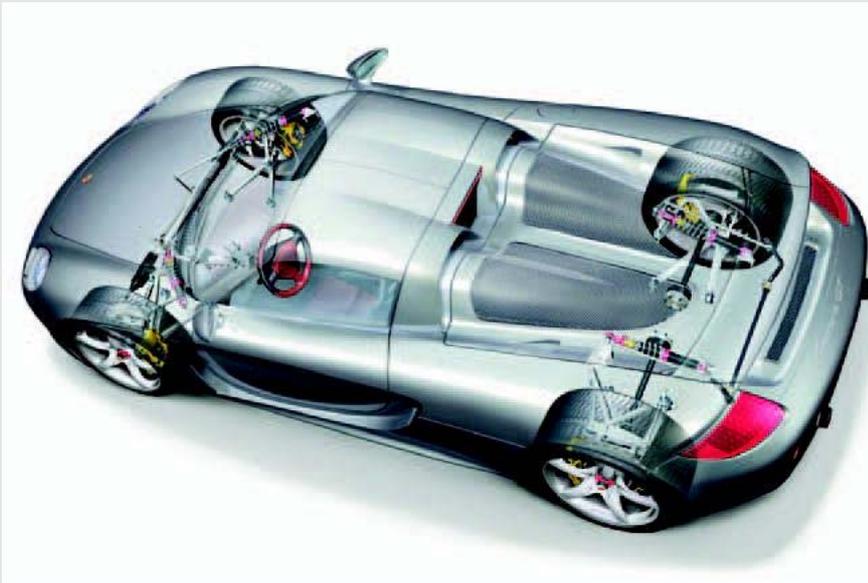


### General



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The chassis design of the Carrera GT is based on the GT1 Le Mans racing car. The speeds achievable with the Carrera GT demand special chassis provision in respect of dynamic response, resilience, springing and damping. For increased dynamic stability when driving at high speeds, measures to generate downforce are necessary. These in turn must be taken into account when arranging springs/shock absorbers, as must the fact that as downforce is increased, air resistance increases also. In consideration of these aspects, the lower cross-struts for the rear axle of the Carrera GT, which lie completely in the airstream, have been designed with an optimised aerodynamic profile. Many detail measures in determining the chassis, the suspension, the tyres and the aerodynamics have resulted in outstanding handling characteristics, steering precision and agility combined with high back end stability. In addition to this the layout and tuning of the chassis achieves well-mannered behaviour on the road even if the driver attempts actions which would change a stable condition to an unstable one.

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## Carrera GT

The Carrera GT chassis, set up without compromise for dynamic performance, is tuned the same for all world markets.

This includes also the vehicle height, which may not be adjusted, since the ground clearance directly affects the aerodynamics of the undertray and thus the downforce of the vehicle.

Appropriate dimensions and measuring points are laid down for checking the vehicle height.

The lower disc springs for the spring struts can be adjusted to allow the loads on each wheel to be set to within the stated tolerances for balancing the vehicle.

Permissible variations in loads on each wheel are 10 kg on an axle and 15 kg diagonally.

The front and rear axles operate on the "Pushrod" principle.

This means that suspension and spring movements are not transmitted directly to the spring arms, but indirectly via a push rod and a rocker arm.



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This has the advantage that the spring struts can be placed where they are not affected by aerodynamic influences and they can be more rigidly attached to the chassis structure. The rocker arm that is required can also be accorded leverage in translating the wheel spring movement to the spring strut, allowing sensitive response to the springing.

## Driving dynamics

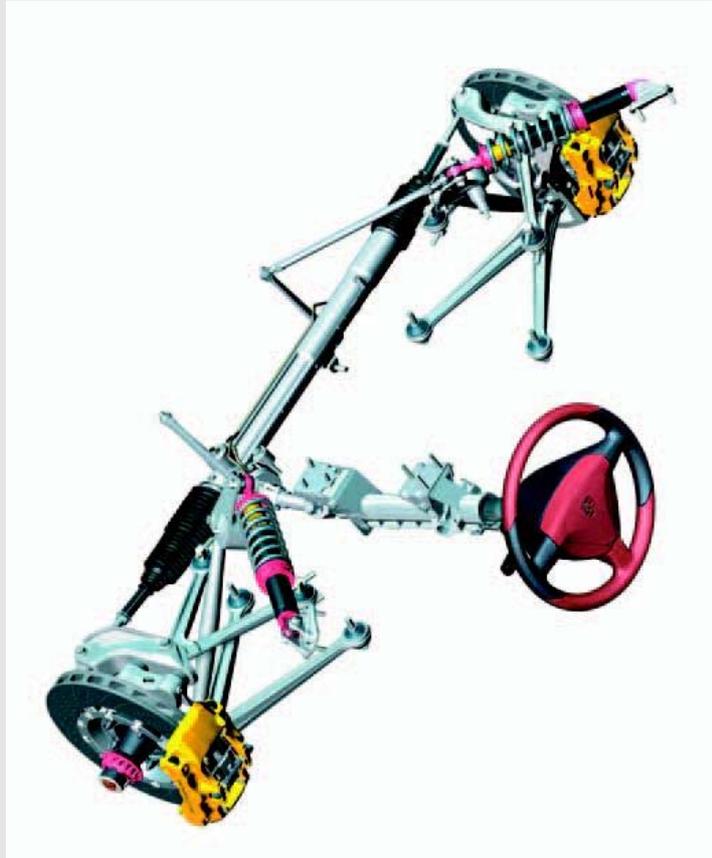
Driving dynamics is one of the core competences of the Porsche company and has been applied thoroughly to the Carrera GT, achieving the following characteristics:

- Outstanding driveability and best possible dynamics with high reserves of safety in all situations.
- Greatest driving pleasure at all speeds.
- Smooth and safe driveability at all speeds, even when changing lanes.
- Best controlled load-reversal reactions in curves and exceptionally high lateral acceleration possible.
- Agile, direct and precise steering with markedly good feel for the road.
- Lowest roll, twitch and yawing movements, with lowest pitching because of the very low centre of gravity.
- Shortest possible braking distances, even during extremely heavy sustained braking, with high vehicle stability during the braking operation.
- Responsive traction control (TC).

## Summary of the chassis systems

Axle geometry fully adjustable	Optimum adjustment facilities for setting the tolerances, e.g for use on race tracks
Double wishbones for front and rear axles	Precise wheel location with good force transfer to the bodyshell
Spring and shock absorber linkages on the "pushrod" principle	Spring struts indirectly actuated via a pushrod and rocker arm from the wishbone/wheel carrier
Adjustable spring struts Wheel loads adjustable	Wheel loads adjustable for exact balance of the vehicle
Rear axle stabiliser adjustable	Vehicle dynamic properties adjustable from sporty oversteer thro to understeer
Traction control "TC"	Vehicle stabiliser assistance during acceleration
ABS 5.7	4-channel anti-lock system for brakes. Each wheel is controlled separately
Engine drag torque control	Prevents loss of grip by the drive wheels during sporty changing down

### Front axle



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The Carrera GT is fitted with double wishbone pushrod axles with forged aluminium links.

