



The 2005 Audi A6 Engines and Transmissions



Audi

Academy

**SELF-STUDY PROGRAM
COURSE NUMBER 992403**

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Self-Study Program for the 2005 Audi A6



The 2005 Audi A6

- Introduction to the vehicle
- Body technology
- Passenger protection
- Air conditioning

Course Number: 991403



The 2005 Audi A6 Engine and Transmissions

- 3.2 V6 FSI
- 4.2 V8
- 3.0 V6 TDI Common Rail
- Automatic transmissions
- Manual transmissions

Course Number: 992403



The 2005 Audi A6 Running Gear

- Front axle technology
- Rear axle technology
- Steering system
- ESP
- Electromechanical parking

Course Number: 993403



The 2005 Audi A6 Electrical System

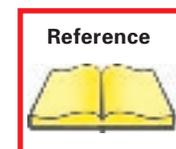
- Networking
- Bus topologies
- Convenience electronics
- Infotainment

Course Number: 994403

The Self-Study Program provides information on the fundamentals of the design and function of new vehicle models, new vehicle components or new technologies.

The Self-Study Program is not a Workshop Manual! Specified values serve only to make the information easier to understand and relate to the software version that was valid at the time the Self-Study Program (SSP) was created.

For maintenance and repair work, please make sure to use the current technical documentation.

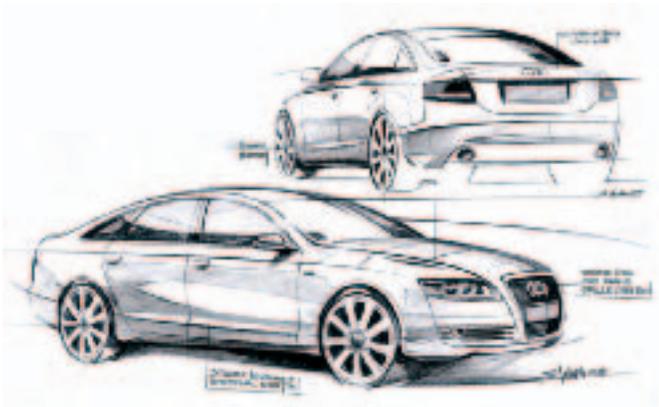


The New Audi A6 – the Most Progressive Vehicle Takes the Lead

Design and performance are the main driving elements on its way to the top position. Furthermore, the new Audi A6 embodies the consequent continuation of the familiar Audi brand values, sports appeal, progressiveness and intrinsic quality, which are evident in the fourth generation of this sporty business limousine.



"Vorsprung durch Technik" - this guiding principle is consistently maintained in the new 2005 Audi A6 through its innovative technologies.



The MMI operating system in the interior of the vehicle is the central control for the extensive functionalities. The driver-orientated cockpit design provides a perfect workplace, which is both stylish and sophisticated. The high functionality is emphasized by the customer-orientated features in the safety and convenience function areas.



Introduction

The 2005 Audi A6 will have two engines available at the North American introduction. A 4.2 liter V8 and the 3.2 V6 FSI. Both engines will be mated to automatic transmissions and quattro all wheel drive system.

The 4.2 liter V8 was introduced in the 2004 Audi S4. It will also be used in the Audi A8L.

The 3.2 V6 FSI is a newly designed engine. It features four-valve per cylinder with direct fuel injection into combustion chamber.

3.2 V6 FSI Engine

The new 3.2 V6 FSI engine is significantly different from the previous 3.0 liter V6 in that the camshafts are now driven by chains located on the back of the engine block.

All camshafts feature continuously variable timing adjustment. The adjusters are locked into position until sufficient oil pressure is developed after starting the engine.

Engineers set the following development goals for the engine:

- Reduced fuel consumption
- High performance
- Sporty and agile behavior with a high level of comfort
- Powerful, sportingly dynamic V6 sound

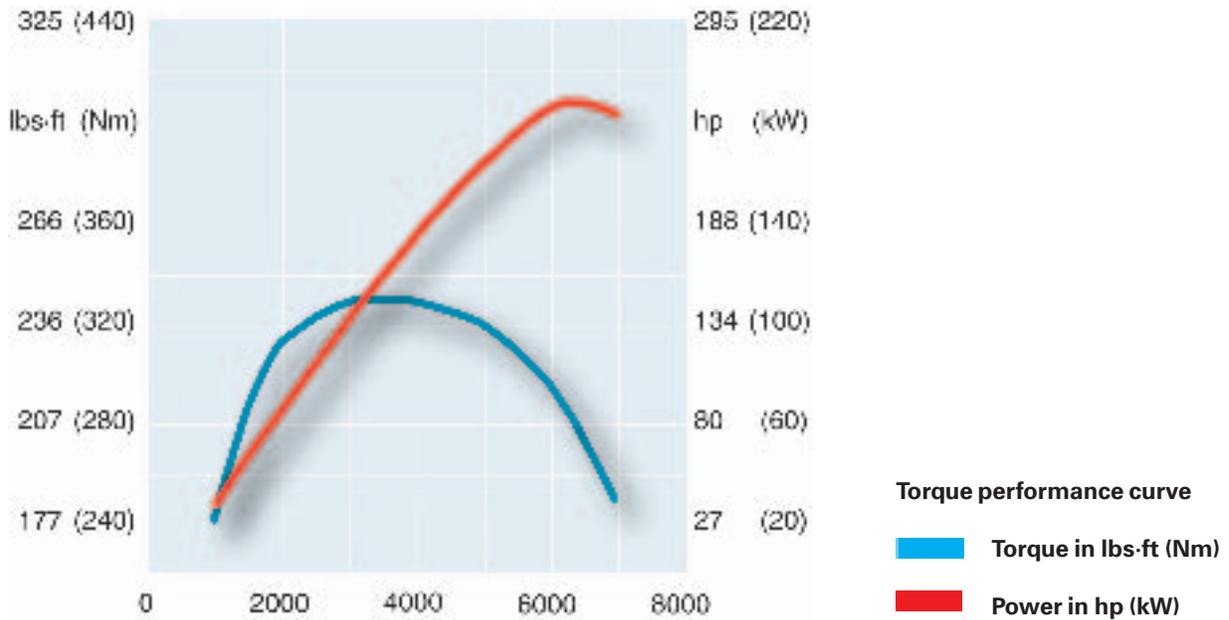
The 3.2 V6 FSI has the following technical features:

- Light-weight crankcase made of an aluminum/silicon/copper alloy
- Light plastic variable length intake manifold
- Balancer shaft for the elimination of first-order free inertia forces
- Low-friction cylinder head with roller-type cam followers
- Front ancillary units driven by Poly-V belts
- Continuous adjustments of the intake and exhaust camshafts
- Siemens engine management with EPC (Electronic Pedal Control)



3.2 V6 FSI Engine

Technical Data



Code	AUK
Type	V engine with an angle of 90°
Displacement in cm³	3123
Power in hp (kW)	255 (188) at 6,500 rpm
Torque in lbs-ft (Nm)	243 (330) at 3,250 rpm
Engine Speed	7,200 rpm
Bore in inches (mm)	3.33 in (84.5 mm)
Stroke in inches (mm)	3.65 in (92.8 mm)
Compression	12.5 : 1
Weight in lb (kg)	Approx. 374 (169.5)
Firing order	1-4-3-6-2-5
Ignition gap	120°
Engine management	Siemens with EPC
Engine oil	SAE 0W 30
Exhaust standard	LEV I

3.2 V6 FSI Engine

Mechanical Features

Crankcase and crankshaft assembly

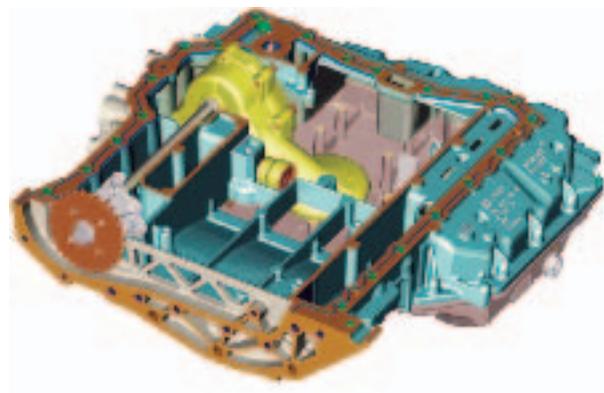
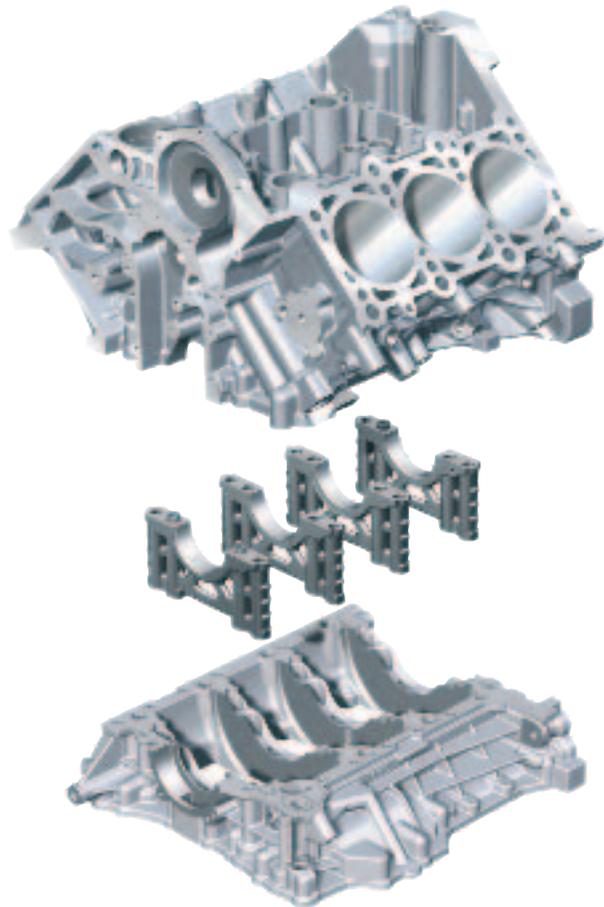
The engine block is made of an aluminum alloy. This is an over-eutectoid monoblock manufactured using the chill-casting procedure.

The block does not use cylinder liners.

Hard primary silicon particles, which are deposited in the liquefied material, are exposed in a special procedure.

The bottom of the engine block (bedplate) houses the four main crankshaft bearings.

The oil pump is integrated in the top of the oil pan while the oil level sensor is housed in the bottom portion.

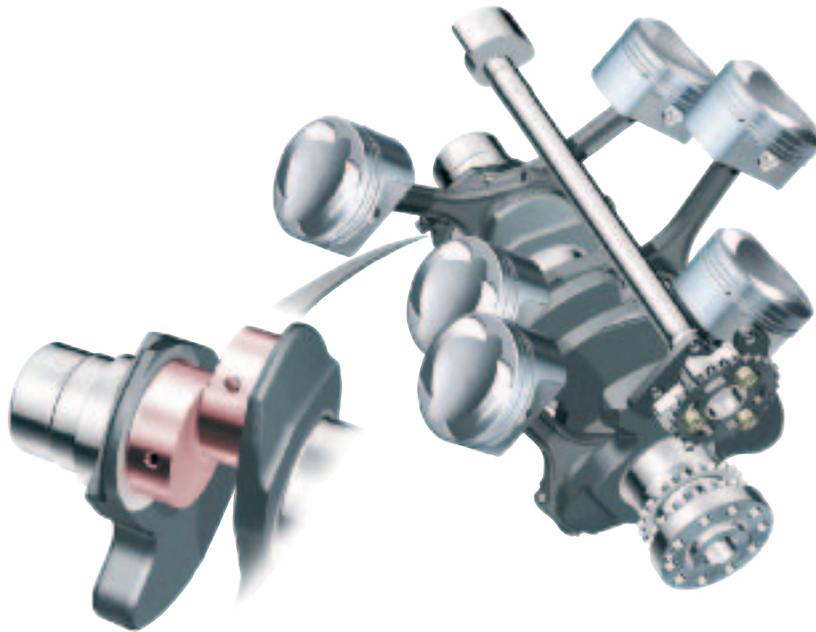


3.2 V6 FSI Engine

The four-plane crankshaft is forged steel with a vibration damper. The crankshaft journals are .04 in (1 mm) wider and the connecting rod journals are .08 in (2 mm) wider when compared to the previous 3.0 L V6 engine. This increases the rigidity and strength of the crankshaft.

The use of different alloys in the connecting rods (from C70 to 33 Mn VS4) allowed the reduction of their size and weight. They are also able to withstand higher load forces.

The connecting rods feature trapezoidal upper ends while the lower ends are mechanically cracked to provide for precision alignment during assembly.



Forged pistons with an FSI-specific combustion chamber are used in the 3.2 V6 engine. Piston pins are coated with a wear resistant ferrous coating.

The pistons are cooled by oil spray jets from the bottom.



3.2 V6 FSI Engine

Crankcase Ventilation

Exhaust blow-by gases are removed only through the cylinder head covers.

A rough separation of the oil is performed in the cylinder head covers using a labyrinth.

The blow-by gases are routed out of the cylinder head covers and into the internal engine V compartment. This contains the dual-cyclone oil separator, which diverts the separated oil directly into the crankcase and also heats the purified blow-by gases to 68 - 77°F (20 - 25°C). The application of heat prevents the hose and the pressure-regulating valve from freezing.

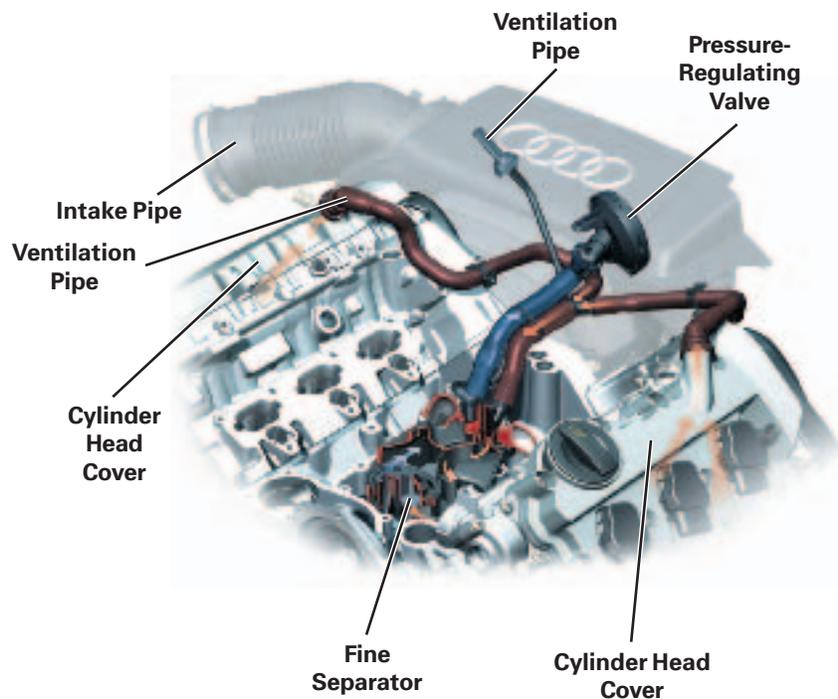
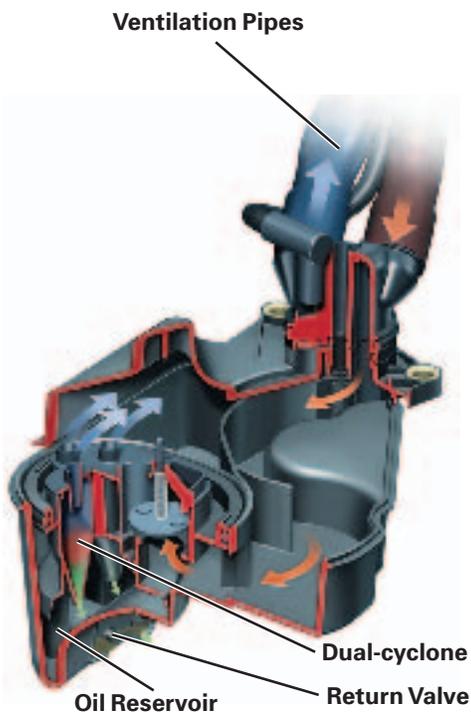
The blow-by gases are passed on to the intake manifold via the pressure-regulating valve and then to the combustion system.

The use of active crankcase ventilation also prevents freezing.

Here, the blow-by volume flow is raised in the near-idle speed range. To do this, fresh air is removed from the intake pipe and routed directly into the crankcase.

This has a positive effect on the oil quality since more water and fuel residues are removed from the engine oil due to the higher throughput of blow-by gases.

The connection is mounted in front of the throttle and on the V compartment cover. To prevent the blow-by gases from being sucked in (as a result of the pressure difference between the crankcase and the intake pipe at full speed and when the throttle is open), a return valve is integrated in the pipe.



3.2 V6 FSI Engine

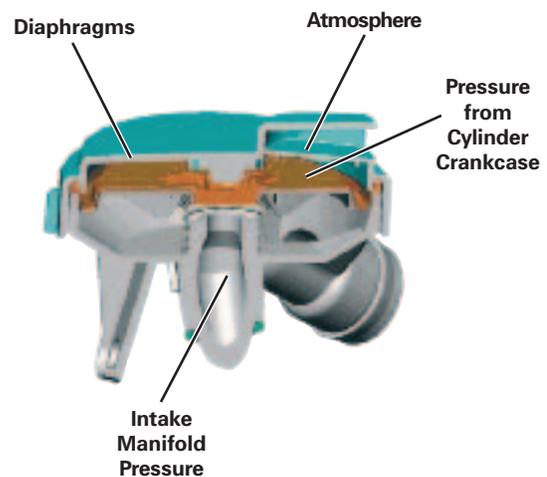
Pressure-Regulating Valve

The pressure-regulating valve regulates the gas throughput and pressure compensation of the crankcase ventilation system. It is a spring-loaded diaphragm valve.

The control connection is linked to the intake manifold. The intake manifold pressure works on the diaphragms. This actuates the valve. There is a strong vacuum in the intake manifold when the throttle is closed. This vacuum closes the pressure-regulating valve against the spring force.

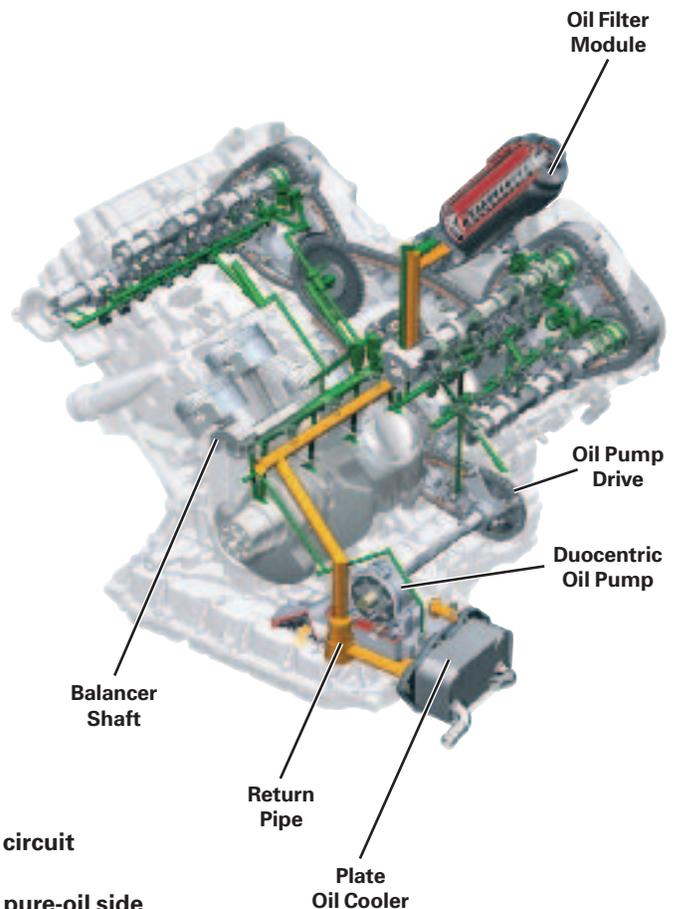
The shaft seals may be damaged if the pressure-regulating valve is faulty (defective diaphragms). If the pressure-regulating valve does not close, an excessively high vacuum builds up in the crankcase. The shaft seals are pulled inward and can then start to leak.

If the valve does not open, too much pressure builds up in the crankcase. This can also damage the shaft seals.



Oil Supply

- Forced-feed lubrication designed for oil specification SAE 0W 30
- Oil pressure control on pure oil-side
- Duocentric oil pump with cold-start valve as overload protection for oil cooler and oil filter
- The oil supply for the camshaft adjusting motors and the head-side chain modules has been separated from the cylinder head oil supply. As a result, the oil pressure in the cylinder head could be reduced.
- New oil filter module means that filters can be changed faster and in a more environmentally friendly way.

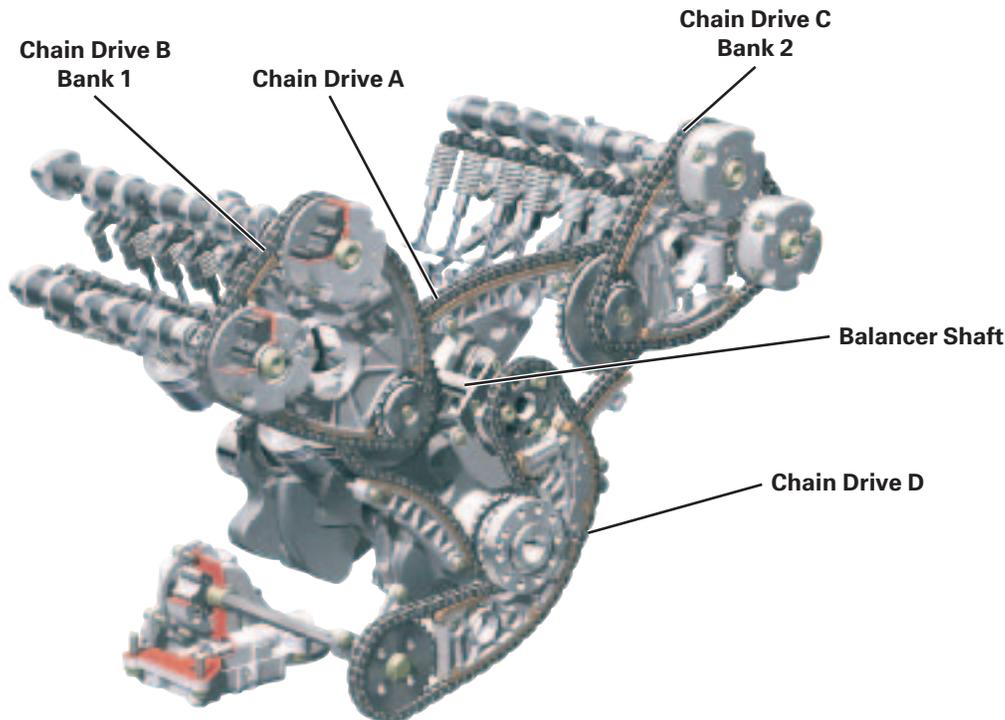


 Forced oil circuit

 Return on pure-oil side

3.2 V6 FSI Engine

Drive Chains



The chain drive is located at the rear of the engine. It is arranged over two levels. Four chains are installed in total.

3/8-inch sleeve chains are used for chain drive A, B, and C. A single roller chain is used for chain drive D. The chains are designed for the service life of the engine.

- Chain drive A: Crankshaft intermediate sprockets
- Chain drive B/C: Camshaft drive
- Chain drive D: Oil pump via idler shaft and balancer shaft

The chains are lubricated using oil spray, which is controlled by the camshaft adjusters.

The chain drives A, B and C are tensioned using mechanical chain tensioners with a hydraulic damping function. Chain drive D is tensioned using a simple mechanical tensioner.

Low-friction guide elements guarantee the smooth running of the entire engine control system.

Balancer Shaft

The masses rotating and oscillating in the engine produce vibrations, which cause noise and rough operation.

Free inertia forces of the first order reduce the level of comfort and can be balanced by the balancer shaft.

The shaft is made of GGG 70. It is located in the V of the engine and is supported by two bearings.

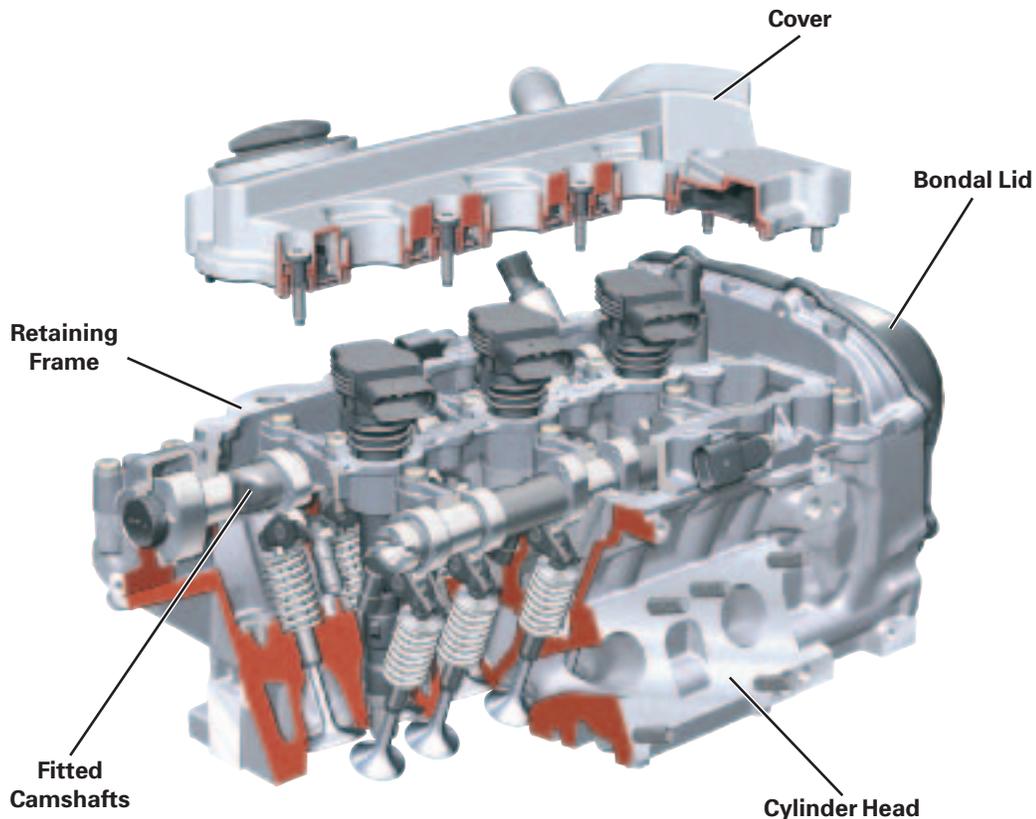
The balancer shaft is driven at engine speed by the chain drive. The direction of rotation of the balancer shaft is opposite of engine rotation.

Oil is supplied via two bores on the main bearing assembly.

3.2 V6 FSI Engine

Cylinder Head

- Aluminum cylinder head
- FSI inlet pipes with variable movement; the horizontal pipe produces a tumble effect
- Valve actuation via roller-type cam followers with hydraulic clearance compensation
- Valve guide made of sintered material (Chromium-plated valves are required.)
- Spring retainer made of hardened aluminum with additional wear-resistant washer
- Simple valve spring
- 2 camshafts installed for each cylinder head
- Inlet camshaft adjusters (adjustment range up to a crank angle of 42°)
- Exhaust camshaft adjusters (adjustment range up to a crank angle of 42°)
- 4 Hall Senders for camshaft position detection
- Camshaft bearing caps designed as a retaining frame
- A multi-layer metal seal cylinder head gasket with silicon pads on the chain housing
- Detached plastic cylinder head cover with integrated oil separator (as a labyrinth)



3.2 V6 FSI Engine

Camshaft Adjusters

The camshaft adjusters are manufactured by Denso.

Both the intake camshaft adjuster and the exhaust camshaft adjuster have an adjusting range of up to a crank angle of 42°. The rotor and stator are weight-optimized and are made of aluminum.

Spring-loaded sealing elements are used for the radial sealing of each of the four pressure chambers.

The adjusters must be locked in a defined position until the required engine oil pressure is built up after starting the engine. Locking takes place in the retard position.

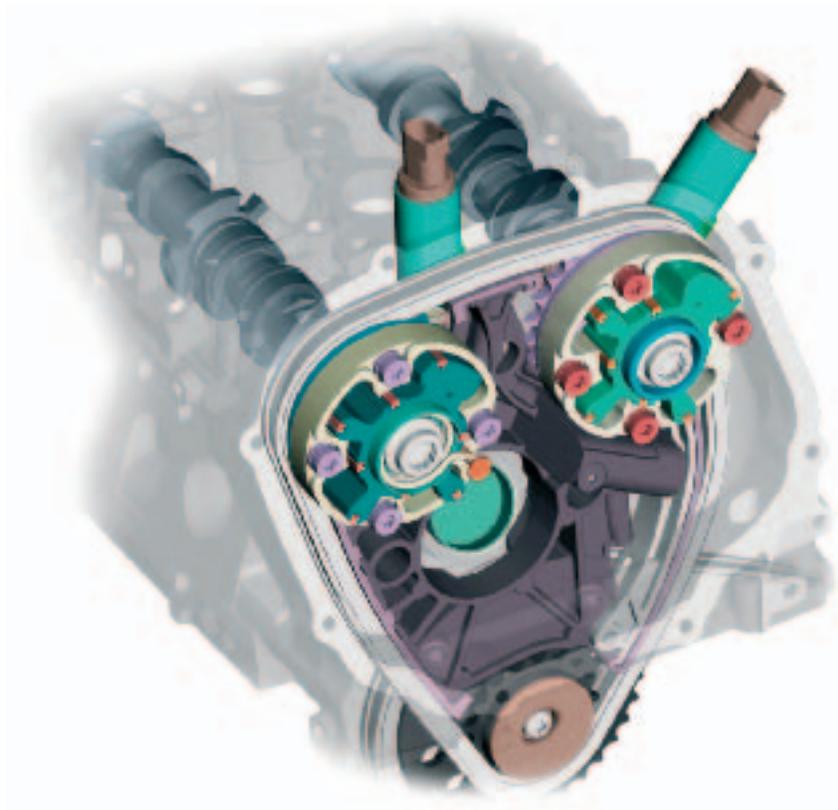
Intake Camshaft Adjuster

Locking is free from play here.

Exhaust Camshaft Adjuster

A return spring supports the movement of the adjuster into the advanced position.

When the engine is stopped, the adjuster is locked in the retarded position and the return spring is tensioned. A limited amount of play has been allowed at the locking pin so that the adjuster releases safely.



3.2 V6 FSI Engine

Air Intake System

The air intake system, from the intake opening at the front of the vehicle to the air outlet at the filter element, is the same for all engines.

A cylindrical air filter cartridge is used to increase the useful life of the air filter. An outlet valve in the filter housing has been used to optimize the discharge of water from the filter housing.

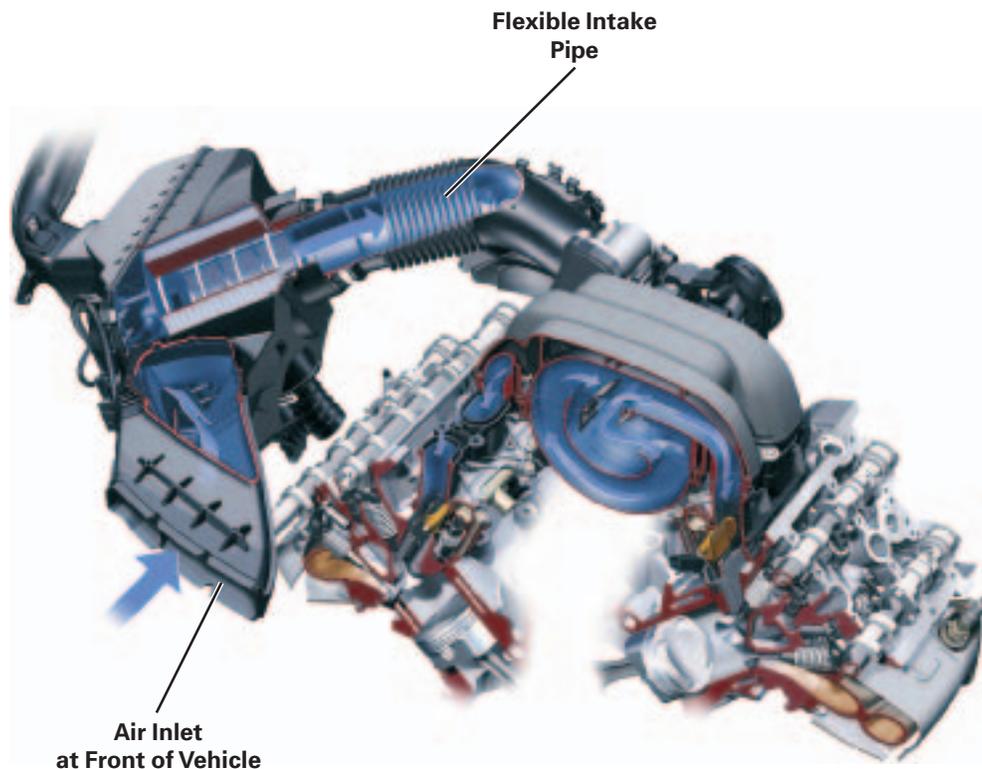
If the engine requires a large amount of air, the Engine Control Module J623 activates the Intake Air Switch-over Valve N335 and a vacuum modulator opens the inlet in the wheel housing.

If an excessively high vacuum is created in the air filter housing (for example, by an obstruction of the air intake opening at the front of the vehicle) the passive opening of the wheel housing is opened. The increased vacuum forces the flap open. The air intake system from the wheel housing has an intake tube with flow-optimized cross-sections.

A snow filter and hot-air intake system installed on vehicles for cold countries. The hot-air intake system is controlled by a wax element.

The throttle body is a single-flow system with water-heating.

Note
Engine management is performed without an air flow sensor. The mass air flow is calculated from the engine speed and intake manifold pressure.



3.2 V6 FSI Engine

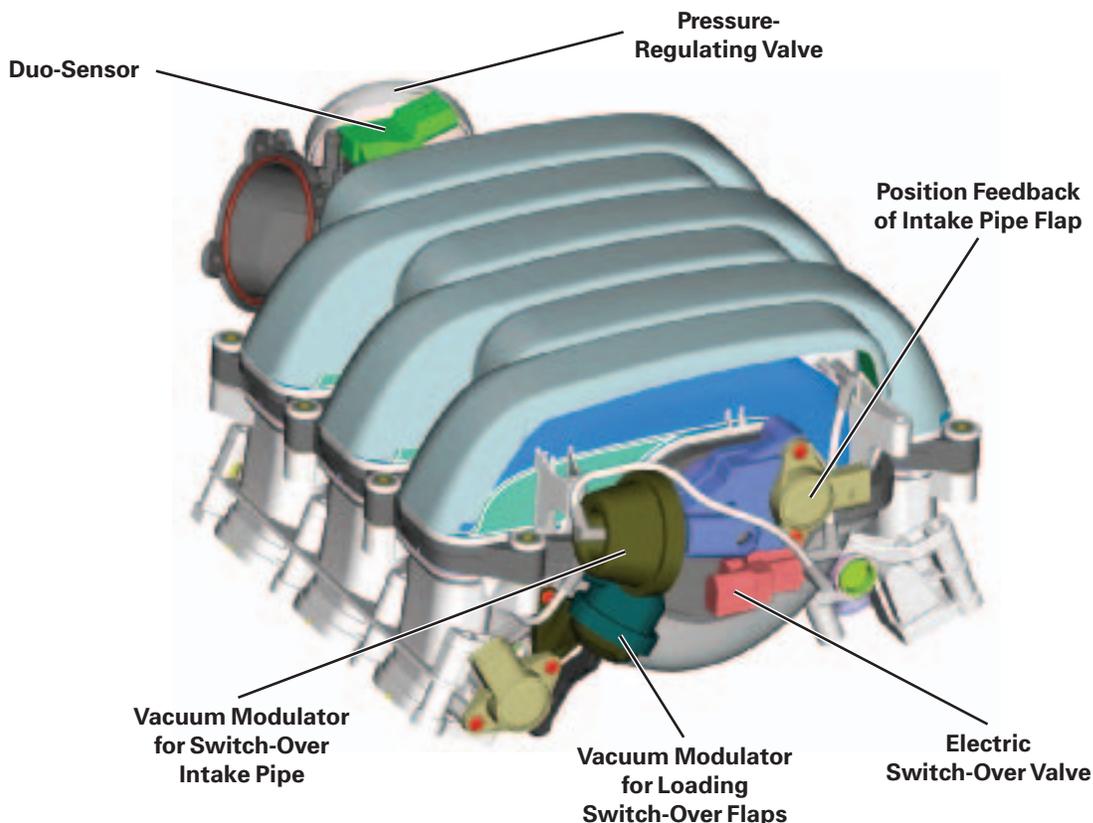
The variable intake manifold is isolated from the engine to reduce noise. It functions in two positions: long intake runners for developing torque and short intake runners for developing power at higher RPM.

An electric solenoid performs the switch over function by regulating the engine vacuum to an accumulator.

Two shafts are used for longitudinal switching of the flaps in the intake manifold. They are connected together by a gear set. The air flaps have an airfoil to improve the airflow through the manifold. The flaps also have an elastomer extrusion-coating to help prevent air leaks.

A duo-sensor (pressure and temperature) and pressure regulating valve for the crankcase ventilation system are also located on the intake manifold.

Note
The Engine Control Module J623 continuously monitors the position of the intake manifold flaps by using Hall Sensors.



3.2 V6 FSI Engine

The intake tube in the cylinder head is divided horizontally into two halves by an inserted refined-steel plate.

It is possible to close off the lower intake tube using the intake tube flaps. This increases the flow intensity and causes a rolling movement (tumble) of the air columns in the combustion chamber.

The intake tube flaps are mounted eccentrically to reduce any flow losses. As a result, they are completely integrated into the tube wall in the open position.

The 2-stage adjustment of the intake tube flaps is done by vacuum motors. In normal operating position, the flaps are closed as a result of spring force.

The position of the flaps is reported to the Engine Control Module by Hall Sensors.

This feature of the intake system is not operational for vehicles in the North American market.



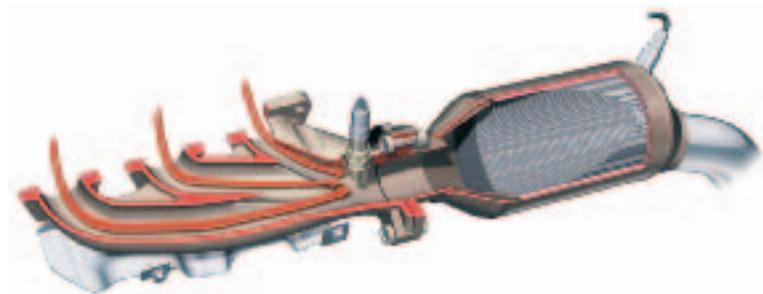
Exhaust system

The exhaust manifold is a cast-iron part.

Connections to the cylinder head are divided into individual flanges in order to prevent thermal stress. The exhaust gases are combined from cylinder 3 to cylinder 2 to cylinder 1.

The oxygen sensor is located at the best possible flow point for all three cylinders, thereby allowing cylinder-selective oxygen sensing.

