

Reference Manual



S58 ENGINE



Technical Training

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Technical training.
Product information.

S58 Engine



BMW Service

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General information

Symbols used

The following symbol is used in this document to facilitate better comprehension or to draw attention to very important information:



Contains important safety information and information that needs to be observed strictly in order to guarantee the smooth operation of the system.

Information status: February 2019

BMW Group vehicles meet the requirements of the highest safety and quality standards. Changes in requirements for environmental protection, customer benefits and design render necessary continuous development of systems and components. Consequently, there may be discrepancies between the contents of this document and the vehicles available in the training course.

The information contained in the training course materials is solely intended for participants in this training course conducted by BMW Group Technical Training Centers, or BMW Group Contract Training Facilities.

This training manual or any attached publication is not intended to be a complete and all inclusive source for repair and maintenance data. It is only part of a training information system designed to assure that uniform procedures and information are presented to all participants.

For changes/additions to the technical data, repair procedures, please refer to the current information issued by BMW of North America, LLC, Technical Service Department.

This information is available by accessing TIS at www.bmwcenternet.com.

Additional sources of information

Further information on the individual topics can be found in the following:

- Owner's Handbook
- Integrated Service Technical Application
- Aftersales Information Research (AIR)

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S58 Engine

1. Introduction

1.1. Highlights

The S58 engine is the successor to the S55 engine. Like the S55 engine in the BMW M4 and BMW M2 Competition, the S58 engine is based on a BMW AG standard production engine. The S58 engine is based on the B58TU engine, as the engine identification highlights.

Technical updates and modifications of M GmbH make the engine suitable for motor racing.

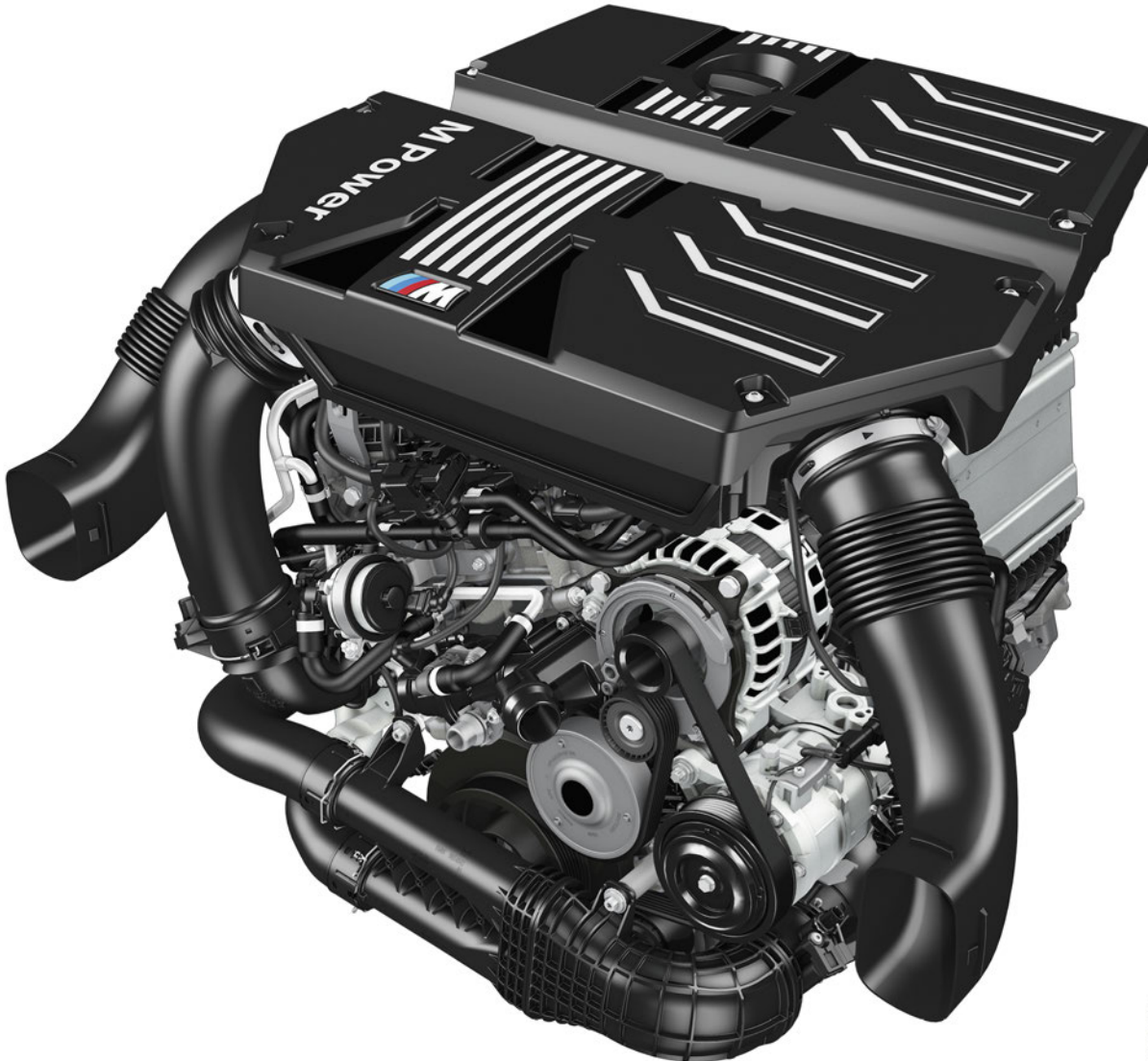
With its turbocharged, high-revving design, the new M engine delivers impressive and undreamt-of power development with a nominal output of 353 kW/480 hp compared with the 317 kW/431 hp of its predecessor. The maximum torque, an indicator of the power delivery and performance perceived by the driver, has risen from 550 Nm to 600 Nm. This has been achieved despite the fact that fuel consumption and CO₂ emissions have been reduced with the aid of the BMW EfficientDynamics measures.

As the S58 engine is based on the B58TU engine, it has been possible to carry over a number of engine components from the B58TU standard production engine. The other 90% of the engine components are new developments or synergy parts with the B58TU engine. All the technical data is above that of the predecessor.

S58 Engine

1. Introduction

1.1.1. Technical data



T018-1635

S58 engine, overall view

Model	Unit	F80/F82***	F97/F98
Engine		S55B30T0	S58B30T0
Design		R6	R6
Displacement	[cc]	2979	2993
Bore hole/Stroke	[mm]	84.0/89.6	84.0/90.0
Power at engine speed	[kW/hp] [rpm]	317/425 5550-7300	353/473 6250 375/503**** 6250****

S58 Engine

1. Introduction

Model	Unit	F80/F82***	F97/F98
Power output per liter	[kW/l]	106.4	117,9 125.3****
Torque at speed	[Nm/lb-ft] [rpm]	550/406 1850-5500	600/442 2600-5600 2600-5950****
Compression ratio	[ε]	10.2 : 1	9.3 : 1
Oil quantity	[l]	6.5	7
Digital Motor Electronics		MEVD17.2.G	DME 8.6.S
Exhaust emissions legislation		ULEV 70	ULEV 70
Acceleration 0-100 km/h	[s]	4.3 4.1***	4.2 4.1****

* Electronically limited.

** With M Driver's Package (SA 7ME).

*** With M double-clutch transmission with Drivelogic .

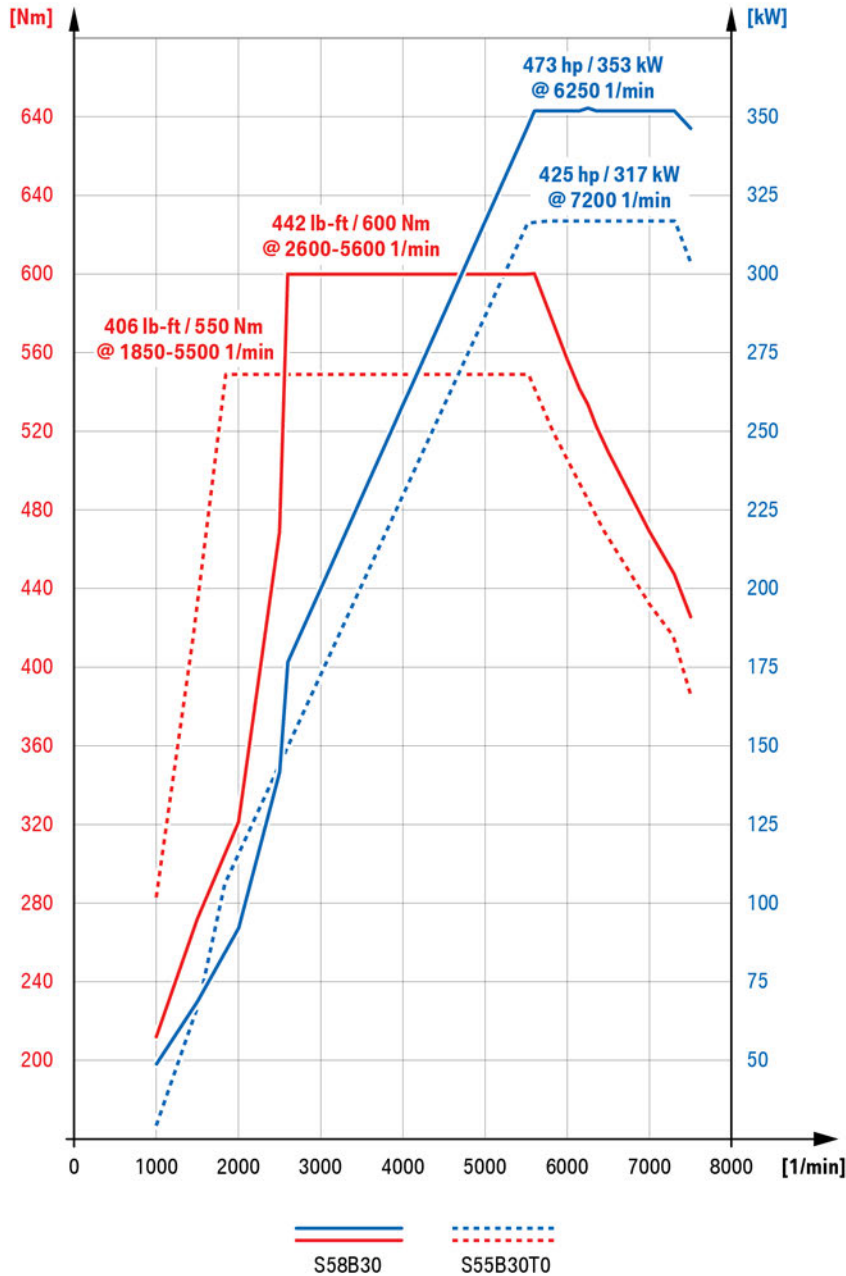
**** With Competition package (SA 7MN/7MA).

S58 Engine

1. Introduction

1.1.2. Full load diagram

In comparison with the predecessor, the S58 engine features lower fuel consumption with higher power and torque data.



Full load diagram for F82 with S55 engine compared with F97/F98 with S58 engine

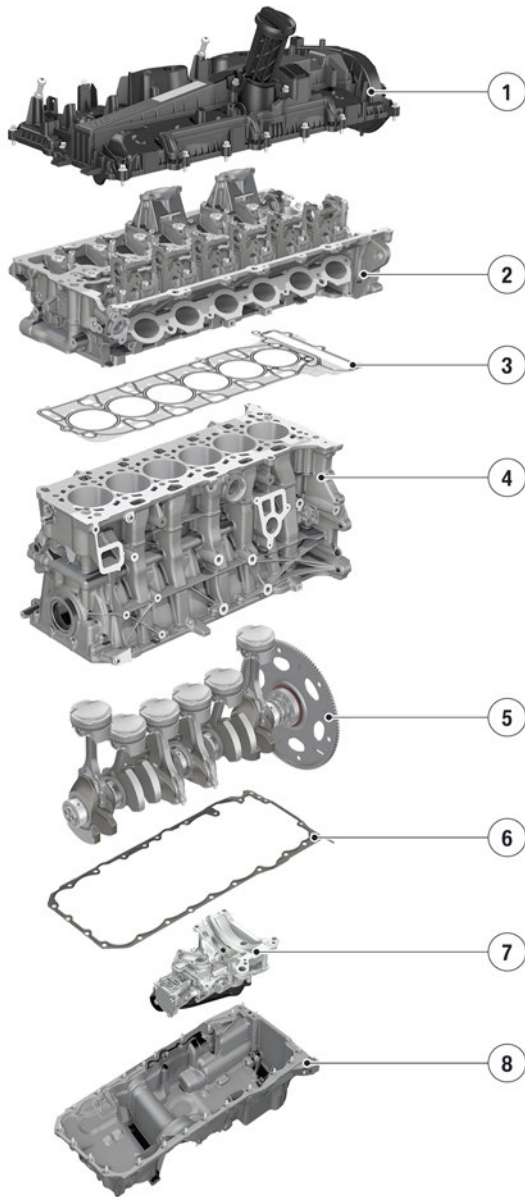
T018-1636_2

S58 Engine

1. Introduction

1.2. B58/S58 new features/changes

1.2.1. Overview



T018-1637

S58 engine, exploded diagram

Index	Explanation
1	Cylinder head cover
2	Cylinder head
3	Cylinder head gasket
4	Crankcase

S58 Engine

1. Introduction

Index	Explanation
5	Crankshaft drive
6	Sump gasket
7	Oil supply
8	Oil sump

1.2.2. Comparison of S58 engine and B58TU engine

Engine mechanics

Component	New ¹	Same ²	Comment
Cylinder head cover	●		Adapted to two high pressure pumps Adapted crankcase ventilation
Cylinder head	●		Mounting for the two high pressure pumps B58 split-cooling concept discontinued Water chamber cross-sections enlarged Crankcase ventilation gas ducting
Cylinder head gasket	●		Revised cylinder head gasket due to higher combustion pressure of S58 engine
Crankcase	●		Adapted for bi-turbo No attachment for heat management module Additional oil ducts for switchable piston cooling Additional oil ducts
Crankshaft with bearings	●		Stroke increased to 90 mm Adaptation to the high-speed concept of main bearings and crankshaft
Connecting rod	●		Connecting rod bore hole in small connecting rod eye Lead-free connecting rod bearing shells Adopted from S63B44T4 engine

S58 Engine

1. Introduction

Component	New ¹	Same ²	Comment
Piston and wrist pin	●		Adaptation of the piston and wrist pin to high-speed concept Coated wrist pin Diamond-Like Carbon (DLC)
Chain drive		●	Concept carried over from B58TU engine Timing chain adapted to S58 engine Guide rail adapted to the S58 engine
¹ New design ² Identical concept			

Valve gear

Component	New ¹	Same ²	Comment
Camshafts	●		Exhaust camshaft with twin triple cams for the driving the high pressure pumps.
Intake valves		●	Material change
VANOS		●	Adjusters shorter and more compact design Modified camshaft sprockets due to adapted timing chain
Fully variable valve lift adjustment		●	Optimization of work curve for the valve opening, adaptation to high-speed concept Intermediate lever adapted
¹ New design ² Identical concept			

Belt drive and ancillary components

Component	New ¹	Same ²	Comment
Belt drive		●	Vibration damper for adaptation to high-speed concept Additional belt roll between belt wheel crankshaft and air conditioning compressor
¹ New design ² Identical concept			

S58 Engine

1. Introduction

Oil supply

Component	New ¹	Same ²	Comment
Oil supply	●		Additional oil sump lid Oil pump designed as spur-gear pump Additional oil return pumps Additional oil extraction, exhaust turbocharger Centrally switchable piston cooling

¹New design

²Identical concept

Air intake and exhaust emission system

Component	New ¹	Same ²	Comment
Exhaust turbocharger	●		Bi-exhaust turbocharger with electrical wastegate valve Mono-scroll concept
Air intake duct	●		New air intake duct for use of indirect charge air cooling New clean air ducts Modified intake silencer in engine cover
Exhaust system	●		Optimized for minimal exhaust gas pressure Electrical exhaust flaps Active Sound Design (ASD) in the passenger compartment Sports exhaust system as optional equipment

¹New design

²Identical concept

Vacuum system

Component	New ¹	Same ²	Comment
Vacuum pump	●		Single-stage vacuum pump Integrated in oil pump

¹New design

²Identical concept

S58 Engine

1. Introduction

Fuel preparation

Component	New ¹	Same ²	Comment
Injectors		●	Solenoid injectors Injectors for CVO support
High pressure pump	●		Double high pressure pump
¹ New design ² Identical concept			

Cooling

Component	New ¹	Same ²	Comment
High-temperature circuit for engine cooling	●		Revised for high-performance operation without power restriction New mechanical coolant pump (higher delivery rate and delivery head) Additional electric coolant pump for exhaust turbocharger Cooling throttle body Split cooling discontinued Heat management module dispensed with Data-map thermostat
Low-temperature circuit for charge air cooling	●		Indirect charge air cooling with two heat exchangers Own coolant circuit Electric coolant pump
¹ New design ² Identical concept			

Engine electrical system

Component	New ¹	Same ²	Comment
Digital Motor Electronics (DME)		●	DME 8.6.S
Spark plugs	●		Air spark plug, new part S58 engine
¹ New design ² Identical concept			

S58 Engine

2. Engine History

2.1. Variants of the BMW 6-cylinder M engines

Engine	Version	Series	Displacement in cm ³	Stroke/ Bore hole in mm	Power in kW/HP at RPM	Torque in Nm/lb-ft at RPM
S52B30	US	E36	2990	85.8/86.06	177/240 6000	305 4250
S52B32	US	E36	3152	89.6/86.4	177/240 6000	320 3800
S54B32	US	E46	3246	91.0/87.0	248/338 7900	355 4900
S55B30	US	F80 F82 F83	2979	89.6/84.0	317/425 5500-7300	550/406 1850-5500
S55B30	US	F87	2979	89.6/84.0	302/405 5230-7000	550/406 2350-5230

S58 Engine

3. Engine Identification

3.1. Engine designation and engine identification

3.1.1. Engine designation

In the technical documentation, the engine designation is used to ensure unambiguous identification of the engine.

The technical documentation also contains the short form of the engine designation S58, which only indicates the engine type.

Position	Meaning	Index/Explanation
1	Engine developer	M, N = BMW Group P = BMW M Sport S = BMW M GmbH W = External developer
2	Engine type	1 = R4 (e.g. N12) 4 = R4 (e.g. N43) 5 = R6 (e.g. N53) 6 = V8 (e.g. N63) 7 = V12 (e.g. N73) 8 = V10 (e.g. S85)
3	Change to the basic engine concept	0 = Basic design 1 to 9 = Modifications, e.g. to combustion process
4	Working method or fuel type and possibly installation position	B = Petrol, longitudinal installation D = Diesel, longitudinal installation H = Hydrogen
5	Displacement in liters	1 = 1 liter +
6	Displacement in 1/10 liter	8 = 0.8 liters = 1.8 liters
7	Performance class	K= Lowest U= Lower M = Medium O = Upper (standard) T = Top S= Super
8	Redesign relevant to approval	0 = New design 1–9 = Revision

S58 Engine

3. Engine Identification

Breakdown of the S58 engine designation

Index	Explanation
S	BMW M GmbH development
5	6-cylinder in-line engine
8	Petrol engine with Turbo-Valvetronic direct injection (TVDI)
B	Petrol engine, longitudinal installation
30	3.0 liters displacement
T	TOP performance class
0	New development

S58 Engine

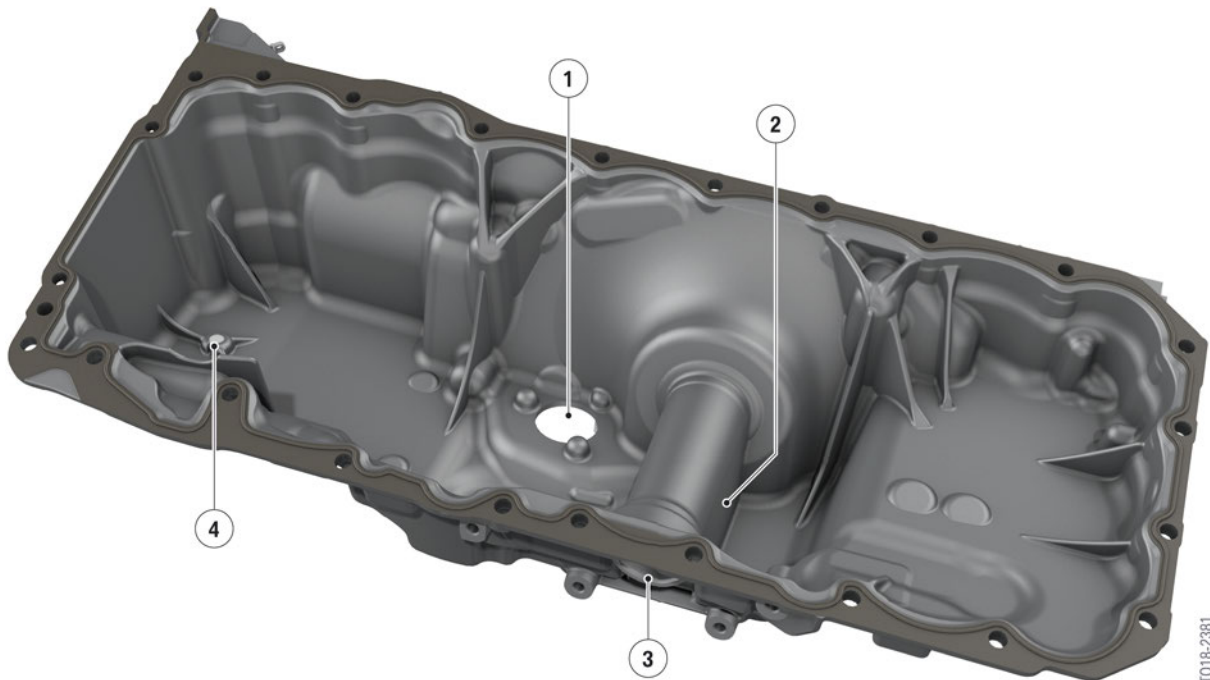
4. Engine Mechanical

4.1. Engine housing

The engine housing comprises the crankcase, the cylinder head, the cylinder head cover, the sump and the gaskets.

4.1.1. Oil sump

The sump of the S58 engine is a cast aluminium design made of AlSi9Cu3. The sump originally made of magnesium on the S55 engine was also replaced by cast aluminium sump in the course of life-cycle development of the S55 engine. An additional partition in the area of the drive shaft passages in the forward area of the sump further restricts oil movement under longitudinal and lateral acceleration forces.



S58 engine, oil sump

Index	Explanation
1	Oil-level sensor mount
2	Bulkhead
3	Output shaft passage
4	Oil drain plug

To ensure that the engine oil in the front, smaller sump is drained completely during an engine oil service, the sump features a small drain hole through which the engine oil can flow into the rear sump.

Sealing of the sump against the crankcase is provided by means of a sealing compound.

S58 Engine

4. Engine Mechanical



The precise procedure for sealing the sump can be found in the up-to-date information in the BMW workshop system ISTA.

4.1.2. Crankcase

The crankcase of the S58 engine is made of gravity die-cast Al Si 7 Cu 0.5 Mg.

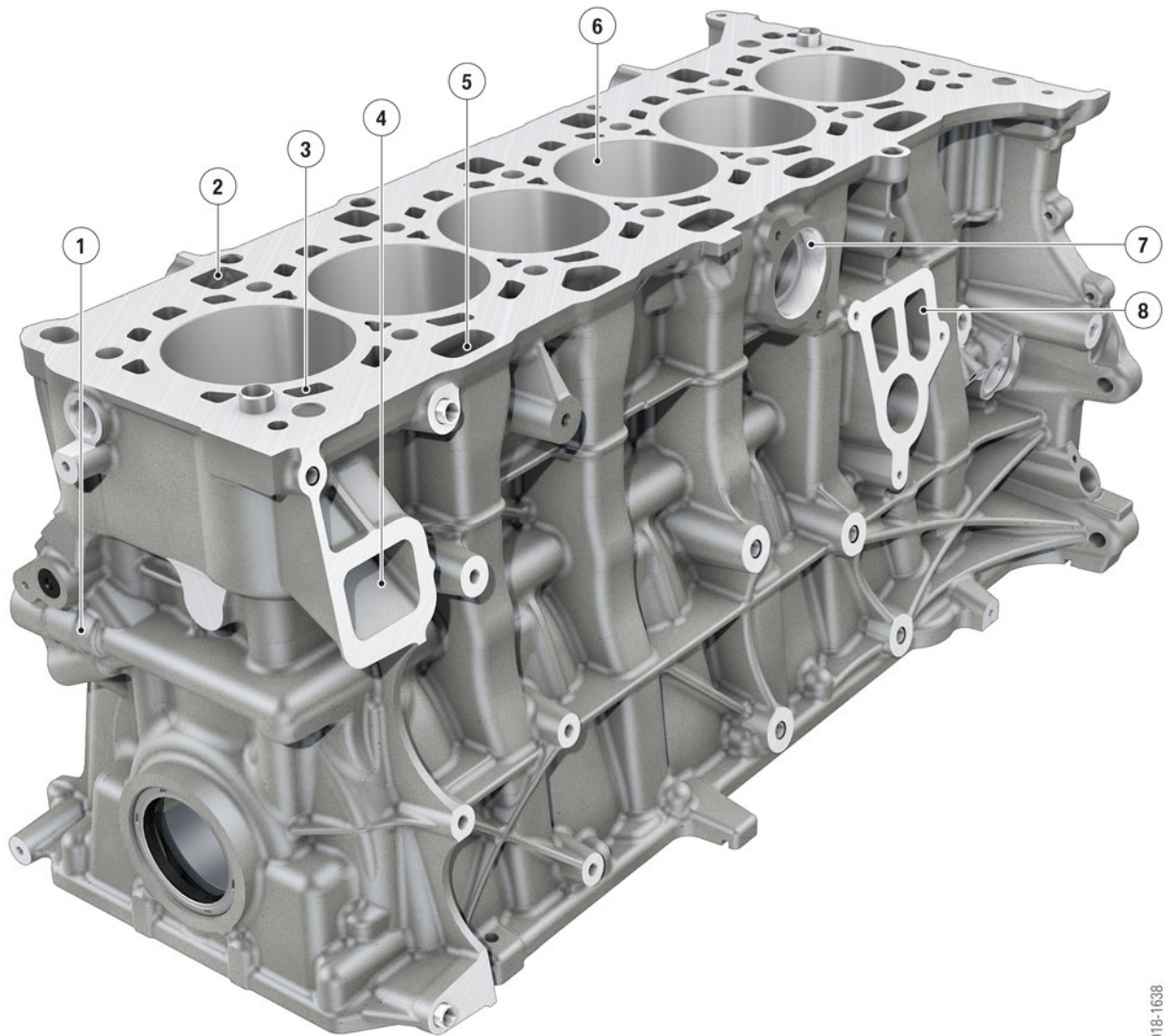
As a heat management module is not used on the S58 engine, the coolant ducts and the coolant pump mounting have had to be adapted to the crankcase.

That involved increasing the cross-sections of the water chambers in order to minimize the flow velocity of the coolant in the crankcase as much as possible due to the high delivery rate of approx. 300 l/min of the new coolant pump.

Furthermore, the mounting points for the ancillary components specific to the S58 engine have been adapted to the crankcase, and the oil ducts for piston cooling via the oil spray nozzles have been integrated.

