Service Information

2008 Technik Introduction

Cayenne V6 & V8 (9PA)

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Foreword

The Cayenne opens up a new chapter in its success story. Four years after the market launch of the model, Dr. Ing. h.c. F. Porsche AG presents the second generation of its sporty off-road vehicle.

The new 2nd generation Cayenne, Cayenne S and Cayenne Turbo models have new, higher-performance engines with direct fuel injection (DFI). The basic version of the sporty off-road vehicle has an increased power output of 40 HP (29 kW). The Cayenne is now driven by a 290 HP (213 kW) six-cylinder engine. Displacement has been increased from 3.2 liters to 3.6 liters and the torque was increased from 230 ftlb. (310 Nm) to 285 ftlb. (385 Nm).

Thanks to the new direct fuel injection system (DFI) and the introduction of VarioCam Plus valve control, the Cayenne S, which features a V8 naturally aspirated engine with an increased displacement of 4.8 liters, achieves a torque of 370 ftlb. (500 Nm) compared to the previous torque of 311 ftlb. (420 Nm). It now has an engine power of 385 HP (283 kW) – an increase of 45 HP (33 kW) compared to the previous model.

The engine power of the new top model Cayenne Turbo is 50 HP (37 kW) higher than the previous model. The new eight-cylinder engine, which is driven by two turbochargers, has a power output of 500 HP (368 kW) and a torque of 518 ftlb. (700 Nm) compared to the max. torque of 459 ftlb. (620 Nm) on the previous model.

The proven Porsche Traction Management system (PTM), which distributes 62 percent of the engine power to the rear wheels and 38 percent to the front wheels in basic mode, ensures ideal power transmission. A multiple disc clutch allows up to 100 % of the drive torque to be directed to the front or rear as required.

Technical data is intended to provide an overview only. As it is subject to change during the course of the model year, refer to the Workshop Manual for up-to-date technical data.

The active chassis control system Porsche Active Suspension Management (PASM) with air suspension comes as standard on the Cayenne Turbo. This type of chassis can now be optimised using the new roll stabilization system Porsche Dynamic Chassis Control (PDCC), which Porsche has introduced for the first time. Continuous roll stabilization reduces the vehicleís lateral inclination during cornering and balances the vehicle in practically all driving situations.

All Cayenne models have Porsche Stability Management (PSM) with brake assist, enhanced Trailer Stability Management and off-road ABS. These functions ensure a faster braking response, significantly reduced instability for vehicles with a trailer, for example, and optimized braking effect on loose surfaces.

Bi-Xenon headlights (which come as standard on the Cayenne Turbo) guarantee even more active safety. The headlights not only have a static cornering light, but now also feature for the first time a dynamic cornering light, which is activated once the vehicle is travelling at more than 2 mph (3 km/h). This light is available as an option on the Cayenne and Cayenne S.

The Service Information Technik is not intended as a reference for repairs or for the diagnosis of technical problems. For complete workshop information refer to the electronic Workshop Manual in PIWIS.

The information contained in this brochure is correct at the time of going to press in March, 2007.

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General

Completely new engines have been developed for the Cayenne S and Cayenne Turbo for the 2008 model year.

The main development aims were:

- More power and torque, while at the same time,
- Improving fuel economy and,
- Reducing the weight of the engine compared to previous engines.

These development aims have essentially been achieved due to the following enhancements and new technologies:

- Larger displacement
- Direct fuel injection (DFI)
- Sport button as standard
- VarioCam Plus
- Demand controlled oil pump

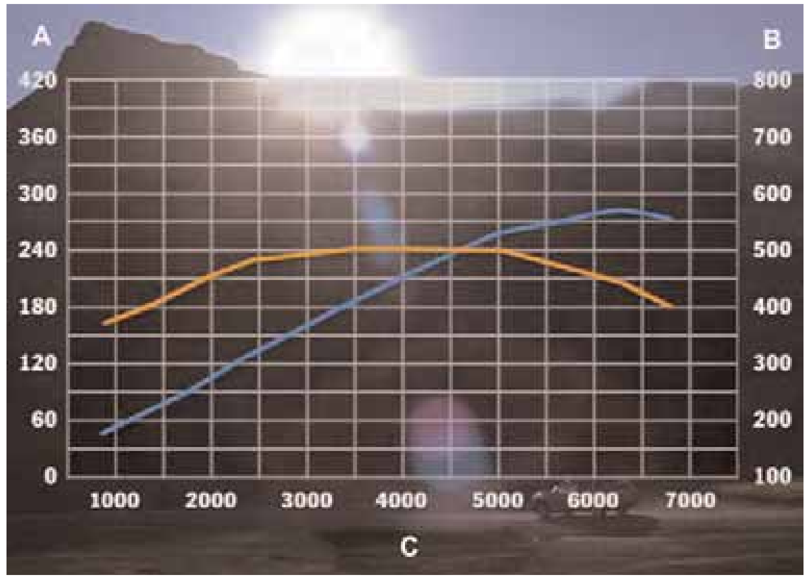
Contents

V8

Engine – Cayenne V8

A - Power rating in kW
B - Torque in Nm
C - Engine speed

Cayenne S Full Load Curve



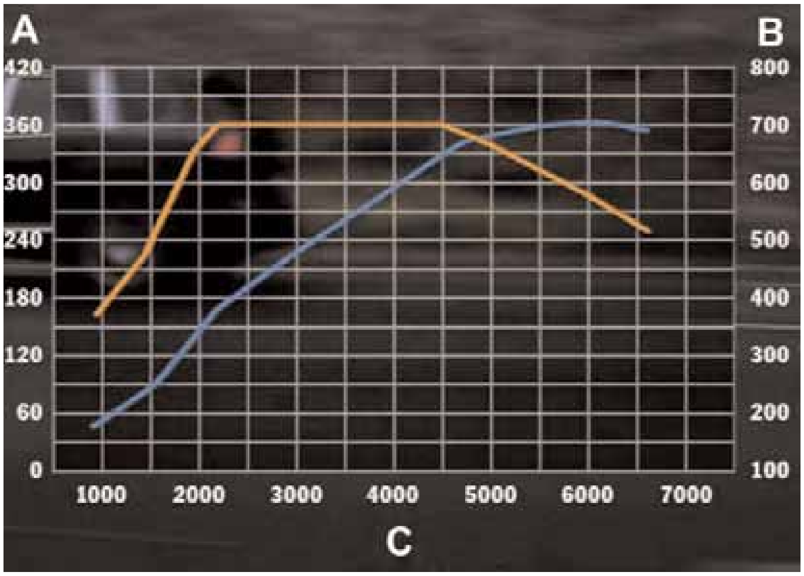
Engine Data – Second Generation Cayenne S

Engine type	M48.01
No. of cylinders	8
Bore	96 mm
Stroke	83 mm
Displacement	4.8 Liter
V-angle	90
Compression ratio	12.5
Max. output	385 HP (283 kW)
At engine speed	6200 rpm
Max. torque	370 ftlb. (500Nm)
At engine speed	3500 rpm
Governed speed	6700 rpm
Engine weight (manual transmission)	503 lbs (228 kg)
Engine weight (Tiptronic transmission)	456 lbs (217 kg)
Firing order	1-3-7-2-6-5-4-8

Engine Data – Previous Cayenne S V8 for Comparison

Engine Type	M48.00
Number of Cylinders	8
Bore	93 mm
Stroke	83 mm
Displacement	4.5 Liter
Compression Ratio	11.5
Max. Power	340 hp (250 kW)
at Engine Speed	6000 rpm
Max. Torque	310 ftlb. (420 Nm)
at Engine Speed	2500 – 5500 rpm
Governed Engine Speed Tiptronic	6500 rpm
Engine Weight	500 lbs (227 kg)
Firing Order	1-3-7-2-6-5-4-8

Cayenne Turbo Full Load Curve



A - Power rating in kW
B - Torque in Nm
C - Engine speed

Engine Data – Second Generation Cayenne Turbo

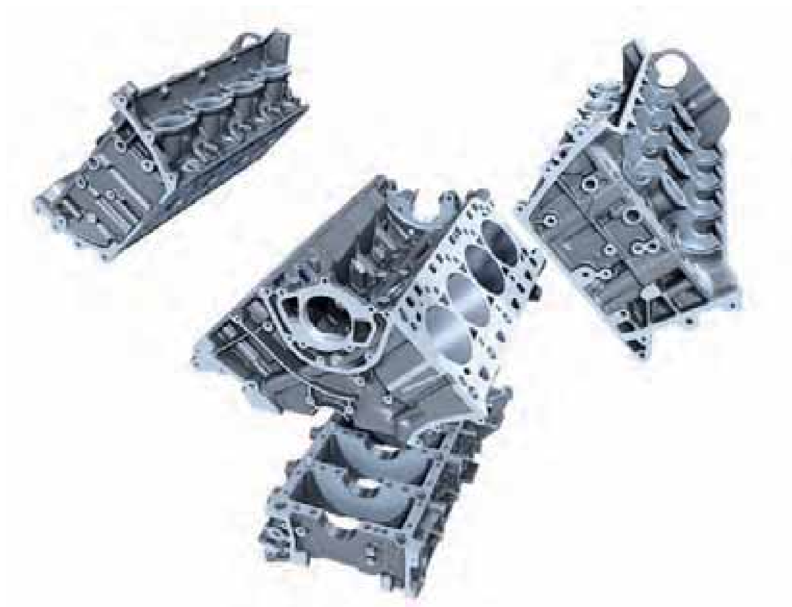
Engine type	M48.51
No. of cylinders	8
Bore	96 mm
Stroke	83 mm
Displacement	4.8 Liter
V-angle	90
Compression ratio	10.5
Max. output	500 HP (358 kW)
At engine speed	6000 rpm
Max. torque	518 ftlb. (700Nm)
At engine speed	2250-4500 rpm
Governed speed	6700 rpm
Engine weight	520 lbs (236 kg)
Firing order	1-3-7-2-6-5-4-8

Engine Data – Previous Cayenne Turbo V8 for Comparison

Engine Type	M48.50
Number of cylinders	8
Bore	93 mm
Stroke	83 mm
Displacement	4.5 Liter
Compression Ratio	9.5
Max. Power	450 hp (331 kW)
at Engine Speed	6000 rpm
Max. Torque	458 ftlb. (620 Nm)
at Engine Speed	2250 - 4750 rpm
Governed Engine Speed Tiptronic	6500 rpm
Engine Weight	558 lbs (253 kg)
Firing Order	1-3-7-2-6-5-4-8

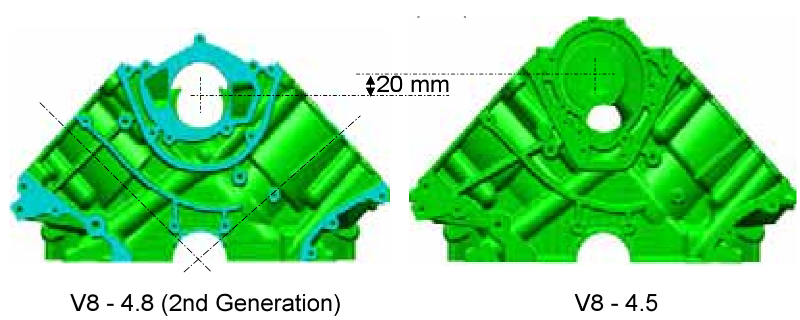
Crankcase

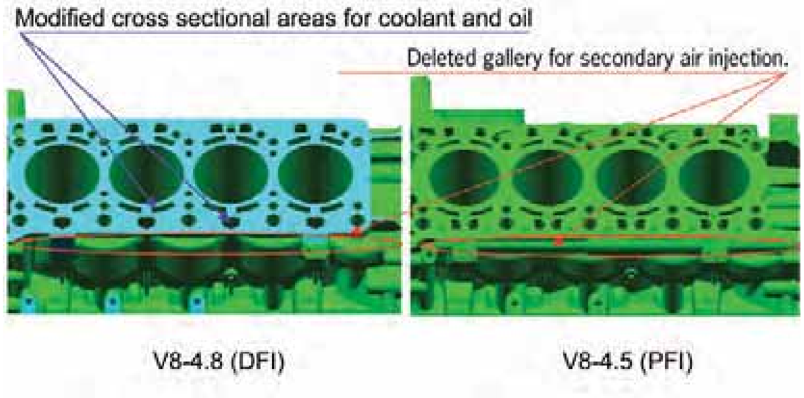
The crankcase in the Porsche Cayenne S and Cayenne Turbo is designed as a two-piece closed-deck component in a light metal alloy (AlSi17Cu4Mg). In the closed-deck design, the sealing surface of the crankcase is, for the most part, closed to the cylinder head, only the bores and channels for oil and coolant are exposed. The entire structure is additionally strengthened as a result of this design. This leads to less cylinder distortions and helps to reduce oil consumption.

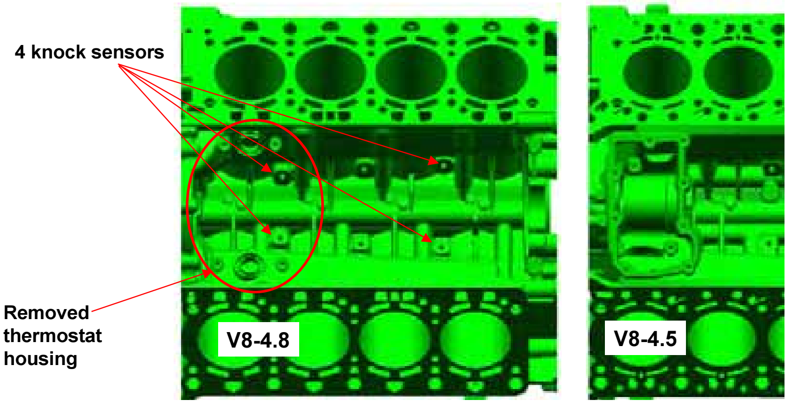


Modified water flow circuit.

The alloy used for the crankcase is known as a hypereutectic alloy in which silicon crystals form. These silicon crystals are exposed using several specialized honing processes in order to make the surface more durable. The crankcase has been lowered by 20 mm compared to the previous engine. As a result, the coolant pump and thermostat housing cover are also 20 mm lower and a modified water flow circuit was required.







The lower part of the crankcase is machined and paired together with the upper part. To keep the weight as low as possible, the spheroidal graphite iron inserts are no longer used and the wall thickness has been reduced.

A low-pressure chill-casting procedure is used to make the upper and lower part of the crankcase.

Crankshaft

The drop-forged crankshaft runs in five bearings and has eight counter-weights. Main bearing 3 is designed as a thrust bearing. Axial play is determined by two thrust washers, which are inserted into the bearing halves. The main bearings are two-component bearings and have a diameter of 64 mm. Since the lower part of the crankcase is made of an all aluminum alloy, the main bearings are stronger than those used previously and the retaining lugs have been changed to avoid confusion. The main bearings are also “lead-free.”

Torsional Vibration Balancer

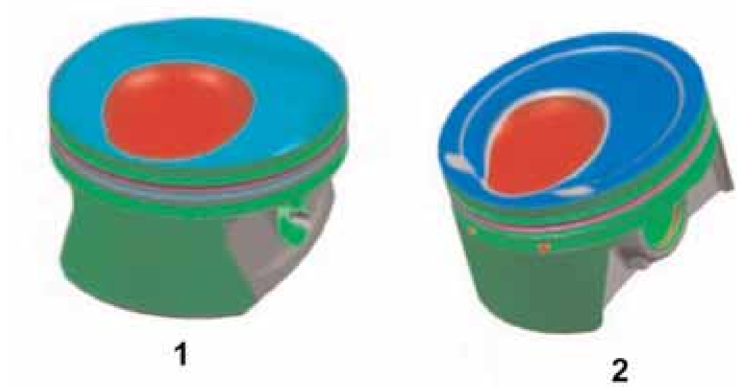
A torsional vibration balancer is used to reduce torsional vibrations on the crankshaft and to minimize component stress, e.g. on the belt drive. A shock absorber with the very best damping characteristics was selected because of the greater power impulses associated with direct fuel injection engines.

The viscous shock absorber has a floating flywheel in silicon oil in the housing. This allows the counter movement of the bearing mass to a not quite evenly rotating crankshaft.

Connecting Rods

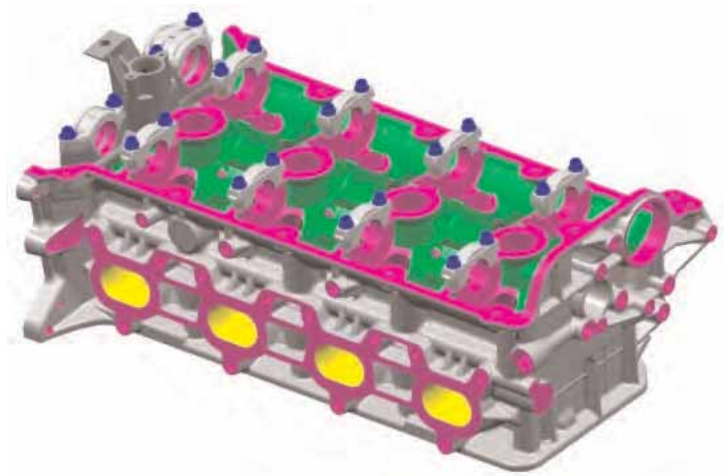
Compared to the 4.5 liter engine, the connecting rods are 2.4 mm longer. This reduces piston lateral runout and is more efficient. The connecting rod bearings are "lead-free" three-component bearings with a diameter of 54 mm. Oil is supplied to the connecting rod bearings via a Y-bore in the crankshaft.

Pistons



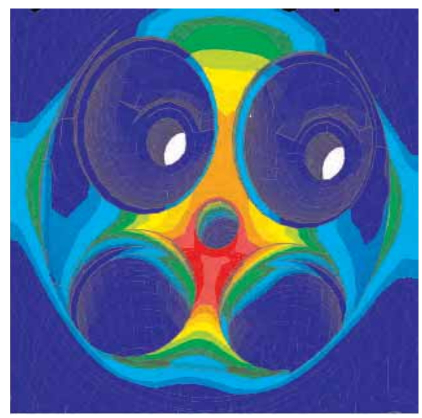
1 - Piston (naturally aspirated engine)
2 - Piston (turbo engine)

The pistons are designed as recessed pistons made of aluminum alloy. They have an iron coating (Ferrocout) at the sides to improve friction characteristics. The pistons are different on cylinder bank 1 and 2 both in the Cayenne S and Cayenne Turbo. Another difference between the pistons in the Cayenne S and Cayenne Turbo is that the combustion cavities have different depths because the compression ratios of both engines are different. The piston ring packages for the turbo and naturally aspirated engines are the same.



Cylinder head water jacket.

The cylinder head and camshaft mount is one joined component and is identical for the Cayenne S and Cayenne Turbo.

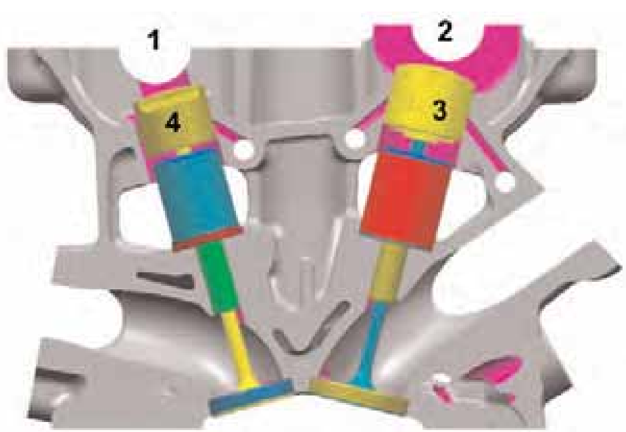


Combustion chamber stress area.

Technical Data, Valve Drive

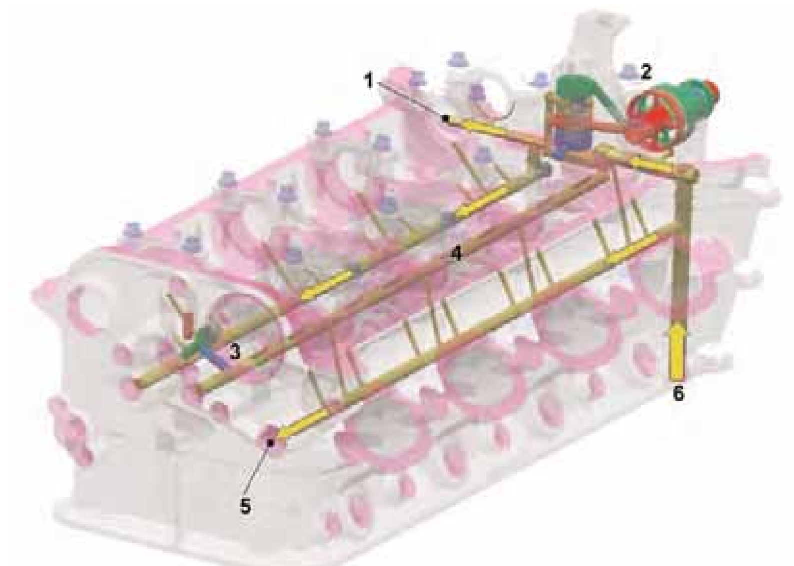
Intake valve diameter	38.3mm
Intake valve lift, large	11.0mm
Intake valve lift, small	3.6mm
Exhaust valve diameter	33.0mm
Exhaust valve lift, cyl. 3, 4, 5, 7	9.2mm
Exhaust valve lift, cyl. 1, 2, 6, 8	8.0mm
Intake valve angle	13.5°
Exhaust valve angle	15.4°
Fuel injector installation angle	29.0°
Camshaft bearing diameter	28.0mm

To ensure efficient gas exchange and valve lift control, the camshaft mount is 9 mm higher on the intake side compared to the outlet side. This arrangement meant that is was possible to optimize the intake port. The cooling system was designed in such a way that high temperature parts are optimally cooled. The cylinder head is made of AlSi7Mg.



1 - Exhaust side
2 - Intake side
3 - Operating plunger
4 - Outlet valve tappet

Oil Supply in the Cylinder Head



1 - Oil supply to the chain tensioner
2 - Camshaft control system
3 - Valve lift control system
4 - Oil supply for valve lift control
5 - Oil supply for turbocharger
6 - Oil intake

Camshaft Control With Valve Lift Control (VarioCam Plus)

The requirements imposed on engine design with regard to higher performance combined with improved driving comfort, compliance with emission regulations and reduced fuel consumption give rise to conflicting design criteria.

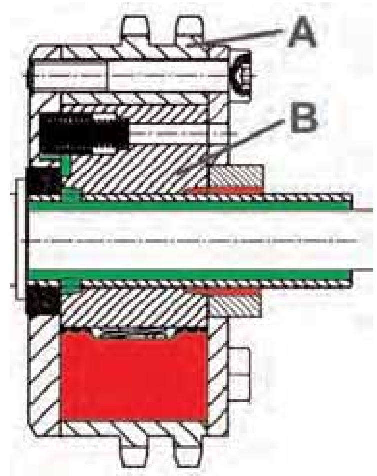
The development of the VarioCam Plus was therefore based on the idea of producing a variable engine, which can be optimized for maximum performance and also for regular driving in city traffic or on secondary roads. A control system for the intake camshaft to vary the opening and closing times in combination with a valve lift system is necessary.

Camshaft Control

Camshaft control on the intake camshaft is based on the principle of a vane controller. The DME control unit determines the current position of the camshaft in relation to the crankshaft (actual angle) on the basis of the speed sensor signal and the Hall sensor signal. The position control in the control unit receives the desired nominal angle via the programmed map values (speed, load, engine temperature). A regulator in the DME control unit activates a solenoid hydraulic valve according to the desired adjustment when there is a difference between the target angle and actual angle. The adjustment angle is 50° in relation to the crankshaft (25° in relation to the camshaft).

Vane Controller

The vane controller consists essentially of the stator **(-A-)**, which is installed on the crankshaft via the sprocket, the rotor **(-B-)**, which is installed on the camshaft, the inserted vanes and two lids. The sprocket is mounted to the outer diameter of the stator. It is interlocked with the crankshaft via the chain drive. The rotor is screwed securely to the camshaft. Rotation is possible between the rotor and stator (inner mounting of the controller). The rotation is limited by the vanes inserted in the rotor and by the stops on the stator. The vanes also divide the recesses on the stator into two separate chambers.

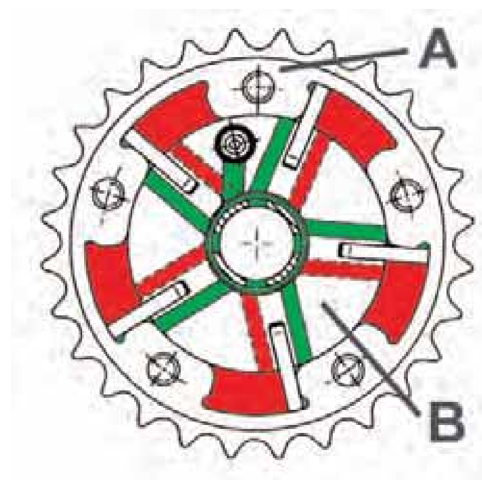


A - Stator
B - Rotor

These chambers can be filled with oil via oil bores and oil passages in the rotor. To guarantee secure sealing, small springs are installed between the vanes and rotor. The chambers are each sealed off at the sides with a lid fixed to the sprocket. The controller is locked at a stop (retarded). To do this, a spring-loaded pin in the retarding device of the controller moves into a bore in the lid. An interlocked connection between the stator and the rotor is created for the engine's starting process. This locking prevents noises during the period before oil pressure is produced.

Function

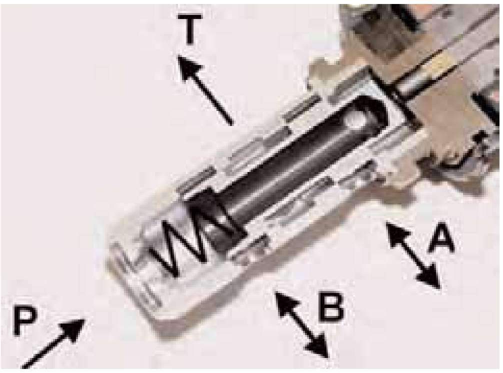
Two chambers, which act in different directions of flow, are contained in the controller. Filling of one chamber turns the rotor with respect to the stator. The rotor and the camshaft can be turned back into the original position by filling the other chamber. The oil of the non-pressurize chamber flows back into the chamber via the solenoid hydraulic valve.



