

Engine - V6 4.0L Petrol -**Sealers**

Item	Land Rover Part No.
Engine timing cover to cylinder block	STC 50550
Rear main bearing cap to cylinder block	8510302

Lubricant - UK, Europe and ROW - Not NAS/Japan

Item	Specification
* Recommended Lubricant	The use of 5W/30 oil to Specification WSS - M2C929-A is preferred. Where oil to this specification is not available, then 5W/30 oil meeting specifications ACEA A1/A3 or API SJ or SL may be used.

* **WSS is a Ford prefix to the oil specification****Lubricant - NAS/Japan**

Item	Specification
* Recommended Lubricant	Use 5W/30 oil meeting Specification WSS-M2C929-A (GF4) and 'Certified for Gasoline Engines' by the American Petroleum Institute (API).

* **WSS is a Ford prefix to the oil specification****Capacity**

Item	Capacity
Dry fill including filter	6.4 litres (11.2 pints) (6.7 US quarts)
Oil and filter change - Maximum	5.7 litres (10.0 pints) (6.0 US quarts)
Amount of oil required to bring the level from the lower to the upper holes on the dipstick	1.4 litres (2.4 pints) (1.5 US quarts)

General Specification

Item	Specification
Type	4.0 litre, 60 degree 'V', petrol engine, single overhead camshaft per cylinder head, 2 valves per cylinder
Cylinder arrangement	V6, when looking towards the rear of the engine, cylinders 5 and 6 are at the rear.
Cylinder numbering	Number 1, 3, 5 cylinder - right hand bank; Number 2, 4, 6 cylinder - left hand bank
Bore - nominal	100.4 mm (3.952 in)
Stroke	84.4 mm (3.322 in)
Capacity	4009 cm ³ (244.5 in ³)
Firing order	1 - 2 - 3 - 4 - 5 - 6
Compression ratio	9.75:1
Direction of rotation	Anti-clockwise viewed from rear of engine
Maximum power	156 Kw (209 bhp) @ 4750 rev/min
Maximum torque	346 Nm (255 lb-ft) @ 3500 rev/min
Dimensions:	
Length	669 mm (26.3 in)
Width	712 mm (28.0 in)
Height	747 mm (29.4 in)
Maximum permissible cylinder head warp	0.08 mm (0.003 in)
Engine oil pressure:	
At Idle	1.8 - 2.0 bars (180 - 200 kPa) (26.0 - 29.0 lb/in ²)
At 3500 rev/min	3.3 to 3.6 bars (330 - 360 kPa) (48.0 - 52.0 lb/in ²)

Torque Specifications

Description	Nm	lb-ft
Engine RH mounting bracket bolts	80	59
Engine RH mounting bracket nut	90	66
* Engine RH mounting to bracket bolts:		
Stage 1	45	33
Stage 2	Further 60°	Further 60°
+ LH and RH Exhaust manifold nuts	25	18
Dipstick tube bolt	10	7
* Exhaust system to exhaust manifold bolts	40	30
+ RH valve cover bolts/studs	10	7
+ LH valve cover bolts/studs	10	7
CMP sensor bolt	6	4
++ LH/RH camshaft cap bolts:		
Stage 1	6	4
Stage 2	16	12
*+ # Cylinder head bolts:		
Stage 1 - M12 bolts	30	22
Stage 2 - M12 Bolts	Further 80°	Further 80°
Stage 3 - M12 bolts	Further 80°	Further 80°
M8 bolts	35	26
Cylinder head coolant flange bolts	10	7
RH Cylinder head ground connector bolt	10	7
Generator mounting bracket bolts	45	33
+ Generator bolts	45	33

Description	Nm	lb-ft
Generator electrical connector nut	10	7
A/C compressor mounting bracket bolts	45	33
Knock sensor bracket bolt	10	7
Knock sensor retaining clip bolt	10	7
Electrical harness bridge bolt	45	33
EGR pipe nuts:		
Stage 1	Lightly tighten	Lightly tighten
Stage 2	40	30
Battery terminal clamp nut(s)	5	3.5
Wiring harness clamp bolt - RHD only	10	7
Oil pick-up pipe Torx screws	10	7
Oil strainer bolt	10	7
Oil pump Torx screws	20	15
Oil cooler lines nut and bolt	25	18
Oil cooler adapter	60	44
Transmission fluid lines bolt	10	7
Transmission fluid lines nut	10	7
Transmission support bracket nut	20	15
Transmission bolts	45	33
Engine front cover:		
M6 bolts	10	7
M8 bolts and studs	20	15
Coolant pump bolts	10	7
Ground cable nut	20	15
+ Cylinder block cradle:		
Stage 1	Lightly tighten 2 rear bolts	Lightly tighten 2 rear bolts
Stage 2	Loosen 2 rear bolts	Loosen 2 rear bolts
Stage 3	Lightly tighten 2 rear bolts	Lightly tighten 2 rear bolts
Stage 4 - Outer bolts, nuts and Torx screws	10	7
Stage 5 - 2 rear bolts	43	32
Stage 6 - Cylinder block cradle set screws	7	5
Stage 7 - Cylinder block cradle bolts	15	11
Stage 8 - Cylinder block cradle bolts	34	25
* Crankshaft pulley bolt:		
Stage 1	55	40
Stage 2	Further 85°	Further 85°
LH and RH camshaft sprocket bolts:		
Stage 1	20	15
Stage 2	Further 100°	Further 100°
Oil temperature sensor	20	15
Radiator access panel bolts	10	7
Oil pan bolts	10	7
Wiring harness to oil pan nuts	6	4
** Balance shaft Torx bolts	29	21
LH camshaft drive cassette chain guide bolt	25	18
RH camshaft drive cassette bolt	12	9
* RH cassette jackshaft drive sprocket bolt (Rear):		
Stage 1	40	35
Stage 2	Further 45°	Further 45°
* Jackshaft sprocket Torx bolt (Front):		
Stage 1	45	33
Stage 2	Further 70°	Further 70°
Crankshaft position sensor (CKP) bolt	8	6
* Steering column lower universal joint 'Patchlok' bolts	25	18
Jackshaft thrust plate Torx bolts	10	7
Oil pump drive gear bolt	20	15
LH and RH hydraulic timing chain tensioner	45	33
Primary timing chain tensioner bolt	10	7
Oil filter	18	13
Oil drain plug	37	27
+* Starter motor cable nut	10	7
Starter motor bolts	45	33
Fuel rail bolts	25	18
Valve cover fuel line clip bolt	10	7
+ Intake manifold bolts	10	7
* RH catalytic converter to the exhaust manifold bolts	22	16
* LH catalytic converter to the exhaust manifold bolts	22	16
Flexplate to torque converter Torx bolts	45	33
Road wheel nuts	140	103

* New nuts/bolt(s) must be fitted

** New Torx bolts must be fitted

+ Bolts/Torx bolts/studs must be tightened in sequence

++ Bolts must be tightened in a diagonal sequence commencing with the 2 centre bearing caps

Lubricate threads of bolts with engine oil prior to fitting

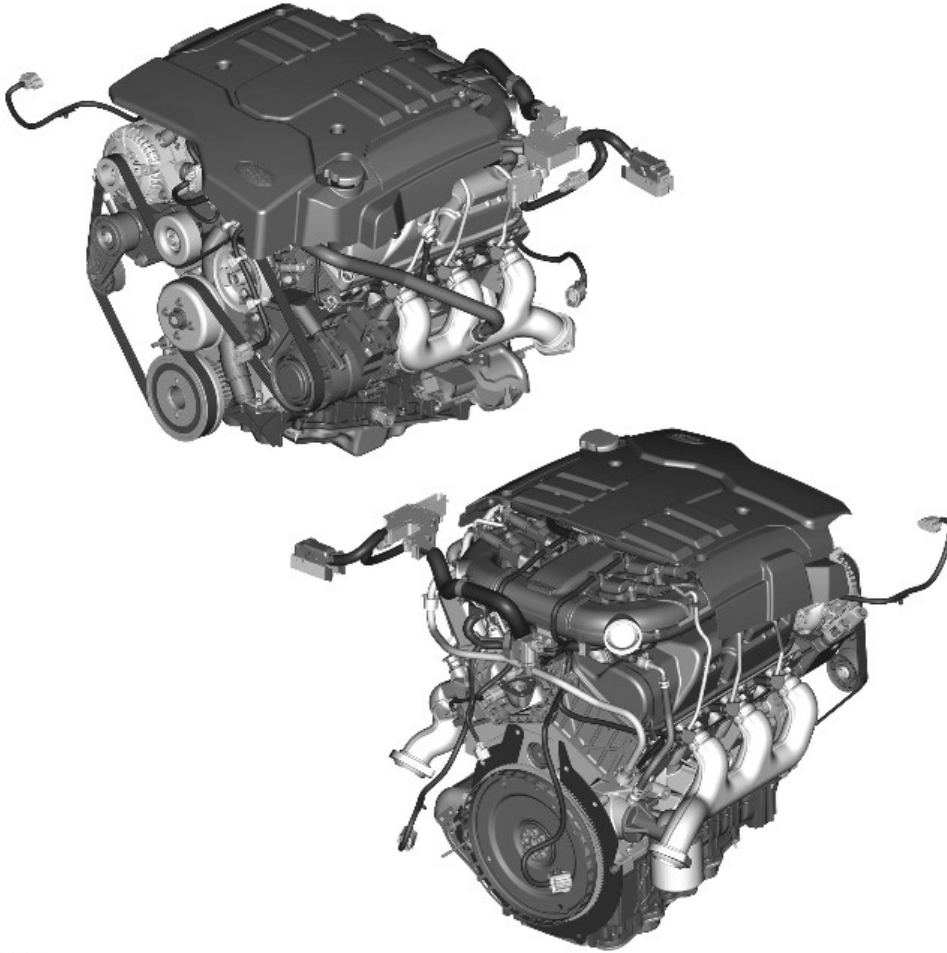
+ * Damage to internal components will result if this torque is exceeded

Engine - V6 4.0L Petrol - Engine

Description and Operation

External View

• NOTE: Variant without oil cooler shown.



E50486

GENERAL

The V6 petrol engine is a 4.0 litre, 6 cylinder, 60 degrees 'V' unit, with 2 valves per cylinder, operated by a single overhead camshaft. The engine emissions comply with ECD4 (European Commission Directive) and USA Tier 2 Bin 8 legislative requirements and employs catalytic converters, electronic engine management control, positive crankcase ventilation and exhaust gas recirculation to limit the emission of pollutants. The cooling system is a low volume, high velocity system. The fuel injection system is controlled by the Engine Control Module (ECM).

The cylinder block is of cast iron construction with a cast aluminum ladder frame and balance shaft assembly bolted to the bottom of the block. The cylinder heads are cast aluminum with vinyl ester composite camshaft covers. The single-piece oil sump is formed from pressed steel. The intake manifold is manufactured from cast aluminum and incorporates a central chamber with six inlet port tracts.

For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Description and Operation). The dual wall stainless steel 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.

Technical Features

The technical features include:

- A six cylinder, 60 degree 'V' configuration liquid cooled cast iron cylinder block
- Pistons comprise two compression rings and a three piece oil control ring
- Two aluminum cylinder heads, each incorporating a single hollow camshaft
- Rocker valve arms with hydraulic lash adjusters
- Engine front cover manufactured from aluminum which accommodates the coolant pump assembly
- Each camshaft is driven by a separate single row chain
- Electronically controlled vacuum operated Exhaust Gas Recirculation (EGR) valve
- Exhaust re-treatment by means of catalytic converters
- Cast aluminum engine ladder frame assembly
- A fully counter balanced cast iron crankshaft
- An advanced engine management system incorporating electronic throttle control
- Electronic Intake Manifold Tuning Valve (IMTV) with ECM control
- Emissions comply with ECD4 (European Commission Directive) and USA Tier 2 Bin 8 legislative requirements.

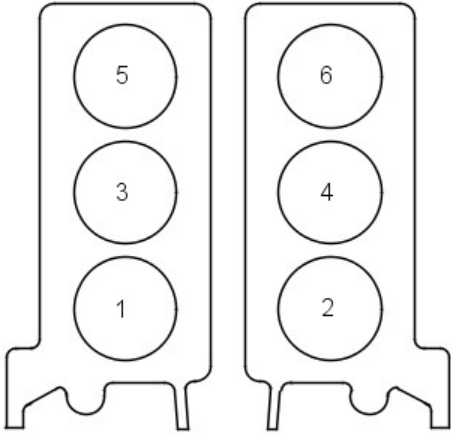
Engine Data

The technical data is detailed below.

	DESCRIPTION	TYPE
Configuration	60 degree V6	
Maximum power	156 kW at 4750 rpm	
Maximum torque	346 Nm at 3000 rpm	
Displacement	4009cc	
Stroke/bore	84.4mm/100.4mm	
Compression ratio	9.7:1	
Firing order	1 2 3 4 5 6	
Oil capacity	6.4 litres	

CYLINDER NUMBERING

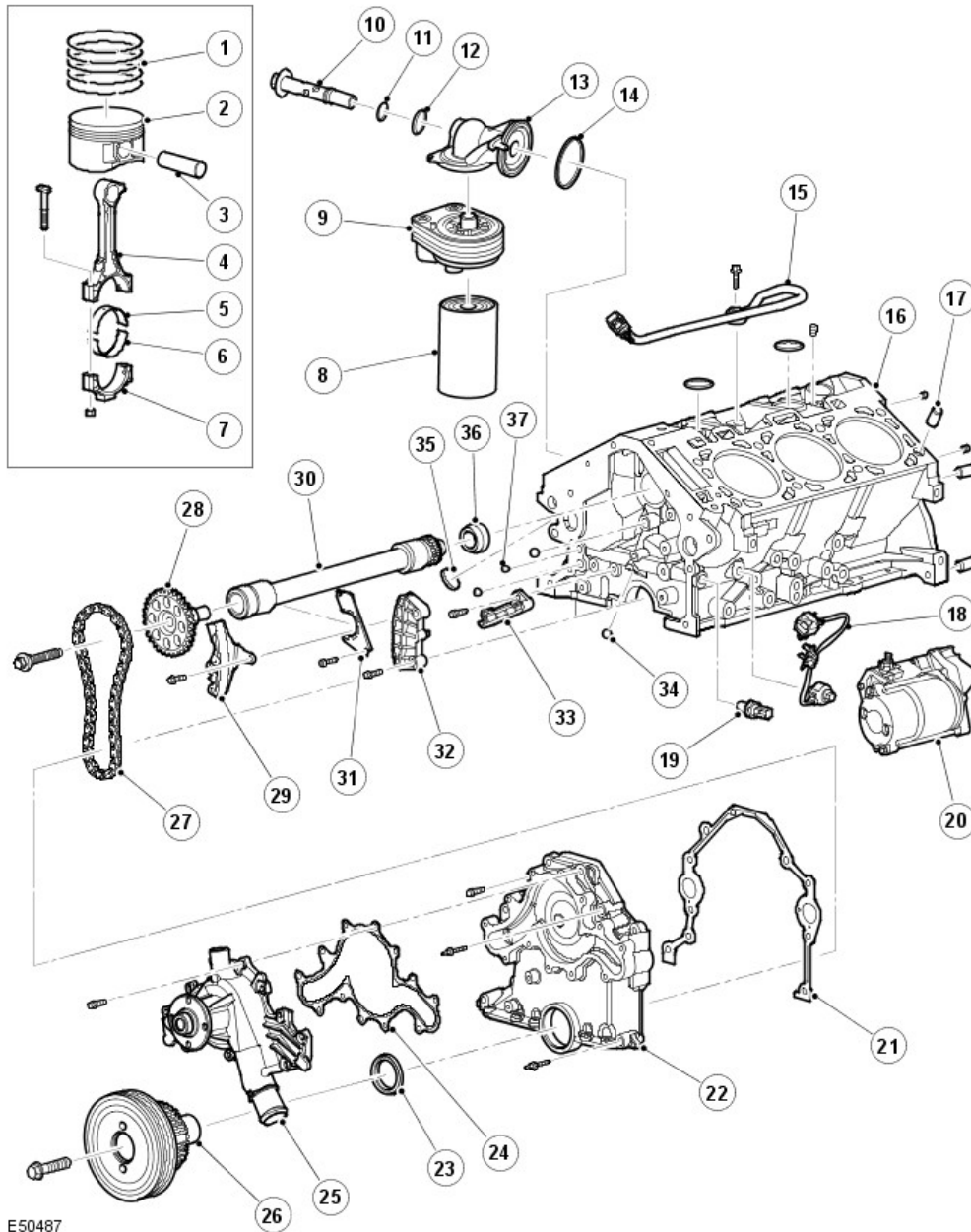
The cylinders are numbered as shown below, with cylinders 1 and 2 at the front of the engine.



E133974

CYLINDER BLOCK COMPONENTS

• NOTE: Variant with oil cooler shown.



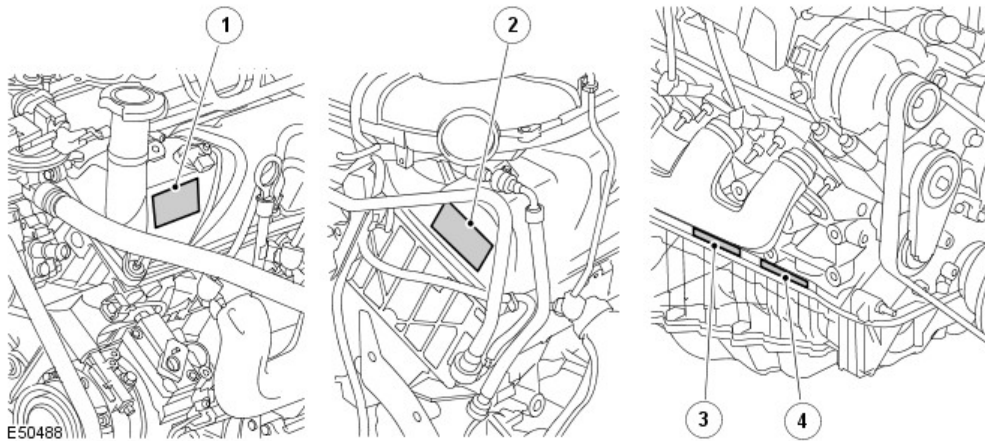
E50487

Item	Part Number	Description
1	-	Piston Rings
2	-	Piston
3	-	Piston pin
4	-	Connecting rod
5	-	Connecting rod bearing - upper
6	-	Connecting rod bearing - lower
7	-	Connecting rod cap
8	-	Oil filter
9	-	Oil cooler (if fitted)
10	-	Oil filter adapter mounting bolt
11	-	O ring
12	-	O ring
13	-	Oil filter adapter
14	-	O ring
15	-	Knock sensor
16	-	Cylinder block
17	-	Locating dowel
18	-	Knock sensor
19	-	Oil pressure switch
20	-	Starter motor
21	-	Gasket
22	-	Front cover
23	-	Seal
24	-	Gasket
25	-	Water pump
26	-	Crankshaft pulley
27	-	Jackshaft shaft chain
28	-	Jackshaft shaft sprocket
29	-	Chain tensioner
30	-	Jackshaft shaft
31	-	Jackshaft thrust plate
32	-	Chain guide
33	-	Chain guide
34	-	Oil gallery plug
35	-	Plug
36	-	Spacer
37	-	Oil gallery plug

Cylinder Block

The cylinder block is a '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.

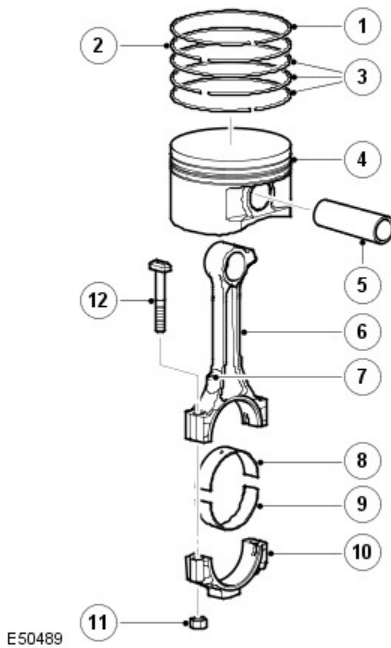
Engine Data Locations



Item	Part Number	Description
1	-	Engine data
2	-	Engine data
3	-	Vehicle Identification Number (primary location)
4	-	Vehicle Identification Number(secondary location)

Engine data is marked at three locations.

Pistons and Connecting Rod Assembly



Item	Part Number	Description
1	-	Piston ring, upper compression
2	-	Piston ring, lower compression
3	-	Piston rings, oil control
4	-	Piston
5	-	Piston pin
6	-	Connecting rod
7	-	Oil squirt hole
8	-	Connecting rod bearing, upper
9	-	Connecting rod bearing, lower
10	-	Connecting rod cap
11	-	Nut
12	-	Bolt

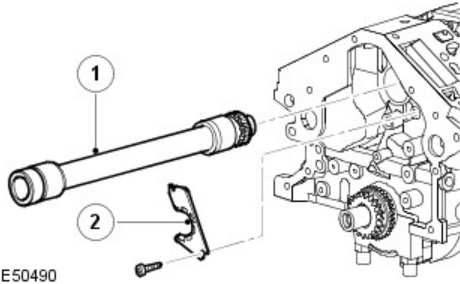
The aluminum alloy, thermal expansion, lightweight pistons, with semi-floating piston pins, are offset to the thrust side and are carried on forged steel connecting rods. Pistons are supplied in four grades, 1, 2, 3 and 4. The pistons are marked to ensure they are correctly oriented in the cylinder bore; the 'arrow' mark should be toward the front of the engine.

The V6 petrol engine utilizes forged steel H-sectioned connecting rods, with the piston pin being an interference fit in the small end of the connecting rod. The big ends are horizontally split.

Selective bearing shells with two grades of thickness; standard and 0.25 mm undersize, control big end bearing diametric clearance. The big-end upper and lower bearing shells are plain with locating tags.

Each piston is fitted with two compression rings and an oil control ring. The top compression ring has a nitrided surface, a process that involves the diffusion of nitrogen into the surface layers of a low carbon steel. The formation of nitrides provides an increased hardness. The 2nd compression ring is chrome-plated. The oil control rings have stainless steel top and bottom rails and integral expander rings.

Jackshaft Assembly

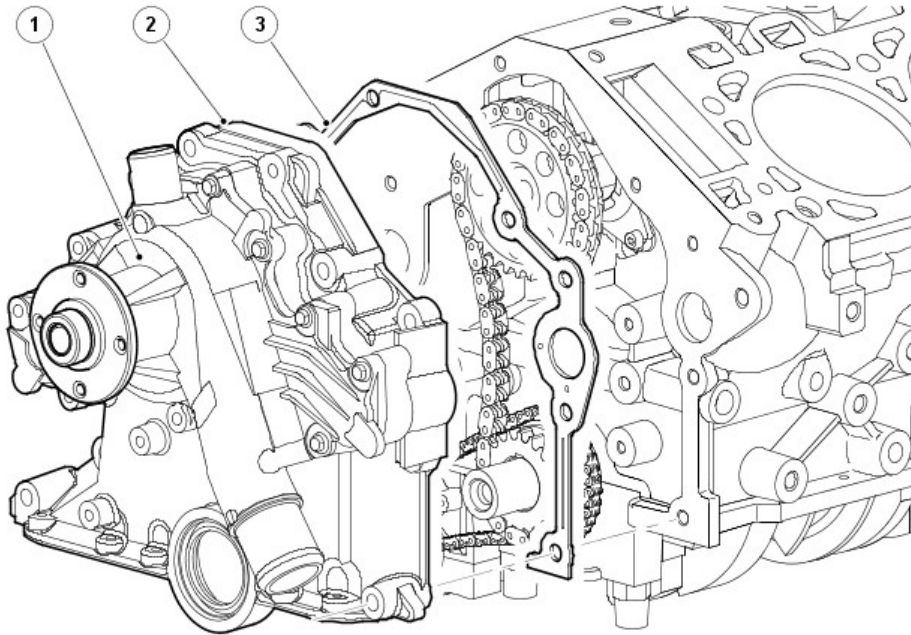


E50490

Item	Part Number	Description
1	-	Jackshaft
2	-	Thrust plate

The Jackshaft assembly is located centrally in the upper part of the cylinder block. The assembly is used to supply drive to each camshaft, via a chain. The LH camshaft is driven from the front of the Jackshaft and the RH camshaft is driven from the rear. The Jackshaft assembly is driven, via a chain, by the crankshaft gear at the front of the engine. The assembly is held in position by a thrust plate.

Front Cover and Water Pump Assembly



E50491

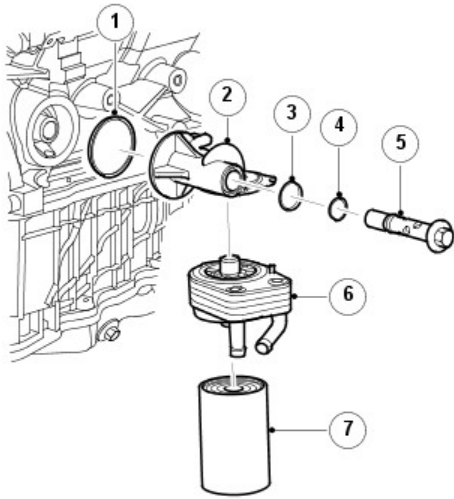
Item	Part Number	Description
1	-	Water pump assembly
2	-	Engine front cover
3	-	Gasket

The aluminum front cover assembly is secured to the engine block by five bolts and five studs and is sealed via a gasket. The front cover also houses the crankshaft front seal.

The water pump is attached to the engine front cover assembly and is secured and sealed, to the front cover, by twelve bolts and a gasket. A poly-vee belt drives the water pump via the crankshaft.

Oil Cooler (If Fitted) and Filter Assembly

- NOTE: Variant with oil cooler shown.



E50492

Item	Part Number	Description
1	-	O ring
2	-	Adapter
3	-	O ring
4	-	O ring
5	-	Adapter mounting bolt
6	-	Cooler assembly (if fitted)
7	-	Oil filter

A full-flow, disposable canister-type oil filter is attached to the oil cooler assembly (if fitted).

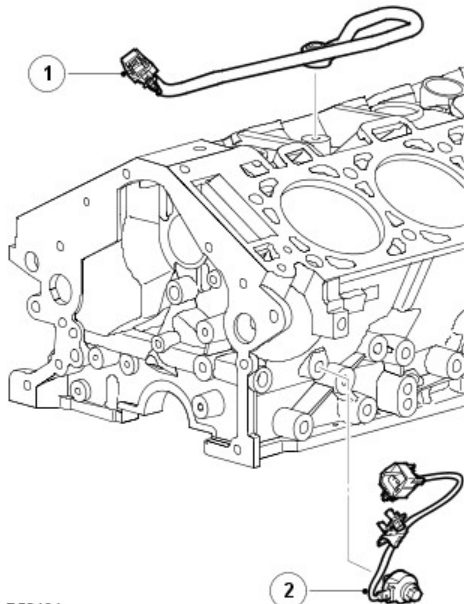
The oil filter and cooler assembly (if fitted) is attached the rear RH side of the cylinder block and consists a full-flow, disposable canister-type filter, cooler (if fitted) and an adapter.

The filter adapter-mounting bolt locates in the cylinder block oil gallery and is sealed by an 'O' ring. The filter adapter houses the adapter bolt and is also sealed to the cylinder block by an 'O' ring.

The oil cooler (if fitted) keeps the engine lubrication oil cool, under heavy loads and high ambient temperatures and is cooled by the engine cooling system.

Oil is delivered to and from the oil cooler (if fitted) through galleries in the cylinder block. Hoses from the engine cooling system are connected to two pipes on the oil cooler for the supply and return of coolant.

Knock Sensors



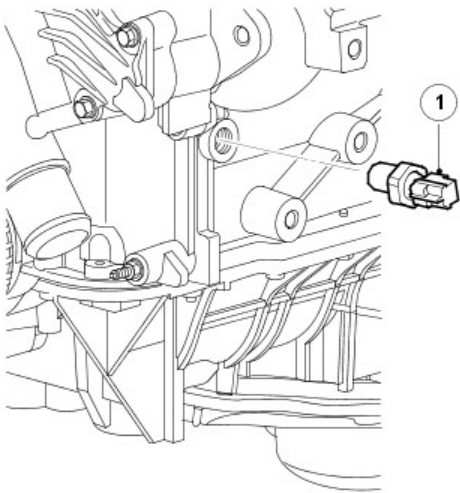
E50494

Item	Part Number	Description
1	-	RH knock sensor
2	-	LH knock sensor

The knock sensors are installed in the cylinder block in two different locations. One is located on the inboard of the RH cylinder bank and one is located at the front of the LH side of the cylinder block, next to the oil pressure switch. They are piezo-electric sensors that provide inputs to detect and locate detonation during combustion.

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

Oil Pressure Switch

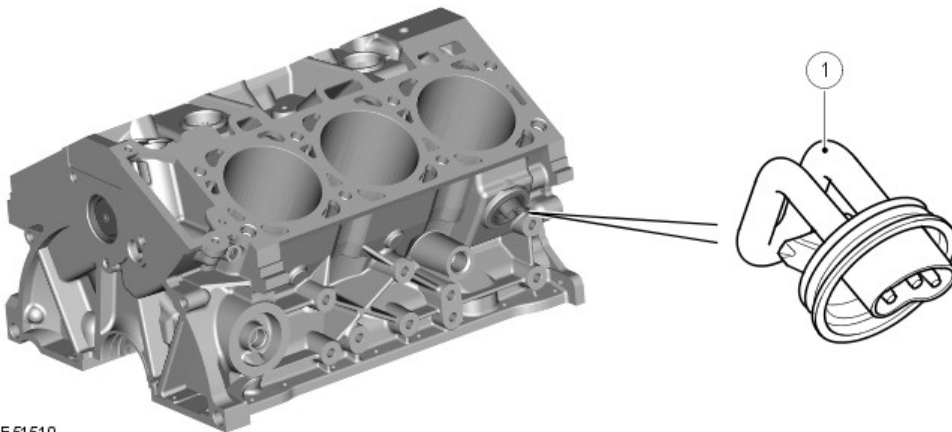


E50495

Item	Part Number	Description
1	-	Oil Pressure Switch

The oil pressure switch is located in a port at the front LH side of the cylinder block. It detects when a safe operating pressure has been reached during engine starting and initiates the illumination of a warning light in the instrument cluster if the oil pressure drops below a given value. The switch operates at a pressure of 0.15 to 0.41 bar (2.2 to 5.9 psi).

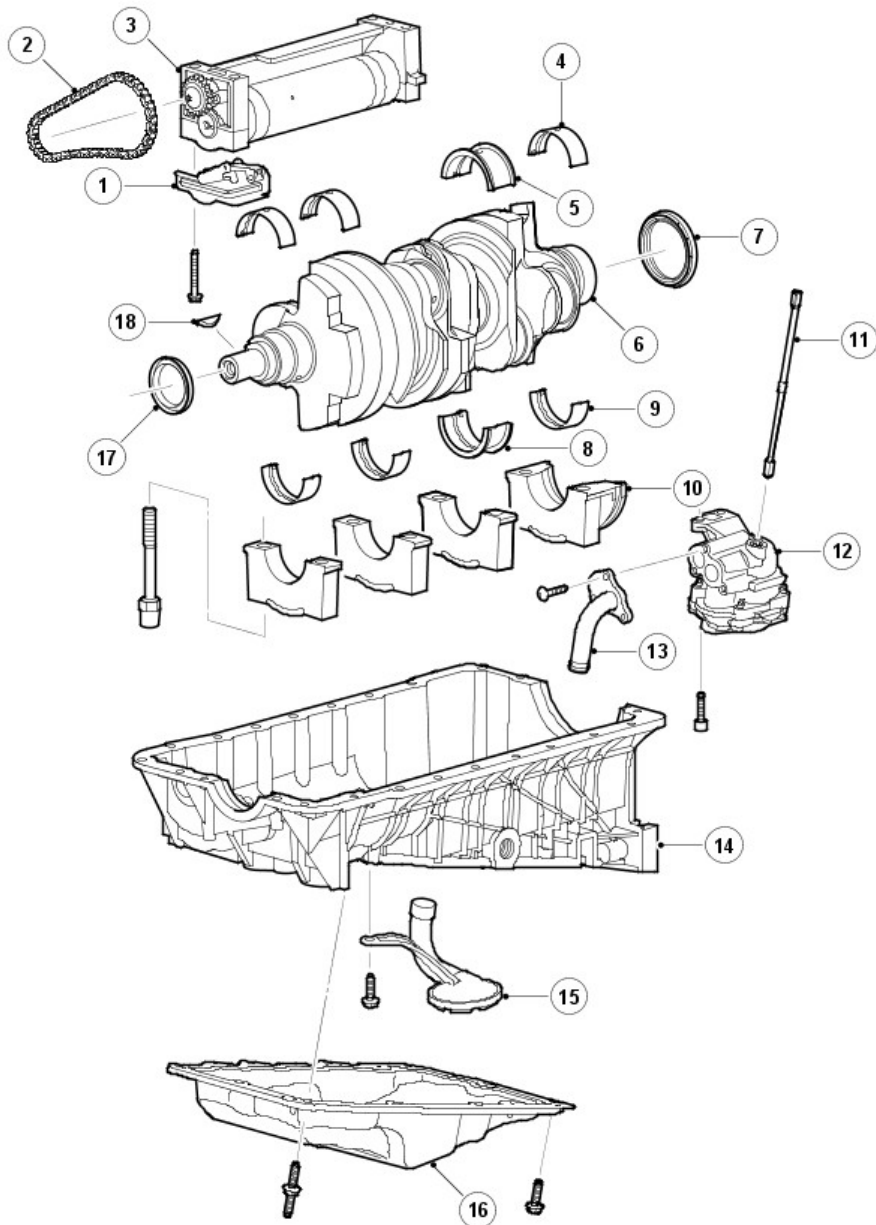
Engine Block Heater



E51510

For cold climate markets an engine block heater is fitted, which is located at the front of the LH side of the cylinder block.

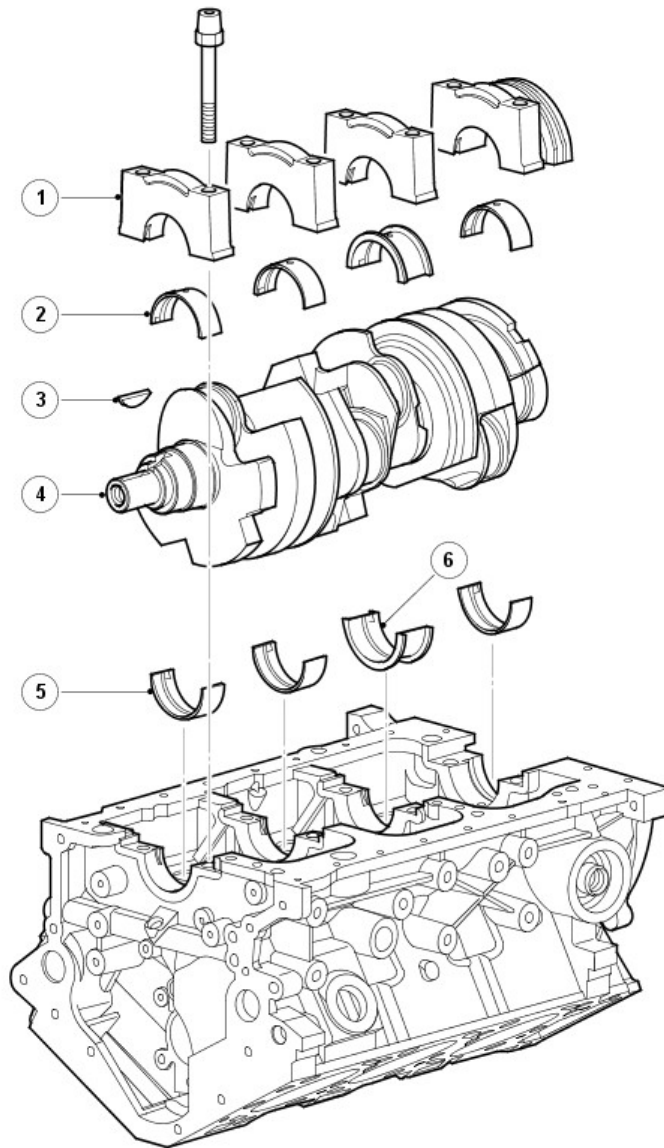
CRANKSHAFT, SUMP AND OIL PUMP COMPONENTS



E50497

Item	Part Number	Description
1	-	Tensioner
2	-	Chain
3	-	Balance shaft assembly
4	-	Main bearing, upper
5	-	Main thrust bearing, upper
6	-	Crankshaft
7	-	Crankshaft oil seal, rear
8	-	Main thrust bearing, lower
9	-	Main bearing, lower
10	-	Main bearing cap, rear
11	-	Intermediate shaft
12	-	Oil pump
13	-	Pick-up pipe adapter
14	-	Ladder frame
15	-	Oil pick-up pipe
16	-	Sump
17	-	Crankshaft oil seal, front
18	-	Key

Crankshaft and Main Bearings



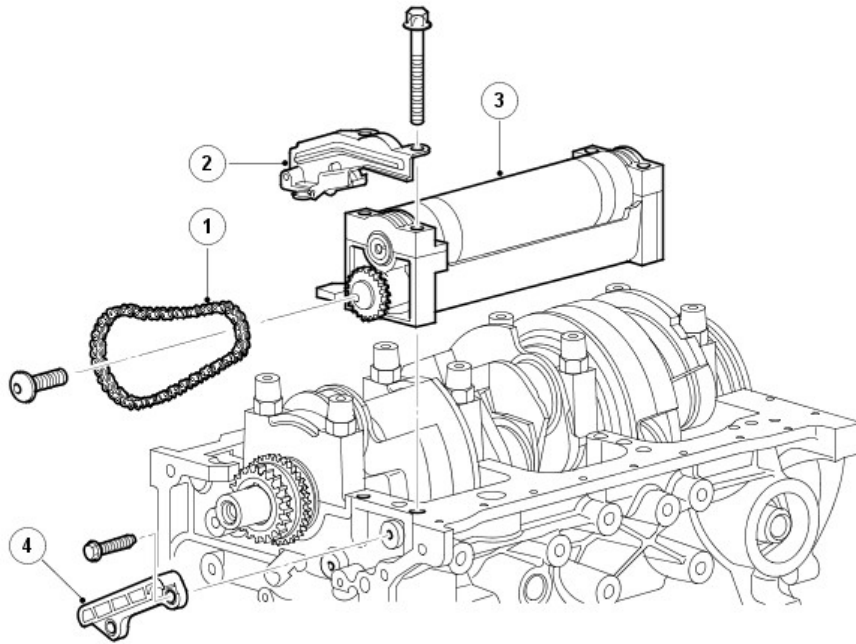
E50498

Item	Part Number	Description
1	-	Main bearing cap
2	-	Main bearing, lower
3	-	Key
4	-	Crankshaft
5	-	Main bearing, upper
6	-	Main bearing, thrust

The crankshaft is supported on four main bearings, with each pair of crankpins mutually offset by 30 degrees to give equal firing intervals. Cast in Spheroidal Graphite (SG) iron, the crankshaft has cold rolled fillets on all journals, except the outer mains, for toughness and failure resistance. The nine crankshaft counterweights increase smoothness and reduce bearing wear by splitting the loads evenly across the bearings. Thrust washer halves at the top and bottom of number three main bearing control end-float.

Oil grooves are provided in the upper and lower halves of all the main bearing shells to supply oil, via drillings in the crankshaft, to the connecting rod big-end bearings.

Balance Shaft Assembly



E50500

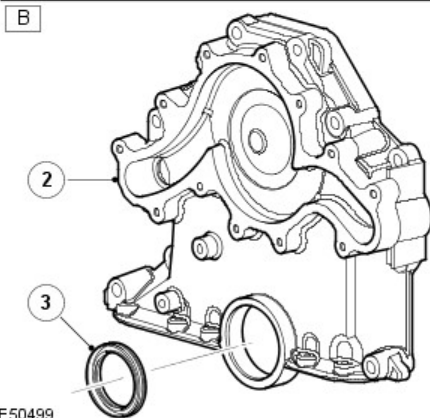
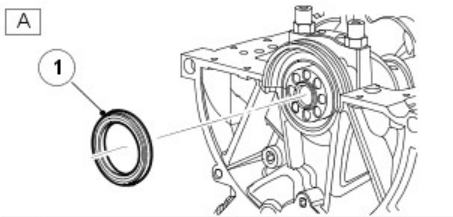
Item	Part Number	Description
1	-	Drive chain
2	-	Tensioner assembly
3	-	Balance assembly
4	-	Chain guide

A 60 degree V6 is often thought of inherently balanced, because its first-order forces can be compensated by crankshaft counter-weighting. However, the V6 4.0L engine generates a second-order unbalanced at twice the crank speed.

To achieve the desired smoothness, the V6 4.0L engine includes a unique counter-rotating balance shaft, which is chain driven by the crankshaft and runs at twice engine speed. The shaft produces an opposite second-order force, which cancels the inherent unbalance.

Since the balance shaft is positioned on the bottom the cylinder block, on the RH side and is secured by 4 bolts. Because the unit is near the engine oil level, it is encased in a steel tube to avoid aerating the oil. The balance shaft attaches to the engine as an assembled unit, including an integrated gear and lubrication system. The gear is needed to rotate the shaft in the same direction as the unbalanced force.

Crankshaft Oil Seals

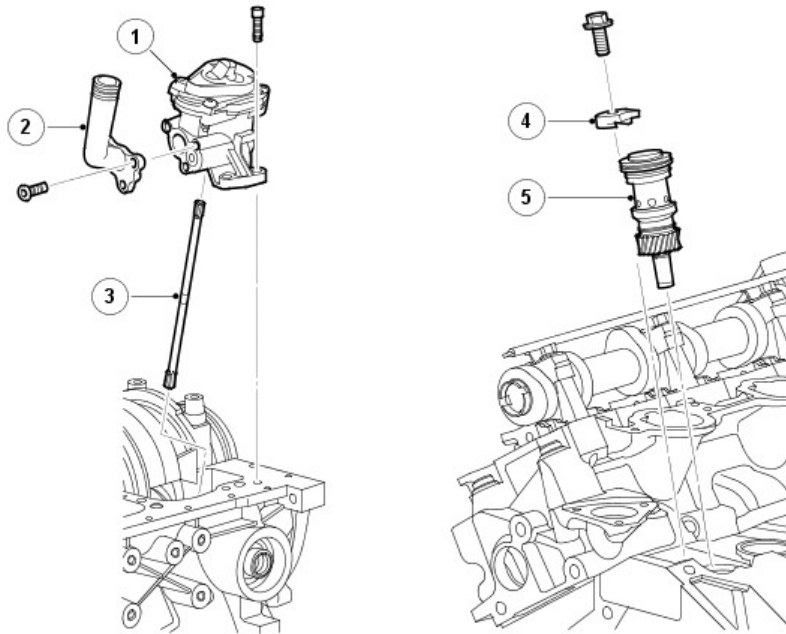


E50499

Item	Part Number	Description
A	-	Rear
B	-	Front
1	-	Rear seal
2	-	Front cover
3	-	Front seal

The rear crankshaft oil seal is a press fit in the rear of the cylinder block. The front crankshaft oil seal is located in the engine front cover assembly, just below the water pump.

Oil Pump

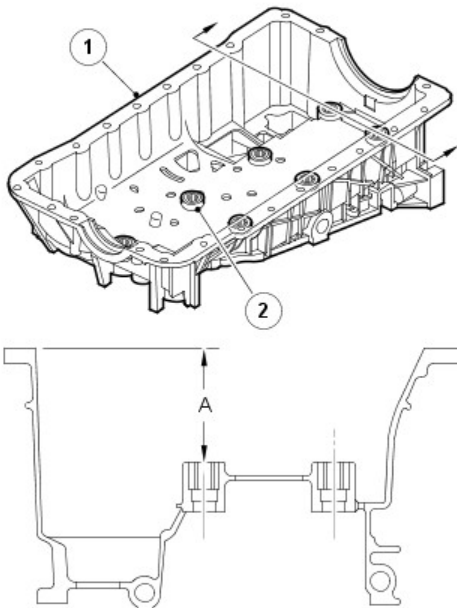


E50501

Item	Part Number	Description
1	-	Oil pump
2	-	Pick-up pipe adapter assembly
3	-	Intermediate shaft
4	-	Clamp
5	-	Drive assembly

The oil pump is located on the RH rear underside of the cylinder block, contained within the ladder frame assembly, and is secured by two bolts. The unit is driven by the jackshaft, via an intermediate shaft, and receives its oil feed from the main gallery via drillings in the cylinder block. The intermediate shaft locates through the cylinder block and is connected to the drive assembly, which is situated in the 'V' at the rear of the engine and held in place via a clamp. The oil pump housing includes the oil pressure relief valve.

Engine Ladder Frame Assembly



E50502

Item	Part Number	Description
A	-	69.8 mm minimum
1	-	Engine bulkhead housing
2	-	Crankshaft main bearing cap adjustment screw

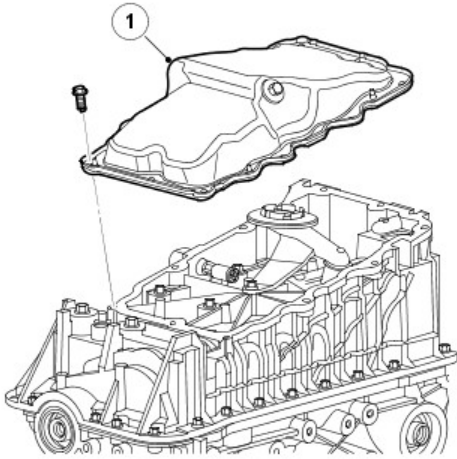
The ladder frame is fitted to the lower cylinder block, via 20 bolts and 2 studs and nuts, to stiffen the base structure thus helping to reduce Noise, Vibration and Harshness (NVH). The frame is made of high-pressure die cast aluminum.

Located in the bulkhead housing are eight crankshaft main bearing cap adjustment screws.

A gasket seals the joint between the bulkhead housing and the cylinder block.

A port for the oil level gauge tube is included in the casting on the LH side of the cylinder block.

Sump

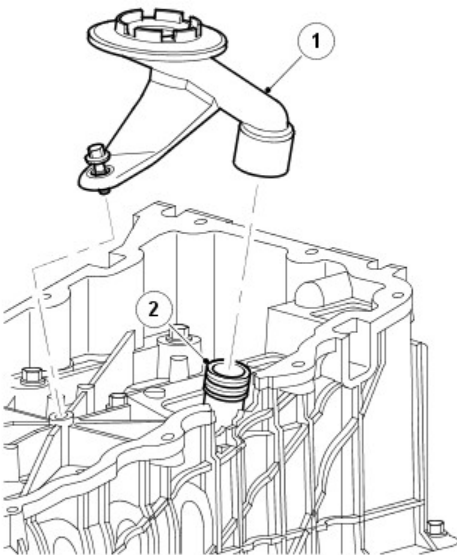


E50503

Item	Part Number	Description
1	-	Sump

The pressed steel sump is a wet-type, sealed to the ladder frame using a gasket and 10 bolts.

Oil Pick-up

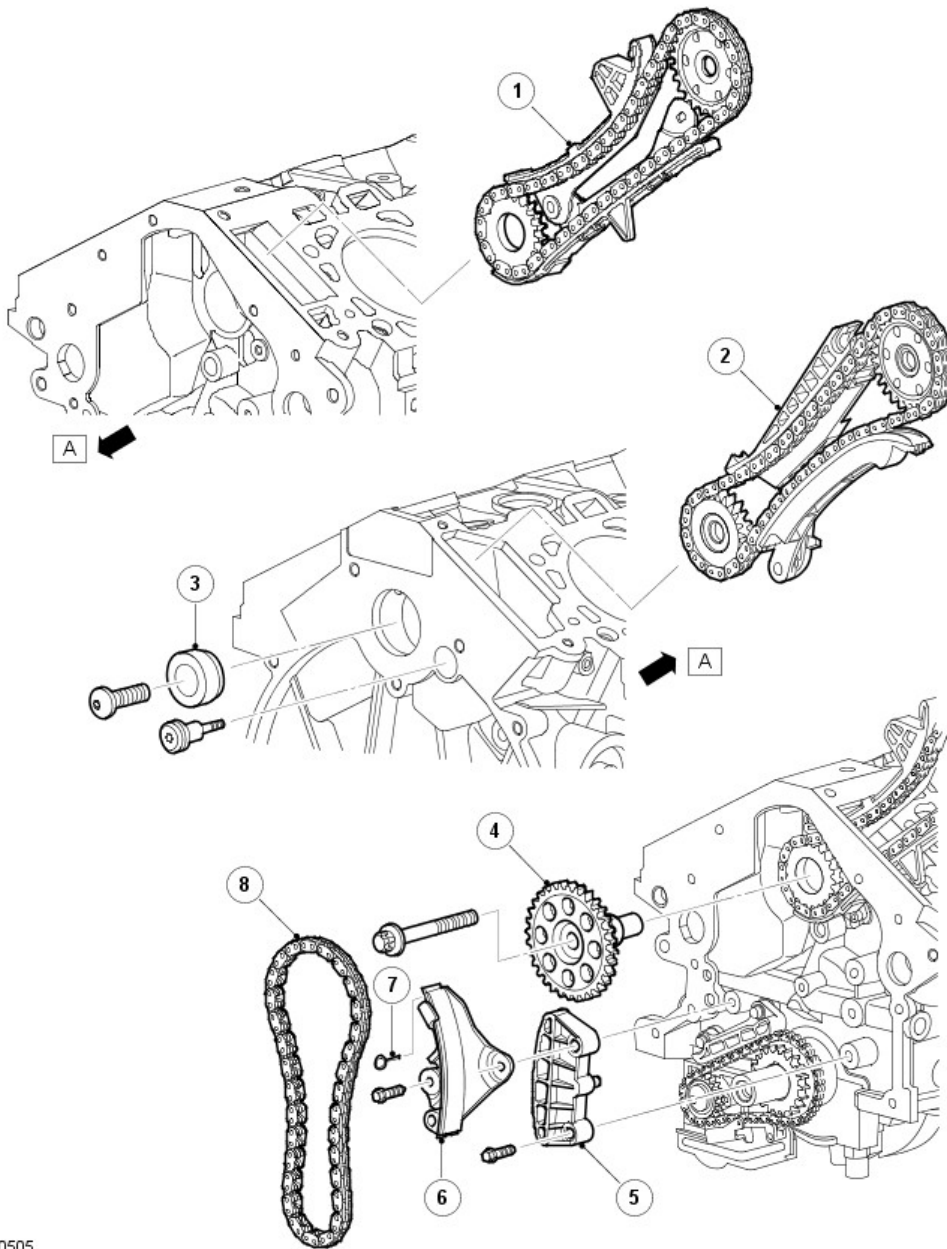


E50504

Item	Part Number	Description
1	-	Oil pick-up

The oil pick-up is a two-piece unit with strainer located in the center of the sump oil well, as a source for the supply of engine lubrication oil to the oil pump. Oil is drawn through the end of the pick-up and strained to prevent solid matter from entering the oil pump.

CAMSHAFT TIMING COMPONENTS



E50505

Item	Part Number	Description
A	-	Front of engine
1	-	LH camshaft drive assembly
2	-	RH camshaft drive assembly
3	-	Spacer
4	-	Jackshaft sprocket
5	-	Chain guide
6	-	Jackshaft chain tensioner
7	-	Tensioner pin
8	-	Jackshaft chain

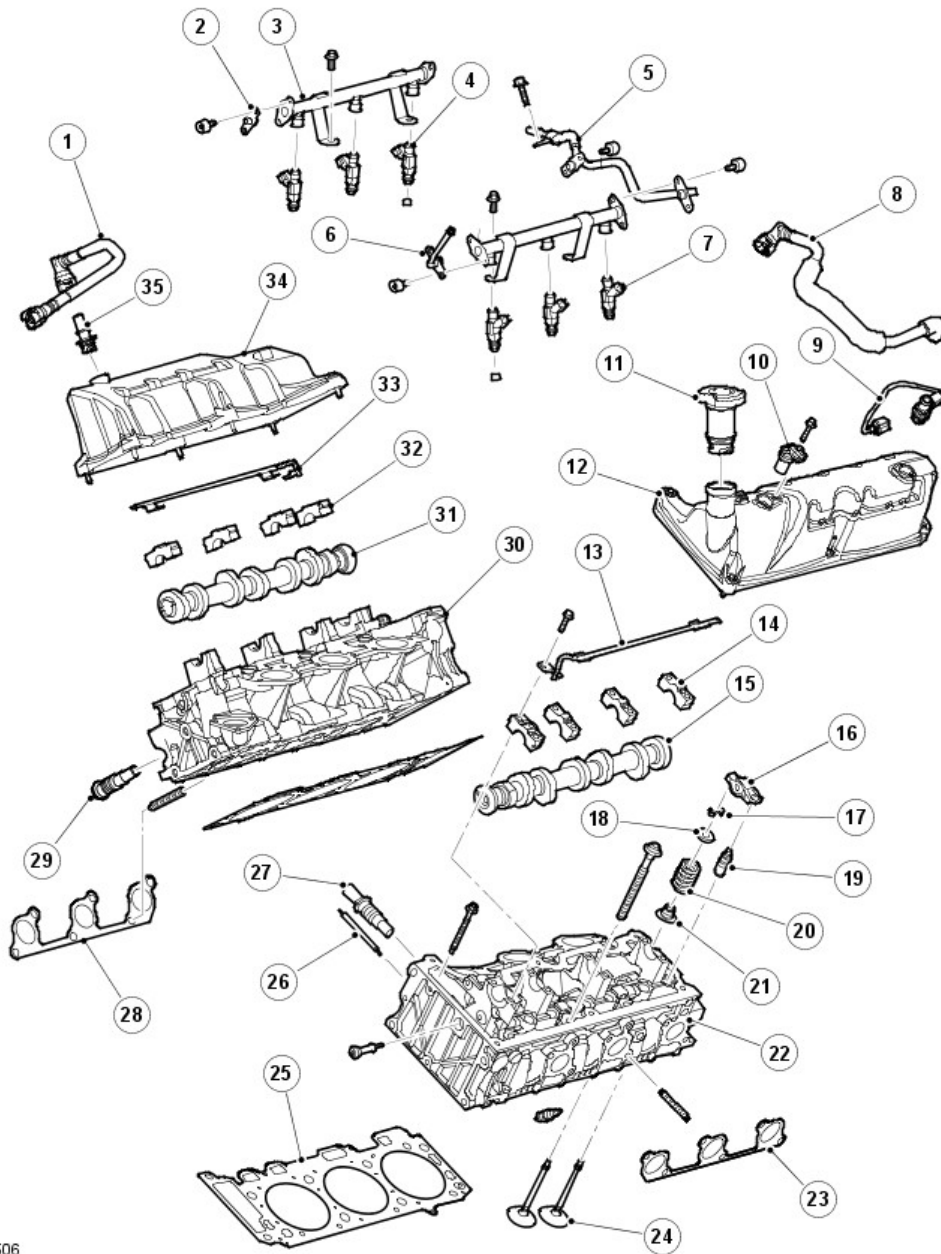
Camshaft Drive Assembly

Each camshaft drive assembly comprises:

- A jackshaft gear
- A camshaft gear
- A drive chain
- A chain guide

The LH drive assembly is driven from the front of the jackshaft and the RH assembly from the rear.

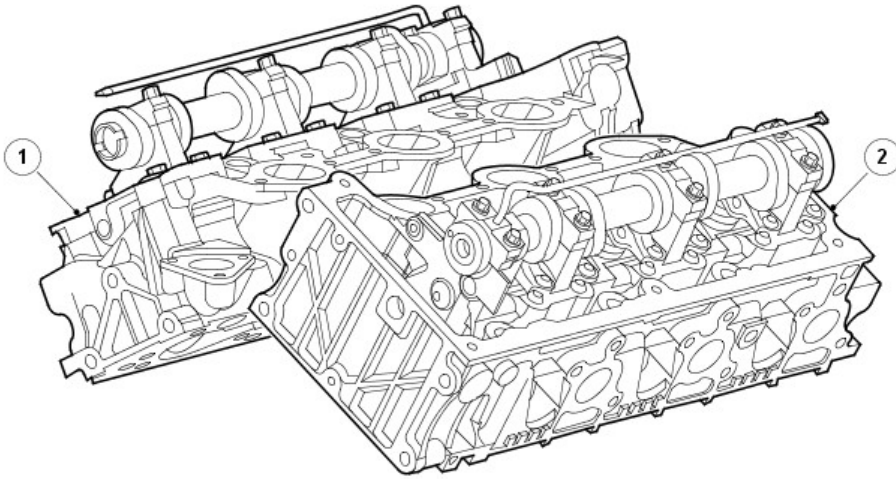
CYLINDER HEAD COMPONENTS



E50506

Item	Part Number	Description
1	-	Hose, crankcase emissions, RH camshaft cover to intake manifold
2	-	End cover
3	-	RH Fuel rail
4	-	LH injectors (3 of)
5	-	Fuel supply line
6	-	Schrader valve
7	-	RH injectors (3 of)
8	-	Hose, crankcase emissions, LH camshaft cover to intake manifold
9	-	Electrically heated positive crankcase ventilation valve
10	-	Camshaft position (CMP) sensor
11	-	Oil filler cap
12	-	LH camshaft cover
13	-	LH valve rocker arm oil supply tube
14	-	LH camshaft bearing caps
15	-	LH camshaft
16	-	Valve rocker arm
17	-	Collet
18	-	Valve spring retainer seat
19	-	Hydraulic lash adjuster
20	-	Valve spring
21	-	Valve stem seal
22	-	LH cylinder head
23	-	LH exhaust manifold gasket
24	-	Valves
25	-	Cylinder head gasket
26	-	Volume reduction plug/valves
27	-	Timing chain tensioner
28	-	RH exhaust manifold gasket
29	-	Timing chain tensioner
30	-	RH cylinder head
31	-	RH camshaft
32	-	RH camshaft bearing caps
33	-	RH valve rocker arm oil supply tube
34	-	RH camshaft cover
35	-	Crankcase ventilation valve

Cylinder Heads



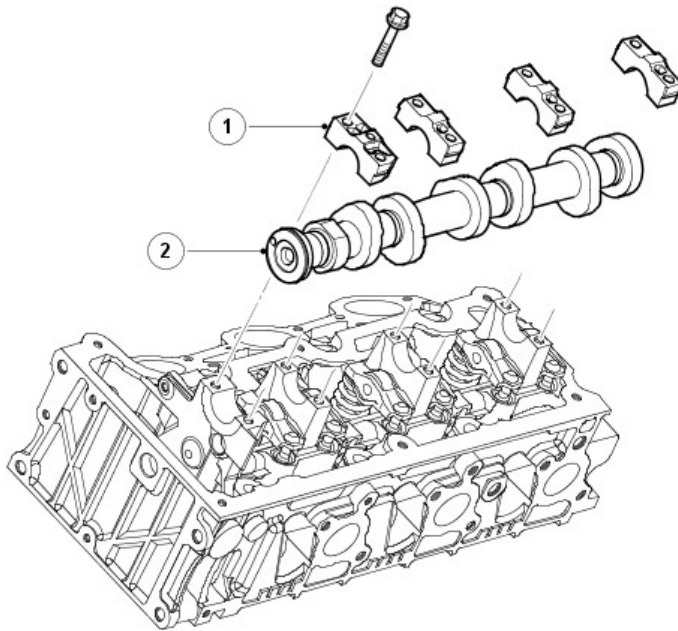
E50507

Item	Part Number	Description
1	-	RH cylinder head
2	-	LH cylinder head

The cross-flow cylinder heads are based on a twin valve, central spark plug combustion chamber, with the inlet ports designed to induce swirl and control the speed of the induction charge. This serves to improve combustion and hence fuel economy, performance and exhaust emissions.

LH and RH cylinder heads are identical castings.

Camshafts



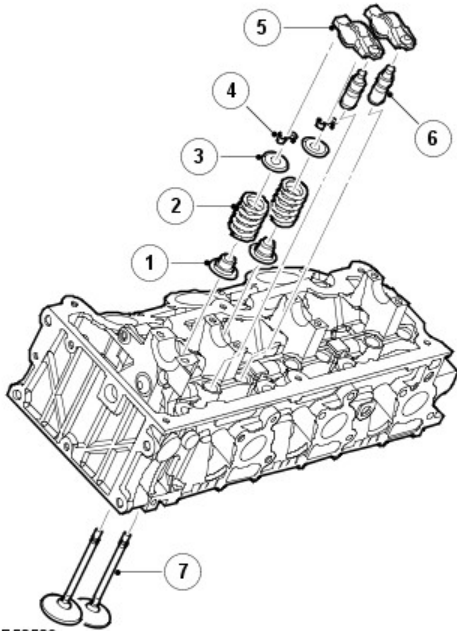
E50508

Item	Part Number	Description
1	-	Bearing cap
2	-	Camshaft

A single camshaft on each cylinder bank is retained by a camshaft carrier, line bored with the cylinder head. The camshafts are located by a flange, which also controls end-float.

The LH camshaft incorporates a reluctor, which is used in conjunction with the Camshaft Position (CMP) sensor to measure engine position.

Valves and Hydraulic Lash Adjusters



E50509

Item	Part Number	Description
1	-	Valve stem seal
2	-	Valve spring
3	-	Valve spring retainer seat
4	-	Valve spring retainer key
5	-	Rocker arm
6	-	Hydraulic lash adjuster
7	-	Valve

The valve springs are made from spring steel and are of the parallel single-coil type. The bottom end of each spring rests on the flange of a spring retainer, which has an integral valve stem seal. The top end of the spring is held in place by a spring retainer, which is held in position at the top end of the valve stem by split taper collets. The taper collets have grooves on the internal bore that locate to grooves ground into the upper stems of the valves.

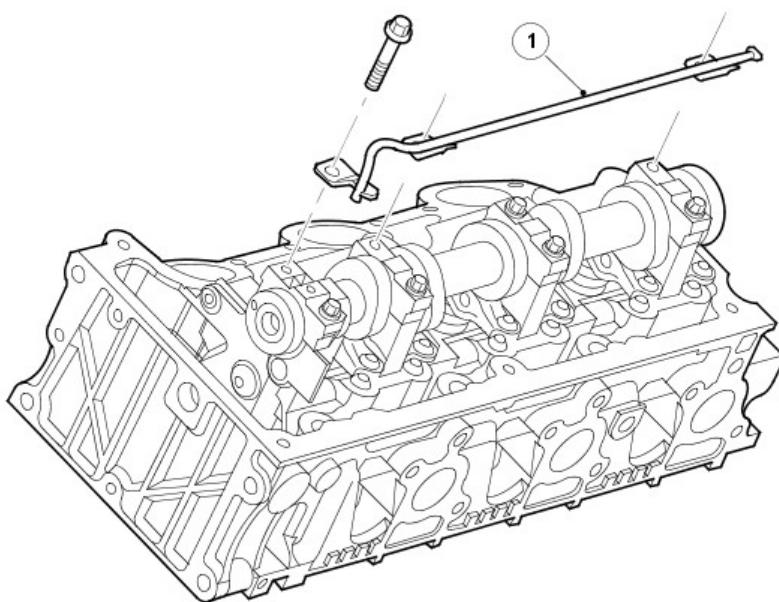
Valve seats and valve guides are an interference fit in the cylinder head.

The valves are operated through roller-type finger rockers and hydraulic lash adjusters, actuated by the camshaft lobes. When the camshaft lobe presses down on the top of a finger rocker, roller mechanism, the respective valve is forced down, opening the affected inlet or exhaust valve. The use of this type of actuation method helps reduce friction in the valve timing mechanism.

The body of the hydraulic lash adjusters contains a plunger and two chambers for oil feed and pressurized oil. The pressurized oil is supplied to the lash adjusters via the main oil galleries in the cylinder head and through a hole in the side of the lash adjuster body. The oil passes into a feed chamber in the lash adjuster and then through to a separate pressure chamber via a one way ball valve.

Oil flow from the pressure chamber is determined by the amount of clearance between the lash adjuster outer body and the center plunger. Oil escapes up the side of the plunger every time the lash adjuster is operated, the downward pressure on the plunger forcing a corresponding amount of oil in the lash adjuster body to be displaced. When the downward pressure from the camshaft and finger rocker is removed (i.e. after the trailing flank of the camshaft lobe has passed), oil pressure forces the lash adjuster's plunger up again. This pressure is not sufficient to effect the valve operation, but eliminates the clearance between the finger rocker and top of the valve stem.

Valve Rocker Arm Oil Supply Tube

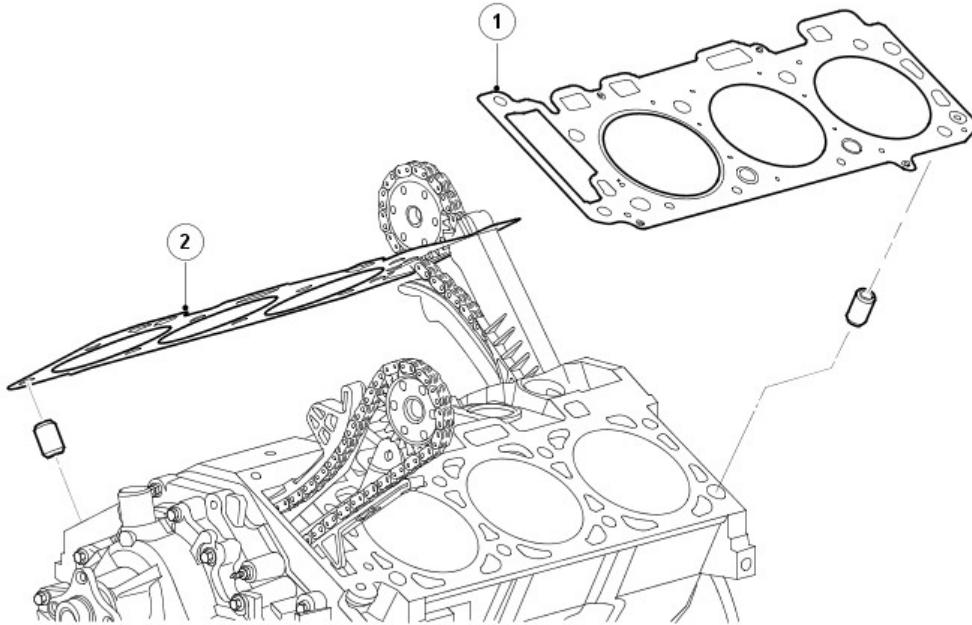


E50510

Item	Part Number	Description
1	-	Valve rocker arm oil supply tube

The valve rocker arm oil supply tube locates on top of each camshaft and is secured by two bolts to the front and rear camshaft bearing caps. Oil is supplied to the tube via a gallery in the cylinder head and is distributed to each rocker arm through adjacent spray holes in the tube.

Cylinder Head Gasket

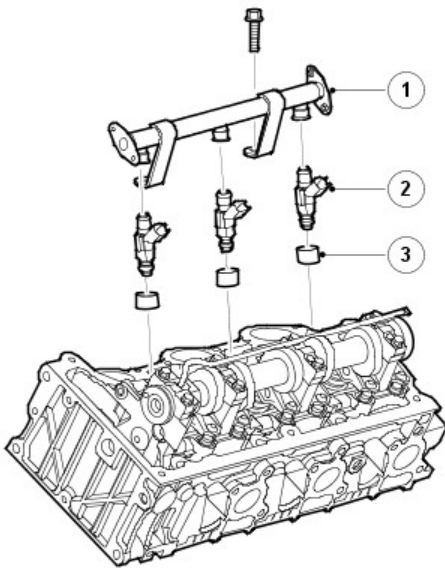


E50511

Item	Part Number	Description
1	-	LH cylinder head gasket
2	-	RH cylinder head gasket

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

Fuel Injectors



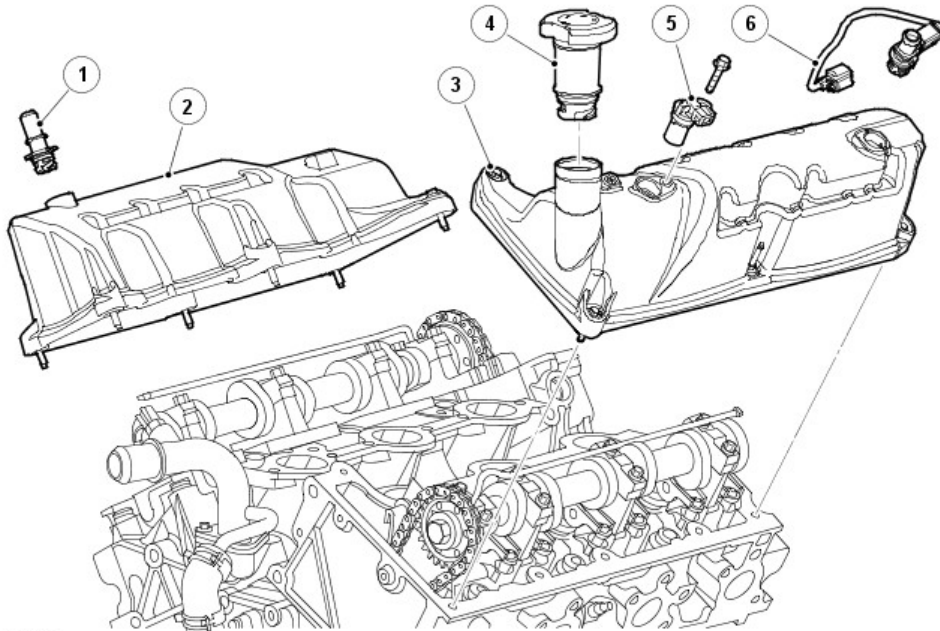
E50512

Item	Part Number	Description
1	-	Fuel rail
2	-	Injector
3	-	Adapter

The fuel injectors are installed in each of the two fuel rails, one per cylinder head. The injectors are electromagnetic solenoid valves controlled by the ECM. Each injector nozzle locates in the cylinder head via an injector insert adapter. An 'O' ring seals each injector to the fuel rail. The fuel jets from the injectors are directed onto the back of the intake valves.

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

Camshaft Cover

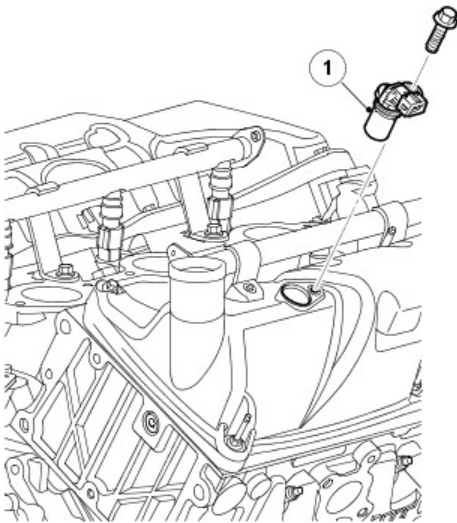


E50513

Item	Part Number	Description
1	-	Crankcase ventilation valve
2	-	RH camshaft cover
3	-	LH camshaft cover
4	-	Oil filler cap and extension
5	-	Camshaft Position (CMP) sensor
6	-	Electrically heated positive crankcase ventilation valve

The camshaft covers are manufactured from thermo-plastic. The LH cover incorporates a hole, located directly above the camshaft reluctor, for the camshaft position sensor. The LH cover also incorporates the engine oil filler aperture.

Camshaft Position (CMP) Sensor



E50514

Item	Part Number	Description
1	-	CMP sensor

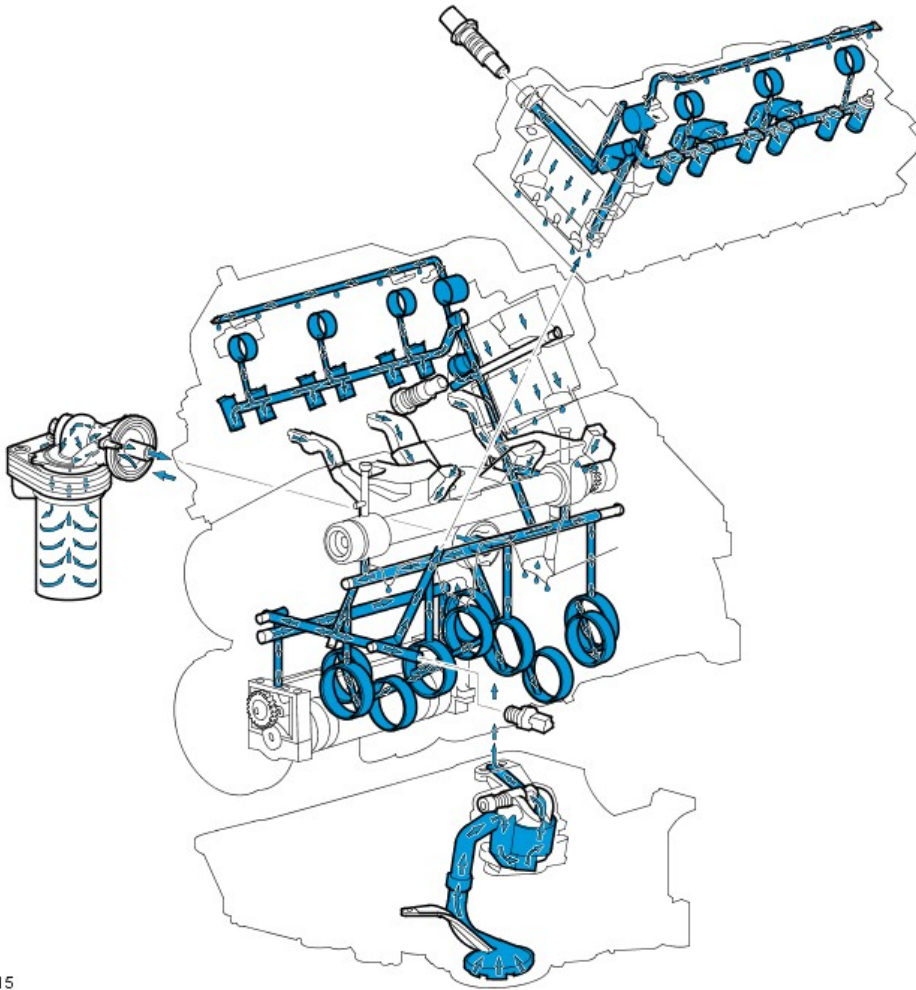
The CMP sensor is installed at the front of the LH camshaft cover. It is a variable reluctance sensor that provides an input to the ECM regarding the position of the camshaft.

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

The reluctor for the camshaft position sensor is located at the front of the LH camshaft. A flat, machined surface near the front of each camshaft, enables the camshafts to be locked during the valve timing procedure.

LUBRICATION SYSTEM

- NOTE: Variant with oil cooler shown.



E50515

The lubrication system is of the full-flow filtration, force-fed type.

Oil is drawn, via a strainer and pick-up pipe in the sump into the jackshaft driven oil pump which has an integral pressure relief valve. The strainer in the pick-up pipe prevents any ingress of foreign particles from passing through to the inlet side of the oil pump and damaging the oil pump and restricting oil drillings. The oil pressure relief valve in the oil pump opens if the oil pressure becomes excessive and diverts oil back around the pump.

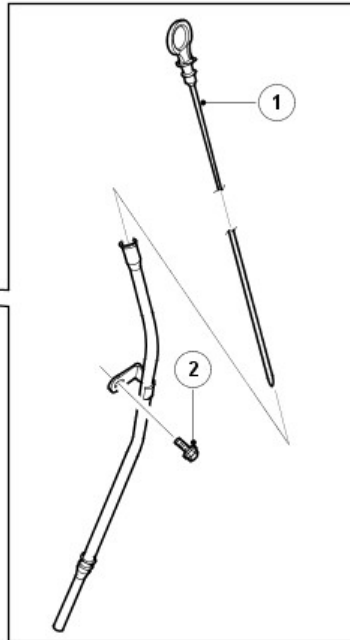
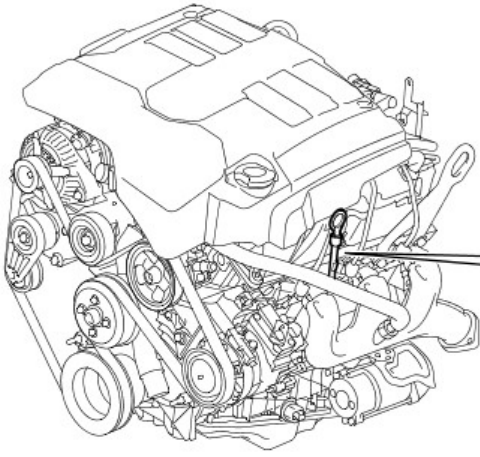
Pressurized oil is pumped through the oil filter, mounted on the oil pump housing. The lubrication system is designed so that a higher proportion of oil flow is directed to the cylinder block main oil gallery while a lower proportion of oil flow, (controlled by a restrictor in the oil filter housing), is directed to the engine oil cooler (if fitted). The remainder of the oil flow from the outlet side of the oil filter is combined with the return flow from the oil cooler (if fitted) before being passed into the cylinder block main oil gallery.

The main oil gallery has drillings that direct the oil to each cylinder head and the main bearings. Cross drillings in the crankshaft main bearings carry the oil to the connecting rod big-end bearings. Oil galleries in the cylinder head carry the oil to the camshafts and the hydraulic lash adjusters.

The oil pressure switch is located in the cylinder block to sense the oil pressure level before the oil flow enters the main gallery in the cylinder block. A warning lamp in the instrument cluster is illuminated if low oil pressure is detected.

Oil at reduced pressure is directed to each cylinder bank via two restrictors in the cylinder block/cylinder head locating dowels, one at the front on the LH bank and the other at the rear on the RH bank. Oil then passes through a drilling in the cylinder head to the camshaft carrier, where it is directed via separate galleries to the camshaft bearings and hydraulic tappet housings. Return oil from the cylinder head drains into the sump via the cylinder head bolt passages.

Oil Level Gauge

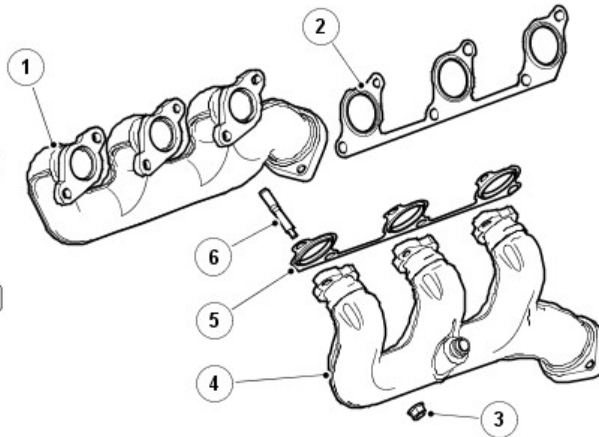
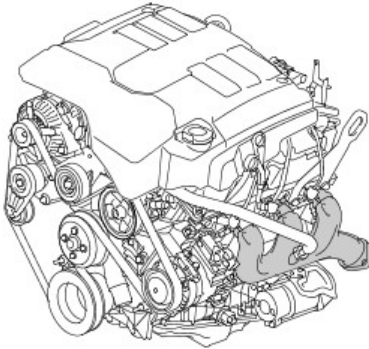


E50516

Item	Part Number	Description
1	-	Oil level gauge
2	-	Oil level gauge tube

The oil level gauge locates along the LH side of the cylinder block, 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



E50517

The dual wall stainless steel exhaust manifolds are unique for each cylinder bank.

The exhaust manifolds are sealed to the cylinder heads via metal gaskets.

Engine - V6 4.0L Petrol - Engine

Diagnosis and Testing


For additional information.

REFER to: [Engine - V6 4.0L Petrol](#) (303-00 Engine System - General Information, Diagnosis and Testing).

Engine - V6 4.0L Petrol - Engine Oil Draining and Filling

General Procedures

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

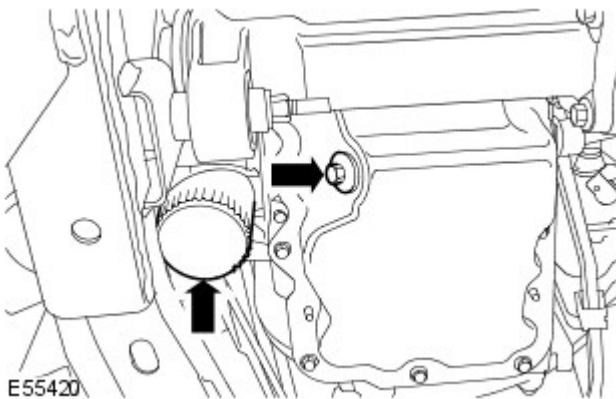
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

4. Remove the oil pan drain plug.
 - Position a container to collect the fluid.
 - Discard the oil drain plug seal.

5. Remove the oil filter.
 - Position a container to collect the fluid.
 - Discard the oil filter.



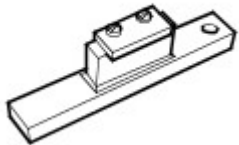





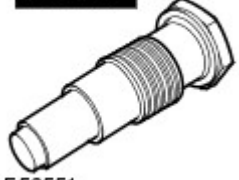
6. To install, reverse the removal procedure.
 - Lubricate the oil filter seal with clean engine oil and tighten to 18 Nm.
 - Install a new seal.
 - Tighten the drain plug to 37 Nm.

7. Fill the engine with oil.

8. Check and top-up the engine oil.

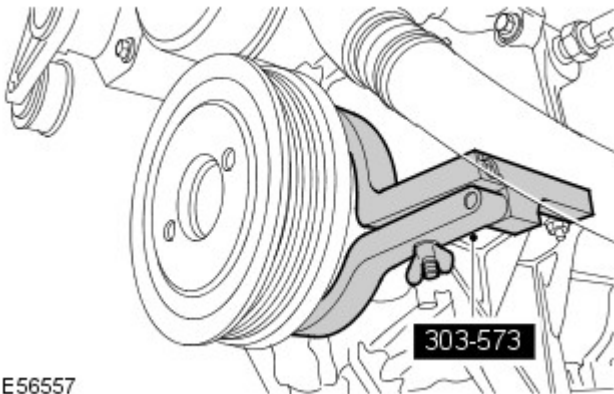
Engine - V6 4.0L Petrol - Camshaft Timing

General Procedures

Special Tool(s)	
<p>303-1146</p>  <p>E56552</p>	<p>Camshaft timing checking tool</p> <p>303-1146</p>
<p>303-573</p>  <p>E54427</p>	<p>Crankshaft TDC timing/locking tool</p> <p>303-573</p>
<p>303-575</p>  <p>E56553</p>	<p>Camshaft Bolt Tool</p> <p>303-575</p>
<p>303-565</p>  <p>E56554</p>	<p>Camshaft Bolt Socket</p> <p>303-565</p>
<p>303-576</p>  <p>E56555</p>	<p>Camshaft locking tool adaptor</p> <p>303-576</p>
<p>303-597-01</p>  <p>E56556</p>	<p>Camshaft sprocket adjusting/locking tool</p> <p>303-597-01</p>
<p>303-571</p>  <p>E56551</p>	<p>Camshaft timing chain tensioning tool</p> <p>303-571</p>

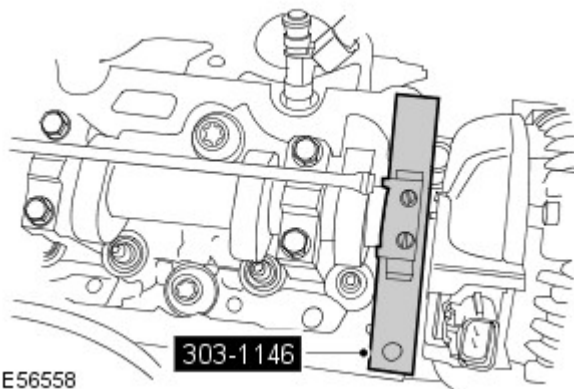
1. Check the camshaft timing.

2. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Remove both valve covers.
4. Rotate the crankshaft clockwise, until number one cylinder is on TDC. Check the camshaft lobes are on the back of the cam.
5. Lock the crankshaft.
 - Install the special tool.
 - Tighten the screw.



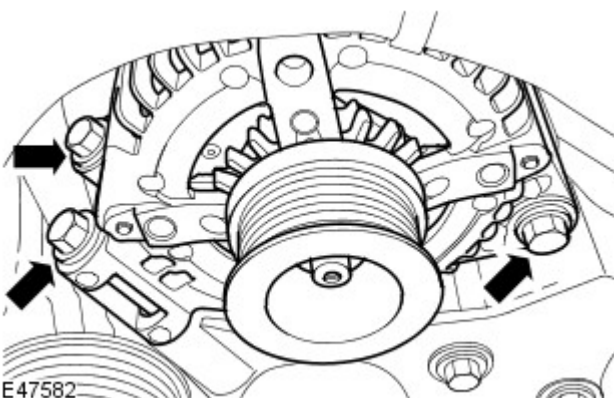
E56557

6. Install the special tool to the slot in the camshaft, the base of the special tool must remain in contact with the cylinder head. If the special tool can be passed from one side of the cylinder head to the other without resistance then the camshaft is correctly timed. Repeat the procedure on the other camshaft. If both camshafts are found to be correct, then no further action is required.

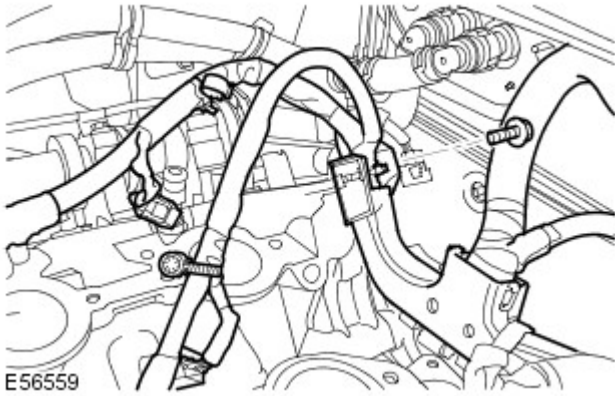


E56558

7. If the camshaft timing is found to be incorrect, proceed with the adjustment. Note both camshafts must be re-timed with the camshaft roller followers removed.
8. Remove the camshaft roller followers.
For additional information, refer to: [Camshaft Roller Follower](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
9. Position the generator aside for access.
 - Remove the 3 bolts.

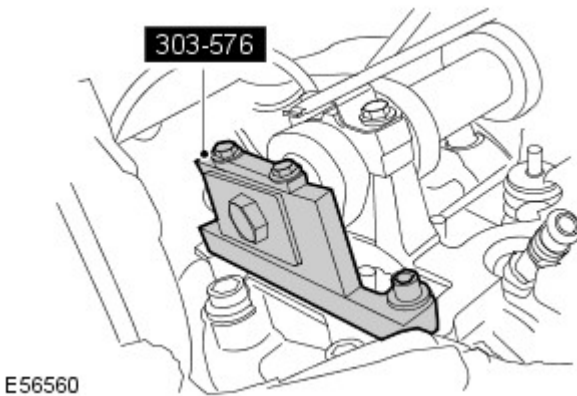


E47582



10. Remove the RH cylinder head harness carrier bolt.

- Position the harness carrier aside for access.

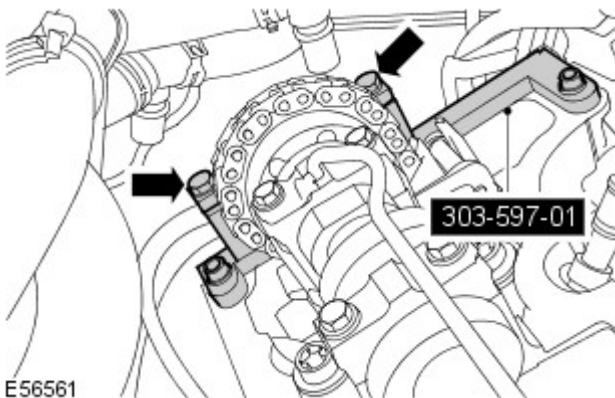


11. **CAUTION:** Damage to the camshaft will occur if the alignment tool is used to release the camshaft sprocket bolt.

- NOTE: The camshaft timing slot is off center. Correctly timed the slot will be horizontal and below the center line.

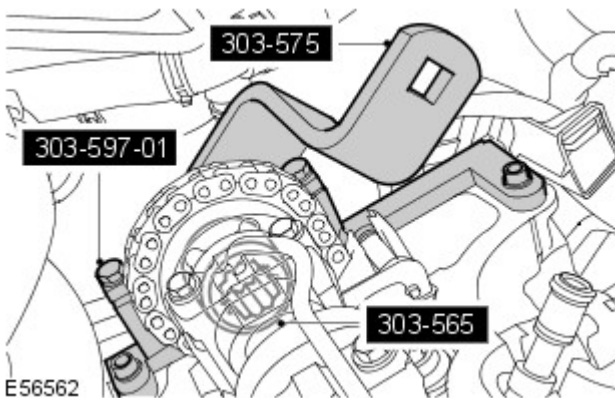
Install the camshaft alignment special tool.

- Clean the component mating faces.
- Tighten the bolts to 10 Nm (7 lb.ft).
- Lock the camshaft, tighten the special tool bolt to 45 Nm (33 lb.ft).



12. Install the special tool to the RH cylinder head.

- Clean the component mating faces.
- Tighten the bolts to 10 Nm (7 lb.ft).
- Tighten the saddle clamp bolts to 10 Nm (7 lb.ft).

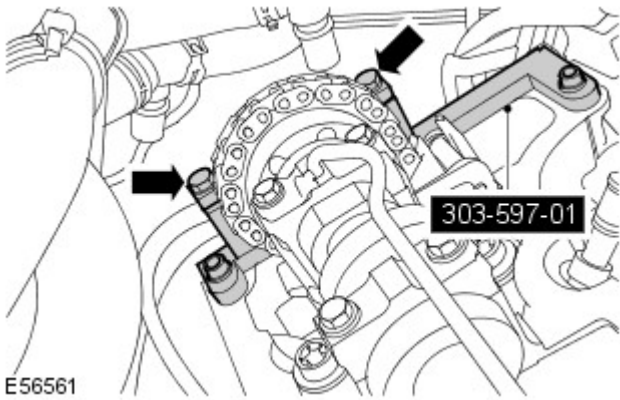



13. **CAUTION:** The RH camshaft sprocket bolt has a left hand thread.

Using the special tool, loosen the RH camshaft sprocket bolt.

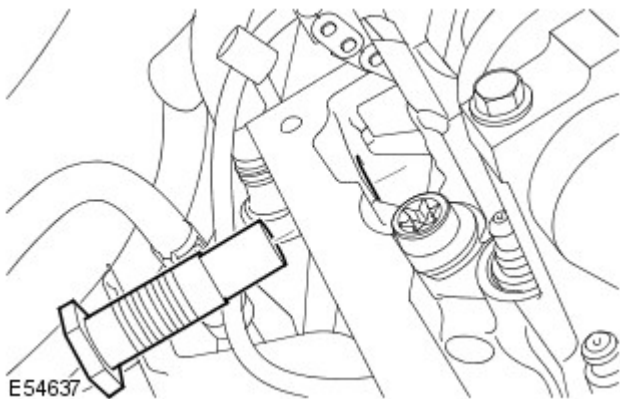
- Remove and discard the bolt.

14. Loosen the special tool saddle clamp bolts.



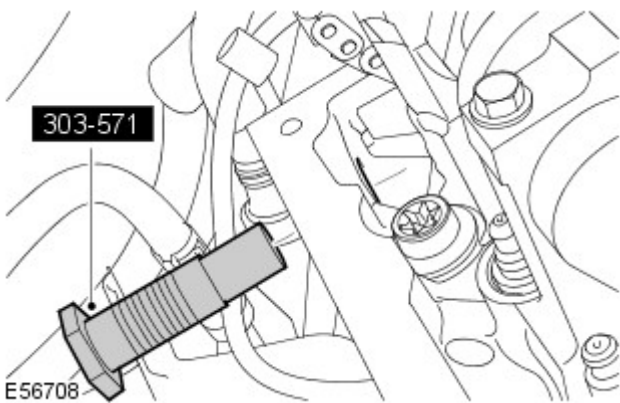
15.  CAUTION: Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the RH hydraulic timing chain tensioner.

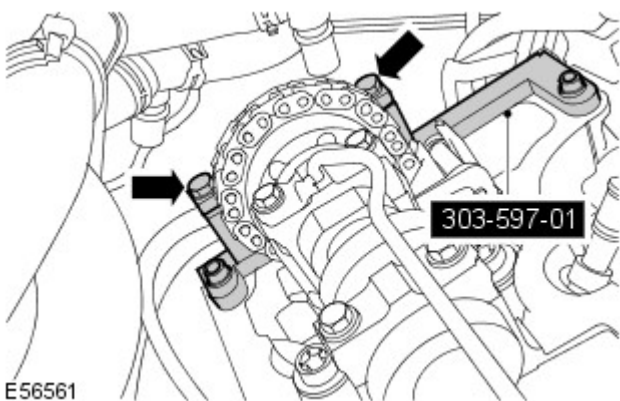


16. Install the special tool.

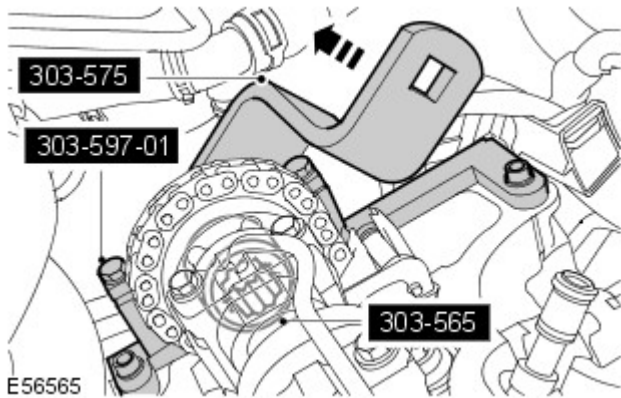
- Clean the component mating faces.



17. Tighten the saddle clamp bolts to 10 Nm (7 lb.ft).



18. Using the special tool, tighten the camshaft sprocket bolt to 20 Nm (15 lb.ft), then a further 100 degrees.




19. Remove the special tools.
20. Install the RH hydraulic timing chain tensioner.
- Install a new seal.
 - Clean the component mating faces.
 - Tighten the tensioner to 44 Nm (32 lb.ft).

21. NOTE: If either camshaft is disturbed, both camshafts MUST be retimed.

- NOTE: The LH camshaft sprocket bolt has a right hand thread.

