

Technical training.
Product information.

B58 Engine



BMW Service

Edited for the U.S. market by:
BMW Group University
Technical Training

ST1505

9/1/2015

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 and national-market versions

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.

This document basically relates to the European version of left hand drive vehicles. Some operating elements or components are arranged differently in right-hand drive vehicles than shown in the graphics in this document. Further differences may arise as the result of the equipment specification in specific markets or countries.

Additional sources of information

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

- Owner's Handbook
- Integrated Service Technical Application.

Contact: conceptinfo@bmw.de

©2015 BMW AG, Munich

Reprints of this publication or its parts require the written approval of BMW AG, Munich

The information contained in this document forms an integral part of the technical training of the BMW Group and is intended for the trainer and participants in the seminar. Refer to the latest relevant information systems of the BMW Group for any changes/additions to the technical data.

Contact:

Andreas Karo

Tel.: +49 (0) 89 382 40620

E-mail: andreas.karo@bmw.de

Information status: **April 2015**

BV-72/Technical Training

B58 Engine

Contents

1.	Introduction.....	1
1.1.	Model overview.....	1
1.2.	Modular design.....	1
1.2.1.	TwinPower Turbo.....	5
1.3.	Technical data.....	6
1.3.1.	Power and torque graph.....	6
1.4.	Engine identification.....	7
1.4.1.	Engine designation.....	7
1.4.2.	Engine identification.....	9
2.	Engine Mechanical.....	10
2.1.	Engine housing.....	10
2.1.1.	Cylinder head cover.....	11
2.1.2.	Cylinder head.....	13
2.1.3.	Crankcase.....	14
2.1.4.	Oil sump.....	17
2.2.	Crankshaft drive.....	17
2.2.1.	Crankshaft.....	17
2.2.2.	Connecting rod.....	18
2.2.3.	Piston.....	21
2.2.4.	Chain drive.....	22
2.3.	Valve gear.....	24
2.3.1.	VANOS.....	24
2.3.2.	Valvetronic.....	25
2.4.	Belt drive.....	30
3.	Oil Supply.....	31
3.1.	Oil circuit.....	31
3.2.	Map control.....	31
3.3.	Oil pump.....	31
3.3.1.	Normal operation.....	33
3.3.2.	Emergency operation.....	33
3.4.	Oil filter module.....	35
3.4.1.	Filter bypass valve.....	36
3.4.2.	Heat exchanger bypass valve.....	36
4.	Cooling System.....	37
4.1.	Cooling circuit, B58 engine.....	37
4.1.1.	Special features.....	38
4.2.	Heat management module.....	38
4.2.1.	Cooling circuits.....	42

B58 Engine

Contents

4.2.2.	Operating strategy.....	43
4.3.	Mechanical coolant pump.....	45
5.	Intake Air and Exhaust System.....	46
5.1.	Intake air system.....	46
5.1.1.	Charge air cooling.....	46
5.2.	Exhaust emission system.....	50
5.2.1.	Exhaust turbocharger.....	50
5.2.2.	Charging pressure control.....	51
5.2.3.	Exhaust system.....	53
5.2.4.	Exhaust emission standards.....	54
6.	Vacuum Supply.....	57
6.1.	Vacuum pump.....	57
7.	Fuel System.....	59
7.1.	Fuel preparation.....	59
7.1.1.	Direct rail.....	60
7.1.2.	Solenoid valve injector.....	62
8.	Engine Electrical System.....	67
8.1.	Component temperature sensor.....	67
8.2.	Digital Motor Electronics.....	68
8.3.	DME 8.6 system wiring diagram.....	69

B58 Engine

1. Introduction

This training manual describes the special characteristics of the B58 engine in the B58B30M0 variant. It also describes and illustrates differences to the N55 engine in the N55B30M0 variant. The document also describes the common factors of the current B38 installed in the I12 and future B48 and B57 engines. The US market will receive the B58B30M0 ULEV II and B56B30M0 SULEV variants.

The most important development characteristics relate to BMW EfficientDynamics and its modular kit strategy. Using uniform processes means that development and manufacturing costs can be lowered. In production, the complexity of the manufacturing process planning and implementation is reduced. In Service, the warehousing is simplified as a result of the reduction of part variety, and the safe handling of products is increased.

1.1. Model overview

The following table provides an overview of the BMW models in which the new engine will be used from mid-July 2015:

Model	Version	Series	Displacement in cm ³	Power in kW(Hp) at	Torque in Nm (lb-ft) at
340i	US version	F30, F31, F34	2998	240 (320) 5200 - 6500	450 (330) > 1380
340i xDrive	US version	F30, F31, F34	2998	240 (320) 5200 - 6500	450 (330) > 1380

1.2. Modular design

The B58 6-cylinder engine forms part of the new in-line engine family. The B58 engine features elements including double VANOS, TwinPower exhaust turbocharger technology, indirect charge air cooling that has been integrated into the intake system and a heat management module.

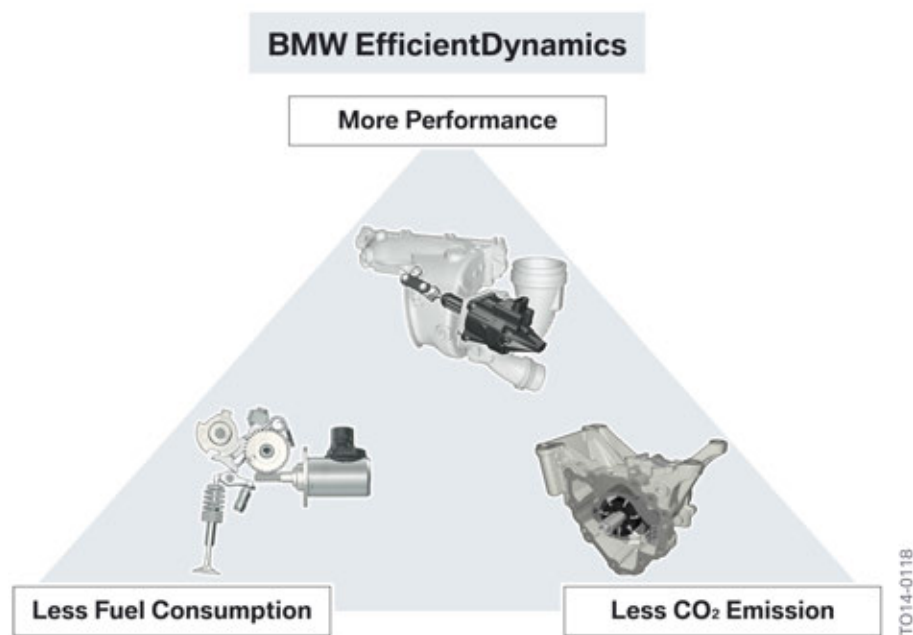
The EfficientDynamics strategy of the N engine generation has resulted in a large number of different technologies finding their way into the BMW engine world. The strategy for the simplification of inspection work is also pursued with the B engine generation.

The new engine generation is mainly characterized by lower fuel consumption and fewer exhaust emissions (It complies with Euro 6 in ECE and ULEV II in the US). A characteristic map-controlled oil pump, an injection system with direct rail and electric arc wire injection cylinder bores are used to achieve low fuel consumption. All engines are also equipped with an automatic engine start-stop function and intelligent generator control as a further EfficientDynamics measure.

Compared with the N engines, the new B engine generation demonstrates a considerably higher number of common and interchangeable parts with the Bx7 diesel engines and the Bx8 gasoline engines.

B58 Engine

1. Introduction



BMW EfficientDynamics strategy of the Bx8 engine generation

Description	Explanation
BMW EfficientDynamics	BMW EfficientDynamics strategy
More performance	More performance
Less fuel consumption	Less fuel consumption
Fewer CO ₂ emissions	Less carbon dioxide emissions

BMW EfficientDynamics also stands for more power, less consumption and less carbon dioxide emissions in the new engine generation. With the additional modular strategy, other objectives such as lower costs, greater production flexibility, as well as enhanced customer satisfaction, are now also being pursued.

B58 Engine

1. Introduction



Modular strategy of Bx8 engine generation

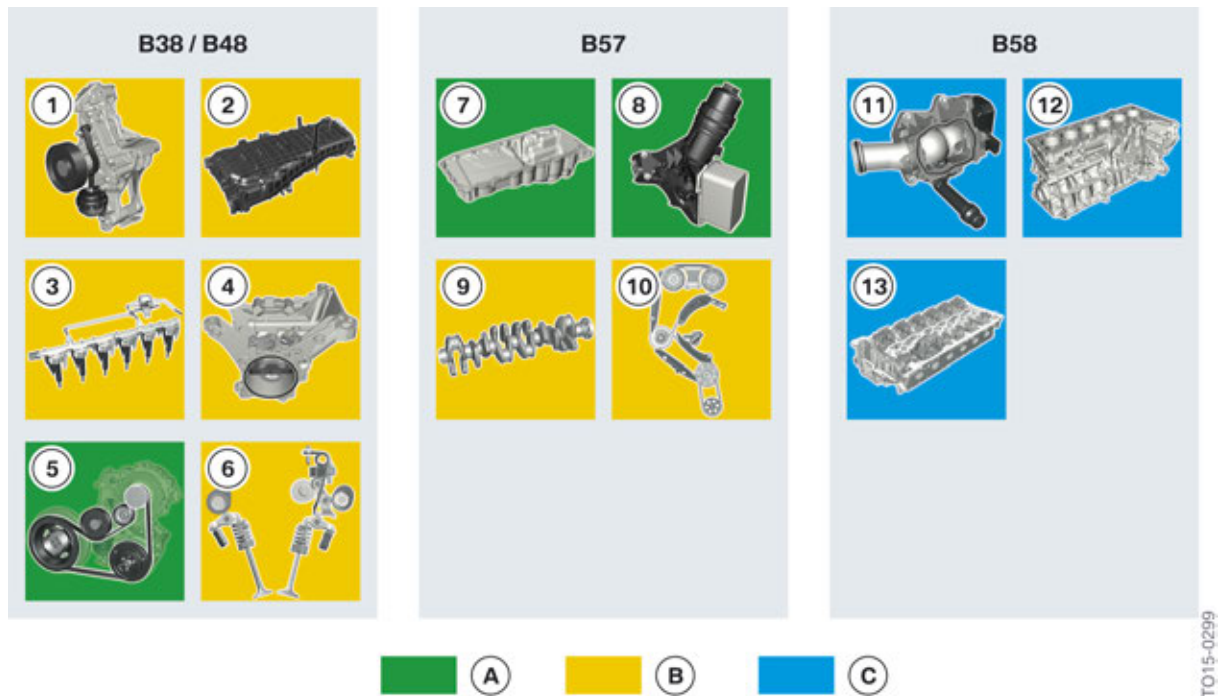
Description	Explanation
Modular	Modular strategy
Enhanced customer satisfaction	Enhanced customer satisfaction
Greater flexibility	Greater flexibility
Less costs	Less costs

The modular strategy aims for different effects throughout the product development process and product life cycle. For instance, using uniform processes means that development and manufacturing costs can be lowered. In production, the complexity of the manufacturing process planning and implementation is reduced. In Service, the warehousing is simplified as a result of the reduction of part variety, and the safe handling of products is increased.

The following graphic provides an overview of the new, common and adapted parts of the new engine generation.

B58 Engine

1. Introduction



Overview of common and synergy parts in the B58 engine

Index	Explanation
A	Common parts
B	Adapted parts (from other engines)
C	New parts
B38	3-cylinder gasoline engine
B48	4-cylinder gasoline engine
B57	6-cylinder diesel engine
B58	6-cylinder gasoline engine
1	Coolant pump
2	Intake manifold
3	Direct rail
4	Oil pump
5	Belt drive
6	Valvetronic
7	Oil sump
8	Oil filter housing
9	Crankshaft

B58 Engine

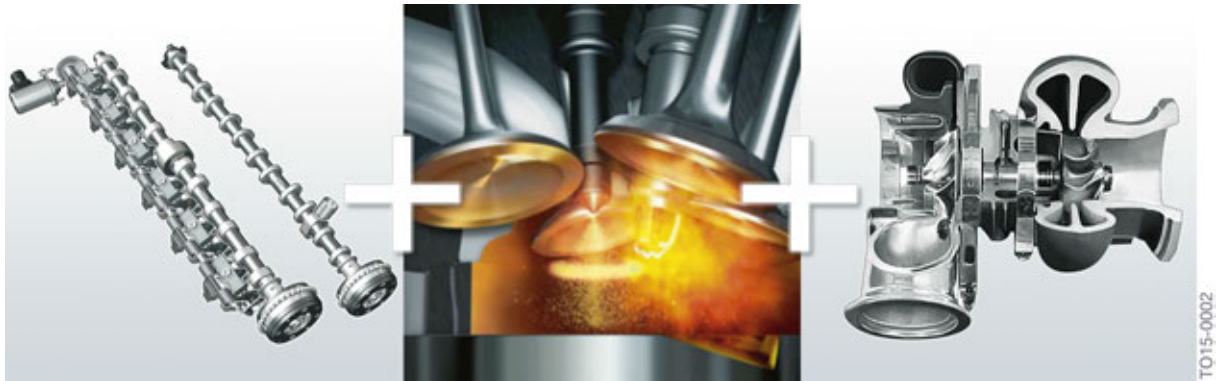
1. Introduction

Index	Explanation
10	Chain drive
11	Heat management module
12	Crankcase
13	Cylinder head

Common parts are parts which are used with the same function and housing structure in various products. In contrast, adapted parts have the same operating principle, but are adapted to the different requirements.

1.2.1. TwinPower Turbo

All Bx8 engines are equipped with the established TwinPower Turbo Technologies.



TwinPower Turbo Technology, Bx8 engine

TwinPower Turbo is the BMW umbrella term that with regard to gasoline engines means that the following technologies are used:

- VANOS
- Valvetronic
- Direct injection
- Turbocharging

B58 Engine

1. Introduction

1.3. Technical data

The B58 engine is the successor to the N55 engine. The following table compares the technical data for both engines.

	Unit	N55B30M0 (F30/335i)	B58B30M0 (F30/340i)
Number of cylinders/ design		6 cylinders/in-line	6 cylinders/in-line
Displacement	[cm ³]	2979	2998
Bore/stroke	[mm]	84.0/89.6	82/94.6
Power output at engine speed	[kW] (Hp) [rpm]	225 (300) 5800 - 6400	240 (320) 5200 - 6500
Torque at engine speed	[Nm] (lb-ft) [rpm]	400 (300) 1200 - 5000	450 (330) > 1380
Compression ratio	[ε]	10.2 : 1	11 : 1
Fuel consumption complying with EU	[l/100 km]	8.9	—
Fuel Octane range	RON	91-100	91-100
CO ₂ pollutant emissions	[grams per kilometer]	209	—
Digital Motor Electronics		MEVD 17.2	DME 8.6
Exhaust emission legislation		ULEV II	ULEV II
Engine oil specification		BMW Longlife-01 BMW Longlife-04	

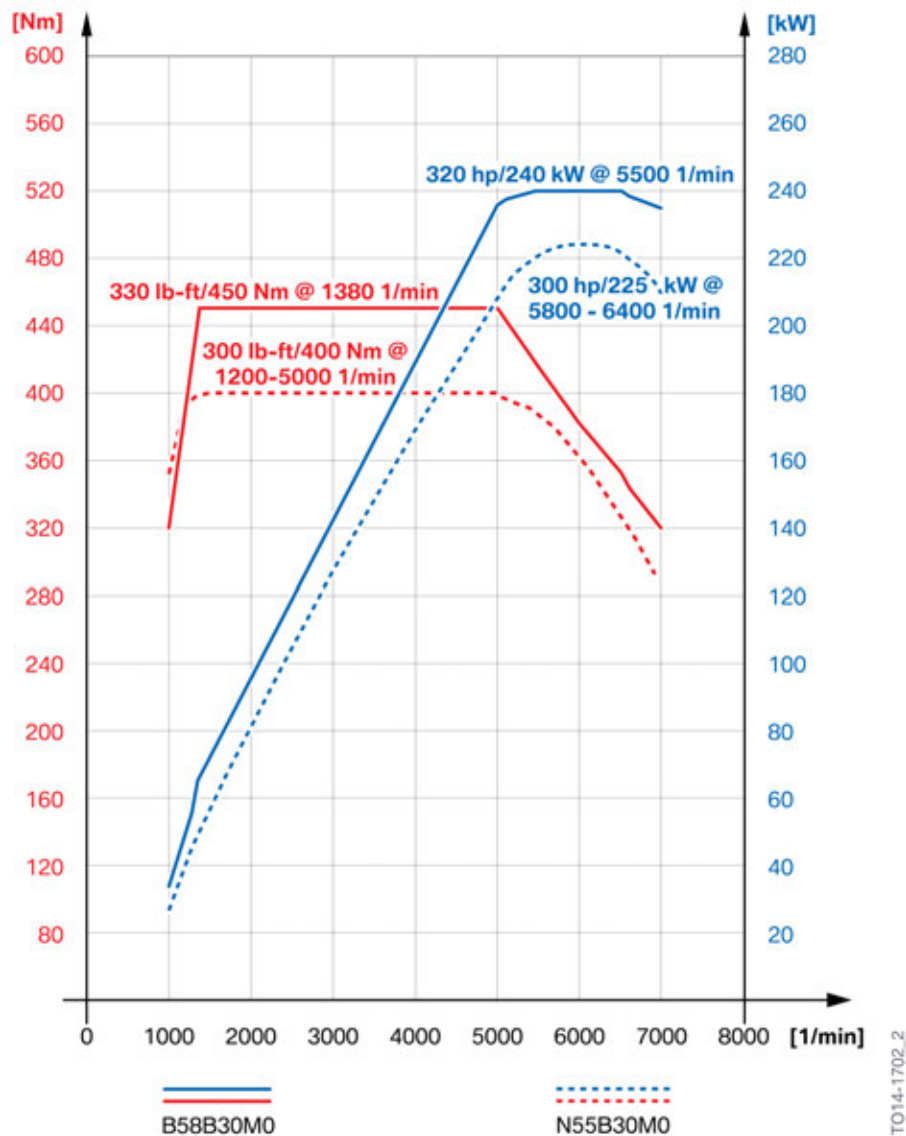
The data on consumption and CO₂ pollutant emissions for this model was unavailable at the time this document was created.

1.3.1. Power and torque graph

The following performance diagram shows the power and torque curve at different engine speed ranges. In addition to an increased power and torque, the new engine also complies with the ULEV II exhaust emission standard.

B58 Engine

1. Introduction



Performance diagram of the B58B30M0 engine

1.4. Engine identification

1.4.1. Engine designation

The technical documentation uses the abbreviation of the engine identification B58B30M0, which only enables engine type assignment. The following table provides information about the significance of the individual positions in the engine identification.

