





The most efficient and sportiest Carrera ever

# Identity shaping in three digits: the new 911

THIS MODEL HAS BEEN THE GOLD STANDARD IN ITS CLASS FOR GENERATIONS. BUT NOW THE 911 SETS THE BENCHMARKS IN PERFORMANCE AND EFFICIENCY EVEN HIGHER – DEMONSTRATING ONE HUNDRED PERCENT PURE PORSCHE INGENUOUS ENGINEERING.





## Cutting-edge technology in every area



The new 911 Carrera embodies the competence, passion and technological expertise of Porsche more than any other model generation. Four key development aspects define the new 911: lightweight construction, performance, efficiency and emotions. Porsche Engineering has also played a significant part in creating the new generation of the 911 by developing the new seven-speed manual transmission.

With the new generation of the 911, Porsche engineers have once again combined the latest technological developments in an exceptional way, in order to provide maximum driving pleasure and efficiency. This ingenious engineering is not just evident in the sports cars, but also in a wide range of engineering projects for external customers. Aspects

like lightweight construction, performance, efficiency and emotions are increasingly playing an equally important role here as in the 911.

### **Efficiency**

Lightweight construction throughout the vehicle and extremely economical

engines in comparison to their output have always given the 911 Carrera an exceptional power-to-weight ratio and exemplary fuel consumption. The new generation differentiates itself from the competition even further in both areas: with a power-to-weight ratio of 4.7 kilograms per kW (10.3 lb per kW), the new 911 Carrera S clearly comes out top of

its class. And in NEDC consumption, the 911 Carrera and the 911 Carrera S, each with Porsche Doppelkupplungsgetriebe (PDK), once again boast unmatched and exceptional figures, with 8.2 l/100 km (28.6 mpg imp.) and 8.7 l/100 km (27 mpg imp.) respectively.

This huge step forward rests on the design: the entire new 911 Carrera has been designed for more efficiency, minimized rolling resistance and optimized operating strategies. The main basis for this efficiency is lightweight construction. The completely new aluminum-steel construction of the body not only enables the new model to be up to 45 kilograms (99 lbs) lighter than previous generations, but also ensures a weight advantage of more than 100 kilograms (220 lbs) over the lightest of competitors.

The mechanical components of the engines have been made even more frictionless, and to reduce consumption even more, vehicle electrical system recuperation and a map-controlled coolant thermal management system have been added. Through innovations and corresponding improvements in these two areas, Porsche has succeeded in reducing consumption in the NEDC by 0.45 l/100 km (522.7 mpg imp.). The efficiency target has also been achieved with the help of the first ever seven-speed transmission in automotive construction and the Porsche Doppelkupplungsgetriebe (PDK), also with seven speeds. Porsche Engineering led the development of the manual seven-speed transmission, working together with the transmission manufacturer ZF Friedrichshafen AG (see info box on pages 14/15).

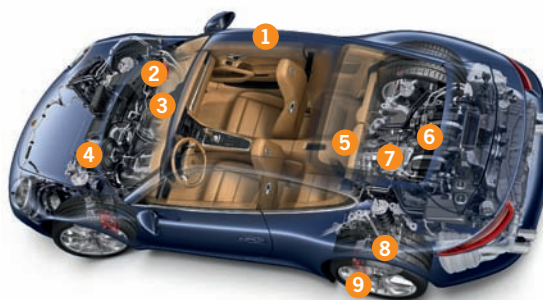


The extremely impressive 911 Carrera and 911 Carrera S models are highly efficient with maximum performance

With the new 911 Carrera generation, Porsche has also further improved the fine details of the previous generation's exemplary aerodynamics. The basic building blocks of the aerodynamic design are the streamlined body surface, the new rear spoiler and the cooling system, which does not require large air intakes underneath the vehicle, thereby enabling the smoothest possible vehicle floor. The aerodynamically effective area of the rear

spoiler was widened from 898 millimeters to 1,137 millimeters. It is extended automatically at 120 km/h (75 mph) and retracted at 80 km/h (50 mph), but can also be extended below these speed limits at the push of a button. Further aerodynamic improvements were secured by optimized air brake spoilers, aerodynamically optimized exterior mirrors, improved engine ventilation and optimized fairings on the front wheels.

