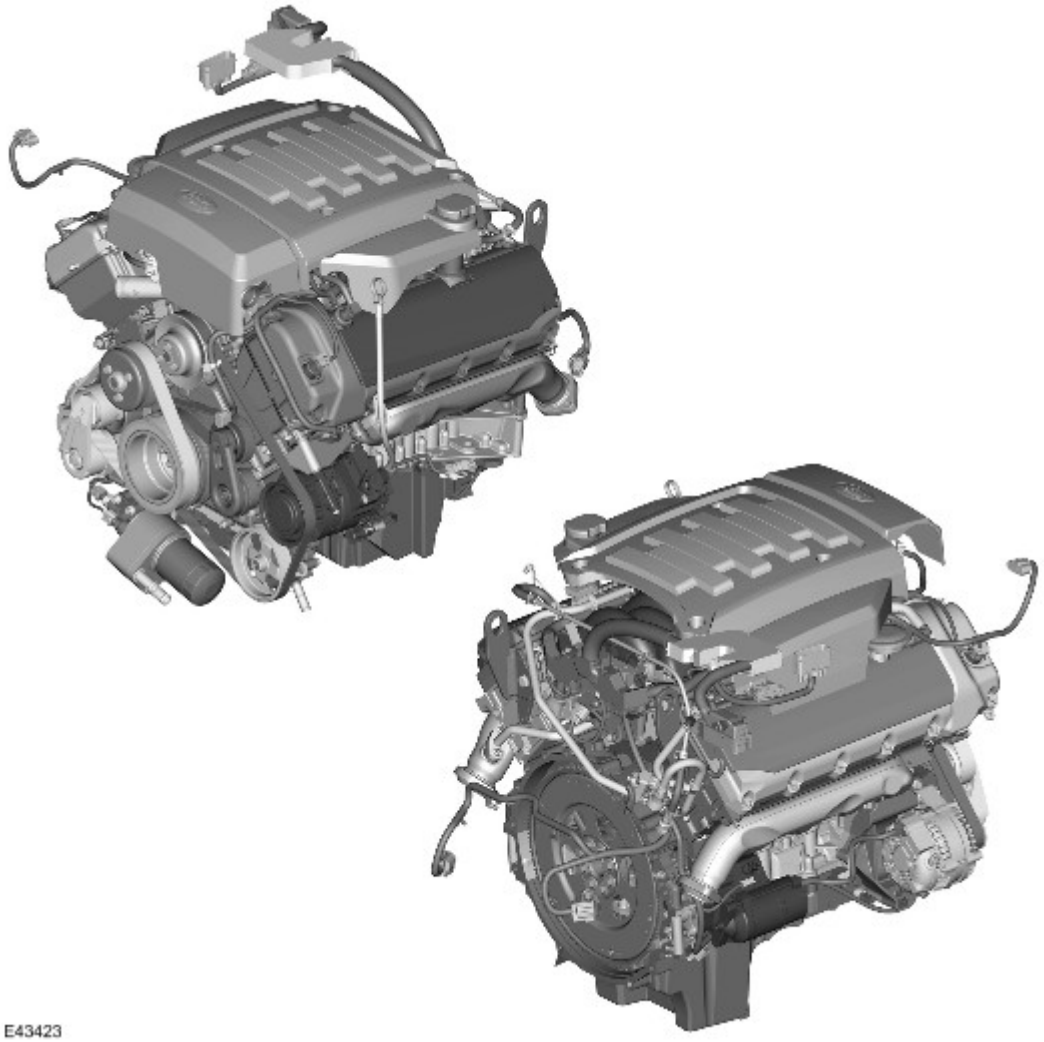
Published : Nov 21, 2005

Engine

External View



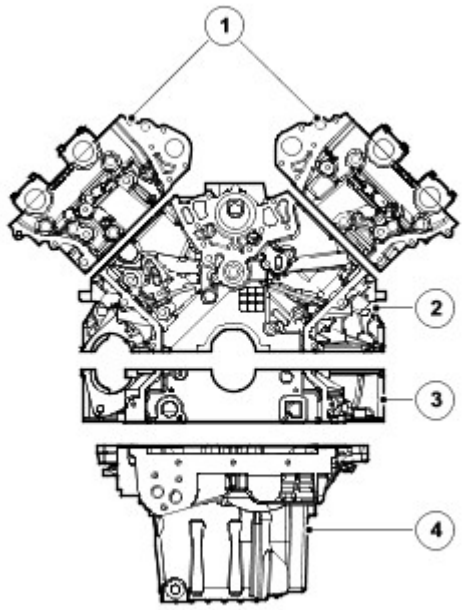
E43423

GENERAL

The V8 petrol engine is a 4.4 litre, 8 cylinder, 90 degrees 'Enclosed' V unit, with 4 valves per cylinder, operated by two overhead camshafts. The engine emissions comply with ECD3 (European Commission Directive) and US Federal Tier2 Bin 8 legislative requirements and employs catalytic converters, electronic engine management control, positive crankcase ventilation and exhaust gas re-circulation to limit the emission of pollutants. The cooling system is a low volume, high velocity system. The Engine Control Module (ECM) controls the fuel injection system.

The cylinder block is of aluminium alloy construction with cast iron liners and a cast aluminium bedplate bolted to the bottom of the block to improve lower structure rigidity. The cylinder heads are cast aluminium with thermo-plastic camshaft covers. The single-piece oil sump is also cast aluminium. The fabricated stainless steel twin skin exhaust manifolds are unique for each cylinder bank and a moulded plastic acoustic cover is fitted over the upper engine to reduce engine-generated noise.

Engine Structure



E43424

Item	Part Number	Description
1	-	Cylinder heads
2	-	Cylinder block
3	-	Bed plate
4	-	Structural sump

TECHNICAL FEATURES

The technical features include:

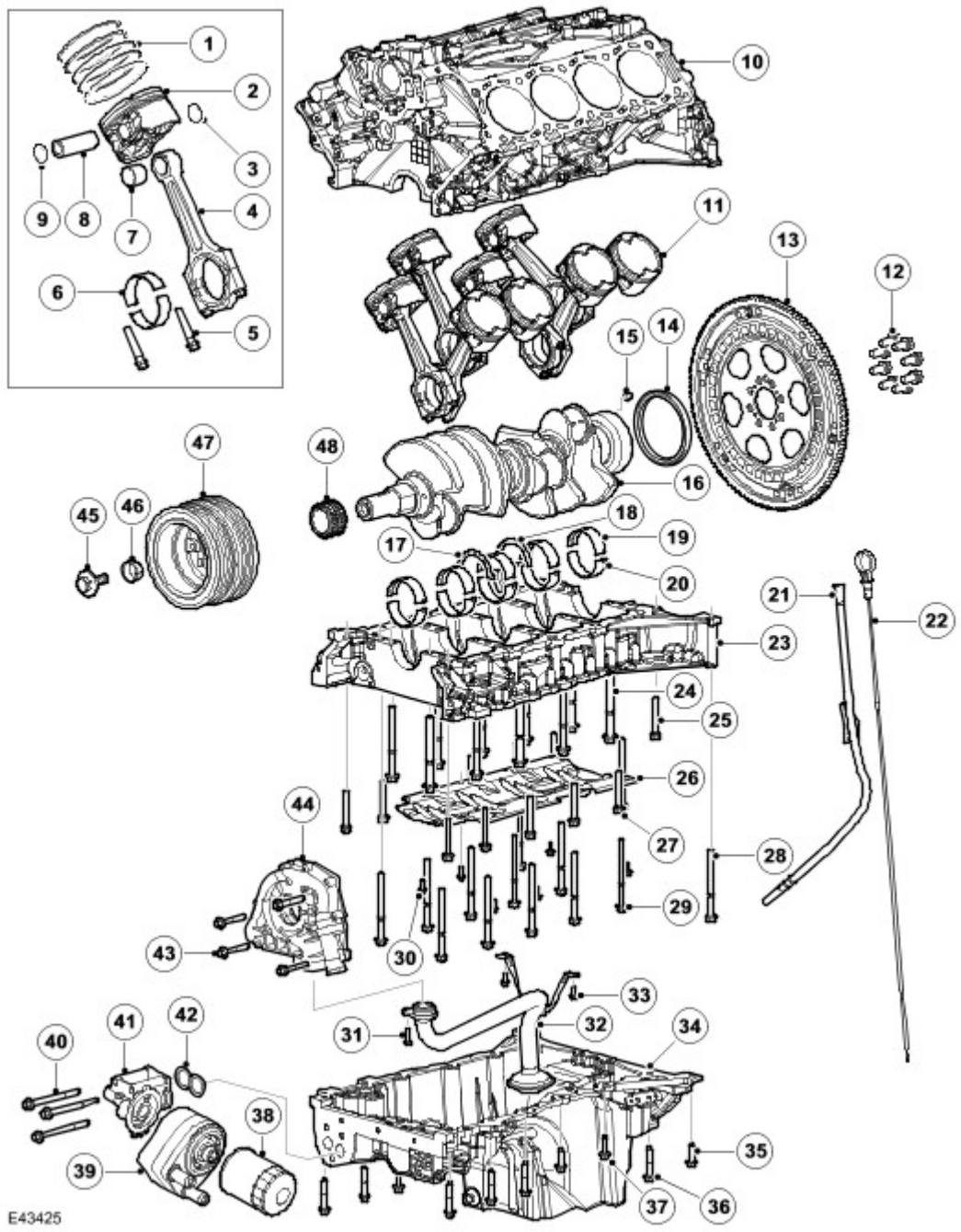
- An eight cylinder 90 degree 'Enclosed V' configuration liquid cooled aluminium cylinder block with cast iron liners
- Pistons are of open-ended skirt design, with two compression rings and a three piece oil control ring
- Two aluminium cylinder heads, each incorporating two hollow camshafts manufactured in chilled cast iron
- Four valves per cylinder
- Aluminium graded valve lifters (shimless)
- Variable Valve Timing (VVT) (inlet only)
- Top fed, 12-jet fuel injectors
- Engine front cover manufactured from aluminium which accommodates the crankshaft front oil seal
- Primary and secondary chains drive the camshafts
- An aluminium bed plate
- A cast iron crankshaft
- Fracture-split connecting rods in sintered-forged steel
- A twin multi-vee belt, which drives the front end accessories
- Fabricated stainless steel twin skin exhaust manifolds
- Electronic Exhaust Gas Recirculation (EGR) valve
- An advanced engine management system incorporating electronic throttle control
- Meets with the fault handling requirements, as detailed in the European On-Board Diagnostic (EOBD) III, US Federal OBD and California OBDII legislation .

