



Diesel Engines

M57/M67 Common Rail

Course contents/Background material

Information status:

09/98

BMW
Service Training

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Introduction

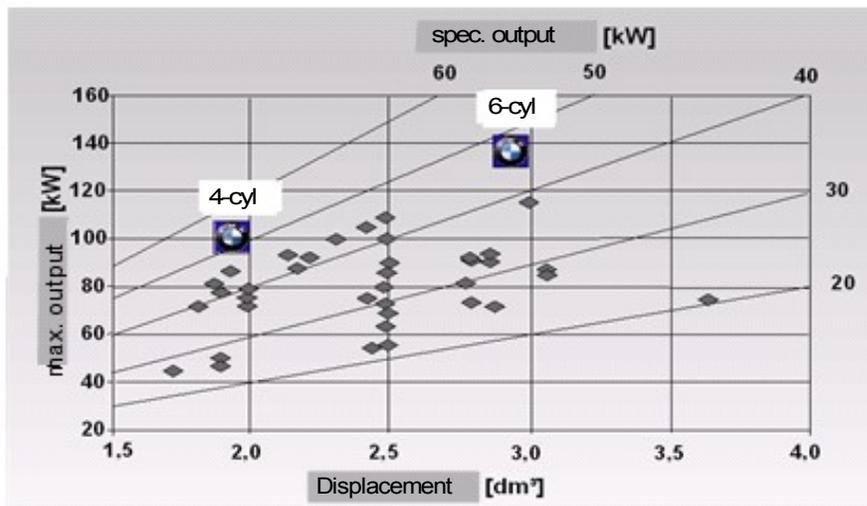


BMW is successively developing a new family of diesel engines with direct injection (DI) that will include 4-cylinder, 6-cylinder and 8-cylinder engines.

Following the successful introduction of the M47D20 4-cylinder engine, a new 6-cylinder engine will soon be phased into series production.

This engine features all the design characteristics of the second generation of direct injection diesel engines and represents the currently most advanced diesel technology available in passenger vehicles.

Thanks to its outstanding performance and high comfort properties in conjunction with excellent exhaust quality and integral fuel economy, this engine enjoys a leading position in the competitive environment.



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Fig. 1: Competitive situation M47/M57

Initially, the new M57 engine will be installed in the form of a top-of-the-range diesel engine in the 5 and 7 Series. The M67 will enhance the top end of the diesel engine range in the 7 Series.

Parallel to this, the well-proven indirect injection engines (IDI) will still remain in the product range.

Objectives



The layout and design particularly of the six-cylinder engine is based on the following primary objectives:

- The creation of a top-of-the-range diesel engine for all BMW model series
- Maintaining the leading competitive position with regard to output power and torque development as well as comfort in the entire diesel vehicle segment
- Securing marketability by the use of future-oriented technical concepts incorporating further development capabilities

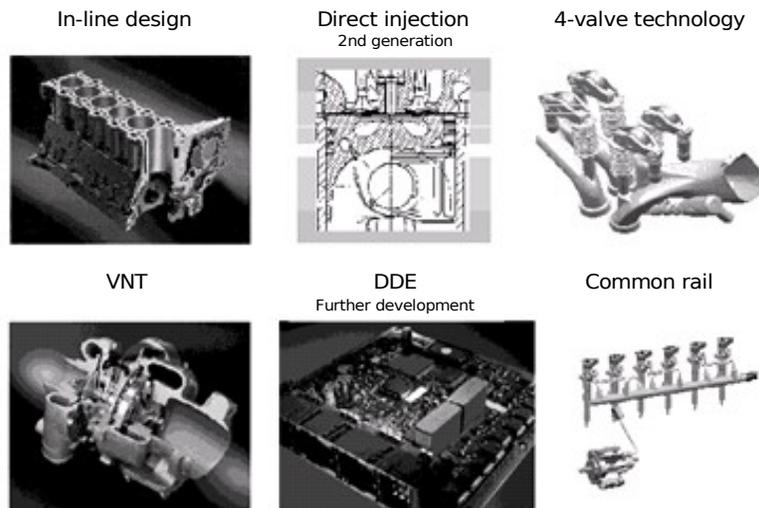
Concepts



The concept features of the new engines correspond to those of second generation DI diesel engines.

The advantages in fuel consumption offered by the first series-produced DI diesel engines were offset by a series of disadvantages regarding acoustic comfort, performance, emission, passenger compartment heating and costs compared to modern IDI diesel engines.

In contrast to this, with second generation DI diesel engines it has been possible to improve all customer-relevant features, with the exception of costs, by incorporating new or further developed technical concepts.



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Fig. 2: Technical concepts

The superiority of these engines is the result of non-compromising basic engine design (modular system) in conjunction with progressive technical concepts.

Engine views



Fig. 3: M57 engine - General view

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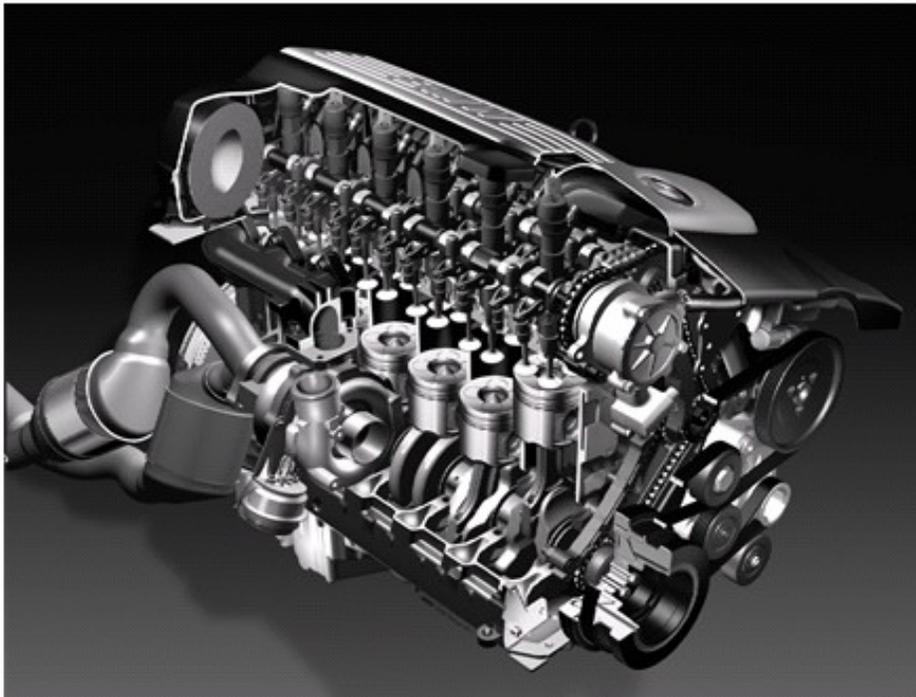


Fig. 4: M57 engine - Sectional view

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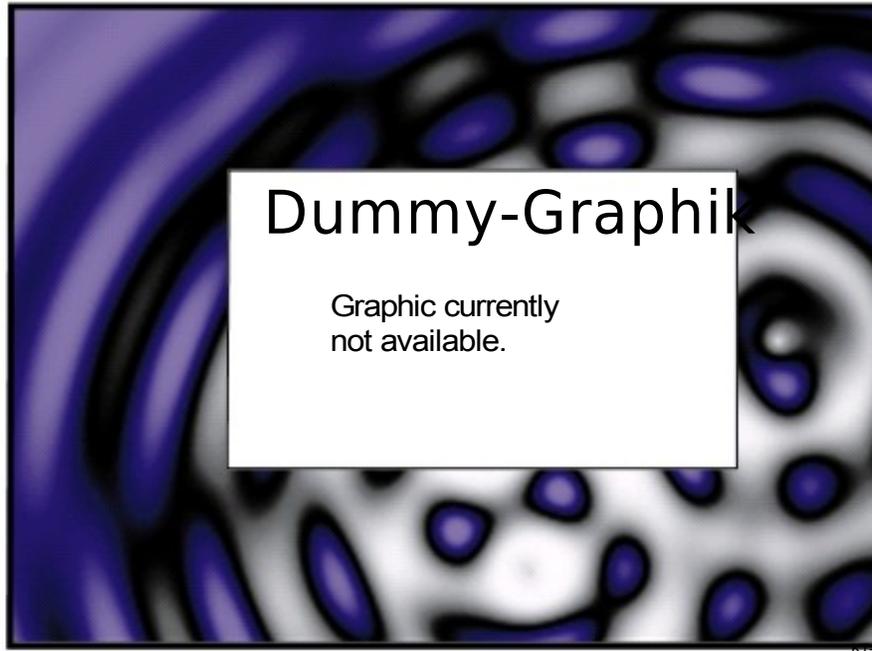


Fig. 5: M67 engine - General view

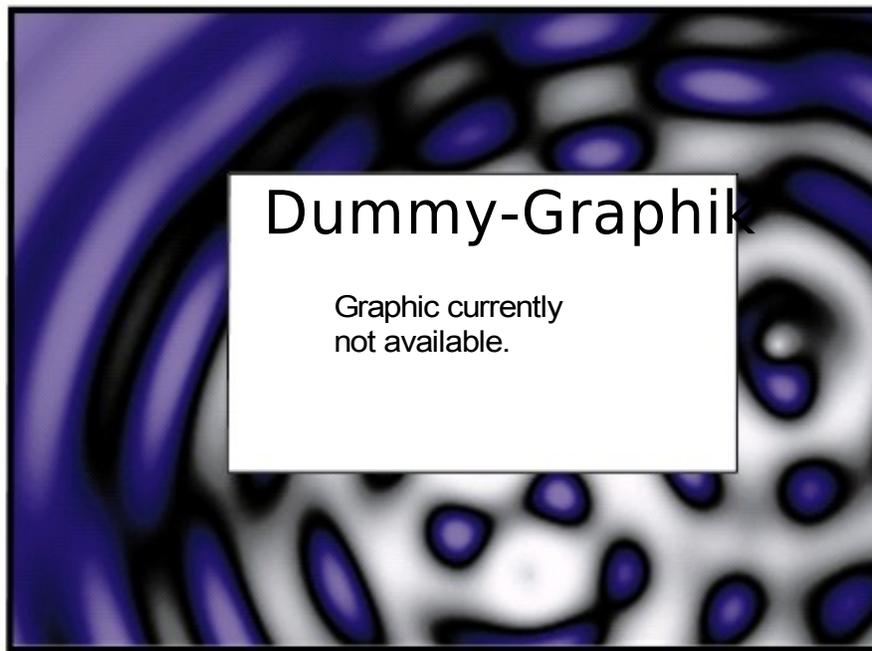


Fig. 6: M67 engine - Sectional views

Technical features



Common features

- Light-alloy cylinder head
- 4-valve technology with centrally arranged injection nozzle
- Valves and springs identical to M47
- Exhaust turbocharger with variable nozzle turbine (VNT)
- Compression ratio 18:1, compression 20 - 25 bar (operating temperature)
- Common rail injection system
- Air mixture $1.15 \leq \lambda \leq 4$
- Cooling duct pistons with central crown bowl
- Electronically controlled exhaust gas recirculation
- Exhaust re-treatment by means of diesel-specific oxidation catalytic converter and engine-close primary catalytic converter
- Switchable hydraulic engine mounts
- 7-blade fan wheel with viscous clutch drive
- Average inspection intervals 20 000 up to max. 25 000 km limited to 2 years
- The engine begins to cut out at 4000 rpm. The injected volume is reduced continuously. The cutout limit is reached at approx. 4800 rpm

M57-specific features

- In-line 6-cylinder engine with cast-iron crankcase
- High-pressure fuel pump (CP1)
- Plastic cylinder head cover
- Plastic manifold based on two-shell weld technology

M67-specific features

- Cast iron 90° V8 cylinder engine with cracked bearing caps
- High pressure fuel pump (CP3)
- Aluminium cylinder head cover
- Thin-walled cast air intake plenum
- Two-piece oil pan
- Bi-VNT with electrical guide vane adjustment

DDE control unit



Different control units are used depending on the type of engine:

- M57 - DDE 4 (different characteristic maps for E38/E39)
- M67 - DDE 4.1

Technical data

The data of the new M57 and M67 engines are as follows:

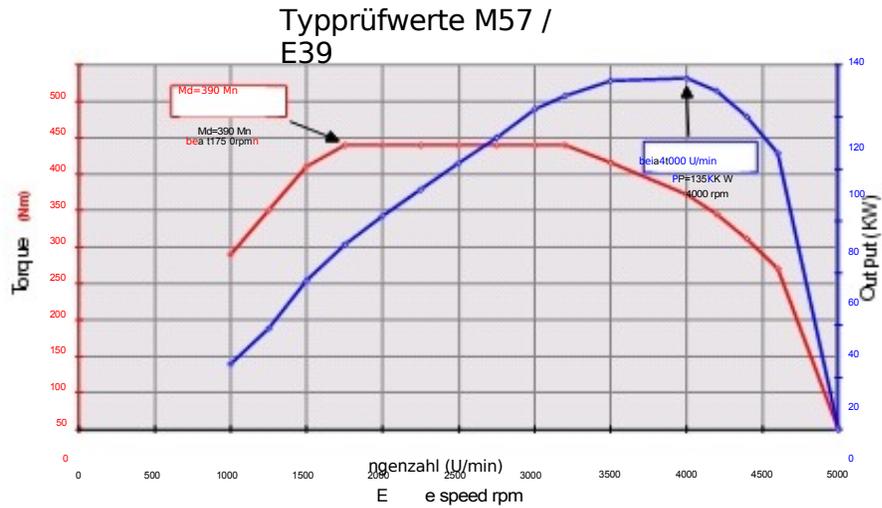
	M57	M67	
Engine type/valves	R6/4	V90-8/4	-
Displacement (eff.)	2926	3901	ccm
Stroke/bore	88.0/84.0	88.0/84.0	mm
Compression ratio	18 : 1	18 : 1	-
Engine weight	210	277	kg
Power to weight ratio	1.56	1.58	kg/kW