B58 Engine

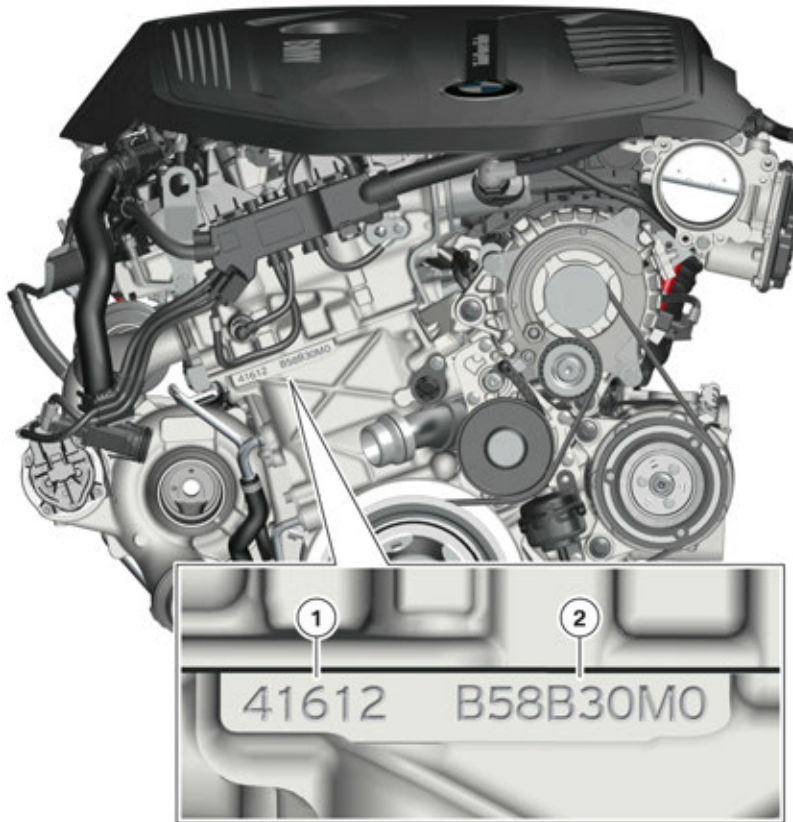
1. Introduction

Position	Meaning	Index	Explanation
1	Engine developer	N, B W	BMW Group engine Third-party engine
2	Engine type	3 4 5	3-cylinder in-line engine 4-cylinder in-line engine 6-cylinder in-line engine
3	Change to the basic engine concept	7 8	Diesel direct fuel injection with turbocharging Gas engine with Turbo-Valvetronic direct injection (TVDI)
4	Working method or fuel and installation position	A B C D K	Gas engine, transversal installation Gas engine, longitudinal installation Diesel engine transversal installation Diesel engine longitudinal installation Gas engine, transversal installation, rear
5 + 6	Displacement in 1/10 liter	12 15 16 20 30	1.2 liter displacement 1.5 liter displacement 1.6 liters displacement 2.0 liters displacement 3.0 liters displacement
7	Performance classes	K U M O T S	Lowest Lower Middle Upper Top Super
8	Revision relevant to approval	0 1 2	New development First revision Second revision

B58 Engine

1. Introduction

1.4.2. Engine identification



Engine identification for B58 engine

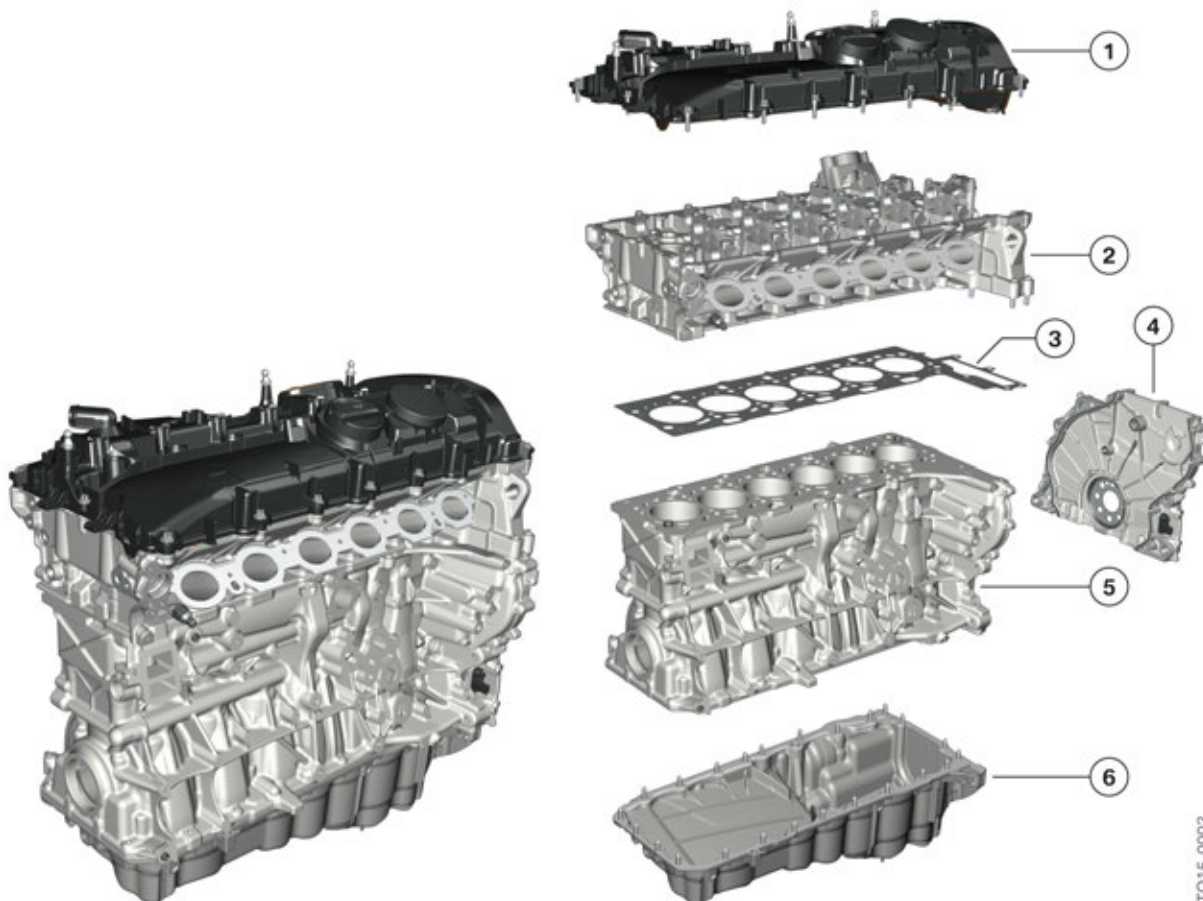
Index	Explanation
1	Engine number
2	Engine designation

The engine identification is embossed on the crankcase in order to uniquely identify the engine. The engine identification, engine number together with the engine type make it possible to uniquely identify and assign the engine.

B58 Engine

2. Engine Mechanical

2.1. Engine housing



TO15-0003

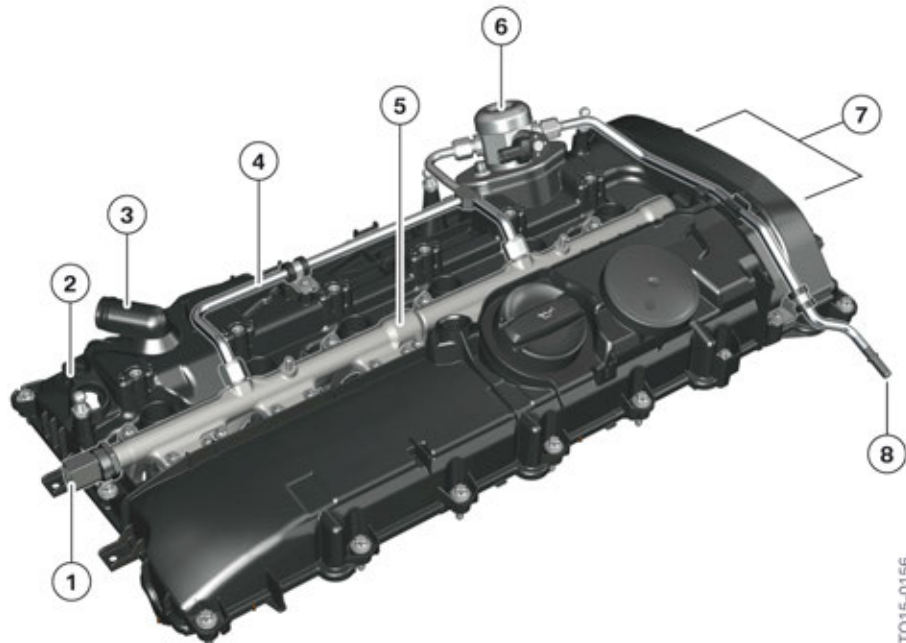
Engine housing of B58 engine

Index	Explanation
1	Cylinder head cover
2	Cylinder head
3	Cylinder head gasket
4	Chain case cover
5	Crankcase
6	Oil sump

B58 Engine

2. Engine Mechanical

2.1.1. Cylinder head cover



Cylinder head cover B58 engine

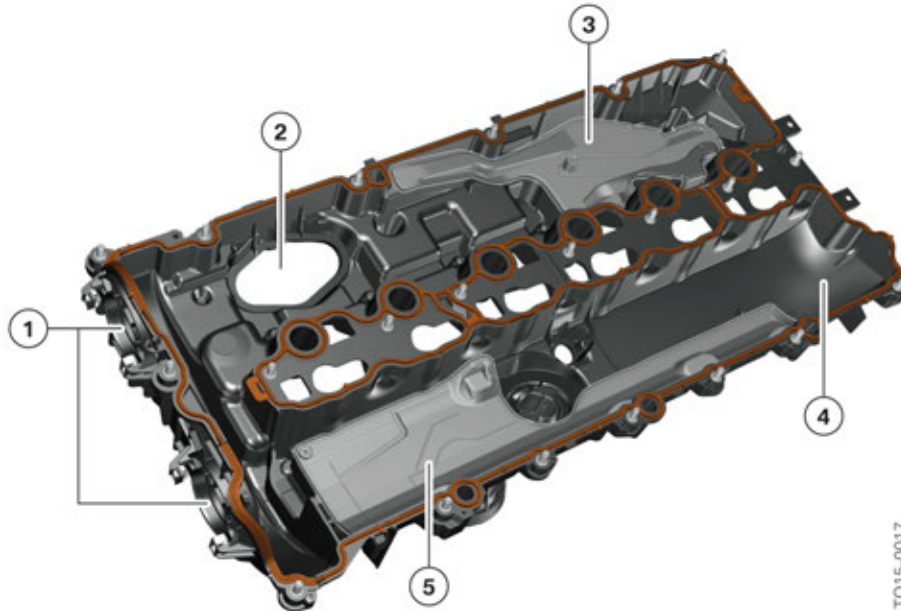
Index	Explanation
1	Pressure sensor
2	Accommodates the camshaft sensor
3	Connection for the integrated crankcase ventilation at full load
4	High-pressure line
5	Direct rail, 2 x 3 units
6	High pressure pump
7	Fixtures for VANOS actuators
8	Low-pressure line

In comparison to the N55 engine, the fixtures for the VANOS solenoid valve actuators of the B58 are not in the cylinder head, but in the cylinder head cover. The mounting of the VANOS solenoid valve actuators has also changed. They are not bolted on, but are attached to the cylinder head cover using a bayonet fitting and retaining clips. A new special tool has been developed for removal and installation without causing damage.

B58 Engine

2. Engine Mechanical

Crankcase venting components



Crankcase ventilation, B58 engine

Index	Explanation
1	Fixtures for VANOS actuators
2	Fixture for high pressure pump
3	Separation at full load operation
4	Cylinder head cover
5	Separation at partial load operation

The crankcase ventilation in Bx8 engines is designed as a two-stage system and has the following objectives:

- Regulation of the internal engine pressure
- Cleaning the blow-by gases to remove engine oil
- Recirculation of the cleaned blow-by gases in the intake area

When the engine is in operation, blow-by gases from the combustion chamber pass through the cylinder walls and enter the crankcase chamber. These blow-by gases contain unburnt fuel and exhaust gases. They are mixed with engine oil in the crankcase (in the form of oil mist).

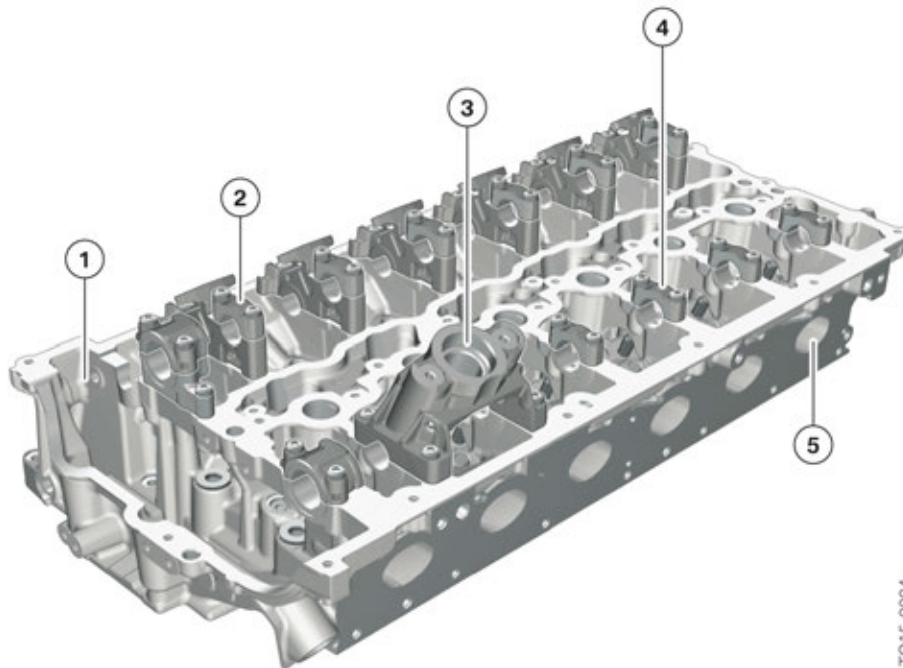
The volume of the blow-by gases is dependent on the engine speed and the load. Without crankcase ventilation excess pressure would arise in the crankcase. This excess pressure would be present in all cavities connected to the crankcase (e.g. oil return duct, chain shaft, etc.) and lead to oil leakage at the seals.

B58 Engine

2. Engine Mechanical

The crankcase ventilation prevents this. It routes the extensively engine oil-free blow-by gases to the clean air pipe and the separated droplets of oil flow back to the oil sump via an oil return pipe. In addition, the crankcase ventilation, in combination with a pressure control valve, ensures a low vacuum in the crankcase.

2.1.2. Cylinder head



Cylinder head of B58 engine

Index	Explanation
1	Cylinder head
2	Axial bearing, intake camshaft
3	Mounting, high pressure pump
4	Axial bearing, exhaust camshaft
5	Exhaust ports

Technical features:

- Material: AlSi7MgCU0.5
- Coolant cooling according to the cross-flow principle
- Four valves per cylinder
- Mounting of the valve gear
- Mounting of the Valvetronic and the Valvetronic servomotor
- Mounting of the high pressure pump.

B58 Engine

2. Engine Mechanical

Cooling concept of cylinder head

The B58 engine is equipped with a cylinder head featuring transverse flow cooling. In the case of cross-flow cooling, the coolant flows from the hot exhaust side to the cooler intake side. This has the advantage of enabling a more uniform heat distribution to prevail throughout the cylinder head. Loss of pressure in the cooling circuit is also prevented.

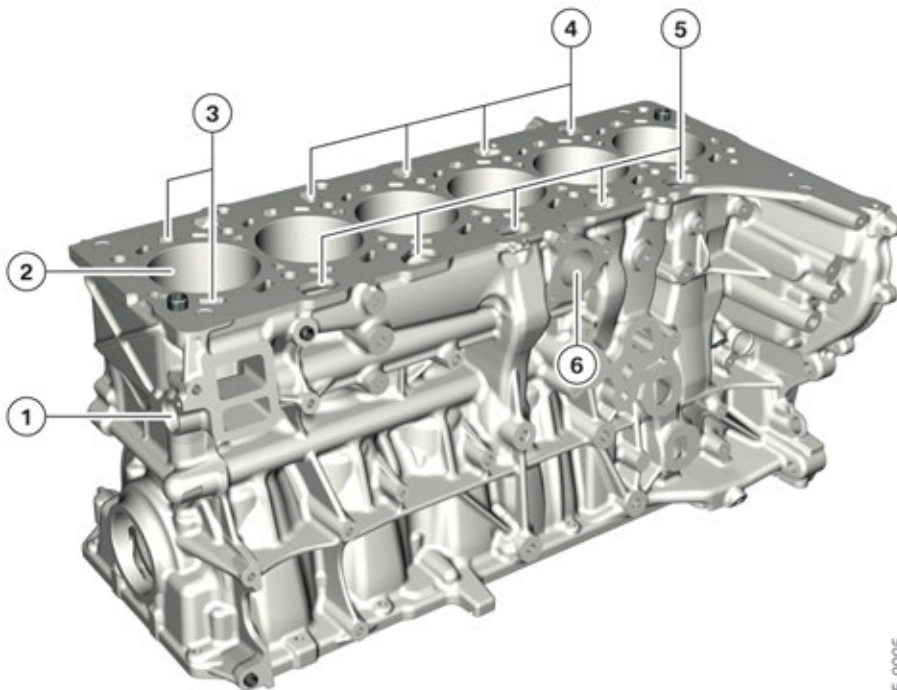
2.1.3. Crankcase

The crankcase is a completely new design which takes the different requirements of gasoline and diesel engines into account in one common part.

Overview

	Unit	N55B30M0	B58B30M0
Displacement	[cm ³]	2979	2998
Bore	[mm]	84	82
Stroke	[mm]	89,6	94,6
Compression ratio		10,2 : 1	11 : 1

Overview



TO15-0005

Crankcase of B58 engine

B58 Engine

2. Engine Mechanical

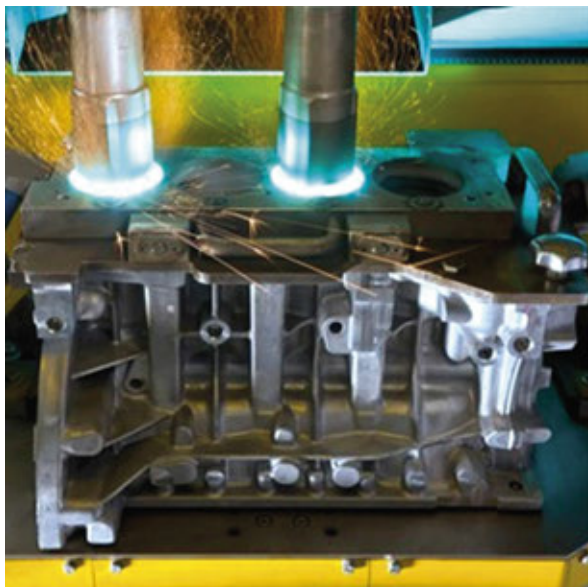
Index	Explanation
1	Radiator return
2	Cylinder liner, coated with LDS
3	Coolant ducts
4	Engine oil ducts (on the exhaust side)
5	Engine oil ducts (on the intake side)
6	Coolant outlet from crankcase

Characteristics of crankcase:

The closed deck crankcase was equipped with a completely new structure which can be identified by a complex array of ribs on the exhaust and intake side and an additional reinforcement frame on the oil sump side. The structural measures of the B58 are summarized below:

- Heat-treated all aluminum crankcase made from AlSiMgCu 0.5
- Electric arc wire-sprayed cylinder walls
- Weight-optimized main bearing cap of crankshaft
- Closed deck design
- Deep skirt
- Oil ducts for the use of a map-controlled oil pump

Electric arc wire spraying (LDS)



Electric arc wire spraying method, Bx8 engine

B58 Engine

2. Engine Mechanical

The cylinder walls of the B58 engine are coated with electric arc wire spray (LDS). In this procedure a conductive metal wire is heated until it melts. The melt is then sprayed onto the cylinder barrels at high pressure. This layer of ferrous material is roughly 0.3 mm thick, extremely wear-resistant and facilitates an efficient transfer of heat from the combustion chambers to the crankcase, and from there to the coolant ducts.

Advantages:

- Lower weight
- High wear resistance
- Good heat dissipation to the crankcase
- Lower internal engine friction due to excellent lubrication properties



Due to the thin material application during the electric arc wire-spraying procedure, subsequent machining of the cylinder barrels is not possible.

Closed deck

With the closed-deck design, the coolant ducts around the cylinder are closed from above and provided with coolant bore holes. This design is mainly reserved for BMW diesel engines. Due to the high combustion pressures in the diesel engine, a greater degree of rigidity is required in order that the forces can be safely absorbed. As the gasoline engine uses the same unfinished cast part as the diesel engine, it also benefits from this robust design.

Deep Skirt

With the "deep skirt" concept, the side walls extend far downwards. This lends the crankcase a high degree of stability and considerable flexibility in terms of the piston stroke length.

Embossed crankshaft bearing cap

The weight of the main bearing caps on the crankshaft was further enhanced for the new B58 engine. The new main bearing caps are common parts for the Bx8 engines. When the impression connection is made the main bearing cap is designed with a profile. When the main bearing bolts are tightened for the first time, this profile pushes into the surface of the bearing block on the crankcase side.

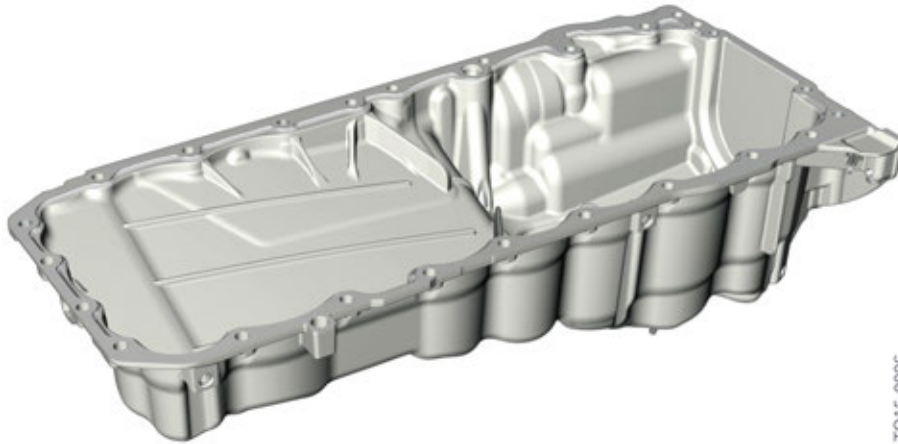


Replacing the main bearing caps, or positioning in another bearing position on the crankshaft, is not allowed and will lead to engine damage.

B58 Engine

2. Engine Mechanical

2.1.4. Oil sump

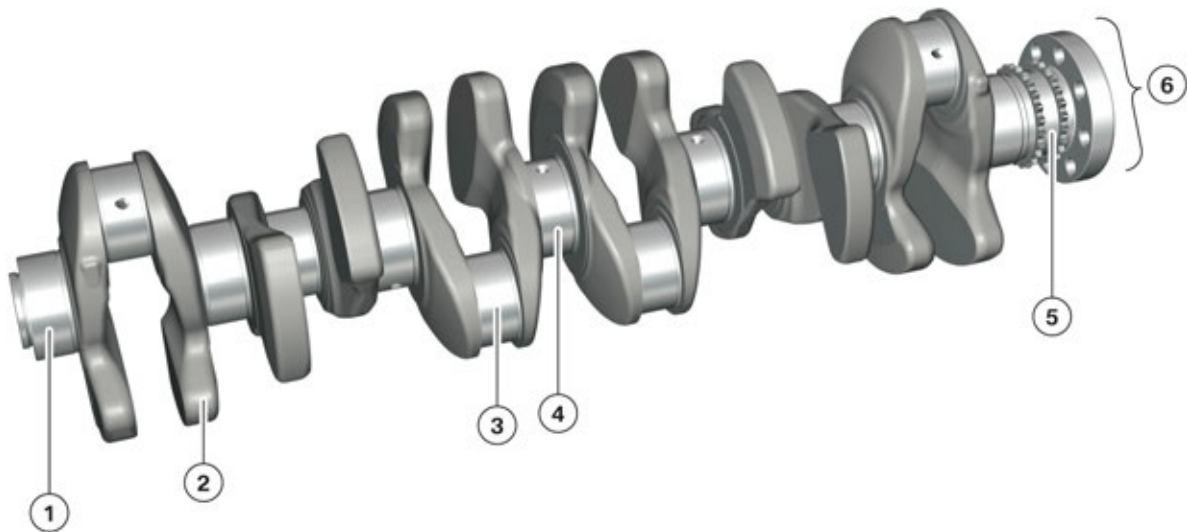


Oil sump of B58 engine

The oil sump is manufactured from die-cast aluminum and designed as a common part in engines with the same number of cylinders (B57/B58).

