12

Eure!TechFLASH

THE UP-TO-DATE TECHNICAL INSIGHT IN AUTOMOTIVE TECHNOLOGY & INNOVATIONS

EDITION 12

Engine downsizing technology (Ecoboost)

IN THIS ISSUE

EureTechFlash is an AD International publication (www.ad-europe.com)

Download all EureTechFlash editions at www.eurecar.org

INTRODUCTION

Downsizing technology

Downsizing refers to the concept of miniaturisation and optimisation of the performance of an engine to give it similar or superior characteristics to that of engines of a larger cubic capacity. Moreover, this technique reduces the pollutant emission levels to the atmosphere and fuel consumption is improved.

Over recent years, practically all manufacturers have started to use downsizing technology. Through engineering, the thermal efficiency of internal combustion engines has been improved to such an extent that they can be designed with a much smaller size while maintaining, or even exceeding, the performance of much larger engines.

By combining a reduction in the number of cylinders and/or the cylinder capacity, with the addition of various systems such as direct fuel injection, forced induction, variable valve timing, variable valve lift, variable intake, intelligent heat management, etc., brands are capable of building high-power engines, the majority of which are no larger than 1600 cm³ and have less than four cylinders.

Even though downsizing is focused on petrol engines, it has also been applied to diesels, with the emergence of what are called modular architectures; smaller petrol and diesel engines with similar characteristics are built on the same base and share a large number of elements, thus reducing the cost and reliability problems the manufacturers have experienced.

Engine manufacturers with downsizing technology

Many car manufacturers have used downsizing technology in one of their engines. Below there is a non exhaustive table which lists the main engines of this type:

Brand	Model	Commercial name	Number of cylinders	Cylinder capacity	Power output
Audi	A1	TFSI	3	999 cm³	70 kW/95 HP
	A3, Q2	TFSI	3	999 cm³	85 kW/115 HP
BMW	Series 1	TwinPower Turbo	3	1.499 cm³	80 kW/109 HP
	Series 1, Series 2, Series 3	TwinPower Turbo	3	1.499 cm³	100 kW/136 HP
	i8	TwinPower Turbo	3	1.499 cm³	170 kW/231 HP
Citroën	C3, C3 Aircross, C3 Picasso, C4, C4 Cactus, C4 Picasso	PureTech	3	1.199 cm³	81 kW/110 HP
	C3 Aircross, C4, C4 Picasso, Grand C4 Picasso	PureTech	3	1.199 cm³	96 kW/131 HP
Ford	Fiesta, B-MAX, C-MAX, Grand C-MAX, Tourneo Courier, Tourneo Connect	EcoBoost	3	998 cm³	74 kW/100 HP
	Fiesta, B-MAX, EcoSport, C-MAX, Grand C-MAX, Mondeo	EcoBoost	3	998 cm³	92 kW/125 HP
	Fiesta, EcoSport	EcoBoost	3	998 cm³	103 kW/140 HP

MINI	One	TwinPower Turbo	3	1.198 cm³	75 kW/102 HP
	One First	TwinPower Turbo	3	1.198 cm³	55 kW/75 HP
Opel	Astra	ECOTEC Turbo	3	999 cm³	77 kW/105 HP
	Crossland X	ECOTEC Turbo	3	1.199 cm³	81 kW/110 HP
	Crossland X, Grandland X	ECOTEC Turbo	3	1.199 cm³	96 kW/131 HP
Peugeot	208, 308, 2008, Partner Tepee	PureTech	3	1.199 cm³	81 kW/110 HP
	308, 2008, 3008, 5008	PureTech	3	1.199 cm³	96 kW/131 HP
SEAT	Ibiza	EcoTSI	3	999 cm³	70 kW/95 HP
	Ibiza	EcoTSI	3	999 cm³	81 kW/110 HP
	Ibiza, Ateca	EcoTSI	3	999 cm³	85 kW/115 HP
Škoda	Spaceback, Rapid	TSI	3	999 cm³	70 kW/95 HP
	Spaceback, Rapid	TSI	3	999 cm³	81 kW/110 HP
	Octavia, Karoq	TSI	3	999 cm³	85 kW/115 HP
Volkswagen	Up!	TSI	3	999 cm³	66 kW/90 HP
	Golf	TSI	3	999 cm³	81 kW/110 HP

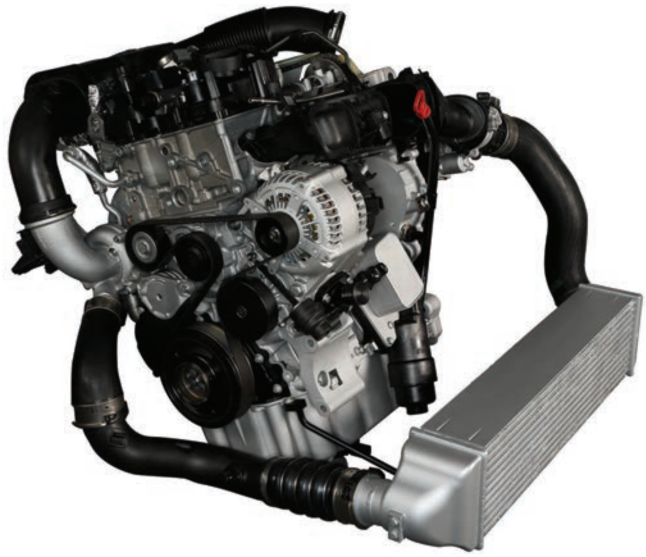
General characteristics per manufacturer

BMW-MINI

The BMW group has a family of downsized engines that covers both diesel and petrol, called **EfficientDynamics**. As a result of the modular construction strategy, all the engines, except the six-cylinder diesels, share up to 60 % of their parts.

The term TwinPower Turbo refers to the German company's engine technology that allows it to meet the requirements of this category. It combines the latest injection systems with forced induction (direct high-pressure injection and dual inlet turbocharger in the petrol engines, and common rail injection of up to 2000 bar and variable geometry turbocharger in the diesel engines), double VANOS variable valve timing and, in practically all the versions, the Valvetronic valve variable lift system.

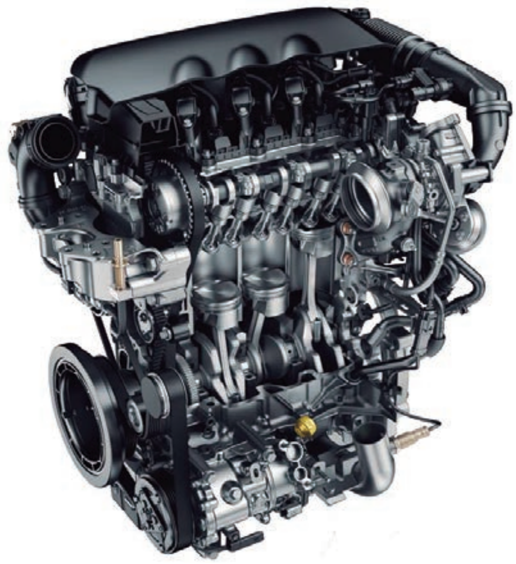
As a result of the technical innovations adopted by the brand, there are petrol or diesel options of three cylinders with various power outputs, starting from the MINI One 55 kW, 1.2 cm³ petrol engine, up to 170 kW supplied by the BMW model i8 hybrid engine, which combines a petrol engine of 1500 cm³ with an electric motor for a total of 266 kW. The cylinder block is always aluminium and the closed-deck type, and a balancer shaft is fitted to reduce vibrations.



PSA Group

It produces three-cylinder downsized petrol engines, called **PureTech**. Thanks to its modular design, there are two versions, one naturally aspirated and one turbocharged, the latter using 40 % of the components of the former. The turbocharged engine is equipped with high pressure direct injection at 200 bar and variable intake and exhaust camshaft timing. The low inertia turbocharger is capable of rotating at 240,000 rpm, providing 95 % of the torque from 1500 to 3500 rpm.

All the PureTech engines are 1.2 litre, with power outputs of 50 and 60 kW for those that do not have a turbocharger, and 81 and 96 kW for those that are turbocharged. One of the mechanical innovations to note is the special coating on the pistons, rings and tappets, known as DLC (Diamond Like Carbon). The crankshaft is offset 7.5 mm with respect to the vertical axis of the cylinders, with the purpose of achieving the most uniform wear possible of the sleeves, and the timing belt is bathed in oil. These solutions achieve a 30 % reduction in friction compared with conventional engines. Moreover, the oil pump is managed electronically to regulate the flow and the cooling system consists of a double circuit (one for the cylinder head and another for the block). The exhaust manifolds are oversized and integrated into the engine, so the operating temperature can be reached quickly.



