



## **Audi TT RS with 2.5l R5 TFSI Engine**

The Audi TT RS developed by quattro GmbH breathes new life into venerable old traditions. Thanks to a turbocharged 2.5-litre five-cylinder inline engine, permanent all-wheel drive, a sporty yet comfortable suspension and the design, both the Coupe and the Roadster are uncompromising sports cars.

Turbocharged five-cylinder petrol engines already put the first generation of the Audi quattro ahead of the competition. The new engine generation combines turbocharging with petrol direct injection. The TFSI engine develops 250 kW (340 hp) from 2480 cm<sup>3</sup> of cubic displacement – that's an output of 137.1 hp per litre. The Coupe weighs in at a mere 1450 kilograms and has a power-to-weight ratio of only 4.3 kilograms per hp, while the equivalent figure for the Roadster (1510 kilograms) is 4.4.

The TT RS Coupe's powerplant launches it from a standing start to 100 kph in 4.6 seconds, as against 4.7 seconds for the Roadster. The top speed of both versions is electronically limited to 250 kph, but can be delimited to 280 kph at the customer's option.

Peak torque is 450 Nm and is continuously available from 1600 rpm to 5300 rpm, giving the car formidable pulling power. And yet, the TT RS Coupe gets by on only 9.2 litres of fuel per 100 km (Roadster: 9.5 litres per 100 km), making it another example of how Audi blends dynamism and efficiency.



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## The aims of this Self-Study Programme

In this Self-Study Programme you will learn the key distinctions between the Audi TT RS (Coupe and Roadster) and the production model. The central feature of both models is the new 2.5l RS TFSI engine. Once you have worked your way through this Self-Study Programme, you will be able to answer the following questions:

- ▶ What changes have been made to the design, the body, the interior, the equipment, the power transmission system and the suspension system?
- ▶ How is the new five-cylinder engine designed and configured?
- ▶ What do you have to pay attention to during servicing?

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► This Self-Study Programme teaches the basics of the design and function of new models, automotive components or technologies.

**It is not a Repair Manual. The values specified are for illustrative purposes only and refer to the software version valid at the time of preparation of the SSP.**

For further information about maintenance and repair work, always refer to the current technical literature. Terms which are indicated in italics and marked by an asterisk (\*) are explained in the glossary at the back of this Self-Study Programme.



Note

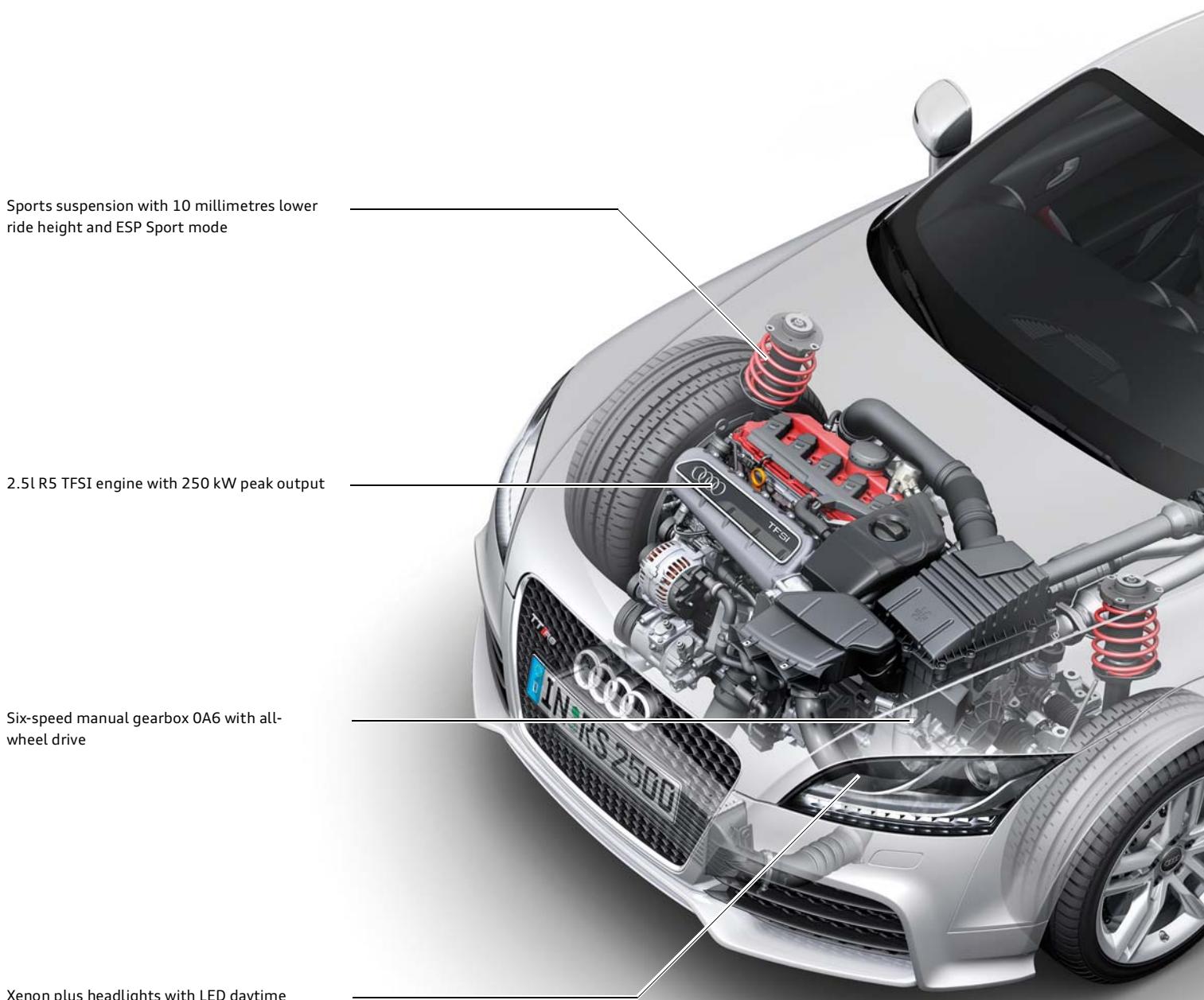


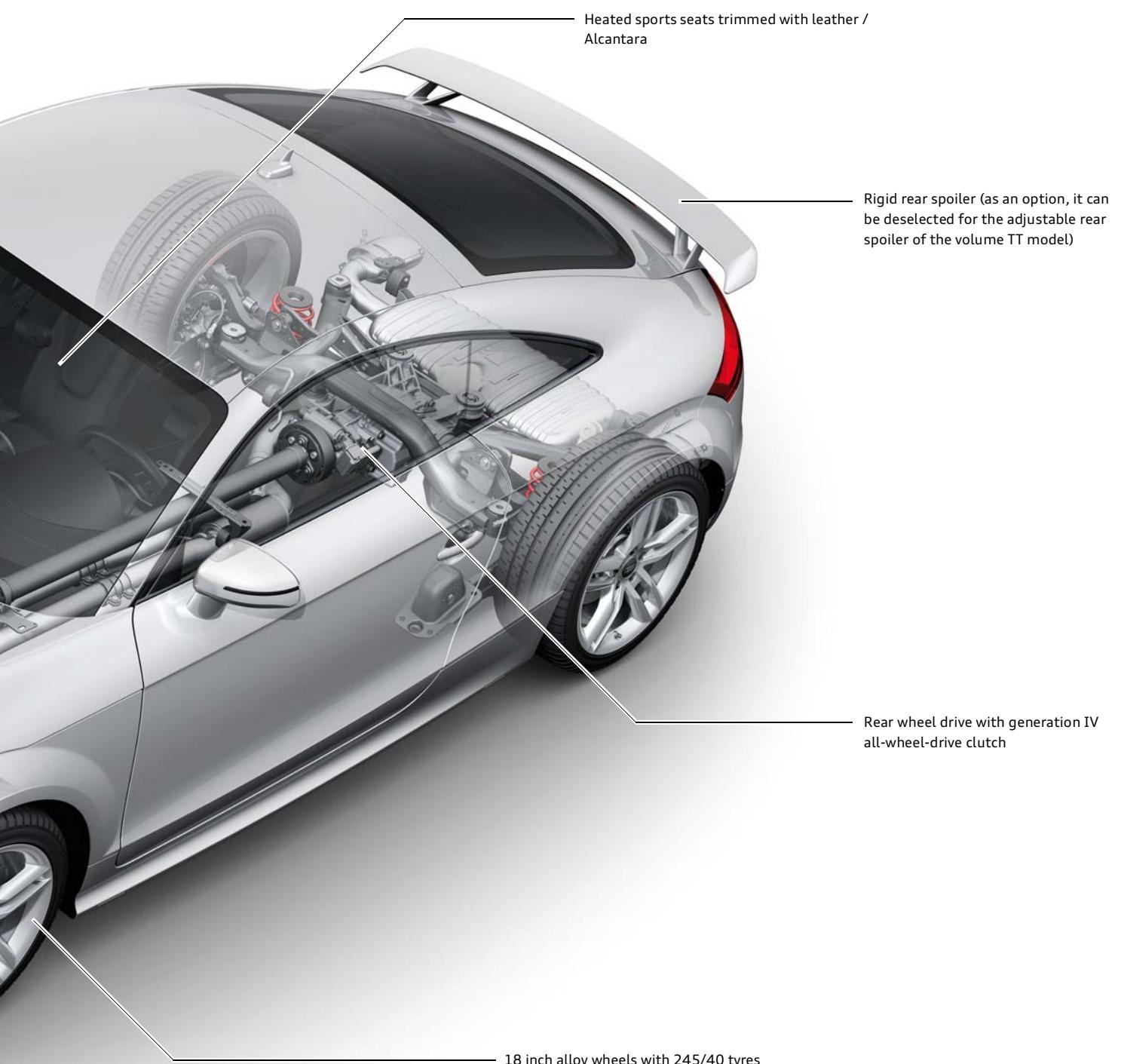
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# Introduction

## Presentation

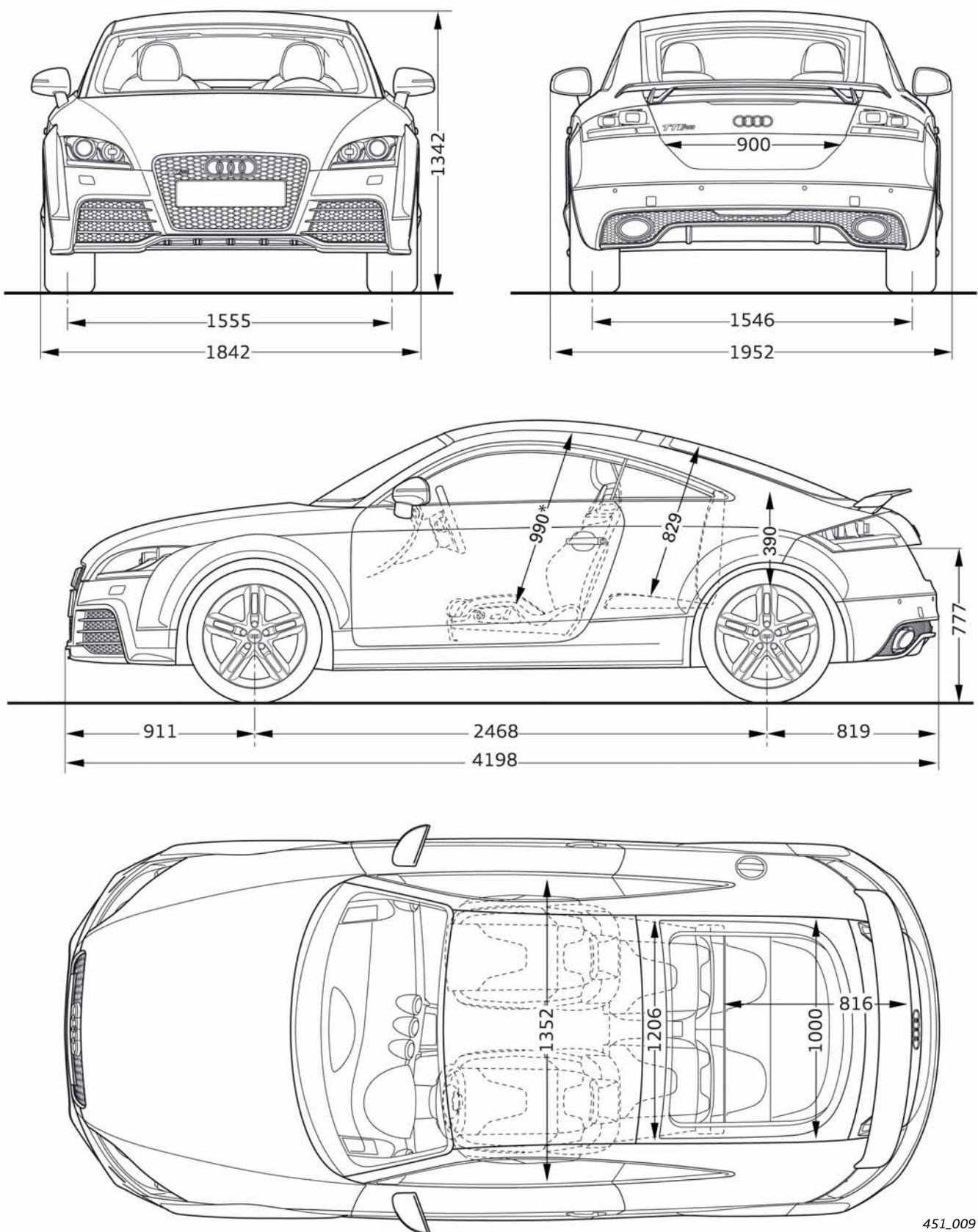
The Audi TT RS is without doubt the flagship of the TT series. In addition to the high-performance five-cylinder turbo engine, it has a number of other technical highlights which you can read about extensively in this self-study programme.





## Dimensions

### Audi TT RS Coupe



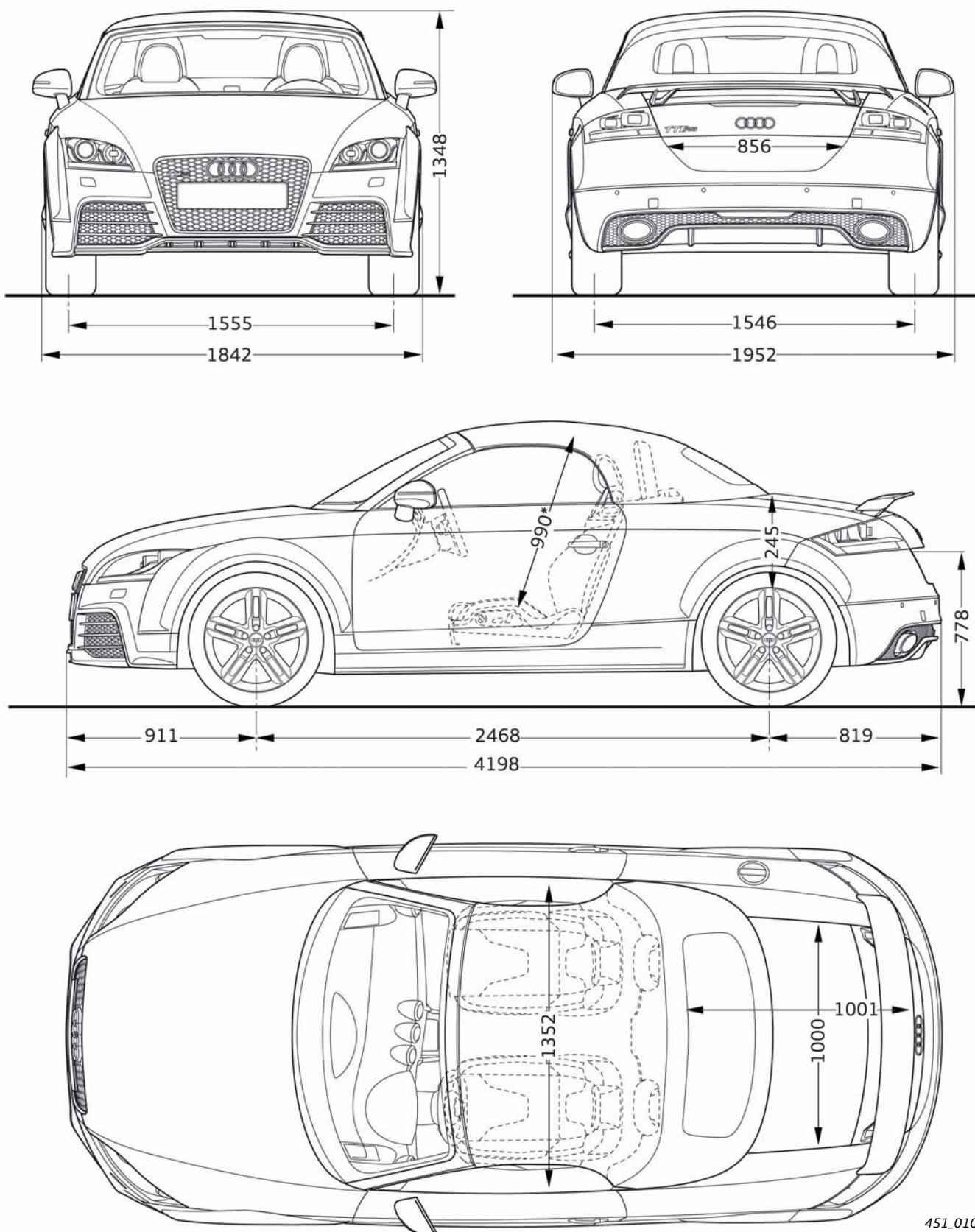
<sup>1)</sup> max. headroom

All dimensions are given in millimetres

Dimensions refer to the vehicle's kerb weight

451\_009

## Audi TT RS Roadster



451\_010

	Coupe	Roadster
<b>Kerb weight in kg</b>	1450	1510
<b>Permissible gross weight in kg</b>	1830	1830
<b>Luggage capacity (seats folded down) in l</b>	290/700	250/-
<b>Fuel tank capacity in l</b>	60	60
<b>Drag coefficient <math>c_w</math></b>	0.32	0.34

# Body

## Design

From a purely visual standpoint, the Audi TT RS Coupe and the Roadster are both charismatic athletes. Even when stationary, they seem to be straining at the leash. The muscular sheet-metal body and the tautly curved surfaces bounded by sharp lines give the impression of a sculpture in motion. A series of design highlights impart the TT RS with that air of raw power which characterises a top of the line model.

## Side view

From the side, the 18-inch wheels, the large brakes and the flared side skirts of the Audi TT RS instantly catch the eye. The door mirror housings have a matt aluminium finish as standard and are optionally available in the body colour or in carbon. The "Black Styling Package" featuring a black singleframe grille frame is optional.



451\_011

## Front view

As always on an Audi, the front end is characterised by the single-frame grille which is encircled by a frame with a matt aluminium finish. The grille insert, which sports a TT RS badge, features a shiny black rhombus design mirroring that of the big side air intakes. Their flared edges draw air into the engine compartment: the left intake directs the air to the gearbox; the right intake routes air to an additional water cooler. The turbocharger takes in air through the upper section of the single-frame grille, while the intercooler sits behind the lower segment of the grille.

The front skirt has been redesigned. Its splitter and the rear spoiler collectively provide perfect aerodynamic balance.

Audi offers the splitter, the moulded lip of the diffuser insert and the mounting for the rear spoiler in aluminium look as an option.



451\_012

## Headlight design

The headlight design is a distinguishing feature of all current Audi models. Xenon plus headlights are standard on the TT RS. They are accentuated by daytime running lights whose 12 LEDs are arranged in a straight line.

Together with the "wings" (dual plastic wings), the LEDs turn the headlights into design objects in their own right.



451\_013



451\_014

## Rear view

The rear bumper includes an integrated diffuser insert that surrounds the two large, oval tailpipes. A "TT RS" logo also adorns the rear of the car.

The TT RS comes as standard with a wide, stationary spoiler that increases the downforce on the rear axle and thus improves stability at high speeds. The spoiler of the volume model is available as an alternative; it automatically extends at 120 kph and retracts again at 80 kph.



451\_015

## Technical features and occupant protection

Like on the "normal" Audi TT, the body is noted for its low weight thanks to an innovative hybrid body construction developed by Audi. Up front the body is made of lightweight aluminium components assembled using Audi Space Frame ASF technology; steel is used at the rear.

This solution guarantees maximum rigidity and a balanced distribution of axle loads. The bodyshell of the Coupe weighs 206 kilograms, while the body of the TTS Roadster weighs in at 251 kilograms Roadster owing to the special reinforcements. Audi won the **EuroCarBody AWARD 2006** for the innovative body concept of the Audi TT and Audi TT RS.



451\_017

### Other body and occupant protection features:

- ▶ Enlarged front air intakes, striking rear diffuser insert
- ▶ Stationary rear spoiler
- ▶ Dual-stage driver and front passenger front airbags
- ▶ Driver and front passenger belt tensioners and belt force limiters
- ▶ In a rear-end collision, head restraints support the back of the head
- ▶ Head/thorax side airbags for protection in the event of a side impact

### Winner of the EuroCarBody AWARD 2006 for its innovative body concept



451\_016



#### Reference

The body construction is described in Self-Study Programme 383 "Audi TT Coupe '07 – Body".  
The occupant protection systems are described in Self-Study Programme 380 "Audi TT Coupe '07".

## Interior

The interior design of the Audi TT RS features a number of modifications.

The entire interior is dressed in dynamic black.