S58 Engine

4. Engine Mechanical



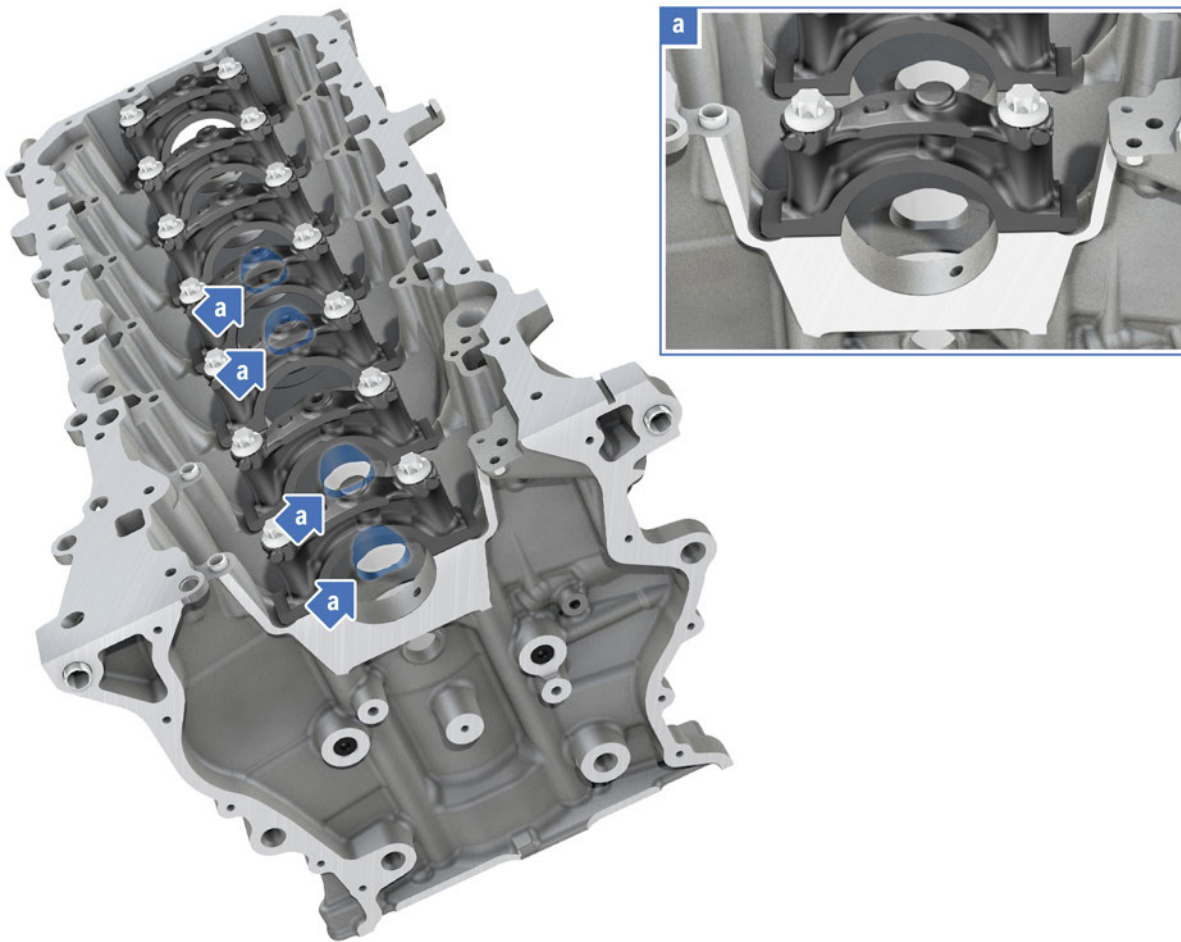
S58 engine, crankcase

T018-1638

Index	Explanation
1	Engine oil duct for spray nozzles
2	Engine oil return, exhaust side
3	Engine coolant ducts (water chamber passages)
4	Coolant pump mounting
5	Intake-side engine oil return and gas replacement duct
6	Cylinder liners, LDS-coated
7	Coolant duct (coolant return to radiator)
8	Oil filter module mounting

S58 Engine

4. Engine Mechanical



TO18-1640

S58 engine, ventilation bore holes in the crankcase

The crankcase has drilled longitudinal ventilation holes (a). Those longitudinal ventilation holes (a) improve pressure equalization between the oscillating air columns created by the up and down movement of the pistons.

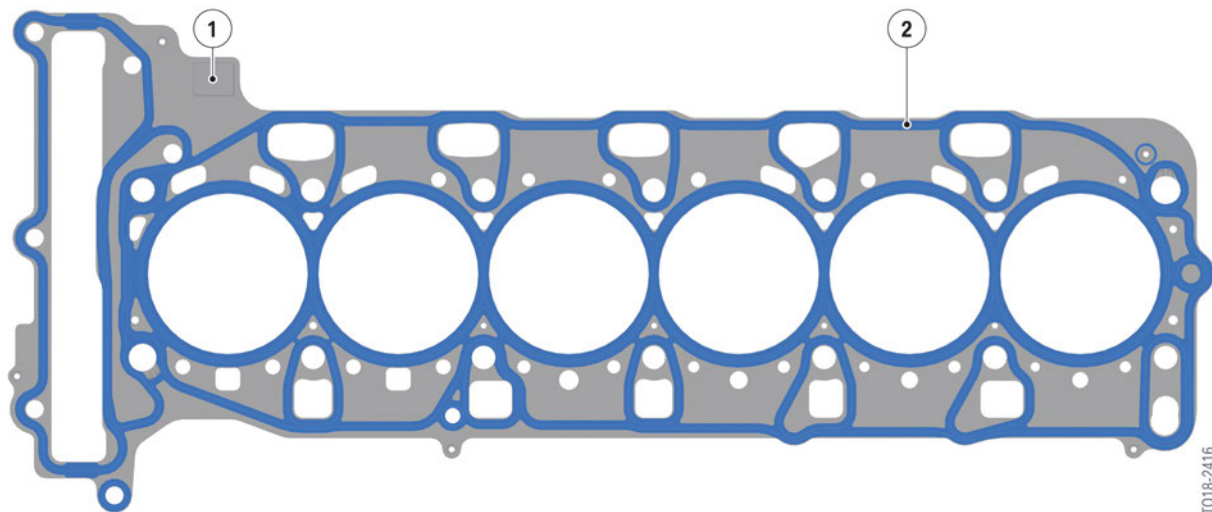
In addition, adaptations of the connections to the two exhaust turbochargers, were necessary for the oil supply and coolant cooling.

4.1.3. Cylinder head gasket

In contrast with the B58TU engine, the cylinder head gasket in the S58 engine is made up of 4 layers (3 layers in the B58TU engine) because the combustion pressure is higher than in the S58 engine. Furthermore, the contact faces with the cylinder head and cylinder block are no longer fully coated but instead have a partial screen print coating. The cylinder head gasket has been adapted to the crankcase and the cylinder head in terms of the sealing bead pattern.

S58 Engine

4. Engine Mechanical



S58 engine, cylinder head gasket coating

Index	Explanation
1	Cylinder head gasket
2	Partial screen printing coating

4.1.4. Cylinder head

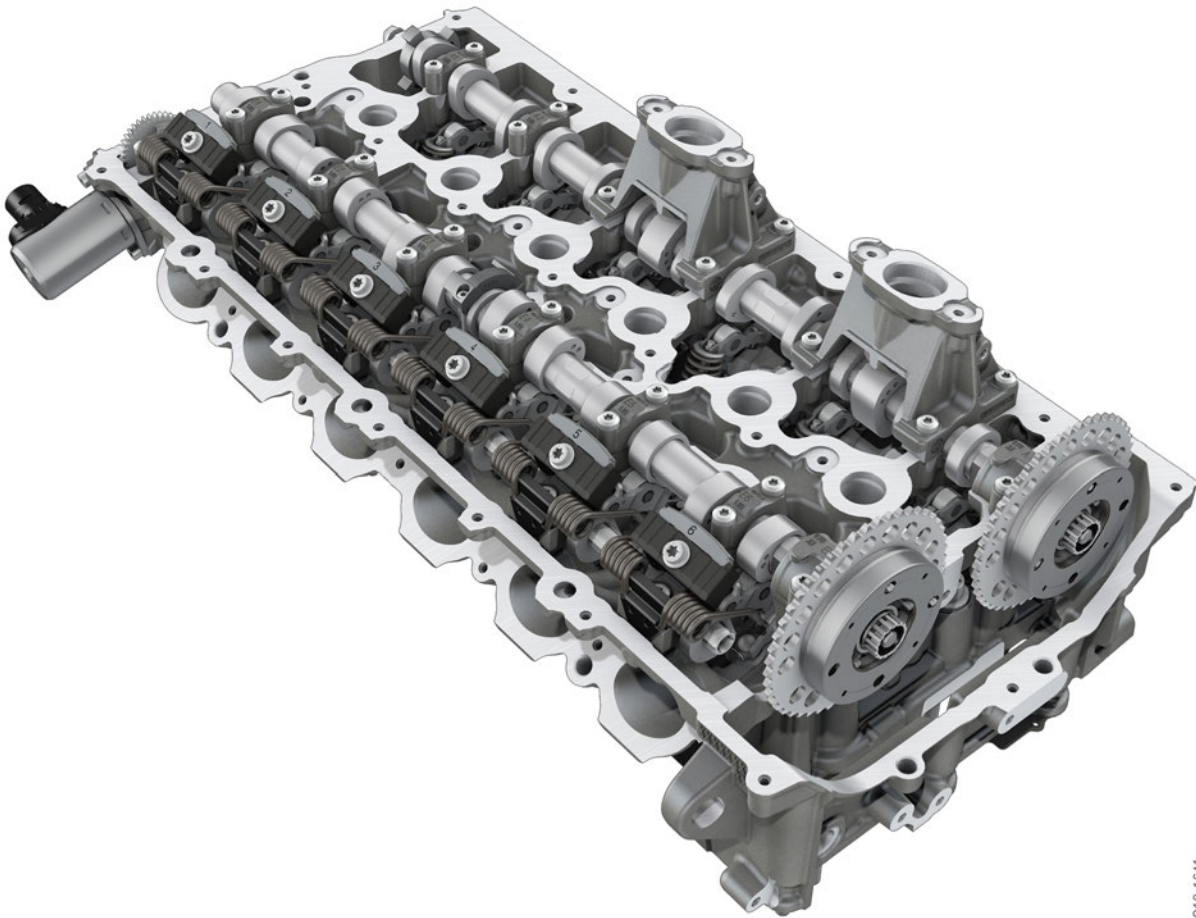
The cylinder head of the S58 engine has been adapted to motor racing requirements. The basic design of the cylinder head matches that of the B58TU engine. In addition, the cylinder head has a core manufactured using a 3D printing process. The additive manufacturing process makes it possible to produce geometrical shapes that cannot be achieved with conventional metal casting methods. Thanks to 3D printing technology, the cylinder head core of the new engine is lighter in weight and has optimized coolant duct routing in temperature management terms. The S58 engine again features direct injection, turbocharger aspiration and Valvetronic valve timing. The cylinder head is very compact and is equipped with the 4th-generation Valvetronic technology.



The combination of exhaust turbocharger, Valvetronic and direct fuel injection is known as **Turbo Valvetronic Direct Injection (TVDI)**.

S58 Engine

4. Engine Mechanical



T018-1641

S58 engine, cylinder head

The cylinder head of the S58 engine has been redesigned with regard to coolant duct routing. Thus, the S58 engine does not feature the split-cooling concept used on the B58TU engine.

In addition, the mountings for the two high-pressure pumps on the cylinder head have been adapted.

4.1.5. Cylinder head cover

Design

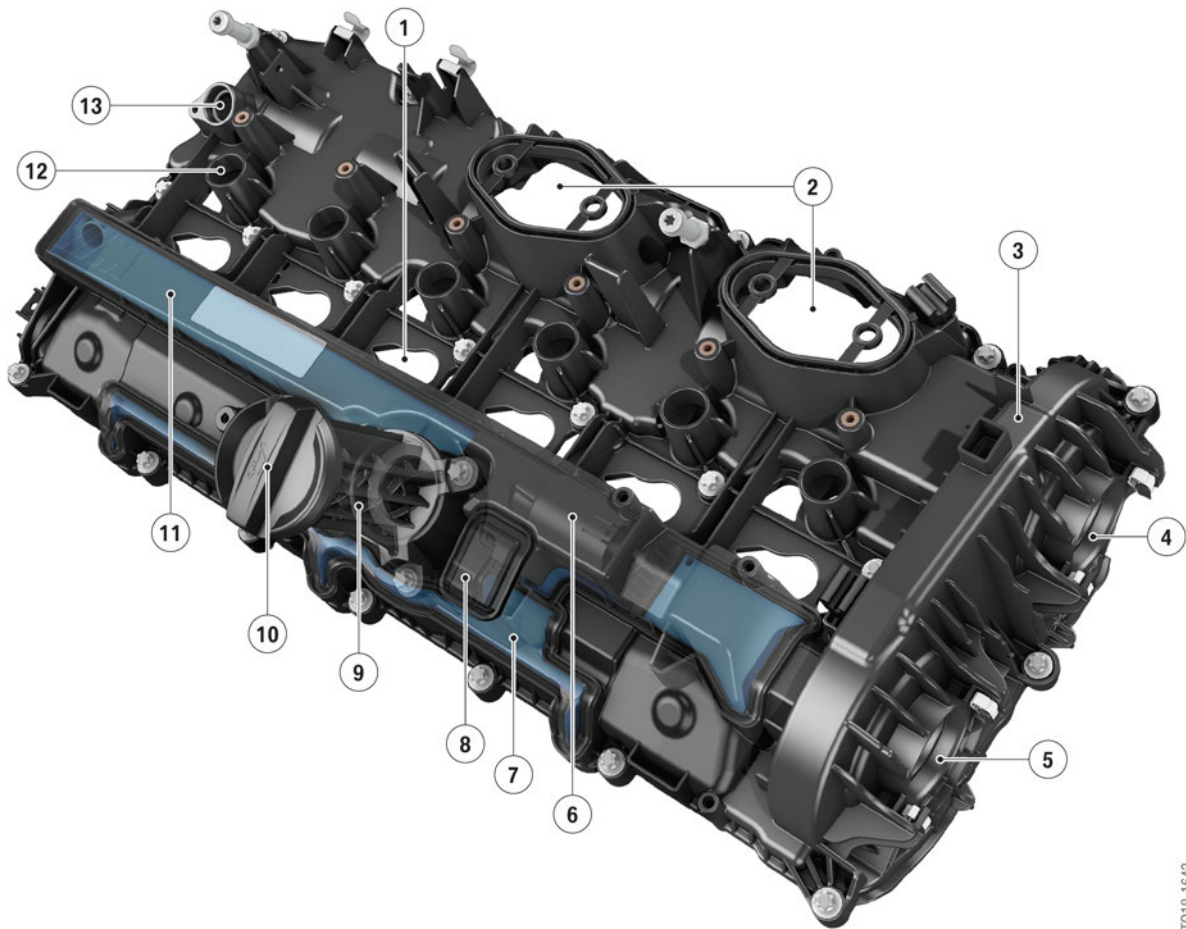
The cylinder head cover is a new part on the S58 engine. As distinct from the cylinder head cover of the B58TU engine, the mounts for the two high pressure pumps are machined into the cylinder head cover of the S58 engine.

All the components for crankcase ventilation and the blow-by ducts are also integrated in the cylinder head cover. The integrated valves ensure that the blow-by gases are reliably fed into the intake air.

The S58 engine is equipped with a positively controlled crankcase ventilation system.

S58 Engine

4. Engine Mechanical



T018-1642

S58 engine, cylinder head cover with crankcase ventilation

Index	Explanation
1	Through-holes for injectors
2	Mountings for high pressure pumps
3	Housing, chain drive
4	Mount for exhaust-side VANOS solenoid valve actuator
5	Mount for intake-side VANOS solenoid valve actuator
6	Particle separator
7	Blow-by gas distributor rail
8	Crank case vent valve
9	Oil filler neck
10	Oil filler cap
11	Blow-by gas duct
12	Through-holes for spark plugs
13	Accommodates the camshaft sensor

S58 Engine

4. Engine Mechanical

The blow-by gases pass through the opening in the area of no. 6-cylinder into the settling chamber in the cylinder head cover. From the settling chamber, the blow-by gases pass through the particle separator with ball valve where they are separated from the oil by an artificial-felt element. The blow-by gases separated from the oil next pass either through the crankcase vent valve via the cylinder head into the intake area upstream of the intake valves or to the intake area upstream of the turbocharger, depending on the engine operating mode. The separated oil is directed via a return duct discharging into the sump below the oil level. A non-return valve in the lower part of the crankcase in the area of the sump ensures that no oil from the sump can pass into the crankcase ventilation system from the sump.



The precise procedure for removing and installing the cylinder head cover can be found in the up-to-date information in the BMW workshop system ISTA.

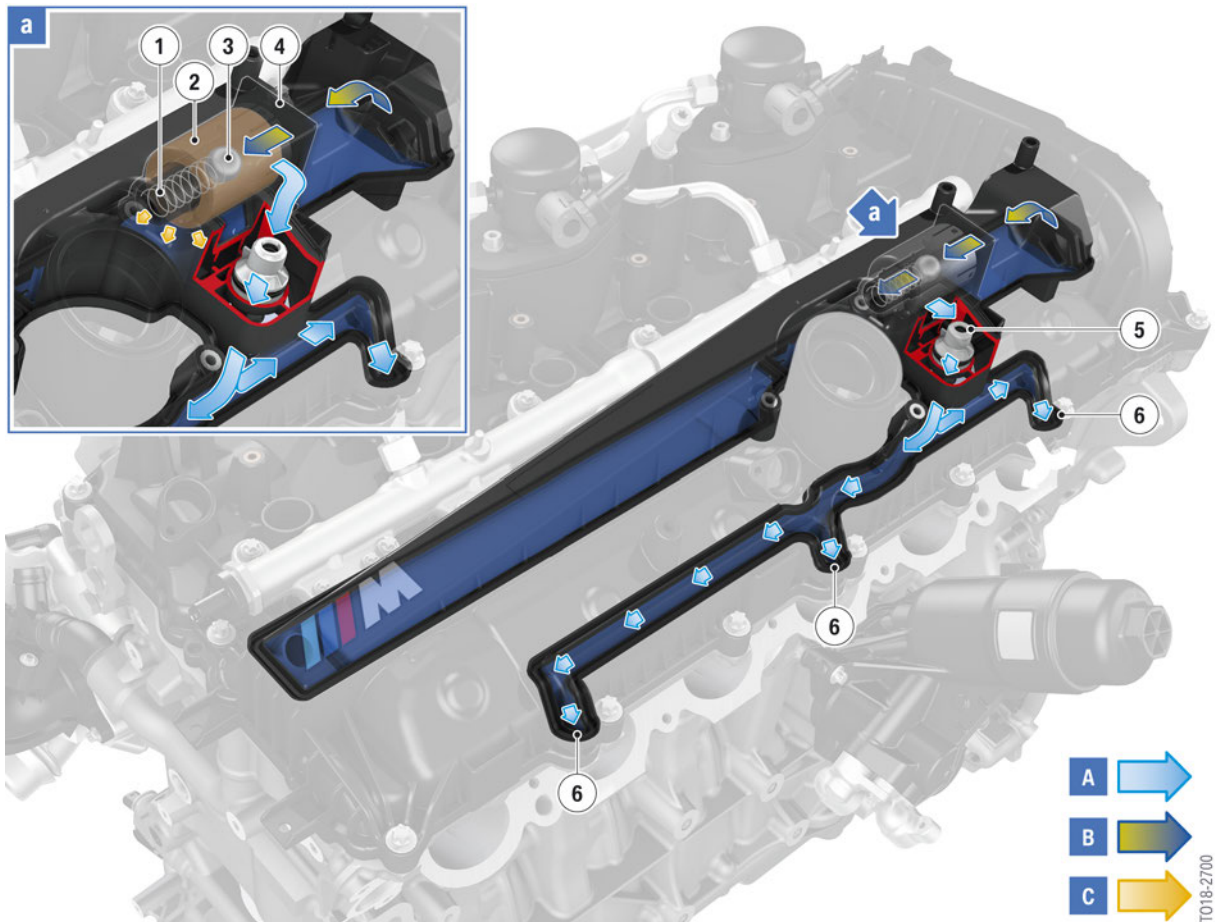
Operating principle

The standard function can only be utilized while there is a vacuum in the intake plenum, i.e. in naturally aspirated mode.

In naturally aspirated mode, the crankcase vent valve and the ball valve in the particle separator in the cylinder head cover are opened by the vacuum in the intake plenum. The blow-by gases are routed via the distributor rail integrated in the cylinder head cover directly into the cylinder head intake ports.

S58 Engine

4. Engine Mechanical



S58 engine, naturally aspirated mode

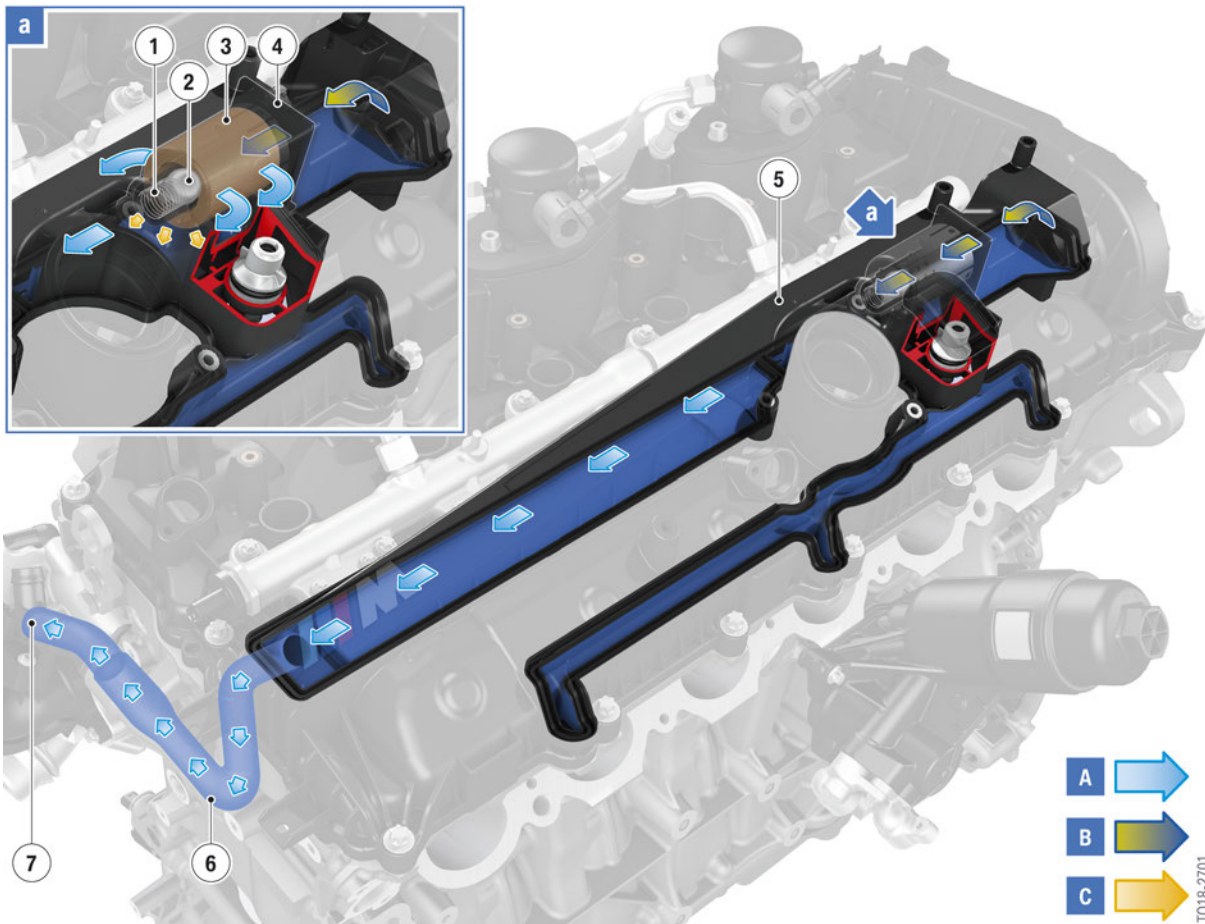
Index	Explanation
A	Clean blow-by gas
B	Blow-by gas
C	Oil
1	Control spring
2	Artificial-felt element for oil separation
3	Ball valve
4	Bulkhead
5	Crank case vent valve
6	Blow-by gas ducts

Once the pressure in the intake plenum rises, it is no longer possible for the blow-by gases to be introduced via this route. The crankcase vent valve seals off the duct to the intake plenum.

The then greater intake-air demand generates a vacuum in the clean air pipe between the turbocharger and the intake silencer. That vacuum is sufficient to keep the ball valve in the particle separator in the cylinder head cover open and draw off the blow-by gases.

S58 Engine

4. Engine Mechanical



S58 engine, turbocharger-aspirated mode

Index	Explanation
A	Clean blow-by gas
B	Blow-by gas
C	Oil
1	Control spring
2	Ball valve
3	Artificial-felt element for oil separation
4	Bulkhead
5	Blow-by gas ducts
6	Blow-by gas ducts in the cylinder head
7	Blow-by gas introduction

S58 Engine

4. Engine Mechanical



If there is a complaint about higher oil consumption and at the same time an exhaust turbocharger fouled with oil is diagnosed, then it cannot be immediately concluded that the exhaust turbocharger is faulty. If the fouling is already present after the introduction of the blow-by gases, then the entire engine must be checked for leaks. The cause of an excessive blow-by gas flow rate may be faulty gaskets or crankshaft seals. Leaking crankshaft seals may generate oil consumption of up to 3 liters/1000 km (620 miles).

4.1.6. Engine cover

The engine cover was adapted to the S58 engine. The engine cover is also the intake silencer of the S58 engine.



S58 engine, engine cover

TO18-1643

4.2. Crankshaft

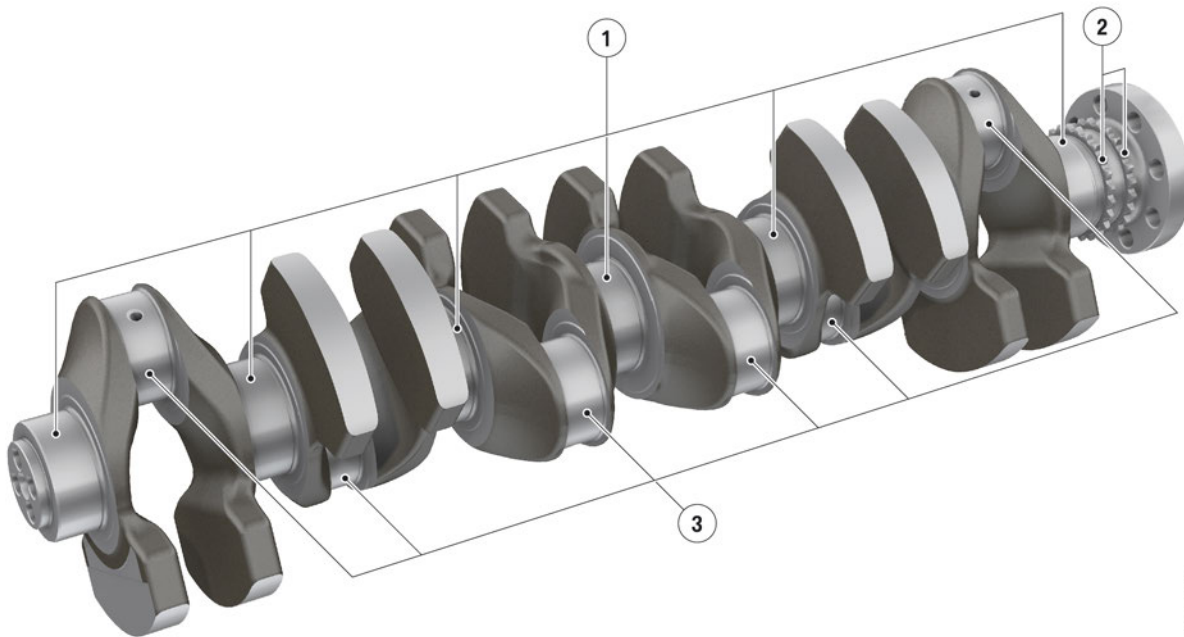
4.2.1. Crankshaft with bearings

Crankshaft

The crankshaft is an optimized-weight design and has been adapted to the high-revving characteristics and greater power output of the S58 engine. Thus the crankshaft of the S58 engine weighs approx. 21.2 kg (47 lbs). The crankshaft is also called a lightweight construction crankshaft. The crankshaft is made from a steel alloy 42CrMoS4 Mod and is then nitrocarbonized in the gas. The timing chain and oil pump are connected by gears.

S58 Engine

4. Engine Mechanical



T018-2382

S58 engine, crankshaft

Index	Explanation
1	Main bearing
2	Drive for oil pump and valve gear
3	Connecting rod bearing

Crankshaft main bearing

The crankshaft main bearings are adapted to the S58 engine. Adaptations were necessary in order to satisfy the higher demands of the high-revving design. The bearings are a lead-free design. The material combination for the lower bearing shells takes the form of a Federal Mogul G488. For the upper bearing shells a Federal Mogul G490 is used. The thrust bearing is located at the 4th bearing position.



When replacing the crankshaft main bearings, the bearing shell classification must be taken into account. The precise procedure for replacing the crankshaft main bearing shells can be found in the up-to-date information in the BMW workshop system ISTA.