2.2. Crankshaft drive

2.2.1. Crankshaft



Crankshaft of B58 engine

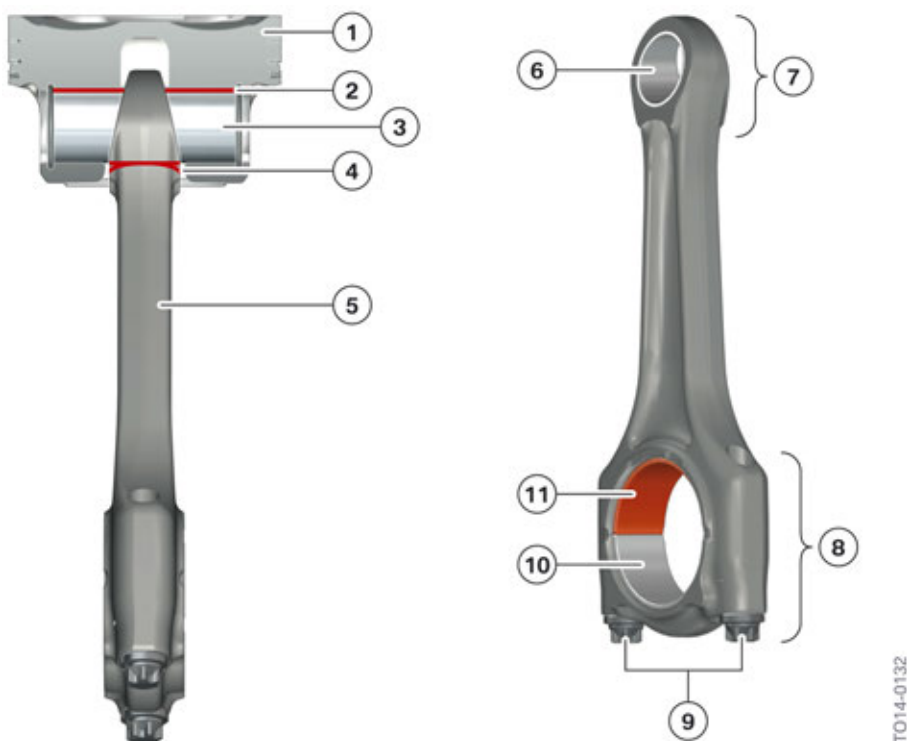
B58 Engine

2. Engine Mechanical

Index	Explanation
1	Crankshaft main bearing
2	Counterweight
3	Connecting rod bearing journal
4	Guide bearing
5	Integrated input pinion
6	Side providing the force

The crankshaft of the B58 engine is made of forged steel. It is identical to the crankshaft of the B57 engine with regard to the flange geometries and bearing widths. The pinions for the timing chain drive and the oil pump have been integrated into the crankshaft.

2.2.2. Connecting rod



Connecting rod of Bx8 engine

Index	Explanation
1	Piston
2	Area transferring the force
3	Wrist pin
4	Connecting rod bearing bush with shaped bore hole
5	Connecting rod

B58 Engine

2. Engine Mechanical

Index	Explanation
6	Connecting rod bush
7	Small connecting rod bore (trapezoidal shape)
8	Large connecting rod bore (cracked)
9	Connecting rod bolts of the connecting rod bearing cap
10	Connecting rod bearing shell of the connecting rod bearing cap
11	Connecting rod bearing shell of the connecting rod (IROX-coated)

The Drop-forged, cracked connecting rods installed in the B58 have enhanced weight when compared to the B48 engine.



If a connecting rod bearing cap is mounted the wrong way round or on another connecting rod, the fracture structure of both parts is destroyed and the connecting rod bearing cap is no longer centered. In this event the entire connecting rod set must be replaced with new parts in Service please observe the specified tightening torque and angle of rotation specifications in the repair instructions.

IROX coating

In order to comply with the increasingly stringent exhaust emission regulations, most combustion engines today are equipped with an automatic engine start-stop function. This has led to a huge increase in starting cycles.

To ensure the engine runs smoothly, it is important that sufficient lubricating oil is supplied to the bearing positions of the crankshaft. If the oil supply can be ensured, solid body contact will not occur between the connecting rod bearing journal and connecting rod bearing shell due to the thin lubricating film.

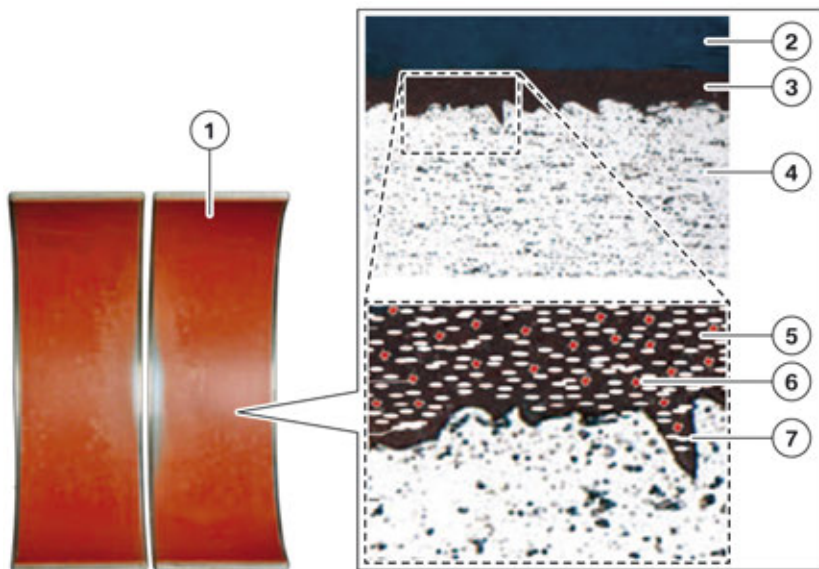
If the engine is now stopped, it will not be possible for the mechanically-driven oil pump to maintain the oil supply. The oil film between the bearing positions flows off. Solid body contact occurs between the connecting rod bearing journal and connecting rod bearing shell. Once the engine is restarted, it takes a certain amount of time for the lubricating film to fully re-establish itself. The connecting rod bearing shell may be subject to wear in this short period. The IROX coating reduces this wear to a minimum.

The IROX-coated bearing shells are only located on the connecting rod side as here the load acts mainly on the bearing shells. The bearing shell caps are equipped with a bearing shell without IROX coating.

The IROX bearing shells are red due to their special coating.

B58 Engine

2. Engine Mechanical



TO14-0130

Detailed magnification of the IROX coating of the Bx8 engine

Index	Explanation
1	IROX-coated bearing shell
2	Oil film
3	IROX coating
4	Bearing shell
5	Binding resin
6	Hard particle
7	Solid lubricant

The IROX coating is applied to a conventional bearing shell. It consists of a binding resin matrix made of polyamide-imide with embedded hard particles and solid lubricants. The polyamide-imide ensures, in combination with the hard particles, that the bearing shell surface is so hard that material abrasion is no longer possible. The solid lubricants reduce surface friction and replace the oil film which briefly no longer exists between the bearing shell and the connecting rod bearing journal during the starting phase.

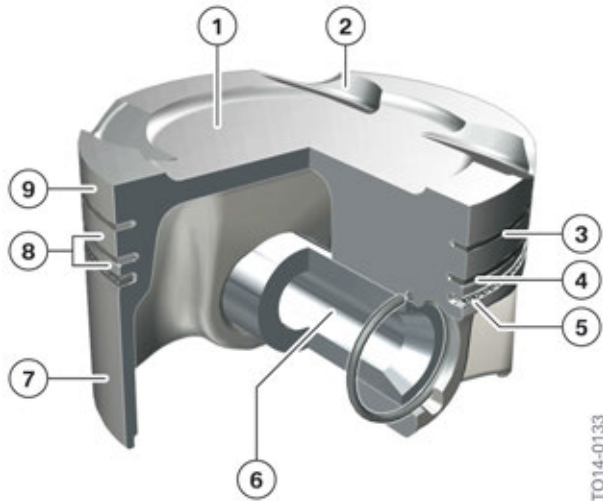
Bearing shell classification of connecting rod bearing

The connecting rod bearing shells are available in one standard size. It is therefore not necessary to follow a procedure similar to that used with the main bearing shells of the crankshaft.

B58 Engine

2. Engine Mechanical

2.2.3. Piston



Piston of Bx8 engine

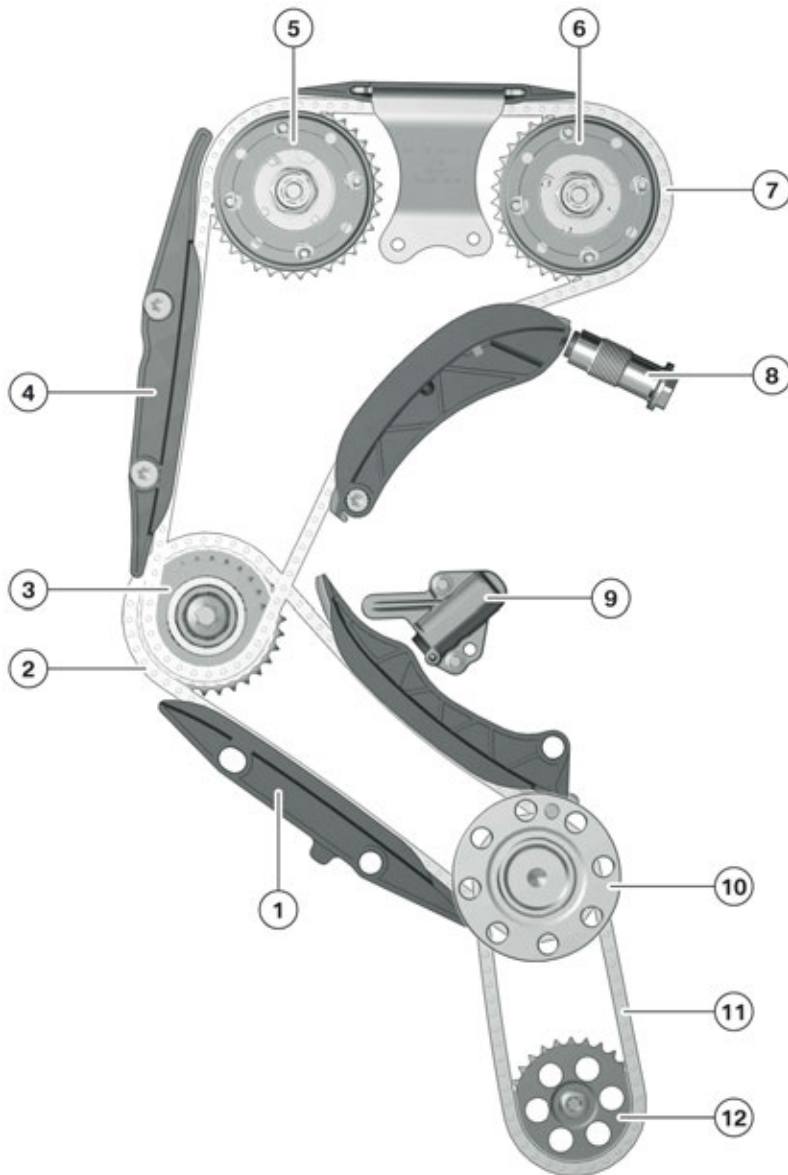
Index	Explanation
1	Piston crown
2	Valve relief
3	1. Piston ring, recheck ring
4	2. Piston ring, taper faced piston ring
5	Oil scraper ring
6	Wrist pin
7	Piston skirt
8	Ring bar
9	Fire land

Pistons with enhanced weight identical to those used in the B48 engine are used. For more information regarding the pistons please refer to the B48 engine training information.

B58 Engine

2. Engine Mechanical

2.2.4. Chain drive



TO15-0007

Chain drive for B58 engines

Index	Explanation
1	Lower guide rail
2	Lower timing chain
3	Intermediate shaft pinion
4	Upper guide rail
5	VANOS with intake camshaft sprocket
6	VANOS with exhaust camshaft sprocket

B58 Engine

2. Engine Mechanical

Index	Explanation
7	Upper timing chain
8	Top chain tensioner with top tensioning rail
9	Bottom chain tensioner with bottom tensioning rail
10	Crankshaft
11	Oil pump chain
12	Oil pump pinion

The chain drive is on the transmission side. The inertia of the transmission at this end of the engine significantly reduces the rotary oscillations and also therefore the loads acting on the chain drive.

Features:

- Chain drive at the side of the engine emitting the forces
- Simple sleeve-type chains
- Electric motor of the combined oil-vacuum pump via a separate chain
- Plastic tensioning rails and guide rails
- Hydraulic chain tensioner with spring preload

As a standard crankcase is used for both gasoline and diesel engines, the Bx8 engines are equipped with a two-part chain drive. With this arrangement, the bottom timing chain drives the camshaft sprocket of the intermediate shaft. In the diesel engines, the output for the high pressure pump is located on this intermediate shaft. In the gasoline engines, the drive torque is simply diverted to the top timing chain via the intermediate shaft. In contrast to diesel engines, there is no ancillary component output.

The lubrication of the bottom timing chain is ensured by the oil mist in the crankcase and the engine oil that drips off.

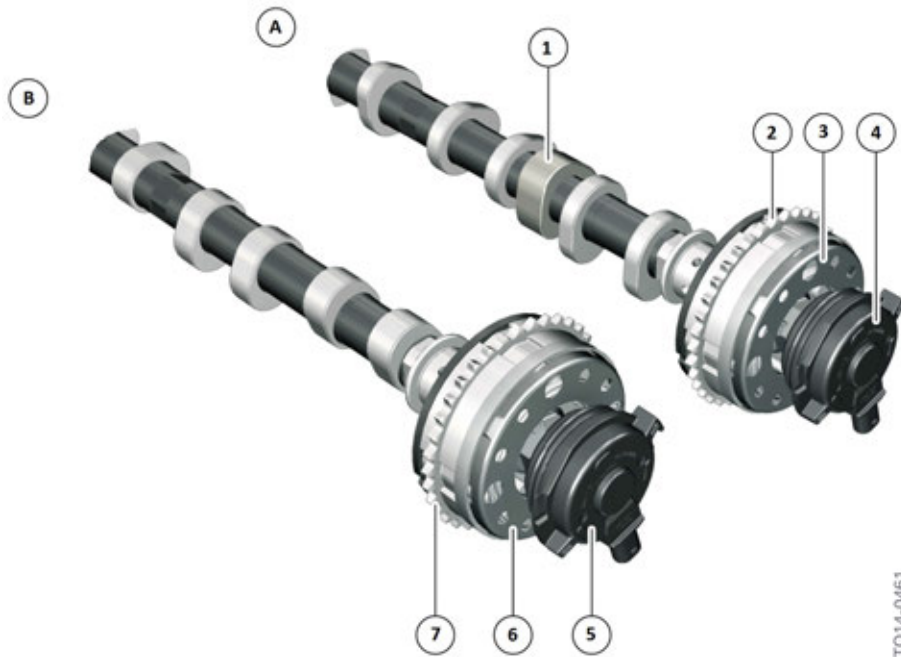
In the Bx8 engines, the combined oil-vacuum pump is also driven by the crankshaft via a separate drive chain.

B58 Engine

2. Engine Mechanical

2.3. Valve gear

2.3.1. VANOS



Double VANOS Bx8 engine

Index	Explanation
A	Exhaust camshaft
B	Intake camshaft
1	Triple cam for high pressure pump drive system
2	Exhaust camshaft sprocket
3	VANOS unit, exhaust side
4	VANOS solenoid valve actuator, exhaust
5	VANOS solenoid valve actuator, intake
6	VANOS unit, intake side
7	Intake camshaft sprocket

The valve overlap times have a significant impact on the characteristics of a gasoline engine. An engine with smaller valve overlap therefore tends to have a high maximum torque at low engine speeds but the maximum power which can be achieved at high engine speeds is low. The maximum power achieved with a large valve overlap on the other hand is higher, but this is at the expense of the torque at low engine speeds.

B58 Engine

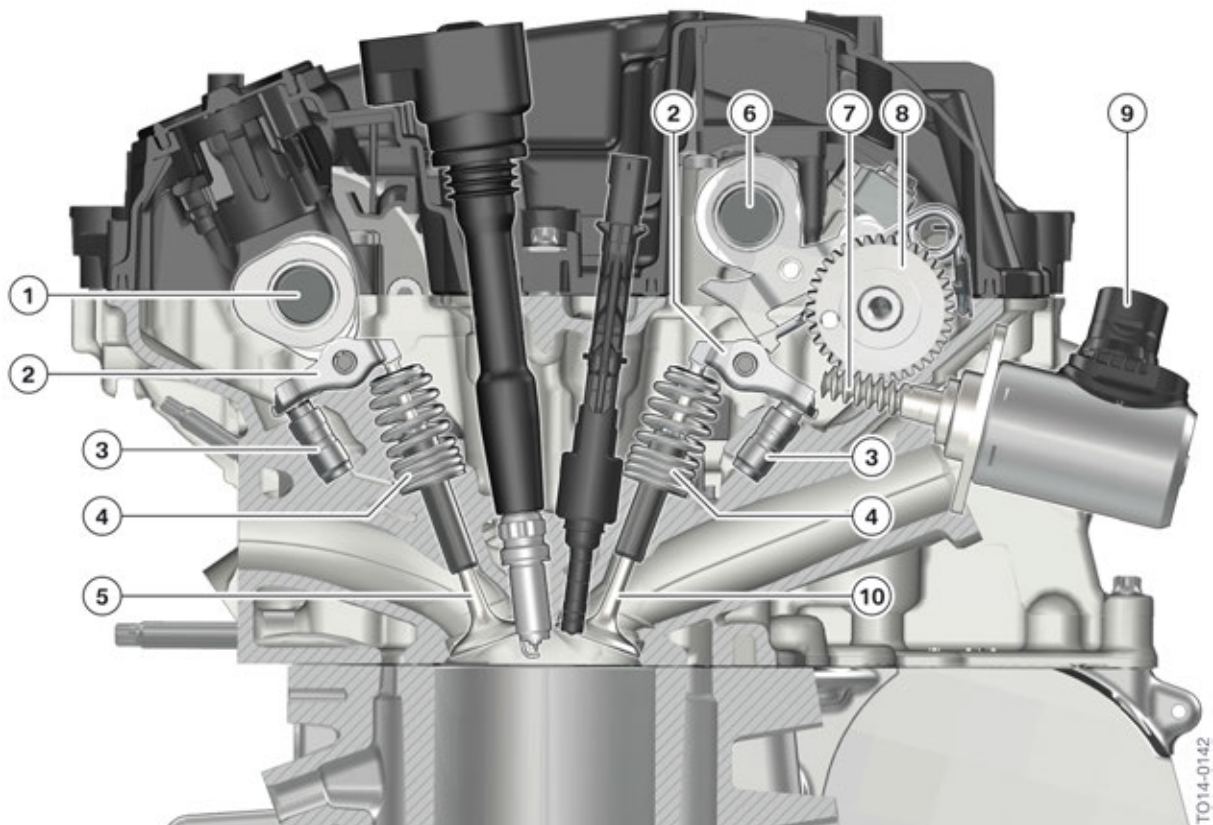
2. Engine Mechanical

The VANOS provides a solution. It makes a high torque possible in the low and medium engine speed range and a high maximum power in the higher engine speed ranges. A further benefit of the VANOS is the option of internal EGR. This reduces the emission of harmful nitrogen oxides NO_x, particularly in the partial load range. The following is also achieved:

- Faster heating up of catalytic converter
- Lower pollutant emissions during cold start
- Reduction in consumption

2.3.2. Valvetronic

The Valvetronic has been further developed for use in the new Bx8 engines. A distinguishing feature of the VVT4 is the Valvetronic servomotor is located outside of the cylinder head.



Valvetronic 4th generation B58 engine

Index	Explanation
1	Exhaust camshaft
2	Roller cam follower
3	Hydraulic valve clearance compensation element
4	Valve spring
5	Exhaust valve

B58 Engine

2. Engine Mechanical

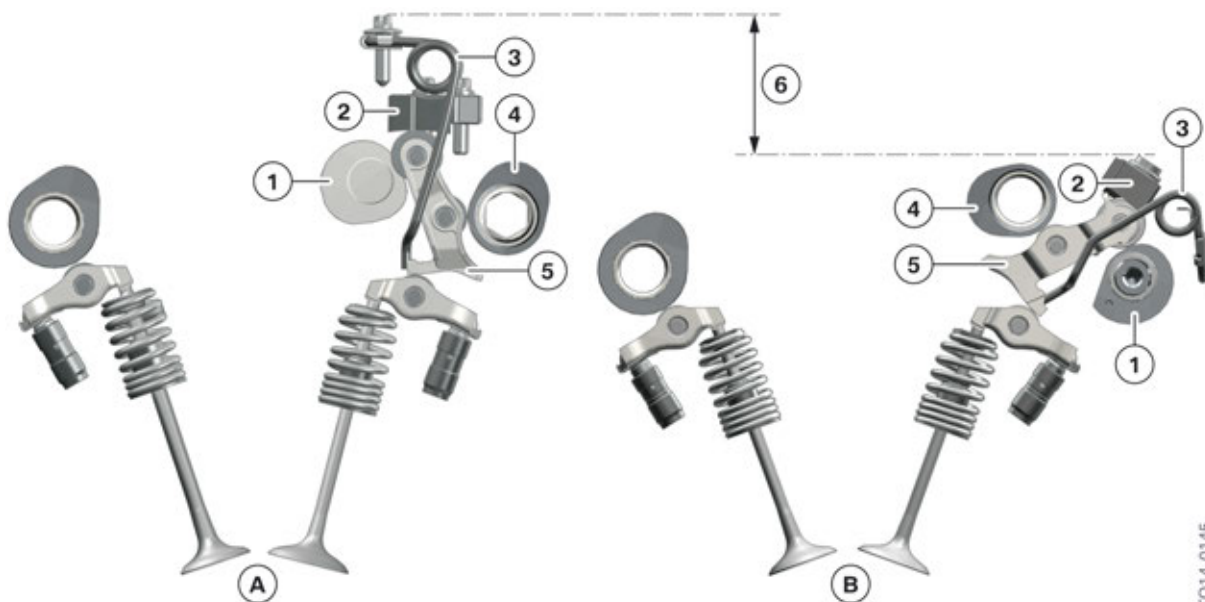
Index	Explanation
6	Intake camshaft
7	Worm gear
8	Eccentric shaft
9	Electrical connection, Valvetronic servomotor
10	Intake valve

Valvetronic comprises a fully-variable valve lift control and a double VANOS. It operates according to the principle of throttle-free load control. With this system, a throttle valve is only used to stabilize the engine operation at critical operating points and to ensure a slight vacuum for the engine ventilation. A very small vacuum can be produced in the intake pipe by slightly tilting the throttle valve, which allows treated blow-by gases to be introduced into the intake port during naturally-aspirated engine operation.

