Engine description

Engine M132

On its market launch the new smart fortwo will be available with a new 3-cylinder gasoline engine with a displacement increased to 999 cm^3.

Three different engine variants are available:

- Power-reduced naturally aspirated engine (45 kW)
- Naturally aspirated engine (52 kW)
- Turbocharged engine (turbocharger) (62 kW)

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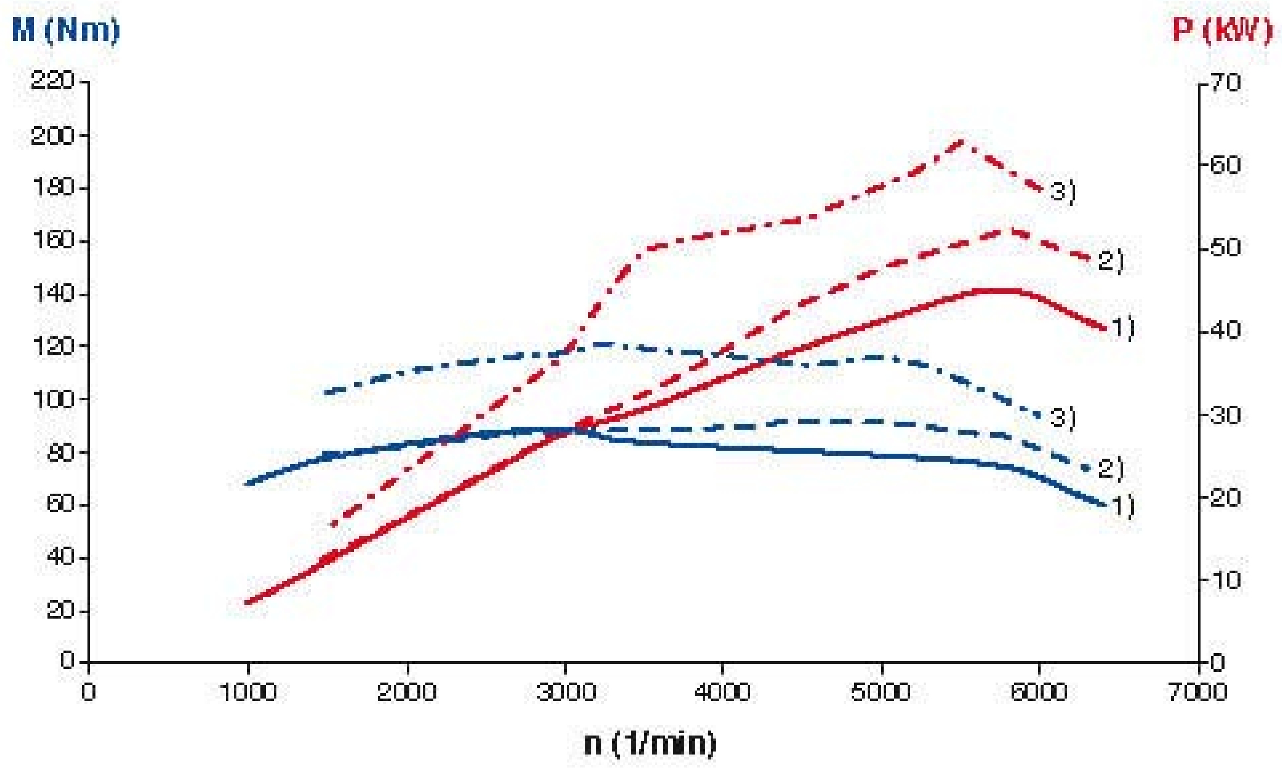
Shown on 3-cylinder gasoline engine with turbocharger

Innovation

The new gasoline engines M132 are all based on the same basic engine. The different power variants are obtained by turbocharging and different software versions.

Power and torque graph

The red characteristics represent the power curve (P) in relation to the engine speed (n).
The blue characteristics represent the torque curve (M) in relation to the engine speed (n).