Production phase-in of each engine:

	530d	730d	740d
Production phase-in	09/98	09/98	03/99

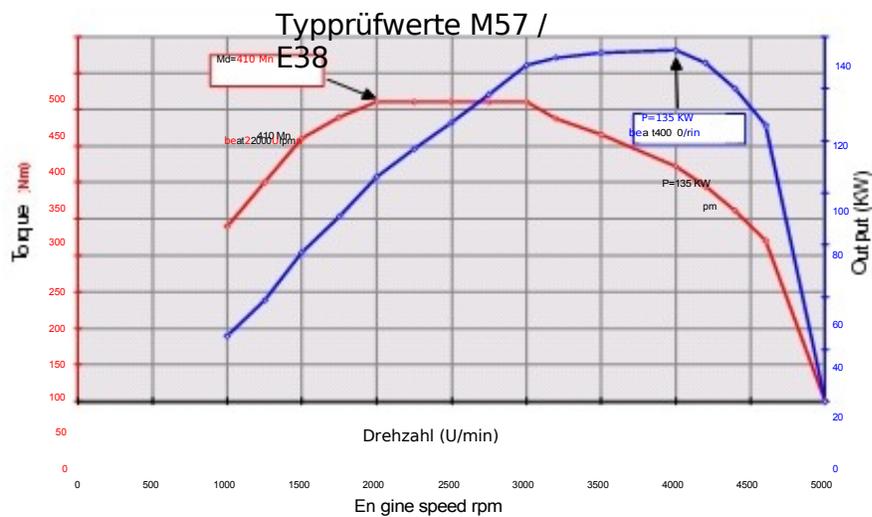
The engine values below apply to specific vehicles:

	530d	730d	740d
M57	135 kW/4000 rpm	135 kW/4000 rpm	
	390 Nm / 1750 - 3200 rpm	410 Nm / 2000 - 3000 rpm	
M67			175 kW/4000 rpm
			560 Nm/2000 rpm



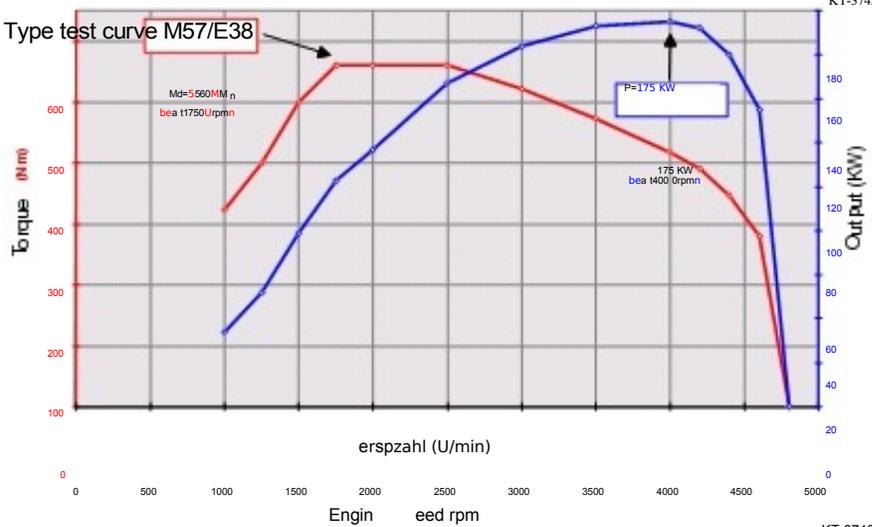
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Fig. 7: Type test curve M57/E39



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Fig. 8: Type test curve M57/E38



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Fig. 9: Type test curve M67/E38

Exhaust emission legislation

Pollutant limits have been further reduced in exhaust emission guidelines. These limits for EU-3 will come into force as from 01.01.2000 for new type approvals.



Pollutant	EU-2	EU-3	EU-3 D	
	Since 1996	As from approx. 2000	Since 01.07.97	
CO	1.00	0.64	0.60	g/km
(NO _x + HC)	0.70 (0.90)*	0.56	0.56	g/km
PM	0.08 (0.10)*	0.05	0.05	g/km

PM: Particle mass
*) Different limits applied in part to direct injection diesel engines

Tab. 1: Exhaust emission limits for diesel engines

The DI engines fulfil the more stringent requirements specified in the exhaust emission guidelines by means of the following measures:



- Internal engine measures
- Controlled exhaust gas recirculation (EGR) ϕ_{τ} (refer to Sec. 8)
- Catalytic converter ϕ_{τ} (refer to Sec. 8)
- Common rail (adaptation of injection characteristics)

Notes on exhaust emission standards/test cycles



EU-3 D

- Since 01.07.97 in Germany only (for tax reasons)
- Testing at room temperature 20 - 30 °C
- Cold run (40 sec. idling speed without measurement, conditioning)
- 2 test cycles (urban/extra-urban)
- Total duration: 11 km in 20 min.
- Average speed: 32 km/h
- Max. speed: 120 km/h

EU-3

- As from approx. 2000
- Tendency to more stringent values
- 40 sec. idle speed run dropped

The values of the EU-3 D standard and EU-3 standard are not comparable due to different test cycles.

EU-4

- As from approx. 2005

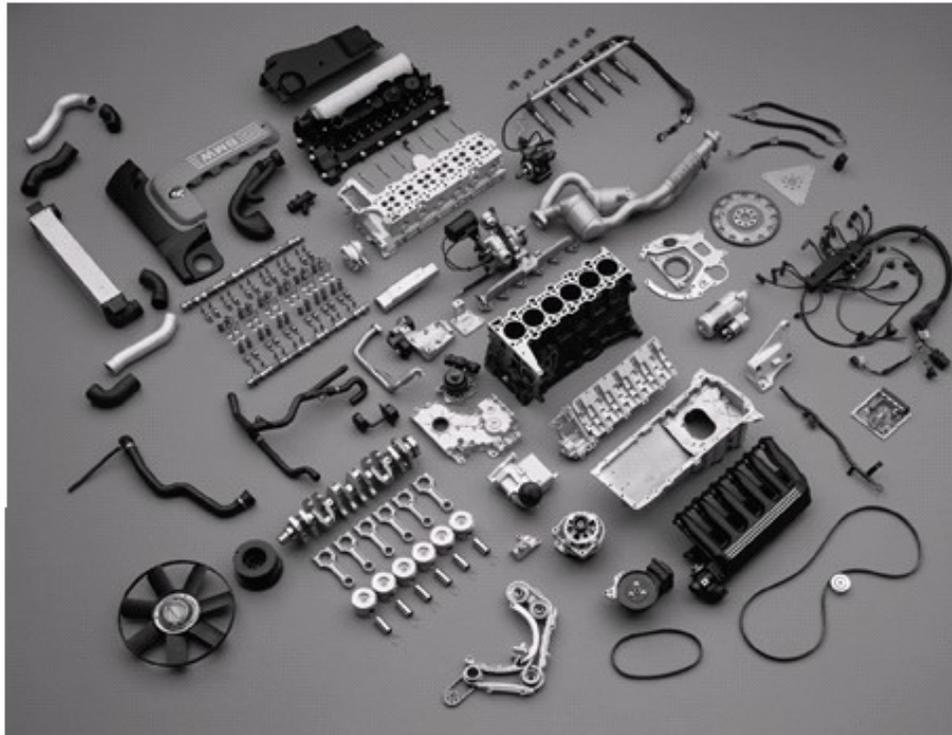
Engine components



System structure

The engine consists of the following main components:

- Engine block
- Cylinder head gasket
- Cylinder head
- Cylinder head cover
- Valve gear
- Crankshaft
- Flywheel
- Connecting rods with bearings
- Pistons with rings and pins
- Chain drive
- Oil pan
- Timing case cover



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Fig. 10: Engine components and add-on parts - M57

Differences between the components for the M57 and M67 engines are listed separately.

Component description



Engine block

The engine block represents the central component of the power plant. It houses the crankshaft, connecting rods and pistons.

The following features apply both to the M57 and M67:

- Crankshaft position/rpm sensor mounted on crankcase for radial sensing at inner incremental wheel (last crankshaft web)
- Oil supply gallery for oil spray nozzles with central pressure control valve

M57-specific features

- Material: Grey cast iron
- Support spar concept as on the M47 (i.e. interconnected horizontal and vertical box profiles)
- Cast flange for mounting common rail high pressure pump
- Reinforcement shell with integrated oil deflector function, split design in area of cylinder 1 to 2 (oil pump)
- Oil spray nozzles (common part M47)

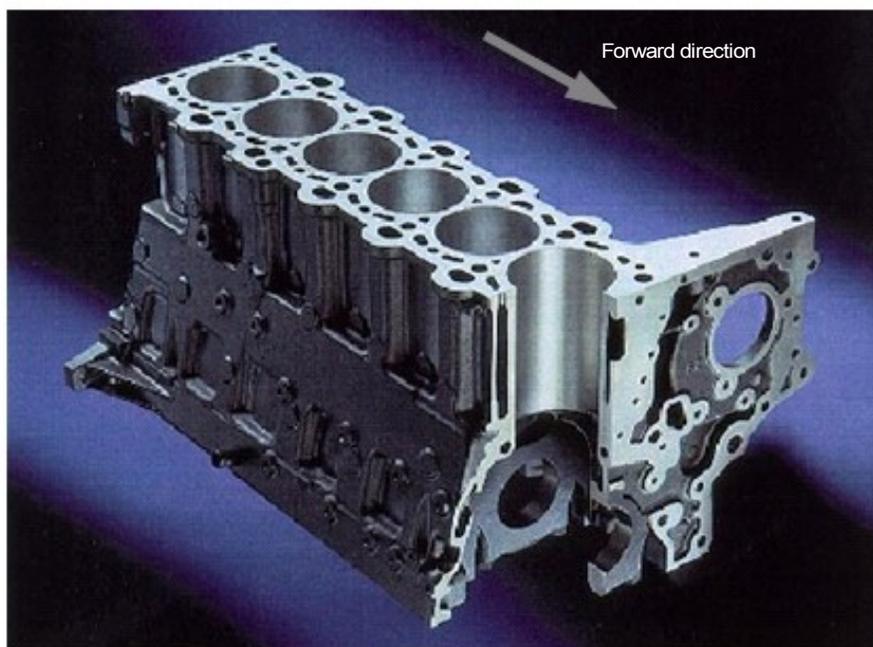


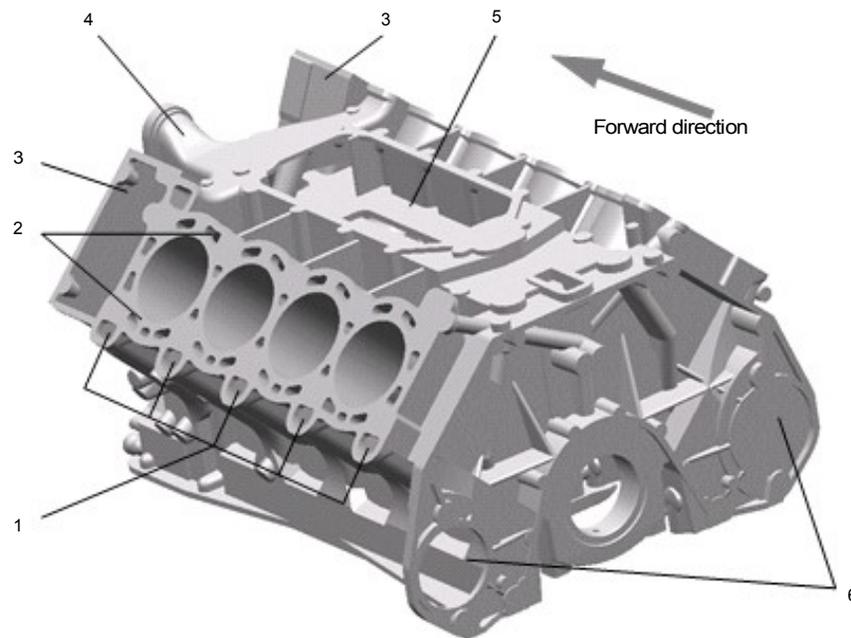
Fig. 11: Engine block - section M57

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M67-specific features



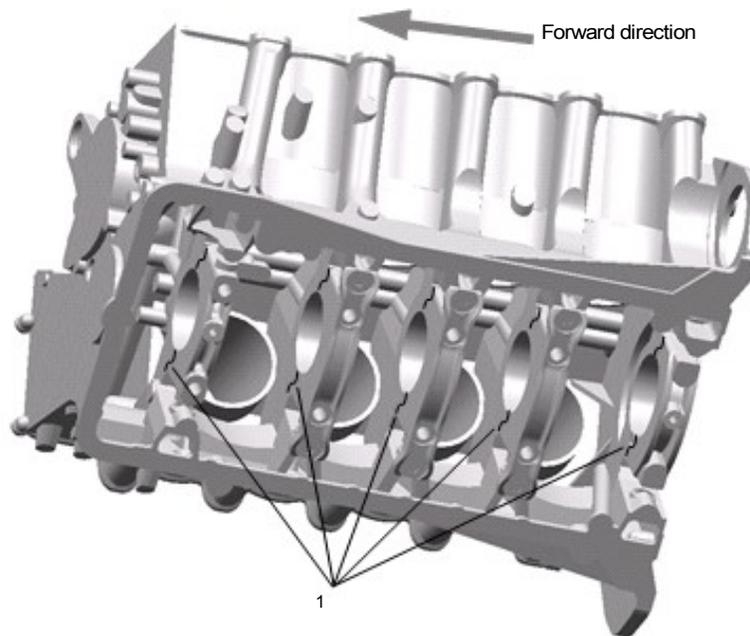
- Cast starter flange on both sides, cast timing case
- Integrated water flow control to water pump
- Oil supply gallery for oil spray nozzles with central pressure control valve
- Piston spray nozzles each with two spray openings



