Issue 02/2004

Porsche **Engineering** Magazine

Ceramic clutch:
The PCCC (Porsche Ceramic Composite Clutch) from Porsche – a world first fitted as standard in the Carrera GT super sports car.

Wheelchair chassis:
The electric wheelchair from the Alber company sets new standards in its segment. Porsche Engineering played an instrumental role in the development of the chassis.

Focus on the complete car:
Porsche's competence in the development of high-performance variants is particularly evident in the 911 GT3 RS, which has been fitted out especially for motor racing.

Porsche Engineering Group GmbH (PEG), a subsidiary of Dr. Ing. h.c. F. Porsche AG, is responsible for the sports car manufacturer's worldwide contract development activities.

Porsche is the only car manufacturer to place its comprehensive engineering know-how at the disposal of international customers from various branches of industry.

Together with its subsidiaries in Germany and abroad, the Porsche Engineering Group offers engineering services relating to the area of cars and transportation worldwide under the joint brand name of Porsche Engineering.

To this end, Porsche Engineering is able to draw on the capabilities of over 3,000 employees from the areas of design, prototype construction, testing, process planning, procurement, logistics or production.

If you would like to know more about Porsche Engineering, please send an e-mail requesting our image brochure to the following address:
stefanie.landenberger@porsche.de

Insights

The new Porsche 911 comes in two variants
Page 21

Electrics & Electronics — **Complete Vehicle** — Industrial Engineering — Styling — Production Support

Expertise in complete vehicle development
Page 17

Special
Design and testing working hand in hand for 30 years
Page 22

Dear readers,

Once again, this issue presents a small selection of projects from Porsche's development activities. Porsche Engineering stands for innovative solutions. Solutions which we also offer to you, our international customers. After all, why should you need to re-invent the wheel?

Lightweight design. In this issue we present the Carrera GT's innovative body structure made of carbon fiber materials. The development of this structure called on our engineers to to optimize existing technologies and to try out a whole range of new approaches. In addition to the monocoque, the subframe has also been developed in carbon fibre-reinforced plastic (CFRP) - an absolute first for a standard production vehicle and a highly practical development for everyday use.

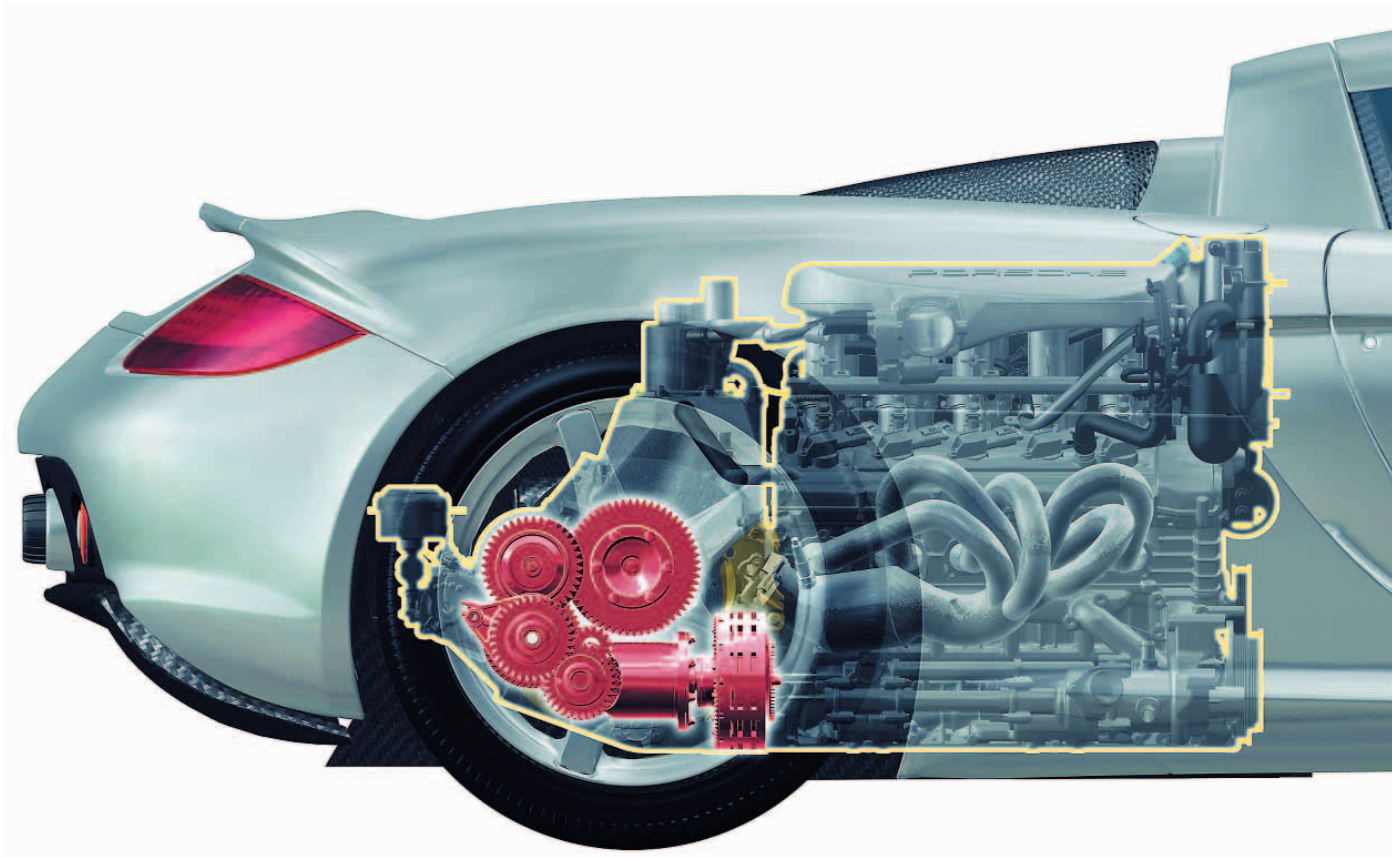
Low position design. Another technological highlight is the new Porsche Ceramic Composite Clutch (PCCC), which has initially been developed especially for the Carrera GT. In addition to optimising the weight of the vehicle, the lowest possible position has also been achieved for the powertrain. This called for a small clutch, however. Here again, the focus is on practicality in everyday use.

High performance. Porsche Engineering has long been a partner to international vehicle manufacturers in developing high-performance variants of standard production vehicles. Early examples here include the Audi RS2 or the Mercedes-Benz 500E in the 1990s. This issue illustrates the special challenges involved in developing a high-performance derivative on the basis of a standard production vehicle by reference to the current 911 GT3 RS.

One quality which our customers value is our willingness and capability to venture into other fields of application. We develop an array of other products, in addition to cars. One area is medical engineering. Our experience from the automotive field led to astounding results in developing the chassis for an electric wheelchair.

We hope you enjoy reading this issue.

The ceramic clutch – a world first from Porsche



The ceramic clutch enables a particularly low center of gravity for the engine.