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Power and torque graph for M 132

1 45 kW/89 Nm power-reduced engine
2 52 kW/92 Nm naturally aspirated engine
3 62 kW/120 Nm turbocharged engine

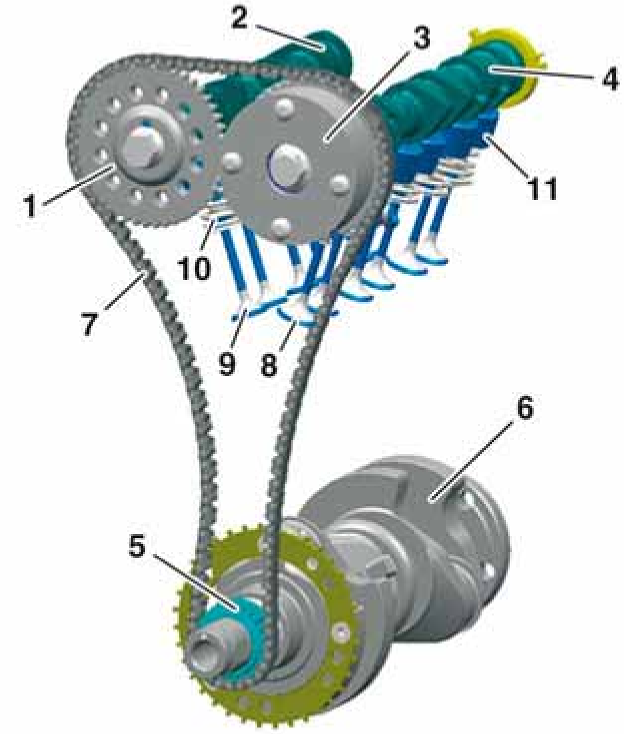
Engine data

M132				
	Unit	Power-reduced	Naturally aspirated	Turbo
Engine model designation	M	132.910		132.930
Rated output	kW at rpm	45 5800	52 5800	62 5250
Rated torque	Nm at rpm	89 3000	92 4500	120 3250
Compression ratio	e	11.4:1		10.0:1
Engine configuration/no. of cylinders		inline/3		
Camshaft configuration/number		overhead/2		
Displacement	cm^3	999		
Bore	mm	72		
Stroke	mm	81.8		
Cylinder angle	°	45		
Fuel		Premium gasoline, unleaded 95 octane		
Emission regulations		EU 4		

Valve assembly

The timing chain drives the camshaft adjuster and the exhaust camshaft sprocket via the crankshaft gear. The timing chain is guided by a slide rail. A tensioning rail and chain tensioner ensure that the chain is at the right tension to prevent wear and noises.

The intake and exhaust camshafts regulate the gas exchange in the engine via the intake and exhaust valves. Variable camshaft adjustment improves the response time at idle and in the partial-load range. At the same time, the camshaft adjustment helps to achieve the stipulated exhaust emissions limits.



