

With Model Year 2013, Lamborghini is reinterpreting the concept of reduced fuel consumption according to the spirit of the brand: effectiveness, lightness, and no compromises on performance.

The package of measures introduced by Lamborghini on the MY 2013 Aventador (from 398 to 370 g/Km of CO₂ emissions on the NEDC cycle, which is 7% less than the previous MY and up to 20% less at highway speeds) combines lightness and effectiveness without requiring compromises in performance or limitations on the maximum RPM allowed for the L539 V12 engine.

Start and Stop.

This system shuts off the engine when the vehicle is stopped and there is no need to let it idle (for example, to operate the air conditioning system or recharge the battery).

Engine shutoff.

Using the CAN communication network, the electronic control units responsible for the safety and status of the vehicle send a signal that shuts off the engine when it is not absolutely necessary, thus lowering the consumption of fuel.

The engine stays off (in the OFF mode) until one of the control units requires it to be restarted (for example, because the temperature in the passenger compartment is rising, and the air conditioning compressor must be operated to maintain comfort).

Restarting: the World Debut of the C-Box.

The revolutionary approach taken by Lamborghini becomes clear when the powerful 6.5 liter V12 engine must be restarted by its 2.4 Kw starting motor.

When the starting battery delivers such high power, it is subjected to an abrupt voltage drop. Among other things, this dims the lights and shuts off the radio and the Bluetooth/hands-free system built into the vehicle. In short, it has unmistakable consequences for the occupants.

The traditional solution to these problems is to increase the size of the battery (but this adds to the weight of the vehicle) and to include a DC/DC converter to provide proper power feed to the MMI devices (which in turn increases weight and complexity).

Lamborghini has revolutionized the approach to restarting the vehicle by powering the 2.4 Kw starting motor with the C-Box system, an accessory containing 6 Super Capacitor cells having a total capacity of 200 F (unthinkable only a few years ago), and a power relay that can withstand a current of over 1600 A. Developed by the Lamborghini Research and Development Department in cooperation with Dimac RED, the C-Box is controlled by the GFA auxiliary function control unit using a software algorithm that was also conceived and developed by Lamborghini R&D.

The C-Box fully provides the power required for starting the engine, whether it is restarting from the Start and Stop OFF mode or being started normally.

At these moments, the battery (which feeds the vehicle's electrical system) and the C-Box (which only feeds the starting motor) are isolated from each other, so the voltage feeding the vehicle's electrical system remains constant at 12 V, which is the ideal condition. The capacitor can deliver an extremely high current, with peaks greatly exceeding 1000 A, so that it feeds the starting motor perfectly.

The high power supplied by the C-Box, combined with the refined starting strategy implemented by Lamborghini R&D with the LIE engine control system (Lamborghini Electronic Injection, a system totally designed and built in Sant'Agata), result in a restart time (typically less

than 180 msec) that is 25% shorter than that offered by traditional battery-operated Start-Stop systems.

Relieving the battery of the need to start the engine has drastically reduced its size and, as a result, its weight.

The reduced mass of the battery thoroughly compensates for the weight of the C-Box. In fact, the entire starting system is three kilos lighter than the standard system used in MY 2012.

Thanks to the long useful life of the C-Box (more than 1,000,000 cycles) and the elimination of current peaks on the battery, the energy storage system will last virtually the entire life of the vehicle.

Pickup.

In traditional start-stop systems, the restart and pickup phases are clearly separated from each other. Typically, operating a pedal (releasing the brake or pressing the clutch) causes a restart, and then the vehicle is accelerated in the traditional way.

Lamborghini decided to take a more radical approach. During the stop phase, no driver action is required - not even a press on the brake pedal. To execute a restart and a vehicle pickup, the driver merely presses the accelerator pedal. Thanks to development and fine tuning work on the engine and gearbox control systems, vehicle startup and pickup are coordinated seamlessly in an extremely short time, which allows the driver to fully exploit the stop phase and to control vehicle motion in a smooth, uniform manner.

Cylinder Deactivation System (CDS).

By and of itself, cylinder deactivation is not a new idea. The principle that deactivating several cylinders increases the load on the cylinders remaining in operation (and therefore, their efficiency) has long been known.

The principle is usually applied by disabling the intake and exhaust valves of the cylinders to be shut off. This requires a significantly more complicated valve train which is heavier and less suited to operate at the high RPMs that are typical of super sports engines, such as the Lamborghini L539 V12 installed in the Aventador.

To solve this problem, Lamborghini has chosen a simpler, more original, brilliant solution that combines the sporty characteristics of the power plant - whose RPM limiter is set at 8500 - with the need to reduce the environmental impact of the vehicle.

Conditions of implementation.

Any modification of the engine control system must ensure absolute compliance with anti-pollution regulations. As a result, the numerous conditions required for implementing the Lamborghini strategy include circumstances associated with the efficiency of the catalytic converters. In plain terms, cylinder deactivation cannot take place until the converters reach their temperature of maximum efficiency. Also, when the minimum temperature of converter efficiency (approx. 400°C) is reached, the cold cylinder bank is reactivated and the hot bank is shut off. Under normal driving conditions, this occurs about every three minutes, but the time may vary with the load placed on the engine, its RPM, and the ambient temperature.

Other conditions for implementation are vehicle speed (less than 140 Km/h, which is abundantly below the limit mandated by traffic laws in most of the world's markets), engine RPM (3000), vehicle load, and setting the "Strada" mode on the driving mode selector.

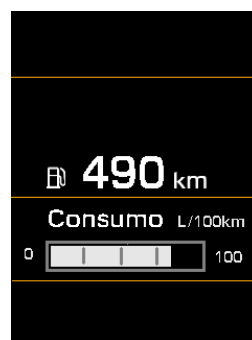
The strategy.

When the conditions for implementing the CDS strategy are met, the software algorithm that controls the CDS system, which was developed exclusively by Lamborghini R&D and is integrated into the LIE (Lamborghini Electronic Injection), shuts down one of the two cylinder banks gradually and in a way that is practically indiscernible by the driver. This occurs whenever it is unnecessary for all 12 cylinders to be operating and is accomplished by shutting off the fuel injection, regulating the torque by varying the position of the electrically actuated throttle (Drive by Wire), and adjusting the spark advance.

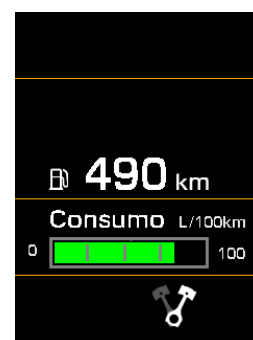
In this condition, the spark is maintained to burn any oil vapors that may reach the intake manifold through the blow-by system.

Below 135 Km/h, up to 3000 RPM and under suitable load conditions, only 6 cylinders are allowed to operate. The engine control system alternates the active cylinder bank to ensure that the temperature of the catalytic converters is always correct for complying with the stringent emissions limits in Europe and the United States, and in most world markets. Throughout this process, the engine continues to turn smoothly, and there are no consequences whatsoever on the occupants of the vehicle, both during normal driving and when the gears are shifted.

If the pressure on the accelerator pedal is increased, the entire engine comes back on line to deliver the full torque and RPM that it is capable of and which are totally unaffected by the CDS system.



**Instrument cluster
display - 12 cylinder
operation**



**Instrument cluster
display - 6 cylinder
operation**