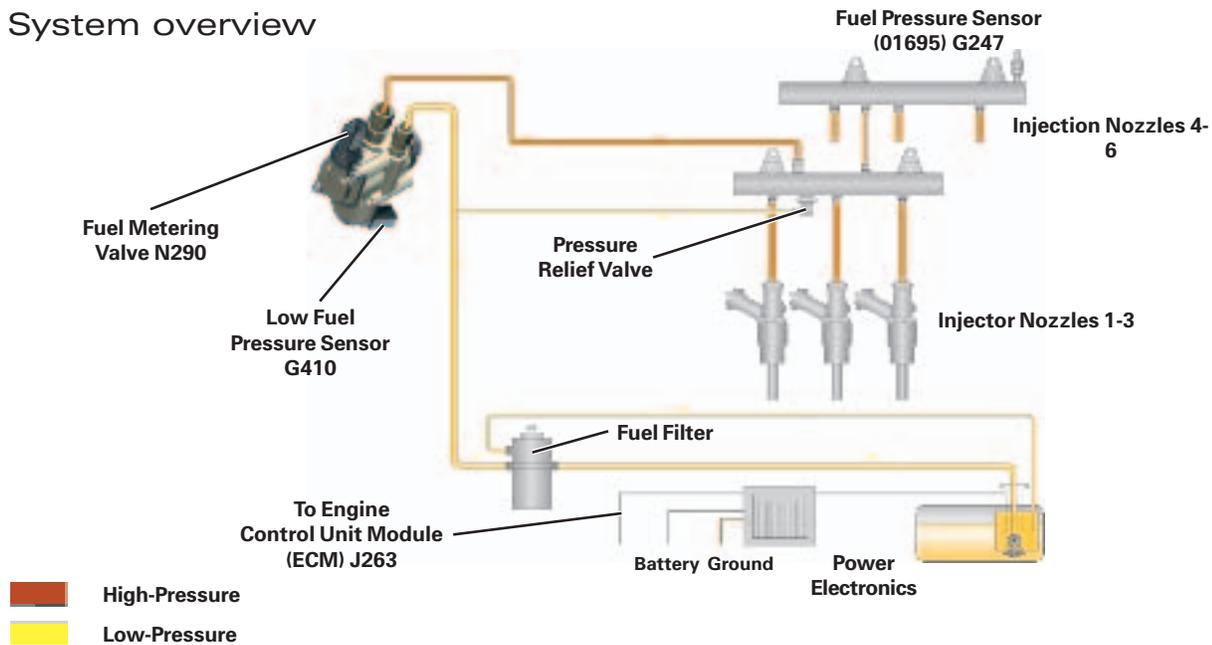
Engine management can thus have a greater influence on the fuel/air mix formation of each cylinder.



3.2 V6 FSI Engine

Fuel supply

System overview



The fuel supply system is divided into two systems; the low-pressure and the high-pressure system.

The low-pressure system is a requirement-regulated fuel system. Here, the power of the electric fuel pump (EFP) is regulated by a PWM signal (pulse width-modulated).

Signal transfer from the Engine Control Module J623 to the performance electronics also takes place via the PWM signal. There is no fuel return line.

The Low Fuel Pressure Sensor G410 ensures that the variable pressure is maintained.

The pre-feed pressure must be increased by 29 psi (2 bar) for the following operating conditions:

- When stopping the engine (electric fuel pump after-run)
- Before starting the engine (fuel pump fore-run), when the ignition is on or when the driver's door contact is opened
- While starting the engine and up to around 5 seconds after engine start
- When warm-starting to prevent the formation of vapor bubbles

Advantages

Advantages include:

- Energy saving due to the lower power consumption of the electric fuel pump
- Lower heat absorption in the fuel – only the fuel quantity that is currently required is compressed
- The service life of the electric fuel pump is extended
- Reduced noise, particularly at idle speed
- On-board diagnosis of the low-pressure system and the accumulator of the high-pressure system is possible (via the Low Fuel Pressure Sensor)



Note:

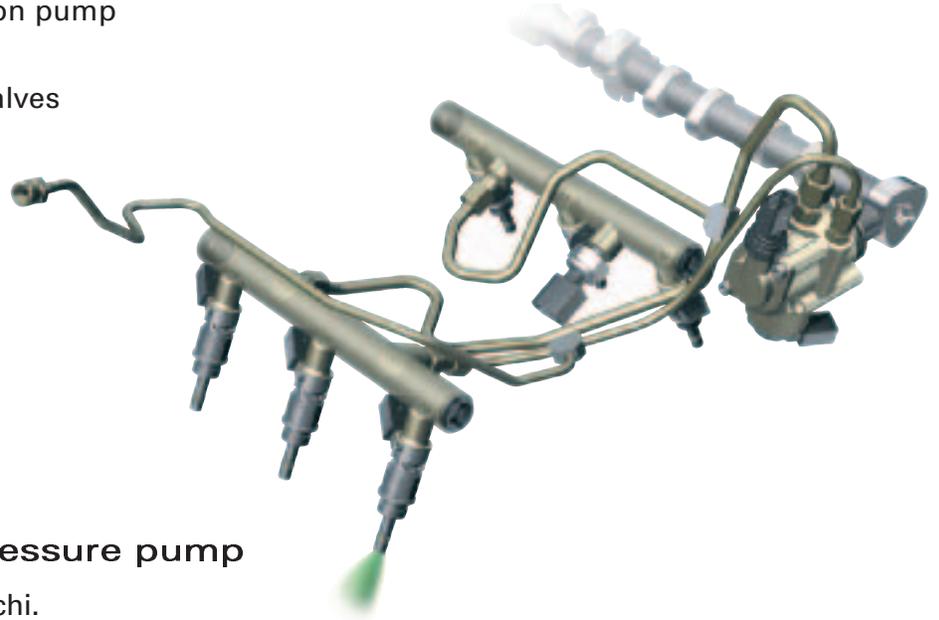
When the power electronics or the Engine Control Module (ECM) J623 is replaced, the pump control unit must always be adapted accordingly using the specified troubleshooting steps.

3.2 V6 FSI Engine

High-pressure system

The high-pressure system is made up of the following components:

- High-pressure fuel distributor panel, integrated in the intake manifold flange, with pressure sensor and pressure-control valve
- High-pressure fuel injection pump
- High-pressure fuel lines
- High-pressure injection valves



Single-piston high-pressure pump

This is manufactured by Hitachi.

It is driven at the end of the inlet camshaft of Bank II via a cam lobe.

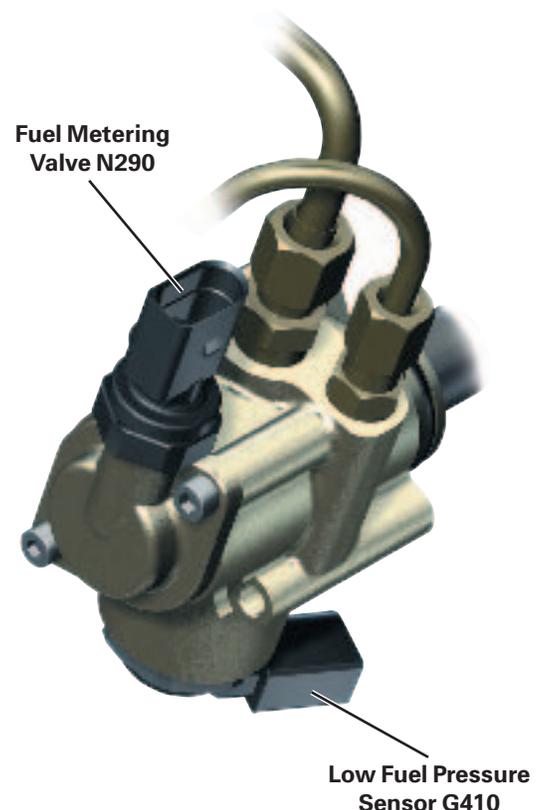
It produces fuel pressure of between 435 and 1740 psi (30 and 120 bar.) The pressure is set by the Fuel Metering Valve N290, depending on the nominal value. The Fuel Pressure Sensor G247 monitors the pressure here.

The pump does not have a return line, but feeds the controlled fuel back into the flow-side internally. The Low Fuel Pressure Sensor G410 is integrated in the pump.

This system is a requirement-regulated, high-pressure pump.

This means that only the quantity of fuel determined by the Engine Control Module (ECM) J623 is fed into the high-pressure rail.

The advantage of this system compared with a continuous-feed, high-pressure pump is the reduced drive power. Only the fuel that is actually needed is fed into the system.

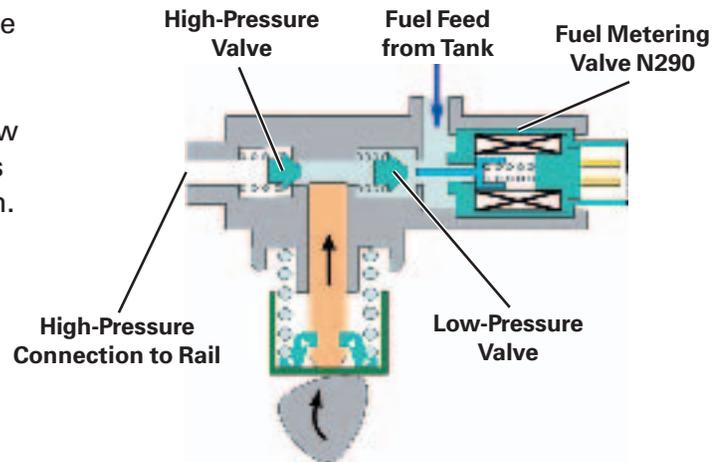


3.2 V6 FSI Engine

Intake stroke

The shape of the cam and the force of the piston springs move the pump piston downwards. The increased space in the inside of the pump causes the fuel to flow in. The Fuel Metering Valve N290 ensures that the low pressure valve remains open.

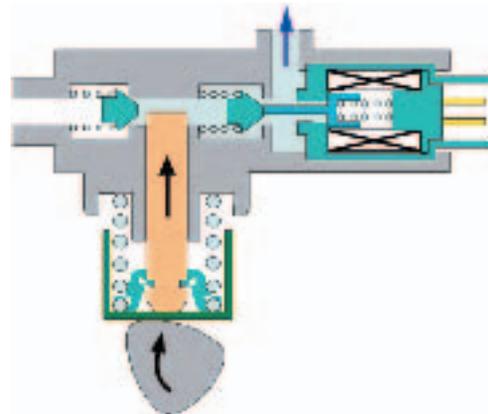
The Fuel Metering Valve N290 is de-energized.



Useful stroke

The cam moves the pump piston upwards. Pressure still cannot be built up because the Fuel Metering Valve N290 is de-energized.

This prevents the low-pressure inlet valve from closing.

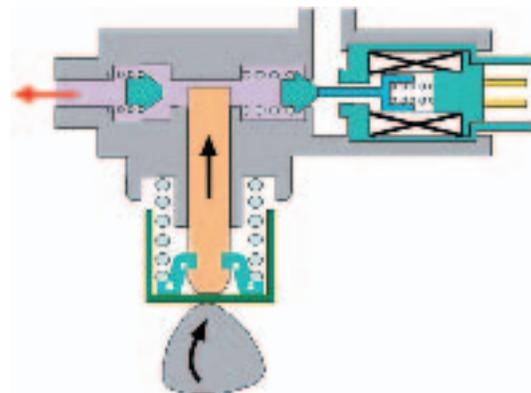


Pressure stroke

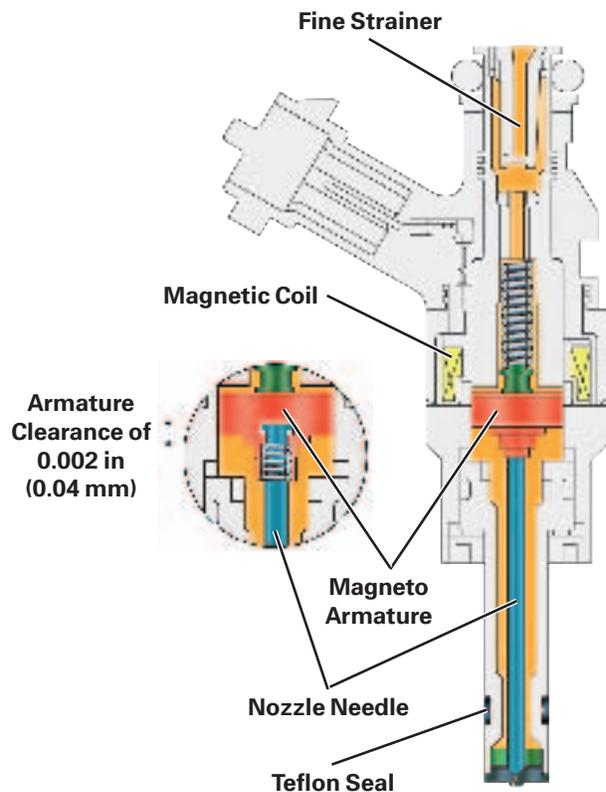
The Engine Control Module (ECM) J623 now supplies current to the Fuel Metering Valve. The magneto armature is drawn up.

The pressure inside the pump presses the low-pressure inlet valve into its seat.

If the pressure inside the pump exceeds the rail pressure, the return valve is pushed open and fuel is delivered to the rail.



3.2 V6 FSI Engine



Like the high-pressure pump, the high-pressure injection valves are also manufactured by Hitachi. Their job is to inject fuel directly into the combustion chamber at the right time and in the right quantity.

The Engine Control Module (ECM) J623 activates the injection valves by applying approx. 65 volts of power. The quantity of fuel is determined by the opening time and the fuel pressure.

The combustion chamber is sealed with a Teflon seal, which must always be replaced following disassembly.

Note
Always use Special Tool T10133 when replacing the Teflon injector seals.

FSI operating methods

The FSI combustion procedure is essentially restricted to homogeneous operation.

The “layer loading operation” method is not implemented for the following reason.

In the lower engine speed range and with a low engine load, a high-volume 6-cylinder engine has a lower thermal load than a 4-cylinder engine with low piston displacement. Due to the low exhaust gas temperature, the NO_x storage catalytic converter does not reach its operating temperature of up to 1112°F (600°C).

The “homogeneous operation” method is divided into two operating states.

1. Homogeneous operation with closed intake manifold flap

The intake manifold flap is closed in the engine speed range up to approx. 3,750 rpm or with an engine load of up to 40%, depending on the map. The lower intake pipe is closed off.

The mass air flow, which is sucked in, is accelerated via the top intake pipe and flows in rolls (tumbles) into the combustion chamber.

Injection takes place in the intake tract.

2. Homogeneous operation with open intake manifold flap

The intake manifold flap opens at an engine speed of approx. 3,750 rpm or with an engine load of more than 40%. This ensures high air throughput at a high engine speed and engine load.

This is supported by a high volume-dimensioned two-stage intake pipe, which has switched to suit the performance range (short intake pipe).

Injection also takes place in the intake tract here.

3.2 V6 FSI Engine

Engine Management

System Overview

Sensors

Manifold Absolute Pressure (MAP) Sensor G71
Intake Air Temperature (IAT) Sensor G42

Engine Speed (RPM) Sensor G28

Camshaft Position (CMP) Sensor G40
Camshaft Position (CMP) Sensor 2 and 3 G163/G300
Hall Sender G301

Throttle Valve Control Module
Angle Sensor 1 and 2 for Throttle Drive
(Power Accelerator Actuation) G187 and G188

Throttle Position (TP) Sensor G79
Sender for Acceleration Pedal Position G185
Clutch Pedal Switch F36
Clutch Pedal Starter Interlock Switch F194 only

Brake Light Switch F
Brake Pedal Switch F47

Fuel Pressure Sensor G247

Low Fuel Pressure Sensor G410

Intake Manifold Runner Position Sensor G336
Intake Manifold Runner Position Sensor 2

Knock Sensor G61, G66
Knock Sensors (KS) 1 and 2 G61/G66

Engine Coolant Temperature (ECT) Sensor G62

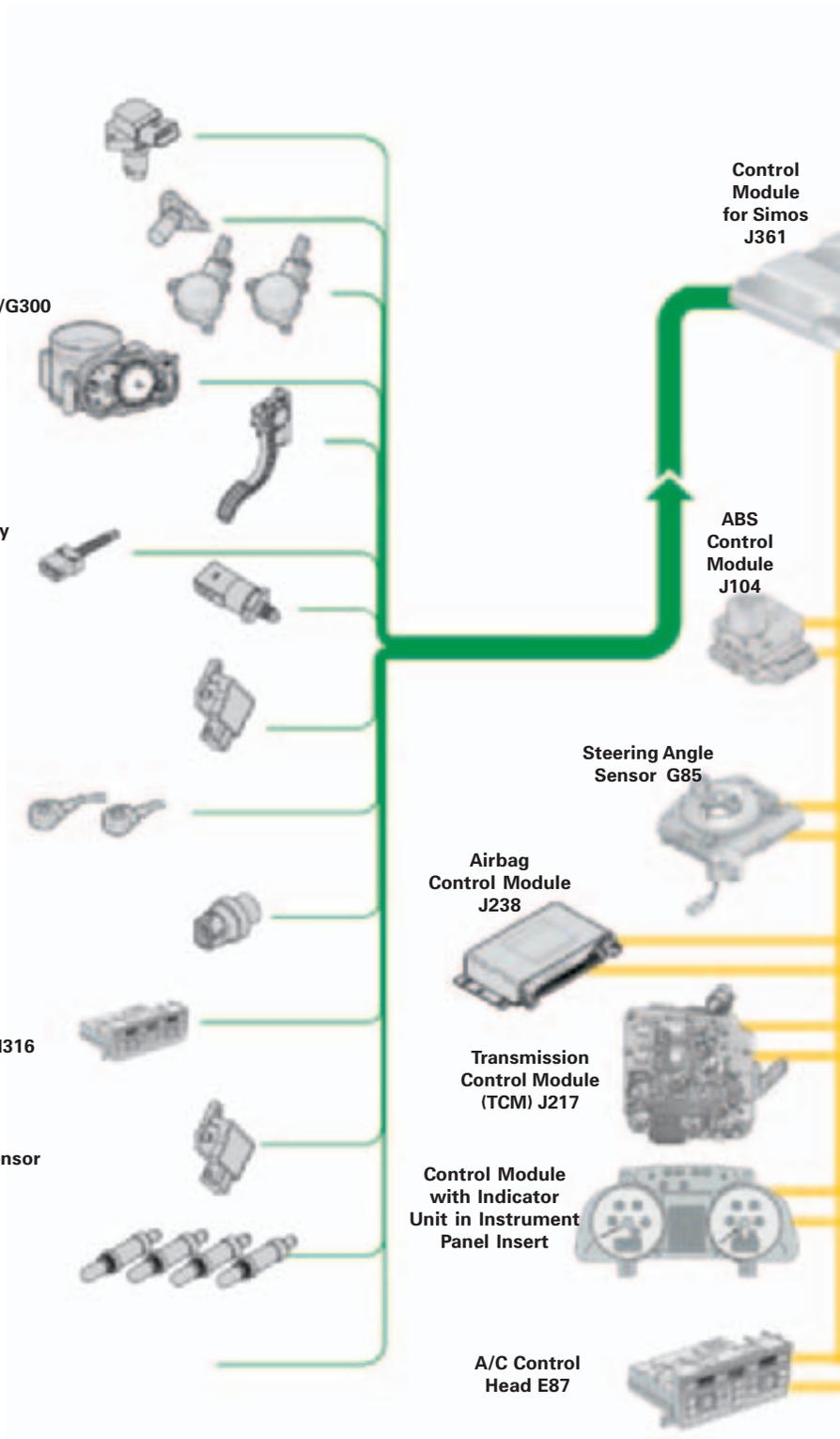
Intake Manifold Runner Control (IMRC) Valve N316

Intake Manifold Tuning (IMT) Valve Position Sensor
(P2076) G513

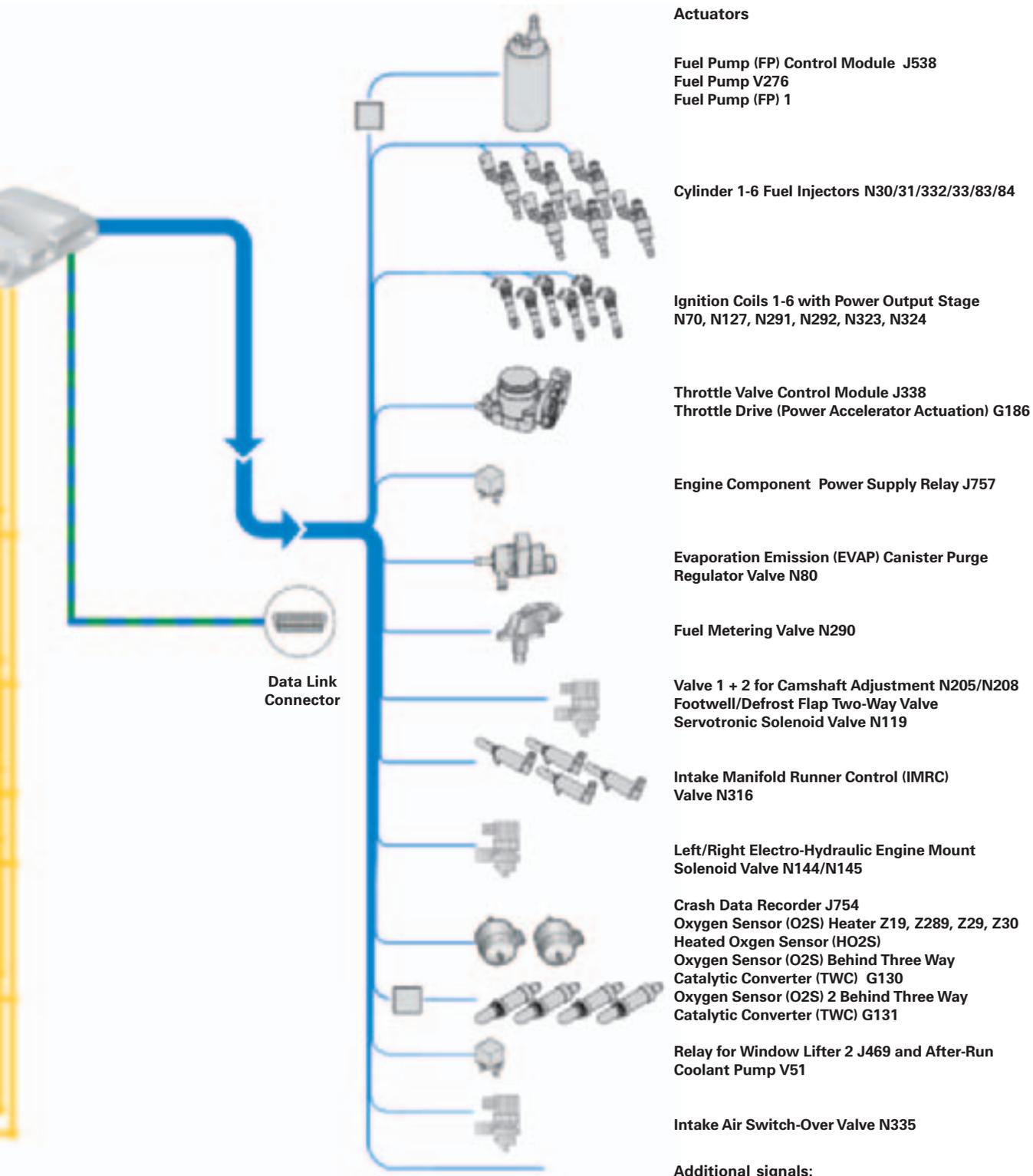
Heated Oxygen Sensor (HO2S) 2 G108+
Heated Oxygen Sensor (HO2S) G39
Oxygen Sensor (O2S) Behind Three Way
Catalytic Converter (TWC) G130+
Oxygen Sensor (OS2) 2 Behind Three Way
Catalytic Converter (TWC) G131

Additional signals:

- J393 (Door Contact Signal)
- J518 (Start Request)
- J695 (Output from Starter Relay, Terminal 50 Stage 2)
- J53 (Output from Starter Relay, Terminal 50 Stage 1)
- J518 (Terminal 50 on Starter)
- J364 (Auxiliary Heating)
- E45 (Cruise Control System)



3.2 V6 FSI Engine



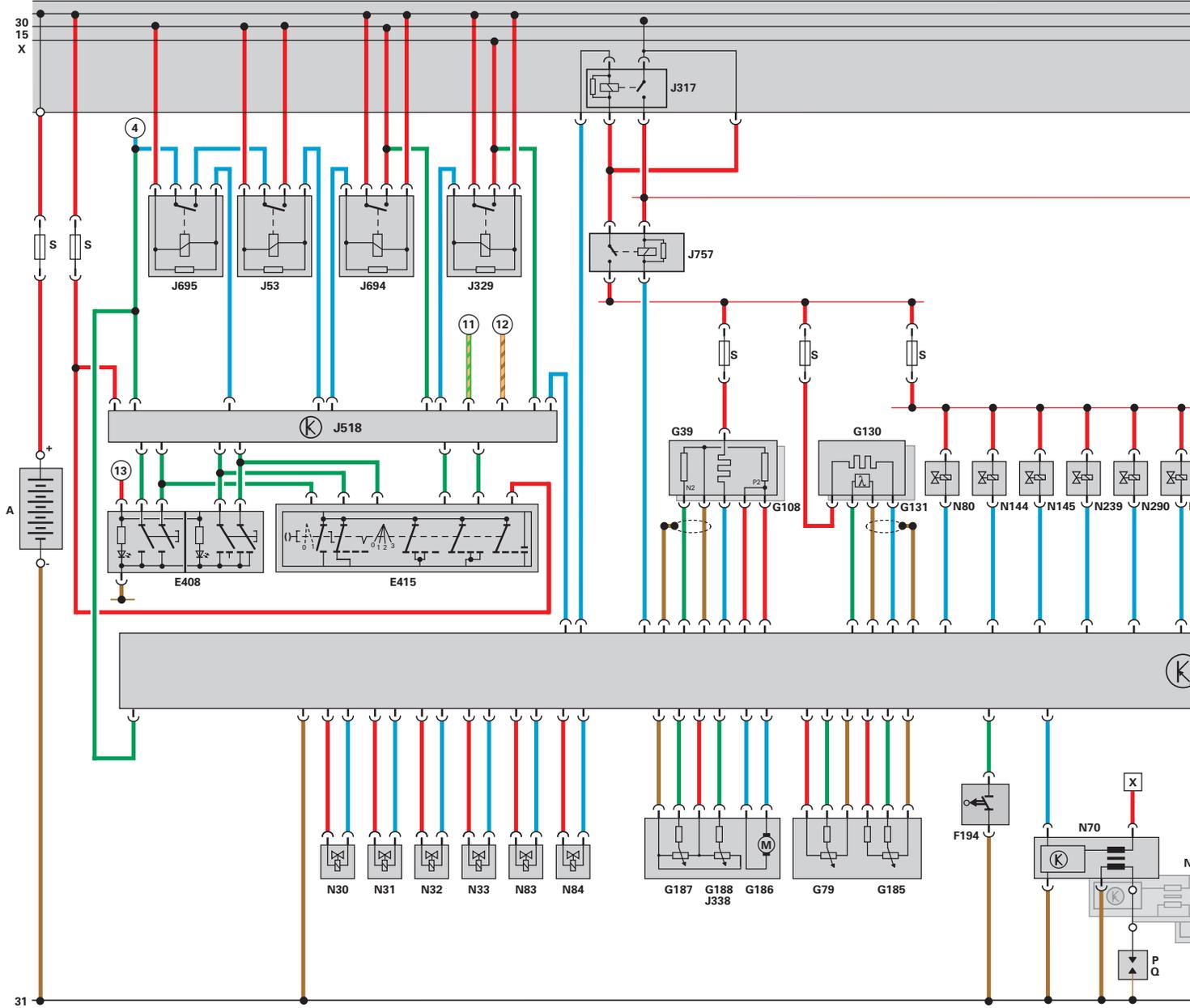
3.2 V6 FSI Engine

	= Input signal		= Positive		= Bi-directional
	= Output signal		= Ground		= CAN BUS

Components

A	Battery	N31	Cylinder 2 Fuel Injector
E45	Cruise Control Switch	N32	Cylinder 3 Fuel Injector
E408	Access/Start Authorization Button	N33	Cylinder 4 Fuel Injector
E415	Access/Start Authorization Switch	N70	Ignition Coil 1 with Power Output Stage
F19	Clutch Pedal Starter Interlock Switch manual transmission only)	N80	Evaporation Emission (EVAP) Canister Purge Regulator Valve)
G	Sender for fuel gauge	N83	Cylinder 5 Fuel Injector
G28	Engine Speed (RPM) Sensor	N84	Cylinder 6 Fuel Injector
G39	Heated Oxygen Sensor (HO2S)	N127	Ignition Coil 2 with Power Output Stage
G40	Camshaft Position (CMP) Sensor	N144	Left Electro-Hydraulic Engine Mount Solenoid Valve
G42	Intake Air Temperature (IAT) Sensor	N145	Right Electro-Hydraulic Engine Mount Solenoid Valve
G61	Knock Sensor (KS) 1	N156	Intake Manifold Change-Over Valve
G62	Engine Coolant Temperature (ECT) Sensor	N205	Valve 1 for camshaft adjustment
G66	Knock Sensor (KS) 2	N208	Valve 2 for camshaft adjustment
G71	Manifold Absolute Pressure (MAP) Sensor	N290	Fuel Metering Valve
G79	Throttle Position (TP) Sensor	N291	Ignition Coil 3 with Power Output Stage
G108	Heated Oxygen Sensor (HO2S) 2	N292	Ignition Coil 4 with Power Output Stage
G130	Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC))	N316	Intake Manifold Runner Control (IMRC) Valve
G131	Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC)	N318	Camshaft Adjustment Valve 1 (exhaust)
G163	Camshaft Position (CMP) Sensor 2	N319	Camshaft Adjustment Valve 2 (exhaust)
G169	Fuel Level Sensor 2	N323	Ignition Coil 5 with Power Output Stage
G185	Sender 2 for accelerator pedal position	N324	Ignition Coil 6 with Power Output Stage
G186	Throttle drive (power accelerator actuation)	N335	Intake Air Switch-over valve
G187	Angle sensor 1 for throttle drive (power accelerator actuation)	S	Fuse
G188	Angle sensor 2 for throttle drive (power accelerator actuation)	S204	Fuse 1 (30)
G247	Fuel Pressure Sensor	V51	After-Run Coolant Pump
G300	Camshaft Position (CMP) Sensor 3	V276	Fuel Pump (FP) 1
G301	Camshaft Position (CMP) Sensor 4	①	Fuel level for instrument panel insert
G336	Intake Manifold Runner Position Sensor	②	Fuel level for instrument panel insert (for quattro only)
G410	Low Fuel Pressure Sensor	③	Terminal 87, from auxiliary heating control module
G501	Driveshaft 1 Speed Sensor	④	Door contact signal
G513	Intake Manifold Tuning (IMT) Valve Position Sensor	⑤	Terminal 50, stage 1
G512	Intake Manifold Runner Position Sensor 2	⑥	Terminal 50, stage 2
J53	Starter Relay	⑦	Terminal 50
J271	Motronic Engine Control Module (ECM) Power Supply Relay	⑧	Selector lever position (P/N)
J317	Power Supply (Terminal 30, B+) Relay	⑨	Engine speed
J329	Voltage Supply Terminal 15 (B+) Relay	⑩	Fan stage 1
J338	Throttle Valve Control Module	⑪	Redundant brake light signal
J361	Control module for Simos	⑫	Brake light signal
J496	Auxiliary Engine Coolant (EC) Pump Relay	⑬	CAN Drive data bus, High
J518	Access/Start Control Module	⑭	CAN Drive data bus, Low
J538	Fuel Pump (FP) Control Module	⑮	CAN Convenience data bus
J694	Power Supply Relay (terminal 75x)	⑯	CAN Drive data bus
J695	Starter Relay 2	⑰	To lights
J757	Engine Component Power Supply Relay		
N30	Cylinder 1 Fuel Injector		

 +  connections within the function diagram



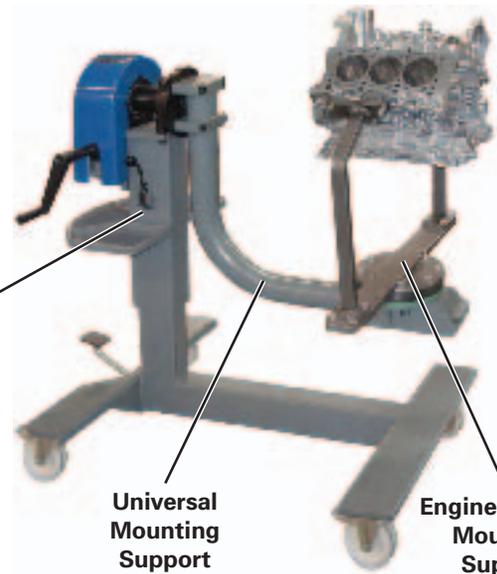
3.2 V6 FSI Engine

Special Tools

Here are the new Special Tools for the 3.0 V6 TDI and the 3.2 V6 FSI Engine.



Engine and
Transmission
Holder VAS 6095



Universal
Mounting
Support

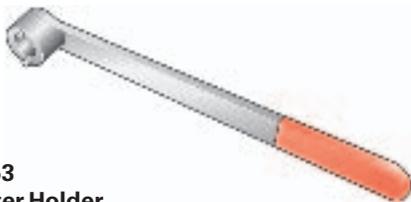
Engine-Specific
Mounting
Support



T40048
Assembly Device for
Crankshaft Sealing Ring



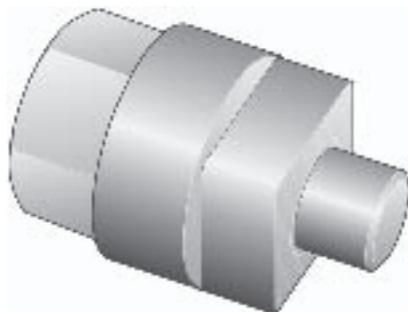
T40049
Adapter
Crankshaft Turns on Flywheel Side



T40053
Counter Holder
for High-Pressure Fuel Pump Wheel



T40055
Socket Wrench
for High-Pressure Line

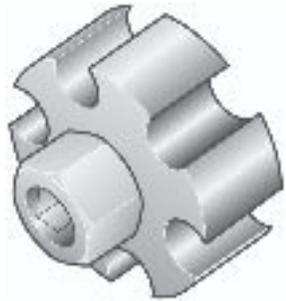


T40058
Adapter
Crankshaft Turns Belt Pulley

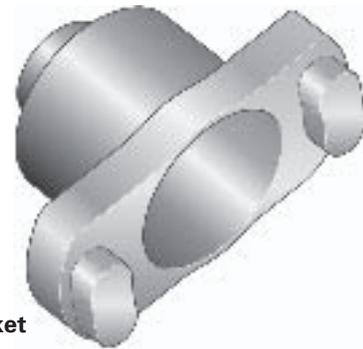


T40060
2 Alignment Pins
for Chain Sprocket

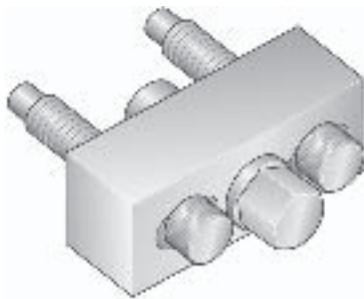
3.2 V6 FSI Engine



T40061
Adapter
for Camshaft



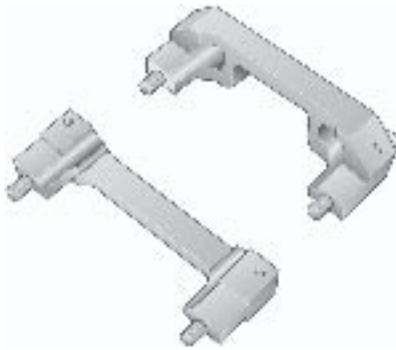
T40062
Adapter
for Chain Sprocket



T40064
Pullers
for High-Pressure Fuel Pump Wheel



T40069
Fixing Pin



T40070
Camshaft Fixing Device



T40071
Lock Pin
for Chain Tensioner



VAS 5161
Valve Keys

4.2 V8 Engine

Introduction

The 4.2 liter V8 engine has been redesigned to reduce its overall size. This allows it to be used in engine compartments of smaller configurations.

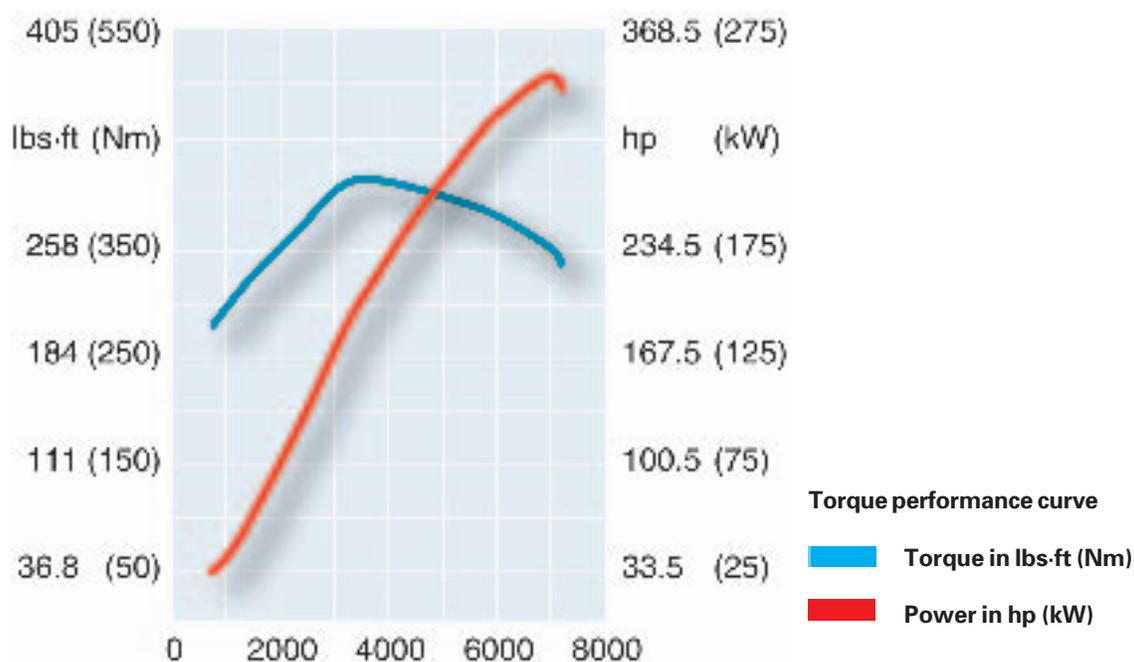


Reducing the overall length was accomplished by replacing the toothed belt at the front of the engine with multiple long-life single row chains mounted at the rear of the engine block.

This design shortens the engine by 2.0 in (52 mm) to make it 18.3 in (464 mm) in length.

