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valeo added

SUMMARY

Comfort and Detection Systems

valeo added™

Parking and Manoeuvring aids

Intelligent assistance systems make parking and manoeuvring not only easier, but above all safer.

Restricted visibility

Drivers don't always have perfect visibility all around them. Obstacles often lurk in blind spots. Driving in a parking lot and manoeuvres such as reversing into a parking space or out of an angled parking space are always risky – especially when rear visibility is restricted. The increasing usage of concrete blocks or large stones that are invisible to the driver are part of the problem. This issue is all the more serious for older drivers who, as time passes, may find it more difficult to perceive quickly and thoroughly what's happening around their vehicle. Perception can also be affected by time pressure, heavy traffic or other distractions.

Innovative and useful aids

Many cars are nowadays fitted with park aid sensors. These systems most commonly use ultrasonic sensors in the bumpers to detect obstacles and alerting the driver about them with sound signals. While the driver quickly receives accurate information as to the distance to an obstacle, he still does not know exactly where the obstacle is. Many cars also offer a graphic display to address this problem. More and more new cars also feature rearview cameras in addition to ultrasonic parking assistance. They provide a clear view of the vehicle's surroundings, but cannot indicate the remaining distance to an obstacle. Valeo has succeeded in combining ultrasonic signals with a camera in order to make the most of both technologies. If an obstacle is detected, information about distance, for example in the form of coloured bars, is superimposed on the screen. Thus the driver has all the information he needs in one place.

While typical parking aids restrict themselves to the area behind and in front of the vehicle, Valeo is working on complementing this functionality with side protection. The system records the position of an identified obstacle and follows it out of the range of the ultrasonic sensors. This is made possible by a complex algorithm to determine the vehicle's movement. In the future, the driver will also be informed about obstacles next to the car – either acoustically or visually. Side protection is particularly useful when manoeuvring in tight places, as can be seen by the numerous traces of paint on the concrete pillars in car-parks.

In a comprehensive survey, many customers admitted to having problems with parallel parking. The semi-automatic Valeo Park4U® system performs this operation in no time. It takes over the vehicle's steering, while the driver controls the vehicle's speed. The process of finding a parking space begins by simply pressing the Park4U® button. Sensors scan the side of the street and measure the length of empty parking spaces. When a sufficiently large space is detected, the driver is informed by a visual indicator. The newest system requires no more than a space of 1.1 meters in addition to the length of the vehicle. The system can recognize spaces at speeds of up to 30km/h, so any following traffic is not inconvenienced. The side of the vehicle can be selected using the indicator control. After reaching the starting position the driver puts the car in reverse and operates accelerator, brake and, if necessary, also the clutch. Park4U® now operates the steering and manoeuvres the vehicle into the space. The manoeuvre can be temporarily interrupted at any point. The parking sensors also inform the driver of any obstacles that may be in the vehicle's way. Because the system functions at up to 7kph, nothing stands in the way of a speedy park. If parking in one backward shot is not feasible due to the short slot length, a complex calculation is used to move the vehicle backward and forward until it is ideally positioned. The parking manoeuvre is finished as soon as the vehicle is parked completely straight. Park4U® is compatible with manual

and automatic transmissions. It is currently available on the Volkswagen Touran, Tiguan, Passat, Passat CC, Golf and Golf Plus models. It is also available on the Skoda Superb, Skoda Yeti, Audi A3 and Lancia Delta. In the US it is now available on various Ford models. Valeo is continually developing the system's functionality. In future, Park4U® will be able to use even smaller spaces, steer the car out of parking spaces, and park in perpendicular spaces.

When reversing out of parking spaces, oncoming traffic is often only seen at the last minute. This is where another novelty from Valeo, Cross Traffic Alert, can help: radar sensors installed in the side of the rear bumper inform the driver of any danger. Particularly when visibility is restricted by other cars, this is a valuable aid for the driver. Cars that are fitted with the Valeo Blind Spot Detection already have appropriate sensors in place.

Owing to today's increased demands of aerodynamics, as well as protection for pedestrians, modern vehicles often have restricted visibility. This is where the Valeo multi-camera system can help. Up to 5 miniature digital cameras all around the vehicle help to give the driver a complete overview. This makes parking and reversing simpler and safer, particularly in places where obstacles are numerous or not always visible (e.g. posts or low walls, pedestrians, animals or simply the kerb). The construction of the system offers a large range of possibilities: while one camera observes the area behind the vehicle, two further cameras in the front bumper display pedestrians, cyclists or vehicles which are approaching – even before they appear in the driver's field of vision. Two further cameras in the wing mirrors keep an eye on the area directly beside the vehicle. Thus the 5-camera system offers the driver an unrestricted view all around the car. The Valeo multi-camera system is currently available on the Land Rover models Range Rover, Range Rover Sport and Discovery. BMW will offer the system with it all new 5-series Gran Turismo. By mid 2010 four more vehicles will follow.

Operating principle

Valeo is a leading supplier of sensor technology for the automotive industry, covering a wide range of ultrasonic, camera and radar systems. Valeo uses the most modern CMOS (Complementary Metal Oxide Semiconductor) technology in its cameras, while the radar system uses narrowband 24GHz sensors. These radar sensors cover a very wide area of 150° and locate obstacles by scanning individual sectors in rapid succession.

Park4U® solely uses ultrasound sensors – four sensors each installed in the front and the rear bumper, two further sensors are positioned on either side of the front of the vehicle in order to detect the available space. In case the kerb is sufficient its position is also taken into account for the calculation of the ideal parking trajectory. If there is a lowered kerb (or none at all), Park4U® calculates a trajectory to align the car with the vehicle parked in front. Park4U® works in conjunction with the existing power steering system so no additional parts are needed. The system communicates with the steering and the vehicle's other electronic systems via a high-speed CAN bus.

Advantages of driving aids for Parking and Manoeuvring

Advantages for the carmaker

- Park Assist systems address a main customer need.
- Drivers are very aware of innovations in this area.
- The ultrasonic, radar and camera technologies are reliable and proven.
- Park4U® is extremely affordable. If the vehicle is already fitted with a Valeo Park Assist System, it requires just two additional sensors and a switch.

Advantages for the driver

- Parking and reversing becomes easier and safer.
- Valeo systems are easy to understand and simple to use.
- Improved safety not only for drivers, but also for pedestrians and other vehicles.
- The system assists the driver without taking away control of the vehicle.
- Park4U® simplifies one of the most difficult manoeuvres.
- Park4U® offers outstanding value for money.
- Cross Traffic Alert makes reversing out of parking spaces safer and less stressful.
- The multi-camera system offers unrestricted visibility all around the vehicle.

Next generation Park Assist

Valeo has made the successful Park4U® system even better.

Parking is now simpler than ever before

Following its debut in the Volkswagen Touran, Valeo's semi-automatic parking aid, Park4U®, has now become firmly established in the marketplace. Only two years after its launch, the system is now available in eight Volkswagen, three Audi, and two Skoda models under the name "Park Assist". Lancia offers it in the new Delta under the name "Magic Parking". Park4U® has also arrived on the North American market and is available in five models from Ford Lincoln, and Mercury. Other manufacturers are to follow, and the system will be available in thirty different models by the end of 2010.

The second generation of Park4U® has been available since spring 2009 in different Volkswagen models. A mere 55cm to the front and rear of the vehicle are enough for the system to park, which is reduction of over 20% in comparison to the first generation. This is all made possible through a more complex geometrical calculation of the approach vector, which can now take into account multiple reversing maneuvers. The steering assistance is no longer ended after the first reverse maneuver, but aids the driver until the vehicle is finally parked, regardless of the number of maneuvers necessary.

Park4U® parks the car parallel to the kerb within a few seconds. Two ultrasonic sensors installed on either side of the car scan the edge of the road and detect suitable spaces. The parking maneuver itself works just as before, but is now hands-free. As soon as the car has stopped and the reverse gear has been engaged, the system takes over the steering, while the driver continues to control the speed of the vehicle with the accelerator and brake. Park4U® has already calculated the optimal approach into the parking space and steers the vehicle into it. The ultrasonic sensors in front and to the rear give the driver additional security and help him to use the available space as efficient as possible. If he so desires, the driver can end the maneuver at any time: as soon as he touches the steering wheel, the system automatically deactivates.

Park assist systems make parking and reversing not only more convenient, but also safer. Last year, Valeo's Park4U® system was awarded the "Genius" safety prize by Allianz Insurance for its role in reducing parking accidents, which account for a third of all car insurance claims made in Germany.

The next generation

Valeo's Park4U® system is constantly being developed and in the future will be able to offer drivers both new and improved functions. In addition to further reducing the space necessary to park to 40cm behind and in front of the car, the range of situations in which Park4U® can aid the driver will also be expanded. It will be possible to use the system to park on a curve, in a narrow side-street, or when the space is bordered by a trash-can rather than a car. In addition, the approach vector will be better suited to the particular situation, in order to make the parking experience seem more natural.

Park4U® will now also be able to help the driver with perpendicular parking, as well as in exiting a parking space. The Exit Assistant will measure the space to the front and rear of the vehicle and determine the best strategy for exiting the parking space. While the driver controls the vehicle's speed, the system takes over the steering, just as it does in parking. The system recognizes when the space can be exited and is automatically deactivated on leaving the space, so that the driver can merge with the traffic.

The parking assistant for perpendicular parking spaces offers the familiar Park4U® function for reversing into a perpendicular space. Here, too, the space is detected and measured as the vehicle drives past, the approach vector is calculated and the vehicle is steered into the space automatically, while the driver operates the pedals. Making this possible required a tremendous amount of work by the development team. For example, the process of determining the position of the vehicle had to be modified significantly and the path calculation had to be redeveloped from scratch to take account of the new geometry.

Valeo is already thinking about the next step. For instance, the combination of ultrasonic sensors and cameras offers hitherto unknown possibilities. The first trials have shown that these two technologies complement each other perfectly. Future assistance systems for parking and manoeuvring will thus be much more powerful, but remain simple to use.

Operating principle

Vehicles which are already equipped with a Valeo park assist system in the front and rear bumpers only need two further sensors to the sides at the front. These are used to detect and measure possible parking spaces. The sensors use Valeo's proven ultrasonic technology and have been optimized for their particular task. In addition to this, they also complement the other distance sensors and thus improve the normal park assist function.

The measurement of the parking spaces takes place on both sides of the car simultaneously. The driver chooses the side they want to park on using the indicator. The sensors to the side detect the start and end of the space by registering the contours of the bumpers on the cars which border the space. The kerb is also registered and taken into account when calculating the parking maneuver. If there is no kerb, the vehicle is parked in line with the car in front of it.

Park4U® uses the control unit of the existing park assistant, which is extended for this purpose, so no additional parts are needed. The steering does not require any additional mechanical parts either. Park4U® utilizes a wealth of information from other systems in the vehicle. The data exchange takes place over a powerful CAN network.

In order not to inconvenience the following traffic, the vehicle can drive at speeds of up to 30kmh while scanning for a park. The possible distance to the parked cars is a realistic 50 to 150cm. Reliable functionality is guaranteed at parking speeds of up to 7kmh. If this speed is exceeded, the system deactivates for safety reasons. This also occurs if the driver takes hold of the steering wheel, indicating that they wish to finish parking manually.

Advantages of Park4U®

Advantages for carmakers

- Based on proven and robust ultrasonic technology.
- Compared to Valeo Park Assist, it only requires two further sensors and a button, as well as a modification of the control unit.
- Offers significant added value.
- Simply perceivable and easily demonstrated functionality.
- Fulfills the end customer's expectations of the system.

Advantages for the user

- Park4U® sets new standards: parking has never been so easy.
- The driver can focus completely on what's going on around the vehicle.
- The driver retains control of the car at all times.
- Very good value for money.

Cross Traffic Alert

Safely reverse out of parking spaces, even with limited visibility.

Limited visibility

Reversing out of parking spaces is frequently dangerous, since the driver typically only sees approaching vehicles very late. Even experienced drivers often feel uncertain and stressed when backing out of a parking space. This is where Valeo's Cross Traffic Alert can help by alerting drivers to possible dangers, giving the driver valuable assistance, especially when the vehicles alongside are blocking the view.

Radar sensors installed in the rear bumper monitor the traffic even while the vehicle is still in the parking space. The system registers the distance, direction and speed of approaching vehicles and determines whether they pose a danger for the driver exiting a parking space. If an approaching object is considered to be a danger, the driver is given an audible and/or visual signal to wait until the road is clear again. Vehicles which have Valeo's Blind Spot Detection already have these sensors on board.

Cross Traffic Alert is currently available in North America in the Lincoln MKT and MKZ, the Ford Fusion and Taurus, and the Mercury Milan.

Operating principle

Cross Traffic Alert uses radar sensors with an operating frequency of 24GHz. Each of the two fully electronic sensors scans the surroundings with seven individual radar beams in a wide angle of 150° and a distance of up to 20 meters. A complex algorithm analyzes the information from the sensors and determines the distance, direction, speed and nature of every object. Objects which are not relevant, such as parked vehicles or those which are driving away, are reliably filtered out by the system, avoiding unnecessary warnings. The broad scanning field and the fine angular resolution of the seven radar beams enable Cross Traffic Alert to also function with angled parking spaces.

In contrast to optical systems, the millimetric wave technology functions in nearly all weather conditions and can be used in almost every country, owing to the radar's narrow 200MHz bandwidth. The radar sensors are easily fitted behind any non-metallic bumper fascia and thus do not interfere with the vehicle's styling.

Advantages of Cross Traffic Alert

Advantages for carmakers

- No extra parts are needed in addition to Valeo's Blind Spot Detection.
- The narrow frequency band of 24GHz is authorized in all countries.
- The absence of moving parts ensures robust technology.
- Excellent reliability and relevance of the warnings owing to the seven individual radar beams.
- The system does not affect the vehicle's styling.

