Overview of new products/features/modifications: Introduction of new inline engine OM 656

Service Information

Mercedes-Benz

SN00.00-P-0064A	Overview of new products/features/modifications: Introduction of new inline engine OM 656	12.07.2017

Model 222 with engine 656.9

P07.00-2254-79

OM 656 - the new 6-cylinder inline engine generation

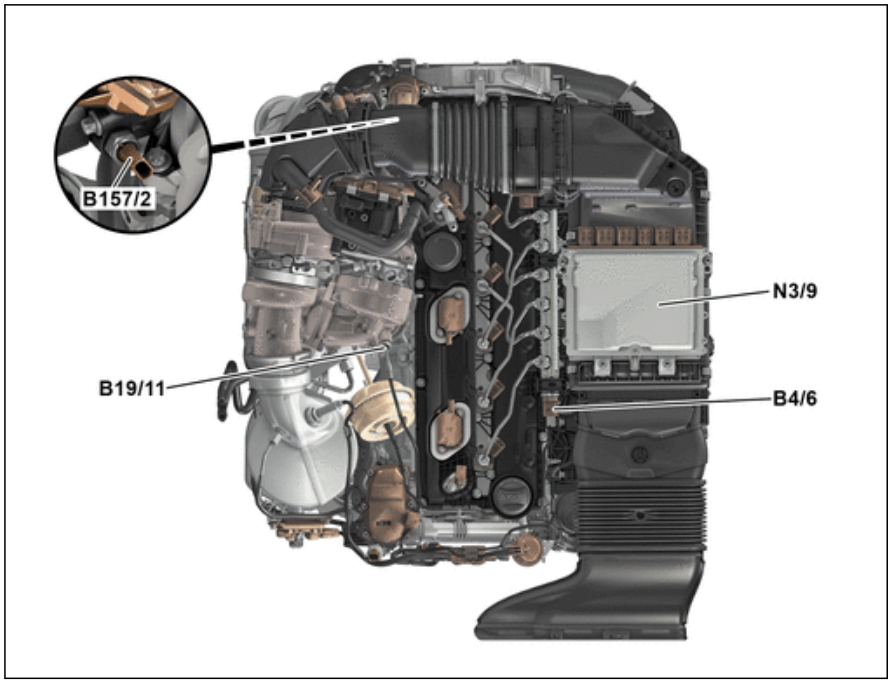
The new inline engine cylinder, OM 656, will be introduced to the 2017 facelift of model series 222 in two output variants, the 350 d with 210 kW and the 400 d with 250 kW. Thus it takes over from the V6 diesel engine OM 642.

The new engine generation is characterized by the following components and systems:

- An oil pump integrated in the crankcase
- Gearwheel drive in combination with a timing chain on the flywheel side for driving the high-pressure pump, oil pump, balance shafts and the two camshafts
- Optimized heat management
- Two-stage exhaust gas recirculation (EGR) with coolant-cooled precooler and exhaust gas recirculation cooler with switchable bypass duct
- Cylinder head with 2-piece coolant jacket
- Rapid glowing system with glow output stage
- Load-level controlled preinjection and postinjection
- Fuel injectors with piezo valves
- 2-stage exhaust gas turbocharger with electronic boost pressure regulator
- Combined, near-engine mounted emissions control system
- CAMTRONIC on exhaust valves

View of the engine from above

B4/6	*High pressure fuel pressure sensor*
B19/11	*Temperature sensor upstream of turbocharger*
B157/2	*Low-pressure exhaust gas recirculation temperature sensor*
N3/9	*CDI control unit*



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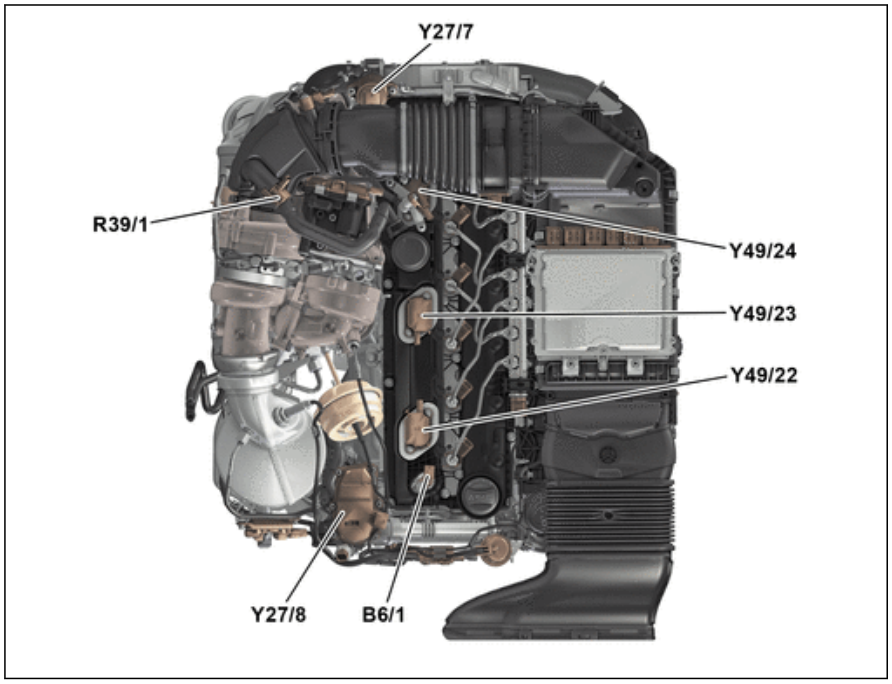
View of the engine from above

B6/1	*Camshaft Hall sensor*
R39/1	*Vent line heater element*
Y27/7	*Low-pressure exhaust gas recirculation actuator*
Y27/8	*High-pressure exhaust gas recirculation actuator*
Y49/22	*Cylinder 1 and 2 exhaust CAMTRONIC actuator*
Y49/23	*Cylinder 3 and 4 exhaust CAMTRONIC actuator*
Y49/24	*Cylinder 5 and 6 exhaust CAMTRONIC actuator*



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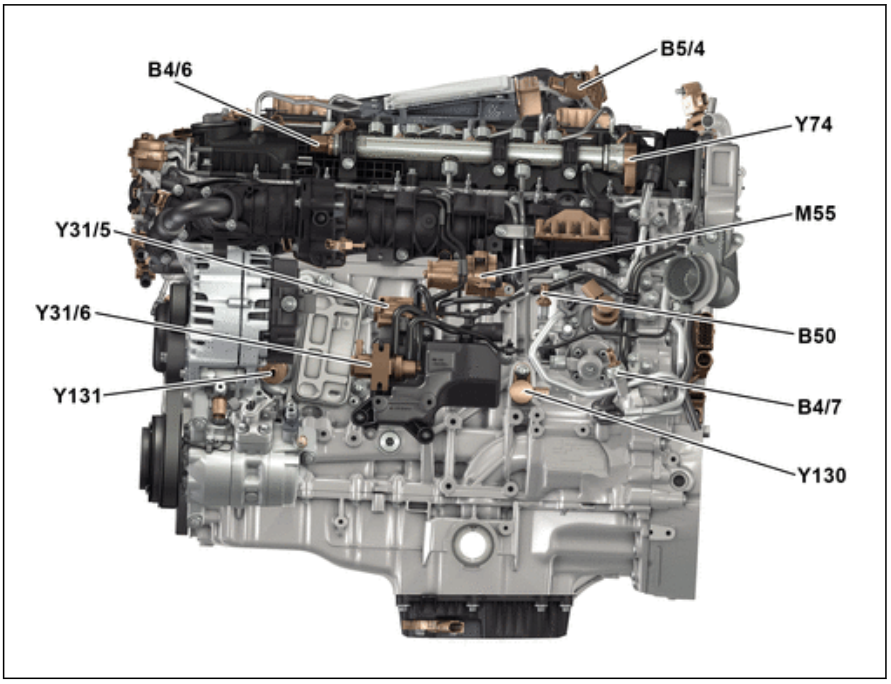
View of engine from left