The following graphic provides an overview of the design of the Valvetronic.

The following components have been revised in the Valvetronic for use in the B58 engine:

- Assembled eccentric shaft
- Adjustment range increased from 190° (N55) to 253° (B58)
- Smaller worm gear ratio of 37:1
- Thinner lighter sliding blocks with only one screw connection
- Return spring inserted and not bolted
- Oil spray nozzle for lubrication of worm gear omitted
- Smaller more powerful Valvetronic servomotor



Comparison of Valvetronic N55 with Bx8 engine

B58 Engine

2. Engine Mechanical

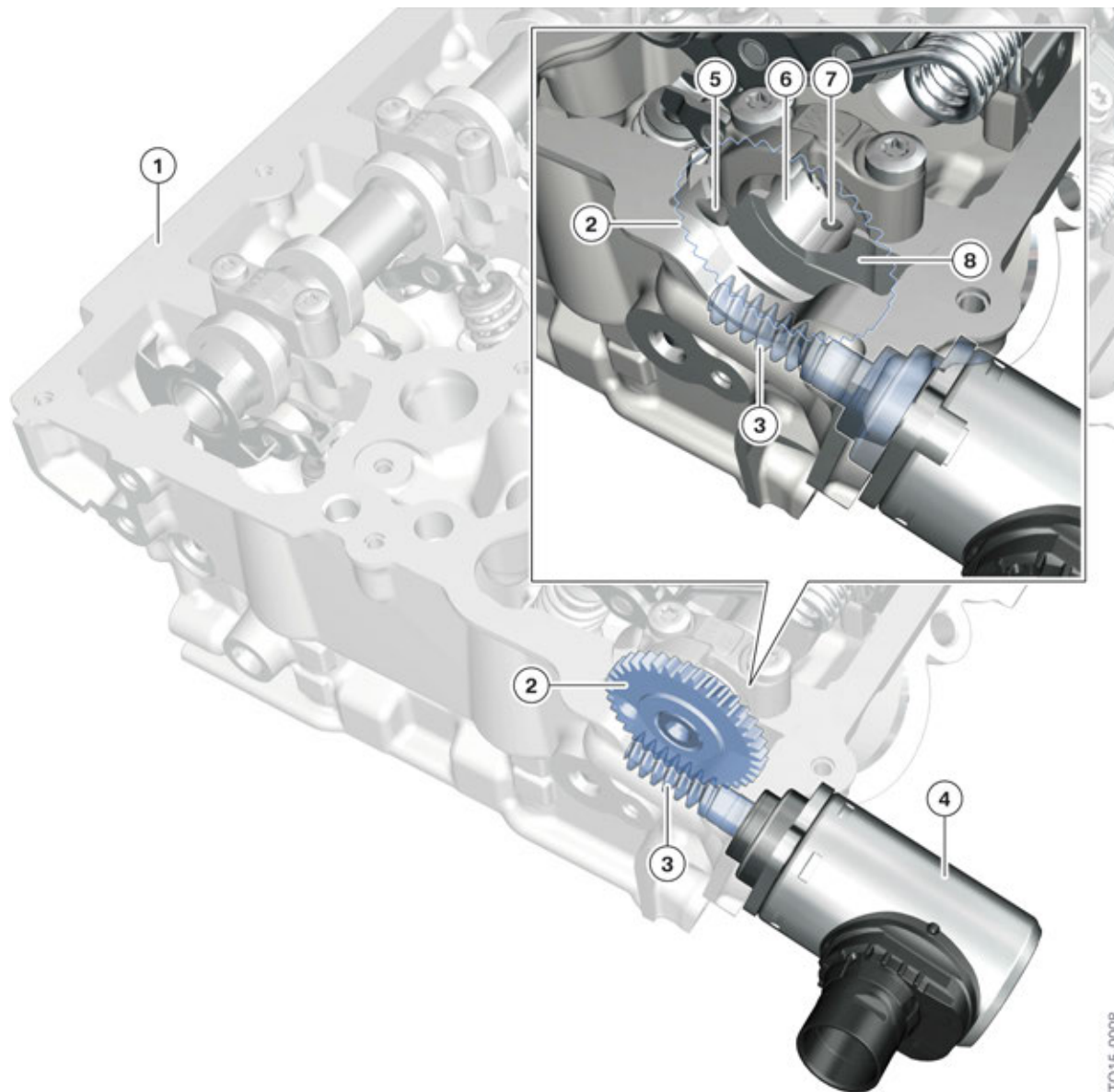
Index	Explanation
A	Valvetronic, N55 engine
B	Valvetronic, B58 engine
1	Eccentric shaft
2	Gate
3	Return spring
4	Camshaft
5	Intermediate lever
6	Height of installation space

By reworking the Valvetronic, it has been possible to significantly reduce the installation space. A considerable height advantage has been gained by swapping round the intake camshaft and the eccentric shaft. The new position of the intermediate lever and gate simplifies the application of force in the cylinder head. The gate is therefore only attached to the bearing support with one screw and is positioned via two precise contact surfaces in the cylinder head. The return spring for the intermediate lever between the cylinder head and bearing position is self-supporting and does not require its own attachment point. The eccentric shaft is, as is already the case with the camshaft, an "assembled" design.

B58 Engine

2. Engine Mechanical

Lubricating oil supply to the Valvetronic worm gear



TO15-0008

Lubricating oil supply to the Valvetronic worm gear, Bx8 engine

Index	Explanation
1	Cylinder head
2	Input pinion of the eccentric shaft
3	Worm gear of Valvetronic servomotor
4	Valvetronic servomotor

B58 Engine

2. Engine Mechanical

Index	Explanation
5	Outlet hole
6	First bearing position of eccentric shaft
7	Inlet hole
8	Oil chamber

Due to the fast adjustment speeds of the eccentric shaft of less than 300 milliseconds from minimum to maximum stroke and the wide adjustment range from 0.2 millimeters (minimum) to 9.9 millimeters (maximum) valve lift with a small transmission ratio, sufficient lubrication between the worm gear of the Valvetronic servomotor and the input pinion of the eccentric shaft must be ensured. The lubricating oil reaches the oil chamber via an inlet hole at the first bearing position of the eccentric shaft. Here, the oil volume rises to the lower edge of the outlet hole. The excess oil flows back to the oil circuit via the outlet hole. The gearing of the worm gear is now supported in the oil bath and is therefore lubricated at all times.

Information on disassembly and installation work

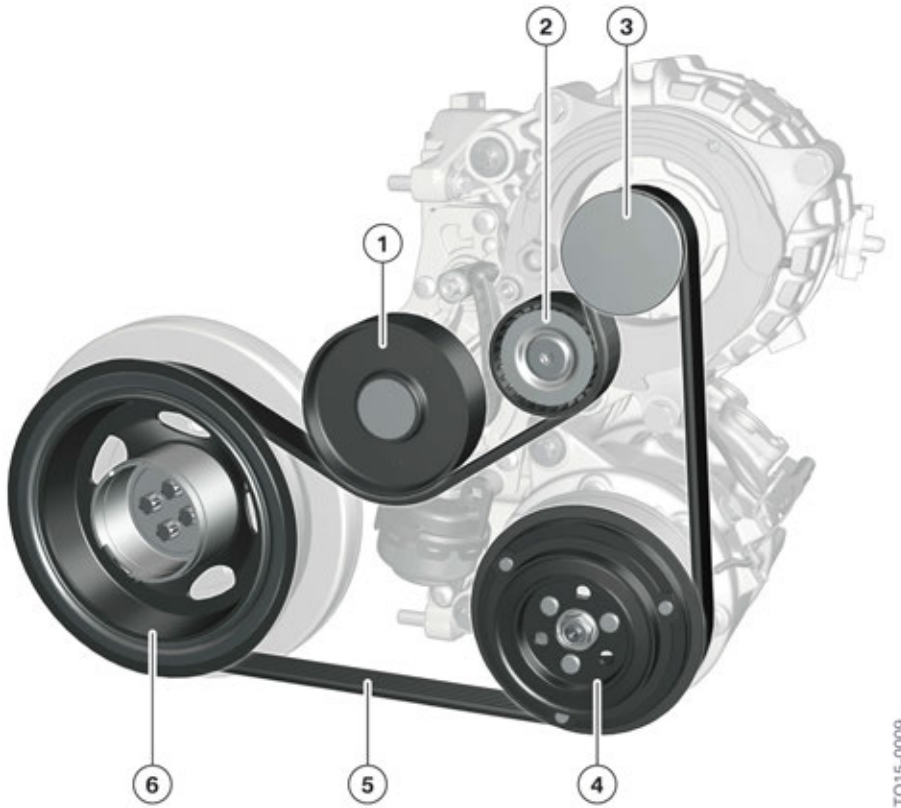
As numerous changes have been made, a new special tool is used to remove the return springs.

The hexagon socket on the Valvetronic servomotor is for manual adjustment of the worm gear. This is necessary if the Valvetronic servomotor needs to be removed, for example. To avoid damage to the worm gear, it must be greased prior to start-up using a special lubricant (Longtime PD part number: 83 19 2 160 340). The Valvetronic in the Digital Engine Electronics (DME) can be taught-in using the teach-in routine in ISTA. During this process, the limit positions of the system are determined once again and stored in the Digital Engine Electronics (DME). The precise procedure for removing the Valvetronic is described in the current repair instructions.

B58 Engine

2. Engine Mechanical

2.4. Belt drive



B58 engine belt drive

TO15-0009

Index	Explanation
1	Coolant pump
2	Tensioning pulley
3	Alternator
4	Air conditioning compressor
5	Ribbed V-belt
6	Crankshaft vibration damper

The belt drive is a single-belt drive in which all ancillary components are driven using only one belt.

The length of the drive belt changes due to thermal expansion and ageing. The drive belt must be pressed onto the belt pulley with a defined force to ensure the torque can be transferred at any time. Therefore the belt tension is exerted by an automatic tensioning pulley which compensates for belt stretching over the full service life.

B58 Engine

3. Oil Supply

3.1. Oil circuit

With force-fed circulation lubrication the oil is drawn out of the oil sump by the oil pump through an intake pipe and forwarded into the circuit. The oil passes through the engine oil cooler with an integrated full-flow oil filter and from there into the main oil duct, which runs in the engine block parallel to the crankshaft. Branch ducts lead to the crankshaft main bearings. There are bore holes between the main bearings of the crankshaft and the connecting rod bearing journal which admit the oil to the lubricating points of the connecting rod bearing.

Some of the oil is diverted from the main oil duct and directed to the cylinder head to the relevant lubricating points and adjustment units. When the engine oil flows through the consumers, it either returns to the oil sump via the return ducts or it drips back freely.

3.2. Map control

The Bx8 engines are equipped with the familiar map-controlled oil pump which is already used. The actual oil pressure is recorded via an oil pressure sensor and forwarded to the Digital Engine Electronics (DME). The Digital Engine Electronics (DME) performs a target/actual comparison based on the stored characteristic maps. The map-controlled control valve is activated by means of a pulse-width modulated signal until the nominal pressure stored in the characteristic map has been reached. During this process, the delivery rate of the oil pump varies according to the oil pressure in the oil duct to the map-controlled control chamber.

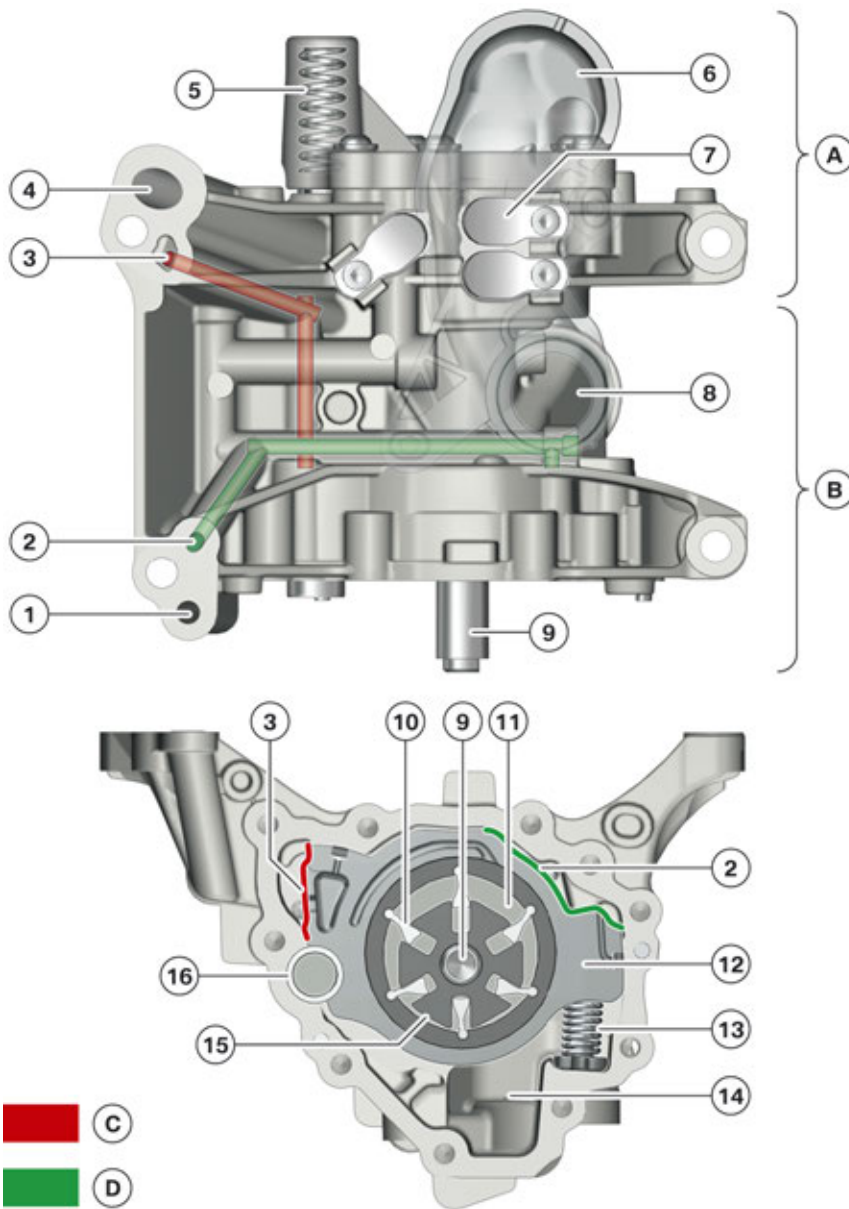
3.3. Oil pump

The oil pump plays a central role in modern combustion engines. Due to the high power and enormous torque which is present even at low engine speeds, it is necessary to ensure a reliable oil supply. This is necessary due to the high component temperatures and heavily loaded bearings. To achieve low fuel consumption, the delivery rate of the oil pump must be adapted to the requirements.

The oil pump is driven by a chain from the crankshaft.

B58 Engine

3. Oil Supply



Design of oil pump, Bx8 engine

TO14-0569

Index	Explanation
A	Vacuum pump
B	Oil pump
C	Second-level control area (emergency operation)
D	Map-controlled control area (normal operation)
1	Vacuum duct to vacuum pump
2	Oil duct to map-controlled control chamber
3	Oil duct to second-level control chamber

B58 Engine

3. Oil Supply

Index	Explanation
4	Oil pressure channel, pump output
5	Pressure-limiting valve
6	Intake pipe with filter
7	Discharge valves, vacuum pump
8	Oil intake port
9	Pump shaft
10	Rotor with pendulum
11	Suction side
12	Adjusting ring
13	Adjusting ring spring (2x)
14	Pump input
15	Major thrust face
16	Bearing tube (center of rotation)

A vacuum pump is integrated into the oil pump housing.

A rotor with pendulum rotates on the pump shaft as shown in the graphic. A crescent-shaped cavity arises through the eccentric position. During this process, the oil is drawn into the expanding chamber (intake side) and is supplied via the contracting chamber (pressure side).

When the engine is in operation, oil pressure is applied to the map-controlled control surface and the second-level control surface of the oil pump. Depending on the oil pressure, the adjusting ring is pushed via the center of rotation at the bearing tube to varying degrees of force against the adjusting ring springs. The change in eccentric position of the adjusting ring changes the size of the chamber, and therefore also the intake and pressure power of the oil pump.

To prevent overloading of the oil pump, a filter is installed upstream of the pump inlet. The maximum oil pressure of the oil circuit at the pump outlet is restricted by a pressure limiting valve. The opening pressure of the pressure limiting valve is 11.4 bar +/- 1.4 bar.

3.3.1. Normal operation

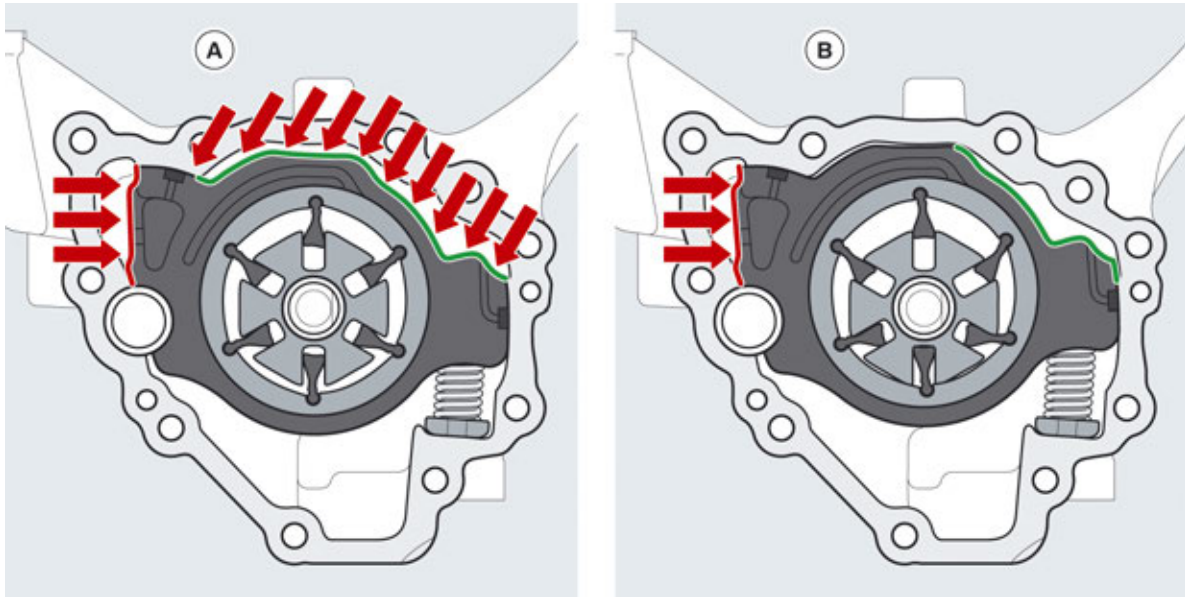
The oil pump has two separate control loops in order to guarantee normal operation (map-controlled control operation) and emergency operation (second-level control operation).

3.3.2. Emergency operation

During emergency operation, the system operates without the map control by the Digital Engine Electronics (DME). The map-controlled control valve is de-energized in this operating condition and is therefore closed. The purpose of the emergency operation is to maintain the oil pressure in the oil pump at a consistently high level. The oil pressure is guided directly from the main oil duct to the second-level control chamber. This leads to an adjustment of the adjusting ring against the adjusting ring spring and thus a reduction of the volumetric flow. As it contains no actuators, intervention in this control system is not possible and it also cannot be switched off.

