Product Information.
N47 TOP engine.

BMW Service

The information contained in the Product Information and the Workbook form an integral part of the training literature of BMW Aftersales Training.

Refer to the latest relevant BMW Service information for any changes/supplements to the technical data.

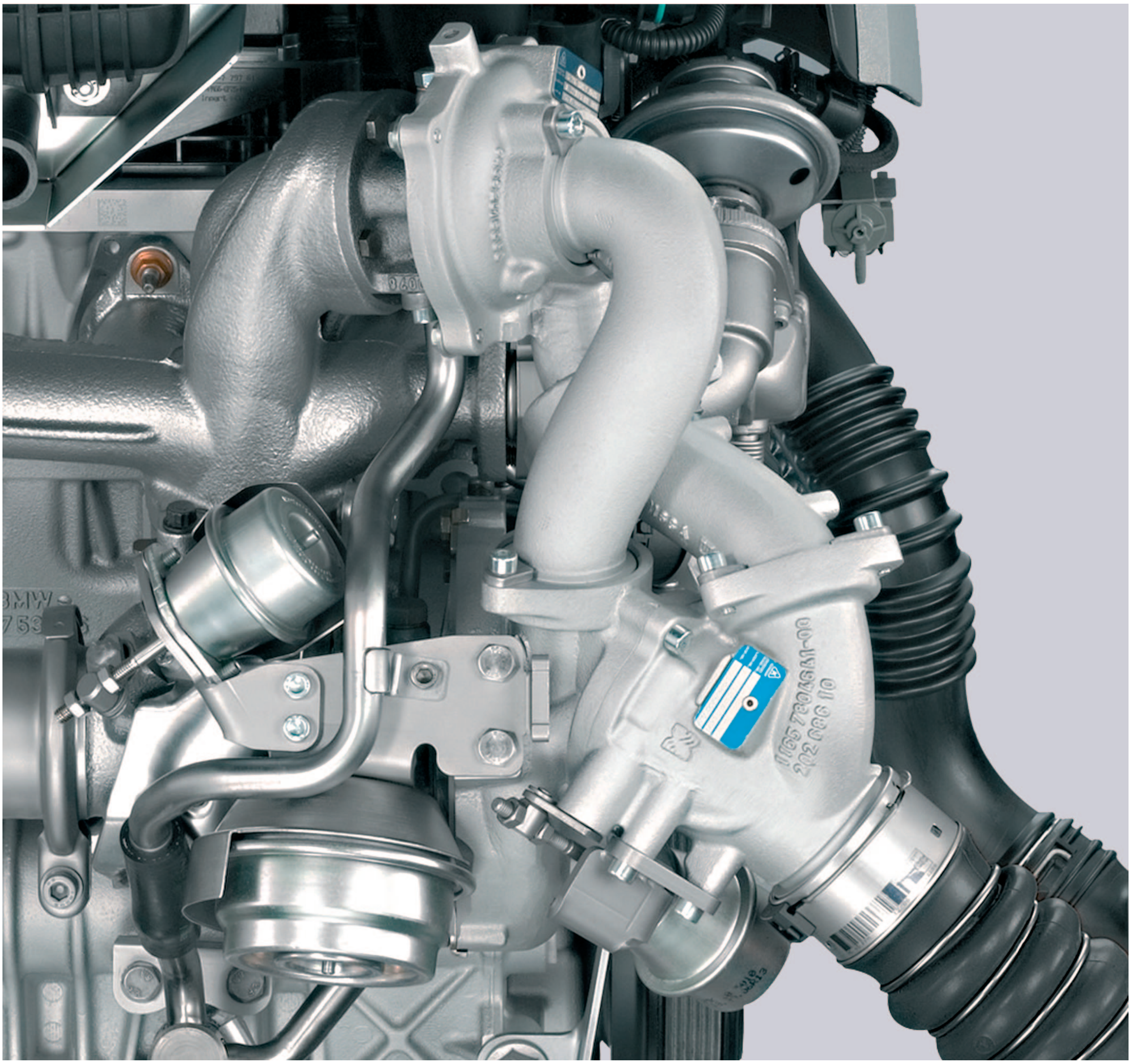
Information status: June 2007

Contact: conceptinfo@bmw.de

Product Information.
N47 TOP engine.

Twin Turbo with two-stage turbocharging

Up to 2,000 bar injection pressure



Notes on this Product Information

Symbols used

The following symbols are used in this Product Information to improve understanding and to highlight important information:

⚠ contains information to improve understanding of the systems described and their function.

◄ identifies the end of a note.

Information status and national variants

BMW vehicles satisfy the highest requirements of safety and quality. Changes in terms of environmental protection, customer benefits and design render necessary continuous development of systems and components. Discrepancies may therefore arise between specific details provided in this Product Information and the vehicles available during the training course.

This documentation only describes European left-hand-drive variants. In right-hand-drive vehicles some control elements and components are arranged differently from what is shown in the graphics in this Product Information. Further discrepancies may arise from market- or country-specific equipment specifications.

Additional sources of information

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

- in the Owner's Handbook
- in the BMW diagnosis system
- in the Workshop Systems documentation
- in BMW Service Technik.

Contents.
N47 TOP engine.

Objectives.
N47 TOP engine.

Product Information and reference material for practical applications

This Product Information is intended to provide you with information on the design and operation of the N47 TOP engine.

The Product Information is designed as a work of reference and supplements the contents of the BMW Aftersales Training course. The Product Information is also suitable for private study.

As preparation for the technical training course, this Product Information provides an insight into the new N47 TOP 4-cylinder diesel engine. In conjunction with the practical exercises carried out in the training course, the aim of the Product Information is to equip participants with the skills to carry out servicing work on the N47 TOP engine.

Existing technical and practical knowledge of current BMW diesel engines will make it easier to understand the systems and their functions presented here.

Models.
N47 TOP engine.

Engine variants

Models with N47 TOP engine for market launch in Autumn 2007.

Model	Series	Engine	Cylinder capacity in cm^3	Bore/stroke in mm	Power in kW/bhp at rpm	Torque in Nm at rpm	Market launch
123d	E81	N47D20T0	1995	90/84	150/204 4000	400 1750	9/07
123d	E87	N47D20T0	1995	90/84	150/204 4000	400 1750	9/07
123d	E82	N47D20T0	1995	90/84	150/204 4000	400 1750	11/07