4.2 V8 Engine

Technical Data

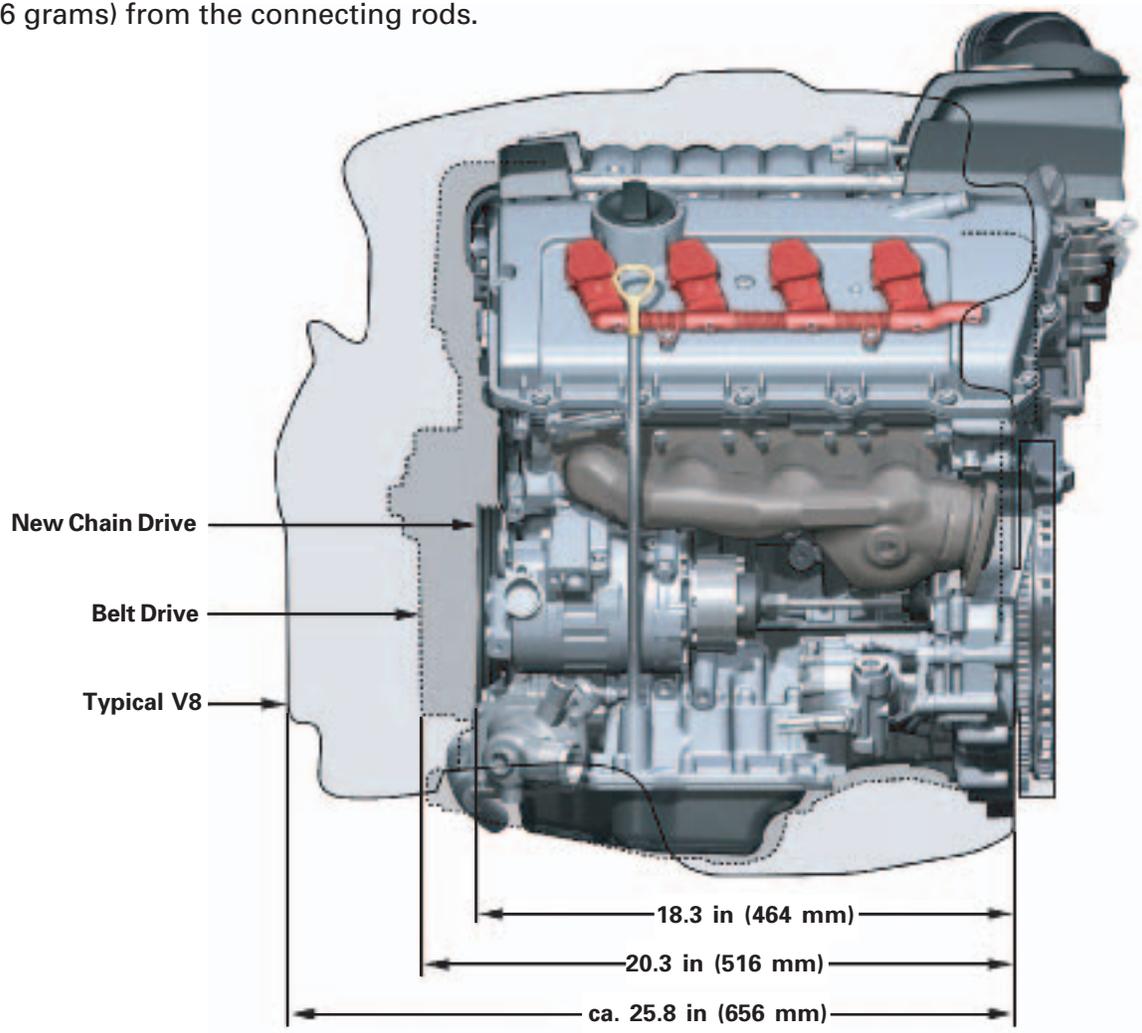


Code	BAT
Type	V8 spark-ignition engine
Displacement in cm³	4163
Power in hp (kW)	335 (246) at 6,600 rpm
Torque in lbs·ft (Nm)	310 (420) at 3,500 rpm
Bore in inches (mm)	3.3 in (84.5 mm)
Stroke in inches (mm)	3.7 in (92.8 mm)
Compression	11 : 1
Firing order	1-5-4-8-6-3-7-2
Engine management	Bosch Motronic
Engine oil	SAE 0W 30
Exhaust standard	LEV 1

4.2 V8 Engine

The use of magnesium components reduced the weight of the engine by 11 lb (5 kg) to 429 lb (195 kg), making it as light as the 2.7 liter V6 biturbo. Further weight savings came from a reduction of .15 lb (70 grams) per piston, and .145 lb (66 grams) from the connecting rods.

As a result, the power to weight ratio of the 4.2 has improved from 10.6 lb/hp (5.9 kg/hp) to 13 lb/hp (4.8 kg/hp). The reduced and balanced weight also produced impressive handling characteristics.



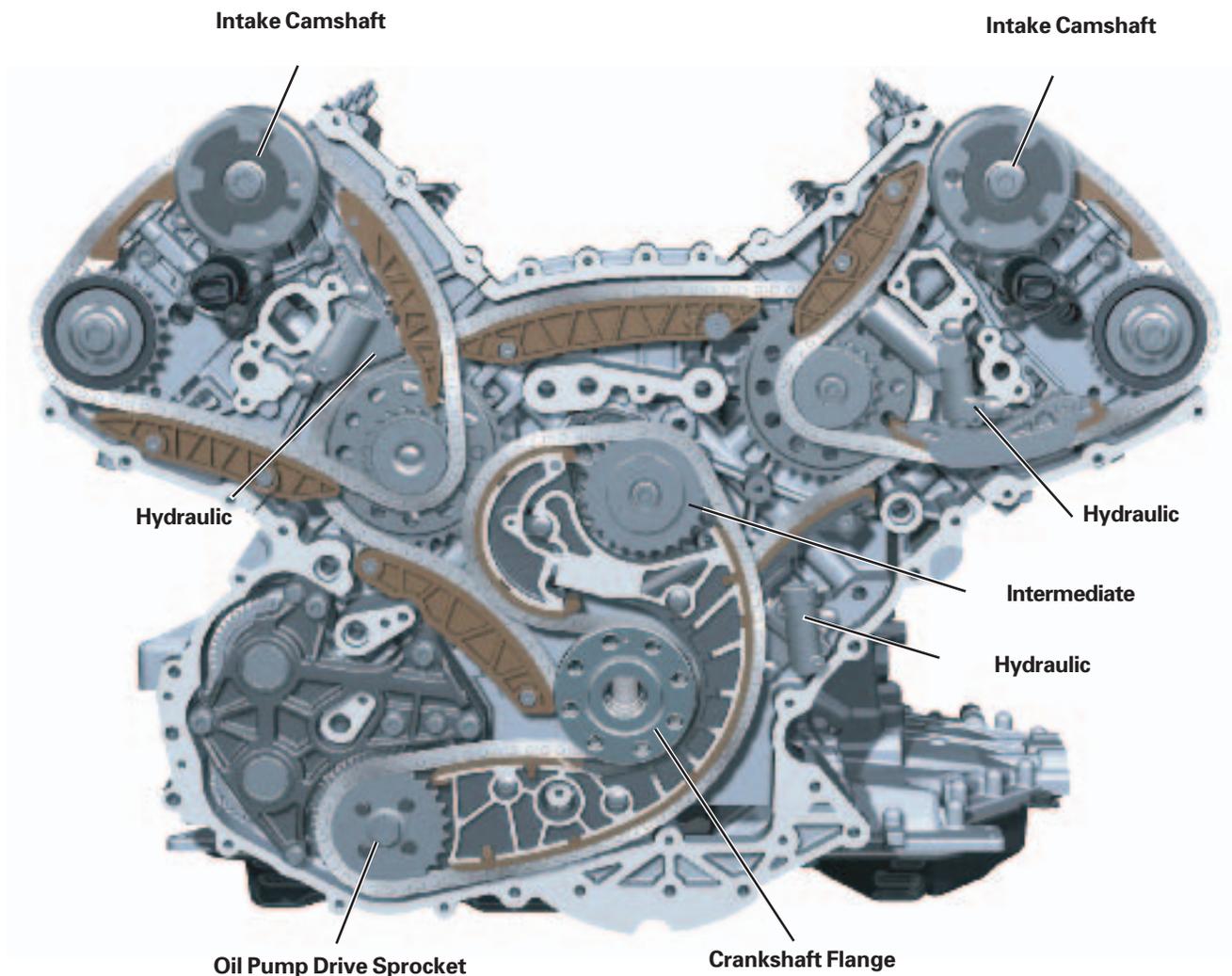
The short build length of the engine offers further advantages. With Quattro all-wheel drive requiring a longitudinally-mounted engine ahead of the front axle, this shorter V8 makes the car's weight distribution more favorable.

4.2 V8 Engine

The aluminum block has eight aluminum alloy cylinders divided into two banks. The forged steel crankshaft has four main bearings.

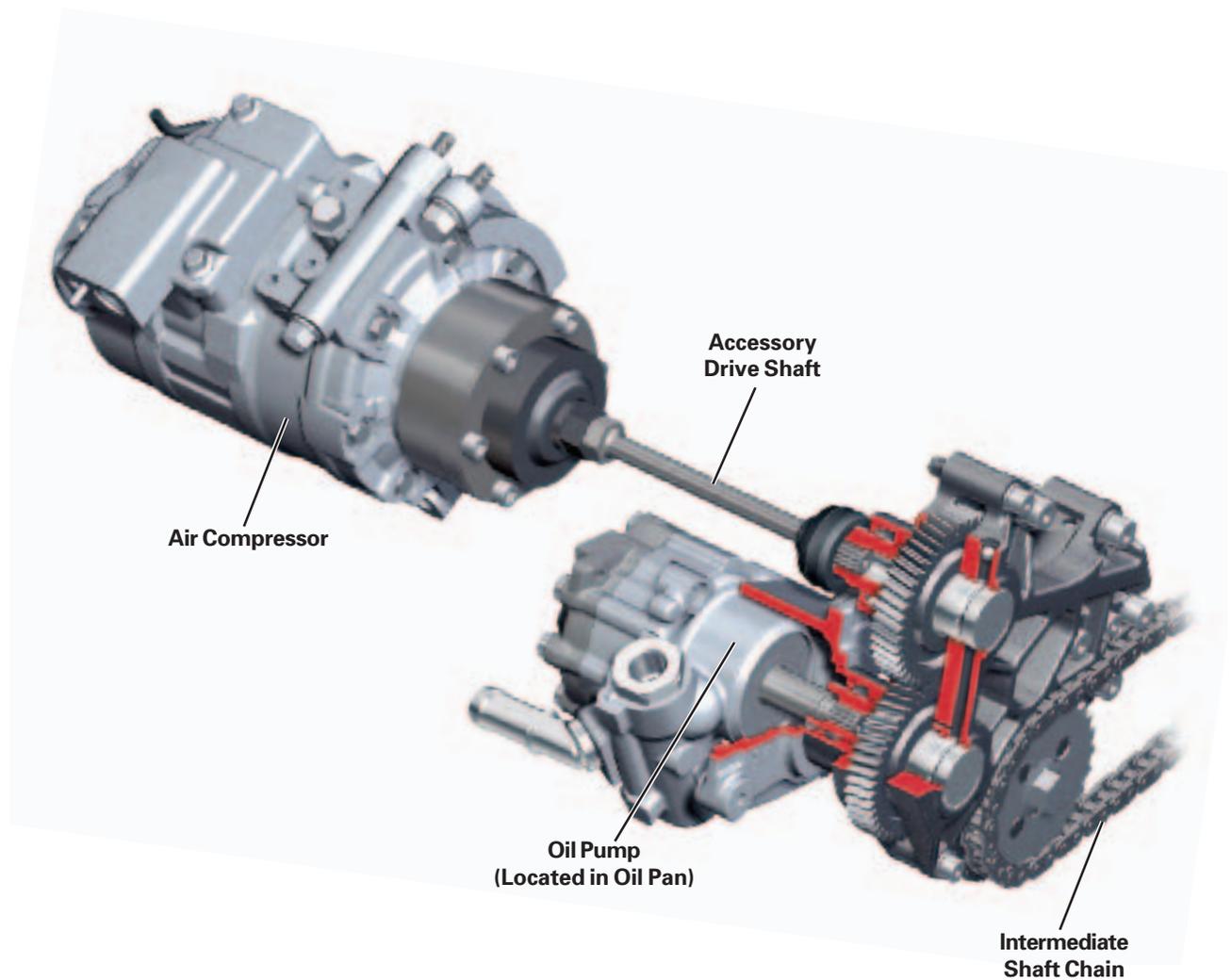
The fourth chain is driven by the other crankshaft sprocket. It operates various accessory drives.

There are four chains operating on two levels in the re-designed engine. One of the two sprockets on the crankshaft powers a chain that drives two intermediate shafts, one per cylinder bank. From each of these, a short chain drives the two camshafts in each head. The intake camshaft is driven by a stepless cam phase adjuster.



4.2 V8 Engine

Accessories such as the oil and water pumps and the A/C compressor are driven directly by sprockets or intermediate shafts.



3.0 V6 TDI Engine with Common-Rail Injection

Introduction

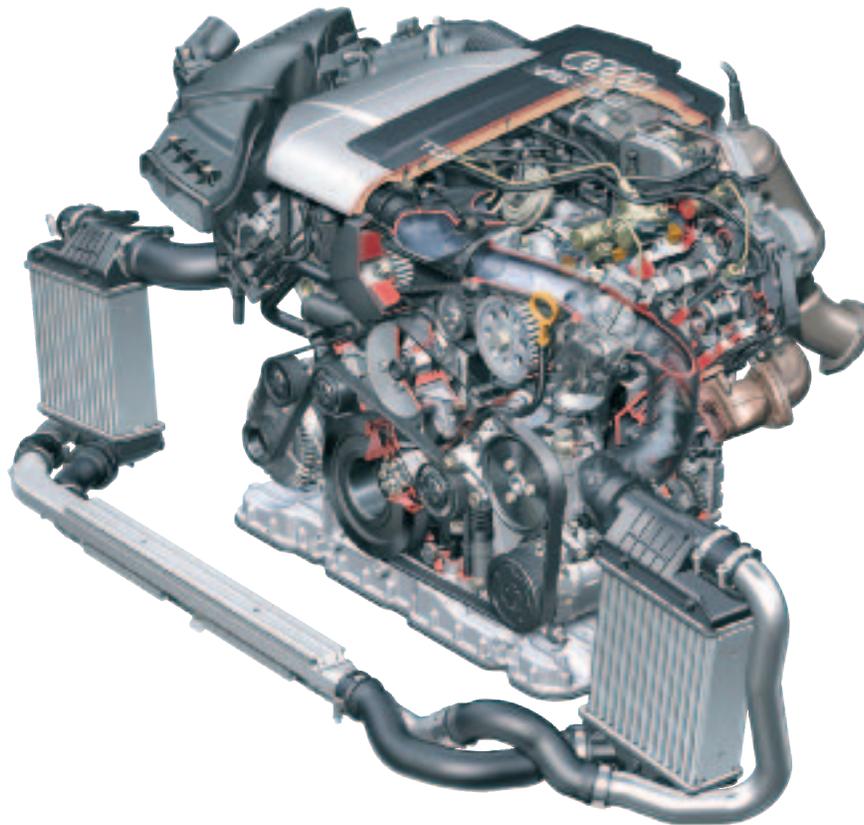
With the 3.0 V6 TDI engine with common rail, Audi has introduced the fourth engine in the new generation of V engines.

Its dimensions and its total weight of approx. 485 lb (220 kg) make it one of the lightest and most compact V6 diesel engines.



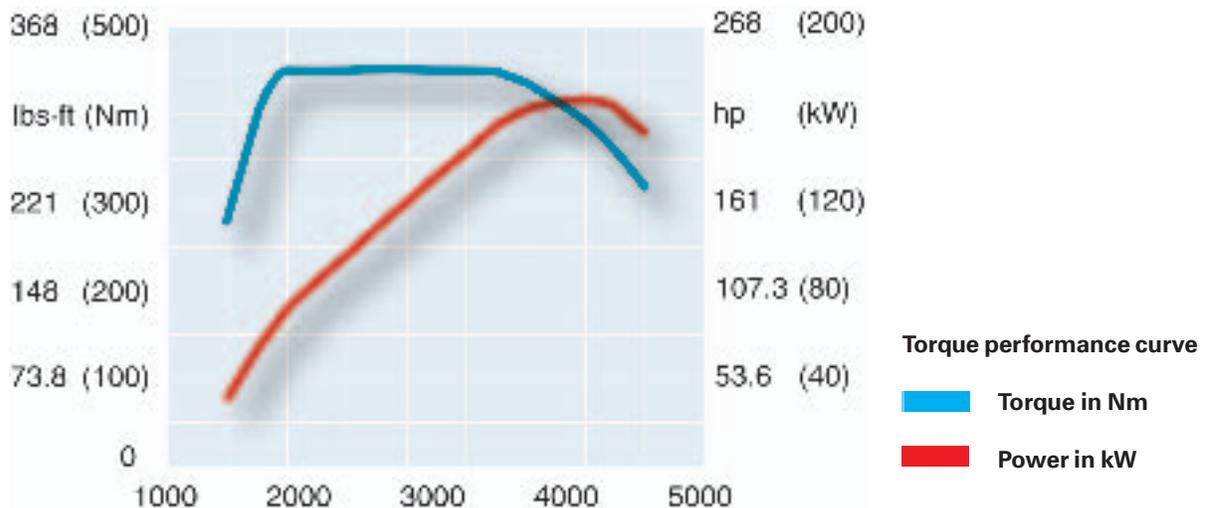
Note

This engine is not currently available in the North American market.



3.0 V6 TDI Engine with Common-Rail Injection

Technical Data



Code	BMK
Type	V engine with an angle of 90°
Displacement in cm³	2967
Power in kW (hp)	165 (224) at 4,000 rpm
Torque in Nm	450 at 1,400 to 3,250 rpm
Bore	3.3 in (83.0 mm)
Stroke	3.6 in (91.4 mm)
Compression	17.0 : 1
Weight	Approx. 487 lb (221 kg)
Firing order	1-4-3-6-2-5
Emission control	With catalytic converter, oxygen sensor, cooled exhaust gas recirculation (particle filter optional)
Engine management	EDC 16 CP, (common rail)
Exhaust standard	EU IV

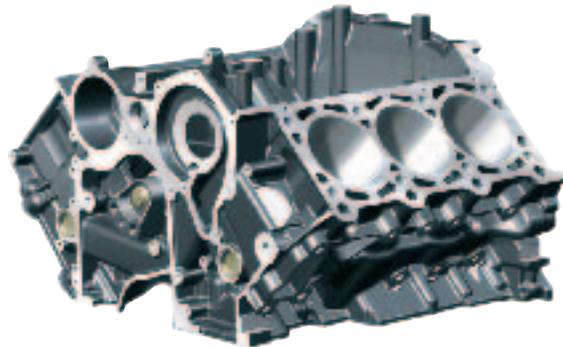
3.0 V6 TDI Engine with Common-Rail Injection

Mechanical Features

Crankcase

The engine block is made of GGV-40 (vermicular graphite cast iron) with a cylinder gap of 3.54 in (90 mm) (previously 3.46 in (88 mm)).

The cylinder bores undergo UV-photon honing for friction optimization in order to minimize initial oil consumption.



UV Photon Honing

UV photon honing involves using a laser beam to smooth the cylinder bores following honing.

The laser beam, which is applied at high force, melts down the remaining metal nibs in the one-billionth range. A smooth cylinder bore is achieved immediately in this way rather than through the working of the piston.



Crank Drive

The crankshaft is forged from temper-hardened steel. It is mounted in four main bearings of the main bearing frame.

Industrially cracked trapezoid con-rods are bolted to the crankshaft using a sputtered bearing at the top and a 3-material bearing at the bottom.

Piston

A cast piston without valve pockets and with a centrally arranged piston trough is cooled with injection oil via a ring channel (as for 3.3 I V8 CR).

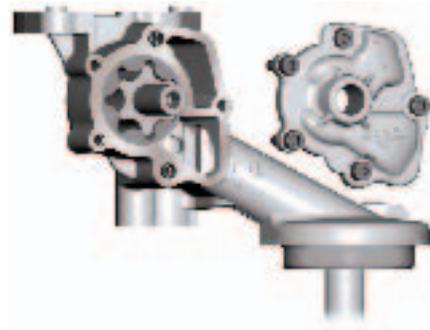


3.0 V6 TDI Engine with Common-Rail Injection

Oil Pump

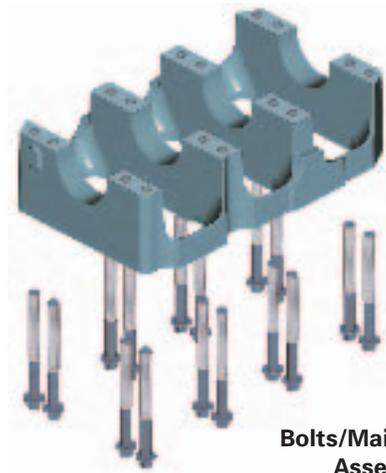
The tried-and-trusted Duocentric oil pump is used for the new generation of V6 engines.

It is driven by the chain drive via a hexagon shaft.



Retaining Frame

A sturdy retaining frame made of GGG 60 forms the main bearing assembly and serves to reinforce the crankcase.

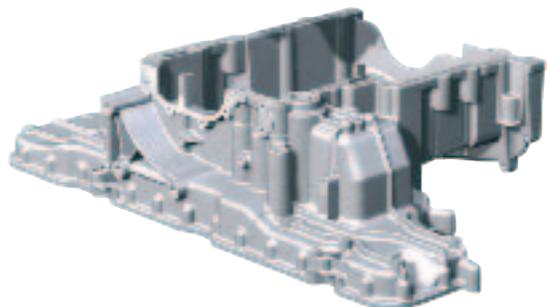


Bolts/Main Bearing Assembly

Top Section of Oil Pan

The division between the crankcase and the oil pan is at the middle of the crankshaft.

The two-section oil pan is made up of an aluminum pressure-cast top section and a plate steel bottom section.

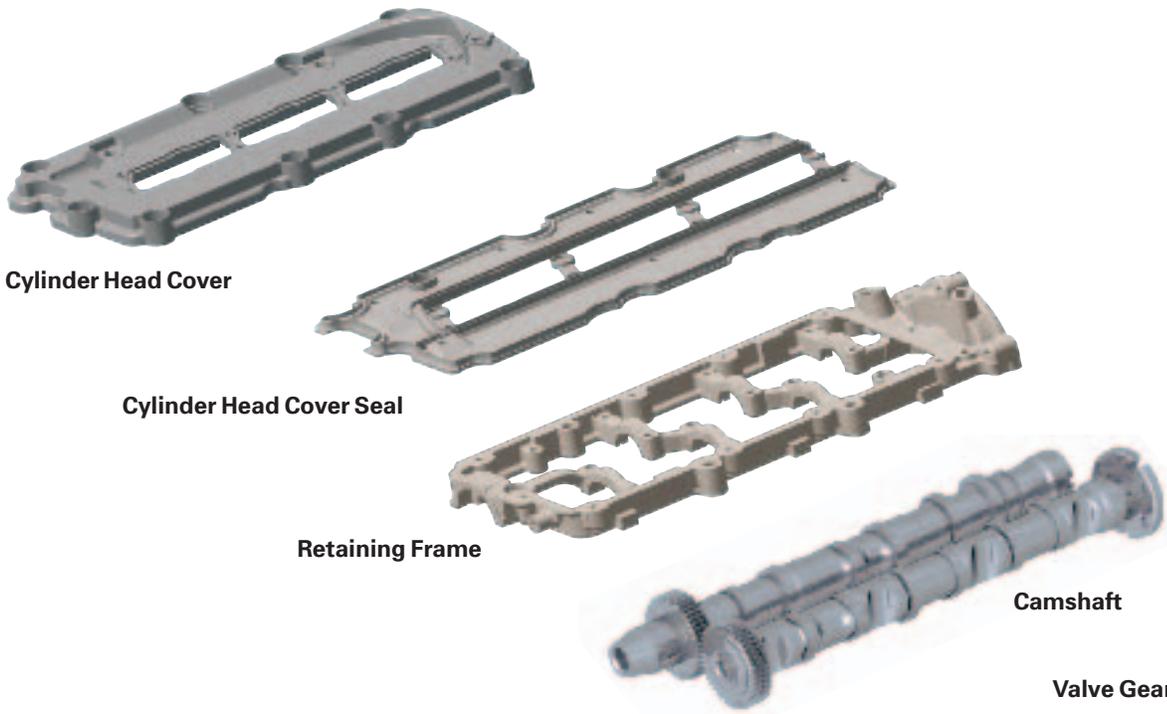


3.0 V6 TDI Engine with Common-Rail Injection

Cylinder Head

Four valves per cylinder ensure optimum charging of the combustion chamber. In the new V6 TDI, the valves are actuated by roller-type cam followers with hydraulic valve clearance compensation.

The acoustics of the unit benefits from the use of the roller-type cam followers. These, together with the tensioned and practically play-free camshaft drive pinions, reduce the mechanical noise of the valve gear.

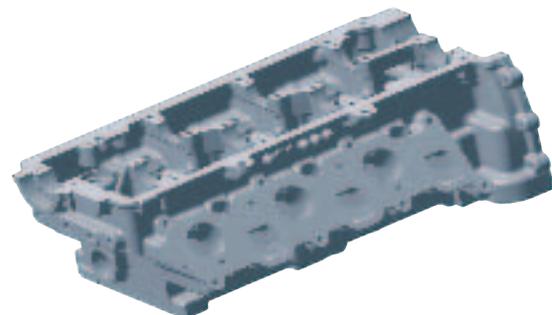


Camshaft

The two sturdy camshafts are manufactured from a precision steel tube, cam rings and the two steel plugs using the IHU procedure*. The exhaust camshafts are driven by the inlet camshafts via spur gears.

The spur gears are straight-toothed (previously the spur gears had beveled teeth).

* IHU – internal high-pressure recasting

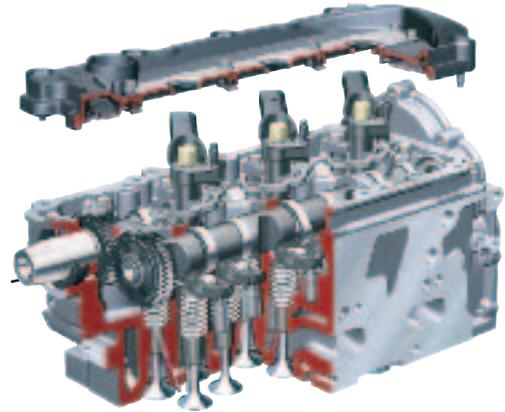
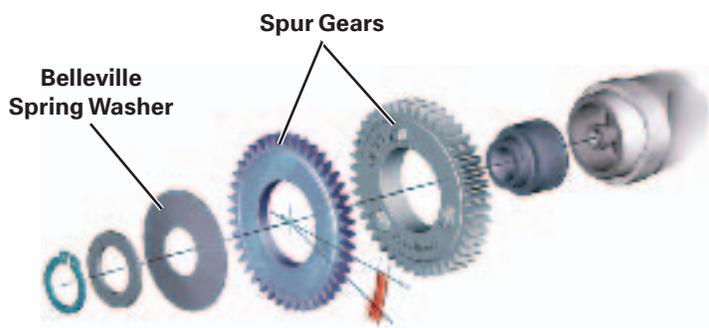


3.0 V6 TDI Engine with Common-Rail Injection

Tooth Profile Clearance Compensation

The spur gear of the exhaust camshaft (driven spur gear) comes in two parts. The wide spur gear is held on the camshaft through spring actuation and has three ramps at the front.

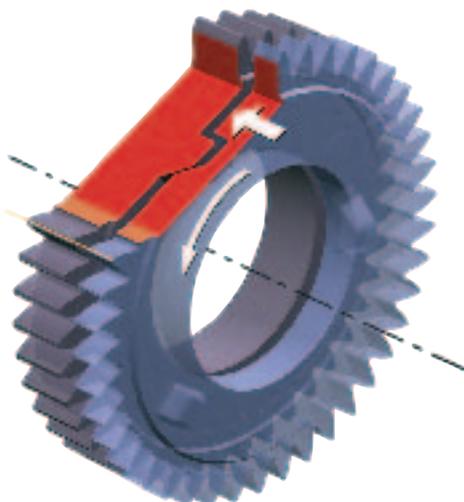
The narrow spur gear has the corresponding grooves and is capable of both radial and axial movement.



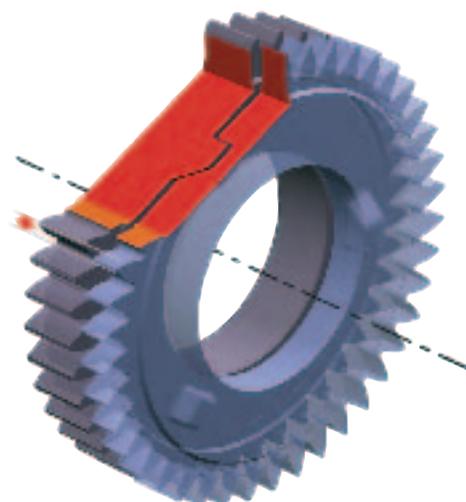
Note
Please see assembly instructions in the Repair Manual.

A defined axial force is produced via a Belleville spring washer, where the axial movement is converted at the same time into a rotary movement with the help of the ramps. This offsets the teeth of the two driven spur gears, which in turn affects tooth clearance compensation.

Installation Position



Clearance Compensation



3.0 V6 TDI Engine with Common-Rail Injection

Chain Drive

The chain drive is designed as a simplex bush chain (single chain) and is fitted at the gearbox side. It is made up of a central chain (drive A) running from the crankshaft to the intermediate sprockets and a chain to the inlet-side camshaft of both the left and right cylinder heads (drive B + C).

And on a second level, from the crankshaft to the oil pump drive and the balancer shaft (drive D).

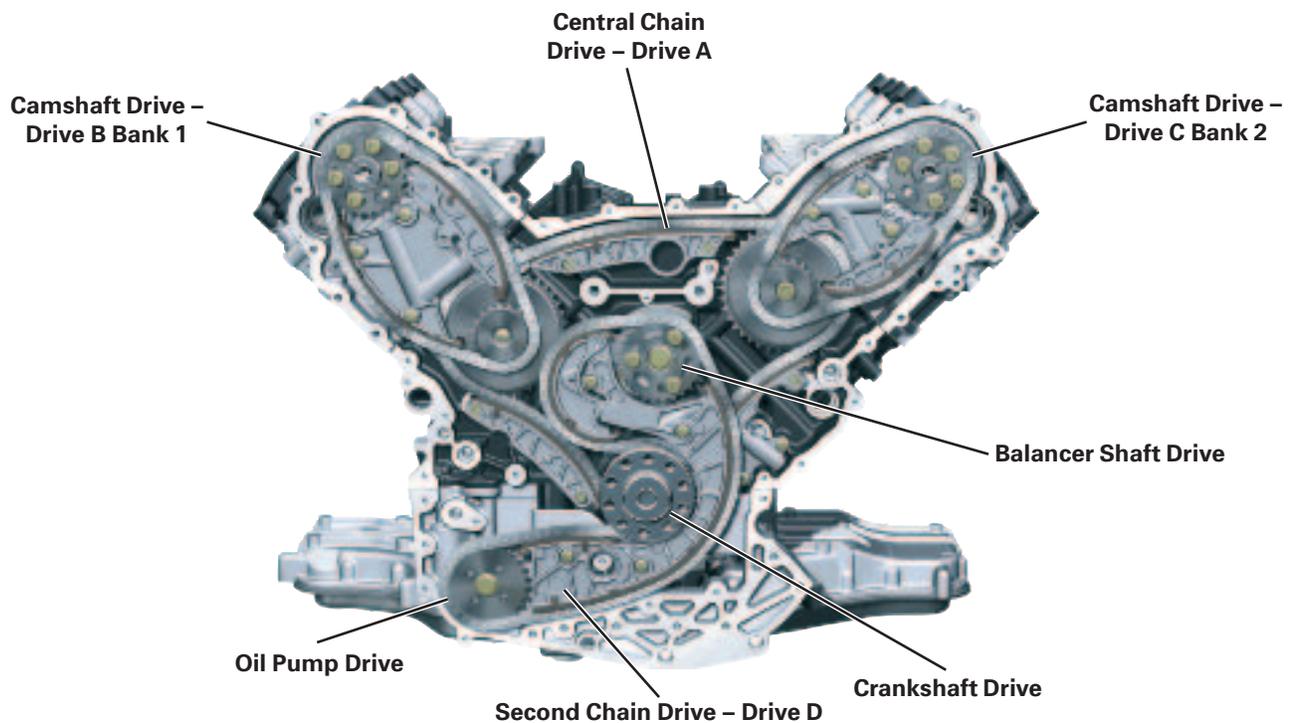
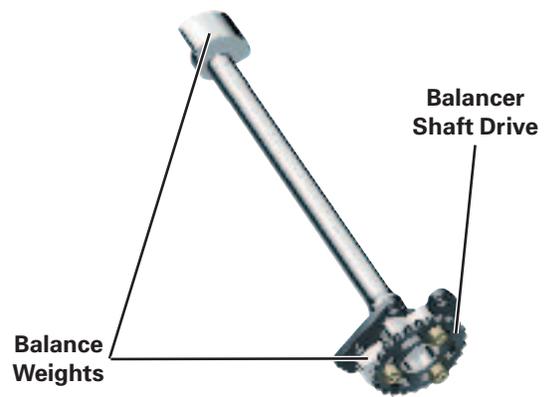
A separate hydraulic, spring-supported chain tensioner with the required chain guides is fitted for each chain drive.

An advantage of this is that it has been design to be maintenance-free for the service life of the engine.

Balancer Shaft

The new feature here is that the balancer shaft is accommodated in the inner V of the engine block, where the shaft goes through the engine and the balancing weights are secured at the ends.

Driven by chain drive D, the balancer shaft turns at crankshaft speed opposite the direction of rotation of the engine.



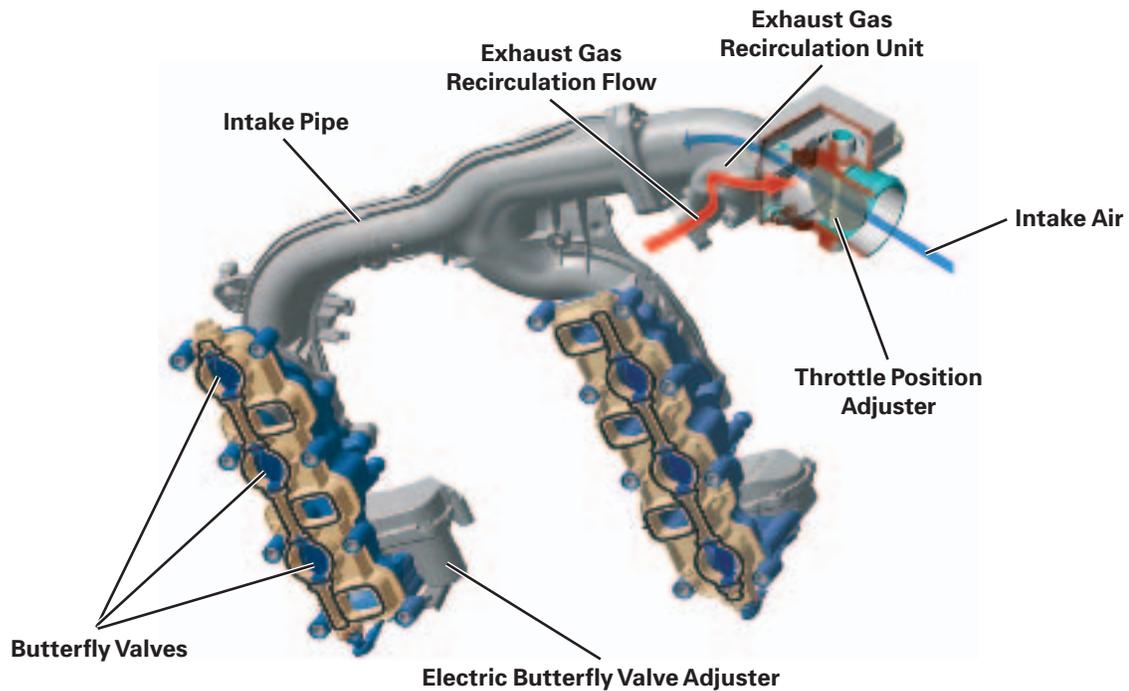
3.0 V6 TDI Engine with Common-Rail Injection

Air Intake

Intake Manifold with Butterfly Valves

Butterfly valves that can be regulated smoothly are integrated into the intake tract. These can be used to adapt the air movement according to the current engine speed and load with regard to emissions, consumption and torque/power.

The butterfly valve adjuster with potentiometer reports the current position of the butterfly valve back to the Engine Control Module (ECM) J623.



Exhaust Gas Recirculation:

This involves high-pressure exhaust gas recirculation.

The entry of exhaust gases into the intake tract counters the intake air flow. This results in a constant mixture of fresh air and exhaust gas.

Throttle Position Adjuster:

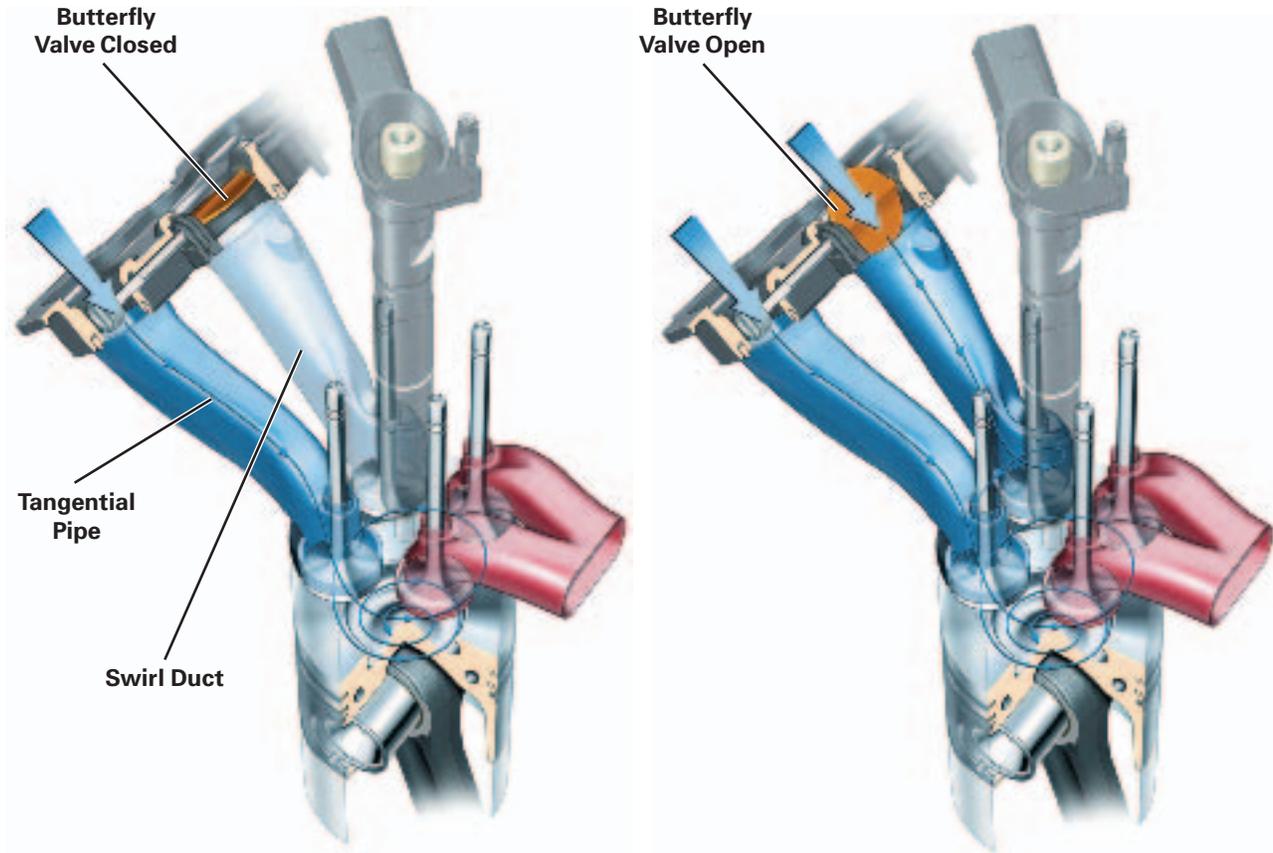
The throttle is closed in order to stop the engine. This reduces the compression effect and achieves softer engine coasting. In addition, the exhaust gas recirculation rate can be increased through targeted, map-controlled closure.

Note

The throttle and butterfly valves are opened in coasting mode in order to check the air flow sensor and balance the oxygen sensor.

3.0 V6 TDI Engine with Common-Rail Injection

Intake Manifold with Electric Adjuster for Controlling the Butterfly Valves



To optimize the torque and combustion, a closed swirl duct increases the swirl at low loads.

When the engine is started, the butterfly valves are open and are only closed again at idle speed (duty cycle: approx. 80%).

Continuous opening is performed from idle speed to approx. 2,750 rpm (duty cycle: approx. 20%).

To optimize performance and combustion, an open swirl duct allows a high level of cylinder charging at high loads.

The butterfly valves are always completely open at a speed of approx. 2,750 rpm or higher.

At idle speed and during coasting, the butterfly valve is also open.

Note

When the adjuster is replaced, it must be adapted to suit the butterfly valves.

The valve body must also be replaced when the adjuster is replaced from another engine.

3.0 V6 TDI Engine with Common-Rail Injection

VTG Turbocharger

To help ensure a fast response from the turbocharger at low speeds, air guide vane adjustment has been implemented using an electric adjuster.