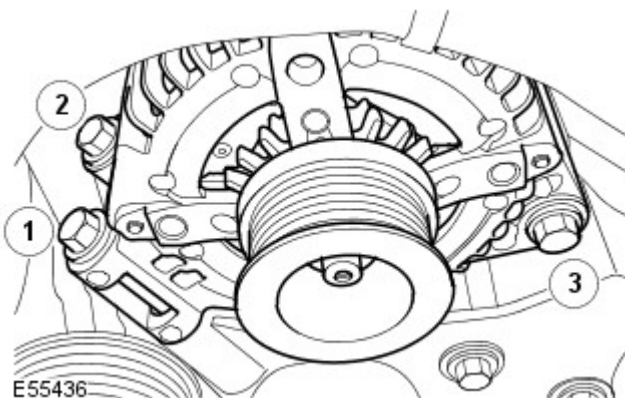
Repeat the above procedure to adjust the LH camshaft timing.

22. Install the camshaft roller followers.
For additional information, refer to: [Camshaft Roller Follower](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

23.  CAUTION: Tighten the bolts in the sequence shown.

Install the generator.

- Clean the component mating faces.
- Tighten the bolts to 45 Nm (33 lb.ft).



24. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Camshaft RH

In-vehicle Repair

Removal

- NOTE: Removal of the LH camshaft is similar to this procedure.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Refer to valve timing check and adjust.
For additional information, refer to: [Camshaft Timing](#) (303-01, In-vehicle Repair).

3. Remove the camshaft sprocket bolt.

- Position the sprocket and chain aside.

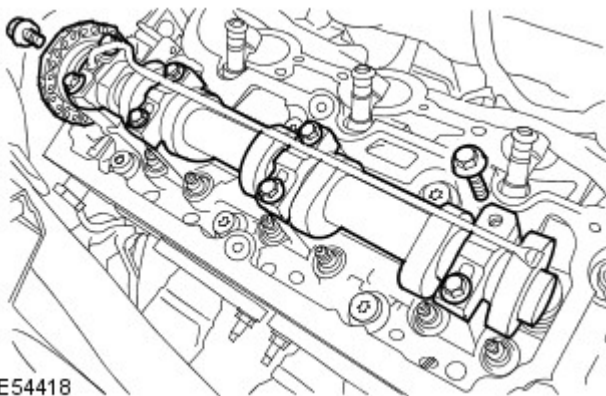
4. NOTE: Remove the camshaft bearing caps evenly and in stages.

- NOTE: Note the fitted position.

Remove the camshaft bearing caps.

- Remove the 8 bolts.
- Collect the camshaft oil supply line.

5. Remove the camshaft.



Installation

1. Install the camshaft.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.

2. NOTE: Note the fitted position.

Install the camshaft bearing caps.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.

3. NOTE: After installing the bolts check the camshaft is free to rotate.

Install the camshaft oil supply line.

- Thoroughly clean and inspect the oil supply line.
- Prime the oil supply line with clean engine oil.
- Working in a diagonal sequence, evenly and progressively tighten the bolts in 2 stages.
- Tighten the bolts to 6 Nm (4 lb.ft).
- Tighten the bolts to 16 Nm (12 lb.ft).

4. Install the camshaft sprocket bolt.

- Install the bolt, but do not tighten fully at this stage.

5. Adjust the valve timing.

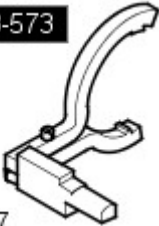
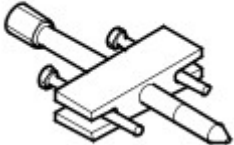


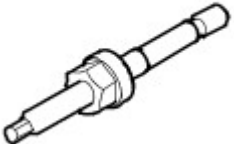
For additional information, refer to: Camshaft Timing (303-01, In-vehicle Repair).

6. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

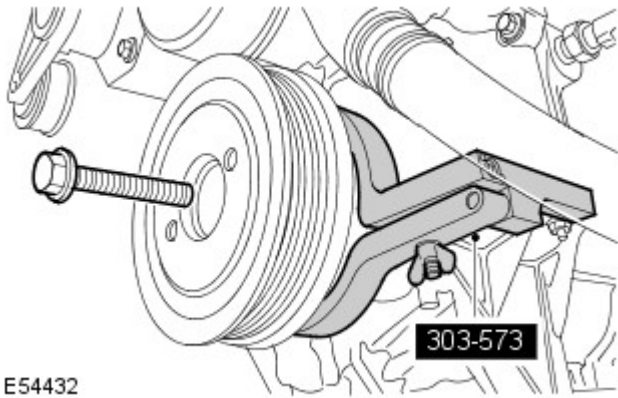
Engine - V6 4.0L Petrol - Crankshaft Pulley

In-vehicle Repair

Special Tool(s)	
 <p>303-573</p> <p>E54427</p>	<p>Crankshaft TDC timing/locking tool</p> <p>303-573</p>
 <p>303-1149</p> <p>E54428</p>	<p>Remover crankshaft damper pulley</p> <p>303-1049</p>
 <p>303-107</p> <p>E54429</p>	<p>Remover oil seal front cover</p> <p>303-107</p>
 <p>303-1148</p> <p>E54430</p>	<p>Installer oil seal front cover</p> <p>303-1148</p>
 <p>303-102</p> <p>E54431</p>	<p>Installer - crankshaft damper pulley</p> <p>303-102</p>

Removal

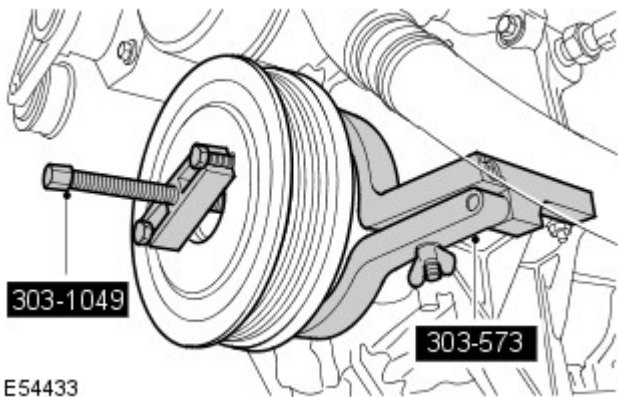
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Using the special tool, retain the crankshaft front pulley.



4. NOTE: The crankshaft pulley retaining bolt will be very tight.

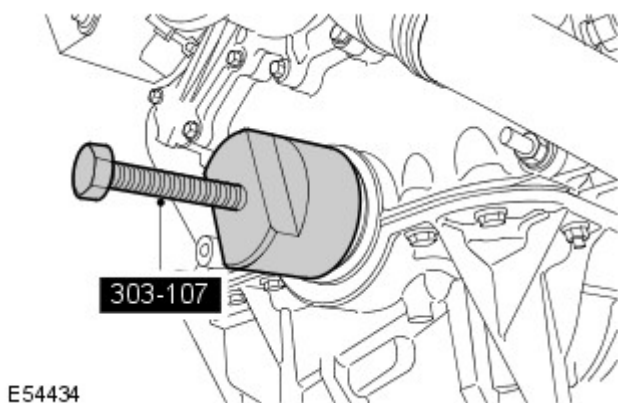
Remove the crankshaft pulley retaining bolt.

- Discard the bolt.



5. Using the special tools, remove the crankshaft pulley.

- Collect the washer.
- Remove the special tools.



6. Using the special tool, remove the crankshaft front seal.

7. Check the crankshaft damper pulley and the washer for damage.

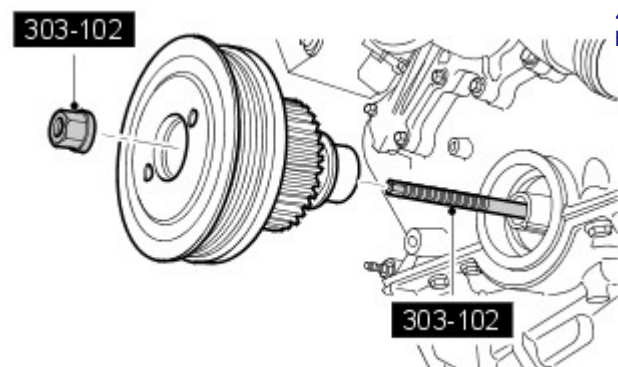
Installation

1. Clean all the crankshaft pulley mating faces.

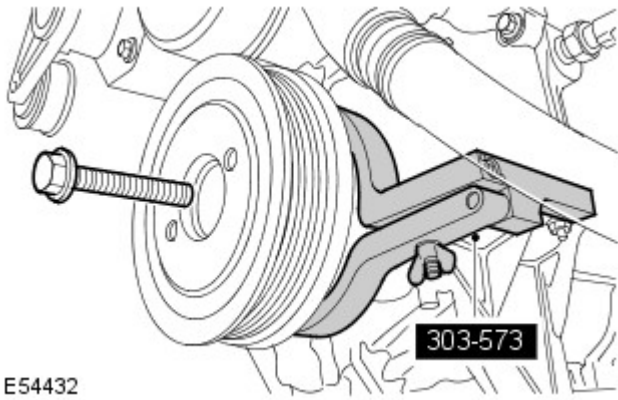
2. Using the special tool, install the crankshaft front seal.

4.  CAUTION: The seal with head in the crankshaft pulley must be cleaned out before installing a new crankshaft pulley bolt.

- Remove the special tool.
- Install, but do not tighten, the new crankshaft pulley bolt.



E54436



5. Tighten the crankshaft pulley bolt.

- Install the special tool.
- Tighten the bolt to 55 Nm (40 lb.ft).
- Tighten the bolt a further 85 degrees.
- Remove the special tool.

6. Install the accessory drive belt.

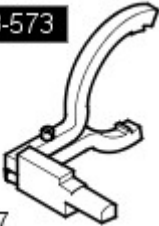
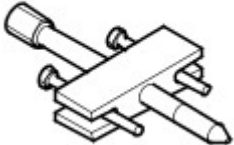


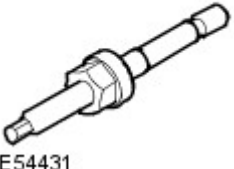
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).

7. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Crankshaft Front Seal

In-vehicle Repair

Special Tool(s)	
 <p>303-573</p> <p>E54427</p>	<p>Crankshaft TDC timing/locking tool</p> <p>303-573</p>
 <p>303-1149</p> <p>E54428</p>	<p>Remover crankshaft damper pulley</p> <p>303-773</p>
 <p>303-107</p> <p>E54429</p>	<p>Remover oil seal front cover</p> <p>303-107</p>
 <p>303-1148</p> <p>E54430</p>	<p>Installer oil seal front cover</p> <p>303-1148</p>
 <p>303-102</p> <p>E54431</p>	<p>Installer crankshaft damper pulley</p> <p>303-102</p>

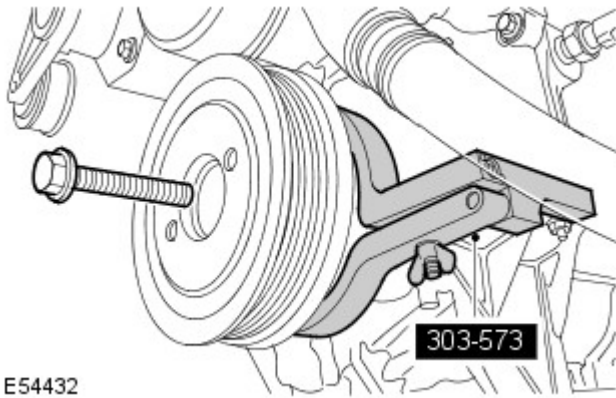
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Using the special tool, retain the crankshaft front pulley.

4. NOTE: The crankshaft pulley retaining bolt will be very tight.

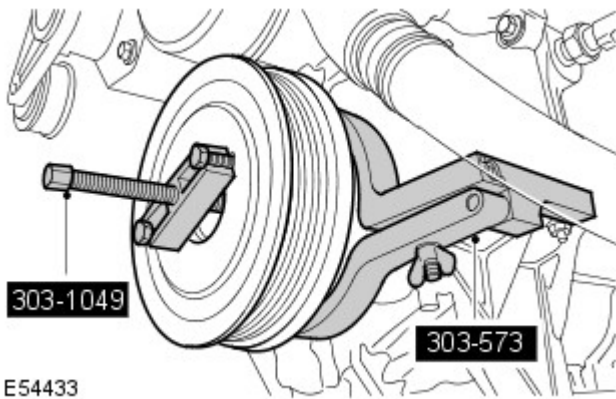
Remove the crankshaft pulley retaining bolt.

- Discard the bolt.



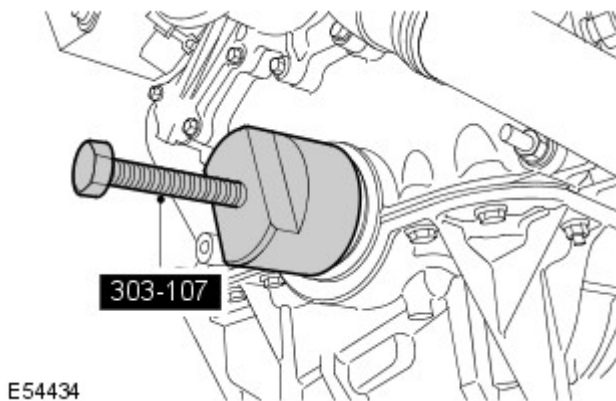
5. Using the special tools, remove the crankshaft pulley.

- Collect the washer.



6. Remove the special tools from the crankshaft pulley.

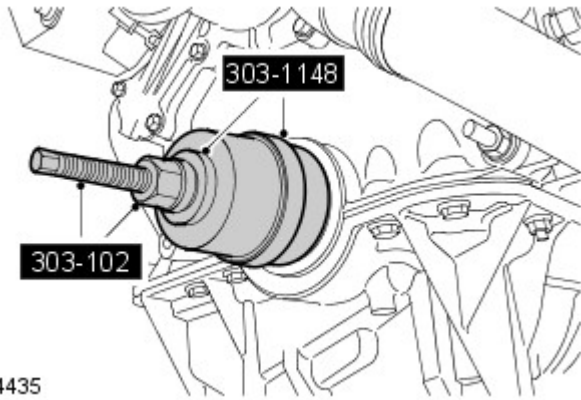
7. Using the special tool, remove the crankshaft front seal.



8. Check the crankshaft damper pulley and the washer for damage.

Installation

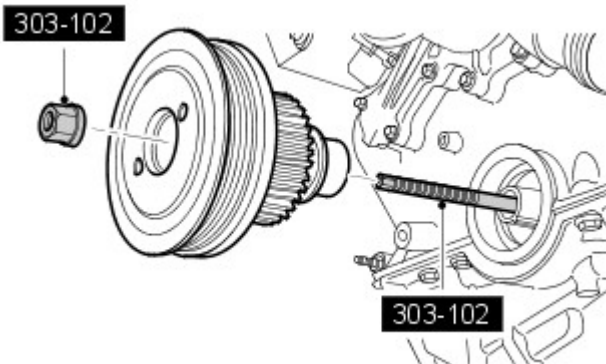
1. Clean all the crankshaft pulley mating faces.



E54435

2. Using the special tool, install the crankshaft front seal.

- Lubricate the seal with clean engine oil.



E54436

3. Using the special tool, install the crankshaft pulley.

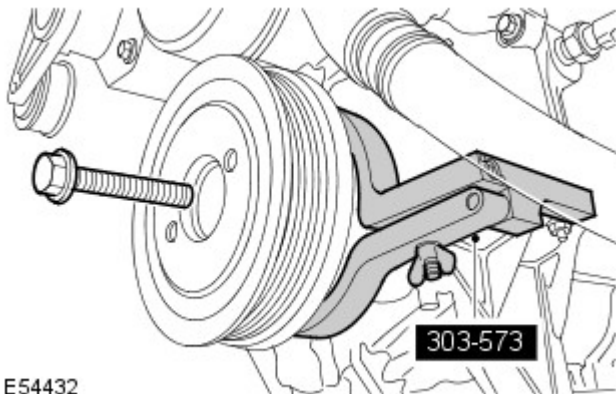
- Lubricate the seal with clean engine oil.
- Remove the special tool.

4.  **CAUTION:** The screw thread in the crankshaft pulley must be cleaned out before installing a new crankshaft pulley bolt.

Install, but do not tighten, a new crankshaft pulley bolt.

5. Tighten the crankshaft pulley bolt.

- Install the special tool.
- Tighten the bolt to 45 Nm (33 lb.ft).
- Tighten the bolt a further 85 degrees.
- Remove the special tool.



E54432

6. Install the accessory drive belt.



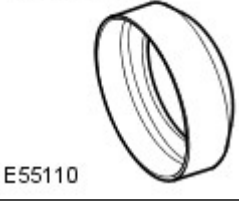
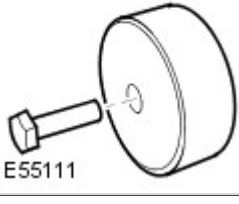
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).

7. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


Engine - V6 4.0L Petrol - Crankshaft Rear Seal

In-vehicle Repair

Special Tool(s)	
 <p>303-903 E50940</p>	<p>Oil seal remover 303-903 (LRT-12-092)</p>
 <p>303-527 E55109</p>	<p>Crankshaft rear oil seal installer 303-527</p>
 <p>303-525 E55110</p>	<p>Crankshaft rear oil seal installer 303-525</p>
 <p>303-579 E55111</p>	<p>Crankshaft rear oil seal installer 303-579</p>

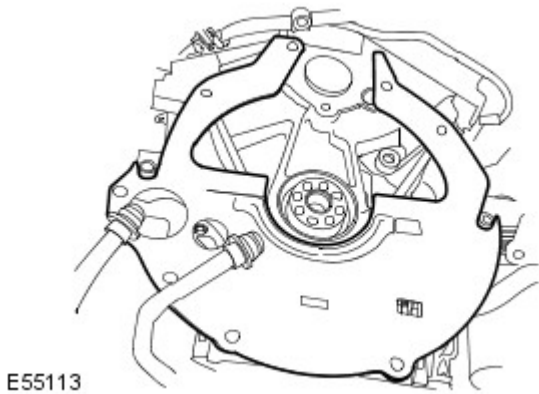
Removal


- NOTE: The seal installation tools are available individually or as a set 303-S524

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

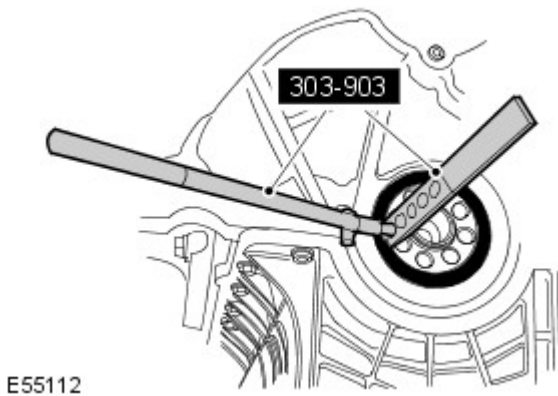
Raise and support the vehicle.
3. Remove the torque converter flexplate.
For additional information, refer to: [Flexplate](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

4. Remove the closing plate.



5.  **CAUTION:** Care must be taken to avoid damage to the seal register and running surface.


Using the special tools, remove and discard the crankshaft rear oil seal.



Installation

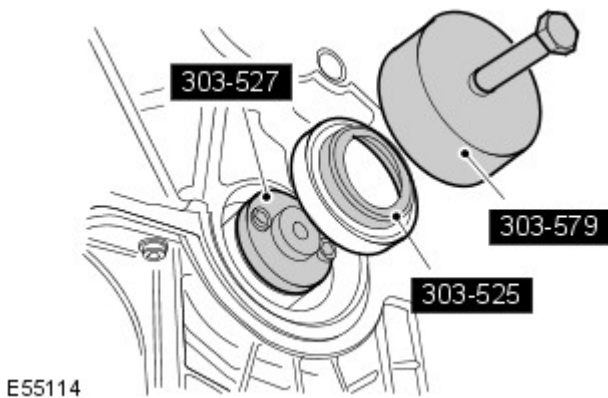
1. Install the special tool, 303-527.

- Make sure the components are clean and dry.
- Tighten the 2 Allen screws.

2.  **CAUTION:** Make sure the seal is installed parallel

Using the special tool, install the crankshaft rear oil seal.

- Lubricate the seal with clean engine oil.
- Partially install the crankshaft rear oil seal.
- Tighten the bolt to fully install the seal.



3. Install the closing plate.

- Clean the components.

4. Install the torque converter flexplate.

For additional information, refer to: [Flexplate](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).


5. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

6. Check and top-up the engine oil.


Engine - V6 4.0L Petrol - Cylinder Block Cradle

In-vehicle Repair

Special Tool(s)	
 <p>303-596</p> <p>E54344</p>	<p>Cylinder block cradle insert adjustment tool</p> <p>303-596</p>

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

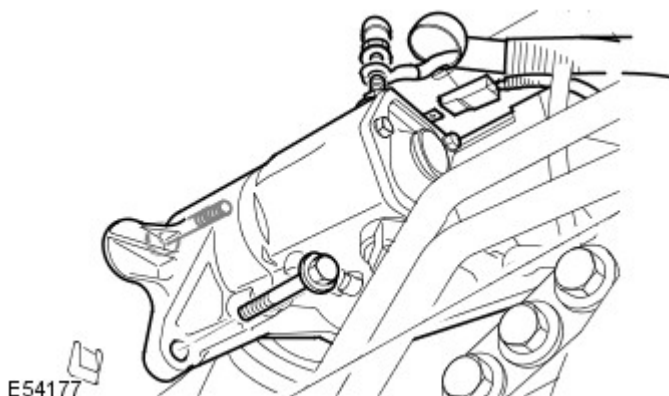
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the RH front wheel and tire.

4. Position the starter motor to one side.

- Remove the 2 bolts.
- Remove the terminal upper cover.
- Remove the terminal lower cover.
- Remove the nut.
- Disconnect the 2 electrical connectors.



5. Remove the front axle tube.

For additional information, refer to: [Axle Tube](#) (205-03 Front Drive Axle/Differential, In-vehicle Repair).

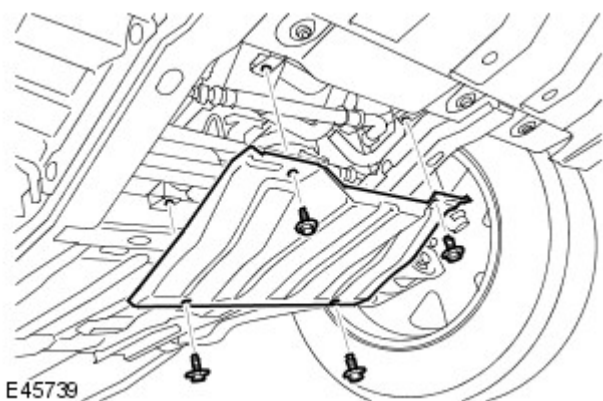
6. Remove the oil pan.

For additional information, refer to: [Oil Pan](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

7. Remove the front stabilizer bar.

8. Remove the radiator access panel.

- Remove the 4 bolts.






9. Release the engine oil cooler lines.

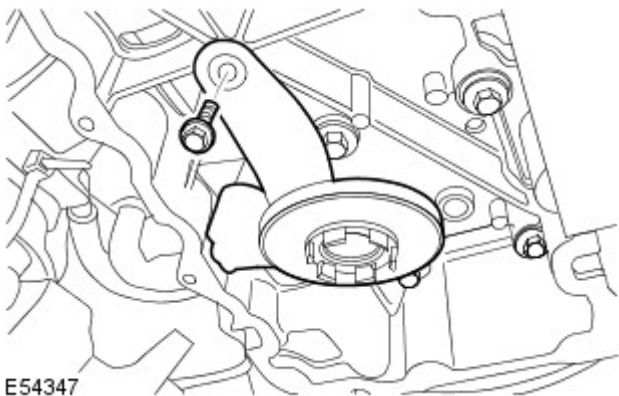
- Remove the bolt.
- Remove the nut.
- Tie the lines aside.



10.  CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the oil temperature sensor.

- Disconnect the electrical connector.
- Remove and discard the O-ring seal.



11. Remove the oil strainer pick-up assembly.

- Remove the bolt.

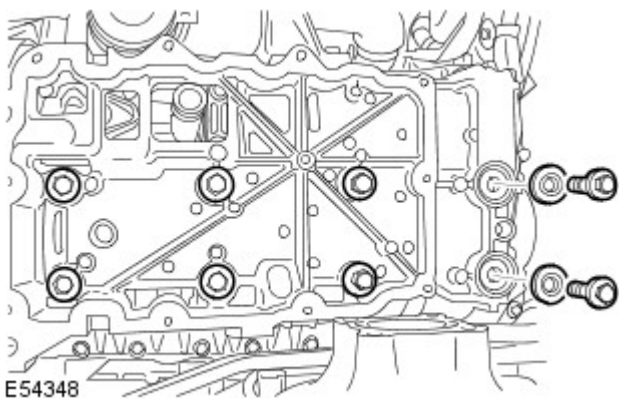
12. Remove the dipstick.

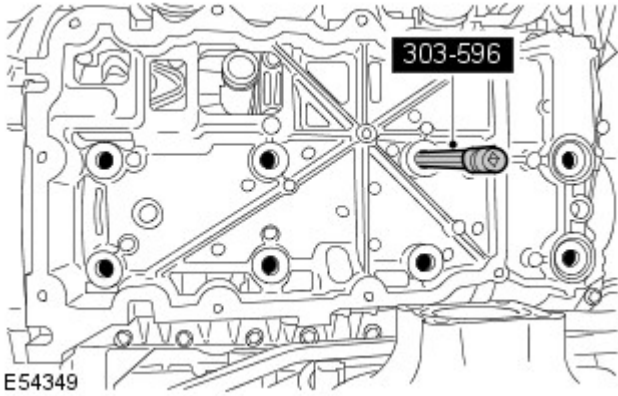
13. Using suitable ties, secure the transmission fluid lines and the wiring harness clear of the cylinder block cradle flange.


14. NOTE: Note the fitted position of the 2 sealing washers.

Remove the 8 cylinder block cradle bolts.

- Remove and discard the 2 sealing washers.



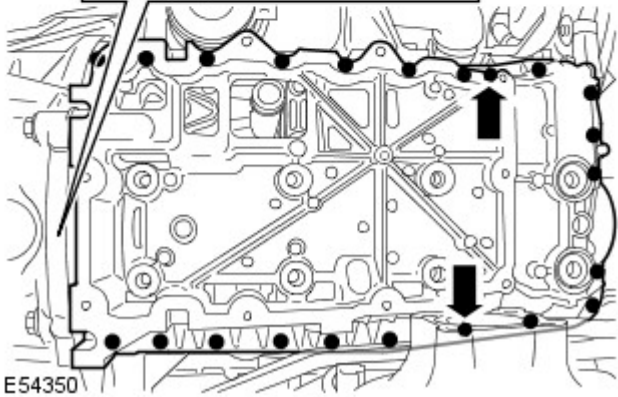
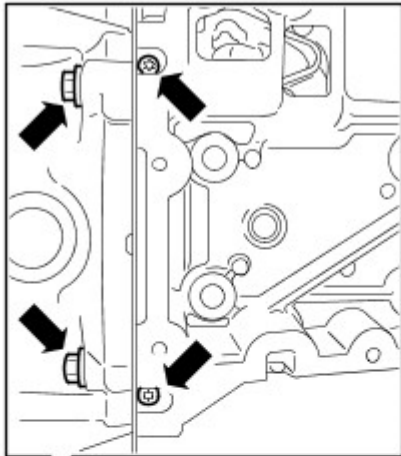


15.  **CAUTION:** Failure to loosen the set screws may result in damage to the cylinder block cradle.

Using the special tool, loosen the 8 cylinder block cradle set screws.

16. Remove the cylinder block cradle.

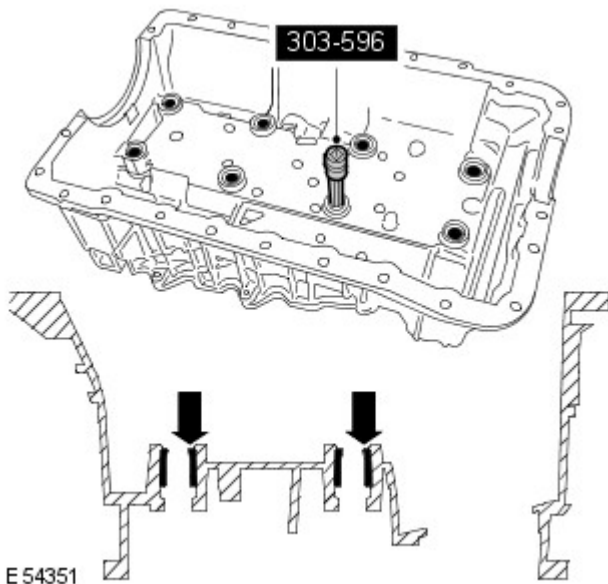
- Remove the 2 rear bolts.
- Remove the 2 Torx screws.
- Remove the 2 nuts.
- Remove the 20 bolts.
- Remove and discard the gasket.




Installation

1. Clean the cylinder block cradle.

- Clean the component mating faces.
- Remove the sealant from the main bearing cap cavities.



2.  **CAUTION:** Failure to loosen the set screws may result in damage to the cylinder block cradle.

Position the cylinder block cradle set screws.

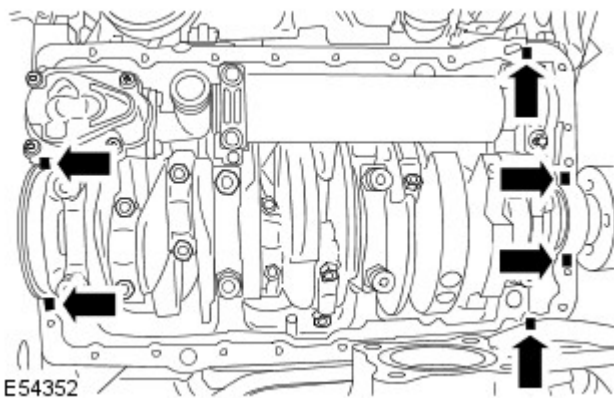
- Using the special tool, adjust the set screws until they are below the cylinder block cradle boss face.

E 54351

3. **NOTE:** The cradle must be installed within 20 minutes of the sealant application.

Apply sealant to the cylinder block cradle.

- Apply sealant to the 6 places shown.



E 54352

4.  **CAUTION:** Make sure the gasket is installed correctly.

Install the cylinder block cradle.

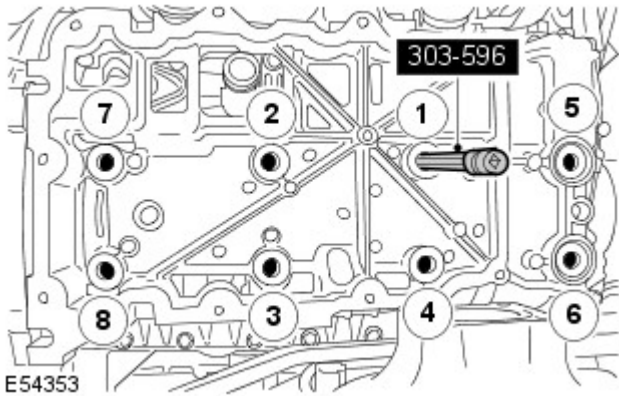
- Install a new gasket.
- Install, then evenly and progressively lightly tighten the outer bolts, nuts and Torx screws.

5. Align the cylinder block cradle to the cylinder block rear face.

- Install and tighten the 2 rear bolts.
- Loosen the 2 rear bolts.
- Lightly tighten the 2 rear bolts.

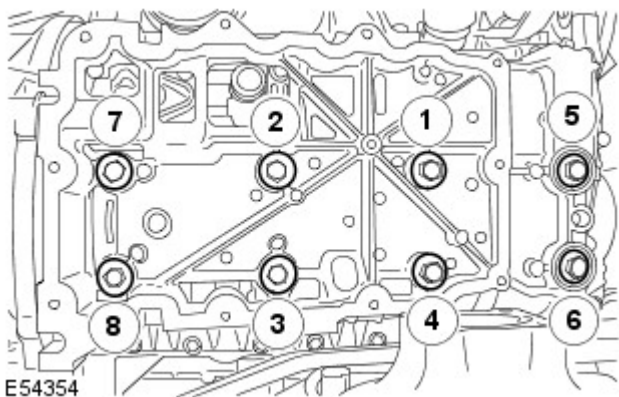
6. Evenly and progressively, tighten the outer bolts, nuts and Torx screws to 10 Nm (7 lb.ft).

7. Tighten the 2 rear bolts to 43 Nm (32 lb.ft).



8. Using the special tool, tighten the 8 cylinder block cradle set screws.

- Tighten the set screws in the sequence shown to 7 Nm (5 lb.ft).



9. NOTE: The sealing washers are fitted to the silver coloured bolts. The silver coloured bolts are fitted in the 2 forward holes.

Install the 8 cylinder block cradle bolts and tighten in 2 stages.

- Install 2 new sealing washers.
- Tighten the bolts in sequence to 15 Nm (11 lb.ft).
- Tighten the bolts in sequence to 34 Nm (25 lb.ft).

10. NOTE: Lubricate new seals with clean engine oil.

Install the oil strainer pick-up assembly.

- Clean the components.
- Tighten the bolt to 10 Nm (7 lb.ft).

11. Install the oil pan.

For additional information, refer to: [Oil Pan](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

12. Install the dipstick.

- Clean the component.

13. NOTE: Lubricate new seals with clean engine oil.

Install the oil temperature sensor.

- Clean the component mating faces.
- Install a new O-ring seal.
- Tighten the oil temperature sensor to 20 Nm (15 lb.ft).
- Connect the electrical connector.

14. Position the engine oil cooler lines.

- Tighten the bolt and the nut to 25 Nm (18 lb.ft).

15. Install the radiator access panel.

- Tighten the 4 bolts to 10 Nm (7 lb.ft).

16. Install the front stabilizer bar.

17. Install the front axle tube.

For additional information, refer to: [Axle Tube](#) (205-03 Front Drive Axle/Differential, In-vehicle Repair).

18. Install the starter motor.

- Clean the component mating faces.

- Connect the electrical connectors.
- Tighten the nut to 10 Nm (7 lb.ft).
- Install the terminal lower cover.
- Install the terminal upper cover.
- Tighten the bolts to 45 Nm (33 lb.ft).

19. Install the RH front wheel and tire.

20. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

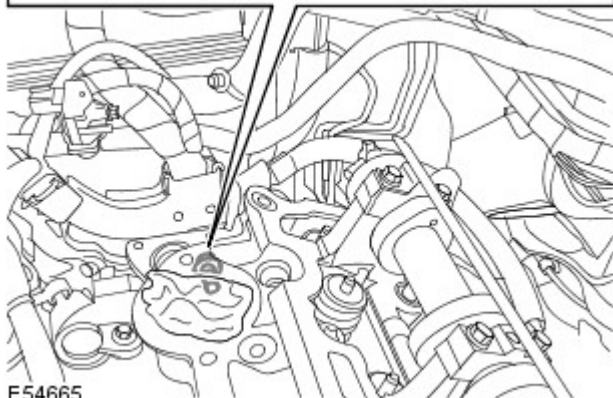
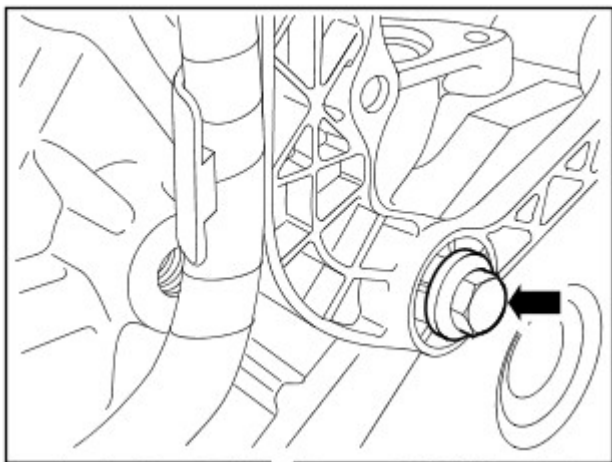
Engine - V6 4.0L Petrol - Cylinder Head LH

In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the coolant.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
3. Refer to camshaft timing. For additional information, refer to: [Camshaft Timing](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
4. Remove the exhaust manifold.
For additional information, refer to: [Exhaust Manifold LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
5. Release the harness bridge for access.

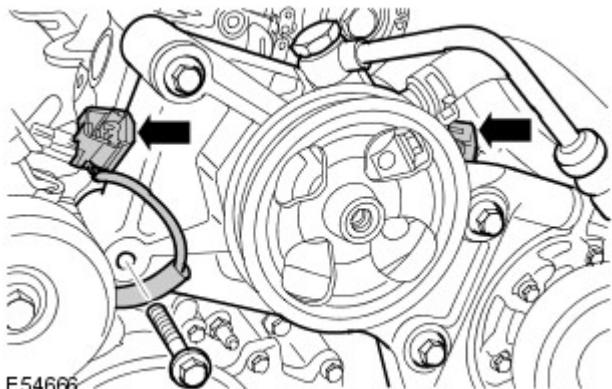
- Remove the bolt.



E54665

6. Position the A/C compressor mounting bracket assembly aside.

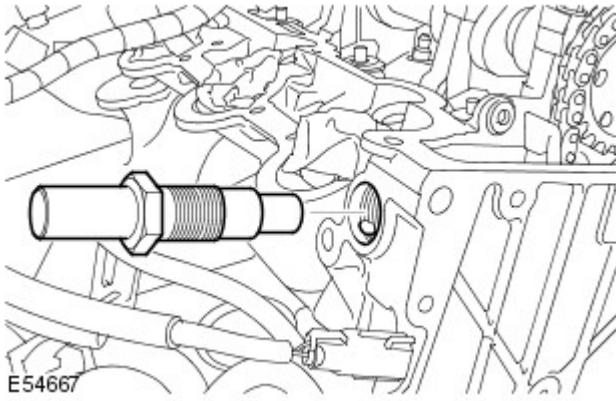
- Remove the 4 bolts.
- Release the knock sensor electrical connector retaining clips.
- Tie the bracket aside.



E54666

7. Remove the LH hydraulic timing chain tensioner.

- Clean the component mating faces.

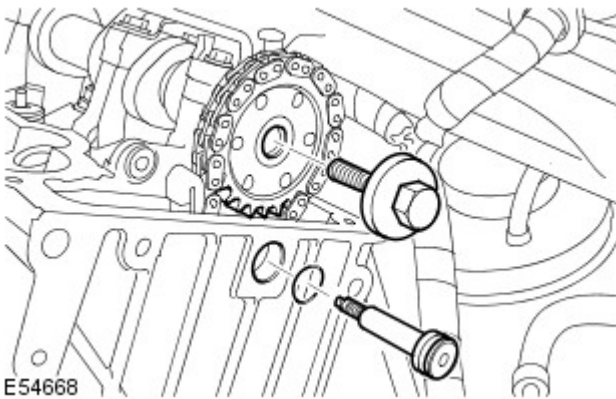


8. Remove the Torx bolt retaining the chain guide.

- Remove and discard the O-ring seal.

9. Remove the camshaft sprocket bolt.

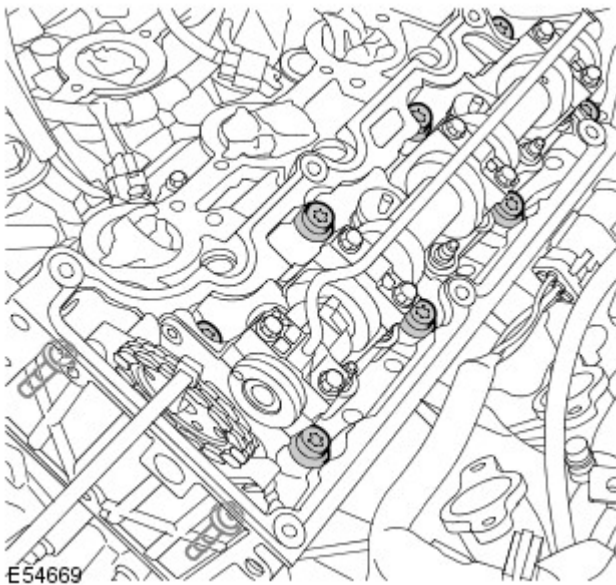
- Remove the camshaft sprocket.
- Secure the chain to the guide with a cable tie.

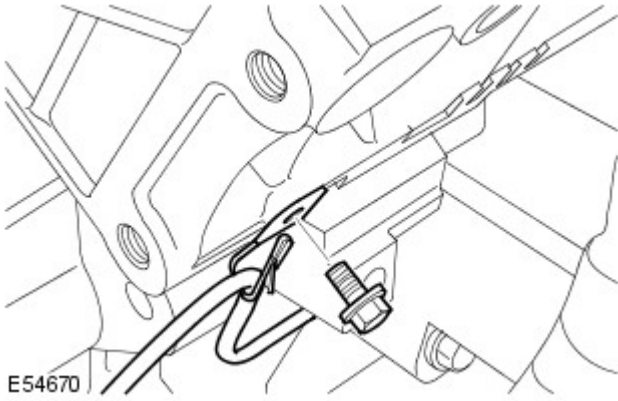


10.  **CAUTION:** Working in a diagonal sequence, progressively loosen the bolts.

Remove the 10 cylinder head bolts.

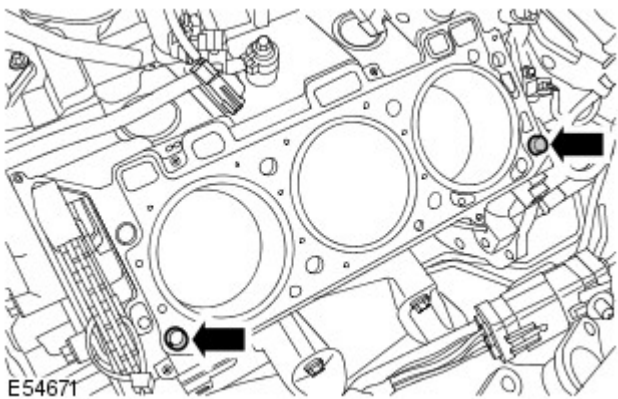
- Discard the bolts.





11. Remove the cylinder head LH assembly.

- Release the KS electrical harness clip.
- Remove the bolt.



12. Remove and discard the cylinder head gasket.

- Clean the cylinder head locating dowels.
- Clean and inspect the cylinder head and cylinder block.

13. NOTE: Remove the camshaft bearing caps evenly and in stages.

- NOTE: Note the fitted position.
- NOTE: Do not disassemble further if the component is removed for access only.

Remove the camshaft bearing caps.

- Remove the 8 bolts.
- Collect the camshaft oil supply line.

14. Remove the camshaft.

Installation

1. Install the camshaft.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.

2. NOTE: Note the fitted position.

Install the camshaft bearing caps.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.

3. NOTE: After installing the bolts check the camshaft is free to rotate.

Install the camshaft oil supply line.

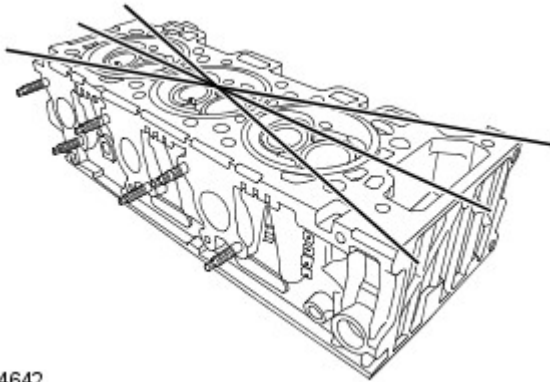
- Thoroughly clean and inspect the oil supply line.
- Prime the oil supply line with clean engine oil.
- Tighten the bolts evenly in 2 stages to the sequence shown.
- Tighten the bolts to 6 Nm (4 lb.ft).

- Tighten the bolts to 16 Nm (12 lb.ft).

4. Clean the component mating faces.

5. Check cylinder head face for distortion, across the center and from corner to corner.

For additional information, refer to: [Specifications](#) (303-01C Engine - V6 4.0L Petrol, Specifications).



E54642

6.  **CAUTION:** The head gasket must be installed over the cylinder block dowels.

Install a new cylinder head gasket.

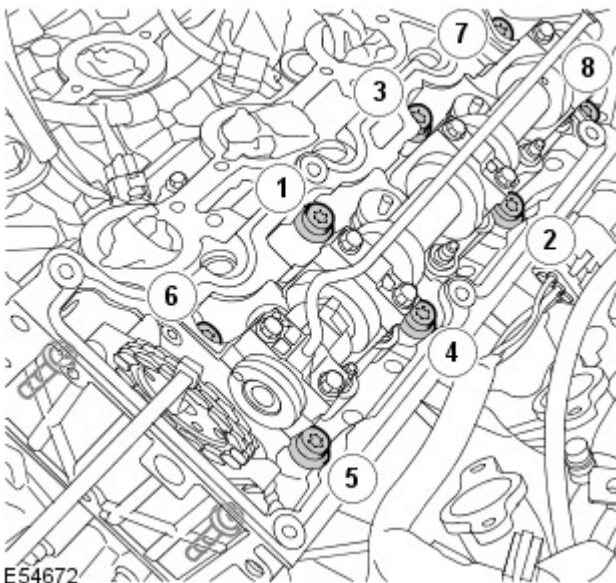
7. Install the cylinder head LH assembly.

- Install the knock sensor bracket.
- Tighten the bolt to 10 Nm (7 lb.ft).

8. **NOTE:** Tighten the bolts 1 to 8 in the sequence shown. The M12 bolts are tightened in 3 stages.

Install the cylinder head bolts.

- Lubricate the new cylinder head bolt threads with clean engine oil.
- Tighten the M12 bolts to 30 Nm (22 lb.ft), then a further 80 degrees.
- Tighten the M12 bolts a further 80 degrees.
- Tighten the M8 bolts to 35 Nm (26 lb.ft).



E54672

9. Install the exhaust manifold.

For additional information, refer to: [Exhaust Manifold LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

10. Install the Torx bolt retaining the chain guide.

- Install a new O-ring seal.
- Tighten the bolt to 10 Nm (7 lb.ft).
- Clean the component mating faces.

11. Install the A/C compressor mounting bracket assembly.

12. Adjust the belt tension. For additional information, refer to: [Camshaft Timing](#) (303-01C Engine - V6 4.0L Petrol, General Procedure).

13. Tighten the bolts to 45 Nm (33 lb.ft).

14. Install the electrical harness bridge.

- Secure the wiring harness.
- Tighten the belt to 45 Nm (33 lb.ft).
- Tighten the RS clip retaining bolt to 10 Nm (7 lb.ft).

15. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

16. Refill and bleed the cooling system.

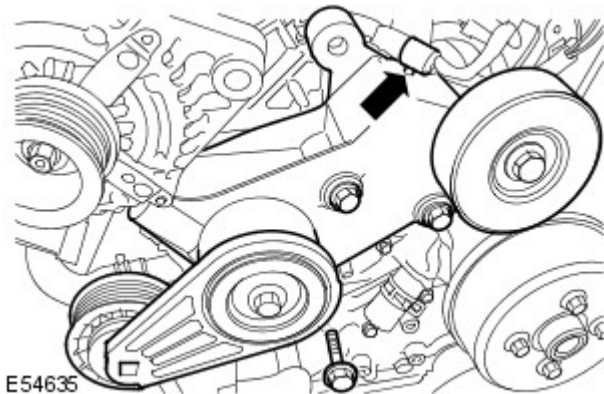
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).

Engine - V6 4.0L Petrol - Cylinder Head RH

In-vehicle Repair

Removal

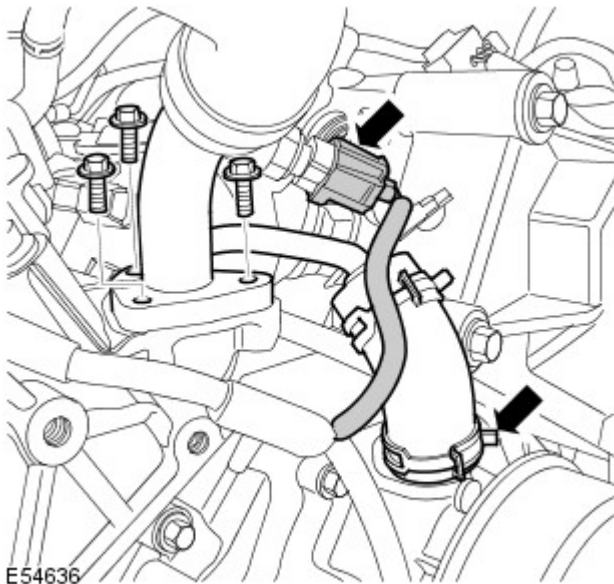
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the coolant.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
3. Refer to camshaft timing. For additional information, refer to: [Camshaft Timing](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
4. Remove the exhaust manifold.
For additional information, refer to: [Exhaust Manifold RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
5. Position the generator mounting bracket aside.



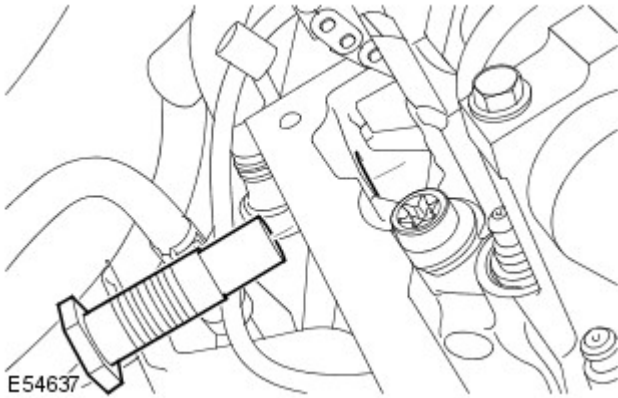
- Remove the 3 bolts.
- Release the wiring harness clip.
- Disconnect the engine coolant temperature (ECT) sensor electrical connector.

6. Remove the cylinder block coolant outlet elbow.

- Disconnect the engine coolant temperature (ECT) sensor electrical connector.
- Release the clip securing the coolant pump hose.
- Remove the 3 bolts.

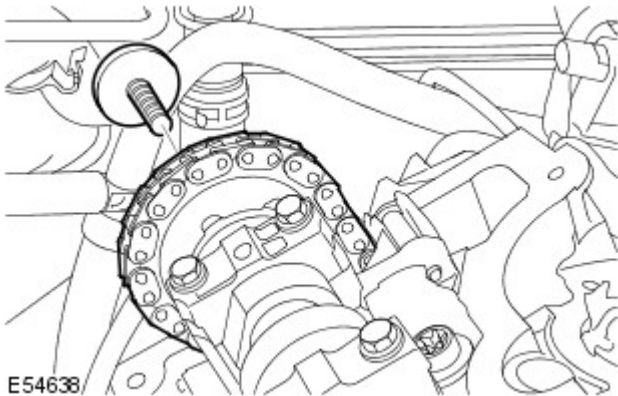



7. Remove the RH hydraulic timing chain tensioner.



8. Remove the camshaft sprocket bolt.

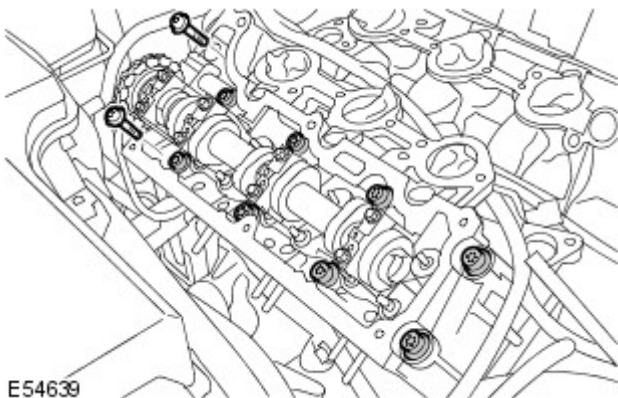
- Remove the camshaft sprocket.
- Secure the chain to the guide with a cable tie.



9.  **CAUTION:** Working in a diagonal sequence, progressively loosen the bolts.

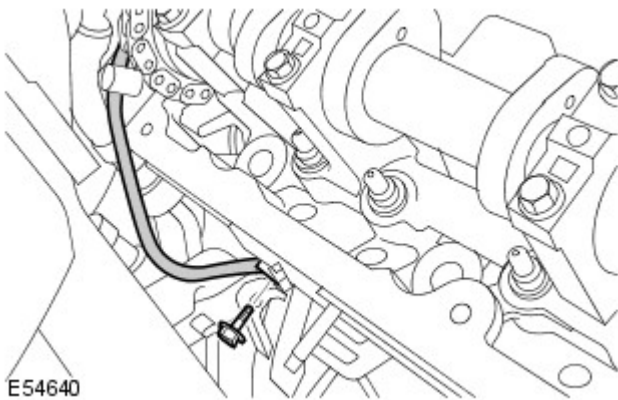
Remove the 10 cylinder head bolts.

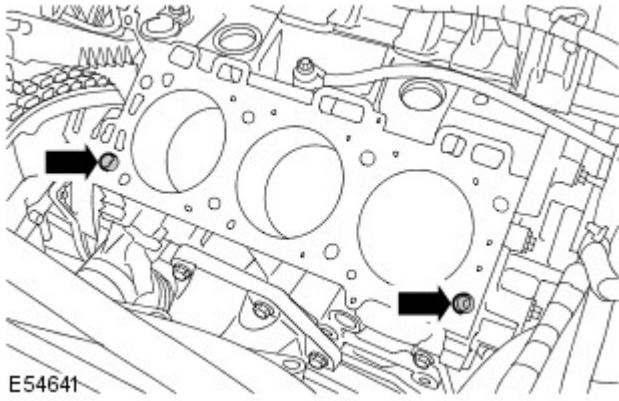
- Discard the bolts.



10. Remove the RH cylinder head assembly.

- Disconnect the cylinder head earth connector.
- Remove the bolt.





11. Remove and discard the cylinder head gasket.

- Clean the cylinder head locating dowels.
- Clean and inspect the cylinder head and cylinder block.

12. NOTE: Remove the camshaft bearing caps evenly and in stages.

- NOTE: Note the fitted position.
- NOTE: Do not disassemble further if the component is removed for access only.

Remove the camshaft bearing caps.

- Remove the 8 bolts.
- Collect the camshaft oil supply line.

13. Remove the camshaft.

Installation

1. Install the camshaft.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.

2. NOTE: Note the fitted position.

Install the camshaft bearing caps.

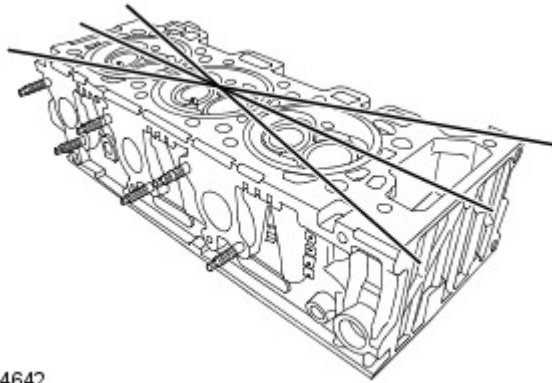
- Clean the component mating faces.
- Lubricate the components with clean engine oil.

3. NOTE: After installing the bolts check the camshaft is free to rotate.

Install the camshaft oil supply line.

- Thoroughly clean and inspect the oil supply line.
- Prime the oil supply line with clean engine oil.
- Tighten the bolts evenly in 2 stages to the sequence shown.
- Tighten the bolts to 6 Nm (4 lb.ft).
- Tighten the bolts to 16 Nm (12 lb.ft).

4. Clean the component mating faces.



E54642

5. Check cylinder head face for distortion, across the center and from corner to corner.
For additional information, refer to: [Specifications](#) (303-01C Engine - V6 4.0L Petrol, Specifications).

6.  **CAUTION:** The head gasket must be installed over the cylinder block dowels.

Install a new cylinder head gasket.

7. **NOTE:** Care must be taken when installing the ground connections. The engine will fail to start on either or both banks if the ground is poor.

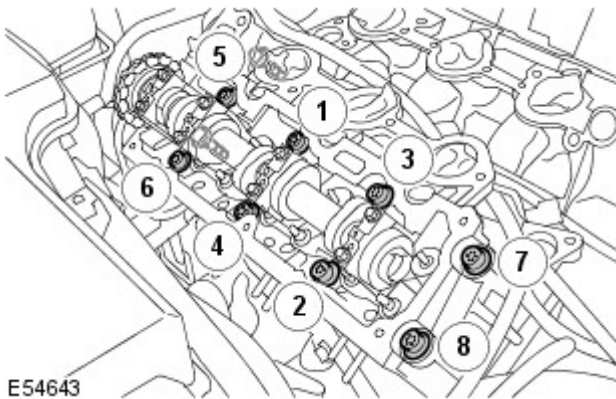
Install the cylinder head RH assembly.

- Connect the cylinder head earth ground connector.
- Tighten the bolt to 10 Nm (7 lb.ft).

8. **NOTE:** Tighten the bolts 1 to 8 in the sequence shown. The M12 bolts are tightened in 3 stages.

Install the cylinder head bolts.

- Lubricate the new cylinder head bolt threads with clean engine oil.
- Tighten the M12 bolts to 30 Nm (22 lb.ft), then a further 80 degrees.
- Tighten the M12 bolts a further 80 degrees.
- Tighten the M8 bolts to 35 Nm (26 lb.ft).



E54643

9. Install the exhaust manifold.
For additional information, refer to: [Exhaust Manifold RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

10. **NOTE:** The thread is left handed.

Install the camshaft sprocket bolt.

- Remove and discard the cable tie.
- Clean the component mating faces.
- Install and lightly tighten the camshaft sprocket bolt.

11. Install the RH hydraulic timing chain tensioner.

- Tighten the tensioner to 45 Nm (33 lb.ft).

12. Install the cylinder head coolant flange.

- Clean the component mating faces.
- Tighten the bolts to 10 Nm (7 lb.ft).
- Secure the hose with the clip.
- Connect the ECT sensor electrical connector.

13. Install the generator mounting bracket.

- Clean the component mating faces.
- Tighten the bolts to 45 Nm (33 lb.ft).
- Secure the wiring harness.
- Connect the ECT sensor electrical connector.

14. Adjust the valve timing. For additional information, refer to: [Camshaft Timing](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).

15. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

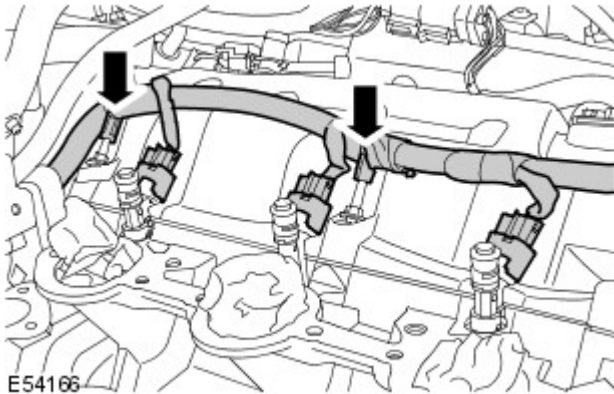
16. Refill and bleed the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).

Engine - V6 4.0L Petrol - Valve Cover LH

In-vehicle Repair

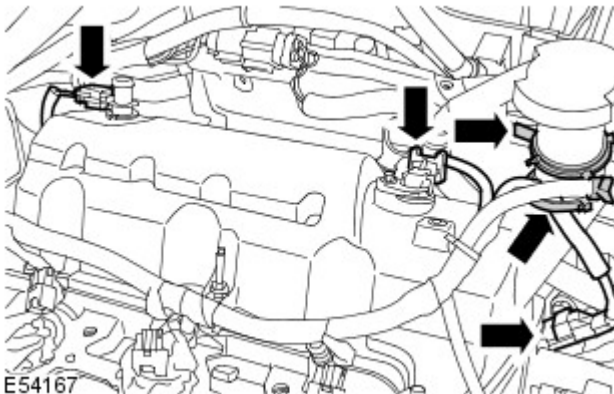
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the fuel rail.
For additional information, refer to: [Fuel Rail](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Removal and Installation).
3. Position the injector harness aside.




- Release the 2 clips.
- Disconnect the 3 fuel injector electrical connectors.

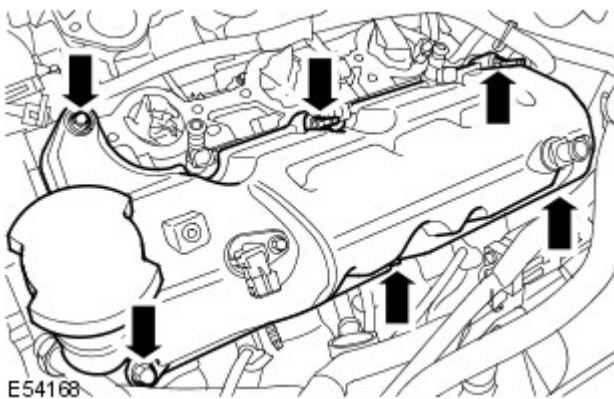
4. Disconnect the 3 electrical connectors.



- Release the harness clip from the filler neck.
- Noting the installed position of the Knock sensor electrical harness in relation to the oil filler tube, remove and discard the cable tie.

5.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the valve cover.



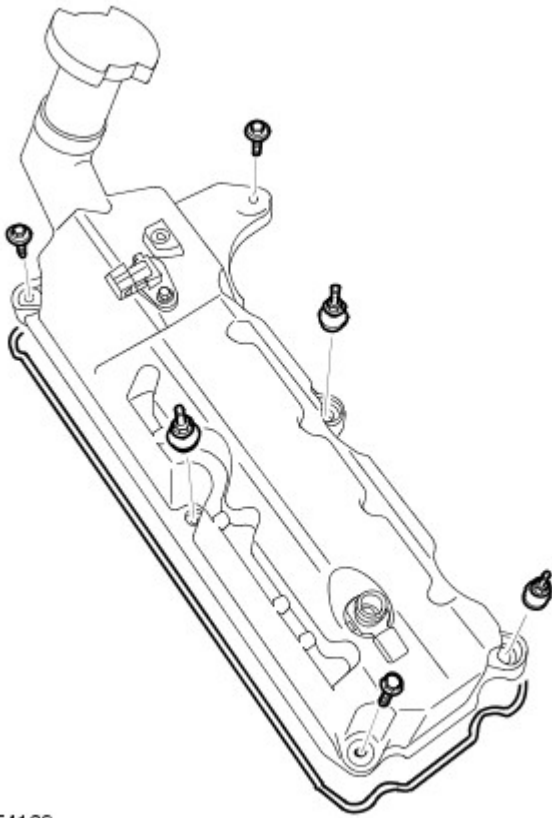
- Remove the 3 bolts.
- Remove the 3 studs.

6. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove and discard the gasket.

7. NOTE: Note the fitted position.

Remove the bolts and studs. Remove and discard the seals.



E54169

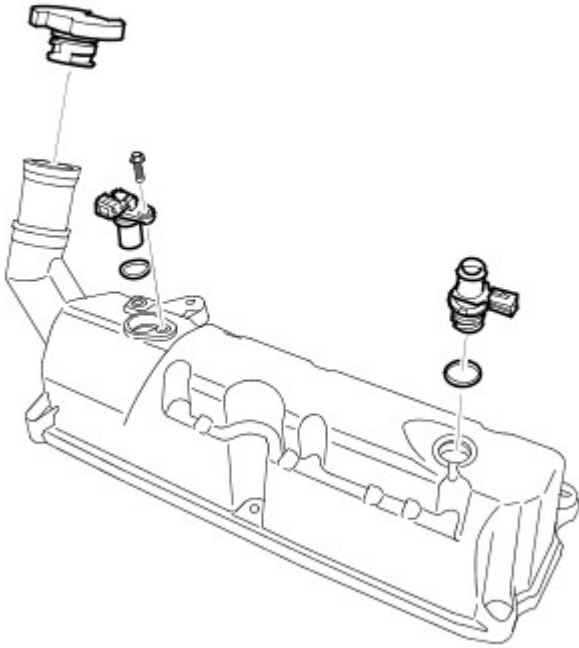
8. Remove the camshaft position (CMP) sensor.

- Remove the bolt.
- Remove and discard the O-ring seal.

9. Remove the engine breather valve.


- Remove and discard the O-ring seal.

10. Remove the oil filler cap.



E54170

Installation

1. Install the oil filler cap.
2. Install the engine breather valve.
 - Install a new O-ring seal.
3. Install the CMP sensor.
 - Install a new O-ring seal.
 - Tighten the bolt to 6 Nm (4 lb.ft).
4. Install the bolts and studs.
 - Install the new O-ring seals.
 - Install the new gasket.
5. Install the valve cover.
 - Clean the component mating faces.
 - Evenly and progressively tighten the bolts and studs, in the sequence shown, to 10 Nm (7 lb.ft).
 - Secure the electrical harness with the clip.
6.  **CAUTION:** Make sure the knock sensor electrical harness is returned to the original fitted position.

Install the injector harness.

 - Secure with the clips.
 - Connect the fuel injector electrical connectors.
 - Connect the 3 electrical connectors.
 - Install a new cable tie.
7. Install the fuel rail.

For additional information, refer to: [Fuel Rail](#) (303-04E Fuel

Charging and Controls - V6 4.0L Petrol, Removal and Installation).

8. Connect the battery ground cable.

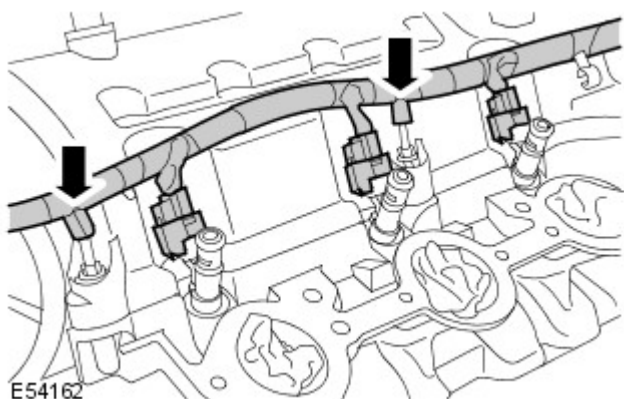
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Valve Cover RH

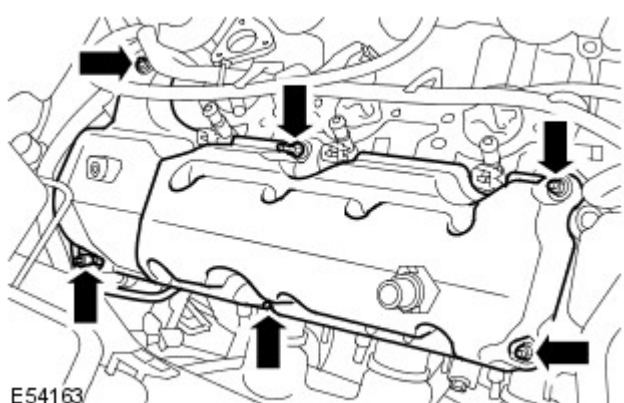
In-vehicle Repair


Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the fuel rail.
For additional information, refer to: [Fuel Rail](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Removal and Installation).
3. Position the injector harness aside.



- Release the 2 clips.
- Disconnect the 3 fuel injector electrical connectors.



4.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the valve cover.

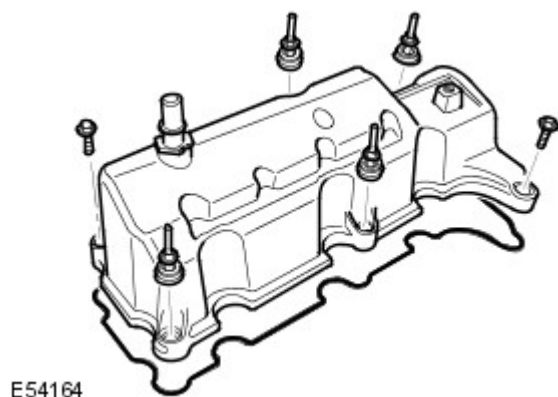
- Release the wiring harness retaining clip.
- Remove the 2 bolts.
- Remove the 4 studs.

5. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove and discard the gasket.

6. **NOTE:** Note the fitted position.

Remove the bolts and studs. Remove and discard the seals.



Installation

1. Install the bolts and studs.

- Install the new O-ring seals.

- Install the new gasket.

2. Install the valve cover.

- Clean the component mating faces.

- Evenly and progressively tighten the bolts and studs, in the sequence shown, to 10 Nm (7 lb.ft).

- Secure the electrical harness with the clip.

3. Install the injector harness.

- Secure with the clips.

- Connect the fuel injector electrical connectors.

4. Install the fuel rail.


For additional information, refer to: [Fuel Rail](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Removal and Installation).

5. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Camshaft Roller Follower

In-vehicle Repair

Special Tool(s)	
	Camshaft roller follower remover/replacer
	303-581

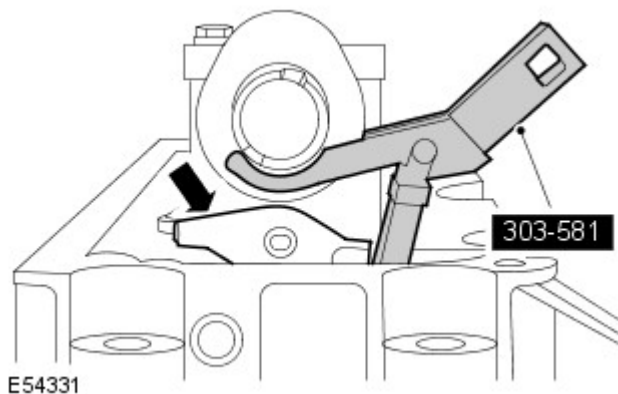
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the LH valve cover.
For additional information, refer to: [Valve Cover LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the RH valve cover.
For additional information, refer to: [Valve Cover RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Remove the viscous fan assembly.
For additional information, refer to: [Cooling Fan](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
5. **NOTE:** Make sure the camshaft lobe is opposite the camshaft roller follower, prior to removal.

- **NOTE:** Mark each camshaft roller follower and lash adjuster. Make sure each component is returned to its original fitted position.

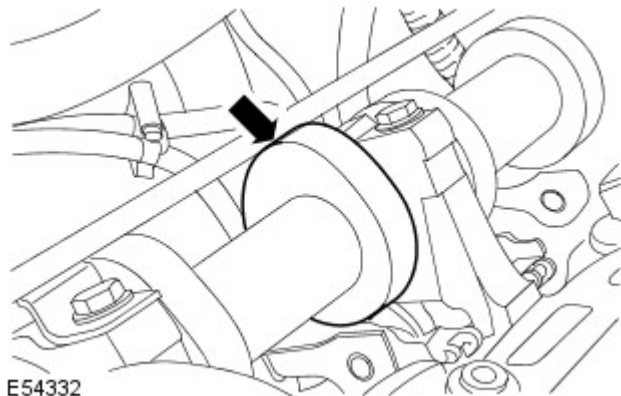
Using the special tool, remove the camshaft roller followers.

- Depress the valve spring.



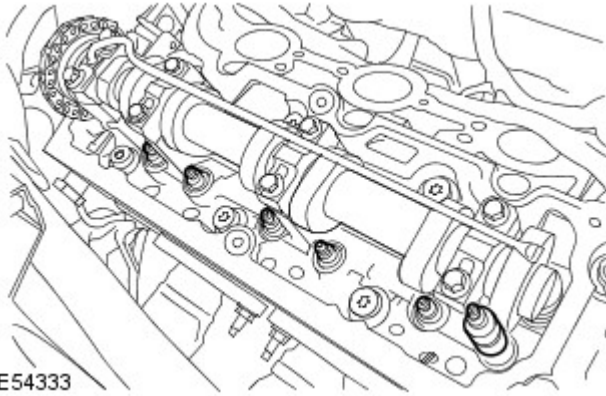
E54331

6. Rotate the engine as required to access the remaining camshaft roller followers.



E54332

7. Remove the hydraulic lash adjusters.



Installation

1. **NOTE:** Install the components to their original fitted positions.

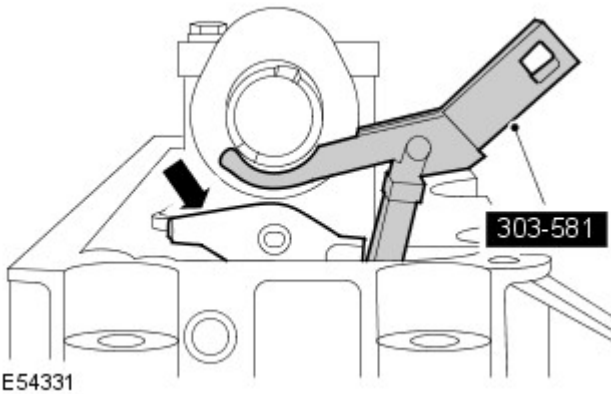
Install the hydraulic lash adjusters.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.

2. **NOTE:** Install the components to their original fitted positions.

Using the special tool, install the camshaft roller followers.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.
- To install, reverse the removal procedure.




3. Rotate the engine as required to access the remaining camshaft roller followers.
4. Install the viscous fan assembly.
For additional information, refer to: [Cooling Fan](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
5. Install the RH valve cover.
For additional information, refer to: [Valve Cover RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
6. Install the LH valve cover.
For additional information, refer to: [Valve Cover LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
7. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Engine Mount LH

In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.


3. Remove the LH exhaust manifold.
For additional information, refer to: [Exhaust Manifold LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

4. Release the starter motor cable.

- Release the terminal cover.
- Remove the terminal nut insulator.
- Remove the nut.



E45827

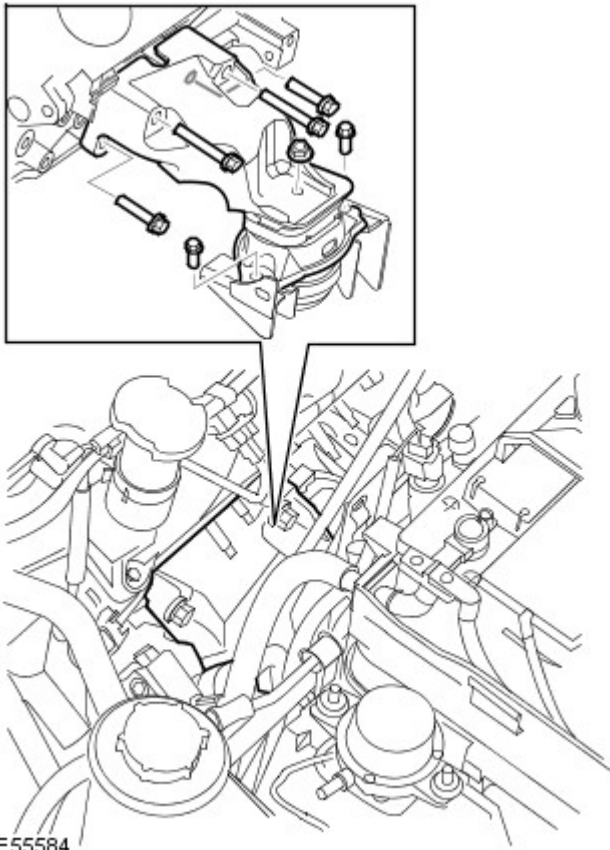
5.  **CAUTION:** Protect the engine during this operation.

Remove the engine mount bracket.

- Support the engine.
- Remove the 4 bolts.

6. Remove the engine mount.

- Remove and discard the 2 bolts.



Installation

1. Install the engine mount.

- Clean the component mating faces.
- Tighten the new bolts to 45 Nm (33 lb.ft), then a further 60 degrees.

2. Install the engine mount bracket.

- Clean the component mating faces.
- Tighten the bolts to 80 Nm (59 lb.ft).
- Remove the engine support.

3. Connect the starter motor cable.

- Tighten the nut to 10 Nm (7 lb.ft).
- Install the terminal nut insulator.
- Install the cover.

4. Install the exhaust manifold.

For additional information, refer to: [Exhaust Manifold LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).


5. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Engine Mount RH


In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

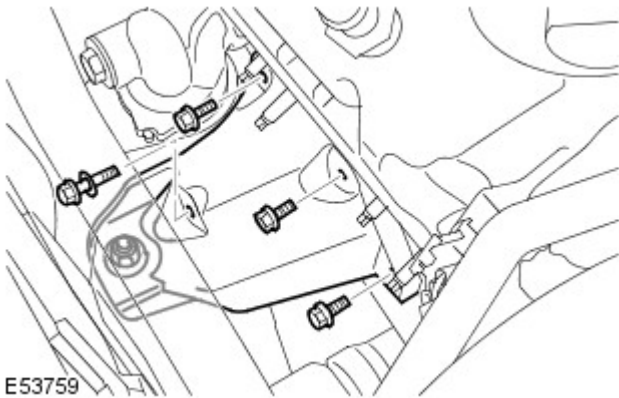
Raise and support the vehicle.

3. Remove the RH exhaust manifold.
For additional information, refer to: [Exhaust Manifold RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

4.  **CAUTION:** Protect the engine during this operation.

Remove the engine mount bracket.

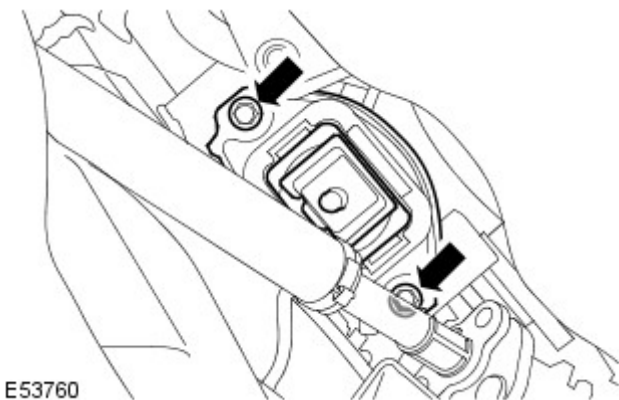
- Support the engine.
- Remove the nut.
- Remove the 4 bolts.



E53759

5. Remove the engine mount.

- Remove and discard the 2 bolts.



E53760

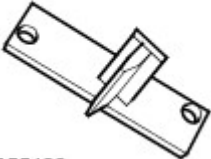
Installation

1. Install the engine mount.
 - Clean the component mating faces.
 - Tighten the new bolts to 45 Nm (33lb.ft), then a further 60 degrees.
2. Install the engine mount bracket.
 - Clean the component mating faces.
 - Tighten the bolts to 80 Nm (59 lb.ft).
 - Remove the engine support.
 - Tighten the nut to 90 Nm (66 lb.ft).
3. Install the exhaust manifold.
For additional information, refer to: [Exhaust Manifold RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Flexplate

In-vehicle Repair

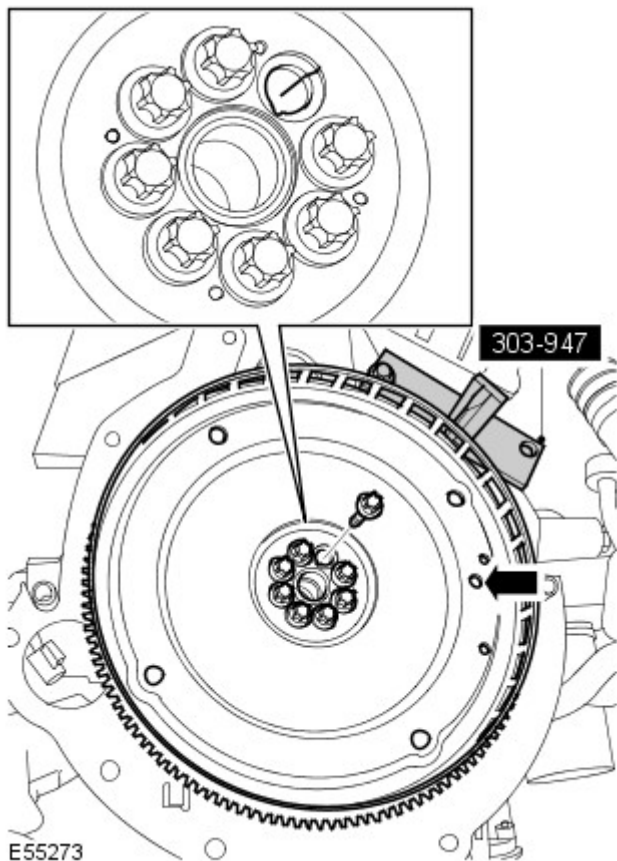
Special Tool(s)	
 <p>303-947</p> <p>E55482</p>	<p>Flex plate locking tool</p> <p>303-947 (LRT-12-145)</p>

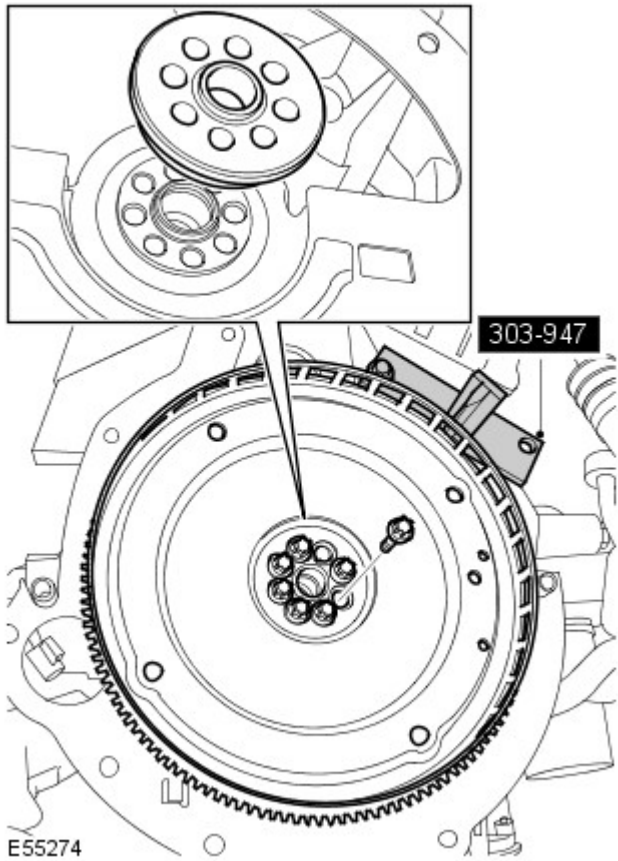
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the transmission.
For additional information, refer to: [Transmission](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, Removal and Installation).
4. Flexplate alignment.

- Rotate the crankshaft until number 1 cylinder is at TDC. The timing hole in the flexplate will be horizontal as shown.
- Using the special tool, lock the flexplate.
- Remove the Torx bolt shown to reveal the timing notch.
- Mark the position of the bolt hole with the notch in relation to the crankshaft.

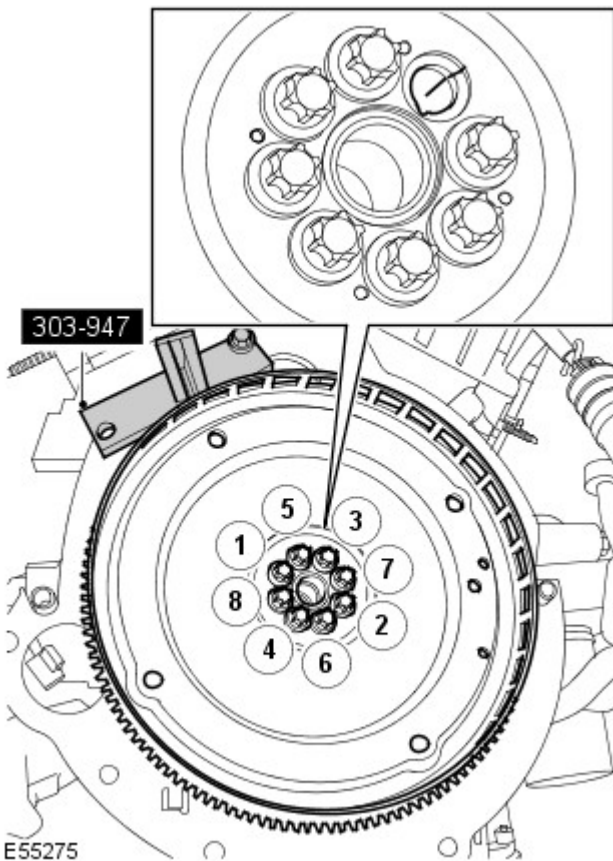




5. Remove the torque converter flexplate.
 - Remove the 7 remaining Torx bolts.
 - Remove the spacer.

Installation

1. Install the torque converter flexplate.



- Clean the component mating faces.
- Install the spacer.
- Align the bolt hole with the alignment notch, to the mark previously made on the crankshaft.
- Using the special tool, lock the flexplate.
- Tighten the Torx bolts evenly in 2 stages, in the sequence shown.
- Tighten the Torx bolts to 15 Nm (11 lb.ft).
- Tighten the Torx bolts to 72 Nm (53 lb.ft)


2. Install the transmission.
For additional information, refer to: [Transmission](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, Removal and Installation).

- 3.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Oil Pump

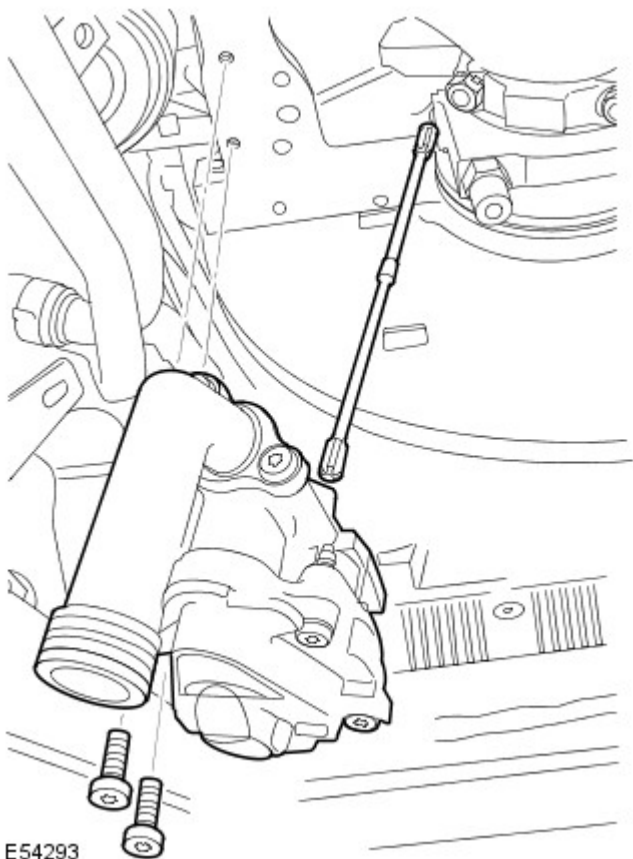
In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the front wheels and tires.
4. Remove the cylinder block cradle.
For additional information, refer to: [Cylinder Block Cradle](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
5. Remove the oil pump assembly.

- Remove the 2 Torx screws.
- Remove the driveshaft.

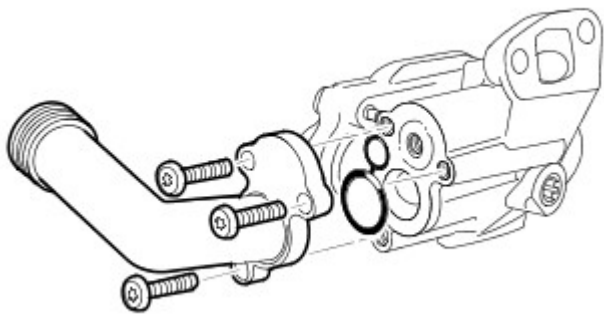


E54293

6. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the oil pickup pipe.

- Remove the 3 Torx screws.
- Remove and discard the seal.



E54294

Installation

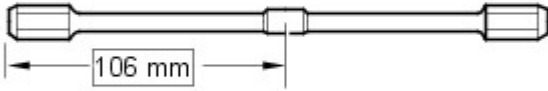
1. Install the oil pickup pipe.

- Clean the component mating faces.
- Install a new seal.
- Tighten the Torx screws to 10 Nm (7 lb.ft).

2.  **CAUTION:** The oil pump driveshaft is not symmetrical. The longer end shown, is fitted into the oil pump.

Install the oil pump assembly.

- Clean the component mating faces.
- Prime the oil pump.
- Install the driveshaft.
- Tighten Torx screws to 20 Nm (15 lb.ft).




E54292

3. Install the cylinder block cradle.
For additional information, refer to: [Cylinder Block Cradle](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Install the front wheels and tires.
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Oil Pan

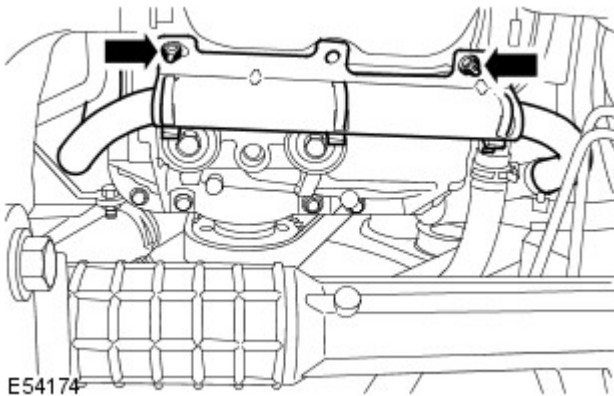
In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Drain the engine oil.
For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
4. Release the harness bracket.

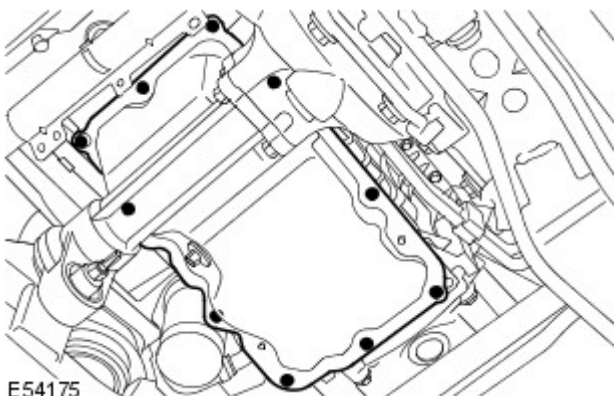
- Remove the 2 nuts.



E54174

5. Remove the oil pan.

- Remove the 10 bolts.
- Remove and discard the gasket.



E54175

Installation


1. Install the oil pan.
 - Clean the component mating faces.
 - Install a new gasket.
 - Evenly and progressively tighten the bolts to 10 Nm (7 lb.ft).
2. Install the harness bracket.
 - Tighten the nuts to 6 Nm (4 lb.ft).
3. Fill the engine with oil.
For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Oil Cooler

In-vehicle Repair

Removal

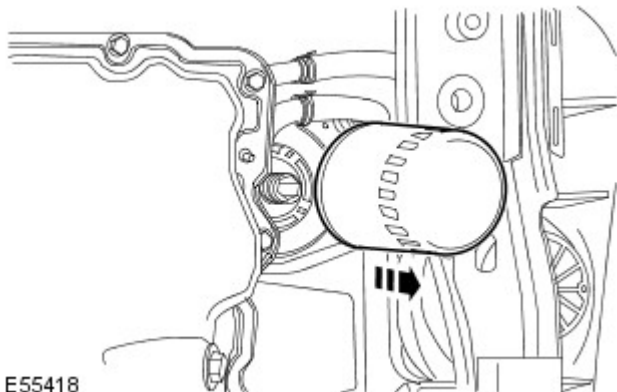
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the oil filter.

- Position a container to collect the fluid.



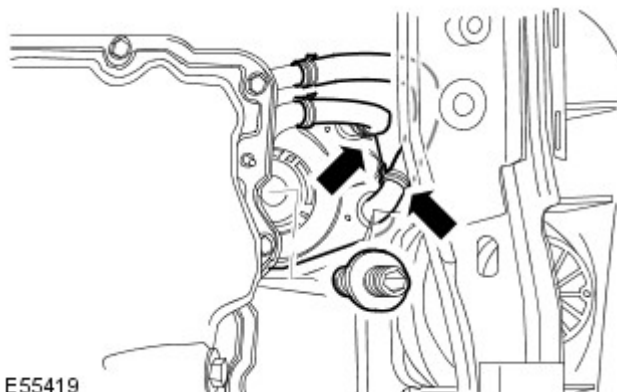
E55418

4. **NOTE:** Note the fitted position of the oil cooler assembly.

Remove the oil filter adapter.

- Release the cooler from the oil filter head.

5. Clamp, then disconnect the coolant hoses from the oil cooler.



E55419

6. Remove the oil cooler.

Installation

1. **NOTE:** Fill the oil cooler with coolant to eliminate the air, prior to connecting the coolant hoses.

To install, reverse the removal procedure.

- Tighten the adapter to 60 Nm (44 lb.ft)
- Lubricate the oil filter seal with clean engine oil and tighten to 18 Nm (13 lb.ft).

2. Check and top-up the engine oil.

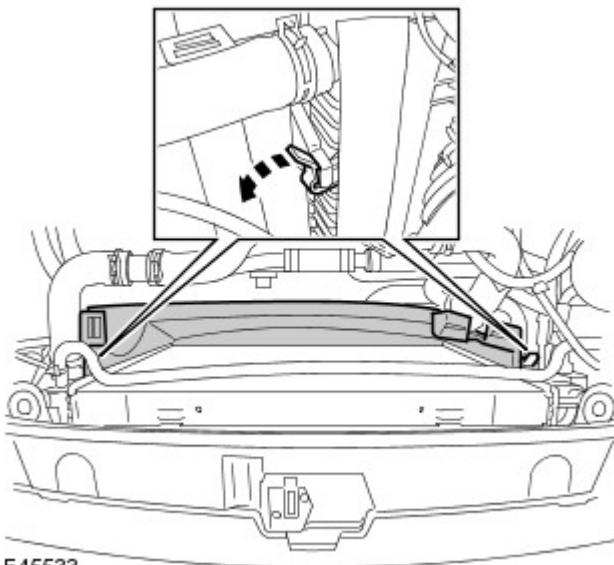
3. Top-up and bleed the coolant.

Engine - V6 4.0L Petrol - Engine Front Cover

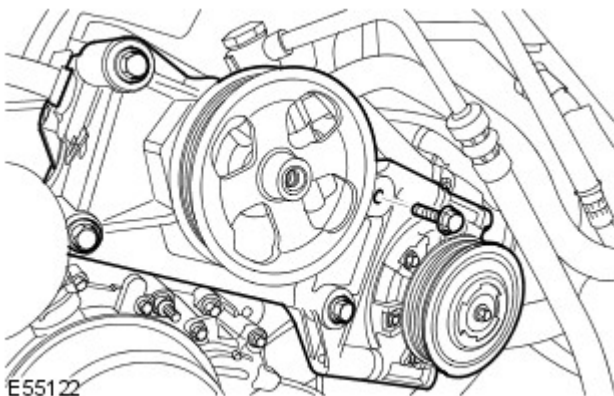
In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
3. Remove the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Remove the crankshaft pulley.
For additional information, refer to: [Crankshaft Pulley](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
5. Remove the cooling fan lower shroud.
 - Release 2 clips from the cooling fan lower shroud.
 - Release and remove the cooling fan lower shroud from the cooling pack.