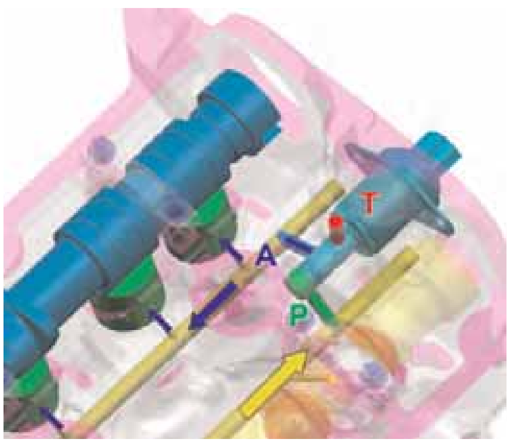
A - Stator
B - Rotor

If the oil supply and the oil return are interrupted at the solenoid hydraulic valve (center position of the valve) during the filling of a chamber, the controller remains at the position just assumed. The chambers lose oil through leakage so that the controller leaves its position. The solenoid hydraulic valve is controlled correspondingly by the control unit, and the controller returns to the desired position.

Solenoid Hydraulic Valve



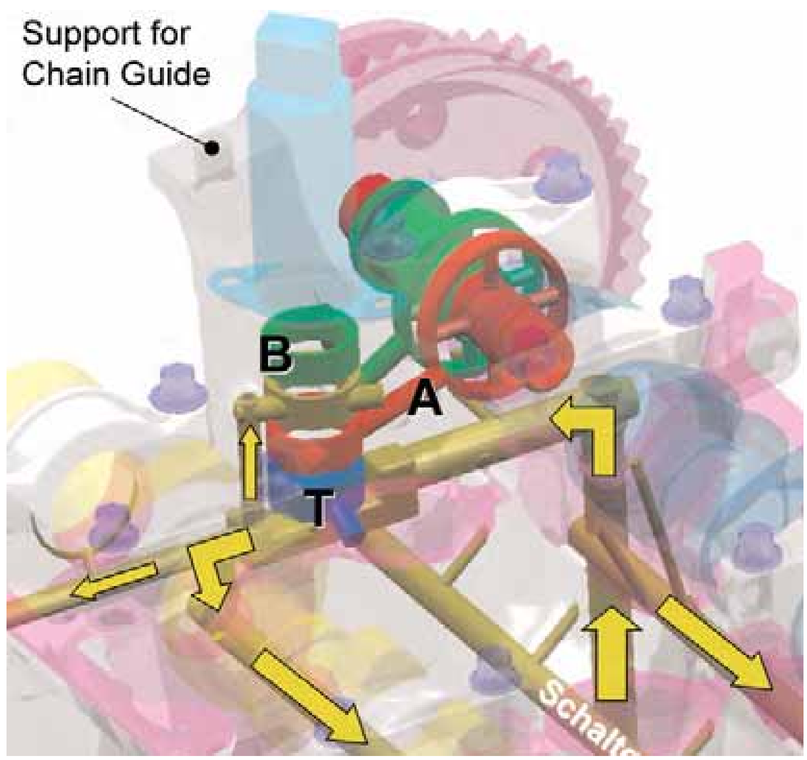
T - Solenoid hydraulic valve
P - Main oil pressure
A - Control pressure



The solenoid hydraulic valve is designed as a 4-way proportional valve, which connects one of the two control lines **(-A/B-)** to the oil pressure supply line **(-P-)** depending on the control unit specification and opens the other line so that the oil can flow into the crank chamber **(-T-line-)**.

If the **-A-** line is pressurized with oil, the controller will change direction to advance the valve timing. If the **-B-** line is pressurized with oil, the controller will change direction to retard the valve timing. Both control lines are closed in the center position. The camshaft is held in the desired position. In addition, any intermediate position between the three switch positions described above can be set via the control unit.

Therefore, it is possible not only to move the adjustment position very quickly but also to move it very slowly in the case of slight deviations of the valve from the central position. In this way, the solenoid hydraulic valve defines the adjustment direction and speed of the controller.



- Oil supply for cam phaser camshaft bearings and timing chain tensioner integrated in one bearing support.
- Screw connection of bearing support together with cam cap bolts.
- Oil Supply for first camshaft bearing (intake side) integrated in A-B oil supply for cam phaser (bleed > T).
- Advantage: no separate oil supply housing (V8 - 4.5) and no square section sealing rings necessary.

Tappet Evolution

Cayenne V8 engines use a "Ultra Leichtbau" lightweight 3CF bucket tappet.

Advantages are:

- Reduced mass
- Increased rigidity

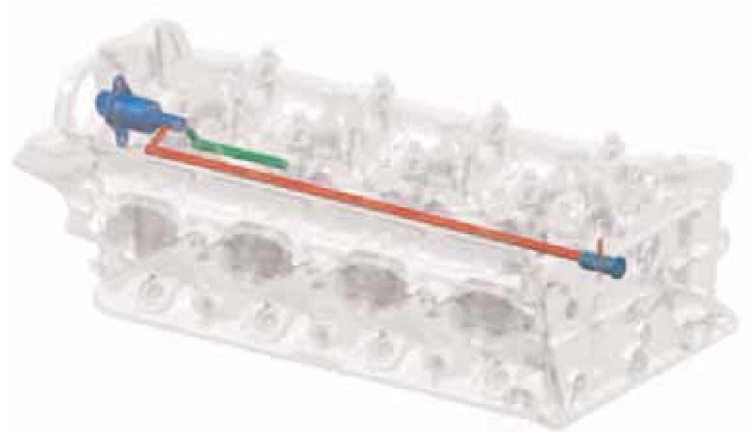
Cylinder Head Design

Previous Cylinder Head

Second Generation Cylinder Head

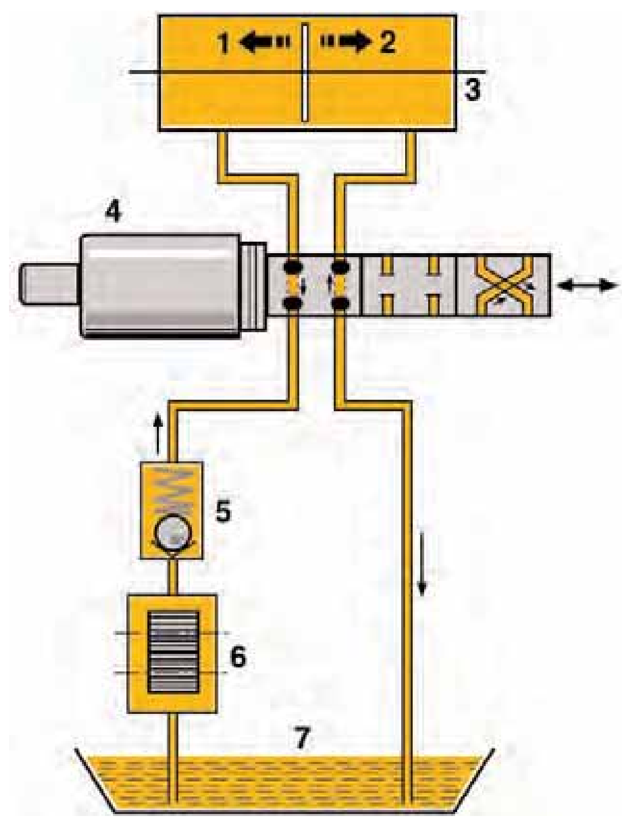
Additional weight savings were gained from the second generation V8 engine cylinder head design. On the left is the previous V8 4.5 liter cylinder head – fully machined, total weight including camshaft housing and bolts was 41 lbs (18.6 kg). On the right is the new second generation 4.8 liter head – fully machined, total weight including valve cover and DFI is 28 lbs (12.6 kg).

Scavenging Concept



A scavenging restrictor is installed on the end of the control pressure line to keep the switching time to a minimum during valve lift control. This scavenging restrictor is used to bleed the line and reduce switching time.

Check Valve



1 - Adjustment direction retarded
2 - Adjustment direction advanced
3 - Camshaft controller
4 - Solenoid hydraulic valve
5 - Check valve
6 - Oil pump
7 - Oil pan

The camshaft requires a high drive torque at times due to the valve actuation, but the camshaft continues rotating unaided at other times (alternating torques). If a check valve is inserted into the P-line and the solenoid hydraulic valve is energized, for example (adjustment in direction of advanced valve timing), the controller automatically intakes oil via the feed line, the solenoid hydraulic valve and the check valve for an advancing camshaft. If the camshaft then tries to lag due to the high drive torque, the check valve closes and the oil cannot escape. The camshaft is driven by the oil cushion of the sprocket during this time, as with a freewheel. The advancing and lagging phases of the camshafts repeat so that the camshaft automatically shifts to advanced valve timing in stages.

As the principle described above only functions with well sealed adjustment control systems and low-friction valve drives, oil pressure is required. To ensure that an extremely large oil pump is not required, the principle described above is taken advantage of when the engine is hot and at a low oil pressure through the use of the check valve. The check valve serves to increase the adjustment speed at low oil pressures.

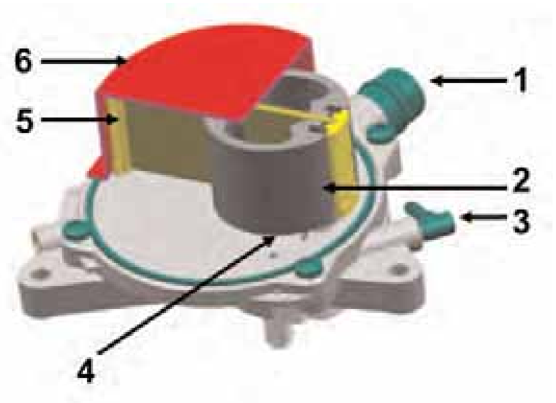
Valves, Valve Springs

The intake and exhaust valves on the Cayenne S and Cayenne Turbo have a shaft diameter of 6 mm. The intake and exhaust valves are bimetallic, i.e. the materials used for the valve plate and the lower part of the valve stem are different to those used for the upper part of the valve stem. In addition, the exhaust valves on the Cayenne Turbo are filled with sodium.

The intake valve springs on the Cayenne S and Cayenne Turbo are identical. They are designed as a conical double valve spring set. This gives a very compact design. The exhaust valve springs on the Cayenne S are conical single valve springs. The Cayenne Turbo features cylindrical double-valve spring sets to ensure that the exhaust valves close, even at higher pressures in the exhaust system.

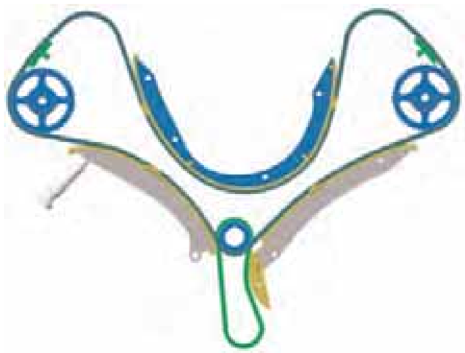
Vacuum Pump

Increased engine dethrottling means that the vacuum supply is no longer sufficient for unfavorable underlying conditions, e.g. low external air pressure at high altitudes and highly dynamic driving. A mechanical single-vane pump driven by the camshaft is used for this reason.



1 - Intake opening
2 - Rotor
3 - Secondary load connection
4 - Outlet valve in crank chamber
5 - Vane with guide shoes
6 - Housing

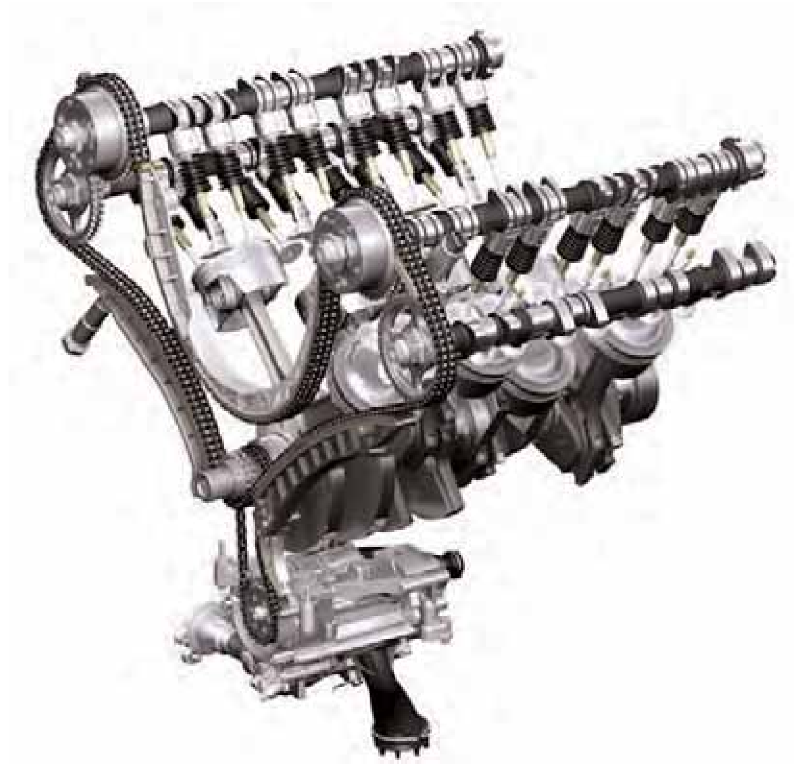
The pump delivery rate is 260cm/revolution.



The chain is guided by two specially coated guide rails. The lower guide rail on cylinder row 1 to 4 is also designed as a tensioning rail. The hydraulic chain tensioner is connected to the engine oil circuit and is totally maintenance free.

The chain drive consists of a 3/8" 8 mm wide duplex bush chain, which drives the two intake and exhaust camshafts.

Timing Drive Mechanism



Camshafts With Cylinder Specific Cam Contours

The intake and exhaust camshafts for both engines have a basic outer diameter of 38 mm. The intake valve lift is 3.6 mm and 11 mm. The exhaust valve lift on cylinders 1, 2, 6 and 8 is 8 mm, while the exhaust valve lift on cylinders 3, 4, 5 and 7 is 9.2 mm.

The engine design, with a V8 crankshaft and 90° throw, guarantees superb mass and torque balancing. In this engine design and a design with normal cam contours (same cam strokes), individual cylinders would be hindered during exhaust outflow into the exhaust manifold. The reason for this is that the surge of exhaust gas that emerges during the early (sooner than normal) exhaust valve opening for the respective cylinder (e.g. cylinder 2) goes into the overlap period of the next cylinder (cylinder 3). This would have a detrimental effect on the charging of the cylinders. Too many residual exhaust gases would also have a negative effect on the knock limit.

The firing order of the Cayenne (1-3-7-2-6-5-4-8) would put cylinders 3, 4, 5 and 7 at a disadvantage in terms of volumetric efficiency. These cylinders therefore have a larger cam stroke. This means that the cylinders are charged evenly, which results in an optimized torque curve in the entire rpm range.

Sprocket

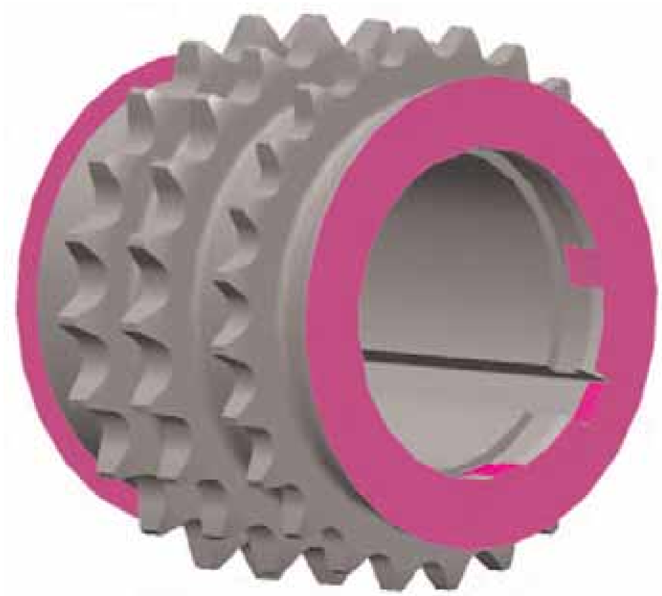


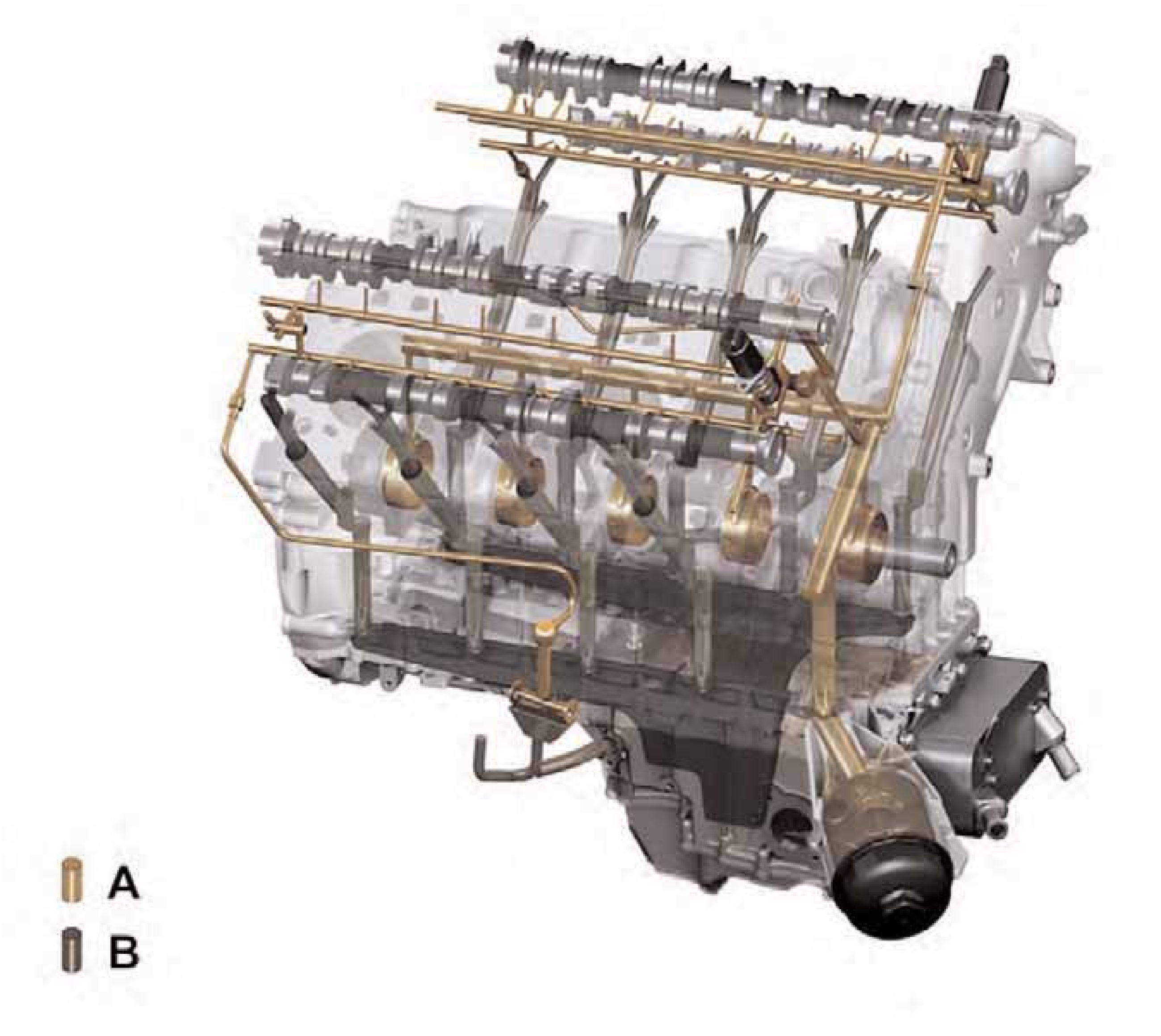
Illustration above shows the surface of the friction disk viewed under a microscope.

The lower sprocket, which drives the timing chain and the chain for the oil pump, has a friction disk on the front (facing the pulley) and rear (facing the crankshaft) for improved torque transmission.

Belt Drive

The secondary units, such as the generator, coolant pump, power-steering pump and air conditioning compressor, are driven from the torsional vibration balancer via a polyrib belt. A maintenance free belt tensioner ensures the correct belt tension in all operating states.

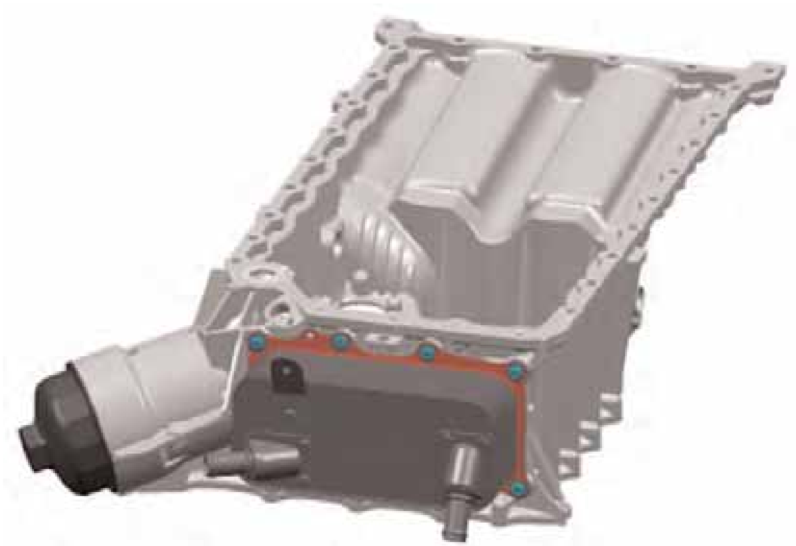
Lubricating Oil System



A - Pressure oil channels
B - Oil return channels

To guarantee a reliable oil supply in all driving situations, the V8 engines in the Cayenne S and Cayenne Turbo have an integrated dry-sump lubrication system.

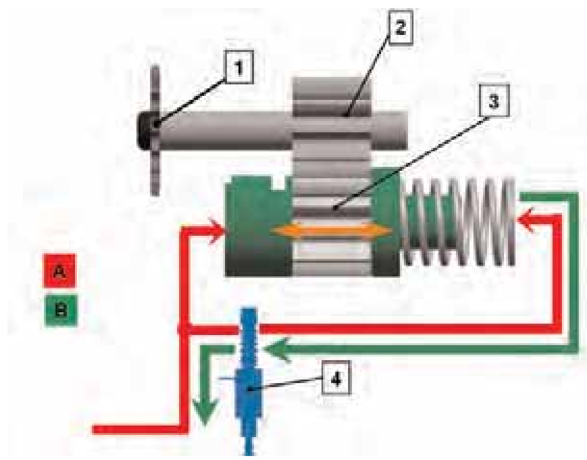
The oil pan is designed in two parts and has an upper and lower part. The oil-water heat exchanger and the oil filter are fitted directly on the upper part of the oil pan. To ensure a lightweight design, the windage tray, the oil return collection tank and the suction pipe are all together in a plastic housing fitted in the oil pan.



The oil pan wall is very thin so as to keep the weight as low as possible.

Oil Pump

The integration of VarioCam Plus, the mechanical vacuum pump and the fact that the lower part of the crankcase is fully aluminum means that oil throughput on the Cayenne S and Cayenne Turbo is very high. A relatively large and efficient pump must be used to guarantee the required oil supply. However, a lot of energy is required to drive such a pump and this energy requirement in turn increases fuel consumption. To counteract this, a variable oil pump is used for the first time in the Cayenne S and Cayenne Turbo.

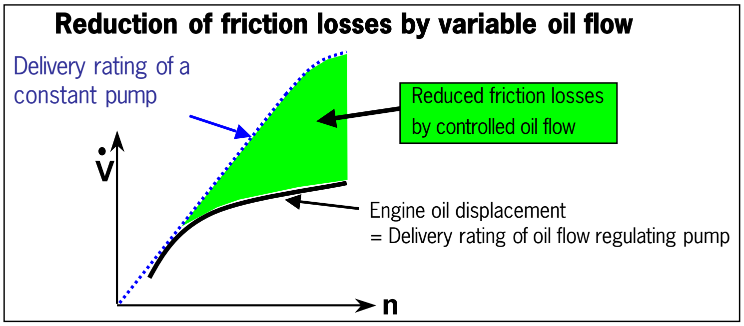


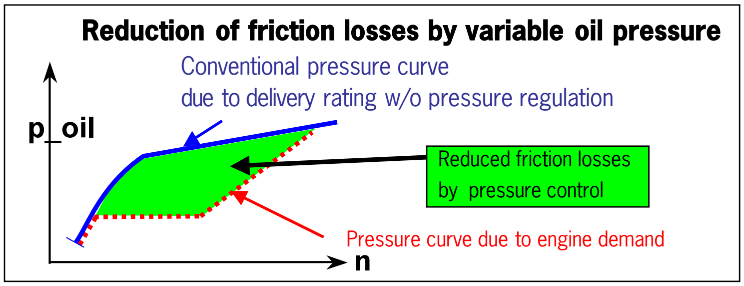
1 - Oil pump chain drive gear
2 - Oil pump driven gear
3 - Movable oil pump gear
4 - Oil pump control valve (lowers pressure on spring end of control piston)

Function

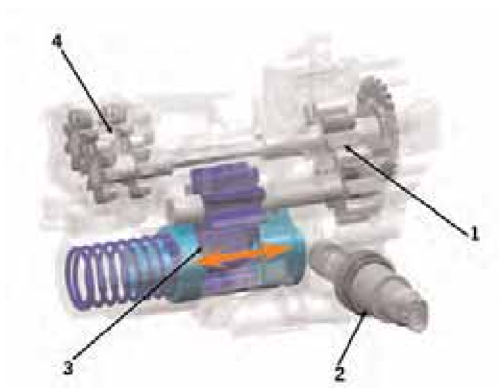
Depending on the input values for engine rpm, engine load, engine oil temperature and the expected change in engine rpm, a specific control valve position **(-4-)** is defined using a map in the DME control unit. The control valve position regulates the oil pressure for the spring piston on the gear wheel, which can move in axial direction. The oil pressure on the control piston is not regulated on the other side. The control valve is open fully in the non-energized state and as a result, the oil pressure is the same on both sides, which means that the gear wheel will not move.

In other words: the pressure difference between the spring piston and the control piston can be used to control every position. When the gear wheel moves, the teeth are still only partially engaged and as a result, performance and friction as well as energy requirements are reduced.