In this type of axle construction the springing and wheel guidance functions are clearly separated.

The stainless steel pushrod is connected not to the aluminium hollow-cast wheel carrier but to the wishbone. This reduces the steering-induced changes in height and wheel loading to a minimum. The pushrod is dimensioned to cater for the forces that arise, i.e. the wall thickness is optimised between resistance to kinking and achieving low component weight.

The wheel forces acting on the wishbones are optimally transferred to the stiff carbon fibre monocoque through wide mounting base points. At the mounting base points for the lower front axle wishbones there are additional reinforcing plates to spread the forces over a large area.

The mounting of the wishbones, unavoidably in vehicles with a race sport layout, is non-damping. Metal balls are fitted in a plastic bearing race with a steel shell pressed on. These mounting parts have absolutely no play.

All multi-dimensional transfer links are mounted using these sealed stainless steel mountings, called uniball mountings.

The wheel carriers, to which the steering and gauging rods are attached, and to which the wheel bearings and axle stubs are bolted, are aluminium gravity castings.

The scrub radius is set to a slightly positive geometry, so as to minimise the effects of forces that arise during braking and acceleration and which are perceptible as jerks at the steering wheel. In connection with the dynamic tyre pressure distribution over the wheel contact area, effectively a negative scrub radius is achieved with a small distortion force leverage.

The castoring offset is 25 mm which together with the stiffly geared steering system gives typical Porsche dynamic but smooth steering behaviour.

The materials selection and sizing of the front axle components was performed with a view to best stiffness values with lowest sprung and unsprung masses.

### Technical data front axle

Spring rate	70 N/mm
Spring wire diameter	10.5 mm
Number of turns	9.5
Spring travel compression/expansion	
Auxiliary spring: spring response rate	33 N/mm
Auxiliary spring: spring wire profile	Rectangular 4 x 10 mm
Auxiliary spring: number of turns	4.5
Ground clearance to DIN, empty	86 mm
Stabiliser diameter	18.7 mm
Overall track	+4'
King-pin angle	-1° 40'
Castoring offset	+11.5° (25 mm)
Scrub radius	

## Carrera GT

### Wishbones

The front axle suspension comprises 2 forged aluminium triangular wishbones with maintenance-free uniball joints to transfer forces to the chassis. The mounting points of the wishbones to the chassis are designed with a broad mounting base, so as to provide the optimum spread of forces into the chassis.

The ball bearing joints are absolutely maintenance-free and have no play. For protection against water and dirt each joint is sealed with 2 protective rubber caps.

If a joint is damaged or displays increased play the entire wishbone must be changed.

On the upper wishbones the rear strut is provided with a groove, which is for protection of the chassis in the event of a crash.

In an accident there will be corresponding forces on the wheel suspension, and the wishbone is designed to deform at this point so as to protect the chassis from damage by overstressing.

The wishbone will not however break.

The reduction in wishbone cross-section area does not affect its strength.



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### Wheel carriers

The wheel carriers are aluminium castings.

The front wheel carrier has both the forged wishbones attached to it by ball joints.

The force transfer of wheel spring movements is performed by the front push rods, which transfer the forces arising to rocker arms and then to the spring struts bolted to the monocoque

The front push rods are connected to the lower wishbones, which keeps to a tolerable minimum the possible changes to wheel load and vehicle height level that can arise from steering actions.

The upper wishbones and the track rods form together with the wheel carrier an L-shaped profile, to which the steering arm is bolted, and connected to the compensating washers for pitch adjustment with the wheel carrier.

A two-row angular ball bearing is pressed on to each wheel carrier, which can be renewed only replaced together with the complete wheel carrier.



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### Spring struts

The spring struts comprise a non-adjustable damper unit. The damper casing has a universal external thread for the drilled nut for wheel load adjustment and for the actual chassis spring which presses against the damper. The spring is tensioned by means of the upper disc spring which is screwed to the damper piston rod and the drilled nuts which are located on the damper body.

## Carrera GT



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The spring layout is linear.

So as to ensure that even under maximum spring travel in the front wheel suspension the main spring at all times rests on its disc springs, an auxiliary spring is placed beneath the main spring on the front spring struts.

This auxiliary spring is designed so that its turns remain on the block at all times, even at extreme spring travel.

The working travel of the auxiliary spring is a maximum of only a few millimetres.

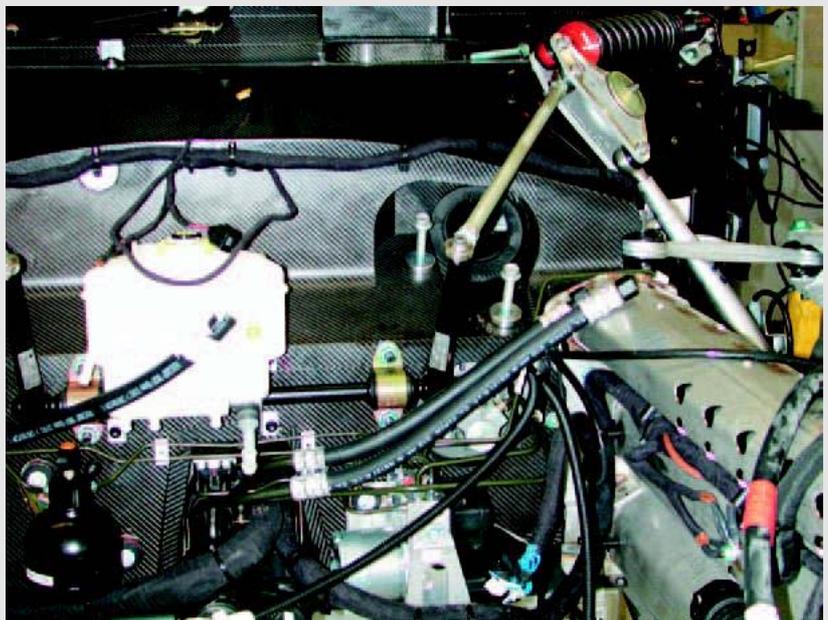
### Stabilisers

The front stabiliser comprises solid steel with 18.7mm diameter and has an arm of each side, each with a connecting rod for force transfer to the rocker arm that is connected to the spring strut. The positive connection of both flexional arms with the stabiliser is formed by a polygon connection.

Because of the restricted installation space the stabiliser is in 3 parts. The actual torsion bar is mounted on two Silentblock rubber mountings which are provided with Teflon coated slide sleeves and are bolted to the splashboard of the monocoque. The flexional arms are screwed on, one at each end of the torsion bar, which as well as pure force transfer is also loaded in torsion and thus provides a stabiliser effect.

The components are of highly heat-treated steel and are coated with anti-rust agent.

The front stabiliser is non-adjustable.



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**Steering**

The steering column is equivalent to that in the 986/996 sports cars and is accommodated to the Carrera GT suspension and steering shaft with two cardan shaft joints.

The hydraulic lower support for the rack and pinion steering is bolted rigidly to the monocoque front wall on the left hand side in the direction of travel, and by definition in front of the front axle. This design significantly increases the safety of the occupants of the vehicle, and also is in line with the FIA standard for motor sport vehicles. On the right hand side of the vehicle the steering rack is semi-floating, to permit thermal expansion resulting from changes in temperature of the material.

