

# **Lamborghini Gallardo**

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## **The name**

Ferruccio Lamborghini – born under the zodiac sign of Taurus – when he founded the famous super car company, that since then bears his name, gave to it the symbol of the fighting bull.

Later, in the '60 decade, when the Miura was introduced, he named the car after a famous bull's race, and this practice became a tradition for the House of the Bull.

Honouring this tradition, the Management of Automobili Lamborghini have decided to baptize their latest model with the name of a fighting bull's breed: the Gallardo (pron.: ga:yàrdo).

Most people probably are not aware that the origins of the fighting bull proceed from five main breeds, that is: Cabrera, Navarra, Vasqueña, Vistahermosa and Gallardo.

Today, ninety percent of the fighting bull breeds proceed from Vistahermosa branch, with some exceptions, such as the Miura race - that comes from the Navarro - which is today the only breeding stock that maintains a pure origin. Another exception is the breeding race of "Partido de Resina" - that was called once of "Pablo Romero"-, that comes from the Gallardo race.

Historically, these bulls have enjoyed a well-deserved fame of being the most beautiful specimen within the race.

The Gallardo breed was created in the XVIII century. It draws its name from Francisco Gallardo and his brothers – cattle breeders at (of the) Santa Maria (Cadiz) – who, thanks to the good results obtained by their bulls' behaviour in the arena, reached a considerable prestige in the most important plazas de toros.

Although the Gallardo family is considered the creator of this fundamental race of fighting bulls, it has been established that its origins are older, as they can be attributed to the Brothers Cartujos of Jerez (Cadiz), who bred it from the collection of the so called "diezmos" which was a tax that all cattle breeders and farmers had to pay to the catholic Church. The payment was made by giving to the Church one of every ten calves the herd would be increased by.

Bernardo de Quiros, a Navarro priest with a farm in the Rota location (Cadiz), taking advantage of his ecclesiastic relationships, bought the cattle (cows and calves) from the Dominican brothers. Years later, the Gallardo brothers bought a large part of the breeding stock from him.

Francisco Gallardo, through a selection, succeeded in fixing the characters of the Gallardo race, that can be resumed as follows: good looking face, heavily built, with a majority of black or gray mantle. During the fight they were famous for being very courageous and to maintain their strength and aggressiveness till the last tercio, which all bullfights fans loved.

After Francisco Gallardo's death, his heirs sold the breeding stock in three lots, one of which ended in the hands of Juan Miura, great-grandfather of the current owners of this legendary bulls breeding ranch.

## **The concept**

Designed to redefine its segment as the best high performance sports car and driving behaviour that fits its driver in every situation. The Gallardo is the synthesis of a true sports car that can be used on an every day basis. While matching these two apparently conflicting objectives, the guideline for Lamborghini engineers has been to fulfil the necessary comfort requirements without any compromise in the performances expected of a true Lamborghini car.

The choices for engine, transmission, space frame and body, suspensions, brakes and electronics are then all in line with such an objective.

The result is a compact (length 4.3 m) 2-seater high performance car (maximum speed well over 300 km/h), that can be driven with pleasure both on race tracks and on long distance journeys on country and city roads.

The layout has been conceived to reach the high performance targets, on the basis of the sports-oriented concept for which Lamborghini is well known.

The basic characteristics of such a layout are:

- mid-rear mounted engine, with the gearbox behind the engine
- permanent four-wheel drive system
- independent double wishbone suspension system
- aluminium space frame
- low centre gravity
- weight distribution 42% front, 58% rear
- two front mounted water radiators and one side mounted oil cooler
- wheelbase 2.560 mm, front track 1.622 mm, rear track 1.592 mm
- total length 4.300 mm, width 1.900 mm, height 1.165 mm

Particular attention was paid to achieve the correct weight distribution, true to Lamborghini's engineering tradition. In fact, the chosen weight distribution is the optimal for a sports car, with advantages for traction, braking and handling.

The lowering of the centre of gravity has also been a fundamental guideline, which also lead to the engineering decisions for engine and transmission layout.

## **The design**

The Gallardo design vision was initiated in the year 2000.

The challenging and simultaneously fascinating task of our designers was to cultivate the attributes from Lamborghini and combine them in an extremely individual packaging.

Its design, based on an Italdesign-Giugiaro style proposal was developed by the Lamborghini Centro Stile to incorporate the parameters of our extreme design philosophy.

The Gallardo dimensions combined with the competitive performance targets ensure the car an athletic compactness.