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Valve assembly

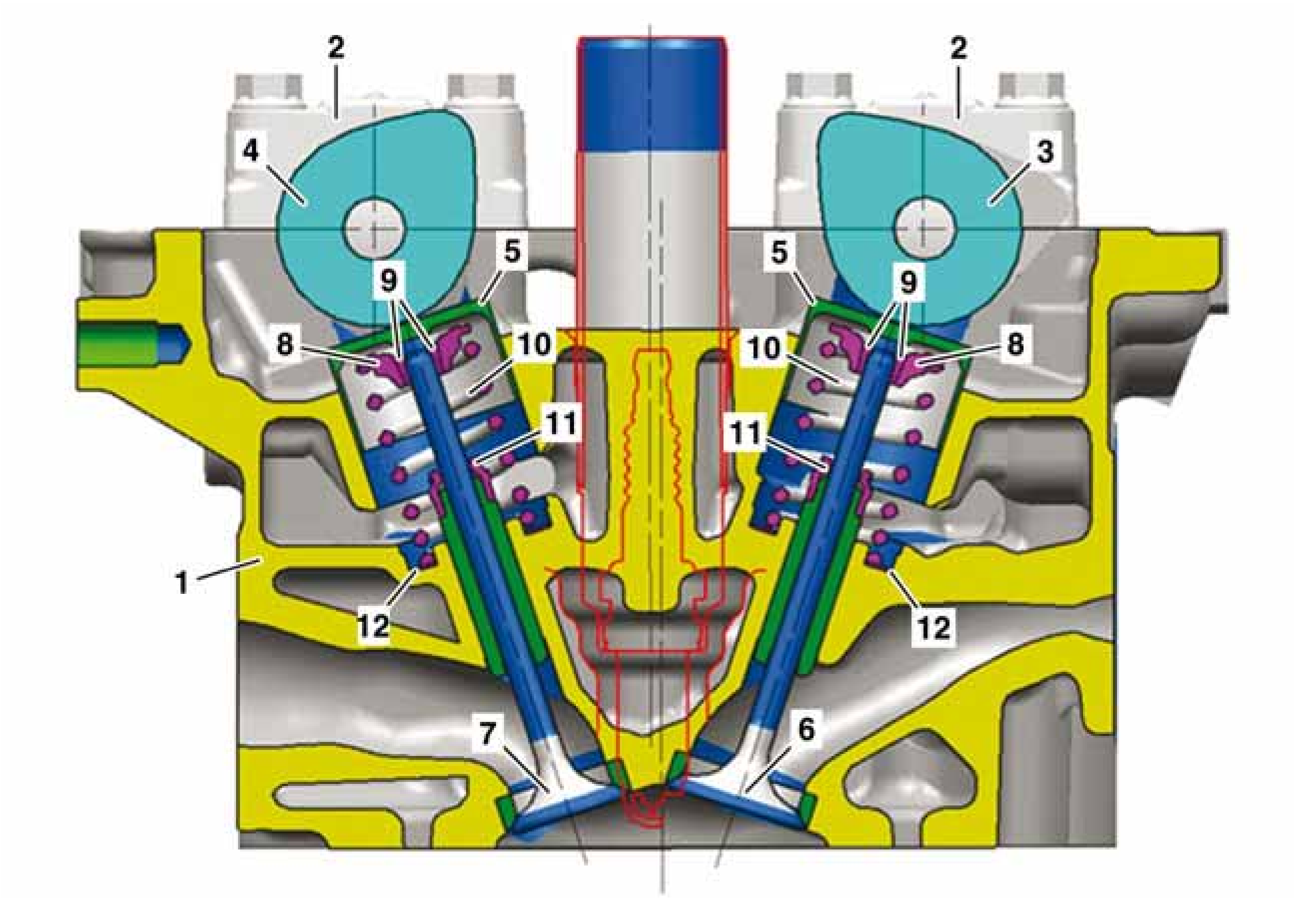
1 Exhaust camshaft sprocket
2 Exhaust camshaft
3 Camshaft adjuster
4 Intake camshaft
5 Crankshaft gear
6 Crankshaft
7 Timing chain
8 Intake valve
9 Exhaust valve
10 Valve spring
11 Cup tappet

Valve timing

General

The gasoline engines are equipped with mechanical cup tappets. The mechanical stress on the cams and cup tappets makes it necessary to check and adjust the valve clearance.

Find and insert the appropriate cup tappet by reference to its markings.
The valve clearance is adjusted by exchanging the cup tappets. These are available in various thicknesses.



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1 *Cylinder head*
2 *Camshaft bearing cap*
3 *Intake camshaft*
4 *Exhaust camshaft*
5 *Cup tappet*
6 *Intake valve*
7 *Exhaust valve*
8 *Valve spring retainer*
9 *Valve locks*
10 *Valve spring*
11 *Valve stem seal*
12 *Valve seat*

Injection control

The new engine M132 features an ME (motor electronics) gasoline injection and ignition system. The central control unit of this system is the ME-SFI [ME] control unit. It is networked over CAN with the following components:

- Instrument cluster
- SAM control unit
- Automated manual transmission control unit
- Heater/AC operating unit
- ESP control unit
- Steering assist control unit
- Data link connector

The ME-SFI control unit puts its information on the CAN, making it accessible to all the other networked components on the CAN. The information from other components reaches the ME-SFI control unit in the same way. For example, the signal from the clutch motor, which is read directly by the automated manual transmission control unit, reaches the ME-SFI control unit in this way.

