

3. POWERTRAIN

303 : Engine

303-00 : Engine System - General

Specifications

Specifications

Lubricants, Fluids, Sealers and Adhesives

	Specifications
Brake fluid	Shell ESL (Dot 4)

Bearing Inspection

1. Inspect bearings for the following defects.
 1. Cratering - fatigue failure
 2. Spot polishing - incorrect seating.
 3. Imbedded dirt engine oil.
 4. Scratching - dirty engine oil.
 5. Base exposed - poor lubrication.
 6. Both edges worn - journal damaged.
 7. One edge worn - journal tapered or bearing not seated.

Camshaft Bearing Journal Clearance

1. NOTE:

Make sure that the following stages are followed exactly. The tappets or followers must be removed to carry out this measurement.

NOTE:

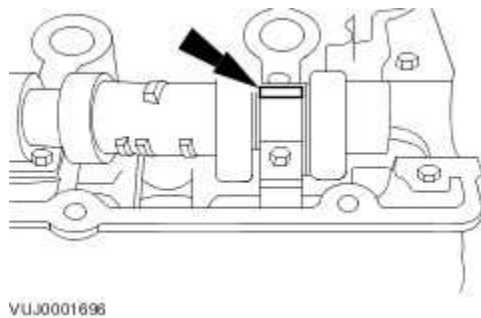
Make sure that the camshaft is to specification.

NOTE:

The bearing caps and journals should be free from engine oil and dirt.

Position on a length of plastigage on the bearing cap.

- Insert the camshaft, without lubrication, into the cylinder head.
- Position a plastigage strip, which should be equal to the width of the bearing cap, on the bearing journal.



2. Install the camshaft bearing caps.

- Follow the relevant tightening sequence.

3. NOTE:

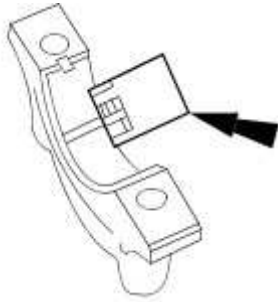
Do not strike the bearing caps.

Remove the camshaft bearing caps.

- Follow the relevant loosening sequence.

4. Using the special tool, read off the measurement.

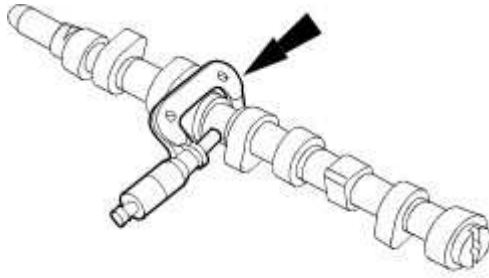
- Compare the width of plastigage with the plastigage scale.
- The value that is read off is the bearing clearance.
- If the values are not to specification install a new camshaft.



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Camshaft Bearing Journal Diameter

1. Determine the diameter of the camshaft journals.
 - Using a micrometer measure the diameter at 90 degrees intervals to determine if the journals are out-of-round.
 - Measure at two different points on the journal to determine if there is any tapering.
 - If the measurements are out of the specified range, install a new camshaft.



VUJ0001695

Camshaft End Play

1. NOTE:

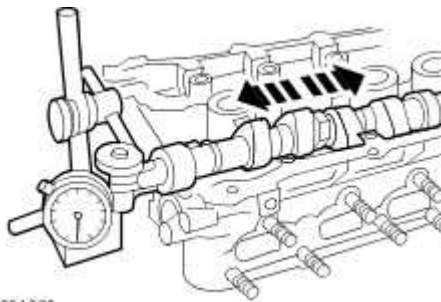
Make sure that the camshaft is to specification.

Using the special tool, measure the end play.

- Slide the camshaft in both directions. Read and note the maximum and minimum values on the dial indicator gauge.

End play = maximum value minus minimum value.

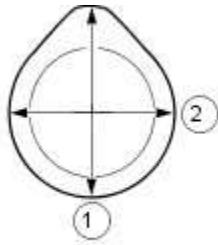
- If the measurement is out of specification, install new components.



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Camshaft Lobe Lift

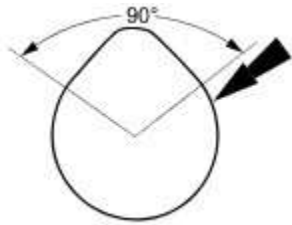
1. Measure the diameter (1) and diameter (2) with a vernier caliper. The difference in measurements is the lobe lift.



VUJ0001699

Camshaft Surface Inspection

1. Inspect camshaft lobes for pitting or damage in the active area. Minor pitting is acceptable outside the active area.



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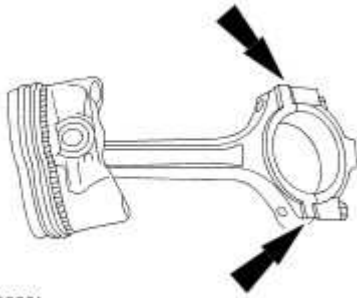
Connecting Rod Cleaning

1.



CAUTION: Do not use a caustic cleaning solution or damage to connecting rods may occur.

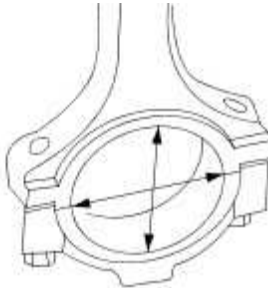
Mark and separate the parts and clean with solvent. Clean the oil passages.



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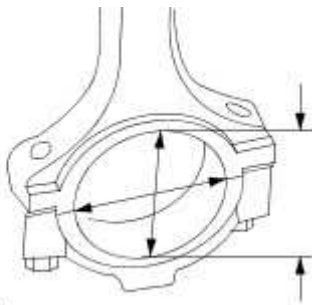
Connecting Rod Large End Bore

1. Measure the bearing bore in two directions. The difference is the connecting rod bore out-of-round. Verify the out-of-round is within specification.



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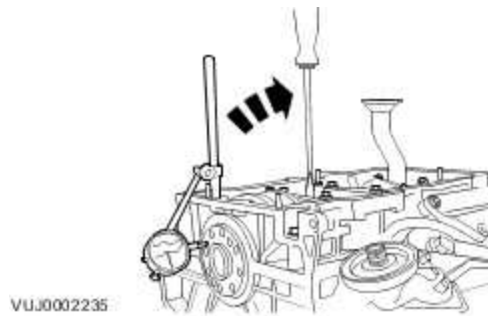
2. Measure the bearing bore diameter in two directions. Verify the bearing bore is within specification.



VUJ0002222

Crankshaft End Play

1. Using the Dial Indicator Gauge with Brackets, measure the end play.
 - Measure the end play by lifting the crankshaft using a lever.
 - If the value is out of the specification, install new thrust half rings to take up the end float and repeat the measurement.



Crankshaft Main Bearing Journal Clearance



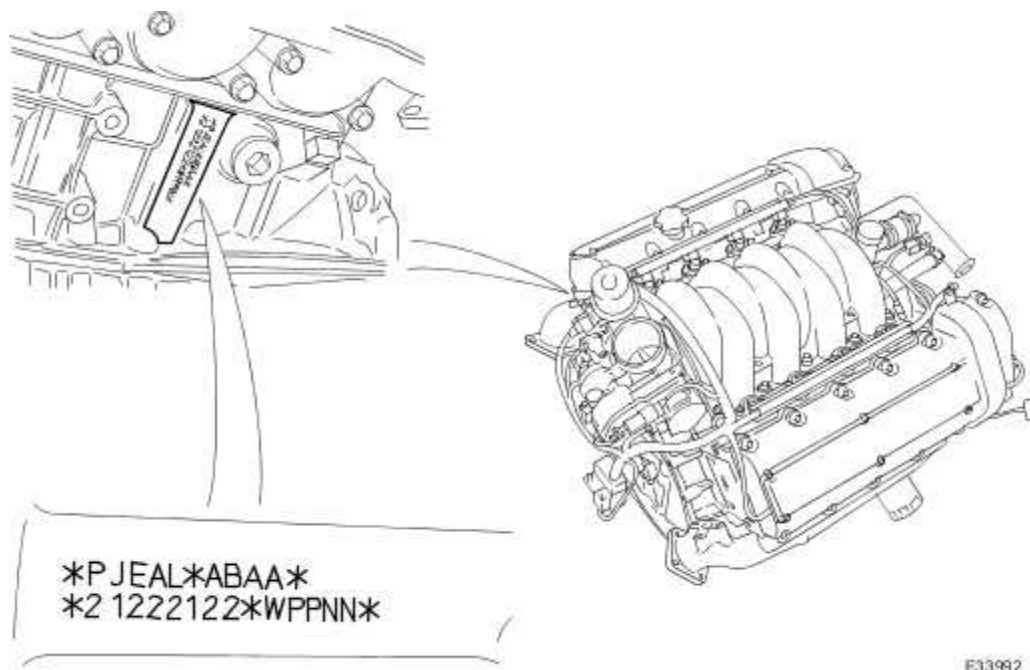
CAUTION: THESES PROCEDURES SHOULD NOT BE CARRIED OUT DURING THE MANUFACTURERS WARRANTY PERIOD.

1. NOTE:

Example - *PJEAL* - Crankshaft Main Journal Diameter.

Read the grade letters from LEFT to RIGHT = FRONT to REAR of engine eg. for this example engine, the crank journal at the front of the engine is grade P, and at the rear is grade L.

- The selection of main bearing shells is described in the following chart.



2. NOTE:

Example - *ABAA* - Crankshaft (Big End Bearing) Crankpin Diameter

NOTE:

For vehicles built up to 2002 MY.

NOTE:

If the crankshaft main bearing carrier retaining bolts have been marked with a center punch dot, they must be discarded and new bolts installed.

Read the grade letters from LEFT to RIGHT = FRONT to REAR of engine eg. for this

example engine, the crankpin at the front of the engine is grade A and at the rear is also grade A.

- Grade A = 56,000 to 55,994 mm (Bearing Shell Color Code - Blue).
- Grade B = 55,994 to 55,988 mm (Bearing Shell Color Code - Green).
- Grade C = 55,988 to 55,982 mm (Bearing Shell Color Code - Yellow).

3. **NOTE:**

Example - *ABAA* - Crankshaft (Big End Bearing) Crankpin Diameter

NOTE:

For vehicles built from 2002 MY.

NOTE:

If the crankshaft main bearing carrier retaining bolts have been marked with a center punch dot, they must be discarded and new bolts installed.

Read the grade letters from LEFT to RIGHT = FRONT to REAR of engine eg. for this example engine, the crankpin at the front of the engine is grade A and at the rear is also grade A.

- Grade A = 53,000 to 52,994 mm (Bearing Shell Color Code - Blue).
- Grade B = 52,994 to 52,988 mm (Bearing Shell Color Code - Green).
- Grade C = 52,988 to 52,982 mm (Bearing Shell Color Code - Yellow).

4. **NOTE:**

Example - *21222122* - Cylinder Bore and Piston

The cylinder bore grades read from LEFT to RIGHT as follows:

- Bank 2 - Cylinder 1, Bank 2 - Cylinder 2, Bank 2 - Cylinder 3, Bank 2 - Cylinder 4, Bank 1 - Cylinder 4,
- Bank 1 - Cylinder 3, Bank 1 - Cylinder 2, Bank 1 - Cylinder 1.
- (Note, in earlier publications Bank 1 was described as A-Bank and Bank 2 as B-Bank)
- Grade 1 Bore = 85,990 to 86,000 mm.
- Grade 2 Bore = 86,000 to 86,010 mm.
- Grade 3 Bore = 86,010 to 86,020 mm.

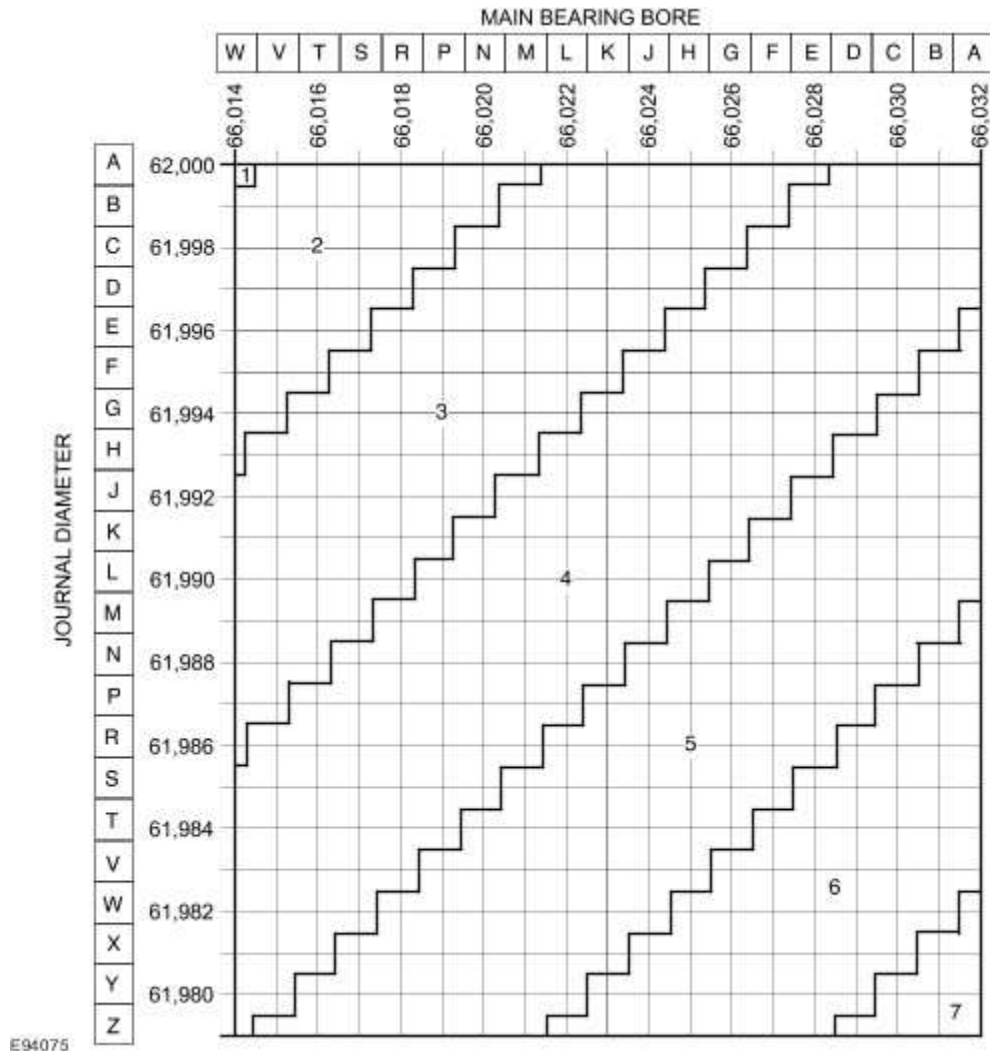
5. **NOTE:**

Example - *WPPNN* - Crankshaft Main Bearing Bore in Cylinder Block

Read the grade letters from LEFT to RIGHT = FRONT to REAR of engine eg. for this example engine, the crank journal bore at the front of the engine is grade W, and at the rear is grade N.

- The selection of main bearing shells is described in the following JOURNAL DIAMETER AND MAIN BEARING BORE CHART.

6. JOURNAL DIAMETER AND MAIN BEARING BORE CHART



7. NOTE:

THIS PROCEDURE SHOULD ONLY BE CARRIED OUT WHEN REPLACING MAIN BEARING SHELLS.

NOTE:

Refer to the JOURNAL DIAMETER AND MAIN BEARING BORE CHART in step 6 for tolerance and bearing information.

The number in each diagonal band represents a PAIR of color coded main bearing shells which must be used with a specific journal, depending on the combination of journal diameter and crankshaft bore diameter. The color codes for each band are as follows:

1. Blue / Green and Blue / Green
- Blue / Green and Blue

- Blue and Blue
- Blue and Green
- Green and Green
- Green and Yellow
- Yellow and Yellow
- Consider crankshaft journal 5 (from the example grade markings on the cylinder block) - the cylinder block bore is Grade N and the crankshaft journal diameter is Grade L. From the chart, it will be seen that the point of intersection is in Band 4 which equates to one Blue shell and one Green shell.
- When the appropriate pair of color codes have been selected for a journal, either color may be installed to the cylinder block or to the bedplate, but, the shell which is to be installed to the cylinder block must have an oil groove and the shell which is to be installed to the bedplate must be plain.

8. NOTE:

THIS PROCEDURE SHOULD ONLY BE CARRIED OUT WHEN A REPLACEMENT CRANKSHAFT OR CYLINDER BLOCK HAS BEEN FITTED.

NOTE:

Refer to the JOURNAL DIAMETER AND MAIN BEARING BORE CHART in step 6 for tolerance and bearing information.

The thickness grade of all main bearing shells are to be selected to give a total running clearance of not less than 0.022 mm or greater than 0.040 mm.

- Each bearing bore in the block/bedplate assembly should be measured at two mutually perpendicular diameters 45° to the vertical in the middle of the bearing.
- The minimum diameter of the two is to be used.
- Each crankshaft main bearing journal should be measured dynamically at a point in line with the middle of each bearing.
- When the appropriate pair of color codes have been selected for a journal, either color may be installed to the cylinder block or to the bedplate, but, the shell which is to be installed to the cylinder block must have an oil groove and the shell which is to be installed to the bedplate must be plain.

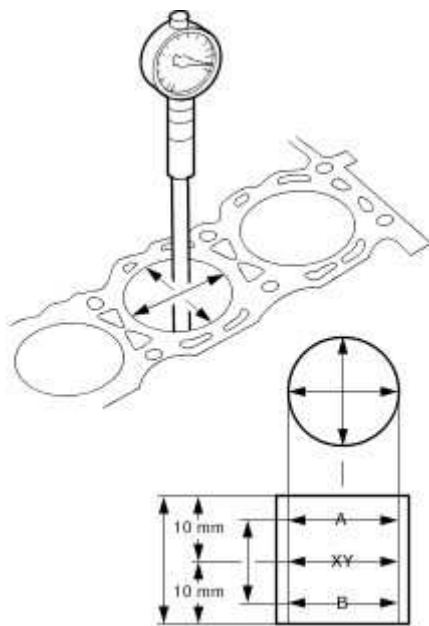
Cylinder Bore Out-of-Round

1. NOTE:

The main bearing caps or lower crankcase must be in place and tightened to the specified torque; however, the bearing shells should not be installed.

Measure the cylinder bore with an internal micrometer.

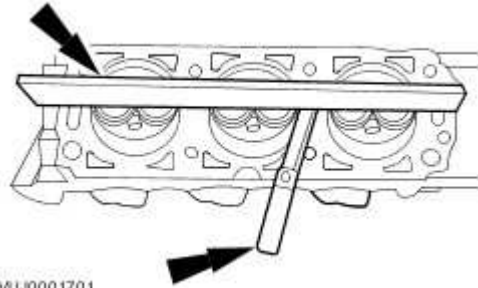
- Carry out the measurements in different directions and at different heights to determine if there is any out-of-roundness or tapering.
- If the measurement is out of the specified range, hone out the cylinder block or install a new block.



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Cylinder Head Distortion

1. Measure the cylinder block/cylinder head distortion.
 - Using the special tool, measure the mating face distortion.
 - If the value is not to specification rework the mating face.



Exhaust Manifold Cleaning and Inspection

1. Inspect the cylinder head joining flanges of the exhaust manifold for evidence of exhaust gas leaks.
2. Inspect the exhaust manifold for cracks, damaged gasket surfaces, or other damage that would make it unfit for further use.

Piston Inspection

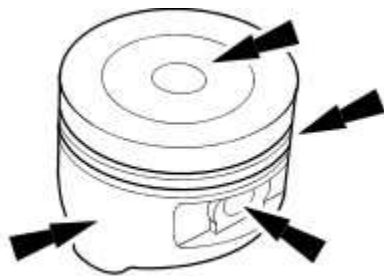
1.



CAUTION: Do not use any aggressive cleaning fluid or a wire brush to clean the piston.

Carry out a visual inspection.

- Clean the piston skirt, pin bush, ring grooves and crown and check for wear or cracks.
- If there are signs of wear on the piston skirt, check whether the connecting rod is twisted or bent.



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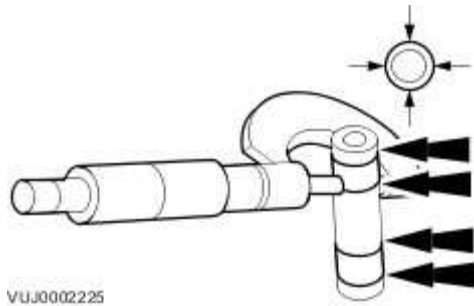
Piston Pin Diameter

1. NOTE:

The piston and piston pin are a matched pair. Do not mix up the components.

Measure the piston pin diameter.

- Measure the diameter in two directions.
- If the values are not to specification, install a new piston and a new piston pin.



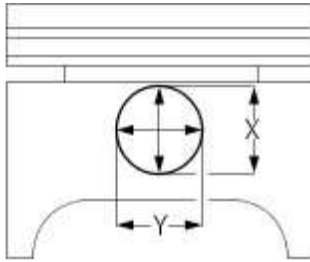
Piston Pin to Bore Diameter

1. NOTE:

The piston and piston pin form a matched pair. Do not mix up the components.

Measure the diameter of the piston pin bore.

- Measure the diameter in two directions.
- If the values are not to specification, install both a new piston and a new piston pin.



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Piston Ring End Gap

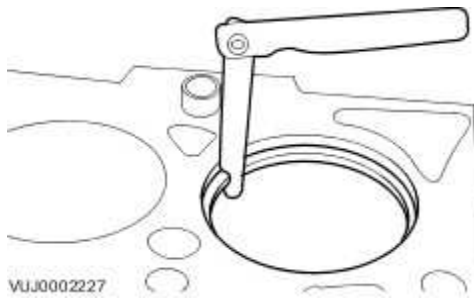
1.



CAUTION: Do not mix up the piston rings. Install the piston rings in the same position and location.

Using the Feeler Gauge, measure the piston ring gap.

- The values given in the specification refer to a gauge ring used during production.

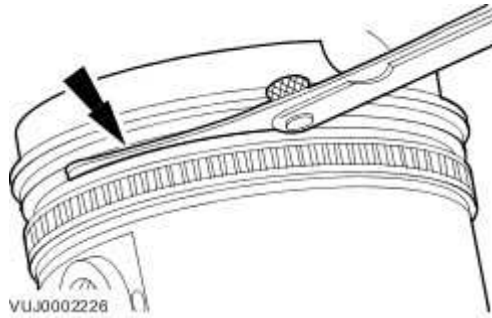


Piston Ring-to-Groove Clearance

1. NOTE:

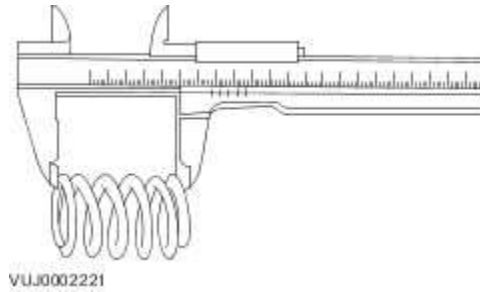
The piston ring must protrude from the piston groove. To determine the piston ring clearance, insert the Feeler Gauge right to the back of the groove, behind the wear ridge.

Using the Feeler Gauge, measure the piston ring clearance.



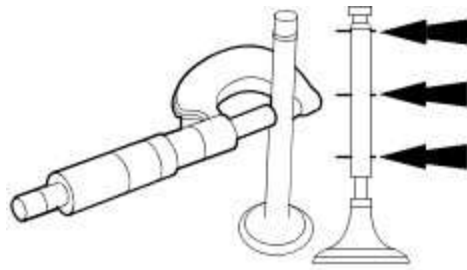
Valve Spring Free Length

1. Using a vernier gauge, measure the free length of each valve spring. Verify the length is within specification.



Valve Stem Diameter

1. Using a micrometer measure the diameter of the valve stems.
 - If the measurements are not to specification, install a new valve.



VUJ0002220

Diagnosis and testing

Engine

Inspection and Verification

- 1 . Verify the customer concern by operating the system.
- 2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
• Coolant leaks • Oil leaks • Leaks in the fuel system • Visibly damaged or worn parts • Loose or missing fixings	• Fuses • Loose or corroded electrical connectors • Harnesses • Sensors

- 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 concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

NOTE:

If an engine is suspect, when the vehicle remains under the Manufacturers warranty refer to the Warranty Policy and Procedure manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new engine.

NOTE:

Due to the possibility of loose carbon, that has become trapped between the valve face and seat, effecting the pressure readings, when carrying out a compression test and some cylinders are found to have low pressures, install the spark plugs, road test the vehicle and re-test the suspect cylinders. If the correct pressures are restored, no further action is required.

Symptom	Action

All engine related issues	Check ECM for Diagnostic Trouble Codes (DTCs) and refer to DTC Index. Electronic Engine Controls
Difficult to start hot and cold	Carry out general engine checks: Compression test. Refer to component tests in this section. Valve clearances. Valve Clearance Check (12.29.47) Spark plug condition and color
Poor idle	- Ensure the air intake system is free from leaks - Carry out general engine checks: Compression test. Refer to component tests in this section. Valve clearances. Valve Clearance Check (12.29.47) Spark plug condition and color - Check for collapsed catalytic converter/blocked exhaust system - Check long and short term fuel trim datalogger signals Readings up to 10%: may be considered as acceptable if the readings are equal bank to bank Positive readings of between 10-20%: check for air leaks in air intake system Negative readings of between 10-20%: check for over fuelling e.g. leaking injectors, high fuel pressure Readings above 20%: check for DTCs and refer to DTC Index. Electronic Engine Controls - Carry out a vacuum gauge check. Refer to component tests in this section.
Insufficient power/Insufficient compression	- Ensure the air intake system is free from leaks - Carry out general engine checks: Compression test. Refer to component tests in this section. Valve clearances. Valve Clearance Check (12.29.47) Spark plug condition and color - Check for collapsed catalytic converter/blocked exhaust system - Check long and short term fuel trim datalogger signals Readings up to 10%: may be considered as acceptable if the readings are equal bank to bank Positive readings of between 10-20%: check for air leaks in air intake system Negative readings of between 10-20%: check for over fuelling e.g. leaking injectors, high fuel pressure Readings above 20%: check for DTCs and refer to DTC Index. Electronic Engine Controls - Carry out a vacuum gauge check. Refer to component tests in this section.
Oil consumption	- Carry out oil leak check followed by an oil consumption test. Refer to the component tests in this section - If oil consumption is excessive: - Check the integrity of the engine breather system - Carry out general engine checks: Compression test. Refer to component tests in this section. Valve clearances. Valve Clearance Check (12.29.47) Spark plug condition and color
Noise	Refer to the Special Service Messages on the Electronic Product Quality Report (EPQR) system for sound files. If the symptom does NOT compare to any of the sound files, contact Dealer Technical

Component Tests

Engine Oil Leaks

NOTE:

Before installing new gaskets or oil seals, make sure that the fault is clearly established.