The steering rack is a further development by ZF and is characterised by significant optimisation of friction levels and a special hydraulic power assistance profile specially tuned to the requirements of the Carrera GT.

The overall steering train is designed for direct yet sensitive response, which shows in the good handling characteristics and outstanding agility.

The moderate steering wheel ratio of 15.7 :1 and the resulting 2.59 steering wheel turns lock to lock allow direct feedback from the road surface, which is so important for a sports car. This is important information for the driver, since it gives a significant feeling for the contact with the road and gives feedback on the physical limits for driving.

The steering wheel diameter of the vehicles based on the 911 range is 375 mm. It is also provided with an airbag.

**Steering data**

Steering wheel diameter	375 mm
Steering wheel ratio	$i = 15.7 :1$
Turning circle diameter	12.9 m
Turning track diameter	12.3 m
Steering wheel turns lock to lock	2.59

### Hydraulic power steering

The hydraulically assisted rack and pinion steering draws its pressurised oil from an engine-driven vane pump.

The pressure supply lines to the steering rack are hydraulic lines of steel. For acoustic insulation the final connection of the feed line to the steering rack is a fibre reinforced hose of polymer materials. The return is a steel tube, which to accommodate longitudinal movements of the steering rack has several coiled turns for length compensation.

The pump is bolted to the engine on the left hand side in the direction of travel and is driven by a polymer Vee belt.

The expansion tank is in the engine compartment above the servo pump on the left hand side alongside the cooling water header tank. The system is filled with approx. 1.1 litres Pentosin CHF 11S.

The power-assisted steering operates in the same way as for the 996/986 sports cars.

### Steering column

The Carrera GT is fitted as standard with a steering column mechanically adjustable for length, which is rigidly fixed to the monocoque bodyshell.

The length adjustment range of the steering column is 40 mm.

The clamping lever for the column length adjustment is underneath the steering column, as in the 996.

The steering column also is interchangeable with those of the 996/986.

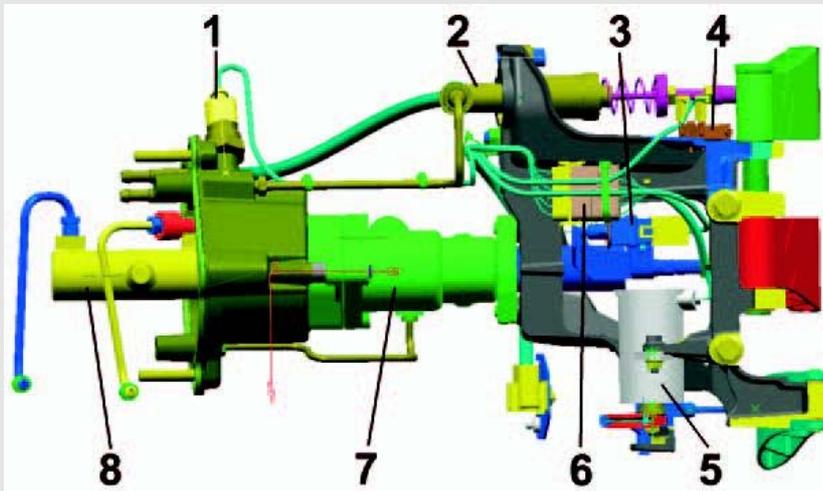
## Pedals

The pedal box module comprises a cast aluminium carrier, on which as well as the pedals is also mounted the hydraulic brake servo, clutch master cylinder, pedal position sensor, clutch switch and brake light switch. It is bolted to the bodyshell.

The pedal box module (pedals, pedal carrier, master brake cylinder, hydraulic brake servo) is bolted directly to the monocoque on the front of the scuttle.

The pedal box module is hidden from sight up to the pedals with a removable cover of carbon fibre. This cover incorporates the air outlet for the footwell air vent.

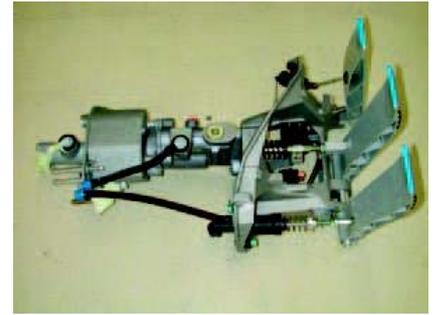
Working on the components, for instance exchanging the hydraulic parts and adjusting the electrical parts, is very awkward or even impossible when they are in their installed location.



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- 1 - Clutch pressure sensor
- 2 - Clutch master cylinder
- 3 - Brake light switch
- 4 - Mechanical clutch switch
- 5 - Pedal position sensor
- 6 - Connection plug
- 7 - Hydraulic brake servo
- 8 - Master brake cylinder

## Carrera GT



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The exact operations for repair and adjustment work on the pedals and the parts connected to them can be found in the relevant sections of the Technical Manual.

## Carrera GT

### Rear axle

The rear axle of the Carrera GT is, like the front axle, built around a double wishbone pushrod axle.

The rear axle design is attached to mounting points on the equipment carrier within the load-bearing vehicle structure.

In contrast to the front axle pushrod connections, at the rear these are on the wheel carriers. This permits the lower wishbones to have lightweight slim form, since they carry "only" the wheel guidance forces. Together with the form of the lower wishbones as aerofoil sections this leads to significantly lower air resistance for the parts of the rear wheel suspension that lie in the diffuser airstream of the lower undertray.



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### Technical data rear axle

Spring rate	80 N/mm
Spring wire diameter	11.75 mm
Number of turns	11.9
Spring travel compression/expansion	
Ground clearance to DIN, empty	86 mm
Toe-in per wheel	+10'
King-pin angle	- 1° 30'
Last running	
Stabiliser	tube $\varnothing$ 17.2 x 2.5 mm

**Wishbones**

The rear axle suspension also 2 triangular wishbones with maintenance-free uni-ball joints to transfer forces to the chassis. The mounting points of the wishbones to the chassis are also designed with a broad mounting base, so as to provide the optimum spread of forces into the chassis.



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The upper wishbone is, like that of the front axle, of forged aluminium and is secured with two bolts to an L-shaped aluminium forged part, the steering arm at the wheel carrier. These connections take up the pitch adjustment through inserted parts.

At the rear end of this forged part the adjustable track rod for the rear wheels is attached.

The lower wishbone, in contrast to all the other steering arms, is of corrosion-resistant stainless steel welded design. The profile of the wishbones is aerodynamically optimised in the form of an inverted wing of an aircraft.

The reason for this laborious method of construction lies in the position of the lower wishbones in the direct airflow of the tail diffuser beneath the undertray. By these measures, together with moving the rear pushrods largely out of the airstream at the wheel carrier, the air resistance can be reduced and the aerodynamics of the rear axle improved.



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## Carrera GT

The ball joints are absolutely maintenance-free and have no play. For protection against water and dirt each joint is sealed with 2 protective rubber caps.

