Reference Manual

S63TU4 ENGINE

Technical Training

Technical training.
Product information.

S63TU4 Engine.

Edited for the U.S. market by:
BMW Group University
Technical Training
ST1916 9/1/2019

BMW Service

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: July 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 Manual
- Integrated Service Technical Application
- Aftersales Information Research (AIR)

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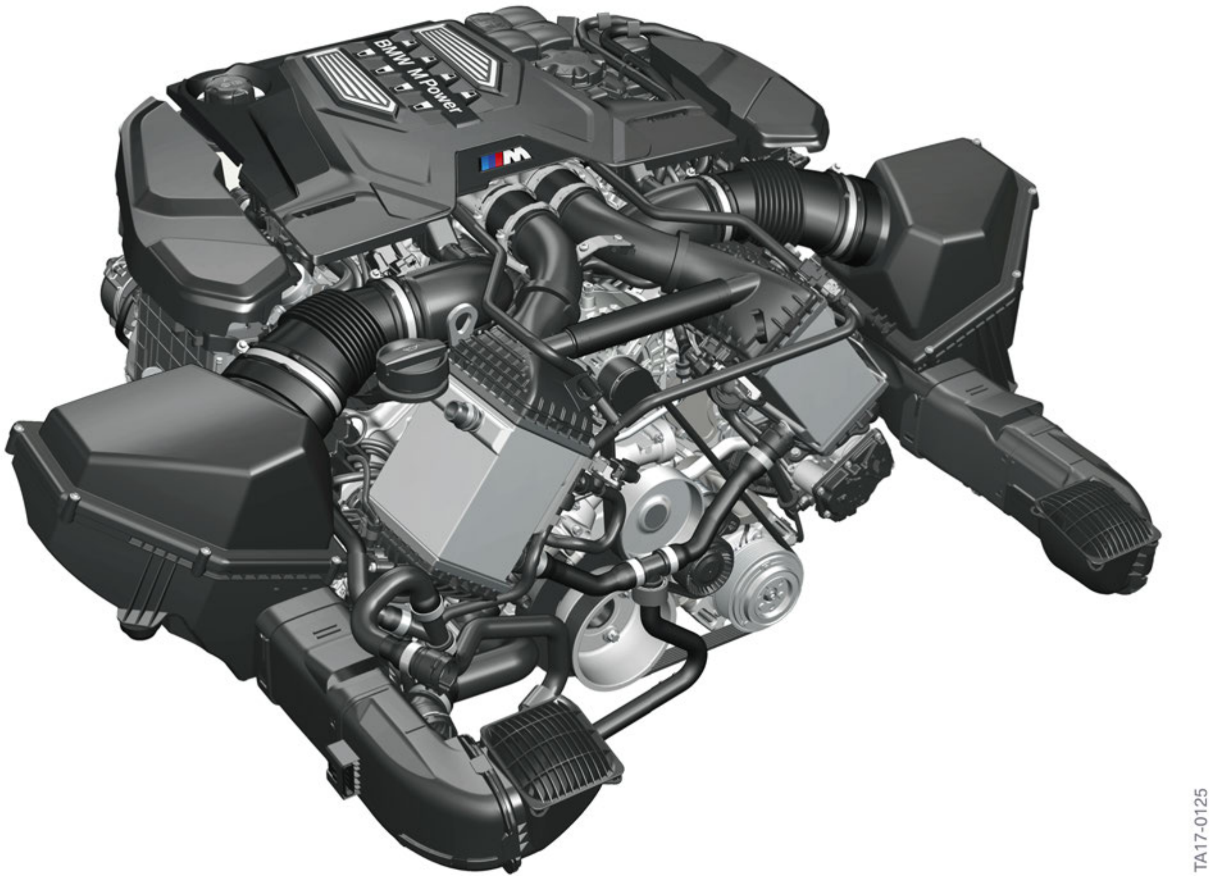
S63TU4 Engine.

1. Introduction.

The S63B44T4 engine is the powerplant for various M vehicles and has been taken over to a large extent from the F90. It is an advancement of the S63B44T2 engine and technically based on the N63TU3 engine (N63B44T3).

This document describes only the differences to the S63TU2 engine (S63B44T2).



S63B44T4 engine

Model designation	Engine designation	Use
BMW M5	S63B44T4	11/2017
BMW M8	S63B44T4	07/2019

1.1. Technical data

	Unit	S63B44T0	S63B44T2	S63B44T4
Series		F1x/F06	F85/F86	F90/F91/F92
Model designation		BMW M5/M6	BMW X5 M BMW X6 M	BMW M5 BMW M8
Design		V8	V8	V8

S63TU4 Engine.
1. Introduction.

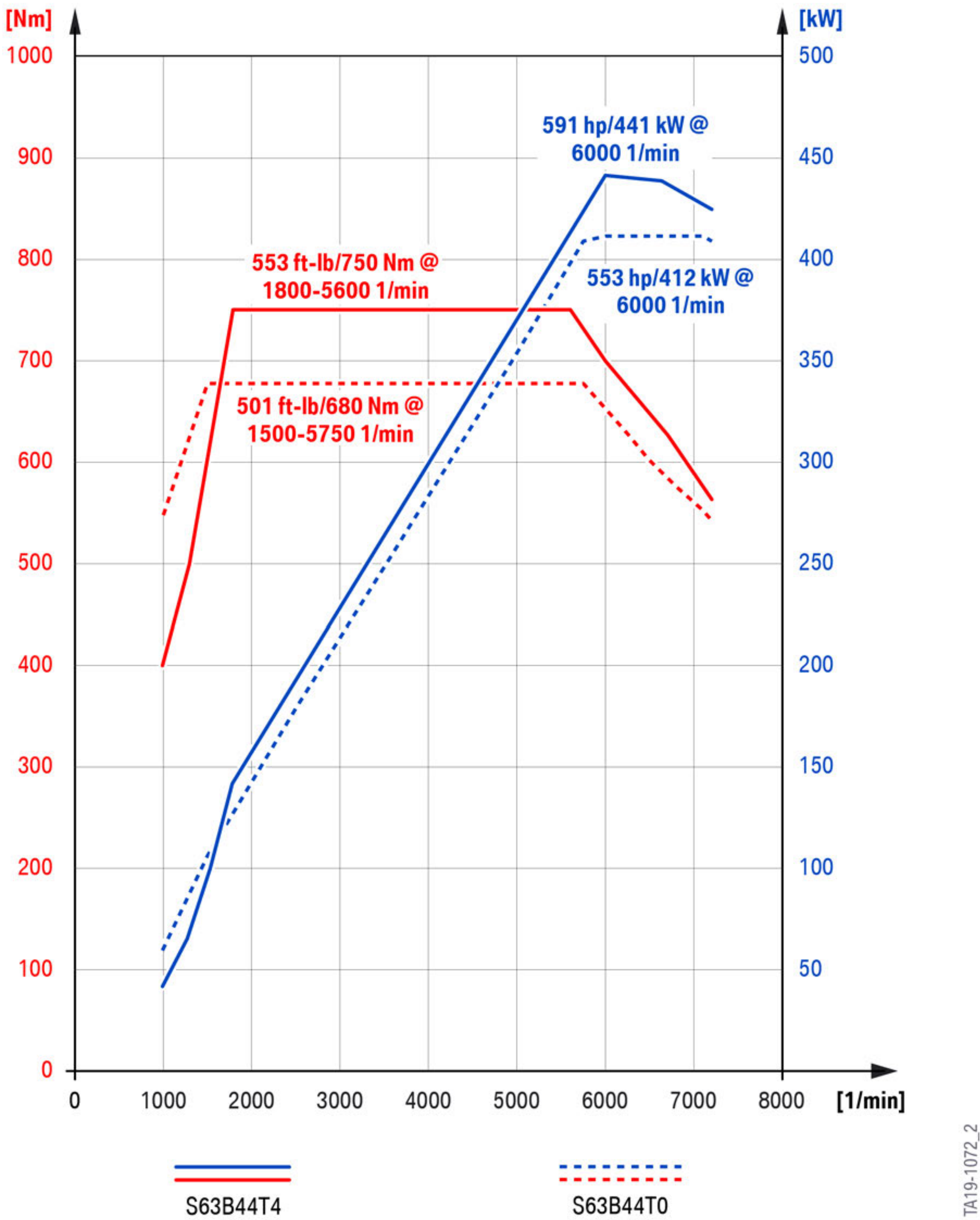
	Unit	S63B44T0	S63B44T2	S63B44T4
Displacement	[cc]	4395	4395	4395
Firing order		1-5-4-8-6-3-7-2	1-5-4-8-6-3-7-2	1-5-4-8-6-3-7-2
Bore hole/Stroke	[mm]	89/88.3	89/88.3	89/88.3
Power at engine speed	[hp] [rpm]	553 567** 6000-7000	567 6000-6500	591 617** 6000
Redline	[rpm]	7200	6800	7200
Power output per liter	[hp/l]	125.6	129.0	134.5 140.4**
Torque at speed	[ft lb] [rpm]	501 1500-5750 1500-6000**	553 2200-5000	553 1800-5600 1800-5860**
Compression ratio	[ε]	10.0	10.0	10.0
Valves per cylinder		4	4	4
Fuel rating	[RON (AKI)]	98 (93)	98 (93)	98 (93)
Fuel	[RON (AKI)]	95-98 (91–93)	95-98 (91–93)	91-98 (87–93)
Digital Motor Electronics		MEVD17.2.H	MEVD17.2.H	DME 8.8T.0
Maximum speed	[mph]	155 (190*)	155 (173*)	155 (190*)

* Only in conjunction with M Driver´s package SA 7ME
** Only in conjunction with Competition package SA 7MA.

S63TU4 Engine.

1. Introduction.

1.2. Full load diagram



S63B44T4 engine, full load diagram

S63TU4 Engine.
2. Engine History.

Overview of S63 engines at BMW M GmbH.

Engine	Model	Series	Displacement in cc	Power output in hp	Torque in ft lb	Used as of
S63B44O0	BMW X5M/ X6M	E70/E71	4395	547	442	2010
S63B44T0	BMW M5	F10	4395	553	501	2011
S63B44T0	BMW M6	F12/F13	4395	553	501	2012
S63B44T0	BMW M6 Competition	F12/F13	4395	567	501	2012
S63B44T0	BMW M5 Competition	F10	4395	567	501	2013
S63B44T0	BMW M6	F06	4395	553	501	2013
S63B44T0	BMW M6 Competition	F06	4395	567	501	2013
S63B44T0	BMW M5 "30 Years M5"	F10	4395	591	516	2014
S63B44T0	BMW M6 Competition	F12/F13	4395	591	516	2015
S63B44T0	BMW M6 Competition	F06	4395	591	516	2015
S63B44T2	BMW X5M/ X6M	F85/F86	4395	567	553	2015
S63B44T4	BMW M5	F90	4395	591	553	2017
S63B44T4	BMW M5 Competition	F90	4395	617	553	2018

S63TU4 Engine.

3. Engine Identification.

3.1. Engine identification

The engine identification is used in the technical documentation in order to clearly identify the engine.

There is no engine with the designation S63B44T3 at BMW M GmbH.

Index	Explanation
S	BMW Group "M GmbH"
6	V8 engine
3	Engine with exhaust turbocharger, Valvetronic and direct fuel injection (TVDI)
B	Gasoline engine installed longitudinally
44	4.4 l displacement
T	Top performance class
4	Fourth redesign

The engines have an identification mark on the crankcase to ensure unmistakable identification and classification. This engine identification is necessary for approval by government authorities. The first six digits of the engine identification correspond to the engine designation.

3.2. Engine number

The engine number can be found on the engine above the engine identification. This consecutive number, in conjunction with the engine identification, permits clear identification of each individual engine.

S63TU4 Engine.

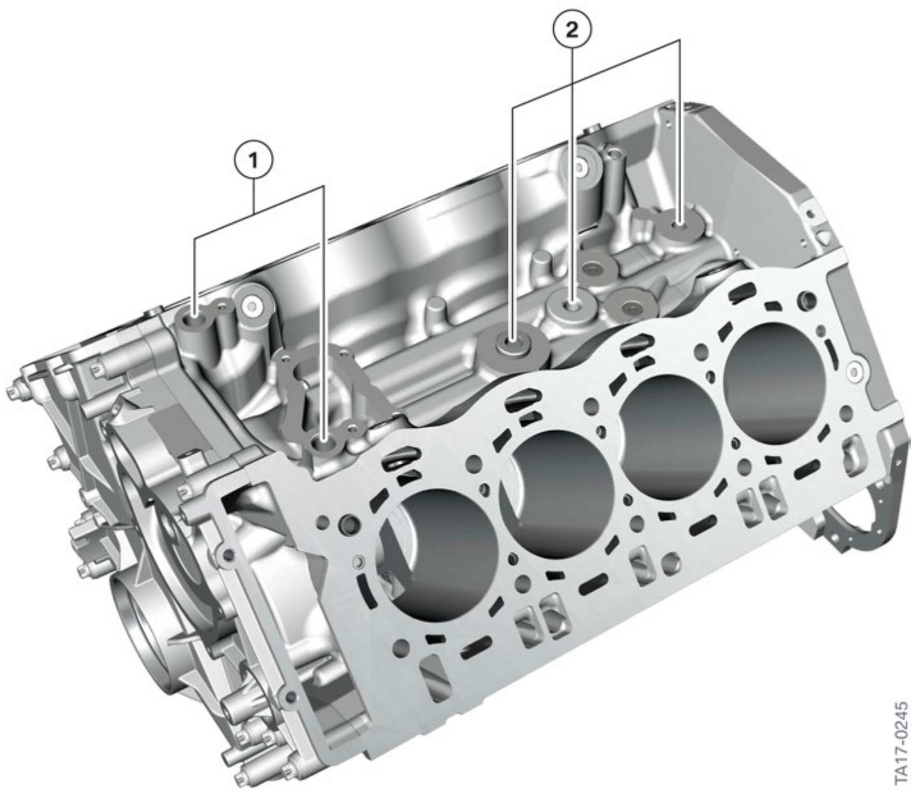
4. Engine Mechanics.