If the oil leak cannot be identified clearly by a visual inspection, carry out an Ultraviolet test:

Fluorescent Oil Additive Method

- 1 . Clean the engine with a suitable cleaning fluid (brake cleaner).
- 2 . Drain the engine oil and refill with recommended oil, premixed with Diesel Engine Oil Dye or equivalent. Use a minimum 14.8 ml (0.5 ounce) to a maximum 29.6 ml (1 ounce) of fluorescent additive to all engines. If oil is not premixed, fluorescent additive must first be added to the crankcase.
- 3 . Run engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks using a 12 Volt Master UV Diagnostic Inspection Kit or equivalent. A clear bright yellow or orange area will identify leak. For extremely small leaks, several hours may be required for the leak to appear.
- 4 . As necessary, pressurize the main oil gallery system to locate leaks due to incorrectly sealed, loose or cocked plugs. If the flywheel bolts leak oil, look for sealer on the threads.
- 5 . Repair all leaks as necessary.

Compression Test

General Remarks

NOTE:

Removing fuses and disconnecting electrical components may cause the Engine Control Module (ECM) to log Diagnostic Trouble Codes (DTCs). After the measurements have been carried out, DTCs should be cleared from memory by connecting to the Manufacturer Approved Diagnostic System.

NOTE:

Only check the compression pressure with the valves set to the prescribed clearance (if this can

be adjusted).

The compression pressure should be checked with the engine at operating temperature.

Check the Compression Pressure



WARNING: Move gear selector lever to 'P' position. Failure to follow this instruction may result in personal injury.

- 1 . Remove the fuel pump relay.
- 2 . Start the engine - the engine will start, run for a few seconds then stall.
- 3 . Remove the spark plugs.
- 4 . Install the compression tester.
- 5 . Install an auxiliary starter switch in the starting circuit. With the ignition switch OFF, using the auxiliary starter switch, crank the engine a minimum of five compression strokes and record the highest reading. Note the approximate number of compression strokes required to obtain the highest reading.
- 6 . Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes.
- 7 . Install the removed components in reverse order, observing the specified tightening torques.
- 8 . Clear all DTCs from the ECM.

Interpretation of the Results

NOTE:

Due to the possibility of loose carbon that has become trapped between the valve face and seat effecting the pressure readings, when carrying out a compression test and cylinders are found to have low pressures, install the spark plugs, road test the vehicle and re-test the suspect cylinders. If the correct pressures are restored, no further action is required.

The indicated compression pressures are considered within specification if the lowest reading cylinder is within 75% of the highest reading.

If the cylinder pressures are found to be low, carry out a leakdown test to determine the location of the fault (if any leakback can be heard through the engine breather system suspect the piston rings, if any leakback can be heard through the inlet system suspect the inlet valve or seat, if any leakback

can be heard through the exhaust manifold suspect the exhaust valve or seat. If the measurements for two cylinders next to each other are both too low then it is very likely that the cylinder head gasket between them is burnt through. This can also be recognized by traces of engine oil in the coolant and/or coolant in the engine oil).

Oil Consumption Test

The amount of oil an engine uses will vary with the way the vehicle is driven in addition to normal engine-to-engine variation. This is especially true during the first 16,100 km (10,000 miles) when a new engine is being broken in or until certain internal components become conditioned. Vehicles used in heavy-duty operation may use more oil. The following are examples of heavy-duty operation:

- Trailer towing applications
- Severe loading applications
- Sustained high speed operation

Engines need oil to lubricate the following internal components:

- Cylinder block cylinder walls
- Pistons and piston rings
- Intake and exhaust valve stems
- Intake and exhaust valve guides
- All internal engine components

When the pistons move downward, a thin film of oil is left on the cylinder walls. As the vehicle is operated, some oil is also drawn into the combustion chambers past the intake and exhaust valve stem seals and burned.

The following are examples of conditions that can affect oil consumption rates:

- Engine size
- Operator driving habits
- Ambient temperatures
- Quality and viscosity of oil
- Engine is being run in an overfilled condition (check the oil level at least five minutes after a hot shutdown with the vehicle parked on a level surface. The oil level should not be above the top of the cross-hatched area and the letter "F" in FULL).

Operation under varying conditions can frequently be misleading. A vehicle that has been run for several thousand miles on short trips or in below-freezing ambient temperatures may have consumed a "normal" amount of oil. However, when checking the engine oil level, it may measure up to the full mark on the oil level indicator due to dilution (condensation and fuel) in the engine crankcase. The vehicle then might be driven at high speeds on the highway where the condensation and fuel boil off. The next time the engine oil is checked it may appear that a liter of oil was used in about 160 km (100 miles). Oil consumption rate is about one liter per 2,400 km (1,500 miles).

Make sure the selected engine oil meets Jaguar specification and the recommended API performance

category "SG" and SAE viscosity grade as shown in the vehicle Owner's Guide. It is also important that the engine oil is changed at the intervals specified for the typical operating conditions.

The following diagnostic procedure is used to determine the source of excessive oil consumption.

NOTE:

Oil use is normally greater during the first 16,100 km (10,000 miles) of service. As mileage increases, oil use decreases. High speed driving, towing, high ambient temperature and other factors may result in greater oil use.

- 1 . Define excessive consumption, such as the number of miles driven per liter of oil used. Also determine customers driving habits, such as sustained high speed operation, towing, extended idle and other considerations.
- 2 . Verify that the engine has no external oil leaks as described under Engine Oil Leaks in this section.
- 3 . Carry out an oil consumption test:
 - ▶ Run the engine to normal operating temperature. Switch engine OFF and allow oil to drain back for at least five minutes .
 - ▶ With vehicle parked on level surface, check the engine oil level.
 - ▶ If required, add engine oil to set level exactly to the FULL mark.
 - ▶ Record the vehicle mileage.
 - ▶ Instruct the customer to return for a level check after driving the vehicle as usual for 1,610 km (1000 miles).

- Check the oil level under the same conditions and at the same location as the initial check.

NOTE:

If the oil consumption rate is unacceptable go to Step 4.

4 . Check the Positive Crankcase Ventilation (PCV) system. Make sure the system is not plugged.

5 . Check for plugged oil drain-back holes in the cylinder head and cylinder block.

6 . If the condition still exists after carrying out the above tests go to step 9.

7 . Carry out a cylinder compression test. Refer to the Compression Test procedure in this section. This can help determine the source of oil consumption such as valves, piston rings or other areas.

8 . Check valve guides for excessive guide clearance. Install new valve stem seals after verifying valve guide clearance.

9 . Worn or damaged internal engine components can cause excessive oil consumption. Small deposits of oil on the tips of the spark plugs can be a clue to internal oil consumption.

Intake Manifold Vacuum Test

Bring the engine to normal operating temperature. Connect a vacuum gauge or equivalent to the intake manifold. Run the engine at the specified idle speed.

The vacuum gauge should read between 51-74 kPa (15-22 in-Hg) depending upon the engine condition and the altitude at which the test is performed. Subtract 4.0193 kPa (1 in-Hg) from the specified reading for every 304.8 m (1,000 feet) of elevation above sea level.

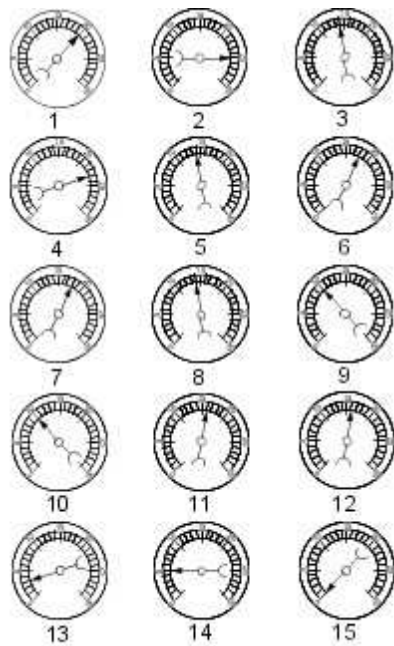
The reading should be steady. As necessary, adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust damper until needle moves easily without excessive flutter.

Interpreting Vacuum Gauge Readings

A careful study of the vacuum gauge reading while the engine is idling will help pinpoint trouble areas. Always conduct other appropriate tests before arriving at a final diagnostic decision. Vacuum gauge readings, although helpful, must be interpreted carefully.

Most vacuum gauges have a normal band indicated on the gauge face.

The following are potential gauge readings. Some are normal; others should be investigated further.



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1 . NORMAL READING: Needle between 51-74 kPa (15-22 in-Hg) and holding steady.

2 . NORMAL READING DURING RAPID ACCELERATION: When the engine is rapidly accelerated, the needle will drop to a low (not to zero) reading. When the throttle is suddenly released, the needle will snap back up to a higher than normal figure.

3 . NORMAL FOR HIGH-LIFT CAMSHAFT WITH LARGE OVERLAP: The needle will register as low as 51 kPa (15 in-Hg) but will be relatively steady. Some oscillation is normal.

4 . WORN RINGS OR DILUTED OIL: When the engine is accelerated, the needle drops to 0 kPa (0 in-Hg). Upon deceleration, the needle runs slightly above 74 kPa (22 in-Hg).

5 . STICKING VALVES: When the needle remains steady at a normal vacuum but occasionally flicks (sharp, fast movement) down and back about 13 kPa (4 in-Hg), one or more valves may be sticking.

6 . BURNED OR BENT VALVES: A regular, evenly-spaced, downscale flicking of the needle indicates one or more burned or damaged valves. Insufficient hydraulic valve tappet or hydraulic lash adjuster clearance will also cause this reaction.

7 . POOR VALVE SEATING: A small but regular downscale flicking can mean one or more valves are not seating correctly.

8 . WORN VALVE GUIDES: When the needle oscillates over about a 13 kPa (4 in-Hg) range at idle speed, the valve guides could be worn. As engine speed increases, the needle will become steady if guides are responsible.

9 . WEAK VALVE SPRINGS: When the needle oscillation becomes more violent as engine RPM is increased, weak valve springs are indicated. The reading at idle could be relatively steady.

10 . LATE VALVE TIMING: A steady but low reading could be caused by late valve timing.

11 . IGNITION TIMING RETARDED: Retarded ignition timing will produce a steady but somewhat low reading.

12 . INSUFFICIENT SPARK PLUG GAP: When spark plugs are gapped too close, a regular, small pulsation of the needle can occur.

13 . INTAKE LEAK: A low, steady reading can be caused by an intake manifold or throttle body gasket leak.

14 . BLOWN HEAD GASKET: A regular drop of fair magnitude can be caused by a blown head gasket or warped cylinder head to cylinder block surface.

15 . RESTRICTED EXHAUST SYSTEM: When the engine is first started and is idled, the reading may be normal, but as the engine RPM is increased, the back pressure caused by a clogged muffler, kinked tail pipe or other concerns will cause the needle to slowly drop to 0 kPa (0 in-Hg). The needle then may slowly rise. Excessive exhaust clogging will cause the needle to drop to a low point even if the engine is only idling.

When vacuum leaks are indicated, search out and correct the cause. Excess air leaking into the system will upset the fuel mixture and cause concerns such as rough idle, missing on acceleration or burned valves. If the leak exists in an accessory such as the power brake booster, the unit will not function correctly. Always repair vacuum leaks.

303-01A : Engine – 4.2L SC V8 – AJV8

Specifications

Specifications

Engine Data

Engine Description	Engine Capacity	Maximum Engine Torque (EEC)	Maximum Engine Power (EEC)	Maximum Engine Torque (SAE)	Maximum Engine Power (SAE)	Compression Ratio	Bore	Stroke
90° 'Vee' 8 Cylinder 32 Valves	4196 cm ³	560 Nm/413 lb/ft at 4000 RPM	410 BHP/306 kW at 6250 RPM	560 Nm/413 lb/ft at 4000 RPM	420 BHP/313 kW at 6250 RPM	9.1:1 ± 0.5:1	86.0 mm	90.3 mm

Engine Firing Order

Firing Order

1 : 2 : 7 : 3 : 4 : 5 : 6 : 8

Engine Valve Clearance (cold)

Intake Valve	Exhaust Valve
0.18 - 0.22 mm	0.23 - 0.27 mm

Spark Plugs

Specification	Spark Plug Gap
AJ8 4575	0.9 - 1.0 mm

Lubricants, Fluids, Sealers and Adhesives

Description	Specification
Core plug and stub pipe retainer	WSK-M2G349-A4
Engine oil, SAE 5W-30	WSS-M2C-913B
Sealant	WSE-M4G323-A4

Capacities

Description	Liters
Engine oil, initial fill	8.5
Engine oil, service fill with oil filter change	7.0

Cylinder head and Valvetrain

Item	Specification
Cylinder head maximum permitted warp (mm)	0.125
Valve guide inner diameter (mm)	5.00 - 5.02
Intake valve effective length (mm)	88.87 - 89.17
Exhaust valve effective length (mm)	88.40 - 88.70
Valve stem to guide clearance intake decimetrical (mm)	0.022 - 0.057
Valve stem to guide clearance exhaust decimetrical (mm)	0.030 - 0.065
Valve head diameter intake (mm)	34.8 - 35.0
Valve head diameter exhaust (mm)	30.8 - 31.0
Intake valve face angle (degrees)	45° 15' 30" ± 7° 30'
Exhaust valve face angle (degrees)	45° - 44° 45'
Valve stem diameter intake (mm)	4.963 - 4.978
Valve stem diameter exhaust (mm)	4.955 - 4.970
Valve spring free length (mm)	43.5 MAX
Valve spring installed height (mm)	33.20
Camshaft lobe lift intake (mm)	8.50
Camshaft lobe lift exhaust (mm)	8.50
Camshaft journal to cylinder head bearing surface clearance diametrical (mm)	• Front bearing 0.045 - 0.085 • Other bearings 0.055 - 0.075
Camshaft journal diameter standard runout limit (mm)	• Center bearing to outer bearings 0.07 • Other bearings to outer

	bearings 0.05
Camshaft journal diameter standard out of round (mm)	0.005

Torque Specifications

Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner retaining bolt	40	30	-
Air conditioning compressor retaining bolts	25	18	-
Air conditioning compressor mounting bracket bolt	25	18	-
Camshaft bearing caps retaining bolts	10	7	88
Camshaft exhaust sprocket	A	-	-
Camshaft position sensor bolt	7	5	62
Connecting rod to bearing cap bolts	A	-	-
Coolant drain in engine block - plug M10 x 16	25	18	-
Coolant pump bolt	8 + 90°	6 + 90°	71 + 90°
Crankshaft damper pulley - bolt	320	236	-
Cylinder head - bolt	A	-	-
Engine cover (top)	4	3	35
Engine cover (top) mounting bracket - nut	6	4	53
Engine front cover retaining bolts	12	19	-
Engine mounting to engine mounting bracket - nut	48	35	-
Engine mounting to subframe - nut	63	46	-
Engine mounting bracket to engine - bolt	40	30	-
Engine wiring harness bracket - nut/bolt	10	7	88
Exhaust manifold - bolt	A	-	-
Exhaust manifold heat shield - bolt	3	2	27
Flexplate - bolt	A	-	-
Generator upper retaining bolts	2	15	-
Ignition coil retaining bolts	5	4	44
Intake manifold assembly retaining bolts	21	15	-
Intercoolers	12	9	-
Intercooler duct clamp plates	21	15	-
Knock sensor retaining nuts	20	14	-
Lifting eye (front) - bolt	30	22	-
Lifting eye (rear) - bolt	40	30	-
MAP sensor	6	4	53

Oil filter	17	13	-
Oil filter housing to engine - bolt	21	15	-
Oil level indicator tube - nut	6	4	53
Oil pan to oil pan body - bolt	A	-	-
Oil pan body to engine	A	-	-
Oil pan drain plug	25	18	-
Oil pump pick-up pipe to oil pan body - bolt	12	9	-
Oil pump to engine block - bolt	12	9	-
Oil pump to pick-up pipe - bolt	12	9	-
Piston cooling jet - bolt	9	7	80
Plug - M30 x 12 to engine block	50	37	-
Plug (flanged) - M30 - 1.5 x 20 to engine block	50	37	-
Power steering pump retaining bolts	25	18	-
Power steering pump bracket to engine - bolt	28	18	-
Primary timing chain tensioner - bolt	12	9	-
Primary timing chain tensioner, guide blade - bolt	12	9	-
Radio frequency interference suppressor to engine cover bracket - bolt	10	7	88
Secondary timing chain tensioner - bolt	12	9	-
Spark plugs	27	20	-
Starter motor retaining bolts	43	32	-
Supercharger	21	15	-
Supercharger outlet duct - bolt	10	7	88
Supercharger outlet duct - screw	21	15	-
Timing belt cover - bolt	A	-	-
Valve cover - bolt	A	-	-
Variable camshaft timing, oil control solenoid housing - bolt	22	16	-
Variable camshaft timing, oil control solenoid housing - nut	11	8	-
Variable camshaft timing sprocket - center bolt	A	-	-

A = refer to procedure for correct torque sequence

Valve Clearance Adjustment (12.29.48)

Special Service Tools



Tappet hold-down tool
303-540



Tappet hold-down tool adaptor
303-540/02



Fan nozzle - air gun
303-590



CAUTION: Rotating the crankshaft in a counterclockwise direction may cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.



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

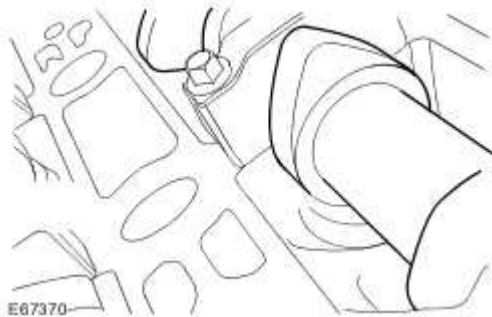
1. Remove the cover and disconnect the battery ground cable.

Specifications

2. Check the valve clearances.

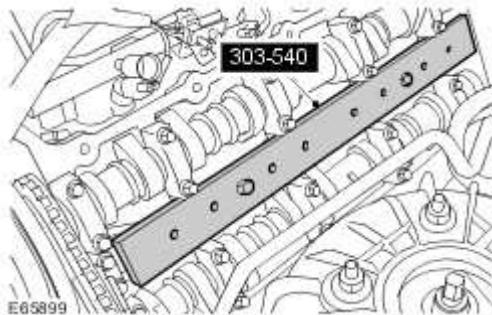
Valve Clearance Check (12.29.47)

3. Rotate the engine clockwise to position the camshaft lobe away from the valve tappet.



4. Install the special tool 303-540, to the cylinder head.

- Tighten the 2 bolts to 10 Nm (7 lb.ft).



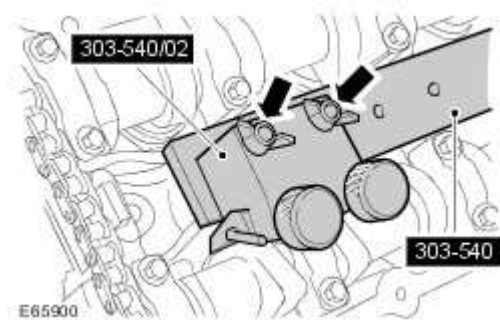
- 5.



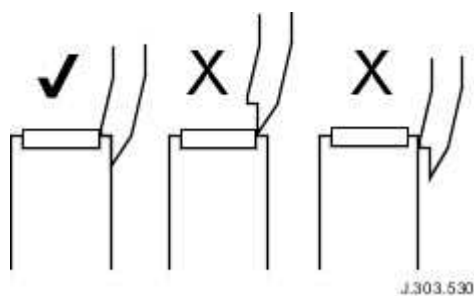
CAUTION: Do not rotate the crankshaft while the special tool 303-540/02 is attached to 303-540.

Attach the special tool 303-540/02 to 303-540.

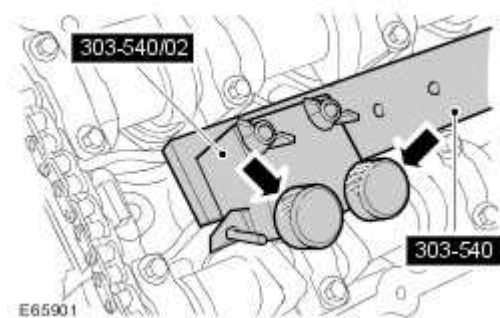
- Secure with the 2 wing nuts.



6. Position the special tool to the tappet as shown.



7. Using the special tool, compress the valve spring.



8.



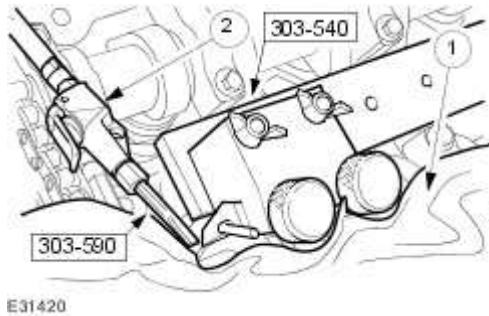
CAUTION: Do not use a magnet to remove shims. Failure to follow these instructions may result in damage to the vehicle.

NOTE:

Use the following formula to calculate the required shim thickness. Original shim thickness + measured shim clearance - desired clearance = required shim thickness.

Remove, clean and measure the shim.

- Surround the immediate working area with a cloth, to retain any loose shims displaced by the compressed air.
- Use the special tool 303-590, aimed at the edge of the shim, to lift it from the tappet. Note the position of each one.



9.



CAUTION: Shims must be fitted with the size markings facing the tappet, not the camshaft.

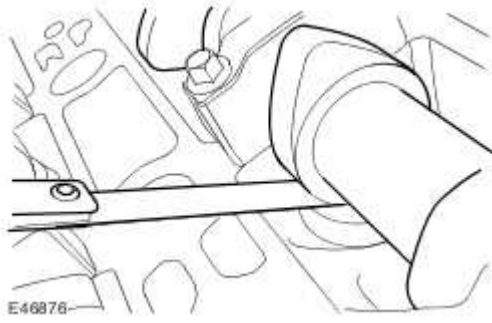


CAUTION: Do not use a magnet to install shims. Failure to follow these instructions may result in damage to the vehicle.

Install the new shim.

- Clean the components.
- Lubricate the shim with clean engine oil.
- Release and remove the special tools as required.

10. Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



11. Repeat the above procedure for the remaining valves.

Valve Clearance Check (12.29.47)



CAUTION: Rotating the crankshaft in a counterclockwise direction may cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.



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

1. Remove the cover and disconnect the battery ground cable.

[Specifications](#)

2. Remove the LH valve cover.

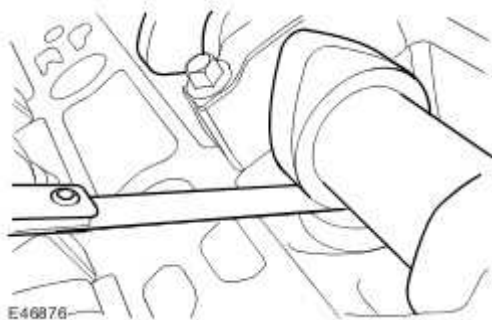
[Valve Cover LH \(12.29.43\)](#)

3. Remove the RH valve cover.

[Valve Cover RH \(12.29.44\)](#)

4. Rotate the engine clockwise to position the camshaft lobe away from the valve tappet.

5. Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



6. Repeat the above procedure for the remaining 31 shims.

7. Adjust the clearance as necessary.

8. For cylinder head data, refer to specifications.

[Specifications](#)

9. Install the RH valve cover.

[Valve Cover RH \(12.29.44\)](#)

10. Install the LH valve cover.

[Valve Cover LH \(12.29.43\)](#)

11. Connect the battery ground cable and install the cover.

[Specifications](#)

Engine Oil Draining and Filling

Special Service Tools



Wrench, Oil filter
303-752



WARNING: The spilling of hot engine oil is unavoidable during this procedure, care must be taken to prevent scalding.



CAUTION: Correct installation of the oil filler cap can be obtained by tightening the cap until an audible click is heard.

NOTE:

Clean the components general area prior to dismantling.

1. Remove the cover and disconnect the battery ground cable.
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.

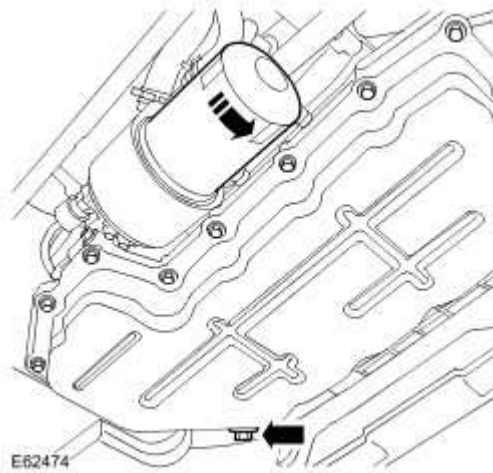
3. Remove the engine undershield.
Air Deflector (76.11.41)

4. Remove the oil pan drain plug.

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

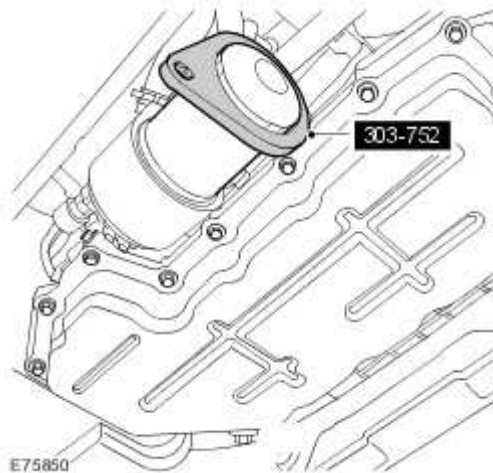
5. Remove the oil filter.