The Carrera GT super sports car is the first standard production vehicle in the world to be fitted with the Porsche Ceramic Composite Clutch (PCCC). The double-disk dry clutch developed by Porsche meets the typical racing requirements of a small diameter and low weight combined with a long service life.

Porsche set itself ambitious aims in developing the Carrera GT: The overall objective was to evolve a super sports car from existing racing vehicle concepts which would be suitable for everyday use and which could be produced in small batches. One of the central topics here was the clutch, which needed to be as light and as small in diameter as possible, as the position of the center of gravity is a crucial factor in a vehicle which sets out to be a super sports car. The smaller the clutch and the shorter the distance between the center of the crankshaft bearings and the underside of the engine housing, the lower the engine can be installed and the lower the center of gravity will be. Previously, only a carbon-fiber clutch had been able to provide these typical racing characteristics. This option would have fallen short of the given requirements with regard to service life, driver comfort and practicality in everyday use, however.

The Carrera GT is the first standard production vehicle worldwide to be fitted with the new ceramic clutch.

As no appropriate clutch system for the Carrera GT was available on the market, Porsche's engineers teamed up with selected partners to develop a completely new clutch using innovative materials for friction disks and linings.

In the course of these development efforts, the specialists were able to draw on experience which they had acquired with the Porsche Ceramic Composite Brake (PCCB). The short-staple reinforced ceramic material proved an extremely robust, heat-resistant and durable option here.

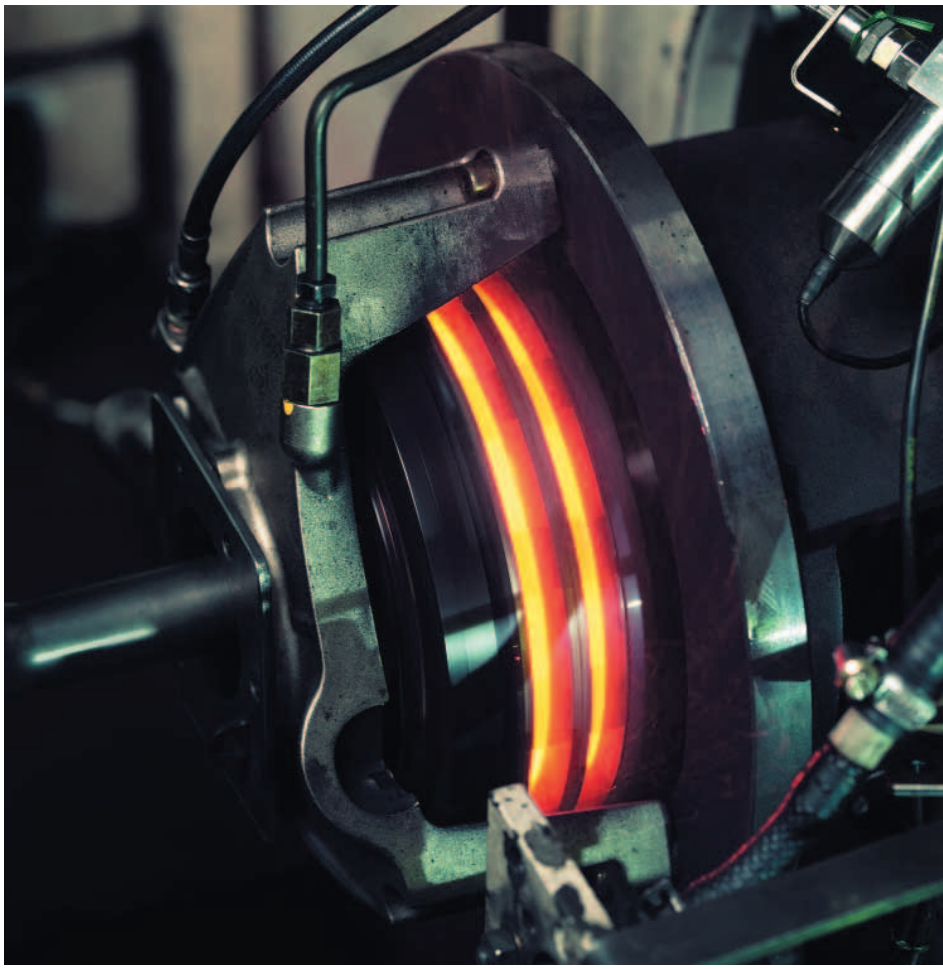
In the first test, a conventional clutch was configured with a short-staple fiber ceramic material. The conventional material failed to withstand the stress induced by centrifugal force and friction heat. The special innovative arrangement of a fabric structure consisting of carbon fibers as the load-bearing element enabled the strength of the carbon fibre-reinforced silicon carbide disks to be increased to such a degree that the clutch system was able to withstand engine speeds of up to 20,000 rpm combined with extreme thermal loads without incurring any damage.

A water jet cuts the friction disk out of the ceramic plate at around 3,000 bar.

Several layers of carbon fibre fabric are processed with carbon-rich resin to produce plate material, which is subsequently converted into carbon at approximately 800 degrees Celsius and then siliconized at 1,400 degrees Celsius. The individual disks are cut out of the resultant ceramic plates by means of a high-pressure water jet.

The subsequent tests confirmed that these disks were now able to cope with the high levels of stress, displaying only a very slow rate of wear.

The driver comfort aspect also had to be taken into account. The dynamic ten-cylinder engine with its extremely low rotational mass made moving off with the necessary comfort a particular challenge for the Porsche developers.



The PCCC in the overload test on the Porsche test bench.

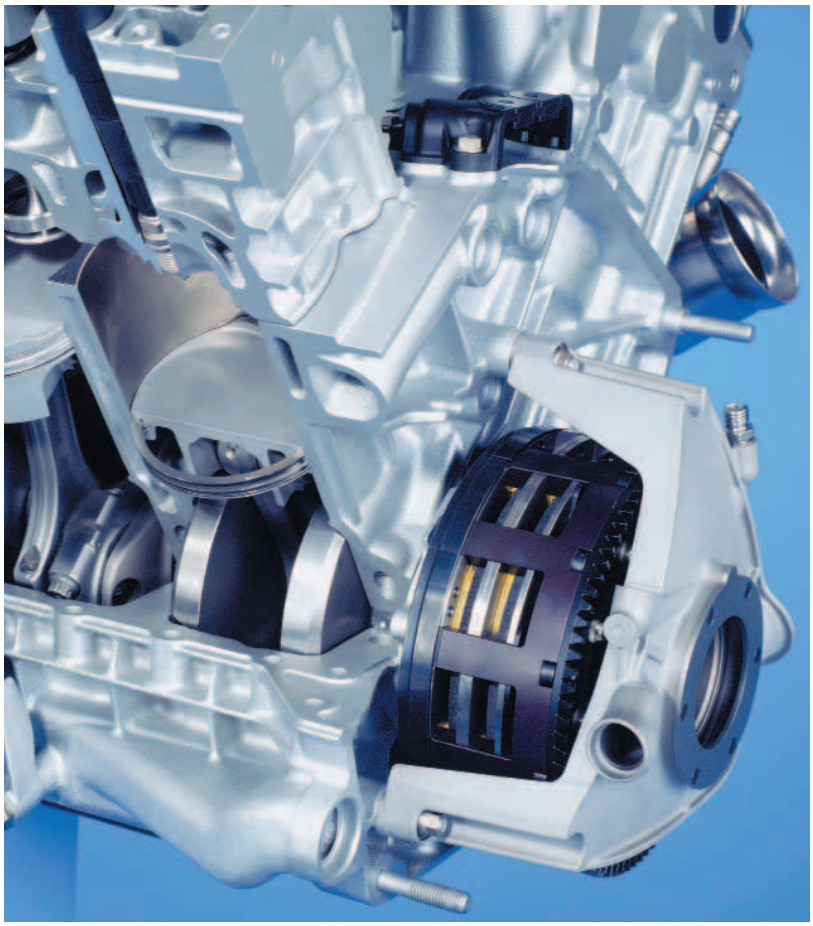
The synchronization of the manual transmission was optimized so as to require only low shifting forces.

