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Service Information

2015 Technik Introduction

Macan S, Macan Turbo, Macan S Diesel

Porsche AfterSales Training

Student Name: _____

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Date: _____

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We have attempted to render the text within this publication to American English as best as we could. We reserve the right to make changes without notice.

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Printed in the USA

Foreword

Porsche has again built a Sports Car with the new model range. A vehicle with 5 doors, 5 seats and a raised sitting position ensures a high level of everyday usability with plenty of space for hobby, leisure and sport activities. In spite of this, the Macan still offers the dynamic performance and agility that befits a Sports Car. Porsche therefore presents the first Sports Car in the compact SUV segment, a vehicle that does not just catch the eye by virtue of its exterior proportions, but which also shines with its inner values.



The Macan S is powered by a 3.0-liter V6 biturbo engine and the Macan Turbo by a 3.6-liter V6 biturbo engine of the Panamera. The 2nd generation 3.0-liter V6 turbo diesel engine from the Panamera and Cayenne is used in the Macan S Diesel. All engine units are designed for maximum efficiency and agility in combination with the standard Porsche Doppelkupplung and therefore make a major contribution to the impressive driving dynamics of the Macan.

The lane keeping assist system is used as a driver assistance system for the first time at Porsche. This system initiates corrective steering intervention to bring the vehicle back into the lane when it detects that the driver is inadvertently straying from the lane or is changing lanes without indicating. The number of driver assistance systems in the Macan provides optimum support for the driver, allowing him to recognize the dangers that occur in road traffic in good time and therefore avoid accidents.

A high level of qualification throughout the entire AfterSales organization is essential to meet the high expectations of Porsche customers, in spite of the ever increasing complexity of the technology used in the vehicles and the growing number of different variants. This Service Information Technik describes the technical highlights and innovative systems of the new model range.

The Service Information Technik is not intended as a basis for repairs or for diagnosis of technical problems. Information for repairs or diagnosis is available in the PIWIS workshop manual. Please also refer to the information offered by the Porsche Academy, which is being constantly expanded and updated.



Important Information Regarding the Macan S Diesel!

At the time of printing of this Macan SIT book, the delivery date, equipment and specifications that will be offered in the North American market has not yet been determined. All Macan S Diesel data/equipment/specifications listed herein are subject to change without notice. You will be informed accordingly once this information has been determined.

Contents

1	Engine	1
1.1	Macan S and Macan Turbo	1
1.2	Macan S Diesel	20
2	DME engine electronics	37
	Macan S and Macan Turbo	
2.1	General information	37
2.2	Fuel system	41
2.3	Intake system	45
2.4	Mixture formation	55
2.5	Ignition system	60
2.6	Exhaust/emission control	62
2.7	Additional DME functions	65
	Macan S Diesel	
2.8	General information	70
2.9	Fuel system	75
2.10	Intake system	80
2.11	Exhaust/emission control	84
2.12	Glow system	94
2.13	Cooling system	95
2.14	Active sound	100
3	Power transmission	103
3.1	Porsche Doppelkupplung	107
3.2	Transmission – Oil system	108
3.3	Parking lock	114
3.4	Transmission control	115
3.5	Electronics	118
3.6	Transmission – Protection	123
3.7	Emergency programs	124
4	Chassis	125
4	Chassis	125
4.1	Front axle	126
4.2	Rear axle	132
4.3	Steering	137
4.4	Wheels and tires	144
4.5	Brakes	147
4.6	Control systems	155

Engine

DME engine electronics

Power transmission

Chassis

5	Body	163
5.1	Aerodynamics	165
5.2	Bodyshell	166
5.3	Body repairs	169
6	Body – Exterior equipment	171
6.1	Front view	171
6.2	Side view	179
6.3	Roof	182
6.4	Rear view	183
7	Body – Interior equipment	187
7.1	Multi-function steering wheel	189
7.2	Seat system	190
7.3	Interior trim	191
7.4	Storage concept	192
7.5	Luggage compartment	193
7.6	Restraint system	194
8	Heating & Air-conditioning	197
8.1	Ventilation/air routing	198
8.2	Operation	203
8.3	Refrigerant circuit	207
8.4	Actuators and sensors	210
8.5	Topology	211
9	Electrics and electronics	213
9.1	Network topology	214
9.2	Vehicle electrical system	215
9.3	Lighting system	221
9.4	Front-end electronics	225
9.5	Rear-end electronics	229
9.6	Instrument cluster	231
9.7	PVTS/PCC	233
9.8	Assistance systems	235
9.9	Infotainment	240

1.1 Macan S and Macan Turbo

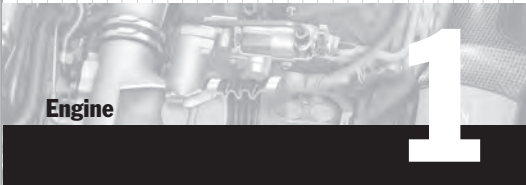
General Information

The Macan S is powered by a 3.0-liter V6 biturbo engine and the Macan Turbo by a 3.6-liter V6 biturbo engine. Both engines are based on the 3.6-liter V6 naturally aspirated engine of the Panamera, but have been completely redeveloped apart from a few components such as the crankcase. Its 90° V arrangement and its very compact design mean that the Macan S and Macan Turbo have a low center of gravity. The Macan S engine has a power output of 340 hp (250 kW) at 5,500 – 6,500 rpm, while the Macan Turbo develops 400 hp (294 kW) at 6,000 rpm.

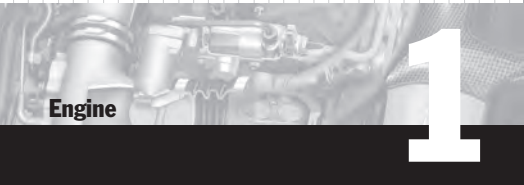
The new 3.0-liter and 3.6-liter V6 biturbo engines make consistent use of downsizing and offer impressive performance combined with outstandingly high efficiency. Particular attention was paid during the development of these new engines to achieving the highest specific output combined with outstanding emission and fuel consumption values.



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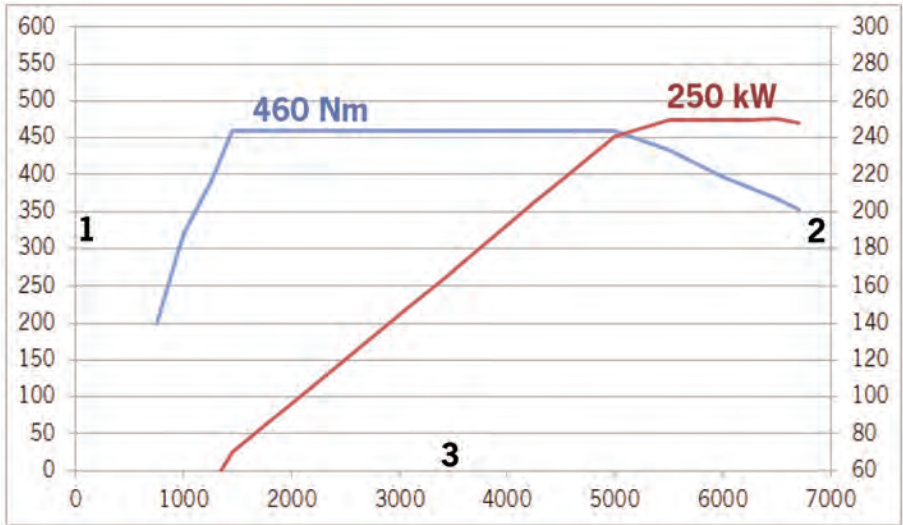


1.1 Macan S and Macan Turbo	1
1.2 Macan S Diesel	20



- 1 Torque in Nm
- 2 Power in kW
- 3 Engine speed rpm

Full load curve of Macan S

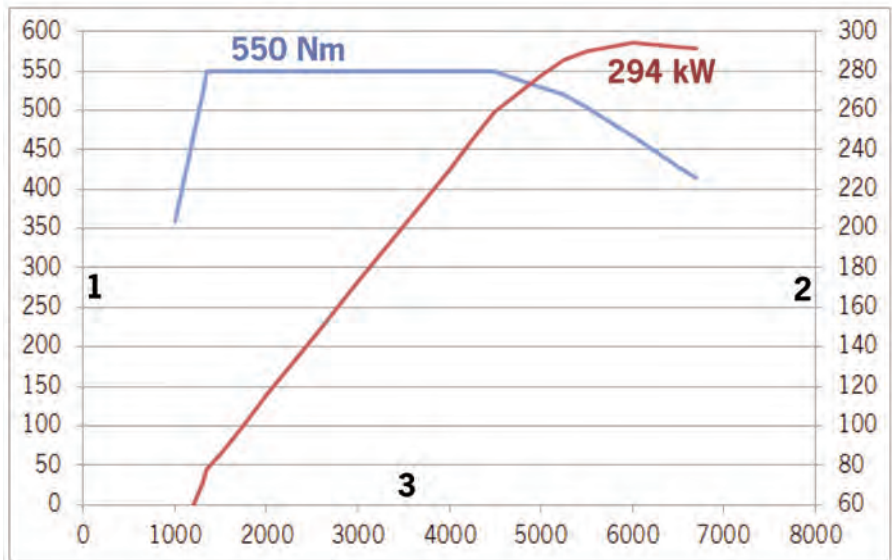


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Technical engine specifications for Macan S

Engine type		CTM (M4630)
Number of cylinders		6
Displacement	cm ³	2,997
Bore	mm	96
Stroke	mm	69
Compression ratio		9.8:1
Engine power at rpm	kW/(hp) rpm	250/(340) 5,500 – 6,500
Max. torque at engine speed	ft. lbs. (kW) rpm	340 (460) 1,450 – 5,000
Governed speed	rpm	6,700

Full load curve of Macan Turbo



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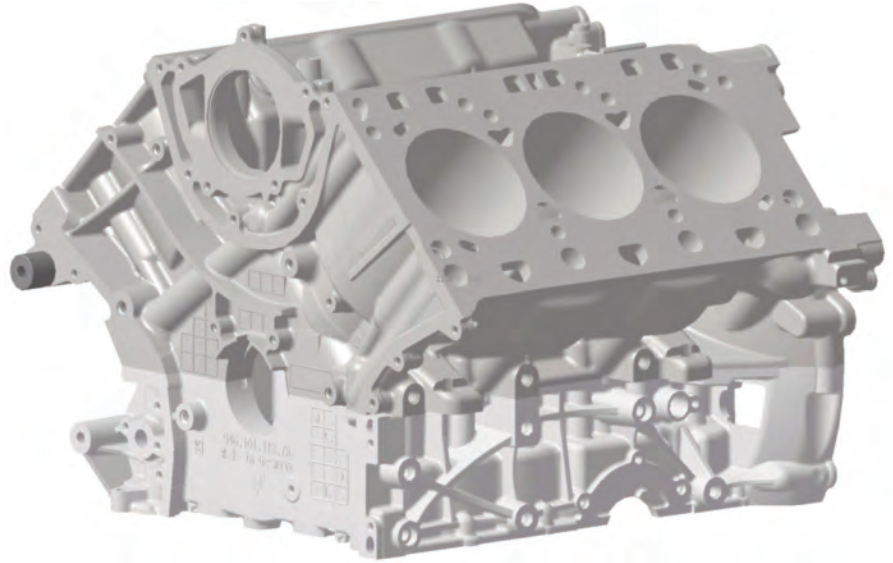
Technical engine specifications for Macan Turbo

Engine type		CTL (M4635)
Number of cylinders		6
Displacement	cm ³	3,604
Bore	mm	96
Stroke	mm	83
Compression ratio		10.5:1
Engine power at rpm	kW/(hp) rpm	294/(400) 6,000
Max. torque at engine speed	ft. lbs. (kW) rpm	406 (550) 1,350 – 4,500
Governed speed	rpm	6,700

Engine

Crankcase

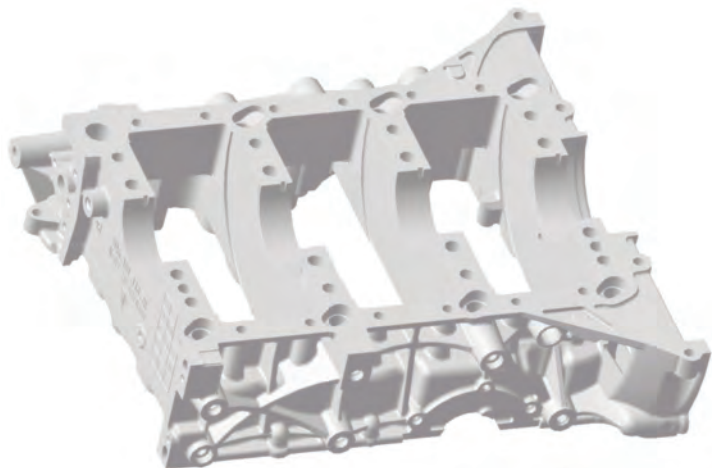
The crankcase in the Porsche Macan S and Macan Turbo is designed as a two-piece closed-deck component in a light metal alloy (AlSi17Cu4Mg). In the closed-deck design, the sealing surface of the crankcase to the cylinder head is largely closed. There are bores and channels for oil and coolant. The entire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



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The alloy used for the crankcase is a hypereutectic alloy in which silicon crystals form in order to create a wear-resistant surface. The cylinder lining is machined by multiple special honing operations (spiral slide honing).

The crankcase lower part is machined together with the upper part and paired. To keep the weight as low as possible, inserts made from spheroidal graphite cast iron have been dispensed with and the wall thickness reduced. A low-pressure chill-casting procedure is used to make the upper and lower parts of the crankcase.

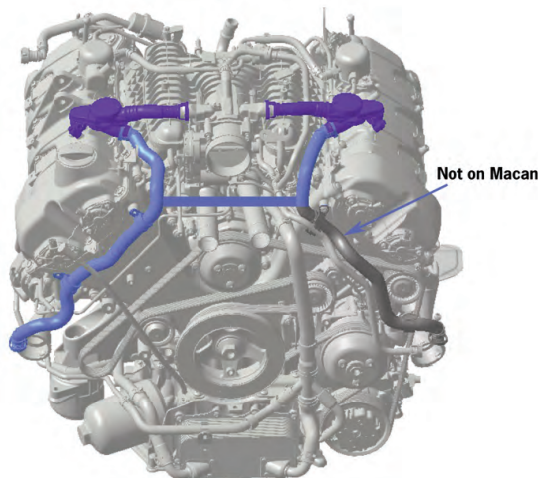


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Crankcase ventilation

During combustion, every engine blows some of the combustion gases past the pistons towards the crankcase – these gases are called blow-by gases. If these gases were not removed, the pressure in the crankcase would increase considerably. A vent connection is fitted in the crankcase for this reason. For environmental protection reasons, these gases are not released into the atmosphere but are returned to the engine for combustion via the intake system. These crankcase ventilation gases naturally contain a high proportion of engine oil and other combustion residues. If these gases enter the intake duct, they will contaminate the intake air and can then impair running smoothness and exhaust emissions and also reduce knock resistance.

These reasons show why effective oil separation is important for the engine. The crankcase ventilation system can reduce the amount of fuel that enters the engine oil during combustion. The Positive Crankcase Ventilation (PCV) system ensures that the crankcase is ventilated with fresh air, which results in the accelerated evaporation of the fuel carried in. For this purpose, fresh air is tapped between the charge-air cooler and throttle valve and supplied via a line to the crank chamber. The pressure gradient that exists at any time between the removal point and the crankcase causes a steady flow of fresh air through the crankcase. To ensure the legally required 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). This system thus ensures a constant disposal of the fresh air delivered by the PCV system and the blow-by gases, which are supplied to the combustion process in this way.



1_63_13 USA

Crankcase ventilation takes place on a cylinder bank-specific basis in the V6 biturbo engine. At idle speed, a vacuum is present in the expansion intake manifold due to the lack of boost pressure and low air throughput of the turbochargers. The crankcase is vented via the intake pipe. This takes place individually for each bank side. If boost pressure is present so that there is an overpressure in the expansion intake manifold, venting then takes place via the intake side of the intake ducts of the turbocharger. The vent paths are controlled by means of two pressure-regulating valves mounted on the banks.

Engine

1



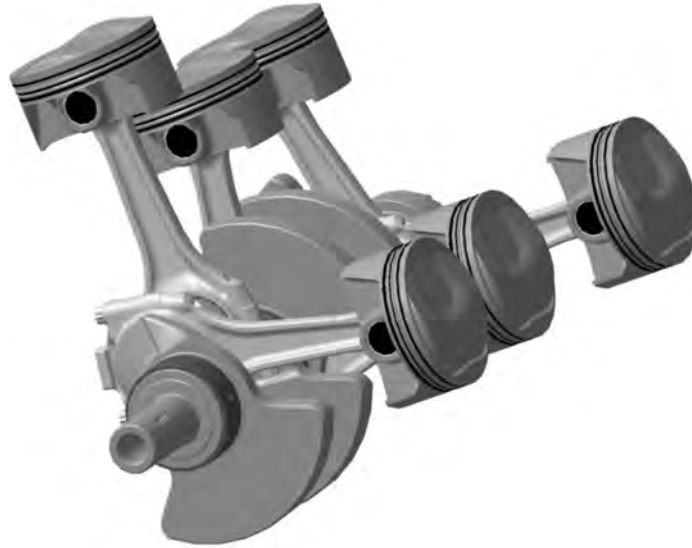
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Note:

On USA engines, the driver side cylinder bank connects to the passenger side vent hose.

Crankshaft

The drop-forged crankshaft runs in four bearings and has six balancing 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 binary bearings with a diameter of 64 mm. Since the lower part of the crankcase is made of an all-aluminum alloy, the main bearings are reinforced and the retaining lugs have been changed to avoid confusion.



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Connecting rod

A predetermined breaking point is produced on the big end of the forged connecting rods with a length of 162.4 mm for the 3.0-liter V6 biturbo engine and a length of 155.4 mm for the 3.6-liter V6 biturbo engine. The connecting rod is then broken (cracked) at this point. The two parts are aligned with one another via the fractured surface created in this way. In order to prevent incorrect assembly, the rods are additionally labelled with matching numbers and the bores for the fastening screws are offset. The connecting-rod bearings are designed as binary bearings at the cap end and ternary bearings at the rod end. The diameter is 52 mm for the 3.0-liter V6 biturbo engine and 54 mm for the 3.6-liter V6 biturbo engine. The connecting-rod bearings are supplied with oil via bores in the crankshaft.



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Piston

The forged pistons are designed as recessed-head type pistons and made of an aluminum alloy. A special lightweight design is used to reduce the piston weight and therefore increase engine liveliness. A plastic coating permeated with iron particles applied by screen printing (Ferropaint) is used to improve the running-in characteristics and increase resistance to seizing. The engine friction is reduced by the DLC (Diamond Like Carbon) coating of the piston rings. The pistons of cylinder banks 1 and 2 are different. The position and shape of the piston recess allows the injected fuel to be whirled around and mixed with the air that is drawn in.



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Timing drive with balance shaft

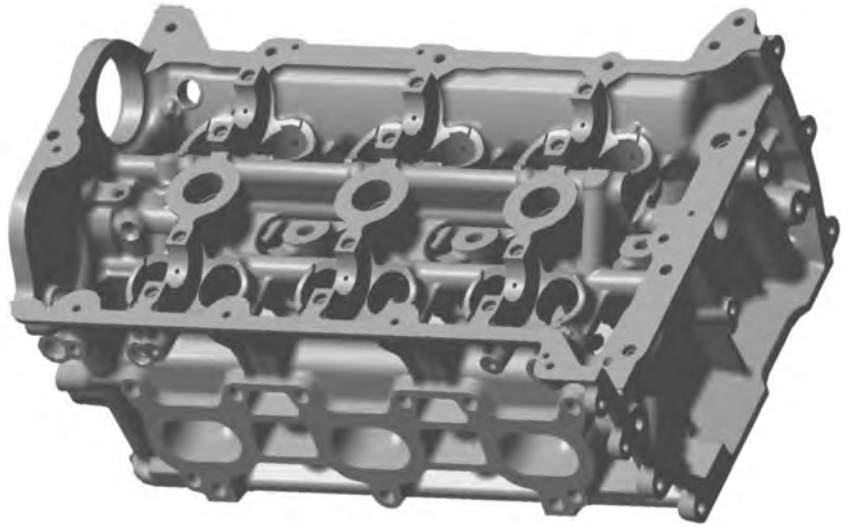
A free first-order moment of inertia is produced in the 90° V6 biturbo engine which is compensated by balancing weights on the crankshaft and masses on the balance shaft. Since the balance shaft should be installed as centrally as possible under the middle of the engine, it is installed directly next to the oil pump housing.



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The module housing with oil pump and balance shaft must reliably transmit the introduced forces and moments under all engine operating conditions. The balance shaft is supported by plain bearings. The shaft rotates at the same speed as the engine counter to the engine's direction of rotation.

Cylinder head



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The cylinder head and camshaft mounting make up a common component that features cross-flow cooling. The cylinder head is made of AlSi7Mg.

Camshafts



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The intake and exhaust camshafts have a base circle diameter of 34 mm, the intake position with constant lift (40 mm) and the high-pressure pump drive (36 mm). A differential lift is realized on the intake side between the two intake valves in order to obtain a stable charge movement (swirl) in the combustion chamber. Intake valve 1 is still designed as switchable between 3.6 and 10.3 mm, whereas intake valve 2 has a constant lift of 2.5 mm. The exhaust valve lift is 9.85 mm for all cylinders. In addition, the fuel high-pressure pumps are driven by both intake camshafts via a triple cam with 4.7 mm lift.

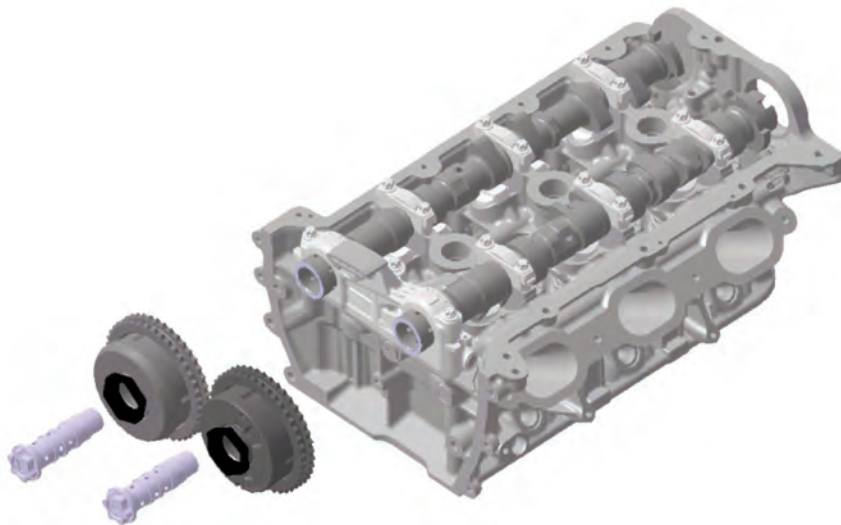
Camshaft control with valve lift adjustment (VarioCam Plus)

Due to the high requirements related to a variable valve drive, VarioCam vane adjusters are used on the intake and exhaust camshafts for the first time in the Macan S and Macan Turbo V6 biturbo engine. Since the exhaust adjuster has to perform adjustment counter to the engine's direction of rotation when the engine is switched off, this is additionally equipped with a torsion spring to assist adjustment. Both vane adjusters can be continuously adjusted by map control.

VarioCam adjustment ranges

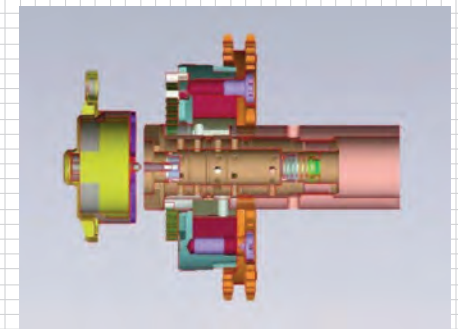
Intake camshaft: 50.0° crank angle (25.0° camshaft angle)

Exhaust camshaft: 55.0° crank angle (27.5° camshaft angle)

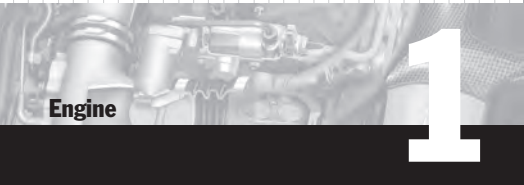


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A new feature of the VarioCam adjustment system is the central valve bolt. This has the task of establishing force transmission between the camshaft and vane adjuster. A 4-way proportional control valve is also integrated in the bolt. The valve is supplied via camshaft bearing 1. An actuator (electromechanical solenoid) aligned axially with respect to the camshaft axis is responsible for controlling the valve and therefore also adjustment. The advantages of the central valve concept include the increased adjustment speed and higher control accuracy of the adjustment system. This is achieved by very short oil ducts and the resultant short control distances. A further advantage is provided by the very compact installation dimensions due to the central arrangement in the camshafts and vane adjusters.



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Valve, valve springs



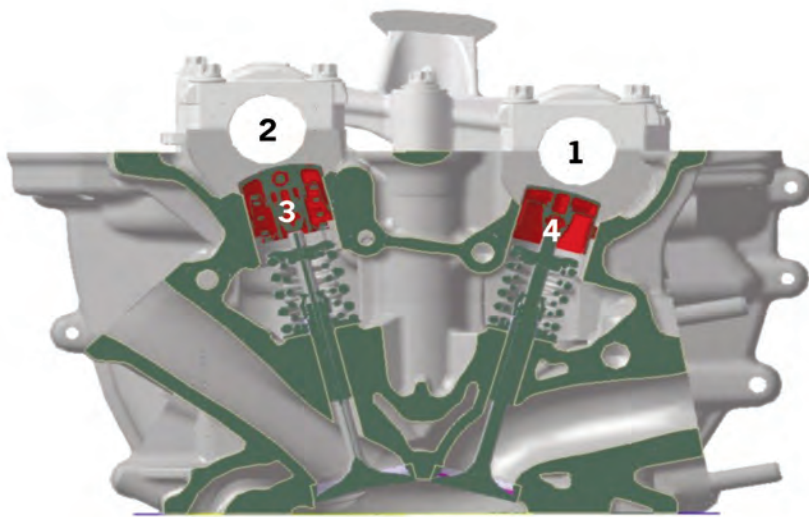
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The intake and exhaust valves of the V6 biturbo engines have a stem diameter of 6 mm. The intake valves are monometallic valves, whereby the intake valve with constant lift is additionally salt bath-nitrided. The exhaust valves are bi-metallic, i.e. different materials are used for the valve head and the lower part of the valve stem compared with the upper part of the valve stem. In addition, the exhaust valves on the V6 biturbo engine are filled with sodium. The intake valve springs for the switchable intake valve are designed as a conical double spring set. This permits realization of a very compact design. A single beehive-shaped spring is used for the intake valve with constant lift. This allows generation of very low spring forces with good intrinsic damping. Cylindrical double valve spring sets are installed here as well to ensure that the exhaust valves close even at higher pressures in the exhaust system.

Technical data of valve drive

Intake valve diameter	38.3 mm
Intake valve 1, large lift	10.3 mm
Intake valve 1, small lift	3.6 mm
Intake valve 2 lift	2.5 mm
Exhaust valve diameter	33.0 mm
Exhaust valve lift	9.85 mm
Intake valve angle	13.5°
Exhaust valve angle	15.4°
Fuel injector installation angle	29.0°
Camshaft bearing diameter	28.0 mm

Valves



1_74_13

In order to ensure a good gas exchange cycle and enable the required valve lift adjustment, the camshaft bearing is 9 mm higher on the intake side than on the exhaust side. This arrangement meant that it was possible to optimize the intake port. The cooling system was designed in such a way that parts subject to high thermal loads are optimally cooled.

Lubrication

Lubricating oil system

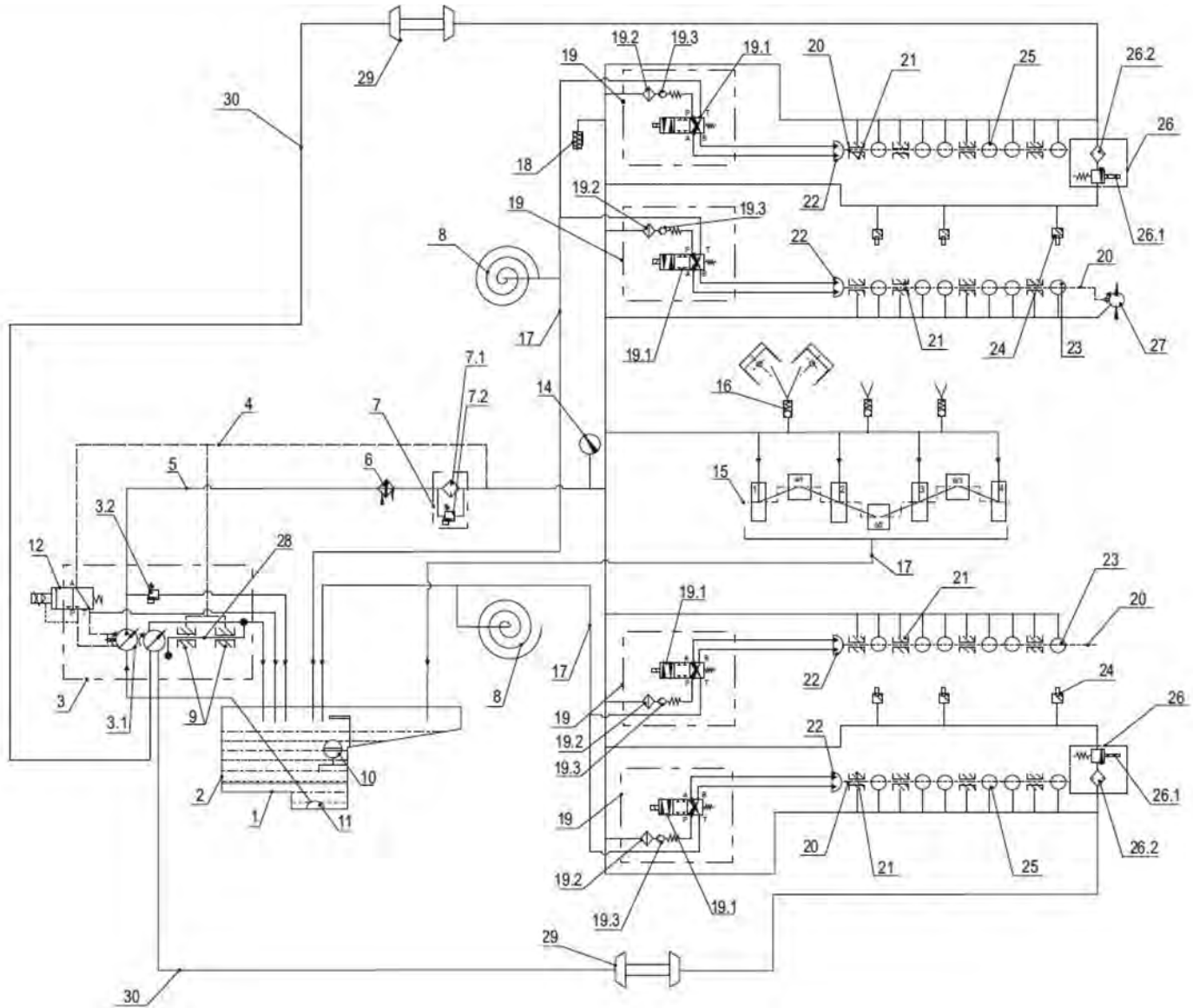


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To guarantee a reliable oil supply in all driving situations, the V6 biturbo engines in the Macan S and Macan Turbo have an integrated dry-sump lubrication system. The oil pan is designed in two parts and has an upper and lower part. The oil-water heat exchanger and the oil filter are fitted directly on the upper part of the oil pan. The newly developed plastic oil windage tray was adapted to the crank drive geometry of the V6 BT and reduces the oil foaming caused by the blow-by gases.

Engine

Oil circuit

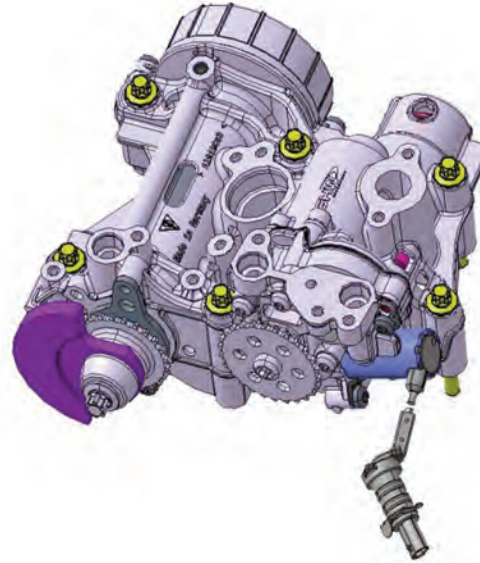


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- 1 Oil pan
- 2 Oil guide housing
- 3 Controllable oil pump
 - 3.1 Oil pump – pressure stage
 - 3.2 Pressure relief valve
- 4 Oil regulating line
- 5 Oil pressure pipe
- 6 Oil-water heat exchanger
- 7 Main flow oil filter
- 8 Oil mist separator (2x) (cyl. head cover)
- 9 Balance shaft bearing
- 10 PULS – Oil level sensor
- 11 Intake pipe with screen
- 12 Oil pump control valve
- 13 Vacuum pump
- 14 Oil pressure sensor
- 15 Crankshaft
- 16 Piston oil spray nozzle (3x)
- 17 Oil return ducts
- 18 Chain tensioner
- 19 Hydraulic valve for camshaft control
 - 19.1 Hydraulic valve – 4/3 directional-control valve
 - 19.2 Hydraulic valve – filter
 - 19.3 Hydraulic valve – check valve
- 20 Camshaft
- 21 Camshaft bearing
- 22 Camshaft actuator
- 23 Intake hydraulic tappet – lubrication/valve clearance
- 24 Intake hydraulic tappet – switching
- 25 Exhaust hydraulic tappet – lubrication/valve clearance
- 26 Hydraulic valve for valve lift adjustment
 - 26.1 Valve lift adjustment – control valve
 - 26.2 Valve lift adjustment ñ filter
- 27 Vacuum pump
- 28 Balance shaft
- 29 Turbocharger
- 30 Turbocharger extraction line

Variable oil pump

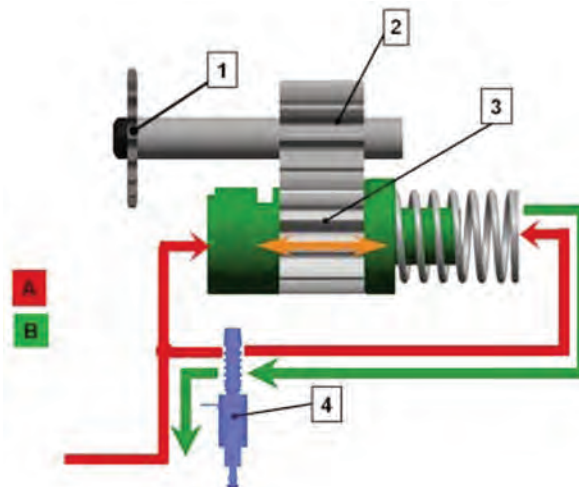
The V6 biturbo engines are also equipped with an electronic demand-controlled oil pump in order to reduce drive losses and thus increase the efficiency of the engine while at the same time reducing the fuel consumption. The oil pump and its delivery rate are pressure and volume controlled over the entire engine rpm range. In other words, a demand-based oil pressure is set with a defined oil volume for each engine operating state, e.g. different engine speeds and loads. The oil pump is integrated compactly in the oil pan area and is powered directly by the crankshaft via a chain.



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Like the V8 biturbo engines, the V6 biturbo engines also have an additional pressure oil line for lubricating the turbochargers. A turbocharger suction pump is integrated in the main oil pump for extraction of the lubricating oil.

- 1 Drive pinion
- 2 Fixed gear wheel
- 3 Axially displaceable gear wheel
- 4 Control valve

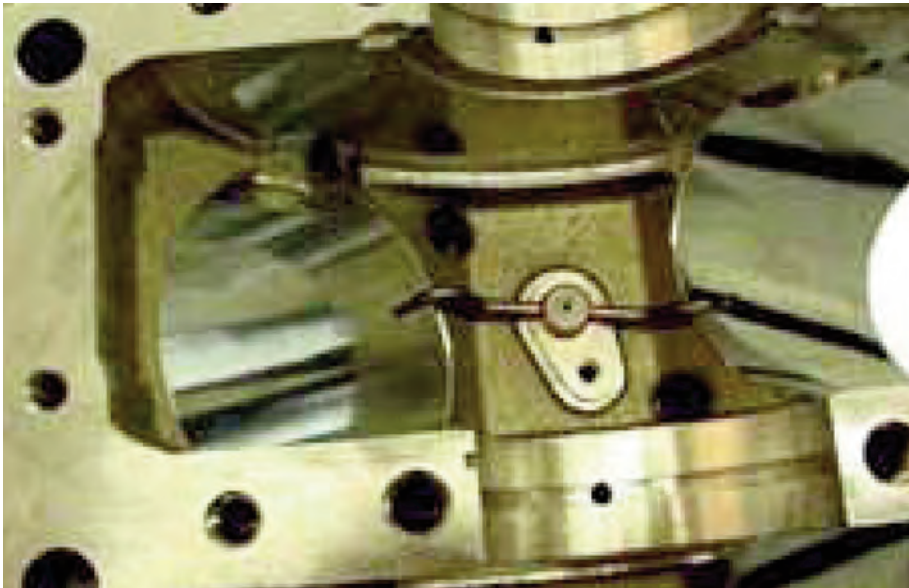


Depending on the input variables of engine speed, engine load, engine oil temperature and the expected change in engine speed, a specific control valve position is defined using a map in the DME control unit. The control valve position regulates the oil pressure for the control piston on the gear wheel, which can be displaced in axial direction. No oil pressure

is present on the other side (spring piston) and only the spring force acts here. The control valve is open fully in non-energized state, there is no oil pressure at the control piston (path B), and there is therefore no displacement of the gear wheel. In contrast, the control piston side is pressurized with oil pressure in energized state (path A), and this displaces the gear wheel against the acting spring force. The teeth are then only partially engaged as a result of gear wheel displacement. The power and friction and therefore also the energy requirement are thus reduced.

Oil spray nozzles

Oil spray nozzles are installed on the upper part of the crankcase in order to reduce the piston temperature. Spray oil cooling also has the benefit that spray oil is used for improved lubrication of the cylinder lining. In order to ensure the necessary engine oil pressure at low revs and high engine oil temperatures, the spray nozzles have an opening pressure of approximately 26 psi (1.8 bar).



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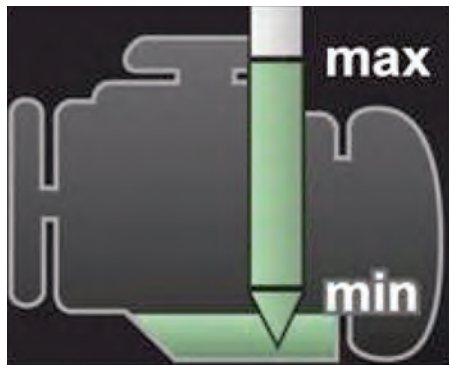
Determination of the oil level

The oil level measurement is performed while driving over a distance of 31 miles (50 km) as well as with warm engine (oil temperature $> 149^{\circ}\text{F}/65^{\circ}\text{C}$) and horizontally parked vehicle (engine off $> 120\text{ sec.}$) and ignition on.

Determination when topping off oil

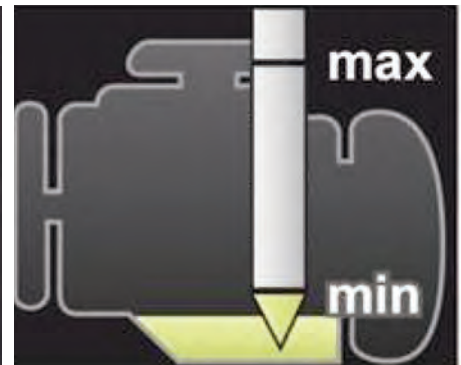
The oil level is reset after the hood is opened. The oil level can be measured immediately when the hood is closed. Preconditions: Oil temperature $> 149^{\circ}\text{F}$ (65°C) and engine is off for longer than 120 sec. If the preconditions are not met, the message "Oil level available only after short time/distance" appears in the multi-function display. If the vehicle is driven off immediately after opening the hood without the conditions being met, it is necessary either to drive for a minimum of 9 miles (15 km) or the vehicle must be stopped with the engine at operating temperature (oil temperature $> 158^{\circ}\text{F}/70^{\circ}\text{C}$) for 2 minutes with the engine off and ignition on in order to view the oil level in the multi-function display. The quantity difference between the minimum and maximum markings is 1.58 quarts (1.5 liters.) If the oil level indication function fails, the message "Failure Oil level measurement" is shown on the multi-function display.

The oil-level indicator no longer displays segments as from the Panamera MY 2014. A continuous bar is displayed instead. In the event of a MIN warning, the warning also includes indication of the maximum oil quantity that can be topped off.



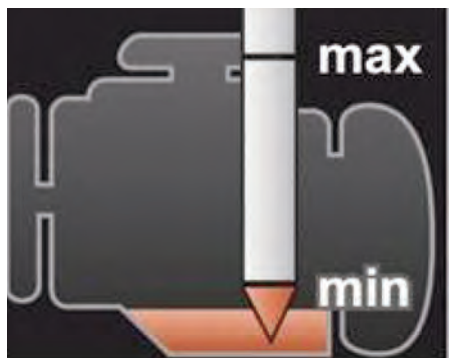
Normal

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Minimum

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Below minimum

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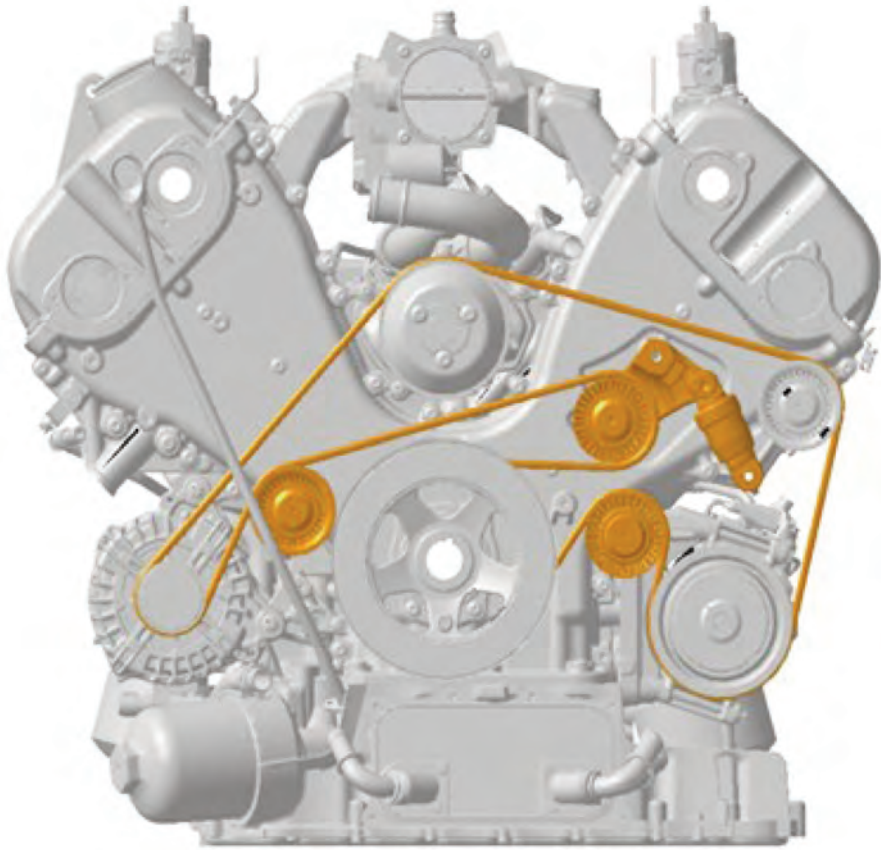


Above maximum

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Belt Drive

The auxiliary units, such as the three-phase generator, coolant pump, servo pump and air-conditioning compressor, are driven by the torsional vibration balancer via a polyrib belt. A maintenance-free belt tensioner ensures the correct belt tension in all operating states.



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Engine

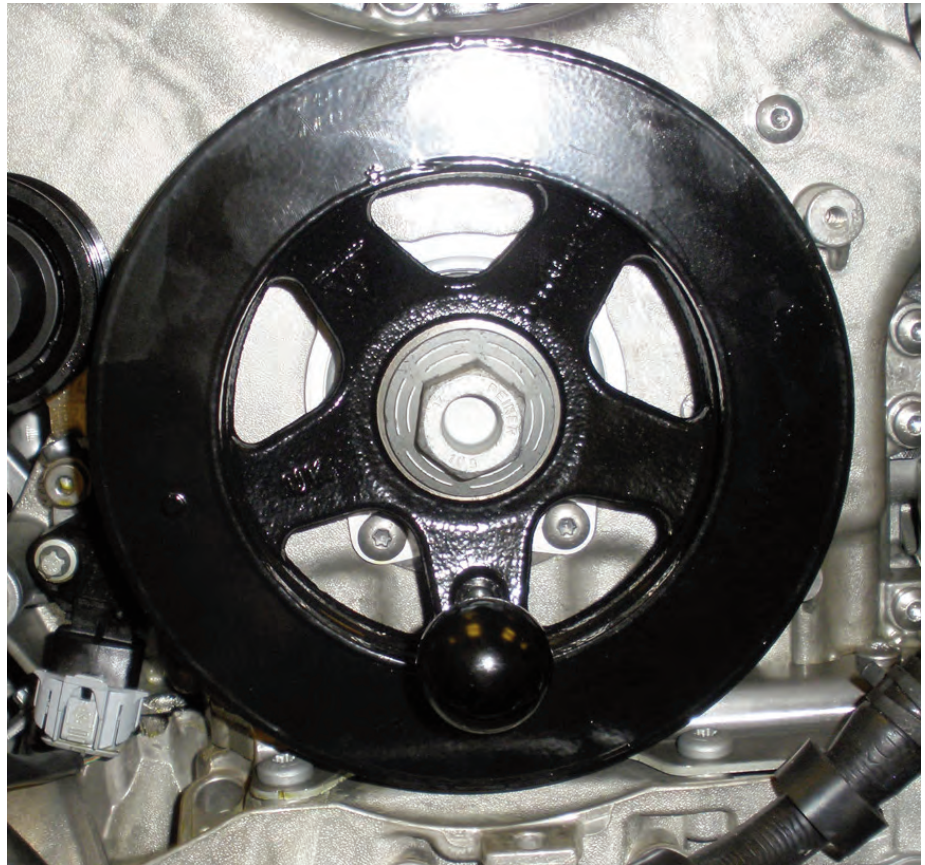
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Torsional vibration damper

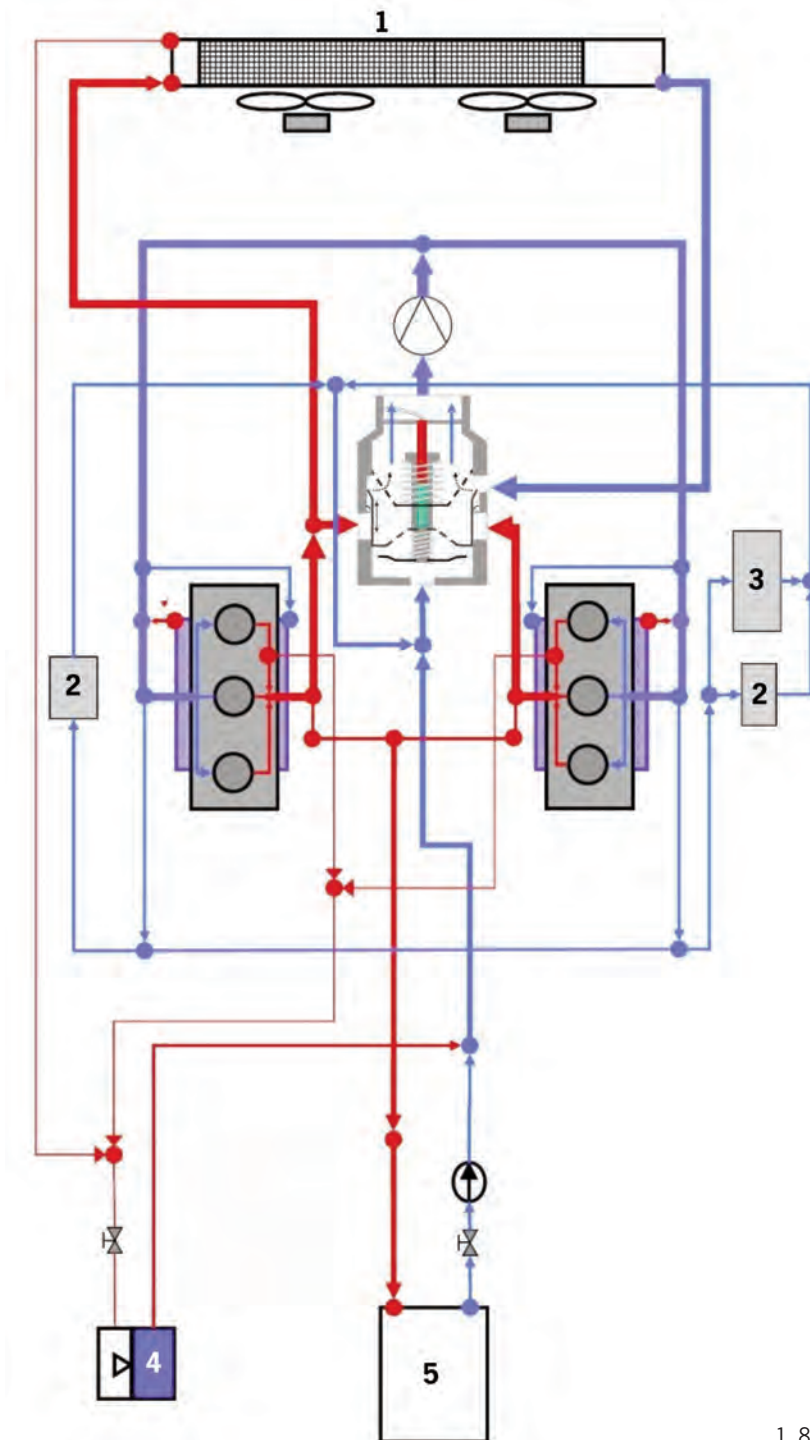
A torsional vibration damper is used to reduce torsional vibrations on the crankshaft and to minimize component stress, e.g. on the belt drive. Since higher gas-force excitations (vibrations) occur with a turbocharged direct injection petrol engine, a damper design with the best possible damping characteristics was chosen. The viscous damper consists of a flywheel floating in silicone oil inside the crankcase. This allows the counter-movement of the more inert mass in relation to a not quite uniformly rotating crankshaft. An optimized staking bore is also provided.



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Cooling

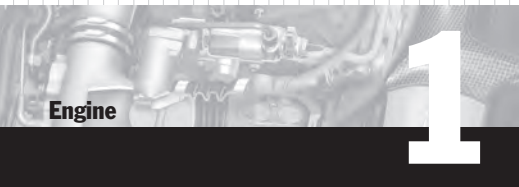
Cooling system of Macan S and Macan Turbo



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Cooling system **without** engine-independent heating

- | | |
|----------------------------------|------------------|
| 1 Coolant radiator | 2 Turbocharger |
| 3 Engine oil heat exchanger | 4 Expansion tank |
| 5 Heat exchanger for pass. comp. | |



Engine



Important Information Regarding the Macan S Diesel!

At the time of printing of this Macan SIT book, the delivery date, equipment and specifications that will be offered in the North American market has not yet been determined. All Macan Diesel data/equipment/specifications listed herein are subject to change without notice. You will be informed accordingly once this information has been determined.

1.2 Macan S Diesel

General Information

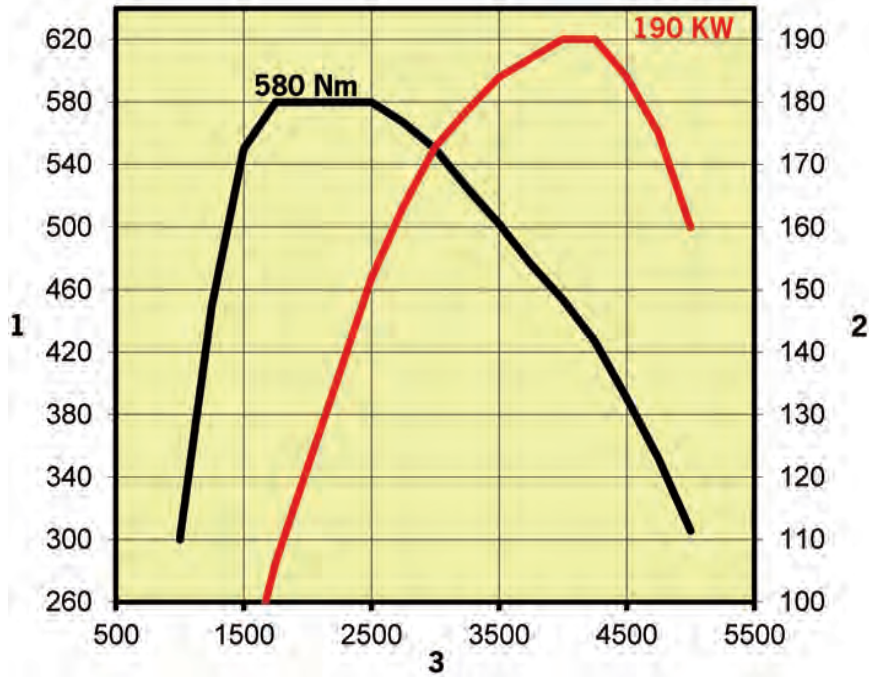
The 2nd generation 3.0-liter V6 turbo diesel engine familiar from the Panamera and Cayenne is used in the Macan S Diesel. By adaptations of technical details, it was possible to increase the engine power to 258 hp (Panamera: 250 hp) and the maximum torque to 428 ft. lbs. (580 Nm) (Panamera: 406 ft. lbs./550 Nm). At the same time, the fuel consumption was reduced and pollutant emissions optimized. A modern emission control system with selective catalytic reduction (SCR) is used for reduction of nitrogen oxides (NO_x) in the exhaust gases. The chemical synthetic product urea (AdBlue®) is used in this system.



The features of this second-generation 3.0 I V6 turbo diesel engine include the following:

- Engine block made from vermicular graphite cast iron, aluminum cylinder head, upper part of oil pan made from die-cast magnesium
- EURO 6, EURO 4 (country-specific)
- CO₂ emissions 150 g/km, EURO 6
- SCR emission control system, EURO 6
- Turbo diesel engine with variable turbine geometry (VTG)
- Common Rail CP 4.2 from Bosch
- Four valves per cylinder
- Central swirl flap
- Two-part chain drive
- Wet-sump lubrication with demand-controlled oil pump
- Thermal management

Full load curve of Macan S Diesel



Engine

1

- 1 Torque in Nm
- 2 Power in kW
- 3 Engine speed rpm

Technical engine specifications for Macan S Diesel

Engine type		CTB
Number of cylinders		6
Displacement	cm ³	2,967
Bore	mm	83
Stroke	mm	91.4
Compression ratio		16.8:1
Engine power at rpm	kW/HP rpm	190/258 4,000 – 4,250
Max. torque at engine speed	ft. lbs. (kW) rpm	428 (580) 1,750 – 2,500
Governed speed	rpm	5,200
Engine weight	kg	198



1_34_13



1 Cylinder block

- 90° V-cylinder crankcase
- Homogeneous monobloc made from vermicular graphite cast iron (GJV 450)
- Final machining of the cylinder liner takes place by special fixture honing with a subsequent UV photon exposure process

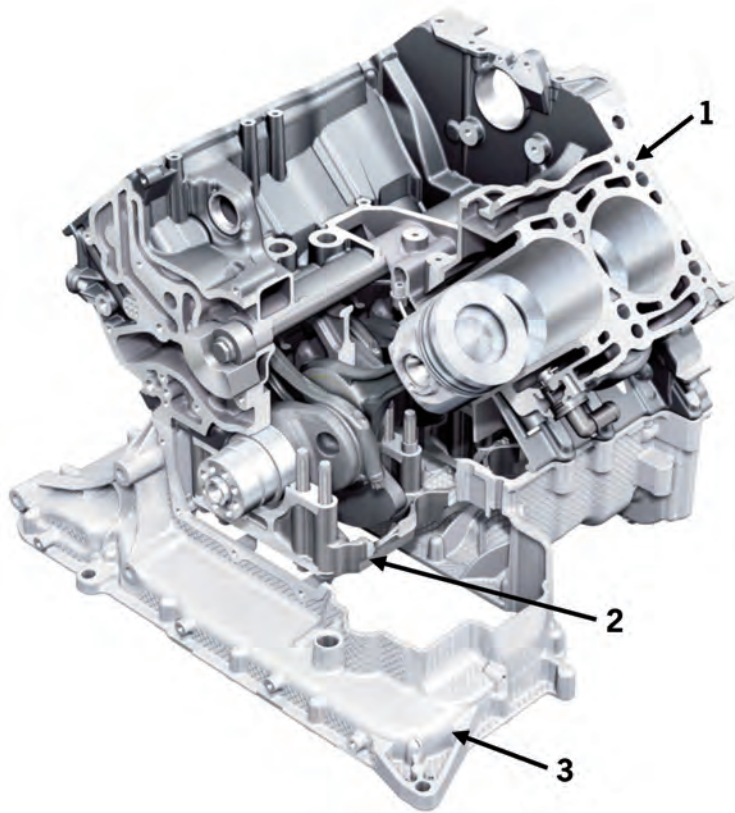
2 Ladder frame

- Robust ladder frame made from spheroidal graphite cast iron (GJS 600)
- Reinforcement of the crankcase
- Main bearing assembly

3 Upper part of oil pan

- Made from die-cast magnesium
- The separation between cylinder block and oil pan is located at the middle of the crankshaft
- A baffle plate made from plastic is used to settle the engine oil in the oil pan
- Oil level and oil temperature sensor in lower part of oil pan made from sheet steel (not shown)

Crankcase



1_35_13

On the power output side, the crankcase is sealed by a sealing flange made from magnesium (timing case cover). Cylinder 1 is positioned opposite the power output side on the right in driving direction. In the special fixture honing process, the cylinder head is simulated with a type of special fixture, which is screwed onto the cylinder block during machining of the liner surfaces. This virtually eliminates all static distortion that can later occur in the cylinder liners due to tightening of the cylinder-head screws. The perfectly round bore permits a significant reduction in the piston ring prestress. The last processing step for the cylinder bore is the UV photon exposure process. Here, a laser beam melts the surface of the cylinder liner, allowing nitrogen to penetrate the material. This smoothens and hardens the cylinder surface.

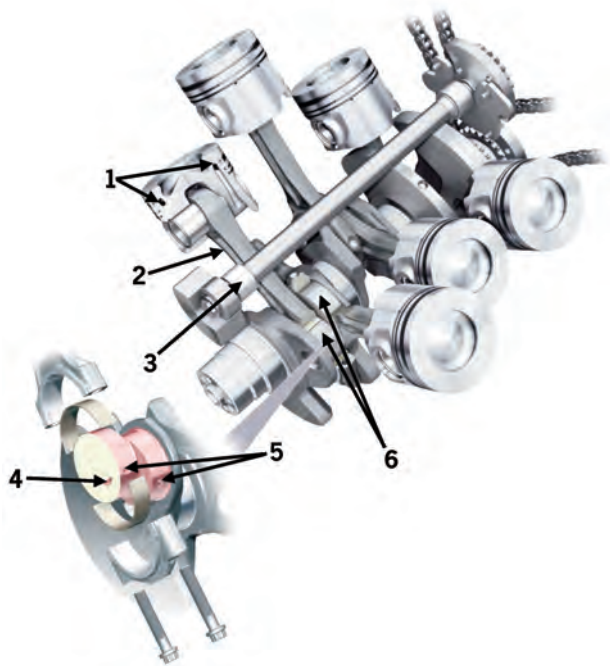
Crankcase ventilation

The oil separation of the engine ventilation system is located in the cylinder heads, with coarse and fine oil separators in the cylinder head covers. Both crankcase vents lead to the pressure-regulating valve, and from there to the intake side of the turbocharger. After the coarse oil separator has pre-cleaned the blow-by gases using a labyrinth, the swirl ports produce a fast rotational movement of the gases. As a result, the smallest oil droplets are thrown onto the swirl port walls by the centrifugal force, and from there flow back into the cylinder head.



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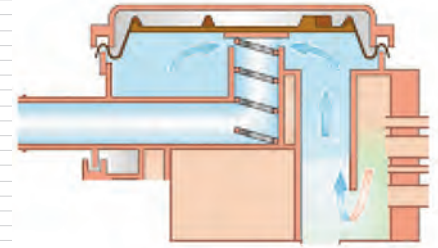
Crankshaft Drive



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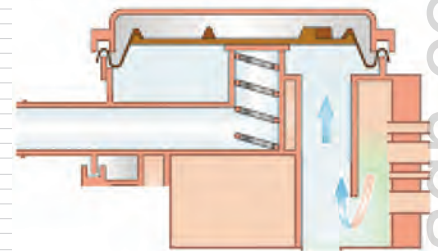
Engine

1



Valve open, no vacuum

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Valve closed, high vacuum

1_37b_13

- 1 Cooling oil ring channel
- 2 Trapezoidal connecting rod
- 3 Balance shaft
- 4 Transverse bore of the crankshaft for Item 5
- 5 Oil supply bore of the connecting-rod bearings
- 6 Split connecting-rod bearing pin



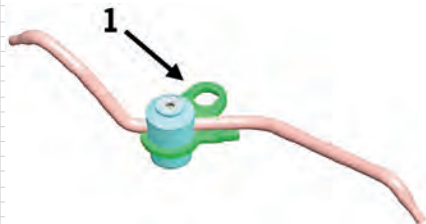
Important!

In a six-cylinder engine, the ignition interval is 120° . Due to the V-angle of 90° between the two cylinder banks, a 30° crankshaft throw is required for the three crankshaft journals. A crankshaft of this type is called a "split-pin crankshaft".

- 1 Recessed pistons
- 2 Trapezoidal connecting rod
- 3 Bearing shells
- 4 Connecting-rod bearing cap
- 5 Wide collar (same side)
- 6 Color marking (same cylinder)



1_40_13



New oil spray nozzles

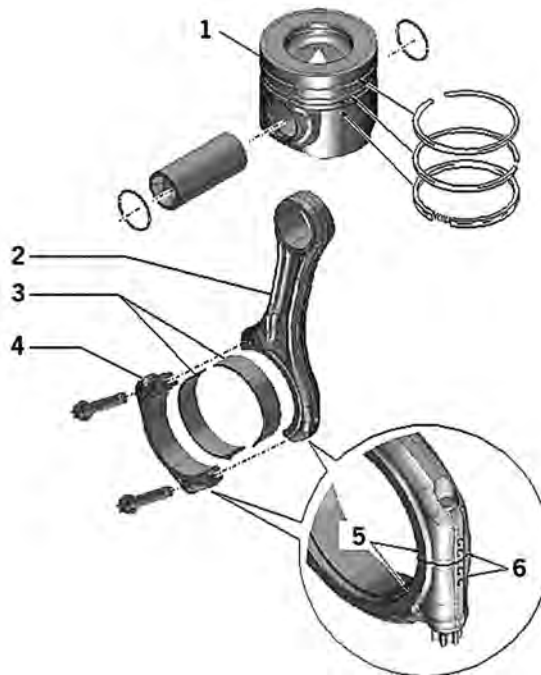
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1 Modified metal tab

Crankshaft

The forged crankshaft made from the material 42 CrMoS4 is realized in split-pin design for the 90° V-engine in order to achieve identical ignition intervals. The crankshaft stroke is 91.4 mm. The crankshaft is supported by four bearings, main bearing 3 is designed as a thrust bearing to compensate for the axial play. Both main and connecting-rod bearing pins are induction-hardened to ensure adequate strength, whereby the split-pin area presents a major challenge in the form of a shearing effect. It was possible to reduce the weight by omitting the middle balancing weights and introducing lifting pin lightening bores. Bearing shells of the correct thickness are allocated to the cylinder block and bearing covers at the factory. Colored dots on the bearing shell indicate the thickness of the bearing shell.

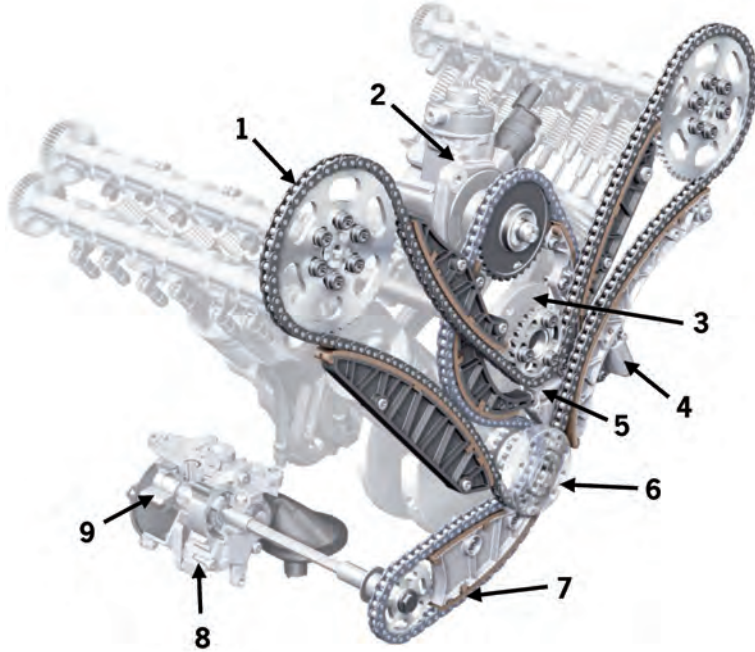
Pistons and connecting rods



1_39_13

The forged rods are split at an oblique angle and cracked. With the rods split in the breaking process (cracking), the connecting-rod bearing cap only fits in one position and only on the correct connecting rod. The aluminum pistons are designed for optimum cooling of the recess edge and ring packet with a salt core cooling gallery and oil spray cooling. The high thermal load is thus counteracted at ignition pressures of up to approximately 2682 psi (185 bar). A salt core cooling gallery is produced by a process where cooling galleries are formed during casting of the aluminum piston by casting in easily soluble salt cores. New oil spray nozzles are installed in the Macan S Diesel. They open only as from a pressure of approximately 43.5 psi (3 bar), i.e. only when the volume flow-controlled oil pump delivers the large oil quantity (as from approximately 2,500 rpm). The new oil spray nozzles have a modified metal tab in order to prevent incorrect installation.

Timing drive mechanism



1_42_13

The chain drive of the 3.0 I V6 turbo diesel engine consists of two chains: a timing chain for driving the camshafts and the balance shaft and a chain for the auxiliary drive. In the timing drive mechanism, a relatively long bush chain with 206 links is used to drive the two intake camshafts and the balance shaft. In order to counteract chain lengthening during the service life, the chain pins additionally have a wear-resistant coating. The auxiliary drive chain is also designed as a bush chain. It drives the fuel high-pressure injection pump positioned at the rear in the inner V as well as the combined oil and vacuum pump in a shared housing. Since the sprocket on the drive shaft of the fuel high-pressure pump can be moved axially, assembly and disassembly of the fuel high-pressure pump are still possible with the engine installed despite the installation position.

Engine

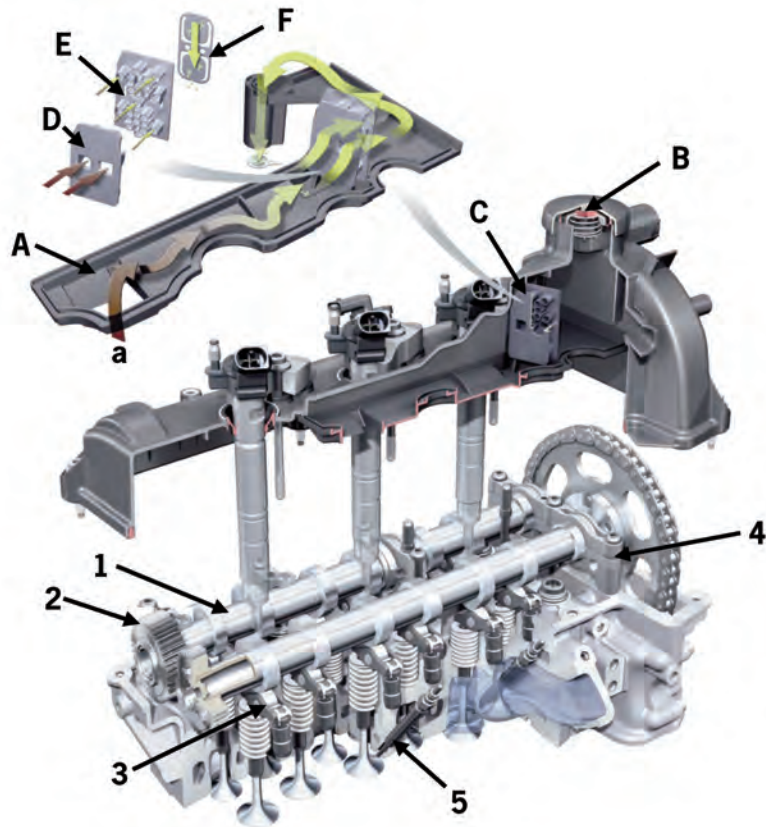
1

- 1 Timing chain for camshafts and balancershaft
- 2 Fuel high-pressure pump CP 4.2
- 3 Balance shaft
- 4 Chain tensioner for timing chain
- 5 Chain tensioner for auxiliary drive
- 6 Crankshaft
- 7 Timing chain for auxiliary drive
- 8 Two-stage, volume flow-controlled oil pump
- 9 Vacuum pump



- 1 Assembled hollow camshafts
- 2 Spur gears
- 3 Rocker arm with hydraulic valve clearance compensation
- 4 Camshaft mounting saddles (consisting of bearing block and bearing cover)
- 5 Glow element
- A Oil separator module
- B Pressure-regulating valve
- C Fine oil separator, consisting of
- D Closure cap with swirl port
- E Swirls
- F Closing spring
- a Entry of blow-by gases

Cylinder head



1_43_13

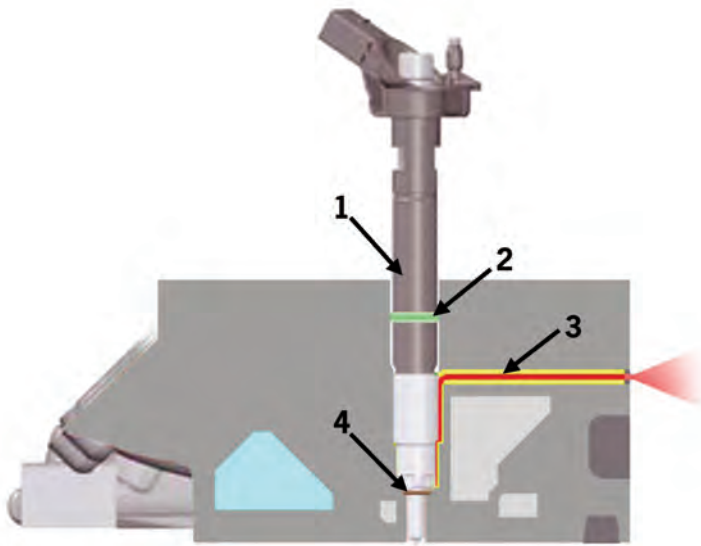
The two camshafts are supported by way of four camshaft bearing blocks in the cylinder heads made of aluminum. These bearing blocks are screwed onto the flat upper side together with four bearing covers. The four-valve combustion process is characterized by a swirl port and charge duct on the intake side in each case, as well as two exhaust ports that are already joined into a Y-pipe in the cylinder head.

Camshafts

Four assembled hollow camshafts with a bearing diameter of only 24 mm contribute to the lightweight construction concept and to the reduced internal friction of the engine. Only the intake camshafts are driven by the timing chain in each case; these drive the exhaust camshafts via spur gears. The tooth backlash compensation installed in the Cayenne Diesel and Panamera Diesel has been omitted on the Macan Diesel.

Vent duct in the cylinder head

In the event of leaks in the area around the injector sealing ring (4), the pressurized gas can escape out from the combustion chamber via a duct. The vent duct is located in the cylinder head above the exhaust manifold.

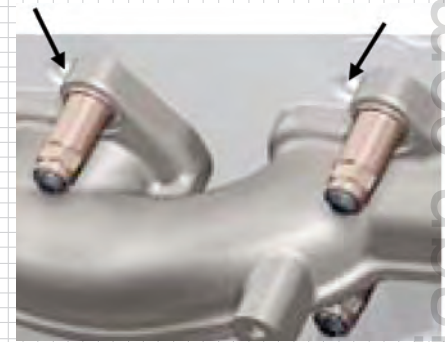


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The vent duct prevents the overpressure in the combustion chamber from reaching the compressor side of the turbocharger through the crankcase ventilation system and possibly causing malfunctions. Engine oil escaping at one or more vent ducts indicates a faulty O-ring on the injector, which seals the injector bore against engine oil.