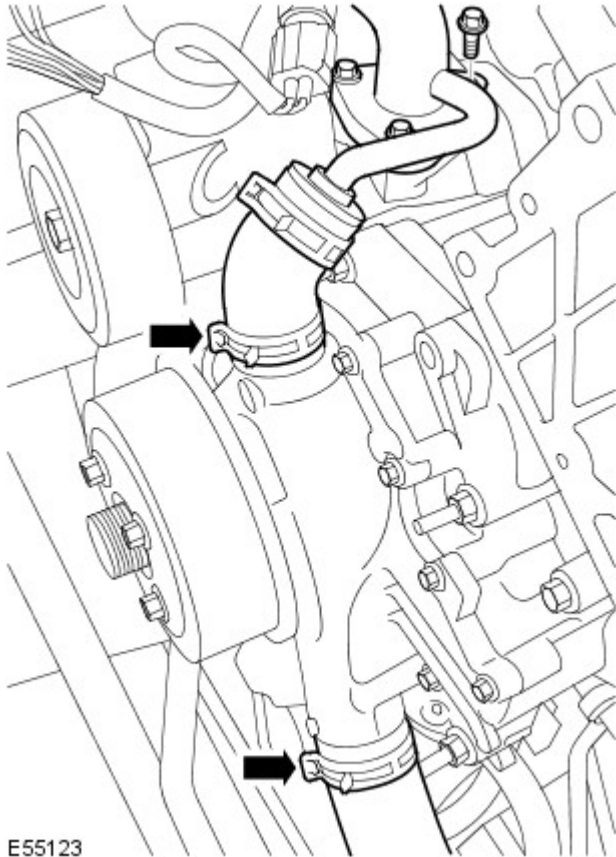


E45533



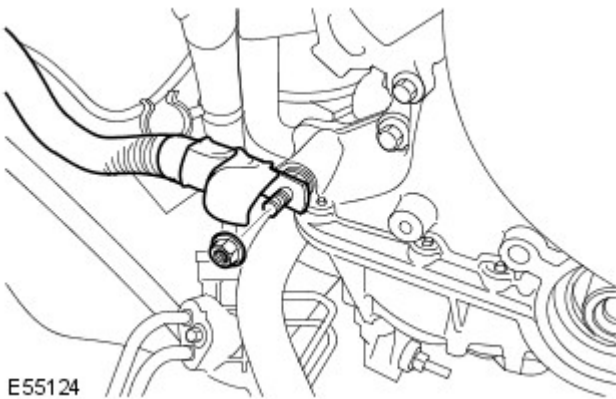
E55122

6. Position the A/C compressor mounting bracket assembly aside.
 - Remove the 4 bolts.
 - Tie aside.



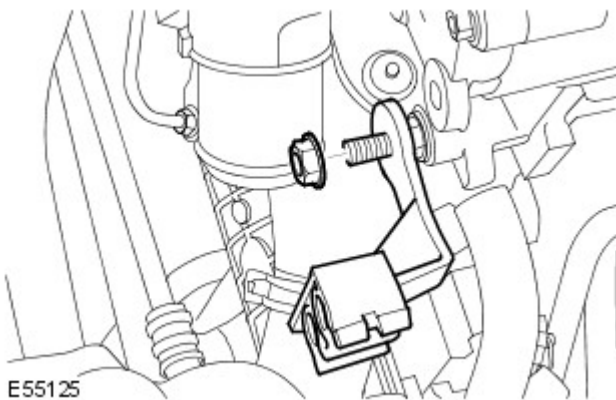
7. Disconnect the 2 hoses from the coolant pump.

- Release the cylinder head coolant flange, to aid coolant hose removal.
- Remove the 3 bolts.
- Position the coolant hoses aside for access.



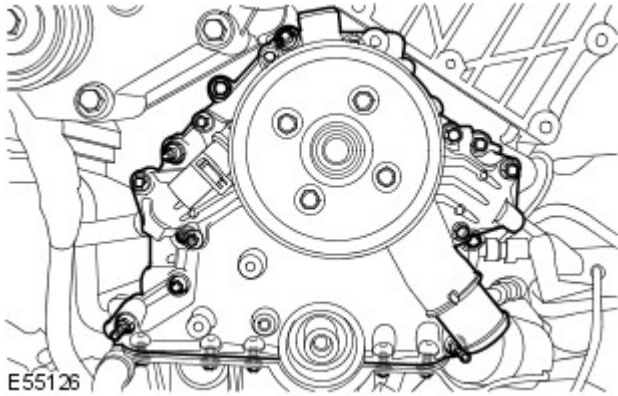
8. Disconnect the engine ground cable.

- Remove the nut.



9. Release the transmission line support bracket.

- Remove the nut.
- Position aside.



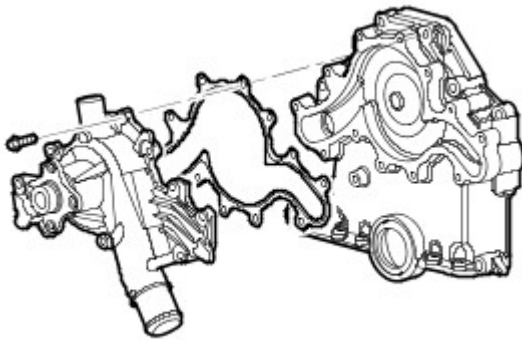
10. Remove the engine front cover.

- Remove the 5 studs.
- Remove the 4 bolts.
- Remove the 5 cylinder cradle bolts.
- Remove and discard the gasket.

11. NOTE: Do not disassemble further if the component is removed for access only.

Remove the coolant pump.

- Remove the 12 bolts.
- Remove and discard the gasket.




E55127

Installation

1. Install the coolant pump.

- Clean the component mating faces.
- Install the new gasket.
- Tighten the bolts to 10 Nm (7 lb.ft).

2.  **CAUTION:** Care must be taken when removing sealant from gasket faces, prevent damage to the mating faces.

• **NOTE:** The component must be installed within 20 minutes of the sealant application.

• **NOTE:** Make sure the cylinder block cradle gasket is located correctly around the front oil seal.

Install the engine front cover.

- Clean the component mating faces.
- Spirit wipe the gasket mating faces.
- Install a new gasket.
- Apply sealant to the 4 places shown.

3. NOTE: Tighten the bolts in two stages.

Install the engine front cover bolts.

- Evenly and progressively tighten the bolts and studs to 8 Nm (6 lb.ft).
- Tighten the M6 bolts to 10 Nm (7 lb.ft).
- Tighten the M8 bolts and studs to 20 Nm (15 lb.ft).

4. Install the transmission support bracket.

- Tighten the nut to 20 Nm (15 lb.ft).

5. NOTE: Care must be taken when installing the ground connections. The engine will fail to start on either or both banks if the ground is poor.

Connect the engine ground cable, make sure the mating faces are clean.

- Tighten the nut to 20 Nm (15 lb.ft).

6. Install the A/C compressor mounting bracket assembly.

- Release the cable tie.
- Tighten the bolts to 45 Nm (33 lb.ft).

7. Install the crankshaft pulley.

For additional information, refer to: [Crankshaft Pulley](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

8. Install the cooling fan shroud.

9. Install the intake manifold.

For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

10. Refill and bleed the cooling system.


For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).

11. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Timing Drive Components

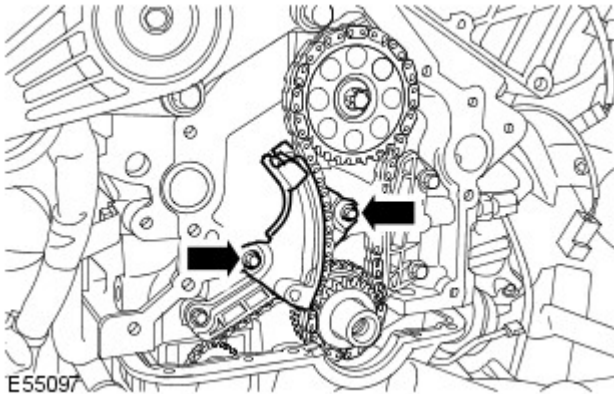
In-vehicle Repair

Special Tool(s)	
 <p>303-674</p> <p>E55101</p>	<p>Crankshaft rotating tool</p> <p>303-674</p>

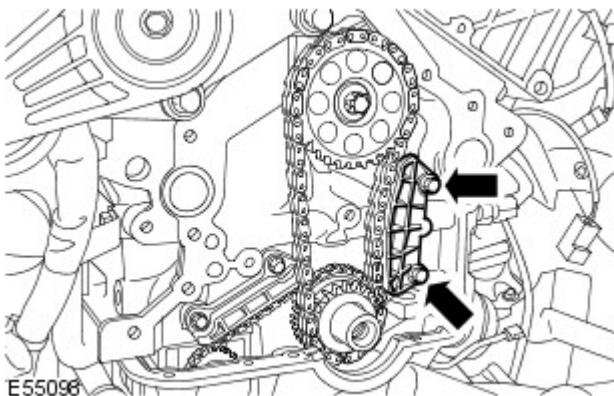
Removal

• NOTE: This procedure covers the removal and installation of the following components: Primary timing chain tensioner, timing chain guide, jackshaft sprocket, crankshaft sprocket and timing chain.

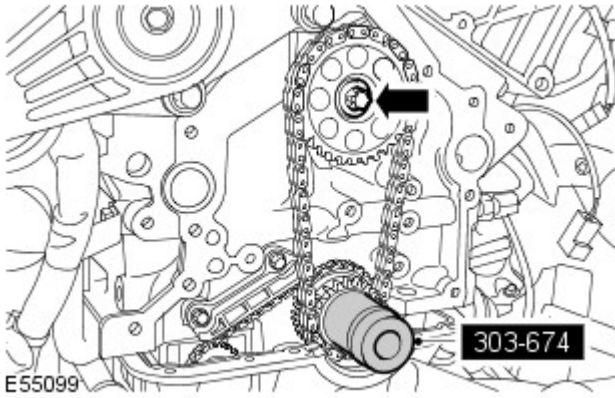
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine front cover.
For additional information, refer to: [Engine Front Cover](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the primary timing chain tensioner.
 - Remove the 2 bolts.



4. Remove the primary timing chain tensioner guide.
 - Remove the 2 bolts.

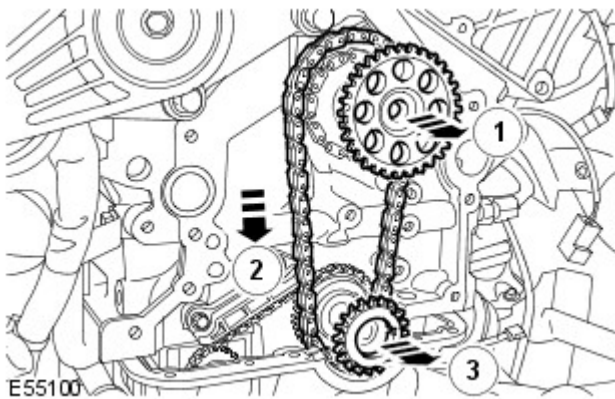


5. Install the special tool to the crankshaft.



6. Remove the jackshaft sprocket.

- Using an additional wrench and the special tool, restrain the jackshaft sprocket.
- Remove and discard the Torx bolt.



7. NOTE: Note the fitted position.

Remove the crankshaft sprocket.

- Remove the primary timing chain.

Installation

1. Install the primary timing chain.
 - Clean the component mating faces.
 - Install the crankshaft sprocket, the recessed face locates to the crankshaft side.
 - Install the special tool to the crankshaft.
2. Install the jackshaft sprocket.
 - Clean the component mating faces.
 - Locate the primary timing chain to the sprockets.
 - Install a new Torx bolt, lightly tighten at this stage.
3. Install the timing chain guide.
 - Clean the component mating faces.
 - Tighten the bolts to 20 Nm (15 lb.ft).
4. Install the timing chain tensioner.
 - Clean the component mating faces.
 - Tighten the bolts to 10 Nm (7 lb.ft).
5. Tighten the new Torx bolt to 45 Nm (33 lb.ft), then a further 70 degrees.
6. Install the engine front cover.
For additional information, refer to: [Engine Front Cover](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
7. Adjust the valve timing.
For additional information, refer to: [Camshaft Timing](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
8. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information,

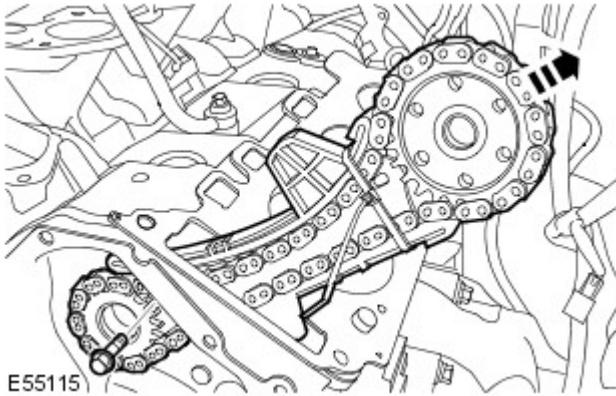
Specifications).

Engine - V6 4.0L Petrol - Camshaft Drive Cassette LH

In-vehicle Repair

Removal

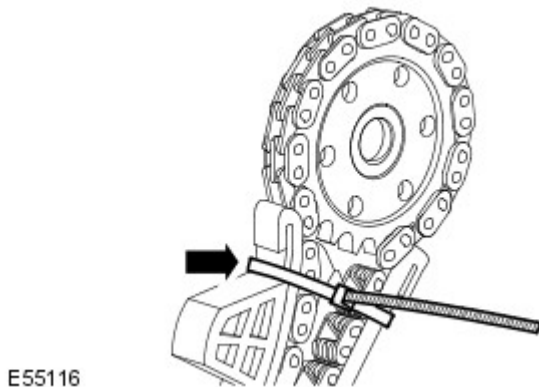
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the cylinder head LH assembly.
For additional information, refer to: [Cylinder Head LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the timing drive components.
For additional information, refer to: [Timing Drive Components](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Remove the camshaft drive cassette assembly.
 - Remove the bolt retaining the chain guide.



5. **NOTE: Do not disassemble further if the component is removed for access only.**

Disassemble the cassette assembly.

- Release the cable tie.
- Remove the sprockets and the chain.
- Clean and inspect the components for deterioration.




Installation

1. Assemble the cassette assembly.
 - Install the chain and the sprockets.
 - Secure with a cable tie.
2. Install the camshaft drive cassette assembly.
 - Tighten the bolt to 25 Nm (18 lb.ft).
3. Install the timing drive components.
For additional information, refer to: [Timing Drive Components](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Install the cylinder head LH assembly.
For additional information, refer to: [Cylinder Head LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Camshaft Drive Cassette RH

In-vehicle Repair

Special Tool(s)	
 <p>303-634</p> <p>E55195</p>	Sprocket holding tool RH rear cassette 303-643

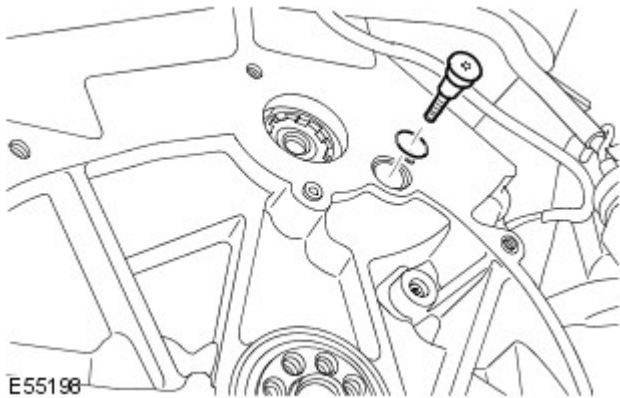
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the RH cylinder head assembly.
For additional information, refer to: [Cylinder Head RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the torque converter flexplate.
For additional information, refer to: [Flexplate](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Remove the cylinder block jackshaft plug.
 - Drift to release.



5. Using the special tool, remove the RH cassette jackshaft drive, sprocket bolt.
 - Remove and discard the Torx bolt.





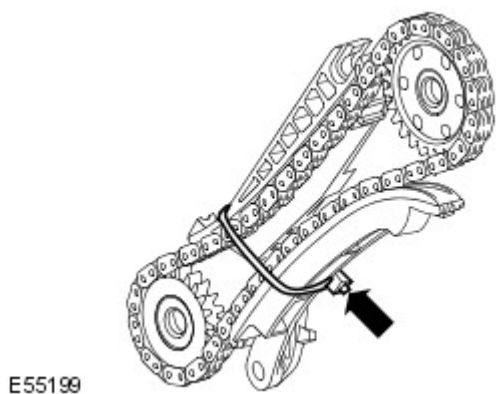
6. Remove the camshaft drive cassette assembly.

- Remove the bolt retaining the chain guide.
- Remove and discard the O-ring seal.

7. **NOTE:** Do not disassemble further if the component is removed for access only.

Disassemble the cassette assembly.

- Release the cable tie.
- Remove the sprockets and the chain.
- Clean and inspect the components for deterioration.



Installation

1. Assemble the cassette assembly.

- Install the chain and the sprockets.
- Secure with a cable tie.

2. Install the camshaft drive cassette assembly.

- Install a new O-ring seal.
- Tighten the bolt to 12 Nm (9 lb.ft).

3. Using the special tool, tighten the new jackshaft sprocket bolt to 40 Nm (30 lb.ft), then a further 45 degrees.



4. Install the cylinder block jackshaft plug.

- Clean the component mating faces.

5. Install the torque converter flexplate.

For additional information, refer to: [Flexplate](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

6. Install the cylinder head RH assembly.

For additional information, refer to: [Cylinder Head RH](#) (303-01C


Engine - V6 4.0L Petrol, In-vehicle Repair).

7. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Engine Dynamic Balance Shaft

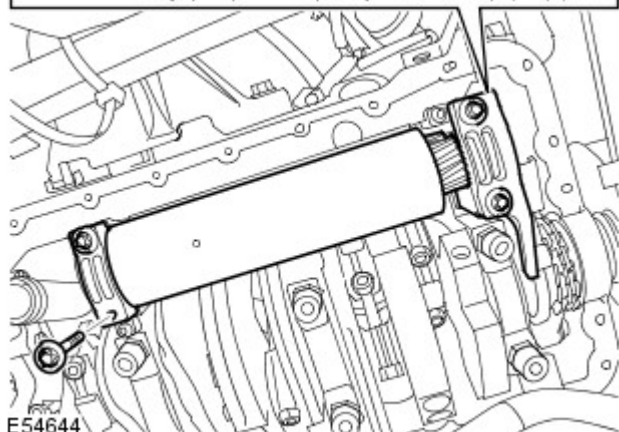
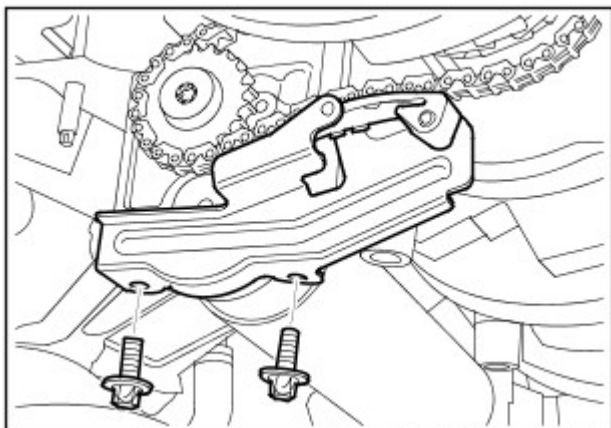
In-vehicle Repair

Special Tool(s)	
 <p>303-573</p> <p>E54427</p>	<p>Crankshaft TDC timing/locking tool</p> <p>303-573</p>

Removal

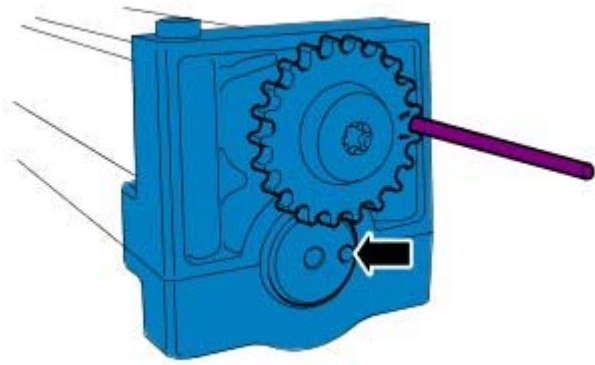
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the front wheels and tires.
4. Remove the cylinder block cradle.
For additional information, refer to: [Cylinder Block Cradle](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
5. Remove the balance shaft.
 - Remove the 4 Torx bolts.
 - Remove the drive chain tensioner.
 - Remove the tensioner blade.



E54644

Installation



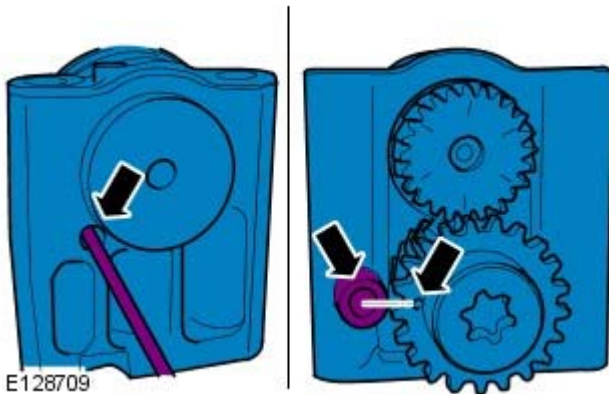
E54645

1. NOTE: Vehicles fitted with early type balance shaft.

- NOTE: Due to the gear ratio, it may be necessary to rotate the balance shaft up to 7 complete turns to find the correct position.

Align the balance shaft.

- Clean the components.
- Lubricate the components.
- Install a 4 mm (0.16 in) pin to lock the shaft as shown.



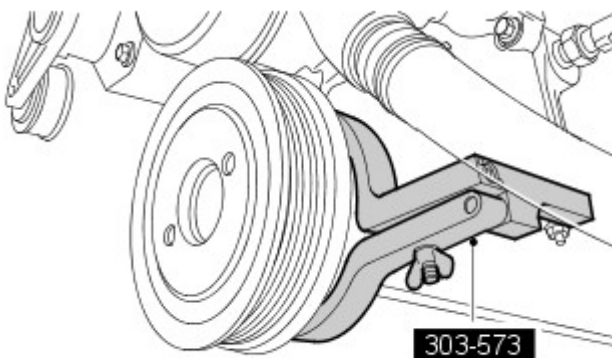
E128709

2. NOTE: Vehicles fitted with later type balance shaft.

- NOTE: If a new balance shaft is being fitted make sure the timing pin is not removed prior to fitting.
- NOTE: Due to the gear ratio, it may be necessary to rotate the balance shaft up to 7 complete turns to find the correct position.

Align the balance shaft.

- Clean the components.
- Lubricate the components.
- Install a 4 mm (0.16 in) pin to lock the shaft as shown and that the shaft can not rotate.
- Make sure the drive gear timing marks are aligned as shown.



E54646

3. Rotate crankshaft clockwise until number one cylinder is at TDC and install the special tool.

4. Install the balance shaft.

- Clean the component mating faces.
- Engage the drive chain.
- Install the drive chain tensioner.
- Tighten the Torx bolts to 15 Nm (11 lb.ft).
- Tighten a further 90 degrees.
- Remove the locking pin.
- Remove the special tool.

5. Install the cylinder block cradle.

For additional information, refer to: [Cylinder Block Cradle](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).


6. Install the front wheels and tires.

7. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

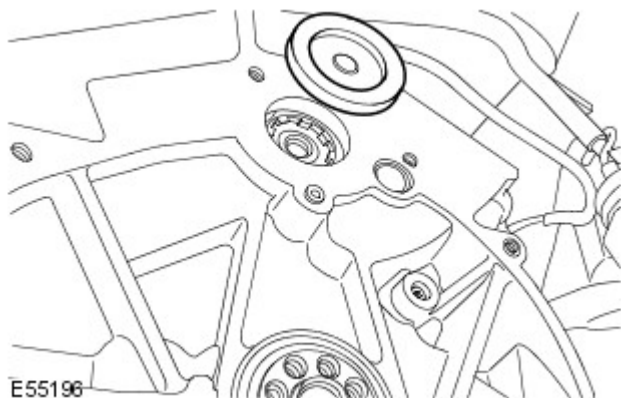
Engine - V6 4.0L Petrol - Jackshaft

In-vehicle Repair

Special Tool(s)	
 <p>303-634</p> <p>E55195</p>	Sprocket holding tool RH rear cassette
	303-643

Removal

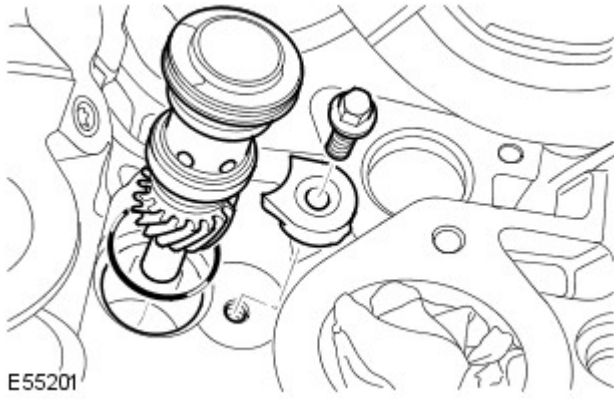
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the torque converter flexplate.
For additional information, refer to: [Flexplate](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the cylinder block jackshaft plug.
 - Drift to release.



4. Using the special tool, remove the RH cassette jackshaft drive, sprocket bolt.
 - Remove and discard the Torx bolt.

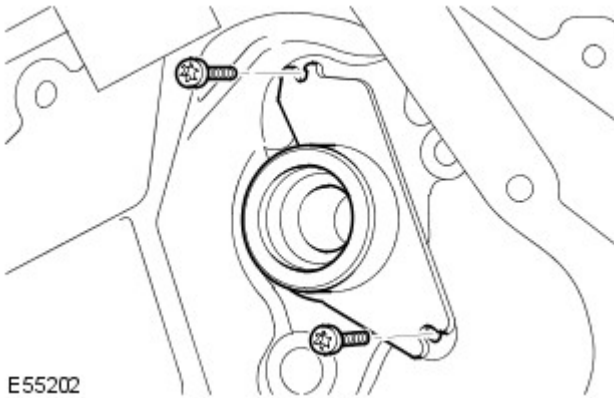


5. Remove the camshaft drive cassette LH assembly.
For additional information, refer to: [Camshaft Drive Cassette LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).



6. Remove the oil pump drive gear.

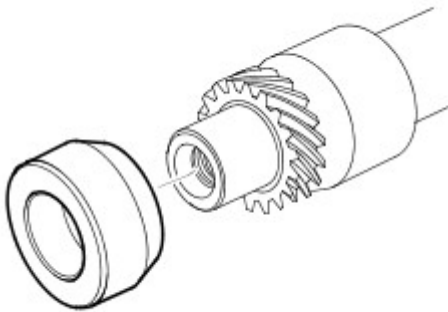
- Remove the bolt.
- Remove the clamp.
- Remove and discard the O-ring seal.



7. Remove the jackshaft thrust plate.

- Remove the 2 Torx bolts.

E55203



8. Remove the jackshaft.

- Collect the spacer.

Installation

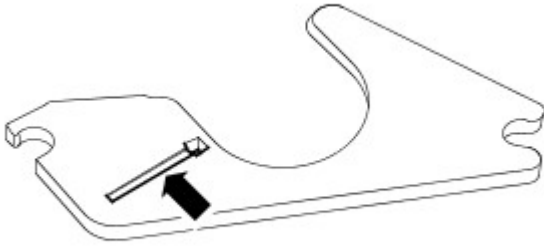
1. Install the jackshaft.

- Clean the component mating faces.
- Install the jackshaft spacer.
- Lubricate the components with clean engine oil.

2. NOTE: The groove in the thrust plate must face the cylinder block.

Install the jackshaft thrust plate.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.
- Tighten the Torx bolts to 10 Nm (7 lb.ft).



E55204

3. Install the oil pump drive gear.

- Clean the components.
- Lubricate the components with clean engine oil.
- Install a new O-ring seal.
- Install the clamp.
- Tighten the bolt to 20 Nm (15 lb.ft).

4. Install the camshaft drive cassette LH assembly.

For additional information, refer to: [Camshaft Drive Cassette LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

5. Using the special tool, install the RH cassette jackshaft drive, sprocket bolt.

- Clean the component mating faces.
- Using the special tool, tighten the new jackshaft sprocket bolt to 40 Nm (30 lb.ft), then a further 45 degrees.



E55200

6. Install the cylinder block jackshaft plug.

- Clean the component mating faces.

7. Install the torque converter flexplate.

For additional information, refer to: [Flexplate](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

8. Connect the battery ground cable.

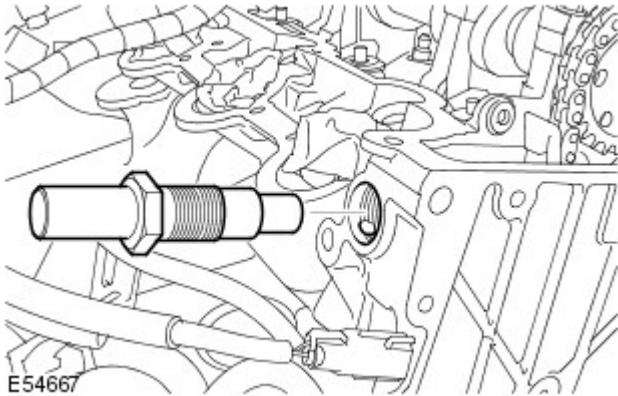
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


Engine - V6 4.0L Petrol - Hydraulic Timing Chain Tensioner LH

In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).



3.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the LH hydraulic timing chain tensioner.

Installation


1. Install the LH hydraulic timing chain tensioner.
 - Clean the component mating faces.
 - Tighten the tensioner to 45 Nm (33 lb.ft).
2. Install the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Hydraulic Timing Chain Tensioner RH

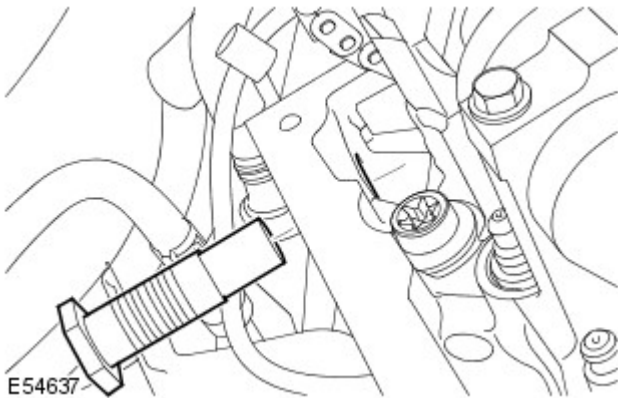
In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the RH hydraulic timing chain tensioner.




Installation

1. Install the RH hydraulic timing chain tensioner.
 - Clean the component mating faces.
 - Tighten the tensioner to 45 Nm (33 lb.ft).
2. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Intake Manifold

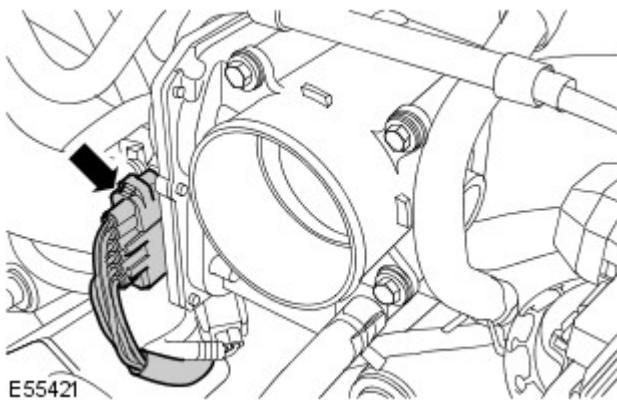
In-vehicle Repair

Special Tool(s)	
	Fuel spring lock decoupling tool
	310-044

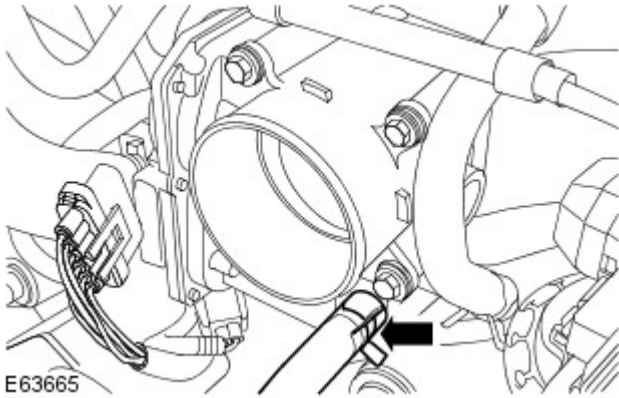
Removal

• **NOTE:** Removal of the intake manifold on early vehicles will involve the partial dismantling of the fuel rail and the removal of the purge valve and mounting bracket. Once removed, it will also be necessary to remove some excess material from the intake manifold, see 'installation' steps 1 and 2.

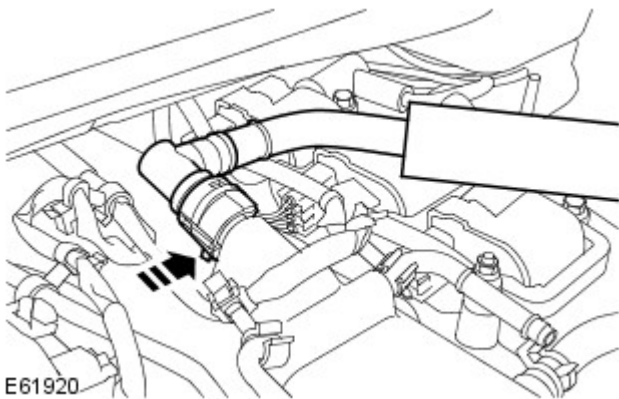
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Secure the hood in the service position.
 - Release the support struts.
3. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove the air intake resonator.
For additional information, refer to: [Intake Air Resonator](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
5. Disconnect the throttle body electrical connector.




6. Disconnect the intake manifold coolant hose.
 - Clamp the relevant hose, to minimise coolant loss.
 - Release the clip.

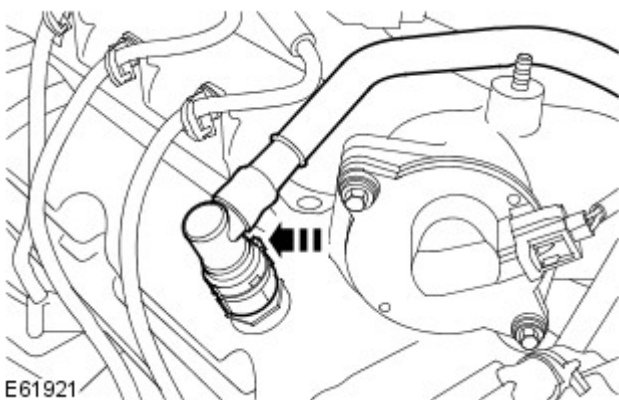


7. Disconnect the throttle body coolant hose.
- Clamp the hose to minimise coolant loss.
 - Release the clip.

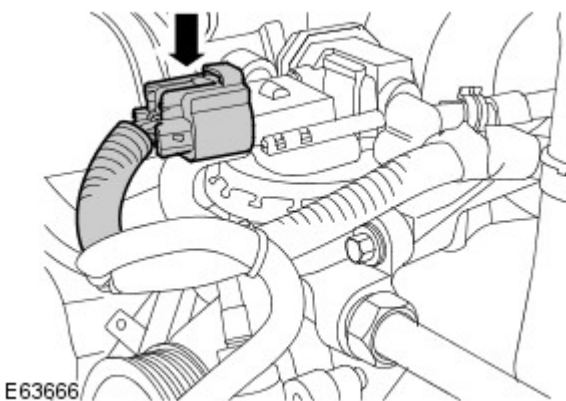


8.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

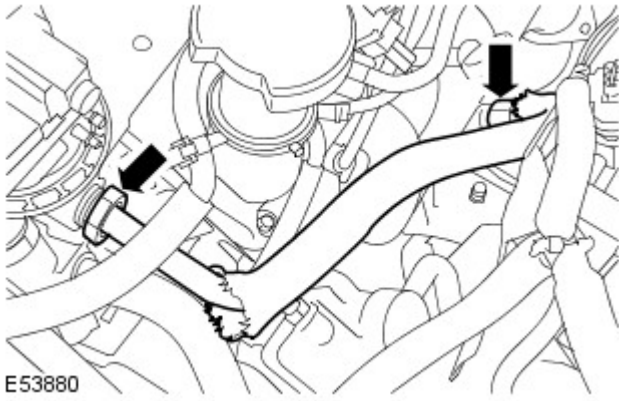
Disconnect the crankcase vent hose.



9. Remove the RH crankcase vent hose.

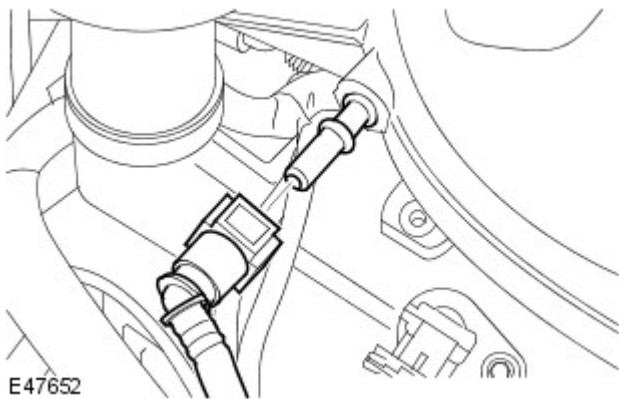


10. Disconnect the EGR valve electrical connector.



11. Disconnect the EGR valve feed pipe.

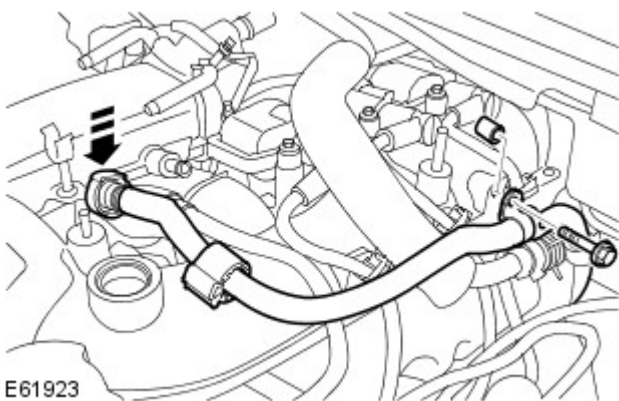
- Loosen the EGR valve feed pipe union nut, at the exhaust manifold.
- Disconnect the union nut, securing the EGR pipe to the valve.



12. Disconnect the intake manifold vacuum pipe assembly.

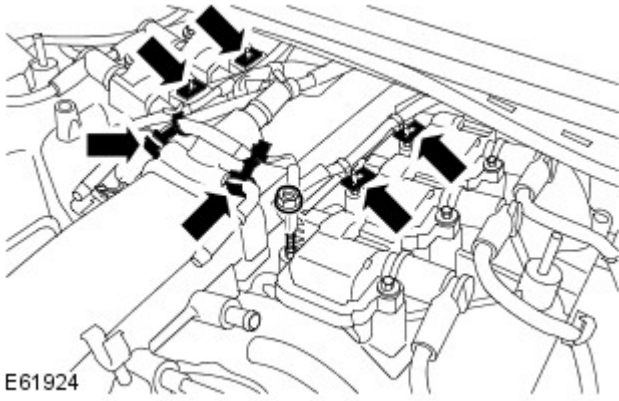


13. Disconnect the intake manifold tuning valve electrical connector.



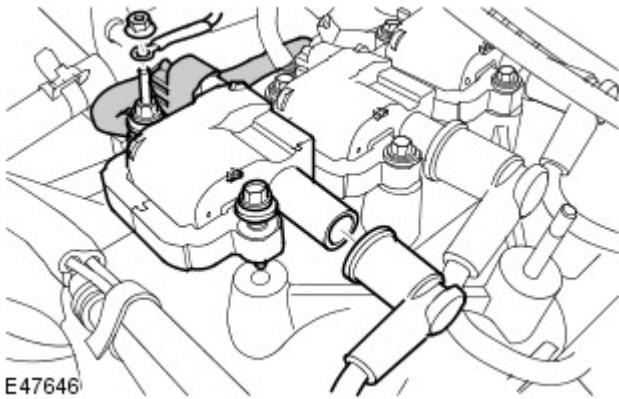
14. Release the purge line from the intake manifold.

- Remove the clip retaining bolt.
- Collect the spacer.



15. Release the coil wiring harness.

- Release the 6 clips.
- Remove the 2 coil harness ground nuts.

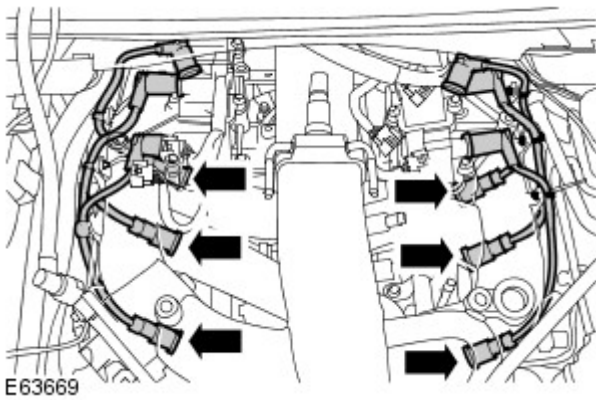


16. Disconnect the 6 coil electrical connectors.

17. NOTE: Note the fitted position of the fasteners.

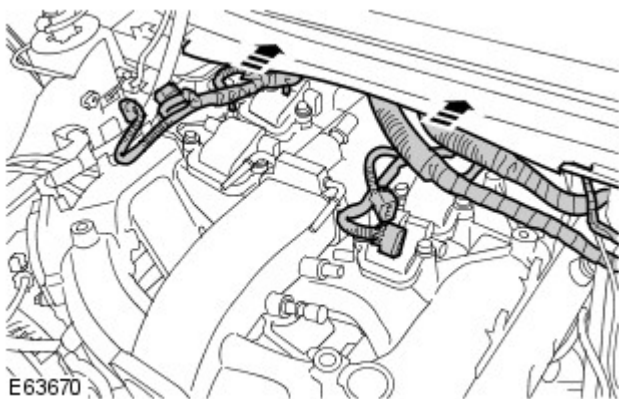
Remove the 2 rear ignition coils.

- Disconnect the sparking plug lead elbows at the coils.
- Remove the 2 bolts and 2 studs.
- Discard the fastener O-rings to aid installation.



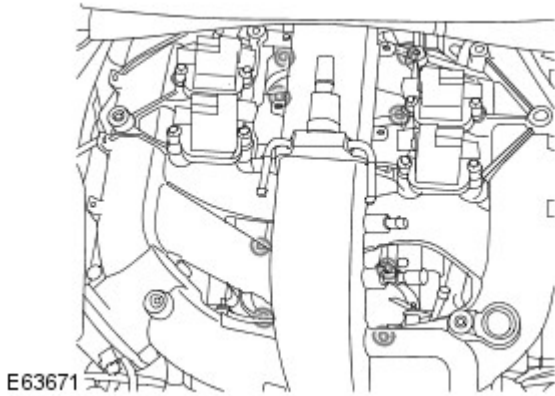
18. Disconnect the HT leads at the sparking plugs.

- Position the leads aside.



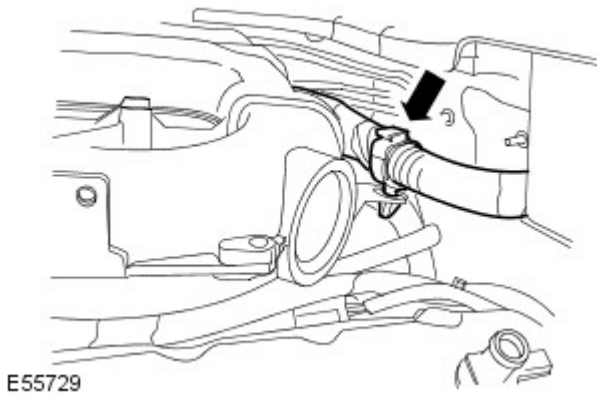
19. Position the engine wiring harness aside for access.

20. Remove the 8 intake manifold bolts.



21. NOTE: The type of clip may vary depending on the hand of drive.


Release the intake manifold wiring harness clip.




22. WARNINGS:

 Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.

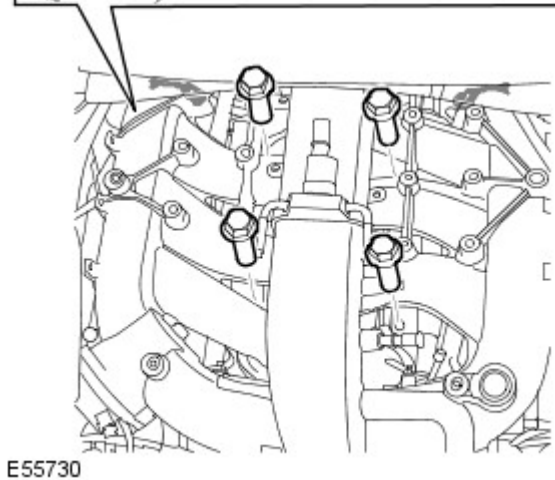
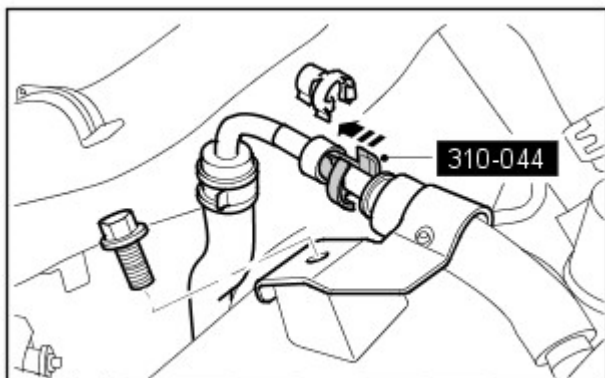
 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

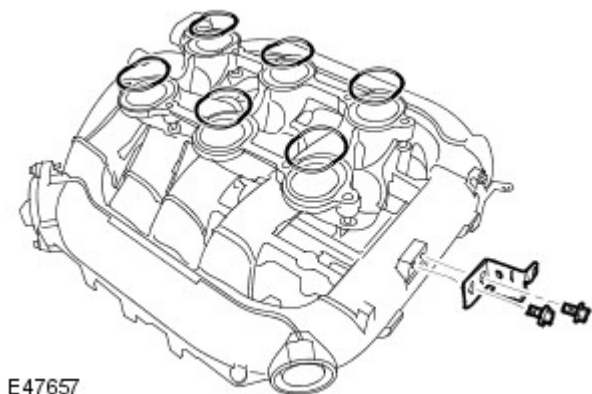
 Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.

 If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.

Using the special tool, disconnect the fuel line.

- Remove the security clip.
- Early vehicles only: Remove 4 bolts and release the fuel rail and injectors.
- Early vehicles only: Disconnect the LH and RH cylinder head, rear fuel injector electrical connectors.
- Early vehicles only: Remove the bolt and release the valve cover fuel line clip.
- Early vehicles only: Cable tie the purge valve to the wiring harness.





E47657

23. CAUTIONS:

⚠ Early vehicles only: The purge valve and mounting bracket are bolted to the rear of the intake manifold and foul the fuel rail crossover link. Damage will occur if force is used when attempting to remove the intake manifold. If this occurs, remove the LH side, battery tray inner wall and base, for access to the purge valve bolt.

⚠ Care must be taken to avoid damaging the purge valve assembly during removal of the intake manifold.

• **NOTE:** Due to the lack of access it may be necessary to break the engine and transmission wiring harness clips, care must be taken not to damage the wiring harnesses.

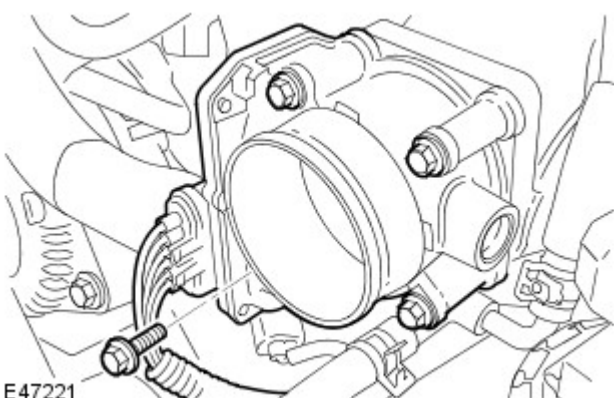
Release and then remove the intake manifold.

- Discard the gaskets.
- Install blanking caps to the exposed ports.

24. NOTE: Do not disassemble further if the component is removed for access only.

Remove the throttle body.

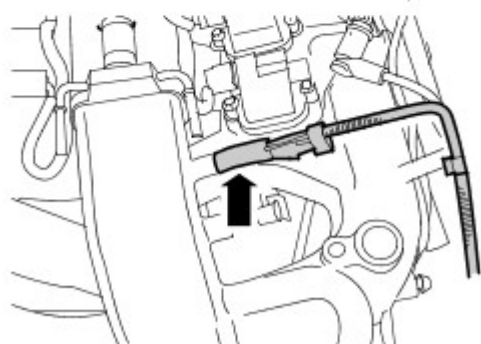
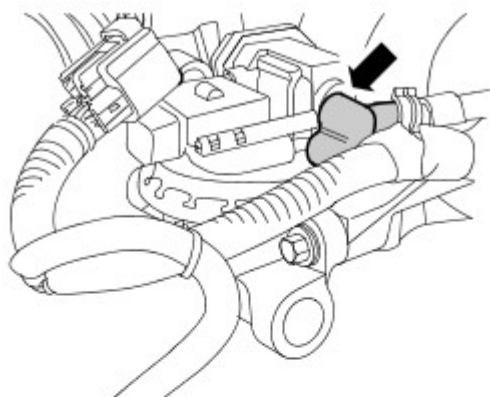
- Remove the 4 bolts.
- Remove and discard the throttle body gasket.
- Disconnect the coolant hose.



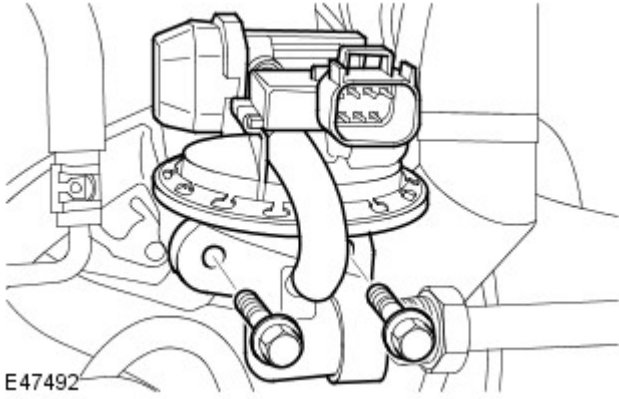
E47221

25. Disconnect the EGR valve vacuum hose.

- Disconnect and remove the vacuum hose at the intake manifold.



E63832

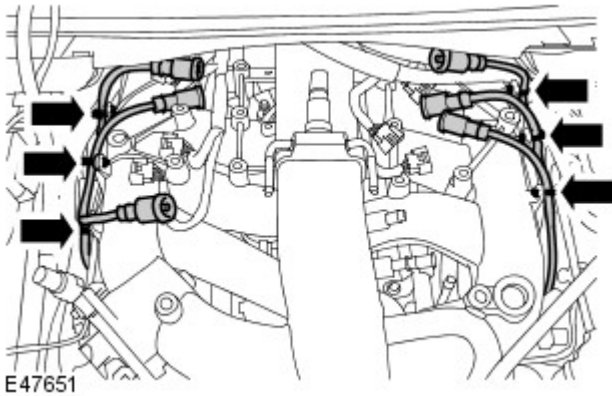


26. Remove the EGR valve.

- Remove the 2 bolts.
- Collect and discard the gasket.

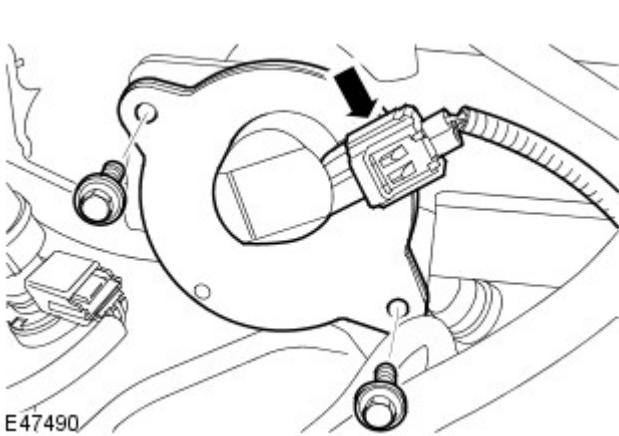
27. Remove the remaining ignition coils.

- Disconnect the sparking plug lead elbows at the coils.
- Remove the bolts and studs. Remove and discard the seals.



28. Remove the HT leads.

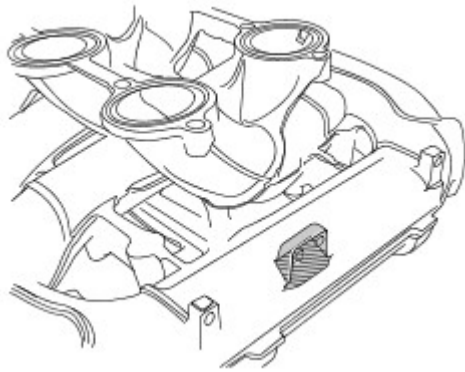
- Release the 6 plug lead clips.




29. Remove the intake manifold tuning valve.

- Remove the 2 bolts.
- Discard the O-ring seal.

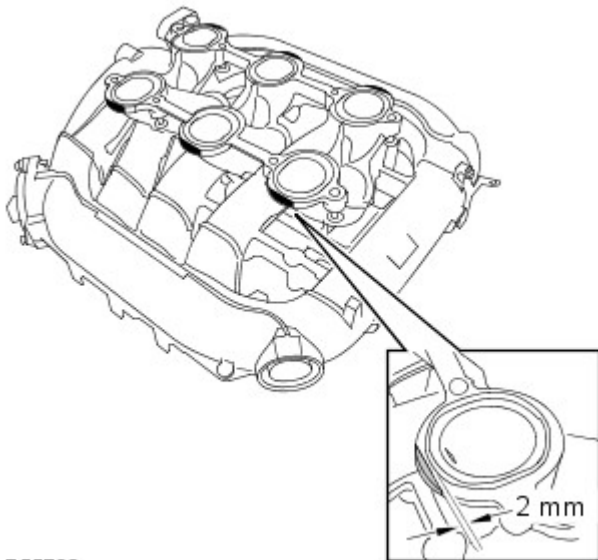
Installation



E55731

1.  **WARNING:** Make sure there are no sharp edges after removing material.

Early vehicles only: Remove the center casting lug.



E55732

2. Early vehicles only: Remove excess material from the outside edges of the 6 intake manifold flange faces; file to within 2 mm of the gasket edge.

3. Early vehicles only: Install the fuel rail and injectors.

- Clean the component mating faces.
- Tighten the bolts to 25 Nm (18 lb.ft).
- Connect the fuel injector electrical connectors.
- Tighten the M6 bolt to 10 Nm (7 lb.ft).

4. Install the intake manifold tuning valve.

- Clean the component mating faces.
- Install a new O-ring seal.
- Tighten the bolts to 10 Nm (7 lb.ft).

5. Secure the HT leads to the intake manifold with clips.

6. **NOTE:** Note the fitted position of the fasteners.

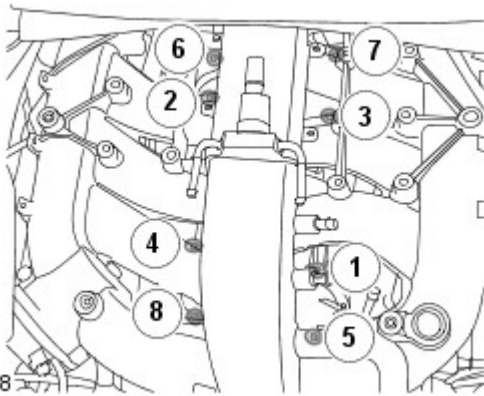
Install the 4 ignition coils.

- Tighten the bolts to 6 Nm (4 lb.ft).
- Tighten the studs to 6 Nm (4 lb.ft).
- Connect the HT electrical connections.


7. Install the EGR valve.

- Clean the component mating faces.
- Install a new gasket.
- Tighten the bolts to 25 Nm (18 lb.ft).

8. Connect the vacuum hose to the EGR valve.
9. Connect the EGR vacuum hose to the intake manifold.
 - Clean the component mating faces.
 - Connect the vacuum hose to the EGR valve.
10. Install the throttle body.
 - Clean the component mating faces.
 - Install a new gasket.
 - Tighten the 4 bolts to 10 Nm (7 lb.ft).
11. Install the throttle body coolant hose.
 - Secure the clip.
 - Remove the hose clamp.
12. Secure the wiring harness to the intake manifold.
 - Secure the wiring harness clip.



E47658

13.  **CAUTION:** Care must be taken prior to tightening the intake manifold bolts. Make sure the electrical harness, vacuum and purge valve lines are not trapped.

- NOTE: To aid installation: Position a Torx drive and extension, to the rear LH bank intake manifold Torx bolt, prior to installing the intake manifold. Retain with tape.
- NOTE: The ignition coils are removed from the illustration for clarity.

Install the intake manifold.

- Clean the component mating faces.
 - Install the gaskets.
 - Evenly and progressively tighten the bolts in the sequence shown to 10 Nm (7 lb.ft).
14. Install the remaining ignition coils.
 - Tighten the bolts to 6 Nm (4 lb.ft).
 - Tighten the studs to 6 Nm (4 lb.ft).
 - Connect the HT electrical connections.
 15. Connect the ignition coil electrical connectors.
 16. Connect the fuel line to the fuel rail.
 - Clean the component mating faces.
 - Install the clip.
 17. Secure the coil wiring harness.
 - Connect the coil harness ground cables.
 - Tighten the nuts to 6 Nm (4 lb.ft).
 - Position and secure the clips.
 18. Connect the intake manifold tuning valve electrical connector.
 19. Connect the vacuum pipe to the inlet manifold.
 20. Secure the purge line to the intake manifold.
 - Install the spacer.
 - Install the bolt.
 - Tighten the bolt to 6 Nm (4 lb.ft).
 21. Connect the crankcase vent hose.
 - Clean the component mating faces.

- Secure the clip.
- Remove the hose clamp.

23. Install the air intake resonator.

For additional information, refer to: [Intake Air Resonator](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).

24. Install the engine cover.

For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

25. Connect the hood support struts.

26. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

27. Check and top-up the coolant.

Engine - V6 4.0L Petrol - Exhaust Manifold LH

In-vehicle Repair

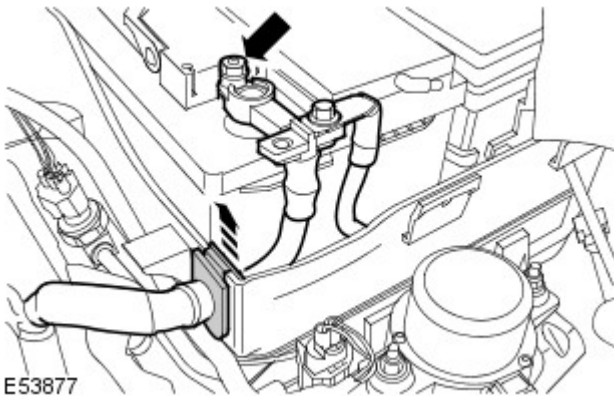
Removal

All vehicles

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

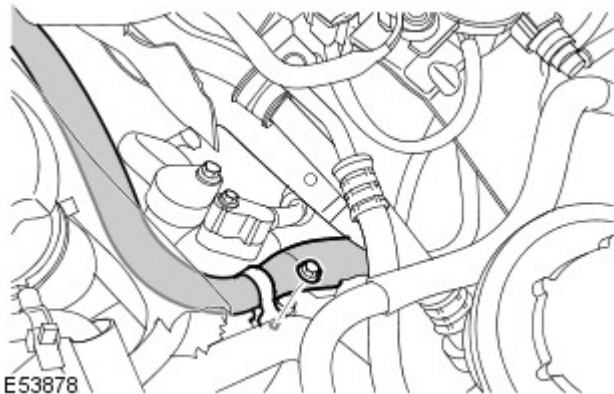
Right-hand drive vehicles

3. Release the battery positive cable.
 - Loosen the clamp.
 - Release the grommet.




Right-hand drive vehicles

4. Release the wiring harness clip.
 - Remove the bolt.



All vehicles

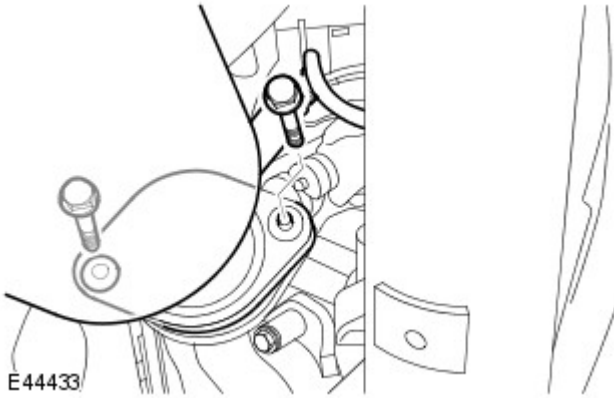
5.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.


6. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

7. Release the exhaust system from the exhaust manifold.

- Remove and discard the 2 bolts.

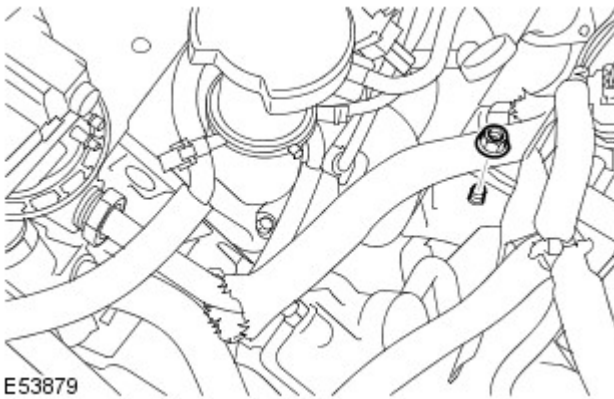



8. Lower the vehicle.

9.  CAUTION: Protect the engine during this operation.

Raise the engine clear of its LH mount.

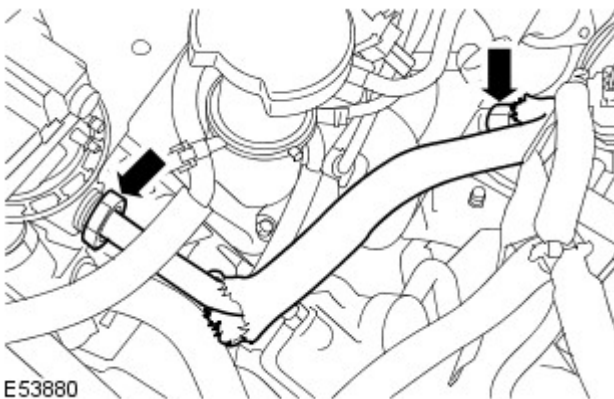
- Remove the nut.



10.  CAUTION: Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the EGR pipe.

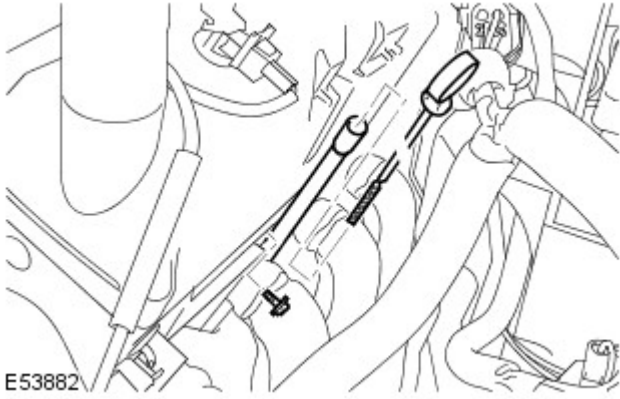
- Release the 2 union nuts.




11. Disconnect the high tension (HT) electrical connectors.

- Move the leads aside for access.

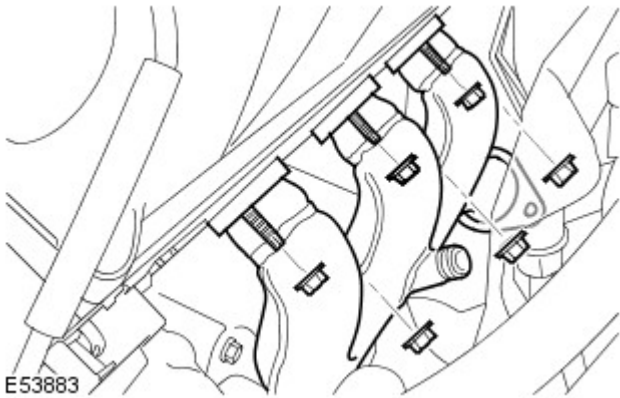




12.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the dipstick tube.

- Remove the dipstick.
- Remove the bolt.
- Discard the O-ring seal.



13. Remove the exhaust manifold.

- Remove the 6 nuts.
- Remove and discard the gasket.

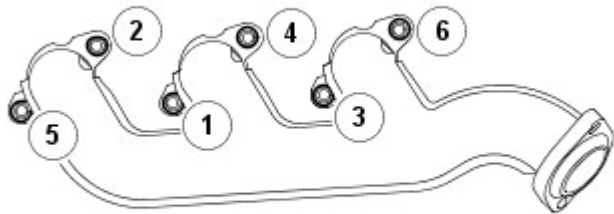
Installation

All vehicles

1. **NOTE:** The exhaust manifold gasket connecting links must be positioned to the lower edge of the manifold.

Install the exhaust manifold.

- Install a new gasket.
- Clean the component mating faces.
- Tighten the nuts evenly in the sequence shown to 25 Nm (18 lb.ft).



E53884

2. Install the dipstick tube.

- Clean the component mating faces.
- Install a new O-ring seal.
- Lubricate the seal with clean engine oil.
- Tighten the bolt to 10 Nm (7 lb.ft).
- Install the dipstick.

3. Connect the HT electrical connectors.

4. Install the EGR pipe.

- Clean the component mating faces.
- Initially, finger tighten the nuts.
- Finally, tighten the nuts to 40 Nm (30 lb.ft).

5. Lower the engine onto its mount.
 - Tighten the nut to 90 Nm (66 lb.ft).
6. Raise the vehicle.
7. Install the exhaust system.
 - Clean the component mating faces.
 - Install new bolts and tighten to 40 Nm (30 lb.ft).
8. Install the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
9. Lower the vehicle.

Right-hand drive vehicles

10. **NOTE:** Apply petroleum jelly to the battery terminals.

Connect the battery positive cable.

- Clean the component mating faces.
- Install the grommet.
- Tighten the clamp nut to 10 Nm (7 lb.ft).

Right-hand drive vehicles

11. Secure the wiring harness clip.
 - Tighten the bolt to 10 Nm (7 lb.ft).

All vehicles


12. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
13. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Exhaust Manifold RH

In-vehicle Repair

Removal

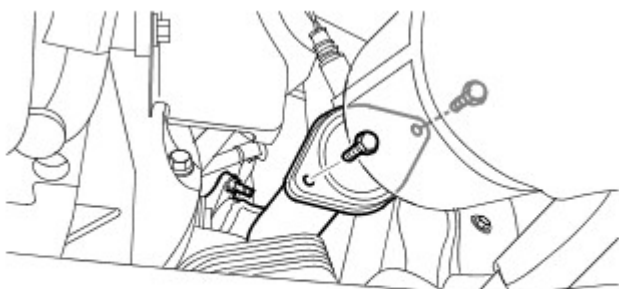
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

4. Release the exhaust system from the exhaust manifold.

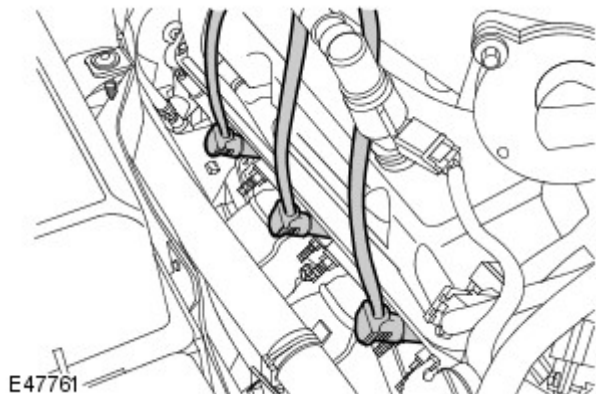
- Remove and discard the 2 bolts.



E47760

5. Lower the vehicle.
6. Disconnect the high tension (HT) electrical connectors.

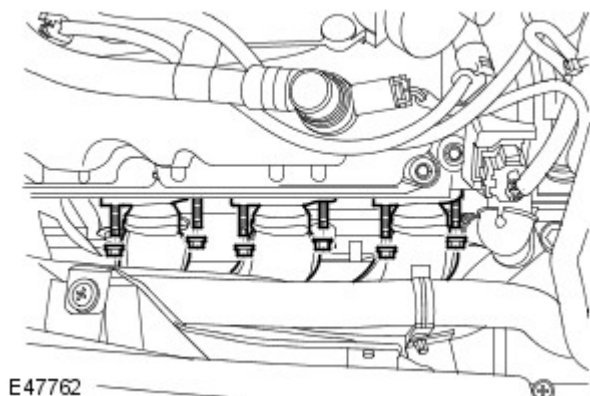
- Move the leads aside for access.



E47761

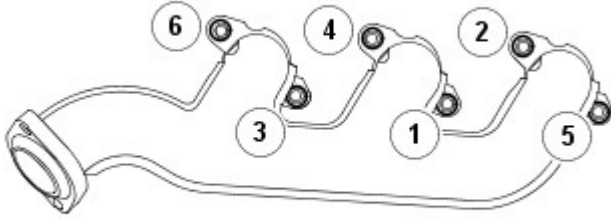
7. Remove the exhaust manifold.

- Remove the 6 nuts.
- Remove and discard the gasket.



E47762

Installation



E47773

1. Install the exhaust manifold.

- Clean the component mating faces.
- Install a new gasket.
- Evenly and progressively, tighten the nuts to 25 Nm (18 lb.ft).

2. Connect the HT electrical connectors.

3. Raise the vehicle.

4. Install the exhaust system.

- Clean the component mating faces.
- Install new bolts and tighten to 40 Nm (30 lb.ft).

5. Lower the vehicle.

6. Install the engine cover.


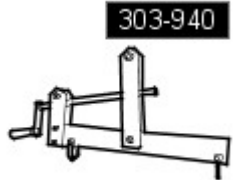

For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

7. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Engine

Removal

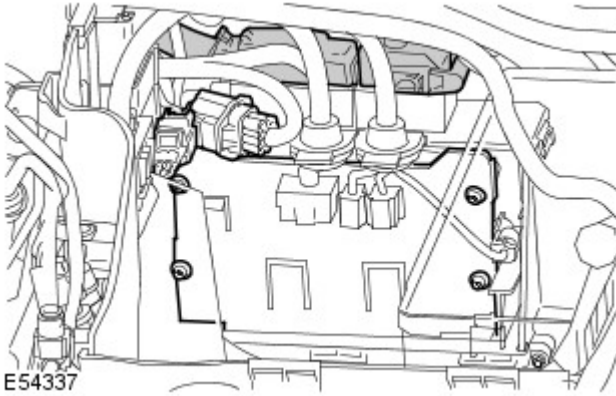
Special Tool(s)	
 <p>303-1147</p> <p>E55563</p>	<p>Engine lifting cradle - 4.0L</p> <p>303-1147</p>
 <p>303-940</p> <p>E61659</p>	<p>Engine lifting bracket</p> <p>303-940 (LRT-12-138)</p>
 <p>303-940/1</p> <p>E61731</p>	<p>Lifting chains</p> <p>303-940/1</p>

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Secure the hood in the service position.
3. Raise and support the vehicle.
4. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
5. Drain the engine oil.
For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
6. **NOTE:** Early vehicles will require the partial release of the fuel rail, to allow the intake manifold to be removed.

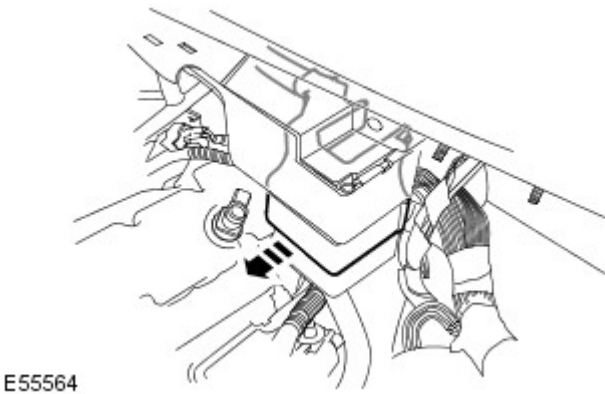
Remove the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
7. Remove the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

8. Disconnect the 2 ECM electrical connectors.



9. Release the wiring harness from the plenum.

- Release the 2 clips.
- Position the wiring harness aside.

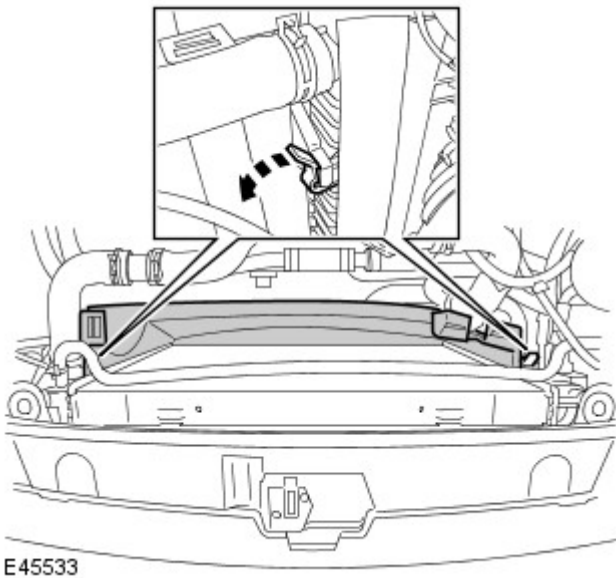


10. Remove the accessory drive belt.

For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).

11. Remove the lower fan shroud.

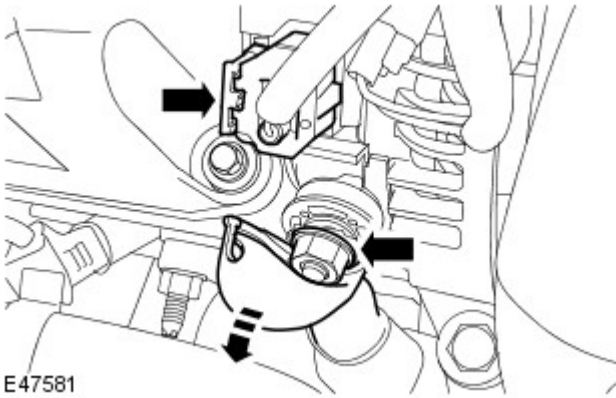
- Release 2 clips from the cooling fan lower shroud.



12. Install a shield to protect the radiator core from damage.

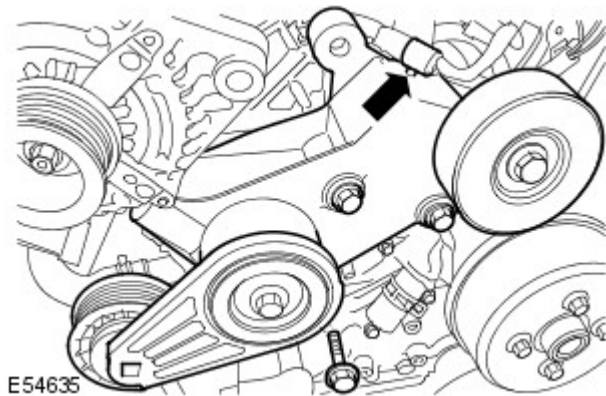
13. Disconnect the generator electrical connectors.


- Disconnect the electrical connector.



14. Position the generator mounting bracket aside.

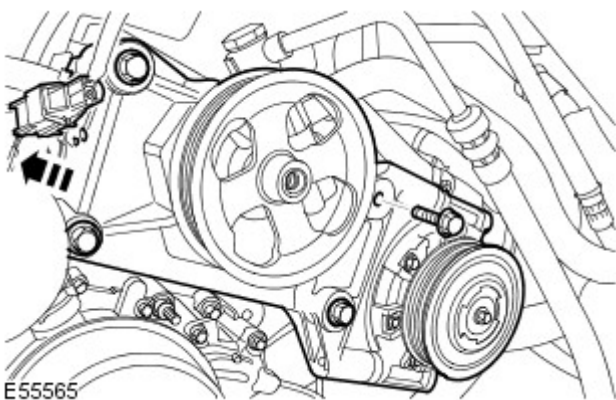
- Remove the 3 bolts.
- Release the wiring harness clip.
- Remove and discard the cable tie.



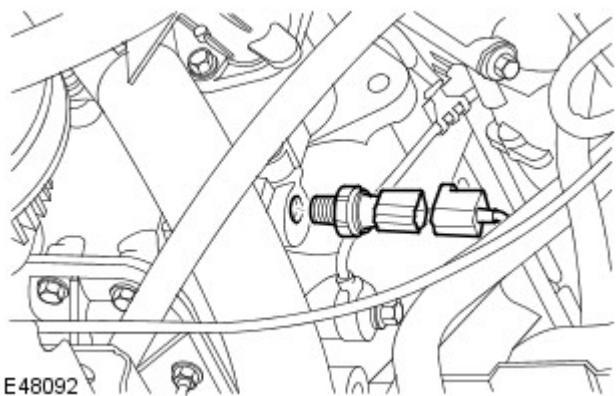
15.  CAUTION: The A/C system will remain fully charged during this procedure, care must be taken when positioning the assembly aside.

Position the A/C compressor mounting bracket assembly aside.

- Disconnect the A/C compressor electrical connector.
- Release the LH KS electrical connector retaining clip.
- Remove the 4 bolts.

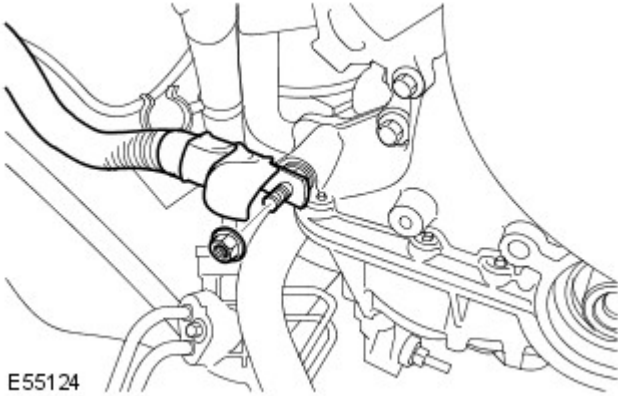


16. Disconnect the engine oil pressure (EOP) sensor electrical connector.



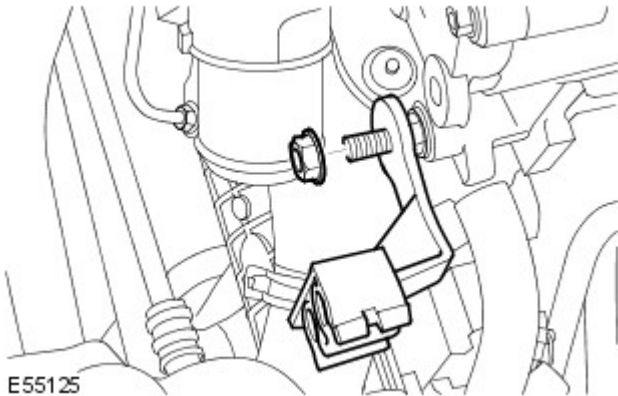
17. Disconnect the engine ground cable.

- Remove the nut.



18. Release the transmission cooler pipes.

- Remove the nut.
- Position aside.



19. Remove the EGR pipe.

- Loosen the EGR union nut and release the pipe.



20. Check the road wheels are in the straight ahead position, then remove the upper clamp bolt.

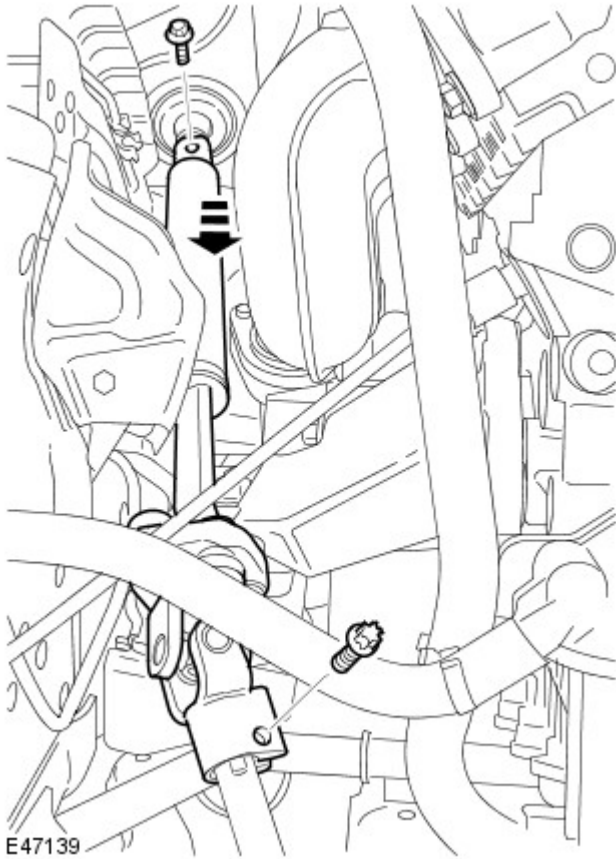
- Discard the retaining bolt.

21. Remove the steering gear universal joint clamp bolt.

- Discard the retaining bolt.

22. Release the upper steering column shaft.

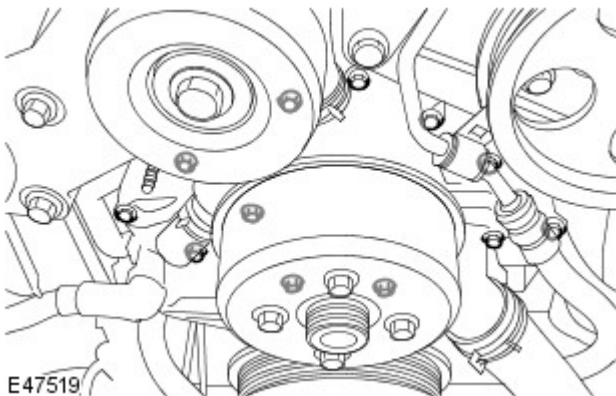
23. Release and remove the shaft and joint assembly.



E47139

24. Release the coolant pump hose.

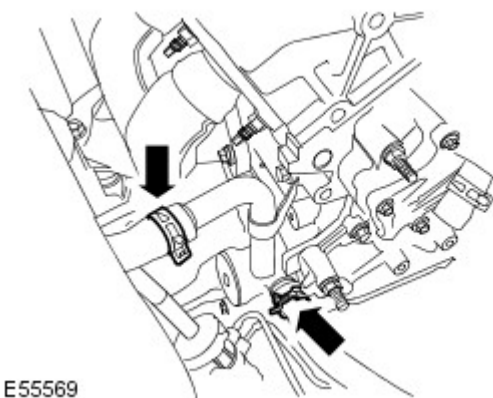
- Position aside.
- Release from the clip.



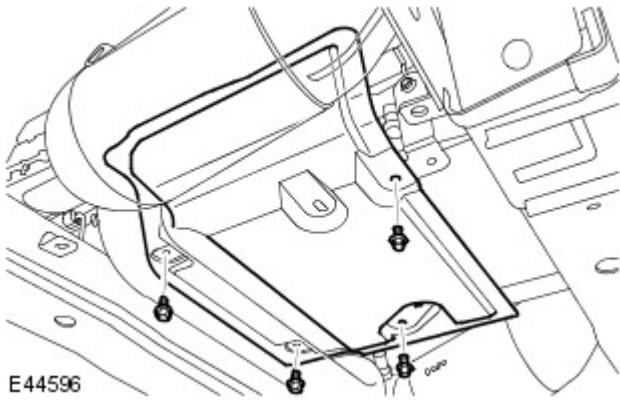
E47519

25. Disconnect the 2 engine oil cooler, coolant hoses.

- Release the 2 clips.



E55569



26. Remove the transmission heat shield.

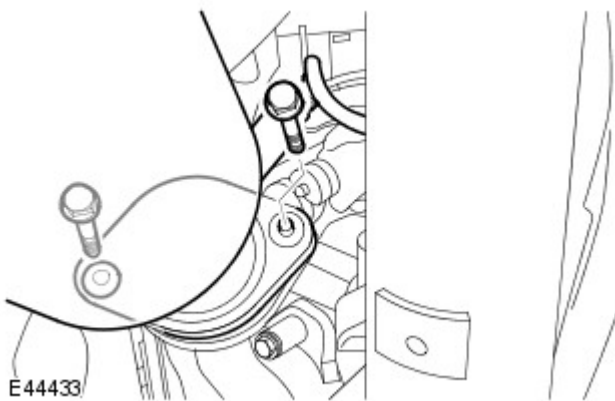
- Remove the 4 bolts.

27. Disconnect the LH catalyst monitor sensor electrical connector.

- Release HO2S harness from bracket.

28. Disconnect the LH catalytic converter from the exhaust manifold.

- Remove the 2 bolts.

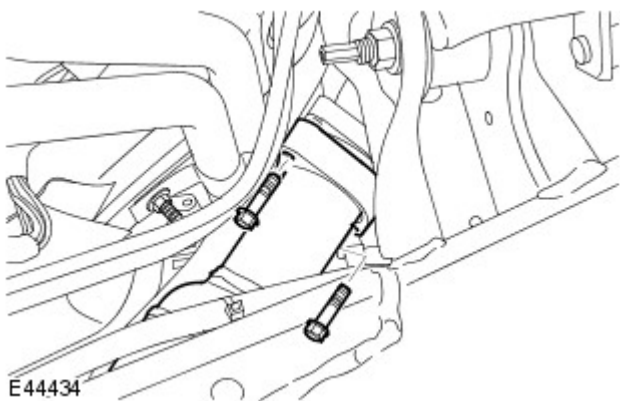


29. Disconnect the RH catalyst monitor sensor electrical connector.

- Release HO2S harness from bracket.

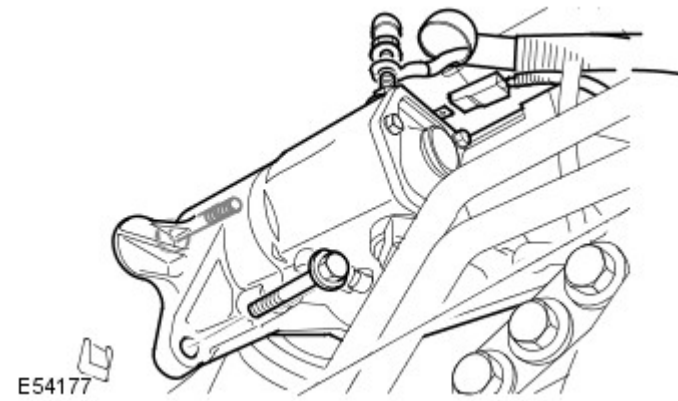
30. Disconnect the RH catalytic converter from the exhaust manifold.

- Remove the 2 bolts.



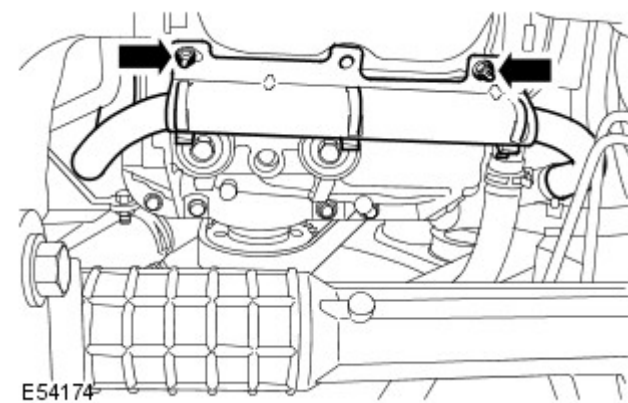


31. Disconnect the engine oil temperature sensor electrical connector.



32. Release the starter motor.

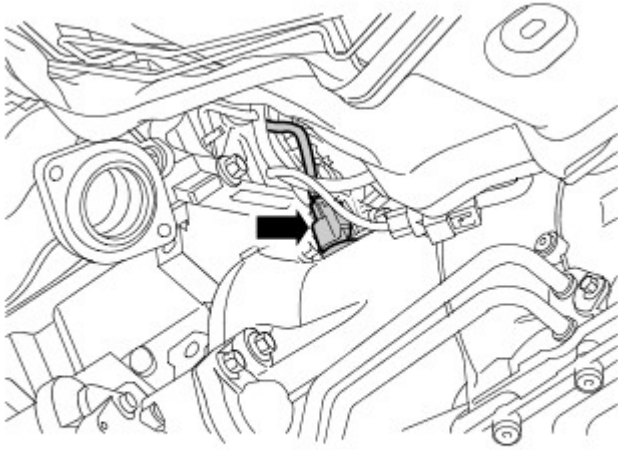
- Remove the 2 bolts.



33. Release the harness bracket.

- Remove the 2 nuts.

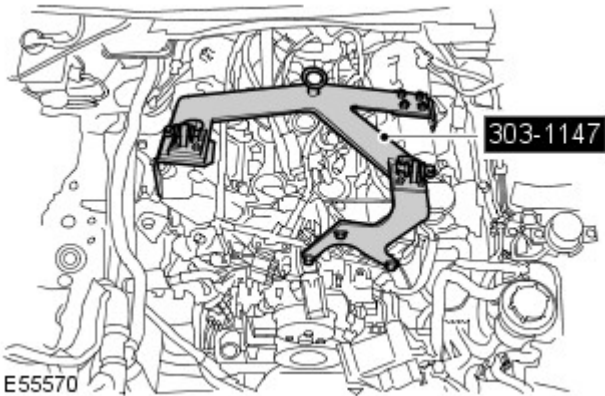
34. Disconnect the crankshaft position (CKP) sensor electrical connector.



E63835

35. Install the engine lifting bracket.

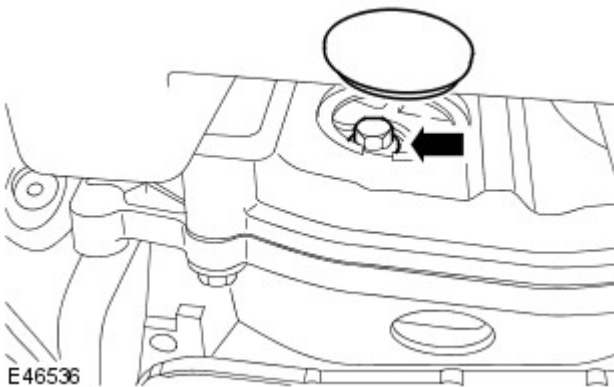
- Tighten the bolts to 45 Nm (33 lb.ft).
- Evenly and progressively, tighten the nuts to 25 Nm (18 lb.ft).



E55570

36. Release the flexplate.

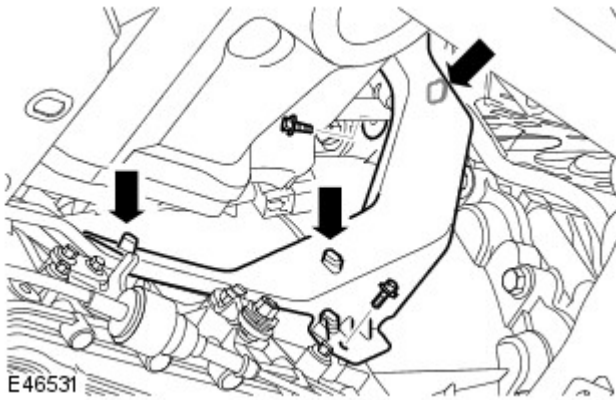
- Rotate the crankshaft to access the retaining bolts.
- Remove the 4 bolts.




E46536

37. Release the fuel pipe and purge line heat shield.

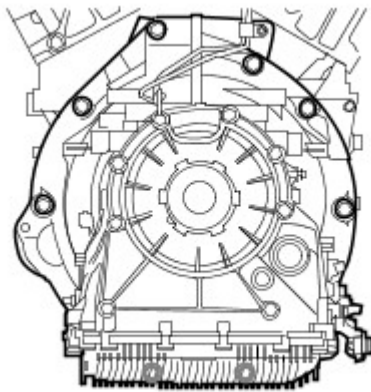
- Remove the 2 bolts.
- Position the fuel line shield aside for access.




38.  **WARNING:** Support the engine. The engine will fall forward when the transmission is removed.

Remove the transmission bolts.

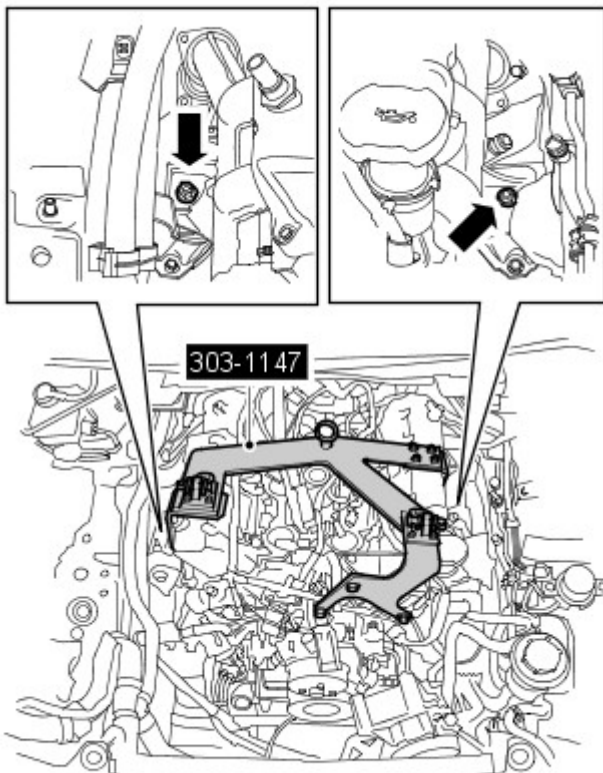
- Connect the lifting chains.
- Support the transmission.
- Remove the 8 bolts.