Direct input signals come from:

- Knock sensor
- Charge pressure sensor
- Camshaft Hall sensor
- Coolant temperature sensor
- Intake manifold pressure sensor
- Accelerator pedal sensor
- O2 sensor downstream of TWC [KAT]
- O2 sensor upstream of TWC [KAT]
- Crankshaft position sensor
- Throttle valve actuator
- Oil pressure switch

Direct output signals go to:

- Fuel pump relay
- Fuel pump with fuel level sensor
- Throttle valve actuator
- Cylinder 1 ignition coil
- Cylinder 2 ignition coil
- Cylinder 3 ignition coil
- EGR [ARF] switchover valve
- Adjustable camshaft timing solenoid
- Cylinder 1 fuel injection valve
- Cylinder 2 fuel injection valve
- Cylinder 3 fuel injection valve
- Fuel tank vent valve
- Pressure regulator valve

There are also the following inputs on the ME-SFI control unit:

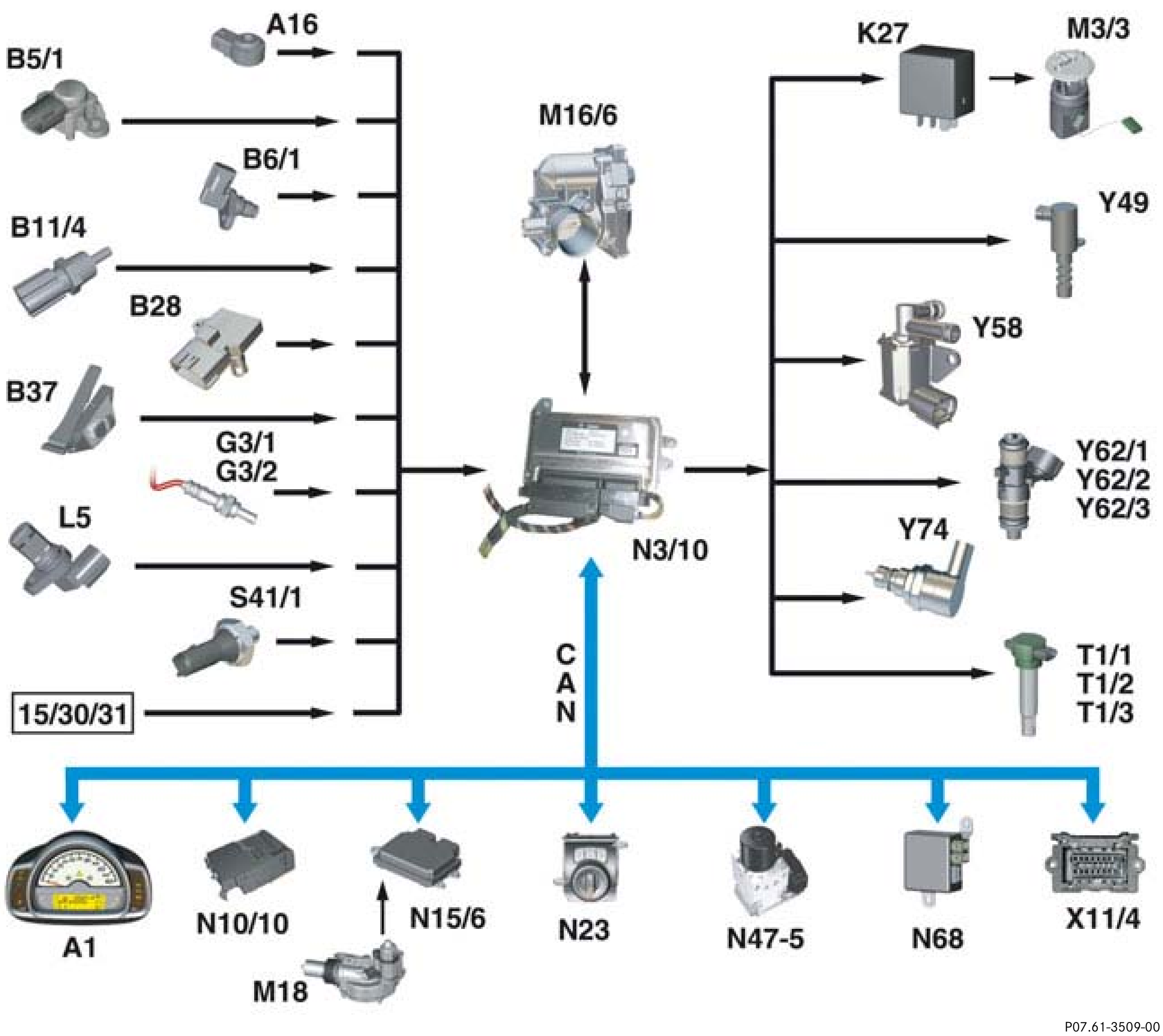
- Circuit 15
- Circuit 30
- Circuit 31

Function

The engine is controlled according to load by the performance map based on the signals arriving either directly or over CAN. The actuators are actuated via direct lines in accordance with the values computed by the ME-SFI control unit. Information intended for other components is put on the CAN.