History

Four-cylinder diesel engines at BMW

Engine	Model	Series	Cylinder capacity in cm^3	Power in kW/bhp	Torque in Nm	Engine management	First used	Last used
M41D17	318tds	E36	1665	66/90	190	DDE2.1	9/94	9/00
M47D20O0	320d	E46	1951	100/136	280	DDE3.0	4/98	9/01
M47D20O0	520d	E39	1951	100/136	280	DDE3.0	9/99	5/03
M47D20U0	318d	E46	1951	85/115	240	DDE3.0	9/01	3/03
M47D20O1	320d	E46	1995	110/150	330	DDE5.0	9/01	3/04
M47D20U1	318d	E46	1995	85/115	240	DDE5.0	3/03	3/04
M47D20U1	318d	E46	1995	85/115	240	DDE506	3/04	3/05
M47D20O1	320d	E46	1995	110/150	330	DDE506	3/04	9/06
M47D20U2	118d	E87	1995	90/122	280	DDE603	9/04	3/07
M47D20O2	120d	E87	1995	120/163	340	DDE604	9/04	3/07
M47D20O2	X3 2.0d	E83	1995	110/150	330	DDE506	9/04	9/05
M47D20O2	320d	E90	1995	120/163	340	DDE604	3/05	9/07
M47D20U2	318d	E90	1995	90/122	280	DDE603	9/05	9/07

Engine	Model	Series	Cylinder capacity in cm^3	Power in kW/bhp	Torque in Nm	Engine management	First used	Last used
M47D20O2	320d	E91	1995	120/163	340	DDE604	9/05	9/07
M47D20O2	X3 2.0d	E83	1995	110/150	330	DDE604	9/05	9/07
M47D20U2	318d	E91	1995	90/122	280	DDE603	3/06	9/07
M47D20O2	520d	E60	1995	120/163	340	DDE604	3/06	9/07
M47D20O2	520d	E61	1995	120/163	340	DDE604	3/06	9/07
N47D20U0	118d	E87	1995	105/143	300	DDE7.0	3/07	Still current
N47D20O0	120d	E87	1995	130/177	350	DDE7.1	3/07	Still current
N47D20O0	320d	E92	1995	130/177	350	DDE7.1	3/07	Still current
N47D20U0	118d	E87	1995	105/143	300	DDE7.0	5/07	Still current
N47D20O0	120d	E87	1995	130/177	350	DDE7.1	5/07	Still current
N47D20U0	318d	E90	1995	105/143	300	DDE7.0	9/07	Still current
N47D20O0	320d	E90	1995	130/177	350	DDE7.1	9/07	Still current
N47D20U0	318d	E91	1995	105/143	300	DDE7.0	9/07	Still current
N47D20O0	320d	E91	1995	130/177	350	DDE7.1	9/07	Still current
N47D20O0	520d	E60	1995	130/177	350	DDE7.1	9/07	Still current
N47D20O0	520d	E91	1995	130/177	350	DDE7.1	9/07	Still current
N47D20O0	X3 2.0d	E83	1995	130/177	350	DDE7.1	9/07	Still current

BMW diesel engines with two-stage turbocharging

Engine	Model	Series	Cylinder capacity in cm^3	Power in kW/bhp	Torque in Nm	Engine management	First used	Last used
M57D30T1	535d	E60	2993	200/272	560	DDE606	9/04	3/07
M57D30T1	535d	E61	2993	200/272	560	DDE606	9/04	3/07
M57D30T2	335d	E90	2993	210/286	580	DDE626	9/06	Still current
M57D30T2	335d	E91	2993	210/286	580	DDE626	9/06	Still current
M57D30T2	335d	E92	2993	210/286	580	DDE626	9/06	Still current
M57D30T2	X3 3.0sd	E83	2993	210/286	580	DDE626	9/06	Still current
M57D30T2	535d	E46	2993	210/286	580	DDE626	3/07	Still current
M57D30T2	535d	E87	2993	210/286	580	DDE626	3/07	Still current
M57D30T2	X5 3.0sd	E70	2993	210/286	580	DDE626	10/07	Still current

Introduction.
N47 TOP engine.

Top power class

In March 2007, the new generation of four-cylinder diesel engines was launched. These engines, which have been newly developed from scratch, stand out mainly for their significantly higher efficiency by comparison with their predecessors. An increase in power output has been accompanied by a considerable reduction in fuel consumption.

Until now, the N47 engine has been available in a lower power class (N47D20U0) and an upper power class (N47D20O0). From September, these two variants will make way for a Top power class bearing the engine designation N47D20T0.

This Top power class is founded on the Variable Twin Turbo technology debuting in 2004 with the 535d. Two differently sized, sequential turbochargers resolve the trade-off between response and power.

The turbocharging of the N47 TOP engine does not differ from the M57TU1 or M57TU2 TOP engine in how it operates.

The N47 TOP engine performs in the same power class as the M57D30U2 engine but has the advantage of being less heavy, which is best evidenced in the 1 Series. In terms of power output per litre, it even surpasses the 100 bhp/l threshold, which until only recently was a respectable value for motor sports engines.

An overview of innovations, modifications and special features

The following table provides an overview of the modifications to the N47 engine. A distinction is made as to whether a component is new, whether a component or a system has been modified, or whether there is direct similarity with the N47D20O0 engine.

In the text that follows, only the fundamental modifications to the N47D20T0 engine are then described.

Component	New component	Modification	as OL	Remark
Rotational vibration damper	●			A viscous torsional vibration damper is fitted instead of a conventional rubber one. The TVD similarly has a freewheel. Unlike the N47 OL, however, the freewheel is not only fitted to vehicles with manual transmission but also to vehicles with automatic transmission.
Oil supply		●		The oil supply has been expanded with an oil supply and return line for the additional turbocharger.
Charge-air line		●		The charge-air line from the exhaust turbocharger to the charge-air cooler has been adapted to the space available in its installation location.

Component	New component	Modification	as OL	Remark
Intake manifold			●	It is the same intake manifold (with electrically operated swirl flaps), that is also used on the upper power class.
EGR module		●		The EGR valve has been reinforced. Travel feedback discontinued. In vehicles with manual transmission, the EGR cooler has a bypass like the N47D20O0 engine.
Exhaust turbocharger	●			Variable Twin Turbo technology, i.e. two-stage turbocharging with differently sized, sequential turbochargers. The exhaust turbocharger unit is identical to the M57TU1 TOP and M57TU2 TOP engines in its operation. The component itself, however, is of a new construction optimized to the favourable flow properties and smaller space requirement.
DPF	●			The diesel particulate filter is a new component with a greater cross-sectional area for increased flow rate. Its outer shape is identical to that of the N47 OL engine in right-hand-drive vehicles.
DPF sensors		●		Due to the new DPF, the installation locations of the oxygen sensor, exhaust backpressure sensor and exhaust temperature sensor have changed.
Exhaust system	●			The exhaust system is new. Unlike the N47 engine, which has an intermediate and rear silencer, the N47 TOP engine has a front and intermediate silencer.

Component	New component	Modification	as OL	Remark
Vacuum system		●		By comparison with the upper power class, the negative pressure system has been expanded with two electropneumatic pressure converters (EPDW), an electrical changeover valve (EUV) for two-stage turbocharging and a vacuum accumulator.
Fuel system		●		The fuel system is comparable in its layout to that of the upper power class, i.e. with PIEZO injectors. However, the maximum pressure has been increased to 2,000 bar and the system adapted accordingly.
Engine electrical system		●		DDE7.1 is used as it is for the N47D20O0 engine. However, instead of controlling the electric motor of the VNT, it controls the EPDW and the EUV of the turbocharger assembly.
Engine wiring harness		●		Like the negative pressure system, the engine wiring harness has been expanded with the EPDW and the EUV.

