

Porsche 911 still evolving

If any car demonstrates the meaning of the words "automotive evolution," it is the **Porsche 911**. In the more than four decades since its first dramatic appearance, the 911 has become a symbol of design-concept survival. The new 911, designated 997 by the factory, is a further evolution of all that has gone before. At a glance, the 997 is not so different from the current 996 (which will remain in production for a while). However, technologically it is significantly developed, and changes to the exterior (it is slightly wider and shorter than its predecessor) and interior are also extensive.

The technical aspects include a new engine, new six-speed gearbox, variable-ratio power steering, and what the company describes as Porsche Active Suspension Management (PASM). And

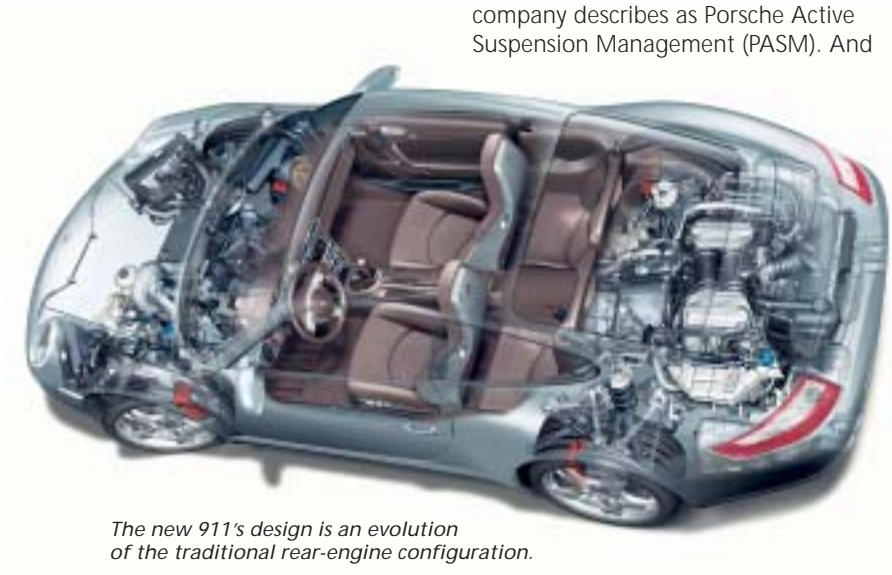
for the first time in 27 years, there is now a 911 available as standard with a choice of two engine capacities; the Carrera has a 3.6-L engine with 239 kW (321 hp) at 6800 rpm and 370 N•m (273 lb•ft) at 4250 rpm, while the Carrera S has a 3.8-L unit with 261 kW (350 hp) at 6600 rpm and 400 N•m (295 lb•ft) at 4600 rpm. Specific output of the Carrera and Carrera S are 66.5 and 68.3 kW/L (89.2 and 91.6 hp/L), respectively. Both engines are flat-sixes.

Bernd Kahnau, Project Manager, Carrera Product Line, emphasized the importance of the engines making the right noises, although each is different from the other. "We have given the larger boxer engine an even more powerful and muscular sound, ensuring that the difference between the two models is borne out clearly, not just by the gas pedal," said Kahnau. A Helmholtz resonator is positioned in the air-filter housing between the hot-film air mass meter and throttle butterfly. It is activated between 5000 and 6000 rpm, reducing oscillations of the intake noise within the 260-Hz frequency range.

There is a visual difference between the two engines of the 997, with the 3.8-L unit having a silver-colored intake system. The S also has quadruple exhaust tailpipes, the regular Carrera two. The extra engine capacity has been achieved by increasing the 3.6-L unit's bore by 3 mm (0.12 in) to 99 mm (3.90 in), with the stroke unchanged at 82.8 mm (3.26 in).

"Both engines feature Porsche's VarioCam Plus stroke-adjustment system made up of two interacting, switchable cup tappets operated by two cams of various size on the intake shaft," said Kahnau. "This serves first to optimize the engine's output and torque while at the same time improving fuel economy and exhaust emissions as well as the car's running refinement. Both engines are fitted worldwide with cascade-type catalytic converters." The engines meet EU 4 and LEV emissions requirements.

Transmission choice on the 997 is a newly developed six-speed manual or a



The new 911's design is an evolution of the traditional rear-engine configuration.



The 911 (designated 997) has reverted to a "traditional" headlight design, and the car is slightly wider at the rear than the 996. The Carrera S version (right) has quadruple tailpipes to the Carrera's two.



Even the exterior mirrors of the 911 contribute to downforce.