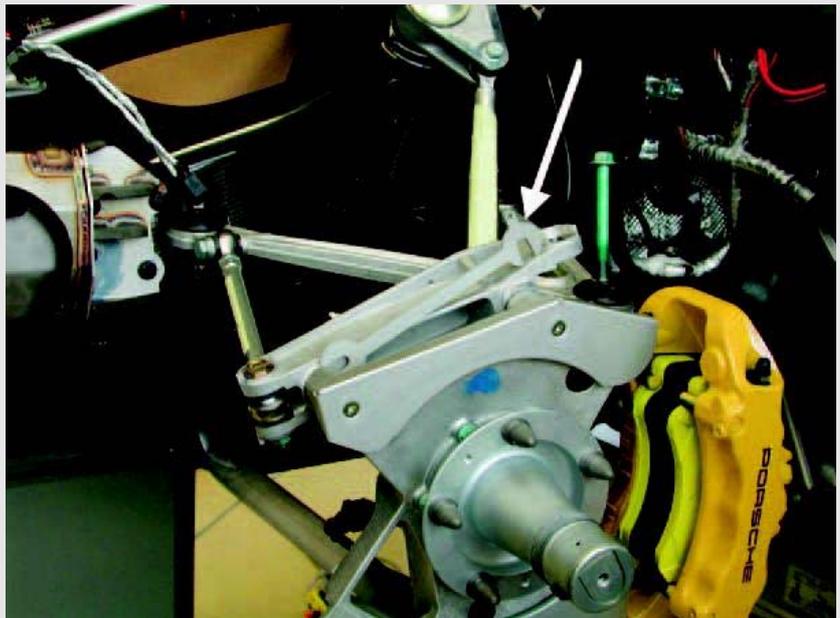
If a joint is damaged or displays increased play the entire wishbone must be changed.

### Wheel carriers

The rear wheel carriers are aluminium castings, like the front wheel carriers.

The rear wheel carriers have connections not only to both wishbones but also to the pushrod which connects to the rocker arm of the spring strut and via the forged steering arm to the rear track rods, to adjust the rear axle toe-in.

The upper wishbones and the track rods are bolted together to form together with the wheel carrier an L-shaped profile connected to the compensating washers for the pitch adjustment with the wheel carrier.



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In each wheel carrier is pressed a two-row angular ball bearing, which if it has to be renewed must be replaced together with the complete wheel carrier.

### Spring struts

The spring struts, like those on the front axle, comprise a non-adjustable damper unit, which on the damper casing has a universal external thread for the drilled nut for wheel load adjustment and for the actual chassis spring which presses against the damper.

The spring is tensioned by means of the upper disc spring which is screwed to the damper piston rod and the drilled nuts which are located on the damper body.

The chassis spring on the rear axle is also a linear arrangement.

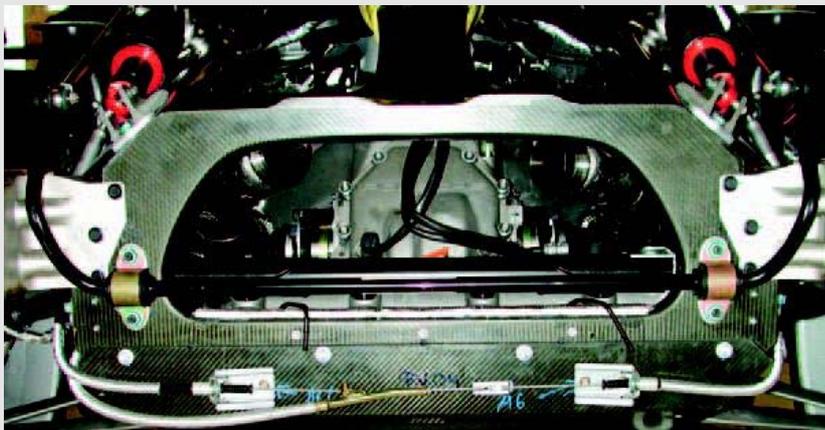
### Stabilisers

The stabiliser on the rear axle is similar to that on the front axle with two connecting rods adjustable for length connected via the rear rocker arms with the spring strut.

The stabiliser itself is a single piece item secured to the rear axle and is bolted to the bodyshell with 2 rubber mountings (like the front axle) between the rear wall of the equipment carrier and the final exhaust muffler.



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The rear stabiliser is also of highly heat-treated steel, but is in the form of a tube (D: 17.2 x 2.5).

## Carrera GT



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The rear stabiliser, in contrast to that at the front is adjustable for hardness of response in three stages.

As delivered it is set to the hardest ride, which tends towards oversteer in a sporty dynamic style of driving.

The two other settings change the driving dynamics successively towards understeer.

### Wheels

The newly developed wheels of the Carrera GT are manufactured of magnesium using a special forging process. The 5-spoke design is retained. On the front axle 19" rims are fitted; on driving axle, 20" rims.

The manufacturing process for the wheels is the same as that used for manufacturing the wheels of Formula 1 racing cars. This technique gives optimum strength, paired with seriously light weight. The weights saving compared to aluminium rims is approx. 25 %.

Low unsprung masses in the wheel assembly are indispensable for responsive design of springing and damping characteristics.

To protect the magnesium against its readiness to oxidise, the entire rim is protected with a special surface coating of magnesium oxide and clear varnish.

At the annual inspection all rims must be checked for damage and either repaired or replaced according to the provisions of the Technical Manual.

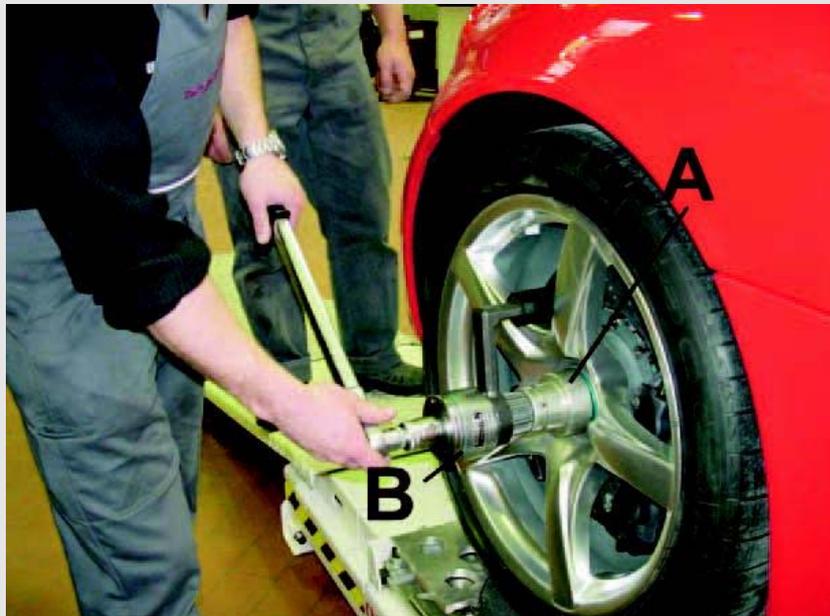
**Central securing nut/wheel nuts**

Use of the motor racing style of central wheel fastening for mounting the wheel securing it to the wheel carriers means that only a single central securing nut of aluminium is used. This nut has a wave-shaped multi-tooth external profile and can be removed and tightened only with the corresponding nut socket driver. This solution is at the same time an effective means of theft protection. On the left hand side of the vehicle the threads are right handed, and on the right hand side of the vehicle the threads are left handed. This arrangement means that the wheels are self-tightening in use on the vehicle.