B58 Engine

3. Oil Supply

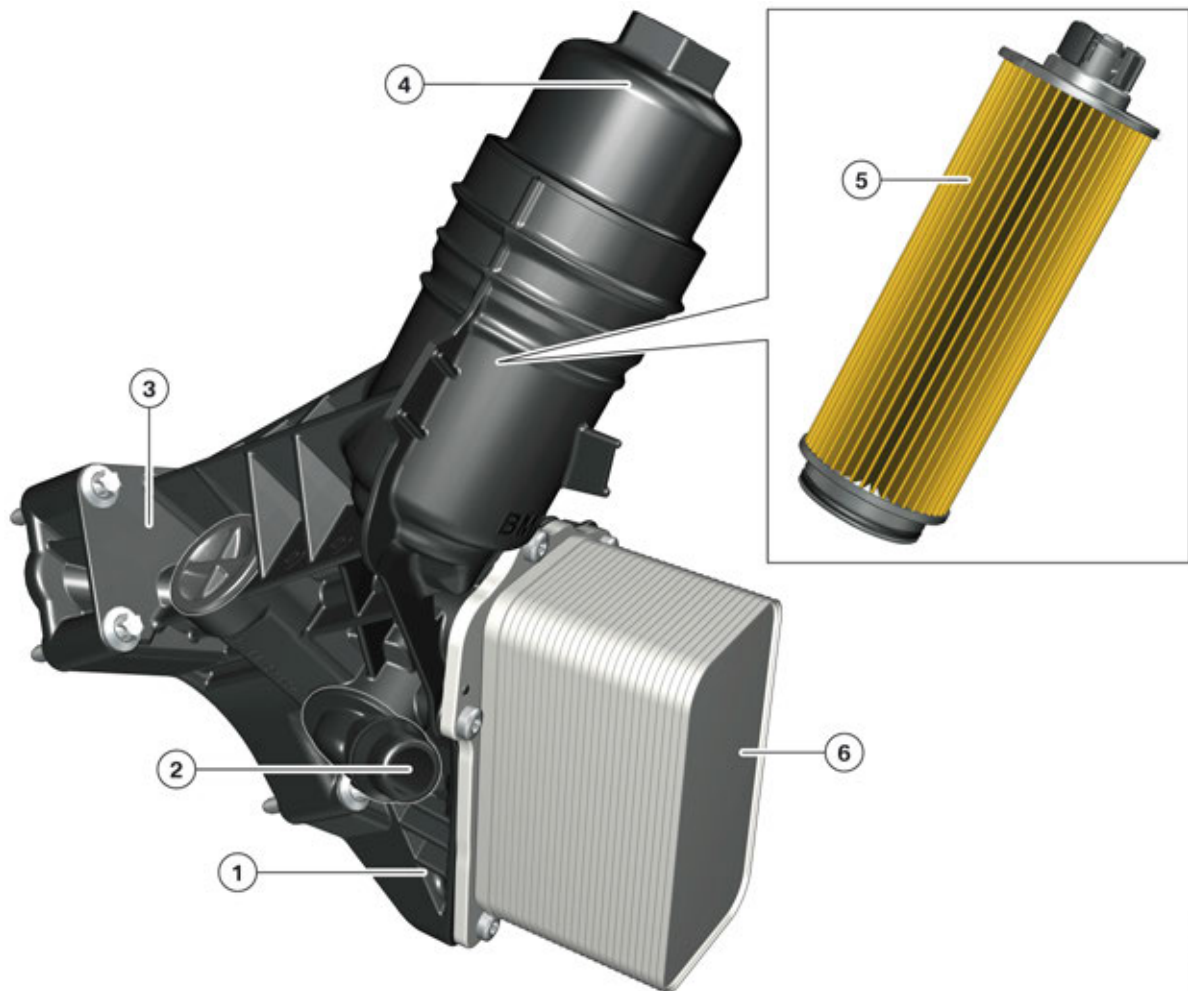


Index	Explanation
A	Normal operation
B	Emergency operation

B58 Engine

3. Oil Supply

3.4. Oil filter module



B58 engine oil filter module

TO15-0010

Index	Explanation
1	Heat exchanger bypass valve
2	Coolant connection
3	Oil filter housing
4	Internal filter bypass valve
5	Oil filter element
6	Oil/coolant heat exchanger

The oil/coolant heat exchanger, the coolant bypass valve, the filter bypass valve and the filter element have been integrated into the oil filter module. Internal oil and coolant ducts in the plastic housing mean there is no need for external lines.

B58 Engine

3. Oil Supply

3.4.1. Filter bypass valve

When a filter is obstructed, the filter bypass valve ensures that engine oil reaches the lubrication points of the engine. It opens when the differential pressure upstream and downstream of the oil filter is 2.5 bar \pm 0.3 bar.

3.4.2. Heat exchanger bypass valve

The heat exchanger bypass valve has the same function as the filter bypass valve. If, as a result of a blocked oil-to-water heat exchanger, the oil pressure rises, the filter bypass valve opens at an oil pressure of 2.5 bar \pm 0.3 bar and the lubricating oil can flow uncooled to the lubrication points.



In Service, the specified torques for the oil drain plug and the oil filter cover must be observed. The two O-rings must be replaced each time the oil filter cover and the oil drain plug are opened. Both O-rings are included in the oil filter service kit.



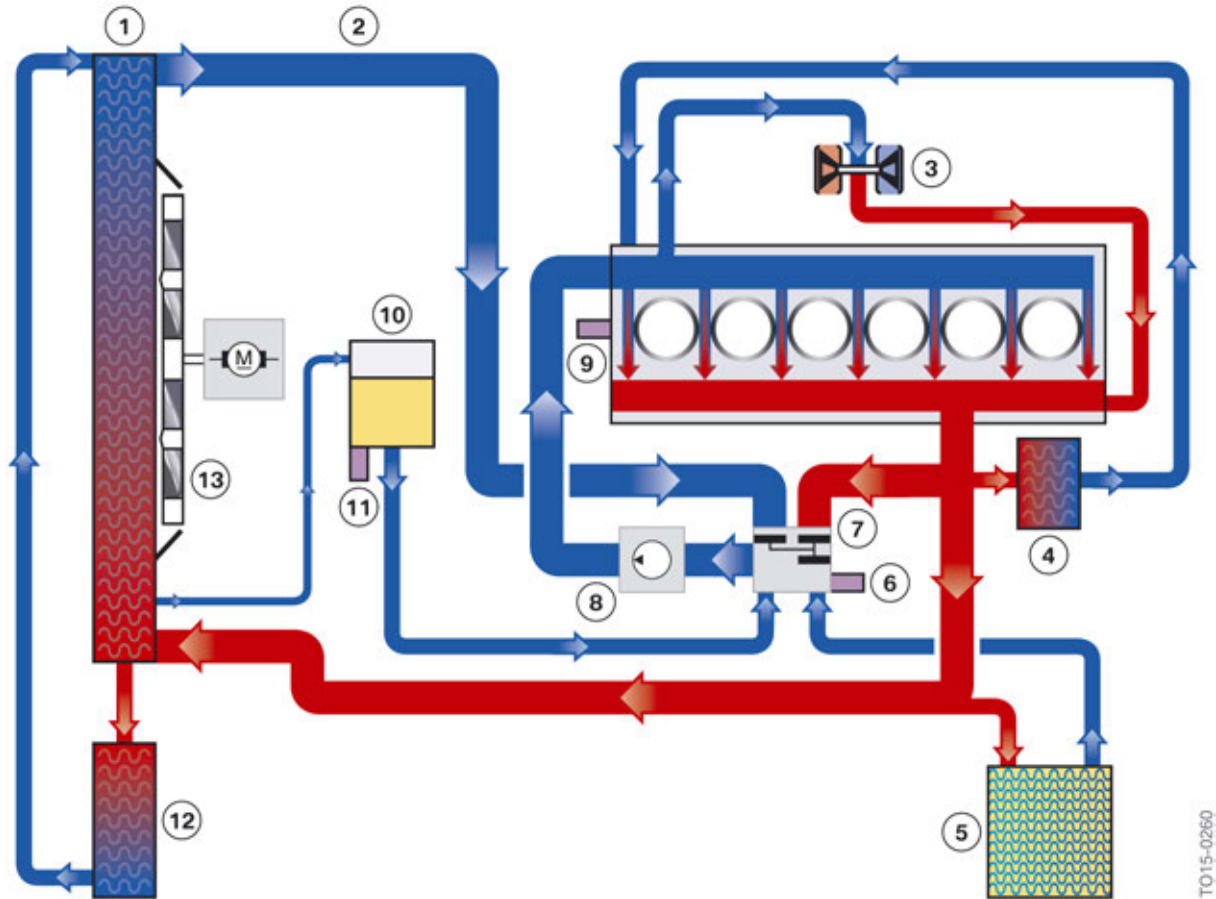
Only BMW approved engine oils should be used.

B58 Engine

4. Cooling System

4.1. Cooling circuit, B58 engine

The following graphic provides an overview of the different cooling circuits.



Cooling circuit, B58 engine

TO15-0260

Index	Explanation
1	Radiator
2	Towards the heat management module
3	Exhaust turbocharger
4	Engine oil/coolant heat exchanger
5	Heat exchanger
6	Rotary valve position sensor
7	Heat management module
8	Coolant pump
9	Component temperature sensor

B58 Engine

4. Cooling System

Index	Explanation
10	Expansion tank
11	Coolant level switch
12	Auxiliary radiator
13	Electric fan

In order to protect components from overheating damage, the engine oil as well as the transmission fluid are cooled using coolant. A mechanical coolant pump circulates the coolant in the cooling circuit. The heat is removed by the coolant and re-emitted to the ambient air using a heat exchanger (radiator). An electric fan is used to assist the radiator output.

4.1.1. Special features

The special features of the B58 cooling system include:

- Heat management module
- Mechanical coolant pump

4.2. Heat management module

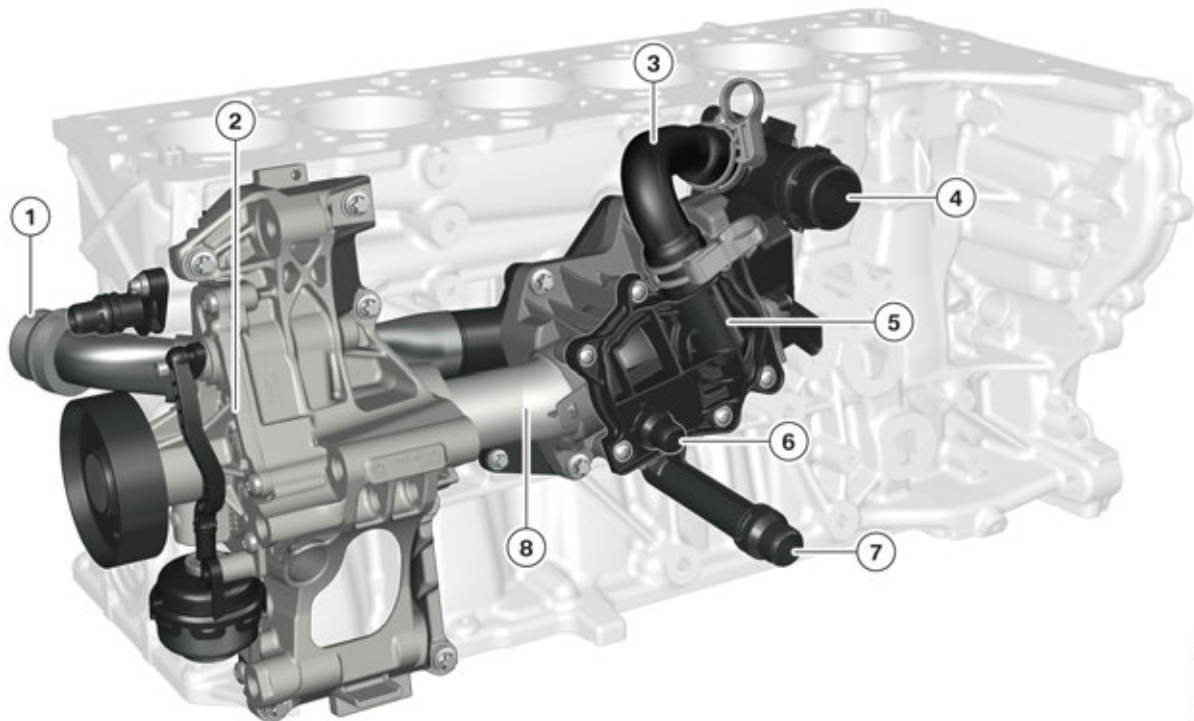
In engines with a thermostat and expansion element the coolant heats up the wax inside an operating housing. The wax liquefies from a certain, specified temperature. In this process, it expands and acts on a working piston in the housing, which releases the coolant flow towards the radiator using a poppet valve. If the coolant temperature falls below the opening temperature, a spring presses the poppet back into its initial position and closes the coolant flow towards the radiator. The engine maintains a specified temperature range.

In electrically heated thermostats the wax in the operating element is heated up by the coolant and additionally by electrical heating. This combination allows the Digital Motor Electronics (DME) to control the engine temperature of the different load conditions more precisely.

The conventional thermostat in the B58 engine is replaced by a so-called heat management module. The following graphic shows the installation position of the heat management module.

B58 Engine

4. Cooling System



B58 engine heat management module

Index	Explanation
1	Radiator return
2	Coolant pump with alternator fixture and air conditioning compressor (note that the switchable water pump, in the illustration, is not for US).
3	Short-circuit line
4	Crankcase coolant output
5	Heat management module
6	Expansion tank return
7	Heating return
8	Coolant pump connection



The switchable (vacuum controlled) water pump, in the illustration, is not for US.

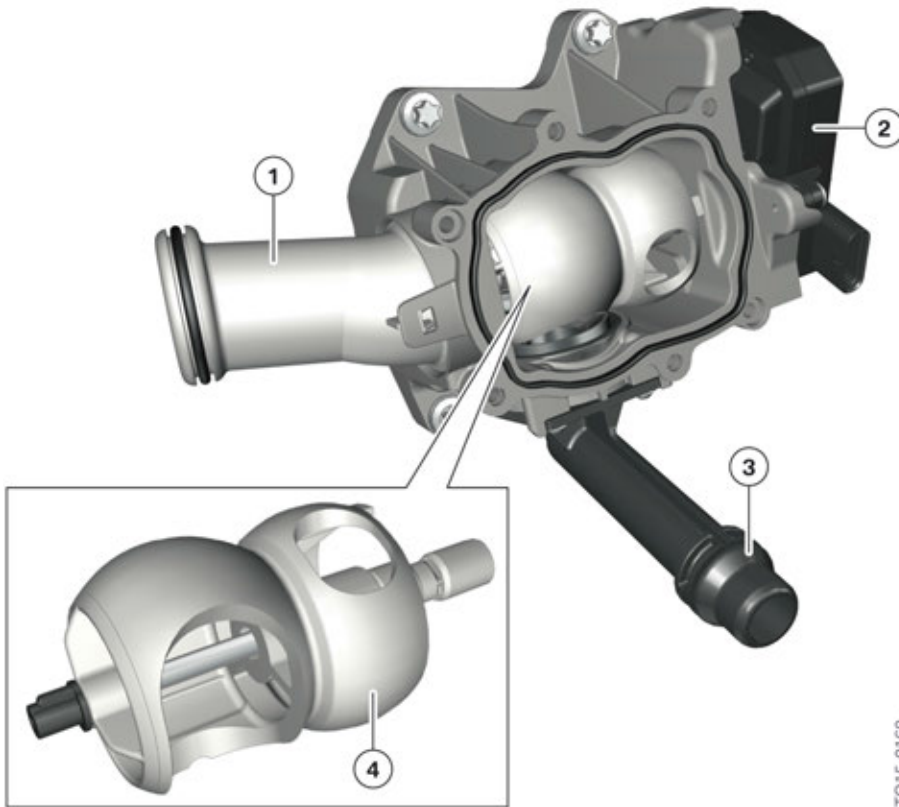
The heat management module is electrically operated. In contrast to a map controlled thermostat with expansion element, there is no direct, physical connection to the coolant temperature.

The opening cross-sections of the various cooling ducts can be variably opened and closed using a rotary valve. The Digital Motor Electronics (DME) require elements including the coolant temperature from the coolant temperature sensor and the material temperature of the cylinder head from the component temperature sensor to correctly position the rotary valve.

B58 Engine

4. Cooling System

A position sensor in the electrical actuator of the heat management module forwards the current position of the rotary valve to the Digital Motor Electronics (DME). As a result, the exact position of the rotary valve can be determined so that it releases or seals a precisely defined cross-section towards the different coolant ducts. The adjustment of cross-sections ideally adapts the flow rates of the cooling ducts connected to the heat management module to the operating points. Warm-up and cooling of the engine and the supply of additional ancillary components can be implemented as required and therefore the fuel consumption is reduced.



B58 engine heat management module

TO15-0160

Index	Explanation
1	Coolant output towards the coolant pump
2	Electrical actuator
3	Heating return
4	Rotary valve

B58 Engine

4. Cooling System

The heat management module consists of the following components intended to control the cooling requirement:

- Rotary valve
Connects or seals individual coolant connections
- Direct current motor (DC)
Drive to adjust the rotary valve
- Position sensor
Position feedback from the rotary valve to the engine control unit (DME)
- Transmission
Transforms the torque of the direct current motor (DC).



A service function in the BMW ISTA diagnosis system enables the end stops of the position sensor to be taught-in again.

The following table lists the technical data of the heat management module.

Direct current motor (DC)	Technical data	Position sensor	Technical data
Voltage range in volts (V)	6,0 – 16,0	Voltage range in volts (V)	4,5 – 5,5
Power consumption in ampere (A)	0,3 – 1,5	Power consumption in milliamper (mA)	20 – 35
Transmission ratio	1:492	Output signal	SENT report [*]
Adjustment speed rate	40° per second	Rotational angle of the rotary valve in degrees	200°

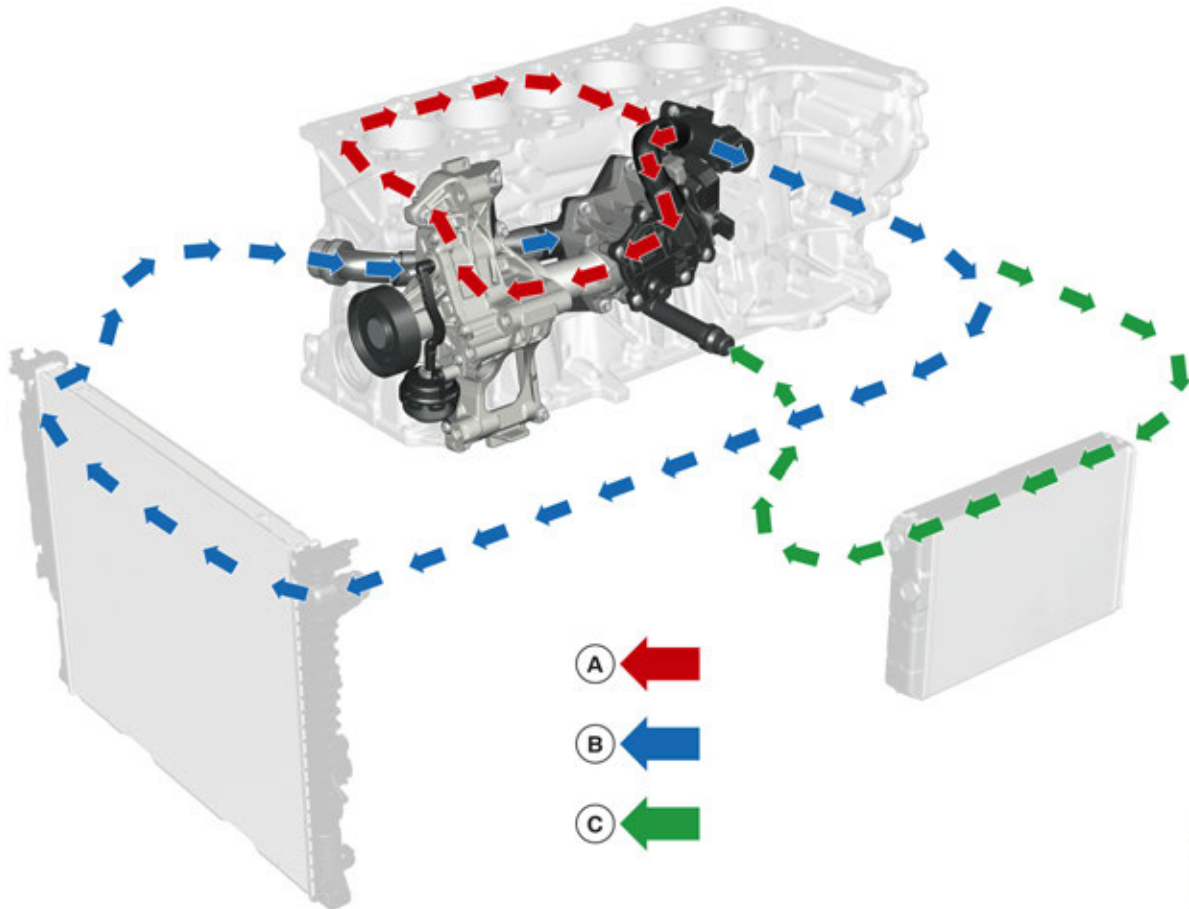
^{*} SENT report = Single Edge Nibble Transmission

The SENT report is a digital interface for communication between sensors and control units.

B58 Engine

4. Cooling System

4.2.1. Cooling circuits



TO15-0586

Coolant flow of the minor and main coolant circuit on the B58 engine

Index	Explanation
A	Minor coolant circuit
B	Main coolant circuit
C	Heater circuit

The coolant is directed via the radiator when the main coolant circuit is open.

If the minor coolant circuit is open, the coolant is directed from the crankcase directly into the heat management module using a short-circuit line.

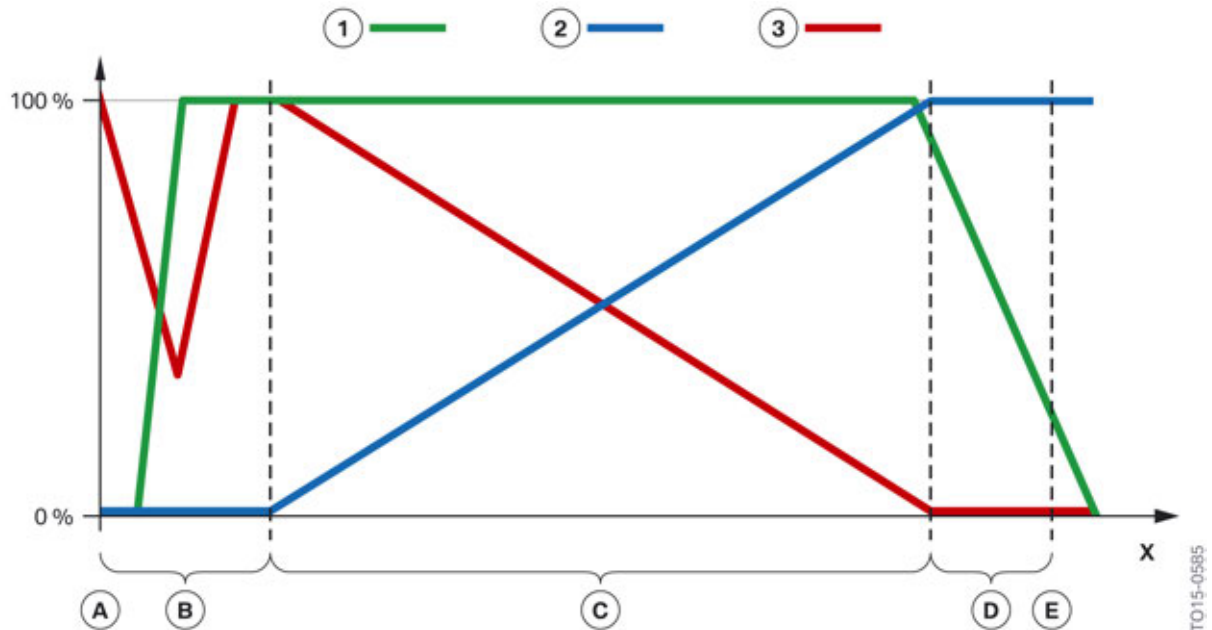
When the heater circuit is open the coolant is directed via the heat exchanger for the heating system.