#### Using the latest technology for more performance and efficiency



1. Lightweight structures
2. Low drag, variable aerodynamics
3. Start/stop function, coasting, on-board electrical system recuperation
4. Electro-mechanical steering
5. Drive train incl. seven-speed PDK/world's first seven-speed MT
6. Engine technology
7. Thermal management of engine + transmission
8. Reduced residual braking torque
9. Reduced tire rolling resistance

## Ingenious Porsche Engineering

# The development of the new seven-speed manual transmission

Porsche Engineering led the development of the world's first and only manual seven-speed transmission in the automotive sector, working together with the transmission manufacturer ZF Friedrichshafen AG. The new transmission was based on the Porsche Doppelkupplungsgetriebe (PDK). Taking the manual gear changes into consideration, the ratios of the third and seventh gears were modified in comparison with the PDK. The third gear has a higher ratio, which reduces consumption. The seventh gear has a lower ratio to maintain pulling power even at comparatively low speeds.

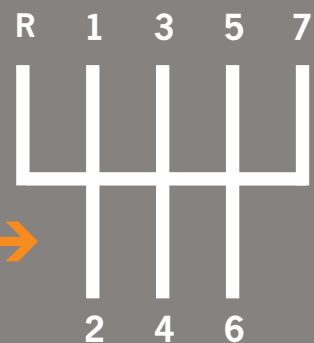
### Shifting gears

Gears are shifted out via two cable winch mechanisms. One cable is for selecting the gear and the other is for shifting it. The transmission uses an H-shaped shift pattern. As the manual transmission is based on the PDK transmission, and neighboring gears (for example first gear and second gear)

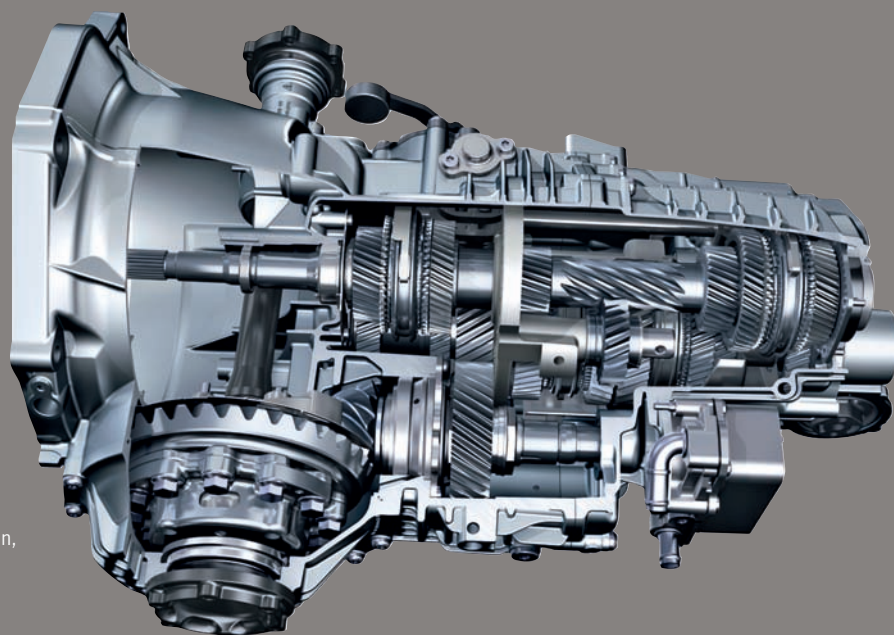
Shift pattern before conversion



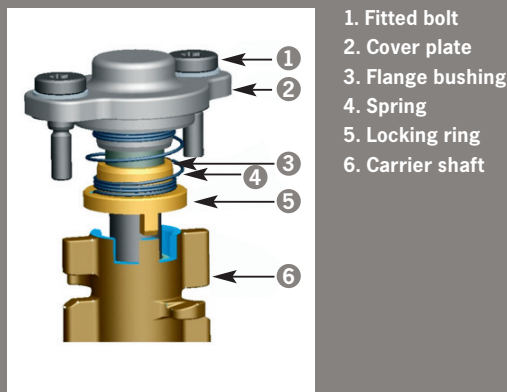
Shift pattern after conversion



are not positioned directly opposite each other in the PDK transmission, a completely new internal gear shift had to be developed. The goal here was to convert the shift pattern to an H-shaped shift pattern with a new internal gear shift. The mechanism that enables this conversion is based on an invention by the company ZF Friedrichshafen AG.