The 911 Carrera S gets a 3.8-L 261-kW (350-hp) flat-six.



The PASM adaptive damper system is standard fitment on the Carrera S.

five-speed Tiptronic system with steering wheel buttons for manual shifting. The manual is designed for decreased shift forces, and its lever travel is shortened compared to the 996 gearbox by some 15%. The Tiptronic also has a "completely revised" gearshift strategy, with shift times reduced at high engine speeds. Both 911 versions share the same 3.44:1 final drive ratio.

Performance figures for the Carrera S include a 0-100 km/h (0-62 mph) time of 4.8 s (0.2 s quicker than the Carrera) and a 0-200 km/h (0-124 mph) time of 16.5 s (1 s quicker than the Carrera). The Carrera's top speed is 285 km/h (177 mph), with the S reaching 293 km/h (182 mph). EU standard composite fuel consumption of the lower-powered (manual) Carrera is 11.0 L/100 km, with the S achieving 11.5 L/100 km.

Chassis developments involve suspension, steering, and brakes. The standard fitment of PASM on the Carrera S is

significant. The system uses adaptive dampers that, in principle, use the same structure and configuration as regular passive dampers by forcing oil through orifices. But for the PASM system, oil is also able to flow through a bypass valve in addition to the regular openings. With the valve opening and closing by means of a sliding component, the flow of oil is increased or reduced, with damper forces being adjusted infinitely in the process.

Two accelerometers monitor the vertical movements of the car's body. The signals they transmit are compared by a control unit to the car's lateral acceleration, steering angle, road speed, brake pressure, and engine torque. Taking the data provided by the CAN bus (Porsche also uses a MOST bus), the system determines the optimum damper control line and sets the dampers to the appropriate level and response on each wheel. The use of CAN and MOST buses allows 29 control units to exchange data,

boosting systems-integration efficiency and saving wiring weight. There are "normal" and "sport" system settings. Lowered sports suspension is an option. The Carrera has 18-in wheels, the S 19-in.

The variable-ratio steering reduces steering wheel turns lock-to-lock from 2.98 to 2.62. "The result is a significant improvement of agility on winding roads and serpentines," said Kahnau. "Once the steering-wheel lock exceeds a limit of approximately 30°, steering transmission becomes increasingly direct." The steering wheel is height- and reach-adjustable.

The Carrera has inner-vented, cross-drilled brake discs of 318 mm (12.5 in) diameter front and 299 mm (11.8 in) rear. The Carrera S gets the 911 Turbo's system with 330 mm (13.0 in) discs front and rear and four-piston calipers. Optional are ceramic composite brakes, which Kahnau says have been developed further with inner cooling ducts.

"An increase in the number of cooling ducts makes the discs even stronger and stiffer in retaining their shape, significantly reducing deformities of the discs under high pressure forces from the pads," Kahnau said. Of 350 mm (13.8 in) diameter, the cross-drilled and inner-vented ceramic composite brake discs are about 50% lighter than their metal equivalent and reduce unsprung mass of the Carrera S by about 14 kg (31 lb).



The 911's optional ceramic brakes have been developed further with inner cooling ducts.



The significantly revised 911 features an optional stopwatch atop the IP.

Weight is a focus for Porsche just as it is for every manufacturer. The Carrera comes in at 1395 kg (3075 lb) unladen, although it has a higher level of equipment than the 996. This reduction is due to what Kahnau cited as "intelligent lightweight engineering," particularly through "modifications" to the body-in-white plus the use of aluminum for the luggage compartment lid and for the rear axle subframe, for which it saves about 1 kg (2.2 lb).

The aerodynamics of the 911 has long been a subject of abiding interest at Porsche, with past solutions including some very large engine-cover-mounted fixed spoiler designs. Compared against the 996's 0.30, the 997's Cd factor ranges from 0.28 (Carrera) to 0.29 (Carrera S). The CdA is 0.56 for the Carrera and 0.58

for the S, with lift coefficients of 0.05 at the front and 0.02 rear.

Aerodynamic challenges included the fact that the Carrera S needs 20% more cooling air. Changes to achieve this cooling include air ducts that are as short and straight as possible. Outgoing air from the radiator no longer flows down vertically ahead of the front wheels but rather is guided sideways directly into the wheel arch. It reduces losses in the airflow ducts and minimizes the lift effect on the front axle. There are ram-air flaps around the electric fan that open at 70 km/h (43 mph).

Other aerodynamic highlights include a rear spoiler that deploys at 120 km/h (75 mph) and retracts at 80 km/h (50 mph) as well as greater curvature for the A-pillars. Porsche says that even the

exterior mirrors and the double arms on which they are mounted create downforce on the front axle and guide airflow to the rear spoiler for added rear-axle downforce.

