the topic of which varies each year. It gives the children a chance to express themselves freely and, if they are selected, of meeting winners from other countries during an international final.

For secondary schools, the "Express Yourself" initiative targets 12-to-15s. 87,000 secondary school children from four different countries have already taken part in it since its launch in 2003. The aim of this international operation is to create posters on the topic of safety which encourage responsible behaviour.
In senior high school, to address the problem of road accidents being the first cause of mortality in young people between 15 and 24 years of age, Renault is working in many countries. With the assistance of local partners Renault, is leading several initiatives whose common objective is to help young drivers or future drivers acquire responsible and safe behaviour.





RENAULT COMMUNICATION

MORE INFORMATION

The teaching sheets as well as the rules of the international contest are downloadable:
in English on **www.safety-for-all.com**
in French on **www.securite-pour-tous.com**

The safety of pedestrians

The theme of safety is not only addressed to vehicle occupants. It also concerns all other road users and among them, one group that is **particularly vulnerable – pedestrians.**

RENAULT COMMUNICATION

BASIC FACTS

Pedestrians have no means of protection during an impact with the front of a vehicle and therefore they are particularly vulnerable. To take account of this, the bumpers and bonnets of current cars deform to dissipate the energy from the impact to as great an extent as possible.

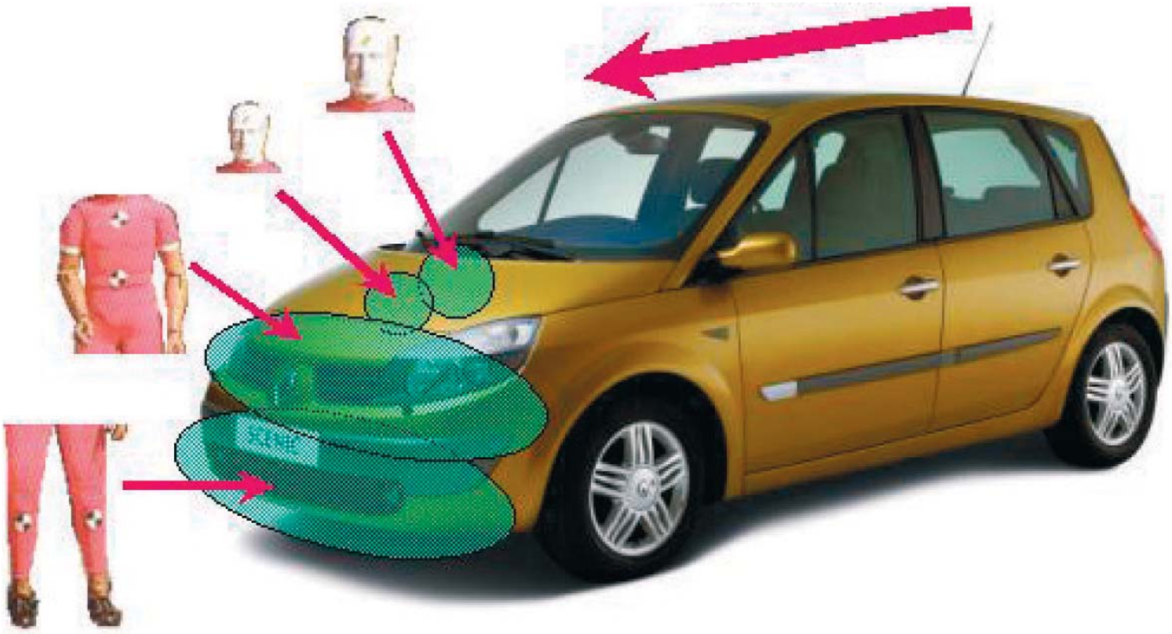
In the same way, the shape of the front bumper is designed so that the point of impact is level with the lower part of a pedestrian's legs, a zone containing no vital organs. In addition, this low impact point causes the leg to bend, making it possible to minimise the risk of injury to the knees, which can be potentially crippling.

IN SHORT

The shapes and materials that make up the front end of the vehicle – bumper, radiator grille and bonnet – are designed to limit the seriousness of injuries they may cause to pedestrians in the event of an impact.

HOW DOES IT WORK?

Numerous studies of impacts involving pedestrians are carried out at the time of crash tests, in particular during those that Euro NCAP practises (see sheet). Several tests are carried out that make it possible to evaluate the level of protection of the front of the vehicle when pedestrians are involved – head-against-bumper tests, femur-hip against "bonnet nose", adult head and head child against bonnet and windshield. These tests are representative of a vehicle hitting a pedestrian at 40 kph. Studies such as these have made possible the development of elements with mechanical behaviour and shapes that are optimised to effectively deaden the shock at the time of a collision with a pedestrian and thus reduce the risk of exposing them to serious injury. Euro NCAP takes these results into account in a specific "pedestrian impact" test score.