When tests carried out on the test bench to examine misuse revealed temperatures of over 800 degrees Celsius in the ceramic friction disks, it became clear that the materials for all the components in the clutch would have to be selected with corresponding care.

The maximum thermal load for the disks made of carbon fibre-reinforced silicon carbide is over 1,400 degrees Celsius and is thus not a critical factor.

Lining carrier disks made of titanium with rivetted-on sinter linings were chosen for the driving disks. This choice combines resistance to centrifugal forces and high temperatures with low weight and a subsequent low rotating mass.

Comprehensive tests on the test bench and extensive trials in the vehicle under extreme loads showed that the PCCC is able to at least match the service intervals of conventional clutches.



The small diameter of the clutch disks enables a low position for the crankshaft.

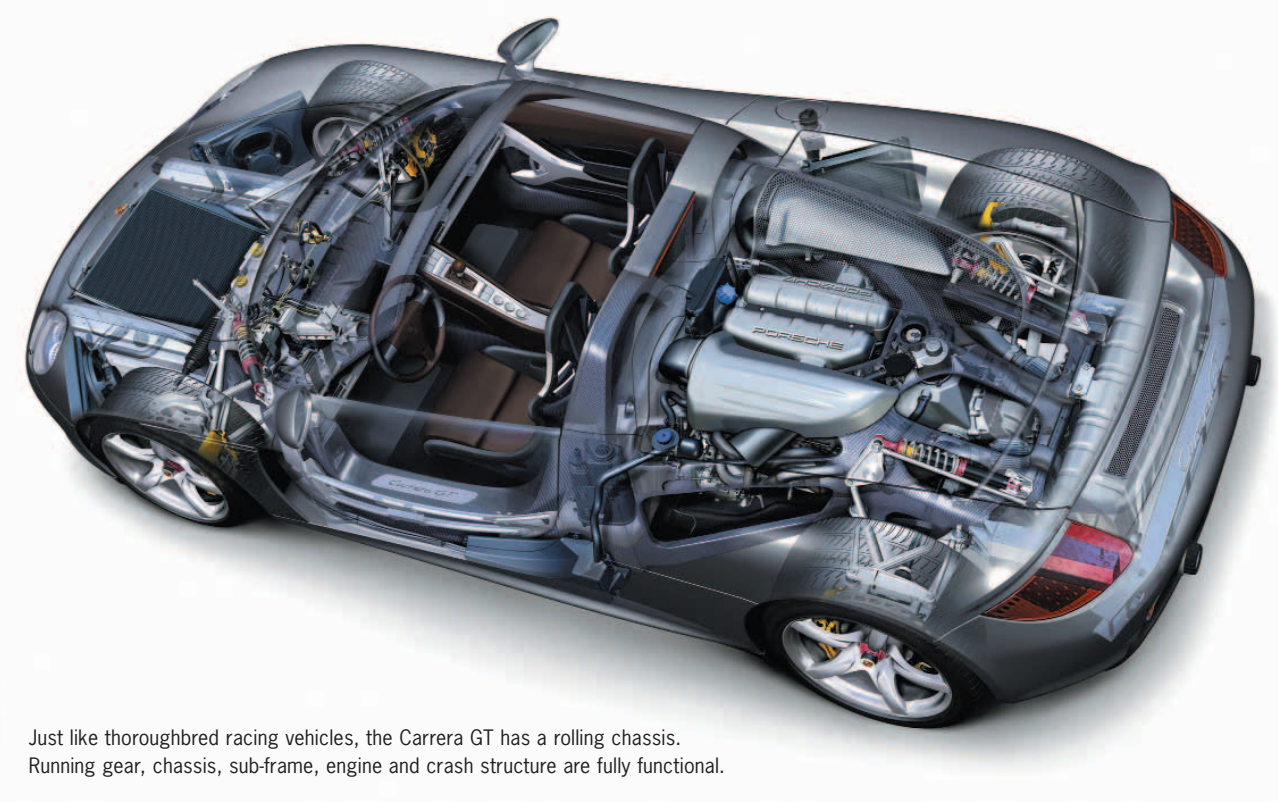
The engineers have thus more than met the requirements for the clutch of the Carrera GT. Notwithstanding the fact that the costs are substantially higher than that of a conventional clutch on account of the highly involved production process and the small quantity produced to date.The PCCC trailblazes a line of development which possesses excellent future prospects for high-stress applications in standard production vehicles, too.

The comprehensive experience which Porsche's engineers have acquired in the fields of composite ceramics, PCCC and series production can be applied in the development of the most diverse types of drives - particularly in the high revs range. Porsche Engineering offers this knowledge in the international arena. ■

Technical information

Type	Two-disk dry clutch
External diameter	192 mm
Weight	3.5 kg
Materials	Carbon fibre-reinforced silicon carbide
Transmission	Maximum of more than 1,000 Nm
Run-out speed	Over 20,000 r.p.m.

Thoroughbred racing engineering for safe and enjoyable driving



Just like thoroughbred racing vehicles, the Carrera GT has a rolling chassis. Running gear, chassis, sub-frame, engine and crash structure are fully functional.

The Porsche Carrera GT is high-tech incarnate. In developing this vehicle, Porsche's engineers have managed to integrate pure racing technology into a high-performance vehicle suitable for everyday use. As is customary in motor racing, the Carrera GT features a so-called rolling chassis.

Low weight, maximum torsional rigidity and a low center of gravity were the main objectives addressed by the Porsche development engineers. As is customary in motor racing, the chassis is also the central component of the Carrera GT, comprising monocoque, windscreen frame and roll-over structure. The development team soon agreed that the monocoque should be made of carbon fibre-reinforced plastic (CFRP), as only fiber composites combine low weight with maximum rigidity to guarantee the desired characteristics of maximum performance, dynamics and safety. The monocoque fulfills all the structural functions, such as the transfer of reaction forces from the chassis and the drive, which are normally performed by the body shell. In contrast to the conventional body design featuring a large number of individual components, the monocoque is produced from a few CFRP shell elements which are bonded together in high-pressure ovens.

This solution promptly gave way to the next difficult question: What was the rear of the car to look like and how was it best to be connected to the monocoque?