Safety changes include an additional load path along the front axle crossbar. Head airbags are now fitted in the side-window sills, and there is an additional thorax bag in each seat backrest. The latest 911 gets a new seat design, and sports seats are offered with adjustment of the cushion and backrest for width. On the instrument panel, the rev counter remains the dominant instrument. Both digital and analogue speedometer readings are used, and there is a Sports Chrono Package stopwatch for track day or competition use.

Stuart Birch

Kia Spectra long on safety, space

Launched this past spring, the redesigned 2004 **Kia** Spectra is taking aim at compact-class competitors such as the **Toyota** Corolla, **Honda** Civic, and **Ford** Focus by offering best-in-class standard safety features and interior volume. The new Spectra also gets a longer wheelbase, wider track, and more horsepower than its predecessor for better handling characteristics and improved performance.

"The new Spectra is an example of Kia's commitment to move beyond our traditional strengths of high value by delivering...high levels of comfort, roominess, and a class-leading array of safety features," said Peter Butterfield,

President and CEO, Kia Motors America.

Standard safety features on all models include six airbags: advanced driver and passenger front airbags, dual front seat-mounted side airbags, and full-length side-curtain airbags. To ensure proper deployment of the front airbags, sensors controlling the front supplemental restraints determine whether the seatbelt is buckled and gauge the severity of a frontal impact before deployment. An additional occupant sensor for the front passenger seat measures factors such as seat position and passenger weight for safe airbag operation.

The Spectra will be the lowest-priced vehicle in the U.S. to offer a side-curtain

airbag system, said Butterfield, and the only vehicle in its segment to include the technology as standard equipment.

"Using safety as a mark of distinction, Kia's goal over the next few years is to become the first manufacturer to offer side-curtain airbags as standard equipment on all of our models, and we are making huge strides toward that objective," he said.

The sedan comes equipped with standard four-wheel disc brakes. A four-sensor, four-channel antilock braking system with electronic brake distribution is optional on the EX trim level and the five-door 2005 Spectra5 hatchback, which was introduced at the New York



The redesigned Kia Spectra (top) and Spectra5 hatchback feature six airbags as standard equipment, a first for the compact segment.



The four-door Spectra's larger dimensions result in 97 ft³ (2750 L) of passenger room, which is tops in its class.

International Auto Show in April and is due out this summer. Additional safety features include front seatbelt pretensioners and force limiters, reinforced doors and side-impact beams, front and rear crumple zones, fuel system cut-off, and three-point seatbelts for all five seating positions.

The Spectra's 102.8-in (2610-mm) wheelbase is 2 in (51 mm) longer than the previous version, width is 68.3 in (1735 mm) vs. 67.7 in (1720 mm), and height is 57.9 in (1470 mm) vs. 55.7 in (1415 mm). The larger dimensions result in the sedan's 97 ft³ (2750 L) of passenger room, which is tops in its class. At 12.2 ft³ (345 L) of storage space, the trunk volume has increased nearly 20% compared to that of its predecessor.

The Spectra's new 2.0-L DOHC engine, which also powers the Hyundai Elantra, incorporates multipoint electronic fuel injection and continuously variable valve timing, a Kia first. The inline four-cylinder engine produces 138 hp (103 kW), 14 hp (10 kW) more than the

previous version, and 136 lb•ft (184 N•m), 17 lb•ft (23 N•m) more than before. The new engine can be mated to either a five-speed manual or an optional electronically controlled four-speed automatic transmission.

A PZEV-SULEV engine—another first for Kia—that produces 132 hp (98 kW) and 133 lb•ft (180 N•m) is available in California, Massachusetts, Maine, New York, and Vermont.

The Spectra shares a platform with the Elantra, but the tuning of the suspension is completely different, said Fred Aikins, Product Strategy Manager for Kia Motors America. The sedan incorporates a four-wheel independent suspension, with MacPherson struts in front and a multilink design in the rear. Front and rear stabilizer bars are standard on all Spectra models. Handling is enhanced via a rack-and-pinion steering system equipped with engine-speed-sensitive power assist.

Building upon the sedan platform, the Spectra5 adds a sport-tuned suspension, 16-in alloy wheels and tires, a strut tower

bar—the first ever on a Kia—for a stiffer chassis and better handling, and design features such as front and rear spoilers, rear valance, side sills, fog lights, leather-wrapped steering wheel and shift knob, and metal-finish trim throughout the interior, including metal pedals. As with the sedan, the Spectra5 offers best-in-class passenger room at 98.1 ft³ (2780 L), and its cargo capacity is 18.3 ft³ (520 L).