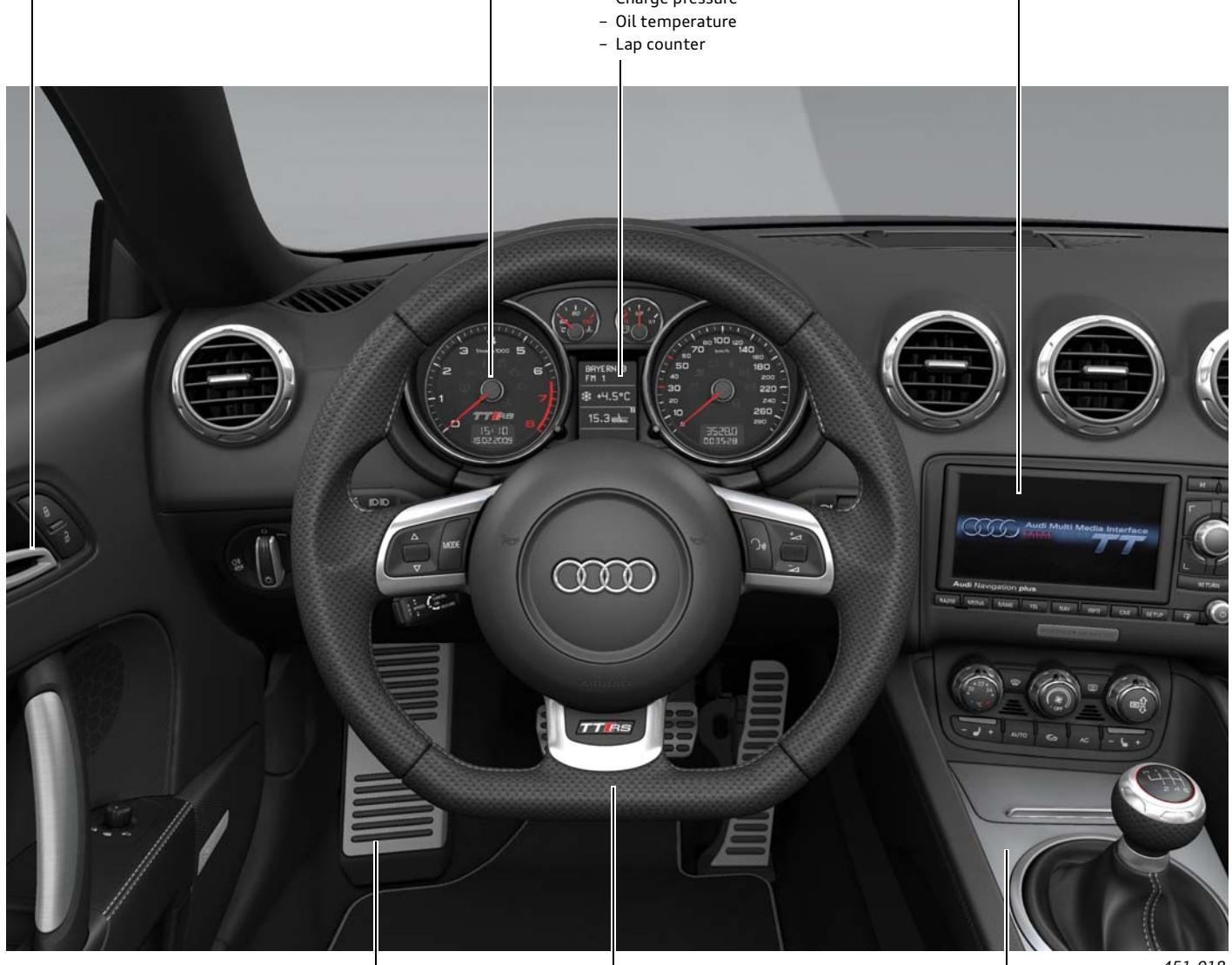
RS-style door openers with two narrow bars

Rev counter featuring the "TT RS" logo

Driver information system with additional displays for:

- Charge pressure
- Oil temperature
- Lap counter

"TT RS" welcome screen in the optional navigation system plus display



451\_018

Footrests and pedals in aluminium look

Three-spoke multifunction sports steering wheel, flattened at the bottom and bound in perforated leather with silver stitching and a "TT RS" logo

Brushed aluminium inlays

## Seats

The front occupants are welcomed by deep-set sports seats which are trimmed in a mixture of leather and Alcantara. They have a wide range of adjustability. The upholstery leather has a special "TT RS" grained texture.

The front seat backs can be released for folding down by pressing either of the 2 handles in the slots in the backrest.

Seat back release handles



451\_019

# 2.5l R5 TFSI engine

## Introduction

Audi was the brand most noted for its five-cylinder engines in the 1980s. The powerful engines sharpened the new, sporty profile and reinforced Audi's proverbial "Vorsprung durch Technik".

The five-cylinder engines combined the efficiency of a four-cylinder with the cultivation of a six-cylinder at a lower weight and in a compact size. A turbocharged version was later launched. It was the first engine concept to embrace the principle of *downsizing*\* and it caused a sensation when it was first unveiled 30 years ago.



451\_020

## Synopsis of previously installed five-cylinder engines

The first five-cylinder engine debuted in the spring of 1977 in the Audi 100 5 E. It had a capacity of 2.1 l and developed 100 kW (136 hp). A five-cylinder normally aspirated diesel with a displacement of two litres and producing 51 kW (70 hp) was released in the autumn of 1978. The first turbocharged, five-cylinder petrol engine was added to the product line-up in 1979. With an output of 125 kW (170 hp) and 265 Nm of torque, the Audi 200 5 T was the new flagship model and one of the fastest saloons of its day.

1980 saw the launch of the Audi quattro unifying the two technologies of turbocharging and all-wheel drive. The turbocharged five-cylinder produced 147 kW (200 hp) when it first went on sale. In the 1984 Sport quattro, a direct motorsports derivative, it developed 225 kW (306 hp) - and was, therefore, one the most powerful production engines of the 1980s.

The 1989 Audi 100 TDI, a 2.5-litre model developing 88 kW (120 hp) and 261 Nm of torque, marked a milestone in automotive history.

In the mid 1990s, the five-cylinder engines were gradually replaced by the new V6 units, but not without one last hurrah: the 1994 RS 2 produced 232 kW (315 hp).

As a practical Avant with the power of a sports car, it established an entirely new class of automobile.



Audi quattro, model year 1980

451\_021



Audi RS2, model year 1994

451\_022

## Five-cylinder engines in motorsport

The strength and ruggedness of the Audi design was proved in the competition cars for the World Rally Championship, where the supercharged five-cylinder pumped out a good 350 kW (476 hp).

The high point in the motorsports career of the five-cylinder was marked by two all-out racing cars. The Audi Sport quattro S1, with which Walter Röhrl won the Pikes Peak Hill Climb in the US state of Colorado in 1987, produced around 440 kW (approx. 600 hp). IMSA-GTO, a touring car based on the Audi 90, dominated the US racing scene with 530 kW (approx. 720 hp) from only 2.2 litres of displacement.



Audi Sport quattro S1

451\_023



Audi IMSA-GTO

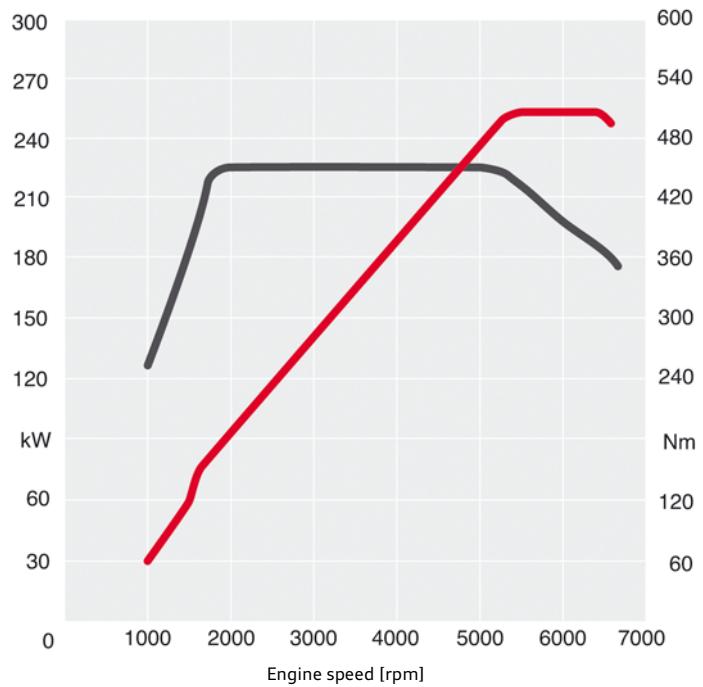
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## Specifications

### Torque/power curve

Max. power in kW

Max. torque in Nm



451\_005

### Engine code

CEPA

### Engine type

Five-cylinder inline engine

### Displacement in cm<sup>3</sup>

2480

### Stroke in mm

92.8

### Bore in mm

82.5

### Valves per cylinder

4

### Firing order

1-2-4-5-3

### Compression ratio

10:1

### Output in kW at rpm

250/5400 – 6500

### Torque in kW at rpm

450/1600 – 5300

### Fuel grade

98 RON <sup>1)</sup>

### Engine weight in kg

183

### Engine management

Bosch MED 9.1.2

### Exhaust emission standard

EU 5

### Carburetion

FSI (homogeneous) direct injection with demand-based high and low fuel pressure regulation  
Engine management with p/n control and without air mass meter

### Exhaust gas aftertreatment

Continuous lambda control, with sensors upstream and downstream of the catalytic converter

### CO<sub>2</sub> emissions in g/km

214

<sup>1)</sup> premium unleaded petrol with a 95 RON rating can also be used, but results in a drop in power

## Cylinder block

The cylinder block, with its extremely short dimensions, originates from the 2.5L R5 MPI naturally aspirated engine which VW has been fitting on Bora and Jetta models for the North American market since 2004.

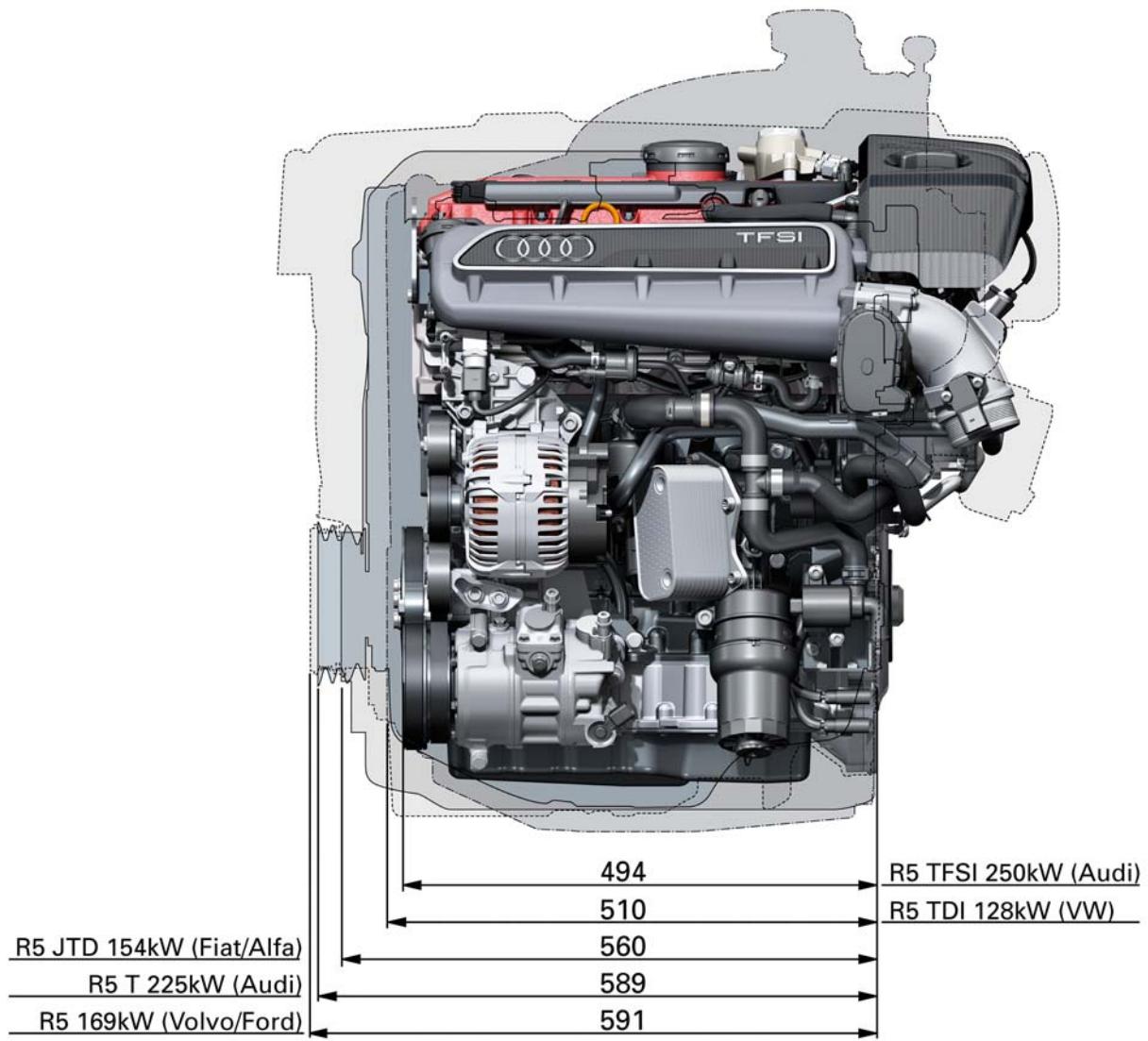
It lends itself very well to transverse mounting due to its very short overall length, and is the shortest and most powerful engine in its class (see figure below).

The piston cooling spray nozzles are mounted in the crankcase.



451\_025

## Competitive comparison

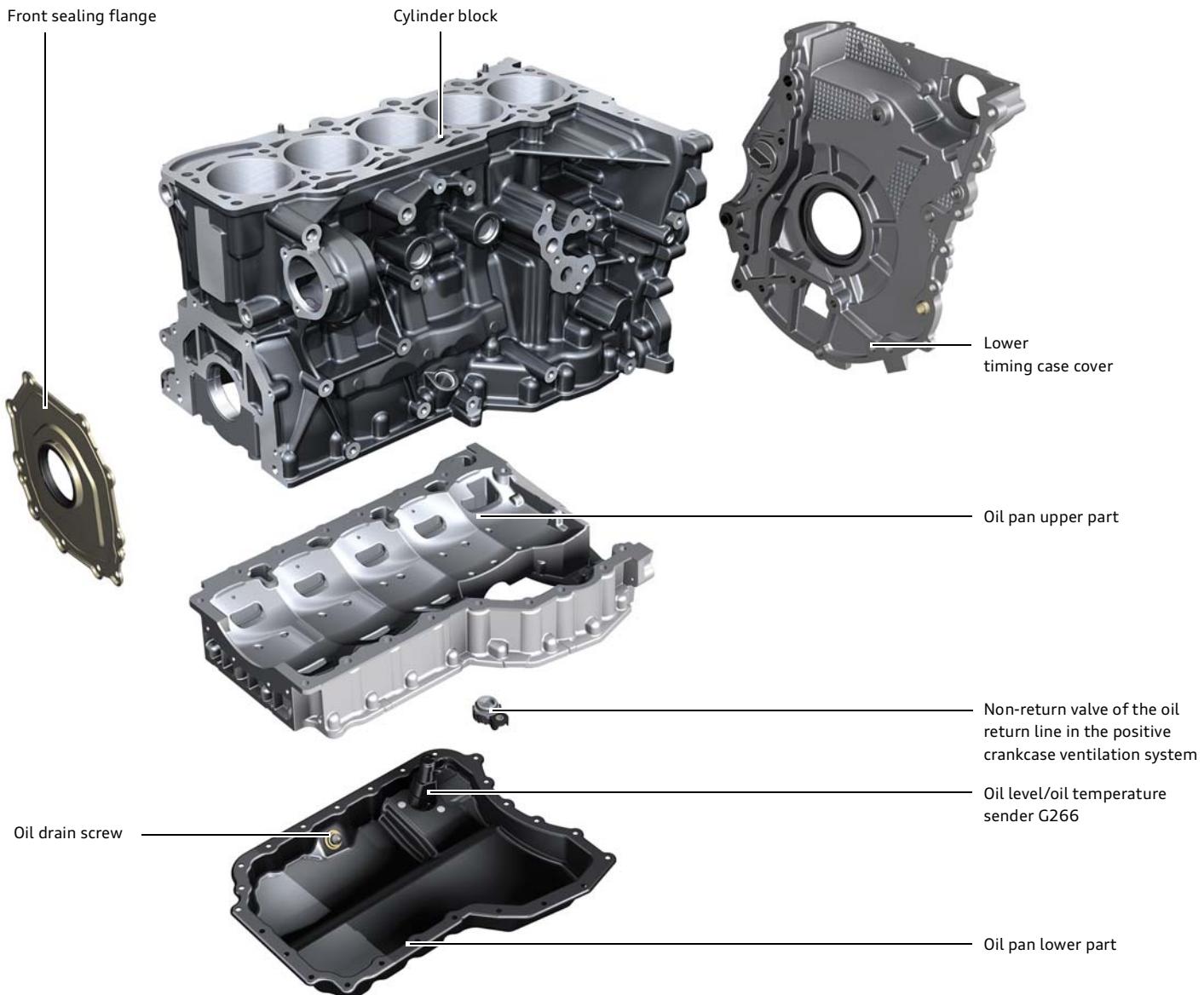


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## Material selection

The engine block is made from a high-tensile cast iron material, previously used by Audi in its V6 and V8 TDI engines. This is the first time that it is used in a petrol engine.

It is needed because the conrod bearings and main bearings have a relatively small width. Incidentally, this material was also used for the cylinder blocks of naturally-aspirated racing engines during the 1990s.



451\_037

## Oil pan

The oil pan is of two-part construction. The upper part acts as a baffle plate and supports the oil pump. It is bolted together with the crankcase. The oil pump is bolted to the cylinder block. The lower part of the oil pan is made from sheet steel and accommodates the oil level/oil temperature sender G266 and the oil drain screw.

The front sides are sealed by the timing case cover on the gearbox side and by a sealing flange on the vibration damper side. Both seal off the crankshaft by means of a shaft oil seal. The oil pans and the front-side covers are sealed against the cylinder block by liquid sealant.

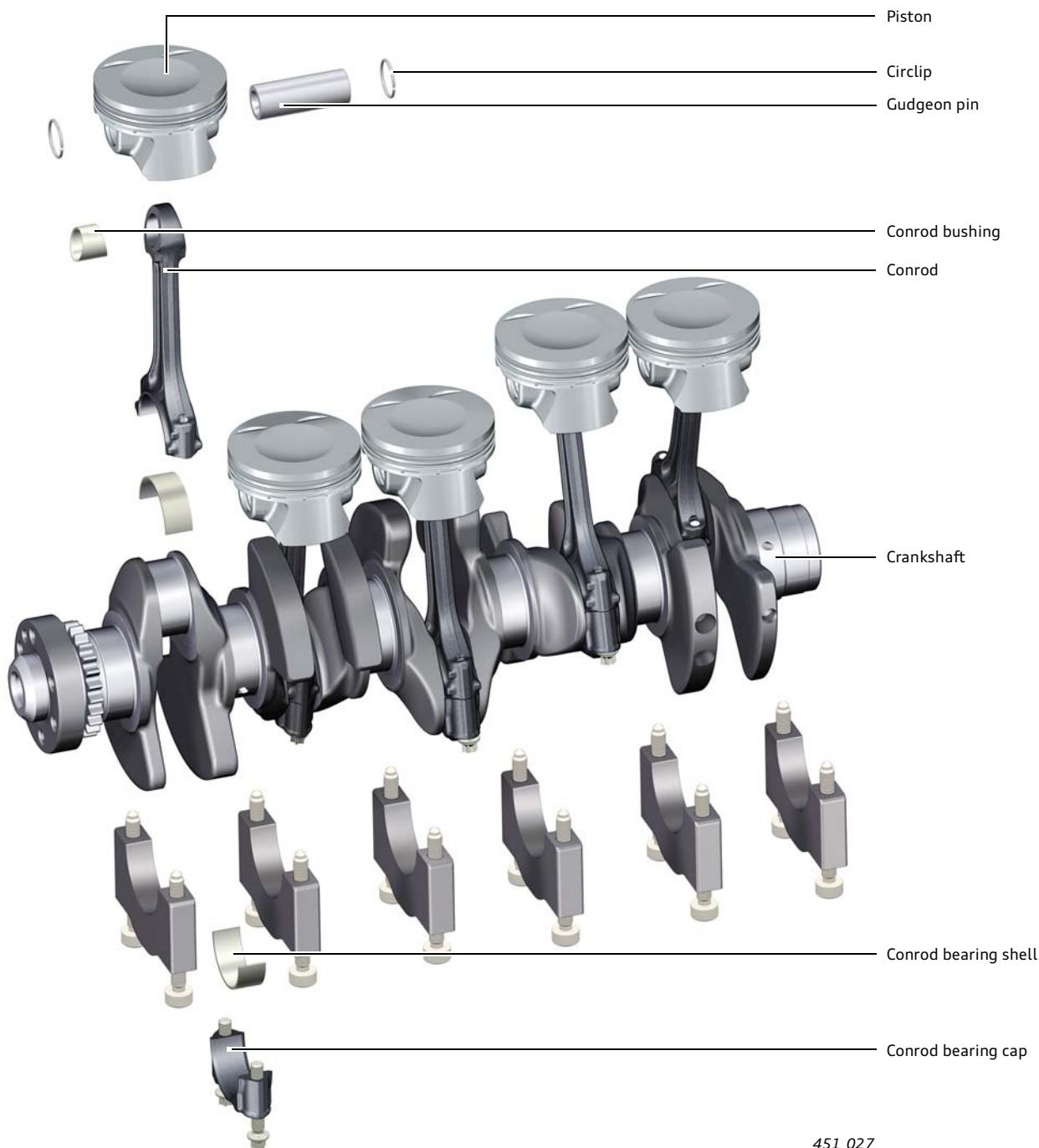
### Note

The liquid sealants differ and, therefore, have different part numbers. Refer to ETKA and the Workshop Manual for specifications.

## Crankshaft drive

The steel crankshaft runs in six bearings. The main bearing is 58 mm in diameter, while the conrod bearing is 47.8 mm in diameter.

The torsion vibration damper is located at the front end and is configured as a *viscodamper\**.