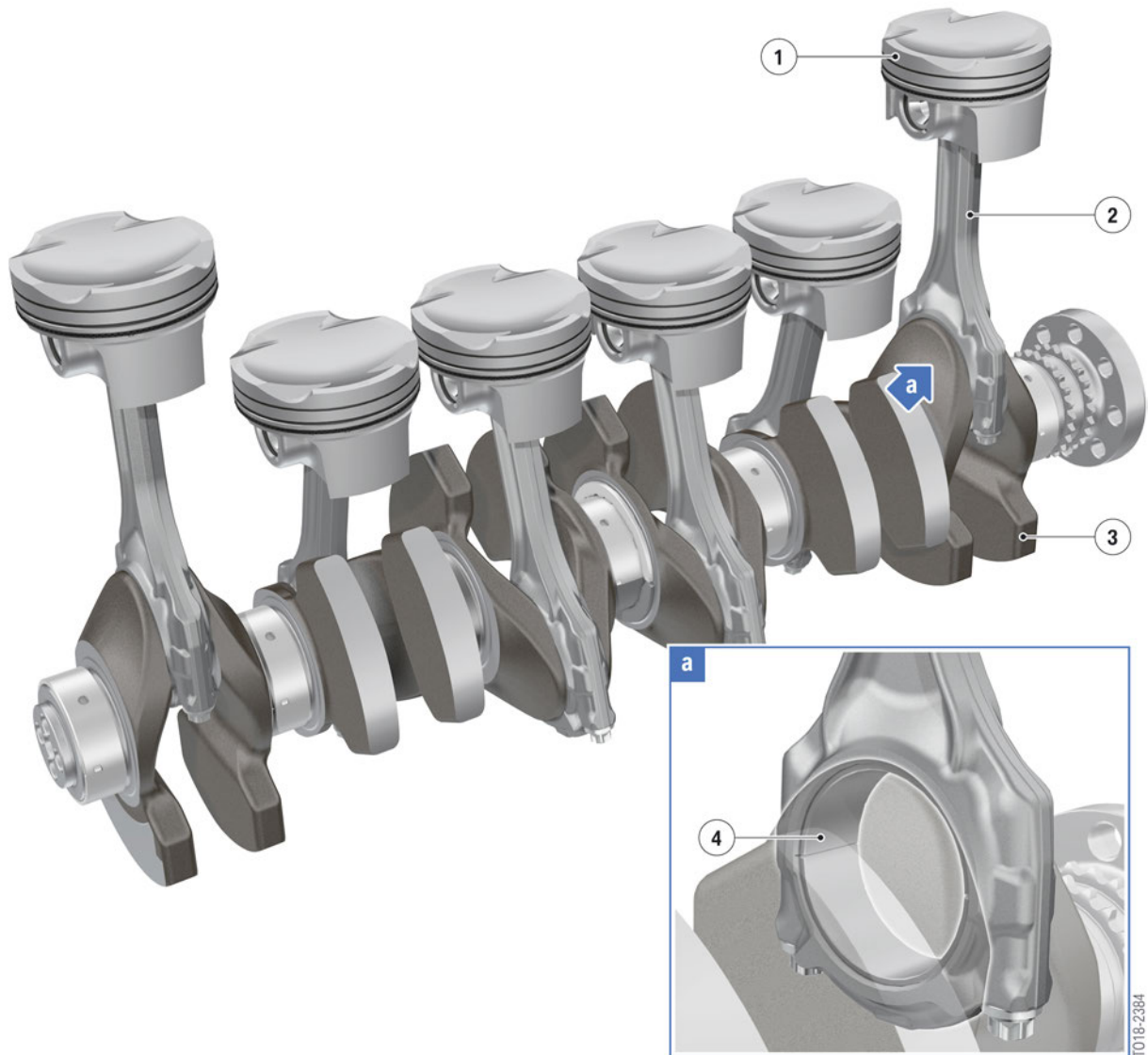
4.2.2. Connecting rod with bearing

The forged connecting rod of the S58 engine has a nominal length of 151.1 mm. The connecting rod is a carry-over part from the S63B44T4 engine. As with other BMW engines, the small end has a profiled bore. The force acting from the piston via the wrist pin is optimally distributed to the bushing surface by this shaped bore and the edge load.

S58 Engine

4. Engine Mechanical

The big-end bearing shells are of the lead-free type. Consequently, a Federal Mogul G488 is used on both the rod side and the bearing-cap side.



S58 engine, connecting rod bearing

Index	Explanation
1	Piston
2	Connecting rod
3	Crankshaft
4	Connecting rod bearing

S58 Engine

4. Engine Mechanical

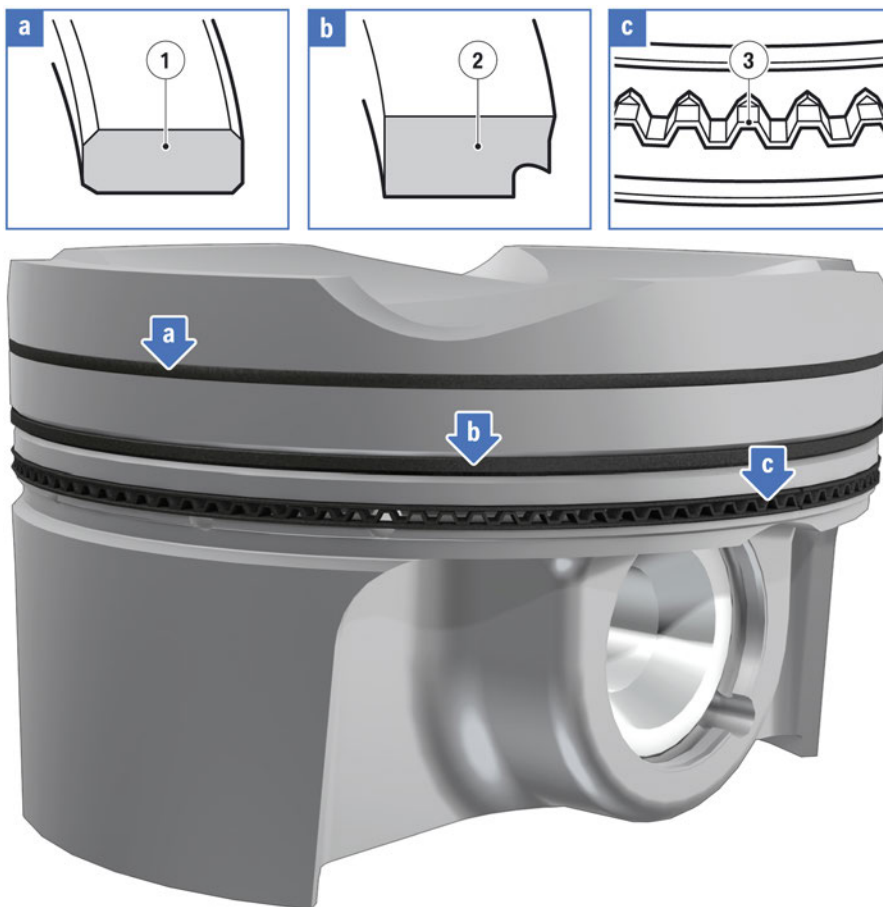
4.2.3. Piston with wrist pin and piston rings

The shape and material properties of the piston have been adapted to the higher demands in terms of the high-revving design of the S58 engine with a rated engine speed of 7500 rpm.

A forged slipper-skirt piston made by the manufacturer Mahle is used. The piston is made from the M142P alloy (AlSi12Cu3Ni2Mg). This alloy is particularly suitable for high-performance petrol engines. For the S58 engine, the piston alloy is formed by forging, which produces slightly different microstructures and properties. That is indicated by the suffix "P" in the alloy designation.

The piston skirt is Grafal-coated, which is necessary due to the LDS-coated cylinder liners.

The piston diameter is 84 mm. The first piston ring is a nitride plain rectangular compression ring. The 2nd piston ring is a taper-faced piston ring. The oil scraper ring is a nitride ES oil scraper ring.



T018-2385

S58 engine, piston with wrist pin and piston rings

Index	Explanation
1	Plain compression ring
2	Taper-faced piston ring
3	ES oil scraper ring

S58 Engine

4. Engine Mechanical

Wrist pin

The wrist pin with circlip was revised accordingly to the higher requirements in the S58 engine. The material and the strength were adapted to satisfy the high-speed concept.

A so-called wrist pin with restricted volume change with 23 mm diameter is used. The wrist pin is made from the alloy 16MnCr5 and then case hardened (DLC diamond-like carbon).

4.3. Camshaft drive/chain drive

The entire chain drive system driving the camshafts on the S58 engine has been carried over from the N58TU engine. As on the B58TU engine, the composite camshafts are driven by an adapted single bushed-roller chain with 154 links. The tensioning rail is a carry-over part from the B58TU engine, while the bushed-roller chain itself and the guide rail have been adapted to the high-revving concept and higher power of the S58 engine.

S58 Engine

4. Engine Mechanical



T018-2415

S58 engine, chain drive

Index	Explanation
1	Slide rail with holder
2	Bushed-roller chain for camshafts
3	Chain tensioner
4	Tensioning rail
5	Bushed-roller chain for oil pump
6	Oil pump sprocket
7	Guide rail

As on the B58TU engine, the oil pump is driven by a single bushed-roller chain with 58 links.

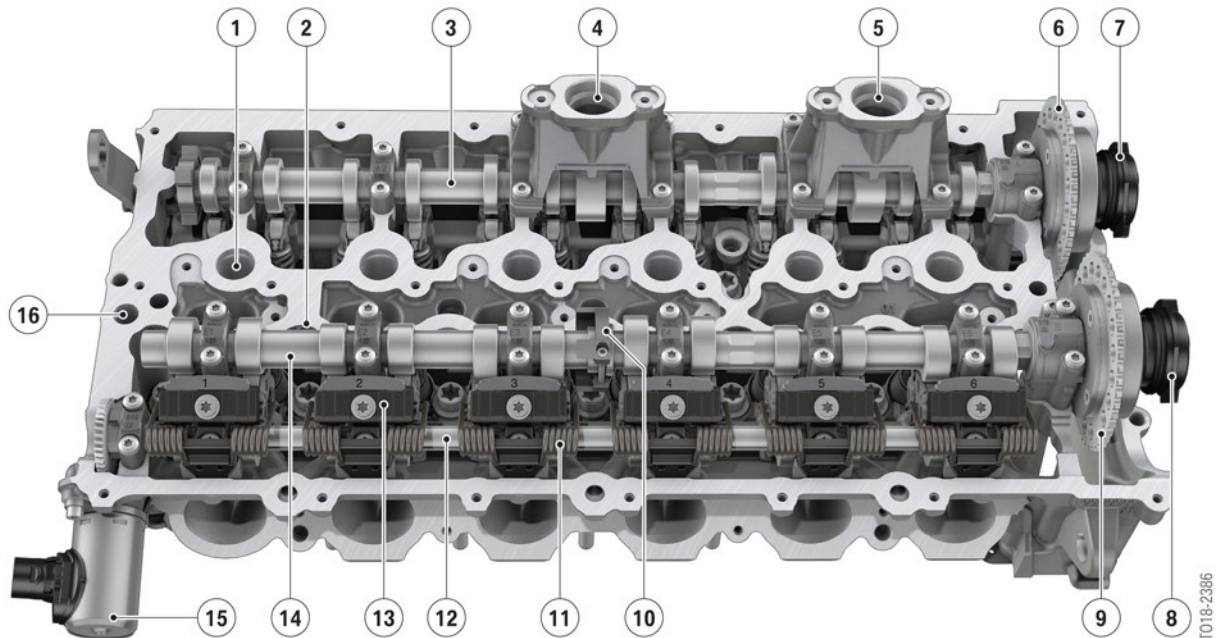
S58 Engine

5. Valve Gear

5.1. Design

The following graphic shows the design of the cylinder head on the S58 engine with the combination of Valvetronic IV and direct injection.

The way in which the Valvetronic IV functions is the same as on the modular engines and is therefore not described in this product information.



S58 engine, overview of valve gear

Index	Explanation
1	Spark plug shaft
2	Injector shaft
3	Exhaust camshaft
4	Mounts for high pressure pump 1
5	Mounts for high pressure pump 2
6	VANOS unit, exhaust camshaft
7	VANOS solenoid valve actuator, exhaust
8	VANOS solenoid valve actuator, intake
9	VANOS unit, intake camshaft
10	Camshaft sensor reluctor ring, intake side
11	Torsion spring
12	Eccentric shaft

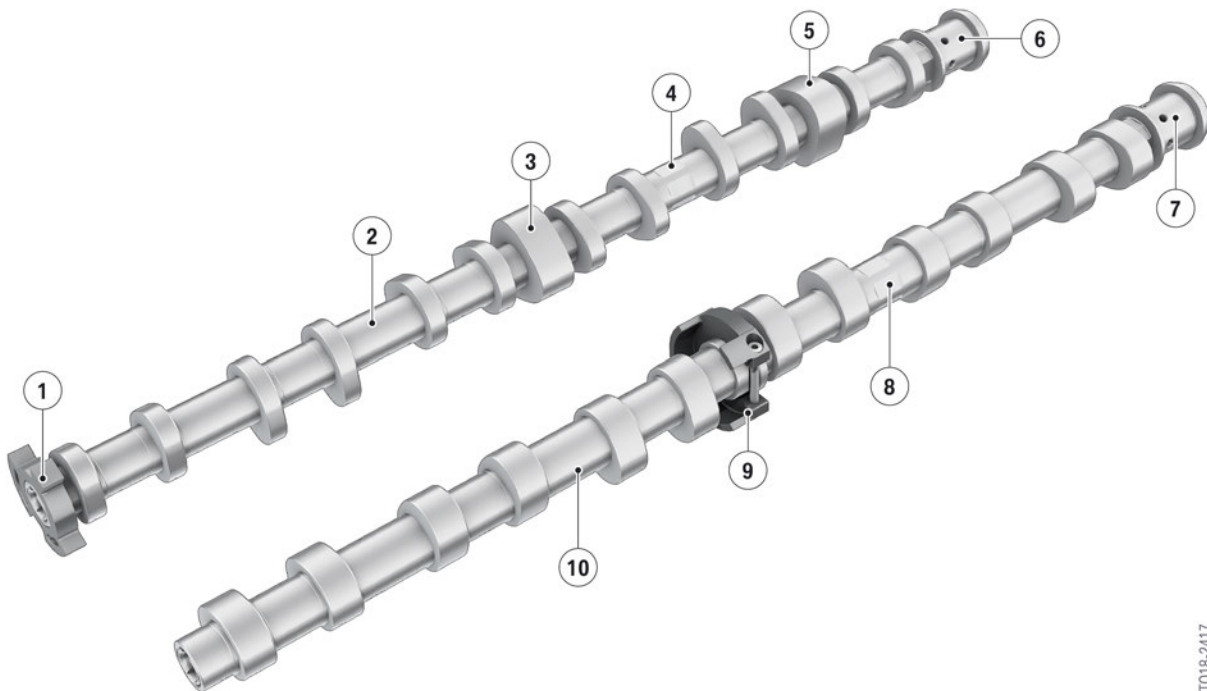
S58 Engine

5. Valve Gear

Index	Explanation
13	Gate
14	Intake camshaft
15	Valvetronic servomotor
16	Bore hole for introduction of blow-by gas

5.1.1. Camshafts

In the S58 engine, similar to the S55 engine, only lightweight construction camshafts are used. The lightweight-design camshafts for the S58 engine are composite camshafts as used on the modular engines.



T018-2417

S58 engine, composite camshaft

Index	Explanation
1	Camshaft sensor retractor ring, exhaust side
2	Exhaust camshaft
3	Triple cam for high pressure pump 1
4	Flats for open-end spanner
5	Triple cam for high pressure pump 2
6	Mount for VANOS adjuster, exhaust side

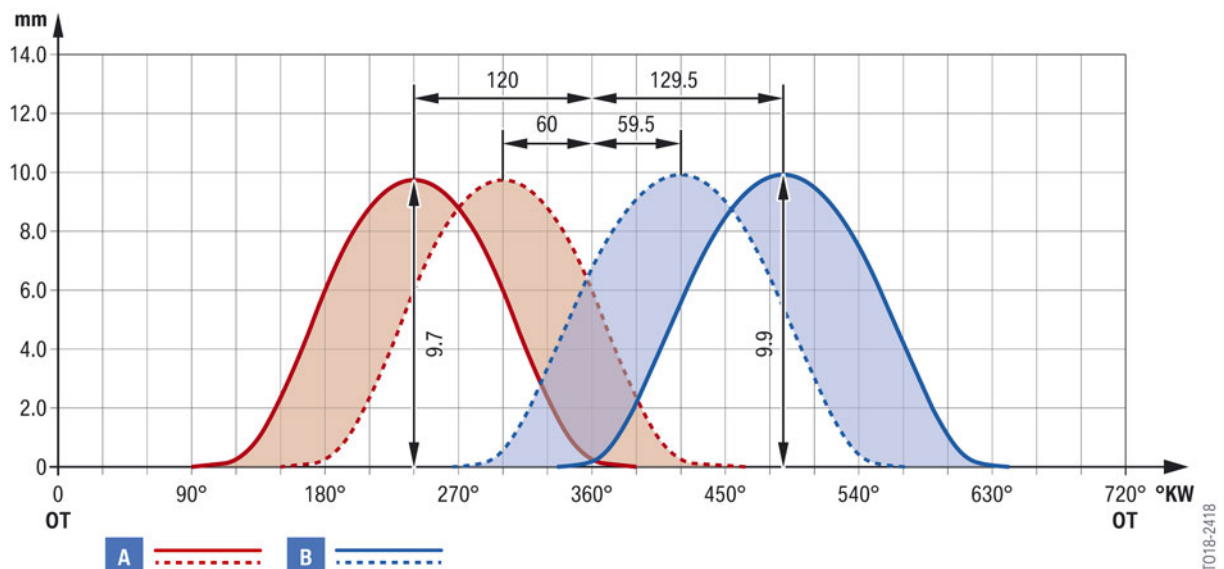
S58 Engine

5. Valve Gear

Index	Explanation
7	Mount for VANOS adjuster, intake side
8	Flats for open-end spanner
9	Camshaft sensor reductor ring, intake side
10	Intake camshaft

The camshafts have been adapted to the high-revving concept of the S58 engine in terms of cam shape and timing. In addition, the exhaust camshaft also has double cams for driving the high-pressure pump. The reductor rings for the camshaft sensors have been realigned in comparison with the B58TU engine.

5.1.2. Timing



S58 engine, timing diagram

Index	Explanation
A	Exhaust
B	Intake

		B58B3001	S58B30T0
Intake valve diameter	[mm]	30.1	30.1
Exhaust valve diameter	[mm]	28.5	28.5
Maximum valve lift, intake/exhaust valve	[mm]	9.9/9.7	9.9/9.7
Steering axis inclination, intake camshaft (VANOS adjustment range)	[crankshaft degrees]	70	70
Steering axis inclination, exhaust camshaft (VANOS adjustment range)	[crankshaft degrees]	60	60

S58 Engine

5. Valve Gear

		B58B3001	S58B30T0
Camshaft adjustment, intake	[crankshaft degrees]	122.5–52.5	129.5–59.5
Camshaft adjustment, exhaust	[crankshaft degrees]	120–60	120–60
Opening period Intake camshaft	[crankshaft degrees]	258.2	273.5
Opening period Exhaust camshaft	[crankshaft degrees]	261.9	262.3

5.1.3. Intake and exhaust valves

The valve stem of the intake valve has a diameter of 4.92 mm. For the exhaust valve the diameter is 5.92 mm. The reason for the larger diameter is that the exhaust valve is hollow and has a sodium filling. In addition, the valve seat of the exhaust valve is armor-plated.

In contrast with the B58TU, the intake valve material for the S58 engine, has been upgraded to a higher-quality alloy material to cope with the thermal and higher stress on the engine.

5.1.4. Valve springs

Due to the different shaft diameters between the intake and exhaust valves the valve springs are different.

5.2. Valvetronic

5.2.1. VANOS

Overview

The design and function of the variable camshaft timing system on the S58 engine is the same as on the B58TU engine. The VANOS system had already been optimized by virtue of the single chain drive on the B58TU engine in comparison with the B58 engine. That optimization resulted in shorter and more compact adjusters.

The camshaft sprockets of the VANOS units have been adapted to suit the single bushed-roller chain on the S58 engine.

VANOS solenoid valve actuators

The VANOS solenoid valves used on the S58 engine are identical to those on the B58TU engine.

S58 Engine

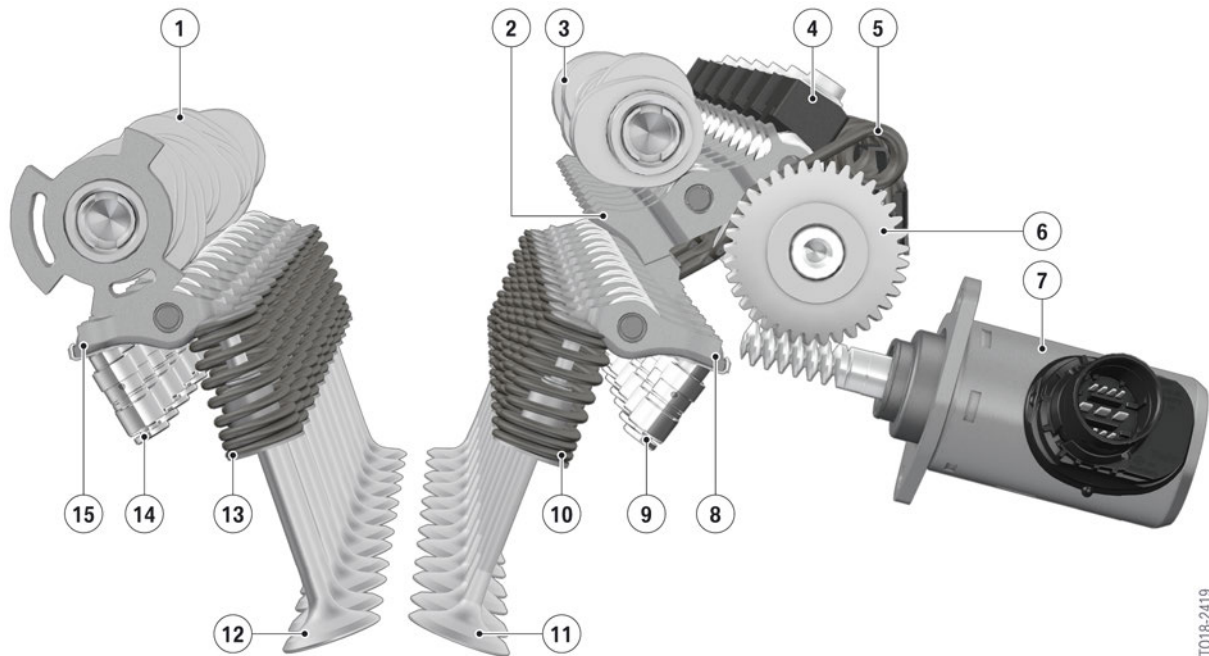
5. Valve Gear

5.2.2. Valve lift control

Overview

As can be seen from the following graphic, the design of the valve lift control system has not changed in comparison with the B58TU engine.

Due to the higher engine speeds of the S58 of up to 7500 rpm, the working curve of the eccentric shaft and intermediate lever has been adapted.



S58 engine, valve lift control

T018-2419

Index	Explanation
1	Exhaust camshaft
2	Intermediate lever
3	Intake camshaft
4	Gate
5	Torsion spring
6	Eccentric shaft
7	Valvetronic servomotor
8	Roller cam follower, intake side
9	Hydraulic valve clearance compensator, intake side
10	Valve spring, intake side
11	Intake valve

S58 Engine

5. Valve Gear

Index	Explanation
12	Exhaust valve
13	Valve spring, exhaust side
14	Hydraulic valve clearance compensator, exhaust side
15	Roller cam follower, exhaust side

S58 Engine

6. Belt Drive & Ancillary Components

6.1. Belt drive

Due to the modified design, the belt drive stem has had to be adapted. Between the combined vibration absorber and belt pulley on the crankshaft and the air conditioning compressor, an additional tensioning pulley is used. With help of the additional tensioning pulley possible oscillations of the drive belt between the vibration absorber with belt pulley and air conditioning compressor are suppressed.



TO18-2420

S58 engine, belt drive

Index	Explanation
1	Belt pulley, alternator
2	Ribbed V-belt
3	Belt tensioner
4	Belt pulley, A/C compressor
5	Additional tensioning pulley
6	Combined vibration absorber and belt pulley
7	Coolant pump belt pulley

S58 Engine

6. Belt Drive & Ancillary Components

The belt pulley for driving the coolant pump has been made as large in diameter as possible in order to reduce the speed of the pump and, thereby, the coolant delivery rate at high engine speeds (cavitation).

The diameter of the belt pulley for driving the alternator has been changed in comparison with the one on the B58TU engine. That was necessary because, as a result of the higher revving speeds of the S58 engine compared with the B58TU engine, the alternator would otherwise have been driven too fast.

S58 Engine

7. Oil Supply

7.1. Differences in the oil supply

- Sump with a small front oil sump as a volume buffer
- Aluminium frame with oil extraction pipes and ducts bolted to the crankcase
- Plastic cover with integrated gasket for better separation of the front and rear sump partitions
- Oil pump as external gear pump with map control
- Additional twin oil return pumps
- Two oil spray nozzles per cylinder, plus one switchable nozzle
- Centrally controllable piston cooling via oil spray nozzles.

7.2. Oil supply adaptations

The controlled-volumetric-flow pendulum vane pump familiar from the B58TU engine is not used on the S58 engine. The reason for this is that the S58 engine has an additional suction pump for the front oil sump. With the same concept involving a volume-flow-controlled pendulum-slide pump, this would have been too large for the limited packaging space. In addition, the volume-flow-controlled pendulum-slide pump used in the B58TU engine would not have been capable of providing a reliable oil supply in the high engine speed ranges that occur in the S58 engine.

Therefore, a spur-gear pump with integrated twin oil return pump, which is also a spur-gear pump, is used on the S58 engine. This combination is more compact at a higher delivery rate than the volume-flow-controlled pendulum-slide pump.

The external gear pump is volume-flow-controlled and is supplemented by a map control.

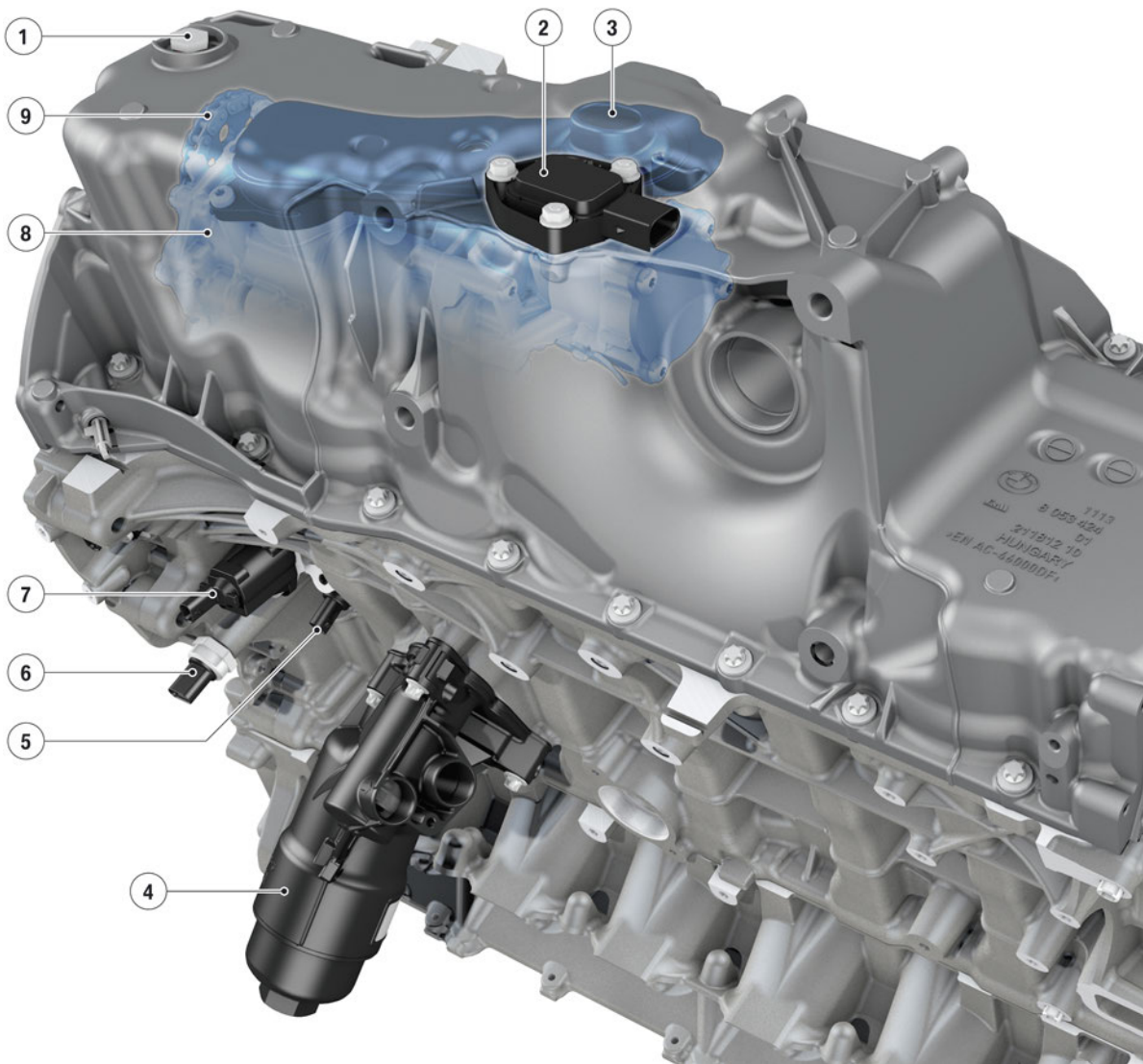
Bolted onto the intake side of the crankcase is the oil filter module. The oil pressure sensor, the oil temperature sensor and the data-map control valve for the data-map controlled oil pump are bolted to the crankcase behind the oil filter module.