The four-door Spectra is available in two trim levels: LX and EX. Optional equipment for the EX model includes 15-in alloy wheels, power moonroof with tilt, and a rear spoiler. A four-door SX model will be available for the MY2005, featuring a sport-tuned suspension, a strut tower bar, 16-in alloy wheels, front and rear spoilers, rear valance, side sills, and metal pedals.

"There's a lot of customization potential with this car," said Aikins, adding that Kia will place greater emphasis on the annual **SEMA** (Specialty Equipment Market Association) Show in Las Vegas in November largely because of the new Spectra.

Ryan Gehm

Fortwo, forfour, formore: smart moves forward

Car companies may use a plethora of adjectives to describe their design, engineering, and styling capabilities but, in general, most follow predictable, well worn—and commercially safe—routes to production. Occasionally, though, a company will boldly set out along a very different path. **DaimlerChrysler's Smart** did this, working in partnership with the creator of Swatch watches to produce a

radically different, two-seat, futuristic city car with a three-cylinder rear engine, the likes of which the automotive world had never seen before.

It was initially difficult to take seriously, and there were certainly concerns at a very high level within DaimlerChrysler as to whether it was really going to succeed. But it did, and now the smart range is expanding to

such a degree that a model will be sold in the U.S., although it will not be the little city-coupe that started it all. It will be a new SUV ("smart utility vehicle") called formore, of which the first official graphic impression has been released. Slated for the U.S. in 2006, it will constitute the fourth smart model range after the city-coupe (now called the fortwo), roadster, roadster-coupe, and



The smart forfour (top) has plastic body cladding and an interior not as off-beat as the fortwo city coupe's.



The smart forfour is being built in The Netherlands alongside the Mitsubishi Compact Car.



The smart formore SUV, to be offered in the U.S., will have all-wheel drive.

the forfour (four doors, four seats) that is just now going on sale in Europe but is not planned for the U.S. Although few details have been released, the formore will have all-wheel drive and be manufactured at DaimlerChrysler's Juiz de Fora plant in Brazil, which has 60,000 units per annum capacity. The U.S. is expected to take about 30,000 formores a year.

But that is all in the future; the new smart car of the moment now in production is the forfour, which draws heavily on **Mitsubishi** mechanicals (DCX has a 37% stake in Mitsubishi Motors Corp.), although smart insists that these components have been applied in such a way that smart's DNA is very much undiluted. Perhaps, but the fact is that mechanically, forfour is conventional compared to other smart models. With this car, it is its aesthetics and overall design elements that give it an individualism that separates it from the pack.

To use smart's words, the components "developed in collaboration" with Mitsubishi to create the forfour include its gasoline engines built at MDC Power in Thuringia; the rear axle; structural components in the vehicle's underbody; the manual transmission; and the emissions and fuel tank systems. These

components are produced strictly in accordance with smart standards in terms of technical and product specifications, says smart. The car is being built at Born, in the Netherlands, alongside the Mitsubishi Compact Car (Colt). The new smart has adapted **Mercedes-Benz** equipment including a multifunctional steering wheel; rain and light sensors; audio, navigation, and communication systems; and locking system. The forfour and the new Mitsubishi Compact Car are described as being the first non-Mercedes-Benz models to be designed using DaimlerChrysler's electrics and electronics platform, which include ABS, brake assist, and crawl function of the optional automatic gearbox.

The forfour, which is 3752 mm (147.7 in) long, 1684 mm (66.3 in) wide, and 1450 mm (57.1 in) high, rides on a 2500-mm (98.4-in) wheelbase and has a mass (without driver) of under 1000 kg (2205 lb), depending on version, giving a mass-to-power ratio of 12.2 kg/kW (20.1 lb/hp), which is comparable to that of the smart roadster and roadster-coupe.

Three gasoline engines spanning 1.1 to 1.5 L and 55 to 80 kW (74 to 107 hp) are offered. The smallest engine has

three cylinders. The two 1.5-L three-cylinder diesels have outputs of 50 and 70 kW (74 and 94 hp), respectively. These are sourced from the DaimlerChrysler plant at Stuttgart-Unterturkheim. Unlike other smart models, as standard the engines drive through a conventional five-speed manual gearbox. However, an automated manual similar to that fitted to other smarts is an option.