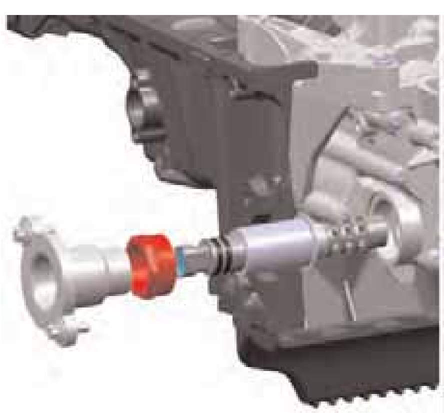


Cayenne Turbo Oil Pump



1 - Intake stage
2 - Control valve
3 - Variable pressure stage
4 - Turbocharger suction pump

The Cayenne Turbo has an additional pressure oil line for turbocharger lubrication. A turbocharger suction pump **(-4-)** is integrated in the main oil pump for suctioning off the lubricating oil.



The control valve is fitted on the oil pump in such a way that it can be accessed from the outside.

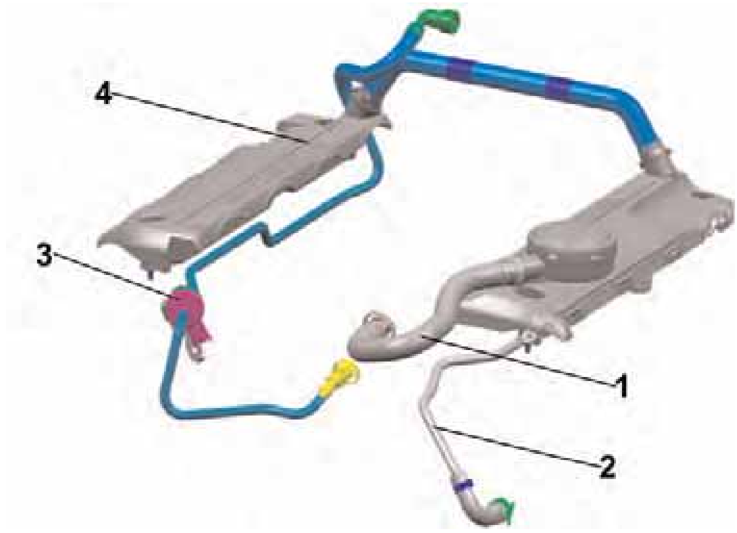
Oil Spray Jets

The temperature of the pistons in the Cayenne S and Cayenne Turbo engine is reduced by means of spray cooling. The spray jets are fitted on the upper part of the crankcase. The spray oil is also used for improved lubrication of the cylinder lining. To ensure the necessary engine oil pressure at low rpms and high engine oil temperatures, the spray jets have an opening pressure of approx. 1.8 bar.

Positive Crankcase Ventilation

During combustion, every engine blows some of the combustion gases past the piston towards the crankcase – these gases are called blow-by gases. If these gases are not drawn off, the pressure in the crankcase would increase considerably. A vent connection is installed in the crankcase for this reason. For environmental protection reasons, these gases are not released into the atmosphere, but are sent back to the engine for combustion via the intake system. Of course, these positive crankcase ventilation gases contain a high proportion of engine oil and other combustion residues as well as fuel residues in some cases. If these gases get into the intake duct, they will contaminate the intake air and can then impair running smoothness, exhaust emissions and reduce knock resistance. For these reasons effective oil separation is important for the engine.

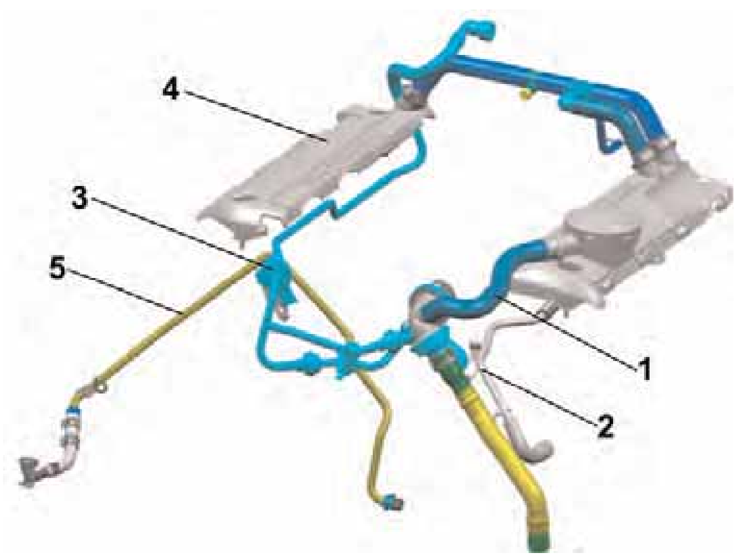
Positive Crankcase Ventilation – Naturally Aspirated Engine



1 - Return connection for blow-by gases
2 - Return line
3 - Tank vent
4 - Positive crankcase ventilation

Positive Crankcase Ventilation - Turbo Engine

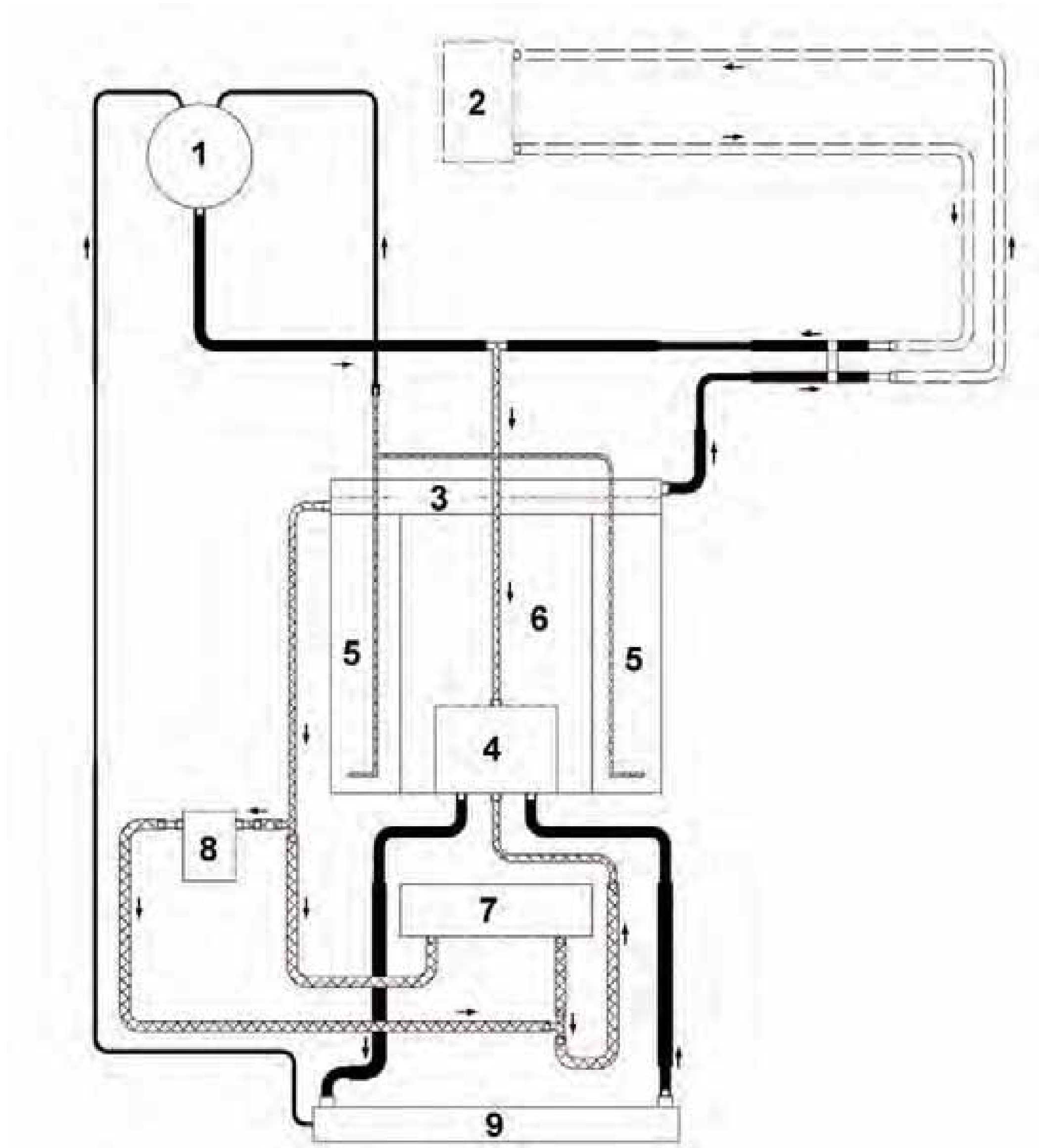
The positive crankcase ventilation system in the Cayenne Turbo can reduce the amount of fuel that goes into the engine oil during combustion. The aeration and ventilation system (Positive Crankcase Ventilation-PCV) ventilates the crankcase with a steady stream of fresh air, which accelerates the evaporation of fuel that is carried in.



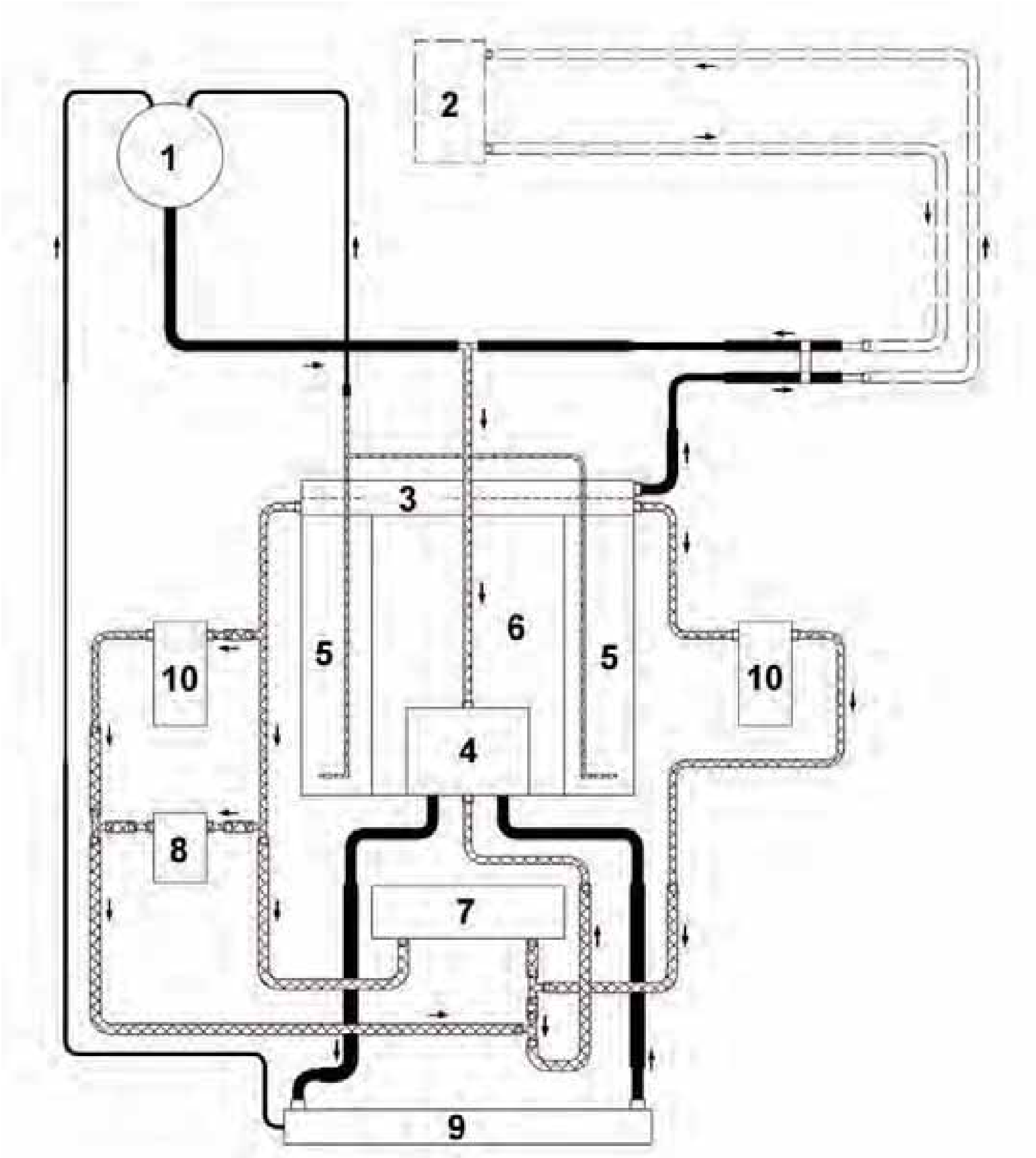
1 - Return connection for blow-by gases
2 - Return line
3 - Tank vent
4 - Positive crankcase ventilation
5 - PCV connection

For this purpose, fresh air is removed between the charge air cooler and throttle valve and is delivered to the crank chamber via a line. The pressure that exists at any time between the removal position and the crankcase causes a steady flow of fresh air through the crankcase. To ensure enough vacuum in the crankcase in all operating states, the vacuum in the intake manifold is used in the part-load ranges. A pressure regulating valve regulates this vacuum until the required value is reached. The vacuum from the compressor is used in the boost range (no vacuum present).

Cayenne S Cooling System



1 - Coolant reservoir
2 - Heat exchanger
3 - Coolant collection pipe
4 - Coolant pump/thermostat housing
5 - Cylinder head
6 - Crankcase
7 - Oil-water heat exchanger
8 - Generator
9 - Radiator

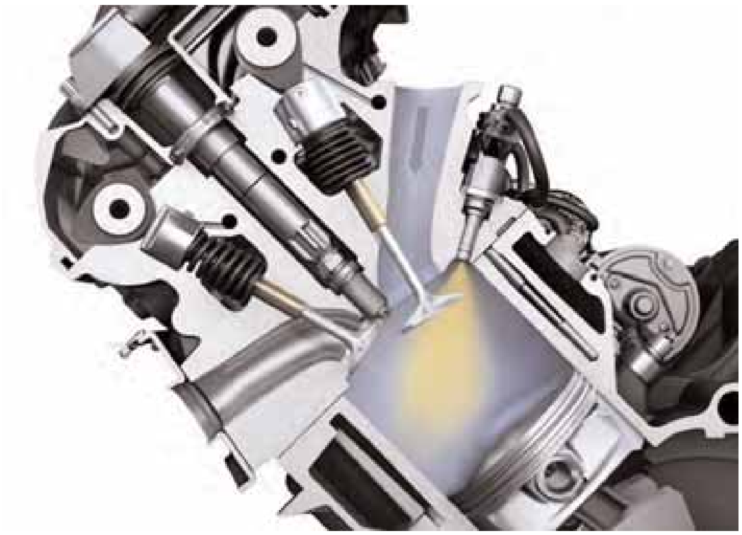


1 - Coolant reservoir
2 - Heat exchanger
3 - Coolant collection pipe
4 - Coolant pump/thermostat housing
5 - Cylinder head
6 - Crankcase
7 - Oil-water heat exchanger
8 - Generator
9 - Radiator
10 - Turbocharger

General

The main focus here is on new developments and modifications compared to previous Cayenne models.

Direct Fuel Injection (DFI)



A totally redesigned generation of engines with DFI is used for the new Cayenne models: a 3.6 l V6 engine for the Cayenne, a 4.8 l V8 naturally aspirated engine for the Cayenne S and a 4.8 l V8 bi-turbo engine for the Cayenne Turbo.

Development objectives for the new DFI engines:

- More power and torque.
- Reduced fuel consumption.
- Reduced weight.

These objectives have been achieved thanks to the following enhancements and new technologies:

- Increased displacement for more power and torque.
- Use of direct fuel injection (DFI).
- Higher compression ratio.
- Sport button as standard.
- VarioCam Plus (for V8 engines).
- Demand-controlled oil pump (for V8 engines).
- New intake systems adapted specifically for each engine.
- VarioCam Plus (for V8 engines) for controlling the intake camshaft and valve lift.
- New sports exhaust system (optional for Cayenne S with Tiptronic S).
- Demand controlled variable oil pump for improved engine efficiency (for V8 engines).

Contents

The most important technical components of the direct fuel injection system are:

- The fuel low pressure system.
- The fuel high pressure system.
- The fuel rail (central high pressure distribution pipe).
- The fuel injectors.
- Modifications to the cylinder head.
- Special recessed pistons for the relevant engine.

Porsche is using direct fuel injection (DFI) for the first time in its new generation of Cayenne engines. DFI offers numerous advantages compared to intake manifold injection. The main objective here is to achieve an air/fuel mixture adapted specifically to the respective operating and charge states of the engine using an injection system and mixture formation. This provides the perfect solution for meeting the various demands relating to economy, power, vehicle handling and emissions.

With direct fuel injection, the fuel is injected directly into the combustion chamber and mixture formation takes place almost completely in the combustion chamber.

The direct fuel injection system used in the new Cayenne models is characterized by the following:

- Homogeneous operation.
- Better cylinder filling.
- Reduced knock sensitivity.
- Higher compression ratio.
- High pressure stratified charge ignition.
- Dual injection.

The direct fuel injection system used in the new Cayenne engines is based on homogeneous operation. The mixture of air and fuel is distributed as evenly as possible in the combustion chamber, thereby allowing optimal combustion. With this system, the fuel is injected directly into the combustion chamber at a pressure of up to 1740 psi (120 bar).

Within the injector, the fuel jet creates a vortex (rotated around the longitudinal axis). This rotation forms a conical cloud of fuel. The fine atomization produced by this allows faster evaporation of the fuel. The fuel evaporation process takes the required heat energy from the air, thereby cooling the air. This reduces the cylinder charge volume and additional air is drawn in through the open intake valve, which in turn improves cylinder filling. The reduced temperature level also helps to meet the prerequisites for the higher compression ratio in all new Cayenne engines since knock sensitivity has been improved. The higher compression ratio in turn increases engine efficiency.

Start Phase of DFI Engines

High pressure stratified charge ignition is used in the DFI systems of the new Cayenne engines in order to optimize cold starting with regard to fuel consumption and emissions. With this ignition system, fuel injection occurs very late – just before the end of the compression stroke – when starting the engine. The high pressure stratified charge ignition system injects fuel directly only once into the specially molded piston recess so that a stratification, which creates an ignitable mixture, is formed around the spark plug. The piston recess ensures that the injected fuel is directed straight to the spark plug. This reduces both the amount of fuel required and the emissions compared to intake manifold injection.

Catalytic Converter Heating Phase in DFI Engines

Once the high pressure stratified charge ignition system starts the engine, engine management switches to the catalytic converter heating phase. In this operating state, a dual injection system helps to bring the catalytic converter to the temperature required for optimal conversion as quickly as possible by increasing the exhaust emissions temperature.

The 2nd injection of fuel into the piston recess occurs just before the end of the compression stroke with the intake valves closed. The air/fuel mixture is ignited very late and this increases the exhaust emissions temperature. As a result, emissions during the start phase are reduced and the secondary air pumps are no longer required for all engines.

Upper Load Range of DFI Engines

Dual injection always occurs in the upper load range up approx. 3500 rpms. The amount of fuel required for combustion is distributed in two consecutive injection processes. In the upper load range, both injections occur during the intake stroke (intake synchronous injection) with the intake valves open, thereby ensuring reduced fuel consumption through improved homogenization.

Piston Recesses in DFI Engines

The piston recesses are important for high pressure stratified charge ignition and for dual injection during the catalytic converter heating phase. They allow late injection of fuel in order to create an ignitable air/fuel mixture around the spark plug for late ignition. 2

Note!

Intake manifold injection

> With the intake manifold injection system, the fuel is injected into the intake duct earlier and mixture formation takes place partly in the intake duct and partly in the combustion chamber. During the intake process, fuel is deposited on cylinder walls and valves and as a result, this fuel is no longer available for combustion. This is particularly the case during the start phase of the engine at low temperatures and the consequence of this is that the amount of fuel used exceeds the amount of fuel that is actually needed for combustion.

Sport Button

All new Cayenne models already have a Sport button as standard, which is located centrally in the center console under the shift lever or Tiptronic S gear selector. This button allows the driver to choose between the vehicle's fuel consumption tuning (normal mode) and sport tuning (sport mode). When the Sport button is pressed, a "SPORT" logo lights up in the instrument cluster.

In the Motronic area, pressing the Sport button (in High-Range mode only) affects the following systems, depending on the vehicle equipment:

- When the Sport button is activated, a more sporty accelerator pedal characteristic produces a more spontaneous engine response, underpinning the sporty character. This is achieved via a steeper rise for the electronic throttle characteristic. This means that the throttle is opened further and faster with the same accelerator pedal travel when the Sport button is pressed.
- Maximum full-load torque is available at all times in the Sport button's sport mode. In normal mode, electronic engine management restricts the engine management functions in order to optimize fuel consumption. If full power is required in a certain driving situation (e.g. when passing), it can be achieved at any time by initiating a kick down. Engine management switches to the sport mode map at this time.
- The Sport button lends a sportier feel to the transitions between traction and deceleration, as well as between deceleration and traction. This means that throttle activation and ignition are switched to a more direct map when accelerating and particularly when decelerating, resulting in a more spontaneous and dynamic load cycle.
- The sports exhaust system available for the Cayenne S in combination with Tiptronic S is also activated using the Sport button.

Sport mode remains active until either the Sport button is pressed a second time or the driver switches off the ignition. This deactivates sport mode and the settings revert to normal mode.

On the new Cayenne V6 engine, displacement has been increased by 0.4 liters to 3.6 liters with a compression ratio of 12.25. Engine power has increased by 40 HP to 290 HP, while the torque is now 285 ftlb. (385 Nm), an increase of +56 ftlb. (+75 Nm). Idling rpm is 680 and maximum engine rpm is 6700.

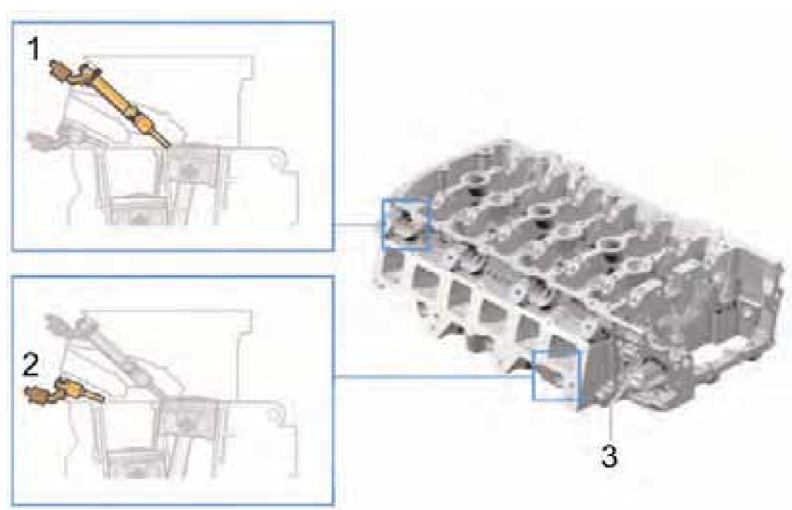
Significant modifications to the V6 DFI engine:

- Direct fuel injection (DFI).
- New engine control unit Bosch MED 9.1.
- New extended twin branch exhaust system and additional main catalytic converter.
- New cylinder head for DFI.
- New recessed pistons.
- Continuous camshaft adjustment on intake and exhaust side.
- Intake system with variable intake manifold.

Motronic Control Units MED 9.1

The new DME control unit MED 9.1 from Bosch has been specially adapted to suit direct fuel injection and the modified engine specifications of the V6 DFI engine. It can be programmed with the country-specific data records of the Cayenne V6.

Cylinder Head



The design of the direct fuel injection system, with two separate high pressure rails, the arrangement of the fuel injectors **-1-** (for cylinders 1, 3, 5) and **-2-** (for cylinders 2, 4, 6) as well as the high pressure pump **-3-**, has made it necessary to redesign the cylinder head.

Piston Recesses

The piston recesses **-1-** on the V6 engine have been adapted for the purpose of achieving optimal stratification of the air/fuel mixture during the late injection processes that characterize high pressure stratified charge ignition as well as during the catalytic converter heating phase.

The compression ratio has been increased from 11.5:1 to 12.25 due to improved inner cooling. This reduces fuel consumption and optimizes engine power.

Cayenne V8 DFI Engines

The totally redesigned family of V8 engines includes a naturally aspirated engine for the new Cayenne S and a turbocharged version for the new Cayenne Turbo. Specific design work and tuning has resulted in an identical parts concept between the naturally aspirated and turbo engine.

Key changes:

- Direct fuel injection (DFI).
- Engine control unit Siemens EMS SDI 4.1.
- Increased displacement.
- New cylinder head for DFI.
- Special recessed pistons for Cayenne S and Cayenne Turbo.
- Use of VarioCam Plus.
- Demand controlled variable oil pump.

Motronic Control Unit EMS SDI 4.1

A completely new DME control unit EMS SDI 4.1 developed by Siemens is used for the V8 engines. This is designed specifically to meet the requirements for using the direct fuel injection system and VarioCam Plus. The control of fuel injectors, which are the main elements of the direct fuel injection system, is particularly important here. The DME control unit can be programmed for individual countries using the data records for Cayenne S and Cayenne Turbo.

Cayenne S DFI Engine

On the new V8 naturally aspirated engine in the Cayenne S, the displacement has been increased by 0.3 liters to 4.8 liters with a compression ratio of 12.5. Engine power has been increased by 45 HP to 385 HP, while the torque is now 370 ftlb. (500 Nm) – an increase of +59 ftlb. (+80 Nm). Idling rpm is 580 rpm (550 rpm for AT with transmission range engaged) and maximum engine rpm is 6700. The new DME control unit EMS SDI 4.1 has been specially adapted to suit direct fuel injection and the modified engine specifications of the V8 naturally aspirated engine.

- DFI direct fuel injection.
- Intake system with variable intake manifold.
- Enhanced exhaust system.
- New sports exhaust system (optional, in conjunction with Tiptronic S).

Piston Recess

The piston recesses are specifically designed to suit the characteristics of the V8 naturally aspirated engine during late injection with the high pressure stratified charge ignition system and during the catalytic converter heating phase.

The increase in the compression ratio from 11.5 to 12.5:1 on the V8 naturally aspirated engine as a result of DFI serves to optimize both engine power and fuel consumption.

Cayenne Turbo DFI Engine

On the new Cayenne Turbo, displacement has also been increased by 0.3 liters to 4.8 liters with a compression ratio of 10.5. Engine power has increased by 50 HP to 500 HP, while the torque is now 518 ftlb. (700 Nm – an increase of +56 ftlb. (+80 Nm). Idling rpm is 580 rpm (550 rpm for AT with transmission range engaged) and maximum engine rpm is 6700. The new DME control unit EMS SDI 4.1 has been specially adapted to suit direct fuel injection and the modified engine specifications of the V8 turbo engine.

