

Powerkit

911 Carrera S

— With the Porsche Exclusive/Tequipment individualization program, customers have the opportunity to customize their vehicles according to their wishes. As part of this program, the powerkit for standard naturally aspirated engines is continuing a long tradition in the annals of Porsche history. Customers are given the opportunity to boost the performance of their top-flight standard power units yet another notch without having to dispense with the comfort features of the current Carrera series.

By Dirk Becker, Stephan Hübner Photos by Jörg Eberl, Jürgen Koch



911 CARRERA S WITH POWERKIT: Fuel consumption (in l/100 km)
urban 13.8–12.2 · extra-urban 7.1–6.7 · combined 9.5–8.7; CO₂ emissions 224–205 g/km

The powerkit for the engine of the 3.8-liter Carrera S of the new 911 series has been available since June of this year. Output jumps from 294 kW (400 hp) to 316 kW (430 hp), thereby reaching a level previously reserved for the cars in the GT series.

The power boost is achieved without increasing the engine speed compared to the series or dialing back the high torque of 440 Nm in favor of increased power. Despite the additional power, the philosophy of delivering the Carrera driving characteristic of powerful acceleration even at low rpms is retained.

Like the kit project for the 911 of the preceding series, this powerkit was developed in close cooperation with the corresponding departments of Porsche AG and Porsche Engineering.

Working from the functional base concept defined in concert by the teams involved, the final customer-ready product was developed and implemented by the engineers and technicians at the Bietigheim-Bissingen site, Weissach development center and the Zuffenhausen production plant.

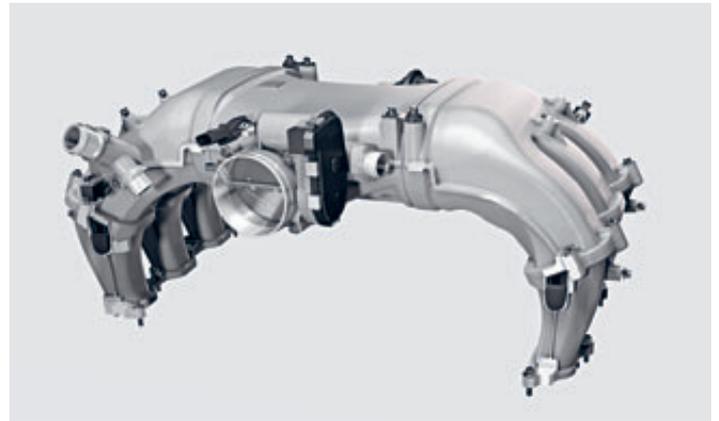
The engine displacement and maximum permissible engine speed adopted from the basic powertrain represent a sensible framework both from a technical and an economic standpoint.

The objective of increasing engine power is thus achieved by increasing the air efficiency, i.e. by enlarging the quantity of air fed into the engine per cycle.

In contrast to an externally charged engine, which uses technical aids (turbochargers, compressors) to pump additional air into the combustion chamber, the powerkit utilizes physical effects, more precisely compression waves, in the intake system to press additional air into the engine with each intake of air.

The powerkit for the Carrera S consists of an extensive package of components:

Flow-optimized cylinder heads with polished channels, a dual-position resonance intake system with enlarged valve lift and adapted valve spring package as well as a sports exhaust system are the primary power components, which are flanked by a range of new peripheral assemblies.



The highlight of the Carrera S powerkit is the newly developed variable resonance intake system with 6 plus 1 switchable valves that switch between power- and torque-optimized geometries.

Last but not least, there is a completely redesigned engine control (mapping) that is the key to converting the additional combustion air into power.

Cylinder heads

In contrast to the series model, the powerkit for the Carrera S has mechanically polished gas exchange channels in the cylinder heads. Prior to polishing there is a local, three-stage channel contour machining procedure that proved its mettle in the predecessor engine kit.

Starting with a series model rough part, after machining the gas exchange channels in the intake port they are deburred and polished by means of a flow grinding procedure. In this procedure, a paste-like grinding medium is pressed through the channels under precisely defined conditions (pressure, temperature, volume flow). Because the motion of the grinding medium is similar to the gas flow, the result is an ideal, uniform polish that cannot be achieved to such perfection through manual reworking. The result finds expression in a further improvement of the dimensionless flow coefficient Alpha K, an indicator of the fluid flow efficiency of the gas cycle channels. In conjunction with the enlarged valve lift and the dual-position resonance intake system, this leads to an increase in the air efficiency. >

Intake system

A cast aluminum intake system with six coordinated resonance-induction intake ducts is largely responsible for the additional engine charge. For each cylinder bank, three switchable valves create channel activation of the power channel geometry to the torque channel geometry and power channel geometry. Valve control is successfully performed by the engine control mapping utilizing vacuum actuators that are supplied by the engine vacuum pump.