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



6. Using the special tool, install the oil filter.

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



7. Tighten the drain plug to 25 Nm (18 lb.ft).

- Install a new seal.

8. Fill the engine with oil.

9. Connect the battery ground cable and install the cover.

Specifications

10. Start engine and run at idle speed until the oil pressure warning light extinguishes.

- Stop the engine.
- Check for leaks.

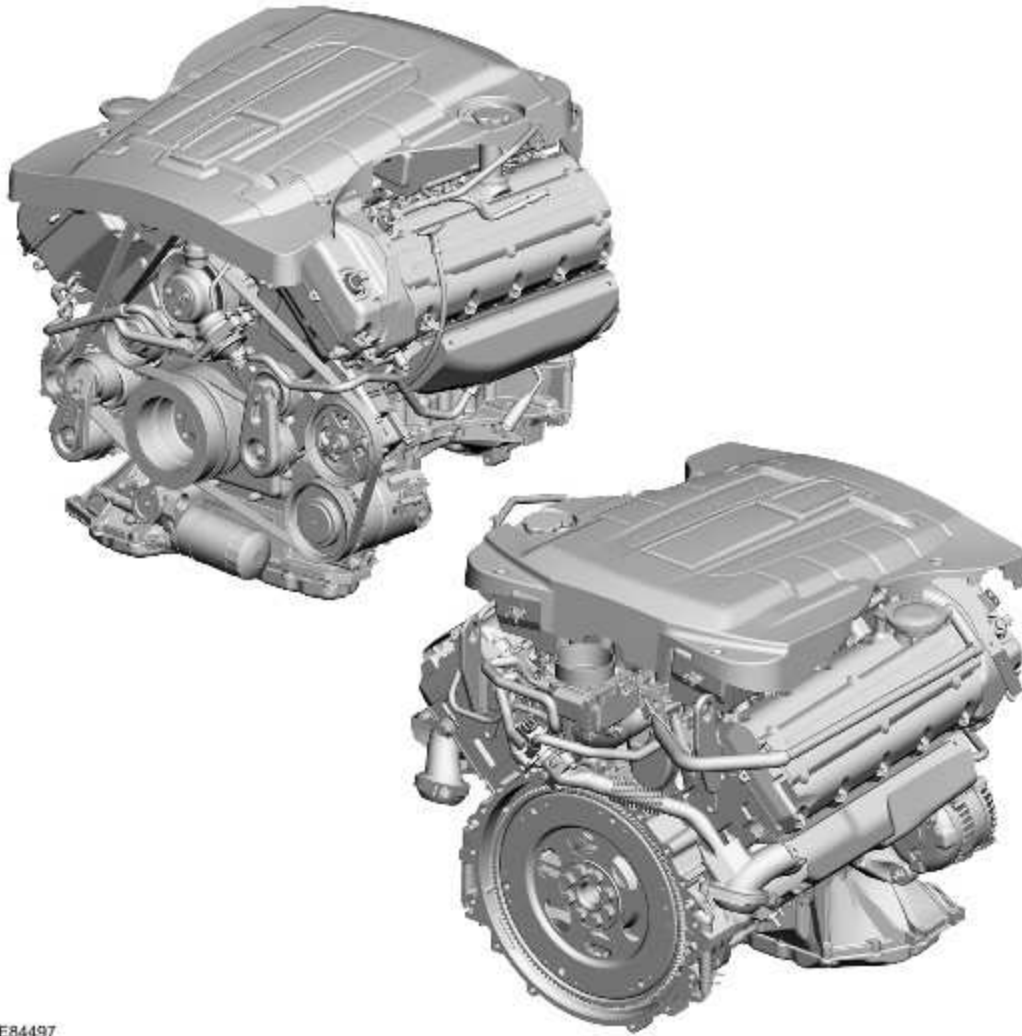
11. Install the engine undershield.

Air Deflector (76.11.41)

12. Check and top-up the engine oil.

Engine

EXTERNAL VIEW



E84497

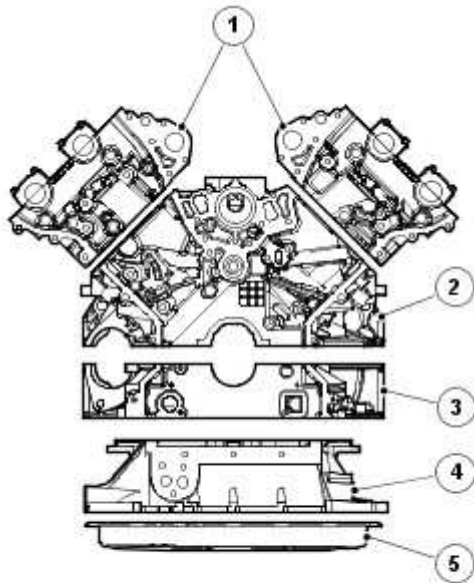
OVERVIEW

The V8 supercharged petrol engine is a 4.2 liter, 8-cylinder, 90 degrees 'Enclosed' V unit, with 4 valves per cylinder, operated by 2 overhead camshafts per cylinder head. The engine emissions comply with ECD4 (European Commission Directive) legislative requirements and employs catalytic converters, electronic engine management control and positive crankcase ventilation to limit the emission of pollutants. The cooling system is a low volume, high velocity system. The Engine Control Module (ECM) controls the fuel injection system, the ignition system and the electric throttle.

The cylinder block is of aluminum alloy construction with cast iron liners. A cast aluminum bedplate is bolted to the bottom of the block to improve lower structure rigidity. The cylinder heads are cast aluminum with thermo-plastic camshaft covers. The single-piece oil sump is also cast aluminum. The

fabricated stainless steel twin skin exhaust manifolds are unique for each cylinder bank. A moulded plastic acoustic cover is fitted over the upper engine to reduce engine-generated noise.

Engine Structure



E7 1998

Item	Part Number	Description
1		Cylinder heads
2		Cylinder block
3		Bedplate
4		Structural sump
5		Sump pan

TECHNICAL FEATURES

The technical features include:

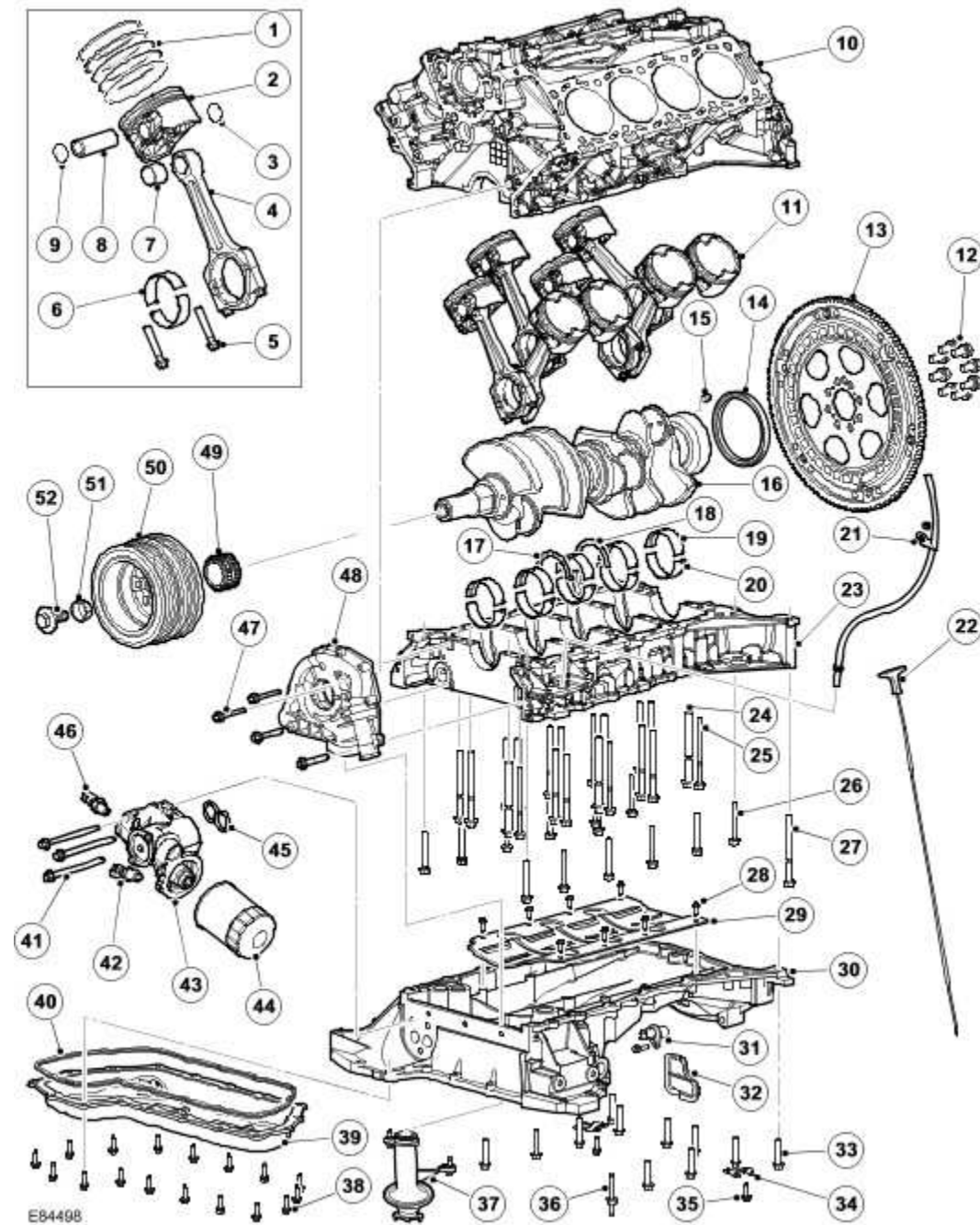
- An 8-cylinder 90-degree 'Enclosed V' configuration liquid cooled aluminum cylinder block with cast iron liners
- Pistons are of open-ended skirt design, with 2 compression rings and a 3-piece oil control ring
- Two aluminum cylinder heads, each incorporating 2 camshafts manufactured in chilled cast iron
- Four valves per cylinder

- Graded valve lifters (shimless)
- Belt driven supercharger
- Top fed, 12-hole fuel injectors
- Engine front cover manufactured from aluminum, accommodating the crankshaft front oil seal
- Primary and secondary chain drive for the camshafts
- An aluminum bedplate
- A cast iron crankshaft
- Fracture-split connecting rods in sintered-forged steel
- A twin multi-V belt, driving the front-end accessories
- Fabricated stainless steel twin skin exhaust manifolds
- An advanced engine management system incorporating electronic throttle control
- Meets with the fault handling requirements, as detailed in the European On-Board Diagnostic (EOBD) III, US Federal OBD and California OBDII legislation.

ENGINE DATA

DESCRIPTION	TYPE
Configuration	90 degree V8
Maximum power	283 kW at 5750 rpm
Maximum torque	550 Nm at 3500 rpm
Displacement	4196 liters
Stroke/bore	90.3/86 mm
Compression ratio	9.1 : 1
Firing order	1 5 4 2 6 3 7 8
Oil volume	7 liters (wet)

CYLINDER BLOCK COMPONENTS



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

5		Bolts
6		Connecting rod bearing shells
7		Bearing
8		Piston pin
9		Circlip
10		Cylinder block
11		Piston assemblies
12		Bolts (8 off)
13		Flywheel
14		Seal
15		Dowel
16		Crankshaft
17		Thrust washer
18		Thrust washer
19		Bearing shells - upper
20		Bearing shells - lower
21		Oil level gage tube
22		Oil level gage
23		Bedplate
24		Bolts (10 off)
25		Bolts (10 off)
26		Bolts (12 off)
27		Bolt

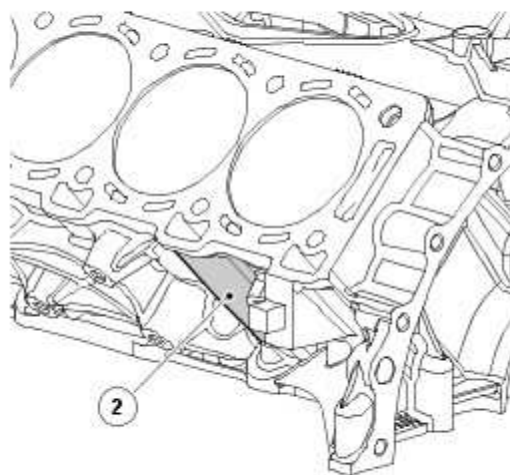
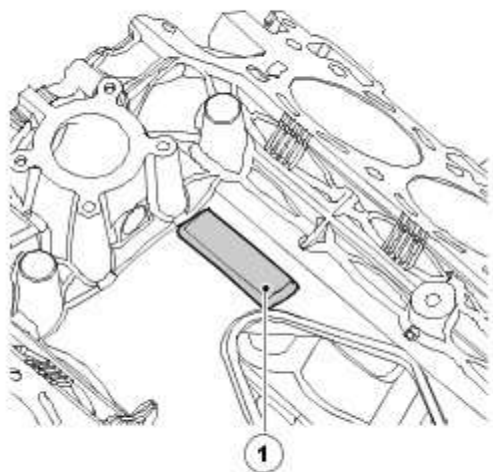
28		Bolts (8 off)
29		Windage tray
30		Sump
31		Crankshaft Position (CKP) sensor
32		Flange
33		Bolts (11 off)
34		Clip
35		Bolts (2 off)
36		Stud
37		Oil pick-up pipe
38		Bolts (17 off)
39		Sump pan
40		Gasket
41		Bolts (3 off)
42		Engine oil temperature sensor
43		Oil filter head assembly
44		Oil filter
45		Seal
46		Oil pressure switch
47		Bolts (4 off)
48		Oil pump
49		Crankshaft sprocket
50		Crankshaft pulley

51		Taper collet
52		Crankshaft bolt

Cylinder Block

The cylinder block is an 'Enclosed V' design, which provides an inherently rigid structure with good vibration levels. A low volume coolant jacket improves warm-up times and piston noise levels; the longitudinal flow design of the jacket, with a single cylinder head coolant transfer port in each bank, improves rigidity and head gasket sealing. The right hand cylinder bank is designated as 'A' bank, and the left hand as 'B' bank. The cylinder bores are numbered from 1 to 4, for bank 'A' and 5 to 8 for bank 'B', starting from the front of the engine (for more information refer to the Vehicle Specification Book (VSB)).

Engine Data Locations



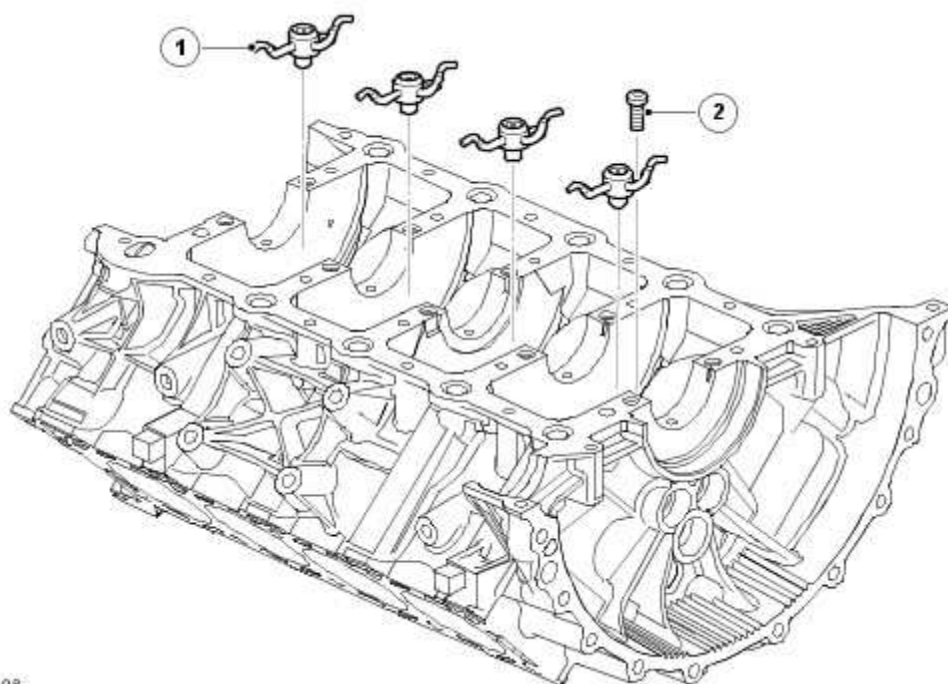
E43426

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

Engine data is marked at 3 locations, 2 on the cylinder block (shown) and 1 on the engine front cover, which consists of a label displaying the engine number. Component diameters are represented by

alphabetical and numerical codes; keys to the codes are in the Service Repair Procedures (SRP) section of this manual.

Piston Cooling Jets



E56198

Item	Part Number	Description
1		Piston cooling jet (4 off)
2		Bolt (4 off)

Jets located in the cylinder block provide piston and piston pin lubrication and cooling. These jets spray oil on the underside of the piston.

Lubrication oil is distributed through the cylinder block, via the main oil gallery and channels bored in the block, to all critical moving parts. These channels divert oil to the main and big-end bearings via holes machined into the crankshaft.

Connecting Rods and Pistons

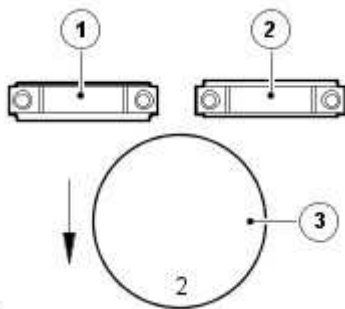


E43427

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

The pistons are of the open-ended skirt design with a dished crown. They are also manufactured from a higher strength aluminum alloy and incorporate a thicker top land to resist the increased thermal and mechanical loads produced by supercharging. Three piston rings, 2 compression and 1 solid oil control ring, are installed on each piston. Each piston is installed on a piston pin located in an bronze bushing in the connecting rod.

Connecting Rod and Piston Installation



E43428

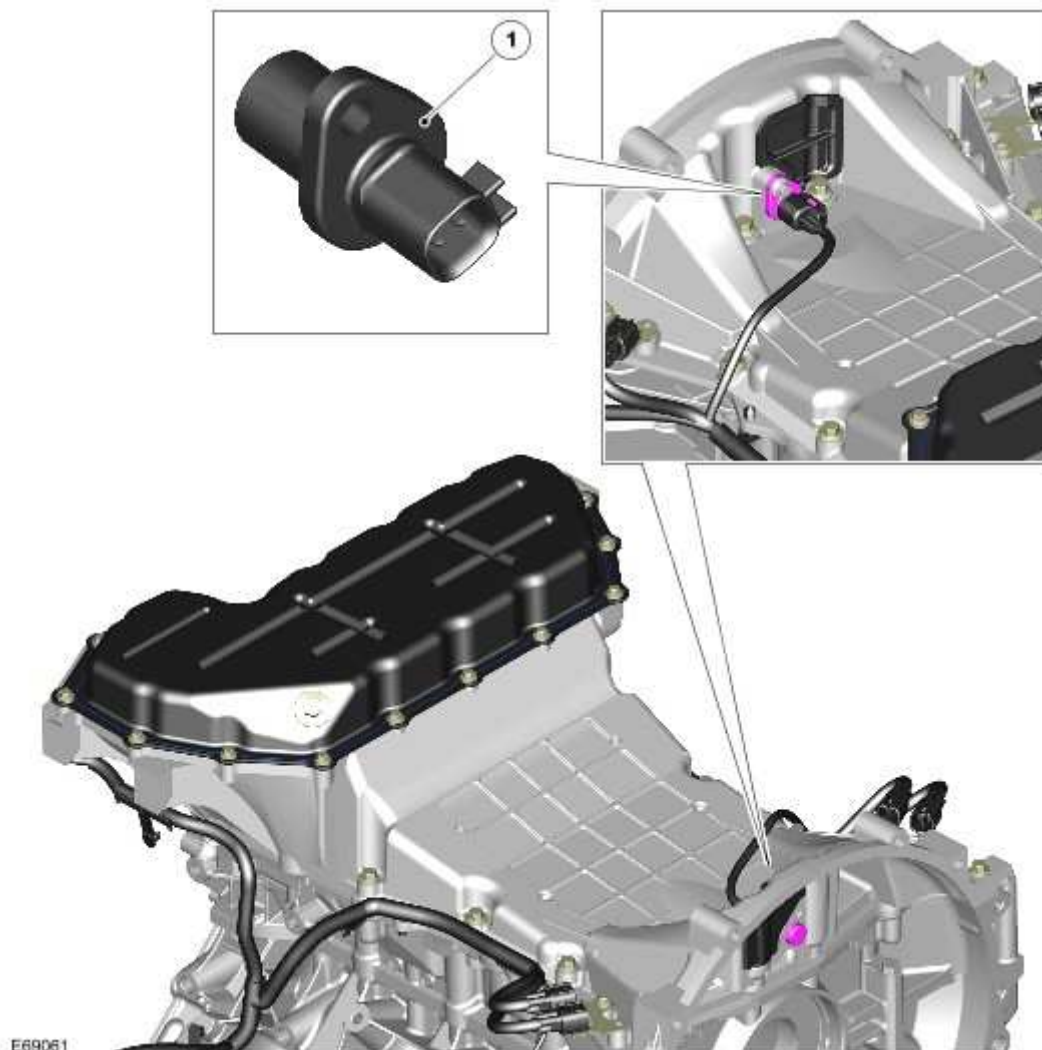
Item	Part Number	Description

1		Bank A (RHS)
2		Bank B (LHS)
3		Piston

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

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

Crankshaft Position Sensor



Item	Part Number	Description

1		Crankshaft position sensor (CKP)

The CKP sensor is installed at the rear of the sump. It is a variable reluctance sensor that provides an input of engine crankshaft speed and position. For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - Vehicles Without: Supercharger)

Knock Sensors

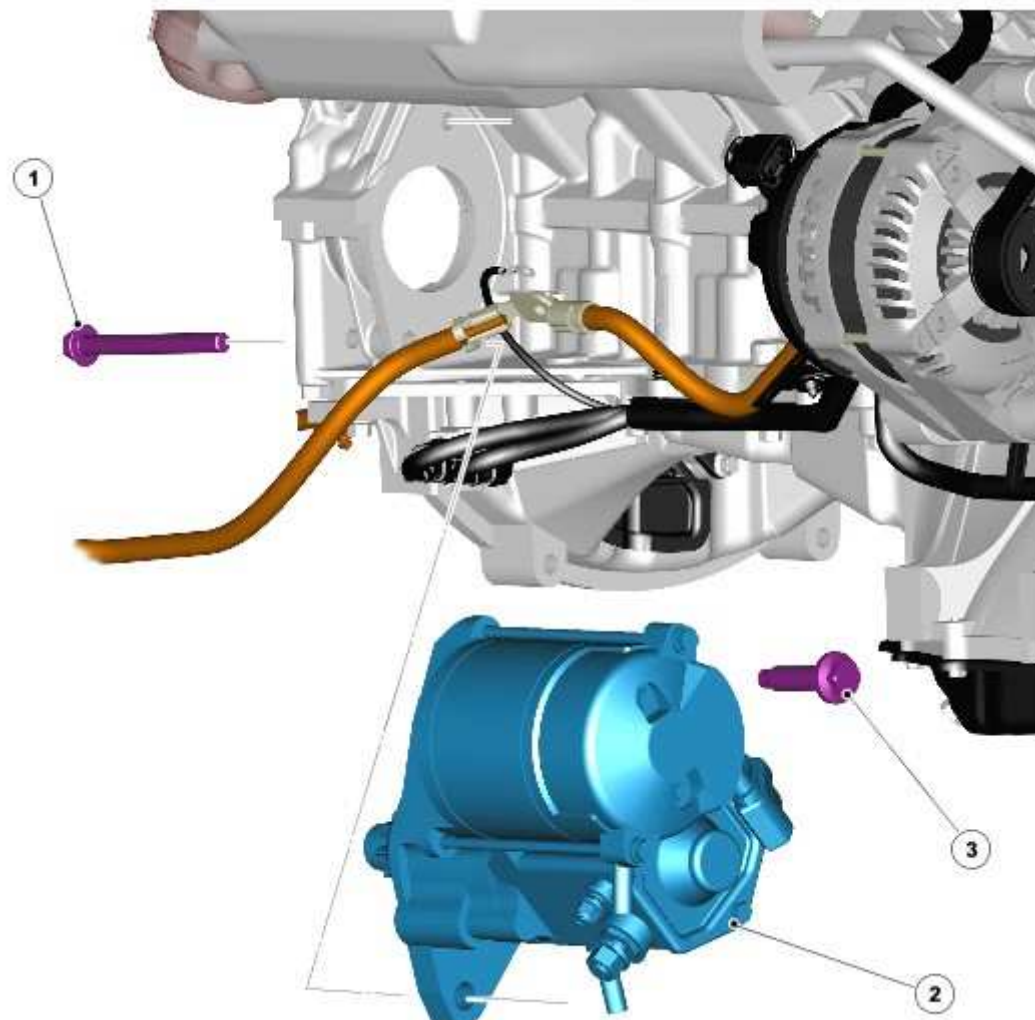


Item	Part Number	Description
1		Knock sensor
2		Bolt

The knock sensors are installed in the cylinder block on the inboard side of each cylinder bank. They are piezo-electric sensors that provide inputs to detect and locate detonation during combustion. For

additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - Vehicles Without: Supercharger)