39.  **WARNING:** Make sure the torque converter remains with the transmission.

Remove the engine.


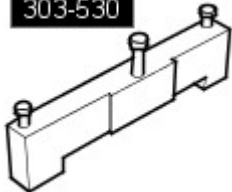


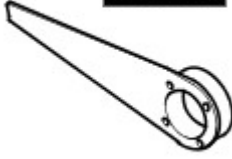

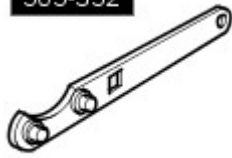
- Remove the 2 engine mount nuts.
- Remove the engine RH mount.
- Raise the engine.
- With assistance, carefully remove the engine.



40. Install the torque converter retainer.

Engine - V6 4.0L Petrol - Engine

Disassembly

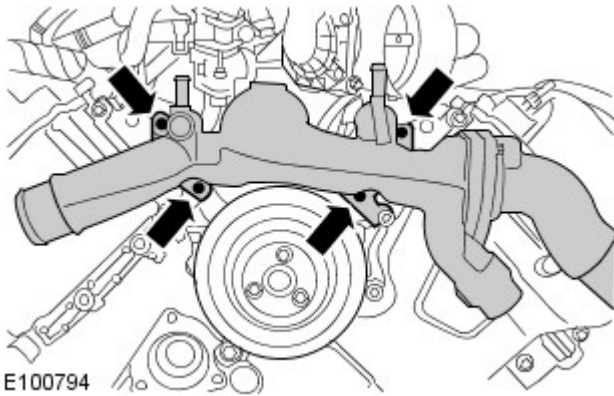
Special Tool(s)	
<p>303-645</p>  <p>E46881</p>	<p>Timing Setting tool</p> <p>303-645</p>
<p>303-530</p>  <p>E46879</p>	<p>Camshaft setting/locking tool</p> <p>303-530</p>
<p>303-1100-01</p>  <p>E67144</p>	<p>Adapter - Crankshaft seal installer</p> <p>303-1100-01</p>
<p>303-191-03</p>  <p>E46730</p>	<p>Adapter</p> <p>303-191-03</p>
<p>303-893</p>  <p>E46728</p>	<p>Holding Tool Crankshaft Pulley</p> <p>303-893(LRT-12-080)</p>
<p>303-191-04</p>  <p>E59251</p>	<p>Bolts and spacers</p> <p>303-191-04</p>
<p>303-532</p>  <p>E46880</p>	<p>Timing chain tensioning tool</p> <p>303-532</p>

Disassembly

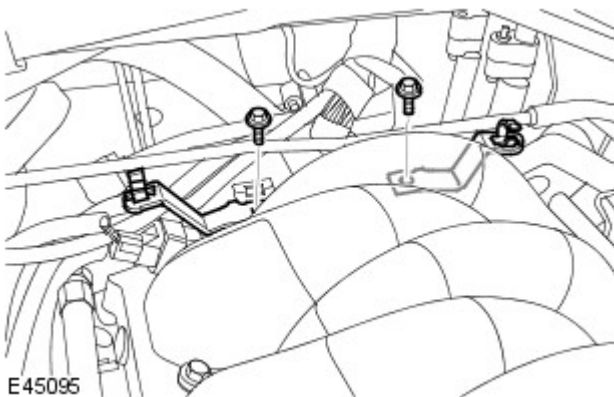
1. Remove the engine assembly.
2. Secure the engine to the engine stand.
 - Align the engine to the engine stand.
 - Adjust the engine stand legs into position.
 - Mount the engine to an engine stand.
 - Fully tighten the engine stand leg nuts.
3. Release the camshaft position (CMP) sensor connector block from the intake manifold assembly.



4. Remove the coolant manifold.
 - Remove the 4 bolts.
 - Disconnect the electrical connector.



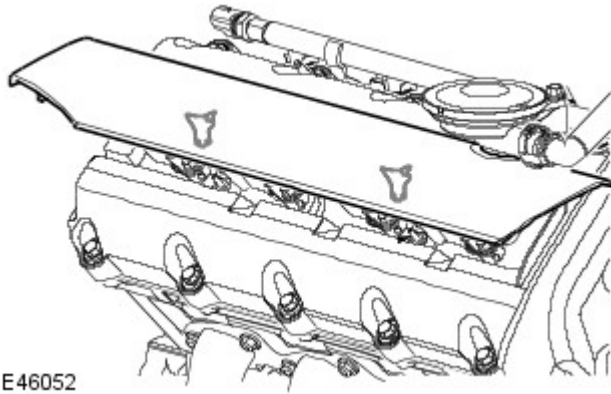
5. Position the wiring harness support bracket aside for access.
 - Remove the 2 bolts.



6. NOTE: RH illustration shown, LH is similar.

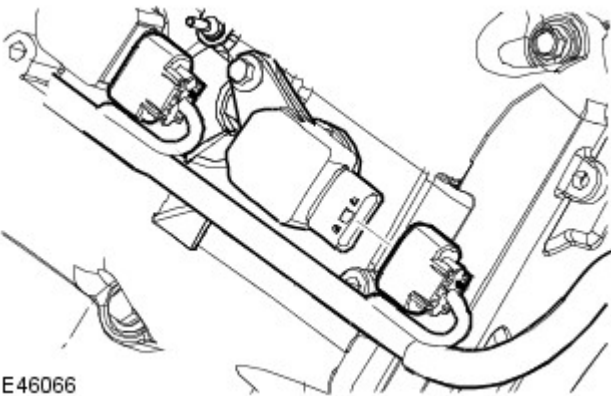
Remove both the ignition coil-on-plug covers.

- Release from the 2 clips.



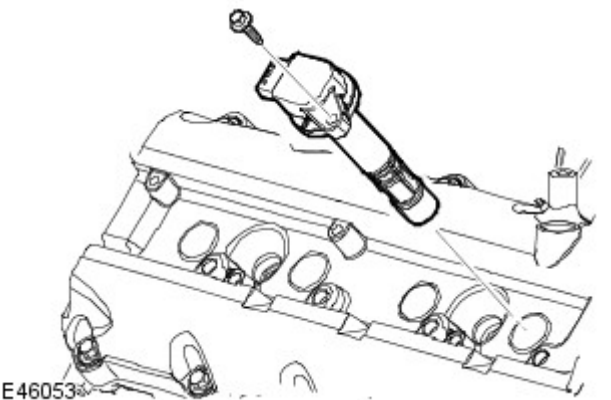
7. NOTE: RH illustration shown, LH is similar.

Disconnect the 8 ignition coil-on-plug electrical connectors.



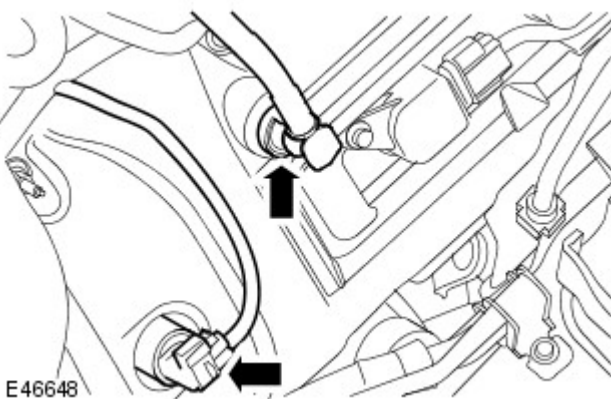
8. Remove the 8 ignition coil-on-plugs.

- Remove the 8 bolts.



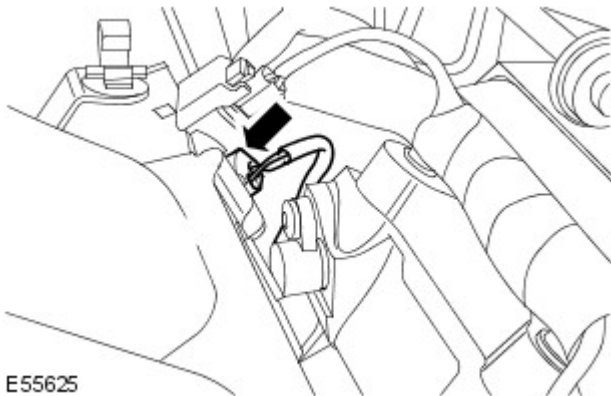
9. Disconnect the valve cover breather hose.

- Disconnect the variable camshaft timing (VCT) oil control solenoid electrical connector.
- Repeat the operation for the other side.



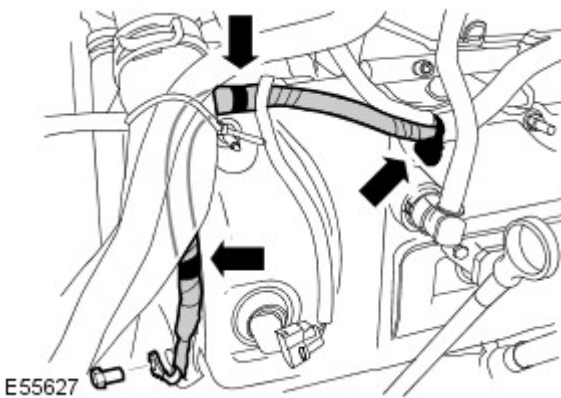


10. Disconnect the engine coolant temperature (ECT) sensor electrical connector.



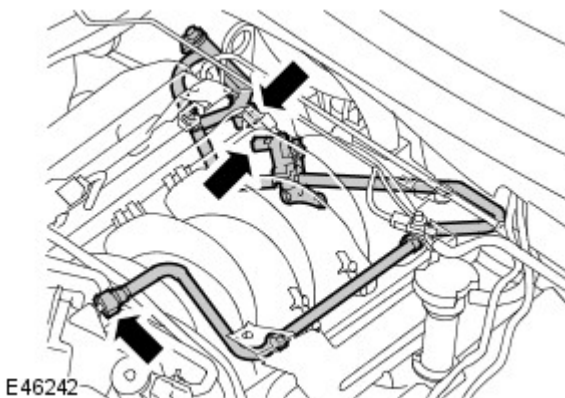
11. Disconnect the CMP sensor electrical connector.

- Repeat the above procedure for the RH side.



12. Disconnect the cylinder head earth connector.

- Remove the bolt.
- Release the 3 clips.

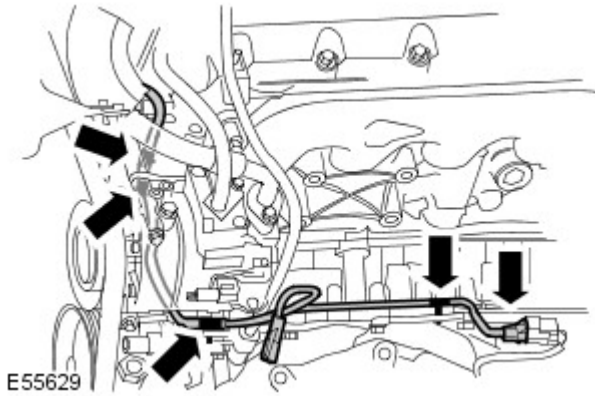


13. Disconnect the knock sensors (KS) electrical connector.

14. Release the purge valve from the mounting bracket.

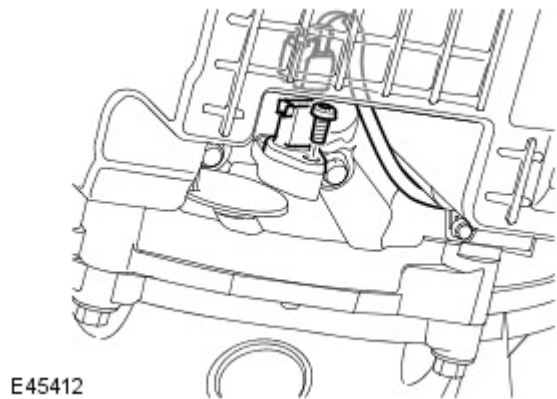
- Disconnect the quick release connector.
- Disconnect the electrical connector.
- Remove the bolt.

15. Release the 5 air conditioning (A/C) harness retaining clips.



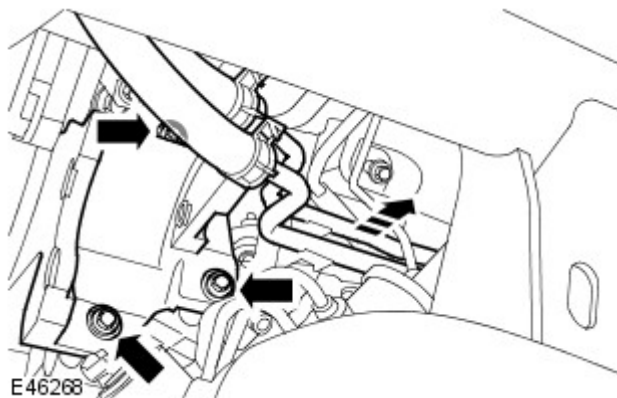
16. Remove the crankshaft position (CKP) sensor.

- Disconnect the electrical connector.
- Remove the Torx screw.



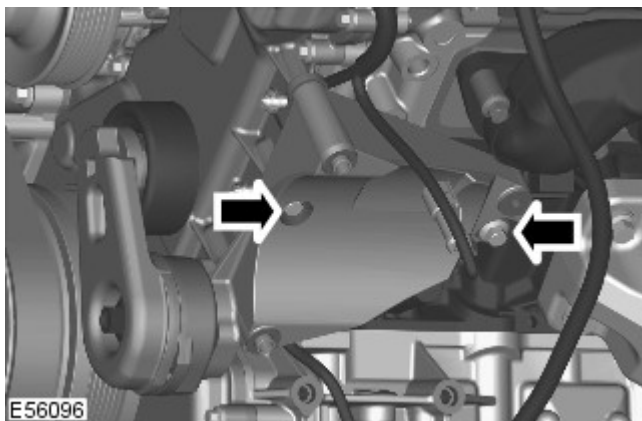
17. Remove the power steering pump mounting bracket.

- Remove the 3 bolts.
- Release the transmission cooler pipe clips.

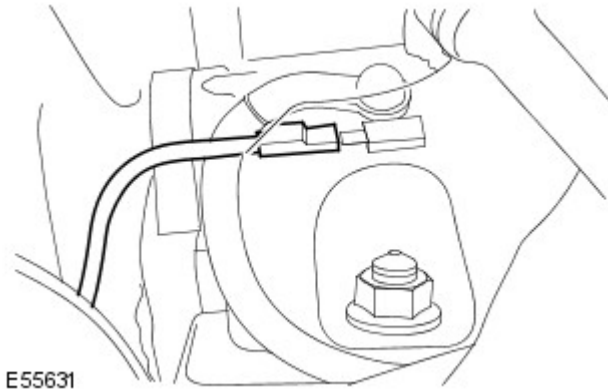


18. Remove the A/C compressor mounting bracket.

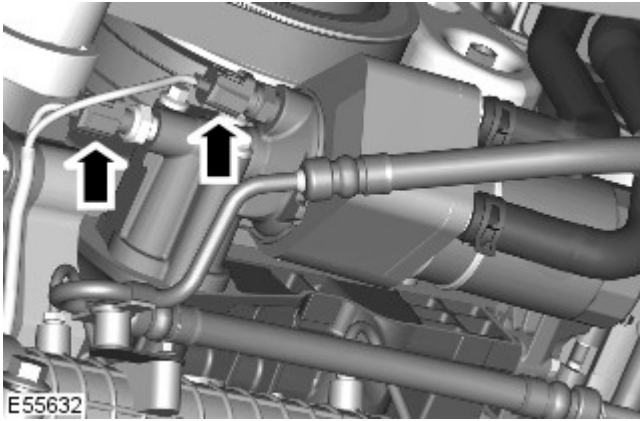
- Remove the 2 bolts.



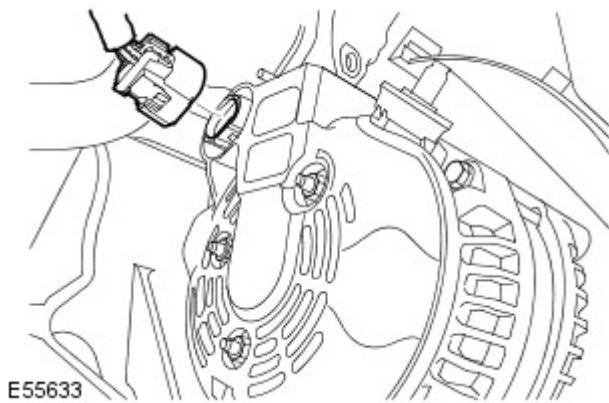
19. Disconnect the starter motor connector.



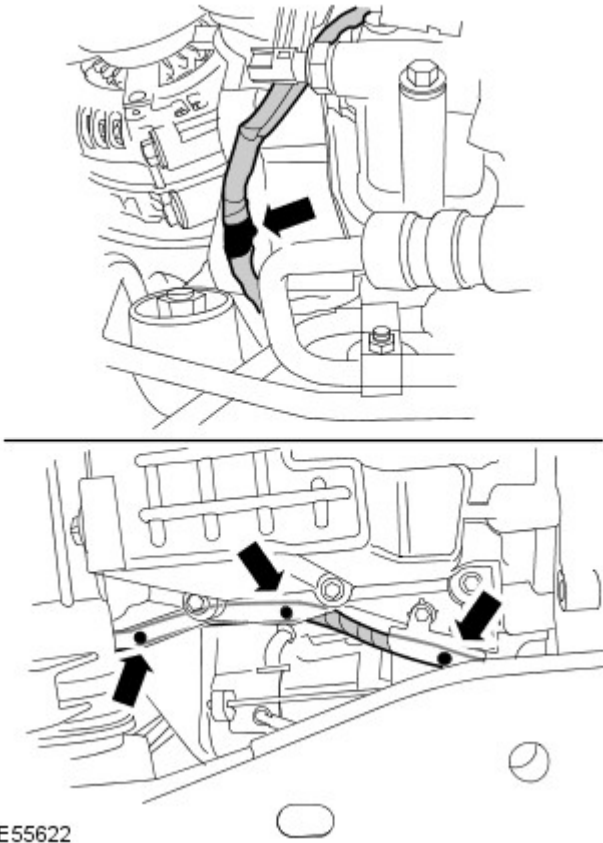
20. Disconnect the oil temperature and oil pressure sensors.



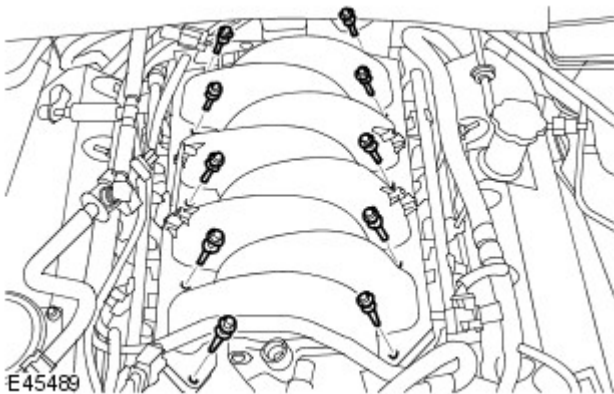
21. Disconnect the generator connector.




22. Release the 4 clips securing the generator harness.



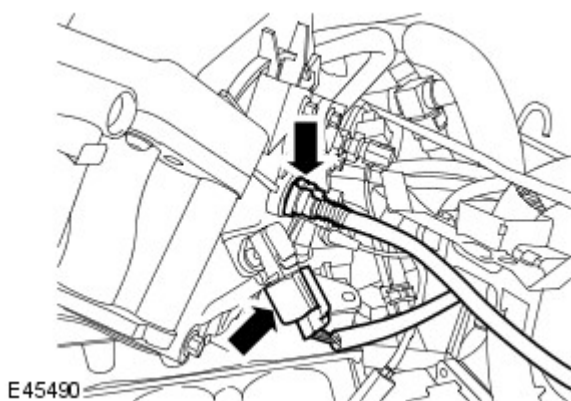
23. Remove the 10 intake manifold bolts.



24.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

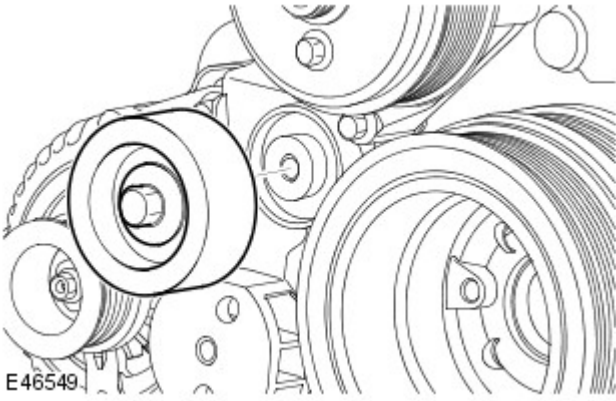
Remove the intake manifold.

- Disconnect the brake booster vacuum hose from the intake manifold.
- Discard the gaskets.
- Disconnect the manifold absolute pressure (MAP) sensor electrical connector.



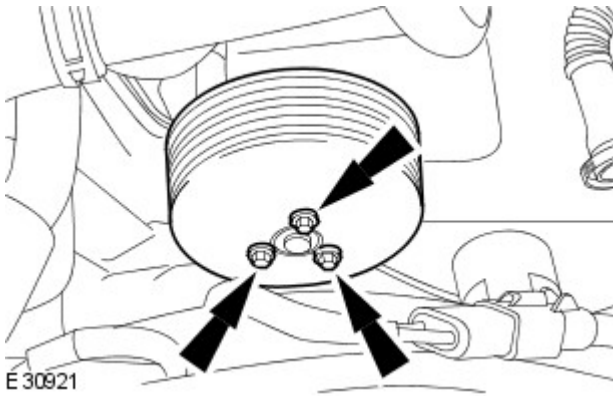
25. Remove the accessory drive belt idler pulley.

- Remove the bolt.

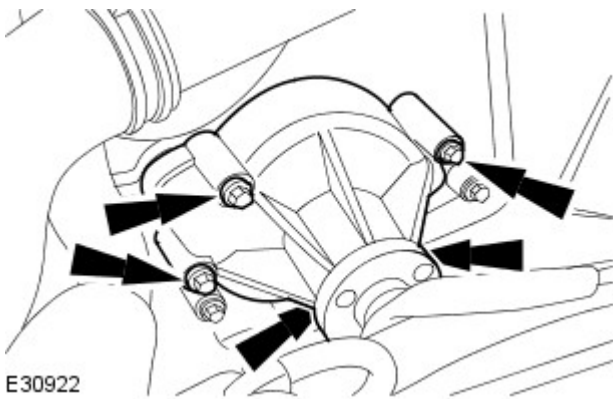


26. Remove the coolant pump pulley.

- Remove the 3 bolts.

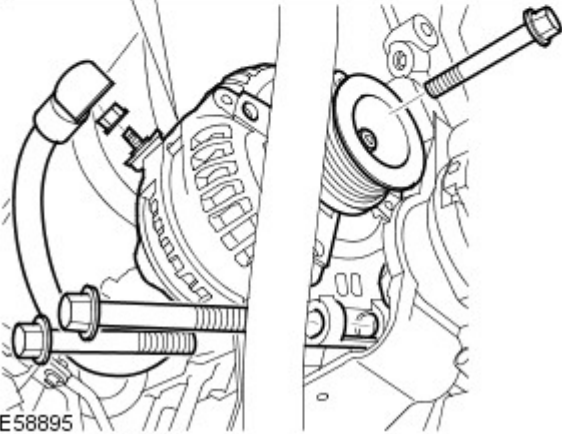
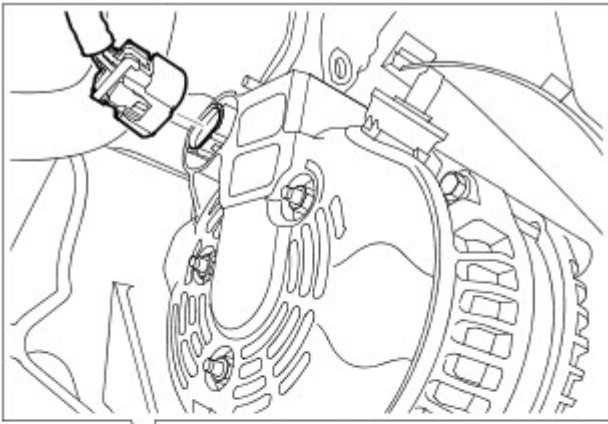


27. Remove the coolant pump.



28. Remove the generator.

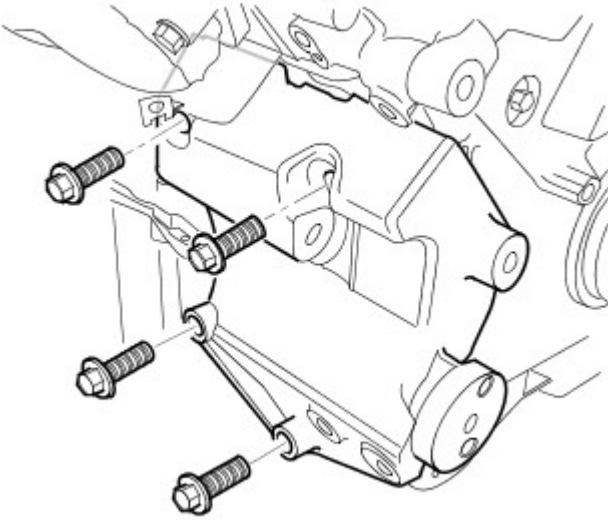
- Disconnect the electrical connector.
- Remove the 3 bolts.



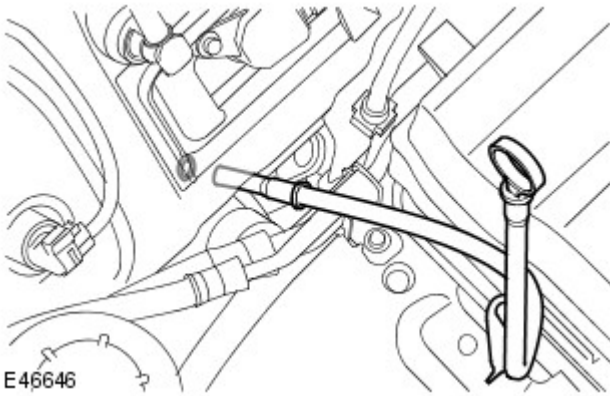
E58895

29. Remove the generator mounting bracket.

- Remove the 4 bolts.

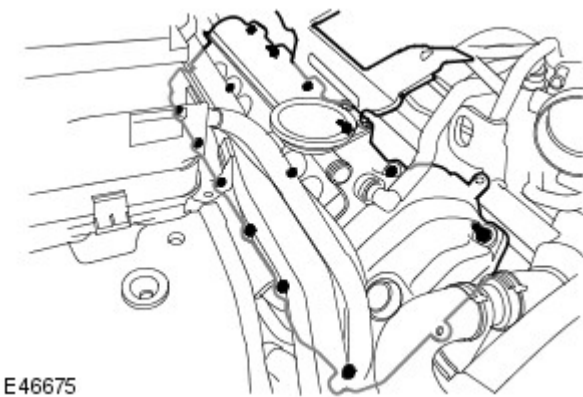


E58798



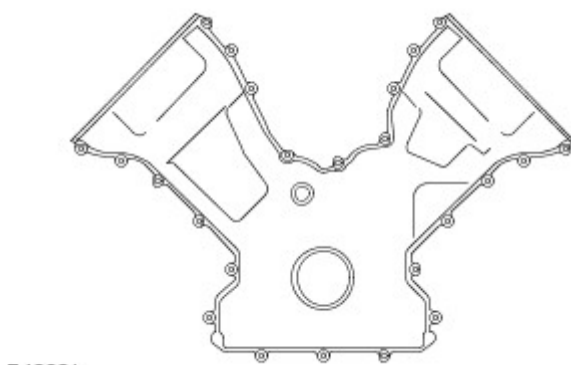
30. Remove the oil level indicator and tube.

- Remove the nut.
- Discard the O-ring seal.



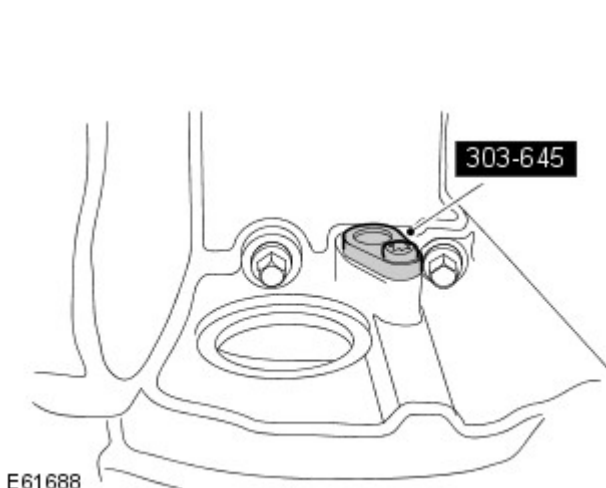
31. Remove the RH valve cover.

- Remove the 14 valve cover retaining bolts.
- Remove and discard the valve cover gasket.
- Remove and discard the valve cover plug aperture seals.
- Repeat the operation for the LH side.



32. Remove the engine front cover.

- Release the engine wiring harness clips.
- Remove the 24 bolts.
- Remove and discard the gasket.

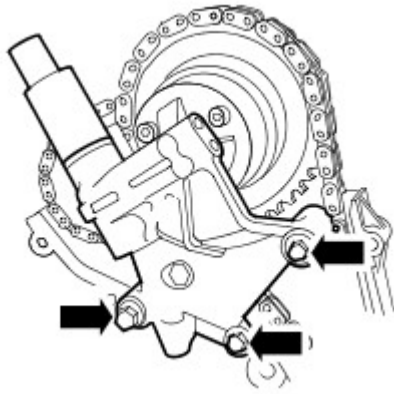


33. Rotate the crankshaft until the flats on the camshafts are parallel with the cylinder head joint faces.

34. NOTE: The engine is now in the SAFE position.

Lock the crankshaft.

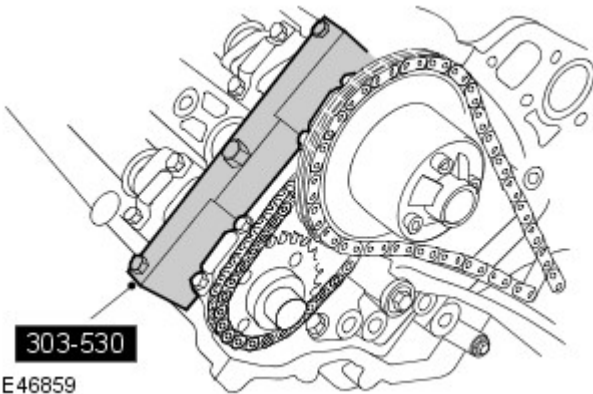
- Install the special tool.
- Install the screw.



E46858

35. Remove the RH VCT control unit.

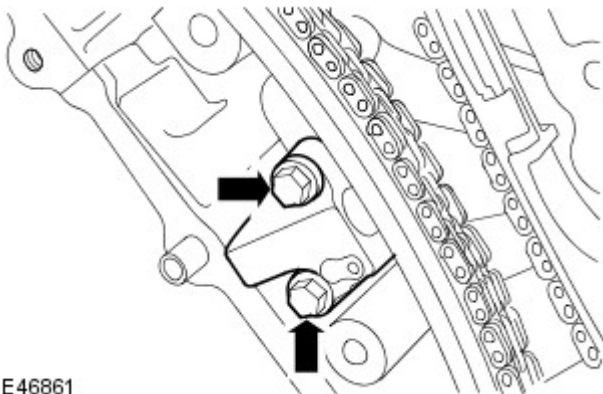
- Remove the 3 bolts.
- Remove and discard the O-ring seals.



E46859

36. Install the special tool to the RH cylinder head.

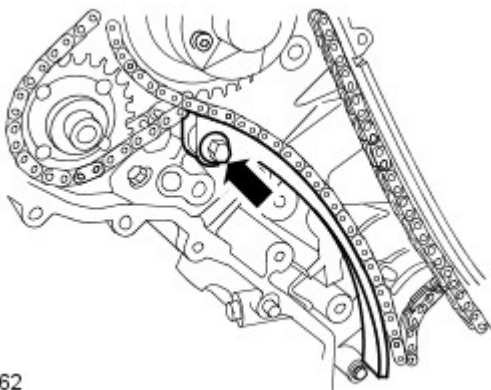
- Install the 3 bolts.



E46861

37. Remove the RH primary timing chain tensioner assembly.

- Remove the 2 bolts.

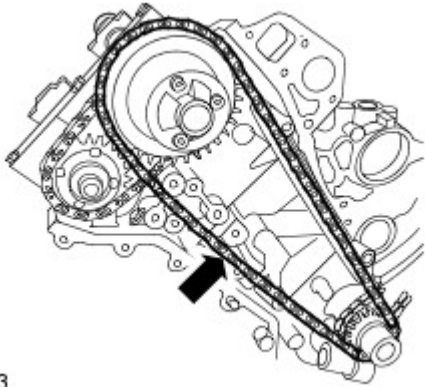


E46862

38. Remove the RH primary timing chain tensioner guide.

- Remove the bolt.

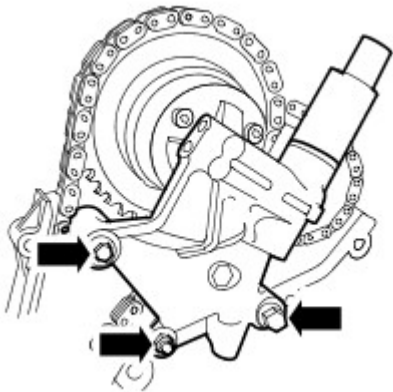
39. Remove the RH primary timing chain.



E46863

40. Remove the LH VCT control unit.

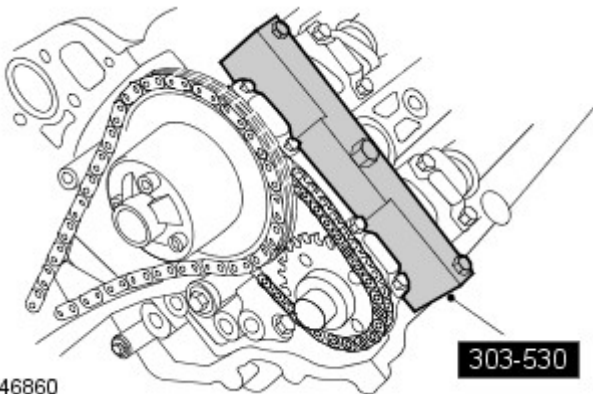
- Remove the 2 bolts.
- Remove the nut.
- Remove and discard the O-ring seals.



E48360

41. Install the special tool to the LH cylinder head.

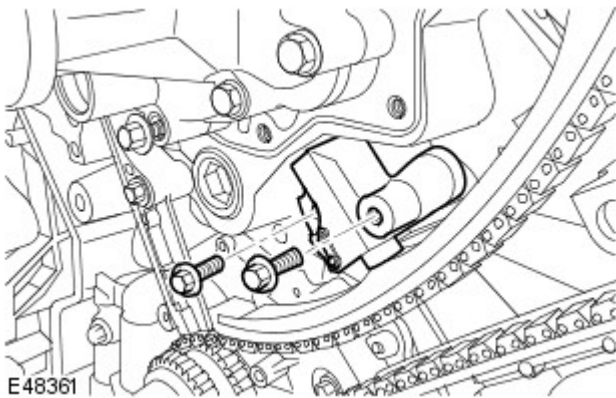
- Install the 3 bolts.



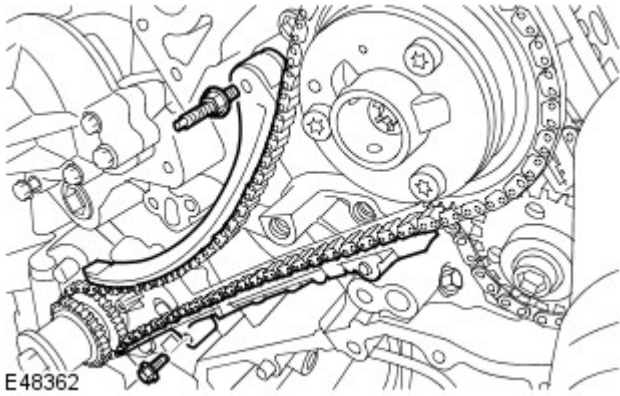
E46860

42. Remove the LH primary timing chain tensioner.

- Remove the 2 bolts.

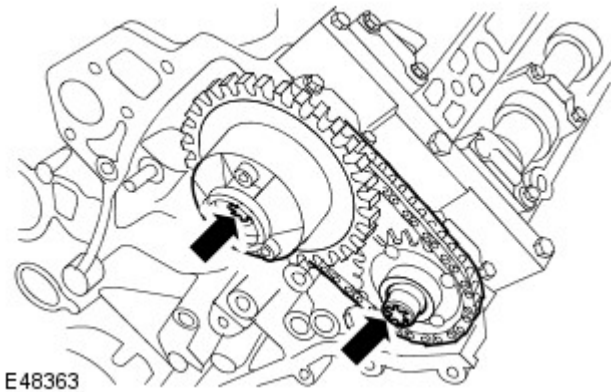


E48361



43. Remove the LH upper and lower primary timing chain tensioner guides.

- Remove the stud.
- Remove the bolt.

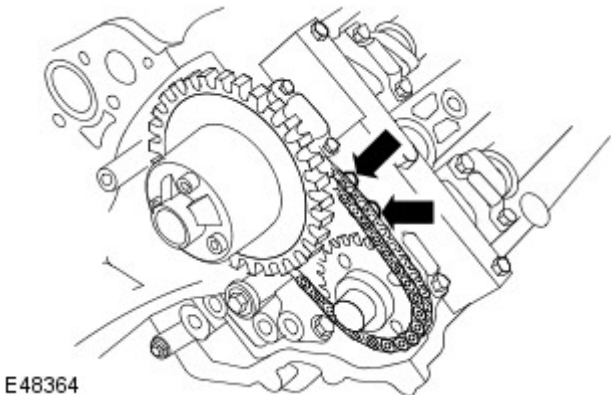


44. Remove the LH primary timing chain.

45.  CAUTION: Discard the bolts.

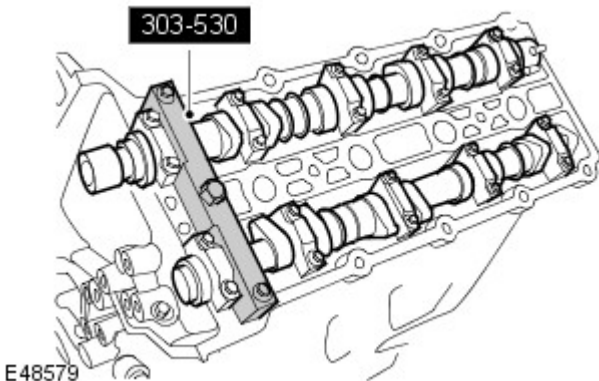
Remove the camshaft sprockets.

- Remove the 2 bolts.



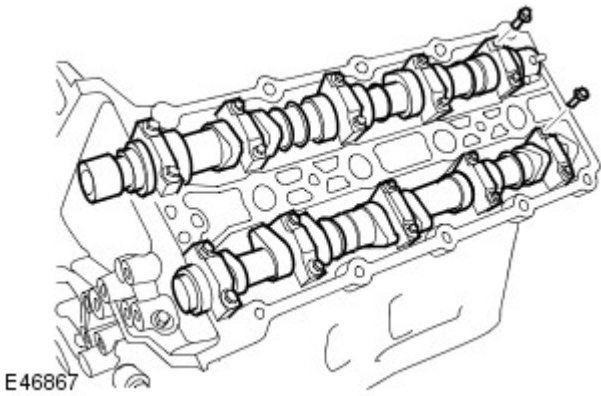
46. Remove the secondary timing chain tensioner and the secondary timing chain.

- Remove the 2 bolts.



47. Remove the special tool from the LH cylinder head.

- Remove the 3 bolts.



48.  CAUTION: Evenly and progressively, release the camshaft bearing caps.

• NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

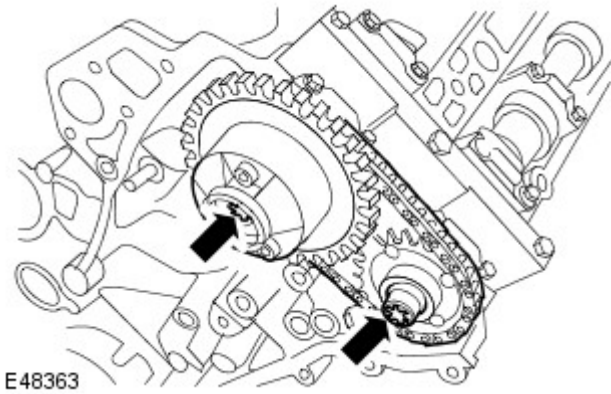
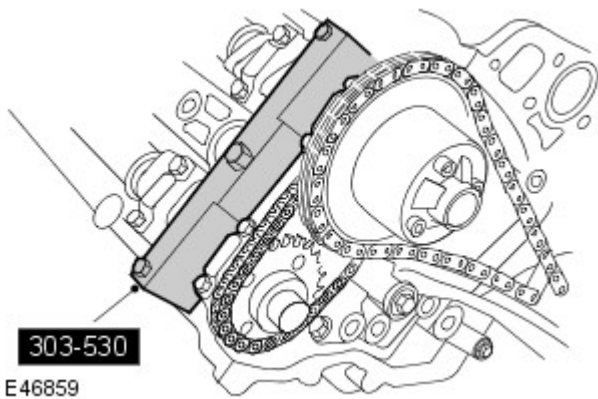
Remove the camshaft bearing caps.

- Remove the 20 bolts.

49. Remove the camshafts.

50. Install the special tool to the RH cylinder head.

- Install the 3 bolts.



51.  CAUTION: Discard the bolts.

• NOTE: LH illustration shown, RH is similar.

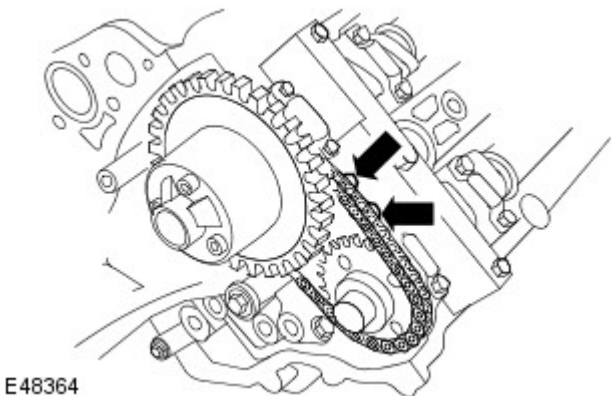
Remove the camshaft sprockets.

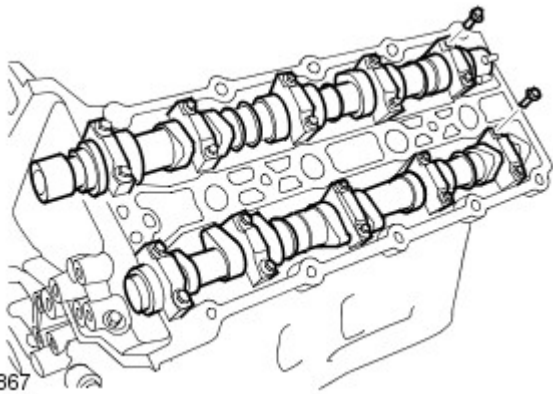
- Remove the 2 bolts.

52. NOTE: LH illustration shown, RH is similar.

Remove the secondary timing chain tensioner and the secondary timing chain.

- Remove the 2 bolts.





E46867

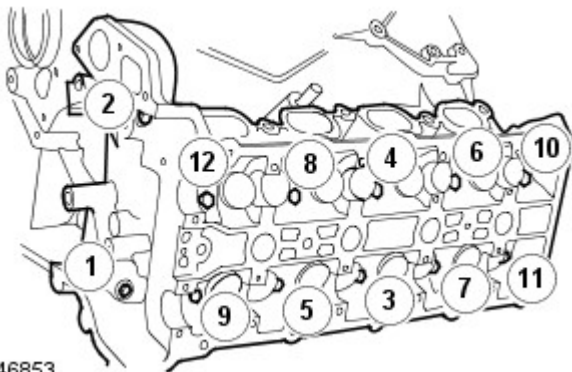
53. ⚠ CAUTION: Evenly and progressively, release the camshaft bearing caps.

• NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

• NOTE: LH illustration shown, RH is similar.

Remove the camshaft bearing caps.

- Remove the 20 bolts.



E46853

54. CAUTIONS:

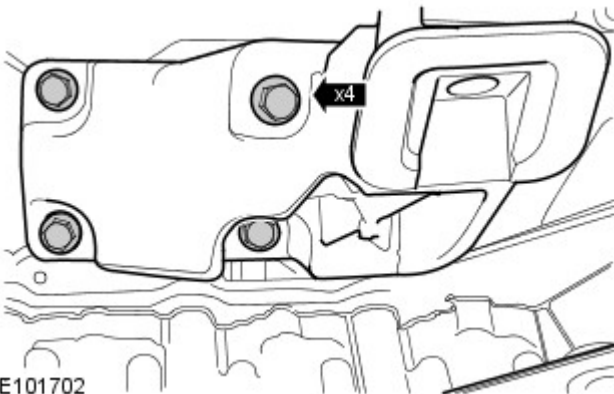
⚠ Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be removed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.

⚠ The bolts can only be used twice, mark the bolts with a center punch. If two punch marks are visible, discard the bolts.

Remove the LH cylinder head assembly.

- Remove the 12 cylinder head bolts.
- With assistance remove the cylinder head.
- Remove and discard the cylinder head gasket.
- Clean the cylinder head locating dowels.
- Clean the component mating faces.
- Repeat the operation for the RH side.

55. Remove 4 bolts securing the engine mount bracket to the cylinder block.

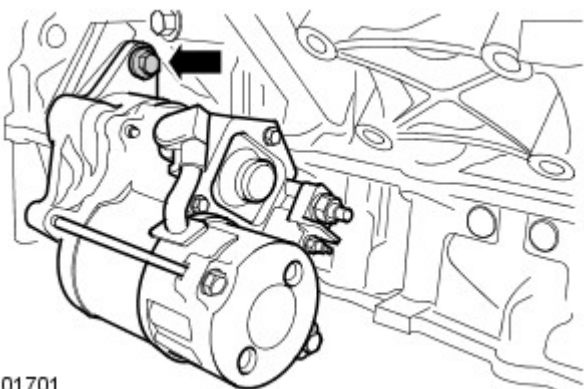


E101702

56. ⚠ CAUTION: Note the position of the bolt.

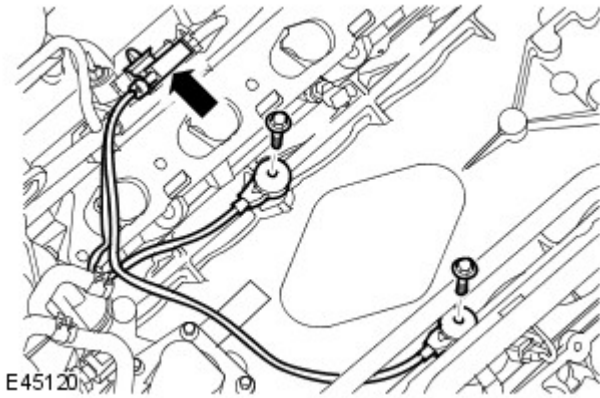
Remove the starter motor.

- Remove the remaining starter motor bolt.



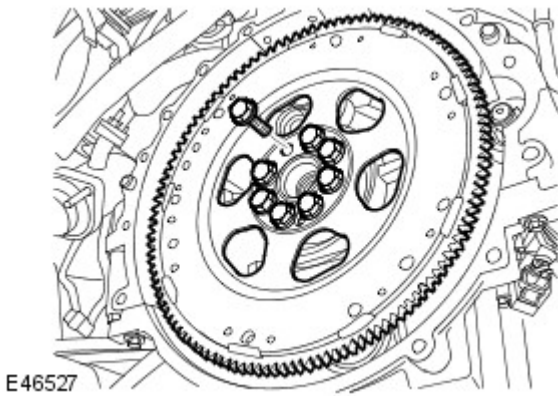
E101701

57. Remove the KS.



58. Remove the flexplate.

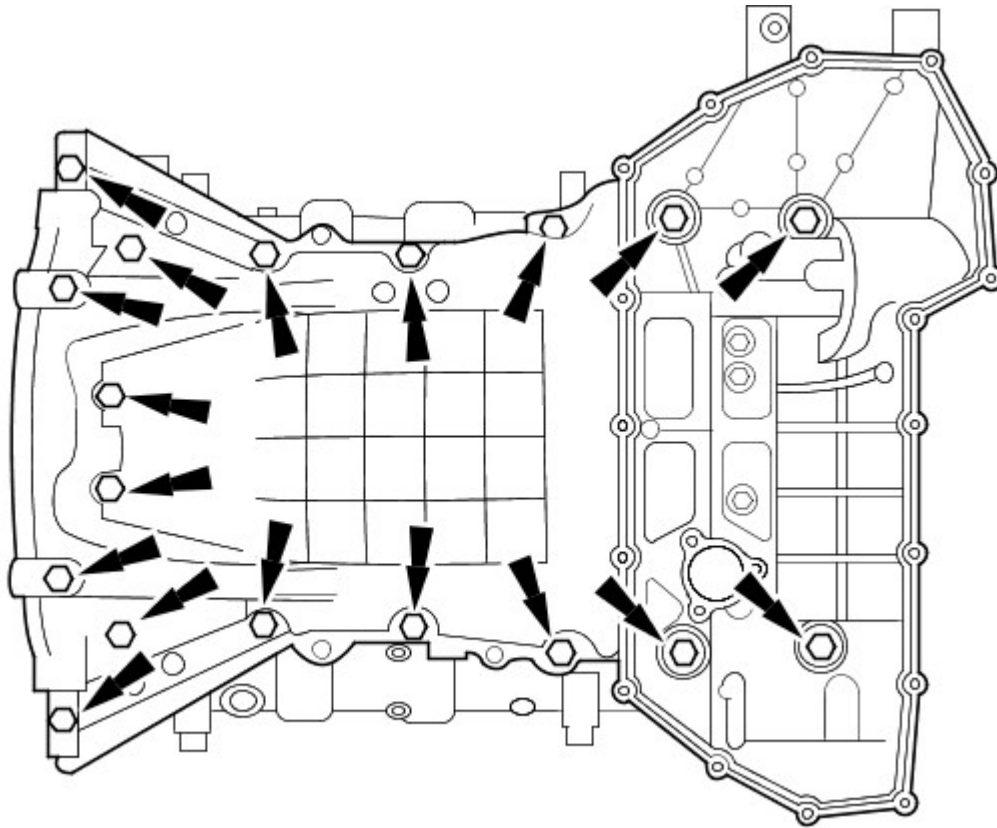
- Remove and discard the 8 bolts.



59. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Remove the oil pan.

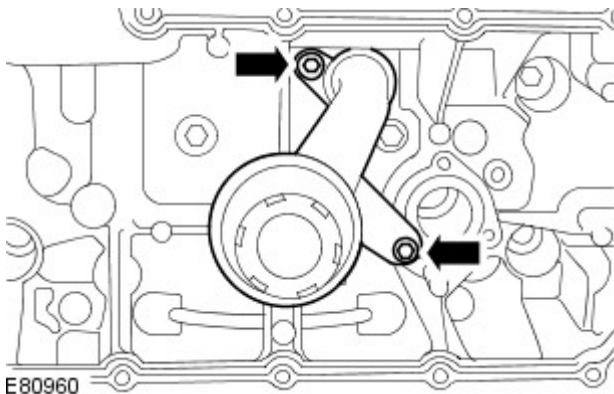
- Remove the 18 bolts.
- Clean all the mating faces and reusable parts thoroughly and check for damage.



VUJ0002435

60. Remove the oil strainer pick-up assembly.

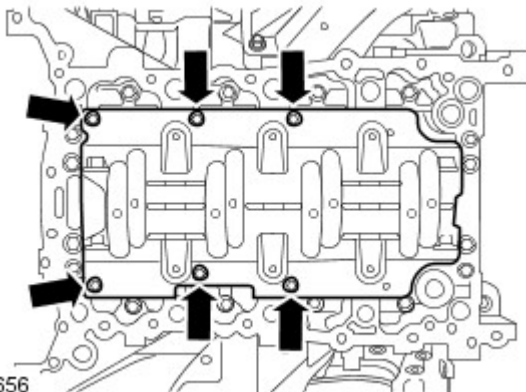
- Remove the 2 bolts.
- Remove and discard the O-ring seal.



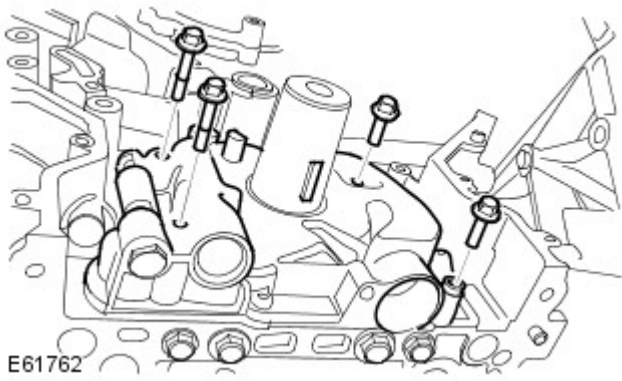
E80960

61. Remove the baffle plate.

- Remove the 6 bolts.



E82656



62. Remove the oil pump assembly.



- Remove the 4 bolts.
- Remove and discard the gasket.
- Clean the component mating faces.

63. Remove the engine from the engine stand.

- With assistance, remove the engine block from the stand.

Engine - V6 4.0L Petrol - Cylinder Head

Disassembly and Assembly of Subassemblies

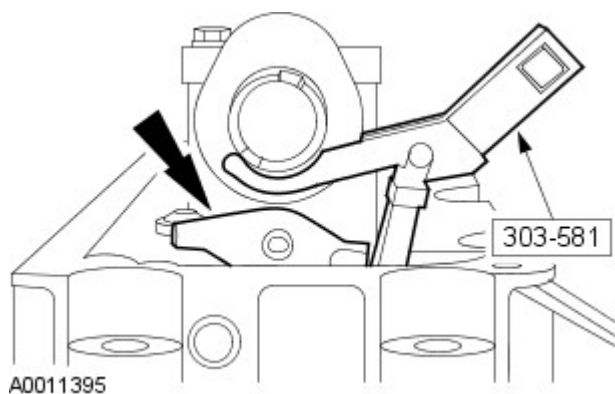
Special Tool(s)	
 <p>ST1830-A</p>	Compressor, Valve Spring 303-581 (T97T-6565-A)
 <p>ST1824-A</p>	Installer, Valve Stem Oil Seal 303-370 (T90T-6571-A)

Materials

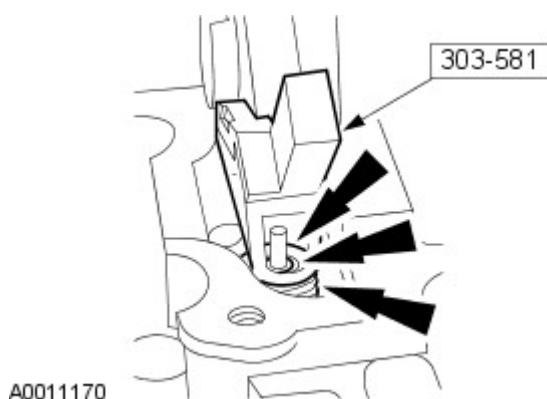
Name	Specification
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent	WSS-M2C153-G

Disassembly

1. Remove the spark plugs.
2. Using the special tool, remove the camshaft roller followers.

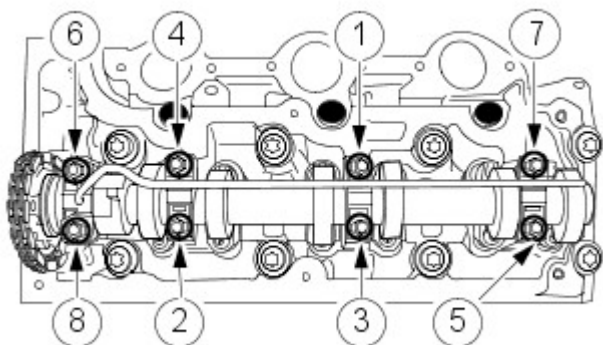


3. Using the special tool, remove the valve spring retainer keys, the valve spring and the retainer.



4. Remove the valve.
5. Repeat the procedure until all of the valves are removed.
6. Remove the valve stem seals.

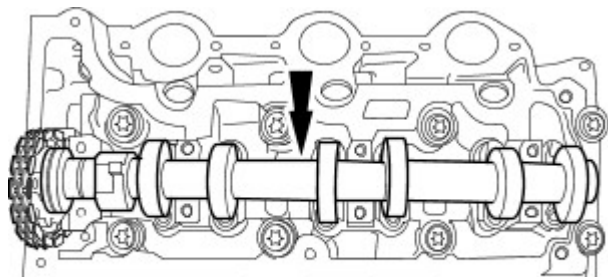
7. NOTE: Mark the position of the camshaft bearing caps so they can be installed in the original position.



GA2294A

Remove the bolts in the sequence shown and remove the camshaft bearing caps.

8. Remove the camshaft.



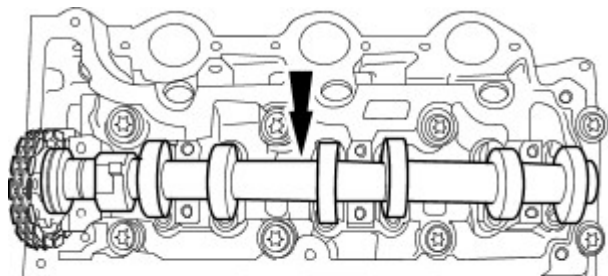
GA2295-A

9. Inspect the cylinder head. For additional information, refer to For additional information, refer to: [Cylinder Head Distortion](#) (303-00 Engine System - General Information, General Procedures).

Assembly

• NOTE: Prior to assembly, coat all of the valve train components with clean engine oil.

1. Install the camshaft.



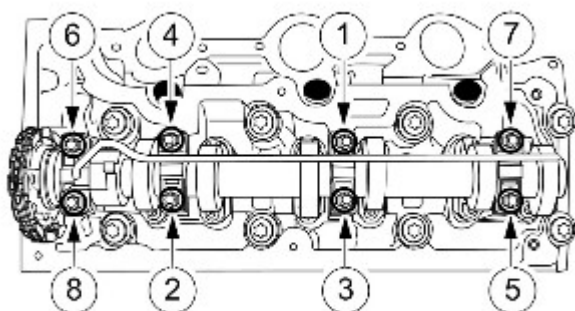
GA2295-A

2. NOTE: The camshaft bearing caps must be installed in the original position.

• NOTE: After installing the bolts, check the camshaft for free rotation.

Position the oil supply tube, the camshaft bearing caps, and bolts.

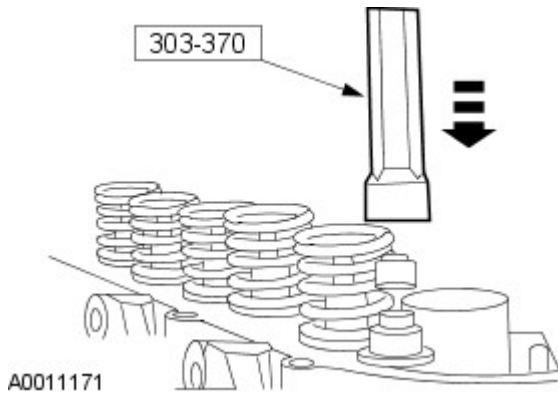
- Tighten in the sequence shown in two stages:
- Stage 1: Tighten to 6 Nm (53 lb-in).
- Stage 2: Tighten to 16 Nm (12 lb-ft).



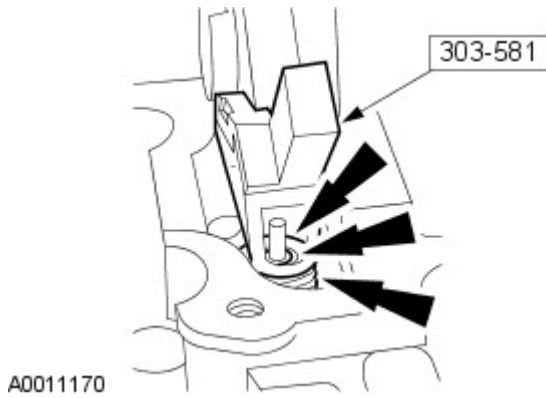
E134851

3. Install the valve.

4. Using the special tool, install the valve stem seals.

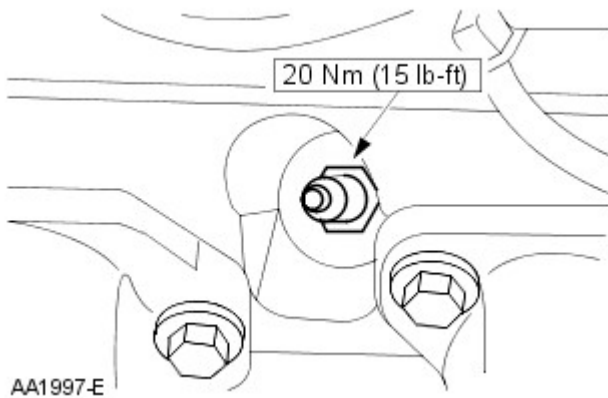


5. Using the special tool, install the valve spring, the retainer and the retainer keys.



6. Repeat the procedure until all of the valves are installed.


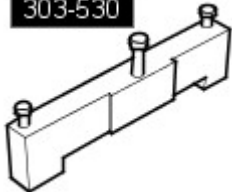


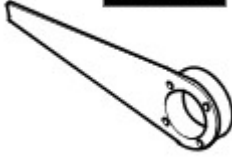

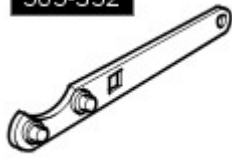
7. Install the spark plugs.



8. Install the camshaft roller followers only when the cylinder head is installed in the vehicle and the timing procedure has been carried out.

Engine - V6 4.0L Petrol - Engine

Assembly

Special Tool(s)	
 <p>303-645</p> <p>E46881</p>	<p>Timing Setting tool</p> <p>303-645</p>
 <p>303-530</p> <p>E46879</p>	<p>Camshaft setting/locking tool</p> <p>303-530</p>
 <p>303-1100-01</p> <p>E67144</p>	<p>Adapter - Crankshaft seal installer</p> <p>303-1100-01</p>
 <p>303-191-03</p> <p>E46730</p>	<p>Adapter</p> <p>303-191-03</p>
 <p>303-893</p> <p>E46728</p>	<p>Holding Tool Crankshaft Pulley</p> <p>303-893(LRT-12-080)</p>
 <p>303-191-04</p> <p>E59251</p>	<p>Bolts and spacers</p> <p>303-191-04</p>
 <p>303-532</p> <p>E46880</p>	<p>Timing chain tensioning tool</p> <p>303-532</p>

Assembly

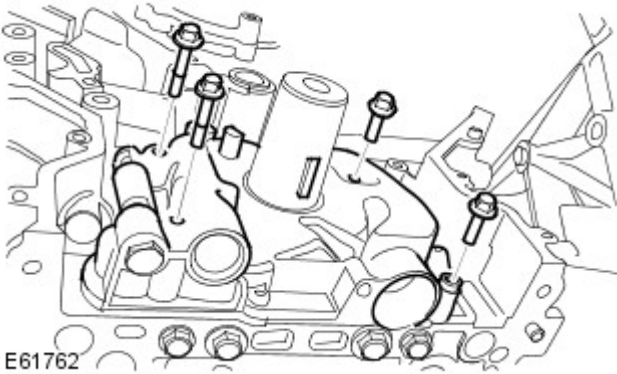
1. Secure the engine to the engine stand.

- Align the engine to the engine stand.
- Adjust the engine stand legs into position.
- Mount the engine to an engine stand.
- Fully tighten the engine stand leg nuts.

2. NOTE: Install a new gasket.

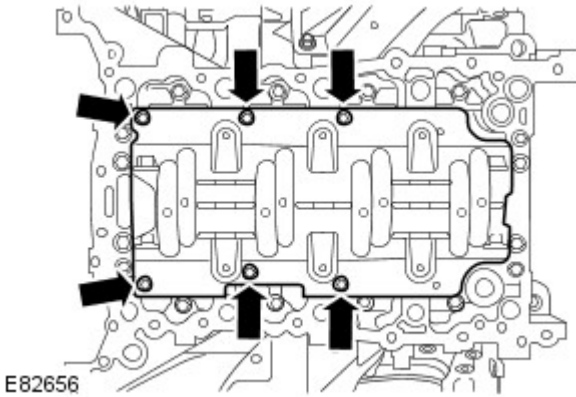
Install the oil pump assembly.

- Clean the component mating faces.
- Install the gasket.
- Tighten the bolts to 10 Nm.



3. Install the baffle plate.

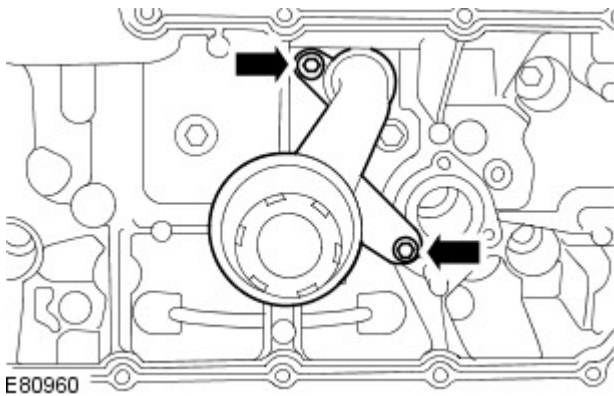
- Tighten the 6 bolts to 6 Nm.



4. NOTE: Install a new O-ring seal.

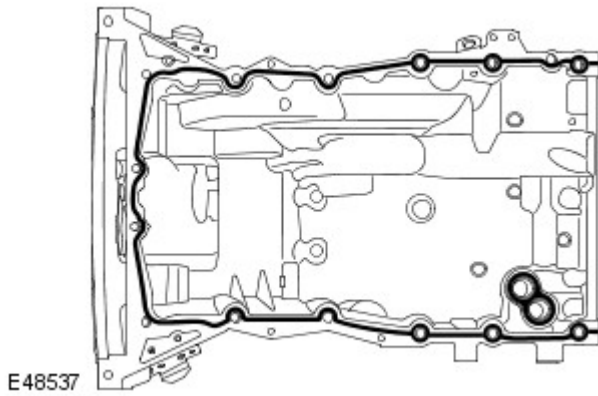
Install the oil strainer pick-up assembly.

- Install the O-ring seal.
- Tighten the M6 bolt to 10 Nm.
- Apply sealant to the M5 bolts.
- Tighten the M5 bolts to 6 Nm.

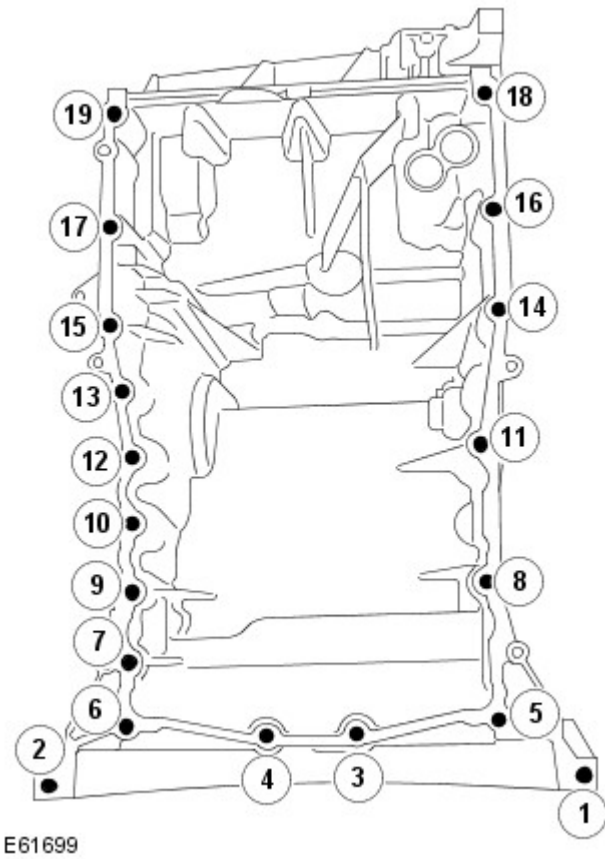


5. Install the oil pan.

- Clean the component mating faces.
- Apply a 3 mm diameter bead of sealant, to the area indicated.
- Install the bolts, but do not tighten fully at this stage.



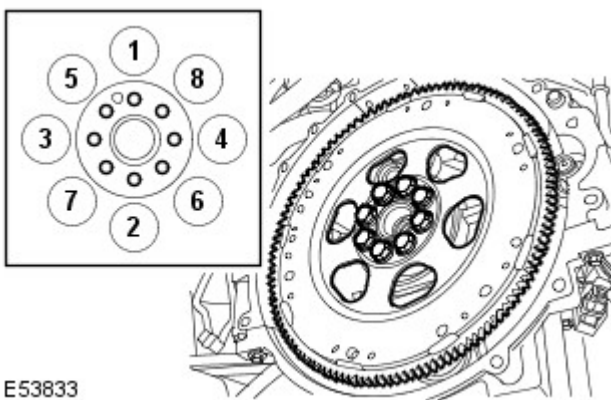
6. Tighten the oil pan bolts in the sequence shown to 20 Nm.



7. NOTE: Prevent the flexplate from rotating.

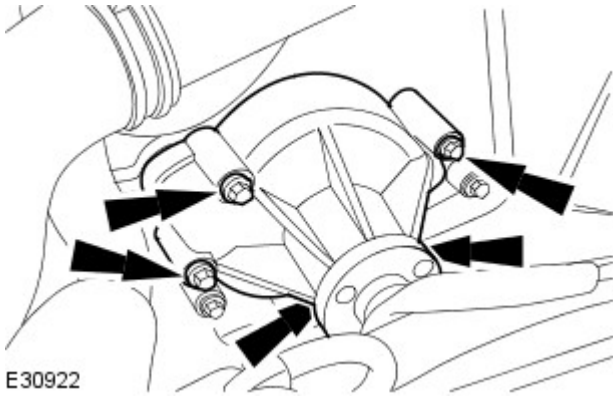
Install the flexplate.

- Clean the component mating faces.
- Tighten the bolts evenly in 2 stages to the sequence shown.
- Tighten the bolts to 15 Nm.
- Tighten the bolts to 110 Nm.



8. Install the coolant pump.

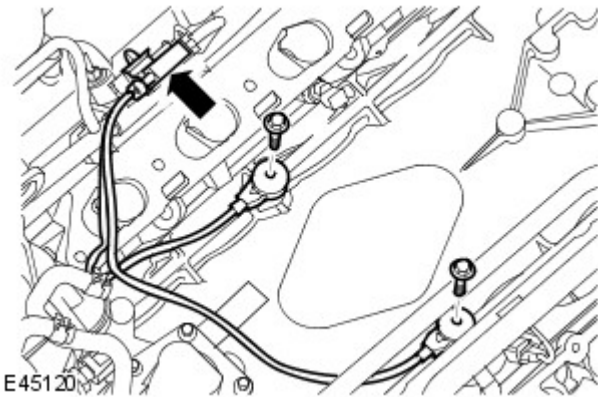
- Tighten the 5 bolts to 10 Nm.



9. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Install the knock sensors (KS).

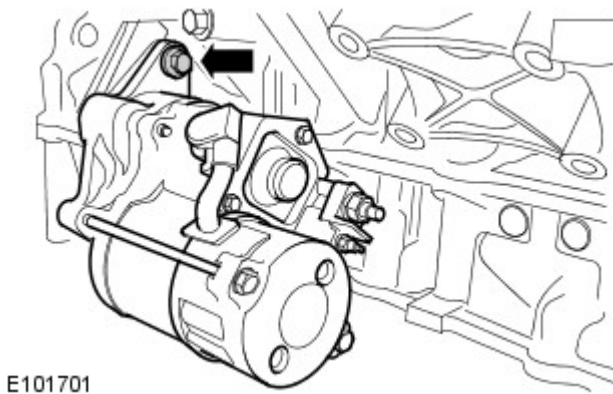
- Tighten the bolts to 20 Nm.



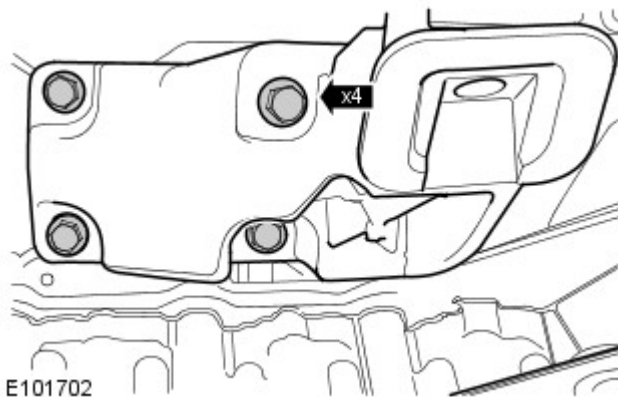
10. Position the starter motor.

- Install the starter motor.

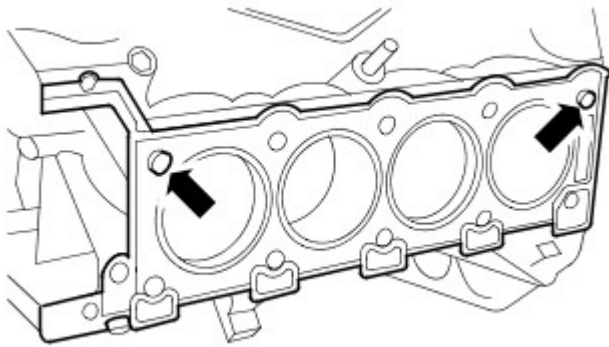
1. Tighten the bolt to 45 Nm.



11. Attach the engine mounting bracket.



12. NOTE: The cylinder head gaskets must be installed over the cylinder head to block dowels.



E46854

Install the RH cylinder head.

- Clean the component mating faces.
- Clean the cylinder head locating dowels.
- Install a new cylinder head gasket.
- With assistance install the cylinder head.
- Repeat the operation for the LH side.

13. ⚠ CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be installed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.

• NOTE: Tighten the bolts 1 to 10 in the sequence shown.

• NOTE: LH illustration shown, RH is similar.

Install the cylinder head bolts.

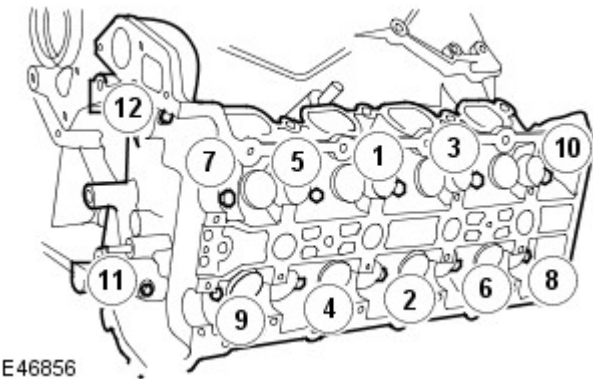
- Tighten the bolts to 20 Nm.
- Tighten the bolts to 35 Nm.
- Tighten the bolts 1 to 10, a further 90 degrees.
- Tighten the bolts 1 to 10, a further 90 degrees.
- Tighten the M8 bolts 11 and 12, to 25 Nm.
- Repeat the operation for the LH side.

14. Install the LH camshafts.

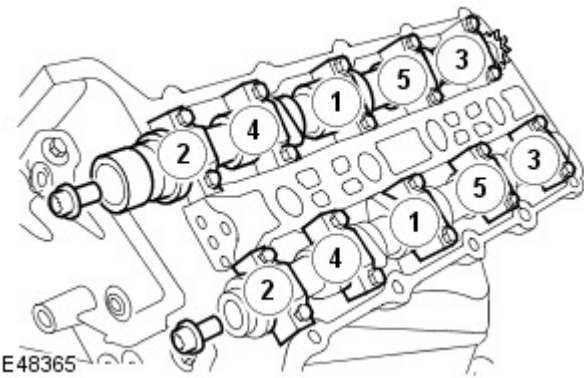
- Clean the component mating faces.
- Lubricate the journals and camshaft lobes.

15. Install the camshaft bearing caps.

- Evenly and progressively tighten the bolts in the sequence shown to 10 Nm.




E46856



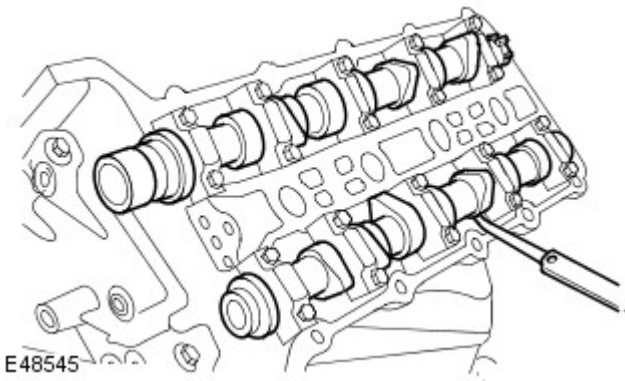
E48365

16. Install the sprocket retaining Torx bolts to the camshafts.

17.  CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

Measure and record the tappet clearances.

- Rotate the camshafts using the Torx bolts.

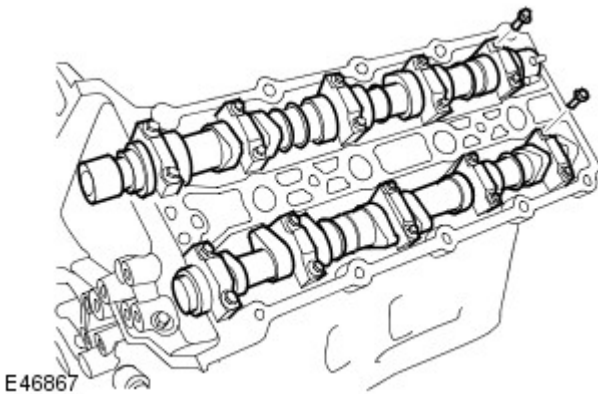


18. NOTE: Remove the camshaft bearing caps evenly and in stages.

• NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

Remove the camshafts.

- Remove the 20 bolts.



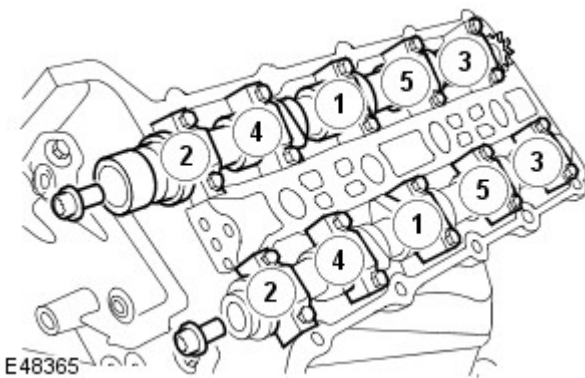
19. Remove the valve tappets, replace with selected tappets.


20. Install the camshafts.

- Lubricate the journals and camshaft lobes.
- Clean the component mating faces.

21. Install the camshaft bearing caps.

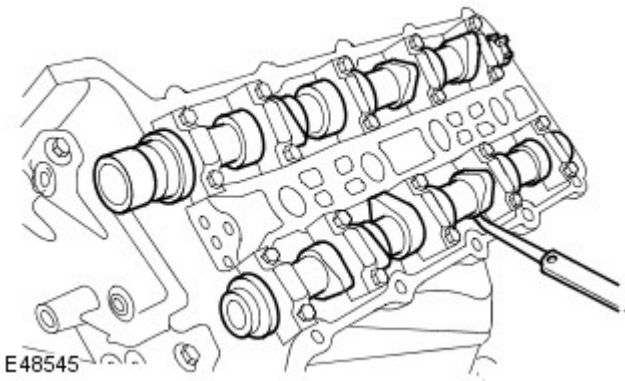
- Evenly and progressively tighten the bolts in the sequence shown to 10 Nm.



22.  CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

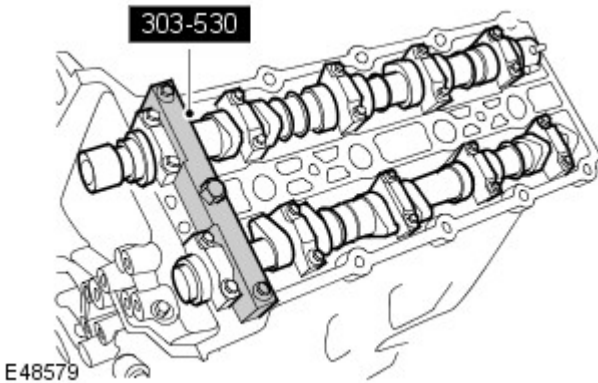
Check valve tappet clearances are correct.

- Rotate the camshafts using the Torx bolts.
- Remove the camshaft Torx bolts after the check is complete.



23. Repeat the operation for the RH camshafts.

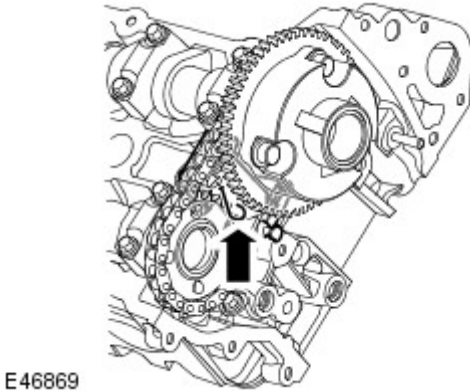
24. Install the special tool to the LH cylinder head.



25. NOTE: RH illustration shown, LH is similar.

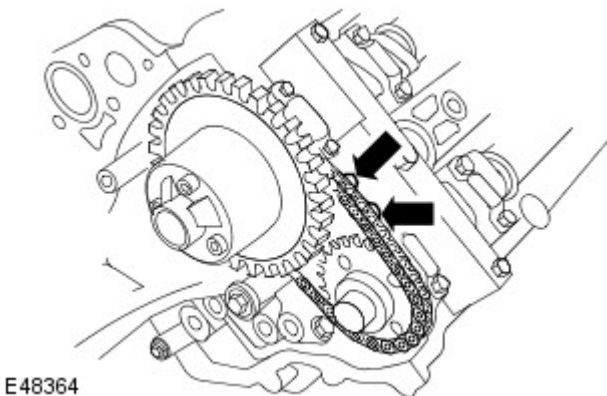
Depress the LH secondary timing chain tensioner piston.

- Using 1 mm diameter metal rod, retain the chain tensioner piston.



26. Install the LH secondary timing chain tensioner retaining bolts.

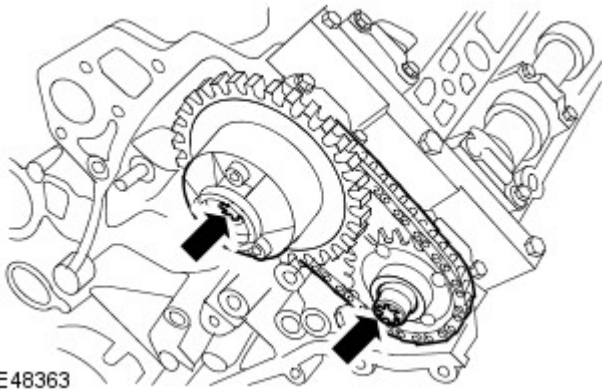
- Tighten the bolts to 12 Nm.



27. NOTE: Lightly tighten the camshaft sprocket Torx bolts, the sprockets **MUST** be free to move.

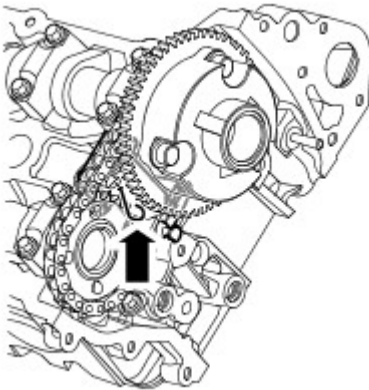
Install the LH secondary timing chain and sprockets to the camshafts.

- Install the sprocket retaining Torx bolts to the camshafts.



28. Tension the secondary timing chain.

- Remove the retaining rod.

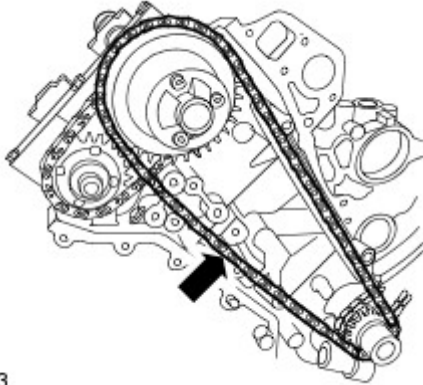


29. Repeat the operation for the RH camshafts.

30. NOTE: RH illustration shown, LH is similar.

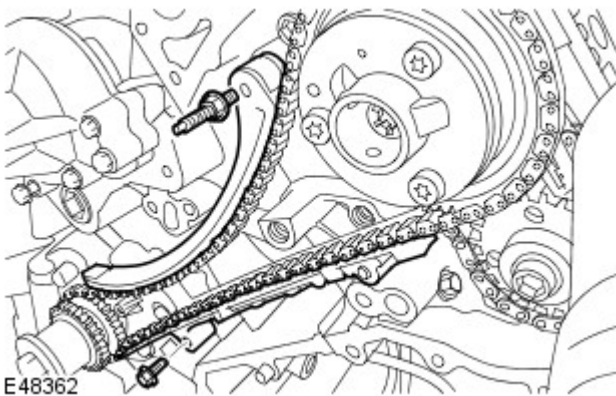
Install the LH primary timing chain.

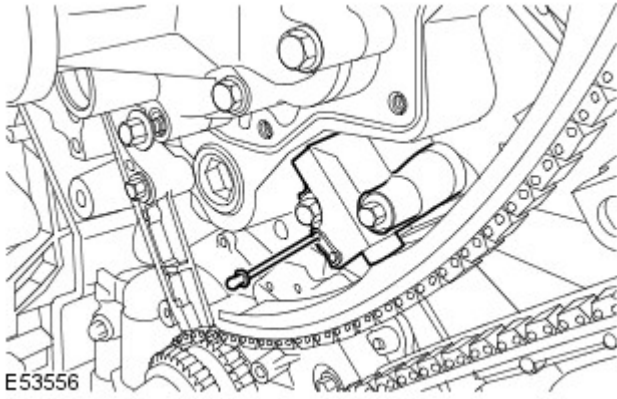
- Make sure the timing chain slack is on the tensioner side of the timing chain.



31. Install the LH primary chain tensioner guide.

- Tighten the stud to 12 Nm.

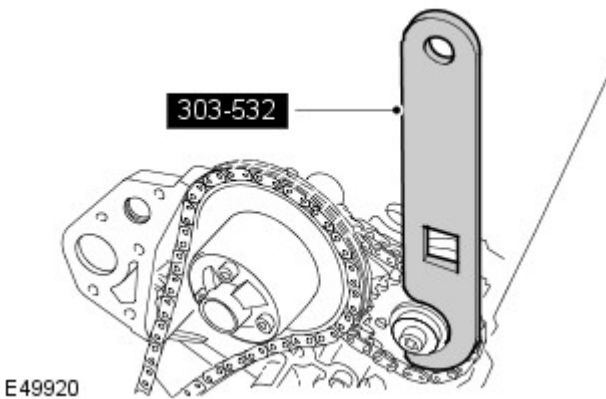




32. ⚠ CAUTION: During timing chain tensioner compression, do not release the ratchet stem until the timing chain tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.

Install the LH primary timing chain tensioner.

- Using 3 mm diameter metal rod, retain the chain tensioner piston.
- Tighten the bolts to 12 Nm.
- Remove the retaining rod.



33. CAUTIONS:

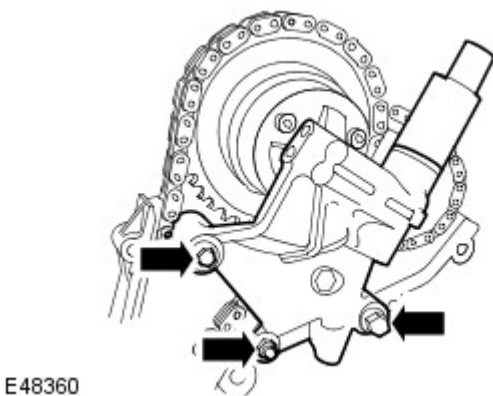
⚠ Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.

⚠ The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.

⚠ Make sure that new bolts are installed.

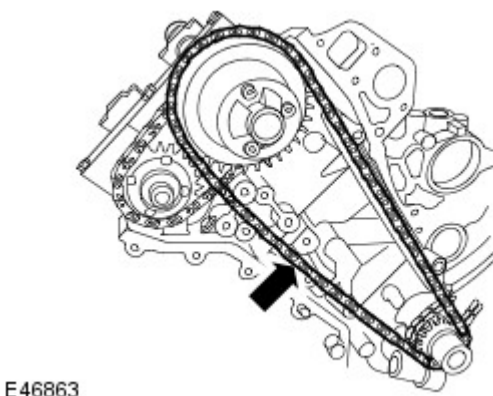
Install the special tool to the exhaust camshaft sprocket.

- Tighten the intake camshaft sprocket bolt to 20 Nm then a further 90 degrees.
- Tighten the exhaust camshaft sprocket bolt to 20 Nm then a further 90 degrees.



34. Install the LH variable camshaft timing (VCT) oil control unit.

- Install the new O-ring seals.
- Tighten the new bolts to 22 Nm.
- Tighten the nut to 10 Nm.

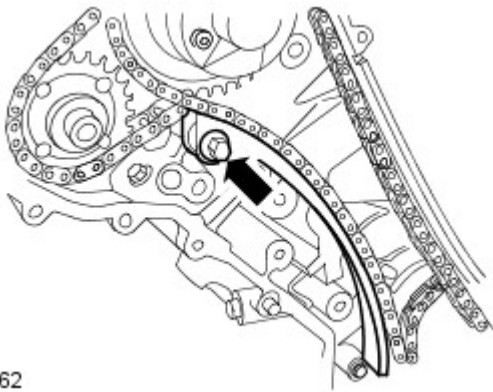


35. Install the RH primary timing chain.

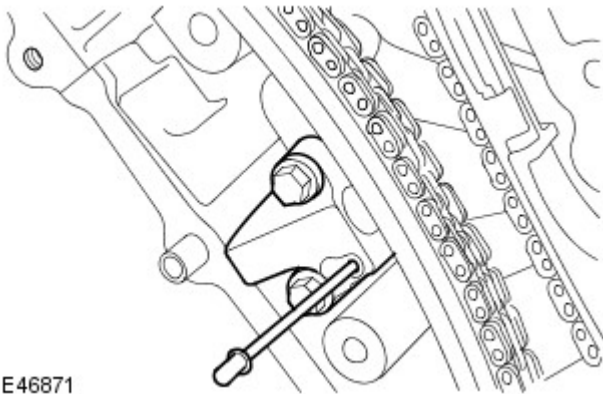
- Make sure the timing chain slack is on the tensioner side of the timing chain.

36. Install the RH primary timing chain tensioner guide.


- Tighten the bolts to 12 Nm.



E46862




E46871


37.  **CAUTION:** During timing chain tensioner compression, do not release the ratchet stem until the timing chain tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.

Install the RH primary timing chain tensioner.

- Using 3 mm diameter metal rod, retain the chain tensioner piston.
- Tighten the bolts to 12 Nm.
- Remove the retaining rod.

38. **CAUTIONS:**

 Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.

 The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.

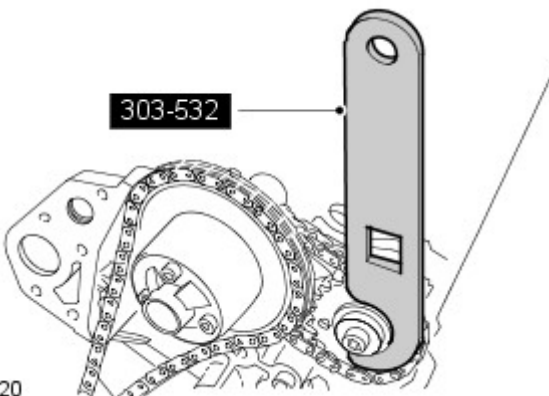
 Make sure that new bolts are installed.

Install the special tool to the exhaust camshaft sprocket.

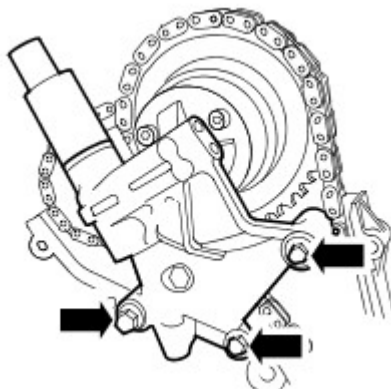
- Tighten the intake camshaft sprocket bolt to 20 Nm then a further 90 degrees.
- Tighten the exhaust camshaft sprocket bolt to 20 Nm then a further 90 degrees.

39. Install the RH VCT oil control unit.

- Install the new O-ring seals.
- Tighten the new bolts to 22 Nm.