The sump has a silicon sealant coating and is bolted to the crankcase. The sump is made of die-cast aluminium and holds the oil level sensor and the oil drain plug.

The position and length of the oil pump intake snorkel has been adapted to the geometric shape of the oil pump. An additional twin oil return pump is flange-mounted on the oil pump. This was necessary in order to adapt the oil supply to racetrack use. This ensures a secure oil supply, even when the oil level is displaced during lateral and longitudinal accelerations, as can occur during racing applications.

S58 Engine

7. Oil Supply



S58 engine, oil sump with oil pump

Index	Explanation
1	Oil drain plug
2	Oil-level sensor
3	Oil intake snorkel, sump, rear
4	Oil filter housing
5	Oil temperature sensor
6	Oil pressure sensor
7	Map control valve
8	Characteristic map-controlled external gear pump
9	Oil pump sprocket

S58 Engine

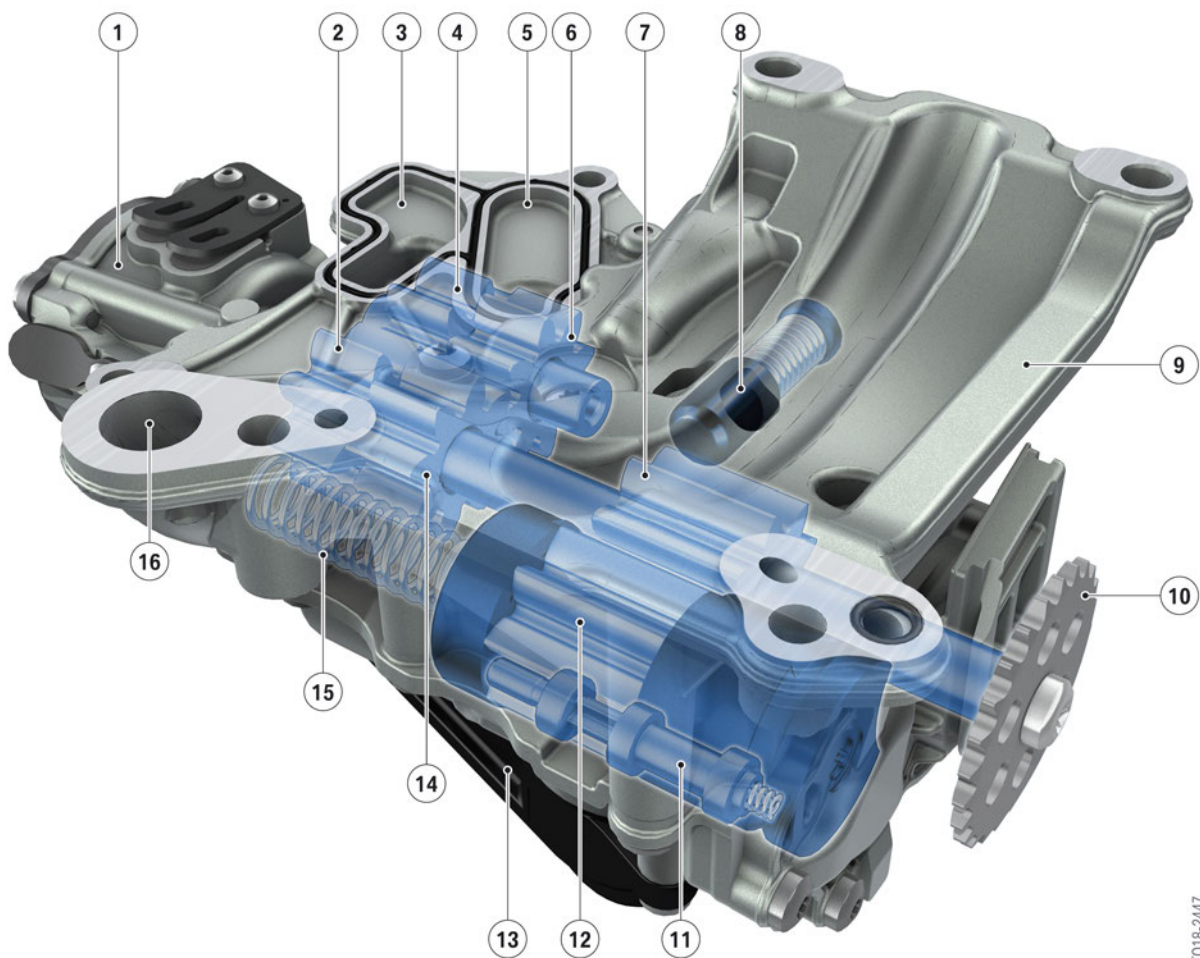
7. Oil Supply



The precise procedure for sealing the sump can be found in the up-to-date information in the BMW workshop system ISTA.

7.3. Oil pump

The oil pump is screwed to the crankcase and is driven by the crankshaft via a chain.



S58 engine, oil sump with suction pump

T018-2447

Index	Explanation
1	Vacuum pump
2	Drive gear suction pump
3	Intake port, front left sump (oil return pump)
4	Impeller, oil return pump, front left sump
5	Intake port, front right sump and turbocharger (oil return pump)

S58 Engine

7. Oil Supply

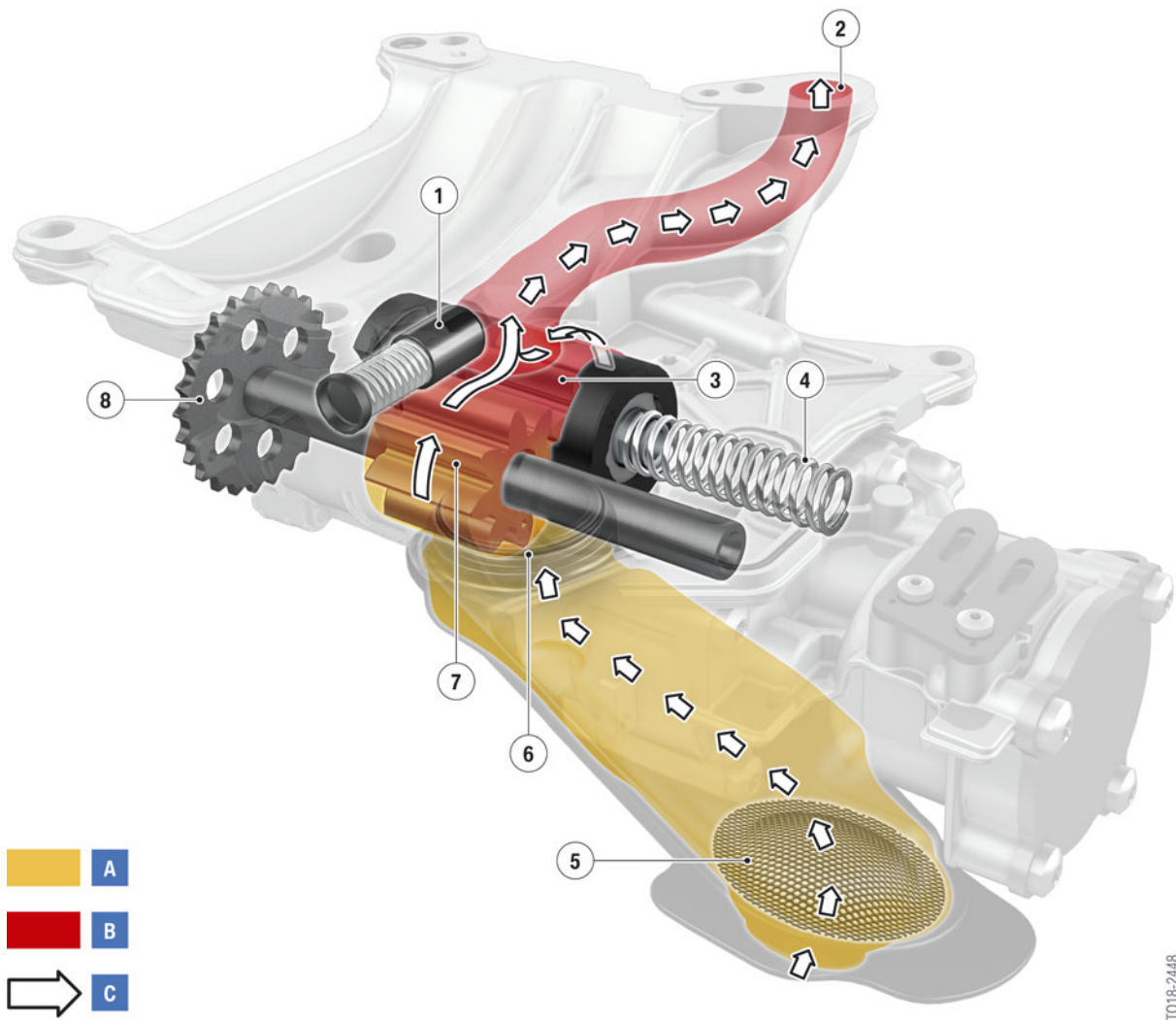
Index	Explanation
6	Impeller, oil return pump, front right sump and turbocharger
7	Powertrain for oil pump
8	Pressure relief valve
9	Oil pump housing
10	Oil pump sprocket
11	Control plunger
12	Axially movable impeller
13	Oil intake snorkel, sump, rear
14	Drive gear suction pump
15	Pressure control spring
16	Engine oil duct

From the oil intake snorkel, the oil is conveyed by the external gear oil pump via the gears into the engine oil duct, into the engine block and to the oil filter.

The non-driven oil pump gear can be axially shifted in this pump, thereby varying the delivery rate. Axial shifting is effected by the oil pressure from the filtered oil duct coming from the main oil duct, which can be varied via the map control valve by means of a control piston. The operating principle of the external gear oil pump ensures that the required oil quantity and the oil pressure are supplied in each case.

S58 Engine

7. Oil Supply



S58 engine, external gear oil pump

T018-2448

Index	Explanation
A	Intake side
B	Major thrust face
C	Direction of flow/direction of rotation
1	Oil intake snorkel pressure relief valve, rear sump
2	Oil duct into the engine block (unfiltered oil)
3	Axially movable impeller
4	Oil pump drive pressure control spring

S58 Engine

7. Oil Supply

Index	Explanation
5	Intake pipe with strainer
6	Spring diaphragm
7	Sprocket
8	Oil pump sprocket

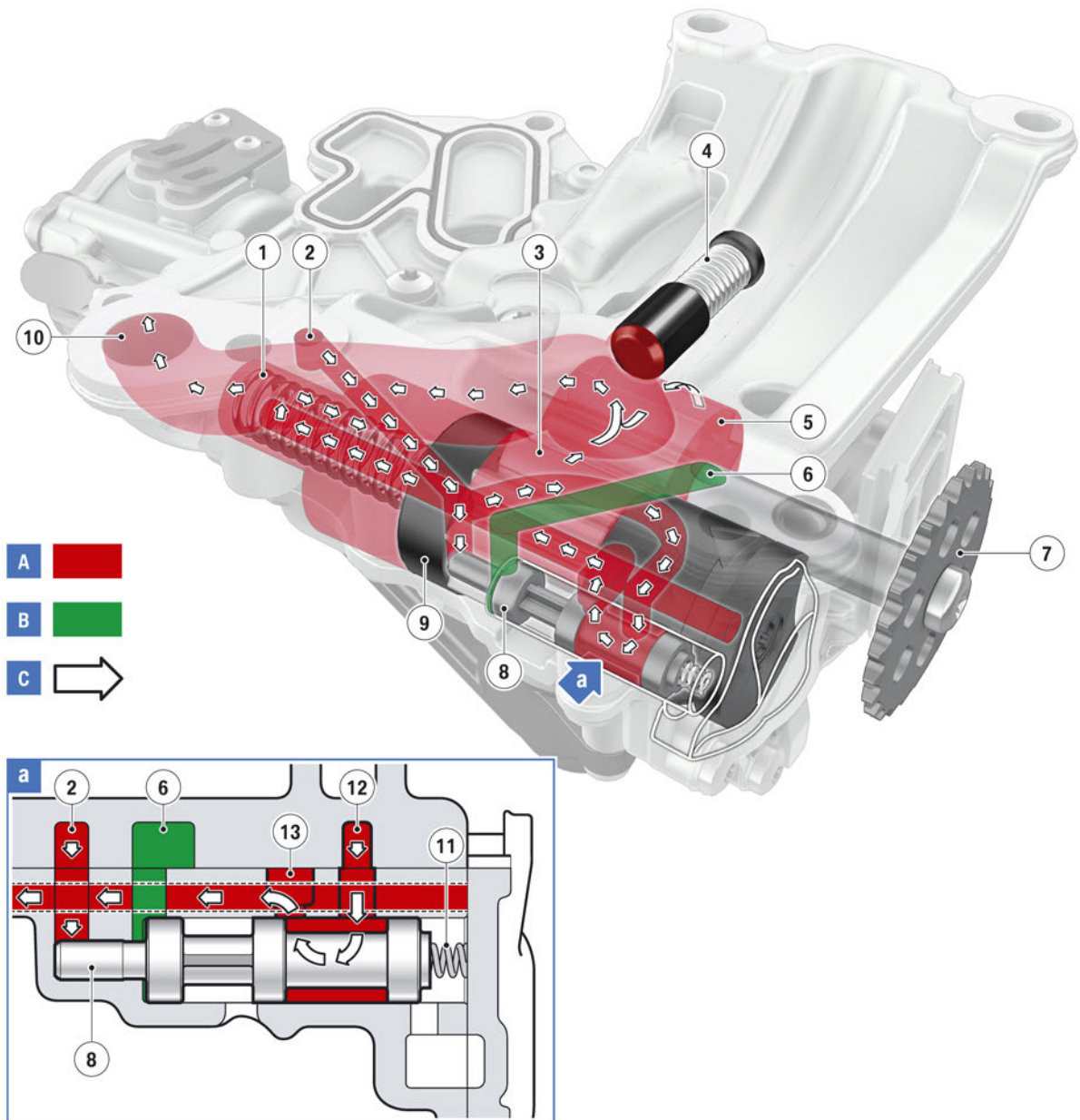
A spring diaphragm (6) is installed at the end of the intake pipe. The spring diaphragm dampens any acoustically conspicuous pressure vibrations caused by conveying of the unfiltered oil in the intake pipe.

7.3.1. Maximum delivery

In its basic position, the oil pump is held in the maximum delivery position by the pressure control spring (1). This position can also be actively approached via the map control valve from the minimum delivery position. The map control valve is switched so that the oil can flow into the sump via the map control valve. This position of the data-map control valve simultaneously directs the oil pressure from the filtered oil duct (2) via the oil duct (12) to the back of the piston pressure side (9) of the axially variable pump impeller (3). This oil pressure on the piston (9) supports the pressure control spring (1) and presses the axially movable impeller (3) into the maximum delivery position.

S58 Engine

7. Oil Supply



S58 engine, maximum delivery

T018-2449

Index	Explanation
A	Second level control pressure
B	Map control pressure
C	Oil pressure
1	Pressure control spring
2	Control line, second-level control (emergency operation)
3	Axially movable impeller
4	Pressure relief valve

S58 Engine

7. Oil Supply

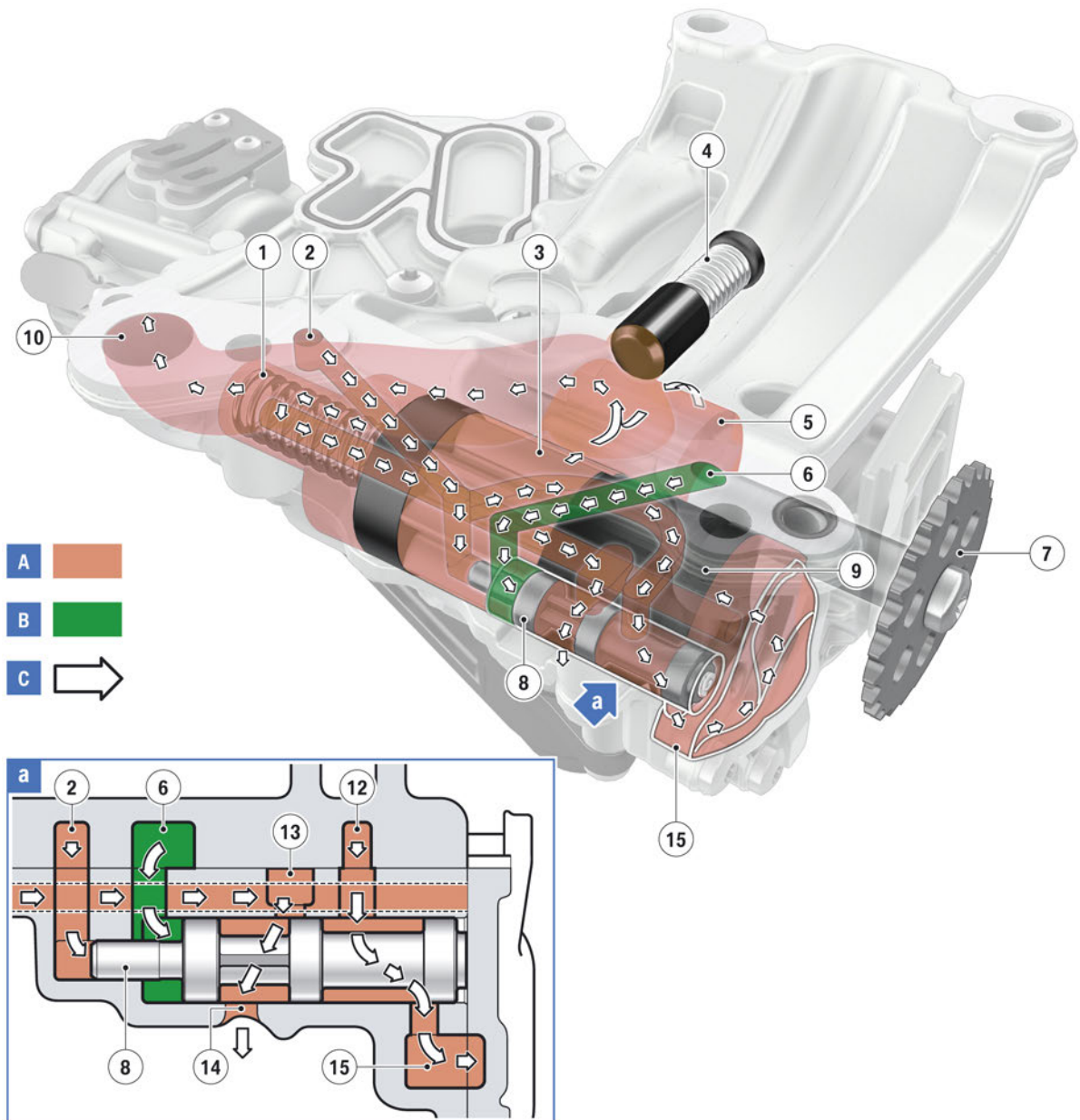
Index	Explanation
5	Sprocket
6	Control line of map control valve (map control pressure)
7	Oil pump drive
8	Control plunger
9	Piston pressure side of the axially movable impeller
10	Oil duct into the engine block (unfiltered oil)
11	Control piston spring
12	Second level control pressure
13	Oil duct to the piston pressure side

7.3.2. Minimum delivery

If the data-map control valve directs the data-map control pressure via the control line (6) to the larger face of the control piston (8), the data-map control pressure overcomes the second-level control pressure due to the difference in surface area on the control piston (8). The map control pressure presses against the control piston spring and thus adjusts the control piston (8) toward minimum delivery. By being moved to the minimum delivery position, the control piston (8) opens the oil duct to the piston pressure side (15). The filtered oil from the oil duct (12) is now conveyed to the front piston pressure side (9) of the axially movable impeller (3). On account of the axial shift caused by the oil pressure, the planes of contact of the external gear wheels are reduced and the delivery rate of the filtered oil decreases. The oil on the rear piston pressure side can flow back into the sump via the oil duct outlet (13) and the oil return flow (14).

S58 Engine

7. Oil Supply



S58 engine, minimum delivery

T018-2450

Index	Explanation
A	Second level control pressure
B	Map control pressure
C	Oil pressure
1	Pressure control spring
2	Control line, second-level control (emergency operation)
3	Axially movable impeller
4	Pressure relief valve

S58 Engine

7. Oil Supply

Index	Explanation
5	Sprocket
6	Control line, second-level control (emergency operation)
7	Oil pump drive
8	Control plunger
9	Piston pressure side of the axially movable impeller
10	Oil duct into the engine block (unfiltered oil)
12	Second level control pressure
13	Oil duct outlet
14	Oil return from piston to sump
15	Oil duct to the piston pressure side

Through the interaction of the map control with the control piston (8), the delivery rate of the oil can be influenced via the axially movable impeller (3) by means of the Digital Motor Electronics (DME).

7.3.3. Second-level control (emergency operation)

During normal operation or if the map control fails, the delivery rate is determined via the second level control. The second-level control pressure (2) acts on the smaller, rear surface of the control piston (8). The second level control pressure (2) presses against the control piston spring and thus adjusts the control piston (8) toward minimum delivery. By being moved towards the minimum delivery position, the control piston (8) opens the oil duct to the forward piston pressure side (15). The filtered oil from the oil duct (12) is now conveyed to the front piston pressure side (9) of the axially movable impeller (3). On account of the axial shift caused by the oil pressure, the planes of contact of the external gear wheels are reduced and the delivery rate of the filtered oil decreases.

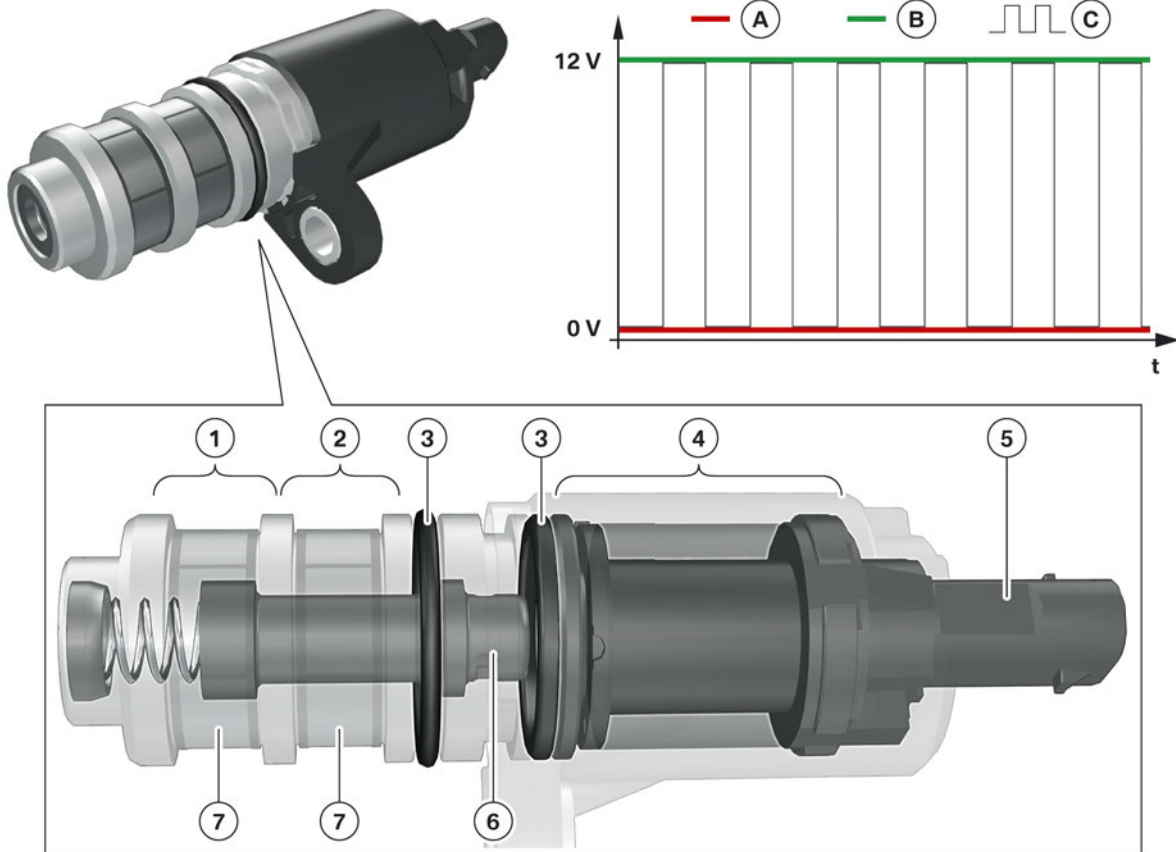
7.4. Map control valve

On the S58 engine, the data-map control valve is mounted on the crankcase and connected to the oil pump via holes drilled in the crankcase.

The map-controlled control valve is a proportional valve which can control the oil pressure steplessly.

S58 Engine

7. Oil Supply



S58 engine, characteristic map control valve

TO14-0590

Index	Explanation
A	Voltage value, maximum actuation for control chamber, maximum pressure
B	Voltage value, minimum actuation for control chamber, depressurized
C	Voltage value at 50% actuation
1	Oil duct to oil pump
2	Oil duct from the oil filter
3	Sealing ring
4	Solenoid coil
5	Electrical connection
6	Valve spool
7	Filter

The oil pressure sensor and the oil temperature sensor are connected to the main oil duct and supply the actual oil pressure and the engine oil temperature to the DME control unit. The DME calculates the required target oil pressure based on the engine's operating point and the temperature. A pulse-width modulated signal is sent to the map-controlled control valve based on the determined setpoint deviation. Depending on the pulse-width modulated signal, the width of the valve spool opening in the

S58 Engine

7. Oil Supply

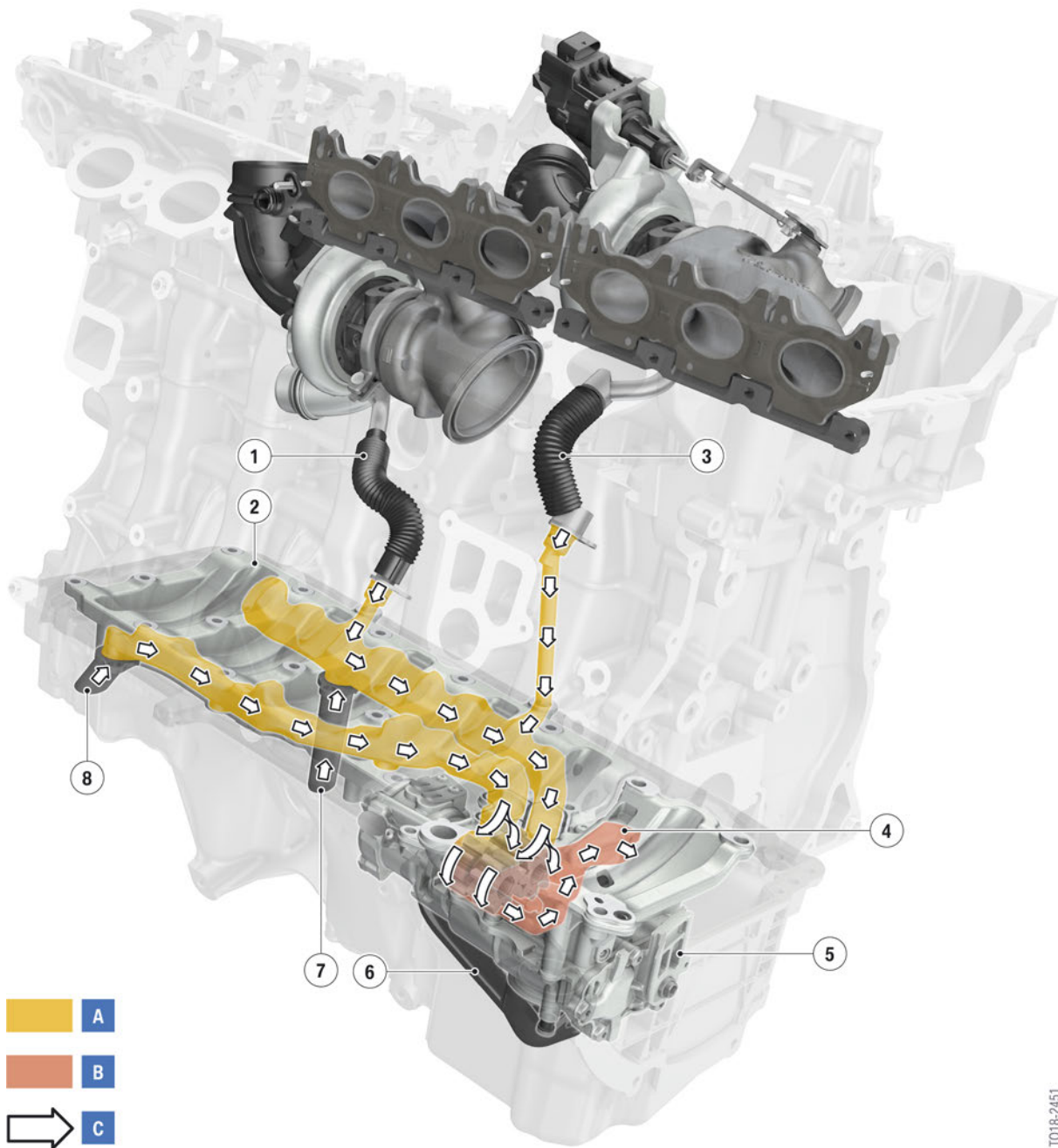
map-controlled control valve varies. Depending on the available opening cross-section, more or less engine oil can flow from the oil duct of the oil filter into the oil duct and to the oil pump. This oil flow changes the position of the control piston in the oil pump, and therefore the delivery rate of the pump.