- 1 Injector
- 2 O-ring
- 3 Vent duct
- 4 Copper sealing ring



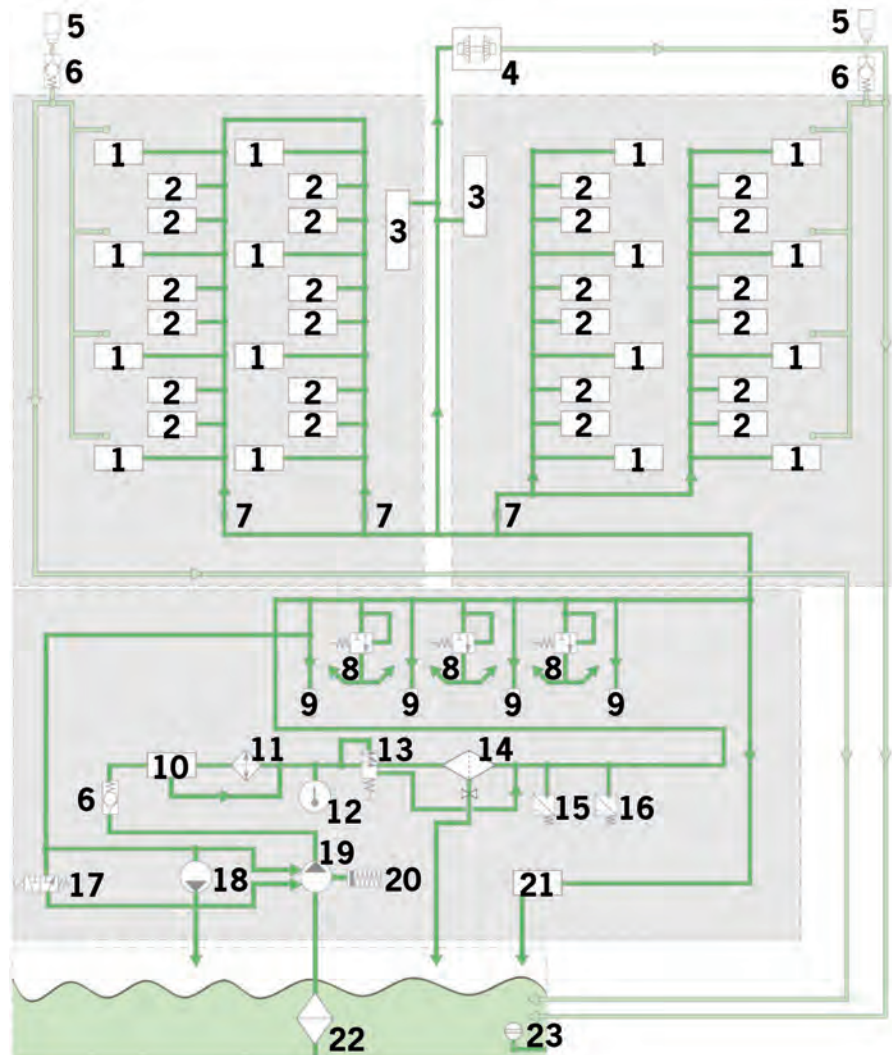
Vent duct

1_45_13

- 1 Camshaft bearing
- 2 Compensating element
- 3 Chain tensioner
- 4 Turbocharger
- 5 Oil mist separator
- 6 Check valve
- 7 Throttling point
- 8 Spray nozzles
- 9 Main bearing
- 10 Thermostat
- 11 Heat exchanger
- 12 Oil temperature sensor
- 13 Filter bypass valve
- 14 Oil filter
- 15 Oil pressure switch for reduced oil pressure
- 16 Oil pressure switch
- 17 Solenoid valve
- 18 Vacuum pump
- 19 Oil pump
- 20 Overload protection valve
- 21 Bearing pin, oil pump drive wheel
- 22 Suction screen
- 23 Oil level sensor

Lubrication

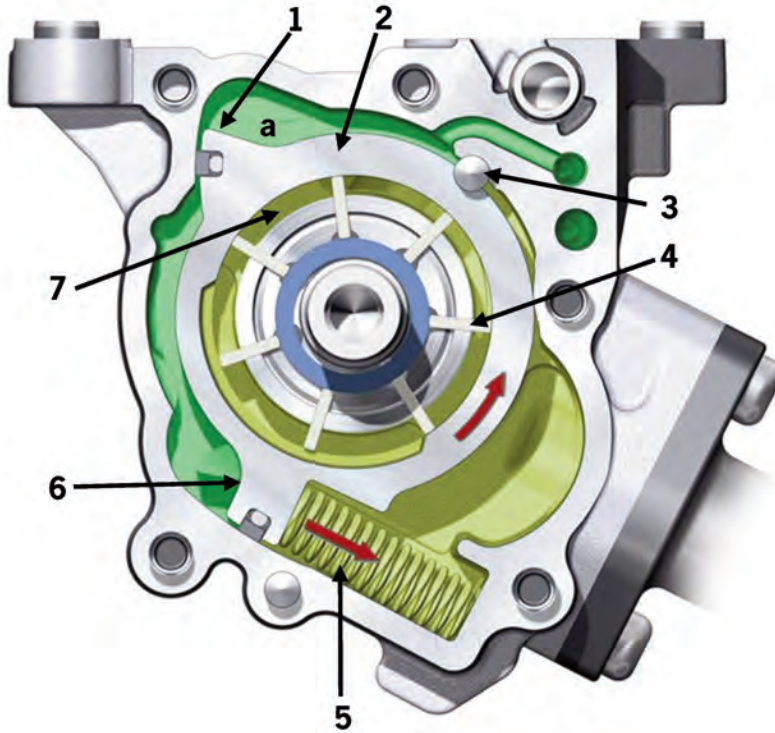
Oil circuit



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Oil pump

A vane pump is used as the oil pump. The delivery characteristic of this pump can be changed by way of a rotatably mounted adjusting ring. This permits realization of volume flow control, which contributes to reducing the required drive power depending on the engine load and speed.



- 1 Control surface 1
- 2 Adjusting ring
- 3 Support
- 4 Vane cells
- 5 Control spring
- 6 Control surface 2
- 7 Delivery space
- a Acting oil pressure

Low delivery rate

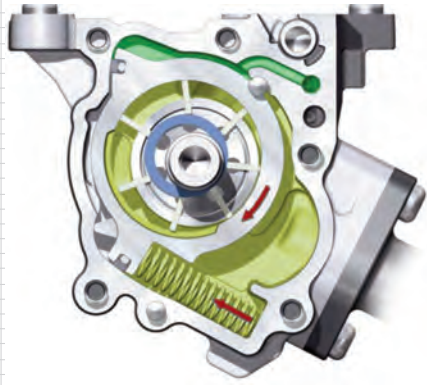
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Oil pressure can be applied to the adjusting ring (2) via the two control surfaces (1) and (6) and the ring thus pivoted against the force of the control spring (5).

Low delivery rate

In the low rpm range, the energized (terminal 15) solenoid valve for oil pressure control is actuated with a ground signal by the engine control module and opens the oil duct to the second control surface (6) of the adjusting ring. Both oil flows then act with the same pressure on both control surfaces. The resultant forces are greater than the force of the control spring. The adjusting ring is rotated in counter-clockwise direction and reduces the delivery space (7) between the vane cells. The lower pressure level is switched depending on the engine load, engine speed, oil temperature and other operating parameters, thereby reducing the drive power of the oil pump.

1



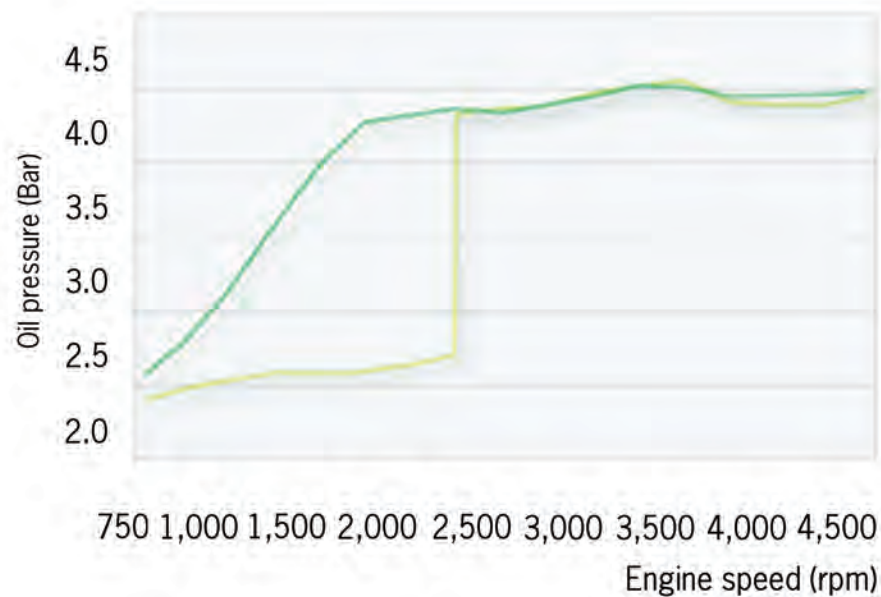
High delivery rate

1_48_13

- Solenoid valve de-energized
- Solenoid valve switched

High delivery rate

Using a map dependent on the speed and torque, the DME disconnects the solenoid valve for oil pressure control from the ground connection so that the oil duct to control surface 2 is closed. The oil pressure present then acts only on control surface 1 and opposes the force of the control spring with a lower force. The control spring then pivots the adjusting ring around the support in a clockwise direction. The adjusting ring now rotates out of the center position and increases the delivery space between the individual vane cells. A greater quantity of oil is delivered due to the larger spaces between the vane cells. The higher oil flow quantity is opposed by resistance from the oil bores and the bearing clearance of the crankshaft, which allows the oil pressure to increase. A volume flow-controlled oil pump with two pressure stages is therefore realized.

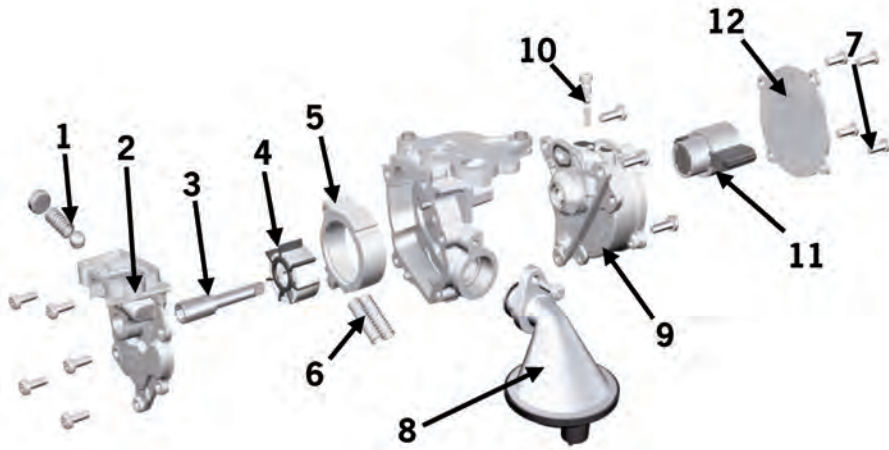


Oil pressure characteristic for an oil temperature of 212° F (100° C).

1_49_13

Vacuum pump

Flanged directly onto the oil pump, the vacuum pump is also located in the oil pan. In the vacuum pump, the vacuum is delivered by a rotor with moving vane.



1_50_13

The installation position of the vacuum pump in the oil pan offers several advantages:

- Friction-optimized drive
- Lower center of gravity
- Improved pedestrian protection thanks to additional space between the vehicle engine and hood

The vacuum is routed via the cast-in ducts in the upper part of the oil pan to the vacuum line screwed on externally. The connected components, in particular the vacuum brake booster, are therefore supplied with the required vacuum.



- 1 Ball valve
- 2 Oil pump cover
- 3 Drive shaft
- 4 Vane cells
- 5 Adjusting ring
- 6 Control springs
- 7 Oil pump housing
- 8 Suction pipe
- 9 Vacuum pump housing
- 10 Ball valve
- 11 Rotor with vane of the vacuum pump
- 12 Vacuum pump cover



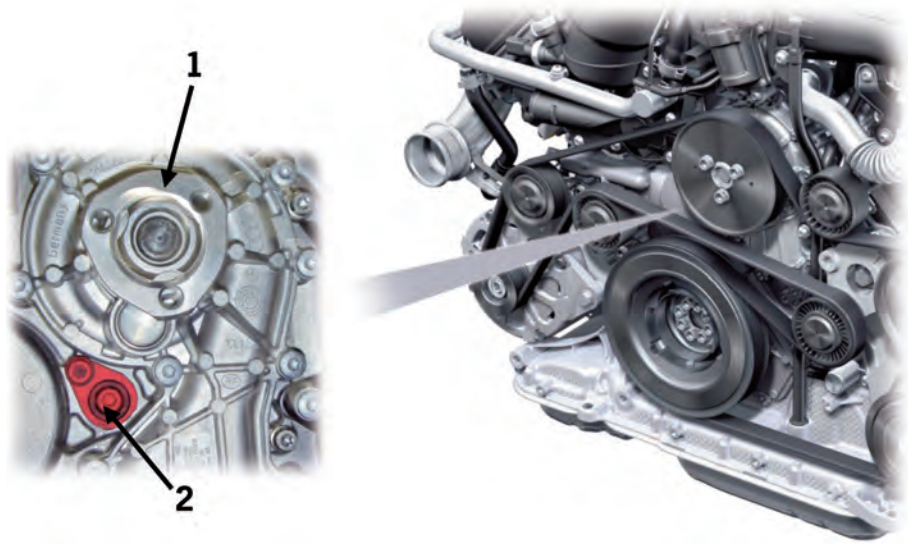
Vacuum pump

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- 1 Mounting for the drive wheel of the coolant pump
- 2 Thermostat

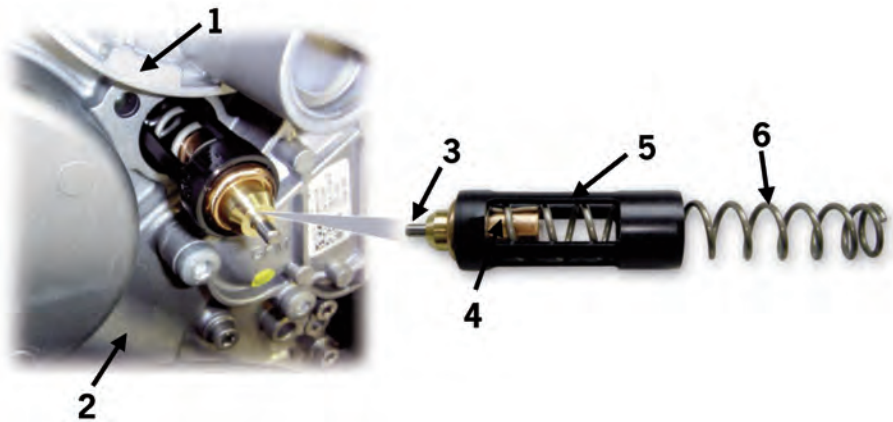
Engine oil cooler with thermostat-controlled bypass duct

The engine oil cooler also includes an oil-side oil cooler bypass in order to support thermal management (also see Chapter 2 DME). Coolant permanently flows through the engine oil cooler. A bypass duct is opened at oil temperatures $< 217^{\circ}\text{F}$ (103°C) by means of a wax expansion element. The main volume flow of the oil is routed past the engine oil cooler. Installation position: The thermostat is located in the cylinder block below the coolant pump.



1_52_13

- 1 Coolant pump housing
- 2 Cylinder block
- 3 Lifting pin
- 4 Expansion-element thermostat
- 5 Guide sleeve
- 6 Compression spring

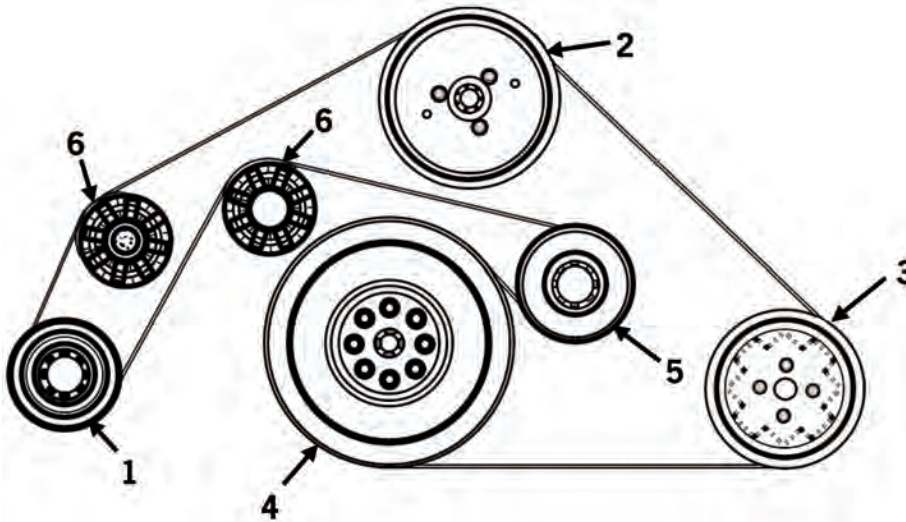


Design

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Belt drive

Unlike in the Panamera and Cayenne, the steering of the Porsche Macan S Diesel is equipped with electromechanical power assistance. The belt drive was modified for this reason, since it was possible to omit the drive for the servo pump. The belt drive connects the crankshaft, three-phase generator, coolant pump, and air-conditioning compressor. A mechanical, spring-loaded tensioner is used as the tensioning device. Both sides of the poly-V-belt are used by the deflection rollers and the tensioning roller.



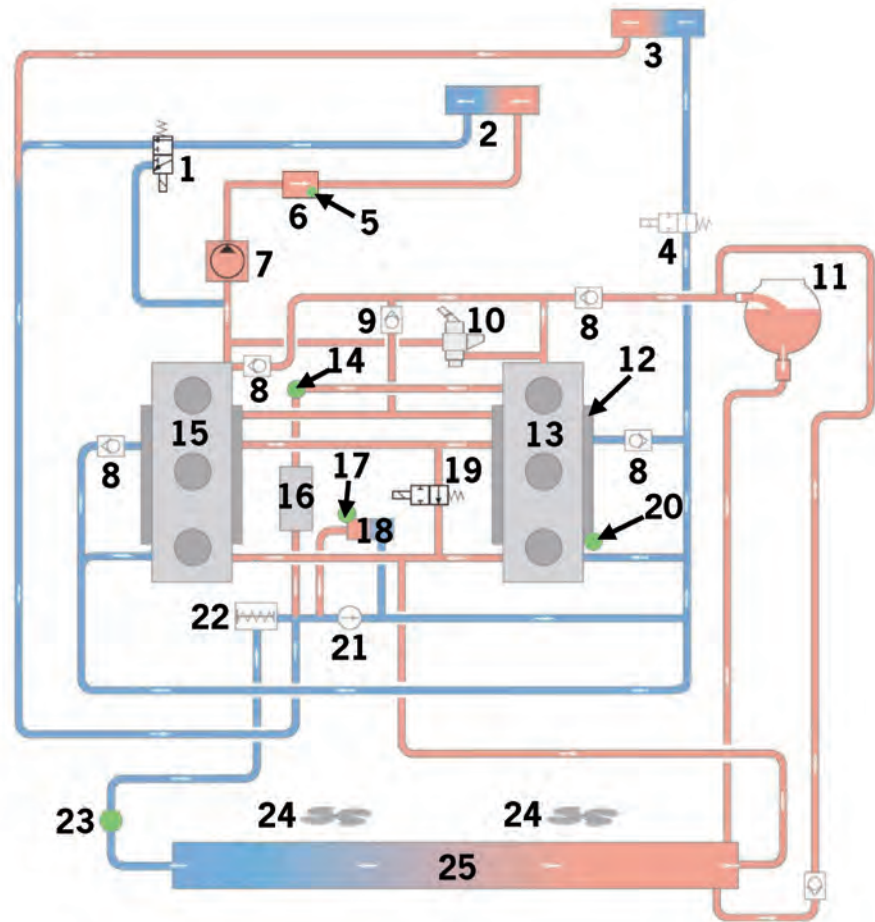
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- 1 Generator
- 2 Coolant pump
- 3 Air-conditioning compressor
- 4 Vibration damper
- 5 Tensioner
- 6 Deflection roller

Cooling

Cooling system

- 1 Switch-over valve for engine-independent heating mode (optional)
- 2 Heater heat exchanger
- 3 ATF heat exchanger
- 4 Shut-off valve for ATF heat exchanger
- 5 Temperature sensor for engine-independent heater/auxiliary heater
- 6 Engine-independent heater (optional)/auxiliary heater
- 7 Electric coolant pump for heater heat exchanger
- 8 Check valve
- 9 Check/vent valve
- 10 Injector for reducing agent
- 11 Coolant expansion tank
- 12 Engine block
- 13 Cylinder head, bank 2
- 14 DME coolant temperature sensor
- 15 Cylinder head, bank 1
- 16 EGR cooler
- 17 Engine oil temperature sensor
- 18 Oil cooler
- 19 Coolant shut-off valve
- 20 Coolant temperature sensor for thermal management
- 21 Mechanical coolant pump
- 22 Map-controlled thermostat
- 23 Radiator outlet coolant temperature sensor
- 24 Radiator fan
- 25 Coolant radiator

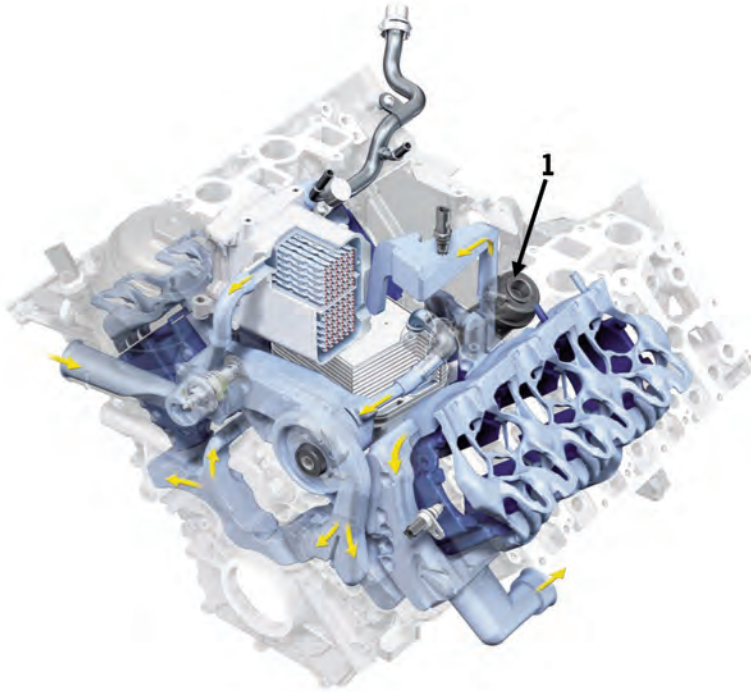


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Since the Porsche Macan S Diesel is equipped with an emission control system with selective catalytic reduction (SCR) in order to achieve compliance with the requirements of the EURO 6 emission standard, the cooling system of the vehicle also incorporates the injector for reducing agent in order to ensure efficient cooling of the metering valve. The rest of the cooling system essentially corresponds to that of the Panamera Diesel and Cayenne Diesel.

Thermal management (component description)

In order to reduce fuel consumption and emissions, the Macan S Diesel features an extensive thermal management system with a so-called split-cooling concept. The goal of this concept is to keep the warm-up phase of the engine as short as possible and at the same time to lower the temperature of the cylinder heads and increase the temperature of the engine block.

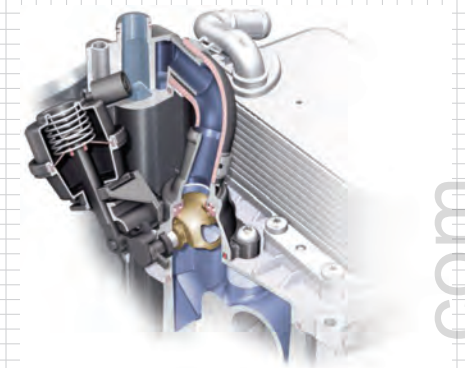


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Separation of cylinder head cooling and cylinder block cooling is realized by way of an electropneumatically operated coolant shut-off valve (1). This is located in the inner V of the 3.0-liter V6 turbo diesel engine.

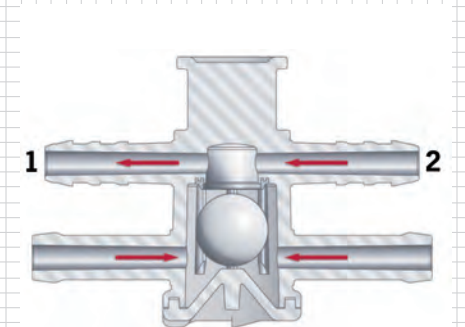
Check/vent valve

The water jackets of the cylinder banks are connected with a manifold in the cylinder heads via the cylinder head gaskets. This ensures that air bubbles can leave the cylinder block circuit at the highest point in the system – even with standing coolant. The vent lines lead from the manifolds to the vent valve, which connects the permanent venting system of the cylinder head circuit and the venting system of the cylinder block circuit with each other. The vent valve seals the two part circuits from each other by way of a floating ball. If the cylinder block circuit is vented, it is therefore also not possible for heat energy to be dissipated from the cooling system via the permanent vent. The valve simultaneously has the function of a check valve. The operating principle and control strategies of thermal management are described in more detail in Chapter 2 DME.



Coolant shut-off valve

1_56a_13



From cylinder head, bank 1

1_57_13

- 1 To coolant expansion tank
- 2 From engine block (inner V)



2 DME Engine electronics

General Information

Different DME systems are used for the different Macan models on an engine-specific basis. An overview of the engine-specific features of the different DME engine electronics systems is provided in the sections on the Macan S and Macan Turbo as well as Macan S Diesel.

2.1 Macan S and Macan Turbo

3.0 I and 3.6 I V6 biturbo engines

The 3.0 I V6 biturbo engine is installed in the Macan S, while the Macan Turbo has a 3.6 I V6 biturbo engine. The 3.0 I V6 biturbo engine already installed in the current Panamera S serves as a basis for both engines. Low fuel consumption was achieved for both engines thanks to efficiency enhancements and the use of the latest engine technology.



V6 biturbo engine

2_83_13

Development objectives for the 3.0 I and 3.6 V6 biturbo engines

- High performance
- High efficiency
- High engine power
- High torque over a wide rpm range
- Low fuel consumption
- Low emissions

Enhancements

- Improved Auto Start Stop function
- Coasting function
- High boost pressure

Macan

DME engine electronics

2



Macan S

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Macan Turbo

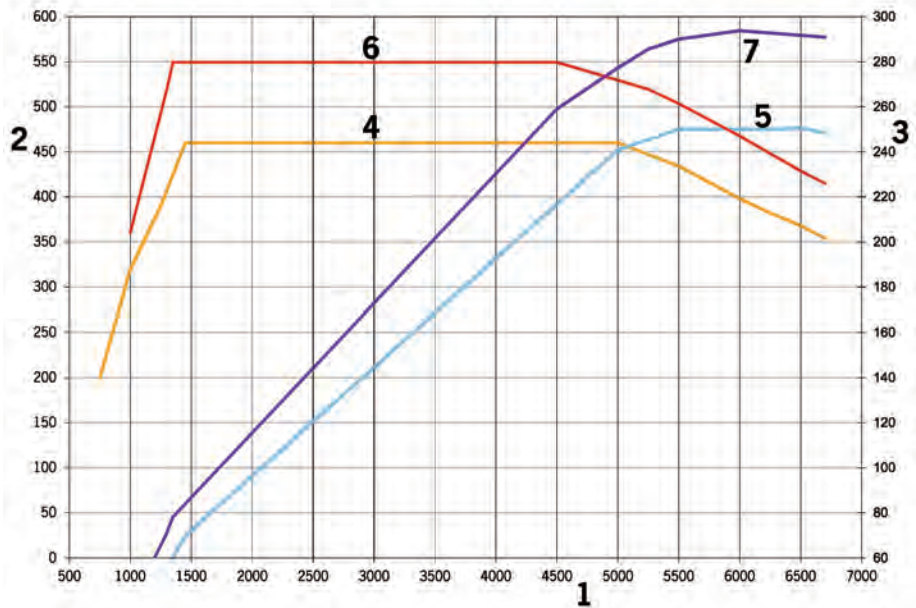
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2	DME Engine electronics	37
2.1	Macan S and Macan Turbo	37
2.2	Fuel system	41
2.3	Intake system	45
2.4	Mixture formation	55
2.5	Ignition system	60
2.6	Exhaust/emission control	62
2.7	Additional DME functions	65
2.8	Macan S Diesel	70
2.9	Fuel system	75
2.10	Intake system	80
2.11	Exhaust/emission control	84
2.12	Glow system	94
2.13	Cooling system	95
2.14	Active sound	100

Engine specifications of the V6 biturbo engines

	Macan S	Macan Turbo
Displacement	2,997 ccm	3,604 ccm
Engine power	340 hp/250 kW 5,500 – 6,500 rpm	400 hp/294 kW 6,000 rpm
Torque	340 ft. lbs./460 Nm 1,450 – 5,000 rpm	406 ft. lbs./550 Nm 1,350 – 4,500 rpm
Compression ratio	9.8:1	10.5:1
DME control unit	Continental EMS SDI 10	EMS SDI 10
Idle speed	635 rpm	635 rpm
Max. engine speed	6,700 rpm	6,700 rpm
Intake camshaft adjustment	25° camshaft angle/ 50° crank angle	25° camshaft angle/ 50° crank angle
Exhaust camshaft adjustment	27.5° camshaft angle/ 55° crank angle	27.5° camshaft angle/ 55° crank angle
Fuel low-pressure (approximately)	43.5-80 psi/3-5.5 bar	43.5-80 psi/3-5.5 bar
Fuel high-pressure (approximately)	1740-2900 PSI/ 120-200 bar	1740-2900 PSI/ 120-200 bar
Radiator fan (dual fan)	2 x 400 W	2 x 400 W

- 1 Engine speed (rpm)
- 2 Engine torque (Nm)
- 3 Engine power (kW)
- 4 Torque Macan S
- 5 Power Macan S
- 6 Torque Macan Turbo
- 7 Power Macan Turbo



Engine power/torque Macan S/Macan Turbo

2_84_13

Principles of engine electronics systems (DME)

Like in the Panamera S V6 biturbo engine, the DME control unit EMS SDI 10 from Continental is used for the Macan V6 biturbo engines. The DME control unit (top picture) is located in the E-box in the plenum panel on the left; it projects into the passenger compartment on the left under the dashboard. The relay and fuse carrier (center picture) with most relays and fuses for the DME area is located under the DME control unit.

The basic functions of the DME control unit correspond to those of the EMS SDI 7.1. In addition to the improved processing power of the EMS SDI 10 DME control unit, the main new features of the DME control unit include monitoring of four adjustable camshafts and the application of the two turbochargers.

DME control unit EMS SDI 10

The DME control unit EMS SDI 10 controls the following functions and communicates with the corresponding components:

- Direct fuel injection (DFI)
- Returnless fuel system
- Fuel low-pressure control
- Fuel high-pressure control
- Electronic accelerator
- Electronic throttle with idle speed control
- VarioCam (at intake and exhaust camshafts)
- VarioCam Plus (at one intake valve per cylinder)
- Demand-controlled oil pump
- Expansion intake manifold
- Stereo lambda control circuits
- Static high-voltage ignition distribution with individual ignition coils
- Cylinder-specific knock control (with 2 knock sensors)
- Differential Hall-effect sensor (detects engine speed, reference mark and direction of rotation of the engine)
- Digital pressure sensor on the intake manifold (detects intake manifold pressure and intake air temperature)
- Digital pressure sensor ahead of electronic throttle (for boost pressure control)
- Thermal management (controls map thermostat, switching valve on PDK and radiator shutter)
- Auto Start Stop function
- Coasting
- Variable deceleration fuel cutoff
- Vehicle electrical system recuperation
- On-board diagnosis for monitoring the emission control system

DME engine electronics

2



DME control unit in E-box

2_85_13



Relay and fuse carrier in E-box

2_86_13



DME control unit EMS SDI 10

2_87_13



Use only released tools for installation of the multi-pole encoder wheel. Observe instructions in the PIWIS information system.

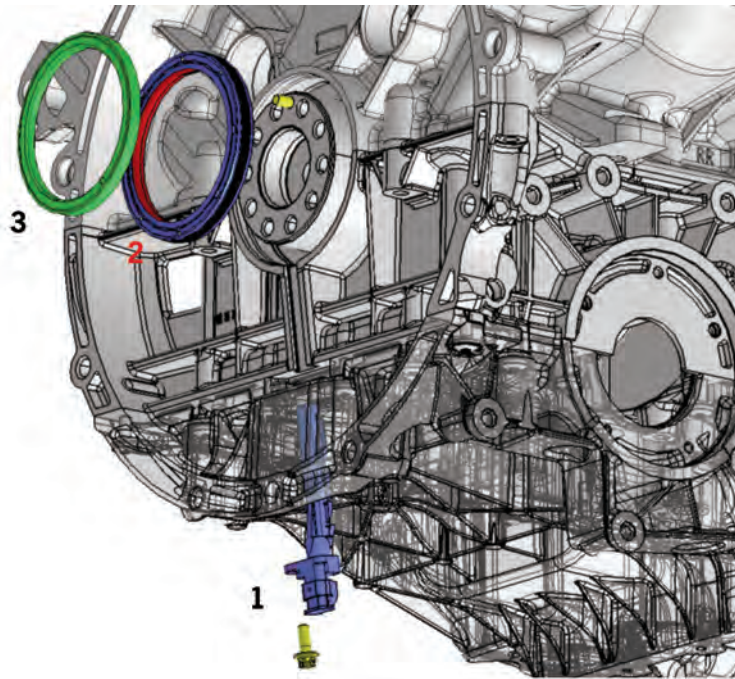
- 1 Speed sensor
- 2 Radial shaft seal
- 3 Multi-pole encoder wheel

**Note!**

The multi-pole encoder wheel must not come into contact with a magnetic field; if necessary, perform check in accordance with instructions in the PIWIS information system.

Crankshaft position sensor

The crankshaft position is detected by a newly developed position sensor. This operates according to the differential Hall-effect sensor principle. The direction of rotation of the crankshaft can be additionally detected with the differential Hall-effect sensor. This is routed through a T-groove in the bottom part of the crankcase and is screwed onto the oil guide housing. Detection of the direction of rotation is an important feature for vehicles with Auto Start Stop function and allows detection of the exact crankshaft position for an accelerated restart. The most important new feature is the multi-pole encoder wheel with 60 – 2 teeth which is pressed onto the crankshaft in the correct position. This is used by the position sensor for detection of the two main variables “Engine speed” and “Crankshaft position”. The segment gap is used by the DME control unit as a reference mark for detection of the crankshaft position. The DME control unit needs the engine speed and crankshaft position in order to calculate the injection timing and the injection quantity.



2_88_13

In addition to an installation position that reduces the required installation space, detection of the crankshaft position at the transmission-side crankshaft journal has the advantage that the sensing accuracy can be further improved by a small number of components in the tolerance chain compared with sensing at the outer edge of the flywheel.

2.2 Fuel system

Fuel quality

The engine is designed for unleaded fuel 93 octane ($R_{\frac{1}{2}}^M$). Adaptation is performed by the knock control if fuels with a fuel quality of at least 90 octane are used.

Fuel tank

The Macan models are equipped with a single-chamber fuel tank made of plastic with one fuel removal point and a fuel-level sensor. The filling capacity is 19.8 Gal. (75 liters) for the Macan Turbo and 17.2 Gal. (65 liters) for the Macan S, of which 2.4 Gal. (9 liters) are reserve. The 19.8 Gal. (75 liters) fuel tank can be optionally ordered for the Macan S.



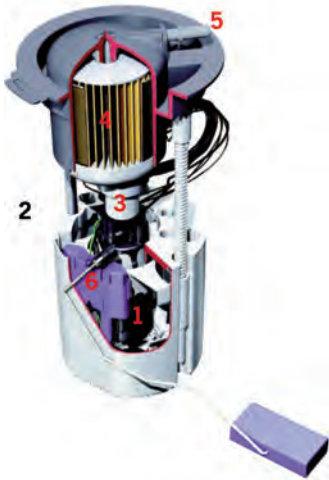
The safety instructions and specifications in the PIWIS information system Group 2 must be observed when working on the fuel system.

- 1 Fuel tank
- 2 Anti-slosh element
- 3 Rollover valve with pressure control valve
- 4 Rollover valve with pressure control valve
- 5 Tank filler neck
- 6 Delivery-sensor unit with integrated fuel filter
- 7 Degassing tank with labyrinth
- 8 Fuel supply line

Fuel tank for gasoline engines

2_89_13

An anti-slosh element is fitted inside the tank bladder on all variants to suppress fuel sloshing movements. This is already fitted during the manufacturing process and is welded to the upper and lower tank shells. In addition to reducing sloshing, this element also stiffens the tank bladder.



Delivery unit

2_90_13



The fuel pump must never be supplied directly with electrical power. This will damage the fuel pump.

Fuel vapors are produced by gasoline which are routed into the active carbon filter by two valves. Rollover valves with ball pressure-holding function are used. These seal off the tank if the vehicle rolls over so that no fuel can escape. Both valves vent into an expansion tank on the top of the tank. A labyrinth prevents liquid fuel from entering the active carbon filter. This tank is drained in the direction of the fuel tank by way of a vacuum produced as a result of the fuel cooling down.

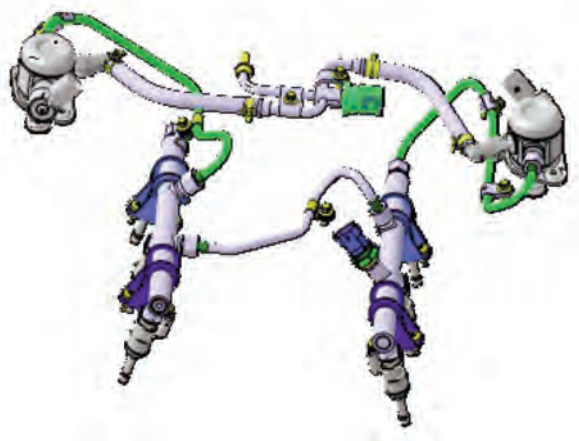
- Low-pressure side with Returnless Fuel System
- A demand-controlled electric fuel pump
- Fuel filter (lifetime filter in the tank)
- Fuel-pressure regulator (rel. fuel pressure approximately 79.75 psi (5.5 bar))
- Tank ventilation via carbon canister
- Tank leakage diagnostic system (NVLD) for vehicles intended for the USA

Electric fuel pump

The demand-controlled three-phase AC fuel pump (1) is located in the bottom area of the delivery unit (2). The delivery unit also contains the fuel pressure regulator (3), the fuel filter (4, lifetime filter), the fuel low-pressure connection (5) and the fuel-level sensor (6). The electric fuel pump must be operated only via the upstream control unit, which is located above the fuel tank on the left next to the flange of the delivery unit.

Low-pressure side

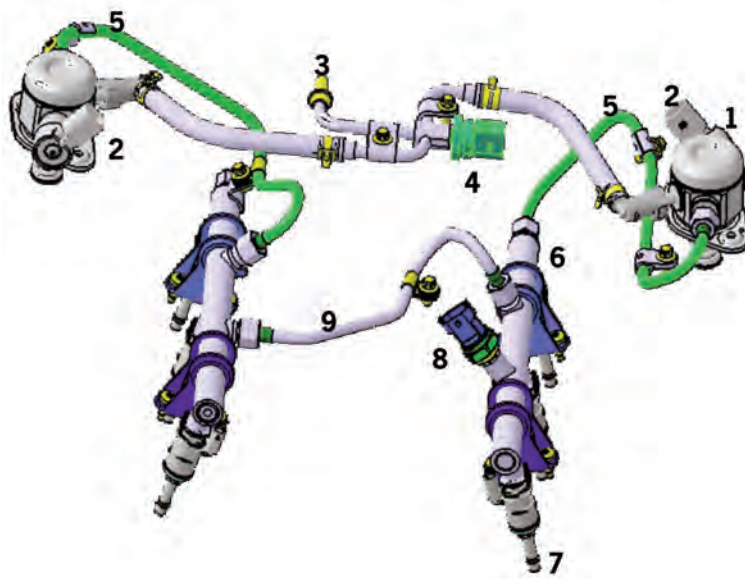
The low-pressure fuel system of the Macan V6 biturbo engines corresponds to that of the Panamera MY 2014 V6 biturbo. An important feature is the three-phase AC fuel pump. This is operated with alternating current by a control unit. The fuel low pressure is regulated by the control unit based on a map (engine speed control). The pressure is monitored by a fuel low-pressure sensor, which is mounted on the distribution pipe to the two high-pressure pumps.



2_91_13

High-pressure side

The fuel high-pressure system of the Macan V6 biturbo engines operated with pressures of approximately 1740 psi (120 bar) at idle speed up to 2900 psi (200 bar) at full throttle. The fuel high pressure is generated by two demand-controlled fuel high-pressure pumps driven by the intake camshaft. The quantity control valves of the fuel high-pressure pumps regulate the fuel pressure based on demand in accordance with a map in order to achieve optimum combustion and low fuel consumption combined with high power and high torque.



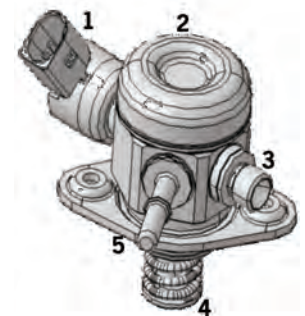
2_92_13

Fuel high-pressure pumps

The V6 biturbo engine has two fuel high-pressure pumps which are installed on the valve cover of the cylinder heads. These one-piston axial pumps are actuated by a triple cam of the intake camshafts of bank 1 and bank 2. The fuel high pressure is regulated to the required value by the PWM signal of the quantity control valves, which are installed on the fuel high-pressure pumps. If there is no PWM signal present at the quantity control valve, the valve is de-energized and fully opened. The fuel pressure is then reduced to the minimum value. The fuel under high pressure is fed into the two rails of the cylinder banks. A connecting line between the two fuel rails allows compensation even of very small pressure differences. Measurement of the fuel high pressure by the fuel high-pressure sensor can take place on only one of the two rails since the same pressure is present in both rails.

General information on diagnosis:

A routine in the PIWIS Tester allows testing of the fuel-high pressure pumps by pump selective activation and measurement of the generated fuel high-pressure at the fuel high-pressure sensor. In the event of a fault, the faulty fuel high-pressure pump can be detected with the high-pressure sensor on the rail.



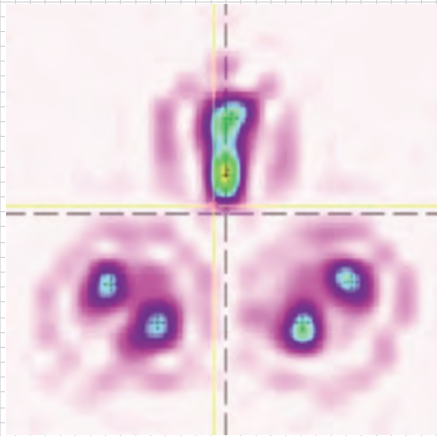
2_93_13

- 1 Quantity control valve
- 2 High-pressure pump
- 3 Fuel high-pressure connection
- 4 Coupling rod with spring
- 5 Fuel low-pressure connection



6-hole injector

2_94_13



Spray pattern of 6-hole injector

2_97_13

Injection strategies when the engine is at operating temperature:

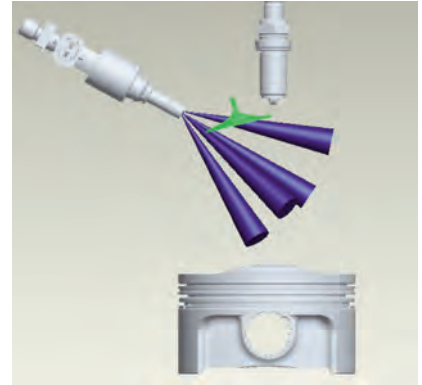
- Idle speed (warm)
Single injection
- Acceleration and high load (1,750 rpm < engine speed < 2,050 rpm)
Double injection
- Acceleration and high load (engine speed < 1,750 rpm)
Triple injection
- Engine speed > 2,050 rpm
Single injection

DFI – Direct Fuel Injection

DFI improves internal cooling of the combustion chamber by mixture formation directly in the cylinder. The higher compression ratio made possible as a result of this develops more power, while at the same time improving the efficiency of the engines. Fuel injection is controlled by the engine control unit.

Injectors

New 6-hole injectors (see left Fig. 2_94_13) are used in the V6 biturbo engine. In addition to improved fine fuel distribution in the combustion chamber, multi-hole injectors allow better swirling of the fuel and thus ensure an optimized combustion process for lower emissions combined with increased efficiency and power. Fuel injection was optimized with respect to torque, power, fuel consumption and emissions. It was possible to significantly reduce soot emissions in combination with the newly developed combustion process.



2_95_13

It was possible to significantly improve the running smoothness of the engine through the combination of a higher fuel injection pressure (up to 2900 psi/200 bar) and the 6-hole injector. The figures above and at the side show the spray patterns of the multi-hole injectors. With direct fuel injection, the engine control unit regulates the injection timing for each cylinder individually as well as the injected fuel quantity for each cylinder bank. This optimizes the combustion process and fuel consumption. Depending on operating condition, multiple fuel injection also takes place in order to heat up the catalytic converter to operating temperature more quickly after a cold start and to achieve a higher torque at low engine speeds.



2_96_13

Injection strategies

Depending on the required torque and current engine speed, the engine control unit determines the best injection strategy for efficient fuel consumption and high engine power. Between one and three fuel injections can be performed depending on operating condition.

2.3 Intake system

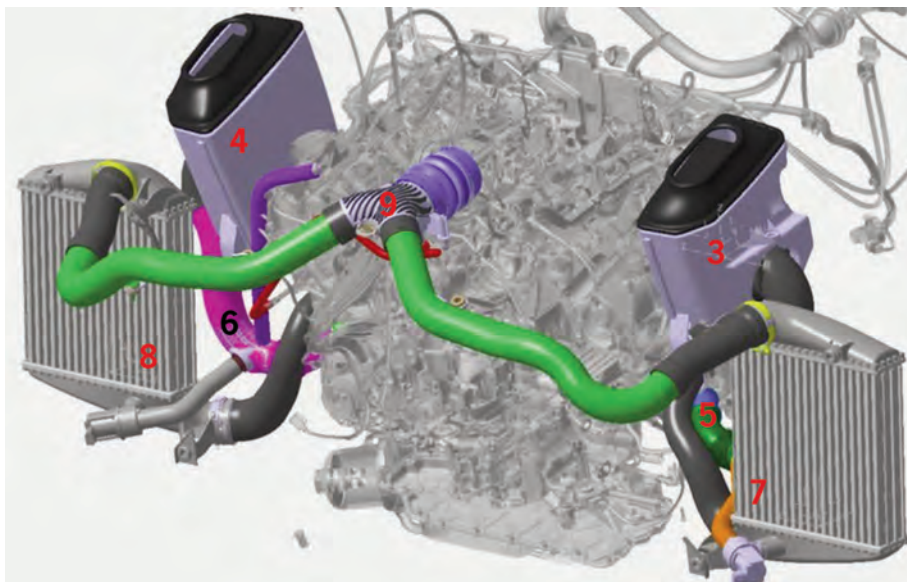
The illustration shows the twin-branch intake air routing of the V6 biturbo engines from the radiator grille, under the hood to the air cleaners on the left and right.



Intake opening through the hood

2_98_13

The bottom illustrations show the air routing in the engine compartment. The intake air (1) is routed from below into the hood through the grille (2). From the hood, the air is routed through the air cleaners on the left (3) and right (4) to the intake side of the turbochargers on the left (5) and right (6). After the turbochargers, the compressed air is cooled down in the charge air coolers on the left (7) and right (8) and then merged again ahead of the electronic throttle (9).



Air routing at charge air coolers

2_100_13

DME engine electronics



The maintenance interval for the air-cleaner elements can be found in the country-specific maintenance schedules in the PIWIS information system.



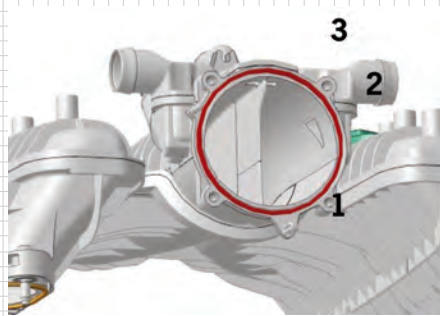
Air routing

2_99_13

Expansion intake manifold

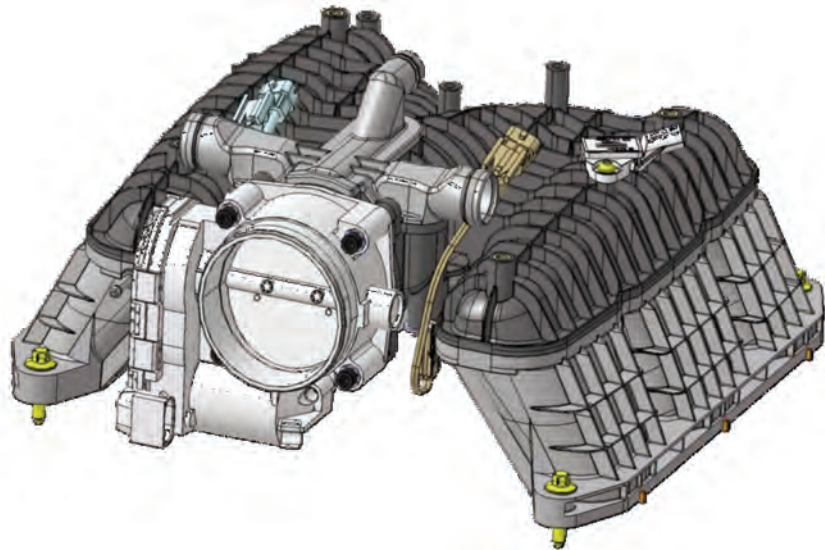
The Macan V6 biturbo engines have a twin-branch expansion intake manifold. It is generally true for all intake systems that air flows through them. In addition to the air flow, air oscillations are also produced by opening of the intake valves. These oscillations comprise a compression phase (air compression) when the intake valves are closed and an expansion phase (air expansion) when the intake valves open. In an expansion intake manifold, the air ahead of the combustion chamber is used and routed into the combustion chamber in its expansion phase. This means, however, that less air is supplied into the cylinders. This is compensated by a slightly increased boost pressure of the turbochargers.

The higher charge-air temperature that results from the increased boost pressure is in turn compensated for by optimized charge air coolers. The fresh air cooled down by the charge air cooler is additionally cooled again by further expansion in the expansion intake manifold. Since air cools down when it expands, the air charge has a lower temperature before the compression phase. The therefore cooler fuel-air mixture can be ignited with optimum power development, thereby achieving enhanced efficiency once more.



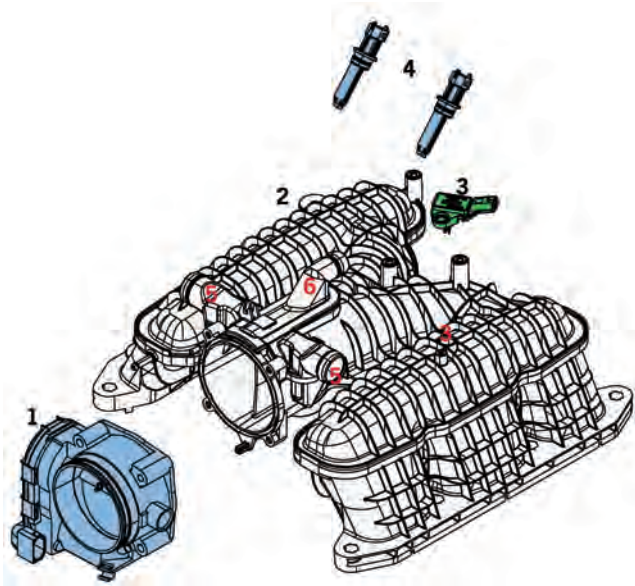
2_102_13

- 1 Separator element for separating the two chambers
- 2 Entry point for crankcase ventilation
- 3 Entry point for tank ventilation



2_101_13

The expansion intake manifold requires short distances over the intake valve for optimum operation. This was realized by two separate chambers for the left and right cylinder banks. The expansion intake manifold has a separator element after the throttle valve (electronic throttle) which separates the two chambers. In order to ensure optimum mixture control, the intake ports for tank ventilation and crankcase ventilation were also designed so that uniform supply into both chambers is possible behind the throttle valve.



2_103_13

Intake port

Aerodynamic measures were implemented in the air intake port of the cylinder head in order to optimize the combustion process. Optimization of the combustion process can also take place by enhanced mixing of the fuel-air mixture. An optimally mixed fuel-air mixture can be ignited with optimum power development. A further benefit of improved combustion is the fact that lower amounts of pollutants are produced. The running smoothness of the engine can also be further improved. Double masking was applied on the cylinder head in order to intensify the swirl of the air flowing in.

Tank Ventilation

In the V6 biturbo engines, tank ventilation takes place either into the expansion intake manifold (at idle speed) or into the intake side of the left turbocharger (at boost pressure), depending on the boost pressure present. The system is controlled by interconnection of two check valves. The goal of both methods of tank ventilation is to achieve homogeneous distribution of the gases extracted from the carbon canister to both cylinder banks under all load conditions.

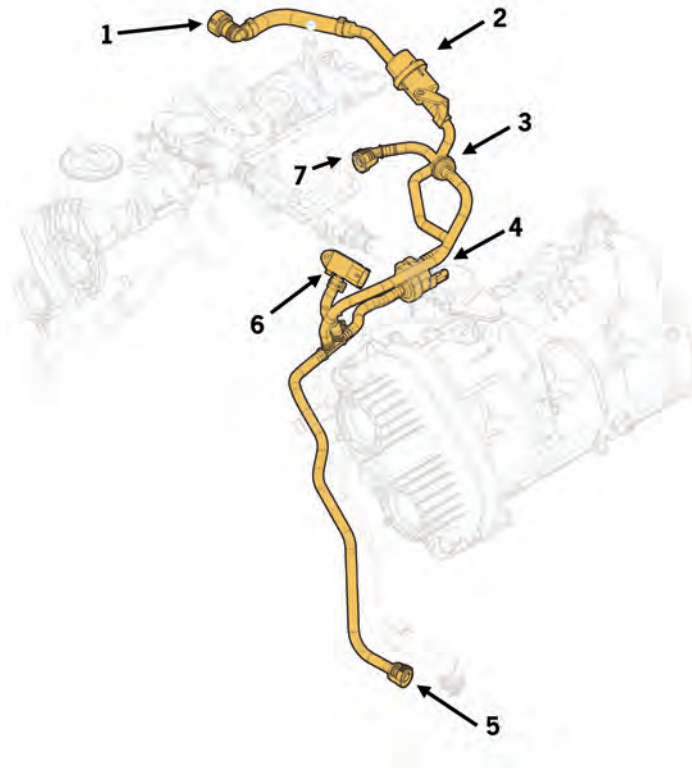
Ventilation in the near-idle range

Ventilation takes place into the expansion intake manifold (7) in the near-idle range where there is a vacuum downstream of the throttle valve. The gases are distributed directly into both chambers of the expansion intake manifold. Homogeneous distribution of the fuel gases extracted from the carbon canister to both cylinder banks is advantageous.

Ventilation at boost pressure

Tank ventilation takes place according to the Venturi principle into the intake side of the left turbocharger for faster scavenging of the carbon canister under full load, i.e. with open throttle and boost pressure in the expansion intake manifold. A Y-type distribution pipe is located ahead of the electronic throttle in order to achieve homogeneous distribution of the gases sucked in from the carbon canister. This pipe was designed so that the air flows can be mixed downstream of the left and right charge air coolers and then supplied as a homogeneous air-gas mixture to the two chambers of the expansion intake manifold.

- 1 Transfer point from vehicle
- 2 Damping volume
- 3 Check valve
- 4 Tank vent valve
- 5 Transfer point to turbocharger
- 6 Pressure sensor
- 7 Transfer point for intake manifold

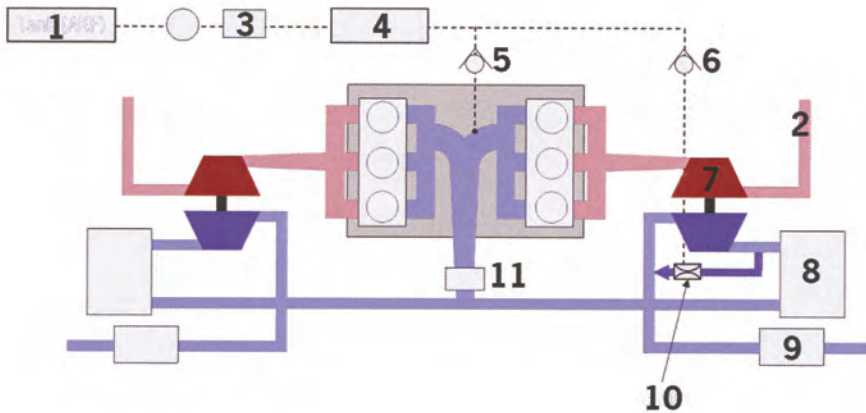


Tank ventilation in the engine compartment

2_104_13

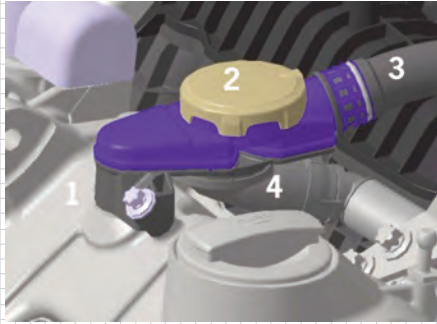
Ventilation principle

There is an air flow through the bypass line between the pressure side of the turbocharger (downstream of the compressor) and the suction side due to the pressure difference. This volume flow attempts to compensate for the pressure difference. A Venturi nozzle (10) is integrated in the bypass line. The volume flow creates a vacuum at the connecting line of the Venturi nozzle for the tank ventilation. The check valve (6) opens, the gas flow through the Venturi nozzle into the fresh intake air and are then compressed by the compressor of the turbocharger (7) and supplied to the combustion chamber.



2_105_13

- 1 Fuel tank (active carbon filter)
- 2 Damping volume
- 3 Tank vent valve
- 4 Pressure sensor
- 5 Check valve
- 6 Check valve
- 7 Turbocharger
- 8 Charge air cooler
- 9 Air cleaner
- 10 Venturi nozzle
- 11 Throttle valve (electronic throttle)



2_107_13

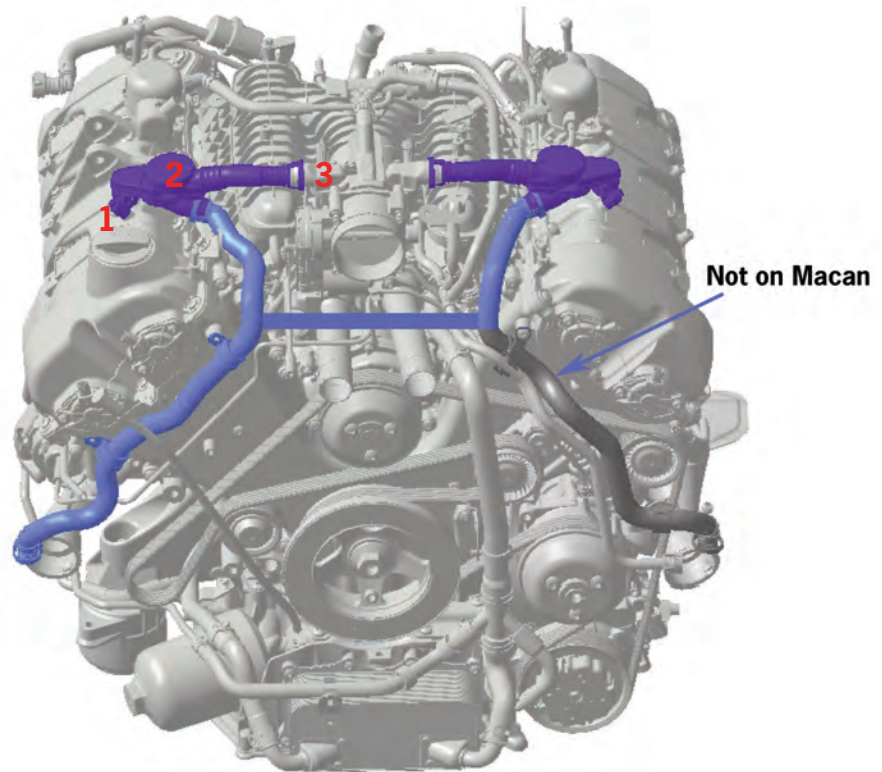
- 1 Crankcase ventilation connection at the cylinder head
- 2 Crankcase ventilation with integrated pressure-regulating valve
- 3 Crankcase ventilation into the expansion intake manifold
- 4 Crankcase ventilation into the intake side of the turbocharger

Note:

On USA engines, the driver side cylinder bank connects to the passenger side vent hose.

Crankcase ventilation

Crankcase ventilation also takes place on a cylinder bank-specific basis. At idle speed, a vacuum is present in the expansion intake manifold due to the lack of boost pressure and low air throughput of the turbochargers. The crankcase is vented via the intake pipe. This takes place individually for each bank side. If boost pressure is present so that there is an overpressure in the expansion intake manifold, venting then takes place via the intake side of the intake duct of the right turbocharger. The ventilation channels are controlled by means of two pressure-regulating valves which are mounted on the cylinder banks.



1_63_13 USA

With the enhanced crankcase ventilation system, it was possible to reduce the amount of fuel entering the engine oil during combustion as a result of the combustion gases that flow past the piston rings and enter the crankcase ("blow-by gases"). The enhanced aeration and ventilation system (Positive Crankcase Ventilation) ventilates the crankcase with a stream of fresh air, which accelerates the evaporation of any fuel that is carried in.

For this purpose, fresh air is tapped between the charge-air cooler and throttle valve and supplied via a line to the crank chamber. The pressure gradient that exists at all times between the tapping location and the crankcase causes a steady flow of fresh air through the crankcase in all map points. The vacuum in the intake pipe is used in the partial load range to ensure the legally required vacuum in the crankcase under all driving conditions. A pressure-regulating valve regulates this vacuum until the required value is reached. In the operating range with built-up charge pressure (full load), in which no vacuum is present in the intake pipe, the vacuum in front of the compressor is used.

This system therefore ensures constant disposal of the fresh air delivered by the positive crankcase ventilation system and the blow-by gases, which are supplied to the combustion process in this way. To prevent the crankcase ventilation system from freezing during the winter, the blow-by gases are supplied to the combustion air through a heatable connector.

Pressure sensor for detecting the engine load and intake air temperature

As was already the case in the Panamera V6 biturbo engine, digital pressure sensors are used. Use of a pressure sensor to detect the engine load dethrottles the intake path compared with the vehicles with hot-film mass air flow sensor. This digital sensor also measures the temperature of the intake air. This sensor is installed on the left side of the intake manifold after the expansion point.

Advantages of the pressure sensor for detecting the engine load:

- Increased power as a result of dethrottling of the intake section
- Greater precision at low air-flow rates
- Enhanced resistance to soiling

Pressure sensor for measuring the boost pressure

The digital pressure sensor for measuring the boost pressure (4) is located upstream of the throttle valve (2) on the Macan V6 biturbo engines.



Installation positions

2_108_13

- 1 Pressure sensor, engine load/air temperature
- 2 Throttle valve (electronic throttle)
- 3 Pressure sensor for tank ventilation



Installation position of
booster pressure sensor

2_109_13

Scavenging

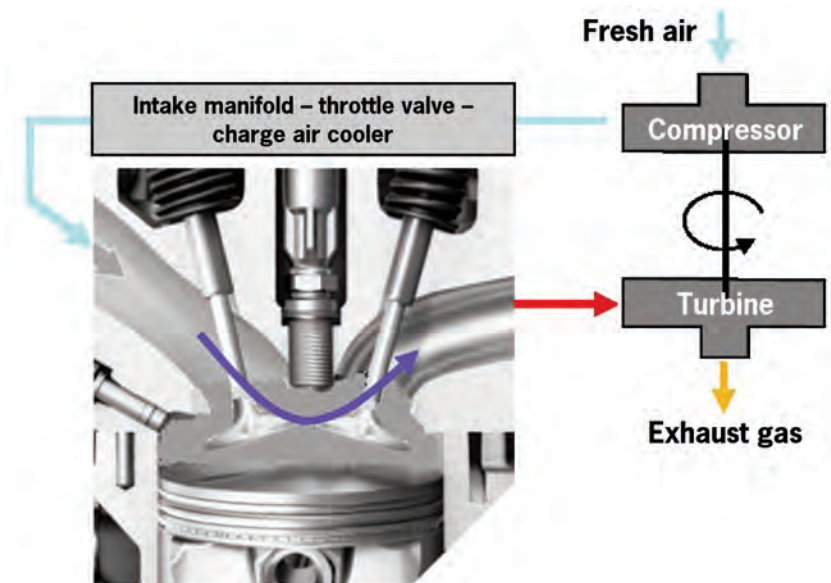
Scavenging is the process of removing exhaust gases from the cylinder after combustion and replenishing the cylinder with fresh air. A valve overlap of the intake and exhaust valves is intentionally activated for scavenging. The goal is to realize a slightly positive pressure gradient across the combustion chamber. The combustion chamber is flushed with fresh air and cooled. This has the advantage of reducing the combustion chamber temperature. At the same time, the remaining hydrocarbon fractions are flushed out and the knock sensitivity of the engine is reduced.

The result is a better center of combustion with lower combustion fluctuations and reduced soot emissions. This allows the fuel consumption to be reduced once more. Scavenging is used at low engine speed and under corresponding load conditions. Due to the higher air throughput through the turbine of the turbocharger, it is possible to increase the speed of the turbine and therefore of the compressor. Higher turbocharger speeds result in an increase in the boost pressure, which in turn means increased torque and faster responsiveness of the turbocharger.



Note!

Fuel injection takes place only when the exhaust valves are fully closed.



2_110_13

The air concentration in the exhaust tract increases when scavenging is activated. The oxygen sensor measures a lambda value greater than 1 in the exhaust gas. In the combustion chamber, however, the lambda value is 1 for optimum combustion.

Turbocharger

The turbocharging system in the V6 biturbo has two wastegate turbochargers in a parallel configuration. The exhaust side of the turbocharger consists of a one-piece housing in integral cast steel design (3) from the manifold to the exhaust turbine and is joined to the fresh-air compressor side at the turbocharger by a clamped connection. The turbocharger has a lubricating oil supply and a water cooling system connected to the engine cooling system. The connecting shaft of the turbocharger establishes a mechanical connection between the exhaust turbine and fresh-air compressor and rotates at speeds of up to 195,000 rpm.



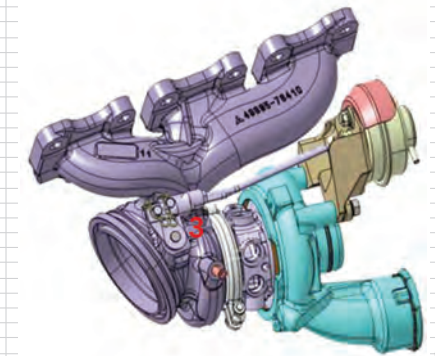
Turbocharger arrangement

2_112_13

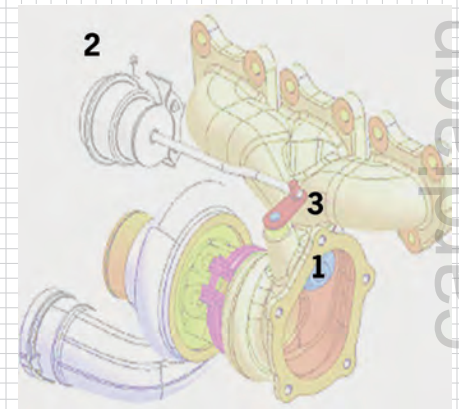


Turbocharger

2_113_13

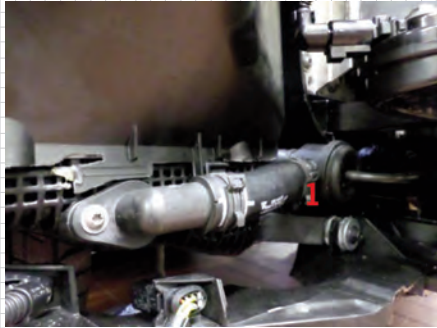
Exhaust manifold with
turbocharger housing

2_111_13



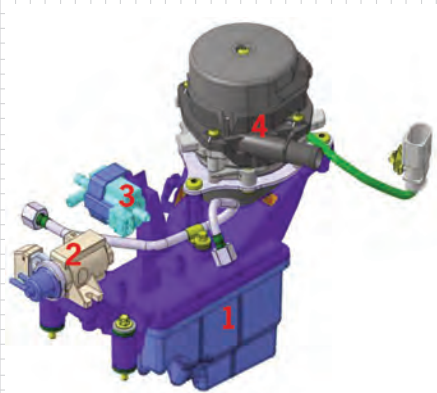
2_114_13

- 1 Wastegate valve
- 2 Wastegate vacuum unit
- 3 Exhaust manifold with turbocharger housing



Installation position of diverter valve 2_116_13

1 Diverter valve

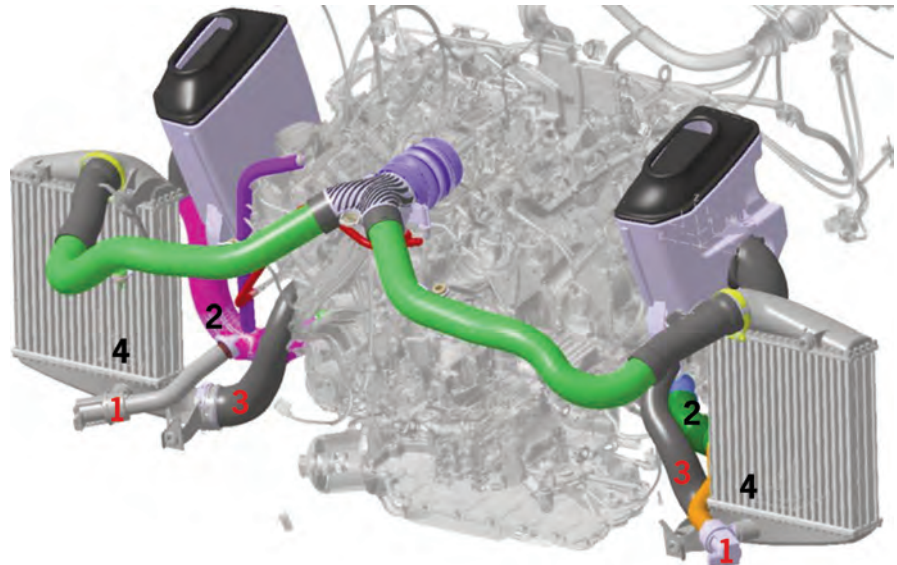


2_117_13

- 1 Vacuum reservoir
- 2 Boost pressure control switching valve
- 3 Deceleration air switching valve
- 4 Secondary-air pump

Deceleration air system

Maintaining the boost pressure in deceleration operation of turbocharged engines is of great importance in order to ensure fast responsiveness of the engine. For downsizing units with higher boost pressures in particular, optimized deceleration air recirculation control is extremely important. If the throttle valve is closed by the electronic throttle actuator after a change from traction to deceleration mode, the boost pressure increases abruptly and the engine air throughput is reduced. The mass air flow through the turbocharger turbine decreases. Since the compressor has to work against the closed throttle valve, it initially generates an increase in boost pressure. The boost pressure then falls, since the turbine speed decreases due to the lower volume flow.



2_115_13

A bypass (1) is opened between the suction side (2) and pressure side (3) of the compressor in order to maintain the boost pressure, thereby allowing compressed air to pass from the charge air cooler (4) to the suction side of the turbocharger. The compressor then runs practically in freewheel mode and can maintain its speed for longer. As a result, the turbine speed is higher after deceleration operation and the engine offers better responsiveness for acceleration. The electropneumatic switching valve for deceleration air is located under the intake pipe in the area of the vacuum reservoir.

Possible faults in the deceleration air area:

- Valve does not open (1) > sluggish acceleration
- Valve does not close (1) > no boost pressure
- Valve opens independently (1) > low boost pressure, valve overheating

In order to prevent the valve from opening independently, it is necessary to tap the pressure supply upstream of the throttle valve. As a result, an overpressure is present at the diverter valve control line in partial load operation with boost pressure.