The combination of vibration tube and resonance induction is therefore utilized in full—the flat-six engine is predestined for this like no other engine construction concept.

In addition, the intake system has a tuning flap in the collector volume that enables separation of the two cylinder banks and thus contributes to an even better torque curve during partial load operation.

Compared to the predecessor intake system, lightweight construction measures allowed 25 percent weight savings. The goal of general weight reduction for the vehicle as a whole is achieved in part by an improved casting procedure that enables reduced wall thicknesses (by 2.5–3 millimeters on average) without compromising the durability of the product. Thanks to appropriate construction measures, it was also possible to reduce the time required to mount the intake system on the engine.



Improved torque curve in partial load operation: The cast aluminum intake system has a tuning flap in the receiver volume that enables separation of the two cylinder banks.



Compared to the series version (left), the intake ports of the cylinder heads in the 911 Carrera S powerkit are additionally machined and polished (right).

Inlet camshaft

Another component of the powerkit is inlet camshafts with a larger valve lift compared to the series model. At high engine speeds, they display their benefits through an additional quantity of air in the combustion chamber, enabling a power boost at high rpms. The familiar valve-lift shift to a smaller inlet cam for partial load operation from the series model is retained here as well.

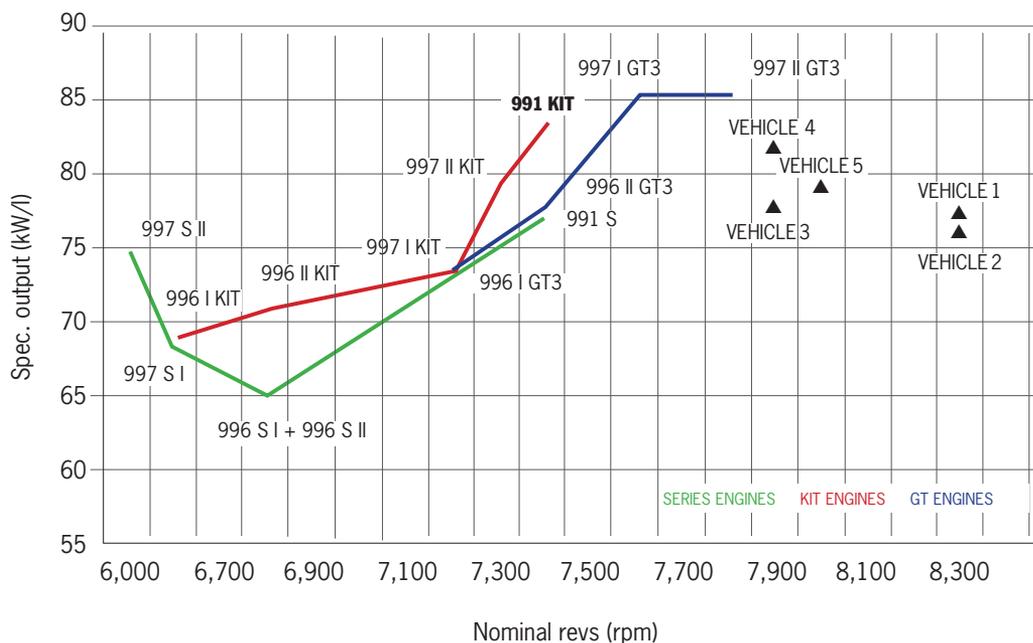
Other features

A supplementary part of the kit package is an additional water cooler that safely disperses the increased engine heat and thus ensures a healthy temperature balance. The sports exhaust system de-throttles the exhaust tract and impresses with its

gravelly sound. The Sport Chrono package, dynamic engine mount and a kit-specific engine cover round out the package.