ENGINE DATA

DESCRIPTION	TYPE
Configuration	90 degree V8
Maximum power	220 kW at 6000 rpm
Maximum torque	425 Nm at 4000 rpm
Displacement	4.396 litres

Stroke/bore	90.3/88.0 mm
Compression ratio	10.50 : 1
Firing order	1 5 4 2 6 3 7 8
Engine weight	208 kg (approx.)
Oil volume	7.5 litres (wet)

CYLINDER BLOCK COMPONENTS



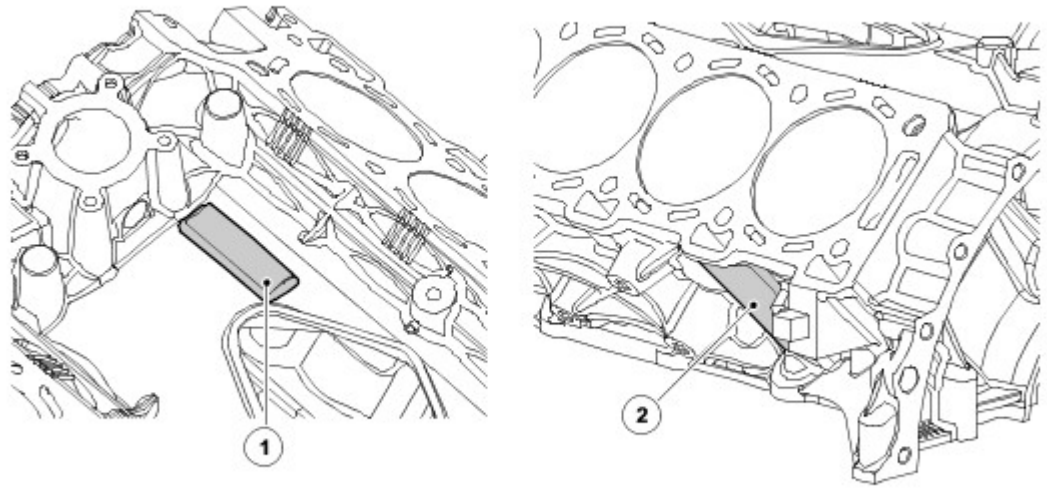
Item	Part Number	Description
1	-	Piston rings
2	-	Piston
3	-	Circlip
4	-	Connecting rod
5	-	Bolts

6	-	Connecting rod bearing shells
7	-	Bearing
8	-	Gudgeon pin
9	-	Circlip
10	-	Cylinder block
11	-	Pistons
12	-	Bolts
13	-	Flywheel
14	-	Seal
15	-	Dowel
16	-	Crankshaft
17	-	Thrust washer
18	-	Thrust washer
19	-	Bearing shells - upper
20	-	Bearing shells - lower
21	-	Oil level gauge tube
22	-	Oil level gauge
23	-	Bedplate
24	-	Bolts
25	-	Bolts
26	-	Windage tray
27	-	Bolts
28	-	Bolts
29	-	Bolts
30	-	Bolt
31	-	Bolt
32	-	Oil pick-up pipe
33	-	Bolts
34	-	Sump
35	-	Bolts
36	-	Bolts
37	-	Bolts
38	-	Oil filter
39	-	Oil cooler assembly
40	-	Bolts
41	-	Oil filter head assembly
42	-	Seals
43	-	Bolts
44	-	Oil pump
45	-	Crankshaft bolt
46	-	Taper collet
47	-	Crankshaft pulley
48	-	Crankshaft sprocket

Cylinder Block

The cylinder block is an 'Enclosed V' design, which provides an inherently rigid structure with good vibration levels. A low volume coolant jacket improves warm-up times and piston noise levels; the longitudinal flow design of the jacket, with a single cylinder head coolant transfer port in each bank, improves rigidity and head gasket sealing. The right hand cylinder bank is designated as bank'A' (cylinders 1 to 4), and the left hand as bank 'B' (cylinders 5 to 8).

Engine Data Locations

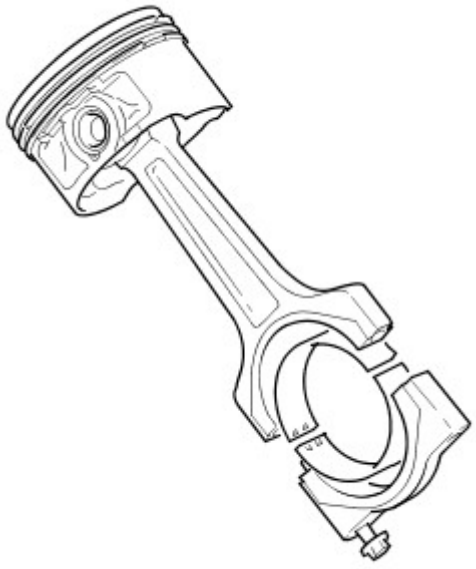


E43426

Item	Part Number	Description
1	-	Engine part number
2	-	Engine data (main bearing diameters, cylinder bore diameters, etc), emissions code and engine number

Engine data is marked at three locations, two on the cylinder block (shown) and one on the engine front cover, which consists a label displaying the engine number. Component diameters are represented by alphabetical and numerical codes; keys to the codes are in the Service Repair Procedures (SRP) Manual.

Connecting Rods and Pistons



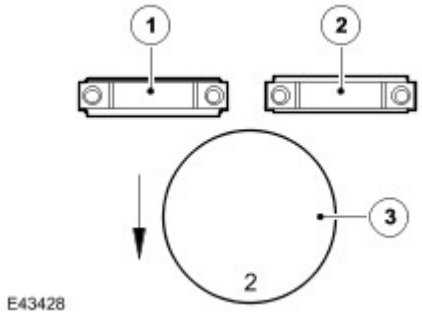
E43427

The connecting rods are manufactured from sinter-forged steel and have fracture-split bearing caps. The bearing

caps are produced by fracturing the opposing sides of the connecting rod at the bearing horizontal centre line. As well as being easier to manufacture, when reassembled the fractured surfaces interlock to form a strong seamless joint. The cylinder position is marked on adjoining sides of the joint to identify matching connecting rods and bearing caps. The connecting rod bearings are aluminium/tin split plain bearings.

The pistons are of the open-ended skirt design. Three piston rings, two compression and one oil control, are installed on each piston. Each piston is installed on a gudgeon pin located in a aluminium/tin bushing in the connecting rod.

Connecting Rod and Piston Installation

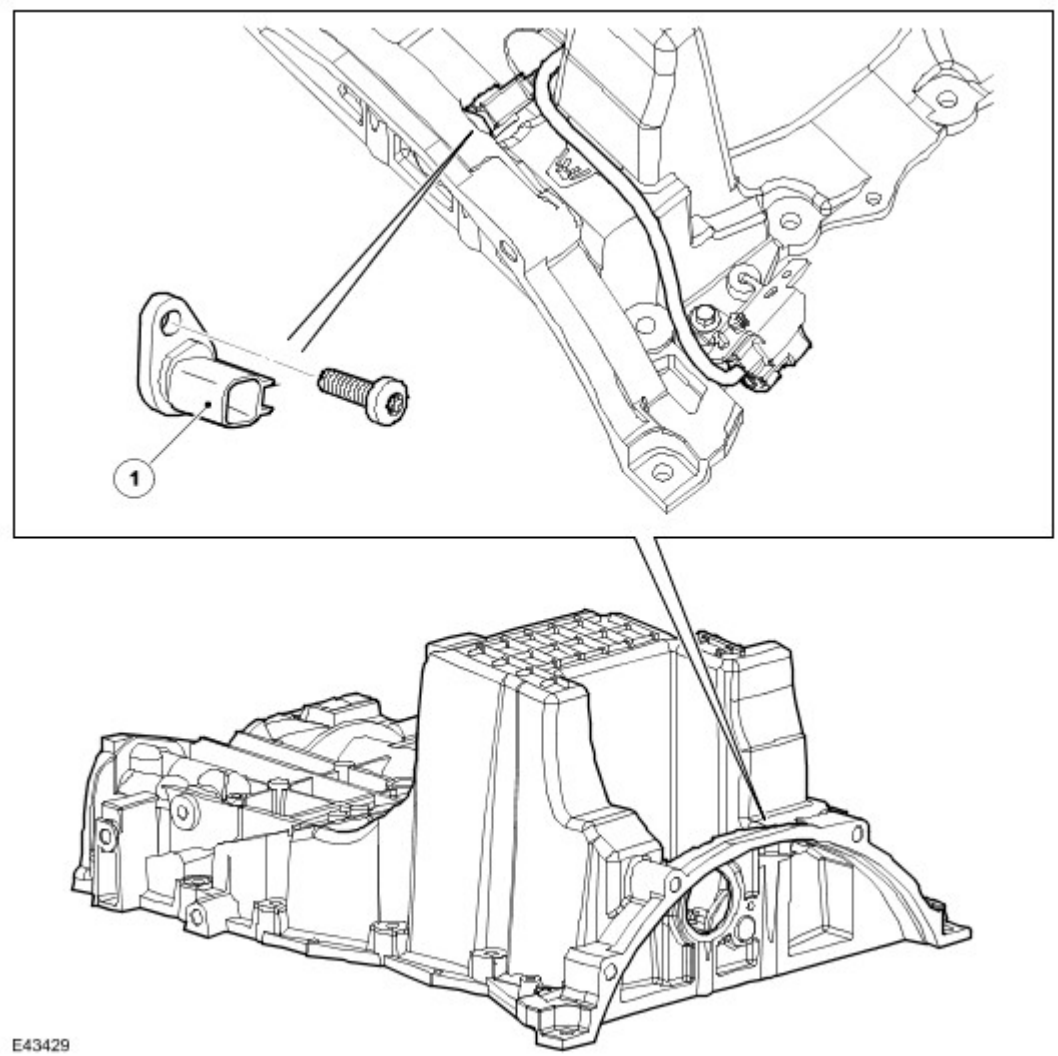


Item	Part Number	Description
1	-	Bank A (RHS)
2	-	Bank B (LHS)
3	-	Piston

The piston grade number is stamped on the crown of the piston and must coincide with that for each cylinder bore. The piston must be assembled in the correct orientation for the designated cylinder bore:

- Bank 'A' - piston grade number and the thick flange of the connecting rod must face the front of the engine
- Bank 'B' - piston grade number and the thin flange of the connecting rod must face the front of the engine