B4/6	*High pressure fuel pressure sensor*
B4/7	*Fuel pressure sensor*
B5/4	*Low-pressure turbocharger boost pressure sensor*
B50	*Fuel temperature sensor*
M55	*Intake port shutoff actuator motor*
Y31/5	*Boost pressure control pressure transducer*
Y31/6	*Wastegate pressure transducer*
Y74	*Pressure regulator valve*
Y130	*Engine oil pump valve*
Y131	*Oil spray nozzle shutoff valve*



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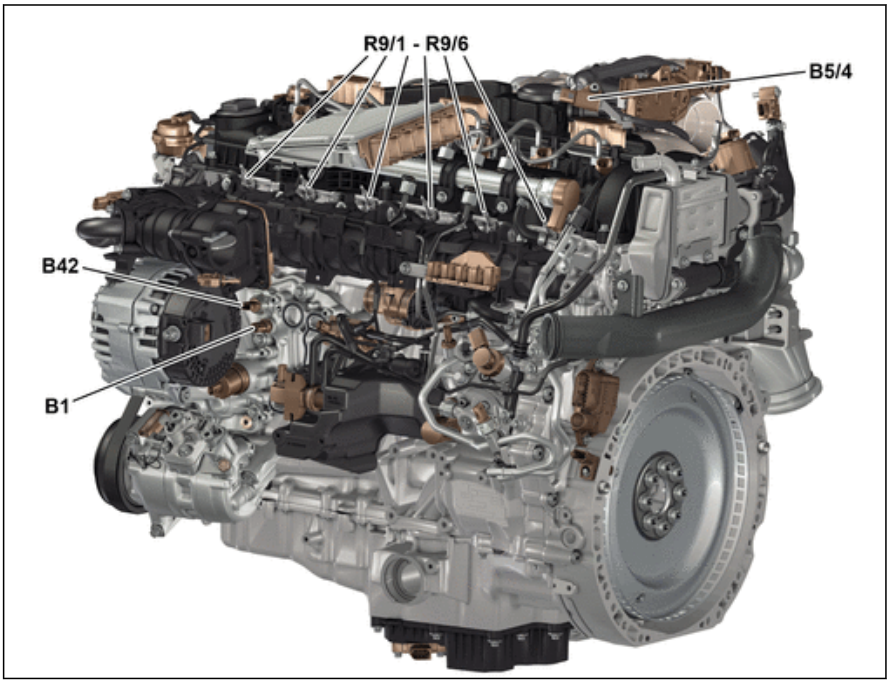
View of engine from rear left

B1	*Engine oil temperature sensor*
B5/4	*Low-pressure turbocharger boost pressure sensor*
B42	*Engine oil pressure sensor*
R9/1	*Cylinder 1 glow plug*
R9/2	*Cylinder 2 glow plug*
R9/3	*Cylinder 3 glow plug*
R9/4	*Cylinder 4 glow plug*
R9/5	*Cylinder 5 glow plug*
R9/6	*Cylinder 6 glow plug*



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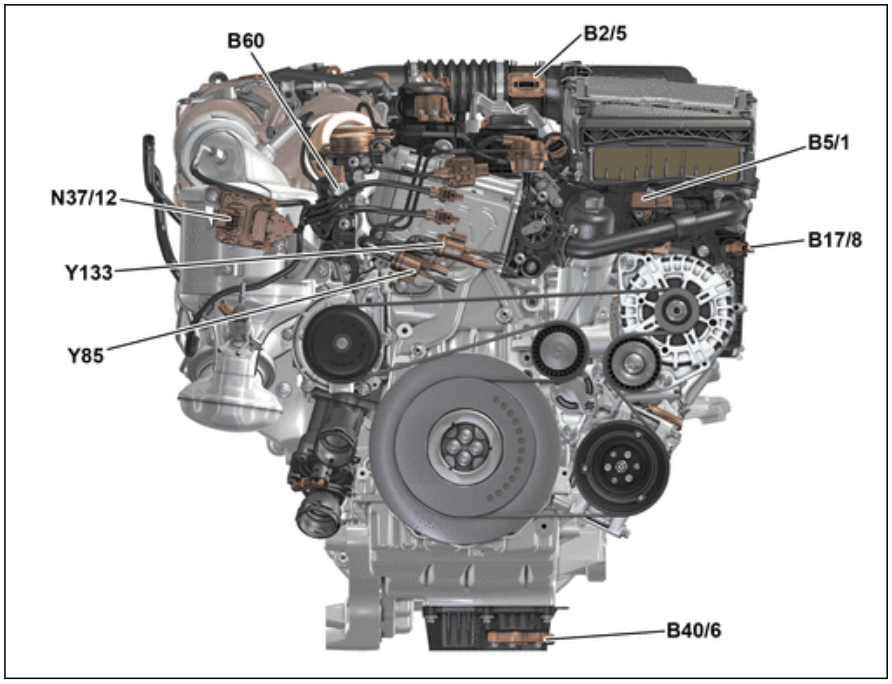
View of the engine from the front

B2/5	*Hot film mass air flow sensor*
B5/1	*Boost pressure sensor*
B17/8	*Charge air temperature sensor*
B40/6	*Engine oil fill level sensor*
B60	*Exhaust pressure sensor*
N37/12	*Control unit of NOx sensor upstream of diesel oxidation catalytic converter*
Y85	*Exhaust gas recirculation cooler bypass switchover valve*
Y133	*Coolant pump switchover valve*



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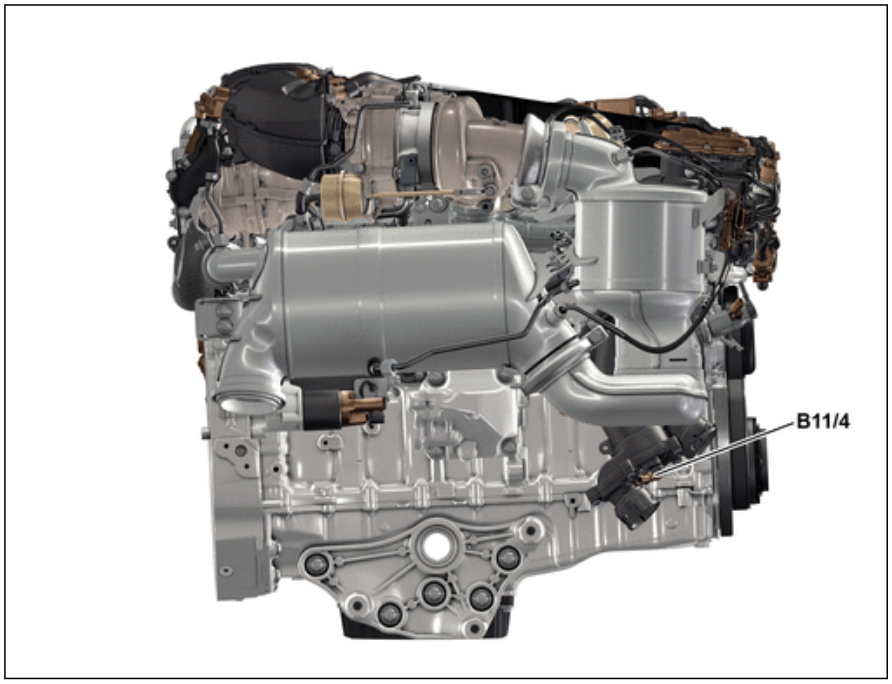
View of engine from right