4.1. Crankcase

The crankcase in the S63B44T4 engine was taken over from the N63B44O2 engine and adapted to the S63B44T4. As of 07/2019 the same electric arc wire sprayed cylinder barrels that are featured in the modular engines are used in the S63B44T4 engine. Like its predecessor in the S63B44T0 engine, the closed-deck crankcase in the S63B44T4 engine characterized by a double main bearing screw connection with side wall connection.

The crankcase cast part consists of the cylinder bores with electric arc wire sprayed barrels, the bearing ways with the bore holes for the crankshaft and associated bearings and the water jackets of the cylinders.

In the V-chamber of the S63B44T4, the connections that are used in the N63B44O2 for the engine oil coolant heat exchanger are closed.



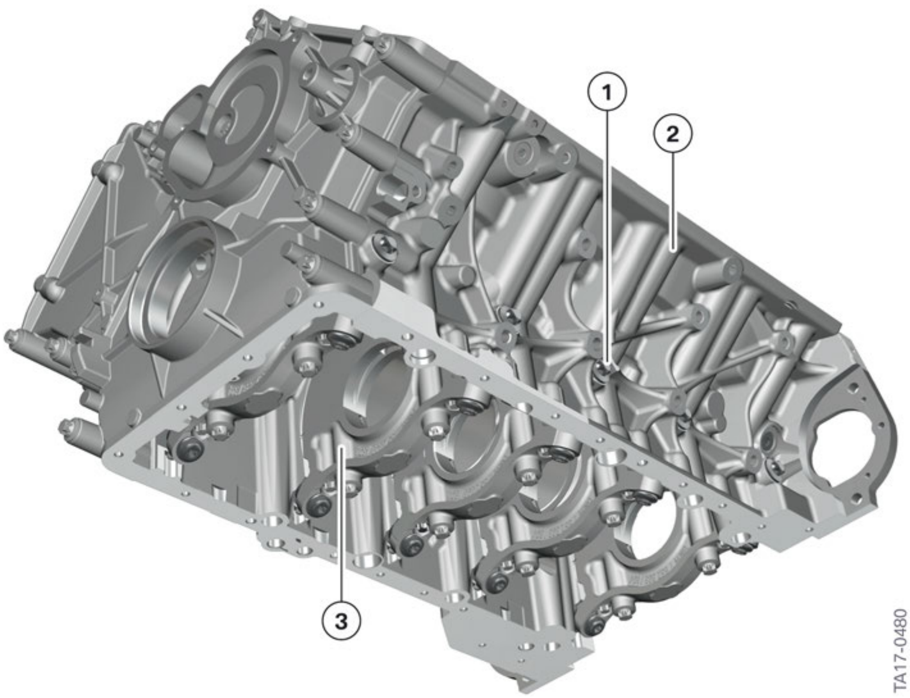
S63B44T4 engine, crankcase

Index	Explanation
1	Exhaust turbocharger oil supply
2	Closed connections of the engine oil coolant heat exchanger in the S63B44T4 engine

The S63B44T4 engine features the already familiar, external air/engine oil heat exchanger that is installed in front of the cooling module.

S63TU4 Engine.
4. Engine Mechanics.

The crankcase of the S63B44T4 engine has undergone further changes to certain details. The most prominent change is the additional screw connection for the main bearing caps on the crankcase. In the S63B44T4 engine, a triple main bearing cap screw connection is used that encompasses the double main bearing cap screw connection with side panel connection, already in use in the N63B44O2 engine, and an additional screw connection laterally in the crankcase.



S63B44T4 engine, main bearing cap screw connection

Index	Explanation
1	Lateral main bearing cap screw connection
2	Crankcase
3	Main bearing cap screw connection with side panel connection

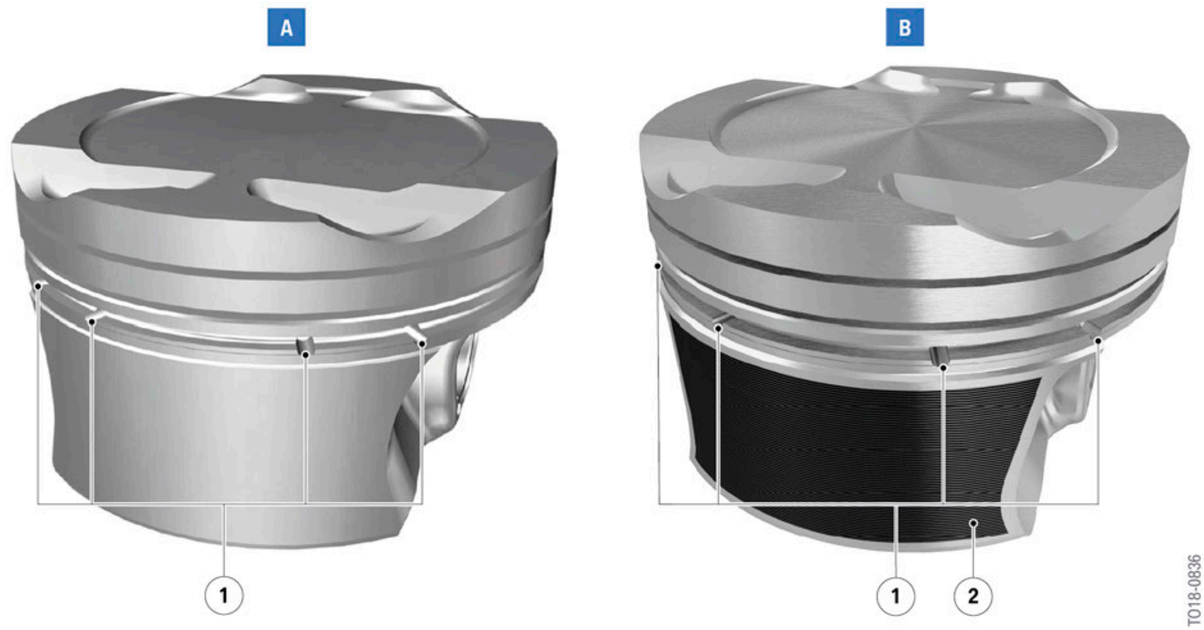
The additional screw connection was necessary to adapt the crankcase to the even higher power output and torque values of the S63B44T4 engine.

4.2. Crankshaft drive

The crankshaft drive without the pistons and bearing shells of the S63B44T4 engine has been taken over entirely from the S63B44T2 engine. Since 07/2019 the bearing shells have been replaced in the S63B44T4 engine. A new material composition is used for the main bearing shell.

As of 07/2019 newly developed cast pistons with a graphite coating on the piston skirt are used in the S63B44T4 engine. This is necessary because the cylinder barrels are electric arc wire sprayed and the pistons were therefore adapted at the same time. In terms of the oil discharge concept, however, the pistons correspond to the pistons of the N63B44T3 engine. The shape of the piston crown in the

S63B44T4 engine was modified in order to achieve a compression ratio of 10:1 in the S63B44T4 engine as opposed to 10.5:1 in the N63B44T3 engine. In addition, the piston crown was adapted for use of the solenoid valve injectors with a fuel injection pressure of 350 bar.



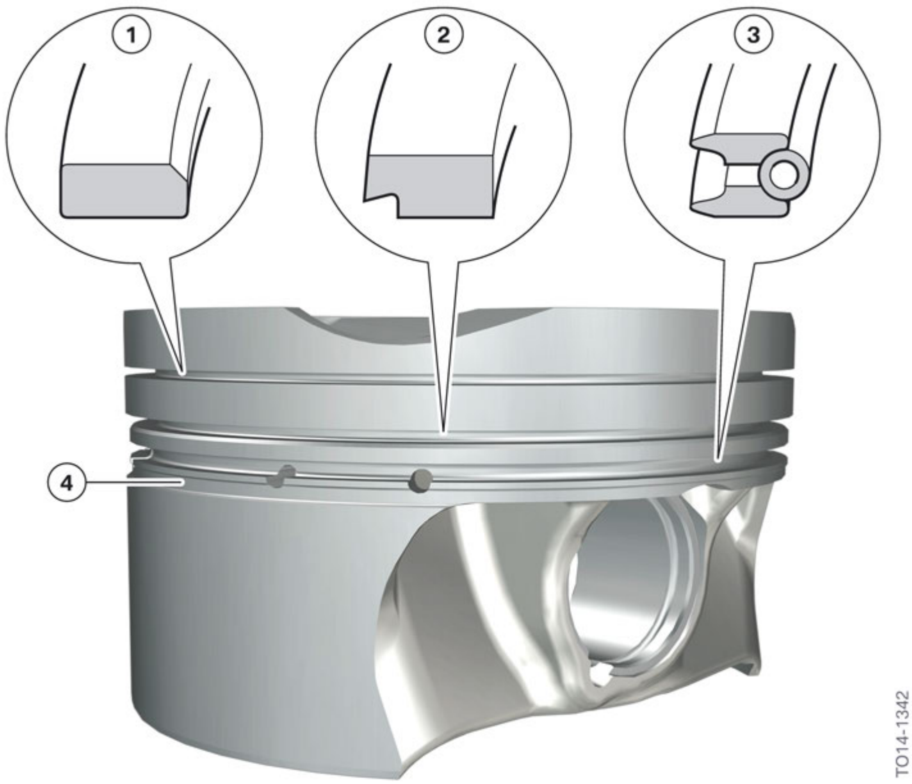
S63B44T4 engine, piston comparison

Index	Explanation
A	S63B44T2 engine, piston
B	S63B44T4 engine, piston
1	8 oil drains
2	Graphite coating on piston skirt

In order to improve the oil drainage in the S63B44T4 engine, the piston was fitted with an additional oil groove underneath the oil scraper ring groove, as on the N63B44T3 engine. Together with the 8 oil drains in the piston skirt, the additional oil groove helps the drainage of oil pushed down by the oil scraper ring when the piston moves down. This prevents the oil from being carried past the piston rings, in particular when the engine is in coasting overrun mode (during which a vacuum is generated in the combustion chamber).

In terms of the piston rings, the ring package from Federal Mogul has been used. The oil scraper ring in the S63B44T4 engine is a "UFlex" ring from Mahle.

4. Engine Mechanics.



S63B44T4 engine, cast pistons with piston rings

Index	Explanation
1	Plain rectangular compression ring with ball-shaped tire tread (B-ring)
2	Taper faced piston ring (NM-ring)
3	U-ring with spiral expander (UFlex)
4	Additional oil groove

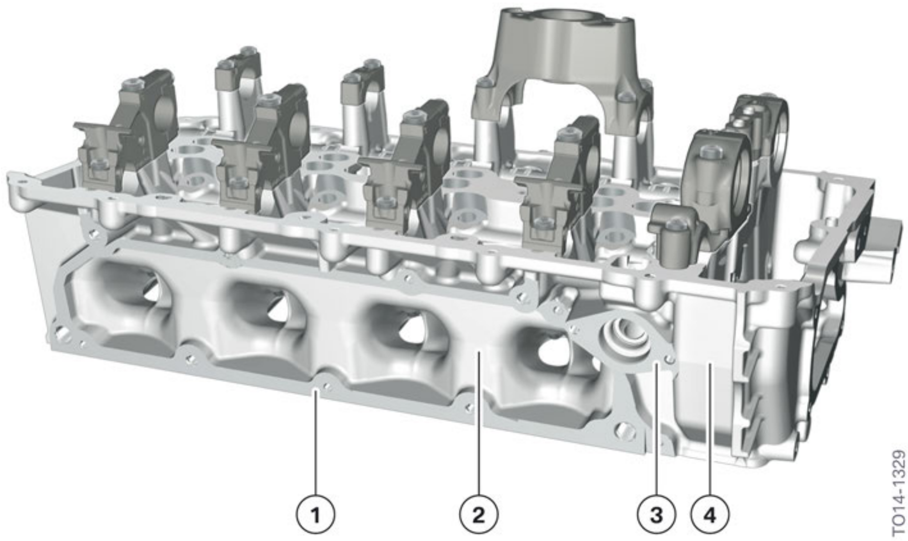
For further information on the crankshaft drive of the S63B44T4 engine, please refer to the Product Information for the “ST1202 S63TU Engine”.

4.3. Cylinder head

The cylinder head of the S63B44T4 engine is based on the same concept as the N63B44O2 engine and has the same partially integrated intake system. Thanks to this intake system partially integrated in the cylinder head, the flow characteristics of the incoming fresh gases have been optimized and the space required to install the intake pipe has been significantly reduced. Feed-throughs, such as for the new injectors for the HDEV 6, were specifically adapted to the cylinder head of the S63B44T4 engine.

S63TU4 Engine.

