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The acceleration and driving dynamics of the new 911 Turbo are simply breathtaking—and it stems from the nature of this new Porsche. If you take a closer look at the engine, you will discover finely honed technology that sets milestones in fuel economy despite a power output of 500 horsepower and peak torque of up to 700 Nm (516 lb.-ft.). So the question of how timely such a potent engine might be can be answered quite simply: more than ever!

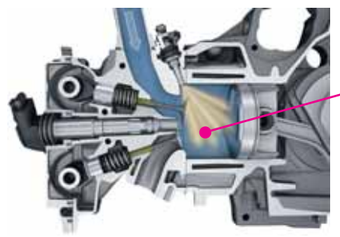
Technology

The Joy of Full-Load Driving

01

Impressive data on the new 911 Turbo engine (coupe with PDK)
Power output: 500 hp (368 kW) at 6,000 rpm
Top track speed: 312 km/h (194 mph)
Acceleration: 0–100 km/h (62 mph) in 3.6 sec (3.4 sec with Sport Chrono Package)
Fuel consumption: 11.4 liters/100 km (20.6 mpg)

02



Direct gasoline injection with 140 bars (2,031 psi) injection pressure

03

New closed-deck crankcase design with integrated main bearings

Turbocharging with dual chargers with variable turbine geometry in a symmetrical arrangement

04

The 500-horsepower flat-six engine hisses in thermodynamic ecstasy; the tires spin, screaming for mercy; the Porsche Stability Management system vies for control on both drive axles. In spectacular spurts, the white 911 Turbo Cabriolet sprints from one curve of the racetrack to the next. The enormous acceleration of the new turbo engine is equivalent to that of a race car, with a sprint from zero to 100 km/h (62 mph) in 3.8 seconds. So the comment by the expert behind the wheel feels just a little deflating: “Actually, this is our new fuel-economy engine,” says Dr. Heinz-Jakob Neusser, head of Porsche Drivetrain Development.

Neusser is already steering swiftly toward the next curve. The rear engine hisses under the full-load pressure of 0.8 bars (11.6 psi), and one fact is already evident: other modern fuel-economy engines sound a lot less exciting than the “9A1-TOP” engine. That’s what this 500-horsepower unit is called among insiders at the Weissach Development Center. And an engine born under the constellation “TOP” is destined to leave all competitors in the dust.

Of course, at Porsche, the technical know-how of enabling the driver to always deliver just the right boost to a good engine through a turbocharger has existed for 35 years. But the 2009 Turbo drives like a big naturally aspirated engine, responding deftly to every touch on the gas pedal, however slight. Achieving this was by no means simple. In the past, there was always a metallurgical roadblock to the goal of adjusting the turbocharger in a gasoline engine to respond precisely as required by the load with the same smooth elegance one can take for granted in today’s diesel engines. The steel components controlling the turbocharger work well up to 900 °C (1,652 °F), as required in diesel operation, but they tend to fail at temperatures above 1,000 °C (1,832 °F)—which are inevitable in the hotter exhaust of a gasoline engine. Neusser relates: “What solved this dilemma was a phone call to Krupp in Essen that put us in touch with the specialist who helped us with the nickel-based superalloy we are using today.”

This space-age material from the world of rocket engines enables the dual turbochargers of the new Porsche Turbo to be precisely controlled from the roaring power of 500 full-load horsepower all the way down to a gentle idling speed of 680 rpm—with an elegant smoothness never before achieved. “And whenever something works at Porsche today, we’ll be able to make it work tomorrow for any compact car,” says Neusser. Serving as a think tank, Porsche in Weissach will be the ideal hub from which to disseminate this technology under contracts with other automakers.