Technical data

Designation		N47D20O0	N47D20T0
Type		4 inline	4 inline
Cylinder capacity	[cm^3]	1995	1995
Stroke/bore	[mm]	90/84	90/84
Output at engine speed	[kW/bhp] [rpm]	130/177 4000	150/204 4400
Torque (1st gear) * at engine speed	[Nm] [rpm]	280 1750	400 2000
Torque (remaining) at engine speed	[Nm] [rpm]	350 1750	400 2000
Cutoff speed	[rpm]	4800	5200
Power output per litre	[kW/l]	65.16	75.19
Compression ratio	ε	16.0	16.0
Cylinder gap	[mm]	91	91
Valves/cylinders		4	4
Inlet valve dia.	[mm]	27.2	27.2
Exhaust valve dia.	[mm]	24.6	24.6
Main bearing journal dia. of crankshaft	[mm]	55	55
Big-end bearing journal dia. of crankshaft	[mm]	50	50
Engine management		DDE7.1	DDE7.1
Emissions standard		EURO 4	EURO 4

* Applies only to vehicles with manual transmission.

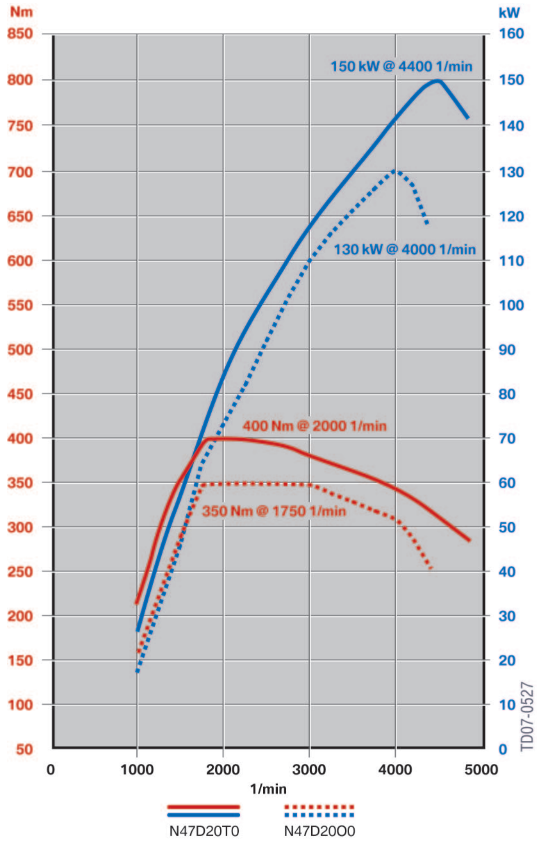
The N47 TOP engine has no torque limitation in first gear because a more powerful transmission is fitted.

Engine	Transmission	Model
N47D20U0	GS6-17DG	I
N47D20O0	GS6-37BZ	H
N47D20T0	GS6-53DZ	G

Full-load diagram

The N47 TOP engine is set apart from the upper power class by a significant increase in overall performance and a beefier torque curve.

In addition, the N47 TOP engine has a wider engine speed range.



1 - Full load diagram of the N47D20T0 by comparison with the N47D20O0 engine

System overview.
N47 TOP engine.

Engine identification

Engine designation

The engine designation is used in the technical documentation for unique identification of engines.

The N47 engine already has the following variants:

- N47D20U0
- N47D20O0.

These are now supplemented by the N47 TOP engine, which bears the engine designation **N47D20T0**.

The technical documentation may also contain the abbreviated form of the engine designation, N47, which only makes it possible to identify the engine model.

This means:

Index	Explanation
N	BMW Group "New generation"
4	4-cylinder engine
7	Direct diesel injection
D	Diesel engine
20	2.0-litre capacity
T	Top power class
0	New development

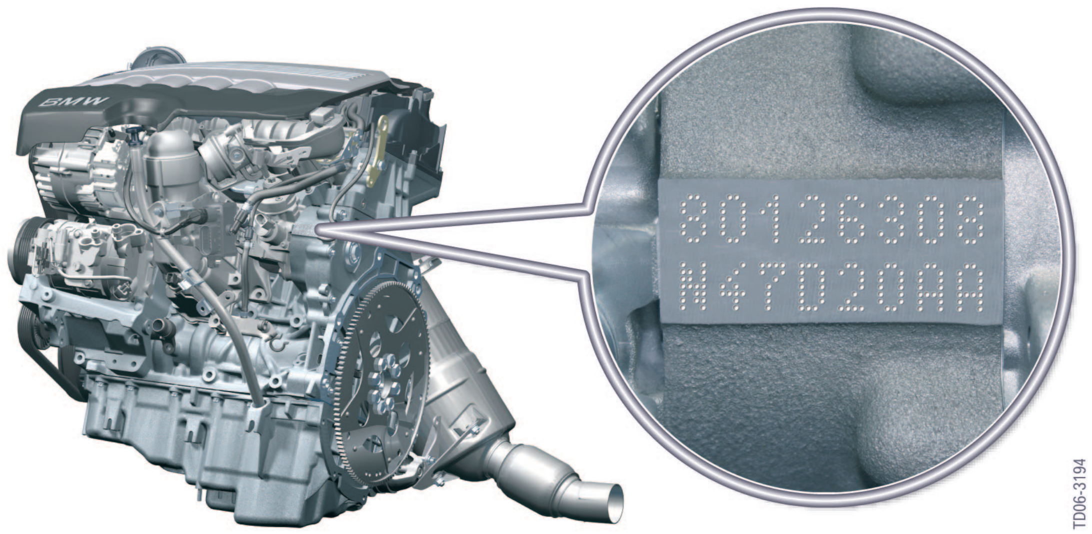
Engine identifier and number

The crankcase of the engine is marked with an identifier for unique identification and assignment of the engine. This engine identifier is also required for approval by the authorities. The first seven positions are relevant here.

With the N47 engine, the engine identifier has, for diesel engines too, been changed so as to comply with the new standard whereby the first six positions are the same as the engine designation. The same applies to the N47 TOP engine.

The engine number is a serial number that makes it possible to uniquely identify any individual engine.

The engine identifier and number are located on the crankcase on the bracket of the high-pressure fuel pump.



1 - Engine identifier and number on the N47 engine

System components.
N47 TOP engine.