The long wheelbase complemented by short overhangs dynamise its appearance.

It was clad in the typical and unique mono volume proportioning, our heritage initiated by the Countach and integrates the Lamborghini design attributes of purism, athleticism and sharpness.

The cab-forward cockpit integrated in the body by a strongly slanted front screen and tensed pillars, the complex surfacing intersected by crisp graphics and its cooling flow oriented detailing evokes as in the Lamborghini tradition in its proportions and formal language a strong aeronautical influence.

Starring blade like front light graphics, the front face is orchestrated around the dominant cooling inlets.

The scissor door cinematic has been reserved as traditional to the 12-cylinder lineage.

The foldable side mirrors slanted forward dynamising the side view are mounted on an evolutive shoulder incorporating air inlets.

The flush integration of the door handles emphasize the lateral air intakes and like all details improves the aerodynamic efficiency.

The rear lights prolonging the lines of the upper air intakes develop an aerodynamic lip present also on the rotating spoiler, combining once again function and emotion.

The wheels, a strong differentiating factor in the Lamborghini history develop the traditional round holes design theme interacting them with spokes.

From the very beginning and in coherence with the defined layout, the design phase was completely integrated in the project development. Thus, a complete matching between style requirements and functional requirements has been reached, avoiding style elements without functional basis or functional parts with poor visual appearance.

To conclude, the Gallardo design in details and proportions highlights our unmistakable and uncompromising presence.

## **The engine**

The Lamborghini V10 cylinder DOHC four valve V90 5 liter, 500 Hp, 510 Nm, is the concept solution for the high performance Gallardo.

Instead of the more classical choice of a V72, an angle of 90 degrees was preferred in order to limit the height of the engine with advantages in the car layout (e.g. lower engine bonnet and better rear view) and in the lowering of the centre of gravity (i.e. better car dynamic characteristics). Even firing intervals (that ensure the smoothness of the engine) are guaranteed by the adoption of crankpins incorporating an 18-degree offset.

A dry sump lubrication system not only achieves the correct lubrication even in extreme dynamic conditions, but also permits the centre of gravity to be lowered further.

The torque output is optimised in the full rpm range. In order to achieve such an objective, the charge efficiency was increased at various speeds by a precise utilization of gas dynamic effects that take place in the intake and exhaust system. These effects are managed by the adoption of a variable geometry intake manifold and of a continuously variable valve timing system, both for intake and exhaust.

While the variable geometry (which can be defined as “variable length”) guarantees the correct base gas dynamic characteristics both at low rpm (long runners) and high rpm (short runners), the variable valve timing system guarantees the most suitable valve opening and closing moments for each rpm. For instance, the intake valve closing moment is anticipated at low rpm and retarded at high rpm in order to coincide with the positive peaks of the pressure pulsations at the intake valves.

Thus, the maximum torque of 510 Nm is reached at 4500 rpm, with 80% of this maximum already achieved at only 1500 rpm; conversely, the maximum power is obtained at a much higher speed, i.e. 7800 rpm.

The throttle control is performed via a Drive by Wire system, with two electronic throttle bodies.

The construction technology is obviously all aluminium.

In summary:

- concept: V10 90°, 4V, crankpin offset 18°, integrated liners with eutectic alloy
- capacity: 5 litre, bore 82.5 mm, stroke 92.8 mm
- timing system: DOHC chain driven, continuously Variable inlet and exhaust Valve Timing
- inlet system: Variable Geometry
- exhaust system: two separated banks with two “5 in 1” exhaust manifolds
- ignition system: individual coils directly mounted on each spark plug
- engine electronic management: Lamborghini LIE
- lubrication system: dry sump
- max power 500 hp (368 Kw) at 7800 rpm
- max torque 510 Nm at 4500 rpm



## **The electronics**

The core of the Gallardo's electronic system is the new generation Lamborghini LIE engine management system based on the strong Lamborghini know-how in this field. This system is connected, through a sophisticated CAN BUS network to the Lamborghini vehicle computer GFA and to the e-gear, ESP/ABS, Dashboard ECUs and the other satellite ECUs (doors modules, climate system, rear spoiler, comfort/infotainment). In order to improve the direct control of the main functions and the driving safety, all main information and warnings are centralized on the instrument panel.

A dedicated ECU controls the air bags operation.