As an addition safety feature the wheel has also two spring-loaded safety wedges which engage positively in the crown-shaped leading part of the wheel nut.

The colour coding of the wheel nuts also stems from motor racing. This assists recognition of the wheel nuts to the corresponding side of the vehicle and identifies the sense of the thread.

On the left hand side the right hand threaded nuts are anodised red, on the right hand side the left hand threaded nuts are anodised blue. These colour codings are exactly those used in motor racing.



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To undo and tighten the wheel nuts a special nut socket driver which matches the nuts is necessary. In the trunk of the vehicle there is a matching socket driver of high tensile aluminium, with which using a suitable wrench the nuts can be undone. Under no circumstances must the socket be driven with an impact driver.

## Carrera GT



The torque multiplier is not supplied with the vehicle. See list of special tools.



Under no circumstances must the part being assembled have large differences in temperature, since once the temperatures are in balance the tightening torque will not longer be correct.



The corresponding tyre pressures can be found in the Owner's Manual or for technical information in the Technical Manual.



On safety grounds the tyres may not be used when they are more than four years old.

If no tools with the corresponding leverage are available, the nut can be undone and tightened using a torque multiplier with an integral reaction element. The torque multiplier has a multiplication ration of 3:1.

On each occasion the nuts are fitted they must be checked for any dirt in the thread or on the cone, and if necessary they must be cleaned. The nuts must be lubricated on the thread and on the cone with a special grease.

Each time a wheel is fitted, a check must be made that the circular groove in the rim's conical seating for the central securing nut is still present. This small groove is an indication of the necessary presence of a defined mounting face for the central nut. If the groove can no longer be felt, the rim must be replaced.

### Tyres

Because of the particular demands of drive power, traction, driving dynamics and safety, new tyres were developed specially for the Carrera GT, with very large road contact area.

The tyres to match the rims are made by Michelin, Pilot Sport range sizes 265/35 ZR19 on the front axle and 335/30 ZR20 on the rear axle.

Since the Carrera GT vehicle has been designed with driving dynamics as the main priority, no winter tread tyres are available.

### Punctures/tyre sealant

The Carrera GT is equipped as standard for the event of a puncture, with a tyre repair system "Tyre Fit".

Provided the tyre is not very seriously damaged, this allows the vehicle still to be driven, and the time spent in the hazardous area is reduced to a minimum.

The tyre sealant is a quick and easy technique for recovering mobility in the event of a puncture. It is capable of sealing punctures that arise from the usual causes such as nails and screws, so that the journey can be continued at reduced speed (max. 80 km/h / 50 mph) to the nearest Porsche Center or tyre dealer. The defective entire wheel does not have to be removed from the vehicle. In the storage area of the the engine compartment there is a bottle of tyre sealant and the associated electric compressor.

In the event of a puncture the valve of the damaged tyre must be removed using the valve extractor supplied with the vehicle tool kit, before the tyre sealant can be pumped into the tyre. After the special injection valve has been fitted, the tyre must be inflated using the compressor to a pressure of at least 2.5 bar. After driving for a period of approx. 10 min as a rule the sealing process has been achieved. The tyre pressure must be checked again and further inflated as necessary to bring it to the correct set value.

The compressor and the tyre sealant are kept in the storage area of the engine compartment.

The 12 volts socket for powering the compressor is located in the glove compartment.

### **Punctures/tyre sealant**

The Carrera GT is fitted as standard with a new digital tyre pressure checking system (RDK). The system allows continuous monitoring of the tyre pressures of all four wheels during a journey, including when the vehicle is stopped.

The great difference between digital systems and analogue systems lies on the one hand in the wiring, and on the other hand in the signal processing which is performed immediately on receipt by an evaluation logic within the digital antennas.

Conventional copper cables carry the information from the antennas to the RDK control unit. The RDK control unit performs the further signal processing and passes the information to the multi-function instrument.

No coaxial cables are used. This means that the system is very much more secure than other systems against interference.

The tyre pressure checking system with digital antennas used by Porsche is a 4-wheel system. The data transmission from the wheel sensors to the control unit is performed by radio transmission in the high frequency range (HF range, 433/315 MHz). Information exchange within the vehicle periphery is performed by the CAN comfort bus.

From each of the measurement and sender units fitted at the tyre valve a radio signal is sent at regular intervals to the antenna that is mounted in the wheel arch. The antenna passes the signal to the RDK control unit.

The RDK control unit evaluates the tyre inflation pressure and the rate of change of pressure and sends these to the vehicle computer. When a warning is given, the pressure difference from the set pressure will be displayed (e.g. set 2.2 bar, actual 1.9 bar, display = - 0.3), so that the driver can reinflate the tyre irrespective of the tyre temperature/the gauge reading on the tyre pump, by the pressure difference of 0.3 bar.

For driving on a race track, or driver's individual preferred air pressure values, these can be input separately through the multi-function instrument into the RDK. The RDK then monitors these individual values.

For safety reasons the tyre pressure menu can be called up and used only when the vehicle is stationary. In the main menu during the journey the unfiltered actual pressures can be continuously displayed.

The compressor and the tyre sealant are kept in the storage area of the engine compartment.



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### The tyre pressure checking system offers the following advantages:

- Increased safety through 2-stage warning:
  1. Early information ("soft warning", yellow) between 0.2 and 0.4 bar less than set pressure
  2. Immediate warning ("hard warning", red) if >0.4 bar less than set pressure or if sudden loss of pressure
- More convenience because the usual tyre pressure check every 14 days is no longer required. Tyre pressures need only be corrected when the corresponding display shows it is necessary
- Longer tyre life (an underpressure of 0.3 bar can reduce the life of a tyre by up to 25 %)
- Lower fuel consumption because rolling resistance is less when tyre pressures are correct
- Optimum vehicle handling
- Individual input of tyre set pressures for use on race tracks
- Convenient to use:

No need to look up the correct tyre pressures on the tyre pressure plate. The applicable pressure values are automatically communicated to the RDK control unit (table calibration)
- This table calibration eliminates variations in accuracy of readings of tyre gauges applied to the wheel. The display using the values determined by the pressure sensors in the vehicle is significantly more precise
- In the event of a warning the tyres can be inflated to the correct pressure even in the warm state, since the pressure shortfall against the set value is displayed on a temperature-compensated basis (inflation info)
- During the journey the absolute pressures of the tyres can be displayed and it can be seen how the tyre pressures rise and fall according to how the driving style and the ambient conditions affect the temperature
- All warnings are specific to the wheel position concerned.