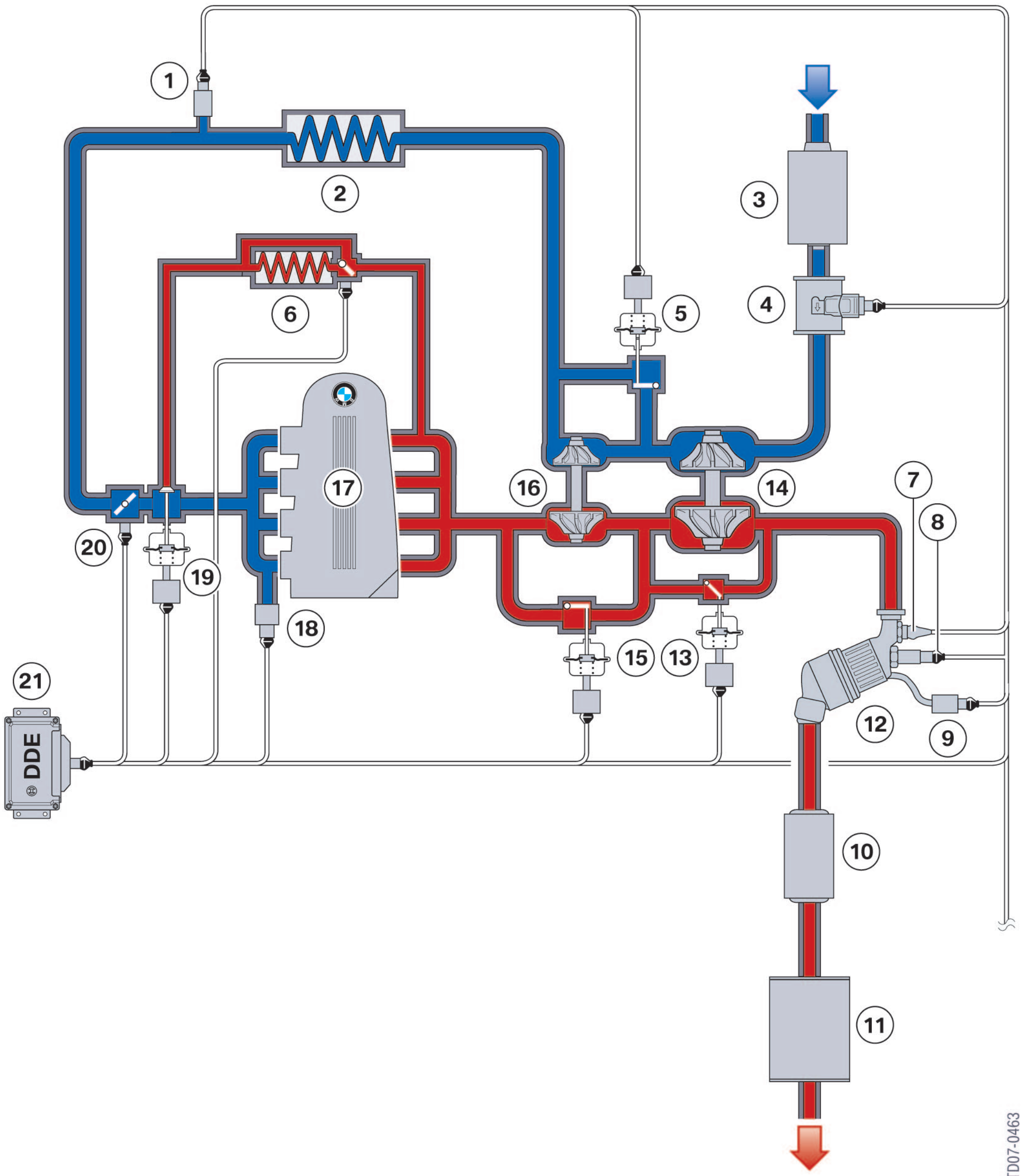
Intake air and exhaust system

The N47 TOP engine is equipped with two-stage turbocharging, which is already a feature of the M57TU TOP and M57TU2 TOP engines. This unit has been optimized to flow properties and space requirements. The rest of the intake air and exhaust system is largely similar to that of the N47D20O0 engine.

One difference in the exhaust system by comparison with the N47 engine is the use of silencers. In this respect, vehicles are equipped differently depending on the engine concerned, as demonstrated by the following table.

	N47	N47 TOP
Front silencer		●
Centre silencer	●	●
Rear silencer	●	

The illustration on the next page provides an overview of the intake air and exhaust system of the N47 TOP engine.



1 - N47 TOP engine intake air and exhaust system

Index	Explanation	Index	Explanation
1	Charge-air temperature sensor	12	Oxidation catalytic converter and diesel particle filter
2	Charge-air cooler	13	Wastegate valve
3	Intake silencer (air cleaner)	14	Low-pressure-stage exhaust turbocharger
4	Hot-film air-mass sensor (HFM)	15	Turbine control valve (also main control valve)
5	Compressor bypass valve	16	High-pressure-stage exhaust turbocharger
6	EGR cooler with bypass valve	17	N47 TOP engine
7	Exhaust temperature sensor	18	Boost-pressure sensor
8	Oxygen sensor	19	EGR valve
9	Exhaust back pressure sensor	20	Throttle valve
10	Front silencer	21	Digital Diesel Electronics
11	Centre silencer		

Exhaust turbocharger

Operating characteristics of a turbocharger

The operating characteristics of a turbocharger are described by a characteristic map. It represents the relationship between pressure and flow rate.

The effective characteristic-map range of the turbocharger is limited by:

- the pumping limit
- the choke line
- the maximum permissible turbocharging speed.

Pumping limit

At insufficient flow rates and excessive pressures, the flow no longer acts on the compressor blades. Pumping is interrupted as a result. Due to the presence of negative pressure on the intake side, the air flows backwards through the compressor until pressure conditions have stabilized and the air reverts to flowing forwards again.

Pressure begins to build up again. The process repeats itself in swift succession. The term "pumping" is derived from the noise thereby produced.

Choke line

The maximum flow rate of the turbocharger is restricted by the cross section at the compressor inlet. Regardless of any increase in speed, the throughput cannot be increased above a specific value. This value is reached when the air in the turbine wheel inlet reaches sonic speed.

Two-stage turbocharging

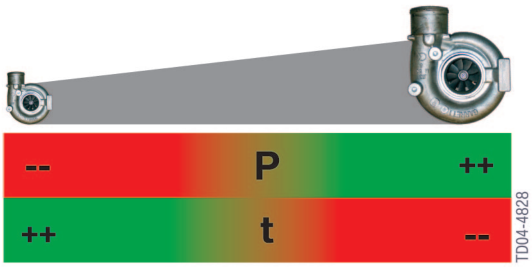
Due to the operating characteristics described above, engineers always face a trade-off arising from the design of the turbocharger.

A small turbocharger responds quickly and delivers beefy torques at low engine speeds. However, the power it is able to deliver is limited because it soon reaches the pumping limit and choke line. While it can generate high pressures, the flow rate is restricted by its size.

A large turbocharger is capable of generating high power output at high engine speeds. It responds slugglishly, however, and is unable to achieve high charge-pressures at low engine speeds.

One solution aiming to resolve this trade-off is the variable turbine geometry (VNT, variable nozzle turbine), which is used in most BMW diesel engines. Thanks to an adjustment of the guide vanes of the turbine wheel, the flow cross section can be adapted to the engine operating point. However, even this system has limits imposed on it, with the effect that not all of the engine's operating range can be optimally exploited.