When the car is in use, the sub-frame is continuously exposed to sources of extreme stress in the form of heat, oil, moisture or road salt. Following extensive tests and theoretical analyses, the Porsche engineers were certain that the rear part of the car could be produced in carbon fibre-reinforced plastic. This was a revolutionary breakthrough, as up to this point the material had only been used in the aerospace sector or for structural and panel parts in motor racing.

The chassis and the bolted-on sub-frame are the key structural components, forming a torsionally and flexurally rigid unit – the Carrera GT's backbone, as it were. They support the front and rear wheel suspension and absorb the forces acting on the vehicle from the crash structures. At the same time, they also support and serve as a bearing structure for the panel components and the interior.

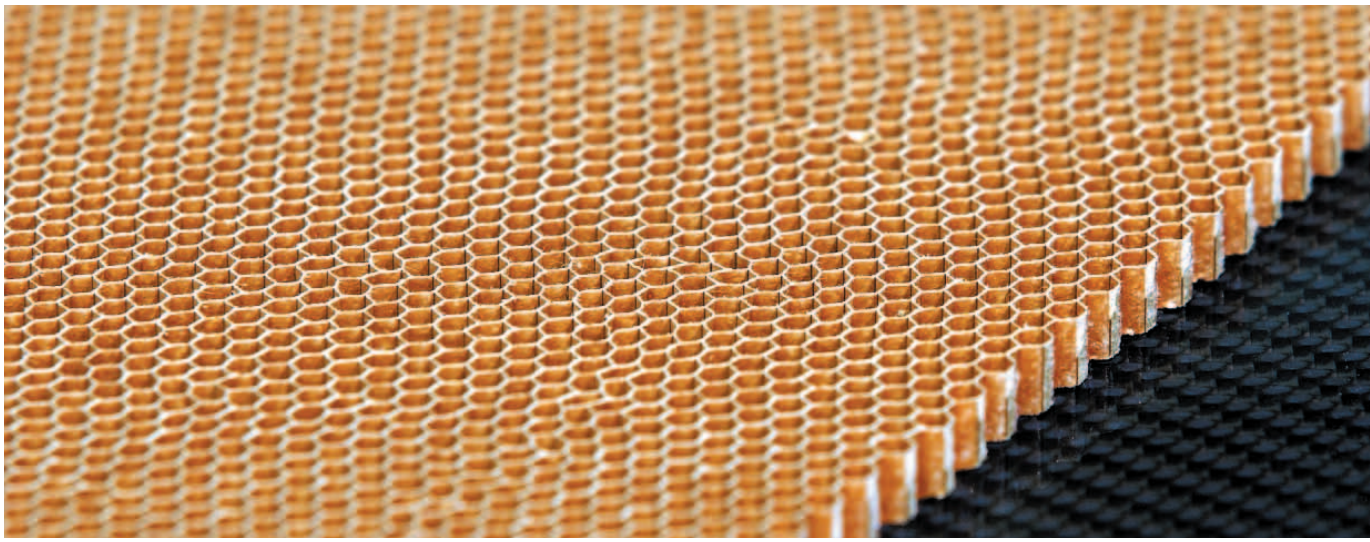
An integral body frame is the norm in car manufacturing today. In contrast, the Carrera GT features a so-called rolling chassis – just like a thoroughbred racing car. The fully functional rolling chassis comprises the chassis itself, sub-frame, drive, running gear and crash structures.

Sophisticated processing of carbon fibers

The structural parts are manufactured by means of an involved manual process in so-called sandwich design. The monocoque consists of around 1,000 individual blanks. The production process for each CFRP component begins by placing carbon fiber mats impregnated with synthetic resin (prepregs) in the respective production moulds. Resin type, fiber type, fiber orientation and the thickness of the fabric mats are dependent on the load range or area of application and the subsequent function of the component concerned. Accordingly, these parameters require to be defined. Porsche has obtained crucial information on the behavior of the structure under operating loads and with due regard to the worldwide safety requirements by means of comprehensive FEM simulations.

Depending on the given requirements, additional layers of up to 20 millimeter thick honeycomb material are placed on the inserted mats with adhesive films as packing between the CFRP outer layers. The honeycomb material is made of aluminum or aramid paper, depending on the component's intended function.

Additional layers of impregnated carbon fiber matting are then laminated on. This leads to a substantial increase in the rigidity of com-



So-called honeycomb material between the individual CFRP layers provides for additionally enhanced rigidity on components which are subject to particularly high levels of stress.

ponents which are subject to particularly high levels of stress.

To enable the attachment of additional components to the load-bearing CFRP structure - from simple screw connections to attachment points for the chassis or drive which are subject to high levels of stress – aluminum inserts are laminated into the structure and structurally bonded with the outer carbon fiber layers in an autoclave. The Porsche engineers conducted in-depth investigations into the specific electrochemical properties of the carbon fiber materials in conjunction with the metallic materials commonly used in car manufacturing. On the basis of this knowledge, they were able to develop special coatings or barriers which met the high quality requirements for every type of application.

Components are attached to laminated-on aluminum inserts.

Finally, the mould is sealed air-tight with a foil, evacuated and subjected in an autoclave to a pressure of 6 to 8 bar and – depending on the given requirements – to a temperature of over 180 degrees Celsius. In the course of this process, the resin systems polymerize and bond honeycomb or inserts with the carbon fiber via the adhesive films.

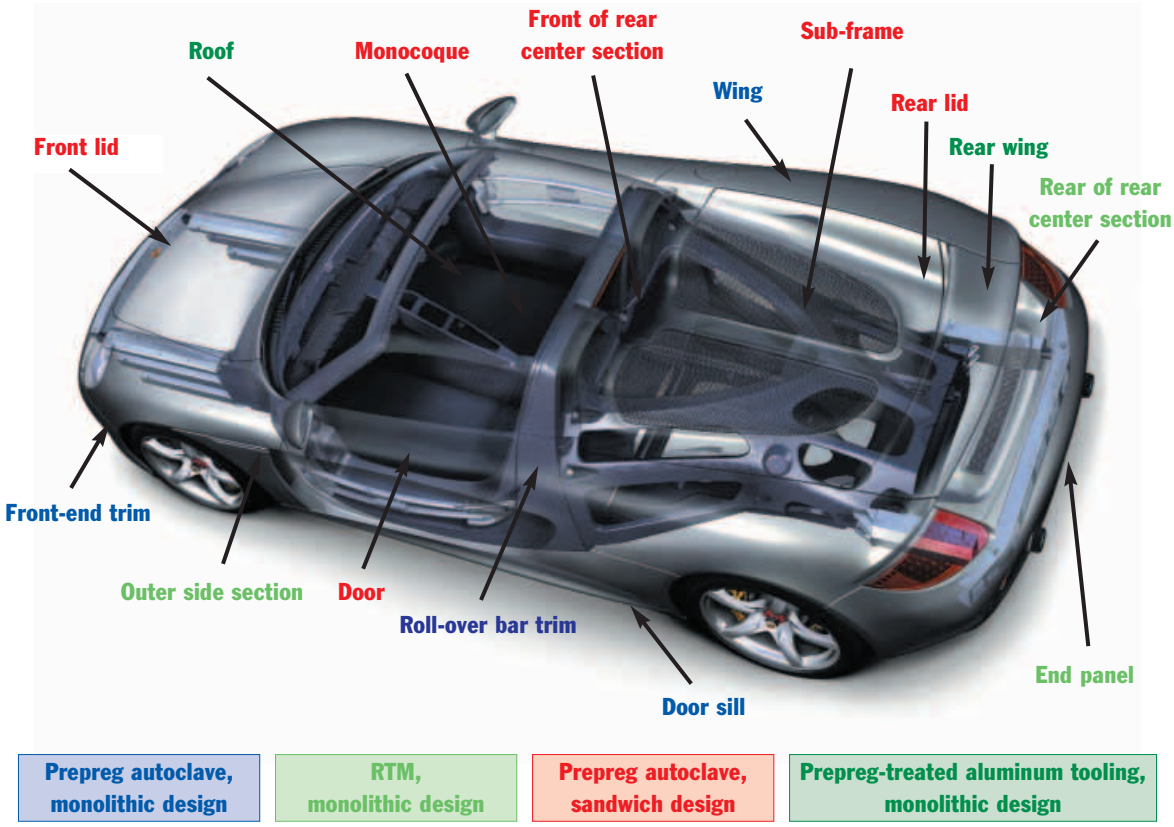
Despite their enormous capacity to withstand stress, most CFRP parts weigh up to 40 per cent less than comparable conventional components, which means that the Carrera GT sets new standards in terms of weight. The entire monocoque weighs in at barely 100 kilograms.