Advantages for the user

- Safe and stress-free reversing out of parking spaces.
- Simple and intuitive display.
- Helpful with perpendicular and angled parking spaces.
- Simultaneously monitors both directions.
- Reliable recognition of all types of vehicles (cars, trucks, motorcycles).

Multi-Camera System

Five cameras to detect obstacles during parking and manoeuvring.

Restricted vision

In many new vehicles, the driver has very restricted visibility of the immediate surroundings. Smaller and smaller side and rear windows, as well as vehicle contours that are dictated by the needs of aerodynamics and pedestrian protection, mean that precise and safe parking and manoeuvring is scarcely possible any more. The multi-camera system developed by Valeo can aid the driver by offering a perfect view of the vehicle's surroundings. Up to 5 miniature digital cameras record the surroundings and transmit the images to an intelligent control unit, which thoroughly prepares and optimizes the images before they are displayed on the colour screen of the navigation system.

Unimpeded visibility

A wide-angle camera installed in the rear of the car provides a view of the area which was previously hidden when reversing. This makes parking and reversing much safer and less stressful. If the vehicle approaches an obstacle, the driver is warned acoustically by the Park Assist System, as well as by coloured bars superimposed on the video display. Trajectory overlays show where the car will go with the steering wheel in its current position.

Two cameras installed on the left and right of the front bumper allow the driver to see approaching pedestrians, cyclists or cars when entering a street with poor visibility, so the driver can effectively see around corners. The dangerous manoeuvre of feeling one's way into traffic, where one is dependent on other drivers being considerate, is a thing of the past.

In the wing mirrors, there are two further cameras which monitor the area directly beside the vehicle. The driver can easily see, for example, how far he is from the kerb or a low bollard. Taken together, these cameras offer the driver unimpeded visibility all around the vehicle. The Valeo 5-camera system is currently available on the Land Rover models Range Rover, Range Rover Sport and Discovery. BMW will offer the system with its all new 5-series Gran Turismo. By mid 2010 four more vehicles will follow.

Operating principle

Valeo uses the latest CMOS (Complementary Metal Oxide Semiconductor) technology in its cameras, which offers good image quality even in bad light, or in high contrast environments, such as when driving into an underground car park. In order to monitor as much of the surroundings as possible, the cameras have a field of view of 172°. This would normally result in a fish-eye effect, but a powerful algorithm filters this out, presenting the driver with a natural, immediately understandable image of the surroundings.

As the cameras cannot monitor the corners of the car nor deliver precise information about distance, Valeo has combined its camera technologies with its proven Ultrasonic Park Assist System. The strengths of each technology complement each other perfectly. The distances measured by the ultrasonic sensors can, for example, be superimposed as a series of coloured bars on the camera image, giving the driver all the information they need in one place.

In order to make reversing more convenient, the projected course of the car can be dynamically superimposed on the image. The great advantage of the Valeo system is that if an obstacle appears in the picture, the course line is not displayed beyond this distance, i.e. it does not appear to continue beyond the object. This prevents the display of distracting content, enabling the driver to take in the relevant information more quickly and accurately.

Advantages of multi-camera systems

Advantages for the carmaker

- Park Assist systems address a real customer need.
- Multi-camera systems are a good way of distinguishing the product.
- Customers appreciate the high quality of camera-based Park Assist systems.
- The number of cameras used can be varied to suit the particular vehicle.

Advantages for the user

- Constant unimpeded visibility of the vehicle's immediate surroundings.
- Safe and convenient parking and manoeuvring.
- Easy to operate.
- Easily understandable display due to intelligent image processing.
- More safety also for pedestrians and other road users.

Rain-Light-Humidity Sensor

The multi-function sensor on the windshield.

Rain sensors have become standard

Driving in the rain is one of the more unpleasant situations for drivers. Restricted visibility, reflections and changing volumes of rainfall tax the driver's concentration, so they tire more quickly. Sensors which automatically control the windshield wipers lighten this load considerably and are more and more becoming standard equipment on modern cars.

Customer-oriented innovation

Valeo, one of the world's leading suppliers of rain sensors, has further developed this technology, creating a true multifunction sensor. In addition to making things easier for the driver, the aim is to make driving safer and reduce fuel consumption. In addition to the normal function of measuring the rainfall, the sensor also automatically switches on the lights in low light, and turns them off as soon as the light improves. Tunnel entrances are recognized early, in order to turn the lights on in time. Valeo has combined all these functions in a single sensor, which is so small that it can be integrated almost invisibly into the mirror arm.

Valeo has now expanded the so-called Rain-Light-Tunnel sensor with another consumer-friendly function: the sensor module measures the temperature and relative humidity at the windshield and accurately assesses the danger of misting up. By intelligently controlling the air-conditioning, this can be prevented even before the driver is aware of impaired visibility. In addition to clear vision improving safety, the sensor also helps to reduce fuel consumption and emissions by enabling an intelligent use of the air-conditioning compressor. In addition, the humidity inside the vehicle can be controlled more precisely, thus improving the well-being and the concentration of the driver, particularly on long stretches. The Rain-Light-Humidity sensor is making its debut in the brand new Porsche Panamera.

Valeo is already working on further functions for this unassuming, but now irreplaceable, multifunction sensor. The main priority is to retain the compactness of the sensor. This is becoming increasingly important as the sensor frequently has to share space at the rearview mirror with a video camera. Valeo is doing its part by offering the world's smallest rain sensor and one of the smallest front cameras available, thus ensuring that the driver's field of view is not impaired, as well as preserving the design of the interior. Even today, the camera and sensor together offer an abundance of functions to make driving more convenient, safer and more environmentally friendly.

Advantages of the Rain-Light-Humidity Sensor

Advantages for the carmaker

- Extremely light and compact sensor.
- Robust and economical technology.
- Independent of prevailing light conditions.
- Multi-level control of the windshield wipers.
- Standby function for the automatic closing of the sun-roof or convertible roof.

Advantages for the user

- Easy to operate.
- Reacts quickly to changing conditions (e.g. spray when driving past a truck).
- By taking over routine functions, driving is eased significantly.
- Intelligent control of lighting and air-conditioning helps to reduce fuel consumption.
- Improved well-being with a more pleasant interior climate.

Blind spot detection

Blind spot detection: an innovative warning system for changing lanes.

A quick and safe lateral warning system

Changing lanes is always risky, particularly if a car in the next lane is going much faster or slower. And then there's also the blind spot – an area behind the car which cannot be seen in the wing mirror. Valeo's blind spot detection lets the driver know if there are any vehicles in this spot – invaluable information, particularly if the driver suddenly decides to change lanes.

A radar sensor on either side of the rear of the car detects any vehicle (car, truck, motorcycle) next to and behind it. Oncoming cars, as well as cars that are being overtaken, are detected, but not indicated. The driver receives this information in the form of a warning symbol which is cleverly integrated into the wing mirror. This ensures immediate and intuitive reception of this information.

When changing lanes, it is necessary to be able to make a decision instantaneously. Information about the speed and distance of any approaching vehicles plays an important role. This decision is aided by the development of a system which will warn the driver if there is a danger of collision with a vehicle in the adjacent lane. This offers additional safety in changing lanes.

Later this year, the Valeo radar system will be able to aid the driver in a completely different situation. When reversing out of a parking space, the system will inform the driver about any cross traffic, which is often difficult for the driver to see. This function will save the driver a lot of stress and hassle in everyday driving.

Valeo's blind spot detection is available on several General Motors brands, including Cadillac and Buick, Chevrolet, GMC, and is also fitted on the new Jaguar XF. The system was recognized by a prestigious PACE Award in 2007.

Operating principle

The radar emits millimetric waves of 24GHz and sweeps an area with a radius of 8 meters across a field of view of 150° between the front and rear of the vehicle. Only part of this area is analyzed by the blind spot detection system, according to the requirements of the model and the automaker. The radar has no moving parts and is fully electronic. The millimetric wave technology functions in nearly all weather conditions. This extremely practical driving aid can be used in almost every country in the world, owing to the radar's narrow 200MHz bandwidth.

The radar sensors are easily fitted behind the bumper fascia. Since they can be fitted behind non-metallic parts, they do not interfere with the vehicle's styling.

The blind spot radar can establish the precise position of all obstacles in the adjacent lane. This information is then analyzed by an algorithmic program to determine the type of obstacle, its relative speed and direction. Parked and oncoming vehicles are filtered out by the system. The intuitive warning symbol is easily understood and very reliable.

The benefits of blind spot detection

Advantages for the automaker

- The narrow frequency band of 24GHz is authorized in all countries.
- The radar functions reliably regardless of the speed of the vehicle.
- It can be used in almost all weather conditions.
- The system does not affect the vehicle's styling.

Benefits for the user

- With reliable information from the blind spot detection system, the driver can change lanes safely.
- Relaxing, stress-free driving.
- Immediate and intuitive warning.
- The radar can detect cars, trucks and motorcycles.
- Both sides of the vehicle are continuously monitored.

Smart Car Key

The Valeo Smart Car Key communicates with vehicle over long distances and controls new functions.

Bi- directional Long-distance connection

The possibility of communicating with a vehicle over long distances can be very helpful. Users can make sure that their vehicle is correctly locked and that the doors and trunk are closed and check the car's current condition. They can also be informed of possible dysfunctions, pre-program vehicle functions, remotely launch vehicle functions and even transfer data from a computer.

Smart Extended functionalities

The Smart Car Key developed by Valeo is an extension of the existing Passive Entry and Start system. It can be used to control new functions, including the pre-ventilation of the cabin, and works over much longer distances (up to 500m). Feedback from the vehicle can be indicated by a light, a buzzer or a display.

If a command cannot be executed, warning messages are sent and the user is guided through the steps to understand and solve the problem. The current state of the vehicle can be displayed on a mini-screen on leds: door locks, alarm, temperature range in the passenger compartment, fuel level and tire pressure. The Smart Car Key can also be used to transfer data that has been downloaded from a computer, such as navigation addresses, or MP3 files, to the vehicle's on-board system.

Operating principle of the Smart Car Key

The main innovation is a long-distance communication system between the key and the vehicle. Valeo has selected the frequency of 868MHz in both directions for the current prototype and the key is powerful enough to communicate with the vehicle over distances of more than 200 meters, and up to 500m.

The 27 x 20mm screen (128 x 96pixels) can be black and white or color. The dimensions and the number of pixels can be adjusted, as can the functions controlled by the key. By way of example, data can be exchanged between two keys in order to synchronize them. The Smart Car Key can also be used as a USB storage device with a capacity of 1GB, which can be increased to 4GB with the built-in µSD card.

Advantages of the Smart car key

Advantages for the carmaker

- Technological image thanks to the new functions that can be remotely controlled using the Smart Car Key.
- Possibility to customize the key design with the carmaker's brand, which gives the device a high-profile identity.
- Modular design offering different levels of functionality and design.

Advantages for the user

- Long distance access to the vehicle data in order to check the vehicle remotely.
- Possibility of using functions over long distances.
- Possibility of transferring data from a computer.
- Easy-to-use design for simple and intuitive navigation.

Tailgate “Smart Closure”

Automatic trunk closure makes loading easier.

Unloading the trunk

When unloading the trunk, the user sometimes has to leave the vehicle with both hands full, so it is impossible to close the trunk manually or press the electric closure control without depositing this load on the wet or dirty ground. This is where a closure assistance system requiring no manual controls would be appreciated by the user.

Sensor-operated closure

Valeo is a leader in the motorization of the trunk, providing compact motors for hinges. Valeo can now offer a smart assistance function that preprogrammes the trunk to close only when the user moves away from the vehicle, simply by pressing a button, easily accessible on the inner side of the trunk, before beginning to unload. The trunk is now programmed to close but will only do so when all users have moved to a safe distance.

The system detects the presence of people using sensors installed for the Park Assist. The calculator engages the trunk’s motors or electric jacks when the safety zone is clear.

This function is already available for carmakers.

Operating principle

The Smart Closure system does not require any additional parts for vehicles that are already fitted with powered tailgates and park assist sensors. Since vehicles generally have four or six ultrasound sensors on the rear bumper, the system may not detect the user when the closure is engaged. The program caters for this eventuality, waiting for the individual to move away, since this will necessarily take them through the surveillance zone.

If somebody approaches the vehicle during closure, the system continues the operation and deploys its anti-pinch mechanism.

Advantages of tailgate “Smart Closure”

Advantages for the carmaker

- Adds intelligence to the function.
- Requires no extra equipment.

Advantages for the user

- It is no longer necessary to have one hand free to close the trunk manually or press the button for electric closure.
- Appearance of “magic” closing.

Optimum Latch

This door latch, which is standardized world-wide, offers improvement in both user comfort and robustness; it also reduces the manufacturing cost and weight of the locking system.

Enhanced user comfort

When a potential customer tests a new vehicle, the slightest detail becomes important and may sway the decision to buy. Opening and closing a door, for example, is one of the most popular tests. The customer must feel the subjective sensations of a quality product and a "well-oiled" mechanical system. The doors' locking mechanism forms part of this analysis, and its specifications therefore go beyond the basic functions such as opening and closing.

Optimized latch at every level

The first advantage of the new door latch developed by Valeo is its ease of use. Activating it does not generate any mechanical resistance to disturb the hand, and the system ensures a constant level of effort throughout the vehicle's lifetime.

Its other major feature is that it is standardized world-wide. Standardization does not currently exist, and products have been developed in disorderly fashion, to meet the different regulations of the world's markets. In addition, the same carmaker will have a wide range of latches which are not interchangeable and are classified by model and by year of production. Valeo's standardized latch has been developed to meet the demands of a majority of carmakers, and can also be adapted to more specific uses once some minor modifications have been made. This standardization also makes it possible to reduce development time on a latch for a specific product.