- 1 - Oil return
2 - Coolant ducts
3 - Timing case cover (cast)
4 - Coolant return, integrated collection duct
5 - Space for oil-to-water heat exchanger directly in water pump feed
6 - Starter flange (LHD or RHD)

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Fig. 12: Engine block - view M67



1 - Cracked bearing cap

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Fig. 13: Engine block - view M67 (from below)

- Cracked bearing caps
- V-engine-compliant threaded connection of main bearing caps with additional support brackets

Technical data:

	M57	M67	
Cylinder spacing	91	98	mm
Crankcase height	225 ¹ , 285 ²	245.0	mm
Bore	84.0		mm
Bank offset		18.0	mm

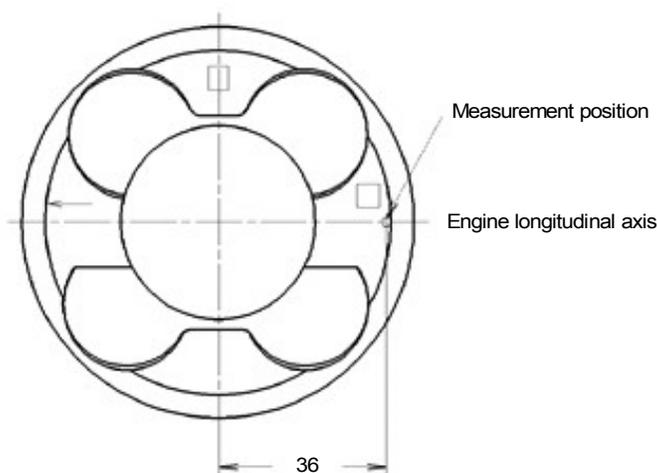
1.) 225.0 from centre of crankshaft to sealing surface of cylinder head
 2.) 285.0 overall height

Cylinder head gasket



The cylinder head gasket seals off the transition points between the engine block and cylinder head.

- Multi-layer steel gasket
- Water flow cross-sections adapted (cylinder-specific) to requirements facilitating uniform coolant flow
- 3 different gasket thicknesses, selected according to determined piston clearance



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Fig. 14: Determining thickness of cylinder head gasket

	Piston clearance x
1-hole gasket	$x \leq 0.92 \text{ mm}$
2-hole gasket	$0.92 \text{ mm} < x \leq 1.03 \text{ mm}$
3-hole gasket	$1.03 \text{ mm} < x$

Cylinder head



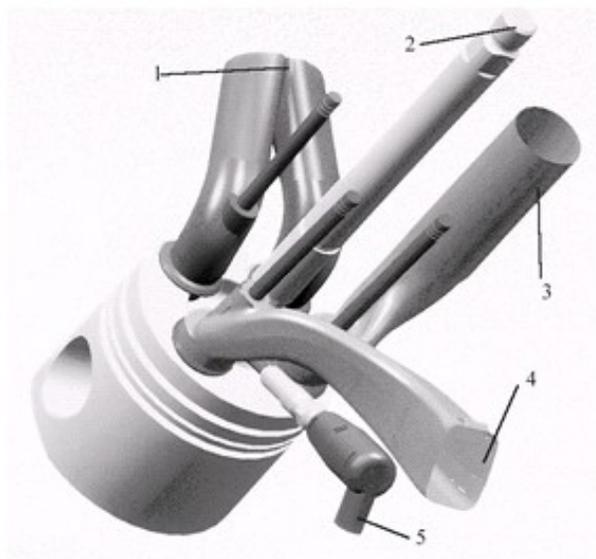
The cylinder head represents the upper limit of the combustion chamber. It accommodates the necessary valve timing elements (valves, injectors, camshafts).

The following features apply both to the M57 and M67:

- Cast aluminium, cast timing case
- Coolant flow from exhaust to inlet side
- Central, vertical upright arrangement of common rail fuel injector
- 4-valve arrangement (as on M47)
- Exhaust ports combined in cylinder head (as on M47)
- Cylinder head bolts not accessible with camshafts mounted in position
- Glow plugs (heater plugs) arranged on inlet side
- Leak-proof arrangement of oil galleries/holes (e.g. for hydraulic valve lash adjusters)

M57-specific features

- Coolant outlet arranged in centre between cylinders 3 and 4
- Inlet port configuration (1 swirl/1 tangential port) adapted to common rail injection system



- 1 - Exhaust ports
- 2 - Fuel injector
- 3 - Swirl port (inlet)
- 4 - Tangential port (inlet)
- 5 - Glow (heater) plug

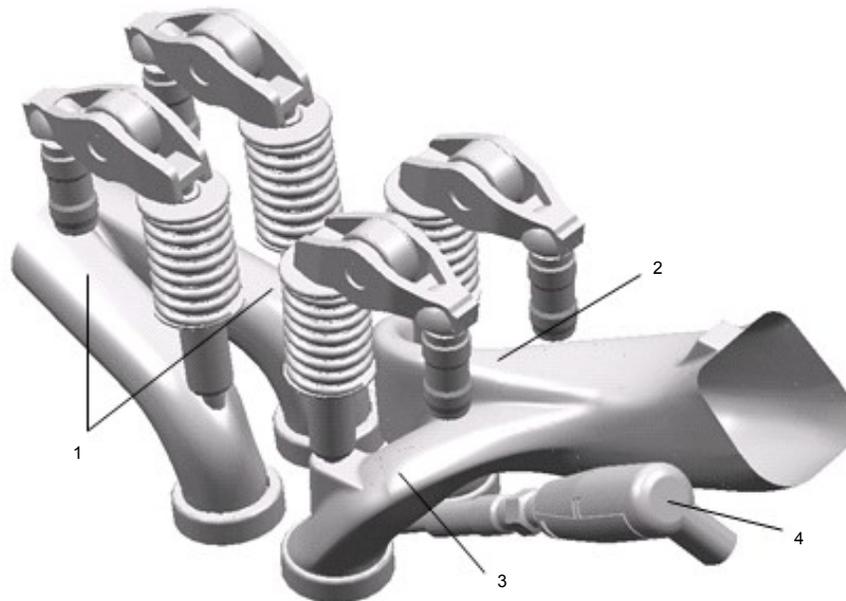
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Fig. 15: Inlet port configuration - view M57

M67-specific features



- Inlet port configuration (1 swirl/1 tangential port), twin-port arrangement



- 1 - Exhaust ports
- 2 - Swirl port (inlet)
- 3 - Tangential port (inlet)
- 4 - Glow (heater) plug

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Fig. 16: Inlet port configuration - view M67 with twin port

Technical data:

		M57	M67	
V-angle	Inlet valves	3.75		degrees
	Exhaust valves	3.0		degrees

Cylinder head cover



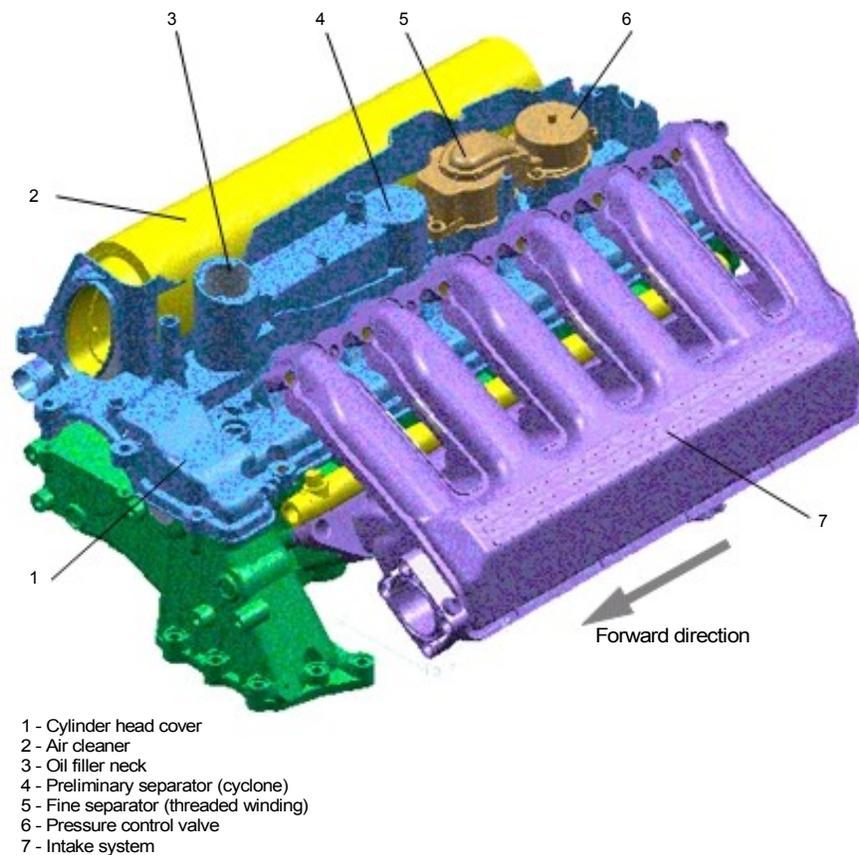
The cylinder head cover combines the oil separator and intake silencer in the intake module system.

The following feature applies both to the M57 and M67:

- Mounting on cylinder head by means of decoupling elements

M57-specific features

- Plastic housing
- Integrated oil separator, preliminary separation with cyclone, fine separation with threaded winding downstream

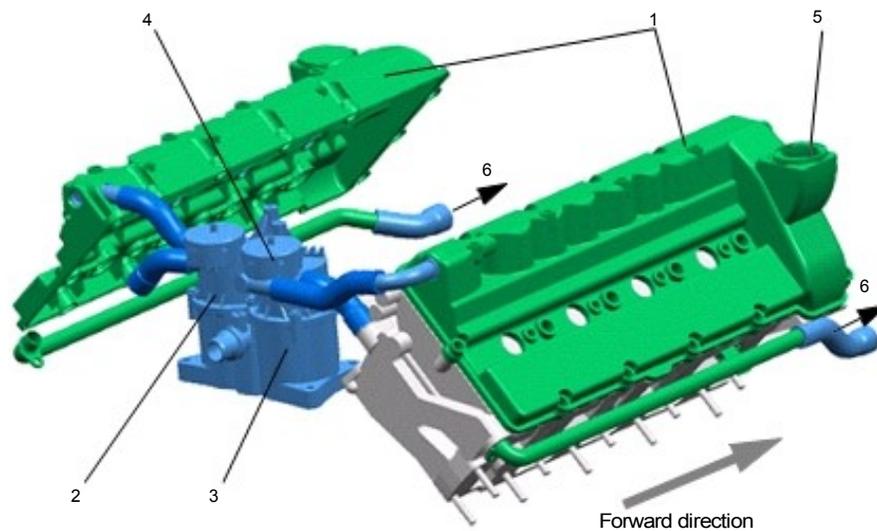


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Fig. 17: Intake module - M57

M67-specific features

- Aluminium casing
- Integrated oil separator, preliminary separation by means of cyclone separator, fine separation with threaded winding downstream



- 1 - Cylinder head cover
- 2 - Preliminary separator (cyclone)
- 3 - Fine separator (threaded winding)
- 4 - Pressure control valve
- 5 - Oil filler neck
- 6 - To clean air line

Fig. 18: Intake module - M67

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Valve gear

The valve gear consists of the camshafts, rocker arms as well as the valves and springs.

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The following features apply both to the M57 and M67:

Camshaft

- Chilled cast iron
- New inlet and exhaust camshafts
- Negative cam radius 67 mm

Rocker arm

- Roller-type rocker arm with one hydraulic valve lash per valve (common part with M47)
- Mounted on valve lash adjuster with oil supply

Valves and springs

- Common part with M47
- Inlet and exhaust valves identical
- Bottom valve plate with integrated valve stem seal



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Fig. 19: Valve gear - M47/M57/M67

M57-specific features

- Vacuum pump driven by front of exhaust camshaft



M67-specific features

- Vacuum pump driven by front of inlet camshafts 1 - 4

Technical data:

	M57	M67	
Valve diameter	25.9		mm
Valve seat angle	45		Degrees
Valve stem diameter	6		mm

Crankshaft



The crankshaft converts the linear stroke motion of the pistons into rotary motion.