Starter

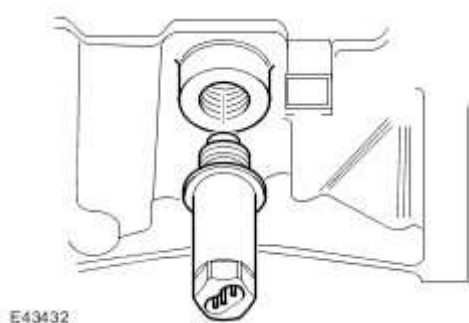


E69062

Item	Part Number	Description
1		Bolt
2		Starter motor
3		Bolt

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

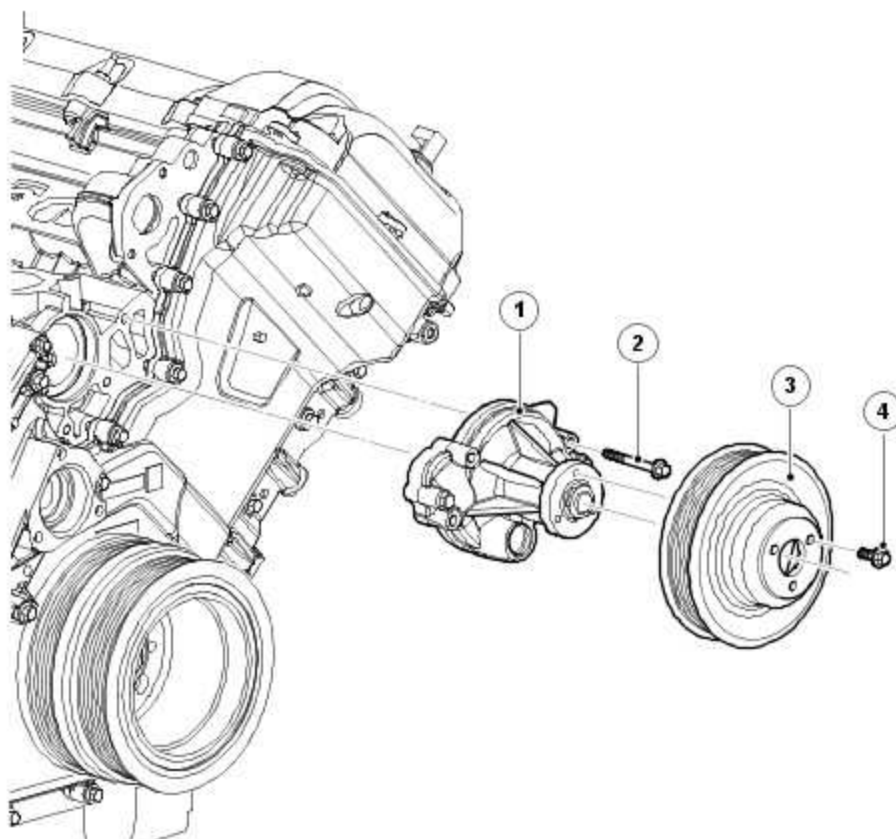
Coolant Drain Plug/Heater



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

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

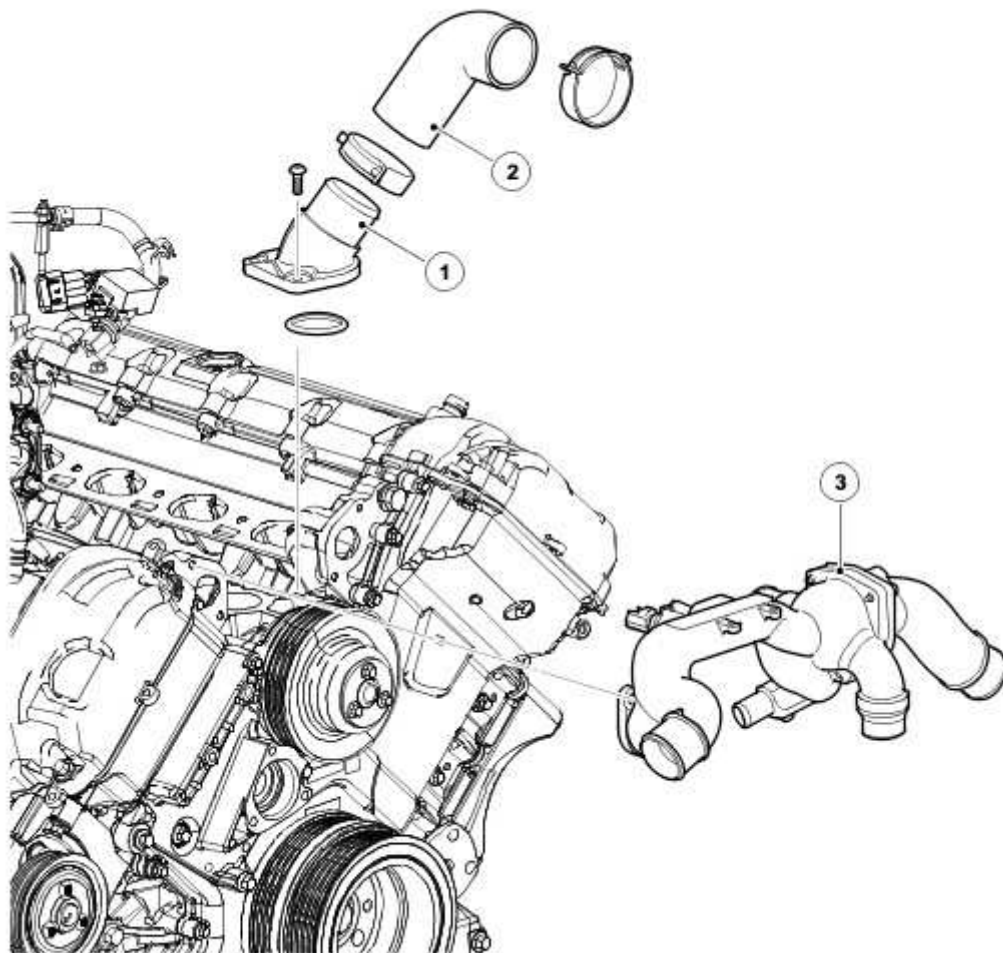
Coolant Pump



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

The coolant pump is installed between the 2 cylinder banks, on the front face of the cylinder block.

Coolant Inlet and Outlet Assembly



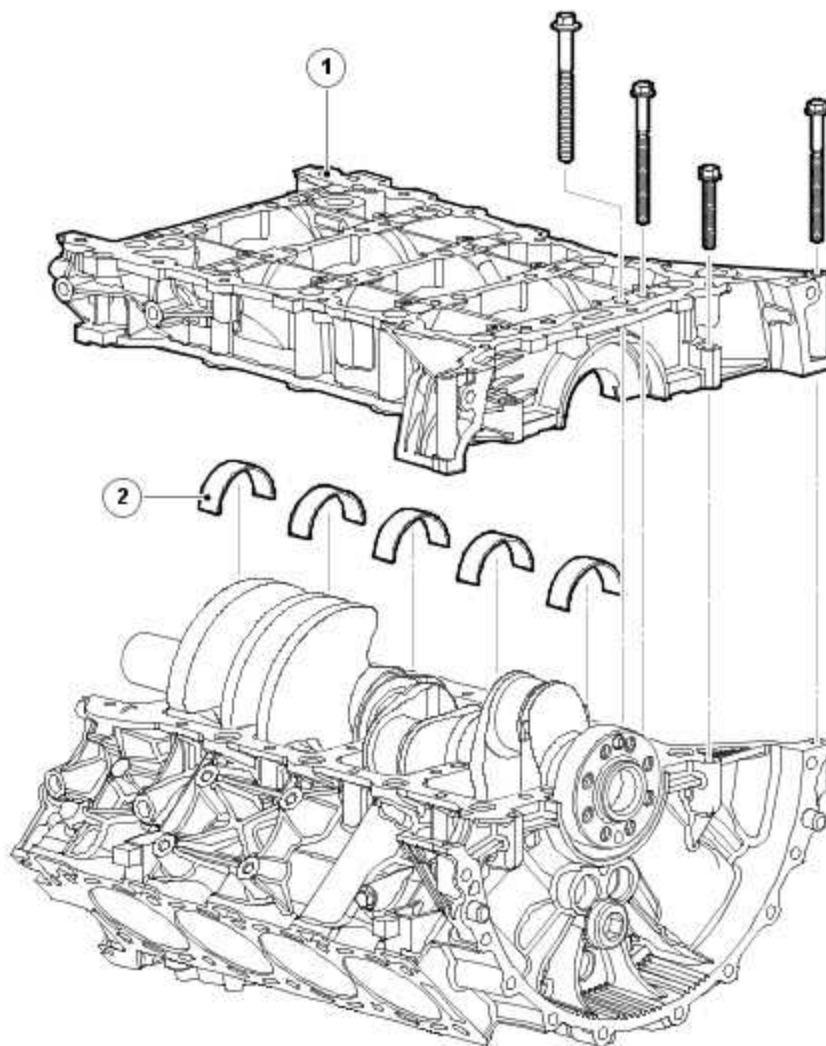
E56199

Item	Part Number	Description
1		Coolant outlet elbow

2		Coolant hose
3		Thermostat housing

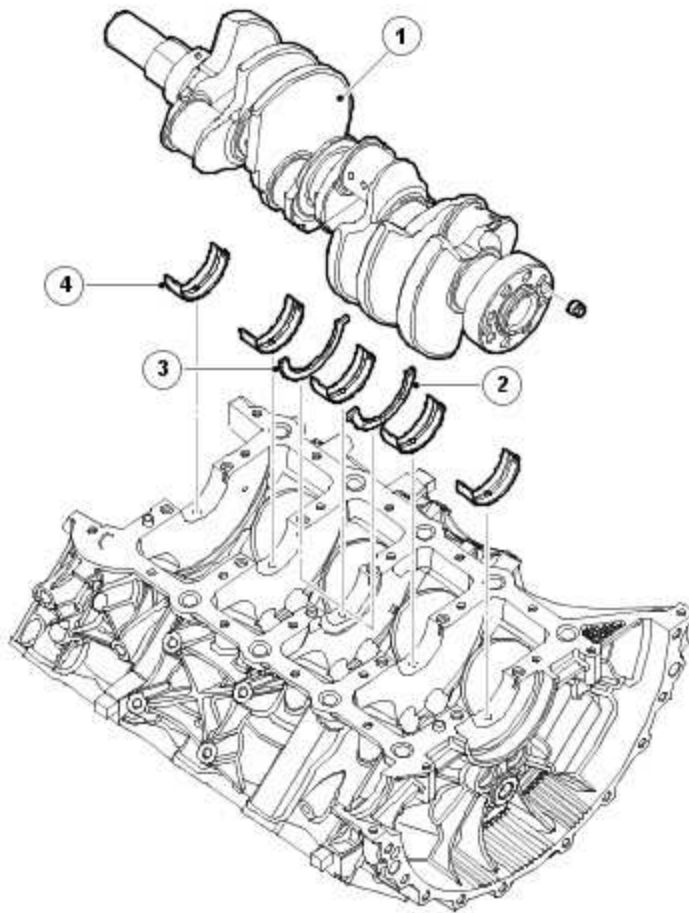
To accommodate the installation of the supercharger, the thermostat housing and coolant outlet duct are combined into an aluminum alloy coolant outlet assembly, which is installed between the 2 cylinder banks, immediately above the coolant pump. A hose connects the coolant outlet assembly to a coolant inlet housing attached to the coolant pump intake on the cylinder block. The thermostat controls the flow of coolant through the radiator.

CRANKSHAFT AND SUMP COMPONENTS



Item	Part Number	Description
1		Bedplate
2		Main bearings - lower

Crankshaft and Main Bearings



E43436

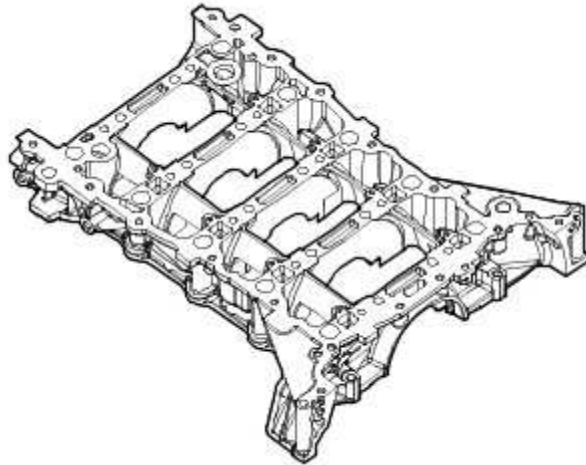
Item	Part Number	Description
1		Crankshaft
2		Thrust washer
3		Thrust washer
4		Main bearings - upper

Six counter-balance weights ensure low vibration levels from the 4 throw, 5 bearing crankshaft. Manufactured in cast iron, the crankshaft also has undercut and rolled fillets for improved strength.

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

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

Bedplate



E43437

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

Two hollow dowels align the bedplate with the cylinder block.

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

Sump

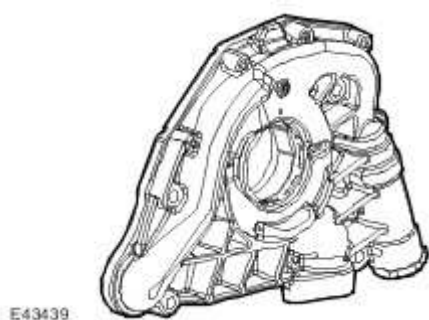


E69060

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

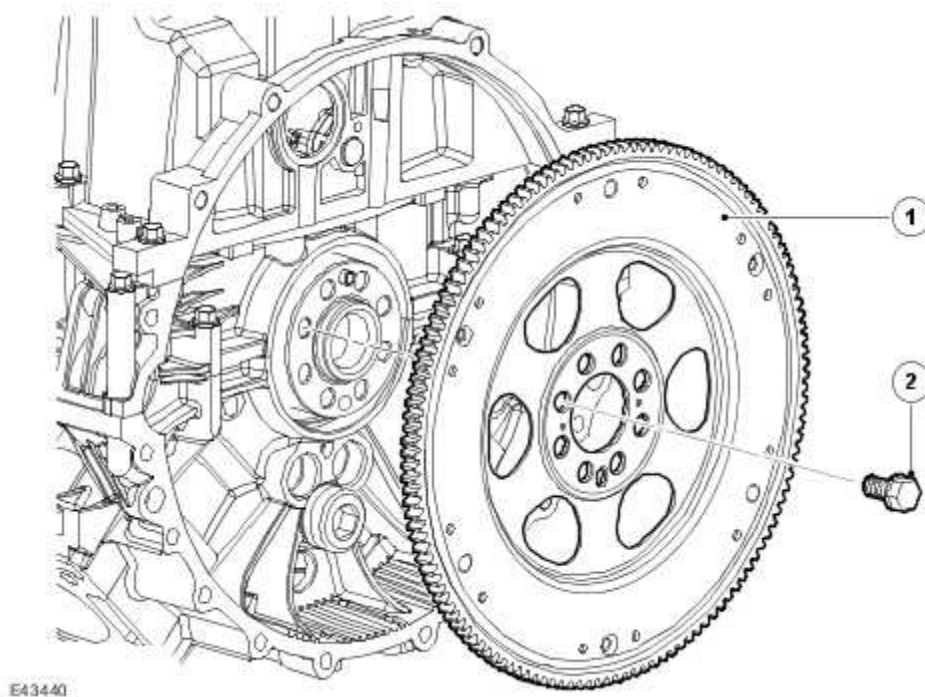
A bead of sealant seals the joint between the structural sump and the bedplate.

Oil Pump



The oil pump is installed on the crankshaft at the front of the engine. The pump outlet port aligns with oil passages in the bedplate (See lubrication section for more information).

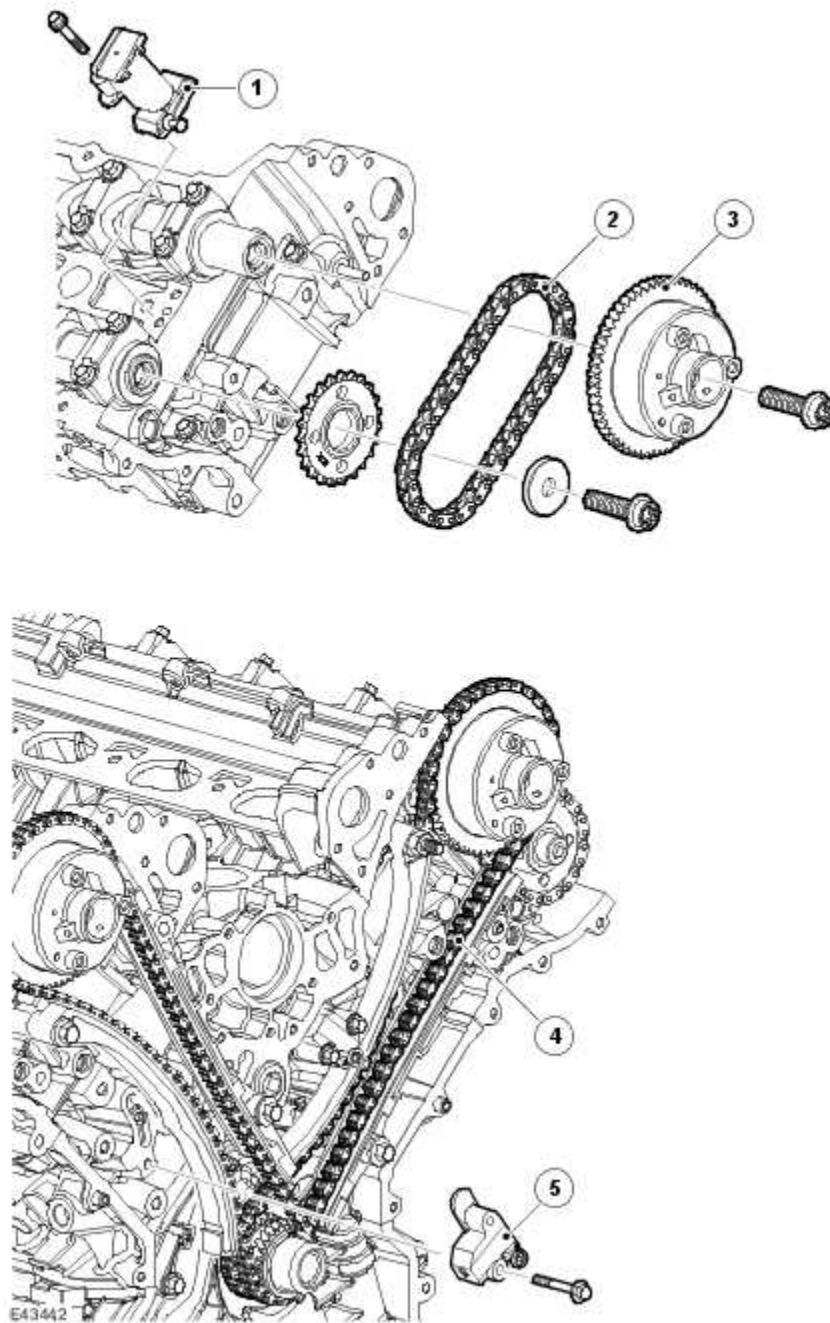
Starter Drive Plate



Item	Part Number	Description
1		Starter drive plate
2		Bolt

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

CAMSHAFT TIMING COMPONENTS



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

5		Primary chain tensioner

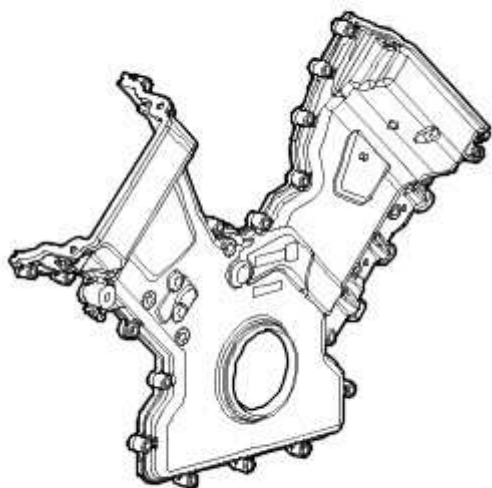
Timing Gear

Multiple link primary and single row secondary chains drive the camshafts of each cylinder bank. The primary chains transmit the drive from 2 sprockets on the crankshaft to variable valve timing units on the intake camshafts. The secondary chains transmit the drive from the variable valve-timing units to sprockets on the exhaust camshafts.

A key locates the 2 drive sprockets on the crankshaft. The crankshaft's torsional vibration damper retains the sprockets in position. The variable valve timing units and the exhaust camshaft sprockets are non-interference, non-keyed fits on their respective camshafts; the drive being transmitted by the face to face friction load produced by the valve timing unit/sprocket securing bolt.

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

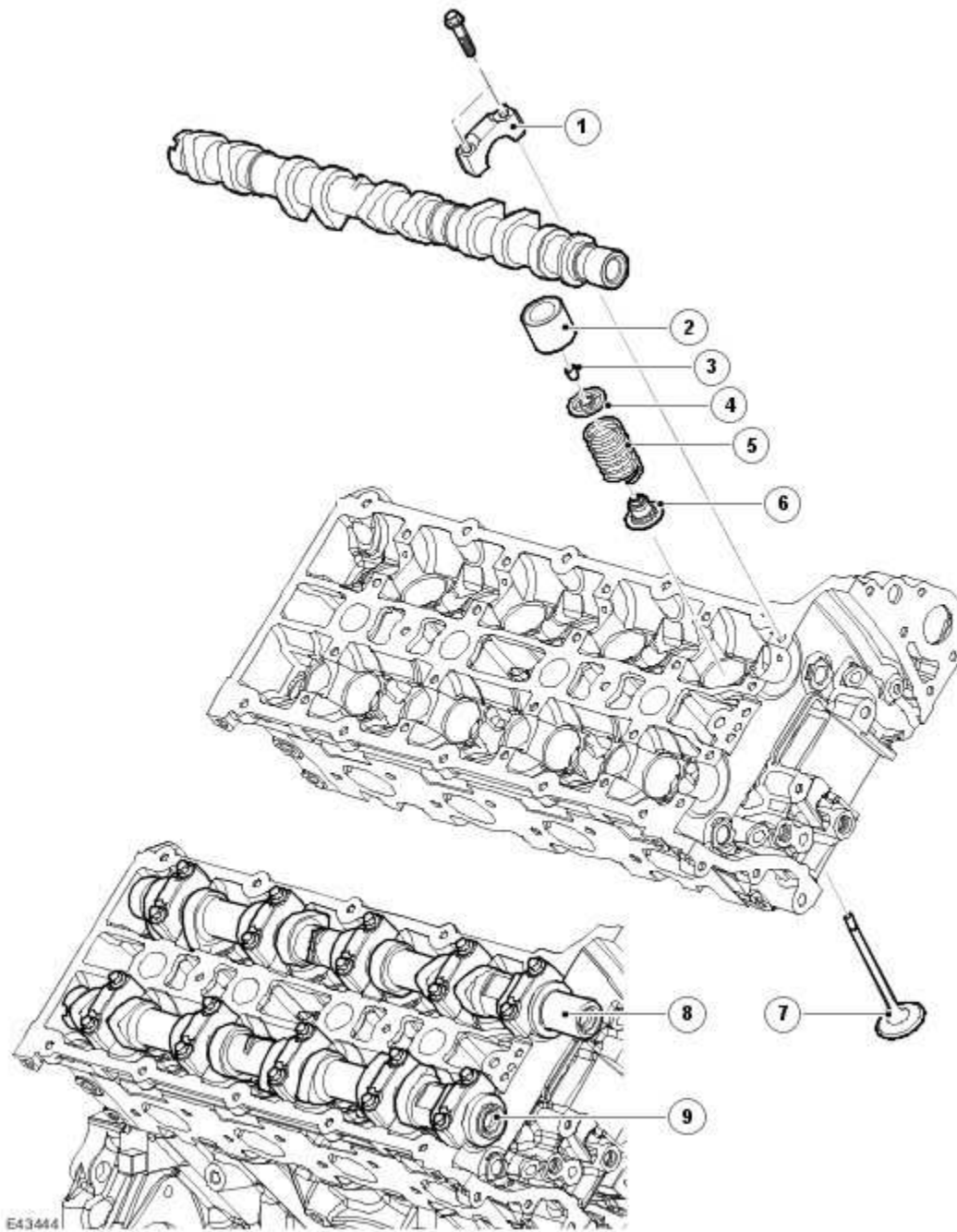
Timing Cover



E43443

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

CYLINDER HEAD COMPONENTS



Item	Part Number	Description
1		Camshaft bearing cap
2		Tappet (shimless)
3		Collet
4		Valve spring cap

5		Valve spring
6		Valve stem oil seal
7		Valve
8		Inlet camshaft
9		Exhaust camshaft

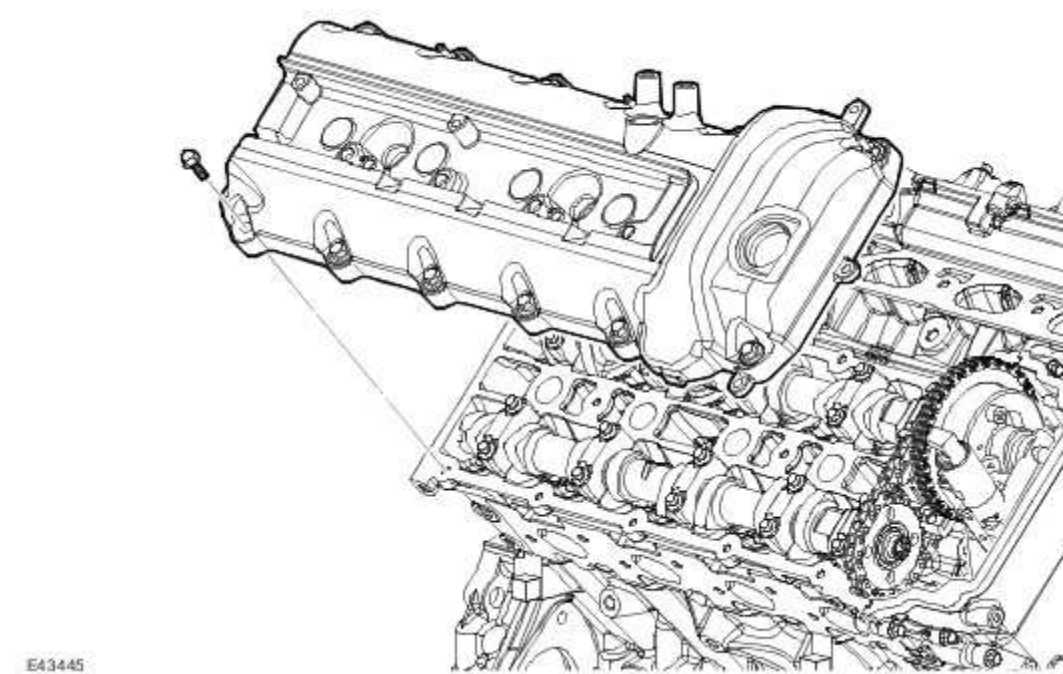
Cylinder Heads

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

The 14 mm (0.55 in) spark plugs, 1 per cylinder, locate in recesses down the centre line of each cylinder head.