The world's first ever seven-speed manual transmission, developed by Porsche Engineering

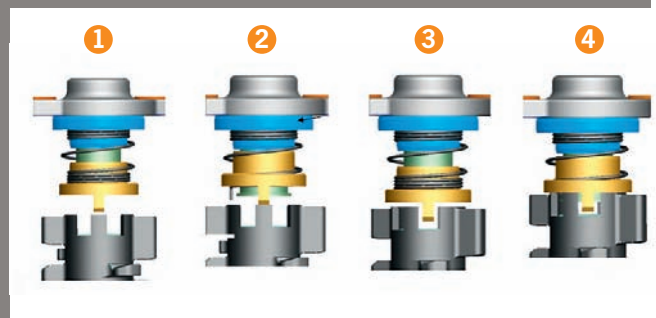


Through this invention, any gear arrangement in the gear set of the transmission can be converted into an H-shaped shift pattern that is familiar and comprehensible for the driver. The main element of the gear shift is the carrier shaft, which can move translationally (in a straight line) and rotationally (turning). The carrier shaft's movement is transmitted to the cable winches outside it and transferred to the gears by the lever mechanism on the shift cover. In order to select a gear, the carrier shaft is pushed axially in the shift gear frame. The carrier shaft is then turned in order to shift gears. The shift forks are linked to the individual shift gear frames via the shift rods. Through the unique arrangement of the shift fingers on the carrier shaft, the shift gear frames of each gear are moved at the same time through this rotation during the shift from first gear into second gear.

### Seventh gear shift lock

In order to prevent inadvertently shifting to seventh gear, a special shift lock was developed. That means that it is only possible to change into the gate for seventh gear if fifth or sixth gear was selected beforehand. However, the driver can shift back down at any time.

*Martin Kuhn*



**Figure 1**

**Gate 3/4 selected →**

Locking ring is decoupled from the carrier shaft by 1 mm

**Figure 2**

**Gate 5/6 selected →**

Carrier shaft pushes the locking ring upwards and blocks gate 7

**Figure 3**

**Shift into fifth or sixth gear →**

Carrier shaft rotates by 29° → Locking ring moves back in axial direction and releases gate 7

**Shifting out of fifth or sixth gear →**

Carrier shaft rotates back to neutral position → Locking ring is radially pretensioned by the rotating spring

**Figure 4**

**Shifting to gate 7 →**

Carrier shaft pushes the locking ring upwards



In this way, like its forerunners, the new 911 Carrera characteristically combines exciting sportiness with exemplary efficiency. The formula for this: Porsche Intelligent Performance.

### Performance

The proof of the 911 Carrera's performance gain speaks for itself: the new 911 Carrera with optimal sporty equipment can lap the Nürburgring's Nordschleife in 7:40 minutes – 14 seconds faster than the previous model.

The overall design of the new 911 Carrera provides the foundation for this significant improvement in performance. The lengthening of the wheelbase by 100 millimeters and the wider front track width alone – 46 millimeters wider in the 911 Carrera and 52 millimeters wider in the 911 Carrera S – results in completely new vehicle geometry with even more driving stability at high speeds, when on the straight and when cornering.

The second main reason for improved performance is the new drive unit. Both engines, with 3.5 liters and 3.8 liters displacement, have been designed according to motor racing principles for high revs. The maximum engine speed of the six-cylinder engines has been increased by 300 rpm to 7,800 rpm. The entire intake manifold has also been optimized. The intake air flows through flow-optimized channels, new multi-hole injectors inject the fuel more efficiently and exhaust emissions exit the 911 Carrera through a system with reduced backpressure. The fine-tuning of the aerodynamics has succeeded in reducing the total lift ( $C_A$ ) of the new 911 Carrera models by 0.02, to a mere 0.05.

Even more agility in the new 911 Carrera is provided by Porsche Torque Vectoring (PTV). This system consists of a mechanical limited-slip rear differential and variable torque distribution to the rear axle.

For the first time ever, Porsche has used electro-mechanical power steering

developed from scratch for the new 911 Carrera. This also has a tangible effect on performance: When braking on road surfaces with different levels of grip, a tug on the steering wheel imparts a steering input in the desired direction, making it easier for the driver to stabilize the vehicle and keep it in the desired lane.

Another decisive contribution to the impressive increased performance of the new 911 Carrera is provided by the entirely newly developed optional Porsche Dynamic Chassis Control (PDCC). The intelligent control of the PDCC system is, for example, able to exercise individual control over the hydraulic actuators, depending on the driving situation, influencing self-steering behavior in the process and consequently improving vehicle stabilization.

### Lightweight construction

With the new 911 Carrera, Porsche sets new standards in lightweight construction. Up to 45 kilograms less total weight than the previous generation means a total weight reduction of 98 kilograms in the basic vehicle design. The reason for this difference: increased safety requirements, a longer wheelbase, fuel consumption reduction measures and a more powerful product firstly led to a weight increase of around 58 kilograms in comparison to the previous models.