7.5. Oil supply during high acceleration

In order to adapt the oil supply system to motor racing requirements, a twin oil return pump has been installed to ensure the system functions effectively. The oil return pump assists return of the oil from the turbochargers and from the forward sections of the sump back to the rear section of the sump.

S58 Engine

7. Oil Supply



S58 engine, suction pump

Index	Explanation
A	Intake side
B	Major thrust face
C	Direction of flow/direction of rotation
1	Return pipe
2	Aluminium frame

T018-2451

S58 Engine

7. Oil Supply

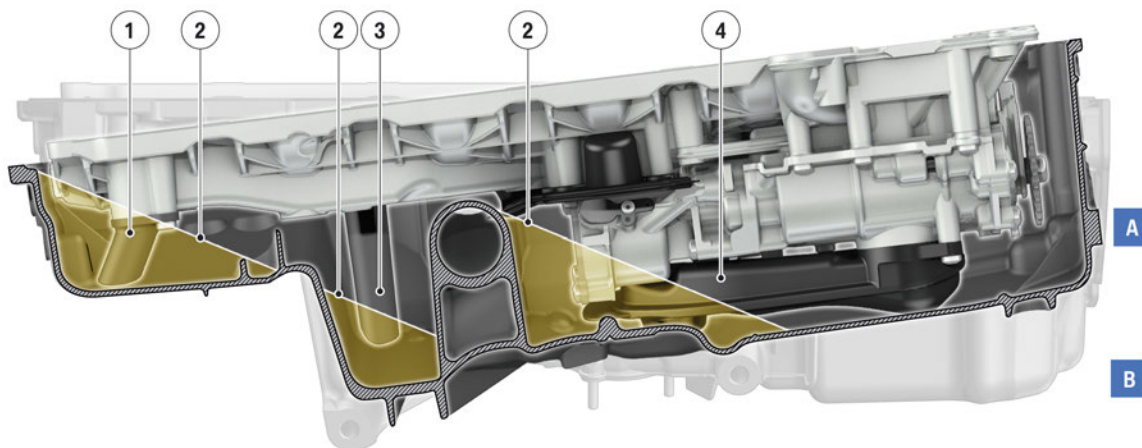
Index	Explanation
3	Suction pump
4	Oil intake snorkel, sump, rear
5	Return opening
6	Oil intake snorkel, sump, front right
7	Oil intake snorkel, sump, front left

With these changes, the oil supply can be guaranteed up to a longitudinal acceleration of 1.3 g. Even in the case of lateral acceleration, for example during cornering, this structure enables a secure oil supply up to constant 1.3 g.

In such driving situations, the engine oil is drawn out of the front of the sump through the front oil intake snorkel by the return pumps during longitudinal acceleration. The oil drawn off is pumped back to the rear part of the sump via the return pipe in the aluminium frame. There the external gear oil pump can take up the oil again via the rear oil intake snorkel and deliver it to the engine lubrication points.

Also at the bearing positions of the exhaust turbocharger the engine oil may collect due to the centrifugal force during lateral acceleration conditions. This prevents a normal backflow to the oil sump and thus also a supply of fresh cool engine oil at the bearing positions.

To counteract this effect, at the bearing positions of the exhaust turbocharger the engine oil is continuously drawn in by the suction pump and delivered to the oil sump.



S58 engine, oil sump with suction pump

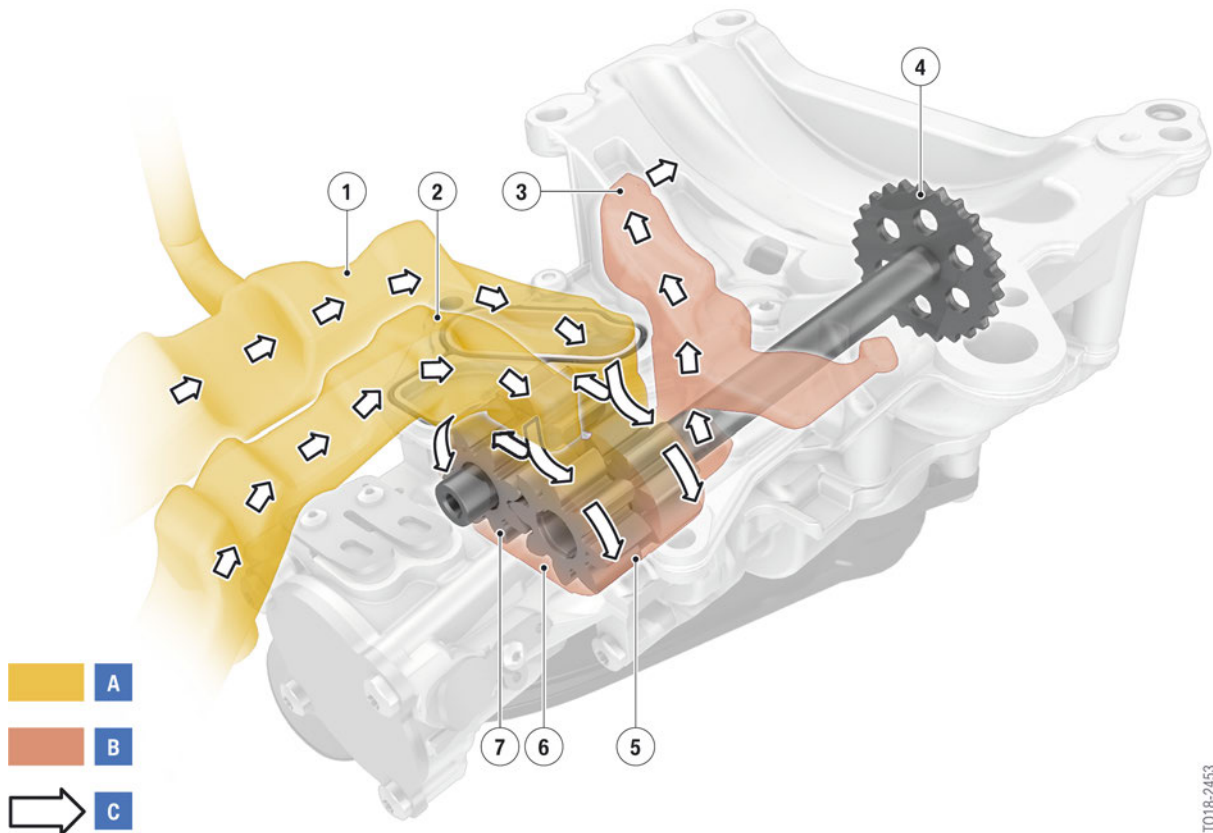
S58 Engine

7. Oil Supply

Index	Explanation
A	Sump in the event of extremely negative longitudinal acceleration (hard braking)
B	Sump during normal driving
1	Oil intake snorkel, sump, front left
2	Oil level in event of extreme negative longitudinal acceleration (hard braking)
3	Oil intake snorkel, sump, front right
4	Oil intake snorkel, sump, rear

The twin oil return pumps are spur-gear oil pumps. The outer upper chamber of the gear pump is the suction chamber. The oil intake snorkels from the front part of the sump are connected to the suction chamber and the engine oil is drawn off through the aluminium frame with integral oil return pumps.

The lower chamber is a pressure chamber. Via the pressure chamber, the drawn-in engine oil is delivered back to the rear oil sump via the return opening in the upper section of the oil pump unit. The engine oil in the rear oil sump is thus available again to the oil pump via the oil intake snorkel.



S58 engine, twin oil return pumps

T018-2453

S58 Engine

7. Oil Supply

Index	Explanation
A	Intake side
B	Major thrust face
C	Direction of flow/direction of rotation
1	Intake port (turbocharger and front right sump)
2	Intake port (front left sump)
3	Return flow opening in rear sump
4	Oil pump drive
5	Sprocket
6	Pressure chamber
7	Impeller

7.6. Oil spray nozzles

Two types of oil spray nozzle are used on the S58 engine. They are the conventional regulated oil spray nozzles with a permanently set opening and closing pressure, and the switchable oil spray nozzles.

	S58 engine
Switchable oil spray nozzle	
Opening pressure	0 bar
Closing pressure	0 bar
Controlled oil spray nozzle	
Opening pressure	> 4.3 bar
Closing pressure	< 4.0 bar

The controlled oil spray nozzles used on the intake side of the crankcase are conventional oil spray nozzles with a permanently set opening and closing pressure.

The oil spray nozzles do not open until the oil pressure reaches 4.3 bar in order to ensure sufficient piston crown cooling regardless of the load at high engine speeds. The oil spray nozzles close again if the oil pressure falls below 4 bar.

The switched oil spray nozzles on the exhaust side are brought into action for cooling at high loads and engine speeds and also for lubrication at very low engine speeds with high engine loads.



In order to achieve an optimum cooling effect, it is essential to position the oil spray nozzles exactly. Non-compliance may lead to damage to the engine. Please observe the current repair instructions in the BMW workshop system ISTA.

S58 Engine

7. Oil Supply

7.7. Centrally controllable piston cooling via oil spray nozzles

In addition to the bearing positions, the oil pump also supplies the oil spray nozzles with the required volumetric flow, whereby the consumption of the oil spray nozzles significantly influences the power of the oil pump.

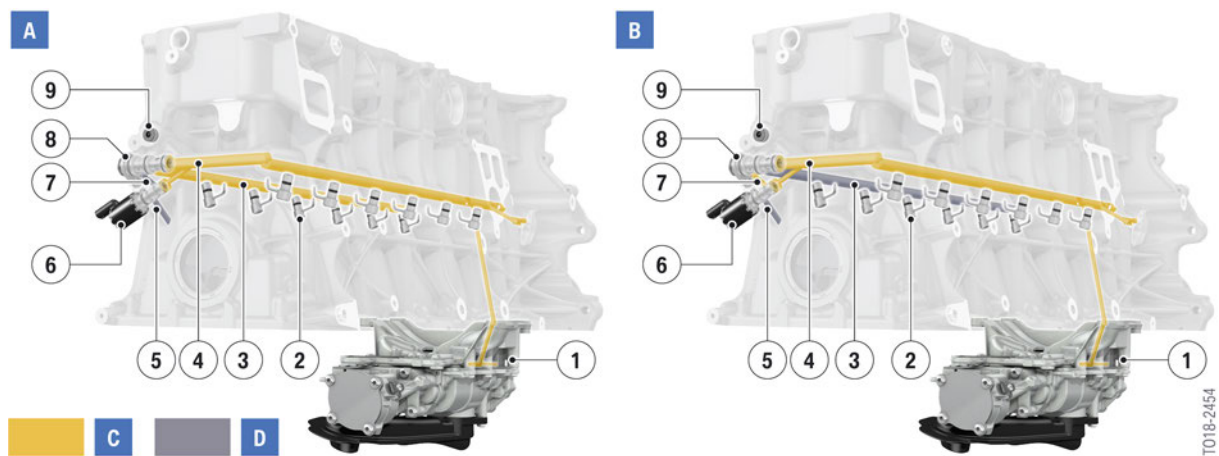
For that reason, the S58 engine is the first petrol engine to feature centrally controllable piston cooling. Deactivating the piston cooling reduces the oil pump power. In turn, this reduces the power loss of the engine and saves fuel in the partial load range with the same vehicle performance.

The centrally controllable piston cooling has the following special features:

- Additional oil ducts in the cylinder crankcase
- Oil spray nozzles without defined opening pressure
- Piston cooling control valve
- Piston cooling relay valve.

The central valve controls the oil spray nozzles on the exhaust side of the crankcase. This enables requirement-based piston cooling over the entire characteristic map range of the engine.

The following system overview provides an initial outline of the structure of the piston cooling in the S58 engine.



S58 engine, piston cooling

Index	Explanation
A	Piston cooling active (piston cooling control valve de-energized)
B	Piston cooling not active (piston cooling control valve energized)
C	Oil pressure
D	Depressurized
1	Oil pump
2	Oil spray nozzle
3	Oil duct to the oil spray nozzles

S58 Engine

7. Oil Supply

Index	Explanation
4	Main oil duct from oil filter
5	Return channel
6	Piston cooling control valve
7	Control channel
8	Piston cooling relay valve
9	Seal plug

As a result of the controllable piston cooling used on the S58 engine, the piston cooling can be selectively deactivated independently of engine oil pressure with the following benefits:

- Lower drive power of the oil pump
- Smaller dimensioning of the oil pump
- Lower fuel consumption
- Lower exhaust emissions

7.7.1. Relay valve control valve

The valves have the task of selectively activating or deactivating the piston cooling and consist of the following two components:

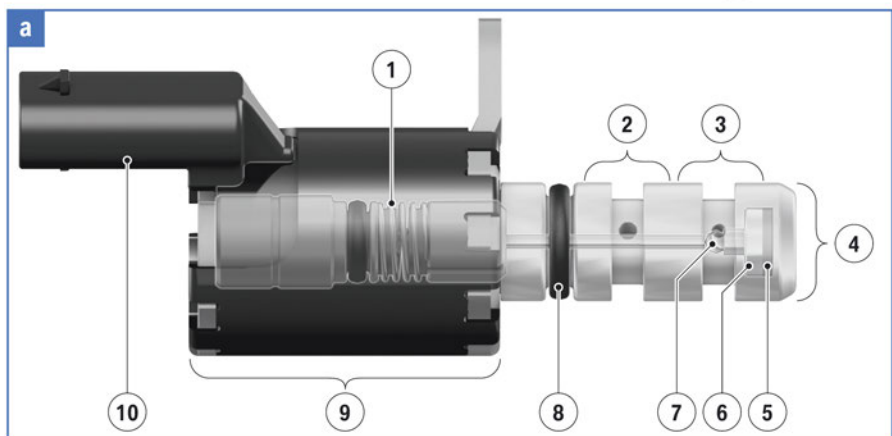
- Piston cooling control valve
- Piston cooling relay valve

Piston cooling control valve

The piston cooling control valve is necessary in order to operate the piston cooling relay valve. Actuation is performed on demand by the DME control unit.

S58 Engine

7. Oil Supply



S58 engine, piston cooling control valve

Index	Explanation
1	Compression spring
2	Return channel to the crank space
3	Control channel to piston cooling control valve
4	Main oil duct from oil filter
5	Oil strainer
6	Valve seat
7	Valve ball
8	Sealing ring
9	Solenoid coil
10	Electrical connection

The piston cooling control valve has the following two switching positions:

- Piston cooling control valve de-energized:
 - The force of the compression spring holds the piston cooling control valve closed.
 - Return channel is connected to the control channel.

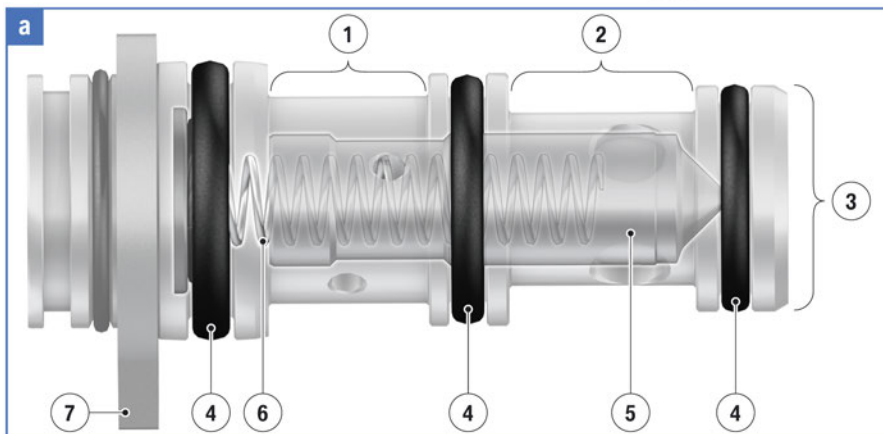
S58 Engine

7. Oil Supply

- Piston cooling control valve energized by the DME control unit:
 - Solenoid coil pulls against the spring force.
 - Control channel is opened to the oil from the main oil duct.
 - Return channel is closed by the valve ball.

Piston cooling relay valve

The piston cooling relay valve is a purely mechanical valve and has the task of activating or deactivating piston cooling.



S58 engine, piston cooling relay valve (central valve)

Index	Explanation
1	Control channel from piston cooling control valve
2	Oil duct to the oil spray nozzles
3	Main oil duct from oil filter
4	Sealing ring
5	Piston
6	Spring
7	Mounting cap

S58 Engine

7. Oil Supply

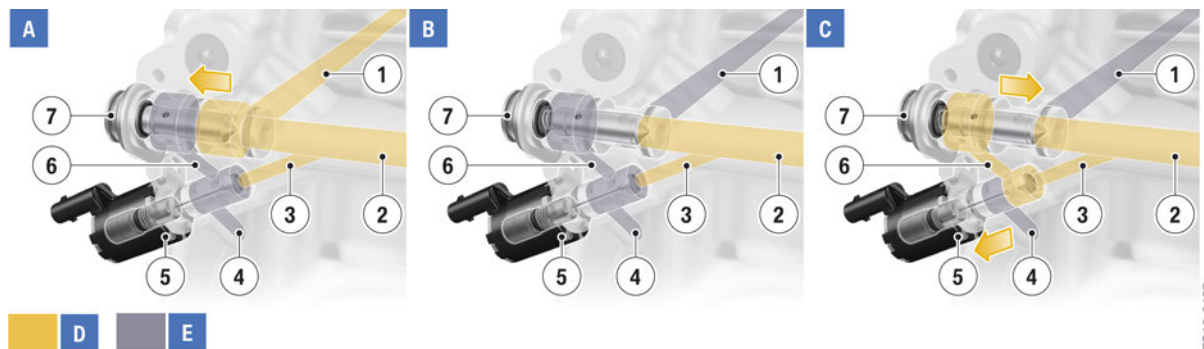
The following operating condition opens the piston cooling relay valve and activates piston cooling:

- Oil pressure from the main oil duct > 1 bar.
 - Piston is moved against the spring force.
 - Channel to the oil spray nozzles is opened and the pistons are cooled.
 - Oil that is behind the piston can drain into the crank chamber via the control channel, the piston cooling control valve and the return channel.

The following operating conditions prevent the piston cooling relay valve from opening and deactivate piston cooling:

- Oil pressure from the main oil duct < 1 bar.
 - Spring force is greater than the oil pressure from the main oil duct.
 - Channel to the oil spray nozzles is not opened.
- Piston cooling control valve energized.
 - Oil is directed from the piston cooling control valve through the control channel to the space behind the pistons of the piston cooling relay valve.
 - Oil pressure and spring force generate a back-pressure and seal off the piston cooling relay valve from the main oil duct.
 - The channel to the oil spray nozzles can no longer be opened.

Illustration of central valve functions



S58 engine, illustration of central valve function

Index	Explanation
A	Piston cooling control valve de-energized, oil pressure in main oil duct > 1 bar. Piston cooling active
B	Piston cooling control valve de-energized, oil pressure in main oil duct < 1 bar. Piston cooling deactivated
C	Piston cooling control valve energized, oil pressure in main oil duct > 1 bar. Piston cooling deactivated
D	Oil pressure
E	Depressurized

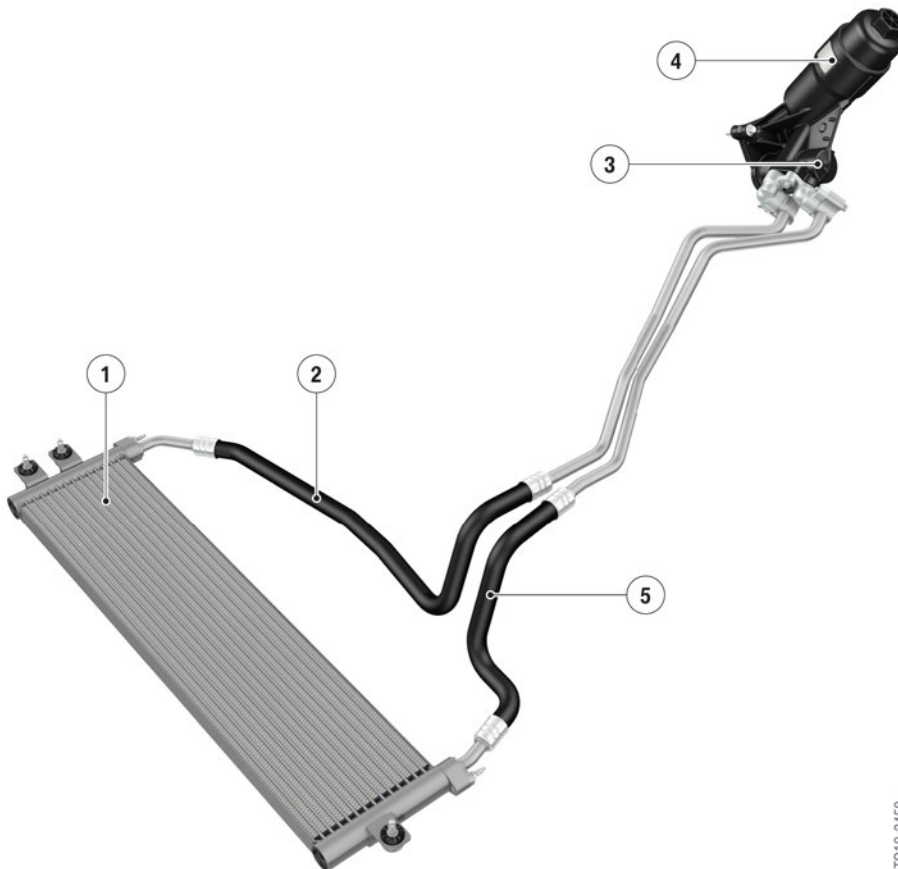
S58 Engine

7. Oil Supply

Index	Explanation
1	Channel to the oil spray nozzles
2	Main oil channel to piston cooling relay valve
3	Main oil channel to piston cooling control valve
4	Return channel
5	Piston cooling control valve
6	Control channel
7	Piston cooling relay valve

7.8. Oil filter and engine oil cooling

The oil filter housing is made from aluminium. For engine cooling, a discrete engine oil cooler is used which is fitted horizontally in front of the radiator module. Depending on the engine oil temperature, a thermostat at the oil filter housing enables the oil flow to the engine oil cooler.



S58, engine oil cooling

T018-2459

S58 Engine

7. Oil Supply

Index	Explanation
1	Engine oil cooler
2	Engine oil pipe, return
3	Thermostat
4	Oil filter
5	Engine oil pipe, supply

The thermostat opens and closes under the following three operating conditions:

- Engine oil temperature $< 100 \pm 2 \text{ }^\circ\text{C}$ ($212 \pm 35 \text{ }^\circ\text{F}$): The entire oil flow is passes directly through the oil filter.
- Engine oil temperature $100 \pm 2 \text{ }^\circ\text{C} - 114 \pm 2 \text{ }^\circ\text{C}$ ($212 \pm 35 \text{ }^\circ\text{F} - 237 \pm 35 \text{ }^\circ\text{F}$): Part of the oil flow passes through the engine oil cooler and then through the oil filter, the rest passes directly through the oil filter.
- Engine oil temperature $> 114 \pm 2 \text{ }^\circ\text{C}$ ($237 \pm 35 \text{ }^\circ\text{F}$): The flow through the engine oil cooler is regulated in order to obtain the target engine oil temperature.

$100 \text{ }^\circ\text{C}$ ($212 \text{ }^\circ\text{F}$) is chosen as the initial opening temperature because then the condensation water in the oil evaporates through the crankcase ventilation system.

7.9. Engine oil monitoring

7.9.1. Oil pressure

Because the S58 engine has a data-map controlled oil pump, it is necessary to precisely register the oil pressure. For that reason, an oil pressure sensor is used.

The advantages of the sensor are:

- Measurement of the absolute pressure (previously used relative pressure)
- Characteristic map control possible at every engine speed

7.9.2. Oil temperature

The familiar oil temperature sensor from the N55 engine is used to measure the oil temperature.

7.9.3. Oil level

The familiar oil-level sensor, which simultaneously measures the temperature in the sump, is used to measure the oil level.

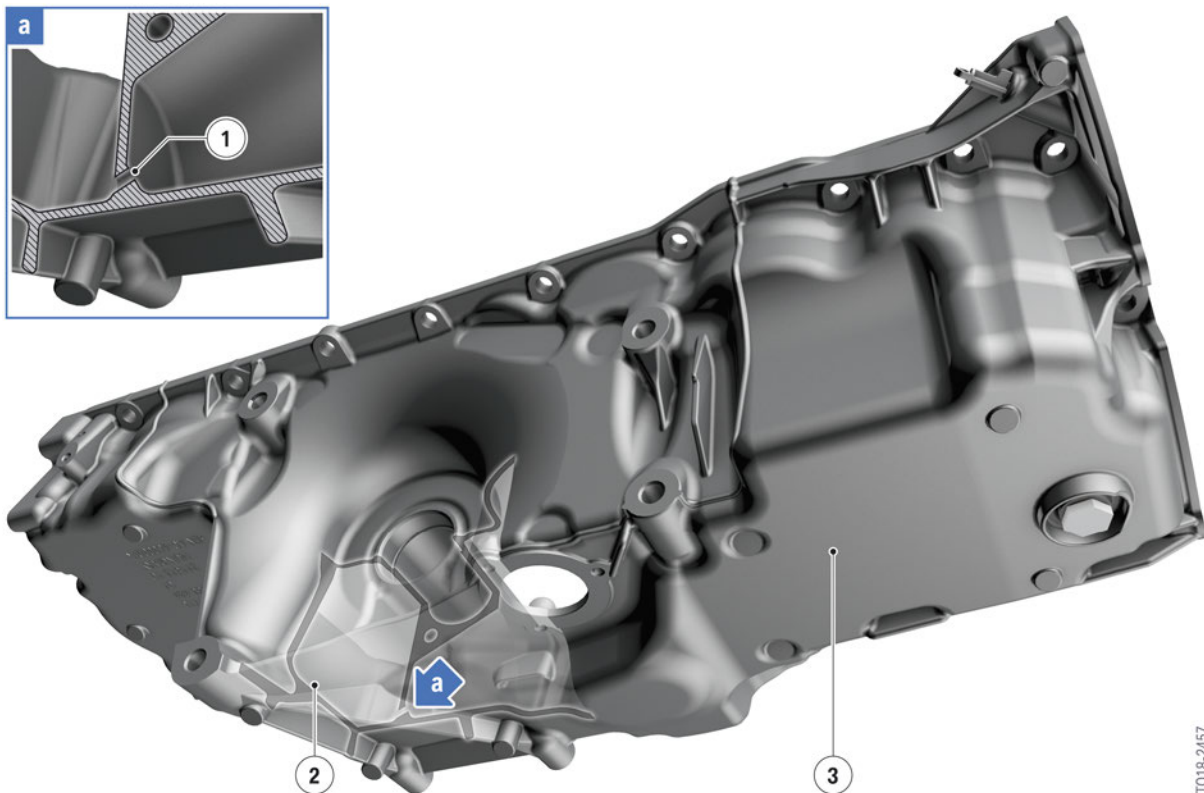
S58 Engine

7. Oil Supply

7.10. Service information

At present, as with other BMW M models with S engines, an engine oil change at 2,000 km (1200 mile) (running-in check) is provided for in the case of the S58 engine.

To ensure that the engine oil in the front, smaller sump is drained completely during an engine oil service, the upper section of the sump features a small drain hole through which the engine oil can flow to the rear sump.



S58 engine, drain hole

Index	Explanation
1	Drain hole
2	Front, smaller oil sump
3	Rear oil sump



The current engine oil recommendations and capacities can be found in the current documentation of the BMW workshop information system or the vehicle Owner's Handbook.