High level of safety as a result of carbon fiber composites

Porsche's engineers opted for carbon fibre composites as the material for the Carrera GT's high-performance components, as this is the only material able to combine maximum performance and driving dynamics with minimum weight and maximum rigidity. As a result of these properties, the high-tech fiber also offers a very high standard of safety. The Carrera GT attains the highest possible level of flexural and torsional rigidity for a standard production roadster. This outstanding overall rigidity is even far superior to the high level attained by a modern coupé.

Chassis, sub-frame and crash structures: Austenitic stainless steel absorbs the major part of the energy acting on the vehicle in a crash.

The Carrera GT's safety concept is based on the current requirements in motor racing. It is designed to ensure that the monocoque remains free of any structural damage in the statutory tests. A rigid passenger cell ensures the necessary survival space. The major part of the energy acting on the vehicle is absorbed

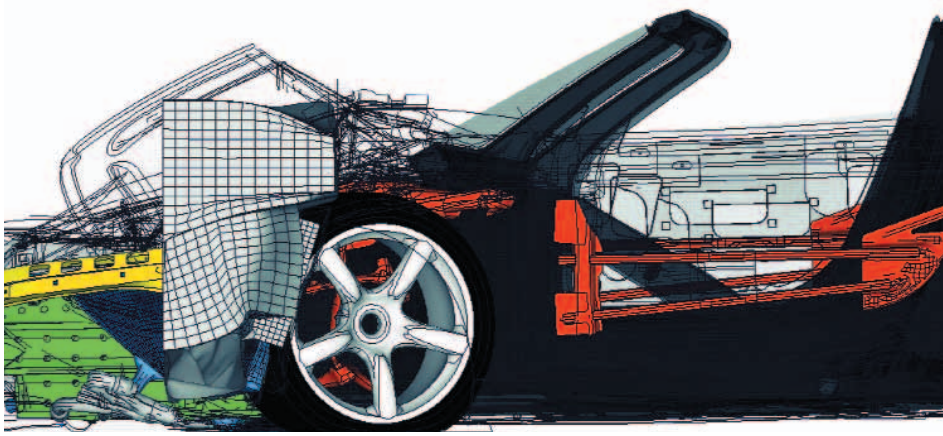


Apart from the monocoque and sub-frame, numerous other components are also produced in CFRP.

by the crash structures, which are made of austenitic stainless steel.

Porsche has examined the vehicle's crash behavior in extensive virtual tests. The engineers conducted extensive research in order to obtain an understanding of the overall system. In this context, suitable simulation tools were defined, detailed material structures were mapped in an FE model, material laws were evolved and simulations and experiments were systematically compared at the key stages of the development process. In order to examine the interaction of monolithic and sandwich materials in combination with metallic materials, for example, each individual carbon fiber layer was mapped in a calculation model.

The engineers have optimized this method to such an extent that the behavior of carbon fibers and steel in a crash can be calculated with a very good degree of correlation to experimental investigations.



The frontal crash simulation calculation – here with 40% overlap – corresponds to the experiment.

Porsche's competence in CFRP

In the course of developing the Carrera GT, Porsche has examined CFRP and its properties in great depth under the most diverse conditions. Aspects such as long-term and corrosion behavior, surface quality and crash properties have been examined in detail, calculated and optimized for the Carrera GT.

Porsche has also managed to develop the CFRP components for exterior and interior in a very high quality with regard to appearance.

The diverse modes of use for fiber composites in the Carrera GT have provided Porsche's engineers with an extensive knowledge of these materials which enables them to offer competent solutions in all manner of areas relating to CFRP.

This makes Porsche Engineering the right address when it comes to developing carbon fiber components – and not only in the automotive field. ■

A wheelchair all set for adventure

The Adventure remains a reliable means of transport, even on difficult terrain.

The Adventure wheelchair from the Ulrich Alber company sets new standards in the field of electric wheelchairs. Sporting a modern design, it is modular, light, comfortable and safe. Porsche Engineering played an instrumental role in the development of the chassis.

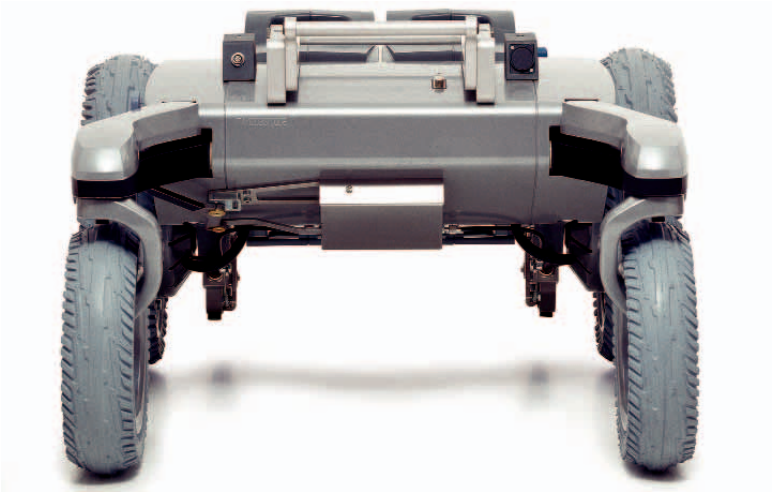
High curbs, cobblestones or countryside tracks often mean the end of the road for wheelchair users. Previously, those electric wheelchairs which were able to navigate such barriers offered the user little comfort and safety. A further drawback was the heavy design of many wheelchairs, which meant that they could only be transported in a special vehicle.