451\_027

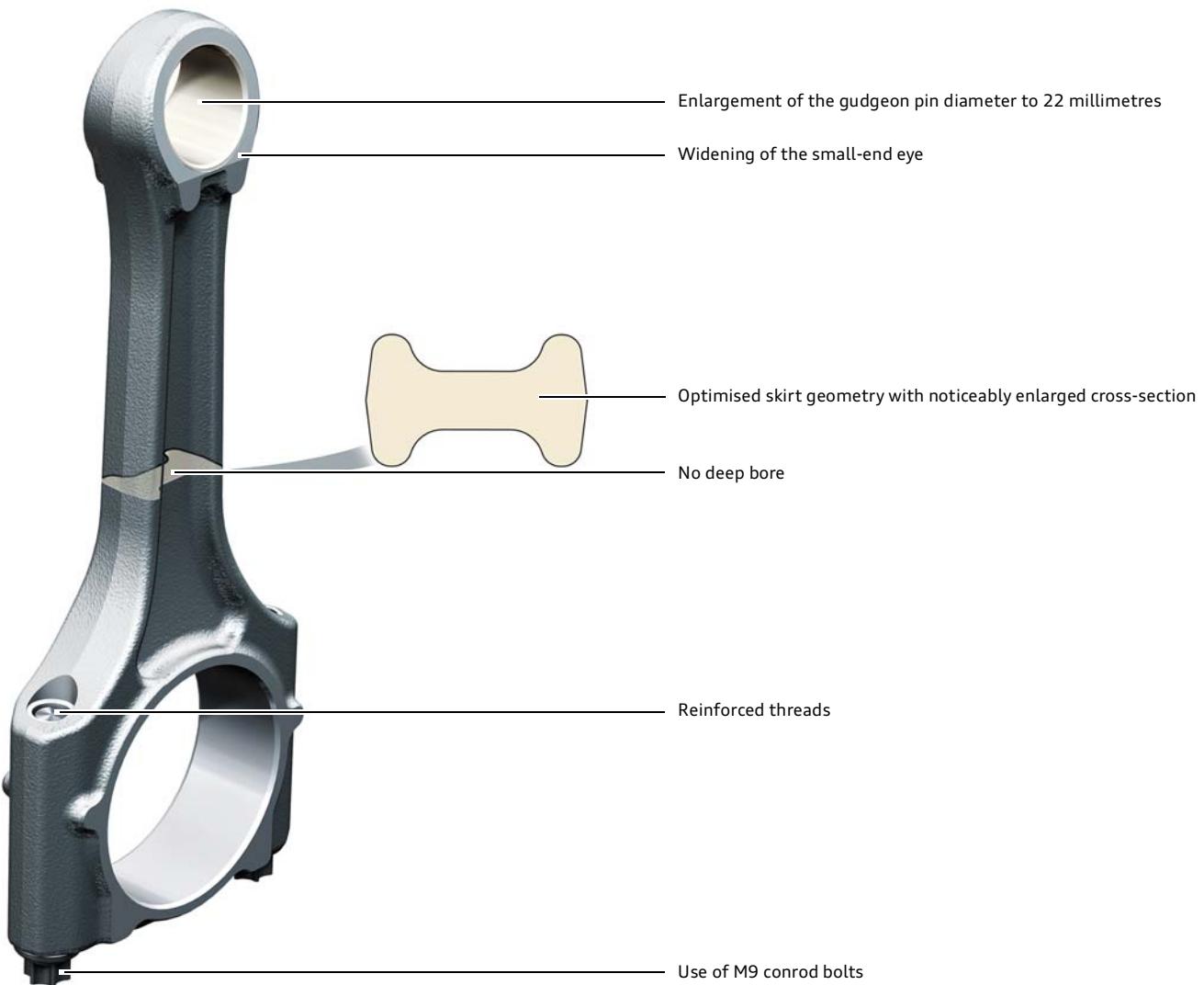
## Specifications of the cylinder block

Cylinder included angle in mm	88
Block height in mm	220
Conrod length in mm	144
Crankshaft bearings	6
Main bearing diameter in mm	58
Conrod bearing diameter in mm	47.8

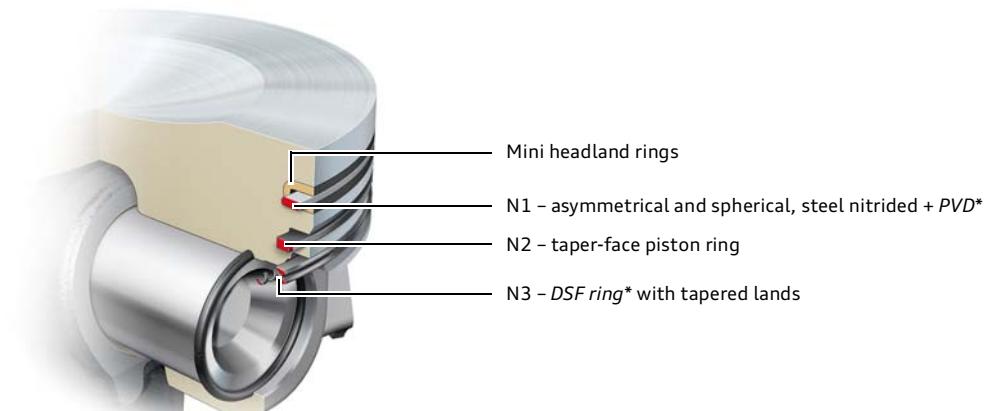
## Pistons and conrods

During the development of the *box piston\**, special emphasis was given to low oil consumption and low weight. The box piston is made of a highly heat-resistant alloy and has a cast-in ring land for the upper piston ring. Due to the high load to which it is subjected, it has asymmetrical skirts and bevelled box walls on the thrust and counter-thrust sides.

The conrod is manufactured as a forged crack conrod without a deep bore. The pin on the small-end side of the conrod is 22 millimetres in diameter, and the bearing is made from lead-free materials.



451\_028

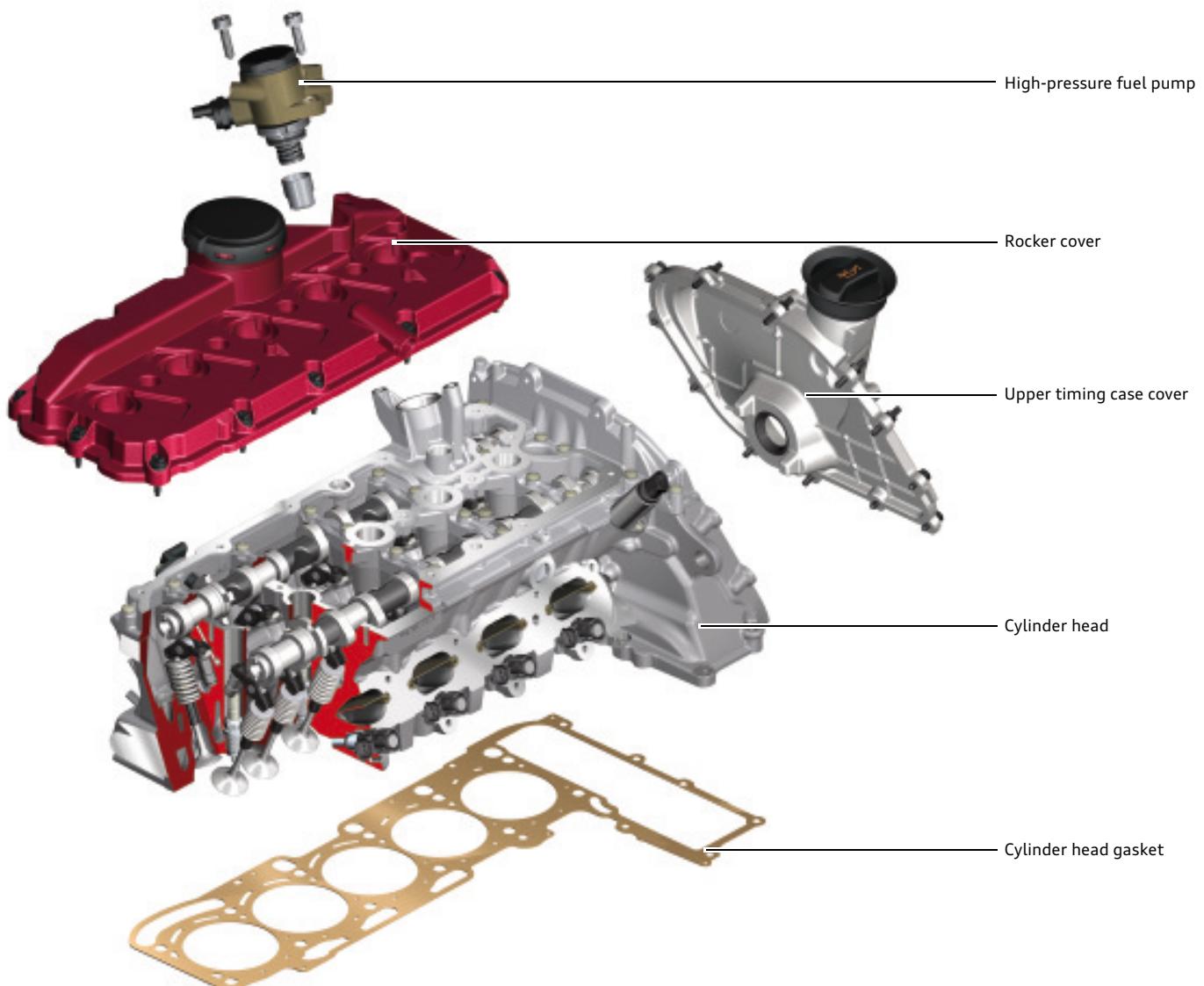


451\_029

## Cylinder head

The cylinder head is also a modified carry-over part sourced from VW's 2.5l R5 MPI engine. To withstand the higher stresses which occur in a turbocharged FSI engine, it was necessary to make the following modifications:

- ▶ Different aluminium casting alloy
- ▶ Lower-set water jacket around the spark plug
- ▶ Tempered exhaust valve seat rings
- ▶ Attachment of the high-pressure pump to the ladder frame
- ▶ Optimised exhaust cam contour
- ▶ Additional exhaust cam phaser
- ▶ The exhaust valves are sodium-filled for cooling
- ▶ Turbo-specific intake port (to produce the required tumble air flow in the combustion chamber)



451\_006

<b>Intake valve diameter in mm</b>	33.85
<b>Exhaust valve diameter in mm</b>	28
<b>Intake valve lift in mm</b>	10.7
<b>Exhaust valve lift in mm</b>	10
<b>Intake camshaft adjustment range in ° crank angle</b>	42
<b>Exhaust camshaft adjustment range in ° crank angle</b>	22

## Chain drive

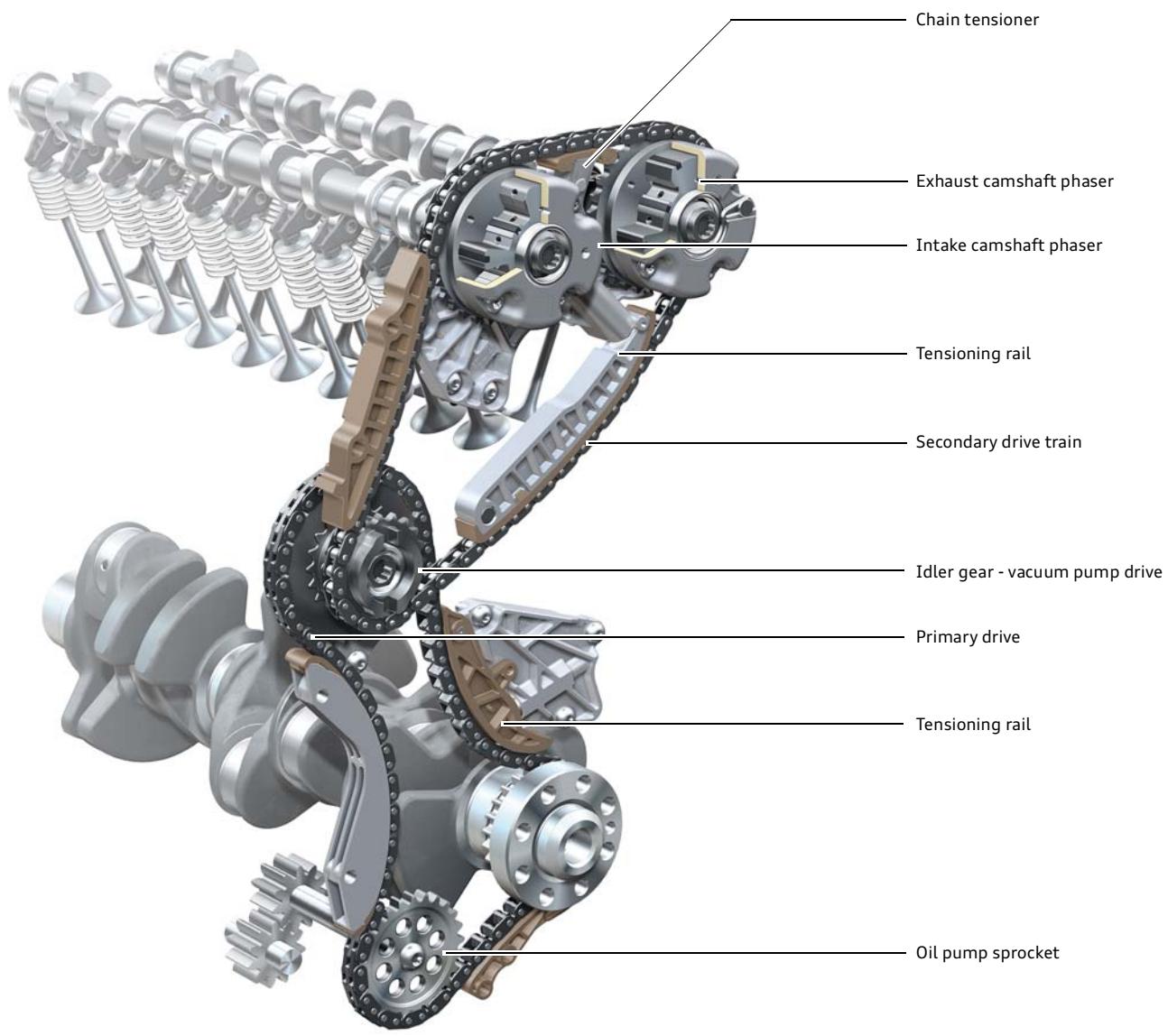
The timing gear of the five-cylinder TFSI engine is located on the power output side. It is of two-stage construction and is driven by two different chain types.

In the first stage of the chain drive, the oil pump and an idler gear are driven by the crankshaft. The oil pump has a low ratio. The crankshaft also drives an idler gear, which has two tasks. Firstly, it drives both camshafts, and, secondly, it drives the vacuum pump. Both drives have hydraulically damped chain tensioners.

A 3/8" gear chain is used in the primary drive train (for driving the oil pump and the idler gear). It is similar in design to the chains in the 1.8L R4 TFSI engine and offers acoustic advantages over a roller chain. A 3/8" roller chain is used in the secondary drive.

The entire chain drive is lubricated by the oil returning from both camshaft phasers and by a bore in the high-pressure chamber of the "soft" chain tensioner in the secondary drive. There is no replacement interval for the chain drive.

## Configuration



### Note

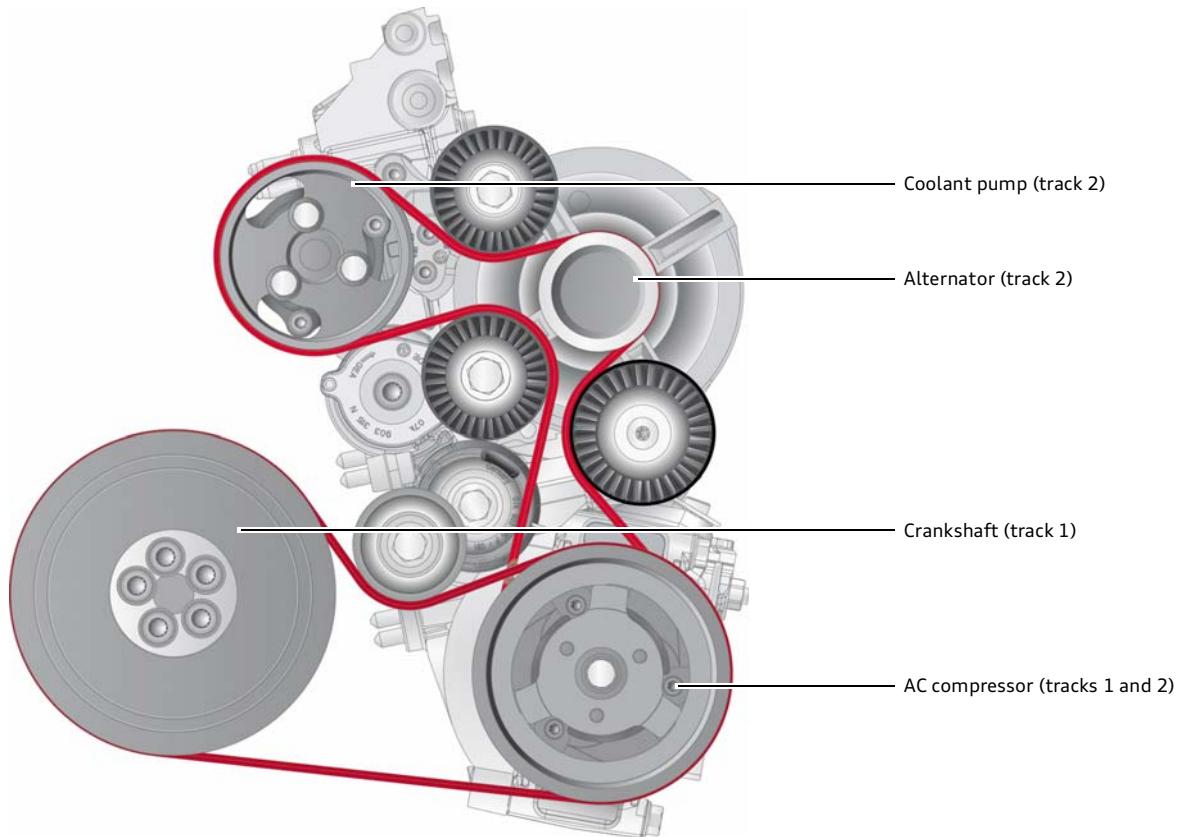
After assembly work on the chain drive, all seals must be replaced on each of the timing case covers. Refer to the Workshop Manual for specifications.

## Belt drive

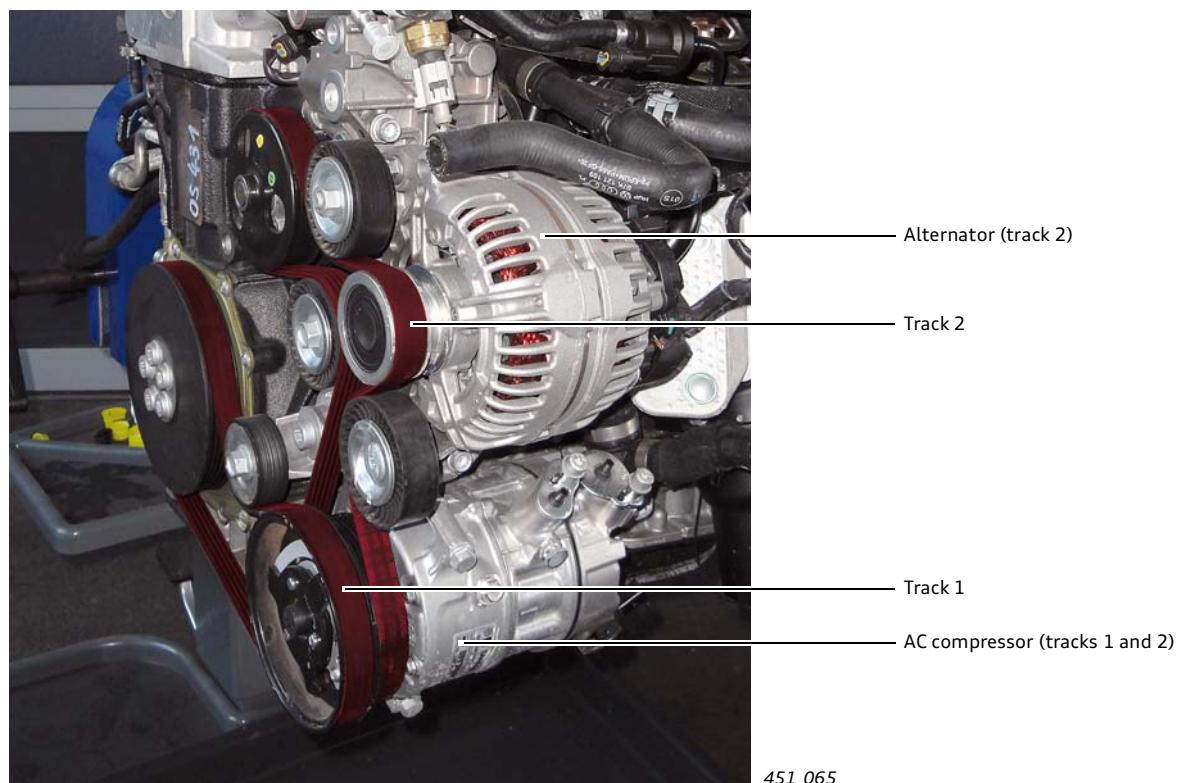
For reasons of space, the belt drive for driving the refrigerant compressor, alternator and coolant pump is of two-stage construction. The torsion vibration damper on the crankshaft drives the refrigerant compressor via the first pinion gear. The refrigerant compressor has twin belt pulleys. They transmit drive to the second belt drive, which, in turn, drives the alternator with freewheel and the coolant pump.

Both poly-vee belts have five ribs and a polyester cord as a tension member. Both belt tensioners are friction-damped. The complete belt drive is designed for lifetime operation.

## Configuration



451\_033



451\_065

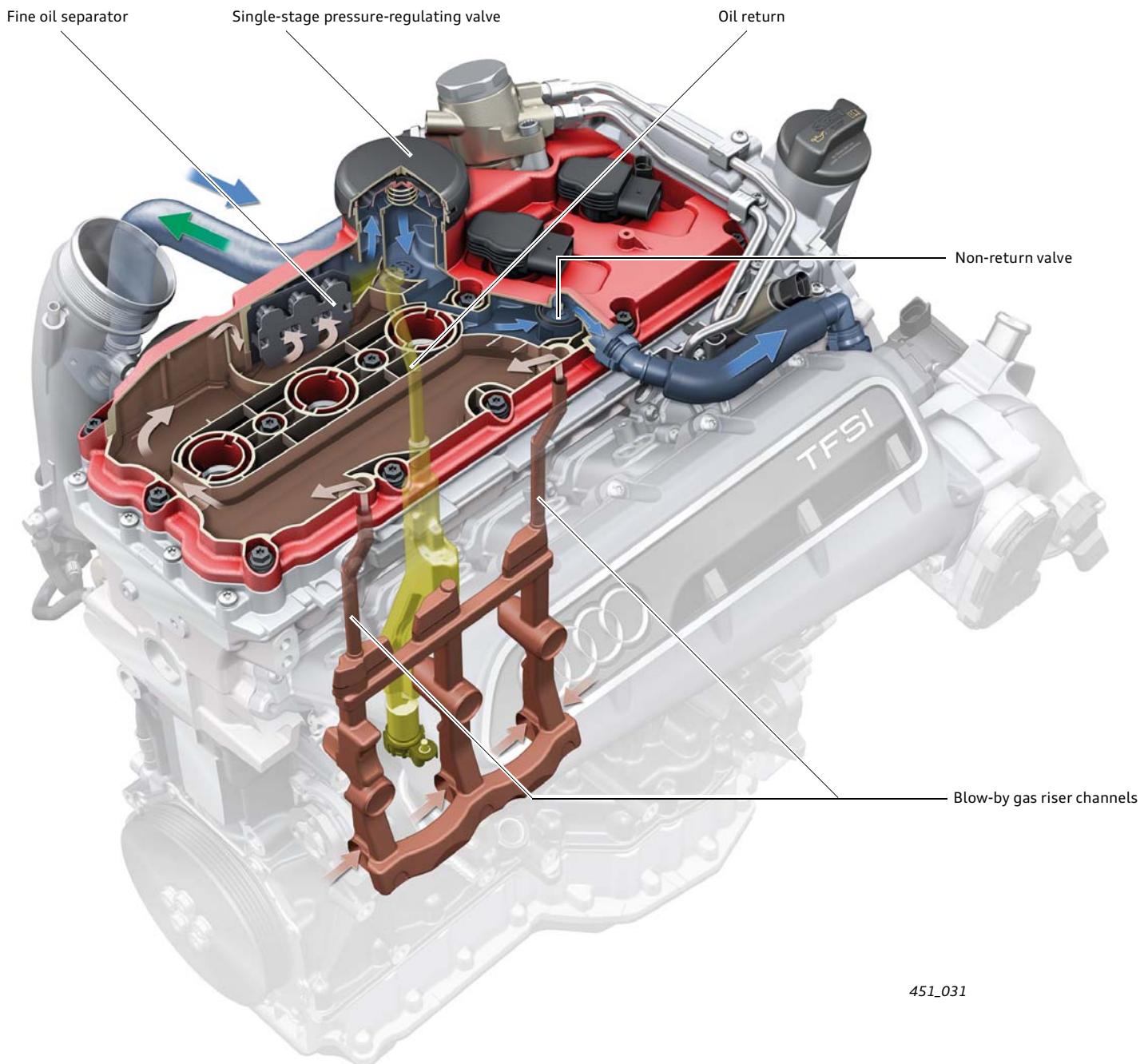
## Crankcase ventilation

The crankcase ventilation system is configured as a head ventilation system. The extraction point for the *blow-by gases\** is located in the cylinder block. The riser channels are protectively located in the bearing saddle of main bearings two, three and four. The blow-by gases are admitted directly into the rocker cover through the cylinder head.