S58 Engine

8. Intake Air and Exhaust System

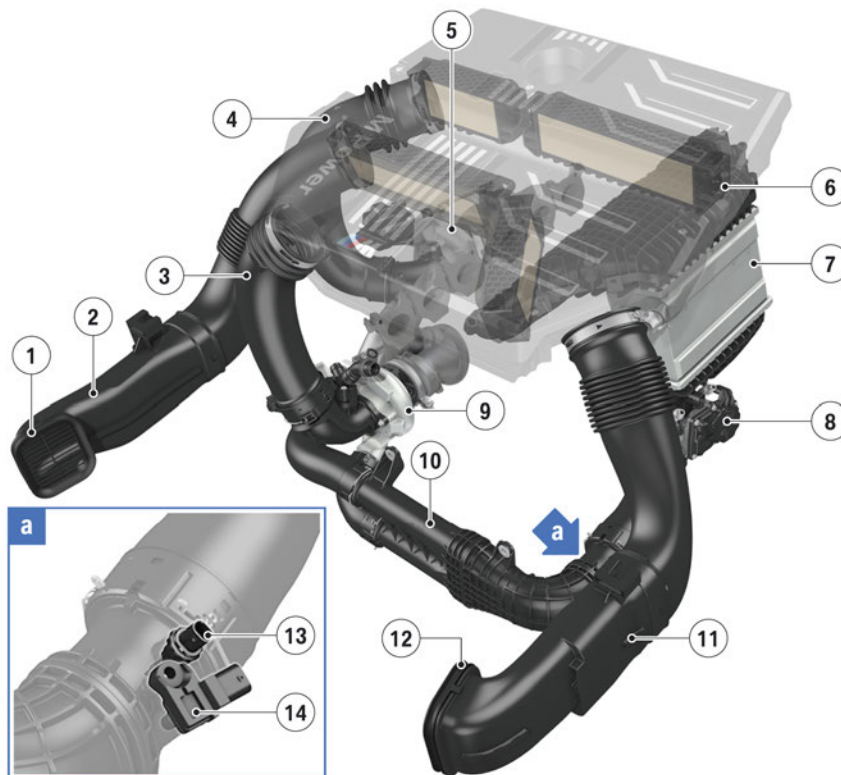
8.1. Air intake system

8.1.1. Overview

For the S58 engine the intake air system had to be completely realigned.

- Air intake duct up to the intake silencer
- Clean air duct due to new exhaust turbochargers completely new
- Crankcase venting components
- Indirect charge air cooling
- Coolant-cooled electromotive throttle controller
- Tank ventilation system adapted.

As can be seen from the graphics, the design of the intake air system is more complex, as two turbochargers are fitted and indirect charge air cooling is employed.



S58 engine, intake air system

T018-2461

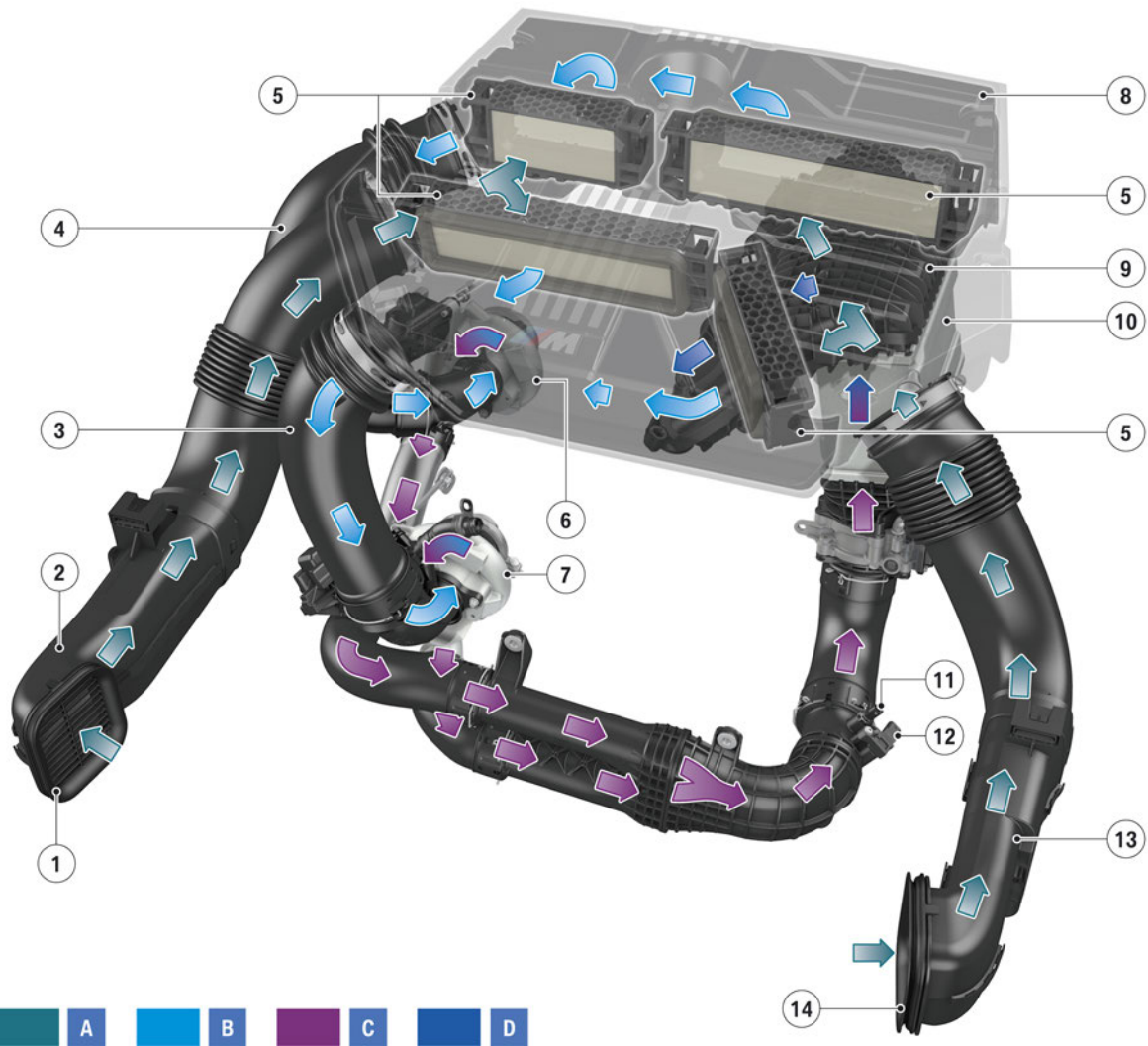
S58 Engine

8. Intake Air and Exhaust System

Index	Explanation
1	Intake snorkel, right
2	Unfiltered air pipe, right
3	Clean air duct, cylinders 1-3
4	Clean air duct, cylinders 4-6
5	Exhaust turbocharger, cylinders 4-6
6	Intake silencer
7	Intake plenum with indirect charge air cooler
8	Throttle valve
9	Exhaust turbocharger, cylinders 1-3
10	Y charge air pipe
11	Unfiltered air pipe, left
12	Intake snorkel, left
13	Intake air temperature sensor
14	Charging pressure sensor before throttle valve

S58 Engine

8. Intake Air and Exhaust System



S58 engine, intake air system from above

T018-2460

Index	Explanation
A	Unfiltered air
B	Clean air
C	Heated charge air
D	Cooled charge air
1	Intake snorkel, right
2	Unfiltered air pipe, right
3	Clean air duct, cylinders 1-3
4	Clean air duct, cylinders 4-6
5	Air cleaner
6	Exhaust turbocharger, cylinders 4-6

S58 Engine

8. Intake Air and Exhaust System

Index	Explanation
7	Exhaust turbocharger, cylinders 1-3
8	Intake silencer cover
9	Intake plenum
10	Indirect charge air cooler
11	Intake air temperature sensor
12	Charging pressure sensor before throttle valve
13	Unfiltered air pipe, left
14	Intake snorkel, left

8.1.2. Air mass determination

On the US and Europe versions, the intake air mass flow is not measured by a hot-film air mass meter but calculated by the DME. For this calculation, an experience-based filling calculation (filling model) is programmed in the DME. The following signals are applied to this calculation.

Signals:

- VANOS setting (load sensing)
- Throttle valve position (throttling)
- Intake air temperature (air density correction)
- Engine temperature (air density correction)
- Engine speed (cylinder charging)
- Intake manifold differential pressure (throttling correction)
- Ambient pressure (air density based on altitude correction).

The air mass calculated in this way is adjusted and corrected if necessary in line with the oxygen sensor signals (air/fuel ratio) and the injection period (fuel quantity). Should the oxygen sensors fail, a fault memory entry is made in the DME (air mass plausibility). Adjustment to the calculated air mass does not apply in this case.

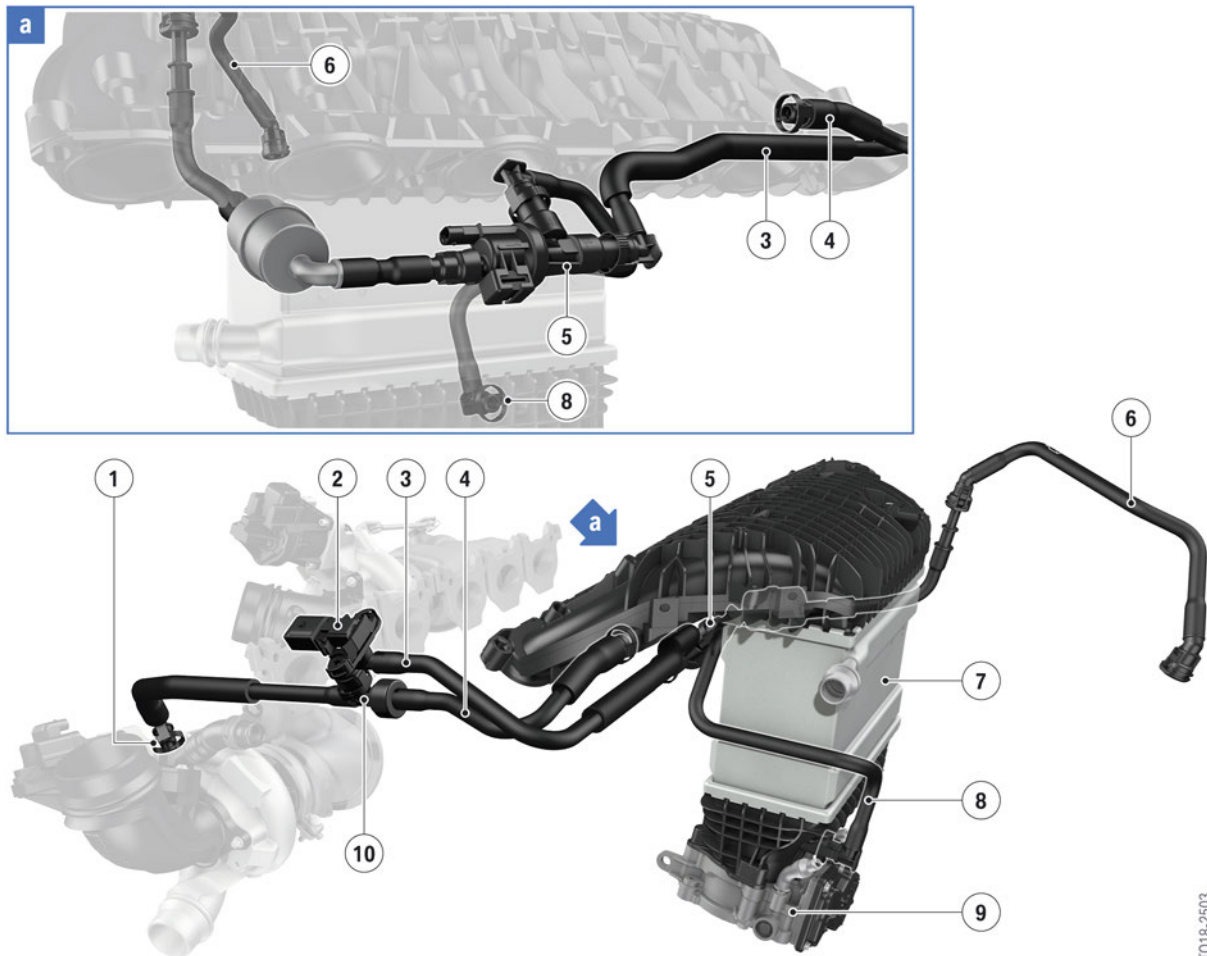
The monitoring of the tank ventilation system for leaks that is legally required on the US is performed by the venturi nozzle pressure sensor on the S58 engine. Therefore, it has been possible to dispense with the hot film air mass meter.

8.1.3. Tank ventilation system

In a carbon canister the fuel vapors are stored temporarily and fed for combustion via the tank vent valve. With turbocharging it is necessary to also adapt this system to the specifications.

S58 Engine

8. Intake Air and Exhaust System



S58 engine, tank ventilation system

TO18-2503

Index	Explanation
1	Connection before turbocharger
2	Venturi nozzle pressure sensor
3	Tank ventilation line
4	Intake plenum connection
5	Tank vent valve
6	Connection to the tank ventilation line from the carbon canister
7	Indirect charge air cooler
8	Connection after throttle valve
9	Throttle valve
10	Venturi nozzle

S58 Engine

8. Intake Air and Exhaust System

8.1.4. Venturi nozzle pressure sensor

The flow of scavenging air is generated by the vacuum in the intake pipe. In order to be able to scavenge in turbocharged mode as well, vacuum is generated by means of a venturi nozzle. The venturi nozzle is powered by an air mass flow which is tapped downstream of the intercooler and fed back in upstream of the impeller. The venturi nozzle pressure sensor in the tank vent pipe is used to diagnose the second feed-in point of the tank ventilation system.

Strain gauges are used to determine the pressure. A steel diaphragm in the sensor fitted with strain gauges is deformed by the pressure present. The changes in resistance of the strain gauges are electronically analyzed by a Wheatstone bridge. The voltage measured is then included in the tank ventilation diagnosis as an actual data reading. The venturi nozzle pressure sensor is a differential pressure sensor.

8.1.5. Carbon canister

To meet emission standards in the US, a carbon canister with a larger volume is used. The basic function of the carbon canister has not changed. The increase in volume is solely for the purpose of collecting larger amounts of fuel vapor and retaining them for longer before a flushing operation by the tank vent valve takes place.

8.2. Exhaust emission system

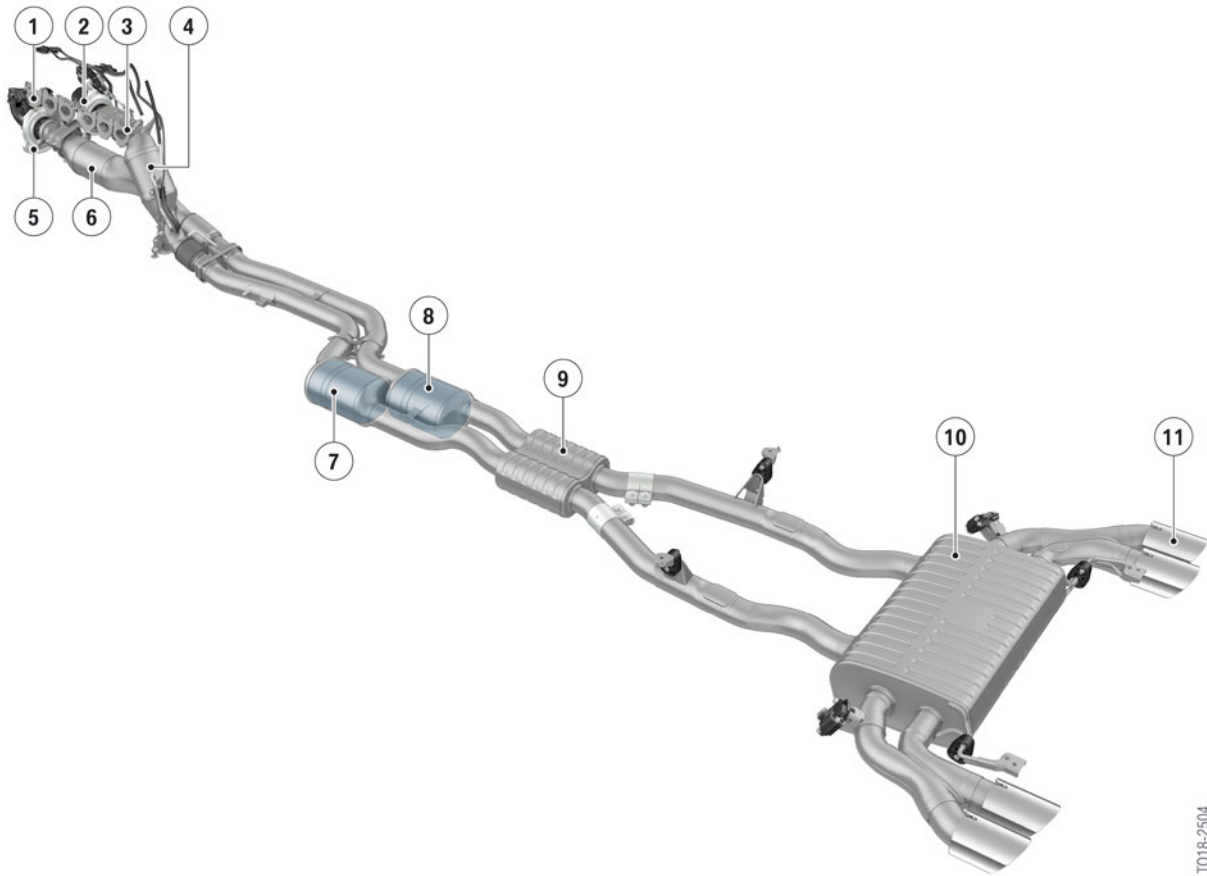
8.2.1. Overview

The exhaust emission system has a different structure in the S58 engine with the two exhaust turbochargers than in the B58TU engine with a twin-scroll exhaust turbocharger. The exhaust system is a cylinder-dependent twin-pipe design.

The exhaust system was designed for minimum exhaust gas pressure. With this dethrrottling of the exhaust system, the efficiency of the gas exchange could be optimized even further.

S58 Engine

8. Intake Air and Exhaust System



TO18-2504

S58 engine, exhaust system

Index	Explanation
1	Exhaust manifold, cylinders 1-3
2	Exhaust turbocharger, cylinders 4-6
3	Exhaust manifold, cylinders 4-6
4	Catalytic converter, cylinders 4-6
5	Exhaust turbocharger, cylinders 1-3
6	Catalytic converter, cylinders 1-3
7	Catalytic converter/particulate filter (Not for the US)
8	Catalytic converter/particulate filter (Not for the US)
9	Center silencer
10	Rear silencer
11	Exhaust tailpipes

S58 Engine

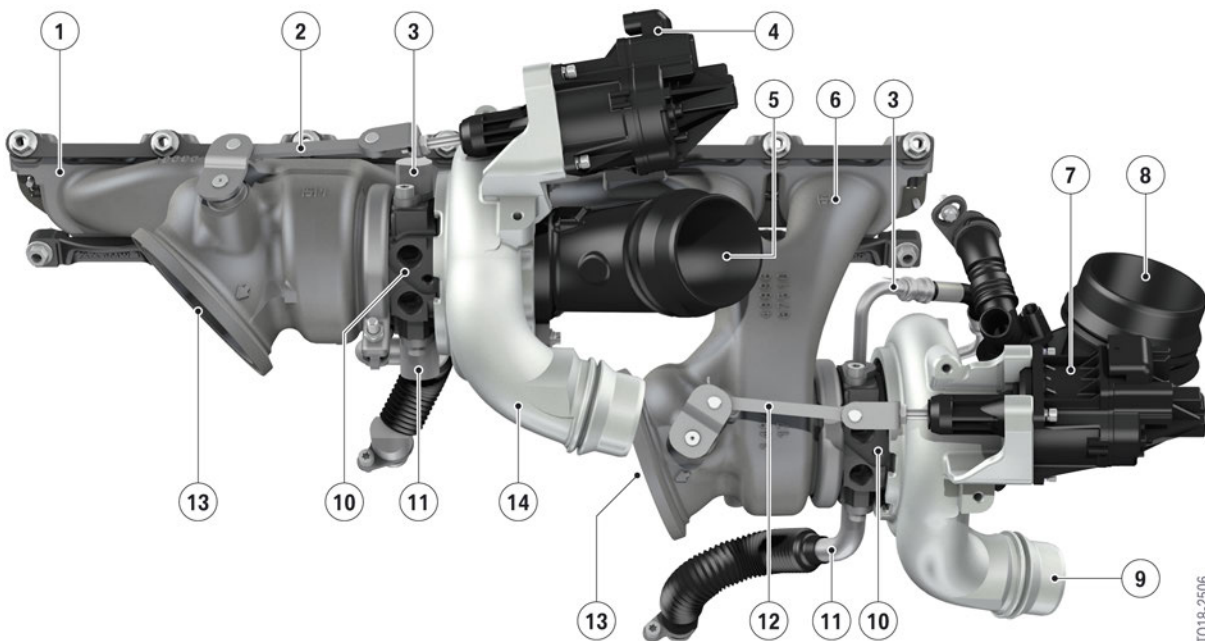
8. Intake Air and Exhaust System

Overview of available exhaust systems on F97/F98 with S58 engine

Standard exhaust system	US version
Upstream catalytic converter	●
Underbody catalytic converter	●
Front oxygen sensor	●
Monitoring oxygen sensor	●
Exhaust flap	●
Chrome-plated tailpipe trims	●
M Sport exhaust system	
Continuous exhaust flap	●
Black chrome-plated tailpipe trim	●

8.2.2. Exhaust manifold with turbocharger

The exhaust manifold is designed in relation to the bank. One exhaust manifold is used for every bank. The condensing of the three exhaust ducts into a single exhaust duct results in an optimal inflow of the turbine of the exhaust turbocharger. The exhaust manifold is cast into one part together with the turbine housing of the exhaust turbocharger and is thus one component.



T018-2506

S58 engine, connection of exhaust turbocharger at the engine housing

S58 Engine

8. Intake Air and Exhaust System

Index	Explanation
1	Exhaust manifold, cylinders 4-6
2	Wastegate valve, control rod, cylinders 4-6
3	Oil feed line
4	Electrical wastegate valve actuator, cylinders 4-6
5	Clean air feed, cylinders 4-6
6	Exhaust manifold, cylinders 1-3
7	Electrical wastegate valve actuator, cylinders 1-3
8	Clean air feed, cylinders 1-3
9	Connection for the charge air cooler, cylinders 1-3
10	Coolant connections
11	Oil return
12	Wastegate valve, control rod, cylinders 1-3
13	Connection for the exhaust system
14	Connection for the charge air cooler, cylinders 4-6

The S58 engine has a twin-turbocharger system using mono-scroll turbochargers as also used on the S55 engine. The system supplier for the mono-scroll turbocharger assembly on the S58 engine is the MHI Group.

8.2.3. Electrical wastegate valve actuator

The S58 engine uses an electric wastegate controller. The function of the electric wastegate controller on the S58 engine is the same as on the BMW AG engines.

The fundamental advantages of the electric wastegate controller are:

- High adjustment speed
- Precise charging pressure control
- High closing force, thus less leakage and quicker build-up of charging pressure
- Complete opening of the wastegate valve possible. This supports quick heating up with a cold catalytic converter.
- Thus lower exhaust emissions
- Fuel economy

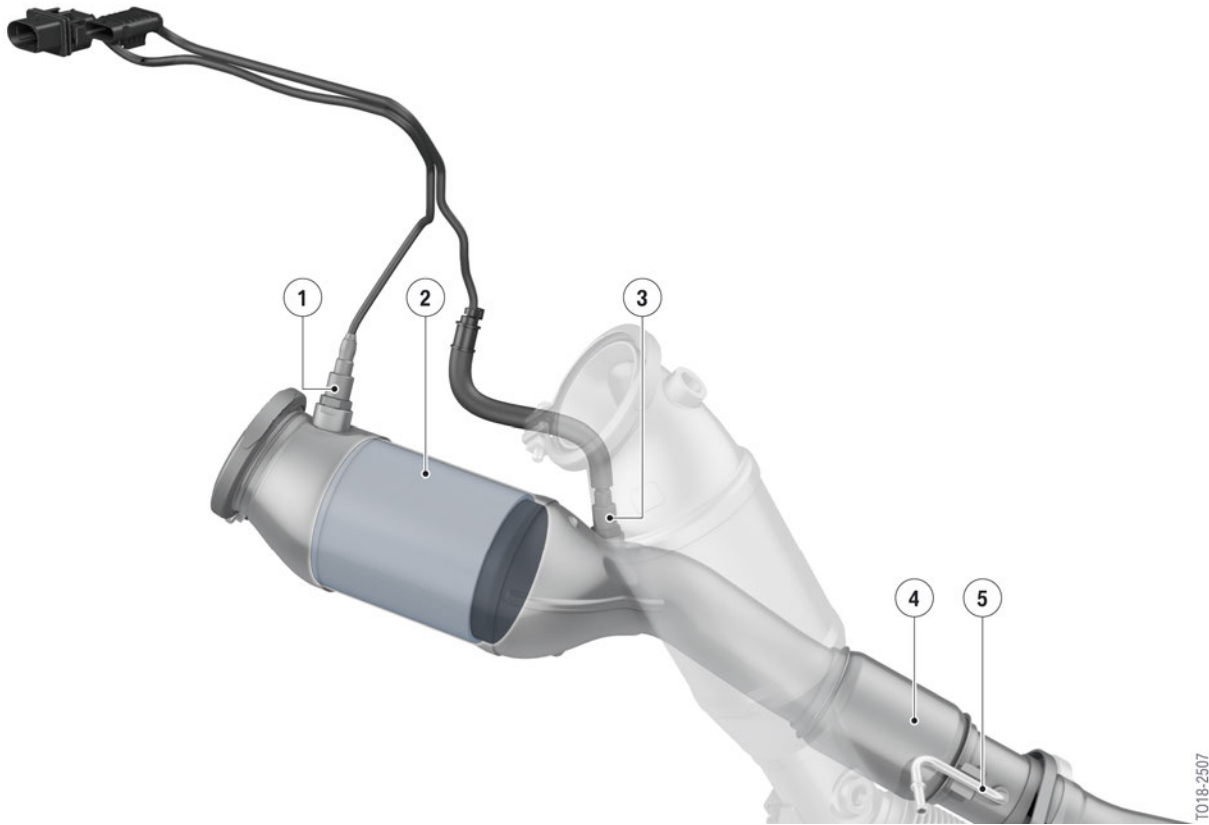
The electric wastegate controller is controlled directly by the DME control unit using a pulse-width modulated (PWM) signal.

8.2.4. Catalytic converter

The S58 engine has one close-to-engine catalytic converter per cylinder bank, each with a ceramic monolith.

S58 Engine

8. Intake Air and Exhaust System



S58 engine, catalytic converter

Index	Explanation
1	Oxygen sensor upstream of monolith catalytic converter, cylinders 1-3
2	Monolith catalytic converter, cylinders 1-3
3	Oxygen sensor downstream of monolith catalytic converter, cylinders 1-3
4	Decoupling element
5	Differential pressure sensor connection

8.2.5. Front oxygen sensor

The oxygen sensor (LSU 5.2) from Bosch is used as a control sensor before the catalytic converter. The function is comparable to the oxygen sensor (LSU AVD) and therefore is not described in detail here.

The oxygen sensor before catalytic converter (LSU 5.2) is characterized by the following advantages:

- High signal running, especially in charged operation due to lower M dynamic pressure dependence
- Increased durability thanks to reduced pump voltage
- Increased accuracy

S58 Engine

8. Intake Air and Exhaust System

- Rapid operating readiness < 7 s
- Higher heater output at 10 W
- Increased temperature compatibility
- Improved system connector with better contact properties

The LSU 5.2 has an extended measuring range. It is thus possible to measure precisely from oxygen sensor 0.65 and higher. The new oxygen sensor is operational earlier, meaning exact measured values are available after only 7 s.

The measuring dynamics of the sensor is higher, whereby it is possible to determine the air/fuel ratio in each cylinder separately and thus also control it. As a result, a homogeneous exhaust flow can be adjusted, the emission levels lowered and the long-term emission behavior optimized.

8.2.6. Monitoring oxygen sensor

The oxygen sensor after the catalytic converter is also called a monitoring sensor. The monitoring sensor LSF XFOUR from Bosch is used which is the successor sensor to the LSF 4.2.

The LSF Xfour needs the DME 8.6.S for signal analysis and is distinguished by the following characteristics:

- To achieve quicker response characteristics after engine start (half of the LSF 4.2 value), a stronger controlled heater has been integrated in the LSF Xfour.
- This improves signal stability.
- Less space is required for installation.
- Thanks to the high temperature resistance and optimal thermoshock protection, the resistance to condensation in the exhaust tract following a cold start has been improved.



Depending on the conditioning of the emission control systems, it may take around 30 seconds for the full power of the engine to be available after it is started. In that period, the DME control unit activates a substitute program that is required in order to quickly bring the emission control systems up to operating temperature. In that situation the full power of the engine is not available as normal. If necessary, the driver is notified of the situation by a CCM (check control message).

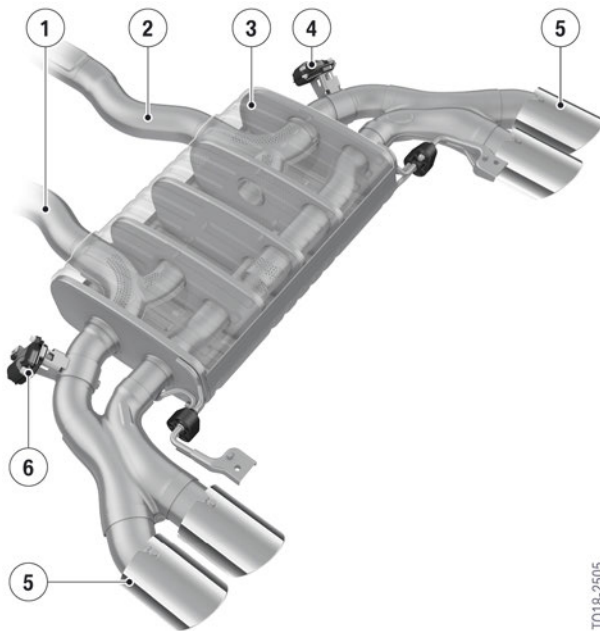
8.2.7. Rear silencer

The rear silencer has the typical M chrome-plated exhaust tailpipe trims.