2.4 Mixture formation

The composition of the fuel-air mixture and the interaction of lambda control and mixture adaptation are important features of mixture formation. Mixture adaptation takes place on a cylinder bank-specific basis in the V6 biturbo engine. The sensors for monitoring the fuel-air mixture are the oxygen sensors and the pressure sensor with temperature detection function. The oxygen sensors determine the ratio between the air mass supplied to the combustion chamber and the air mass required for stoichiometric combustion. This signal provides information about whether combustion is too lean or too rich. This information is used by the mixture adaptation system to adapt the engine to its optimum operating range.



V6 biturbo engine

2_118_13

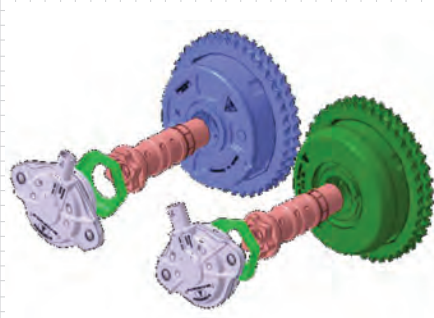
In addition to mixture adaptation, the distribution of the fuel is of central importance in the DFI engine in order to ensure optimum combustion in compliance with the legal emission limits. The distribution of the fuel in the combustion chamber can be determined on the one hand by the position and spray angles of the multi-hole injectors and on the other by the swirl and tumble of the fresh air flowing into the chamber. For this purpose, the intake side on the V6 biturbo engine was designed for optimum air swirl with respect to valve lift and intake port geometry. A further characteristic feature for optimized charge motion in the V6 biturbo engine is the asymmetric valve lifts, which are realized by the different cam profiles on the intake camshaft. The geometric design of the piston crown additionally contributes to optimizing charge motion in the combustion chamber.



V6 biturbo piston

2_119_13

- 1 Oil supply for retarded timing
- 2 Oil supply to cylinder head
- 3 Reset spring
- 4 Oil supply for advanced timing



Camshaft adjuster

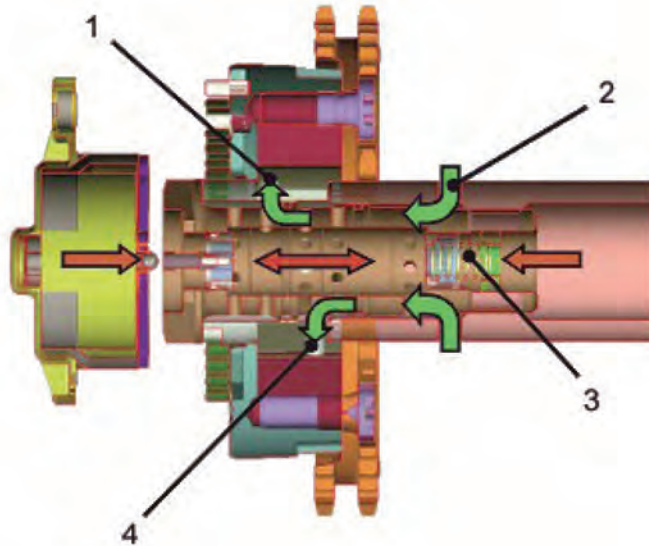
2_122_13

VarioCam Plus

VarioCam vane adjusters are used on the intake and exhaust camshafts of the V6 biturbo engines. Both vane adjusters can be continuously adjusted by map control.

VarioCam adjustment ranges

Intake camshaft: 0 to 50.0° crank angle (25.0° camshaft angle)
 Exhaust camshaft: 0 to 55.0° crank angle (27.5° camshaft angle)

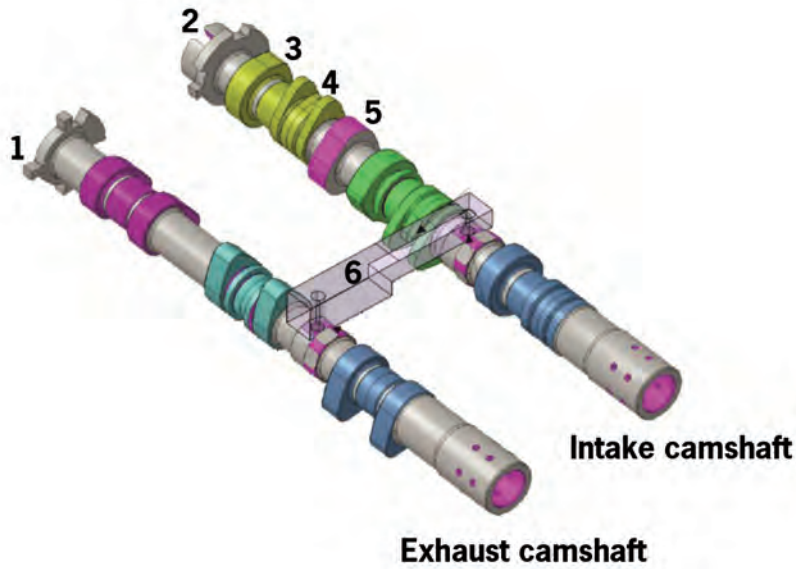


2_120_13

The central bolt establishes a frictional connection between the VarioCam adjustment device and the camshaft. In addition to the function of connecting the VarioCam system and camshaft, the central bolt also performs the function of adjustment as initiated by the actuator.

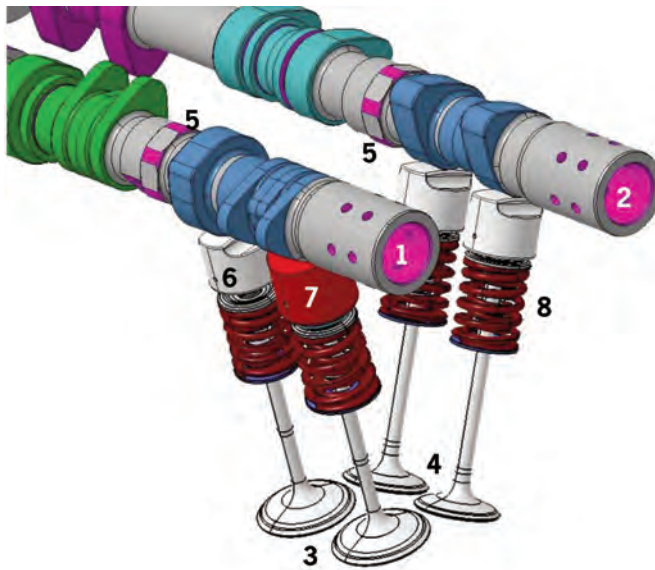
The advantages of the modified camshaft control system with central axial switching valve include the higher adjustment speeds due to the lower pressure losses in the oil supply, which was realized through very short oil ducts. The omission of further oil ducts in the cylinder head as well as simpler oil transfer between cylinder head and camshaft bearing are design modifications and optimizations in the cylinder head. A significant advantage of the axial arrangement of the switching valve compared with the decentralized switching valve is increased switching performance, i.e. increased adjustment speeds and the associated reduced installation space. It was also possible to therefore improve the hot idle behavior.

A further new feature is the intake camshaft with a total of four different cam shapes. Three of the four cam shapes are responsible for the intake valves. One cam profile is for the fixed large lift and two other cam profiles for the variable valve lift switchover of the intake valves between small and medium lift. The intake camshaft has an innovative design with just one intake valve with adjustable lift, while the lift of the second intake valve is fixed; this is called asymmetric valve control. The fourth cam profile is responsible for driving the fuel high-pressure pump.



2_121_13

An optimum cylinder charge is required with low engine speeds and high torque requirement. Air swirling is advantageous for optimum combustion. This can be realized by up to three injections in combination with small valve lifts, which result in strong swirl generation. The fuel can then be ignited for optimum power development.



2_123_13

- 1 Rotor on exhaust camshaft
- 2 Rotor on intake camshaft with connection for vacuum pump
- 3 Cam profile for fixed valve lift
- 4 Cam profile for variable valve lift
- 5 Triple cam for fuel high-pressure pump
- 6 Assembly aid for camshafts



Note!

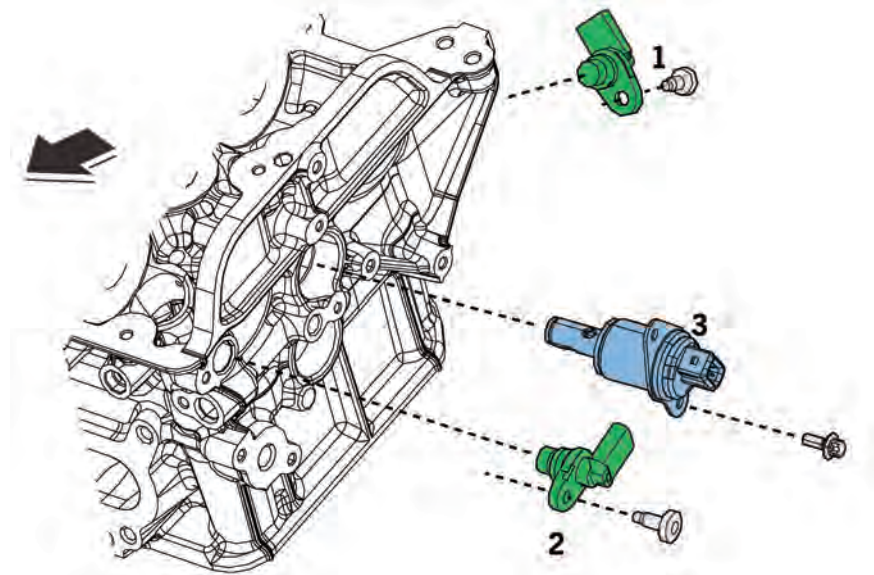
The data on the valve lift can be found in Group 1.

- 1 Oil bores in the VarioCam intake camshaft
- 2 Oil bores in the VarioCam exhaust camshaft
- 3 Intake valves
- 4 Exhaust valves
- 5 Area for positioning the assembly aid
- 6 Hydraulic tappet for fixed valve lift
- 7 Hydraulic tappet for variable valve lift
- 8 Double-spring unit

- 1 Hall-effect sensor, intake camshaft
- 2 Hall-effect sensor, exhaust camshaft
- 3 Valve lift switchover valve, intake valves

Sensors and actuators on the cylinder head

The position of each camshaft is monitored by a Hall-effect sensor. The Hall-effect sensors are installed in the cylinder head housing on the opposite side of the camshaft adjuster (VarioCam). The switching valves for valve lift switchover are located on the face end of the cylinder head of cylinders 3 and 6.



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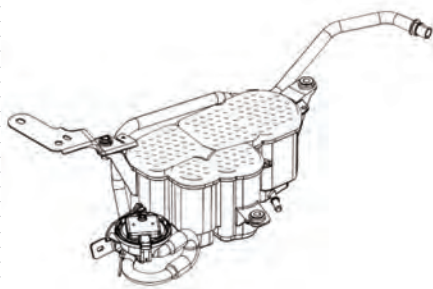
Tank ventilation/carbon canister

Carbon canister

The carbon canister is located on the underbody on the left next to the fuel tank. The ventilation paths to the intake side of the engine were already described in the section on the intake system.

Carbon canister with tank leakage diagnosis NVLD

The Macan vehicles intended for the USA feature the NVLD (Natural Vacuum Leak Detection) system for tank leakage diagnosis. The pneumatic part of the NVLD module is located on the carbon canister. With this system, tank leakage diagnosis is performed as a passive long-term test when the vehicle is stationary for an extended period, which means that no short test is required for this purpose. The components and function of the NVLD system with NVLD evaluation unit (electronic part with temperature sensor) and an NVLD module (pneumatic part) have already been described in detail in the SIT, Group 2 for the 911 Carrera (991).

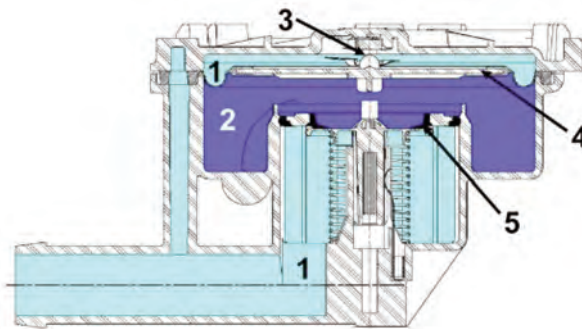


Carbon canister with NVLD

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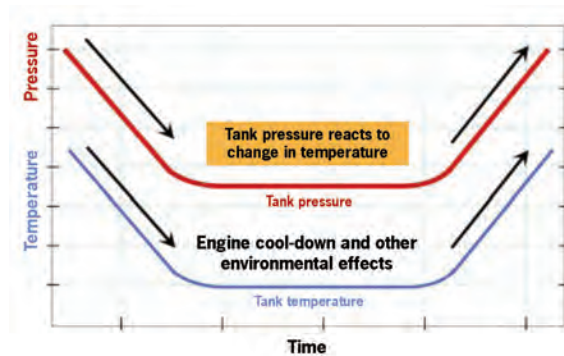
NVLD module

Functional principle of the pneumatic part (bottom figures). If a vacuum (1) of -2.5 mbar is produced in the fuel tank after the vehicle is switched off as a result of long-term cooling, the diaphragm (4) moves upwards and closes the switch (3). The conical seal (5) limits the maximum vacuum to 6.0 mbar. The electric vacuum switch (3) is actuated by vacuum when the diaphragm is raised. It closes and opens at 2.5 mbar relative vacuum. The conical seal (5) limits the vacuum when the diaphragm is raised. It opens at 6.0 mbar, and closes at 3.0 mbar. The maximum pressure in the tank is limited to +5.0 mbar.



NVLD design

2_127_13



NVLD pressure and temperature characteristic with tight system

2_128_13



NVLD module

2_129_13



Ignition coil arrangement

2_130_13

- Pin 1 = Engine ground (terminal 4a)
 Pin 2 = Ignition signal (DME)
 Pin 3 = Body ground (terminal 31)
 Pin 4 = Positive (terminal 87)

**Note!**

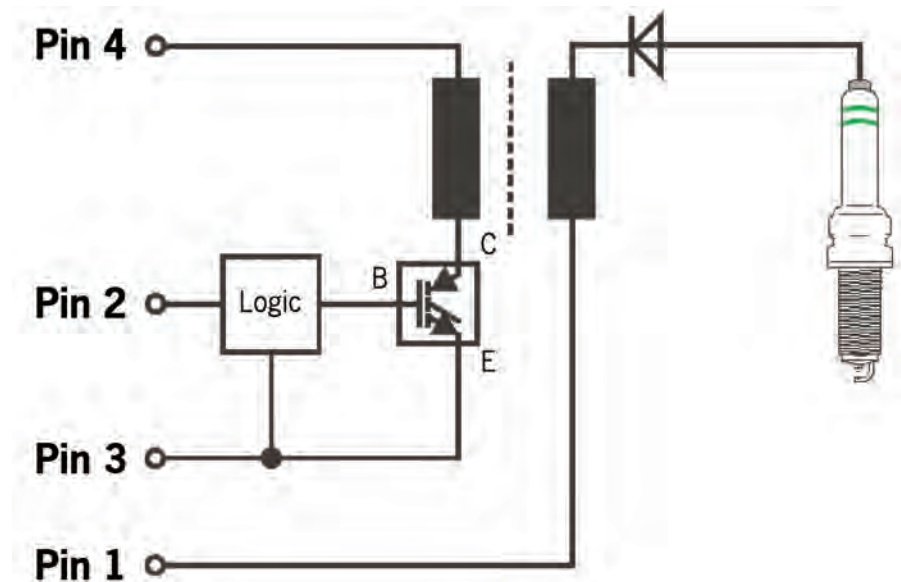
Diodes on the secondary side prevent an ignition spark from arcing over due to induction and therefore initiating undesired combustion when the magnetic field is switched on.

A resistance measurement is therefore not possible.

2.5 Ignition system

Single-spark ignition coils

New ignition coils with captive steel screws are used in the V6 biturbo engines. The newly developed ignition coils generate a higher ignition voltage and are realized in “plug top” design. Ignition voltages of up to 25 kV were normal in the past. In the V6 biturbo engine, ignition voltages of over 30 kV up to 35 kV are required. A higher ignition voltage means that the ignition coil of the spark plug must provide higher ignition energy. The requirement for higher ignition energy must be met by higher ignition coil performance. Higher ignition energy levels require geometrically larger ignition coils. In the previous projects, bar ignition modules were used where the coil was accommodated in the plug hole. Since the installation space in the plug hole is geometrically limited, the coil is located in the ignition coil head in the “plug top” design. More installation space is available here.



Circuit diagram of ignition coil

2_131_13

Components in the head of the “plug top” single-spark ignition coils:

- Ignition coil (iron core with primary and secondary windings)
- Connection terminals for engine wiring harness
- Diodes for switch-on spark suppression
- Connection for spring for spark plug contacting

Spark plugs

The spark plugs in the V6 biturbo engine can be visually distinguished from the previous spark plugs by the modified high-voltage terminal. These spark plugs no longer have a terminal stud but instead have a contact plate for contacting. The connection point between the secondary winding and spring for contacting the spark plug in the ignition coil can be aligned if necessary. A further distinguishing feature of the new spark plugs is the smooth insulator design, which permits air-gap-free contact of the silicone sheath on the ignition coil. Local voltage peaks at the transition points are minimized by the new

connection head and the related modified winding of the contacting spring. These two measures significantly increase the insulation capacity of the ignition system and therefore allow the required ignition energy to be directed safely into the combustion chamber.



Spark plug V6BT

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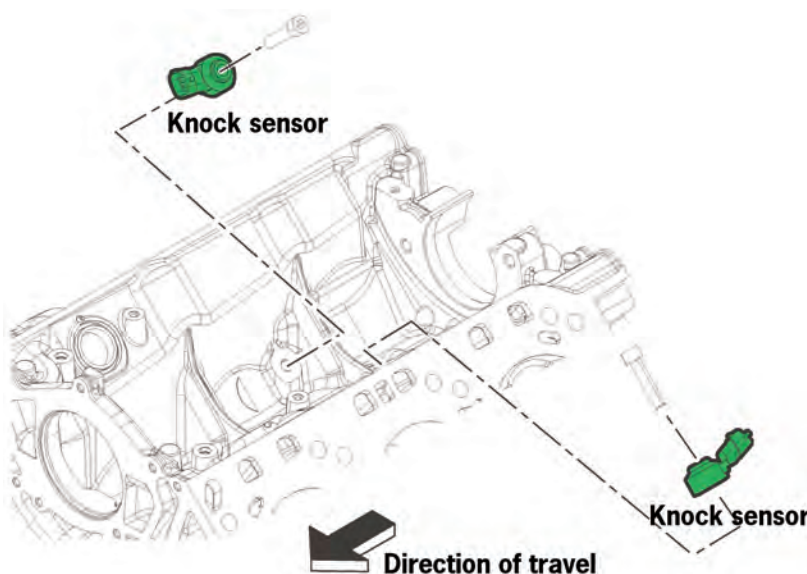
Connection head

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The new contacting design requires optimum seating of the ignition coil contacting spring on the connection head of the spark plug. The pull-off forces of the bar ignition modules for removal are higher due to the lack of grooves on the spark plug. Slight coating of the silicone sheath with talcum powder is permitted to facilitate re-installation and above all removal of the ignition coil. Other lubricants must not be used as they can negatively influence the insulation capability of the ignition system. No special tool is required for renewed disassembly with this procedure. A cable loop is sufficient as a disassembly aid.

Knock sensors

The V6 biturbo engines have two knock sensors (1) in the V of the engine block for knock detection.



Knock sensor arrangement

2_134_13



Further information on positioning of the spring in the ignition coil is provided in the PIWIS information system.



The safety instructions and specifications in the PIWIS information system, Group 2, must be observed when working on the ignition system. The country-specific change intervals for the spark plugs, plug type, heat rating and tightening torques can be found in the PIWIS information system/maintenance schedule.



Maintenance-relevant note:

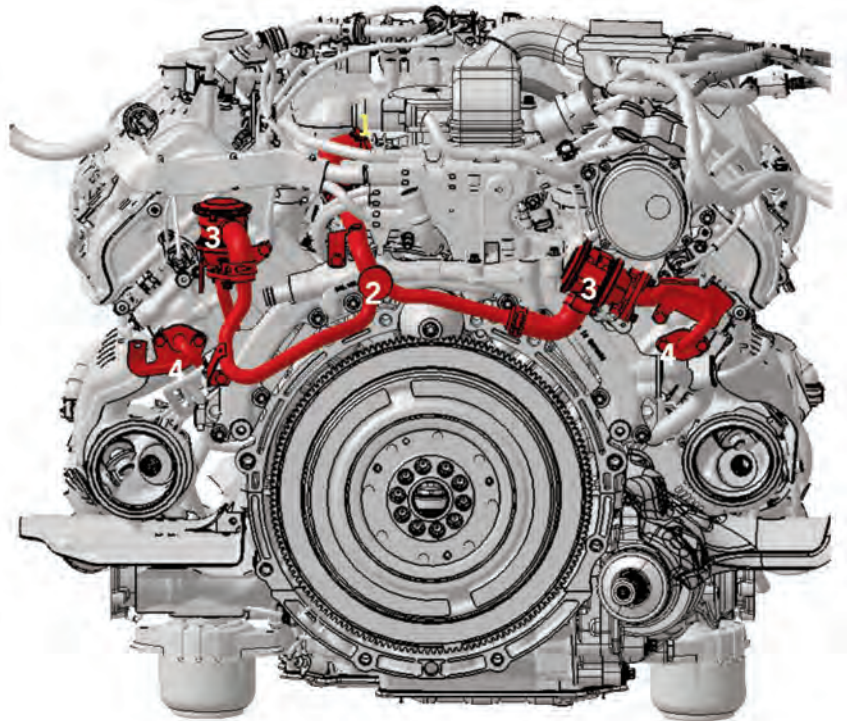
Coat the insulators and silicone sheaths with talcum powder.

2.6 Exhaust system/emission control

The combustion of the air/fuel mixture in the engine is never complete. Fuel that does not burn is delivered into the exhaust system during the exhaust stroke and does not therefore contribute to torque build-up. This always results in HC and CO raw emissions. The exhaust system components, such as the exhaust manifold, the primary and main catalytic converters with the oxygen sensors and the front and main mufflers with the tailpipes are precisely matched components of a control loop, which must ensure optimum exhaust gas aftertreatment not only when the engine is at operating temperature, but also when starting the engine and in the warm-up phase.

Secondary-air injection (EURO 6 and LEV 2/ULEV vehicles)

- 1 Connection on the secondary air pump
- 2 Secondary-air distributor for banks 1 and 2
- 3 Check valve for secondary air
- 4 Connection on cylinder head, banks 1 and 2



Air injection system

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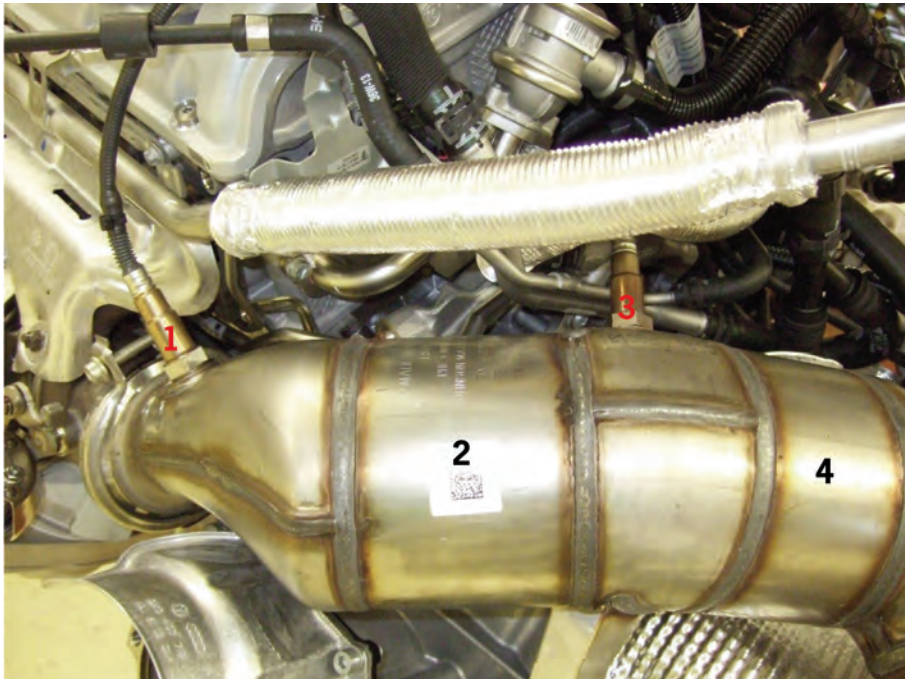
A check valve allows additional air to be injected into the exhaust system upstream of the catalytic converter for a defined period by way of the secondary-air pump under corresponding conditions during the warm-up phase. The rich engine operation in this operating state produces a higher level of carbon monoxide (CO) and hydrocarbon (HC) in the exhaust gas, which is combusted using the secondary air injected immediately behind the exhaust valves. The heat that is released during post-combustion means that the optimum operating temperature of the catalytic converter for optimum exhaust aftertreatment is reached more quickly.

Catalytic converters

Emission control

The left and right cylinder banks each feature:

- a lambda control with
- continuous pre-catalytic converter sensor (LSU broadband oxygen sensor)
- a ceramic pre-catalytic converter
- a post-catalytic converter sensor (LSF step-change oxygen sensor)
- a ceramic main catalytic converter



Cascade catalytic converter

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One cascade catalytic converter is installed for each cylinder bank in the V6 biturbo engines. The broadband oxygen sensor upstream of the catalytic converter (1 – LSU) is located just behind the turbocharger flange. With the cascade catalytic converter, the step-change oxygen sensor downstream of the catalytic converter (3 – LSF) is located directly between the pre-catalytic converter (2) and main catalytic converter (4).



Exhaust tailpipes Macan S

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Exhaust tailpipes Macan Turbo

2_141_13

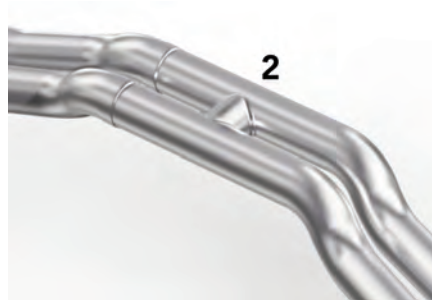
Exhaust system

The exhaust systems on the Macan S and Macan Turbo have a two-branch design downstream of the two cascade catalytic converters (1).



2_137_13

A crossover point (2) is integrated in the middle section of the twin-branch exhaust system. Downstream of the two mufflers (3), the Macan Turbo has an electric actuator (4) on the outer pipe of the right muffler for switching the exhaust flap when requested by the DME control unit. The engine sound can be made even sportier by way of the flap control (4) on the optional sports exhaust system. For this purpose, the mufflers (3) have a modified internal design and both have an electric actuator (4) on the outer pipe.



Crossover point

2_138_13



Electric actuator

2_139_13

The exhaust tailpipe covers of the Macan S (5) and Macan Turbo (6) have a unique design.

2.7 Additional DME functions

Auto Start Stop function

The Macan models are equipped with an enhanced Auto Start Stop function. The enhanced Auto Start Stop function switches off the combustion engine under defined conditions at speeds of less than 1 mph (2 km/h) and therefore exploits additional fuel-saving potential. The DME control unit that controls the Auto Start Stop function has been optimized so that the engine can be switched off automatically in as many cases as possible to minimize fuel consumption for the driver in day-to-day use.

The Auto Start Stop function can be activated and deactivated by way of a button in the center console (1). The function is available as soon as the coolant temperature, engine oil temperature and transmission fluid temperature have exceeded a certain temperature, the air conditioning system has reached its setpoint temperature and all other operating conditions in accordance with the Owner's Manual are met. If the vehicle is stopped by brake operation and the brake pedal is held down, the Auto Start Stop function switches off the engine at a speed of less than 1 mph (2 km/h). The driver is informed of this by the green Auto Start Stop symbol (bottom figure – 2) in the instrument cluster. The tachometer falls to zero. The selector lever can remain in position D or M. The engine remains stopped even if the lever is shifted to P or N. If the engine cannot be switched off automatically, the driver is informed about this by a yellow Auto Start Stop symbol (bottom figure – 3) in the instrument cluster when the vehicle is stationary.

The engine is not switched off or restarted again in this case, if for example:

- "Sport" mode is activated
- Vehicle electrical system voltage is too low
- Maneuvering or parking is detected, i.e. reverse gear is engaged or the steering wheel is turned by a large angle
- Climate control/heating with residual heat function cannot guarantee that the set temperature can be maintained without running the engine
- Also at very low and very high outside temperatures
- The air suspension is adapting the vehicle level

If the driver's door is opened after an automatic stop when selector-lever position D or N is engaged, an automatic engine start is executed to remind the driver that the Auto Start Stop function is still active. In selector-lever position D, the parking brake is additionally engaged. The brake warning light appears on the instrument cluster and the indicator light on the parking brake switch lights up. If the vehicle is left after an automatic engine stop when selector-lever position P is engaged, no automatic engine start is executed. Auto Start Stop mode is resumed if the driver closes the driver's door and presses the brake within 30 seconds of leaving the vehicle. If one of these requirements is not met, the engine has to be started manually. The message "Please start engine manually" will appear on the multi-function display in the instrument panel.

DME engine electronics

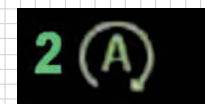
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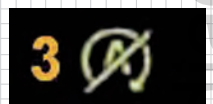
Center console button

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- 1 Auto Start Stop function
- 2 Exhaust system
- 3 Sport
- 4 Sport Plus



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2_144_13



Note!

Helpful information for diagnosis of the Auto Start Stop function is available in the DME control unit under the actual values in the filter ST.

Coasting function

The Macan models feature the coasting function. Coasting refers to operating the vehicle with the engine disengaged, for example on slight downhill gradients; the engine is operated at idle speed so that the function of the auxiliary systems (alternator, air-conditioning compressor, coolant pump, etc.) is maintained. During coasting, the kinetic and potential energy of the vehicle is directly used to overcome running resistance forces.

Although no fuel is used during deceleration with deceleration fuel cutoff, the vehicle is decelerated significantly more. If no deceleration is desired, additional fuel must be used to cover the lost distance. After the driver gently presses the accelerator, the engine revs up smoothly and immediately with early upshifts; after the driver gently releases the accelerator, the engine intermittently coasts with the clutches disengaged and at idle speed until the brake is pressed or the accelerator is pressed again. If the driver wishes to coast for a certain distance, for example when approaching a built-up area, the engine is automatically disengaged and kept at idle speed. The vehicle can therefore coast for a longer distance than in engaged state, leading to lower fuel consumption.

If the driver indicates a wish to decelerate by pressing the brake, the engine is immediately re-engaged in order to use the engine's trailing throttle fuel cutoff; the fuel supply is interrupted during this process and the engine braking effect additionally shortens the vehicle's stopping distance. Coasting can alternatively be intentionally activated by manually shifting up above the current maximum possible gear. The savings that can be achieved depend on the driving style and conditions of use. The efficiency of the function depends on an anticipatory and relaxed driving style; after a short familiarization time, the driver will have become accustomed to the longer coasting distance of his/her vehicle. The disengagement and engagement operations are imperceptible to the driver. The tachometer dropping to idle speed is the only indication to the driver that he is in coasting mode. The Auto Start Stop button switches the Auto Start Stop function on and off and activates and deactivates coasting mode. When the system is switched off, the indicator light in the button lights up "red".

The preconditions for coasting mode include the following:

- Driving with selector lever in position D
- Coasting mode is activated (indicator light in the button is off)
- Sport or Sport Plus mode deactivated
- PSM active
- Cruise control mode not active
- Engine, transmission and battery have reached operating temperature
- Relaxed/economic driving style
- Slight uphill gradients (up to approximately 10%) or slight downhill gradient
- Remove foot slowly from accelerator pedal

Vehicle electrical system recuperation

When the accelerator pedal is released quickly, the DME control unit detects that the driver does not want the coasting function. Deceleration fuel cutoff is initiated in conjunction with vehicle electrical system recuperation in these cases. To this end, the generator power is increased in a targeted manner by the generator regulator during braking

and the recuperated energy is fed into the starter battery. The increased generator power acts with a higher braking torque on the crankshaft of the combustion engine via the belt drive. This leads to vehicle deceleration, boosting the conventional brake system. The voltage is lowered again during acceleration and the available energy can be fed into the vehicle electrical system in order to supply the electrical consumers. This reduces the load on the combustion engine, and the full drive power can be made available for propulsion. An intelligent algorithm in the energy management system evaluates various input variables of the components involved, thereby allowing active coordination of every recuperation operation based on the battery charge condition and driver request.

Thermal management of the V6 biturbo engines

Thermal management on these vehicles includes the following components/functions:

- Two-stage thermostat with electric heating element (map-controlled)
- Coolant temperature sensor on the cylinder head at the rear right
- Coolant temperature sensor at radiator outlet
- Continuously variable radiator fan on radiator

The thermal management system controlled by the DME control unit has three main areas, temperature control and heat adjustment between:

- Combustion engine
- Porsche Doppelkupplung
- Passenger compartment (heating)

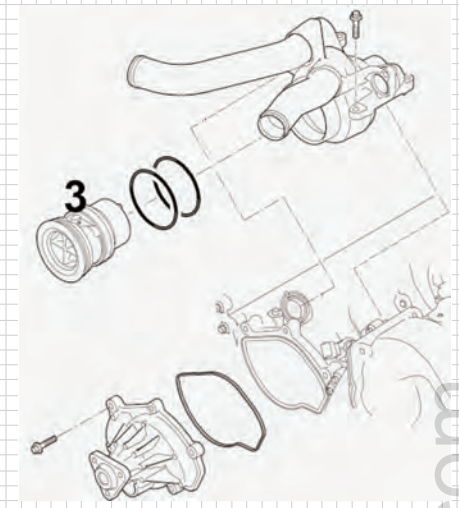
Goals:

- Quickly bringing components to their optimum operating temperature (reduction in friction)
- Reduction in engine and transmission friction through map-controlled regulation of the operating temperature
- Meeting the comfort requirements of passengers (heating power)

Advantages of thermal management with electrical activation of the coolant thermostat by the DME control unit for map-controlled coolant temperature control and operating temperature regulation when the engine is warm between 201° F (94° C) and 221° F (105° C):

- Map-controlled coolant temperature regulation by suppressing coolant flow in the warm-up phase
- Faster engine and transmission warm-up
- Reduced engine and transmission friction
- Lower fuel consumption (-1.5% in the NEDC)
- Reduced emissions
- Fast heating of the passenger compartment

2 temperature sensors were used in the engine cooling system for thermal management control. Coolant temperature sensor on the cylinder head at the rear right (1 – bottom right figure). Another temperature sensor is located on the coolant hose (radiator outlet).



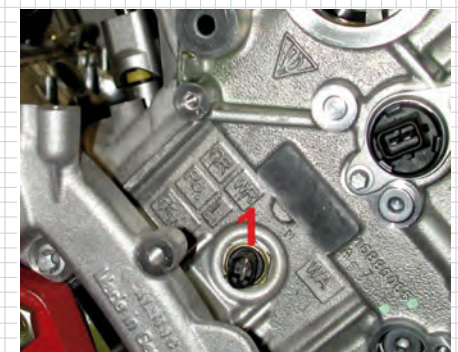
Installation position of thermostat 2_145_13

3 Thermostat with heating element



Thermostat

2_146_13



Installation position of NTC

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1 Temperature sensor on cylinder head



Thermostat closed

2_148_13



Heating circuit open

2_149_13



Both circuits open

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Cold engine:

The thermostat is fully closed when the engine is cold (stationary coolant); in other words, the small heating circuit and large cooling circuit are closed.

The thermostat has the following opening temperatures without electrical auxiliary heater:

- Bypass approximately 185° F (85° C) (small heating circuit)
- Radiator return line approximately 225° F (107° C) (large radiator circuit)

Engine warm-up phase:

In order to quickly achieve circulation in the heating circuit (bypass) in the warm-up phase, a large electrical map thermostat heating current is required after a cold start.

The heating current for the electric heating element in the thermostat is reduced as from an engine temperature of approximately 158° F (70° C) so that the thermostat does not immediately open the large cooling circuit.

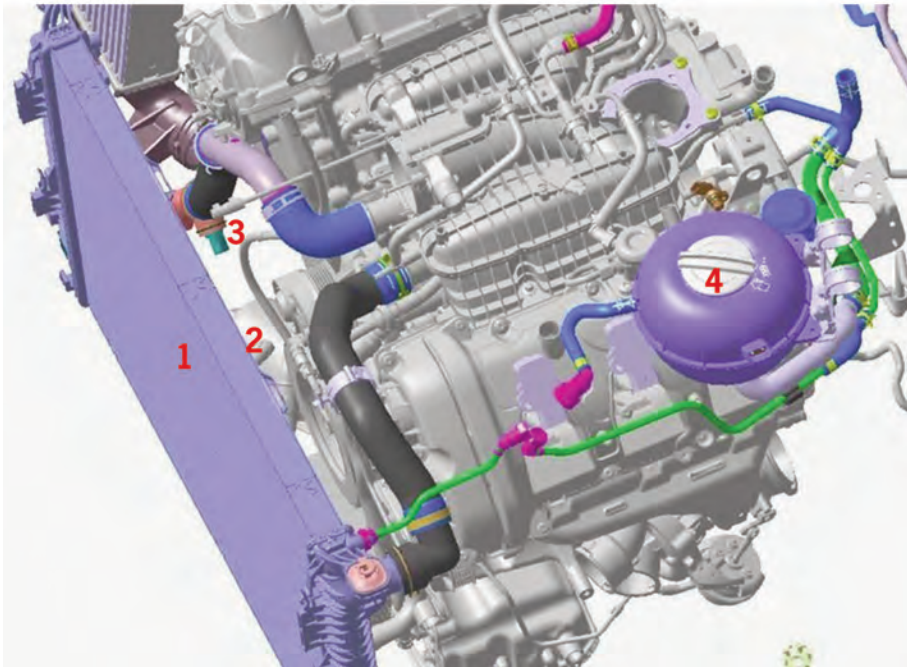
If an engine temperature of approximately > 194° F (90° C) and an oil temperature of > 104° F (40° C) are exceeded, the engine setpoint temperature is increased to 221° F (105° C). At the same time, the heating current is reduced again significantly so that the coolant in the small circuit is heated as quickly as possible to 221° F (105° C) (the large circuit remains closed).

Engine at operating temperature:

Both thermostat states (heating circuit and cooling circuit) are open when the engine is at operating temperature; the coolant can therefore circulate in both circuits. At an engine temperature of approximately 221° F (105° C), the heating current is adjusted correspondingly so that the engine setpoint temperature is maintained when the large cooling circuit is opened. When the Sport button is pressed or in the case of a very dynamic driving style, the engine setpoint temperature is reduced to 201° F (94° C). For this purpose, the heating current is increased significantly again to open the thermostat (large cooling circuit) further. The temperature at the radiator outlet increases when the large cooling circuit is opened.

Electric fans for coolant radiators

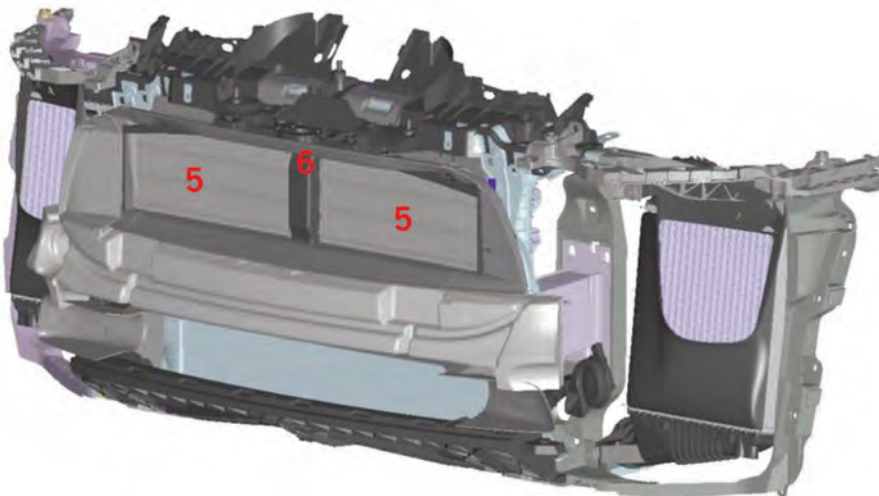
The electric radiator fan (2) is located behind the coolant radiator (1). The electric radiator fan is designed as a dual fan with 2 x 400 W. The fan motors are steplessly activated as required. The coolant expansion tank (4) is located in the engine compartment on the left.



Cooling system

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The temperature sensor for the engine temperature is located at the rear on the right cylinder head and the temperature sensor for the radiator return line on the right coolant hose (3). A shutter (5) is located in front of the radiator which can be closed and opened by an actuating element as required. The actuating element is located in the area (6) behind the radiator shutter.



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2.8 Macan S Diesel

General Information

The Macan S Diesel is equipped with the second-generation 3.0 I V6 turbo diesel engine familiar from the current Panamera and Cayenne. However, the Macan has an emission control system called "selective catalytic reduction" (SCR for short) in order to reduce the nitrogen oxides (NO_x) in the exhaust gas and thus ensure compliance with the strictest current emission limits worldwide. The following chapter contains information on the familiar diesel-specific DME topics as well as on this SCR system.



Diesel engine

Development goals for the engine

The Porsche philosophy is characterized by performance and efficiency. Both of these were therefore also the core objectives when developing the Macan S Diesel. With increased power and torque compared with the Panamera Diesel and Cayenne Diesel combined with a simultaneous reduction in fuel consumption and emissions, these objectives were impressively achieved in the Macan S Diesel.

The following contribute to this in the area of engine electronics:

- Common Rail CRS3-20 from Bosch
- Turbocharging with adjustable guide blades (VTG)
- Central swirl flap
- Extensive thermal management
- Auto Start Stop function
- Low-temperature exhaust gas recirculation with switchable cooler for exhaust gas recirculation
- Oxidation catalytic converter, diesel particulate filter and SCR system

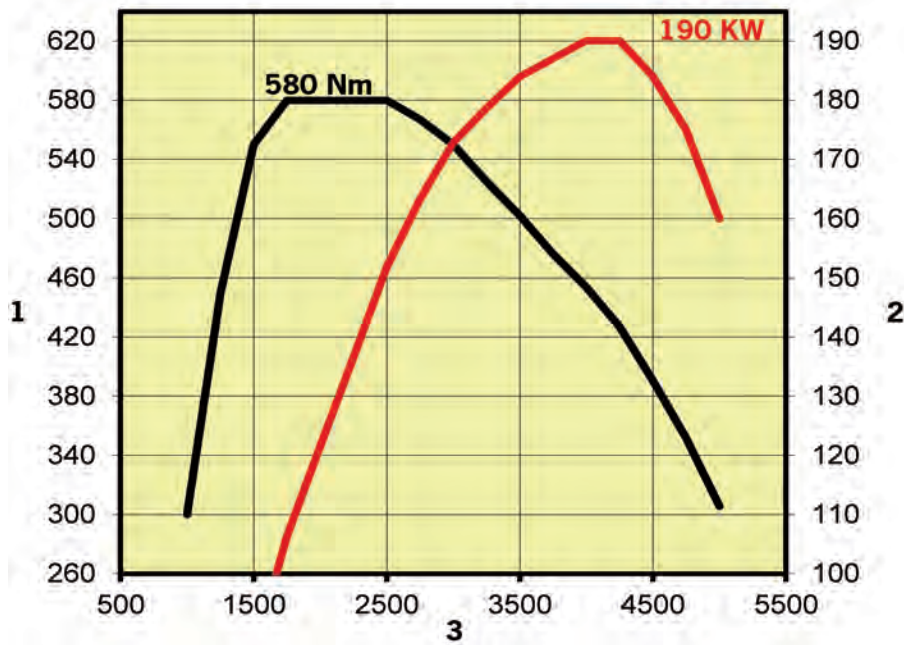


Important Information Regarding the Macan S Diesel!

At the time of printing of this Macan SIT book, the delivery date, equipment and specifications that will be offered in the North American market has not yet been determined. All Macan Diesel data/equipment/specifications listed herein are subject to change without notice. You will be informed accordingly once this information has been determined.

Engine specifications of the diesel engine

Displacement	2,967 ccm
Engine power	258 hp (190 kW) at 4,000 – 4,250 rpm
Engine torque	428 ft. lbs. (580 Nm) at 1,750 – 2,500 rpm
Compression ratio	18.8:1
Idle speed	620 +/- 100 rpm
Max. engine speed	5,200 rpm



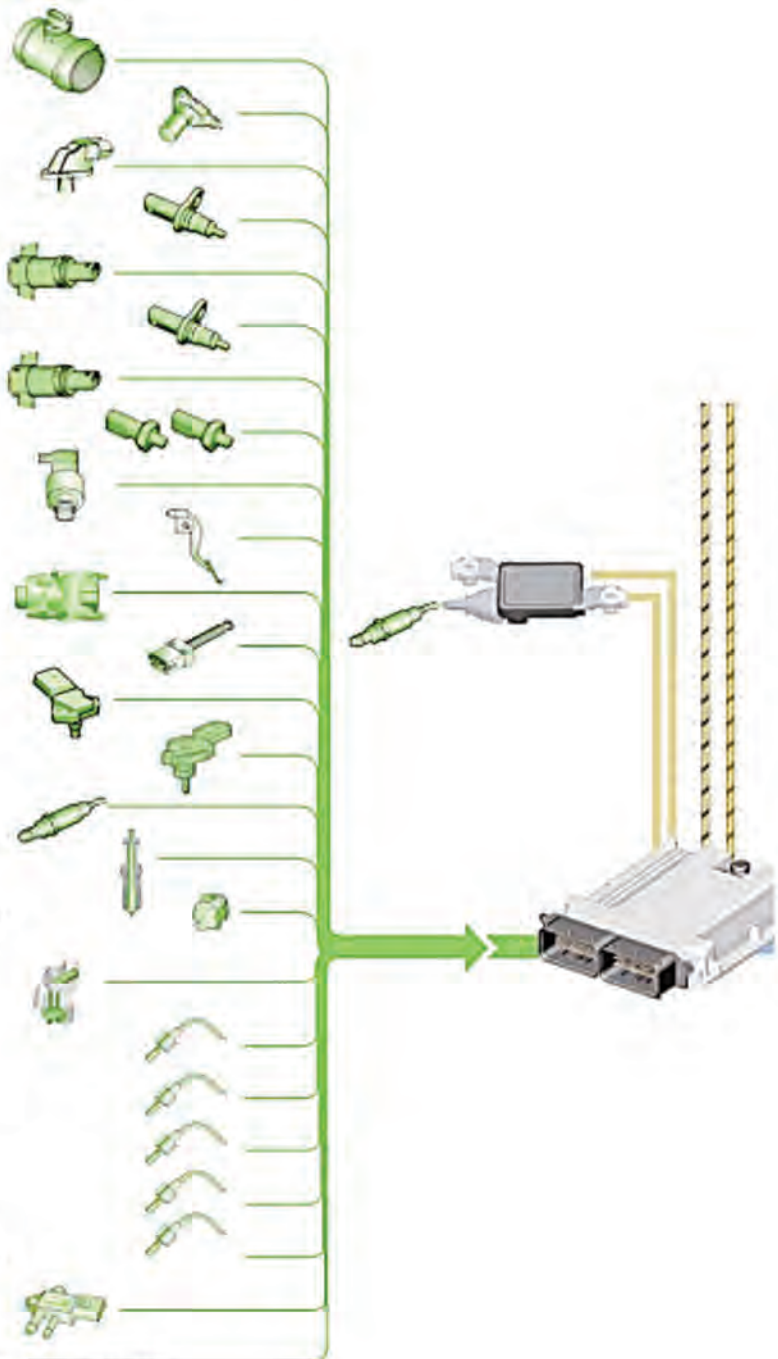
Engine power/torque Macan S Diesel

CAN networking

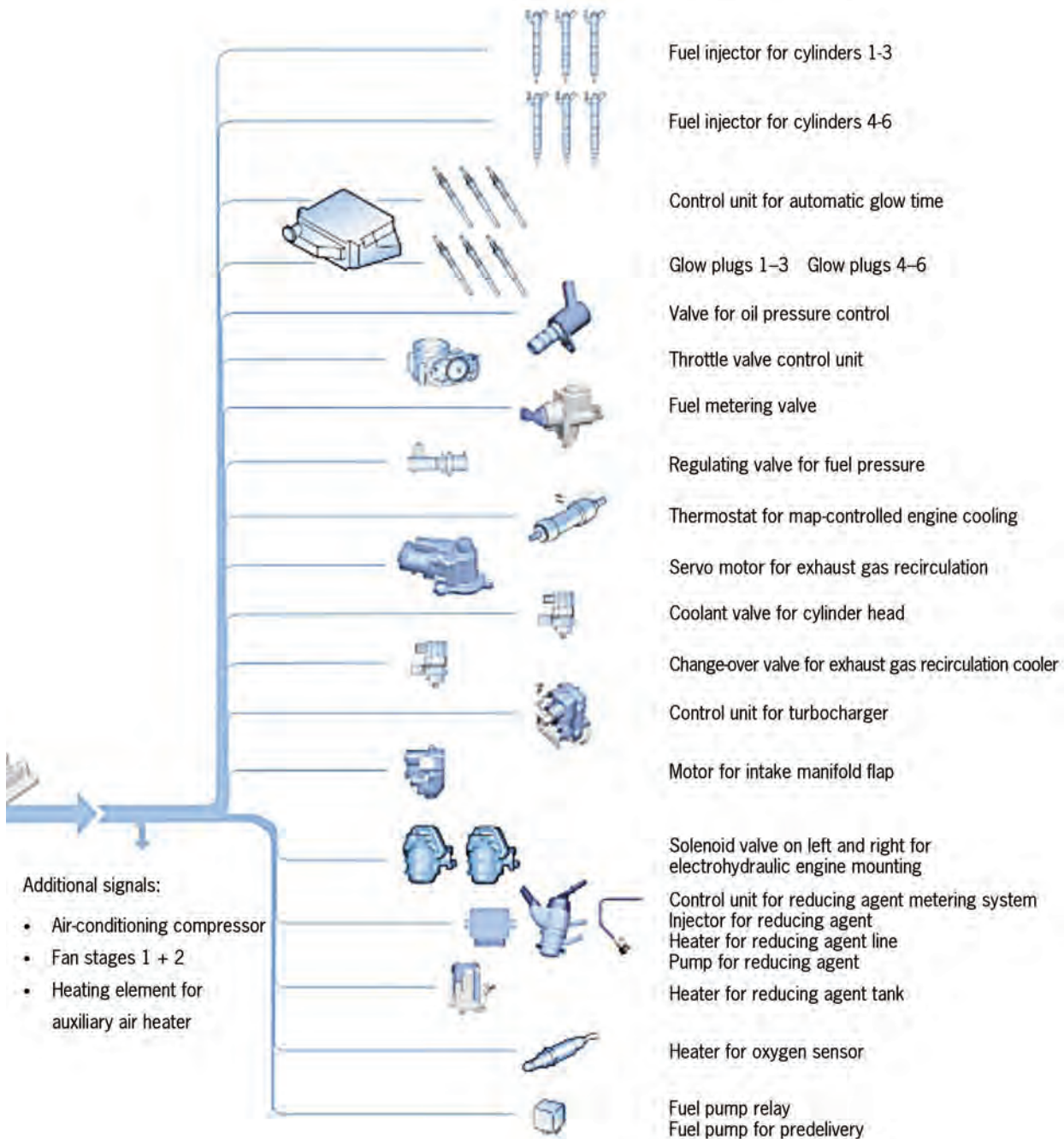
In addition to the sensors and actuators that are connected directly to the DME control unit, the DME control unit also has access to other data, which is assigned to other control units as input or output variables. Access to this external data takes place via the Drive CAN. In addition, the DME control unit communicates with the NO_x sensor via a Private CAN.

System overview

Mass air flow sensor
 Engine speed sensor
 Hall sender
 Coolant temperature sensor
 Coolant temperature sensor at radiator outlet
 Temperature sensor for engine temperature control
 Fuel temperature sensor
 Oil pressure switch 1+2
 Fuel pressure sensor
 Accelerator-pedal position sensor
 Sensor 2 for accelerator-pedal position
 Potentiometer for exhaust gas recirculation
 Brake light switch
 Pressure sensor for brake booster
 Boost pressure sensor
 Intake air temperature sensor
 Oxygen sensor
 Tank level sensor for reducing agent
 Pressure sensor for reducing agent metering system
 Temperature sensor for reducing agent
 Exhaust temperature sensor 3
 Temperature sensor for exhaust gas recirculation
 Exhaust temperature sensor 1
 Exhaust temperature sensor 4 (after DPF)
 Exhaust temperature sensor 2 (ahead of catalytic converter only BIN 5)
 Differential pressure sensor



Additional signals: Cruise control, speed signal, start request to DME,
 terminal 50, Crash signal from airbag control unit



DME control unit

The Bosch Common Rail system CRS3-20 with an engine control unit EDC 17 is used in the Macan S Diesel. It is installed at the front left in the plenum panel. The wiring harness is routed directly to the engine without disconnection point.

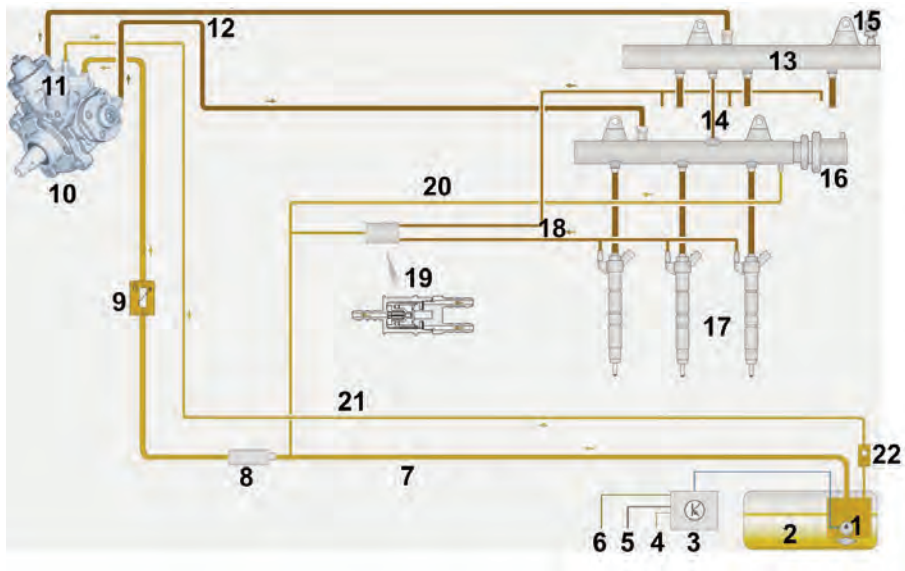
The EDC 17 engine control unit is responsible for the following functions:

- Control of the fuel pressure in the high-pressure reservoirs (rail 1 and rail 2)
- Control of the fuel quantity in the high-pressure reservoirs (rail 1 and rail 2)
- Precise activation of the piezo-injectors
- Power supply for the piezo-injectors
- Low-pressure fuel supply via demand-controlled in-tank fuel pump
- Control of the exhaust gas recirculation rate
- Control of the exhaust gas recirculation temperature
- Activation of the control unit for automatic glow time
- Volume flow-controlled oil pump
- Activation of the throttle valve unit
- Activation of the adjustable turbine geometry at the turbocharger
- Activation of the swirl flap
- Activation of the solenoid valve on left and right for electrohydraulic engine mounting
- Activation of control unit for reducing agent metering system
- Activation of injector for reducing agent
- Activation of heater for reducing agent line
- Activation of heater for reducing agent tank
- Activation of pump for reducing agent
- Activation of oxygen sensor heater
- Initiation and monitoring of diesel particulate filter regeneration
- Cruise control
- Thermal management
- Vehicle electrical system recuperation

2.9 Fuel system

Overview of the low-pressure and high-pressure fuel system components

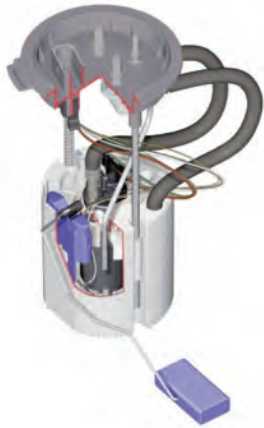
The fuel system of the Macan S Diesel can be divided into the two areas of fuel low-pressure and fuel high-pressure.



Fuel supply, low-pressure side

The fuel tank of the Macan S Diesel largely corresponds to the fuel tank of the Macan models with gasoline engines. The internal structure is simpler and has fewer individual components relating to the fuel tank ventilation system. This is due to the different behaviors of the fuels. The outgassing rate of gasoline is much higher than diesel, so gasoline tanks need an additional active fuel tank ventilation system with carbon canister and also tank leakage diagnosis in some countries that the diesel fuel tank does not need. The Macan S Diesel is equipped as standard with a 15.8 Gal. (60 liter) fuel tank; a 19.8 Gal. (75 liter) fuel tank is available as an option. The reserve capacity starts as from a fill quantity of 2.1 Gal. (8 liter) for both variants.

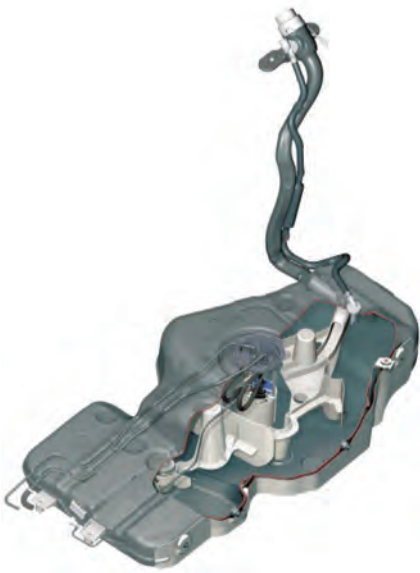
- 1 Reservoir housing with in-tank fuel pump
- 2 Fuel tank
- 3 Fuel pump control unit
- 4 Ground connection
- 5 +12 V connection
- 6 DME signal line
- 7 Fuel supply line
- 8 Fuel filter
- 9 Fuel temperature sensor (NTC)
- 10 Fuel high-pressure pump CP 4.2
- 11 Fuel metering valve
- 12 Fuel high-pressure line
- 13 Distributor tube (rail)
- 14 Connecting line for rails
- 15 Fuel high-pressure sensor
- 16 Regulating valve for fuel pressure
- 17 Piezo injector
- 18 Injector return line
- 19 Restrictor
- 20 Distributor tube return line
- 21 Fuel high-pressure pump return line
- 22 Pressure control valve



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**Note!**

Refer to the country-specific maintenance schedule for the change interval of the fuel filter.



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In-tank fuel pump

The in-tank fuel pump pumps the fuel from the fuel pump chamber to the fuel high-pressure pump in the engine compartment via the fuel filter. The in-tank fuel pump is located in the front area of the fuel tank in the reservoir housing at the lowest point of the tank. It is operated as required as a function of engine load and engine speed via a separate control unit. It is a brushless AC pump. The brushless motor speed request for the in-tank fuel pump is transmitted from the DME control unit to the control unit of the in-tank fuel pump via pulse width modulation.

A predelivery pressure of approximately 50.75 psi (3.5 bar) is present at the high-pressure pump at idle speed. The delivery pressure is adapted while the engine is running. If necessary, the in-tank fuel pump is briefly activated to build up pressure when the driver's door is opened and/or when the ignition is switched on to ensure the necessary fuel pressure to start the engine. The electric in-tank fuel pump is self-priming and forms a sensor-delivery unit together with the lever sensor for the main chamber. A wiper potentiometer in three-wire technology is used as a sensor for the fuel level indicator.

The signals of the fuel level sensor are transmitted directly to the control unit for the instrument cluster via electric lines. The fuel filter is located in the area of the right underbody. It is protected against soiling and excessively low ambient temperatures by the underbody protection. On the Macan S Diesel, the return line from the fuel pressure regulating valve and injectors is connected with the supply line upstream of the fuel filter.

That is why the fuel filter on the Macan Diesel only needs two connections:

- the intake from the in-tank fuel pump and
- the supply line in the direction of the fuel high-pressure pump

Misfueling prevention

The mechanical misfuelling protection familiar from the Panamera is used in the Macan S Diesel. Fuel nozzles for gasoline and diesel at fuel pumps have different diameters. The diameter of the diesel fuel nozzle is bigger than the gasoline fuel nozzle. A mechanical device prevents the flap in the tank filler neck opening

Misfuelling prevention device closed (nozzle for gasoline)

The spout diameter of the fuel nozzle for gasoline is not wide enough for the springloaded pawl to unlatch the flap in the tank filler neck. The flap prevents the fuel nozzle being inserted into the tank filler neck; misfuelling is not possible.

Misfuelling prevention device open (nozzle for diesel)

The larger diameter of the fuel nozzle for diesel pushes the pawl outwards and opens the spring-loaded flap in the tank filler neck. The flap is opened against spring force by inserting the nozzle. The vehicle can be refuelled.

Incorrect fuel

One of the most frequent faults in the injection system on diesel vehicles is caused by misfuelling, or in some cases also by using poor-quality diesel. Operating the engine with the wrong fuel (gasoline, lower-quality diesel, biodiesel, etc.) will generally result in mechanical damage in the high-pressure pump first of all because only diesel of sufficient quality has adequate lubrication properties. The increased mechanical wear causes abraded particles (swarf) to form within the CP 4.2. The metal filings gradually contaminate the entire fuel system. First the swarf enters the high-pressure components, and the metal particles later also enter the fuel tank via the return line. From there, the filings are carried to the fuel supply system on the low-pressure side.

Using the wrong fuel can not only result in increased wear to moving components in the fuel system, but also entail further damage e.g.:

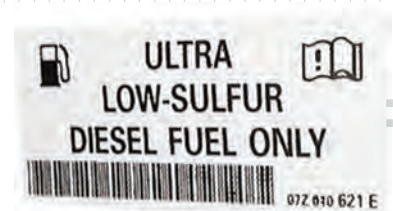
- Damage to/corrosion of seals by aggressive components (greatly increased sulphur content, aggressive acids) in the fuel
- Accelerated dilution of the engine oil when using fuel of inferior quality (injection quantities are increased)
- Thickening of the engine oil (excessive aromatic content in the fuel)
- Clogging of the injector outlet holes and the diesel particle filter by aromatics and/or impermissibly high sulphur content in the fuel
- Damage to/impairment of the entire exhaust system, in some cases formation of a green substance that is liquid when hot and hardens when cold (impermissibly high sulphur content in the fuel)



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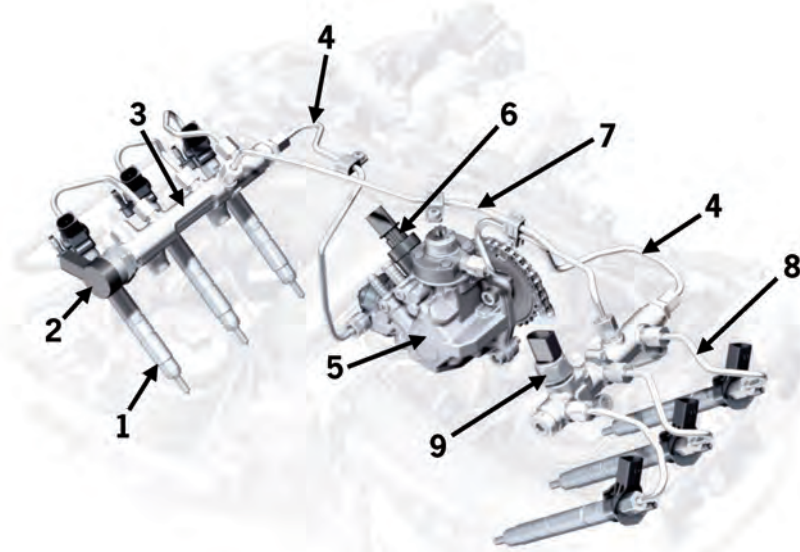
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- 1 Piezo injector
- 2 Regulating valve for fuel pressure
- 3 Rails (pressure reservoirs)
- 4 High-pressure lines for high-pressure pump to rails
- 5 High-pressure pump CP 4.2
- 6 Fuel metering valve
- 7 High-pressure connecting line for rails
- 8 High-pressure connecting line for injectors
- 9 Fuel high-pressure sensor



Caution: Danger of accident and destruction! The safety and cleanliness instructions in accordance with the current safety literature must be observed for all work on the fuel high-pressure system.

Fuel supply, high-pressure side



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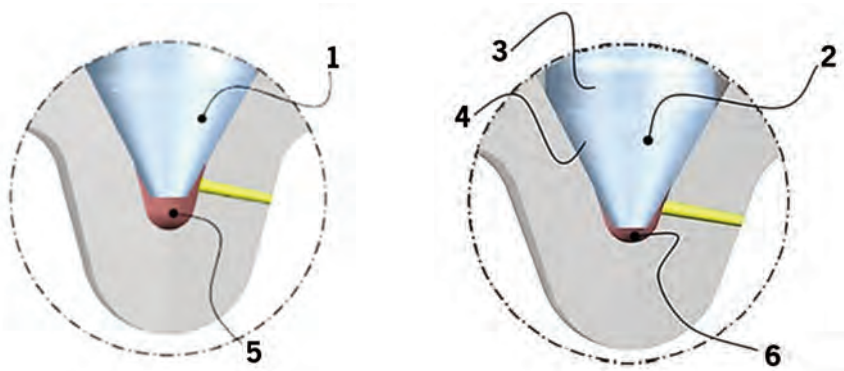
The Bosch Common Rail system CRS3-20 with piezo injectors is used as the high-pressure injection system. The maximum rail pressure is 29,000 psi (2,000 bar). The rail pressure is generated by a two-plunger high-pressure pump, the CP 4.2 with aluminum housing. The high-pressure pump is located on the transmission side in the inner V of the cylinder block below the turbocharger. It is driven directly by the chain for auxiliary drives. A ratio of 1:0.75 with respect to the crankshaft was chosen to ensure that delivery is synchronous with fuel injection. Since the 2-plunger high-pressure pump is actuated by a double cam, this means that there are six deliveries in two crankshaft revolutions. Pump mounting on the engine is phase-orientated in order to minimize the chain forces. The fuel injection quantity differences between the individual cylinders, which are particularly important for low emissions, are extremely low over the whole map range. The piezo injectors are connected to the forged rails by very short stainless steel lines.

Injectors

The injectors in the Macan S Diesel and the fuel injection strategy were optimally adapted in order to:

- keep the fuel consumption as low as possible
- achieve high running smoothness of the engine and
- permit reliable and fast regeneration of the diesel particulate filter

When designing the injectors, great importance was attached to a small flow quantity and the lowest possible counter-pressure in the return line of the injectors. The previously required (Panamera and Cayenne up to MY 11) pressure control valve in the injector return line has been replaced by a small restrictor where the two return lines from the injectors of the two cylinder banks meet. The smaller flow quantity was achieved by a modified sac hole geometry (improved Midi sac hole) on the injector, which leads to lower NO_x emissions. The modified needle seat (ZK needle seat – cylindrical collar with conical seat) makes the injector less sensitive to coatings and deposits from the fuel.



ZI needle seat with Midi sac hole

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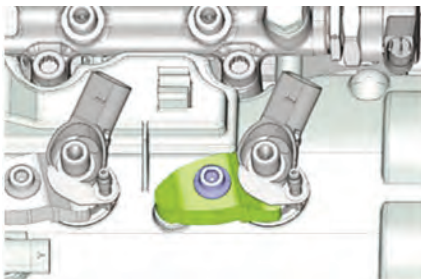
Old version

ZK needle seat with i-Midi sac hole

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New version

The injectors are secured by way of clamping claws on the outside of the valve cover. This means that it is not necessary to remove the valve covers to install and remove the injectors.



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On the second-generation diesel engine, the DME control unit can generate up to two pre-injections, the main injection and up to three post-injections. The three post-injections serve to regenerate the diesel particulate filter (DPF).



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- 1 ZI needle seat
- 2 ZK needle seat
- 3 Cylinder
- 4 Cone
- 5 Midi sac hole
- 6 i-Midi sac hole

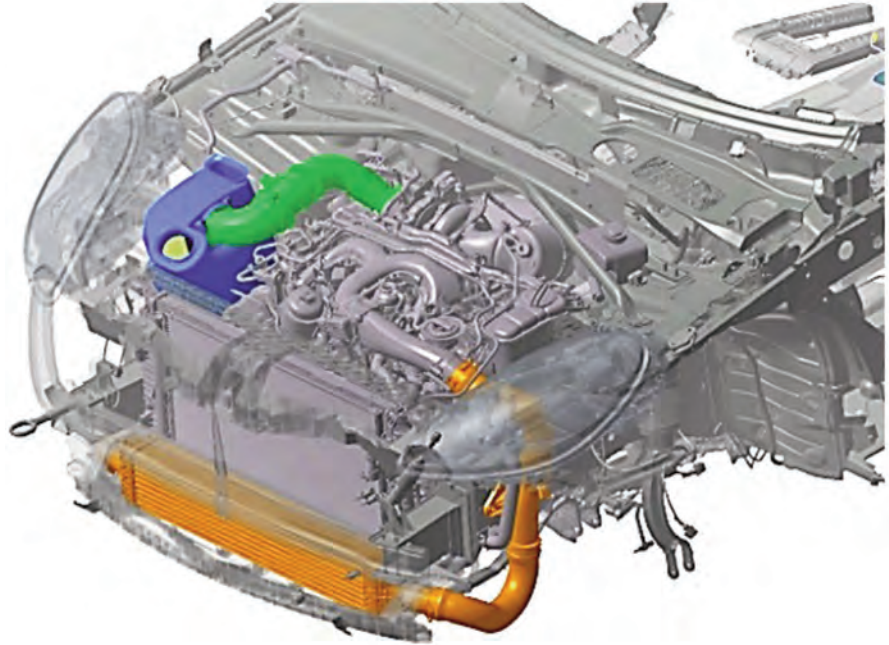


Note!

It may be necessary to renew parts when an injector is removed and installed. The instructions in the Workshop Manual

2.10 Intake system

Air routing



Throttle valve and exhaust gas recirculation inlet

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Routing of the intake air through the hood essentially corresponds to the air routing for the gasoline engines, but with only one air cleaner on the right side. The air is routed from the air cleaner to the intake side of the turbocharger, is compressed there and is cooled by the charge-air cooler. The compressed and cooled air reaches the throttle valve module via a plastic pipe. After the throttle valve module, the recirculated exhaust gas is fed into the intake tract using a thermally-isolated stainless steel construction in such a way as to achieve favorable flow characteristics. Actuation of the throttle valve is necessary in order to generate a vacuum. This is a precondition for recirculation of the exhaust gases.

The NO_x and soot content decreases. Thanks to the geometric design for exhaust gas infeed, wall deposits on the inner wall of the plastic pipe are avoided in all operating points and good mixture characteristics are ensured at the same time. The throttle valve is also actuated for regeneration purposes and to improve the engine's switch-off behavior.

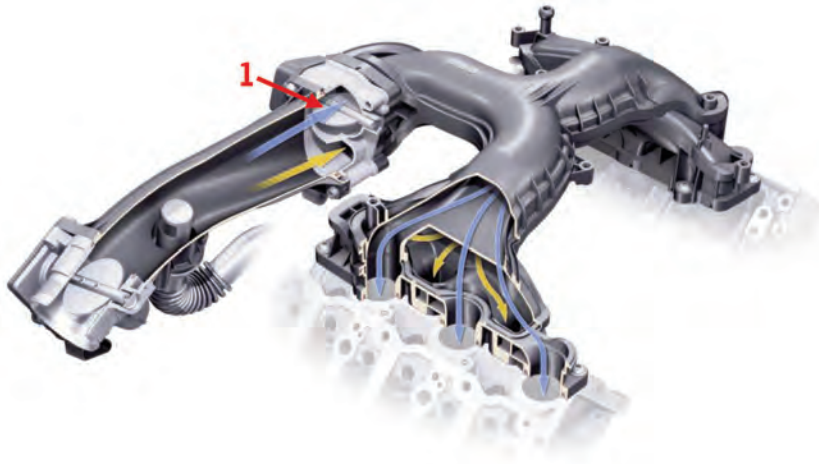


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- 1 Exhaust inlet from EGR valve
- 2 Throttle valve

Swirl flap

In the second-generation 3.0 l diesel engine, swirl flap control is performed only by one swirl flap. Switching of the swirl flap takes place steplessly depending on load and engine speed in order to achieve good swirling at low load and good charging at high rpm.