RENAULT COMMUNICATION

Seat-belt reminder
audible alarm

Known as an SBR, standing for Seat-belt Reminder, this device **warns the driver if he has not fastened his safety belt** or has fastened it incorrectly.

RENAULT COMMUNICATION

BASIC FACTS

The seat belt is an essential safety element in the event of impact, even at low speed. Some people wrongly believe that wearing it on in-town trips serves no purpose, because speeds are low. However, at 50 kph, in an impact against a wall, restraining a 75 kg adult is equivalent to developing force that exceeds 2 tonnes (source: La Sécurité Routière). It is impossible for the human body to either compensate for such forces or "to hold on to the steering-wheel". Seat belts prevent the wearer being projected against the rigid elements of the cabin: windscreen, doors, front seats, etc. A seat belt can resist effort exceeding 3 tonnes. Even when driving in town, wearing a seat belt is essential and the seat belt reminder alarm emphasises this.

IN SHORT

The alarm sounds for the first time in the event of non-fastening or incorrect fastening of the seat belt as soon as the vehicle speed exceeds 20 kph.

HOW DOES IT WORK?

1 DETECTION OF UNFASTENED SEAT BELTS

Through a sensor placed in the loop of the belt buckle ratchet, the device detects the absence of belt locking. In addition, it deduces the speed of the car based on information from the wheel tachometers. As soon as this exceeds 20 kph, the computer illuminates a warning light on the dashboard and at the same time sounds a first audible alarm lasting 30 seconds.

If after this lapse of time no modification of belt locking has been detected, the device produces a second, more strident, level of alarm lasting 90 seconds. These two levels of alarm mean that the driver is progressively informed of a possible defect in the seat belt locking mechanism.

2 A DOUBLE ROLE

The audible seat-belt reminder alarm makes it possible to inform the driver of defective belt locking that could compromise its effectiveness. In addition, it is an incentive to fasten seat belts, even during short, in-town journeys.

MORE INFORMATION

http://www.securiteroutiere.gouv.fr/ressources/conseils/la-ceinture-de-securite.html

The 3rd generation System for Restraint and Protection (SRP3)

The 3rd generation Renault System for Restraint and Protection (SRP3) takes account of the violence of the impact and the position of the occupants of the vehicle so as to **optimise the effectiveness of protection.**

RENAULT COMMUNICATION

BASIC FACTS

The idea of the 3rd generation Renault System for Restraint and Protection is to prepare the vehicle and its occupants for an impact once it becomes inevitable. The level of protection, and therefore of safety, varies greatly depending on the position of the car's occupants at the moment of impact. The system aims to take account of these differences. In the first place, it acts on the safety belt pretensioners to clamp the driver and passengers to their seats. It is important for there to be space between the body and the cabin so that the energy is absorbed progressively, so limiting the risk of traumas. This situation can be likened to a sharp deceleration: the greater the distance available to slow down from a given speed to a halt, the less violent the deceleration will be. It is the same phenomenon in braking – stopping a vehicle travelling at 60 kph in just a few metres is much more brutal than stopping it over, say, a hundred metres. Thus, the greater the space separating a person from the stiff elements of the cabin, the more the impact will be deadened. In the second place, the system adapts the response of the airbags (see sheet) to the violence of the impact because of double volume and the controlled vent with which they are now fitted.

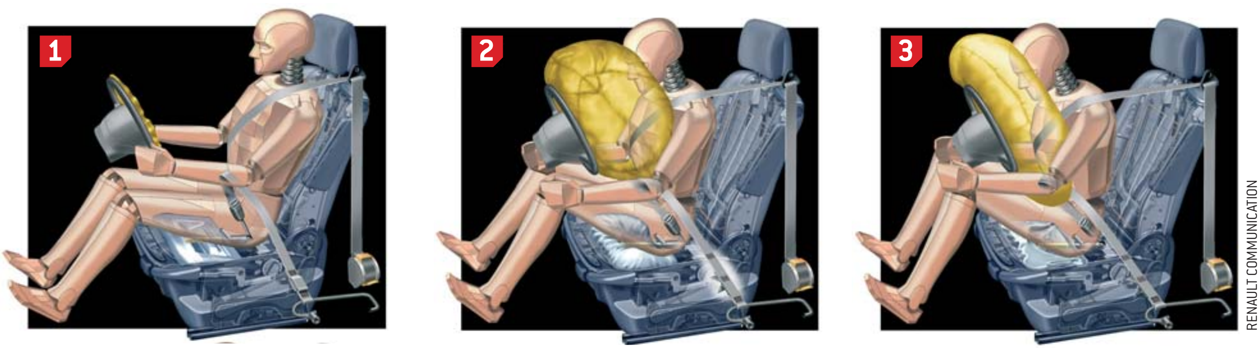
IN SHORT
By analysing the violence of the impact, SRP3 adapts the response of safety devices such as safety belt pretensioners and airbags, to deaden the impact as much as possible.