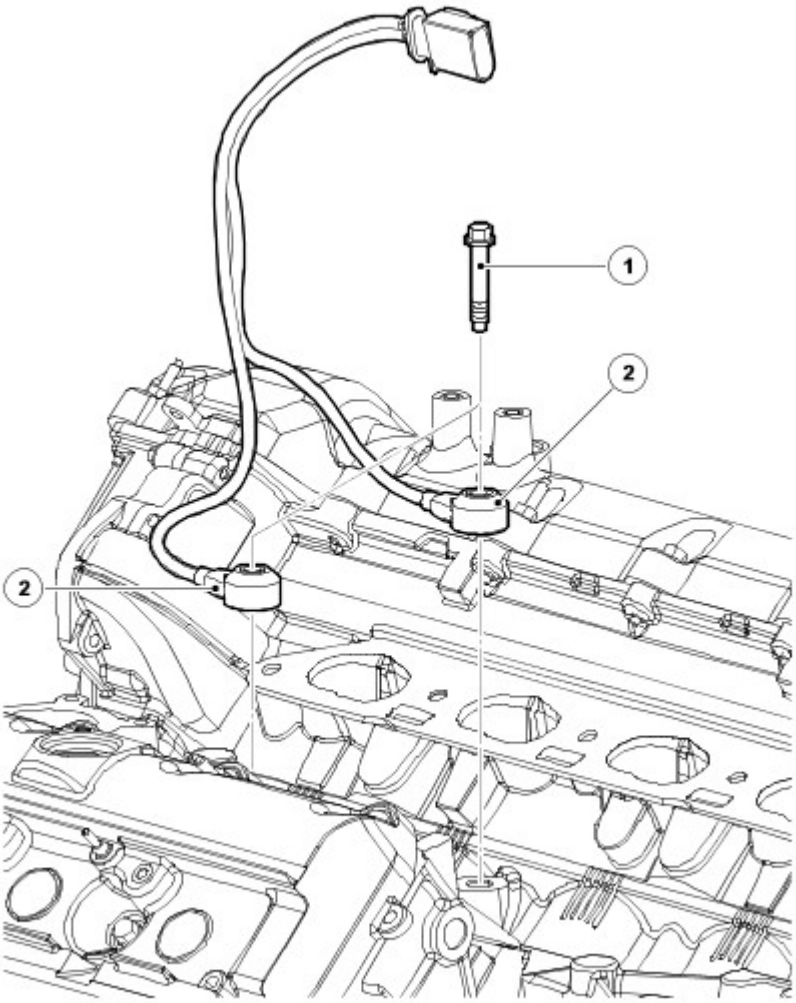
Crankshaft Position Sensor



Item	Part Number	Description
1	-	Crankshaft position sensor (CKP)

The CKP sensor is installed at the rear of the sump. It is a variable reluctance sensor that provides an input of engine crankshaft speed and position. For additional information, refer to Electronic Engine Controls (303-14B Electronic Engine Controls - 4.4L)

Knock Sensors

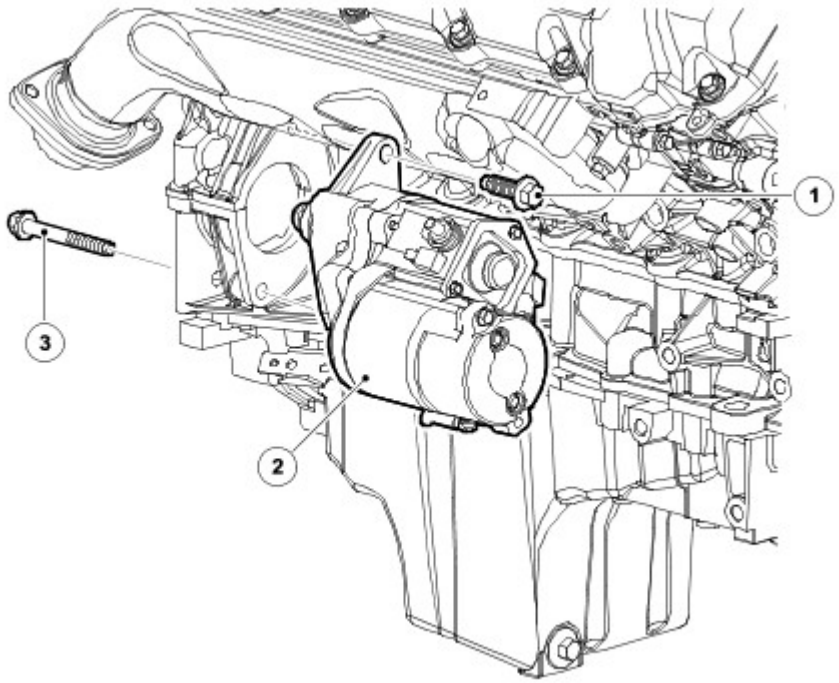


E43430

Item	Part Number	Description
1	-	Bolt
2	-	Knock sensor

The knock sensors are installed in the cylinder block on the inboard side of each cylinder bank. They are piezo-electric sensors that provide inputs to detect and locate detonation during combustion. For additional information, refer to Electronic Engine Controls (303-14B Electronic Engine Controls - 4.4L)

Starter

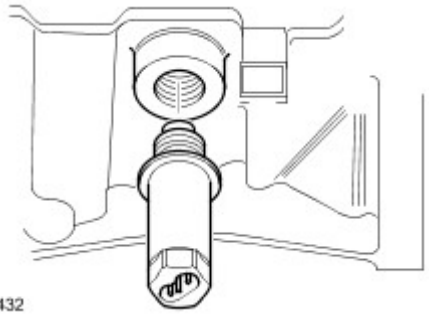


E43431

Item	Part Number	Description
1	-	Bolt
2	-	Starter motor
3	-	Bolt

The engine starter motor is installed at the rear right side of the engine, at the cylinder block to bedplate split line. For additional information, refer to Starting System (303-06B Starting System - 4.4L)

Coolant Drain Plug/Heater

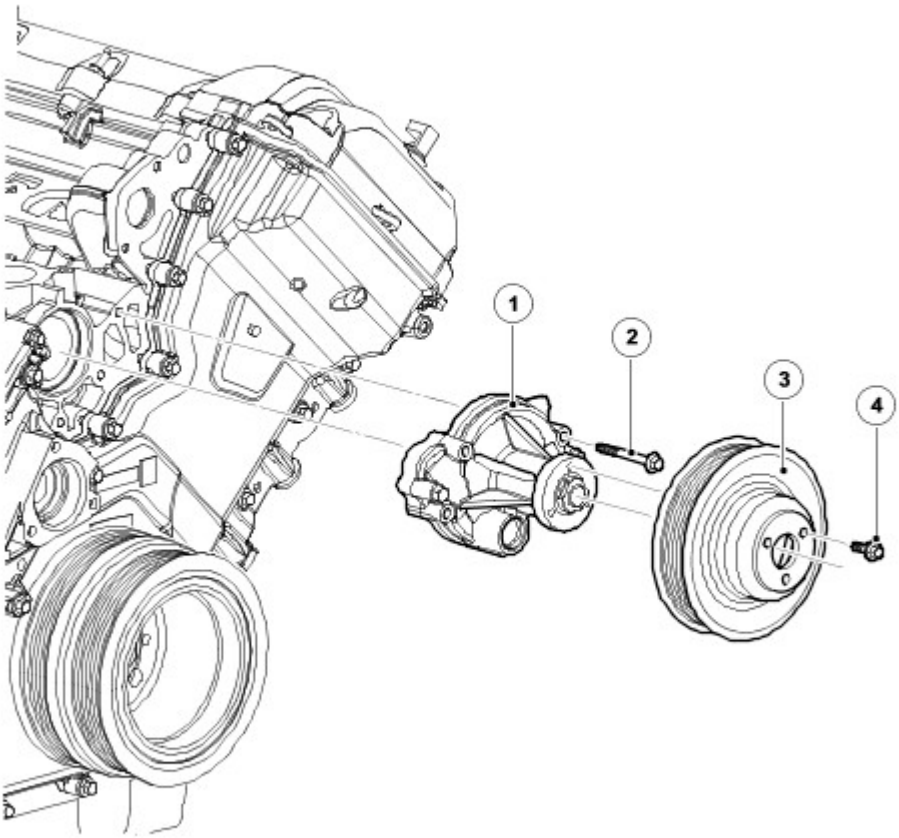


E43432

A coolant drain plug is installed on the rear left side of the cylinder block. On vehicles with the cold climate package, the cylinder block heater replaces the drain plug.

On vehicles destined for Canada, the coolant heater is installed during engine manufacture, but for Scandinavian vehicles the heater is supplied in kit form to be installed at the dealership.

Coolant Pump

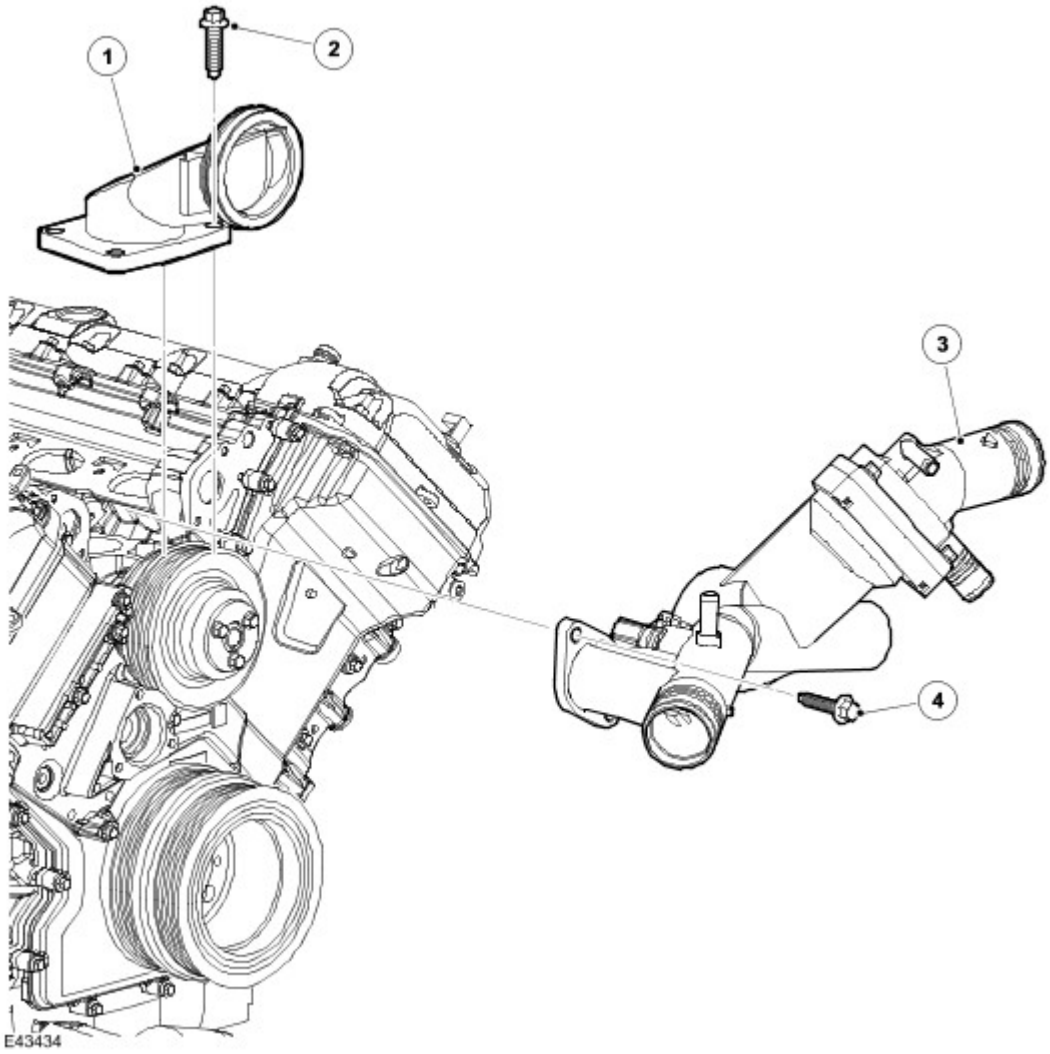


E43433

Item	Part Number	Description
1	-	Coolant pump
2	-	Bolt
3	-	Pulley
4	-	Bolt

The coolant pump is installed between the two cylinder banks, on the front face of the cylinder block.