## Tyre pressure monitoring

This distinguishes the following situations:

### Minor loss of tyre pressure

A minor loss of tyre pressure (0.2 bar less than the set pressure), such as that due to diffusion, is indicated to the driver as an early warning, visually and acoustically ("soft warning"), that the tyres should be checked and inflated to correct pressure at the next suitable opportunity.

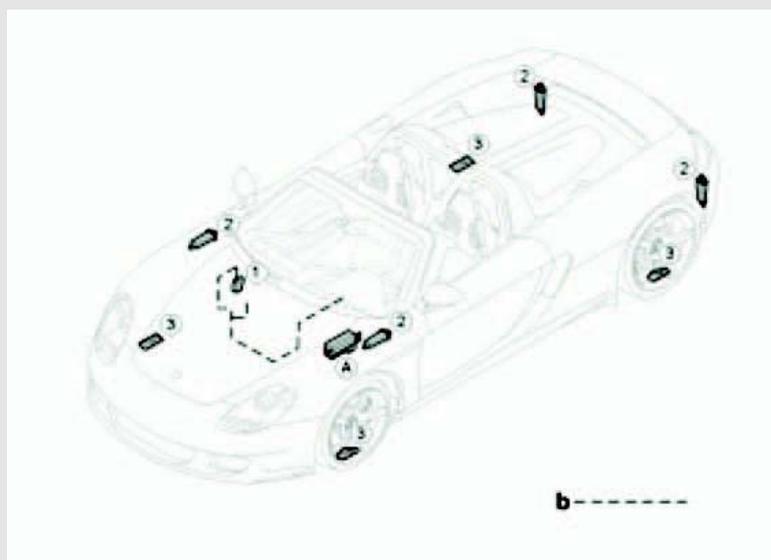
### Major loss of tyre pressure

In the event of a major loss of tyre pressure (0.4 bar less than the set pressure) the driver is immediately given a visual warning. At the same time a warning buzzer sounds and the warning signal is activated ("hard warning"). This display is maintained as long as the ignition is switched on, including when during the journey the vehicle is stopped.

## Design

The tyre pressure checking system comprises the following components:

- 4 wheel senders
- 4 antennas in the wheel arches
- RDK control unit in the passenger footwell
- Display on the matrix display in the multi-function instrument



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- 1 - RDK control unit
- 2 - Digital antenna
- 3 - Wheel sender
- A - Diagnostics socket/fusebox
- b - CAN connection

### Wheel senders

The wheel senders are screwed to the metal valves on the wheel rims. They are secured to the wheel rims using a hollow Torx screwdriver to tighten a screw fitted with a tamperproof pin. The additional weight is approx. 30 grams which can be balanced out by adding balance weights, obviating the need for special wheels. Furthermore, when a wheel is changed, the wheel sender can be reused.

The following components are incorporated in the wheel sender:

- Sender antenna
- Pressure sensor
- Temperature sensor
- Measurement and control electronics
- Battery

Pressure sensor, temperature sensor and measurement/control electronics are combined within a sensor unit.

Depending on the national standards, one of two different carrier frequencies is used for radio transmissions. In most countries the approved carrier frequency is 433 MHz. For a few countries (e.g. in Asia and Africa) a carrier frequency of 315 MHz is used. The respective carrier frequency is hard wired into the sensors, antennas and control units. Furthermore, the part numbers identify the variants. Additionally the sensors are colour coded:

433 MHz dark grey/olive green

315 MHz pale grey

The tyre pressure checking system will only function correctly when all system components are set to the same carrier frequency.

The wheel sender transmits the following information:

- Individual Identity Number (ID)
- Current tyre pressure (absolute pressure)
- Current tyre air temperature
- Status of the integral battery
- Plus status, synchronisation and control information necessary for security of data transmission

## Identity number

Each wheel sender has an individual Identity number (ID) in the form of a max. 10-position number (which is stamped into the wheel sender itself). The ID is contained in the data telegrams sent by the wheel sender and is passed through to the control unit. The RDK control unit learns the IDs that belong to the wheel senders on the vehicle, and their wheel position, using a complex process, and saves them. Learning takes place only when the vehicle is moving. This prevents inadvertent changes to the learned information originating from wheel senders in other vehicles, e.g. when stopped at traffic lights or in a car park.

## Learning process

The learning process is divided into 3 phases:

### 1. Recognition of the respective wheel

When a new set of tyres is fitted, the system starts the process of learning the ID of the wheel senders in the vehicle's wheels. During this learning phase the message "No monitoring, system learning" appears in the display and the RDK warning lamp is lit. On completion of learning the ID of the wheel senders in the vehicle's wheels, the RDK warning lamp will go out. The system can now recognise loss of tyre pressure and if necessary give a warning, albeit not a warning specific to a particular wheel position.

### 2. Wheel position allocation

Once the wheel senders fitted to the vehicle have been recognised, the learning of the respective wheel positions on the vehicle begins. After all wheel positions have been learnt the system can immediately display the pressure at each wheel position in the main menu, and in the RDK menu will appear the pressure levels with variations from the set pressures. The system can now display a loss of tyre pressure at the corresponding wheel position, with data regarding the amount of pressure shortfall from the set pressure.

### 3. Confirmation phase.

This learning process is needed mainly for checking whether in the meantime one or more wheels has been changed, without the new wheel being registered in the system using the RDK menu. This phase is restarted each time the ignition is switched on. When this last learning phase has been completed, the system is oblivious to all other wheel senders.

Activation of the system by inputting the wheel sender ID can be performed using the system tester or by undertaking a journey of approx. 20 minutes in the vehicle.



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### **Tyre pressures**

The wheel sender captures the current tyre pressure (absolute pressure measurement) which is sent to the RDK control unit for evaluation.

### **Temperature**

The temperature signal enables temperature-dependent pressure compensation. Temperature compensation is performed in the RDK control unit. This allows the measured tyre pressures to be standardised to a temperature of 20 °C.

At tyre temperatures greater than 120 °C the RDK may for a brief time report a system fault, and cease functioning. When the temperature falls below this level the system will again operate normally.

### **Connection between tyre pressure and temperature**

As the tyres heat up during a journey the pressure in the tyres increases. This pressure can be significantly higher than the stated pressure setting for the cold state (approx. 20 °C). Recognition of this pressure-temperature dependency allows warning messages of loss of tyre pressure to be displayed even though the absolute pressure of air in the tyre displayed in the vehicle computer is greater than the set pressure for the tyre. Such warning messages are correct!

The air pressure in a closed system changes in proportion to temperature. In in the relevant temperature range a temperature change of 10 °C caused a pressure change of approx. 0.1 bar.

So as to take account of this circumstance, the wheel sender in addition to the pressure sensor has also a temperature sensor. This allows calculation of compensation for temperature-dependent pressure changes in the tyres. Temperature compensation is performed in the RDK control unit. This allows the measured tyre pressures to be standardised to a temperature of 20 °C.

When a warning is given and the tyre pressures are reported in the RDK menu, the amount of pressure shortfall from the set pressure is also temperature-corrected to 20 °C. This avoids the risk that large changes in temperature may result in false alarms or missed warnings. When tyres are being pumped up this system gives pressure readings that are independent of the temperature of the tyres, so that tyre pressures can be set correctly, even for hot tyres.