B11/4	*Coolant temperature sensor*



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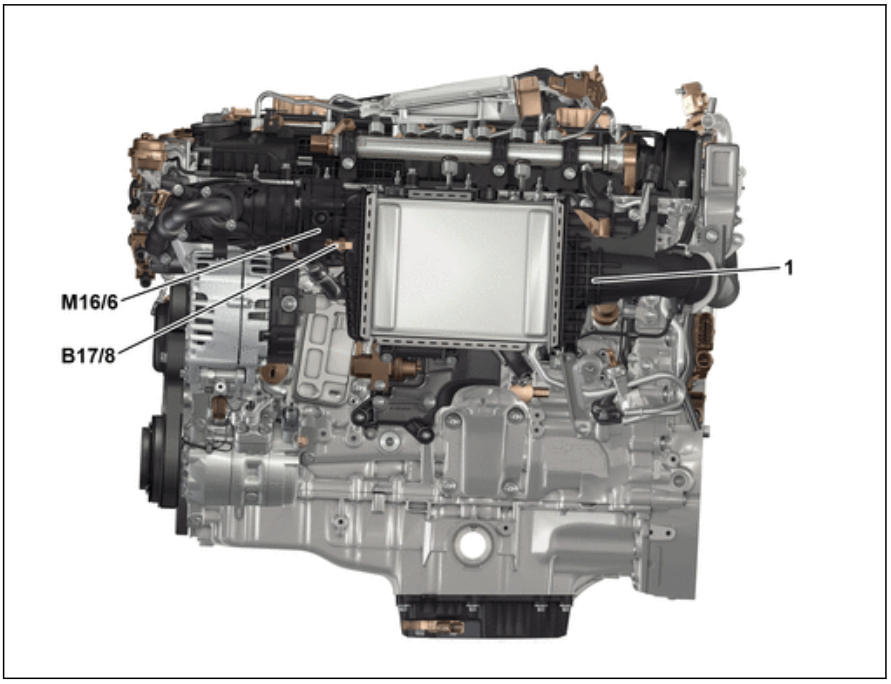
View of engine from left

1	*Charge air cooler*
B17/8	*Charge air temperature sensor*
M16/6	*Throttle valve actuator*



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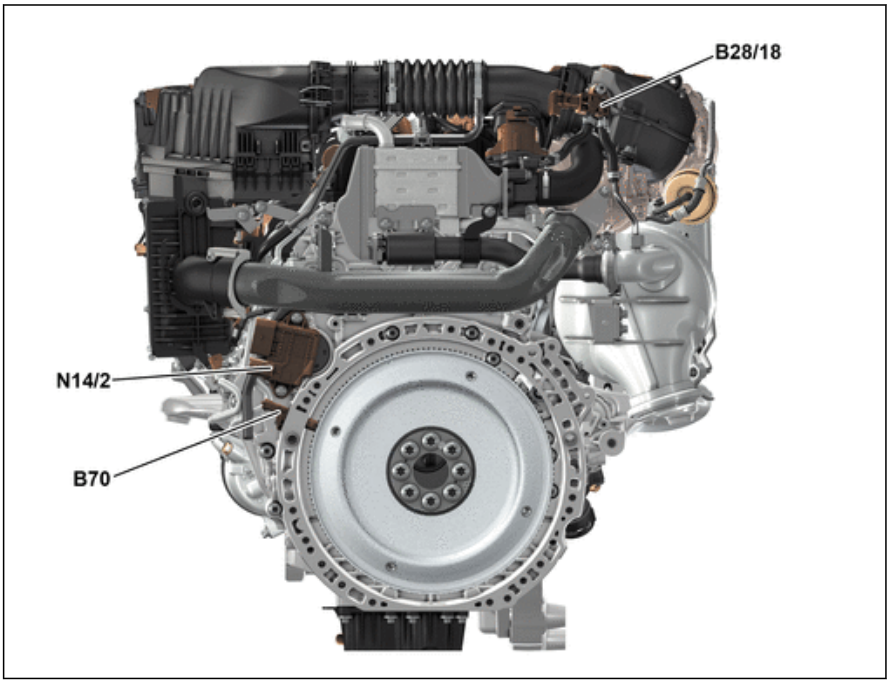
View of the engine from the rear

B28/18	*Low-pressure exhaust gas recirculation differential pressure sensor*
B70	*Crankshaft Hall sensor*
N14/2	*Glow output stage*



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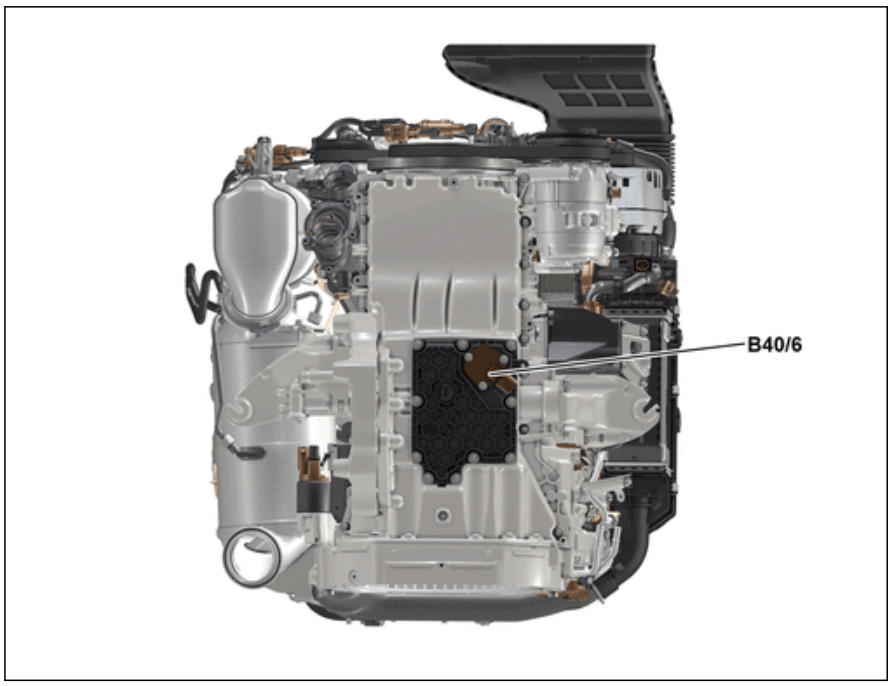
Engine view from below

B40/6 *Engine oil fill level sensor*



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View of fuel high-pressure system