Ulrich Alber, a company based in Albstadt-Tailfingen, Germany, which specializes in rehabilitation equipment, launched an ambitious project to address the numerous problems in this area. The Adventure was designed in just three years. This electric wheelchair with full suspension is suitable for indoor and outdoor use. It is a reliable means of transport, even in difficult terrain.

Alber called on the engineers from Porsche Engineering for support in developing the chassis. The chassis specification for the Adventure placed the priority on a lightweight construction, comfortable suspension and an all-round attractive design. It was also important for the wheelchair to be easily dismantlable and stowable in a mid-size car by one person without great effort.

In view of these requirements the engineers quickly opted for independent wheel suspension as is used in cars. Each wheel is provided with full suspension and hydraulic damping. This ensures that the electric wheelchair remains stable and very comfortable, even on uneven terrain. The effective damping additionally benefits users who are susceptible to spasms triggered by vibrations.

On the front axle the wheels are installed on two parallel wishbones. This ensures constant castor throughout the entire suspension travel. The spring and damper element work together with a stabilizer in a central case (extruded profile). The stabilizer reduces tilt substantially on uneven terrain, ensuring that the user feels safe and secure at all times. A rectangular tube serves as a stabilizer which is adjustable to the user's individual weight.

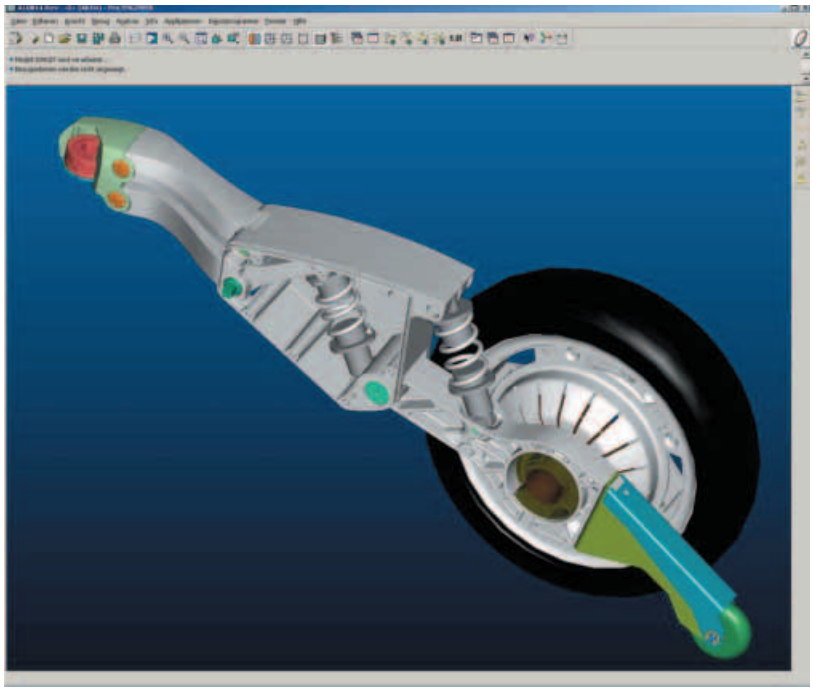


The wheels fitted on two parallel trailing links are suspended on one-armed forks which transmit all operating loads.

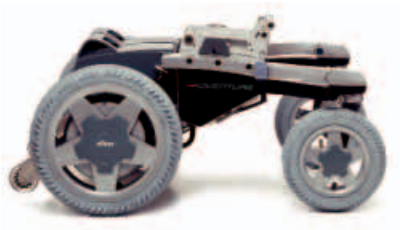
Anyone who has pushed a supermarket trolley will be familiar with the way the trailing wheels block as a result of torsional vibration. Such an unpleasant situation can also apply to wheelchairs. Following comprehensive test runs at a test site which Albers set up especially for this purpose, the engineers opted for a light rotary damper based on an elastomer. This damper prevents vibration of the steering wheels at all speeds, without compromising the wheelchair's maneuverability or taking up any valuable space in the footwell.

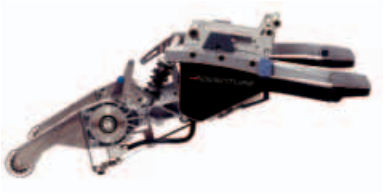
The front wheels are suspended on the inside on a one-armed fork. This delicate fork is fully in keeping with the design concept and safely transmits all the operating loads. The Porsche engineers arrived at this solution by mapping a non-linear calculation model of the wheelchair with user. This enabled precise prediction of the effects of the forces acting on the wheelchair when passing over an obstacle, for example.

The electric wheelchair features a trailing link at the rear. This link is attached to the rear wheel via a



bayonet connection and establishes electrical contact with the wheel-hub drive in the rear wheels. The suspension and damping are visible here and are also continuously adjustable to the user's needs.

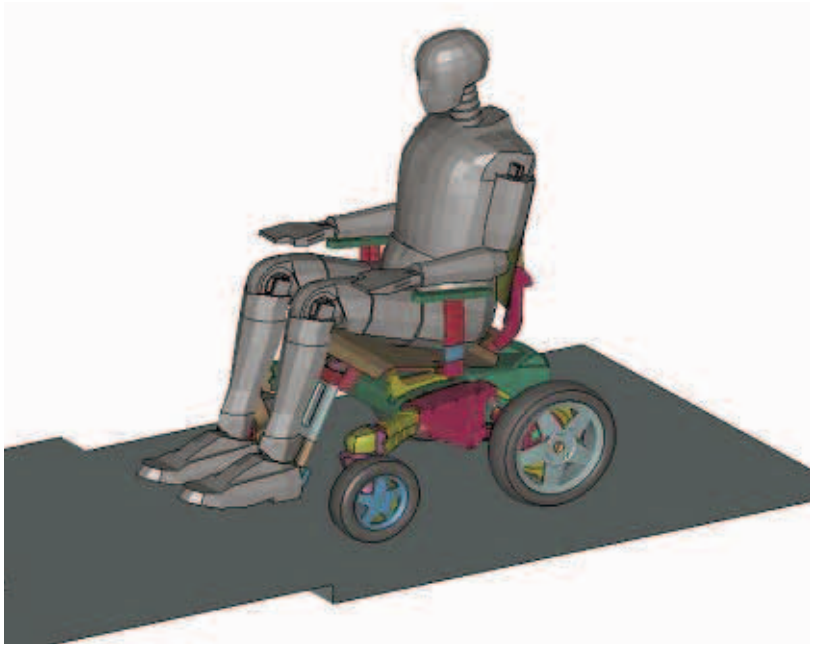




Each wheel is provided with full suspension and hydraulic damping.

Steering is effected via different speeds of the drive wheels; the front wheels steer in passive mode. This enables the wheelchair to turn on the spot. The wheel hub motor developed by Alber itself is particularly efficient, enabling the use of relatively small batteries. This, in turn, has a positive effect on overall weight, agility and range. The modular design enables batteries, wheels and seats to be removed from the chassis quickly and without the use of any tools.