The main functions are:

Engine:

- torque model based
- throttle control with Drive by Wire system
- fuel injection (multipoint sequential) management and ignition (individual coils directly mounted on the spark plugs) management
- variable geometry intake system management
- variable valve timing management
- on board diagnostic system management
- emission control management
- "black box" recorder

Vehicle:

- robotized gearbox shifting (e-gear)
- full vehicle stability management (ESP), including traction control (ASR), ABS with electronic brake force distribution, front automatic brake differential (ABD)
- climate system management
- rear spoiler management
- air bags management
- instrument panel and comfort-infotainment management

## **The transmission**

The main feature is the permanent four-wheel drive transmission, based on the well-proven Lamborghini Viscous Traction system.

Such a system, which at constant speed on homogenous adhesion roads presents a traction force distribution around 30% front, 70% rear, is conceived to be “self-regulating”, without the necessity of electronic controls. Indeed, thanks to the chosen characteristics of the viscous coupling, an intrinsic regulating closed loop operates in all conditions, varying the traction force distribution as a function of the dynamic weight distribution variations and of the adherence conditions.

Thus, during acceleration (or during climbing) on high adherence roads, the distribution will change favouring the rear axle (more rear traction force percentage, e.g. 80%, corresponding to the increased weight on the rear axle). However, if in these conditions the rear axle tends to lose adherence, more traction is immediately biased to the front, with the system tending to reach a point where the adhesions utilized by the two axles are identical.

The gearbox is 6 speed, using of the latest generation double and triple-cone synchronizers and optimised actuation linkage in order to achieve precision and velocity in shifting while ease of operation is guaranteed.

A robotized sequential gear shifting system, the Lamborghini e-gear, has also been developed, maintaining the basic mechanical gearbox unchanged. The main features of this system, available as an option, are:

- electronic control, interfaced via CAN bus to the engine control system and the ESP system
- actuation by paddles directly mounted on the steering column
- possibility to select different operating modes: normal, sport, automatic, low adherence
- very fast but smooth shifting, equal to or better than that which is achievable by a very good driver with a standard gearbox

The rear differential features a friction-type 45% limited slip, while the front differential slip limitation is controlled by the ABD (automatic brake differential) function of the ESP system

The clutch is a reduced diameter double plate clutch. This is logical consequence of the Gallardo’s engineering car concept definition, in order to keep the engine (and consequently the centre of gravity) as low as possible.

## **Space frame and body**

Together with the perfect definition of suspension, weight distribution, centre of gravity and aerodynamic characteristics, the achievement of high body stiffness is fundamental to obtain optimal car dynamics and driving enjoyment even on long trips.

For the Gallardo Lamborghini engineers have chosen to utilize the aluminium technology developed by AUDI, world leader in this field.

The final solution results in a structural aluminium space frame, based on aluminium-extruded parts welded to aluminium cast joint elements. On this structural frame, the exterior aluminium body parts are mounted by differentiated systems (rivets or screws or welding) depending on the function of the part. Other external “hang-on” parts (such as the bumpers) are made of thermoplastic material and connected by bolts.

Such a solution has achieved a very good torsion stiffness (over 23000Nm/°), with an optimal stiffness/weight ratio and also with excellent energy-absorption capabilities during the crash tests.

The reduced space frame and body weight permit to achieve a total car “dry” weight of 1430 kgs (in spite of its 4WD).

## **Suspensions and brakes**

The choice of double wishbones front and rear suspension system, true to Lamborghini engineering tradition and a must for high performance sports cars, has been confirmed also for the Gallardo.

The accurate definition of the geometry, of the characteristics of springs and stabilizing bars and the adoption of Koni “selfadjusting” FSD dampers have been fundamental in achieving the desired handling, high speed stability and comfort performances.

Great attention was given to optimising the Gallardo’s dynamic behaviour in curve. In order to guarantee the best car controllability, the dynamics are slightly under steering at the beginning of the curve and neutral for all the rest of the curve. No wind-up effects (typical of some 4WD cars with viscous transmission) are detectable, even in sharp cornering.

The introduction of “antidive” and “antisquat” characteristics guarantee optimal car behaviour also during acceleration and braking.

The Pirelli Pzero tires (front 235/35 ZR19, rear 295/30 ZR19) guarantee optimal adherence characteristics in the various driving conditions. As an option winter tires with the same dimensions have been developed.

The choice of 19” wheels has permitted the installation of large diameter brake disks (front 365mm, rear 335) together with Brembo 8-piston callipers in the front and 4-piston callipers in the rear.

Such a braking system, which also features a state of the art ABS/ESP system, guarantees excellent brake efficiency (deceleration over 1.1 g on dry) and the absence of fading phenomenon also after extreme use. The full stability control system (ESP) has been conceived and calibrated in order to assist the driver in demanding conditions, while still allowing a true sports driving experience.