1 Central swirl flap

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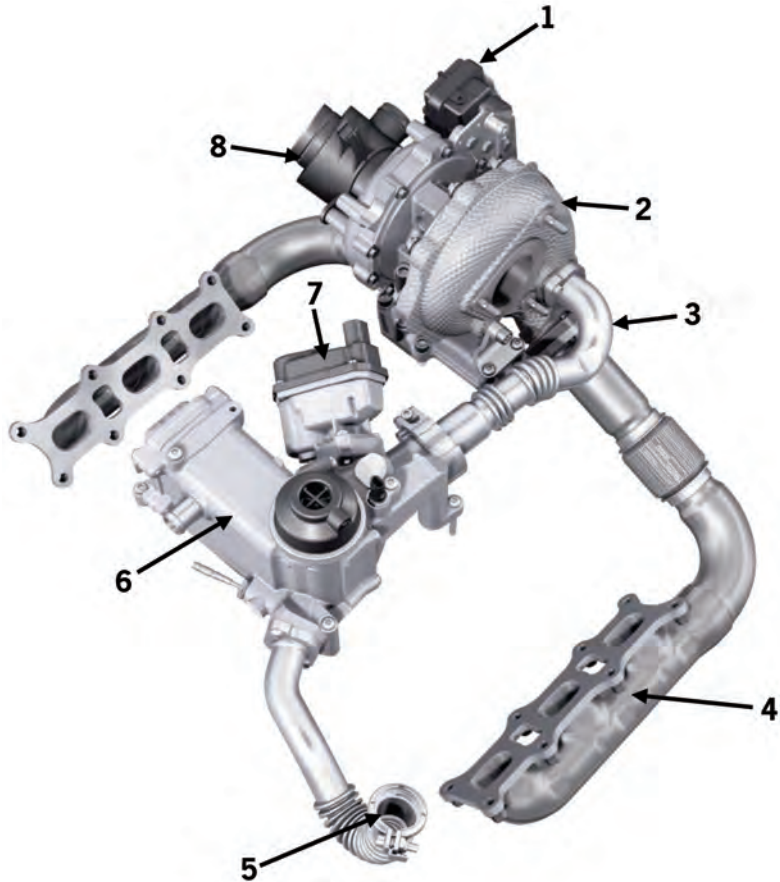
Two-part intake manifold

Downstream of the central swirl flap, the intake manifold is realized in twin branches up to the two cylinder banks. The upper half routes the air into the filling ports and the lower half routes the air into the swirl ports. If the swirl flap closes the filling ports in the lower rpm range, for example, the cylinders are filled with air only via the swirl ports. The gas speed increases and therefore also the swirl effect. This results in better filling of the cylinders and more effective combustion. The plastic intake manifold comprises three shells that are friction-welded together. The intake manifold geometry has been matched with respect to pressure loss and equal distribution of the air flows to the individual cylinders.

Turbocharging

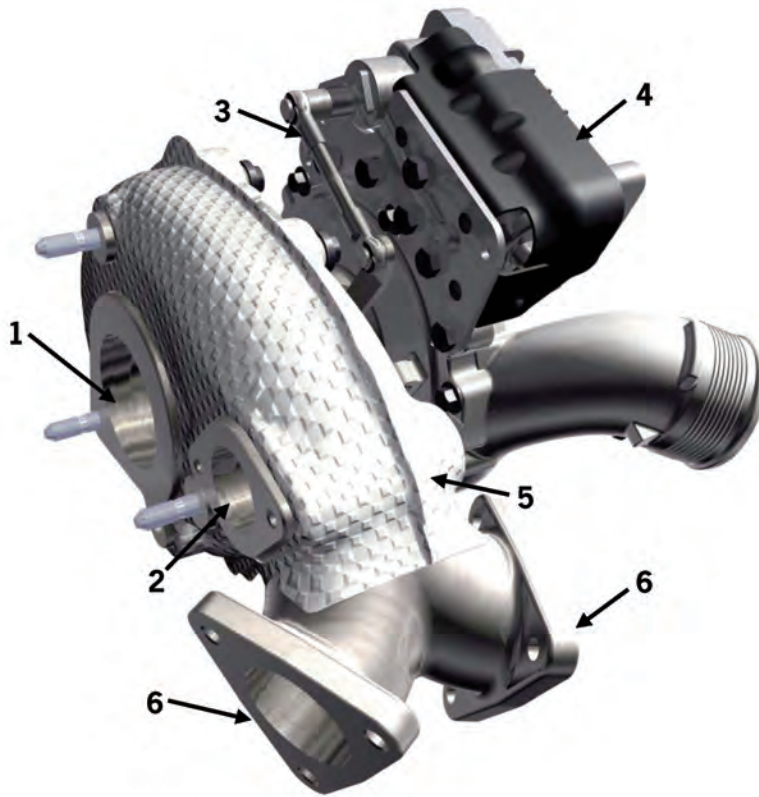
A revamped, smaller Garret VTG turbocharger is used in the Macan S Diesel. The compressor wheel was modified for the part-load range and the turbine wheel efficiency was optimized. This made it possible to increase the maximum boost pressure from 26 psi (1.8 bar) (relative) to 37.7 psi (2.6 bar) (relative).

- 1 Control unit for turbocharger
- 2 Integral insulation
- 3 Exhaust gas recirculation pipe
- 4 Air-gap insulated exhaust manifold
- 5 Recirculated exhaust gas infeed, intake pipe
- 6 Exhaust gas recirculation cooler
- 7 Servo motor for exhaust gas recirculation
- 8 Helmholtz resonator



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A Helmholtz resonator is installed on the charge air side behind the turbocharger for the purpose of noise reduction. As well as using an air gap-insulated exhaust manifold, the exhaust turbine housing of the VTG turbocharger is enclosed with a heat-insulating aluminum foil (integral insulation) in order to reduce the heat emitted by the exhaust gases into the engine compartment and to effectively transfer the exhaust-gas temperature to the oxidation catalytic converter and the diesel particulate filter. The operating temperature of the catalytic converter and the necessary ignition temperature for the soot particles deposited in the diesel particulate filter are reached even more quickly and emissions are reduced.

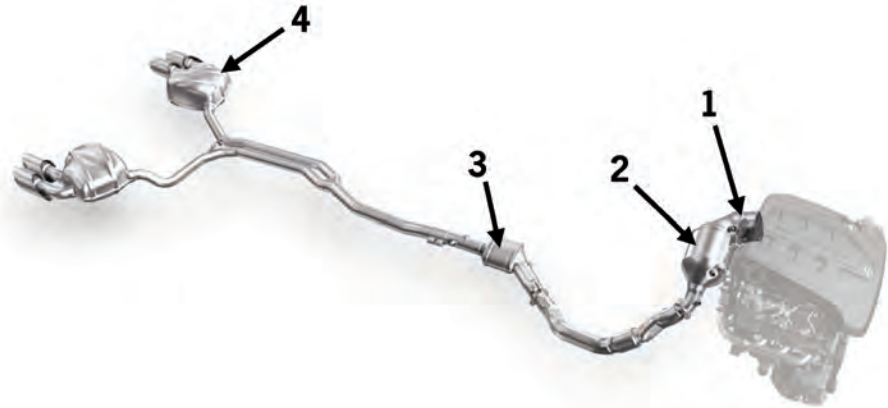


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The engine oil lubrication supply and return lines at the turbocharger are now integrated in the bearing pedestal and therefore in the turbocharger housing. The design keeps the number of individual components and interfaces small and reduces the risk of oil leaks. The intake manifold with its very low throttling losses and the intake ports with optimized swirl and flow rate contribute to good internal engine turbocharging capability. Both of these permit good cylinder charging combined with low charge cycles losses. The exhaust-gas temperature sensor mounted on the exhaust side serves the purpose of component protection. If the turbocharger becomes too hot, the maximum boost pressure is reduced until the temperature of the component is back within the required range.

- 1 Oxidation catalytic converter
- 2 Diesel particulate filter
- 3 Slip catalyst
- 4 Main mufflers

2.11 Exhaust system/emission control



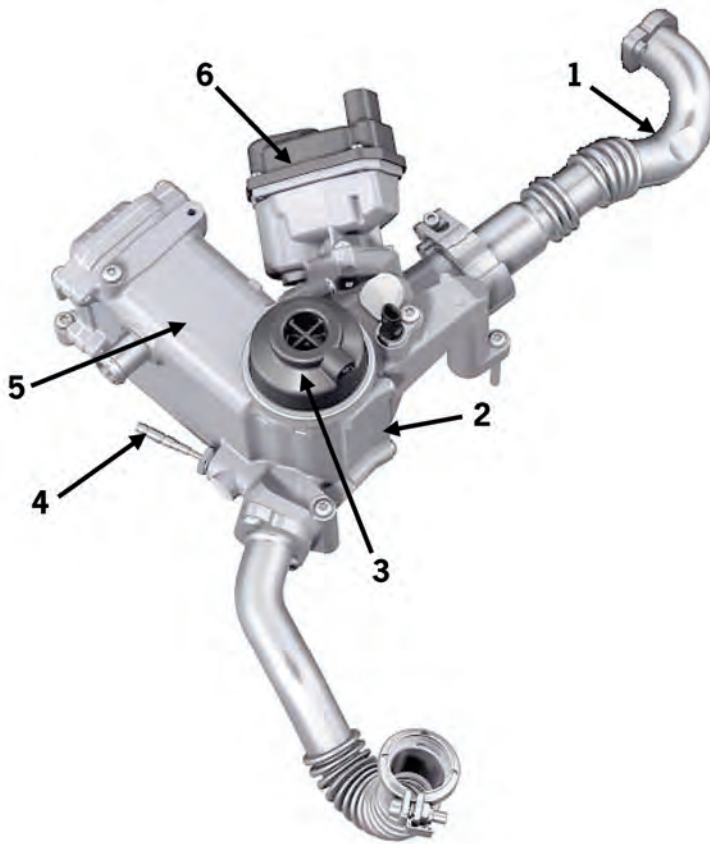
Exhaust system of Macan S Diesel

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Reduction of emissions

The reduction of pollutants in exhaust emissions and here above all nitrogen oxides (NO_x) is a challenge faced by automotive manufacturers all over the world. The new statutory limit values of the EURO 6 standard and the international parallel regulations on emission limits, e.g. BIN 5, Tier 2 and LEV III, must be observed. In a first step, it is attempted to keep production of pollutants and thus raw emissions as low as possible by internal engine measures and new combustion processes (friction optimization, improved cylinder charging or reduced combustion temperature by way of low-temperature exhaust gas recirculation). In a second step, an oxidation catalytic converter converts carbon monoxide (CO) and uncombusted hydrocarbons (HC) into carbon dioxide (CO_2) and water (H_2O). Finally, a diesel particulate filter retains extremely fine soot particulates, before the NO_x emissions are further reduced in a selective catalytic reduction (SCR) process by the use of synthetic urea.

Exhaust gas recirculation (EGR)



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The exhaust gas recirculation system plays an important role in ensuring that the exhaust emissions levels are not exceeded. For high exhaust gas recirculation rates, the exhaust gas is removed via a connection optimized for pressure loss on the turbo-charger housing upstream of the turbine and, depending on the operating condition, supplied to the intake area downstream of the throttle valve via the EGR valve.

EGR module

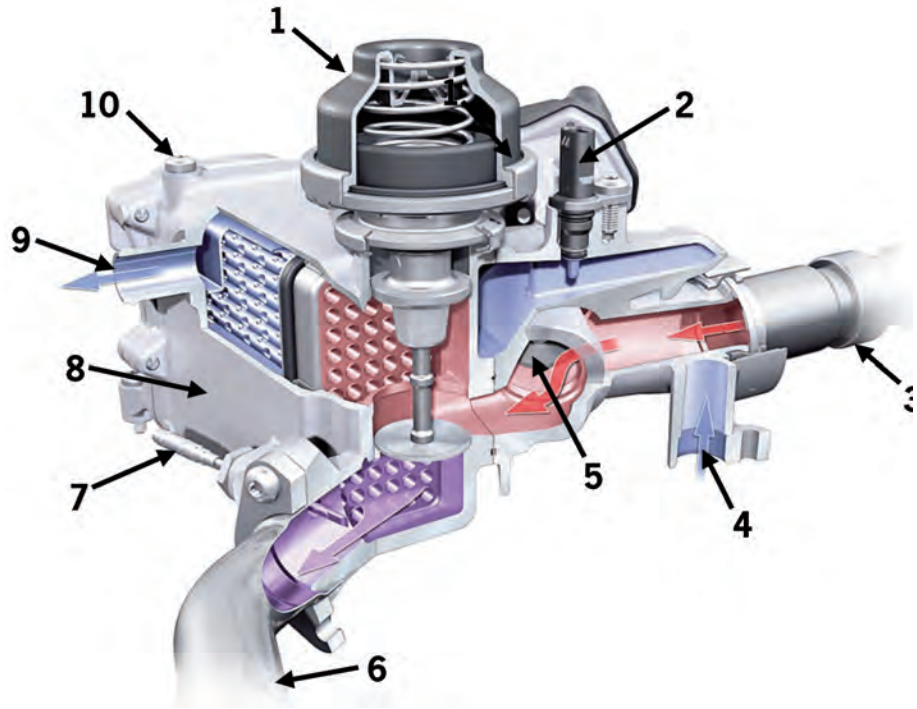
All the functional elements of the exhaust gas recirculation system are installed in the EGR module. It consists of the EGR valve, EGR cooler, bypass valve and exhaust-gas temperature sensor. The exhaust-gas temperature sensor is used for diagnostic purposes (bypass valve function, coking of the exhaust gas section). The coolant temperature sensor for the DME control unit is located in the module housing.

EGR valve

The electronically actuated EGR valve located on the “hot side” can be continuously adjusted. The pressure loss is kept low by the large seat diameter of 30 mm.

- 1 Bypass valve for EGR cooler
- 2 DME coolant temperature sensor
- 3 Exhaust gas supply (from VTG turbocharger)
- 4 Coolant supply from cylinder head
- 5 EGR valve
- 6 Diversion of exhaust gases to intake manifold
- 7 EGR exhaust-gas temperature sensor
- 8 EGR cooler
- 9 Coolant drain (to oil filter module thermostat housing)
- 10 Bleeder screw

Switchable cooler for exhaust gas recirculation



2_59_13

The EGR cooler in stainless steel tubular design is integrated in the aluminum housing of the module and again offers increased cooling performance in the Macan S Diesel. A pneumatically actuated poppet valve is used to bypass the EGR cooler. In contrast to an EGR flap, which still leaves an unavoidable gap open even in closed condition, the sealing seat of the poppet valve guarantees tightness in cooling operation for good cooling performance.

Exhaust gas aftertreatment

After the exhaust gases have left the cylinder heads and exhaust manifold, they first flow through the oxidation catalytic converter. There, carbon monoxide (CO) and hydrocarbons (HC) are oxidized to carbon dioxide (CO₂) and water vapor (H₂O). Due to the oxygen surplus, reduction of the nitrogen oxides (NO_x) is not yet possible here. Downstream of the oxidation catalytic converter and still ahead of the diesel particulate filter with SCR coating, the synthetic urea AdBlue® is metered via the reducing agent injector at a corresponding exhaust temperature.

Different chemical processes then take place:

1. When the reducing agent is injected into a hot gas flow, the water evaporates first.



2. Thermolysis then takes place, where the urea decomposes into isocyanic acid and ammonia.



3. If hot surfaces are available, the isocyanic acid can be converted by hydrolysis into carbon dioxide and a further molecule of ammonia.



4. Ammonia is stored in the particulate filter with SCR coating and reacts with nitrogen monoxide (NO) and nitrogen dioxide (NO₂) from the exhaust stream to produce nitrogen (N₂) and water (H₂O).



Diesel particulate filter – DPF

Integration of the SCR coating in the particulate filter with a copper zeolite permits a close-coupled arrangement of the system. After a cold engine start, the operating temperature of the SCR catalytic converter is reached more quickly and is also maintained for longer under conditions with low engine load.



Note!

The water necessary for the reaction is available in the exhaust flow as a reaction product from the engine combustion processes. In this way, two molecules of ammonia can be obtained from one urea molecule and used for reactions at the particulate filter with SCR coating.



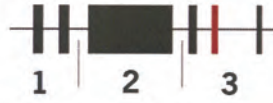
Note!

The reducing agent used is a highly-pure, transparent 32.5-percent urea/water solution which is marketed under the brand name AdBlue®.

The reducing agent is non-toxic, nonflammable, biologically degradable and classified in the lowest water hazard category. It is not a hazardous substance or hazardous goods.

Thermolysis = A chemical reaction where the starting material is decomposed into several substances by heat

Hydrolysis = Splitting of a chemical compound by water



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- 1 Pre-injection
- 2 Main injection
- 3 Post-injection



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**Note!**

In chemistry, an exothermic reaction (usually chemical) is one where energy is released into the surroundings in the form of heat.

Injection strategy

The DPF continues to perform its previous function of filtering soot particulates. In order to determine the loading of the particulate filter, the exhaust pressure is measured upstream and downstream of the particulate filter and not with respect to atmospheric pressure. If necessary regeneration is detected, this is initiated by an additional second post-injection closely following the main injection. A total of six injections can be carried out.

Second post-injection

The second post-injection close to the main injection is necessary because:

- the combustion temperature in the Macan S Diesel during combustion of the diesel fuel is relatively low due to its low fuel consumption during engine operation and the Auto Start Stop system
- the risk of an overloaded DPF, particularly when driving short distances, had to be further reduced

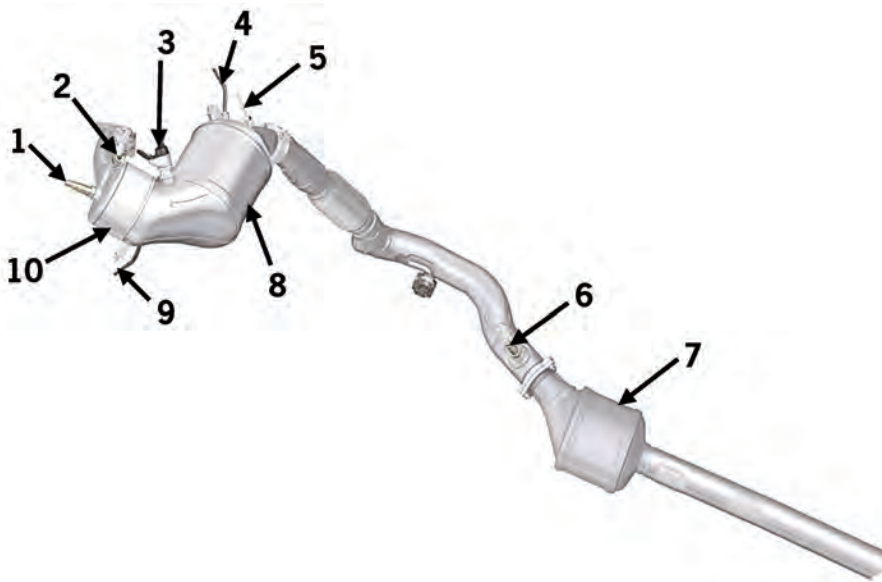
The disadvantage of the low fuel consumption is that the combustion chambers cool down. The injection strategy therefore had to be adapted to achieve the necessary regeneration temperatures. Rather than just compensating for the temperature deficit, the additional post-injection improves it. The probability of requiring regeneration initiated by PIWIS Tester II in the workshop is further reduced.

Third post-injection

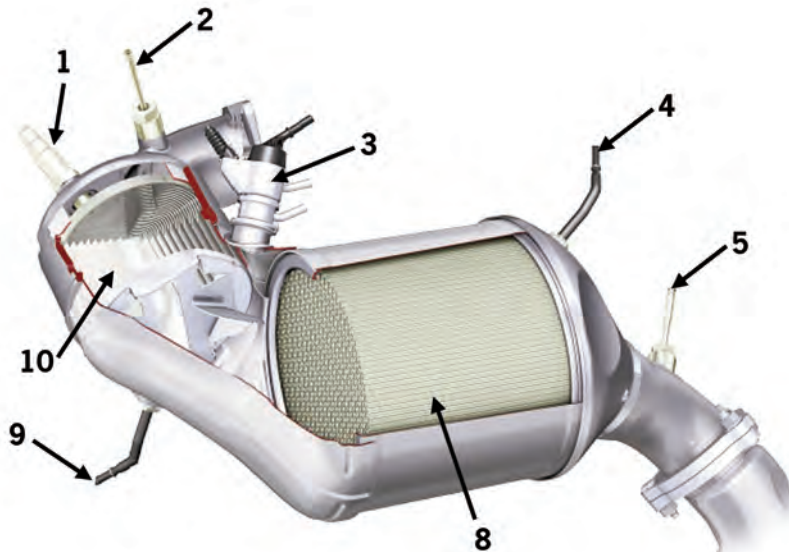
During the regeneration phases, the main injection is initially followed by two post-injections close to the combustion point. The third post-injection takes place later on its own. The purpose of the third post-injection is to produce an exothermic reaction in the oxidation catalytic converter; it uses very small injection quantities and helps to achieve the necessary ignition temperature for the diesel particles in the filter. During the exothermic reaction, the fuel injected when the exhaust valves are open reaches the oxidation catalytic converter without igniting. The fuel is converted into heat in the oxidation catalytic converter without a flame forming. The additional heat is transported into the diesel particulate filter by the exhaust flow.

Components of the SCR system (selective catalytic reduction)

The exhaust gas aftertreatment system consists of the reducing agent tank system with water-cooled injector for reducing agent, a close-coupled oxidation catalytic converter, an SCR-coated diesel particulate filter and an ammonia slip catalyst upstream of the main mufflers.



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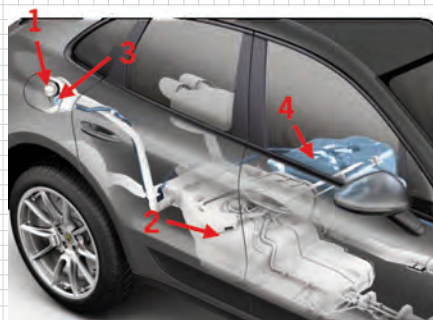


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- 1 Electrical connection
- 2 Connection for AdBlue® line
- 3 Coolant return
- 4 Coolant supply
- 5 AdBlue® outlet



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- 1 Fuel filler neck
- 2 Fuel tank
- 3 AdBlue® filler neck
- 4 Reducing agent tank

The exhaust-gas temperature sensors upstream and downstream of the oxidation catalytic converter are used to monitor the operating temperature in the oxidation catalytic converter. At the same time, these values of the two exhaust-gas temperature sensor are important measured variables for regeneration of the diesel particulate filter. In order to determine the loading of the particulate filter, the exhaust pressure is measured upstream and downstream of the particulate filter and not with respect to atmospheric pressure. The exhaust-gas temperature sensor downstream of the diesel particulate filter monitors the regeneration temperature.

Injector for reducing agent

The metering device for a reducing agent, AdBlue®, in the exhaust system comprises, amongst other things, a control valve, a metering valve and a cooling device. The cooling device is realized as a cooling jacket. This is connected with the cooling system of the engine and ensures effective cooling of the metering valve. The coolant flows through the injector in coolant ducts. By way of counterflow cooling, the cooled coolant enters the injector at the bottom, flows through the injector and is then fed back into the cooling system at the top.

Ammonia slip catalyst

An ammonia slip catalyst is installed downstream of the SCR-coated diesel particulate filter which performs two tasks with its combined coating of SCR and oxidation catalytic converters:

- The carbon monoxide (CO) produced by soot regeneration is oxidized to carbon dioxide (CO₂) by the noble metal coating
- As a second task, the ammonia slip catalyst also ensures that no NH₃ (ammonia) leaves the exhaust system under any circumstances. NH₃ is oxidized to N₂ and H₂O here

Reducing agent tank

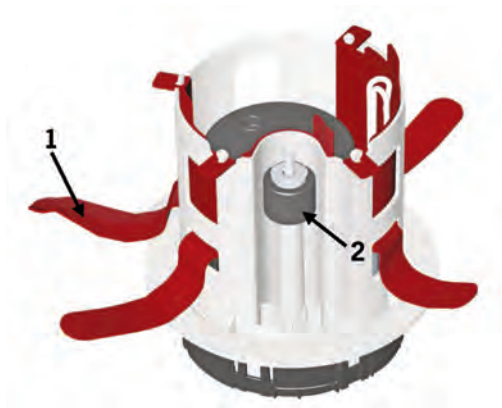
The reducing agent tank is located on the underbody on the left next to the fuel tank. The connector for the filling line, the aeration and vent lines and the drain connection are located in the outside area of the reducing agent tank. The control unit for the reducing agent metering system and the swirl pot are also installed on the tank.

This swirl pot contains the pump for the reducing agent and accommodates the sensors for the reducing agent temperature, reducing agent pressure, level and the heater for the reducing agent system inside the pot. The connection for the heated metering line to the water-cooled reducing agent injector and the connector for the electrical connections are located outside the swirl pot.

Swirl pot

The swirl pot is installed in the reducing agent active tank from below and contains the following components:

- Reducing agent pump
- Pressure sensor for reducing agent metering system
- Heater for reducing agent tank with heating element
- Reducing agent filter
- Tank level sensor for reducing agent
- Temperature sensor for reducing agent



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Since the reducing agent has the property of freezing at 12° F (-11° C), the reducing agent metering system is equipped with a heater. The swirl pot contains an integrated heating element which heats the swirl pot with all internal components (resistance heater). The metering line to the reducing agent injector, which is located outside the pot, is also heated by a resistance heater.

- 1 Heating for reducing agent
 - Resistance in flexible silicone mat
 - Total power 120 W
- 2 Tank level sensor for reducing agent
 - Multi-reed switch with magnetic float
 - 6 usable levels

Pressure sensor for reducing agent

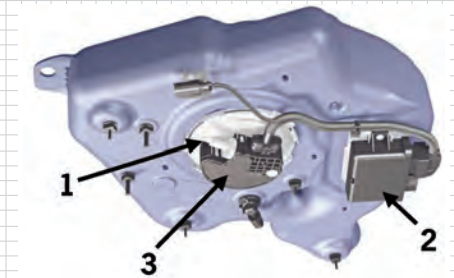
- Piezo pressure sensor
- Operating range: -7.25....130 psi (-0.5...9 bar)

Reducing agent pump

- Gear pump with brushless motor
- Delivery pressure 72.5 psi (5 bar)
- Pressure or rpm control

Temperature sensor for reducing agent

- NTC
- Operating range: -40° F...176° F (-40 °C...80 °C)



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- 1 To the injector for reducing agent
- 2 Control unit for reducing agent metering system
- 3 Swirl pot

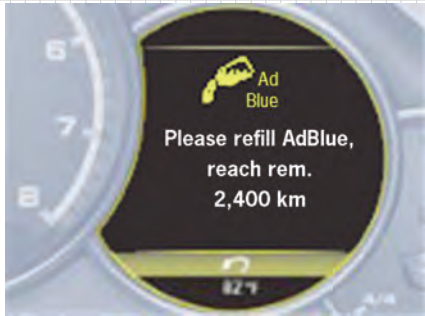
Warnings and display strategy

The displayed remaining range is calculated on the basis of the remaining reducing agent quantity in the tank and the reducing agent consumption. A message is sent to the instrument cluster as the reducing agent level falls starting at 1,500 miles (2,400 km). The message is repeated depending on time or distance covered.

Fill level, stage 1

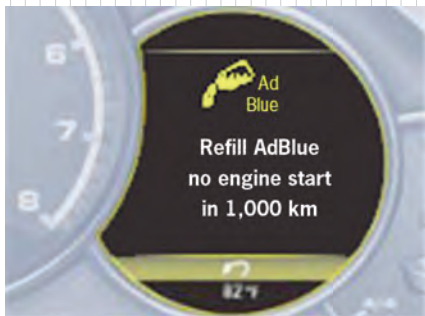
This information for the driver is displayed when the remaining range with the AdBlue® fill level is only 1,500 miles (2,400 km). AdBlue® has to be topped up.

The step interval of the remaining range display is 62 miles (100 km).



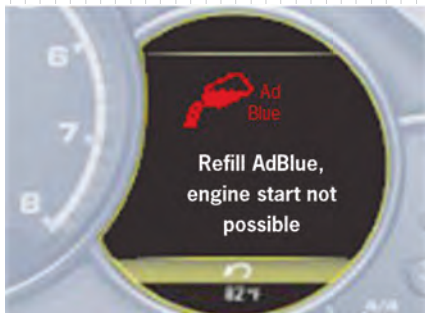
Fill level, stage 1

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Fill level, stage 2

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Fill level, stage 3

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Fill level, stage 2

This information for the driver is displayed when the remaining range with the AdBlue® fill level is only 600 miles (1,000 km). AdBlue® must be topped up, otherwise it will no longer be possible to restart the engine after the specified range when the engine has been switched off.

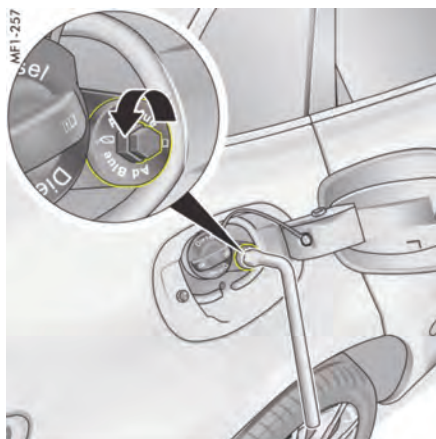
The step interval of the remaining range output is 31 miles (50 km).

Fill level, stage 3

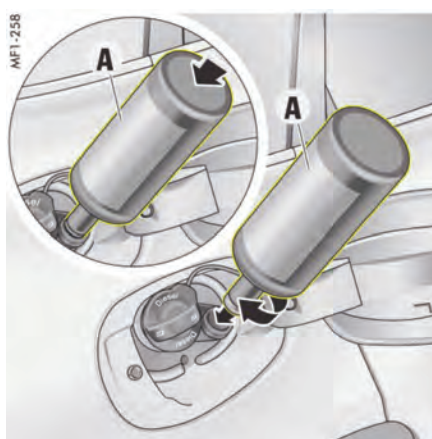
This information for the driver is displayed when there is no more AdBlue® in the reducing agent tank. AdBlue® must be topped up, otherwise it will no longer be possible to start the engine when it has been switched off.

Refilling AdBlue®

The reducing agent tank in the vehicle is filled via the AdBlue® filler neck at the right next to the diesel filler neck. The AdBlue® tank of the Macan S Diesel has a capacity of approximately 6 Gal. (23 liters). Various size containers are available to the customer through the Porsche dealership's parts department for refilling AdBlue®.



Excerpt from the Owner's Manual 2_71_13



2_72_13

Only use AdBlue® approved by Porsche, which meets the requirements of ISO 22241-1. Refill at least 6 qts. (5.7 liters) of AdBlue® (corresponds to three Porsche-recommended AdBlue® refill containers, see A in illustration).

Macan

DME engine electronics

2



Note!

The instructions and specifications of the current service literature must always be observed.



AdBlue® is a corrosive fluid that can irritate the skin and damage your eyes, mucous membranes and respiratory tract.

- In the event of contact with the skin, eyes and mouth, wash off immediately with plenty of clean water (for approximately 15 minutes). Contact a doctor if necessary
- If swallowed, do not induce vomiting unless instructed to do so by a doctor. Seek medical attention immediately



Note!

AdBlue® corrodes surfaces such as painted vehicle parts, plastics, clothing and carpets.

- Clean off spilled AdBlue® immediately using a wet cloth and plenty of cold water
- Remove crystallised AdBlue® using warm water and a sponge

2.12 Glow System

The glow system is activated only after the ignition is switched on (terminal 15). The engine starts automatically after the initial terminal 50 signal as soon as the cylinders have been sufficiently preheated, i.e. the driver does not need to turn the ignition key again during the preglow process. If the starter does not start immediately when terminal 50 is activated via the ignition key, it means that the preglow function is still active; this is indicated to the driver by way of the glow indicator light until the engine starts.

The DME control unit also uses the ambient temperature in addition to the engine coolant temperature to calculate the necessary glow time. With moderate coolant and ambient temperatures, the preglow time is so short that the time it takes the engine to start is comparable with petrol engines. The glow elements reach their operating temperature of approximately 1832° F (1000° C) within 2 seconds. In addition to preglowing, the functions of post-glowing and intermediate glowing are also implemented in the Macan S Diesel. A new feature that a pressure sensor is integrated in the glow plugs of the second and fifth sensors in each case. These so-called PSG (Pressure Sensor Glow Plug) glow plugs allow measurement of the combustion pressure in the cylinder combustion chamber. The DME control unit can therefore adapt the injection timing by way of cylinder pressure-controlled combustion and can thus also optimally adapt the pressure characteristic of combustion to different fuel qualities and exhaust gas recirculation rates.

- 1 Diaphragm with piezoresistive effect for pressure detection
- 2 Axially displaceable heating element



2_73_13

The combustion development is determined from the pressure signal of the combustion chamber pressure sensor and the engine speed signal. A correction value is calculated for the target combustion development on the basis of the deviation from the target/actual value comparison, and this value is applied both in the injection and air systems. The fuel quality, and the cetane number in particular, has a major influence on combustion development and the burn-through rate. With a low cetane number, the ignition capability of the fuel is reduced and the ignition delay significantly increased as a result. The center of combustion is retarded. This leads to misfires and incomplete combustion processes.

2.13 Cooling system

Auto Start Stop function

The Auto Start Stop function largely corresponds to that of the gasoline engines. In addition to the familiar stop prevention factors such as engine temperature, air conditioning system, energy management or vacuum for brake booster, an Auto Stop can also be prevented on the Macan S Diesel if regeneration of the diesel particulate filter is active. Refer to the Owner's Manual for other conditions.

Thermal management

Diesel engines reach the required operating temperature more slowly than gasoline engines. There are lower heat losses during combustion of the fuel in the combustion chambers than with gasoline engines for the specific aim of achieving low fuel consumption when the engine is at operating temperature. Getting the engine to warm up as quickly as possible offers huge additional fuel-saving potential. In order to accelerate this process, the Macan S Diesel is equipped with a comprehensive thermal management system. The modern thermal management system increases efficiency.

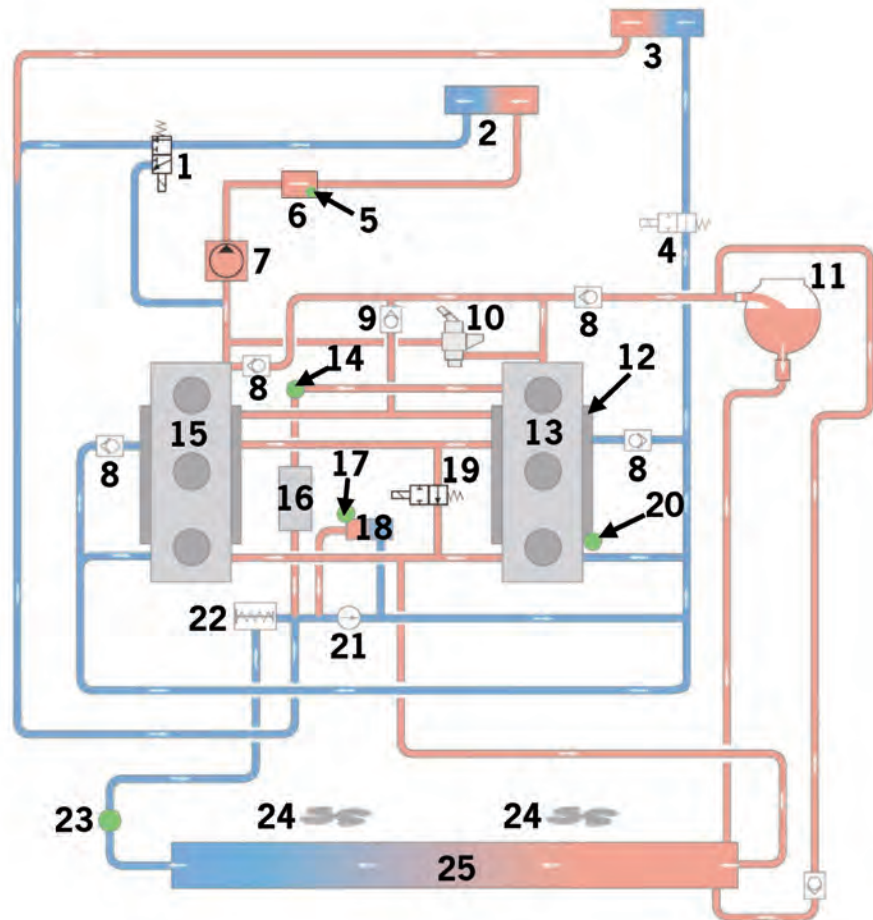
The increase in efficiency is achieved by:

- getting the diesel engine to heat up as quickly as possible and
- having a coolant temperature in the engine block of 221° F (105° C) when the engine is at operating temperature

It was possible to meet the requirements for the cooling system through use of a cooling system with split-cooling concept. The concept also includes an engine oil side oil cooler bypass that is switched via a thermostat in order to further assist fast warm-up.

Functional diagram of thermal management

- 1 Switch-over valve for independent heating mode (optional), shut-off valve for auxiliary heater
- 2 Heater heat exchanger
- 3 ATF heat exchanger
- 4 Shut-off valve for ATF heat exchanger
- 5 Temperature sensor for engine-independent heater/auxiliary heater
- 6 Engine-independent heater (optional)/auxiliary heater
- 7 Electric coolant pump for heater heat exchanger
- 8 Check valve
- 9 Check/vent valve
- 10 Injector for reducing agent
- 11 Coolant expansion tank
- 12 Engine block
- 13 Cylinder head, bank 2
- 14 DME coolant temperature sensor
- 15 Cylinder head, bank 1
- 16 EGR cooler
- 17 Engine oil temperature sensor
- 18 Oil cooler
- 19 Coolant shut-off valve
- 20 Coolant temperature sensor for thermal management
- 21 Mechanical coolant pump
- 22 Map-controlled thermostat
- 23 Radiator outlet coolant temperature sensor
- 24 Radiator fan
- 25 Coolant radiator



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Split-cooling concept

A cooling system with split-cooling concept is used in the second generation diesel engine, i.e. coolant flows through the cylinder block and the cylinder heads in two parallel, separate cooling circuits.



Cylinder head cooling

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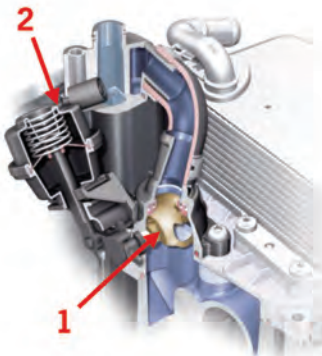


Cylinder block cooling

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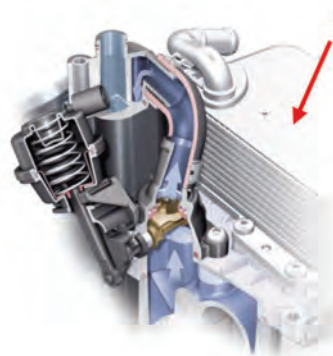
The continuously running coolant pump located at the front end of the inner V delivers the coolant in the cylinder block to the exhaust outlet sides of the engine unit. Here, the volume flow is divided up between the cylinder heads and cylinder block, before it flows back to the intake side of the coolant pump after passing through the two partial circuits.

In order to ensure that the engine block heats up quickly, the cooling system is separated by an electropneumatically activated coolant shut-off valve between the cylinder block and cylinder head cooling circuits.



Coolant shut-off valve closed

2_78_13



Coolant shut-off valve open

2_79_13

- Cylinder block cooling circuit
- Cylinder head cooling circuit

- 1 Ball valve
- 2 Pulldown cell
- 3 Engine oil heat exchanger

Cylinder head cooling

The cylinder head cooling circuit consists of:

- Coolant chambers of the two cylinder heads
- Engine oil and EGR cooler
- ATF heat exchanger
- Heater heat exchanger with PTC auxiliary heater
- Engine-independent heater (option)

A single-stage, map-controlled thermostat with a heatable wax expansion element is available for controlling the cylinder head temperature.

Cylinder block cooling

The cylinder block can be supplied with coolant on the outer sides of the cylinder banks via one check valve on each side. The coolant shut-off valve is activated by the DME control unit as a function of the temperature signal from the coolant temperature sensor for thermal management. The coolant can only flow through the cylinder block when the coolant shut-off valve is open. The coolant flows from the cylinder block to the coolant radiator when the coolant shut-off valve is open.

Check valves

The check valves prevent coolant backflow between the two cylinder banks when the coolant shut-off is closed, which would lead to undesired heat dissipation from the cylinder block.

Operating modes

Cold start, warm-up < 149° F (65° C)

Cylinder head cooling

The thermal management system attempts to keep the temperature in the cylinder head cooling system at 149° F (65° C), but no more than 194° F (90° C), to achieve:

- sufficient valve cooling
- optimum charging of the cylinders with oxygen
- good cooling of the exhaust gases in the EGR cooler

The thermostat is de-energized during the warm-up phase and remains closed with coolant temperatures < 149° F (65° C) in the cylinder heads; no heat energy is dissipated to the main coolant radiator. The coolant is circulated uncooled into the cylinder heads by the mechanical coolant pump. The coolant permanently flows through the oil cooler, even if the oil cooler bypass is active. The coolant shut-off valves upstream of the heat exchangers are opened when necessary to warm up the ATF faster and to heat the passenger compartment.

Cylinder block cooling

The vacuum-controlled shut-off valve for coolant positioned in the coolant outlet of the cylinder block is closed; there is no circulation of coolant in the engine block. The

coolant warms up faster as a result. The setpoint temperature in the engine block is 221° F (105° C). It is detected by the coolant temperature sensor for thermal management. The higher coolant temperature in the engine block shortens the engine's warm-up phase and reduces the friction in the engine. The result is less engine wear and reduced fuel consumption.

Warm-up 149° F – 221° F (65 °C – 105° C)

Cylinder head cooling

The thermostat is energized above 149° F (65° C) and starts to open. If the heating element in the thermostat is faulty, it will open even without being energized above approximately 194° F (90° C). The open thermostat establishes the connection between the cylinder head cooling circuit and coolant radiator. The coolant temperature in the cylinder heads is maintained at 149° F (65° C) for as long as possible. If the temperature can no longer be maintained, the DME control unit assumes 194° F (90° C) as the new setpoint temperature for the cylinder heads. A thermostat located in the engine oil cooling system opens from approximately 217° F (103° C) and releases the engine oil flow so that the oil can be cooled by passing through the oil cooler.

Cylinder block cooling

The shut-off valve remains closed, the coolant in the engine block is standing as long as the coolant temperature is < 221° F (105° C).

At operating temperature >= 221° F (105° C)

Cylinder head cooling

The thermostat is fully open at a coolant temperature of 194° F (90° C) .

Cylinder block cooling

When the engine is fully warm, the temperature level of the cylinder block cooling system is regulated to approximately 221° F (105° C) by opening and closing the vacuum-controlled ball valve. The ball valve is electropneumatically actuated by the DME control unit. The open shut-off valve for coolant establishes a link between the engine block and the cylinder head cooling system. The warm coolant from the cylinder head and cylinder block cooling circuits is mixed before being routed into the coolant radiator and cooled there. The radiator fans are additionally activated if necessary. The cooled coolant is routed from the coolant radiator via the open thermostat to the coolant pump. The coolant pump pumps the cooled coolant back into the cylinder block and the cylinder heads, the circuit is closed. The cooling system features permanent venting.

**Note!**

A shaker, also known as a tactile transducer, is essentially a loudspeaker without loudspeaker diaphragm. This task is performed by the windscreen, which directs the sound into the passenger compartment.

The shaker consists in principle of three components:

the vibrating mass, the terminal for electrical connection with the control unit for tactile sound and the mounting bolt for attachment on the installation surface.

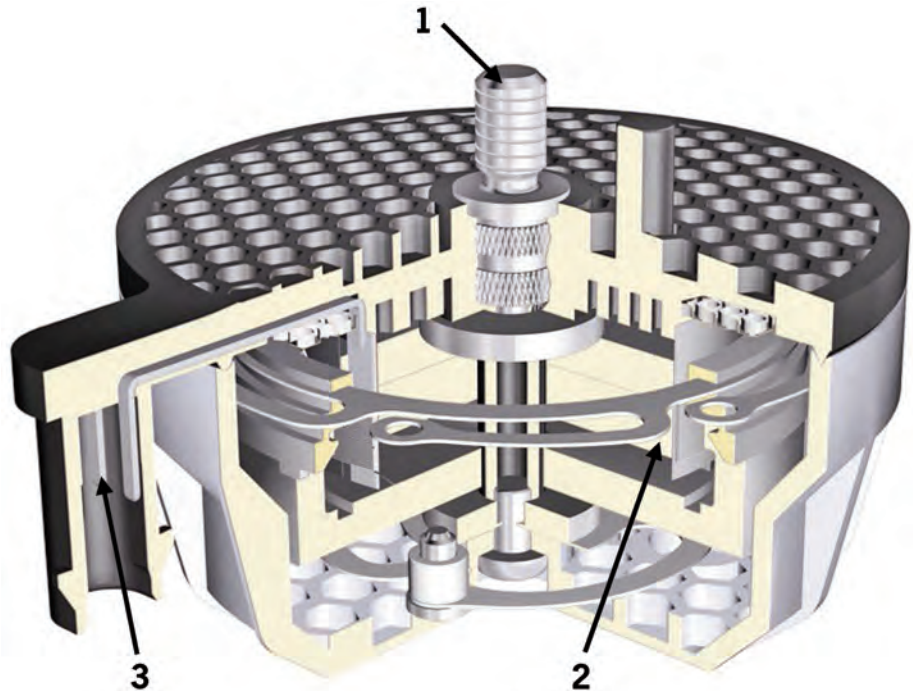
- 1 Mounting bolt with thread
- 2 Vibrating mass
- 3 Electrical connection

2.13 Active sound

Two systems can be optionally installed in the Macan S Diesel to optimize the engine sound. The first system – the shaker – optimizes the engine sound in the passenger compartment, while the second system influences the outside sound by way of an active rear muffler.

Shaker – engine sound optimization in the interior

The system for passenger compartment sound optimization comprises a signal generator, a signal amplifier and a shaker. Different sound files are stored on the control unit for tactile sound which are played back depending on the vehicle and operating data (load, engine speed, driving speed) and forwarded to the shaker. The shaker then generates the tactile sound. This is transmitted into the passenger compartment via the body and windshield. The shaker is installed in the middle of the windshield root using a special holder; it is the “tuning fork” of the system.

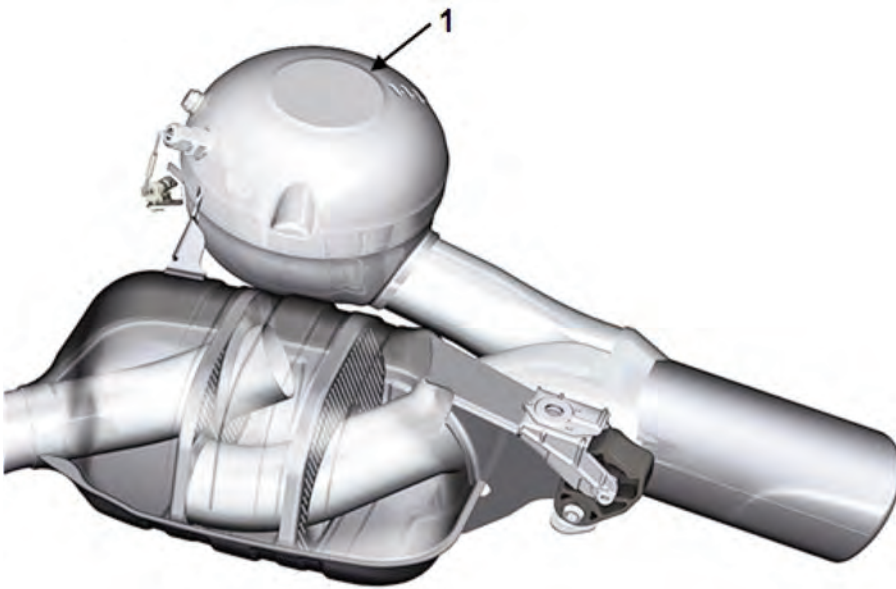


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Active rear muffler – engine sound optimization outside the vehicle

The second system for optimization of the outside sound includes an exhaust system with mounted loudspeaker housings, a control unit for engine noise generation and the two actuators activated by the control unit. The control unit receives vehicle data (engine speed, engine load, driving speed on the Drive CAN). The actuators generate sound waves corresponding to the control unit specifications from the map. The sound module is formed by additional loudspeaker housings on the main mufflers, whose output pipes feed into the tailpipes of the exhaust system. The signal generator, which is installed in the control unit of engine noise generation, generates a spectrum of vibrations dependent on the engine operating state.

The signal spectrum is amplified into a power signal in the control unit for engine noise generation and is converted into sound waves by the actuator. The Active Sound system is able to generate specific frequencies (engine orders) in order to achieve a desired sound design. In contrast to conventional exhaust systems with passive mufflers, the exhaust sound can be adapted to the driving situation.



1 Active rear muffler

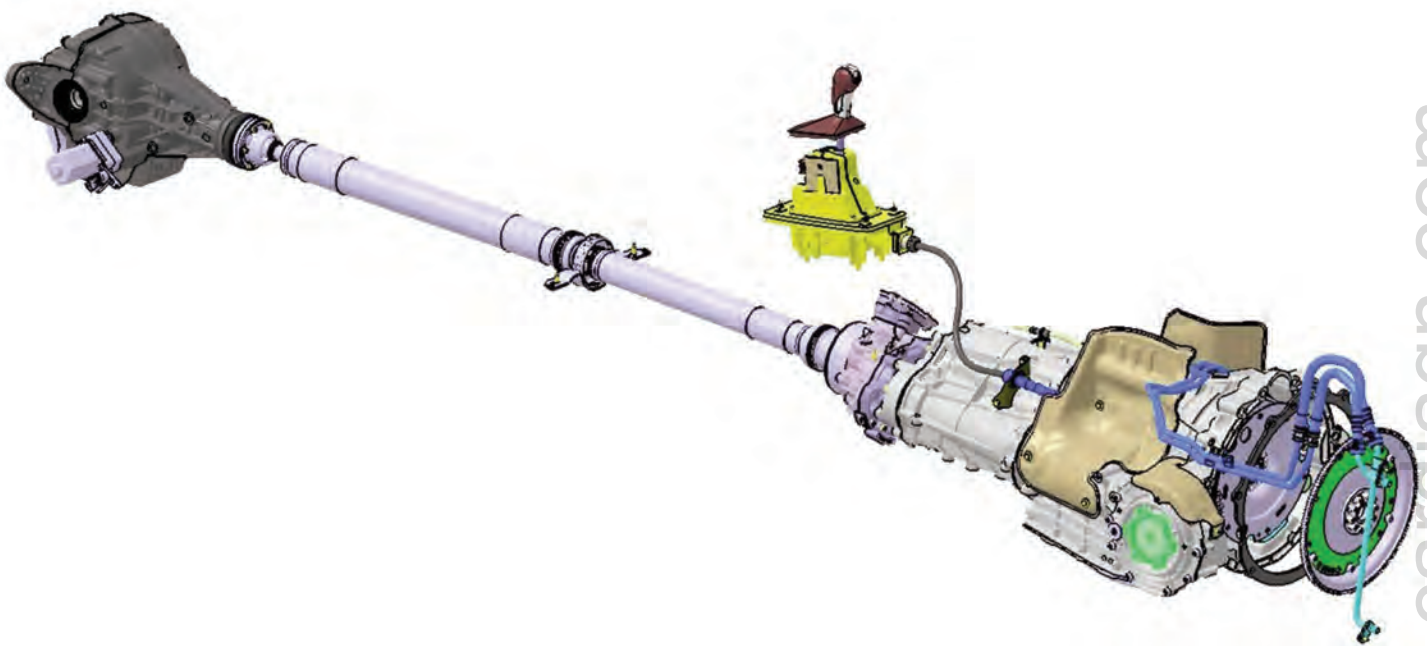
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3 Power transmission

General information

The combination of the positive characteristics of an automatic transmission (driving comfort, gear shifting without interruption in power delivery) and of a manual transmission (sportiness and efficiency) as well as extremely short shift times and “direct power transmission” were also realized in the new Macan using the Porsche Doppelkupplung as a double-clutch transmission. Driver power is transmitted via the transmission plate to the dual-mass flywheel. From here, the torque is transmitted to the electrohydraulically controlled double clutch, which alternatively selects the even or odd gears. The transmission is therefore divided into two partial transmissions.



3_01_13

3	Power transmission	103
3.1	Porsche Doppelkupplung	107
3.2	Transmission – Oil system	108
3.3	Parking lock	114
3.4	Transmission control	115
3.5	Electronics	118
3.6	Transmission – Protection	123
3.7	Emergency programs	124

Technical data**Clutch**

Double clutch, radially nested, wet multi-plate clutch with dual-mass flywheel

Clutch plate diameter on Porsche Doppelkupplung

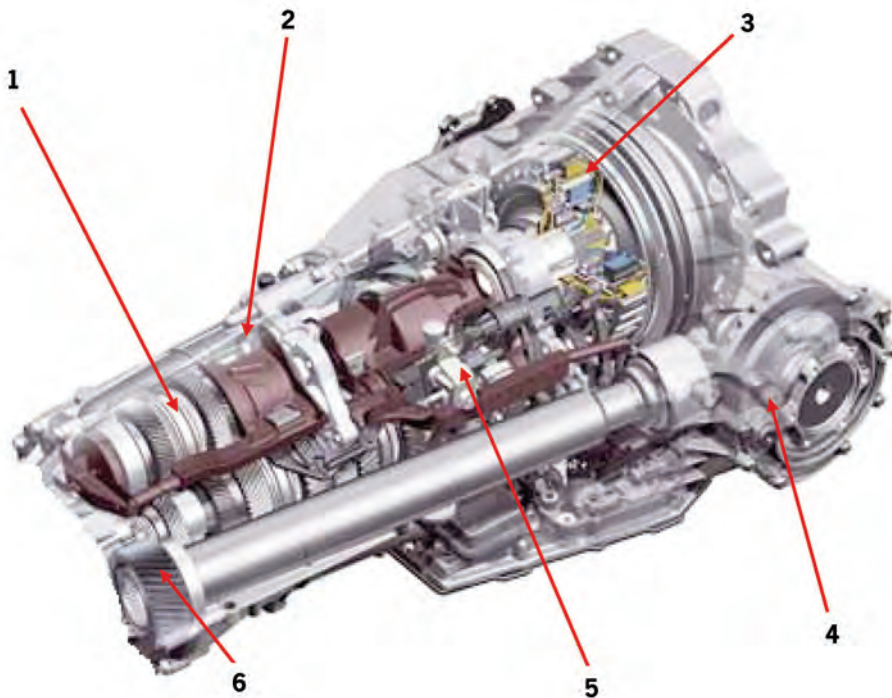
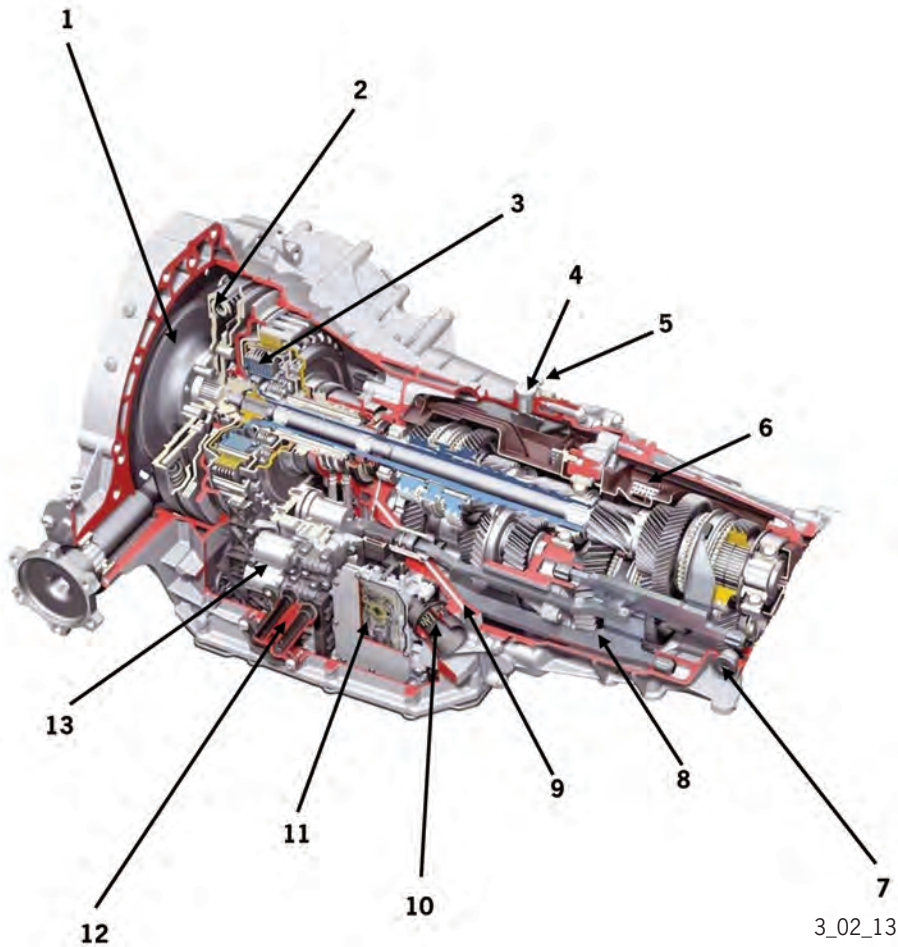
Clutch 1: 270 mm/10.63 in

Clutch 2: 148 mm/5.83 in

Transmission ratios:

	Macan Diesel S	Macan Macan Turbo	Macan S
Transmission type	DL501-7A		
1st gear	3.692		
2nd gear	2.150		
3rd gear	1.344	1.406	
4th gear	0.974	1.025	
5th gear	0.739	0.787	
6th gear	0.574	0.625	
7th gear	0.462	0.519	
Reverse gear	2.944		
Beveloid drive ratio	1.129		
Front-axle ratio	4.125		3.875
Rear-axle ratio	4.667		4.400
Torque distribution for all-wheel drive FA/RA	Variable by hang-on		

Transmission sectional view – component overview



Power transmission

3

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Transmission mechanics

Drive power is transmitted via the transmission plate to the dual-mass flywheel. From here, the torque is transmitted to the electrohydraulically controlled double clutch, which alternatively selects the even or odd gears. The transmission is therefore divided into two partial transmissions.

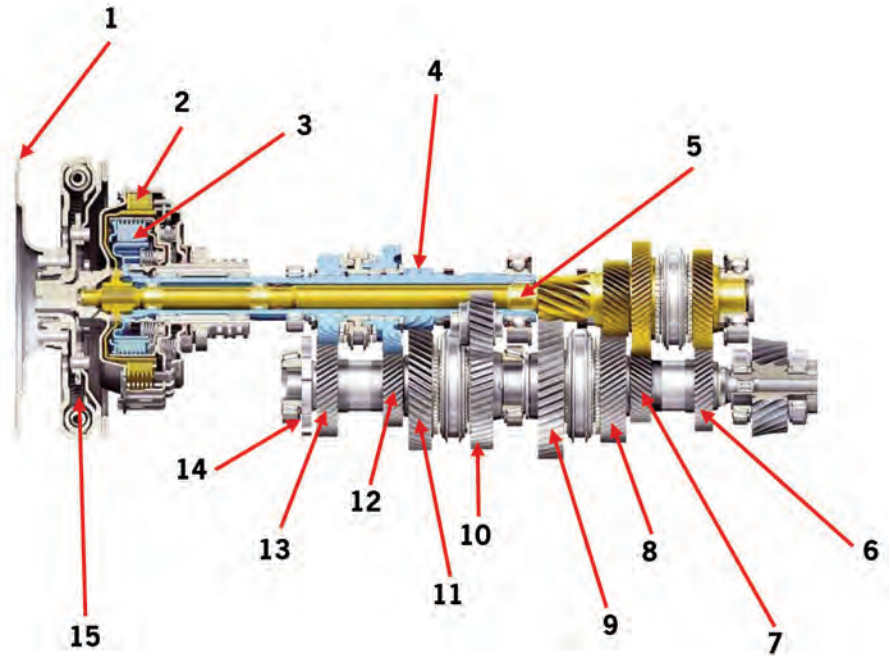
Partial transmission 1

The odd gears (1, 3, 5, 7) can be driven with clutch K1 via the central input shaft 1.

Partial transmission 2

The even gears (2, 4, 6) and reverse gear can be driven with clutch K2 via input shaft 2 (a hollow shaft). The output power is transmitted via the common output shaft, from which the torque is delivered directly to the hang-on clutch.

- 1 Transmission plate
- 2 Clutch K1
- 3 Clutch K2
- 4 Input shaft 2
- 5 Input shaft 1
- 6 5th gear
- 7 7th gear
- 8 3rd gear
- 9 1st gear
- 10 Reverse gear
- 11 2nd gear
- 12 6th gear
- 13 4th gear
- 14 Parking lock
- 15 Dual-mass flywheel



3_04_13

3.1 Porsche Doppelkupplung

Design features

The Porsche Doppelkupplung has two tasks:

- Closing power transmission when driving away and interrupting power transmission when stopping
- Shifting gears (= change-over to the respective partial transmission)

The Porsche Doppelkupplung double-clutch transmission was designed so that clutch K1 is located at the outside and therefore has the larger diameter. This takes into account the higher loads to which K1 is subjected as the starting clutch (in 1st gear). Small pressure cylinders and the use of coil spring packs on both clutches ensure good control characteristics for starting and gear shifts. It was possible to omit hydraulic pressure compensation. The dynamic pressure build-up which occurs at higher engine speeds due to centrifugal forces is corrected by the clutch control. A pressure characteristic is available for this purpose which allows compensation of the dynamic pressure build-up in every situation.

Gearshift sequence

Moving off:

1st gear and reverse gear are always engaged in selector-lever position P or N. This means that it is always possible to drive off without any delay. Depending on what the driver decides, the correct gears are already preselected for reversing or driving forwards.

Shifting gear:

The driver wants to move off in forward direction and moves the selector lever to D and drives off in 1st gear. As from a defined speed of approximately 9 mph (15 km/h), 2nd gear is engaged in partial transmission 2 (reverse gear was previously engaged).

When the shift point for the 1-2 upshift is reached, the gear change takes place by lightning-fast opening of clutch K1 and simultaneous fast closing of clutch K2 without any interruption in power delivery. The engine torque is reduced during the shift operation (overlap) in order to improve shift comfort and protect the clutch.

The entire shift operation takes place within a few hundredths of a second. 3rd gear is now already engaged (preselected) in partial transmission 1. The above-described process is repeated alternately for the following gear shifts 2-3 to 6-7.

Synchronization

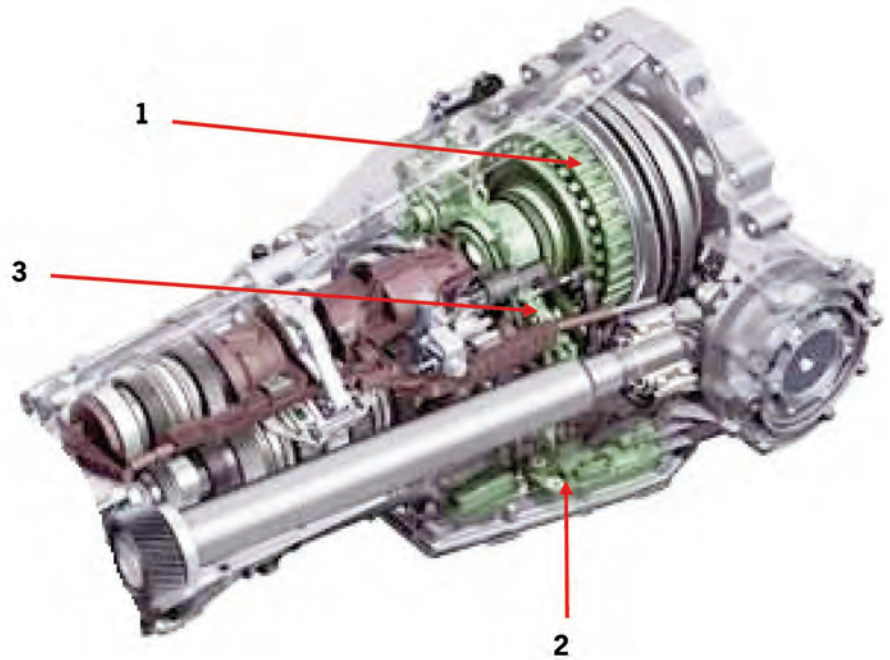
In order to achieve the extremely short shift times, all synchronizers are equipped with carbon-coated synchronizer rings. Gears one to three and reverse gear are additionally designed as triple-cone synchronized due to the high loads. A single-cone synchronizer is sufficient for gears four to seven.

3.2 Transmission – oil system

Oil system – ATF

The Porsche Doppelkupplung has two separate oil supply systems. The double clutch, mechatronics and oil supply are located in the first oil system. These components are operated with a special ATF developed especially for the PDK transmission. This ensures fast reaction of the shift and clutch control even at low temperatures and serves to lubricate and cool the double-clutch transmission. An important requirement for the ATF is that it must permit a high control quality of the double-clutch transmission.

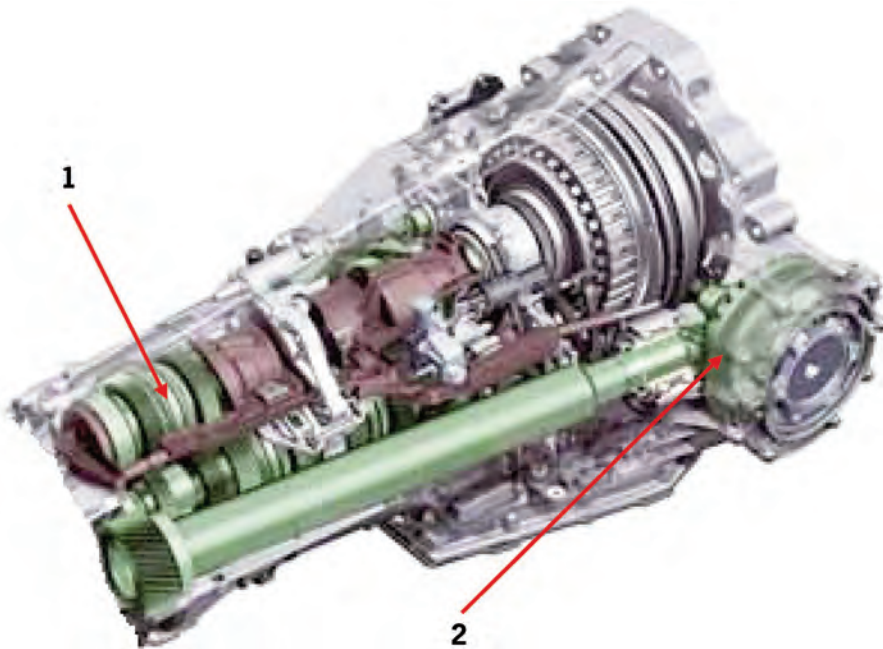
- 1 Double clutch
- 2 Mechatronics
- 3 ATF pump



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Oil system – gear oil

The manual transmission, transfer case (center differential) and front-wheel drive are combined in the second oil system. Lubrication takes place by way of hypoid gear oil with a special oil additive for the center differential. This separation of the oil systems meant that it was possible to realize an optimum design for the individual transmission components. It was thus not necessary to make any compromises with respect to different lubricant requirements.



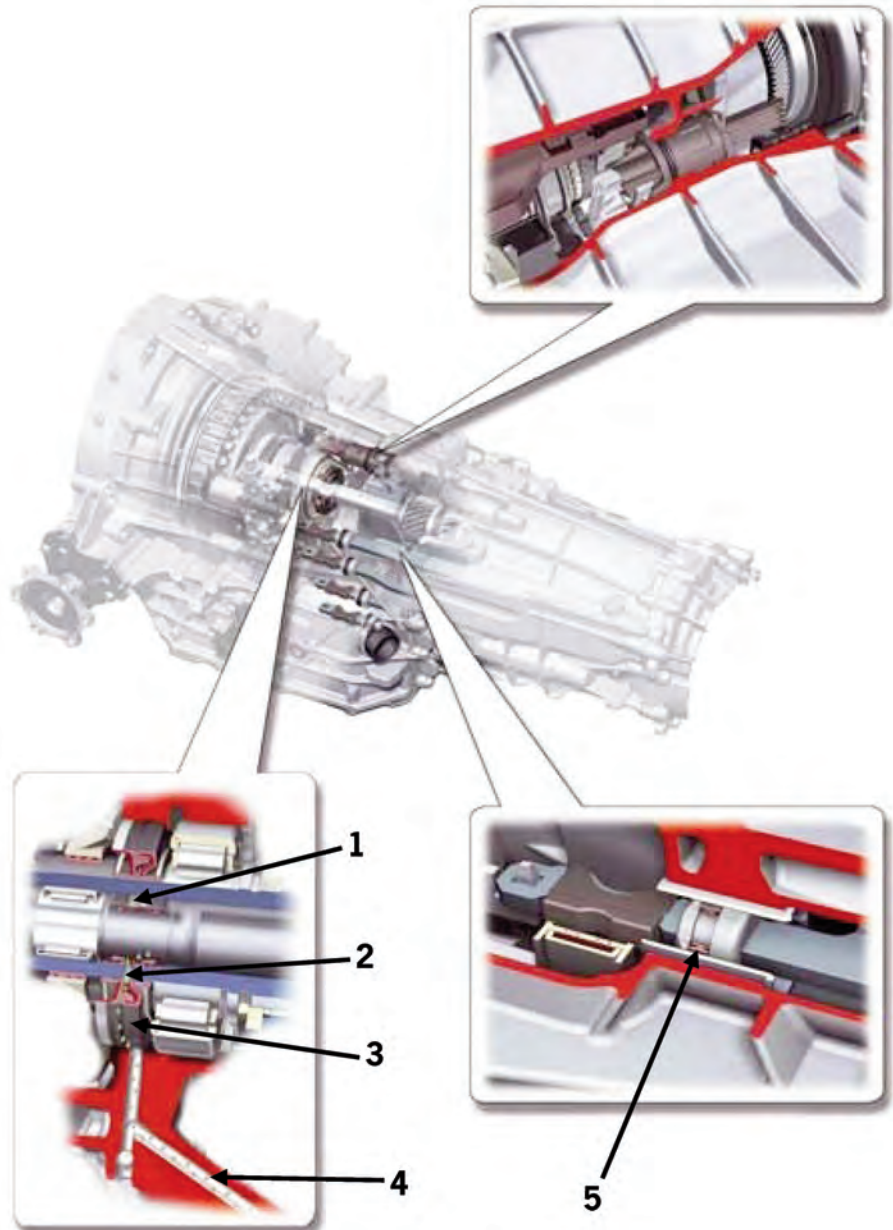
- 1 Manual transmission
- 2 Front-axle final drive

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Sealing of the oil systems

Reliable sealing of the oil spaces with respect to each other must be guaranteed at the transition points of the two oil systems. Ingress of transmission oil into the ATF oil space (the ATF mixes with the gear oil) would impair fault-free operation of the double clutch, for example. Special sealing elements are installed at the corresponding locations so that this does not occur.

- 1 Double rotary shaft seal, input shaft 1
- 2 Transverse bore
- 3 Double rotary shaft seal, input shaft 2
- 4 Leakage oil bore
- 5 Axial seal



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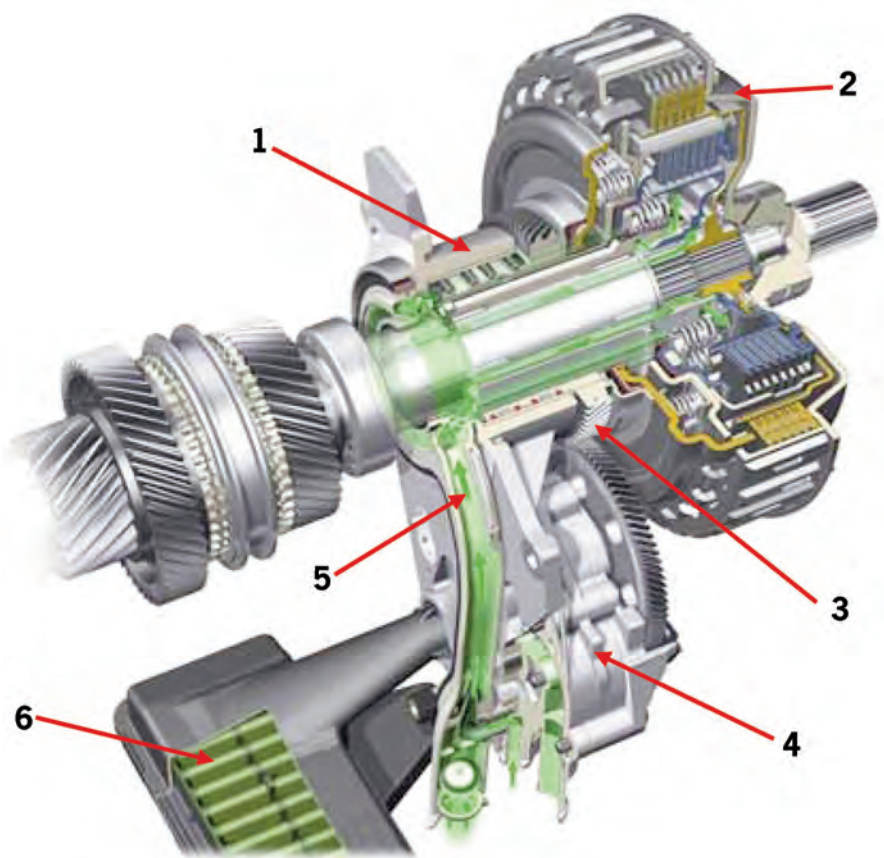
Sealing of input shafts 1 and 2 takes place with one double rotary shaft seal in each case (a total of four radial sealing rings). If a radial seal is leaking, the leakage oil bore ensures that the oil in question can drain away and cannot enter the other oil space in each case. The transverse bore in input shaft 2 establishes a connection from input shaft 1 to the leakage oil bore.