The engine-lifting eyes are bolted to the cylinder heads, 2 on the rear (1 per head) and 1 at the front.

Camshaft Covers



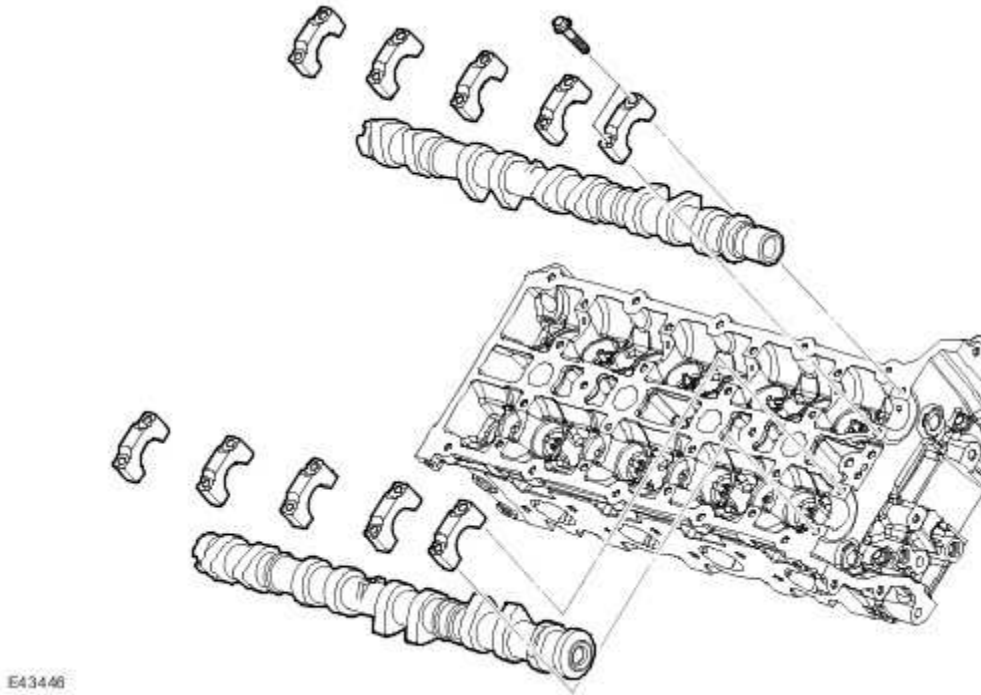
The camshaft covers are manufactured from thermo-plastic. The A bank camshaft cover incorporates an outlet for the part load engine breather and the Pressure Control Valve (PCV). The B bank camshaft cover incorporates an outlet for the full load engine breather and the engine oil filler cap. Identical oil separators are incorporated below the breather outlet in each cover.

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

Cylinder Head Gasket

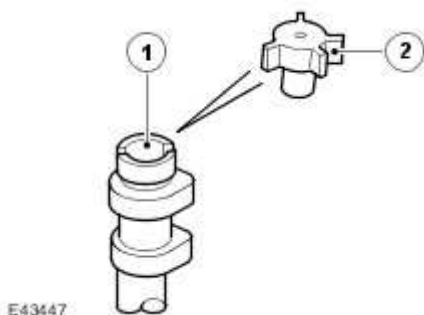
The multi-layered steel cylinder head gasket has cylinder specific water flow cross-sections for uniform coolant flow.

Camshafts



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

Sensor Ring

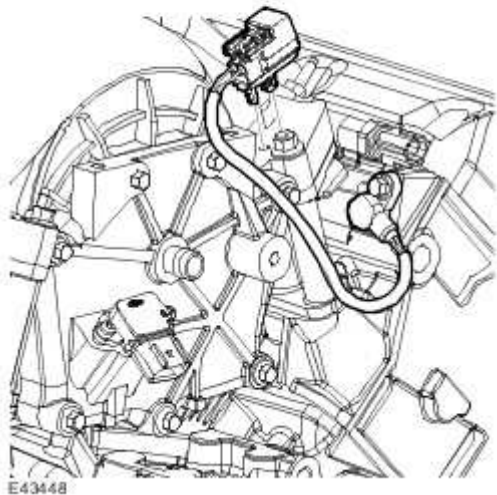


Item	Part Number	Description

1		Inlet camshaft
2		Sensor ring

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

Camshaft Position Sensor



The camshaft position sensors are installed in each cylinder head at the rear of the intake camshaft. It is a variable reluctance sensor that provides an input to the ECM regarding the position of the camshaft. For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - Vehicles Without: Supercharger)

Inlet and Exhaust Valves

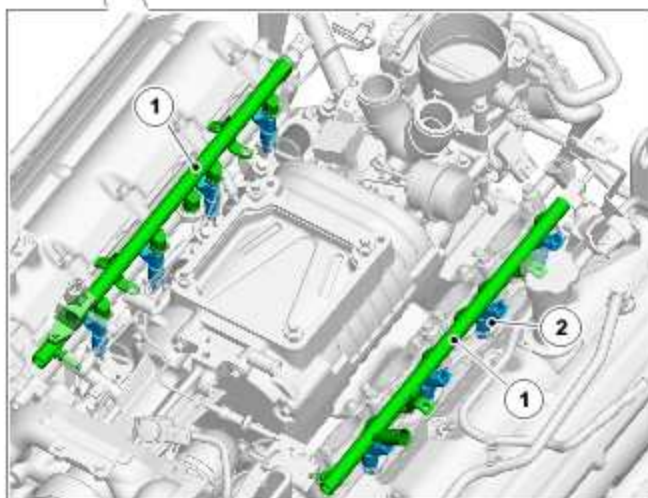
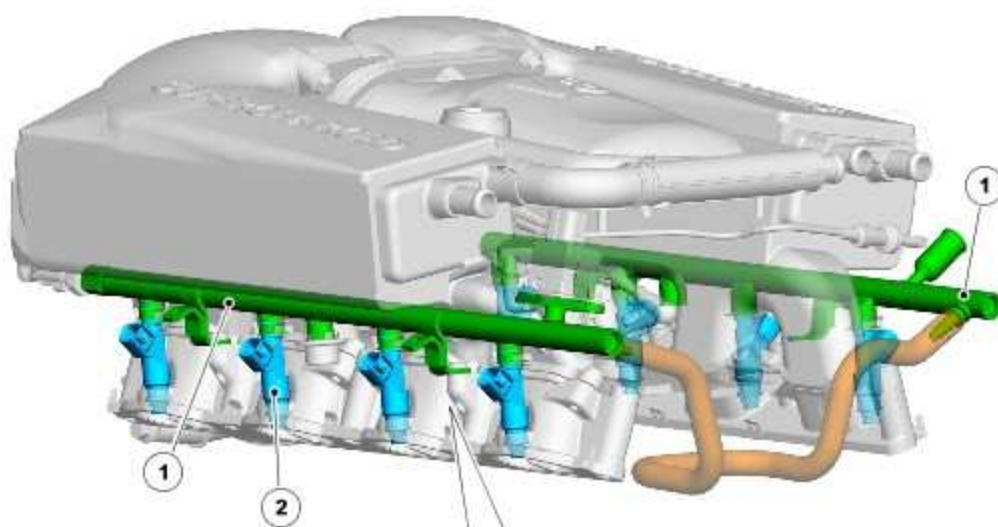
Each cylinder head incorporates dual overhead camshafts operating 4 valves per cylinder via solid shimless valve lifters.

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



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

Fuel Injectors



E84500

Item	Part Number	Description
1		RH fuel rail (2 off, 1 per bank)
2		Injector (8 off, 4 per bank)

Eight, top fed, 12-hole, fuel injectors are installed in the fuel rails and are held in position by spring clips. Two O-rings are installed between the injector mounts of the fuel rails and the related recesses in the intercooler adapters. The injectors are electromagnetic solenoid valves controlled by the ECM.

The fuel jets from the injectors are directed onto the back of the intake valves. For additional information, refer to [Electronic Engine Controls \(303-14 Electronic Engine Controls - Vehicles Without: Supercharger\)](#)

Fuel Rails

The fuel rails are installed on the intercooler adapters. A fuel crossover pipe connects the fuel rails together at the front of the engine.

VARIABLE VALVE TIMING (VVT)

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

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

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

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

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

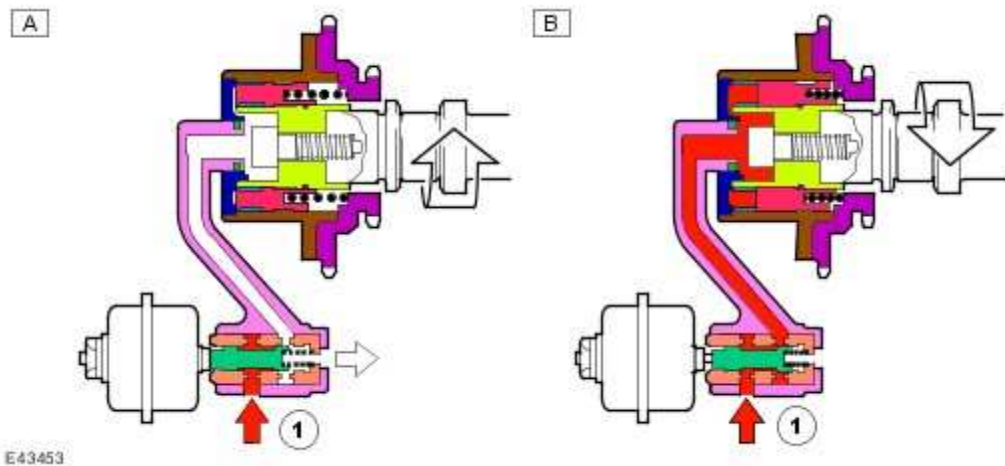
The ECM controls the VVT, using engine speed and load, and engine oil temperature signals to calculate the appropriate camshaft position. For additional information, refer to [Electronic Engine Controls \(303-14 Electronic Engine Controls - Vehicles Without: Supercharger\)](#)

The continuous VVT system provides the following advantages:

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

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

Variable Valve Timing (VVT) Operation



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

The VVT unit is a hydraulic actuator mounted on the end of the intake camshaft, which advances or retards the intake camshaft timing and thereby alters the camshaft to crankshaft phasing. The oil control solenoid, controlled by the ECM, routes oil pressure to either the advance or retard chambers located either side of the 3 vanes interspersed within the machined housing of the unit.

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

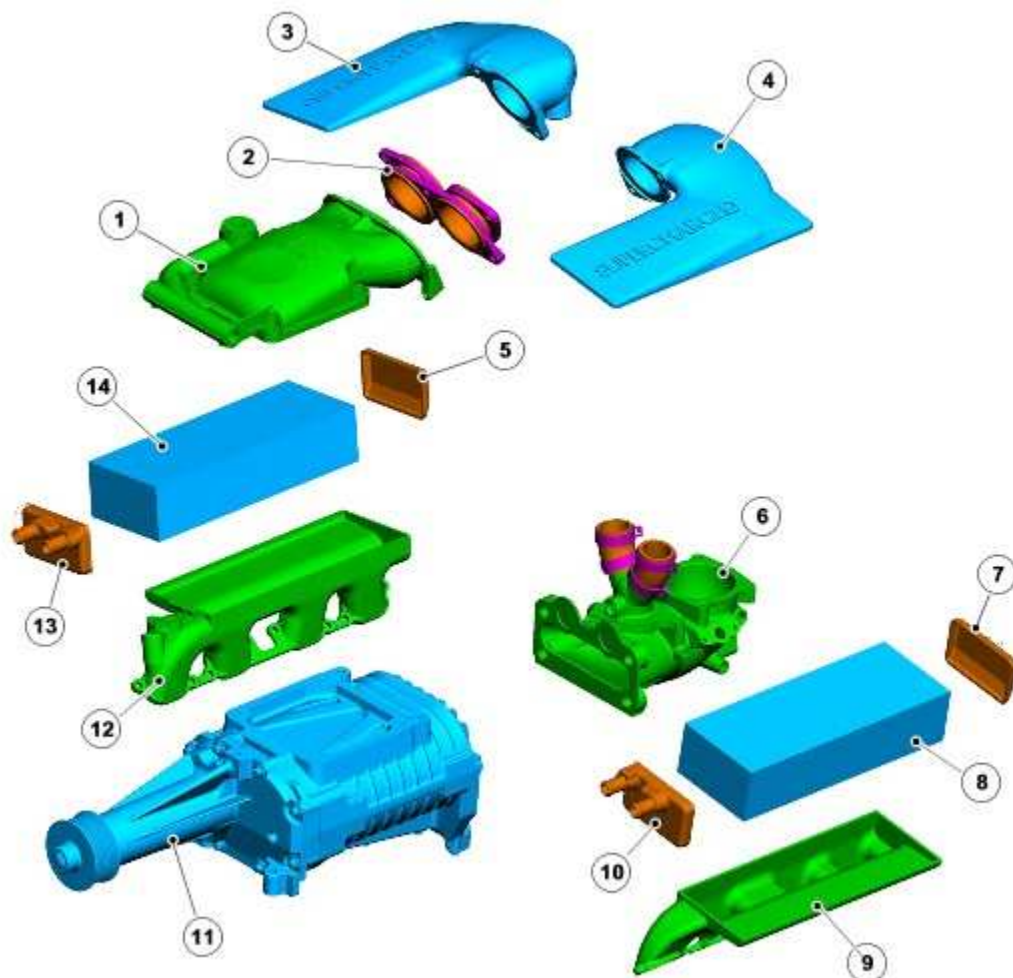
When directed by the ECM, the VVT unit will be set to the optimum position between full advance and retard for a particular engine speed and load. This is achieved when the ECM sends the energising signal to the oil control solenoid until the target position is met. At this point, the energizing signal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

Engine oil properties and temperature can affect the ability of the VVT mechanism to follow demand changes to the cam phase angle. At very low oil-temperatures, movement of the VVT mechanism is

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

The VVT does not operate when engine oil-pressure is below 1 bar (14.5 psi), as there is insufficient pressure to control the phasing. This usually occurs when the engine is shutting-down and the VVT has returned to the retarded position. The stopper pin locks the camshaft to the VVT unit to ensure camshaft stability during the next engine start-up.

SUPERCHARGER



E84501

Item	Part Number	Description
1		Supercharger outlet assembly

2		Supercharger outlet duct clamp
3		RH intercooler air inlet duct
4		LH intercooler air inlet duct
5		RH Intercooler coolant return connection
6		Throttle body and by-pass valve adapter assembly
7		LH Intercooler coolant return connection
8		LH intercooler
9		LH intercooler adapter
10		LH Intercooler coolant inlet and outlet connection
11		Supercharger assembly
12		RH intercooler adapter
13		RH Intercooler coolant inlet and outlet connection
14		RH intercooler

The supercharger is a compressor used to pump air into the cylinders. This increases the concentration of oxygen and fuel in the charge to create a more powerful combustion inside the cylinder. This increases cylinder pressure upon ignition and creates more power.

As the supercharger compresses the air its temperature increases. This raise in air temperature reduces the potential for power gains. By installing intercoolers the air is cooled to overcome this.

The supercharger is an Eaton M112 unit attached to the 3 mounting bosses between the 'V' of the cylinder block. Positive alignment with the drive belt is provided by a dowled mounting bracket. An 8-ribbed belt drives the supercharger, via the crankshaft, at 2.1 engine speed. The maximum pressure increase is approximately 0.8 bar.

On the 4.2L V8 supercharged engine the intake manifold is replaced by:

- A supercharger
- Two intercoolers
- Outlet assembly
- A bypass valve
- A bypass valve actuator

- Two intercooler adapters

The supercharger has a sealed-for-life internal lubrication system.

Intercooler

Each of the 2 intercoolers is a fin and tube air-to-liquid heat exchanger. Two rubber ducts, secured by clamp plates, provide the interfaces between the outlet duct and the intercoolers. After passing through the heat exchanger core, the air flows into individual outlets to the cylinders. At the rear of the B bank intercooler there is a mounting boss for an air intake temperature sensor.

Outlet Assembly

The outlet assembly directs air from the supercharger into the 2 intercoolers. A filler point for the intercooler coolant system is integrated into the front and right side of the outlet duct. A vacuum take-off for the fuel pressure regulator/cruise control system is located on the right side of the outlet assembly. Isolating bolts, to reduce noise, secure the outlet assembly to the supercharger and a rubber gasket seals the supercharger to the outlet assembly throttle body and by-pass valve adapter.

Bypass Valve

The bypass valve attaches to an opening in the induction elbow and controls a bypass flow from the intercoolers back to the inlet side of the supercharger. At closed or partially open throttle settings (i.e. idle and most cruise conditions), the bypass valve is fully open to provide maximum bypass and optimum fuel economy. As the throttle opens, the bypass valve progressively closes to reduce the bypass flow and increase the pressure of air supplied to the engine for optimum power output.

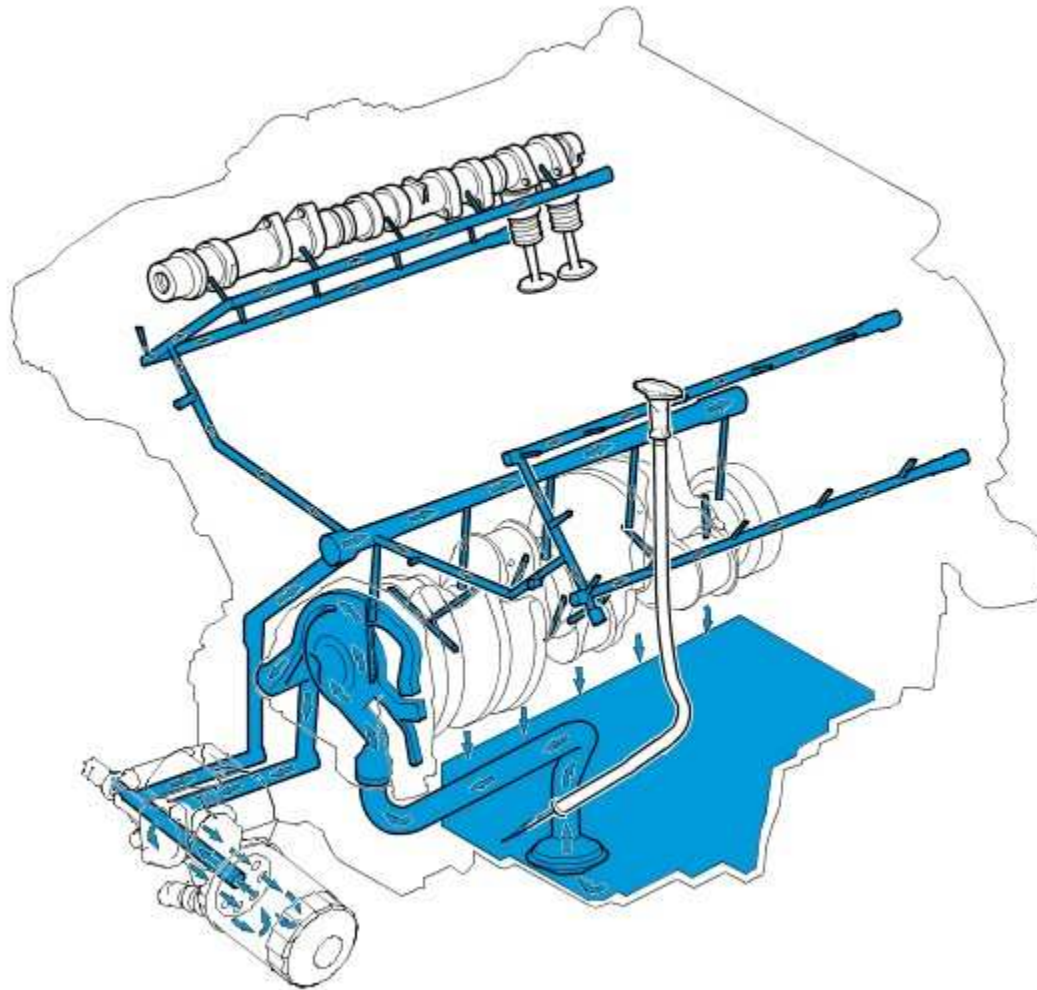
Bypass Valve Actuator

The bypass valve actuator is a diaphragm-operated actuator attached to the valve spindle of the bypass valve. A vacuum pipe connects the actuator to the induction elbow.

Intercooler Adapter

The intercooler adapters provide an interface between the intercoolers and the cylinder heads, and also locate the fuel rails and injectors. One-piece gaskets seal the joints between the intercoolers and the intercooler adapters, and between the intercooler adapters and the cylinder heads.

LUBRICATION SYSTEM



E84502

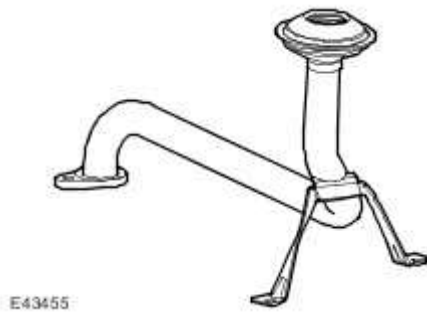
Oil is drawn from the reservoir in the oil pan and pressurised by the oil pump. The output from the oil pump is then filtered, cooled and distributed through internal oil passages.

All moving parts are lubricated by pressure or splash oil. Pressurised oil is also provided for the timing gear chain tensioners and the piston cooling jets.

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

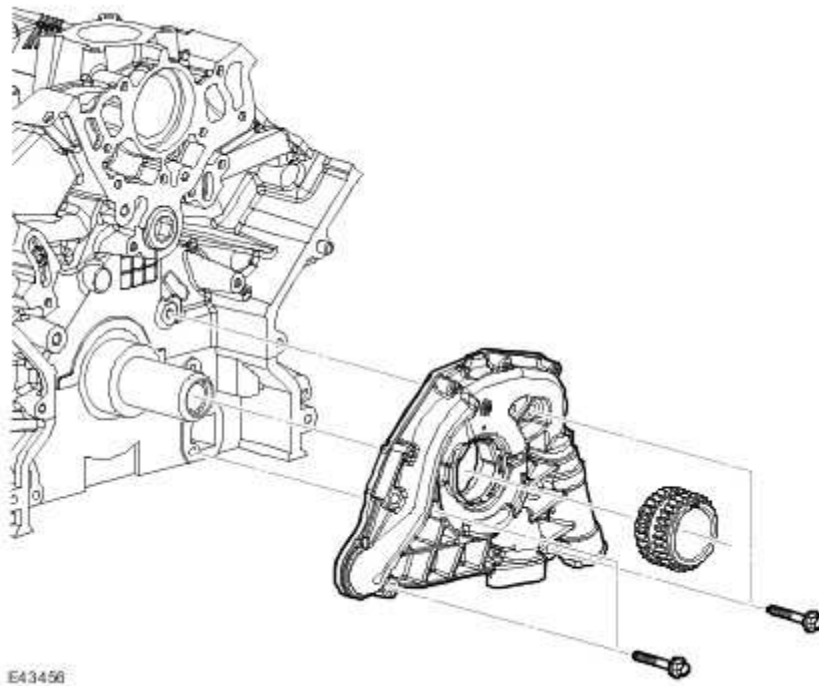
System replenishment is through the oil filler cap on the 'B' bank camshaft cover.

Oil Pick-up



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

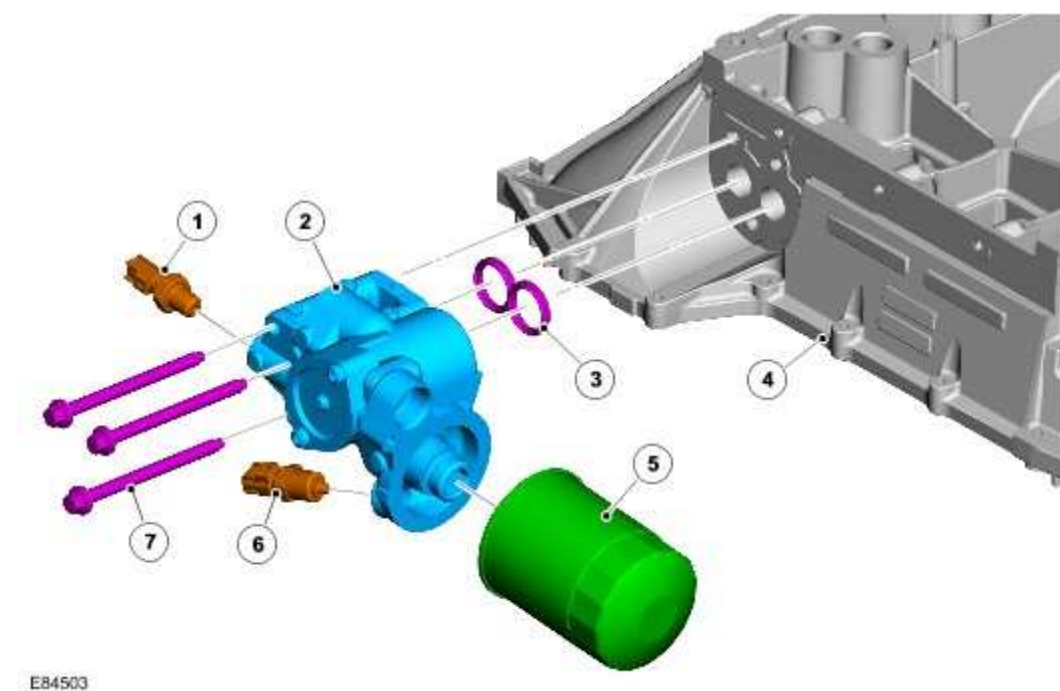
Oil Pump



The oil pump is installed on the crankshaft at the front of the engine. The pump outlet port aligns with oil passages in the bedplate.