The blow-by gases are pre-cleaned as they pass through the riser channels.

A windage tray is integrated in the upper part of the oil pan as protection for the oil pan. The returning oil is admitted into the oil pan below the oil level.

### Overview



#### Note

The sectional view does not show the PCV combi valve and the second non-return valve.

## Function (see also Fig. 451\_040 on page 24)

At first, the gas and oil spray mixture admitted into the rocker cover flows into a relatively large hollow chamber, where the first oil droplets deposit on the walls. The gas then passes through a fine oil separator.

The fine oil separator operates on the centrifugal force principle and employs a so-called axial cyclone (\**Polyswirl*™).

The separator comprises four permanently open swirls and six packs of up to nine swirls, which can be activated and deactivated according to the flow rate.

The six packs are activated and deactivated by locking springs with different spring characteristics.

The fine oil separator is opened by the flow of blow-by gases (which is dependent on engine speed) and closed by the spring force of the locking springs.

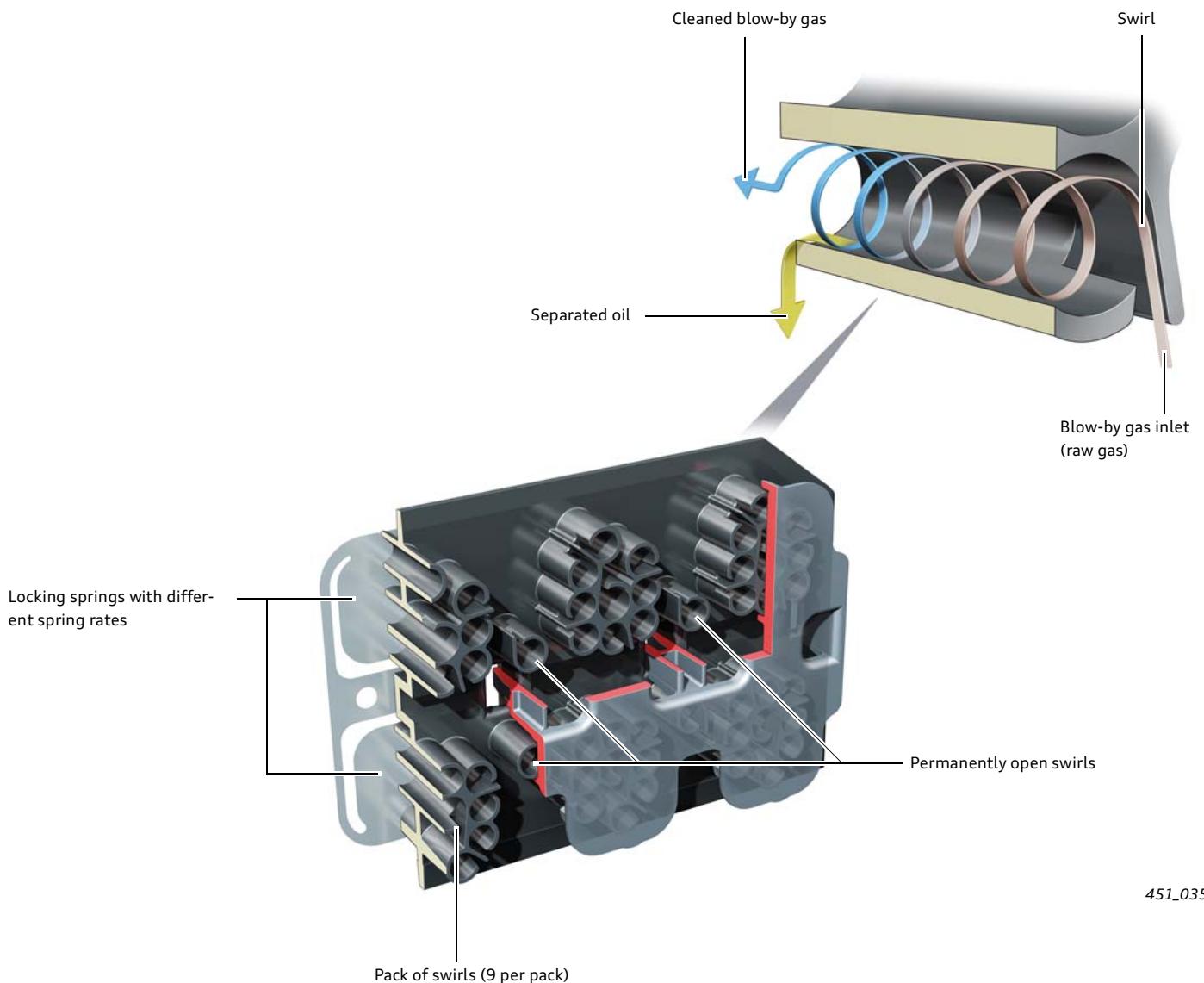
The separated oil coming from the rocker cover and the fine oil separator is recirculated continuously into the oil pan below the engine oil level via the oil return line.

In the extreme event of icing or malfunctioning, a pressure relief valve in the rocker cover (PCV combi valve) prevents excessively high pressure from damaging the engine. To avoid drawing oil from the oil pan into the intake in such a condition, another non-return valve closes. This valve is integrated in the upper part of the oil pan.

The cleaned blow-by gas is now directed to the engine for combustion. For this purpose, the gas passes through the single-stage pressure-regulating valve. Depending upon the compression ratio in the intake manifold, they then flow through the non-return valves into the intake manifold downstream of the throttle valve or upstream of the exhaust turbocharger turbine.

The pressure-regulating valve is integrated in the rocker cover, where there is sufficient space to allow a larger valve of single-stage design. The non-return valves (to the intake manifold or to the supercharger side) are optimised for pressure differential and, together with the pressure-regulating valve, produce the required partial vacuum in the crankcase.

## Fine oil separator



451\_035

## Positive crankcase ventilation system

The engine has a PCV\* system for purging the crankcase with fresh air at part throttle. This system helps to separate the fuel and water which usually become entrained in the oil in the combustion process during engine operation. If fuel and water are allowed to remain in the oil sump, they can ice up at low ambient temperatures and damage the ventilation system and the engine (e.g. loss of oil pressure due to ice sludge clogging up the oil intake snorkel, oil leaks due to excess pressure in the engine).

By admitting ambient air extracted downstream of the air filter, the fuel and water are channelled through the rocker cover and into the cylinder head. The dry fresh air then flows through the chain shaft and into the crankcase, absorbing moisture and fuel along the way, thereby "flushing" the engine dry.

This useful life of the oil is greatly prolonged by this measure, as it slows down the ageing process.

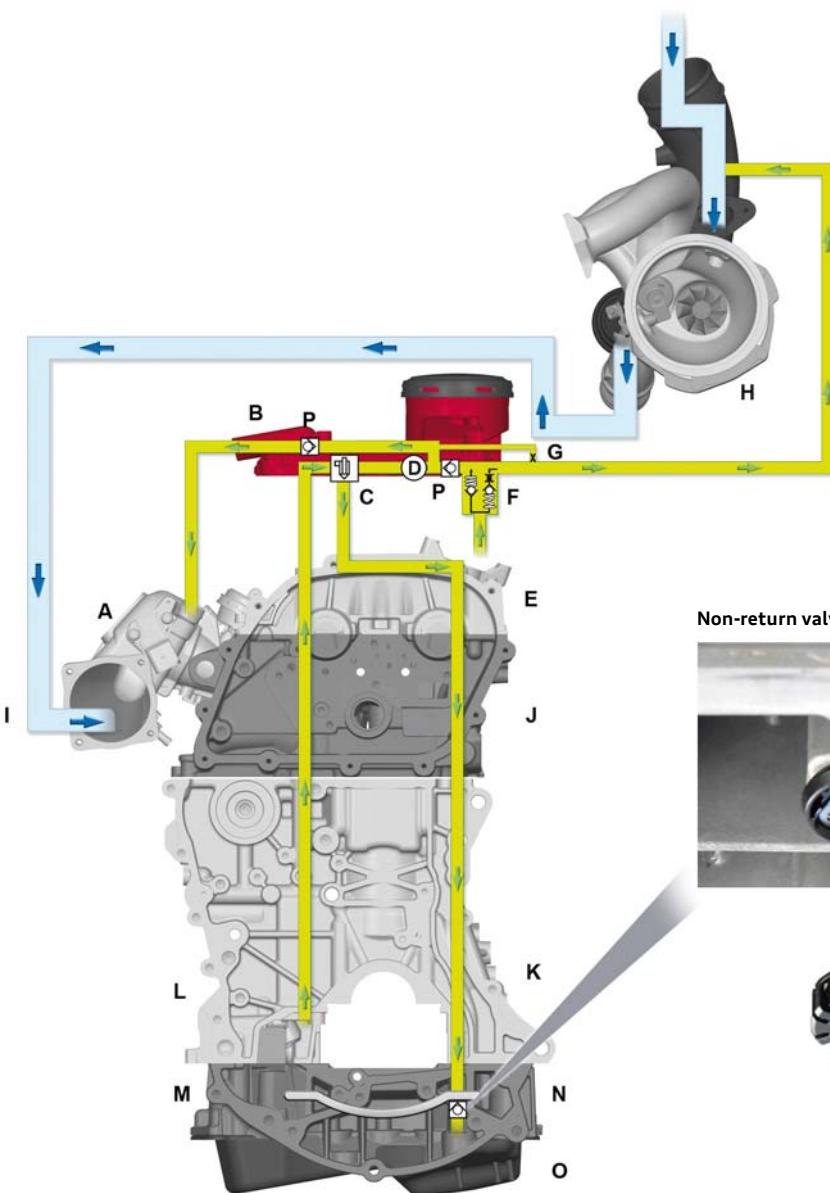
The fresh air for crankcase ventilation is extracted from the positive crankcase ventilation line running to the exhaust turbocharger.

The PCV valve, a combi valve, is integrated in the rocker cover. This valve has the following tasks:

- ▶ If a slight partial vacuum is present in the crankcase during normal operation, it opens in order to vent the crankcase. Fresh air flows from the line downstream of the air filter and into the engine.
- ▶ If a pressure of over 100 millibars develops in the engine, the excess pressure is relieved into the line, thereby protecting the crankcase seals.

Furthermore, all Audi systems are still designed in such a way that non-installation or faulty installation is diagnosable. If one of the two crankcase ventilation lines is not installed, the unmetered air is diagnosed via the lambda control system and indicated to the driver by lighting-up of the MIL lamp.

## Function diagram of the crankcase ventilation system



### Legend

A	Throttle valve
B	Rocker cover
C	Fine oil separator
D	Pressure-regulating valve
E	Ladder frame
F	PCV combi valve
G	Diagnosis channel (closed)
H	Exhaust turbocharger
I	Intake manifold
J	Cylinder head
K	Cylinder block
L	Extraction point in cylinder block
M	Windage tray in oil pan upper part
N	Oil return line below oil level
O	Oil pan
P	Non-return valves

Non-return valve



451\_040

### Note

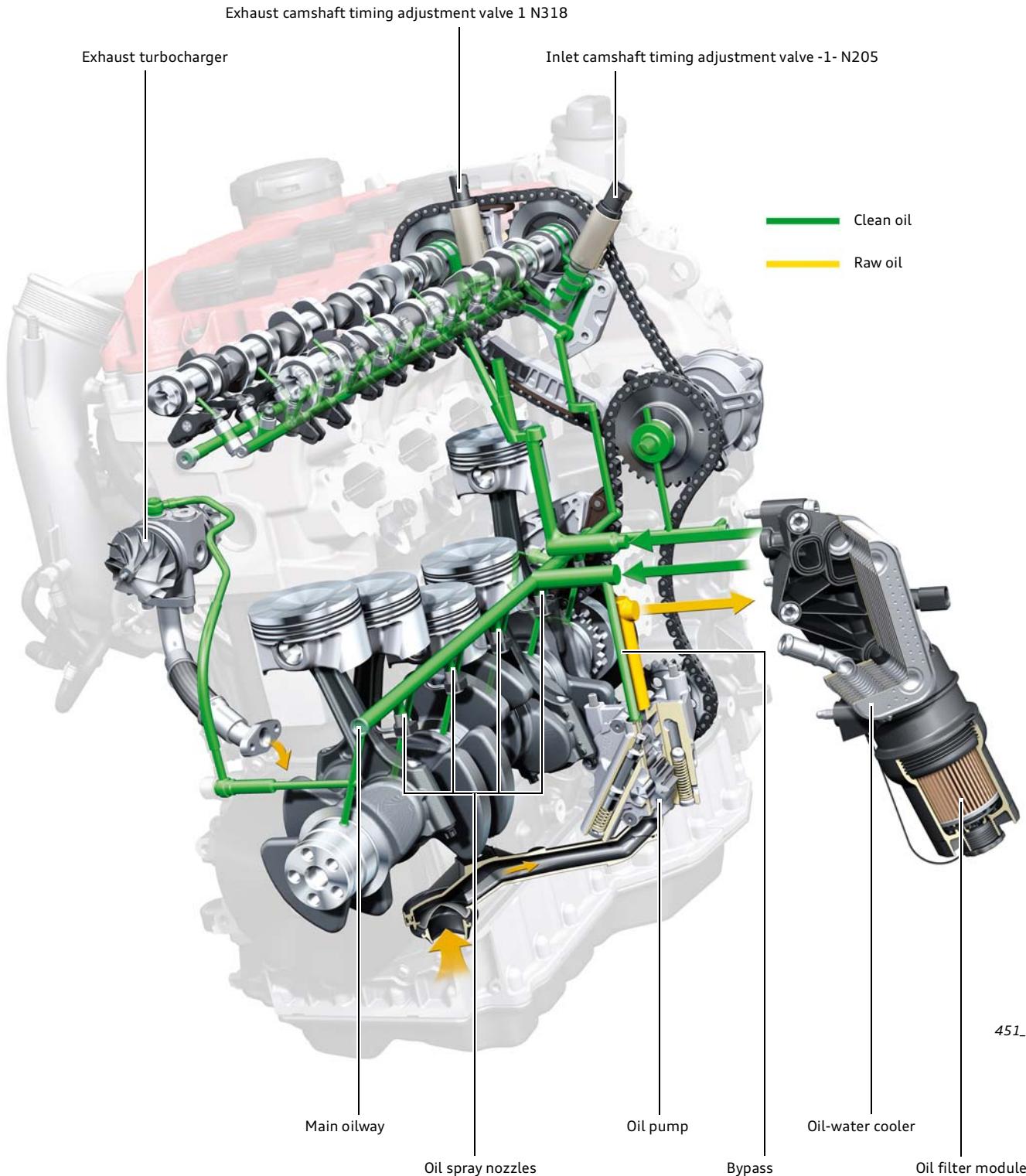
All components required for cleaning and ventilation are integrated in the rocker cover. If one of these components fails, the complete rocker cover has to be replaced.

## Oil supply

Since high longitudinal and transverse acceleration forces are to be expected in a sports engine of this kind, the oil supply has to function reliably even in extreme conditions. For this reason, the engine has a relatively high oil capacity (initial fill: 7 litres). Secondly, the oil pump intake line is fitted in such a way as to provide protection against air induction under high vehicle dynamics.

## Oil circulation system

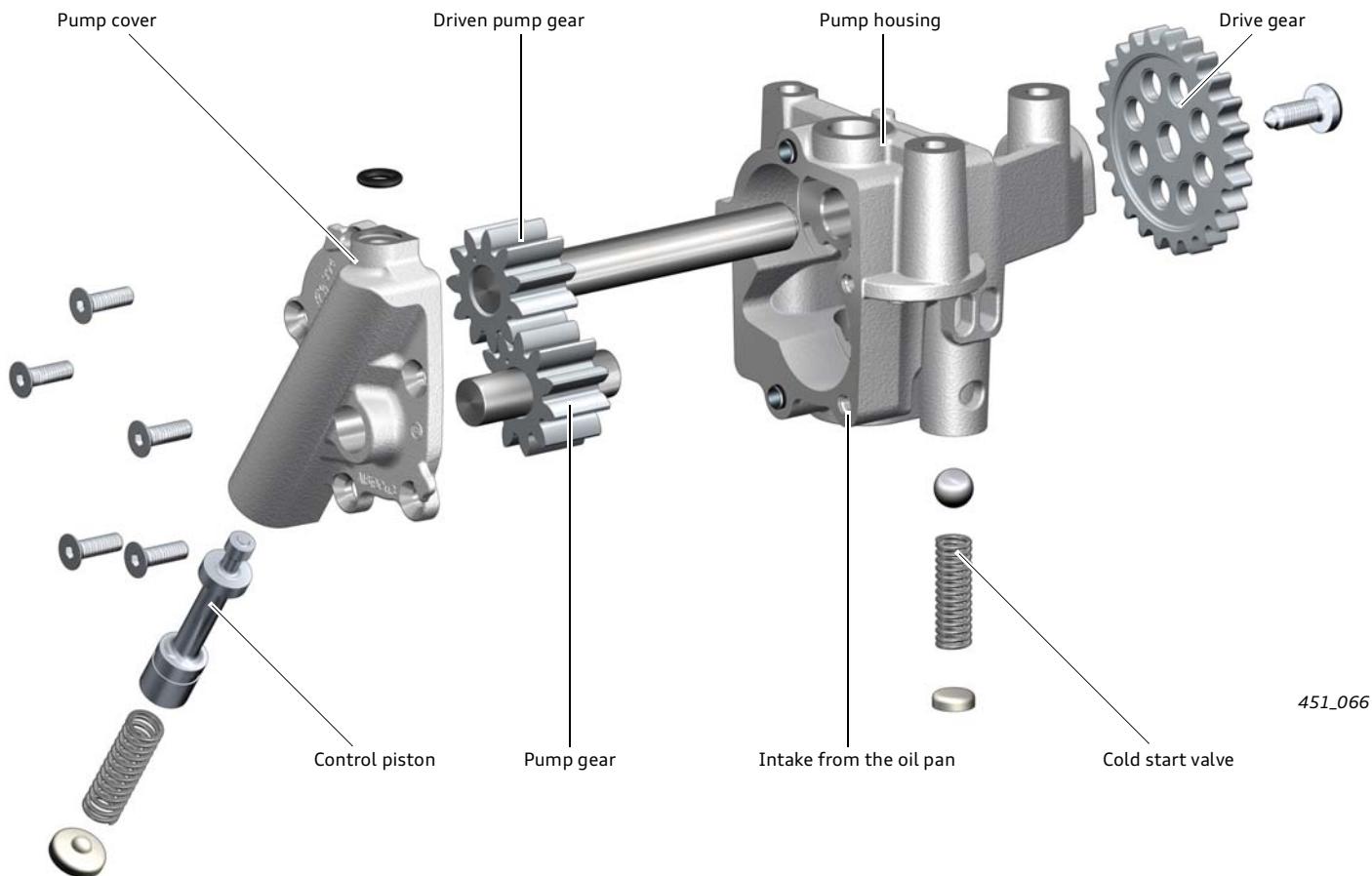
The oil pressure (raw oil) produced by the oil pump is initially circulated through the oil filter module and then through the oil cooler. The clean oil now flows along oilways to the lubrication points (consumers). The oil filter and the oil cooler are component parts of the plastic oil module. Non-return valves for the cylinder head and cylinder block, as well as a cooler bypass valve, are integrated in the oil module.



## Oil pump

The chain-driven oil pump is a gear pump configured as a fixed displacement pump. It integrates the cold start valve and the control piston.

The control piston opens at pressures of up to 3.7 (+0.7) bar. The cold start valve opens at pressures of up to 13 bar.



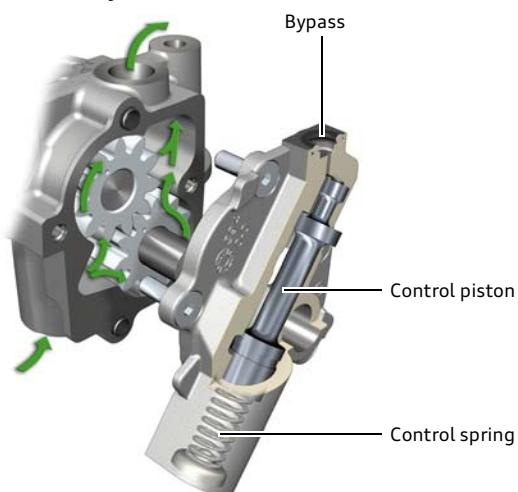
451\_066

### Function of the pressure regulation system

A bypass branches off from the main oilway and back into the oil pump (see Fig. 451\_032), where prevailing oil pressure acts on the spring-loaded control piston. If the pressure acting on the face of the piston exceeds the force produced by the control spring, the control piston will be pushed back, thereby opening a port in the pump.

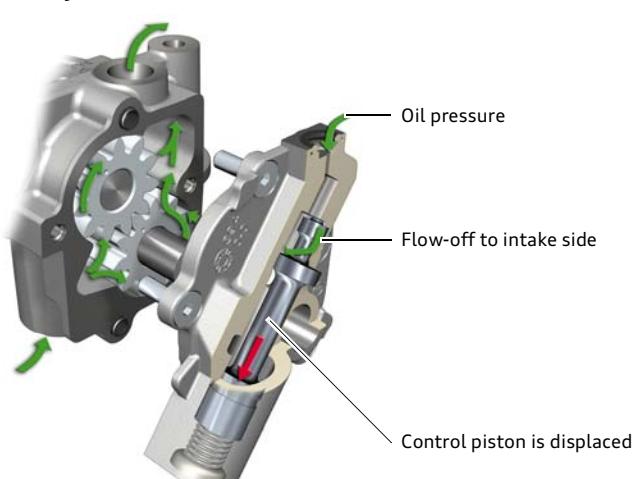
The surplus oil is thus recirculated to the intake side of the pump until the oil pressure is just below 3.7 bar, when the force of the control spring pushes the control piston back and re-closes the bypass. In this way, a constant oil pressure of 3.7 (+0.7) is maintained across the entire engine speed engine (except at idle and at low rpm).