The ME-SFI control unit has an integral fault memory and can exchange information with STAR DIAGNOSIS via a data link connector that is connected to the CAN.

Gasoline injection and ignition system



Data flow chart of gasoline engine injection system

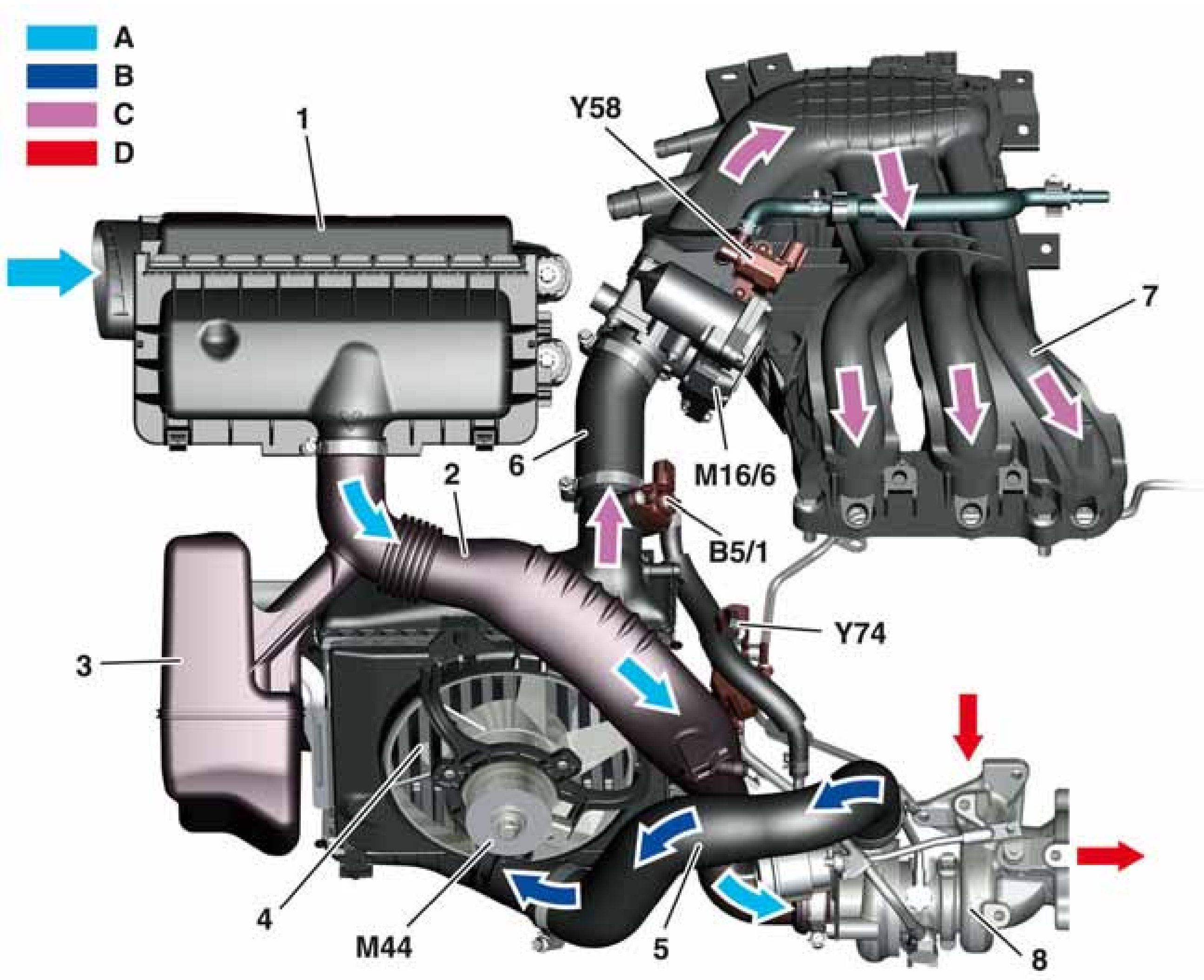
15/30/31	*Circuit status*
A1	*Instrument cluster*
A16	*Knock sensor*
B5/1	*Charge pressure sensor (turbocharged engine only)*
B6/1	*Camshaft Hall sensor*
B11/4	*Coolant temperature sensor*
B28	*Intake manifold pressure sensor*
B37	*Accelerator pedal sensor*
G3/1	*O2 sensor downstream of TWC [KAT]*
G3/2	*O2 sensor upstream of TWC [KAT]*
K27	*Fuel pump relay*
L5	*Crankshaft position sensor*
M3/3	*Fuel pump with fuel level sensor*
M16/6	*Throttle valve actuator*
M18	*Clutch motor*
N3/10	*ME-SFI [ME] control unit*
N10/10	*SAM control unit*
N15/6	*Automated manual transmission control unit*
N23	*Heater/AC operating unit*
N47-5	*ESP control unit*
N68	*Steering assist control unit*
S41/1	*Oil pressure switch*
T1/1	*Cylinder 1 ignition coil*
T1/2	*Cylinder 2 ignition coil*
T1/3	*Cylinder 3 ignition coil*
X11/4	*Data link connector*
Y49	*Adjustable camshaft timing solenoid*
Y58	*Tank vent valve*
Y62/1	*Cylinder 1 fuel injection valve*
Y62/2	*Cylinder 2 fuel injection valve*
Y62/3	*Cylinder 3 fuel injection valve*
Y74	*Pressure regulator valve (turbocharged engine only)*
CAN	*Controller Area Network (data bus/CAN bus)*