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

Oil Filter Assembly



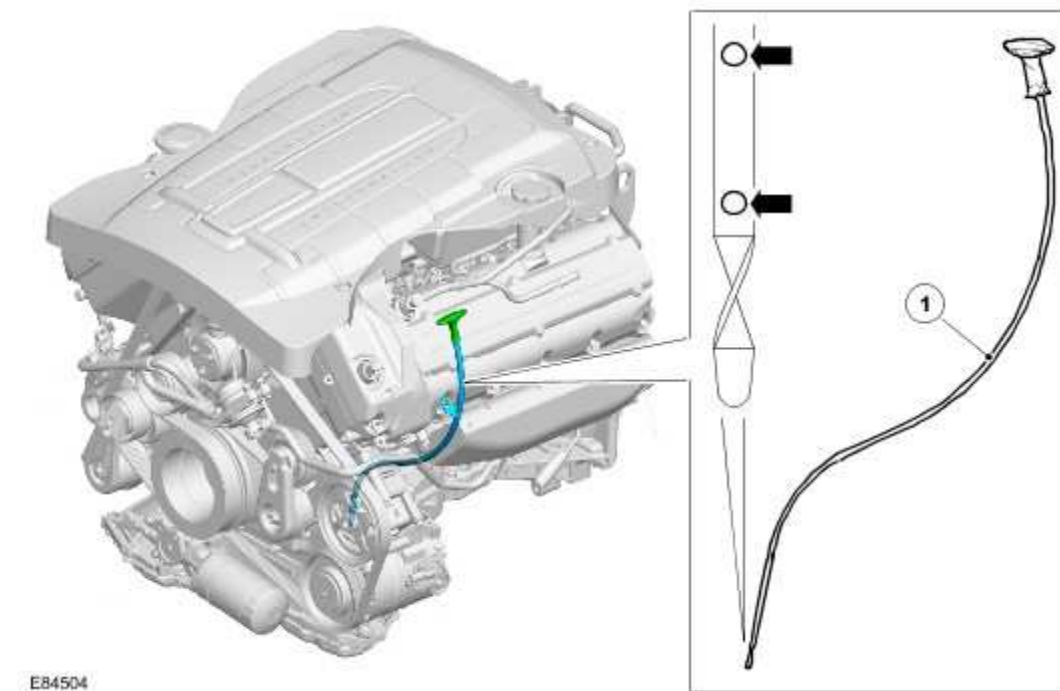
Item	Part Number	Description
1		Oil pressure switch
2		Oil filter head assembly
3		Seal
4		Sump
5		Oil filter
6		Oil temperature sensor
7		Bolt (3 off)

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

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

Oil temperature is monitored through a Negative Temperature Coefficient (NTC) sensor. The sensor is mounted near to the oil pressure sensor at the front of the engine and locates into the oil filter head assembly.

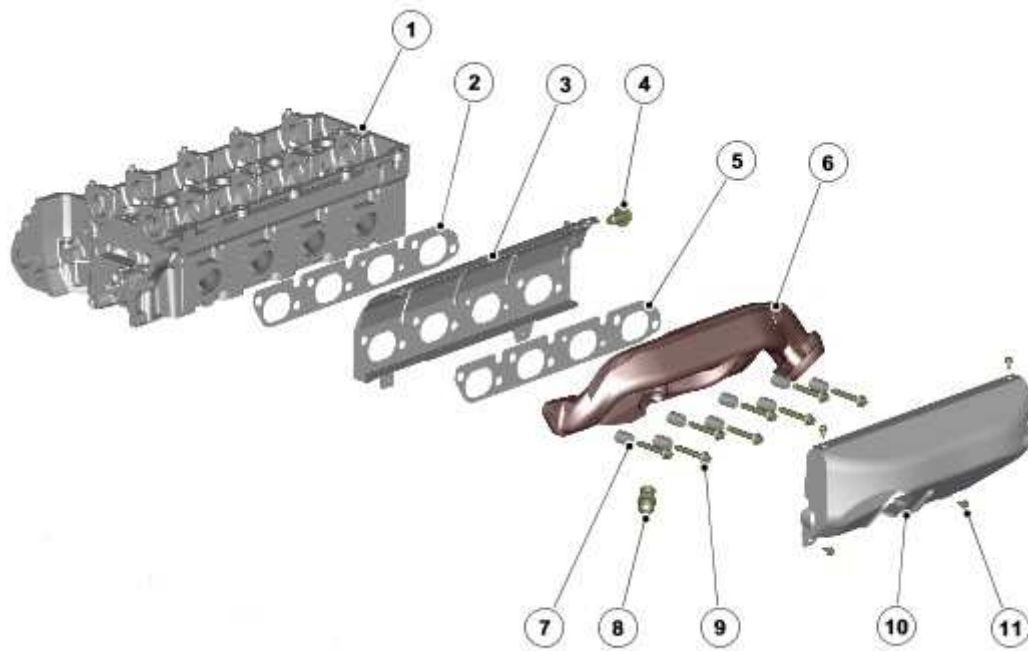
Oil Level Gage



Item	Part Number	Description
1		Oil level gage

The oil level gage locates along the left side of the oil pan, supported in a tube installed in the sump. Two holes in the end of the gage indicate the minimum and maximum oil levels. There is a difference of approximately 1.5 liters (1.58 US quart) between the 2 levels.

EXHAUST MANIFOLD



E72001

Item	Part Number	Description
1		Cylinder head
2		Gasket
3		Heat shield
4		Bolt
5		Gasket
6		LH exhaust manifold
7		Spacer (8 off)
8		Connector for Secondary Air Injection (SAI)
9		Bolt (8 off)
10		Heat shield
11		Bolt (4 off)

The fabricated stainless steel twin skin exhaust manifolds are unique for each cylinder bank.

Each exhaust manifold assembly includes 2 metal gaskets, located either side of the inner heat shield, 2 heat shields and a connection for the Secondary Air Injection (SAI) system. For additional information, refer to Engine Emission Control (303-08 Engine Emission Control - Vehicles Without Supercharger)

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

Diagnosis and testing

Engine

No Data Available

Crankshaft Main Bearing Carrier

No Data Available

Removal

Engine (12.41.01)

Special Service Tools



303-536

Engine lifting brackets

303-536



303-749

Engine lifting brackets

303-749



E85340

Engine lifting bracket

303-1297



E45289

Fuel spring lock decoupling tool

310-D005

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications

2 . Evacuate the A/C system.

- . For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging (82.30.30)

3 . Remove the hood.

For additional information, refer to Hood (76.16.01)

4 . Remove the cowl vent screen.

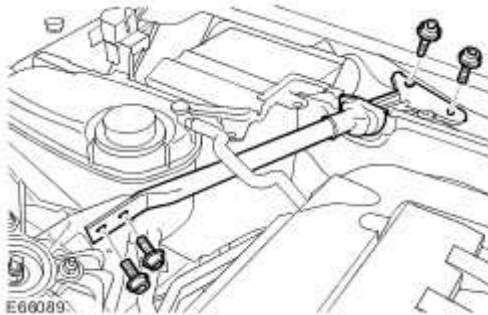
For additional information, refer to Cowl Vent Screen (76.10.01)

5 . Remove the engine compartment braces.

▶ Release the grommet.

▶ Remove the 4 Torx bolts.

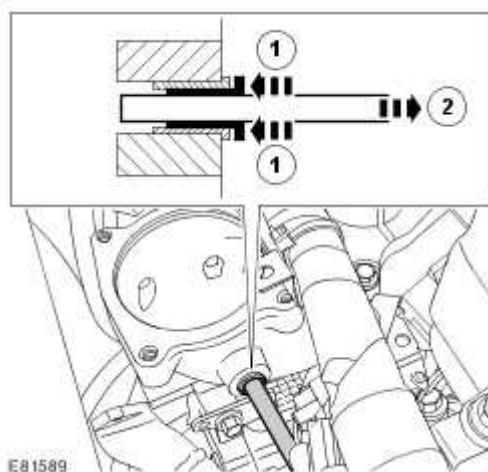
▶ Repeat the above procedure for the other side.



6 . Remove the intake air resonator.

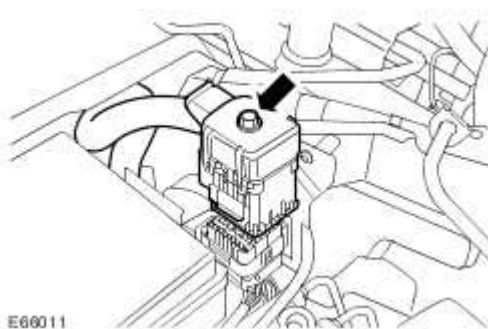
For additional information, refer to Intake Air Resonator

7 . Disconnect the brake booster vacuum hose quick release connector.



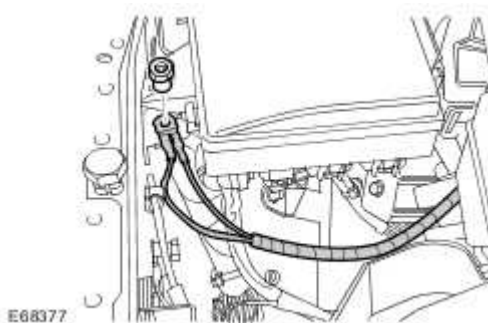
8 . Release and disconnect the engine wiring harness electrical connector.

► Fully loosen the bolt.



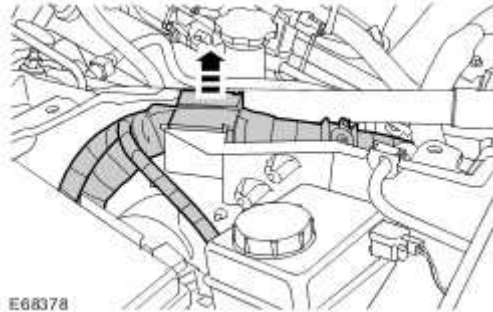
9 . Release the ground cable from the power distribution box bracket.

► Remove the nut.

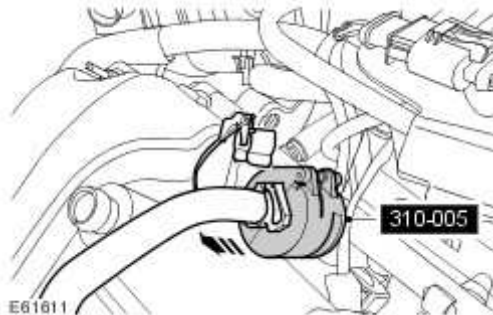


10 . Release the engine wiring harness from the engine compartment side wall.

▶ Release the grommet.



11 . Disconnect the fuel line.

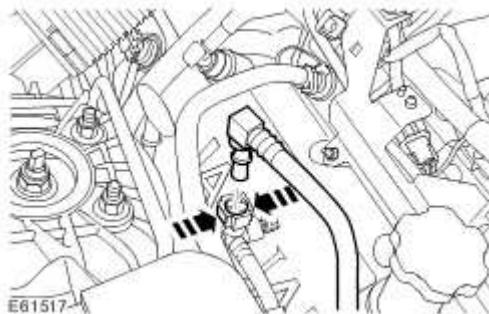


12



- 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.

Release the clip and disconnect the purge inlet line.



13



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.

14 . Remove the air deflector.

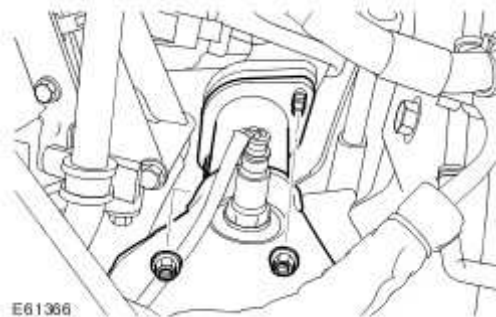
For additional information, refer to Air Deflector (76.11.41)

15 Drain the cooling system.

For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8

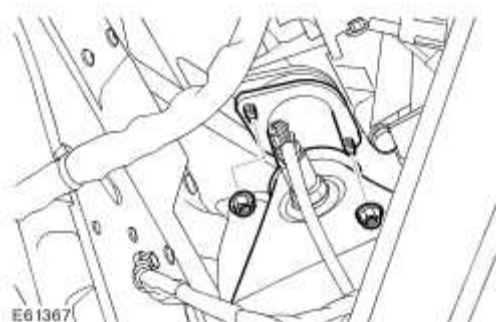
16 . Disconnect the LH catalytic converter from the exhaust manifold.

▶ Remove and discard the 2 nuts.



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

▶ Remove and discard the 2 nuts.



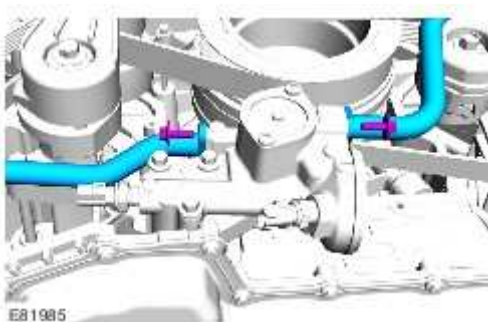
18



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 2 engine oil cooler lines.

- ▶ Remove the 2 bolts.
- ▶ Remove and discard the 2 O-ring seals.
- ▶ Position hoses in front of the anti roll bar.



19 .



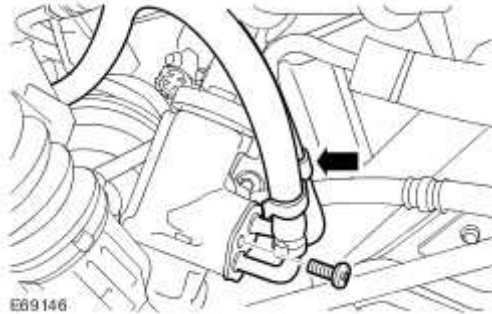
CAUTION: Always plug any open connections to prevent contamination.

Disconnect the high pressure line from the power steering gear.

- ▶ Remove and discard the Torx bolt.

▶ Remove and discard the O-ring seal.

▶ Release from the clip.



20

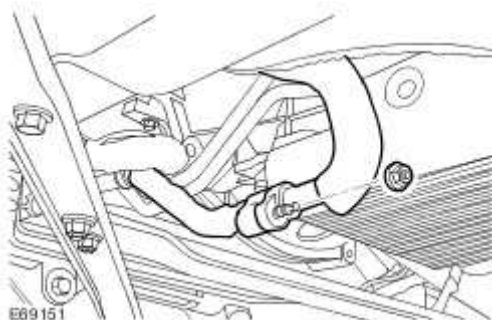


CAUTION: Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Disconnect the A/C high-pressure line from the intermediate joint.

▶ Remove the nut.

▶ Discard the O-ring seal.

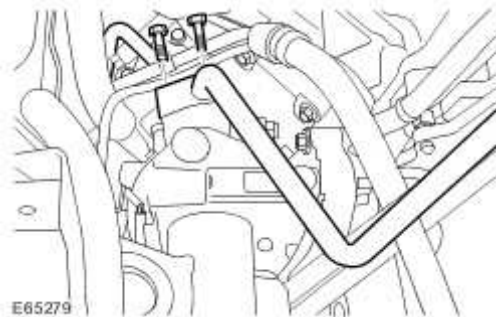


21 . Disconnect the refrigerant lines from the A/C compressor.

▶ Remove the 2 bolts.

▶ Remove and discard the 2 O-ring seals.

- ▶ Remove the lower A/C pipe.
- ▶ Disconnect and tie aside the upper A/C pipe.



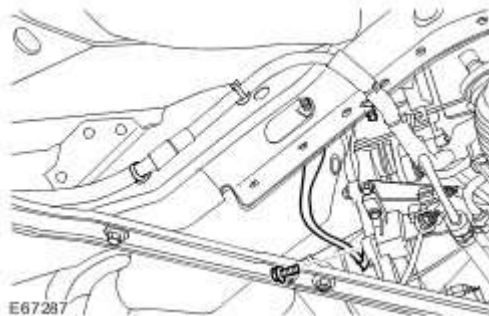
22



CAUTION: The transmission ground cable must be replaced if disconnected from the vehicle body.

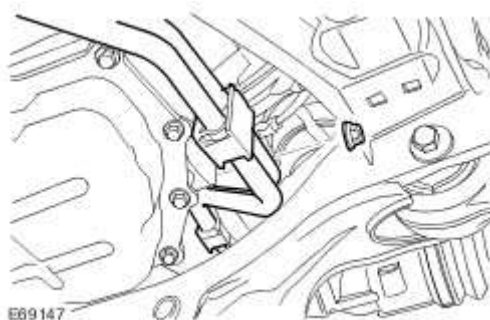
Disconnect the transmission ground cable.

- ▶ Remove the bolt.



23 . Release the transmission fluid lines from the engine.

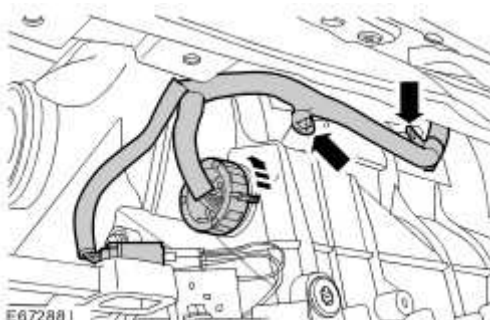
- ▶ Remove the nut.
- ▶ Release the clip.



24 . Release the wiring harness from the RH side of the transmission.

▶ Disconnect the 2 electrical connectors.

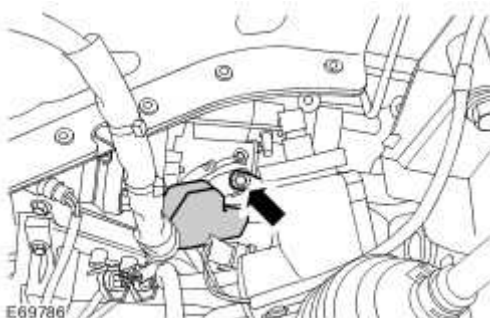
▶ Carefully release the 2 clips.



25 . Disconnect the battery positive and generator cables.

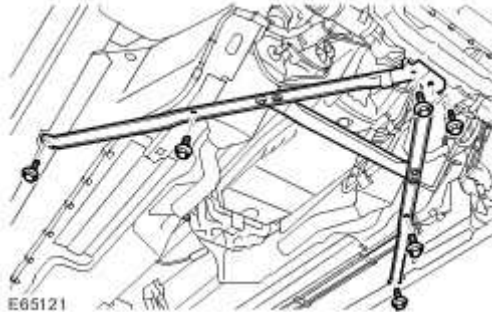
▶ Release the cover.

▶ Remove the nut.



26 . With assistance, remove the A-frame.

▶ Remove the 6 bolts.

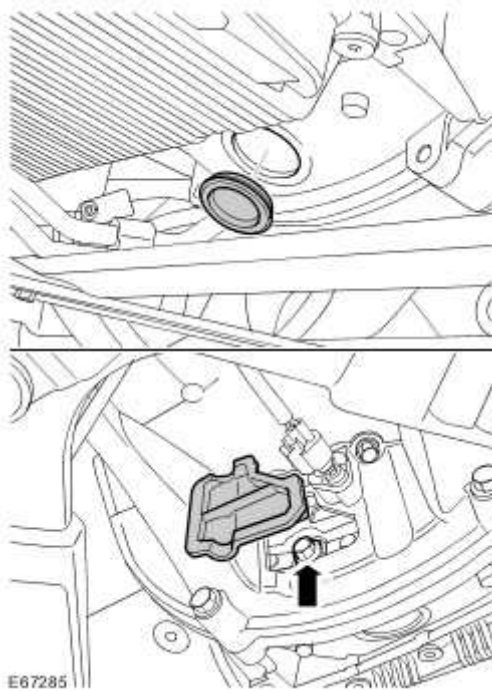


27 . Release the flexplate.

▶ Remove the access plugs.

▶ Rotate the crankshaft to access the retaining bolts.

▶ Remove and discard the 3 bolts.

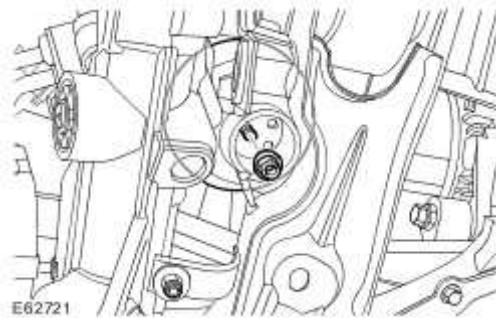


28 . **NOTE:**

RH illustration shown, LH is similar.

Release the engine mounts.

- ▶ Remove and discard the 2 nuts.



29 . Lower the vehicle.

30



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.

NOTE:

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

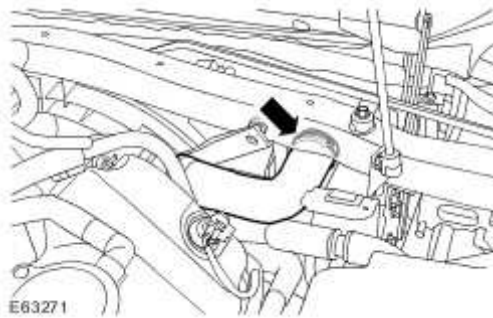
Disconnect the charge air cooler coolant hoses.

- ▶ Position an absorbent cloth to collect fluid spillage.
- ▶ Release the 2 clips.
- ▶ Tie aside.
- ▶ Repeat the above procedure on the opposite side.



31 . Disconnect the radiator upper hose.

▶ Release the hose clip.

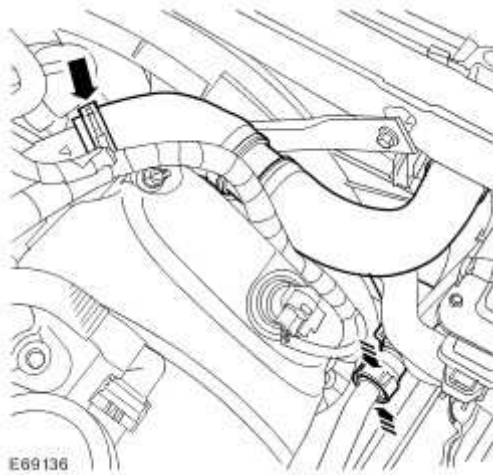


32 . Remove the radiator top hose.

▶ Release the clips.

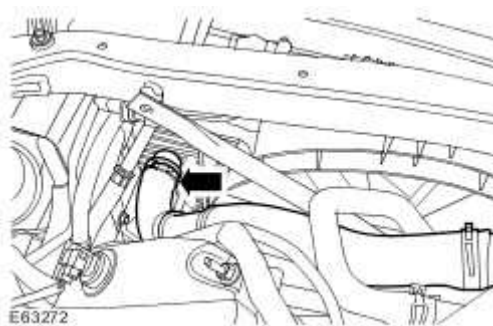
▶ Disconnect the quick release connector.

▶ Tie the hose assembly aside for access.



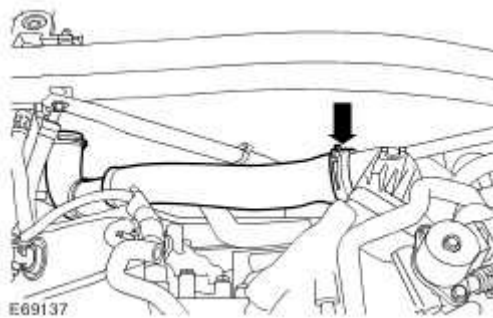
33 . Disconnect the radiator lower hose.

▶ Release the hose clip.



34 . Remove the radiator lower hose.

▶ Release the clip.

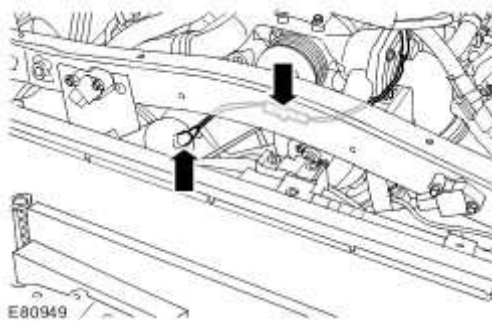


35 . Disconnect the secondary air injection (AIR) control valve supply hose.



36 . Disconnect the secondary air injection (AIR) reservoir vacuum line.

▶ Release the clip.



37 . Release the power steering fluid reservoir.

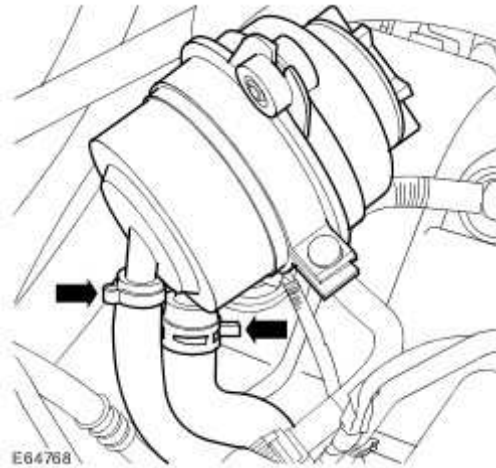
▶ Remove the 2 bolts.



38 . Disconnect the power steering supply hose.

▶ Position a container to collect the fluid spillage.

▶ Release the hose clip.

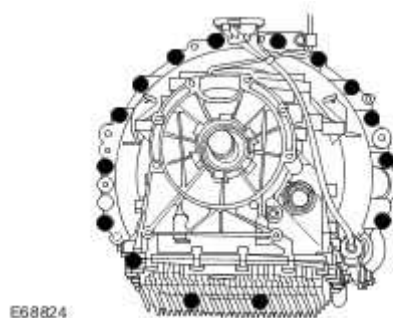


- 39 .  **CAUTION: Make sure the torque converter remains connected to the transmission.**

Release the transmission from the engine.