Different options mean that carmakers now have an increased range of latches at their disposal: mechanical only or power-assisted (up to four), superlock or dead lock, integrated help or automatic unlock. This optimized, standardized latch will be available as from 2011, when all Valeo Security Systems production sites will be able to produce it.

Operating principle

Extreme standardization of the latch is the result of significant work carried out in-house in order to study standards in the different world markets, analyze feedback, and compare existing products. The development also focused on achieving a high level of performance in terms of ease of use, e.g. minimum effort and noise when opening.

This very thorough development process made it possible to offer a product at both lower cost and lower weight, thanks to a reduced number of parts, and the carefully studied reduction in the weight of each component. The latch is now more robust, with, for example, enhanced resistance to freezing and rust; and the whole system is totally waterproof. The Optimum latch is protected by seven patents.

Advantages of Optimum Latch

Advantages for the carmaker

- Very wide product standardization.
- Reduced development time on latch for specific product.
- Available in a range of different versions.
- 5 to 10% weight advantage.
- Optimized cost.
- More robust, and 100% sealing guaranteed.
- Easily produced by all Valeo Security Systems production sites.

Advantages for the user

- Reduced effort to open maintained throughout vehicle's lifetime.
- Noise made when operating confirms high quality of system.

New Technologies in Human-Machine Interface

Valeo is meeting automotive manufacturers' needs for change in vehicle interior through new concepts that offer greater design freedom, harmonized interiors, and easy, intuitive operation.

Today's cars offer sophisticated HVAC and multimedia systems. While this makes travelling comfortable and pleasant for the car's occupants, it tends to overload the center area with a complex array of different controls. What is more, drivers want to be able to use their personal devices while driving in a safe way. Automakers are therefore facing a dilemma: how to offer an increased number of functions while keeping the same ease of use, perfect ergonomics and making driving safe? Valeo is answering to this need by a wide range of new solutions and concepts such as the control panels, E-media™, or Senseative® Seat controls.

Control panels

Valeo is responding to the need for new kinds of controls in the center stack area with several interface technologies that can simultaneously manage air-conditioning and all multimedia applications - radio, CD, MP3, and GPS - without compromising their content. This HMI (Human-Machine Interface), known as the faceplate, is available independently of applications such as HVAC or radio.

Advantages of Valeo control panels

Advantages for the carmaker

- Control panels customized to specific brand identity.
- Harmonized design of different control systems.
- Increased styling possibilities.
- Differentiation capacity through wide selection of technologies that meet marketing, technical and economic needs.
- Innovative systems such as touch sensitive surfaces with vibration feedback.
- Controls for the complete car interior controls range.
- From dedicated HMI to multi-functional HMI.
- Controls that can manage a wide range of systems.
- Space-saving via the integration of controls into a single product.
- Increased possibilities for managing a large number of functions without compromising the content.
- Modular HMI solution able to follow function deployment depending on trim-level and cross-platform.

Advantages for the user

- Intuitive controls.
- User-friendly with a pleasant feel.
- A range of functions in a small, accessible space.
- Pleasant and harmonized interior design.
- Safe interface solution for external user devices.

E-Media™ controls

The E-media™ control console helps motorists control even the most sophisticated on-board comfort and communications devices quickly and in complete safety.

Making the most of control capacity

Many drivers find electronic control consoles far too complex, with lots of menu levels that demand close attention and prevent users from making the most of all the functions offered by the vehicle's equipment.

Simple, intuitive controls

Valeo has developed an easy-to-use control console that can be used intuitively to adapt and control the vehicle's equipment, without limiting the range of possibilities offered by electronic technology.

The E-Media™ control console has three separate joysticks, each fitted with a contact sensor that can be used to display a menu by simply touching the joystick. Each function menu has no more than two levels. Valeo's ergonomics and design specialists paid close attention to the graphical user interface that perfectly illustrates the structure of the system. The vehicle's central screen schematically displays the position and use of each control. Bars and arrows are used to represent rotations or lateral and longitudinal sideways movements. Some functions are controlled by rotating the joystick, while others use buttons in order to make the use of the system more natural.

Advantages of E-Media™ control

Advantages for the carmaker

- The E-Media™ system reduces the number of buttons, without limiting the number of functions.
- It can control a multitude of functions using the CAN, MOST or other protocols.
- The finish can be easily customized (illuminated central symbol) and additional functions can be included (touch detection, magnetic indexing).

Advantages for the user

- The E-Media™ system controls numerous functions and offers a broad range of possible settings.
- The graphical representation on the screen shows the position of the control and the movements used to adjust the function. The driver's eyes remain on the screen rather than on the joystick for safer use.
- The system is simple and intuitive to use. The user's attention remains focused on driving the vehicle.

Senseative® seat controls

Senseative offers new touch-sensitive, easy-to-use controls.

Easier to use

Electric seats are increasingly common in vehicles. They are usually controlled using a 3D model representing the back and cushion of the seat. Moving either one of these parts horizontally or vertically causes the corresponding part of the seat to move. But users often have difficulty finding and using these controls.

A new technology

The Senseative® touch-sensitive seat control represents a significant step forward in terms of ease of use. The 3D model makes way for four segments corresponding to the possible movements of the seat and the electric buttons are replaced by a touch-sensitive system with four resistive sensors. The different parts of the seat can be moved by simply sliding a finger on the corresponding segment, then pressing the button.

Advantages of Senseative® control

Advantages for the carmaker

- Great design freedom thanks to flat controls that can be easily integrated into the surfaces of the vehicle and possible application of different high-quality coatings (metal in particular).
- Compact technology that can be used to increase the number of functions, even in places that are not visible.
- Controls can provide visual or tactile feedback.
- Flat controls reduce the risk of accidental damage.
- Reduced number of parts (tools, process, etc.).
- Watertight integration that meets IP54 standard.

Advantages for the user

- A new generation of more intuitive and effortless controls.
- Can even be used with gloves.
- Operating principle that eliminates the risk of accidental movement.
- Modern design.

Powertrain Systems

valeo added™

Dual dry clutch

Automatic transmission with the dual dry clutch has proved to be the most effective and best suited to the needs of the European market.

An automatic gearbox that delivers

European motorists are finally turning to automatic transmission, which simplifies driving by carrying out gear changes itself. This makes hill starts and parking maneuvers more comfortable, and driving in built-up areas and heavy traffic more relaxing. Users do not want to see higher fuel bills, however, and would like automatic transmission to be more affordable.

The dual dry clutch: a perfect solution

The dual-clutch transmission concept is a response to end-users' demands for both increased driving comfort and fuel savings, unlike traditional automatic transmission which increases fuel consumption. Valeo offers a dual dry clutch developed using its manual gearbox experience. The clutch to clutch torque transfer is designed to offer maximum comfort when shifting gears. Valeo's offer includes the clutches and actuators. This solution couples technologies already tried and tested in series production, such as bonded rather than riveted linings, and others, such as travel adjustment integrated within the actuators, specially developed to ensure dual-clutch strength and reliability.

When combined with electro-mechanic actuator technology, dual dry clutches offer significantly higher performance than that of the hydraulically actuated double clutch systems. The solution therefore offers fuel savings and CO_2 emissions reductions of around 4% compared to wet Dual Clutch and at least 6% compared to an automatic gearbox.

Operating principle

The dual dry clutch offered by Valeo contains three plates. The central clutch plate is fixed axially and its rotation is linked to the engine's flywheel. A clutch disk presses on each side of the central plate, and a moving plate presses in turn on the disks. The clutch on the plate's motor side engages both when starting and when shifting to odd gears. The clutch on the plate's gearbox side engages only when shifting to even gears and reverse. Each of the two parts of the dual clutch module alternately transmits torque to one of the two coaxial input shafts of the transmission: one is hollow and is used for even gears, and the other is solid and used for odd gears. The plates are engaged by an electromechanical actuator applying a force, via a release fork, to a diaphragm spring that presses onto the corresponding moving plate. When stationary, the two clutches are disengaged because, unlike manual gearboxes, they are actively closed for safety reasons.

To obtain maximum comfort during gearshifts, the opening of the first clutch must be perfectly synchronized with the closing of the second. Astute choices of masses and materials ensure that the dual clutch module has sufficient thermal qualities to absorb the energy of these synchronization phases. Valeo therefore utilizes its Freepod® plates with bonded linings offering a longer clutch plate life. This exclusive patented technology allows the total thickness of both plates to be reduced and thereby optimizes the thermal mass, which is key in efficient double dry clutch operation.

The engaging of a clutch requires the balancing of the forces applied by the diaphragm and those by the actuator. In order to reduce the demands made on the electric motor, the actuator includes an assisting spring, which uses a cam to exert a force close to that of the diaphragm. The electric motor then provides the additional force required to control the plate engaging and disengaging actions, thereby consuming less energy. 15 Amperes electric current are required during gearshifts, but only 1 Ampere is required between gearshifts to keep both clutches closed. This contributes to the

exceptional efficiency of Valeo's dual dry clutch. The actuators lastly include a bidirectional travel adjustment mechanism that adjusts for disk wear and also adjusts automatically for production tolerances. This last point simplifies the vehicle assembly process.

The dual dry clutch can be fitted in conjunction with a dual mass flywheel if required for particular diesel or gasoline engines. Current developments can cover torque up to 350Nm depending on the space available, the vehicle weight and the gearing reduction in the gearbox's first gear.

Advantages of dual dry clutch

Advantages for the carmaker

Valeo offers a highly efficient dual clutch system, providing exceptional performance:

- Dual dry clutches are more efficient than dual wet clutches, because:
  - the clutch plates are dry instead of being immersed in an oil bath, requiring a hydraulic pump;
  - they use electromechanical rather than hydraulic actuators.
- The system results in a reduction of more than 6% in CO_2 emissions compared to a conventional automatic gearbox and a reduction of about 4% compared to a wet friction dual clutch gearbox.
- Reliability is ensured by the careful choice of technologies that minimize the number of dual clutch components, the use of clutch plates with bonded linings and the wear adjustment mechanism integrated in each actuator.
- The dual dry clutch can be easily adapted to a large number of gearboxes.

Advantages for the user

The customer enjoys better performance, greater fuel economy and improved comfort and driving pleasure:

- The Valeo dual dry clutch provides the driving comfort of automatic drive transmission coupled with lower fuel consumption than that offered by a manual gearbox.
- The sporty nature of the transmission adds real driving pleasure to this design.

e-Valve: the electromagnetic valve control system

Despite a slowdown in innovation investment in the automotive industry, Valeo is constantly striving to optimize the e-Valve system. Valeo remains the world's first automotive supplier to demonstrate the robustness of electromagnetic valve control systems. In addition to cutting fuel consumption and CO_2 emissions by as much as 20%*, the system can also be perfectly integrated with electric hybrid engines.

The need for a new technology

The pressing need to cut CO_2 emissions is an issue that the automotive industry must address and solve quickly. It is therefore essential to improve the overall efficiency of the internal combustion engine, not by making minor tweaks here and there, but by proposing quantum steps forward in terms of technology.

A tried and tested technology

For many years now, Valeo has been working on electromagnetic valve control systems, which represent a fundamental improvement to the internal combustion engine. Valeo's e-Valve technology allows automakers to reduce vehicle emissions and consumption by 15% to 20% in the EEC mixed driving cycle. This significant gain is all the more advantageous because it only requires a few components of the powertrain to be changed. In combination with the StARS+X hybrid system, fuel consumption can be reduced by as much as 30%.

The e-Valve system replaces the traditional mechanically driven camshaft with an electromagnetic control system that actuates each valve individually and independently of the position of the crankshaft. In addition to the almost unlimited scope for timing settings and variations in the opening times, e-Valve also enables each valve to operate independently, which means that a given number of cylinders can be deactivated. This feature drastically improves the ecological performance of the internal combustion engine. By way of example, it is now possible to optimize engine performance with respect to the instantaneous power requirements of the driver, applying different engine strategies such as cylinder deactivation or the Atkinson-Miller cycle. This flexibility in engine valve control also significantly increases low-end torque, enhancing driving comfort. Finally, the e-Valve system is part of the trend towards the electrification of vehicle components, and in particular electric hybrid engines.

Valeo is the first automotive supplier in the world to demonstrate the robustness of its electromagnetic valve control system. The e-Valve has progressed well beyond the conceptual design stage and demonstrations on prototype vehicles, to a point where it can be mass produced.

Operating principle

The fundamentally specific feature of e-Valve is that valve control is totally independent of the position of the crankshaft. Each valve is actuated by two electromagnets that are specifically dedicated to opening and closing the valves. The two opposing springs alternately provide the force required to open and close the valves. The whole unit is controlled by an electronic management system (the Valve Control Unit) with an integrated 14/42 Volt converter and cooling system.

By replacing the air throttle valve, the e-Valve system also does away with pumping losses that are due to the partial closure of this valve (high pressure drop during inlet travel at low load) and are detrimental to fuel consumption. As a result, idle speed can also be lowered. Engine manufacturers also have a broad choice of settings, which are no longer fixed but are infinitely and continuously variable. This development helps to reconcile parameters that were previously

antagonistic, such as torque at low rpm, power at high rpm and the reduction of fuel consumption and emissions. Deactivating some cylinders by temporarily closing their valves enables the active cylinders to operate in a more efficient range. The combination of all these new options reduces fuel consumption and CO_2 emissions by 15 to 20%.

In addition, more and more on-board systems are switching to by-wire controls. Electromagnetic valve control systems are just one example. This development is perfectly in line with another underlying trend towards electric hybrid road vehicles, which recover the kinetic energy generated by braking, which would otherwise be wasted. In this case, driving the valves with the e-Valve system requires no additional energy. Another point of compatibility between these two advanced technologies is that the e-Valve system allows the engine to start when the valves are open. This feature facilitates synchronization between starting the engine and the Stop-Start function, which will soon be installed in a greater numbers of cars.