B58 Engine

4. Cooling System

4.2.2. Operating strategy

The following diagram shows the positions of the rotary valve with an increasing coolant temperature.



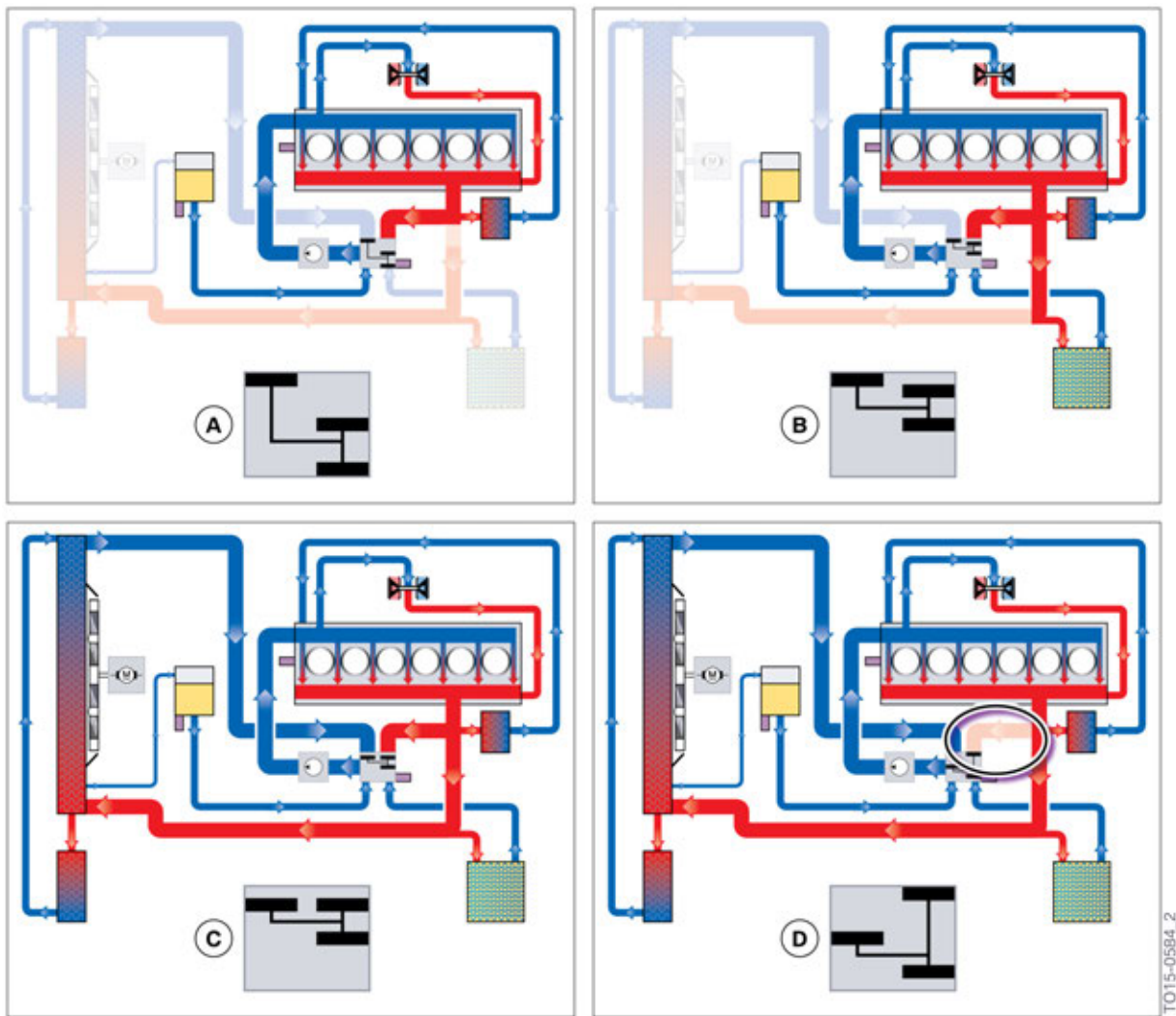
Circuit diagram of the heat management module in the B58 engine

Index	Explanation
0 %	Rotary valve closed
100 %	Rotary valve open
A	Cold-start phase
B	Warm-up phase
C	Operating temperature
D	Transfer from normal operation to maximum cooling requirement
E	Maximum cooling requirement
X	Rotational angle of the rotary valve in degrees (increasing engine temperature)
1	Heater circuit
2	Main coolant circuit
3	Minor coolant circuit

The openings on the rotary valve vary the cross-sections of the different coolant ducts depending on the rotational angle of the rotary valve. The following graphic schematically illustrates the phases from cold start to maximum cooling requirement.

B58 Engine

4. Cooling System



Switching modes of the heat management module in the B58 engine

Index	Explanation
A	Cold start
B	Warm-up phase
C	Operating temperature
D	Maximum cooling requirement

Cold-start phase, Figure A

The short-circuit line is 100% open in the cold-start phase. The coolant connections towards the radiator and heating are closed.

Warm-up phase, Figure B

During the warm-up phase the connection to the heating is opened in addition to the short-circuit line. The line from the radiator remains closed.

B58 Engine

4. Cooling System

Engine at operating temperature, Figure C

Figure C shows the control in normal conditions (operating temperature). The cross-sections to the corresponding connections are opened to a greater or lesser extent depending on the coolant temperature, so that coolant can flow through the minor and main coolant circuit and the heater circuit.

Maximum cooling requirement, Figure D

The radiator connection is opened by 100% and the short-circuit line is completely closed to provide maximum cooling at high dynamic loads and/or high ambient temperatures. In this process, the heat exchanger for the heating system is blocked by 90% to be able to provide the radiator with even more volumetric flow.

The coolant connection to the expansion tank is not controlled. As a result, it is permanently open so that any coolant demand in the coolant circuit can be compensated for by the expansion tank at any time.

4.3. Mechanical coolant pump

The structure and function of the mechanical coolant pump of the B58 engine are identical to the B48 engine (synergy part). The component description and functional description are found in B48 engine training information manual.

B58 Engine

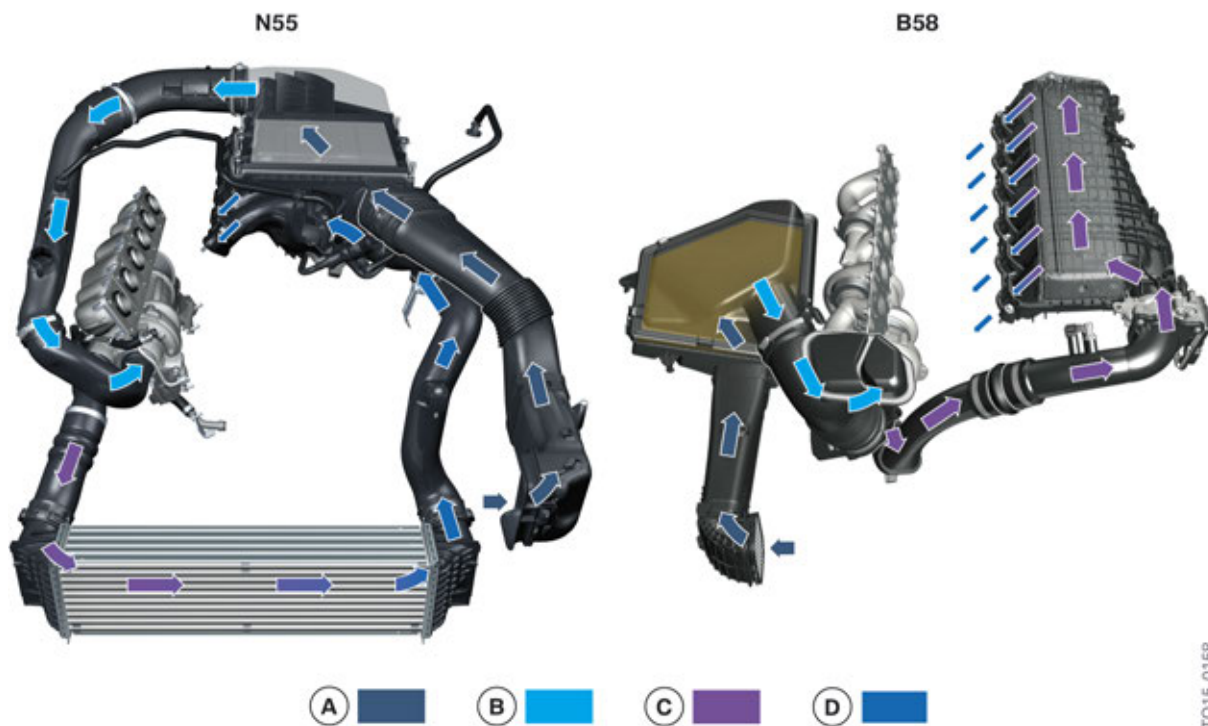
5. Intake Air and Exhaust System

5.1. Intake air system

The unfiltered air reaches the intake silencer with air cleaner via the unfiltered air line with intake air grille. The unfiltered air is filtered in the intake silencer with air cleaner. Then the clean air is directed to the turbocharger via the hot film air mass meter and the clean air pipe. Depending on the load condition, the blow-by gases from the crankcase are also introduced into the clean air pipe upstream of the turbocharger or directly into the intake ports.

The clean air is compressed and heated in the turbocharger. The compressed, warm charge air is then sent to the charge air cooler via a charge air hose. From the charge air cooler the now cooled charge air is directed to the intake system via an additional charge air hose and the adapter pipe with charge air temperature and charging pressure sensor.

5.1.1. Charge air cooling



Charge air line in the N55 engine compared with the B58 engine

Index	Explanation
A	Fresh air
B	Purified air
C	Heated charge air
D	Cooled charge air

The amount of oxygen which can be sent into the combustion chamber is reduced because the air heats up and expands during compression in the turbocharger. The charge air cooler counteracts this effect by cooling compressed air and achieving the best possible conditions for combustion. The air density is increased and therefore oxygen content per volume is also increased.

B58 Engine

5. Intake Air and Exhaust System

Two charge air intercooler types are currently used. **Direct**, air-cooled charge air cooling and **indirect**, coolant-based charge air cooling.

Direct charge air cooling is the most common type of intercooler and is used in the majority of forced induction engines. In this process, the compressed air is discharged into the ambient air using an air-to-air heat exchanger located in the air flow in front of the vehicle. In contrast, indirect charge air cooling cools the charge air with an air-to-coolant heat exchanger which is located on the engine, between the compressor and the throttle valve.

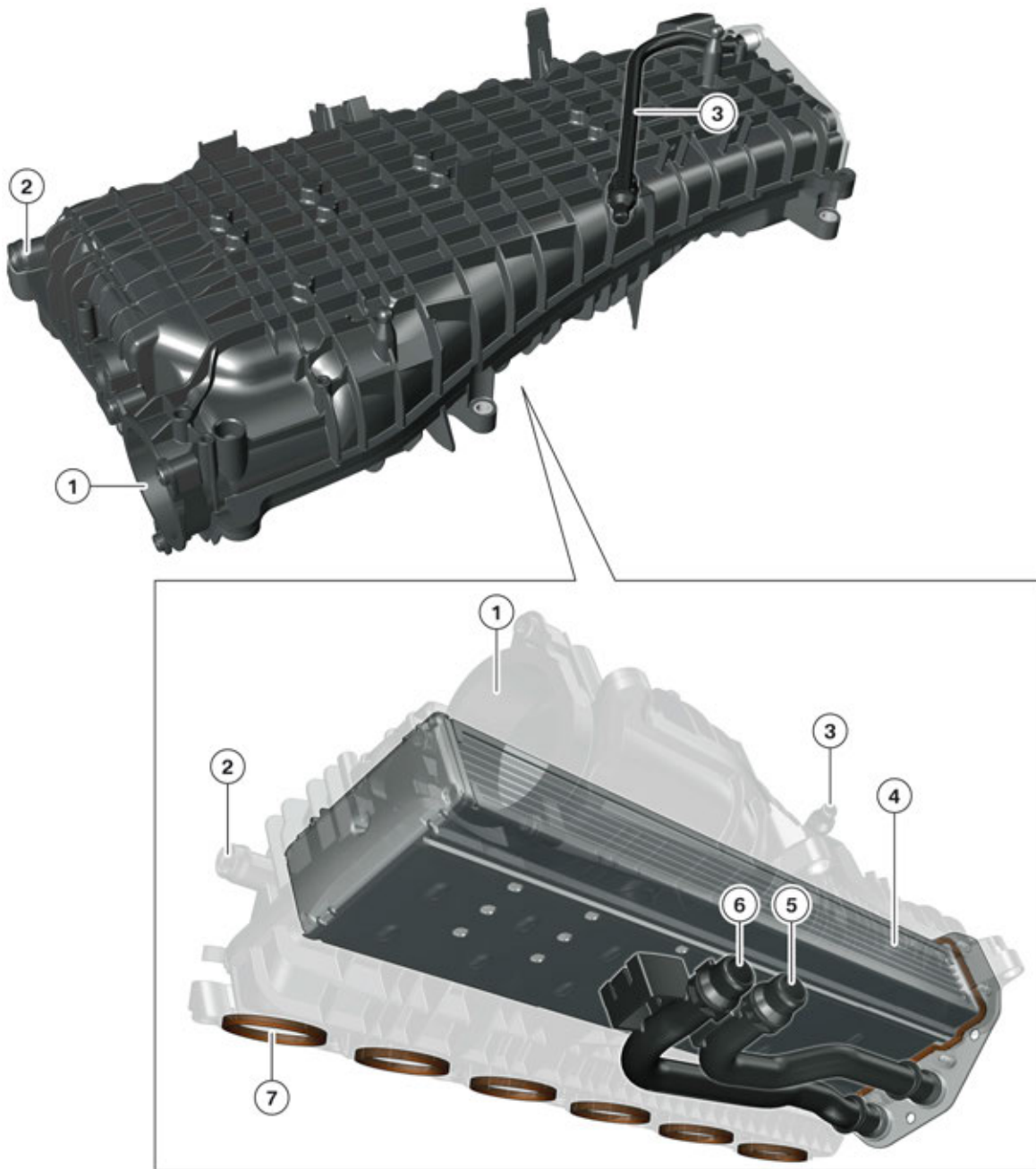
In the B58 engine the charge air intercooler has been integrated into the intake plenum (integrated, indirect charge air cooler — ILLK). The compressed air flows through the charge air intercooler in several plates, around which the coolant flows.

The benefits of integrated, indirect charge air cooling are:

- Lower charge air volume between compressor and intake valve
- More even temperature distribution within the intake ports
- Increased performance due to higher intake pressure
- Improved response characteristics due to the use of a smaller turbocharger
- Reduction in consumption by modifying the ignition point and transmission ratio

B58 Engine

5. Intake Air and Exhaust System



TO15-0012

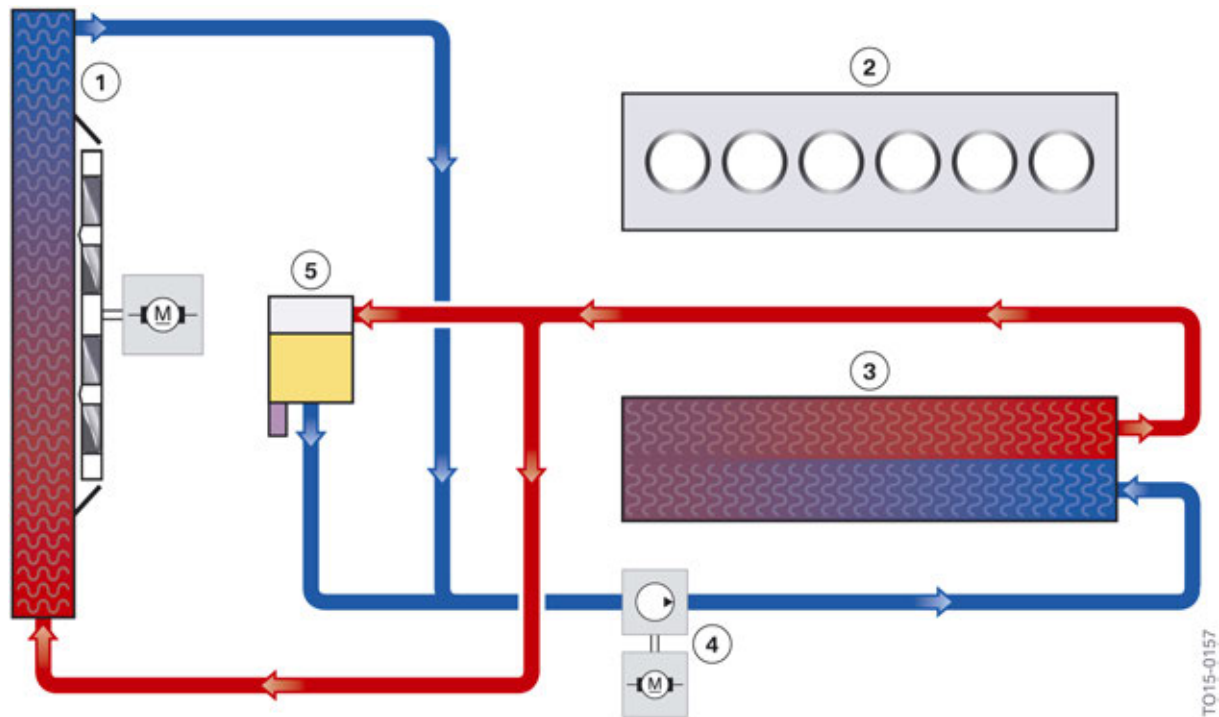
Integrated, indirect charge air cooler intake plenum

B58 Engine

5. Intake Air and Exhaust System

Index	Explanation
1	Throttle valve fixture
2	Tank bleeder
3	Bleed line to the expansion tank
4	Charge air cooler
5	Coolant return
6	Coolant supply
7	Cylinder head connection

The two-shell, friction-welded intake neck housing consists of polyamide 6 as well as 35% glass fiber PA6 GF35 and has been enhanced in terms of weight. Reinforced polyamide materials unite high rigidity and material strength with extreme impact resistance. This makes them extremely resilient to mechanical wear.



Integrated, indirect charge air cooling in the low-temperature coolant circuit of the B58 engine

Index	Explanation
1	Low-temperature radiator
2	B58 engine
3	Integrated, indirect charge air cooler
4	Electric coolant pump
5	Expansion tank

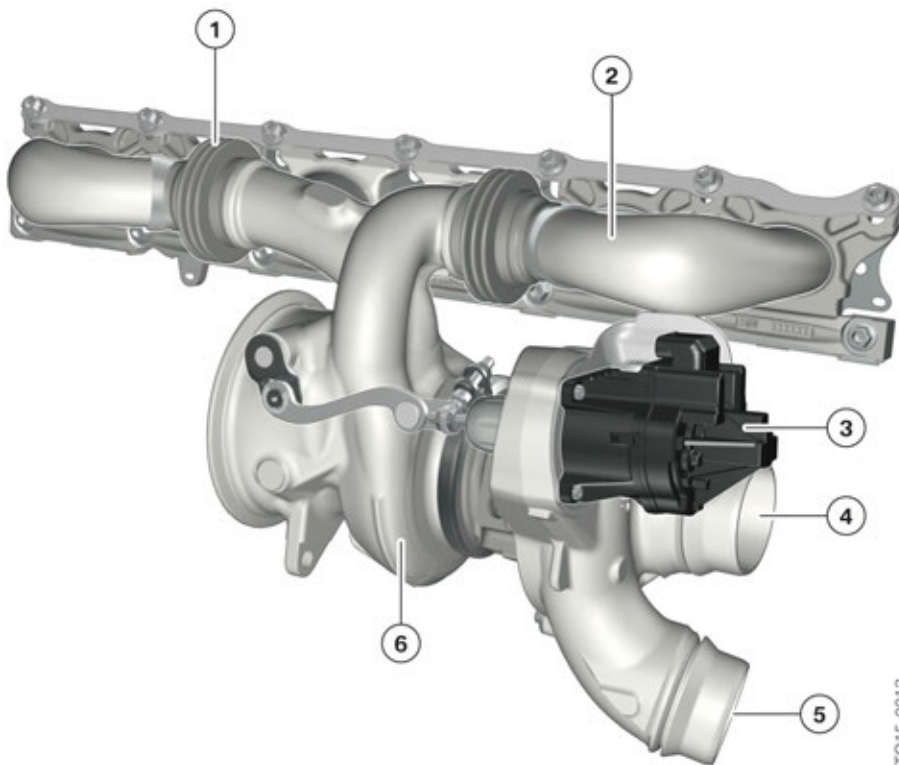
B58 Engine

5. Intake Air and Exhaust System

The charge air cooler has been integrated into the low-temperature coolant circuit and it can be replaced individually if necessary. The electrical auxiliary coolant pump is actuated by the Digital Motor Electronics (DME) and processes approximately five liters of coolant within the low-temperature coolant circuit. It is bled as per the official data in the repair instructions.