#### Full delivery



451\_072

#### Delivery with flow-off



451\_079



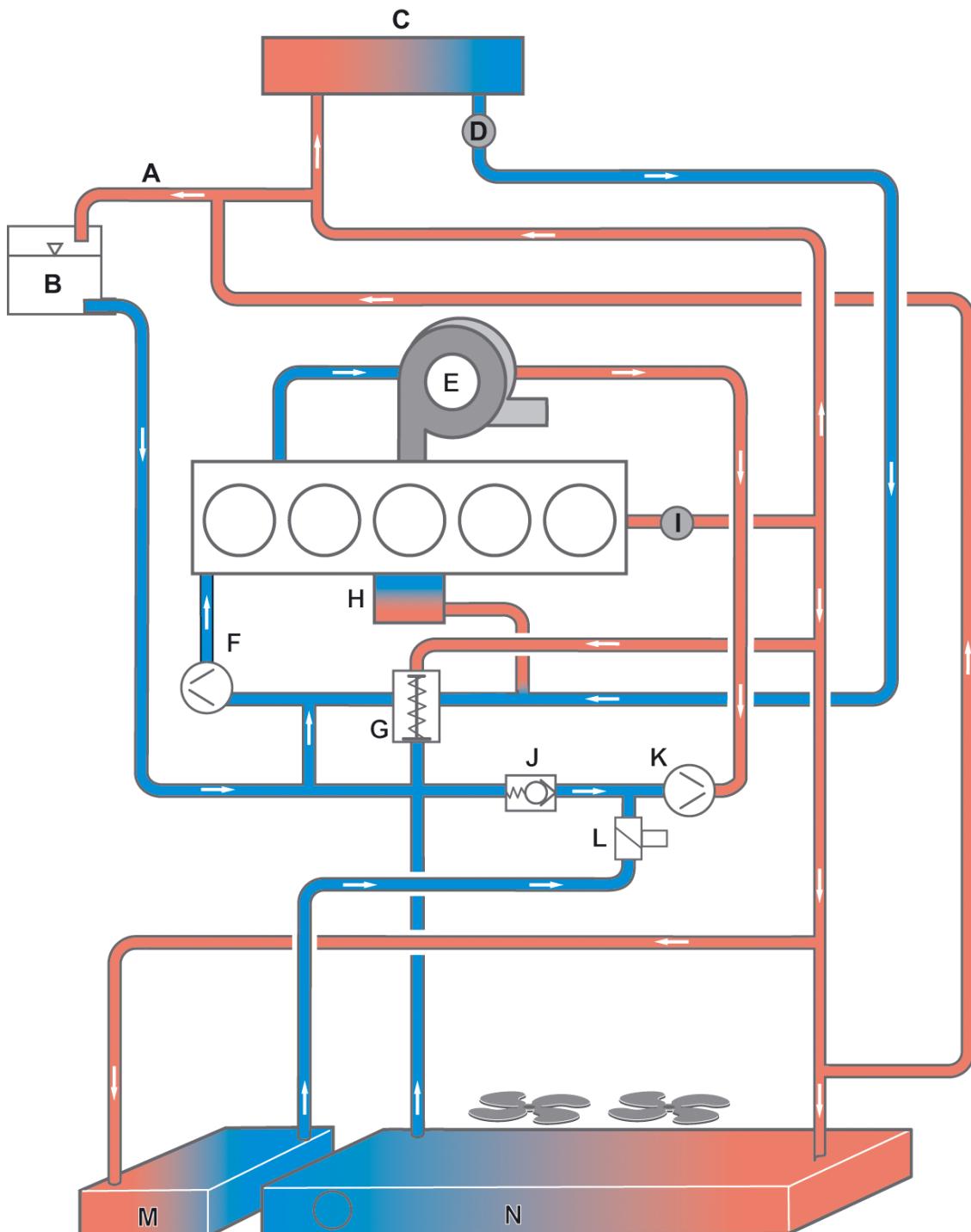
#### Reference

A self-regulating oil pump will be adopted from calendar week 36/2010. The design and function of a self-regulating oil pump of this type are described in Self-Study Programme 436 "Modifications to the chain-driven 4-cylinder TFSI engine".

## Cooling system

The cooling concept is based on longitudinal flow through cylinders 1 to 5. The coolant pump is driven by the auxiliary drive by means of a poly-vee belt and is designed to control the high thermal load on the turbo engine.

To prevent the turbocharger from overheating when the engine stops, the cooling system is equipped with a coolant run-on pump V51. When required, it is activated by the engine control unit (map) via the auxiliary coolant pump relay J496.



451\_007

### Legend:

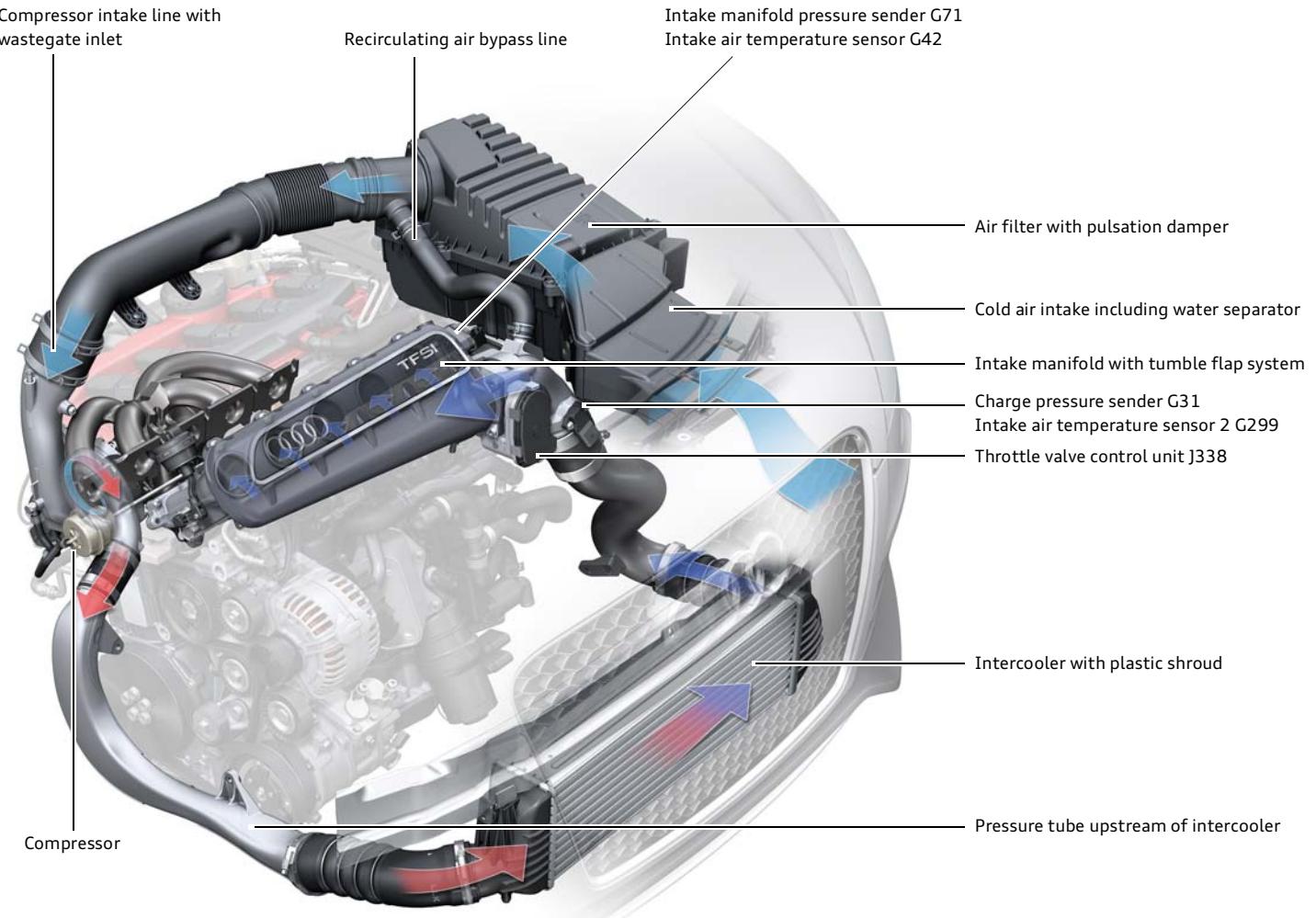
A	Breather pipe	H	Engine oil cooler
B	Expansion tank	I	Coolant temperature sender G62
C	Heater heat exchanger	J	Non-return valve
D	Vent screw	K	Coolant run-on pump V51
E	Exhaust turbocharger	L	Coolant circuit solenoid valve N492
F	Coolant pump	M	Auxiliary cooler
G	Coolant thermostat	N	Cooler

# Air supply

## Fresh gas side

When designing the intake path, the main focus was on high efficiency and capacity. The cross-sections were optimally adapted to the available space and the air flow was configured to be as direct as possible.

Air flow rates of up to 1000 kg/h are possible.



451\_034

## Intercooler

The greatest pressure losses always occur in the intercooler, which has been systematically developed and improved in this regard. The new intercooler is positioned at the lower front end and is, therefore, fully exposed to the back pressure of the exhaust gases. Hence, it was possible to maximise the outer cooling air mass flow. This, in turn, allowed the fins in the intercooler to be configured favourably. The total pressure loss along the entire compressed air flow path is only 135 millibars at maximum flow.



451\_069

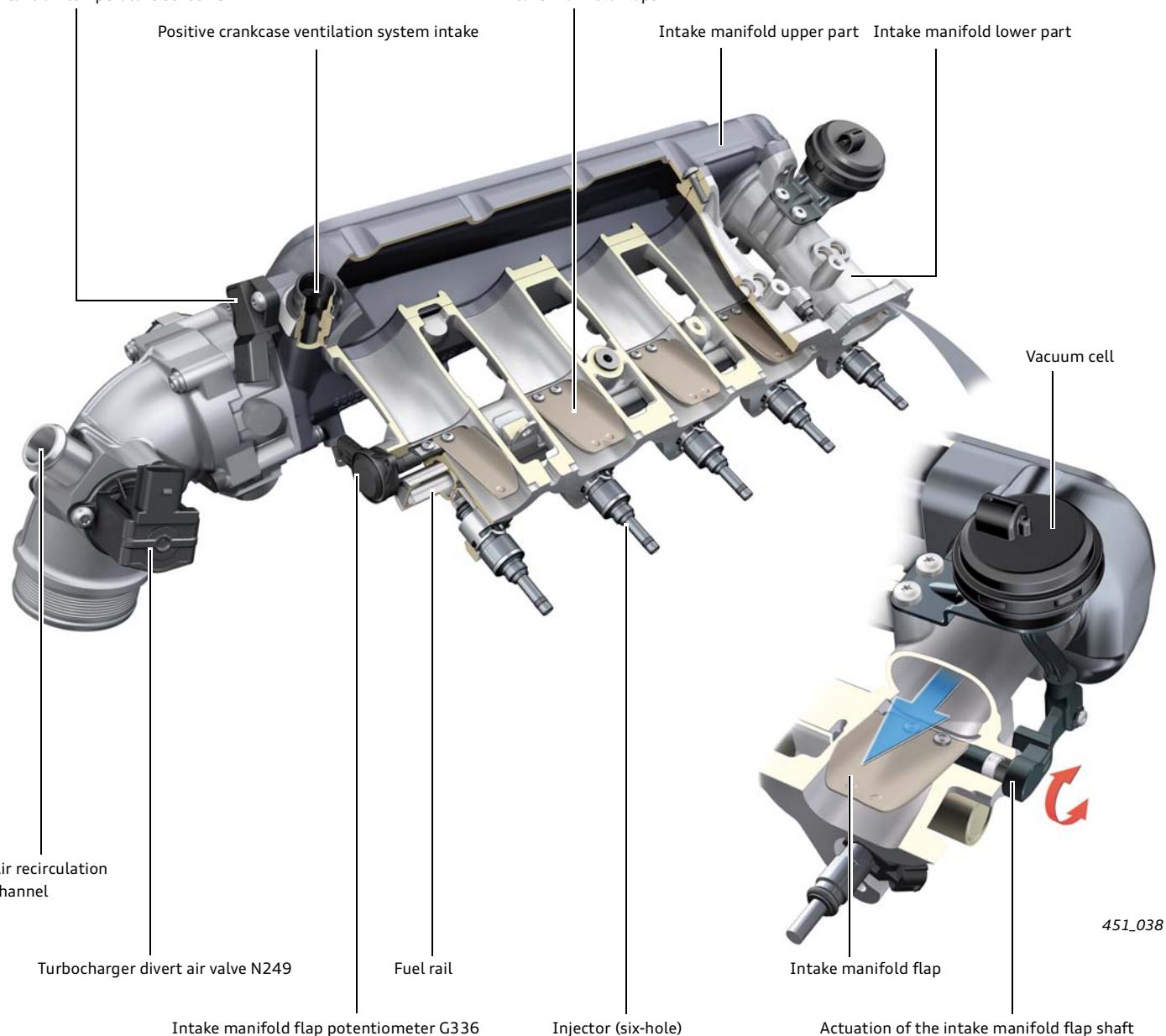
## Intake manifold with intake manifold flaps

The intake manifold is a two-part sand casting comprising the intake plenum and the intake arm gallery. A pneumatically actuated system of flaps is integrated in the intake gallery. In conjunction with the tumble intake port, this system produces the turbulence necessary for optimal mixture homogenisation. The flap position requested by the engine control unit is measured by the intake manifold flap potentiometer G336 and monitored by the engine control unit.

When the intake manifold flap valve N316 is not activated, no partial vacuum is admitted and the intake manifold flaps are fully closed.

The intake plenum, in combination with the rocker cover and the small engine shroud, is the central component of the engine bay design - a design which openly displays the technology behind this Audi RS model, too.

Intake manifold pressure sender G71  
Intake air temperature sensor G42



451\_038

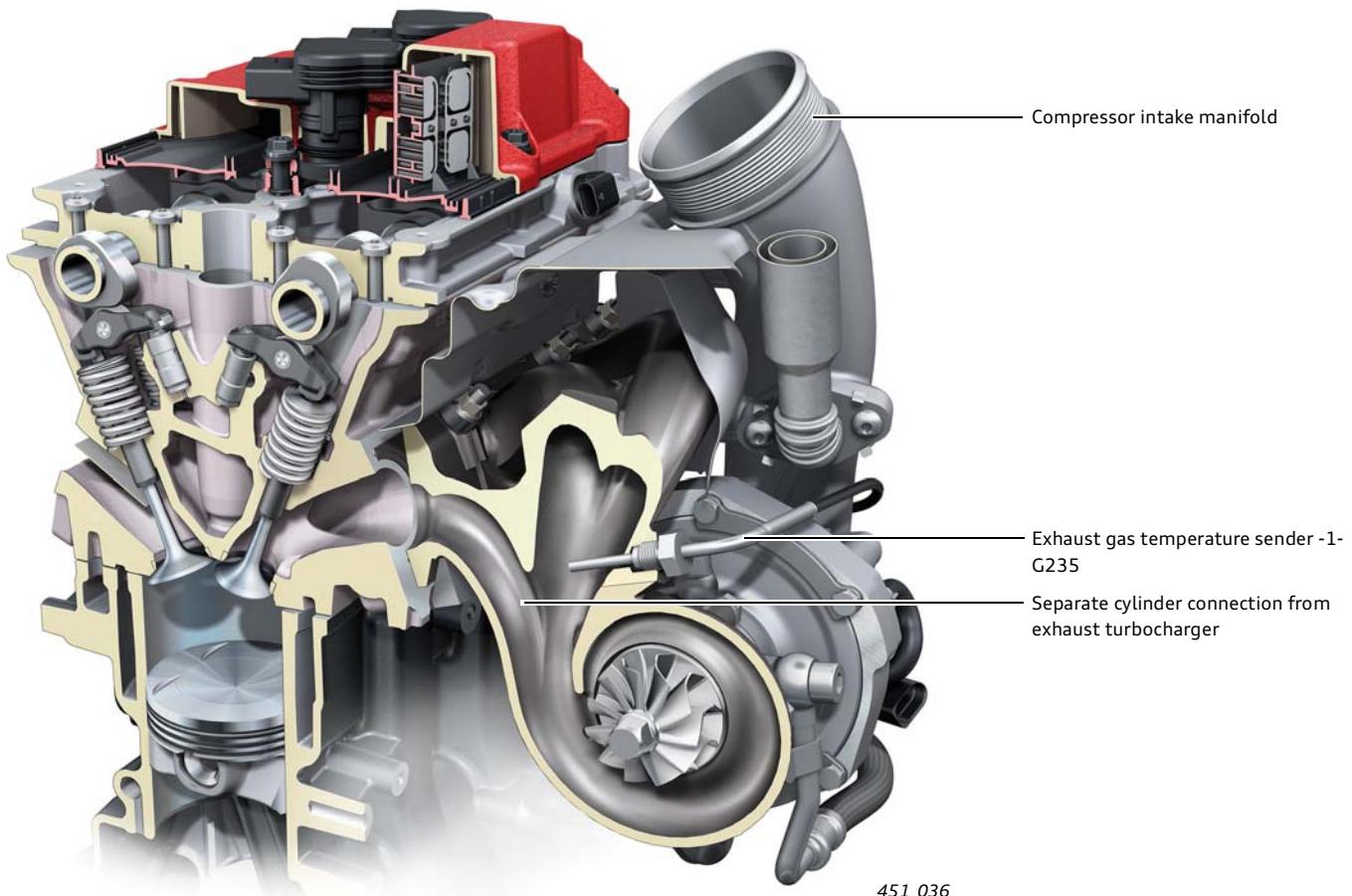
## Exhaust end

The exhaust end consists of the following subassemblies:

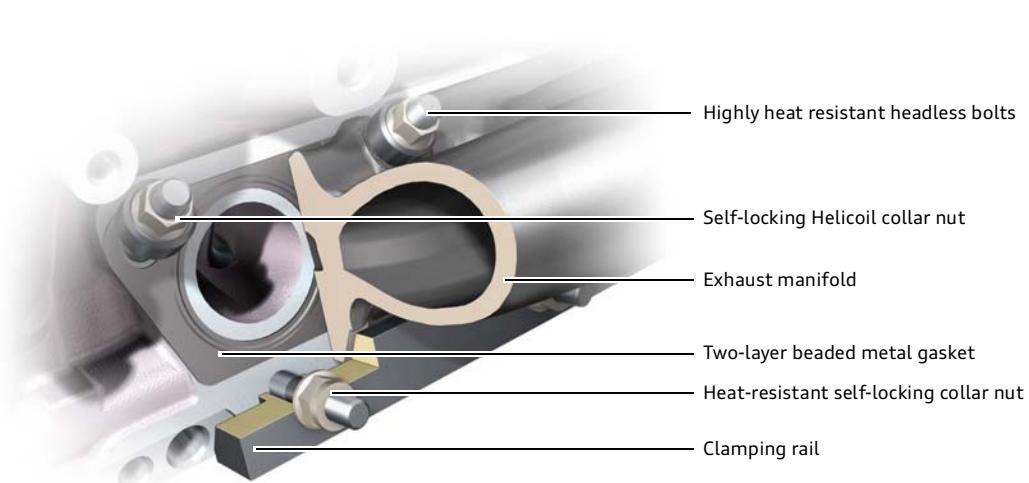
- ▶ Manifold exhaust turbocharger (exhaust turbocharger) module
- ▶ Close-coupled pre-catalyst
- ▶ Twin-flow headpipe with isolating elements
- ▶ Two underbody catalytic converters with the following centre silencers
- ▶ Rear silencer with twin tailpipes

The exhaust turbocharger module is a derivative of the four-cylinder TFSI engine. The exhaust gases are admitted separately into the turbine from the "additional" cylinder. The figure below shows the separate connection between the exhaust turbocharger and cylinder no. 3.

The exhaust turbocharger module attachment system, like the modular design principle, derives from the four-cylinder engines. The "clamping flange attachment system" is again used here (see diagram 451\_051). A modified screw attachment system will be introduced at a later date.



## Clamping flange attachment system



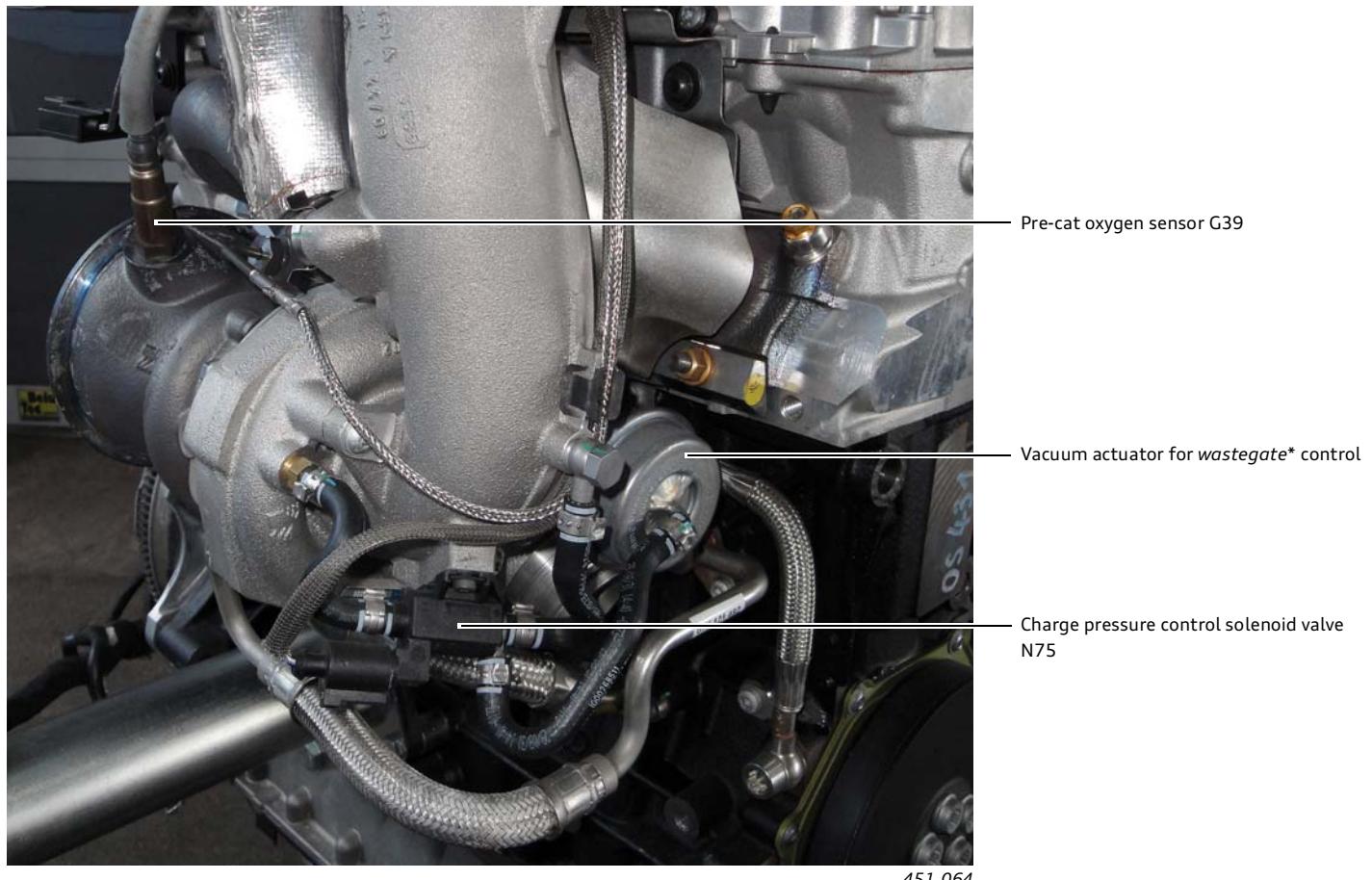
## Exhaust turbocharger

The exhaust turbocharger in use - a type K16 turbocharger by Borg Warner Turbo Systems - is characterised by high efficiency over a wide operating range.

It is large in size – its compressor wheel is 64 millimetres in diameter at the outlet end. At full throttle it can compress 290 litres of air per second, and it produces relative charge pressures of up to 1.2 bar. Its housing has a separate oil supply.

It is also integrated in the cooling circuit. After an engine stoppage, the coolant run-on pump V51 dissipates the accumulated heat.