The electrical exhaust flaps are activated directly by the DME by a pulse-width modulated signal.

S58 Engine

8. Intake Air and Exhaust System



S58 engine, electric exhaust flaps

Index	Explanation
1	Exhaust pipe, left
2	Exhaust pipe, right
3	Rear silencer
4	Electrical exhaust flap actuator (EAKS), right
5	Twin tailpipe
6	Electrical exhaust flap actuator (EAKS), left

8.2.8. Electrically controlled exhaust flaps

The exhaust flaps are integrated in the rear silencer in the outer exhaust tailpipes. The exhaust flaps are operated by an axially aligned electric motor with integrated gears and electronics. The electric controller for the exhaust flaps has the following connections:

- Voltage supply (+)
- Ground (-)
- Actuating wire (signal line)

The exhaust flaps can be used influence the acoustics of the engine at low engine revs and low loads for reasons of comfort. In addition, the exhaust flap is intended to reduce the external noise levels in everyday urban use.

At high engine speeds and high engine loads, the exhaust gas counterpressure can be reduced by opening the exhaust flap.

S58 Engine

8. Intake Air and Exhaust System

If the electric controller detects an internal fault, it notifies the DME control unit engine management.

The exhaust flap cannot adopt an intermediate setting; it is either fully opened or closed. The flap is moved to the respective mechanical end stops by means of pulse-width modulated signals (PWM signals).

Electrical exhaust flap	S58B30T0 engine
Installation location	right and left
PWM signal open	10% duty cycle
PWM signal closed	90% duty cycle



The electrical controller of the exhaust flap can be replaced separately. The controller can be moved into an installation position using the BMW diagnosis system ISTA.

The exhaust flaps are operated on a demand-oriented basis and can be influenced by setting the engine dynamics control buttons to **“Efficient”**, **“Sport”** or **“Sport+”**.

Apart from the engine dynamics control buttons, the position of the exhaust flaps can also be influenced by the sound button in the center console switch cluster.

In default mode the button is deactivated and the acoustic characteristics linked to the modes. If the Sound button is pressed then the vehicle interior acoustics are trimmed to the maximum comfort setting. That is independent of the selected driving mode – in other words the Sound button overrides other acoustics settings.

Thus, in order to obtain maximum comfort (quietness) when the Sound button is active, the exhaust flap is kept closed for as long as possible. Therefore, it no longer opens when the driver calls for more power but instead in response to the exhaust mass flow rate. It remains closed as long as it does not affect performance and fuel consumption or until the perceived noise level in the vehicle interior is more comfortable.

Activation of the Sound button also reduces all other activities that have an effect on the interior acoustics (ASD).

If the vehicle has not entered sleep mode, i.e. is started up again after being parked for a short period, the settings are retained. The same applies to the Auto Start/Stop function.

Due to the internal interconnection of the exhaust tailpipes, the exhaust always flows through both pairs of tailpipes regardless of the flap setting.

The sound button is connected with the Body Domain Controller (BDC) via a LIN bus.

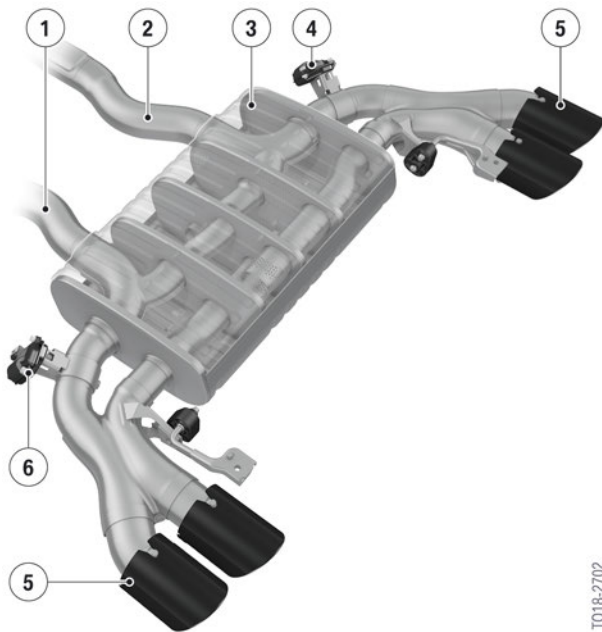
8.2.9. M Sport exhaust system

The M Sport exhaust system SA 1MA comes as standard with Competition package SA 7MN on the F97/F98.)

S58 Engine

8. Intake Air and Exhaust System

The design of the sports exhaust system only differs from the standard production exhaust system by virtue of the internal design of the rear silencer. That design feature in the area of the rear silencer and the controlled exhaust flaps has made it possible to give the F97/F98 with M Sport exhaust system an even more distinctly powerful, richer and more emotive sound than the standard production exhaust system.



T018-2702

S58 engine, M Sport exhaust system

Index	Explanation
1	Exhaust pipe, left
2	Exhaust pipe, right
3	Electrical exhaust flap actuator (EAKS), right
4	Rear silencer
5	Twin tailpipe
6	Electrical exhaust flap actuator (EAKS), left

In contrast with the exhaust flaps on the standard exhaust system, the exhaust flaps of the M Sport exhaust system can adopt intermediate positions. Therefore, it is possible for the exhaust flaps to be continuously variably adjusted to any position. On vehicles with the M Sport exhaust system, the exhaust flap is fully open in Sport mode.

The sports exhaust system of the F97/F98 features black chrome-plated tailpipe trims as a visual identification feature.

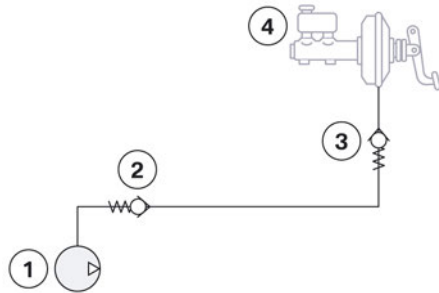
A further, more emotive adaptation of the interior sound in the F97/F98 with M Sport exhaust system is made possible by a different Active Sound Design (ASD) tuning.

S58 Engine

9. Vacuum System

9.1. Design

The S58 engine has a vacuum pump for generating the necessary vacuum for the brake booster.



S58 engine, vacuum system

TO14-0226

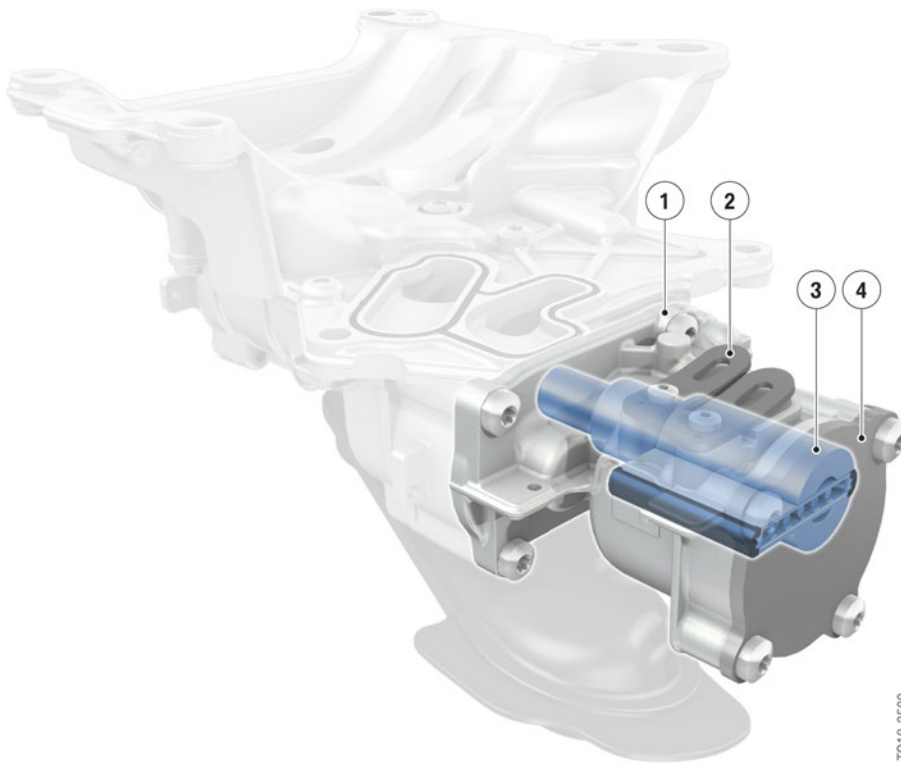
Index	Explanation
1	Vacuum pump
2	Non-return valve
3	Non-return valve
4	Brake booster

9.1.1. Vacuum pump

The vacuum pump is attached to the oil pump. The vacuum pump is only required for supplying the brake booster.

S58 Engine

9. Vacuum System



T018-2509

S58 engine, vacuum pump

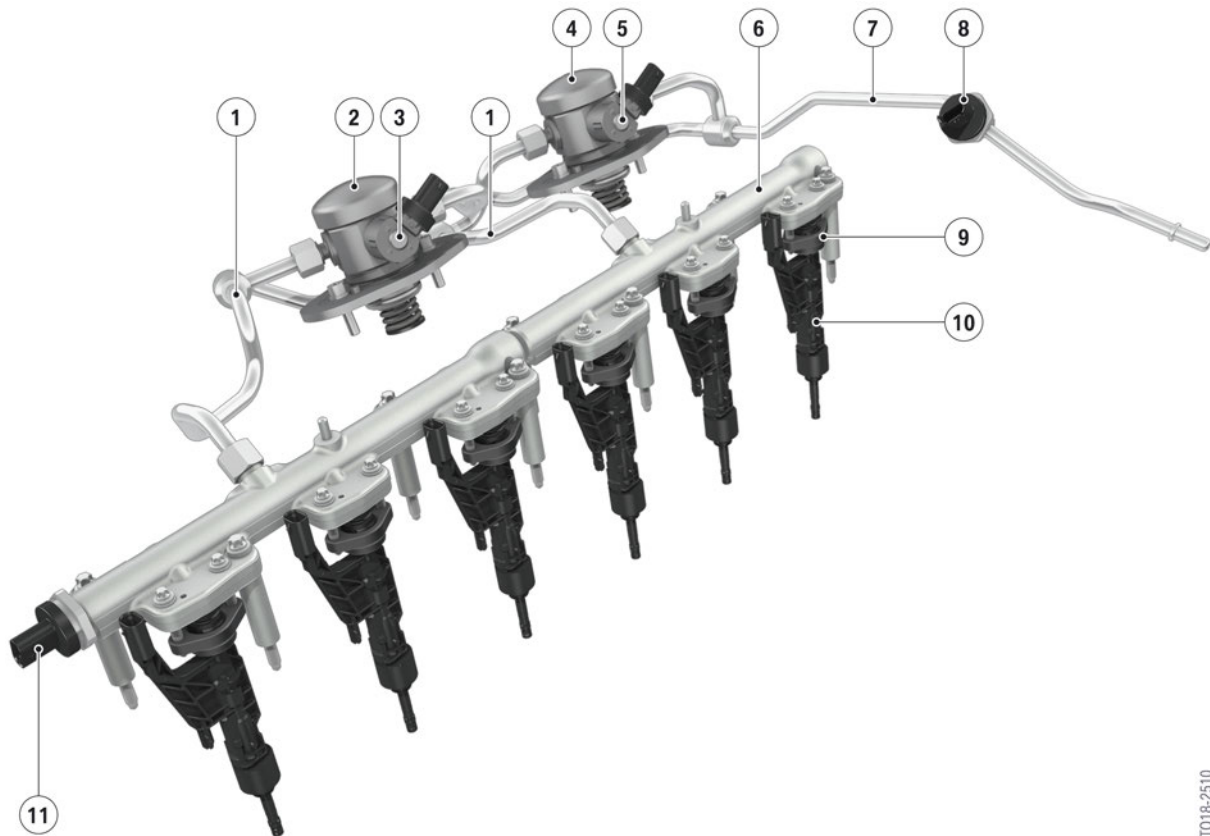
Index	Explanation
1	Screw connection
2	Diaphragm valve
3	Vacuum pump
4	Sealing plate

S58 Engine

10. Fuel Preparation

10.1. Overview

The following overview shows the entire fuel preparation. The fuel preparation of the S58 engine is closely related to the fuel preparation of the B58TU engine. As distinct from the B58TU engine, the S58 engine uses twin high-pressure pumps. This is necessary in order to provide the higher fuel level in the rail to achieve the required performance data and engine speeds of the S58 engine.



S58 engine, high-pressure injection in the overview

T018-2510

Index	Explanation
1	High pressure line for injectors
2	High pressure pump 1
3	Volume control valve 1
4	High pressure pump 2
5	Volume control valve 2
6	Rail
7	Fuel feed line

S58 Engine

10. Fuel Preparation

Index	Explanation
8	Fuel pressure sensor
9	Holding clamp
10	Solenoid valve injector
11	Rail pressure sensor

10.2. Low-pressure fuel system

The F97/F98 with S58 engine is fitted with a 65-liter fuel tank.

The fuel is delivered from the fuel tank through the electric fuel pump via the feed line at a primary pressure of 5 bar to the high pressure pumps. The fuel is conveyed from the electric fuel pump as required.

To monitor the fuel pressure, a fuel low-pressure sensor is used that measures and monitors the fuel pressure on the low-pressure side. The fuel low-pressure sensor is connected to and monitored by the DME.

In the event of a failure of the fuel pressure sensor the electric fuel pump continues to operate at 100% delivery rate with terminal 15 ON.

10.3. High-pressure fuel system

For the S58 engine, the high-pressure injection HDE 6 is used.

Changes were made in regard to the fuel injection pressure, which can now range up to 350 bar. Increasing the fuel injection pressure from 200 bar to 350 bar results in the following advantages:

- Improved fuel atomization
- More efficient delivery
- Reduced fuel wall film formation
- Shorter injection periods

These advantages due to the fuel injection pressure increase to 350 bar led to the following improvements:

- Reduction in particle emissions
- Improved engine response under high engine load
- Improved engine response under M dynamic engine operation

Bosch high-pressure fuel injection valves with the designation HDEV 6 with CVO are used. Due to the fuel system pressure increase from 200 bar to 350 bar, the solenoid valve injectors HEDV6 were optimized using suitable materials and coatings.

S58 Engine

10. Fuel Preparation

The S58 engine has two high-pressure pumps connected in parallel. The two high-pressure pumps are operated in alternation every 30 seconds. That ensures that both high-pressure pumps are evenly loaded when the vehicle is being driven moderately. When the vehicle is being driven harder or at full power, both high-pressure pumps are operated simultaneously. This was necessary in order to satisfy the higher throughput volume of fuel at high engine speeds. Control is effected by means of the volume control valve of the high-pressure pumps using a PWM signal.

The piston and tappet of the high-pressure pump have been modified and materials adapted but its general design is familiar from the previous 3, 4, 6 and 8-cylinder engines. The triple cams on the high-pressure pump drive mechanisms for each pump have an interval of 120° in each case. The two drive cam pairs, which drive the two high-pressure pumps, are arranged so that there is a delivery every 60°.



Work on the fuel system is only permitted after the engine has cooled down. The coolant temperature must not exceed 40 °C. This stipulation must be observed without fail, as otherwise there is a risk of fuel being sprayed back on account of the residual pressure in the high-pressure fuel system.

When working on the high-pressure fuel system, it is essential to adhere to conditions of absolute cleanliness and to observe the work sequences described in the repair instructions. Even the slightest contamination and damage to the screwed fittings of the high-pressure lines can cause leaks.

When working on the fuel system of the S58 engine, it is important to ensure that the ignition coils are not fouled with fuel. The resistance of the silicone material is greatly reduced by sustained contact with fuel. This may result in flashovers on the spark plug head and thus in misfires.

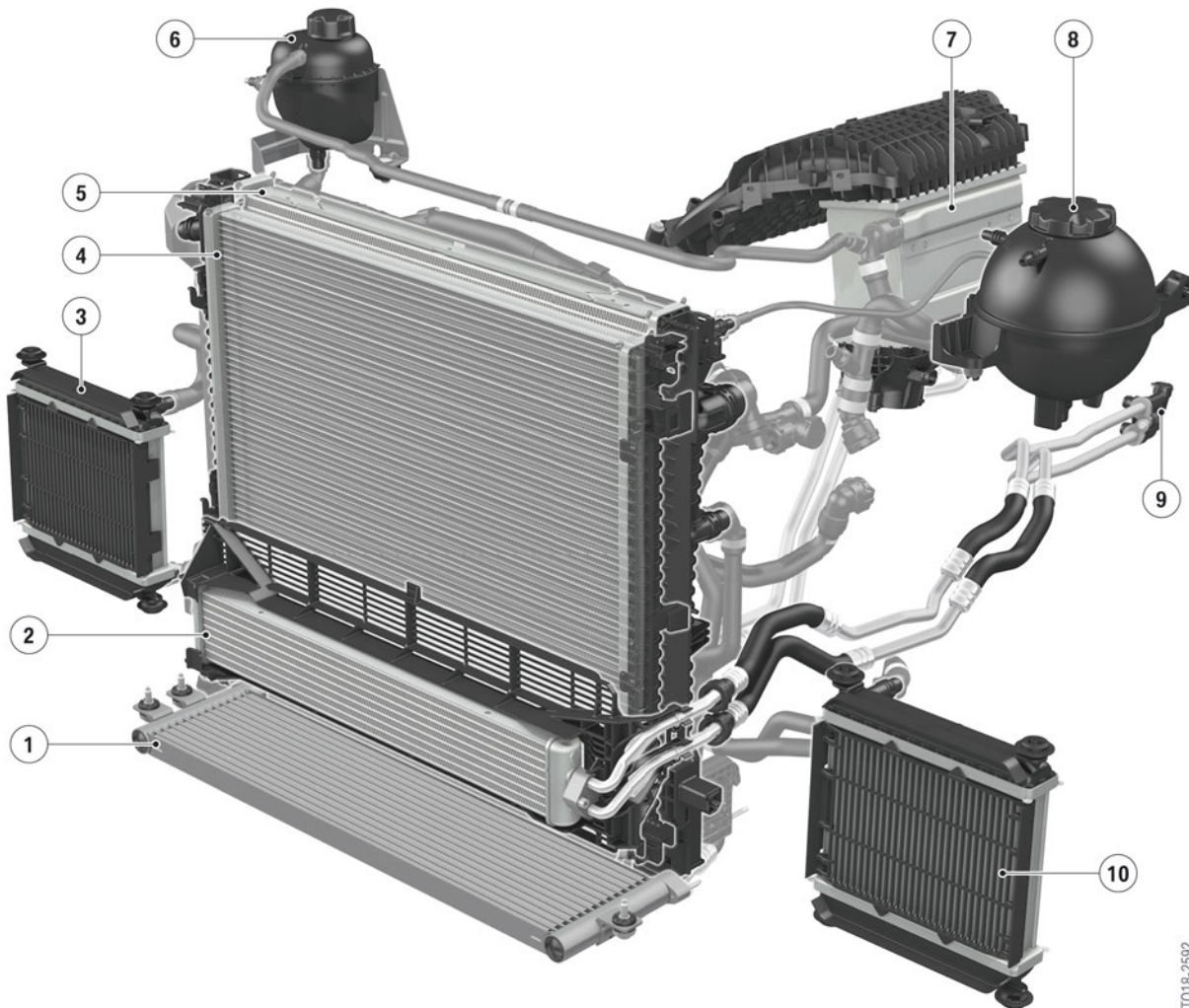
- Before making any modifications to the fuel system, without fail remove the ignition coils and protect the spark plug shaft against ingress of fuel by covering with a cloth.
 - Prior to a new installation of the solenoid valve injectors, the ignition coils must be disassembled and the highest possible level of hygiene ensured.
 - Ignition coils heavily fouled by fuel must be replaced.
 - The CVO function comprises the "injector" and "digital engine electronics" (DME) system components. These components therefore have to be identified with the vehicle identification number in the EPC in the event of a replacement.
 - Where injectors and DME support the CVO function, the injection quantity compensation during the replacement of one of the components is omitted.
 - An excessive rotational angle at the injector shank, and excessive tensile and compressive forces during removal and installation can lead to damage and therefore leaks in the fuel system.
 - For any service work required, the current information and specifications in the documents in the Integrated Service Technical Application (ISTA) must be observed in each case.
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S58 Engine

11. Cooling System

11.1. Overview

The cooling system of the S58 engine consists of an engine and charge air cooling system plus an oil cooling system for the engine oil and the M automatic transmission.



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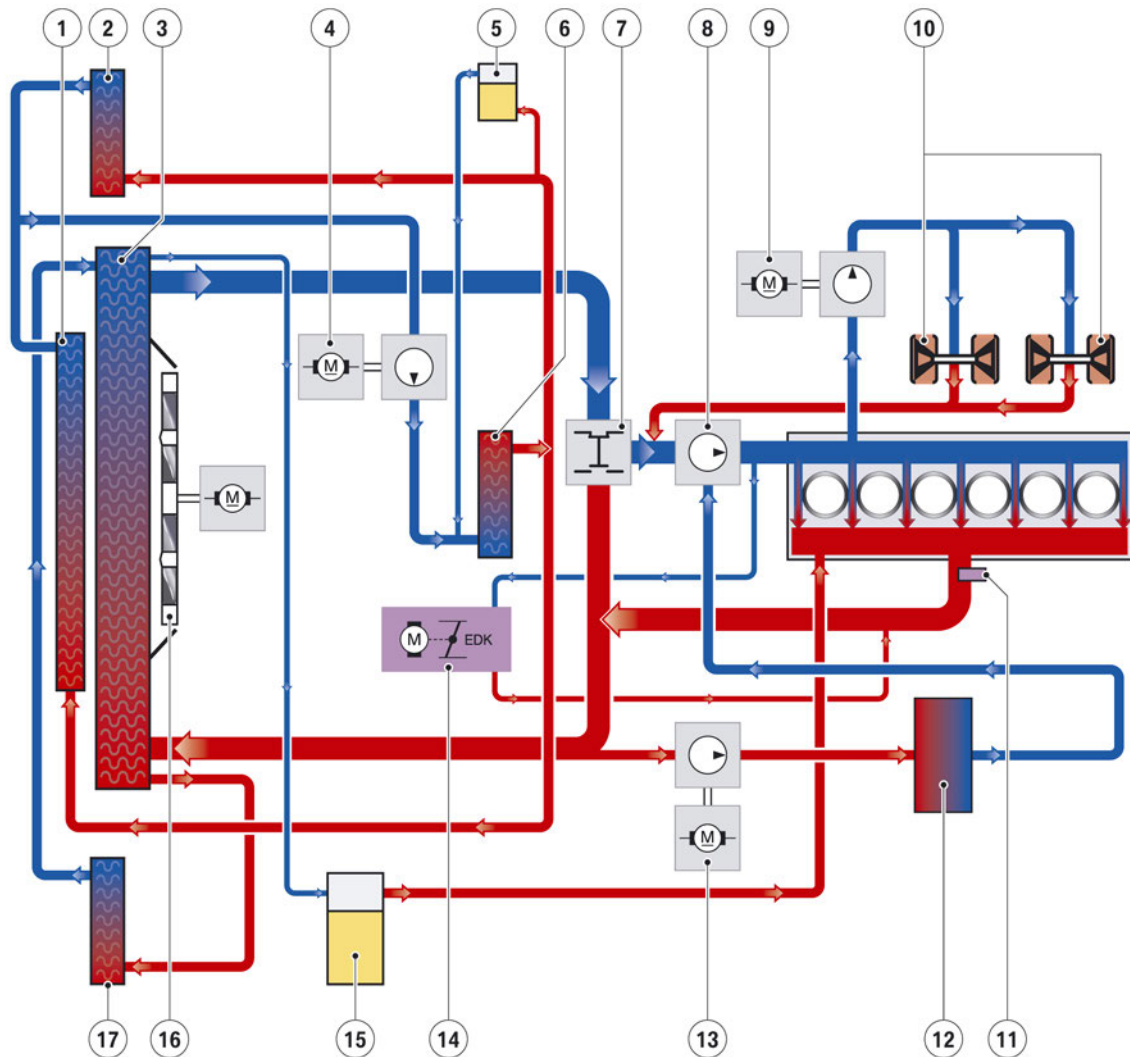
S58 engine, cooling systems

Index	Explanation
1	Engine oil cooler
2	Transmission oil cooler
3	Upstream low-temperature radiator, charge air
4	Low-temperature cooler, charge air
5	Radiator, engine
6	Coolant expansion tank, charge air

S58 Engine

11. Cooling System

Index	Explanation
7	Indirect charge air cooler
8	Coolant expansion tank, engine
9	Thermostat for transmission oil cooling
10	Auxiliary radiator, engine



S58 engine, engine cooling with exhaust turbocharger and charge air cooling

Index	Explanation
1	Low-temperature cooler, charge air
2	Upstream low-temperature radiator, charge air
3	Radiator, engine
4	Electric coolant pump, low-temperature circuit, charge air
5	Coolant expansion tank, charge air

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S58 Engine

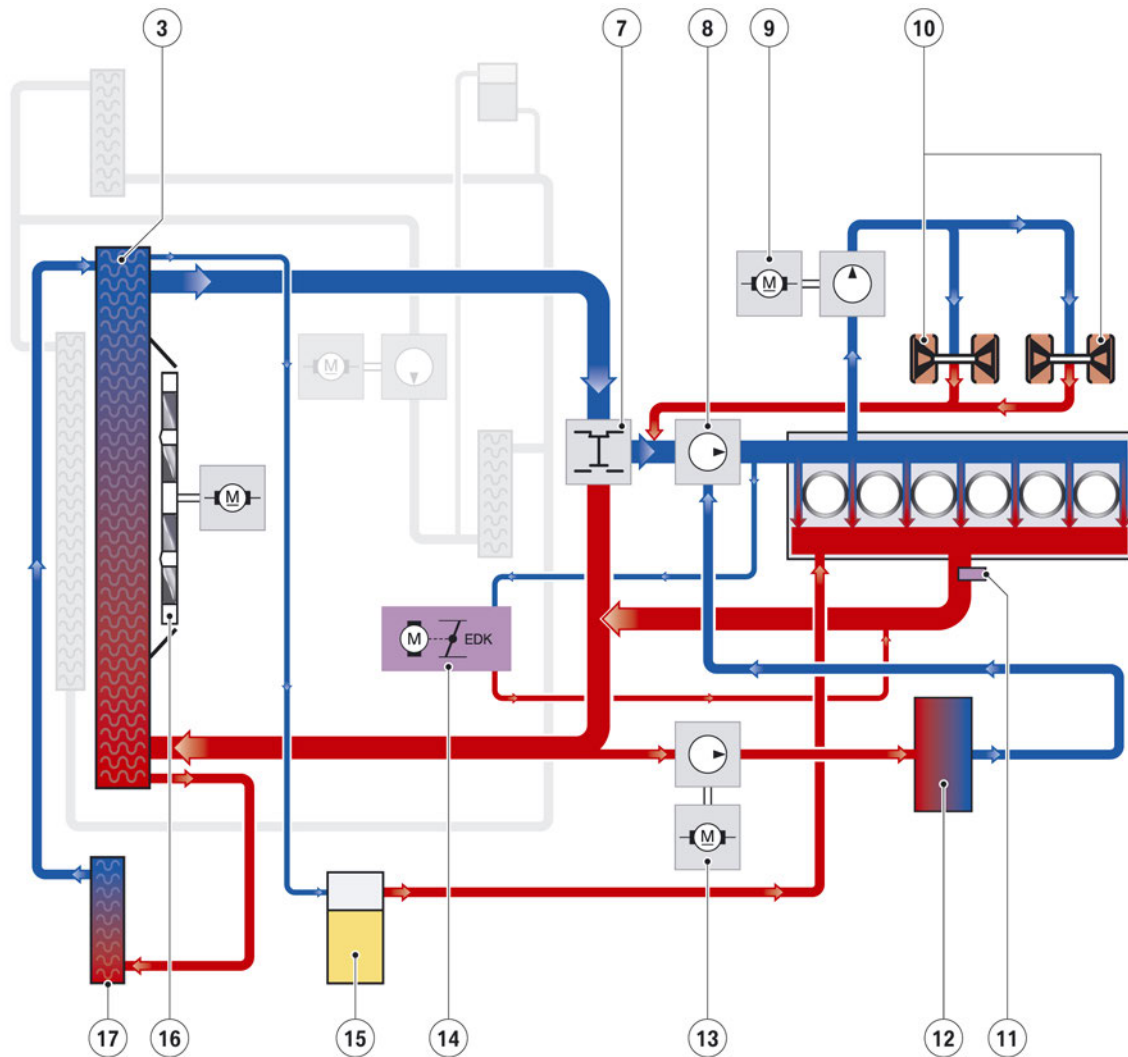
11. Cooling System

Index	Explanation
6	Indirect charge air cooler
7	Thermostat
8	Mechanical coolant pump, engine
9	Electric coolant pump for exhaust turbocharger
10	Exhaust turbocharger
11	Coolant temperature sensor
12	Heater matrix for vehicle interior heating
13	Electric coolant pump, heating for passenger compartment
14	Throttle valve
15	Coolant expansion tank, engine
16	Electric fan
17	Auxiliary radiator, engine