The following features apply both to the M57 and M67:

- Threaded connection on front end of crankshaft designed as 4-hole mounting (replaces central bolt)
- Thrust bearing designed as constructed bearing

M57-specific features

- Material C38 mod.
- Bearing surfaces and radii inductively hardened
Main bearings (as on M47)
- Thrust bearing arranged between cylinders 5 and 6
- RPM signal taken from last crankshaft web, incremental wheel screwed on crankshaft web

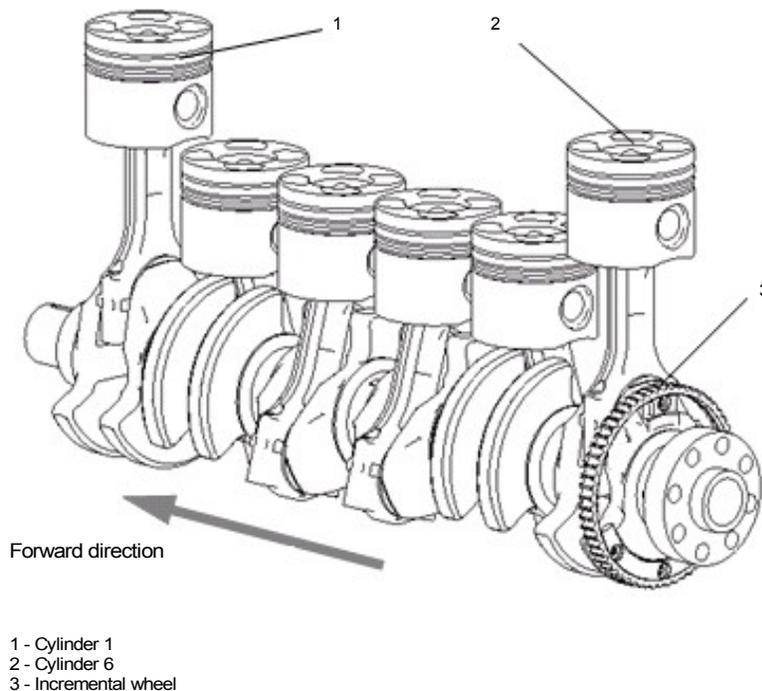


Fig. 20: Crankshaft drive - view M57

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M67-specific features



- Material 42 CrMo 4, nitrocarburized
- Shaft cranked at two levels (similar to M62)
- Main bearing, common part with M62
- Thrust bearing with integrated bearing, arranged on flywheel end of main bearing

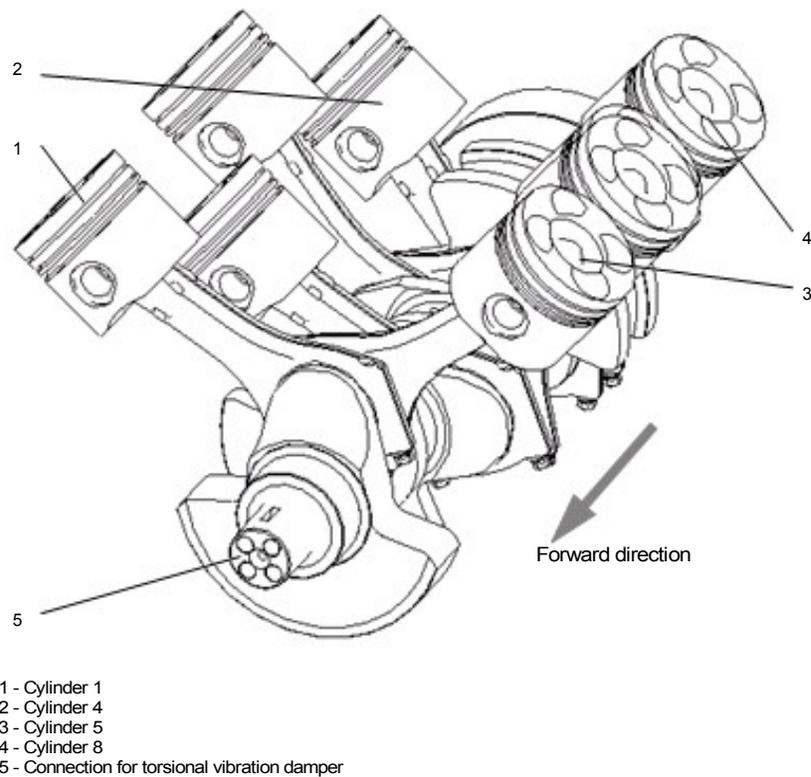


Fig. 21: Crankshaft drive - view M67

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Flywheel



The flywheel is located between the engine and gearbox. The task of the flywheel is to increase the rotating mass so as to enable more uniform rotary motion.

Various types of flywheel are used depending on the type of gearbox installed.

M57-specific features

- Manual gearbox: Dual-mass flywheel
- Automatic gearbox: Sheet-metal flywheel based on sandwich design

M67-specific features

- Automatic transmission (5HP30):
Sheet metal flywheel with integrated incremental wheel,
TDC allocation adapted to control unit

Technical data:

		M57	M67	
V-angle	Inlet valves	3.75		degrees
	Exhaust valves	3.0		degrees

Connecting rods with bearings



The connecting rod connects the piston to the crankshaft. Each connecting rod is mounted such that it can rotate.

The following features applies both to the M57 and M67:

- Big-end bearing half on connecting rod end designed as sputter bearing

M57-specific features

- Connecting rod : Common part with M47
- Material C40 mod.
- Cracked version

M67-specific features

- Material C70
- For assembly reasons, obliquely split trapezoidal connecting rod, cracked

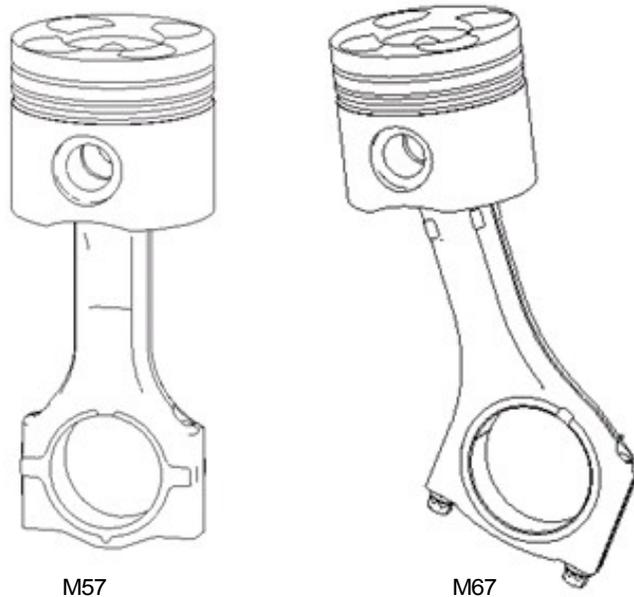


Fig. 22: Piston with connecting rod

Technical data:



	M57	M67	
Distance between hole centres	135	155	mm
Piston pin (gudgeon pin) diameter	30.0		mm
Crankshaft diameter			mm
Cracked connecting rods	48	57.6	mm

Pistons with rings and pins

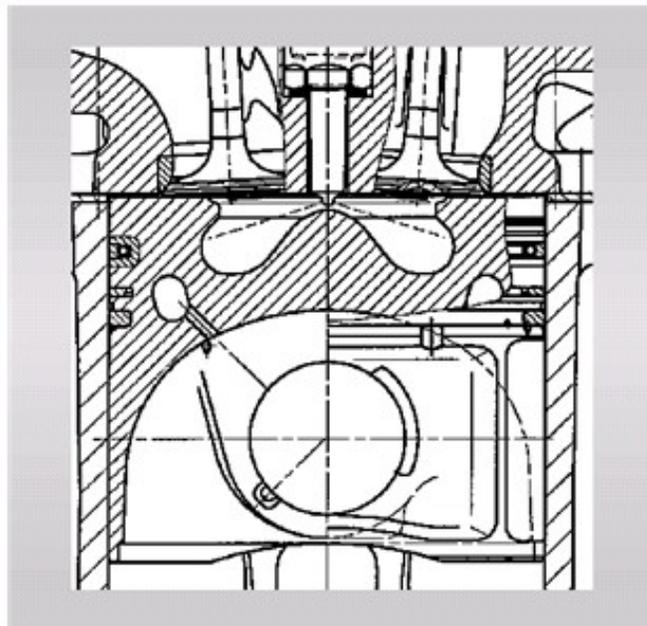


The piston forms the moving bottom wall of the combustion chamber. Its specially designed shape contributes to ensuring optimum combustion. The piston rings seal off the gap to the cylinder wall so as to ensure high compression and as little gas as possible enters the crankcase.

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The following features apply both to the M57 and M67:

- Cooling duct piston with rotationally symmetrical piston crown bowl specific to DI common rail
- The lobe in the piston crown bowl is higher than on the M47



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Fig. 23: Sectional view of combustion chamber

M67-specific features

- The pistons of cylinder bank 1 (1 - 4) and cylinder bank 2 (5 - 8) differ as the valve arrangement is not symmetrical (different valve pockets on piston); the pistons are identified accordingly

Chain drive



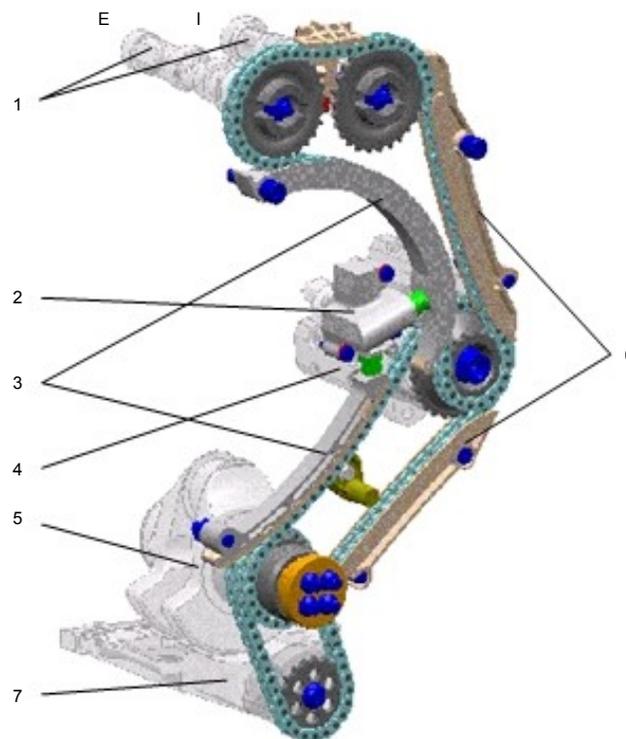
The rotary motion of the crankshaft is transferred to the camshaft via the chain drive. In this way it defines the interaction between the stroke motion of the piston and the movements of the valves.

The following features apply both to the M57 and M67:

- 2-piece chain drive
- Tensioning rail made from aluminium die casting with plastic slide lining
- Bushed roller chains

M57-specific features

- Chain drive 1: From crankshaft to common rail high pressure pump
- Chain drive 2: From common rail high pressure pump to camshafts
- Double-acting chain tensioner



- 1 - Camshaft
- 2 - Chain tensioner
- 3 - Tensioning rail
- 4 - Common rail high pressure pump
- 5 - Crankshaft
- 6 - Guide rail
- 7 - Oil pump

Fig. 24: Chain drive - M57:

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M67-specific features



- Chain drive 1: From crankshaft to inlet camshaft, bank 1 (cyls. 1 - 4)
- Chain drive 2: From crankshaft to inlet camshaft, bank 2 (cyls. 5 - 8)
- Drive of camshafts with respect to each other by means of spur-toothed gearwheels
- Common rail high pressure pump driven by gearwheels for engine speed adaptation of inlet camshaft, bank 2
- Two chain tensioners mounted in cylinder head from outside

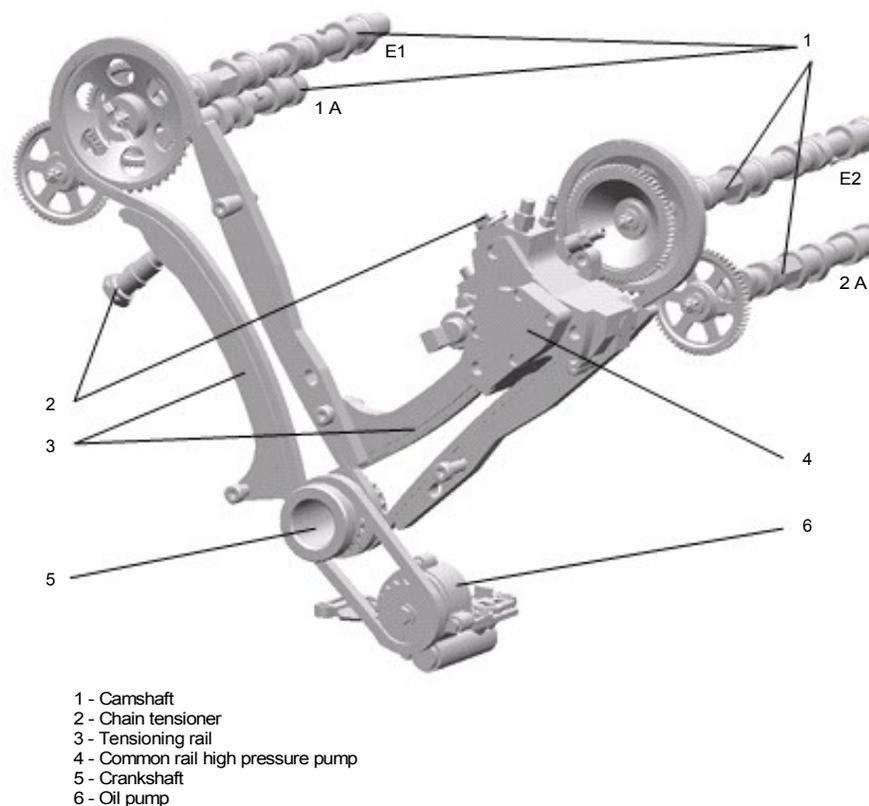


Fig. 25: Chain drive - M67:

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Oil pan

The oil pan represents the bottom end of the engine and serves as an oil collection reservoir. The position of the oil pan (sump) depends on the design of the front axle.