The optimum solution would be two turbochargers. A small one for rapid response and a large one for delivering maximum power.



2 - Advantages of two-stage turbocharging

Index	Explanation
P	Engine output
t	Response characteristic

And this is precisely what has been realized with the BMW TOP diesel engines. The engine is equipped with two, sequential exhaust turbochargers. A small turbocharger is responsible for the high-pressure stage, a larger turbocharger for the low-pressure stage. Both turbochargers have a rigid turbine geometry without adjustable turbine blades.

Engine	Boost pressure (absolute) [bar]
N47 TOP	3.0
N47	2.6
M57TU TOP	2.85
M57TU2 TOP	2.95

The two turbochargers can be variably combined. This makes it possible to achieve optimum balance for the entire operating range. This type of interaction is realized by the use of various valves.

These are:

- Turbine control valve (exhaust side)
- Compressor bypass valve (air side)
- Wastegate valve (exhaust side).

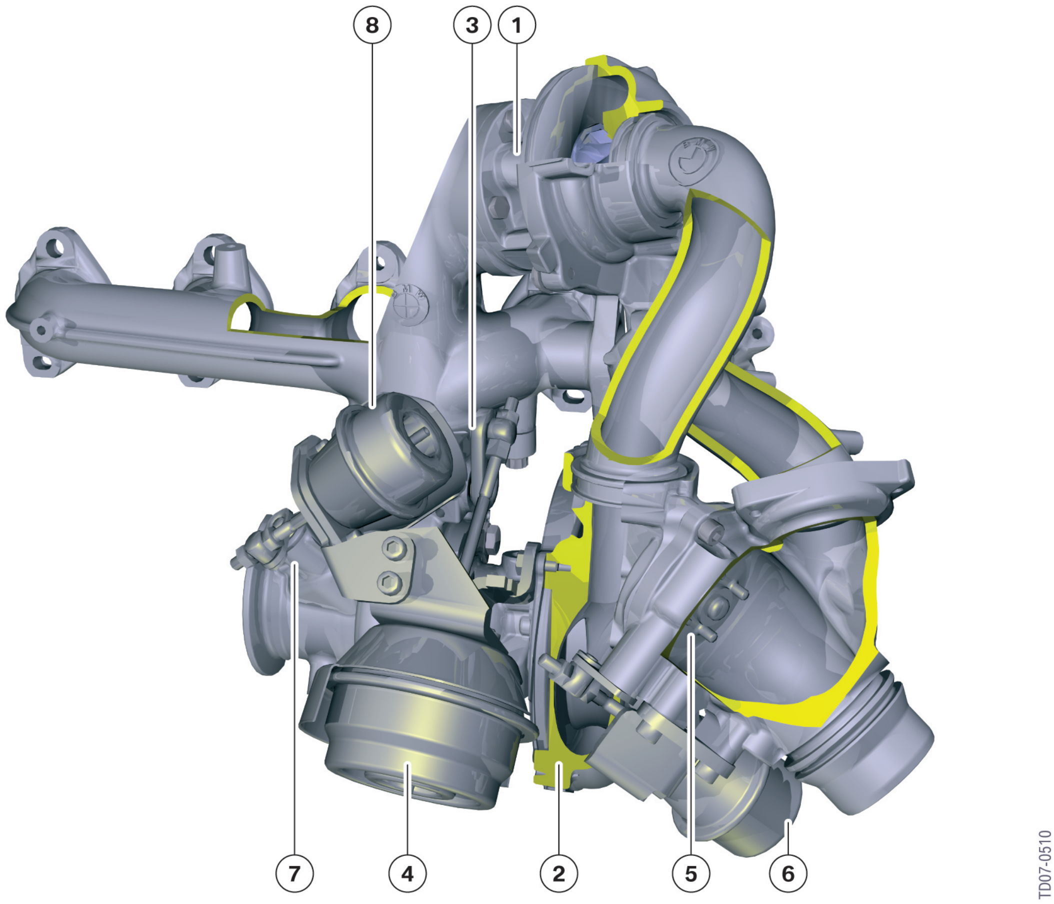
Design in 3D animation

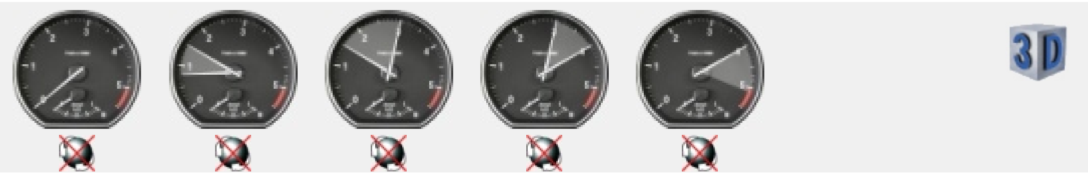
To aid understanding, the design and the flap position are replicated by means of the following animation.

The animation is started by clicking on the graphic with your mouse.

The buttons underneath the graphic can be used to control the flap position as a function of the engine speed range.

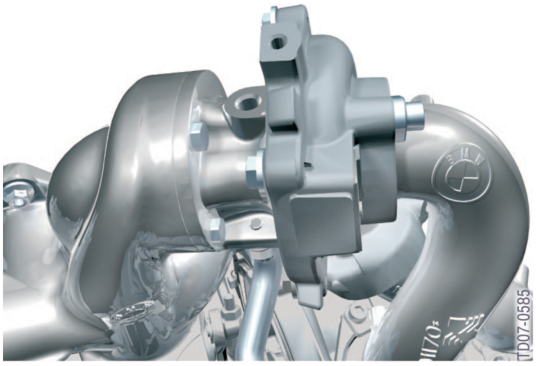
The animation is supported by Adobe Reader version 7.08 or more recent versions.





Index	Explanation	Index	Explanation
1	High-pressure stage	5	Compressor bypass valve
2	Low-pressure stage	6	Vacuum canister for the compressor bypass valve
3	Turbine control valve	7	Wastegate valve
4	Vacuum canister for the turbine control valve	8	Vacuum canister for the wastegate valve

High-pressure stage



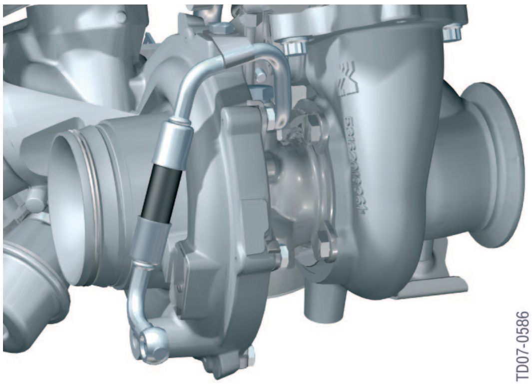
3 - High-pressure stage

The high-pressure stage is the smaller of the two turbochargers. This is known as an "integral manifold" because the housing of the turbocharger and the exhaust manifold are a single, cast component.

The high-pressure stage does not have a flap.

An oil inlet and outlet provide the means for bearing lubrication.