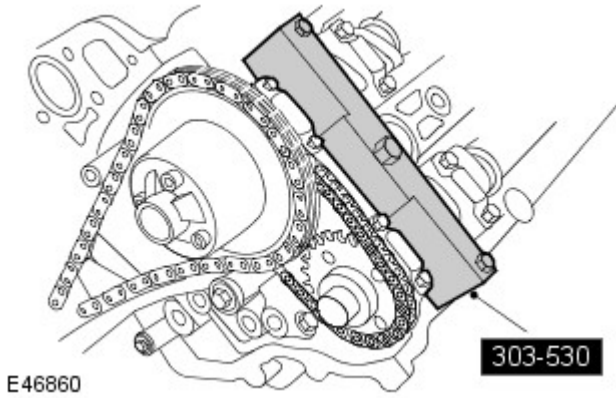


E49920

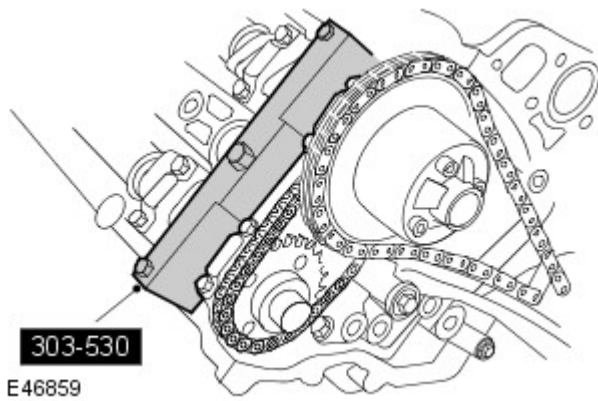


E46858

40. Remove the special tool from the LH cylinder head.

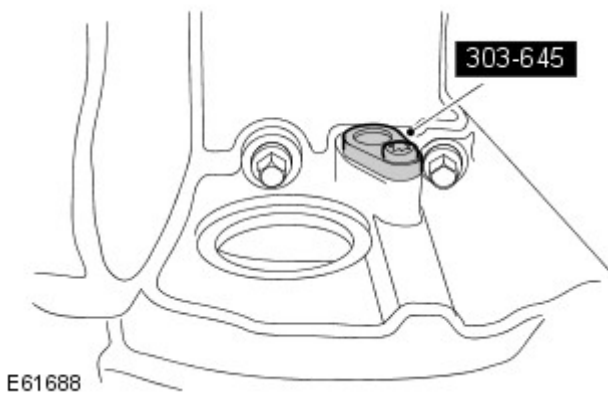


41. Remove the special tool from the RH cylinder head.



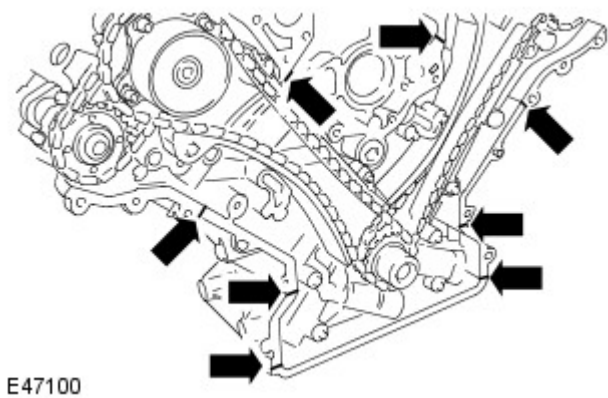
42. Remove the crankshaft locking tool.

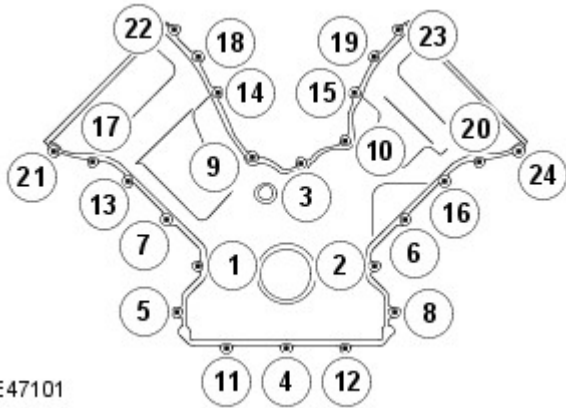
- Remove the screw.



43. Install the engine front cover.

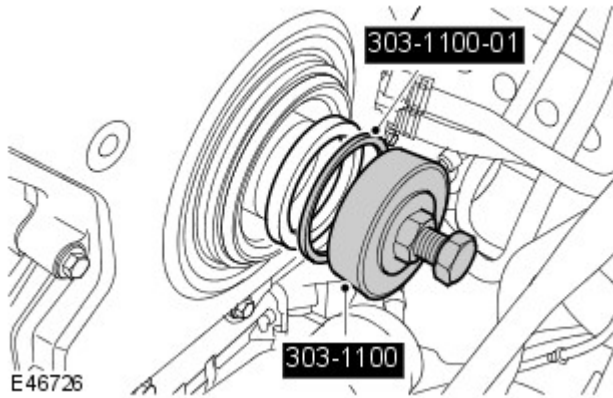
- Clean the component mating faces.
- Apply a bead of sealant 3 mm diameter, by 12 mm long, to the 8 places indicated.





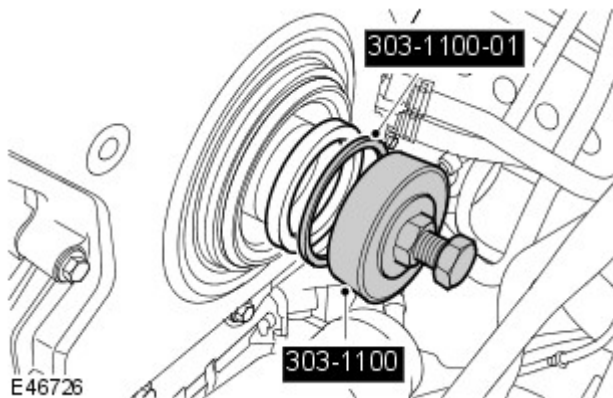
E47101

44. Evenly and progressively tighten the bolts in the sequence shown to 12 Nm.



45. Using the special tools, install the crankshaft front seal.

- Clean the component mating faces.
- Lubricate the seal with clean engine oil.
- Use the discarded crankshaft bolt with the service tool.



46. Using the special tools, install the crankshaft front seal.

- Clean the component mating faces.

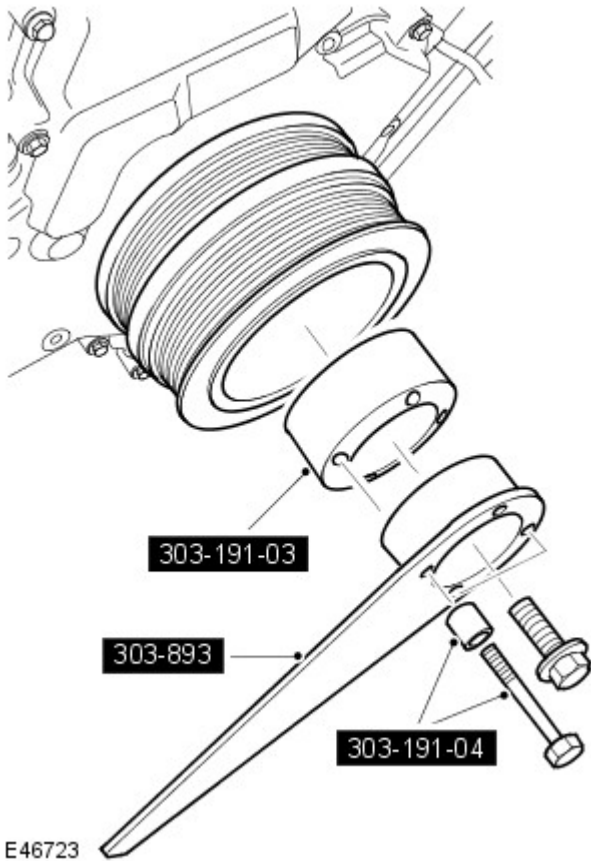
47. Install the crankshaft pulley.

- Lubricate the seal with clean engine oil.


48. Install the crankshaft pulley locking ring.

49.  **CAUTION:** The screw thread in the crankshaft pulley must be cleaned out before installing a new crankshaft pulley bolt.

Install, but do not tighten, the new crankshaft pulley bolt.



E46723

50.  **CAUTION:** Under no circumstances should the crankshaft setting peg, 303-645, be used in the following operations, to restrain the crankshaft.

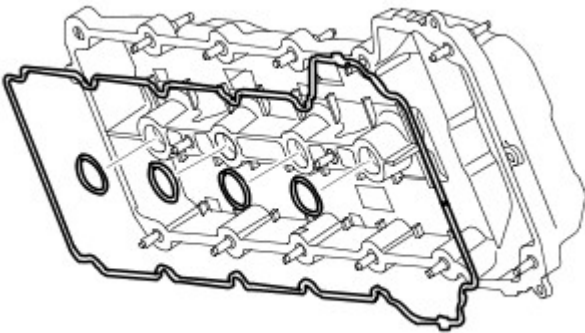
Using the special tools, retain the crankshaft pulley.

- Tighten the crankshaft pulley bolt to 380 Nm.

51. Remove the special tools.

52. Install new valve cover plug aperture gaskets.

- Install a new valve cover gasket.

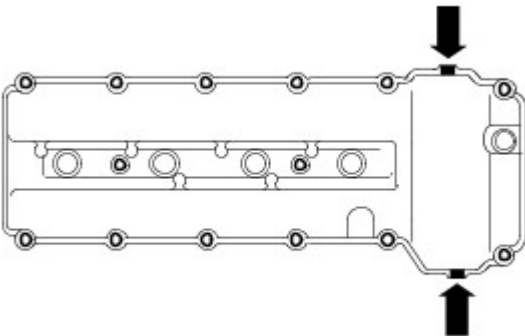


E46652

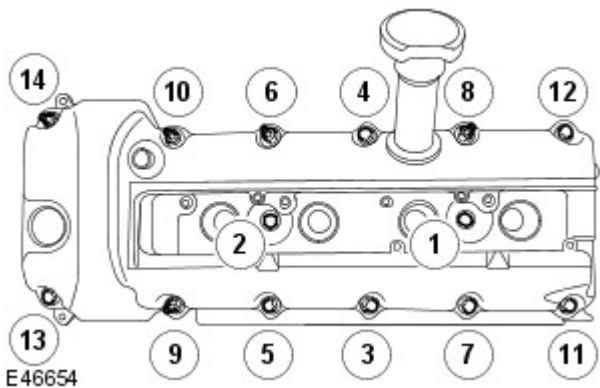
53. **NOTE:** Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

Install the valve cover.

- Clean the component mating faces.

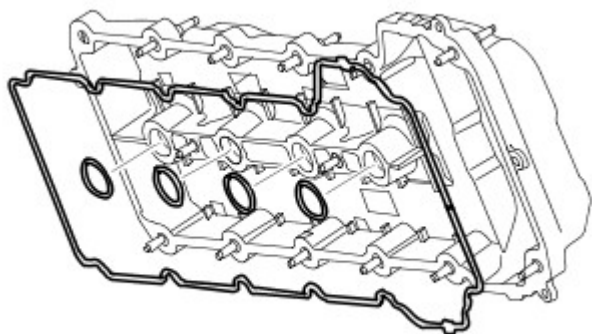


E49922



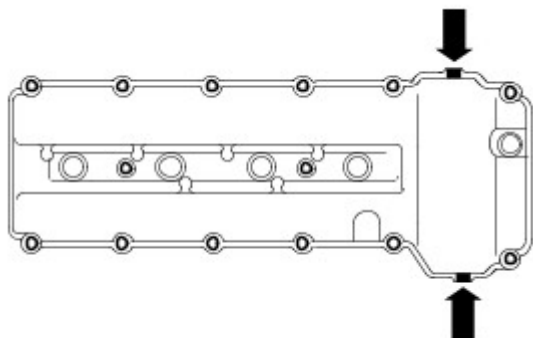
54. Install the valve cover retaining bolts.

- Install valve cover retaining bolts to their position previously noted.
- Complete the tightening sequence as illustrated.
- Tighten the bolts to 12 Nm.



55. Install new valve cover plug aperture gaskets.

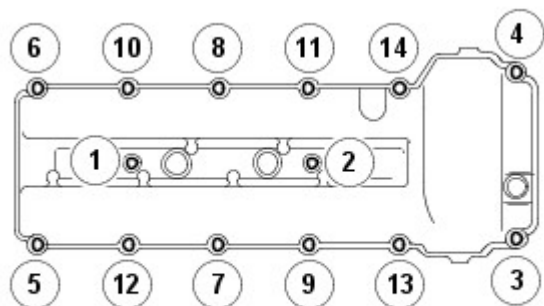
- Install a new valve cover gasket.



56. NOTE: Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

Install the valve cover.

- Clean the component mating faces.

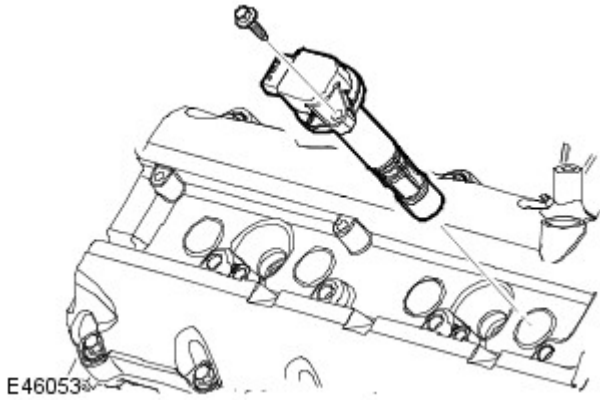


57. Install the valve cover retaining bolts.

- Install valve cover retaining bolts to their position previously noted.
- Tighten the bolts to 12 Nm.
- Complete the tightening sequence as illustrated.

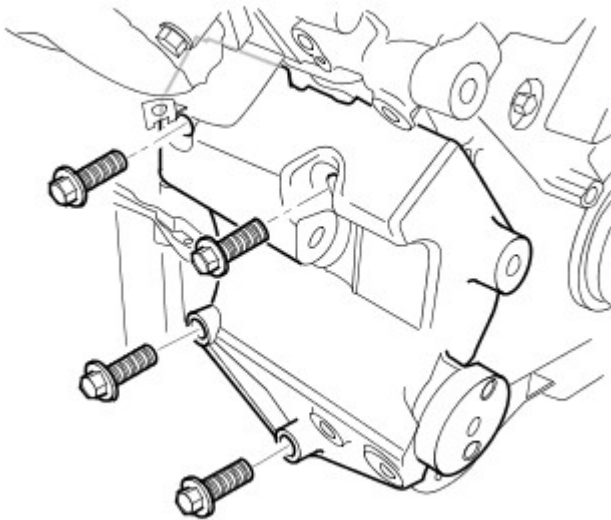
58. Install the 8 ignition coil-on-plugs.

- Install the 8 bolts.
- Tighten the bolts to 6 Nm.



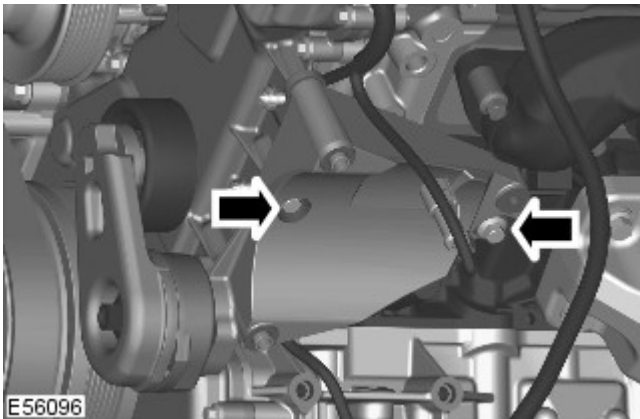
59. Install the generator mounting bracket.

- Clean the locating dowels.
- Clean the component mating faces.
- Tighten the bolts to 45 Nm.



E58798

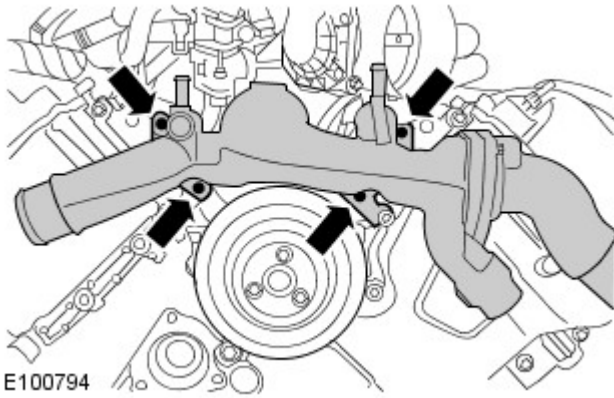
60. Install the A/C mounting bracket.



E56096

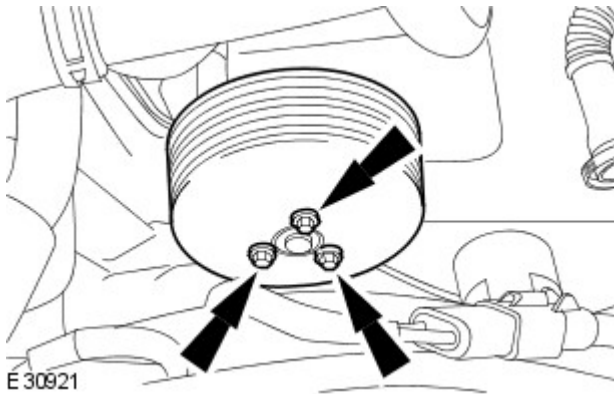
61. Install the coolant manifold.

- Tighten the bolts to 6 Nm.



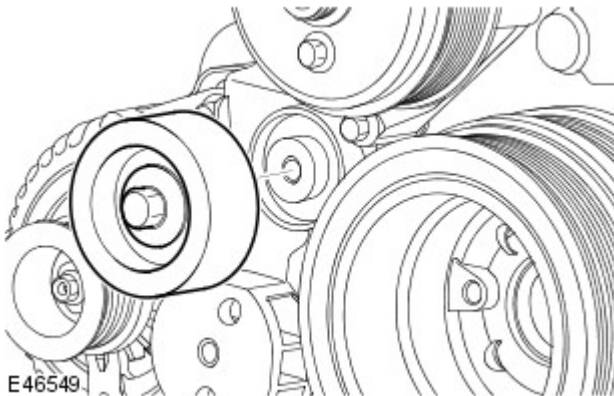
62. Install the coolant pump pulley.

- Tighten the bolts to 10 Nm.



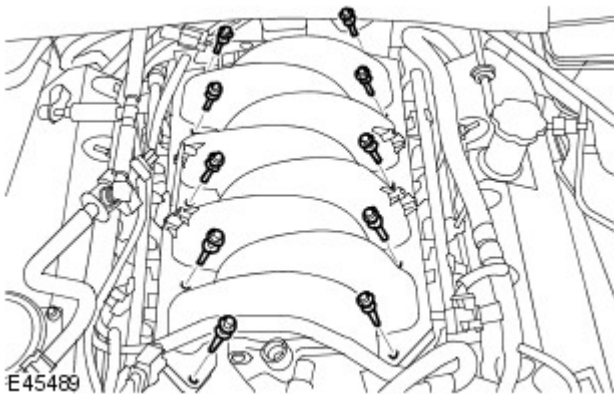
63. Install the accessory drive belt idler pulley.

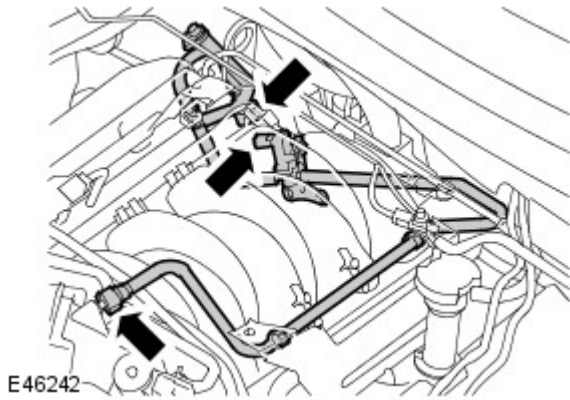
- Tighten the bolt to 25 Nm.



64. With assistance, install the intake manifold.

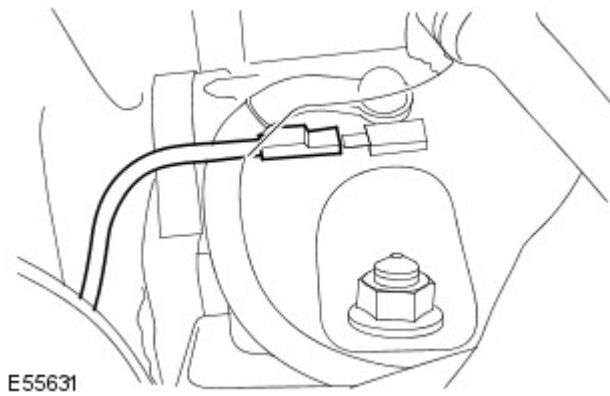
- Install the gaskets.
- Evenly and progressively tighten the bolts to 20 Nm.





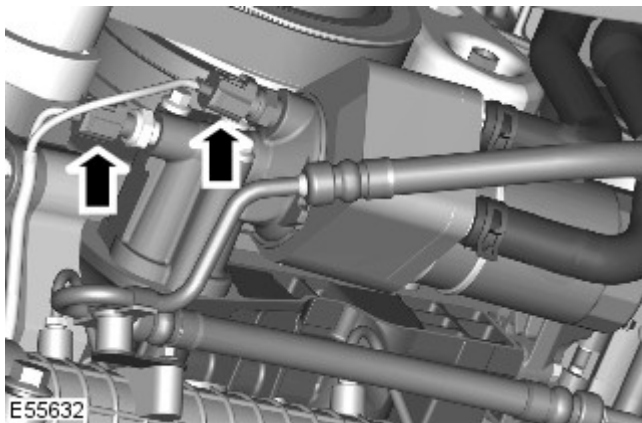
65. Install the purge valve.

- Secure the electrical harness with the clip.
- Tighten the bolt to 6 Nm.
- Connect and secure the electrical connector.

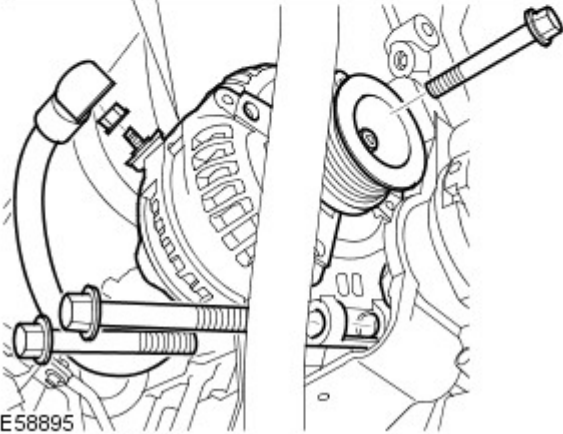
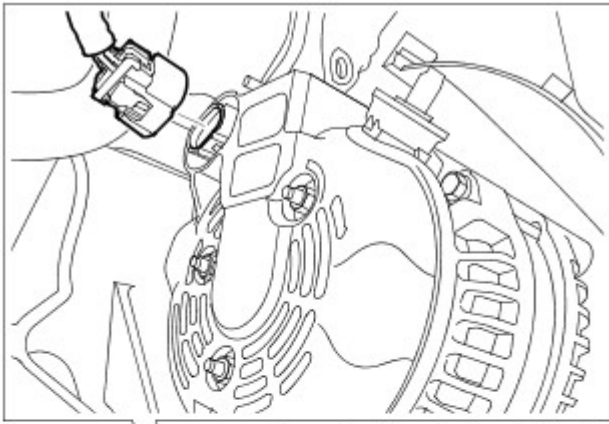


66. Connect the starter motor positive cable.

- Secure the cover.



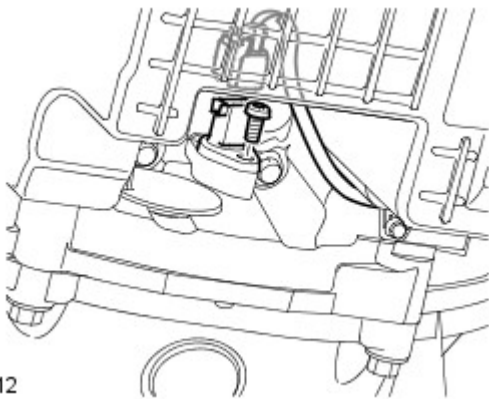
67. Connect the oil temperature and oil pressure sensors.



E58895

68. Install the generator.

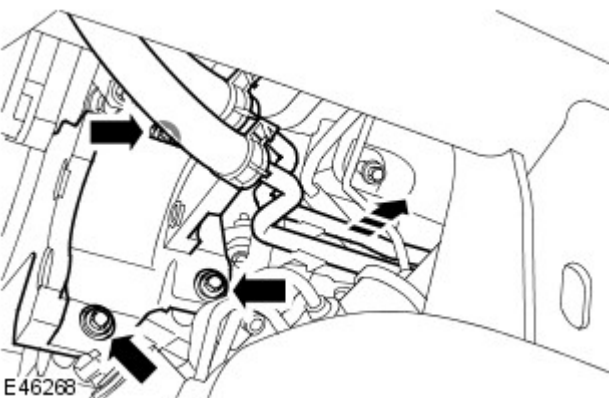
- Clean the component mating faces.
- Tighten the bolts to 48 Nm.
- Connect the generator electrical connector.
- Secure the clips.



E45412

69. Install the crankshaft position (CKP) sensor electrical connector.

- Connect the CKP sensor electrical connector.



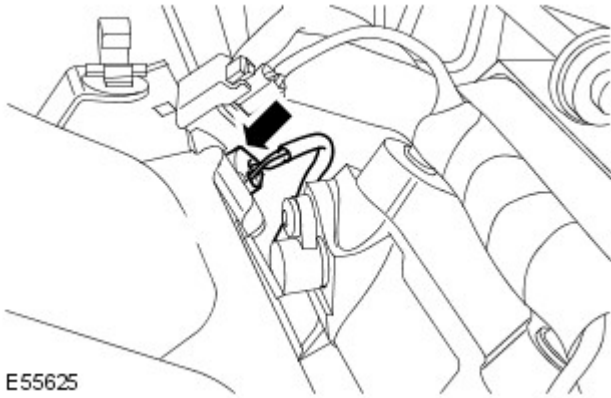
E46268

70. Install the power steering pump mounting bracket.

- Clean the component mating faces.
- Tighten the bolts to 25 Nm.
- Secure the transmission cooler pipes into clips.

71. Connect and secure the CMP sensor electrical connectors.

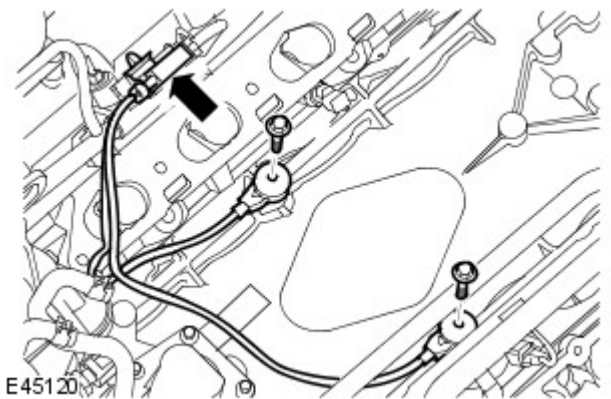
- Repeat the operation for the RH side.



E55625

72. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Connect the KS electrical connector.



E45120

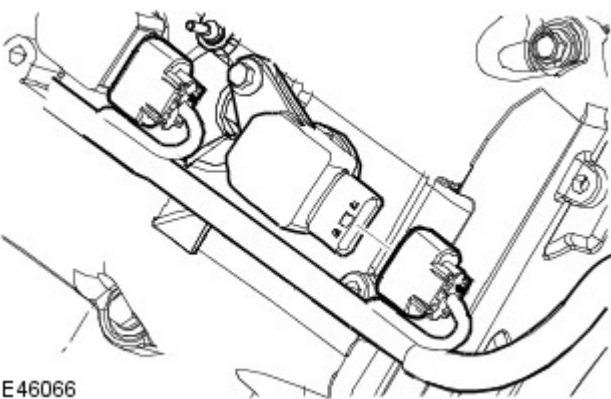
73. Connect the engine coolant temperature (ECT) sensor electrical connector.



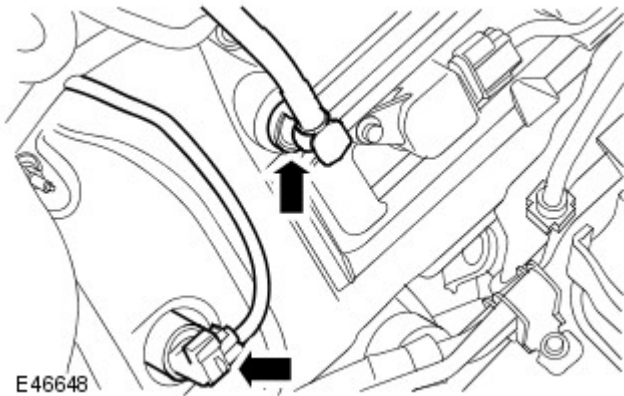
E44468

74. Connect the ignition coil-on-plug electrical connections.

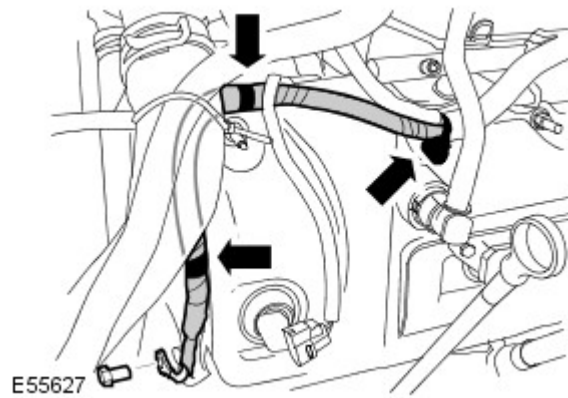
- Install the clips.
- Repeat the above procedure for the other side.



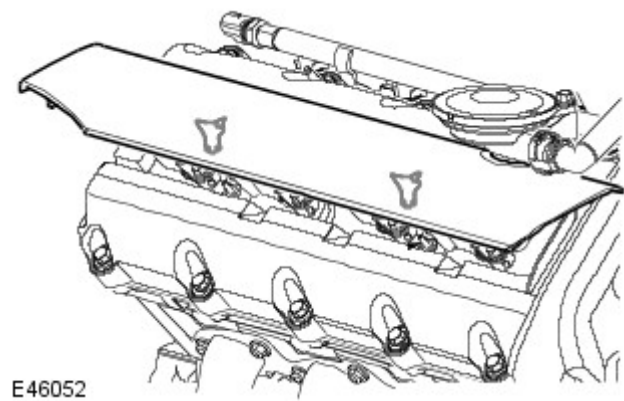
E46066



- 75.** Connect the VCT oil solenoid electrical connector.
- Repeat the above procedure for the other side.
 - Connect the valve cover breather hose.



- 76.** Connect the cylinder head earth ground connector.
- Install the bolt.
 - Secure the 3 clips.



- 77.** Install the ignition coil-on-plug cover.
- Secure the clips.
 - Repeat the above procedure for the other side.

78. Remove the engine from the engine stand.

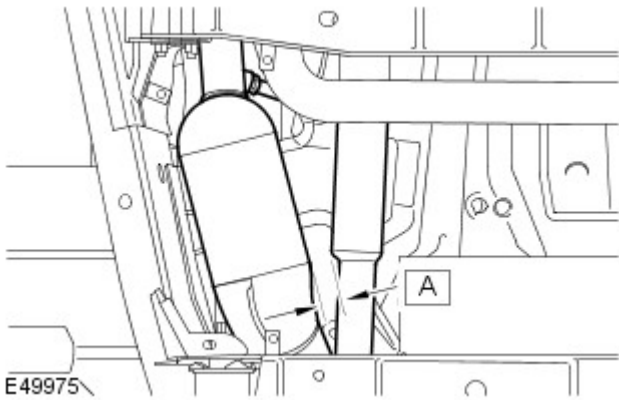
79. Install the engine assembly.


Engine - V6 4.0L Petrol - Engine

Installation

Installation

1. Remove the torque converter retainer.
2. Install the engine.
 - Connect the lifting chains.
 - Carefully lower the engine until approximately 35mm above engine mounts.
 - With assistance align the engine to the transmission and engine mounts.
3. Install the RH engine mount.
4. Install the transmission retaining bolts.
 - Clean the component mating faces.
 - Remove the guide pins.
 - Tighten the bolts to 45 Nm (33 lb.ft).
5. Tighten the engine mount nuts to 90 Nm (66 lb.ft).
6. Remove the engine lifting bracket.
 - Disconnect the lifting chains.
 - Remove the 7 bolts.
 - Remove the 12 nuts.
7. Attach the flexplate to the torque converter.
 - Rotate the crankshaft to access the retaining bolts.
 - Tighten the bolts to 45 Nm (33 lb.ft).
 - Install the grommet.
8. Connect the CKP sensor electrical connector.
 - Clean the component mating faces.
9. Connect the HO2S electrical connectors.
10. Install the engine wiring harness support bracket.
11. Connect the engine oil temperature sensor electrical connector.
12. Install the starter motor.
 - Clean the component mating faces.
 - Tighten the bolts to 45 Nm (33 lb.ft).
13. Position the fuel pipe and purge line heat shield and secure with bolts.
14. Position the RH catalytic converter to the exhaust manifold.
 - Clean the components.
 - Tighten the new bolts to 22 Nm (16 lb.ft).



15.  **CAUTION:** Make sure there is a clearance (A) of 25 mm to 30 mm between the closest points of the LH catalytic converter and the front driveshaft.

Position the LH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).

16. Install the transmission heat shield.

17. Connect the engine oil cooler hoses.

- Secure with the clips.

18. Connect the coolant pump hose.

- Secure with the clip.

19. Install the steering column lower universal joint assembly.

- Install new patchlock bolts and tighten to 25 Nm (18 lb.ft).

20. Connect the ECT sensor electrical connector.

21. Install the EGR pipe.

- Clean the component mating faces.
- Install to the exhaust manifold, but do not fully tighten the union nut at this stage.

22. Install the transmission cooler pipes.

- Install the support bracket.
- Tighten the nut to 10 Nm (7 lb.ft).

23. Connect the engine ground cable, make sure the mating faces are clean.

- Tighten the nut to 25 Nm (18 lb.ft).
- Install the cover.

24. Install the A/C compressor mounting bracket assembly.

- Clean the component mating faces.
- Tighten the bolts to 45 Nm (33 lb.ft).
- Install the KS electrical connector clip.
- Connect the A/C compressor electrical connection.

25. Install the generator mounting bracket.

- Clean the component mating faces.
- Tighten the bolts to 45 Nm (33 lb.ft).
- Secure the clip.
- Install a new cable tie.

26. Connect the EOP sensor electrical connector.

27. Connect the generator electrical connectors.

28. Install the accessory drive belt.

For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).

29. Install the cooling fan lower shroud.
 - Remove the radiator protection.
 - Position and secure in the clips.
30. Install the wiring harness to the plenum.
 - Secure with the clips.
31. Connect the ECM electrical connectors.
32. Install the battery tray.

For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
33. Install the intake manifold.

For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
34. Tighten the nuts securing the EGR pipe to the exhaust manifold and EGR valve to 25 Nm (18 lb.ft).
35. Fill the engine with oil.

For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
36. Refill and bleed the cooling system.

For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
37. Return the hood from the service position.
 - Release the 2 clips.
 - Connect the struts and secure with the clips.
38. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
39. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Engine Cooling - V6 4.0L Petrol -

Fluids

Item	Specification
* Anti-freeze	Havoline Extended Life Coolant (XLC) or any ethylene glycol based anti-freeze containing no methanol with only Organic Acid Technology (OAT) corrosion inhibitors
Anti-freeze concentration - Will provide frost protection to -40°C (-40°F)	50%
Specific gravity of coolant at 20°C (68°F), to protect against frost down to -40°C (-40°F)	1.068
Amount of anti-freeze to use for 50% concentration:	
Without rear passenger compartment heater	4.2 litres (6.7 pints) (4.0 US quarts)
With rear passenger compartment heater	5.6 litres (8.9 pints) (5.35 US quarts)



CAUTION: No other anti-freeze should be used with Havoline Extended Life Coolant.

Capacity

Item	Capacity
Without rear passenger compartment heater	8.4 litres (13.4 pints) (8.0 US quarts)
With rear passenger compartment heater	11.1 litres (17.8 pints) (10.7 US quarts)

General Specifications

Item	Specification
Cooling system type	Pressurised, thermostatically controlled with remote header tank
Radiator	Cross flow with integral transmission oil cooler
Expansion tank	Remote - fitted with a bleed screw and low coolant level sensor
Pressure cap rating	110 kPa (1.1 bar) (16 lbf/in ²)
Thermostat:	
Starts to open	88° C (190° F)
Fully open	95° C (203° F)
Cooling fan	Engine driven, viscous coupled with electronic control
Cooling fan diameter	470 mm (18.5 in)
Direction of rotation	Counter clockwise
Coolant pump	Centrifugal flow impellor, belt driven from crankshaft

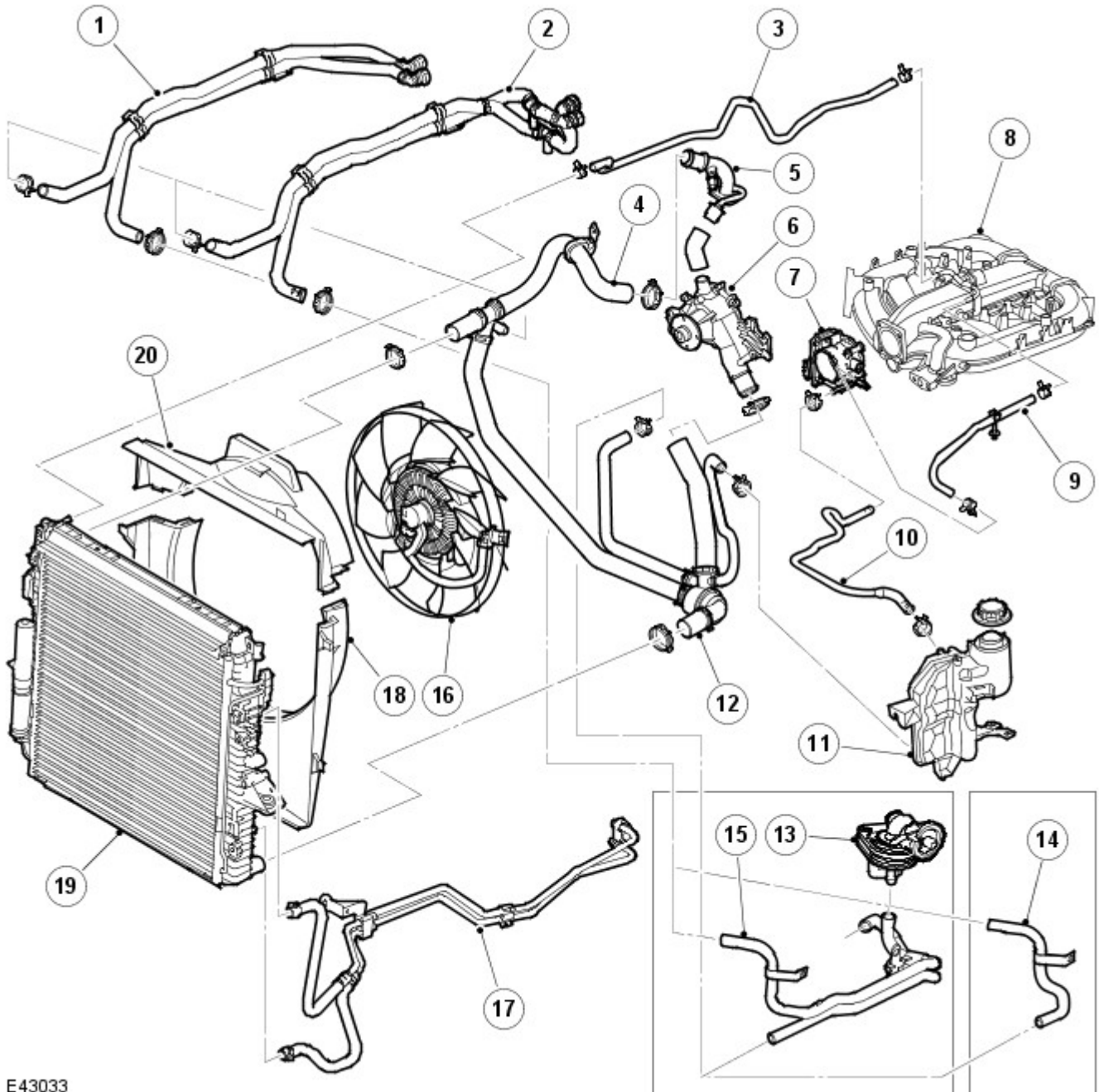
Torque Specifications

Description	Nm	lb-ft
Coolant pump bolts	10	7
Coolant pump pulley bolts	25	18
Power steering pipe clip bolt	10	7
Coolant expansion tank bolt	10	7
Vacuum pump bolts	10	7
Radiator bolts	25	18
Air Conditioning (A/C) condenser bolt	6	4
Radiator access panel bolts	10	7
Cooling fan viscous coupling bolts	10	7
Cooling fan assembly	65	48
Coolant bleed screw(s)	3	2

Engine Cooling - V6 4.0L Petrol - Engine Cooling

Description and Operation

Cooling System Component Layout



E43033

Item	Part Number	Description
1	-	Heater hose, inlet and outlet
2	-	Heater hose, inlet and outlet for vehicles with rear heater (optional)
3	-	Hose, radiator to intake manifold
4	-	Radiator top hose
5	-	Engine Coolant Temperature (ECT) sensor
6	-	Water pump
7	-	Throttle body
8	-	Inlet manifold
9	-	Throttle body coolant hose
10	-	Hose, engine to expansion tank
11	-	Expansion tank
12	-	Radiator bottom hose
13	-	Engine oil cooler (if fitted)
14	-	Hose (for vehicles without engine oil cooler)
15	-	Hose, inlet and outlet (for vehicles with engine oil cooler)
16	-	Cooling fan
17	-	Transmission oil cooler pipes

18	-	Radiator cowl, lower
19	-	Radiator
20	-	Radiator cowl, upper

GENERAL

The cooling system employed is of the pressure relief by-pass type, which allows coolant to circulate around the engine and the heater circuit while the thermostat main valve is closed. The primary function of the cooling system is to maintain the engine within an optimum temperature range under changing ambient and engine operating conditions. Secondary functions are to provide heating for the passenger compartment and cooling for the transmission fluid and engine oil.

The cooling system comprises:

- A radiator
- A passenger compartment heater matrix
- An Engine Oil Cooler (EOC)
- A coolant pump
- A Pressure Relief Thermostat (PRT)
- An expansion tank
- A viscous fan
- Connecting hoses and pipes.

ENGINE COOLING SYSTEM

The coolant is circulated by a centrifugal pump mounted on the front of the engine and driven by an ancillary drive 'polyvee' belt. The coolant pump circulates coolant through the cylinder block and cylinder heads via a chamber located in the 'vee' of the engine. Having passed through the engine the coolant returns to the thermostat housing via the bypass pipe. Coolant also circulates through the top hose to the heater matrix. The coolant returns via the EOC to the engine side of the PRT.

The PRT housing contains a normal thermostat, which is positioned such that the wax's temperature is controlled by both the coolant from the radiator and the bypass. This results in the thermostat being able to vary its opening temperature dependant on ambient conditions. The PRT also contains a sprung loaded valve, which limits the amount flow using the bypass. This means that the engine can run without coolant flowing through the bypass temporarily, to improve heater performance.

The radiator is a cross flow type with an aluminium matrix and has a drain tap on the lower right-hand rear face. The lower radiator mountings are located part way up the end tanks. The mountings are fitted with rubber bushes, which sit on the upper chassis rails. The radiator upper is mounted by pins, which are pushed through rubber bushes mounted in the Front End Carrier (FEC) above the radiator. The radiator also incorporates two connections for the transmission oil cooler pipes.

The radiator top hose is connected to the PRT by the bypass hose and the bottom hose is directly connected to the outlet side of the thermostat housing.

The expansion tank is fitted forward of the LH suspension turret in the engine compartment. The expansion tank allows for the expansion of the coolant as the engine gets hot and also supplies the engine with coolant as the coolant in the engine contracts. The tank also allows any air trapped in the coolant to be removed.

The liquid cooled transmission fluid cooler is mounted in the cold side radiator end tank. It is positioned in the middle of the LH end tank.

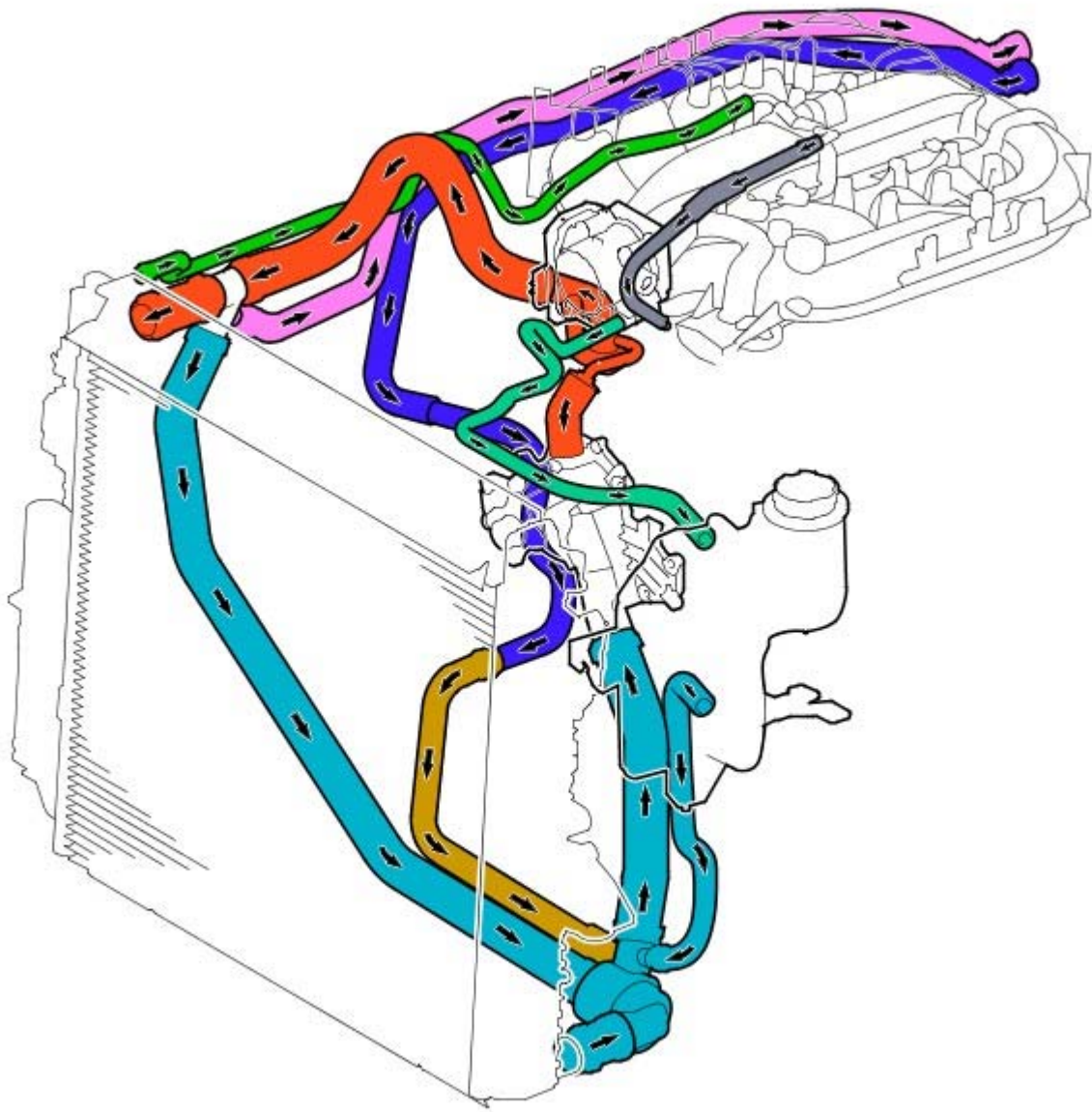
For additional airflow through the radiator matrix, particularly when the vehicle is stationary, there is an engine driven Viscous fan unit fitted to the rear of the radiator. The fan is used for engine cooling and for Air Conditioning (A/C) system cooling. The fan is mounted using a left hand thread.

The viscous fan unit is electronically controlled by the ECM to optimise fan speed for all operating conditions.

• **NOTE:** If the electrical connections to the viscous fan are disconnected the fan will 'idle' and overheating may result. The ECM stores the appropriate fault codes in this case.

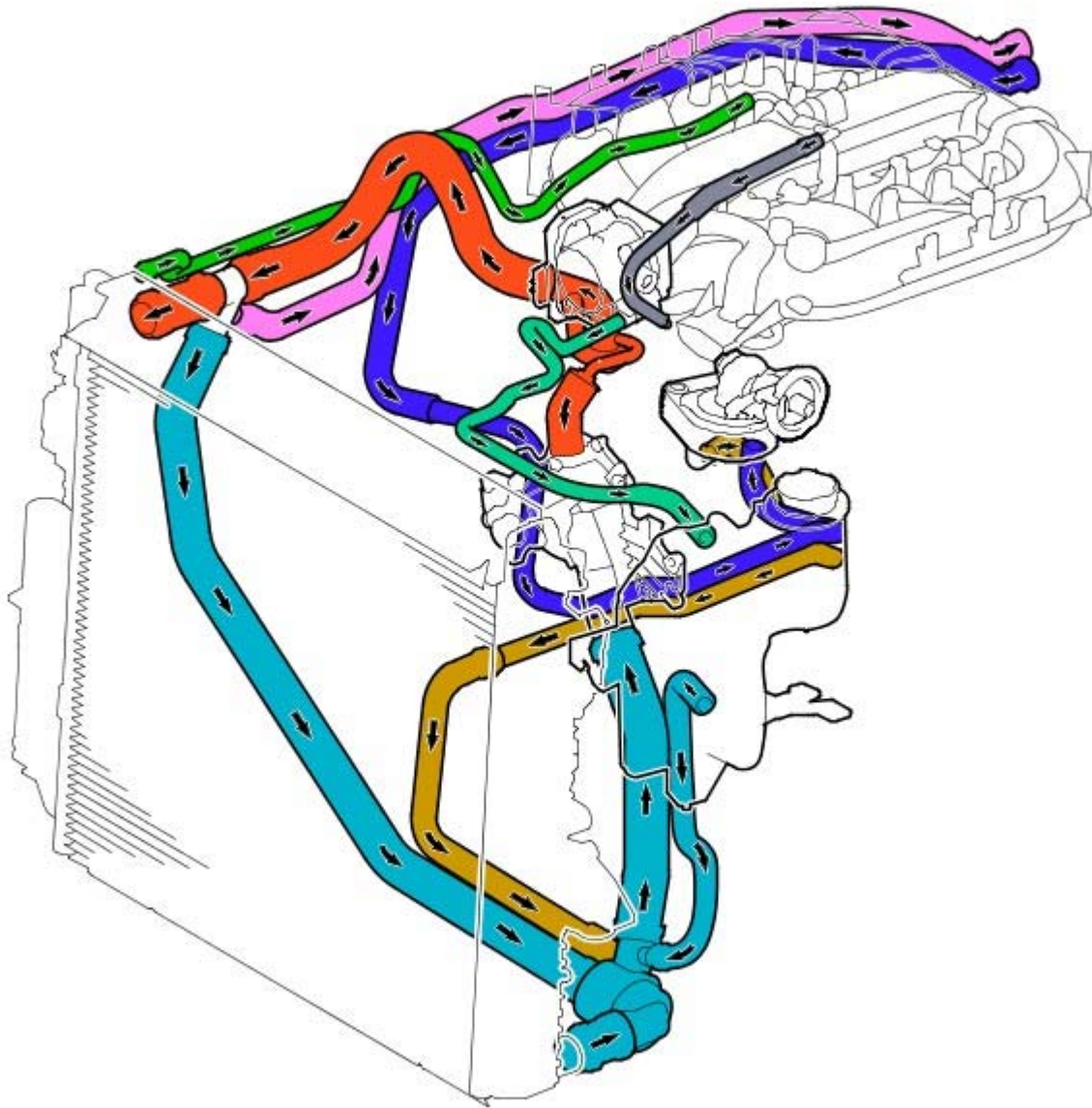
ENGINE COOLING SYSTEM OPERATION

Cooling System Coolant Flow, Without Engine Oil Cooler



E43034

Cooling System Coolant Flow, With Engine Oil Cooler



E43035

When the engine is running the coolant pump is driven by the ancillary drive belt. This forces coolant to circulate around the engine, heater and EOC, while the thermostat and bypass valve are shut. As the temperature and pressure increases the bypass valve is forced open allowing coolant to circulate through the bypass valve. When the temperature reaches 82°C (180°F) the main thermostat begins to open, allowing coolant to circulate through the main radiator. As the thermostat progressively opens (fully open at 95°C (203°F)), the bypass valve progressively closes forcing any coolant through the heater or radiator. Once coolant is allowed to circulate through the radiator, the transmission fluid cooler begins to receive coolant flow.

The increased coolant volume, created by heat expansion, is directed to the expansion tank through a bleed hose from the top of the radiator. The expansion tank has an outlet hose which is connected into the coolant circuit. This outlet hose returns the coolant to the system when the engine cools.

Coolant flows through the radiator from the top right hand tank to the bottom left hand tank and is cooled by air passing through the matrix. The temperature of the cooling system is monitored by the Engine Control Module (ECM) via the Engine Coolant temperature (ECT) sensor located in the cylinder head. The ECM uses signals from this sensor to adjust fuelling according to engine temperature.

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

To control the cooling fan, the ECM sends a Pulse Width Modulated (PWM) signal to the cooling fan module (integral to the ECM). The frequency of the PWM signal is used by the cooling fan module to determine the output voltage supplied to the fan motor.

The ECM varies the duty cycle of the PWM signal between 0 and 100% to vary the fan speed. If the PWM signal is outside the 0 to 100% range, the cooling fan module interprets the signal as an open or short circuit and runs the fans at maximum speed to ensure the engine and gearbox do not overheat.

The speed of the cooling fan is also influenced by vehicle road speed. The ECM adjusts the speed of the cooling fans, to compensate for the ram effect of vehicle speed, using the Controller Area Network (CAN) road speed signal received from

the Anti-lock Braking System (ABS) module.

Pressure Relief Thermostat (PRT)

The thermostat is exposed to 85% hot coolant from the engine on one side and 15% cold coolant returning from the radiator bottom hose on the other side. This allows the thermostat to react to the ambient conditions and provide coolant control for both winter and summer use. Hot coolant from the engine passes via holes in the by-pass flow valve into a tube which surrounds 85% of the thermostat sensitive area. Cold coolant from the radiator conducts through the remaining 15% of the sensitive area. In cold ambient conditions, the engine temperature is raised by approximately 10°C (50°F) to compensate for the heat loss of 15% exposure to the cold coolant returning from the bottom hose. This improves heater performance and engine warm-up.

The by-pass flow valve is held closed by a light spring and operates to further assist engine and heater warm-up. When the main valve is closed and the engine speed is at idle, the coolant pump does not produce sufficient flow and pressure to overcome the spring and open the valve. In this condition the valve prevents coolant circulating through the by-pass circuit and directs coolant through the heater matrix only. This provides a higher flow of coolant through the heater matrix improving passenger comfort in cold conditions.

When the engine speed increases above idle, the coolant pump produces a greater flow and pressure than the heater circuit can accommodate. The build up of pressure acts on the flow valve, overcoming the spring pressure, opening the valve and relieving the pressure in the heater circuit. The valve then modulates to provide maximum coolant flow through the heater matrix and allowing excess coolant to flow into the by-pass circuit to provide the engine's cooling requirements at higher engine speeds. The thermostat then regulates the flow through the radiator to maintain the engine at the optimum temperature. Maximum opening of the thermostat, and therefore maximum flow through the radiator, occurs if the coolant temperature reaches 95°C (203°F).

Engine Cooling - V6 4.0L Petrol - Engine Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the engine cooling system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Engine Cooling](#) (303-03C Engine Cooling - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Coolant leaks ● Coolant Hoses ● Coolant expansion tank ● Radiator ● Heater core ● Accessory drive belt ● Viscous fan 	<ul style="list-style-type: none"> ● Fuses ● Harnesses ● Loose or corroded connector(s) ● Engine Coolant Temperature (ECT) sensor

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Coolant loss	<ul style="list-style-type: none"> ● Hoses ● Hose connections ● Radiator ● Water pump ● Heater core ● Gaskets ● Engine casting cracks ● Engine block core plugs 	Carry out a visual inspection. If there are no obvious leaks, carry out a cooling system pressure test. Rectify any leaks as necessary.
Overheating	<ul style="list-style-type: none"> ● Low/Contaminated coolant ● Thermostat ● Viscous fan ● ECT sensor ● Restricted air flow over the radiator 	Check the coolant level and condition. Carry out a cooling system pressure test. Rectify any leaks as necessary. Check the thermostat and rectify as necessary. Check the viscous fan operation, make sure the viscous fan rotates freely. Check for obstructions to the air flow over the radiator. Rectify as necessary.
Engine not reaching normal temperature	<ul style="list-style-type: none"> ● Thermostat ● Viscous fan ● Thermostat ● Electric fan ● Fan speed module 	Check the thermostat operation. Check the viscous fan operation, make sure the viscous fan is not seized. Rectify as necessary.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Engine Control Module \(PCM\) 4.0L V6](#) (100-00 General Information, Description and Operation).

Engine Cooling - V6 4.0L Petrol - Cooling System Draining, Filling and Bleeding

General Procedures

⚠ WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

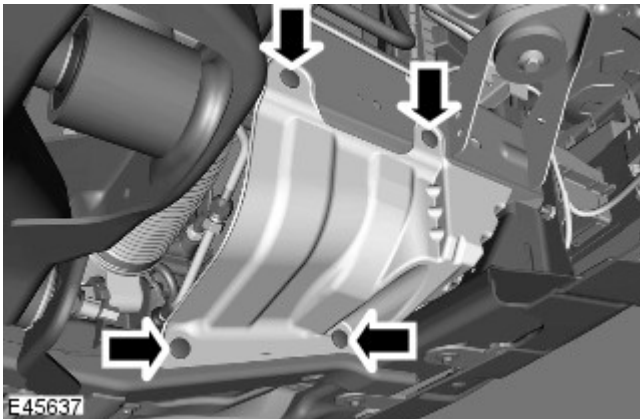
All vehicles

1. Position the vehicle on a lift.
2. Set the heater controls to maximum.
3. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

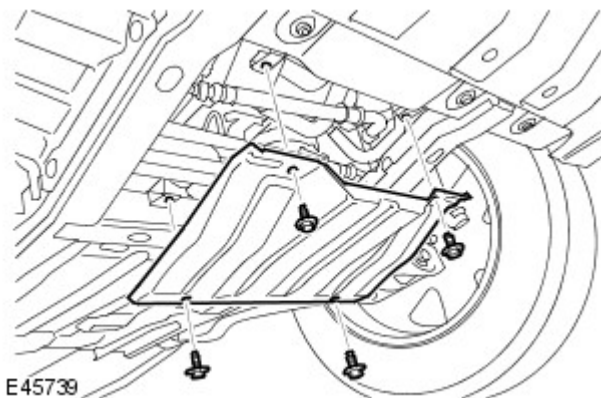
⚠ WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Remove the coolant expansion tank cap.

6. Remove the front LH splash shield.
 - Remove the 4 clips.



7. Remove the radiator access panel.
 - Remove the 4 bolts.



8. Position a container to collect the fluid.



9.  **CAUTION:** Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

Release the clip and disconnect the radiator lower hose, allow the coolant to drain.

Vehicles with auxiliary climate control

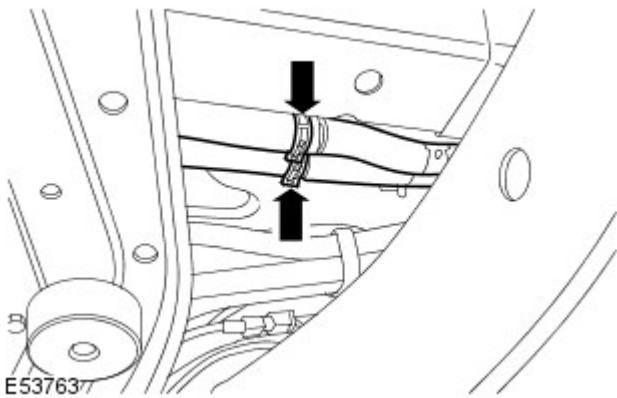
10. Remove the spare wheel and tire.

- Remove the tool kit.
- Access the winch.

11. Position a container to collect the fluid.

12. Disconnect the rear heater coolant hoses.

- Release the 2 clips.
- Allow the coolant to drain.



Vehicles with auxiliary climate control

13. Connect the rear heater coolant hoses.

- Secure the clips.

14. Install the spare wheel and tire.

- Stow the tool kit.

15. Connect and secure the radiator lower hose.

- Secure with the clip.

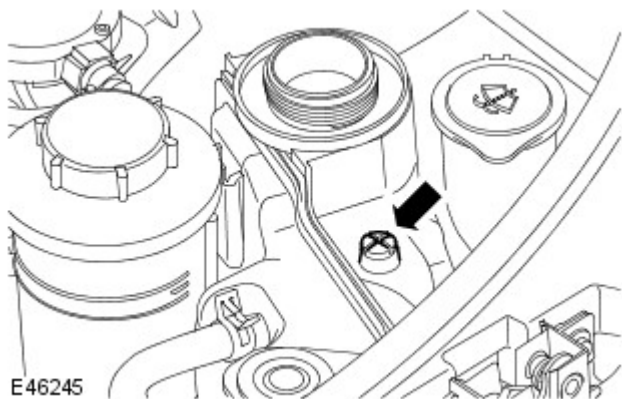
All vehicles

16. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

17. Connect exhaust extraction hoses to the tail pipes.

18. Loosen the coolant expansion tank bleed screw.



19. Refill the cooling system.

20. Start and run the engine.

- Hold the engine speed at 2,500 RPM for 30 seconds.
- Return the engine to idle for 30 seconds.
- Repeat the above procedure a further four times.

21. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank until a steady stream of coolant is seen returning to the expansion tank. Tighten the expansion tank bleed screw.

- Hold the engine speed at 3,000 RPM for one minute.

22. NOTE: When the coolant bleed is complete and prior to installing the expansion tank cap, top-up the expansion tank to 30mm above the maximum level.

Install the coolant expansion tank cap.

23. Run the engine until the thermostat opens.

24. Switch the engine off and allow to cool.

25. Install the engine cover.

For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

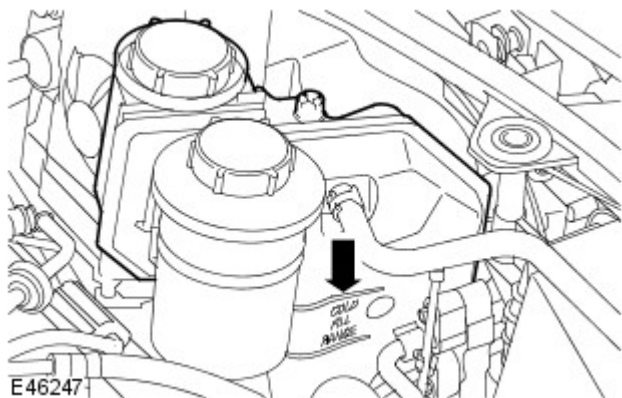
26. Clean any remaining coolant from the chassis and surrounding area.

27. Install the radiator access panel.

- Tighten the 4 bolts to 10 Nm (7 lb.ft).

28. Install the front LH splash shield.

29. Check and top-up the coolant if required.



Engine Cooling - V6 4.0L Petrol - Cooling System Draining and Vacuum Filling

General Procedures

⚠ WARNING: To avoid having scalding hot coolant or steam blowing out of the cooling system, use extreme care when removing the coolant pressure cap from a hot cooling system. Wait until the engine has cooled, then wrap a thick cloth around the coolant pressure cap and turn it slowly until the pressure begins to release. Step back while the pressure is released from the system. When certain all the pressure has been released (still with a cloth) turn and remove the coolant pressure cap from the coolant expansion tank. Failure to follow these instructions may result in personal injury.

• CAUTIONS:

⚠ The engine cooling system must be maintained with the correct concentration and type of anti-freeze solution to prevent corrosion and frost damage. Failure to follow this instruction may result in damage to the vehicle.

⚠ Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

1. Set the heater controls to maximum HOT.

2. **⚠ WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

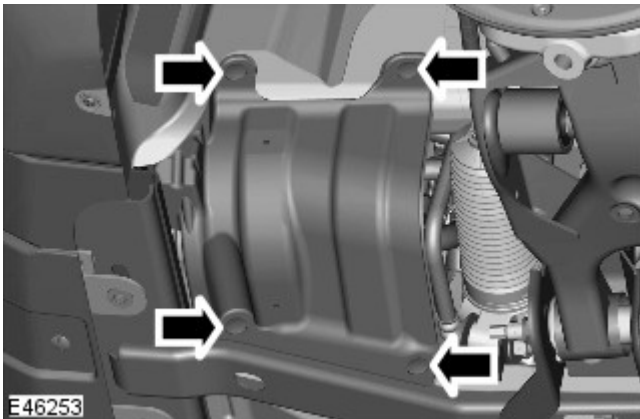
Remove the coolant expansion tank cap.

3. **⚠ WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

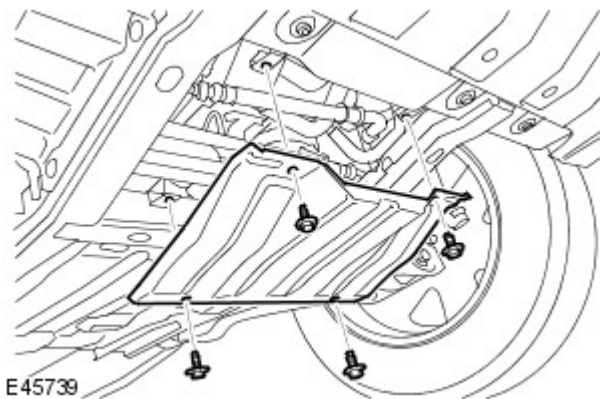
4. Remove the front LH splash shield.

- Remove the 4 clips.

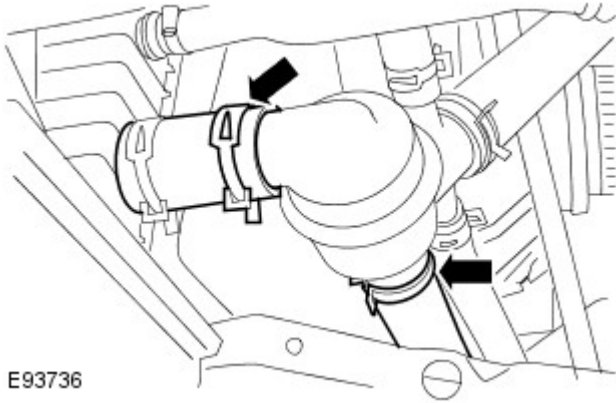


5. Remove the radiator access panel.

- Remove the 4 bolts.



6. Position a container to collect the fluid.



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7. Disconnect the coolant hoses from the thermostat housing.

- Release the 2 clips.
- Allow the coolant to drain.

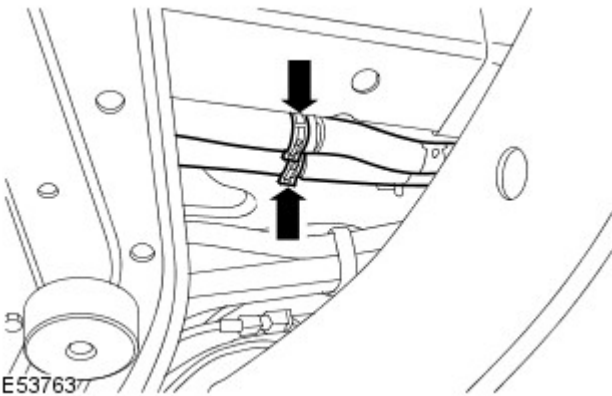
8. Remove the spare wheel and tire.

- Remove the tool kit.
- Access the winch.

9. Position a container to collect the fluid.

10. Disconnect the rear heater coolant hoses.

- Release the 2 clips.
- Allow the coolant to drain.



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11. Connect the rear heater coolant hoses.

- Secure the clips.

12. Install the spare wheel and tire.

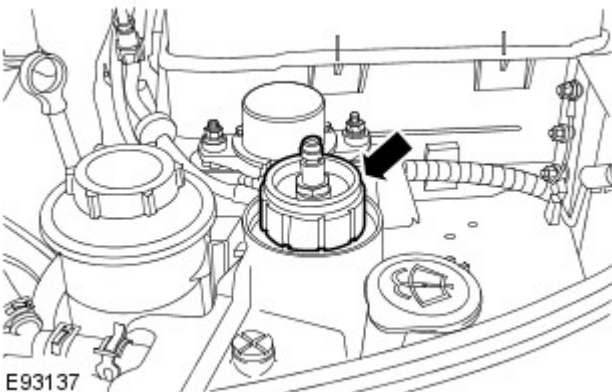
- Install the tool kit.

13. Connect the coolant hoses to the thermostat housing.

- Secure with the clips.

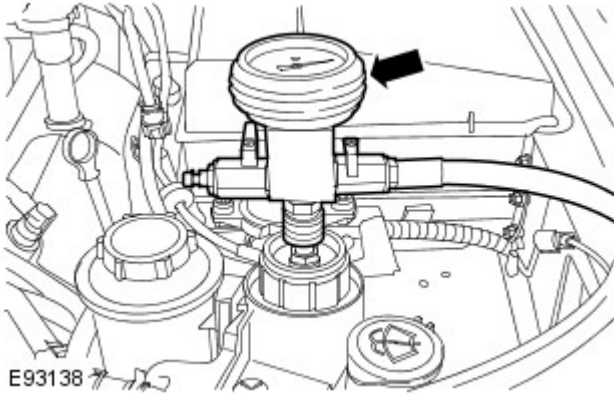
14. Prepare a sufficient amount of coolant to the specified concentration.

15. Install the cooling system vacuum refill adaptor to the expansion tank.

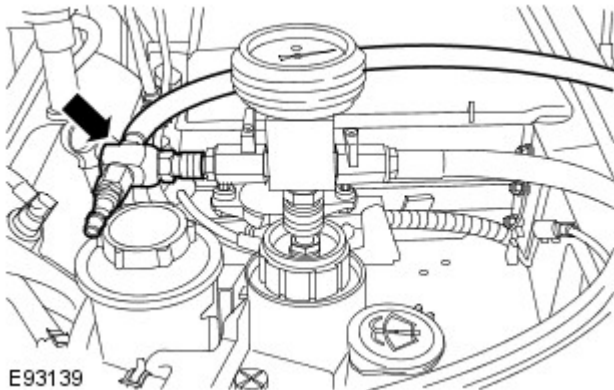


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16. Install the vacuum filler gauge to the cooling system vacuum refill adaptor.



17. Install the venturi tube assembly to the vacuum filler gauge.

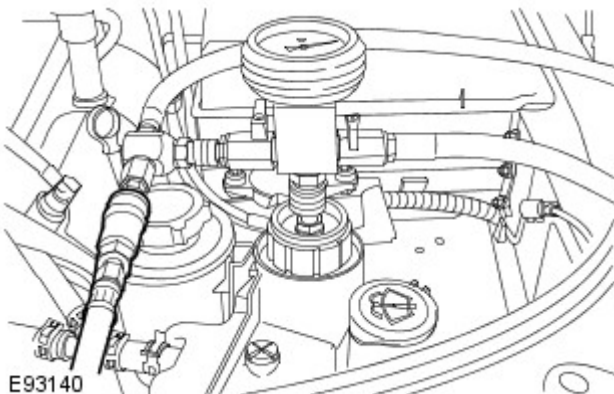


18. NOTE: Make sure both valves on gauge assembly are in the closed position.

- NOTE: Small diameter or long airlines may restrict airflow to the coolant vacuum fill tool.

- NOTE: The coolant vacuum fill tool needs an air pressure of 6 to 8 bar (87 to 116 psi) to operate correctly.

Connect a regulated compressed air supply to the venturi tube assembly.

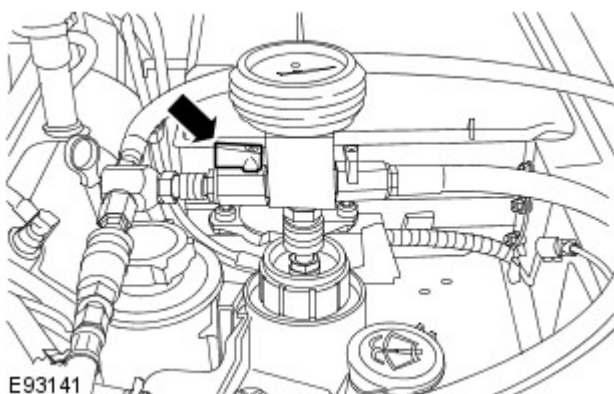


19. NOTE: Make sure air cannot enter the hose.

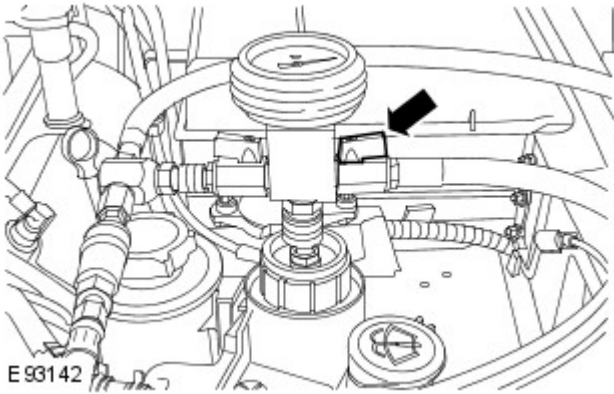
Position the coolant pick-up pipe into a container of clean coolant.

20. Position the evacuated air hose into a container.

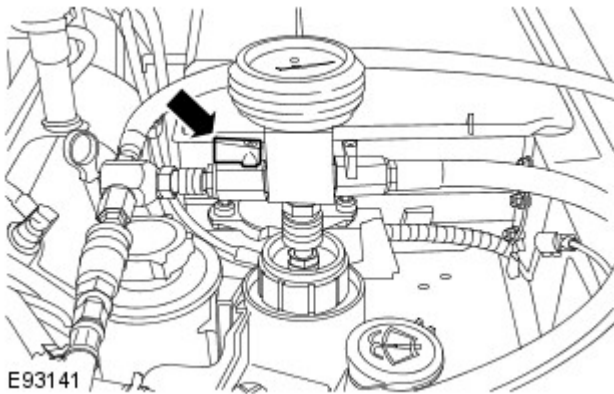
21. Open the air supply valve.



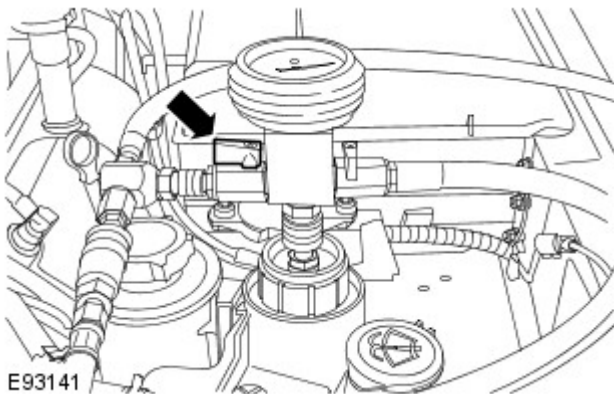
22. Open the coolant supply valve for 2 seconds to prime the coolant supply hose.



23. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.

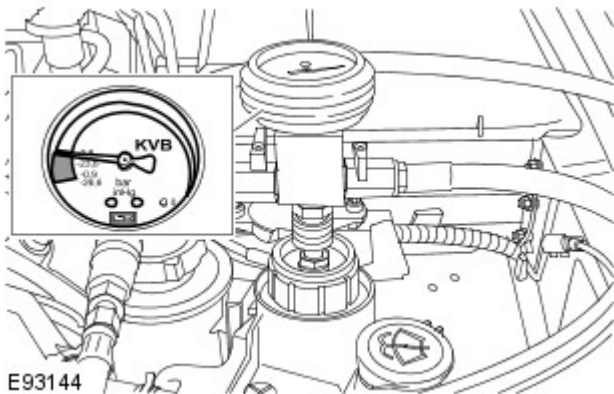


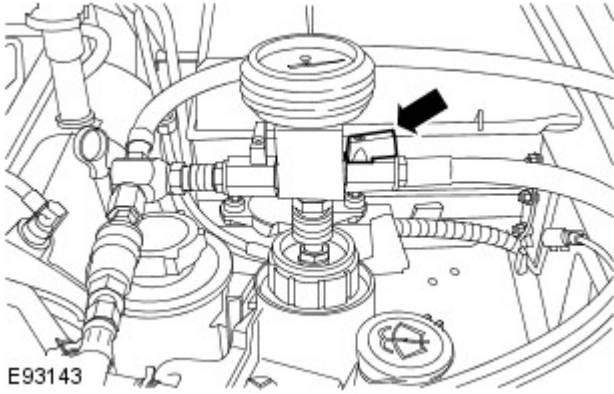
24. Close the air supply valve.



25. Allow one minute to check the vacuum is held.

- Disconnect the compressed air supply.





26. NOTE: Close the coolant supply valve when the coolant expansion tank MAX mark is reached or coolant movement has ceased.

Open the coolant supply valve and allow the coolant to be drawn into the system.

27. Remove the vacuum filler gauge and cooling system vacuum refill adaptor assembly.

28. Connect exhaust extraction hoses to the tail pipes.

29. Start and run the engine.

- Hold the engine speed at 2,500 RPM for 30 seconds.
- Return the engine to idle for 30 seconds.
- Repeat the above procedure a further 4 times.

30. Keep the coolant level in the expansion tank at the maximum level mark until a steady stream of coolant can be seen returning.

31. NOTE: When the coolant bleed is complete and prior to installing the expansion tank cap, top-up the expansion tank to 30mm above the maximum level.

Install the coolant expansion tank cap.

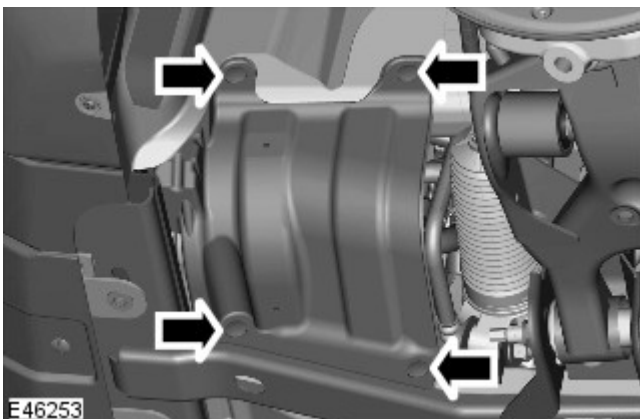
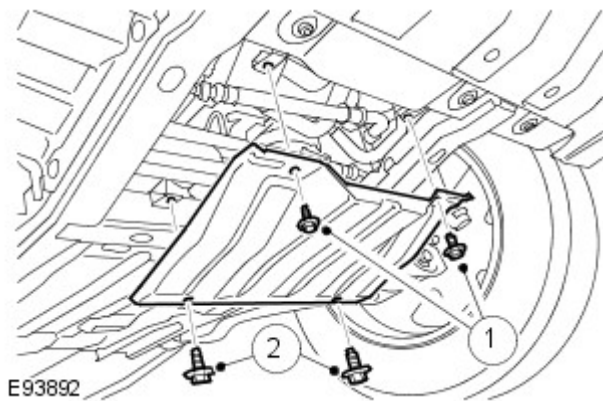
32. Run the engine until the thermostat opens.

33. Switch the engine off and allow to cool.

34. Clean any spilt coolant from the vehicle.

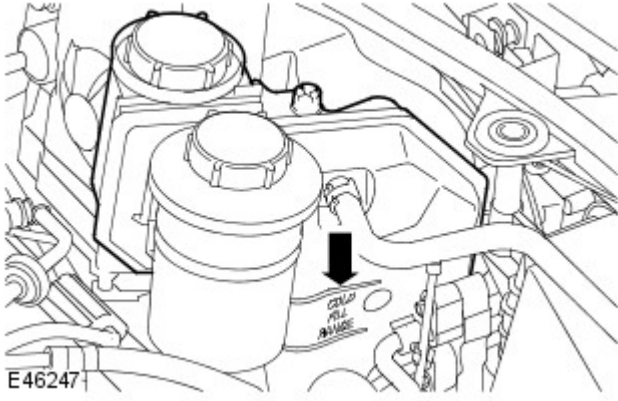
35. Install the radiator access panel.


1. Tighten the 2 bolts to 10 Nm (7 lb.ft).
2. Tighten the 2 bolts to 62 Nm (46 lb.ft).



36. Install the front LH splash shield.

- Install the 4 clips.



37.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Check and top-up the coolant if required.


Engine Cooling - V6 4.0L Petrol - Cooling System Pressure Test

General Procedures

• NOTE: The following procedure will enable the cooling system to be pressure tested for condition and leaks. Stage 1 will check the expansion tank cap register seal and the cap for leaks. Stage 2 will check the entire cooling system.

• NOTE: It will be necessary to use the cooling system test kit, Part Number LR-218, which is available under the equipment programme.

1. Examine the coolant hoses for signs of cracking, distortion and security of the hose connections.

2.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

Disconnect the coolant expansion tank bleed hose.

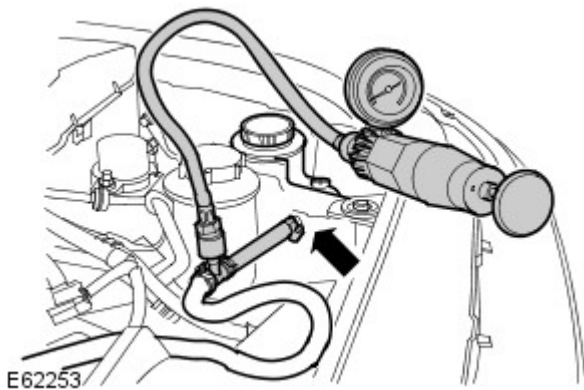
- Release the clip.

3. Install the 'T' piece adaptor (part of the cooling system test kit) between the coolant expansion tank and the coolant bleed hose.

- Secure with the 2 clips.

4. Install the coolant pressure pump assembly.

- Connect to the 'T' piece.




5. Pressurize the cooling system.

- Slowly pressurize the cooling system to 1.0 bar (100 kPa) (14.5 psi).
- Check the pressure remains above 0.9 bar (90 kPa) (13 psi) after waiting for 30 seconds.
- During the pressure drop check, listen for a hissing noise from the expansion tank cap.

6. NOTE: If the coolant expansion tank cap is found to be leaking, replace the cap.

Depressurize the cooling system.

- Disconnect the 'T' piece.
- Connect the coolant expansion tank bleed hose.
- Secure the clip.

7.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

Remove the coolant expansion tank cap.

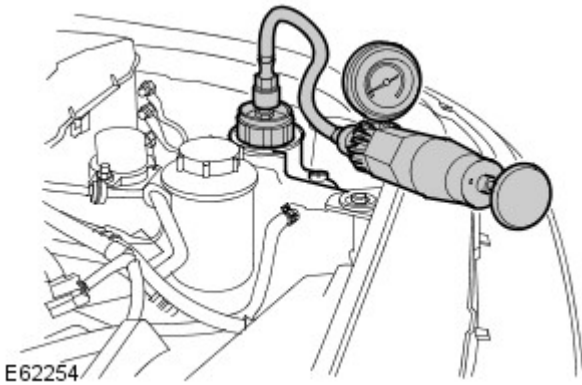
8. NOTE: This adaptor is part of the cooling system test kit.

Install adaptor K83 to the coolant expansion tank.

- Clean the component mating faces.
- Lubricate the seal.

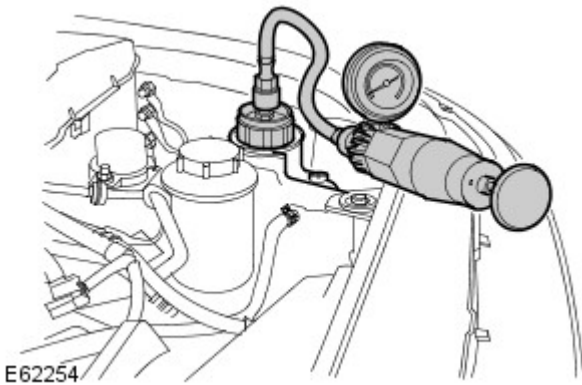
9. Install the coolant pressure pump assembly.

- Slowly pressurize the cooling system to 1.5 bar (150kPa) (22 psi), check the pressure over a 5 minute period. A small pressure decay of approximately 0.15 bar (15 »kPa) (1 psi) over the first minute is normal, as the air in the expansion tank cools.
- If the pressure continues to drop after the initial tolerance, there is a coolant leak.



10. Depressurize and remove the pressure pump and gauge.

- Install the coolant expansion tank cap.

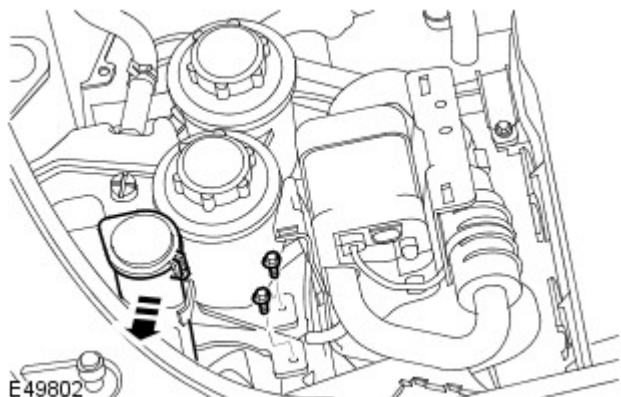


Engine Cooling - V6 4.0L Petrol - Coolant Expansion Tank


Removal and Installation


Removal

1. Remove the LH headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
2. Release the windshield washer reservoir filler neck.
3. Release the coolant expansion tank.
 - Remove the 2 bolts.



4. Release the power steering fluid reservoir.

5.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

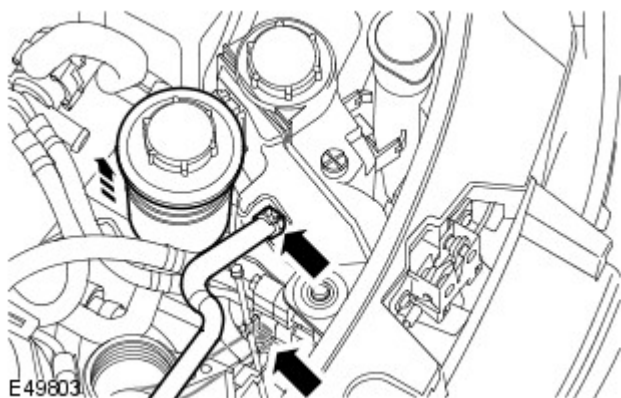
 **CAUTION:** Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

Disconnect the 2 hoses from the coolant expansion tank.

- Position an absorbent cloth to collect fluid spillage.
- Position a container to collect the fluid.
- Clamp the hoses
- Release the 2 clips.

6. Remove the coolant expansion tank.

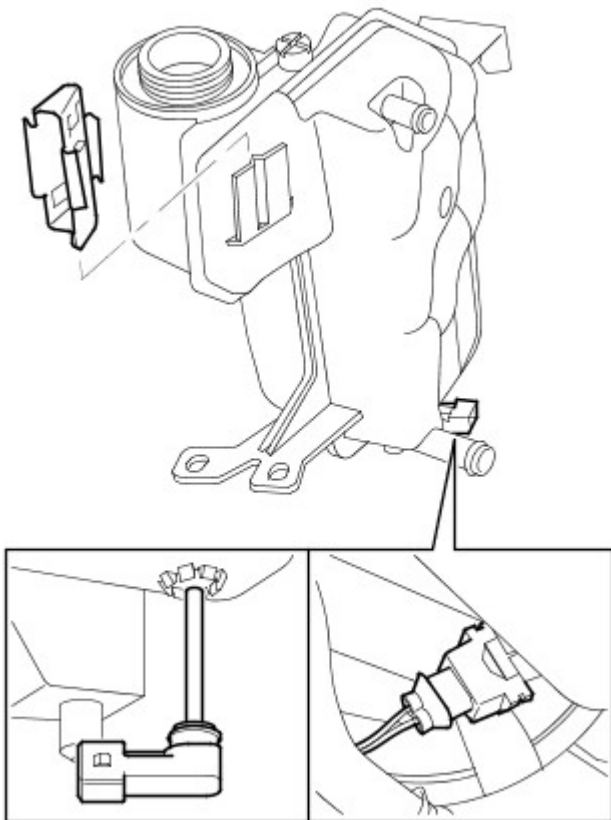
- Disconnect the coolant low level sensor electrical connector.



7. NOTE: Do not disassemble further if the component is removed for access only.

Remove the coolant low level sensor.

- Remove the coolant expansion tank support bracket.



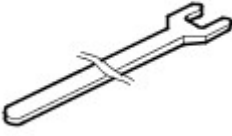
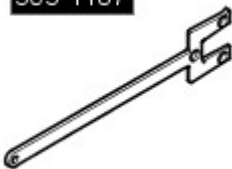
E47510

Installation

1. Install the bracket.
2. Install the coolant low level sensor.
3. Install the coolant expansion tank.
 - Connect the coolant low level sensor electrical connector.
4. Connect the coolant hoses to the expansion tank.
 - Secure with the clips.
5. Top-up the coolant.
 - Loosen the coolant expansion tank bleed screw.
 - Fill the coolant expansion tank until coolant emerges from the cooling system air bleed screw.
 - Remove the hose clamps.
 - Tighten the bleed screw to 8 Nm (6 lb.ft).
6. Secure the coolant expansion tank.
 - Tighten the bolts to 10 Nm (7 lb.ft).
7. Check and top-up the coolant.
 - Install the coolant expansion tank pressure cap.
8. Secure the power steering fluid reservoir.
 - Attach to the mounting bracket.
9. Secure the windshield washer reservoir filler neck.
 - Locate in clip.
10. Install the LH headlamp assembly.
For additional information, refer to: [Headlamp Assembly \(417-01 Exterior Lighting, Removal and Installation\)](#).

Engine Cooling - V6 4.0L Petrol - Cooling Fan

Removal and Installation

Special Tool(s)	
 <p>303-1142</p> <p>E46076</p>	<p>Viscous coupling spanner</p> <p>303-1142</p>
 <p>303-1167</p> <p>E46075</p>	<p>Viscous coupling pulley retaining tool</p> <p>303-1167</p>

Removal

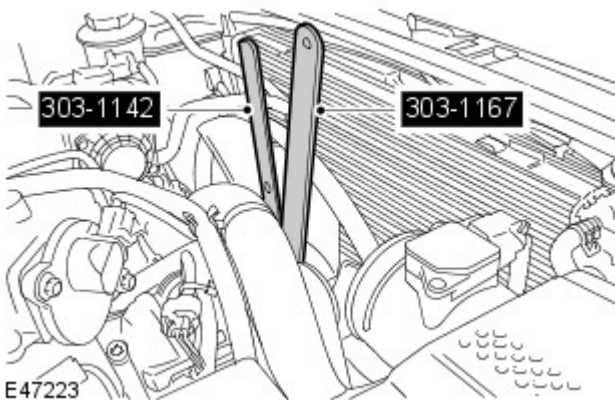
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the cooling fan shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
3. Disconnect the cooling fan control electrical connector.

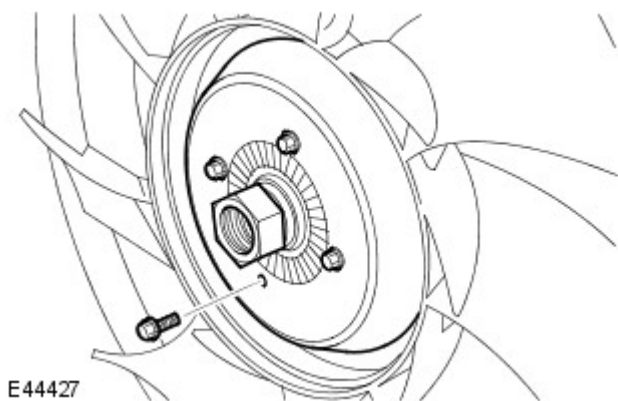


4. **NOTE:** The thread is right handed.

Using the special tools, remove the cooling fan.

- Remove the cooling fan assembly.





5. NOTE: Do not disassemble further if the component is removed for access only.

Remove the viscous coupling from the cooling fan.

- Remove the 4 bolts.

Installation

1. To install, reverse the removal procedure.

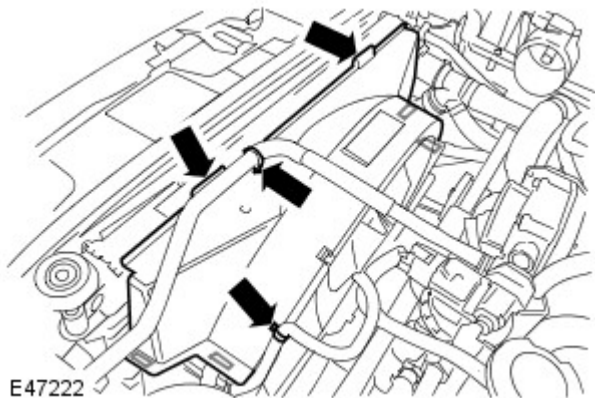
- Install the cooling fan to the viscous coupling, tighten the bolts to 10 Nm (7 lb.ft).
- Tighten the cooling fan assembly to 65 Nm (48 lb.ft).

Engine Cooling - V6 4.0L Petrol - Cooling Fan Shroud

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the air intake resonator.
For additional information, refer to: [Intake Air Resonator](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
3. Remove the upper fan shroud.
 - Release the coolant expansion hose.
 - Release the fan wiring harness clip.
 - Release the 4 fan shroud clips.



Installation

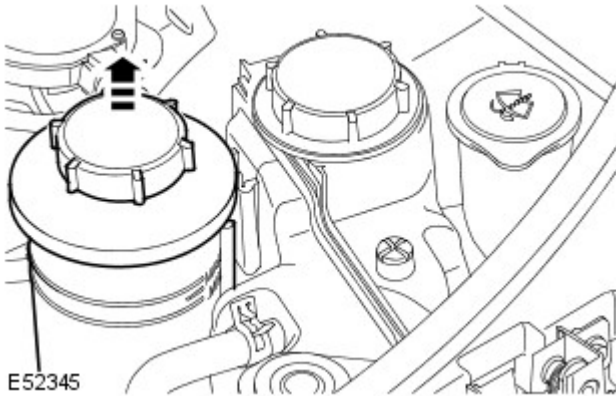
1. To install, reverse the removal procedure.