1 *Fuel system high pressure pump*

B4/6 *High pressure fuel pressure sensor*

Y74 *Pressure regulator valve*

Y76/1 *Cylinder 1 fuel injector*

Y76/2 *Cylinder 2 fuel injector*

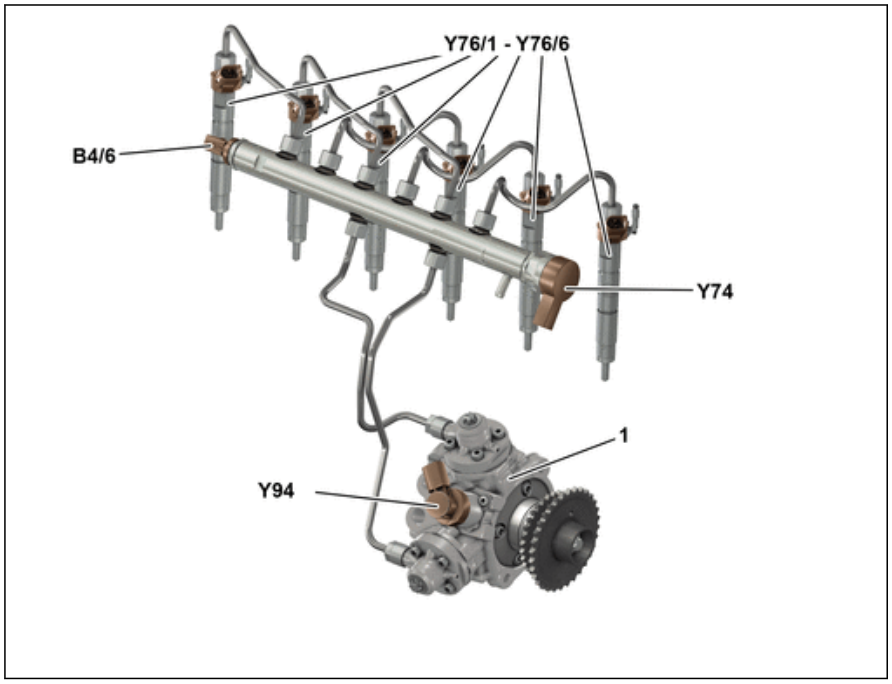
Y76/3 *Cylinder 3 fuel injector*

Y76/4 *Cylinder 4 fuel injector*

Y76/5 *Cylinder 5 fuel injector*

Y76/6 *Cylinder 6 fuel injector*

Y94 *Quantity control valve*



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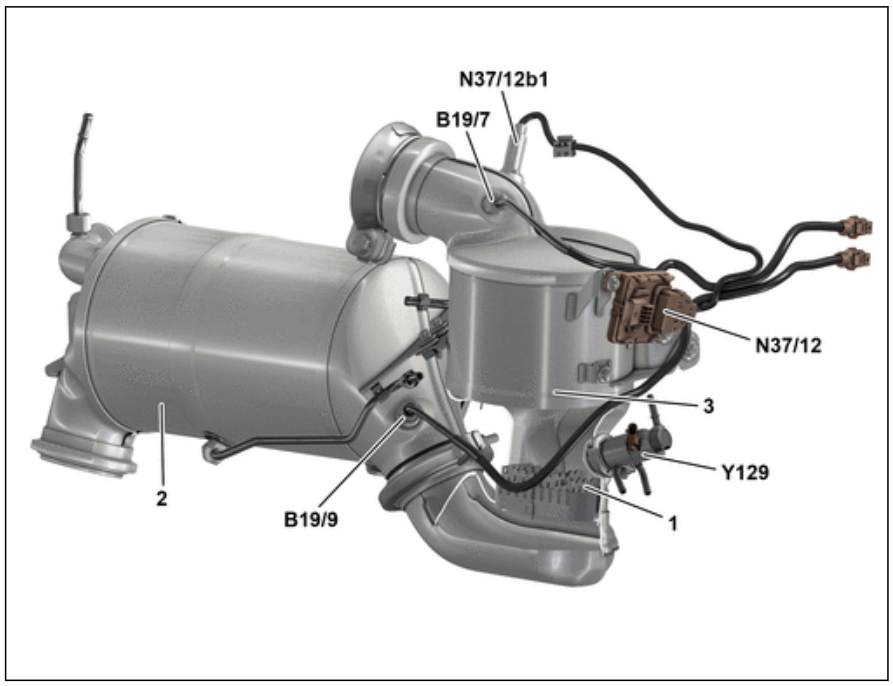
Partial view of the exhaust system

1	*Evaporator discs*
2	*Diesel particulate filter / SCR catalytic converter*
3	*Diesel oxidation catalytic converter*
B19/7	*Temperature sensor upstream of catalytic converter*
B19/9	*Temperature sensor upstream of diesel particulate filter*
N37/12	*Control unit of NOx sensor upstream of diesel oxidation catalytic converter*
N37/12b1	*NOx sensor upstream of diesel oxidation catalytic converter*
Y129	*AdBlue® metering valve*



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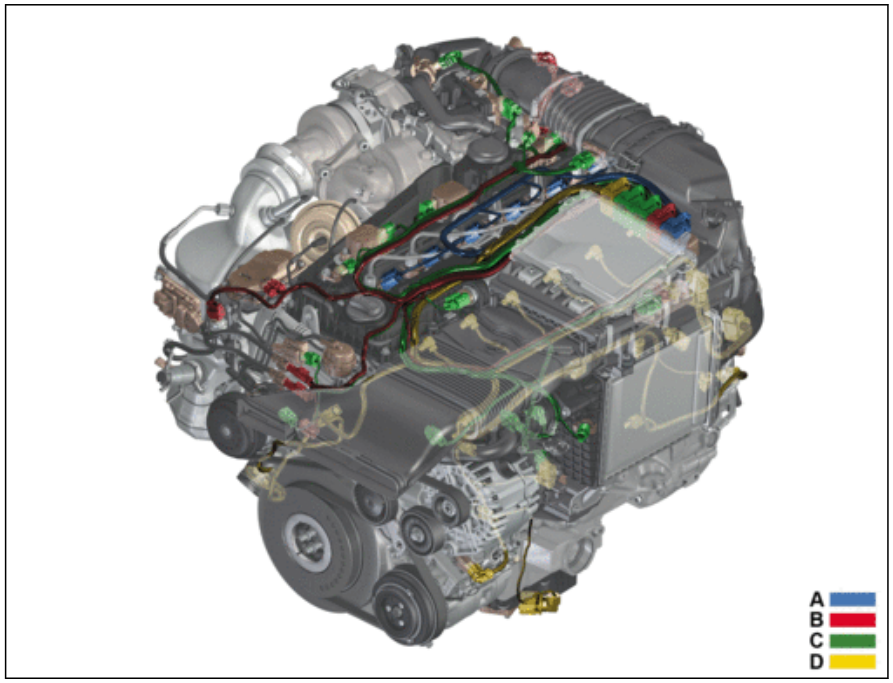
View of engine wiring harnesses

A	*Crankcase wiring harness*
B	*Cylinder head and intake air system wiring harnesses*
C	*Exhaust system wiring harness*
D	*Injection wiring harness*