The variable turbine geometry turbocharger is one element in a network of subsystems helping reduce fuel consumption in the new engine. To sum these up:

- Turbocharging by dual chargers in a symmetrical arrangement
- Direct fuel injection (140 bars [2,031 psi] injection pressure)
- Optimization of the expansion intake duct for a maximized cooling effect
- Special shape of the intake ducts to generate a pronounced “tumble” motion of the intake air in the combustion chamber
- Dual-intake air cooling
- Innovative dual catalytic converters per cylinder bank
- Closed-deck design of the crankcase
- Single-casting crankcase with integrated main bearings
- Die-cast monobloc crankcase of supereutectic AlSi17 alloy, with integrated main bearings
- Six-hole fuel-injector design with 140 bars [2,031 psi] injection pressure
- Multistage oil pump with load-controlled mapping

**Dr. Heinz-Jakob Neusser,
head of Porsche Drivetrain Development**

“Balancing a multitude of details is what makes the whole system work.”

“Balancing a multitude of details is what makes the whole system work,” says Neusser. “A precise and very lively response to small gas-pedal movements in the partial-load range was a lot more important to us than plus/minus 150 newton-meters [110 lb.-ft.] or 50 to 80 horsepower.”

In this approach, direct fuel injection is the key to greater power without an increase in fuel consumption. Neusser explains: “Of course, that’s where you can accomplish the greatest gains. The cooling effect achieved by the six-hole injectors at 140 bars (2,031 psi) injection pressure—in the Carrera that’s 120 bars (1,740 psi)—when the fuel jets are injected into the cylinder makes for almost benign thermal conditions even at full load.” Direct fuel injection cools the cylinder charge so thoroughly that the compression could be raised and the engine does not tend to knock, even at full throttle.

Less is more—that’s certainly true where weight is concerned. The new Turbo is also the product of a lean diet: at 219 kilograms (483 lbs.), it now weighs 10 kilograms (22 lbs.) less than the previous engine model. In its assembly-ready state with all attachments, the weight reduction comes to 20 kilograms (44 lbs.).

Taken together, the changes made in the crankcase were so profound one can virtually speak of a new engine. The crankcase, which was previously cast in two parts, is now pressure-diecast as a single aluminum monolith. Each half combines the crankshaft bearings and the cylinder bores within the same casting. The engine’s mechanical robustness is substantially enhanced by the switch from an open-deck to a closed-deck design. A main feature is the cooling passages around the cylinder bores, which are perfectly formed within the casting. To further increase the overall strength of the aluminum structure, the entire crankcase is subjected to additional thermal treatment: once it has been diecast, the whole crankcase is baked at specific temperatures for specified times in the foundry’s high-tech furnaces. Neusser adds: “The precise roundness of the aluminum cylinders is further improved to an enormous extent, as they have been honed out by entirely mechanical means. Therefore, the piston rings within them operate under ideal conditions, so they can practically last forever.”

Even the oil pump has been engineered to improve its power-to-weight ratio and is now map-controlled: the pumping gear has been designed to make its tooth pitch adjustable so it never consumes more energy than necessary. The exhaust system contains surprises as well. Each cylinder bank is equipped with two catalytic converters of the latest ceramic type. Each of these contains 400 cells per square inch (650 mm^2), which means that each individual duct has a cross-section of less than 1.6 mm^2 (0.0025 square inches), as well as an extremely thin wall, barely thicker than a sheet of paper. Neusser notes: “There is virtually no resistance to the exhaust flow anymore. Not to mention the fact that we’re already compliant with the European EU5 exhaust standard as well as the LEV II/LEV standard in the United States.” The Porsche Turbo has another outstanding characteristic for a sports car in this class: it isn’t subject to the unpopular gas-guzzler tax in the United States.

When it comes to driving performance, the new Porsche Turbo goes all out at full load with its 500 horsepower (368 kW) and up to 700 Nm (516 lb.-ft.; with the Sport Chrono Package). In the partial-load range it operates almost as miserly as a late-model diesel. That’s borne out by the values of specific fuel consumption, measured in grams per kilowatt-hour. This value allows comparisons of engines of dissimilar sizes and is used in rating their fuel economy. State-of-the-art diesel engines set the bar at about 200 grams per kilowatt-hour. Such values in gasoline engines are usually fifty percent higher: 300 grams per kilowatt and hour used to be an insurmountable barrier. But the new Porsche Turbo runs at 250 grams per kilowatt-hour in at least part of its engine-speed range—close to the ideal region of the thrifty diesels.

So go for it!