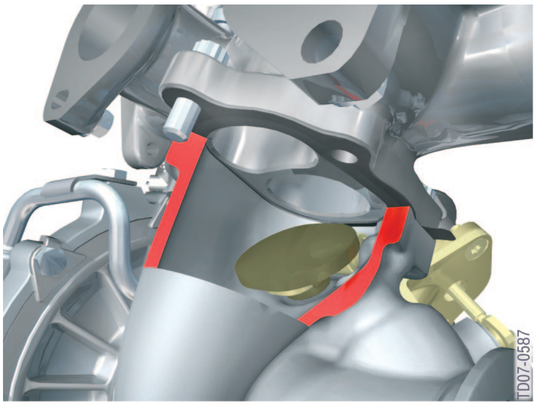
Low-pressure stage



4 - Low-pressure stage

The large turbocharger holds the turbine control valve and the wastegate valve. It is secured to the exhaust manifold and is additionally supported against the crankcase. The low-pressure stage also has a dedicated oil supply for the bearing.

Turbine control valve



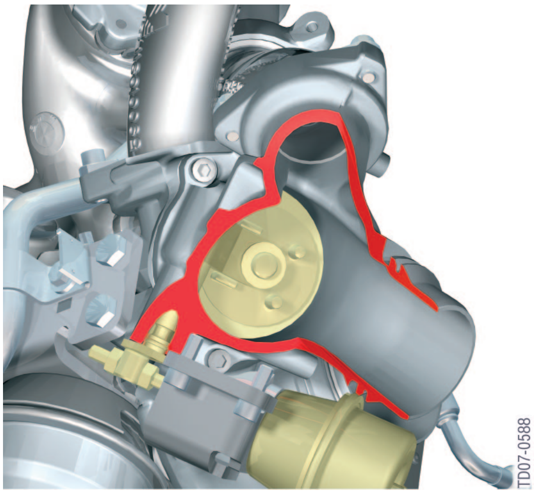
5 - Turbine control valve

The turbine control valve opens a bypass duct on the exhaust side leading to the low-pressure stage (avoiding the high-pressure stage). It is operated pneumatically by a vacuum canister and can be variably adjusted.

An electropneumatic pressure converter (EPDW) introduces a vacuum into the vacuum canister.

The turbine control valve is also known in development as the main control valve.

Compressor bypass valve

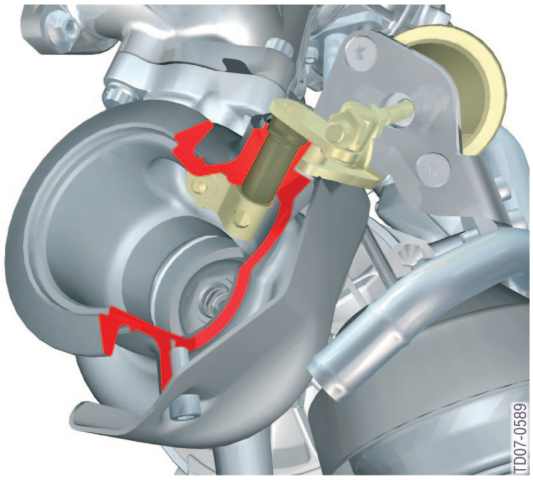


6 - Compressor bypass valve

The compressor bypass valve controls the bypassing of the high-pressure stage on the air-intake side. It is operated pneumatically by a vacuum canister. The compressor bypass valve is either fully opened or completely closed.

An electric changeover valve (EUV) introduces a vacuum into the vacuum canister.

Wastegate valve



7 - Wastegate valve

On reaching the nominal engine output, the wastegate valve opens to prevent high boost and turbine pressures. Some of the exhaust gas is routed through the wastegate valve bypassing the turbine of the low-pressure stage. It is operated pneumatically by a vacuum canister. The wastegate valve can be variably adjusted.

An electropneumatic pressure converter (EPDW) introduces a vacuum into the vacuum canister.

Switch points

The valves are controlled by the DDE for optimum turbocharging over the engine's entire operating range. The switch points are stored in a characteristic map, which mainly covers engine speed and engine load. There is a gradual transition between switch points. In addition, a hysteresis behaviour prevents jittery, back and forth switching at the switch points.

The (highly simplified) illustrations on this fold-out page demonstrate the different switching positions for two-stage turbocharging under full load.

Index	Explanation	Index	Explanation
1	Turbine control valve	4	High-pressure stage
2	Wastegate valve	5	Compressor bypass valve
3	Low-pressure stage		

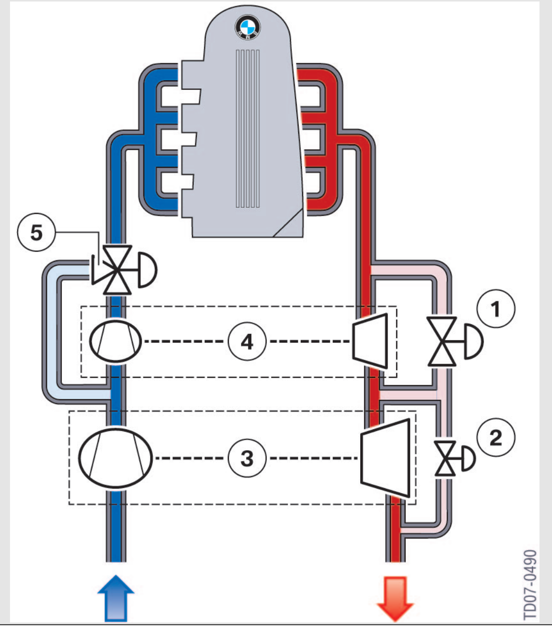
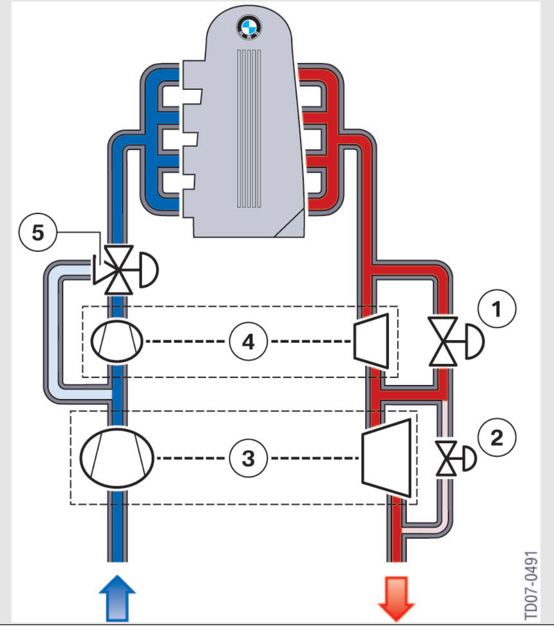
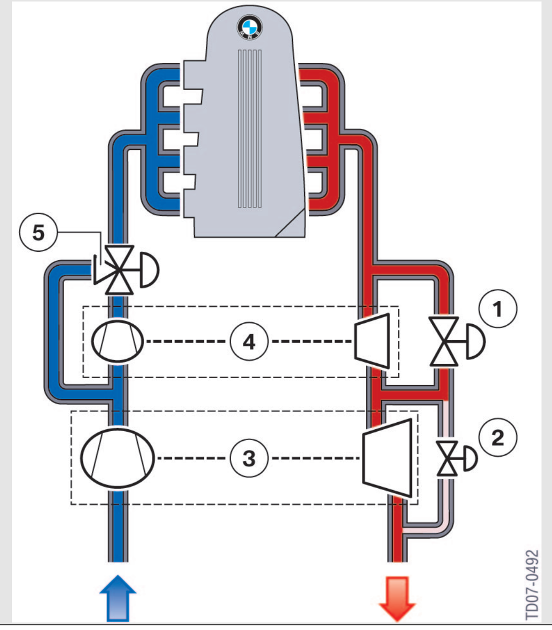
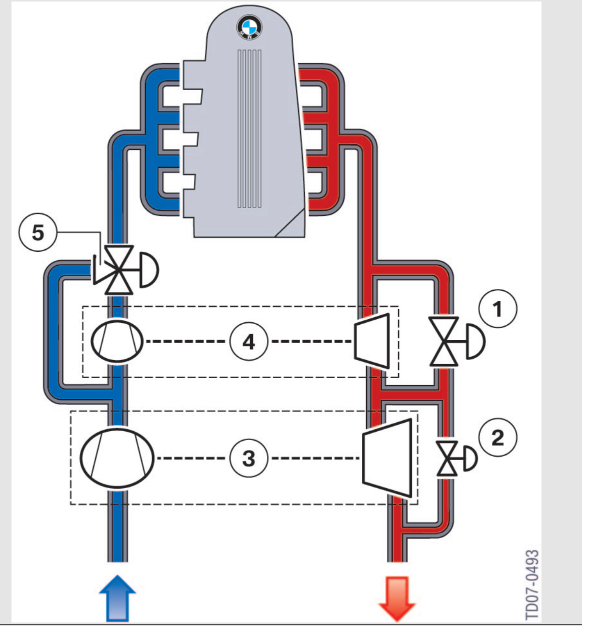
Emergency operation