Two other major trends can be observed in the development of the internal combustion engine: supercharging, related to downsizing, and the emergence of new affordable and economical engines. The e-Valve system is compatible with these new developments, and is a very competitive technology on engines with two valves per cylinder instead of four.

The e-Valve system in detail

The e-Valve system has two actuators, one for each pair of valves for cylinders with four valves or a single actuator for cylinders with two valves. Valve movement is controlled by two magnets that harness the energy released by two opposing springs. At the start of the valve opening operation, the valve is released by the upper magnet. The upper spring releases, opening the valve. The lower magnet catches the armature plate, fully compressing the lower spring and keeping the valve open for the required time. Valve closure follows the identical procedure in reverse. The valve is kept closed by a locking strategy, reducing the energy being consumed by the magnets. The valves also remain closed while the engine is at standstill. Noise due to the opening and closing of the valves is reduced by controlling the speed of the valve as it reaches the upper and lower limits of its travel.

The Valve Control Unit (VCU), which is cooled by the engine cooling system, operates on a standard 12-Volt vehicle architecture. It is equipped with a voltage converter to supply current to the actuators with 42 Volts.

The flexible e-Valve system allows infinitely variable valve timing and valve opening duration, reducing pumping losses and also enabling the deactivation of some cylinders. In addition, opening and shutting valves at low engine speeds optimizes filling compared to a cam system, hence improving performance at low speed. As well as improved thermodynamic performance and torque, it is also possible to use several strategies, such as switching momentarily to a Miller cycle, or accelerating gas intake speed and turbulence by opening one valve, thus reducing the creation of pollutant gases. The system also facilitates the introduction of new combustion processes, such as HCCI or multi-stroke, including two-stroke. Current tests on prototype vehicles are focusing largely on half-camless systems, which control inlet valves only and offer most of the benefits and an excellent cost-benefit ratio.

The e-Valve system also benefited from a new development process designed to achieve greater robustness. The use of robust 6-Sigma engineering methods and digital simulation enabled a broad range of configurations to be precisely validated without making any physical parts, since the model had already been validated. Only the final configuration was produced at the end of the new development cycle, an approach that saved a lot of time and offered a remarkable level of quality of the final product. The tests matched the simulations perfectly and demonstrated the robustness of the e-Valve system under real working conditions: temperature variations, vibrations, severe conditions, etc. The system is now ready for industrial production, because the constraints relating to manufacturing dispersions have been solved. The product is now completely “repeatable”, which means that all functions are available under all circumstances and over time. The development process went through a number of evolutions, including the addition of a HLA (Hydraulic Latch Adjuster) compensating the mechanical clearance of the system and the use of a highly precise and robust valve position sensor.

Advantages of e-Valve system

Advantages for the carmaker

- Valeo is the first automotive supplier in the world to demonstrate the robustness of its product.
- The e-Valve system is ready for industrial production.
- This technology offers answers to new engine trends: it is compatible with supercharging and can be adapted to engines with two valves per cylinder instead of four.
- Pumping losses are reduced to virtually zero, which improves performance and lowers the idling speed.
- Engine manufacturers benefit from almost infinitely variable valve opening settings, with a positive effect on torque, especially at low rpm, NO_x and HC emissions and the recycling of exhaust gases.
- The system is highly adaptable in terms of cylinder capacity, types of injection, types of admission, and for engines that are already in production with conventional distribution by camshafts.
- The introduction of new operating strategies is simplified: disconnection of cylinders, HCCI combustion, multi-stroke, including two-stroke, etc.
- Starting the engine is made easier when using the Stop-Start function.
- While the electromagnetic system controls both the inlet and exhaust, the mechanical part is simplified as the timing actuation belt or chain, and camshaft, are no longer required.

Advantages for the user

- Consumption is reduced by 15-20%.
- CO_2 emissions are reduced by 15-20%.
- Low-end torque is increased by 15-20%.
- Greater ease of use when restarting with the Stop-Start function.
- In combination with the StARS+X hybrid system, fuel consumption and CO_2 emissions can be reduced by as much as 30%.

(*) Compared to an indirect-injection four-cylinder engine without variable valve timing.

Hybrid and electric vehicles for everybody

From micro-hybrids to electric cars, through several levels of hybridization, Valeo is developing a range of innovative powertrains and comfort enhancements accessible to a large proportion of the market.

Electrification, the future of the car

Most people realize that industry has to change with the times, taking account of dwindling oil reserves, pollution of the atmosphere, water and topsoil, global warming, waste management etc. The automotive sector will also have to undergo a revolution. The best response is the introduction of electric motors that can support and eventually replace engines that run on fossil fuels, allowing motorists to maintain their freedom of travel in comfort and safety.

As an electric powertrain specialist, Valeo will offer a range of solutions for powertrains with the required level of hybridization: 2kW, 4kW, 15kW, 25kW, 50kW and 100kW. These include the engine and its electronic management and are designed for different kinds of vehicle electrification, ranging from micro-hybrids to 100% electric vehicles, through the various intermediary stages. The engine cooling system is more complex in hybrid vehicles and Valeo has developed a plug & play approach that allows easy addition of new devices without architecture modification. Valeo is also developing several offers for the thermal management of batteries, and an innovative heating system that maintains the normal level of comfort while limiting the impact on autonomy.

Micro-hybrid vehicles

In city driving, vehicles are stationary for about 35% of the time, while the engine idles to no purpose. A system capable of switching the engine off automatically at a red light, say, and starting it up again automatically and rapidly as soon as the driver asks for power would therefore be very useful.

Valeo is the only automotive supplier to offer two alternative stop-start solutions, one based on a starter-alternator and one on a heavy-duty starter.

First solution: StARS starter alternator

Valeo's landmark starter alternator

StARS (Starter Alternator Reversible System) is a starter alternator providing the Stop-Start function. It is installed in place of the alternator, is driven by a belt, and can replace the starter. It is compatible with all manual and automatic transmissions, motorizations up to 2l for gasoline engines and 1.6l for diesel engines.

The Stop-Start function is fully automatic and can provide fuel savings of up to 6% in European urban-suburban use, and up to 25% in congested city driving.

Thanks to its advanced design, the StARS starter alternator can be adapted to any Stop-Start strategy required by the automaker. It can also shut off and restart the engine when the vehicle is moving slowly, which further increases potential fuel savings. This function cannot be provided by heavy-duty starter systems without affecting comfort.

In 2004, Valeo became the first automotive supplier to market a starter alternator. StARS now equips some models of the Citroën C3 and C2, Mercedes A and B Classes and the Smart Fortwo. The second-generation i-StARS is smaller and easier to install, as the power electronics is integrated into the electrics. Valeo's range of i-StARS and i-StARS+ covers all gasoline and diesel engines on the market and the Group has signed several large-scale contracts for the introduction of Stop-Start technology by the end of 2010.

Advantages for the carmaker

- Fuel savings and reduced carbon dioxide emissions for a reasonable cost.
- At 3 kW for 14V, the starter power is high.
- Electrical efficiency greater than that of a conventional alternator.
- Fuel savings optimized by shutting off the engine before the vehicle reaches a complete stop.
- The engine can be restarted in the process of stopping, if, for example, the driver unexpectedly changes their mind.

Advantages for the user

- Fuel savings and reduction of carbon dioxide emissions of around 6%; up to 8% in European urban-suburban use and up to 25% in heavy urban traffic.
- The engine stops and restarts automatically.
- The engine restarts in less than 350 milliseconds.
- The engine restarts completely silently.
- Engine noise and vibrations are eliminated when the vehicle is at a temporary standstill, which represents 35% of city driving time on average.

Second solution: ReStart heavy-duty starter

A heavy-duty starter can perform the same function, having been adapted for repeated stopping and starting. The stop-start function is also fully automatic, delivering fuel savings of around 4% in European urban-suburban use.

ReStart is suitable for all engines and all capacities. It can start at very low temperatures.

The system has scarcely any impact on the vehicle's architecture, allowing it to be introduced very rapidly in response to demand for fuel-saving technologies.

Advantages for the carmaker

- Fuel savings and reduced carbon dioxide emissions for a reasonable cost.
- Installation identical to that of a conventional starter.
- The length of the powertrain is not increased, as it is when starter alternators are incorporated in the shaft line.

Advantages for the user

- Fuel savings and reduction of carbon dioxide emissions by around 4% in European urban-suburban use.
- The engine stops and restarts automatically.
- Engine noise and vibrations are eliminated when the vehicle is at a temporary standstill, which represents 35% of city driving time on average.

Micro mild hybrid vehicles

Micro mild hybrid vehicles have a new function, the Kinetic Energy Recovery System, which recovers part of the vehicle's kinetic energy during braking.

New technological development for Valeo's starter-alternator

On micro mild hybrid vehicles, StARS functions have been extended to include kinetic energy recovery. The energy recovered can reach 5kW, when the system is working as a generator with a voltage of 25-28V. The energy recovered can be fed back into the electrical network via a voltage transformer, without drawing on the engine's power. It can supply power-hungry functions or StARS in engine mode by providing the combustion engine with torque, thereby reducing powertrain consumption.

Kinetic braking energy, converted to electricity, is stored in supercapacitors which take up scarcely more space than a standard battery. Supercapacitors have the advantage of storing and restoring high levels of electric power repeatedly without significantly degrading their capacity. This feature is perfect for the frequent charging/discharging cycles of the energy-recovery starter-alternator. Supercapacitors also have efficiency close to 100%. Energy is typically stored in 10 cells of 2.8 volts connected in series, with a total capacity around 200 farads. An electronic management system manages the charging voltage of supercapacitors between 18 and 25 volts, ensuring that the vehicle always has enough energy to start. If the battery is low or very old, the converter can use its remaining energy to recharge the supercapacitors, allowing them to start the engine.

Compared to a conventional car, micro mild hybrid vehicles cut fuel consumption and carbon dioxide emissions by around 10-12% in European urban-suburban use, which is a considerable figure given the relative simplicity of the concept, the small number of adjustments made to the engine and the low premium. A European model will be equipped with StARS 14+X as of 2011.

Advantages for the carmaker

The StARS 14+X starter-alternator offers the same benefits as StARS, as well as the following:

- Fuel consumption and carbon dioxide emissions reduced by 10-12% in European urban-suburban use, for a competitive market price. Kinetic energy recovery during braking and engine assistance during acceleration, without major adjustments to the engine.
- Energy stored in compact supercapacitors.
- Extremely durable energy storage unit, requiring no replacement or maintenance.
- High energy efficiency for both the StARS 14+X starter-alternator and supercapacitors.
- Compatible with all engines, gasoline and diesel, and all capacities.

Advantages for the user

The StARS 14+X starter-alternator offers the same benefits as StARS, as well as the following:

- Consumption is reduced by 10-12% in European urban-suburban use.
- Carbon dioxide emissions are reduced by 10-12% in European urban-suburban use.
- Moderate electrical assistance.
- If the battery is low, the supercapacitors can convert the remaining energy into instant power sufficient to start the engine.

Mild hybrid vehicles: looking ahead to 2013

In addition to its Stop-Start functions and the recovery of kinetic energy, this technology provides the engine with additional torque, allowing carmakers to reduce engine capacity significantly. Known as downsizing, this reduction of capacity for equivalent power is the leading contributor to fuel savings. These engines are supercharged to maintain equivalent power. Hybridization is particularly useful in these circumstances, since the electrical system instantly supplies high torque at low speed or during a rapid increase in load or speed, whereas a combustion engine with a lower capacity, especially a turbocharged one, either cannot provide torque or cannot provide it fast enough. This hybridization provides both increased driving comfort and fuel savings. Research carried out by carmakers, Valeo and independent laboratories have shown that electric motor power between 10 and 15kW provides optimal fuel savings and total system cost. Compared to a conventional car, a mild hybrid model reduces fuel consumption and carbon dioxide emissions by 15-20%.

Two affordable electrical systems

Valeo will offer the market optimal solutions in terms of cost and function, by drawing on similar developments that pre-date StARS, such as inverters governing the electrics in the generator or the engine, voltage transformers and the original technology for integrating power electronics.

Valeo offers two electric machines, to cater for different architectures, both existing and planned. The first family, the "long cylinder", remains similar in diameter to traditional alternators and of a length appropriate for the required output. Its belt drive on the front end of the engine or on the transmission will simplify its integration against the powertrain. The second family will be a circular-shaped motor-generator, inserted between the combustion engine and the transmission. The first family is better suited to widespread standardization and will allow engines to be hybridized without significant alterations to the architecture, therefore saving on investments. The second will be used for breakthrough architectures, and will therefore be better integrated, but less conducive to standardization.

Operating voltage will be determined by a cost-performance analysis of the energy storage systems compared to the cost-performance analysis of the machines themselves and the associated electronics (inverter and converter).

The Valeo system for mild hybrid vehicles is compatible with both gasoline and diesel engines, and is part of the MHYGALE programme (Mild HYbride GénérALisablE), which is subsidized by the French public purse via the Grenelle Environnement in order to develop a so-called "mild" hybridization that most people can afford and that has a significant impact on global carbon dioxide emissions. The Group's partners in this project are PSA Peugeot Citroën, Freescale, Alter and Ceitecs, as well as five university laboratories – G2E Lab Grenoble, L2EP Lille, LAAS Toulouse, LME Valenciennes and LMPGM Lille.

Valeo plans to launch its system for mild-hybrids in 2013.

Advantages for the carmaker

- Affordable mild hybrid, standards designed for high production volumes, and therefore cost optimization.
- Optimization of downsizing.
- Optimal harmonization of the combustion engine and electrical assistance.
- Excellent cost-benefit ratio in terms of fuel savings and carbon dioxide emissions reductions.
- Double Valeo offer for closer adaptation to carmakers' requirements.
- High efficiency of electric drive systems.