The new wheelchair concept has already come in for recognition: The Adventure has received the "red dot award: product design 2004" for outstanding design. The Adventure achieved the ranking "red dot: best of the best". Of 1,673 products, 381 received awards, with 33 making the "best of the best" category. The "red dot" is awarded annually by the Design-Zentrum Nordrhein-Westfalen, Germany. ■



A non-linear calculation model of the wheelchair and user enables precise calculation of travel over obstacles.

Technical information

Weight	96.7 kg
Max. load	140 kg
Top speed	12 km/h
Suspension travel front/rear	58/58 mm
Range	Up to 45 km
Climbing ability with load of 140 kg	18 %
Turning radius	0.88 m

Expertise in complete vehicle development

The development of high-performance derivatives requires in-depth expertise in the area of tuning and adapting the complete vehicle. Porsche's competence in this field is particularly evident in the 911 GT3 RS, which has been developed especially for motor racing.

Porsche has a long tradition of developing high-performance variants based on existing vehicle models. Customer projects from this field are also playing an ever more significant role. The Audi RS2 and Mercedes-Benz 500E were developed together with Porsche, for example.

Developing a series model into a high-performance derivative is about much more than simply lowering the vehicle and improving performance by means of a harder chassis and spoilers. Safety requirements in particular mean that the entire vehicle has to be adapted to the increased power and enhanced driving dynamics.

Porsche's all-embracing competence in this area is illustrated particularly well by the example of the 911 GT3 RS.

After a period of more than 30 years, Porsche decided in 2003 to build a successor to the legendary Carrera 2.7 RS (1972) and the 911 SC RS (1984) as a limited edition. The aim

Tuning and coordination of the 911 GT3 RS were carried out in close collaboration between Motor Racing and Series Development.

was to develop a thoroughbred high-performance variant of the 911 which could also serve as a homologation model for international GT motor racing. In addition to an optimum power-to-weight ratio, the road variant was also to possess technical refinements which could subsequently be deployed in the racing version.

To ensure the desired enhanced performance, the chassis, body, engine, exhaust system, tires, aerodynamics and interior of the 911 GT3 RS were modified and duly coordinated.

Fully revised chassis geometry

In order to bring the 911 GT3 RS into shape for the race track, the vehicle's center of gravity was first of all lowered, as a result of which the RS is 30 millimeters lower than the 911 Carrera. The chassis was also fully revised with regard to spring rates, spring characteristic and damper characteristics. As the lowering of vehicles generally results in an undesired enlargement of the wishbones' working angle, specially developed wheel carriers are deployed on the 911 GT3 RS. The modified attachment points of these wheel carriers enable horizontal positioning of the wishbones despite the lower position of the vehicle. This leads to a harmonious camber characteristic over the compression and rebound travel. This renders the vehicle more readily controllable in extreme driving situations and results in noticeably more precise steering.

The wheel carriers of the front axle incorporate a double clamp for the spring struts which further enhances guidance of the front axle. This results in an even more stable vehicle, particularly during heavy braking on race circuits.

The dynamic performance potential of the RS is only exploited to the full as a result of the combination of lower center of gravity, modified suspension and damping, optimized stabilizer characteristic and a tailor-made chassis geometry. The resultant effect goes well beyond the "lower and harder" formula. A particularly detailed understanding of the way in which the individual measures interact is crucial to achieving this result.

Lighter and safer: The body

To ensure an optimum power-to-weight ratio for the 911 GT3 RS, the bodyshell was made lighter than that of the 911 GT3, without compromising on safety in the process. Additional weight advantages are achieved by producing the wing and the front hood in Carbon/Kevlar. A standard lightweight roll cage offers the occupants protection in more ways than one. The cage additionally braces the attachment points on the body, thereby optimizing the properties of the 911 GT3 RS's chassis and providing for more precise handling.

Special openings in the front section deliberately direct the exhaust air from the radiators over the vehicle.

The 911 GT3 RS possesses no lift, guaranteeing optimum driving stability.

Drive and drivetrain dynamics are key to the car's character

The lightweight concept also extends to the engine. In particular, the rotating masses must be as minimal as possible. This is the only way of achieving higher engine speeds and increased power output with the same displacement.

Porsche's engineers were able to reduce the weight of the valve drive by a total of two kilograms, for example, by using hollow camshafts and newly developed lightweight tappets. The tappets of the 911 GT3 RS now have a diameter of only 28 millimeters and a curved base. This so-called crowning of the base makes it possible to reduce the diameter, as the necessary surface contact between tappet and cam is retained. The valves are also produced in a high-strength, lightweight material. A special valve produces a vacuum in the crankcase which reduces the engine's pump losses.

The connecting rods are made of titanium. A lightweight crankshaft which is plasma-nitrided for increased strength and pistons of reduced weight round off the lightweight engine concept.

The connection between engine and transmission on the RS is established via a single-mass flywheel, which possesses a lower rotational mass than a dual-mass flywheel. Special control units take account of the attendant parameters to ensure perfectly coordinated engine management.

A specially developed back-pressure hood facilitates aspiration of the engine. At high speeds, this hood results in overpressure at the air inlets, thereby facilitating air intake by the engine and generating more power – up to 15 bhp at top speed. Here too, however, the interaction between individual components requires due consideration – the resonance intake system must be coordinated perfectly with the back-pressure hood.

The lively engine now generates 280 kW (381 bhp) at 7,300 r.p.m. from a displacement of 3.6 liters. The maximum engine speed is 8,200 r.p.m. The volumetric efficiency stands at 105.8 bhp.

Optimum aerodynamics

In order to achieve optimum aerodynamic behavior in accordance with the enhanced performance, a compromise has to be found between the lowest possible lift at the front and rear axles and a low drag coefficient. The large rear wing provides the 911 GT3 RS with increased downforce at the rear axle. In order to bring the downforce at the front axle into balance

The large rear wing provides the 911 GT3 RS with increased downforce at the rear axle.

with this rear downforce, the engineers incorporated special openings in the front section for the exhaust air from the radiators. As a result, the exhaust air from the radiators is deliberately directed over the vehicle and the desired balance is restored between the downforce at the front and rear axles.

The 911 GT3 RS as a whole does not possess any lift, resulting in excellent driving stability at high speed.

Tailor-made tires

The tires also require specific design in keeping with the vehicle's enhanced performance and the possible use on the race track. The 911 GT3 RS possesses ultra high performance tires which permit higher lateral acceleration.

Interior

Naturally enough, the prime focus with regard to the interior design of the 911 GT3 RS was on sporty elements. The entire ergonomics have been geared to use on the race track. The 911 GT3 RS is fitted with the statutory fire extinguisher and the seats are covered in a flame-retardant material. All haptic elements are covered in Alcantara, to offer adequate grip and prevent slipping.

The entire ergonomics of the 911 GT3 RS has been geared to use on the race track.