ATF supply – lubrication

An adequate ATF supply is necessary for operation of the transmission. The required oil flow and oil pressure are provided by an external gear pump, which is driven by the double clutch via a gear stage.

The ATF pump supplies the mechatronics with the necessary oil pressure for the following functions:

- Control of the multi-plate clutch (closing and disengaging power transmission)
- Cooling and lubrication of the multi-plate clutch
- Control of the shift hydraulics for shifting the transmission



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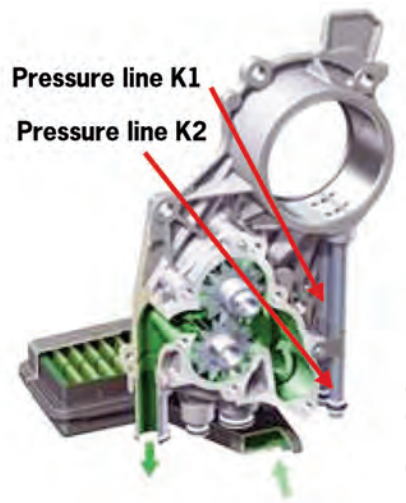
The **sucking jet pump** is used to increase the cooling oil flow for clutch cooling and operates according to the Venturi principle. It doubles the cooling oil quantity without it being necessary to additionally increase the pump output. This means that it is possible to dimension the oil pump correspondingly smaller, thereby improving the efficiency of the transmission.

Power transmission

3

Pressure line K1

Pressure line K2



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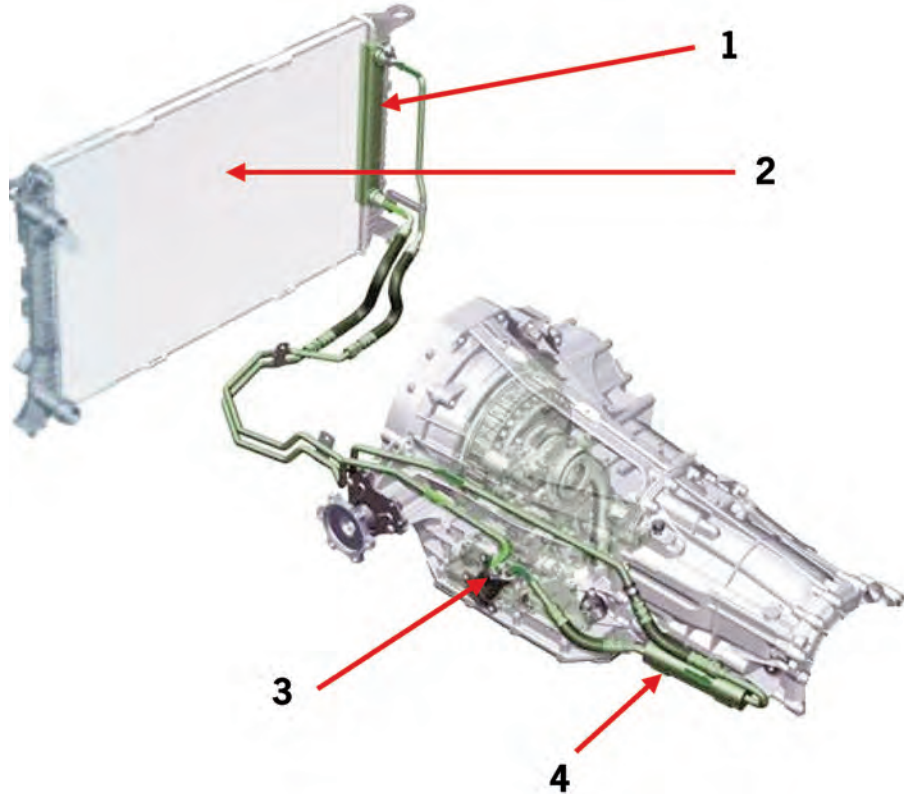
- 1 Rotary lead-in
- 2 Double clutch
- 3 Oil pump drive
- 4 ATF pump
- 5 Sucking jet pump
- 6 Suction filter

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ATF cooling

ATF cooling takes place by way of a coolant-oil heat exchanger (ATF cooler) integrated in the engine radiator. There is a pressure filter in the supply line to the ATF cooler which ensures good cleaning of the ATF together with the suction filter. Both filters are designed for the transmission lifetime and are not subject to any change interval. There is a differential pressure valve in the pressure filter. This opens if the flow resistance is too high, e.g. due to a clogged filter or very cold ATF. The circuit to the ATF cooler is therefore always guaranteed.

- 1 ATF cooler
- 2 Engine radiator with ATF cooler
- 3 Connecting module
- 4 ATF pressure filter



Important!

Note on the ATF cooler:

If the ATF cooler leaks, coolant will enter the ATF. Even the smallest quantities of coolant in the ATF will have a detrimental effect on clutch control. It is possible to establish whether there is glycol in the ATF by way of the new glycol test.



Important!

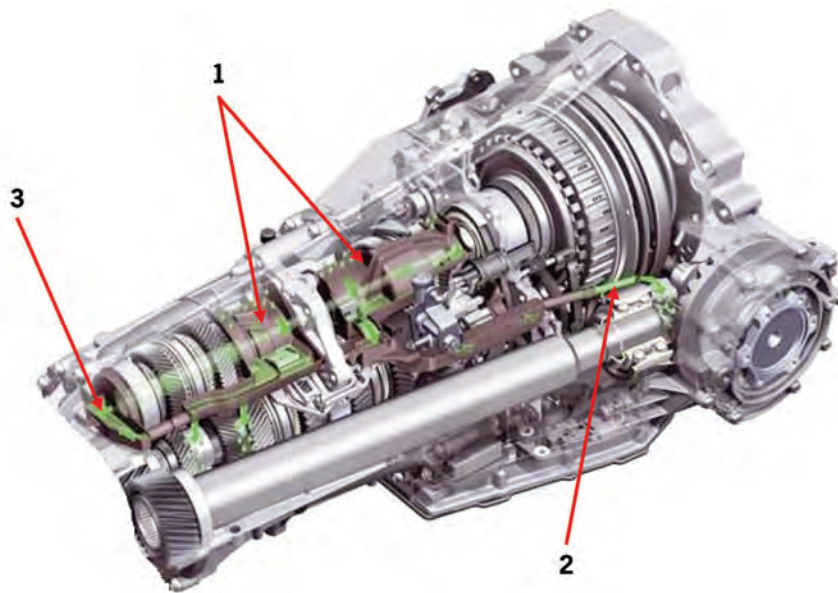
Note on the ATF filter:

Replacement of the pressure filter is required only in the event of contamination of the ATF due to transmission damage (e.g. swarf, abraded particles in the oil, mixing of the ATF with coolant, gear oil or other substances). In this case, the ATF cooler must also be flushed or replaced if necessary.

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Lubrication of manual transmission

Targeted lubrication by way of oil collecting pans and special oil guides permits a very low oil level. Churning losses are reduced as a result and the transmission efficiency is improved. Lubrication of the bearings for the shift wheels of the input shafts takes place via the hollow-bored input shaft 1. Transverse bores in the shafts route the oil to the bearing points.



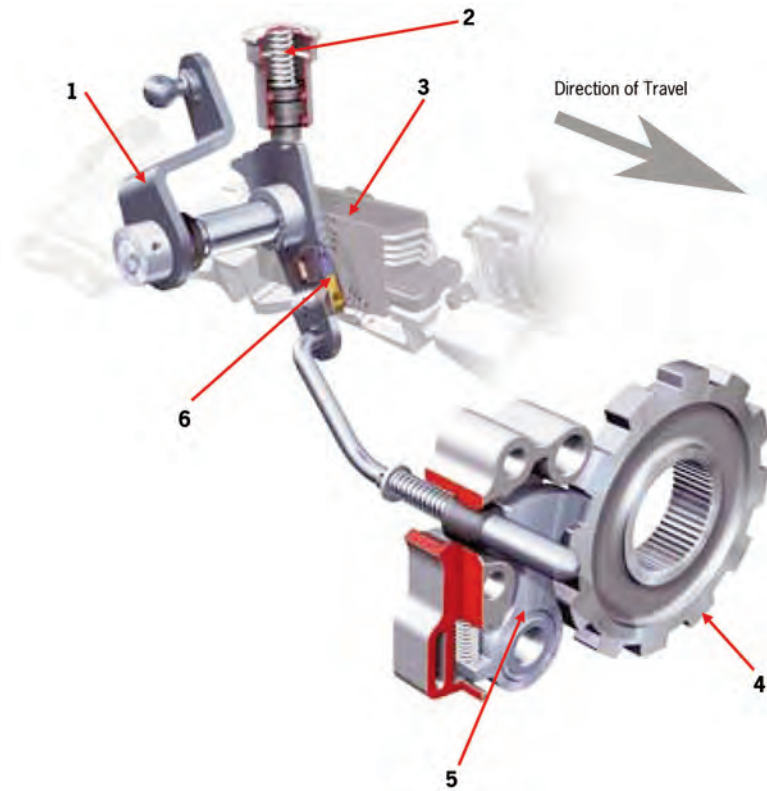
- 1 Oil collecting pans
- 2 Oil guide, front-wheel drive
- 3 Oil guide, input shaft 1

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3.3 Parking lock

Since there is no power transmission when the engine is stopped (both clutches are open), the Porsche Doppelkuppung requires a parking lock similar to automatic transmissions. The parking lock wheel is connected with the output shaft. The pawl is actuated purely mechanically by the selector lever cable. The sensor for the selector-lever position is also actuated via the selector shaft and the lever for the parking lock. For this purpose, there is a permanent magnet on the lever that actuates the parking lock. The magnetic field of this magnet acts on the sensor. The transmission control unit detects the position of the selector lever P, R, N, D and S on the basis of the signals determined by the sensor for the selector-lever position.

- 1 Shift lever
- 2 Detent
- 3 Transmission range sensor
- 4 Parking lock
- 5 Pawl
- 6 Permanent magnet

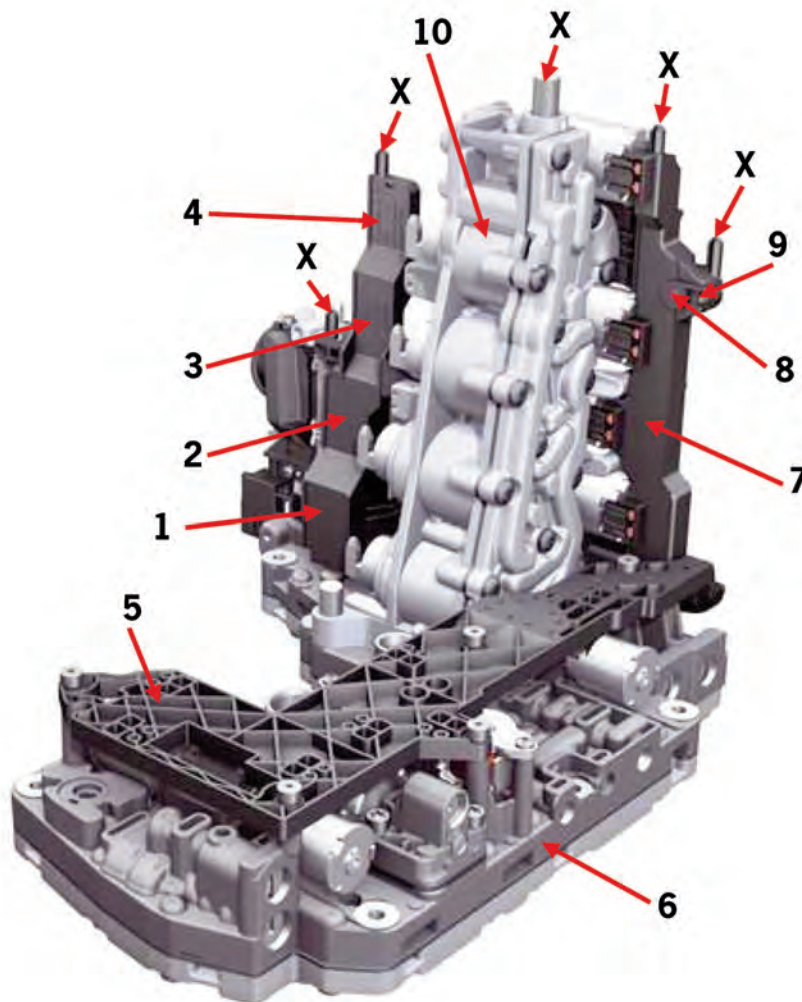


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3.4 Transmission control

Mechatronics

Transmission control is performed by a newly developed mechatronic system. Its control concept allows the speed of gear engagement and the force required to be controlled or regulated very sensitively when changing gear. Depending on the driving situation, this means that very fast gearshifts can be realized while also avoiding any impairment in comfort for coasting gearshifts, for example. The mechatronic system is the central transmission control unit. It combines the electrohydraulic control unit (actuators), the electronic control unit and some of the sensors in one unit. Due to the longitudinal design, the sensors for the speed of the two transmission input shafts and the transmission range sensor are accommodated on a separate holder (PC board 3).



- 1 Distance sensor 1
- 2 Distance sensor 2
- 3 Distance sensor 3
- 4 Distance sensor 4
- 5 PC board 1
- 6 Electrohydraulic control unit
- 7 PC board 2
- 8 Transmission input speed sensor
- 9 Clutch temperature sensor
- 10 Gear actuator module

X Mounting points in transmission housing

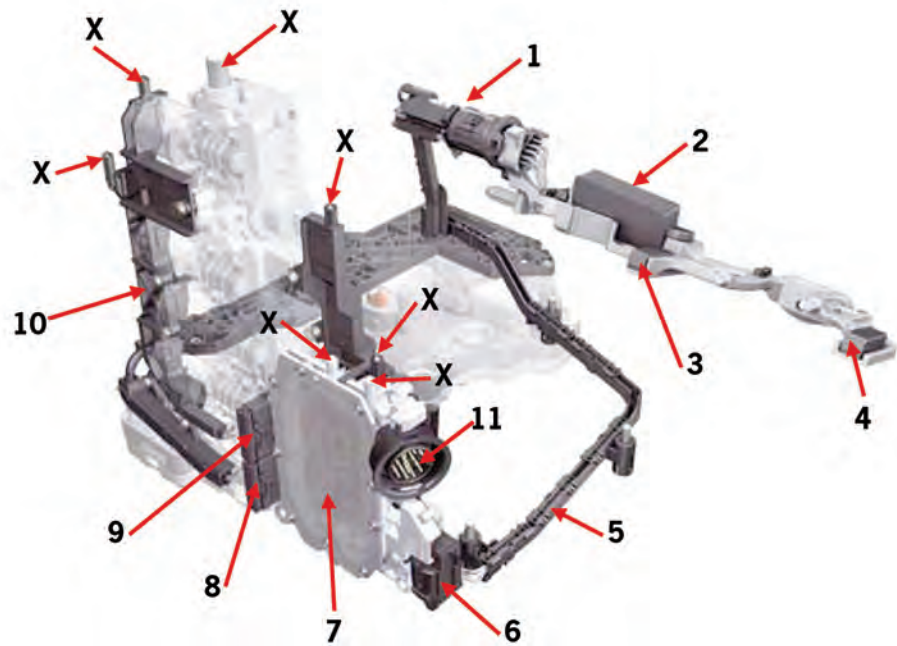
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- 1 Plug connection of sensor module wire harness
- 2 Transmission range sensor
- 3 Sensor 2 for transmission input speed
- 4 Sensor 1 for transmission input speed
- 5 Wire harness/cable duct
- 6 Plug connection of transmission control unit wire harness
- 7 Transmission control unit
- 8 Plug connection of transmission control unit PC board 1
- 9 Plug connection of transmission control unit PC board 2
- 10 PC board 2
- 11 Plug connection of transmission control unit vehicle wire harness

X Mounting points in transmission housing

The mechatronic system carries out open- and closed-loop control operations and performs the following functions:

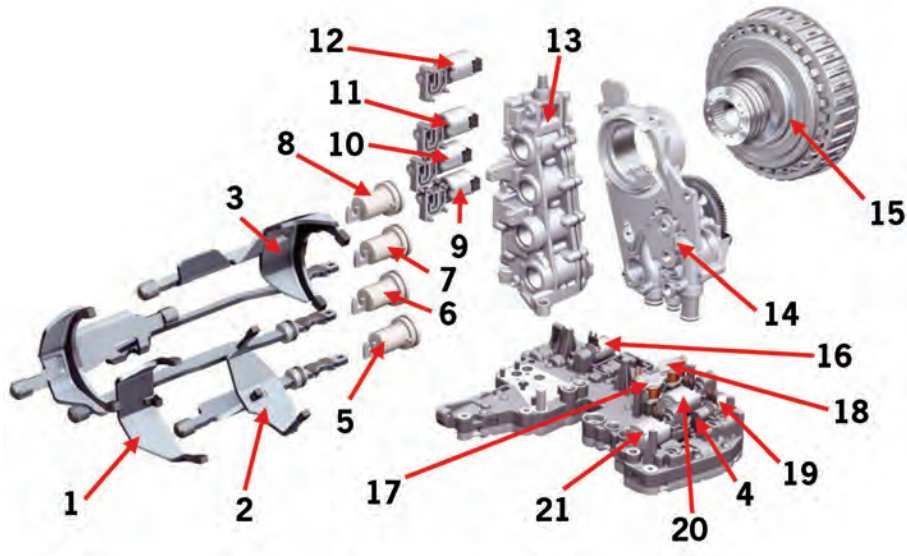
- Adaptation of the oil pressure in the hydraulic system to the respective requirements
- Closed-loop control of the double clutch
- Closed-loop control of clutch cooling
- Selection of the shift points
- Closed- and open-loop control of gear shifting
- Communication with other control units
- Emergency programs
- Self-diagnosis



3_14_13

Hydraulics/overview

The illustration shows the electrohydraulic control unit with all the components that are activated by the actuators.



3_15_13

The shift rails/shift forks do not have any detent mechanism. The positions of the shift forks are held in the respective desired position by the gear actuators. There are only the detents in the shift sleeve and synchronizer hub.

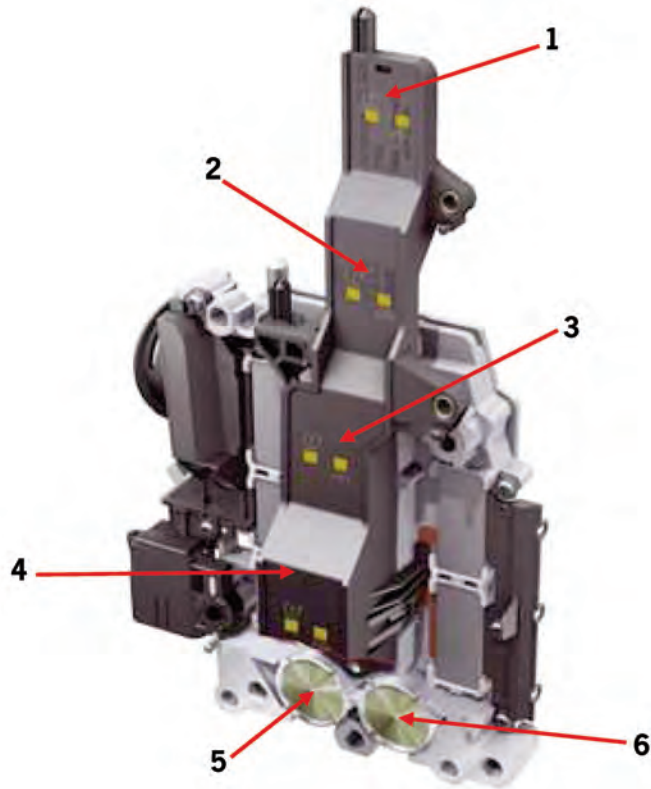
- 1 Shift fork 1-3
- 2 Shift fork 2-R
- 3 Shift fork 4-6
- 4 Shift fork 5-7
- 5 Gear actuator 2-R
- 6 Gear actuator 1-3
- 7 Gear actuator 5-7
- 8 Gear actuator 4-6
- 9 Solenoid valve 2-R
- 10 Solenoid valve 1-3
- 11 Solenoid valve 5-7
- 12 Solenoid valve 4-6
- 13 Gear actuator module
- 14 ATF pump
- 15 Double clutch
- 16 Valve for cooling oil
- 17 Clutch valve K1
- 18 Clutch valve K2
- 19 Main pressure valve
- 20 Pressure control, partial transmission 2
- 21 Pressure control, partial transmission 1

3.5 Electronics

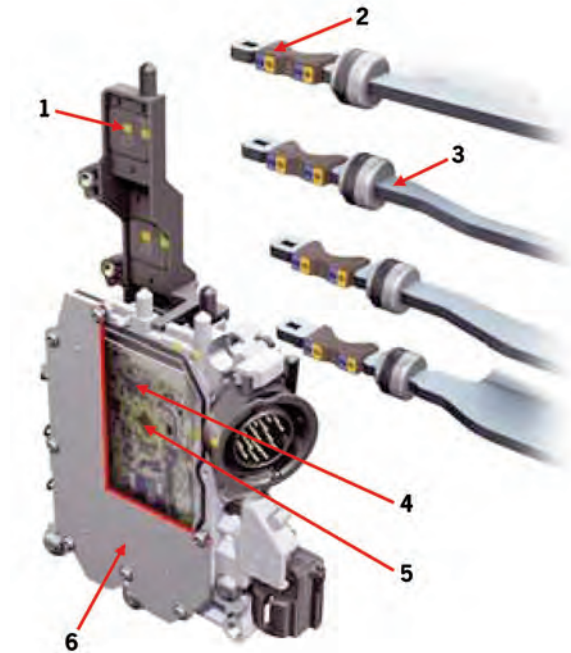
Integrated sensors

The transmission control unit forms an inseparable unit together with the four distance sensors and the two sensors for hydraulic pressure. Two temperature sensors are integrated in the transmission control unit. One sensor is positioned so that it provides exact feedback on the ATF temperature. The other sensor is integrated directly in the processor and detects the temperature directly at the endangered components. The two temperature sensors monitor each other for plausibility. Monitoring of the electronics temperature is very important so that temperature-reducing measures can be initiated early on if necessary (see chapter "Protective functions"). In addition to the safety aspects, the ATF temperature influences the clutch control and hydraulic control. For this reason, the ATF temperature also plays an important part for control and adaptation functions. The hydraulic pressure sensors 1 and 2 are used for monitoring the clutch pressure and for adaptation of the main pressure and partial transmission pressures.

- 1 Distance sensor 4 for gear actuator 4-6
- 2 Distance sensor 4 for gear actuator 5-7
- 3 Distance sensor 4 for gear actuator 1-3
- 4 Distance sensor 4 for gear actuator 2-R
- 5 Sensor 1 for hydraulic pressure (K1)
- 6 Sensor 2 for hydraulic pressure (K2)

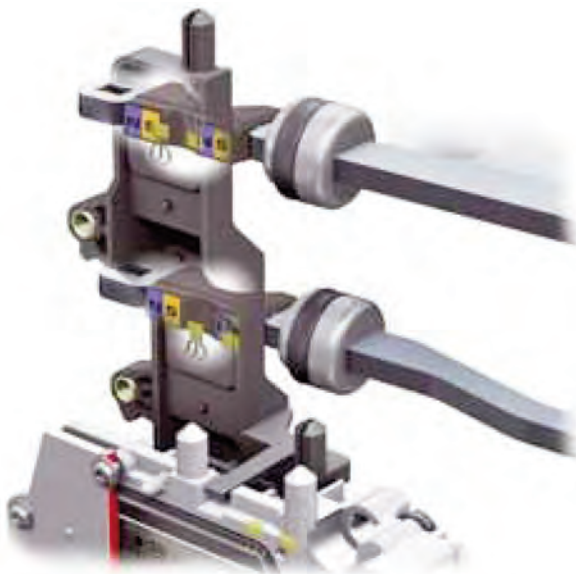


3_16_13



3_17_13

The four distance sensors determine the position of each shift rail/shift fork. The transmission control unit needs this information so that it can immediately diagnose inadmissible positions and activate an emergency program if necessary. Exact distance measurement is also necessary so that the gears can be shifted sensitively. The different phases for synchronization and shifting of the gears can therefore be activated in a highly targeted manner.



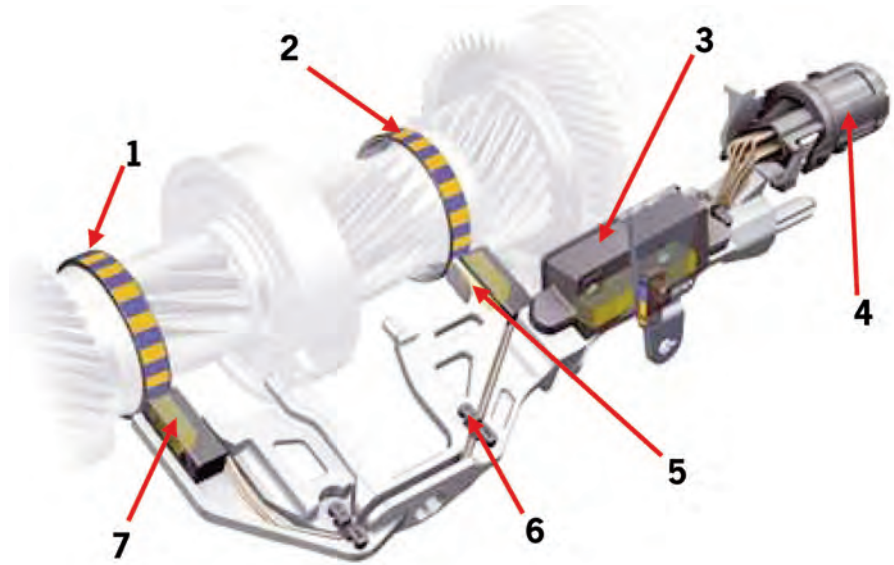
3_18_13

A distance sensor comprises two Hall-effect sensors and two permanent magnets, which are mounted on the shift rail. The Hall-effect sensors output a voltage corresponding to the distance depending on the position of the magnets in relation to the Hall-effect sensors. The position signal is generated by evaluation of the two voltage signals.

- 1 Encoder wheel, input shaft 1
- 2 Encoder wheel, input shaft 2
- 3 Transmission range sensor
- 4 Plug connection
- 5 Sensor 2 for transmission input speed
- 6 PC board 3
- 7 Sensor 1 for transmission input speed

Separate sensors

The sensors 1 and 2 for the transmission input speed and the transmission range sensor are mounted together on one carrier (PC board 3). The two speed sensors are so-called "intelligent sensors". With three Hall-effect sensors in each case and the corresponding evaluation electronics, it is possible to distinguish between forward travel, reverse travel and a magnetic field that is too weak. The control unit received the information from the sensors already evaluated in the form of a pulse-width-modulated (PWM) signal.



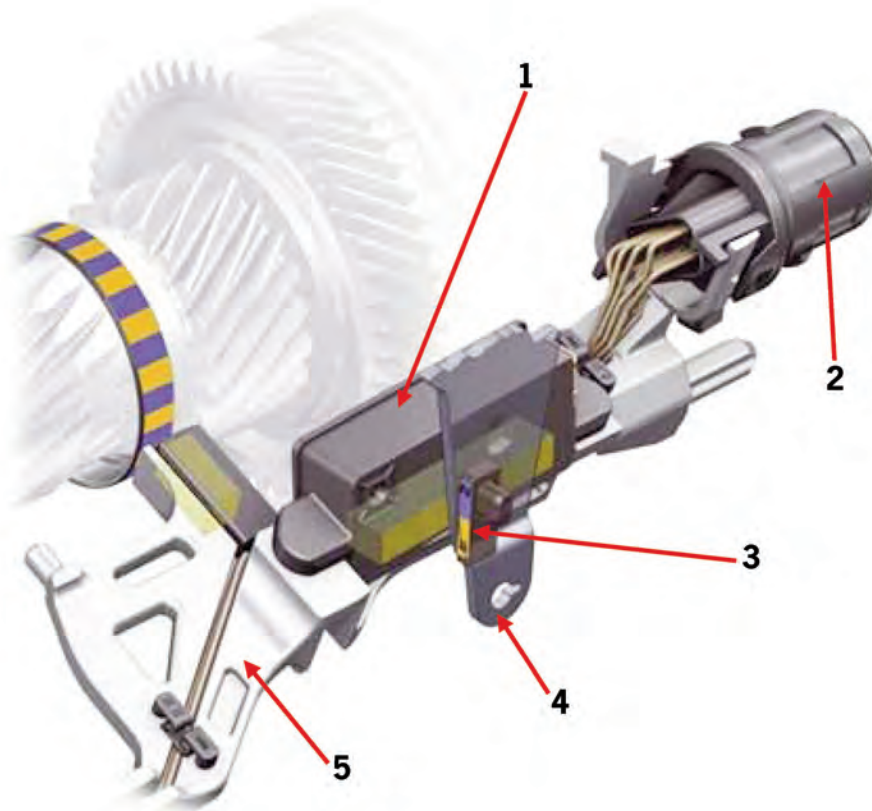
3_19_13

The different states are indicated to the control unit by different pulse widths. This means, that the speed signal has a different pulse width for forward travel than for reverse travel.

Signal utilization

- Determination of the clutch output speed for calculation of the clutch slip
- Determination of the synchronous speed for shift control

The transmission stage sensor is located in the transmission and is part of the sensor module. The transmission stage sensor is a proximity-type distance sensor which is used to determine the selector-lever positions (P, R, N, D and S). There is a permanent magnet on the lever for the parking locks which acts on the transmission stage sensor. The parking lock lever is connected with the shift lever by means of a shaft. It is actuated by the selector lever by way of a selector lever cable.



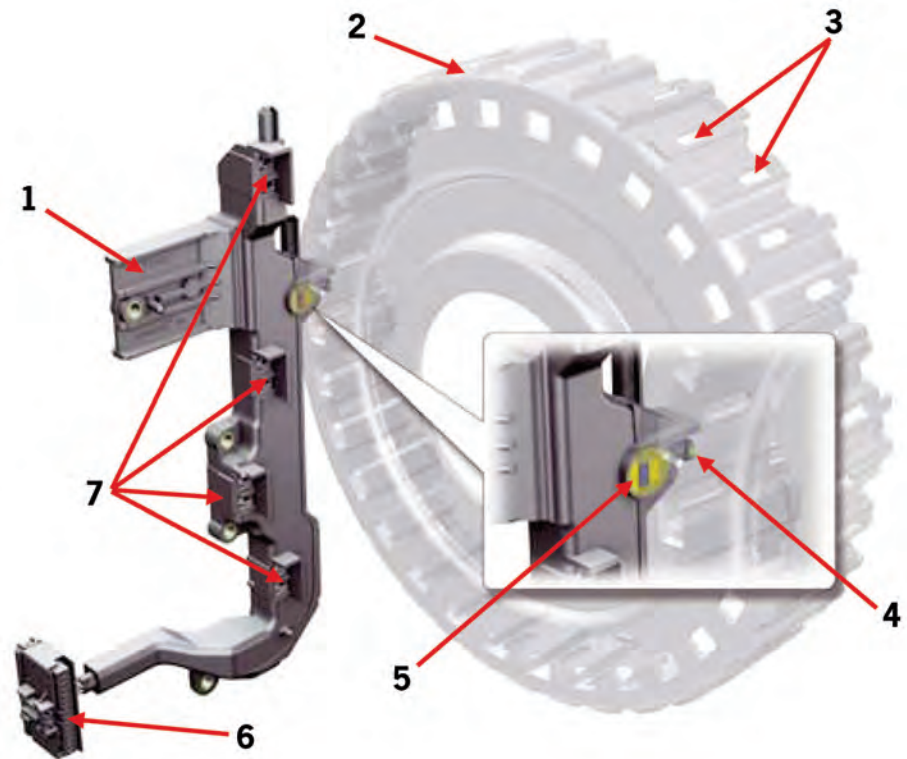
- 1 Transmission range sensor
- 2 Plug connection
- 3 Permanent magnet
- 4 Parking lock lever
- 5 PC board 3

3_20_13

The transmission control unit requires the selector lever position for the following functions and to generate the following signals and information:

- Information about the driver request/driving state (forward travel, reverse travel, neutral) for activation of the clutches and gear actuators
- Information for selection of the shift program “D” or “S”
- Signal for controlling the starter inhibitor
- Signal for controlling the P/N lock (shift lock)
- Generation of reverse gear information (e.g. for back-up lights, parking assistant, etc. ...)
- Control of the selector-lever position display in the instrument cluster and shift mechanism

- 1 PC board 2
- 2 Outer plate carrier of clutch K1
- 3 Outlet openings for cooling oil
- 4 Clutch temperature sensor
- 5 Sensor 3 for transmission input speed
- 6 Plug connection for transmission control unit
- 7 Plug connections to the gear actuator valves



3_21_13

The transmission range sensor is a so-called PLCD sensor (distance sensor). The abbreviation PLCD stands for Permanent magnetic Linear Contactless Displacement sensor and describes a proximity-type sensor that measures a linear distance using a permanent magnet. The signal of the transmission stage sensor is very important for transmission control and is safety-relevant. The sensor is present twice (redundant) for this reason. The transmission stage sensor therefore comprises two parallel sensor elements. The transmission control unit always evaluates both sensors. Sensor 3 for the transmission input speed and the temperature sensor for the clutch are part of PC board 2.

Sensor 3 for the transmission input speed is a Hall-effect sensor. It detects the clutch input speed of the double clutch (= the engine speed after the dual-mass flywheel). The outer plate carrier of clutch K1 acts as an encoder wheel.

The signal for the clutch input speed ...

- is used for more precise control of the clutches
- is used for adaptation of the clutches
- is used for microslip regulation

The temperature sensor for the clutch measures the temperature of the cooling oil ejected from the double clutch, which can be used as a basis for deriving the clutch temperature. The temperature sensor monitors the clutch temperature so that protective measures can be initiated above a defined oil temperature in order to prevent a further increase in temperature.

3.6 Transmission – Protective functions

Control unit temperature monitoring

High temperatures have a negative influence on the service life and functionality of electronic components. The integration of the transmission control unit into the transmission (surrounded by the ATF) means that it is very important that the temperature of the electronics and consequently the temperature of the ATF are monitored. Above a temperature of approximately 275° F (135° C) (determined by one of the two temperature sensors in the transmission control unit), the transmission electronics must be protected against any further increase in temperature. The transmission control unit initiates a reduction in the engine torque above this value in order to decrease the heat input. The engine torque can be gradually reduced up to a temperature of approximately 293° F (145° C) until the engine is only running at idle speed. The clutches are then open and the vehicle no longer has any drive. When the protective function is initiated, an entry is made in the fault memory and the message “Possible to drive on carefully” appears on the instrument cluster.

Clutch protection

If the temperature of the clutch cooling oil exceeds a value of approximately 320° F (160° C) (determined by the temperature sensor), this means that a potentially damaging critical temperature range has been reached in the clutch. These temperatures are caused e.g. when moving off on extreme gradients (possibly with trailer) or if the vehicle is held on a gradient with the clutch (without pressing the brakes). The engine torque is reduced above a cooling oil temperature of 320° F (160° C) as a protective function. If the cooling oil temperature increases further, the engine torque is gradually reduced; potentially this can result in the engine only running at idle speed. The clutches are then open and the vehicle no longer has any drive. When the protective function is initiated, an entry is made in the fault memory and the message “Possible to drive on carefully” appears on the instrument cluster. For added protection, the clutch temperature is determined using a calculation model. If the calculated temperature exceeds a defined value, the measures described above are initiated.

Towing

The usual restrictions for automatic transmissions must be observed when towing a vehicle with Porsche Doppelkupplung (PDK):

- The selector lever must be in position “N”
- The towing speed must not exceed 30 mph (50 km/h)
- The maximum towing distance must not exceed 30 mph (50 km/h)

Reason:

When the engine is stopped, the oil pump is not powered and certain parts in the transmission are not lubricated. If the towing speed of 30 mph (50 km/h) is exceeded, impermissible speeds occur in the transmission and in the double clutch since there is always a gear engaged in both of the partial transmissions. Failure to observe the towing conditions can therefore result in serious damage to the transmission.

**Important!**

- * The gears still available depend on the respective fault. Certain gears are blocked as appropriate to the fault in order to ensure that the components are protected against overspeed.

Once it is ensured that there is no gear engaged in the partial transmission which has been shut down, all gears in the intact partial transmission are shifted without any further restrictions.

3.7 Emergency programs

Emergency programs enable consequential damage to be prevented and mobility to be maintained in the event of malfunctions. There are also so-called protective functions which protect specific components against overloading. If specific system faults occur, the transmission control unit shuts down the relevant partial transmission and activates the appropriate emergency program (driving with the intact partial transmission).

Driving with partial transmission 1, partial transmission 2 shut down:

- Only gears* 1, 3, 5 and 7 can be shifted (with interruption in power delivery)
- Reversing not possible

Driving with partial transmission 2, partial transmission 1 shut down:

Only gears* 2, 4, 6 and reverse can be shifted (with interruption in power delivery).

Complete shutdown of the transmission:

The transmission is completely shut down in the event of especially serious faults, e.g. faulty CAN Drive, immobilizer not recognizing transponder chip, detection of the wrong gear ratio at the gears or of the final drive.

4 Chassis

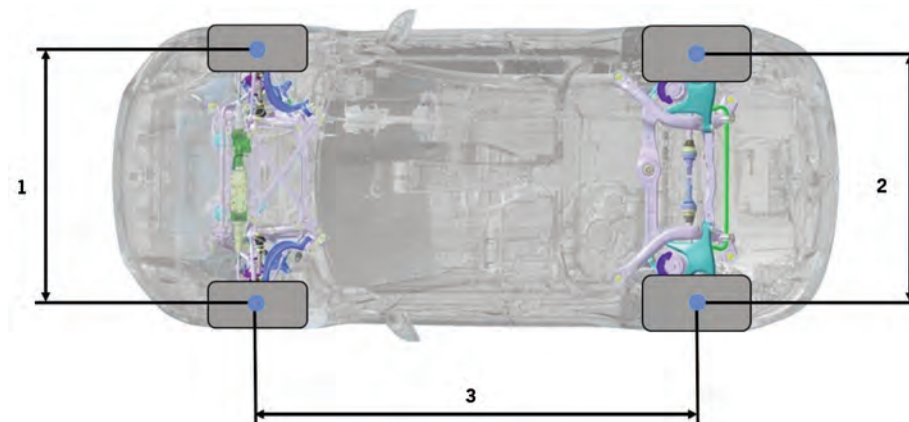
General information

The Porsche Macan uses a newly developed chassis based on the Volkswagen Group's MLB platform ("Modular Longitudinal Matrix"). The primary development objective was typical Porsche driving dynamics, combined with outstanding driving safety and high comfort. This has been realized using a number of Porsche technologies from the Sports Car sector, e.g. PCCB, which constitute a unique selling proposition in this vehicle class.

To offer the customer a high degree of personalization, there are different chassis and brake systems to choose from:

- Steel spring suspension, standard
- Porsche Active Suspension Management (PASM), optional
- Adaptive air suspension, optional
- 18-inch brake system, standard on the Macan S
- 18-inch brake system, standard on the Macan Turbo
- 19-inch brake system with PCCB, optional

Wheelbase and track width



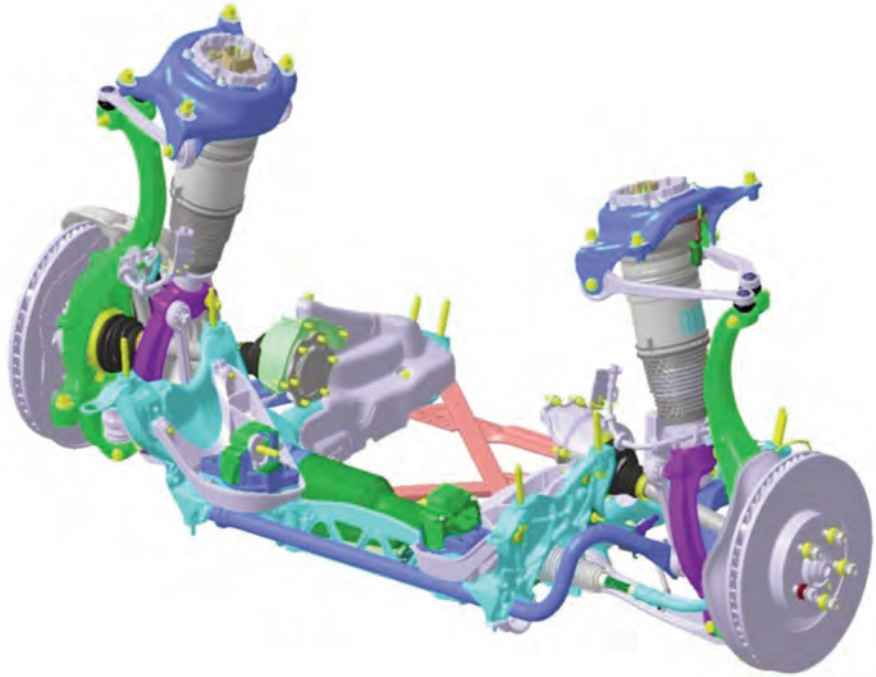
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The specified values apply to vehicles with 18-inch/19-inch wheels (values in brackets for 20-inch/21-inch wheels).

1 = 1,658 mm (1,648 mm)
2 = 1,656 mm (1,660 mm)
3 = 2,810 mm

4 Chassis	125
4.1 Front axle	126
4.2 Rear axle	132
4.3 Steering	137
4.4 Wheels and tires	144
4.5 Brakes	147
4.6 Control systems	155

4.1 Front axle



Front axle (illustration shows vehicle with air suspension)

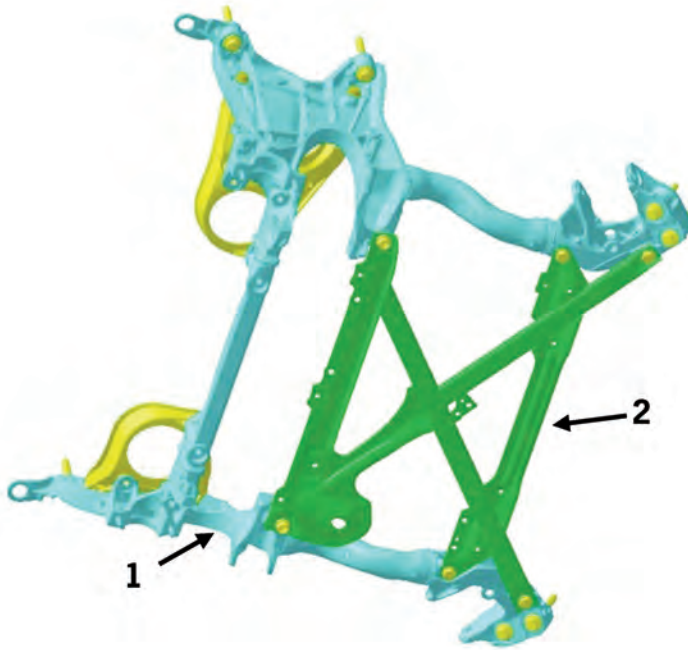
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The Porsche Macan uses a five-link front axle with a front steering system which has been systematically designed for optimum steering behavior and agility. The control arms of the five-link front axle as well as the body-mounted front-axle carrier are made of aluminum. Extensive reinforcement measures reduce the transmission of rolling noise, therefore increasing the driving comfort. The arrangement of the control arms at the wheel produces a small lever arm. This greatly reduces the drive and disturbing force influences on the steering. Transverse and longitudinal forces are handled separately. The rubber mountings are rigid in transverse direction to promote dynamic and precise handling. The mountings are softer in longitudinal direction to increase comfort. The steering gear is mounted on the axle carrier, thus achieving high steering precision and good centering around the center position.



4_03_13

Axle carrier



Axle carrier with reinforcing cross (illustration shows Macan S Diesel)

4_04_13

The axle carrier is open to the rear and screwed rigidly to the body at eight points. It supports the lower control arm plane, the steering, the anti-roll bar, the engine mounts and various small brackets. A reinforcing cross made of sheet steel is attached to the underside using six screws.

**Important!**

The vehicle must not be supported by its wheels when the engine mounts, steering gear and reinforcing cross have been removed. Danger of body damage!



Axle carrier Macan S Diesel

4_05_13



Axle carrier Macan S/Macan Turbo

4_06_13

The axle carrier comes in two different versions to satisfy the different space requirements of the engines. Both versions feature an aluminum hybrid construction. The complete unit provides additional reinforcement for the body structure and is an integral part of the front-end crash structure.

Mounting saddle



Upper mounting saddle, steel spring 4_07_13



Upper mounting saddle, steel spring with PASM, adaptive air suspension 4_08_13

Two different mounting saddles are used for steel spring, PASM and air suspensions. Both versions are made of cast aluminum. The mounting saddles are each fastened to the body using four screws and support the upper control arm plane and the spring strut.

Axle struts

Lower control arm plane

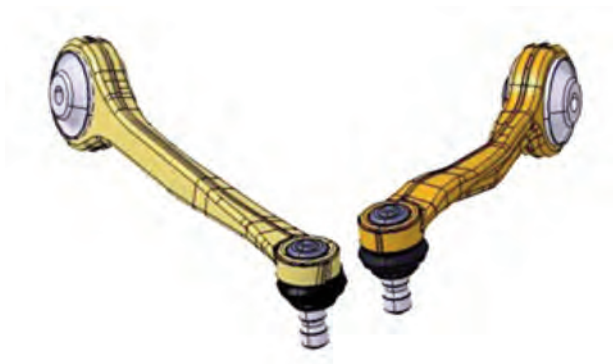
- 1 Radius arm
- 2 Hydraulic mount
- 3 Supporting arm
- 4 Rubber/metal joint



Radius arm, supporting arm

4_09_13

The lower control arm plane uses two axle struts ("separated design"). The radius arm essentially absorbs longitudinal forces, while the supporting arm absorbs transverse forces. The radius and supporting arms are forged from aluminum. The radius arm is supported by a large-volume hydraulic mount at the axle carrier. The supporting arm is screwed to the axle carrier using a rubber/metal joint.

Upper control arm plane

Upper control arm

4_10_13

The upper control arm plane also features a separated design. The two control arms are forged from aluminum and mainly absorb transverse forces. They are supported on the upper mounting saddle by large rubber/metal joints.

Spring strut

Steel spring strut

4_11_13



Air spring strut

4_12_13

Three possible versions are used depending on the chassis the customer wants:

- Conventional (uncontrolled) steel suspension
- Steel suspension with controlled dampers (PASM)
- Air suspension with controlled dampers (PASM)

A cast shock absorber fork is used to ensure clearance for the drive shaft. This is connected to the damper at the top via a clamped threaded connection. It is screwed directly to the supporting arm at the bottom.



Mounting saddle with control arms fitted

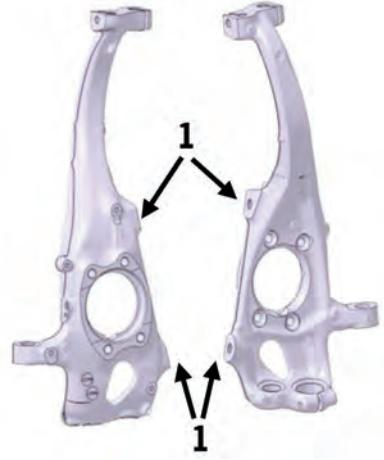
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Individual components of the steel spring strut

4_14_13

Wheel carrier



Radius arm, supporting arm

4_15_13

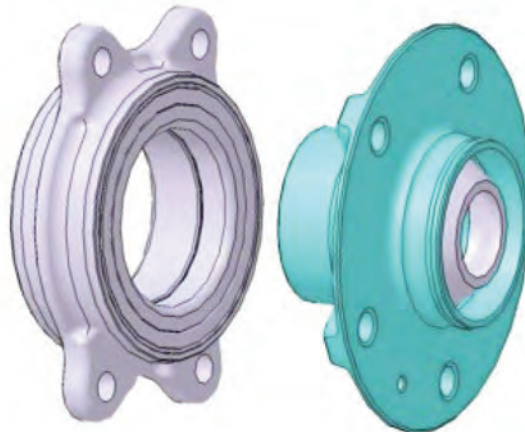
The wheel carrier is forged from aluminum and represents the link between the lower and upper control arm planes. The brake callipers are screwed radially to the wheel carrier.

Wheel bearing



Wheel bearing with flange fitted
(view from wheel carrier)

4_17_13



Wheel bearing (wheel carrier side)

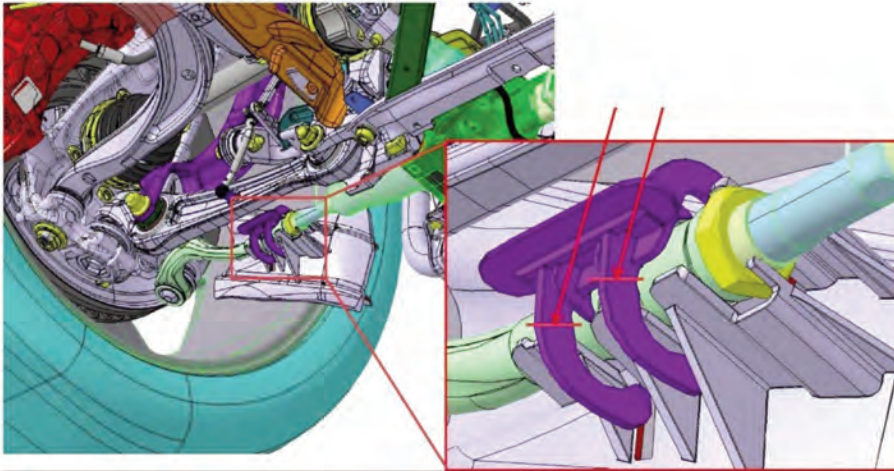
4_16_13

The wheel bearings are mounted on the wheel carrier using four dome-shaped bolts. The wheel flange has a hole circle of 112 mm and supports the drive shaft via short splines on the inside. For service cases, the wheel bearing is supplied together with the wheel hub already pressed in.

Alignment and adjustment

Toe

The toe values can be individually adjusted at the tie rods. The air-guide vanes of the brake cooling system must be removed from the tie rods for this so that the lock nuts are accessible.



4_18_13

Since the clips are almost impossible to remove without damaging them, the two lower arms of the clips must be cut using side cutters if they need to be removed (see red arrows). To be able to verify proper seating of the clips during installation, the air-guide vanes and clips have check lugs that must be flush in installed condition (see illustration).

Camber

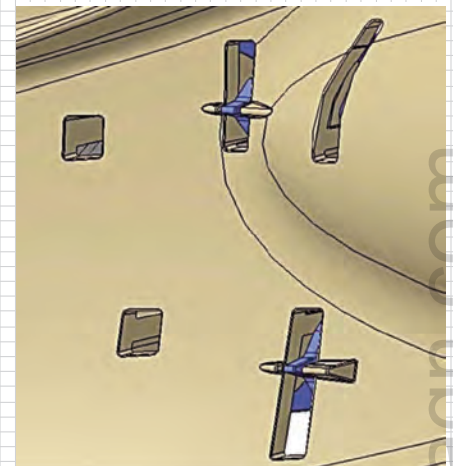
The camber can be slightly centered by shifting the axle carrier in a transverse direction in the area of the bore tolerances:

- Raise vehicle
- Remove underbody protection
- Detach tunnel cross member
- Unscrew fastening screws 1 to 8 for axle carrier, if necessary remove heat shield
- Move axle carrier with plastic-coated mounting lever including engine mount and anti-roll bar in appropriate direction (see illustration), brace mounting lever centrally between axle carrier and body longitudinal member for this
- Before checking camber values, deflect vehicle springs fully several times at front axle
- Replace axle carrier fastening screws and tighten to prescribed torque or torque angle
- Complete vehicle
- Check all other axle adjustment values and correct if necessary



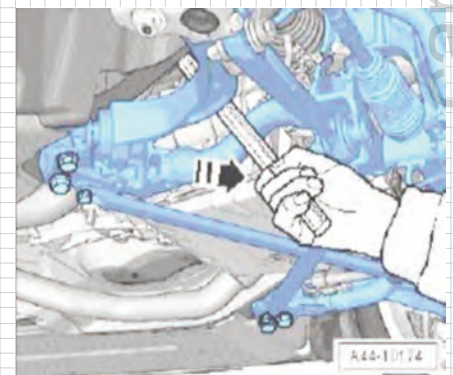
Important!

The clips of the air-guide vanes must always be replaced.



Check lugs for indicating correct installation

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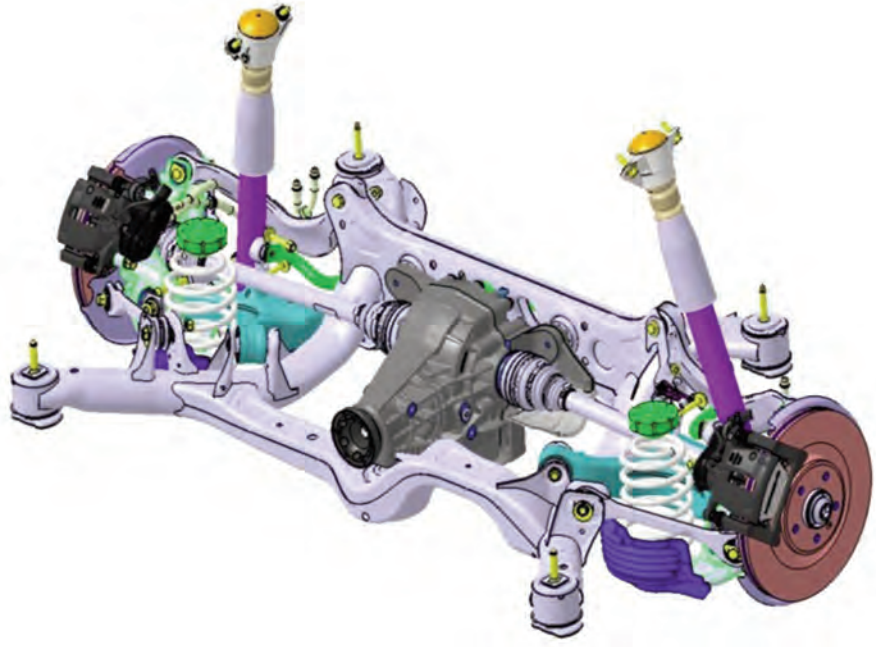
Camber centering

4_20_13



The specifications in the Workshop Manual are always definitive. The adjacent description of work is simply intended to illustrate the basic procedure for camber centering in the technical training course.

4.2 Rear axle



Rear axle (illustration shows vehicle with steel spring suspension)

4_21_13

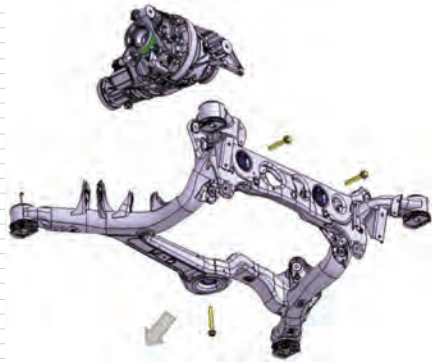
The rear axle of the Porsche Macan is a trapezoidal link axle with a separate axle carrier. To achieve optimum responsiveness, the springs and dampers are linked directly by the wheel carrier. The trapezoidal links and wheel carriers as well as the upper control arm are made of aluminum to reduce the unsprung weight. The torsionally and flexurally rigid axle carrier is made of higher-strength steel. The axle carrier is connected elastically to the body by way of four large rubber mountings.

Axle carrier



4_22_13

There are mounts for axle struts, anti-roll bar and rear axle differential on the axle carrier. The rear axle differential is connected via three threaded connections.



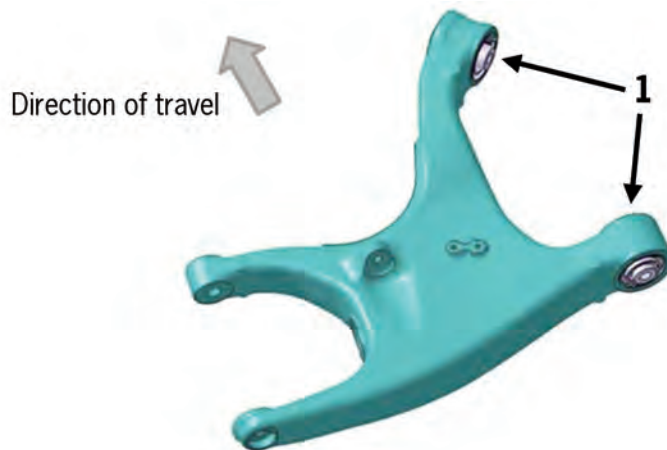
Mount for rear axle differential

4_23_13



Important!

Note the installation direction when replacing the rubber/metal mounts at the axle carrier.

Axle strut

Trapezoidal link

4_24_13

The trapezoidal link represents the lower control arm plane with a mount for the wheel carrier and transmits propulsion and brake forces. The anti-roll bar and height sensor are also mounted on the trapezoidal link. It is connected to the axle carrier via two rubber/metal joints (1). The trapezoidal link is made of aluminum and is hollow cast to reduce weight.

Upper control arm plane

Upper control arm

4_25_13



Rear tie rod

4_26_13

The upper control arm plane consists of the upper control arm and the tie rod. The tie rod is arranged in front of the middle of the wheel. Both control arms mainly absorb lateral forces. They are equipped with rubber/metal joints at both ends.

**Important!**

Three possible versions are used depending on the installed chassis:

- Conventional (uncontrolled) steel suspension
- Steel suspension with controlled dampers (PASM)
- Air suspension with controlled dampers (PASM)

Springs and shock absorbers

Steel spring, without PASM

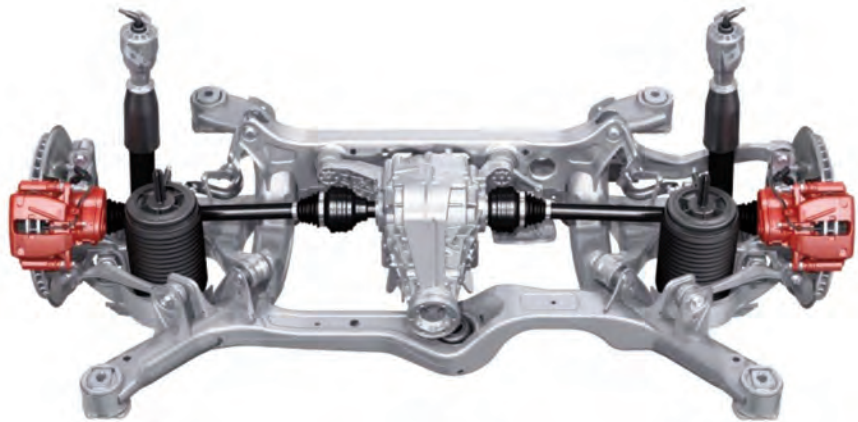
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The steel or air spring and the shock absorber are supported directly on the wheel carrier. The separated design (spring and damper separate) achieves a damper ratio of almost 1:1. This results in very good kinematic ratios for the suspension and damping. The result is optimum suspension comfort combined with precise handling. The precise damping is effective even with low compression and rebound movements. This component arrangement also permits a very compact construction with a large load width and flat loadspace floor.



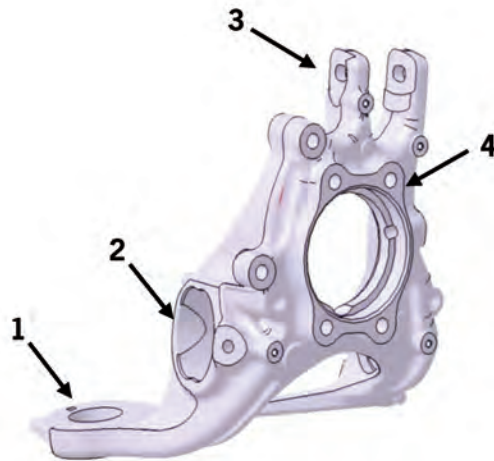
Air spring, rear axle

4_29_13



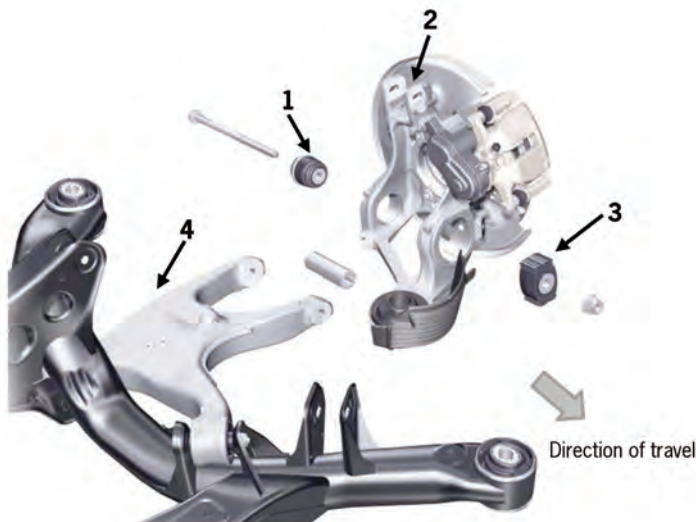
Rear axle with air spring

4_28_13

Wheel carrier

4_30_13

The wheel carrier is made of aluminum and supports all the axle struts on the wheel side. The wheel bearing is fastened to the wheel carrier in the same way as on the front axle, using four dome-shaped bolts (see also the section “Front axle, wheel bearing”).



Attaching the wheel carrier

4_31_13

The connection with the trapezoidal link is established at the rear by way of a ball joint and at the front by way of an elastomer thrust element. This permits relative movement between the wheel carrier and trapezoidal link, which allows the axle geometry to make selective adjustments in response to the dynamic loads experienced during driving.



Wheel bearing (wheel carrier side) 4_32_13

- 1 Ball joint
- 2 Wheel carrier
- 3 Elastomer thrust element
- 4 Trapezoidal link

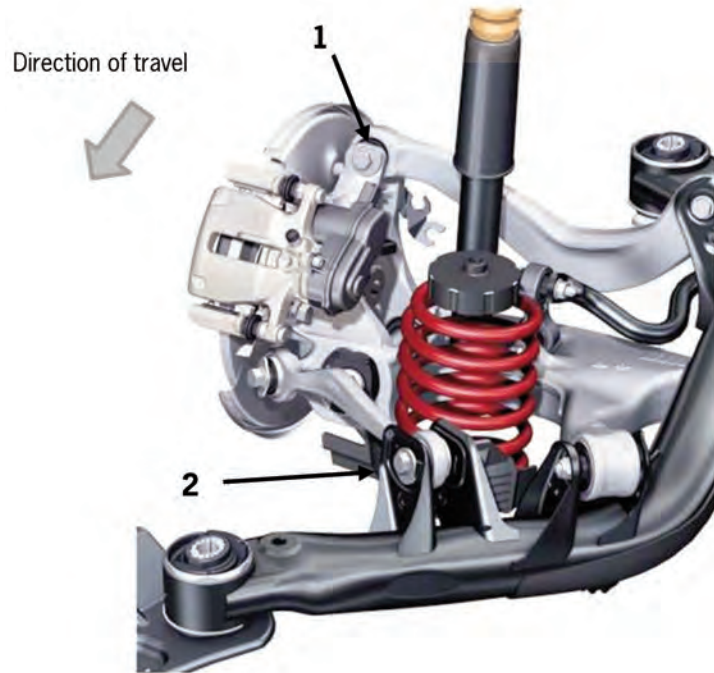
1 Eccentric adjuster, individual camber

2 Eccentric adjuster, individual toe



The specifications in the Workshop Manual are always definitive.

Alignment and adjustment



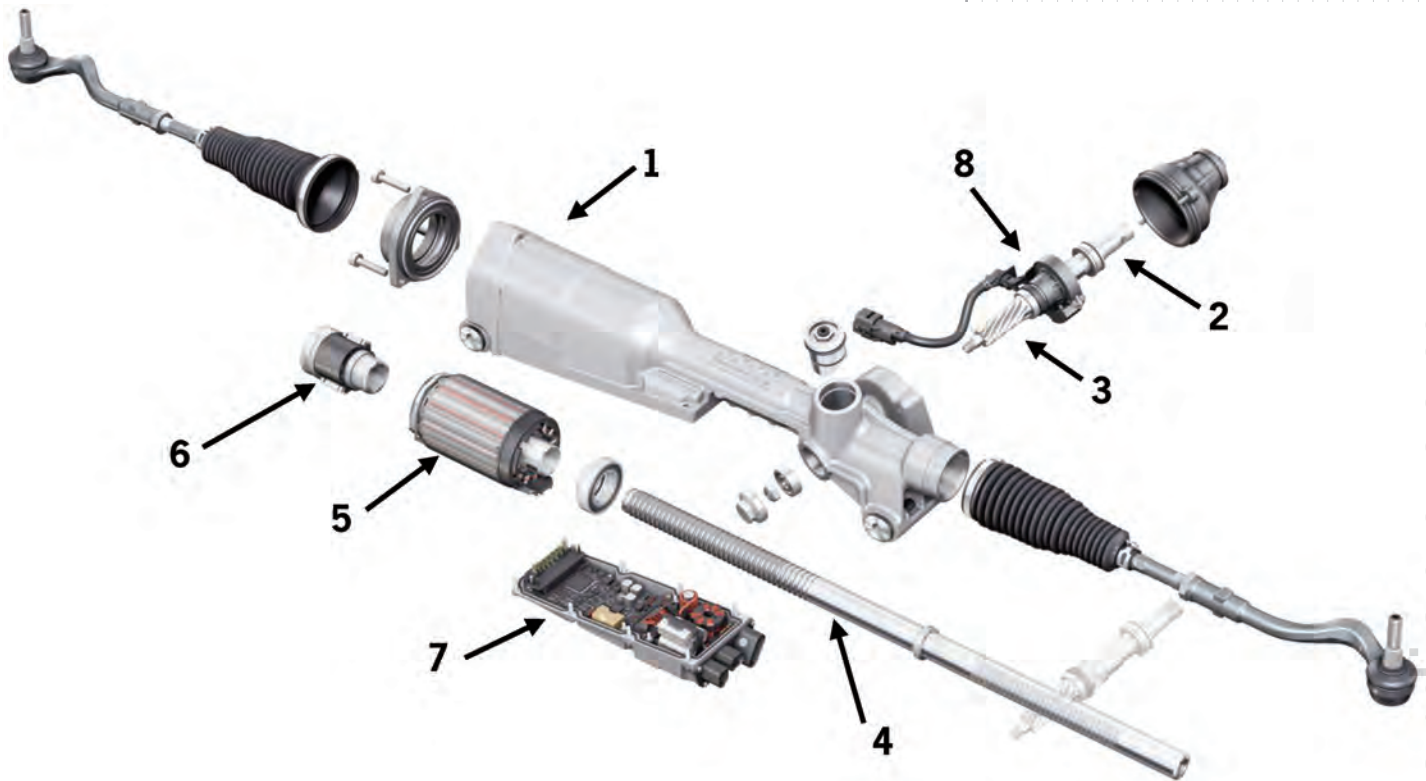
Eccentric adjuster, rear axle

4_33_13

The individual toe and individual camber values can be corrected on each axle side at the rear axle. There are eccentric adjusters at the tie rods and the upper control arms on the rear axle for this.

4.3 Steering

The Porsche Macan uses a completely newly developed electromechanical steering gear. Power assistance is provided by an electric motor arranged concentrically to the steering rack. This design takes up minimal space yet delivers very high performance. The efficiency is also much higher than with conventional mechanical/ hydraulic steering gears, resulting in fuel consumption benefits.



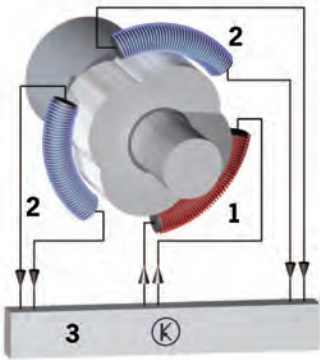
Electromechanical steering

The steering essentially consists of:

- Housing (1)
- Steering shaft (2)
- Steering pinion (3)
- Steering rack (4)
- Drive motor with rotor position sensor (5)
- Drive gear (6)
- Control unit (7)
- Steering torque sensor (8)

4_34_13

- 1 Stator
- 2 Rotor
- 3 Rotor disc (rotor position sensor)

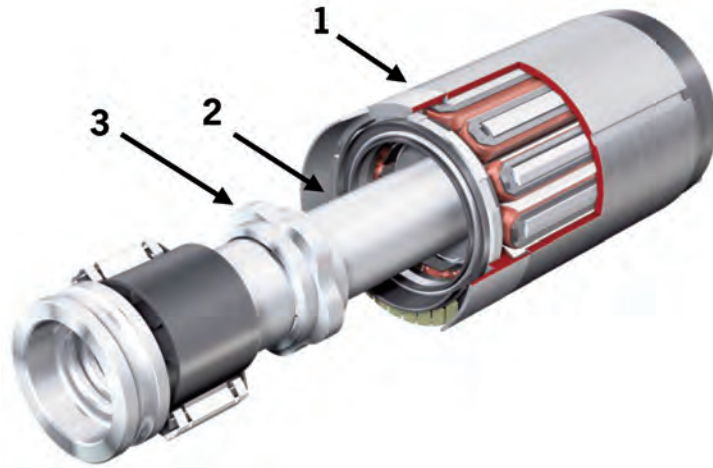


Rotor position sensor

4_36_13

- 1 Excitation coil
- 2 Pickup coil
- 3 Control unit

Components and structure



Drive motor with rotor position sensor

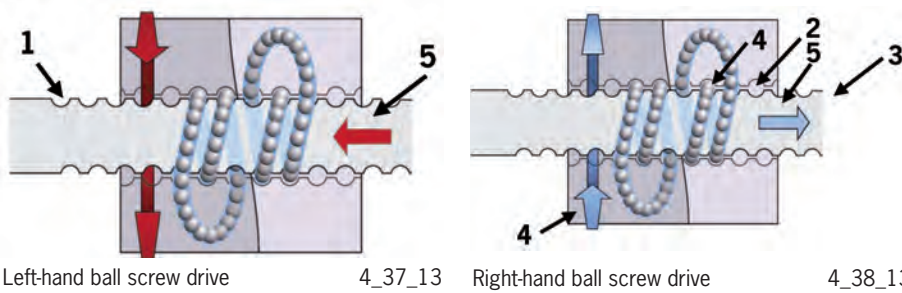
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The drive motor supplies the steering torque required for the power assistance. A brushless, permanently excited three-phase synchronous motor is used. The stator consists of 12 field coils. The coils are connected in series in groups of four and are energized with a sinusoidal current characteristic. The phases of the three currents are displaced to each other. The three magnetic fields generated in this way produce a rotating magnetic field that induces the synchronous rotation of the rotor. The rotor with ten permanent magnets is designed as a hollow shaft and mounted on the steering rack.

Rotor position sensor

The control unit needs the exact position of the rotor to calculate the stator current characteristic; this position is determined by the rotor position sensor. The rotor position sensor consists of a rotor disc made of field-conducting metal, an excitation coil and two pickup coils. The excitation coil is supplied with a sinusoidal voltage via the control unit. This generates a magnetic field that is transmitted to the two pickup coils via the rotor disc. The magnetic field induces a voltage in the two pickup coils; the displacement of these two coils' phases is proportional to the rotor position. The sensor is aging-resistant and is wear-free.

Drive gear



Left-hand ball screw drive

4_37_13

Right-hand ball screw drive

4_38_13

A ball screw drive is used to convert the rotation of the drive motor into a linear movement which acts on the steering rack. A ball screw drive works in a similar way to a bolt/nut connection, but with the threads replaced by running grooves. Power transmission between the nut (recirculating ball nut) and bolt (steering rack) takes place by way of balls that roll in the running grooves. As with the balls in a ball bearing, the balls move forwards and backwards in a closed circuit as appropriate to the direction of rotation of the bearing ring or the recirculating ball nut. The recirculating ball nut therefore has a return channel that picks up the balls at the outlet of the running groove and returns them to the start.

To reduce the friction, the ball circuits are kept as short as possible. That is why two separate circuits are used in the recirculating ball nut. The recirculating ball nut is permanently connected to the hollow shaft of the drive motor. Power assistance is provided in accordance with the direction of rotation of the drive motor when the front wheels are turned to the right and left. The amount of assistance steering torque is dependent on the current being supplied to the drive motor. The control unit automatically reduces the power assistance shortly before the mechanical stops of the steering rack are reached ("soft" stop).