Engine Cooling - V6 4.0L Petrol - Engine Coolant Level Switch

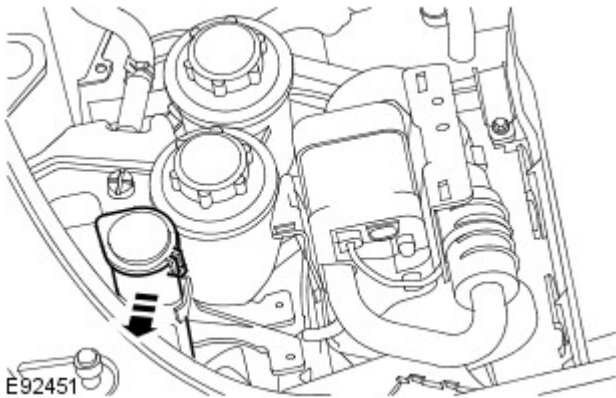
Removal and Installation

Removal

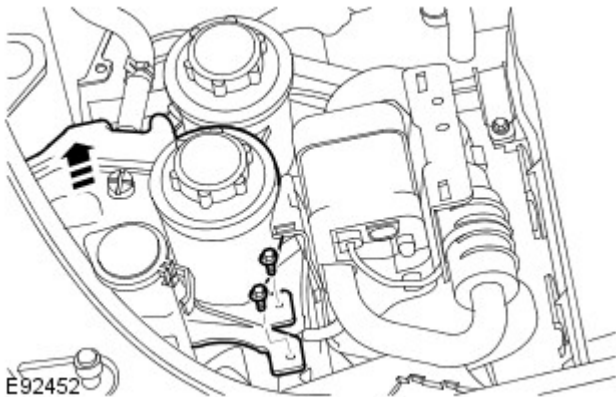
1. Release the power steering fluid reservoir from the bracket.



2. Release the windshield washer reservoir filler neck.



3. Reposition the coolant expansion tank.
 - Remove the 2 bolts.



4. Remove the engine coolant level switch.

Installation

1. NOTE: Disconnect the engine coolant level switch electrical connector. **CAUTION: Make sure the click can be heard when the engine coolant level switch is correctly installed.**

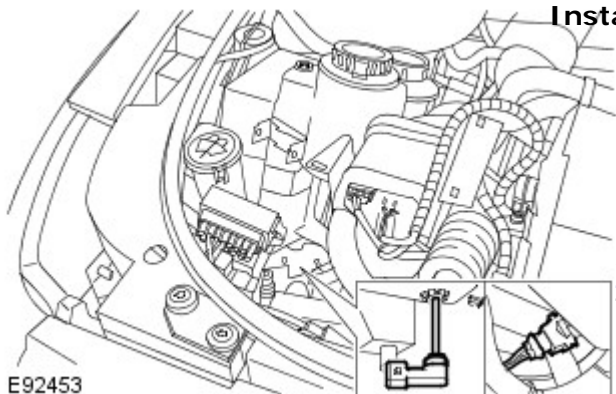
Install the engine coolant level switch.

- Connect the engine coolant level switch electrical connector.

3. Secure the windshield washer reservoir filler neck.
2. **CAUTION: Make sure that the component is correctly located on the locating peg.** Secure the power steering fluid reservoir to the bracket.

Secure the coolant expansion tank.

- Tighten the bolts to 10 Nm (7 lb.ft).



Engine Cooling - V6 4.0L Petrol - Radiator

Removal and Installation

Removal



WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.



CAUTION: Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

• **NOTE:** Always protect the cooling pack elements to prevent accidental damage.



1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Disconnect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

3. Drain the cooling system.

For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).

4. Remove the viscous fan assembly.

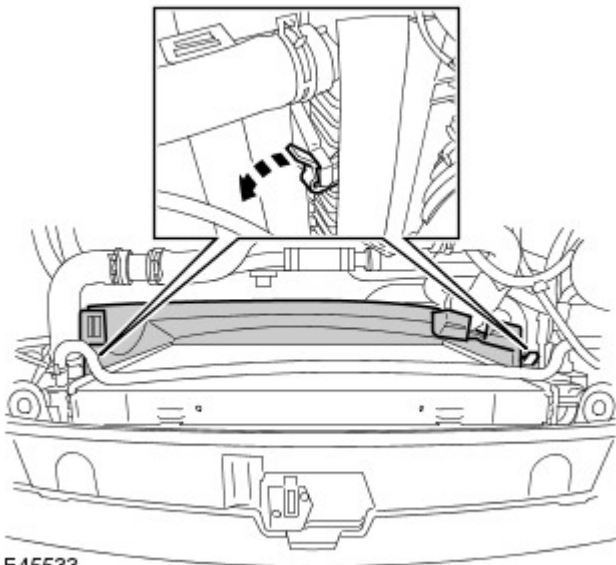
For additional information, refer to: [Cooling Fan](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).

5. Remove the radiator grille.

For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

6. Remove the lower fan shroud.

- Release the 4 clips.
- Release the coolant hose.



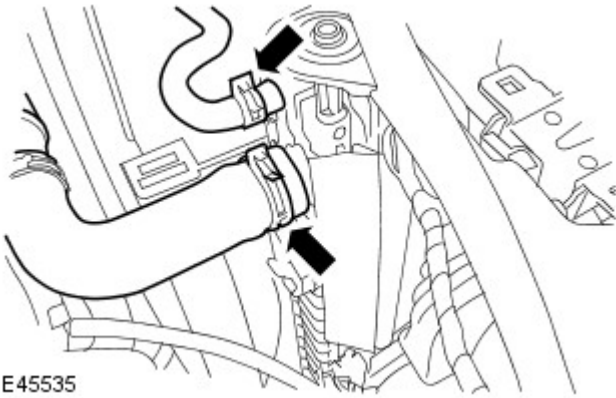
E45533

7. Disconnect the coolant expansion tank hose.

- Release the clip.

8. Disconnect the radiator upper hose.

- Release the clip.



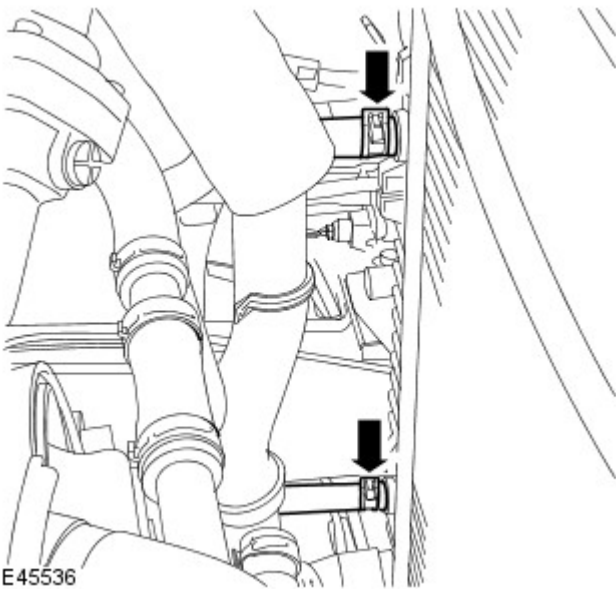
E45535

9.  CAUTION: Always plug any open connections to prevent contamination.

- NOTE: Some fluid spillage is inevitable during this operation.

Disconnect the transmission cooler hoses.

- Release the 2 clips.
- Position a container to collect the fluid.

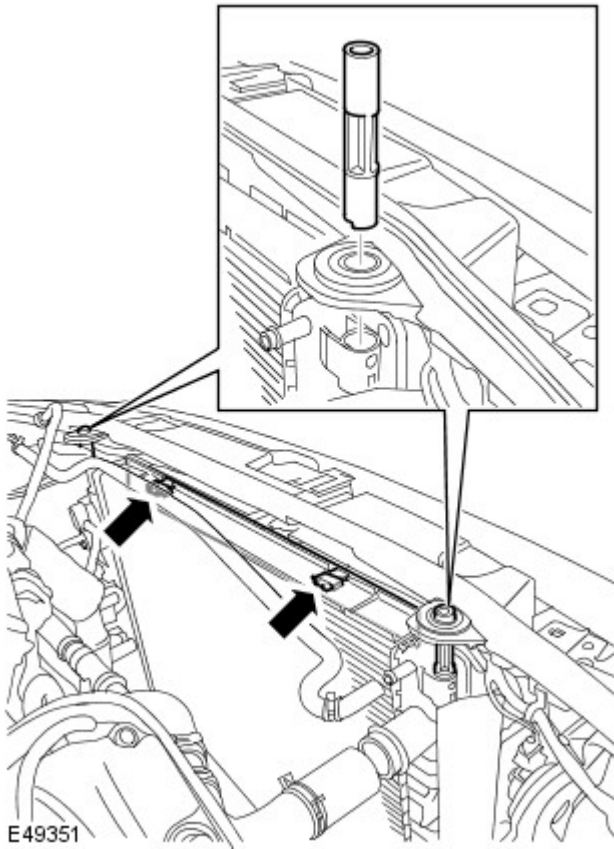


E45536

10. Remove the radiator securing pegs.

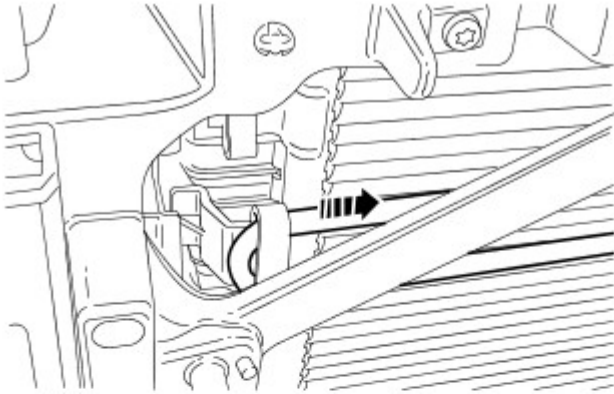
11. Remove the radiator upper deflector.

- Release the 2 clips.

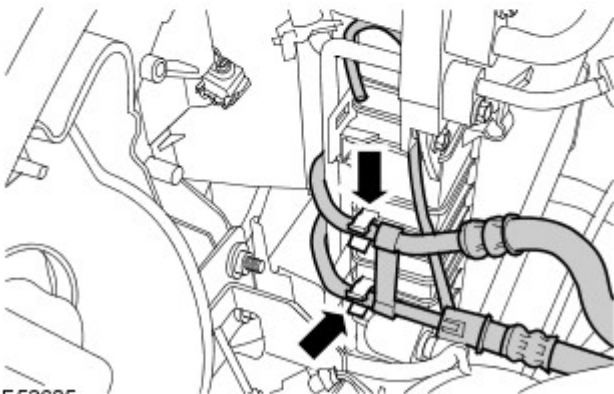


12. Release the power steering fluid cooler.

- Release the clips.
- Tie the line aside.

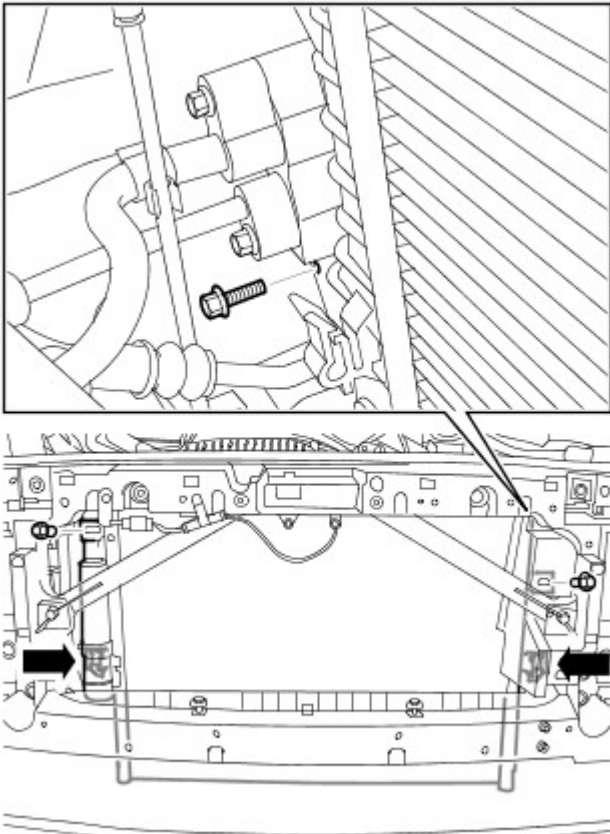


13. Release the front differential breather line.



14. Release the A/C condenser.

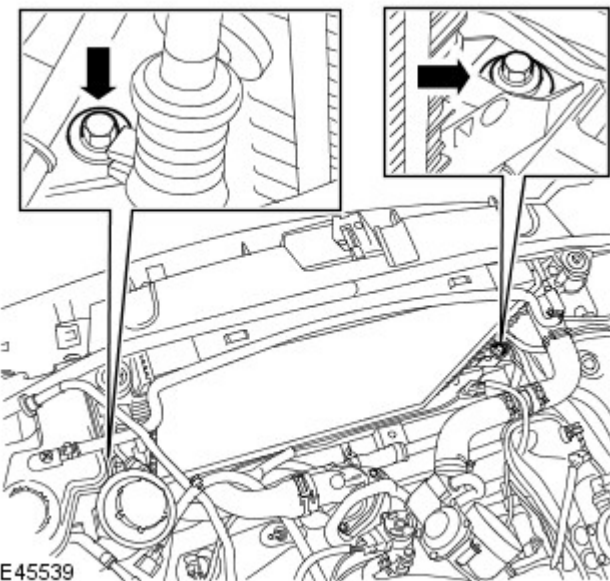
- Remove the 2 screws.
- Remove the bolt.
- Release from the 2 clips.



E49353

15. Remove the radiator.

- Protect the elements from damage.
- Remove the 2 radiator retaining bolts.



E45539

16. NOTE: Do not disassemble further if the component is removed for access only.

Remove the power steering fluid cooler line clip.

Installation

1. Install the power steering fluid cooler line clip.
2. Install the radiator.
 - Remove the element protection.
 - Tighten the bolts to 25 Nm (18 lb.ft).
3. Install the radiator upper deflector.
4. Install the A/C condenser.

- Secure in the clips.
 - Tighten the screws.
 - Tighten the bolt to 6 Nm (4 lb.ft).
5. Install the power steering fluid cooler.
- Secure in the 3 clips.
6. Install the radiator securing pegs.
7. Install the transmission cooler hoses.
- Install the clips.
8. Connect the radiator upper hose.
- Secure with the clip.
9. Connect the expansion tank hose.
- Secure with the clip.
10. Install the lower fan shroud.
- Secure in the clips.
 - Secure the coolant hose.
11. Install the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
12. Install the viscous fan assembly.
For additional information, refer to: [Cooling Fan](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
13. Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
14. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
15. Check automatic transmission fluid level.
For additional information, refer to: [Transmission Fluid Level Check](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

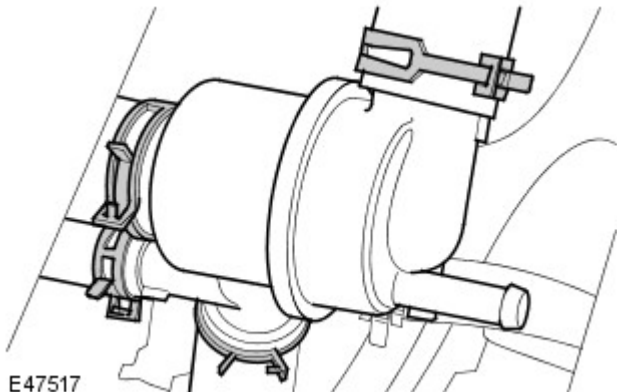
Engine Cooling - V6 4.0L Petrol - Thermostat

Removal and Installation

Removal

1. Drain the cooling system.
For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03 Engine Cooling - 4.4L, General Procedures).
2. Remove the thermostat.

- Release the clips and disconnect the 4 remaining coolant hoses.



Installation


1. To install, reverse the removal procedure.
2. Refill the cooling system.
For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03 Engine Cooling - 4.4L, General Procedures).
3. **NOTE:** For NAS vehicles only.


If required, carry out a long drive cycle.
For additional information, refer to: Powertrain Control Module (PCM) Long Drive Cycle Self-Test (303-14A, General Procedures).

Engine Cooling - V6 4.0L Petrol - Coolant Pump

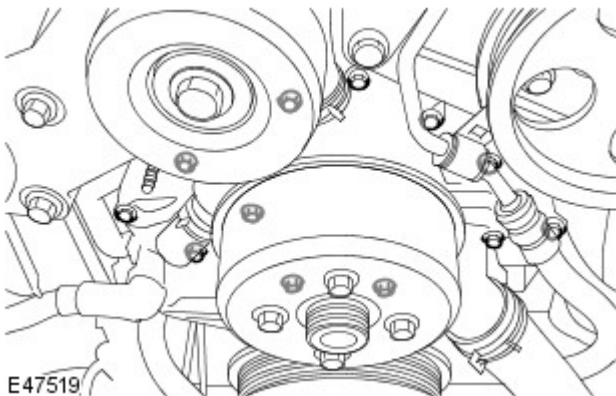
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
4. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
5. Remove the bolt from the power steering pipe clip.
 - Position the pipe aside when removing the coolant pump.
6. Remove the coolant pump.
 - Disconnect the coolant rail hose from the coolant pump.
 - Remove the 12 bolts.
 - Discard the gasket.

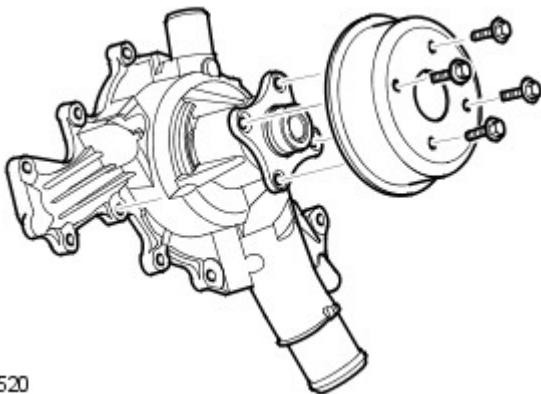


E47519

7. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the coolant pump drive pulley.

- Remove and discard the 4 bolts.
- Remove the coolant pump capping hose.



E47520

Installation

1. To install, reverse the removal procedure.
 - Tighten the coolant pump retaining bolts.
 - Install the coolant pump pulley.
 - Tighten to 10 Nm (7.18 ft.lb).
 - Clean the component mating faces.
3. Tighten the coolant pump pulley retaining bolts.
 - Install a new gasket.

- Tighten to 25 Nm (18 lb.ft).

4. Install the power steering pipe.

- Tighten the bolt to 10 Nm (7 lb.ft).

5. Install the accessory drive belt.

For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).

6. Refill the cooling system.

For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).


7. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine Cooling - V6 4.0L Petrol - Water Pump

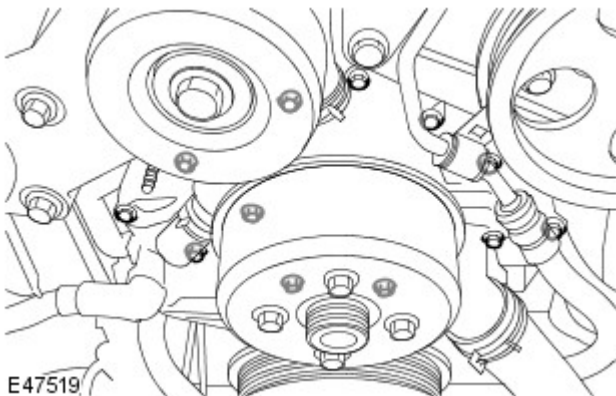
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

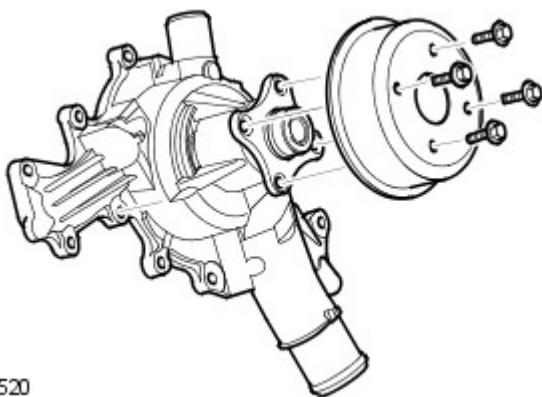
Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
4. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
5. Remove the bolt from the power steering pipe clip.
 - Position the pipe aside when removing the coolant pump.
6. Remove the coolant pump.
 - Disconnect the coolant rail hose from the coolant pump.
 - Remove the 12 bolts.
 - Discard the gasket.



7. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the coolant pump drive pulley.

- Remove the 4 bolts.
- Remove the coolant pump capping hose.



Installation

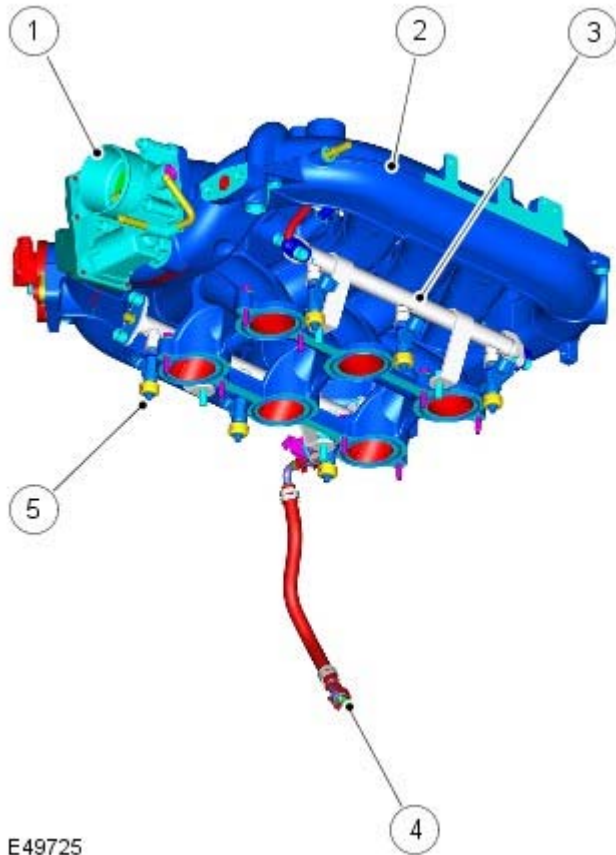
1. To install, reverse the removal procedure.
 - Tighten the coolant pump retaining bolts.
 - Install the coolant pump pulley.
 - Tighten the bolts to 10 Nm (7 lb.ft).
 - Clean the component mating faces.
3. Tighten the coolant pump pulley retaining bolts.
 - Install a new gasket.

- Tighten the bolts to 25 Nm (18 lb.ft).
4. Install the power steering pipe.
 - Tighten the bolt to 10 Nm (7 lb.ft).
 5. Install the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
 6. Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
 7. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Fuel Charging and Controls - V6 4.0L Petrol - Fuel Charging and Controls

Description and Operation

Component Locations



E49725

Item	Part Number	Description
1	-	Throttle body
2	-	Intake manifold
3	-	Fuel rail
4	-	Fuel jump hose
5	-	Fuel injectors (6 of)

GENERAL

The major components of the fuel charging and control system comprise an intake manifold, a fuel pump, a fuel rail and six injectors. The fuel pump supplies fuel from the tank at a constant pressure, via a pipe routed along the underside of the vehicle, to the fuel rail. The fuel rail distributes the fuel equally to each of the six injectors.

INTAKE MANIFOLD

The intake manifold is located on top of the engine. The manifold is manufactured from a composite material with metal insert fixings. The manifold comprises a central chamber with six tracts leading to the inlet ports on the engine. For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Description and Operation).

FUEL PUMP

The submersible electric pump fuel pump and the fuel pressure regulator are located in the fuel tank. A pump module flange on top of the fuel tank allows access to the fuel pump for removal and installation.

The fuel pump, when running, outputs fuel at a constant pressure to the fuel rail. The pressure regulator controls the pressure. Excess fuel from the pressure regulator is directed to the front jet pump. The controlled pressure provides more fuel to the fuel rail than the maximum requirement of the engine; therefore a constant pressure is maintained in the rail under all operating conditions.

For additional information, refer to: [Fuel Tank and Lines](#) (310-01C Fuel Tank and Lines - V6 4.0L Petrol, Description and Operation).

The fuel pump is controlled by the ECM via a fuel pump relay, which is located in the Battery Junction Box (BJB).

When the ignition is switched to position II, the ECM provides an earth path for the coil of the fuel pump relay on pin 95 of ECM connector C0634. The relay is energised for a short period to pressurise the fuel system. When the ECM senses that the engine is being cranked by receipt of a valid signal from the Crankshaft Position (CKP) sensor, the ECM energises the fuel pump relay for as long as the engine is running.

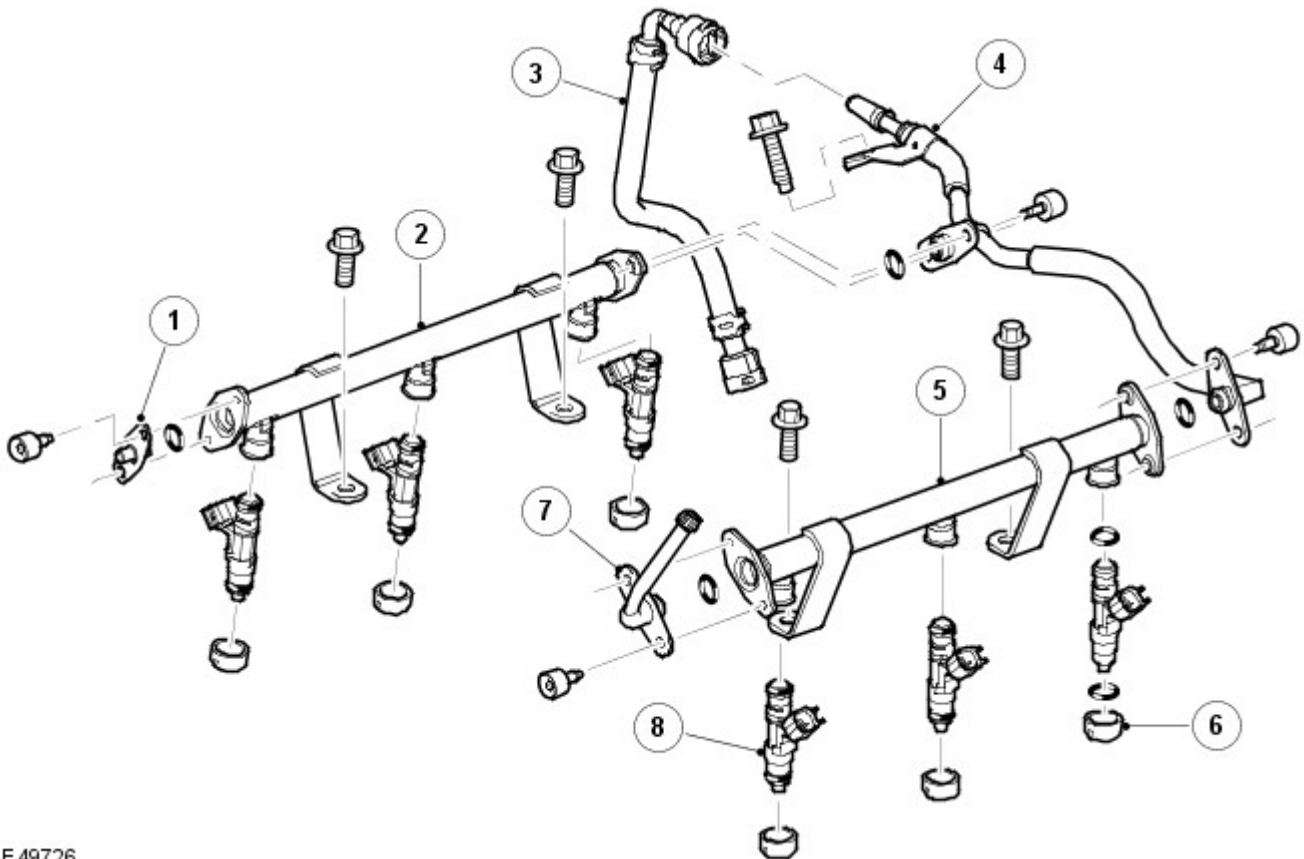
For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol,

Description and Operation).

THROTTLE BODY

The throttle body is located centrally at the front of the intake manifold. The engine torque is controlled by the electronic throttle body. An electronic pedal assembly determines throttle opening. The signal from the pedal assembly is sent to the EMS and the throttle is opened to the correct angle by means of an electric motor integrated into the throttle body. Sensors in the throttle body are used to determine the position of the throttle plate and the rate of change in its angle. For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

FUEL RAIL



E 49726

Item	Part Number	Description
1	-	End cover
2	-	RH fuel rail
3	-	Fuel jump hose
4	-	Fuel supply pipe
5	-	LH fuel rail
6	-	Injector seat inserts
7	-	Schraeder valve
8	-	Injectors (6 of)

Each fuel rail maintains a constant fuel pressure of 4.5bar (65 psi) and is attached to each cylinder head with two bolts. Three fuel injectors are installed in each cylinder head and connected to the fuel rail. 'O' ring seals are used to seal the injectors in both the fuel rails and cylinder heads. A quick release coupling connects the feed pipe from the fuel tank to the fuel rail via the fuel jump hose.

A flange with two threaded holes on the rear of the LH and RH fuel rails provide attachment for the fuel supply pipe. The fuel supply pipe has two metal-flanged ends, which locate on the fuel rail. A seal prevents leakage and each flange is secured with two bolts.

A Schraeder valve is installed in the front end of the LH fuel rail to provide a pressure test connection for maintenance.

INJECTORS

Six injectors are held between the fuel rails and each cylinder head. The injectors are sealed to the fuel rail and cylinder head by 'O' ring seals, which should be renewed whenever an injector is refitted to an engine. A small amount of engine oil can be applied to the 'O' rings to aid installation. No other form of lubrication should be used. Each injector sits on an insert that also needs to be renewed each time an injector is replaced.

Each injector contains a solenoid-operated needle valve, which is closed while the solenoid winding is de-energised. The solenoid winding is connected to a power feed from the main relay and to an earth through the ECM. The ECM switches the earth to control the opening and closing of the needle valve. While the needle valve is open, fuel is sprayed into the cylinder inlet tract onto the back of the inlet valves. The ECM meters the amount of fuel injected by adjusting the time that the needle valve is open.

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

Fuel Charging and Controls - V6 4.0L Petrol - Fuel Charging and Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Fuel Charging and Controls](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fuel leaks ● Damaged fuel lines ● Damaged push connect fittings ● Fuel level ● Fuel contamination/grade/quality ● Throttle body ● Damaged fuel tank filler pipe cap ● Damaged fuel tank filler pipe 	<ul style="list-style-type: none"> ● Fuses ● Inertia switch ● Loose or corroded electrical connectors ● Harnesses ● Sensor(s) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	<ul style="list-style-type: none"> ● Low/Contaminated fuel ● Ignition system ● Fuel system ● Crankshaft Position (CKP) sensor ● Harness ● Engine Control Module fault 	Check the fuel level and condition. For ignition system tests, refer to the relevant section of the workshop manual. Check for injector DTCs. For CKP and harness tests, refer to the relevant section of the workshop manual. Refer to the warranty policy and procedures manual if a module is suspect.
Engine cranks and fires, but will not start	<ul style="list-style-type: none"> ● Evaporative emissions purge valve ● Fuel system ● Spark plugs ● Ignition coil failure(s) 	For purge valve tests, refer to the relevant section of the workshop manual. Check for injector DTCs. For ignition system tests, refer to the relevant section of the workshop manual.
Difficult to start cold	<ul style="list-style-type: none"> ● Check coolant anti-freeze content ● Battery ● Crankshaft position (CKP) sensor ● Fuel system ● Evaporative emissions purge valve 	For battery information, refer to the relevant section of the workshop manual. For CKP sensor tests, refer to the relevant section of the workshop manual. Check for injector DTCs. For purge valve tests, refer to the relevant section of the workshop manual.
Difficult to start hot	<ul style="list-style-type: none"> ● Injector leak ● Fuel system ● Fuel temperature sensor ● Intake air temperature (IAT) sensor ● Mass air flow (MAF) sensor ● Evaporative emissions purge valve ● Ignition system 	Check for injector DTCs. For fuel temperature sensor, intake air temperature sensor and Mass Air Flow sensor tests, refer to the relevant section of the workshop manual. For purge valve and ignition system tests, refer to the relevant section of the workshop manual.

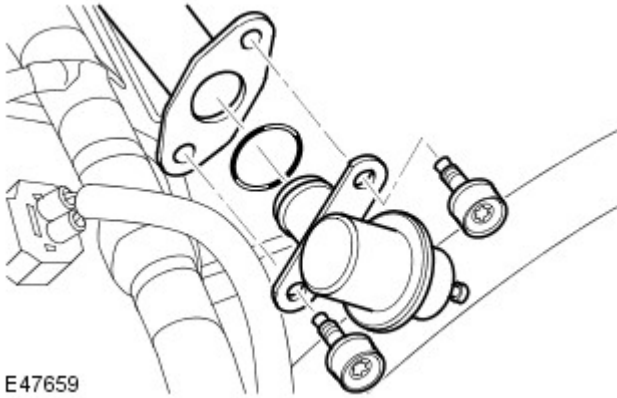
Symptom	Possible Causes	Action
Difficult to start after hot soak (vehicle standing after engine has reached operating temperature)	<ul style="list-style-type: none"> ● Injector leak ● Fuel system ● Fuel temperature sensor ● Intake air temperature sensor ● Mass Air Flow sensor ● Evaporative emissions purge valve ● Ignition system 	Check for injector DTCs. For fuel temperature sensor, intake air temperature sensor and Mass Air Flow sensor tests, refer to the relevant section of the workshop manual. For purge valve and ignition system tests, refer to the relevant section of the workshop manual.
Engine stalls soon after start	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● Engine control module relay ● Mass Air Flow sensor ● Fuel rail pressure (FRP) sensor ● Ignition system ● Air filter restricted ● Air leakage ● Fuel lines 	Check the engine breather system. Check the engine control module relay operation. For Mass Air Flow sensor and fuel rail pressure sensor and ignition system tests, refer to the relevant section of the workshop manual. For air intake and fuel line information, refer to the relevant section of the workshop manual.
Engine hesitates/poor acceleration	<ul style="list-style-type: none"> ● Fuel pump ● Fuel lines ● Injector leak ● Fuel pressure ● Air leakage ● Throttle position (TP) sensors ● Accelerator pedal position (APP) sensor ● Throttle motor ● Ignition system ● HO2 sensors ● Transmission malfunction ● Restricted pedal travel (carpet, etc) 	For fuel pump and fuel line information, refer to the relevant section of the workshop manual. Check for injector DTCs. For intake system checks, throttle position sensor and accelerator pedal position sensor tests, refer to the relevant section of the workshop manual. For throttle motor tests refer to the guided diagnostic routine on the approved diagnostic system. For ignition system tests, refer to the relevant section of the workshop manual. Check for DTCs relating to HO2 sensors, refer to the DTC index. For transmission information, refer to the relevant section of the workshop manual. Check the accelerator pedal travel.
Engine backfires	<ul style="list-style-type: none"> ● Fuel pump ● Fuel lines ● Air leakage ● Mass Air Flow sensor ● Accelerator pedal position sensor ● HO2 sensors ● Ignition system 	For fuel pump and fuel line and intake system information, refer to the relevant section of the workshop manual. For Mass Air Flow sensor and accelerator pedal position sensor tests, refer to the relevant section of the workshop manual. Check for DTCs relating to HO2 sensors, refer to the DTC index. For ignition system tests, refer to the relevant section of the workshop manual.
Engine surges	<ul style="list-style-type: none"> ● Fuel pump ● Fuel lines ● Mass Air Flow sensor ● Harness ● Throttle position sensors ● Throttle motor ● Ignition system 	For fuel pump and fuel line information, refer to the relevant section of the workshop manual. For Mass Air Flow sensor and throttle position sensor tests, refer to the relevant section of the workshop manual. For throttle motor tests refer to the guided diagnostic routine on the approved diagnostic system. For ignition system tests, refer to the relevant section of the workshop manual.
Engine detonates/knocks	<ul style="list-style-type: none"> ● Fuel pump ● Fuel lines ● Fuel quality ● Knock sensor (KS)/circuit malfunction ● Fuel rail pressure sensor ● Mass Air Flow sensor ● HO2 sensors ● Air leakage ● BARO sensor malfunction (internal engine control module fault) 	For fuel pump and fuel line information, refer to the relevant section of the workshop manual. For fuel rail pressure sensor, Mass Air Flow sensor and knock sensor tests, refer to the relevant section of the workshop manual. Check for DTCs relating to HO2 sensors, refer to the DTC index. For intake system, refer to the relevant section of the workshop manual. Refer to the warranty policy and procedures manual if a module is suspect.
No throttle response	<ul style="list-style-type: none"> ● Accelerator pedal position sensor malfunction ● Throttle position sensors ● Throttle motor 	For accelerator pedal position sensor and throttle position sensor tests, refer to the relevant section of the workshop manual. For throttle motor tests refer to the guided diagnostic routine on the approved diagnostic system.
Poor throttle response	<ul style="list-style-type: none"> ● Accelerator pedal position sensor malfunction ● Throttle position sensors 	For accelerator pedal position sensor, throttle position sensor, engine coolant temperature sensor and Mass Air Flow sensor tests, refer to the relevant section of the workshop manual. For intake system checks refer to the relevant section of the workshop manual. For breather system checks, refer to the relevant section of the workshop manual.
DTC Index For a list of Diagnostic Trouble Codes (DTCs) that could be triggered on this format, please refer to the relevant section of the workshop manual. For Intake system checks refer to the relevant section of the workshop manual.	<ul style="list-style-type: none"> ● Mass Air Flow sensor ● Transmission malfunction ● Traction control event ● Air leakage ● Breather system disconnected/restricted 	For a list of Diagnostic Trouble Codes (DTCs) that could be triggered on this format, please refer to the relevant section of the workshop manual. For Intake system checks refer to the relevant section of the workshop manual.

Fuel Charging and Controls - V6 4.0L Petrol - Fuel Pressure Regulator

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake manifold.
For additional information, refer to: Intake Manifold Assembly (303-04, Removal and Installation).
3. Remove the fuel pressure regulator.
 - Remove the 2 Torx bolts.
 - Remove and discard the O-ring seal.




E47659

Installation

1. Install the fuel pressure regulator.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the bolts to 6 Nm (4 lb.ft).
2. Install the intake manifold.
For additional information, refer to: Intake Manifold Assembly (303-04, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


Fuel Charging and Controls - V6 4.0L Petrol - Fuel Rail

Removal and Installation

Special Tool(s)	
 <p>310-044</p> <p>E50921</p>	Fuel spring lock decoupling tool
	310-044


Removal

• WARNINGS:

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

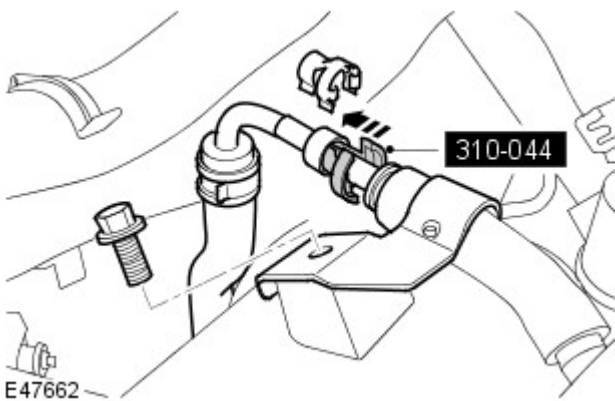
 Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.


1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Release the fuel supply line.
 - Remove the bolt.

4.  **WARNING:** The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

Using the special tool, disconnect the fuel line.

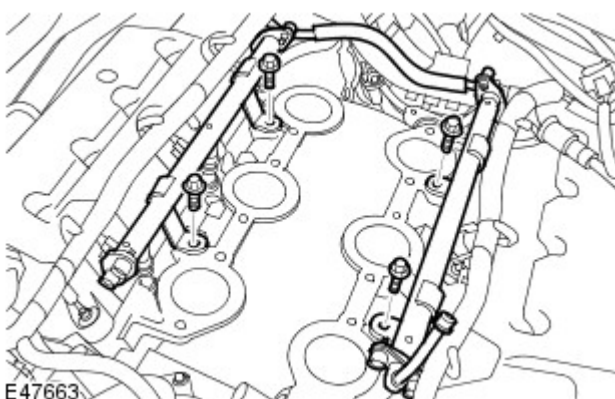
- Position an absorbent cloth to collect fluid spillage.
- Depress the quick release connector.

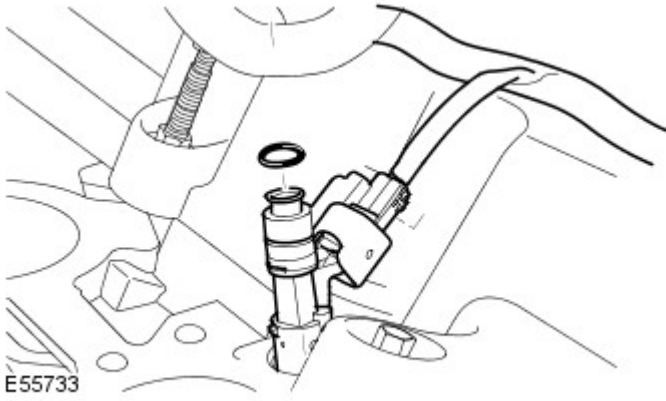


5.  **WARNING:** The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

Remove the fuel rail.

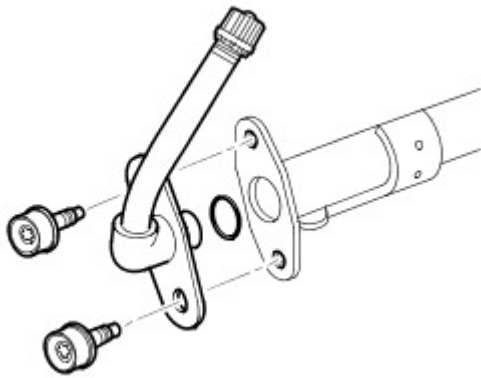
- Remove the 4 bolts.
- Position an absorbent cloth to collect fluid spillage.





6. Release and remove the fuel injectors.

- Remove and discard the fuel injector O-ring seals.



7. Remove the schraeder valve.

- Remove the 2 Torx bolts.
- Discard the O-ring seal.

Installation

1. Install the schraeder valve.

- Clean the component mating faces.
- Install a new O-ring seal.
- Tighten the bolts to 6 Nm (4 lb.ft).

2. Clean the components.

3. Install the fuel rail.

- Install fuel injector O-ring seals.
- Lubricate the O-ring seals.
- Tighten the bolts to 25 Nm (18 lb.ft).

4. Connect the fuel line to the fuel rail.

- Clean the component mating faces.
- Install the clip.
- Tighten the bolt to 6 Nm (4 lb.ft).

5. Install the intake manifold.

For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

6. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

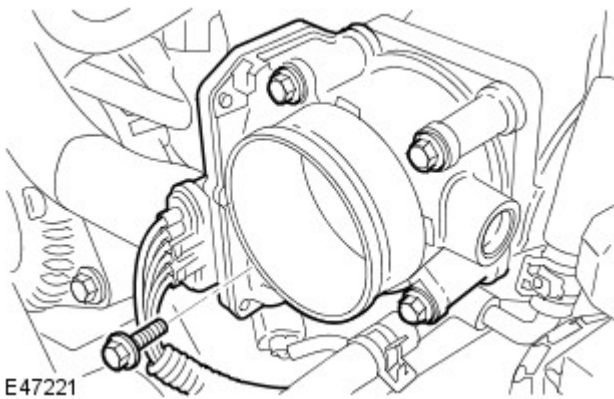
Fuel Charging and Controls - V6 4.0L Petrol - Throttle Body Gasket

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the air intake resonator.
For additional information, refer to: [Intake Air Resonator](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
4. Remove the throttle body.

- Remove the 4 bolts.
- Remove and discard the throttle body gasket.



Installation

1. Install the throttle body.
 - Clean the components.
 - Install a new gasket.
 - Tighten the 4 bolts to 10 Nm (7 lb.ft).
2. Install the air intake resonator.
For additional information, refer to: [Intake Air Resonator](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
3. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


Fuel Charging and Controls - V6 4.0L Petrol - Fuel Injector


Removal and Installation


Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. WARNINGS:

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

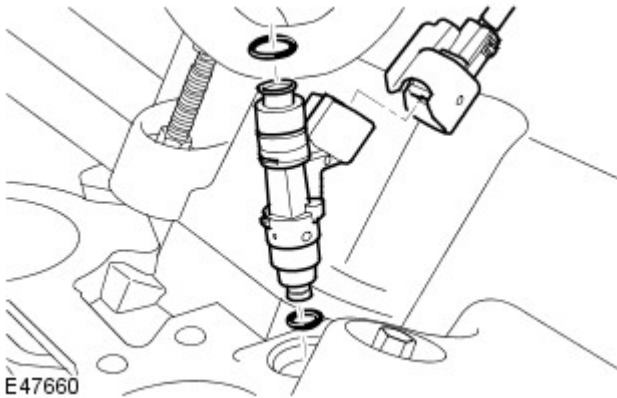
 CAUTION: Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the fuel rail.

For additional information, refer to: [Fuel Rail](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Removal and Installation).

3. Remove the fuel injector.

- Release the injector.
- Disconnect the electrical connector.
- Remove and discard the O-ring seal.



Installation

1. Clean the component mating faces.
2. To install, reverse the removal procedure.
 - Lubricate the new O-ring seal with clean engine oil.

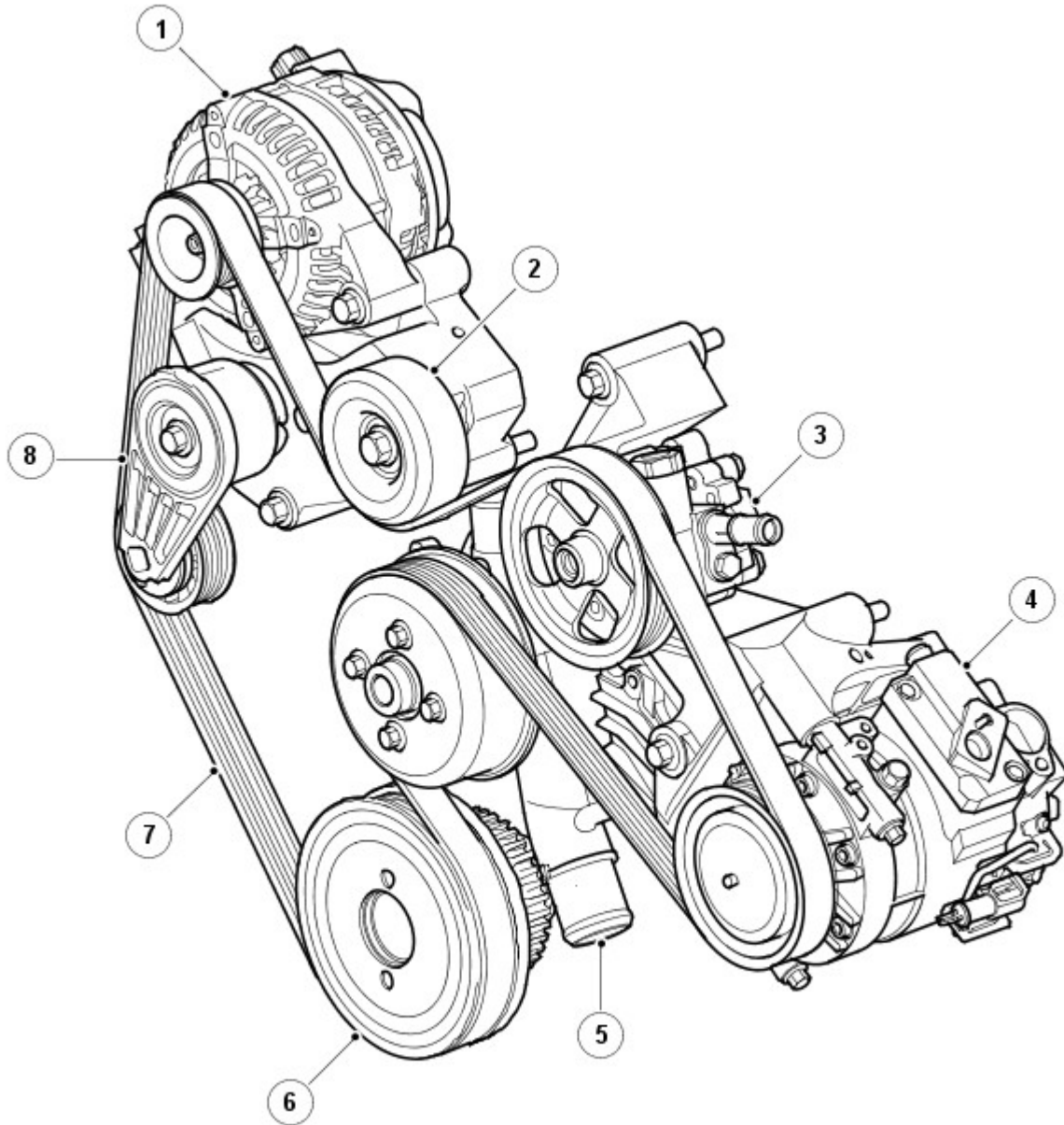
Accessory Drive - V6 4.0L Petrol -

Torque Specifications

Description	Nm	lb-ft
Generator drive belt tensioner bolt	45	33
Accessory drive belt idler pulley bolt	45	33

Accessory Drive - V6 4.0L Petrol - Accessory Drive

Description and Operation



E50592

Item	Part Number	Description
1	-	Generator
2	-	Deflection pulley
3	-	Power steering pump
4	-	A/C compressor
5	-	Coolant pump
6	-	Crankshaft pulley
7	-	Accessory drive belt
8	-	Tensioner assembly

The engine crankshaft pulley drives the accessory components, which comprise the torsional vibration damper, generator, power steering pump, A/C compressor and coolant pump, via the accessory drive belt.

The belt, which is maintenance free poly-V type belts, are automatically pre-loaded by the tensioning rollers and are routed over deflection pulleys in order to maintain sufficient adhesion about the drive wheels. This ensures slip-free drive of the accessory components.

Accessory Drive - V6 4.0L Petrol - Accessory Drive

Diagnosis and Testing

Principles of Operation

For a detailed description of the accessory drive system and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Accessory Drive](#) (303-05C Accessory Drive - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection

Mechanical
<ul style="list-style-type: none"> ● Belt drive belt condition (cracking/damage/contamination) ● Belt tension ● Pulley alignment ● Coolant pump ● Belt tensioner assembly ● Air conditioning compressor ● Power steering pump ● Crankshaft pulley ● Generator ● Dynamic response pump pulley ● Deflection pulley ● Cooling fan pulley

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.



CAUTION: If the engine is run without the accessory drive belts connected to eliminate driven components, diagnostic trouble codes, (DTCs) may be set which must be cleared before the vehicle is returned to the owner. The engine should not be run for more than 2-3 minutes with the belts disconnected. Failure to follow this instruction may result in damage to the vehicle.

4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Noise	<ul style="list-style-type: none"> ● Belt condition ● Belt tension ● Pulleys misaligned ● Driven components (including tensioners) 	Check the belt condition (see visual inspection). Check the tensioner function. Check the pulley alignment. Check the driven components for excessive resistance to rotation. Rectify as necessary.
Drive belt does not hold tension	<ul style="list-style-type: none"> ● Belt condition ● Tensioner fault 	Check the belt condition (see visual inspection). Check the tensioner function. Rectify as necessary.

DTC Index

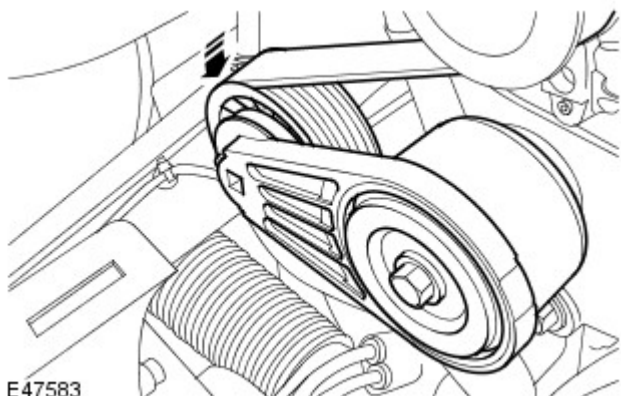
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Accessory Drive - V6 4.0L Petrol - Accessory Drive Belt

Removal and Installation

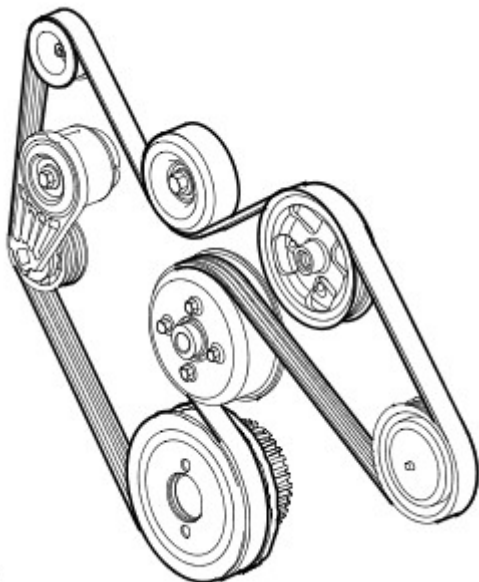
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the viscous fan assembly.
For additional information, refer to: [Cooling Fan](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
3. Release the accessory drive belt.
 - Rotate the accessory drive belt tensioner counterclockwise.
4. Remove the accessory drive belt.



Installation

1. To install, reverse the removal procedure.
 - Clean and inspect the drive pulleys for damage.



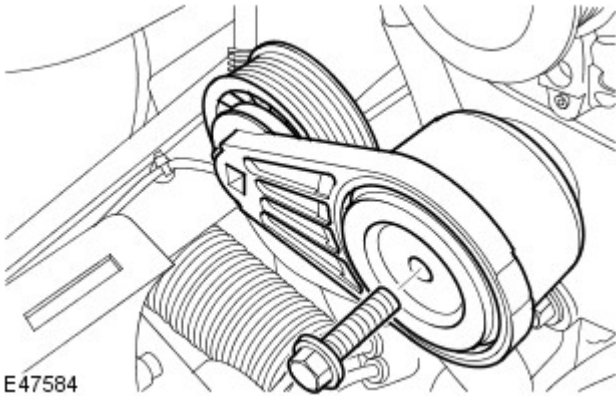
2. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Accessory Drive - V6 4.0L Petrol - Accessory Drive Belt Tensioner

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the generator drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Remove the generator drive belt tensioner.
 - Remove the generator drive belt tensioner bolt.



Installation

1. Install the generator drive belt tensioner.
 - Clean the component mating faces.
 - Tighten the bolt to 45 Nm (33 lb.ft).
2. Install the generator drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Connect the battery ground cable.

Accessory Drive - V6 4.0L Petrol - Accessory Drive Belt Idler Pulley

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the generator drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Remove the accessory drive belt idler pulley.
 - Remove the bolt.



Installation

1. Install the accessory drive belt idler pulley.
 - Tighten the bolt to 45 Nm (33 lb.ft).
2. Install the generator drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Starting System - V6 4.0L Petrol -

Starter Motor

Item	Specification
Starter motor:	
Make	Denso
Type	RA - Pre-engaged
Voltage	12
Current consumption	1.8 kW

Torque Specifications

Description	Nm	lb-ft
* Starter motor positive terminal nut	10	7
Starter motor bolts	45	33
** Lower steering column universal joint retaining bolt	25	18
Upper suspension arm and brake line heat shield nuts and bolts	10	7



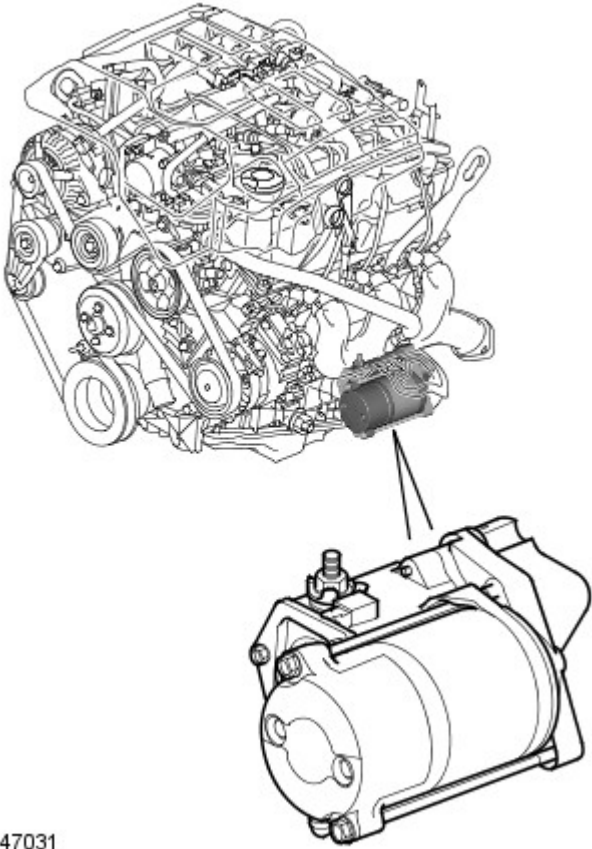
CAUTION: * Damage to the internal connections will occur if this torque is exceeded

**** New patchlok bolt must be installed**

Starting System - V6 4.0L Petrol - Starting System

Description and Operation

STARTER MOTOR



E47031

The starter motor is rated as a 1.8kW and is a Denso level three sealed unit. It is an RA type starter motor, which is of the offset design with the solenoid being directly behind the pinion to give a more positive engagement to the ring gear. The motor is geared directly to the pinion. Each starter motor is of the pre-engaged type and comprises of a series wound motor and an overrunning clutch. This starter incorporates labyrinth breathing tubes to help with sealing and drainage.

The starter solenoid is energised by a signal from the ECM when the ignition switch is moved to the crank position. When engine cranking is requested, the ECM checks that a valid key code has been received before granting the crank request.

The power for starter operation is supplied on a substantial single cable connected direct from the battery positive terminal. The cable is connected to the solenoid via a copper threaded stud with an anti-rotational device and secured with a nut.

The starter motor is located on the rear LH side of the engine block. The motor is secured to the block and protrudes through an aperture to drive the flywheel via a ring gear.

Starting System - V6 4.0L Petrol - Starting System

Diagnosis and Testing

Principles of Operation

For a detailed description of the starting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Starting System](#) (303-06C Starting System - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Gear selector lever cable adjustment (vehicles with automatic transmission) ● Starter motor ● Engine (turns freely) 	<ul style="list-style-type: none"> ● Battery ● Fuses ● Starter relay ● Wiring harness(es) ● Damaged, loose or corroded connectors ● Ignition switch ● Generator ● Transmission Control Module (TCM) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
The engine does not crank (starter motor does not turn)	<ul style="list-style-type: none"> ● Gear selector not in P or N position (vehicles with automatic transmission) ● Battery ● Starter relay ● Invalid key code received by Central Junction Box (CJB) ● Harness/Connectors ● Starter motor ● Ignition switch ● Generator ● Transmission Control Module (TCM) ● Engine Control Module (ECM) ● Engine seized 	Make sure the gear selector is in the P or N position and correctly adjusted. Check the battery condition and state of charge. Check for DTCs indicating an immobilizer fault. Check the starter motor relay, ignition switch and generator circuits. Refer to the electrical guides. Check for TCM and ECM DTCs. Check that the engine turns freely.
The engine does not crank (starter motor does turn)	<ul style="list-style-type: none"> ● Starter motor installation ● Starter motor ● Flywheel/Drive plate ring gear 	Check the starter motor installation (fasteners tight, starter motor square to engine, etc). Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc.
Engine cranks too slowly	<ul style="list-style-type: none"> ● Battery ● Harness/Connectors ● Starter motor ● Oil grade 	Check the battery condition and state of charge. Check the starter motor circuits. Refer to the electrical guides. Check the engine oil grade and condition.
Engine cranks too fast	<ul style="list-style-type: none"> ● Low engine compression 	Check the engine compressions.
Excessive starter motor noise	<ul style="list-style-type: none"> ● Starter motor ● Flywheel/Drive plate ring gear ● Starter motor installation/casing 	Check the starter motor installation (fasteners tight, motor square to engine, etc). Check the starter motor casing condition. Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Engine Control Module \(PCM\) 4.0L V6](#) (100-00 General Information, Description and Operation).

Starting System - V6 4.0L Petrol - Starting System Vehicles With: Smart Key

Diagnosis and Testing

Principles of Operation

For a detailed description of the starting system, refer to the relevant Description and Operation section in the workshop manual.

REFER to: Starting System (303-06A, Description and Operation).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Steering column ● Brake pedal ● Smart key ● Steering Wheel 	<ul style="list-style-type: none"> ● Fuses ● Harnesses and connectors ● Warning lamp operation ● Smart key operation ● Engine start operation

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, check for Diagnostic Trouble Codes (DTC's) and refer to the DTC Index.



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle

• NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the warranty policy and procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• NOTE: Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system)

• NOTE: When performing voltage or resistance tests, always use a digital multimeter accurate to three decimal places and with a current calibration certificate. When testing resistance, always take the resistance of the digital multimeter leads into account

• NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests

• NOTE: Inspect connectors for signs of water ingress, and pins for damage and/or corrosion

• NOTE: If diagnostic trouble codes are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals

Symptom Chart

Symptom - Message Displayed	Symptom - Possible Cause	Action
Smart key not found - Refer to handbook	Ignition mode fails to switch on	GO to Pinpoint Test A.
• NOTE: Back up start - 10MY onwards	Ignition mode fails to switch on	GO to Pinpoint Test B.
Smart key not found - Refer to handbook		
Press start and brake	Engine fails to crank	GO to Pinpoint Test C.
Steering column locked	Ignition switches off after 3 seconds	GO to Pinpoint Test D.
• NOTE: For diesel engines	Ambient temperatures below zero	GO to Pinpoint Test E.
Engine still not cranking		

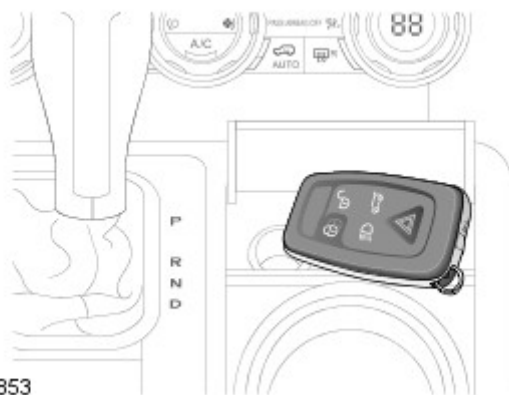

Pin Point Test

PINPOINT TEST A : SMART KEY NOT FOUND - REFER TO HANDBOOK

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: IGNITION MODE FAILS TO SWITCH ON	
• NOTE: In normal operation, pressing the start button for one second will cause the vehicle to enter the ignition mode. If the procedures below are followed the engine should crank	
• NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected	
• NOTE: For manual transmission vehicles ensure the clutch is fully depressed	
1	Ensure the smart Key is within the cabin area. Check the smart key is not close to any electrical devices e.g. Smart phones, laptops, laptop cases, games consoles and game console bags, briefcases, metal objects etc. All can affect the system performance and may block its communication with the vehicle. If the smart key battery low warning message has been displayed it is likely that the smart key battery has insufficient charge. Refer to section 'Back Up Start' for 10MY onwards

	<p>Has the vehicle started?</p> <p>Yes No further action required</p> <p>No Check and install a new battery as required. Clear the DTC and retest. If the problem persists, contact dealer technical support</p>
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PINPOINT TEST B : BACK UP START - 10MY ONWARDS - SMART KEY NOT FOUND - REFER TO HANDBOOK

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: IGNITION MODE FAILS TO SWITCH ON	
<ul style="list-style-type: none"> NOTE: In normal operation, pressing the start button for one second will cause the vehicle to enter the ignition mode. If the procedures below are followed the engine should crank NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected NOTE: For manual transmission vehicles ensure the clutch is fully depressed 	
 <p>E138853</p>	
 <p>E138855</p>	<p>1 On pressing the start button, smart key not found. When this warning is displayed the smart key should be brought into close proximity with the immobilize antenna unit. For the location of the immobilize antenna unit, see illustration. Hold the key in the location and press the start button again. If this process fails the first time, try repositioning the key around the immobilize antenna unit location, repeat the sequence again</p>
	<p>Has the vehicle started?</p> <p>Yes No further action required</p> <p>No Contact dealer technical support</p>

PINPOINT TEST C : PRESS START AND BRAKE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: ENGINE FAILS TO CRANK	
<ul style="list-style-type: none"> NOTE: Conditions for starting in addition to pressing the start button are NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected NOTE: For manual transmission vehicles ensure the clutch is fully depressed NOTE: If the engine can be heard to crank there is no fault with the smart key NOTE: If the locking pin is still engaged, turn the steering wheel to overcome the side load NOTE: Start authorisation defined as Ignition functions, Steering column lock engagement, Engine immobilize and smart key authorisation 	
	<p>1 Check that there is sufficient brake pressure, (Automatic transmission only). Attempt another start making sure that the brake pedal is pressed firmly so the message is no longer displayed. In certain conditions this may require a more effort than usual</p>
	<p>Has the vehicle started?</p> <p>Yes No further action required</p> <p>No Contact dealer technical support</p>

PINPOINT TEST D : STEERING COLUMN LOCKED

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: IGNITION SWITCHES OFF AFTER 3 SECONDS	
• NOTE: Conditions for starting in addition to pressing the start button are	
• NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected	
• NOTE: For manual transmission vehicles ensure the clutch is fully depressed	
• NOTE: If the engine can be heard to crank there is no fault with the smart key	
• NOTE: If the locking pin is still engaged, turn the steering wheel to overcome the side load	
• NOTE: Start authorisation defined as Ignition functions, Steering column lock engagement, Engine immobilize and smart key authorisation	
	<ol style="list-style-type: none"> 1 Unlock the vehicle using the key fob, within 3 minutes of unlocking ensure the steering wheel can rotate freely. Perform a further lock and unlock check and attempt to start vehicle. If the steering 'column locked' message is still displayed, Lock the vehicle with the key fob and ensure the column is locked (If installed) by turning the steering wheel. Then unlock the vehicle ensuring the column Steering wheel can turn freely. Now perform another start attempt
	Did the engine start? Yes No further action required No Contact dealer technical support


PINPOINT TEST E : ENGINE STILL NOT CRANKING	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: AMBIENT TEMPERATURES BELOW ZERO	
	<ol style="list-style-type: none"> 1 Hold the start button down for at least 4 seconds while starting the vehicle
	<ol style="list-style-type: none"> 2 Switch the ignition on, wet the windscreen and activate the wipers. when the wipers are in operation press the start button, If the wipers stop, the Engine is allowed to start
	Did the engine start? Yes No further action required No Contact dealer technical support

Starting System - V6 4.0L Petrol - Starter Motor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

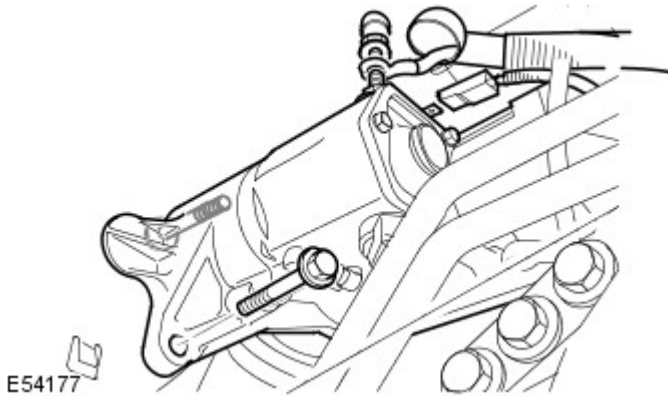
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).

4. Remove the starter motor.

- Remove the 2 bolts.
- Remove the terminal upper cover.
- Remove the terminal lower cover.
- Remove the nut.
- Disconnect the 2 electrical connectors.



Installation

1. Install the starter motor.

- Clean the component mating faces.
- Connect the electrical connectors.
- Tighten the nut to 10 Nm (7 lb.ft).
- Install the terminal lower cover.
- Install the terminal upper cover.
- Tighten the bolts to 45 Nm (33 lb.ft).

2. Install the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).

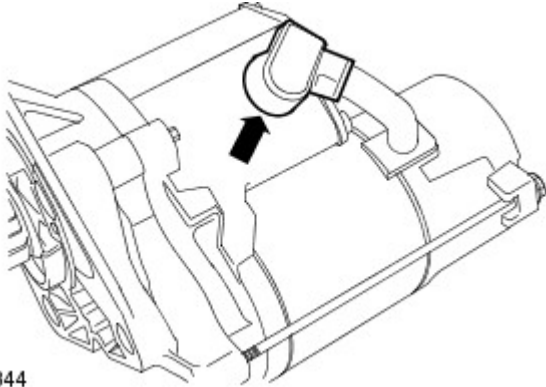
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Starting System - V6 4.0L Petrol - Starter Solenoid

Removal and Installation

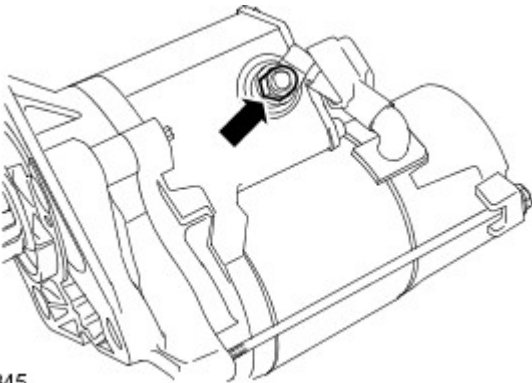
Removal

1. Remove the starter motor.
For additional information, refer to: [Starter Motor](#) (303-06C Starting System - V6 4.0L Petrol, Removal and Installation).
2. Release the starter motor terminal cover.



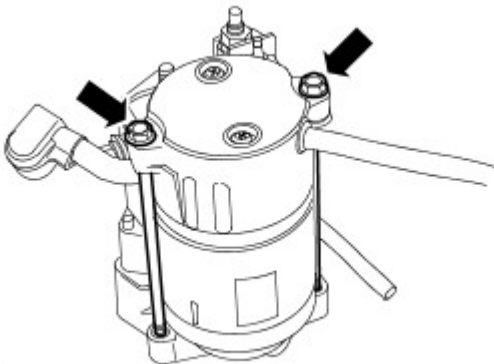
E92344

3. Release the starter motor terminal.
 - Remove the nut.




E92345

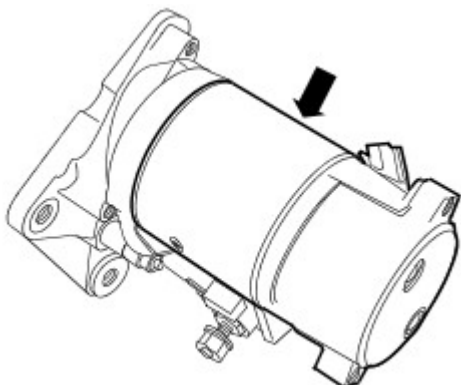
4. Remove the starter motor bolts.



E92220

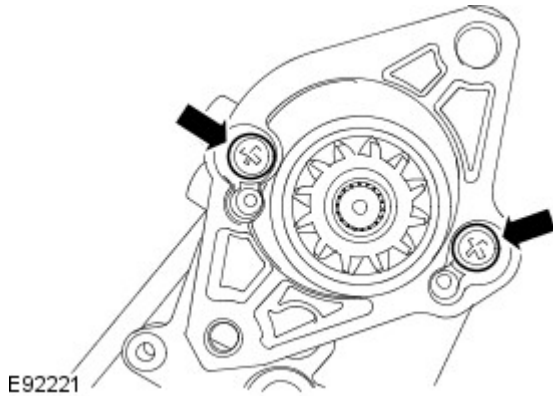
5.  **CAUTION:** Make sure the starter motor armature remains located inside the motor housing.


Remove the starter motor from the gear housing.



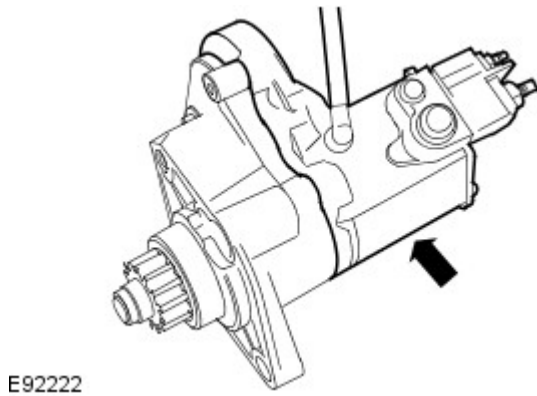
E92346

6. Remove the starter solenoid screws.




7.  CAUTION: Make sure the gears and bearings remain located in the gear housing.

Remove the starter solenoid.



Installation

1.  CAUTION: Make sure the gears and bearings remain located in the gear housing.

Fit the starter solenoid to the gear housing.

2. Fit the starter solenoid screws.

- Tighten to 10 Nm (7 lb.ft).

3. Install the starter motor to the gear housing.

4. Install the starter motor bolts.

- Tighten to 10 Nm (7 lb.ft).

5. Secure the starter motor terminal.

- Tighten the nut to 5 Nm (4 lb.ft).

6. Secure the starter motor terminal cover.

7. Install the starter motor.

For additional information, refer to: [Starter Motor](#) (303-06C Starting System - V6 4.0L Petrol, Removal and Installation).

Engine Ignition - V6 4.0L Petrol -

General Specification

Item	Specification
* Spark plugs - Platinum:	
Make	Motorcraft
Type	AGSF 24PM
** Gap	1.4 mm (0.055 in)
+ Spark plugs - Copper:	
Make	Motorcraft
Type	SGSF 22L
++ Gap	1.4 mm (0.055 in)
Ignition coils:	
Make	Denso
Type	'Coil near plug'

* May be used with either LEADED or UNLEADED fuels but if used with LEADED fuel, they must be replaced at 15,000 mile (24,000 km) intervals

** Plugs must not be 're-gapped' in service, if gap is not as specified, plug(s) must be replaced

+ May only be used with LEADED fuel

++ New plugs must have the gap set to 1.4 mm (0.055 in) prior to installation, plugs must not be 're-gapped' in service, if gap is not as specified, plug(s) must be replaced

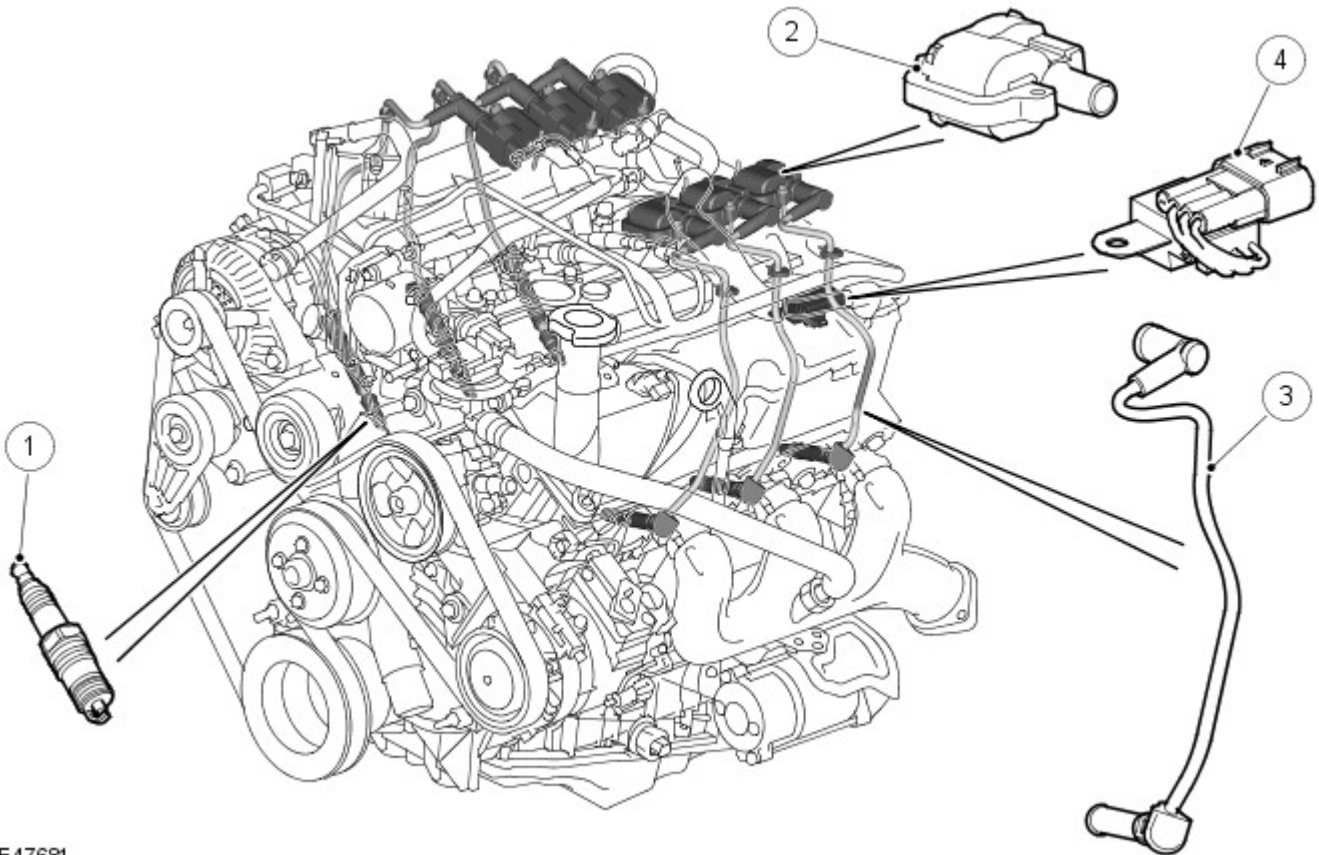
Torque Specifications

Description	Nm	lb-ft
Ignition coil bolt/stud	6	4
Spark plugs - Platinum or copper	18	13

Engine Ignition - V6 4.0L Petrol - Engine Ignition

Description and Operation

COMPONENT LOCATIONS



E47681

Item	Part Number	Description
1	-	Spark plug
2	-	Ignition coil
3	-	Spark plug wire
4	-	Capacitor

GENERAL

The 4.0L engine ignition system has a single platinum tipped spark plug per cylinder, with each spark plug powered by a separate remote ignition coil. The three ignition coils for each cylinder bank are grouped together on the related side of the air inlet manifold. The ignition coils are directly driven by the Engine Control Module (ECM).

Power for the ignition coils is supplied from the main relay and a fuse in the Battery Junction Box (BJB).

Each ignition coil contains a power stage to switch the current in the primary circuit. The ECM controls the switching with a signal to the power stage. A capacitor is connected in parallel with the power supplies to the ignition coils, to suppress Radio Frequency Interference (RFI). The ECM monitors operation of the ignition coils using a feedback signal from each of the power stages. If a fault is detected the ECM stores an appropriate fault code.

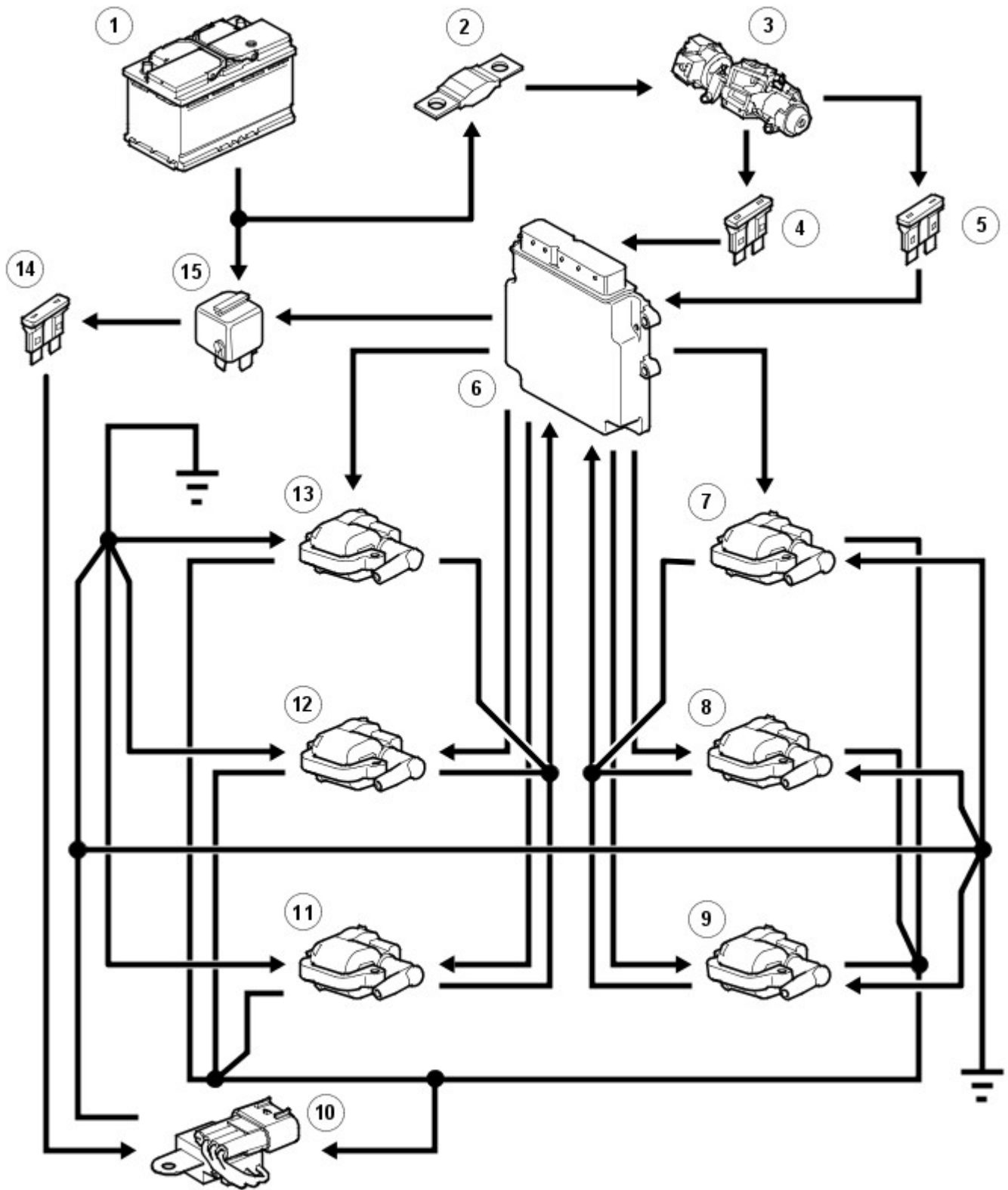
The ECM varies the dwell time of the ignition coils depending on battery voltage and engine speed, to ensure a constant energy level is produced in the secondary coil each time the power stage is switched. This ensures a good spark is always produced by the spark plug without excessive primary current flow, thus avoiding overheating or damage to the ignition coils.

The ECM calculates the ignition timing for individual cylinders from:

- Engine speed.
- Camshaft position.
- Engine load.
- Engine temperature.
- The knock control function.
- On automatic transmission models, the shift control function.
- The idle speed control function.

ENGINE IGNITION CONTROL DIAGRAM

• NOTE: A = Hardwired connections



A →

E47682

Item	Part Number	Description
1	-	Battery
2	-	Fusible link 11E, BJB
3	-	Ignition switch
4	-	Fuse 25P, ignition feed, Central Junction Box (CJB)
5	-	Fuse 60P, crank feed, CJB
6	-	ECM
7	-	Ignition coil 6
8	-	Ignition coil 5
9	-	Ignition coil 4
10	-	Capacitor
11	-	Ignition coil 1

12	-	Ignition coil 2
13	-	Ignition coil 3
14	-	Fuse 17E, BJB
15	-	Main relay

Engine Ignition - V6 4.0L Petrol - Engine Ignition

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine ignition system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Engine Ignition](#) (303-07A Engine Ignition - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Engine oil level ● Cooling system coolant level ● Fuel level ● Fuel contamination/grade/quality ● Exhaust gas recirculation (EGR) valves 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Loose or corroded electrical connectors ● Ignition coils ● Sensor(s) ● Engine Control Module (ECM) ● Transmission Control Module (TCM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	<ul style="list-style-type: none"> ● Engine breather system disconnected/restricted ● Ignition system ● Fuel system ● Electronic engine control 	Ensure the engine breather system is free from restriction and is correctly installed. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	<ul style="list-style-type: none"> ● Evaporative emissions purge valve ● Fuel pump ● Spark plugs ● HT short to ground (tracking) check rubber boots for cracks/damage ● Ignition system 	Check for evaporative emissions, fuel system and ignition system related DTCs and refer to the relevant DTC Index
Difficult cold start	<ul style="list-style-type: none"> ● Engine coolant level/anti-freeze content ● Battery ● Electronic engine controls ● Exhaust Gas Recirculation (EGR) valve stuck open ● Fuel pump ● Purge valve 	Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index

Symptom	Possible Causes	Action
Engine stalls soon after start	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● ECM relay ● Electronic engine control ● Ignition system ● Air intake system restricted ● Air leakage ● Fuel lines 	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC Index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	<ul style="list-style-type: none"> ● Fuel pressure, fuel pump, fuel lines ● Injector leak ● Air leakage ● Electronic engine control ● Throttle motor ● Restricted accelerator pedal travel (carpet, etc) ● Ignition system ● EGR valve stuck open ● Transmission malfunction 	Check for fuel system related DTCs and refer to the relevant DTC Index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC Index
Engine backfires	<ul style="list-style-type: none"> ● Fuel pump/lines ● Air leakage ● Electronic engine controls ● Ignition system 	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls, ignition system related DTCs and refer to the relevant DTC Index
Engine surges	<ul style="list-style-type: none"> ● Fuel pump/lines ● Electronic engine controls ● Throttle motor ● Ignition system 	Check for fuel system failures. Check for electronic engine controls, throttle system and ignition system related DTCs and refer to the relevant DTC Index
Engine detonates/knocks	<ul style="list-style-type: none"> ● Fuel pump/lines ● Air leakage ● Electronic engine controls 	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls related DTCs and refer to the relevant DTC Index
No throttle response	<ul style="list-style-type: none"> ● Electronic engine controls ● Throttle motor 	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC Index
Poor throttle response	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● Electronic engine control ● Transmission malfunction ● Traction control event ● Air leakage 	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC Index. Check for air leakage in intake air system

DTC Index


For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Engine Control Module \(PCM\) 4.0L V6](#) (100-00 General Information, Description and Operation).

Engine Ignition - V6 4.0L Petrol - Spark Plugs

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.  **CAUTION:** It is important to twist the spark plug wire boot while pulling upward to avoid possible damage to the spark plug wire.

- **NOTE:** Note the fitted position.

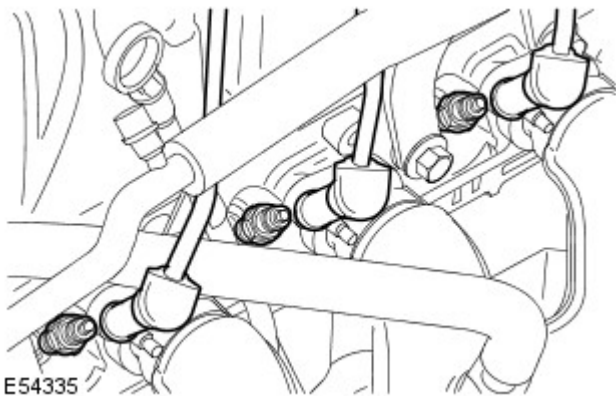
Disconnect the high tension (HT) electrical connectors.

4.  **WARNING:** Eye protection must be worn.


- **NOTE:** Use compressed air to remove any foreign material from the spark plug wells.

Clean the area surrounding the spark plugs.

5. Remove the spark plugs.



Installation

1.  **CAUTION:** Prior to fitting new copper spark plugs, check that the electrode gaps are set to 1.4 mm, adjust if necessary. Existing platinum or copper spark plugs must not be re-gapped in service; if the electrode gap is incorrect new spark plugs must be fitted.

- **NOTE:** Do not apply lubricant to the threads.

Install the spark plugs.

- Check the spark plug gap, refer to specifications.
- Tighten the spark plugs to 18 Nm (13 lb.ft).

2.  **CAUTION:** Install spark plug wires to positions noted on removal. Do not cross wires.

Connect the HT electrical connectors.

- Apply silicone grease to inside of spark plug boot.

3. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00

Battery and Charging System - General Information,
Specifications).

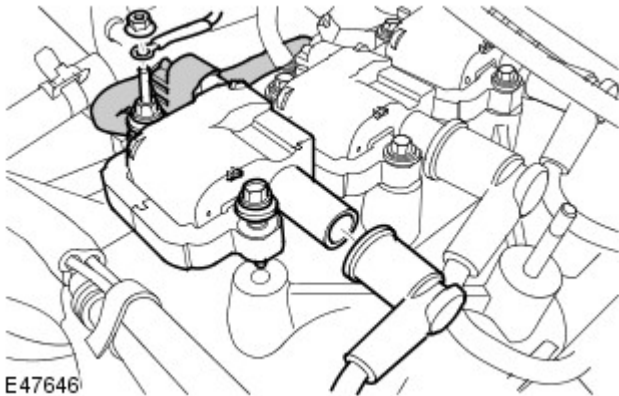
Engine Ignition - V6 4.0L Petrol - Ignition Coil

Removal and Installation

Removal

- NOTE: Note: Ignition coils 2 ,3, 5 & 6 have harness retaining clips that need to be detached before removal.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Disconnect the ignition lead from the coil.
4. Remove the ignition coil.



- Disconnect the ignition coil electrical connector.
- Remove the nut.
- Remove the ground cable.
- Fully loosen the stud.
- Fully loosen the bolt.

Installation

1. To install, reverse the removal procedure.
 - Tighten the bolt to 6 Nm (4 lb.ft).
 - Tighten the stud to 6 Nm (4 lb.ft).
 - Install the ground cable.
 - Tighten the nut to 6 Nm (4 lb.ft).
 - Connect the ignition coil electrical connector.
 - Connect the ignition lead to the coil.

Engine Emission Control - V6 4.0L Petrol -

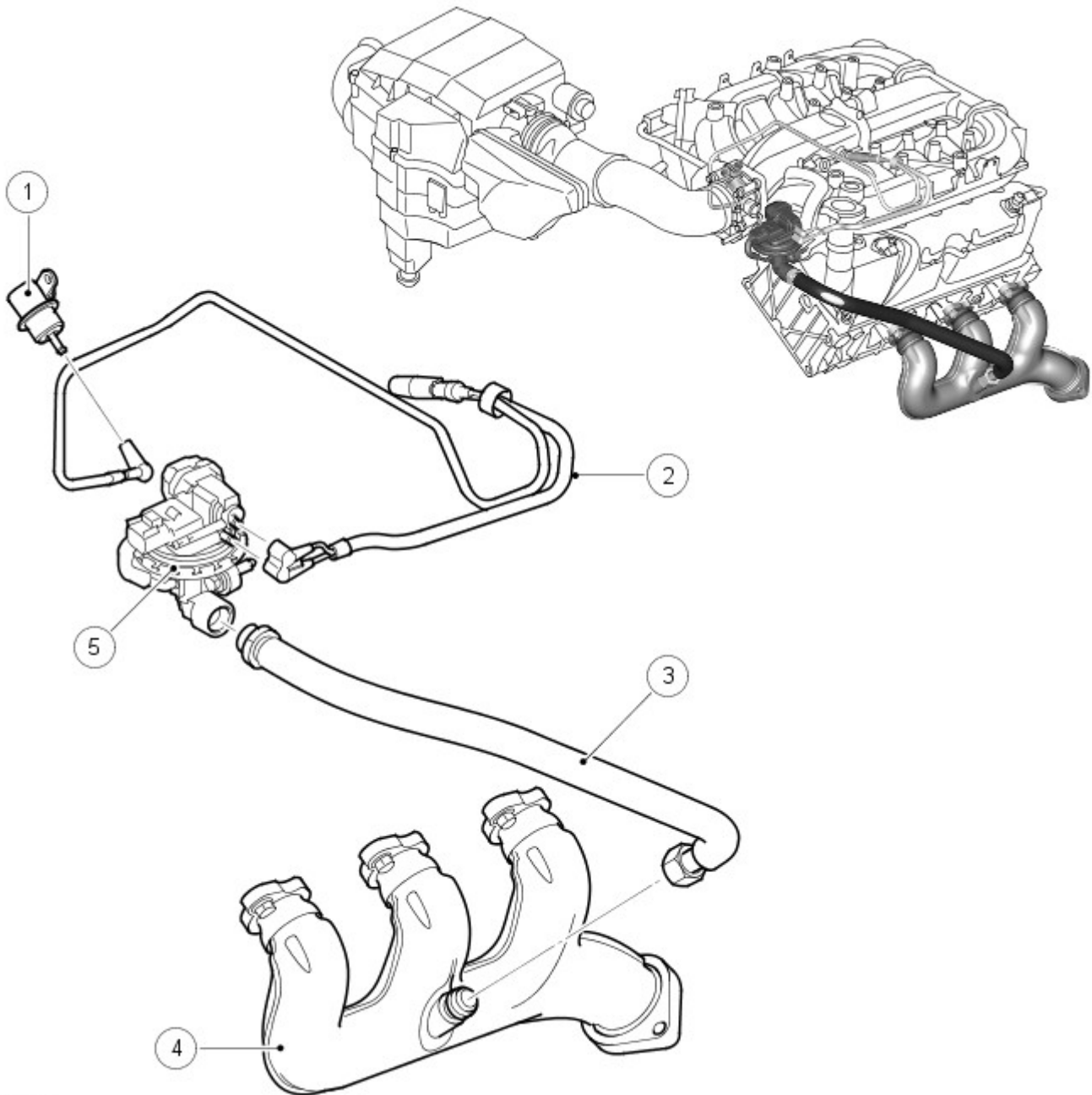
Torque Specifications

Description	Nm	lb-ft
Exhaust gas recirculation (EGR) modulator valve bolts	25	18
Exhaust gas recirculation (EGR) feed pipe to EGR valve union nut	25	18

Engine Emission Control - V6 4.0L Petrol - Engine Emission Control

Description and Operation

Exhaust Gas Recirculation Component Location



E48510

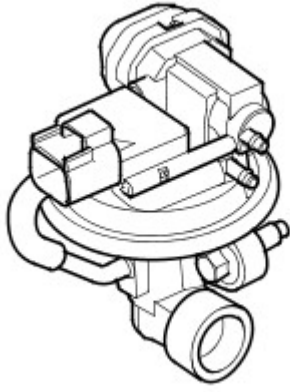
Item	Part Number	Description
1	-	Fuel rail damper
2	-	Vacuum control hoses
3	-	Exhaust manifold to Exhaust Gas Recirculation (EGR) hose
4	-	Exhaust manifold
5	-	ESM valve

Engine emissions on the V6 petrol engine are controlled by the Engine Control Module (ECM). The engine emission control system comprises:

- EGR system
- Crankcase emission system

EGR SYSTEM

ESM Valve



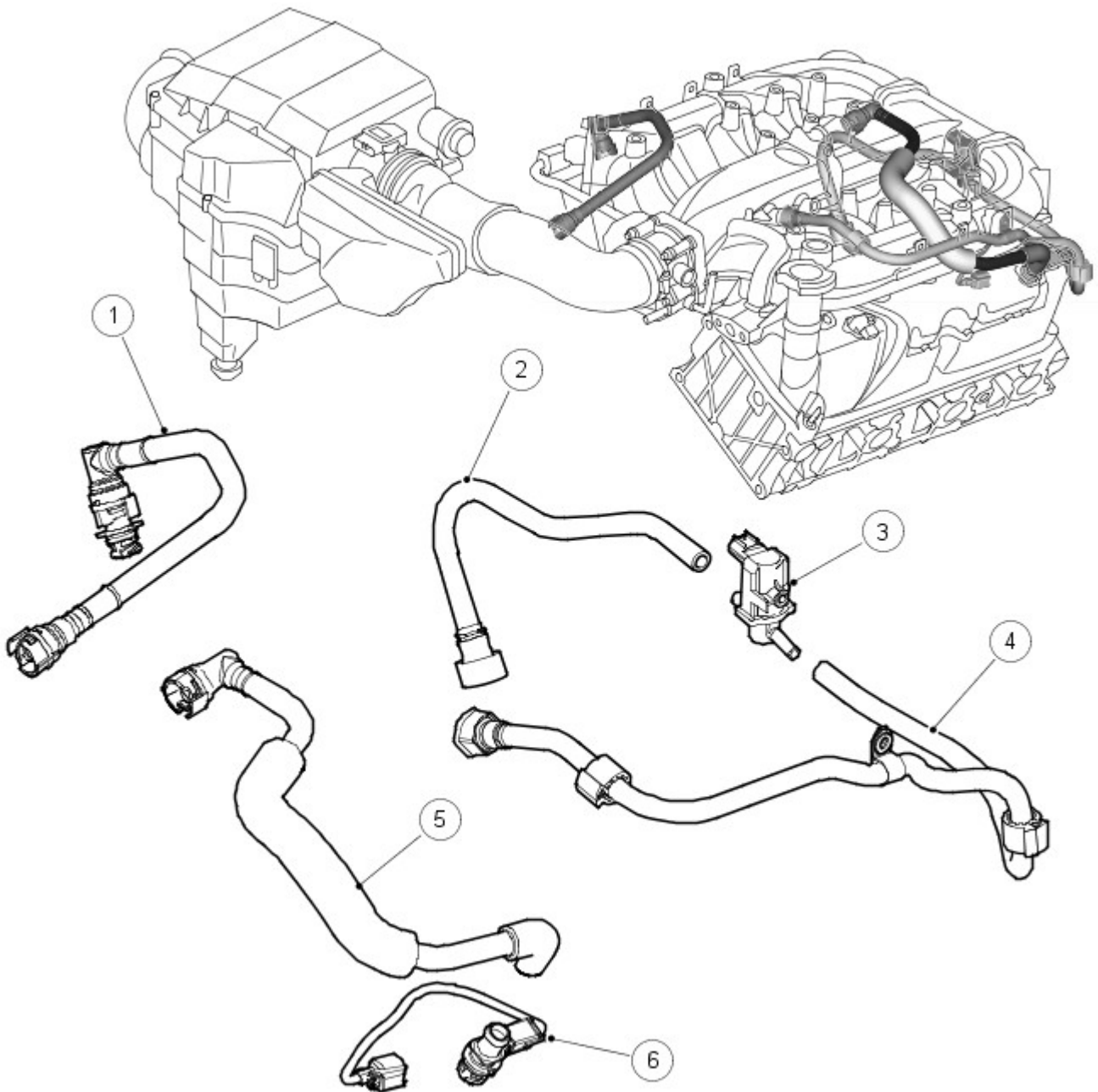
E48511

The EGR System Module (ESM) valve is located on the intake manifold with a pipe connecting the exhaust manifold to the valve. Connection between the sensor and the harness is via a six-way connector. The ESM valve is electrically controlled by a Pulse Width Modulated (PWM) signal. The ESM valve allows burned exhaust gas to be recirculated back into the engine. Since exhaust gas has much less oxygen than air, it is basically inert. The exhaust gas takes the place of air in the cylinder and reduces combustion temperature. As the combustion temperature is reduced, so are the oxides of nitrogen (NOx) emissions.