Opel

The Opel Turbo **ECOTEC** engines also have a modular architecture, the smallest is a 77 kW, 1 litre, three-cylinder, and the most powerful is a 147 kW, 1.6 litre four-cylinder. The key technologies are: direct petrol injection, forced induction by turbocharger, continuously variable timing and an engine block manufactured in lightweight aluminium.

The injectors are six-hole and are located centrally in the chambers for efficient combustion, while optimum engine breathing is obtained by means of variable valve timing.

The exhaust manifold is integrated into the cylinder head that, at the same time, is located very close to the low inertia turbocharger. This configuration makes fast engine loading possible to deliver high power, for this reason the maximum torque of 166 Nm, available from 1800 rpm, is nearly 30 % higher than in the 1.6 litre naturally aspirated engine at the same rpm, and combustion efficiency is also 20 % higher.

The water pump is switchable, it uncouples when the engine coolant is cold to accelerate heating, and the oil pump is electronically managed to regulate the pressure, both these systems contribute to low fuel consumption. To refine the engine, a balancer shaft is installed in the oil sump, this rotates at the same speed as the crankshaft and its mass is optimised to counteract the vibrations of the three-cylinder engines.

Volkswagen Group

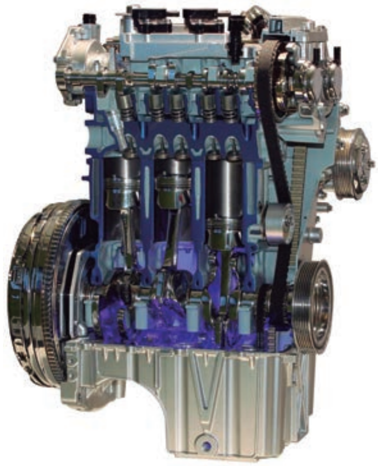
This manufacturer is a pioneer in the development of downsized engines, after launching onto the market the 1.4 **TSI** direct petrol injection and twin-charged engine (fixed geometry turbocharger and supercharger). The range is made up of 1000, 1200 and 1400 cm³ engines, all with direct injection and forced induction (currently by means of a single turbocharger). There are different power levels depending on the version, the 1.0 TSI has three cylinders and develops 66, 70, 81 or 85 kW - basically depending on the turbocharger pressure - and the most powerful is a 1.4 litre and 110 kW four-cylinder engine.

The incorporation of the heat exchanger inside the intake manifold reduces the total volume of the boost pressure circuit, prevents the pressure dropping and maintains a high-power delivery at high engine speeds, in spite of using a small turbocharger. The smaller turbine diameter facilitates its acceleration when the speed of the exhaust gases in the manifold is very low, this means that the highest torque possible is available in the low speed ranges which are most used.

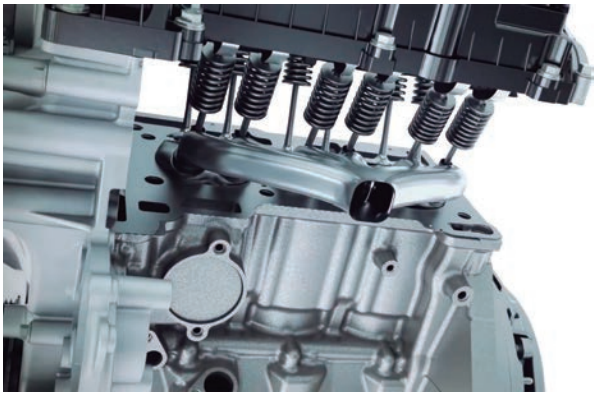
The high-torque that these engines offer, higher than 200 Nm in the case of the most powerful, is compensated by the injection pressure of up to 250 bar, which achieves a saving of up to 6 % in fuel consumption with respect to the previous 1.2 TSIs. The adjustable flow oil pump also contributes to this, as it continually adjusts the pressure required to the engine load conditions.

ECOBOOST ENGINE TECHNOLOGY

The Ford technicians have managed to achieve a 20 % improvement in fuel consumption and 15 % in the level of CO2 emissions. This has been largely possible through the engine design and the adoption of three key technologies, which are: direct petrol injection, turbo-charging and variable valve timing in the intake and exhaust phases. Two three-cylinder **EcoBoost** variants can be found on the market; they are both 1.0 litre, but have different power outputs.



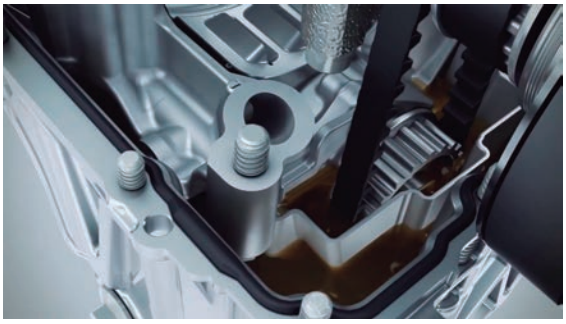
The majority of EcoBoost engine blocks are aluminium, a material that provides a significant weight reduction. The weight of the crankshaft has been optimised to eliminate engine vibration, thus avoiding the fitting of a balancer shaft. As there is no shaft, a vibration damper-pulley is used with a compensating mass. Furthermore, low friction coatings have been applied, for example on the pistons, to refine the engine operation.



In addition, the exhaust manifold is integrated into the cylinder head, this arrangement lightens the weight of the assembly and reduces exhaust pipe temperatures, which allows a stoichiometric ratio of the air-fuel mixture throughout the engine map.

The cooling system is equipped with an independent mini-circuit, apart from the main small and large circuits. Through this, it circulates the coolant for the first stage of the heating phase only. This helps to rapidly heat the engine and the oil for the early reduction of friction between the lubrication points.

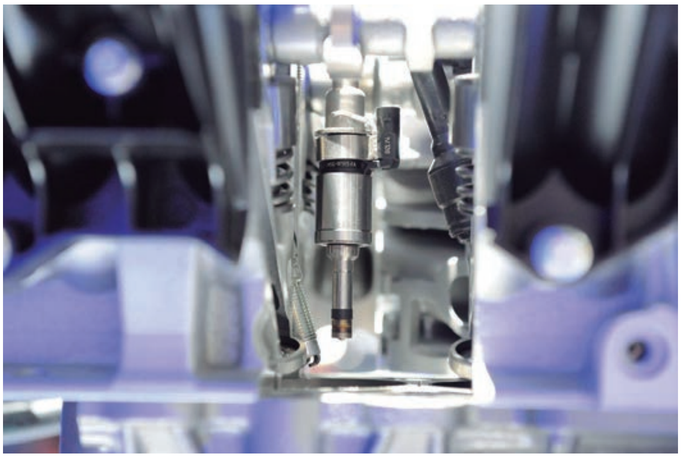
The timing belt is bathed in engine oil. This reduces the friction losses by approximately 20 %, thus improving fuel consumption and carbon dioxide emissions. Furthermore, this also minimises noise and guide rails are not necessary.



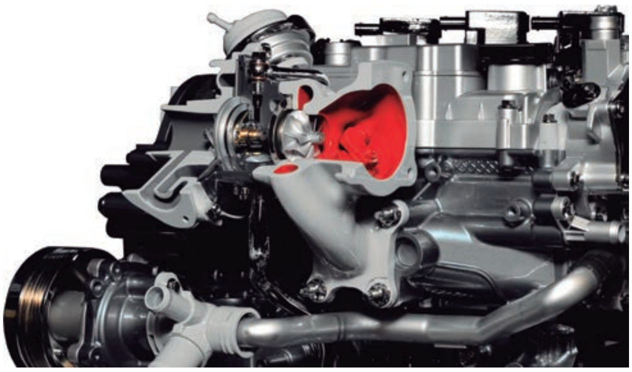
The independent variable camshaft timing for intake and exhaust helps to optimise the gas flow through the combustion chamber at all engine speeds, which reduces the force exerted by the piston. This system also improves smoothness at idling speed, increases torque and power at low and high speed, reduces turbocharger lag and saves fuel.

Direct fuel injection provides better engine cooling, precise combustion of the mixture in the cylinders and less knocking.

This technology is known as SIDI (Spark Ignited Direct Injection). The petrol is injected in drops smaller than 0.02 mm directly into the cylinders at high pressure of up to 200 bar, this reduces emissions especially during start-up, increases compression, saves fuel and increases engine power. Multiple injection by combustion cycle is also possible, which improves consumption and emissions.



The very small, low inertia turbocharger is capable of rotating at more than 200,000 rpm, to lessen the lag effect.