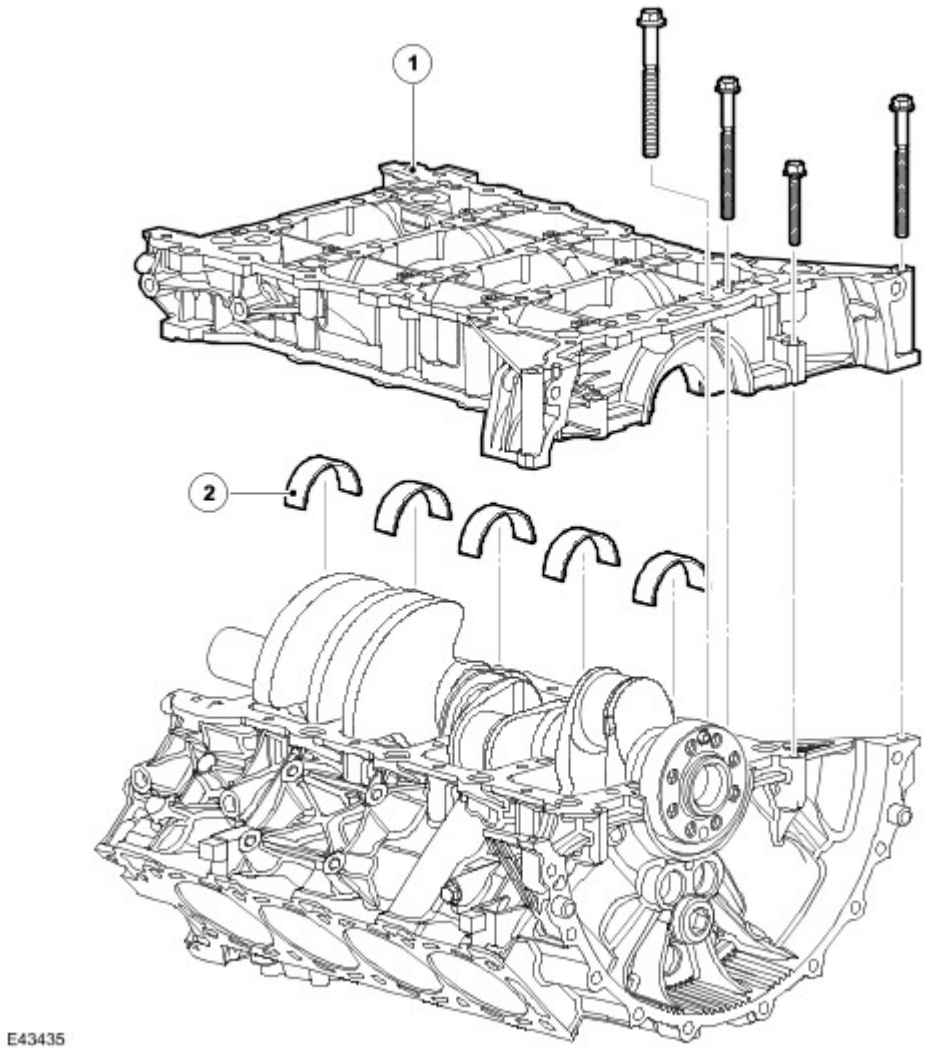
Thermostat Housing



Item	Part Number	Description
1	-	Coolant outlet elbow
2	-	Bolt
3	-	Thermostat housing
4	-	Bolt

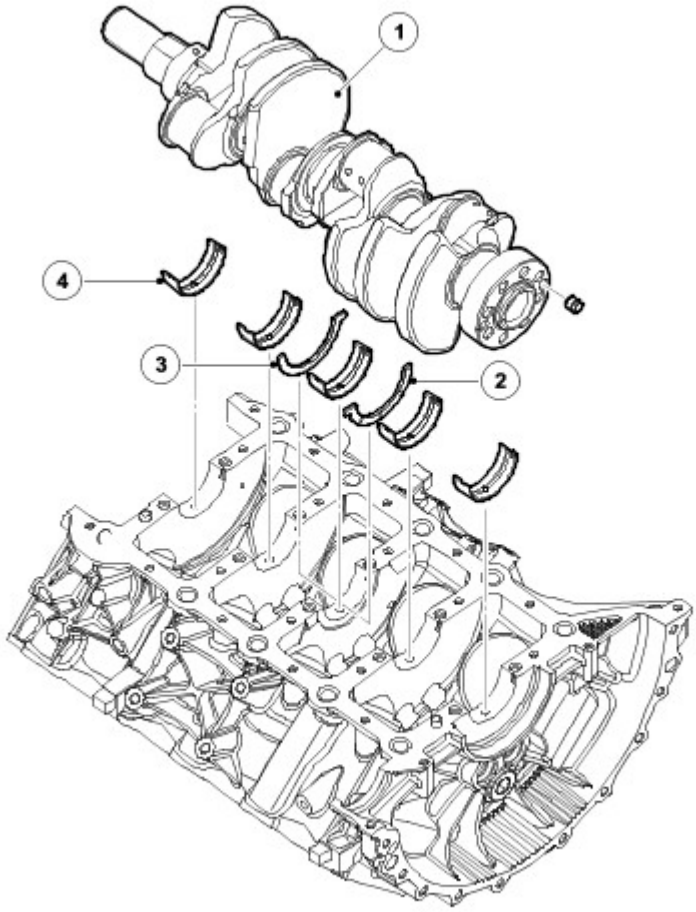
The composite thermostat housing is installed between the two cylinder banks, immediately above the coolant pump. The thermostat controls the flow of coolant through the radiator.

CRANKSHAFT AND SUMP COMPONENTS



Item	Part Number	Description
1	-	Bedplate
2	-	Main bearings - lower

Crankshaft and Main Bearings



E43436

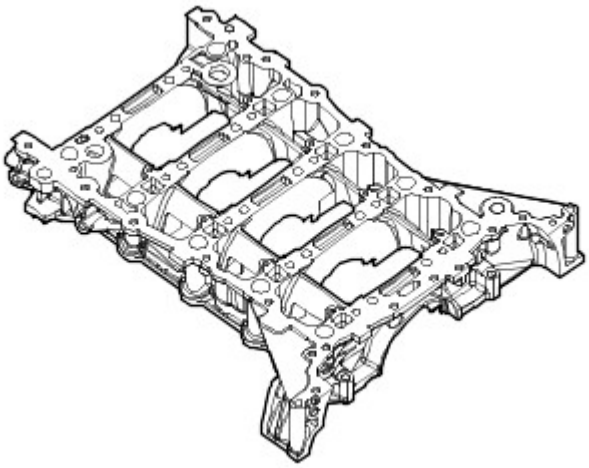
Item	Part Number	Description
1	-	Crankshaft
2	-	Thrust washer
3	-	Thrust washer
4	-	Main bearings - upper

Six counter-balance weights ensure good vibration levels from the four throw, five bearing crankshaft. Manufactured in cast iron, the crankshaft also has undercut and rolled fillets for improved strength.

The crankshaft rear oil seal is a press fit in the bedplate to cylinder block interface.

The main bearings are aluminium/tin split plain bearings. An oil groove in the upper half of each bearing transfers the oil into the crankshaft for lubrication of the connecting rod bearings. A aluminium/tin thrust washer is installed each side of the top half of the centre main bearing.

Bedplate



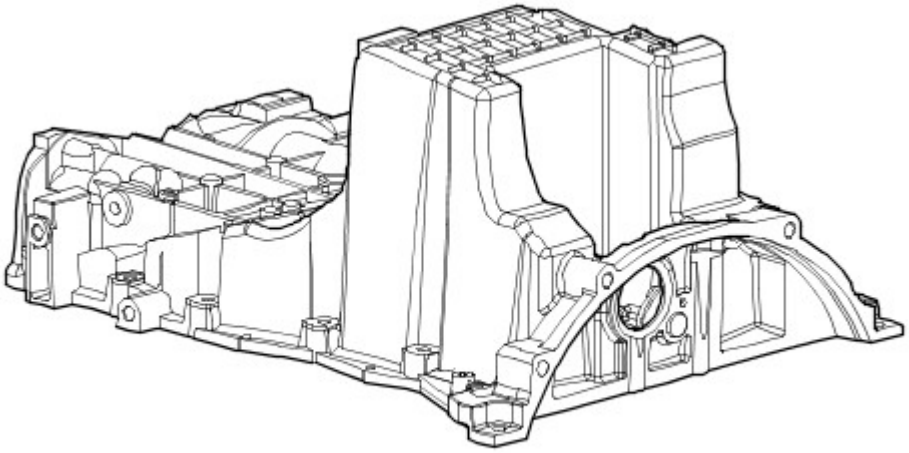
E43437

The bedplate is a structural casting bolted to the bottom of the cylinder block to retain the crankshaft. The use of a bedplate further improves rigidity. Iron inserts, cast into the main bearing supports of the bedplate, minimise main bearing clearance changes due to heat expansion.

Two hollow dowels align the bedplate with the cylinder block.

Beads of sealant seal the joint between the bedplate and the cylinder block.

Sump

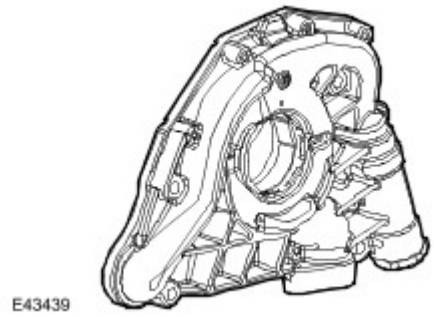


E43438

The aluminium alloy structural sump is bolted to the bedplate. A windage tray attached to the underside of the bedplate isolates the oil pan from the disturbed air produced by the rotation of the crankshaft, to prevent oil aeration and improve oil drainage. A rubber plug at the rear of the structural sump seals the port that provides access to the torque converter securing bolts. The engine oil drain plug is located at the front right corner of the oil pan.