## Battery

The energy required for electronics is provided by an integral lithium battery. So as to facilitate the longest possible operating life for the tyre pressure sensors, the control electronics incorporates an ingenious energy management system. The battery life on the Carrera GT can be read using the Porsche system tester. The battery life is dependent on the operating conditions, but is designed for approx. 7 years. In principle the battery should be changed if the operating life is expected to be less than the life of the tyres.

## Energy management

Relatively infrequent sendings of data (approx. 1x/min) are sufficient for measuring tyre pressures. Any loss of pressure must however be detected immediately and sent to the control unit.

The energy management differentiates between normal send mode and high-speed send mode by using different measurement and sending intervals.

As long as the sensor finds tyre pressure to be constant the tyre pressure sensor operates in normal send mode. It measures the pressure and temperature every 3 seconds but as long as the values remain constant sends the values only every 54 seconds.

If it detects a loss of pressure at a rate greater than 0.2 bar per minute, the sensor changes immediately into high-speed send mode, in which it measures and sends every 0.8 seconds. After the vehicle has been switched off and a certain delay has elapsed the system switches into power-saving mode (sleep mode).

This energy management means that the drain on the sensors battery is as little as possible, whilst providing a high level of security in the monitoring.

A battery life of 5 to 10 years is possible by this means (average 7 years).

The battery is a component of the tyre pressure sensor and cannot be exchanged separately.

This new RDK system offers the facility of triggering a request data telegram from the wheel senders and using the reply for communications path diagnostics.

This trigger facility allows the possibility of further reducing the frequency of data telegrams and thus still further protecting the battery capacity.

## Carrera GT

### RDK antennas

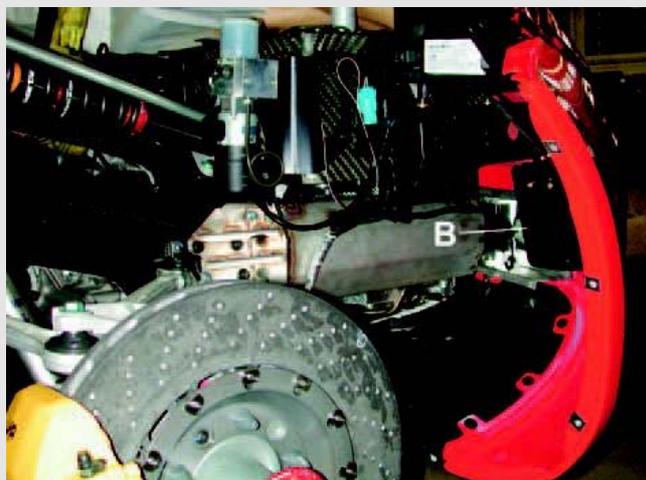
The antennas receive the radio signals from the wheel senders, transduce these into LIN bus-compatible signals and send them for further processing to the RDK control unit.

The tyre pressure checking system possesses 4 antennas, which are mounted in the wheel arches behind the wheel arch liners.



A - antenna front axle

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B - antenna rear axle

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The antennas receive all radio signals that impinge within their reception and frequency ranges. This means that each antenna receives also the radio signals of all wheel sensors within range. The radio signals are filtered and selected within the control unit, so that the correct data are processed.

### RDK control unit

The RDK control unit evaluates the radio signals that come from the antennas, prioritises them, and sends corresponding information to the multi-function instrument. The RDK control unit is located in the passenger footwell, front right.

### Brakes

As is usual with Porsche vehicles, in the Carrera GT also particular emphasis has been placed on an effective brake system. The Carrera GT is series-built with Porsche Ceramic Composite brakes.



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The PCCB offers, especially at high performances, favourable characteristics of consistently short brake piston travel because of its small tendency to fading with high and above all constant coefficient of friction.

A further advantage of the PCCB is the expectation of a long working life.

Compared to metal brake discs the wear is exceptionally little, because of the extreme hardness of the surface.

- Wear in the components of the brake system is however strongly dependent on the individual
- driving style, so no generally applicable statement of absolute
- performance can be given

Since the Carrera GT in its extremely sporty design is arranged for a balanced weight distribution, the brake discs on the front and rear axles are both the same size.

## Technical data PCCB brake system

<i>Brake system data</i>	<i>Front axle</i>	<i>Rear axle</i>
Brake disc diameter	380 mm	380 mm
Brake disc thickness	34 mm	34 mm
Brake caliper type	Brembo 6 piston fixed caliper	Brembo 6 piston fixed caliper
Number of pistons	6	6
Piston diameter (in pairs)	28/32/36 mm	28/30/32 mm
Pad area per pad	112 cm <sup>2</sup>	112 cm <sup>2</sup>
Brake servo	hydraulic	
Amplification factor	3.6	
Master brake cylinder diameter	26.99 mm	
Handbrake		Bowden cable on floating calipers
Pad area per pad		19,5 cm <sup>2</sup>

Essentially the PCCB fitted to the Carrera GT is subject to the same conditions and restrictions as for all other Porsche vehicles with PCCB.

### Brakes

The tandem master brake cylinder is placed at the height of the brake pedal and in front of it at the front of the vehicle. The brake fluid reservoir is at a somewhat different height to the master brake cylinder. It is located in front of the steering rack on the front side of the monocoque and is accessible by a flap in the trunk for maintenance and checking.

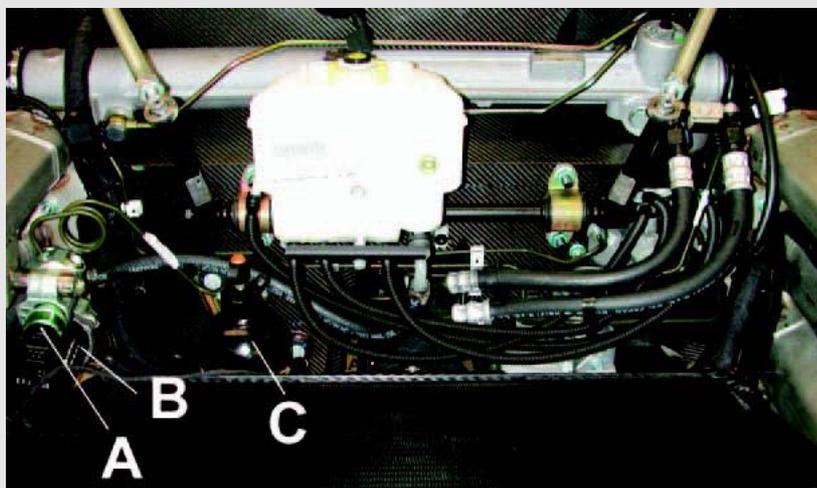
The hydraulic brake servo is integral with the master brake cylinder, and lies in front of the master brake cylinder.

### Brake servo

The brake servo operates hydraulically and is charged with servo pressure by an electric pump through a pressure accumulator.

The electric pump runs continuously and audibly as soon as the ignition is switched on. The pump runs until the brake servo pressure circuit and the pressure accumulator have attained their working pressure and the pressure switch has detected maximum pressure.