The ESM valve has an integrated Differential Pressure Feedback-Electronic/Manifold Absolute Pressure (DPFE/MAP) sensor. This pressure transducer monitors the pressure differential on either side of an orifice in the ESM system flow path and then transmits that information to the ECM. The pressure drop measured across this orifice is used to estimate the flow rate of recirculated exhaust gas. An Electronic Vacuum Regulator (EVR) is used to control the vacuum signal to the ESM valve based on the electrical signal from the ECM. The ECM monitors the ESM level based on the feedback from the DPFE/MAP sensor, which creates a closed loop system.

CRANKCASE VENTILATION SYSTEM

Crankcase Ventilation System Component Location



E48512

Item	Part Number	Description
1	-	Crankcase Ventilation (CCV) Hose and cam lock connector
2	-	Engine to evaporative emissions control tube
3	-	Evaporative emissions control valve
4	-	Crankcase Ventilation (CCV) hose
5	-	Positive Crankcase Ventilation(PCV) hose and PCV valve
6	-	PCV jump lead with integral thermistor

Positive Crankcase Ventilation (PCV) Valve



E48513

The crankcase ventilation system comprises:

- Positive Crankcase Ventilation (PCV) valve
- Positive Crankcase Ventilation (PCV) hose
- Crankcase Ventilation (CCV) hose

The PCV is an electrically heated control valve that allows the gas from left hand cylinder head to flow into the air intake. The PCV valve is electrically heated to allow it to remain operational in cold climates. The PCV heater power is fed from the fuel pump relay, therefore heating is always active while the engine is running. The current supplied is internally regulated by the PCV.

Engine Emission Control - V6 4.0L Petrol - Engine Emission Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine emission control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Engine Emission Control](#) (303-08C Engine Emission Control - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Exhaust gas recirculation system ● Breather hoses ● Positive crankcase ventilation valve ● Fuel level ● Fuel contamination/grade/quality ● Throttle body 	<ul style="list-style-type: none"> ● Fuses ● Loose or corroded electrical connectors ● Exhaust Gas Recirculation (EGR) valve ● Engine Control Module (ECM)

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Difficult to start cold	<ul style="list-style-type: none"> ● Battery ● Crankshaft Position (CKP) sensor ● Exhaust Gas Recirculation (EGR) valve stuck open ● Fuel system ● Evaporative emissions purge valve 	For battery information, CKP sensor, fuel system and purge valve tests, refer to relevant workshop manual section. Check the EGR valve.
Engine stalls soon after start	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● Engine Control Module (ECM) relay ● MAF sensor ● Ignition system ● Air filter restricted ● Air leakage ● Fuel lines 	Check the engine breather hoses, PCV, etc. Check the Engine Control Module (ECM) relay operation. For MAF sensor, ignition system tests, air intake and fuel line information, refer to relevant workshop manual section.
Poor throttle response	<ul style="list-style-type: none"> ● APP sensor malfunction ● TP sensors ● ECT sensor ● MAF sensor ● Transmission malfunction ● Traction control event ● Air leakage ● Breather system disconnected/restricted 	For APP, TP, ECT, MAF sensor tests, intake system checks and transmission information, refer to relevant workshop manual section. Check the breather system hoses, PCV, etc.

DTC Index


For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Engine Control Module \(PCM\) 4.0L V6](#) (100-00 General Information, Description and Operation).

Engine Emission Control - V6 4.0L Petrol - Exhaust Gas Recirculation (EGR) Modulator Valve

Removal and Installation

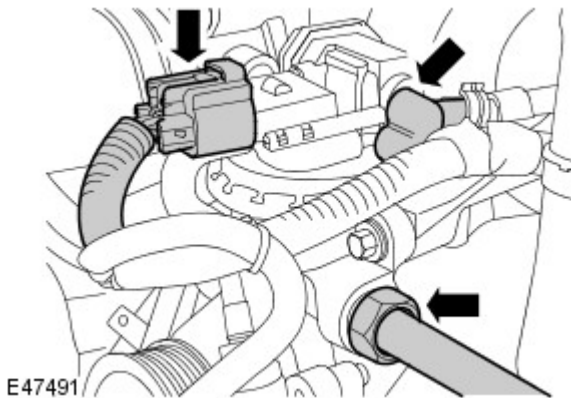
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Disconnect the EGR valve electrical connector.
4. Disconnect the EGR valve vacuum hose.

5.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Disconnect the EGR valve feed pipe.

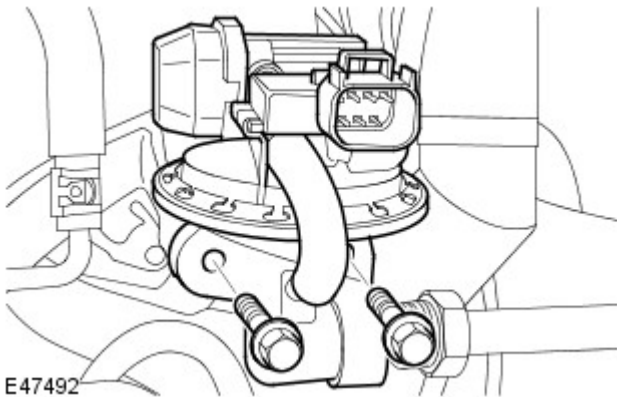
- Loosen the EGR union nut and release the pipe.



E47491

6. Remove the EGR valve.

- Remove the 2 bolts.
- Collect and discard the gasket.



E47492

Installation

1. Install the EGR valve.
 - Clean the component mating faces.
 - Install a new gasket.
 - Tighten the bolts to 25 Nm (18 lb.ft).
2. Connect the feed pipe to the EGR valve.
 - Tighten the union to 25 Nm (18 lb.ft).
3. Connect the vacuum hose to the EGR valve.
4. Connect the EGR valve electrical connector.
5. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
6. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00

Battery and Charging System - General Information, Specifications).

7. NOTE: For NAS vehicles only.

If required, carry out a long drive cycle.
For additional information, refer to: Powertrain Control Module (PCM) Long Drive Cycle Self-Test (303-14A, General Procedures).

Intake Air Distribution and Filtering - V6 4.0L Petrol -

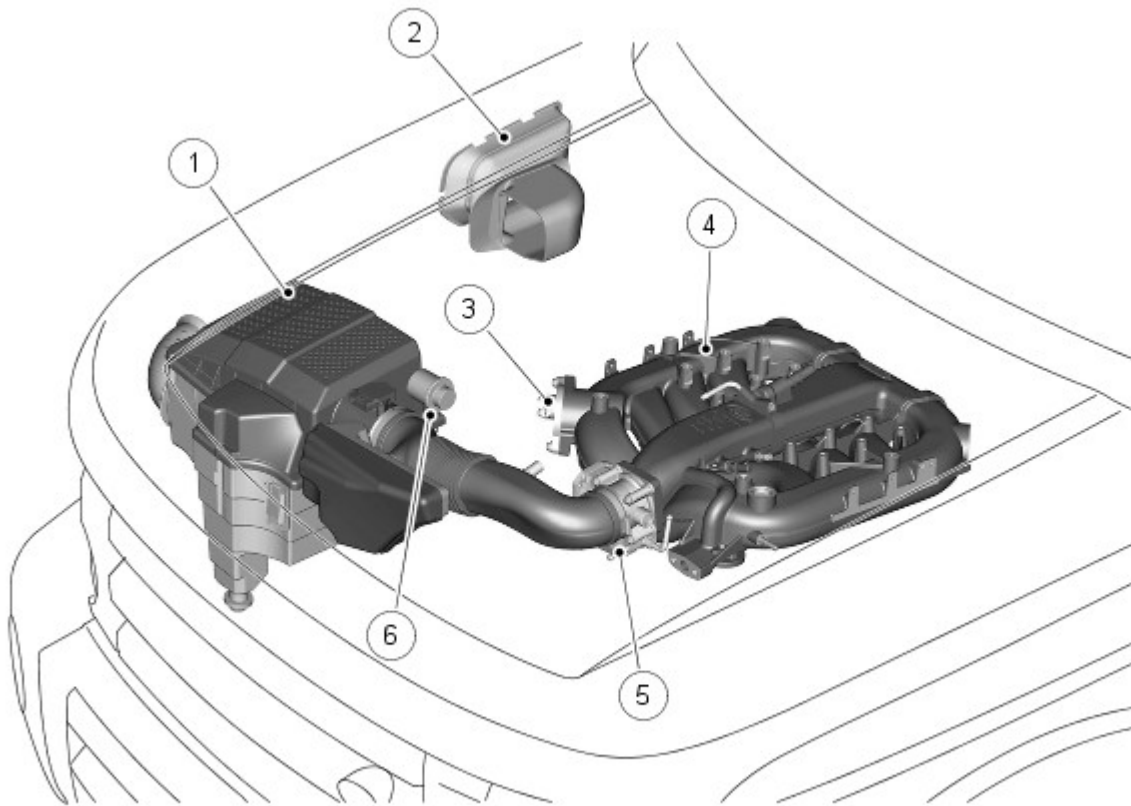
General Specification

Item	Specification
Air cleaner	Mann and Hummel fitted with replaceable paper element, air flow meter and optional service indicator
Air flow meter:	
Make	Denso
Location	Air intake duct
Service indicator - Optional:	
Type	Transparent body giving visual indication of filter element condition
Location	In the filter housing adjacent to the clean air duct

Intake Air Distribution and Filtering - V6 4.0L Petrol - Intake Air Distribution and Filtering

Description and Operation

4 Liter V6 Petrol Intake Air Distribution and Filtering Component Location



E45603

Item	Part Number	Description
1	-	Air filter box
2	-	Air intake
3	-	Intake manifold tuning valve (IMTV)
4	-	Intake manifold
5	-	Electronic throttle
6	-	Filter minder (optional fit)

The 4.0 Liter V6 engine air intake and distribution system comprises:

- Air filter box
- Air intake
- Intake manifold
- Electronic throttle

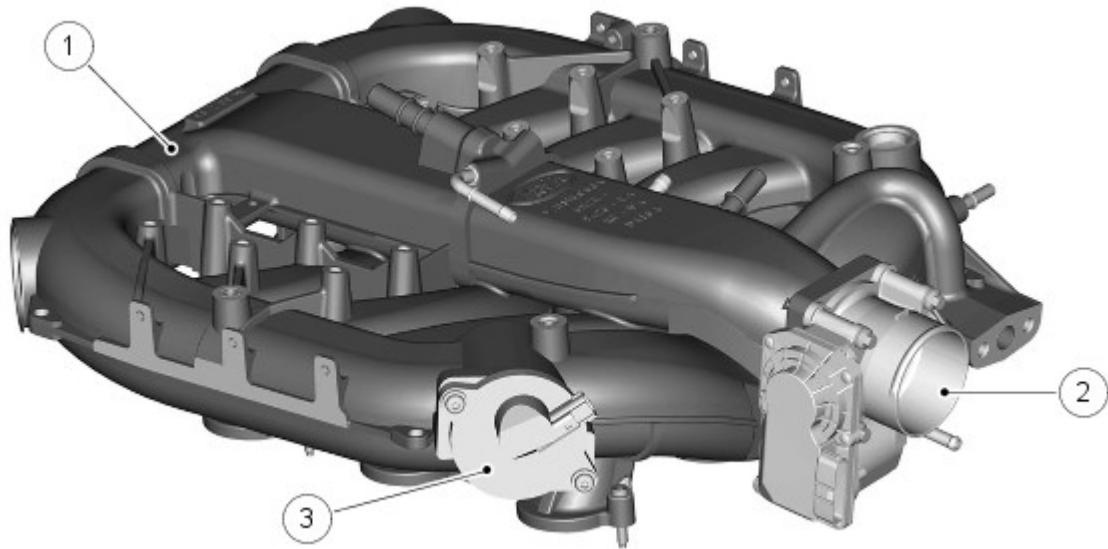
AIR FILTER BOX

The air filter box is located in the front of the engine bay on the inside of the RH front wing. Air is drawn from the air intake in the wing through the wing cavity and into the air filter box.

After the air filter box there is a resonator located after the Mass Air flow/ Intake Air Temperature (MAF/IAT) sensor.

INTAKE MANIFOLD

Air Intake Manifold



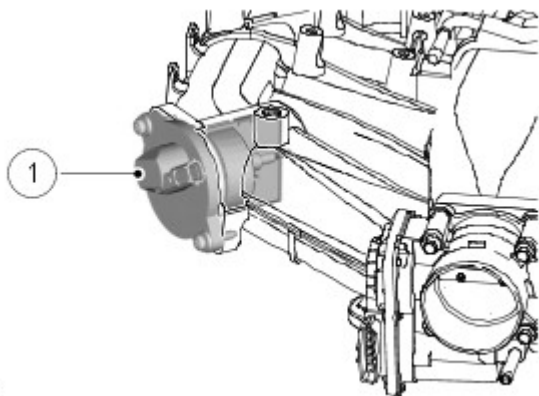
E45604

Item	Part Number	Description
1	-	Intake manifold
2	-	Electronic throttle
3	-	Inlet manifold tuning (IMTV)

The intake manifold is located on top of the engine between the two cylinder banks. The manifold is manufactured from an aluminium alloy. The intake manifold comprises a central chamber with six tracts leading to the inlet ports on the cylinder heads.

INTAKE MANIFOLD TUNING VALVE (IMTV)

Intake Manifold Tuning Valve



E45605

Item	Part Number	Description
1	-	Intake Manifold Tuning Valve (IMTV)

Intake Manifold Tuning Valve

The Intake Manifold Tuning Valve (IMTV) is located at the front right hand side of the air intake manifold. The IMTV is controlled by a PWM signal from the ECM

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

. The IMTV moves a plate within the inlet manifold to allow or block sonic pulses between the split manifold halves. This, in effect, extends the inlet runners and optimises for better low rpm torque.

Intake Air Distribution and Filtering - V6 4.0L Petrol - Intake Air Distribution and Filtering

Diagnosis and Testing

Principles of Operation

For a detailed description of the intake air distribution and filtering system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Intake Air Distribution and Filtering](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Hoses and ducts (damage/connections) ● Air cleaner element (contaminated/blocked) ● Restricted air intake ● Supercharger ● Supercharger (cooling fan) drive belt ● Supercharger seals and gaskets ● Charge air coolers (damage/connection) 	<ul style="list-style-type: none"> ● Mass Air Flow (MAF) sensor ● Manifold Absolute Pressure (MAP) sensor ● Manifold Absolute Pressure/Temperature (MAPT) sensor ● Throttle body ● Harness (security/damage) ● Connections (security/damage)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Vehicle does not start/hard starting/poor performance	<ul style="list-style-type: none"> ● Restricted/Blocked air intake ● Restricted/Blocked air cleaner element 	Clear the restriction. Replace the air cleaner element as necessary. Refer to the relevant workshop manual section.
Excessive intake noise	<ul style="list-style-type: none"> ● Intake pipe disconnected/damaged after the air cleaner ● Air cleaner assembly incorrectly assembled/damaged 	Check the intake system and hoses for correct installation/damage. Refer to the relevant workshop manual section.
Lack of boost	<ul style="list-style-type: none"> ● Supercharger drive belt broken/slipping ● Supercharger fault ● Supercharger air intake fault ● Major air leakage (after the supercharger) 	Check the supercharger and drive belt. Check the charge air coolers. Refer to the relevant workshop manual section.
Noise	<ul style="list-style-type: none"> ● Supercharger drive belt slipping ● Supercharger fault ● Major air leakage (after the supercharger) 	Check the supercharger and drive belt. Remove the supercharger drive belt and recheck for noise. Turn the supercharger by hand and check for excessive resistance. Check for excessive play at the supercharger pulley. Check the charge air coolers. Refer to the relevant workshop manual section.

DTC Index

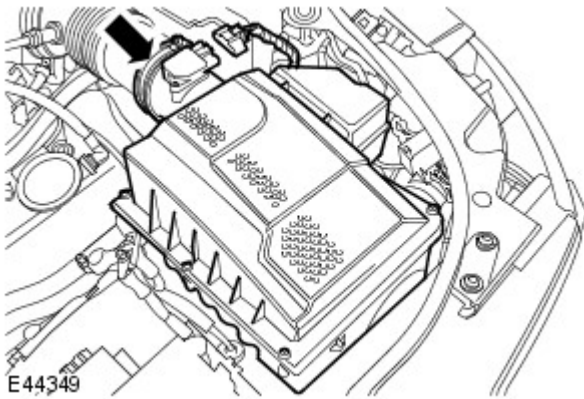
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Engine Control Module \(PCM\) 4.0L V6](#) (100-00 General Information, Description and Operation).

Intake Air Distribution and Filtering - V6 4.0L Petrol - Air Cleaner

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Release the air cleaner intake pipe.
 - Loosen the clip.
3. Disconnect the mass air flow (MAF) sensor electrical connector.



4. Remove the air cleaner assembly.

Installation

1. **NOTE:** When installing the air cleaner, make sure the locating pegs fit securely into the grommets.

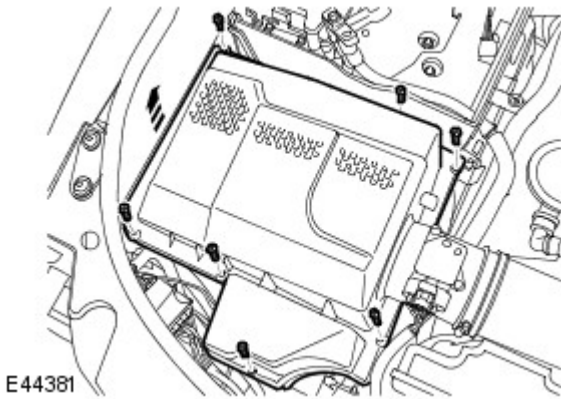
To install, reverse the removal procedure.

Intake Air Distribution and Filtering - V6 4.0L Petrol - Air Cleaner Element

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the air cleaner housing cover.
 - Remove the 7 screws.
3. Remove the air cleaner element.



Installation

1. Clean the base of the air cleaner.
2. To install, reverse the removal procedure.

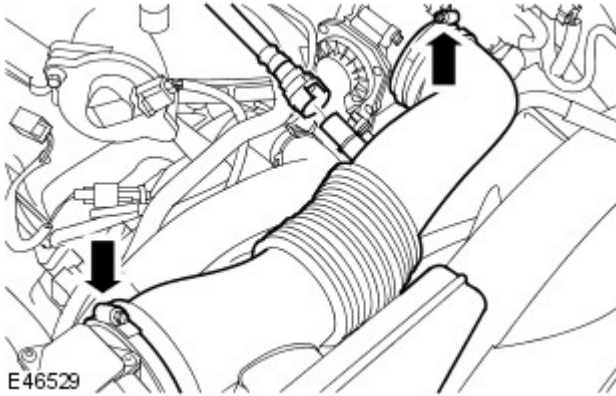
Intake Air Distribution and Filtering - V6 4.0L Petrol - Intake Air Resonator

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the air cleaner outlet pipe and intake air resonator.

- Release the 2 clips.
- Disconnect the breather hose.



Installation

1. To install, reverse the removal procedure.

Evaporative Emissions - V6 4.0L Petrol -

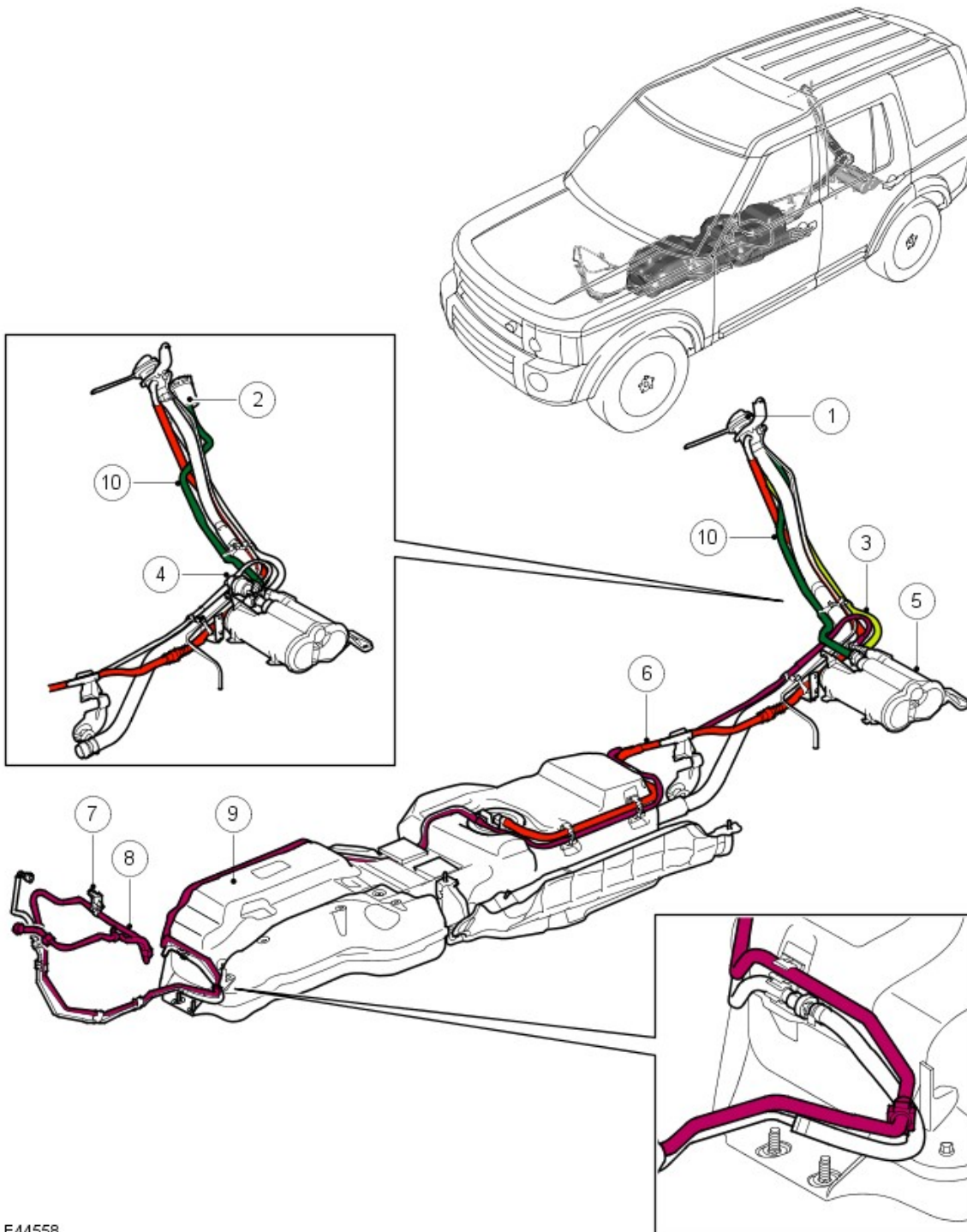
Torque Specifications

Description	Nm	lb-ft
Evaporative emissions canister bolts	23	17

Evaporative Emissions - V6 4.0L Petrol - Evaporative Emissions

Description and Operation

4.0L V6 Evaporative Emissions Component Layout



E44558

Item	Part Number	Description
1	-	Fuel filler head
2	-	DMTL pump filter (NAS only)
3	-	Fuel tank vent hose to canister
4	-	DMTL pump (NAS only)
5	-	Charcoal canister
6	-	Fuel tank breather hose from tank
7	-	Purge valve
8	-	Purge hose
9	-	Fuel tank
10	-	Charcoal canister vent hose (All except NAS) or DMTL pump vent hose (NAS)

GENERAL

The 4.0L V6 Evaporative emission (EVAP) control system reduces the level of hydrocarbons released into the atmosphere by fuel vapor venting from the fuel tank. The system comprises a charcoal canister, purge valve and interconnecting vent pipes and hoses. The vent pipes are connected to the system components using quick release connectors.

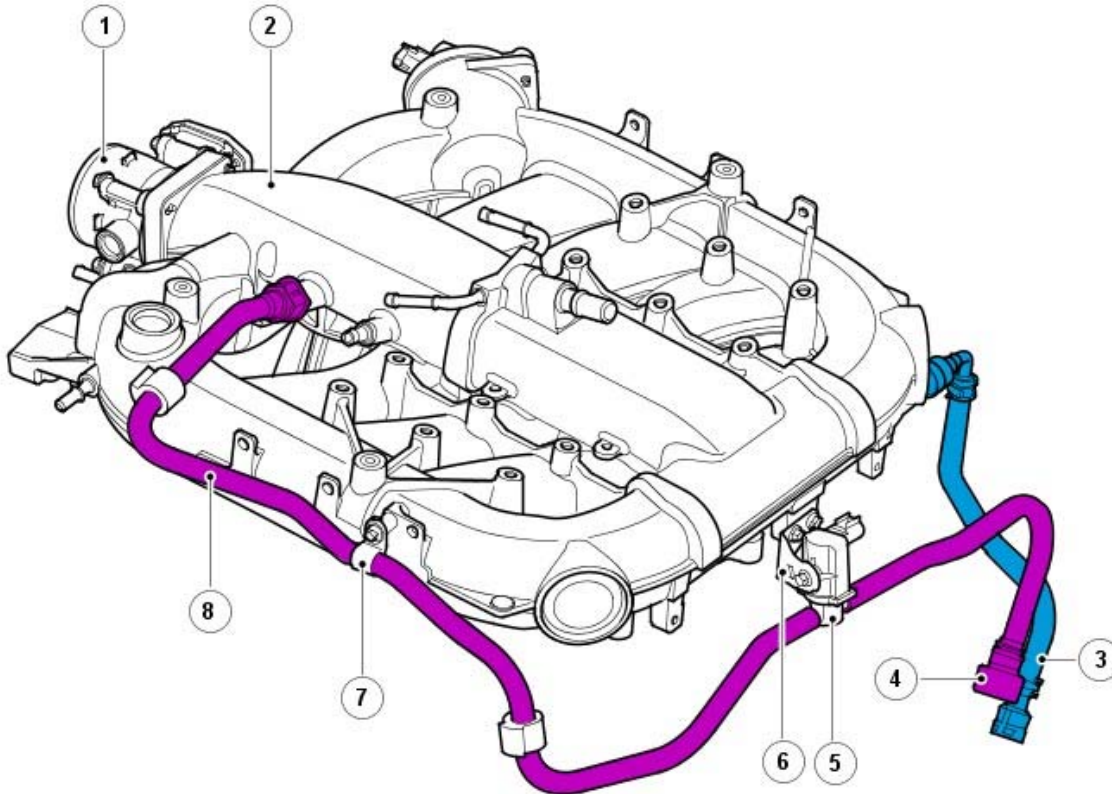
Fuel vapor is generated by the fuel in the tank and the amount of vapor produced increases as the fuel heats up. Fuel vapor can flow freely to the charcoal canister via the tank venting system. The venting system consists of roll over valves and a liquid vapor separator mounted internally in the tank and then externally via a breather line. The breather line allows the fuel vapor to flow to the charcoal canister via a 'Y' piece mounted on the filler head.

On NAS vehicles the vapor generated during refueling flows without restriction to the charcoal canister.

On all vehicles except NAS, the vapor is restricted in its path to the charcoal canister but can flow freely during the refueling operation to atmosphere, via the filler opening.

The vapor passes into the charcoal canister where it is absorbed and stored by the charcoal. Because there is a limit to the amount of vapor the canister can contain, the fuel vapor is purged from the canister when the engine is running and burned in the engine.

PURGE VALVE AND HOSES



E44559

Item	Part Number	Description
1	-	Electric throttle
2	-	Air intake manifold
3	-	Fuel feed jump hose (Ref. only)
4	-	Purge hose
5	-	Purge valve
6	-	Bracket
7	-	Hose clamp
8	-	Manifold to purge valve hose

The purge valve and purge hose are located on the air intake manifold, which is attached to the top of the engine and covered by the engine acoustic cover.

The purge hose is connected, at the right hand rear of the engine, from the purge valve with a quick release coupling to the purge line which runs parallel with the fuel feed line along the top of the fuel tank to the charcoal canister.

The purge hose is connected to the purge valve on the air intake manifold and is routed, via a hose clamp, to a connection on the manifold. The hose is connected to the air intake manifold with a quick release connector.

The purge valve is located on a bracket at the rear of the air intake manifold and secured with a single bolt. The purge valve is a solenoid operated valve which is closed when de-energised. The valve is controlled by the Engine Control Module (ECM) and is cycled when engine operating conditions are correct to allow purging of the charcoal canister.

The purge valve is Pulse Width Modulated (PWM) at 10Hz by the ECM. At this high frequency the pulses of purge gas flowing into the inlet manifold are almost a continuous flow. The valve operates between 5% and 100% duty or mark space ratio (% open time).

The ECM waits until the engine is running above 40°C (104°F) coolant with closed loop fuel operational. Under these conditions the engine

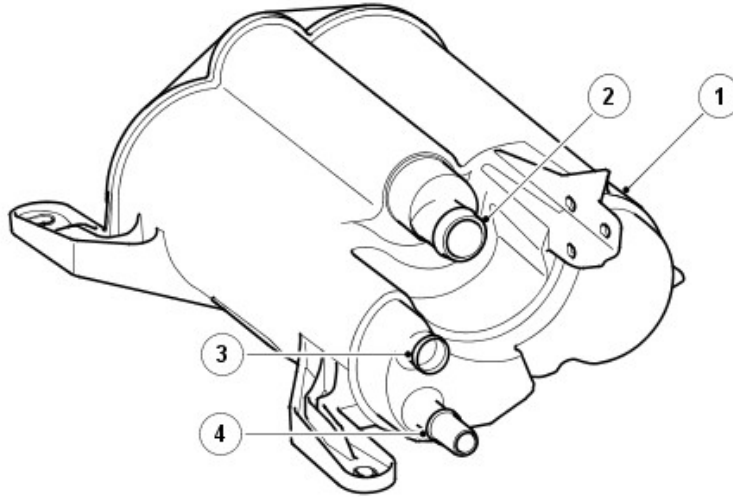
should be running smoothly with no warm up enrichment. The purge valve duty (and flow) is initially ramped slowly because the vapor concentration is unknown (a sudden increase in purge could cause the engine to flood). The concentration is then determined from the amount of adjustment that the closed loop fuelling is required to make to achieve the target Air Fuel Ratio (AFR). Once the concentration has been determined, the purge flow can be increased rapidly and the injected fuel can be proactively adjusted to compensate for the know purge vapor and the target AFR control is maintained.

When the purging process is active, fresh air is drawn into the charcoal canister via the DMTL pump atmospheric vent connection and its filter on NAS vehicles and via the vent hose connection and the spider trap on non NAS vehicles.

On NAS vehicles the system does not include a pressure test point. Pressure testing of the purge valve hose is achieved by disconnecting the purge valve joint on the underside of the vehicle, forward of the fuel tank and connecting a special tool to allow the system to be pressure tested. The test performs a pressure test on the purge hose connection forward of the fuel tank back to the charcoal canister. The special tool is then connected to the purge hose connection forward of the fuel tank to perform a pressure test on the purge hose to the purge valve.

CHARCOAL CANISTER

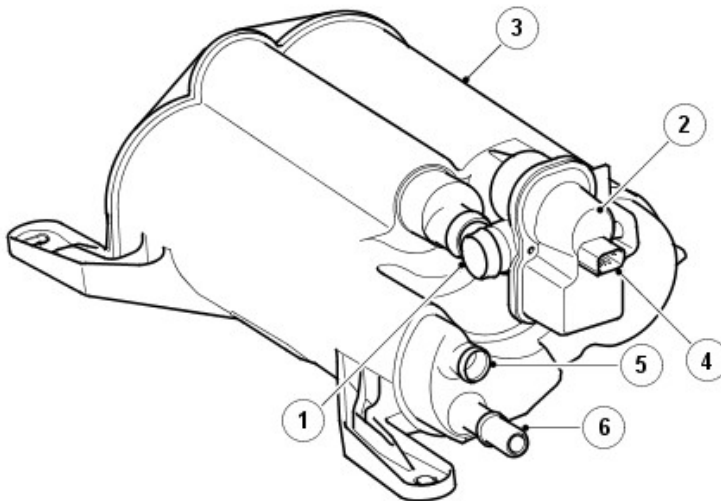
Charcoal Canister - All except NAS



E44560

Item	Part Number	Description
1	-	Charcoal canister
2	-	Charcoal canister atmospheric vent connection
3	-	Purge hose connection
4	-	Charcoal canister tank vent connection

Charcoal Canister - NAS



E44561

Item	Part Number	Description
1	-	Charcoal atmospheric vent connection (via DMTL pump)
2	-	DMTL pump
3	-	Charcoal canister
4	-	Electrical connector
5	-	Purge hose connection
6	-	Charcoal canister vent hose connection

The charcoal canister is located in a central position, forward of the spare wheel. It is attached at the rear with two bolts which screw into the spare wheel carrier. At the front, the canister has two lugs which locate in the parking brake module support bracket.

The canister on ROW vehicles has a capacity of 1400 cc (85.4 in³).

The canister on NAS vehicles has a capacity of 3000 cc (183 in³).

The canister has three ports which allow for the attachment of the atmospheric vent hose, the purge hose and the tank vent hose. On NAS vehicles the atmospheric vent hose connection allows for the attachment of the DMTL pump.

The canister contains a bed of activated charcoal or carbon. The charcoal is produced using special manufacturing techniques to treat the charcoal with oxygen. The oxygen treatment opens up millions of pores between the carbon atoms resulting in a highly porous charcoal with a

very large effective surface area which is capable of absorbing large quantities of fuel vapor. Once treated the charcoal is known as 'activated' carbon or charcoal. The charcoal canister on NAS vehicles uses a higher grade charcoal to meet the requirements of LEV2 emission regulations.

DIAGNOSTIC MONITORING OF TANK LEAKAGE (DMTL) - NAS ONLY

The DMTL system is a legislative requirement for NAS vehicles. The DMTL system periodically checks the EVAP system and the fuel tank for leaks when the ignition is switched off.

The DMTL system comprises the previously described components of the EVAP system with the following additional components: a DMTL pump and a DMTL filter.

The DMTL pump is connected to the atmospheric vent of the charcoal canister and incorporates an electric air pump, a Positive Temperature Co-efficient (PTC) heating element, a normally open valve and a reference orifice. The DMTL pump is only operated when the ignition is switched off and is controlled by the ECM. The ECM also monitors the electric air pump operation and the normally open valve for faults.

The DMTL filter protects the pump from dust being drawn into the system when the pump is being operated. The filter is located on the fuel filler head and is connected to the DMTL pump by a hose.

DMTL Operation

To check the fuel tank and the EVAP system for leaks, the ECM operates the DMTL pump and monitors the current draw. Initially, the ECM establishes a reference current by pumping air through the reference orifice and back to atmosphere. Once the reference current is determined, the ECM closes the normally open valve which seals the EVAP system. The purge valve remains de-energised and is therefore closed. The output from the air pump is diverted from the reference orifice and into the EVAP system.

When the normally open valve is closed, the load on the air pump falls to zero. Providing there are no leaks, the air pump will begin to pressurise the EVAP system and the load and current draw in the pump increases. By monitoring the rate and level of the current increase, the ECM can determine if there is a leak in the EVAP system.

During normal vehicle operation, the ECM energises the heating element in the pump to prevent condensation formation and possible incorrect current readings.

Leaks are classified as:

- Minor - equivalent to a hole diameter of 0.5 to 1.0 mm (0.02 to 0.04 in)
- Major - equivalent to hole diameter of 1.0 mm (0.04 in) or greater.

The ECM performs a check for major leaks each time the ignition is switched off, providing the following conditions are met:

- The vehicle speed is zero
- The engine speed is zero
- The pressure altitude (70kPa (10.15 lbf/in²) derived from engine load calculations) is below 3047 m (10,000 feet)
- The ambient temperature is between 0 and 40°C (32 and 104°F)
- The charcoal canister load factor is 2 or less (where the load factor is a measure, between -1 and +30, of the fuel vapor stored in the charcoal canister. Where -1 is 0% fuel vapor, 0 is stoichiometric fuel vapor level and +30 is 100% saturated with fuel vapor.
- The fuel tank level is valid and between 15 and 85% of nominal capacity
- The engine running time during the previous cycle was more than 10 minutes
- The battery voltage is between 10 and 15 volts
- The last engine off time was more than 180 minutes
- No errors are detected with the EVAP components, the ambient air temperature and the fuel level
- High range must be selected on the transfer box.

• NOTE: A leak test can be performed using T4. This overrides the above conditions and is useful for checking correct system and component operation.

The ECM performs a check for minor leaks after every 14th major leak check or after refuelling is detected.

When the leak check is complete, the ECM stops the DMTL pump and opens (de-energises) the normally open valve.

If the fuel filler cap is opened or refuelling is detected during the leak check, by a sudden drop in the current draw or a rise in the fuel level, the ECM aborts the leak check.

If a leak is detected during the check, the ECM stores an appropriate fault code in its memory. If a leak is detected on two consecutive checks, the ECM illuminates the Malfunction Indicator Lamp (MIL) in the instrument cluster on the next drive cycle.

The duration of a leak check can be between 40 and 270 seconds depending on the results and fuel tank level.

Evaporative Emissions - V6 4.0L Petrol - Evaporative Emissions

Diagnosis and Testing

Principles of Operation

For a detailed description of the evaporative emission system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Evaporative Emissions (303-13 Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fuel filler cap and seal ● Fuel filler neck ● DMTL fresh air filter (restriction, etc) ● Fuel tank (leaks, damage, etc) ● Fuel lines and joints, etc ● Carbon canister ● Purge valve ● Diagnostic module fuel tank leak (DMTL) pump module 	<ul style="list-style-type: none"> ● Fuses ● Connectors ● Harness ● Purge valve ● Diagnostic module fuel tank leak (DMTL) pump

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.
5. **5.** Where K-Line, Vacutec or other proprietary smoke test equipment is available, it should be utilized to assist with Evaporative Emissions System leak diagnosis.

Symptom Chart

Symptom	Possible Causes	Action
Difficulty in filling fuel tank	<ul style="list-style-type: none"> ● Restriction in the vapour line between the fuel tank and the carbon canister outlet/atmospheric port 	Check for restrictions/damage, etc (see visual inspection)
Fuel smell	<ul style="list-style-type: none"> ● System leak ● Purge valve inoperative 	Check for leaks, check the purge valve operation
'Check Fuel Filler Cap' displayed on Message Center	<ul style="list-style-type: none"> ● Fuel filler cap missing/not tightened after refuelling 	Check the fuel filler cap and seal

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Evaporative Leak OBD Fault Rectification Guide

Determine Which DTC Has Been Stored

Using the manufacturer approved diagnostic system, choose **diagnostic session**, then choose the following symptom paths : **Powertrain/engine system/fuel vapour and odor, Powertrain/engine system/fuel tank, Electrical/instruments /warning lamps/engine malfunction lamp/lamp illuminated, Powertrain/engine system/engine performance/fuel consumption high**

• **NOTE:** This guide covers DTCs that relate to evaporative leak monitoring, as listed in the table below

DTC	Description
P0442-00	DMTL small leak
P0447-00	DMTL COV electrical low (open)
P0448-00	DMTL COV electrical high
P0455-00	DMTL rough leak
P2401-00	DMTL pump electrical low (open)
P2402-00	DMTL pump electrical high
P2404-2F	DMTL noise fault
P2404-29	DMTL reference leak

DTC	Description
P2405-00	DMTL reference current low
P2406-00	DMTL reference current high
P2450-00	DMTL COV stuck open
P2451-00	DMTL COV stuck closed
P240B-00	DMTL heater electrical low (open)
P240C-00	DMTL heater electrical high

Attempt To Replicate The Fault Using The "Fuel Leak Check" Forced Test

1. Record any DTCs that has been logged
2. Using the manufacturer approved diagnostic system, in the **Recommendations** tab run the **Fuel Leak Check** forced test
3. For the test to run the fuel level must be between 15% and 85%
4. During this procedure the engine must be off
5. The possible responses from the test and the associated DTCs are listed below
6. If again no fault is found it could suggest that the failure mode is a borderline condition (refer to section 3) or that it was caused by incorrect fitment of the fuel cap or the fuel filler neck is at fault therefore it is important not disturb the fuel cap
7. Disconnect purge pipe from the purge valve, observe the condition of connection (the seating and condition of the "O" ring) and then reconnect. Using the manufacturer approved diagnostic system, run **Purge Valve Self Test** (to clean the purge valve) then run the **Fuel Leak Check**
8. If the test failed, a smoke test is required to determine the cause of the leak

• NOTE: P240B & P240C are not included in the **Fuel Leak Check** forced test (these monitors run at every ignition on and complete within 30 seconds)

Response Description	ID	Equivalent DTC
Function running: Reference leak measurement	1	
Function running: Rough leak measurement	2	
Function running: Small leak measurement	3	
Function running: 2nd ref leak measurement	4	
Function running: COV Cleaning	5	
Function aborted due to conditions: Vbatt conditions not correct (too high/ low)	11	
Function aborted due to conditions: Variation Ref. I (reference current) too high	12	P2404-29
Function aborted due to conditions: DMTL electrical fault	13	P0447, P0448
Function aborted due to conditions: Maximum diagnostic time exceeded	14	
Function aborted due to conditions: Crash detected	15	
Function aborted due to conditions: Refuel detected	20	
Function aborted due to conditions: Filler cap opened	21	
Function aborted due to conditions: Engine start	23	
Function aborted due to conditions: Noisy current measurement	24	P2404-2F
Function aborted due to conditions: Ambient temp outside range	26	
Function aborted due to conditions: Ambient pressure outside range	27	
Function aborted due to conditions: Other conditions	29	
Function complete - Tight system, fault free	30	
Function complete - Fine leak detected	31	P0442
Function complete - Rough leak detected	32	P0455
Function complete - Module error	33	P2401, P2402, P2450, P2451, P2405, P2406, P2404-29
Function complete - Medium leak detected	34	P0442, P0455

Read The "Ranking values" To Determine How Far Away The Result Is From The Failure Threshold

9. When the **Fuel Leak Check** forced test has completed the test results (known as ranking values) will be displayed
10. These should be compared against the limits shown in the table below
11. If the test result is borderline then there is a risk that a failure will occur at a later date (during customer usage of the vehicle)
12. To avoid this the vehicle should be carefully checked for any small leaks

Ranking Value	Normal Result For Tight System	Leak Failure Condition
Rough Leak (40 thou+)	0 > = 50	>= 128
Small Leak (20 thou+)	0 > = 60	>= 128

TRACE THE ROOT CAUSE OF THE FAULT

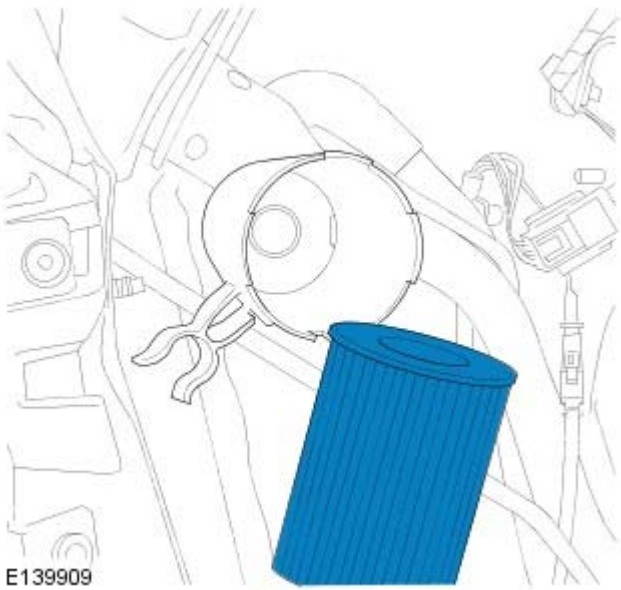
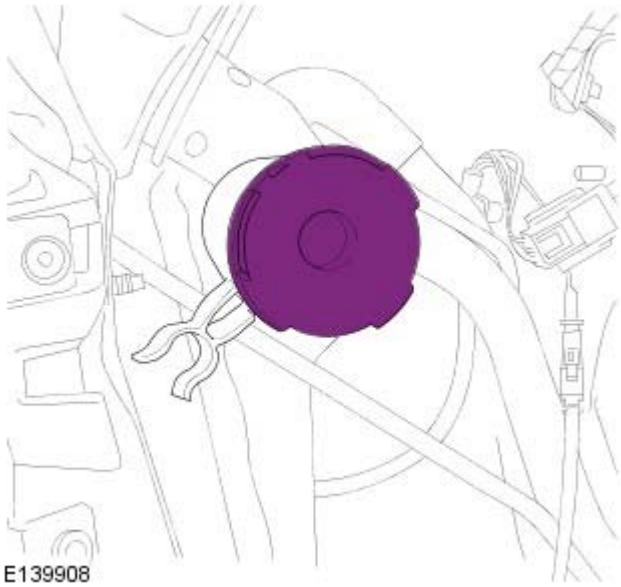
The list below provides some suggested actions to help trace the root cause of the fault

Each action should be followed up with a **Fuel Leak Check** forced test (and ranking value check) in order to determine if any improvement has been made

DTC	Fault Description	Fault Rectification Actions after smoke test
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DTC	Fault Description	Fault Rectification Actions after smoke test
P0442-00	DMTL small leak	<ul style="list-style-type: none"> ● 1. Inspect / refit filler cap after smoke test (inspect filler neck for correct fitment to pocket so that filler neck protrudes) ● 2. Run engine at idle; Using the manufacturer approved diagnostic system, run Purge Valve Self Test (to clean the purge valve) ● 3. Check that the DMTL module wiring connector has been installed correctly and that the seals around the connector body and individual wires are in good condition ● 4. Check all fuel system connections are correctly installed and secure ● 5. Visually inspect purge canister, purge pipes, fuel tank and filler neck for any obvious damage ● 6. Try isolating the purge valve by fitting a blanking plug to the purge pipe ● 7. Carry out a smoke test ● 8. Replace the DMTL module
P0447-00	DMTL COV electrical low (open)	<ul style="list-style-type: none"> ● 1. Check fuse ● 2. Check that fuse fits tightly into the fuse holder ● 3. Check that the DMTL module wiring connector has been fitted correctly ● 4. Check wiring harness continuity between DMTL module and ECU connectors ● 5. Replace DMTL module
P0448-00	DMTL COV electrical high	<ul style="list-style-type: none"> ● 1. Check wiring ● 2. Replace DMTL module
P0455-00	DMTL rough leak	<ul style="list-style-type: none"> ● 1. Inspect / refit filler cap after smoke test (inspect filler neck for correct fitment to pocket so that filler neck protrudes) ● 2. Run engine at idle; Using the manufacturer approved diagnostic system, run "Purge Valve Self Test" (to help clean the purge valve) ● 3. Check that the DMTL module wiring connector has been installed correctly and that the seals around the connector body and individual wires are in good condition (surprisingly, this is a potential leakage path!) ● 4. Check all fuel system connections are correctly installed and secure ● 5. Visually inspect purge canister, purge pipes, fuel tank and filler neck for any obvious damage ● 6. Try isolating the purge valve by fitting a blanking plug to the purge pipe ● 7. Carry out a smoke test ● 8. Replace DMTL module
P2401-00	DMTL pump electrical low (open)	<ul style="list-style-type: none"> ● 1. Check fuse ● 2. Check that fuse fits correctly into the fuse holder ● 3. Check that the DMTL module wiring connector has been fitted correctly ● 4. Check wiring harness continuity between DMTL module and ECU connectors ● 5. Replace DMTL module
P2402-00	DMTL pump electrical high	<ul style="list-style-type: none"> ● 1. Check wiring ● 2. Replace DMTL module
P2404-2F	DMTL noise fault	<ul style="list-style-type: none"> ● Replace DMTL module
P2404-29	DMTL reference leak	<ul style="list-style-type: none"> ● Replace DMTL module
P2405-00	DMTL reference current low	<ul style="list-style-type: none"> ● Replace DMTL module
P2406-00	DMTL reference current high	<ul style="list-style-type: none"> ● 1. Check for any blockages in the DMTL ventilation pipe & filter ● 2. Replace DMTL module
P2450-00	DMTL COV stuck open	<ul style="list-style-type: none"> ● Replace DMTL module
P2451-00	DMTL COV stuck close	<ul style="list-style-type: none"> ● Replace DMTL module
P240B-00	DMTL heater electrical low (open)	<ul style="list-style-type: none"> ● 1. Check fuse ● 2. Check that fuse fits tightly into the fuse holder ● 3. Check that the DMTL module wiring connector has been fitted correctly ● 4. Check wiring harness continuity between DMTL module and ECU connectors ● 5. Replace DMTL module
P240C-00	DMTL heater electrical high	<ul style="list-style-type: none"> ● 1. Check wiring ● 2. Replace DMTL module

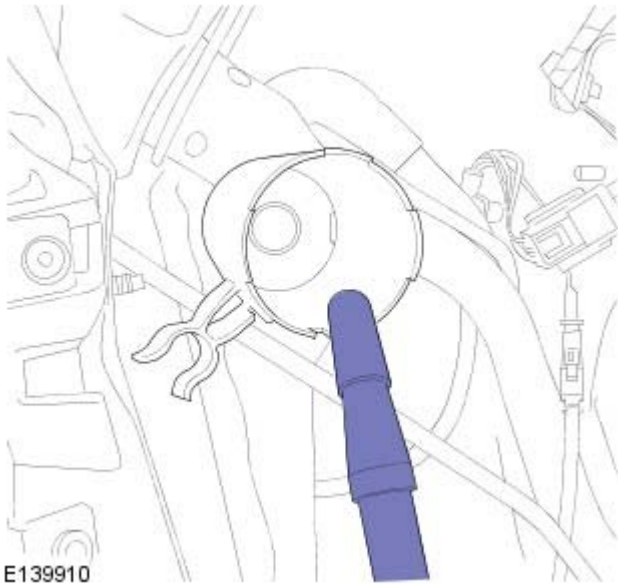
Pre and 10MY Denso/Bosch PCM Systems



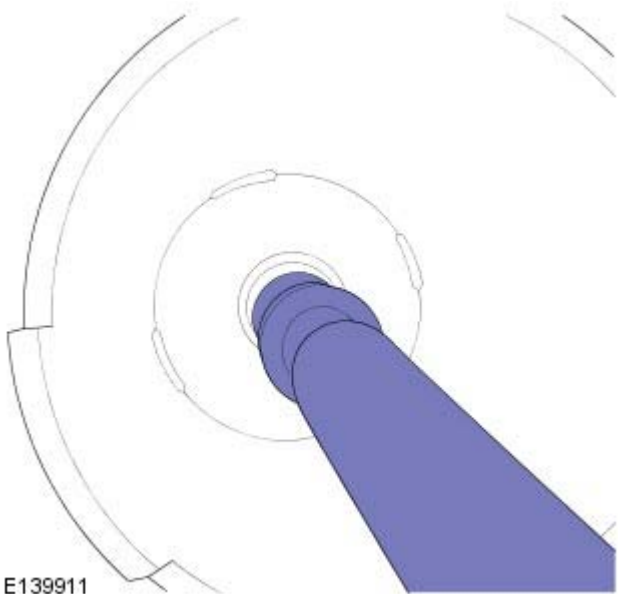
CAUTION: The Maximum pressure of the EVAP system is 0.07 bar **do not exceed**

• **NOTE:** Apart from the purge valve connection, it is recommended to smoke test the EVAP system without disturbing any joints associated with the system, this will determine the leak more accurately and quickly

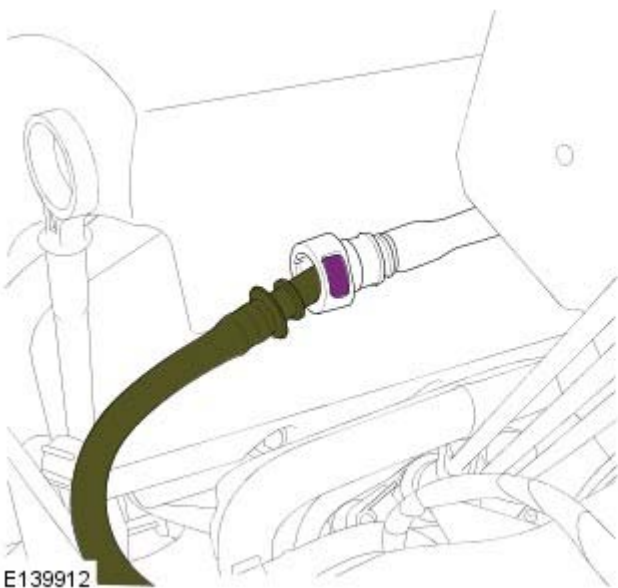
- 1. Remove rear wheel arch liner to access fuel filler neck
- 2. On the fuel filler neck the DMTL filter will be visible as shown in picture. Unclip filter housing from fuel filler neck to gain better access to DMTL filter
- 3. Remove carefully the top of filter to expose filter and remove
- 4. Attach rubber adapter to tip of smoke machine nozzle to ensure tight seal to filter housing. Disconnect the purge pipe from purge valve; this will be an escape point for the smoke to exit
- 5. Allow tester to complete self-test and green READY light to turn ON 2. For best Tester performance; completely unwind Tester's supply hose
- 6. Press **Smoke** on control panel to fill EVAP system with smoke vapour. The control panel **Smoke** light will light indicating smoke production. The smoke setting is on a 15 minute timer. Pressing the **Smoke** button again turns Tester off. It is normal for the flow meter ball, while in the smoke mode, not to be as steady as when it is in the **Test** mode. Note: The pressure gauge is active only after smoke cycle is complete
- 7. Continue introducing smoke into the EVAP System until the flow meter's ball stops descending and this assures the system test pressure is met and smoke will appear from the purge pipe, then close off purge pipe with special tool (Test Adapter Hose/EVAP Port 310-142)



E139910



E139911



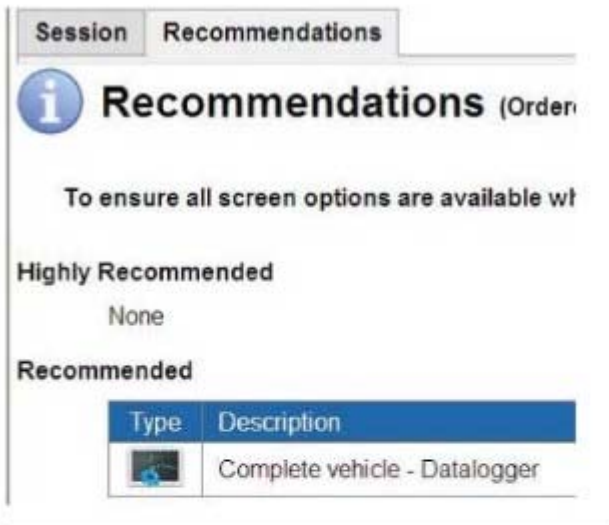
E139912



CAUTION: On some vehicles, the DMTL filter can not be removed, in these instances fill the system through the purge valve and smoke will appear from the filter

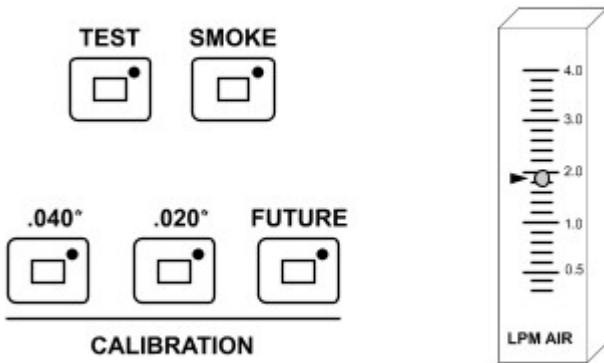
Pre 10MY Vehicles

On pre 10MY DMTL systems, Using the manufacturer approved diagnostic system, select **Measurement application** session then select the **Recommendations** tab which will give you access to **Datalogger**. Then select **Engine systems** then select the **Output state control** data-logger signal **Engine output 1 – diagnostic module – tank leakage -change over valve active** which will close the system. Then select **Engine output 1 – diagnostic module – tank leakage – pump active** this will pressurize the EVAP system



- Engine output 1 - engine management system warning lamp.
- Engine output 1 - malfunction indicator warning lamp.
- Engine output 1 - diagnostics module - tank leakage - test complete.
- Engine output 1 - diagnostics module - tank leakage - heater active.
- Engine output 1 - diagnostics module - tank leakage - pump active.
- Engine output 1 - diagnostics module - tank leakage - changeover valve active.
- Engine output 2 - heated exhaust gas oxygen heater active - bank 2.

E139916



E139913

10MY vehicles

On 10MY vehicles a smoke test application is available so therefore only smoke fill the system and then run the application

- 8. Follow the EVAP system path with the halogen light provided and looks for the smoke exiting the leak(s) or use the UV light provided and look for the dye deposited at the exact location of the leak(s)
- 9. Repair the leak(s) and perform the **Fuel Leak Check** application again or smoke test to verify repair, as well as to make sure there are no additional leaks in the EVAP system

The UltraTraceUV® smoke solution's dye feature is especially helpful when the leak is in an area that is not readily visible, as on the top of the fuel tank or behind a panel. Once you gain access to the area of the leak, wear the yellow UV glasses and shine the UV light provided to identify the exact location of the leak(s). Smoke exiting a very small leak is even easier to see with lower pressure. If you encounter smoke leaking out of an area but find it difficult to pinpoint exactly where the source of the leak is; try reducing the pressure in the system being tested by turning the Tester OFF and allow the pressure to dissipate. The longer a particular leak is allowed to leak, the more fluorescent dye material will be deposited

at that leak. With some vapour system leaks, the leak may only present itself under vacuum and not under pressure. If equipment permits, test the system in both states. Purge valve faults [P0441, P0444, P0458 and P0459] should all inhibit DMTL leak test and therefore need to be resolved prior to any DMTL issues. For this reason, when smoke testing the vapour system, it should be sufficient to enter the system at the connection up stream of the purge valve. If no leak is found then testing the remainder of the system up to the purge valve is recommended

• **NOTE:** It may be possible to search for small leaks using a gas analyzer and looking for HC (hydro carbon) spikes. This should enable leaks to be detected in areas of the vapor system that our out of sight of the technician. The solenoid should be deactivated after five minutes to prevent potential damage. Check that connector and individual terminals are sealed correctly

Phase-One – (quantifying the leak)



E139914

- 1. Connect the tester supply hose to vehicle EVAP system. > Refer to appropriate vehicle application
- 2. Determine if the vehicle's EVAP system you are testing is governed by a .020" (0.5 mm) or .040" (1 mm) acceptable leak standard. Press the appropriate calibration standard on the tester's control panel and observe the position of the flow meter ball. > This function automatically turns off in 10 seconds
- 3. Position the flow meter's pointer flag so that it aligns with the measurement observed in step 2 above. > This sets PASS / FAIL mark
- 4. Close vehicle's EVAP Vent Solenoid. > Refer to appropriate vehicle application
- 5. Press TEST on control panel and fill EVAP system. > This introduces 5-minutes of nitrogen gas
- 6. Look for flow meter ball to stop descending indicating that the vehicle system is full. > Fill time 1-4 minutes depending on system volume
- 7. Compare flow meter ball reading to pointer flag. > ABOVE flag = FAIL (go to Phase-Two). > BELOW flag = PASS (test complete)

Testing With Pressure and Vacuum Decay

In addition to quantifying the leak with the Phase-One flow test, the Tester allows you the flexibility of testing the vehicle's EVAP system by using either **Pressure Decay** or **Vacuum Decay** methods. Below are instructions for performing both decay tests

Pressure-Decay Test

• **NOTE:** The Pressure Decay test is best performed immediately after the Phase-one flow test, since the system has already built up pressure

At the completion of the Phase-one flow test, the EVAP system is fully pressurized, since the Phase-one test uses pressure to perform its flow test. Testing pressure decay with the Vacutec® 522B-J/LR is very simple. All you need to do is the following:

- 1. Allow tester to complete self-test and green **READY** light to turn ON
- 2. Connect Tester supply hose to vehicle EVAP system
- 3. Close vehicle's EVAP Vent solenoid > Refer to appropriate vehicle application
- 4. Press **VACUUM** switch on the tester control panel
 - NOTE: The vacuum switch is on a 30-second timer, which should be sufficient time to draw the appropriate vacuum from the EVAP system. Press VACUUM switch again if additional time is required
- 5. After vacuum timer turns off, observe the vacuum gauge for any decay (loss of vacuum) indicating a leak in the EVAP system




E139915


- NOTE: Disconnect the Tester from the vehicle after the Vacuum Decay Test. The fuel pressure in the vehicle's fuel tank is constantly changing due to the vehicle's fuel volatility and that could cause the Tester's pressure gauge to exceed its maximum reading limits

Evaporative Emissions - V6 4.0L Petrol - Evaporative Emission System Leak Test

General Procedures

Special Tool(s)	
 <p>310-142 E67117</p>	<p>EVAP tool 310-142</p>


• NOTE: The following procedure allows a fuel leak, indicated by the Malfunction Indicator Lamp (MIL), to be accurately located. The test must only be carried out once it has been established that there are no obvious faults with any of the fuel system components.


-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.


Position the vehicle on a lift.

- Check the components in the fuel and EVAP system for obvious damage. Make sure all the connections are secure.
- Connect T4 to the vehicle.
 - Run the DMTL test.
 - Follow the on-screen prompts and force the DMTL to close.

4. WARNINGS:

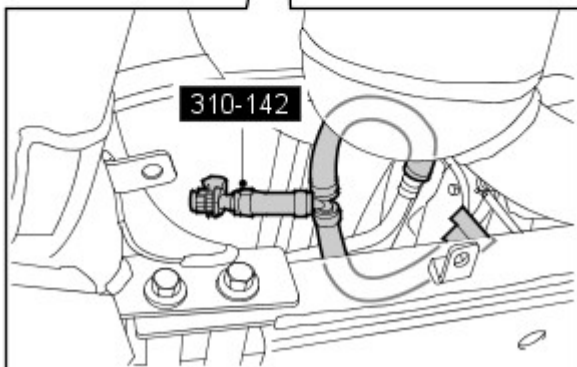
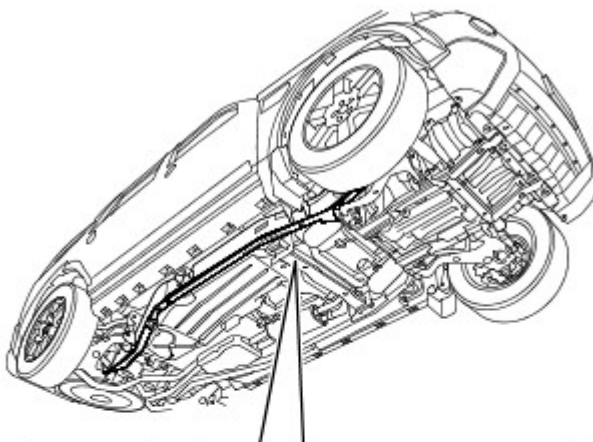
 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.


 **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Install the special tool to the purge line.

- Release the clip and disconnect the purge line.
- Clean the component mating faces.
- Connect the special tool.



E67118

-  **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the purge line at the emission canister line.


- Release the clip.
6. Carry out the procedures in order, from the instruction sheet supplied with the EVAPS diagnostic testing station 310-115 (LRA-19-004) or (LRA-19-005A).
 7. When a leak is detected, replace the component as necessary and repeat the test to validate the repair.
 8. Connect the purge line to the emission canister line.
 - Clean the component mating faces.
 - Secure with the clip.
 9. Disconnect the special tool from the purge line.
 - Clean the component mating faces.
 - Connect the purge line.
 10. Disconnect T4 from the vehicle.

Evaporative Emissions - V6 4.0L Petrol - Evaporative Emission Canister

Removal and Installation

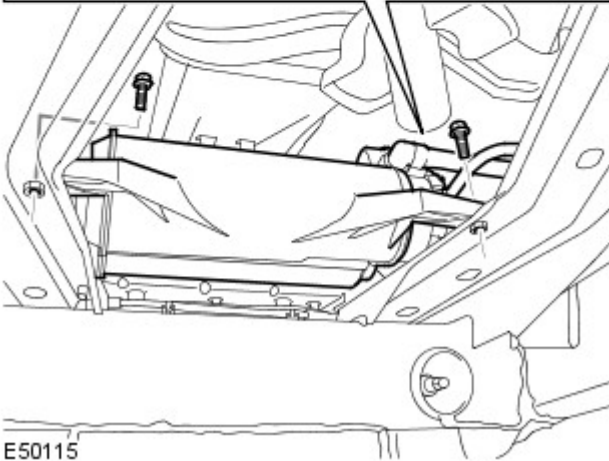
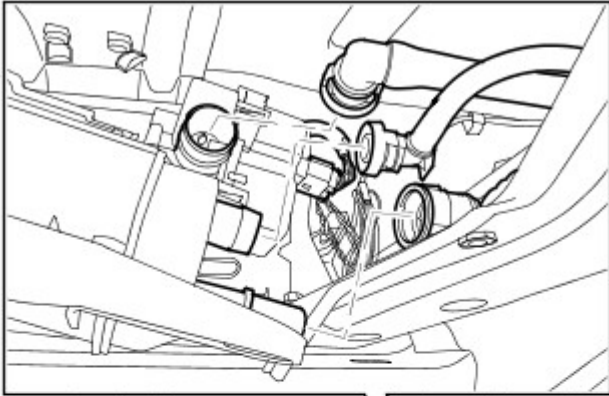
Removal

1. Remove the spare wheel and tire.

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the evaporative emissions canister.



E50115

- Remove the 2 bolts.
- Disconnect the 3 lines.
- Disconnect the electrical connector.

4. **NOTE:** Do not disassemble further if the component is removed for access only.

NAS vehicles: Remove the fuel tank leakage detection module.

- Remove the 3 screws.



E50116

Installation

1. NAS vehicles: Install the fuel tank leakage detection module.

- Install the screws.

2. Install the evaporative emissions canister.

- Connect the electrical connector.
- Connect the lines.

- Tighten the bolts to 23 Nm (17 lb.ft).

3. Install the spare wheel and tire.

Evaporative Emissions - V6 4.0L Petrol - Evaporative Emission Canister

Purge Valve


Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake manifold casting.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. **NOTE:** Note the fitted position.

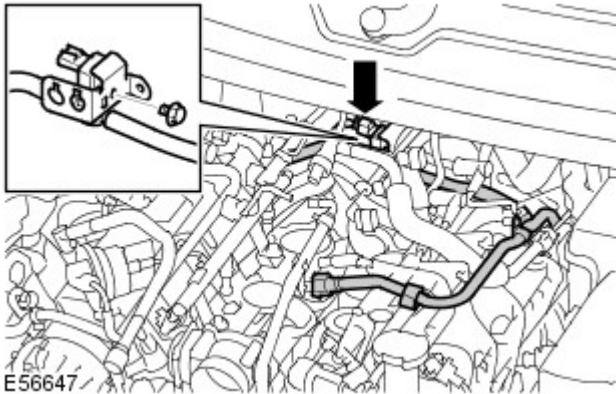
Release the purge valve from the mounting bracket.

- Remove the bolt.

4.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the purge valve.

- Disconnect the 2 hoses.
- Disconnect the electrical connector.



Installation

1. Connect the purge valve.
 - Connect the hoses.
 - Connect and secure the electrical connector.

2. **NOTE:** Align to the position noted on removal.

Install the purge valve, align the peg and tighten the bolt to 6 Nm (4 lb.ft).


3. Install the intake manifold casting.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Evaporative Emissions - V6 4.0L Petrol - Fuel Tank Leakage Monitoring Pump

Removal and Installation

Removal

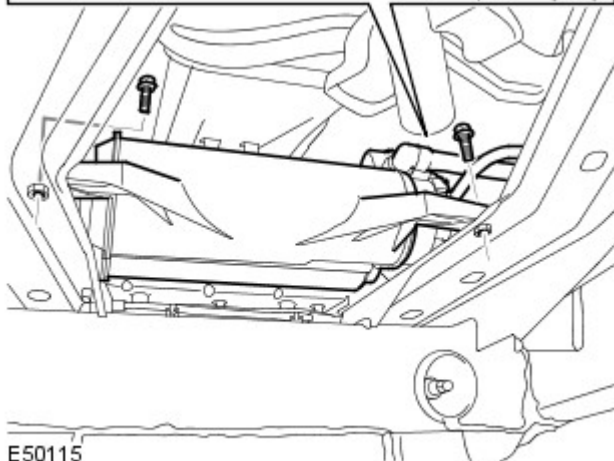
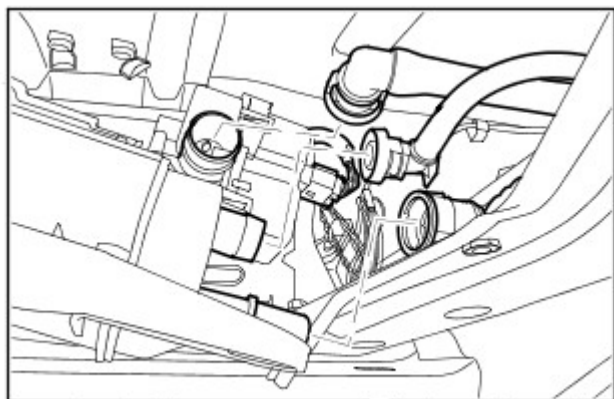
1. Remove the spare wheel and tire.

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the evaporative emissions canister.

- Remove the 2 bolts.
- Disconnect the 3 lines.
- Disconnect the electrical connector.



E50115

4. Remove the fuel tank leakage detection module.

- Remove the 3 screws.



E50116

Installation

1. Install the fuel tank leakage detection module.

- Install the screws.

2. Install the evaporative emissions canister.

- Connect the electrical connector.

- Connect the lines.
- Tighten the bolts to 23 Nm (17 lb.ft).

3. Install the spare wheel and tire.


Evaporative Emissions - V6 4.0L Petrol - Fuel Tank Leakage Monitoring

Pump Filter

Removal and Installation

Removal

1. Remove the spare wheel and tire.

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Position the vehicle on a lift.

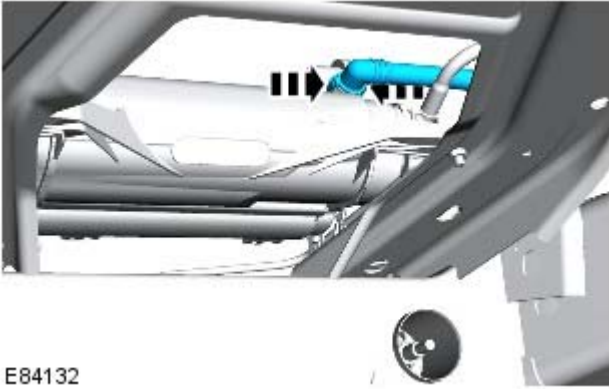
3. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

4. Remove the RH rear wheel and tire.

5. Remove the fender moulding.
For additional information, refer to: [Rear Quarter Panel Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

6. Release the fuel leak detection filter.

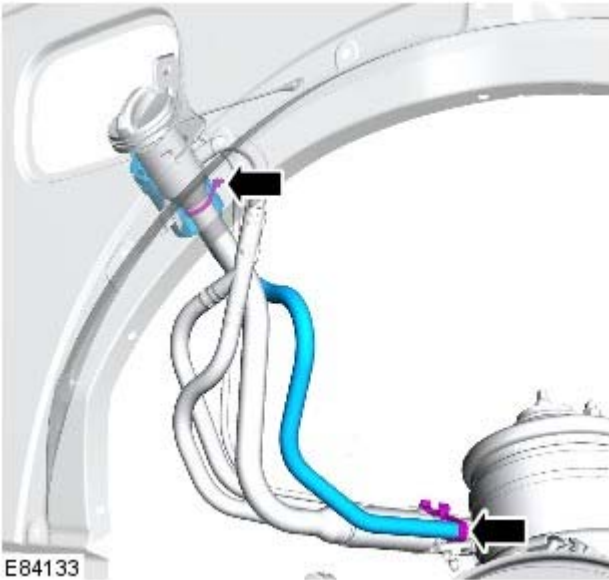
- Disconnect the breather hose from the fuel leak detection pump.



E84132

7. Remove the fuel leak detection filter and breather hose assembly.

- Release the breather hose from the clip.
- Remove and discard the cable tie.



E84133

Installation

1. Install the fuel leak detection filter and breather hose assembly.

- Secure with a cable tie.
- Secure the breather hose in the clip.

2. Attach the fuel leak detection filter breather hose to the

pump.

3. Install the fender moulding.

For additional information, refer to: [Rear Quarter Panel Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

4. Install the RH rear wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

5. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

6. Install the spare wheel and tire.

Evaporative Emissions - V6 4.0L Petrol - Evaporative Emission Canister Ventilation Filter

Removal and Installation

Removal

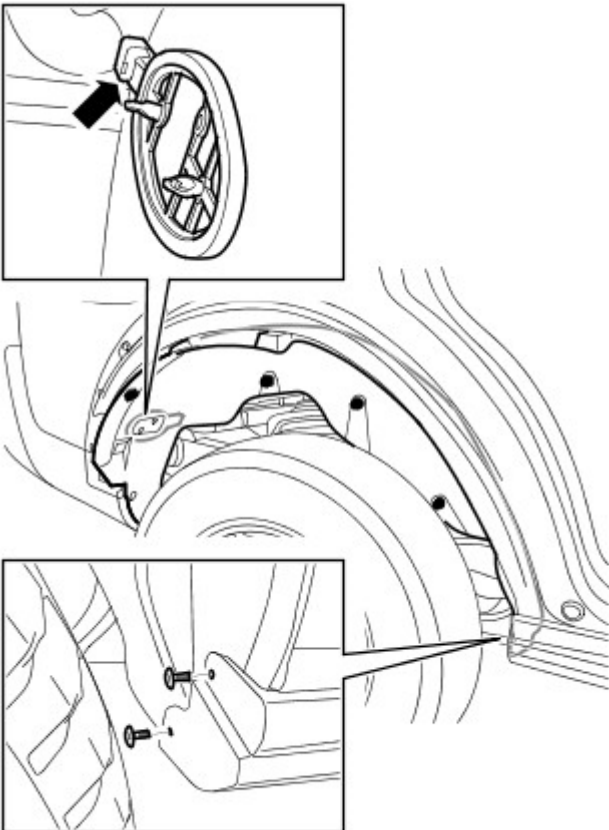
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the RH rear wheel and tire.
3. Remove the RH rear quarter panel moulding.
For additional information, refer to: [Rear Quarter Panel Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
4. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

Remove the RH rear fender splash shield.

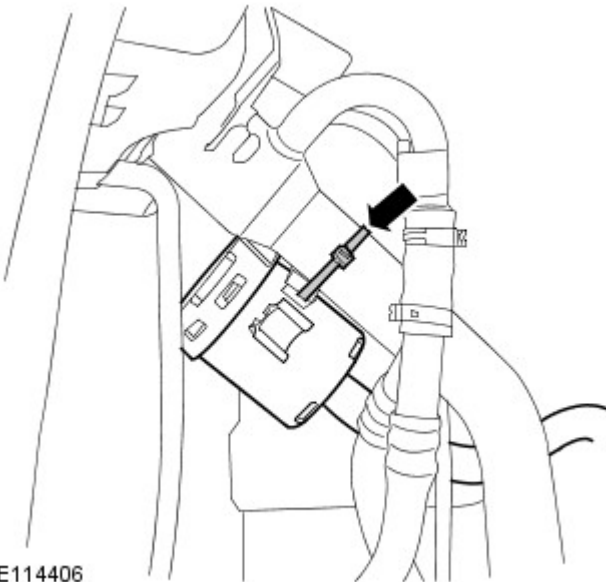
- Remove the 2 screws.
- Remove the 6 retainers.
- Disconnect the electrical connector.



E48478

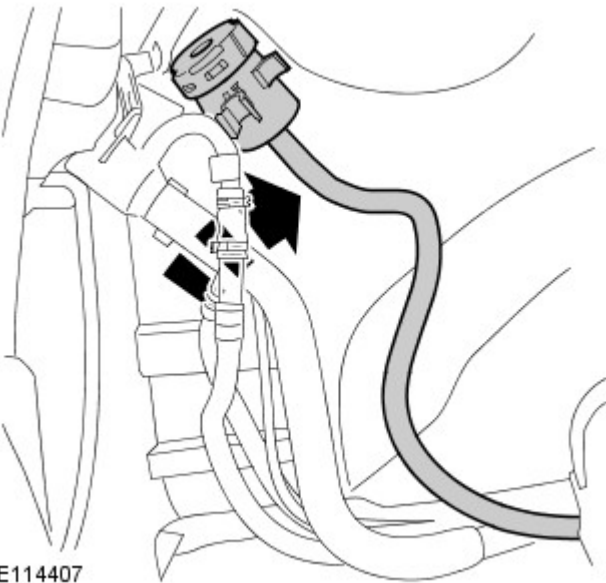
5. Release the evaporative emission canister ventilation filter from the fuel filler pipe.

- Cut the cable tie.



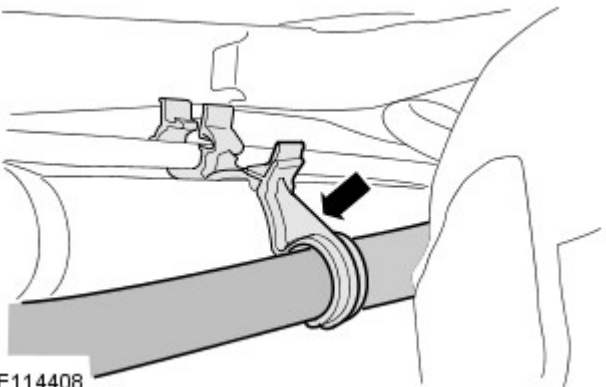
E114406

6. Position the evaporative emission canister ventilation filter to one side.



E114407

7. Release the evaporative emission ventilation filter from the clip.

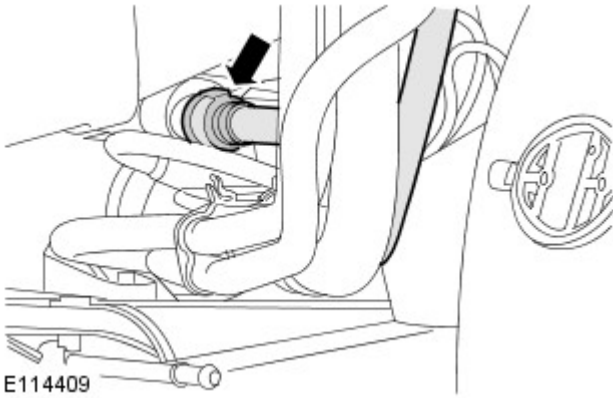


E114408

8. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Remove the evaporative emission canister ventilation filter.

- Release the evaporative emission canister ventilation filter from the evaporative emission canister.



Installation

1. To install reverse the removal procedure.

Electronic Engine Controls - V6 4.0L Petrol -

Lubricants

Item	Land Rover Part No.
* HO2s removal	STC 50545
HO2s threads	Apply suitable high temperature anti-seize compound to threads of sensor

*** Apply to area around sensor threads prior to attempting to remove sensor**

Engine Management System

Item	Description
Engine management system:	
Make	Siemens
Type	PAG EMS - Generation 1

Torque Specifications

Description	Nm	lb-ft
Intake manifold tuning (IMT) valve bolts	10	7
+ Heated oxygen sensor (HO2S)	45	33
* RH catalytic converter to exhaust manifold bolts	22	16
* LH catalytic converter to exhaust manifold bolts	22	16
LH catalyst monitor sensor	45	33
Heat shield bolts	10	7
Mass air flow (MAF) sensor Torx screws	2	1.5
** Camshaft position (CMP) sensor bolt	6	4
Engine coolant temperature (ECT) sensor	18	13
Throttle body bolts	10	7
Crankshaft position (CKP) sensor Torx screw	8	6
Knock sensor (KS) bolt	20	15

+ Apply anti-seize lubricant to threads of sensor - See Lubricants

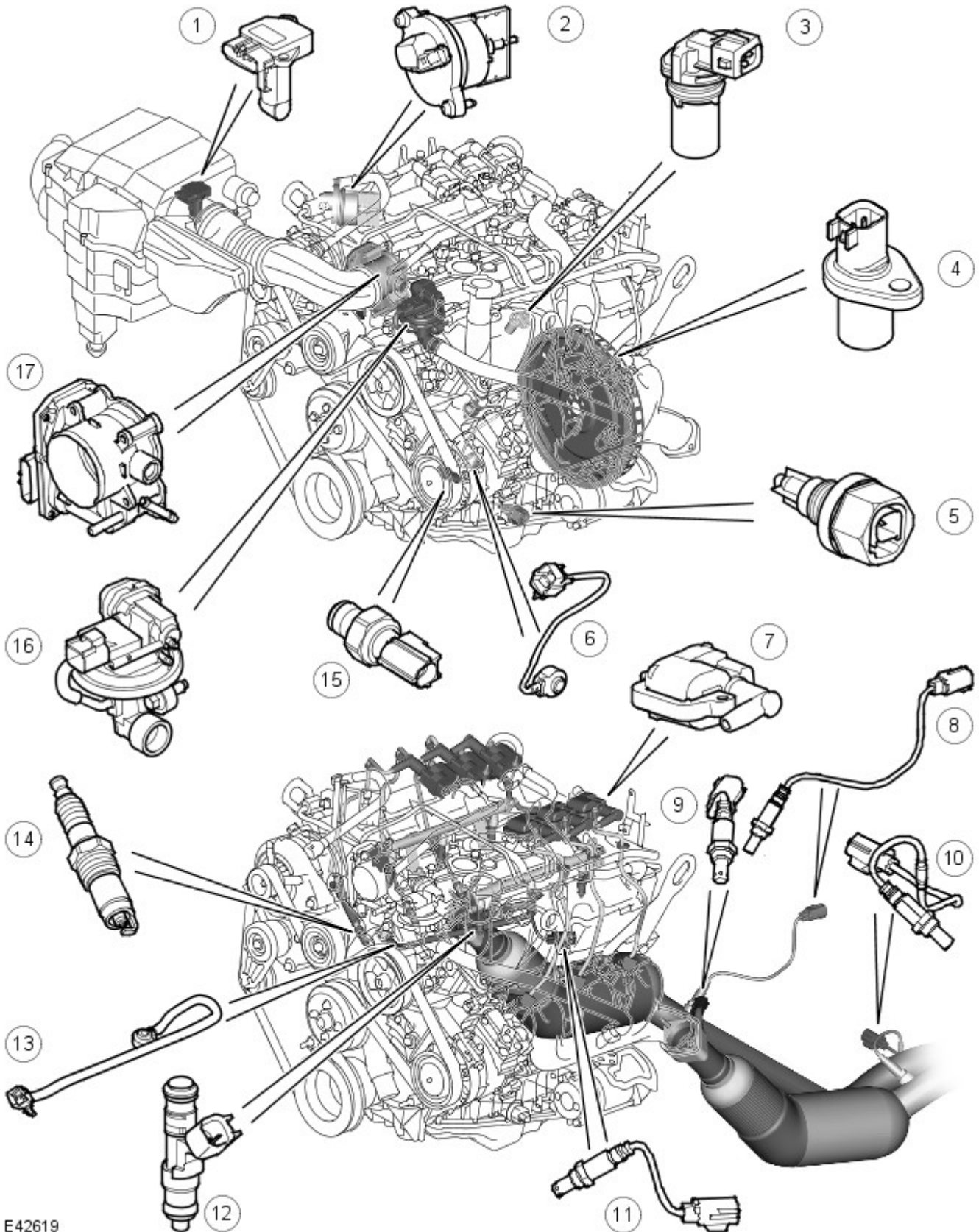
*** New bolts must be fitted**

**** Apply clean engine oil to a new CMP sensor O-ring seal.**

Electronic Engine Controls - V6 4.0L Petrol - Electronic Engine Controls

Description and Operation

4.0 Liter Electronic Engine Controls Component Location Sheet 1 of 2

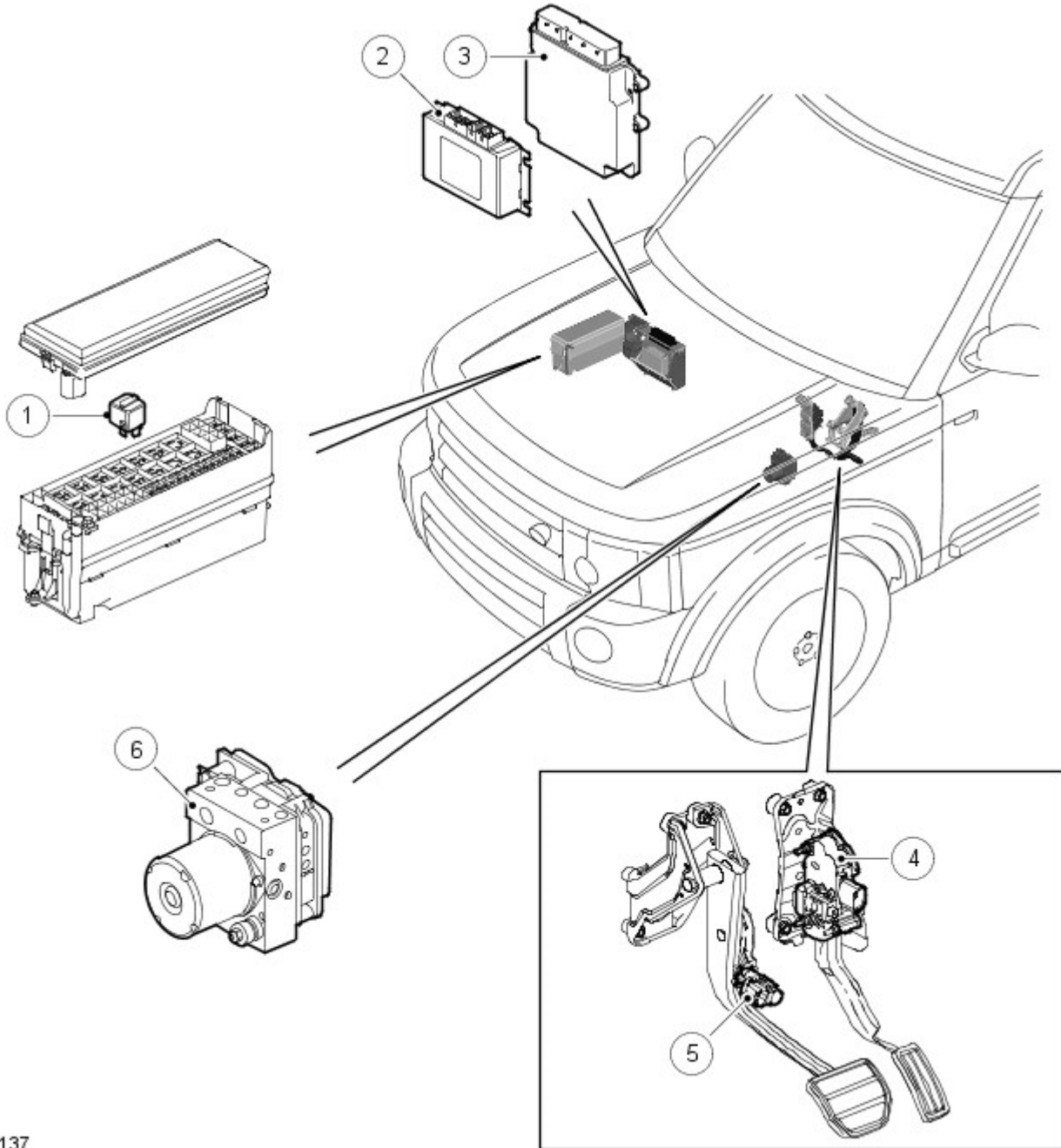


E42619

Item	Part Number	Description
1	-	mass air flow (MAF)/intake air temperature (IAT)
2	-	intake manifold tuning (IMT) valve
3	-	camshaft position (CMP)
4	-	crankshaft position (CKP)

5	-	Engine oil temperature sensor
6	-	Knock sensor
7	-	Ignition coils
8	-	Heated Exhaust Gas Oxygen sensor (HEGO)
9	-	Universal Heated Exhaust Gas Oxygen sensor (UHEGO)
10	-	Heated Exhaust Gas Oxygen sensor (HEGO)
11	-	Universal Heated Exhaust Gas Oxygen sensor (UHEGO)
12	-	Injectors
13	-	Knock sensor
14	-	Spark plugs
15	-	engine oil pressure (EOP) sensor
16	-	exhaust gas recirculation (EGR) valve and pressure differential sensor
17	-	Electric throttle

4.0 Liter Electronic Engine Controls Component Location Sheet 2 of 2

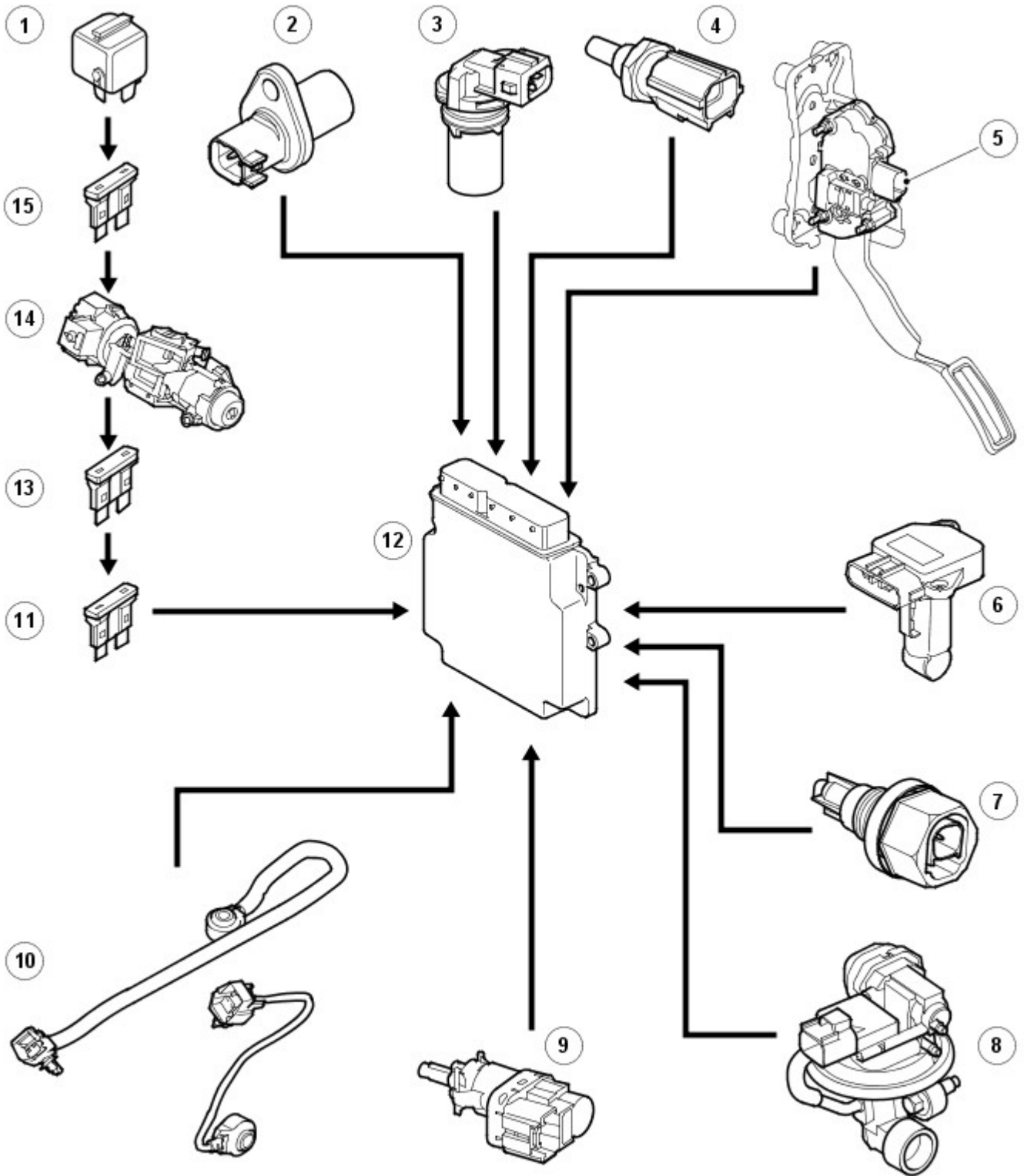


E50137

Item	Part Number	Description
1	-	Main relay
3	-	Transfer box control module
2	-	engine control module (ECM)
4	-	Brake lamp switch
5	-	Clutch switch
6	-	anti-lock brake system (ABS) control module

4.0L EMS Control Diagram Sheet 1 of 2

• NOTE: A= Hardwired



A →

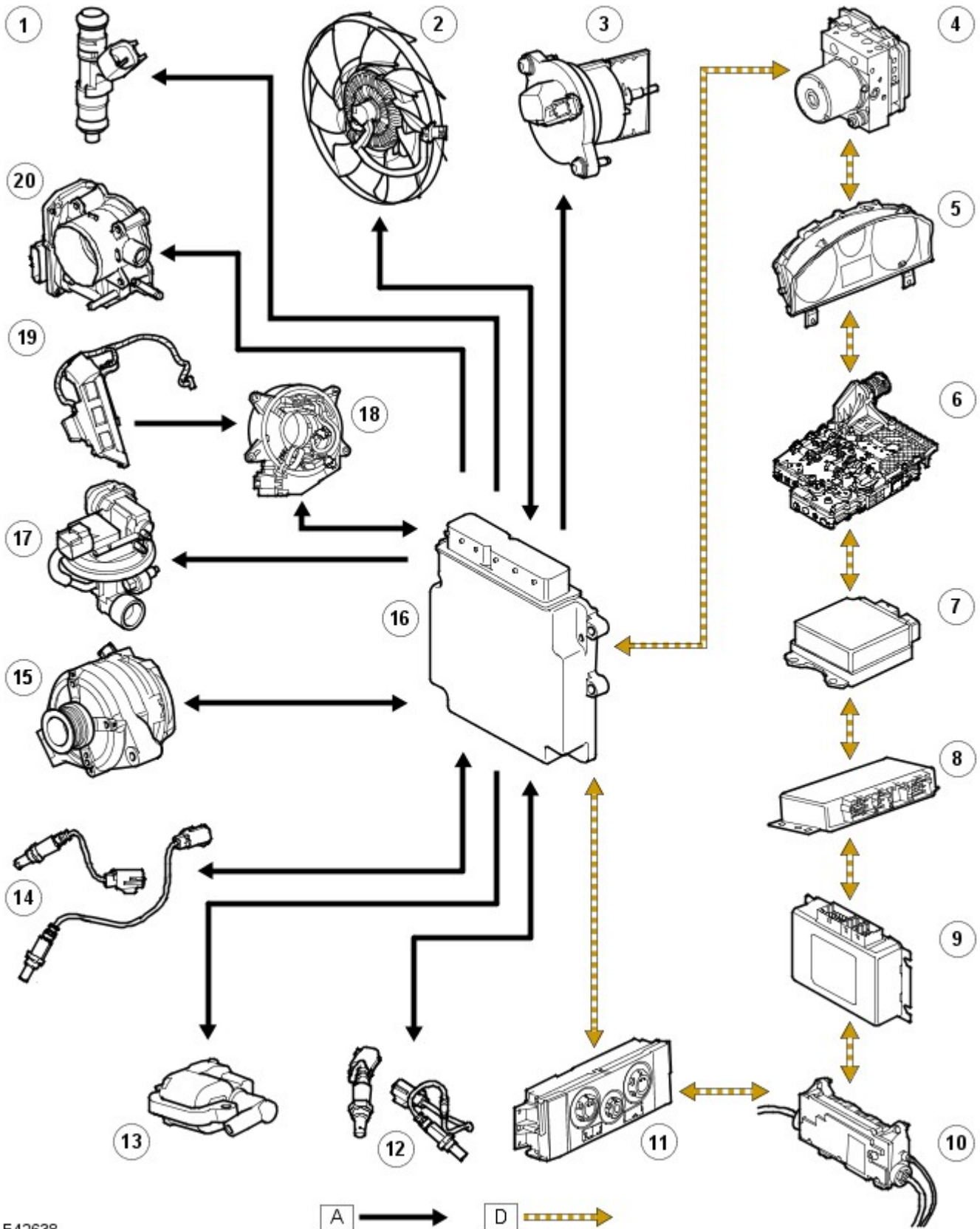
E50136

Item	Part Number	Description
1	-	Main relay
2	-	CKP
3	-	CMP
4	-	engine coolant temperature (ECT) sensor
5	-	accelerator pedal position (APP)
6	-	MAF
7	-	Engine oil temperature sensor
8	-	manifold absolute pressure (MAP)
9	-	Brake light switch
10	-	Knock sensor
11	-	Fuse No 25P

12	-	ECM
13	-	Fuse 60P
14	-	Ignition switch
15	-	Fuseable link 11E

4.0L EMS Control Diagram Sheet 2 of 2

• NOTE: A= Hardwired D= controller area network (CAN) Bus



E42638

Item	Part Number	Description
1	-	Injectors
2	-	Engine cooling fan

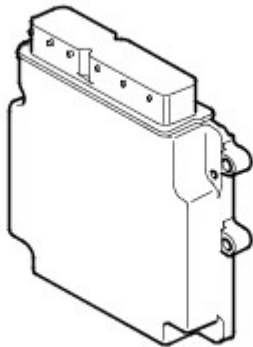
3	-	IMT valve
4	-	ABS control module
5	-	Instrument cluster
6	-	transmission control module (TCM)
7	-	restraints control module (RCM)
8	-	Differential control module
9	-	Transfer box control module
10	-	Electric park brake control module
11	-	automatic temperature control (ATC) module
12	-	Universal Heated Exhaust Gas Oxygen sensor (UHEGO) and Heated Exhaust Gas Oxygen sensor (HEGO)
13	-	Ignition coils
14	-	Universal Heated Exhaust Gas Oxygen sensor (UHEGO) and Heated Exhaust Gas Oxygen sensor (HEGO)
15	-	Generator
16	-	ECM
17	-	EGR valve/differential pressure sensor
18	-	Clock spring
19	-	Speed control switches
20	-	Electric throttle body

GENERAL

The V6 4.0 Liter engine is controlled by an ECM manufactured by DENSO. The Engine Management System (EMS) controls the following:

- Engine fueling
- Ignition timing
- Closed loop fueling
- Knock control
- Idle speed control
- Emission control
- On board diagnostic
- Interface with the immobilization system
- Speed control

ENGINE CONTROL MODULE (ECM)



E42610

The ECM is located in the E-Box in the plenum area on the passenger side of the engine compartment attached to the bulkhead.