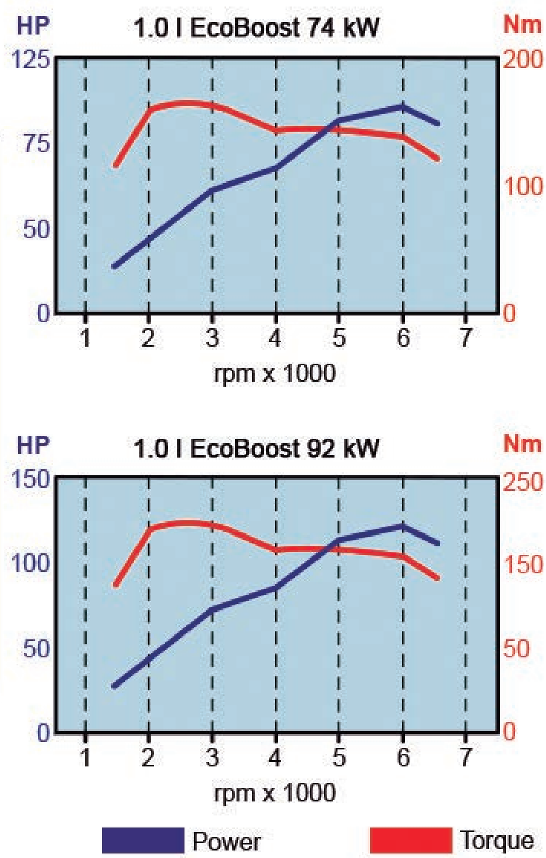
Also, it has been manufactured together with the exhaust manifold to form a single part, this facilitates heat dissipation and reduces the weight of the assembly. The turbocharger can reduce fuel consumption by up to 14 %.

THREE-CYLINDER ENGINE

Technical characteristics

This engine is petrol, three cylinder and 1000 cm³, and was developed by Ford. It has a double overhead camshaft, 12 valves, a Bosch MED 17.0.1 direct injection system, twin independent variable camshaft timing, Ti-VCT, and forced induction by turbocharger. There are two versions with the same structure but different power outputs, which depend on the programming variations of the injection and ignition management, and on the boost pressure of the turbocharger.

Engine	1.0 l EcoBoost 74 kW	1.0 l EcoBoost 92 kW
Engine code	SFJA/SFJB/M2DA	M1JA/M1JE/M1DA
Power output (kW-HP/rpm)	74-100/6000	92-125/6000
Max engine torque (Nm/rpm)	170/1500-4500	200/1400-4500
Max speed (rpm)	6675	6675
Cylinder diameter (mm)	71.9	71.9
Stroke (mm)	81.9	81.9
Cylinder capacity (litres)	998	998
Compression ratio	10 to 1	10 to 1
Firing order	1-2-3	1-2-3
Exhaust gas emissions standard	Euro 5	Euro 5
Injection system	Motronic	Motronic
Supplier	Bosch	Bosch
Type	MED 17.0.1	MED 17.0.1



Engine block, moving parts and cylinder head

Engine block

It is manufactured in grey cast iron using the open deck construction method, which makes manufacture more straightforward as the cylinder cooling ducts are open at the top.
The side walls of the block are reduced in thickness, in a way that does not reduce their effectiveness when it is reinforced. Thanks to these measures, a significant reduction in weight is achieved with high rigidity.

Oil sump

It is manufactured in an aluminium alloy. It has a solid rib that also forms the bottom flange of the joint with the gearbox; this achieves a rigid engine and gearbox assembly. It includes two guide pins for the exact alignment of the engine block surfaces and the oil sump.

Crankshaft

This consists of 4 support points and is fixed to the engine block by means of bearing caps. The three crank pins that fasten the connecting rods are offset at 120° from each other.

The side adjustment of the crankshaft is by means by two thrust bearings, which float on the top bushing of the bearing of support point number 3.

Connecting rods

The small end has a snake head profile, the bearing surface with the gudgeon pin is by means of a press-fitted grooved bronze bushing, the big end is fracture-split and the bearings are smooth without positioning projection.

Pistons

The pistons are manufactured in a light aluminium and silicon alloy. There are pockets for the valves in the head and a combustion chamber. The skirt is graphite coated to reduce friction with the cylinder.

Cylinder head

It is manufactured in a light metal alloy. The spark plugs and injectors, positioned vertically, are housed at the top. The exhaust manifold is part of the cylinder head, and cannot be replaced separately. A multi-layer steel gasket ensures the cylinder head is sealed.

Camshaft

The intake and exhaust camshafts have phase variators that are operated electro-hydraulically.

The intake camshaft is longer than the exhaust, due to the additional triple cam for driving the high-pressure fuel pump. It has five bearings and the bearing cover on the gearbox side incorporates the housing for the high-pressure pump. This is attached to the cylinder head, and uses a sealant for sealing.

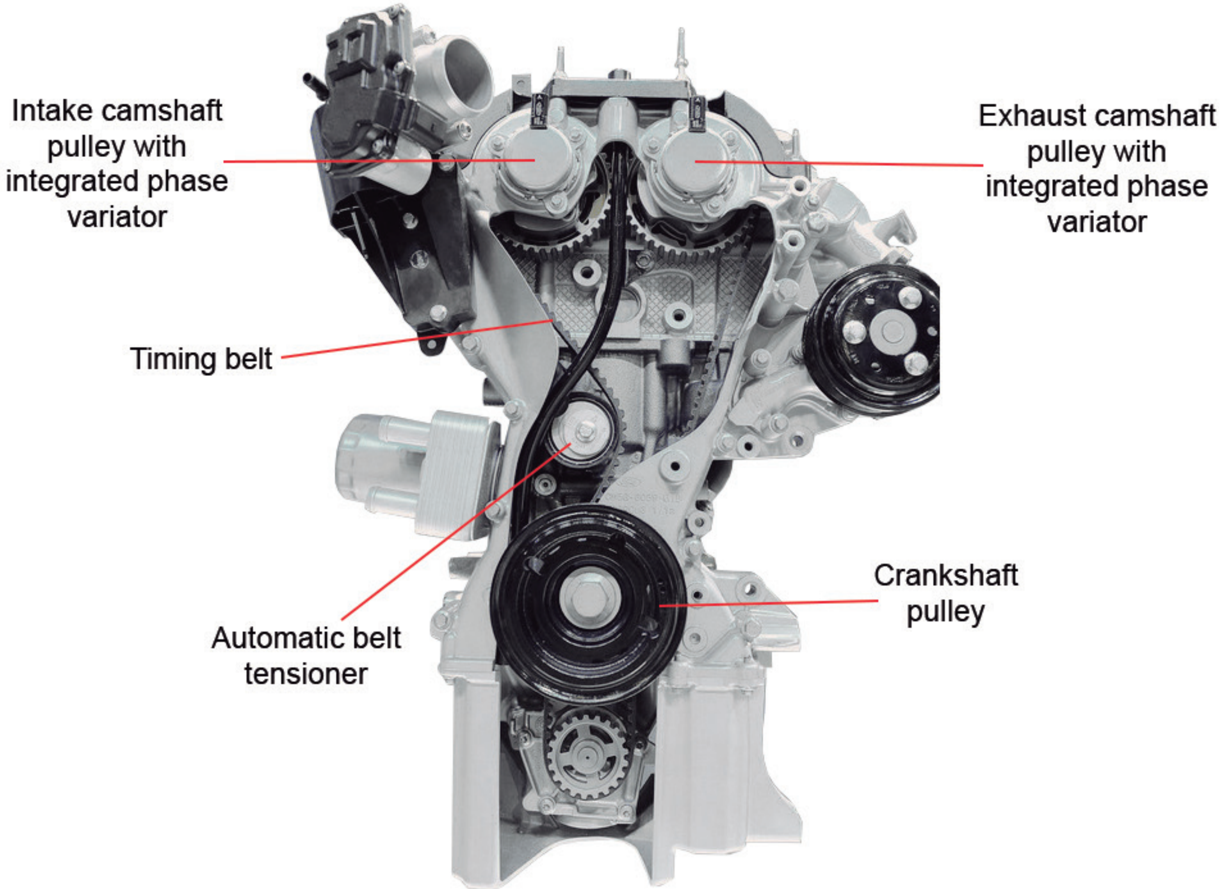
The exhaust camshaft has four bearings and a groove for the vacuum pump drive. Its cover serves as a seal for the cylinder head cover and that of the vacuum pump itself.