4. Engine Mechanics.



S63B44T4 engine, cylinder head

Index	Explanation
1	Sealing flange for intake system
2	Partially integrated intake pipe
3	Flange for Valvetronic servomotor
4	Cylinder head, cylinder bank 1

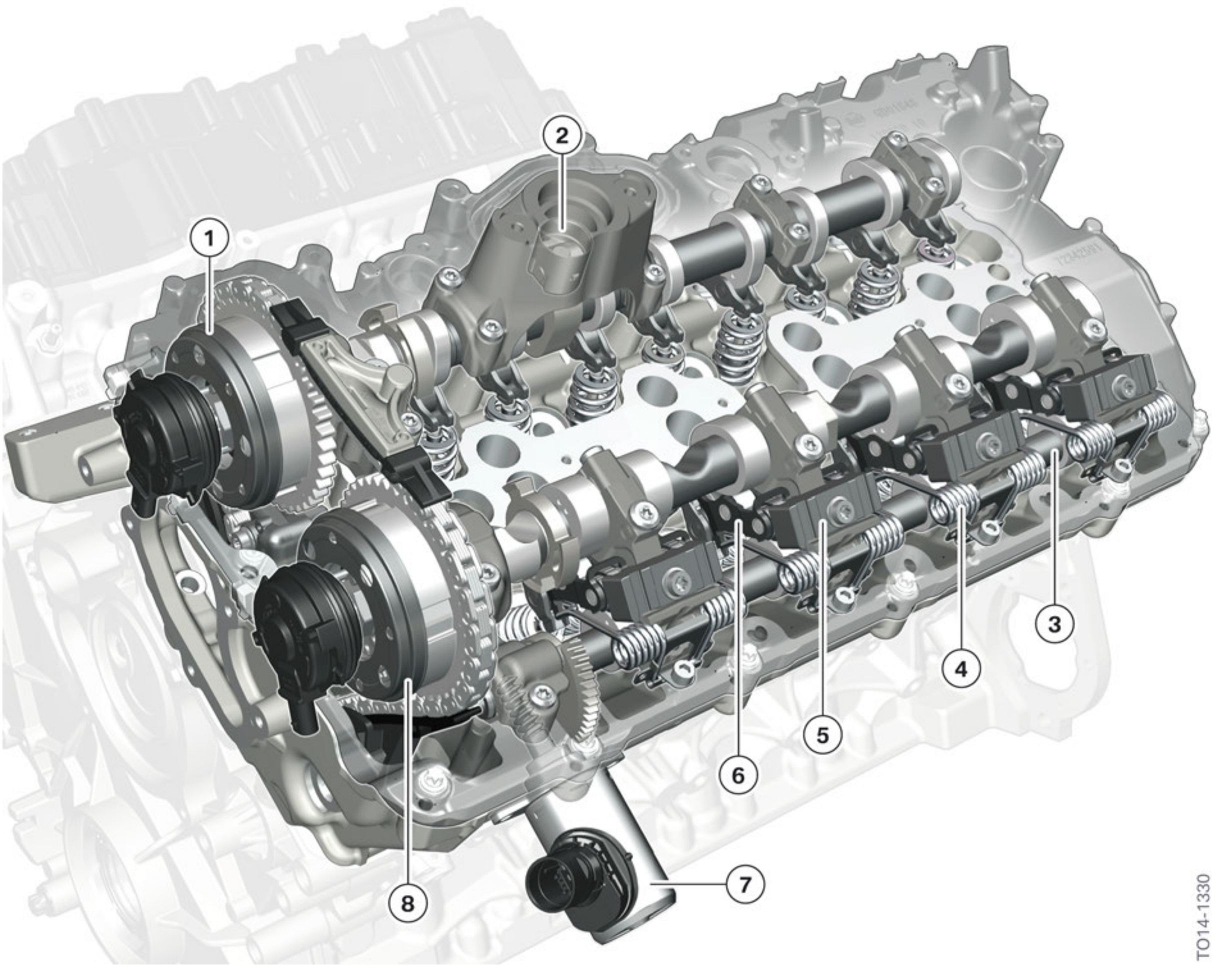
The coolant flows in the cylinder head are separate from the coolant flows in the cylinder jackets. By moving the VANOS solenoid valves into the cylinder head cover and also the VANOS adjusters (as is already the case for the N63B44O2 engine and the modular engines), the bore holes for the VANOS solenoid valves in the cylinder head could be eliminated, meaning that the associated engine oil ducts in the cylinder head can also be simplified.

Valvetronic III technology is used in the S63B44T4 engine. The Valvetronic servomotor is mounted on the intake manifold side of the cylinder head.

⚠

The combination of exhaust turbocharger, Valvetronic and direct fuel injection is known as **T**urbo **V**alvetronic **D**irect **I**njection (TVDI).

4. Engine Mechanics.



S63B44T4 engine, cylinder head with Valvetronic

Index	Explanation
1	VANOS, exhaust side
2	Roller tappet, high pressure pump
3	Eccentric shaft
4	Spring
5	Gate
6	Intermediate lever
7	Valvetronic servomotor
8	VANOS, intake side

4.4. Cylinder head cover

The cylinder head covers contain the oil separators for cleaning the blow-by gases. As in the S63B44T0 engine, a labyrinth oil separator is used to remove oil from the blow-by gases. Each bank has its own oil separator. Further information on the cylinder head cover and crankcase ventilation can be found in the Product Information on the S63TU Engine.

S63TU4 Engine.
5. Oil Supply.

5.1. Differences in the oil supply

- Sump with a small front oil sump as a volume buffer.
- Plastic oil deflector in the top section of the sump with an integrated seal for better separation from the front and rear oil sump.
- Oil pump as external gear pump with map control.
- Additional suction pump.
- Inner and outer oil spray nozzles with defined opening pressure.
- Top and bottom sections of the sump are new parts, since they feature a mount for the map control valve and have been adapted for the external gear pump with suction pump.

5.2. Oil supply adaptations

The volume-flow-controlled pendulum-slide pump already in use in the N63B44O2 engine is not used in the S63B44T4 engine. The reason for this is that the S63B44T4 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 space. In addition, the volume-flow-controlled pendulum-slide pump used in the N63B44O2 engine would not have been capable of providing a reliable oil supply in the high engine speed ranges that occur in the S63B44T4 engine.

For this reason, a so-called external gear pump is used in the S63B44T4 engine with an integrated suction pump, which is also implemented as an external gear pump. This combination is more compact at a higher delivery rate than the volume-flow-controlled pendulum-slide pump.

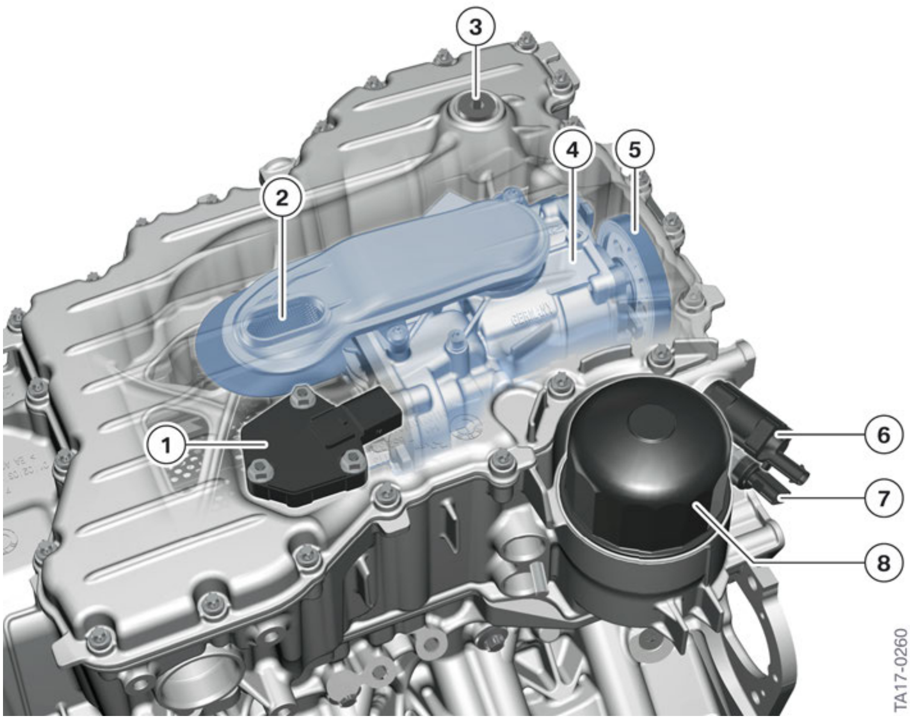
The external gear pump is volume-flow-controlled and is supplemented by a map control.

The oil filter module is integrated in the upper oil sump section on the left-hand side of the engine. The oil pressure sensor and the characteristic map control valve for the characteristic map-controlled oil pump are screwed to the upper section of the oil filter module.

The upper oil sump section is screwed to the crankcase using a beaded metal gasket. The lower oil sump section is screwed to the upper oil sump section. Like the upper oil sump section, the lower oil sump section is made from die-cast aluminum and supports the oil-level sensor and oil drain plug.

The position and length of the oil pump pick-up tube has been adapted to the geometric shape of the oil pump. An additional suction pump was flange-mounted onto the oil pump. This was necessary in order to adapt the oil supply for racetrack use. This ensures a secure oil supply, even when the oil level has shifted during lateral and longitudinal accelerations, as can occur during racing applications.

S63TU4 Engine.
5. Oil Supply.



S63B44T4 engine, oil sump with oil pump

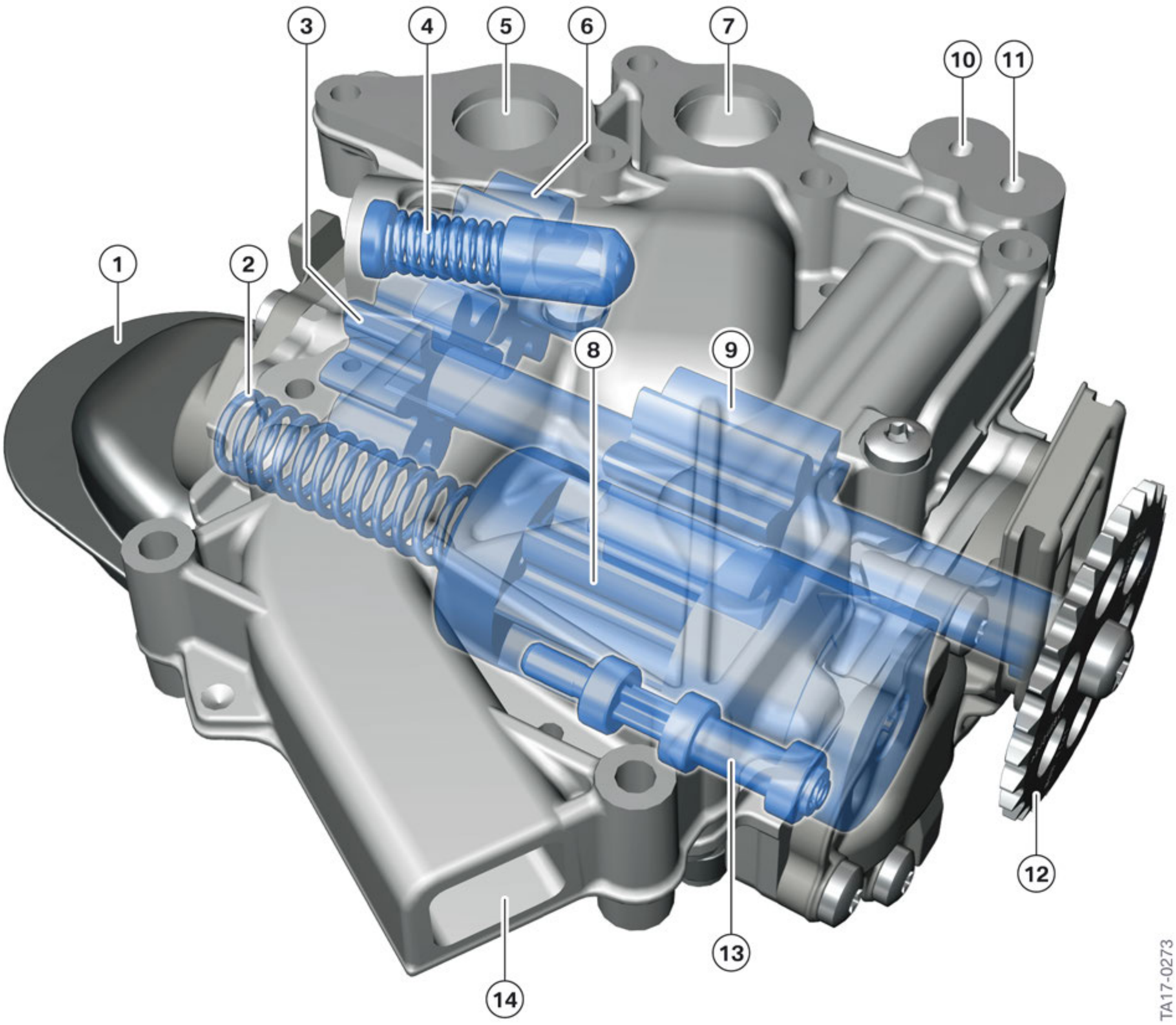
Index	Explanation
1	Oil-level sensor
2	Oil pick-up, sump, rear
3	Oil drain plug
4	Characteristic map-controlled external gear pump
5	Chain drive of the crankshaft
6	Map control valve
7	Oil pressure sensor
8	Oil filter cover

5.3. Oil pump

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

S63TU4 Engine.