Inputs

The ECM has the following inputs:

- Central Junction Box
- Engine Coolant Temperature
- Brake Switch
- Manifold Absolute Pressure
- Accelerator Pedal Position 1
- Accelerator Pedal Position 2
- Throttle Position 1
- Throttle Position 2
- Engine cooling fan Speed
- Engine speed and position sensor (crankshaft sensor)
- Camshaft position sensor
- Engine Oil Temperature
- IAT sensor (integrated into MAF)
- MAF
- Knock sensors (2)
- Speed Control Switches (resistive ladders)
- Oxygen sensors (4)
- Vehicle Speed (via CAN)
- EGR Differential Pressure

- EGRMAP
- Generator Monitor

Outputs

The ECM outputs to the following:

- Throttle Actuator
- Ignition coils (6)
- Oxygen sensor heaters (4)
- Fuel injectors (6)
- EGR Valve
- IMT valve
- Purge Valve
- Fuel pump relay
- Starter Relay
- Air conditioning condenser fan module (CAN)
- EMS Main Relay
- Viscous Fan Control
- Generator Control

The ECM controls the engine fueling by providing sequential fuel injection to all cylinders. Ignition is controlled by a direct ignition system, provided by six plug top coils. The ECM is able to detect and correct for ignition knock on each cylinder and adjust the ignition timing for each cylinder to achieve optimum performance.

The ECM uses a torque-based strategy to generate the torque required by the driver and other vehicle ECU's. The EMS uses various sensors to determine the torque required from the engine. These include:

- Mass Air Flow meter
- Accelerator Pedal Position sensor
- Engine temperatures
- Oxygen sensors

The EMS processes these signals and decides how much torque to generate. Torque is then generated by using various actuators to supply air, fuel and spark to the engine (electronic throttle, injectors, coils, etc.)The EMS also interfaces with other vehicle ECU's, via CAN, to obtain additional information, these include

- ABS control module
- TCM
- Transfer box control module

Pin No	Description	Input/Output
1	CAN	Input/Output
2	CAN	Input/Output
3	Generator monitor	Input
4	UHEGO Bank A ground	-
5	UHEGO Bank B ground	-
6	Crank sensor -	Input
7	Cam sensor ground	-
8	Not used	-
9	Not used	-
10	Sensor ground 3	-
11	Sensor ground 4	-
12	Sensor ground 5	-
13	Not used	-
14	Spare ground	-
15	Sensor ground 6	-
16	Not used	-
17	Not used	-
18	MAF ground	-
19	Knock sensor bank A ground	-
20	Knock sensor bank B ground	-
21	Not used	-
22	Not used	-
23	Oil temperature sensor	Input
24	Sensor power 6	Output
25	LIN A	Output
26	UHEGO B +	Input
27	UHEGO B -	-
28	UHEGO A +	+
29	UHEGO A -	-
30	Crank sensor +	Input
31	Not used	-
32	Not used	-
33	Not used	-
34	CMP signal bank A	Input
35	Not used	-
36	Not used	-
37	Not used	-
38	Differential pressure sensor	Input
39	Not used	-

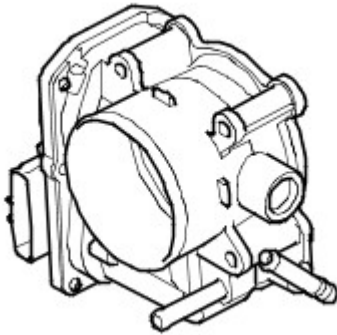
Pin No	Description	Input/Output
40	Fuel pressure sensor	Input
41	Not used	-
42	Knock sensor A +	Input
43	Knock sensor B +	Input
44	Not used	-
45	Not used	-
46	Fuel temperature sensor	Input
47	Sensor power 5	Output
48	Sensor power 4	Output
49	Not used	-
50	Not used	-
51	Not used	-
52	Not used	-
53	Not used	-
54	Not used	-
55	Not used	-
56	Ignition coil cylinder 3 B	Output
57	Ignition coil cylinder 3 A	Output
58	Ignition coil cylinder 2 B	Output
59	Ignition coil cylinder 2 A	Output
60	Ignition coil cylinder 1 B	Output
61	Ignition coil cylinder 1 A	Output
62	Ignition coil ground bank A	-
63	Viscous fan monitor	Input
64	Ignition coil ground bank B	-
65	Throttle position sensor 1	-I
66	Air temperature sensor	Input
67	Throttle position sensor 2	Input
68	Coolant temperature sensor	Input
69	MAP	Input
70	MAF	Input
71	Not used	-
72	Sensor power 3	Output
73	Not used	-
74	Throttle valve open direction -	Output
75	Throttle valve open direction +	Output
76	UHEGO Heater bank A	Output
77	UHEGO Heater bank B	Output
78	Injector cylinder 1 B	Output
79	Injector cylinder 1 B	Output
80	Injector cylinder 2 A	Output
81	Injector cylinder 2 B	Output
82	Injector cylinder 3 A	Output
83	Injector cylinder 3 B	Output
84	Inlet manifold tuning valve 1	Output
85	Not used	-
86	Not used	Output
87	Not used	Output
88	Not used	Output
89	Not used	-
90	EGR	Input
91	Not used	-
92	Purge valve	Output
93	Viscous fan request	Output
94	Not used	-
95	Fuel pump relay	Output
96	Alternator control	Output

ECM Connector C0635 Pin Out Table

Pin No	Description	Input/Output
1	Signal ground 1	-
2	Power ground 1	-
3	Power ground 2	-
4	ECM power	Input
5	Power ground 3	-
6	APP sensor ground 1	-
7	APP sensor ground 2	-
8	Not used	-
9	Not used	-
10	Not used	-
11	Not used	-
12	Park/Neutral signal	Input
13	Not used	-
14	Not used	-
15	Not used	-
16	EMS relay	Output

Pin No	Description	Input/Output
17	Crank request	Output
18	CAN +	Output
19	APP sensor 2 power	Output
20	Fuel pump control	Output
21	Not used	-
22	Not used	-
23	Not used	-
24	APP sensor 1 signal	Output
25		
26	Brake light switch	Input
27	Not used	-
28	Not used	-
29	Not used	-
30	Ignition switch	Input
31	CAN +	Input
32	APP sensor 1 power	Output
33	DMTL	Output
34	Not used	-
35	Speed switch -	Output

ELECTRONIC THROTTLE



E42611

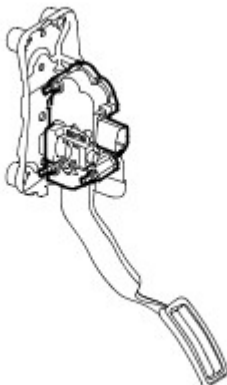
The V6 engine torque is regulated via an electronic throttle body which is located on the intake manifold in the engine compartment. An APP determines the driver demand to control throttle opening. This value is input into the EMS and the throttle is opened to the correct angle by means of an electric motor integrated into the throttle body. Sensors in the throttle body are used to determine the position of the throttle plate and the rate of change in its angle. A software strategy within the ECM enables the throttle position to be calibrated each ignition cycle. When the ignition is turned 'ON', the ECM opens and closes the throttle fully, thus performing a self-diagnostic and calibration. The throttle body is connected to the ECM via a pair of twisted wires to avoid electrical interference.

For additional information, refer to: [Acceleration Control](#) (310-02B Acceleration Control - V6 4.0L Petrol, Description and Operation).

C0175 Electronic Throttle Pin Out Table

Pin No	Description	Input/Output
1	Signal 1	Output
2	5 volt supply	Input
3	Signal 2	Output
4	Ground	-
5	Actuator +	Input
6	Actuator -	-

ACCELERATOR PEDAL POSITION SENSOR (APP)



E42612

The APP is used in conjunction with the electronic throttle body to provide a drive-by-wire system. The sensor is a resistive

type. Sensors in the accelerator pedal are used to determine the driver's request for vehicle speed, acceleration and deceleration. This value is input into the EMS and the throttle is opened to the correct angle by means of an electric motor integrated into the throttle body.

The APP sensor signals are checked for range, and for plausibility. Two separate reference voltages are supplied to the pedal. If one sensor fails, the other can be used as a 'limp – home' input.

The wires that connect the ground and signal from both potentiometers to the EMS are twisted together into two pairs, avoiding having to use a screen wire.

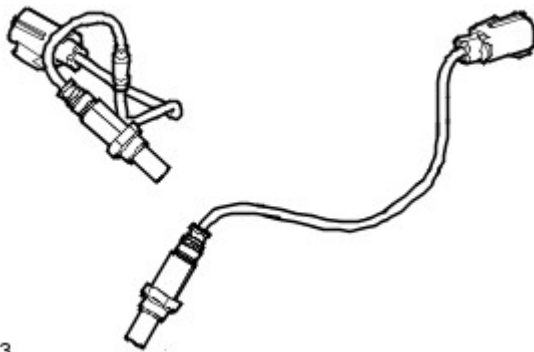
If signal failure occurs, the ECM enters limp home mode. The APP Sensor is located at the accelerator pedal .

C0787 APP Sensor Connector Pin Out Table

Pin No	Description	Input/Output
1	Sensor 2 ground	-
2	Sensor 1 demand	Output
3	Sensor 1 ground	-
4	Not used	-
5	Sensor 2 demand	Output
6	Supply 2 5 volt	Input
7	Supply 1 5 volt	Input
8	Not used	-

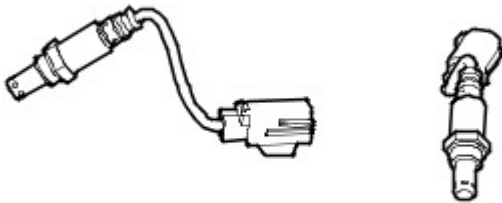
OXYGEN SENSORS

Oxygen Sensor-Upstream



E42613

Oxygen Sensor-Downstream



E42614

There are four oxygen sensors located in the exhaust system. Two upstream (UHEGO) before the catalytic converter and two down stream (HEGO) after the catalytic converter. The sensors monitor the level of oxygen in the exhaust gases and is used to control the fuel/air mixture. Positioning a sensor in the stream of exhaust gasses from each bank enables the ECM to control the fueling on each bank independently of the other, allowing much closer control of the air/fuel ratio and catalyst conversion efficiency.

The Oxygen Sensor needs to operate at high temperatures in order to function correctly. To achieve the high temperatures required, the sensors are fitted with heater elements that are controlled by a pulse width modulation (PWM) signal from the ECM. The heater elements are operated immediately following engine start and also during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperatures. A non-functioning heater delays the sensor's readiness for closed loop control and influences emissions. The PWM duty cycle is carefully controlled to prevent thermal shock to cold sensors.

UHEGO (Universal Heated Exhaust Gas Oxygen) sensors also known as Linear or "Wide Band" sensors produces a constant voltage, with a variable current that is proportional to the oxygen content. This allows closed loop fueling control to a target lambda, i.e. during engine warm up (after the sensor has reached operating temperature and is ready for operation). This improves emission control.

The HEGO sensor uses Zirconium technology that produces an output voltage dependant upon the ratio of exhaust gas

oxygen to the ambient oxygen. The device contains a Galvanic cell surrounded by a gas permeable ceramic, the voltage of which depends upon the level of O2 diffusing through. Nominal output voltage of the device for $I = 1$ is 300 to 500m volts. As the fuel mixture becomes richer ($I < 1$) the voltage tends towards 900m volts and as it becomes leaner ($I > 1$) the voltage tends towards 0 volts. Maximum tip temperature is 1,000 Degrees Celsius for a maximum of 100 hours.

Sensors age with mileage, increasing their response time to switch from rich to lean and lean to rich. This increase in response time influences the ECM closed loop control and leads to progressively increased emissions. Measuring the period of rich to lean and lean to rich switching monitors the response rate of the upstream sensors.

Diagnosis of electrical faults is continually monitored in both the upstream and downstream sensors. This is achieved by checking the signal against maximum and minimum threshold, for open and short circuit conditions.

Oxygen sensors must be treated with the utmost care before and during the fitting process. The sensors have ceramic material within them that can easily crack if dropped/banged or over-torqued. The sensors must be torqued to the required figure, (40-50Nm), with a calibrated torque wrench. Care should be taken not to contaminate the sensor tip when anti-seize compound is used on the thread.

Failure Modes

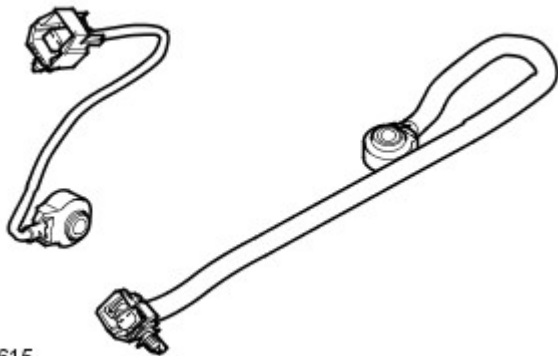
- Mechanical fitting & integrity of the sensor.
- Sensor open circuit/disconnected.
- Short circuit to vehicle supply or ground.
- Lambda ratio outside operating band.
- Crossed sensors Bank A & B.
- Contamination from leaded fuel or other sources.
- Change in sensor characteristic.
- Harness damage.
- Air leak into exhaust system.

Failure Symptoms

- Default to Open Loop fueling for the particular cylinder bank
- High CO reading.
- Strong smell of H₂S (rotten eggs) till default condition.
- Excess emissions.

It is possible to fit front and rear sensors in their opposite location. However the harness connections are of different gender and color to ensure that the sensors cannot be incorrectly connected. In addition to this the upstream sensors have two holes in the sensor tip, whereas the down stream sensors have four holes in the sensor tip for the gas to pass through.

KNOCK SENSORS



E42615

The ECM uses active knock control, which serves to prevent engine damaging pre-ignition or detonation under all operating conditions enabling the engine to operate without additional safety margins. For the ECM to be able to determine the point at which a cylinder is pre-detonating, 2 piezo-ceramic sensors are mounted on the engine block. Each sensor monitors engine knock by converting the engine block noise into a suitable electrical signal, which is then transmitted back to the ECM via a twisted pair cable. The signal is then processed within the ECM to identify the data that characterizes knocking.

This information is compared to known signal profiles to determine whether knock is present. If so, the closed loop control system then retards the ignition on that cylinder, for a number of cycles, after which it gradually moves back towards its original setting.

Failure Symptoms

The following describes the failure symptoms of the knock sensors:

- Knock control disabled and a default "safe ignition map" are used.
- Possible rough running and reduced engine performance.

One sensor is located in the center of the engine valley and the other is located on the front RH side of the cylinder block.

CRANKSHAFT SPEED AND POSITION SENSOR



E42616

The CKP is located on the top of the transmission bell housing just to the left of the center line with the sensor tip adjacent to the flywheel rim. The sensor is a variable reluctance type with a resistance of 1100 Ohms +- 150 Ohms.

The sensor produces the signal which enables the ECM to determine the angle of the crankshaft, and the engine RPM. From this, the point of ignition, fuel injection, etc. is calculated. If the signal wires are reversed a 3° advance in timing will occur, as the ECM uses the falling edge of the signal waveform as its reference/timing point for each tooth.

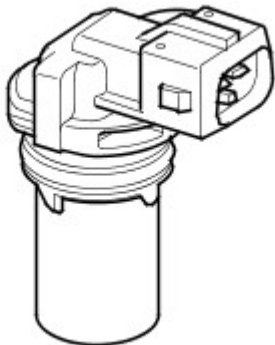
The sensor picks up its signal from a reluctor ring machined into the diameter of the drive plate. The reluctor ring has 36 teeth at 10° intervals and 3° wide. One of the teeth is removed to provide a reference mark which is 60 degrees BTDC No.1 cylinder.

The sensor operates by generating an output voltage caused by the change in magnetic field that occurs as the teeth pass in front of the sensor. The output voltage varies with the speed of the teeth passing the sensor. The higher the engine speed, the higher the output voltage.

The ECM transmits the engine speed over the CAN bus.

If the CKP sensor fails while the engine is running the engine will stall, misfire or run poorly and a relevant fault code will be stored. If the engine is not running when a fault occurs then the engine will not start.

CMP SENSOR

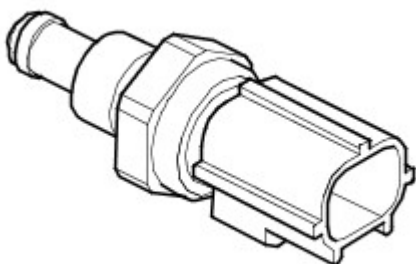


E42617

The CMP is a variable reluctance type sensor located at the front of the engine in the valve cover above number 4 cylinder.

The CMP sensor produces one pulse for every two engine revolutions. The sensor picks up on a reluctor on the LH camshaft.

ECT SENSOR



E42618

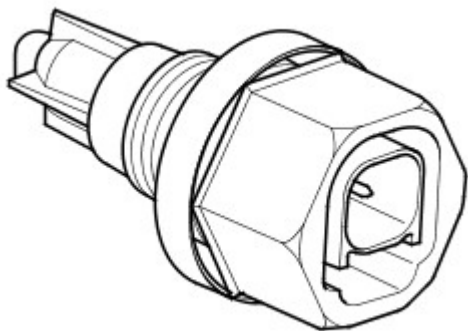
The ECT sensor is a negative temperature coefficient (NTC) type sensor. As coolant temperature rises the resistance of the

sensor falls.

The sensor is located at the front of the engine behind and below the throttle body.

Should the sensor fail the ECM use the oil temperature sensor signal as a backup coolant temperature signal.

ENGINE OIL TEMPERATURE SENSOR

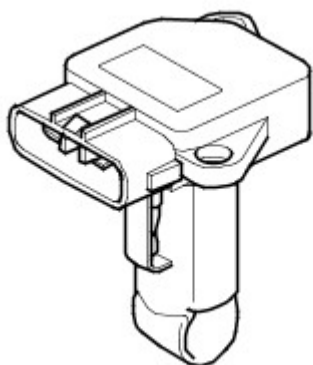


E42632

Oil temperature is monitored through a sensor mounted in the engine sump.

The sensor operates in the range -40 TO 150 degrees Celsius.

MAF/IAT)SENSOR



E42634

The MAF and IAT sensor is located in the air duct between the air filter and throttle body.

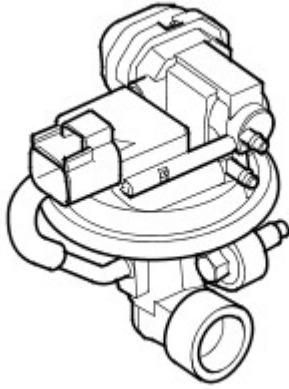
The air mass flow is determined by the cooling effect of inlet air passing over a "hot film" element contained within the device. The higher the air flow the greater the cooling effect and the lower the electrical resistance of the element. The signal from the device is then calculated by the ECM to determine the mass air flow into the engine.

The measured air mass flow is used in determining the fuel quantity to be injected in order to maintain the stoichiometric air/fuel mixture required for correct operation of the engine and exhaust catalysts. Should the device fail there is a software backup strategy that will be evoked once a fault has been diagnosed.

The IAT sensor is integrated into the Mass Air Flow meter. It is a temperature dependent resistor (thermistor), i.e. the resistance of the sensor varies with temperature. This thermistor is a NTC type element meaning that the sensor resistance decreases as the sensor temperature increases. The sensor forms part of a voltage divider chain with an additional resistor in the ECM. The voltage from this network changes as the sensor resistance changes, thus relating the air temperature to the voltage measured by the ECM.

The fixed default value for air temperature is 35°C

MAP SENSOR



E48511

The MAP sensor provides a voltage proportional to the absolute pressure in the intake manifold.

This signal allows the load on the engine to be calculated and used within the internal calculations of the ECM.

The sensor is located in the EGR valve at the front LH side of the engine.

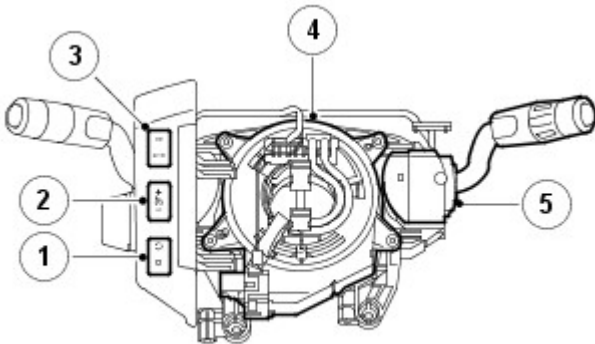
DIFFERENTIAL PRESSURE FEEDBACK-ELECTRONIC/MANIFOLD ABSOLUTE PRESSURE SENSOR (DPFE/MAP)

This pressure transducer monitors the pressure differential on either side of an orifice in the EGR system flow path and transmits that information to the ECM. The pressure drop measured across this orifice is used to estimate the flow rate of recirculated exhaust gas. An Electronic Vacuum Regulator (EVR) is used to control the vacuum signal to the EGR valve based on the electrical signal from the ECM. The ECM monitors the EGR level based on the feedback from the DPFE/MAP transducer, which creates a closed loop system.

EXHAUST GAS RECIRCULATION VALVE (EGR)

The EGR Valve is a PWM controlled valve that allows burned exhaust gas to be recirculated back into the engine. Since exhaust gas has much less oxygen than air, it is basically inert. It takes the place of air in the cylinder and reduces combustion temperature. As the combustion temperature is reduced, so are the oxides of nitrogen (NOx) emissions.

SPEED CONTROL



E47030

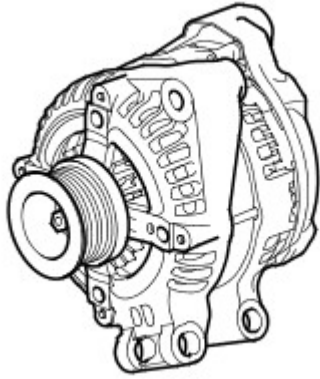
Item	Part Number	Description
1	-	Suspend/resume switch
2	-	Resume/Accelerate/Decelerate (+/-) Switches
3	-	Active speed control time gap switches (for future release)
4	-	Clock spring
5	-	Wiper control column switch

The V6 ECM incorporates a speed control function. The EMS uses a set of resistive ladders to interface with the driver speed control requirements. The speed control is operated from the steering wheel mounted switches. There are three illuminated rocker switches on a resistive ladder.

For additional information, refer to: [Speed Control](#) (310-03C Speed Control - V6 4.0L Petrol, Description and Operation).

The speed control does not have a master switch, it is enabled by pressing the set switch.

GENERATOR



E47591

The Generator has a multi function voltage regulator for use in a 14V charging system with 6÷12 zener diode bridge rectifiers.

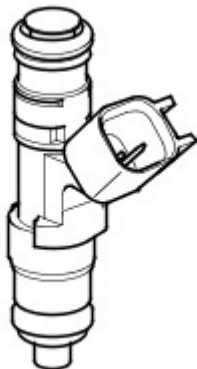
The ECM monitors the load on the electrical system via PWM signal and adjusts the generator output to match the required load. The ECM also monitors the battery temperature to determine the generator regulator set point. This characteristic is necessary to protect the battery; at low temperatures battery charge acceptance is very poor so the voltage needs to be high to maximize any recharge ability, but at high temperatures the charge voltage must be restricted to prevent excessive gassing of the battery with consequent water loss.

For additional information, refer to: Generator (414-02A Generator and Regulator - 4.0L, Description and Operation).

The Generator has a smart charge capability that will reduce the electrical load on the Generator reducing torque requirements, this is implemented to utilize the engine torque for other purposes. This is achieved by monitoring three signals to the ECM:

- Generator sense (A sense), measures the battery voltage at the central junction box (CJB).
- Generator communication (Alt Com) communicates desired Generator voltage set point from ECM to Generator.
- Generator monitor (Alt Mon) communicates the extent of Generator current draw to ECM. This signal also transmits faults to the ECM which will then sends a message to the instrument pack on the CAN bus to illuminate the charge warning lamp.

FUEL INJECTORS



E42640

The ECM controls six fuel injectors located on the cylinder head. The injectors are fed from a common fuel rail as part of a 'returnless' fuel system.

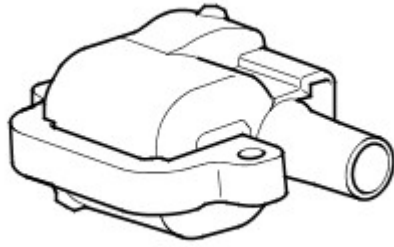
Fuel rail pressure is constant at 4.5 bar (59 psi) and is regulated by a regulator that is integral to the fuel pump module. The ECM monitors the output power stages of the injector drivers for electrical faults. The injector has a default resistance of 14.5 Ohms at 20 Degrees Celsius.

For additional information, refer to: Fuel Charging and Controls (303-04A Fuel Charging and Controls - 4.0L, Description and Operation).

SPARK PLUGS

It is essential that only factory-approved spark plugs be used in service. DO NOT attempt to use 'equivalent' spark plugs. Use of unapproved spark plugs may cause the misfire detection system to malfunction, and the ECM to store misfire faults.

IGNITION COILS



E42644

The Land Rover V6 engine is fitted with ignition coils that are driven directly by the ECM. The coils are mounted on top of the inlet manifold and are connected to the spark plugs by High Tension (HT) leads. The positive supply to the coil is fed from fuse 19 in the battery junction box (BJB). Each coil contains a power stage to trigger the primary current. The ECM sends a signal to each of the coils power stage to trigger the power stage switching. Each bank has a feedback signal that is connected to each power stage. If the coil power stage fails the feedback signal is not sent, causing the ECM to store a fault code.

FUEL PUMP RELAY

The V6 engine has a return less fuel system. The system pressure is maintained at a constant 4.5 bar , with no reference to intake manifold pressure. The fuel is supplied to the injectors from a fuel pump located within the fuel tank. The electrical supply to this fuel pump is controlled by the ECM via the fuel pump relay, in the event of a vehicle impact the ECM will receive a crash signal from the restraints control module and will cut the power supply to the fuel pump relay. The fuel system is pressurized as soon as the ECM is powered up, the pump is then switched off until engine start has been achieved.

The fuel pump relay is located in the CJB. The Fuel pump is contained within the fuel tank.

For additional information, refer to: [Fuel Tank and Lines](#) (310-01C Fuel Tank and Lines - V6 4.0L Petrol, Description and Operation).

VISCOUS FAN CONTROL

The ECM controls an electronically controlled viscous coupled fan to provide engine cooling. The ECM supplies the fan with a PWM signal that controls the amount of slippage of the fan, thus providing the correct amount of cooling fan speed and airflow. The EMS uses a Hall Effect sensor to determine the fan speed.

STARTER RELAY

The starter relay is supplied with power from fuseable link 19 in the Battery Junction Box.

The ECM controls the starter relay by supplying a 12 volt signal to the relay coil when the ignition is in crank position. This relies on the transmission gear position being either P or N.

CONDENSER FAN CONTROL

The ECM receives CAN messages from the ATC control module for idle speed adjustment and for cooling fan.

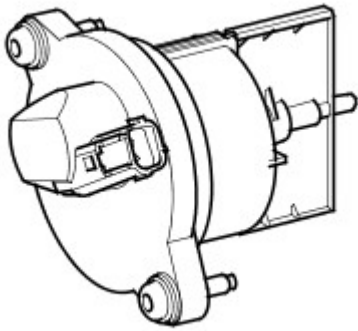
AirConCoolingRequest

This signal defines the level of cooling (from engine cooling fan(s)) required by the ATC system. Calibration within the EMS determines the fan speed required, and which fans will be used, at each requested level.

AirConIdleSpeedRequest

This signal defines whether or not an increase in the engine idle speed is required by the ATC system. The amount of idle speed increase is defined in the EMS calibration.

IMT valve



E42646

The IMT valve moves a plate within the inlet manifold to allow or block sonic pulses between the split manifold halves. This, in effect, extends the inlet tracts for better low rpm torque. The IMT valve is a two position valve and is either fully open or fully closed.

For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Description and Operation).

ECM ADAPTIONS

The ECM has the ability to adapt the values it uses to control certain outputs. This capability ensures the EMS can meet emissions legislation and improve the refinement of the engine throughout its operating range.

The components which have adaptions associated with them are:

- The APP sensor
- The HO2S
- The MAF/IAT sensor
- The CKP sensor
- Electric throttle body.

UHEGO/HEGO and MAF/IAT Sensor

There are several adaptive maps associated with the fueling strategy. Within the fueling strategy the ECM calculates short-term adaptions and long term adaptions. The ECM will monitor the deterioration of the HO2S over a period of time. It will also monitor the current correction associated with the sensors.

The ECM will store a fault code in circumstances where an adaption is forced to exceed its operating parameters. At the same time, the ECM will record the engine speed, engine load and intake air temperature.

CKP Sensor

The characteristics of the signal supplied by the CKP sensor are learned by the ECM. This enables the ECM to set an adaption and support the engine misfire detection function. Due to the small variation between different flywheels and different CKP sensors, the adaption must be reset if either component is renewed, or removed and refitted. It is also necessary to reset the flywheel adaption if the ECM is renewed or replaced. The ECM supports four flywheel adaptions for the CKP sensor. Each adaption relates to a specific engine speed range. The engine speed ranges are detailed in the table below:

Adaptions	Engine Speed, rev/min
1	1800 - 3000
2	3001 - 3800
3	3801 - 4600
4	4601 - 5400

Misfire Detection

Legislation requires that the ECM must be able to detect the presence of an engine misfire. It must be able to detect misfires at two separate levels. The first level is a misfire that could lead to the vehicle emissions exceeding 1.5 times the Federal Test Procedure (FTP) requirements for the engine. The second level is a misfire that may cause catalyst damage.

The ECM monitors the number of misfire occurrences within two engine speed ranges. If the ECM detects more than a predetermined number of misfire occurrences within either of these two ranges, over two consecutive journeys, the ECM will record a fault code and details of the engine speed, engine load and engine coolant temperature. In addition, the ECM monitors the number of misfire occurrences that happen in a 'window' of 200 engine revolutions. The misfire occurrences are assigned a weighting according to their likely impact on the catalysts. If the number of misfires exceeds a certain value, the ECM stores catalyst-damaging fault codes, along with the engine speed, engine load and engine coolant temperature.

The signal from the crankshaft position sensor indicates how fast the poles on the flywheel are passing the sensor tip. A sine wave is generated each time a pole passes the sensor tip. The ECM can detect variations in flywheel speed by monitoring the sine wave signal supplied by the crankshaft position sensor.

By assessing this signal, the ECM can detect the presence of an engine misfire. At this time, the ECM will assess the amount of variation in the signal received from the crankshaft position sensor and assigns a roughness value to it. This roughness value can be viewed within the real time monitoring feature, using T4. The ECM will evaluate the signal against a number of factors and will decide whether to count the occurrence or ignore it. The ECM can assign a roughness and misfire signal for each cylinder, (i.e. identify which cylinder is misfiring).

T4 Diagnostics

The ECM stores faults as diagnostic trouble code (DTC), referred to as 'P' codes. The 'P' codes are defined by on-board diagnostic (OBD) legislation and, together with their associated environmental and freeze frame data, can be read using a third party scan tool or T4. T4 can also read real time data from each sensor, the adaptive values currently being employed and the current fueling, ignition and idle settings.

P Code No	Component/Signal	Fault Description
P0011	CMP/CKP/VVT	Bank A CMP/CKP Position error high , VVT retard position high
P0012	CMP/CKP/VVT	Bank A CMP/CKP Position error low, VVT retard position low
P0021	CMP/CKP/VVT	Bank B CMP/CKP Position error, VVT retard position high
P0022	CMP/CKP/VVT	Bank B CMP/CKP Position error low , VVT retard position low
P0026	VVT	Bank A circuit malfunction range high/low
P0028	VVT	Bank B circuit malfunction range high/low
P0031	UHEGO	Bank A heater control circuit low
P0032	UHEGO	Bank A heater control circuit high
P0051	UHEGO	Bank B heater control circuit low
P0052	UHEGO	Bank B heater control circuit high
P0069	HAC	Sensor circuit/range performance
P0071	Ambient air temperature sensor	Range performance
P0072	Ambient air temperature sensor	Circuit low input
P0073	Ambient air temperature sensor	Circuit high input
P0075	VVT	Bank A open circuit
P0076	VVT	Bank A short to ground
P0077	VVT	Bank A short to battery
P0081	VVT	Bank B open circuit
P0082	VVT	Bank B short to ground
P0083	VVT	Bank B short to battery
P0087	Fuel pressure system	Low fault
P0088	Fuel pressure system	High fault
P0089	Fuel pressure system	Noise fault
P0093	Fuel pressure system	Large leak
P0096	IAT	Sensor range performance
P0101	AFM	Circuit range performance
P102	AFM	Circuit low input
P103	AFM	Circuit high input
P0106	MAP	Sensor range performance
P0107	MAP	Circuit low input
P0108	MAP	Circuit high input
P0111	IAT	Stuck high/low at engine start, stuck high
P0112	IAT	Sensor 1 circuit low input
P0113	IAT	Sensor 1 circuit high input
P0116	ECT	Implausible signal
P0117	ECT	Circuit low input
P0118	ECT	Circuit high input
P0121	Throttle circuit 1 and 2	Range/performance
P0122	Throttle circuit 1	Low input
P0123	Throttle circuit 1	High input
P0125	ECT	Insufficient coolant temperature for closed loop control
P0128	Thermostat monitor	Low coolant temperature - thermostat stuck open
P0131	UHEGO	Bank A short circuit to ground
P0132	UHEGO	Bank A Short circuit to battery
P0133	UHEGO	Bank A slow response
P0136	HEGO	Bank A adaptations
P0137	HEGO	Bank A short circuit to ground
P0138	HEGO	Bank A short circuit to battery
P0139	HEGO	Bank A slow response
P0140	HEGO	Bank A no activity
P0141	HEGO	Bank A heater control circuit malfunction
P0150-1A	HEGO	Bank A element impedance low
P0151	UHEGO	Bank B short circuit to ground
P0152	UHEGO	Bank B short circuit to battery
P0153	UHEGO	Bank B slow response
P0154-00	UHEGO	Bank B slow activation
P0156	HEGO	Bank B adaptations
P0157	HEGO	Bank B short circuit to ground
P0158	HEGO	Bank B short circuit to battery
P0159	HEGO	Bank B slow response
P0160	HEGO	Bank B no activity
P0161	HEGO	Bank B heater control circuit malfunction
P00171	lambda control	Bank A too lean
P0172	lambda control	Bank A too rich
P0174	lambda control	Bank B too lean
P0175	lambda control	Bank B too rich
P0181	Fuel rail temperature sensor	Temperature signal implausible
P0182	Fuel rail temperature sensor	Circuit low input
P0183	Fuel rail temperature sensor	Circuit high input

P Code No	Component/Signal	Fault Description
P0191	Fuel rail pressure sensor	Range/performance
P0192	Fuel Rail Pressure Sensor	Low Input
P0193	Fuel Rail Pressure Sensor	High Input
P0196	Oil temperature sensor	Range/performance
P0197	Oil temperature sensor	Low input
P0198	Oil temperature sensor	High input
P0201	Injector Circuit	Malfunction - Cylinder 1
P0202	Injector Circuit	Malfunction - Cylinder 2
P0203	Injector Circuit	Malfunction - Cylinder 3
P0204	Injector Circuit	Malfunction - Cylinder 4
P0205	Injector Circuit	Malfunction - Cylinder 5
P0206	Injector Circuit	Malfunction - Cylinder 6
P0207	Injector Circuit	Malfunction - Cylinder 7
P0208	Injector Circuit	Malfunction - Cylinder 8
P0222	APP sensor 2	Low input
P0223	APP sensor 2	High input
P0227	APP sensor 1	Low input
P0228	APP sensor 1	High input
P0229	APP sensor	Intermittent fault
P0297	Active speed control	Vehicle over speed condition
P0300	Misfire	Random/multiple cylinder misfire
P0301	Misfire	Cylinder 1
P0302	Misfire	Cylinder 2
P0303	Misfire	Cylinder 3
P0304	Misfire	Cylinder 4
P0305	Misfire	Cylinder 5
P0306	Misfire	Cylinder 6
P0307	Misfire	Cylinder 7
P0308	Misfire	Cylinder 8
P0313	Misfire	Misfire under low fuel condition
P0316	Misfire	Misfire detected in first 1000 revs
P0326	Knock sensor	Sensor 1 high/low performance error
P0327	Knock sensor	Bank A sensor low input fault
P0328	Knock sensor	Bank A high input fault
P0331	Knock sensor	Sensor 2 high/low performance error
P0332	Knock sensor	Bank B sensor low input fault
P0333	Knock sensor	Bank A high input fault
P0335	Crank sensor	Sensor circuit malfunction during crank/running
P0336	Crank sensor	Range/performance fault
P0340	Intake CMP sensor bank A	Fault during cranking/running
P0341	Intake CMP sensor bank A	Range/performance fault
P0345	Intake CMP sensor bank B	Fault during cranking/running
P0346	Intake CMP sensor bank B	Range/performance fault
P0351	Ignition coil	Circuit malfunction cylinder 1
P0352	Ignition coil	Circuit malfunction cylinder 2
P0353	Ignition coil	Circuit malfunction cylinder 3
P0354	Ignition coil	Circuit malfunction cylinder 4
P0355	Ignition coil	Circuit malfunction cylinder 5
P0356	Ignition coil	Circuit malfunction cylinder 6
P0357	Ignition coil	Circuit malfunction cylinder 7
P0358	Ignition coil	Circuit malfunction cylinder 8
P0365	Exhaust CMP sensor bank A	Fault during cranking/running
P0366	Exhaust CMP sensor bank A	Range/performance fault
P0390	Exhaust CMP sensor bank B	Fault during cranking/running
P0391	Exhaust CMP sensor bank B	Range/performance fault
P0401	EGR system	Insufficient flow detected
P0403	EGR system	Valve circuit high/low input
P0405	Differential pressure sensor	Short to ground
P0406	Differential pressure sensor	Short to battery
P0409	Differential pressure sensor	Range performance
P0420	Catalyst system bank A	Efficiency below threshold
P0430	Catalyst system bank	Efficiency below threshold
P0441	Purge valve	Range performance
P0442	DMTL	Medium leak detected
P0447	DMTL	Short to ground
P0448	DMTL	Short to battery
P0455	DMTL	Large leak detected
P0456	DMTL	Small leak detected
P0458	Purge valve	Short to ground
P0459	Purge valve	Short to battery
P0461	Fuel level sensor	Range/performance fault
P0480	Radiator fan module	Control circuit malfunction
P0493	Viscous fan	Speed Out of range
P0501	Vehicle speed	Range/performance malfunction
P0504	Brake switch	Circuit malfunction

P Code No	Component/Signal	Fault Description
P0506	Idle Control System	RPM Lower Than Expected
P0507	Idle Control System	RPM higher Than Expected
P0512	Crank request circuit	High/low input
P0513	Security key	Key invalid
P0532	Air conditioning refrigerant pressure sensor	Low input
P0533	Air conditioning refrigerant pressure sensor	High input
P0560	Battery back up	Malfunction
P0562	Sensor power supply	Low input
P0563	Sensor power supply	High input
P0566	Speed control cancel switch	ON fault
P0567	Speed control resume switch	ON fault
P0568	Speed control	Low/high input
P0569	Decelerate/set/inch switch	ON fault
P0570	Accelerate/set/inch switch	On fault
P0574	Speed control	Speed monitoring
P0576	Speed control	Low input
P0577	Speed control	High input
P0604	ECM self test	RAM error
P0605	ECM self test	ROM error
P0606	ECM self test	Processor error
P0616	Starter relay	Low input
P0617	Starter relay	High input
P0627	Primary fuel pump	no commands received
P0628	Fuel pump	Electrical low
P0629	Fuel pump	Electrical high
P0633	Security	No ID in ECM
P0634	ECM temperature	Internal temperature too high
P0646	Air conditioning clutch relay	Low input
P0647	Air conditioning clutch relay	High input
P0661	Manifold valve output drive 1	Open circuit or short circuit to ground
P0662	Manifold valve output drive 1	Short circuit to battery
P0664	Manifold valve output drive 2	Open circuit or short circuit to ground
P0665	Manifold valve output drive 2	Short circuit to battery
P0668	ECM temperature sensor	Short to ground
P0669	ECM temperature sensor	Short to battery
P0687	EMS control relay	Relay malfunction
P0831	Clutch switch circuit A	Low input
P0832	Clutch switch circuit A	High input
P0834	Clutch switch circuit B	Low input
P0835	Clutch switch circuit B	High input
P0851	Park/Neutral Switch	Input Circuit Low
P0852	Park/Neutral Switch	Input Circuit High
P1136	E Box fan	Fan malfunction
P1146	Generator command line	Low input/communication error
P1155	HEGO Heater bank A	
P1160	UHEGO Bank A	Slow activation
P1197	UHEGO Bank A	Slow activation/open shorted
P1198	UHEGO Bank B	Slow activation/open shorted
P1233	Secondary fuel pump	Output circuit open
P1234	Primary fuel pump	No commands received
P1236	Primary fuel pump	Pump not working when requested
P1244	Alternator command line	High input
P1260	Security limited start	Theft attempt
P1339	Secondary fuel pump	Driver circuit output low/high
P1367	Ignition coil bank A	
P1368	Ignition coil bank A	
P1452	DMTL	Reference current too low
P1453	DMTL	Reference current too high
P1482	DMTL heater control circuit	Low
P1483	DMTL heater control circuit	High
P1582	Flight recorder	Data stored
P1624	Security ID	ID transfer process failed
P1629	Generator	FR line failure
P1632	Generator	Charge system failure
P1646	UHEGO sensor bank A	Slow activation/control module open shorted
P1647	UHEGO sensor bank B	Slow activation/control module open shorted
P1670	E Box fan	Malfunction low
P1671	E Box fan	Malfunction high
P1697	Speed control	Shorter/Longer switch ON fault
P1700	Low gear ratio	plausibility check
P2066	Secondary fuel pump	Range check
P2070	Manifold valve output drive 1	Performance check stuck open/closed
P2071	Manifold valve output drive 2	Performance check stuck open/closed
P2101	Electric throttle	Range performance
P2103	Electric throttle	Throttle duty at 100% continuously

P Code No	Component/Signal	Fault Description
P2105	Electric throttle	malfunction indicator lamp (MIL) request dual fuel cut off
P2106	Intended reduced availability	Re-configuration failure
P2118	Electric throttle system	Over current detection by hardware
P2119	Electric throttle	Throttle stuck open
P2122	APP sensor	Circuit 2 low input
P2123	App sensor	Circuit 2 high input
P2228	HAC sensor	Circuit low
P2229	HAC sensor	Circuit high
P2299	Accelerator pedal	Brake override
P2401	DMTL Pump	Ground short
P2402	DMTL Pump	Battery short
P2404	DMTL Pump	Noise/reference leak fault
P2450	DMTL	COV stuck open
P2451	DMTL	COV stuck closed
P2503	Charging system	Voltage low
P2504	Charging system	Voltage high
P2601	Water pump	Performance fault
P2610	Engine off timer	Timer malfunction
P2632	Secondary fuel pump driver circuit	Output circuit open
P2633	Secondary fuel pump driver circuit	Output low
P2634	Secondary fuel pump driver circuit	High input
P6365	Primary fuel pump	Pump not working when requested
P2636	Secondary fuel pump	Low flow/performance

CENTRAL JUNCTION BOX

The Central Junction box is used to initiate the power up and power down routines within the ECM. When the ignition is turned on, 12V is applied to the Ignition Sense input to pin 30 of connector C0635. The ECM then starts its power up routines and turns on the ECM main relay.

When the ignition is turned OFF the ECM will maintain its powered up state for several seconds (this may be up to 20 minutes in extreme cases when cooling fans are required) while it initiates its power down routine and on completion will turn off the ECM main relay.

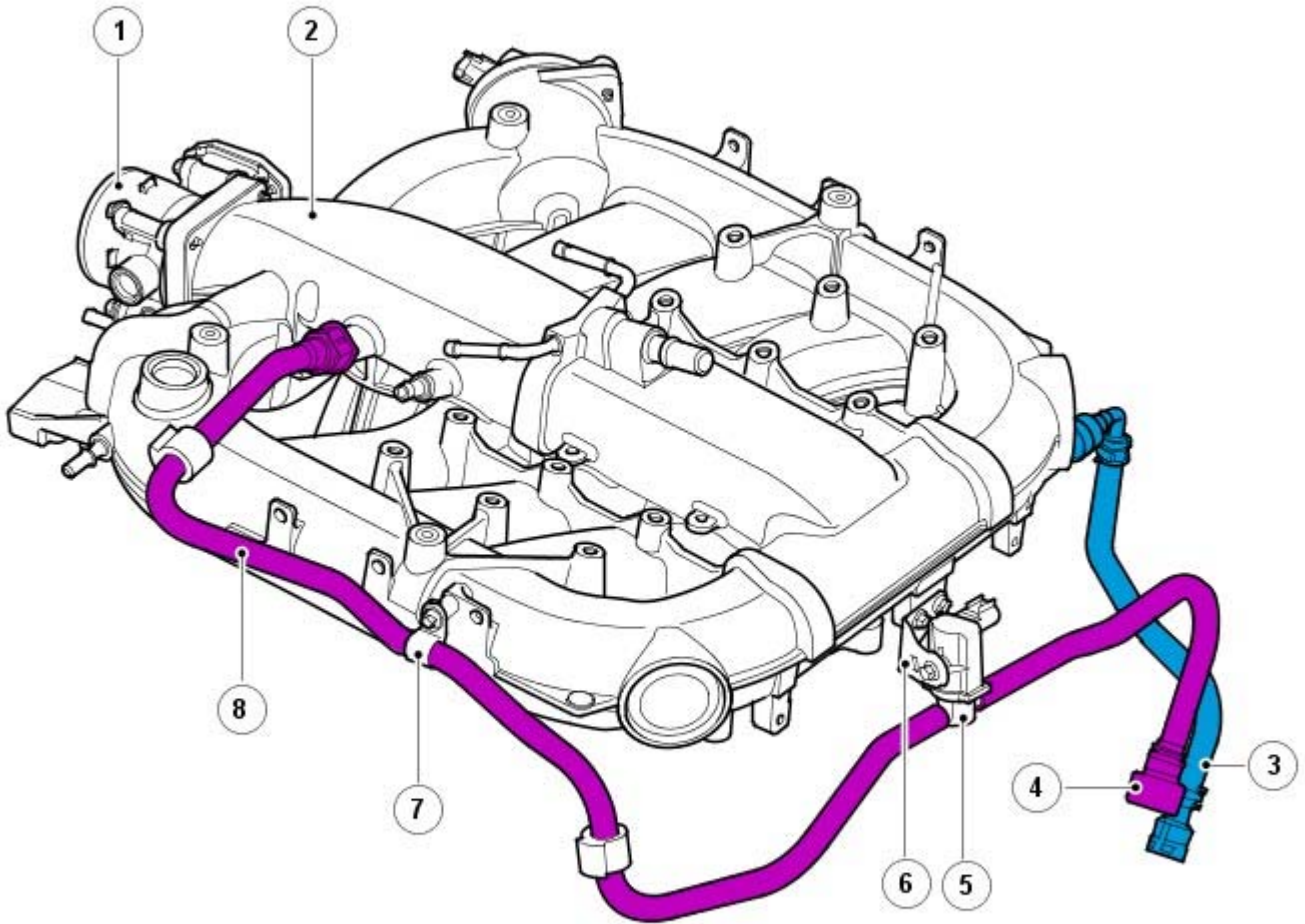
POWER SUPPLIES

The ECM requires a permanent battery level voltage supply and a switched battery level voltage supply. The switched voltage supply is controlled by the ECM via a relay based on the condition of the Central Junction Box input (key position 2).

At key "OFF", the ECM will maintain the switched supply active until internal self checks have been completed. The Main Supply fuse is located in the engine compartment fuse box.

PURGE VALVE

Purge Valve and Hoses



E44559

Item	Part Number	Description
1	-	Electric throttle
2	-	Air intake manifold
3	-	Fuel feed jump hose
4	-	Purge hose connector
5	-	Purge valve
6	-	Purge valve bracket
7	-	Hose clamp
8	-	Manifold to purge valve hose

To meet increasing legislation in fuel evaporative loss the Evaporative Emissions Loss Control System has been introduced to minimize the evaporative loss of fuel vapor from the fuel system to the atmosphere. This is achieved by venting the fuel system through a vapor trap (charcoal canister). The charcoal acts like a sponge and stores the vapor until the canister is purged under the control of the ECM.

The charcoal canister is connected with the inlet manifold, after the throttle body, via a purge valve. This valve is opened and closed according to a PWM signal from the ECM. The canister is purged by drawing clean air through the charcoal, which carries the hydrocarbons into the engine where they are burnt. To maintain drivability and emission control purging must be closely controlled as a 1% concentration of fuel vapor from the canister in the air intake may shift the air/fuel ratio by as much as 20%. Purging must be carried out at regular intervals, to regenerate the charcoal, as its storage capacity is limited, and is cycled with the Fueling Adaption, as both cannot be active at the same time.

The ECM alters the PWM signal to the purge valve to control the rate of purging of the canister. The purging of the canister is done in a controlled manner in order to maintain the correct Stoichiometric air/fuel mixture for the engine. It also ensures the canister itself is purged frequently enough to prevent fuel saturation of the charcoal leading to an excessive build up of fuel vapor (and hence vapor pressure) in the system which could increase the likelihood of vapor leaks. For additional information, refer to: [Evaporative Emissions](#) (303-13A Evaporative Emissions - V6 4.0L Petrol, Description and Operation).

Electronic Engine Controls - V6 4.0L Petrol - Electronic Engine Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the electronic engine control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

- **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Engine oil level ● Cooling system coolant level ● Fuel level ● Fuel contamination/grade/quality ● Fuel leaks ● Accessory drive belt ● Sensor installation/condition ● Viscous fan and solenoid ● Air cleaner condition 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Electrical connector(s) ● 5 volt sensor supply ● Sensor(s) ● Engine Control Module (ECM) ● Transmission Control Module (TCM)

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	<ul style="list-style-type: none"> ● Engine breather system disconnected/restricted ● Ignition system ● Fuel system ● Electronic engine control 	Ensure the engine breather system is free from restriction and is correctly installed. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	<ul style="list-style-type: none"> ● Evaporative emissions purge valve ● Fuel pump ● Spark plugs ● HT short to ground (tracking) check rubber boots for cracks/damage ● Ignition system 	Check for evaporative emissions, fuel system and ignition system related DTCs and refer to the relevant DTC Index
Difficult cold start	<ul style="list-style-type: none"> ● Engine coolant level/anti-freeze content ● Battery ● Electronic engine controls ● Exhaust Gas Recirculation (EGR) valve stuck open ● Fuel pump ● Purge valve 	Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot engine off, after engine has reached operating temperature	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index

DTC Index

Refer to Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to the relevant DTC Index (PCM) 4.0L V6 (100-00 General Information, Description and Operation).

Electronic Engine Controls - V6 4.0L Petrol - Brake Pedal Position (BPP) Switch Adjustment

General Procedures

Check

1. Remove the brake pedal rubber.
2. NOTE: Make sure that the dial test indicator (DTI) gauge is in line with the brake pedal movement.

Position the DTI gauge on a suitable mounting block, as illustrated.



E135356

3. With the aid of another technician, gently press the brake pedal until the stoplamps illuminate.

4. NOTE: The specification is that the stoplamps should illuminate at between 5.5mm and 8.5mm brake pedal travel.

Note the measurement of the brake pedal travel from rest position until the stoplamps illuminated.

Adjust

1. CAUTIONS:



The brake pedal **must not** be pressed during this operation. Failure to follow this instruction may result in damage to the component.



Remove the stoplamp switch.

For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

2. CAUTIONS:



The brake pedal **must not** be pressed during this operation. Failure to follow this instruction may result in damage to the component.



Only use light finger pressure when installing the stoplamp switch. Failure to follow this instruction may result in an incorrectly adjusted stoplamp switch.

Install the stoplamp switch.


For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

3. Check the adjustment of the stoplamp switch by following the **Check** procedure in this procedure and carry out the **Adjust** procedure if required.

Electronic Engine Controls - V6 4.0L Petrol - Engine Oil Pressure (EOP) Sensor

Removal and Installation

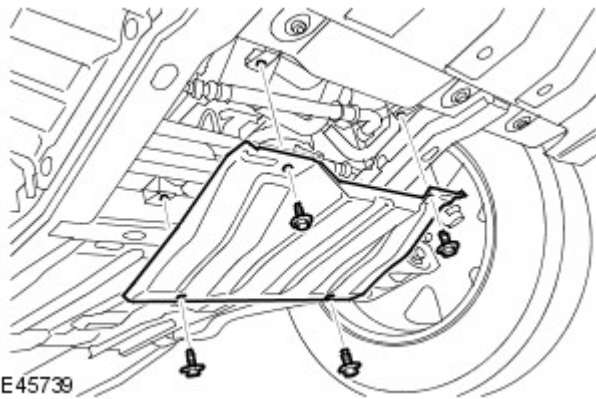
Removal

1. Raise and support the vehicle.
2.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

3. Remove the radiator access panel.

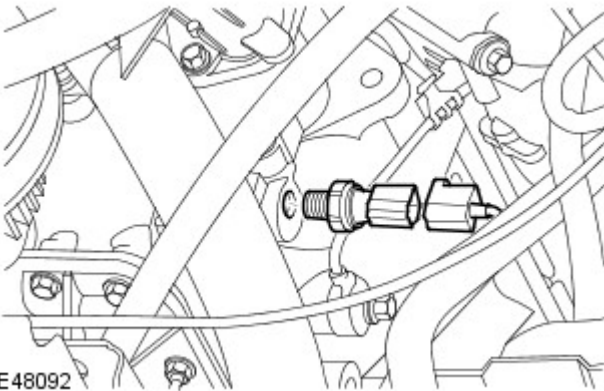
- Remove the 4 bolts.



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4. Remove the EOP sensor.

- Disconnect the electrical connector.
- Position a container to collect the fluid.



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Installation

1. To install, reverse the removal procedure.
 - Clean the component mating faces.
 - Tighten the oil pressure sensor to 13 Nm (10 lb.ft).
2. Check and top-up the engine oil.

Electronic Engine Controls - V6 4.0L Petrol - Oil Temperature Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).



4.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the oil temperature sensor.

- Disconnect the electrical connector.
- Position a container to collect spillage.
- Remove and discard the O-ring seal.

Installation

1. **NOTE:** Lubricate new seals with clean engine oil.

Install the oil temperature sensor.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the oil temperature sensor to 20 Nm (15 lb.ft).
 - Connect the electrical connector.
2. Install the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. Check and top-up the engine oil.

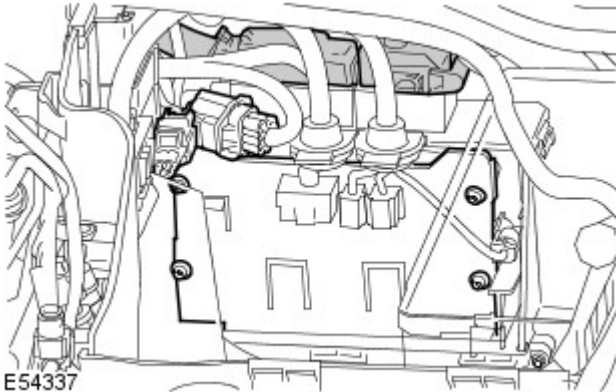
Electronic Engine Controls - V6 4.0L Petrol - Engine Control Module (ECM)

Removal and Installation

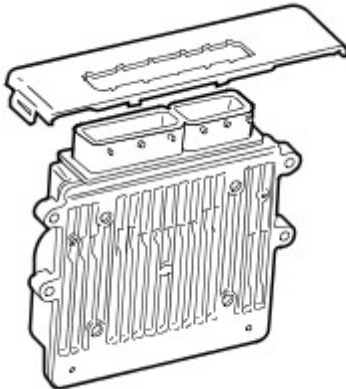
Removal

• NOTE: If the ECM is to be replaced, the T4 must be connected prior to battery disconnection and on-screen instructions must be followed.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the four-wheel drive control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
3. Remove the ECM cover.
 - Disconnect 2 electrical connectors for access.
 - Disconnect the 2 ECM electrical connectors.
 - Remove the 4 Torx screws.



4. Remove the ECM.
 - Remove the ECM top cover.



Installation

1. Install the ECM.
 - Install the ECM cover and secure with Torx screws.
 - Install the ECM upper cover.
2. Connect the ECM electrical connectors.
3. Connect the 2 electrical connectors disconnected for access.
4. Install the four-wheel drive control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
6. Connect T4 to calibrate a new ECM.

Electronic Engine Controls - V6 4.0L Petrol - Engine Coolant Temperature (ECT) Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the throttle body gasket.
For additional information, refer to: [Throttle Body Gasket](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Removal and Installation).
3. Remove the ECT sensor.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the electrical connector.
- Remove and discard the O-ring seal.



Installation

1. To install, reverse the removal procedure.
 - Clean the components.
 - Tighten the ECT sensor to 18 Nm (13 lb.ft).
 - Top-up the coolant.


Electronic Engine Controls - V6 4.0L Petrol - Crankshaft Position (CKP) Sensor

Removal and Installation

Removal


- NOTE: The CKP sensor is located on the LH side of the torque converter housing.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

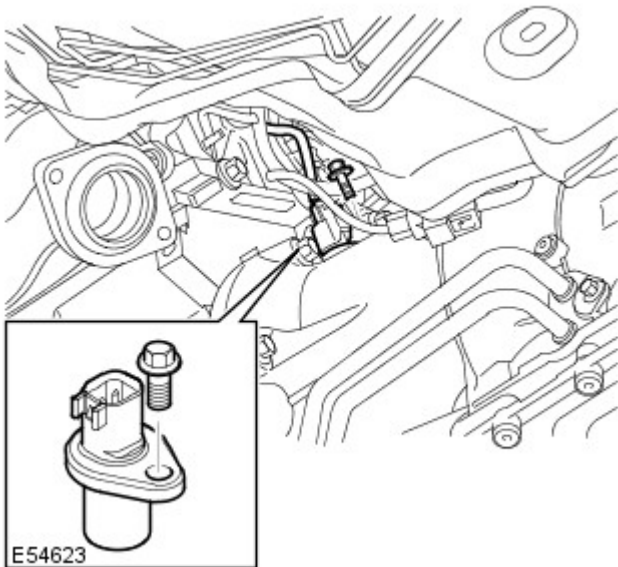
Raise and support the vehicle.

3. Remove the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).

4.  **CAUTION:** Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the CKP sensor.

- Disconnect the electrical connector.
- Remove the bolt.



Installation

1. To install, reverse the removal procedure.

- Clean the component mating faces.
- Tighten the Torx screw to 8 Nm (6 lb.ft).

2. Install the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).

3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

4. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Electronic Engine Controls - V6 4.0L Petrol - Throttle Position (TP) Sensor

Removal and Installation


Removal

- NOTE: The TP sensor is part of the throttle body and cannot be serviced separately.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the air intake resonator.
For additional information, refer to: Resonator (303-12, Removal and Installation).
4. Disconnect the TP sensor electrical connector.



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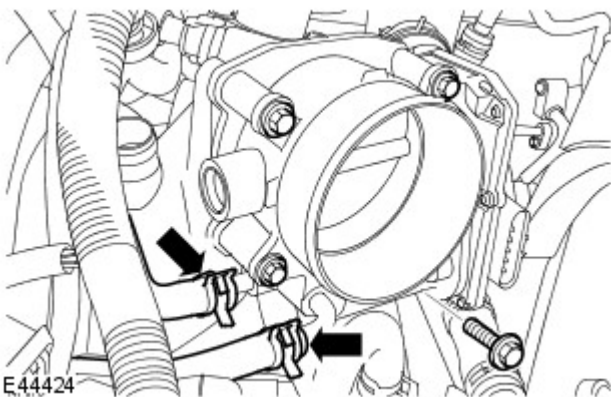
5.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Disconnect the coolant hoses from the throttle body.

- Clamp the throttle body coolant hoses to minimize coolant loss.
- Release the throttle body hose clips

6. Remove the throttle body.

- Remove the 4 bolts.
- Remove and discard the throttle body gasket.



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Installation

1. Install the throttle body.
 - Clean the component mating faces.
 - Install a new gasket.
 - Tighten the 4 bolts to 10 Nm (7 lb.ft).
2. Connect the coolant hoses to the throttle body.

- Secure the throttle body hoses clips.
 - Remove the hose clamps from the throttle body hoses.
- 3.** Install the TP sensor electrical connector.
 - 4.** Install the air intake resonator.
For additional information, refer to: Resonator (303-12, Removal and Installation).
 - 5.** Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 - 6.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
 - 7.** Check and top-up the coolant.
 - 8.** Use T4 to re-calibrate a new TP sensor.

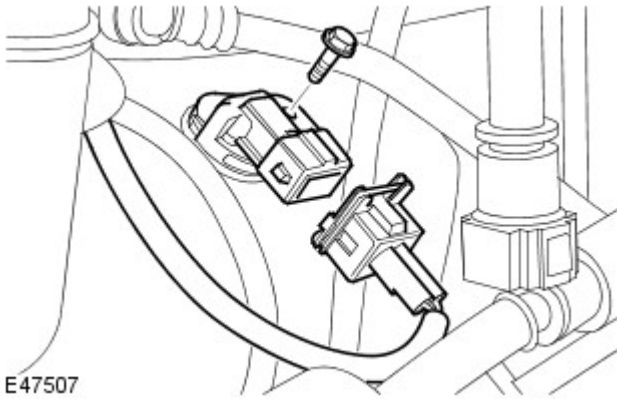
Electronic Engine Controls - V6 4.0L Petrol - Camshaft Position (CMP)

Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the CMP sensor.
 - Disconnect the electrical connector.
 - Remove the bolt.



Installation

1. To install, reverse the removal procedure.
 - Clean the component mating faces.
 1. Lubricate a new O-ring seal with clean engine oil.
 - Tighten the bolt to 6 Nm (4 lb.ft)

Electronic Engine Controls - V6 4.0L Petrol - Knock Sensor (KS) LH

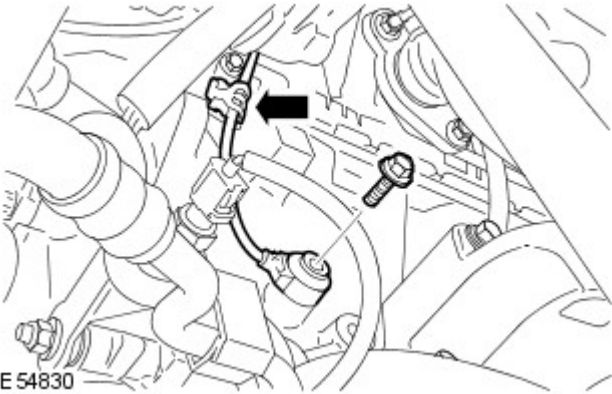
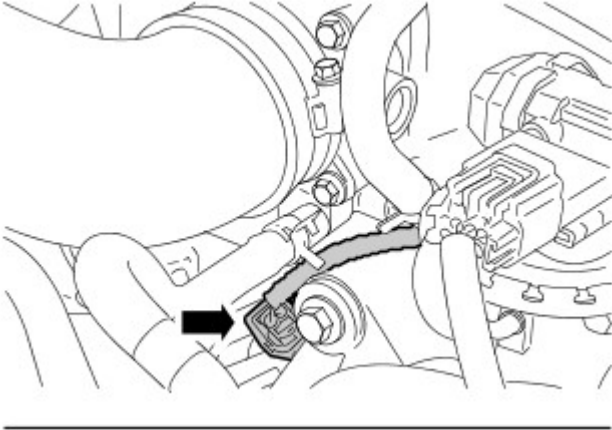
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Remove the KS.

- Disconnect the electrical connector.
- Release the knock sensor electrical connector retaining clips.
- Remove the bolt.



Installation

1. To install, reverse the removal procedure.

- Clean the component mating faces.
- Tighten the bolt to 20 Nm (15 lb.ft).

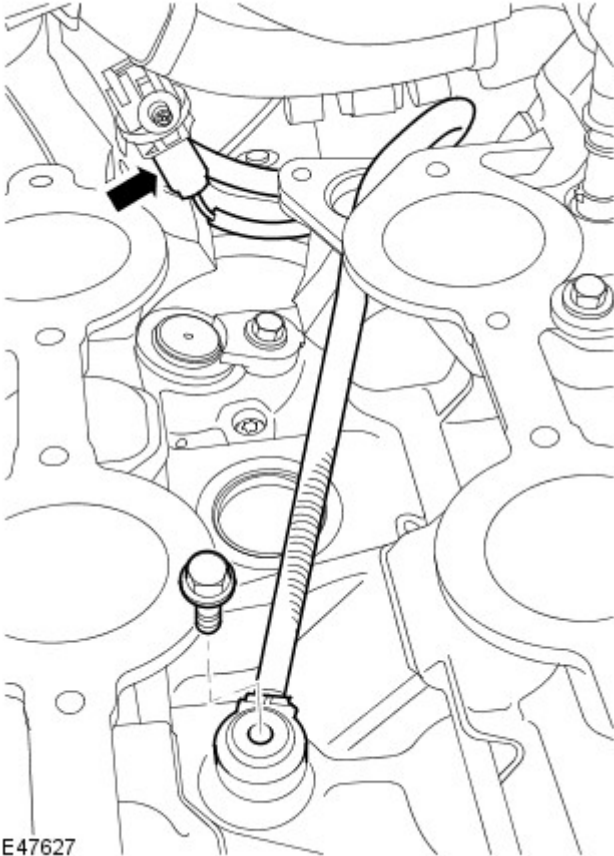
Electronic Engine Controls - V6 4.0L Petrol - Knock Sensor (KS) RH

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the KS.

- Disconnect the electrical connector.
- Release the RH KS electrical connector retaining clip.
- Remove the bolt.




Installation

1. To install, reverse the removal procedure.
 - Clean the component mating faces.
 - Tighten the bolt to 20 Nm (15 lb.ft).


Electronic Engine Controls - V6 4.0L Petrol - Heated Oxygen Sensor (HO2S)

LH

Removal and Installation

Special Tool(s)	
 <p>310-121 E53465</p>	<p>Wrench, HO2S 310-121(LRT-19-014)</p>

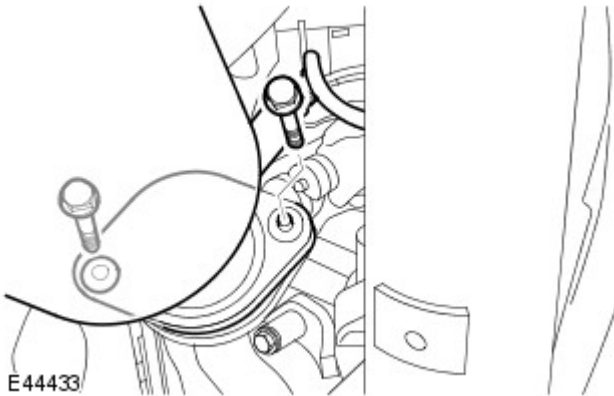
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

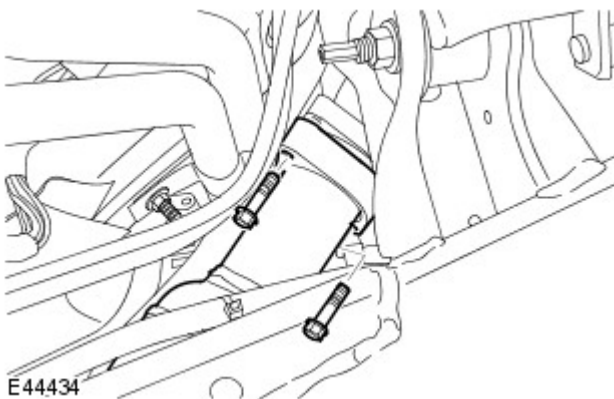
- Disconnect the LH catalytic converter from the exhaust manifold.

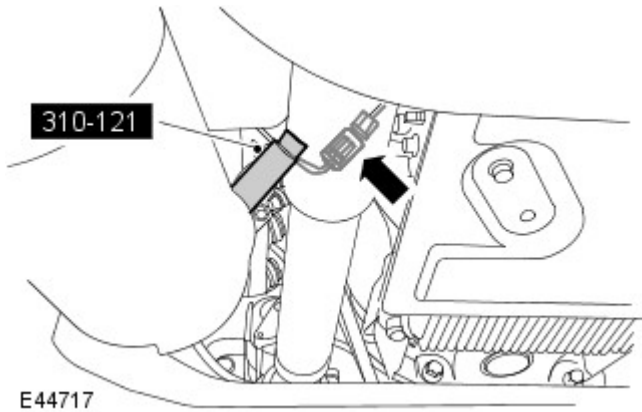
- Remove and discard the 2 bolts.



- Disconnect the RH catalytic converter from the exhaust manifold.

- Remove and discard the 2 bolts.





4. Using the special tool, remove the HO2S.

- Release the wiring harness.
- Disconnect the electrical connector.

Installation

1. CAUTIONS:

 Make sure the anti-seize compound does not contact the HO2S tip.


 Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

Using the special tool, install the HO2S.

- Clean the components.
- Apply an anti-seize compound to the thread of the sensor.
- Tighten the HO2S to 45 Nm (33 lb.ft).
- Connect the electrical connector.
- Attach the wiring harness.

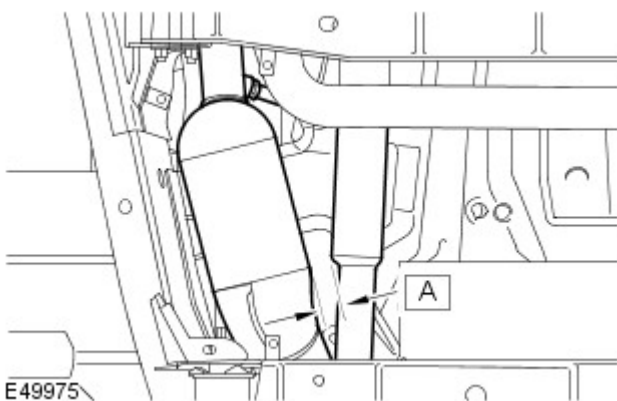
2. Position the RH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).

3.  **CAUTION:** Make sure there is a clearance (A) of 25 mm to 30 mm between the closest points of the LH catalytic converter and the front driveshaft.

Position the LH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).



4. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

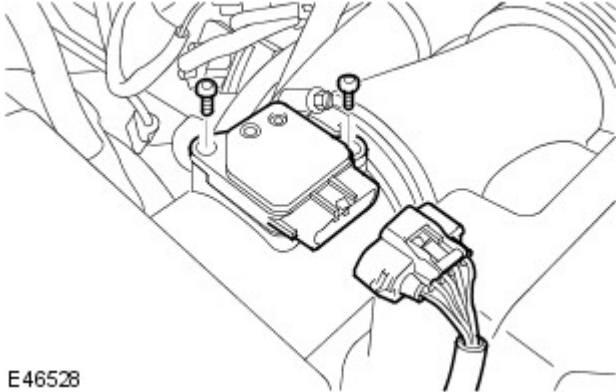
Electronic Engine Controls - V6 4.0L Petrol - Mass Air Flow (MAF) Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the MAF sensor.

- Remove the 2 Torx screws.
- Disconnect the electrical connector.



E46528

Installation

1. To install, reverse the removal procedure.

- Tighten Torx screws to 2 Nm (1.5 lb.ft).

2. NOTE: Federal market vehicles only.

If required, carry out a short drive cycle.

For additional information, refer to: [Powertrain Control Module \(PCM\) Short Drive Cycle Self-Test](#) (303-14D Electronic Engine Controls - V8 5.0L Petrol, General Procedures).

3. NOTE: Non federal market vehicles only.


Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Electronic Engine Controls - V6 4.0L Petrol - Intake Manifold Tuning (IMT) Valve

Removal and Installation

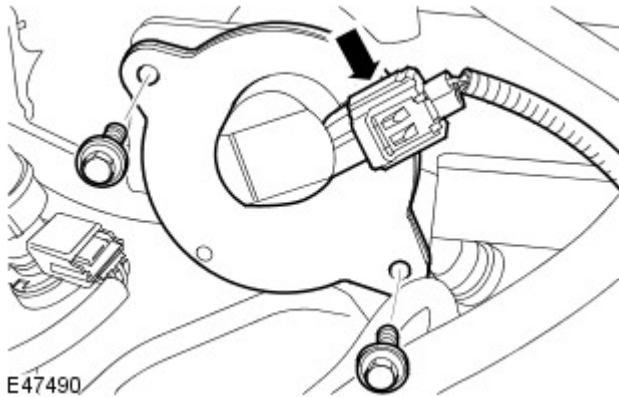
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the intake manifold tuning valve.

- Disconnect the electrical connector.
- Remove the 2 bolts.
- Discard the O-ring seal.

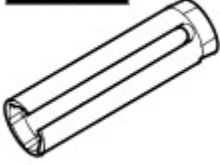


Installation


1. Install the intake manifold tuning valve.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Connect the electrical connector.
3. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Electronic Engine Controls - V6 4.0L Petrol - Catalyst Monitor Sensor LH

Removal and Installation

Special Tool(s)	
 <p>310-121</p> <p>E53465</p>	Wrench, HO2S
	310-121 (LRT-19-014)

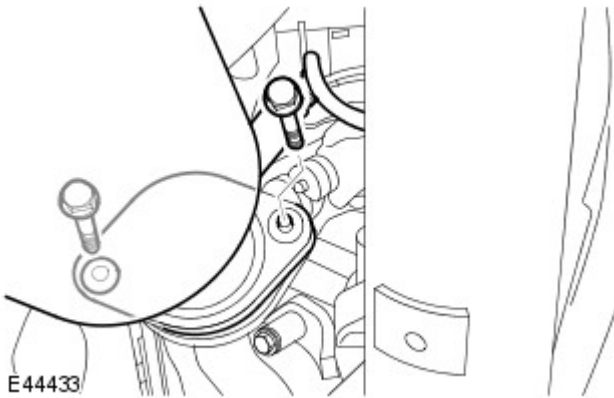
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

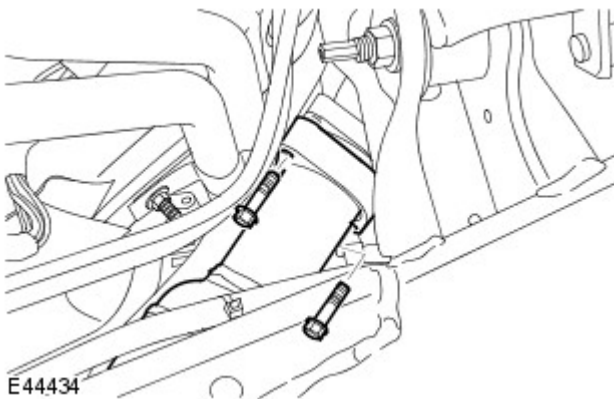
- Disconnect the LH catalytic converter from the exhaust manifold.

- Remove and discard the 2 bolts.



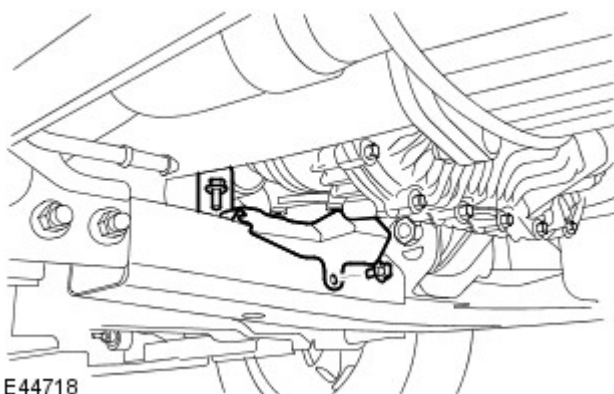
- Disconnect the RH catalytic converter from the exhaust manifold.

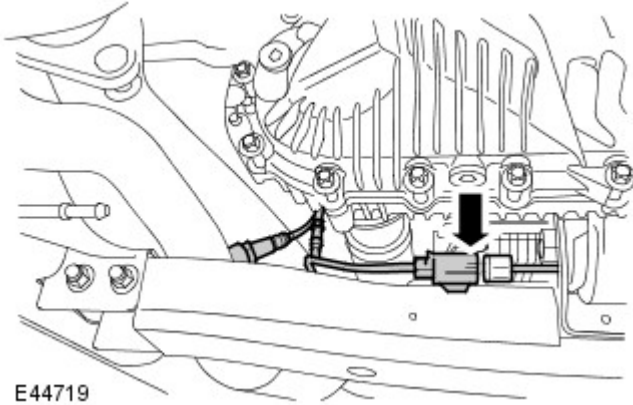
- Remove and discard the 2 bolts.



- Remove the catalyst monitor sensor electrical connector heat shield.

- Remove the 2 bolts.





5. Using the special tool, remove the catalyst monitor sensor.

- Release the wiring harness.
- Disconnect the electrical connector.

E44719

Installation

1. CAUTIONS:



Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.



Make sure the catalyst monitor sensor wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

Using the special tool, install the catalyst monitor sensor.

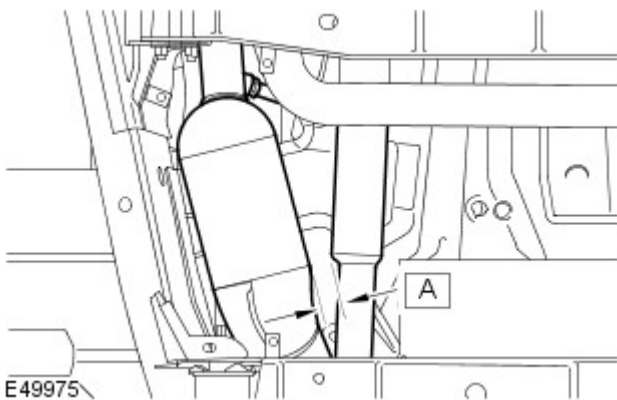
- Clean the components.
- Apply an anti-seize compound to the thread of the sensor.
- Tighten the catalyst monitor sensor to 45 Nm (33 lb.ft).
- Connect the electrical connector.
- Attach the wiring harness.

2. Install the heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).

3. Position the RH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).



E49975

4. CAUTION: Make sure there is a clearance (A) of 25 mm to 30 mm between the closest points of the LH catalytic converter and the front driveshaft.

Position the LH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).

5. NOTE: For NAS vehicles only.

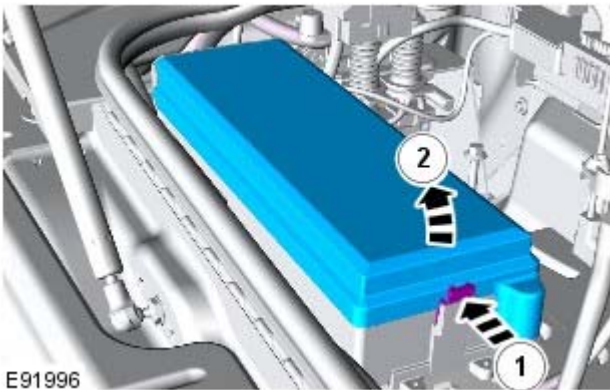
If required, carry out a long drive cycle.
For additional information, refer to: Powertrain Control Module (PCM) Long Drive Cycle Self-Test (303-14A, General Procedures).

Electronic Engine Controls - V6 4.0L Petrol - Engine Control Module (ECM) Cooling Fan

Removal and Installation

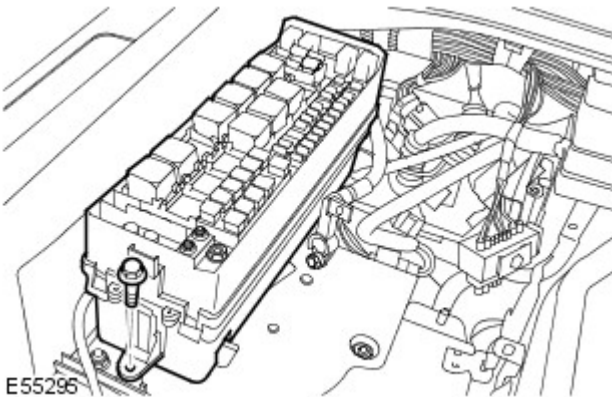
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
3. Remove the engine control module (ECM).
For additional information, refer to: [Engine Control Module \(ECM\)](#) (303-14, Removal and Installation).
4. Remove the battery junction box (BJB) cover.
 - Release the clip.



E91996

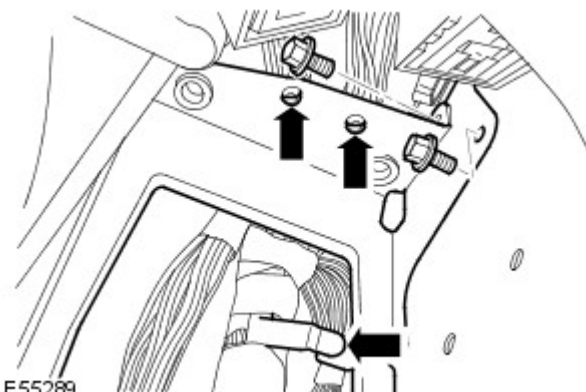
5. Release the BJB from the bracket.
 - Remove the bolt.



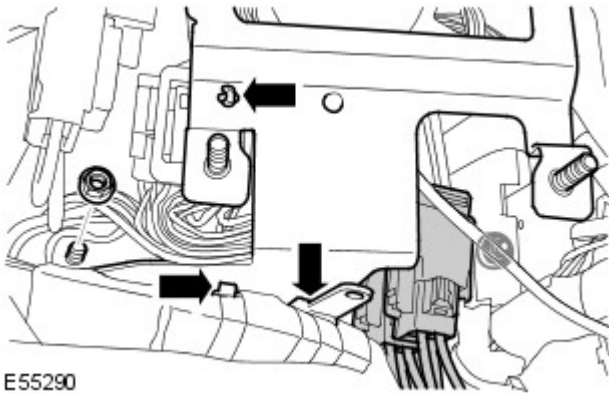
E55296

6. Remove the central junction box (CJB).
For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

7. Release the CJB bracket.
 - Release the 3 upper wiring harness clips.
 - Remove the 2 bolts.



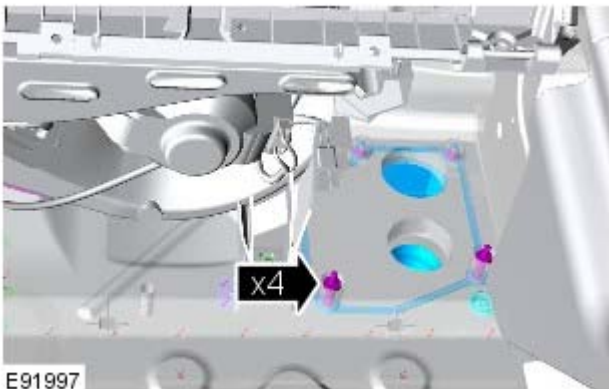
E55289



E55290

8. Remove the CJB bracket.

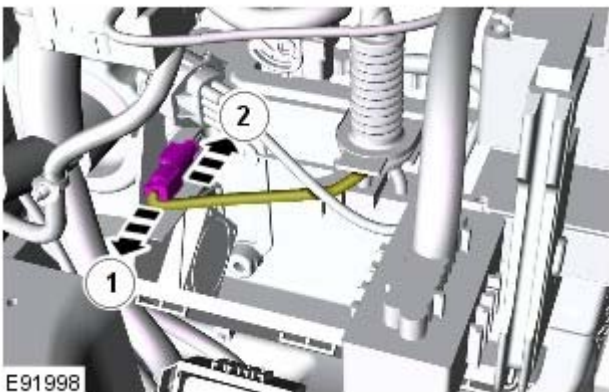
- Disconnect the 2 electrical connectors.
- Release the 3 lower wiring harness clips.
- Remove the 2 nuts.



E91997

9. Release the ECM housing.

- Release the insulation for access to the nuts.
- Remove the 2 nuts and 2 bolts.



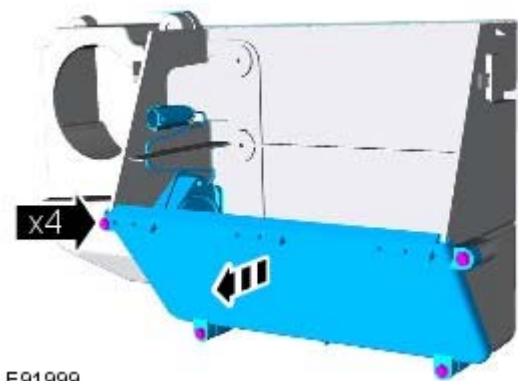
E91998

10.  **CAUTION:** Note of the routing of the wiring harnesses.

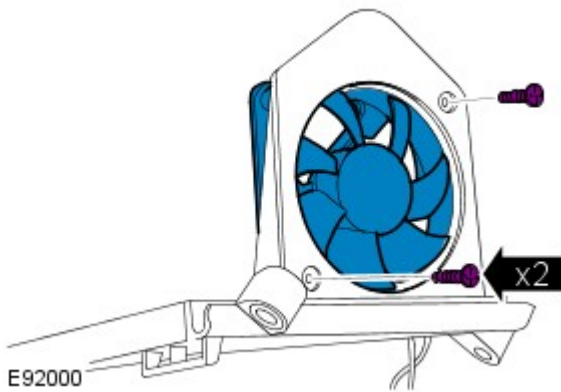
Release and disconnect the ECM cooling fan electrical connector.

11. Remove the ECM housing lower panel.

- Remove the 4 screws.



E91999




- 12.**  **CAUTION:** Note the fitted position of the component prior to removal.

Remove the cooling fan.

- Remove the 2 screws.

Installation

- 1.**  **CAUTION:** Make sure that these components are installed to the noted removal position.


Install the cooling fan.

- Install the 2 screws.

- 2.**  **CAUTION:** Make sure the seal is installed correctly.

Install the ECM housing lower panel.

- Install the 4 screws.

- 3.**  **CAUTION:** Make sure that the wiring harnesses are correctly routed.

Connect and secure the cooling fan electrical connector.

- 4.**  **CAUTION:** Make sure that the seal is correctly located.

Secure the ECM housing.

- Tighten the bolts and nuts to 10 Nm (7 lb.ft).

- 5.** Install the CJB bracket.

- Tighten the nuts to 10 Nm (7 lb.ft).
- Secure the clips.
- Connect the electrical connectors.
- Tighten the bolts to 25 Nm (18 lb.ft).

- 6.** Install the CJB.

For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

- 7.** Secure the BJB to the bracket.

- Tighten the bolt to 6 Nm (4 lb.ft).

- 8.** Install the BJB cover.

- Secure the clip.

- 9.** Install the engine ECM.

For additional information, refer to: Engine Control Module (ECM) (303-14, Removal and Installation).

- 10.** Install the battery tray.

For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

- 11.** Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