5.2. Exhaust emission system

5.2.1. Exhaust turbocharger



Exhaust turbocharger in the B58 engine

Index	Explanation
1	Expansion compensation unit
2	Exhaust manifold
3	Wastegate
4	Input, clean air
5	Charge air output
6	Turbine housing

The exhaust turbocharger of the B58 engine is a twin-scroll turbocharger (6 in 2 exhaust manifold). The exhaust manifold of the 3rd and 4th cylinder and the turbocharger housing form one single cast steel part which cannot be replaced individually. The exhaust manifolds of the 1st/2nd cylinders and the 5th/6th cylinders consist of multiple parts. They consist of stainless steel exhaust manifold pipes

B58 Engine

5. Intake Air and Exhaust System

which have been formed by applying internal pressure and feature forged stainless steel flanges that are welded on as well as an expansion compensation unit made of a nickel and chrome alloy installed between the turbine housing and the exhaust manifold.

The expansion compensation units compensate for material expansion and contraction as a result of both low and high temperatures between the turbine housing and the exhaust manifold and safeguard tension-free connections. The expansion compensation units are welded to the turbine housing and the exhaust manifold and cannot be replaced individually. So-called sliding seats are used in their assembly. In this process, two pipe sections are connected to each other until there is merely a distance of a few tenths of a millimeter to allow the material to expand in length at high temperatures.

Transport protection caps must be used for installation at the engine assembly plant as well as for disassembly in the vehicle or on the removed engine to prevent damage. During installation it is also important to follow the tightening sequence for all bolt connections.



In the event of repairs, the replacement part exhaust turbocharger must be inserted and installed in the clamping strip with installed transport protection caps. Only when the installation is complete is it possible to remove the transport protection caps.

5.2.2. Charging pressure control

The charging pressure is adjusted via an electrical actuator. An electrically controlled wastegate valve controls the charging pressure control in the B58 engine.

Electrified adjustment

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

- Vacuum unit
- Vacuum lines
- Electro-pneumatic pressure converter
- Vacuum reservoir.

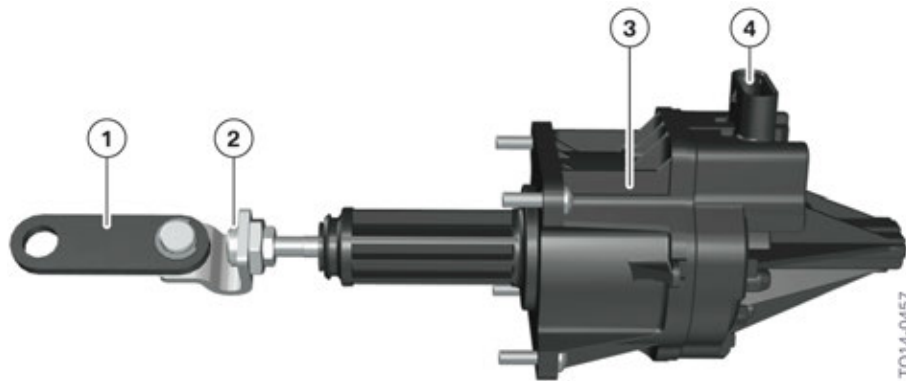
Advantages of electrical activation

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

B58 Engine

5. Intake Air and Exhaust System

Operating principle



Actuator of electrically adjustable wastegate valve

Index	Explanation
1	Actuator linkage
2	Adjustment linkage
3	Actuator
4	Electrical connection

The actuator of the electrically adjustable wastegate valve features a direct current motor and a sensor, resulting in a total of five electrical connections. The wastegate valve is opened or closed by a lifting movement of the linkage.

The actuator of the electrically adjustable wastegate valve can be replaced separately in service. Each time the adjusting linkage is activated, the system must be re-adjusted with the assistance of the BMW diagnosis system ISTA. This measure is not required when replacing the entire turbocharger as the linkage is supplied preset.



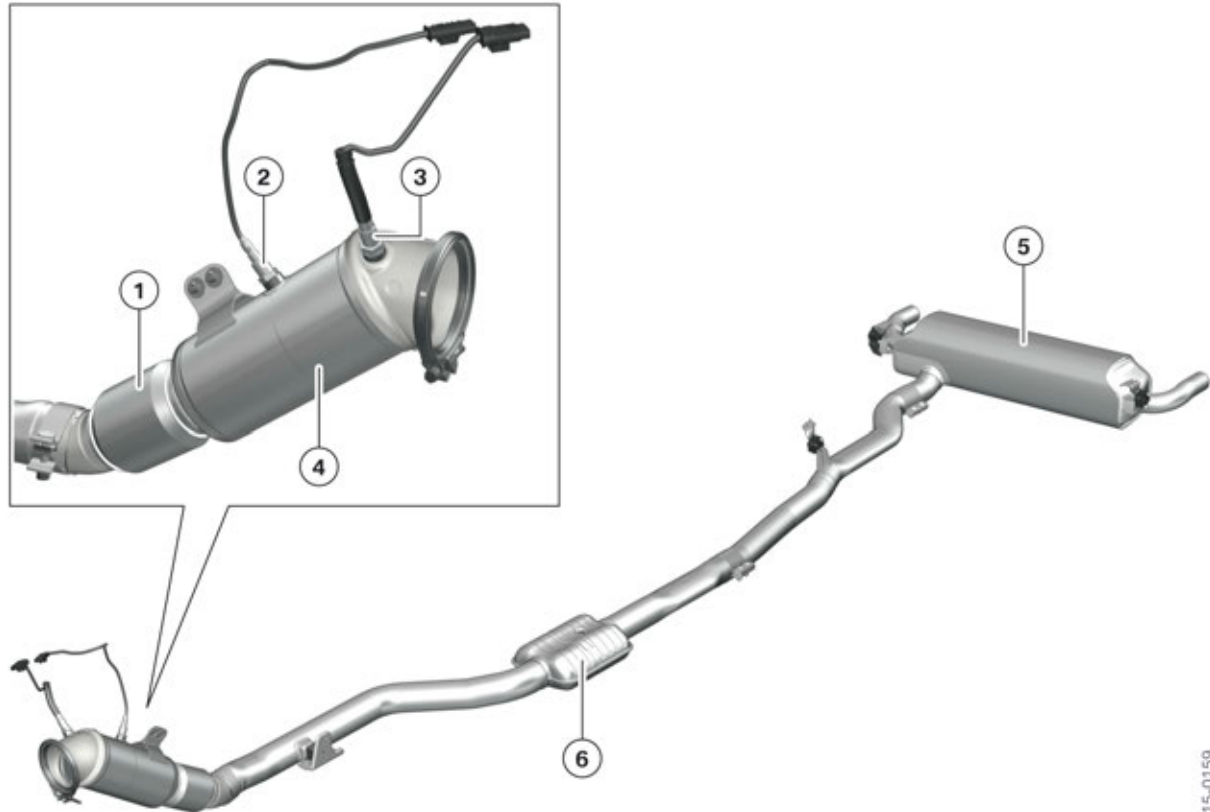
If the actuator is replaced individually, a teach-in routine must be performed using the BMW ISTA diagnosis system.

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

B58 Engine

5. Intake Air and Exhaust System

5.2.3. Exhaust system



B58 engine exhaust system

Index	Explanation
1	Isolation element
2	Monitoring sensor
3	Oxygen sensor
4	3-way catalytic converter, two monoliths
5	Rear silencer
6	Front silencer

In addition to the catalytic converter near the engine with decoupling element, a front silencer, a center silencer and a rear silencer are used, depending on the vehicle type. The catalytic converter housing features two ceramic monoliths of different sizes and a total volume of 2.8 liters:

- 1st monolith: 600 cells per square inch, 125 x 98 mm
- 2nd monolith: 400 cells per square inch, 125 x 130 mm

B58 Engine

5. Intake Air and Exhaust System

5.2.4. Exhaust emission standards

European emission standards (ECE)

The following table provides an overview of the different emissions threshold values of gasoline engines in the European market.

Exhaust emission standards	Introduction	CO g/km	HC +NOx g/km	HC g/km	NMHC g/km	NOx g/km	PM g/km	PN 1/km
EURO 1	07/92	3,16	1,13	-	-	-	-	-
EURO 2	01/96	2,2	0,50	-	-	-	-	-
EURO 3	01/00	2,3	-	0,20	-	0,15	-	-
EURO 4	01/05	1,0	-	0,10	-	0,08	-	-
EURO 5	09/09	1,0	-	0,10	0,068	0,06	4,5*	-
EURO 6	09/14	1,0	-	0,10	0,068	0,06	4,5*	6x10 ¹¹

* For vehicles with direct fuel injection.

The abbreviations of the terms which appear in the table are explained below:

- CO = carbon monoxide
- HC = hydrocarbon
- NOx = nitrogen oxide
- NMHC = non-methane hydrocarbons
- PM = particle matter (fine dust)
- PN = particulate concentration

Since EURO 5, more stringent regulations have been in force for engines with direct fuel injection. From EURO 5, the particulate matter has been evaluated, followed subsequently by the particle concentration with the introduction of EURO 6. The reason for this is that in modern gasoline engines with direct injection no homogeneous fuel/air mixture arises in comparison to engines with intake pipe fuel injection. There are therefore more particles in the exhaust gas (particulate matter).

Further obligations of the manufacturer are monitoring of continuous-service capability of emission reduction equipment over a total distance of 160,000 km (100,000 miles) and correct function over a period of five years, or 100,000 km (62,000 miles) . For this reason, modern combustion engines come with many adaptations that prevent breaches of exhaust emission standards due to use of older fuel.

B58 Engine

5. Intake Air and Exhaust System

US market emission standards

The following table provides an overview of the different emissions classifications and their threshold values in the US market (California and Northeast States).

California and Northeast States Light-Duty Vehicle Emission Standards for Air Pollutants								
LEV II Program								
Standard	Model Year	Vehicles	Emission Limits at Full Useful Life (100,000-120,000 miles)					Air Pollution Score
			Maximum Allowed Grams per Mile					
			NOx	NMOG	CO	PM	HCHO	
ZEV	2004+	LDV, LDT	0.00	0.000	0.0	0.0	0.0	10
PZEV*	2004+	LDV, LDT	0.02	0.010	1.0	0.01	0.004	9.5
SULEV II	2004+	LDV, LDT	0.02	0.010	1.0	0.01	0.004	9
ULEV II	2004+	LDV, LDT	0.07	0.055	2.1	0.01	0.011	7
LEV II	2004+	LDV, LDT	0.07	0.090	4.2	0.01	0.018	6
LEV II option 1	2004+	LDV, LDT	0.10	0.090	4.2	0.01	0.018	5
SULEV II	2004+	MDV4	0.10	0.100	3.2	0.06	0.008	4
ULEV II	2004+	MDV4	0.20	0.143	6.4	0.06	0.016	3
LEV II	2004+	MDV4	0.20	0.195	6.4	0.12	0.032	2
SULEV II	2004+	MDV5	0.20	0.117	3.7	0.06		3
ULEV II	2004+	MDV5	0.40	0.167	7.3	0.06		2
LEV II	2004+	MDV5	0.40	0.230	7.3	0.12		1

*PZEVs have the same standards as SULEV II, but manufacturers must guarantee that the PZEVs meet the standards for a longer vehicle lifetime--15 years/150,000 miles--plus have a fully-sealed, zero-emissions fuel system.

Different emissions classifications and their threshold values for the US market (California and Northeast States).

Glossary		
LDV	Light Duty Vehicle	Passenger Car
LDT	Light Duty Truck	Truck (pickup, minivan, van, SUV) up to 8500 pounds GVWR, divided into sizes based on weight
LDT1	Light Duty Truck 1	Truck up to 6000 pounds GVWR and 3750 pounds LVW
LDT2	Light Duty Truck 2	Truck up to 6000 pounds GVWR, and between 3751 and 5750 pounds LVW
LDT3	Light Duty Truck 3	Truck between 6001 and 8500 pounds GVWR, and between 3751 and 5750 pounds ALVW
LDT4	Light Duty Truck 4	Truck between 6001 and 8500 pounds GVWR, and over 5750 pounds ALVW
LLDT	Light Light Duty Truck	Truck up to 6000 pounds GVWR; includes LDT1 and LDT2
HLDT	Heavy Light Duty Truck	Truck between 6001 and 8500 pounds GVWR; includes LDT3 and LDT4
MDPV	Medium Duty Passenger Vehicle	Truck between 8501 and 10,000 lbs GVWR
MDV	Medium Duty Vehicle	For California standards, a vehicle between 6000 and 14,000 lbs GVWR, divided into sizes based on ALVW
MDV1	Medium Duty Vehicle 1	For California standards, an MDV up to 3750 pounds ALVW
MDV2	Medium Duty Vehicle 2	For California standards, an MDV between 3751 and 5750 pounds ALVW
MDV3	Medium Duty Vehicle 3	For California standards, an MDV between 5751 and 8500 pounds ALVW
MDV4	Medium Duty Vehicle 4	For California standards, an MDV between 8501 and 10,000 pounds ALVW
MDV5	Medium Duty Vehicle 5	For California standards, an MDV between 10,001 and 14,000 pounds ALVW
LVW	Loaded Vehicle Weight	Nominal empty vehicle weight + 300 lbs
ALVW	Adjusted Loaded Vehicle Weight	Average of the curb (empty) weight and the GVWR
GVWR	Gross Vehicle Weight Rating	Maximum fully loaded vehicle weight
Bin	Tier 2 Bin	A set of emission standards within the Tier 2 Program. Manufacturers must certify that each vehicle will not exceed the pollution limits for the selected bin. Manufacturers may choose from the range of bins, as long as all vehicles they sell each model year fall below a certain average emissions limit.
Tier 2	Tier 2 Program	Replaced the Tier 1 Program with even cleaner emission standards
Tier 1	Tier 1 Program	EPA's first program after the Clean Air Act of 1994, setting more stringent vehicle emission standards nationwide than had previously existed
LEV II	LEV II Program	Replaced the LEV I Program with even cleaner emission standards

B58 Engine

5. Intake Air and Exhaust System

Glossary		
LEV I	LEV I Program	California's first "Low Emission Vehicle" program, setting more stringent vehicle emission standards for California than had previously existed
LEV	Low Emission Vehicle	The average emissions standard within the LEV program
TLEV	Transitional Low Emission Vehicle	A temporary emissions standard bridging the gap between the looser Tier 1 and the more stringent LEV standards
ILEV	Inherently Low Emission Vehicle	An emissions standard for alternatively-fueled vehicles with closed and pressurized fuel systems
ULEV	Ultra Low Emission Vehicle	An emissions standard within the LEV program and tighter than the LEV standard
SULEV	Super Ultra Low Emissions Vehicle	An emissions standard that is tighter than the ULEV standard
PZEV	Partial Zero Emission Vehicle	An emission standard that is equivalent to the SULEV standard, with longer vehicle lifetime requirements--150,000 miles/15 years--and a fully sealed, zero-emissions fuel system
ZEV	Zero Emission Vehicle	The tightest emissions standard: zero emissions
NOx	Oxides of Nitrogen	Compounds containing nitrogen and oxygen; they combine with hydrocarbons in the sunlight to form smog
NMOG	Non-Methane Organic Compounds	Compounds containing carbon; they combine with NOx in the sunlight to form smog
NMHC	Non-Methane Hydrocarbons	A subset of NMOGs, containing only carbon and hydrogen; they combine with NOx to form smog
THC	Total Hydrocarbons	All hydrocarbons, including methane; they combine with NOx to form smog
PM	Particulate Matter	Tiny particles of solid matter that lodge in the lungs and deposit on buildings
HCHO	Formaldehyde	A lung irritant and carcinogen
CO	Carbon Monoxide	A colorless, odorless, poisonous gas



In the US market the B58 engine is classified as an ULEV II emission standard engine.

The B58 engine complies with both the EURO 6 (in ECE) and ULEV II (in the US) exhaust emission standards' limits upon its market introduction.

Measures for reduction of exhaust gas emissions

- Precise and fast charging pressure control
- Catalytic converter heating during cold start
- Positioning of catalytic converter near engine
- New LSF Xfour voltage-jump sensor by Bosch.

Catalytic converter heating

When starting the combustion engine from cold, the wastegate valve is opened as wide as possible and the ignition point is adjusted to retard. The retarded ignition point delays the combustion process which in turn supports the heat input for heating of the catalytic converter. As the turbine housing is short, it has been possible to position the catalytic converter very close to the wastegate valve. As the exhaust gas flows into the catalytic converter at the perfect angle and because of its position close to the engine, the catalytic converter reaches its operating temperature very quickly. If the wastegate valve is opened when cold, pulsation of the exhaust gas may cause vibrations in the wastegate valve, which are perceived as noise. This is not due to a defective component, and is normal running noise. This noise becomes less audible as the temperature of the component increases.

Positioning

The catalytic converter near the engine ensures low exhaust temperatures upstream of the catalytic converter input and therefore considerably reduces the degree of catalytic converter ageing.

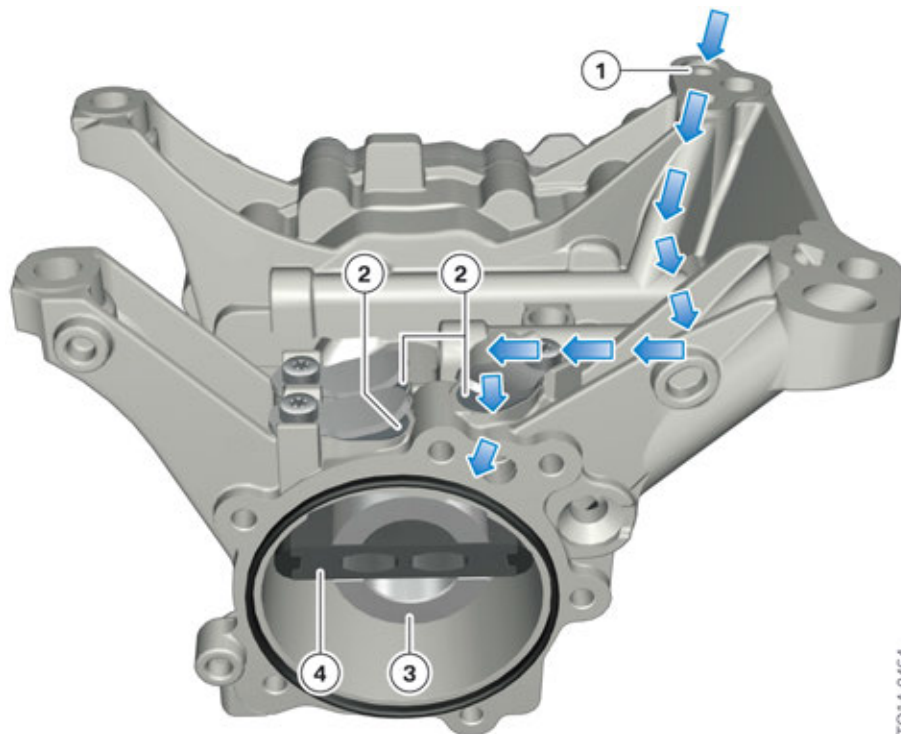
B58 Engine

6. Vacuum Supply

6.1. Vacuum pump

In the B58 engine the vacuum pump and the oil pump are located in a shared housing.

The vacuum duct connects to the vacuum pump, passing through the transmission end of the crankcase. There is a plastic connection at the output of the crankcase to which the various consumers are connected. There is a non-return valve inside this plastic connection.



Vacuum pump, B58 engine

Index	Explanation
1	Vacuum duct
2	Exhaust valves
3	Steel rotor
4	Plastic vane

There is a steel rotor with a plastic vane on the inside of the vacuum pump. It is driven together with the oil pump via a chain from the crankshaft.

The evacuating output of the vacuum pump is 500 mbar vacuum (absolute) in less than six seconds.

As the running surfaces of the vacuum pump are coated with oil, the volume of air drawn in cannot be released into the atmosphere. The air volume delivered by the vacuum pump is transferred to the crankcase via discharge valves. From here, it reaches the air intake system via the crankcase ventilation.

B58 Engine

6. Vacuum Supply



Leaks in the vacuum system lead to a reduced power brake assistance.

B58 Engine

7. Fuel System

The fuel supply is described in the respective product training manuals for the models.

7.1. Fuel preparation

The fuel preparation has been modified to meet the requirements of emission legislation. The injectors have now been bolted to a newly developed direct rail with integrated high-pressure sensor.

B58 engine direct rail

Index	Explanation
1	Injector
2	Holding clamp with bayonet fitting
3	Rail pressure sensor
4	Direct rail (2x3 units)
5	High-pressure line
6	High pressure pump
7	Low-pressure line

The direct injection system has been taken over from the B48 and forms part of the so-called synergy or adapted parts (from other engines). The direct rail represents a departure from the familiar systems used up till now. Here the injectors without high pressure and leakage oil lines are attached to the rail.