- DFI direct fuel injection.
- New intake system.
- Adaptation of turbochargers and boost pressure control.

Piston Recess

The piston recesses are specially adapted to the characteristics of the V8 turbo engine. The increase in the compression ratio from 9.5 to 10.5:1 as a result of DFI serves to optimize both engine power and fuel consumption.

Fuel Supply

The engine is designed to provide optimum performance and fuel consumption if unleaded premium fuel with 93 octane ($\frac{R+M}{2}$) is used. If unleaded premium fuels with a lower octane number is used, the engine's knock controller automatically adapts the ignition timing. The maximum filling approx. 26 Gals. (100 liters), with a reserve of approx. 3 Gals. (12 liters).

Safety

Always read and follow the safety instructions in the Technical Manual, Group 2 when working on the fuel supply system.
> Fuel low-pressure system in DFI engines.

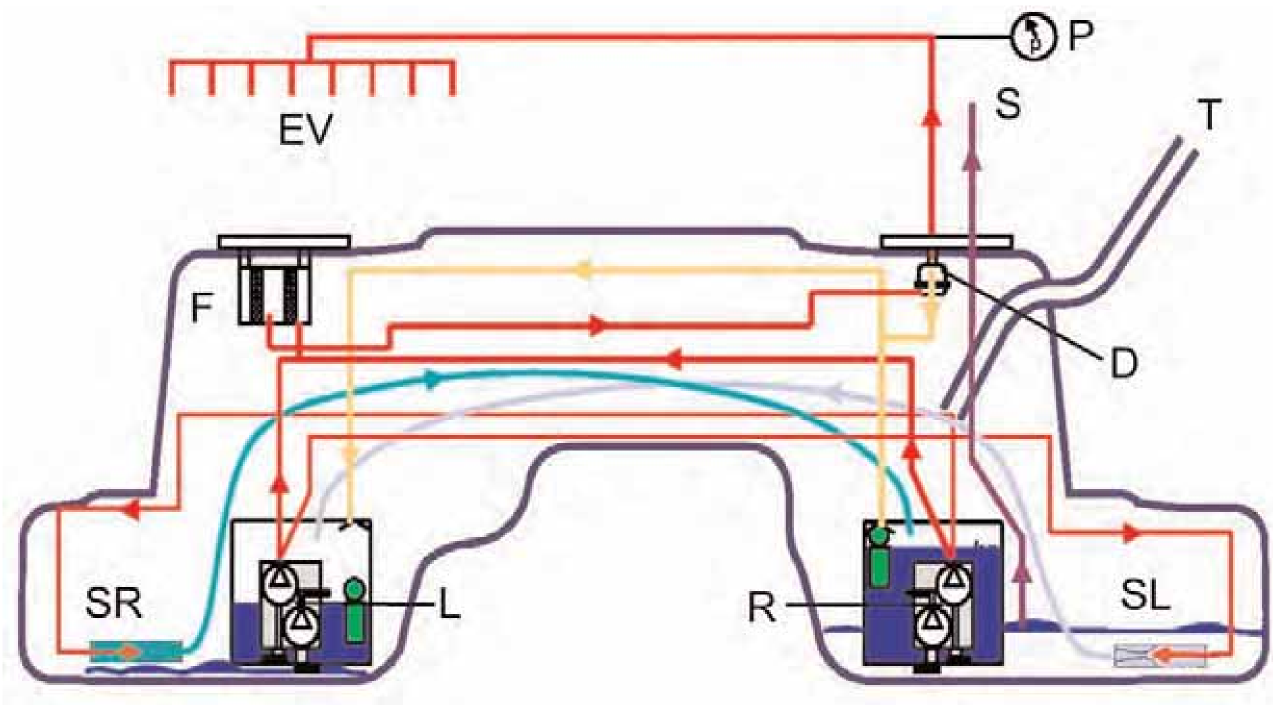
Technical Manual

The procedure for checking the fuel pressure and the amount of fuel delivered by the fuel pumps is described in the Technical Manual.

- The low pressure system delivers the fuel from the fuel tank to the high pressure pump on the cylinder head.
- The new Cayenne vehicles have a returnless fuel system (RF).
- The demand control function of the fuel delivery rate reduces fuel heating in the tank by switching on the second fuel pump.

The fuel tank is not symmetrical. The left half of the tank has a higher volume than the right side. There is a “hump” in the middle so that both chambers are separated from each other once a certain fuel level is reached in the tank. When the tank is half full, the left fuel pump is activated because the left half of the tank has the higher volume. The fuel pumps are each supplied by one sucking jet pump whose hoses are routed diagonally and which “helps itself” to fuel from the other half of the tank.

The fuel pressure and the way in which the two fuel pumps are activated has changed compared to Cayenne vehicles up to model year 2006. On Cayenne vehicles up to M.Y. 2006, the left fuel pump was permanently activated and the right pump was only activated as required (for starting, higher delivery rate, etc.).



Fuel Pressure On The Low Pressure Side.

For DFI engines, the fuel pressure on the low pressure side has been increased to approx. 80 psi/5.5 bar (this was previously approx. 58 psi/4 bar). The left or right fuel pump is operated as the main pump in order to distribute the higher load to both fuel pumps, depending on the fuel level.

The fuel pumps are activated if the level of fuel in the tank is reduced and if the engine requires more fuel:

- Fuel level > 15.8 gal. (60 liters) to 26 gal. (100 liters): When the tank is relatively full, the right fuel pump is activated; if more fuel is required (> 13 gal./50 liters/h), the left pump is activated.
- Fuel level > 4 gals/15 liters to 15.8 gals/60 liters: When the tank is half-full, the left fuel pump is activated; if more fuel is required (> 13 gals/50 liters/h), the right pump is activated.
- Fuel level < 4 gals./15 liters: If the tank is relatively empty, both pumps run continuously.

Other switching functions include:

- If the ignition was switched off for more than 30 minutes, the left fuel pump is activated for approx. 1 to 2 seconds when the driver's door is first opened in order to build up fuel pressure even before the ignition is switched on.
- Both fuel pumps are activated while starting the engine and for several seconds after starting the engine.

T - Tank filler neck
R - Fuel pump unit in right side of tank
L - Fuel pump unit in left side of tank
SL - Sucking jet pump for left fuel pump
SR - Sucking jet pump for right fuel pump
F - Fuel filter (does not need to be changed)
D - Fuel pressure regulator (approx. 80 psi/5.5 bar)
EV - Fuel injectors (cylinders 1 to 6 or 1 to 8)
P - Fuel pressure approx. 80 psi/5.5 bar

Fuel High Pressure System in DFI Engines

The fuel high pressure system generates an injection pressure of up to 1740 psi (120 bar) in the combustion chamber. The components of the V6 engine and the V8 engines are different.

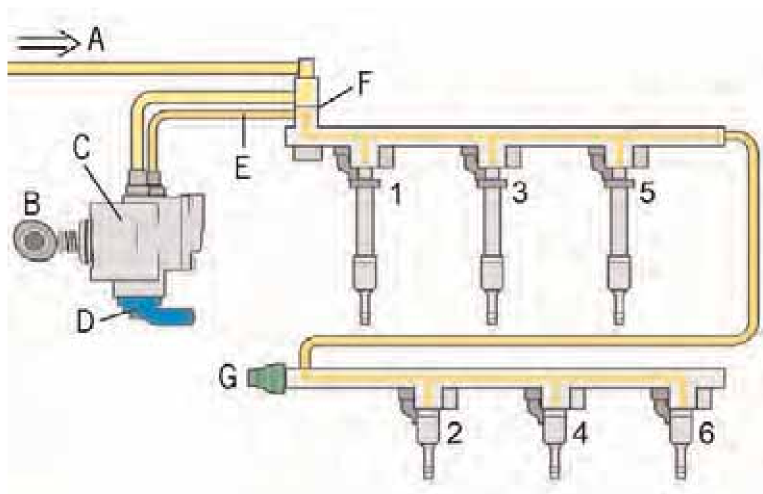
The following pages describe the functions of the components of the V6 DFI engine first, and then those of the V8 DFI engines.

Safety

Always read and follow the safety instructions in the Technical Manual, Group 2 when working on the fuel supply system.

V6 DFI Engine

The fuel high pressure system in the V6 DFI engine is made up of the following parts/components.



A - Low pressure (approx. 80 psi/5.5 bar from the fuel tank)
B - Camshaft
C - Fuel high pressure pump
D - Flow control valve (for fuel high pressure)
E - High pressure line
F - Pressure control valve (max. 1740 psi/120 bar)
G - Fuel pressure sensor
1, 3, 5 - Fuel injectors on high pressure rail, bank 1
2, 4, 6 - Fuel injectors on high pressure rail, bank 2

Fuel High Pressure Pump

The fuel high pressure pump creates a high pressure of up to 1740 psi (120 bar), which is required for injection. It is controlled by demand and adapts the fuel quantity according to engine requirements via a flow control valve. This piston pump with one piston is located on the cylinder head. The high pressure pump is driven by the timing chain via a double-cam gear wheel. The double-cam gear wheel uses a roller to actuate the pump piston, which creates the fuel high pressure in the pump.

C - Fuel high pressure pump with flow control valve
G - DS Fuel pressure sensor

Note

Pressure variations can occur on the low pressure side while measuring fuel pressure at idling speed due to the piston pump on the high pressure side with one piston.

Technical Manual

Always read and observe the specifications in the Technical Manual when securing all fuel lines in the high pressure area.

Flow Control Valve For Fuel High Pressure

The control valve for fuel high pressure located underneath the fuel high pressure pump operates as a flow control valve. The Motronic control unit maintains the fuel high pressure going to the fuel rails of cylinder bank 1 and 2 at a pressure of between 508 psi (35 bar) and 1450 psi (100 bar) via the control valve. If the control valve fails, the Motronic control unit goes into emergency operation, whereby the engine can still run in a limited way with low pressure (80 psi/5.5 bar).

Fuel Pressure Sensor

The fuel pressure sensor is installed on the lower fuel rail (cylinder bank 2) and informs the Motronic control unit about the current pressure in the fuel high pressure system. The Motronic control unit evaluates the signal and regulates the fuel high pressure via the fuel pressure control valve in the high pressure pump. If the fuel pressure sensor fails, the fuel pressure control valve is activated with a fixed value by the engine control unit.

Pressure Control Valve

The pressure control valve is located on the fuel rail of cylinder bank 1. The valve opens a connection to the fuel low pressure system if the fuel pressure in the high pressure system exceeds 1740 psi (120 bar).

Two High Pressure Rails

Two high pressure rails are used in the V6 engine. The fuel is pumped from the high pressure pump to the two distribution rails on cylinder bank 1 and 2 via the high pressure line. The same fuel pressure is available for all fuel injectors from there.

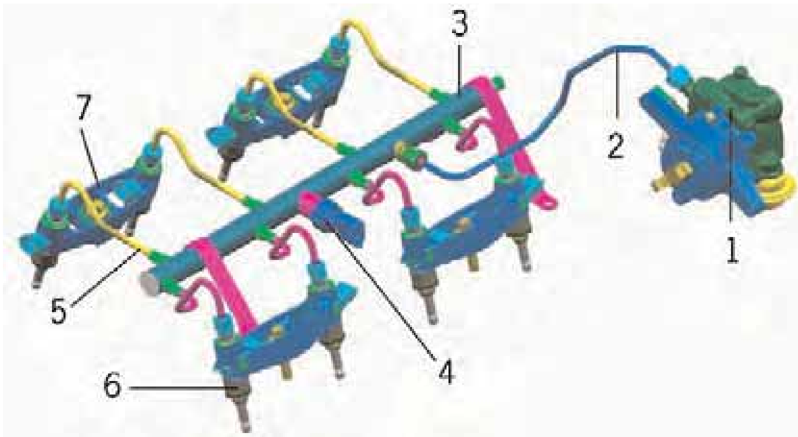
Fuel Injectors/High Pressure Injectors

The electromagnetically operated fuel injectors are located in the cylinder head. They are activated by the Motronic control unit in accordance with the firing order. Following activation, they inject fuel directly into the combustion chamber at a pressure of 580 psi (40 bar) to 1740 (120 bar). The injectors for both cylinder banks are on the intake side of the cylinder head. This arrangement allows the injectors for cylinders 1, 3 and 5 to run through the inlet port on the cylinder head. The injectors for cylinder bank 1 are therefore longer than the injectors for cylinder bank 2.

Since the injectors are inserted from the same side for both cylinder banks, the piston recesses of cylinder bank 1 and 2 must be molded differently so that the injected fuel is whirled around and mixed perfectly with the air that is drawn in. This is necessary because the fuel injectors and intake valves on both cylinder banks are arranged in different angles.

In addition to the amount of fuel injected and the injection time, the shape and alignment of the fuel jet is also important here. A defective injector is detected by the misfire detection system and is not activated again.

Fuel High Pressure System in V8 DFI Engines



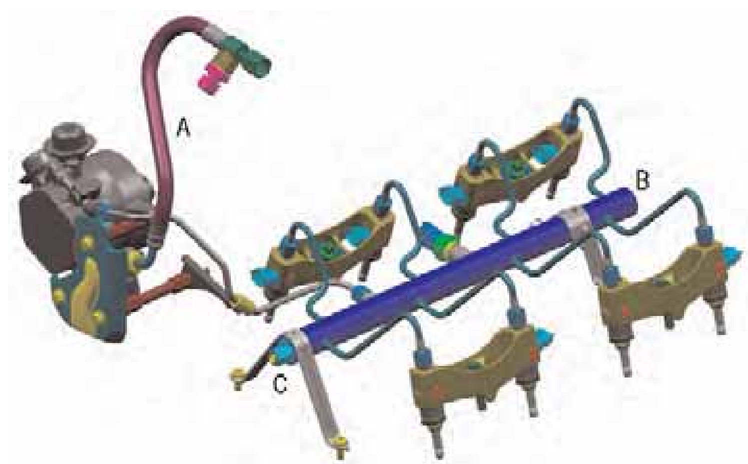
The fuel high pressure system in V8 DFI engines is made up of the these parts/components.

1 - Fuel high pressure pump with flow control valve, pressure control valve and temperature compensator
2 - High pressure line
3 - Fuel rail
4 - Fuel pressure sensor
5 - Fuel line (for fuel injector on cylinder 1)
6 - Fuel injector (cylinder 5)
7 - Retainers for two fuel injectors

Technical Manual

Always read and observe the specifications in the Technical Manual when securing all fuel lines in the high pressure area.

Fuel Temperature Sensor (on low pressure side)



A - Low pressure fuel line
B - Fuel rail
C - Test port

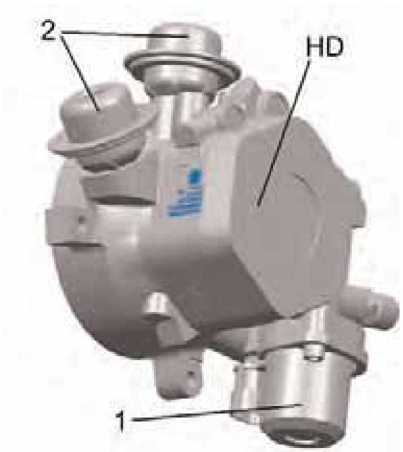
At start of production, all Cayenne V8 engines have a fuel temperature sensor on the low pressure side, which will be replaced by a temperature model in the DME in later production. Depending on the amount of fuel required and the fuel temperature, the DME control unit, together with the flow control valve, regulates the amount of fuel on the high pressure side upstream of the high pressure injectors.

Fuel High Pressure Pump

The fuel high pressure pump pumps the amount of fuel required for injection and builds up a fuel pressure of up to 1740 psi (120 bar). The axial piston pump is driven by the inlet camshaft. The Cayenne S and Cayenne Turbo are equipped with different high pressure pumps.

Cayenne V8 Naturally Aspirated Engine

The high pressure pump used in the Cayenne S is a three-piston pump with a maximum delivery rate of approx. 47.5 gals./180 liters/h at 1740 psi (120 bar). It builds up pressure and ensures flow control. The following components are integrated into the high pressure pump: Flow control valve with pressure reducing function for the fuel high pressure side, pressure control valve, bypass valve, a temperature compensator on the oil side and a fuel strainer on the inlet side with a mesh width of approx. 50 µm. Fuel is distributed via a central high pressure rail with separate lines leading to the fuel injectors.



Cayenne Turbo

The high pressure pump **-HD-** used in the Cayenne Turbo is a six-piston pump with a maximum delivery rate of approx. 58 gals./245 liters/h at 1740 psi (120 bar). It builds up pressure and ensures flow control.

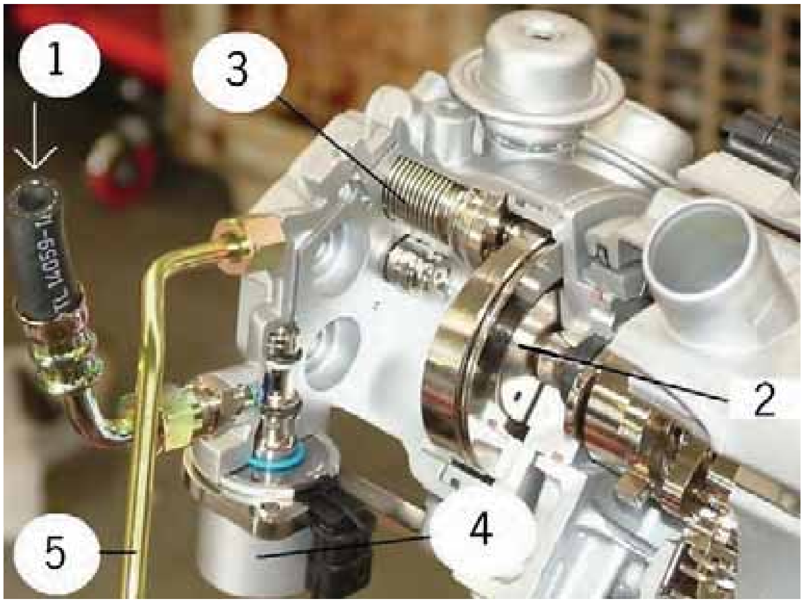
The following components are integrated into the high pressure pump:

Flow control valve **-1-** with pressure reducing function for the fuel high pressure side, pressure control valve, bypass valve, two temperature compensators on the oil side **-2-** and a fuel strainer on the inlet side with a mesh width of approx. 50 µm. Fuel is distributed in the same way as for the V8 naturally aspirated engine via a central high pressure rail with separate lines leading to the fuel injectors.

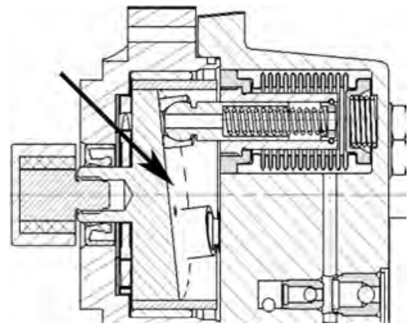
Flow Control Valve For Fuel High Pressure

The electric control valve for the fuel high pressure side **-1-** is located on the fuel high pressure pump and operates as a flow control valve. The Motronic control unit regulates the delivery rate of the high pressure pump in the fuel supply to the pump via the control valve. When the engine is switched off, the fuel high pressure is reduced by an integrated pressure reducing valve. The fuel pressure sensor monitors the required fuel pressure (approx. 580 psi/40 to 1740psi/120 bar).

- If the control valve fails, the Motronic control unit goes into emergency operation, whereby the engine can still run in a limited way with low pressure (80 psi/5.5 bar). In this case, the bypass valve in the pump opens and provides a direct route from the low pressure side to the high pressure side.
- The bypass valve is also activated for filling the empty fuel rail on new engines or following repairs in order to reduce starting times.

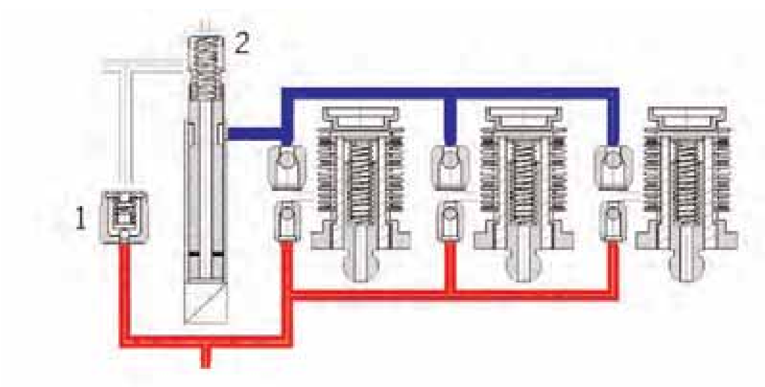


1 - Low pressure (approx. 80 psi/5.5 bar from the fuel tank)
2 - Wobble plate
3 - Fuel high pressure pump
4 - Flow control valve (for fuel high pressure)
5 - High pressure line to fuel rail



Arrow in illustration is wobble plate.

Bypass Valve (including pressure relief valve)



1 - Bypass valve, including pressure relief valve
2 - Volume control valve
Blue - Low pressure inlet from the in-tank fuel pump
Red - High pressure to the injectors

Pressure Control Valve

The pressure control valve is integrated into the fuel high pressure pump. This safety valve opens a connection to the fuel low pressure system if the fuel pressure in the high pressure system exceeds approx. 2030 psi (140 bar).

High Pressure Line

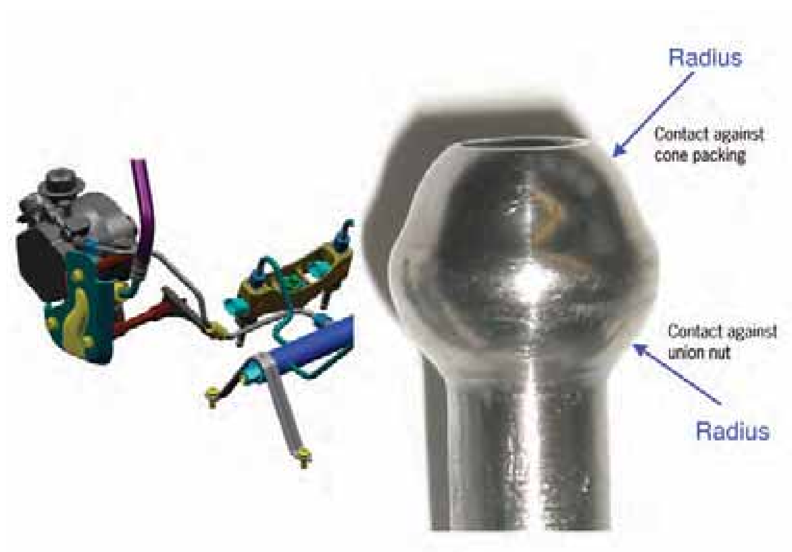
The high pressure line connects the high pressure pump to the fuel rail.

Central High Pressure Rail

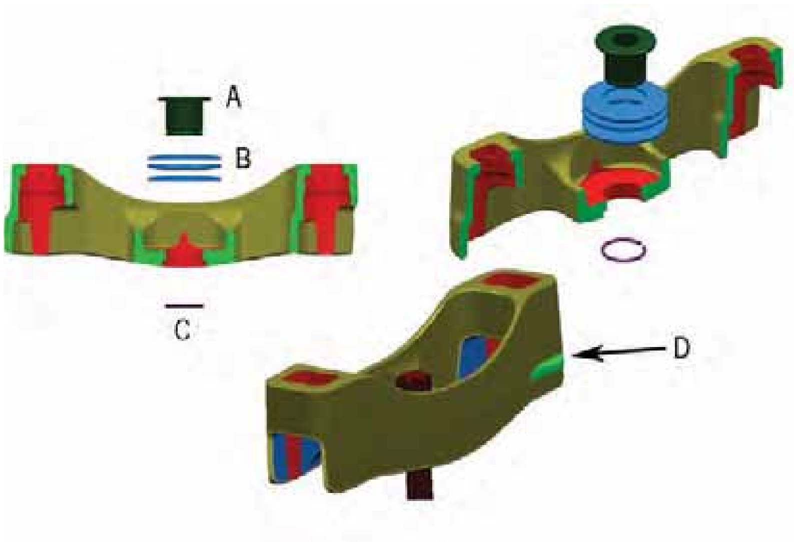
The central high pressure rail in V8 engines is located in the engine's inner V. From here, the fuel is supplied via individual lines to the fuel injectors for cylinders 1 to 8. The high pressure rail provides the same pressure for all injectors. The volume of the high pressure rail is adapted according to the amount of fuel the engine needs (V8 naturally aspirated engine 100 cm^3, V8 Turbo 150 cm^3).

- The rail volume is determined by the required pressure variation behavior and the shortness of the starting time.

High Pressure Fuel Line



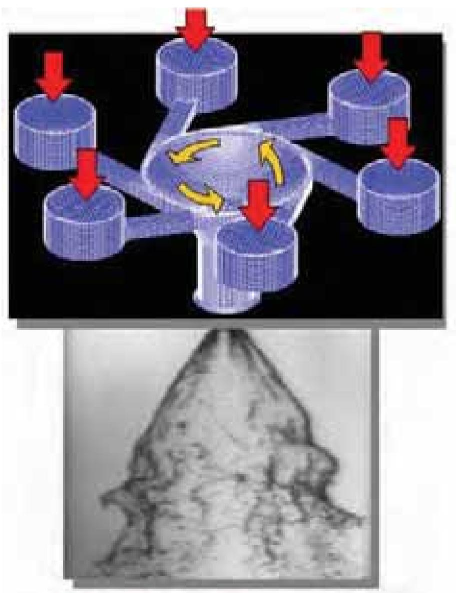
Sealing contact area of the high pressure fuel lines.



A - Buffer
B - Disc spring
C - Lock washer
D - Rib to prevent in correct assembly

Fuel Pressure Sensor

The fuel pressure sensor is installed on the central high pressure rail under the intake system and informs the Motronic control unit about the current pressure in the fuel high pressure system. The Motronic control unit evaluates the signal and regulates the fuel pressure on the high pressure side via the flow control valve.



Fuel Injectors/High Pressure Injectors

The electromagnetically operated fuel injectors are on the intake side of the cylinder head. They are activated by the DME control unit in accordance with the firing order. Following activation, they inject fuel directly into the combustion chamber at a pressure of 580 psi (40 bar) to 1740 psi (120 bar). During this process, a vortex is created even before the fuel emerges at the valve tip.

The Cayenne S and Cayenne Turbo are equipped with different injectors, designed specifically to suit the engine's fuel requirements. The injectors can be differentiated by their part numbers and a color marking. The piston recesses in the V8 naturally aspirated engine and the V8 Turbo are also different so that the injected fuel can be whirled around and mixed perfectly with the air that is drawn in.