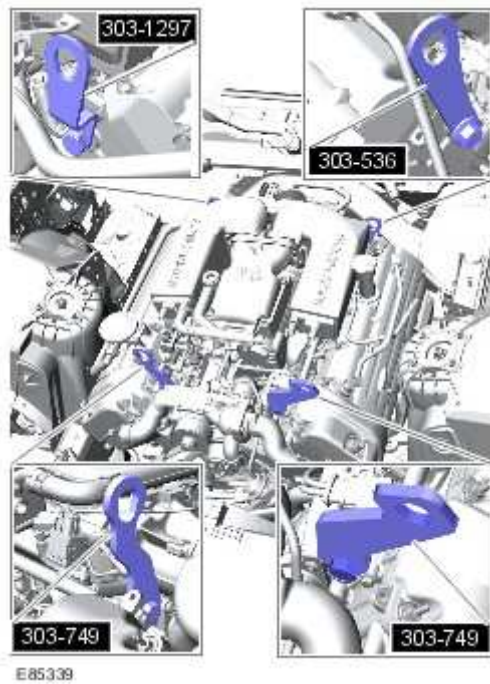
▶ Remove the 15 bolts.

▶ Support the transmission.



- 40 . Install the special tools to the engine.

▶ Support the engine.

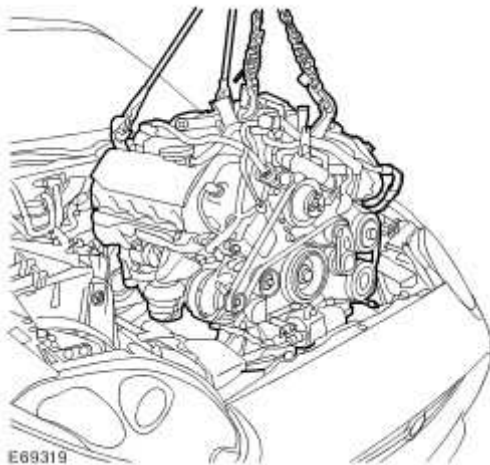


41



CAUTION: Protect the suspension turrets to prevent damage upon engine removal.

With assistance, carefully remove the engine.



42 . Install the torque converter retainer.

Engine (12.41.01)

Special Service Tools



303-536

Engine lifting brackets

303-536



303-749

Engine lifting brackets

303-749



303-1297

E85340

Engine lifting bracket

303-1297



310-D005

E45289

Fuel spring lock decoupling tool

310-D005

Installation

1 . Remove the torque converter retainer.

2 .  **CAUTION: Apply grease of the correct specification to the torque converter spigot.**

With assistance, carefully install the engine.

➤ Clean the component mating faces.

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

3 . Carefully lower the engine onto the engine mounts.

➤ Clean the components.

➤ Tighten the new nuts to 63 Nm (46 lb.ft).

4 . Remove the special tools.

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 . 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 access plugs.

7 . With assistance, install the A-frame.

▶ Tighten the bolts to 55 Nm (40 lb.ft).

8 . Connect the battery positive and generator cables.

▶ Tighten the nut to 10 Nm (7 lb.ft).

▶ Secure the cover.

9 . Attach the wiring harness.

▶ Connect the electrical connectors.

▶ Secure the clips.

10 . Attach the transmission fluid lines to the engine.

▶ Secure with the clip.

▶ Tighten the nut to 6 Nm (4 lb.ft).

11 . Connect the transmission ground cable.

▶ Tighten the bolt to 45 Nm (33 lb.ft).

12 .



CAUTION: Lubricate the new seals with clean refrigerant oil.

Connect the A/C high-pressure line intermediate joint.

▶ Clean the component mating faces.

▶ Install the new O-ring seals.

▶ Tighten the nut to 10 Nm (7 lb.ft).

13 . Attach the power steering gear high-pressure line.

- ▶ Clean the components.
- ▶ Install a new O-ring seal.
- ▶ Tighten the Torx bolt to 25 Nm (18 lb.ft).
- ▶ Secure in the clip.

14 . Connect the low pressure line to the power steering pump.

- ▶ Secure with the clip.

15 . Connect the engine oil cooler lines.

- ▶ Clean the component mating faces.
- ▶ Install new O-ring seals.
- ▶ Tighten the bolts to 7 Nm (5 lb.ft).

16 . Secure the LH catalytic converter to the exhaust manifold.

- ▶ Tighten the nuts to 40 Nm (29.5 lb.ft).

17 . Secure the RH catalytic converter to the exhaust manifold.

- ▶ Tighten the nuts to 40 Nm (29.5 lb.ft).

18 . Install the air deflector.

For additional information, refer to Air Deflector (76.11.41)

19 . Secure the power steering fluid reservoir.

 Tighten the bolts to 6 Nm (4 lb.ft).

20 . Connect the AIR reservoir vacuum line.

21 . Install the radiator bottom hose.

 Install the hoses and secure with the clips.

 Connect the hoses and secure with the clips.

22 . Install the radiator top hose.

 Connect the quick release connector.

 Connect the hoses and secure with the clips.

23 . Attach the engine wiring harness to the engine compartment side wall.

 Position and secure the grommet.

24 . Attach the ground cable to the power distribution box bracket.

 Tighten the nuts to 25 Nm (18 lb.ft).

25 . Connect the engine wiring harness electrical connector and secure with the captive bolt.

26 . Connect the fuel line.

For additional information, refer to Spring Lock Couplings

27 . Connect the brake booster vacuum hose quick release connector.

28 . Install the engine compartment braces.

 Tighten the 4 Torx bolts to 25 Nm (18 lb.ft).

 Install the grommet.

 Repeat the above procedure for the other side.

29 . Install the cowl vent screen.

For additional information, refer to Cowl Vent Screen (76.10.01)

30 . Install the hood.

For additional information, refer to Hood (76.16.01)

31 . Recharge the A/C system.

32 . Connect the battery ground cable and install the cover.

33 . Refill and bleed the power steering.

For additional information, refer to Power Steering System Bleeding (57.15.02)

Camshafts LH (12.13.19)

Special Service Tools



Camshaft setting/locking tool
303-530



Timing Setting tool
303-645



Timing chain tensioning tool
303-532



Tappet hold-down tool
303-540



Tappet hold-down tool adaptor
303-540/02



Fan nozzle - air gun
303-590

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 timing drive components.
For additional information, refer to Timing Drive Components (12.65.13)

- 4 . Remove the special tool from the LH cylinder head.

- 5  **CAUTION: Evenly and progressively, release the camshaft bearing caps.**

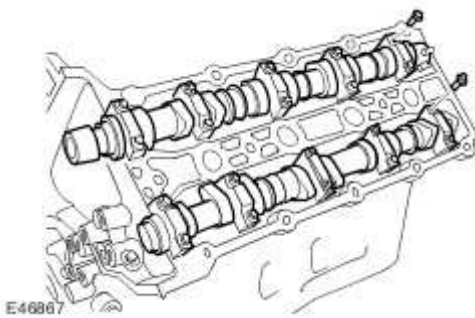
NOTE:

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.

6 . Remove the camshafts.



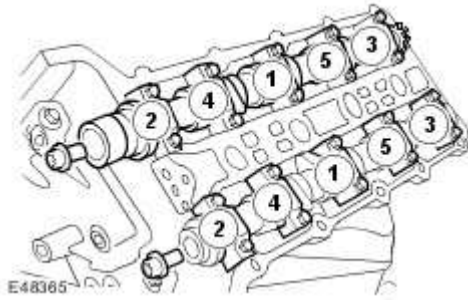
Installation

1 . Install the camshafts.

- ▶ Clean the component mating faces.
- ▶ Replace the valve shims, with the smallest shim available.
- ▶ Lubricate the journals and camshaft lobes.

2 Install the camshaft bearing caps.

- ▶ Clean the component mating faces.
- ▶ Evenly and progressively tighten the bolts in the sequence shown to 10 Nm (7 lb.ft).

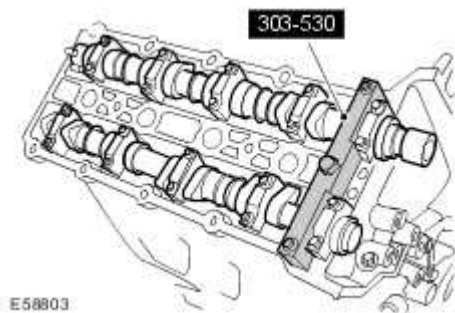


3 . NOTE:

RH illustration shown, LH is similar

Install the special tool to the LH cylinder head.

▶ Install the 3 bolts.



4 . NOTE:

Do not install the LH valve cover until valve clearance adjustment has been completed.

Install the timing drive components.

For additional information, refer to Timing Drive Components (12.65.13)

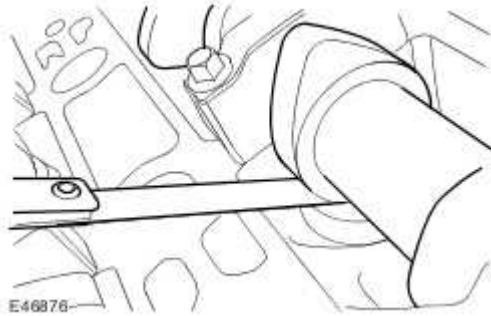
5 . For cylinder head data, refer to specifications.

For additional information, refer to Specifications

6 . Rotate the engine clockwise to position the camshaft lobe away from the valve tappet.

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

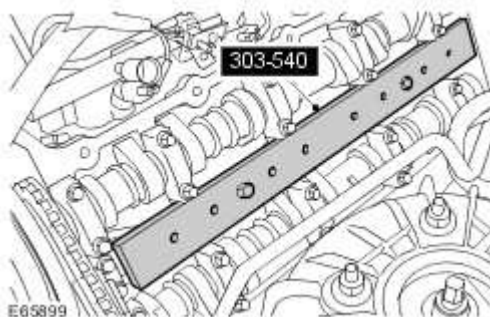
Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



8 . Repeat the above procedure for the remaining 15 shims.

9 . Install the special tool 303-540, to the cylinder head.

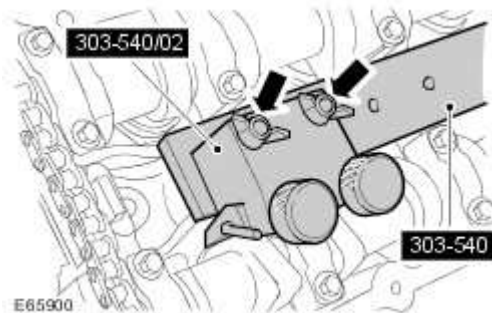
 Tighten the 2 bolts to 10 Nm (7 lb.ft).



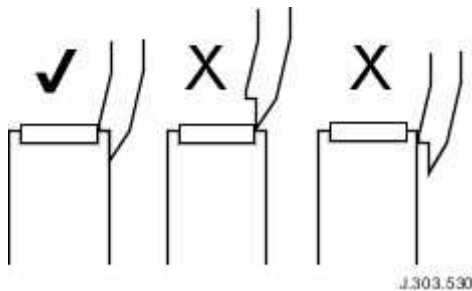
- 10  **CAUTION: Do not rotate the crankshaft while the special tool 303-540/02 is attached to 303-540.**

Attach the special tool 303-540/02 to 303-540.

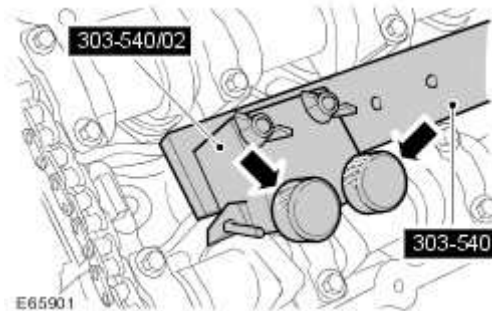
➤ Secure with the 2 wing nuts.



11 . Position the special tool to the tappet as shown.



12 . Using the special tool, compress the valve spring.



13



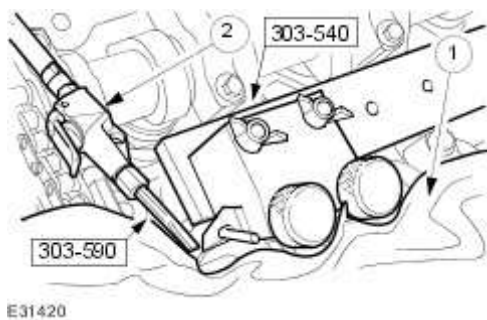
CAUTION: Do not use a magnet to remove shims. Failure to follow these instructions may result in damage to the vehicle.

NOTE:

Use the following formula to calculate the required shim thickness. Original shim thickness + measured shim clearance - desired clearance = required shim thickness.

Remove, clean and measure the shim.

- ▶ Surround the immediate working area with a cloth, to retain any loose shims displaced by the compressed air.
- ▶ Use the special tool 303-590, aimed at the edge of the shim, to lift it from the tappet. Note the position of each one.



14



CAUTION: Shims must be fitted with the size markings facing the tappet, not the camshaft.

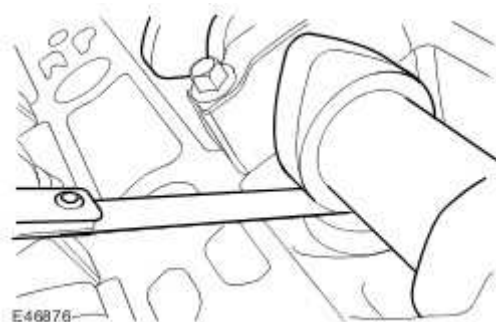


CAUTION: Do not use a magnet to install shims. Failure to follow these instructions may result in damage to the vehicle.

Install the new shim.

- ▶ Clean the components.
- ▶ Lubricate the shim with clean engine oil.
- ▶ Release and remove the special tools as required.

15 Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



- 16 . Repeat the above procedure for the remaining valves.
- 17 . Connect the battery ground cable and install the cover.
For additional information, refer to Specifications

Camshafts RH (12.13.18)

Special Service Tools



Camshaft setting/locking tool
303-530



Timing Setting tool
303-645



Timing chain tensioning tool
303-532



Tappet hold-down tool
303-540



Tappet hold-down tool adaptor
303-540/02



Fan nozzle - air gun
303-590

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 front cover.
For additional information, refer to Engine Front Cover (12.65.01)
- 4 . Remove the crankshaft position (CKP) sensor.
For additional information, refer to Crankshaft Position (CKP) Sensor (18.30.12)

- 5  **CAUTION: Rotating the crankshaft in a counterclockwise direction may cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.**

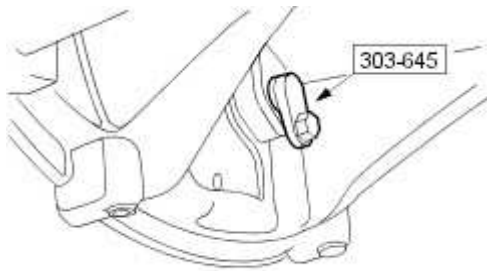


CAUTION: Rotate the crankshaft clockwise to position the engine to top dead center (TDC) number 1 cylinder.

Lock the crankshaft.

▶ Install the special tool.

▶ Install the screw.

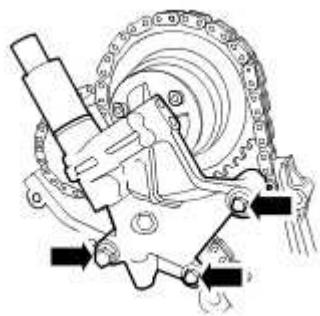


VUJ0002400

6 . Remove the RH variable camshaft timing (VCT) control solenoid housing.

▶ Remove the 3 bolts.

▶ Remove and discard the O-ring seals.

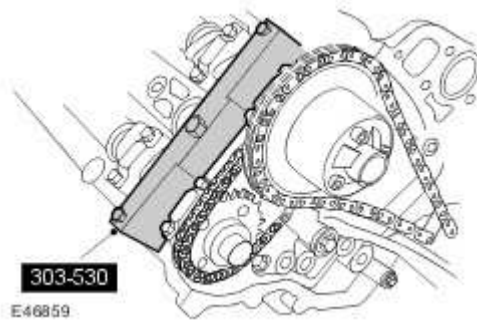


E46858

7 Install the special tool to the RH cylinder head.

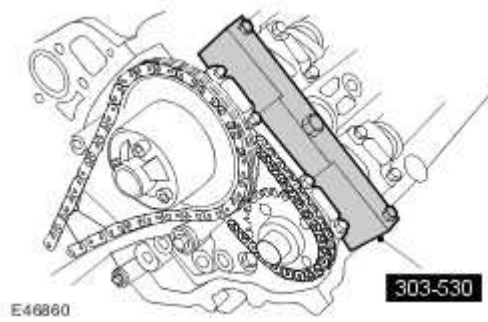
▶ Rotate the crankshaft until the flats on the camshafts are parallel with the cylinder head joint faces.

▶ Install the 3 bolts.



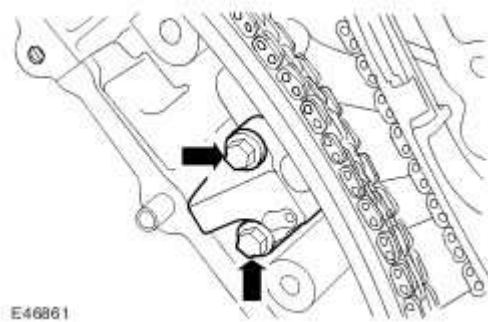
8 . Install the special tool to the LH cylinder head.

▶ Install the 3 bolts.



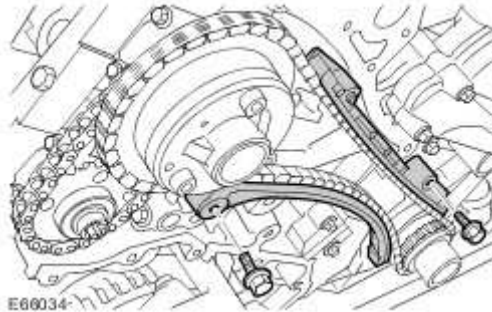
9 . Remove the RH primary timing chain tensioner.

▶ Remove the 2 bolts.

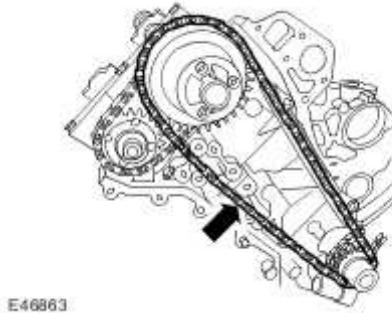


10 . Remove the RH upper and lower primary timing chain tensioner guides.

▶ Remove the 2 bolts.

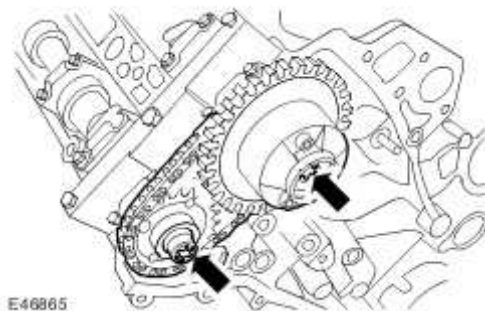


11 . Remove the RH primary timing chain.



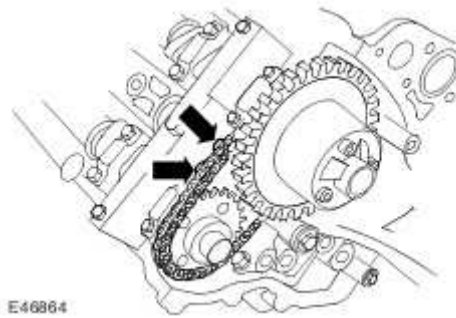
12 . Release the RH camshaft sprocket assembly.

▶ Remove and discard the 2 Torx bolts.



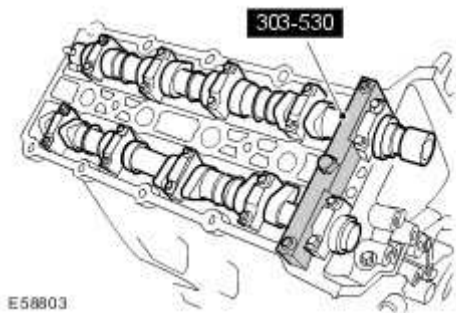
13 . Remove the RH secondary timing chain, tensioner and sprocket assembly.

▶ Remove the 2 retaining bolts.



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

▶ Remove the 3 bolts.



15



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

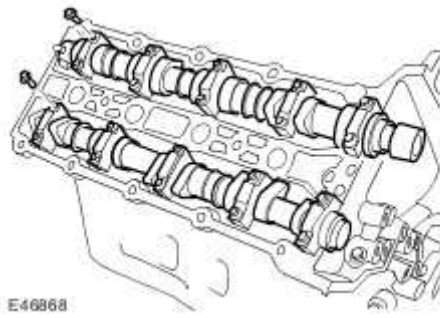
NOTE:

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.

16 . Remove the camshafts.



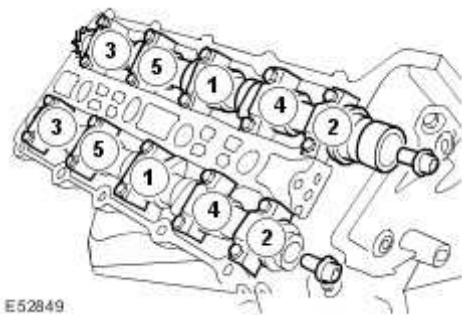
Installation

1 . Install the camshafts.

- ▶ Clean the component mating faces.
- ▶ Replace the valve shims, with the smallest shim available.
- ▶ Lubricate the journals and camshaft lobes.

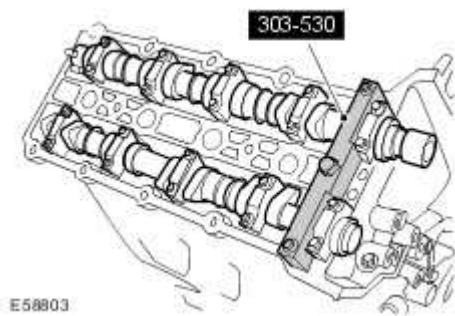
2 Install the camshaft bearing caps.

- ▶ Clean the component mating faces.
- ▶ Evenly and progressively tighten the bolts in the sequence shown to 10 Nm.



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

▶ Install the 3 bolts.



4



CAUTION: Make sure that new bolts are installed.



CAUTION: Make sure the secondary timing chain and camshaft sprockets are free to rotate.

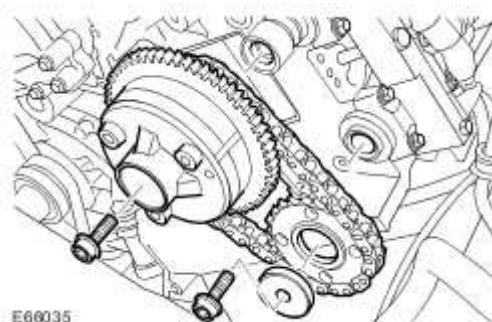
NOTE:

LH illustration shown, RH is similar.

Install the RH secondary timing chain, tensioner and sprocket assembly.

▶ Clean the components.

▶ Install the Torx bolts, but do not tighten fully at this stage.



5 . Install the RH secondary timing chain tensioner retaining bolts.

- ▶ Tighten the bolts to 12 Nm.

6 Install the RH primary timing chain.

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

7 . Install the RH primary timing chain tensioner guides.

- ▶ Tighten the bolts to 12 Nm.

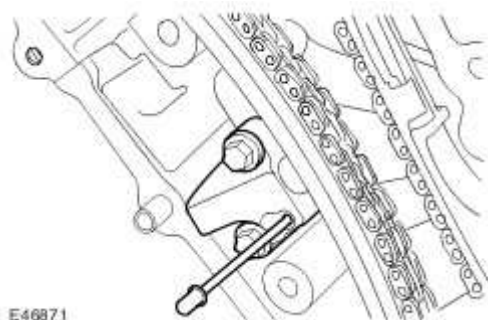
8



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.

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



9



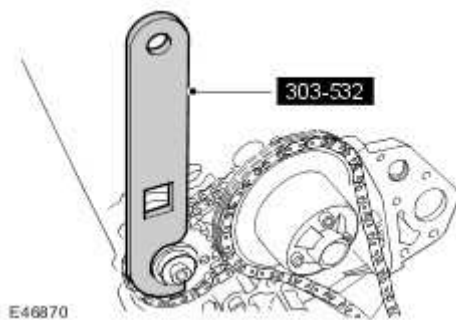
CAUTION: Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.



CAUTION: 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.

Install the special tool to the RH exhaust camshaft sprocket.

- ▶ Tighten the intake camshaft sprocket retaining bolt to 20 Nm + 90 deg.
- ▶ Tighten the exhaust camshaft sprocket retaining bolt to 20 Nm + 90 deg.



10 . Install the RH VCT control solenoid housing.

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

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

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

13 . Remove the crankshaft locking tool.

 Remove the screw.

14 . Install the CKP sensor.

For additional information, refer to Crankshaft Position (CKP) Sensor (18.30.12)

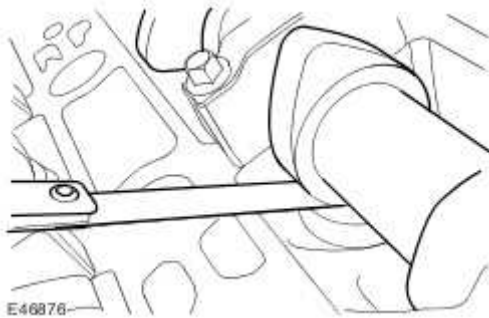
15 . For cylinder head data, refer to specifications.

For additional information, refer to Specifications

16 . Rotate the engine clockwise to position the camshaft lobe away from the valve tappet.

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

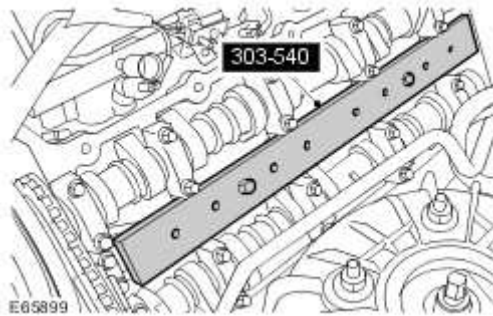
Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



18 . Repeat the above procedure for the remaining 15 shims.