M57-specific features

- Aluminium die cast with integrated thermal oil level sensor
- Oil pan gasket designed as metal-backed gasket (same as on M47, common part E38 and E39)
- Return flow pipe (E38) so that oil from the oil separator can return to the oil sump below the oil level (blow-by gases)

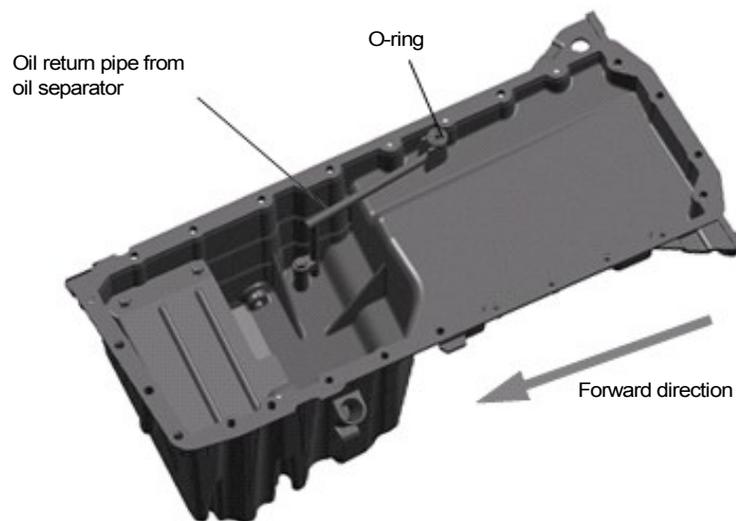
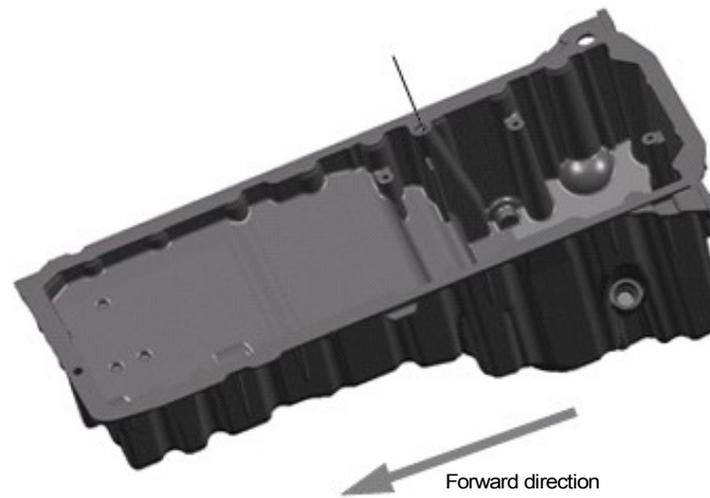


Fig. 26: Oil pan - M57 in E38

KT-3710

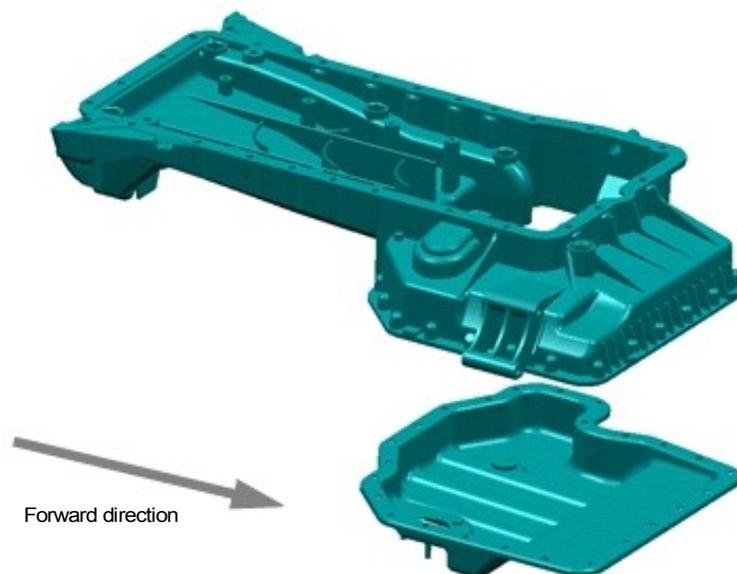


KT-3709

Fig. 27: Oil pan - M57 in E39

M67-specific features

- Two-piece casing
- Upper section made of pressure die cast aluminium with integrated thermal oil level sensor, sheet metal bottom section (common part with M62)
- Oil pan gasket designed as sheet metal backed gasket, gasket of bottom section of oil pan common part with M62



KT-3711

Fig. 28: Oil pan - M67 in E38

Timing case cover (M57)



On the M57 the timing case cover covers the chain drive in the area of the crankcase. On the M67 this cover is integrated in the crankcase.

- Aluminium die casting
- Sealed off from crankcase by means of sheet metal beaded gasket (replace gasket after disassembly)
- Unit and belt tensioner connection on cover

Rear end cover (M67)

The rear end cover houses the rotary shaft seal and seals off the rotating crankshaft from the outside.

- Aluminium die casting
- Sealed off from crankcase by means of sheet metal beaded gasket (replace gasket after disassembly)

Ancillary components and belt drive



Brief description

Various ancillary components are driven by the crankshaft of the engine with the aid of one or two drive belts.

The belt is routed over deflection pulleys in order to ensure sufficient hold (adhesion) about the drive wheels.

Tensioning rollers subject the belt to the necessary preload.

The ancillary components fulfil various tasks only when the engine is running.

Requirements and Objectives

The following requirements and objectives apply to the ancillary components and belt drive.

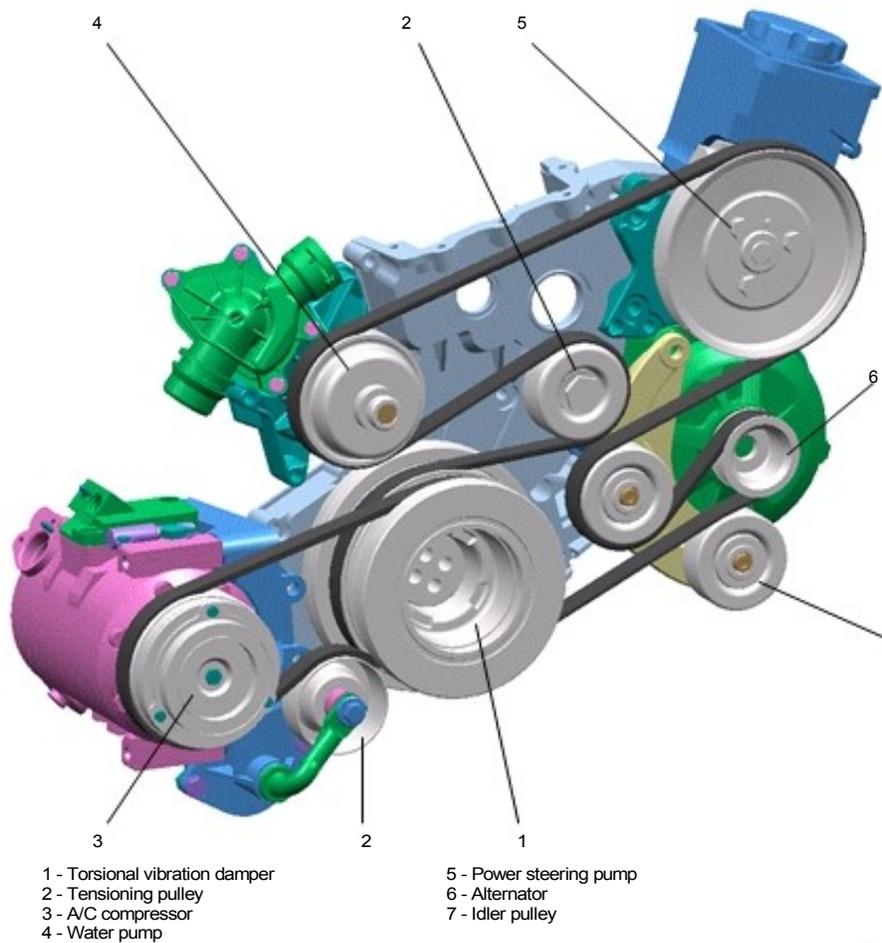
- Requirements
 - Slip-free drive of ancillary components
 - Maintenance-free
 - Optimum power output of ancillary components
- Objectives
 - Improvement of noise characteristics
 - Increase in charge levels in the lower speed range

System structure



The belt drive consists of following components:

- Torsional vibration damper
- Starter motor
- Alternator
- A/C compressor
- Belts
- Tensioning pulleys or one idler pulley



KT-3705

Fig. 29: Belt drive M57 E38/E39

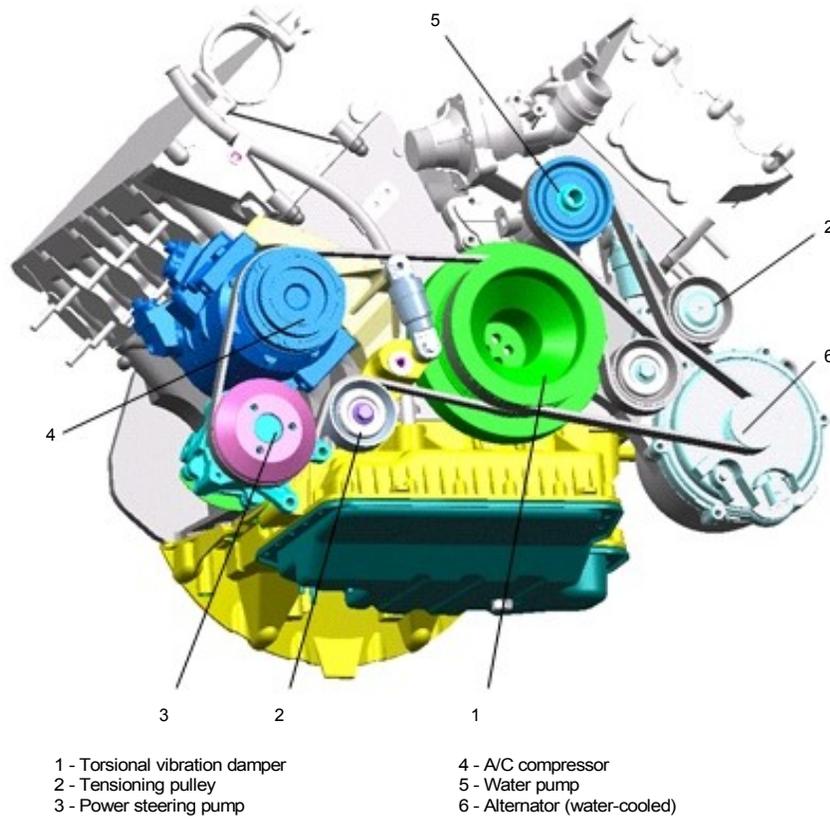


Fig. 30: Belt drive M67 E38

KT-3693

Component description

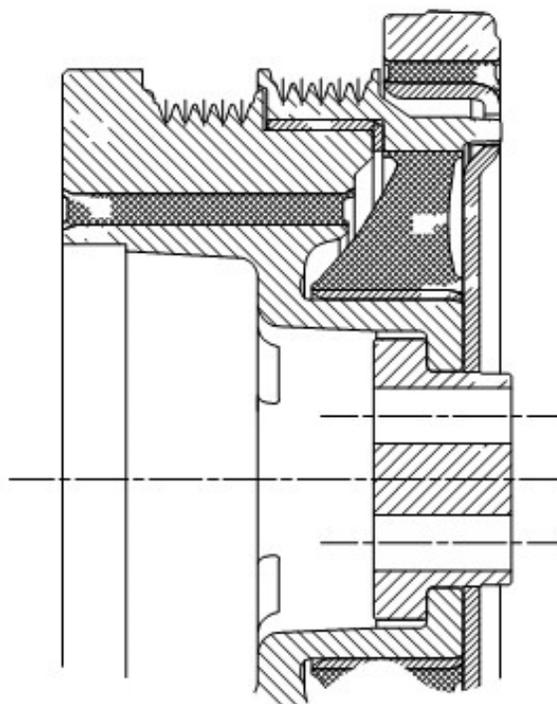


Torsional vibration damper

The M57 and M67 both feature an adaptive (engine-specific) vibration damper with decoupled belt pulley.