This allows the exact positioning of the air guide vane to achieve optimum boost pressure.

In addition, a temperature sensor is integrated in front of the turbine in the turbine housing. This measures the boost air temperature and prevents the turbocharger from overheating.

This is also used to initiate the regeneration of the particle filter if the measured temperature is 842°F (450°C) or higher.

The connection for exhaust gas recirculation is located in the downpipe, which joins the two cylinder banks on the exhaust side.

This involves high-pressure exhaust gas recirculation. This means that the exhaust gas recirculation pressure is always higher than the intake pipe pressure.

Exhaust Gas Recirculation

To achieve a high exhaust gas recirculation flow, a vacuum-controlled exhaust gas recirculation valve is installed. This controls the quantity of exhaust gas recirculated in the intake tract.

To effectively reduce the particle and nitric oxide (NO_x) emissions, the exhaust gases are cooled by a switchable, water-filled exhaust gas recirculation cooler when the engine is warm.



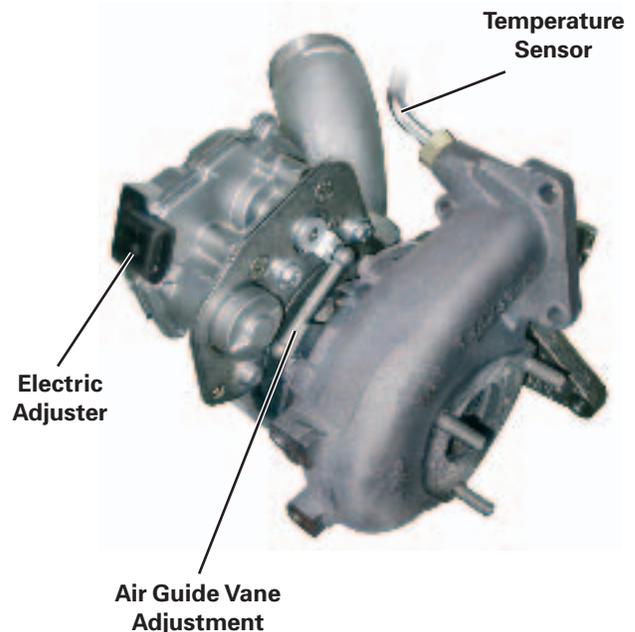
Note

Turbocharger adjustment is performed in a controlled way at:

- a low load and low speed in order to build up the boost pressure quickly.

Turbocharger adjustment is regulated at:

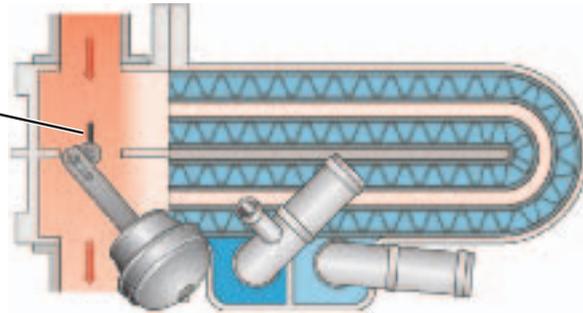
- a high load and high speed in order to maintain the boost pressure at the optimum range.



3.0 V6 TDI Engine with Common-Rail Injection

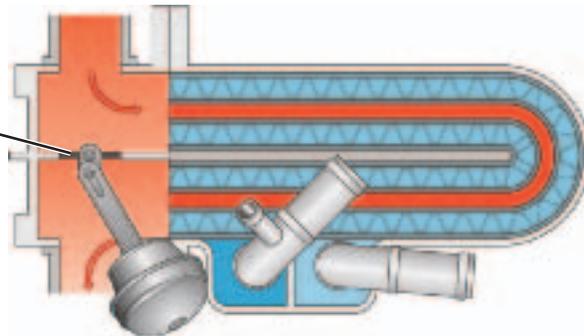
Cold engine: By-pass flap open

Exhaust gas recirculation is performed immediately so as to heat up the catalytic converter as quickly as possible.



Warm engine: By-pass flap closed

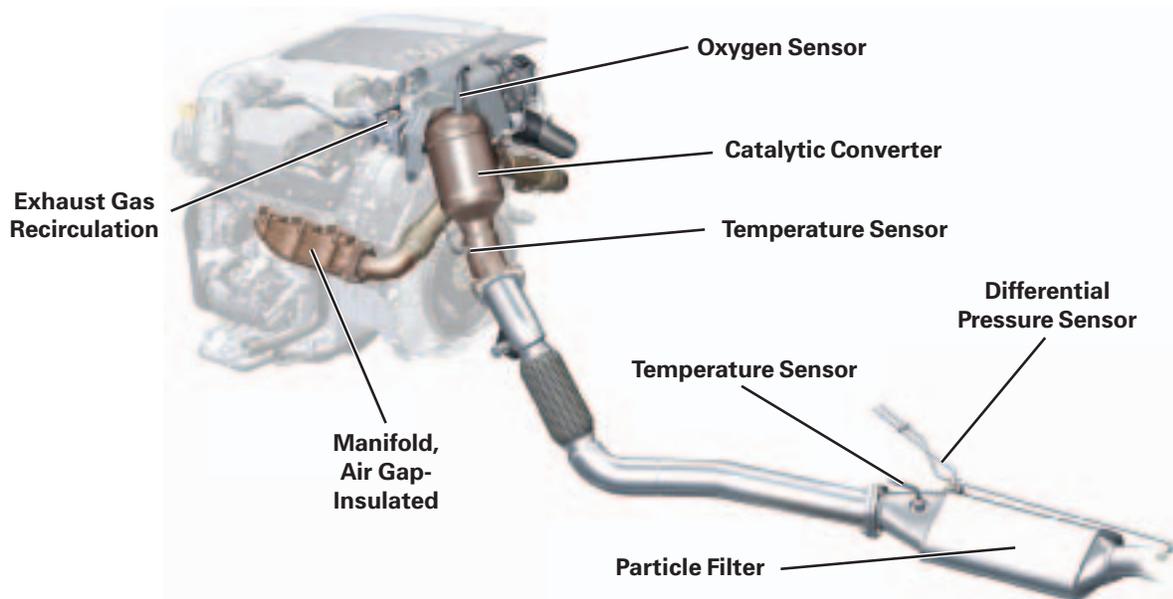
Exhaust gas recirculation must be performed using the water-cooled exhaust gas recirculation cooler.



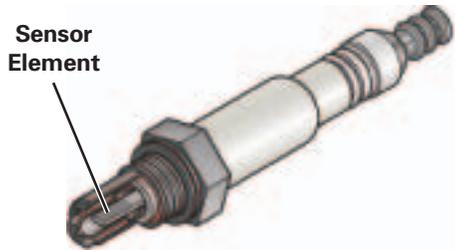
Exhaust System

The exhaust manifolds are designed as an air gap-insulated sheet metal manifold.

They are installed in the inner V of the engine on the exhaust turbocharger.



3.0 V6 TDI Engine with Common-Rail Injection



Oxygen Sensing

An oxygen sensor is used for the first time in an Audi diesel engine.

This is the broadband oxygen sensor, which may already be familiar from the gasoline engine. An important feature of this oxygen sensor is that it can record the oxygen signal over the entire engine speed range.

The oxygen sensor regulates the exhaust gas recirculation quantity and corrects smoke emissions.

Oxygen sensing (approx. 1.3 or less) can help to adjust the exhaust gas recirculation rate to the smoke limit, thereby producing higher exhaust gas recirculation rates.

The engine works with excess air.

Oxygen sensing is also used for mass air flow sensor plausibility (HFM). The mass air flow is calculated from the oxygen value using a calculation model and compared to the value from the Mass Air Flow Sensor G70.

Adjustments can thus be made over the whole system (exhaust gas recirculation, injection, fuel delivery).

Note

If the oxygen signal fails, a fault is entered and the malfunction indicator lamp (MIL) comes on.

3.0 V6 TDI Engine with Common-Rail Injection

Glow Plug System

The Glow Plug system known as the diesel quick-start system is used with new ceramic glow plugs. They reach a temperature of 1,832°F (1,000°C) in two seconds and help ensure a quick-start .

The voltage is reduced step-by-step in the following activating intervals and is significantly less than the available vehicle voltage.

To reduce the voltage draw, the glow plugs are activated with pulse width modulation (PWM) and phase offset.

Voltage Profile

Phase 1: approx. 9.8 V – fast heating

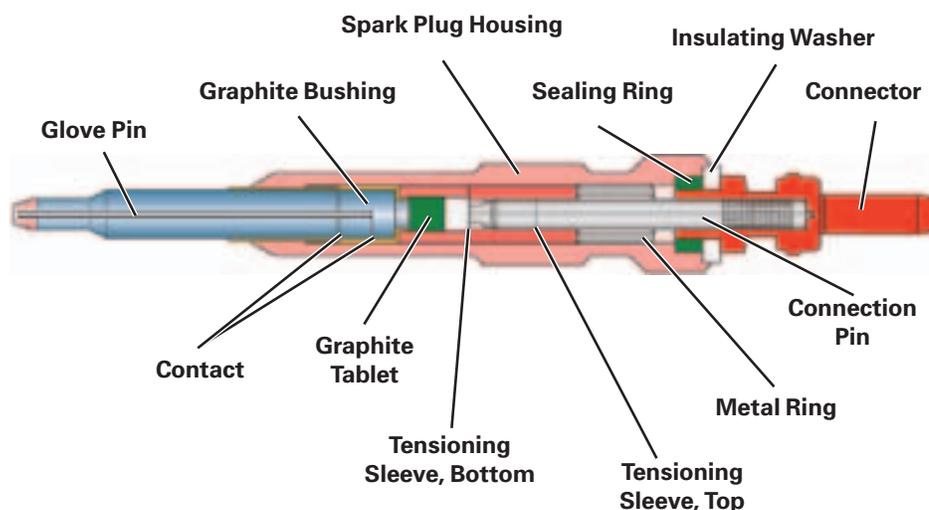
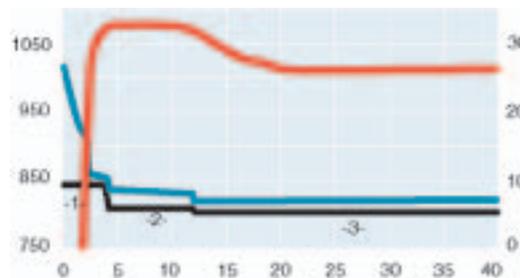
Phase 2: 6.8 V

Phase 3: 5 V

 Temperature curve

 Power curve

 Voltage curve



Note

Please observe the precautionary measures described in the Workshop Manual when working with ceramic glow plugs.

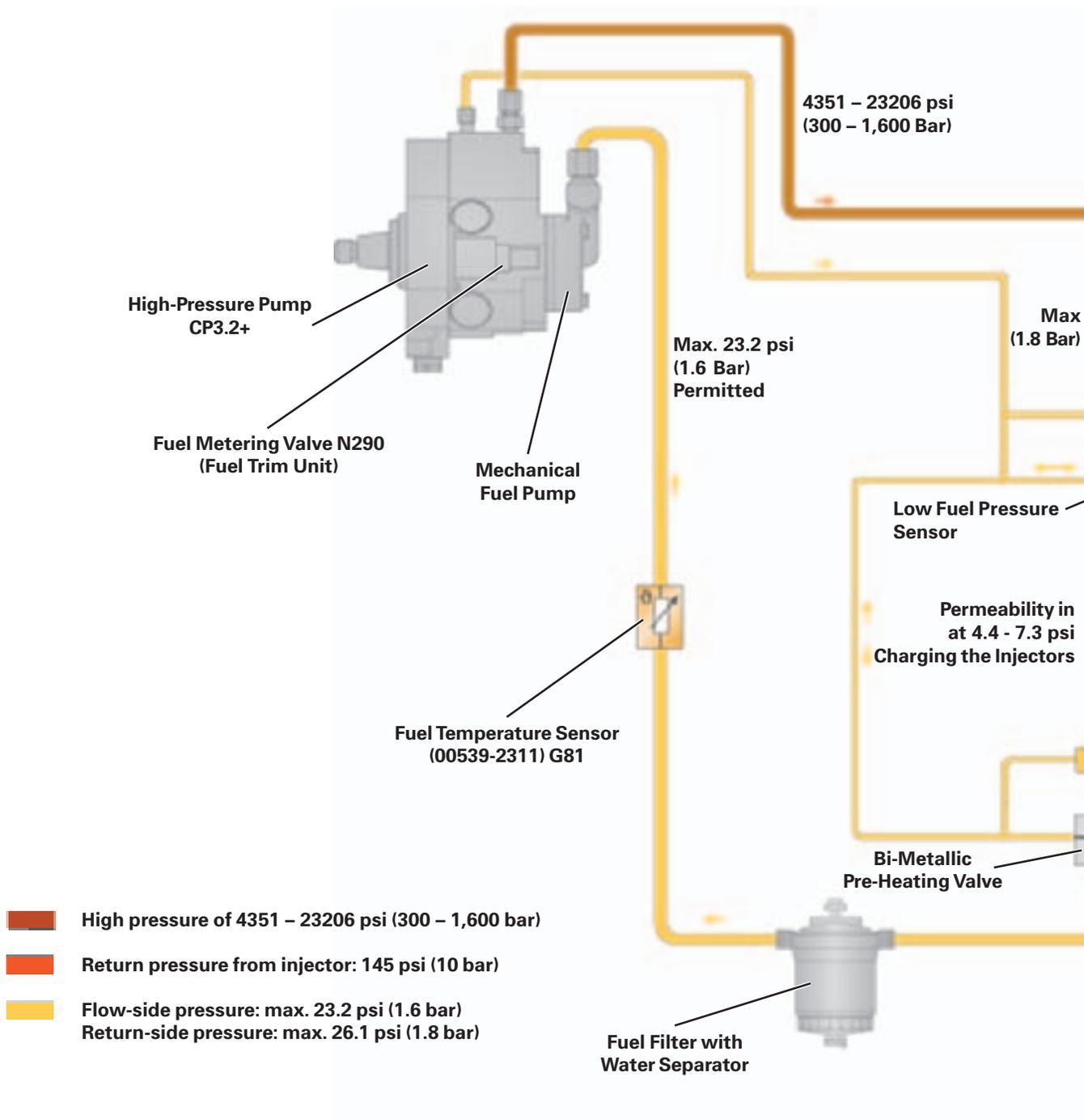
They are very easily damaged!

3.0 V6 TDI Engine with Common-Rail Injection

Fuel Supply – 3rd Generation Common Rail

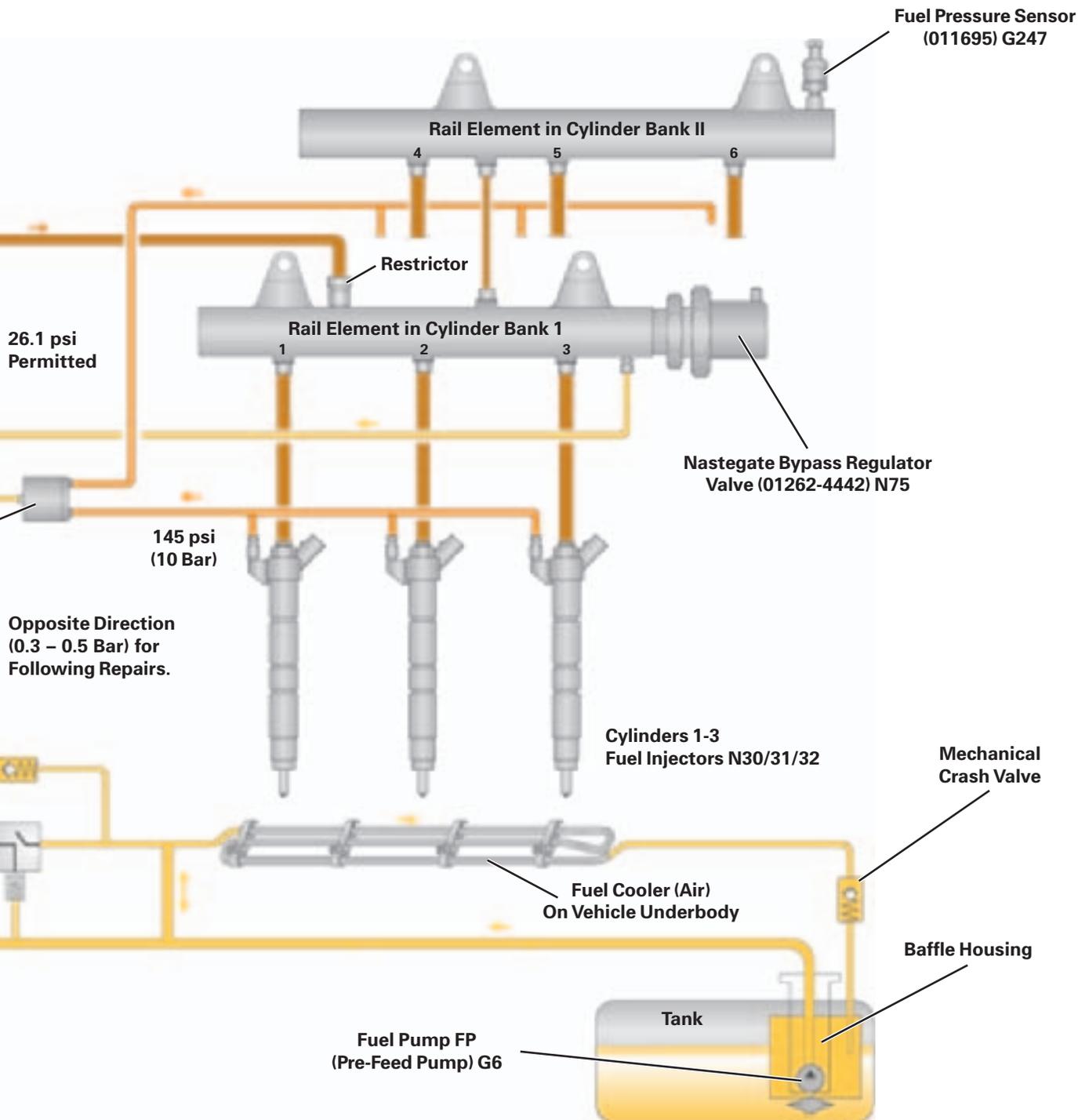
A 3rd generation common-rail system from Bosch controls the fuel/air mixture.

It has a high-pressure pump, driven by a toothed belt and one distributor plate (rail) for each cylinder bank.



3.0 V6 TDI Engine with Common-Rail Injection

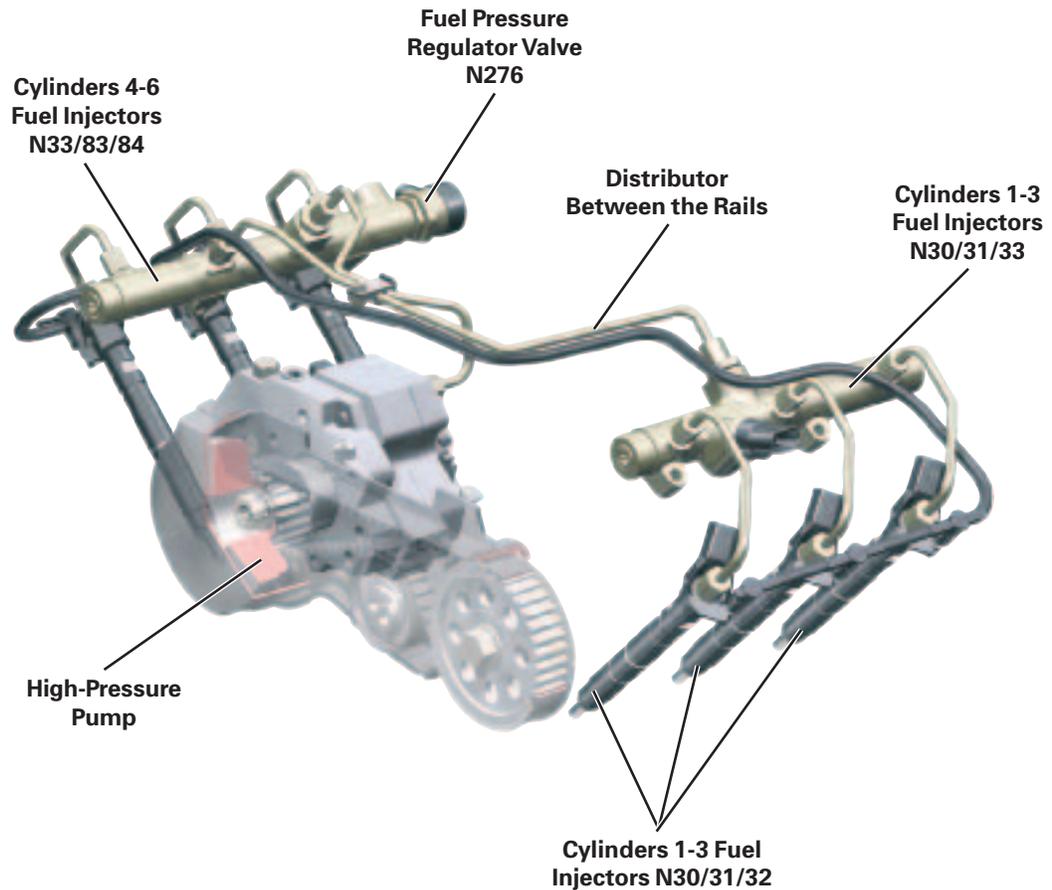
The injection pressure has been increased to 23,206 psi (1,600 bar), which is 3,625.9 psi (250 bar) more than in earlier 2nd generation common-rail systems.



3.0 V6 TDI Engine with Common-Rail Injection

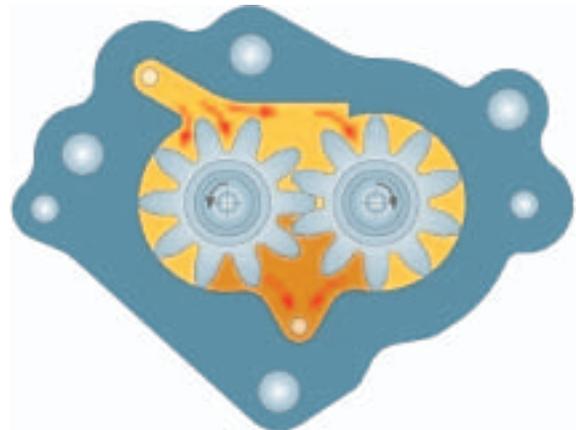
High-pressure Fuel Circuit

Fuel injection involves the Piezo effect. The Piezo injectors are the most important new feature of the new common-rail system.



Gear Pump

The gear pump, which is driven via the eccentric shaft of the high-pressure pump by a toothed belt, feeds the fuel from the tank to the high-pressure pump using the inner tank pump.



3.0 V6 TDI Engine with Common-Rail Injection

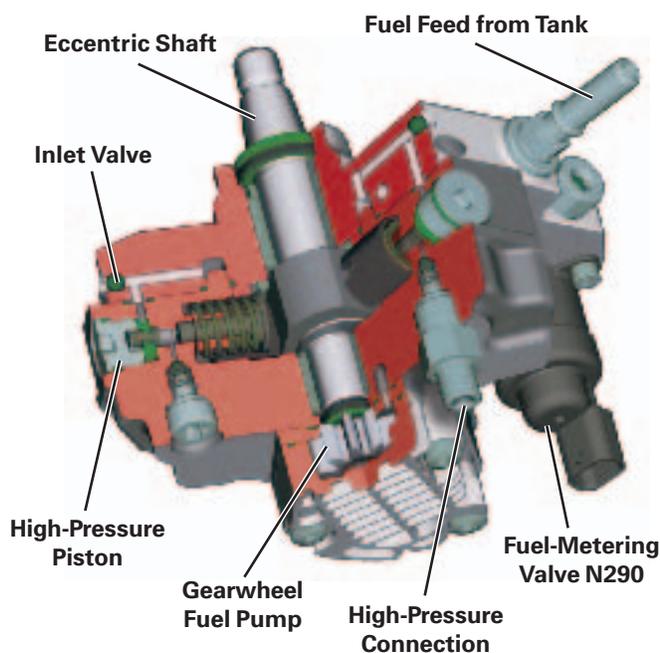
High-pressure Pump

A dual-regulator system is used to regulate the fuel pressure. The Fuel Pressure Regulator Valve N276, located on the fuel rail, is used to regulated fuel pressure at low engine speeds and when the engine is cold. It also is used to reduce engine torque.

At full-power and when the engine is hot, the fuel is routed to the pressure-regulating system via the Fuel Metering Valve N290 to prevent the fuel from heating up unnecessarily.

The Engine Control Module (ECM) J623 initiates injection release when the fuel pressure is 2,900.8 psi (200 bar) or higher in the rail.

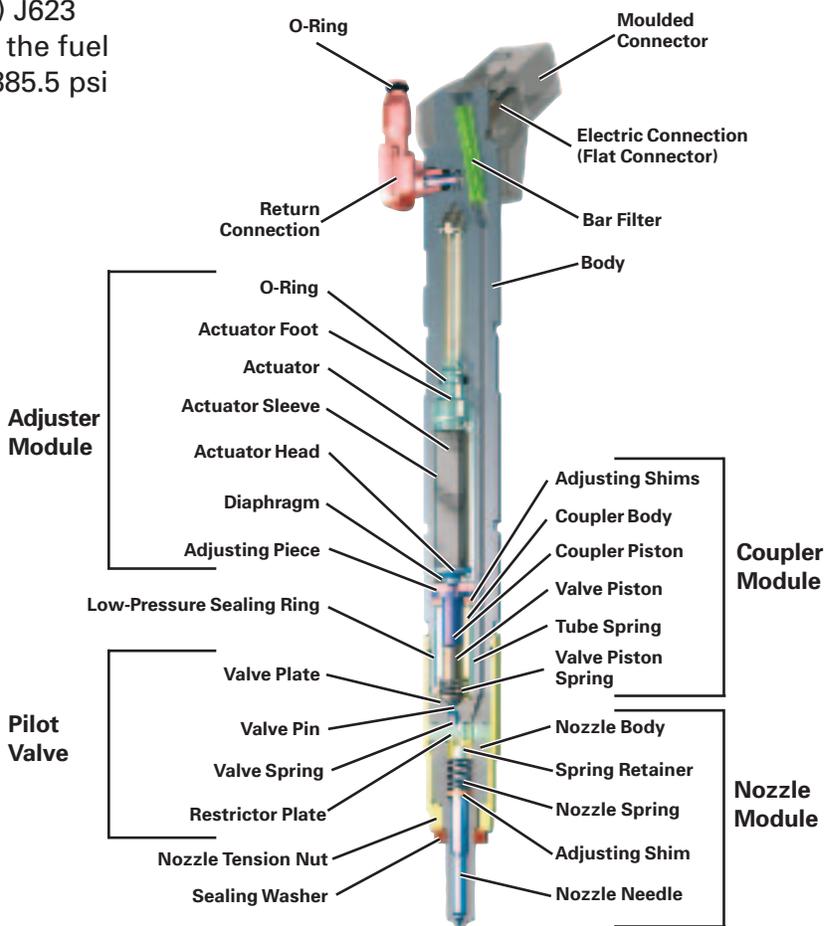
The Engine Control Module (ECM) J623 disables fuel injection as soon as the fuel pressure in the rail falls below 1,885.5 psi (130 bar).



Piezo Injector

Note

Whenever an injector is replaced, it must be adapted to suit the injection system and an injector quantity comparison (IQC) must be performed.



3.0 V6 TDI Engine with Common-Rail Injection

Injector Function

The Piezo effect is used for controlling the injector.

The use of the Piezo element means that the following can be achieved:

- more electrical activation periods per stroke
- very short switching times for several injections
- huge force against the current rail pressure
- high lift accuracy for fast drop-off of the fuel pressure
- activation voltage of 110 – 148 volts, depending on the rail pressure
- 264 Piezo layers are installed in the actuator

Piezo effect

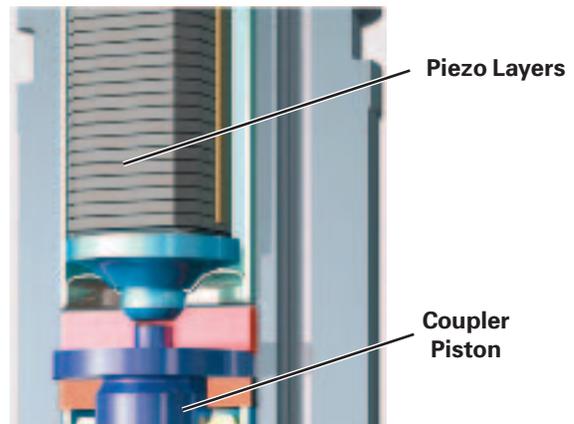
If you deform a crystal made up of ions (turmalin, quartz, Seignette salt), an electric potential is produced.

The Piezo-electric effect can be reversed by applying a certain voltage. This makes the crystal longer.

Caution, high voltage!

Please read safety notes in Repair Manual.

Actuator Module



A hydraulic converter (coupler module) converts the increase in length of the actuator module into hydraulic pressure and motion, which affect the pilot valve.

The coupler module works like a hydraulic cylinder. It is thrown continuously into reverse movement with a fuel pressure of 145 psi (10 bar) by a pressure-regulating valve.

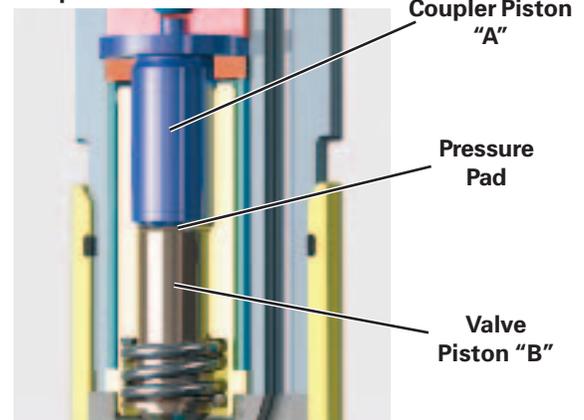
The fuel serves as the pressure pad between coupler piston "A" and valve piston "B" in the coupler module.

When an injector is closed (air in the system), the injector is bled by beginning at starter speed. In addition, the injector is filled against the fuel flow direction with the help of the inner tank pump via the pressure-holding valve.

Note

If this pressure is not present in the reverse stroke, the injector function is disabled.

Coupler Module

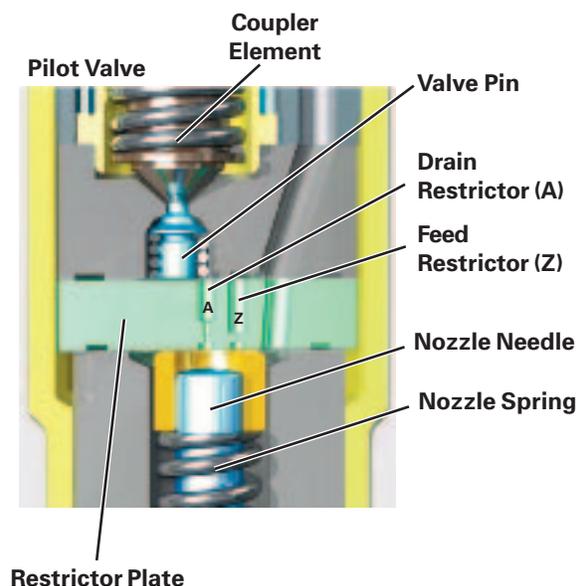


3.0 V6 TDI Engine with Common-Rail Injection

The pilot valve consists of a valve plate, valve pin, valve spring and a restrictor plate.

The fuel flows at current rail pressure through the feed restrictor (Z) in the restrictor plate to the nozzle needle and into the space above the nozzle needle. This produces pressure compensation above and below the nozzle needle. The nozzle needle is kept closed mainly by the spring force of the nozzle spring.

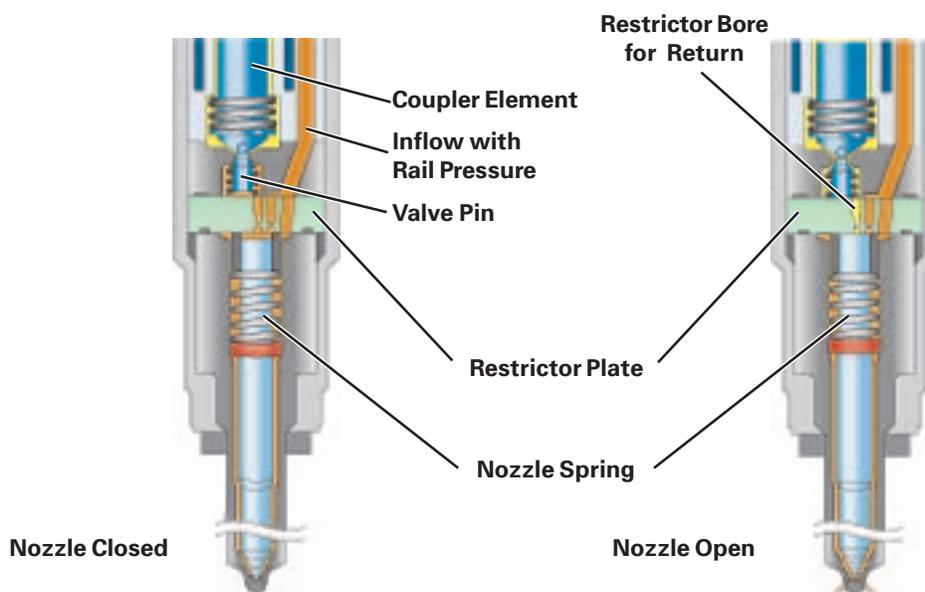
When the valve pin is pressed, the return opens and the rail pressure flows off first through a larger drain restrictor (A) above the nozzle needle. The rail pressure lifts the nozzle needle from its seat, thereby causing injection. The fast switching pulses of the Piezo element result in several injections per stroke one after the other.



Pre- and Post-injections

Two pre-injections are performed when the engine is cold and in the near-idle speed range. As the load increases, the pre-injections are gradually retarded until only the main injection is used at full power.

The two post-injections are needed in order to regenerate the particle filter.



Note

The pre-injections depend on the load, the speed and the engaged gear (acoustics).

- High-Pressure
- Low-Pressure

3.0 V6 TDI Engine with Common-Rail Injection

Particle Filter

A particle filter without a catalytic-effect additive is used in the 3.0 V6 CR diesel engine. The "Catalyzed Soot Filter" (CSF) has a filter coating containing precious metal.

Several sensors are needed in order to initiate the regeneration of the filter and system monitoring. Three temperature sensors are installed – one in front of the turbocharger, one behind the catalytic converter and one in front of the particle filter.

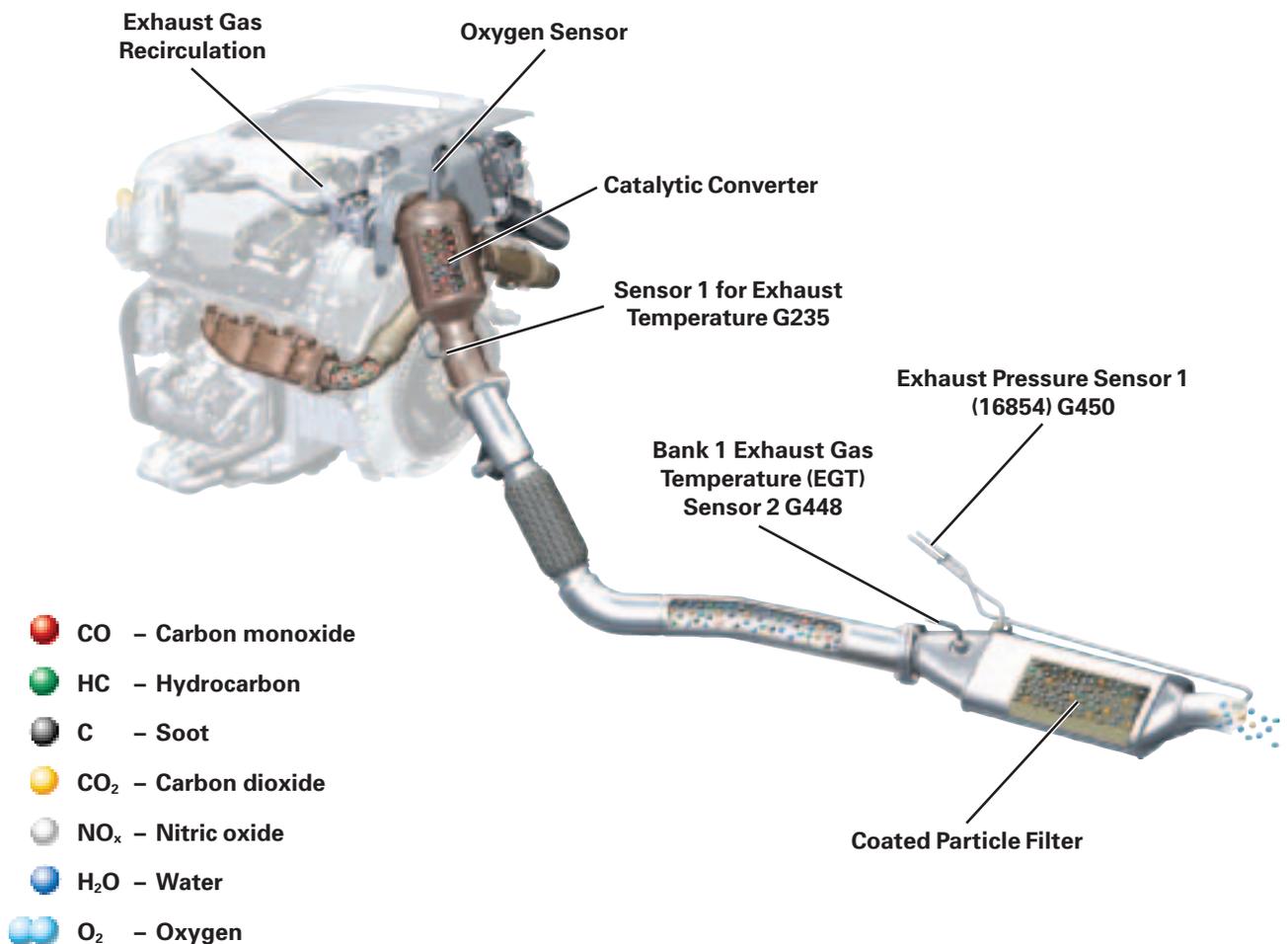
A differential pressure sensor monitors the pressure difference before and after the filter.

The accumulation of soot on the filter is detected here.

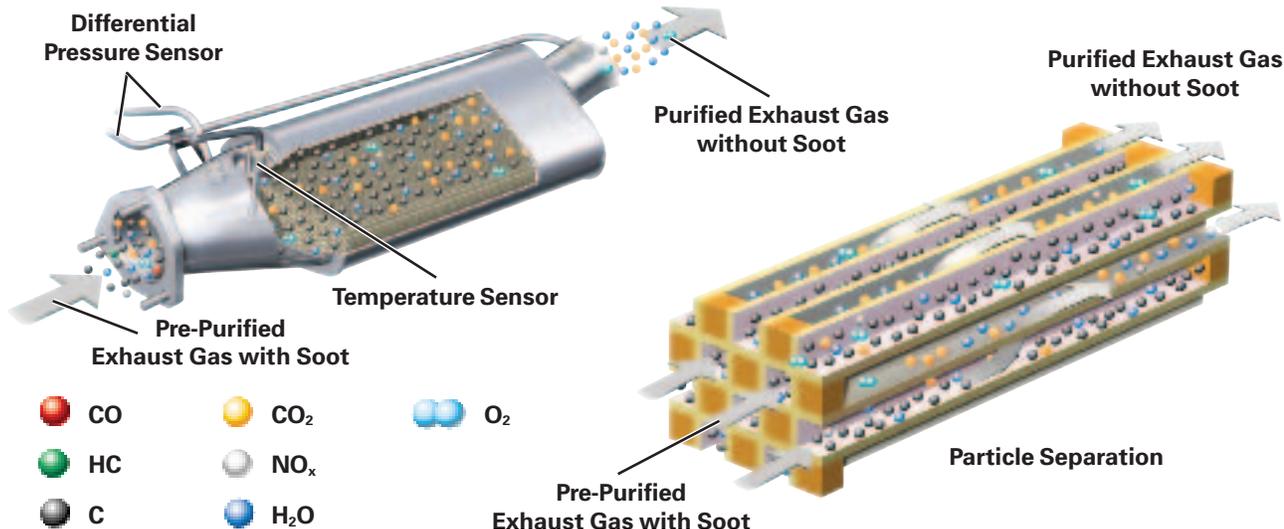
During passive regeneration without engine management intervention, the soot stored in the particle filter is converted slowly and carefully into CO₂.