S58 Engine

11. Cooling System

11.2. Engine cooling



S58 engine, cooling system

T018-2594

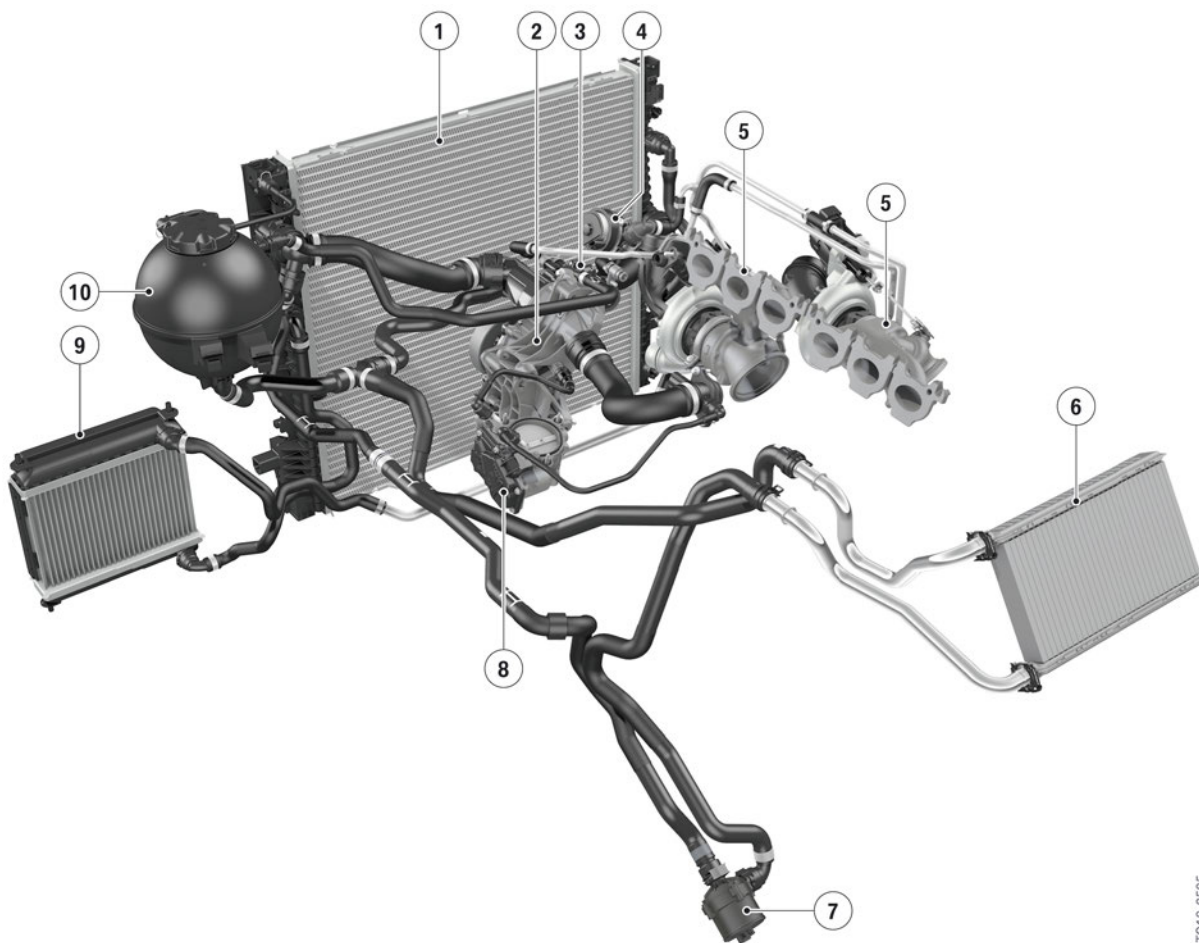
Index	Explanation
3	Radiator, engine
7	Thermostat
8	Mechanical coolant pump, engine
9	Electric coolant pump for exhaust turbocharger
10	Exhaust turbocharger
11	Coolant temperature sensor
12	Heat exchanger for heating system
13	Electric coolant pump, heating for passenger compartment

S58 Engine

11. Cooling System

Index	Explanation
14	Throttle valve
15	Coolant expansion tank, engine
16	Electric fan
17	Auxiliary radiator, engine

The following graphic shows the connection of the additional radiator at the cooling system. The additional radiator is connected with coolant lines at the radiator in parallel, whereby the cooling area increases.



T018-2595

S58 engine, coolant circuit with exhaust turbocharger

Index	Explanation
1	Radiator, engine
2	Mechanical coolant pump, engine
3	Thermostat
4	Electric coolant pump for exhaust turbocharger
5	Turbocharger units

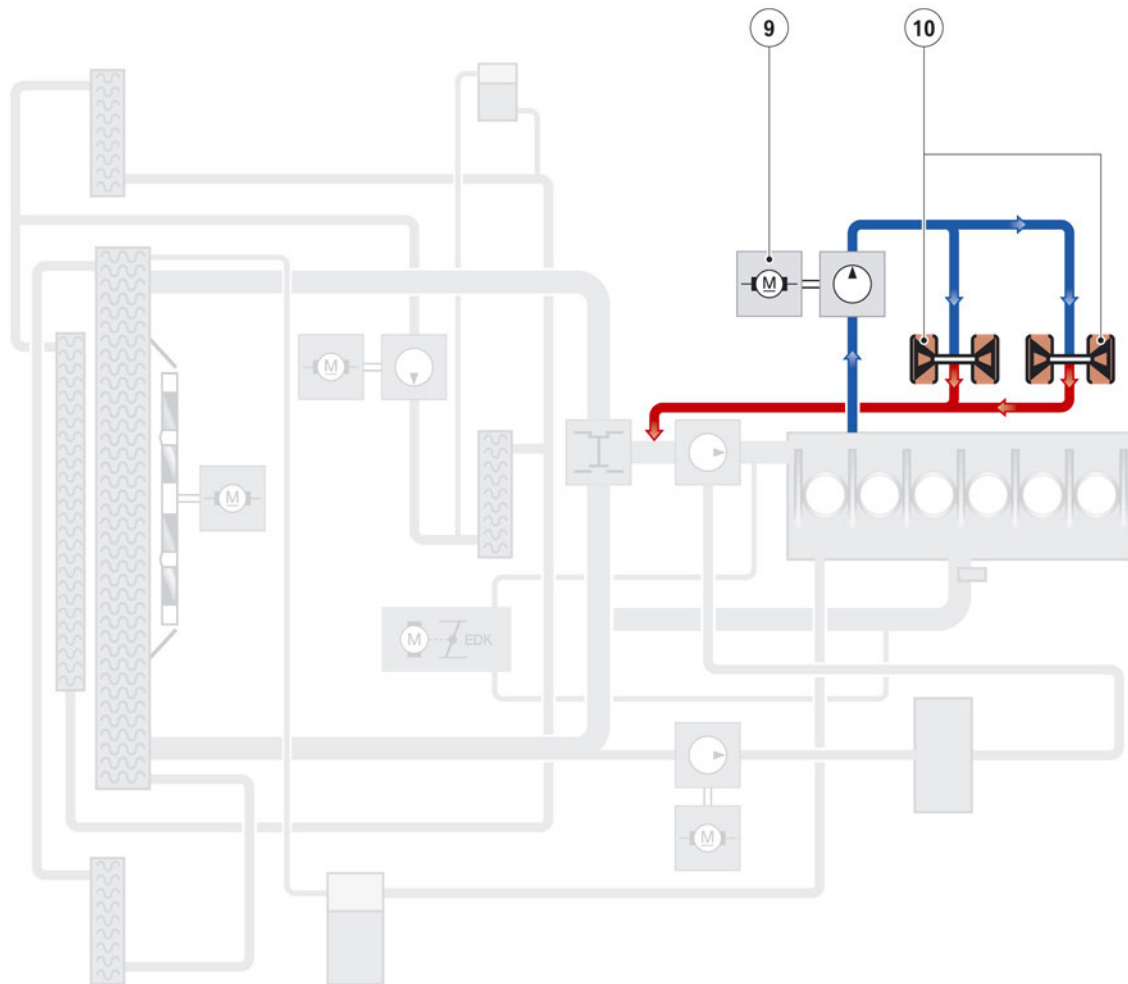
S58 Engine

11. Cooling System

Index	Explanation
6	Heat exchanger for heating system
7	Electric coolant pump, heating for passenger compartment
8	Throttle valve
9	Auxiliary radiator, engine
10	Coolant expansion tank, engine

The thermostat used is a data-map thermostat which can be controlled by the DME. The thermostat starts opening at a coolant temperature of 101 °C (214 °F). The thermostat is fully open at a coolant temperature of 120 °C (248 °F).

11.2.1. Cooling circuit, exhaust turbocharger



S58 engine, cooling circuit of the exhaust turbocharger with electrical auxiliary coolant pump

T018-2596

S58 Engine

11. Cooling System

Index	Explanation
9	Electric coolant pump for exhaust turbocharger
10	Exhaust turbocharger

The electric coolant pump for the turbochargers is a 20 W pump which communicates with the DME via a LIN bus. The conventional coolant pump is driven via the drive belt and cannot be used for cooling the exhaust turbocharger after the engine has shut down. This is why there is an electric coolant pump for this separate cooling circuit. But also during engine operation the electric coolant pump is switched on taking into account the following factors:

- Coolant temperature at the engine outlet
- Engine oil temperature
- Injected fuel quantity

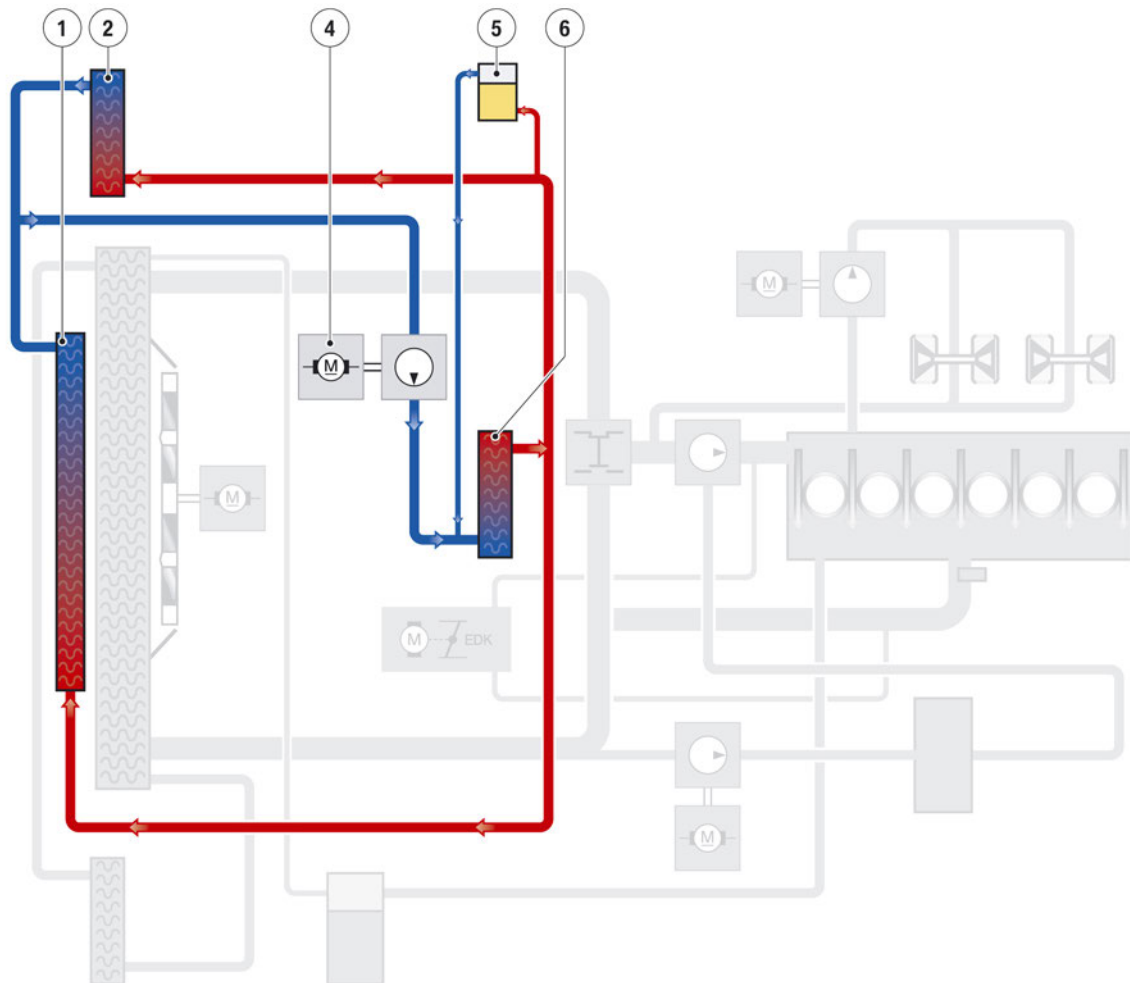
Using these values the heat input into the engine is calculated. The run-on period of the electric coolant pump can last up to 30 min. To improve the cooling effect, the electric fan also cuts in and may run on for up to 11 min.

11.2.2. Charge air cooling

In the S58 engine, like in the B58TU engine, so-called "indirect" charge air cooling is used. During the indirect charge air cooling the charge air is cooled via a low-temperature cooling circuit. The low-temperature coolant circuit is then cooled again by the atmospheric airflow induced by vehicle motion acting on two water-to-air heat exchangers.

S58 Engine

11. Cooling System



T018-2597

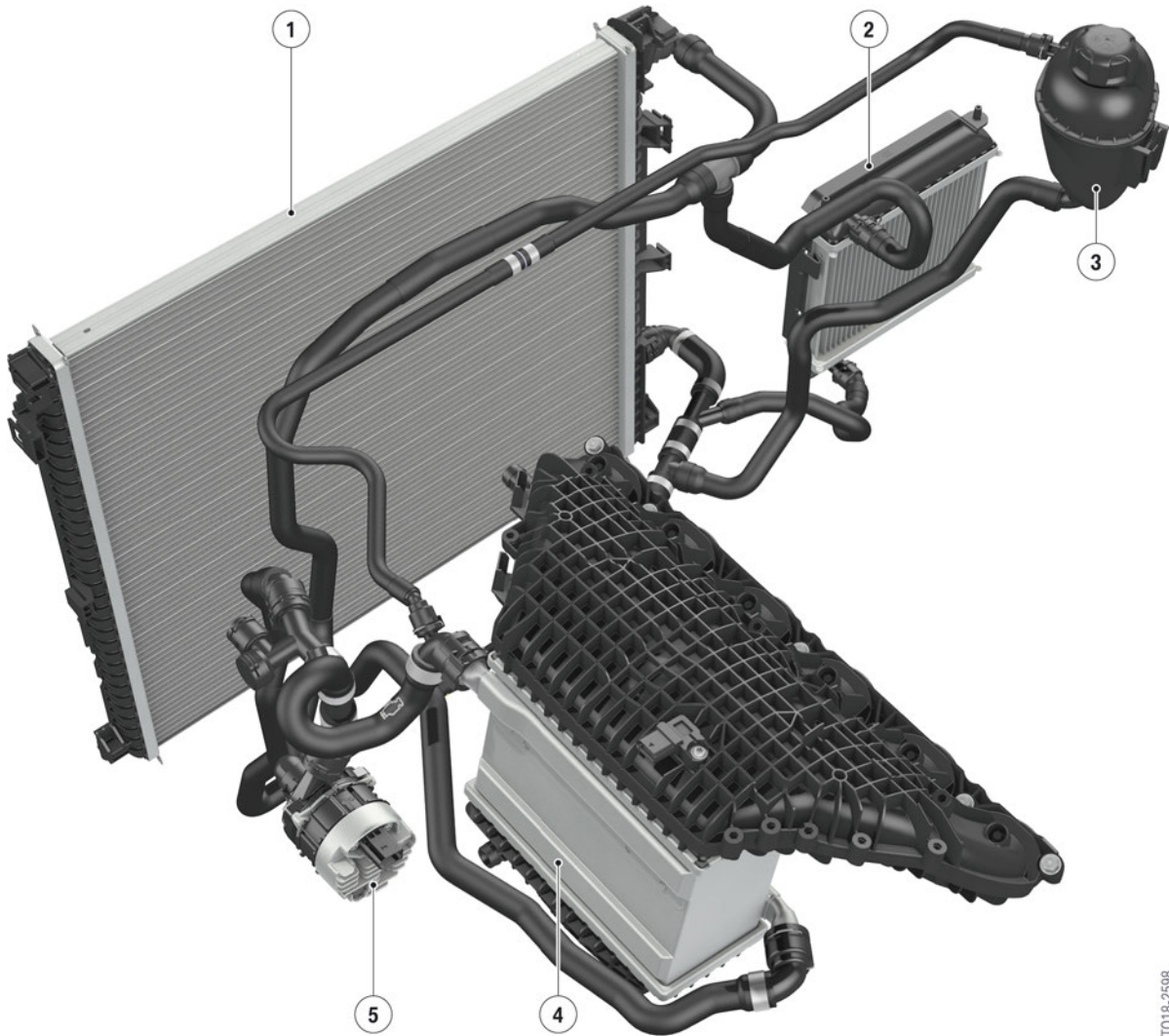
S58 engine, charge air cooling

Index	Explanation
1	Low-temperature coolant radiator, charge air
2	Upstream low-temperature radiator, charge air
4	Electric coolant pump, low-temperature circuit, charge air
5	Coolant expansion tank, charge air
6	Indirect charge air cooler

The capacity of the charge air cooling circuit is approx. 4 liters. The coolant in the charge air cooling system is circulated by a 130 W electric coolant pump which communicates with the DME via a LIN bus. The two water-to-air heat exchangers are connected in parallel and are supplied via an expansion tank, which is attached to the vehicle. The indirect charge air cooler has a cooling power of 36 kW.

S58 Engine

11. Cooling System



T018-2598

S58 engine, cooling circuit, charge air

Index	Explanation
1	Low-temperature coolant radiator, charge air
2	Upstream low-temperature radiator, charge air
3	Coolant expansion tank, charge air
4	Indirect charge air cooler
5	Electric coolant pump, low-temperature circuit, charge air

S58 Engine

12. Engine Electrical System

12.1. Engine control unit

A new generation of Bosch engine control units is used in the S58 engine. 8th-generation engine electronics (DME) features a common control unit platform for petrol and diesel engines that is already used with modular engines. Its appearance is characterized by a uniform housing and a uniform connector strip. However, the hardware inside has been adapted to the various applications.

The control unit code (DME 8.6.S) can be deciphered as follows:

Abbreviation	Meaning
DME	Digital Motor Electronics
8	Control unit generation (modular operating system for petrol and diesel engine)
6	Number of cylinders as hexadecimal figure
S	M Sport engine management

Number of cylinders as a hexadecimal figure:

- 3 = 3-cylinder engine
- 4 = 4-cylinder engine
- 6 = 6-cylinder engine
- S = 8-cylinder engine
- C = 12-cylinder engine

Hardware variant:

- S = M Sport engine management

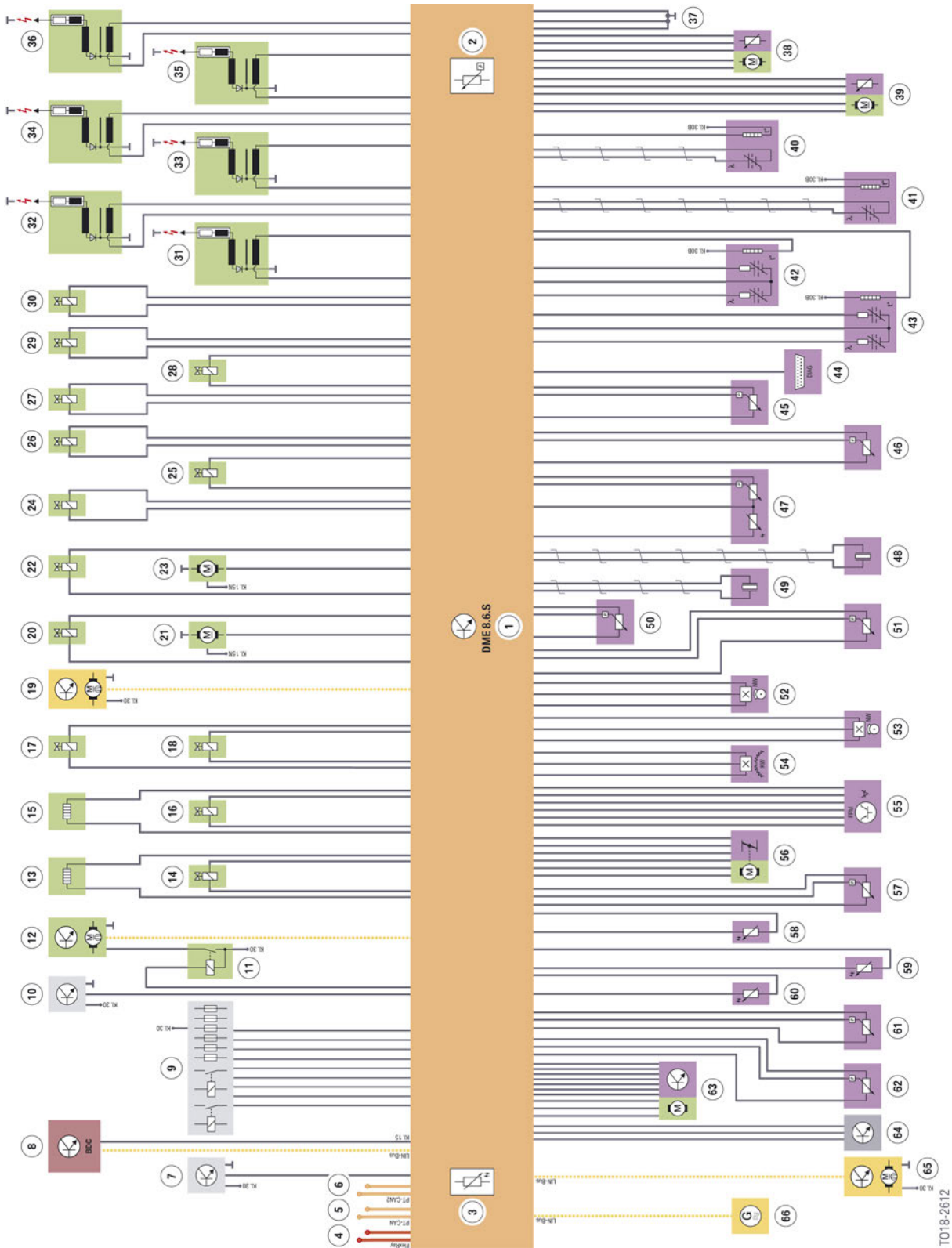
Examples for petrol engines:

- DME 8.4.0H = B48 PHEV* (variant electrical system 1)
- DME 8.6.1 = B58 (electrical system 2 variant)
- DME 8.6.S = S58 (electrical system 2 variant)

S58 Engine

12. Engine Electrical System

12.1.1. DME control unit



S58 Engine

12. Engine Electrical System

Index	Explanation
1	DME 8.6.S
2	Ambient pressure sensor
3	Temperature sensor
4	FlexRay
5	PT-CAN
6	PT-CAN2
7	Natural Vacuum Leak Detection (NVLD)
8	Body Domain Controller (BDC)
9	Power distribution box (symbolic)
10	Fuel Pump Control (FPC)
11	Relay for electric fan
12	Electric fan
13	Blow-by heater
14	Map-controlled valve, oil pump
15	Data-map thermostat
16	Tank vent valve
17	VANOS solenoid valve, intake camshaft
18	VANOS solenoid valve, exhaust camshaft
19	Electric coolant pump, exhaust turbocharger
20	Piston cooling control valve
21	Electrical exhaust flap controller (EAKS)
22	Volume control valve, high pressure pump 1
23	Electrical exhaust flap controller (EAKS)
24	Volume control valve, high pressure pump 2
25-30	Injectors
31-36	Ignition coils
37	Earth
38	Electric wastegate valve controller
39	Electric wastegate valve controller
40	Oxygen sensor LSF Xfour
41	Oxygen sensor LSF Xfour
42	Oxygen sensor LSU 5.2
43	Oxygen sensor LSU 5.2
44	Diagnostic connector
45	Charging pressure sensor before throttle valve

S58 Engine

12. Engine Electrical System

Index	Explanation
46	Rail pressure sensor
47	Charge air temperature and intake-manifold pressure sensor after throttle valve
48	Knock sensors cylinder 1-3
49	Knock sensors cylinder 4-6
50	Venturi nozzle pressure sensor
51	Fuel pressure sensor
52	Camshaft sensor, intake camshaft
53	Camshaft sensor, exhaust camshaft
54	Crankshaft sensor
55	Accelerator pedal module
56	Throttle valve
57	Oil pressure sensor
58	Coolant temperature sensor
59	Oil temperature sensor
60	Intake air temperature sensor
61	Differential pressure sensor, petrol particulate filter (Not for the US)
62	Differential pressure sensor, petrol particulate filter (Not for the US)
63	Valvetronic servomotor
64	Oil-level sensor
65	Electric coolant pump, charge air cooler
66	Alternator



Do not attempt any trial replacement of control units.

Because of the electronic immobilizer, a trial replacement of control units from other vehicles must not be attempted under any circumstances.

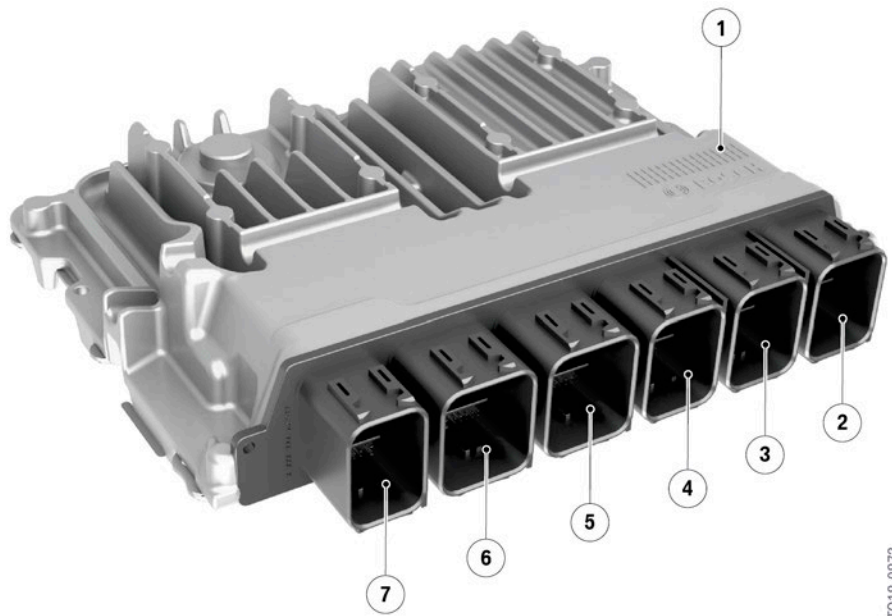
The connector concept is identical to that on the modular engines and features a Nano MQS connector system (Micro Quadlock System). There is a logical division into 6 modules.



Measurements on the wiring harness may only be taken using measuring procedures approved by BMW. Use of the incorrect tools, such as measuring probes, can damage the plug-in contacts.

S58 Engine

12. Engine Electrical System



S58 engine, DME 8.6.S connections

Index	Explanation
1	DME 8.6.S
2	Module 600, injection and ignition
3	Module 500, DME supply
4	Module 400, Valvetronic servomotor
5	Module 300, sensors and actuators 2
6	Module 200, sensors and actuators 1
7	Module 100, vehicle connection

12.1.2. Overall function

The Digital Engine Electronics (DME) is the computing and switching center of the engine control system. Sensors on the engine and on the vehicle deliver the input signals. The signals for activating the actuators are calculated from the input signals, the setpoint values calculated using a computing model in the DME control unit and the stored characteristic maps. The DME control unit activates the actuators directly or via relays.

The PT-CAN wakes up the DME control unit.

The after-run begins once the terminal is switched to OFF. The adaptation values are stored during the after-run. The DME control unit uses a bus signal to signal its readiness to "go to sleep". When all the participating control units have signalled their readiness to "go to sleep", the bus master outputs a bus signal and the control units terminate communication 5 seconds later.

S58 Engine

12. Engine Electrical System

The printed circuit board in the DME control unit accommodates two sensors: a temperature sensor and an ambient pressure sensor. The temperature sensor is used to monitor the temperature of the components in the DME control unit. The ambient pressure is required for calculating the mixture composition.