5. Oil Supply.



S63B44T4 engine, oil sump with suction pump

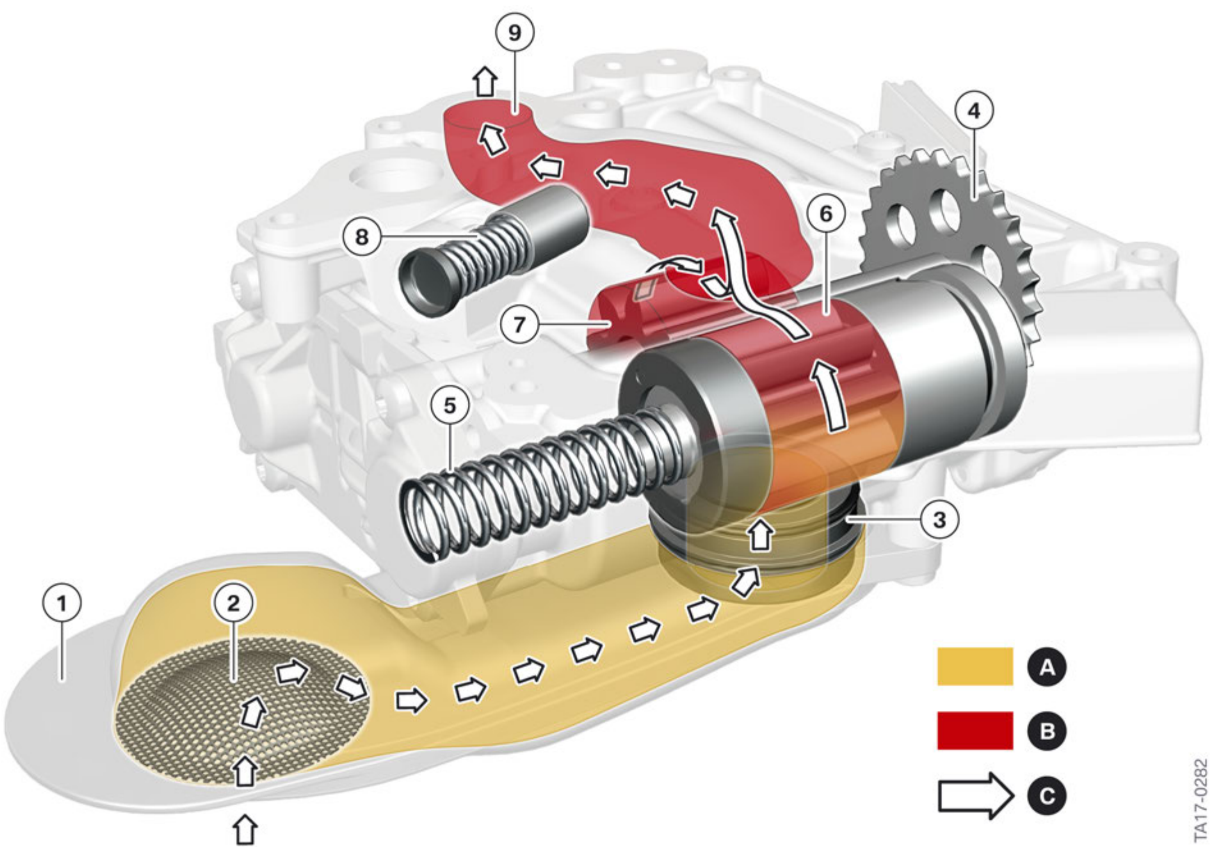
Index	Explanation
1	Oil pick-up, sump, rear
2	Pressure control spring
3	Drive gear suction pump
4	Pressure relief valve
5	Intake port, sump, front (suction pump)
6	Suction pump impeller
7	Engine oil duct
8	Axially movable impeller
9	Sprocket
10	Control line, second-level control (emergency operation)

S63TU4 Engine.
5. Oil Supply.

Index	Explanation
11	Control line of map control valve (map control pressure)
12	Drive for oil pump
13	Control plunger
14	Outlet, suction pump

From the oil pick-up, the oil is transported 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 controlled 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.



S63B44T4 engine, external gear oil pump

Index	Explanation
A	Intake side
B	Major thrust face
C	Direction of flow/direction of rotation
1	Oil pick-up, sump, rear

Index	Explanation
2	Intake pipe with strainer
3	Spring diaphragm
4	Oil pump drive
5	Pressure control spring
6	Axially movable impeller
7	Sprocket
8	Pressure relief valve
9	Oil duct into the engine block (unfiltered oil)

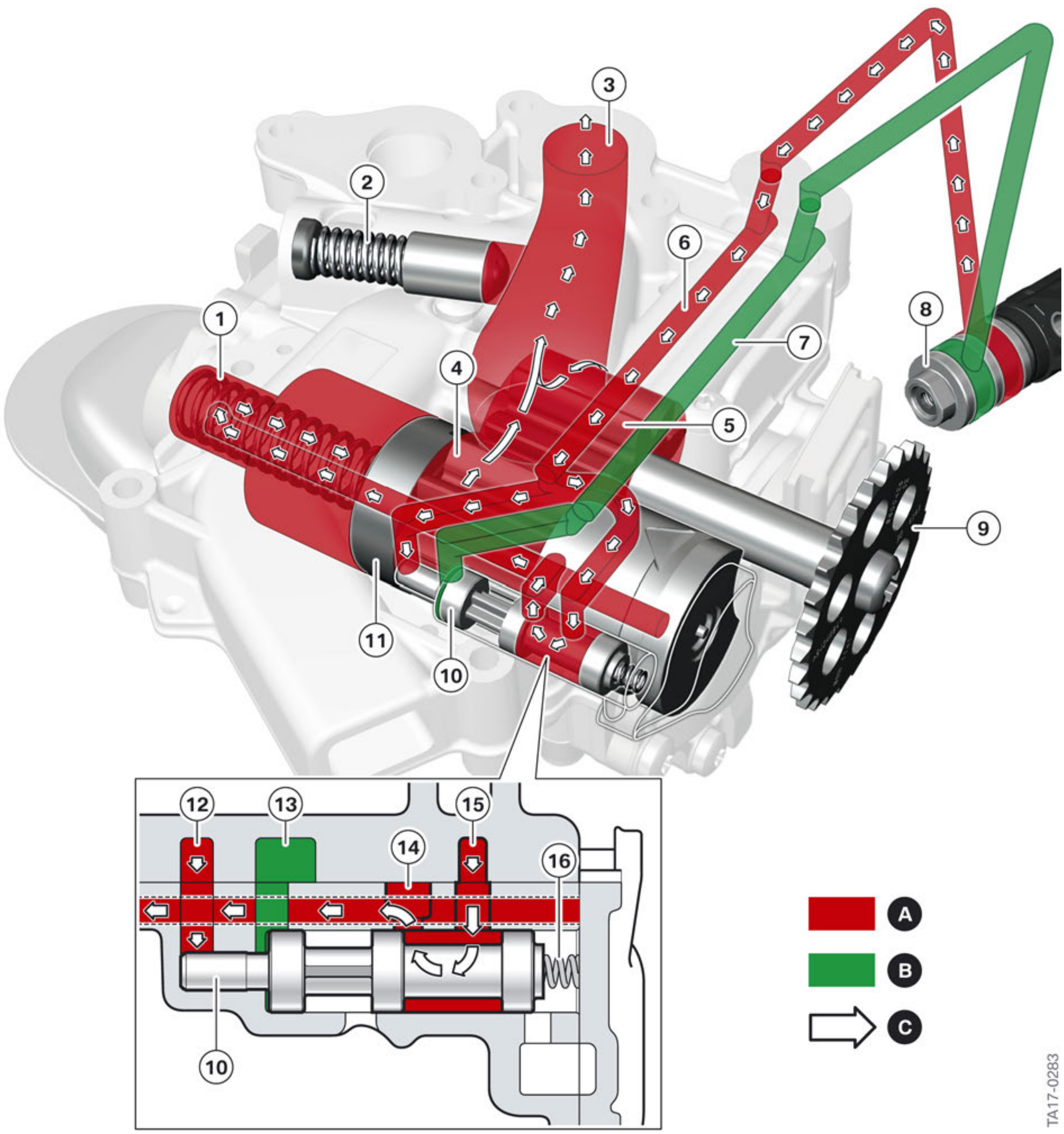
A spring diaphragm (3) is installed at the end of the intake pipe. The spring diaphragm dampens any acoustically noticeable pressure vibrations caused by the movement of the unfiltered oil in the intake pipe.

5.3.1. 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 adjusted via the map control valve (8) from the minimum delivery position. The map control valve (8) is switched so that the oil can flow into the sump via the map control valve (8). This position of the map control valve (8) also transfers the oil pressure from the filtered oil duct (15) to the rear side of the piston pressure side (11) of the axially movable impeller (4). This oil pressure on the piston (11) supports the pressure control spring (1) and presses the axially movable impeller (4) into the maximum delivery position.

S63TU4 Engine.

5. Oil Supply.



S63B44T4 engine, maximum delivery

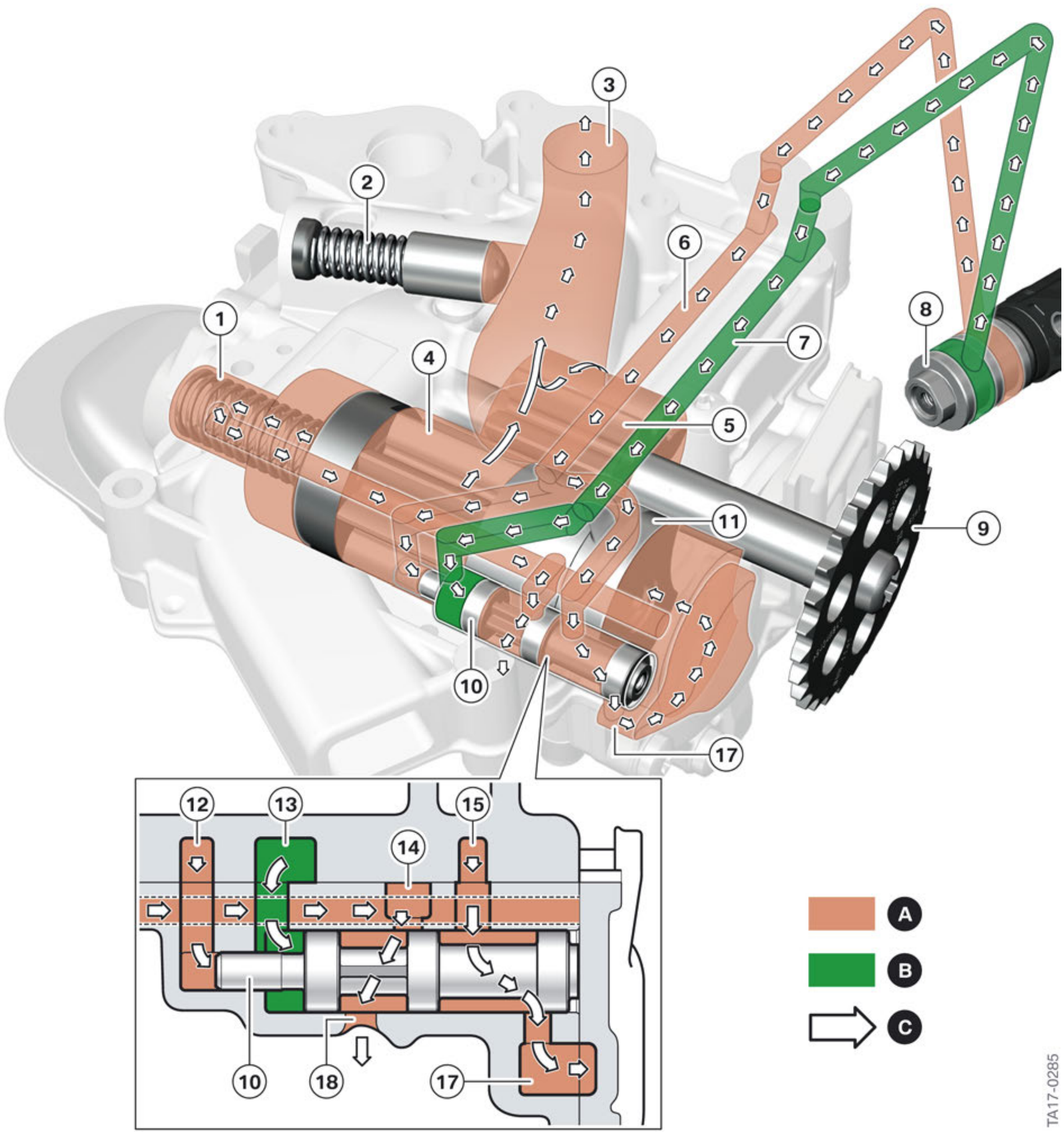
Index	Explanation
A	Second level control pressure
B	Map control pressure
C	Oil pressure
1	Pressure control spring
2	Pressure relief valve

Index	Explanation
3	Oil duct into the engine block (unfiltered oil)
4	Axially movable impeller
5	Sprocket
6	Control line, second-level control (emergency operation)
7	Control line of map control valve (map control pressure)
8	Map control valve
9	Oil pump drive
10	Control plunger
11	Piston pressure side of the axially movable impeller
12	Second level control pressure
13	Map control pressure
14	Oil duct to the piston pressure side
15	Oil duct coming from the map control valve
16	Control piston spring

5.3.2. Minimum delivery

If the map control pressure is transferred to the larger surface area of the control piston (10) via the control line (7) by the map control valve (8), the map control pressure exceeds the second level control pressure due to the surface area difference on the control piston (10). The map control pressure presses against the control piston spring and thus adjusts the control piston (10) toward minimum delivery. By setting the control piston (10) to minimum delivery, the control piston (10) opens the oil duct on the piston pressure side (17). The filtered oil from the oil duct (15) is now sent to the front piston pressure side (11) of the axially movable impeller (4). On account of the axial shift caused by the oil pressure, the contact surfaces 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 (14) and the oil return flow (18).

5. Oil Supply.



S63B44T4 engine, minimum delivery

Index	Explanation
A	Second level control pressure
B	Map control pressure
C	Oil pressure
1	Pressure control spring
2	Pressure relief valve

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

Through the interaction of the map control with the control piston (10), the delivery rate of the oil can be influenced via the axially movable impeller (4) by means of the Digital Motor Electronics (DME).