Air intake

Fresh air is drawn in and filtered by the air filter. The fresh air travels through the air line into the turbocharger, where it is compressed. The compressed and heated fresh air is cooled in the charge air cooler and forced into the charge air manifold.

Intake air resonator

The intake air resonator acts as a pulsation damper during load changes to minimize variations in the air flow.



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1	*Air filter housing*	*M44*	*Charge air fan motor*
2	*Air line*	*Y58*	*Tank vent valve (installation location shown on naturally aspirated engine; installed on frame-type integral support in turbocharged engine)*
3	*Intake air resonator*		
4	*Charge air cooler*		
5	*Charge air pipe to charge air cooler*		
6	*Charge air pipe to charge air manifold*	*Y74*	*Pressure regulator valve*
7	*Charge air manifold*		
8	*Turbocharger*	*A*	*Fresh air*
		B	*Hot charge air*
B5/1	*Charge pressure sensor*	*C*	*Cooled charge air*
M16/6	*Throttle valve actuator*	*D*	*Exhaust gas*

Belt drive

Belt adjustment and description of stretch belt

Self-tensioning belt drive

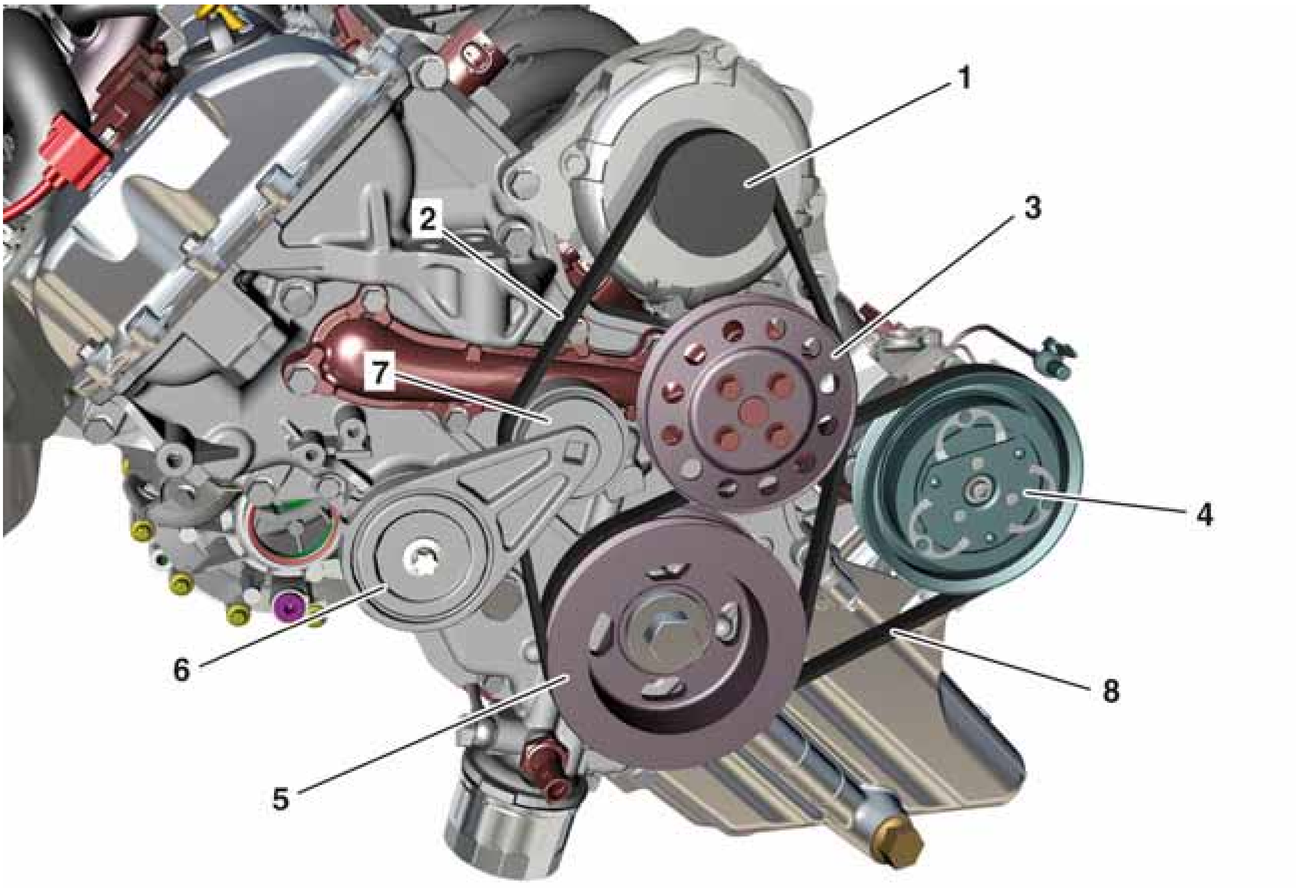
The alternator and the coolant pump are driven by a poly-V belt with tensioning device.

The poly-V belt is tensioned via a new spring-loaded tensioning device. To install and remove the poly-V belt the tensioning device must be rotated clockwise using a special tool to slacken the tension in the belt drive. The tensioning device can then be locked in place and the poly-V belt removed.

Stretch belt

The refrigerant compressor is driven by means of a stretch belt.

The stretch belt does not need a tensioning device, but it must be replaced after a specified mileage. It is removed and installed with the aid of a special tool that guides the stretch belt over the belt pulley of the refrigerant compressor. The stretch belt can be pulled on or off the belt pulley by cranking the engine in its normal direction of rotation.



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Belt drive illustrated on turbocharged engine

1 *Alternator belt pulley*
2 *Poly-V belt*
3 *Coolant pump belt pulley*
4 *Refrigerant compressor belt pulley*
5 *Crankshaft pulley*
6 *Tensioning device*
7 *Tensioning device belt pulley*
8 *Stretch belt*