Control unit

The control unit determines the phase displacement and magnitude of the supply voltages for the stator windings of the drive motor based on all the input information. The resulting current flow in the stator determines the torque of the electric motor and therefore the assistance steering torque. These assignments are stored in the control unit using maps. The output final stages required to activate the drive motor are integrated into the control unit.

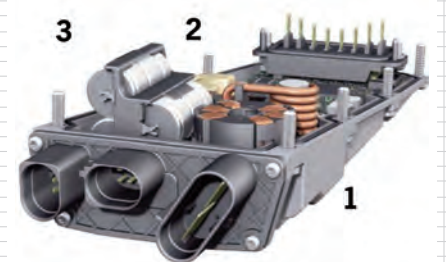
There are three electrical connections on the front:

- 1 Power supply for terminal 30, terminal 31
- 2 Signal supply for terminal 15, CAN bus
- 3 Steering torque sensor



Steering control unit

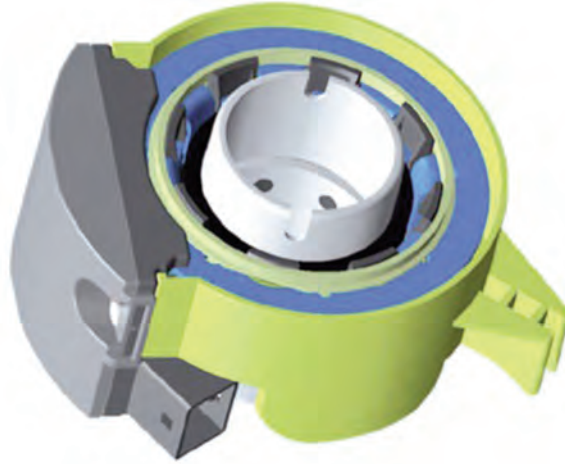
4_39_13



Electrical connections

4_40_13

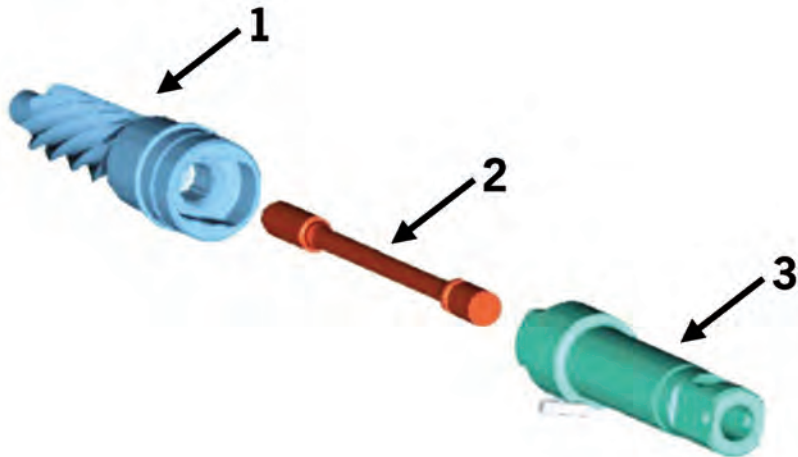
Steering torque sensor



4_41_13

The main influencing variable for calculating the required power assistance is the steering torque applied to the steering wheel, which is determined by the steering torque sensor.

- 1 Steering pinion
- 2 Torsion shaft
- 3 Steering shaft

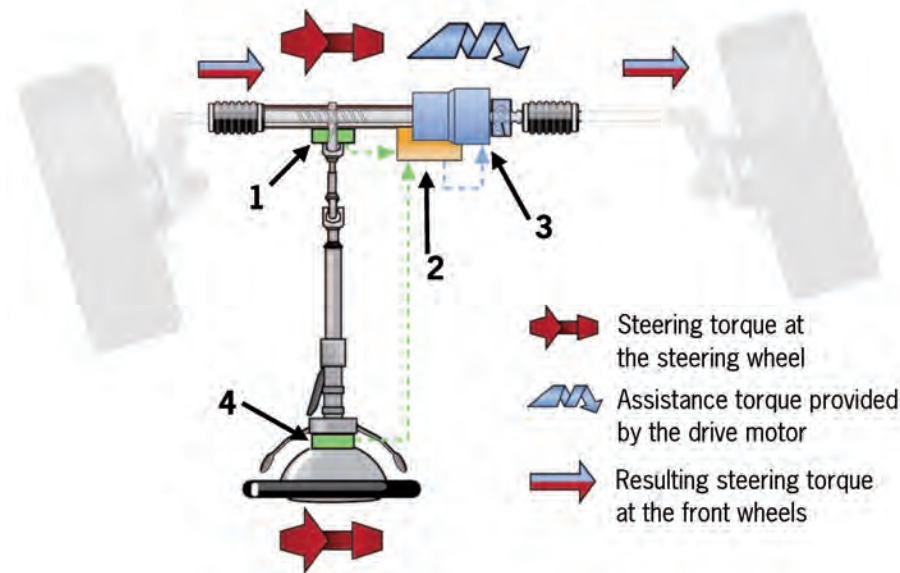


Torsion shaft

4_42_13

The steering torque shaft is mounted on the steering gear at the height of the steering shaft, which is connected to the steering pinion via a torsion bar. Applying a steering torque results in relative rotation between the steering shaft and steering pinion; the magnitude of this rotation is proportional to the applied steering torque. The rotation is recorded by the steering torque sensor using two Hall-effect sensors and forwarded to the control unit.

Function



Functional principle of electromechanical steering

4_43_13

- 1 After the data bus wakes up, the control unit executes an initialization routine with subsequent self-test.
- 2 Power steering is active above an engine speed of 300 rpm (starting). If no steering torque is applied (no measurable rotation of the torsion rod), the control unit synchronizes the signals from the steering torque sensor and the steering-angle sensor (mounted on the steering column behind the steering wheel). The dependence between the two signals is stored in the control unit as a map.
- 3 During driving, the level of power assistance to be provided is defined on the basis of the steering torque, steering angle and vehicle speed.
- 4 Power assistance is switched off when the combustion engine is switched off and the vehicle speed drops below 4 mph (7 km/h).

Special functions

The electromechanical design of the steering enables the implementation of further protective and comfort functions.

The functions currently implemented are:

- End stop protective function ("soft" stop)
- System assistance for lane keeping assist (option)
- Steering recommendation for μ -split braking (see figure 4_44_13)

Steering recommendation for μ split braking

Steering recommendation for μ -split braking

4_44_13

When braking on surfaces with different coefficients of friction, an undesired yawing moment can build up. The standard steering recommendation counteracts this by providing a brief steering torque pulse at the steering wheel in the steering direction required to stabilize the vehicle. Following the steering recommendation guarantees improved braking stability and also a shorter braking distance, since the PSM system does not need to reduce the braking force as much. The steering recommendation can, however, also be actively overridden at any time if called for by the traffic situation.

Servicing and scope of diagnosis



Steering gear (tie rods shown without air-guide vanes)

4_45_13

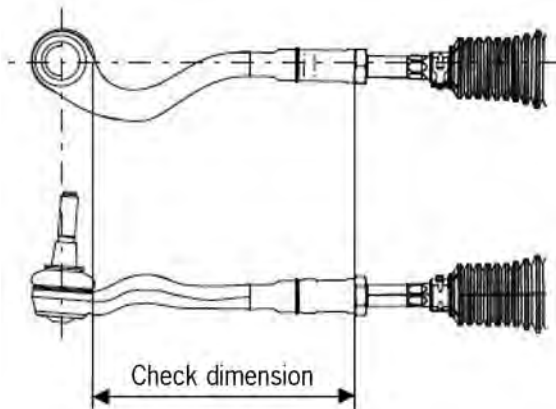
Indication of system faults

The electromechanical steering is self-diagnosing. Tie rods, bellows and the entire steering gear can be replaced in the event of damage. When replacing the steering gear, the control unit must be coded and the mechanical end stops taught using PIWIS Tester II.

The control unit uses a two-tier prioritization system for system faults:

- For system faults which in principle enable continued use of the vehicle, e.g. steering stops not taught, a **yellow warning light** lights up, a plain-text message appears on the instrument cluster and the fault is stored in the steering control unit. Power assistance can be reduced and the vehicle can be carefully driven to a Porsche dealer.
- For serious system faults, a **red warning light** lights up permanently on the instrument cluster. Here too, a plain-text message appears on the instrument cluster and the fault is stored in the fault memory. **The vehicle can no longer be driven.**

Detection of accident damage



Check dimension for tie rod

4_48_13

There is a “tie rod check dimension” specified for reliable detection of damage at the steering gear or deformation of the tie rods. If the check dimension is less than 188 mm, the entire steering gear including the two tie rods must be replaced.

Technical data

Steering range	mm	136 ± 1
Overall ratio		14:1
Max. current consumption	A	105
Weight	lbs.	33.95



Yellow warning light

4_46_13



Red warning light

4_47_13



The specifications in the Workshop Manual must be observed.

4.4 Wheels and tires

Overview

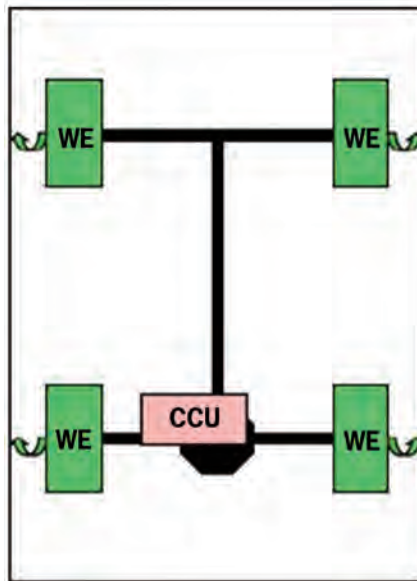
There are several attractive wheel designs in sizes ranging from 18 to 21 inches available to choose from. The Macan S and Macan S Diesel are equipped as standard with the 18-inch Macan S wheel and the Macan Turbo is fitted with the 19-inch Macan Turbo wheel. The 21-inch wheels are available for all Macan models. The 18-inch wheel is a lightweight forged wheel, while the 19 and 20-inch wheels are manufactured using lightweight flow-forming technology. The 21-inch wheel is a lightweight forged wheel.

	Macan S			
				
Axle	FA	RA		
Dimensions	8J x 18"	9J x 18"		
Rim offset	21	21		
Hole circle/ number	112/5			
Tires				
Summer	235/60 R18	255/55 R18		
All Season/ Winter	235/60 R18 M&S	255/55 R18 M&S		
	Macan Turbo		Macan Design	
				
Axle	FA	RA	FA	RA
Dimensions	8J x 19"	9J x 19"	8J x 19"	9J x 19"
Rim offset	21	21	21	21
Hole circle/ number	112/5		112/5	
Tires				
Summer	235/55 R19	255/50 R19	235/55 R19	255/50 R19
All Season/ Winter	235/55 R19 M&S	255/50 R19 M&S	235/55 R19 M&S	255/50 R19 M&S

	Macan Sport Design		RS Spyder Design	
				
Axle	FA	RA	FA	RA
Dimensions	9J x 20"	10J x 20"	9J x 20"	10J x 20"
Rim offset	26	19	26	19
Hole circle/ number	112/5		112/5	
Tires				
Summer	265/45 R20	295/40 R20	265/45 R20	295/40 R20
All Season/ Winter	265/45 R20 M&S	295/40 R20 M&S	265/45 R20 M&S	295/40 R20 M&S
	911 Turbo Design		Sport Classic	
				
Axle	FA	RA	FA	RA
Dimensions	9J x 21"	10J x 21"	9J x 21"	10J x 21"
Rim offset	26	19	26	19
Hole circle/ number	112/5		112/5	
Tires				
Summer	265/40 R21	295/35 R21	265/40 R21	295/35 R21
All Season/ Winter	not available		not available	

Tire pressure monitoring

The third-generation Tire Pressure Monitoring system (TPM 3.0) standard on all models is the same as the system used in the Panamera as of MY 2014. Using four sensors accommodated in the tire valves in the drop center of the rim, it provides a warning when the tire inflation pressure is too low or if the pressure falls rapidly. The driver can check the pressure of all four tires on the 4.8-inch display in the instrument cluster. The pressure display is available above speeds of 16 mph (25 km/h) after starting the vehicle.



4_49_13

WE – Wheel electronics

CCU – Combined control unit

4.5 Brake system

Overview of brake systems

Type	Unit	Macan S	Macan S Diesel	Macan Turbo	! equipment for all Macan models
Actuation					
Pedal Ratio	i	3.3		3.3	3.3
Brake booster		ContiTeves 9/9-inch aluminum tandem booster i=8			
Brake master cylinder ø	mm (in)	28.57 (1.124)		28.57 (1.124)	28.57 (1.124)
Circuit division		Per axle (black/white division)			
Wheel brakes		18"		18"	19"
		Front-axle brake		Front-axle brake	Front-axle brake
					
Brake disc ø and thickness	mm (in)	350 x 34 (13.78 x 1.34)		360 x 36 (14.17 x 1.42)	390 x 38 (15.35 x 1.49)
Brake caliper		Brembo MT6.36		Brembo MT6.36	Brembo MT6.36
Attachment concept		Radial		Radial	Radial
Brake pad area per wheel	cm ² (sq. in)	224 (34.72)		230 (35.65)	230 (35.65)
Caliper screw		M14 x 1.5 x 115		M14 x 1.5 x 115	M14 x 1.5 x 135
Cover plate		Partial area		Partial area	Labyrinth/disc
Deflection vane		Yes (V6 gasoline only)		Yes	Yes
		Rear-axle brake		Rear-axle brake	Rear-axle brake
					
Brake disc ø and thickness	mm (in)	330 x 22 (12.99 x 0.87)		356 x 28 (14.02 x 1.10)	370 x 30 (14.57 x 1.18)
Brake caliper		TRW CII-43 EPB		TRW CII-43 EPB	TRW CII-43 EPB
Attachment concept		Axial		Axial	Axial
Brake pad area per wheel	cm ² (sq. in)	89.4 (13.86)		106 (16.43)	106 (16.43)
Caliper screw		M12 x 1.5 x 38/62		M12 x 1.5 x 38/62	M12 x 1.5 x 38/62
Cover plate		Full area		Full area	Full area

Front-axle brakes

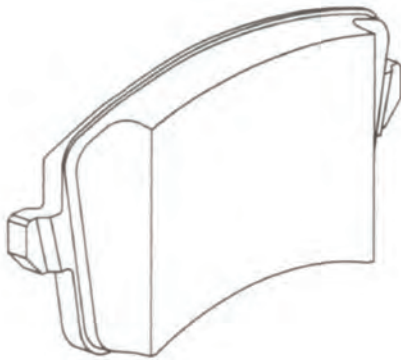
The Macan S and Macan Turbo vehicles use the brakes familiar from the Cayenne (brake disc 350 or 360 mm with 6-piston aluminum fixed caliper). The hub area of the brake discs had to be adapted to the new axle components (hole circle 112 mm, inner centering and mounting). A PCCB brake with a disc diameter of 390 mm is available as an I no. option.

Rear-axle brakes

TRW floating-caliper brakes with integrated parking brake function are used for the first time at the rear axle. The rear-axle calipers on the Macan S and Macan Turbo are identical except for the color. A larger brake disc is used on the Macan Turbo (356 mm instead of 330 mm).

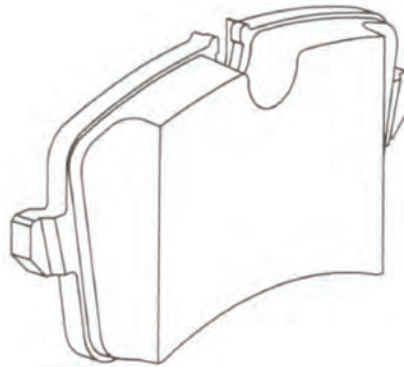
Notes on the rear-axle brake

- For changing the brake pads, piston resetting can only be done electrically via the PIWIS tester. Mechanical resetting by pushing or turning the piston is not possible.
- Always observe the repair instructions.
- Brake calipers are always supplied pre-filled as spare parts (for bleeding purposes).
- The outer and inner pads on the 17" Silver and 18" Red brakes are different (identifiable by the sensor holder on the inner pad).



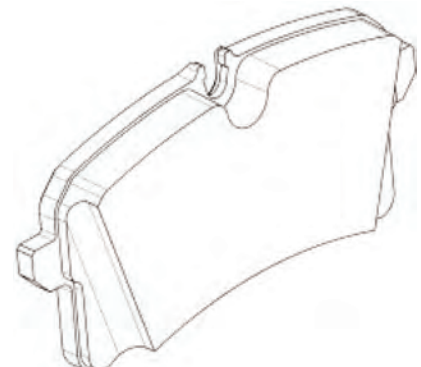
Outer 17" brake pad

4_52_13



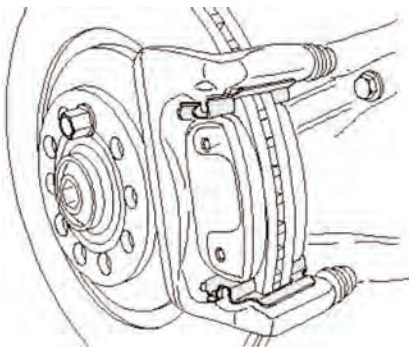
Inner 17" brake pad

4_53_13



Inner 18" brake pad

4_54_13



Fastening springs

4_55_13



Important!

Note the installation direction when replacing the rubber/metal mounts at the axle carrier.

Brake cooling

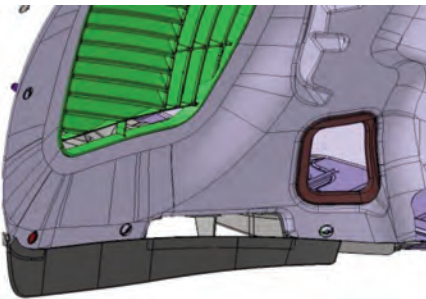
The Macan features typical Porsche ventilation measures consisting of brake air duct, optimized wheel spoiler, deflection vane, optimized exhaust air grille, an additional engine compartment exhaust air vent and an optimized cover plate at the brake discs for optimum brake cooling.



Air flow for brake cooling

4_56_13

Brake ventilation components



Vent

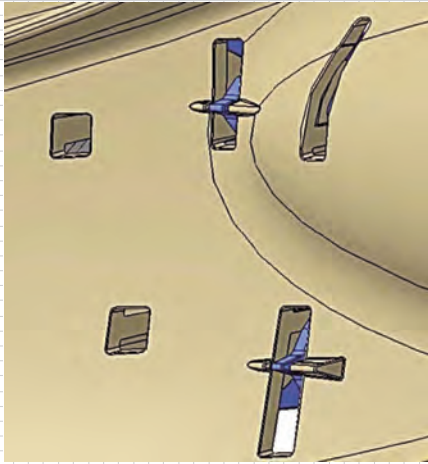
4_57_13



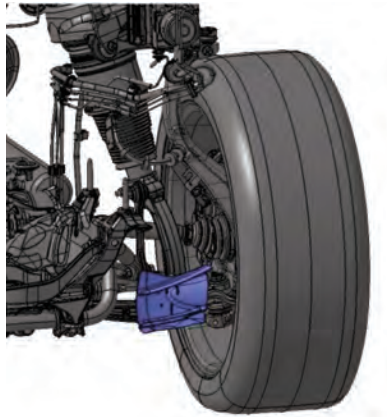
Cover plate

4_58_13

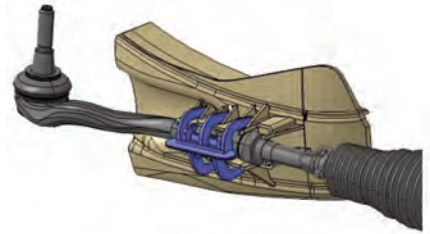
Brake air duct, optimized exhaust air grille, vent for engine compartment exhaust air, wheel spoiler.



Indication of correct installation 4_61_13



Air-guide vane at the front axle 4_59_13



Air-guide vane at the tie rod 4_60_13

Both parts have corresponding check lugs for verifying correct engagement of the clips in the air-guide vane. The air-guide vane can turn $\sim 90^\circ$ on the tie rod if the vehicle makes hard contact with an external object, e.g. big stone or branch when driving off-road. This is intentional to prevent damage to the tie rod. The clip must also be subsequently replaced in this case.

Electric parking brake (EPB)

All Porsche Macan models are equipped with an electric parking brake with a design which is completely new for Porsche. With this brake, there is an actuator comprising DC motor, transmission gearing and spindle drive mounted directly on the rear brake caliper. The parking brake function is realized by electromechanically clamping the same brake pads which also act as the service brake.

Design

The parking brake function by translating the rotation of the DC motor into a very small lifting movement of the brake piston. This is achieved using a double planetary gear set in combination with the spindle drive.

The overall gear ratio is realized in three stages:

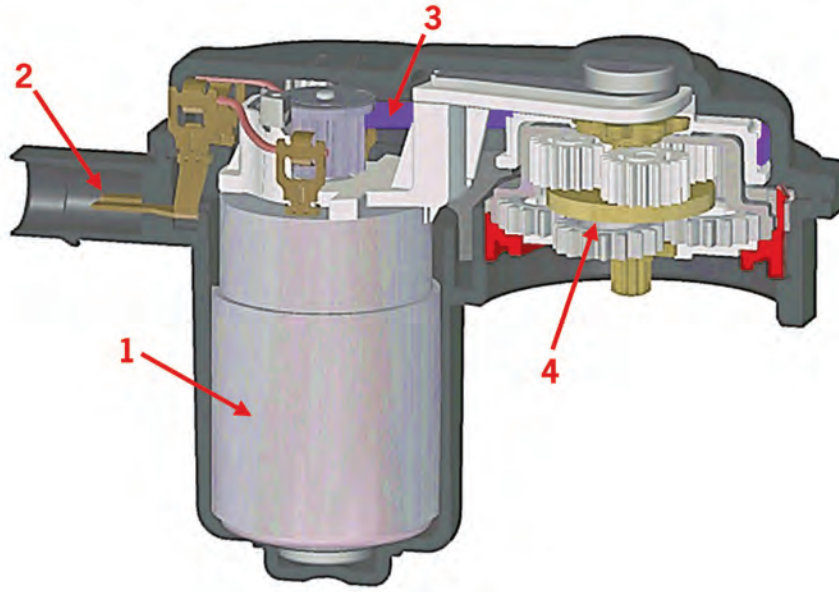
- 1 By the toothed belt drive between the engine and transmission input (1:3),
- 2 by the planetary gear set (1:50) and
- 3 by the spindle drive (1:1.25).

In the first stage, the DC motor drives the sun gear for the first planetary gear set via a helical toothed belt.



Rear-axle brake 4_62_13

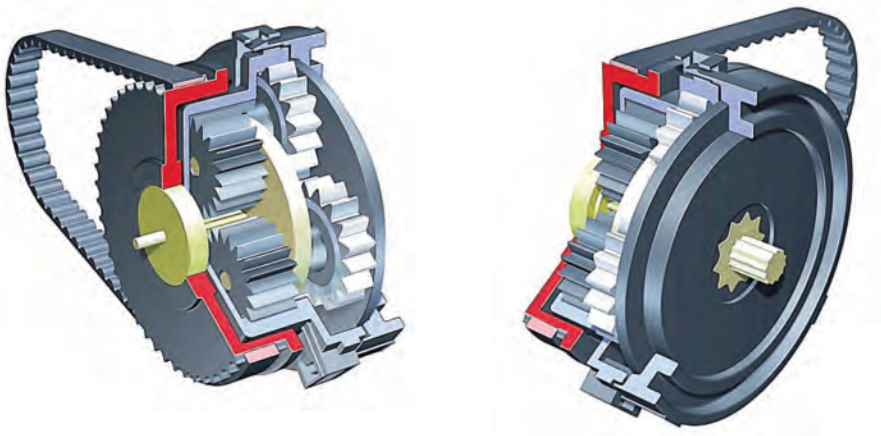
- 1 Brake caliper
- 2 EPB actuator



Cross section of the EPB actuator

4_63_13

The second change in gear ratio takes place in the double planetary gear set. Since the two internal gears are permanently connected to the housing, the sun gear of the first planetary gear set drives the first planet-gear carrier. This acts in the second gear wheel set on the sun gear, which in turn drives the second planet-gear carrier. The planet carrier gear of the second reduction stage is the transmission output gear and is directly connected with the spindle drive.



Double planetary gear set

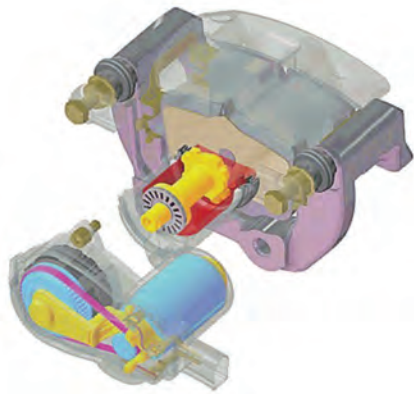
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4_65_13



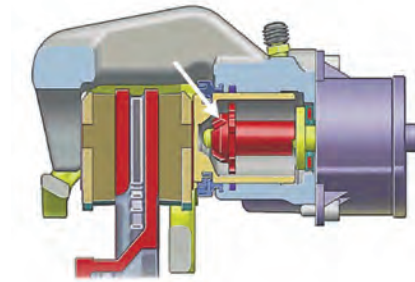
Double planetary gear set, disassembled

4_66_13



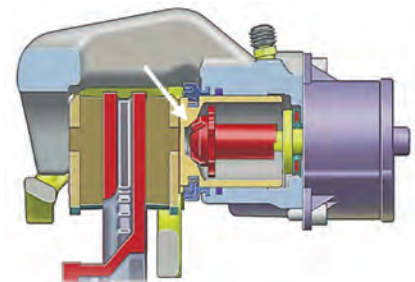
Spindle drive

4_69_13



EPB disengaged

4_67_13



EPB engaged

4_68_13

Electric parking brake is engaged

The nut moves forwards on the spindle and makes contact with the piston. The brake piston is pressed against the brake disc.

Electric parking brake is disengaged

The nut is moved back on the spindle. The load on the brake piston is reduced. The return of the sealing ring to its original shape moves the piston back and releases the brake disc. The brake pad is moved when the EPB control unit activates the DC motor. The activation current increases strongly when the brake pads come into contact with the brake disc. The switch-off time and therefore also the maximum clamping force are defined by evaluating the voltage and current characteristic. There is no direct measurement of the brake pad movement.

EPB control unit

The control unit is installed on the right in the luggage compartment. Activation of the DC motors takes place separately for the left-hand and right-hand motors. There are two processors implemented in the control unit. Enable decisions are always made by both processors. There is a micromechanical inclination sensor integrated into the control unit. The EPB control unit also determines the vehicle's current longitudinal acceleration from the sensor signal. The EPB control unit has its own internal run-on time independently of the CAN run-on time. This is at least 20 seconds. This ensures that when the parking brake is engaged, the display remains active for another 20 seconds after the ignition is switched off.

Electric parking brake functions

Dynamic emergency braking function

If the parking brake switch is pressed at vehicle speeds above 4 mph (7 km/h), braking takes place through active build-up of brake pressure by the PSM system at all four wheels. If the vehicle is then braked to a speed below 4 mph (7 km/h), the electric parking brake is activated and the PSM system stops building up the brake pressure. The PSM system builds up the brake pressure at the request of the EPB control unit. Under certain circumstances, the PSM control unit cannot fulfil this request and build up brake pressure, e.g. if excessive temperature is detected at the wheel brakes or with certain PSM faults. The electric parking brake assumes the PSM function in these cases. The vehicle is then braked by rapidly alternating engagement and disengagement of the parking brake (at a maximum rate of approximately 2 Hz at most), even at speeds above 4 mph (7 km/h). The wheel speeds at the front and rear axles are continuously compared to avoid over-braking the rear axle and thereby prevent handling instability.

Automatic retensioning at high brake disc temperatures

The parking brake is automatically retensioned when the vehicle is stationary and at high brake disc temperatures. The brake disc temperature is measured by the EPB control unit using a temperature model. The EPB control unit measures the current brake disc temperature three minutes after the parking brake is engaged. The brake is retensioned if the temperature is greater than 572° F (300° C), the ignition is switched off or the inclination angle is greater than 15%. The brake is always retensioned at brake disc temperatures above 931° F (500° C) regardless of whether the ignition is switched on or off. This is indicated by the indicator light flashing.

Automatic correction of the brake pad clearance

If the driver does not use the electric parking brake for a long period of time, the distance the spindle drive needs in order to press the brake pads against the brake disc will increase. This is caused by brake pad wear. If the electric parking brake is then actuated, engagement may take much longer under certain circumstances. To prevent this, the parking brake function is automatically activated if it has not been activated over the last 620 miles (1,000 km) driven. The condition for this is that the vehicle is parked with the parking brake disengaged and the ignition switched off.

Test stand mode

Precisely controllable braking on the brake test stand is required for checking the function of the parking brake. Test stand mode is automatically detected after 3 seconds if the rear wheels are moving on the roller of the brake test stand at a constant speed between 1.8 and 5.6 mph (3 and 9 km/h). A prerequisite for this is that terminal 15 must be switched on. The closing behavior of the parking brake is modified by the control unit: each time the switch is pressed, the piston is moved by a defined, small distance and the brake closure is slightly increased.

**Important!**

For the correct procedure for replacing brake pads, the information in the current service literature must be noted and the instructions in the corresponding program in the PIWIS Tester II must be followed.

Changing brake pads

To be able to reset the brake piston in order to change the brake pads, the nut on the spindle drive must first be moved all the way back. The EPB actuators must be appropriately activated using PIWIS Tester II for this purpose. After the brake pads are changed, the brakes must be closed for calibration purposes by activating the DC motors.

Emergency operation

The closed parking brake can be mechanically released if electrical activation is no longer possible or in the event of mechanical malfunction of EPB components. The actuator must be unscrewed from the brake calliper for this and the spindle which is then visible must be turned using a Torx wrench until the brake is released.

4.6 Control systems

Porsche Active Suspension Management (PASM)

PASM is a chassis control system for electronically adjusting the shock absorbers. The adjustable damper system selects the appropriate damper hardness for each wheel according to the driving situation and driving conditions. Driving safety, agility and comfort are optimized.

Three different chassis setups can be selected at the push of a button:

- “PASM Comfort”
- “PASM Sport”
- “PASM Sport Plus”

Comfort mode ensures comfortable chassis tuning. The “PASM Sport” chassis setup offers sporty shock absorber tuning. “PASM Sport Plus” mode offers particularly sporty shock absorber tuning, e.g. for driving on the race circuit. PASM actively and continuously regulates the damper force at the front and rear axles. Sensors record the body acceleration and vehicle height for this. Signals such as lateral acceleration, steering angle, brake pressure and engine torque are also taken into consideration. The control unit calculates the current driving conditions and adjusts the damper hardness in accordance with the preselected mode.

Switching PASM mode on

1. Switch on ignition.
2. Press button (repeatedly).

On the button:

- No indicator light comes on when you select “PASM Comfort” (default setting).
- One indicator light comes on when you select “PASM Sport”.
- Two indicator lights come on when you select “PASM Sport Plus”.

In addition, the selected chassis setup is shown on the multi-function display in the instrument panel for approximately 4 seconds.



Important!

The last selected chassis setup is stored in the memory after the ignition is switched off.



PASM button

4_70_13

**Important!**

- The vehicle height is automatically kept constant when the vehicle is loaded. The individual levels can be set only while the engine is running.
- Frequent level changes can cause the compressor to overheat. In this case, the compressor must cool for several minutes before the level adjustment system is fully functional again. The system automatically adjusts to a selected level when the compressor cools down.



PASM button

4_71_13



Air spring strut, front axle

4_73_13

Porsche Active Suspension Management (PASM) with air suspension and level adjustment

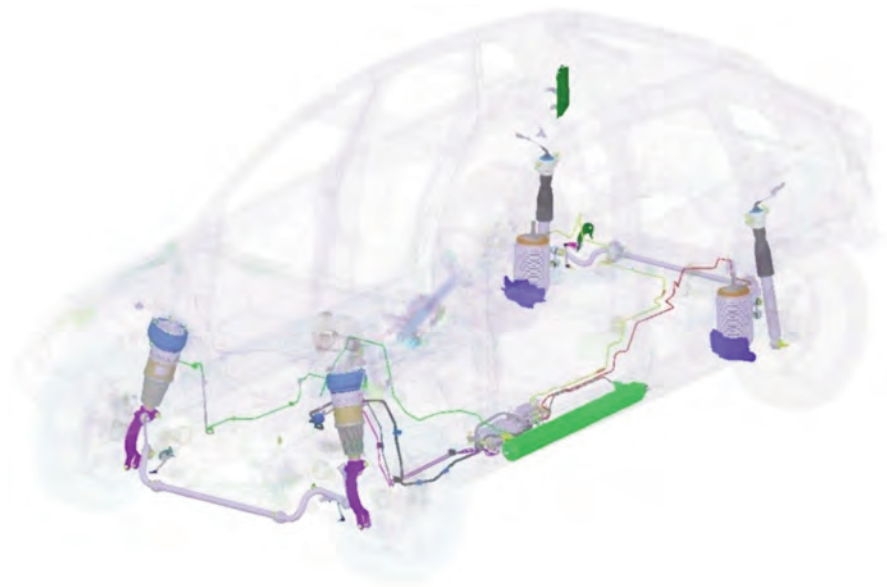
PASM with air suspension and level adjustment is an active shock absorber adjustment and ride height control system. The adjustable damper system selects the appropriate damper hardness for each wheel according to the driving situation and driving conditions. The level adjustment system automatically balances load changes and maintains a constant ride height. Driving safety, agility and comfort are optimized.

Three different chassis setups can be selected at the push of a button:

- “PASM Comfort”
- “PASM Sport”
- “PASM Sport Plus”

Comfort mode ensures comfortable chassis tuning. The “PASM Sport” chassis setup offers sporty shock absorber tuning. “PASM Sport Plus” mode offers particularly sporty shock absorber tuning, e.g. for driving on the race circuit. The vehicle is not lowered to Low Level. In addition to manual mode selection, PASM also adjusts shock absorber tuning for either sporty or comfort driving, depending on the driving situation.

Air suspension



System overview of air suspension

4_72_13

The optional air suspension with level adjustment and height adjustment as well as PASM is 15 mm lower compared with the steel spring suspension of the Macan vehicles and offers enhanced driving dynamics combined with better comfort thanks to the lower center of gravity. The air suspension automatically ensures a constant vehicle level as well as almost constant vibration behavior, irrespective of the load. The fully load-bearing air-spring struts (with integrated dampers at the front axle) and the variable damping system with situation-based, continuous adjustment of damper force reduce body movements.

The ground clearance can be optionally varied in three stages:

- Normal Level,
- High Level I and
- Low Level.

Normal Level

The ground clearance at Normal Level is approximately 190 mm.

High Level I

High Level I in off-road mode is intended for off-road driving, field tracks, forest paths, etc. Compared with Normal Level, the vehicle is raised by around 40 mm (maximum ground clearance 230 mm).

Switching High Level I on and off

High Level I can only be switched on manually and at speeds below approximately 56 mph (90 km/h). The vehicle is automatically raised to High Level I when off-road mode is switched on. If the vehicle is travelling at more than approximately 75 mph (120 km/h) when off-road mode is switched on, the vehicle is automatically lowered to Normal Level. The vehicle is automatically raised again to High Level I if the speed drops below approximately 25 mph (40 km/h). If off-road mode was deactivated, the vehicle is lowered to Normal Level from a speed of approximately 9 mph (15 km/h).

Low Level

Low Level can be selected manually and remains activated in all speed ranges. Compared with Normal Level, the vehicle is lowered by around 10 mm (maximum ground clearance 180 mm).

Switching Low Level on and off

1. Switch on ignition.
2. Start engine.
3. Press button.

When Low Level is selected, the indicator light on the button comes on. The message "Low level selected" appears on the multi-function display.



Important!

- The last manually selected level is retained after the ignition is switched off.
- If Low Level was selected by activating "Sport Plus" mode, the settings will be lost when the ignition is switched off.
- In "Sport Plus" mode, the vehicle is automatically lowered to Low Level.



Air spring, rear axle

4_74_13



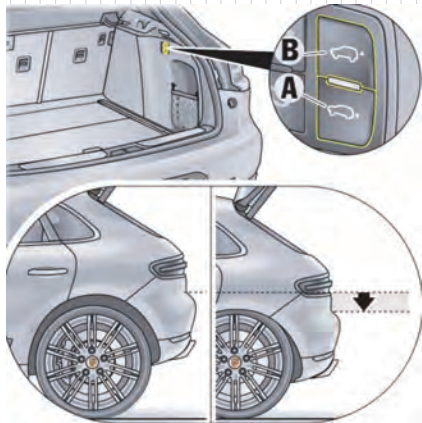
Level button

4_75_13



Important!

Workshop Manual are followed when working on the air springs.



Loading level button

4_76_13



Risk of damage to chassis parts, assemblies and the vehicle underbody. The vehicle may bottom, e.g. when driven down from curbs, if the ground clearance is insufficient in Loading Level. Always raise the rear of the vehicle to Normal Level first before driving off.



Off-road button

4_77_13

Loading Level

Loading Level can be selected for comfortable loading of the loadspace. With this level, the rear is lowered by 40 mm compared with Normal Level. The load sill is lowered continuously using the two buttons A and B on the side trim panel in the luggage compartment on the right in direction of travel.

Lowering the rear of the vehicle

Press button A and hold. The LED between the two buttons A and B comes on. The rear of the vehicle is lowered to Loading Level.

Raising the rear of the vehicle

Press button B and hold. The LED between the two buttons A and B comes on. The rear of the vehicle is raised to its initial level and the LED goes out.

- The vehicle height is automatically kept constant when the vehicle is loaded.
- No other level adjustment processes are executed when the rear of the vehicle is being lowered.
- If the LED between the two buttons **A** and **B** is flashing continuously, the rear of the vehicle cannot be lowered, e.g. when the doors are opened.

Off-road mode

In off-road mode, the transmission and chassis control systems (such as ABS) are automatically adapted to the requirements for off-road driving in order to guarantee the best possible driving dynamics with maximum driving safety. PASM automatically switches to "PASM Sport Plus" mode. Together with air suspension, the vehicle is raised by around 40 mm compared with Normal Level.

Switching off-road mode on and off

Prerequisite: The vehicle is travelling at a speed of less than approximately 56 mph (90 km/h). Press the off-road button. When off-road mode is switched on, the indicator light on the button comes on. In addition, the set driving mode is shown on the multifunction display in the instrument panel for a few seconds.

Activating off-road mode can be useful in the following situations:

- Driving with snow chains.
 - Driving in deep snow or on loose surfaces.
 - Driving downhill and braking on loose surfaces.
 - Driving on uneven surfaces with significantly reduced load on one or more of the wheels (axle articulation).
- Off-road mode remains switched on even if the driving conditions change, e.g. if the vehicle is then driven on the road. The corresponding indicator light on the button stays on, but the transmission and chassis control systems adapt to suit the changed driving conditions.
 - A warning message appears in the instrument panel if there is a fault in the gearshift system.

Sport button

All Macan models are equipped as standard with a SPORT button on the center console to the left of the selector lever. At the push of a button, the engine responds more immediately to throttle inputs, the rev-limiter has a harder setting and the engine dynamics are tuned for performance driving (prerequisite: off-road mode switched off). On the Porsche Doppelkupplung (PDK), the gear-changing points are also shifted into the upper rpm range. The shifting times become shorter, the gear changes stiffer and downshifts are performed with intermediate throttle application. The optional Porsche Active Suspension Management (PASM; standard for Macan Turbo) chassis control system is also switched to Sport mode. If PASM Sport Plus and/or Low Level was previously manually selected, the sportier settings are retained. At the same time, the Auto Start Stop function and coasting are deactivated.

Sport Chrono package

The optional Sport Chrono Turbo package offers an even sportier setup for chassis, engine and transmission. The Sport Chrono package can be recognized by the analog and digital stopwatch on the dashboard as well as the additional SPORT PLUS button on the center console. Another part of the package is the display in the optional Porsche Communication Management (PCM) system. It provides information e.g. about the total driving time, lap distance covered so far and individual lap times. In detail, activating SPORT PLUS mode lowers the suspension to Low Level and activates a stiffer setup for PASM as well as a sportier setup for the engine characteristics. Interventions by Porsche Stability Management (PSM) also take place later. Braking in bends becomes tangibly more agile. At the same time, the "race track shift strategy" is activated. The Porsche Doppelkupplung (PDK) is now tuned for very short shifting times, optimum shift points and torque enhancement during the gearshifts for maximum acceleration. This facilitates even sportier driving. Additionally for the Macan S and Macan Turbo, the idle speed is increased and a hard rev-limiter is activated. Finally, the Launch Control function ensures starting acceleration similar to a racing start. The time advantage for the standard sprint from 0 to 62 mph (100 km/h) is 0.2 s for the Macan S, Macan S Diesel and Macan Turbo. The result is improved lap times and a very large spread between comfort and sportiness.



Sport button

4_78_13



Sport Plus button

4_79_13

Porsche Torque Vectoring Plus (PTV Plus)



4_80_13

The Porsche Torque Vectoring Plus (PTV Plus) system specially adapted to the Macan is available as an option to enhance driving dynamics and stability. It offers variable distribution of engine torque to the rear wheels and electronically controlled rear differential. PTV Plus improves the steering behavior and steering precision as a function of the steering angle and steering speed, accelerator-pedal position, yaw rate and speed through selective braking interventions on the inside rear wheel when cornering. Consequently, a greater amount of drive torque is transferred to the outside rear wheel which supports the steering motion of the car, thereby improving its cornering dynamics. The result is more direct and dynamic steering into the bend.

PTV Plus increases agility and steering precision at low and medium speeds. The system ensures greater driving stability at high speeds as well as when driving quickly through bends and if the wheels spin. Finally, PTV Plus in combination with Porsche Traction Management (PTM) and Porsche Stability Management (PSM) also ensures greater driving stability, e.g. when accelerating out of bends, on different road surfaces as well as in wet and snowy conditions. PTV Plus has also a positive effect during off-road use: spinning of the rear wheels on loose surfaces is reduced through targeted locking and braking interventions.

Multi-collision braking

In the event of an accident, multi-collision braking can help the driver to reduce the risk of skidding and the danger of further collisions during the accident by initiating braking automatically.

Preconditions

Multi-collision braking only works:

- in the event of front, side and rear-end collisions,
- if the airbag control unit detects a corresponding activation threshold during an accident,
- if an accident occurs when the vehicle is travelling at a speed of more than approximately 6 mph (10 km/h).

Information

PSM automatically brakes the vehicle provided the hydraulic brake system, PSM and the electrical system are not damaged and are still working after the accident.

Exceptions

The following activities prevent automatic braking in the event of an accident:

- If the driver presses the accelerator markedly.
- If the brake pressure produced when the driver presses the brake pedal is stronger than the brake pressure applied by the system.



5 Body

General information

The body of the Macan has a conventional steel construction. The box-shaped bodyshell is based on the Audi Q5. The typical Porsche performance-oriented driving properties have been realized once again in the Macan through the targeted use of additional reinforcements made of high-strength and super-high-strength steels, particularly in the area of the front end.



5_01_13

To address the topic of lightweight construction on the Macan, components such as the luggage compartment lid, hood and fenders are made of aluminum. The function of the raw air guide has been integrated into the hood as another measure to cut down on the number of components.

The Macan also impresses with innovative lightweight construction solutions in areas which are not directly visible. For example, the mounting plate and guide rails of the front armrest are made of magnesium. In addition, lightweight butyl rubber laminated with an aluminum foil is used for all the insulating materials in the Macan instead of the more commonly used bitumen.

Macan

Body

5

- Super-high-strength steel
- Higher-strength steel
- High-strength steel
- Deep-drawing steel
- Aluminum sheet

cardiagn.com

5	Body	163
5.1	Aerodynamics	165
5.2	Bodyshell	166
5.3	Body repairs	169

Technical data

The gross vehicle weight is 4,145 lbs. (1,880 kg) for the Macan Diesel, 4,112 lbs. (1,865 kg) for the Macan S and 4,244 lbs. (1,925 kg) for the Macan Turbo.

The Macan models are compact and dynamic with a width of 1,923 mm (without exterior mirrors) and a height of 1,624 mm (zero level).

The low center of gravity and wheelbase of 2,807 mm ensure greater driving stability, particularly when cornering.

The length of 4,681 mm or 4,699 mm (for the Macan Turbo) gives the Macan the sportiest proportions in the SUV segment.

Another special feature of the Macan is the comparatively short overhang of 924 mm at the front and 950 mm at the rear, which further emphasizes the Sports Car character.

High Level I raises the vehicle level by 40 mm, while Loading Level drops the rear of the vehicle to 40 mm below zero level.



Loading Level for the Macan

5_02_13

5.1 Aerodynamics

In order to achieve the sportiness demanded for the Porsche Macan and at the same time design a highly efficient overall vehicle, great importance was attached to the aerodynamic properties when developing the body. The result is a form that is perfectly matched to the overall vehicle geometry.



5_03_13

Additional measures such as a radiator shutter or specially designed underbody panning help to optimize the drag coefficients.

This enabled the following cd values to be achieved on the Macan:

Model	Macan Diesel	Macan Turbo	Macan S
cd value	0.35	0.36	0.37

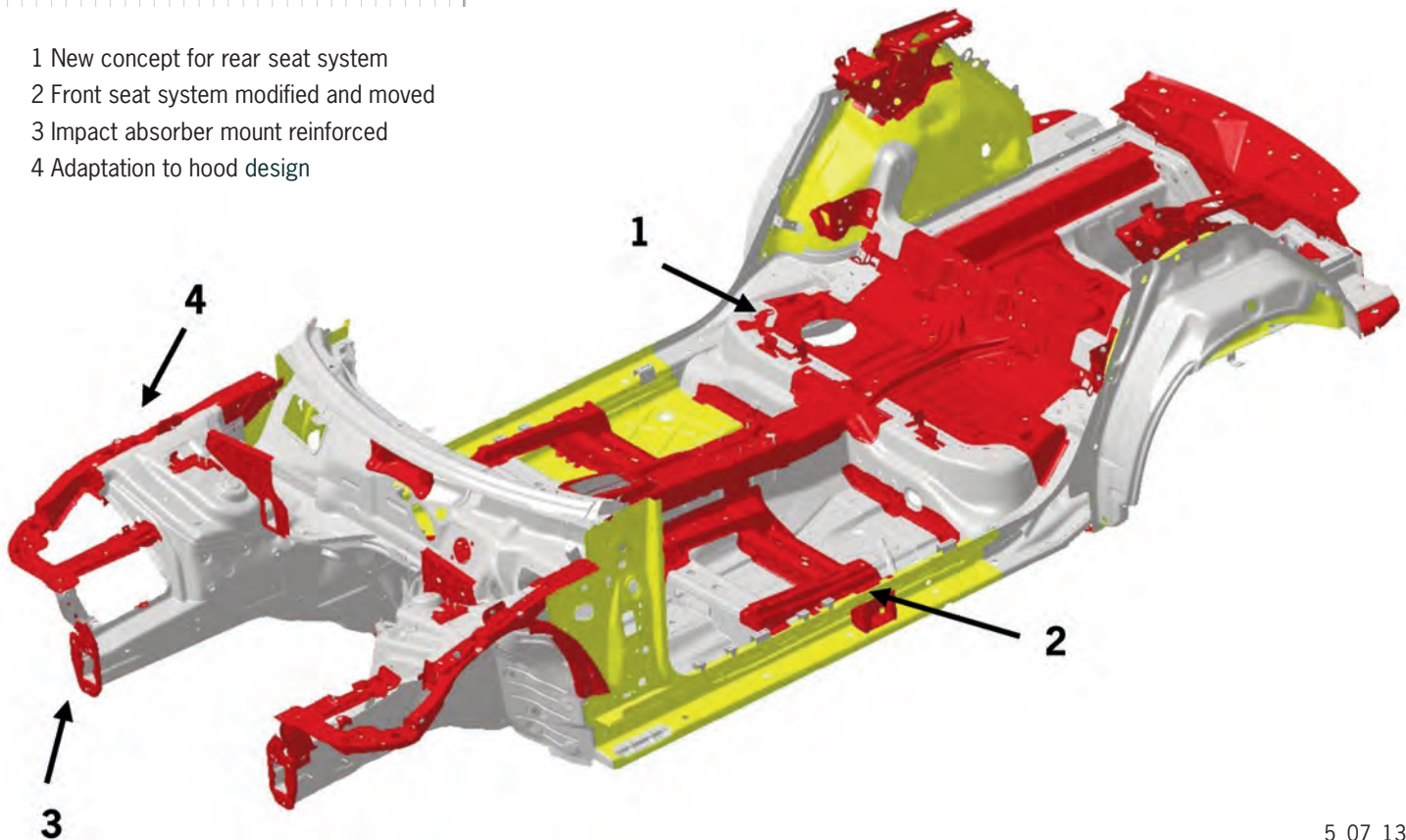
5.2 Bodyshell

As already mentioned, the proven steel construction is used for the bodyshell of the Macan. Further developments in steel processing techniques have allowed the use of extremely thin-walled steels, which have very high rigidity values in order to comply with all relevant safety regulations. The weight enhancements are not restricted to the crash-relevant structures of the bodyshell. The use of aluminum for the hood, fenders and tailgate as well as new structures in the door also contribute to a significant reduction in the body weight.

Body structure

The consistent further development of lightweight steel design makes a crucial contribution to the safety and lightweight construction of the Macan. Furthermore, outstanding body rigidity values have been achieved. The bodyshell structure is largely the same as that of the Audi Q5. However, various further measures have been taken to optimize the bodyshell, such as making adjustments in the front end for the new bonnet design or developing reinforced impact absorber mounts. The cross member structure and changes to the tunnel bridge were additionally necessary to optimize the load paths in the event of a crash.

- 1 New concept for rear seat system
- 2 Front seat system modified and moved
- 3 Impact absorber mount reinforced
- 4 Adaptation to hood design



- Adopted from Audi Q5
- New part
- Adopted from Audi Q5 and cut changed

5_07_13

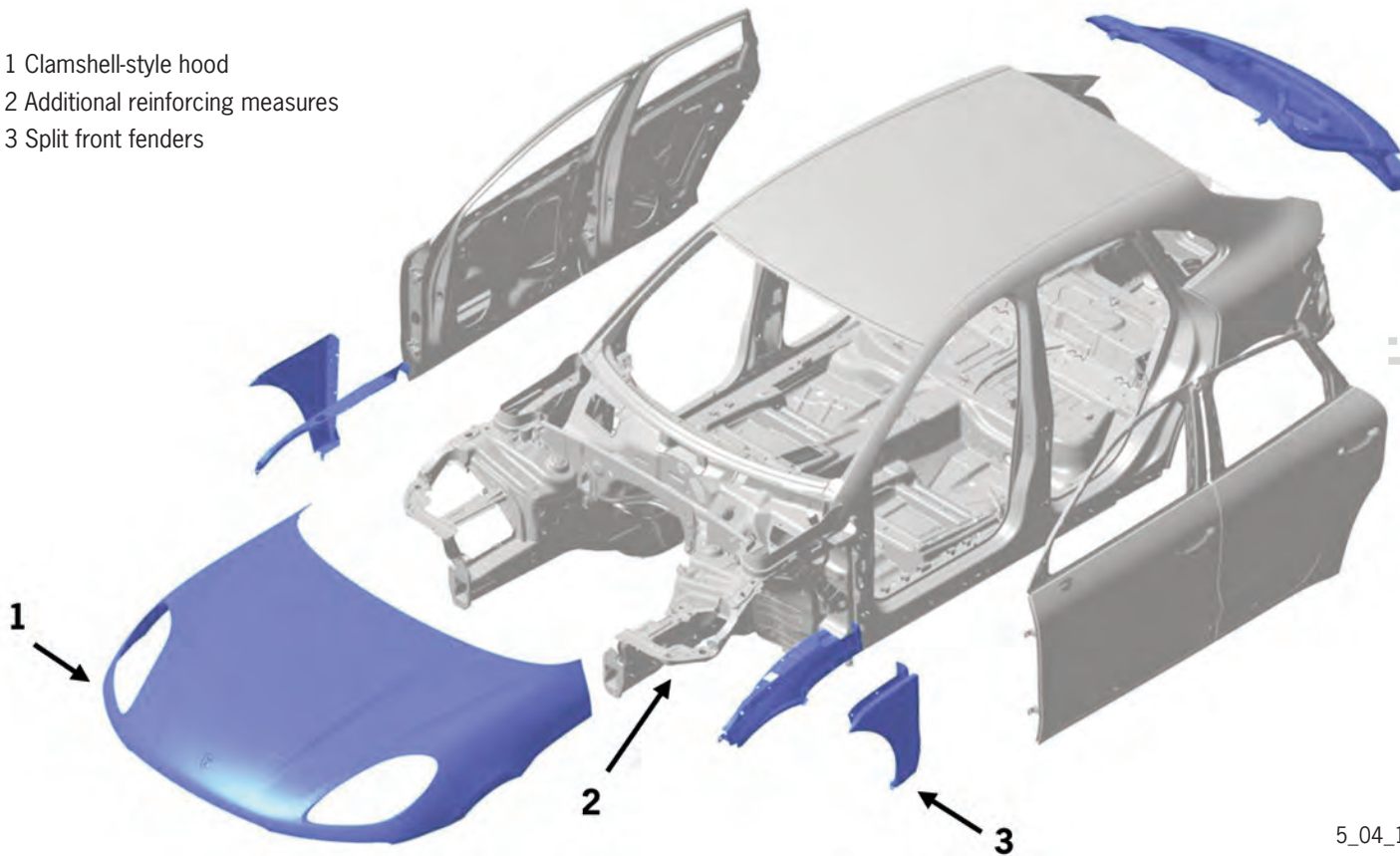
Crash safety

In the event of a crash, the forces which occur are distributed in a defined pattern to longitudinal and cross member structures in the front and rear end. The multi-phase steels used ensure high strength, selective deformability and optimum energy absorption. Reinforcements made from super-high-strength, hot-formed steels also protect occupants in the event of a side impact. They surround the passenger cell like a cage and, with their extreme dimensional stability, play an important role in maintaining the integrity of the cabin and therefore protecting the occupants.

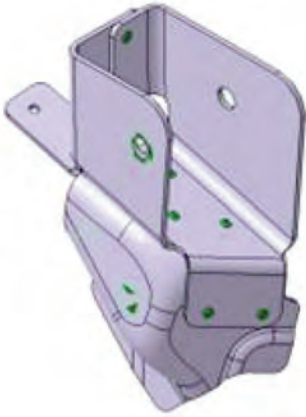
Front end

The new clamshell-style hood and the split fenders required as a result meant that the structure of the front end in the area of the longitudinal members had to be revised in order to guarantee sufficient torsional rigidity.

- 1 Clamshell-style hood
- 2 Additional reinforcing measures
- 3 Split front fenders



5_04_13

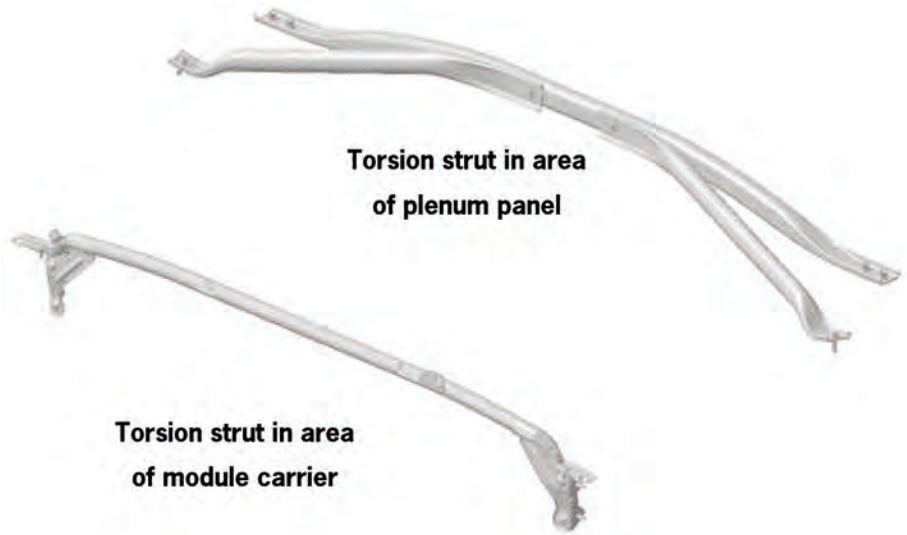


Torque support bracket

5_06_13

Torsion struts and torque support

There are torsion struts installed in the area of the module carrier and plenum panel in order to further increase the torsional rigidity in the front end.

Torsion strut in area
of plenum panelTorsion strut in area
of module carrier

5_05_13

In addition to the torsion struts, the Macan Turbo is also equipped with a torque support (same as the Panamera). The bracket for the support is welded onto the right-hand spring-strut dome (see Fig. 5_06_13).

Joining techniques

The following joining techniques are used to assemble the bodyshell of the Macan:

- Bonding
- Spot welding
- MAG welding

5.3 Body repairs

The main goal for development of the body structure of the new Porsche Macan models was reduction of the body weight. Particular attention is paid here also to passive safety, economy and quality. The lower vehicle weight leads to improved performance as well as lower fuel consumption. The body construction is comparable to that of the Cayenne. The repair concept for the Macan is therefore largely based on the familiar repair concept for the Cayenne.

Repairs to super-high-strength and ultra-high-strength body parts

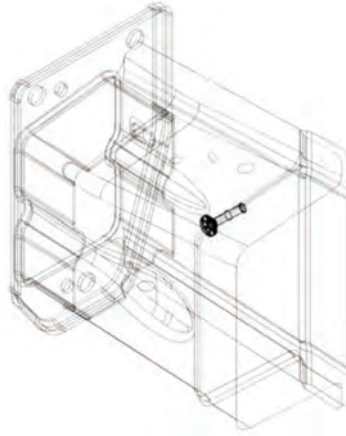
Damaged or deformed super-high-strength and ultra-high-strength body parts can impair torsional rigidity, flexural strength and crash safety. Super-high-strength and ultra-high-strength body parts cannot be reshaped; straightening and reshaping are not permitted. If a body part is damaged or deformed, the complete body part must be replaced. Repairs requiring partial replacement are not permitted for safety reasons. This means that super high-strength and high-strength parts may be replaced only as complete parts.

Welding

Standard processes used in steel body construction are used to join the sheet steel body parts, namely resistance spot welding and also, to a limited extent, metal active gas welding (MAG welding). However, resistance spot welding can only be performed reliably here using Porsche AG's currently approved inverter welding equipment, as otherwise the strength of the body may be compromised and consequential damage may result. A visual assessment of the welding quality is not possible in this instance.

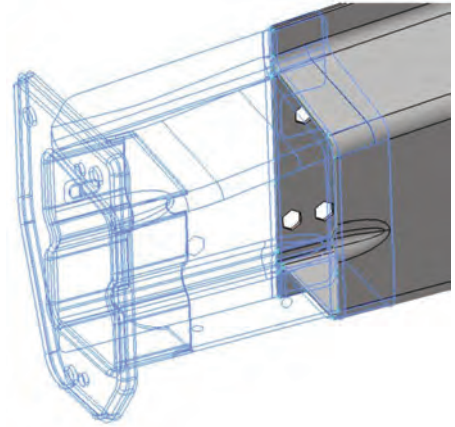
Use of an oxyacetylene welding process is not permitted for repairs to steel. The specifications in the Workshop Manual must be observed for MAG welding on steel sheets. Test welding must be carried out in the case of resistance spot welding of different sheet thicknesses. Body parts made from sheet steel can be welded using the approved inverter resistance spot welding processes and inert gas welding processes.

In order to enable an economic repair of the front longitudinal member following low-speed impacts, a special spare part has been developed (similar to Panamera). For carrying out the repair, a separating cut is made at the longitudinal member and the spare part is then fitted on and welded (see illustrations below).



Longitudinal member
spare part

5_08_13



Sectional repair of
longitudinal member

5_09_13

Bonded joints

In addition to resistance spot welds, adhesive bonding with structural glue is also used in certain areas. This increases the strength of the connection. Adhesive beads are also used at other locations on the body for sealing, electrochemical insulation and noise reduction. The production adhesive cannot be used in After Sales applications. A two-component adhesive Betamate 2096 is used here.

Straightening set

A completely new straightening set is required for body repairs on the Porsche Macan. However, the existing straightening set for an Audi Q5 (type 8R) can be expanded for the Macan. It is set up and used in the same way as existing straightening sets for current vehicle models. The manufacturers are the known companies Caroliner and Celette.

6 Body – Exterior equipment

General information

The Macan's family relationship with the other models in the Porsche Sports Car line-up can be clearly recognized from the front view. A particularly characteristic feature is the dynamic front with the clamshell-style hood, the contoured fenders, the large air intakes and striking headlights.

6.1 Front view

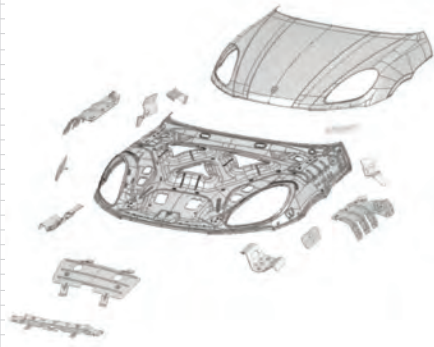
The front apron with its central focal point conveys a feeling of sportiness and gives the Macan models an intent, self-assured face. The Macan Turbo has a specific and even more dynamic front apron as a differentiating feature. The sporty and self-assured appearance of the Macan is underlined by the typical Porsche shape and position of the headlights. The 4-point daytime lights in LED technology used in the Bi-Xenon headlights are a particular highlight here. Previously familiar from the Porsche Turbo models, these 4-point LED daytime lights will be key in shaping the striking light design of all Porsche models in the future. The Macan has a large air intake in the center, with a smaller air intake on each side.



Front view of the Macan

6_01_13

6 Body – Exterior equipment	171
6.1 Front view	171
6.2 Side view	179
6.3 Roof	182
6.4 Rear view	183



Hood design

6_02_13



Macan hinges

6_03_13



Receiving elements for the hood

6_05_13

Clamshell-style hood

The clamshell-style hood (Fig. 6_02_13) extends to the wheel housings. This is done to minimize the visible joints. Precision lines stamped into the hood which run towards the front end give the Macan a wide and muscular appearance. The gap dimensions in the area of the hood are very small (3.5 ± 0.5 mm). The hood is made entirely of aluminum and weighs approximately 40 lbs. (18 kg) as a bare shell. The underside of the hood also reveals an unusual feature: in order to have the hood as low as possible and also meet the strict requirements for pedestrian protection, the inside of the hood features an integrated fresh air guide (Fig. 6_04_13). The air flowing in through the front air intakes is directed into the hood through two ducts and then directly into the turbochargers of the engine units.

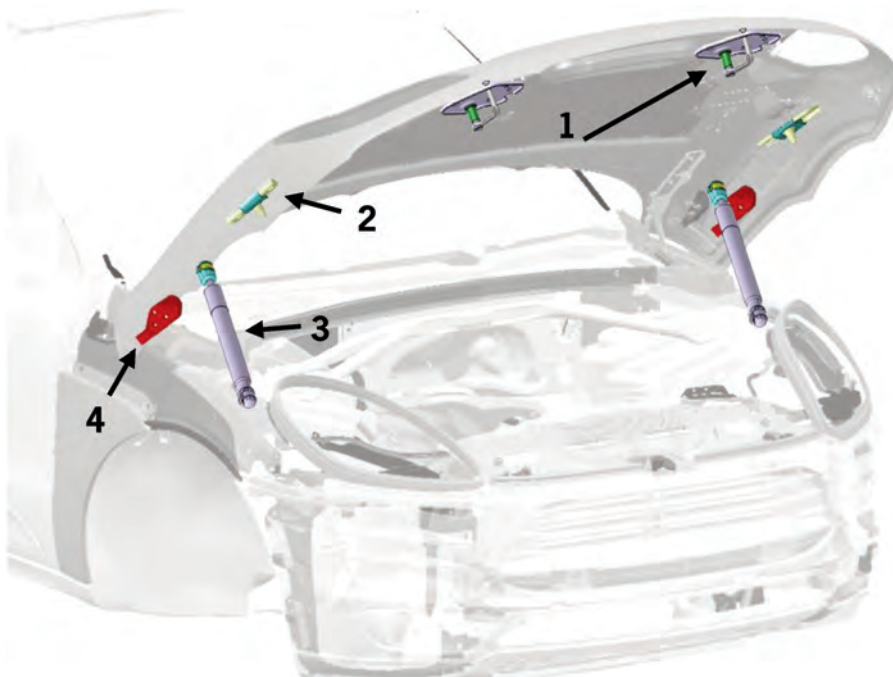


Air guide on the Macan

6_04_13

The hood is attached to the bodyshell using two hinges designed as four-link hinges (Fig. 6_03_13). The hinges permit two opening angles: the angle for the customer position hood 45° , while the angle for the service position is 75.5° . The hood is opened to the service position by detaching the gas dampers and using a special tool (similar to the Cayenne) to position the hood. There are stop screws screwed in at the hinges and a bracket at the A-pillar which serve as a stop/receiving element for the hood (Fig. 6_05_13). Adjusting the gap dimensions using the stops is not permitted.

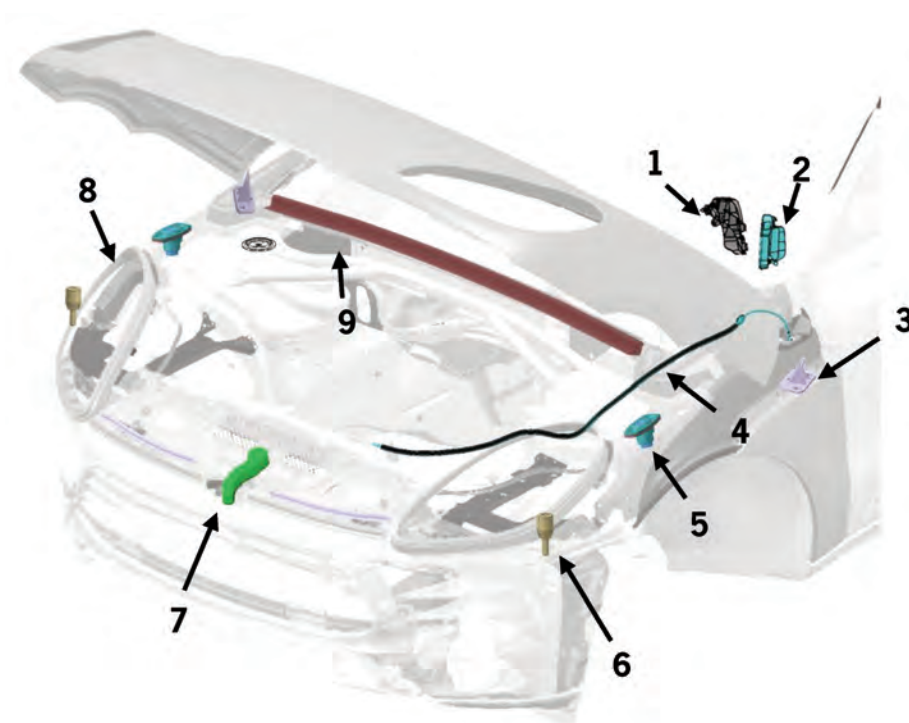
Other add-on parts for the hood are latching pins, the hinges, rubber stops and the strikers for the front lid locks.



Assembly parts for hood (lid side)

6_06_13

The components on the bodyshell for attaching and aligning the hood are shown below.



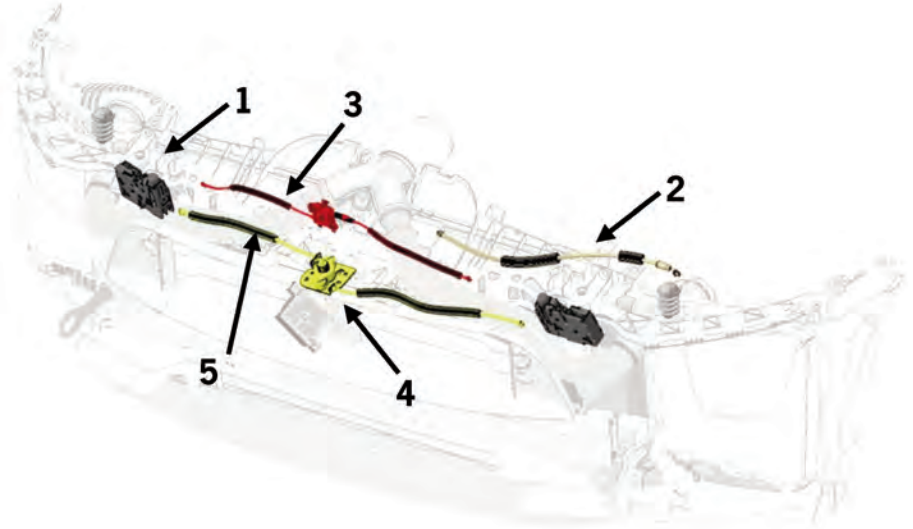
Assembly parts for hood (body side)

6_07_13

The stop (3) acts as a crash support to ensure that the hood moves upwards in a controlled manner in the event of front-end damage so that the A-pillar is not damaged.

- 1 Front lid lock
- 2 Front bowden cable
- 3 Bowden cable for front lid lock
- 4 Release element
- 5 Bowden cable for lid

Another special feature of the design of the clamshell-style hood is the use of two catch hooks attached to the front module. The weight and size of the clamshell-style hood mean it has to be latched on both sides. The hooks can be opened using the actuating lever screwed to the center of the front module.



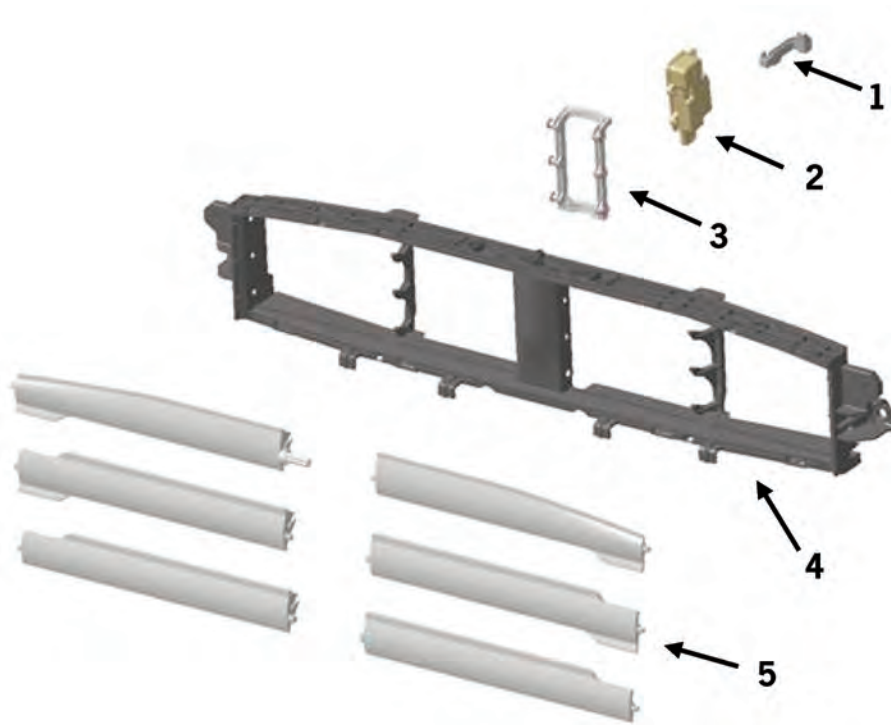
Locking system for hood

6_08_13

The bowden cables are in six sections to simplify assembly; there is also an insert in the bodysell which acts as a guide slot to make it easier to pass through the bowden cable. The front module has a service position to make working on the engine easier. To engage the service position, first the front apron must be removed. The next step is to undo the screw connections at the impact absorbers and screw in a threaded rod. After detaching the torsion strut and the holder for the coolant hoses, the entire front module can be pulled forwards by approximately 80 mm.

Front module – Cooling slats

Like the 918 Spyder, the Macan has cooling slats which are opened and closed electrically as a function of the engine temperature and vehicle speed. As already mentioned, this slat block not only serves to improve the thermal management, but primarily to improve the vehicle's aerodynamics and therefore optimize fuel consumption. The cooling slats are installed in all models. The following illustration shows the structure of the slat block.