A sensor-assisted exhaust gas temperature regulation system ensures that the maximum permissible exhaust temperature of 980 °C is not exceeded in any operating conditions. For this purpose, the exhaust gas temperature sender 1 G235 measures the exhaust gas temperature in the exhaust turbocharger module shortly before the turbine wheel (see diagram 451\_036 on page 30).



### Turbocharger divert air valve N249

The turbocharger divert air valve N249 is not located directly at the turbocharger outlet (see diagram 451\_038 on page 29), rather is attached to the throttle valve body upstream of the throttle valve. The advantage: after the air recirculation valve opens, the movement of the air is preserved along the relatively long route to the intake manifold via the intercooler.

The turbine loses little speed, with the result that the turbocharger responds very quickly after the air recirculation valve closes and the required charge pressure is available.

When the air recirculation valve opens, the air is admitted into the intake side of the compressor downstream of the air filter via the circulating-air bypass line (see diagram 451\_034 on page 28).

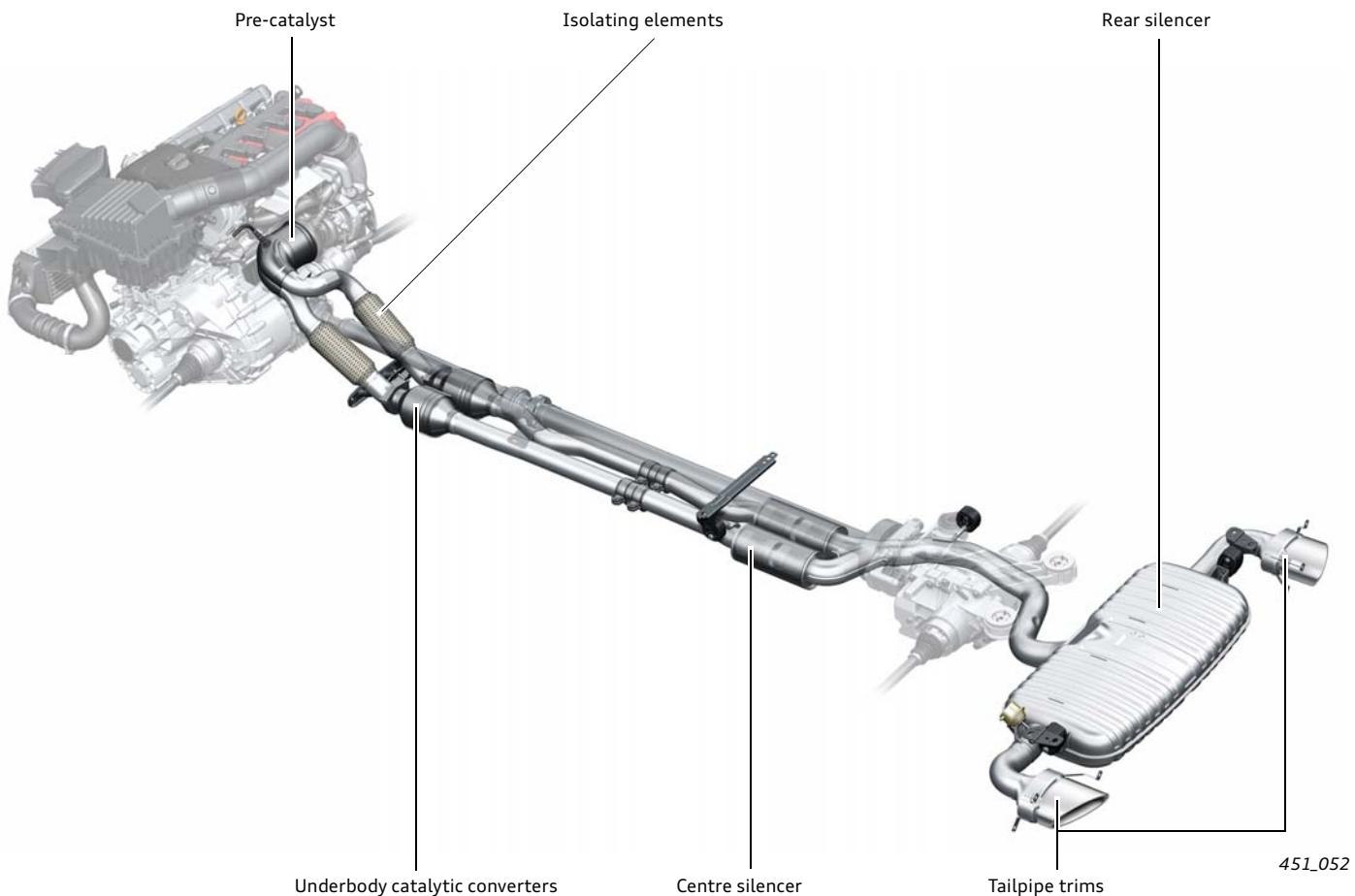
## Exhaust system

When the car is accelerated at full throttle, the typical sound of the five-cylinder engine is delightfully resonant in the intake and exhaust system. And yet the sound is unobtrusive when driving at a constant speed and under moderate acceleration.

To ensure compliance with the EU-5 exhaust emission standard, it was necessary to position the pre-catalyst as close as possible to the turbine outlet. The catalytic converter is made of a ceramic material. The continuous-duty oxygen sensor, which is integrated directly in the exhaust turbocharger module, is also positioned at the turbine outlet. The post-cat oxygen sensor is located directly downstream of the pre-catalyst and has a non-linear characteristic.

The two underbody catalytic converters are positioned further down the exhaust system, which has a twin-flow configuration after the pre-catalyst. Both catalytic converters are of metal construction.

A further focal point in the development of the exhaust system was minimising exhaust gas backpressure. Hence, the exhaust pipes are very large and, in part, have a twin-flow configuration. A sport exhaust system with black tailpipe trims is available as an option, in addition to the basic exhaust system. It has an even more distinctive soundscape.



## Exhaust flap

The exhaust gases are admitted into the large rear silencer behind the two centre silencers. The rear silencer, in turn, has twin tail-pipes.

The left tailpipe is fitted with an exhaust flap. When this flap opens, the sound becomes even more sporty. The exhaust flap is opened and closed by a vacuum cell. For this purpose, the exhaust flap 1 valve 1 N321 is activated by the engine control unit.

If the Sport button is pressed at idle and when the vehicle is at a standstill, the exhaust flap opens, thus allowing the system to be checked quickly and easily. The opening and closing of the exhaust flap are otherwise computed by a map in the engine control unit. If the exhaust flap 1 valve 1 N321 fails or if a leakage occurs in the hose system, the exhaust flap stays continuously open.



## Fuel system

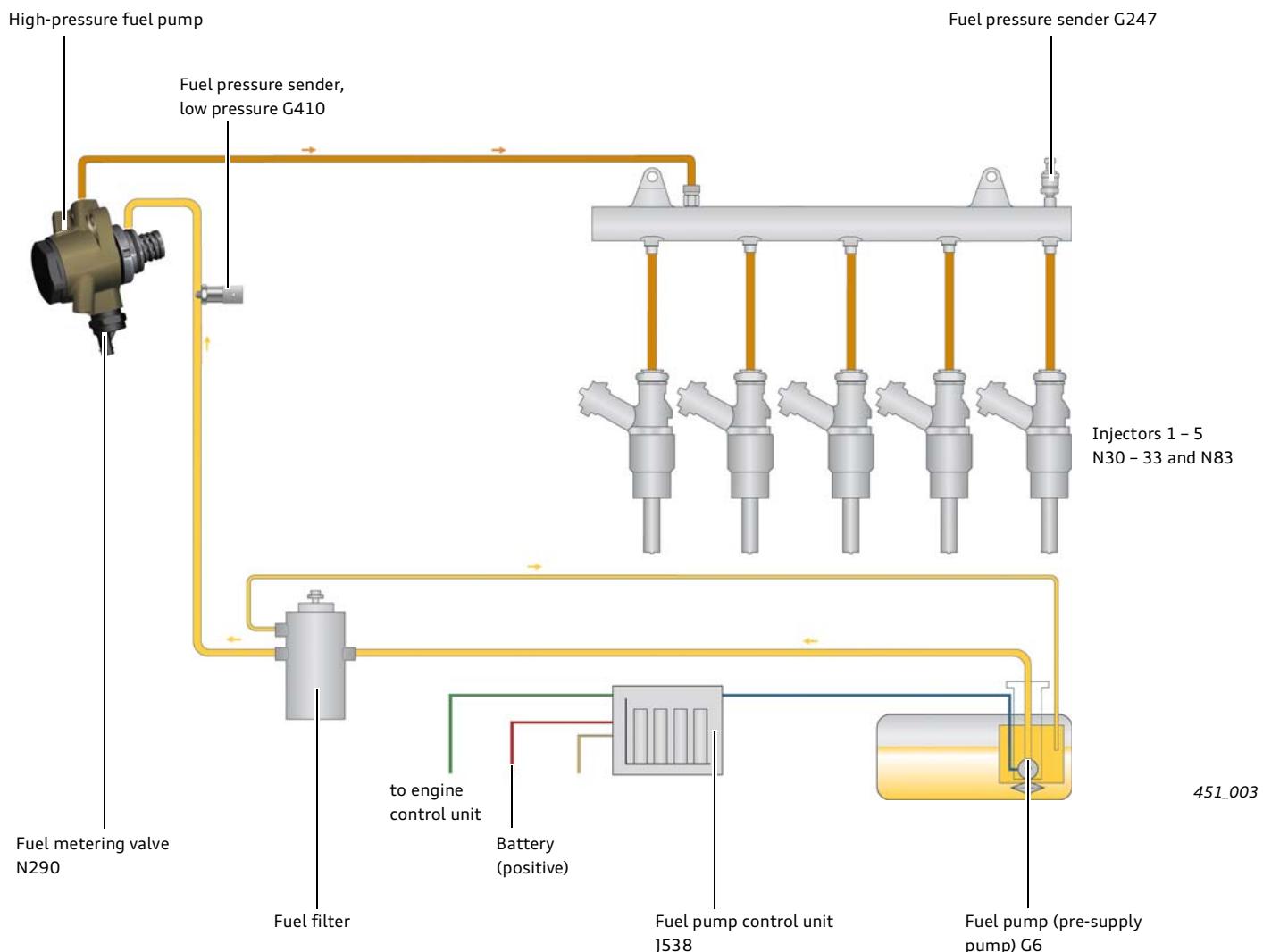
The fuel system is demand-controlled on the high and low-pressure sides. On the low-pressure side, the engine control unit regulates the fuel pump control unit J538 and with it the delivery rate of the fuel pump in the fuel tank.

On the high pressure side, the engine control unit regulates the fuel metering valve N290 directly at the high-pressure pump. To monitor the pressure levels in the system, two fuel pressure senders send their respective signals to the engine control unit.

The central element of the fuel system is a demand-controlled single-piston high-pressure pump. This generation III fuel pump by Hitachi is driven by a three-lobe cam seated on the exhaust camshaft.

The system with a maximum pressure of 120 bar. The pressure-limiting valve in the pump opens at a pressure of approx. 145 bar.

## System overview



### Note

Caution: danger of injury. The system operates at very high pressures. To open the high-pressure side, always follow the instructions given in the Workshop Manual.



### Reference

To learn more about the functional principle and control concept of the high-pressure fuel pump, refer to Self-Study Programme 432 "Audi 1.4l TFSI engine".

# System overview

## Sensors

Charge pressure sender G31

Intake air temperature sensor 2 G299



Intake manifold pressure sender G71

Intake air temperature sensor G42



Engine speed sender G28



Throttle valve control unit J338

Angle sender G188, G187



Hall sender G40 (intake)

Hall sender 3 G300 (exhaust)



Accelerator pedal position sender G79

Accelerator pedal position sender 2 G185

Clutch position sender G476



Brake light switch F

Brake pedal switch F47



Sport program button E541



Fuel pressure sender G247

Fuel pressure sender, low pressure G410



Knock sensor -1- G61

Knock sensor -2- G66



Oil pressure switch F22



Coolant temperature sender G62



Intake manifold flap potentiometer G336



Pre-cat oxygen sensor G39

Post-cat oxygen sensor G130



Exhaust gas temperature sender -1- G235



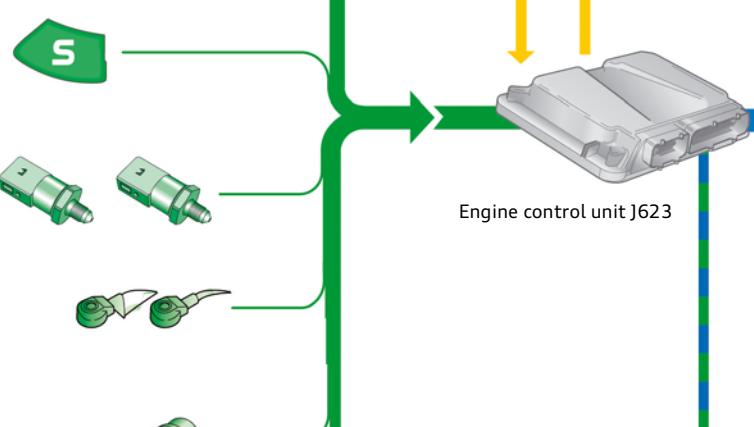
Auxiliary signals:

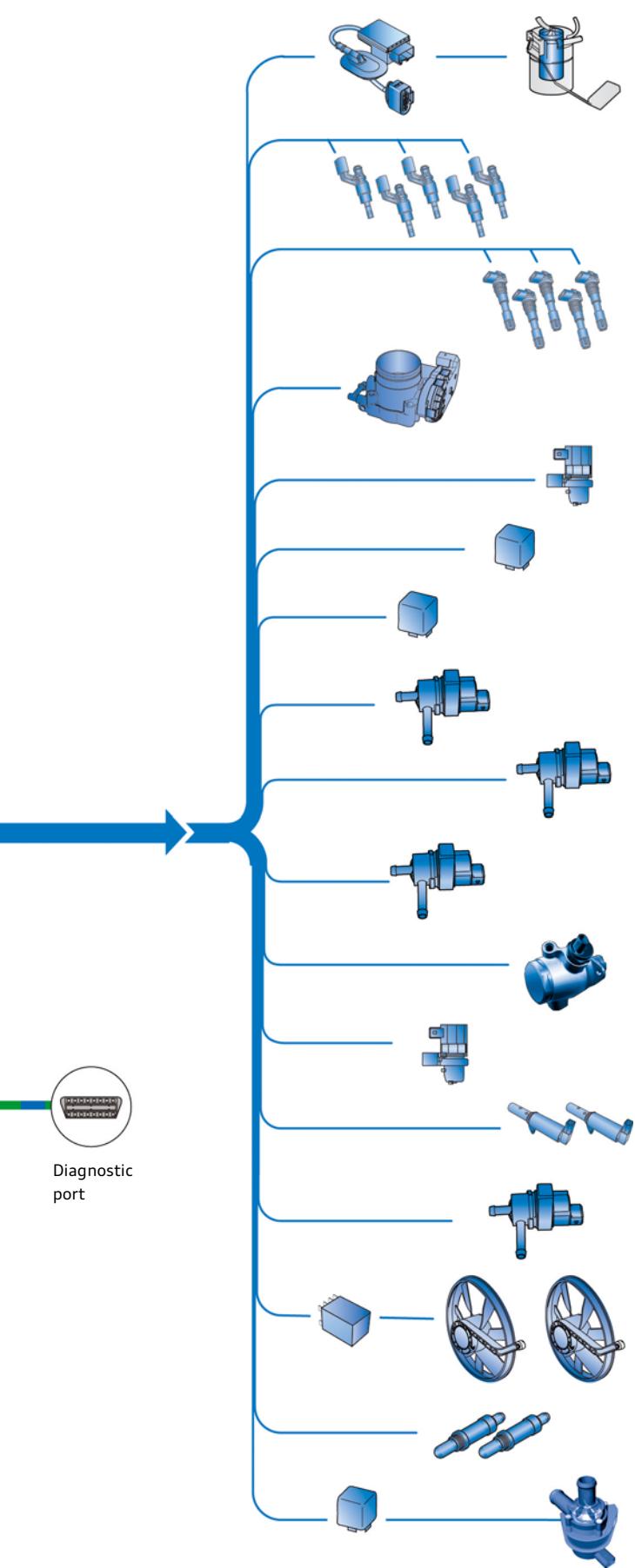
J393 Door contact signal

E45 Cruise control system (ON/OFF)

Powertrain CAN data bus

Engine control unit J623





## Actuators

Fuel pump control unit J538  
Fuel pump (pre-supply pump) G6

Injectors for cylinders 1 – 5  
N30 – 33 and N83

Ignition coils for cylinders 1 – 5  
N70, N127, N291, N292, N323

Throttle valve control unit J338  
Throttle-valve drive G186

Intake manifold flap valve N316

Engine component current supply relay J757

Motronic current supply relay J271

Charge pressure control solenoid valve N75

Activated charcoal filter solenoid valve 1 N80

Turbocharger divert air valve N249

Fuel metering valve N290

Exhaust flap 1 valve N321

Inlet camshaft timing adjustment valve -1- N205  
Exhaust camshaft timing adjustment valve 1 N318

Coolant circuit solenoid valve N492

Radiator fan control unit J293  
Radiator fan V7  
Radiator fan 2 V177

Lambda probe heater Z19, Z29

Auxiliary coolant pump relay J496  
Coolant run-on pump V51

## Engine management

The Bosch MED 9.1.2 measures load by means of the intake manifold pressure sender G71 and the engine speed sender G28. The target for emission classification was compliance with exhaust emission limits EU 5. This was achieved by using the following subassemblies in combination with special injection and catalyst heating strategies:

- ▶ Intake manifold with intake manifold flaps
- ▶ Multi-port injectors in combination with flat pistons
- ▶ Close-coupled pre-catalyst

A secondary air injection system was not needed.

## Operating modes

The following operating modes are possible:

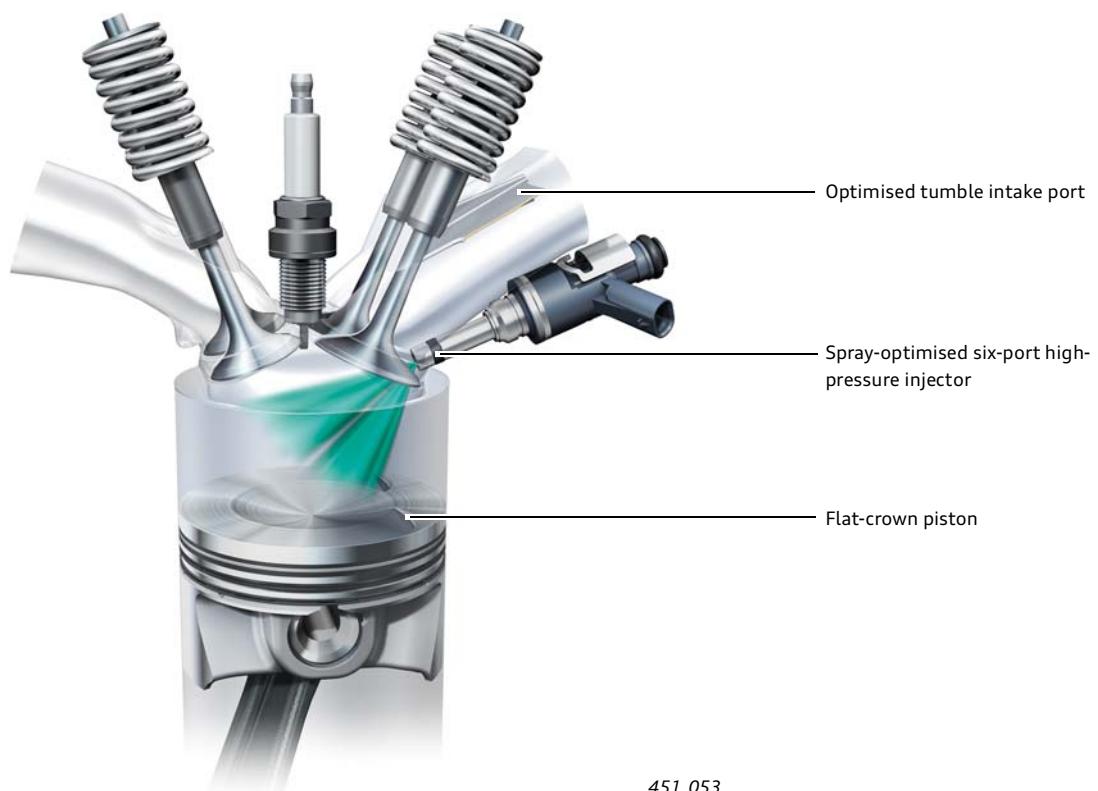
- ▶ High-pressure stratified starting down to an ambient temperature of -26 °C
- ▶ Catalyst heating and engine warm-up with twin injection
- ▶ When the engine is warm and running at low rpm, the amount of residual gas in the cylinders is minimised by high scavenging rates, achieved by adjustment of the intake and exhaust cam-shaft phasings and by adaptation of the valve timings and event duration\*.

In the upper rpm band, the entire system is optimised for high flow rates. In this regard, it is essential that the intake, pressure and exhaust lines be carefully matched and optimised for pressure losses.

## Combustion process

The basis for the development of the combustion process was the Audi 2.0 litre TFSI engine. Like this engine, the 2.5 litre TFSI unit benefits from the acknowledged advantages of multiport valve technology, as shown in diagram 451\_053.

By optimising the spray parameters in combination with a flat piston crown shape, it was possible to improve carburetion compared to the 2.0 litre TFSI engine, despite the approx. 25 % increase in the flow rate of the high-pressure injectors.



451\_053

## Engine load sensing

The load on the 2.5L R5 TFSI engine is determined via the engine speed and the air mass. Since no air mass meter is installed, two identical combined temperature/pressure sensors are used for air mass metering:

- ▶ Charge pressure sender G31, intake air temperature sensor 2 G299
- ▶ Intake manifold pressure sender G71, intake air temperature sensor G42

Two sensors are used because the throttle valve must be regarded as a source of interference - very different pressures can simultaneously exist upstream and downstream of the throttle valve. Another reason is the use of the cast aluminium intake manifold. This manifold accumulates heat and could, therefore, potentially falsify the temperature signal generated by the temperature sensor (G71/G42). The temperature signal generated by the sensor upstream of the throttle valve (G31/G299) is utilised for this purpose.

### First sensor:

Task: measurement of pressure and temperature upstream of the throttle valve

Designation: charge pressure sender G31 and intake air temperature sensor 2 G299

This sensor is the charge pressure sensor, upon whose signal the charge pressure is controlled. Since the throttle valve will be operating wide open as much as possible, there is no need for this valve because charge pressure equals intake manifold pressure.

To achieve better response, however, the charge pressure control unit runs before the throttle valve is wide open. In principle, therefore, it works against the throttle valve.

### Failure of this sensor

If the sensor fails, the charge pressure control system will go into limp-home mode, which means that the engine will be running naturally aspirated. In addition, the EPC and MIL lamps will be activated and a corresponding fault code will be stored in the fault memory.