Operating the five-speed smoothly is something of an acquired technique. Steering-wheel-mounted shift paddles are available with the system that is called "softouch plus." The crawl function for very slow speeds, such as maneuvering in a car park, is comparable to a torque-converter-based automatic system. It seems likely that the formore SUV for the U.S. will have a conventional torque-converter automatic.

All forfours get electric power steering, ESP (Electronic Stability Program), and four-wheel disc brakes. ESP incorporates Hydraulic Brake Assist and a differential lock facility. ABS, including Electronic Brake Force Distribution, is integrated within the ESP system.

In keeping with smart's established structural design, the forfour incorporates

an extrapolated version of the company's "tridion" steel safety cell design and uses colored and interchangeable thermoplastic body panels. High stability of the passenger cell was achieved by the use of parallel side members running under the whole vehicle floor from front to rear. Together with the solid sill sections, these ensure the necessary high degree of rigidity, states smart. The car's doors are of

extruded aluminum section and aluminum sheet, with the plastic paneling attached. Safety systems include two full-size airbags plus side bags, with window bags as an option.

The rear seat of the forfour has 150 mm (5.9 in) of longitudinal adjustment to create more passenger or luggage space; maximum luggage volume with seats folded is 910 L (32 ft³). Roof choices are a solid plastic

type; a panoramic glass roof; and a large, power-opening sunroof.

A sports package is an option on all versions of the forfour. It includes lowered suspension and 6.5 x 16 in wheels with 205/45R-16 H tires. Long established as special equipment suppliers for Mercedes-Benz models, there will be a **Brabus** version of each smart model line.

Stuart Birch

From bicycles to cars in China



The Kunpeng takes its name from a legendary Chinese animal that would transform from a fish into a bird. There are several exterior design cues that embellish the fish motif, such as the headlamps.



Jiexun, which translates to national hero in Chinese, has a shape that carries through the look of a sports coupe with the functionality of a station wagon.

Bicyclists in Beijing, China, increasingly are putting down the kickstand on the two-wheelers and opting for transportation of a different kind. "Within the last four years, bicycle registration has dropped by more than 22%," said Tom Chubb, Vice President of Marketing for **Michelin** Automotive Industry Division, noting that, in Beijing, the number of commuters using bikes dropped to 20% in 2002 from more than 60% in 1998.

As more Chinese look to automobiles for transportation needs, the 2004 Michelin Challenge Design sought vehicle designs intended for the Chinese market in its annual judging event. The 2004 competition recorded 103 entries from 27 countries.

"We created the Michelin Challenge Design because design and innovation are central to virtually everything we do at Michelin," said Chubb. "Working with vehicle designers, we gain a better understanding of markets, technologies, engineering, and future needs."

Winners in the 2004 design competition, displayed at the 2004 NAIAS earlier this year, are the Jiexun concept vehicle

from the **I.DE.A Institute** in Italy and the Kunpeng from China's **Pan Asia Technical Automotive Center (PATAC)**, whose parent companies are **Shanghai Automotive Industries Corp. (SAIC)** and **General Motors**.

The Jiexun showcases a pointed, delta-shaped hood. "The arrow-shaped front end, besides being a main styling feature, creates less obstruction in tight turns and ensures very good crash protection, particularly in offset crashes," said Paolo Caccamo, CEO of I.DE.A. Institute.

Six lenses, connected through fiber optics to a main central light source, compose the headlamps and feature "active connection to steering wheel movements," according to Caccamo. Side mirrors are prismatic, which add to the vehicle's aerodynamics and noise reduction. "Solar cells on the roof structure capture solar energy, providing a small but useful additional energy source," said Caccamo.

The D-segment vehicle can be fitted with four or six seats to meet the "uses of an emerging market like the Chinese," Caccamo said, adding that

several body derivatives could be generated on the same platform.

Kunpeng, which provides seven seats, purposely avoids being a technical-breakthrough vehicle. "The car is intended to be a fairly low-cost vehicle," said James Shyr, Director of Design at PATAC. Shown with fiberglass one-piece body sides, if taken to production the vehicle would use stamped steel instead, "as it's still the cheapest to produce," said Shyr. And instead of the concept's transparent roof, a production version would have a manual sunroof, according to Shyr.

"This is basic but stylish transportation," Shyr said, adding, "We have designed this vehicle with the lifestyle of the average Chinese person in mind."

Both the Jiexun and the Kunpeng were shown in 2003 at a major auto show in Shanghai. "I'm going to make a prediction that within five years there will be Chinese vehicles on their own stand at the North American International Auto Show in Detroit," said John Grimaldi, President of the Original Equipment Tire Business for Michelin Worldwide.

Kami Buchholz