911 Turbo S (WLTP)*: Fuel consumption combined: 11.7 – 11.5 l/100 km; CO_2 emissions combined: 266 – 261 g/km; CO_2 class: G

Innovative performance hybrid system with twin turbocharging

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At Porsche, the Turbo S model designation signifies more than just a form of air intake. It represents the flagship within the model series, and stands for exceptional performance and technological innovation. Which is why, for the 911 Turbo S, Porsche has significantly further developed the innovative design of the exceptionally lightweight T-Hybrid system that was first introduced in the 911 Carrera GTS. While one single electric turbocharger (eTurbo) is fitted in the 911 Carrera GTS, the new 911 Turbo S features a system with two specially designed eTurbos. The powertrain develops a system output of 523 kW (711 PS). This equates to a power increase of 61 PS compared to the predecessor model. The maximum torque is 800 Nm. With this power, the flagship sports car accelerates from 0-100 km/h in 2.5 seconds, two tenths of a second faster than its predecessor.

The extensively revised 3.6-litre six-cylinder boxer engine is based on the recently introduced engine

generation that also powers the 911 Carrera GTS. Compared to its predecessor, the engineers reduced the bore by 5 mm to 97 mm and increased the stroke by 4.6 mm to 81 mm. The lightweight crankcase features enlarged ventilation chambers. Stiff roller cam followers are used in the cylinder heads, to aid efficiency. This technology originates from motorsport and reduces friction while optimising strength. Porsche also uses the tried-and-tested VarioCam technology in the lightweight valvetrain. It controls the camshaft timing precisely for all engine speed and load conditions, thereby guaranteeing optimum performance and reduced fuel consumption. Thanks to an optimised combustion process, the boxer engine also achieves a higher degree of efficiency. In this new generation of engine, the belt drive from the predecessor has been omitted. Instead, an electric motor integrated into the PDK housing takes over the tasks of both the starter motor and alternator, and the air conditioning compressor is driven electrically. This results in a compact design that creates space above the engine for a pulse inverter and DC/DC converter. In addition, the new, particularly compact starter battery is installed there. With an energy capacity of 40 Ah, the lightweight lithium iron phosphate battery (LiFePO4) measures just 90 mm in height and weighs seven kilograms. A newly developed, dual-flow tract for the intake air, including a charge-air cooler and four air filter elements, is located above the boxer engine. This makes optimum use of the available space. Even without its hybrid system, the combustion engine in the new 911 Turbo S develops a power output of 471 kW (640 PS) and a maximum torque of 760 Nm. In order to withstand the resulting loads, Porsche has equipped the engine with new, strengthened cast pistons, which provide a compression ratio of 9.2:1.

The new electric turbochargers

For the first time, Porsche is using eTurbo technology in a 911 Turbo S. Unlike conventional turbochargers, eTurbos are each equipped with an integrated electric motor, which is located between the compressor and turbine wheels and drives the shaft of the turbocharger directly. As a result, it spools up the turbo at lightning speed, regardless of the engine load. Full boost pressure is always available within a very short time. The eTurbos therefore make a significant contribution to the responsiveness, performance and efficiency of the drive system. In addition, the turbochargers are designed in such a way that their electric motors can be used to regulate the boost pressure. They generate electrical energy from the rotation of the shafts. While reducing the turbine speed in the process, they reduce the charge pressure as required. The recovered electrical energy is either fed into the high-voltage battery or passed directly to the electric motor in the PDK housing. In this way, excess boost pressure is not blown off, as is normally the case, but instead used to generate energy. Wastegates to limit the boost pressure, or turbo designs with variable turbine geometry to optimise responsiveness are therefore not necessary.