Valves

There are two intake valves and two exhaust valves. The intake valves have a larger diameter head and are made from a single piece of material. The exhaust valves are hollow and their cavity is filled with sodium, a material that has good thermal conductivity, so that the temperature in the head of the valve can be reduced to around 100 °C. The valves are driven by mechanical hollow tappets.

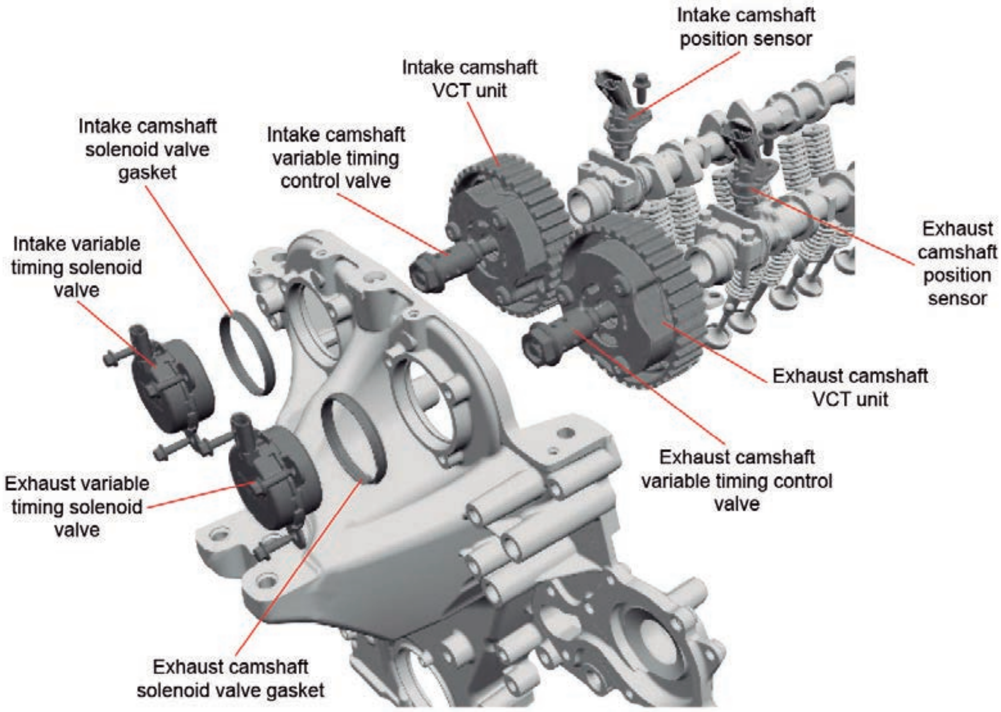
The timing is by belt-in-oil with an automatic tensioner

The timing is by belt-in-oil with an automatic tensioner.



Variable valve-timing

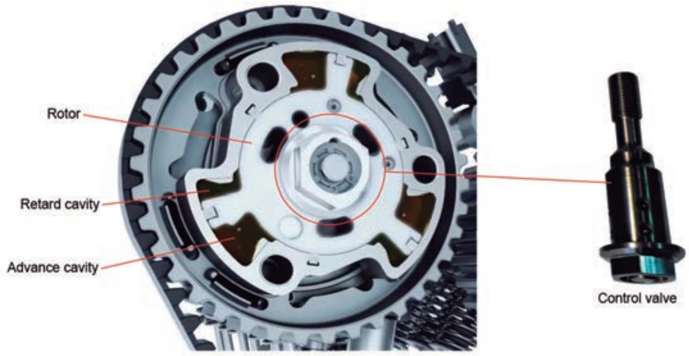
This system has electro-hydraulically actuated twin variable camshaft timing, which allows the variable timing of each camshaft to be independent. For this, each camshaft is equipped with a VCT unit. These are differentiated by the lock position - in the retard position for the intake and in the advance position for the exhaust.



Phase variators

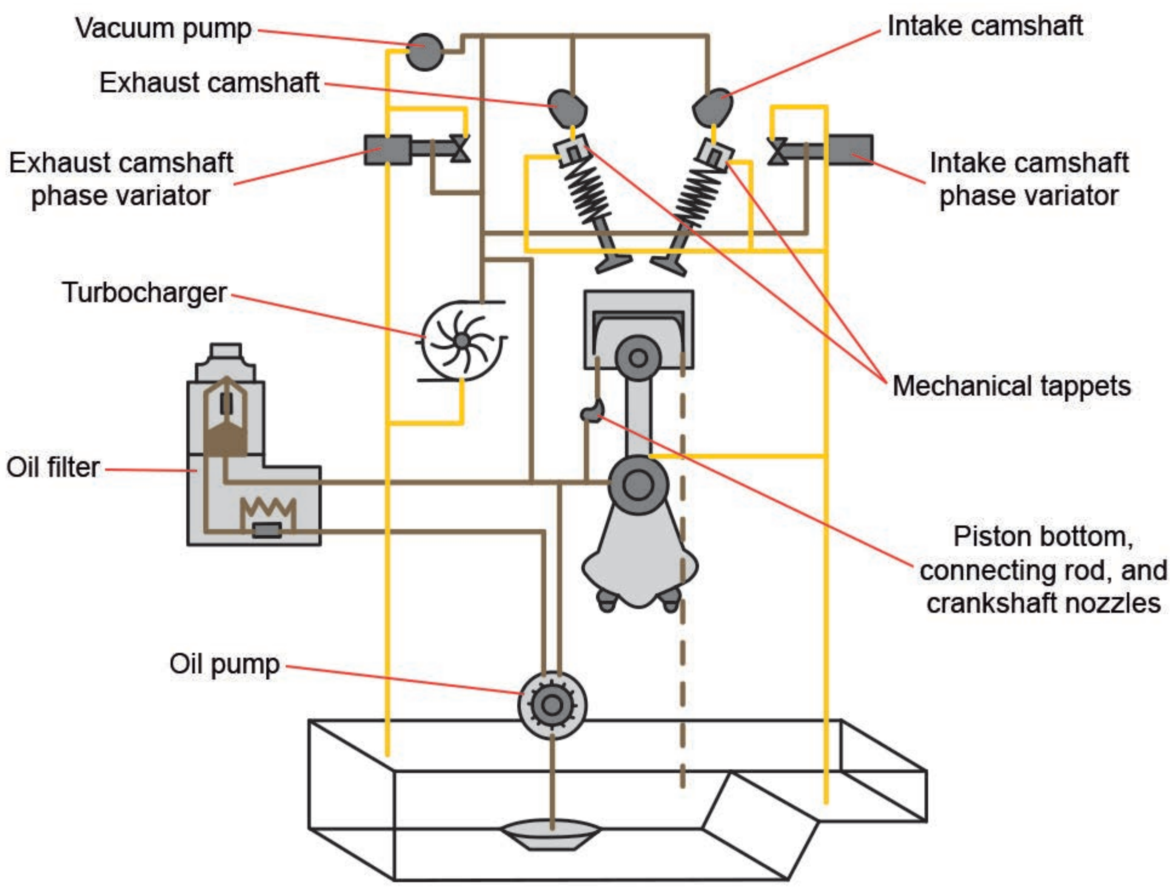
Their purpose is to regulate the opening and closing times of the intake and exhaust valves according to engine speed and load. These are fixed to the variable timing control valves corresponding to the camshafts.
The camshaft position sensors detect the exact angular position of each shaft. The recorded square wave signals are sent to the engine control unit to activate the relevant camshaft timing solenoid valve.

The solenoid valves, after receiving the signal from the unit, move the control valve that regulates the oil flow to the advance or retard cavity of the corresponding phase variator. This rotates the camshaft slightly from its original orientation, which advances or retards the intake or exhaust valves. The unit adjusts the camshaft timing in accordance with the engine load and rpm.



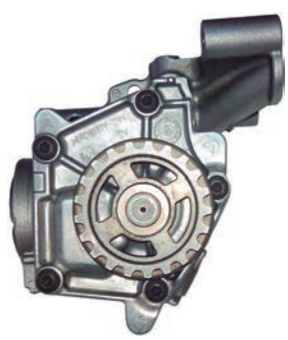
Intake camshaft phase variator

Lubrication system



Oil pump

It is fixed to the bottom of the engine block by means of three bolts. This is a variable type vane pump which regulates the flow rate according to requirements, and it is driven by a toothed belt bathed in engine oil.



Pressure control solenoid valve

It is located on an engine block side. Its purpose is to regulate the pump oil pressure in accordance with the needs of the engine, and it is managed by the control unit with a PWM signal. It is closed in the resting position, but when control of the lubrication pressure is required, the unit acts on the solenoid valve.