HOW DOES IT WORK?

1 SRP3 SYSTEM

An accelerometer detects the impact and measures its intensity. The SRP3 system computer evaluates the severity of the impact in less than 10 ms (ten thousandths of second). It immediately commands the release of the safety belt pretensioners integrated into the buckles of the front seat safety belts, in order to clamp the occupants of the car hard against their seats. If it is a severe impact, the computer triggers other safety belt pretensioners, this time placed at the side of the belt buckles, to hold the occupants against their seats even more firmly which, by keeping the pelvis in position, avoids the phenomenon of submarining (the body slipping under the belt lap-strap).
However, the belt must not retain an occupant with a force greater than 400 kg to protect the thorax of occupants, even when it is fragile. For this reason, a load limiter device allows "controlled slip" of the belt and delivers "slackness" so as not to exceed the outside value limit. Under the action of the load limiter, the belt strap is slackened gradually. As a result, the body of the occupant plunges forwards. It is here that the airbag takes over. There is a similar graduation at the level of airbag management. If the impact is of average violence, the computer begins only partial inflation of the airbags. On the other hand, if the impact is violent, the computer commands maximum inflation of the airbags by triggering a complementary gas generator.
In order to supplement impact deadening, the controlled vents of the airbags open to decrease the internal pressure and are therefore unlikely to themselves be the source of injuries.

2 OPERATION
Three devices act jointly to ensure safety



1 **The pretensioner** linked to the belt buckle limits the forwards displacement of the body by tightening the belt straps across the pelvis and thorax.

2 **The load limiter** reduces pressure exerted by the belt on the thorax, to avoid causing injury during violent impacts.

3 **Controlled vent** airbags, housed in the steering wheel for the driver and in the dashboard for the front passenger, provide further deadening of the impact.

Structure

Programmed deformation of the structure protects the cabin. It dissipates the greatest amount possible of impact energy to preserve the cabin, which, on the contrary, being very stiff, acts as a survival cell. **Renault has for many years carried out highly advanced studies on the programmed deformation of the structure of its vehicles.**

RENAULT COMMUNICATION

BASIC FACTS

To reduce the forces sustained by the occupants in an impact, the aim is to ensure it is the vehicle that absorbs as much as possible. To achieve this, it is divided into a number of zones that have different mechanical behaviour in terms of deformation. The front and rear are designed around deformable structures that act as shock absorbers at the moment of impact. The cabin, on the other hand, is stiffened to constitute a non-deformable space.

IN SHORT

Through progressive deformation, the car structure absorbs the energy of the impact. The stiffened cabin undergoes less violent deceleration and behaves as a survival cell.

HOW DOES IT WORK?

1 ABSORBING ENERGY

At the front, the distance between the bumper and the occupants of the car is exploited to the maximum to absorb the energy of the impact through programmed deformation. To achieve this, the stresses are distributed through the hollow sections of the cross-members. Their profile is also designed to absorb the impact as much as possible. To gain still further in effectiveness, Renault uses steels with very high yield-strengths, whose stiffness is two-and-a-half times higher than that of traditional steels. This characteristic gives them a high capacity to absorb impact energy. The same type of structure is found at the rear of the cabin at the level of the boot, where it is intended to deaden any rear collision. The placing of the stiffest and heaviest elements of the engine compartment, like the engine, the gear box and certain accessories, is also the object of careful study. Because their volume is incompressible, they limit the distance that is useable for energy absorption. These components are usually assembled laterally and, as far as possible, stacked up. This layout has the advantage of preserving the greatest possible area for the deformable space intended to deaden the impact.