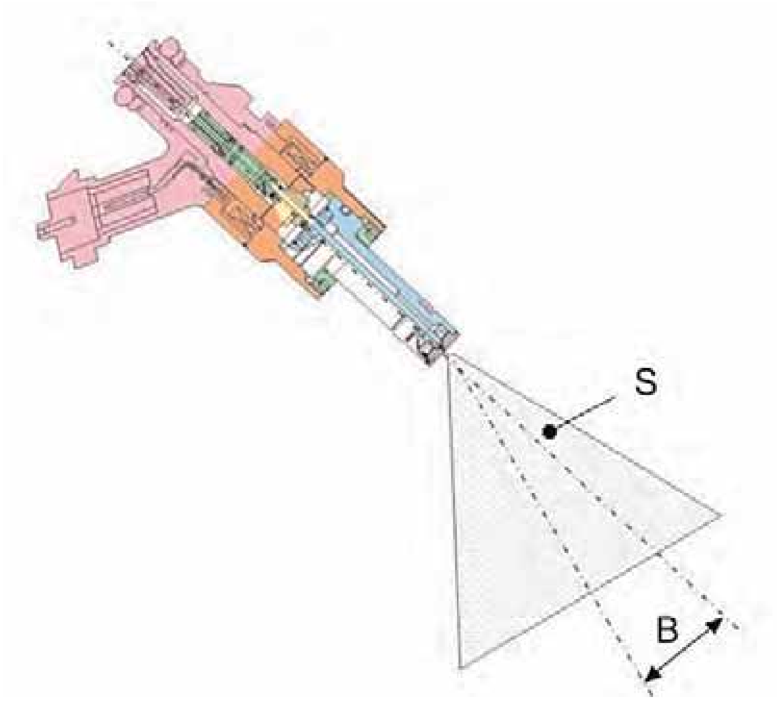
Fuel Injectors -V8 Naturally Aspirated Engine

At a fuel pressure of 580 psi (40 bar) and an injection time of 0.6 ms, the amount of fuel injected is approx. 5.5 mg/stroke. While at a fuel pressure of 1740 psi (120 bar) and an injection time of 5.8 ms, the amount of fuel injected is approx. 67 mg/stroke.

Fuel Injectors -V8 Turbo

At a fuel pressure of 580 psi (40 bar) and an injection time of 0.6 ms, the amount of fuel injected is approx. 7.8 mg/stroke. While at a fuel pressure of 1740 psi (120 bar) and an injection time of 6.1 ms, the amount of fuel injected is approx. 107 mg/stroke.

In addition to the amount of fuel injected and the injection time, the shape and alignment of the fuel jet is also important.



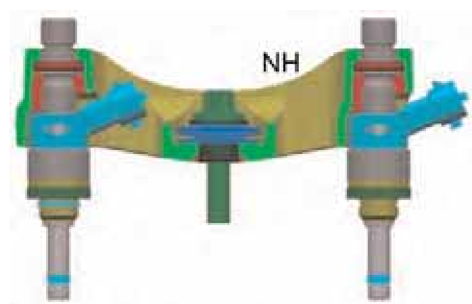
S - Spray angle (taper angle of the fuel jet, approx. 69° on the naturally aspirated engine, 68° on the turbo engine).

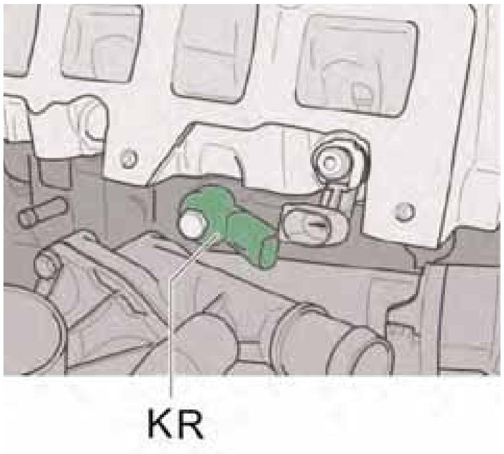
B - Bend angle (distance between the injection jet and the axis of the fuel injector; approx. 8.5° on the naturally aspirated engine, approx. 7.5° on the turbo engine).

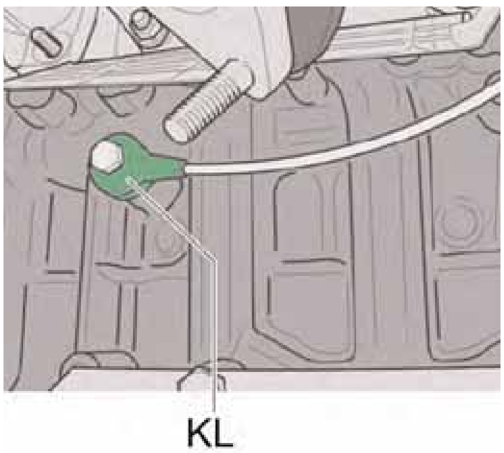
Retainers For Fuel Injectors

The four retainers **-NH-** for the two injectors ensure the following:

- Installation as a pre-assembled unit with injectors installed.
- Twist-lock protection for screwing on fuel lines.
- Exact installation position for aligning the fuel jet in the combustion chamber.
- Correct pretensioning of the fuel injectors in the cylinder head.
- Vibration damper for reducing the transmission of vibrations from the cylinder head to the injectors.







Ignition System

General

The ignition systems used in the V6 and V8 engines largely correspond to the systems used in previous engines. The ignition system map in the DME control unit has been designed to meet DFI specific requirements.

V6 DFI Engine

Knock Sensors

One knock sensor is bolted to the crankcase on the left **-KL-** and another on the right **-KR-**. They detect knocking in individual cylinders. To prevent knocking, the cylinder selective knock control system monitors the electronic ignition timing control system. Based on the signals from the knock sensors, the DME control unit adjusts the ignition timing angle for the knocking cylinder until the knocking stops.

If a knock sensor fails, the ignition timing angles of the affected cylinder group (1-3-5 or 2-4-6) are retarded. This means that a safety ignition timing angle is set to “late”. Knock control for the cylinder group of the remaining, intact knock sensors is unaffected. If both knock sensors fail, the DME control unit goes into knock control emergency operation during which the ignition timing angles are generally retarded, thereby reducing engine power considerably and increasing fuel consumption.

Ignition Coils – V6

The V6 engine still has static high-voltage ignition distribution with individual ignition coils directly on the spark plugs. The DME control unit activates the individual ignition coils individually in the firing order 1-5-3-6-2-4 for each cylinder. The individual ignition coils in the Cayenne V6 have an integrated output final stage, but unlike the Cayenne V8 engines, the diagnostic function is integrated in the Motronic control unit. If an ignition coil fails, fuel injection for the affected cylinder is deactivated. This can happen on up to two cylinders.

Spark Plugs

The V6 engine has air gap spark plugs with one ground electrode, which must be changed every 36,000 miles (60,000 km) or after 4 years according to the Technical Manual.

Note

Spark plug replacement intervals have changed for M.Y. 2008 when compared to the 2003-2006 Cayenne models.

Knock Sensors

All V8 DFI engines have four knock sensors arranged in the V of the engine block. These four knock sensors are required for exact knock detection in V8 DFI engines since stronger vibrations are transmitted to the cylinder head via the fuel injectors during high pressure fuel injection.

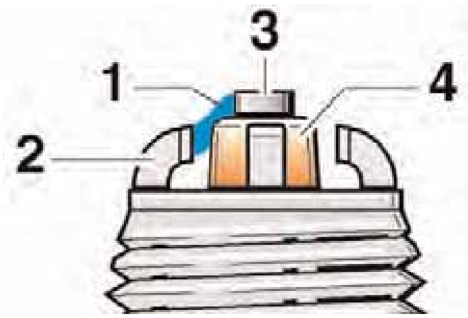
Ignition Coils

The Cayenne has static high-voltage ignition distribution with individual ignition coils attached directly to the spark plugs. The newly enhanced ignition coils in V8 DFI engines work according to the same principle as previous V8 ignition coils.

This system offers the following advantages:

- High level of ignition safety.
- Minimum electromagnetic interference with other electronic components.
- No requirement for ignition cables and distributor ignition.

The DME control unit activates the individual ignition coils individually in the firing order 1-3-7-2-6-5-4-8 for each cylinder. Safer ignition processes and therefore optimized power, together with minimized emissions and fuel consumption are obtained as a result of the measures and advantages described. All parts in this enhanced component are installed as a complete unit in a special rod ignition module housing. This is connected electrically and mechanically to the spark plug in the spark plug recess via the short high-voltage plug. The component is also secured mechanically using bolts. The ignition coil is sealed at the four-pin plug and in the spark plug recess to protect it from spray water.



Structure of the surface gap spark plug in the Cayenne S:
1 - Surface gap
2 - Ground electrode
3 - Centere electrode
4 - Insulator Cayenne Turbo spark plugs

Cayenne S Spark Plugs

The V8 naturally aspirated engine has nickel-yttrium spark plugs with four ground electrodes, which must be changed every 36,000 miles (60,000 km) or after 4 years according to the Technical Manual.

The four ground electrodes are arranged around the ceramic insulator in these surface gap spark plugs. The sparks **-1-** cross the surface of the insulator **-4-** and arc across a small gas gap to the ground electrode **-2-**, which improves the ignition properties. The main advantage of the surface gap spark plugs is the self cleaning effect of the insulator foot tip, since any shunts that occur between the center electrode and the ground electrode through the surface gaps, in particular during a cold start, are eliminated.

Cayenne Turbo Spark Plugs

The V8 turbo engine has air gap spark plugs with one double-platinum ground electrode, which must be changed every 24,000 miles (40,000 km) or after 4 years according to the Technical Manual.

Note

Spark plug replacement intervals have changed for M.Y. 2008 when compared to the 2003-2006 Cayenne models.

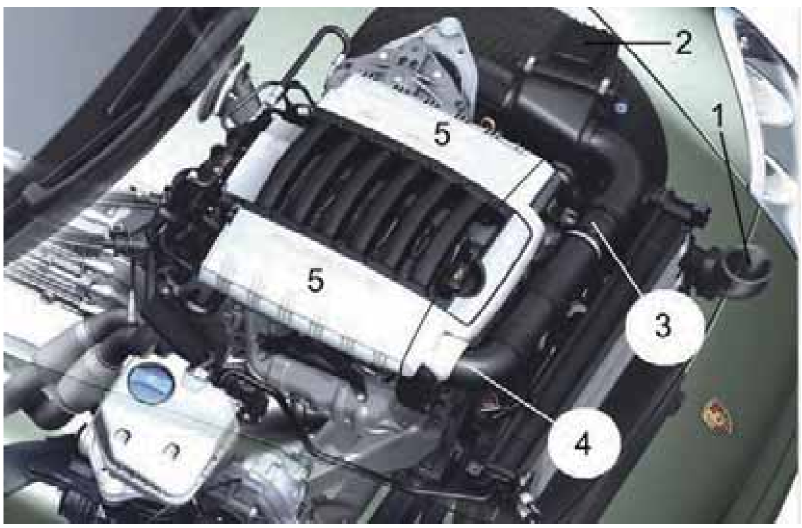
General

The intake systems in all new Cayenne models have been redesigned for direct fuel injection (DFI) in order to achieve a high torque curve. The air cleaner elements must be changed every 72,000 miles (120,000 km) or after 4 years according to the Technical Manual.

Note

Air filter replacement intervals have changed for M.Y. 2008 when compared to the 2003-2006 Cayenne models.

Cayenne V6 Intake System



1 - Air intake behind the left headlight
2 - Air filter housing (with sound opening)
3 - Pipe mass air flow sensor
4 - To electronic throttle
5 - Intake system

The illustration shows the intake system, from the air intake behind the left headlight, the air filter housing with sound opening and the pipe mass air flow sensor to the electronic throttle.

The redesigned intake manifold charging system offers considerably improved filling for the V6 engine. This has resulted not only in an optimal torque curve, but has also improved performance.

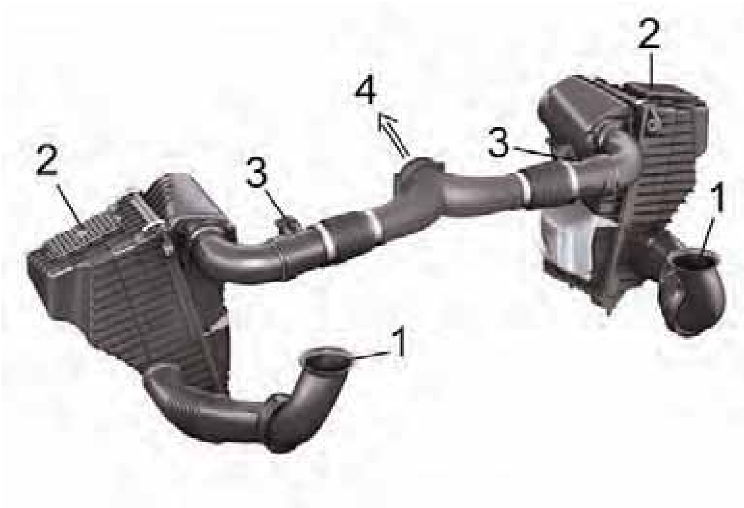
Long Intake Manifold For High Torque

1 - Electronic throttle
2 - Torque accumulator
3 - Power accumulator
4 - Electropneumatic shift valve
5 - Vacuum unit
6 - Operating sleeves (sealed)

The operating sleeves in the intake system move into torque position when the engine is started and until an engine rpm of 4200 is reached and this is apparent from the repositioning of the operating sleeves (in direction of travel at the left front of the intake manifold). The vacuum unit pulls the lever to the left (in direction of travel). The operating sleeve seals the reflection point to the power accumulator, which renders the reflection point to the torque accumulator effective. The effective intake manifold length is approx. 610 mm in torque position.

Short Intake Manifold For High Power

If the engine rpm exceeds 4200, the power position is activated by opening the operating sleeves. The vacuum unit then presses the lever to the right (in direction of travel). The operating sleeve opens the reflection point to the power accumulator, which renders the short intake manifold effective with a length of approx. 235 mm. If activation does not occur, the system remains in power position.



1 - Air intakes behind the left and right headlights
2 - Left and right air filter housings (with sound opening)
3 - Left and right pipe mass airflow sensors
4 - To electronic throttle 2

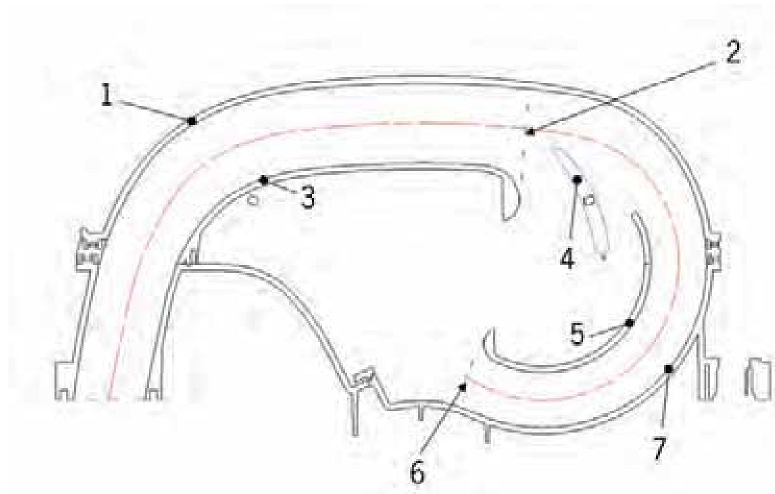
The illustration shows the intake system, from the air intakes behind the left and right headlights, the air filter housings with sound opening and the two pipe mass air flow sensors to the electronic throttle.

Variable Intake System

1 - Electronic throttle
2 - Variable intake system
3 - Diaphragm cell for switching flaps
4 - Connecting link
5 - Shaft for switching flap for cylinder bank 1
6 - Shaft for switching flap for cylinder bank 2

A new feature of the Cayenne S variable intake system is that intake manifolds of different lengths can be used due to a switching mechanism within the intake system. The variable intake system combines the advantage of long intake manifolds (for high torque in the lower rpm range) with short intake manifolds (for high specific power in the upper rpm range). A high torque curve is achieved, depending on the position of the intake manifold switching flap in conjunction with the optimised intake duct geometry.

The DME control unit activates an electropneumatic shift valve, which switches a vacuum to the diaphragm cell. The switching flaps for cylinder bank 1 and 2 are actuated synchronously via a connecting link. In the torque setting up to approx. 4150 rpm, the long intake manifold is effective with a length of approx. 538 mm, while in the power setting, at an engine speed of more than approx. 4150 rpm, the short intake manifold is effective with a length of approx. 284 mm. If the electropneumatic shift valve is not activated, the variable intake manifold remains in power position.



1 - Upper shell
2 - Effective pipe length at power position (284.2 mm)
3 - Middle shell
4 - Sealed plastic flaps on a steel shaft
5 - Inlay
6 - Effective pipe length at torque position (538 mm)
7 - Lower shell

The variable intake system is made of a shell shaped fiber reinforced polyamide. A total of five plastic shells are welded together here. Four switching flaps are installed on a steel shaft for each bank and are coated with silicon for a reliable seal. The weight of the intake system in the 4.8 l naturally aspirated engine compared to the 4.5 l engine is reduced by approx. 10.5 oz (0.3 kg) despite the integration of the switching flaps for the variable intake manifold system.

1 - Air intakes behind the headlights
2 - Left and right air filter housings
3 - Leftand right pipe mass airflow sensors
4 - Left turbocharger (right turbocharger is behind the charge air cooler)
5 - Left and right charge air cooler
6 - Pressure sensor with temperature sensor
7 - To electronic throttle

The illustration shows the intake system, from the air intakes behind the left and right headlights, the air filter housings, the two pipe mass air flow sensors, the turbocharger and the charge air cooler to the electronic throttle. A sensor in front of the electronic throttle records the boost pressure and air temperature.

Turbo Pressure System

The pressure system in the new Cayenne Turbo is manufactured in a plastic shell design like the variable intake system in the Cayenne S. The pressure system comprises three shell elements, where the bottom shell is identical to the variable intake system. It is also made of plastic, for example, to ensure a low weight. Unlike the V8 naturally aspirated engine, the switching flaps are not required since the charge effect is produced by the two turbochargers. As a result, the low-loss short intake manifold lengths are effective for the entire map. The weight of the pressure system in the 4.8 l turbo engine compared to the 4.5 l engine is reduced by approx. 3.3 lbs. (1.5 kg).

Positive Crankcase Ventilation – Cayenne Turbo

With the enhanced positive crankcase ventilation system, it was possible to reduce the amount of fuel produced during combustion and entering the engine oil through the combustion gases, which pass the piston rings and penetrate the crankcase (blow-by gases). The enhanced aeration and ventilation system (Positive Crankcase Ventilation - PCV) now ventilates the crankcase with a steady stream of fresh air, which accelerates the evaporation of fuel that is carried in. For this purpose, fresh air is removed between the charge air cooler and throttle valve and is delivered to the crank chamber via a line.

The pressure that exists at any time between the removal position and the crankcase causes a steady flow of fresh air through the crankcase in all map points. To ensure sufficient vacuum in the crankcase in all map points, the vacuum in the intake manifold is used in the partial load ranges. A pressure regulating valve regulates this vacuum until the required value is reached. In the operating range with accumulated boost pressure (full load) in which there is no vacuum in the intake manifold, the vacuum upstream of the compressor is used.

To prevent the PCV system from freezing during the winter, the blow-by gases on both naturally aspirated and turbo engines are supplied to the combustion air through a heated adapter.

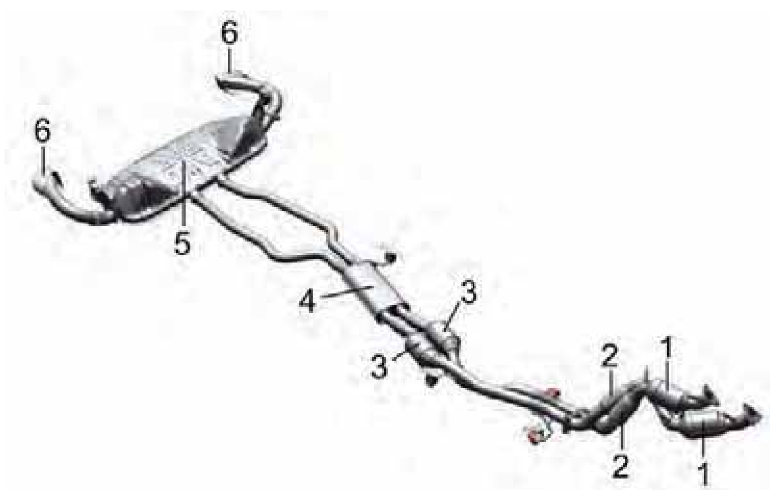
General

The exhaust systems in all new Cayenne models have been redesigned for direct fuel injection (DFI) in order to achieve maximum performance with minimum emissions.

All exhaust systems include the following:

- Two pre-catalytic converters.
- Two main catalytic converters.
- Two oxygen sensors (LSU) in front of the catalytic converters.
- Two oxygen sensors (LSF) behind the catalytic converters.
- Exhaust standard EU4 and LEV2 (USA emission standards).

Cayenne V6 Exhaust System

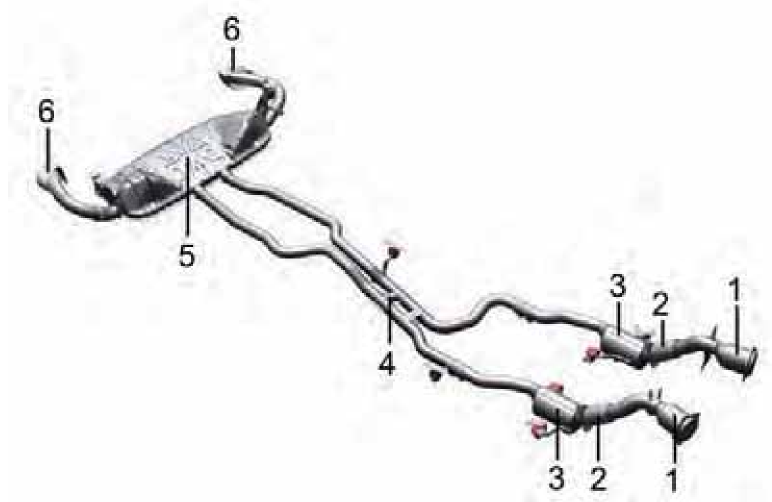


1 - Pre-catalytic converters (metal substrate)
2 - Decoupling elements
3 - Main catalytic converters (ceramic substrate)
4 - Front muffler with crossover pipe
5 - Main exhaust muffler
6 - Exhaust tailpipes with trim

The exhaust system has two pre-catalytic converters and new in the V6 engine, two main catalytic converters as well as a crossover pipe between the two exhaust tracts. The pre-catalytic converters installed in USA vehicles are different to those used in RoW vehicles.

The exhaust quality is monitored by two oxygen sensors (LSU) in front of the pre-catalytic converters and two oxygen sensors (LSF) behind the pre-catalytic converters. In addition, the V6 exhaust system as far as the rear muffler has been designed as a dual flow system. This improves the gas cycle by reducing the exhaust back pressure and ensuring better matching of the gas oscillations in the exhaust system. Behind the two main catalytic converters, there is a crossover pipe in the front muffler that connects the exhaust tracts. As a result, the torque curve is positively influenced at the lower end of the rpm range by an improved gas cycle.

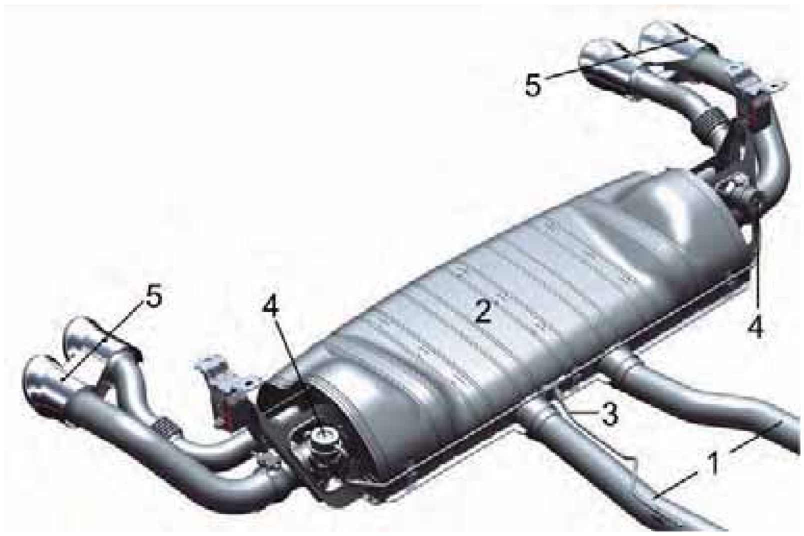
Cayenne S Exhaust System



1 - Pre-catalytic converters (ceramic substrate)
2 - Decoupling elements
3 - Main catalytic converters (metal substrate)
4 - Crossover pipe
5 - Muffler
6 - Exhaust tailpipes with trim

The new Cayenne S features an enhanced exhaust system. To keep emissions to a minimum, it is important that the catalytic converter reaches its optimal operating temperature quickly. To achieve this, the exhaust manifolds in all Cayenne models are short in order to use the high exhaust emissions temperature to heat the catalytic converters.

The modified pipe guide on the exhaust manifold has also resulted in a significantly improved torque. The redesigned connection of the exhaust tracts to shorter, air gap-insulated exhaust manifolds means that the catalytic converter heats up faster due to the reduced thermal mass. The weight of the entire system has also been reduced by other measures, e.g. the use of new pre-catalytic converters and pipes with thin walls.



1 - Dual flow exhaust system
2 - Sports exhaust system muffler
3 - Vacuum line for activation
4 - Diaphragm cell for switching
5 - Two tailpipes at the left and right with twin-tailpipe trim

A sports exhaust system is offered for the first time for the new Cayenne S. The sports exhaust system is activated using the standard Sport button. The sound of the sports exhaust system is controlled while taking the load, speed, engine rpm and gear into account. Like the standard exhaust system up to the muffler, the sports exhaust system has two pre-catalytic converters and two main catalytic converters, the two exhaust tracts of which are linked together via a crossover pipe after the main catalytic converters.