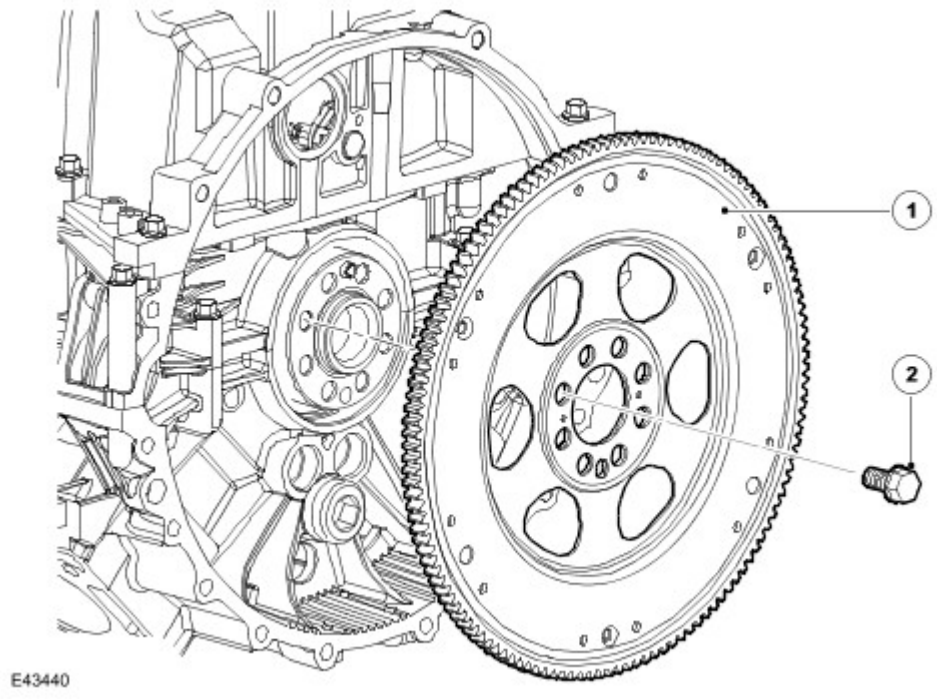
A bead of sealant seals the joint between the structural sump and the bedplate.

Oil Pump



The oil pump is installed on the crankshaft at the front of the engine. The pump inlet and outlet ports align with oil passages in the bedplate.

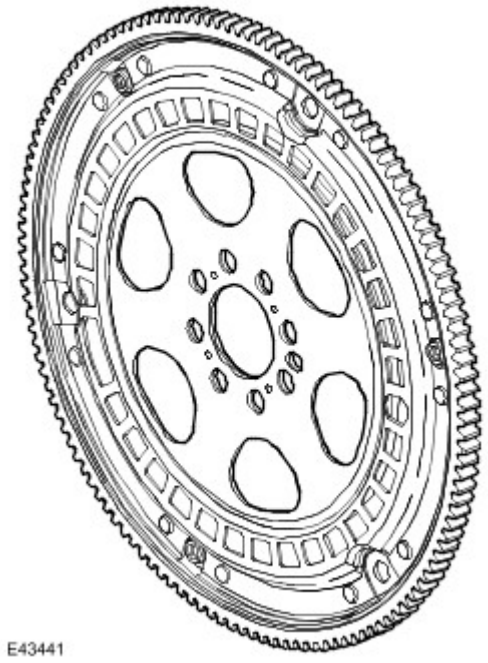
Starter Drive Plate



Item	Part Number	Description
1	-	Starter drive plate
2	-	Bolt

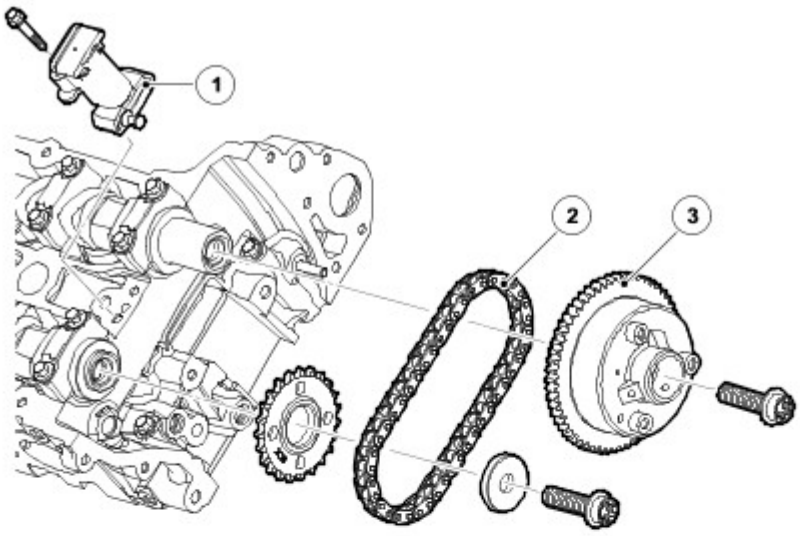
The starter drive plate is attached to the rear of the crankshaft. A timing disc, for the engine speed sensor, is spot welded to the front face of the drive plate.

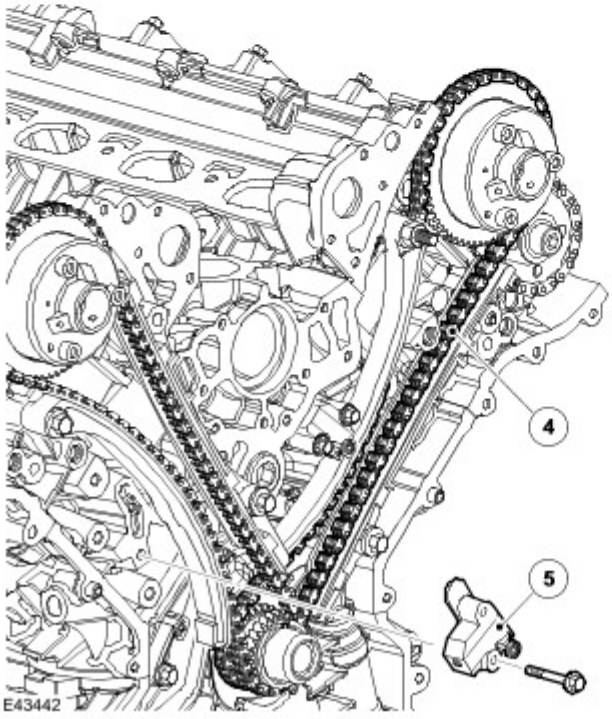
Timing Disc



E43441

CAMSHAFT TIMING COMPONENTS





Item	Part Number	Description
1	-	Secondary chain tensioner
2	-	Secondary chain
3	-	Variable valve timing unit
4	-	Primary chain
5	-	Primary chain tensioner

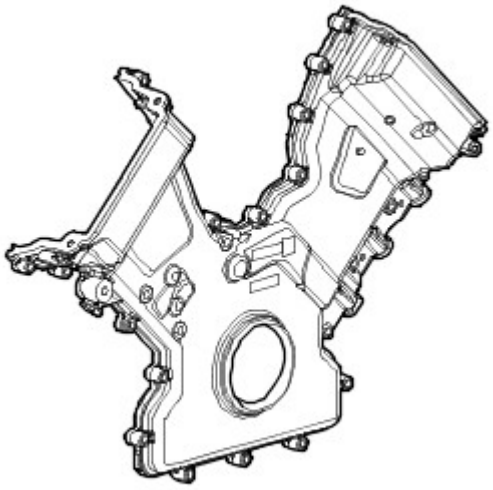
Timing Gear

Multiple link primary and single row secondary chains drive the camshafts of each cylinder bank. The primary chains transmit the drive from two sprockets on the crankshaft to variable valve timing units on the intake camshafts. The secondary chains transmit the drive from the variable valve-timing units to sprockets on the exhaust camshafts.

A key locates the two drive sprockets on the crankshaft. The crankshaft's torsional vibration damper retains the sprockets in position. The variable valve timing units and the exhaust camshaft sprockets are non-interference, non-keyed fits on their respective camshafts; the drive being transmitted by the face to face friction load produced by the valve timing unit/sprocket securing bolt.

Each chain has a hydraulic tensioner operated by engine oil. The primary chains are lubricated via oil squirt tubes located at the front of the engine block, near the crankshaft drive sprockets. A jet of oil from the end of each secondary chain tensioner lubricates the secondary chains. The primary chain tensioners act on pivoting flexible tensioner blades. The secondary chain tensioners act directly on the chains. Guide rails are installed on the drive side of the primary chains.

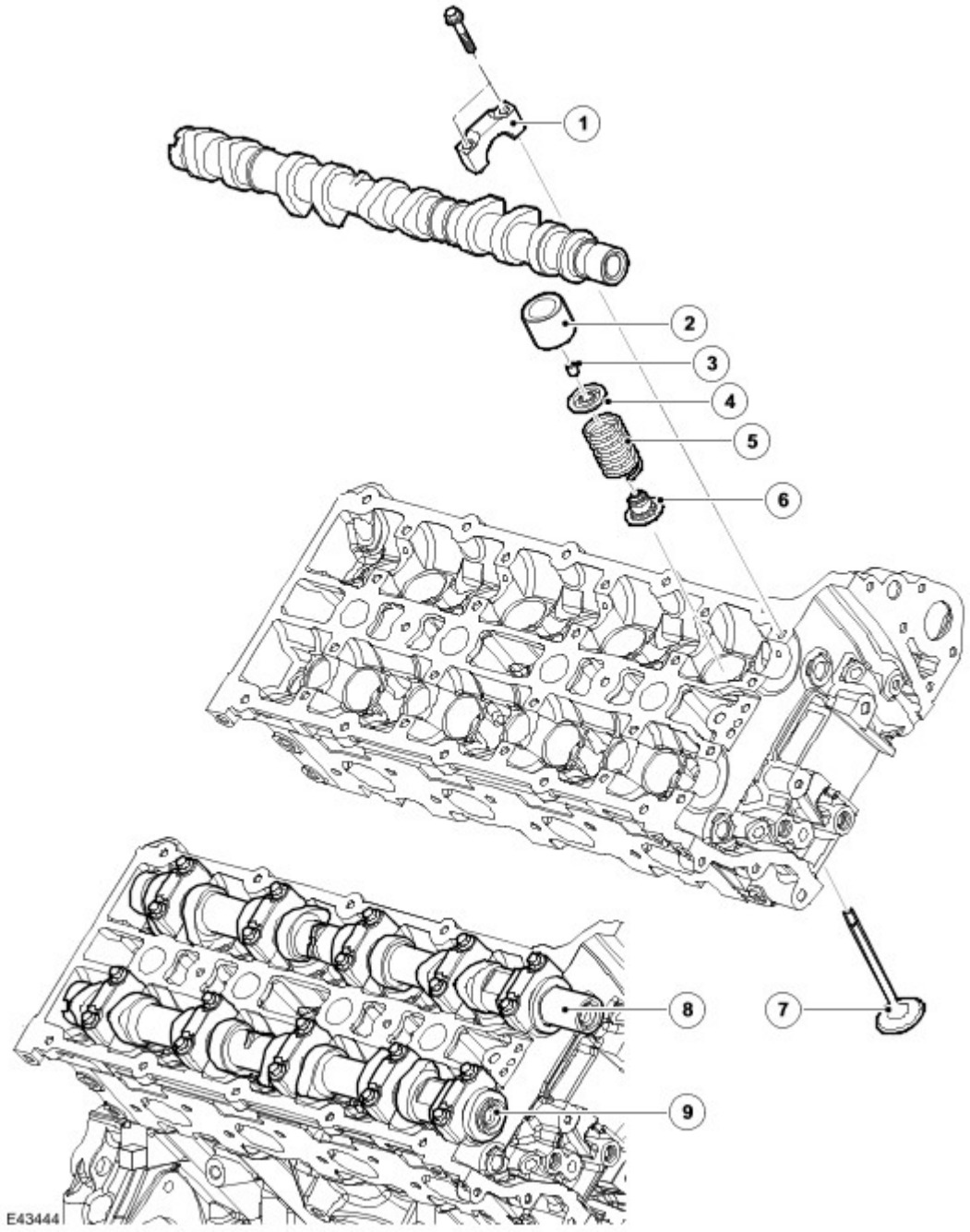
Timing Cover



E43443

The aluminium alloy timing cover accommodates the crankshaft front oil seal (a PTFE lip seal). Silicon rubber in-groove gaskets seal the joint between the timing cover and the front face of the engine.