This happens at temperatures of between 662°F (350°C) and 932°F (500°C), during short trips or city driving due to the relatively low exhaust gas temperatures.

For frequent city travel, an active regeneration must be performed via engine management every 621 - 745 mile (1,000 - 1,200 km).



3.0 V6 TDI Engine with Common-Rail Injection



The filter element is like a conventional catalytic Converter, the only difference being that the pipes are closed off alternately in inlet and outlet direction. This means that the soot-laden exhaust gases must penetrate the gas-permeable silicon carbide walls. The gas, therefore, flows to the exhaust system outlet, while the soot stays on the ceramic wall. This is coated with a mixture of platinum and cerioxide.

The platinum coating of the filter element produces nitrogen dioxide NO₂, which causes soot oxidation above a temperature of 662°F (350°C) (passive regeneration).

The cerioxide component of the coating accelerates the fast thermal regeneration with oxygen (O₂) above 1,076°F (580°C) (active regeneration).

Regeneration is performed, as required, using a pre-programmed simulation model in the Engine Control Module (ECM), which determines the filter loading from the user's driving profile and the value indicated by the differential pressure sensor.

For this purpose, the temperature on the turbocharger is regulated to approx. 842°F (450°C) by performing a post-injection close

to the main injection, by increasing the injection quantity, by delaying the injection time, by disabling exhaust gas recirculation, and by choking on the throttle.

When a temperature of approx. 662°F (350°C) is exceeded behind the catalytic converter, a second post-injection is performed away from the main injection.

This post-injection is so late that the fuel only evaporates and no more combustion takes place.

However, this fuel vapor is converted on the catalytic converter and increases the gas temperature to up to 1,382°F (750°C). Now, the soot particles can be burned. A temperature sensor on the filter adapts the quantity of the remote post-injection in such a way that a temperature of 1,148°F (620°C) is reached in the underbody position, before the filter. The soot particles can thus be burned in a matter of minutes.

With an increasingly high mileage 93,205 - 124,274 mile (150,000 - 200,000 km), the filter becomes blocked, depending on oil consumption, and must be replaced. The remains of burned oil (oil ashes), which do not burn and accumulate in the filter, are responsible for this.

3.0 V6 TDI Engine with Common-Rail Injection

Engine Management

System Overview

Sensors

Mass Air Flow (MAF) Sensor



Engine Speed (RPM) Sensor



Camshaft Position (CMP) Sensor



Engine Coolant Temperature (ECT) Sensor



Fuel Temperature Sensor



Fuel Pressure Sensor



Throttle Position (TP) Sensor
G79 and Sender 2 for
Accelerator Pedal Position G185



Brake Light Switch
Brake Pedal Switch



Heated Oxygen Sensor (HO2S)



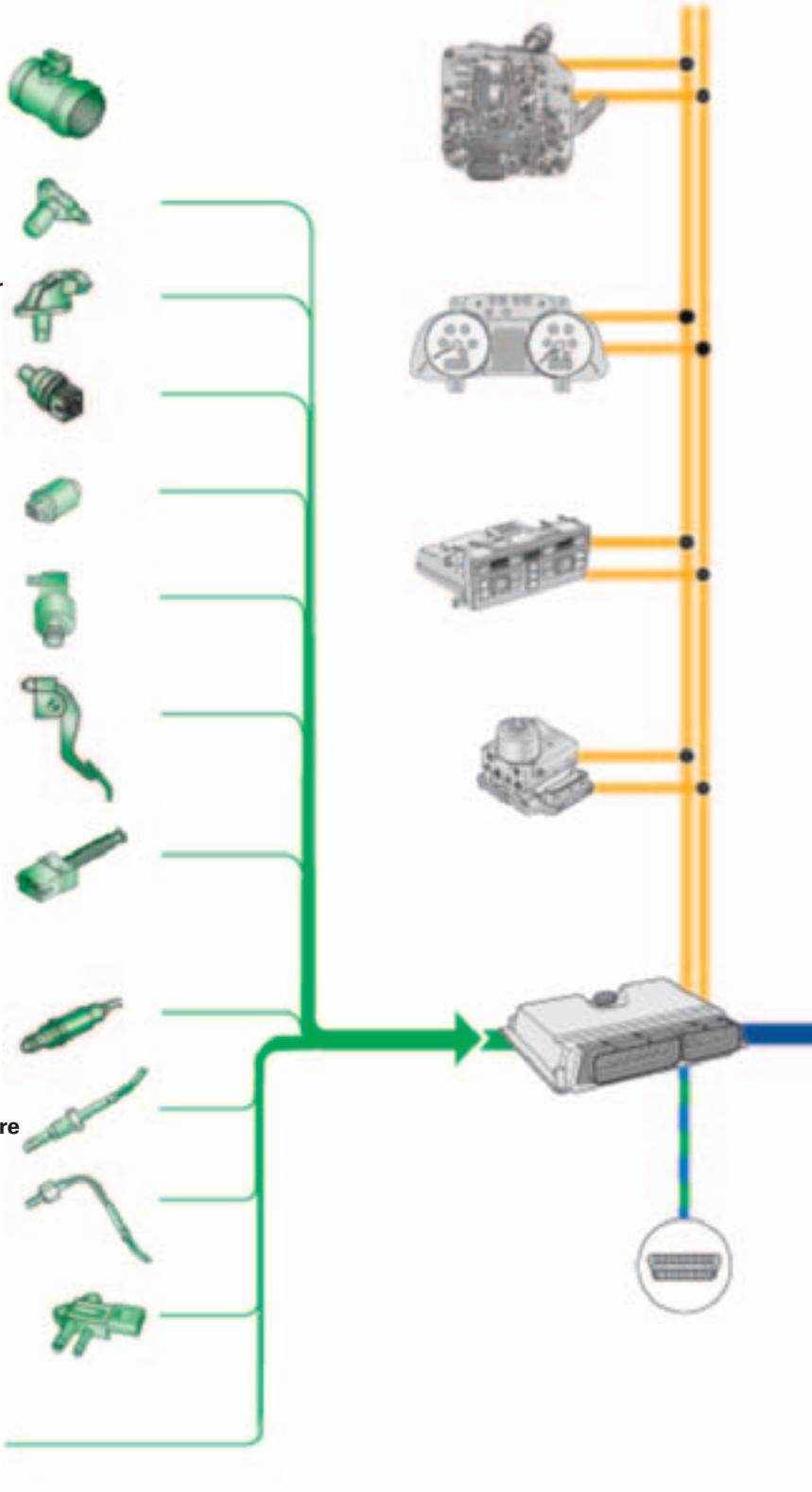
Sensor 1 for Exhaust Temperature
G235 and Exhaust Pressure
Sensor 1 G450



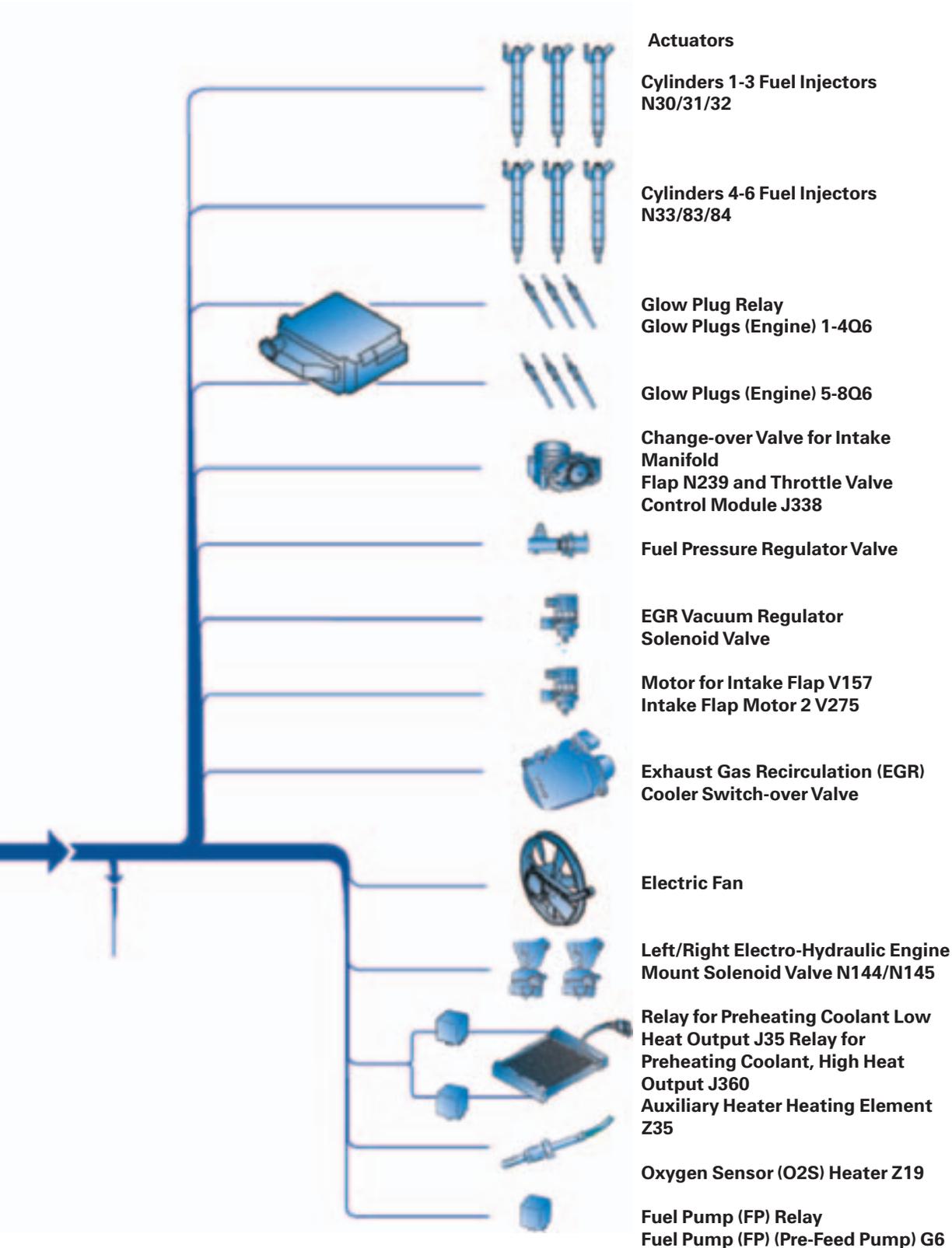
Temperature Sensor 1 for



Additional signals:
Speed Control System
Coolant Temperature Sensor
Speed Signal
Terminal 50
Crash Signal from Airbag Control Module J234



3.0 V6 TDI Engine with Common-Rail Injection



3.0 V6 TDI Engine with Common-Rail Injection

Function Diagram

Color Coding

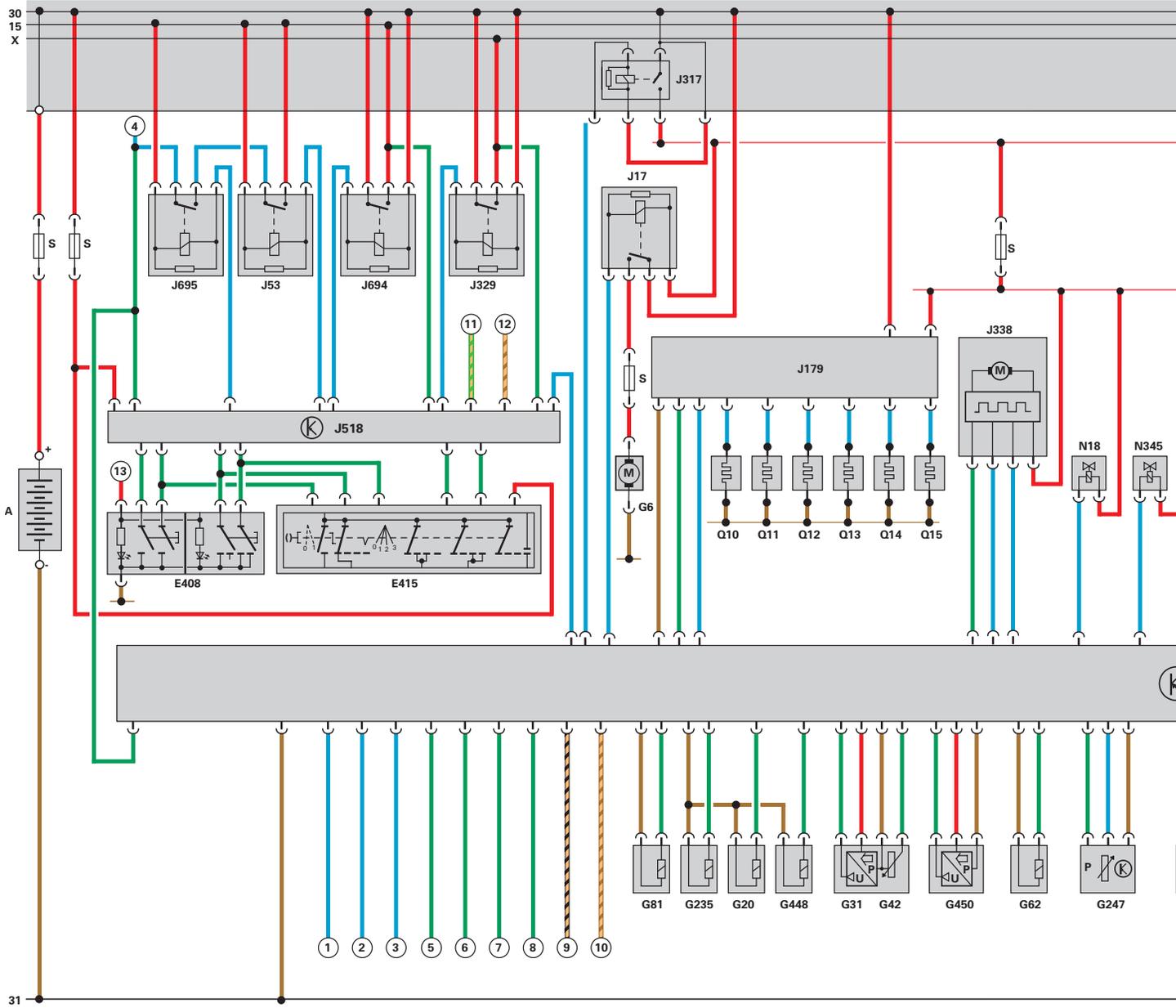
	= Input signal		= Positive		= Bi-directional
	= Output signal		= Ground		= CAN BUS

Components

A	Battery	M9	Left Brake Light
E45	Cruise Control Switch	M10	Right Brake Light
E408	Access/Start Authorization Button	N18	EGR Vacuum Regulator Solenoid Valve
E415	Access/Start Authorization Switch	N30	Cylinder 1 Fuel Injector
F	Brake Light Switch	N31	Cylinder 2 Fuel Injector
F47	Brake Pedal Switch	N32	Cylinder 3 Fuel Injector
F60	Closed Throttle Position (CTP) Switch	N33	Cylinder 4 Fuel Injector
F194	Clutch Pedal Starter Interlock Switch (US model only)	N83	Cylinder 5 Fuel Injector
G20	Temperature Sensor 1 for Catalyst	N84	Cylinder 6 Fuel Injector
G23	Transfer Fuel Pump (FP)	N144	Left Electro-Hydraulic Engine Mount Solenoid Valve
G28	Engine Speed (RPM) Sensor	N145	Right Electro-Hydraulic Engine Mount Solenoid Valve
G31	Charge Air Pressure Sensor	N276	Fuel Pressure Regulator Valve
G39	Heated Oxygen Sensor (HO2S)	N290	Fuel Metering Valve
G40	Camshaft Position (CMP) Sensor	N335	Intake Air Switch-Over Valve
G42	Intake Air Temperature (IAT) Sensor	N345	Exhaust Gas Recirculation (EGR) Cooler Switch-Over Valve
G62	Engine Coolant Temperature (ECT) Sensor (Q10-15	Glow Plugs 1 - 6
G70	Mass Air Flow (MAF) Sensor	S	Fuse
G79	Throttle Position (TP) Sensor	S204	Fuse 1 (30)
G81	Fuel Temperature Sensor	V157	Motor for Intake Flap
G169	Fuel Level Sensor 2	V275	Intake Flap Motor 2
G185	Sender 2 for Accelerator Pedal Position	Z35	Auxiliary Heater Heating Element
G235	Sensor 1 for Exhaust Temperature	Z19	Oxygen Sensor (O2S) Heater
G247	Fuel Pressure Sensor	①	Fan Stage 1
G448	Bank 1 Exhaust Gas Temperature (EGT) Sensor 2	②	Fan Stage 2
G450	Exhaust Pressure Sensor 1	③	Engine Speed
J17	Fuel Pump (FP) Relay	④	To Starter
J49	Fuel Pump (FP) 2 Relay	⑤	Terminal 50
J53	Starter Relay	⑥	Selector Lever (P/N)
J179	Automatic Glow Time Control Module	⑦	Terminal 50, Stage 1
J248	Diesel Direct Fuel Injection (DFI) Engine Control Module (ECM)	⑧	Terminal 50, Stage 2
J317	Power Supply (Terminal 30, B+) Relay	⑨	CAN BUS L
J329	Voltage Supply Terminal 15 (B+) Relay	⑩	CAN BUS H
J338	Throttle Valve Control Module	⑪	CAN BUS Convenience
J359	Relay for Preheating Coolant, Low Heat Output	⑫	CAN BUS Drive
J360	Relay for Preheating Coolant, High Heat Output	⑬	To Lights
J518	Access/Start Control Module		
J694	Power Supply Relay (terminal 75x)		
J695	Starter Relay 2		
J724	Turbocharger 1 Control Module		



Data Link Connector



Automatic Transmissions

Introduction

The multitronic O1J is used in A6 models with FrontTrack® and six cylinder engines.

Multitronic is characterized by its stepless transmission adjustment. It combines high driving comfort with convincing driving dynamics and helps ensure economic driving performance.

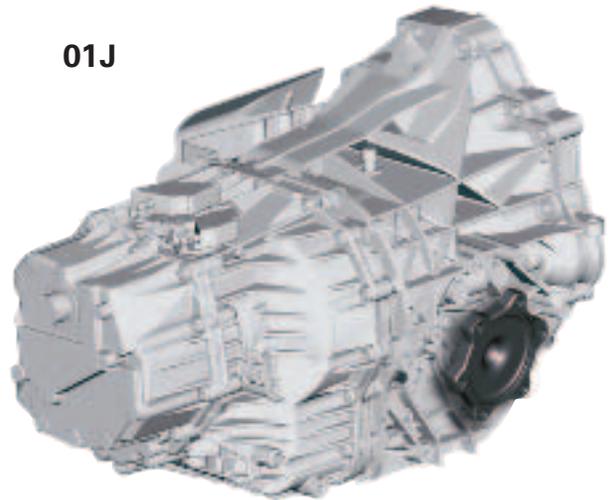
The torque capacity was increased to 243.3 lbf·ft (330 Nm) for the 3.2 FSI engine.

The new 6-gear multi-step automatic transmission 09L is used for all automatic transmission versions with quattro drive.

It is based on the 6-gear automatic transmission generation 09E, which was introduced in the 2004 Audi A8L. A torque capacity of up to 331.9 lbf·ft (450 Nm) means that it can also be combined with the 3.0 I V6 TDI.

This transmission was first used in the Audi S4 sports model.

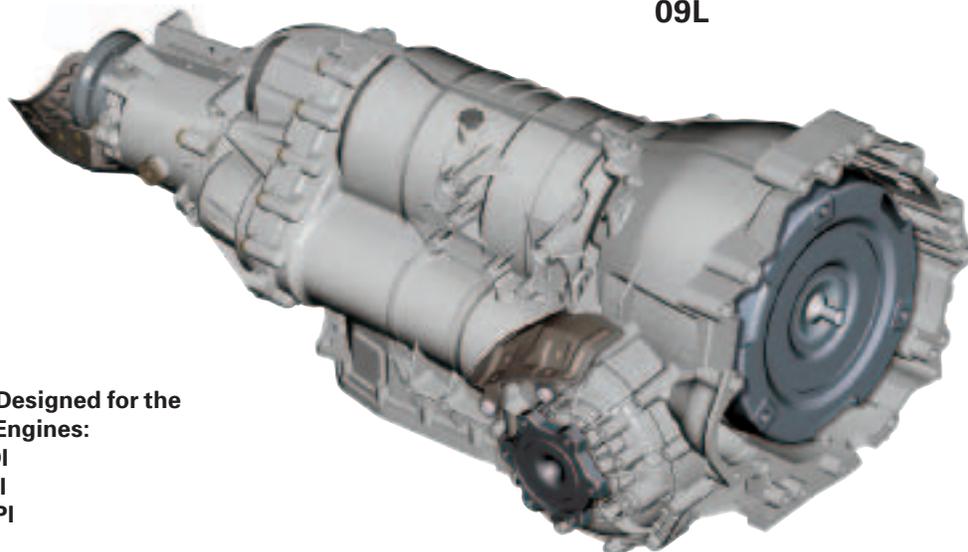
01J



The 01J is Designed for the Following Engines:

- 2.0 R4 TDI PD
- 2.4 V6 MPI
- 3.0 V6 MPI
- 3.2 V6 FSI

09L



The 09L is Designed for the Following Engines:

- 3.0 V6 TDI
- 3.2 V6 FSI
- 4.2 V8 MPI

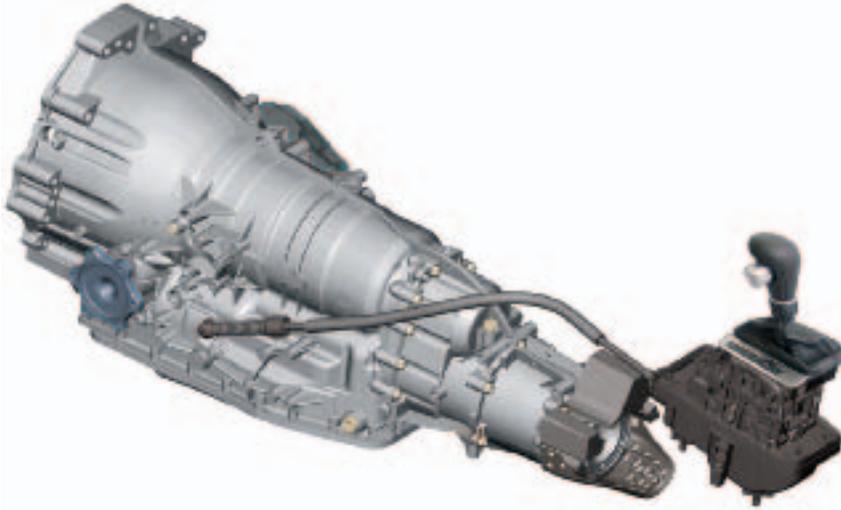
Automatic Transmissions

Gear Selector

The new design has:

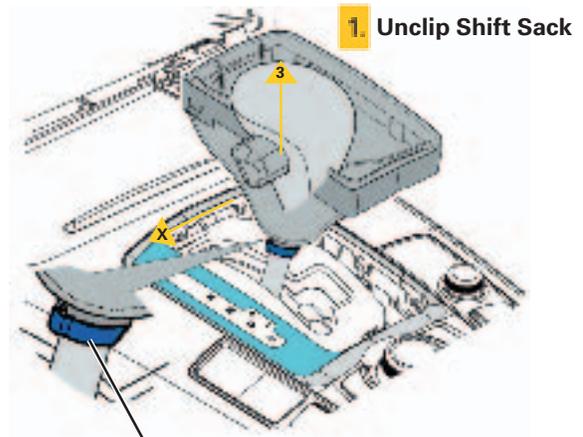
- An independent display unit
- A gear selector with shift boot

Selector Lever Transmission Range (TR) Position Display Y26



The assembly also has changed due to the new design.\

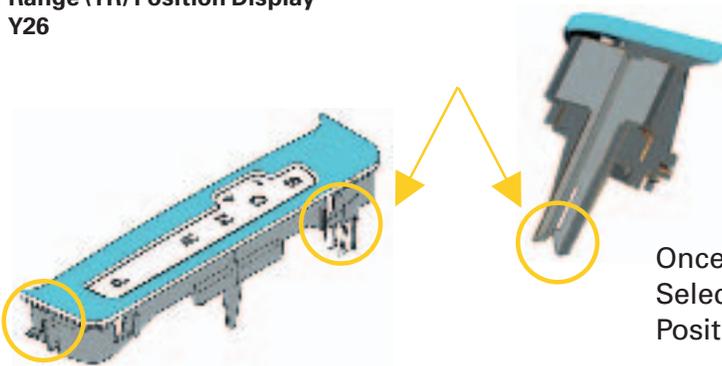
The button must be removed in order to install the gearshift handle.



1. Unclip Shift Sack

2. Open Clamp

Selector Lever Transmission Range (TR) Position Display Y26



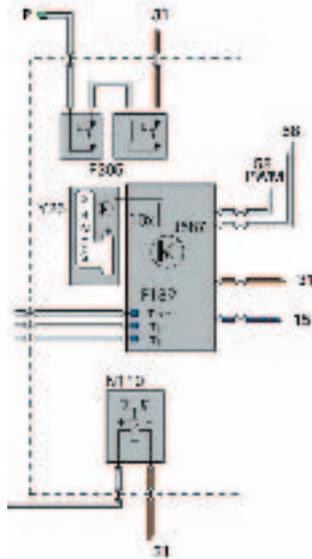
Once the shift boot has been unclipped, the Selector Lever Transmission Range (TR) Position Display also can be unclipped.

Automatic Transmissions

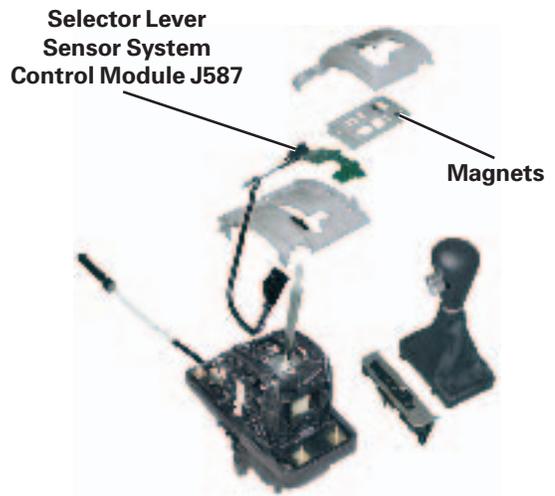
Selector Lever Locks (P Lock and P/N Lock)

We can differentiate between the P/N lock while driving or when the ignition is switched on, and locking the selector lever in position "P" when the ignition key is removed (P lock).

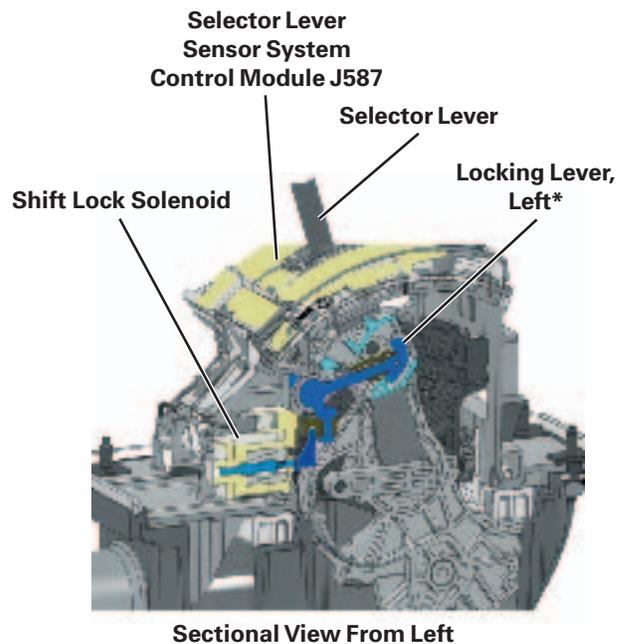
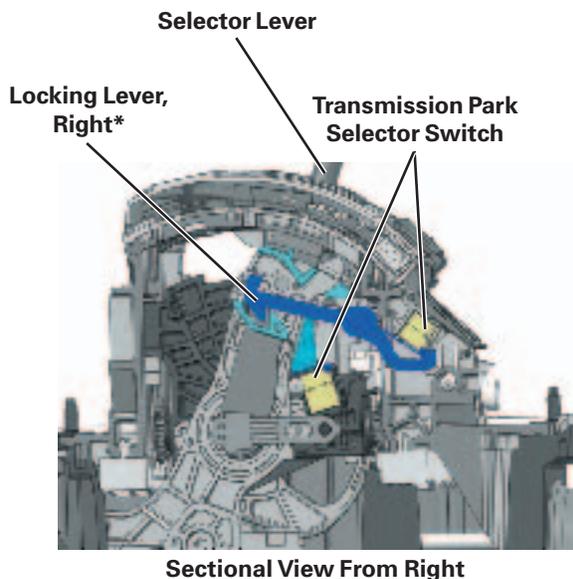
The P lock was previously operated by the steering column lock via a cable from the gear selector lever. This cable is no longer used because of the electric steering column lock and the new ignition switch E415.



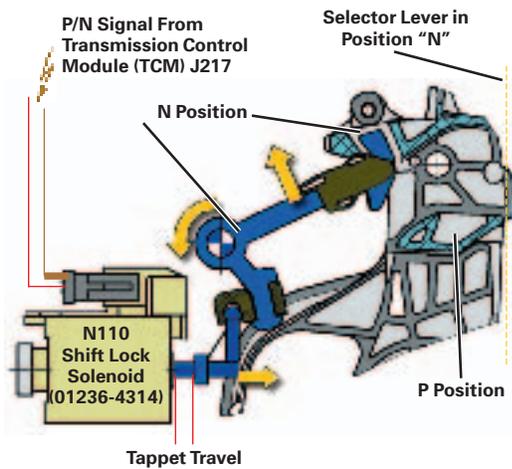
The kinematics of the locking mechanism were designed in such a way as to enable locking both in the de-energized state of the N110 (P) and when current is applied (N).



* The left and right locking lever is linked to an axle (one component).



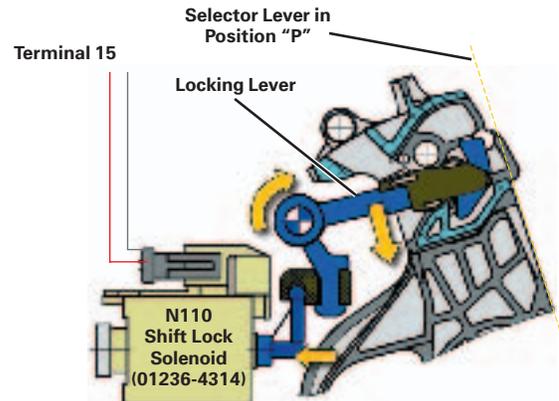
Automatic Transmissions



Lock In Position "P"

Solenoid N110 is deactivated and the locking lever is locked by gravity and the springs in the N110 magnet.

To release the lock, Solenoid N110 is activated and the magnet then pushes the locking lever out of the P position.



Lock In Position "N"

Solenoid N110 is activated and presses the locking lever up, where its hooks engage in the N position and it is locked.

To release the lock, Solenoid N110 is deactivated and the locking lever drops down. Solenoid N110 is controlled directly by the Transmission Control Module J217.

Note

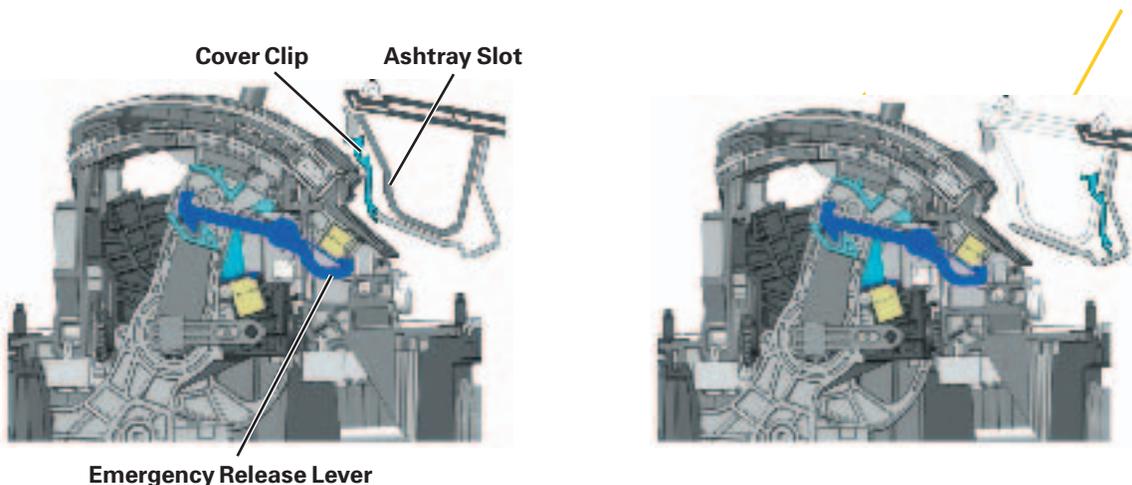
- N110 is controlled by negative voltage in the 09L gearbox.
- N110 is controlled by positive voltage in the 01J gearbox (see the relevant function diagram).

Emergency Release for P Lock

Because the P lock is only released when Solenoid N110 is activated, the selector lever remains locked in position "P" in the event of malfunctions (for example, battery flat, Solenoid N110 does not function, ...).

The emergency release lever on the left locking lever can be used to move the vehicle in such an instance.

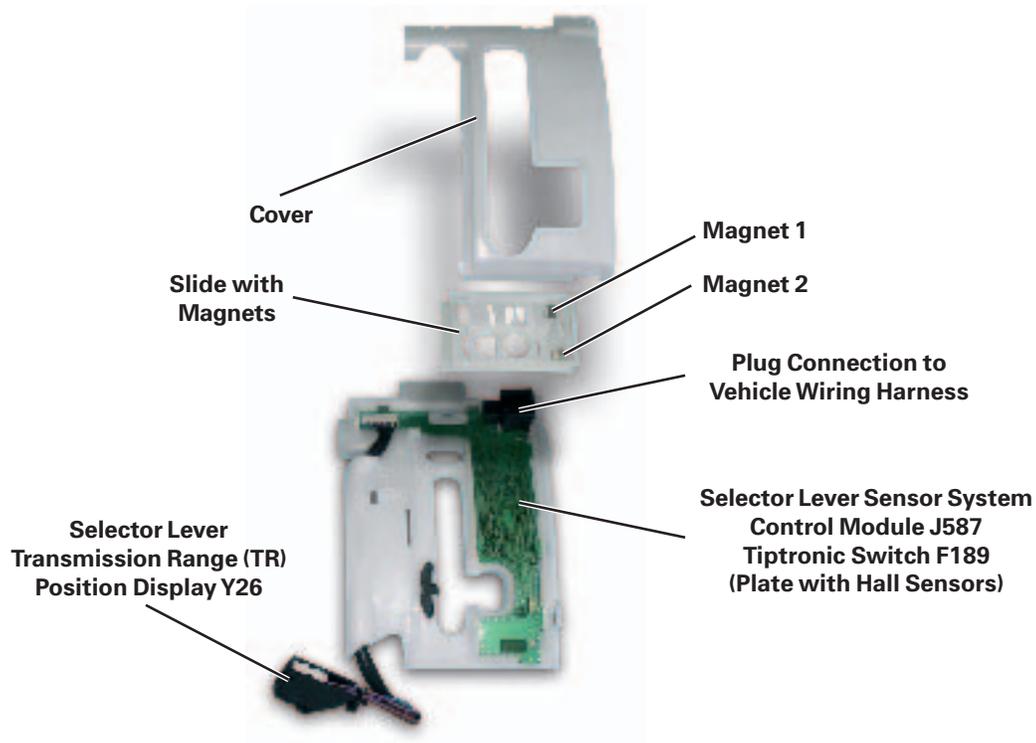
The emergency release can be accessed by removing the ashtray slot and the cover clip beneath it. The locking lever is released by pressing the emergency release lever (for example, with a pin). The button must be pressed and the selector lever pulled back at the same time.



Automatic Transmissions

Selector Lever Sensor System Control Module J587

The selector lever sensors include the Hall Sensors for controlling the display element and the Hall Sensors for the Tiptronic Switch F189.



Selector Lever Transmission Range (TR) Position Display Y26

The Selector Lever Transmission Range (TR) Position Display is supplied with voltage by the selector lever sensors and is activated by the Selector Lever Sensor System Control Module J587 in accordance with the selector lever position.



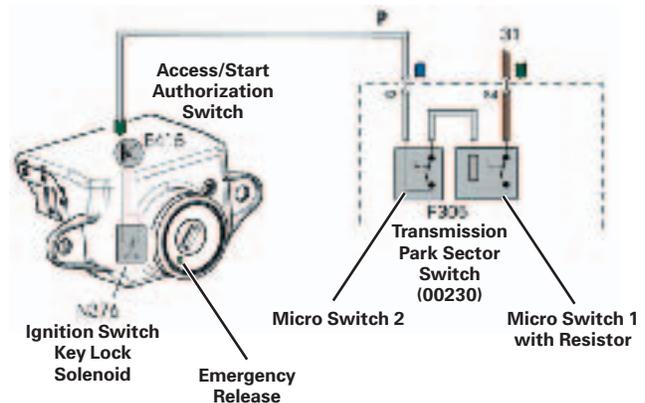
Automatic Transmissions

Ignition Key Anti-removal Lock

The function of the ignition key anti-removal lock is fundamentally changed.

Because of the “electronic ignition switch” E415 (Access/Start Authorization Switch) and the electromagnetic steering column lock, the mechanical connection (cable) from the gear selector to the steering column lock is no longer used.

The release for the ignition key anti-removal lock is controlled by the Access/Start Authorization Switch E415 and is operated by the magnet for the Ignition Switch Key Lock Solenoid N376, which is integrated into the E415.



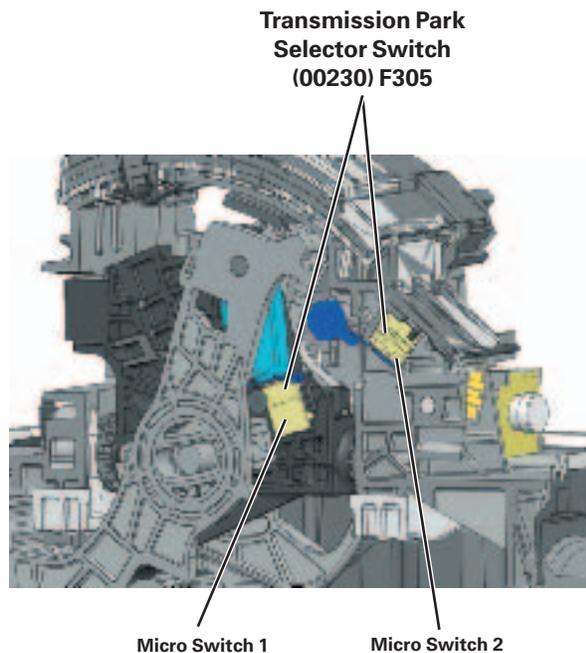
The information from selector lever position “P” supplies Two mechanical micro switches, Transmission Park Selector Switches F305. They are connected in Series and form one unit.

Both switches are closed in selector lever position “P” and supply a ground signal to the Access/Start Authorization Switch E415. If the ignition is switched off, the magnet in the Ignition Switch Key Lock Solenoid N376 is supplied with current for a short time and a lever mechanism lifts up the ignition key anti-removal lock.