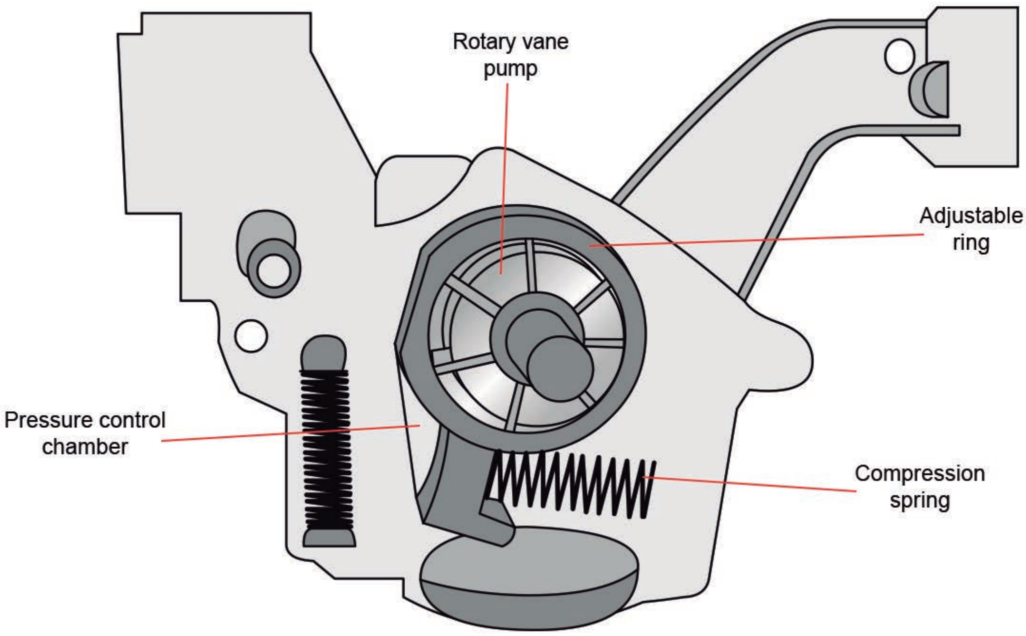
The solenoid valve is closed whenever the engine speed is higher than 3000 rpm and the engine load is high. It is also closed when the engine is running at more than 4750 rpm with low load. In all other circumstances, the solenoid valve is regulated by the control unit to allow a variable oil pressure.

Oil ejectors

They are bolted below the engine block and their job is to inject oil to the pistons and to the connecting rods to keep them properly lubricated and cooled.

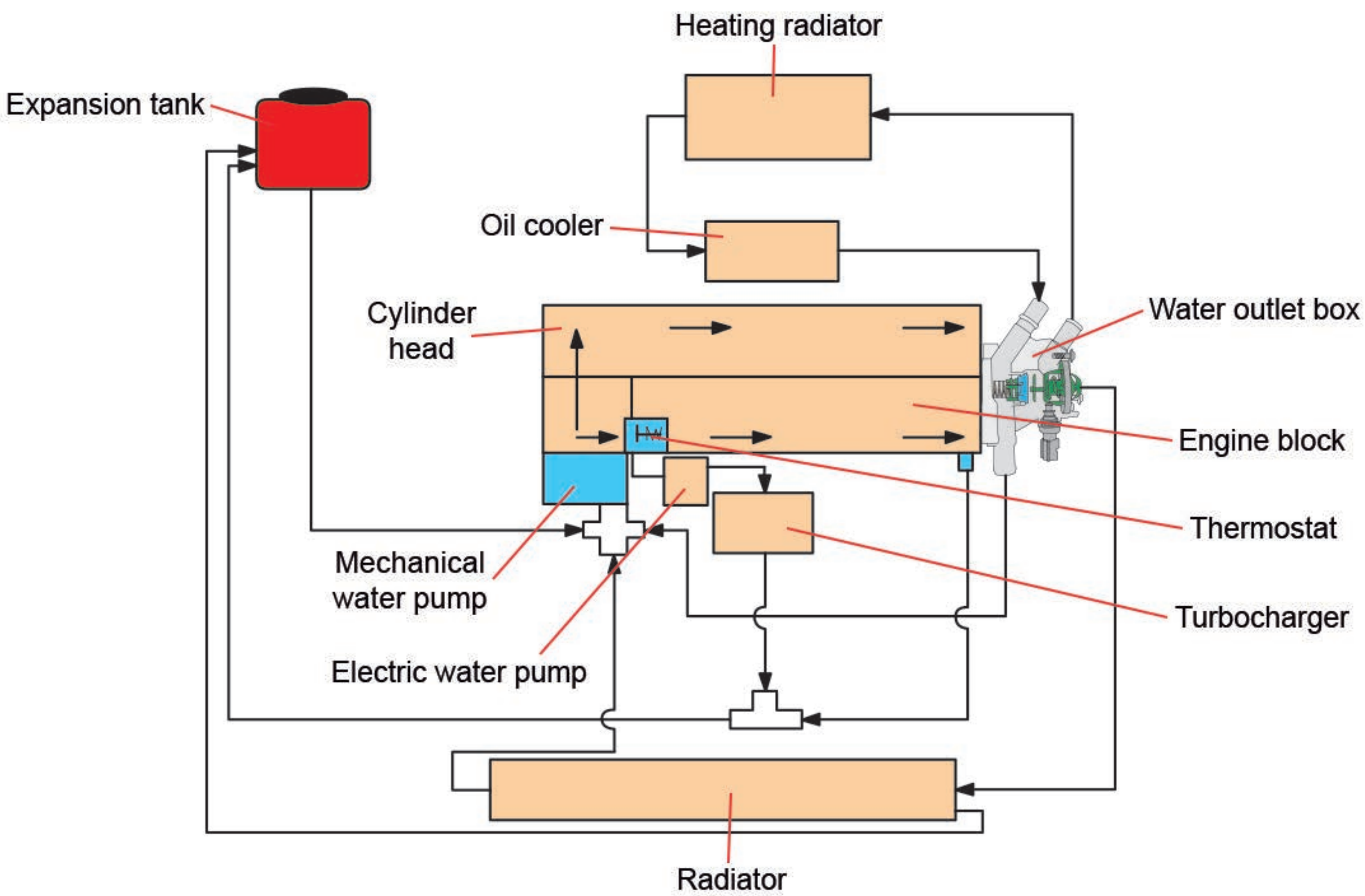
Pressure regulation

The oil pressure in the pressure control chamber can be changed in accordance with operating phases. When the oil pressure in the control chamber exceeds the spring force, the vane pump adjustable ring moves, which will vary to reduce the flow supplied by the pump.