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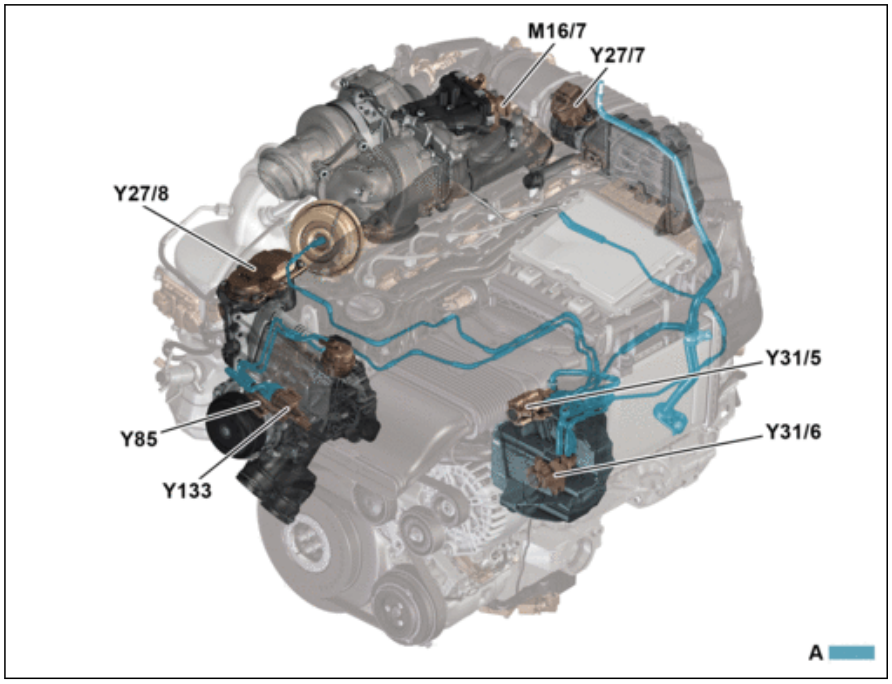
View of vacuum system

M16/7	*Boost pressure control flap actuator*
Y27/7	*Low-pressure exhaust gas recirculation actuator*
Y27/8	*High-pressure exhaust gas recirculation actuator*
Y31/5	*Boost pressure control pressure transducer*
Y31/6	*Wastegate pressure transducer*
Y85	*Exhaust gas recirculation cooler bypass switchover valve*
Y133	*Coolant pump switchover valve*
A	*Vacuum lines*



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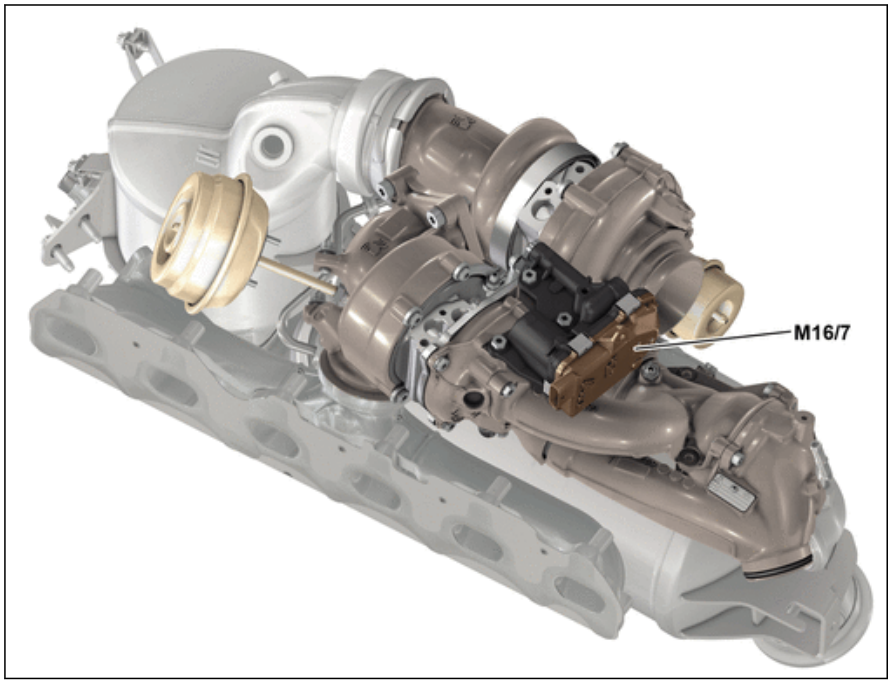
View of ATL

M16/7	*Boost pressure control flap actuator*



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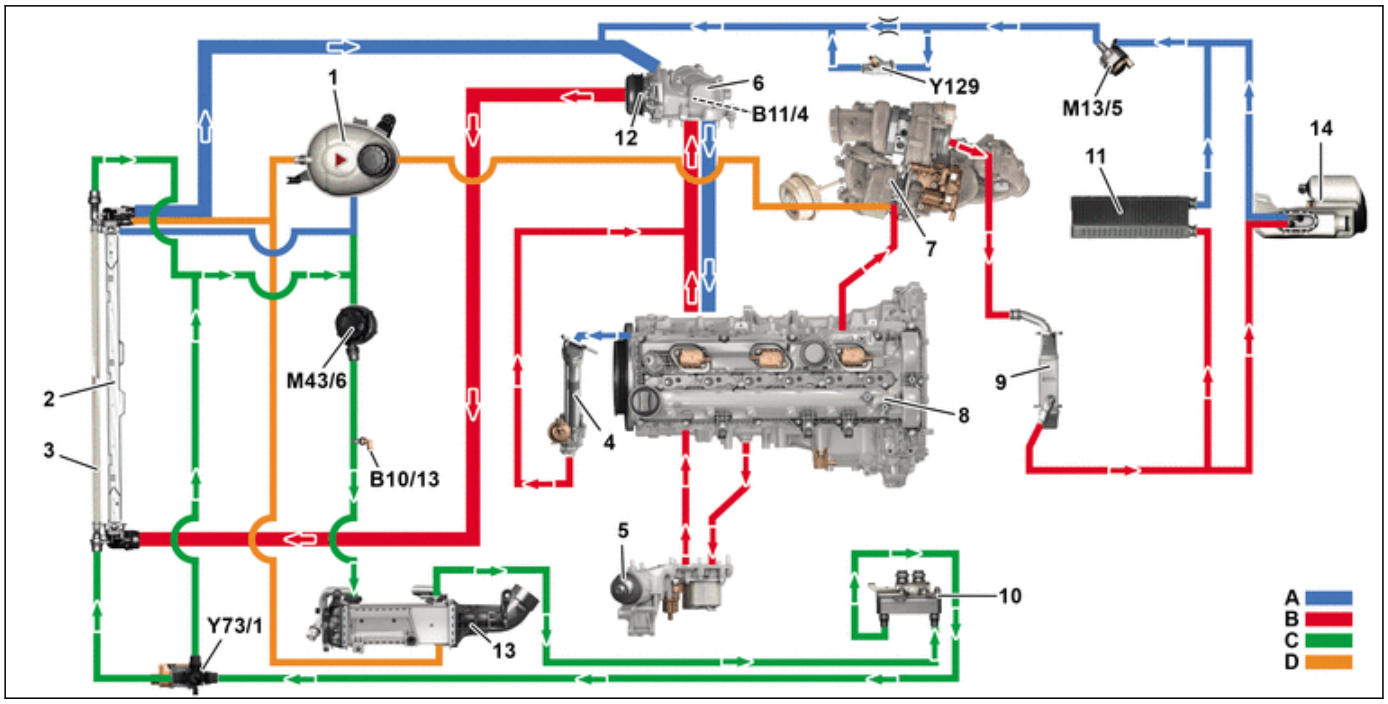
Mechanical engine systems