The cabin, on the other hand, must resist the intrusion of foreign elements. In the same way, it must in no case become an “accordion”, subjecting the passengers to the risk of being crushed. To achieve this and unlike the elements that surround it, it is stiffened to provide a non-deformable cell that protects the occupants. It is completely “ringed” with reinforced parts that constitute a protective belt. The doors are also equipped with pressed steel reinforcements and trimmed with shock-absorbent materials. The interior of the cabin, finally, is designed to deaden the impact of the occupants against its elements. The instrument panel, among other components, is designed from its shape, down to the “skin” that trims it, to deaden any possible impact. Lastly, all the elements likely to cause injury have been modified or moved. The rigid armrest, for example, has given way to a continuous ledge. In the same way, the steering column, essential but too stiff, has undergone major modifications to become retractable and has been covered with a padded trim.

2 DEFORMATION
Dividing impact intensity by five

The programmed deformation of the structure makes it possible to significantly decrease the intensity of the impact and, therefore, its consequences. For example, at 50 kph in an extremely stiff car that only deforms 10 cm, at the moment of impact the occupants undergo deceleration which, at its start, is of a force that is equivalent to a hundred times their own weight (100 G). No human can survive such deceleration. On the other hand, during an identical impact, if the structure of the car provides for deformation of 80 cm, the acceleration undergone by its occupants will be eight times lower. This can be withstood by the human body.

Tyre pressure monitoring system

An essential element of safety, tyres are too often neglected. Significant advances in the geometry of the chassis have made it difficult to detect under-inflation, or a pressure drop. In partnership with one of the biggest names in tyres, Renault has developed a pressure monitoring system which warns the driver of any anomaly.

RENAULT COMMUNICATION

BASIC FACTS

The tyres are the only physical link between the vehicle and the road, and have an essential impact on safety. Their grip coefficient is directly related to their inflation. The profile of a tyre is designed to "hug" the road as much as possible and provide maximum grip, at a specific pressure. Any unsuitable inflation leads to a decrease in grip and may lead to over-consumption, or even a risk of blow-out. Moreover, the configuration of current vehicle bodies, designed to offer optimal road holding, tends to mask the effects of inflation problems. For the driver, the dynamics of the car seem "normal", until he is faced with an emergency or an incident occurs. It is therefore important to inform the driver of any anomaly, by means of a message displayed on the dashboard. The tyre pressure monitoring system fulfils this role.

IN SHORT

Thanks to a permanent radio link with each wheel, the tyre pressure monitoring computer informs the driver of any anomaly such as under-inflation or a puncture, by means of a warning message.

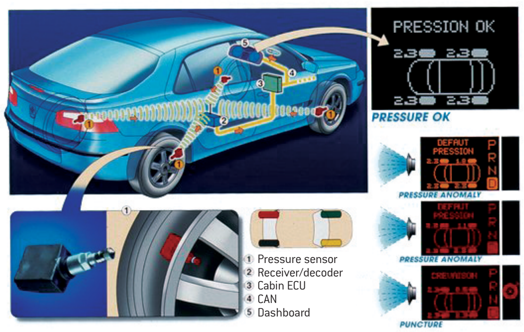
HOW DOES IT WORK?

1 MASTERING TRAJECTORY

A small electronic module housed in the inflation valve of each wheel permanently monitors the tyre. It contains a pressure sensor, a temperature sensor and a radio transmitter. A lithium battery, also included in the electronic module, provides ten years of autonomy. Every minute, by means of a short radio burst, the module transmits the values from the sensors to a computer onboard the vehicle. It correlates this data with other data, such as the wheel rotation speed and acceleration, to detect any anomaly. A loss of pressure, an imbalance in pressure between the wheels, or over- or under-inflation immediately triggers a warning which specifies the type of anomaly and the wheel concerned. Of course, the “radio dialogue” between the wheels and the onboard computer occurs in coded digital form, to eliminate any risk of interaction with any other nearby vehicle also fitted with a tyre pressure monitoring system.

2 RUNNING FLAT

Some systems, such as the PAX System, developed by Renault in partnership with Michelin, go even further. As well as warning of an anomaly, the wheels contain a flexible support on which the tyre tread can rest in the event of a total loss of pressure. This process enables the car to run on a flat tyre for 200 km, albeit at a top speed of 80 kph.



Tyre pressure monitoring system.

RENAULT COMMUNICATION

IN SHORT

On the PAX System, developed in partnership with Michelin, a flexible support replaces the air in the event of a total loss of pressure.

For more information on the tyre pressure monitoring system: securite.renault.fr/fiche.php?id_fiche=25

For more information on the PAX System: www.michelin.fr/fr/auto/pax_2.jsp

Xenon and bi-xenon headlights

By lengthening visibility distance to more than one hundred meters, xenon headlights improve night driving safety because **they make it possible for the driver to better anticipate a risk situation**. Renault has already offered this technology for several years as part of its permanent concern for safety improvement.