The key to success was lightweight construction throughout the vehicle. For the first time in the new 911 Carrera, an aluminum-steel body construction has been used. The underlying idea of this design



Porsche identity: the unmistakable performance of the new 911

is using the right material in the right place. The extensive use of aluminum to reduce the vehicle's weight is therefore balanced with elements of steel of varying degrees of strength for a more rigid body and optimum occupant protection.

Parts that are especially important for passive safety, such as the inner roof frame and the B-pillar, have been made in ultra high-strength, boron-alloyed steels. The new modular roof design also provides advantages in terms of weight. For the series model without a sliding roof, the steel outer skin of the roof has been replaced with significantly lighter aluminum.

The drive train, chassis and electrical equipment have all also been comprehensively redesigned to be lighter. The chassis accounts for more than five kilograms of weight reduction, mostly thanks to the newly constructed front axle with compact lightweight suspension strut.

## Emotions

A highlight of the 911 design is the leather interior of the vehicle. Typical Porsche



The targeted use of a wide range of materials has resulted in a significant reduction in weight

styling meant that the engineers were faced with quite significant challenges. Engineers at Porsche Engineering contributed to the development and implementation of the overall leather design by designing the instrument cluster and the center console as well as the carpet-covered elements. Specifically, they were responsible for creating a strategy for component and tolerance layout and for carrying out covering tests. Managing system and component suppliers and cooperation with the Porsche leather manufactory were also an important part of their job.

The driving experience in the 911 is defined by the design, the sound and the vehicle providing feedback from the road to the driver through shifting gears and revving the engine. The driver experiences real driving pleasure when he feels the performance of the vehicle directly. The main communicator of this is

the sound. Mechanical engine sounds are characterized by higher frequencies and have tonal elements.

The basis of the sound design for the air intake and exhaust systems in the new 911 Carrera was created in the very early stages of the vehicle's design. The layout and dimensions of the manifolds, pipes, catalytic converters and mufflers were all visually illustrated and evaluated with the help of a computer model before there was even any hardware.

The development of muffler systems is one of the core competencies at Porsche and is always carried out at the Weissach Development Center. In order to allow the driver to feel the revs and the power of the engine, the pathways of the air intake and mechanical engine sounds are tuned so that messages from the new 911 to the driver are transmitted in as pure and unadulterated form as possible in all driving conditions.



Porsche Engineering contributed to the development and implementation of the leather interior design

Like no other sports car, the new 911 Carrera shows that by combining the latest cutting-edge technology, exceptional performance and the highest efficiency can be achieved at the same time. Porsche engineers love the challenge of reaching ever higher levels of performance – whether in a sports car or in an external customer project. There's a bit of 911 in all Porsche Engineering projects.



Out in the open

## The 911 Carrera Cabriolet debuts an innovative new roof design

The new open-top models of the 911 Carrera and the 911 Carrera S also belong to the new generation of the classic 911 sports car – the open-air season can begin.

With its completely newly developed and unique roof design, the Cabriolet continues what the Coupé began with its new aluminum-steel body. The typical 911 roof contours have been entirely preserved for the first time. Intelligent lightweight construction, which also includes the use of magnesium for the construction of the convertible top, has ensured less weight and more sportiness, as well as lower consumption and greater comfort. Porsche has managed to reverse the weight spiral for all convertible 911s and has managed to make the new Cabriolet models significantly lighter than their predecessors.

Both new Cabriolets have the same drive system as the Carrera Coupés. A 3.4-liter boxer engine with 257 kW (350 hp)

operates in the rear of the 911 Carrera Cabriolet, and its power is transmitted to the rear wheels by the seven-speed manual transmission. The open-top 911 Carrera S has a 3.8-liter six-cylinder engine with 294 kW (400 hp) and also comes with a seven-speed manual transmission as standard. The convertible 911s also differentiate themselves strongly from the competition in another way: in the NEDC both models consume less than ten liters of fuel for 100 kilometers (23.5 mpg imp.). Alternatively, Porsche Doppelkupplungsgetriebe (PDK) can also be optionally selected for the Cabriolet models, which makes even lower fuel consumption and shorter acceleration times possible.

The longer wheelbase compared to the previous model, the wider front track at the front axle and the new electro-mechanical power steering give the new Cabriolets even sportier driving characteristics, more precision and increased agility. On top of that, additional active control systems are available as standard or as an option depending on the model, which will improve driving dynamics even further.