The mechanical components in engine OM 656 are fundamentally designed for maximum efficiency, advantageous thermodynamic properties and the lowest possible friction losses. These different requirements are achieved by the following measures:

- NANOSLIDE® coating of cylinder barrels
- Use of steel pistons
- Off-set crank assembly (this means that cylinder bores opposite the crankshaft axis are offset towards the cold side)

- Optimized control drive



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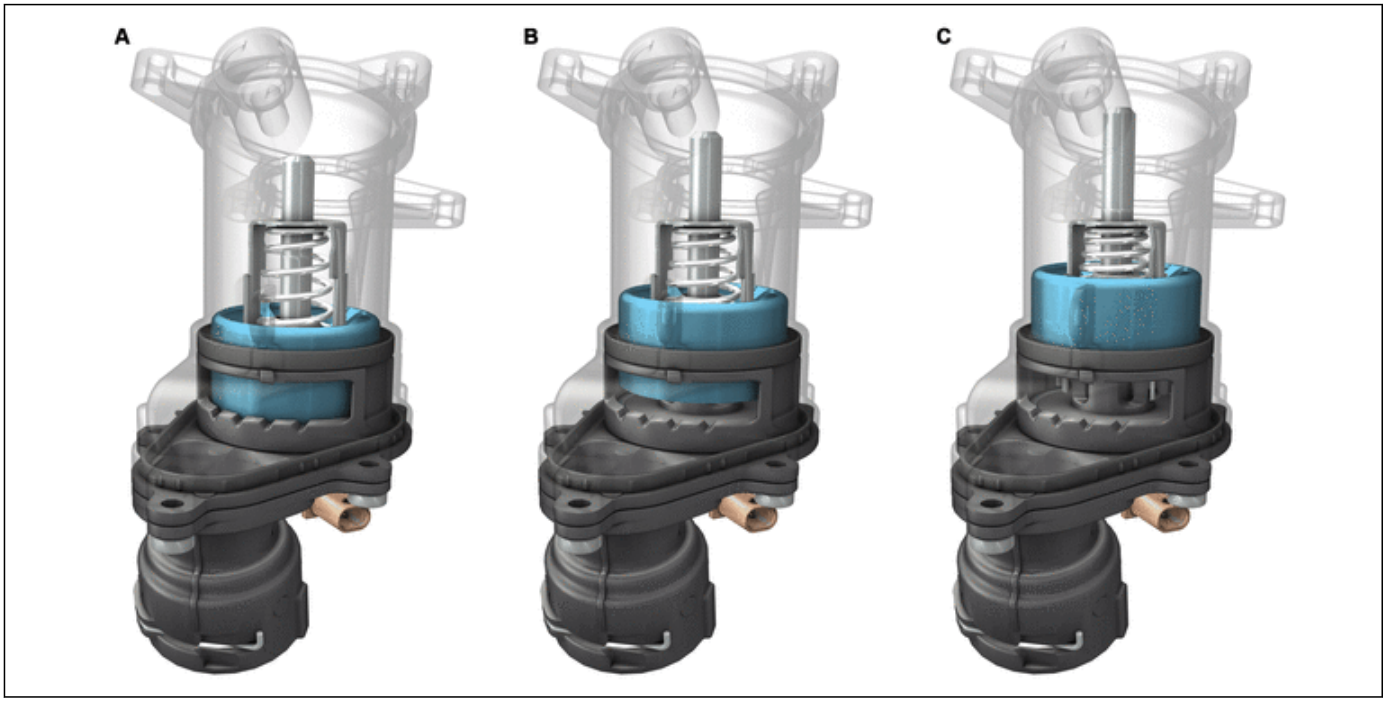
Coolant circuit, shown schematically

1	*Coolant expansion reservoir*	*9*	*Low pressure exhaust gas recirculation cooler*	*M13/5*	*Coolant circulation pump*
2	*Radiator*	*10*	*Transmission oil heat exchanger*	*M43/6*	*Low temperature circuit circulation pump 1*
3	*Low-pressure cooler*	*11*	*Heating system heat exchanger*	*Y73/1*	*Low-temperature circuit switchover valve*
4	*High pressure exhaust gas recirculation cooler*	*12*	*Coolant pump*	*Y129*	*AdBlue® metering valve*
5	*Engine oil heat exchanger*	*13*	*Charge air cooler*	*A*	*Coolant cold*
6	*Coolant thermostat*	*14*	*Washer fluid reservoir*	*B*	*Coolant, warm*
7	*Turbocharger*	*B10/13*	*Low-temperature circuit temperature sensor*	*C*	*Low temperature circuit*
8	*Crankcase*	*B11/4*	*Coolant temperature sensor*	*D*	*Coolant circuit ventilation*

Heat management

Engine OM 656 has optimized heat management which significantly increases the engine's thermodynamic efficiency. This increase is achieved through, among other features, an electric auxiliary pump which is actuated independently of the high-temperature circuit and thus performs demand-based cooling of the components. In addition, a sleeve valve thermostat is used. This sleeve valve thermostat is designed for small flow cross-sections

with low pressure losses and achieves a flow volume of 290 l/min.



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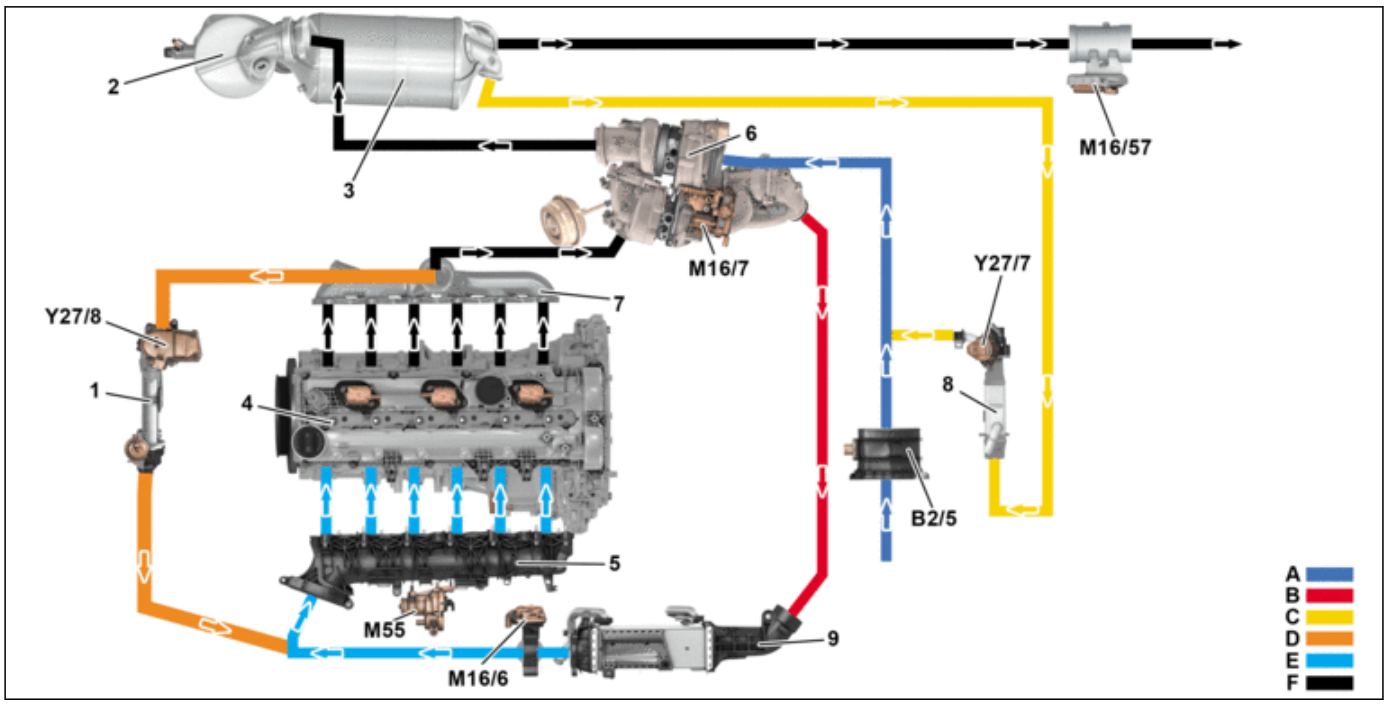
Positions for annual slider thermostat