Advantages for the user

- Fuel consumption and carbon dioxide emissions reduced by 15-20% compared to a traditional engine.
- Driving comfort improved by the additional torque at low speeds and when varying speed.
- Personal contribution to the sustainable development of automotive mobility, for a reasonable price.

Full hybrid vehicles

Full hybrid vehicles are able to move using only electric power, i.e. without recourse to a combustion engine. The limited power of the electric motor and the restricted capacity of the batteries do, however, respectively limit the vehicle's speed and autonomy when in electric mode. Electrical energy is supplied by the batteries and/or a generator powered by a combustion engine, which remains the main source of mechanical energy. The system also provides Stop&start functions, kinetic energy recovery and drive assistance.
By calling on its experience and expertise in the management of electric drive systems, Valeo plans to position itself on the full hybrid and PHEV (Plug-in Hybrid Vehicle) markets.

Rechargeable hybrid and electric vehicles

With 100% electric propulsion, an individual's freedom of movement without any CO_2 emissions will become possible on a local level. The only major restriction to this innovative mode of transport is the autonomy offered by the batteries. However, in Europe, 86% of daily journeys cover a maximum of 60 kilometres, which is a distance that can be easily handled, without recharging, by BEVs, or Battery Electrical Vehicles, featuring the latest technologies.

An electric car is propelled exclusively by the energy stored in batteries, which powers one or more electric motors. An electronic control system manages both the engine's power, as requested by the driver, and the recovery of kinetic energy during deceleration. Transmission may comprise just a gearbox and, in some cases, a differential. The reverse and slow-speed start functions are directly handled by the motor. Lithium-ion batteries, which are already used on small electronic devices such as mobile phones, offer storage capacity four times greater than lead batteries of equivalent weight. To recharge them, there are various possible ways of connecting to the electric distribution network. You can, for example, recharge using an ordinary 220-volt socket (slow charge) or with an additional tri-phase 32-amp power source (semi-fast charge). The latter solution should also become available in towns or in carparks at people's place of work. Given the distinctly higher performance of the powertrain, and depending on the cost of the kilowatt-hour, running costs for an electric car are four to six times lower than for gasoline-driven cars.

The electric car is also available in a so-called "range extended" version, called the REBEV, or Range Extender Battery Electrical Vehicle. The powertrain is still driven exclusively by the electric motor, but this vehicle incorporates an internal combustion engine and a generator rather than a high-capacity battery. It has enough batteries to ensure autonomy in most cases of daily use, with the combustion engine only used for longer-distance journeys.

The rechargeable hybrid vehicle is another concept. It has two parallel-mounted powertrains: one internal combustion and one electric. The electrical energy is stored in a battery which can be recharged either when stopped, using the electrical network, or by taking on some or all of the combustion engine's energy. In electric mode, this vehicle can travel in urban and suburban traffic conditions over a distance of several dozen kilometres.

Whereas hybrid vehicles only use their electric powertrain during a transitory phase, rechargeable electric and hybrid vehicles have to use it over long periods. Their motor and their control electronics therefore require dimensions suitable for permanent operation, and they must attain a very high level of performance. In addition, as they do not have the free source of heat provided by the combustion engine, the heating and air-conditioning functions in the cabin have to be reconsidered, in order to restrict the quantity of energy taken from the battery.

The Valeo second-generation powertrain for electric vehicles

Some so-called "first generation" models are currently being launched. Valeo is developing a second-generation electric powertrain, with better energy efficiency for an affordable price, targeting a large number of potential buyers. Producing an electric powertrain for a limited cost is a vital condition if second-generation rechargeable electric and hybrid car are to be available for mass distribution at economically viable prices without governmental aid for buyers. This development is being undertaken by a consortium pooling the skills and expertise of several companies to promote the emergence of an industrial sector for electrically-driven vehicles. The respective roles of the partners are as follows:

- Valeo – powertrain electronics and the vehicle's heat management,
- Leroy Somer – the electric motor,
- Johnson Controls-Saft – the battery system,
- GKN – transmission,
- Michelin – low energy consumption tyres, ground-to-car connection, and work on motorization in the wheels,
- Leoni – development and production of vehicle's wiring and harnesses.

One objective of this joint development is to provide the most complete final product offer, based on the best technological choices available, avoiding the trap of developing a good solution in terms of one part, only to degrade the efficiency of the final product. Complete powertrains and their various constituents could set the standard for other programmes, both in France and the rest of the world. Valeo also offers innovative solutions providing energy savings in heating, air-conditioning and lighting equipment, enabling electric cars to offer the same level of comfort as current cars.

Advantages for the carmaker

- Powertrain at an affordable cost.
- High energy performance from the Valeo second-generation powertrain.
- Meets the increasingly stringent restrictions on carbon dioxide emissions, since these emissions are only produced by the production of electricity.
- Simpler mechanics than an internal combustion engine – no gearbox or clutch, a compact powertrain, lower requirements of the cooling system, cabin soundproofing and vibration absorbers.
- Range-extended electric vehicles dispel consumers' fears of losing long-distance mobility.

Advantages for the user

- Can travel without local CO_2 emissions.
- Can travel without noise pollution.
- Low price per kilometre.
- Potential autonomy equivalent to a conventional vehicle with combustion engine, thanks to the concept of the range-extended electric vehicle.

Powertrain Thermal Management for Hybrid and Electric Vehicles

As a result of the introduction of an additional powertrain, the Thermal Management of a Hybrid or Electric Vehicle with a range extender is more complex than the traditional Internal Combustion Engine (ICE) one. Optimization of the Thermal Loop is key to extending the electric operation range of the vehicle as proper control enables the effected components to operate with maximum efficiency.

With a standard cooling architecture, the DC/DC converter and the electric motor require the addition of a low temperature loop with a dedicated radiator, water pump, fan system and actuators.

Thanks its UltimateCooling™ Architecture, Valeo has develop a plug and play approach that allows easy addition of new devices without architecture modification.

UltimateCooling™ allows for the use of a single coolant working in 2 loops designed to provide each component with the right coolant flow and the right temperature in order to optimize fuel economy and electrical consumption. The two levels of coolant temperature are supplied by a single, multi-temperature radiator which reduces front-end packaging and minimizes the need for modification.

For Hybrid and Electric Vehicles with a range extender, the ability to simply add components such as the DC/DC inverter, electric motor and battery charger to the low temperature cooling loop via a distributor valve allows for the use of the same cooling architecture for ICE, Hybrid and Electrical Vehicles without modification.

During the plug-in battery charging phase, the cooling system is fully operational in order to protect both the charger and battery. A specific fan motor, able to operate at very low speeds has been developed to ensure long life and quiet operation.

UltimateCooling™ Benefits:

- Architecture compatible and evolution of ICE, Hybrid and Electric Vehicles.
- Improved operating range in electric mode.
- Plug and play architecture.
- Reduction of Front End packaging.
- Fan system life time and noise improvement.

UltimateCooling™ Architecture has already been chosen by 2 European OEMs for their future Hybrid and EV models.

Air-conditioning system in electric vehicles: comfort without compromise

Replacing internal combustion with an electric powertrain must not be detrimental to safety and comfort. In particular concerning thermal comfort, the climate system must still provide its occupants with controlled hot or cold air, whatever the outside temperature.

Unlike a combustion-powered vehicle, and because of its high performance, an electric vehicle dissipates quite few energy in heat losses. Therefore the energy necessary to heat up the cabin has to be taken from battery pack. With the current technology based on PTC elements, the energy necessary to heat up the cabin is so important that it will reduce considerably the vehicle's autonomy in extreme winter conditions. For this specific problem, Valeo is developing solutions ensuring thermal comfort identical to that of an internal combustion vehicle: Rapid thermal comfort for each passenger, and optimum visibility with efficient de-misting.

Complementary innovative heating solutions

Valeo offers innovative heating solutions which should soon replace PTC heating. The first involves the use of a heat pump, which is obtained by reversing the A/C loop cycle thanks to electrovalves. The refrigerant is sent at very low temperature into the heat exchanger on the vehicle's front-end. It is a first time heated up by pumping energy from the ambient air before receiving a second time mechanical energy as it crosses the compressor. This way the temperature of the refrigerant is brought up to at least 50°C, and it can heat the vehicle's cabin. Thanks to the free heating energy brought in by the outside air, this system reduces the energy consumed by the vehicle's battery considerably. This new cycle does however require some specific new components to be developed. The exchanger in the front-end must operate at the same time as both evaporator and condenser, while avoiding the formation of ice. The compressor must also deliver very high compression ratios. Possible derivates of this base heat pump system require other specific heat exchangers, and these are currently developed by Valeo.

Another solution involves recovering heat from other sources. Even if the electric motor offers a very high performance, water cooling is necessary in order to ensure that it operates under all conditions of use. Rather than cooling it by evacuating heat to the outside, its water circuit may be connected to the heating system and may thereby help heat the vehicle interior without drawing excessively on the batteries' energy. The power electronics and the batteries may also be fitted with a heat-recovery circuit containing water or refrigerant. It is also possible to recycle some of the heated air in the cabin rather than evacuating it all towards the extractor outlets.

Valeo's air conditioning system also offers additional functions, such as heating and cooling of batteries, or cabin pre-conditioning.

Advantages for the carmaker

- Thermal management for the cabin and auxiliaries (batteries and power electronics).
- Reduced electric consumption while still maintaining comfort levels.
- Reduced battery energy dedicated to thermal management.
- System compatible with different types of refrigerants.

Advantages for the user

- Comfort levels maintained, in terms of both speed and power of heating.
- Reduction in electric consumption.
- Pre-conditioning as an option.

Thermal management of batteries

An electric vehicle's autonomy and performance depend for a large part on its battery. The capacity to store and restore energy, the battery lifetime and the available power depend significantly on thermal management. Valeo offers a wide range of technologies covering all market applications (hybrid vehicles (mild and full) and electric).

Air cooling

Thermal management of the battery is handled by a module which distributes air from the cabin uniformly across the battery pack. For increased cooling, it is also possible to cool-down air with a dedicated evaporator connected to the A/C loop.

The fan is powered by a high-efficiency brushless motor, and its air flow can be varied through voltage control. This brushless technology eliminates any risk of sparks near the batteries. In order to reduce cabin temperature before starting up the vehicle, the fan can also "pre-cool" the cabin in hot weather, with low electricity consumption.

Benefits

- Improved lifetime and performance of battery pack (NiMH).
- Reliable, robust system.
- Pre-ventilation function.

Liquid cooling

The battery's cells are thermally controlled by a water circuit, cooled by the vehicle's A/C loop. This circuit passes through a water/refrigerant exchanger connected in parallel with the evaporator on the primary A/C loop. In winter conditions, the air-conditioning system is not required to cool the batteries. The water circuit is then diverted towards a low temperature radiator, which disperses the heat directly into the ambient air.

Benefits

- Improved battery (NiMH) reliability.
- Optimum battery performance maintained over time.
- Performance adaptable for new generations of lithium-ion battery.
- Compact system.

Direct cooling

An evaporator is built into the battery module and connected in parallel to the vehicle's conventional air conditioning circuit. This evaporator is in direct contact with the cells of the battery pack. Such a structure ensures direct heat exchange with the cells, and perfect homogeneity of the temperatures inside the pack.

Benefits

- Enhanced battery (Li-ion) reliability.
- High-performance cooling.
- High uniformity of cooling between cells.
- Compact system not requiring a secondary loop.

Cooling through thermoelectricity

The battery cells are cooled using a module containing Peltier cells. When applying voltage to these cells, one side becomes hot while the other side becomes cold. The difference in temperature is controlled by the voltage applied to the cells. By using the cold side or the hot side, it is possible to cool down or heat up the batteries.

One advantage of this system is that it is totally autonomous from the vehicle, apart from the electric connection. It is, for example, particularly well-adapted to the concept of rapid battery quick dropping in order to avoid long stops during the recharge time of the battery.

Benefits

- Autonomous system, independent of a cooling system connected to vehicle.
- Ideal system for quick dropping.
- High reliability of the Peltier module.
- Reversible system enabling heating of batteries.

Thermal Systems

valeo added™

Air quality in the cabin

Valeo offers solutions that increase in-vehicle comfort
by purifying and improving the quality of air in the cabin.

Air pollution

Motorists are becoming increasingly demanding when it comes to the quality of air in the cabin. Many of them spend a lot of time in their vehicle, where the air quality is often deteriorated by pollutants from different sources. The air can contain unpleasant smells, allergens, pollutant gases and particles from different combustions.

Surveys have shown that the quality of air inside a vehicle can be from two to five times worse than that of the air outside.

Broad product range from Valeo

Valeo proposes several filtration technologies that keep the air in the cabin healthy and pleasant. By filtering out different types of pollutants, our solutions protect the occupants and improve their well-being through the addition of innovative functions.

The first level of air purification proposed by Valeo is a filter protecting the occupants against particles measuring between 0.5 and 10 microns that are present in the air in urban areas. This product is already widely available on the market, but new research and development projects are underway to improve its performance with submicronic particles.

The second level of purification involves a combined filter that filters particles and provides protection against pollutant gases and odors, thanks to a layer of active carbon. These two kinds of filter can be supplemented with an anti-allergen function by applying a natural surface treatment that deactivates the allergens that are present in the air during periods of pollination.

A collaborative project has also been launched with a carmaker and research laboratories, in order to increase the level of filtration and the range of pollutants and odors eliminated by the combined filters.

An air purifier is also available. This self-contained module filters out particles, gases and odors. It includes a positive and negative ion generator that makes the air healthier by reducing the number of bacteria in the cabin. This ion generator can be integrated in the air conditioning system or used alone.

In addition to these air purification systems, Valeo also offers a fragrance dispenser to further improve the comfort of the occupants. This new system, which is separate from the air conditioning, includes two perfumes and an intensity control.