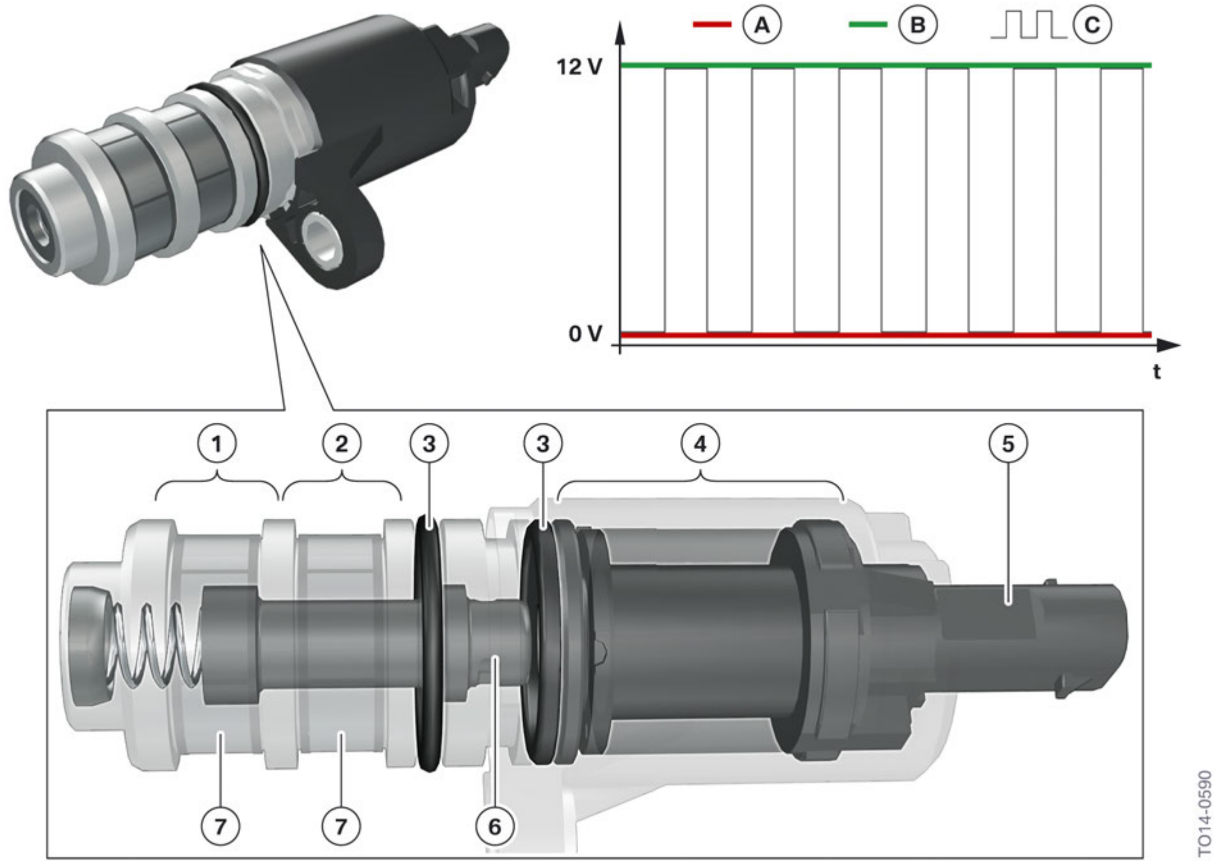
5.3.3. Second-level control (emergency operation)

During normal operation or if the map control fails, the delivery rate is determined via the second level control. The second-level control pressure (6) acts on the smaller, rear surface of the control piston (10). The second level control pressure (6) presses against the control piston spring and thus adjusts the control piston (10) toward minimum delivery. By setting the control piston (10) toward minimum delivery, the control piston (10) opens the oil duct to the front piston pressure side (17). The filtered oil from the oil duct (15) is now sent to the front piston pressure side (11) of the axially movable impeller (4). On account of the axial shift caused by the oil pressure, the contact surfaces of the external gear wheels are reduced and the delivery rate of the filtered oil decreases.

5.4. Map control valve

On the S63B44T4 engine, the characteristic map control valve is installed on the oil sump and is connected with the oil pump via bore holes in the oil sump and crankcase. This design removes the need for interference-prone cable ducts into the oil sump.

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



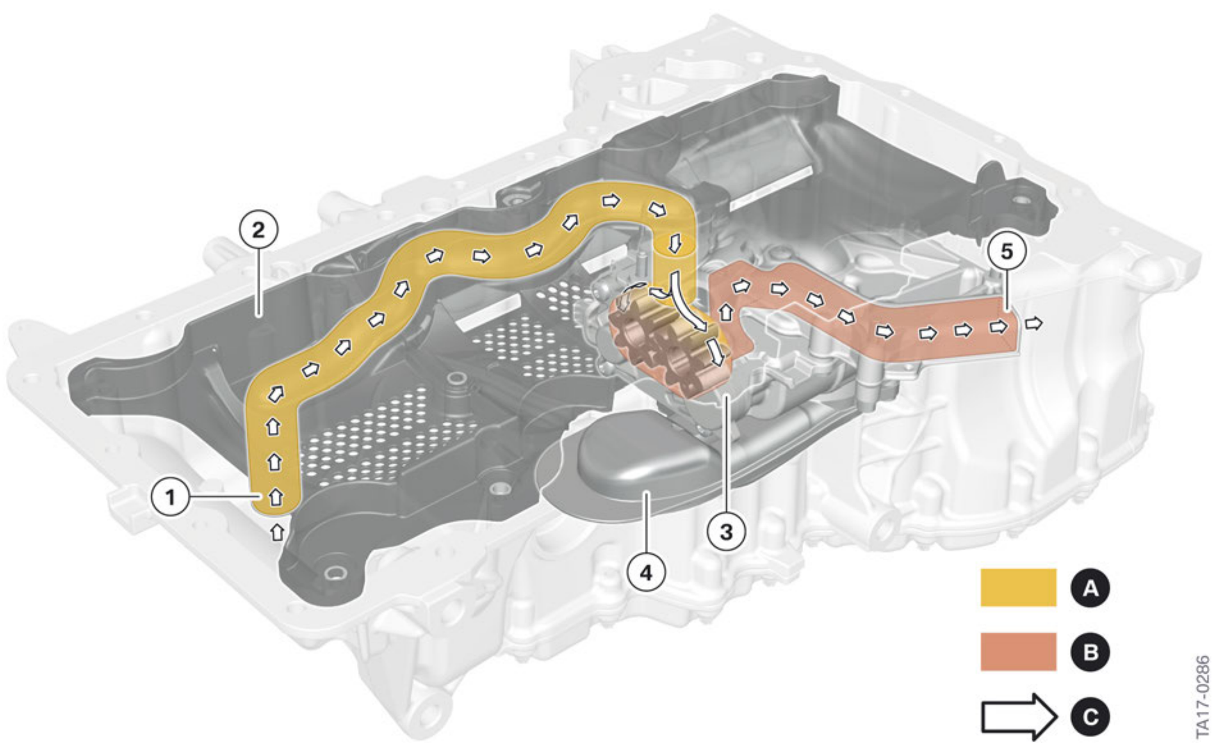
S63B44T4 engine, characteristic map control valve

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 is connected to the main oil duct and delivers the actual oil pressure to the Digital Engine Electronics (DME). 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 map control valve changes. 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.

5.5. Oil supply during high acceleration

In order to adapt the oil supply to motor racing requirements, a second oil pump was installed as a backup. The second oil pump, the so-called suction pump, supports the return flow of the oil from the front areas of the oil sump back to the rear area of the oil sump.



S63B44T4 engine, suction pump

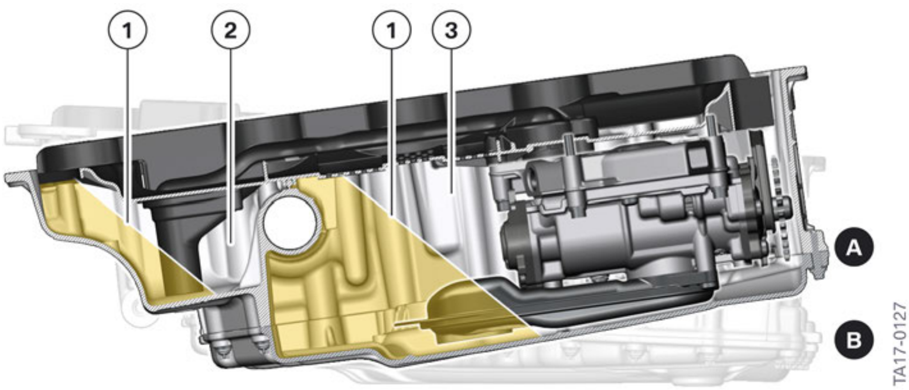
Index	Explanation
A	Intake side
B	Major thrust face
C	Direction of flow/direction of rotation
1	Return pipe
2	Oil deflector
3	Suction pump
4	Oil pick-up, sump, rear
5	Return opening

S63TU4 Engine.

5. Oil Supply.

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 these driving situations, the engine oil is drawn out of the front of the sump through the front oil pick-up by the suction pump during longitudinal acceleration. The drawn-in oil is delivered back to the rear part of the oil sump via the return flow pipe in the oil deflector. There the external gear oil pump can take up the oil again via the rear oil pick-up and deliver it to the engine lubrication points.



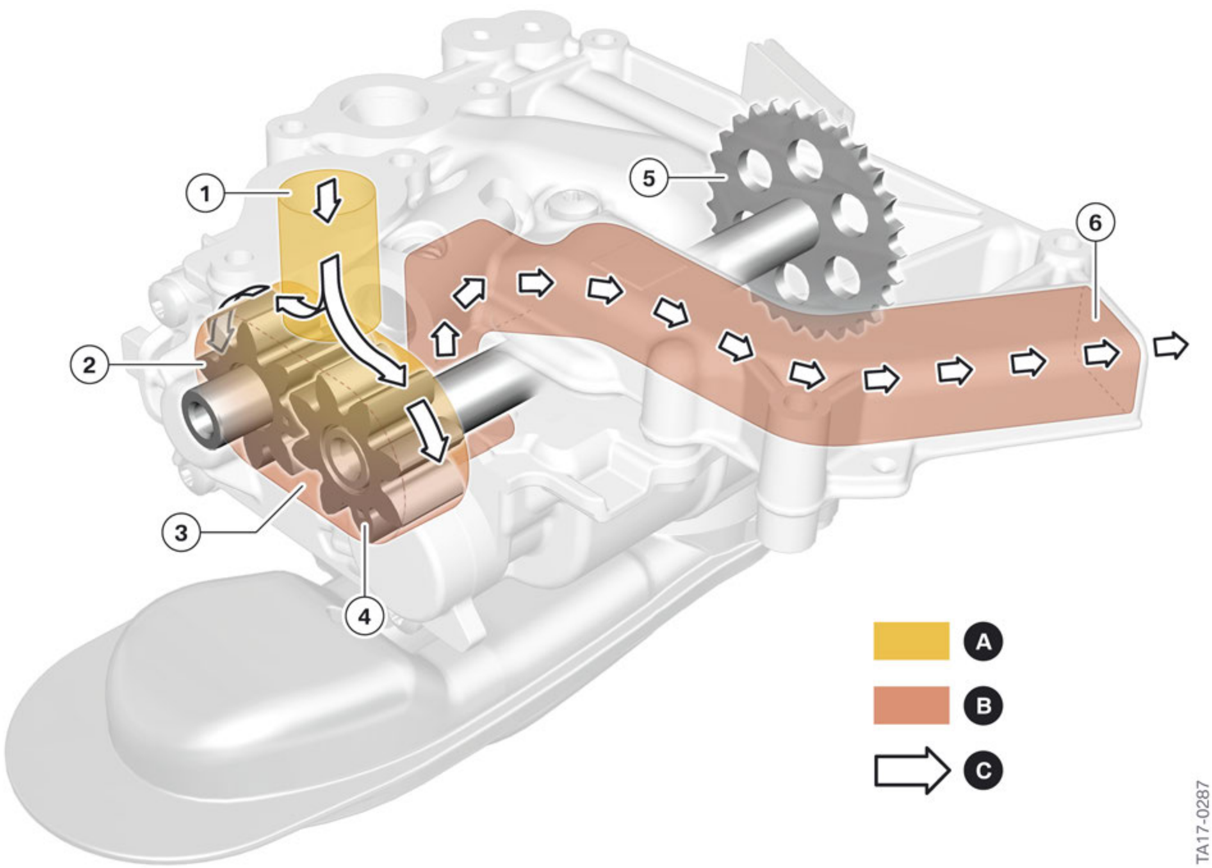
S63B44T4 engine, oil sump with suction pump

Index	Explanation
A	Sump in the event of extremely hard braking
B	Sump during normal driving
1	Oil level in event of extreme hard braking
2	Front oil sump
3	Rear oil sump

The suction pump is a external gear pump. The outer upper chamber of the gear pump is the suction chamber. The oil pick-up from the front sump is connected to the suction chamber and the engine oil is drawn off through the return flow pipe in the oil deflector.

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 pick-up.

S63TU4 Engine.
5. Oil Supply.