If the negative pressure system fails, the turbocharger assembly is brought into the following position by spring force:

- Turbine control valve open
- Compressor bypass valve closed
- Wastegate valve closed.

This corresponds to the position for the medium engine speed range (1,500 to 3,000 rpm), i.e. the range in which a diesel engine is operated during normal driving.

While this contradicts the BMW strategy of creating the conditions for maximum output during emergency operation, it does make more sense in this case because the vehicle remains significantly better to drive.

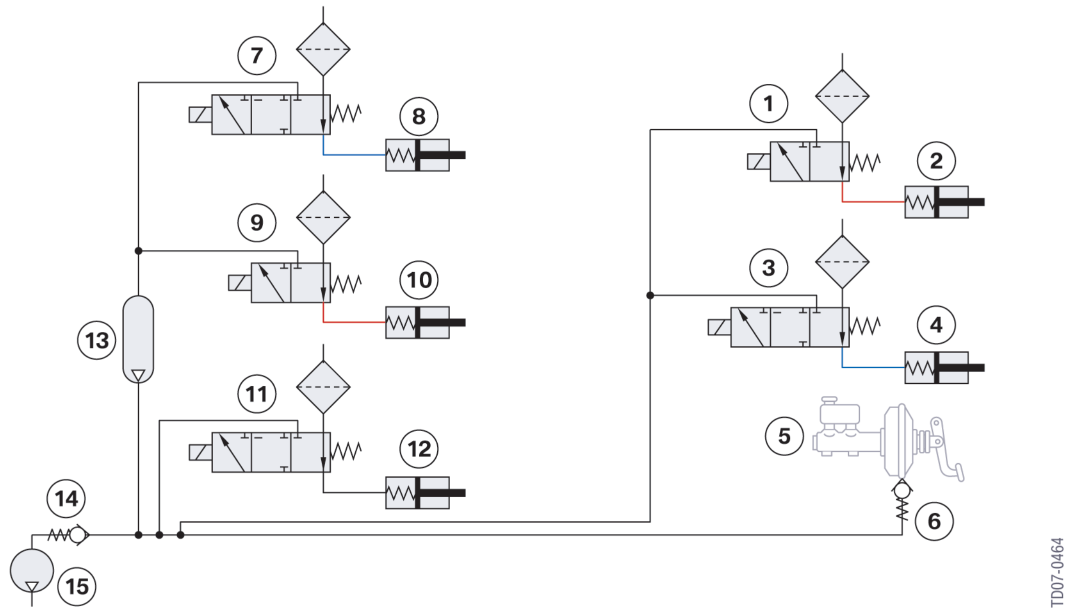
	Lower engine speed range (up to 1,500 rpm)	**Medium engine speed range (1,500 to 3,000 rpm)**	**Upper engine speed range (3,000 to 4,000 rpm)**	**Nominal engine speed range (above 4,000 rpm)**
Valve position	• Turbine control valve closed • Compressor bypass valve closed • Wastegate valve closed.	• The turbine control valve opens continuously with increasing engine speed. • Compressor bypass valve closed • Wastegate valve closed.	• Turbine control valve open • Compressor bypass valve open • Wastegate valve closed.	• Turbine control valve open • Compressor bypass valve open • Wastegate valve opens with increasing engine speed.
Description of turbocharging	The exhaust flow is directed via the turbine wheels in both the high-pressure and low-pressure stage. At this low engine speed, the high-pressure stage is predominant; it turbocharges the engine. The low-pressure stage idles.	More and more exhaust gas bypasses the high-pressure stage with increasing engine speed. In this engine speed range, both stages turbocharge the engine. The higher the engine speed, the more exhaust gas is delivered to the low-pressure stage.	Most of the exhaust gas bypasses the high-pressure stage. The charge air bypasses the compressor of the high-pressure stage. The engine is turbocharged by the low-pressure stage only.	Most of the exhaust gas bypasses the high-pressure stage. Some of the exhaust gas also bypasses the low-pressure stage. The charge air still bypasses the compressor of the high-pressure stage. The engine is turbocharged by the low-pressure stage only. The turbine speed and thus the boost pressure are limited.
Operating characteristics of the turbochargers	The high-pressure stage is operating in its optimum operating range.	The high-pressure stage reaches the pumping limit in this range. The turbine control valve acts like a wastegate for the high-pressure stage. However, the exhaust gas that is diverted does not go unused: it is channelled into the normal exhaust gas upstream of the low-pressure stage.	The high-pressure stage has reached the choke line; air is therefore diverted past it. If this were not to happen, the possible flow rate of the charge air would be limited. The low-pressure stage is operating in its optimum operating range.	In this range, the low-pressure stage also reaches its pumping limit. Surplus exhaust gas is therefore diverted through the wastegate valve.
Graphical illustration				

Negative pressure system

The negative pressure system of the N47 engine has been expanded with the following components for control of the turbocharger assembly:

- Vacuum canisters for:
  - Turbine control valve
  - Compressor bypass valve
  - Wastegate valve
- Electropneumatic pressure converters for:
  - Turbine control valve
  - Wastegate valve
- Electropneumatic changeover valve for the compressor bypass valve
- Vacuum accumulator.