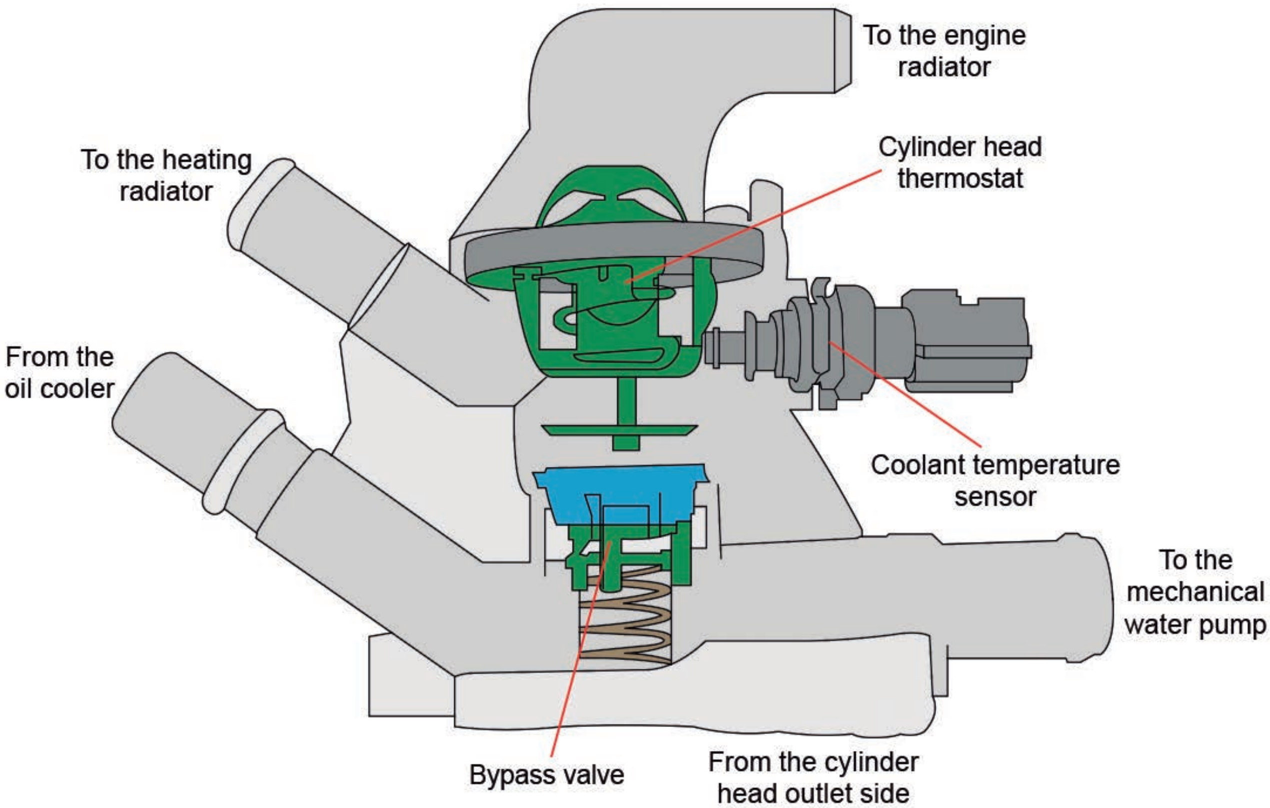
Cooling system

The cooling system has three circuits. In addition to the small and large conventional circuits, a mini-circuit is used during the engine heating phase to reduce the friction between the lubrication elements more quickly. This additional circuit is equipped with a second thermostat on the engine block.



Water outlet box

It is joined to the side of the cylinder head by four bolts. It houses the cylinder head thermostat and the bypass valve. The coolant temperature sensor is also inserted in the water outlet box, this is sealed by means of an O-ring.



Mechanical water pump

This is fixed on a bracket at the front of the engine. It is the vane type and it is sealed to the engine block by an O-ring and sealant. The pump roller is driven by the auxiliary belt.

Engine block thermostat

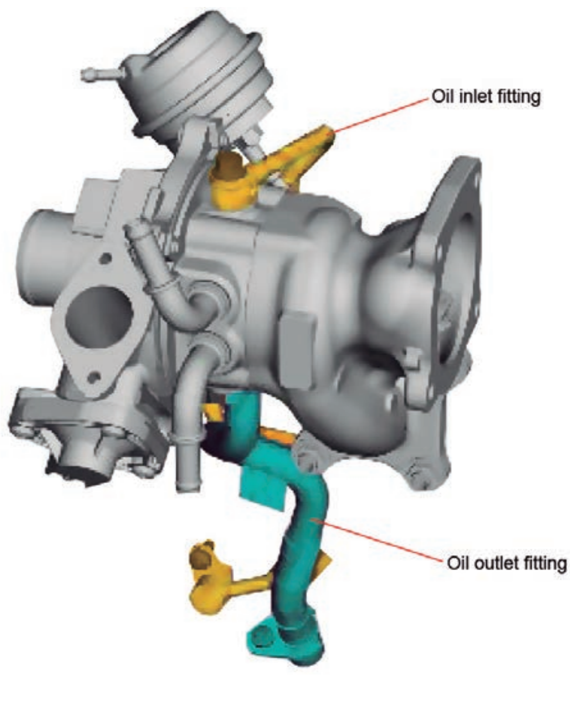
It is located on the back of the engine block. It forms part of the cooling system's additional circuit and only opens during the engine's heating phase.

Electric water pump

Depending on the equipment level, an electric pump may be installed in the coolant circuit line, fixed on a bracket next to the engine's electric fan. The engine control unit only activates the electric pump when the coolant temperature exceeds a critical value. This can happen if the engine stops immediately after the engine has been operating with a high load and during long journeys.

Forced induction system

The turbocharger used in the EcoBoost engine has fixed geometry. The turbocharger has a wastegate actuated by a pneumatic valve and an air recirculation valve.
The function of the air recirculation valve is to recirculate the intake air that passes through the turbocharger so as not to brake the turbocharger's intake turbine. For this it uses a bypass that returns part of the aspirated air back to the intake turbine. The bypass is controlled by a vacuum through a line connected to the intake after the gas flap.
The turbocharger is lubricated by the engine oil. It has oil inlet and outlet fittings to ensure it is correctly lubricated.



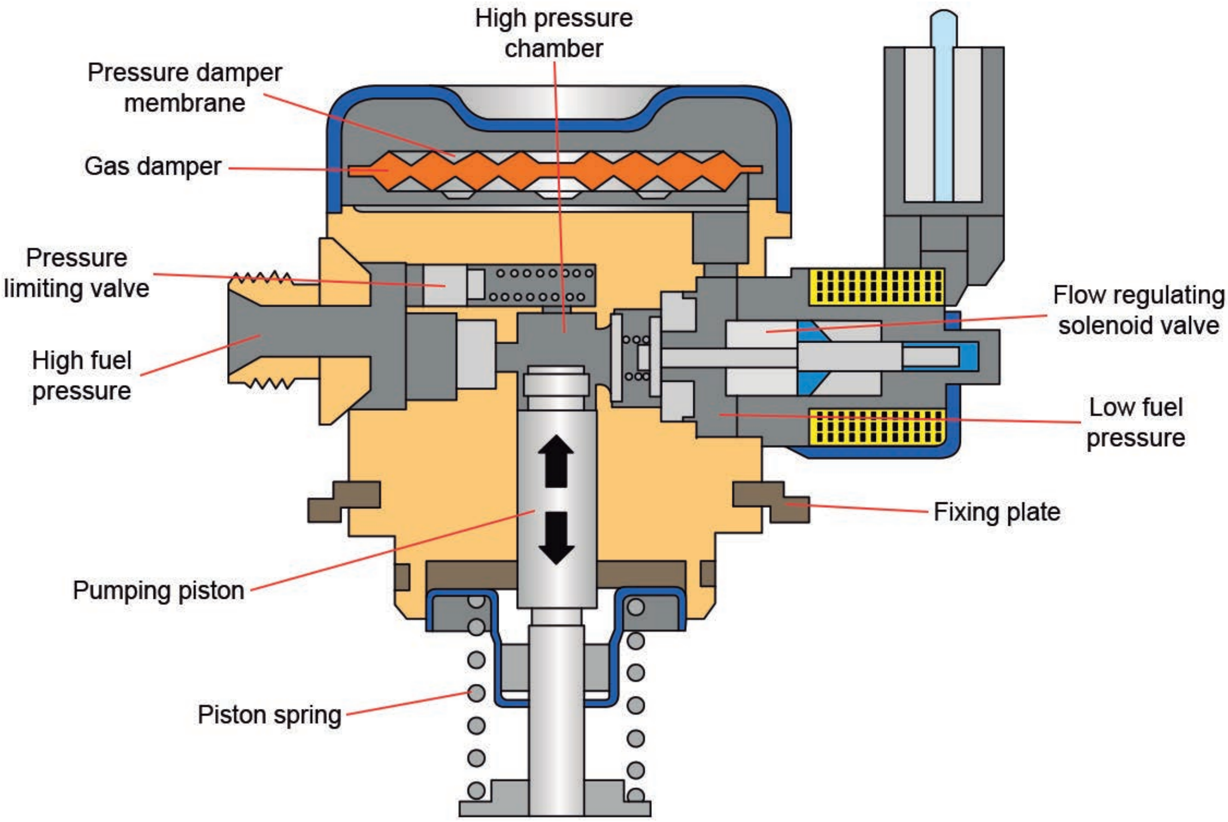
Electronic engine management

The control unit is manufactured by Bosch and uses electronic MED 17.0.1 engine management. The main functions that it controls are:

- Measurement of operating parameters.
- Control of injection pressure.
- Activation of the injectors.
- Ignition system management.
- Boost pressure regulation.
- Variable timing management.
- Alternator charging regulation.
- Engine cooling management.
- Fuel pressure regulation.
- Self-diagnostics.
- Control of running speed.
- Communication with the CAN-Bus network.

Control of injection pressure

The control unit manages the injection pressure for the different engine operating phases, it acts on the flow control valve to adjust the fuel pressure in the injection rail between 40 and 150 bar. A pressure sensor fixed on the rail informs the control unit of the pressure at all times. The fuel is pressurised in the pump's high-pressure chamber when the flow control valve is closed.



The solenoid works, together with the fuel pressure sensor, in a closed control loop in the control unit programming. Through the activation of the solenoid valve, the required fuel pressure is supplied to the injection rail for fuel injection. The solenoid valve is activated in two phases, one is energisation and the other maintenance.