- 1 Latch
- 2 Motor
- 3 Push rod
- 4 Frame
- 5 Slats

Slat block (cooling slats)

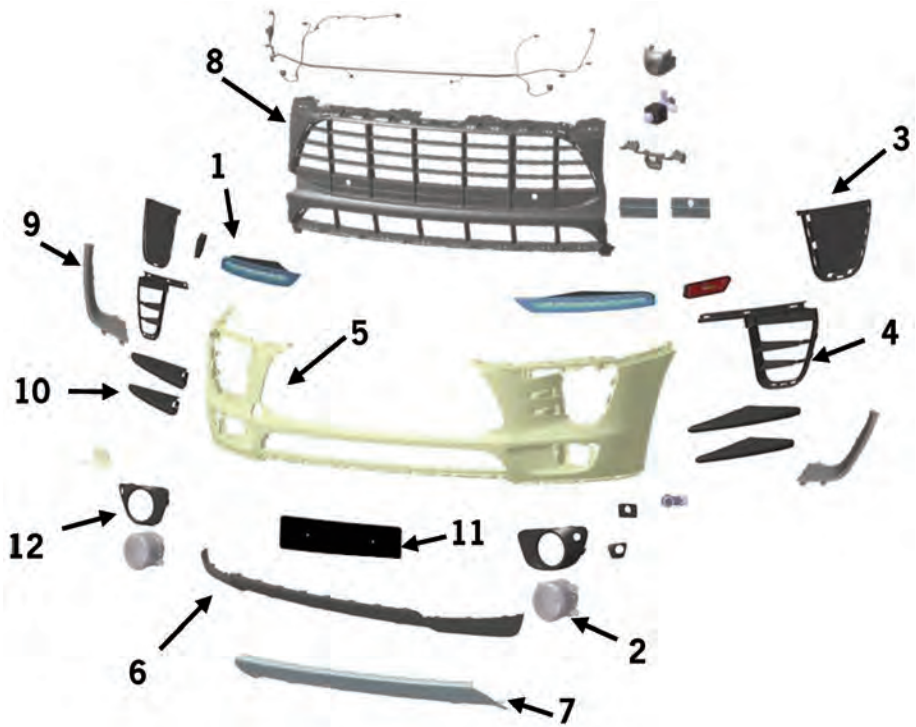
6_09_13

The slats are controlled via an electric motor which drives a push rod. This push rod operates the slats and opens or closes them. The repair concept is designed so that both the entire slat block and all the components can be individually replaced.

- 1 Parking light/indicator
- 2 Fog light
- 3 Air guide, standard models
- 4 Air guide, Macan S
- 5 Front apron
- 6 Front spoiler
- 7 Stainless steel trim
- 8 Center air intake
- 9 Air blade
- 10 Side slats
- 11 License plate carrier
- 12 Fog light trim

Front apron

The front apron design is the same for the standard models and the Macan S (see Fig. 6_10_13). Unlike the standard models, the side air intakes on the Macan S are open. The parking light and the indicators are integrated into one light and are screwed into place above the side air intakes. The round fog lights are located in the lower part of the front apron. The front spoiler is optionally available in grained plastic in Black or painted in the body color. A stainless steel trim is also offered.

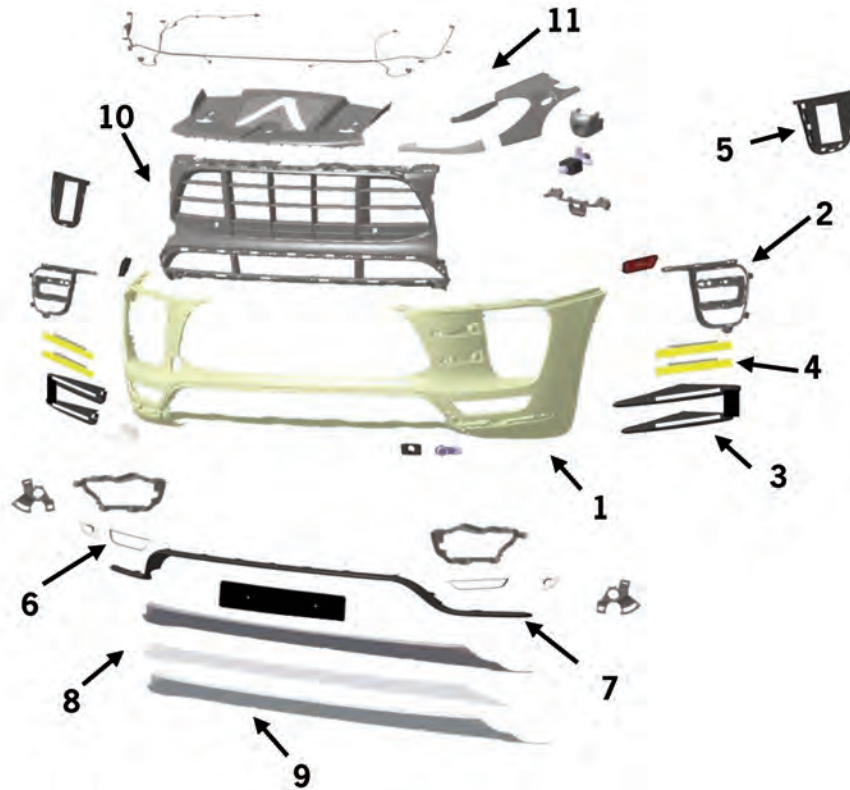


Front apron of the Macan S

6_10_13

The attachment concept for the front apron is the same on all models, i.e. the apron is fitted onto the module carrier and additionally screwed e.g. to the underbody panelling.

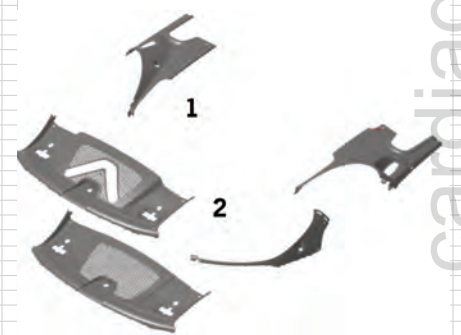
The front apron of the Macan Turbo is markedly different from that of the standard models. The side 3D air intakes on the Macan Turbo are designed as C-shaped slats with integrated indicator (top) and position light (bottom) in LED light guide technology. The design of the spoiler lip on the Macan Turbo is based on the 918 Spyder.



Front apron of the Macan Turbo

6_11_13

The clamshell-style hood means that an additional engine compartment design cover had to be developed which encloses both the front module and the headlights. The design cover is attached using clips and screw points. The design of the side covers around the headlights is the same on all models, the lock coverings on the standard models and the Macan Turbo are different (see Fig. 6_12_13).



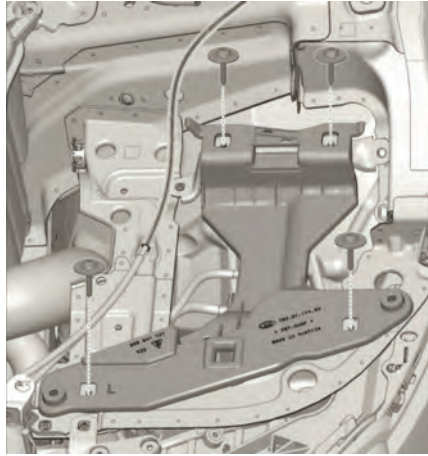
Design cover for the Macan

6_12_13

- 1 Turbo
- 2 Standard

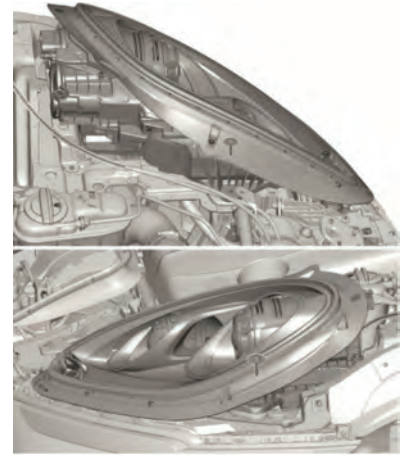
Headlight adjustment

The headlights on the new Macan are another special feature. They are enclosed by the clamshell-style hood. The gap dimension between the headlight and hood is 3.5 mm. The headlights must be mounted on the retaining plate for adjustment. Height adjustment is performed using Witol elements.



Retaining plate

6_14_13



Headlight

6_15_13



Witol element

6_16_13

The Witol element is fastened into the retaining plate and the headlight is brought into position and secured. The fastening screw is then pressed into the Witol element where it is taken up by a spring element (Fig. 6_17_13). By screwing the fastening screw into the nut thread, the compensating element is simultaneously unscrewed until it makes contact with the headlight. If the fastening screw torque exceeds the spring clamping moment, the joining gap is closed. The fastening screw is then screwed into the nut thread until the desired tightening torque is achieved. The result is secure, quick and tension-free connection of the components.

6.2 Side view

The side view is sharply contoured by the sporty sloping roof line, which has the effect of continuing the dynamic character. The design lines leading towards the rear emphasize the flared fender. Together with the shape of the D-pillar, this makes clear that the Macan draws inspiration from the 911. All in all, the Macan sits much lower on the road than its competitors.

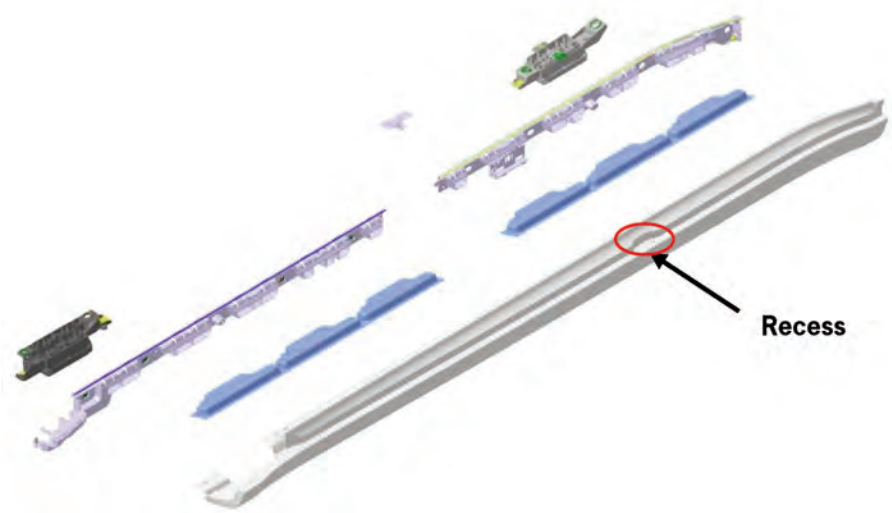


6_17_13

The sideblades at the bottom of the front and rear doors are both a particular visual highlight and a personalization detail. The sideblades take their design cues from the lower door shaping of the 918 Spyder and reference this once again in the front door entry guard. This paired with the filigree door handles makes the proportions of the doors look narrower, while making the flanks look much leaner and sportier. The sideblades on the Macan S and Macan S Diesel are in Lava Black as standard. They therefore offer a particularly sporty contrast, especially with lighter exterior paints. The sideblades on the Macan Turbo are painted in the exterior color for a classically elegant look (optional for the Macan S and Macan S Diesel). The sideblades are optionally available in carbon for even sportier positioning.

Side skirt/running board

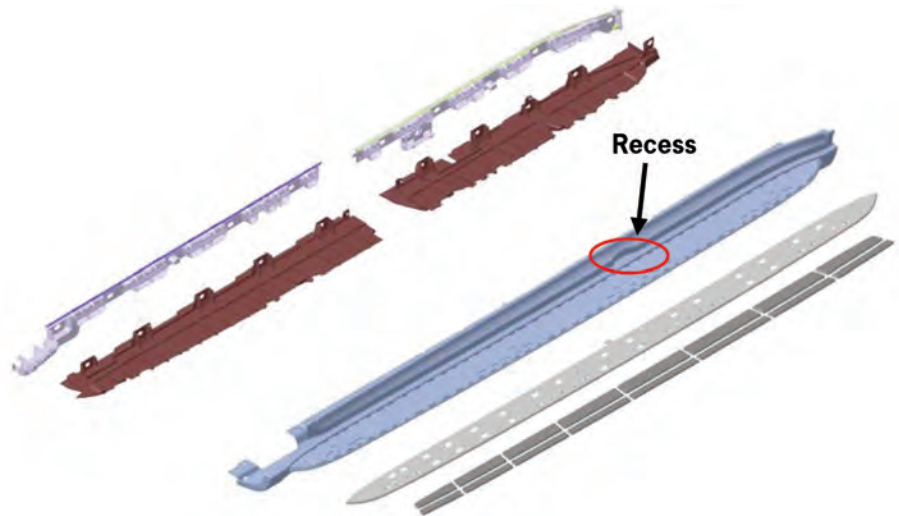
The front door entry guards on all models are in aluminum with the model designation “Macan S” or “Macan turbo” as standard. Like the Porsche rear-engine and mid-engine Sports Cars, the Macan also has a continuous side skirt. This as well as the roof spoiler painted in Black (high-gloss) give the design a more fluent appearance; the doors look more streamlined than on other SUVs.



Side skirt

6_18_13

The attachment concept features retaining strips riveted onto the bodyshell; the side skirt is clipped into these strips. There are also screw connection points in the front, rear and lower section. A recess (see Fig. 6_18_13) has been added in the area of the rear doors for easier removal; the skirt can be simply unclipped from the guide and removed once the screw connection is undone.



Running board

6_19_13

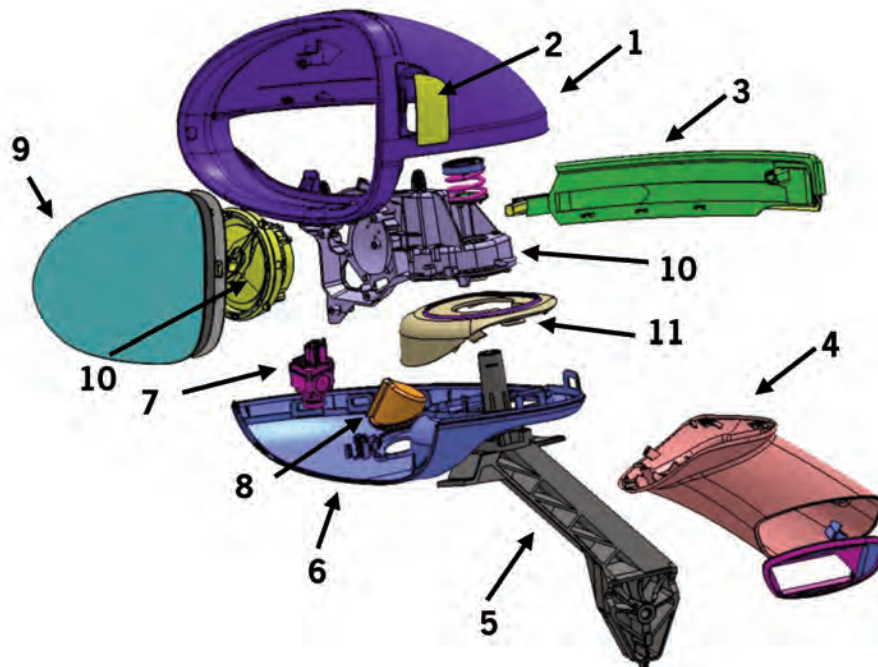
Running boards are available as an option for the Macan; these are fitted into the same retaining strips in place of the side skirts. The body of the running boards is made of plastic and a stainless steel trim is clipped onto it. There are rubber inserts fastened to the trim for step stability.

Doors

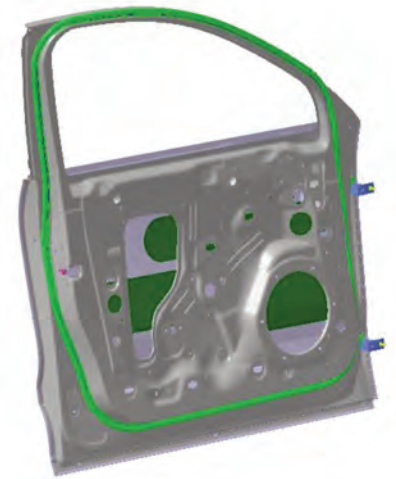
The doors on the Macan have a conventional steel construction. The Macan signals a departure from the previous approach of using door unit carrier on which various components are preinstalled by a supplier. These were installed in the doors in one piece. The disadvantage of this for the AfterSales Service was that for many repairs, the entire door unit carrier had to be removed. For the Macan, all the components in the doors are installed in an optimum installation sequence on a side line in production. The advantage of this for the AfterSales Service is that the components are removed in the reverse sequence and can be assembled in the installation sequence. The doors have a design trim panel which is stuck on in the event of a repair and is equipped with hooks.

Exterior mirror

The exterior mirror on the Macan is attached to the door shoulder. It is available in two designs: a mirror for all models including the Turbo and optionally a mirror with a V-shaped base. The repair concept allows for the mirror housing, mirror base, trim, glass adjustment drive, seals, reinforcing plate including the drive for folding in the mirror, cover cap on the mirror base and mirror glass to be replaced. The optional surround view camera, door courtesy light, warning indicator for lane changing assist and indicator integrated in the mirror can also be replaced.



- | | |
|------------------------|--|
| 1 Mirror housing | 2 Warning indicator for lane changing assist |
| 3 Indicator light | 4 Cover cap |
| 5 Mirror base | 6 Trim |
| 7 Surround view camera | 8 Door courtesy light |
| 9 Mirror glass | 10 Glass adjustment drive |
| 11 Reinforcing plate | |



6_24_13



Standard mirror

6_25_13



Mirror with V-shaped base

6_26_13



Rail end piece

6_21_13

6.3 Roof

Roof rack system/roof rails

Roof rails are available as an option for the Macan. They are mounted using threaded inserts integrated into the outer roof panel. Retrofitting is therefore not possible. The rails are available in high-gloss Black or anodized Silver. Like with the Cayenne, a roof rack system can be fitted on the rails.



Rails with roof rack system

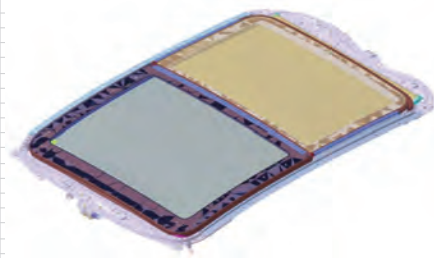
6_20_13

Panoramic Roof System



6_22_13

The Macan optionally comes with a two-part Panoramic Roof System familiar from the Cayenne with an area of over 1 m². The structure and drive mechanism are the same as for the Cayenne roof system, the only difference is the dimensions. The front glass element is electrically tilted and opened. If necessary, the entire glass area can be darkened using an electric roll-up blind. The Panoramic Roof System reduces head room in the rear by 41 mm. Extremely low light transmission values ensure a high level of comfort. The SDARS antenna is installed in the rear area of the outer roof panel with both the full roof and the glass roof.



Panoramic Roof System

6_23_13

6.4 Rear view

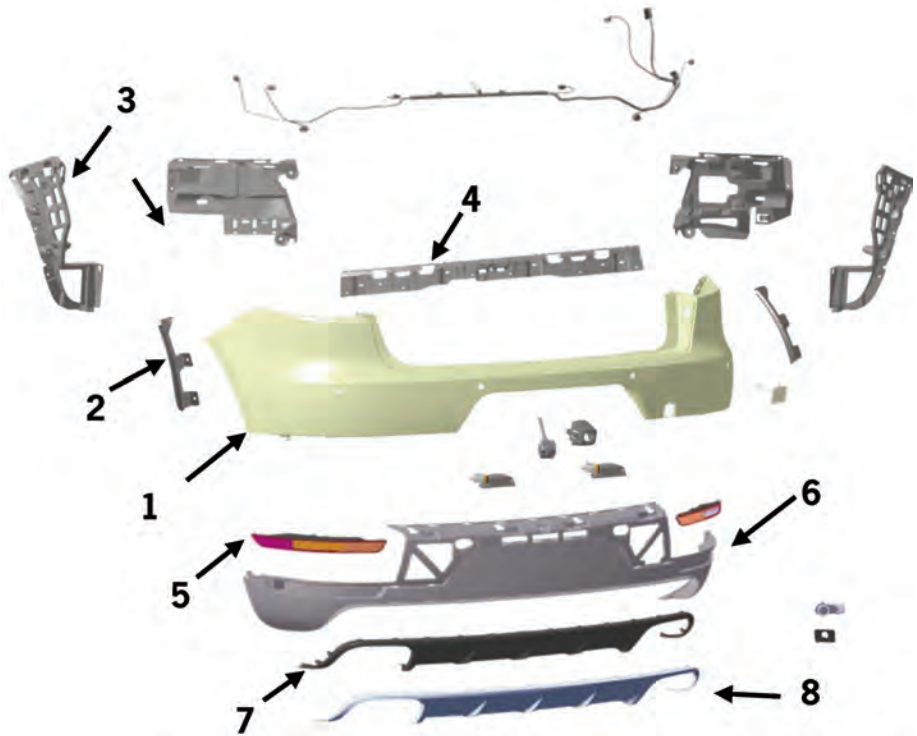
The rear of the Macan combines sportiness and puristic elegance; the Porsche DNA is obvious at first glance. The wide and imposing shoulders give the Macan a timeless design. A striking feature at the rear are the LED lights in 3D design, which also reference the 918 Spyder. Their understated contours and harmonious curves produce a perfect overall design. Two twin tailpipes on the outer left and right – with a different design for the S models and Turbo – frame the diffuser and therefore blend superbly into the overall design of the rear. Sports tailpipes made of chrome-plated stainless steel in Silver or Black with a unique design are available as an option for all three model variants.



6_28_13

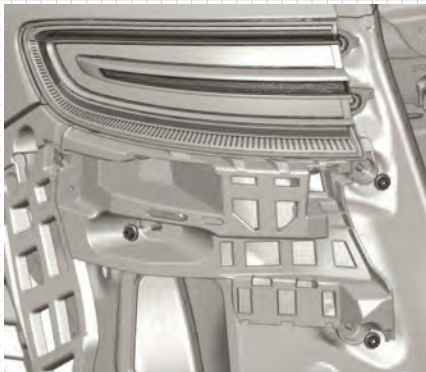
- 1 Rear apron
- 2 Wheel cover on bumper
- 3 Rear guide elements
- 4 Center attachment strip
- 5 Tail light/reflector
- 6 Rear spoiler
- 7 Black trim with grained finish
- 8 Stainless steel trim

Rear apron



6_29_13

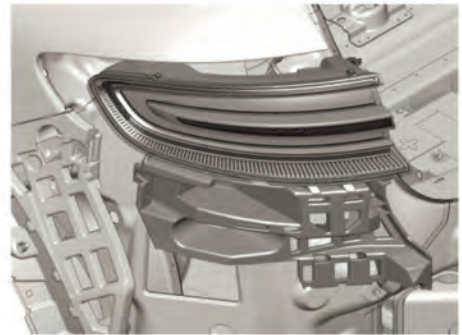
The lower rear area around the license plate carrier is Black. This is painted in the exterior color on the Macan Turbo. The diffuser integrated into the rear contributes to the visual and above all aerodynamic optimization of the vehicle. The vehicle appearance can be further personalized by choosing the stainless steel skid plate and rear panel. If a trailer hitch is installed, this is always combined with the Black trim with grained finish; it is not possible to use the stainless steel trim here. The mounting plates for the rear apron are screwed directly to the bodyshell (see Fig. 6_29_13). This means that the rear apron and mounting plates must be removed in order to disassemble the 3D tail lights.



Screw connections in mounting plate 6_31_13



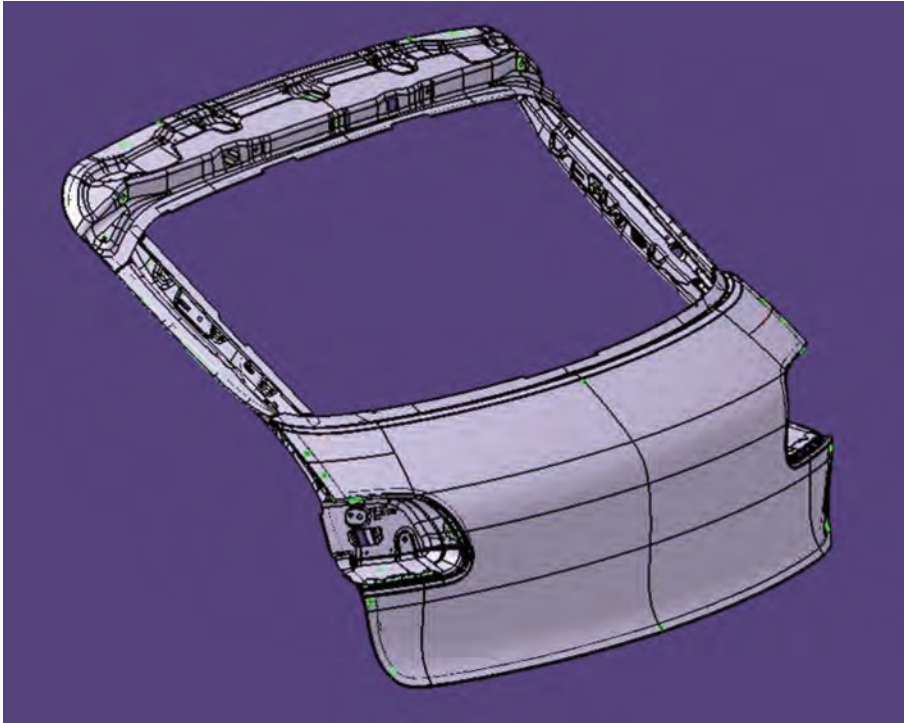
Attachment concept for tail light



6_30_13

Rear lid

For weight reasons, the rear lid on the Macan is also made entirely of aluminum. The lid therefore weighs approximately 13 lbs. (6 kg). All models feature a powerlift tailgate. As on the Panamera, it is operated via a button in the base of the rear window wiper.



6_33_13

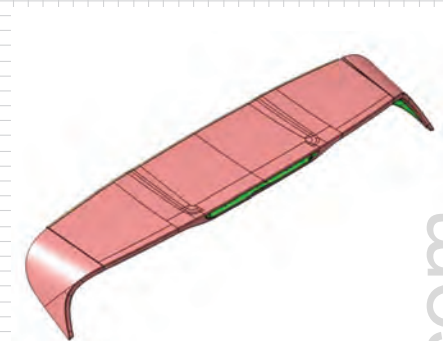
The rear spoiler is attached to the lid by clipping and screwing it into a retaining strip riveted onto the bare lid shell. The LED brake light is clipped into the spoiler. All models have the same rear spoiler.

Trailer hitch



6_34_13

The trailer hitch is attached to the bodyshell by screw connections. Subsequent installation of the trailer hitch is only possible if the vehicle has a factory-fitted preparation. The permissible trailer load is 5,290 lbs. (2,400 kg) for braked trailers and 1,653 lbs. (750 kg) for unbraked trailers. The permissible tongue weight is 529 lbs. (240 kg).



Rear spoiler

6_32_13



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7 Body – Interior equipment

General information

The interior combines the familiar with new highlights such as the new multi-function sports steering wheel. All in all, the interior of the Macan is unmistakably Porsche. The cockpit has the familiar look and feel of a Sports Car. The eye is immediately drawn to the standard multi-function sports steering wheel with shift paddles, whose completely new design has its origins in the 918 Spyder.



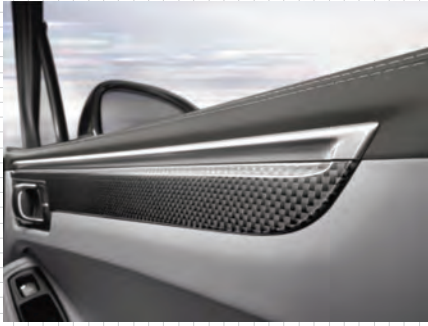
This gives the cabin of the Macan an especially sporty upgrade with additional multi-functional buttons for telephone, radio and on-board computer. The instrument cluster comprises three round instruments with the centrally positioned tachometer. The right-hand tube contains the high-resolution 4.8-inch color display. The ignition lock is in its traditional location on the left of the steering wheel. The elevated center console with the raised gear selector typical of motor racing as well as the typically low seat position result in greater integration of the driver into the cockpit.

Body – Interior equipment

7

7_01_13

7	Body – Interior equipment	187
7.1	Multi-function steering wheel	189
7.2	Seat system	190
7.3	Interior trim	191
7.4	Storage concept	192
7.5	Luggage compartment	193
7.6	Restraint system	194



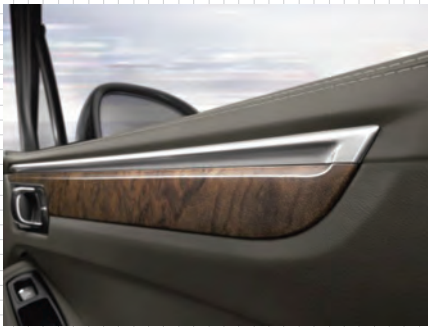
Carbon trim

7_03_13



Brushed aluminum trim

7_04_13



Walnut trim

7_05_13

The buttons for most of the functions are combined in logical groups on the center console. This enables quick and intuitive operation of individual functions. Even the standard equipment for the Macan S offers a sporty and high-end ambience with the interior package in Black piano lacquer and the power seats with the seat center in Alcantara.



Center console on the Macan

7_02_13

The Macan Turbo is equipped as standard with adaptive sports seats with memory package (18-way power seats) in leather as well as the Brushed Aluminum interior package. Trims in carbon, brushed aluminum and dark walnut are additionally available as an option for all models. All trims have silver-colored highlight strips. In addition to the leather interior available as an option for all models, a leather package is offered as a first personalization level (this package is standard equipment on the Macan Turbo). With this package, the upper part of the dashboard, the lid of the center console storage bin, the seat centers, seat bolsters and headrests as well as the armrests on the front and rear door panels are finished in leather.

7.1 Multi-function steering wheel

The multi-function sports steering wheel comes from the 918 Spyder and is equipped as standard with shift paddles made of die-cast zinc. These are permanently attached to the steering wheel and rotate when the steering wheel is moved – for manual gear changes even in dynamic driving situations. The three spokes in the 3, 6 and 9 o'clock positions have an open design. Choosing one of the available trims from the personalization options (dark walnut, carbon, in each case with steering wheel heating) makes it possible to create additional highlights.



7_06_13



Rear seat system

7_09_13



Rear seat system folded down

7_10_13

7.2 Seat system

In the Macan, a relatively low seat position for a SUV contributes to the Sports Car feel. The front seats have been adopted from the Cayenne. As a special feature, the front headrests can be adjusted both vertically and in longitudinal direction. The standard electric 8-way power seat for the driver offers adjustment of the seat height, cushion angle, backrest angle and fore/aft position. The 18-way adaptive sports seats (driver and passenger) are also available as an option (standard for the Macan Turbo).



18-way power seat

7_07_13



8-way power seat

7_08_13



Height adjustment

7_11_13



Fore/aft adjustment

7_12_13

The neck rest is adjusted manually by way of a push button (A) on the headrest. The rear seat system offers space for up to three passengers. The rear seat backrests can be individually folded in the ratio 40:20:40. The luggage compartment therefore offers adequate space for all types of luggage. The optional front seat ventilation system is available for even greater seating comfort (not together with 8-way power seat). The ventilation of the seat cushions and backrests of the front seats is independently adjustable for the left and right in three stages. The repair concept for the seats has been adopted from the Cayenne seats.

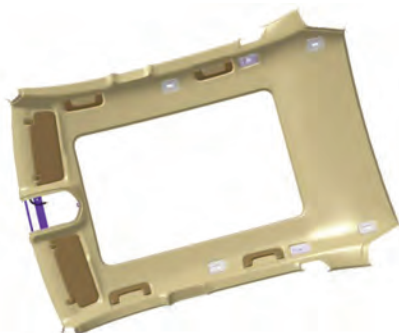
7.3 Interior trim

The interior of the Macan is characterized by sportiness, luxury and functionality. This is mainly due to the design of the interior trim. The interior is available in Black and Luxor Beige as standard, and a leather package in the same colors can additionally be chosen. As well as a leather interior in Black, Luxor Beige and Agate Grey, a natural leather interior in Espresso and a two-tone leather interior in Black/Garnet Red are also available to choose from. For the trim strips, there is a choice of dark walnut, carbon, brushed aluminum and black piano lacquer. The attachment concept for the interior trims has been adopted from the other Porsche vehicles. Two roof linings are available depending on the chosen roof system (full roof, Panoramic Roof System); these can be removed through the rear load space opening in the event of disassembly.



Interior trim panel without PRS

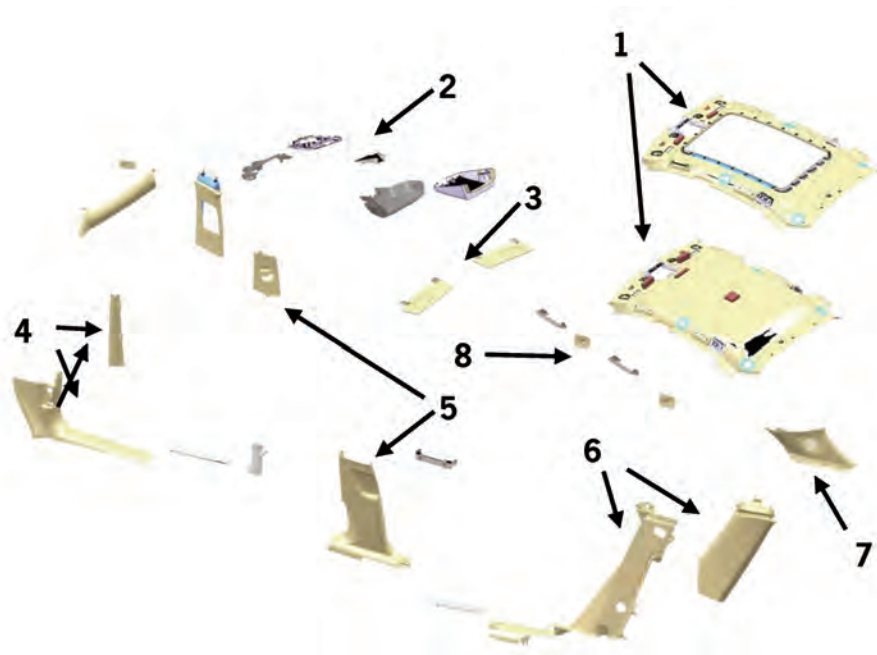
7_13_13



Interior trim panel with PRS

7_14_13

The side trim panels for the A, B, C and D-pillars are also clipped and screwed into the bodyshell.



- 1 Roof lining
- 2 Base plate for antenna/camera
- 3 Sun visor
- 4 A-pillar trim
- 5 B-pillar trim
- 6 C-pillar trim
- 7 D-pillar trim
- 8 Grab handle and attachment lug

Interior trim panels of the Macan

7_15_13

7.4 Storage concept

The storage concept of the Macan offers plenty of space for temporary and permanent “companions” in the vehicle. In addition to the glove box and the compartment in the center console armrest, the side door storage pockets in particular offer space for e.g. bottles up to a size of 1.5 l (front) or 1.0 l (rear). The storage pockets on the backrest shells (part of the storage package) provide the ideal space for the rear passengers to stow books or even tablets. They can also use the open storage compartment in the center console for other items like mobile phones.

For further storage space, the optional storage package with the following components is offered:

- Storage pockets on the backrest shells of the front seats
- Map holder in the glove box
- Oddments tray under the front seats
- Storage net under the luggage compartment cover

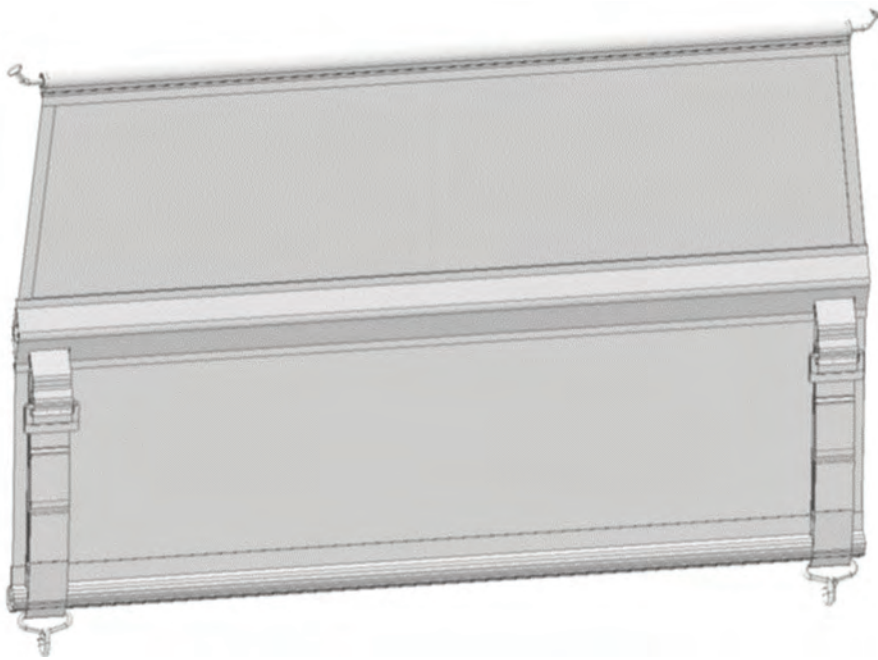


Storage pocket on the backrest shell

7_16_13

7.5 Luggage compartment

The Macan models have a generous luggage compartment. The volume is 17.75 cu. ft. (500 liters) and can be extended to up to maximum 53 cu. ft. (1,500 liters) by folding down the rear seats to the cargo position. The optional cargo management system is available to ensure optimum use of the luggage compartment and safe transportation of all types of objects. The variable system includes 2 rails (integrated into the floor of the luggage compartment), 1 telescopic rod, 4 tie-down points, 1 strap roller, luggage compartment partition net (see Fig. 7_17_13, 7_18_13) and reversible mat. Together with the options for folding down (40:20:40) the rear seat system, this makes the luggage compartment very practical to use and even offers space for the optional ski bag.



Luggage compartment partition net

7_18_13

Body – Interior equipment

7



7_17_13

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7.6 Restraint system

The Macan features two full-size airbags for the driver and passenger as standard. These are augmented by Porsche Side Impact Protection (POSIP).

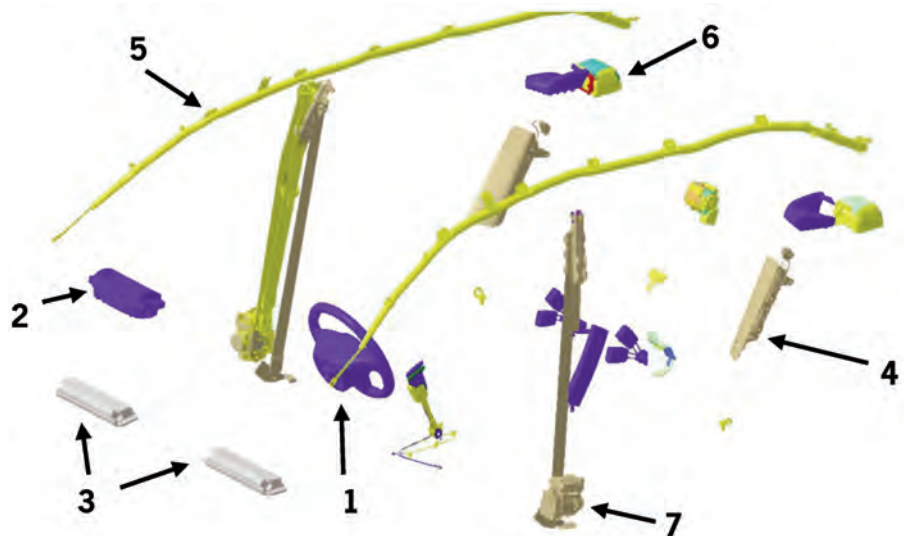


POSIP in the Macan

7_19_13

This comprises a side airbag in each front seat, curtain airbags along each roof frame and the side windows from the A- to the C-pillar, as well as side impact protection elements in each door. Two side airbags in the rear are additionally available as an option. Two additional sensors in the bumper area enable better detection in the event of a frontal collision. A sensor cluster comprising an acceleration and yaw velocity sensor detects an imminent roll-over and automatically activates the curtain airbags and seat-belt pretensioners.

- 1 Roof lining
- 2 Base plate for antenna/camera
- 3 Knee airbags
- 4 A-pillar trim
- 5 B-pillar trim
- 6 C-pillar trim
- 7 D-pillar trim
- 8 Grab handle and attachment lug



POSIP in the Macan

7_20_13

The Macan features 3-point automatic seat belts with pretensioners in the front and outer rear seats, force limiters in the front and a 3-point automatic seat belt on the central rear seat. The outer rear seats in the Macan are equipped as standard with the ISOFIX anchoring system for child seats.



ISOFIX for child seat

7_21_13

Macan

Body – Interior equipment

7



Belt buckle

7_22_13



ISOFIX anchor

7_23_13



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8 Heating and air-conditioning

General information

The Porsche Macan is available with 3-zone or 2-zone automatic climate control. The figure below shows the configuration of the air-conditioned zones for the 3-zone system.



3-zone automatic climate control

8_01_13

With 3-zone automatic climate control, in addition to the front control panel (operating and air-conditioning unit) there is a second control panel in the center console for making the settings for the rear air-conditioned zone. The settings for the rear air-conditioned zone can be made independently of the settings for the front two zones via the temperature rocker switch and the air flow adjusting wheel. The outlet vent vanes can be moved in the desired direction.

The air conditioning in the vehicle is currently operated solely with the familiar refrigerant R134a. This does not undermine the legal requirements imposed by the EU Directive 2006/40/EC as of January 2011 for all member states for vehicles subject to EC type approval.

Macan

Heating and air conditioning

8



Rear operating & air-conditioning unit

8_02_13

8 Heating & Air-conditioning	197
8.1 Ventilation/air routing	198
8.2 Operation	203
8.3 Refrigerant circuit	207
8.4 Actuators and sensors	210
8.5 Topology	211



Air intake cover

8_03_13

- 1 Air intake (air conditioner)
- 2 Defroster intermediate piece
- 3 Air guide for extended ventilation panel
- 4 Air guide for left/right side
- 5 Front left/right footwell
- 6 Air guide for front passenger air vents
- 7 Connecting piece (3 zones)
- 8 Air guide for rear left/right footwell
- 9 Air guide for rear center console

**Important!**

Similar to the Panamera, all air-conditioned zones on the Porsche Macan are supplied by just one air conditioner.

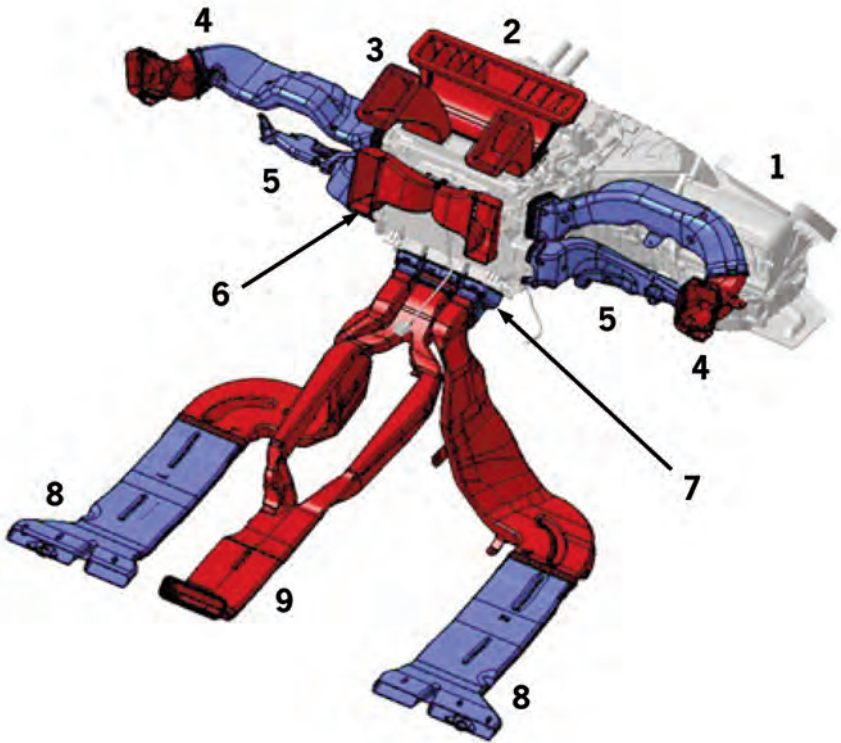
8.1 Ventilation/air routing

The ventilation and air routing on the Macan are similar to the system on the Panamera. This relates primarily to the intake of fresh air as well as the distribution of the air-conditioned air into the passenger compartment. The air intake for the passenger compartment is located under a cover in the right-hand area of the plenum panel. The air quality sensor for the automatic air recirculation function is also located directly at the air intake housing (see also section "Operation").

Air routing with 3 zones

The following illustration shows the air routing for a 3-zone system. As well as the air ducts for the two front air-conditioned zones, there are three further air ducts for conditioning the air in the rear zone:

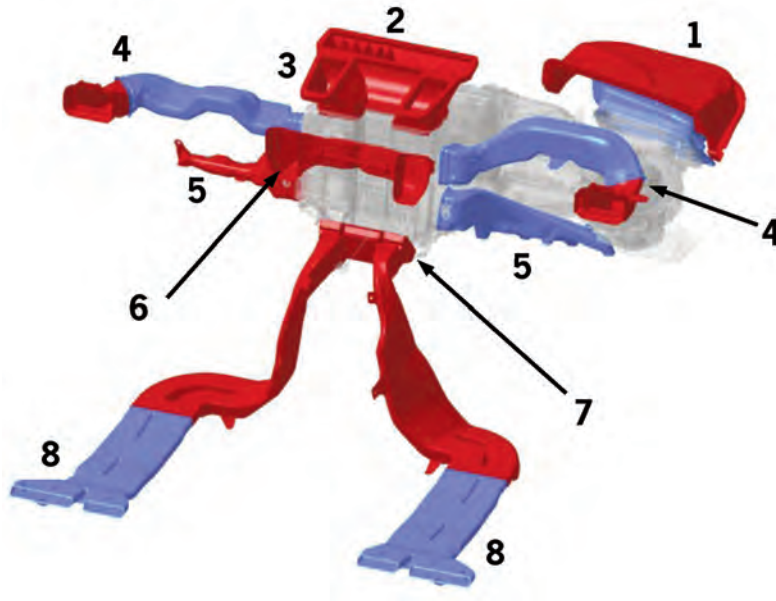
- Air duct for left/right footwell
- Air duct for center console



Air ducts in the 3-zone air-conditioning system

8_04_13

The air routing in a 2-zone air-conditioning system is largely comparable with a 3-zone system. However, the air ducts for the center console are omitted.

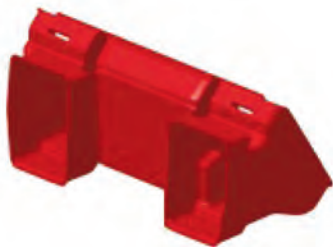


- 1 Air intake cover (air conditioner)
- 2 Defroster intermediate piece
- 3 Air guide for extended ventilation panel
- 4 Air guide for left/right side
- 5 Air guide for front left/right footwell
- 6 Air guide for front passenger air vents
- 7 Connecting piece (2 zones)
- 8 Air guide for rear left/right footwell

Air ducts in the 2-zone air-conditioning system

8_05_13

This is why, among other things, the center part of the connecting piece between the air conditioner and the remaining air ducts (rear) is sealed.



2-zone system



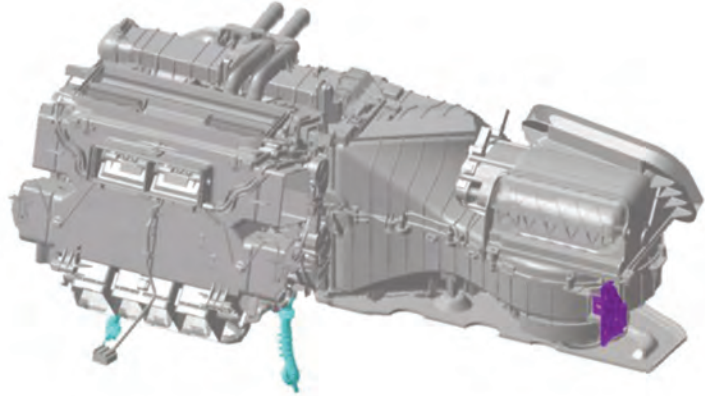
3-zone system

Connecting piece between air conditioner and air ducts (rear)

8_06_13

Air conditioner

The air conditioner is manufactured by Behr. It is available as a 2-zone and 3-zone system for left and right-hand drive vehicles.

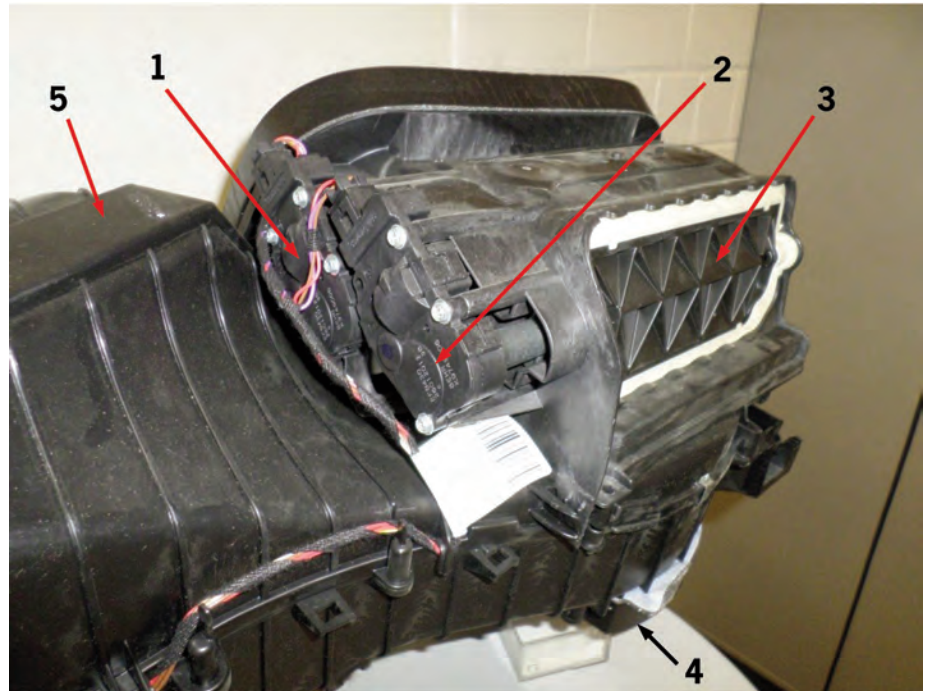


Air conditioner for a 3-zone system, left-hand drive vehicle

8_07_13

The servo motors in both system variants are all directly on the air conditioner. The air conditioner has 10 servo motors in total in the highest equipment level (3 zones). The following illustration shows the installation positions of the servo motors and components on the air conditioner.

- 1 Servo motor for fresh/ram air
- 2 Servo motor for recirculated air
- 3 Recirculation flap
- 4 Fan motor
- 5 Filter housing (filter can be accessed from passenger-side footwell)



Servo motors on head piece of air intake

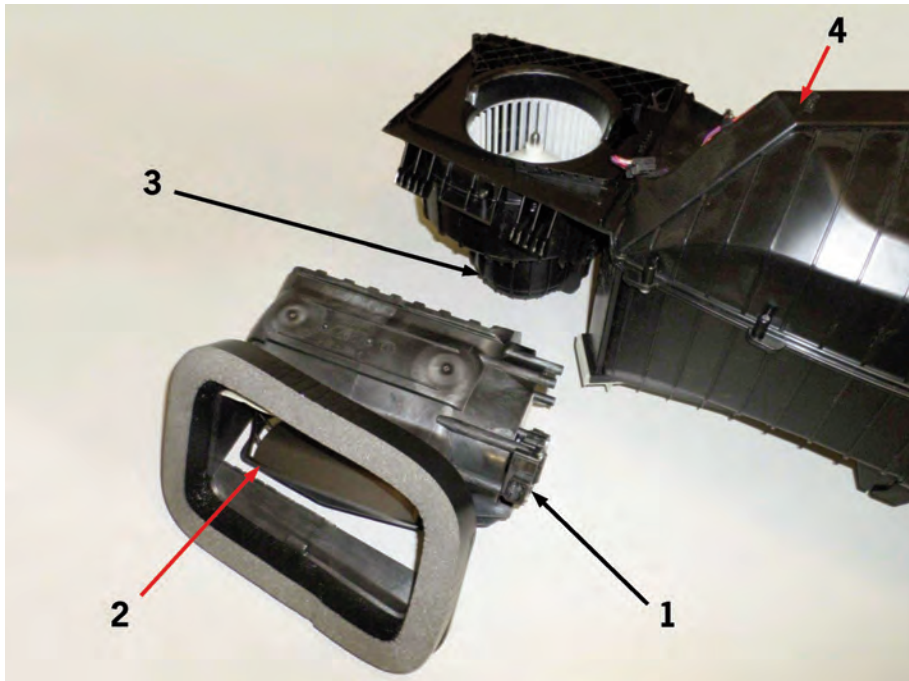
8_08_13



Important!

The flap for the ram air (this flap is for pressure compensation above 50 mph (80 km/h) is located directly behind the fresh-air flap. Both flaps are driven by the same servo motor (fresh-air servo motor) via a link disc.

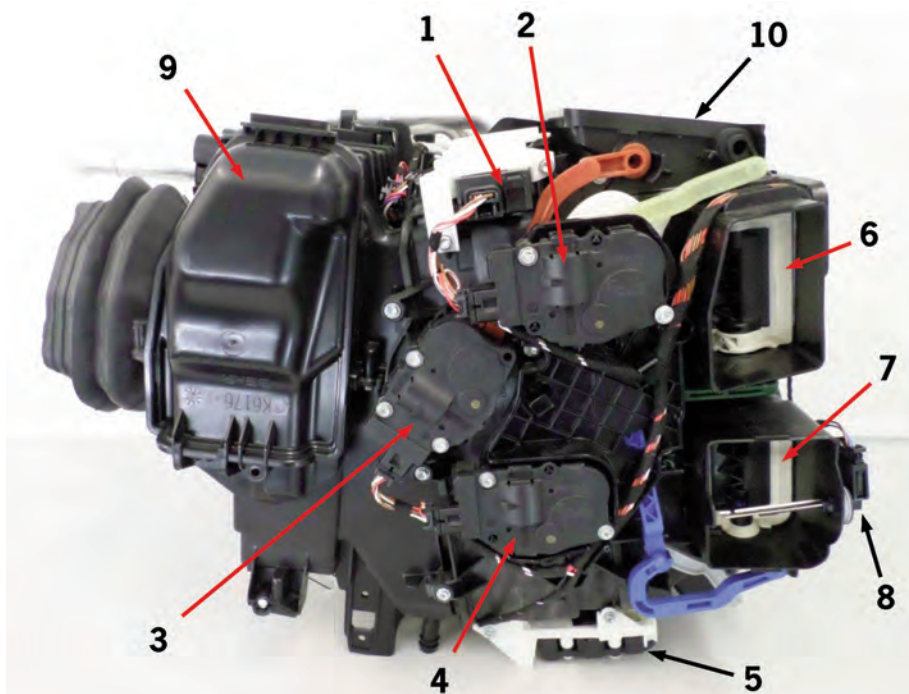
The head piece of the air intake can be removed from the air conditioner. This provides access to the screws of the fresh-air servo motor (air conditioner is removed for this purpose).



Servo motors on head piece of air intake

8_09_13

As usual, most of the servo motors are located directly on the air-mixing chamber of the air conditioner. The following illustration shows the servo motors and the various relevant components on the driver's side.



Air-mixing chamber on driver's side

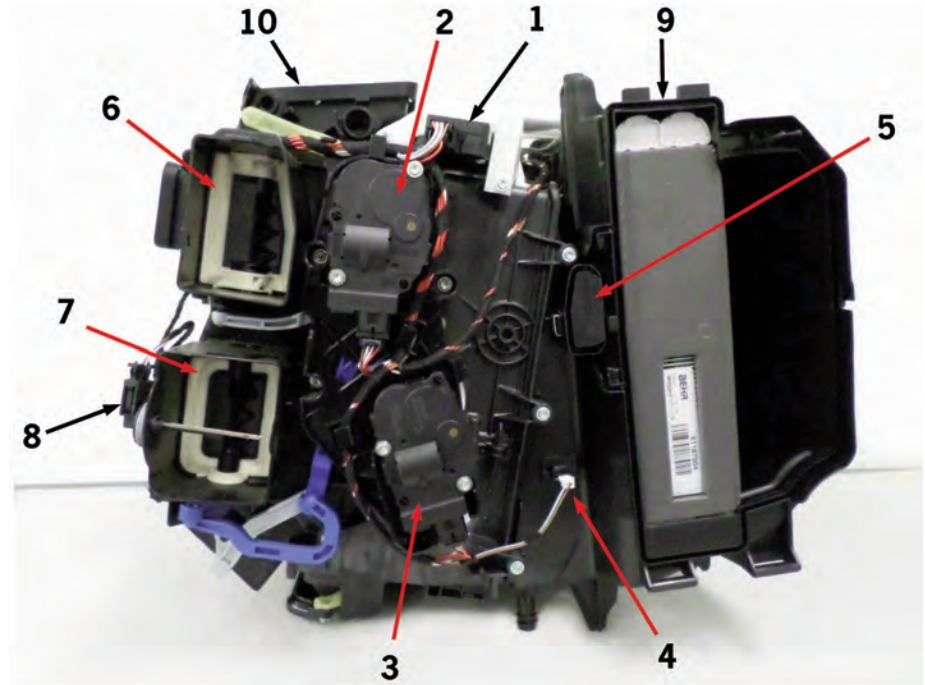
8_10_13

- 1 Servo motor for fresh/ram air
- 2 Flap for ram air
- 3 Fan motor
- 4 Filter housing (filter can be accessed from passenger-side footwell)

- 1 Servo motor for temperature mixing flap (FL)
- 2 Servo motor for center passenger air vent (FL+RL) and "extended ventilation panel" (FL)
- 3 Servo motor for defroster
- 4 Servo motor for side passenger air vent (FL) and footwell (FL+RL)
- 5 Servo motor for temperature mixing flap (RL+RR); omitted for a 2-zone system
- 6 Air distribution/air flow flap for side passenger air vent (FL)
- 7 Air distribution/air flow flap for footwell (FL)
- 8 Temperature sensor for footwell (FL); park position only
- 9 Evaporator housing
- 10 Air outlet connection (defroster/ventilation panel)

- 1 Servo motor for temperature mixing flap (FR)
- 2 Servo motor for center passenger air vent (FR+RR) and "extended ventilation panel" (FR)
- 3 Servo motor for side passenger air vent (FR) and footwell (FR+RR)
- 4 Evaporator temperature sensor
- 5 Connection for cooling duct (glove box)
- 6 Air distribution/air flow flap for side passenger air vent (FR)
- 7 Air distribution/air flow flap for footwell (FR)
- 8 Temperature sensor for footwell (FR); park position only
- 9 Evaporator housing
- 10 Air outlet connection for defroster/ventilation panel

The following illustration shows the servo motors and the various relevant components on the passenger's side. The area of the air intake and the air cleaner housing have been removed for a better view. The air intake in the air-mixing chamber is located on the right of the evaporator.



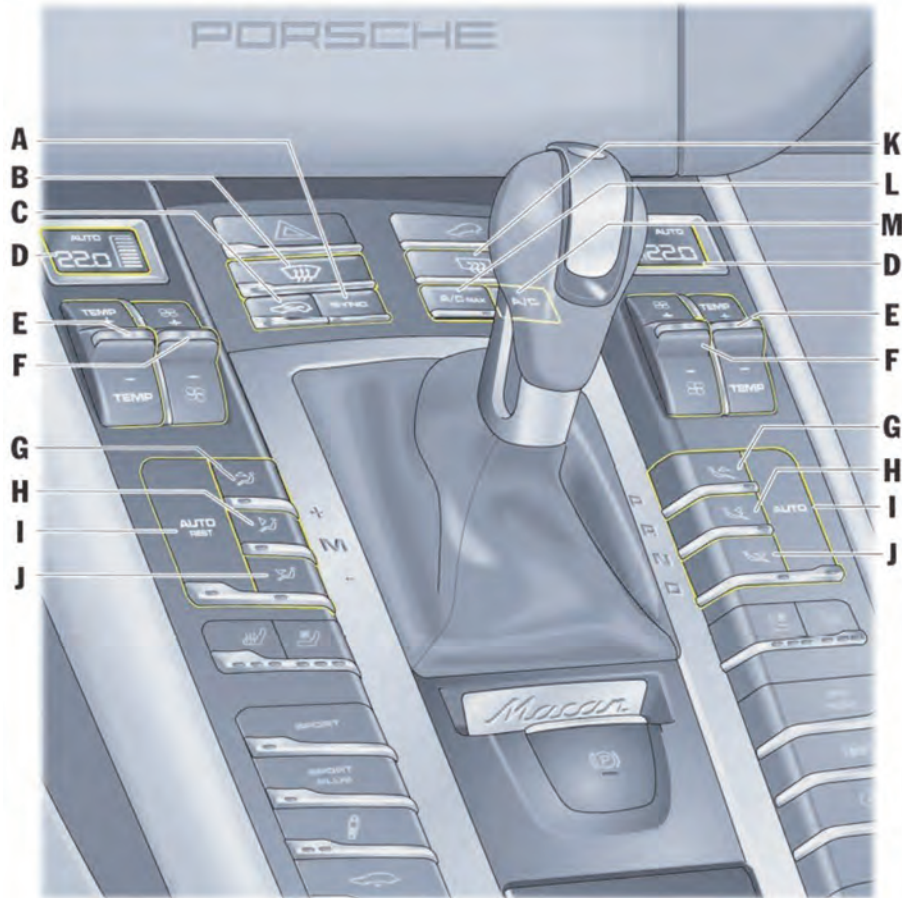
Air-mixing chamber on passenger's side

8_11_13

8.2 Operation

Front operating and air-conditioning unit (OAU)

The operating concept for the Macan as of model year 2015 is familiar from the other model lines. This means that the rocker switches and buttons for controlling the “Air conditioning function group” are again located above and on the right and left of the selector lever (yellow-framed switch groups in Fig. 8_12_13).



Front operating and air-conditioning unit (OAU)

8_12_13

Functions of the air-conditioning system

In addition to the rocker switches for adjusting the temperature and fan speed, the familiar A/C functions are switched on and off by way of buttons. The most important functions are:

- AUTO/REST mode
- SYNC mode (previously MONO mode)
- A/C MAX mode
- Defrost mode
- Air recirculation mode

Some of these functions are described in the following pages.

- A SYNC mode (the driver's A/C settings are applied to the entire vehicle)
- B Defrost mode
- C Air recirculation mode (manual recirculation)
- D Display (left/right)
- E Temperature adjuster (left/right)
- F Air flow adjuster (left/right)
- G Air distribution to windshield
- H Air distribution to center/side vents
- I AUTO/REST mode
- J Air distribution to footwell
- K Rear window/exterior mirror heating
- L A/C MAX mode
- M A/C mode



Front OAU, AUTO/REST button

8_13_13

Similar to the other model lines, pressing the AUTO/Rest button on the Macan activates utilization of the residual engine heat when the ignition is off.

SYNC/A/C MAX mode

If the “SYNC” button is pressed (LED lights up), all the available air-conditioned zones are synchronized (previously MONO mode). All air-conditioned zones are then adjusted to the current setting for the driver’s seat zone and any subsequent changes to this zone. The set values are shown on the driver’s and passenger’s displays (the rear OAU does not have a display). SYNC mode is ended by pressing the button again or by changing the setting for one of the other air-conditioned zones.



Front OAU, SYNC button

8_14_13



Front OAU, A/C MAX button

8_15_13

In A/C MAX mode (indicator light on the button lights up), the entire system is focused on providing maximum cooling capacity as quickly as possible.

The OAU automatically makes the following settings for this:

- Temperature mixing flaps are set to maximum cooling
- Fan runs at maximum speed
- Primary air supply to the passenger air vents
- Air recirculation is set for a short time

In A/C MAX mode, there is no automatic control of the passenger compartment temperature.

Defrosting mode (3-zone air conditioning)

In defrosting mode, the air supply to the rear is automatically cut off to achieve maximum defrosting efficiency. In this mode, the air flows to the windshield and the front side windows.

Air recirculation modes

The following air recirculation modes are available in the Macan:

- Manual air recirculation mode
- Automatic air recirculation mode

Manual air recirculation is always “forced air recirculation”. “Forced air recirculation” is activated by pressing the air recirculation button on the OAU.



Front OAU, defroster

8_16_13

The A/C control unit (integrated in the OAU) sets automatic air recirculation on the basis of various input parameters:

- Automatic air recirculation mode for poor air quality
- Automatic air recirculation mode to assist the refrigerant circuit at outside temperatures above 77° F (25° C)
- Automatic air recirculation mode for approximately 20 seconds after the windshield wiper/washer system is actuated at outside temperatures above 41° F (5° C)

Extended air-conditioning functions

The “extended air-conditioning functions” allow greater personalization and provide enhanced comfort for the air conditioning in the passenger compartment.

The functions listed below are available for the Macan:

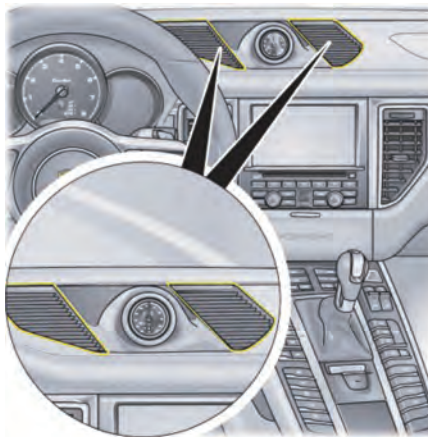
- Automatic air recirculation mode (use of an air quality sensor)
- Air flow adjustment (soft/normal/strong)

The “extended ventilation panel” on top of the dashboard provides additional ventilation for the passenger compartment. Using this panel makes the air flow in the passenger compartment less direct. The automatic function of the air-conditioning system independently regulates the air outflow.



Multi-function display

8_17_13



Extended ventilation panel

8_18_13



The “extended air-conditioning functions” are set via the multi-function display on the instrument cluster.

**Important!**

In defrosting mode, the air supply to the rear is automatically cut off to achieve maximum defrosting efficiency. In this mode, the air flows to the windshield and the front side windows.

- A Adjusting air flow
- B Adjusting temperature
- C Adjusting air flow direction
- D Seat heating
- E Storage bin



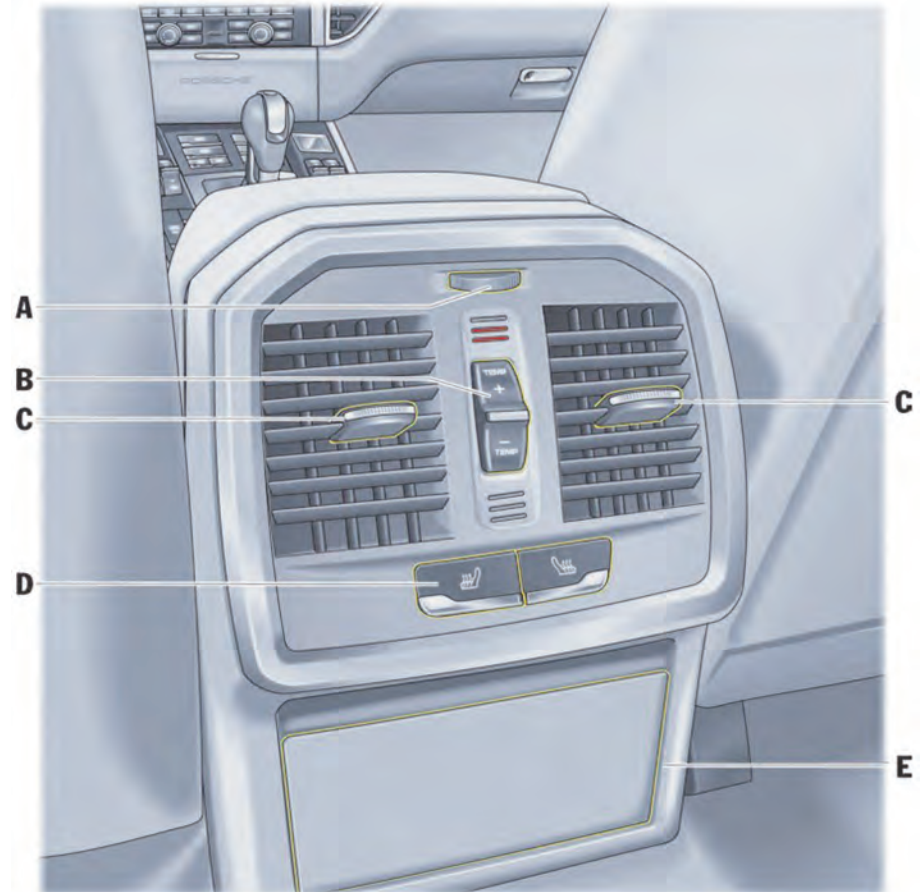
8_14_13



8_13_13

Rear operating and air-conditioning unit (OAU)

With a 3-zone system, the rear passengers have their own control panel for making settings for the rear air-conditioned zone.



8_19_13

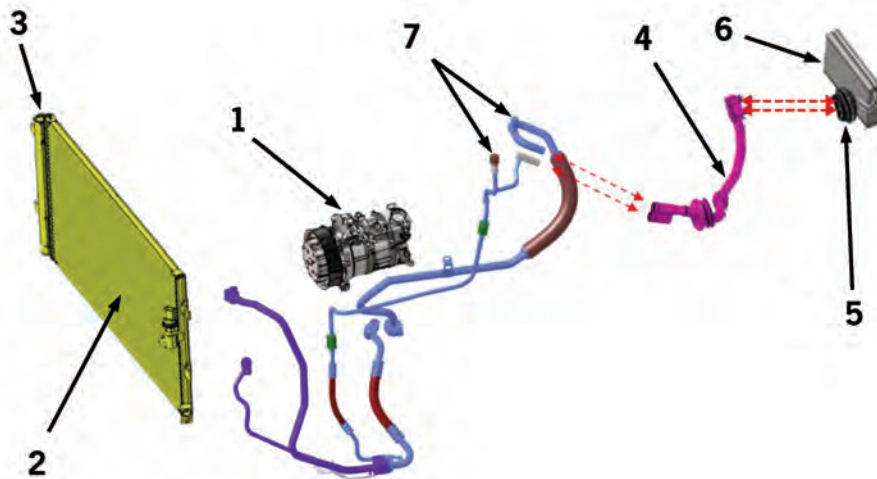
Air distribution in the rear air-conditioned zone in SYNC mode

When SYNC mode is selected (front OAU), the air distribution in the rear air-conditioned zone also depends on the settings for the driver's zone. This results in the following air distribution for the rear passengers:

- a) Air distribution to the windshield selected on the front OAU Air in rear flows to the air vents in the center console
- b) Air distribution to the passenger air vents selected on the front OAU Air in rear flows to the air vents in the center console
- c) Air distribution to the footwell selected on the front OAU Air in rear flows to the air vents in the footwell

8.3 Refrigerant circuit

The familiar refrigerant R134a is currently used in the Macan for all vehicles and the system is operated with this refrigerant. The function and type of most of the components in the refrigerant circuit are therefore familiar. As can be seen in the following illustration, however, the Macan also features an internal heat exchanger (IHE) integrated in the lines of the refrigerant circuit.

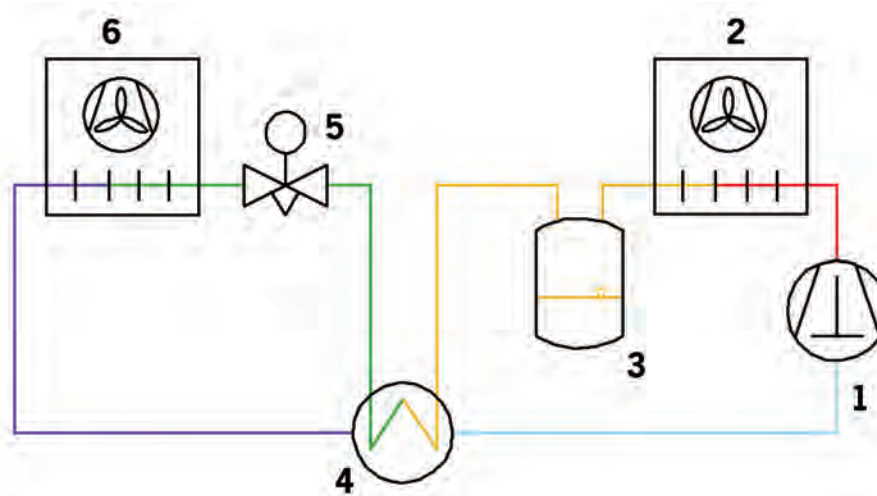


Refrigerant circuit in the 3.6-liter V6 biturbo engine

8_20_13

The IHE is screwed to the expansion valve and positioned in the plenum panel. Comparable with the expansion valve, the IHE is a component at which high voltage and low voltage is simultaneously present.