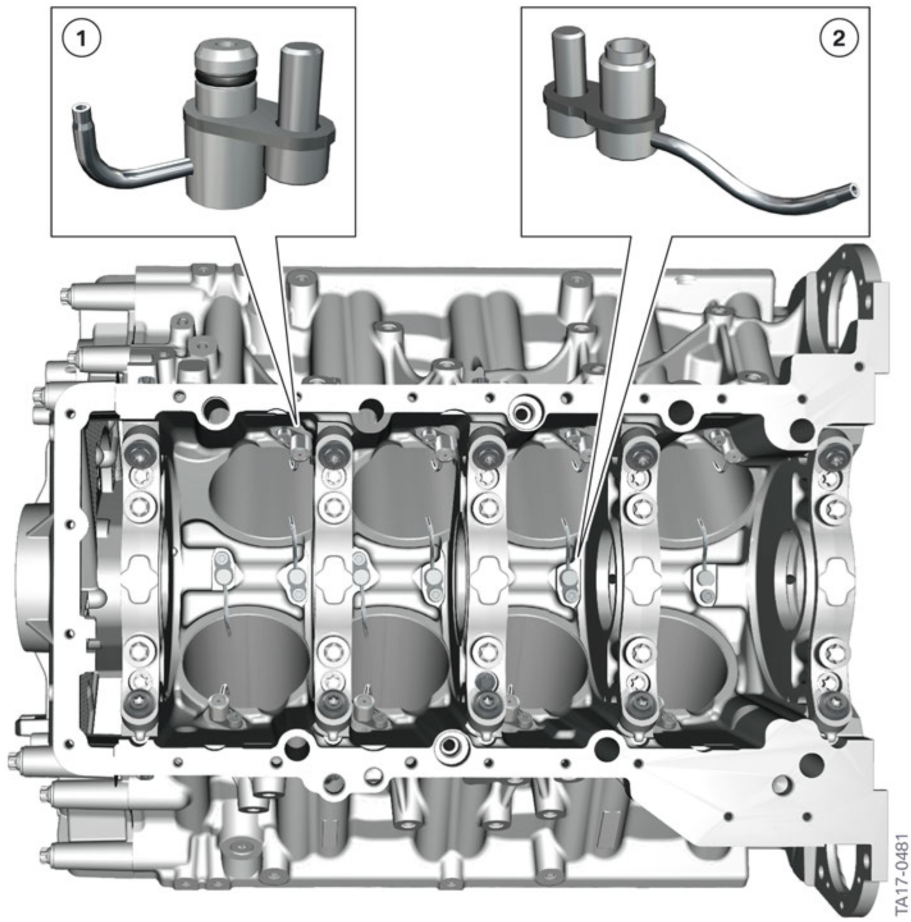


S63B44T4 engine, suction pump

Index	Explanation
A	Intake side
B	Major thrust face
C	Direction of flow/direction of rotation
1	Intake chamber
2	Impeller
3	Pressure chamber
4	Sprocket
5	Oil pump drive
6	Return opening

5.6. Oil spray nozzles/piston crown cooling

The oil spray nozzles for piston crown cooling, as used in the N63B44O2 engine, are in principle familiar. The difference to the N63B44O2 engine lies the fact that, in addition to the already familiar inner oil spray nozzles, additional outer oil spray nozzles have been added as well. The oil spray nozzles incorporate a non-return valve to enable them to open and close only from a specific oil pressure. The opening pressure and closing pressure have been adjusted compared with the N63B44O2 engine. Each cylinder features 2 oil spray nozzles, one inner and one outer, that have the right mounting orientation on account of their styling. In addition to the piston crown cooling, these are also responsible for the lubrication of the gudgeon pins.



S63B44T4 engine, oil spray nozzles for the piston crown cooling

Index	Explanation
1	Outer oil spray nozzle
2	Inner oil spray nozzle (as in the N63B44O2 engine)

On the S63B44T4 engine, the characteristic map control of the volume-flow-controlled oil pump is a key factor in ensuring compliance with the EURO 6 particle emission limit values. Thanks to the oil pump, supplemented by the characteristic map control, the oil pressure can be reduced to under 3.3 bar (47.8 PSI) in the warm-up phase. As a result of this reduction, there is insufficient oil pressure at the oil spray nozzles to open them. This measure also decreases the intended function of the oil spray nozzles, to cool the piston crowns in the warm-up phase. The effect of this is that the piston crowns heat up faster and therefore less fuel is condensed at the cold piston crowns in the warm-up phase, resulting in higher emission values as a result of unburned fuel. When a certain operating temperature is reached, the oil pressure is increased by the characteristic map control of the volume-flow-controlled oil pump, which raises the oil pressure to above the opening pressure for the oil spray nozzles and thus activates the piston crown cooling.

5. Oil Supply.

The outer oil spray nozzles are not opened until an oil pressure of 4.4 bar (63.8 PSI) is reached in order to ensure sufficient piston crown cooling under a high engine load.

	S63B44T2 engine	S63B44T4 engine
Inner oil spray nozzle		
Opening pressure	2.25-2.65 bar (32.6–38.4 PSI)	3.3-3.7 bar (47.8–53.6 PSI)
Closing pressure	2.0 bar (29.0 PSI)	3.0 bar (43.5 PSI)
Outer oil spray nozzle		
Opening pressure	—	4.5 bar (65.2 PSI)
Closing pressure	—	4.2 bar (60.9 PSI)

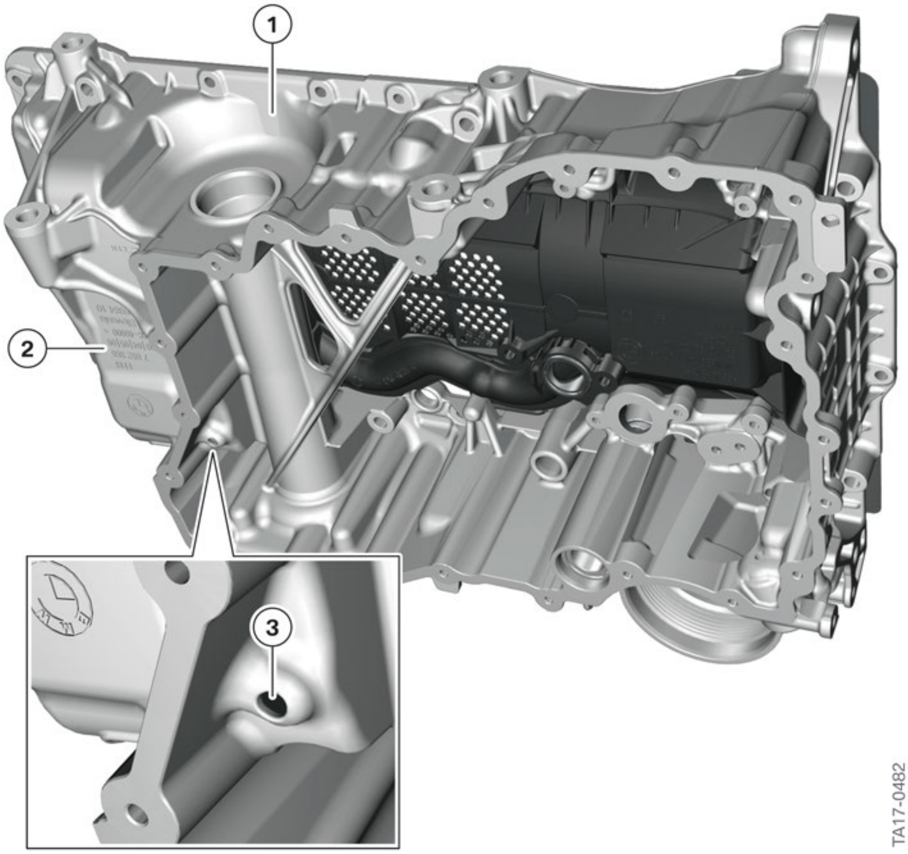
5.7. Service information

At present, as with other BMW M models with S engines, an engine oil change at 1,200 miles (running-in check) is provided for in the case of the S63B44T4 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.

S63TU4 Engine.

5. Oil Supply.



S63B44T2 engine, drain hole

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

⚠

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

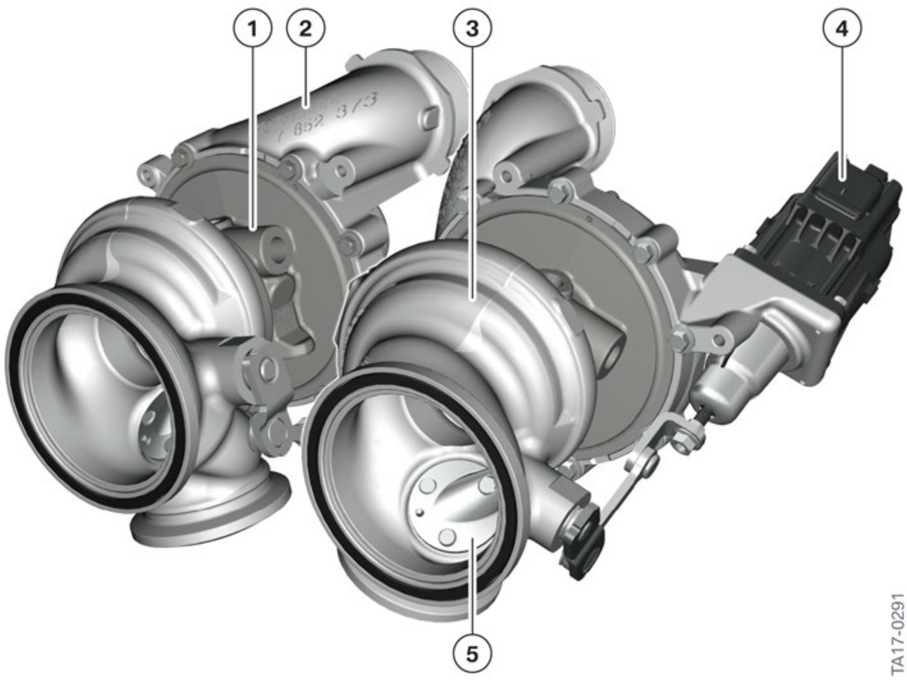
S63TU4 Engine.

6. Exhaust Turbocharger.

As already featured in the S63B44T2 engine, 2 twin-scroll technology exhaust turbochargers are used.

The exhaust turbochargers are supplied with exhaust gas as in the S63B44T2 engine via 2 cross-bank 4-in-2 exhaust manifolds, which is required for the special function of the twin-scroll exhaust turbocharger.

The S63B44T4 engine has 2 exhaust turbochargers supplied by Honeywell. The exhaust turbochargers are twin-scroll exhaust turbochargers and, with the exception of the compressor and wastegate valve actuation, were taken over from the S63B44T2 engine. The compressor and impellers were newly designed for the S63B44T4 engine and thus adapted to its performance structure. Both exhaust turbochargers are a common part for both banks. As on the N63B44O2 engine, a blow-off valve was eliminated with in this overall concept.



S63B44T4 engine, exhaust turbocharger

Index	Explanation
1	Bearing seat
2	Compressor housing
3	Turbine housing
4	Electric wastegate valve controller
5	Single-part wastegate valve

One-piece wastegate valves are used, increasing durability.

⚠

For assembly, precise alignment of the exhaust turbocharger is necessary. Please observe the repair instructions.

S63TU4 Engine.

6. Exhaust Turbocharger.

6.1. Charging pressure control

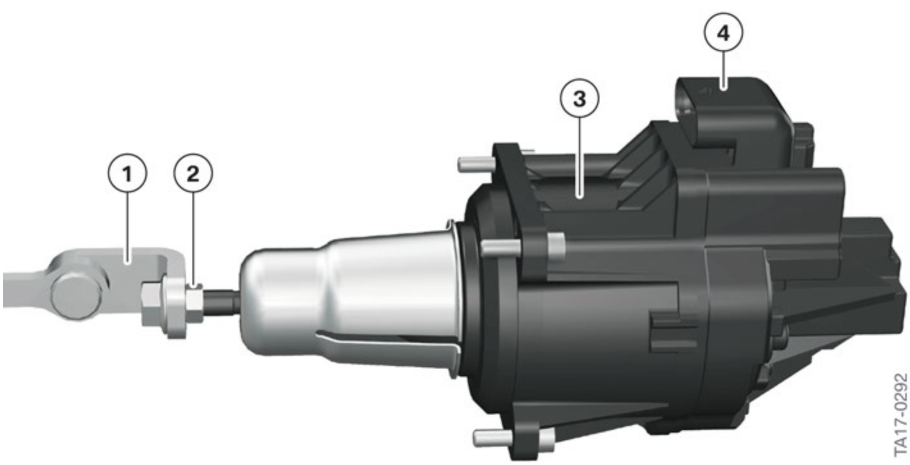
An electrical wastegate valve actuator controls the charging pressure control on the S63B44T4 engine.

In contrast to a vacuum-controlled charging pressure control, the following components are not required:

- Vacuum unit
- Vacuum lines
- Electropneumatic pressure converter
- Vacuum reservoir

This results in the following advantages:

- Faster control speed
- More precise control
- Simpler diagnosis
- Fewer components
- Larger opening angle of wastegate valve



S63B44T4 engine, electric wastegate valve controller

Index	Explanation
1	Stroke linkage
2	Adjusting linkage
3	Actuator
4	Electrical connection

A direct current motor and a sensor are located in the electric wastegate valve controller. resulting in a total of 5 electrical connections on the component. The wastegate valve is opened or closed by a lifting movement of the linkage.

6. Exhaust Turbocharger.

The electric wastegate valve controller can be replaced separately during a service. Each time the adjusting linkage is released, the system must be re-adjusted using the ISTA diagnosis system. This procedure is not required when replacing the entire exhaust turbocharger as the linkage is supplied preset.

⚠

If the electric wastegate valve controller is replaced individually, a teach-in routine must be performed using the ISTA diagnosis system.

The sensor is used to determine the position of the wastegate valve. The wastegate valve can move to any required position between maximum open and maximum closed. When the sensor signal or actuator drops out, the wastegate valve adopts the open position which does not allow charging pressure to build up. This ensures the journey continues with reduced engine performance.

⚠

The position sensor is a linear Hall sensor, therefore a resistance measurement for testing the sensor is not permitted.

S63TU4 Engine.