Directly connecting the solenoid valve injectors to the rail has the following advantages:

- Less volume needs to be available for high-pressure injection
- Fewer interfaces and therefore less problematic with respect to leaks
- Short cycle times during production due to compact design

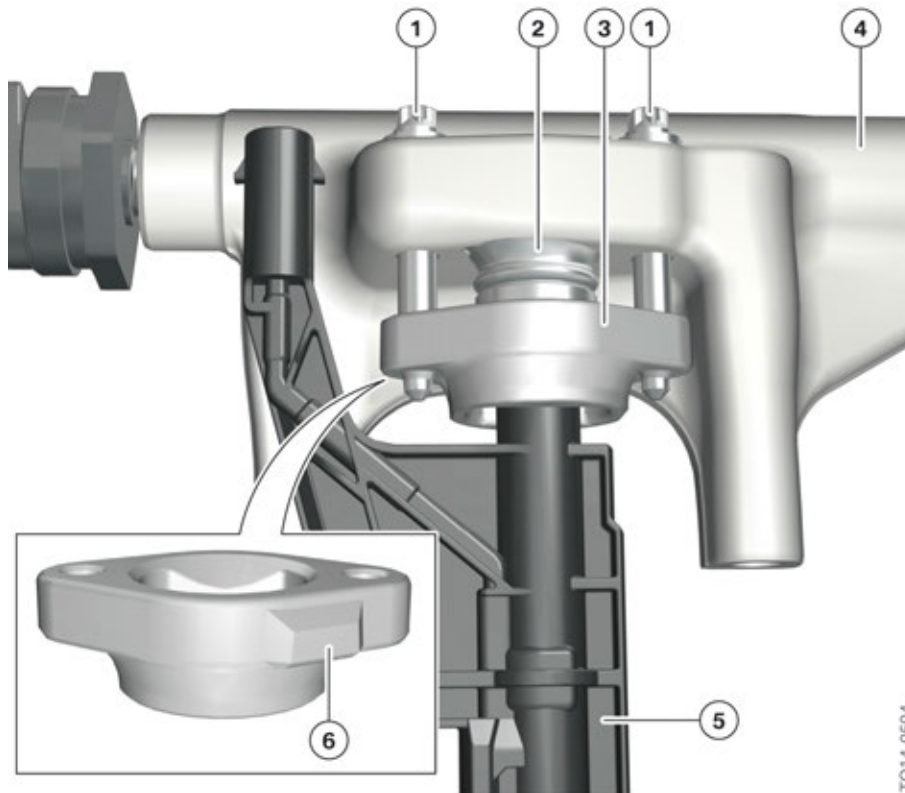


Utmost cleanliness must be observed when carrying out any work on the fuel system!

B58 Engine

7. Fuel System

7.1.1. Direct rail



Mounting the injectors

Index	Explanation
1	Mounting bolts
2	Plastic sleeve
3	Holding clamp with bayonet fitting
4	Rail
5	Solenoid valve injector
6	Cast lug

The solenoid valve injectors are fastened to the holding clamp with a bayonet fitting. There is a plastic sleeve between the holding clamp and direct rail. This is not designed to collect escaping fuel. Its only purpose is to carry out a helium pressure test during preassembly at the factory in order to check the tightness. After the initial assembly, this plastic sleeve is of no relevance to the engine operation. When the solenoid valve injectors are replaced, the plastic sleeves are no longer required and do not need to be reinserted.

Casting lugs develop during production of the retaining bridge when the component is separated from the tool. As a result of the low installation tolerances it is necessary to make sure during installation of the solenoid valve injectors that said cast lugs point in the direction of the exhaust manifold. Mechanical contact between the retaining bridge and the cylinder head cover may result if the cast lugs are pointing in the wrong direction (towards the intake pipe).

B58 Engine

7. Fuel System

The mounting bolts of the holding clamp must be replaced each time they are released.

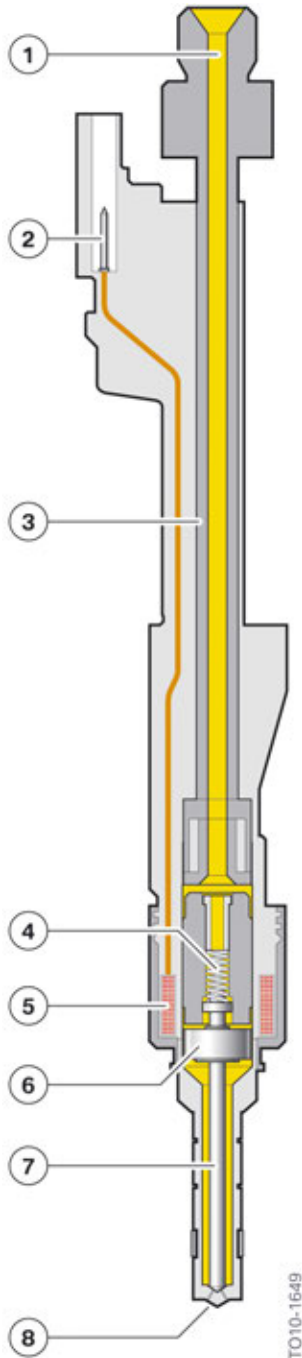


The shank of the solenoid valve injector is sensitive to high pressure and tensile force as well as rotational angles. When removing and installing the solenoid valve injectors, the procedure in the current repair instructions must be followed! If the solenoid valve injectors are damaged, fuel may be discharged.

B58 Engine

7. Fuel System

7.1.2. Solenoid valve injector



HDEV 5.2 solenoid valve injector

B58 Engine

7. Fuel System

Index	Explanation
1	Fuel line connection
2	Electrical connection
3	Stem
4	Compression spring
5	Solenoid coil
6	Armature
7	Nozzle needle
8	6-hole nozzle

As with the N55 engine, the new B58 engine is also equipped with the Bosch HDEV 5.2 solenoid valve injector. The designation of the injectors is a combination of the following:

- HDEV = high-pressure fuel injection valve
- 5 = generation designation
- 1 = maximum fuel injection pressure of 150 bar
- 2 = maximum fuel injection pressure of 200 bar.

When current is supplied to the solenoid coil, a magnetic field is produced which attracts the magnet armature. The magnet armature runs upwards on the nozzle needle. The linear travel of the magnet armature in the direction of the solenoid coil carries the nozzle needle along with it and the nozzle bores are released in the direction of the combustion chamber.

The most current repair instructions must be followed when removing and installing the injectors in Service. If the rotational angle at the shank of the injector is too large, this can lead to damage and therefore leaks in the fuel system.

A special fuel additive is recommended in markets with a poor fuel grade to prevent coking of injectors in direct injection systems. The additive is added to the fuel in the fuel tank from where it arrives at the injectors.



Using an additive approved by BMW (part number 83 19 2 183 738).

Solenoid valve injector

Due to the more stringent exhaust gas emission regulations which are required to meet the EURO 6 exhaust emission standards, technical changes had to be made to the solenoid valve injectors. **These changes have been in effect in the US for some time now, they were introduced in the S55 engine and to the N20 and N55 engine as part of a rolling change.**

As is the case with diesel fuel passenger cars which has been previously discussed (in the N47 and N57 training material), in addition to the limit value for particulate mass (PM), the limit value for the particle concentration (PN) is also stipulated in the exhaust emission standards for gasoline passenger cars.

B58 Engine

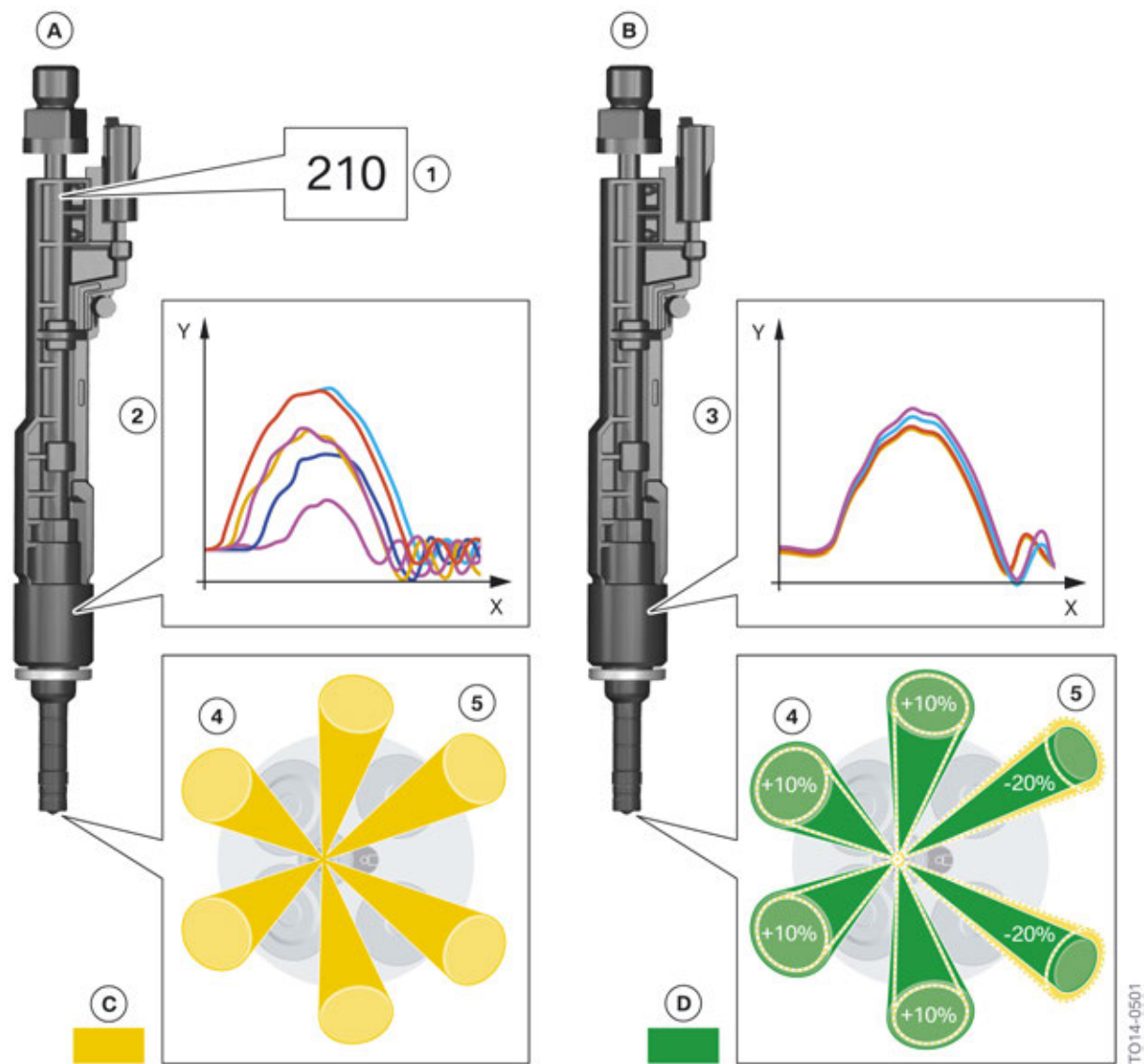
7. Fuel System

The reason for this is that in modern gasoline engines with direct injection no homogeneous fuel/air mixture arises in comparison to engines with intake port fuel injection. There are therefore more particles in the exhaust gas (particulate matter).

As with the S55, N20 and N55 different diameters of (laser-manufactured) bore holes are used with the new high-pressure fuel injection valves, for example. The fuel quantity of the two spray jets in the exhaust direction is reduced by 20 %, which increases the other spray jets by 10 % respectively. For more information see the S55 engine training manual.

The solenoid valve injectors can only be used in a predefined position in the injector shaft of the cylinder head. This ensures correct alignment of the injection pattern in the combustion chamber.

The following graphic illustrates the differences between the EURO 5 and EURO 6 version:



B58 Engine

7. Fuel System

Index	Explanation
A	Solenoid valve injector EURO 5 (N55 ULEV II at SOP)
B	Solenoid valve injector EURO 6 (B58 ULEV II and also used on current US market S55, N55, N20, N26 engines)
C	Even nozzle bore geometry
D	Uneven nozzle bore geometry
X	Opening period
Y	Needle travel
1	Injection quantity compensation code
2	Conventional operation
3	Automatic operation
4	Spray pattern, intake valve side
5	Spray pattern, exhaust valve side

High-pressure fuel injection valves with solenoid coils do not have a linear behavior pattern across the entire service life, mainly in the area of minimal quantity fuel injection. This means over the service life the fuel injection rates vary from one injector to another injector and also from each individual injector. Although the high-pressure fuel injection valves are adapted during start-up via the injection quantity compensation code in the Digital Engine Electronics (DME) in order to compensate for possible manufacturing tolerances of the individual high-pressure fuel injection valves in the Digital Engine Electronics (DME), and to adapt all injectors in relation to one another, this only happens once during start-up (injection quantity compensation). During conventional operation, the parameters for activation of the injectors, such as current and activation duration, are the same for all injectors throughout the entire operating time and cannot be individually adapted. Another adaptation during the entire operating time is no longer possible. This would lead to breaches of the strict exhaust gas emissions legislation, such as EURO 6 and ULEV II, during the operating time.

An automatic operation allows precise dosing of fuel, particularly when using extremely small injection quantities. Analysis of the voltage and current curve in injector mode allows conclusions to be drawn about the movement of the needle. The most important information in relation to the movement of the needle is the needle travel and opening period. The fuel injection rate can be determined from these two variables. It has therefore been possible to omit printing of a injection quantity compensation code on the new solenoid valve injectors.

Service note

When replacing injectors, the taught-in values of the Control Valve Operating (CVO) function and the cylinder imbalance (CIM, US only) function must be reset. This is done with the assistance of the BMW diagnosis system ISTA. Adjustment functions are available in the service functions. In order to notify the Digital Motor Electronics (DME) about the injector exchange, these new type of solenoid valve injector are all taught in with the same dummy value (215). Once the teach-in procedure has been successfully completed, the stored adaptations are reset and new adaptations are taught in via the CVO and CIM function.

B58 Engine

7. Fuel System

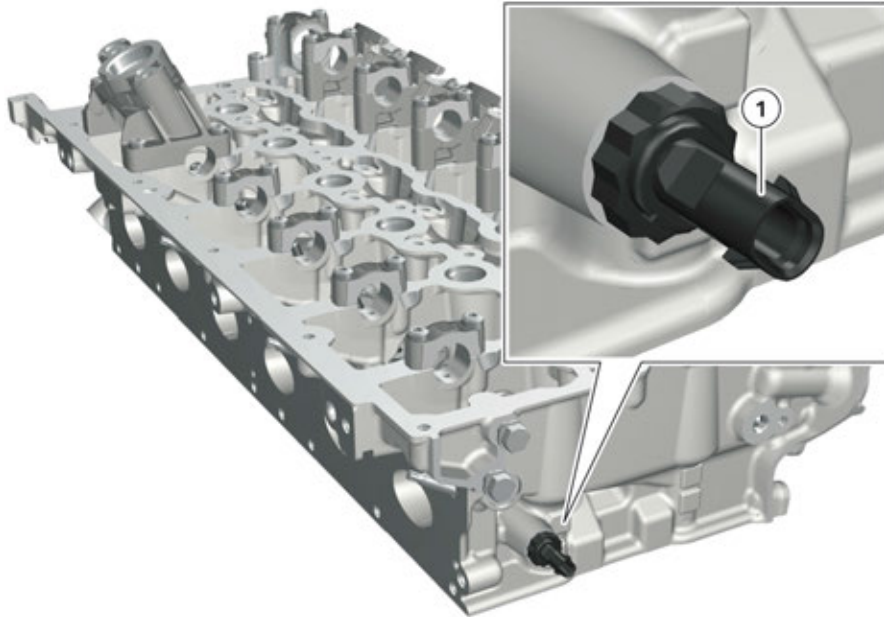


When the solenoid valve injectors are replaced, they must be started up with the assistance of the BMW diagnosis system ISTA.

B58 Engine

8. Engine Electrical System

8.1. Component temperature sensor



B58 engine component temperature sensor

Index	Explanation
1	Component temperature sensor

The B58 engine uses a component temperature sensor in addition to the coolant temperature sensor to control the coolant more precisely with the heat management module. It records the material temperature of the cylinder head around the exhaust gas duct of the first cylinder and forwards it to the DME control unit. As a result, power, consumption and pollutant emissions can be influenced even more efficiently.

This two-pin temperature sensor is a temperature-sensitive resistor (NTC) which covers a temperature range of between - 40 °C and 150 °C (- 40 °F and 302 °F). The temperature is transferred to the sensor using an elastic heat coupler attached to the outside of the sensor.

B58 Engine

8. Engine Electrical System

8.2. Digital Motor Electronics

The new DME generation is designated as DME 8.

Depending on the engine version, DME will be given a certain designation. The following section features an extract of the currently available DME 8 variants.

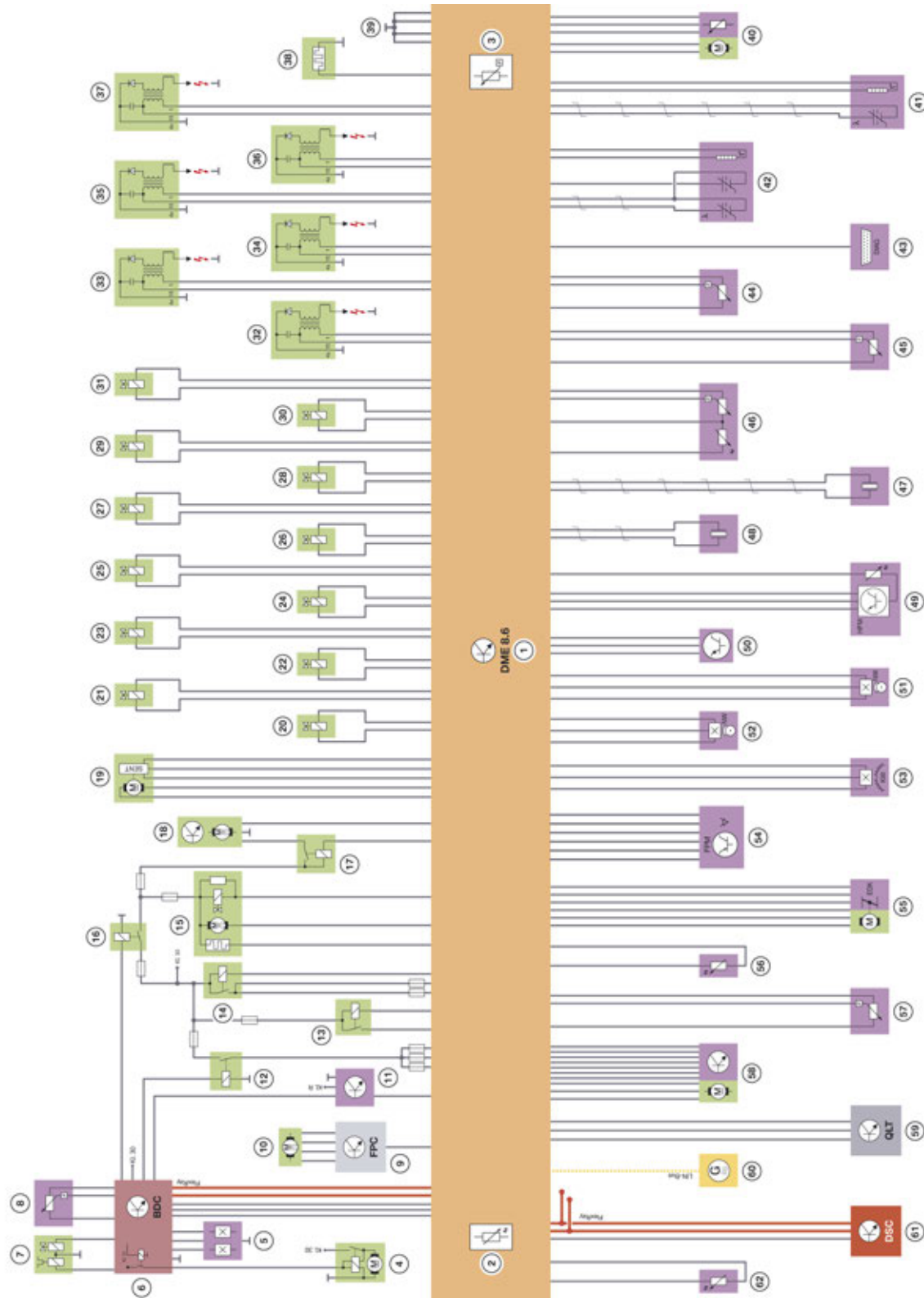
DME 8.x.y.z (x = number of cylinders, y = vehicle electrical system architecture, z = H = Hybrid) is encoded as follows:

- DME 8.4.0 = B48
- DME 8.4.0H = B48 PHEV
- **DME 8.6.0 = B58**
- DME 8.8.0 = N63 TÜ2

B58 Engine

8. Engine Electrical System

8.3. DME 8.6 system wiring diagram



DME 8.6 system wiring diagram in the B58 engine

TO15-0300

B58 Engine

8. Engine Electrical System

Index	Explanation
1	Digital Motor Electronics DME 8.6
2	Temperature sensor
3	Ambient pressure sensor
4	Starter motor
5	Brake light switch
6	Body Domain Controller (BDC)
7	Air conditioning compressor
8	Refrigerant pressure sensor
9	Electric fuel pump control
10	Electric fuel pump
11	Clutch switch
12	Relay, terminal 15N
13	Relay, Valvetronic
14	Relay, ignition and fuel injection
15	Diagnostic module for tank leaks DMTL (US and Korea only)
16	Relay, terminal 30B
17	Relay for electric fan
18	Electric fan
19	Heat management module
20	Mechanical coolant pump shift valve
21	Tank vent valve
22	VANOS solenoid valve, intake camshaft
23	VANOS solenoid valve, exhaust camshaft
24	Map-controlled valve, oil pump
25	Quantity control valve
26 - 31	Injectors, 6-cylinder engine
32 - 37	Ignition coils, 6-cylinder engine
38	Engine ventilation heating (version for cold countries only)
39	Earth connections
40	Actuator for electrically adjustable wastegate valve
41	Oxygen sensor after catalytic converter
42	Oxygen sensor before catalytic converter
43	Diagnostic socket
44	Intake-manifold pressure sensor after throttle valve
45	Rail pressure sensor

B58 Engine

8. Engine Electrical System

Index	Explanation
46	Charge air temperature and charging pressure sensor upstream of throttle valve
47, 48	Knock sensors
49	Hot film air mass sensor
50	Gear sensor
51	Camshaft sensor, intake camshaft
52	Camshaft sensor, exhaust camshaft
53	Crankshaft sensor
54	Accelerator pedal module
55	Electromotive throttle actuator
56	Coolant temperature sensor
57	Oil pressure sensor
58	Valvetronic servomotor
59	Oil level sensor
60	Alternator
61	Dynamic Stability Control DSC
62	Component temperature sensor



Bayerische Motorenwerke Aktiengesellschaft
Qualifizierung und Training
Röntgenstraße 7
85716 Unterschleißheim, Germany