Advantages of Valeo's cabin air quality products

Advantages for the carmaker

- A broad range of specific filters: particles, pollutant gases and allergens.
- Innovative, high added value products:
  - fragrance dispenser that creates an unique olfactory atmosphere in the cabin,
  - An air purification module that improves the quality of air in the cabin by reducing concentrations of particles, gases and bacteria.

Advantages for the user

- A complete range of filters for the different pollutants present inside vehicles.
- Value added products that further improve on-board comfort.

High-performance air conditioning

Valeo's high-performance air conditioning cuts overall vehicle consumption by 3%.

Air conditioning consumption

The need to reduce consumption and CO_2 emissions does not only concern the powertrain. Every item of equipment in the vehicle can make a contribution. Depending on the model, an air conditioning system that is used intensively can consume between 5 and 12% of the engine's power. A more efficient system, generating the same amount of cold while consuming less, would be especially beneficial.

A 30% drop in absorbed energy

As a worldwide specialist in automotive air conditioning systems, Valeo can enable automakers to cut power absorption by 30% in comparison with existing systems. As a result, fuel consumption and CO_2 emissions can be reduced by 3%.

This performance is achieved by using new components that are managed by innovative control algorithms. The air conditioning system features a number of advanced components, including an adaptive expansion valve, a high-performance evaporator and a high efficiency internal heat exchanger. A variable-displacement compressor with improved efficiency is also used.

Operating principle

The control algorithms in a dedicated controller guarantee optimal operation under all circumstances: quick cooling of a very hot cabin, maintaining a comfortable temperature, demisting, etc. This smart control system relies on new algorithms. For example, the smart management of the electric fan limits power consumption to the strict minimum. The system is also equipped with a temperature sensor at the compressor outlet, which can be used to apply optimization algorithms to a new system.

Valeo has also improved the performance of its compressor with seven axial pistons. The cubic displacement can be varied from 0 to 170 cm^3 and the external control of the inlet pressure delivers just the right flow for a given situation. This solution avoids the unnecessary generation of cold. Efficiency has also been boosted by a design that includes an oil separator and improved discharge valves.

The refrigerant loop features a plate internal heat exchanger insuring thermal exchange between evaporator outlet and condenser outlet. Thanks to its high component efficiency, this internal heat exchanger increases the cooling power and improves overall A/C system efficiency.

Lastly, the HVAC unit is fitted with a high-performance evaporator made up of die cut alloy plates and square based inner fins that form a micro-channel-structure (cross counter flow principle).

On top of this a new adaptive expansion valve under development allows a continuous optimization of the set point of the A/C loop whatever the ambient and the driving conditions. This leads to a system efficiency which can be increased up to 40%, especially in low thermal loads.

Advantages of High-performance air conditioning

Advantages for the carmaker

- A 30% drop in absorbed energy:
  - Reduced consumption and CO_2 emissions, less weight and more compact thanks to the reduced sizing of the compressor and the drive mechanisms,
  - Or enhanced comfort thanks to the improved performance of the air conditioning system.
- Improved efficiency for R134a technology or HFO1234yf.

Advantages for the user

- 3% reduction in vehicle consumption.
- 3% reduction in CO_2 emissions.
- Improved comfort.

Exhaust Gas Recirculation (EGR)

Valeo, European leader in Exhaust Gas Recirculation systems, offers new solutions in emissions reduction.

Emissions reductions are necessary

Diesel engines offer lower fuel consumption and CO_2 emissions as compared with gasoline engines. The rejected pollutant gases - carbon monoxide (CO) and unburnt gas (HC) - are reduced by optimal combustion and post-treatment in a catalytic converter and self-regenerating particle filter. However, higher levels of nitrogen oxides (NO_x) are emitted by diesel engines with most countries now lowering the maximum legal level of these emissions.

A tried and tested solution

Valeo's Exhaust Gas Recirculation (EGR) is an efficient, cost-effective system for reducing NO_x. The high-pressure EGR loop takes part of the exhaust gases at the cylinder head outlet and re-injects them into the air intake. The main benefit is that NO_x is reduced at the source by limiting the quantities formed in the combustion process rather than by post-treating the gases. The result is a cleaner combustion process.

The system uses an electric valve, which fully or partially opens the recirculation circuit depending on the operating phase of the engine. The valve is driven by a powerful electric motor that will reliably operate even under the severe constraints imposed by temperature and a highly corrosive environment. The maximum throughput is high and the control of the valve position allows the recirculation rate to be precisely adjusted. The system works in association with an electric throttle valve on the intake side that reduces the quantity of intake air. It is completed by a heat exchanger between the recycled gases and the engine's cooling circuit, which lowers the temperature and increases the mass flow, thereby increasing the reduction of NO_x. The quantity of cooled gas is controlled by a bypass choke included in the system between the EGR valve and the exchanger.

Another of Valeo's advanced projects is a low-pressure EGR loop which increases the mass flow of recycled gases to enable the OEM to achieve Euro VI without post-treatment for most vehicles. Unlike high-pressure architectures, in which the gases are recovered before the turbo turbine where pressure is high, the low-pressure loop takes gases after the turbine and after the DPF where the pressure is lower. Valeo has designed and developed specific components such as a three-way valve on the intake side and a high efficiency EGR cooler with low pressure drop that enables this kind of architectural innovation.

An innovative application for supercharged gasoline engines is also being developed. The use of this system will be paramount for the future of this type of engine: EGR will reduce fuel consumption and carbon dioxide emissions by around 7-8%. These reductions are the result of lower combustion temperatures, which allow a higher engine compression ratio.

As a leader in this field, Valeo has a complete range of competitive solutions based on high- and low-pressure architectures for gasoline and diesel engines. These solutions can meet the most challenging of automakers' demands in terms of cost, quality and reliability.

Operating principle

The new electric EGR valve is made up of an electric motor, gearing, a cam system, a valve and a position sensor. With a high-power DC motor, the valve can be fully opened or closed in just 100 and 75 milliseconds respectively. One of the system's most distinctive features is the progressive cam-driven control device that converts the rotary movement of the engine into a controlled downward travel of the valve. The cams can be used to address several priorities according to valve travel.

Firstly, the valve's opening mechanism must be very reliable. In a highly corrosive environment, there is a danger of the valve being jammed by soot deposits or oil combustion residues. The rotation/travel ratio of the cam increases the thrust force by significantly gearing down the movement. Once the valve is open, the second priority is the speed of travel of the valve. The gradient of the cam is then gradually increased. The cam also ensures that the valve can be closed tightly and quickly. The cams are linked to the valve by two bearings that eliminate friction and risk of seizure.
Valeo has opted for an outward-opening valve for greater dependability since the high exhaust gas pressure generated by a turbocharger applies a force that tends to close the valve. Pressure loss in the gas recycling circuit is low thanks to the clearance area, the aerodynamics of the valve head, and the small diameter of the shaft. This property is especially important when idling and with very low loads. A Hall-effect sensor precisely measures the position of the valve. This is an important point since a precise recirculation rate reduces the flow tolerances and, importantly, enables the engine to meet the Euro V standard which comes into force in 2009.
The capacity to cool the exhaust gases is another major factor contributing to the reduction of NO_x and Valeo has succeeded in improving the heat exchange capacity with the engine coolant. The round corrugated tubes developed for Euro IV have been replaced by flat corrugated tubes to meet Euro V and Euro VI emission standards. This increases the heat exchange surface, resulting in thermal efficiency of 85% and a reduced exhaust gas pressure drop. The U-shaped heat exchange circuit reduces the dimensions of the part. The gases can bypass the cooler via a pneumatically controlled flap. This function is essential for Euro V-compliance and is useful after engine cold start, when the temperature in the combustion chamber must increase quickly in order to minimize HC and CO emissions.

Specific technologies are developed for Euro VI and gasoline applications.

NO_x reduction in detail

High quantities of nitrogen oxides are produced during combustion at high temperatures with excess air. Consequently, both of these parameters must be reduced. By recycling part of the exhaust gases into the intake, the mass of intake air is reduced, as are the quantities of oxygen and nitrogen available for combustion. Lower quantities of oxygen also help to lower the combustion temperature. The heat exchanger, which is cooled by the engine's coolant, increases EGR rate. The EGR gas density can be further reduced by incorporating the UltimateCooling™ concept, which is capable of further lowering the temperature of the coolant and consequently the EGR temperature whenever necessary.

EGR Valve Advantages

Advantages for the carmaker

- The EGR system avoids the need for NO_x post-treatment devices for most vehicles.
- The power of the cam-controlled electric motor offers dependability and enables the valve to be opened and closed quickly.
- The valve remains closed in the event of a malfunction.
- The U-shaped circuit reduces the dimensions of the exchanger.
- The exchanger and bypass valve are protected against high temperatures and exhaust gas surges when the EGR valve is closed (when the valve is on the exhaust side).
- The thermal efficiency of the heat exchanger is 90% with minimal exhaust gas back-pressure.
- Valeo is the only supplier of full EGR systems that include the valve and heat exchanger.
- Valeo already offers innovative solutions for increasing the rate of gas recycling in diesel engines, and cutting CO_2 emissions from gasoline engines by 7-8%.

Advantages for the user

- EGR allows vehicles to meet the requirements of the Euro V and upcoming Euro VI standards with a low additional cost, unlike post-treatment solutions.
- A forthcoming solution for supercharged gasoline engines will reduce fuel consumption and CO_2 emissions by around 7 to 8%.

Valeo is supplying Euro V EGR modules to three leading western Europe car makers. In USA, Valeo is supplying the High Pressure EGR Module for Tier 2 Bin 5 compliant Diesel European cars.

THEMIS™ electronic valve

Smart cooling enhances engine efficiency.

Improving engine cooling management

Powertrain engineers are increasingly focused on emissions reduction and fuel economy savings.
One key technology that can achieve improvements in these areas is the smart control of coolant flow and temperature.

Intelligent thermal management

Valeo has a solution that replaces the traditional thermostat. THEMIS™ (THErmal Management Intelligent System) is an electronic valve (with associated control strategies) that constantly optimizes the flow and temperature of the engine coolant under all conditions.

Located at the outlet of the engine's cooling circuit, it regulates the flow of the engine cooling radiator, the bypass and the cabin heating circuits. The movement of the valve is controlled by an electric motor and a position sensor.

Predictive software is used to accurately control the temperature of the coolant within a narrow band. This optimizes the operation of the engine, particularly during the transition phases. THEMIS™ also improves the cabin heating and can maintain cabin thermal comfort even after the engine has stopped. Furthermore, the air conditioning becomes more efficient with benefits on comfort and fuel economy.

Operating principle

A variation in heat dissipation is anticipated by using a rapid-response valve and an intelligent control algorithm. A conventional wax thermostat is controlled by the temperature of the coolant flowing through it and does not react to the powertrain's immediate needs, sometimes resulting in an operating lag. With THEMIS™, the opening and closing of each circuit is managed by predictive controller software developed by Valeo, which takes into account the vehicle operating conditions. The system adjusts the flow based on engine need and conditions. It also incorporates a closed loop to correct minor fluctuations.

The valve's control maintains an optimum temperature (110°C at low load, for example) while limiting the deviations to ±2°C (compared to ±7°C with a conventional thermostat). The valve opens in less than 1 second as opposed to 20 seconds with a standard thermostat, thus improving engine performance. At high load, the temperature is set lower at 90°C to minimize knocking, improve combustion and reduce temperature stress. Additionally, the oil temperature and viscosity are controlled more accurately, resulting in lower friction-related energy losses.

Other engine functions are also improved. "Zero flow" mode is provided when the THEMIS™ valve completely closes all circuits. This mode is used on a cold start, enabling the temperature of the combustion chamber walls to rise rapidly and improve heat transfer to the engine oil. Test results on a gasoline engine have shown a 30°C rise in temperature of the cylinder head metal in the first few seconds after engine start. Unburned hydrocarbon and carbon monoxide emissions, along with engine oil dilution with fuel, are therefore reduced.

The THEMIS™ valve has the added benefit of a considerable improvement in cabin comfort. Hot coolant normally passes continuously through the heater core in the air conditioning system resulting in parasitic thermal waste that reduces the air conditioning's performance in the summer. However, the THEMIS™ valve closes the hot coolant circuit to the heater entirely when not needed. A reduction of up to 5°C of air temperature has been measured. While improving passenger comfort, this also reduces the effort demanded from the air conditioning compressor, thereby generating fuel savings.

The THEMIS™ valve, used in conjunction with a low-powered auxiliary water pump in the cabin comfort circuit, can assist in maintaining lower coolant temperatures during temporary stops after driving at full load for some time. Problems linked to engine overheating are avoided, as the engine is cooled by coolant that continues to circulate through the radiator.

Advantages of THEMIS™ Valve

Advantages for the carmaker

- Engine efficiency is improved by maintaining the coolant temperature at 110°C when the engine is running at lower loads.
- "Zero flow" mode accelerates the engine's temperature rise when cold, reducing the production of pollutants.
- The coolant temperature is adjusted according to the engine's load, and is 90°C when heavily loaded. CO_2 reduction of 3 to 5% has been measured along with a reduction of 10% of HC and 20% of CO on MVEG cycle.
- The THEMIS™ valve improves engine and cooling system reliability:
  - The engine does not overheat if switched off after a long period at full load, at the top of a hill, for example;
  - The risk of spark knock is reduced due to the speed of the THEMIS™ valve's action;
  - Engine thermal shocks are eliminated;
  - Radiator thermal shocks are eliminated.
- By closing the cabin heating circuit, the air conditioning compressor's and water pump's workload is reduced. The air conditioning compressor and the water pump can both be downsized.
- The THEMIS™ valve facilitates effective heating in hybrid vehicles and Stop-Start vehicles.
- The THEMIS™ valve is easy to install in the engine's water outlet unit.