Technology

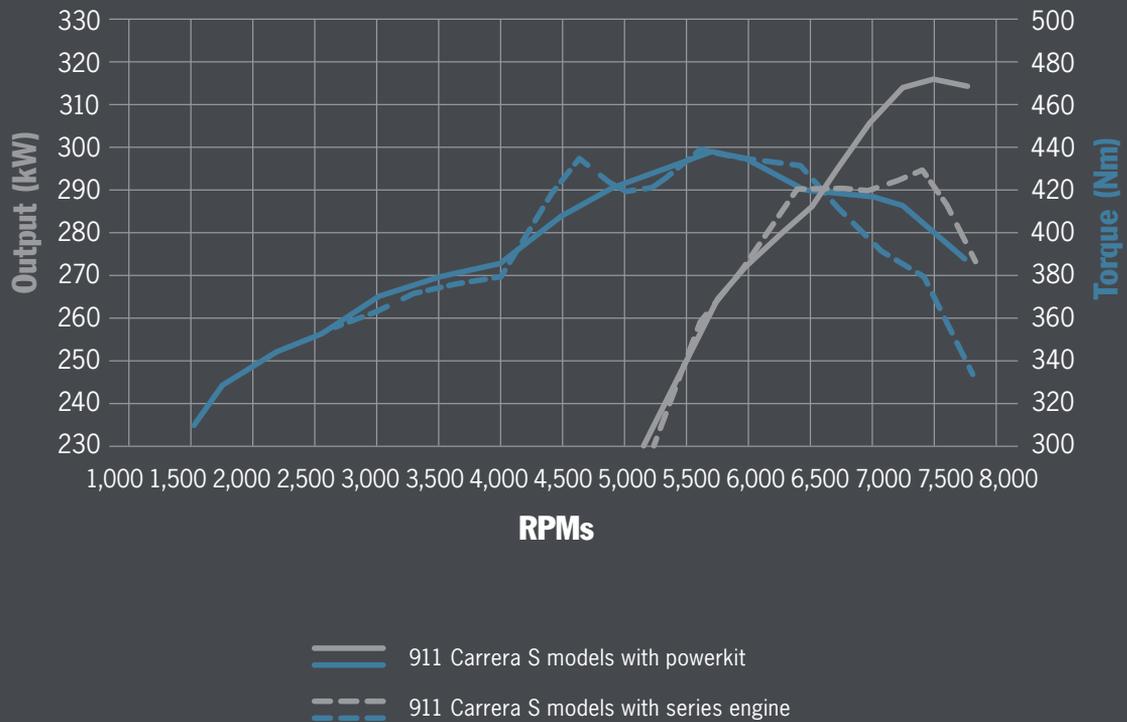
The engine's power output comes in at 83 kW/liter (113 hp/liter)—a figure that, in light of the required engine speed, amply demonstrates the special character of the kit. As the diagram (next page) shows, the high performance figures are achieved at engine speeds that correspond to those of the series engine. So there's no need to think in terms of high engine speed concepts that can compromise drivability in everyday operation. That these impressive values are attained without higher consumption (in the NEDC) compared to the series engine demonstrates the unique character of the new engine. >



Development of the power output per liter over the engine speed of the Porsche 911 Carrera generations and in comparison to competitors (vehicle 1–5)



The kit package for the 911 Carrera S (type 991) enabled a power boost particularly in the upper engine speed range.



Historical overview of Porsche powerkits since the Carrera 996

SERIES CARRERA	YEAR	BASE ENGINE	OUTPUT (kW)	OUTPUT DELTA (kW)	ALLOY INTAKE SYSTEM	MODIFIED CYLINDER HEADS	ENGINE SPEED INCREASE	SPORT EXHAUST SYSTEM	VALVES/ INSERTS	CAM SHAFTS	MODIFIED ENGINE APPLICAT.
991	from 06/12	3.8l	294 to 316	22	●	●		●		●	●
997 II	from 06/09	3.8l	283 to 300	17	●	●	●	●			●
997 I	from 08/05	3.8l	261 to 280	19	●		●	●	●		●
996 II	from 01/02	3.6l	235 to 254	19	●	●		●		●	●
996 I	by 12/00	3.4l	221 to 235	14	●	●	●		●	●	●

Project scope

With the new powerkit for the Porsche Carrera S, Porsche engineers and technicians have once again shown that improved performance doesn't have to come at the expense of fuel efficiency. The development of the resonance intake system with switchable valve units, cylinder heads with channel optimization, inlet camshafts with modified valve lift and a series of accompanying peripheral components from concept to production was completed successfully on the tightest of schedules.

In the early phase of the project, the modified valve train concept was verified on dummy cylinder heads. While development was ongoing, a series of complete engines were built and post-trial examinations were carried out.

Whether the engineers and technicians of Porsche are working on a sports car or some other project, the result is always the same: Porsche Intelligent Performance. ■

Powerkit

911 Carrera S

Technical Specifications:
 Increased output from 294 kW (400 hp) to 316 kW (430 hp). Improved acceleration to 4.0 seconds from 0–100 km/h for Carrera S Coupé with PDK in Sport-Plus mode. Increased top speed to up to 308 km/h (depending on vehicle variant). Fuel consumption remains unchanged despite higher output (in NEDC).