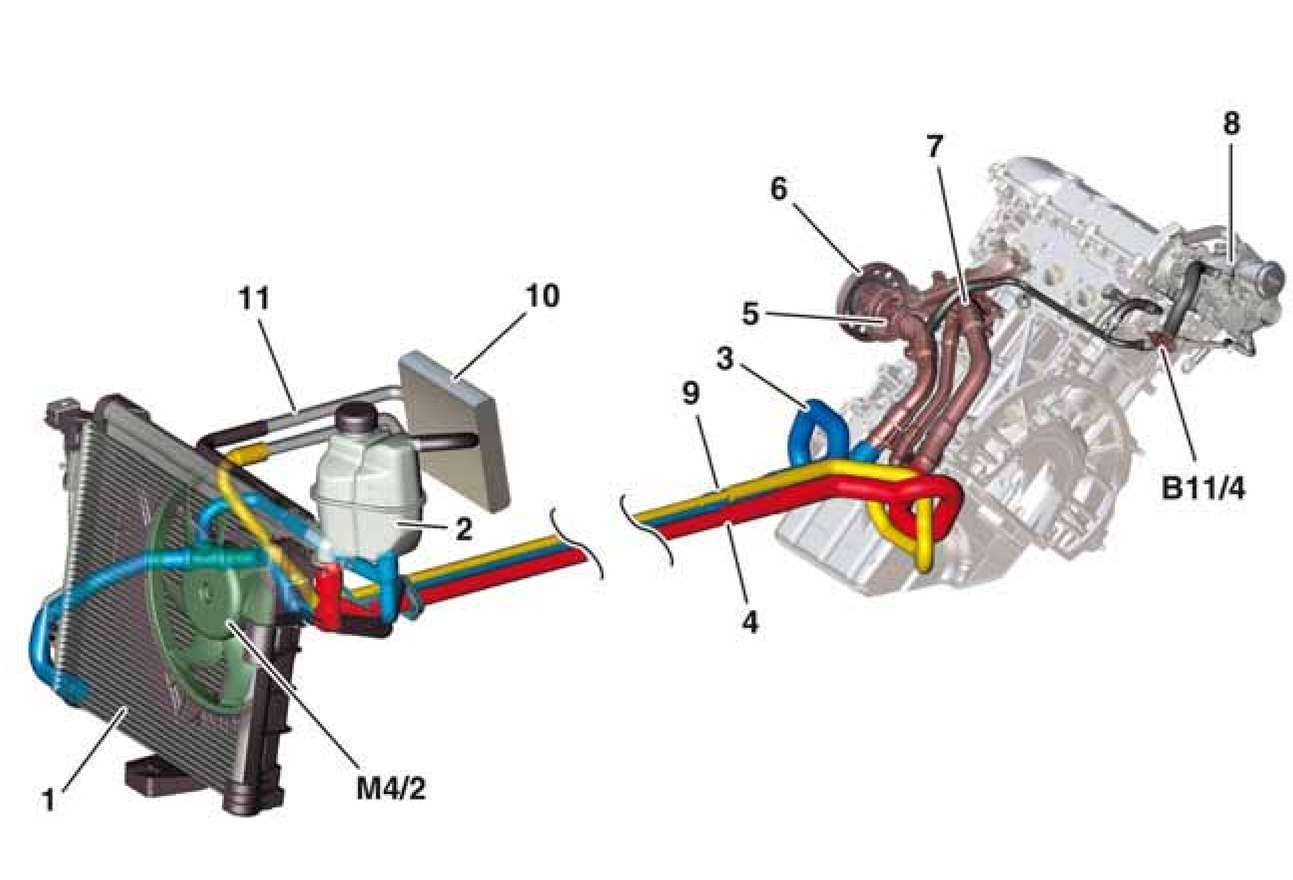
Coolant circuit

In the small cooling circuit the coolant is pumped through the engine, past the thermostat and back to the coolant recirculation pump.
When the engine has reached its operating temperature, the thermostat opens and splits the coolant circuit. The short coolant circuit flows from the thermostat straight to the radiator and on to the coolant recirculation pump.
The long coolant circuit flows from the thermostat to the heater heat exchanger and on to the expansion reservoir.

In the expansion reservoir the circuit is split again, with one stream flowing direct to the coolant recirculation pump and the other passing through the radiator.

The coolant fan motor switches on and off according to the engine temperature measured by the coolant temperature sensor, and cools the coolant.

In turbocharged engines an outlet upstream of the coolant pump provides cooling for the turbocharger.



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1 Radiator
2 Expansion reservoir
3 Coolant return line
4 Coolant feed line (short circuit)
5 Coolant pump
6 Coolant pump belt pulley
7 Thermostat
8 Turbocharger
9 Coolant feed line (long circuit)
10 Heater heat exchanger
11 Coolant pipe

B11/4 Coolant temperature sensor
M4/2 Coolant fan motor

Cooling system

Bleeding cooling system

General

If some or all of the coolant has been drained, the cooling system must be bled after refilling.

Fill

Unscrew the cooling system cap and fill the cooling system up to the "MAX" mark in the expansion reservoir.

Bleeding

Unfasten the clamp, pull off the coolant hose and wait until coolant emerges from the coolant hose and the cylinder head. Then reconnect the coolant hose and fasten it with the clamp.
Top up the expansion reservoir to the "MAX" mark again and screw on the cooling system cap.
Warm up the engine until the thermostat opens.
Switch off the engine and check the coolant level in the expansion reservoir.

> **Note**
> The cooling system must be filled and bled only when the engine is cold.

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1 Cooling system cap
2 Expansion reservoir
3 Coolant hose
4 Clamp