Advantages for the user

- Fuel consumption is reduced due to improved engine temperature management.
- CO_2 emissions are reduced as a result.
- Engine and radiator reliability is improved.
- The cabin is heated more rapidly after the engine is started up in winter during urban driving conditions.
- Air conditioning is more efficient.

UltimateCooling™ System

UltimateCooling™ reinvents the vehicle's thermal architecture.

Cumbersome cooling systems

Balancing the cooling needs of comfort functions, engine efficiency and reliability, and the transmission of considerable power requires an increasingly complex and bulky architecture. As a result, the cooling module located in the front end can include up to four heat exchangers: oil and water radiators, charge air cooler and an air conditioning condenser.

Further to this, new regulations such as Euro VI, downsized engines, and the introduction of Hybrid powertrains have created a need for dual temperature cooling architectures.

This adds considerable weight and takes up a lot of space, while cooling is poorly optimized, undermining vehicle efficiency and cabin comfort.

Reinventing cooling architecture

Valeo's new UltimateCooling™ concept utilizes a single coolant fluid for all heat exchangers, limits the number of components in the front end, and improves thermal flows. The idea is to cool all the heat exchangers – either with the normal hot loop, or with an additional cold loop – and to locate them as close as possible to the part that needs cooling.

An electric water pump, coupled with a valve (if required), provides the coolant flow according to the required uses and priorities. The cold loop feeds the charge air cooler located at the cylinder head intake, the fuel cooler and the air conditioning condenser. The hot loop is responsible for cooling the liquid circulating in the cylinder block and the cylinder head, the engine and/or transmission oil, and heating the cabin. The exhaust gas recirculation (EGR) system cooler and other additional systems may be connected to either of the loops, according to the specifications of the carmaker.

By design this architecture is fully compatible with Full-Hybrid or Hybrid-Plug-in vehicles, using the low temperature loop to cool the DC/DC converter and the electric motor.

The hot and cold loops are cooled either by a single dual-circuit radiator or by two separate radiators, making them both more efficient and more compact. Therefore, the circuits require less space in the vehicle's front-end, which will help to meet future pedestrian impact standards and reduce the number of refrigerant gas leaks and repair costs in the event of front-end impacts.

Operating principle

The sizing of conventional cooling circuits is based on extreme use scenarios. The air conditioning system's condenser is sized for operation when idling and/or at low speeds, whereas the engine's radiator and the charge air cooler are sized for driving at maximum speed or towing a trailer in mountainous conditions. A single coolant is used to 'share' the capacities of all front-end heat exchangers, and thereby improve their efficiency. UltimateCooling™ reduces the volume of the thermal management system while providing equal or increased performance for equal volume.

UltimateCooling™ can give priority to cooling the air conditioning system's condenser during startup conditions, or the engine in hot weather (to cool down the vehicle) and as such will exploit the heat exchanging capacity of both radiators. Similarly, when considerable torque is required, the charge air cooler will utilize the heat exchanging capacity of both radiators.

The cold loop's architecture within the vehicle allows optimal positioning and simplified arrangement of the various heat exchangers, and reduces the volume of the hoses transferring liquids from the engine to the chassis.

The cold loop can also provide efficient cooling for the electronics and motor-generators of hybrid and fuel cell vehicles.

It is also possible to adjust the UltimateCooling™ system's efficiency by means of a control valve between the hot and cold loops. In certain cases, only part of the high-temperature radiator will be required to cool the engine (during urban and highway driving or when ambient temperature is below 35°C, conditions frequently experienced when driving a vehicle), leaving the rest of the radiator's potential to cool other functions.

For Hybrid powertrains, the cold loop will be maximized during period of high electrical consumption to lower the electrical expenditure.

Lastly, a reduction in the number of heat exchangers in the front-end of the vehicle reduces the depth and height of the module, facilitating compliance with "pedestrian impact" standards. In a middle-range prototype produced by Valeo, the maximum depth is reduced from 118mm to merely 50mm with a multi-temperature radiator or 60mm with two radiators, and the total volume of the cooling systems is reduced by 22%.

Advantages of UltimateCooling™

Advantages for the carmaker

- The intake air cooling system is more efficient. Its circuit is shorter, which reduces the transitory response lag under acceleration, while the pressure loss between the charge air compressor and the intake manifold is also minimized.
- Engine performance is increased and pollutant emissions are reduced.
- The improved efficiency of the charge air cooler and the air conditioning condenser increases the vehicle's overall energy efficiency. Fuel consumption can be reduced by up to 6% in an MVEG mixed cycle with the air conditioning operating.
- The multi-temperature radiator reduces the front-end module's dimensional requirements by 40% and maximum depth requirements by approximately 50%.
- The possibility of relocating the condenser reduces the risk of coolant leaks in the event of front-end impacts, representing a potential volume of 750g of R134a liquid that corresponds to approximately 1 ton of CO_2 in terms of greenhouse effect.
- The EGR and fuel circuits can be cooled by the cold loop.
- Architecture fully compatible with Hybrid (diesel or gasoline) powertrains, since the cold loop can also provide efficient cooling for the power electronics and electric motors.

Advantages for the user

- The UltimateCooling™ system reduces fuel consumption by up to 6% when the air conditioning is operating.
- The engine produces more power.
- In the event of a front-end impact:
  - Repair costs are reduced;
  - The risk of leaks is minimized.

UltimateCooling™ has been designed as a scalable Architecture. A first step is already in mass production at major German car makers. Several democars are running at OEMs with excellent results and the first full UltimateCooling™ car in mass production is foreseen in 2012.

Water-cooled charge air cooler

The water-cooled charge air cooler improves acceleration and reduces consumption by up to 2% compared to a conventional air-air cooler.

Improved turbocharging

Most diesels, and an increasing number of gasoline engines, are turbocharged. Turbocharging increases power for the same cubic displacement, or produces the same level of power with reduced fuel consumption and pollutant emissions. The performance of the turbocharger is improved by cooling the compressed air, which automatically improves specific power and lessens pollution.

The trend towards air-water coolers

The intake air entering gasoline or diesel turbocharged engines is traditionally cooled by an air-air heat exchanger located at the front of the vehicle. Valeo has developed a different concept for improved air cooling: an air-to-water heat exchanger in which the air leaving the compressor is cooled by a cold water flow. The main benefit is more efficient cooling, thanks to the heat capacity of water, which is four times greater than that of air. Furthermore, the intake air circuit is shorter, which reduces the engine's lag time when accelerating sharply.

The Valeo water-cooled charge air cooler's first mass-production application was introduced in the Volkswagen Golf TSI engine exhibited at the 2007 IAA Frankfurt Motor Show. The unit represents the first step towards Valeo's new global cooling concept, UltimateCooling™.

Operating principle

The water-cooled charge air cooler is made of brazed aluminum and provides considerably reduced pressure losses. It is located in the engine's intake manifold, eliminating the need for hoses between the engine and the front end of the vehicle. The reduced volume between the compressor outlet and the intake valves reduces response time when accelerating.

The time taken to reach maximum turbocharging pressure at the engine intake is cut by about 250 milliseconds at 1,500rpm, or 14%.

The charge air cooler's coolant circuit is totally independent of the engine's cooling circuit. Since its temperature is no more than 15°C to 20°C higher than the ambient temperature, this circuit is known as the "cold loop". The intake air temperature rises by less than 5°C under acceleration at full load, compared with 20-30°C for an air-to-air system, owing to its greater efficiency and thermal inertia. The coolant is then cooled by a small radiator, which is located at the front or on the side of the vehicle and fed by small-diameter (approximately 20mm) coolant hoses. The coolant is pumped by a small electric pump.

Advantages of Water-cooled charge air cooler

Advantages for the carmaker

The Valeo air-to-water heat exchanger offers many advantages over a conventional air-to-air cooler:

- More efficient cooling and low internal pressure losses.
- The efficiency of the engine is improved, because the intake air is cooler, and therefore denser, for an equivalent power consumption of the turbocharger compressor. Alternatively, the power absorbed by the compressor is reduced for the same mass of intake air.
- Pressure losses between the compressor and the cylinder block inlet are reduced. This cuts consumption, because the compressor does less work for the same mass of intake air. Here again, one alternative is to improve the engine's performance for the same quantity of work done by the compressor, thanks to increased air density.
- For the same power output, the thermal loads applied to the engine's structure are reduced, because all the temperatures in the cycle are lower. Alternatively, the power of the engine can be increased for the same thermal loads.
- The engine's lag time when accelerating is reduced as a result of the shorter distance covered by the air between the compressor and the inlet valves.
- It is easier to control the combustion parameters, because the intake temperature is almost constant.
- The unit is more compact: the cooling module in the front end of the vehicle is up to 20% smaller, and the long charge air ducts leading to a heat exchanger at the front of the vehicle have been eliminated. Installation of a turbo- or supercharged engine in the engine compartment is simplified.
- This concept simplifies implementation of the phase 2 pedestrian impact standard 2003/102/EC.
- Repairs resulting from a front impact are reduced.
- The water-cooled charge air cooler enables the introduction of future low-pressure EGR systems that can handle nitrogen oxide production more efficiently in diesel engines and the use of full-load EGR systems in gasoline engines.

Advantages for the user

- An improved engine response time when starting to accelerate.
- When coupled with the longer gear ratios accepted by turbocharged engines, the intake air cooler's improved efficiency reduces fuel consumption by up to 2%.

Valeo is supplying the Water Cooled Charge Air Cooler for the 1.4TSI Volkswagen engine, largest mass production engine equipped with a Water CAC. The Valeo Water CAC is foreseen to be implemented as the main architecture in the coming years at several OEMs.

Safe4U™ Front End Module

Valeo design sets a new pedestrian protection standard.

Vehicles that care for pedestrians

Following the technologies that have achieved far greater safety for vehicle occupants, vehicles must now provide the best possible protection for pedestrians in the event of a collision. This concerns the front part of the vehicle, commonly named Font End Module, which also must contribute to fuel savings through weight optimization, crash management and perceived quality.

Valeo expertise in Front End Module

As a global supplier of Front End Modules, Valeo proposes the Safe4U™ module designed with cooling, lighting, fascia and an optimized bumper system (Optibumper), sensors and possibly a detection system. This module is supported by a structural part called a bolster. In the Safe4U™ module, thanks to an active and reversible system, the bolster can deform in case of a pedestrian impact, and absorb the energy of impact, therefore minimizing the injuries on the pedestrian uper leg. This bolster is made of steel, aluminum, plastic or hybrid material. Valeo has perfected its use of these technologies, which are already in production for its customers all over the world.

Description of the optimized bumper system: Optibumper (passive lower leg protection)

The bumper system of the Safe4U™ module optimizes the passive protection of passengers and pedestrians.
Two cross members are designed to absorb pedestrian and frontal impacts.

- The upper cross member is in steel, supporting compressible plastic absorbers. These absorbers reduce the risk of injury to the pedestrian lower leg.
- Two plastic crash boxes are attached to the cross member. These Valeo designed crash boxes offer the same compression ratio as steel but in a reduced packaging and are also simpler to manufacture.

Optibumper architecture allows car manufacturers to meet the pedestrian protection EC regulation (CE) n°78/2009 in application in 2013 for new vehicle references, and safety standards for frontal impact IIHS, FMVSS, ECE and Allianz (USA, Asia, EU).
The efficiency of Optibumper allows to reach the maximum score points in the “pedestrian impact” section of the EuroNCAP lower leg test.
In addition, Valeo and the Safe4U™ module offer an active system that increases the pedestrian upper leg and child head protection.
This system is activated either by a pedestrian detection device, or by impact sensors localized in the front bumper. The module stiffness is adapted in order to absorb energy of impact, reducing the force transmitted to the pedestrian: consequently, potential injuries are minimized.
The system allows a reduction of 20 to 40% in pedestrian injuries.
This active system allows to reach the maximum score points in the “pedestrian impact” section of the EuroNCAP upper leg test.

Description of the active system (upper leg pedestrian protection)

Safe4U™ is a unique system developed by the Valeo front end module division engineers specialized in pedestrian protection, crash management, front structure and driving assistance.

The system is activated either by a detection device, or by impact sensors in the front bumper.

- In the case of a pedestrian detection, the system can distinguish pedestrians from other hazards thanks to a radar localized on the upper cross member and two cameras along the radiator grill. Once a risk of collision is recognized, the system activates.
- In the case where the front bumper is equipped with impact sensors, the system is activated as soon as the impact is confirmed. These sensors are also used for active hood for adult head protection.

The active system consists of two actuators assembled on the structural part of the module (the bolster). The actuators make the interface in between the upper cross member, (the hood latch support) and the two vertical members fixed on the main vehicle rails.

When the system is activated, the two actuators release the upper cross member from its supports in less than 15 milliseconds. This allows the upper part of the front end module to swing back, limiting the maximum effort and spreading it over a longer course.

The system is reversible: if the impact does not happen, the actuators move back into place and restore the front end to original stiffness.

Optibumper provides a reduction of 1,5kg (2,5kg for the whole vehicle) and the vehicle overhang is 60 millimeters shorter than a standard system.

The Safe4U™ module combines specialist expertise in many different fields: front end architecture and crash management, electronics detection, pedestrian identification, lighting, cooling, safety and actuators.

Valeo is in charge of the entire development from numerical design to validation and delivery, while meeting customer's deadline.

Safe4U™ offers vehicle manufacturers a technologically advanced product to make vehicles lighter, cheaper to repair and offer optimal pedestrian protection.

Advantages of Safe4U™

Advantages for the carmaker

- Meets the European regulation (CE) n°78/2009 for pedestrian protection, and crash norms (IIHS, FMVSS, ECE and Allianz).
- Offers the highest possible level of protection in the EuroNCAP pedestrian Impact test.
- Provides a weight saving of 1,5kg (2,5kg for the whole vehicle) and reduces car overhang by 60mm.
- Active system reaches unparalleled level of protection.
- Represents Valeo's global solution for carmakers, from design to delivery.