Torsional vibration damper M57 E38/E39

- Dual damper adapted specifically to type of engine
- 3 variants of vibration dampers
(integrated pulley for ancillary component drive)
- Mounting with 4 central bolts
(tightening torque 45 Nm)



KT-4316

Fig. 31: Torsional vibration damper M57

Vehicle	Part number
E39 manual gearbox (S5D 390Z)	2 247 886.1
E39 automatic gearbox (GM-5)	2 247 890.9
E38 automatic gearbox (5HP-24)	2 248 520.9

Torsional vibration damper M67 E38



- Torsional vibration damper with decoupled pulley
- Mounting with 4 central bolts
(tightening torque 45 Nm)

Starter motor

Starter M57 E38/E39

- Starter secured to gearbox casing
- Weight-optimised version

Starter M67 E38

- Starter mounted on engine block on cylinder bank 2 side
- Common part with M51
- Starter cable (separate power supply line for E-box)

Technical data:

	M57	M67	
Rated output	2.2		kW
Rated voltage	12		V
Test voltage	13–0.26 V		V

Alternator (also refer to TLF TA3 M51 TÜ)



Alternator M57 E38/E39 (as on M51)

- Basic compact alternator 95 A with start load response
- Special version 140 A alternator with load response

Alternator M67 E38

- Liquid-cooled compact alternator (as on M62)

A/C compressor

- Output-controlled A/C compressor
- Maintenance-free drive

Belts

Poly-V-belt drive M57 E38/E39

- Maintenance-free
- Automatic retensioning
(concept based on M47)
- Two belt levels
 - Rear: Water pump, power steering pump,
Alternator
 - Front: A/C compressor

Poly-V-belt drive M67

- Maintenance-free
- Self-retensioning
- Two belt levels
 - Rear: A/C compressor, power steering pump
 - Front: Alternator, water pump

Tensioning pulley or idler pulley



The tensioning pulley is designed as a spring-loaded element, thus rendering the hydraulic connection (M47) unnecessary.

The idler pulley arranged on the alternator ensures the belt drive runs more smoothly.

Engine mounts



Brief description

The engine mount principle used on the M57 and M67 engines is basically the same as from the M51TÜ. The damping characteristics of the hydraulic mount are set softer or harder by means of a vacuum. In this way, the vibration transmitted from the engine to the body can be influenced specifically.

Requirements and Objectives

The following requirements and objectives apply to the engine mounts:

- Requirements
 - Various damping characteristics of the mounts
 - Simple design
 - Rapid response characteristics

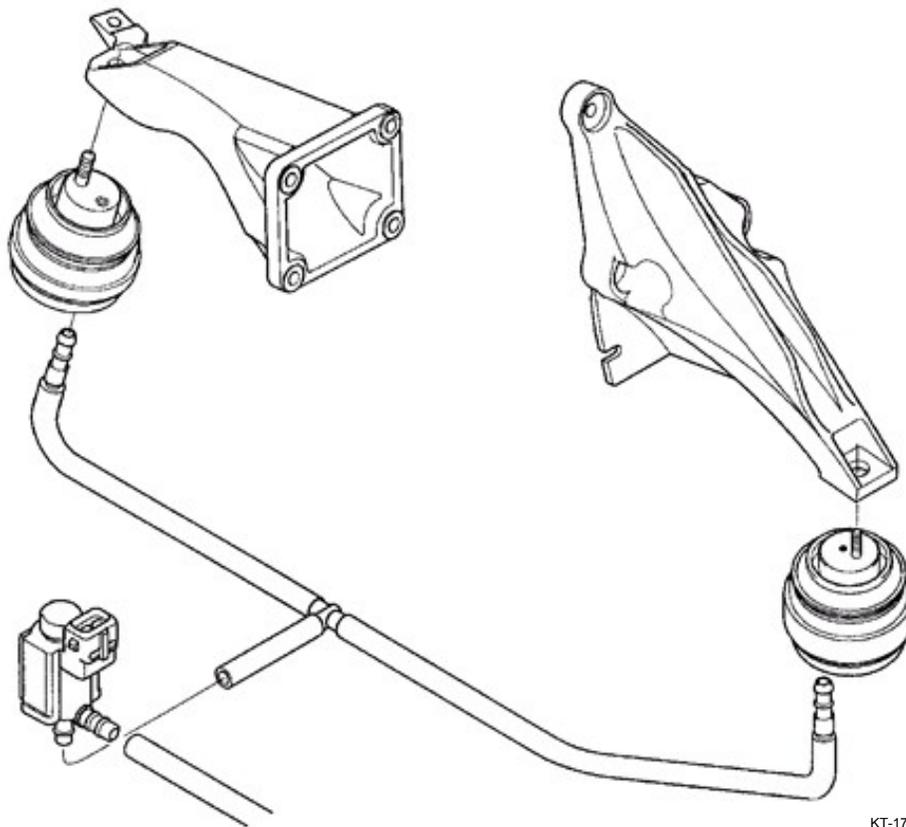
- Objectives
 - Comfort at idle speed
 - Isolation of engine vibration
 - Specific reduction in natural resonance of engine caused by uneven road surfaces and shut-down judder.

System structure



The system consists of:

- Two hydraulic mounts with controlled damping characteristics
- One electric changeover valve
- The control unit (DDE)
- Various electrical and pneumatic lines



KT-172

Fig. 32: System layout

Component description



Hydraulic mount

The damping-controlled hydraulic mount consists of:

- One conventional hydraulic mount
- One control unit

The hydraulic mount with controlled damping characteristics operates by way of vacuum.

In the basic setting, no vacuum is applied to the hydraulic mount. Bypass (14) is closed. This is achieved by means of spring (10) pressing a rubber diaphragm against the sealing surface of the nozzle plate.

The hydraulic fluid can only flow back and forth via an annular duct (5) between the upper (17) and lower (15) chamber. The mount acts as a conventional hydraulic mount. The damping characteristics are hard.

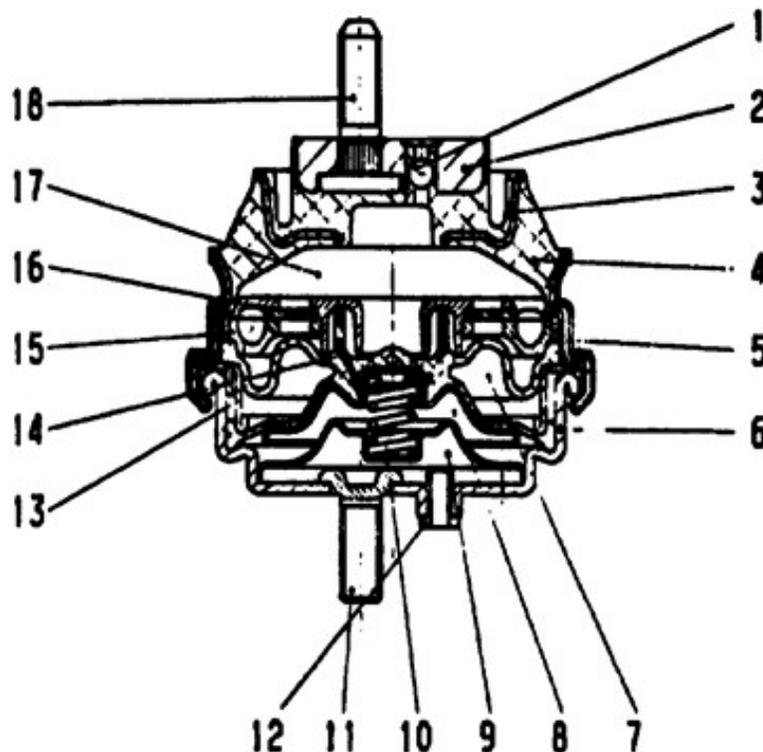


Fig. 33: Damping-controlled engine mount

KT-173

The force exerted by the spring is reduced by applying vacuum to the control unit of the mount (12) so that a bypass now opens permanently. The hydraulic fluid can now flow back and forth via larger cross section between the two chambers. The damping characteristics of the mount are now softer.

a



The damping-controlled engine mount is designed to suit specific types of engine:

M57:

Pin/pin mount

The left and right mounts differ due to the asymmetrical arrangement of the engine mounts. (Spring rate: left 180 N/mm / right 220 N/mm)

M67:

Pin/flange mount

The left and right mounts are inversely symmetrical due to the symmetrical arrangement of the engine mounts. (Spring rate: 350 N/mm)

The left mount features a stop bowl in order to restrict engine movement when taking up torque.



Functional description



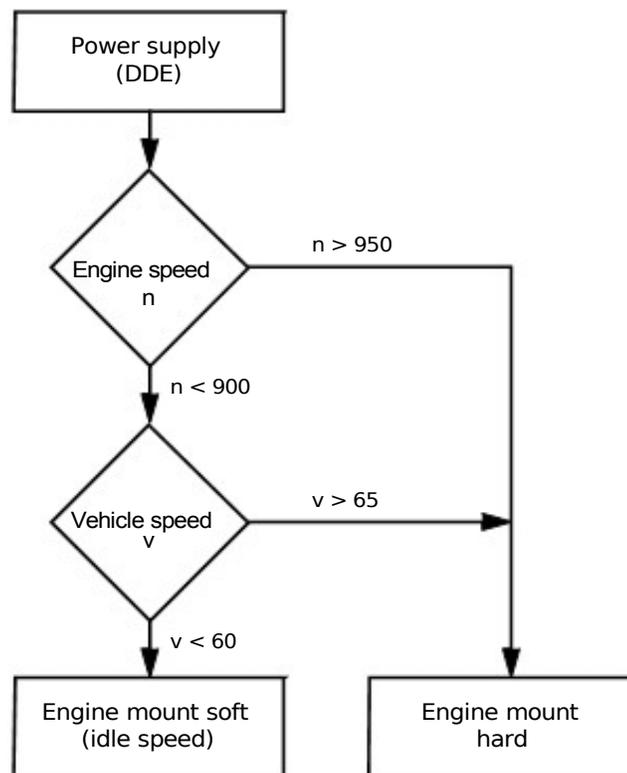
The vacuum necessary to activate the mounts is taken from a distributor in the vacuum line between the vacuum pump and brake booster.

Vacuum is applied simultaneously to both mounts when idling and in the speed range close to idling. As a result, it is possible to change over between hard or soft damping characteristics.

DDE parameters

Activation of the damping-controlled hydraulic mounts by the DDE is based on the following parameters:

	Switching value	Remarks
Engine speed	900 rpm	Hysteresis (+ 50 rpm)
Vehicle speed	60 km/h	Hysteresis (+ 5 km/h)



KT-210

Fig. 34: Sequence diagram/activation, damping-controlled hydraulic mount

Vacuum supply



The necessary volumetric flow is taken from the vacuum line between the vacuum pump and brake booster. For this purpose, the vacuum line of the damping-controlled hydraulic mount is connected to the long outlet of the distributor. The connection for the damping-controlled hydraulic mount is calibrated larger ($\varnothing 0.8$) than the connections for the VNT and EGR ($\varnothing 0.5$).

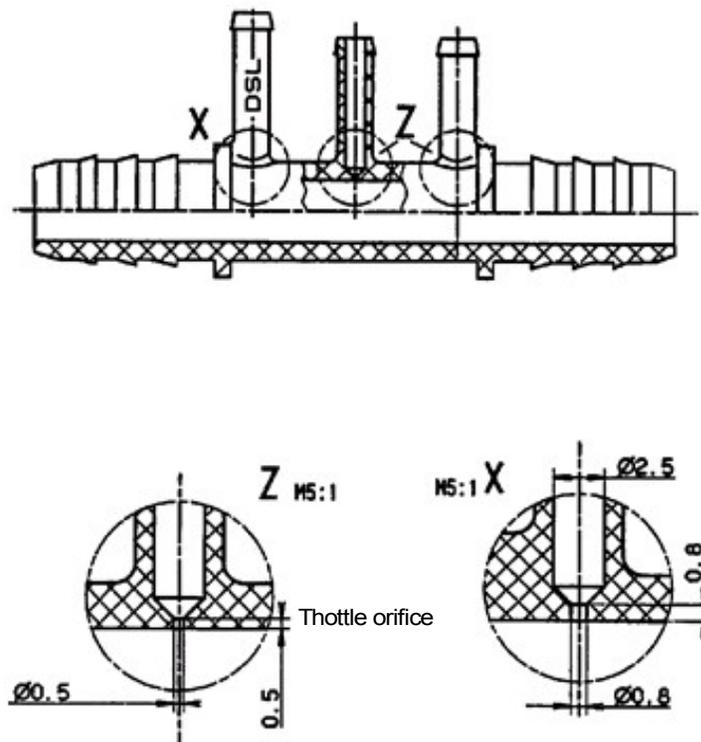


Fig. 35: Distributor

KT-174

The vacuum is within the pressure range from 0.5 to 0.9 bar. It is switched by means of an electric changeover valve.