If the vehicle has been standing a long time, the pump may have to run for a longer period to build up to operating pressure. During this time the display of the vehicle computers can display the warning "Low brake pressure". This warning is cleared as soon as the working pressure is attained.

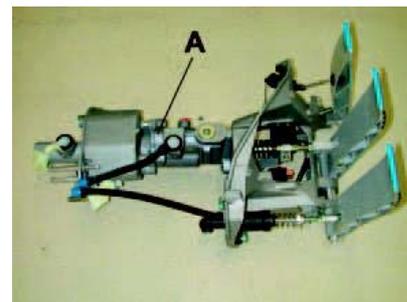


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- A - Pressure switch
- B - Pressure pump
- C - Pressure accumulator

### Brake fluid

The brake system of the Carrera GT is filled with "Super DOT 4" brake fluid. The change interval is 2 years.



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Whilst the warning is displayed, the brake system is in full working order even without brake servo assistance. The brake force assistance that the servo would provide must however be physically applied by the driver.



The brake servo system is functionally the same as in the 993 Turbo/964 C4.



Silicone brake fluid must not be used!

## Carrera GT



The brake calipers for the front and rear axle not identical and must not be interchanged.



For race track operation away from traffic on public roads special pads (P 50) are recommended. These pads are for tough competitive operating conditions and only attain their maximum braking power at high working temperatures.

**These pads are not approved for driving on roads!!**

### Front wheel brakes/rear wheel brakes

The perforated fibre reinforced ceramic brake discs with a diameter of 380 mm and width of 34 mm internally cooled by means of involute-form cooling channels.

The ram pressure forced ventilation of the brakes is fed with brake cooling air from the nose of the vehicle along special air ducts to the brake disc. Ventilation slots on the outside between brake pot and disc further reinforces the cooling effect.

The monobloc aluminium fixed calipers are each provided with 6 pistons. The seating area on which the brake calipers are bolted is exceptionally large and give a correspondingly stiff connection to the wheel carrier. This allows the proportioning and pedal response to be further optimised.

The brake calipers are painted in typical PCCB yellow.



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### Brake pads

The brake pads are specially configured for the brake discs of the PCCB brake system. When exchanging brake pads, fit only pads that are provided for use in the PCCB brake system.

### Handbrake

The handbrake of the Carrera GT acts through two separate floating calipers on the rear axle brake discs, operated by mechanical Bowden cables.

The brake pads for the handbrake are of almost identical material to the brake discs.

The handbrake is applied by a manual handbrake lever, which is mounted to the left alongside the driver's seat.

From the brake lever a long Bowden cable leads directly to the right hand handbrake caliper. The Zug runs behind the cross member of the power unit carrier, where the Bowden cable is attached to a divider piece to which is connected the short brake cable for the left hand handbrake caliper. When the handbrake is applied, this short cable is tightened by the divider piece and the support against the sheath and thus conveys the operating force equally to both handbrake calipers.



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### **ABS**

So as to prevent an individual wheel locking during braking, and to permit the highest possible brake power safely on the road under all circumstances and road conditions, without losing the steerability of the vehicle, the Carrera GT is equipped with a 4-channel anti-lock system of the generation ABS 5.7 from Bosch.

The advantage of 4-channel ABS compared to a 3-channel system is that in ABD operation both rear wheels have independent brake control, through two independent hydraulic valves.

This ABS control at the rear axle is however in conflict with the criteria for vehicle stability and lateral control. This means in reality that the principle of "Select Low" must be applied to the rear axle, meaning that the maximum brake power is governed by the rear wheel with the least adhesive grip.

### **Traction control "TC"**

So as to achieve the best traction during acceleration, the Carrera GT is fitted as standard with a "Traction Control" system.

The "TC" system comprises the components automatic brake differential (ABD 5.7), traction control (TC 5.7) and engine drag torque control (MSR).

### **ABD 5.7**

During acceleration, in the event of the wheel on one side slipping, that wheel is braked by the ABD until stable driving conditions are reattained.

The application of brake pressure is achieved by the individual hydraulic valves for each drive wheel, fitted in the ABS hydraulic block.

The component functions of the ABD 5.7 are implemented in the overall TC 5.7 system.

### **TC 5.7**

The traction control system has the duty of preventing excessive wheelslip at the drive axle thus prevent lateral drift of the rear axle during acceleration. The TC function is active at all speeds when acceleration is applied.

If one (or both) wheels slip, the drive axle(s) for this (these) wheel(s) is braked until the speed of the wheel falls to one at which the wheel does not slip, or both wheels are braked down to a wheel speed level where slipping does not occur.

If because of prolonged TC applications the brake system threatens to overheat then the electronic engine management system will reduce the engine torque until the drive wheels regain forward grip within the adhesive limit.

When traction control is active these interventions will be indicated by a flashing yellow warning lamp in the multi-function instrument.

By engine torque reduction is meant the throttling back (reduction) of the engine torque currently demanded by the gas pedal by a reduction in the mass of combustion air admitted, which is achieved by closing the electronic throttle valve.

A further possibility for torque reduction is to reduce the efficiency of the engine combustion, by retarding the ignition angle. From a thermal point of view there are however strict limits to retarding the ignition angle, so that it may be used only for a short period and for minor control interventions.

### **Engine drag torque control (MSR)**

Within the TC function there exists also engine drag torque control. This may be required for instance after changing down to a lower gear on slippery ground.

On changing down to a lower gear the resulting engine braking effect can be so severe as to fracture the rear axle. MSR prevents this by calling for power (giving gas) through the engine management system.

There is always the possibility that the Carrera GT driver may switch off the traction control functions by pressing the button labelled "TC". He is then reminded of this by the display "TC off" in the multi-function instrument.

It is however inadvisable to switch off the TC functions. Doing so will in any case not lead to better lap times on the race track.

### **Diagnostics**

The ABS and TC systems are connected via the CAN bus system drive to the two Motronic control units and to the multi-function instrument for data exchange. The drive bus has a data frequency of 500 kBaud.

The RDK control unit is connected to the significantly slower CAN bus comfort (100 kBaud) in the multi-function instrument.

The multi-function instrument acts as gateway control unit for control of the data traffic between the bus systems. The multi-function instrument also incorporates the connection port for the Porsche system diagnostics tester for the control units. Diagnostics of the control units is performed using the K line between the multi-function instrument and the system tester.



In the view of PAG drivers should refuse on principle for safety reasons to switch off the TC function.

## Carrera GT



The description, fault indications and repair of these components can be found in the Technical Manual.

All system components are continuously monitored by diagnostics routines for their functional capability and in the event of a fault in the respective control unit the corresponding fault description is registered. Additionally faults in safety-relevant systems are visually indicated by means of indicator lamps in the instrument display and a text message on the matrix display of the vehicle computer.

The fault will remain permanently logged until the fault log is cleared down, the fault is rectified or the control unit is disconnected from the vehicle electrical supply.

The fault log can be cleared down using the Porsche system tester, within which are also further functions, such as those to allow activation of particular actuators, switching of inputs and testing of systems.