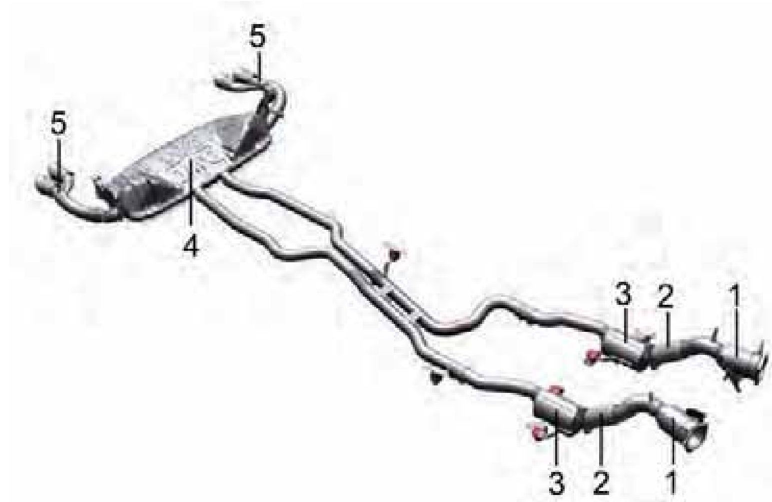
The modified muffler in the sports exhaust system produces an sportier V8 sound. The design of the tailpipes resembles the standard dual tailpipes used on the new Cayenne Turbo. However, a connecting web gives them a unique look reserved exclusively for the Cayenne S with sports exhaust system.

Note

Water fording depth is reduced when the sports exhaust system is installed. Consult vehicle owner's manual for specifics.

Cayenne Turbo Exhaust System

1 - Pre-catalytic converters (metal substrate)
2 - Decoupling elements
3 - Main catalytic converters (metal substrate)
4 - Muffler
5 - Tailpipe at the left and right with twin-tailpipe trim



Compared to the previous model, this exhaust system has been designed specifically to suit the new DFI engine in the Cayenne Turbo.

Exhaust Manifold

This illustration shows the internal design of the Cayenne Turbo exhaust manifold. The internal design of the double-wall, air gap-insulated exhaust manifold has been further enhanced compared to the 4.5 liter engine.

1 - Exhaust manifold
2 - Exhaust turbine
3 - Flange to pre-catalytic converter
4 - Pressure unit for boost pressure control through the bypass valve (wastegate)
5 - Intakeside (from air filter)
6 - Pressure side (to charge air cooler, electronic throttle)

The two turbochargers are arranged in parallel. A low intake manifold volume, short exhaust manifold and a redesigned turbocharger that has been adapted to suit the air consumption of the 4.8 liter DFI engine ensure a good response. A new larger radial turbine is used here compared to the previous 4.5 liter turbo engine. The illustration shows the water cooled turbocharger for the right cylinder bank with the pressure unit for boost pressure control as well as the lubricating oil supply and suction lines.

Boost Pressure Control

1 - Electronic throttle
2 - Cycle valve for boost pressure control
3 - Tank vent valve
4 - Positive crankcase ventilation

The pressure sensor in front of the throttle valve reports the boost pressure to the DME control unit. Depending on the current required and actual boost pressure, the DME control unit activates the cycle valve for boost pressure control according to a pulse/duty factor. This modulates a control pressure, which adjusts the bypass valves (**-W-** wastegate) on the turbochargers via the pressure units for boost pressure control in order to regulate the boost pressure.

Other Functions Of The DME Control Unit

VarioCam Plus Control on V8 DFI Engines

VarioCam Plus technology is used for the first time in V8 engines in the Cayenne model range. This system, which may be familiar to you from the current sports car generation, enables intake valve lift switching in addition to intake camshaft adjustment. This ensures optimum running quality, low fuel consumption and low emissions as well as high power and torque ratings in conjunction with the intake system.

Variable Oil Pump on V8 Engines

The DME control unit is responsible for the demand controlled operation of the variable oil pump, while adjustment is performed hydraulically. Engine management uses the input values for engine speed, temperature and torque. Based on this information, the engaged gear wheel width and therfore the geometric displacement volume of the gear wheel set is changed through the axial movement of a gear wheel (moved hydraulically) and this in turn changes the oil pressure. The pump ensures that only the pumping action required for the relevant load range of the engine is initated. This reduces the energy consumption of the oil pump to a minimum and also ensures demand controlled lubrication.

Control of Electric Radiator Fans

The DME control unit also activates the two drivers for the electric radiator fans in order to achieve infinitely adjustable control.

General

Development of the chassis and suspension systems on the new Cayenne generation had the following goals in order to achieve typical Porsche driving performance:

- Maximum driving safety.
- Exceptional control.
- High level of driving pleasure and agility.
- Outstanding driving comfort and suitability for everyday driving.
- Outstanding traction.

To achieve these goals, the chassis and suspension systems have been adapted to suit the increased performance of the new Cayenne models and their features have been optimized further. For even greater performance and improved driving comfort, a new suspension system called Porsche Dynamic Chassis Control (PDCC) is available.

The following chassis types based on this system are available for the new Cayenne models:

- Steel spring suspension (Cayenne and Cayenne S only).
- Air suspension with Porsche Active Suspension Management (PASM).
- Air suspension with PASM and Porsche Dynamic Chassis Control (PDCC).

To meet the high requirements with regard to the braking performance of a Porsche, all new Cayenne models have a brake system that is optimally designed to suit the relevant vehicle features. A higher performance turbo brake system is used, especially on the Cayenne Turbo.

All Cayenne models feature enhanced Porsche Stability Management (PSM). PSM improves active safety thanks to the following additional functions:

- Enhanced braking readiness.
- Brake assist function.
- Enhanced Trailer Stability Management.
- New ABS tuning for braking on unpaved surfaces.

The new Tire Pressure Monitoring system (TPM) generation is standard equipment for all Cayenne models in the North American market.

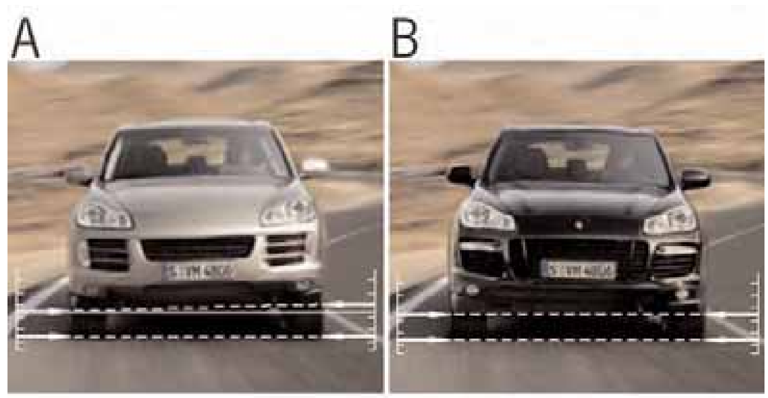
Contents

Porsche Dynamic Chassis Control (PDCC)

The chassis control system Porsche Dynamic Chassis Control (PDCC), which is available on request for all new Cayenne models, can further optimize the already excellent driving dynamics.

PDCC is only available for vehicles with air suspension and PASM. The silver colored chassis control switches on the center console and the logo “PDCC” below the chassis control switches in the interior indicate that a vehicle has PDCC.

PDCC is an active chassis control system. Targeted intervention using active anti-roll bars optimizes the driving characteristics of the vehicle by reducing its tendency to roll.



A - Fast cornering without PDCC
B - Fast cornering with PDCC

The actual benefits of the system for customers are apparent in the following areas:

- Reduced lateral inclination (vehicle lean) during cornering.
- Greater agility.
- Improved driving performance.
- Increased driving comfort.
- Better off-road functionality.

Operating Principle

The entire system involves chassis components used to actively stabilize the vehicle. To create a definable force between body and wheel using additional energy in order to improve driving dynamics, driving comfort and safety.

Principle for creating definable forces between body and wheel using active roll stabilization.

During cornering, a rolling torque is build up via the vehicle rolling axis due to the centrifugal force affecting the center of gravity. This force causes the vehicle body to tilt towards the outer wheel during cornering so the vehicle can quickly reach its driving dynamic limits. The use of anti-roll bars is designed to counteract body tilt and the accompanying wheel load difference. The wheel at the outside of the corner is compressed during cornering, while the wheel at the inside of the corner rebounds. This causes the back of the anti-roll bar to turn (twist). The forces occurring in this way in the anti-roll bar bearing points produce a torque that counteracts the body tilt and distributes the load better on both wheels of an axle.

PDCC is an active roll stabilization system, which records the vehicle's lateral inclination during cornering right from the start and reduces this considerably. This is done using active anti-roll bars on the front and rear axle, which ensure stabilization torques on both axles.

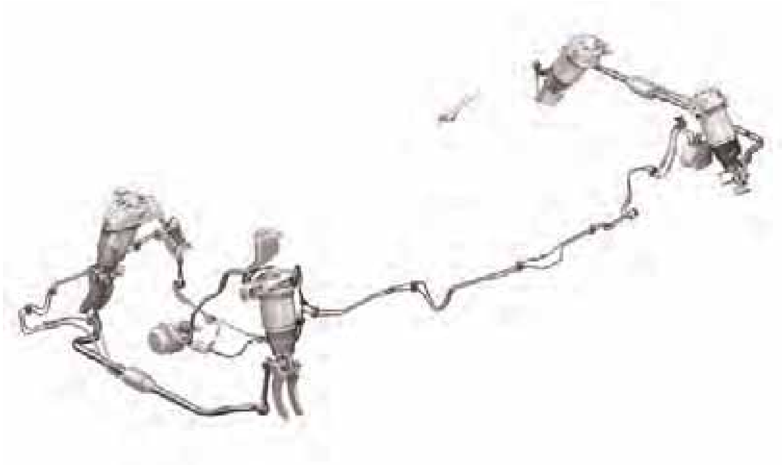
This means that the active anti-roll bars build up specific forces to counteract the lateral inclination of the vehicle, depending on the steering lock and lateral acceleration. PDCC reduces the vehicle's lateral inclination by up to 2.5° compared with a vehicle without PDCC. This improves performance due to improved wheel/road contact.

At the same time, PDCC also records uneven road surfaces (bumps) and can compensate for these by evaluating sensor data from the chassis and speed. This significantly improves driving comfort on various types of road surfaces.

The sensor data is evaluated continuously and appropriate control operations are initiated over the vehicle's entire speed range in order to guarantee the horizontal positioning of the vehicle at all times. One sided destabilizing impulses caused by long undulations in the road surface (so-called copying of rolling motion) can be significantly reduced.

PDCC also offers additional driver benefits for off-road driving. Active anti-roll bar control in conjunction with an integrated surface detection system reduces body movements considerably, thereby ensuring significantly improved comfort. The best possible traction on various road surfaces is particularly important for off-road driving. When the driver activates Low Range mode using the rocker switch on the center console, PDCC switches to off-road mode. The swivel motors are enabled in this mode so that the vane controllers in the housing can turn freely and the anti-roll bar halves are decoupled. This results in maximum axle articulation. To prevent instability at higher speeds and during dynamic maneuvers in Low Range mode, the control system is activated again depending on vehicle speed

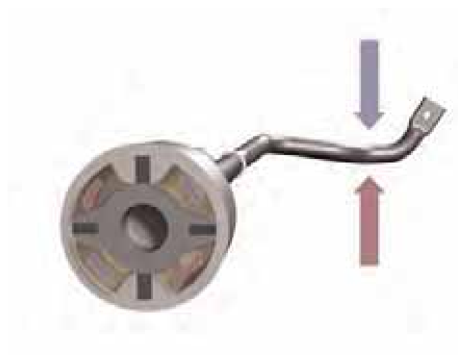
Transmission	**Driving Mode**	**Vehicle Speed**	**PDCC**
High Range	On-road mode	0-Vmax.	Continuous control
Low Range	Off-roadmode	<7.3 mph (35km/h)	Anti-rollbars can turn freely for max. axle articulation
Low Range	Off-road mode	7-35 mph (35-55km/h)	Stabilizing action
Low Range	Off-road mode	> 35 mph (55km/h)	Continuous control



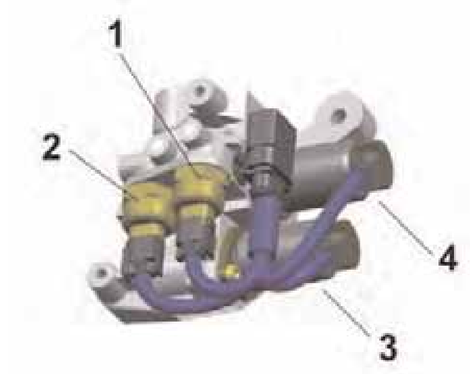
PDCC includes a two-piece anti-roll bar with a hydraulic swivel motor, a high pressure oil pump with lines and power distributor, valve blocks for activating the swivel motors and a control unit for each axle.

Anti-roll Bar With Swivel Motor

The core elements of the system are the active anti-roll bars with hydraulic swivel motors, which are integrated on front and rear axle instead of the conventional mechanical anti-roll bars. The hydraulic swivel motor is connected to one half of the anti-roll bar via the swivel motor housing and to the other half of the anti-roll bar via the swivel motor shaft. A vane controller divides the swivel motor into several chambers, which are filled with oil. A torque that affects the anti-roll bar is built up by specifically activating individual chambers and changing the oil pressure. The system has variable control over the oil pressure and oil flow in both rolling directions and can thus counteract lateral inclination forces in order to keep the vehicle horizontal.



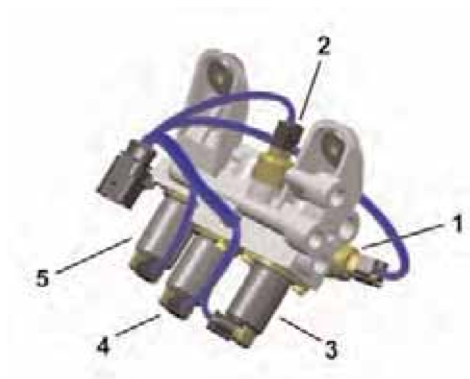
Rear-Axle Valve Block



1 - Pressure sensor
2 - Pressure sensor
3 - Pressure regulating valve
4 - Direction valve

The valve block comprises two pressure sensors (**-1-** and **-2-**), a pressure regulating valve (**-3-**) and the direction valve (**-4-**). The valve block is installed on the left rear-axle suspension subframe.

Front-Axle Valve Block



1 - Pressure sensor
2 - Pressure sensor
3 - Fail-safe valve
4 - Direction valve
5 - Pressure regulating valve

The valve block comprises two pressure sensors (**-1-** and **-2-**), a fail-safe valve (**-3-**), the direction valve (**-4-**) and a pressure regulating valve (**-5-**). The valve block is installed in the right front wheel housing.

Functions

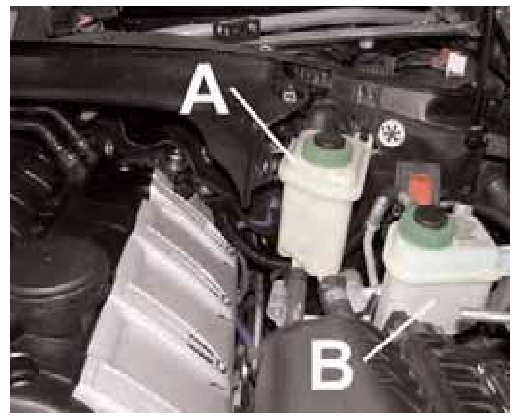
The pressure sensors record the current pressure in the chambers of the swivel motors. Depending on driving dynamics, the direction valves are switched in such a way that pressure is built up or reduced in the chambers in order to create specific forces on the anti-roll bars that will counteract the vehicle's lateral inclination. The pressure regulating valves are activated by the control unit so that the required pressure exists on the swivel motors. The fail-safe valve in the front-axle valve block is de-energized in the event of a fault and reverts to its normal position via spring force. This short circuits the pump hydraulic system and switches the system to a fail-safe mode. For a description, see . "Error message/Fail-safe mode".

Tandem Pump

A tandem pump driven by the drive belt for auxiliary units is responsible for supplying hydraulic pressure. A small fluid reservoir on the pump serves as a pressurized shock absorber. Pressure is controlled on the relevant valve blocks since the pressures in the swivel motors are different. The system is filled with Pentosin CHE 202.

Reservoir

The reservoir (**-A-**) is located in the left of the engine compartment, next to the power steering reservoir (**-B-**). A filter, which filters the oil flowing back in, is integrated in the reservoir. An oil dipstick for checking the oil level is fitted on the lid.



A - PDCC reservoir

B - Power steering reservoir

Control Unit

The control unit is installed under the rear seat at the right. The input data is evaluated continuously and appropriate control operations are initiated in the valve blocks over the vehicleís entire speed range.

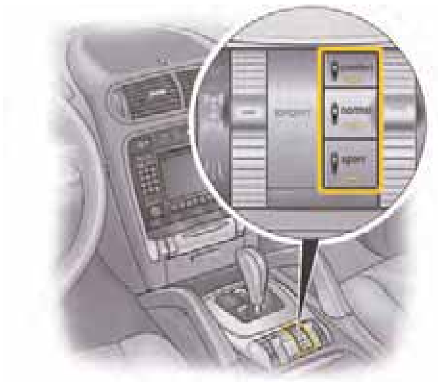
Analogue input signals:
- Level sensor, front left/right.
- Level sensor, rear left/right.
- Level sensor, rear right.
- Body acceleration sensor, front left/right.
- Body acceleration sensor, rear right.
- Rear-axle valve block: Pressure sensor 1, pressure sensor 2.
- Front-axle valve block: Pressure sensor 1, pressure sensor 2.
- PDCC button.

Input signals via drive CAN:
- Vehicle speed.
- Lateral acceleration.
- Yawing speed
- Steering angle.
- Engine speed.
- Nominal engine idle speed.
- Outside temperature.

Output signals:
- Instrument cluster: Text, symbols.
- Rear-axle valve block: Direction valve, pressure regulating valve.
- Front-axle valve block: Direction valve, pressure regulating valve, fail-safe valve.

Technical Manual

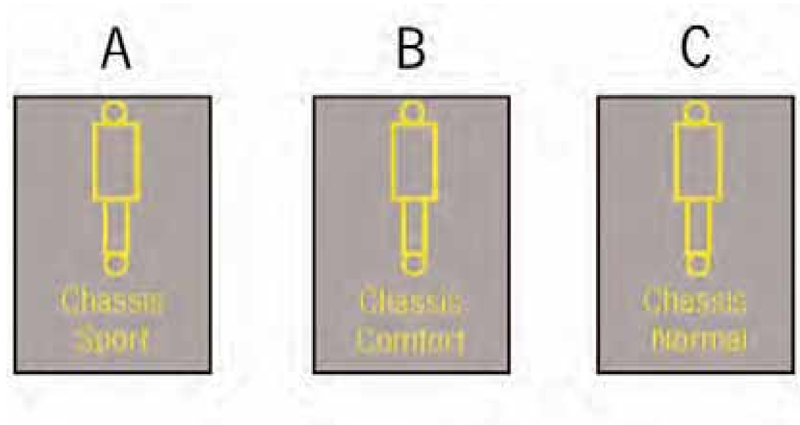
Technical Manual Increased risk of accidents and material damage if too much Pentosin CHF 202 is filled in or if Pentosin CHF 202 comes into contact with the coolant hoses when filling or topping off.



Operation and Display Concept

Porsche Dynamic Chassis Control can be operated using the same chassis control switches Normal, Comfort and Sport that are used for PASM. PASM and PDCC are configured together, depending on which of the three chassis control programmes is selected.

In the Comfort setting, PDCC intervention occurs at reduced control speed so as not to change the character of the high comfort program. Active system intervention in the Sport program, on the other hand, occurs at maximum speed in order to optimize performance.

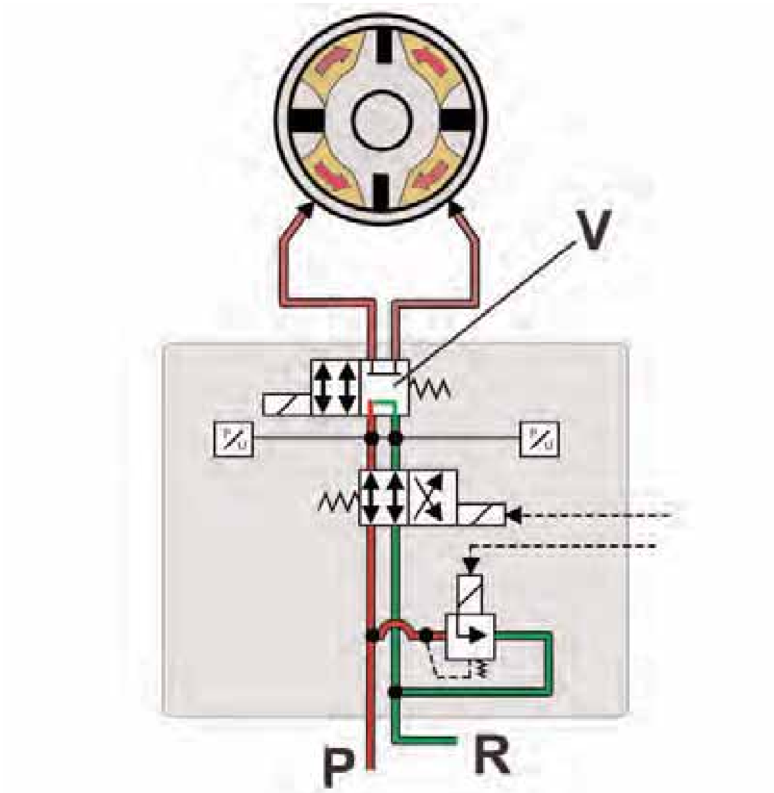


A - Sports chassis
B - Comfort chassis
C - Normal chassis

Enhanced off-road performance is also available automatically as soon as Low Range is activated.

Diagnostics

In addition to on-board diagnosis by the control units and checks on sensors and valves, the pressure that exists in the system is continuously monitored. Depending on the engine speed, the nominal pressure values that are worked out are compared with the current actual pressure values recorded by the four pressure sensors. If a fault is detected, PDCC switches to Fail-safe mode.



P - Hydraulic oil from the pump
R - Oil return to the reservoir
V - Fail-safe valve

If a fault occurs during PDCC operation, the driver is alerted to this by the message “Chassis system defective” on the on-board computer.

The entire system is switched to fail-safe mode to ensure safe driving. The fail-safe valve in the front-axle valve block is de-energized, which causes the pump hydraulic system to short circuit. The hydraulic oil from the pump flows directly back into the reservoir. At the same time, the connections for the swivel motor are closed so that the pressure in the swivel motor is maintained. The anti-roll bar remains in this position and continues to work in the conventional way.

The hydraulic system on the rear axle is completely depressurized so that the vane controllers in the housing can turn freely and the anti-roll bar halves are decoupled. This increases the vehicle’s lateral inclination during cornering. The vehicle responds by understeering slightly, but can be driven at an appropriate speed to the nearest authorized Porsche dealer.

Tire Pressure Monitoring (2nd generation)

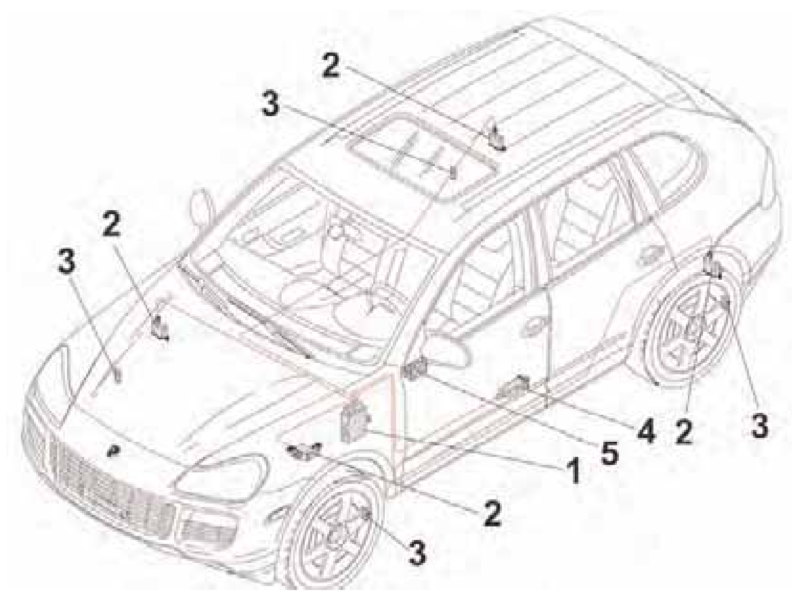
Timely detection of a gradual loss of pressure not only increases driving safety, but can also prevent uneven tire wear and high fuel consumption. The optional Tire Pressure Monitoring system (TPM) has therefore been available for all Cayenne models since 2003. It continually monitors the air pressure in all four tires and displays this information for the driver in the instrument cluster.

The new Tire Pressure Monitoring system (TPM) generation is standard equipment for all Cayenne models in the North American market. The most important additional function in the system is the option for automatically and quickly detecting the wheels mounted on the vehicle (own wheels) and their installation position.

The radio signals from the wheel electronics units are requested by the control unit as required via the trigger senders. The system detects the vehicle's own wheels and the installation position of own wheels by evaluating the trigger location and performing a statistical evaluation of the wheel electronics information received.

Component Locations

The system comprises the following components.



1 - Control unit
2 - Trigger senders
3 - Wheel electronics
4 - Central digital antenna
5 - Left fuse carrier

Control Unit

As in previous models, the control unit is located above the mounting saddle for the foot operated parking brake in the driver's footwell. The control unit analyses the incoming data from the antenna and forwards the relevant information to the instrument cluster. Since the data is transmitted via cable from the central antenna, the control unit is designed to pick up both frequencies (433 RoW/315 MHz USA/Canada). If a new control unit is installed, it must be coded accordingly.

Input signals via CAN

- Vehicle speed
- Outside temperature
- Engine speed

Input signals via LIN (Local Interconnect Network)

- Four wheel electronics units via the digital central antenna

Output signals

- Front left trigger
- Front right trigger
- Rear right trigger
- Rear left trigger
- Instrument cluster

Triggers (trigger senders)

The four triggers, which are located under the wheel housing liners in each of the four wheel housings, send a 125 kHz signal directly to the wheel electronics units in order to transmit the desired information to a central antenna immediately.

When the vehicle is unlocked, the control unit initiates the first 125 kHz signal for each trigger in the four wheel housings one after the other, starting at the left front in clockwise direction. Then, the wheel electronics units are only triggered approx. every 60 seconds while the vehicle is moving. Since the range of the trigger coils is limited to the relevant wheel housing, any possibility of interference affecting other wheels is almost totally eliminated. Depending on many and varied influences from the immediate environment, such as reflections (wet roads, metal grates, guide rails, etc.), external interference (external transmitters), a trigger signal can fail to reach the related wheel sensor or the feedback data protocol can get lost on its way to the central antenna.