Two micro switches are installed for safety reasons:

Micro switch 1 is only actuated (hit) when the selector lever button is released in selector lever position “P” (button not pressed). The series-connected resistor allows the diagnosis of the signal lead.

Micro switch 2 is only actuated when the locking lever for the P/N lock is in the initial position see function description for P/N lock). It signals the actual locking in selector lever position “P.”



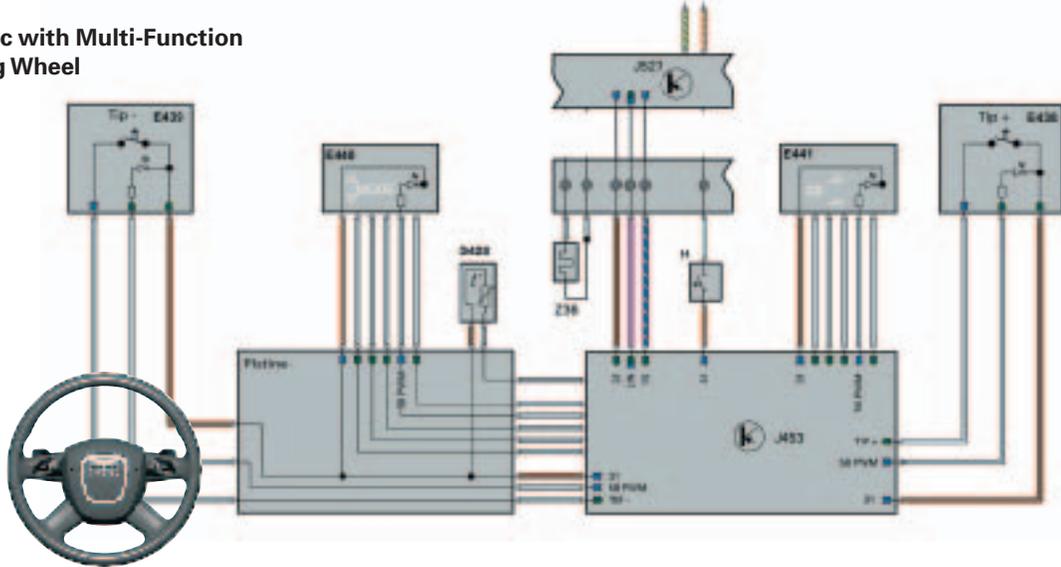
Automatic Transmissions

Steering Wheel Tiptronic

With regard to operation, there are two types of steering wheel Tiptronic:

- with multi-function steering wheel
- without multi-function steering wheel

Tiptronic with Multi-Function Steering Wheel

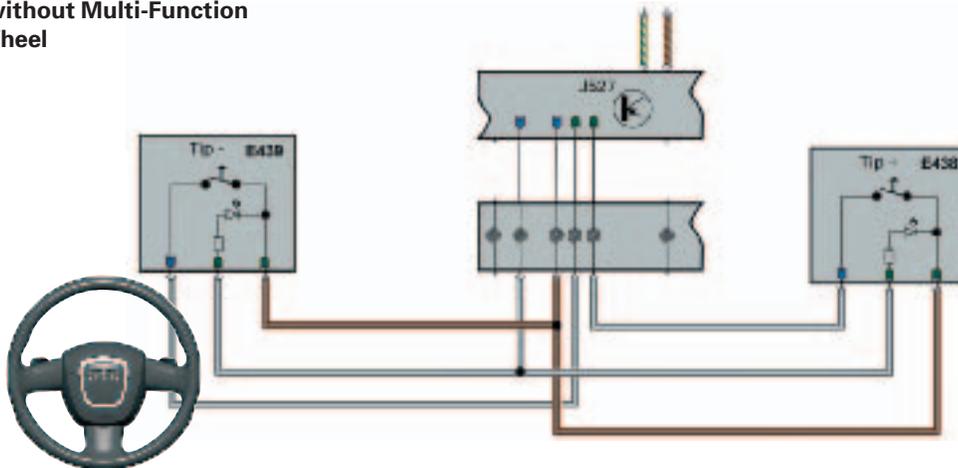


Signal flow for steering wheel Tiptronic with multi-function steering wheel:

- from E438 or E439 directly (discretely) to J453

- from J453 via LIN data bus to J527
- from J527 via CAN Convenience to the gateway J533
- from J533 via CAN Drive to the transmission control unit J217

Tiptronic without Multi-Function Steering Wheel



Signal flow for steering wheel Tiptronic without multi-function steering wheel:

- from E438 or E439 directly (discretely) to J527
- from J527 via CAN Convenience to the gateway J533
- from J533 via CAN Drive to the transmission control unit J217

- E438 Tiptronic Upshift Button (on steering wheel)
- E439 Tiptronic Downshift Button (on steering wheel)
- E440 Left Multi-function Buttons (on steering wheel)
- E441 Right Multi-function Buttons (on steering wheel)
- F350 Spiral Spring
- G428 Heated Steering Wheel Sensor
- J453 Control module for multi-function steering wheel
- J527 Steering Column Electronic Systems Control Module
- Z36 Heated steering wheel

Automatic Transmissions

6-gear Automatic Transmission 09L

The new 6-gear automatic transmission 09L is used as a "quattro automatic gearbox."

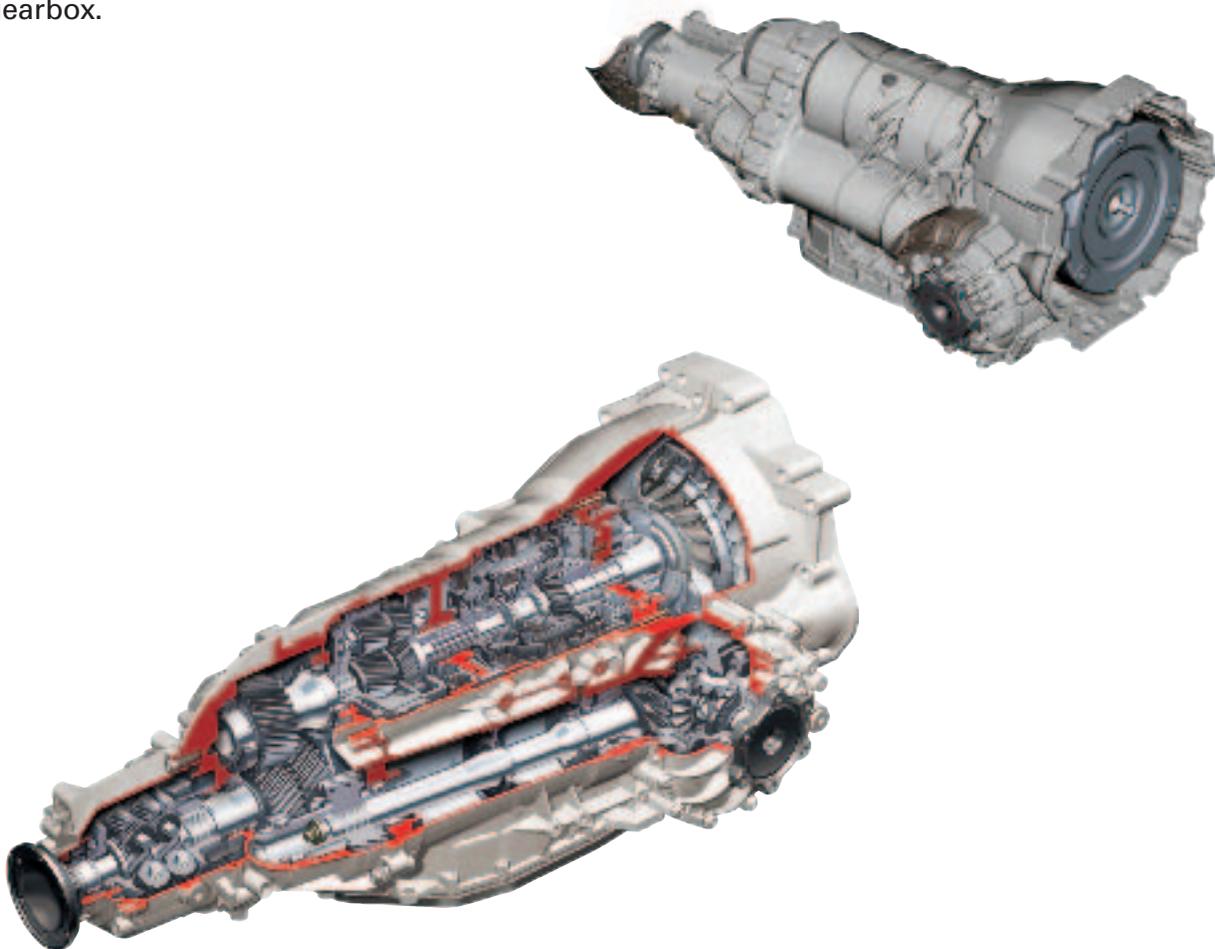
A torque capacity of up to 331.9 lbf·ft (450 Nm) covers the complete engine program available today. It replaces the two 5-gear automatic transmissions 01V and 01L.

The 09L gearbox is a derivative of the 09E gearbox from the system supplier ZF, which should be familiar from the 2003 Audi A8L.

The design and function of the gear mechanism and transmission control is for the most part identical to that of the 09E gearbox.

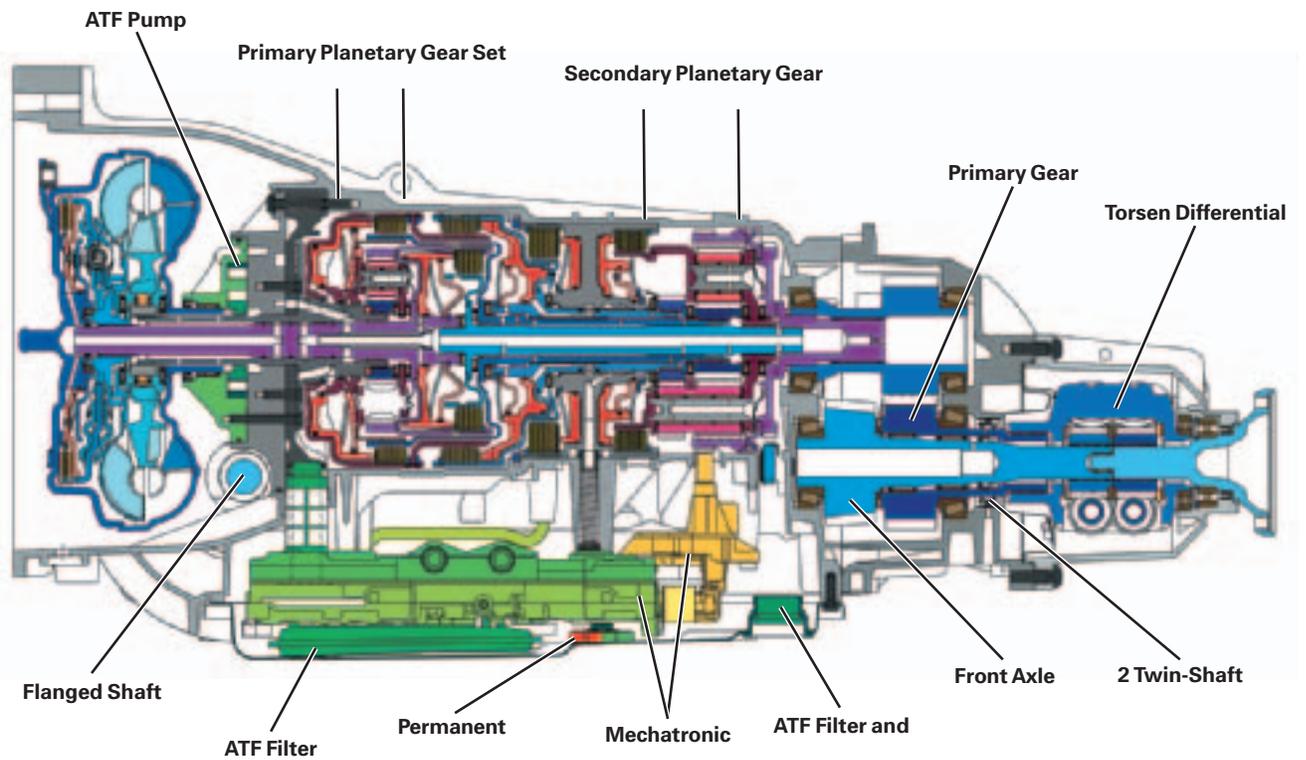
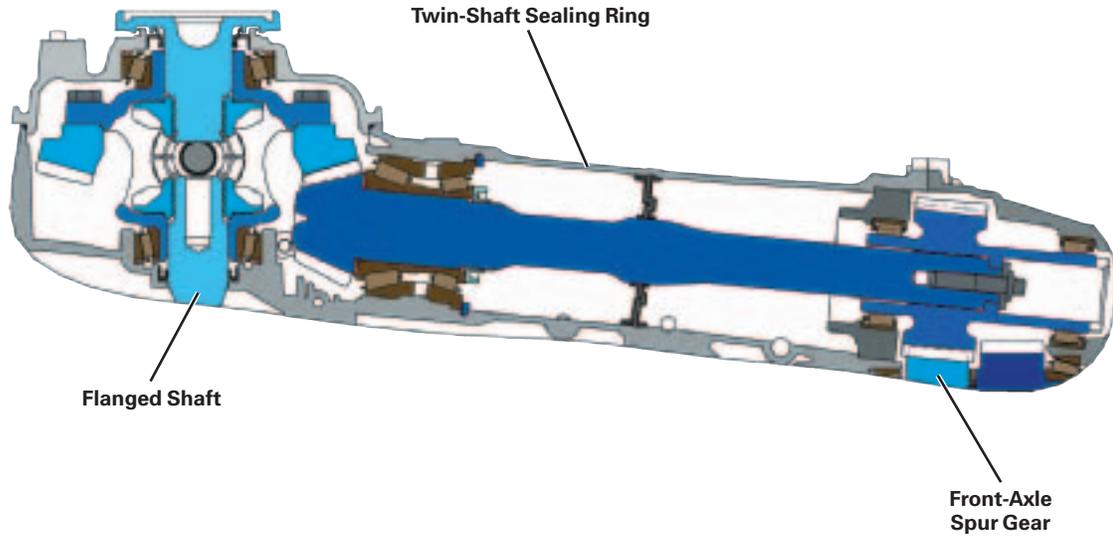
The Lepelletier gear set concept allows 6 gear steps with only 5 switching elements. The main feature of this gear set is its simple and light-weight design.

The main difference between the 09L gearbox and the 09E gearbox is that the 09L has a lower torque capacity and the individual components are therefore laid out differently. The positioning of the front-axle differential was retained from the predecessor models (after the torque converter).



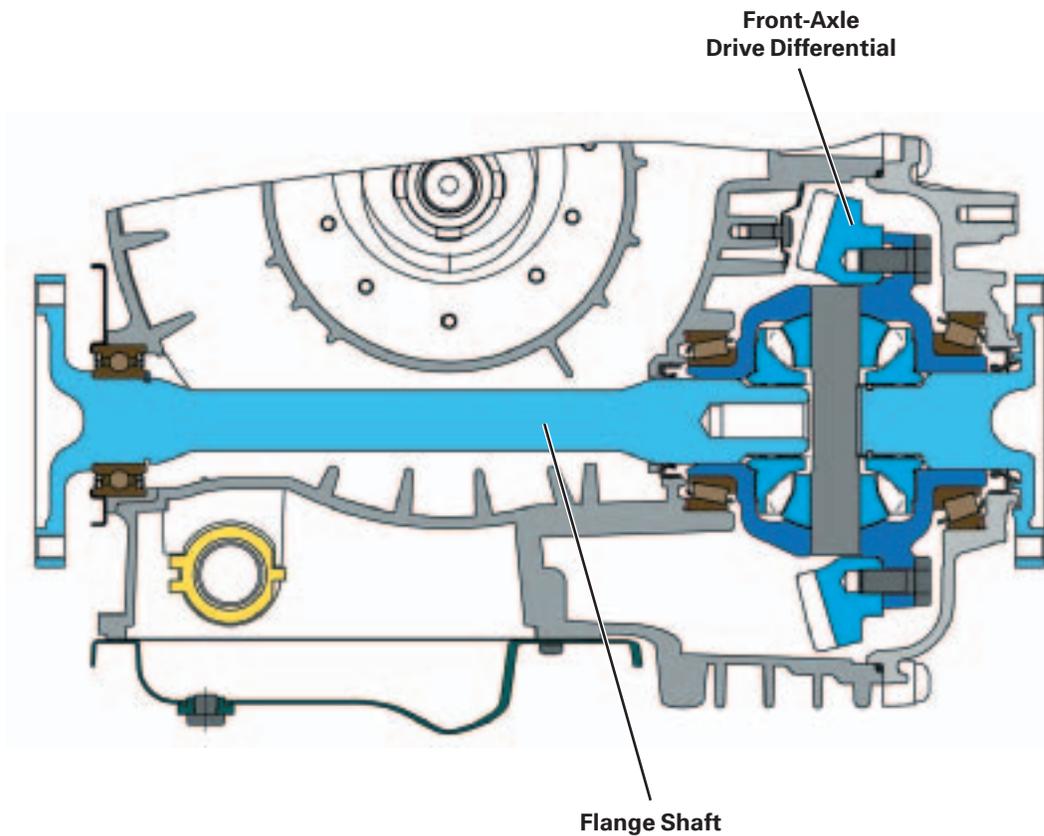
Automatic Transmissions

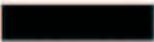
6-gear Automatic Gearbox O9L



Automatic Transmissions

Gearbox Cross-section O9L



-  Hydraulic parts/control
-  Components of the planetary gear sets
-  Shafts/gearwheels
-  Electronic components, control module
-  Multi-disc clutches, bearings, plates, snap rings
-  Plastic, seals, rubber, washers
-  Components of the switching elements for cylinders, pistons and baffle plates
-  Housing, screws, bolts

Automatic Transmissions

Technical Data

Service code	09L
ZF code	6HP-19A
Audi code	AL 420 6Q
Gearbox type	6-gear planetary transmission (multi-step automatic transmission), electronically controlled with hydro-dynamic torque converter with slip-controlled torque converter lockup clutch
Control	Mechatronic (integration of the hydraulic control unit and electric control to form one unit) Dynamic switching program with a separate sport program "S" and the Tiptronic switching program for manual gear change
Torque converter	W255 RH-4 GWK
Power transmission	Permanent four-wheel drive "quattro" with Torsen central differential
ATF	9.5 qt/2.4 gal (9.0 litre) G 055 005 (Shell ATF M-1375.4) Lifetime fill
Differential, FA/RA	1.2 qt/0.5 qt (1.1 litre/0.5 litre) G 052 145 (Burmah SAF-AG4 1016) Lifetime fill
Weight including oil lb (kg)	Approx. 253.5 lb (115 kg)
Max. torque lbf-ft (Nm)	Up to 331.9 lbf-ft (450 Nm), depending on engine version
Kingpin inclination	6.04

Apart from the additional gear ratios and the high torque capacity, improvements have been made to the 09L gearbox. First, it weighs 30.9 lb (14 kg) less (compared to the 01V). In addition, it has:

- Improved efficiency
- Increased kingpin inclination
- Further developed DSP
- Higher shift speeds
- Improved shift quality

Automatic Transmissions

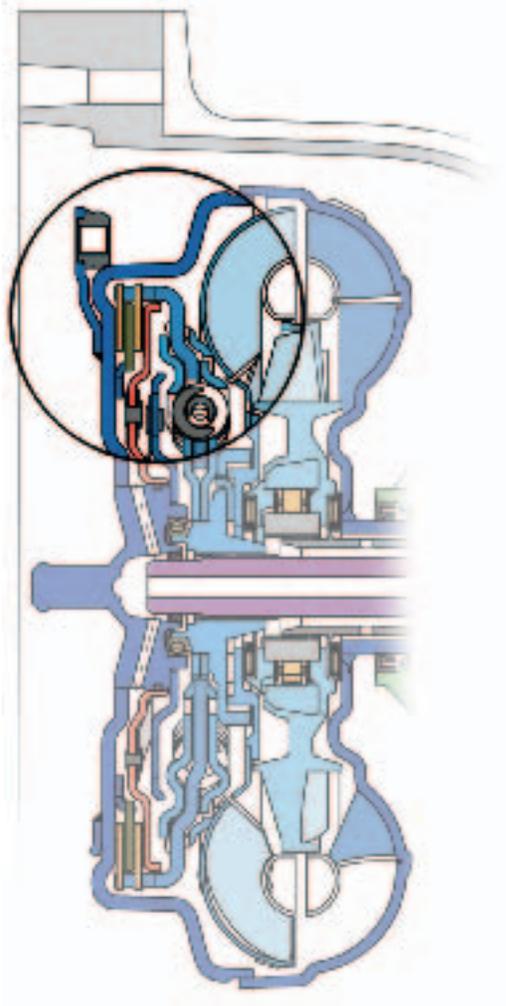
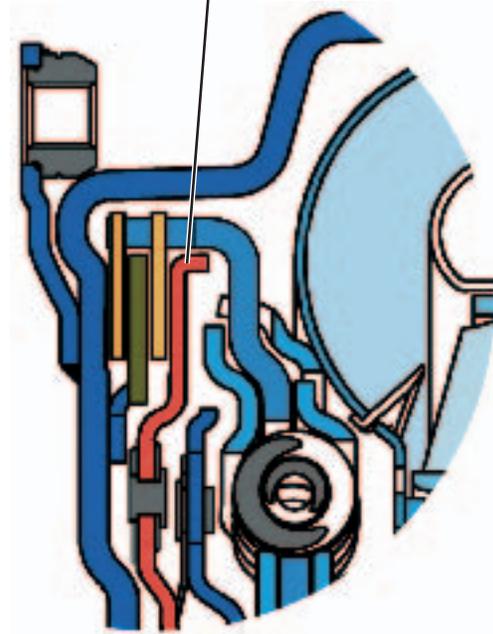
Torque Converter Clutch

The permitted friction conduction of the Torque Converter Clutch has been increased in the 09L gearbox through the use of 4 friction linings.

This allows a considerable expansion of the control operation of the converter clutch, which improves the overall efficiency of the drive line.

ATF G 055 005 is required to ensure the long-term load-bearing capacity of the converter clutch. It has been developed to meet the highest demands.

Converter Clutch with 4 Linings

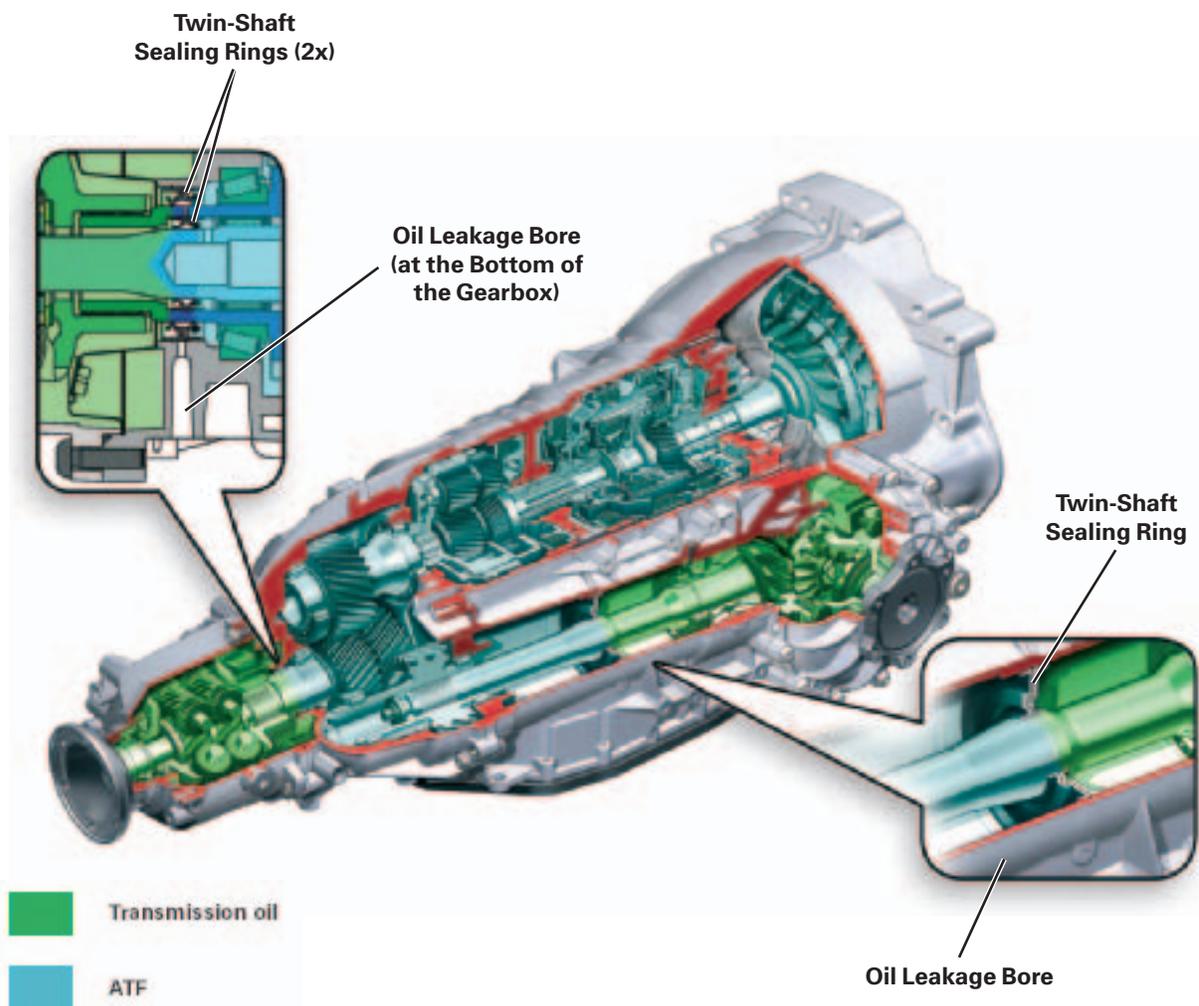


Automatic Transmissions

Oil Management and Lubrication

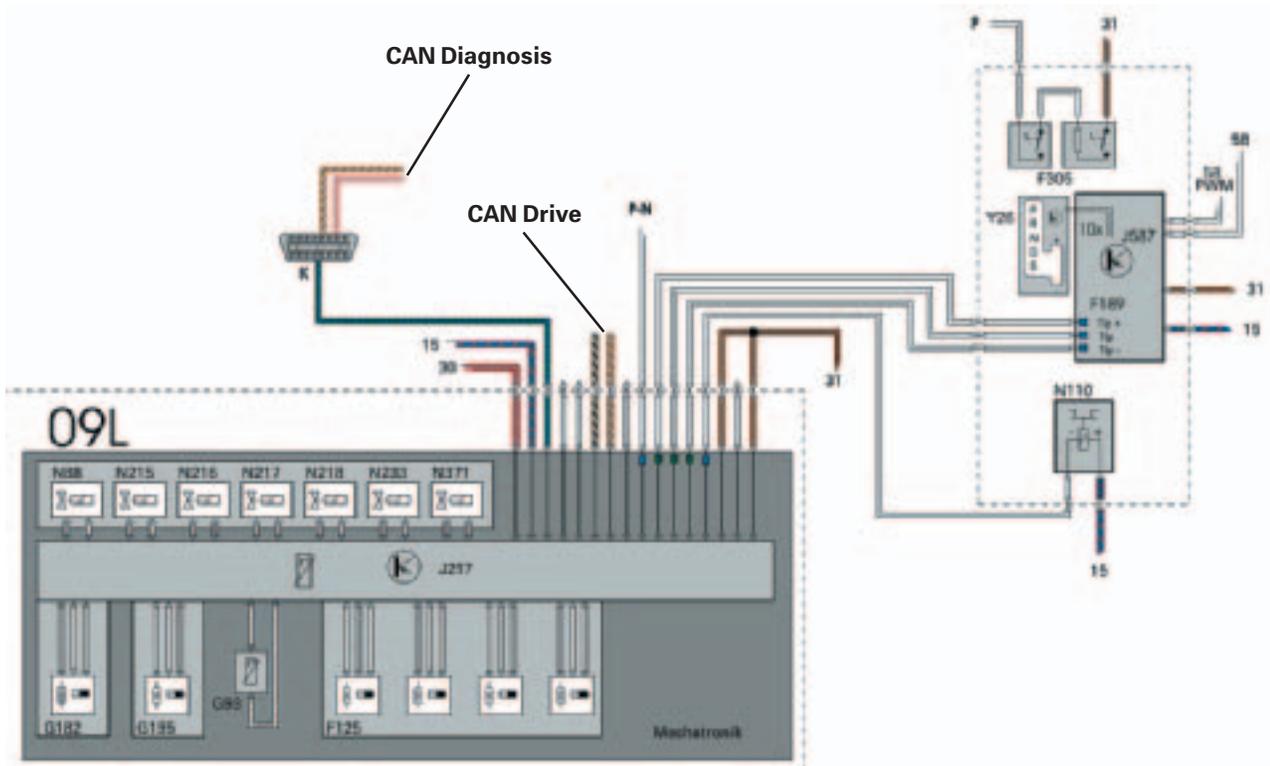
The 09L gearbox has three separate oil chambers. Twin-shaft sealing rings are used to separate the adjacent, yet different oil chambers.

In the event of leaks at the twin-shaft sealing rings, the oil escapes out of the corresponding oil leakage bore.



Automatic Transmissions

Function Diagram for 09L Transmission



Legend

F125	Multi-Function Transmission Range (TR) Switch	Y26	Selector Lever Transmission Range (TR) Position Display
F189	Tiptronic Switch	P P	Signal to Access/Start Authorization Switch E415 (for the ignition key anti-removal lock function)
F305	Transmission Park Selector Switch	P-N	P/N signal to Access/Start Control Module J518 (for the start control function)
G93	Transmission Fluid Temperature Sensor	K	Bi-directional diagnosis lead (K lead)
G182	Sensor for transmission RPM		
G195	Sender for transmission output RPM		
J217	Transmission Control Module (TCM)		
J518	Selector Lever Sensor System Control Module		
N88	Solenoid Valve 1		
N110	Shift Lock Solenoid		
N215	Pressure Control Valve 1 for Auto. Transmission		
N216	Pressure Control Valve 2 for Auto. Transmission		
N217	Pressure Control Valve 3 for Auto. Transmission		
N218	Pressure Control Valve 4 for Auto. Transmission		
N233	Pressure Regulating Valve 5 for automatic transmission (system pressure)		
N371	Pressure Regulating Valve 6 (for automatic transmission) (converter clutch)		

Automatic Transmissions

Transmission Ratio

The gear spread has been increased by 22% compared to the 01V gearbox. Most of that was used to achieve a lower take-off ratio in order to improve take-off dynamics.

On the one hand, the higher kingpin inclination has provided more wheel torque for vehicle acceleration in low gears. While on the other hand, it ensures lower engine speeds for highway driving. As a result, a lower noise level and improved fuel consumption has been achieved.

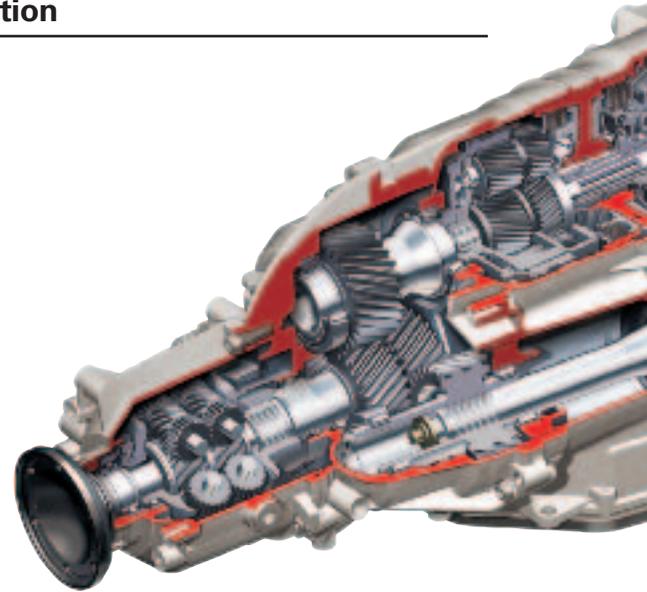
The basic transmission ratio design for top speed is different for diesel engines and petrol engines.

Top speed is reached in 6th gear with diesel engines.

Top speed is reached in 5th gear with petrol engines.

Top speed can be reached both in 5th and 6th gear with corresponding engine power.

	09L	01V
Transmission		
Transmission	ratio	ratio
1st gear	4.171	3.665
2nd gear	2.340	1.999
3rd gear	1.521	1.407
4th gear	1.143	1.000
5th gear	0.867	0.742
6th gear	0.691	
Reverse	3.403	4.096
Kingpin inclination	6.04	4.94



Hydraulics (Lubrication)

A significant reduction in leaks in the hydraulic system, particularly due to the use of new pressure regulators, means that a smaller oil pump can be used. The oil pump in the 09L gearbox still only has 50% of the torque absorption of the 01V gearbox.

Furthermore, a lower-viscosity ATF is used for the 09L gearbox (as for the 09E gearbox). This results in significantly lower torque losses at low temperatures.

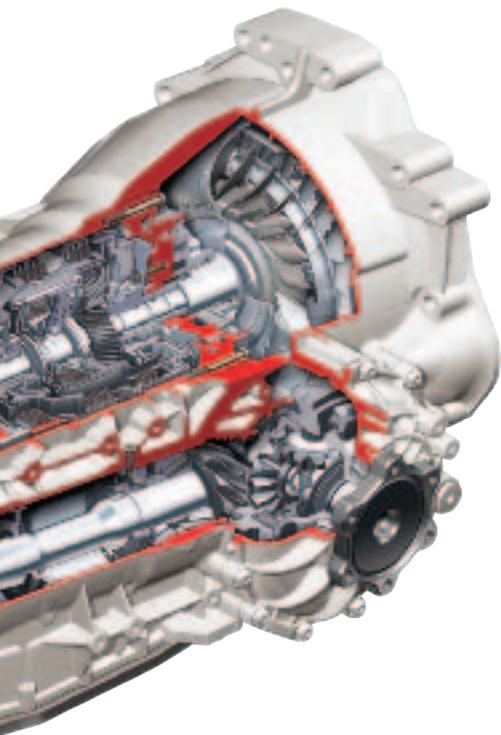
Both measures ensure not only a reduction in fuel consumption, but also a higher top speed.

Automatic Transmissions

Dynamic Switching Program – DSP

The driving strategy has been further developed in order to highlight the sporty character of the new 2005 Audi A6.

For example, depending on accelerator pedal position, vehicle acceleration and lateral acceleration, different switching programs are used in the D and S mode. This eliminates annoying up-shifts, For example, when driving into corners, during sporty driving.



Furthermore, the take-off procedure is already under evaluation in order to change over to different switching characteristics both in the D and S program in the very near future, so that the gearbox can adapt even more quickly to the driver.

To meet the requirements of the new 2005 Audi A6 with regard to comfort and convenience, various tuning parameters for clutch control have been implemented for the D, S and Tiptronic settings.

A spontaneous map set is activated during the switching operation in sport and Tiptronic mode, thereby reducing the switching time.

The main emphasis is on comfort in the D mode, which extends the switching time slightly.

Electro-hydraulic Control

To increase the shift speed, especially for downshifts, more far-reaching functions in relation to engine control have been developed.

Multiple downshifts are interstaged, which contributes to a significant increase in spontaneity. This measure means that during the first downshift, the next downshift is already electrically and hydraulically prepared so that the change can then be performed without delay.

Coasting downshifts are reduced by around 50% through active intermediate acceleration, which significantly increases agility. The spontaneity of downshifts, which are only performed for a light pull, is also increased significantly as a result of this measure.

Automatic Transmissions

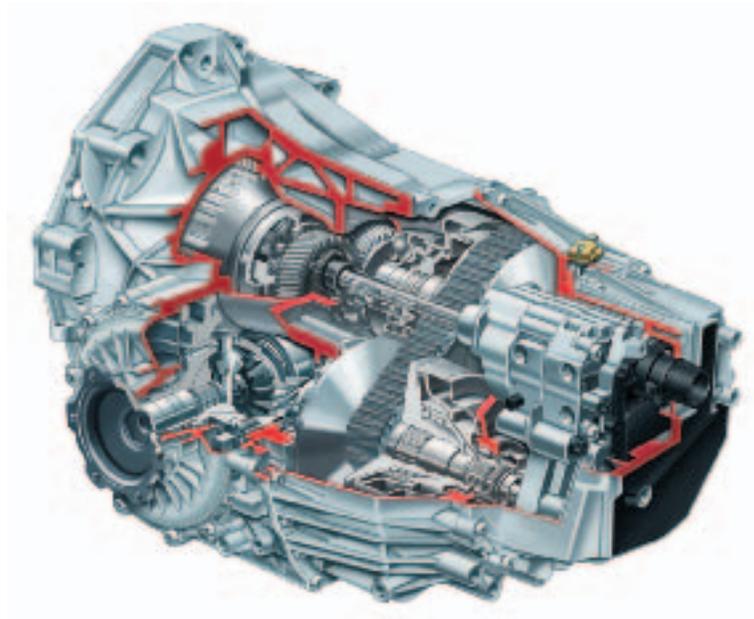
Multitronic 01J

The Multitronic has been developed further with regard to efficiency and sportiness.

When used in combination with the 3.2 V6 FSI engine, the transmission ratio capacity was increased to 243 lbf. ft. (330 Nm) and 252 hp. (188 kW). This was achieved by implementing the following measures:

- The spring packs and the flywheel mass were adapted for the flywheel damper unit.
- The required oil pressure and the oil quantity for clutch cooling was increased for the drive-off clutch.

- The tothing of the spur gears and the bevel gear were strengthened and their cooling system was optimized.
- The material and heat processing was optimized on the variator. The diameter of the disc set shafts was increased. The strength of the shafts was increased by optimizing the oil bore guide.
- The contact point geometry of the chain pin and bevel slide valve was improved to support the higher pressures resulting from the increased torque.
- The hydraulic control system was adapted for the clutch and variator due to the higher pressures.



The gear spread was increased from 6.05 to 6.20 in order to achieve more agility and sportiness while maintaining good fuel consumption values.

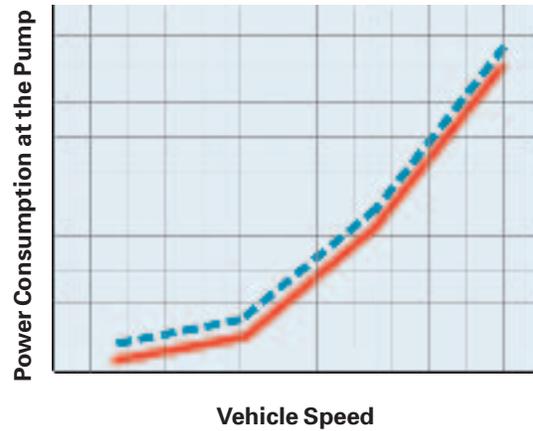
Automatic Transmissions

The transmission efficiency was improved in order to reduce consumption and increase driving power. This was mainly achieved by reducing the pump absorption power.

Two measures must be mentioned here:

- A reduction in leaks on the entire hydraulics system reduces the required oil feed quantity. Newly developed piston rings in the twist inlets of the disc sets have contributed significantly to this.
- A new vane-type pump with a lower power consumption also helps to improve efficiency.