The vacuum hose between the vacuum line and the electric valve is arranged such that the possibility of rodent damage etc. is excluded with a high degree of probability.

Lubrication system



Brief description

The lubrication system of the M57 corresponds to that of the M47. Geometric adaptations and optimisation measures have been implemented.

Requirements and Objectives

The lubrication system must meet the following requirements and objectives:

- Requirements
 - To lubricate sliding surfaces in the engine
 - To dissipate heat
 - To absorb combustion residue of the fuel
 - To seal off gap between cylinder and piston

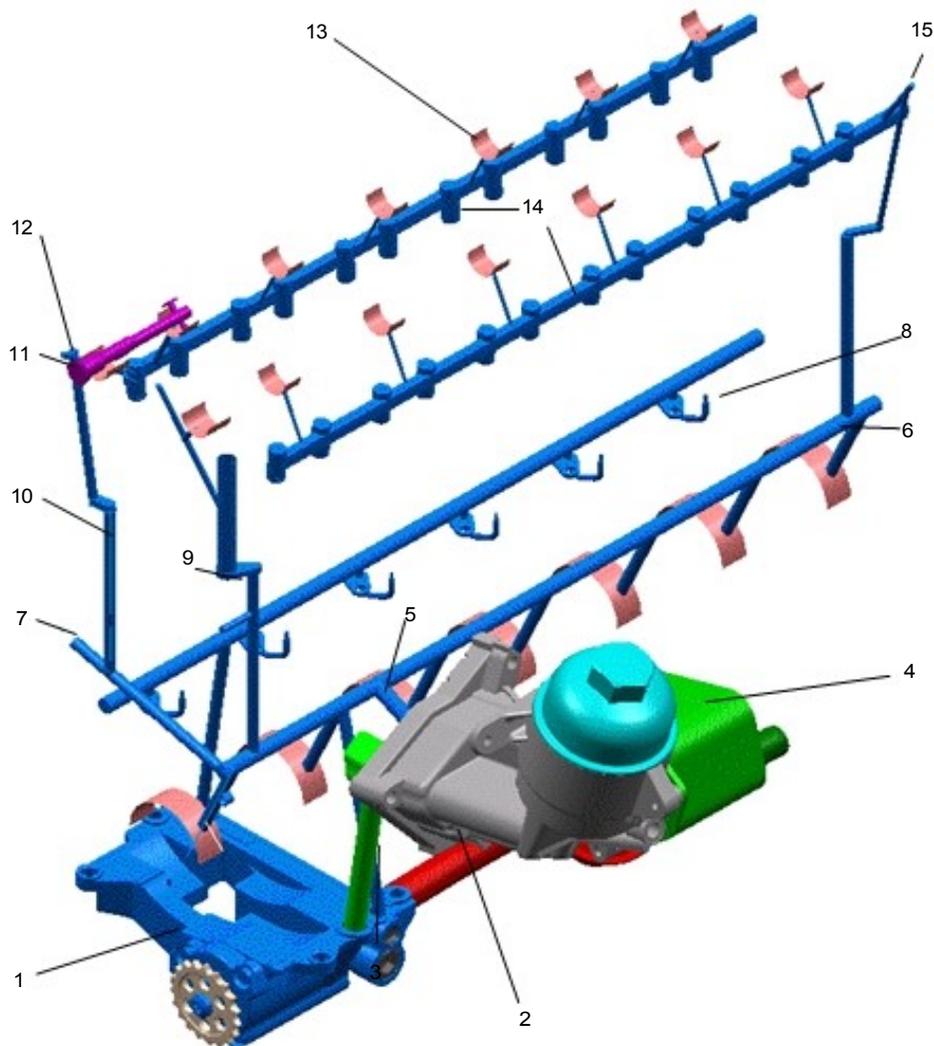
- Objectives
 - To lower oil consumption
 - To increase engine performance
 - To minimise engine wear

System structure



The lubrication system consists of following components:

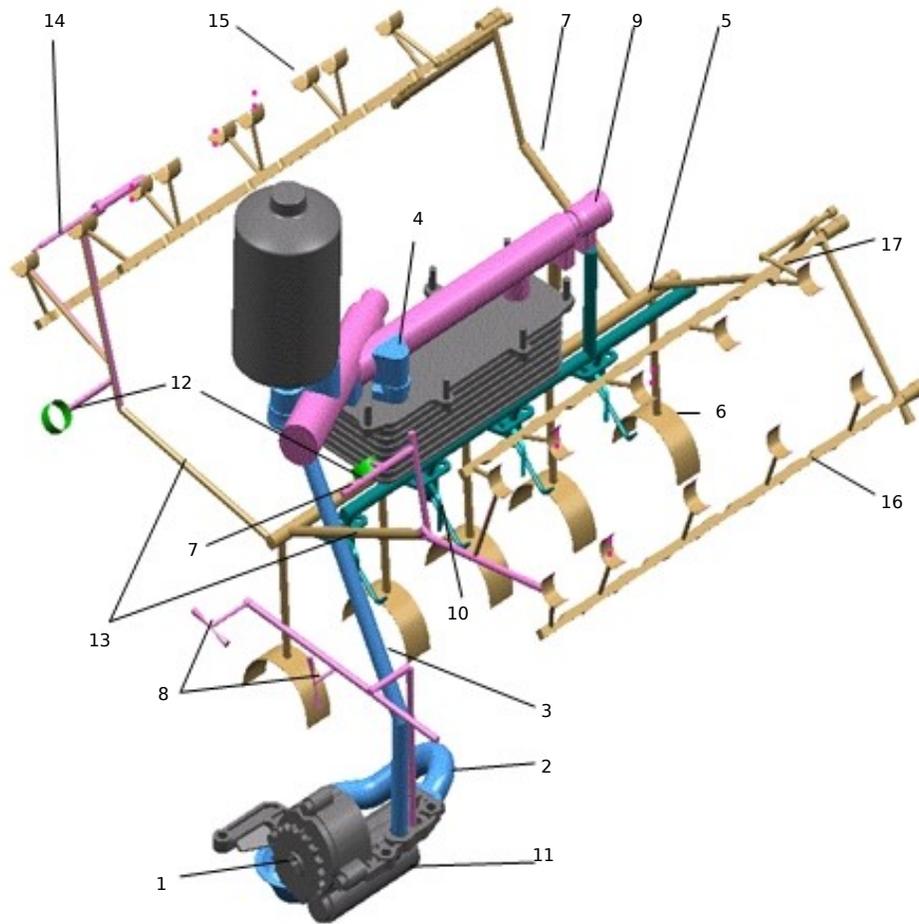
- Oil pan with dipstick (see engine components)
- Oil pump
- Oil filter with integrated oil-to-water heat exchanger
- Oil spray nozzles



- | | |
|---|--|
| 1 - Oil pump | 9 - Pressure supply to chain tensioner |
| 2 - Oil intake pipe | 10 - Riser to cylinder head |
| 3 - Unfiltered oil duct before filter | 11 - Pressure supply to vacuum pump |
| 4 - Oil filter with oil cooler | 12 - Pressure supply for upper chain lubrication |
| 5 - Precision oil gallery after filter (main oil gallery) | 13 - Camshaft bearing |
| 6 - Crankshaft main bearing | 14 - Hydraulic valve lash adjuster gallery (HVA) |
| 7 - Pressure supply to exhaust turbocharger | 15 - Runout stop, HVA gallery |
| 8 - Piston spray nozzle (hook-type nozzle) | |

KT-3847

Fig. 36: Lubrication system overview M57 E38/E39



- | | |
|--|--|
| 1 - Oil pump | 10 - Piston spray nozzle |
| 2 - Oil intake pipe | 11 - Oil pressure control valve |
| 3 - Unfiltered oil duct before filter | 12 - Delivery to chain tensioner |
| 4 - Oil filter with oil cooler | 13 - Riser gallery into cylinder head |
| 5 - Fine oil gallery after filter (main oil gallery) | 14 - Delivery to vacuum pump |
| 6 - Crankshaft main bearing | 15 - Camshaft bearing |
| 7 - Delivery to exhaust turbocharger | 16 - Hydraulic valve lash adjuster gallery (HVA) |
| 8 - Delivery for chain lubrication | 17 - Leak protection HVA gallery |
| 9 - Pressure control valve, piston spray nozzle | |

KT-3848

Fig. 37: Lubrication system overview M67 E38

Component description



Oil pump

Oil pump M57 E38/E39

- Oil pump arranged in oil pan
- Chain drive

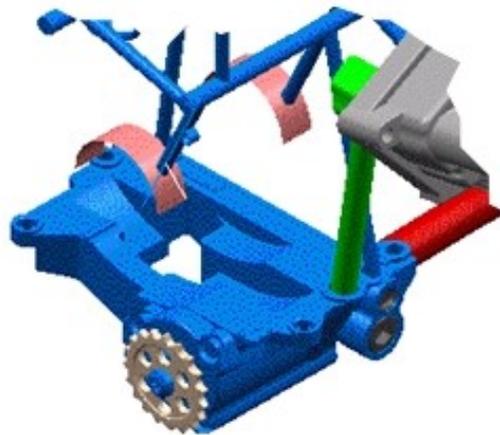
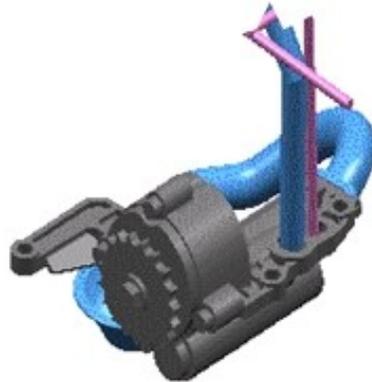


Fig. 38: Oil pump M57

KT-3847

Oil pump M67 E38

- Duocentric pump
- Arranged at bottom of engine block
- Chain drive
- Intake snorkel in oil pan



KT-3848

Fig. 39: Oil pump M67

Technical data

	M57	M67	
Delivery capacity		85	l/min
Opening pressure of cutout valve		4.2-0.2	bar

Oil filter with integrated oil-to-water heat exchanger

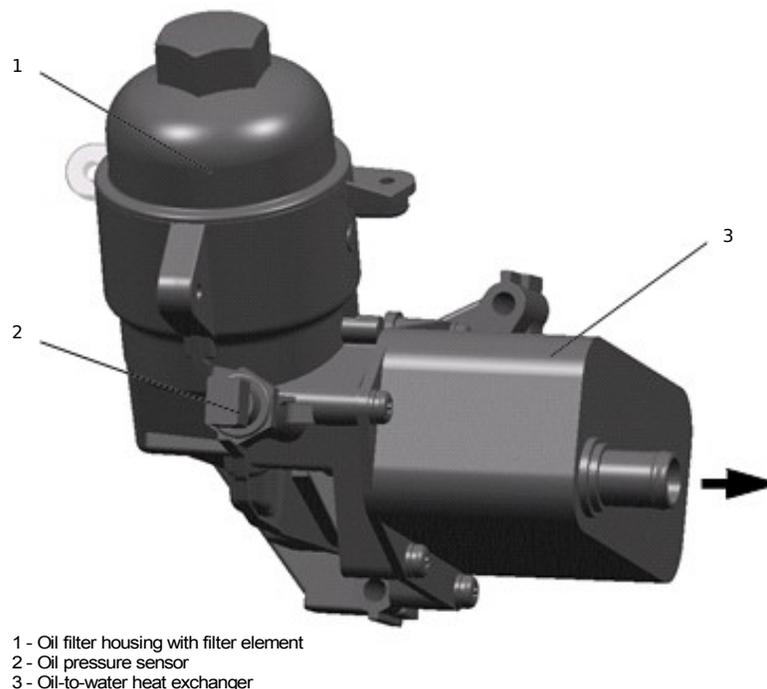


The oil-to-water heat exchanger is connected to both the oil circuit as well as the water circuit of the engine. This arrangement ensures the engine oil is heated faster by the coolant when the engine is cold and is effectively cooled by the coolant when the engine is at operating temperature.

Shortening the warm-up phase greatly contributes to reducing fuel consumption.