RENAULT COMMUNICATION

BASIC FACTS

In night driving, the driver's ability to anticipate is directly related to headlight range. With the intense luminous flux that they deliver, xenon headlights make it possible to increase this and, consequently, to improve safety during night journeys. The use of xenon lamps makes it possible to manage the geometry and directivity of the beam of light that the headlights emit very accurately, to a degree of precision that cannot be achieved with halogen lamps. It is possible to focus their light on the critical zone while reducing dazzle for other road users. Moreover, this optimisation of focus gives xenon headlights increased range for identical power. Lastly, the light of the xenon lamps is close to that of daylight, also known as "equivalent colour temperature". This characteristic gives good colour rendering, which helps the driver identify elements of the vehicle's environment. On systems known as bi-xenon, a retractable shutter modifies the beam of light resulting from a single lamp to change the headlights from dipped mode to main-beam mode.

IN SHORT

Because of their excellent output, xenon lamps deliver a luminous flux that is more intense than that of halogen lamps, for the same power consumption. The optics of the headlight play a part in determining in its effectiveness. The use of xenon lamps makes it possible to improve headlight directivity.

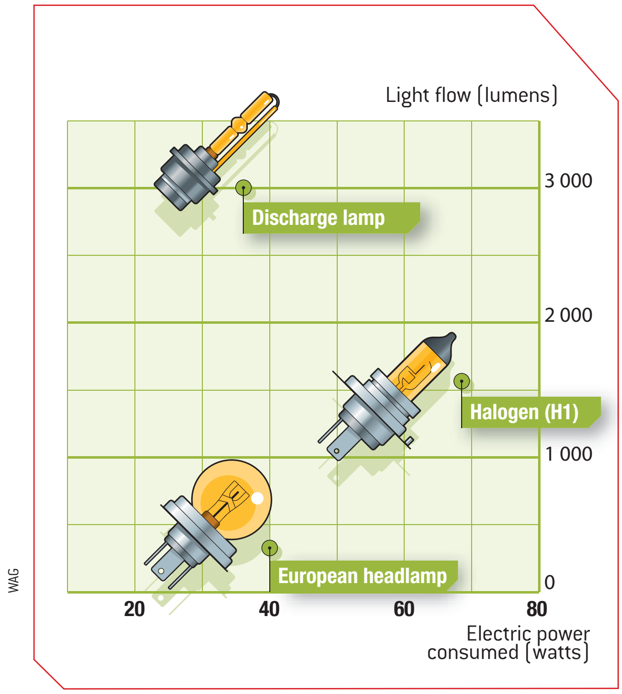
HOW DOES IT WORK?

1 LAMP, REFLECTORS, OPTICS

Xenon lamps are gas-discharge lamps. They do not contain a filament. An electric arc is created between two electrodes in xenon, a rare gas, contained in a small quartz bulb, under pressure. Contrary to halogen lamps, xenon lamps cannot run directly on the 12 to 15 volts that the battery of a car delivers. To form the electric arc, it is necessary to apply a short pulse of 20,000 volts to the electrodes of the lamp. Once the arc starts, its maintenance requires perfectly stabilised power of 85 volts, which must be free from any fluctuation. Management of this, involving both the starting pulse and the regulation of operating voltage, is performed by an electronic module, often called "ballast", integrated into the headlight. Lastly, the output of xenon lamps is much better than that of halogen lamps; i.e. for equivalent electric power consumed, they deliver a much more intense luminous flux.

The headlight does not just consist of the lamp. The light the latter delivers is focused by reflectors and a set of frontal optics comparable to a magnifying glass. The geometry of these two elements determines that of the beam. But why is the focusing so much more accurate?
Like any optical element, the pair consisting of the reflectors and frontal optics only functions perfectly starting from one specific source of light, i.e. comparable to a point. With a halogen lamp, the filament emits light down all its length. This is far from being a point source. On the other hand, on a xenon lamp, the electric arc takes the shape of a tiny sphere comparable to a point source. Reflectors and frontal optics therefore work together under optimal conditions to deliver perfectly controlled geometry for the beam.

2 THE STRENGTHS OF XENON HEADLIGHTS



Range (more than 100 m) and directivity are not only the advantages of xenon headlights. The lifespan of the gas-discharge lamps is five times higher than that of halogens. Moreover, on the bi-xenon system, a progressive modification of the position of the light beam deviation shutter makes it possible to adapt its range to the speed and load of the vehicle. This feature is found on Mégane and Scenic.