CYLINDER HEAD COMPONENTS



Item	Part Number	Description
1	-	Camshaft bearing cap
2	-	Tappet (shimless)
3	-	Collet
4	-	Valve spring cap
5	-	Valve spring
6	-	Valve stem oil seal
7	-	Valve
8	-	Inlet camshaft
9	-	Exhaust camshaft

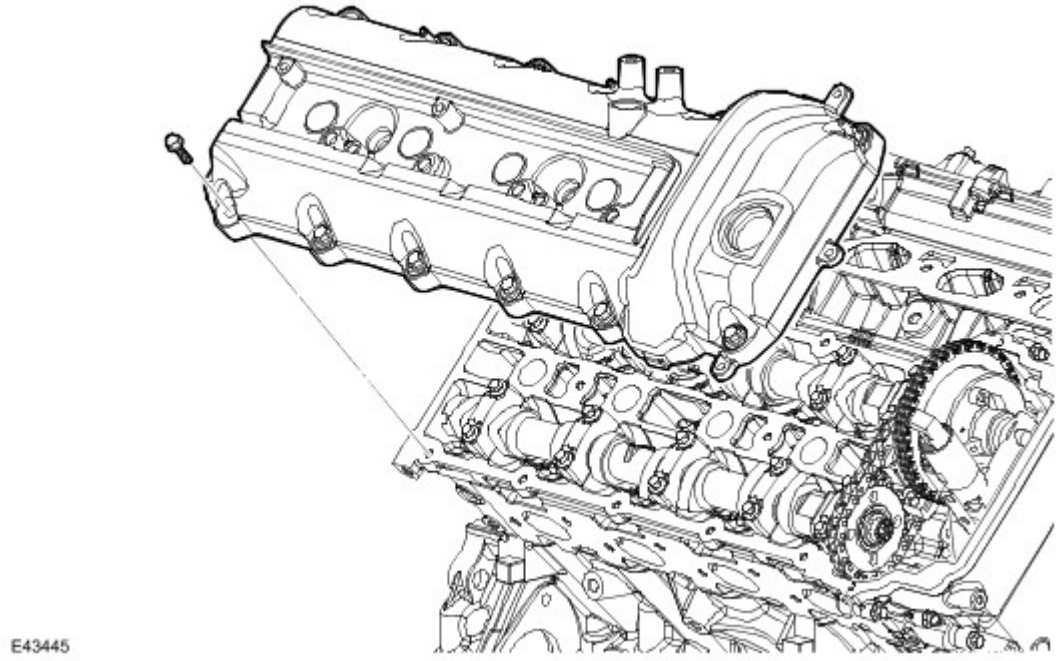
Cylinder Heads

The cylinder heads are unique to each cylinder bank. Deep-seated bolts, to reduce distortion, secure the cylinder heads to the cylinder block. Two hollow dowels align each cylinder head with the cylinder block.

The 14 mm spark plugs, one per cylinder, locate in recesses down the centre line of each cylinder head.

The engine-lifting eyes are bolted to the cylinder heads; two on the rear (one per head) and one at the front.

Camshaft Covers



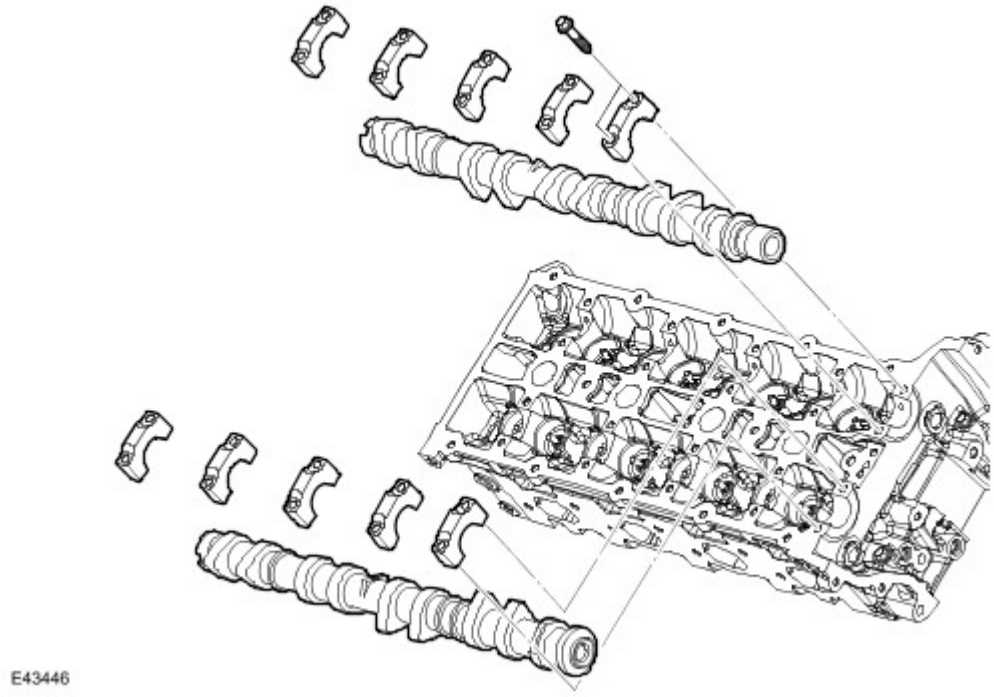
The camshaft covers are manufactured from thermo-plastic. The A bank camshaft cover incorporates an outlet for the part load engine breather. The bank B camshaft cover incorporates an outlet for the full load engine breather and the engine oil filler cap. Identical oil separators are incorporated below the breather outlet in each cover. For additional information, refer to Electronic Engine Controls (303-14B Electronic Engine Controls - 4.4L)

Silicon rubber in-groove gaskets seal the joints between the camshaft covers and the cylinder heads. Together with spacers and seals on the camshaft cover fasteners, they also isolate the covers from direct contact with the cylinder heads, to reduce noise.

Cylinder Head Gasket

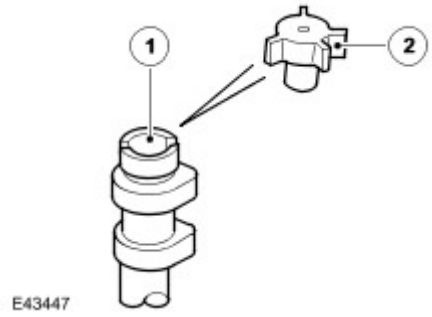
The multi-layered steel cylinder head gasket has cylinder specific water flow cross-sections for uniform coolant flow.

Camshafts



The camshafts are manufactured in chilled cast iron. Five aluminium alloy caps retain each camshaft. Location numbers, 0 to 4 for the intake camshaft and 5 to 9 for the exhaust camshaft, are marked on the outer faces of the caps.

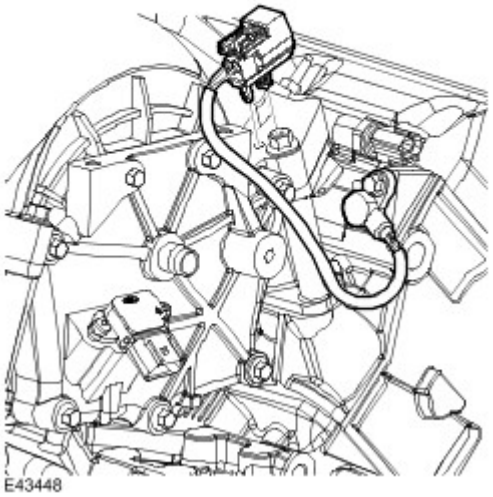
Sensor Ring



Item	Part Number	Description
1	-	Inlet camshaft
2	-	Sensor ring

Timing rings for each camshaft position sensor are located at the rear of both intake camshafts. A flat, machined near the front of each camshaft, enables the camshafts to be locked during the valve timing procedure.

Camshaft Position Sensor



The camshaft position sensors are installed in each cylinder head at the rear of the intake camshaft. It is a variable reluctance sensor that provides an input to the ECM regarding the position of the camshaft. For additional information, refer to Electronic Engine Controls (303-14B Electronic Engine Controls - 4.4L)

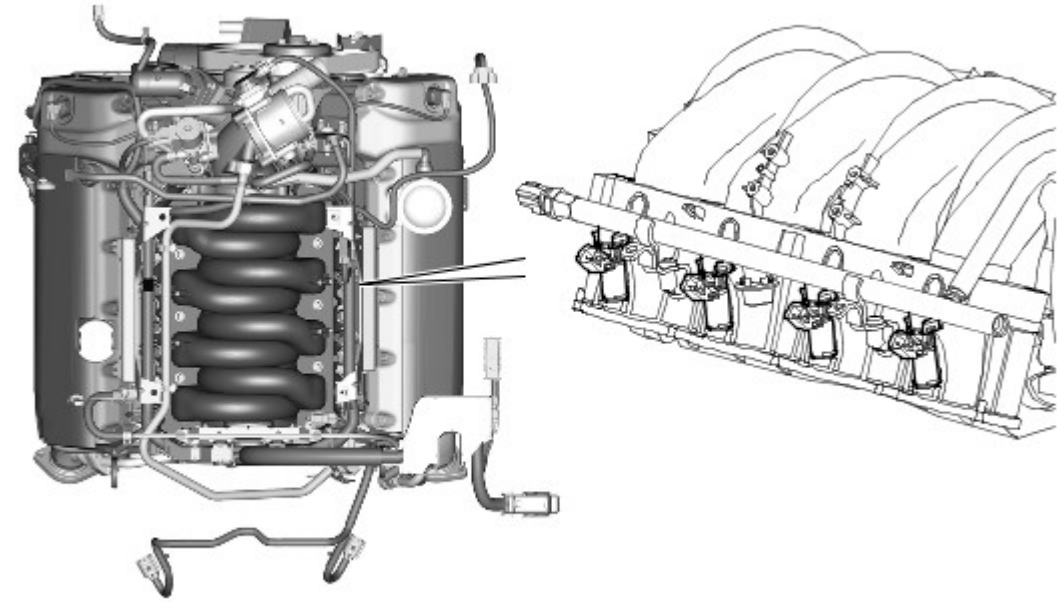
Inlet and Exhaust Valves

Each cylinder head incorporates dual overhead camshafts operating four valves per cylinder via solid shimless aluminium alloy valve lifters.