Impressive performance data

In transforming the 911 GT3 into the 911 GT3 RS, the specialists at Porsche modified numerous components to ensure optimum safety and durability in the face of the new performance data. Tuning and coordination of the overall vehicle was pursued in close collaboration between Motor Sport and Series Development, in order to provide the vehicle with both the necessary racing characteristics and the required practicality in everyday use. The power-to-weight ratio of the 911 GT3 RS now stands at 4.86 kg/kW. With a full tank of 90 liters of fuel, the car weighs 1,360 kilograms (2,998 lbs).

The 911 GT3 RS accelerates from 0 to 200 km/h (124 mph) in 14 seconds. The maximum speed is 306 km/h (190 mph). This high power output is transmitted via a close-stepped 6-speed manual transmission.

Porsche's comprehensive expertise is also available to Porsche Engineering's customers. Porsche is the only renowned manufacturer of high-performance vehicles to place the full scope of its development competence at the disposal of other automobile manufacturers. ■

The new Porsche 911 comes in two variants

For the first time since 1977, Porsche is offering two new 911 models simultaneously – the 911 Carrera and the 911 Carrera S. The sixth generation features an impressive combination of superlative engineering and uncompromising design.

The 239 kW (325 bhp) 911 Carrera is powered by a 3.6 liter horizontally opposed engine. The S version with a newly developed 3.8 liter engine has a power output of 261 kW (355 bhp). 400 Newton meters of torque catapult the S model from 0 to 100 km/h (62 mph) in 4.8 seconds. The Carrera requires exactly 5.0 seconds for this discipline. The maximum speed for the Carrera stands at 285 km/h (177 mph) and for the Carrera S at 293 km/h (182 mph).

Both 911 models feature a newly developed six-speed transmission and a revised chassis which incorporates active damping as standard on the S model. This chassis, which goes by the name of "Porsche Active Suspension Management" (PASM), is available as an option for the 911 Carrera. In "Normal" mode, PASM offers comfortably sporty tuning of the shock absorbers, while after pressing the "Sport" button a harder damper characteristic is activated which supports a particularly agile and sporty style of driving. In addition to PASM, a 20 millimeter lower sports chassis with mechanical rear differential lock is also optionally available for both models.

The wheels and tires have grown in format: The 911 Carrera model is now fitted as standard with 18J wheels in size 8J x 18 with 235/40 ZR 18 tires (front) and 10J x 18 with 265/40 ZR 18 tires (rear). The Carrera S is fitted with 19" wheels/tires in size 8J x 19 with 235/35 ZR 19 (front) and 11J x 19 with 295/30 ZR 19 (rear).

The design of the new Porsche 911 represents an uncompromising continuation of the 911 story, – a blockbuster which has now been running for over 40 years. The new exterior design – including a wider track and a more pronounced mid section – lends the 911 an even more dynamic, clear-lined, powerful and elegant appearance. Other striking features of the evolutionary design are the new circular headlights with additional separate headlights at the front end, more pronounced wings, new double-arm door mirrors, a modified joint style and an aerodynamically optimized rear spoiler. ■

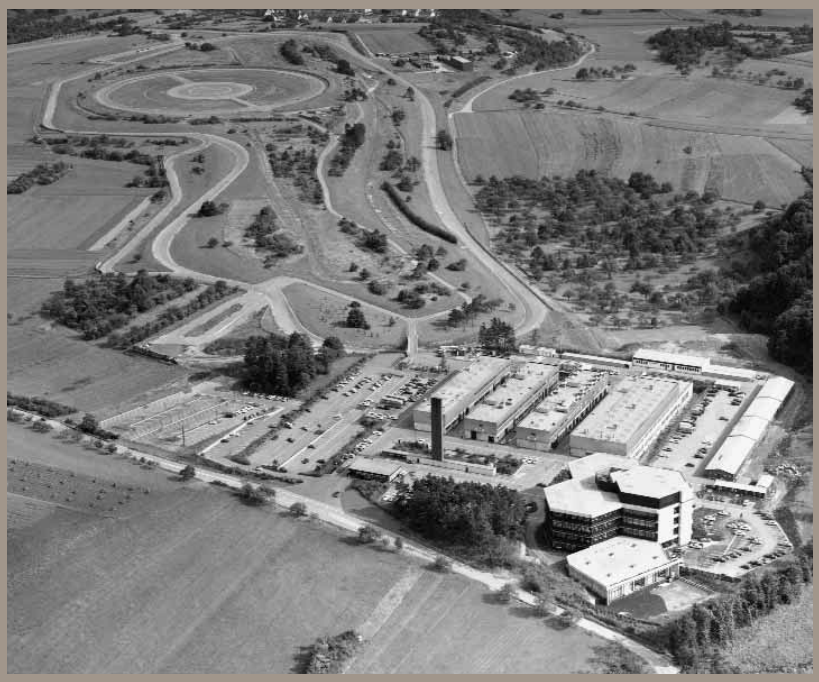
Design and testing working hand in hand for 30 years

It was back in 1974 that Porsche combined the areas of testing and design in Weissach. In so doing, the company established the basis for the "consolidated development center".

The Porsche Research and Development Center has been based in Weissach since 1971. All areas of work relating to trials and testing were first of all located here. The design area, which had been based in Zuffenhausen, subsequently moved to Weissach in the late summer of 1974. This established the basis for today's "consolidated design center".

Despite the enormous growth of the company over the past 30 years, the central approach to development has been retained. Development resources have also been established in Bietigheim and in Troy, USA, to complement the central Research and Development Center.

Optimum networking and communication facilities for the roughly 2,500 technicians and engineers from the various fields of specialization in Weissach are the guarantee for innovative solutions.



Summer, 1975: The areas of design and testing have been jointly housed at the Porsche Research and Design Center in Weissach for a year.

The full scope of development operations is covered at the central Research and Development Center, from individual components to complete drives, from design studies to production-stage prototypes. Development activities do not always focus solely on cars, however. Aircraft engines, fork-lift trucks, advertising pillars or electric wheelchairs are just some examples of development projects which have been carried out under strictest confidentiality for external customers .

Through Porsche Engineering, international customers are able to draw on the full scope of the company's development expertise, from initial concept design through to series production support services. ■

Complete Vehicle · Styling · Body & Safety · Engine · Drivetrain · Chassis · Electrics & Electronics · Testing · Industrial Engineering · Production Support

We love: cars.

We build: cars.

We develop: cars and more.

(And never stop thinking about: cars.)

For more information on contract development services by Porsche:

Phone +49 711 911 - 18 888, Fax +49 711 911 - 18 999

For USA: Phone +1 248 524-0028, Fax +1 248 740-5097

Internet www.porsche-engineering.de, e-mail: peg@porsche.de

Porsche Engineering
driving identities

PORSCHE

Imprint

Publisher
Porsche Engineering
Group GmbH

Address
Porschestraße
D-71287 Weissach
Germany

Tel. +49 (7 11) 9 11-1 88 88
Fax +49 (7 11) 9 11-1 89 99

Porsche Engineering
Services, Inc.
1965 Research Drive
Troy, Michigan 48083
USA

Tel. ++ 1 248 524-0028
Fax ++ 1 248 740-5097

Email: peg@porsche.de
Internet:
www.porsche-engineering.com

Editor
Sabine Schröder
Jens Walther

Porsche Engineering
driving identities