The control unit responds immediately by re-triggering the trigger - repeatedly if necessary at the wheel position at which the expected protocol had failed to materialize as soon as the initiated trigger cycle from front left to rear right is completed. This concept reduces system interference and the wheel electronics units are detected much faster.

Note

The central antenna is designed to pick up various frequencies (433 RoW/315 MHz USA/Canada).

Central Antenna

The digital central antenna (reception frequency 315) is secured close to the center of the underside of the left side member under the vehicle and is protected from stone damage by the sill cover. The signals received from the wheel electronics units are digitalized in the antenna and forwarded to the control unit via two normal lines (LIN bus). The digital antenna has an integrated self-diagnosis facility. This means that when a fault is detected, it is stored in the control unit fault memory and displayed on the PIWIS Tester.

Wheel Electronics

The wheel electronics unit (wheel transmitter 315 MHz) is screwed to the rim using the wheel valve.

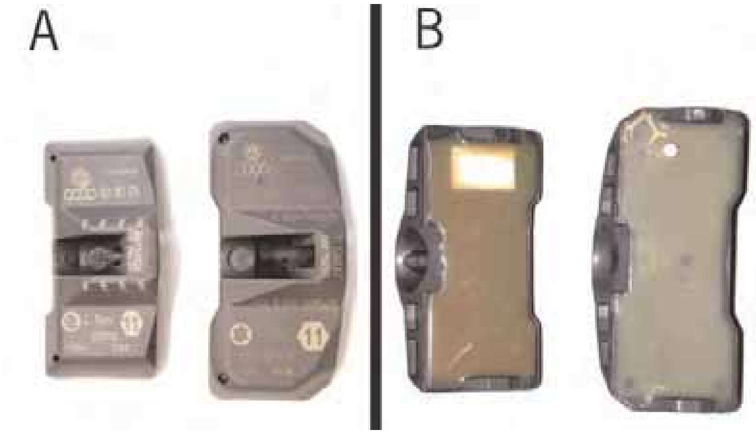
The wheel electronics unit comprises the following components:

- Pressure sensor,
- temperature sensor,
- roll switch,
- measuring and control electronics,
- receiver and transmitter,
- and a battery.

The wheel electronics unit can be triggered and receives send requests from the TPM control unit via four triggers. This means that the antenna always receives only one data protocol and this comes from the wheel electronics unit that received the request to send. This gives the system added protection against interference affecting other antennas. Higher transmission power is used due to the longer radio link to the central antenna.

The roll switch detects whether the wheel is stationary or turning. This information is used either to start a triggered learning process for a moving wheel or to switch off the wheel electronics unit when the wheel has been stationary for a long time.

To avoid confusion with 1st generation wheel electronics, the new wheel electronics unit can be identified by the modified shape of the housing and the small air filter. A modified data protocol ensures that the wheel electronics unit will not be detected if incorrect part is installed and this is stored as a fault in the fault memory.



A - Wheel electronics unit “1st Generation”
B - Wheel electronics unit “2nd Generation”

External features of the new, trigger-activated wheel electronics unit “1st generation” vs. “2nd generation.”

The following aspects of the system have been optimized by changing the system hardware and software:

Fast learning following a wheel change. The wheels of a newly mounted set of wheels are assigned within one minute – often even within a few seconds of selecting the set of wheels in the “Tire pressure” menu and the pressure values are displayed.

Fast Detection of a Wheel Change Without Re-Calibration

If the TPM system is not re-calibrated following a wheel change, the system detects this within max. 3 minutes of driving the vehicle and generates the message “Wheel change? Make new selection” in order to ensure that the correct nominal pressure is configured for the monitoring process by selecting the correct tires.

Immediate Pressure Display at the Start of Each Trip

The TPM control unit knows which wheel set is mounted on the vehicle once the teaching process is complete. The tire pressure values are available as soon as the vehicle is started since the trigger cycle starts immediately once the door is opened and the wheel electronics units have sent the latest data to the control unit.

Fast Pressure Update Following Tire Pressure Adjustment

The differential pressure display filling information in the “Tire pressure” menu is still available when the vehicle is stationary in order to ensure that the tires are filled correctly. As soon as this information is called up, a fast pressure update is generated over a time span of max. 15 minutes and this update information shows the current tire pressure every 10 seconds during tire pressure adjustment.

Partial Monitoring

If a spare wheel without a wheel sensor is mounted in the event of a flat wheel, a unique allocation of the remaining wheel electronics units can still be detected by the trigger system. In this case, the system remains active both when an emergency spare wheel or a spare wheel with no wheel sensor is used, as well as if one or two sensors fail (e.g. due to sealant) and continues to monitor the wheels using the wheel electronics units that are still active.

Note

If a spare wheel with a wheel sensor is mounted in the event of a flat wheel and if this is confirmed by selecting “Spare wheel” is the Spare wheel menu, this wheel will be incorporated into the monitoring process following a brief learning phase.

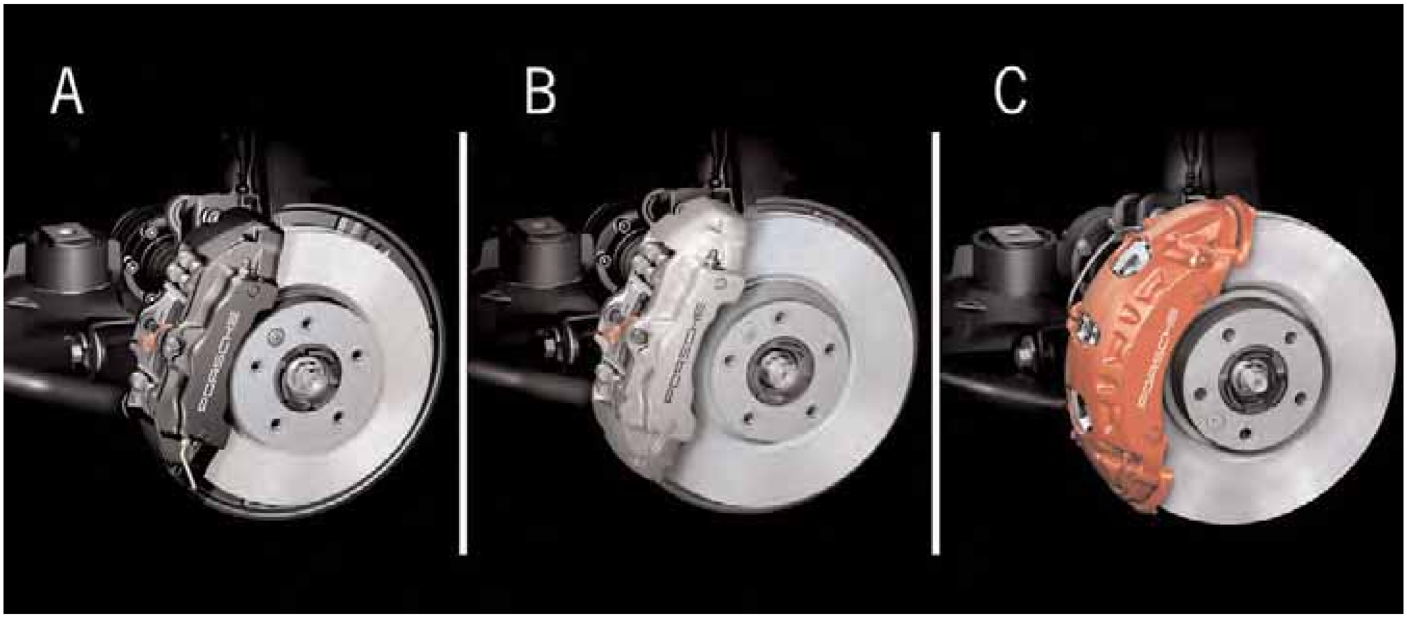
System Cannot be Switched Off, Warning can be Acknowledged

The TPM system can no longer be switched off. As a result, if the pressure is deliberately reduced well below the nominal pressure, e.g. for improved traction on extremely soft or sandy terrain, a flat wheel message will appear continuously in the display.

The hard (red) warning can be acknowledged with the new TPM generation. This clears the display so that any other messages and/or information can be shown. The TPM light in the instrument panel remains activated until the tire pressure is increased to the nominal pressure.

Each time the ignition is switched off and on again, the hard warning re-appears as a reminder and can be acknowledged again if necessary.

To meet the high requirements with regard to the braking performance of a Porsche, all new Cayenne models have a brake system that is optimally designed to suit the relevant vehicle features.



The brake systems can be identified visually as follows:

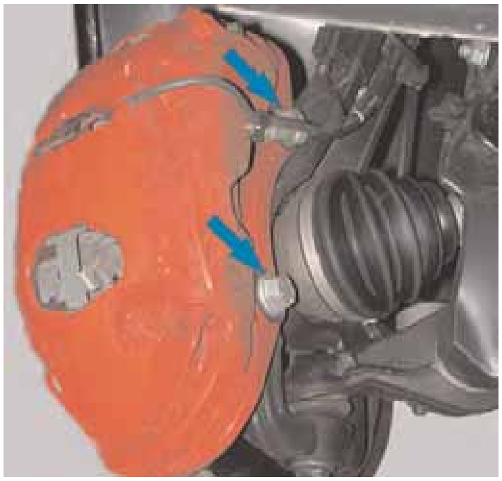
A - Cayenne V6 – Black brake calipers
B - Cayenne S – Silver brake calipers
C - Cayenne Turbo – Red brake calipers

Cayenne Turbo

To achieve the best deceleration values even with the significantly improved performance of the new Cayenne Turbo, it now features an improved turbo brake system with the following enhanced components:

- Larger brake discs
- Reinforced brake calipers
- Optimized brake pads

The brake calipers on the Cayenne Turbo have also been reinforced. The correspondingly larger front brake calipers now have an additional reinforcement frame (**-arrows-**), which is bolted to the caliper housing in four places and serves to strengthen the structure.



Note

The four bolts on the reinforcement frame must not be loosened. To replace the pads, loosen the two bolts for the wheel carrier.

Like the current 911 models with all-wheel drive, the new Cayenne models also feature enhanced Porsche Stability Management (PSM). PSM improves active safety thanks to the following additional functions:

- Enhanced braking readiness
- Brake assist function
- New ABS tuning for braking on loose surfaces

Enhanced Braking Readiness

When the accelerator is released quickly, PSM switches the brake system to a state of enhanced braking readiness: Brake system pre-filling builds up slight pressure in the system. This moves the brake pads slightly on to the brake discs. If the driver then actually presses the brake, maximum braking power can be achieved more quickly. This results in a shorter stopping distance.

Brake Assist

On identifying full braking i.e. when a defined force is exceeded on the brake pedal – brake assist supplies the required brake pressure for maximum deceleration via the PSM hydraulic unit. Brake assist can be deactivated by switching off PSM. Enhanced braking readiness always remains active, however, irrespective of whether PSM is on or off.

Off-road ABS

The off-road ABS system used since model year 2004 has been optimized further.

Off-road ABS control in “Low Range” can now be used for a speed range of up to 50 mph (80 km/h). The ABS control strategy has been modified for braking on unpaved surfaces for conditions such as; when loose gravel, sand or snow build up in front of the tires and create an blocking barrier and locking of the wheels improves control. Off-road ABS is only active when driving straight ahead. If the driver needs to steer, off-road ABS control is switched off automatically to maintain steerability.

Off-road driving in “High Range” mode, the ABS control system that has been optimized to suit the conditions is activated when the driver brakes at a speed of up to 50 mph (80 km/h). Also in this case, for conditions such as; when loose gravel, sand or snow build up in front of the tires and create an blocking barrier and locking of the wheels improves control.

General

The second generation Cayenne models feature a new attractive dynamic design and include the following development goals:

- Increased performance and less consumption.
- Improved active and passive safety.
- Improved everyday suitability and new attractive features.

Additional features and options for the second generation Cayenne include:

- Hydrophopic side windows.
- Automatical tailgate (optional).
- New management system for the luggage compartment (optional).

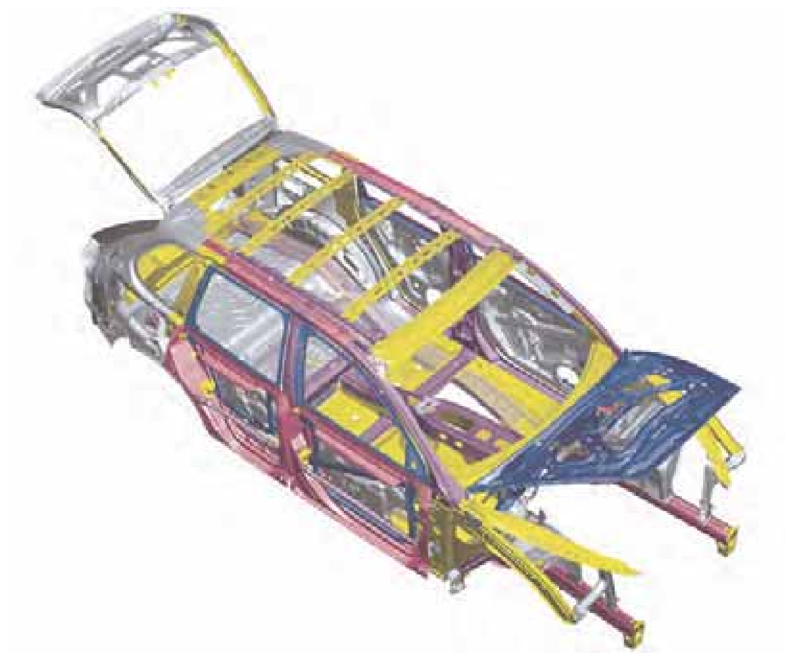
Contents

Body Shell

The exterior body panelling received new design elements while the underling body shell structure components basically remained unchanged from the previous model.

The second generation Cayenne's design criteria carried over from the previous models:

- Excellent static and dynamic body stiffness.
- Excellent passive safety.



High-strength steel

High-strength steel

Sheet steel

Aluminum

Tailored Blanks

Body – Front

The front end changes included new front lights that have a flatter basic shape, which makes all new Cayenne models look wider. The fact that the mid-point of the outer light unit for the headlights has been shifted further out also adds to this look. See section 9 for complete details on the new light systems and features.

Additional design changes include:

- New designed front end and air inlets.
- Stronger contoured front fenders.

Cayenne/S front view.

Cayenne/S front lights.

Cayenne Turbo front view.

Cayenne Turbo front lights.

Body – Rear

The rear end changes included new tail lights that have also been redesigned with LED technology. In addition to the white backup lights, the shape of the rear lights has also been adapted to suit the new rear end design. See section 9 for complete details on the new light systems and features.

Additional design changes include:

- Integrated tailpipes.
- Lower rear diffusor panel.
- Redesigned and enlarged roof spoiler.
- Sharper contoured rear quarter panels.
- New design of the rear cargo compartment.

Cayenne/S rear view.

Cayenne Turbo rear view.

Automatic Rear Lid

The new automatic rear lid, which is much more convenient and highly practical for loading the vehicle, is available as an option for all Cayenne models. The rear lid can be both opened and closed fully automatically at the touch of a button with this option.

Opening The Rear Lid Automatically

When towing a trailer, the rear lid can only be opened using the release button on the rear lid.

The rear lid can be opened in three different ways:

Option 1 – Press the release button on the rear lid. The vehicle must be unlocked in this case. The vehicle does not have to be unlocked if it has Porsche Entry & Drive. You simply need to have the vehicle key with you, e.g. in your pocket.

Option 2 – Press the button on the key for approx. 1 second. If the vehicle is locked, the doors will remain locked when you open the rear lid.

Option 3 – With the ignition switched on, pull the switch in the driver's door and hold it until the rear lid is fully open. The process for opening the rear lid will be interrupted if you release the switch too soon.

Option 1 – Press the release button on the rear lid.

Option 2 – Press the button on the key for approx. 1 second.

Option 3 – With the ignition switched on, pull the switch in the driver's door and hold it until the rear lid is fully open.

Press the button in the rear lid trim. Interrupting the opening/closing process in dangerous situations.

Closing The Rear Lid Automatically

Make sure that the load is not too close to the rear lid when closing it because otherwise the process for closing the rear lid will be aborted and the rear lid will stop and not fully close and lock.

Press the button in the rear lid trim. Interrupting the opening/closing process in dangerous situations.

The opening/closing process is interrupted immediately if one of the following buttons/switches is actuated:

- Pressing the button on the key,
  or releasing the switch in the driver's door,
  or pressing the button in the rear lid trim,
  or pressing the release button on the rear lid.

Automatic opening/closing can be resumed at any time. To do this, simply actuate the relevant button/switch.

Obstacle Detection While Opening The Rear Lid

If the opening process is blocked by an obstacle, the rear lid will not open. An alarm sounds. Once the obstacle is removed, the rear lid can be opened by pressing the button on the key or pulling the switch in the driverís door or pressing the release button on the rear lid.

Obstacle Detection When Closing The Rear Lid

If the closing process is blocked by an obstacle, the closing process is aborted. An alarm sounds and the rear lid remains partially open. Once the obstacle is removed, the rear lid can be closed by actuating a button/switch.

Setting The Opening Height Of The Rear Lid

The opening height of the rear lid can be set individually, for example, so that the rear lid will not hit the garage ceiling. The vehicle height depends on the level settings for vehicles with level control.

Use these steps:

1. Stand behind the vehicle and open the rear lid.
2. Use the button on the key to stop the automatic opening process at about 2/3 of the opening height.
3. Then move the rear lid up with your hand until it is at the required opening height. When doing so, make sure the lid is far enough away from any obstacles.
4. Press the button in the rear lid trim and hold it for approx. 3 seconds. An acknowledge tone sounds and the direction indicators flash once. The opening height for the rear lid is now programmed. The rear lid can now be closed by pressing the button. This setting cannot be deleted. If a different setting is required, repeat the procedure from Step 1 to 4.

Malfunction Of The Rear Lid Drive

The automatic function is not active if the battery voltage is too low. Actuating a button releases the lock on the rear lid and a warning beep sounds for 3 seconds. The rear lid can now be opened manually.

Notes

A warning beep sounds while the automatic rear lid is moving on vehicles designed specifically for the USA and Mexico.

Rear Lid Emergency Operation

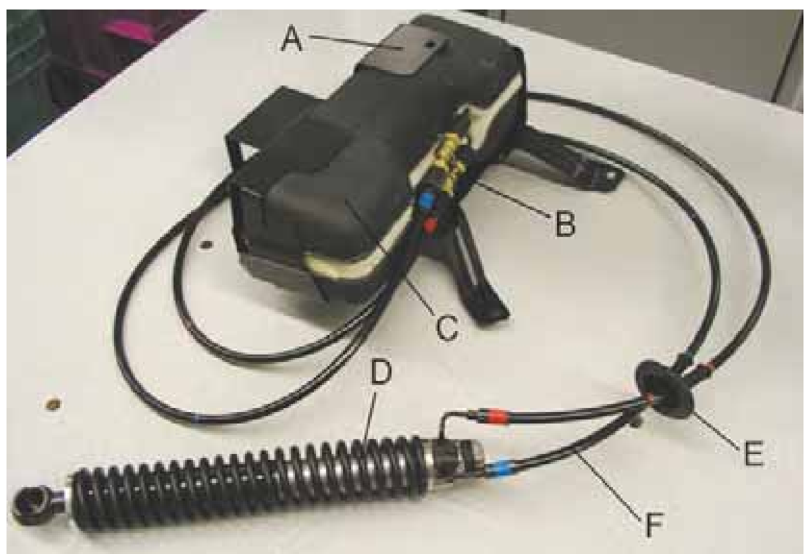
If the automatic opening/closing process is interrupted due to a fault, a warning beep sounds for approx. 3 seconds. Open and close the rear lid manually.

System Overview

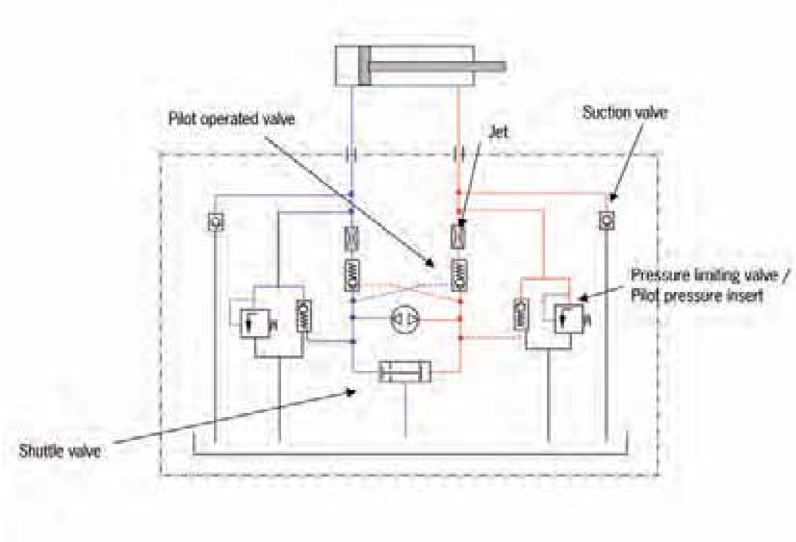
The automatic rear lid has an actuating unit with a hydraulic pump and a spring-supported hydraulic cylinder.

A - Hydraulic cylinder with spring
B - Hoses
C - Hydraulic pump
D - Support

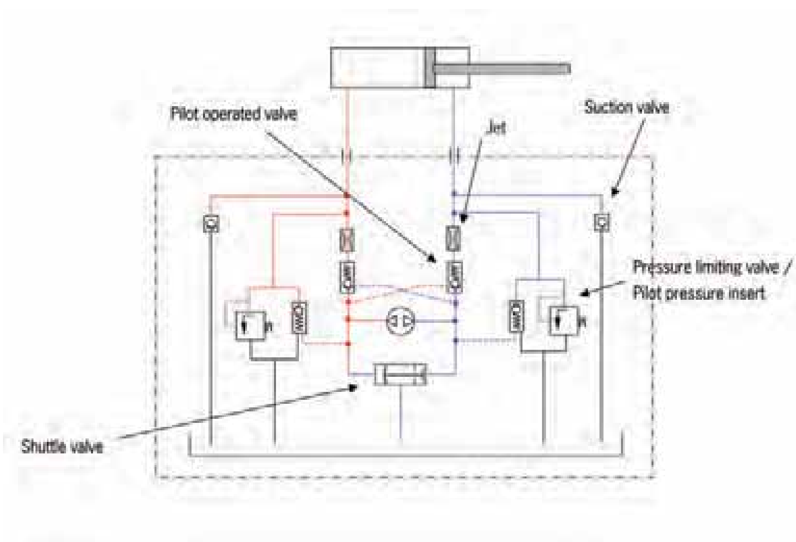
Component Overview



A - Support
B - Quick-connectors
C - Sound capsule
D - Hydraulic cylinder
E - Grommet
F - Hoses

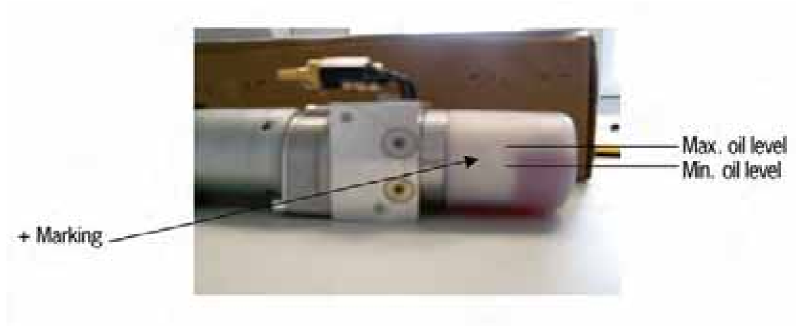


Rear lid opening.



Rear lid closing.

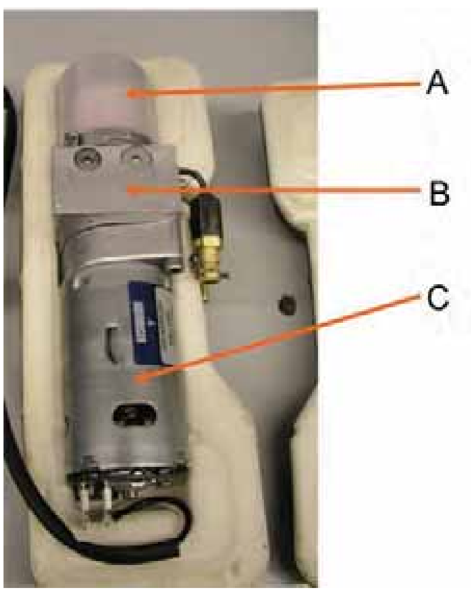
Checking Hydraulic Oil Level



Before checking oil, open and close rear lid 2-3 times automatic to remove any air in the system.

- High oil level – Pressure in the tank could be too high during manual operation!
- Low oil level – Pump noises due to air in system, incomplete opening and closing function!

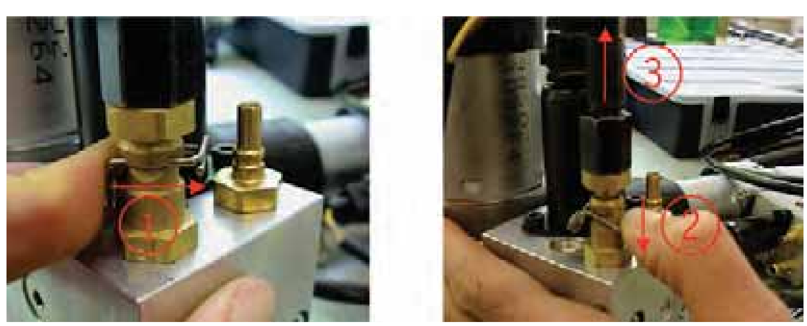
Hydraulic Pump



The hydraulic pump comprises an electric motor, the actual pump and an oil tank. The pump is packed in a sound capsule to reduce noise and is secured in the rear left wheel housing by a support.

A - Tank
B - Pump
C - Electric motor

The spring-supported hydraulic cylinder is connected to the pump by quick connectors. Pressure loading of the cylinder on the piston side drives the cylinder out. Pressure is applied to the rod side by reversing the poles of the electric motor. The control unit for rear lid hydraulics reverses the poles. A maximum pressure of up to 2900 psi (200 bar) exists in the system. The pressure in the system must not exceed 72 psi (5 bar) when removing/installing the quick connectors, otherwise the connectors can be damaged. The automatic rear lid system also has diagnostic capabilities.



Removing the quick connectors.

Notes

Even when the cylinder is extended, the spring is still pretensioned by more than 1000 N.