Oil filter with oil-to-water heat exchanger M57 E38/E39

- Mounted directly on the engine block
- The water for the oil-to-water heat exchanger is supplied directly from the engine block (crankcase)
- In the same way as on the M47, the water outlet is located on the oil-to-water heat exchanger



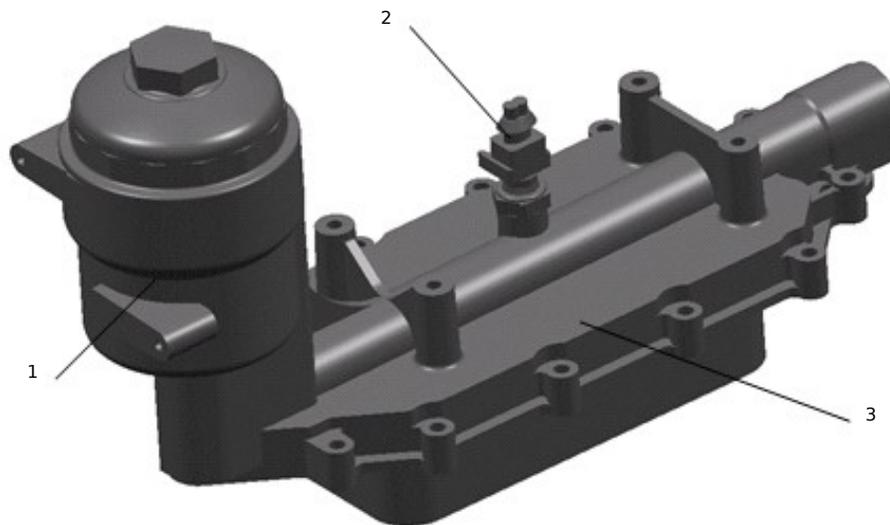
KT-3675

Fig. 40: Oil module M57 E38/E39 (with oil-to-water heat exchanger)

Oil filter with oil-to-water heat exchanger M67 E38



- Mounted directly in V-area of cylinder block
- Oil-to-water heat exchanger located in water bath of V-area



- 1 - Oil filter housing with filter element
2 - Oil pressure sensor
3 - Oil-to-water heat exchanger

KT-3676

Fig. 41: Oil module M67 E38 (with oil-to-water heat exchanger)

Oil spray nozzles

The oil spray nozzles for cooling the piston crown are mounted in the engine block. They are designed as hook-type nozzles.



KT-3847

Fig. 42: Oil spray nozzles

Cooling system



Brief description

The coolant circuit is designed to provide long-term protection against frost and corrosion. The design of the M57 is identical to that of the M51 and in the M67 to that of the M62.

The cooling system has been adapted to the new requirements concerning the cooling capacity and the modified environment (common rail, injection system).

Requirements and Objectives

The following requirements and objectives apply to the cooling system:

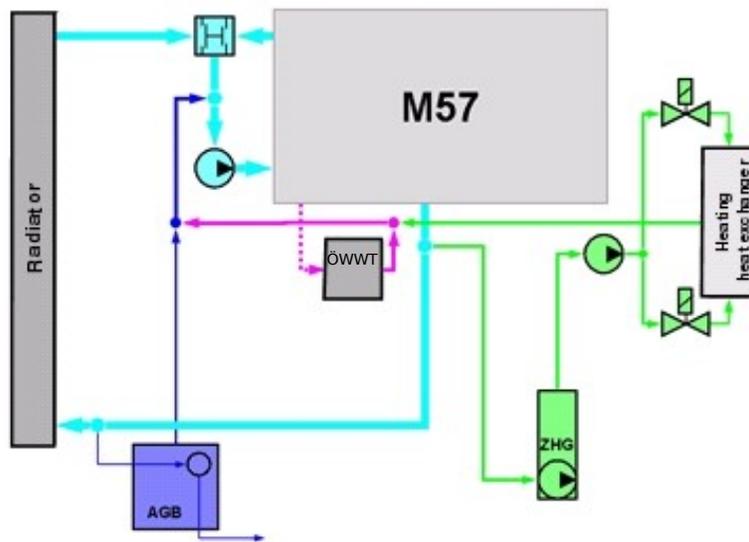
- Requirements
 - Adaptation to injection system (common rail)
 - Simple design (same concept as M51 and M62)
 - All connection points for water-carrying hoses designed as plug-in connections as on the M47
 - Further reduction of emissions and fuel consumption
- Objectives
 - Provision of optimum cooling capacity under all operating conditions
 - Easy-to-service layout

System structure



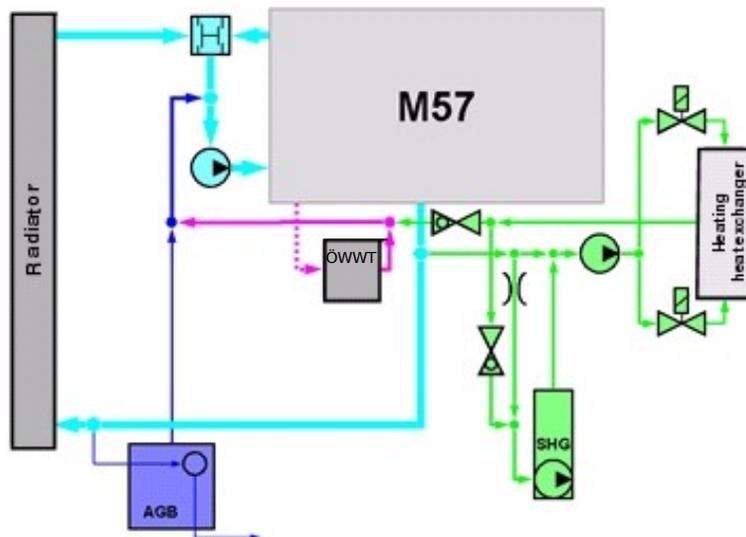
The cooling system consists of following components:

- Water pump
- Thermostat
- Radiator
- Fan/shroud
- Auxiliary heater
- Independent park heating option



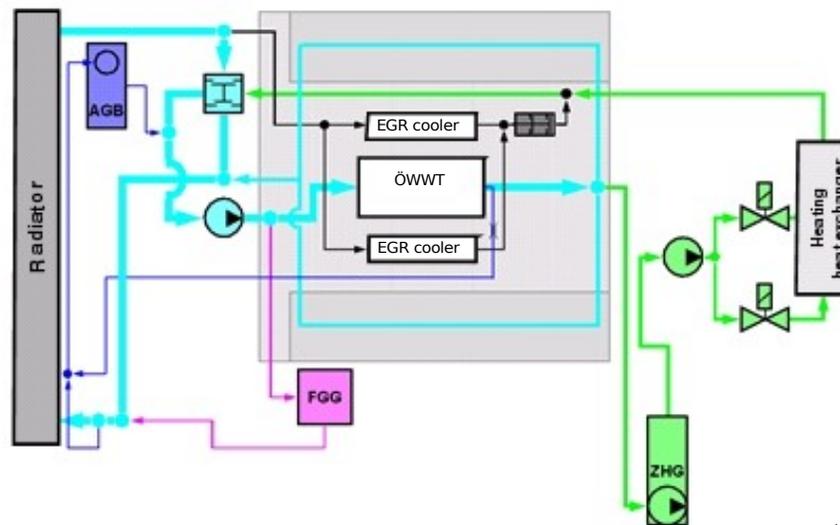
KT-3867

Fig. 43: M57 - Coolant circuit with auxiliary heater



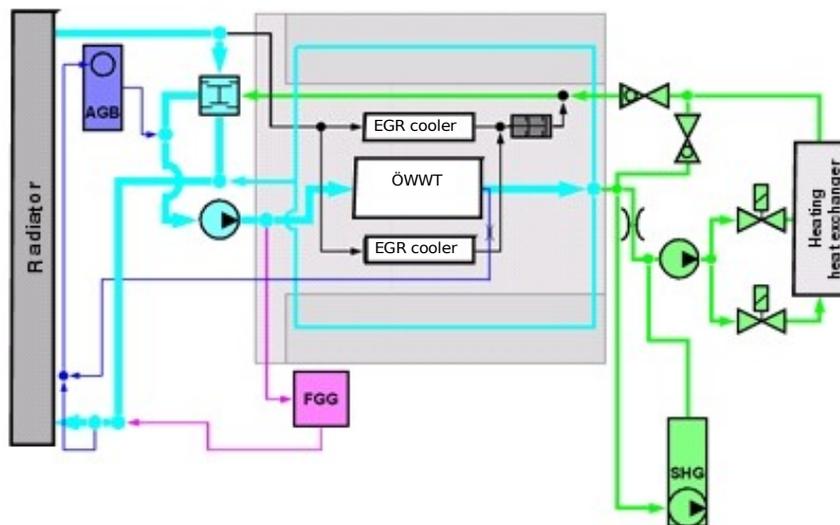
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Fig. 44: M57 - Coolant circuit with independent park heating option



KT-3869

Fig. 45: M67 - Coolant circuit with auxiliary heater



KT-3870

Fig. 46: M67 - Coolant circuit with independent park heating option

The various coolant circuits can be subdivided into several part circuits:

- Engine
- Heating
- Expansion tank
- Engine oil cooler (M57 only)
- Alternator (M67 only)
- EGR cooler (M67 only)

Component description



Water pump

The water pumps for the M57 and M67 are arranged on the end face of the crankcase.

- Thermostat integrated in water pump housing
- Leakage is directed through drainage tubes into the pulley



KT-3880

Fig. 47: Water pump - M57

Thermostat

The following features apply both to the M57 and M67:

- Thermostat integrated in water pump housing
- Opening temperature 88 °C
- No characteristic map cooling, i.e. no characteristic map thermostat

The thermostat is correspondingly adapted to the M57 and M67. The thermostat on the M67 is a common part with the M62.

Radiator

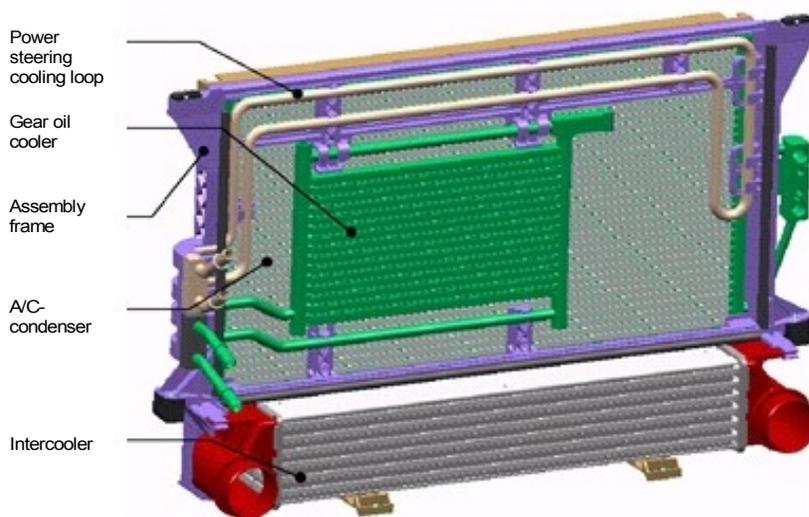


The cooling concept of the M47 has been adapted and further developed for this engine.

The gear oil cooler is integrated in the cooling assembly. The capacity of the intercooler has been adapted to the increased volume and is integrated in the centre of the cooling assembly.

The coolant change interval is every 4 years. When changing, the different filling capacities should be borne in mind:

- M57 E38/E39 approx. 9.2 litre
- M67 E38 approx. 16.0 litre



KT-3865

Fig. 48: Arrangement of cooling assembly - rear view M57 E39/E38

M57-specific features

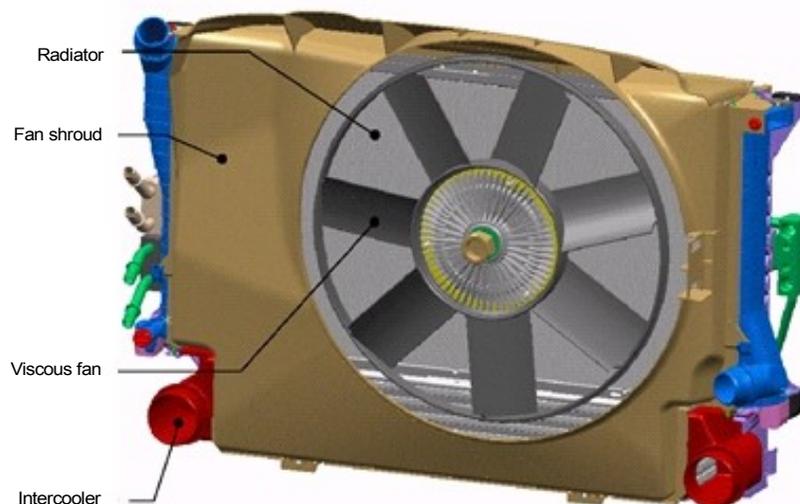
- The AUC sensor is located below the centre of the fan shroud.
- The expansion tank is mounted behind the headlights



Vehicle-specific fan shrouds with different apertures are installed in the E39 and E38. This is necessary due to the fan displacement by approx. 20 mm. The fan will be damaged if interchanged.

For differentiation purposes, an identification code is cast in the top inside of the fan shroud:

- E39M57 Identification code "A"
- E38M57 Identification code "B"



KT-3864

Fig. 49: Arrangement of cooling assembly - rear view M57

M67-specific features

- Expansion tank integrated in fan shroud
- 5 back-up flaps integrated in fan shroud
- The AUC sensor located above the centre of the fan shroud.
- Brush seal installed in cutout of fan shroud to improve uphill driving cooling properties

In the E38, the water level (level switch) for the expansion tank is indicated as standard in the instrument cluster.

Exhaust hood/shutter

No radiator shutters are currently installed in the M57 and M67.



Fan

The M57 and M67 feature a 7-blade plastic fan driven by a viscous clutch. Compared to an electric fan, the viscous fan provides better cooling capacity.

In addition to the viscous fan, an electric fan that is activated by the DDE is arranged in front of the radiator assembly.

Auxiliary heater

An auxiliary heater with connection to the heating circuit is installed as standard in the M57 E38/E39 and in the M67 E38 (as on the M47). It is installed instead of the independent park heating in the vehicle.

The separate auxiliary heater is dropped if the independent park heating option is installed. The independent park heating then assumes the function of the auxiliary heater.