7. Exhaust Emission Systems.

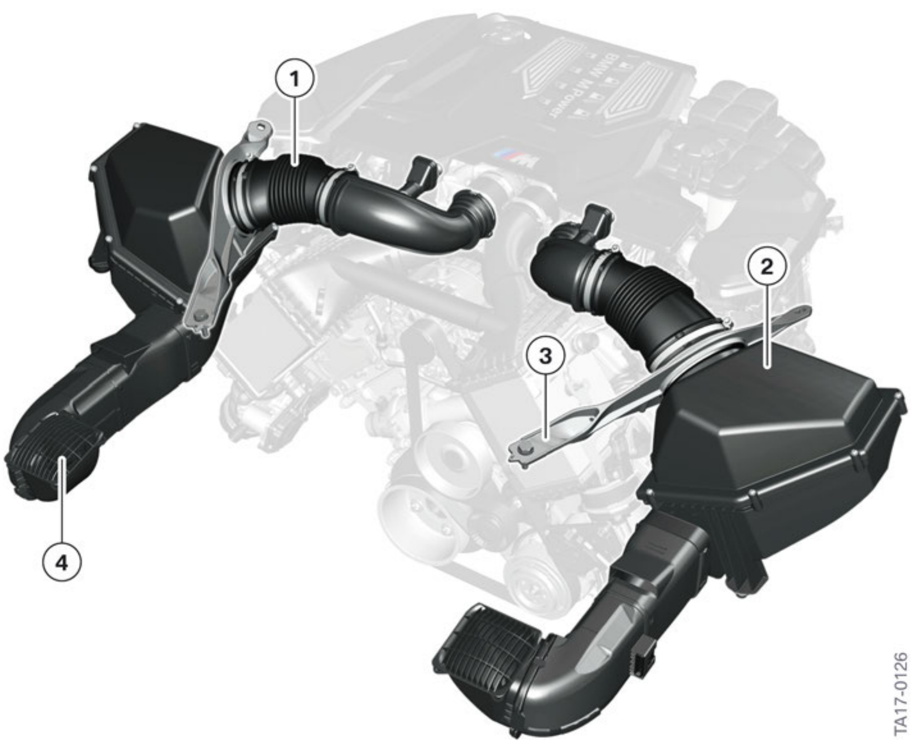
The exhaust emission systems of the S63B44T4 engine are vehicle-specific and are therefore described in the relevant product information for the vehicle.

S63TU4 Engine.

8. Intake Air System.

8.1. Air duct

By eliminating the hot film air mass meter and optimizing the clean air pipe without compromising front end stiffness, the pressure losses in the air intake duct/clean air pipe could be improved by approximately 28% in addition to the increased air flow rates for the S63B44T4 engine.



S63B44T4 engine, intake silencer

Index	Explanation
1	Clean air pipe
2	Intake silencer
3	Rear end strut with opening for clean air pipe
4	Unfiltered air intake

⚠

The front-end struts must be removed and reinstalled to change the air filter. It may be necessary to rework the threads on the aluminum spring strut dome using threaded inserts to ensure their strength after multiple removal and install cycles.

Current information and specifications can be found in the documents of the BMW workshop information systems.

S63TU4 Engine.
8. Intake Air System.

8.2. Air mass determination

In the US and European specification, the intake air mass is not measured directly via a hot film air mass meter, but is calculated in 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).

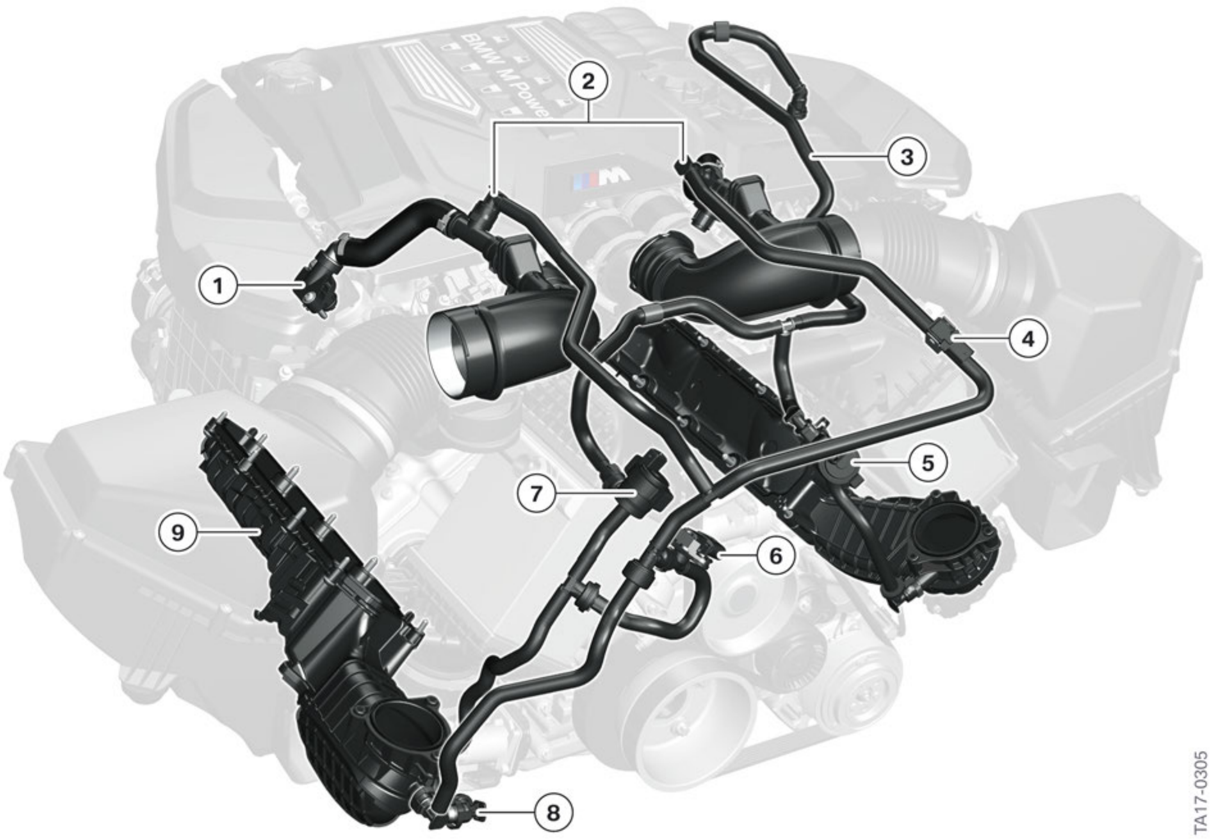
The air mass calculated in this way is adjusted and corrected if necessary in line with the oxygen sensor signals (air/fuel ratio) and the injection period (fuel quantity). Should the oxygen sensors fail, a fault memory entry is made in the DME (air mass plausibility). Adjustment to the calculated air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

The monitoring of the crankcase ventilation and tank ventilation for leakage, which is legally required in the US, is achieved in the S63B44T4 engine by means of the crankcase pressure sensor and tank ventilation pressure sensor. For this reason, the hot film air mass meter could also be deleted in the US version.

8.3. Crankcase ventilation/tank ventilation

To detect leakage in the crankcase ventilation or tank ventilation, a crankcase pressure sensor and a tank ventilation differential pressure sensor are used in the S63B44T4 engine and are connected to the engine control units DME 1 and DME 2.

S63TU4 Engine.
8. Intake Air System.



S63B44T4 engine, crankcase pressure sensor

Index	Explanation
1	Crankcase ventilation connection, cylinder head cover
2	Crankcase ventilation/tank ventilation connection on intake system
3	Tank ventilation line to carbon canister
4	Crankcase pressure sensor
5	Tank vent valve, bank 2
6	Tank ventilation differential pressure sensor
7	Tank vent valve, bank 1
8	Crankcase ventilation line connection
9	Intake manifold

Blow-by gases and gases from the tank ventilation contain a large quantity of hydrocarbons. Existing control systems in the S63B44T4 engine, such as the crankcase ventilation and tank ventilation, return these gases for combustion in a controlled manner via the intake system. To ensure that a malfunction such as leakage will not cause non-combusted hydrocarbons to escape into the atmosphere, the crankcase ventilation is monitored by a crankcase pressure sensor and the tank ventilation is monitored by a tank ventilation differential pressure sensor.

The leakage is detected on the basis of defined setpoint values in the characteristic map of the DME engine control. For this purpose, the DME engine control performs the following steps:

- Measurement of the pressure in the crankcase ventilation and in the tank ventilation system under an engine load and engine speed defined in the characteristic map.
- Comparison of the actual pressure reading with the setpoint pressure value stored in the characteristic map.
- If the setpoint pressure value is exceeded, a leakage is detected.
- Output of a Check Control message (CCM) as driver information.

Good leakage detection by the crankcase pressure sensor and the tank ventilation differential pressure sensor is provided at a medium engine speed of between 500 rpm and 3000 rpm. The engine load for leakage detection is on average between 20 % and 80 % during crankcase pressure measurement.

The tank ventilation differential pressure sensor is connected to the DME 1, while the crankcase pressure sensor is connected to the DME 2 and also monitored by it.

S63TU4 Engine.
9. Fuel Preparation.

9.1. Low-pressure fuel system

To monitor the fuel pressure, a low-pressure fuel sensor is used that measures and monitors the fuel pressure on the low-pressure side. The low-pressure fuel sensor is connected to and monitored by the DME 1.

9.2. High-pressure fuel system

For the S63B44T4 engine, 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 air-fuel mixing
- 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 injectors 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. In the high-pressure pump, the pump piston and plunger were modified and the materials were adjusted. Its design is already in use in the previous 3, 4 and 8-cylinder engines.

⚠

Work on the fuel system is only permitted after the engine has cooled down. The coolant temperature must not exceed 40° C (104° F). This condition must be observed without fail, 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.

S63TU4 Engine.
9. Fuel Preparation.

When working on the fuel system of the S63B44T4 engine, it is important to ensure that the ignition coils are not contaminated 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, always 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 removed and the highest possible level of cleanliness ensured.
- Ignition coils heavily contaminated by fuel must be replaced.
- The CVO function comprises the system components "Injector" and "Digital Engine Electronics" (DME). These components therefore have to be identified with the vehicle identification number in the EPC in the event of a replacement.
- For injectors and a DME which supports the CVO function, the injection quantity compensation during the replacement of one of the components is not used.
- An excessive rotational angle at the injector shank, and excessive tension and compression 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.

S63TU4 Engine.
10. Cooling.

Cooling of the S63B44T4 engine is in part vehicle-specific and therefore described in the relevant product information for the vehicle.

10.1. Charge air cooler

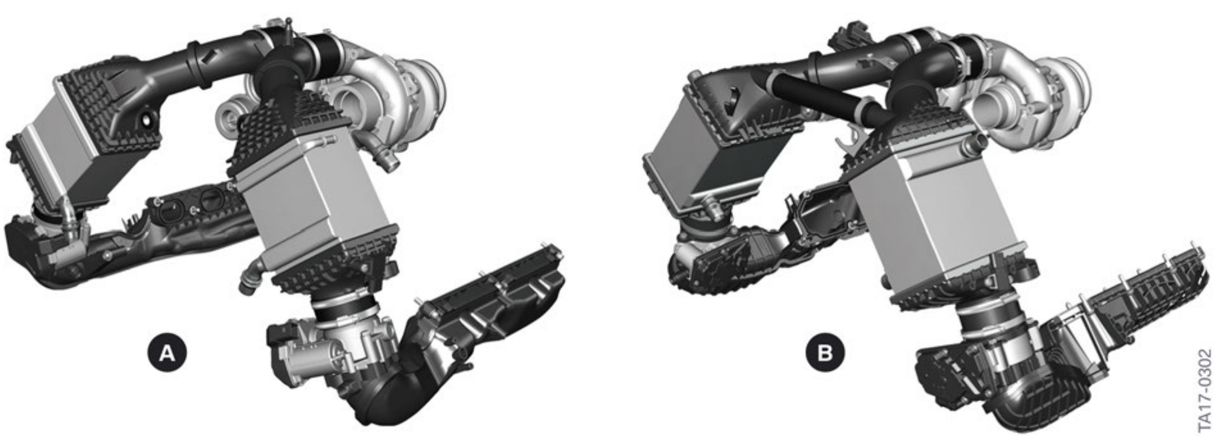
The charge air coolers deliver the following performance data.

- Charge air cooler temperature input: approximately 160° C (320° F)
- Charge air cooler temperature output: approximately < 50° C (< 122° F)
- Cooling power: 32 KW
- Charging pressure: 2.7 bar (39.1 PSI)
- Pressure loss through charge air cooler: < 50 mbar

The charge air coolers in the S63B44T4 engine feature a connecting piece between the cylinder bank 1 charge air cooler and the bank 2 charge air cooler. The connecting piece between the charge air coolers provides pressure compensation between the two cylinder banks.

The pressure compensation results in the following advantages:

- No pressure peaks in the charge air duct
- Optimal use of characteristic maps by the engine control



S63B44T4 engine, charge air cooler comparison

Index	Explanation
A	Charge air cooler S63B44T2
B	Charge air cooler S63B44T4

The system supplier of the charge air coolers is Delphi.

S63TU4 Engine.
11. Engine Electrical System.

A new generation of Bosch engine control units is used in the S63B44TU4 engine. The 8th generation of engine electronics (DME) represents a joint control unit platform for gasoline and diesel engines and is already used for 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.x.yH) can be broken down as follows.

Abbreviation	Meaning
DME	Digital Motor Electronics
8	Control unit generation (modular platform for gasoline and diesel engines)
x	Number of cylinders as a hexadecimal figure
y	Vehicle electrical system architecture
H	Hybrid version

Number of cylinders as a hexadecimal figure:

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

Vehicle electrical system architecture:

- 0 = vehicle electrical system 1 (large series)
- 1 = vehicle electrical system 2 (small series)

Examples for gasoline engines:

- DME 8.4.0H = B48 PHEV* (variant electrical system 1)
- DME 8.6.1 = B58 (variant electrical system 2)
- DME 8.8.0 = N63TU2 (variant electrical system 1)
- DME 8.8.T = S63TU4 (vehicle electrical system 1)
- DME 8.C.0 = N74TU (vehicle electrical system 1)

*PHEV = Plug-in Hybrid Electric Vehicle.