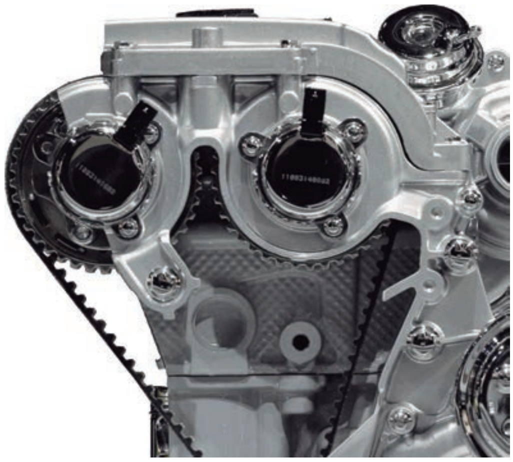
Boost pressure regulation

The control unit manages the boost pressure in order to adjust it specifically to the different operating conditions, it acts on the pressure regulating solenoid valve by means of a PWM signal (pulse-width modulation).

The turbocharger control solenoid valve regulates the turbocharger pressure by acting on the vacuum circuit that feeds the pneumatic valve. It is managed by the control unit by means of a pulse modulated signal by varying the frequency depending on the engine load.

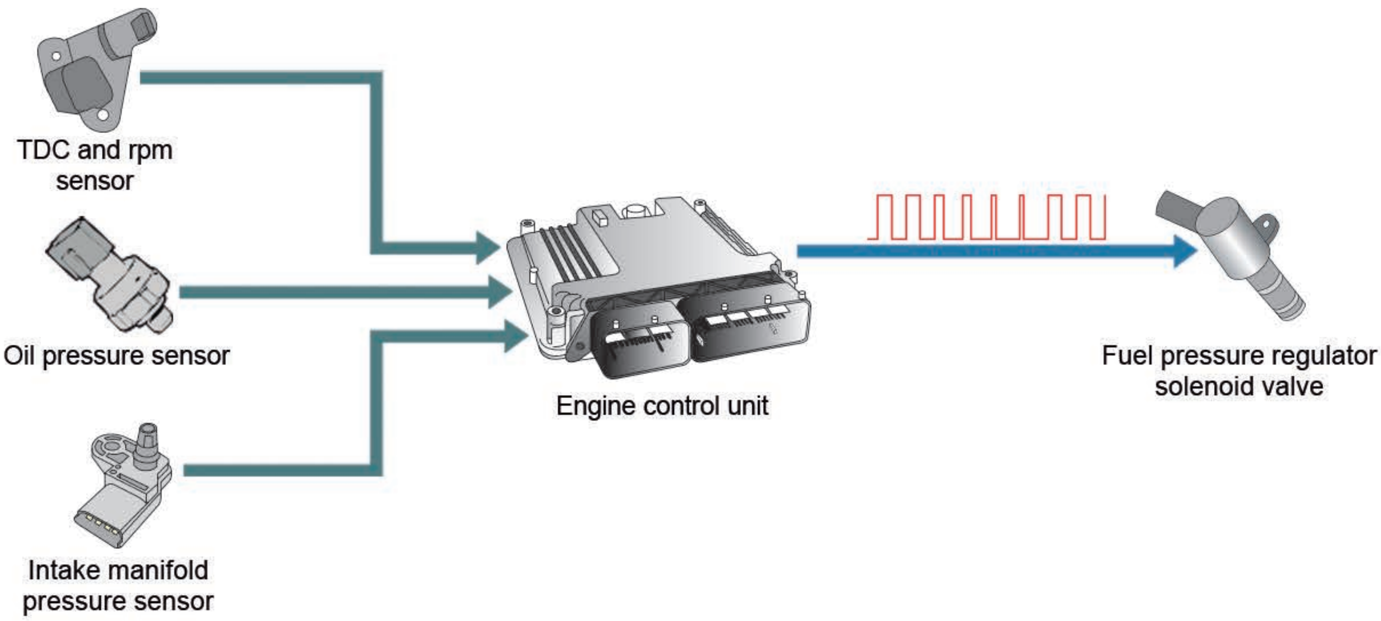
Variable timing management

To adjust the camshaft timing to the operating conditions in accordance with engine load needs, the control unit is commanded by the timing management system, by acting on the control solenoid valves by means of a PWM signal. The solenoid valves are located on the timing cover and fixed just in front of each VTC unit. The control unit activates them, which allows the phase variators to be regulated by means of the oil flow to the hydraulic chambers of the VTC units, so the camshaft timing is adjusted in accordance with the engine map.



Oil pressure management

The control unit is commanded by this management system, by acting on the oil pressure regulating solenoid valve by means of a PWM signal. To determine the amplitude of the excitation signal, the control unit takes signals from the rpm, oil pressure and intake manifold pressure sensors.



MAINTENANCE

The next information is related to Ford EcoBoost engine:

OIL CHANGE	
Engine oil and oil filter	20,000 km or 1 year
Viscosity grade	Synthetic 5W20
Ford approved	ACEA A1/B1 API SN/CF
Capacity with oil filter	4.10 litres
Capacity without oil filter	4 litres

OIL FILTER REPLACEMENT	
Replacement interval	20,000 km or 1 year

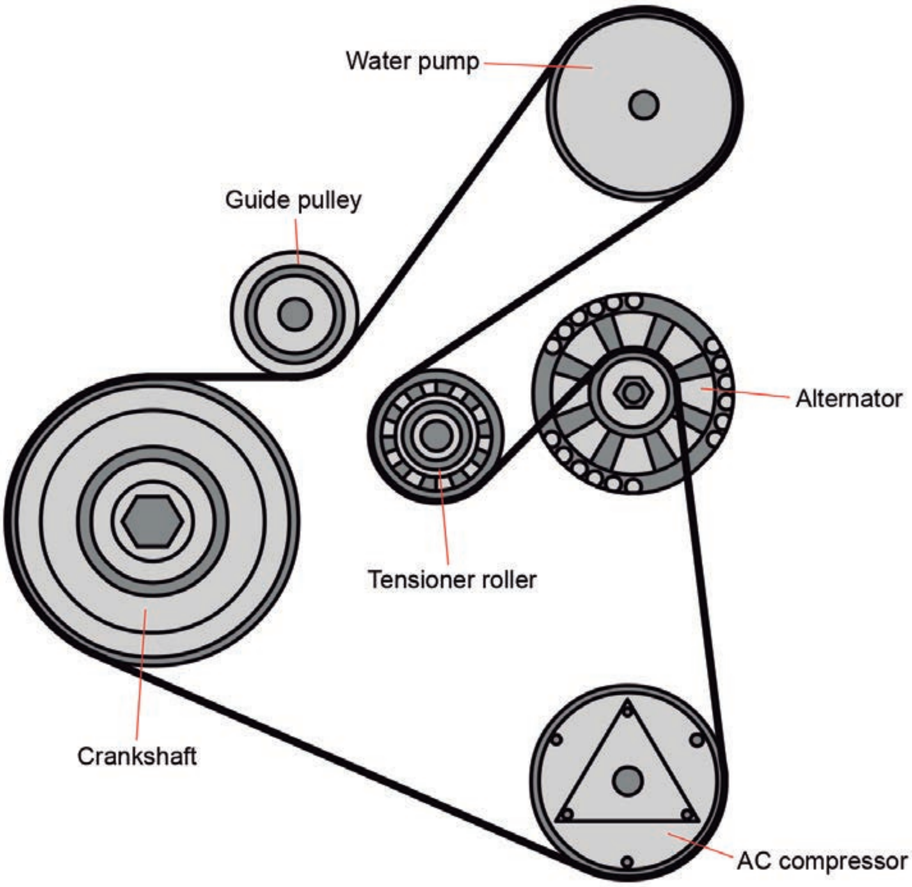
AIR FILTER REPLACEMENT	
Replacement interval	60,000 km or 4 years

SPARK PLUG REPLACEMENT	
Replacement interval	60,000 km or 4 years
The electrode gap should be 0.7 mm.	

COOLANT REPLACEMENT	
The coolant circuit fluid does not have a maintenance interval.	
Approved WSS-M97B44 Organic antifreeze.	
Circuit capacity	5.8 litres

TIMING BELT REPLACEMENT	
Replacement interval	240,000 km or 10 years

REPLACEMENT OF ACCESSORIES BELT	
Replacement interval	240,000 km or 10 years



COMMON FAILURES

Below are some of the most frequent faults that can occur in downsized engines. It is known by many that these engines stretch or break the timing chain, but before deciding that the problem is the chain, some components should first be checked.