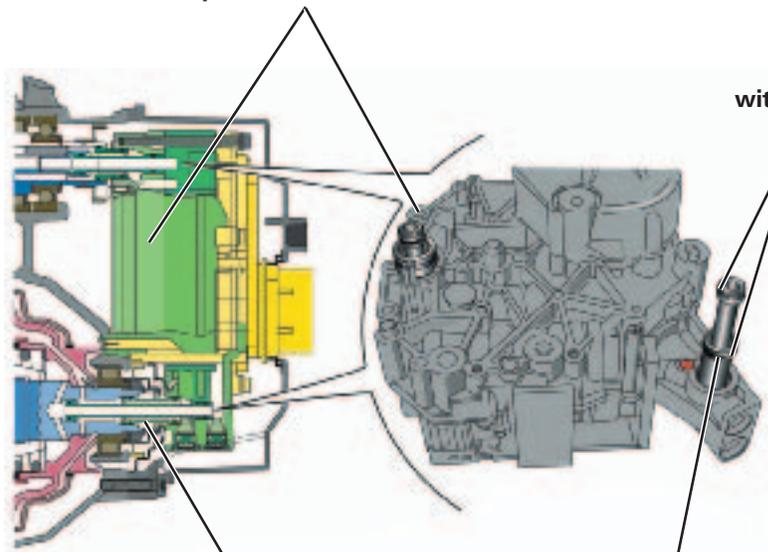
Comparison Between Crescent-Type Pump (Predecessor) and Vane-Type Pump



Piston Rings in the Disc Set Twist Inlets

Hydraulic Control (Hydraulic Control Unit)

Twist Inlets with Piston Rings



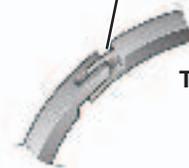
Previously Used Piston Rings



Square-Cut Piston Ring



Diagonal-Cut Piston Ring



T Lock - Piston Ring

The new piston rings with a "T lock" have fewer leaks than the previously used square- or diagonal-cut piston rings.

The required oil feed quantity is lower, which in turn improves efficiency.

Automatic Transmissions

The new oil pump is an up-and-down stroke **vane-type pump**. The pump housing is shaped in such a way that two suction cones and pressure cones exist. The feed capacity per rotation is thus twice as high as with the conventional shape.

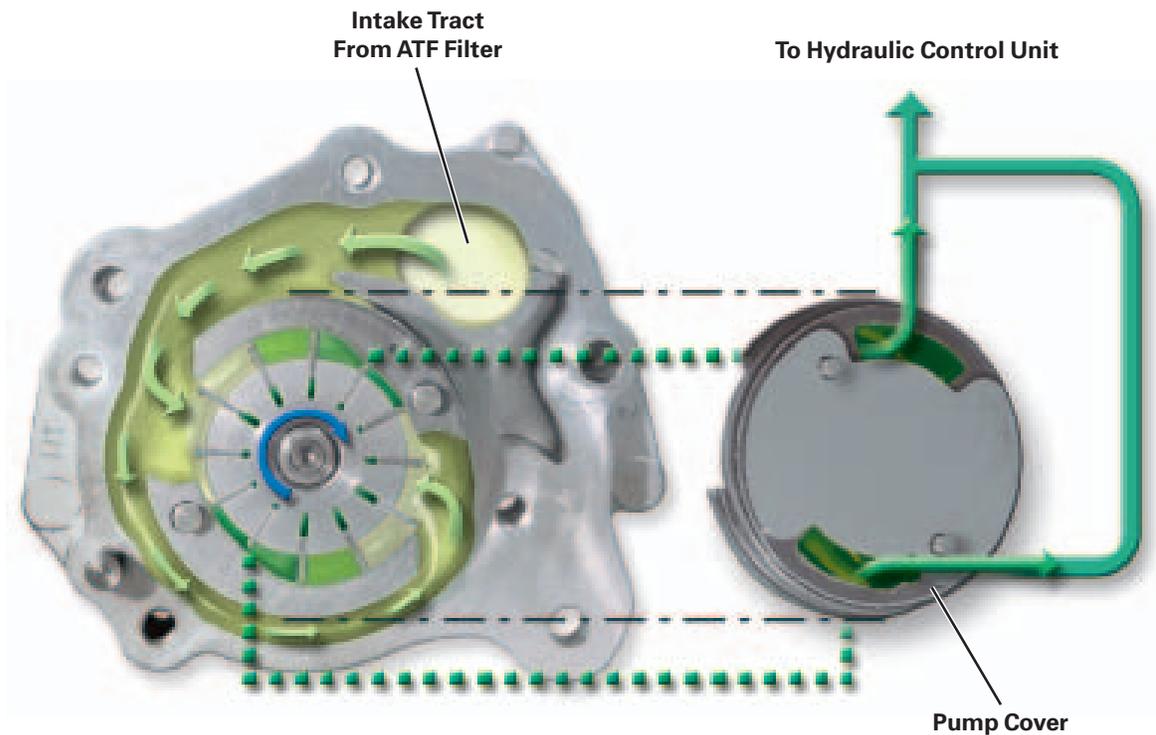
The symmetric shape means that there is not much pressure on the pump shaft.

The vane-type pump is very compact and has a lower power consumption compared with the predecessor pump.

As on the predecessor pump, special measures were implemented to improve the so-called "inner seal."

To compress the pump impeller, the pump pressure is guided into the guide grooves of the rotor, which presses the vanes to the pump housing. The pump chambers are also sealed axially.

The pump pressure is applied to the side housing covers of the pump. As the pressure increases, the housing covers are pressed with more force on to the rotor and its vanes.



Automatic Transmissions

Functions

The following functions have been further developed in order to highlight the sporty character of the new 2005 Audi A6:

- Tiptronic
- Dynamic Regulating Program DRP
- Hill starts

Tiptronic

There are two different gearing variants:

Variant 1: In the tip gate selector lever position or in selector lever position “D” for steering wheel tiptronic, the design is implemented economically as so-called 6+E gearing.

Variant 2: In selector lever position “S” for steering wheel tiptronic, gearing is implemented in the form of a 7-gear “sports-style gearbox” with short transmission ratios.

Dynamic Regulating Program DRP

Switching in 7 gears is now possible in a “stepped” way during acceleration in the S program.

This provides increased engine speed dynamics.



Hill Starts

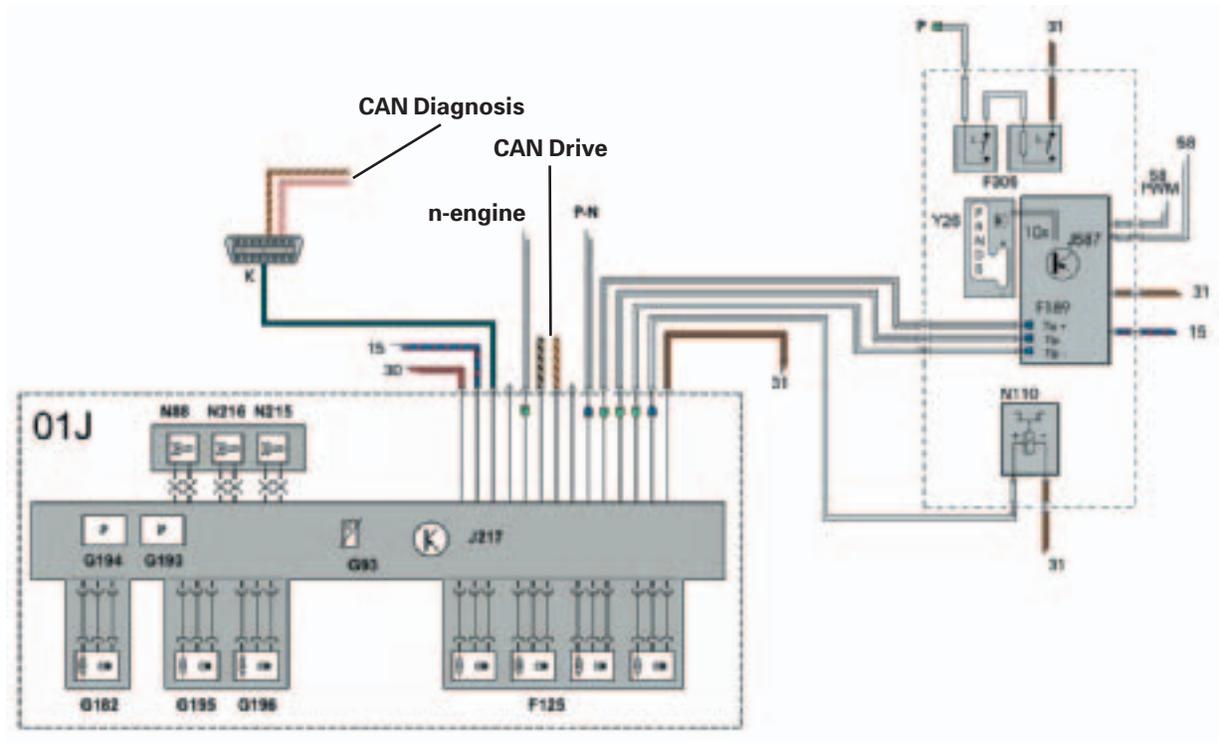
Take-off comfort on hills has been improved. Here, the vehicle is held for a short time by the service brake until the driver accelerates to take off. This prevents the vehicle from rolling back on slopes.

Function:

If the driver takes his/her foot off the brake pedal after stopping on a slope, the braking pressure that was previously applied by the driver is maintained by closing the ABS outlet valves. If the driver puts his/her foot on to the accelerator pedal within one second and accelerates, the brake is opened if the engine torque is sufficient for taking off. If the driver does not press the accelerator pedal immediately after letting off the service brake, the brake is opened again after one second. If the creep torque is not sufficient to hold the vehicle, it will roll back unless the driver intervenes.

Automatic Transmissions

Function Diagram for 01J multitronic



Legend

F125	Multi-Function Transmission Range (TR) Switch	Y26	Selector Lever Transmission Range (TR) Position Display
F189	Tiptronic Switch	P P	P Signal to Access/Start Authorization Switch E415 (for the ignition key anti-removal lock function)
F305	Transmission Park Selector Switch	P-N	P/N signal to Access/Start Control Module J518 (for the start control function)
G93	Transmission Fluid Temperature Sensor	K	Bi-directional diagnosis lead (K lead)
G182	Sensor for transmission RPM	n-engine	Engine speed signal, (from the relevant Engine Control Module J623)
G193	Sender 1 for hydraulic pressure, automatic transmission (clutch pressure)		
G194	Sender 2 for hydraulic pressure, automatic transmission (contact pressure)		
G195	Sender for transmission output RPM		
G196	Sender 2 for transmission output RPM		
J217	Transmission Control Module (TCM)		
J587	Selector Lever Sensor System Control Module		
N88	Solenoid Valve 1		
N110	Shift Lock Solenoid		
N215	Pressure Control Valve 1 for Auto. Transmission		
N216	Pressure Control Valve 2 for Auto. Transmission		

Manual Transmissions

Introduction

In addition to the successful multitronics, newly developed 6-speed transmissions will be used exclusively in the 2005 Audi A6.

Manual transmission

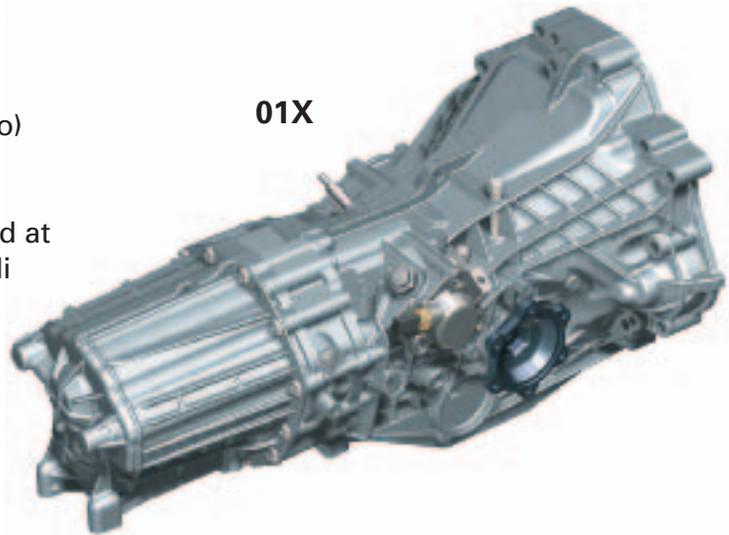
Two new generations of 6-speed manual transmissions, front and quattro versions respectively, now replace the previously used 5-speed and 6-speed transmissions.

In addition to increasing torque capacity, the main emphasis has been placed on reworking the inner and outer gearshift. Gearshift force, comfort and precision have been significantly improved. The transmissions are already used in some Audi A4 and Audi S4 models.

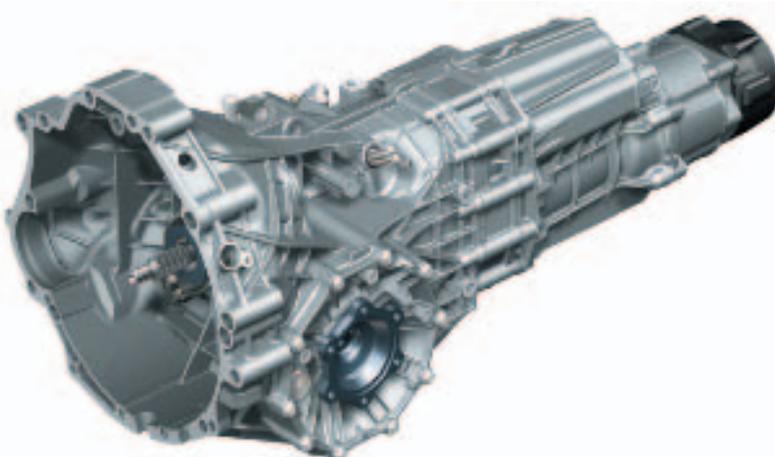
The versions 01X (front) and 02X (quattro) are used for torques of up to 330 Nm.

 Manual transmissions will not be offered at the market introduction of the 2005 Audi A6.

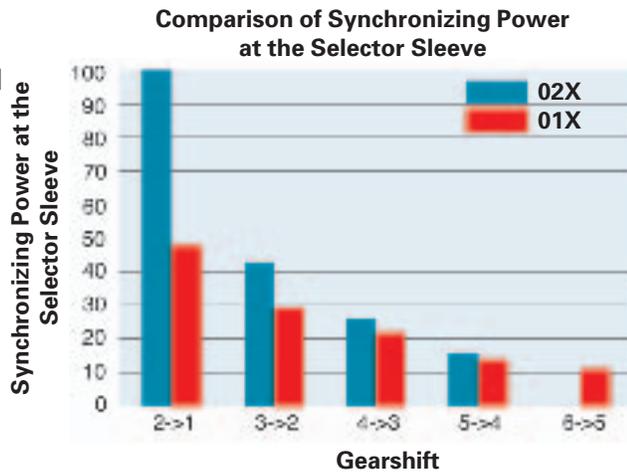
The 01X is designed for the following engines:
– 2.0 R4 TDI PD
– 2.4 V6 MPI
– 3.2 V6 FSI



02X



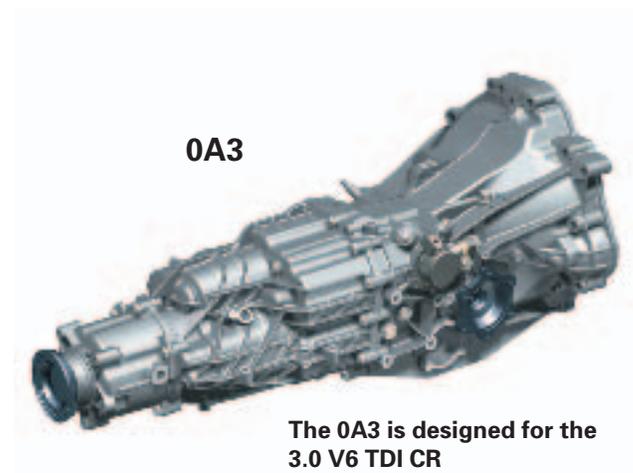
The 02X is designed for the following engines:
– 2.4 V6 MPI
– 3.2 V6 FSI



Manual Transmissions

A maximum possible gear spread in the 7.5 range together with the 6th gear opens up a wide range of possible uses (i.e., for a sporty model with short gearshifts for maximum acceleration or for the very economic model, with a “long” 6th gear for fuel economy without losing out too much on driving dynamics).

The 0A3 (quattro) is used for a torque of 350 Nm or higher.



Technical Data

Service code	0A3	01X	02X
Manufacturer code	ML450 – 6Q	ML310 – 6F	ML310 – 6Q
Development/ manufacturers	Getrag, Audi Getrag	Audi/VW Kassel	Audi/VW Kassel
Weight with oil (without clutch) in kg	72.7	58.6	69.7
Max. torque in Nm	450	330	330
Axle base in mm	82	75	
Oil quantity in l	3.2	3.0	3.5
Housing	3-part	3-part	4-part
	Aluminum with screwed-on steel-plate bearing carrier	Aluminum with central bearing housing	
Synchronization	1st and 2nd gear with triple cones 3rd to 6th gear and Reverse with twin cones	1st gear with triple cones 2nd gear with twin cones 3rd to 6th gear and Reverse with a single outer cone	
Gear spread	Up to max. 7.5 possible	Up to max. 7.68 possible	
Central differential Torque distribution	Torsen 50/50	–	Torsen 50/50

Manual Transmissions

The new 6-speed manual transmission 0A3 is a further development of the tried-and-trusted 01E transmission, which rang in the 6-speed era at Audi at the beginning of the '90s.

Like the predecessor transmission, it was developed jointly by Getrag and Audi and is manufactured by Getrag.

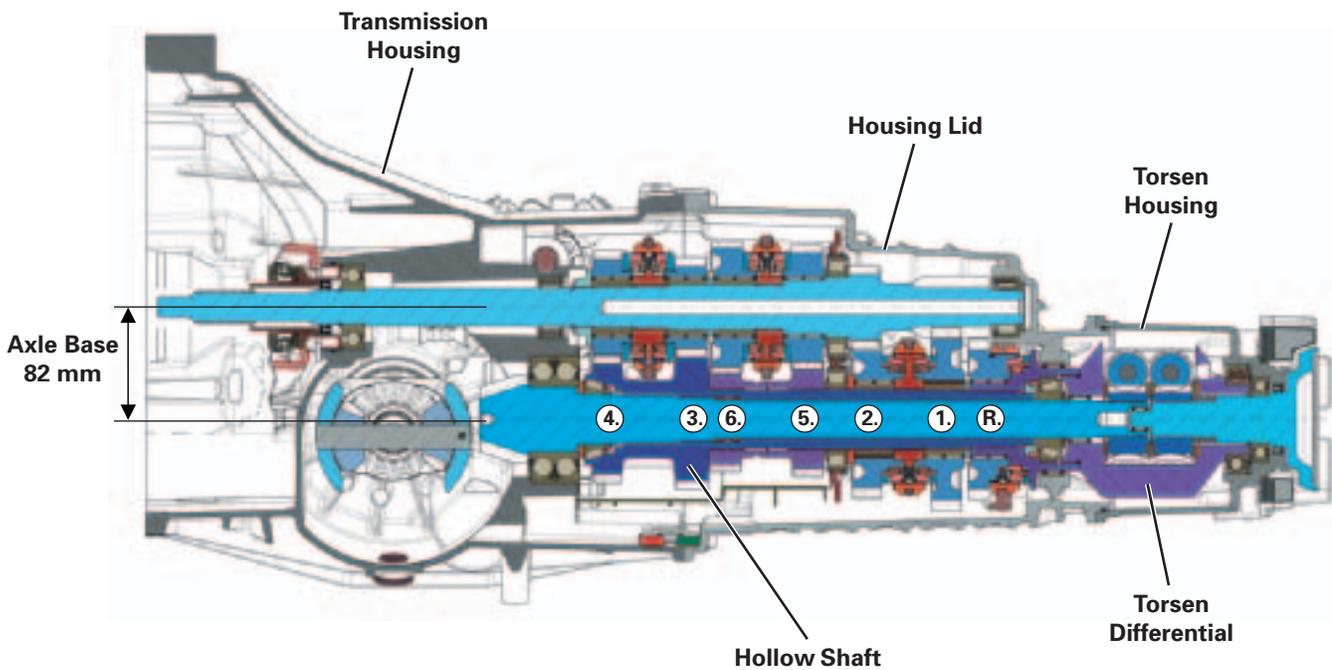
The transmission housing of the 0A3 transmission is divided into 3 parts and is made completely from pressure-cast aluminum.

The axle base, which was increased from 2.95 in (75 mm) (01E) to 3.4 in (82 mm), increases the lever arm, thereby allowing a higher torque transmission.

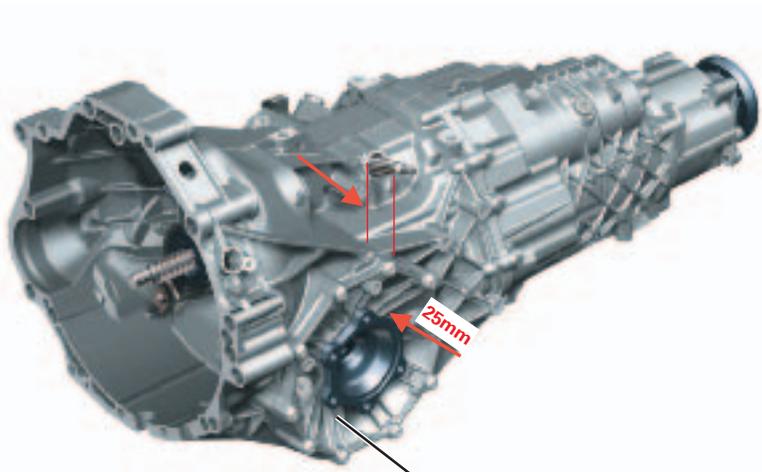
The gear set is operated using the original quattro hollow shaft.

Four-wheel distribution is achieved using the Torsen differential.

0A3



Manual Transmissions



The transmission housing has been widened by .98 in (25 mm) in the final drive area. Widening the transmission housing makes it significantly more sturdy, allowing for increased torque transfer.

This can be recognized by the shell-shaped cover of the final drive.

0A3

Final Drive Cover

Sectional View A-A

Support for Reverse Idler Gearshaft

Screw for Reverse Idler Gearshaft

Position and Assembly of Reverse Idler Gear for Reverse Gear

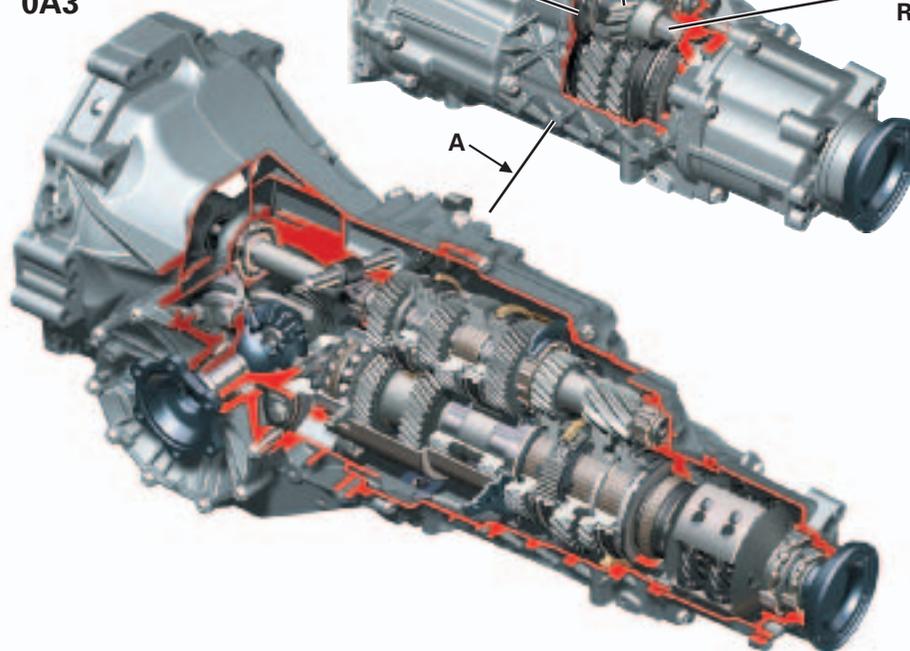
Screw for Reverse Idler Gearshaft

Reverse Idler Gear

Support for Reverse Idler Gearshaft

Reverse Idler Gearshaft

0A3



Manual Transmissions

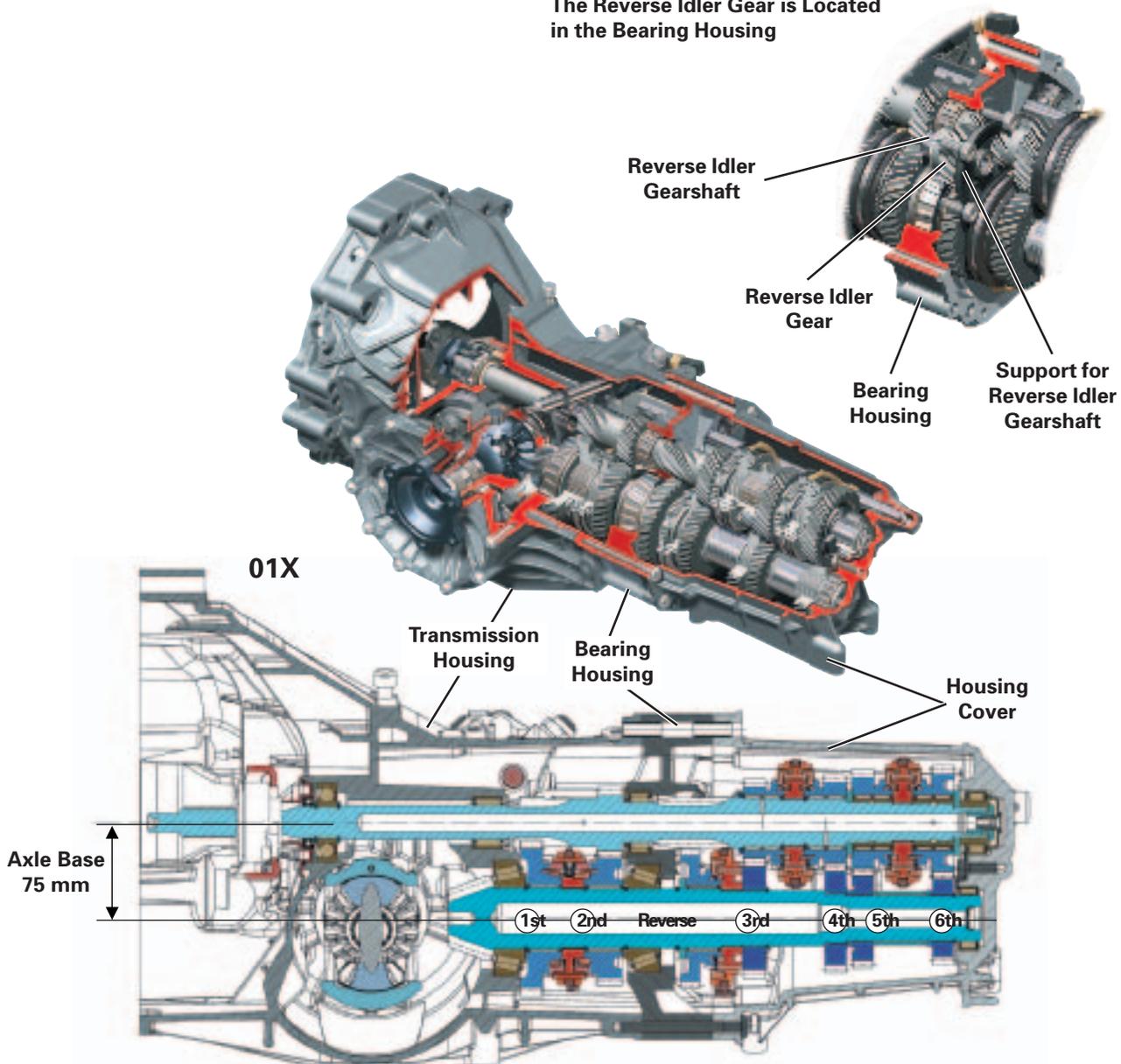
The new 6-speed manual transmissions 01X and 02X replace the previous generation of 5-speed manual transmissions 012 (01W - 0A9) and 01A.

Like the predecessor transmission, they were developed by Audi and are manufactured in the VW plant in Kassel.

The transmission housing of the 01X is divided into 3 parts and is made completely from pressure-cast aluminum.

The axle base, which was increased from 2.80 in [(71 mm) (012)] to 2.90 in (75 mm), increases the lever arm, thereby allowing a higher torque transmission.

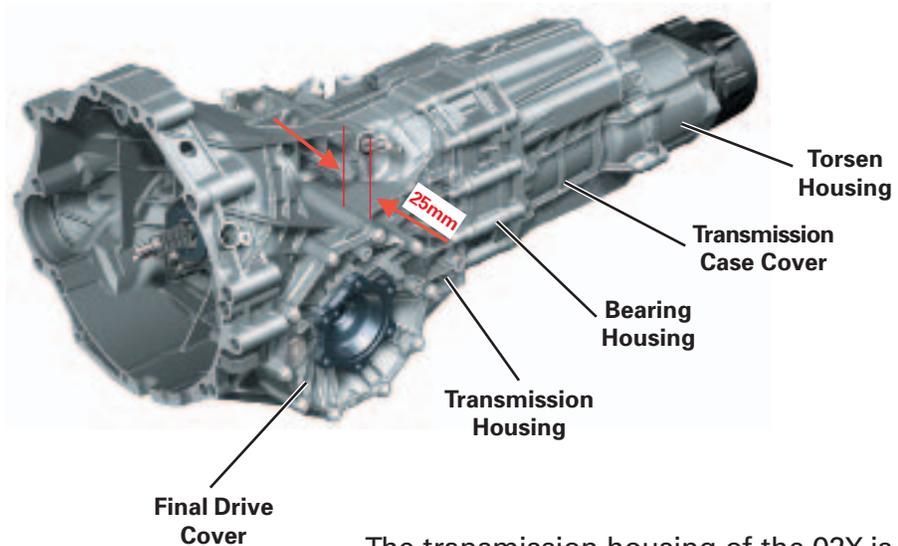
The Reverse Idler Gear is Located in the Bearing Housing



Manual Transmissions

The gear set is operated in the previously way for longitudinal Front transmissions as a twin-shaft transmission and for longitudinal quattro transmissions using the original quattro hollow shaft.

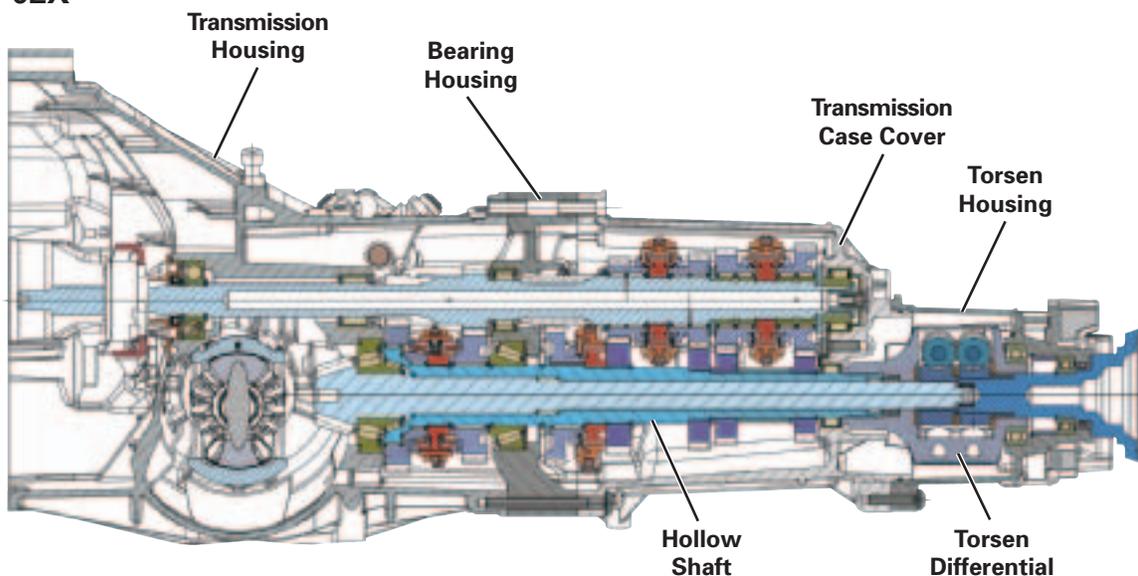
Four-wheel distribution is achieved using the Torsen differential.



The transmission housing of the 02X is made of four aluminum pressure-cast housing sections.

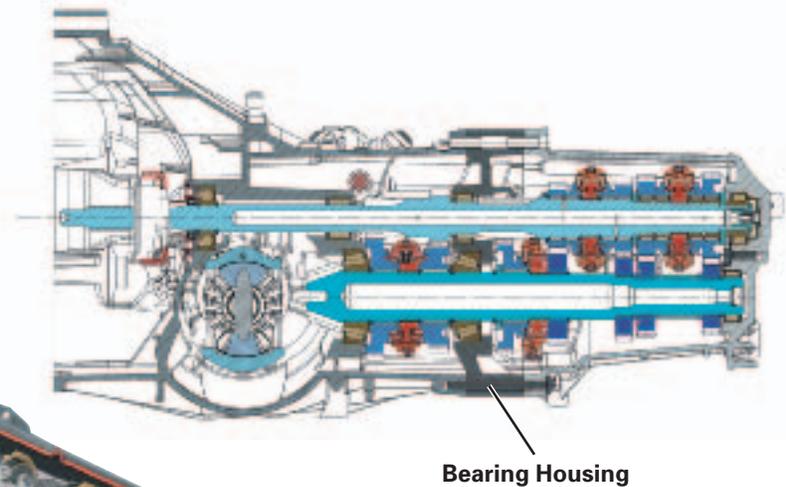
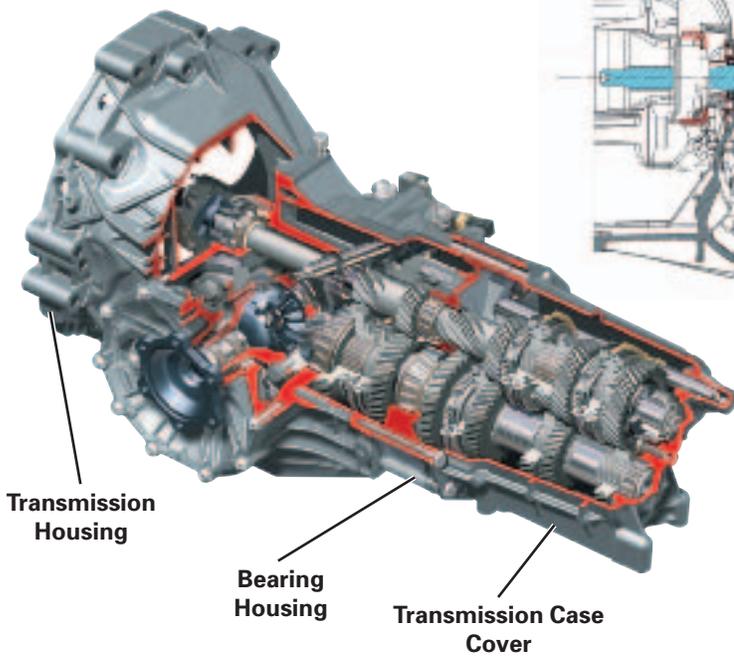
In the 0A3, the transmission housing has been widened in the final drive area in order to make it more rigid (01X and 02X).

02X



Manual Transmissions

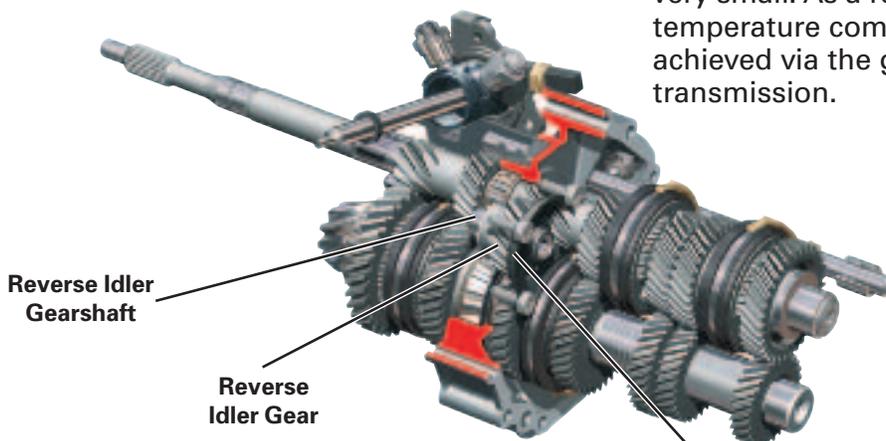
01X/02X Bearings



An aluminum bearing housing, which is screwed in between the transmission housing and the transmission case cover, was developed for the 01X and 02X.

In addition to the radial support function for the input and output shafts, the bearing housing also bears the high axial strengths of the output shaft.

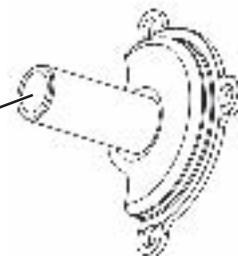
It was possible to keep the distance between the two tapered roller bearings very small. As a result, there is no need for temperature compensation, which is achieved via the gasket in the 012 transmission.



In addition to the input and output shaft, the bearing housing also includes the reverse idler gear and most of the inner gearshift mechanism.

The bearing housing is removed and installed as a complete assembly.

Support for Reverse Idler Gearshaft



Manual Transmissions

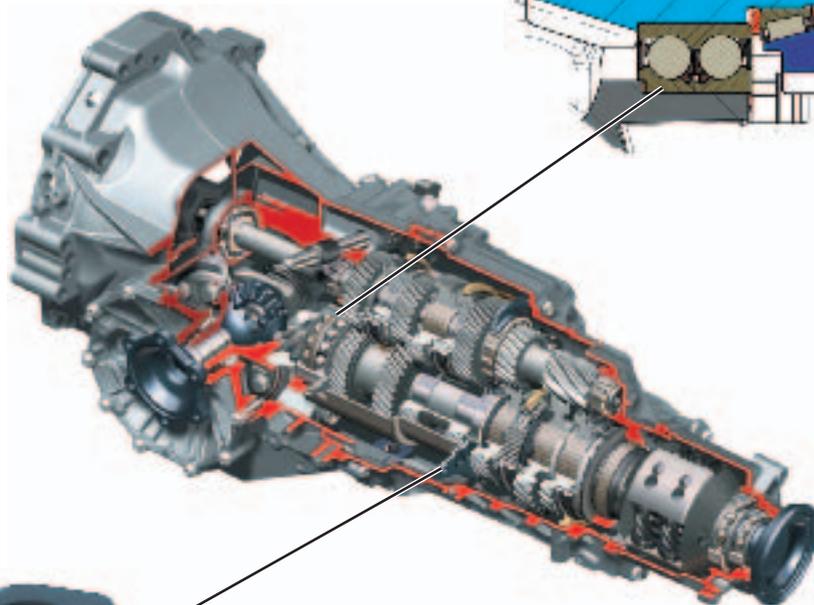
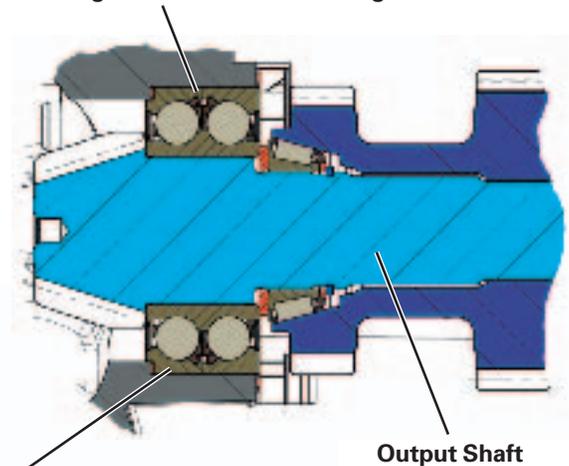
OA3 Bearings

The new feature here is the output shaft bearing application using a double angular contact ball bearing as the fixed bearing. This has important advantages over the conventional pre-tensioned tapered roller bearing:

- The reduced bearing preload reduces friction, which in turn improves efficiency.
- The fixed/loose bearings (see full section) are not affected by the thermal expansion of the transmission housing.

- The double roller bearing, which is used, is a sealed bearing ("clear bearing"). No dirt (e.g. grit) can get into the bearing, which extends the service life significantly.