Internal heat exchanger (IHE)



Circuit diagram for R134a with IHE

8_21_13

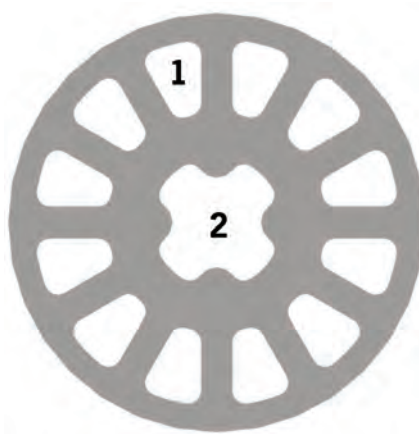
Operating principle

The internal heat exchanger (IHE) transfers heat from the refrigerant on the high-pressure side to the “intake gas” (LP). The refrigerant on the pressure side (HP) is cooled to below the ambient temperature and superheated on the intake side (LP).

Profile and design

The Macan uses an IHE made of aluminum profile integrated into the lines of the refrigerant circuit. In the double-pipe heat exchanger version, there is an outer pipe arranged around the inner pipe. The warmer refrigerant from the high-pressure side passes through the inner pipe in the opposite direction to the colder refrigerant from the low-pressure side flowing through the annular gap. At both ends of the IHE is a block (flange) onto which the intake and pressure lines are separately flanged. The flow of refrigerant into and out of the inner and outer pipes takes place via this block.

- 1 Outer pipe with low pressure
- 2 Inner pipe with high pressure



Cross sectional view of the IHE

8_22_13



Profile of the IHE

8_23_13

Considerations when using an IHE

Positive effects:

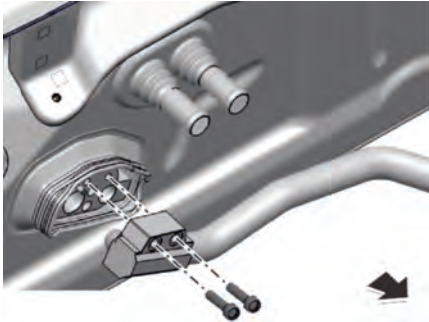
- The IHE improves the efficiency and performance of the R134 system, particularly at high ambient temperatures.
- The evaporator is protected against “wet operation”. The position of the IHE means that drops of liquid are re-evaporated in the IHE low-pressure line before the drops can reach the compressor.
- The IHE evaporates all the R134a from the oil before the refrigerant reaches the compressor (improvement of lubricity).

Negative effects:

- The IHE increases the intake temperature and therefore also the compression temperature at the compressor outlet.
- The IHE is an additional component (increased weight, increased assembly and space requirement, additional costs).

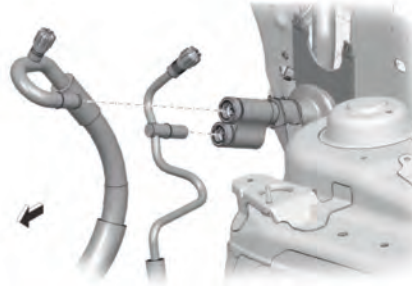
Integration into the refrigerant line system

The IHE is screwed to the expansion valve (illustration on left). The high-pressure and low-pressure lines are plugged into the other end of the IHE (illustration on right).



IHE screwed on

8_24_13



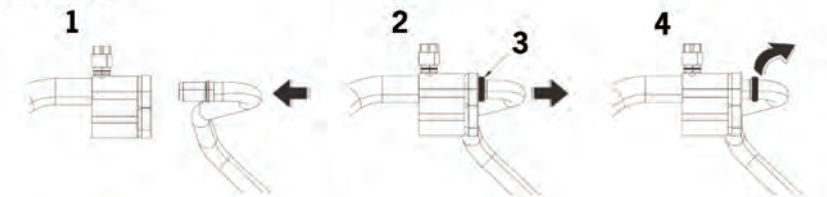
IHE plugged

8_25_13

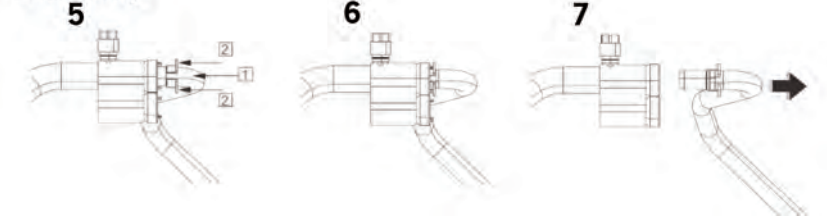
A special tool is required to undo the plug connection (see Figure 8_26_13). In the illustration, the tool is pre-fitted at the flange (block) of the IHE in preparation to undo the connection.

Assembling and disassembling the plug connection at the IHE

Assembly



Disassembly



Fitting and removing the refrigerant lines at the IHE

8_27_13



Special tool applied

8_26_13

- 1 Insert the line until it is felt to engage
- 2 Pull on the line to check the plug connection
- 3 A yellow indicator ring will detach if the connection is correct
- 4 Remove the indicator ring
- 5 Position the removal tool
- 6 Push the line inwards as far as it will go. Then push the removal tool inwards until it is felt to engage
- 7 Pull the line and removal tool out of the housing

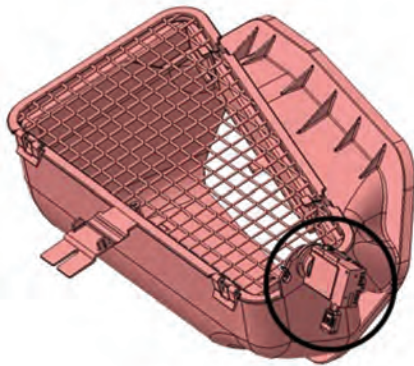
**Important!**

The installation positions of most of the actuators listed here can be found in the sections “Air conditioner” and “Refrigerant circuit”.



Refrigerant pressure sensor

8_28_13



Air quality sensor in air intake housing

8_29_13

8.4 Actuators and sensors

This section provides an overview of the input and output signals processed by the control unit of the air-conditioning system (front OAU).

Actuators

The following actuators are activated in the Macan:

- A/C compressor (externally controlled)
- Servo motors of the air conditioner (see section “Air conditioner”)
- PWM water pump, e.g. utilization of the residual engine heat
- Cooling water/heating shut-off valve (open/closed)
- Seat ventilation, left/right
- Seat heating, left/right

Sensors

Both system variants contain the usual sensors required to operate an air-conditioning system in automatic mode.

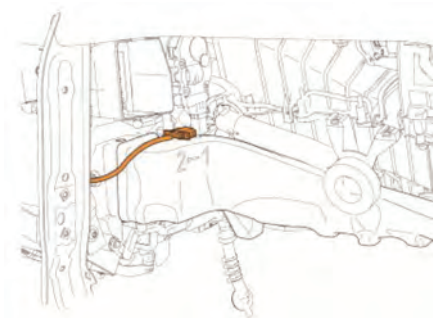
On the Macan, these sensors are as follows:

- Evaporator temperature sensor
- Temperature sensor for passenger air vent, left/right
- Temperature sensor for footwell, left/right
- Outside temperature sensor (front apron)
- Passenger compartment temperature sensor
- Sun sensor, left/right (dashboard)
- Refrigerant pressure
- Air quality sensor (air intake housing)
- Seat temperature sensor, left/right



Temperature sensor for passenger air vent (left)

8_30_13



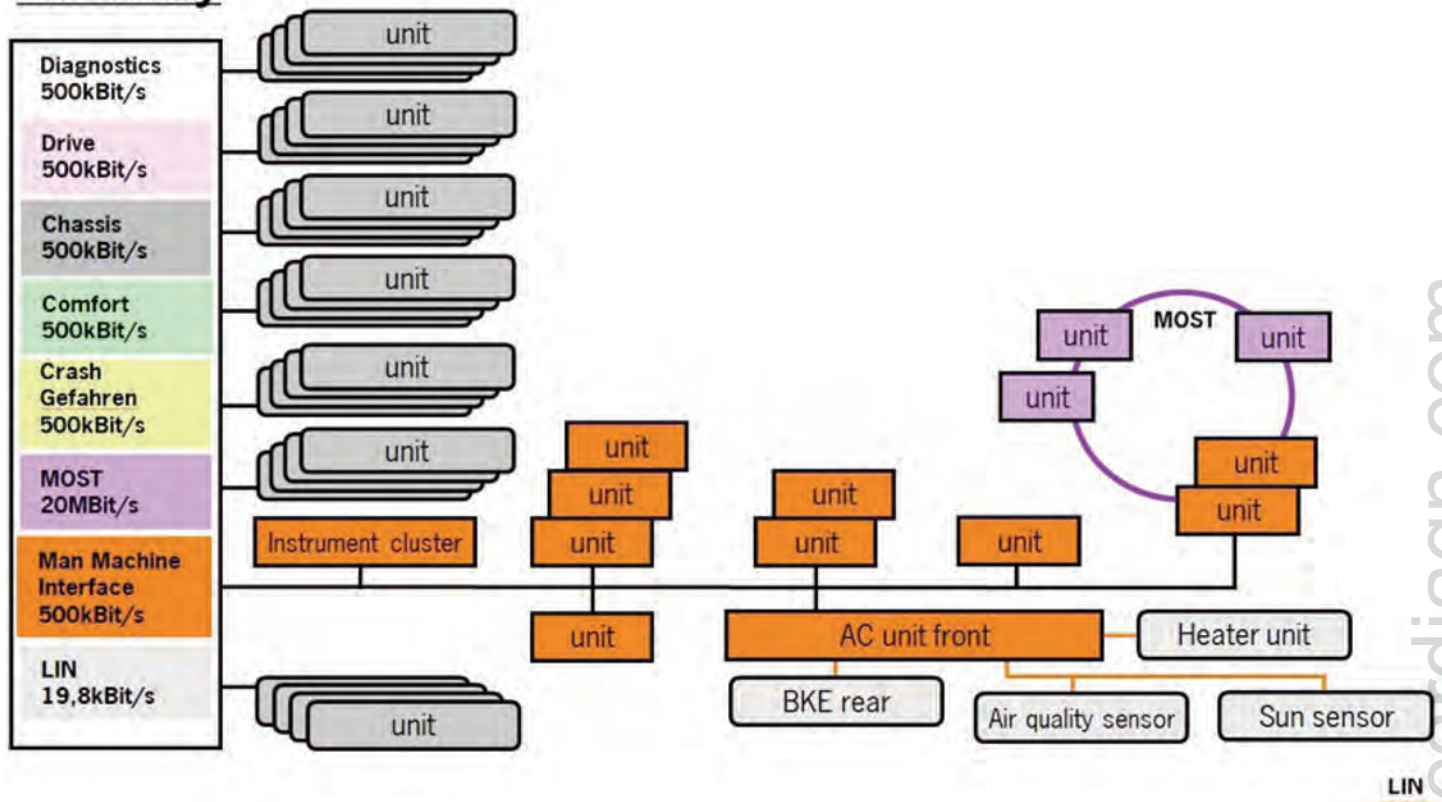
Temperature sensor for footwell (right)

8_31_13

8.5 Topology of the air-conditioning system

The excerpt from the network topology shows how the air-conditioning system is integrated into the data bus environment. The control unit of the air-conditioning system (operating and air-conditioning unit) communicates with other control units via CAN MMI and with external devices and components (sensors) via the LIN bus.

Gateway



The A/C compressor is activated directly via a PWM (pulse width modulation) signal by the air-conditioning system control unit and is thus not included in the topology.

8_32a_13



PORSCHE
Macan S

D S VM8866

car

9 Electrics and electronics

General information

In the area of electrics/electronics, the use of aluminum on the Macan (95B) for components such as the battery and vehicle electrical system supply cables results in a weight saving of more than 7.7 lbs. (3.5 kg) compared to the commonly used copper. Furthermore, the cable lengths have been reduced as far as possible through intelligent line routing.

The 4-point daytime lights in LED technology used in the Bi-Xenon headlights are a particular highlight here. A further striking feature at the rear are the LED lights in 3D design. The lane keeping assist system is used as a driver assistance system for a first time at Porsche. This system initiates corrective steering intervention to bring the vehicle back into the lane when it detects that the driver is inadvertently straying from the lane or is changing lanes without indicating.



4-point LED daytime light

9_01_13



Tail light in 3D design

9_02_13

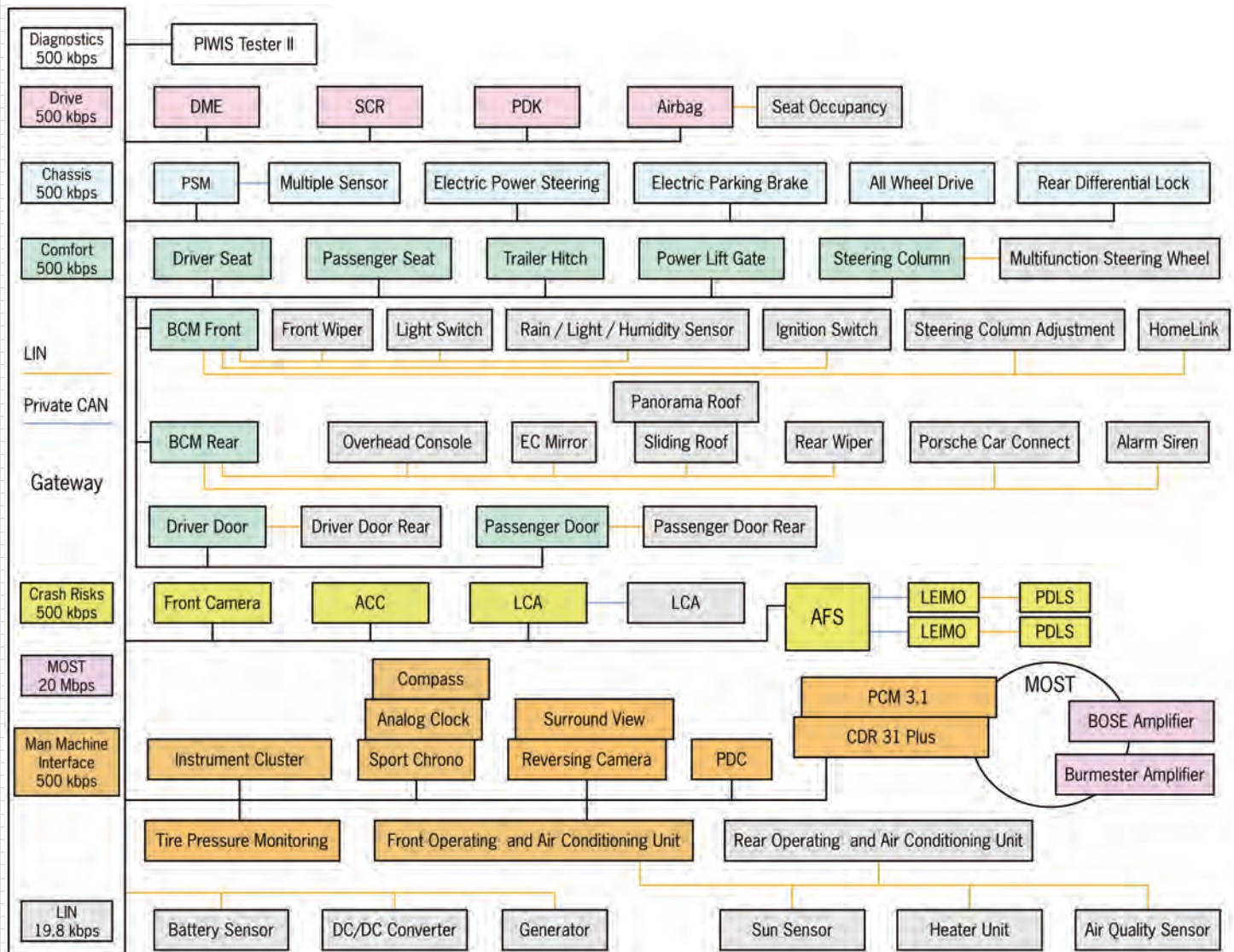


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9	Electrics and electronics	213
9.1	Network topology	214
9.2	Vehicle electrical system	215
9.3	Lighting system	221
9.4	Front-end electronics	225
9.5	Rear-end electronics	229
9.6	Instrument cluster	231
9.7	PVTS/PCC	233
9.8	Assistance systems	235
9.9	Infotainment	240

9.1 Network topology

The following illustration shows the data structure of all networked control units (network topology) for the Macan. The gateway control unit is the central link here, providing the interface to the six CAN data bus systems (Controller Area Network, each with a data transfer rate of 500 kbps). A LIN (Local Interconnect Network with a data transfer rate of 19.8 kbps) connected directly to the gateway contains the energy management system; in addition, the infotainment systems provide an interface between MMI-CAN and the optical MOST (Media Oriented System Transport with a data transfer rate of 20 Mbps).



9.2 Vehicle electrical system/energy management

The Macan comes with an AGM battery (country-dependent), in the sizes 92 Ah/520 A and 105 Ah/580 A. Different types of batteries are used in Porsche vehicles.

Wet batteries

Batteries with liquid electrolyte are called wet batteries. Wet batteries are available as low-maintenance batteries with cell plugs and maintenance-free versions without cell plugs (sealed). The battery fluid is called electrolyte. In a lead-acid battery, sulphuric acid diluted with water is used as the electrolyte. In fully charged state, the sulphuric acid content is approximately 38%, the remainder is distilled water. The ions in the electrolyte enable it to pass an electric current between the electrodes.

AGM batteries

Batteries where the electrolyte is held in a microglass mat are called absorbent glass mat batteries, or AGM batteries for short. The absorbent glass mat in question consists of a mesh of very fine glass fibers. The mat is readily wettable with sulphuric acid and is very absorbent. It acts as a separator. The mat absorbs all the electrolyte. AGM batteries are therefore considered to be leak-proof. Although electrolyte can escape if the battery housing is damaged, the quantities will be very small (at most just a few milliliters).

The battery is sealed with a cover. The cell plugs and the degassing duct are integrated in the cover. AGM batteries are not equipped with a magic eye. AGM batteries are classed as VRLA batteries because of their degassing principle. At Porsche, AGM batteries are used for special requirements such as cycle stability, cold starting or leak protection.

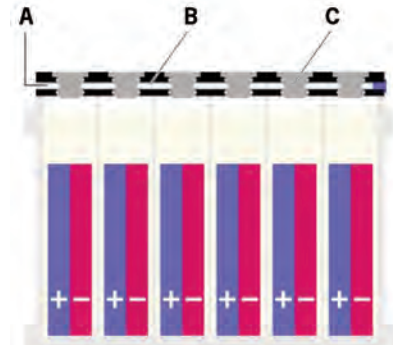
VRLA batteries

Valve regulated lead-acid batteries, or VRLA batteries for short, are batteries with fixed electrolyte. The cell plugs **cannot** be unscrewed. The gases (hydrogen and oxygen) produced during charging are converted back into water within the respective cell. If the battery is overcharged, the excess gas escapes via a degassing valve as a safety valve. Since these electrolyte quantities cannot be replaced, lasting damage to the battery is possible. It is therefore crucial that a battery charger whose charging voltage is limited to 14.4 V is used for charging.



Electrics and electronics

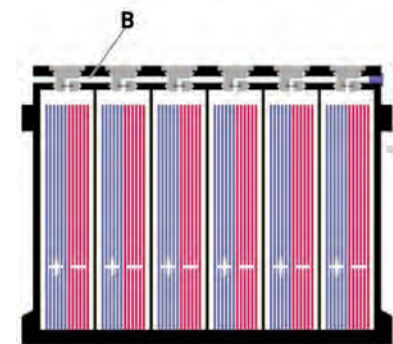
9



Wet battery

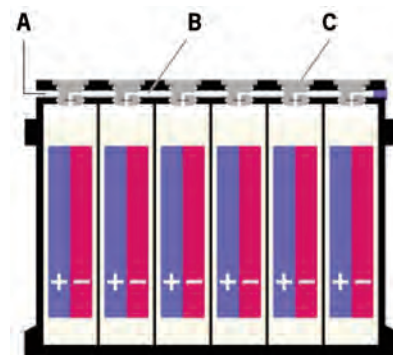
9_05_13

A = Opening
B = Degassing
C = Cell cap



AGM battery

9_06_13



VRLA battery

9_07_13

A = Opening
B = Degassing
C = Cell cap



Battery sensor

9_10_13

**Note!**

In the event of battery replacement, it is necessary to supply the gateway with information (example details given in brackets) regarding:

- battery size (92 Ah),
- technology (AGM),
- scanner code (205JBC3D...)
- and part number (7P0.915.105)

using PIWIS Tester II under the path Maintenance/Repair/Battery replacement. This resets the maps used to calculate the battery condition.

Battery sensor

The battery sensor measures and calculates the energy flow and uses this information to calculate the battery condition. It is installed between the negative terminal of the battery and the ground cable to the body.

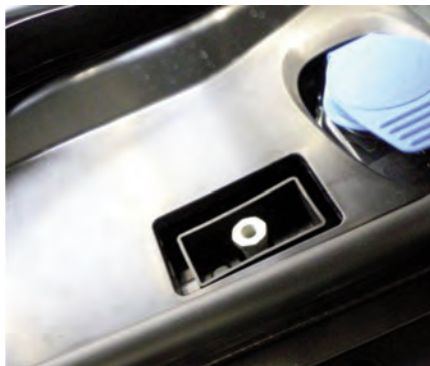
The battery sensor includes/controls the following functions:

- Recording sensor data of the battery (battery voltage, charging/discharge current, temperature)
- Processing sensor data
- Calculating battery-typical parameters
- Battery status detection
- Wake-up functions
- Supplying all measured and calculated data to the gateway control unit for further processing of the determined data in the energy management system

A connector with 2 terminals (terminal 30/LIN) is fitted on the battery sensor control unit (Fig. 9_10_13). Terminal 30/battery positive is used to detect the battery voltage at the positive battery terminal and to supply power to the battery sensor. This means that it is possible to measure the charging voltage of the generator and the open-circuit voltage of the battery. Using the measured values for battery positive/terminal 30, battery current (measured via a shunt in the battery sensor control unit) and negative terminal temperature (NTC in the battery sensor control unit), the battery sensor control unit (slave) calculates the current battery condition by way of an algorithm. This value is transmitted to the gateway (energy management master) via a LIN interface.

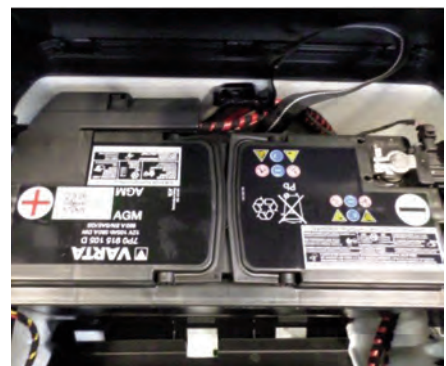
External voltage supply/emergency power supply/jump starting

If the battery is discharged, the vehicle can be manually opened by way of a mechanical key at the driver's door. This provides access to the external power supply point and external power supply is possible using an external voltage source (jump starting/charger).



External power supply

9_08_13



Battery under the loadspace floor

9_09_13

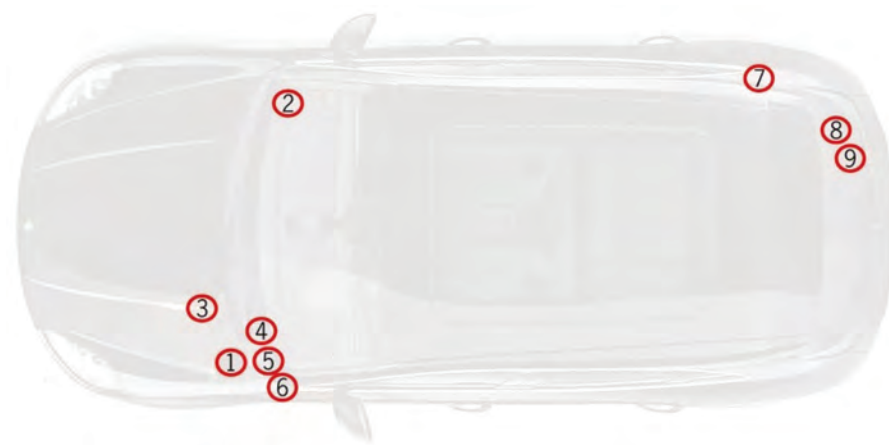
Transport lock

The transport lock of the Macan (95B) can be activated and deactivated with PIWIS Tester II in the gateway under F8/Additional information. There is no mechanical transport lock.

Relays/fuses

Main fuse box/power distributor (central fuse protection)

The main fuse box/power distributor in the Macan is located in the luggage compartment under the luggage tray. The main fuse box contains a pyrofuse/cutoff relay and the main fuses F1-F3.



Installation locations of external power supply, fuses/relays

9_12_13

Detailed information on the relay positions and fuses is provided in the wiring diagram in the PIWIS information system or PIWIS Tester II.



Central fuse protection at positive terminal

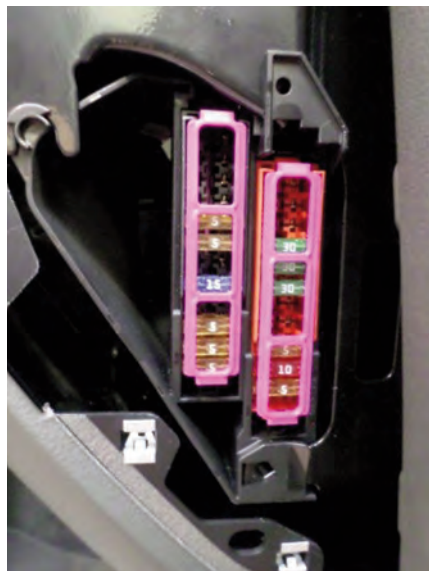
9_11_13

- 1 Jump-start point
- 2 Fuse carrier, passenger's side
- 3 E-box, plenum panel
- 4 Dashboard, driver's side
- 5 Front BCM/front-end electronics
- 6 Fuse carrier, driver's side
- 7 Fuse carrier, rear
- 8 Fuse box 2
- 9 Central fuse protection/power distributor



Fuse carrier,
Driver's side

9_14_13



Fuse carrier,
Passenger's side

9_15_13



Fuse carrier, rear

9_13_13



Gateway CU, under rear seat

9_16_13



Special tool 9838

9_17_13



Auto Start Stop button

9_18_13

Gateway control unit

The gateway control unit is the central interface of the network architecture and permits data exchange between the various networks:

- **C**ontroller **A**rea **N**etwork (CAN)
- **M**edia **O**riented **S**ystem **T**ransport (MOST) and the
- **L**ocal **I**nterconnect **N**etwork (LIN)

In addition, the gateway control unit also contains the Vehicle Network State Manager, which switches the connected systems to a sleep mode after terminal 15 off (Power Down/Sleep function). The gateway also supports the Service organization in fault finding, e.g. fault codes, watchdog, wake-up guardian, closed-circuit current measurement, by providing comprehensive system and diagnostic functions for monitoring network communication.

The gateway includes vehicle energy management as an additional function. This function supports optimization of battery charging during driving as well as minimization of the closed-circuit current by switching off comfort functions and networks when the vehicle is stationary.

Auto Start Stop

The Auto Start Stop function, which is standard on all models, significantly contributes to reduced fuel consumption. The engine switches off as soon as the vehicle reaches a speed of 1 mph (2 km/h) during braking. A symbol on the display of the instrument cluster shows the driver that the Auto Start Stop function has been activated. Although the engine is not running, all audio and communication systems remain switched on and the standard 2-zone automatic climate control continues to maintain the selected temperature. If the brake is released, the system starts the engine again quickly and comfortably. This primarily reduces fuel consumption in city traffic or in congested highway traffic.

The Auto Start Stop function can be deactivated and reactivated by way of a button in the center console. The vehicle automatically deactivates the function in certain situations, e.g. in the event of extreme outside temperatures, when the SPORT button is activated or if the battery state of charge is low.

DC/DC converter

A DC/DC converter is used in combination with the Auto Start Stop system. This DC/DC converter supports the vehicle electrical system when the vehicle is restarted so that voltage-sensitive loads are not switched off as a result of low voltage. An Auto Start Stop cycle is initiated by the decision of the start/stop coordinator (DME). When the engine is switched off, a period follows in which the power supply for the electrical energy/load of the vehicle is taken from the vehicle battery (AGM).

When the engine is started, a first voltage dip then occurs when the starter is engaged and a second voltage dip when the main contacts of the solenoid switch/starter are closed and upon engine breakaway. Subsequently, the voltage recovers as a function of the starter speed, when the starter is switched off and disengaged and when generator charging is started up to the charging voltage. The size of the voltage dip depends on the temperature and all components involved in the current path, the internal resistance and age of the battery as well as the engine counter-torque when it is turned.

Coasting

The coasting function makes more efficient use of the moving vehicle's kinetic energy. If the driver takes his/her foot off the accelerator, e.g. when approaching a built-up area, the engine is automatically disengaged and kept at idle speed. This allows the vehicle to coast for a longer distance than with the engine engaged. Alternatively, coasting can also be intentionally activated by manually shifting up beyond the highest possible gear for the respective vehicle speed.

If the driver indicates a wish to decelerate by pressing the brake, the engine is engaged again comfortably and automatically in a matter of milliseconds and the engine braking effect additionally shortens the vehicle's stopping distance. Likewise, the clutch is quickly engaged if the driver indicates a wish to accelerate by pressing the accelerator pedal. The fuel saving results from the fact that the vehicle's kinetic energy is only used to overcome the rolling resistance and air resistance.

Activation of the coasting function:

- Driving in selector-lever position "D"
- Auto Start Stop function/coasting mode is switched on
- Indicator light in Auto Start Stop button is off
- "Sport", "Sport Plus" or off-road mode is off
- PSM is active
- Cruise control is not active
- Engine, transmission and battery have reached operating temperature
- Relaxed/economic driving style
- Slowly remove foot from accelerator pedal on slight uphill or downhill gradient

The engine is disengaged and runs at idle speed. The vehicle rolls with no engine braking effect. Coasting mode can be identified by the tachometer showing idle speed.



Control unit DC/DC converter

9_19_13



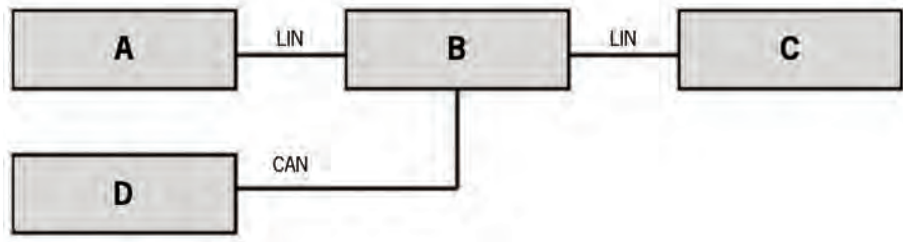
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Vehicle electrical system recuperation

All Macan models feature the recuperation function. With this function, some of the kinetic energy is converted into electrical energy via the generator during the vehicle deceleration phase, e.g. when braking, and is stored in the high-performance starter battery. The generator voltage is actively increased or reduced as appropriate so that the battery can be charged as quickly as possible during deceleration phases and in order to reduce the resistance of the generator in acceleration phases. During acceleration, on the other hand, the full power of the combustion engine is available because the electrical systems are mostly supplied by the energy previously stored in the battery during this period.

Generator control

The generator (3 kW, rated current 220 A) delivers the electrical energy required to supply the electrical/electronic components and systems in the vehicle. The voltage (12-16 V) is largely independent of load and is set by an integrated voltage regulator (LIN interface controller) in accordance with a predefined characteristic. The voltage regulator is implemented as a slave for the gateway control unit (master) and communicates via a LIN interface.



9_21_13

For the purpose of generator control, the information from the battery sensor (A) is transferred to the gateway control unit (B) via LIN (Local Interconnect Network) and the energy requirement is then calculated in the gateway control unit (B) (intelligent algorithm).

The gateway control unit (B) transmits this energy requirement to the generator/voltage regulator (C), which is designed as a LIN interface controller. The generator regulator adjusts the energy requirement in accordance with the request. The gateway control unit (B) receives information about the capacity status via the LIN signal and uses these values to recalculate the energy requirement in the vehicle electrical system.

The information on load response (3 seconds for engine start/generator de-excited) and the braking information (recuperation information) is supplied to the gateway control unit (B) via the DME control unit (D). In addition, the gateway control unit (B) can send an engine speed increase request (3-stage) to the DME (D) in stop & go phases so that the generator (C) can increase its power output in idling phases.

9.3 Lighting systems

Halogen headlights (Standard equipment on Macan S in Canada)

The standard halogen headlights in projector type technology feature:

- automatic headlight range control and
- reflection high-beam lights

This ensures that they always provide bright illumination of the road and safe driving.

Bi-Xenon headlights incl. Porsche Dynamic Light System (PDLS) (Standard equipment on Macan S and Turbo in USA)

In addition to the halogen headlights, Bi-Xenon headlights in projector type technology with:

- static cornering light
- headlight cleaning system and
- automatic dynamic range control

They provide uniform illumination of the road when driving with both dipped and full beams.

Static cornering light

The static cornering light activates auxiliary headlights to illuminate tight corners, e.g. when turning. The function is available at speeds of up to approximately 81 mph (130 km/h) and switches on when the steering wheel is turned.

Automatic dynamic range control

Speed-sensitive headlight range control changes the range and anti-glare contour of the dipped beam at higher speeds, e.g. when driving on a highway, for better illumination of the road. The adverse weather function can reduce reflection and therefore driver glare by masking out the upper light beam when visibility is poor, e.g. when driving in fog.

Highway function in darkness

The distribution characteristics of the driving lights change when driving in darkness at vehicle speeds of more than approximately 81 mph (130 km/h). The light beam becomes longer and the field of vision increases.

Fog lights

The distribution characteristics of the driving lights change when the fog lights are switched on at vehicle speeds below approximately 37 mph (60 km/h). The light beam is widened and glare is reduced.



9_22_13



Note!

The static cornering light as well as the highway function in darkness are activated when the light switch is set to the position "AUTO" (automatic headlights).



9_24_13



Windshield camera/rain sensor

9_26_13

Porsche Dynamic Light System Plus (PDLS Plus)

In addition to PDLS, the optional PDLS Plus includes the dynamic full beam. The dynamic full beam continuously adjusts its range to the distance from the oncoming vehicle or the vehicle travelling in front.

Dynamic full beam

With dynamic full beam, a camera (Fig. 9_26_13) recognizes the light sources of vehicles in front and oncoming vehicles and gradually adjusts the cut-off line of the driving light in several stages between dipped beam and full beam illumination. The stage is selected in such a way that the cut-off line of the driving light reaches to the next recognized vehicle.

The function is activated in darkness if the following conditions are met:

- The light switch is in the position "AUTO"
- The speed is more than approximately 37 mph (60 km/h)
- Dynamic full beam is activated on the multi-function display in the instrument panel
- Dynamic full beam is switched on/activated

In order to avoid full beam illumination within built-up areas, dynamic full beam is not available at speeds below approximately 19 mph (30 km/h). In addition, full beam illumination is automatically switched to dipped beam if two or more street lamps are recognized by the camera.



Light comfort package

The optional light comfort package ensures pleasant interior lighting.

It includes:

- ambient lighting (dimmable) in the door panels and in the roof console, front and rear footwell lighting
- rear reading lights
- ambient lighting strips in the doors as well as
- exterior mirror lights

The vanity mirrors in the sun visors on the driver's and passenger's sides are also illuminated. All lights feature LED technology.

Item	Standard	Light comfort package
Ignition lock	LED	LED
Roof console	Bulb	LED
Glove box	Bulb	LED
Side reading lights	Bulb	LED
Luggage compartment lighting	Bulb	LED
Number plate light	Bulb	LED
Door position lights	Reflector	Bulb
Door ambient light strip	/	LED
Illuminated door storage bin	/	LED
Inner door handle	/	LED
Vanity mirror light	/	LED
Exterior mirror lights	/	LED
Footwell lighting	/	LED



9_28_13

Other functions

Automatic headlights

The automatic headlights function is activated by setting the light switch to the position "AUTO". This comfort function automatically switches the driving lights (dipped beam) on and off depending on the ambient brightness. The automatic headlights function also controls the daytime running lights, the Automatic Coming Home lights and the dynamic cornering light.

Rain function

The driving lights are automatically switched on after more than five seconds of continuous wiper operation. If the wipers have not been used for approximately 4 minutes, the driving lights are switched off.

Automatic range control

When the ignition and dipped beam are switched on, the range of the headlight beam automatically changes in accordance with the vehicle load. The range of the headlight beam is automatically kept constant during acceleration and braking (dynamic range control) on vehicles with Bi-Xenon headlights.

Daytime running lights

If the light switch is set to the position "OFF" (light off), the daytime running lights come on automatically when the ignition is switched on. If the light switch is set to the position "AUTO", the daytime running lights come on automatically in bright conditions and when the ignition is switched on. The daytime running lights are not active when the light switch is set to the dipped beam/driving light position. Regulations for switching the daytime running lights on and off vary according to the legal requirements in each country.

9.4 Front-end electronics

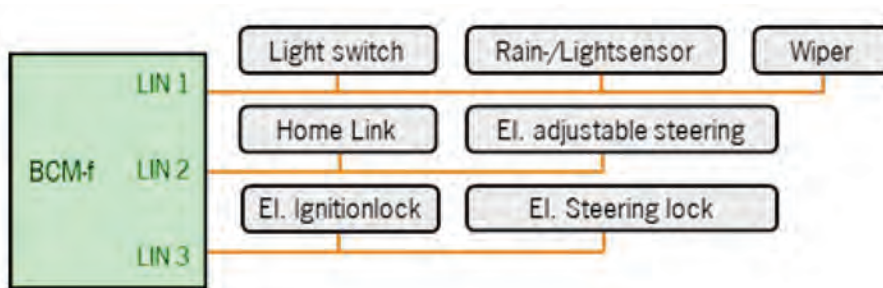
The front-end electronics control unit (BCM front) communicates with the gateway via CAN Comfort. The front-end electronics control unit includes several function groups and functions. These will be described in more detail below.

Three LIN connections are available to control a variety of peripheral devices; these include the following components:

LIN 1 – Rotary light switch, rain/light sensor, windscreen wiper

LIN 2 – Electrically adjustable steering column, HomeLink

LIN 3 – Electronic ignition lock, electric steering lock



9_30_13

Lighting functions

The side marker lights, dipped beam, full beam and fog lights are controlled by a rotary light switch, which is connected to the front-end electronics via a LIN data bus system and a redundant line connection.

The automatic headlights function (rotary light switch position "AUTO") allows automatic control of light functions by the "front-end electronics control unit". This takes place depending on light and weather conditions. A rain/light sensor is connected via a LIN bus for detection of the prevailing conditions. Other functions such as the headlight flasher and indicator functions are controlled by the combined steering column module connected to the CAN data bus (CAN Comfort). The hazard warning light function is activated manually by the hazard warning light button.



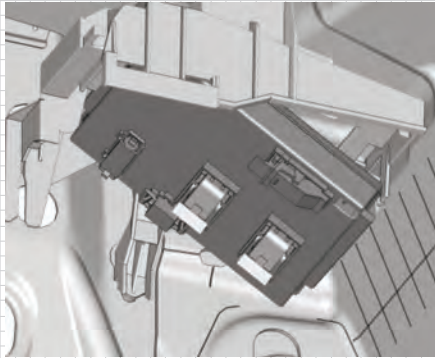
Installation position of front-end electronics control unit

9_29_13



Note!

More detailed information on the individual functions can be found in the function overview illustrations in the wiring diagram.



Front-end electronics control unit 9_31_13

Front-end electronics functions/input signals

- Tailgate button
- Brake fluid sensor
- Electronic ignition lock (position detection), redundant line (LIN failure)
- Vehicle key transponder/electronic engine immobilizer
- Remote control vehicle key
- Washer fluid level
- Door module inputs (opening/closing functions, keyless entry (KESSY))

Front-end electronics functions/output signals

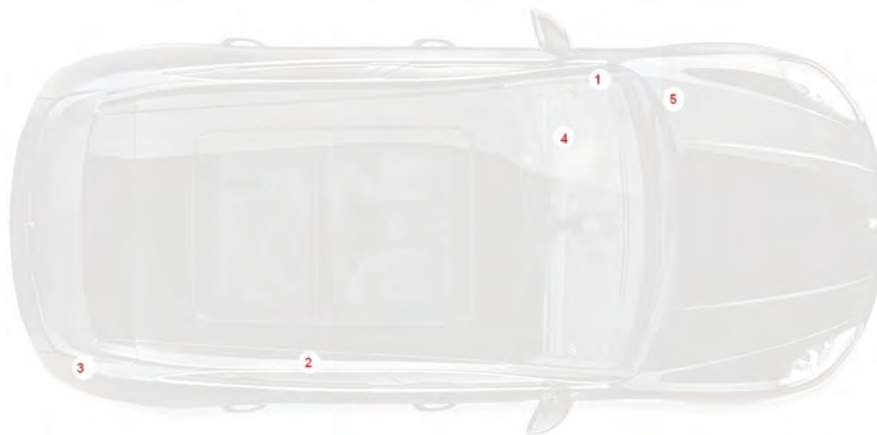
- Two-tone horn relay
- Tank cap actuating element
- Power supply for electronic steering lock
- Power supply for axle height sensor
- Dual washer pump (front/rear)
- Headlight cleaning pump
- Heated washer jets (T. 15)
- Electronic ignition lock anti-removal lock
- Indicator lights/hazard warning lights
- Terminal 15 relay diagnosis
- Terminal 50 (HS/high side) relay
- Electrical socket (SD) relay
- Dipped beam, full beam, fog light, side marker light, footwell lights, headlight beam adjustment

Online engine immobilizer 5

The electronic engine immobilizer 5 protects the vehicle from unauthorized use. A 5th generation online engine immobilizer is used for the Macan. This function has been integrated into the front-end electronics control unit (master). In order to achieve a higher degree of security, the immobilizer is distributed over several components.

These include:

- Vehicle key with transponder
- Front-end electronics control unit
- Electromechanical steering lock (NAR)
- Engine control unit (DME)
- Alarm system master (rear-end electronics/REE)



Online engine immobilizer components

9_32_13

For the engine immobilizer to be enabled, all components must be authenticated by the engine immobilizer master. The engine immobilizer functionality is integrated into the front-end electronics.

The vehicle key (basic and Entry & Drive versions) has a radio interface and a transponder interface. The user can actively operate the central locking system/rear lid via the radio interface, i.e. unlock and lock the vehicle.

A transponder interface is used for the function in the ignition lock. Data is exchanged between the key and the ignition lock via this interface. A battery is not required in the key for this interface.

Online engine immobilizer 5 control units:

- 1 Front-end electronics (BCM front)
- 2 Gateway
- 3 Rear-end electronics (BCM rear)
- 4 Electromechanical steering lock (NAR)
- 5 DME



Vehicle key

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Note!

The vehicle key has numerous interfaces depending on equipment:

Basic version

Radio interface 434 MHz/315 MHz

Transponder interface

Porsche Entry & Drive option

Near-field communication radio interface



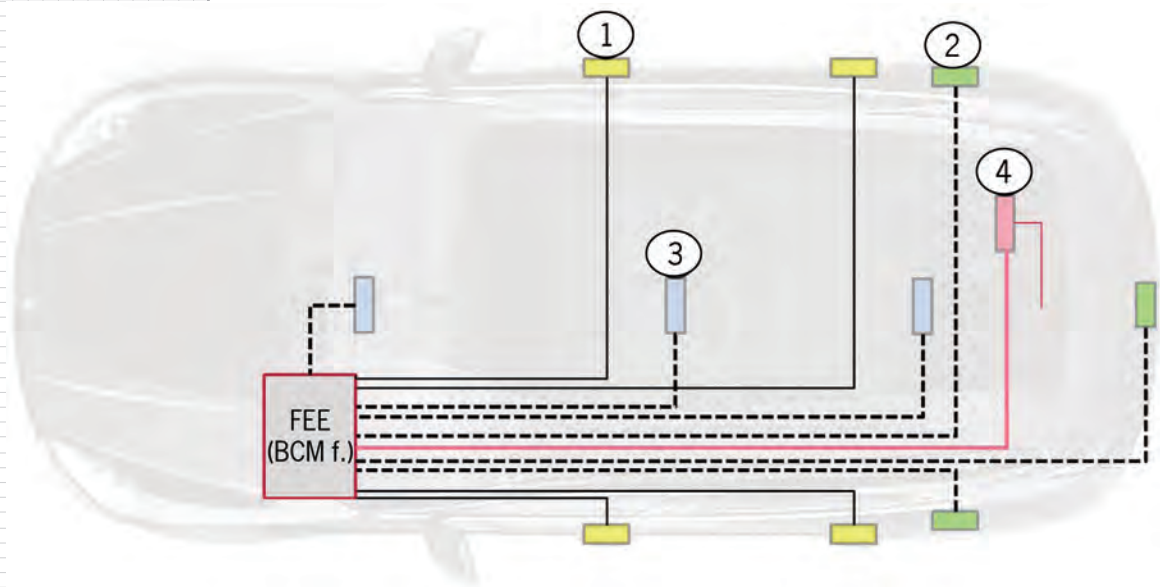
Door handle with 2 capacitive sensors

9_34_13

Porsche Entry & Drive

With the optional equipment “Porsche Entry & Drive”, the key has an additional radio interface for near-field communication/detection of approaching of the vehicle (125 kHz). The central locking system (open/close function) responds via the normal radio interface (434 MHz). Communication between the vehicle key and engine immobilizer master (FEE) is encrypted. Vehicle access with the remote control and access with Porsche Entry & Drive involve the transfer of 32 bits (4 bytes) of encrypted data. This results in approximately 4 million variants.

To start the vehicle, 64 bits (8 bytes) of encrypted data is transferred for authentication of the key. The ignition lock accommodates the vehicle key in the basic version. The inserted vehicle key can be authenticated via the transponder interface in the ignition lock. To do this, the ignition lock converts the radio information into LIN signals for communication with the engine immobilizer master.



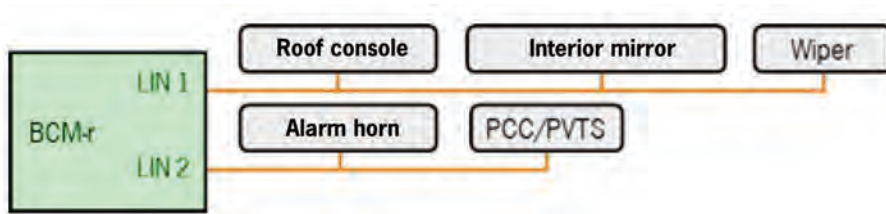
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- 1 Outer door handle electronics
- 2 125 kHz exterior antennas
- 3 125 kHz interior antennas
- 4 Antenna module, central locking system antenna 434 MHz

9.5 Rear-end electronics

The rear-end electronics control unit (BCM rear) communicates with the gateway via CAN Comfort. The rear-end electronics control unit includes several function groups and functions. These will be explained in more detail below. Two LIN connections are available to control a variety of peripheral devices; these connections are assigned to different areas.

- LIN 1 = Roof console, EC interior mirror, sliding roof motor
- LIN 2 = Alarm horn, Porsche Car Connect (PCC)



9_37_13

Rear-end electronics functions/input signals

- Tailgate button
- Brake pad wear sensors
- Electric steering column lock (locked)
- Coolant level

Rear-end electronics functions/output signals (excerpts)

- G1 terminal control
- Exhaust flaps
- Rear wiper
- Heated rear window relay
- Terminal 15 DC/DC converter
- Rear fog light, number-plate lighting, back-up light, brake lights, side marker light, daytime light, door sill ambient lighting, luggage compartment lighting
- Rear window glass breakage
- Alarm horn
- Electric closing aid for tailgate



Installation position of rear-end electronics control unit

9_36_13



Rear-end electronics control unit

9_38_13

Lighting

Daytime running lights (front) are requested by way of a CAN signal from the front-end electronics control unit. However, the daytime running lights are activated by the rear-end electronics.

The rear left and right brake lights and the raised brake light are activated by a hardwired signal from the brake light switch and via a CAN signal (redundant).

The back-up lights are activated by a switch on vehicles with manual transmission and by a CAN signal from the selector lever in the case of automatic transmission.

The tail lights, rear fog lights and number-plate lighting are also connected to this control unit.

Alarm system

The rear-end electronics control unit performs the master function for the alarm system. Opening and closing the vehicle activates and deactivates the alarm system.

The following components are monitored:

- All doors, hood, tailgate, headlights, inclination angle of the vehicle, interior surveillance, glass breakage, trailer

The alarm system function is part of the entry/drive authorization system and can be activated/deactivated by way of the remote control or Porsche Entry & Drive. Interior surveillance and the inclination sensor can also be deactivated.

Alarm horn

The alarm horn is connected via a LIN bus (LIN 2) to the rear-end electronics control unit and triggers an alarm if an attempted theft is detected. The Porsche Vehicle Tracking System (PVTS) is optionally connected to it. The alarm horn is equipment-specific (especially USA) and must be coded in the rear end electronics control unit.

Roof console

The roof console is connected to the rear-end electronics control unit via a LIN bus (LIN 1). It optionally has an integrated inclination sensor and features ultrasonic interior surveillance in all vehicles. Both of these functions can be deactivated by way of a pushbutton (remote control, press 2x) (not applicable for all country variants).

Interior mirror

The electrochromic interior mirror is also connected to this LIN. If the vehicle is locked and an alarm event is detected by the interior surveillance system or the inclination sensor, the roof console sends a signal to the rear-end electronics control unit (alarm system master).

9.6 Instrument cluster

The instrument cluster is the central driver information unit and is used to display data relating to the vehicle, e.g.:

- Engine speed
- Vehicle speed
- Temperatures and fill levels
- Warnings and messages

General vehicle settings can be made in the instrument cluster by way of a selection menu and made available to the control unit network via CAN.

The following vehicle information is shown under the on-board computer functions in the middle display area:

- Vehicle
- Audio
- Telephone
- Map
- Navigation
- Trip
- Tire pressure
- Allwheel
- Chrono
- Speed limit
- ACC



Instrument cluster

9_39_13

The instrument cluster also manages all on-board computer values, e.g. remaining range, and the warnings and information audio signals for the entire vehicle system. The engine and vehicle speed evaluation function determines the noise level in the passenger compartment so that the warning tone intensity can be adapted correspondingly. The audio master supports simultaneous output of at least 3 system tones via the speaker in the instrument cluster (ParkAssist, indicator, warning tone).

**Note!**

If the “Auto Memory” function is activated, the settings stored on the driver’s key or key button are overwritten each time the vehicle is locked.

Memory functions

There are **three ways** of saving vehicle settings (personalization) on the Macan.

The **first** takes place automatically when the vehicle is locked/unlocked via the vehicle key, at the same time the current vehicle settings are stored or called up. Specifically these are:

Ergonomic settings

- Driver’s seat and door mirror (driver memory package)
- Driver’s seat, door mirror, electric steering column (comfort memory package)

Comfort settings (comfort memory package)

- Air conditioning
- Multi-function display and
- Settings for the infotainment system PCM or CDR Plus

The “Auto Memory” function must be activated (ticked) on the multi-function display for this.

The **second** is manually using buttons 1, 2, 3 in the driver’s door. The following settings are stored:

Ergonomic settings

- Driver’s seat and door mirror (driver memory package)
- Driver’s seat, door mirror, passenger’s seat, electric steering column (comfort memory package)



Driver’s door handle

9_40_13



Passenger’s door handle

9_41_13

The **third** is manually using the key button in the driver’s door. The following settings are stored:

Ergonomic settings

- Driver’s seat and door mirror (driver memory package)
- Driver’s seat, door mirror, electric steering column (comfort memory package)

Comfort settings (comfort memory package)

- Air conditioning, multi-function display and Porsche Communication Management (PCM) or CDR Plus

The settings are stored on the key button in the driver’s door and on the vehicle key.

9.7 Porsche Vehicle Tracking System (PVTS), Porsche Car Connect (PCC)

Porsche Vehicle Tracking System (PVTS) is a GSM/GPS-based tracking system, which is used by a Security Operating Center (SOC) to locate the vehicle if it is stolen so that the vehicle can then be secured by the relevant authorities. As soon as the Porsche Vehicle Tracking System (PVTS) detects a theft alarm, the location of the vehicle in question is sent to the SOC.

There are three different types of PVTS equipment:

- PVTS with driver card
- PVTS with remote keypad
- PVTS without driver card/without remote keypad

Function scope

The vehicle will only be located if it was stolen. For this purpose, a text message is sent to the mobile phone number specified by the customer. The location of the vehicle is not revealed in the text message for security reasons.

Commissioning/activation routines for the PVTS

Operating the PVTS without driver card/without remote keypad

When the Porsche Vehicle Tracking System (PVTS) is operated normally, no intervention by the customer is required.

Operating the PVTS with driver card

The PVTS can be automatically disabled using an activated driver card.

Operating the PVTS with remote keypad

A code must be entered using the numeric keys on the remote keypad in order to disable the PVTS. The customer receives the code via text message following activation.

Alarms

The following alarms can be triggered:

- Unauthorized movement of the vehicle: The vehicle is moved without authorization when the ignition is switched off. For vehicles with driver card/remote keypad: The vehicle is moved without the driver card/remote keypad.
- Sabotage: The PVTS was tampered with without authorization.
- Break-in alarm: The alarm system was triggered and is active for more than 15 seconds.
- Ignition lock alarm (for PVTS with remote keypad): The code is not entered on the remote keypad within 3 minutes of switching on the ignition.
- Code alarm (for PVTS with remote keypad): Via the remote keypad.



PVTS control unit,
under rear seat bench

9_42_13



Excerpt from app

9_43_13

Porsche Car Connect (PCC)

On vehicles with the smartphone app Porsche Car Connect, Porsche Vehicle Tracking System (PVTs) settings can be implemented directly using the app. Porsche Car Connect enables remote requesting and control of vehicle-specific services via an iOS® or Android® smartphone.

Other components are:

Remote services

The following content is available via the remote services:

- Vehicle status
- Route statistics
- Comfort and safety

Porsche Vehicle Tracking System (PVTs)

The following content is available via the Porsche Vehicle Tracking System (PVTs) services:

- PVTs special mode administration
- Engine inhibitor

A separate contract with a service provider recommended by the respective Porsche partner is required to use Porsche Car Connect. Annual costs are incurred for this after the inclusive period (6 months).

Transport (transport mode)

If the vehicle is transported with the ignition switched off, e.g. on a ferry, transport mode must be activated. If the vehicle is not transported in transport mode, the system can trigger a false alarm.

Servicing (garage mode)

The PVTs must be set to vehicle servicing mode in the following situations:

- During customer service, e.g. for regular servicing
- When the battery is disconnected

If the vehicle is not serviced in vehicle servicing mode, the system can trigger a false alarm, for which the customer will be billed.

9.8 Assistance systems

Cruise control

Cruise control automatically controls the vehicle speed in accordance with the setting. It also keeps the speed constant when driving downhill by downshifting and braking. Cruise control can be activated at speeds between 19 mph and 149 mph (30 km/h and 240 km/h) by way of a button on the control stalk. Over long distances, this increases comfort for the driver and enables relaxed driving.

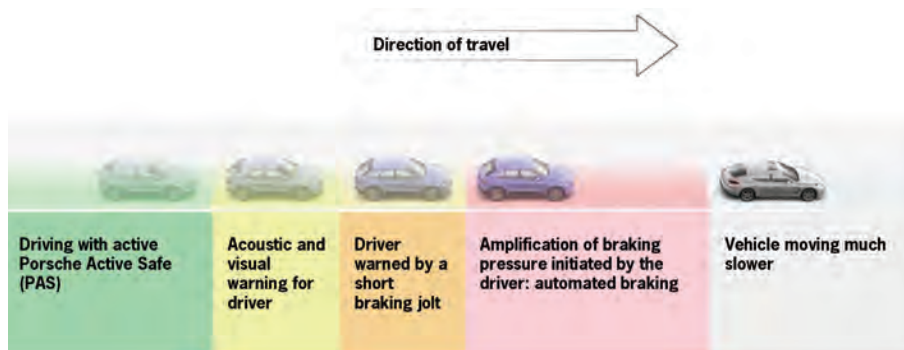
Adaptive cruise control (ACC)

Between 19 mph and 130 mph (30 km/h and 210 km/h), the adaptive cruise control (ACC) assistance system with Porsche Active Safe (PAS) maintains a distance to the vehicle in front that is speed-sensitive and can be preselected in four steps. It automatically adapts the driving speed, bringing the vehicle to a halt if necessary, and moves off again following confirmation by the driver.

Porsche Active Safe

Porsche Active Safe (PAS) also helps to prevent rear-end collisions – even when adaptive cruise control is switched off. For this purpose, the front radar system continuously monitors the traffic situation (without responding to stationary objects) and notifies the driver in good time about critical situations. This is done by pre-conditioning the brake system and readying brake assist.

If the threat of a rear-end collision is increasing, a visual and acoustic warning is initiated and a short braking jolt makes the driver aware of the need for intervention. If the driver does not respond with appropriate application of the brakes, the system amplifies the brake pressure as appropriate to the situation, right up to full braking (target braking).



ACC operating lever

9_44_13

9_45_13



Windshield camera

9_46_13

Lane keeping assist

The lane keeping assist system initiates corrective steering intervention to bring the vehicle back into the lane when it detects that the driver is inadvertently straying from the lane or is changing lanes without indicating. The system also alerts the driver by issuing an acoustic and visual warning.

The driver can override the corrective steering intervention at any time. The lane boundary lines are determined using a camera (Fig. 9_46_13) in order to continuously recalculate the course of the road. If the system assesses the distance from the lane lines as critical at a speed of over approximately 40 mph (65 km/h), it initiates corrective steering intervention and the vehicle is guided back into the lane. In addition, a warning tone sounds when the vehicle drives over the lane marking and the lane line in question is identified on the multi-function display in the instrument panel.



9_47_13

Lane change assist

Lane change assist helps the driver using two radar sensors at the rear of the vehicle (under the rear apron). It monitors the blind spot and the traffic situation behind the vehicle. The LEDs integrated in the two door mirrors serve as the indicators. The system provides assistance when driving on motorways and on country roads. For this reason, it works at a driving speed of between approximately 19 mph and 155 mph (30 km/h and 250 km/h).



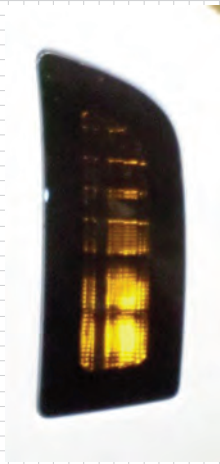
Readiness indicator LEDs in the exterior mirrors

9_48_13

Function

Lane change assist measures the distance and speed difference of the detected vehicles compared to the Macan. Whenever lane change assist regards the speed difference and distance as critical for changing lanes, this is indicated on the relevant exterior mirror. The warning indicator can light up when a vehicle is overtaken or overtakes another vehicle.

If another vehicle is slowly overtaken (speed difference of less than approximately 9 mph (15 km/h)), the warning indicator lights up as soon as this vehicle is in the blind spot and is detected by lane change assist. If there is a greater speed difference, this is not indicated on the exterior mirror.



LEDs in exterior mirror

9_49_13

Lane change assist has 2 warning indicator stages: information stage and warning stage. Depending on whether or not you have set the indicator to indicate that you intend to change lane, lane change assist helps you by activating the relevant warning indicator stage.

Information stage

When the indicator is not activated, the warning indicator in the exterior mirror lights up to indicate that lane change assist on this side has detected a vehicle and considers this critical for changing lanes. The brightness of the warning indicator in the respective exterior mirror is low in the information stage so that you only notice it when you glance at the door mirror. The brightness of the information stage is deliberately weak so as not to distract you while driving without intending to change lanes and looking at the road. The information stage is clearly visible when you look in the exterior mirror.

Warning stage

When the indicator is activated, the respective warning indicator on the exterior mirror flashes brightly several times if lane change assist has detected a vehicle that it regards as critical. When the warning stage flashes brightly several times, this should be an indication for you to check the driving situation again by looking in the exterior mirror and looking over your shoulder.

ParkAssist

ParkAssist helps the driver when parking and maneuvering the vehicle by indicating obstacles and the direction of movement by means of grid lines on the output screen. ParkAssist is activated automatically when reverse gear is selected and the ignition is switched on. If the vehicle has front ParkAssist, this is also automatically activated when the distance between the vehicle and an obstacle in front is less than approximately 3.93 ft. (120 cm). An acoustic signal sounds when the distance between the vehicle and an obstacle in front is less than approximately 2.62 ft. (80 cm). The ParkAssist visual display appears on the central screen of the Porsche communication system.

Front and rear ParkAssist (4 sensors each) is not active:

- At a speed of more than approximately 9 mph (15 km/h)
- When the electric parking brake is activated
- When an attached trailer is detected (trailer connector plugged in)



Ultrasonic sensor in the rear end 9_51_13



Ultrasonic sensor in the front apron 9_50_13

The increased comfort that ParkAssist provides must not induce you to take risks with your safety. Even when using ParkAssist, the driver is still responsible for taking due care when parking and when assessing obstacles. The system cannot replace the driver's attention. Make sure that no persons, animals or obstacles are within the maneuvering area.

When reverse gear is selected, ParkAssist confirms that it is switched on by issuing a short acoustic signal. If the vehicle has front ParkAssist, no acoustic signal will sound when reverse gear is selected. Instead, the ParkAssist visual display will appear on the central screen of the Porsche communication system.

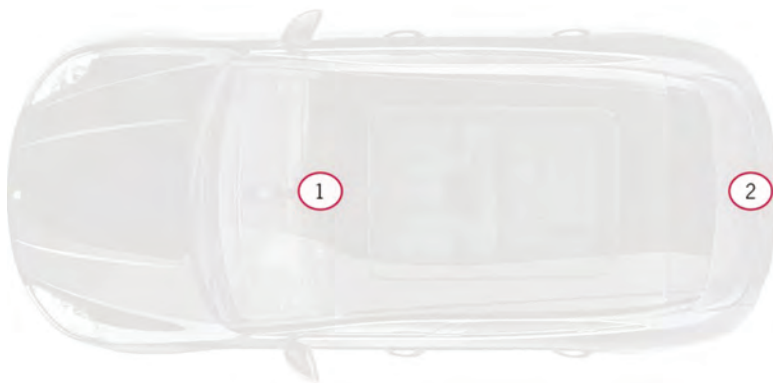
A detected obstacle is signalled by an intermittent tone. The intervals decrease as the obstacle is approached. A continuous tone sounds when the distance is less than approximately 1.15 ft. (35 cm).

Reversing camera

The reversing camera makes controlled, precise reverse parking and maneuvering easier. This is made possible by displaying a color camera image with dynamic guide lines on the screen. The end of the vehicle can also be detected thanks to a wide-angle lens. The system is activated by engaging reverse gear when terminal 15 is ON and/or the engine is running.

The following technical prerequisites apply for equipping a vehicle with a reversing camera system:

- Reversing camera
- Control unit for the reversing camera system
- Display screen (CRD31/PCM 3.1)



9_53_13

The reversing camera visually detects the area behind the vehicle. The control unit for the reversing camera system processes the image from the reversing camera and transmits it to the display screen for output if defined preconditions are met. The display screen displays the image prepared by the control unit for the reversing camera system.



Reversing camera

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- 1 = Display screen
2 = Reversing camera



9_54_13



PCM

9_55_13



Speed limit display

9_57_13

9.9 Infotainment

CDR Plus audio system

All Macan models are equipped as standard with CDR Plus; this infotainment system includes the following equipment:

- Audio system with 11 loudspeakers with a total output of 235 watts (Sound Package Plus)
- 7-inch WVGA touchscreen (Wide Video Graphics Array, 800x480 pixels)
- Radio with analog and digital double tuner
- Single CD/DVD drive (MP3-compatible)
- USB connection with album art (cover art display)
- AUX interface/signal input for external devices

Porsche Communication Management (PCM) incl. navigation module

PCM includes all the above-mentioned functions of the CDR Plus system. It also offers a navigation module with:

- Hard drive with map data for North American
- Perspective map display and 3D navigation map incl. City and Terrain models with superimposed satellite map
- Dynamic route guidance (TMC)
- Advanced dynamic route guidance taking into consideration various traffic flow information
- Automatic route tracking and subsequent reverse route navigation as well as navigation in non-digitized regions using a compass and GPS
- Transfer of online navigation destinations using the optional online services

Electronic logbook

Allows the automatic recording of current mileage, distance covered, date and time as well as the starting point and destination for each trip. It includes PC software for later analysis of the data.

Speed limit

The optional speed limit display is available in combination with PCM. This information system detects speed limits and the beginning and end of no-passing zones using a camera in the windshield. A speed limit display in the color screen of the instrument cluster and the PCM screen provides the driver with a constant supply of information on the limit. If the vehicle enters a no-passing zone, this is also indicated to the driver. If the camera's view is restricted, the speed information taken as a basis for the navigation data is used.

Universal audio interface

All Macan models are equipped as standard with a universal audio interface in the storage compartment of the front center console, offering two connection options:

- USB interface for connecting and charging various iPod® and iPhone® models and for connecting USB memory sticks with MP3 music and MP3 players. Also supports the display of cover art and the playback of podcasts and audio books. Includes operation via PCM, the multi-function steering wheel or the optional voice control. Via the USB connection, up to 5,000 tracks in MP3 format can be transferred to the internal 40 GB hard drive of the Porsche Communication Management (PCM) system and can be played from there and the data from the electronic logbook can be downloaded.
- AUX interface for connecting an external audio source which is then operated directly via the connected PCM system.

Voice control

Voice control allows practically complete operation of all PCM functions using defined voice commands. With coherent address input of navigation destinations, whole-word input of phone book entries or radio station names without the system having to learn them. Simplified operation by way of interactive input and display of menu-specific selection lists.

Telephone module

Internal quad-band GSM telephone module with Bluetooth® interface for ease of use and optimized sound quality. Permits phone use in 3 operating modes:

- With inserted SIM card; connection via the GSM external antenna.
- Via Bluetooth® connection with the SIM Access Profile (SAP). After automatic coupling of the devices, the GSM antenna of the mobile phone is switched off to protect the battery; the connection is then made via the GSM external antenna (only available for mobile phones with SIM Access Profile).
- Via Bluetooth® connection with the Hands-free Profile (HFP). In this case, the GSM connection is always established via the mobile phone antenna. Including microphone, hands-free function, muting and operation of all important telephone functions including call lists and phonebook access (depending on the mobile phone) via PCM, the multi-function sports steering wheel or optional voice control (operating scope dependent on operating mode).

Telephone module with Bluetooth® handset

Additionally comprises a Bluetooth® handset with display and own keypad; this allows discreet telephone calls to be made, also from the rear seat bench. Operation of the Bluetooth® handset is not supported in HFP mode.

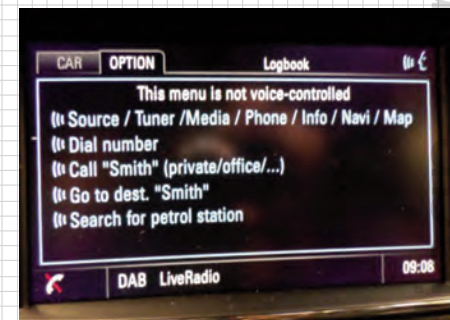
Mobile phone preparation

With Bluetooth® interface for connecting a mobile phone via the Hands-free Profile (HFP). Including microphone, hands-free function optimized for the driver and muting as well as operation of all basic functions.



USB/AUX connection in the center console

9_56_13



Voice control

9_58_13



BOSE subwoofer

9_59_13



9_62_13

BOSE® Surround Sound System

The BOSE Surround Sound System comprises 14 loudspeakers including 200 watt active subwoofer, 9 amplifier channels and offers a total output of 545 watts. The BOSE® technologies Centerpoint® 2 and SurroundStage® allow the system to reproduce stereo sources in Surround mode.

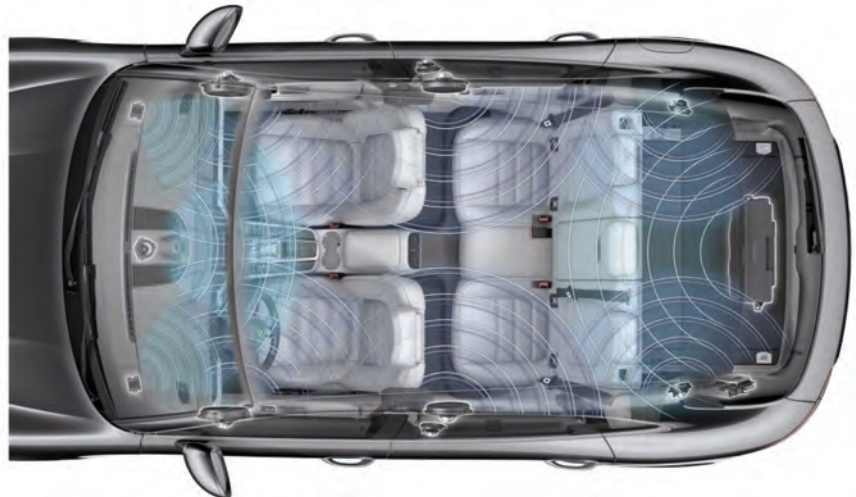


BOSE components

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Burmester® High-End Surround Sound System

The Burmester® High-End Surround Sound System offers a total output of more than 1,000 watts and comprises 16 individually controllable loudspeakers including a 25 cm, 300 watt active subwoofer with Class D digital amplifier. Sophisticated high-end components such as special ribbon tweeters (Air Motion Transformer, AMT) and an acoustically effective diaphragm area of more than 2,400 cm² ensure precise sound playback, even at very high levels. Numerous preset sound sets enable a top-class music experience, while a sound conditioner uses a microphone to precisely adjust the sound to the respective driving situation in real time.



Burmester components

9_61_13

6-disc CD/DVD changer

Integrated into the CDR Plus audio system or PCM instead of the single CD/DVD drive. Includes playback of music in MP3 format as well as audio playback of audio/video DVDs.

Digital radio

In addition to receiving analog stations, also allows reception of digital radio stations with better sound quality, including reception of DAB+ and DMB Audio. With the DAB double tuner, a second DAB tuner is continuously scanning for alternative reception frequencies for the set station and the station list is simultaneously updated. The reception depends on the availability of a local digital network.

Online services

The optional online services enable the integration of online functionalities into PCM using the Aha Radio app. Available for iPhone® and Android® devices.

Includes:

- Web radio and personalized web music
- News feeds, podcasts and audio magazine
- Weather information
- Google Online Point of Interest (search function) with POIs used as navigation destination
- Facebook®, Twitter® and much more.

Display of e-mails and text messages on telephone devices that support the Message Access Profile (MAP). With optional voice control these can also be read aloud.



CD slot

9_63_13

Glossary

Abkürzungen / Abbreviations		
	Deutsch	English
ACC	Abstandsregeltempomat	Adaptive Cruise Control
AFS	Automatische FahrlichtSteuerung	Automatic forward lighting
AGM		Absorbent Glass Mat
ALWR	Automatische Leucht Weiten Regulierung	Automatic headlamp levelling
BCM	Karosseriesteuergerät	Body Control Module
BKE	Bedien Klima Einheit	AC-Unit
CAN		Controller Area Network
DAB	Digitale hörbare Übertragung	Digital Audio Broadcast
DLC		Diamond like Carbon
DFI	Direkteinspritzer	Direct Fuel Injection
DMB	Digitale Mehrfachmedien Übertragung	Digital Multimedia Broadcast
DTMF	Dual Ton Mehrfrequenz	Dual Tone Multi Frequency
ESD	Elektrostatische Entladung	Electro Static Discharge
FLA	FernLichtAssistent	High beam assist
GLW	Gleitende LeuchtWeite	Sliding light
HAL	HinterAchsenLenkung	Rear axle steering
HD		
HMI	Mensch Maschine Schnittstelle	Human Machine Interface
IWT	Innerer WärmeTauscher	
IAGK	Integrierter AbGasKrümmer	
KBA	KameraBasierende Assistenzfunktionen	
LDW	Spurverlassenwarnung	Lane Departure Warning
LEIMO	LEistungsMODul	Performance Module
LIN		Local Interconnect Network
LKS	Spurhalteassistent	Lane Keeping Support
MPI	Mehrfacheinspritzung	Multi Point Injection
MOD	Mobile OnlineDienste	Mobile online services
MOST		Media Oriented System Transport
MTP	Medienübertragungsprotokoll	Media Transfer Protocol
ND	NiederDruck	
PAS		Porsche Active Safe
PASM		Porsche Active Suspension Managemant
PCC	Porsche Fahrzeug Kommunikation	Porsche Car Connect
PDK	Porsche DoppelKupplungs Getriebe	
PDLS	Porsche Dynamisches LichtSystem	Porsche dynamic light system
PDLS Plus		
PTM		Porsche Traction Management
PVTS	Porsche Fahrzeugverfolgungssystem	Porsche Vehicle Tracking System
RdW	Rest Der Welt Märkte	Rest of world
SCR		Selective Catalytic Reduction
SMS	Kurznachricht	Short Message Service
SWA	SpurWechselAssistent	Lane Change Assist
USB	Universelle Serielle Schnittstelle	Universal Serial Bus
VRLA		Valve Regulated Lead Acid
VZA	VerkehrsZeichen Anzeige	Traffic sign view