### Second sensor:

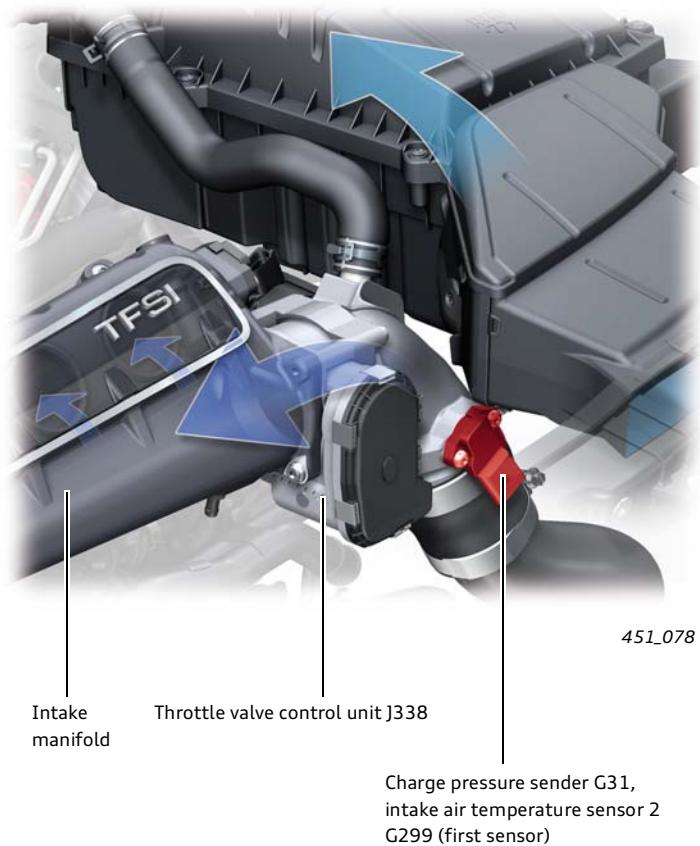
Task: measurement of pressure and temperature in the intake manifold

Designation: Intake manifold pressure sender G71 and intake air temperature sensor G42

This identical combined sensor is the so-called main charge sensor, which replaces the hot-film air mass meter. The air mass flowing through the engine is determined at every operating point from the pressure and temperature signals generated by this sensor. For this purpose, a corresponding quantity of fuel is injected.

### Failure of this sensor

If this sensor fails, the engine will go into limp-home mode. Engine power output will be reduced. In this case, air mass is determined in "alpha-n mode", i.e. based on the throttle valve angle ( $\alpha$ ) and engine speed(s). In addition, the EPC and MIL lamps will be activated and a corresponding fault code will be stored in the fault memory.



## Sport mode

The following functions can be activated with the Sport button:

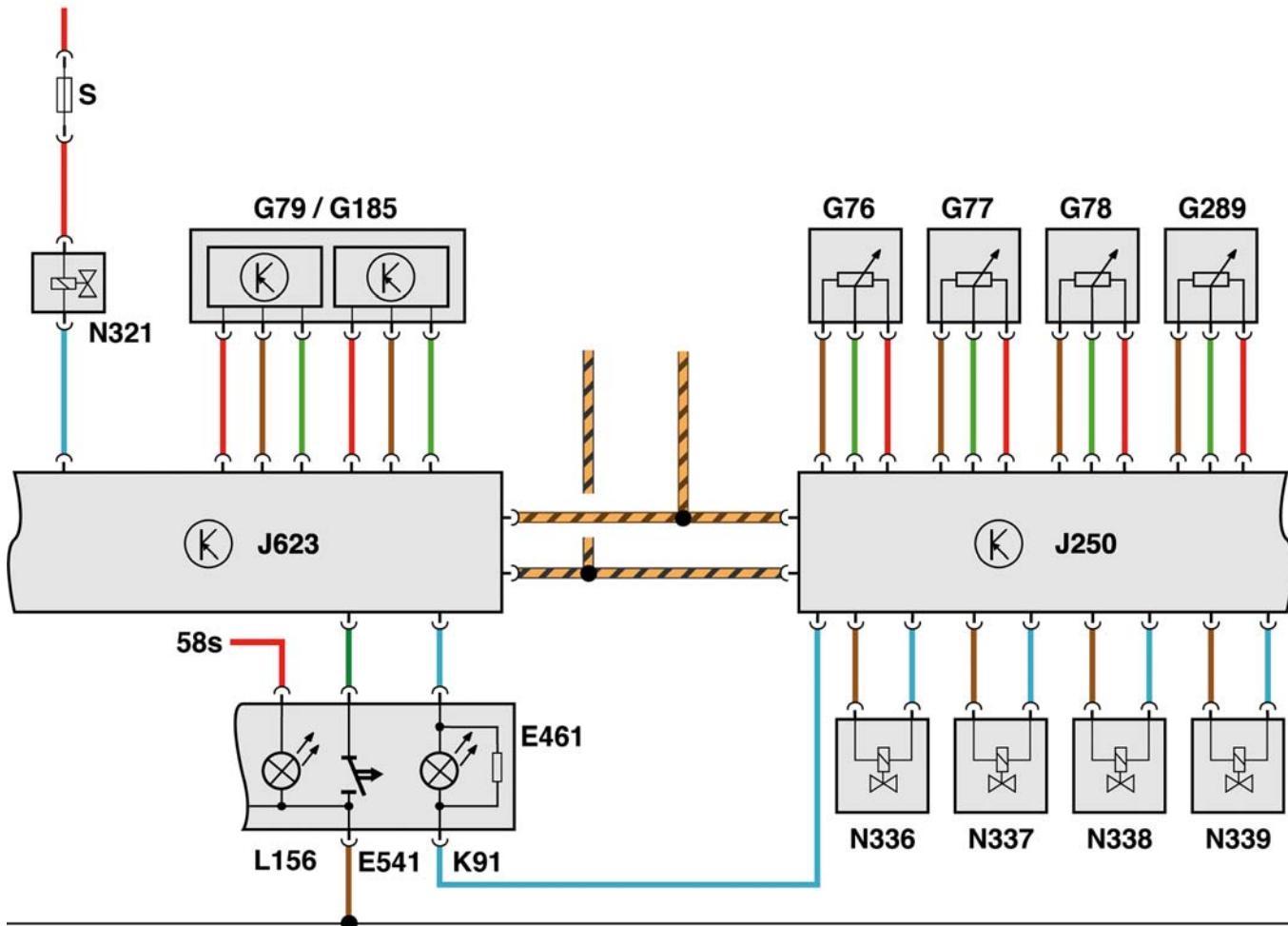
- ▶ Direct accelerator response. A different characteristic curve is selected in the engine control unit.
- ▶ Modification of the exhaust system, i.e. a more sporty set-up. The pneumatic actuator responsible for closing or opening the exhaust flap is activated by the electrical actuation of exhaust flap 1 valve 1 N321 by the engine control unit.
- ▶ The sporty driving mode of Audi magnetic ride is activated.
- ▶ The sport program indicator lamp K91 comes on.



451\_045

Sport program indicator lamp K91 in the Sport button

## Function diagram



31

451\_039

## Legend:

E461	Operating unit in front of centre console
E541	Sport program button
G76	Rear left vehicle level sender
G77	Rear right vehicle level sender
G78	Front left vehicle level sender
G79	Accelerator pedal position sender
G185	Accelerator pedal position sender 2
G289	Front right vehicle level sender
J250	ECD control unit (electronically controlled damping)

J623	Engine control unit
K91	Sport program indicator lamp
L156	Switch illumination bulb
N321	Exhaust flap 1 valve 1
N336	Shock absorber damping adjustment valve, front left
N337	Shock absorber damping adjustment valve, front right
N338	Shock absorber damping adjustment valve, rear left
N339	Shock absorber damping adjustment valve, rear right
S	Fuses in relay plate fuse box

# Power transmission

## Manual gearbox OA6

A new manual six-speed gearbox is responsible for torque transmission in the Audi TT RS.

The power from the six gears and the reverse gear is distributed from the input shaft to three drive shafts, which in turn transmit their torque to the front axle drive gear. This concept is designed to comfortably withstand the high forces produced by the engine. As is usual for Audi, all gearshifts are light, precise and slick. Shift travel has been reduced, and both the selector lever and the gear knob have been matched to the interior design of the Audi TT RS.



451\_070

## Specifications

Manual gearbox	OA6 with all-wheel drive	
Engine code	LNA	
Production period	07/09>	
Assignment	Vehicle type	TT RS '10>
	Engine	2.5l TFSI developing 250 kW
Ratio incl. front axle drive $i_{total}$		
1st gear	13.45	
2nd gear	8.12	
3rd gear	5.51	
4th gear	4.16	
5th gear	3.36	
6th gear	2.83	
	Reverse gear	14.41
Ratio spread	1st – 6th gear	4.75
Front axle drive ratio	Output shaft – 1st/2nd gear	64 : 17 = 3.765
	Output shaft – 3rd – 6th gear	64 : 22 = 2.09
	Output shaft – reverse gear	64 : 20 = 3.200
Weight with oil fill	85 kg	

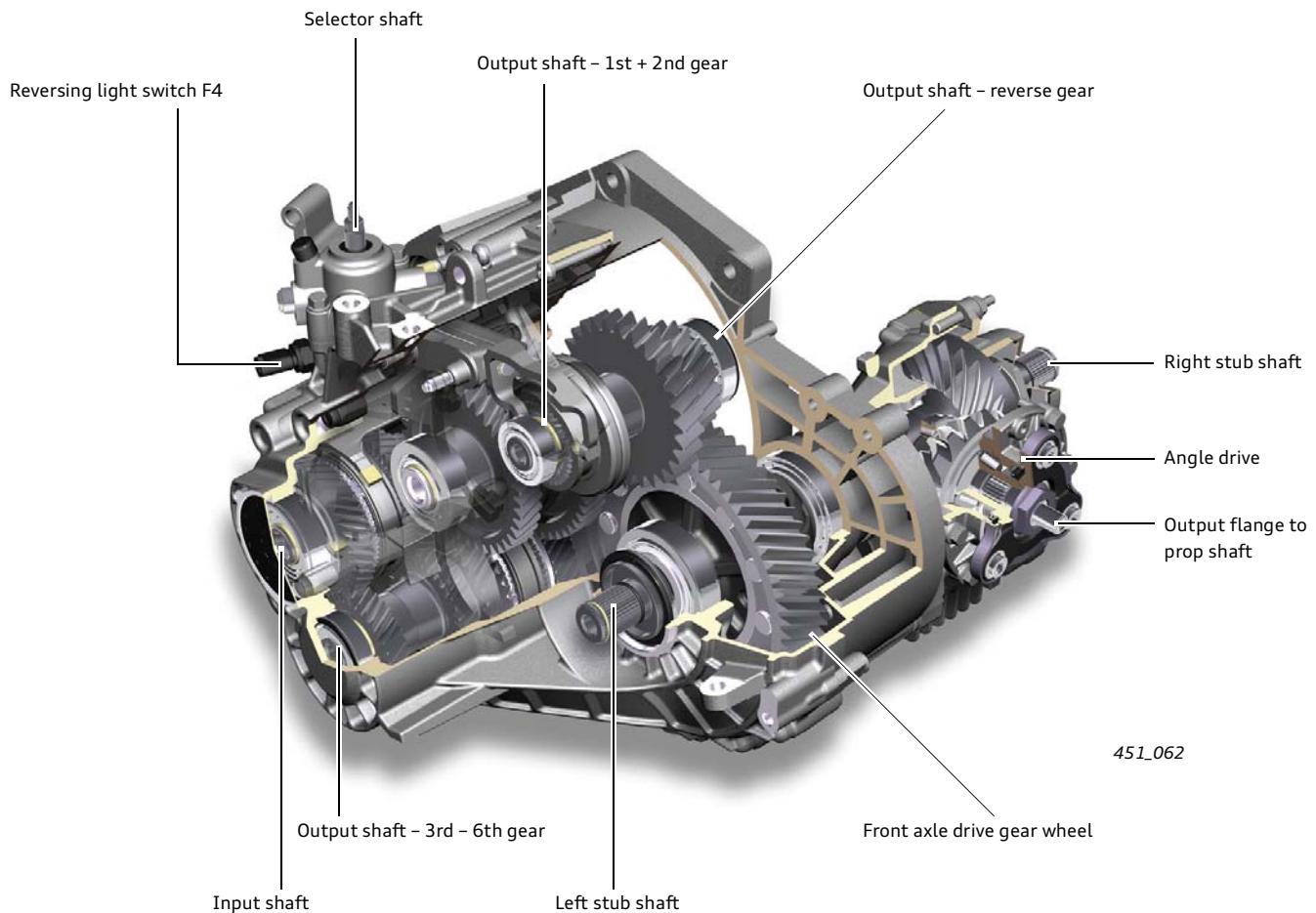
Six-speed manual gearbox OA6 can handle up to 500 Nm of engine torque. It will debut in the Audi TT RS in model year 2010.

### Note

Please refer to the Electronic Parts Catalogue (ETKA) for the following details.

- Assignments of the individual gear wheels
- Gear oil specification
- Bevel box assignments
- Propshaft flange assignments
- Clutch assignments
- Rear-axle drive assignments

## Configuration



## Reverse gear

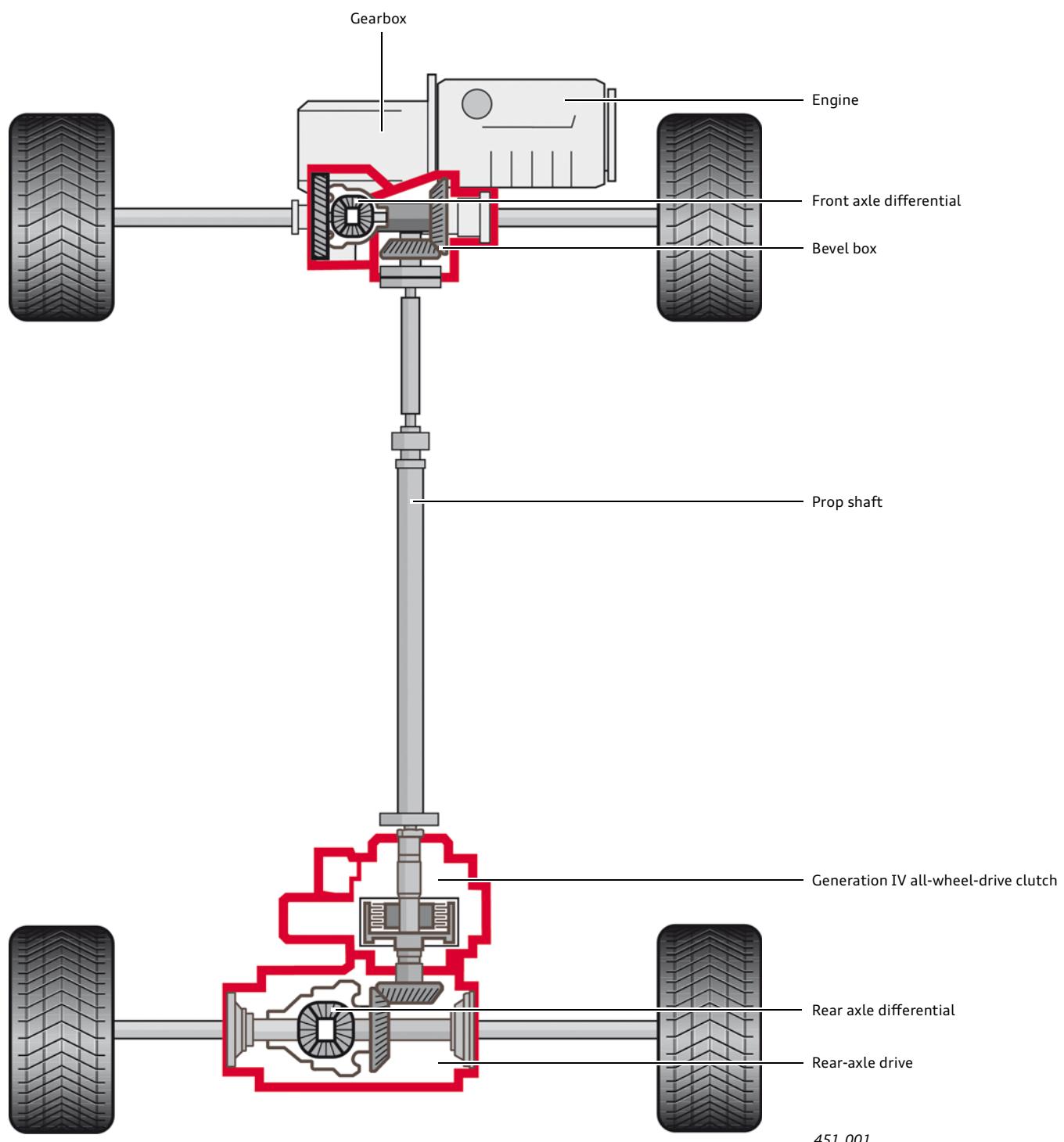
A special feature of the gearbox is that the direction of rotation is reversed for reverse gear. The change gear of the reverse gear slides into mesh with an idler gear which is fixedly connected to the change gear of the first gear.

The change gear of the first gear is itself driven by the input shaft. When frictional engagement is established between the change gear and the reverse gear output shaft by synchronisation of the reverse gear, the reverse gear output shaft transmits the engine torque to the front axle drive gear.

## Drive concept

The permanent quattro four-wheel drive in the version for transverse-mounted engines is standard equipment in the Audi TT RS. The permanent quattro four-wheel drive system also imparts to the Audi TT RS the superior capabilities that have long since been a characteristic trait of Audi models, e.g. extra grip, reduced slip under acceleration, driving dynamics, driving safety and directional stability.

An Audi TT RS handles dynamically and is extremely stable at any speed and in all weather conditions.



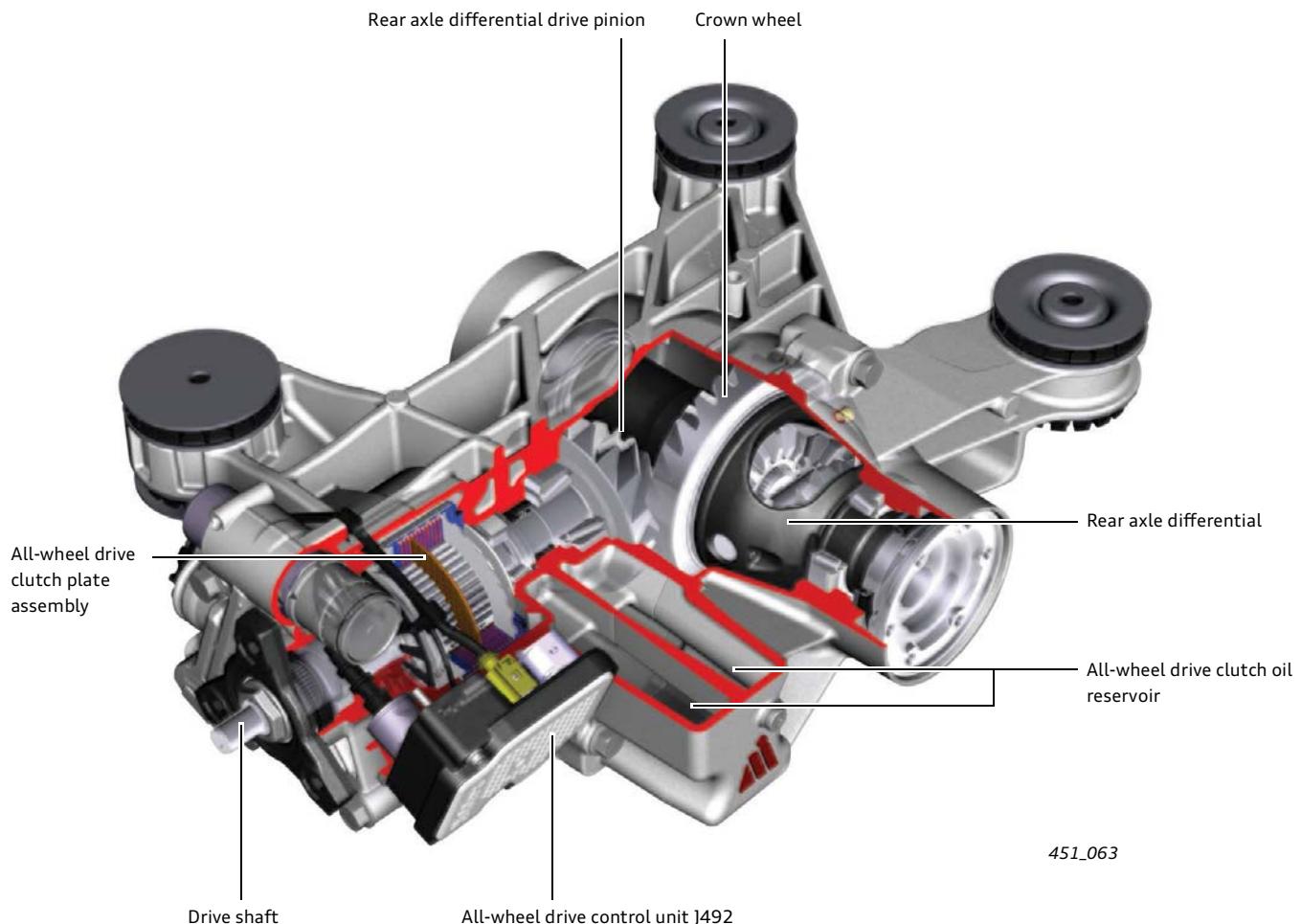
451\_001

## Multi-plate clutch

At the heart of the system is a multi-plate clutch, which is controlled electronically and actuated hydraulically. The clutch control unit permanently analyses the driving conditions. If slip occurs at the front wheels, an electrically driven annular piston pump almost instantaneously generates the oil pressure needed by the clutch to divert the drive torque almost entirely from the front to the rear wheels.

Thanks to a high-performance pressure reservoir, all of this happens within a matter of milliseconds.

To make the already good axle load distribution even better, the clutch is now mounted on the end of the prop shaft in front of the rear axle differential. This clutch is likewise a recently developed, highly compact component, and it is designed to withstand the rigours of heavy use.