Double Angular Contact Ball Bearing



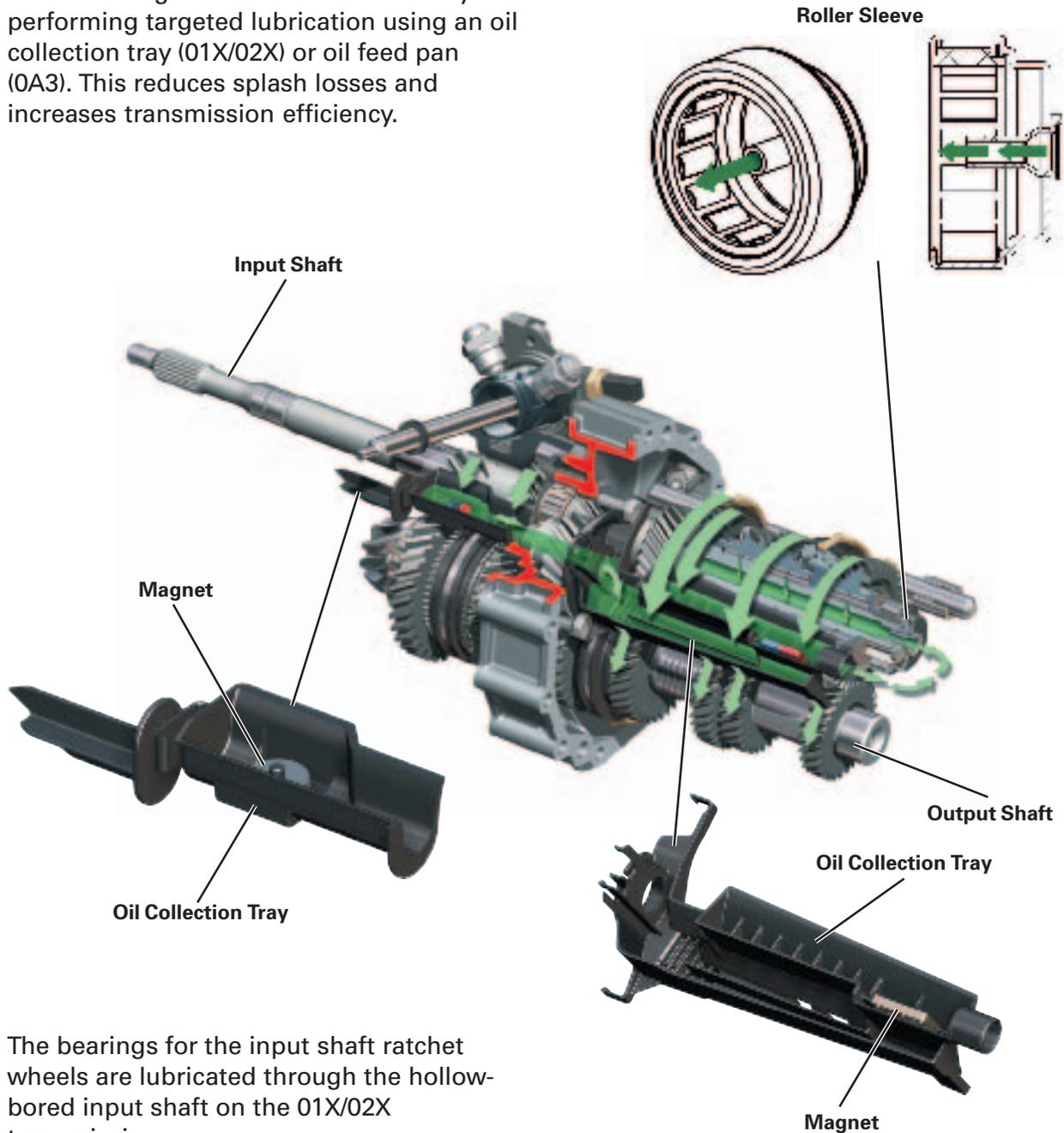
Bearing Carrier

The central shaft is mounted using a screwed bearing carrier made of steel plate. As a result, the housing setup and assembly is simpler.

Manual Transmissions

01X/02X Lubrication

A low oil usage level can be achieved by performing targeted lubrication using an oil collection tray (01X/02X) or oil feed pan (0A3). This reduces splash losses and increases transmission efficiency.



The bearings for the input shaft ratchet wheels are lubricated through the hollow-bored input shaft on the 01X/02X transmission.

Two oil collection trays collect the oil that slides off the gears. The oil is guided into the input shaft bore via ducts in the housing and in the roller sleeve. The cross bores on the bearings guide the oil to the respective bearings.

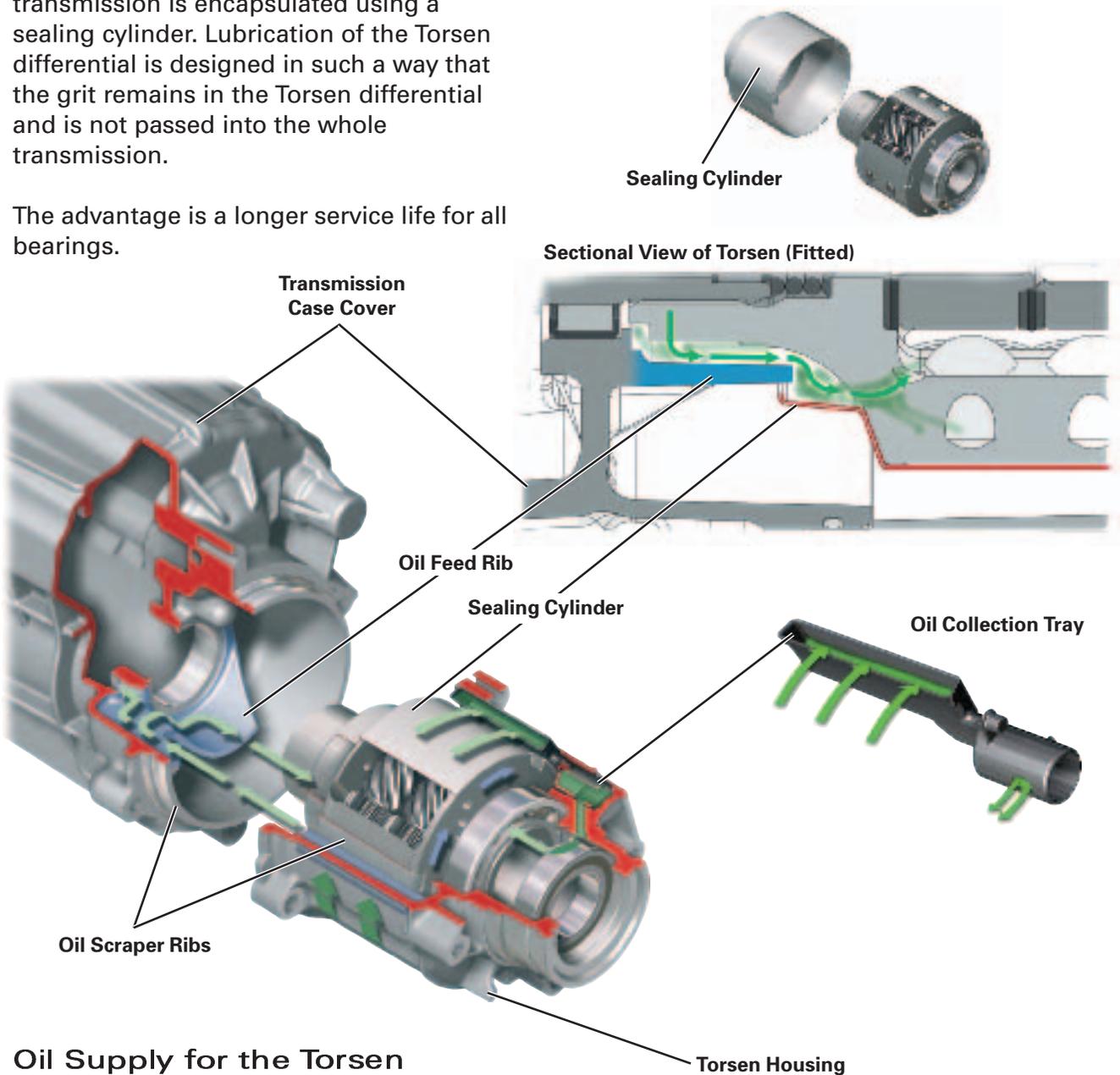
The openings at the bottom of the rear oil collection tray guide the oil on to the output shaft gears.

Manual Transmissions

02X Lubrication

The Torsen differential in the 02X transmission is encapsulated using a sealing cylinder. Lubrication of the Torsen differential is designed in such a way that the grit remains in the Torsen differential and is not passed into the whole transmission.

The advantage is a longer service life for all bearings.



Oil Supply for the Torsen Differential

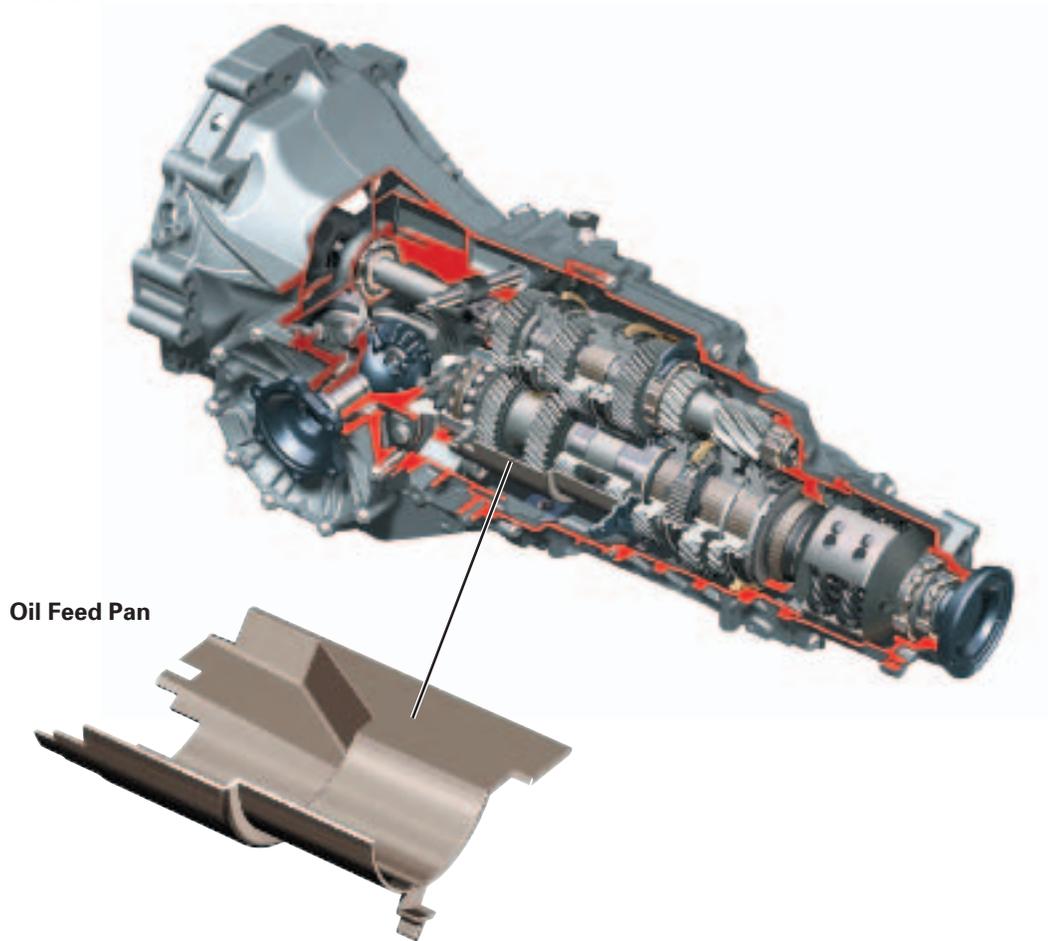
When the Torsen differential rotates, oil is also passed to the outer wall of the sealing cylinder. Most of this oil is scraped off by the oil scraper rib in the Torsen housing and is passed on to the slightly lower oil scraper rib of the transmission case cover. The oil

then flows over the oil feed rib into the sealing cylinder and thus into the Torsen differential.

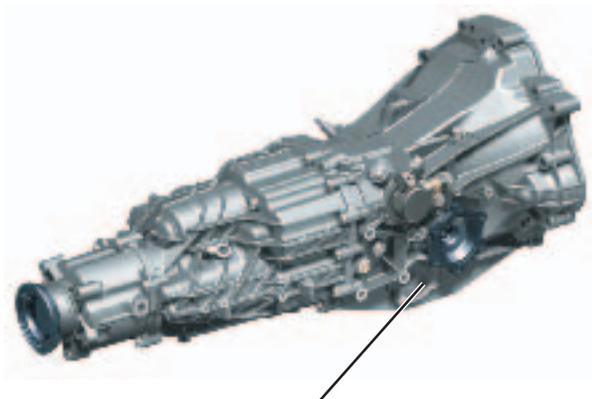
The bores at the back of the Torsen differential allow the oil to flow back into the Torsen housing, thereby limiting the oil level.

Manual Transmissions

OA3 Lubrication



Oil Feed Pan



Oil Pump Installation Position
(Not necessary at present)

The OA3 can be Fitted with an Oil Pump for Oil Cooling, if Required

In the OA3 transmission, an oil feed pan is used for targeted lubrication and also helps to improve efficiency here.

The success of all the measures aimed at improving efficiency is already apparent in that unlike the predecessor transmission, no oil cooling (with oil pump) is necessary.

The new 6-speed transmissions are filled with G 052 911 A (SAE 75W 90 synthetic oil).

The transmission oil does not need to be changed as part of normal maintenance work – “lifetime fill.”

Manual Transmissions

Particular attention was paid to shift comfort in the new transmissions.

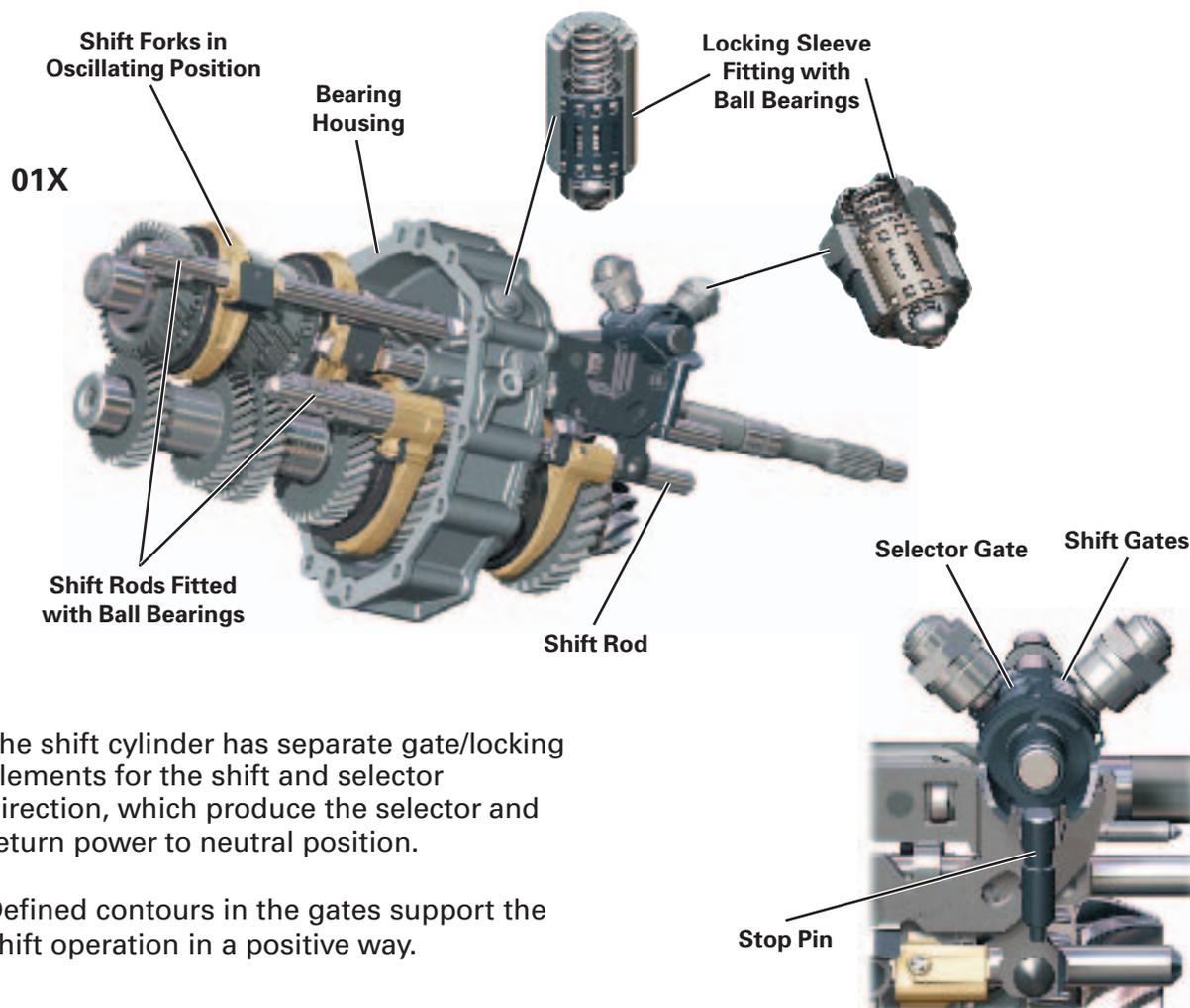
Gearshift force and gearshift times are reduced by reworked, highly-efficient synchronizations.

Reverse gear has also been completely synchronized. The gearshift feel has been optimized thanks to numerous individual measures applied to the internal gearshift operation (locks, shift cylinders, shift rods, selector sleeves, bearings and stops).

To improve the shift operation, the shift rods and locks are fitted with ball bearings.

The gates and locking contours of the shift rods and shift cylinder are designed in such a way that they guarantee freedom from play in neutral position and in the selected end position.

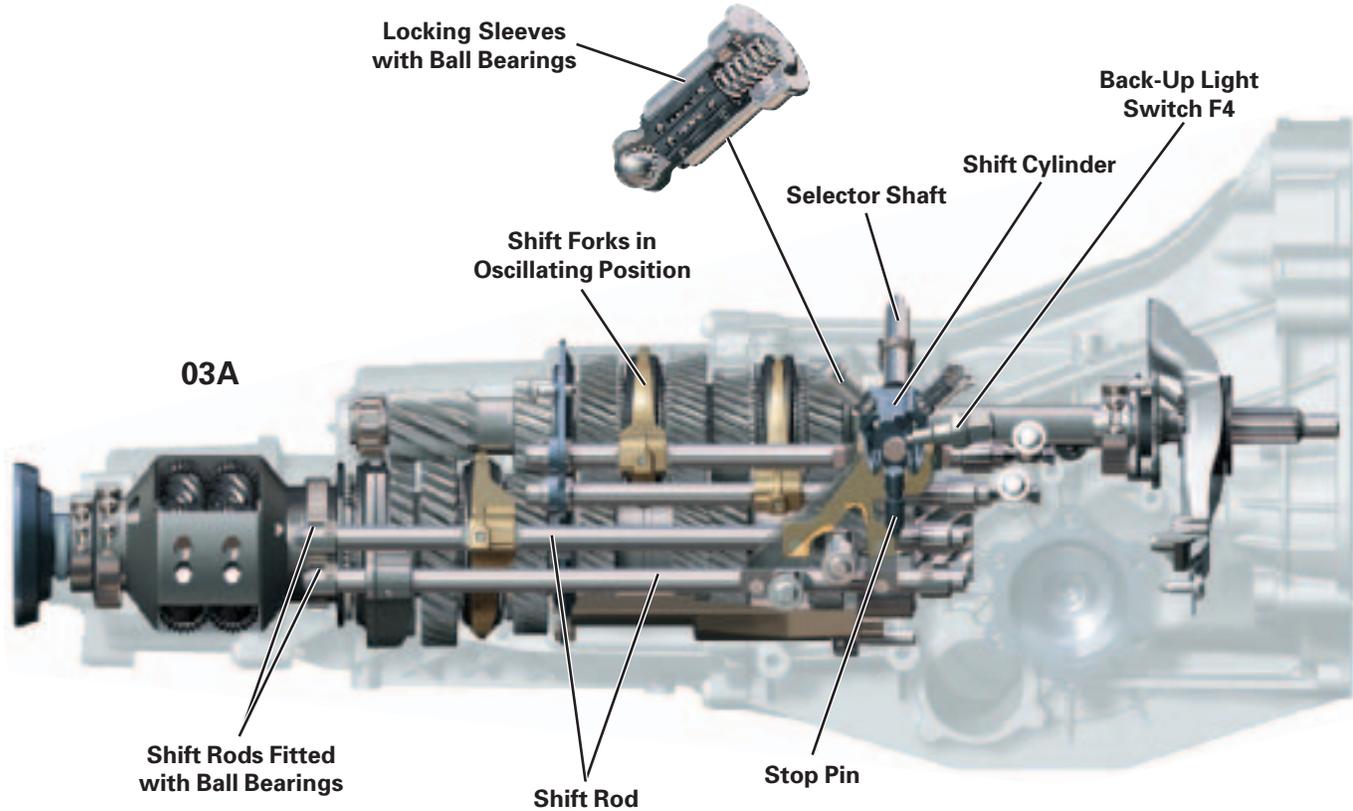
The shift forks of the forward gears are mounted in an oscillating position on the shift rods. This balances out wobbling movements in the selector sleeves and prevents them from reaching the outer gearshift mechanism. As a result, no troublesome vibrations are felt in the gearshift lever.



The shift cylinder has separate gate/locking elements for the shift and selector direction, which produce the selector and return power to neutral position.

Defined contours in the gates support the shift operation in a positive way.

Manual Transmissions



Disengaging the Inner Gearshift Mechanism

The shift cylinder has a stop at its end position (gear engaged).

The kinematics of the locks are designed in such a way that the shift finger of the shift cylinder does not touch the shift jaws of the shift rails in this position.

Vibrations in the shift rods are thus removed from the selector shaft and are therefore not transferred to the manual shift lever.

In neutral, the locks control the disengaging action from the shift finger to the shift jaws.



Manual Transmissions

OA3 synchronization

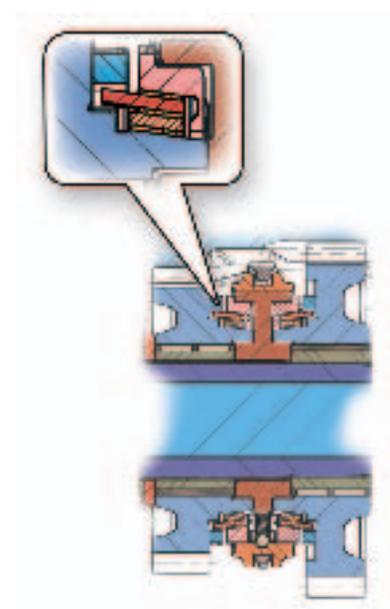
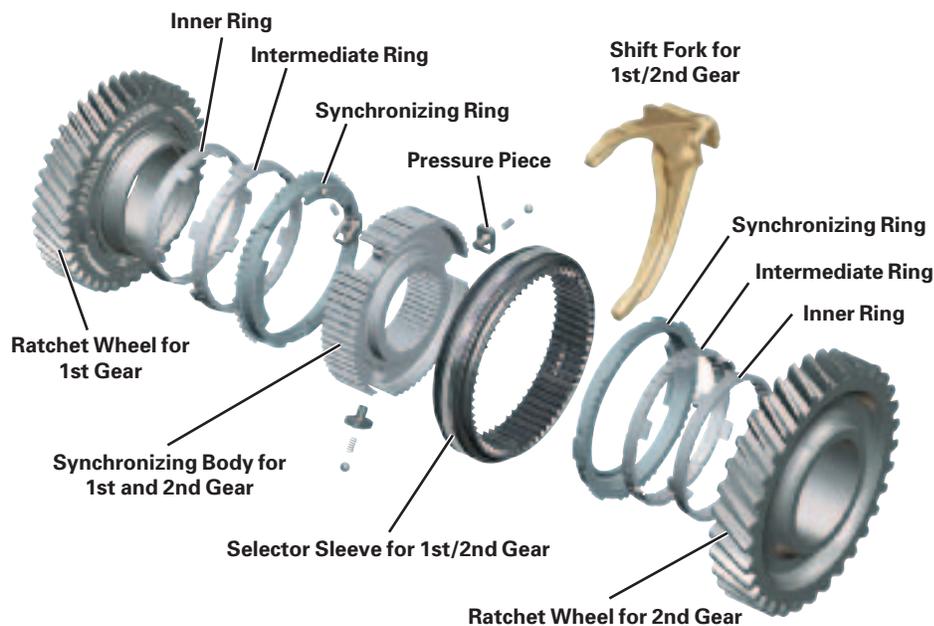
1st and 2nd gear are switched using triple-cone synchronization (the Borg Warner system).

Carbon friction linings are used to achieve a high service life and synchronization performance.

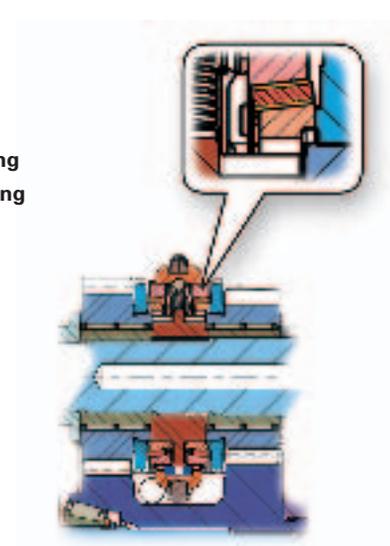
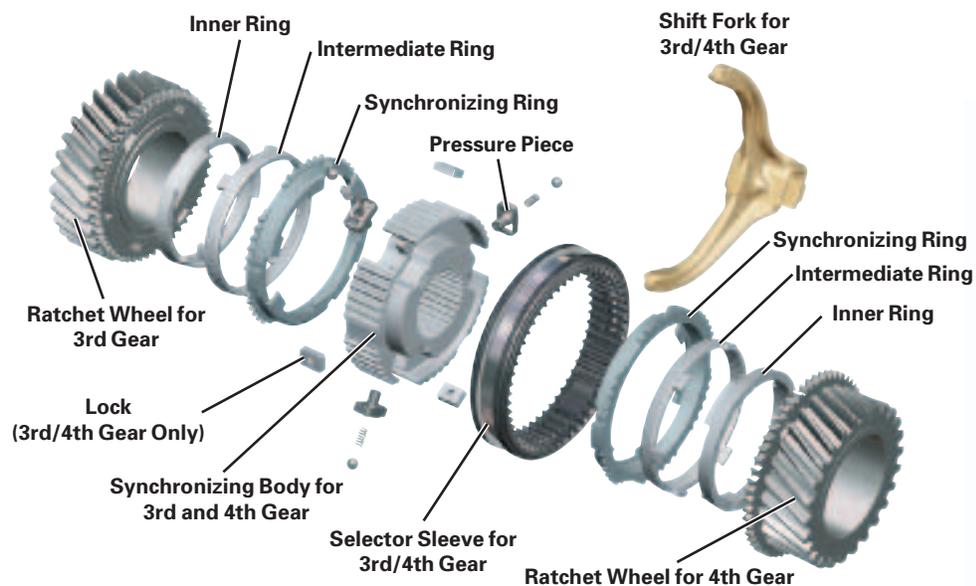
3rd to 6th gear and reverse gear are switched using twin-cone synchronization, also based on the Borg Warner system.

Synchronizing rings with sintered linings are used.

Triple-Cone Synchronization 1st/2nd Gear



Triple-Cone Synchronization 3rd/ 4th/5th/6th and Reverse Gear

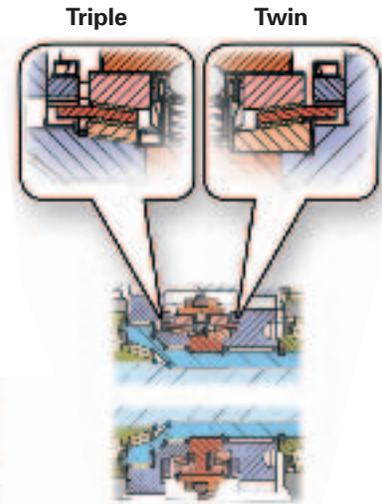
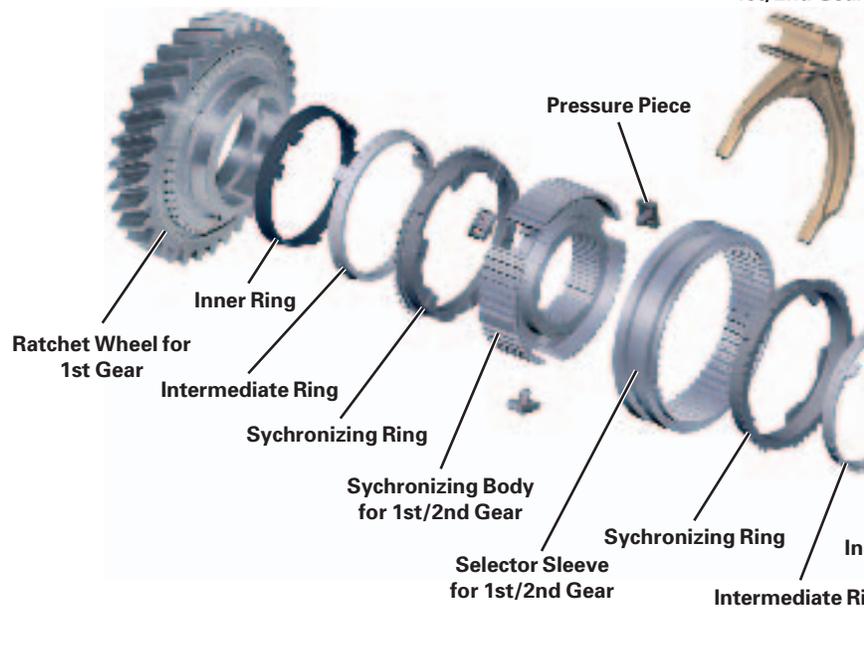


Manual Transmissions

01X and 02X synchronization

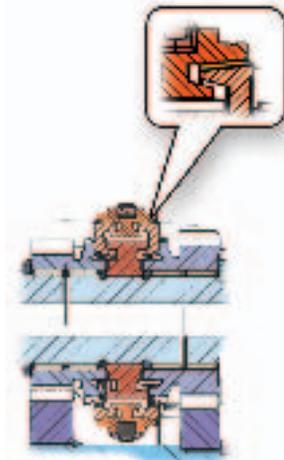
1st gear uses triple-cone synchronization and 2nd gear uses twin-cone synchronization (the Borg Warner system) with carbon linings, while 3rd to 6th gear and reverse gear use single outer cone synchronization, i.e. the Audi system made of molybdenum-sprayed brass.

Triple-Cone Synchronization



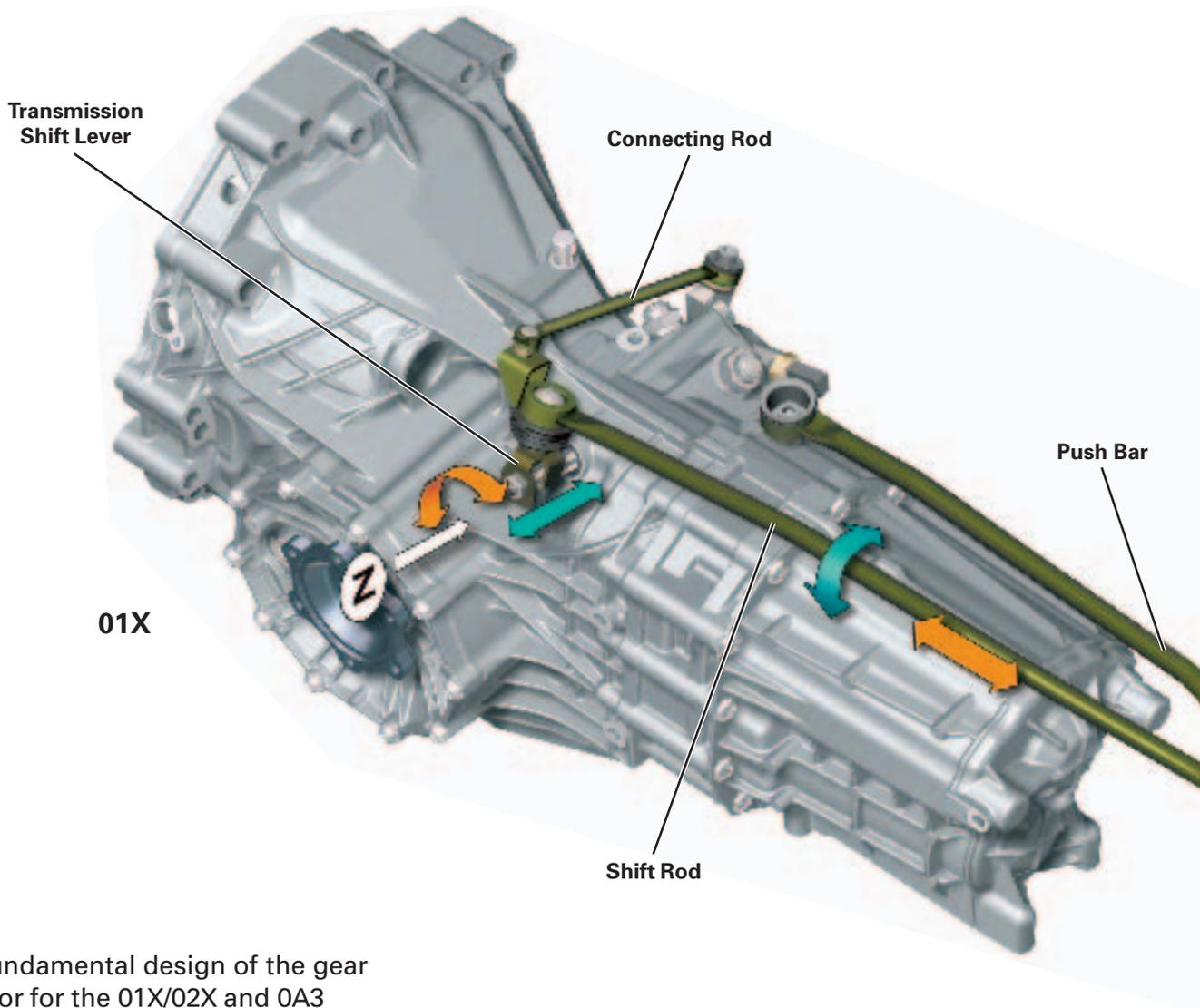
Twin-Cone Synchronization

Single Outer Cone Synchronization 3rd/4th/5th/6th and Reverse Gear



Manual Transmissions

Outer Shift Linkage

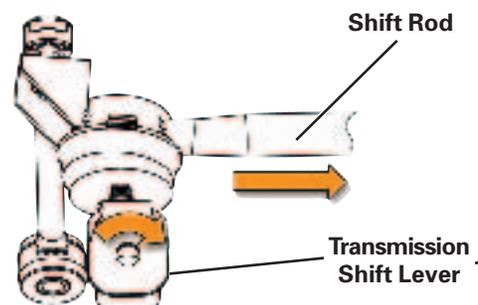


The fundamental design of the gear selector for the 01X/02X and 0A3 transmissions is the same.

The shift direction (view Z in illustration) between the transmission types 01X (02X) and 0A3 is going the opposite way. While the selector shaft is turned to the right to shift into 1st gear in the 01X. For example, it must be turned to the left in the 0A3.

Since the gear selector is the same, the transmission shift lever and also the linkage are adapted according to the relevant transmission type.

View Z
(Example: Shifting into 1st Gear)



Manual Transmissions

Smooth gearshift

To keep the load-shift movements of the transmission as far as possible away from the gearshift lever, the gearshift lever mount is movable.

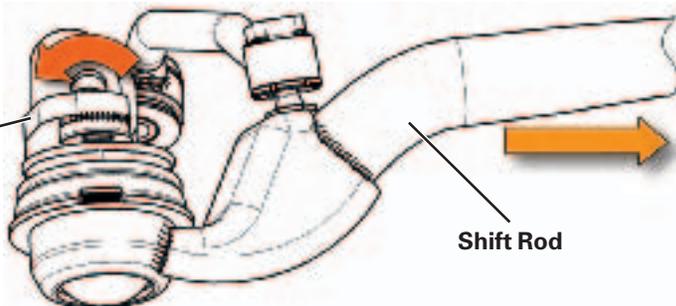
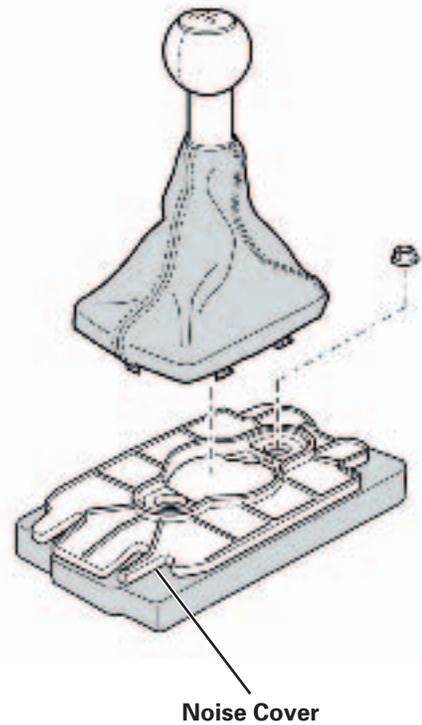
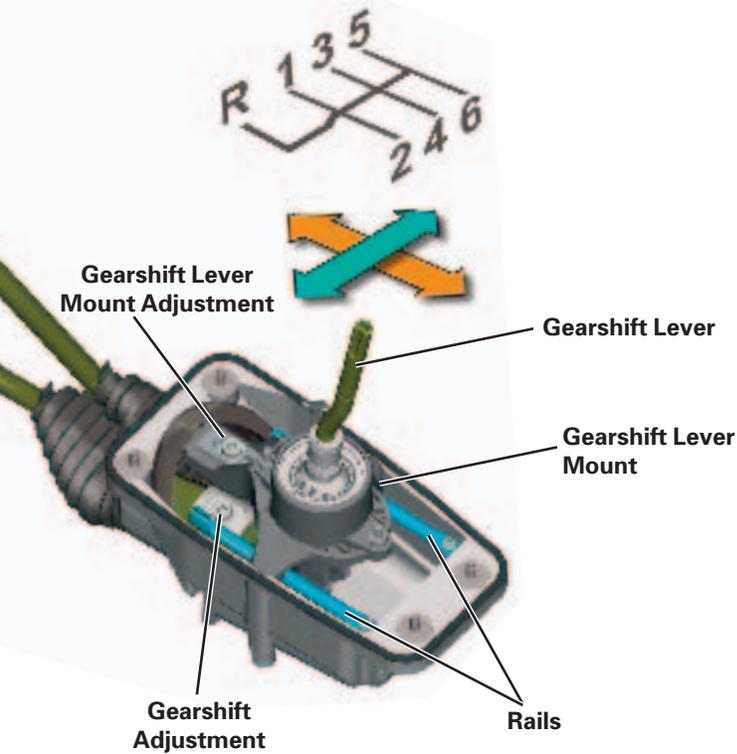
Function:

The shift rod transfers the load-shift movements of the transmission to the gearshift lever. The push bar connects the transmission to the gearshift lever mount and also transfers the transmission movements to the gearshift lever mount.

The gearshift lever mount is supported on two rails that can be moved along the longitudinal axis of the vehicle and can follow the movements of the transmission.

The points at which the push bars are secured to the transmission and ball housing are selected in such a way that the movements caused by the shift rod are balanced out.

The gearshift lever thus remains very much undisturbed in its position during load shifts. When adjusting the gearshift, the position of the gearshift lever mount must first be adjusted. No special tools are needed.



Notes

Knowledge Assessment

An on-line Knowledge Assessment (exam) is available for this SSP.
The Knowledge Assessment may or may not be required for Certification.

You can find this Knowledge Assessment at:

www.accessaudi.com

From the accessaudi.com homepage:

- Click on the "ACADEMY" Tab
- Click on the "Academy Site" Link
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