The lightweight valve gear provides good economy and noise levels. Valve head diameters are 31mm (1.220 in) for the exhaust and 35mm (1.378 in) for the intake. All valves have 5mm (0.197 in) diameter stems supported in sintered metal seats and guide inserts. Collets, valve collars and spring seats locate single valve springs on both intake and exhaust valves. Valve stem seals are integrated into the spring seats.

CAUTION : Due to slight variations in length, the valves are not interchangeable between marques (Land Rover, Jaguar and Aston Martin).

Fuel Injectors



E43449

Eight, top fed, 12-jet, fuel injectors are installed in the fuel rails. The injectors are electromagnetic solenoid valves controlled by the ECM. Two O-rings seal each injector to manifold interface. The fuel jets from the injectors are directed onto the back of the intake valves. For additional information, refer to Electronic Engine Controls (303-14B Electronic Engine Controls - 4.4L)

VARIABLE VALVE TIMING (VVT)

The continuously VVT unit turns the intake camshaft in relation to the primary chain to advance and retard the timing.

The system improves low and high-speed engine performance, engine idle quality and exhaust emission.

The VVT system changes the phasing of the intake valves, relative to the fixed timing of the exhaust valves, to alter:

- the mass of air flow into the engine's cylinders,
- and the engine's torque response and emissions.

The VVT unit uses a vane device to control the camshaft angle (refer to VVT operation). The system operates over a range of 48° and is advanced or retarded to the optimum angle within this range.

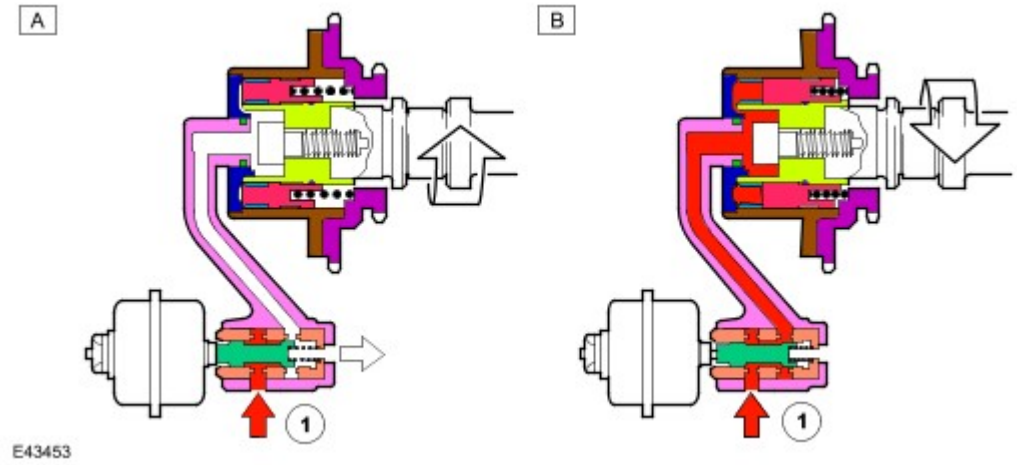
The ECM controls the VVT, using engine speed and load, and engine oil temperature signals to calculate the appropriate camshaft position. For additional information, refer to Electronic Engine Controls (303-14B Electronic Engine Controls - 4.4L)

The continuous VVT system provides the following advantages:

- Reduces engine emissions and fuel consumption by further optimising the camshaft timing, this improves the engine's internal exhaust gas re-circulation (EGR) effect over a wider operating range
- Improves full-load torque characteristics as the camshaft timing is optimised at all engine speeds for superior volumetric efficiency
- Improves fuel economy by optimising torque over the engine's speed range.

This system also has the added benefits of operating at a lower oil-pressure and faster response time when compared to a non-VVT system.

Variable Valve Timing Operation



Item	Part Number	Description
A	-	Retarded
B	-	Advanced
1	-	Engine oil pressure

The VVT unit is a hydraulic actuator mounted on the end of the intake camshaft, which advances or retards the intake camshaft timing and thereby alters the camshaft to crankshaft phasing. The oil control solenoid, controlled by the ECM, routes oil pressure to either the advance or retard chambers located either side of the three vanes interspersed within the machined housing of the unit.

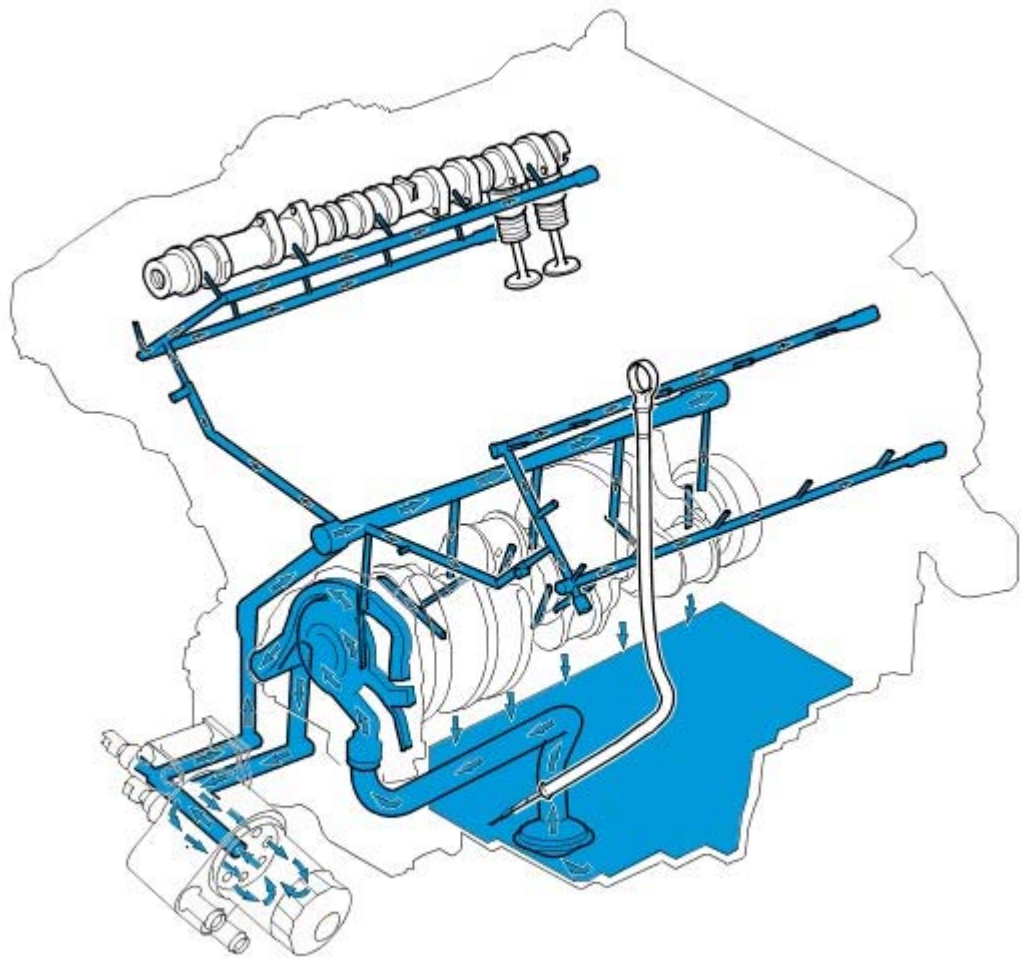
The VVT unit is driven by the primary chain and rotates relative to the exhaust camshaft sprocket. When the ECM requests the camshaft timing to advance, the oil control solenoid is energized moving the shuttle valve to the relevant position to allow engine oil pressure, via a filter, into the VVT unit's advance chambers. When the camshaft timing is requested to retard, the shuttle valve moves position to allow oil pressure to exit the advance chambers, while simultaneously routing the oil pressure into the retard chambers.

When directed by the ECM, the VVT unit will be set to the optimum position between full advance and retard for a particular engine speed and load. This is achieved when the ECM sends the energising signal to the oil control solenoid until the target position is met. At this point, the energizing signal is reduced to hold the solenoid position, and as a result the position of the shuttle valve. This function is under closed-loop control, where the ECM will assess any decrease in shuttle-valve oil-pressure, via signals from the camshaft position sensor. The ECM will increase the energizing signal, when required, to maintain the shuttle-valve hold position.

Engine oil properties and temperature can affect the ability of the VVT mechanism to follow demand changes to the cam phase angle. At very low oil-temperatures, movement of the VVT mechanism is sluggish due to increased viscosity, and at high oil-temperatures the reduced viscosity may impair operation if the oil pressure is too low. To maintain satisfactory VVT performance, an increased capacity oil pump is installed, plus an engine oil temperature sensor to enable monitoring by the ECM. The VVT system is normally under closed-loop control except in extreme temperature conditions, such as cold starts below 0°C. At extremely high oil-temperatures, the ECM may limit the amount of VVT advance to prevent the engine from stalling when returning to idle speed.

The VVT does not operate when engine oil-pressure is below 1.25 bar, as there is insufficient pressure to release the VVT unit's internal stopper pin. This usually occurs when the engine is shutting-down and the VVT has returned to the retarded position. The stopper pin locks the camshaft to the VVT unit to ensure camshaft stability during the next engine start-up.

LUBRICATION SYSTEM



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General

Oil is drawn from the reservoir in the oil pan and pressurised by the oil pump. The output from the oil pump is then filtered, cooled and distributed through internal oil passages.

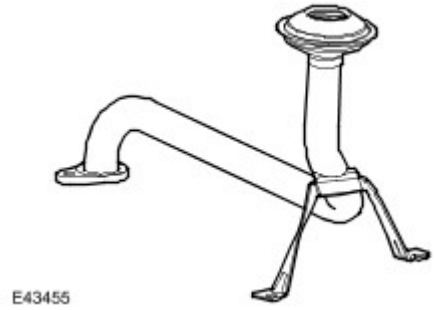
All moving parts are lubricated by pressure or splash oil. Pressurised oil is also provided for operation of the variable valve timing units and the timing gear chain tensioners.

The oil returns to the oil pan under gravity. Large drain holes through the cylinder heads and cylinder block ensure the quick return of the oil, reducing the volume of oil required and enabling an accurate check of the contents soon after the engine stops.

System replenishment is through the oil filler cap on the bank 'B' camshaft cover.