All Cayenne models are equipped with dual front Advanced Airbags that offer upper-body protection with an added degree of intelligence. A weight sensor in the passenger seat automatically switches the passenger side bag off when unoccupied or fitted with a child seat. These are augmented by a side-impact protection system featuring a thorax airbag in each front seat. Curtain type airbags on each side of the roof provide optimal head protection for both rows of seats. When these are deployed, they form a protective cushion along the side of the vehicle.

To provide better detection of a head-on collision, two additional impact sensors are located at the front of the new Cayenne. As a result, the front airbags can be more accurately deployed in response to the specific characteristics of what can often be a complex impact scenario.

The driver and front passenger airbags use a gas generant based on an organic propellant. The airbags are therefore lighter more compact and easier to recycle.

A rollover detection system provides additional protection in the event that the vehicle overturns. Using sensor acquired data, the rollover detection system enables early deployment of the curtain airbags and triggers the seatbelt pretensioners.

Electrics

General

The front lights and tail lights play an important role in styling the appearance of the new Cayenne models and add to the new, dynamic and sporty exterior design.

A battery charge management system (integrated in the vehicle electrical system control unit) is used to ensure optimized battery charging. Increasing the charge voltage at low temperatures not only improves battery recharging in the winter but also ensures better overload protection in the summer. These measures eliminate the need for the auxiliary battery, which had been available up to now as an option. Also, the capacity loss of the battery is compensated for even more quickly after starting the vehicle.

This section will describe the design and technical functions of the enhanced electrical systems in the new Cayenne models.

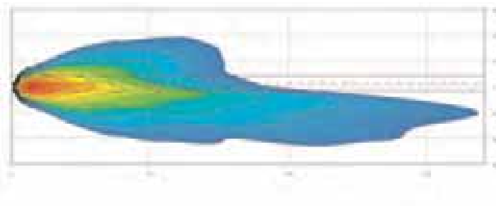
Lighting System

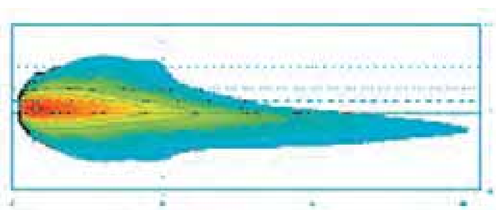
The new front lights on all new Cayenne models have a flatter basic shape, which makes all new Cayenne models look wider. The fact that the mid-point of the outer light unit for the headlights has been shifted further out also adds to this look.

The direction indicator and marker light are positioned separately in bar-shaped light units at the edge of the outer air intakes. They are arranged vertically on the Cayenne and Cayenne S, and horizontally on the Cayenne Turbo. The arrangement of the lights for the top model is based on the design used on the current 911 Turbo. As a result, the new Cayenne Turbo is easily recognizable, even at night. The fog lights are round and are located low down and at the far outer sides of the front end in accordance with their intended function. These round off the sporty look of the new Cayenne models and their low position ensures optimal illumination of the road in conditions of poor visibility.

The tail lights have also been redesigned with LED technology used for the rear and brake lights. This is not just another optical highlight of the new Cayenne models, but actively contributes to improving safety. In addition to the white backup lights, the shape of the rear lights has also been adapted to suit the new rear end design.

Contents





1 - *Headlight control unit*
2 - *Gas-discharge headlight*
3 - *Stepping motor for automatic range adjustment*
4 - *Bulb for static cornering light*
5 - *Stepping motor for dynamic cornering light*

H7 Headlights

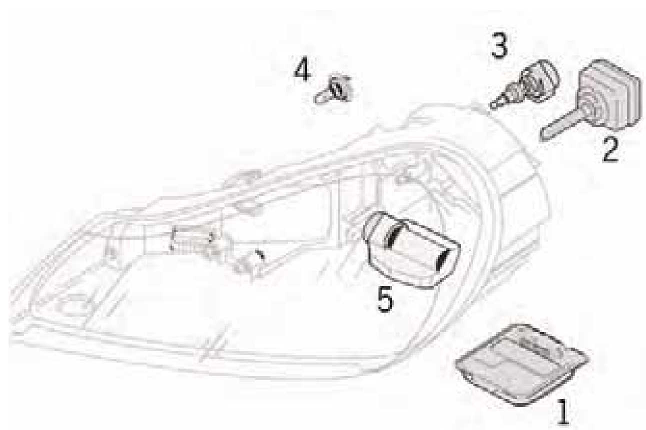
The clear glass look gives an unrestricted view of the new technologies that are used here. The Cayenne and Cayenne S come with H7 projector-type headlights as standard. The light from the light source is projected onto the road via a reflector and a lens and thus allows homogeneous illumination with significantly less dazzling of oncoming traffic.

The H7 projection system offers the following advantages for dipped beam headlights:

- High luminous flux.
- More defined light/dark limit resulting in less dazzle for other road users.
- Homogeneous illumination of the entire road.

Bi-Xenon Headlights

The dynamic cornering light is new for Bi-Xenon headlights (standard for Cayenne Turbo, optional for Cayenne and Cayenne S). In addition to the existing static cornering light, which is particularly useful when turning, the dynamic cornering light provides better illumination of corners on the road, e.g. when driving cross country. Neither the static nor the dynamic cornering light is active when driving straight ahead. A sharp turn of the steering wheel activates the static cornering light while driving (up to max. 80 mph (130 km/h)) and when the vehicle is stationary.



Headlight Control Unit

The headlight control unit only performs functions and supports the activation of required actuators in the headlight. The necessary data is provided via CAN or via a direct connection for the headlight control unit. The headlight control unit is not a “light master” and does not decide which light is switched “ON”. The headlight control unit is connected to the vehicle electrical system control unit (light master) and the gateway control unit.

On vehicles with steel springs, the self-levelling sensors are connected directly to the headlight control unit. The headlight control unit is powered by the vehicle electrical system.

Headlight Control Unit Software

The two headlight control units in the vehicle work independently. Each headlight control unit has the individual software and hardware it requires for calculating the required parameters. During a service, headlight variant coding must be performed and parameters must be set using the PIWIS Tester.

The functions, such as automatic range adjustment, static cornering light and dynamic cornering light, are calculated in the headlight control unit and implemented by the connected bulbs/actuators. The light master (vehicle electrical system control unit) issues the command to switch on the lights.

Dipped Beam

The series reactor (ignition control unit) is integrated in the headlight control unit for the dipped beam function. The headlight control unit is hard wired to the vehicle electrical system control unit (light master). The series reactor (ignition control unit) can also be activated without the power supply (terminal 15) from the headlight control unit.

Diagnosis is performed when terminal 15 is switched on and when the lights are activated. The series reactor (ignition control unit) has a power monitoring and power control system. The headlight control unit sends its status bit to the CAN bus when dipped beam is “ON”. This bit is monitored by the opposite headlight control unit. If a fault is detected, emergency mode is enabled and the message “Check dipped beam” appears on the on-board computer. The same happens if the headlight control unit intentionally switches off the dipped beam headlight because of a problem with the automatic range adjustment and dynamic cornering light functions (message displayed on on-board computer: “Automatic range adjustment failure” or ”Cornering light failure”).

Notes

Headlight control units are not installed in vehicles with halogen headlights. Faults relating to halogen headlights are detected by the light master (vehicle electrical system control unit).

Notes

Diagnosis is performed by the vehicle electrical system control unit (light master).

High Beam, Auxiliary Main Beam, Headlight Flasher

The control motor for high beam activation is hard wired to the vehicle electrical system control unit (light master). The headlight control unit is not responsible for activating the high beam headlight in the headlight module variants.

The auxiliary main beam headlight is also activated by the vehicle electrical system control unit (light master) and its output cannot be regulated. The vehicle electrical system control unit (light master) activates the headlight flasher functions. The required bulbs and motors are activated directly for this purpose.

- Only the auxiliary main beam is activated when terminal 15 is "ON" and terminal 56b (dipped beam) is "OFF".
- The auxiliary main beam and the main beam magnet is activated when terminal 15 is "ON" and terminal 56b (dipped beam) is "ON".
- There is no headlight flasher function when terminal 15 is "OFF".

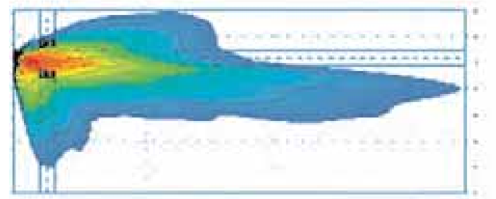
Cornering Light

We differentiate between the variants Static cornering light and Dynamic cornering light for the cornering light function. The driver's visible area is larger and this contributes further to improving active safety. The road is illuminated even better because the two light beams lie side-by-side and do not focus their light on one point. The headlight control unit has the relevant software for calculating the required parameters.

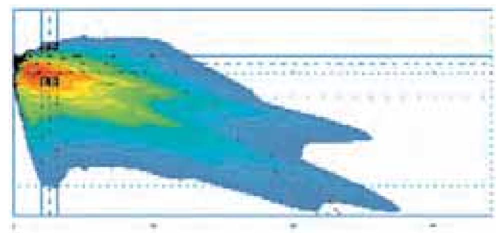
Static Cornering Light

The purpose of the static cornering light is to light up the adjacent area in front of and beside the vehicle with a large beam spread and homogeneous linking with the rays of light emerging from the main headlight. The headlight control unit calculates the required value for the static cornering light bulb from the input values received via the CAN bus.

The static cornering light, with a beam angle of approx. 30° with respect to the direction of travel (controlled by the steering angle), provides better illumination of the road in the direction of the steered corner (e.g. when turning) when the vehicle is stationary or when travelling at speed up to 80 mph (130 km/h).



Bi-Xenon headlights when turning (static cornering light active).



Bi-Xenon headlights during cornering (static and dynamic cornering light active).

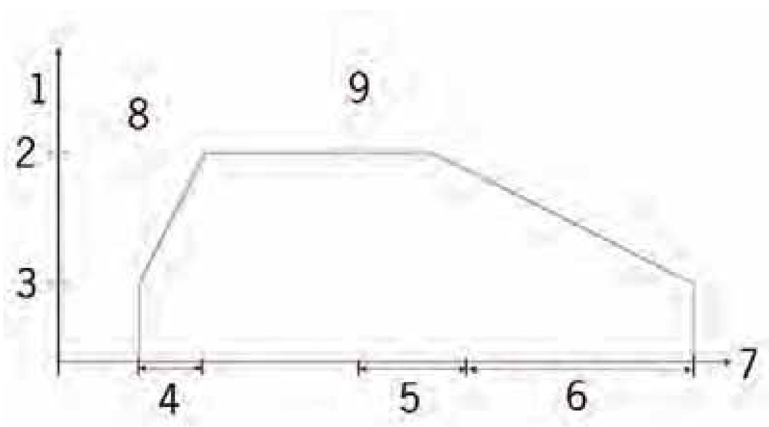
The static cornering light is switched on if the following conditions are met:

- Dipped beam “ON” (via light switch) or the light sensor detects the need for lights “ON”.
- Steering angle a_{on} =2°.
- Speed-dependent.
- Terminal 15 analog and terminal 15 via CAN signal.

The static cornering light is switched off if one of the following conditions is met:

- Dipped beam “OFF”.
- Steering angle a_{off} =< 2°.
- Terminal 15 as CAN signal “OFF”.
- Terminal 15 analog “OFF”.
- High beam “ON”.

Static cornering light control depends on the characteristics that were defined during the development phase. The static cornering light is switched on when there is a jump from 0 % to 30 % ($U_{eff\ jump}$). The voltage is adjusted in a “ramp” from 30 % then to 100 % ($U_{eff\ jump}$). Essentially, a steeper “ramp” (see Phase 4) is used for increasing the voltage. The voltage is reduced using a flatter “ramp” (see Phase 6).



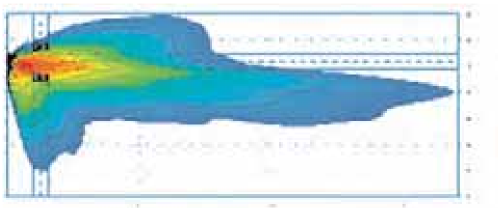
1 - Voltage (U) eff in %
2 - Voltage (U) eff max
3- Voltage (U) eff jump
4 - Time (t) on – switch-on phase
5 - Time (t) – -holding phase
6 - Time (t) off – switch-off phase
7 - Time (t) in ms
8 - Switch-on condition met
9 - Switch-off condition met

The adjusting behaviour depends on the various signals:

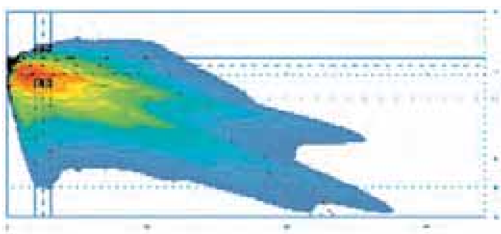
- Steering angle
- Steering angle speed
- Vehicle speed
- Left/right direction indicator
- Reverse gear

Notes

When setting the direction indicator light, the time “t_{ON}” is reduced by a predefined factor.



Bi-Xenon headlights when turning (static cornering light active).



Bi-Xenon headlights during cornering (static and dynamic cornering light active).

Notes

Activating the high beam switches the static cornering light off. In contrast, the dynamic cornering light remains active when travelling at 2 mph (3 km/h) or faster even when high beam is active. This improves visibility for the driver.

Notes

The power supply for the headlight control unit and stepper motors comes directly from a terminal 15 relay.

Dynamic Cornering Light

The steering angle, vehicle speed and yaw rate serve as input values for controlling the dynamic cornering light, which is integrated in the Bi-Xenon light unit. This provides optimal illumination of the road during cornering. The course of the road and any obstacles are detected earlier. The dynamic cornering light is activated at speeds of 2 mph (3 km/h) or higher. The maximum adjustment angle of the headlight at the inside of the bend is 15°, while the value for the headlight at the outside of the bend is 7.5°.

The dynamic cornering light is activated as soon as the following conditions are met:

- Dipped beam “ON” (via light switch) **or**
- the light sensor detects the need for lights “ON” **and**
- vehicle speed > 2 mph (3 km/h),
- engine rpm > 600 rpm,
- positive feedback after referencing the stepper motors.

Stepper Motors (auto. range adjustment, dynamic cornering light)

Each stepper motor is connected to the headlight control unit via an interface. The headlight control unit calculates the required position into which the stepper motor must move, and sends this information to the stepper motor. If a stepper motor fails or malfunctions, a fault is stored in the fault memory and the relevant emergency operation function is initiated.

Each stepper motor is used for a different purpose:

- Stepper motor for automatic range adjustment.
- AFS stepper motor (dynamic cornering light).

During initialization, the headlight control unit checks the number of registered stepper motors. If a difference is detected, a fault is recorded.

Automatic Range Adjustment

The automatic range adjustment function is integrated in the headlight control unit. The dynamic range adjustment system keeps the inclination of the light rays (dipped beam Bi-Xenon module and static cornering light) at the preset value of -1 % independently of the vehicle's load so that neither the vehicle's load nor the pitching movements resulting from the vehicle's driving dynamics can "blind" oncoming traffic when dipped beam is switched on, while at the same time ensuring an adequate range of vision for the driver.

The system responds very quickly to braking or acceleration. The motor begins to adjust the headlights after commencement of the pitching movement. When the vehicle is stationary, the vehicle's inclination is calculated from the sensor signals and the headlight settings are corrected according to the difference between their required and actual positions. The full scope of functions is maintained when high beam is switched on. This results in increased driving safety while at the same time reducing the strain on the driver.

The following CAN signals are required for calculating automatic range adjustment and the functions of the actuators:

- Steering angle
- Yaw rate
- Left + right direction indicator
- Vehicle level, front + rear
- Wheel speed
- Motor operating status
- Dipped beam status
- Light sensor
- Brake light switch
- Reverse gear
- Synchronization data (from headlight control unit)
- Accelerator pedal

Based on these signals, a microprocessor controller calculates the vehicle's pitch angle and the required positions of the stepping motors in the headlight for the purposes of range adjustment.

Notes

Vehicles with steel springs. In this case, the self-levelling sensors are read in directly by the left headlight control unit and the sensor values are transmitted to the right headlight control unit in the form of a CAN signal.

Notes

The system is adapted to the different types of vehicles by programming the vehicle specific parameters using the PIWIS Tester.

Automatic Range Adjustment – Poor Road Surface/Off-road Detection

The automatic range adjustment system includes a function for detecting poor road surfaces/off-road conditions, which counteracts the continual adjustment behavior by using a filter system that significantly reduces actuation of the stepping motors or shutting them down completely. Interfering signals which are superimposed over the sensor signals as a result of the road surface (bumps and pot holes) are filtered out while driving.

Automatic Range Adjustment – Chassis Variants

Two chassis variants are used in the Cayenne (steel spring and air suspension). Two automatic range adjustment variants (coding) are available due to the mechanical and electronic differences between the chassis variants. These are adapted specifically to suit the relevant chassis. The required parameters are assigned for all Cayenne models using the vehicle's required components list.

Notes

Headlights, which are not yet operational (delivery status) and are used, operate in emergency mode will cause a fault to be entered in the fault memory of the headlight control unit "Control unit not coded" if terminal 56b is "OFF".

Coding

The following components must be coded during a service upon delivery of a new headlight.

Chassis:
- Steel springs
- Air suspension

Lights:
- Static cornering light

Country version:
- Left-hand drive
- Right-hand drive
- USA/Canada

Parameter Settings

The following parameters are set:
- Automatic range adjustment parameters (depending on the chassis installed).

Calibration

The self-levelling sensors must be calibrated on vehicles "with steel springs". The self-levelling sensors must be calibrated before adjusting the lights as part of the "vehicle handover".

Re-calibration is only required following repairs, adjustment work on the chassis, replacement of the headlight control unit or replacement of the self-levelling sensors.

Calibration is essential in order to store the zero-position of the self-levelling sensors in the headlight control unit. This set zero value is required in order to calculate the position to be set for the stepper motor for automatic range adjustment.

For vehicles with air suspension, another control unit is used to calibrate the self-levelling sensors in the air suspension system. The values for these self-levelling sensors are stored as CAN signals in CAN. Calibration by the headlight control unit is not required therefore as the required signals are evaluated directly by the headlight control units.

Notes

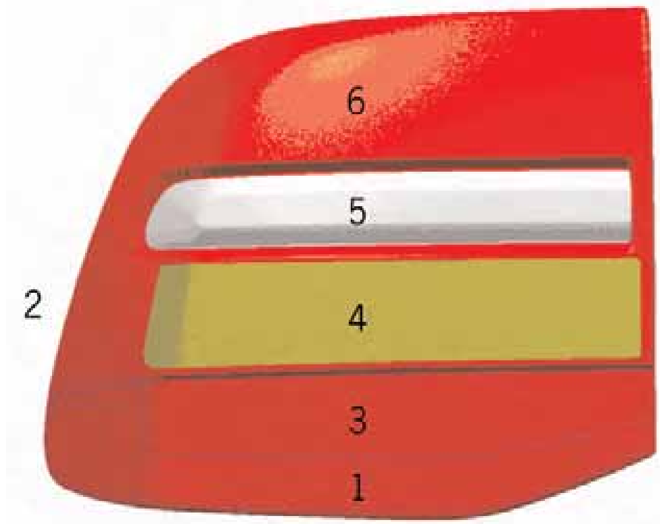
As soon as a calibration error is detected, a fault entry is recorded in the headlight control unit. The driver is alerted to this by the message "Headlight system fault" on the on-board computer in the instrument cluster.

Bulb Failure

The following outputs are monitored:

Bulb	Designation	Output in Watt	Failure detection
Static cornering light	H11	55 W	Series reactor
Xenon	D1+	32–38 W	Series reactor
Auxiliary headlight	H7	55 W	Vehicle electrical system control unit
High beam	Switching motor for beam aperture		Vehicle electrical system control unit

Tail Lights



1 - Reflector
2 - Side marker light with 4 - LEDs
3 - Rear fog light
4 - Direction indicator light
5 - Backup light
6 - Tail light/brake light with 16 LEDs

Notes

The lense area of the direction indicator light (4) is darker for the USA/Canadian market.

The tail lights on the Cayenne models as of model year 2008 are designed as a single unit and combine the indicator light, rear fog lights (left and right), backup light, brake light, marker light and reflector in one housing.

The following features have been added to further improve functionality and design:

- LED technology
- Side marker light
- New design

The most remarkable feature of the new tail lights is the use of 16 LEDs for the rear light and brake light as well as four other LEDs for the marker light. In addition to the visual impact and the long service life, the advantage of LED technology is above all the short response time. While the response time of conventional bulbs is approx. 100 ms, the response time for LEDs is around 0.1 ms.

At a speed of 60 mph (100 km/h), this difference is equivalent to a distance of approx. 3 feet. Earlier signalling of braking therefore means that traffic driving behind the vehicle is warned sooner. The tail light also has a side marker light with LEDs, which is positioned in the lower side section of the tail light.

The main function of the vehicle electrical system control unit is to protect the battery against excessive cyclical loads. Since functions that are relevant to the driver are controlled by vehicle electrical system management and technical safety must be assured at all times, a lot of input data is required on the vehicle electrical system control unit. The status of the vehicle electrical system is mainly determined by comparing the determined voltage with the permitted lower voltage limit.

The status of the vehicle electrical system is determined from the battery voltage values and information relating to high current loads with a short "on" time. The load switching states currently requested by the driver are also stored in the vehicle electrical system control unit. The vehicle electrical system control unit communicates with the DME control unit in order to increase the idling speed if necessary for the purpose of improving the vehicle electrical system status.

Comfort loads can be switched off if necessary, i.e. if the vehicle electrical system status is too negative. The increased battery voltage is then made available to other control units via the CAN bus. Before load switch-off (e.g. plug sockets and cigarette lighter) is activated, the driver is alerted by the warning "Battery low" in the instrument cluster. Once the vehicle electrical system status is no longer critical, the loads are switched back on again in reverse order. Diagnosis of the vehicle electrical system control unit is performed using the PIWIS Tester.

Determining Battery Voltage

The battery voltage is determined in a number of different ways. The current voltage is measured once and the measured value is filtered so that short-term voltage drops, e.g. when servo motors are switched on, do not render the value incorrect. A time based mean value is also determined (unweighted, mean value over a fixed time period) – this has very little effect on short-term loads. If a high-current load is switched on (e.g. status on the CAN bus) and if the current voltage value is lower than the determined value, the mean value is used to detect the vehicle electrical system status. Otherwise the current measured voltage value always has priority.

Notes

Short term loads are defined by an expected "on" time "t_{ON}" of less than 30 seconds at a current of more than 10 A.

Nominal Battery Voltage

The default voltage for the generator is based on the temperature dependent maximum permitted battery voltage. The voltage range that can be set as the generator output voltage over the interface is between 13.5 volts and 15 volts. Since the battery temperature cannot be measured directly, the battery temperature is determined from a map using replacement values.

The battery temperature is calculated using the following available CAN signals:

- Coolant temperature.
- Outside temperature (filtered).
- Idle time of vehicle.
- Indicator light for auxiliary heating (coolant temperature rises when the auxiliary heating system is on).

Determining the Vehicle Electrical System Status

The status of the vehicle electrical system is mainly determined by comparing the determined voltage with a permitted lower voltage limit.

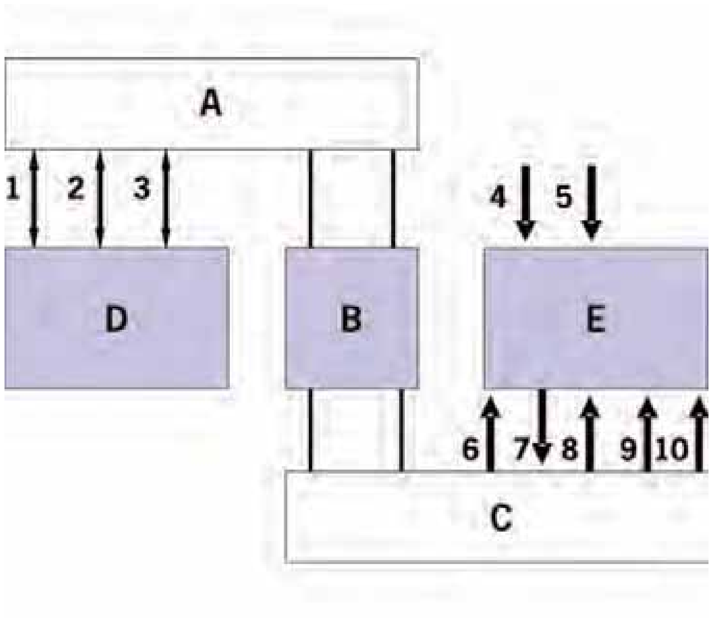
The values determined for:

- Battery voltage,
- DF signal (generator utilization),
- Information about active high current loads with a short "on" time are essentially used to determine the vehicle electrical system status.

The load switching states currently requested by the driver are also stored in the vehicle electrical system control unit.

Division of Functions for Control Units

The DME control unit controls the engine rpm and enables a two-stage increase in idling speed.



A - CAN drive
B - Gateway control unit
C - CAN Comfort
D - Engine control unit (DME)
E - Vehicle electrical system control unit
1 - Engine rpm
2 - Idling rpm increase
3 - Coolant temperature
4 - DF signal
5 - Battery voltage
6 - Switch-on status of loads
7 - Switch-off specification of loads
8 - Outside temperature
9 - Idle time of vehicle
10 - Auxiliary heating system status

The vehicle electrical system control unit has a communication interface with the generator that is used to preset the nominal charging voltage. The generator sends its utilization rate (DF signal) to the vehicle electrical system control unit over this interface. By evaluating the battery voltage and DF signal, the vehicle electrical system control unit evaluates the vehicle electrical system status and switches off comfort loads if necessary.

The battery voltage is monitored via a separate input. The vehicle electrical system control unit communicates with the DME control unit in order to increase the idling speed if necessary for the purpose of improving the vehicle electrical system status.

Porsche Rear Seat Entertainment System

Available as a factory installed option is the new and substantially improved Porsche Rear Seat Entertainment System.

This system includes:

- two video displays,
- one media player,
- two wireless infrared headphones and,
- one remote control.

The media player is now incorporated into the front passenger seat video display. This leaves the middle seat free.

The system is compatible with all standard media formats (e.g., CD, DVD and MP3). A digital anti shock memory ensures continuous, uninterrupted play. It is also possible to connect two separate and individually selectable AV sources, such as a game console or digital camera. The seven-inch swivel mounted TFT (thin film transistor) displays are trimmed in matching interior leather and mounted on the front seat headrests.