TIMING CHAIN

The engine starts and then stops. The engine starts with difficulty. On starting the engine, a metallic noise appears between 1400 and 2000 rpm. The engine runs erratically, particularly at idle. These anomalies may be due to a low oil level, to a deviation from the self-adaptive values relating to the camshaft variators, to the displacement of the camshaft or crankshaft pulleys on their shaft (if there is no key), to the presence of metal chips on the variator solenoid valves, to the loosening of the timing chain due to the seizure of the hydraulic tensioner or to a timing chain stretched by wear.

Check the oil level. Check the state of the position sensor or the position sensors, as applicable, for the camshafts. Check the synchronisation of the timing chain by inserting the timing tools and, once correctly synchronised, ensure the tensioner is in good condition. Check the wear of the timing chain. Inspect for the presence of metal chips in the filters or lines of the phase variator solenoid valves.

The possible solutions range from topping up the oil if necessary, reinitialising the self-adaptive parameters, correctly synchronising the timing chain or replacing the variator solenoid valves, if necessary.

TURBOCHARGER

Lack of power and erratic engine operation at idling speed. The cause of this incident may be due to a missing thick washer on the turbocharger (between the turbocharger actuator and housing).

Read the fault codes in the engine control unit with a diagnostic tool and check that the washer is in the turbocharger joint.

Read the turbocharger actuator parameters for the adaptation of the bottom stop. Install the specific thick washer. Clear the fault codes recorded in the engine control unit with the diagnostic tool.

TECHNICAL NOTES

This section locates the most common faults in downsized engines. Despite the short time that they have been on the market, it has been possible to determine the weak points of these types of engines.

These faults are selected from the online platform: www.einavts.com This platform has a series of sections that specify: make, model, line, system affected, and subsystem, which can be selected independently depending on the desired search.

FORD

B-MAX, C-MAX, Fiesta, Focus, Kuga, Mondeo, S-MAX	
Symptoms	P2107 - Accelerator actuator control module processor. P2108 - Performance of the accelerator actuator control unit. The following symptoms are observed in the workshop: • High fuel consumption. • Unstable idling. • On occasions, the engine does not start or is sometimes difficult to start. A decrease in the pressure is noticed.
Cause	Internal hardware defect in the engine control unit (PCM).
Solution	Repair procedure: • Check the condition of the acceleration system wiring and its components from the accelerator pedal to the engine control unit (PCM). • Check the operation of the throttle valve. • Check the condition and operation of the engine control unit (PCM). • Replace the engine control unit (PCM).

FORD

B-MAX, C-MAX, Fiesta, Focus, Kuga, Mondeo, S-MAX	
Symptoms	PP0642 - Voltage A, Sensor Reference, Low. P0643 - Voltage A, Sensor Reference, High. P0651 - Voltage B, Sensor Reference, Open Circuit. P0652 - Voltage B, Sensor Reference, Low. P0653 - Voltage B, Sensor Reference, High. P1712 - The torque demand signal of the electronic transmission is not admissible (ASM only). Jerks at low RPM. Unstable idling. The engine does not start or is sometimes difficult to start, sporadically. Lack of engine power. Fault message on the multifunction screen: 'EAC FAIL'.
Cause	Defect in the power circuit between the accelerator pedal sensor and the throttle valve body. NOTE: If the vehicle is not in an emergency state and the accelerator electrical system indicator light is not illuminated on the dashboard, the fault may be caused by another system.
Solution	Repair procedure: • Check the condition of the battery power wiring to all the electrical acceleration system components. • Repair the affected cable section and protect it. • Replace the battery. • Replace the affected connector.

PSA GROUP

Citroën Berlingo III, C3, C4, C4 II, C5 III, DS3, DS4, Peugeot 207, 308, 3008, 508, RCZ	
Symptoms	P2191 - The mixture is too lean at a higher engine load. Malfunction indicator lamp (MIL) on. An anti-contamination anomaly message may be displayed. Power loss. Engine jerks between 1500 and 2000 RPM with the engine hot.
Cause	Time lag in the timing chain caused by the hydraulic tensioner of the timing chain.
Solution	Repair procedure: • Read the fault codes reported by the engine control unit (ECM) with the diagnostic tool. • Delete the fault codes reported by the engine control unit (ECM) with the diagnostic tool. • Check the length of the timing chain. • Replace the hydraulic tensioner if the length of the chain is equal or lower than 68 mm. • Replace all the components related with the timing if the length of the timing chain is greater than 68 mm. • Re-programme the engine control unit with updated software. • Carry out a second fault code reading at the control unit (ECU) with the diagnostic tool.

VAG GROUP

Audi A1, A3, SEAT Altea, Ibiza V, Leon, Skoda Fabia, Octavia, Roomster, Yeti, Volkswagen Caddy III, Golf VI, Jetta IV, Polo, Touran	
Symptoms	16400 - P0016 - Camshaft position sensor (G40). Camshaft position sensor (G28). Incorrect correlation. Bench 1. 16725 - P0341 - Camshaft position sensor. Sensor (G40). Signal improbable. P130A - Cylinder disabled. Failure codes reported by the engine control unit. The vehicle has one of the following symptoms: • Irregular functioning of engine. • The engine does not start. NOTE: This newsletter only affects those vehicles that are within a specific production date.
Cause	Timing not synchronised.
Solution	Repair procedure: • Read the fault codes recorded in the engine control unit with the diagnostic tool. • Confirm that the cited fault codes are recorded in the symptom field of this technical note. • Replace the timing kit if the pistons are not damaged. • Replace the timing kit, pistons, valves and spark plugs if the pistons are damaged or if compression is under 7 bar. • Replace the lightened engine and the spark plugs if the cylinders are damaged. • Delete the fault codes recorded in the engine control unit with the diagnostic tool. Carry out a second reading of the fault codes on the engine control unit (ECU) with the diagnostic tool and confirm that the fault codes mentioned in the symptom field of this technical note are NOT displayed. NOTE: A manufacturer's recommended repair kit is available.

VAG GROUP

Audi A1, A3, SEAT Altea, Ibiza V, Leon, Skoda Fabia, Octavia, Roomster, Yeti, Volkswagen Caddy III, Golf VI, Jetta IV, Polo, Touran	
Symptoms	P0170 - Bank 1, fuel injection system. System very lean. Failure code reported by the engine control unit. Malfunction indicator lamp (MIL) on. The engine jerks. NOTE: This newsletter only affects those vehicles that are within a specific production date.
Cause	Soot accumulated on the injector outlet causing low fuel quality.
Solution	Repair procedure: Read the fault codes reported by the engine control unit (ECU) with the diagnostic tool. Confirm that the cited fault code is recorded in the symptom field of this technical note. Check the condition of the injectors. Clean the injectors using an additive if the injectors have a soot accumulation. Replace the injectors if the fault is still present after cleaning. Delete the fault codes reported by the engine control unit (ECU) with the diagnostic tool. Carry out a road test (15 km) at a speed higher than 3000 rpm. Carry out a second reading of the fault codes reported by the engine control unit (ECU) with the diagnostic tool and confirm that the fault code mentioned in the symptom field of this technical note is NOT displayed.

EureTechFlash aims to demystify new technologies and make them transparent, to stimulate professional repairers to keep pace with technology.

Complementary to this magazine, EureTechBlog provides weekly technical posts on automotive topics, issues and innovations.

Visit and subscribe to EureTechBlog on
www.euretechblog.com

Eure!Car®
CERTIFIED MASTERCLASSES

The technical competence level of the mechanic is vital, and in the future may be decisive for the continued existence of the professional repairer.

Eure!Car is an initiative by Autodistribution International, with headquarters in Kortenberg, Belgium (www.ad-europe.com). The Eure!Car program contains a comprehensive series of high-profile technical trainings for professional repairers, which are given by the national AD organizations and their parts distributors in 39 countries.

Visit **www.eurecar.org** for more information or to view the training courses.

industrial partners supporting Eure!Car

BOSCH · brembo · Continental ContiTech · elring Das Original · EXIDE TECHNOLOGIES · FEDERAL-MOGUL MOTORPARTS · Gates · HELLA · INA · KYB Our Precision, Your Advantage · MAHLE · MANN FILTER · metelligroup AUTOMOTIVE PASSION · Nissens DELIVERING THE DIFFERENCE · NGK NTK SPARK PLUGS TECHNICAL CERAMICS NGK SPARK PLUG EUROPE GmbH · MONROE · WALKER · PHILIPS · SCHAEFFLER · SKF · TRW · Valeo · VARTA · ZF

NEXT

CONNECTIVITY SYSTEMS

Disclaimer : the information featured in this guide is not exhaustive and is provided for information purposes only. Information does not incur the liability of the author.