The twin-turbo layout makes it possible to reduce the size of the individual turbochargers, which have been specially designed to meet the specific requirements of the 911 Turbo S. Reduced diameters of 65 mm for the turbine wheel and 73 mm for the compressor wheel bring even greater responsiveness. In addition, the use of the second turbo increases the capacity of energy recuperation from exhaust gases. At full throttle, the electrical power gained in this way is deployed by the electric motor in the PDK housing, significantly improving overall performance. The maximum combined system torque of

the new 911 Turbo S is 800 Nm and is available over an extremely wide rev range from 2,300 to 6,000 rpm. The maximum power output of 523 kW (711 PS) is delivered from 6,500 to 7,000 rpm.

The hybrid system in the new 911 Turbo S

During development of the hybrid system, the focus was on optimum performance with minimal additional weight. To achieve optimum weight distribution, the engineers placed the high-voltage battery of the new 911 Turbo S at the front. It has 216 round cells and a gross energy capacity of 1.9 kWh. It is roughly the same size and weight as a standard starter battery. Continuous water cooling and efficient thermal management ensure that the battery delivers consistently high performance, even during dynamic driving. Its control unit is located under the driver's seat, the pulse inverter and DC/DC converter are located above the boxer engine, which is around 11 cm shallower than its predecessor. The hybrid system operates at a voltage of 400 volts.

In addition to the electric motors in the eTurbos, the new 911 Turbo S is fitted with a motor integrated in the PDK housing. The permanent magnet synchronous motor, which is fully integrated into the transmission housing, is coupled to the crankshaft via the dual-mass flywheel. It measures just 286 mm in diameter and 55 mm in length, delivers a drive torque of 188 Nm even at idle and contributes up to 60 kW to the overall system output. The sophisticated yet highly simplified cooling system, which features an increased radiator fan output, a new centre radiator and a new water pump, is optimised to suit the car's increased cooling requirements.

Operation of the hybrid system varies depending on the driving situation. During highly dynamic driving, the high-voltage battery supplies energy to the eTurbos or the electric motor as required to build up boost pressure more quickly or to apply supplementary torque directly to the drivetrain. While driving at high-speed, the exhaust gas recuperation of the e-turbos feeds the electric motor. This limits the boost pressure and reduces exhaust gas temperature as the drive power increases. When high levels of performance are demanded, the high-voltage battery supplies energy to further increase the system output.

To withstand the torque generated, Porsche has developed a separate PDK specifically for its performance hybrid models. It is based on the transmission from the previous model, but the clutches, gear sets and bevel gear are reinforced. In addition, a taller final drive ratio reduces engine revs at high road speeds. In the new 911 Turbo S, up to 500 Nm of torque is fed to the water-cooled front axle differential via a transfer box.

Pure emotion: the sound of the 911 Turbo S

The most powerful 911 to date is also the most dynamic Turbo S ever. This uncompromising performance can be experienced to a new extent thanks to the careful tuning and the sophisticated overall design of the sports car.

As well as the driving experience, the sound of a sports car contributes significantly to the overall experience. Internal engine modifications are another factor contributing to the even more emotive sound of the new 911 Turbo S. Asymmetric valve timing adds additional frequencies to the sound of the boxer engine, creating a particularly powerful, distinctive sound experience. A new, twin-tip sports exhaust system with rear silencer and tailpipe trims made of titanium also contributes to the unmistakable sound. It is featured on the new 911 Turbo S as standard and ensures maximum performance with minimum weight. In order to protect adjacent components from heat, Porsche is using a new type of heat shield for the first time. It features a three-layer design and consists of two thin sheets (each with a thickness of just 0.25 mm), which enclose an extremely effective insulating material based on cellulose.

MEDIA ENQUIRIES

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Consumption data

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*Further information on the official fuel consumption and the official specific CO_2 emissions of new passenger cars can be found in the "Leitfaden über den Kraftstoffverbrauch, die CO_2-Emissionen und den Stromverbrauch neuer Personenkraftwagen" (Fuel Consumption, CO_2Emissions and Electricity Consumption Guide for New Passenger Cars), which is available free of charge at all sales outlets and from DAT (Deutsche Automobil Treuhand GmbH, Helmuth-Hirth-Str. 1, 73760 Ostfildern-Scharnhausen, www.dat.de).

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