As such, the S63B44T4 engine has Bosch Digital Motor Electronics with the designation DME 8.8.T. There is a separate engine control unit fixed to the engine for every bank. The actuators and sensors of cylinder bank 1 are assigned to the DME 1 control unit; accordingly, the DME 2 control unit is responsible for the functions of cylinder bank 2. DME 1 is the master control unit and receives all information concerning the entire engine, such as regarding the crankshaft sensor, and provides it to the DME 2 control unit directly or via the bus system. Due to the variety of sensors and actuators it was deemed necessary to use 2 control units.

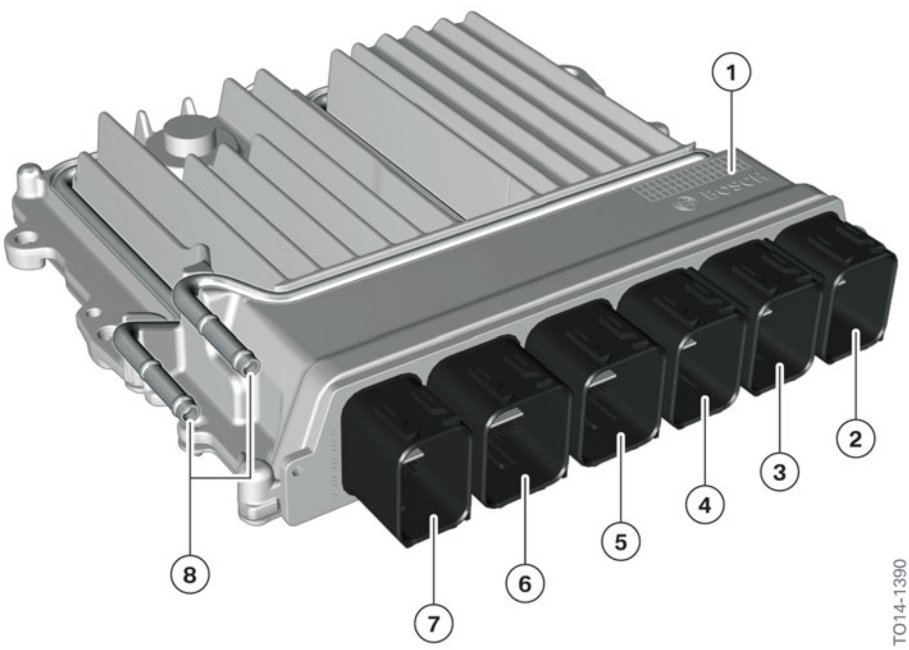
S63TU4 Engine.
11. Engine Electrical System.

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. An immobilizer adjustment cannot be reversed.

The connector concept is identical to that on the modular engines and features a Nano MQS connector system (Micro Quadlok 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.



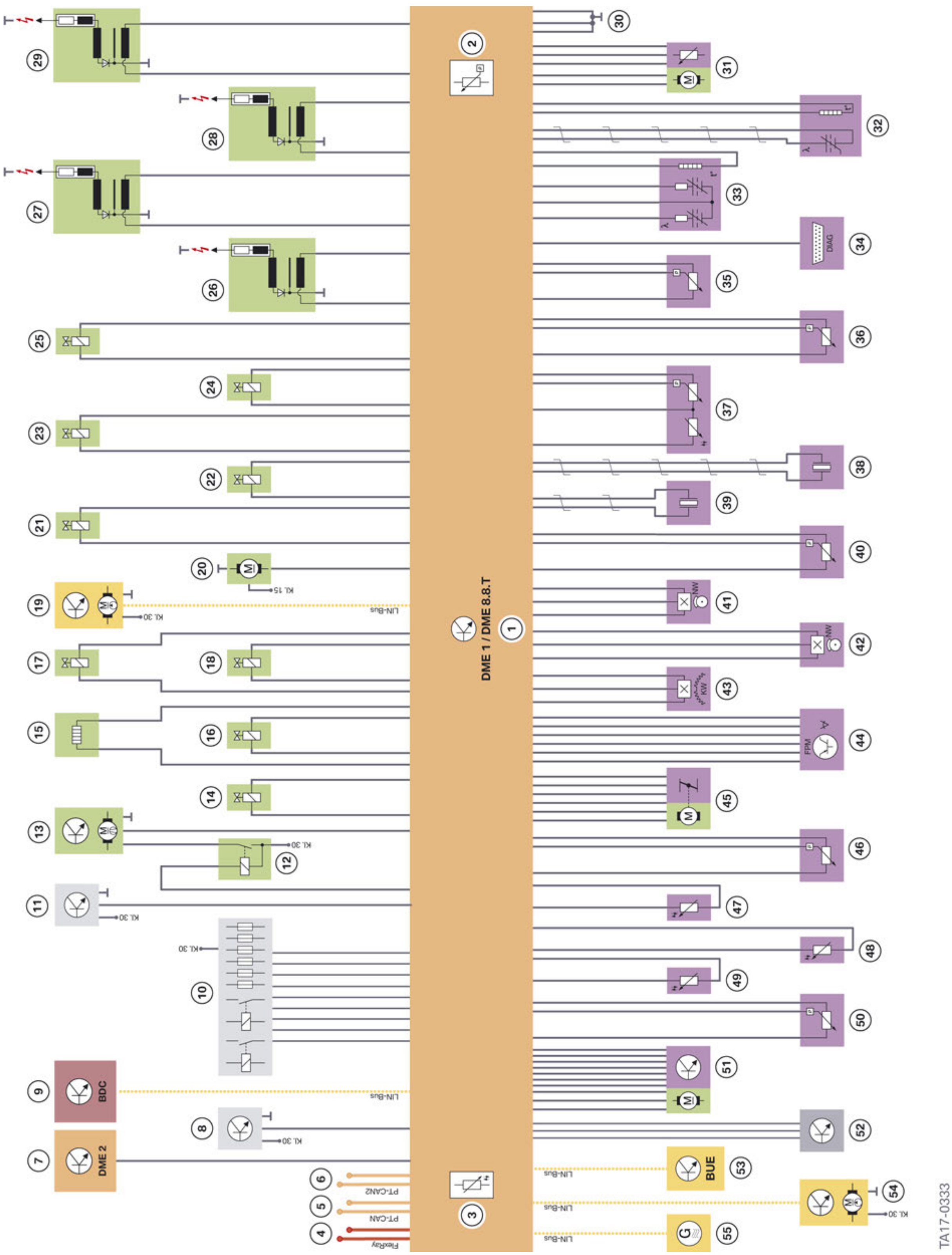
S63B44T4 engine, connections for DME 8.8.T

Index	Explanation
1	Engine control unit DME 8.8.T
2	Module 100, vehicle connection
3	Module 200, sensors and actuators 1
4	Module 300, sensors and actuators 2
5	Module 400, Valvetronic servomotor
6	Module 500, DME supply
7	Module 600, injection and ignition
8	Coolant connections (not connected for the S63B44T2/T4 engine)

S63TU4 Engine.

11. Engine Electrical System.

11.1. DME 1 control unit



S63B44T4 engine, DME 8.8.T DME 1

S63TU4 Engine.
11. Engine Electrical System.

Index	Explanation
1	Engine electronics DME 1 8.8.T
2	Ambient pressure sensor
3	Temperature sensor
4	FlexRay
5	PT-CAN
6	PT-CAN2
7	DME 2 connection
8	Tank leak diagnosis, Natural Vacuum Leak Detection (NVLD) (only US version)
9	Body Domain Controller (BDC)
10	Power distribution box (symbolic)
11	Fuel pump control electronics (FPC)
12	Relay for electric fan
13	Electric fan
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	Electrical exhaust flap controller (EAKS)
21	Fuel quantity control valve
22–25	Injectors
25–29	Ignition coils
30	Ground
31	Electric wastegate valve controller
32	Oxygen sensor LSF Xfour
33	Oxygen sensor LSU 5.2
34	Diagnostic connector
35	Charge air temperature and charging pressure sensor before throttle valve
36	Rail pressure sensor
37	Charge air temperature and intake-manifold pressure sensor after throttle valve
38	Knock sensors cylinder 1-2
39	Knock sensors cylinder 3-4

S63TU4 Engine.

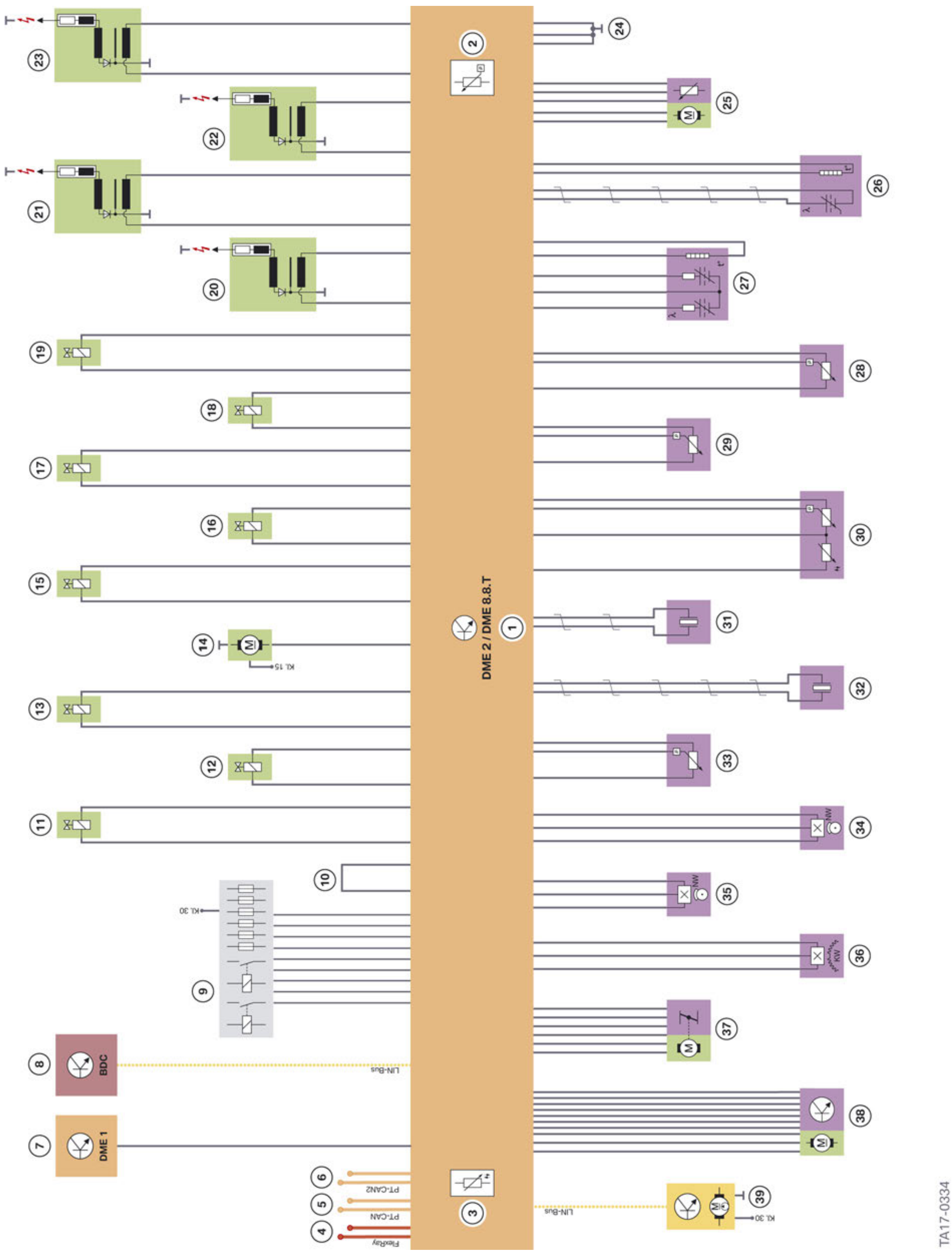
11. Engine Electrical System.

Index	Explanation
40	Fuel low-pressure sensor
41	Camshaft sensor, intake camshaft
42	Camshaft sensor, exhaust camshaft
43	Crankshaft sensor, signal is looped through to DME 2
44	Accelerator pedal module
45	Throttle valve
46	Tank ventilation pressure sensor
47	Coolant temperature sensor
48	Coolant temperature sensor at radiator outlet
49	Oil temperature sensor
50	Oil pressure sensor
51	Valvetronic servomotor
52	Oil-level sensor
53	Battery supervision circuits (BUE)
54	Electric coolant pump, charge air cooler
55	Alternator

S63TU4 Engine.

11. Engine Electrical System.

11.2. DME 2 control unit



S63B44T4 engine, DME 8.8.T DME 2

S63TU4 Engine.
11. Engine Electrical System.

Index	Explanation
1	Engine electronics DME 2 8.8.T
2	Ambient pressure sensor
3	Temperature sensor
4	FlexRay
5	PT-CAN
6	PT-CAN2
7	DME 1 connection
8	Body Domain Controller (BDC)
9	Power distribution box (symbolic)
10	DME 1–DME 2 encoding
11	VANOS solenoid valve, intake camshaft
12	VANOS solenoid valve, exhaust camshaft
13	Fuel quantity control valve
14	Electrical exhaust flap controller (EAKS)
15	Tank vent valve
16–19	Injectors
20–23	Ignition coils
24	Ground
25	Electric wastegate valve controller
26	Oxygen sensor LSF Xfour
27	Oxygen sensor LSU 5.2
28	Charge air temperature and charging pressure sensor before throttle valve
29	Rail pressure sensor
30	Charge air temperature and intake-manifold pressure sensor after throttle valve
31	Knock sensors cylinder 5-6
32	Knock sensors cylinder 7-8
33	Crankcase pressure sensor
34	Camshaft sensor, intake camshaft
35	Camshaft sensor, exhaust camshaft
36	Crankshaft sensor
37	Throttle valve
38	Valvetronic servomotor
39	Electric coolant pump, charge air cooler