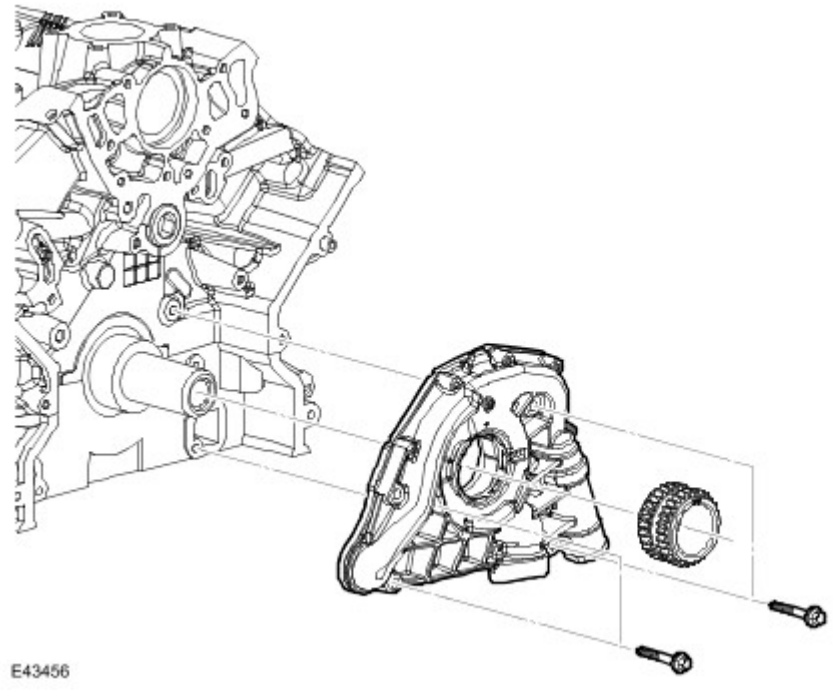
With the exception of the pump, all oil system components are installed on the structural sump.

Oil Pick-up



The fabricated steel oil pick-up is immersed in the oil reservoir to provide a supply to the oil pump during all normal vehicle attitudes. A mesh screen in the inlet prevents debris from entering the oil system.

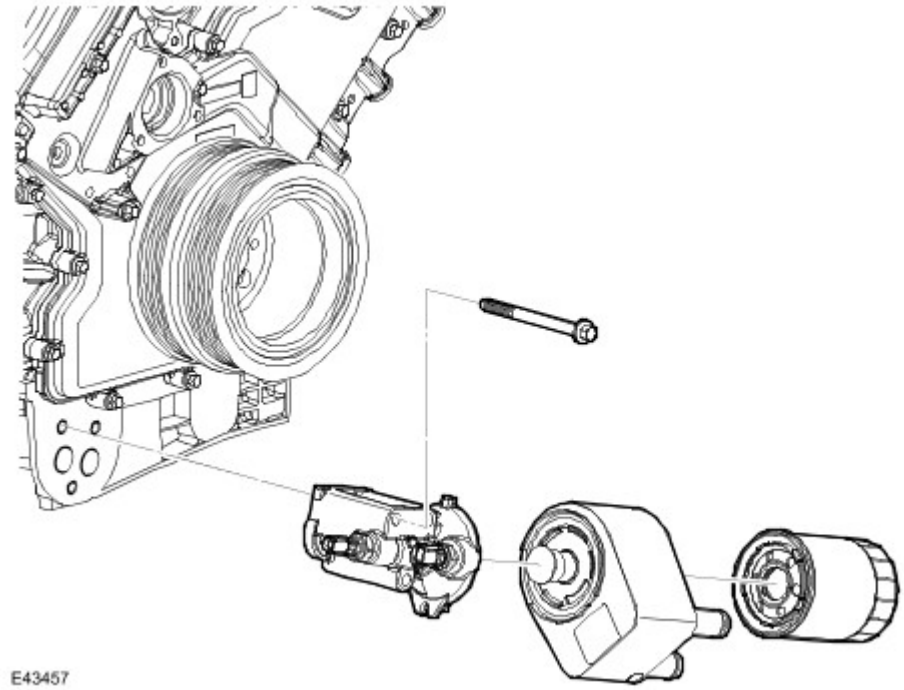
Oil Pump



The oil pump is installed on the crankshaft at the front of the engine. The pump inlet and outlet ports align with oil passages in the bedplate.

The pumping element is an eccentric rotor, which is directly driven by flats on the crankshaft. An integral pressure relief valve regulates pump outlet pressure at 4.5 bar (65.25 psi).

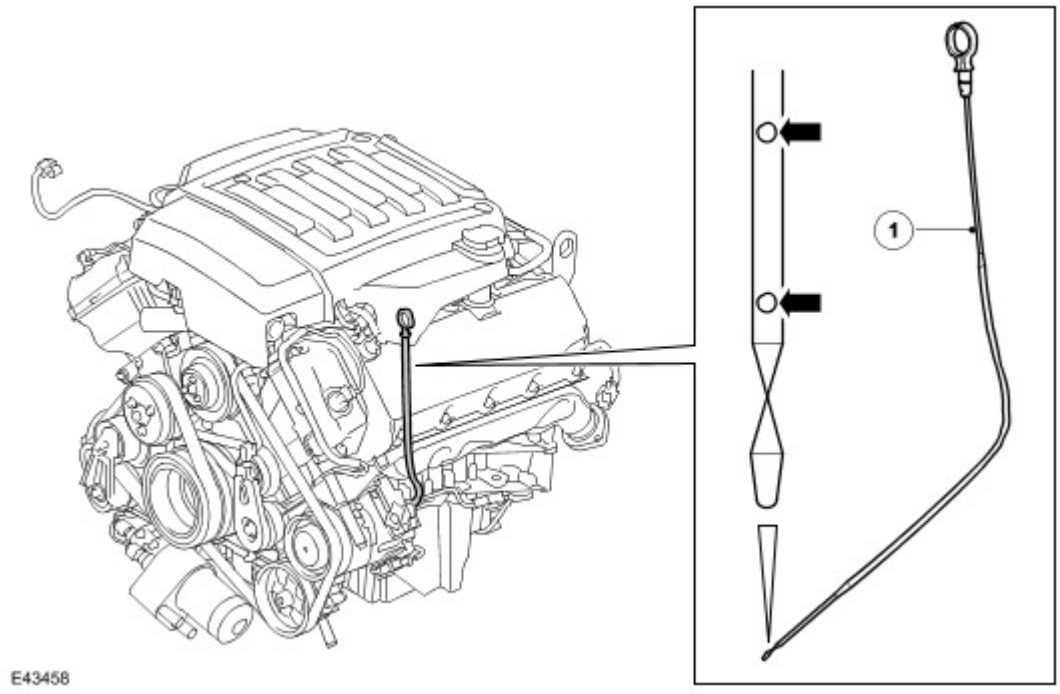
Oil Filter and Oil Pressure Switch



The oil filter is a replaceable cartridge installed on an adapter. An internal bypass facility permits full flow bypass if the filter is blocked.

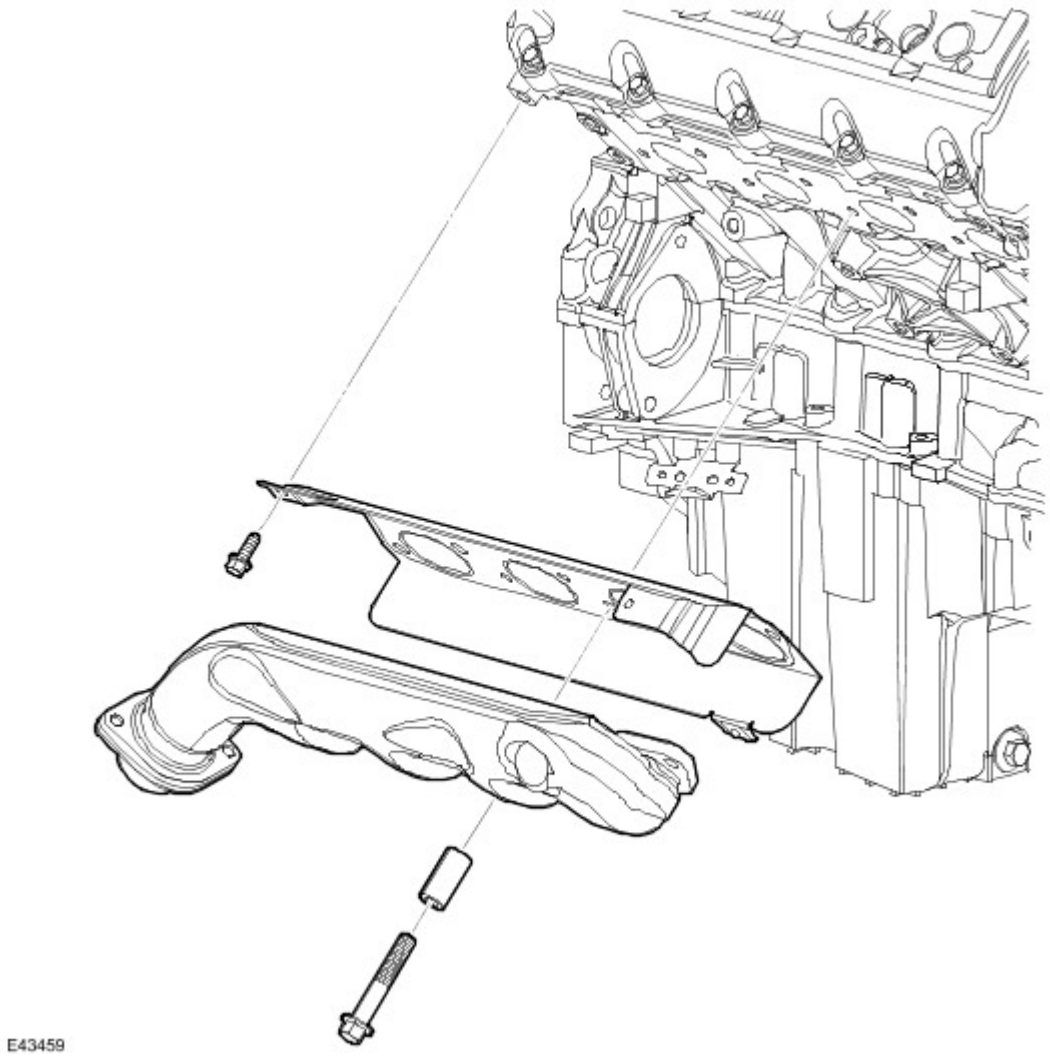
The oil pressure switch connects a ground input to the instrument cluster when oil pressure is present. The switch operates at a pressure of 0.15 to 0.41 bar (2.2 to 5.9 psi).

Oil Level Gauge



The oil level gauge locates along the left side of the oil pan, supported in a tube installed in the sump. Two holes in the end of the gauge indicate the minimum and maximum oil levels. There is a difference of approximately 1.5 litres (1.58 US quart) between the two levels.

EXHAUST MANIFOLD



The fabricated stainless steel twin skin exhaust manifolds are unique for each cylinder bank. The bank B manifold has a connection for the EGR transfer pipe.

Spacers on the securing bolts allow the manifolds to expand and retract with changes of temperature while maintaining the clamping loads.

Heat shields are integrated into the exhaust manifold gaskets.