The rest of the negative pressure system remains unchanged from the N47D20O0 engine.



8 - N47 TOP engine negative pressure system

Index	Explanation	Index	Explanation
1	Electropneumatic changeover valve (EUV)	9	Electropneumatic changeover valve
2	EGR bypass valve vacuum canister	10	Compressor bypass valve vacuum canister
3	Electropneumatic pressure converter (EPDW)	11	Electropneumatic pressure converter
4	EGR valve vacuum canister	12	Wastegate valve vacuum canister
5	Brake force amplifier	13	Vacuum accumulator
6	Non-return valve	14	Non-return valve
7	Electropneumatic pressure converter	15	Vacuum pump
8	Turbine control valve vacuum canister		

There are throttles at the branch-off point from the main negative-pressure line to the consumers. All branch-off lines in use have a throttle with a diameter of 0.8 mm. A branch-off line with a diameter of 0.5 mm is not used and is sealed with a rubber cap.

The supply lines from the solenoid valves (EUV and EPDW) to the vacuum canisters are identifiable as coloured, woven hoses.

Component	Colour
Turbine control valve	blue
Compressor bypass valve	red
Wastegate valve	black
EGR bypass valve	red
EGR valve	blue

Electropneumatic pressure converter (EPDW)

In addition to the EGR valve, the N47 TOP engine is equipped with electropneumatic pressure converters for controlling the turbine control valve and the wastegate valve.

From the negative pressure in the system and ambient pressure, the EPDW generates a pilot pressure (mixed pressure) to which the vacuum canister is then subjected. This produces an adjustment range of infinite variability between open and closed. The DDE delivers the electric signal that governs the pilot pressure set.

The turbine control valve and the wastegate valve are therefore infinitely adjustable.

Electropneumatic changeover valve (EUV)

In addition to the electropneumatic changeover valve for the EGR bypass valve, there is also another for the compressor bypass valve.

Unlike the EPDW, there is no pilot pressure present here; rather, it is simply a case of the negative pressure in the system being forwarded to the vacuum canister.

The position of the compressor bypass valve is not variable; it is either open or closed.

Vacuum accumulator

A new feature that was not part of the N47 engine is the vacuum accumulator. This ensures that the turbine control valve and the compressor bypass valve can continue to be controlled in the event of a collapse in vacuum in the system. If this were not the case, an immediate drop in engine power output would be felt.

A collapse in vacuum in the negative pressure system can occur when the brake force amplifier consumes too much negative pressure. To this end, the vacuum accumulator is equipped with a non-return valve that prevents the release of negative pressure towards the brake force amplifier.

Without this vacuum accumulator, the vacuum pump would have to be dimensioned significantly larger. With this solution, there would still be sufficient negative pressure for controlling the turbocharger assembly when the brake force amplifier were operating at maximum. However, the capacity of a pump like this is only ever needed in very rare cases. A vacuum accumulator is therefore a more efficient means of meeting the highest demands for negative pressure.

Fuel system

The fuel system layout of the N47 TOP engine is identical in principle to that of the N47 OL engine, the difference being, however, the maximum pressure (nominal pressure) of the high-pressure system.

Engine	Nominal pressure [bar]
N47D20U0	1,600
N47D20O0	1,800
N47D20T0	2,000

The high-pressure system of the N47 TOP engine is therefore equipped with a number of modified components, which operate in the same way but have been adapted to cope with the higher pressures. In detail, these are:

- High-pressure pump
- High-pressure accumulator (rail)
- Pressure regulating valve
- Rail-pressure sensor
- Fuel injectors.

High-pressure pump

Like the N47 OL engine, the N47 TOP engine has a CP4.1 high-pressure pump. It has the same layout, but in the case of the N47 TOP engine delivers a higher maximum pressure of 2,000 bar. This was effected by a change in setpoint values.

Due to its higher load, the high-pressure pump's fatigue strength has been subject to improvement. It therefore has the designation CP4.1H.

High-pressure accumulator with pressure regulating valve and rail-pressure sensor

The high-pressure accumulator including pressure regulating valve and rail-pressure sensor have been reinforced to cope with the increased pressure conditions.

The rail-pressure sensor has also had its sensor characteristic curve adapted accordingly. This sensor will be used in all N47 engines from September 2007.

Fuel injectors

The N47 TOP engine has new injectors (CRI3.3 instead of CRI3.2), which are identical in their operation but have been adapted to the higher pressure conditions. These injectors also have a modified nozzle for higher flow rates.

Test questions.
N47 TOP engine.

Questions

Consolidate and recheck what you have learned.

In this section, you have the opportunity to check what you have learned.

You will be asked questions on the subject of the N47 TOP engine presented here.

1. **What is the maximum pressure of the common-rail system in the N47 TOP engine?**

☐ 1,600 bar
☐ 1,800 bar
☐ 2,000 bar.

2. **In which order do the valves of the turbocharger assembly open with increasing engine speed?**

☐ Compressor bypass valve → Turbine control valve → Wastegate valve
☐ Wastegate valve → Compressor bypass valve → Turbine control valve
☐ Turbine control valve → Compressor bypass valve → Wastegate valve
☐ Turbine control valve → Wastegate valve → Compressor bypass valve.

3. **Which of the valves of the turbocharger assembly are closed in unactuated condition (negative pressure system at zero pressure)?**

☐ Compressor bypass valve
☐ Wastegate valve
☐ Turbine control valve.

4. **Which of the valves of the turbocharger assembly are operated by an electropneumatic changeover valve?**

☐ Compressor bypass valve
☐ Wastegate valve
☐ Turbine control valve.

Check it!

Answers to the questions

1. What is the maximum pressure of the common-rail system in the N47 TOP engine?

☐ 1,600 bar
☐ 1,800 bar
☑ 2,000 bar.

2. In which order do the valves of the turbocharger assembly open with increasing engine speed?

☐ Compressor bypass valve → Turbine control valve → Wastegate valve
☐ Wastegate valve → Compressor bypass valve → Turbine control valve
☑ Turbine control valve → Compressor bypass valve → Wastegate valve
☐ Turbine control valve → Wastegate valve → Compressor bypass valve.

3. Which of the valves of the turbocharger assembly are closed in unactuated condition (negative pressure system at zero pressure)?

☑ Compressor bypass valve
☑ Wastegate valve
☐ Turbine control valve.

4. Which of the valves of the turbocharger assembly are operated by an electropneumatic changeover valve?

☑ Compressor bypass valve
☐ Wastegate valve
☐ Turbine control valve.

Bayerische Motorenwerke Aktiengesellschaft
BMW Group Trainingsakademie
Aftersales Training
Röntgenstraße 7
D-85716 Unterschleißheim
Germany