A Position for full throttling B Position for mixed-fuel mode C Position for radiator operation

Emissions

The OM 656 is designed for future RDE (Real Driving Emissions) emissions legislation. All of the components relevant to emissions reduction (diesel oxidation catalytic converter, diesel particulate filter, AdBlue® system) are installed directly on the engine. Thanks to its near-engine mounting, the exhaust gas aftertreatment system has low thermal losses and favorable operating conditions. This is enhanced by the switchable CAMTRONIC exhaust camshaft. This aids in heating up the exhaust system without having any effect on consumption. The OM 656 features multiway exhaust gas recriculation (EGR), which combines cooled high pressure and low-pressure exhaust gas recirculation. This allows the untreated emissions of the engine to be significantly lowered even further throughout the entire characteristics map, while maintaining the combustion process within an economical range.



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EGR shown schematically

1	*High pressure exhaust gas recirculation cooler*	*9*	*Charge air cooler*	*A*	*Intake air*
2	*Diesel oxidation catalytic converter*	*B2/5*	*Hot film mass air flow sensor*	*B*	*Charge air (uncooled)*
3	*Diesel particulate filter / SCR catalytic converter*	*M16/6*	*Throttle valve actuator*	*C*	*Low-pressure exhaust gas recirculation*
4	*OM 656*	*M16/7*	*Boost pressure control flap actuator*	*D*	*High-pressure exhaust gas recirculation*
5	*Charge air distributor*	*M16/57*	*Exhaust flap controller*	*E*	*Charge air (cooled)*
6	*Turbocharger*	*M55*	*Intake port shutoff actuator motor*	*F*	*Exhaust*
7	*Exhaust manifold*	*Y27/7*	*Low-pressure exhaust gas recirculation actuator*		
8	*Low pressure exhaust gas recirculation cooler*	*Y27/8*	*High-pressure exhaust gas recirculation actuator*		

Exhaust gas recirculation

In order to reduce the engine's untreated emissions, multiway exhaust gas recirculation is used in OM 656. This consists of a high-pressure and a low-pressure exhaust recirculation path. The EGR is active from neutral through to the upper partial-load range. The recirculated exhaust is cooled and then fed back into the charge air (cooled). Effects achieved from recirculation:

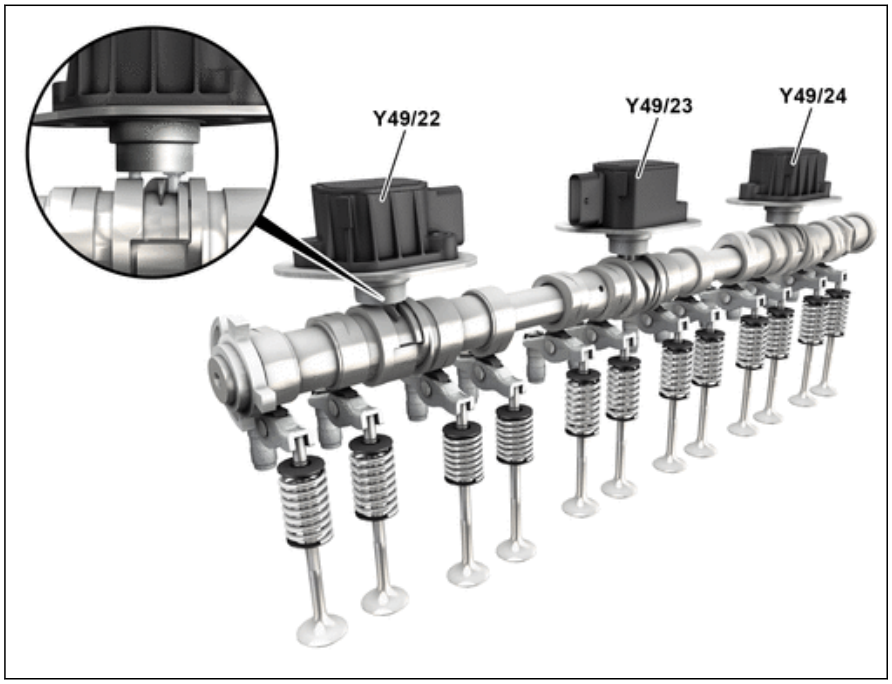
- Reduction of oxygen (O2) concentration in combustion chamber
- Reduction of the combustion temperature through reduction of the combustion speed
- Reduction of the combustion temperature through a higher heat capacity of the recirculated exhaust compared to the intake air

Heat capacity

The heat capacity is a material property and indicates how much heat a substance can store per temperature change.

Partial view of camshaft with CAMTRONIC

Y49/22	*Cylinder 1 and 2 exhaust CAMTRONIC actuator*
Y49/23	*Cylinder 3 and 4 exhaust CAMTRONIC actuator*
Y49/24	*Cylinder 5 and 6 exhaust CAMTRONIC actuator*



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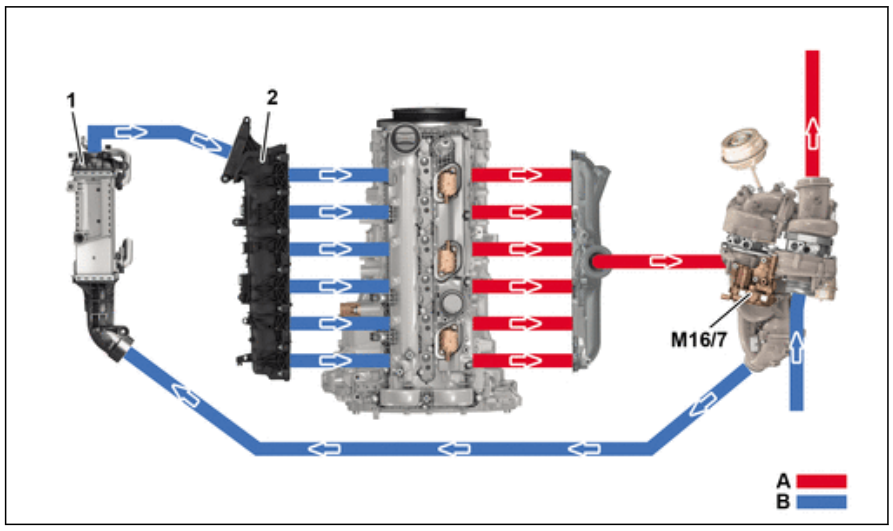
Camtronic

In order to achieve effective exhaust gas cleaning with the desired speed, the CAMTRONIC switchable exhaust camshaft is being used on diesel engines for the first time.