Advantages for the user

- Lighter weight leads to fuel savings and reduced CO_2 emissions.
- Lower repair costs.
- A level of pedestrian protection never reached before (Active system).
- Reversible system (active system) with no impact on vehicle handing.

Visibility Systems

valeo added™

BeamAtic® Premium: The Breakthrough in Lighting Technologies

Optimal visibility when driving in the dark and in all driving situations without glaring other road users.

Driving in Dark

Despite the fact that traffic volume at night is much lower there is a relatively large risk for accidents and especially for fatalities. Recent studies prove that drivers tend not to use the high beam sufficiently mainly due to their concern of glaring oncoming or leading cars. Another reason for the insufficiently use of high beam is the effort of manual switching. Lighting automation is the key solution for both problems.

New advanced lighting systems, based on camera technology contribute to improved visibility at night and thus reduces significantly the risk of accidents.

Automation of high beam switching

Thanks to the Valeo BeamAtic® system the switching between high beam and low beam is done automatically. The new high beam assistant will take over the switching task as soon as an oncoming vehicle appears or a car is driving ahead. The camera monitors the road and leads the fully automated switching operation. As a result of an independent Car Clinic (60 drivers, 3.400km) the average high beam usage was merely at 8% where as with Valeo´s high beam assistant the usage is increased by a factor of 4,7 compared to traditional switching.

The breakthrough: The adaptive driving beam pattern

The further development of BeamAtic® is a camera based advanced high beam assistant, the BeamAtic® Premium system. The vehicle keeps high beam switched on permanently without glaring other drivers; the maximal light is maintained on the road with the exception of the zone where the other vehicle is located.

With this innovation Valeo brings a remarkable gain of safety in night-driving. The permanent high beam usage allows the driver to better anticipate the potential dangers, for example an obstacle or pedestrian on the road.

The system adapted to Xenon headlamps will be on the market in 2010. In the future the system will also be available with other light sources which are under development. The BeamAtic® Premium function is the latest outcome of the developments done by Valeo following the lighting automation roadmap. Valeo is unique in combining both core competences in front camera and advanced lighting technologies. The front camera is an enabler for this breakthrough technology and of course can also be used for other front applications such as Traffic Sign Recognition and Lane Departure Warning. All intelligent front lighting systems are based on the compact CMOS-Multifunction Camera and are all modularly designed.

BeamAtic® systems are equipped with a predictive levelling function which ensures that the light is always on the road avoiding glaring of oncoming vehicles while passing hills or slopes.

Valeo conducts surveys to analyse end consumer expectations and measure the acceptance towards innovative Driving Assistance Systems on a regular basis to have a better understanding of the market and to be able to support the OEMs by choosing the most suitable technologies. These studies were conducted world wide each year. They combine socio cultural trend analyses, online questionnaires as well as focus groups.

The main result that overlaps all surveys is the strong requirement for enhanced visibility. According to recent surveys the acceptance of innovative advanced lighting systems are at 50% and higher.

Operating Principle

In high beam each of the headlamps generates a cone of light. With an oncoming or leading car, the BeamAtic® Premium system maintains these cones of light while placing a mask in the zone represented by the vehicle in the scene. This vehicle is then in a non glaring dark zone. The system follows the trajectory of this vehicle allowing to maintain as much light as the driver would be driving with high beam.

The detection and localization of the oncoming or preceding vehicles are assured by a camera and powerful image processing software.

BeamAtic® Premium also includes advanced lighting functions (AFS) as the so called "Tourist mode" option allowing to drive with a lighting system in left hand drive countries.

Advantages of BeamAtic®

Advantages for the carmaker

- BeamAtic®, BeamAtic® Plus and BeamAtic® Premium innovations are highly attractive to end consumers.
- The exterior dimensions of the headlamps remain unchanged.
- The safety image of the brand is enhanced by the inclusion of new lighting technologies.
- The camera can also be used for other functions.

Advantages for the user

- BeamAtic® Plus and BeamAtic® Premium provide optimal lighting without dazzling other motorists.
- BeamAtic® multiplies the use of high-beam lights by five.
- Better lighting reduces the risk of an accident and makes the driving task more relaxed.

LED daytime running lights

Valeo's LED daytime running lights provide fuel savings of 0.2 liters per 100km compared with low beams.

Improved safety and energy savings

Daytime lights offer undeniable benefits by allowing drivers to spot other vehicles more quickly and more distinctly. Their use will be mandatory in all light vehicles throughout Europe from 2011 onwards. Low-beam lights, which could be used for the same purpose, are designed for night vision and are far too powerful for daytime use. Intensive use of the low-beam lights would increase fuel consumption and shorten the lifetime of the bulbs.

A dedicated function

Valeo has developed a dedicated function that uses Light Emitting Diodes, or LEDs for daytime use. LED daytime lights require no maintenance throughout the vehicle's lifetime and their reduced power requirements cuts fuel consumption by about 0.2l/100km. The recent Audi A5 is fitted with a Valeo daytime lighting system made up of nine LEDs, installed at the base of the front optical units.

Operating principle

The LEDs used for daytime lighting consume just 10 to 20W, compared with the 200W consumed by current low-beam lights using H4 bulbs. This significant reduction in power consumption leads to fuel savings of about 0.2l/100km.

LEDs last four times longer than H4 bulbs, and as long as the vehicle itself, making them ideally suited to intensive use.

Advantages of LED daytime running light

Advantages for the carmaker

- Reduced fuel consumption and CO_2 emissions.
- The design of the LEDs and their easy installation leaves the designer plenty of freedom.
- They give the vehicle a high-tech image.

Advantages for the user

- Vehicles are more visible for other road users during the day.
- Very low consumption of electricity compared with low-beam lights, resulting in fuel savings of almost 0.2l/100km.
- Much longer-lasting than conventional bulbs.
- Customization of the vehicle.

Economical, low-beam LEDs

LED lighting (Light Emitting Diodes) helps reduce fuel consumption and carbon dioxide emissions.

Lighting uses electricity

Lighting is rarely mentioned when the subject of fuel savings arises, but the two 60W halogen bulbs are powered by the alternator, which takes mechanical energy from the engine, which in turns increases the vehicle's fuel requirement.

Low-beam LEDs

An LED unit of just 20W can replace a 60W halogen low beam, for an equivalent amount of light. By 2015 a new development will cut this figure to a mere 15W. If this unit is used just 20% of the time, it will reduce carbon dioxide emissions by 0.66g/km in mixed driving cycles. Similarly, a vehicle using LEDs for all lighting functions (DRL, low beams, turn signals, positions lamps and brake lights) would save around 3g of carbon dioxide per kilometer.

The intensity of the LEDs can in some cases be momentarily reduced, in very heavy traffic for example, when the vehicle is moving slowly, cutting energy consumption even further. This applies, too, when a hybrid vehicle is in electric mode. This option cannot be adapted for halogen bulbs, which turn reddish when the voltage is reduced.

LEDs

LEDs: a lighting revolution... In addition to requiring very little energy, LEDs have a lifespan equal to that of the vehicle itself, or four times as long as traditional halogen bulbs. They provide whiter light, which is more comfortable for human eyes, being closer to daylight, and offer increased styling possibilities for vehicles, both by day and by night, with a unique and innovative visual appearance.

Advantages of low-beam LEDs

Advantages for the carmaker

- 0.66g/km cut in carbon dioxide emissions.
- No need to change the bulb during car life; LEDs last at least as long as the vehicle.
- Increased styling possibilities for the vehicle, both by day and by night, enabling a signature look to be created for a brand or model.
- Modulated energy requirement according to need for light intensity.
- Bending Light Systems without mechanical movement: lighting in bends, junctions, city driving, range, etc.

Advantages for the user

- Reduced fuel consumption and carbon dioxide emissions.
- Improved visual comfort, with light closer to daylight than that provided by halogen bulbs.
- Lifespan as long as that of the vehicle.
- Innovative styling and image.

Xenon lighting

Xenon lighting is the only technology currently available that is capable of improving night vision on a large number of vehicles.

The need to improve night lighting

Visibility is an essential part of road safety. So it comes as no surprise that the accident rate (the number of accidents compared with the number of vehicles on the road) is higher at night. In fact, statistics indicate that it is three times higher. And as people age, average visual acuity and resistance to fatigue when driving at night both drop. It is therefore vital to use the best available lighting technology.

Xenon lighting increases visibility by 30%

Xenon lights stand out for their exceptional efficiency. Xenon low-beam lights effectively illuminate the road for 110 meters, compared with 80 meters for traditional technologies: an increase of more than 30%. At 110km/h, these additional 30 meters of illuminated road give drivers one extra second to react to an obstacle. And Xenon bending lights offer a gain in visibility of 44%.

A study conducted in Germany in 2007 by TÜV Rheinland looked at the correlation between the probability of having an accident at night (as opposed to during the day) on the one hand and at the Xenon take-up rate for the vehicle type on the other. The results speak for themselves. The number of fatalities on German roads could be reduced by 18% if all cars were equipped with Xenon lights. This kind of light could probably save as many lives as ESC, the electronic stability control system. Not only are they more powerful, but Xenon lights produce a light that is close to natural daylight. The same TÜV survey concluded that Xenon lights could prevent 60% of accidents that happen at night on country roads.

Moreover, Xenon lights are one of the few accessories that improve safety, consumption and greenhouse gas emissions. Because they consume less electricity, they cut fuel consumption by up to 0.05l/100km and reduce CO_2 emissions by 1.3g/km (figures taken from a CLEPA press release published in September 2007).

Finally, the visible presence of a lens and the bluish light produced by Xenon bulbs provide stylists with plenty of freedom for creative expression.

Operating principle

Xenon lights are made of two electrodes enclosed in a bulb containing high-pressure Xenon, metal salts and halides. The originality of this technology is that the light source is not created by heating a filament, but by an electric arc between the two electrodes. A high voltage generated by ballast is needed to create the arc. The same principle is used to ignite neon strip lights.

Once the arc has been created, the voltage of the ballast is maintained at 85V. This filament-free technology means that Xenon bulbs are capable of lasting as long as the vehicle.

Advantages of xenon light

Advantages for the carmaker

- Possibility of offering their customers the best lighting technique that is currently available on a large scale.
- Hi-tech image of the front end of the vehicle.
- Greater styling possibilities.

Advantages for the user

- Better lighting that reduces the risk of an accident:
  - Lighting distance of 110 meters, compared with 80 meters with low-beam lights, which gives drivers one extra second to react at 110km/h;
  - Visibility gains of at least 44% with Xenon bending lights.
- A light that is close to natural daylight and is easier on the eye.
- Fuel consumption cut by up to 0.05l/100km, which represents 1.3g/km of CO_2.
- The bulbs last as long as the car.

AquaBlade®

When invisible means visible.

Permanent visibility is essential for driving safety

Rain or shine, day or night, full road visibility is essential for safe and comfortable driving.

To keep the windshield clean and transparent in all conditions, all cars on the road are equipped with windshield wiping and washing systems.

In the traditional windshield washing system, a washer fluid is projected through nozzles situated on the cowl panel or the hood of the vehicle, then wiped out by wiper blades. Since this cycle takes up to 1.5 seconds, the driver would travel up to 21m at 50km/h without a full visibility. This is far too long in cities where constant attention to pedestrians and road traffic is required. On highways, the driver would travel 54m at 130km/h with impaired visibility in the same period.

The fluid flow through nozzles is affected by the surrounding air flow or the vehicle speed. The fluid would spray over the car roof when stationary, and not reach the entire windshield when traveling at a high speed. Consequently, a significant amount of fluid is wasted. This problem is aggravated by the recent evolution of vehicle styling with large windshields, for which the position of nozzles is a real issue for OEMs.

A breakthrough innovation from Valeo

The AquaBlade® technology is Valeo's answer to ensure a permanent visibility in all conditions and to provide the OEM with effective windshield cleaning solutions and styling freedom.

With AquaBlade®, the washer fluid is distributed evenly along the entire length of the blades and wiped out immediately. The washer fluid becomes totally invisible and no longer impairs the driver's visibility.

With AquaBlade®, the washer fluid is distributed perfectly when and where it is required. There are no more problems for cars traveling at high speed or in a big wind. Large windshields can be cleaned easily. Convertible and open-roof drivers are assured to stay dry when cleaning the windshield.

Thanks to the efficient use, the washer fluid consumption is reduced by half. There would be an opportunity for car makers to reduce the reservoir size or to increase the autonomy. For example, by halving the size of a typical 4-litre reservoir, a mass reduction up to 2kg can be achieved, equivalent to a CO_2 emission reduction up to 0.2g/km.

Thanks to AquaBlade®, the driver can now enjoy a full visibility at all times, whilst contributing to the better environment.

Operating principle

The AquaBlade® System is the fruit of Valeo's incessant innovation in wiping and washing systems.

The system receives a command from the driver, activates the washer pump and the wiper motor in a synchronized manner. The washer fluid is conveyed and distributed through the blades with integrated tubes, and wiped out as soon as it is deposited onto the windshield. To achieve the optimum performance, the system takes into account blade position signal from the wiper motor, and calculates the precise timing to activate the washer pump.

The AquaBlade® System is designed to work with standard washer fluids and to withstand frost in the same way as the traditional system.

Advantages of AquaBlade®

Uncompromised safety

- Permanent visibility for driving safety.
- Efficient windshield cleaning regardless the vehicle speed, the blade length and the windshield size.

Visible innovation

- Easy-to-understand, simple-to-use innovation with high consumer perceived value.

Environment & economy

- Mass reduction for CO_2 reduction of up to 0.2g/km.
- Reduced washer fluid consumption.