## **Passive safety**

The Gallardo well exceeds all the European and North American safety standards. Just for example, driver's and passenger's "dual stage" front airbags (complying also with future "out of position requirements"), side "head-thorax" airbags and doors anti-intrusion bars are standard in all versions.

## **The performances**

The high engine power and torque output permit a top speed of 309 km/h and high acceleration capabilities.

This top speed is reached guaranteeing an excellent car stability and controllability.

Indeed, in addition to the optimisation of the suspension characteristics, a must was the definition of the correct aerodynamic features, by concentrating not only on the reduction of the drag coefficient, but, even more important, on the control of the front and rear lift coefficients. Such a study lead to important aerodynamic body refinements (e.g. front flap, flat bottom) and to the implementation of a rear spoiler, electronically controlled as a function of the vehicle speed.

Chassis and body	Lamborghini Gallardo
Frame	Structural aluminium spaceframe, based on aluminium extruded parts welded to aluminium casted joint elements.
Body	Aluminium with thermoplastic "hang on" parts
Suspension	Aluminium double wishbones front and rear suspension system, anti-roll bar, anti-dive and anti-squat, "self adjusting" FSD dampers
ESP	Full ESP system with ABS, ASR and ABD
Brakes	Power vacuum, aluminium alloy calipers: 8 piston front calipers and 4 piston rear calipers. Ventilated discs: $\varnothing$ 365 x 34 mm front - $\varnothing$ 335 x 32 mm rear
Steering	Power-assisted rack and pinion
Tyres (front - rear)	Pirelli Pzero 235/35 ZR 19 - 295/30 ZR 19
Wheels (front - rear)	Aluminium alloy: 8.5" x $\varnothing$ 19" - 11" x $\varnothing$ 19"
Kerb-to-kerb turning circle	11.5 m
Mirrors	External mirror with electrical folding system and heating system, internal mirror with anti-blinding system
Rear spoiler	Electronically controlled
Airbags	Front "dual stage" driver and passenger airbags, side "head-thorax" airbags

Engine	Lamborghini Gallardo
Type	10 cylinders V 90°, DOHC 4 valves, 18° crankpin offset
Displacement	4961 cc
Bore and Stroke	$\varnothing$ 82.5 mm x 92.8 mm
Intake system	Variable geometry
Valve gear	chain driven, intake and exhaust continuously variable valve timing, electronically controlled
Compression ratio	11:1
Maximum power	368 kW (500 hp) at 7800 rpm
Maximum torque	510 Nm at 4500 rpm
Emission control system	Catalytic converters with lambda sensors
Cooling system	Two water radiators + gearbox oil cooler + engine oil cooler
Engine management system	Electronic Lamborghini L.I.E., with individual static ignition, multipoint sequential fuel injection, Drive-by-Wire system, OBD system
Lubrication system	Dry sump

Drivetrain	Lamborghini Gallardo
Type of transmission	Permanent 4-wheel drive with viscous traction system
Gearbox	6 speed + reverse As optional, robotized sequential E-gear system with actuation by paddles on the steering column
Clutch	Double plate $\varnothing$ 215 mm
Rear differential	45% limited slip
Front differential	Slip limitation by ABD function

Performance	Lamborghini Gallardo
Top speed	309 km/h / 192 mp/h
0-100 km/h	4.2 sec
0-1000 m	22.3 sec

Dimensions	Lamborghini Gallardo
Wheelbase	2560 mm
Overall length	4300 mm
Overall width	1900 mm
Overall height	1165 mm
Track (front - rear)	1622 mm - 1592 mm
Weight ("dry"-no fuel)	1430 kg
Weight distribution (front - rear)	Front 42% - rear 58%

Capacities	Lamborghini Gallardo
Fuel Tank	90 litres
Engine oil	10 litres
Engine coolant	20 litres

Fuel consumption	Lamborghini Gallardo
<b>USA fuel consumption (following USA EPA regulations)</b>	
<b>Manual</b>	
	City 9 mpg
	Highway 15 mpg
<b>E□gear</b>	
	City 10 mpg
	Highway 17 mpg
<b>EU fuel consumption (following DIR.EC/1999/100/CE)</b>	
Urban:	29.1 l/100 km
Extra urban:	13.9 l/100 km
Combined:	19.5 l/100 km
CO <sub>2</sub>	450 g/km

# V10 Engine torque and power