In low-load operation, the CDI control unit controls the exhaust CAMTRONIC actuator for cylinder 1 and 2, the exhaust CAMTRONIC actuator for cylinder 3 and 4 and the exhaust CAMTRONIC actuator for cylinder 5 and 6. This actuation triggers a second lift of the exhaust camshaft. This second lift causes hot exhaust gases to flow back into the combustion chamber. These uncooled exhaust gases increase the temperature in the combustion chamber, which in turn causes emission control to become effective earlier.

Forced induction, shown schematically

1	*Charge air cooler*
2	*Intake manifold*
M16/7	*Boost pressure control flap actuator*
A	*Exhaust*
B	*Fresh air*



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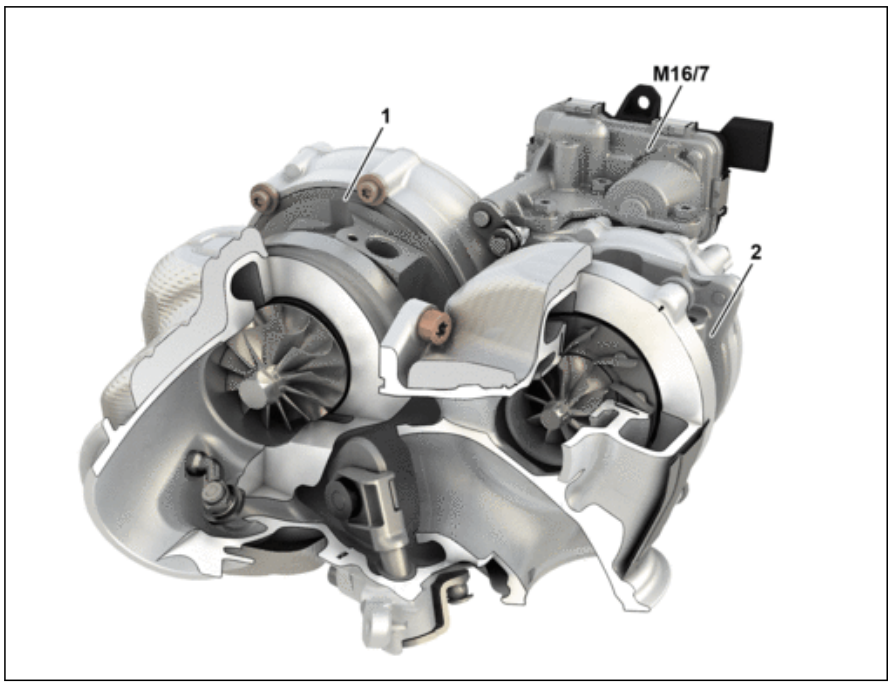
2-stage charging

The necessary boost pressure is generated by the high pressure and the low-pressure turbocharger or just by the low-pressure turbocharger according to the load condition of the engine. For charging by the high pressure and the low-pressure turbocharger a larger or a smaller portion of the exhaust flow in the exhaust turbine housing of the high-pressure turbocharger upstream of the high-pressure turbocharger turbine is directed directly to the low-pressure turbocharger turbine wheel dependent on the boost pressure needed. In this way the low-pressure turbocharger turbine wheel is driven by more or less exhaust energy.

Distribution of the exhaust flow is regulated by the position of the boost pressure control flap. The wastegate and the check valve are closed. If the low-pressure turbocharger is in the position to build up the whole boost pressure on its own, the boost pressure build up takes place by the low-pressure turbocharger. The check valve is opened and the compressed charge air from the low-pressure turbocharger led past the high-pressure turbocharger compressor impeller housing. The boost pressure is limited over the waste gate.

Turbocharger cross-section

1	*Low-pressure turbocharger*
2	*High-pressure turbocharger*
M16/7	*Boost pressure control flap actuator*



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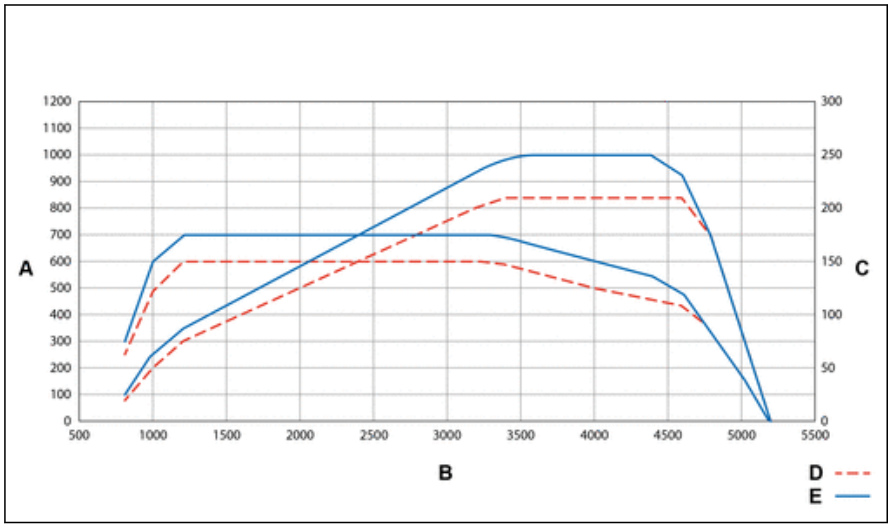
OM 656 performance graph

A	*Torque in Nm*
B	*Rotational speed in rpm*
C	*Output in KW*
D	*OM 656 with 210 kW*
E	*OM 656 with 250 kW*



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Maintenance

The current Mercedes-Benz maintenance strategy also applies to OM 656, country-specific deviations are possible:

- ECE: Fixed maintenance intervals with the "every 25,000 km/12 months" interval
- CHN: Fixed maintenance intervals with the "every 10,000 km/12 months" interval
- USA: Fixed maintenance intervals with the "every 10,000 mi/12 months" interval
- Service A and B always alternate

Additional operations are carried out at these intervals (ECE example):

- Replace air filter insert: every 75,000 km/3 years
- Replace fuel filter on diesel engines: every 75,000 km/ 3 years

New: Draining the engine oil:

Engine OM 656 no longer has an oil dipstick tube and so also no oil dipstick. The engine oil is drained using a drain

screw in the oil pan. The engine oil level is checked using a sensor in the oil pan and via the display on the instrument cluster. This is called up using the steering wheel buttons.

	Unit	OM 642 LS D30 SCR	OM 656 D29 R SCR	OM 656 D29 SCR
Number of cylinders	–	6	6	6
Design	–	V	Inline	Inline
Number of valves/ cylinders	–	4	4	4
Single cylinder volume	cm^3	498	488	488
Swept volume	cm^3	2987	2927	2927
Cylinder spacing	mm	106	90	90
Hole	mm	83	82	82
Stroke	mm	92.0	92.4	92.4
Stroke/bore		1.11	1.13	1.13
Rated output	kW	190	210	250
	at 1/rpm	3600	4000	4000
Maximum torque	Nm	620	600	700
	at 1/rpm	1600...2400	1200...3200	1200...3200
Compression	∑	15.5	15.5	15.5
Injection pressure	bar	1800	2500	2500