451\_063



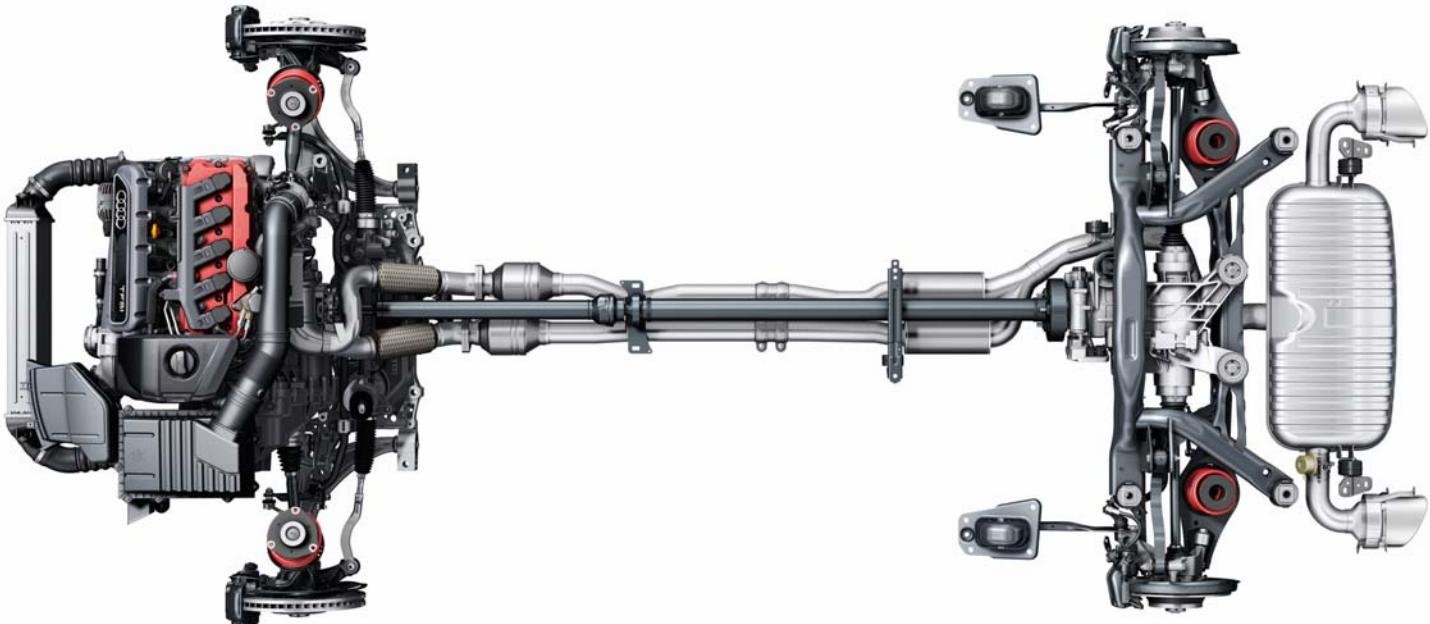
### Reference

The design and function of the generation IV all-wheel-drive clutch are described in Self-Study Programme 414 "4MOTION with generation IV all-wheel-drive clutch".

# Running gear

## Introduction

The suspension system of the Audi TT RS makes use of the excellent qualities that have become a hallmark of the basic Audi TT design.



451\_048

## Front axle

The front wheel suspension system, with a track width of 1555 millimetres, adheres to a proven formula: a McPherson structure with triangular lower wishbones. The pivot bearings, the subframe and the wishbones are made from aluminum. To increase rigidity, the subframe is bolted to the body at six points.

## Steering

The rack-and-pinion steering system comes with variable servo assistance; its characteristics have been adapted to the dynamic character of the TT RS. Because the electromechanical system does not use up energy when the car is driving in a straight line, it is highly efficient and saves about 0.2 litres of fuel per 100 km. The ratio of 16.9:1 is sporty and direct.

## Rear axle

The four-link rear axle (track width: 1546 millimetres) is able to absorb longitudinal and lateral forces separately thanks to its sophisticated design. The longitudinal links absorb the driveline and braking forces, and their relatively soft mounts permit good ride comfort. On the other hand, the three wishbones per wheel – the spring link, the upper wishbone and the tie rod – are attached very rigidly to the subframe to enhance handling dynamics.

The elastokinematic behavior of the rear control arms (all of which are made from high-strength steel grades) has been slightly modified compared with the basic technical configuration. Separate coil springs and newly developed dampers provide vertical support. The body of the TT RS has been lowered 10 millimetres compared to the volume TT model. Audi's designers have tuned the set-up to perfection in the course of exhaustive testing, including endless high-speed laps of the Nürburgring North Loop.

## Audi magnetic ride

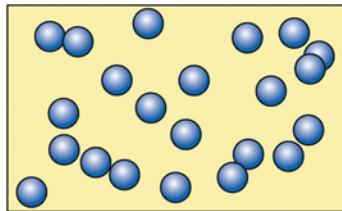
As an option, the customer can order the Audi TT RS with Audi magnetic ride. This system is already available in the volume TT model.

### Functional principle

Circulating inside its damper pistons is a synthetic hydrocarbon fluid containing minute magnetic particles between three and ten micrometers in size. When voltage is applied to a coil, a magnetic field is created in which the orientation of the particles changes.

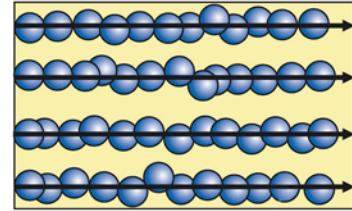
They cluster transversely to the direction of flow of the fluid, thus inhibiting its flow through the piston channels. This alters the damping characteristic within a matter of milliseconds.

Magneto-rheological fluid in a non-magnetised state



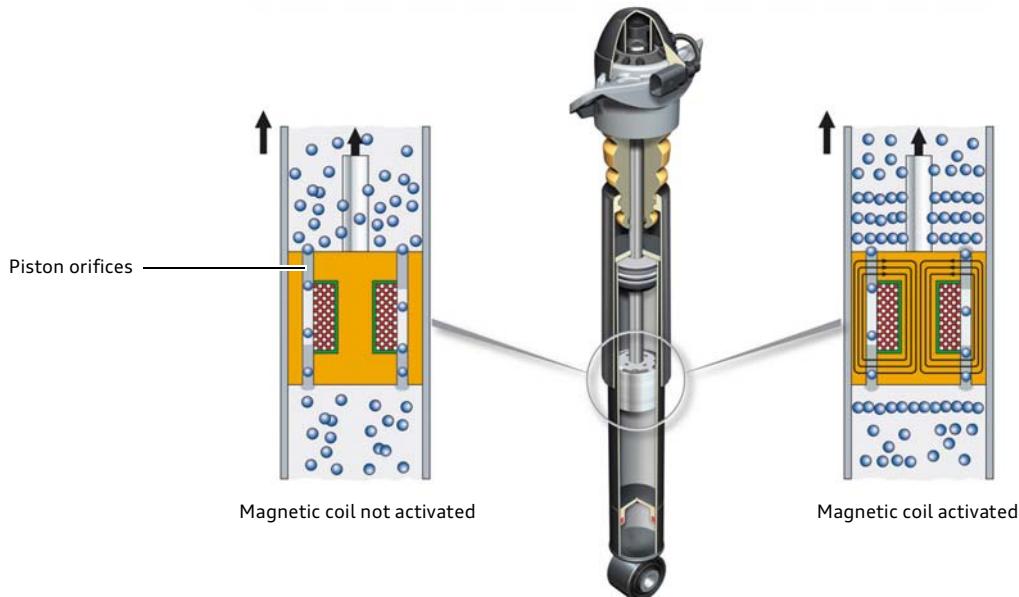
● Magnetic particles

Magneto-rheological fluid in a magnetised state



Magnetic field

451\_050



451\_049

### Operating principle

The system's control unit constantly monitors the driver's style and the condition of the road, adjusting its response accordingly. The driver can change between the Normal and Sport modes at the touch of a button. In Normal mode, when the fluid has a high viscosity, the suspension of the Audi TT RS offers a well-balanced, comfortable ride.

In Sport mode, when flow is inhibited, the suspension is uncompromisingly firm and the car hugs the road without so much as a hint of body roll. The specific stabilisation of each wheel gives even more neutral self-steering behaviour and steering response becomes more precise.



#### Reference

You will find a detailed description of the design and function of the systems in Self-Study Programme 381 "Audi TT '07 – Suspension System".

## Wheels and tyres

The TT RS comes as standard with large cast aluminium wheels featuring a five double spoke design. They are 9J x 18 in size and shod with 245/40 tyres.

A number of other wheel variants are optionally available in sizes of up to 20 inches in diameter. The 19 inch wheels are shod with 255/35-size tyres and optionally available in a high-gloss silver finish or titanium look.

### Overview

18" basic wheel	19" optional wheel	19" optional wheel	20" optional wheel
			
<b>Cast aluminium wheel</b>	<b>Cast aluminium wheel</b>	<b>Cast aluminium wheel</b>	<b>Forged aluminium wheel</b>
9.0J x 18 ET 52 Summer: 245/40 R18 93Y Winter: 245/40 R18 97V	9.0J x 19 ET 52 Summer: 255/35 R19 96Y Winter: 255/35 R19 96V	9.0J x 19 ET 52 Summer: 255/35 R19 96Y -	9.0J x 20 ET 52 Summer: 255/30 ZR20 92Y -



#### Reference

You will find an up-to-date overview of approved wheel-tyre combinations and other wheels in the "Wheels and Tyres" catalogue on the Audi Servicenet and in the Electronic Parts Catalogue (ETKA).

## Brake system

The large wheels conceal high-performance brakes. All four discs are ventilated. They have a diameter of 310 millimetres on the rear axle and 370 millimetres on the front axle. The front friction rings are drilled for maximum heat dissipation and are connected to the aluminium brake drums by hollow-drilled pins.

Four-piston calipers, painted black and sporting the RS logo on the front axle, clamp the discs with a vice-like grip. The calipers are also manufactured from aluminium - this reduces the unsprung masses.

### Front brake



### Electronic stabilisation program (ESP)

The ESP electronic stabilisation program is optimised for dynamic driving, but can be deactivated in two stages using the TCS/ESP button E256 in the centre console.

#### First stage (Sport mode)

In the first stage (Sport mode), traction control is disabled and the brakes intervene somewhat later than in normal operation. To select, push the *ESP OFF* button briefly. The ESP warning lamp in the dash panel insert lights up and *ESP Sport* comes up on the driver information system display. Driving stability is limited in Sport mode.

#### Second stage (complete shutdown)

In the second stage, ESP is completely deactivated. To select, push the *ESP OFF* button for longer than 3 seconds. The ESP warning lamp lights up and *ESP off* comes up on the dash panel insert display. When ESP is deactivated, TCS is disabled at the same time.



#### Note

ESP Sport mode should only be activated for agile handling and sporty driving if the road, weather, visibility and traffic conditions permit.

# Service

## Maintenance work

Maintenance work	Interval
<b>Engine oil change interval with LongLife oil with engine oil specifications</b>	Up to 30,000 km or up to 24 months depending on SIA <sup>1)</sup> (the change interval is dependent on driving style) Engine oil according to VW standard 50400
<b>Engine oil change interval without LongLife oil with engine oil specifications</b>	Fixed interval of 15,000 km or 12 months (whichever comes first) Engine oil to VW standard 50400 or 50200
<b>Engine oil filter replacement interval</b>	At every oil change
<b>Engine oil change quantity (service)</b>	5.7 litres (including oil filter)
<b>Engine oil extraction/drainage</b>	Extraction of the engine oil is not permitted.
<b>Air cleaner replacement interval</b>	60,000 km
<b>Fuel filter replacement interval</b>	Lifetime
<b>Spark plug replacement interval</b>	30,000 km or 6 years (whichever comes first)

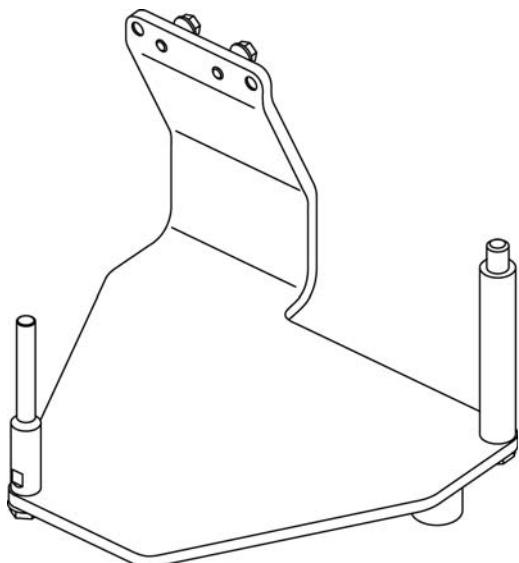
## Timing gear and ancillary units drive

Maintenance work	Interval
<b>Ribbed vee-belt replacement interval</b>	Lifetime
<b>Ribbed vee-belt tensioning system</b>	Lifetime (automatic tensioner)
<b>Timing gear chain replacement interval</b>	Lifetime
<b>Timing gear tensioning system</b>	Lifetime

<sup>1)</sup> SID = Service Interval Display

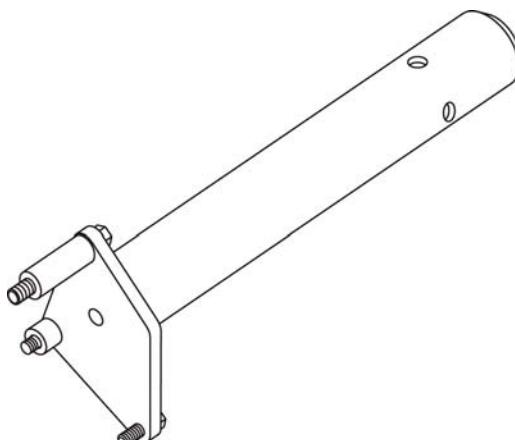
## New special tools for the TT RS

T03000 Engine support



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T03001 Engine support

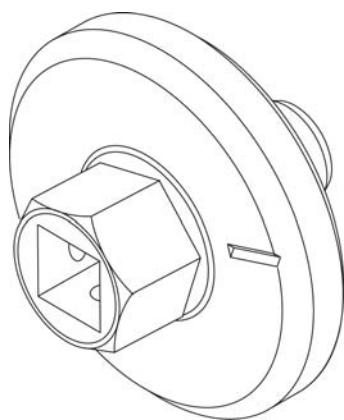


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Removing and installing the engine in combination with the engine and gearbox support V.A.G 1383 A

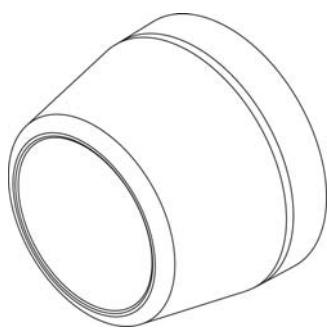
Mounting the engine on the engine and gearbox support VAS 6095 or support clamp VW 313

**T03003 Wrench**



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**T03004 Assembly sleeve**

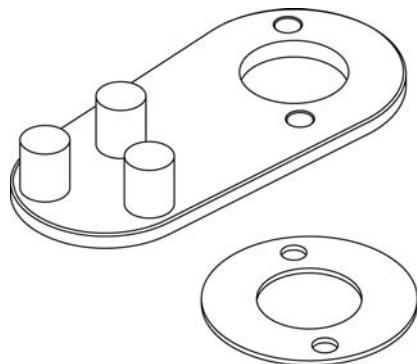


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Set crankshaft to TDC

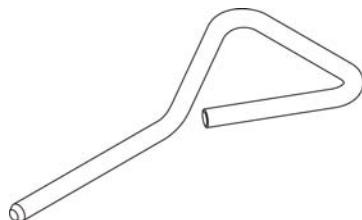
Replace the crankshaft sealing flange on the belt pulley side

**T03005 A Oil pump clamp**



451\_058

**T03006 Locking pin**

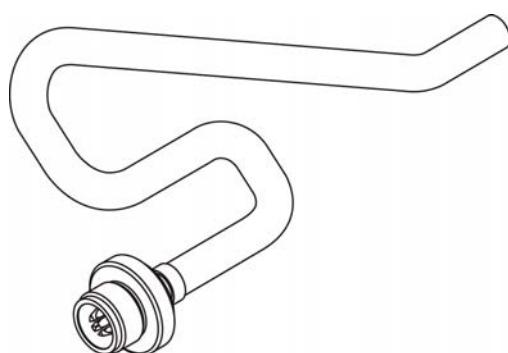


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Oil pump clamp

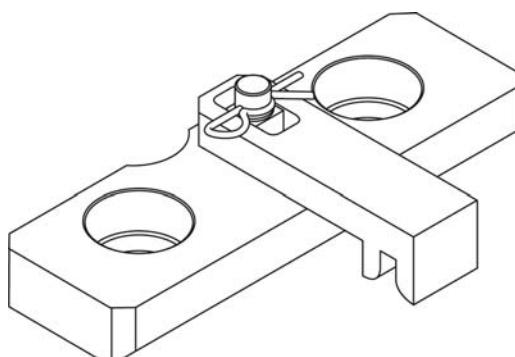
Chain tensioner clamp

**T40057 Oil drain adapter (already on the market)**



451\_060

**T40226 Gauge**



451\_061

Drain engine oil out of the oil filter module

Assembly of the gearbox mounting

# Annex

## Glossary

This glossary explains all terms indicated in italics or marked with an asterisk (\*) in this Self-Study Programme.

### **Blow-by gases**

Blow-by gases are also known as "leakage gases". When the engine is running, blow-by gases flow from the combustion chamber into the crankcase, bypassing the piston. They are produced by the high pressures inside the combustion chamber and the absolutely normal leakage that occurs around the piston rings. Blow-by gases are extracted from the crankcase by a PCV system and admitted into the combustion chamber.

### **PCV**

This abbreviation stands for "Positive Crankcase Ventilation". In this system, fresh air is mixed with the blow-by gases inside the crankshaft chamber. The fuel and water vapours in the blow-by gases are absorbed by the fresh air and discharged via the crankcase ventilation system.

### **Box piston**

Unlike pistons with round skirts, box pistons (or window pistons) are recessed in the area of the skirt which is towards the gudgeon pin. This gives the piston skirt higher rigidity and allows the use of a shorter gudgeon pin.

### **Polyswirl™**

The Polytec Group has developed a passive separation system which considerably reduces the amount of residual oil in the blow-by gases despite its very compact design. Both Audi and Lamborghini currently fit the so-called Polyswirl in their V10 and V8 rocker covers.

### **DFS ring**

Top-bevelled oil control ring with coil expander

### **PVD process**

PVD = Physical Vapour Deposition is a coating process in which the coating material is physically vapour deposited (by kinetic or impact energy) on a material in a vacuum environment. The advantage of this process over the conventional electroplating process is the greater diversity of coating materials (sputter bearings).

### **DNA**

This abbreviation stands for "deoxyribonucleic acid". Deoxyribonucleic acid is a biomolecule which occurs in all living organisms and is the carrier of genetic information. It is used in everyday speech to explain the origin or basis of a concept.

### **Viscous damper**

To reduce the radial vibration caused by the impulse-like transmission of force from the piston to the crankshaft via the gudgeon pin and the connecting rod, torque is briefly increased to peak levels. The result: noise and wear. Torsional vibration dampers attenuate this radial vibration. High-viscosity silicones and oils – so-called viscodampers – are used for this purpose.

### **Downsizing**

Increased efficiency through synergy effects. This means that less material and equipment is needed to achieve the same performance level.

### **Event duration**

Besides the valve opening cross-section (valve lift), the shape of the cam on a camshaft determines the opening duration of the valve. The valve opening duration (event duration) is given in ° crank angle.

### **Wastegate**

To control the charge pressure in a turbocharger, a wastegate is integrated in the exhaust gas flow. If the charge pressure rises above a certain limit, an actuator opens the wastegate. The exhaust gases bypass the turbine and are admitted directly into the exhaust system, thus preventing the turbine speed from rising any further.

### **Nitriding or nitrocarburizing**

Surface treatments improve the running-in behaviour of the piston rings and minimise wear on the piston lining and flanks.

## Test yourself

Which of the following answers is correct?

In some cases, only one answer will be correct.

However, more than one answer might be correct – or even all of them!

### 1. How is the air mass metered in the 2.5l R5 TFSI engine?

- A Using a hot-film air mass meter.
- B Using an air pressure sensor.
- C Using two air pressure sensors.

### 2. How is the oil level of the 2.5l R5 TFSI engine measured/monitored?

- A It is measured dynamically by means of a thermal oil level sender (TOLS) while the vehicle is being driven, and a warning is given when the oil level is low.
- B Using a dip stick.
- C It is measured by an ultrasound oil sensor (PULS) when the vehicle is at idle and at a standstill, and is displayed via the dash panel insert or MMI.

### 3. How are inertial forces balanced in the crank train?

- A By a balancer shaft which is integrated in the cylinder block and driven by the secondary drive chain.
- B By two counteropposed balancer shafts in a balancer shaft module (oil pan).
- C No additional balancing is needed in a five-cylinder inline engine due to its structural design.

### 4. How is the power steering pump in the Audi TT RS driven?

- A By track 1 of the belt drive.
- B By track 2 of the belt drive.
- C The steering on TT RS is servo assisted.

### 5. What is the task of the coolant circuit solenoid valve N492?

- A To open the additional cooling circuit with auxiliary cooler.
- B To control the flow rate in the cooling circuit.
- C To close the additional cooling circuit during the engine's warm-up phase.

### 6. How is power flow established for the reverse gear in manual gearbox 0A6?

- A By changing the direction of rotation via output shaft 3.
- B By changing the direction of rotation via an idler gear which is fixedly connected to the change gear of the first gear.
- C By reversing the direction of rotation via the change gear of the first gear.

Solutions	1. C	2. A, B	3. C	4. C	5. A, C	6. B
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## Summary

Five-cylinder engines are inherent to Audi's DNA\*. Now Audi is building another one – a high-performance powerplant. The Audi TT RS developed by quattro GmbH sports a turbocharged five-cylinder 2.5-litre engine with FSI petrol direct injection that produces 250 kW (340 hp) and 450 Nm of torque, yet consumes only 9.2 litres per 100 km. In conjunction with quattro permanent all-wheel drive, the powerful five-cylinder model offers explosive performance, making the compact Audi TT RS - whether the Coupé or the Roadster - a purist driving machine.

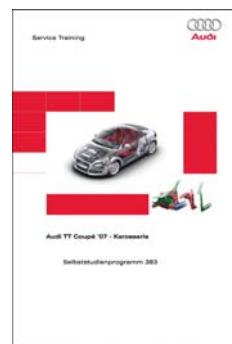
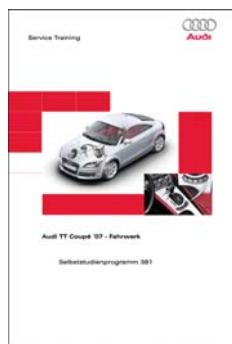
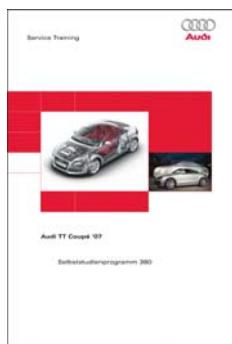
The following table of performance specifications speaks for itself. The Audi TT RS will also be offered with a dual-clutch gearbox at a later date, still unspecified when this SSP went to press.

Audi TT RS Coupé	250 kW/450 Nm	
<b>Standing start acceleration</b>	0 – 100 kph	4.6 s
	0 – 200 kph	15.9 s
<b>Elasticity 80 – 120 kph</b>	Fifth gear	5.1 s
	Sixth gear	5.9 s

In everyday driving at moderate speeds, the car will deliver fuel economy of less than 9 litres/100 km.

## Self-Study Programmes

This Self-Study Programme summarises all you need to know about the Audi TT RS. For further information about the subsystems described in this document, please refer to the relevant Self-Study Programmes.



**SSP 380** Audi TT Coupe '07, order no.: A06.5S00.25.20

**SSP 381** Audi TT Coupe '07 - Suspension System, order no.: A06.5S00.26.20

**SSP 383** Audi TT Coupe '07 - Body, order no.: A06.5S00.28.20

**SSP 436** Modifications to the chain-driven 4-cylinder TFSI engine, order no.: A08.5S00.52.20

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**AUDI AG**  
I/VK-35  
Service.training@audi.de

**AUDI AG**  
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