19 . Install the special tool 303-540, to the cylinder head.

▶ Tighten the 2 bolts to 10 Nm.



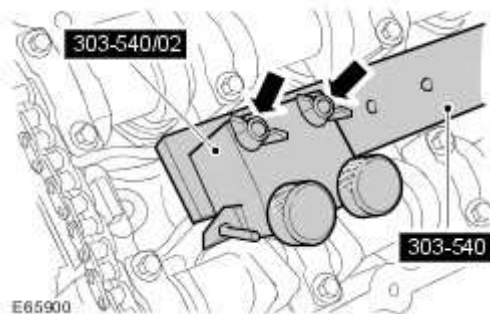
20



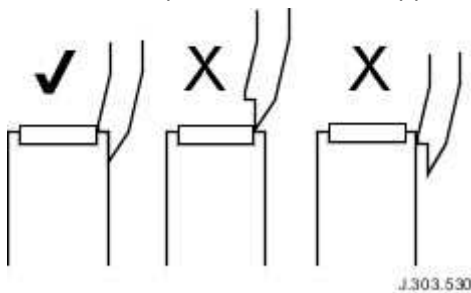
CAUTION: Do not rotate the crankshaft while the special tool 303-540/02 is attached to 303-540.

Attach the special tool 303-540/02 to 303-540.

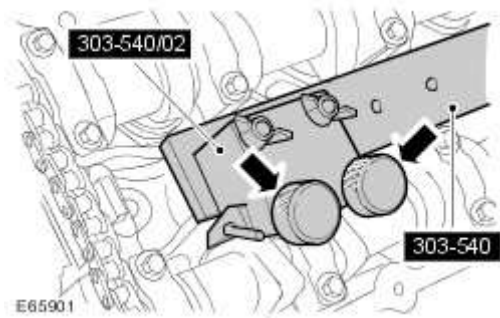
▶ Secure with the 2 wing nuts.



21 . Position the special tool to the tappet as shown.



22 . Using the special tool, compress the valve spring.



23



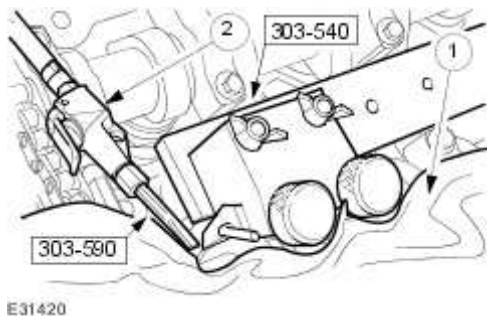
CAUTION: Do not use a magnet to remove shims. Failure to follow these instructions may result in damage to the vehicle.

NOTE:

Use the following formula to calculate the required shim thickness. Original shim thickness + measured shim clearance - desired clearance = required shim thickness.

Remove, clean and measure the shim.

- ▶ Surround the immediate working area with a cloth, to retain any loose shims displaced by the compressed air.
- ▶ Use the special tool 303-590, aimed at the edge of the shim, to lift it from the tappet. Note the position of each one.



24



CAUTION: Shims must be fitted with the size markings facing the tappet, not the

camshaft.

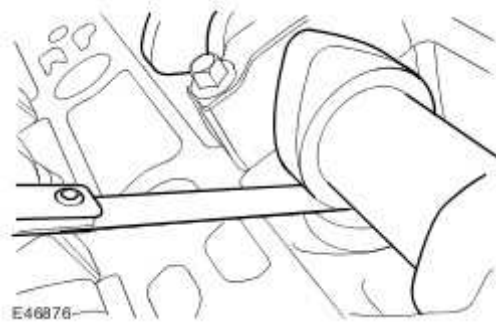


CAUTION: Do not use a magnet to install shims. Failure to follow these instructions may result in damage to the vehicle.

Install the new shim.

- ▶ Clean the components.
- ▶ Lubricate the shim with clean engine oil.
- ▶ Release and remove the special tools as required.

- 25 Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



- 26 . Repeat the above procedure for the remaining valves.
- 27 . Install the engine front cover.
For additional information, refer to Engine Front Cover (12.65.01)
- 28 . Connect the battery ground cable and install the cover.
For additional information, refer to Specifications

Crankshaft Front Seal (12.21.14)

Removal

- 1 . Remove the crankshaft pulley.

For additional information, refer to Crankshaft Pulley (12.21.09)

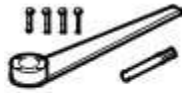
Installation

- 1 . Install the crankshaft pulley.

For additional information, refer to Crankshaft Pulley (12.21.09)

Crankshaft Pulley (12.21.09)

Special Service Tools



303-191

Crankshaft pulley locking tool

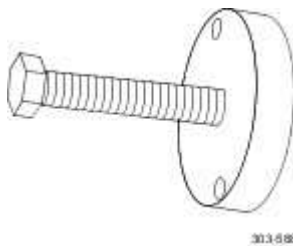
303-191



303-191-02

Crankshaft pulley locking tool adapter

303-191/02



303-588

Crankshaft pulley/damper remover

303-588



303-751

Seal extractor

303-751



303-750

Seal installer

303-750

Removal

1. Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 cooling fan motor and shroud.
For additional information, refer to Cooling Fan Motor and Shroud - Vehicles With: Supercharger (26.25.25)

4. Remove the oil filter housing.
For additional information, refer to Oil Filter Housing

5. Release the accessory drive belt.

-  Rotate the accessory drive belt tensioner counter-clockwise, using a 3/8 " drive wrench.



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

NOTE:

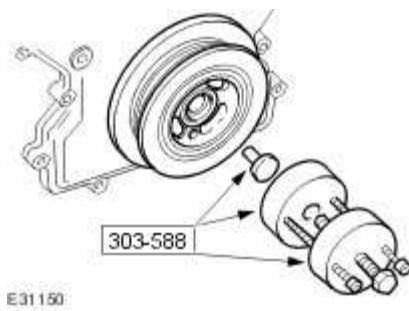
The crankshaft pulley retaining bolt will be very tight.

Using the special tool, retain the crankshaft front pulley.

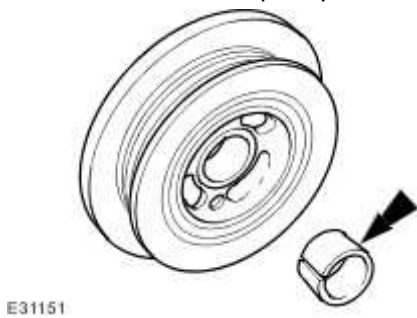
- Remove and discard the crankshaft pulley retaining bolt.
- Remove the special tools.

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

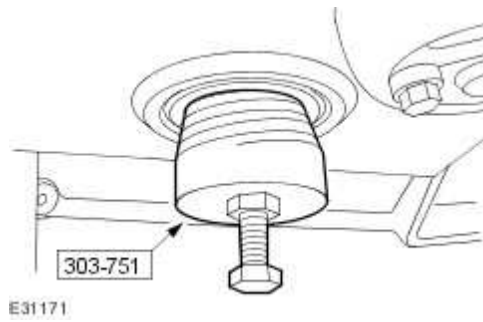
- Collect the locking ring.
- Remove the special tools.



8 . Check the crankshaft pulley and locking ring for damage.



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



Installation

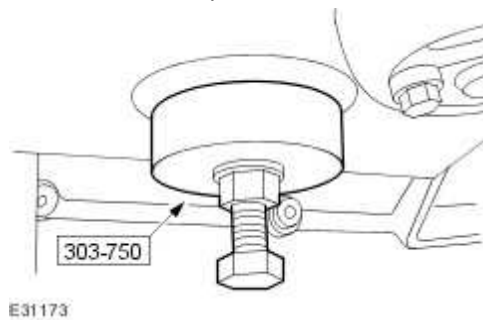
1.  **CAUTION: Make sure the crankshaft seal mating faces are clean and dry.**

-  **CAUTION: Do not remove the seal protector at this stage.**

Using the special tool, install the crankshaft front seal.

- ▶ Clean the component mating faces.

- 2 . Remove the seal protector.



- 3 . Install the crankshaft pulley.

- ▶ Lubricate the seal with clean engine oil.
- ▶ Install the locking ring.

- 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, the new crankshaft pulley bolt.

- 5 .  **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 (280 lb.ft).
-  Remove the special tools.

- 6 . Attach the accessory drive belt.

- 7 . Install the oil filter housing.
For additional information, refer to Oil Filter Housing

- 8 Install the cooling fan motor and shroud.
For additional information, refer to Cooling Fan Motor and Shroud - Vehicles With:
Supercharger (26.25.25)

- 9 . Connect the battery ground cable and install the cover.
For additional information, refer to Specifications

Crankshaft Rear Seal (12.21.20)

Special Service Tools



Crankshaft rear oil seal remover/installer
303-538

Removal

- 1 . Disconnect the battery ground cable.
For additional information, refer to 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.

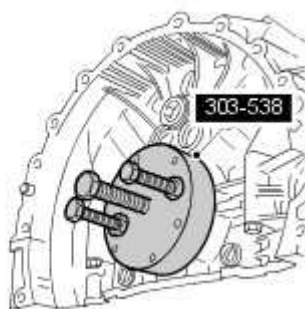
- 3 . Remove the torque converter flexplate.
For additional information, refer to Flexplate (12.53.13)

- 4 . Install the special tools.

▶ Install the 2 bolts.

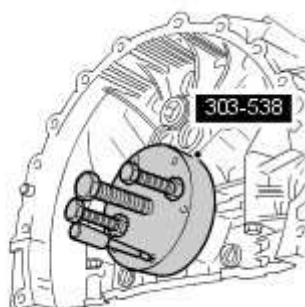
▶ Tighten the 2 nuts to retain the special tool.

E46613



5 . Using the special tool, pierce the seal to create holes for the 6 self-tapping screws.

E46614



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

- ▶ Install the 6 self-tapping screws.
- ▶ Adjust the 2 nuts.
- ▶ Tighten the center bolt.

E46615



Installation

1.  **CAUTION: Do not lubricate the components.**

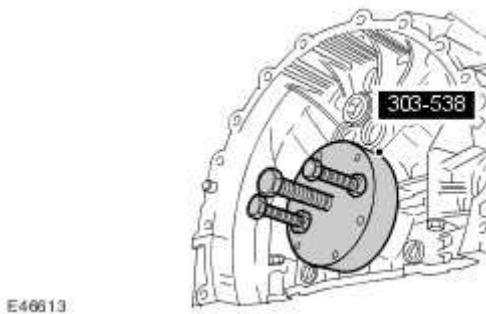
Partially install the crankshaft rear oil seal.

- ▶ Make sure the components are clean and dry.
- ▶ Carefully remove the transit sleeve, leaving the seal on the crankshaft.

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

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

- ▶ Tighten the special tool nuts evenly and progressively to fully install the seal.



3. Install the torque converter flexplate.
For additional information, refer to Flexplate (12.53.13)
4. Check and top-up the engine oil.
5. Connect the battery ground cable.
For additional information, refer to Specifications

Cylinder Head LH (12.29.02)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to 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 fuel injection supply manifold.

For additional information, refer to Fuel Injection Supply Manifold (19.60.13)

4

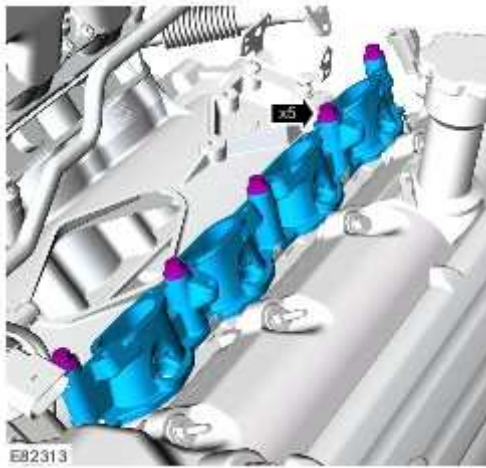


- **CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.**

Remove the LH charge air cooler adaptor assembly.

➤ Remove the 5 bolts.

➤ Discard the gasket.



5 . Remove the timing drive components.

For additional information, refer to Timing Drive Components (12.65.13)

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

7



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

NOTE:

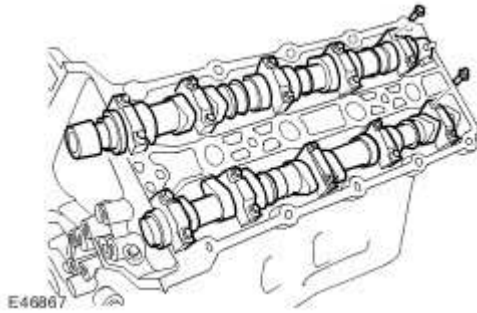
Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

Remove the camshaft bearing caps.



Remove the 20 bolts.

8 . Remove the camshafts.



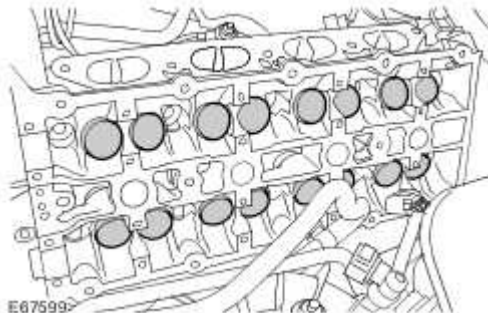
9 . NOTE:

Note the fitted position.

NOTE:

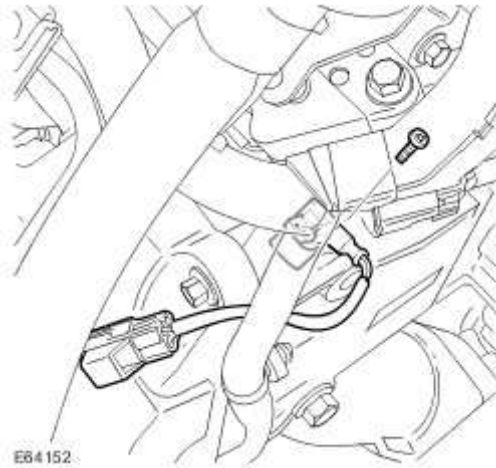
Make sure the shim remains with the tappet.

Remove the 16 tappets.



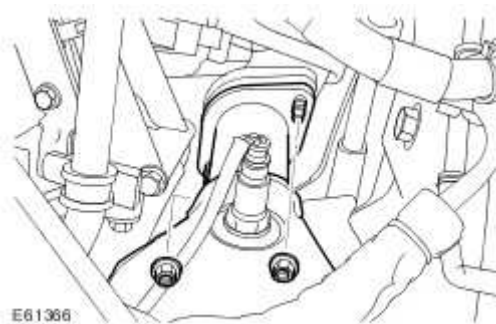
10 . Remove the CMP sensor.

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



11 . Release the LH catalytic converter.

▶ Remove and discard the 2 nuts.



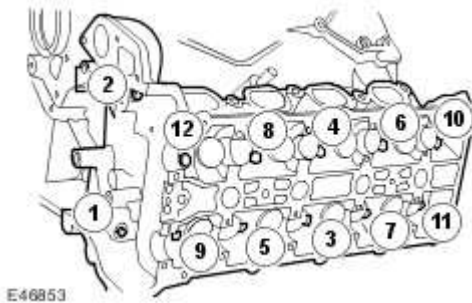
12  **CAUTION:** The bolts can only be used twice, mark the bolts with a center punch. If two punch marks are visible, discard the bolts.

 **CAUTION:** 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.

NOTE:

Remove the bolts in the indicated sequence.

Remove the 12 cylinder head bolts.



13



CAUTION: The cylinder head must not be placed mating face down. Failure to follow this instruction may result in damage to the vehicle.

With assistance remove the cylinder head.

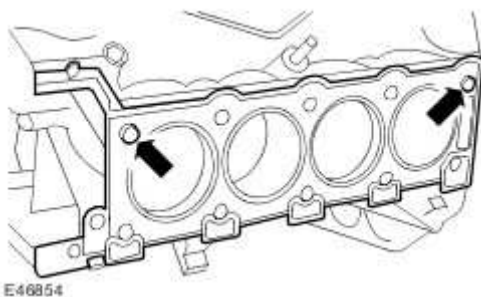
14 . Remove and discard the cylinder head gasket.



Clean the cylinder head locating dowels.



Clean and inspect the cylinder head and cylinder block.

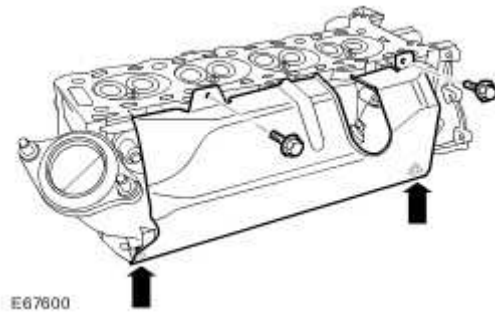


15 . **NOTE:**

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

Remove the LH heat shield.

▶ Remove the 4 screws.



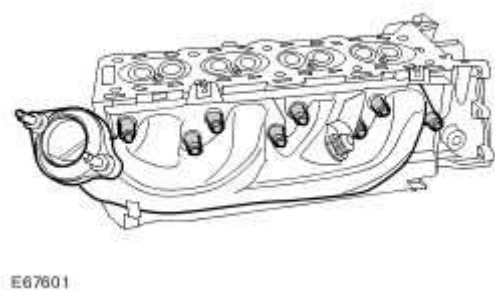
16 . **NOTE:**

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

Remove the exhaust manifold.

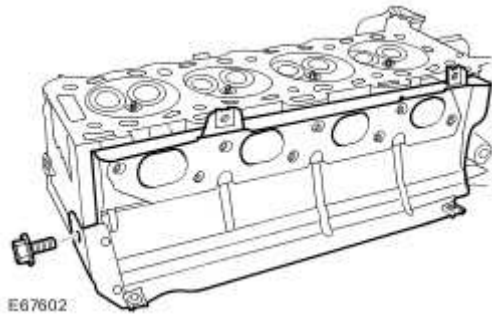
▶ Remove and discard the 8 bolts.

▶ Remove the 8 spacers.



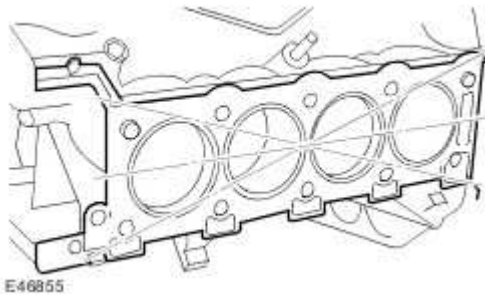
17 . Remove and discard the exhaust manifold gasket.

▶ Remove the bolt.



Installation

- 1 . Clean the component mating faces.
- 2 . Check cylinder head face for distortion, across the center and from corner to corner.



- 3 . For cylinder head face distortion data, refer to specifications.
For additional information, refer to Specifications

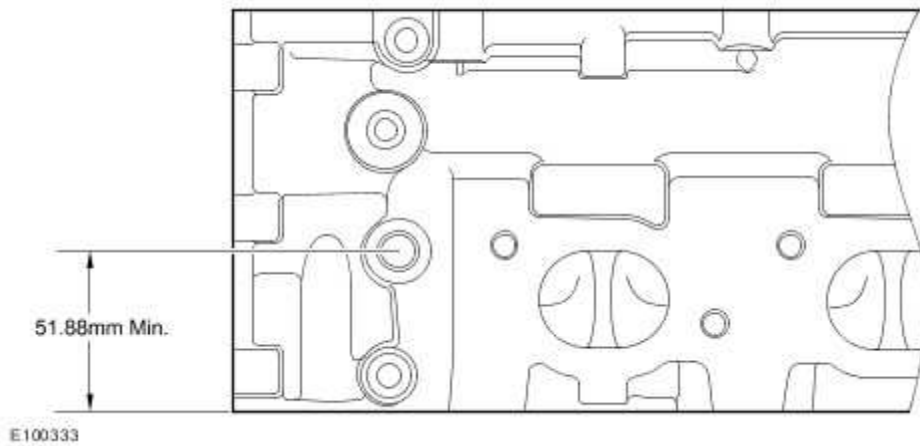
4 NOTE:

For cylinder head with distortion above the maximum allowance, the cylinder head material must be measured.

Measure the cylinder head material.

- Check measurement from the centre of the exhaust dowel to the cylinder head face as shown.

- ▶ If the measurement is less than 51.88 mm the cylinder head requires replacement.

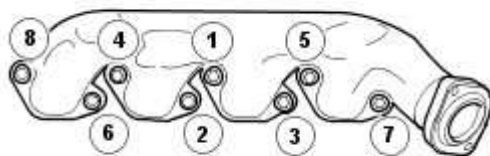


5 . Install the exhaust manifold gasket.

- ▶ Clean the component mating faces.
- ▶ Tighten the bolt to 50 Nm (37 lb.ft).

6 Install the exhaust manifold.

- ▶ Clean the component mating faces.
- ▶ Install the spacers.
- ▶ Evenly and progressively, tighten the new bolts in the sequence shown, to 24 Nm (18 lb.ft).



E65731

7 . Install the heat shield.

 Tighten the screws.

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

Install a new cylinder head gasket.

9 . With assistance install the cylinder head.

10 . **NOTE:**

Tighten the bolts 1 to 10 in the sequence shown.

Install the cylinder head bolts.

 Lubricate the new cylinder head bolt threads with clean engine oil.

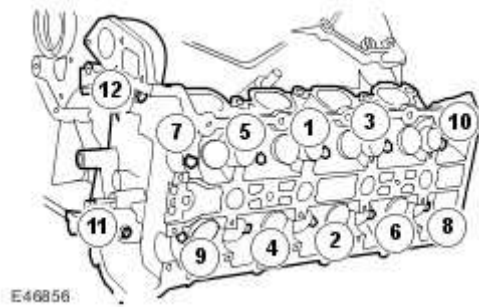
 Tighten the bolts 1 to 10 to 20 Nm (15 lb.ft).

 Tighten the bolts 1 to 10 to 35 Nm (26 lb.ft).

 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 (18 lb.ft).



11 . Attach the catalytic coverter.

- ▶ Tighten the nuts to 40Nm (30 lb.ft).

12 . Install the CMP sensor.

- ▶ Clean the components.
- ▶ Install a new O-ring seal.
- ▶ Tighten the Torx bolt to 7 Nm (5 lb.ft).

13 . Install the tappets.

- ▶ Clean the components.
- ▶ Lubricate the components with clean engine oil.

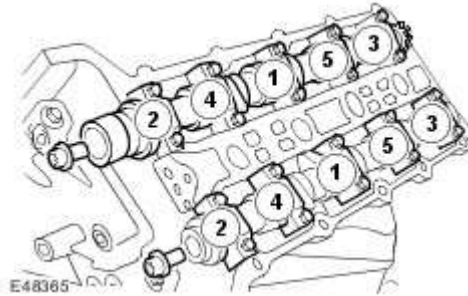
14 . Install the camshafts.

- ▶ Clean the component mating faces.
- ▶ Lubricate the journals and camshaft lobes with clean engine oil.

15 . Install the camshaft bearing caps.

- ▶ Clean the component mating faces.

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

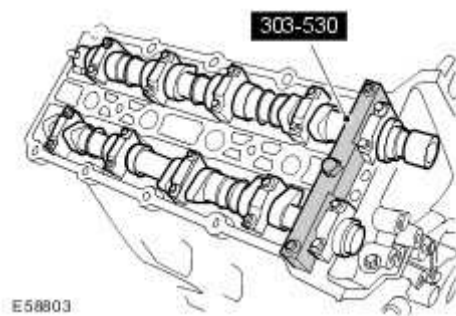


16 . **NOTE:**

RH illustration shown, LH is similar.

Install the special tool to the LH cylinder head.

- ▶ Install the 3 bolts.



17 . **NOTE:**

Do not install the LH valve cover until valve clearance adjustment has been completed.

Install the timing drive components.

For additional information, refer to Timing Drive Components (12.65.13)

18 . Install the charge air cooler adaptor assembly.

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

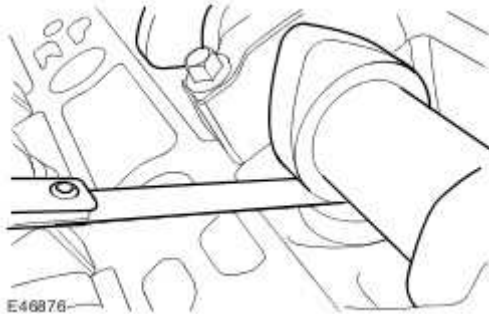
19 . Install the fuel injection supply manifold.

For additional information, refer to Fuel Injection Supply Manifold (19.60.13)

20 . Rotate the engine clockwise to position the camshaft lobe away from the valve tappet.

- 21
-  **CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.**

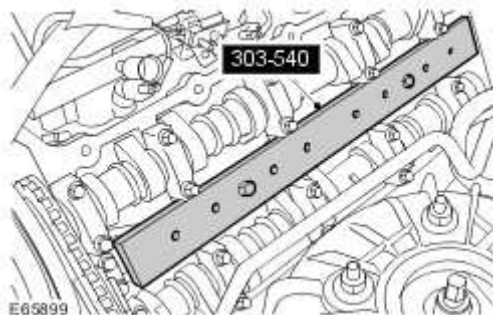
Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



22 . Repeat the above procedure for the remaining 15 shims.

23 . Install the special tool 303-540, to the cylinder head.

- ▶ Tighten the 2 bolts to 10 Nm (7 lb.ft).



24

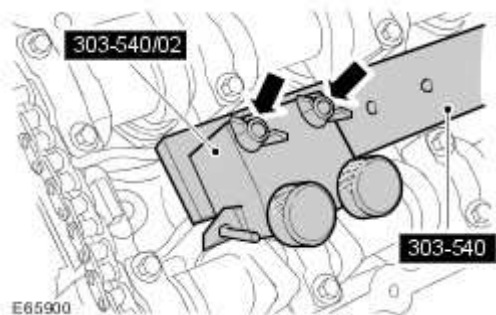


CAUTION: Do not rotate the crankshaft while the special tool 303-540/02 is attached to 303-540.

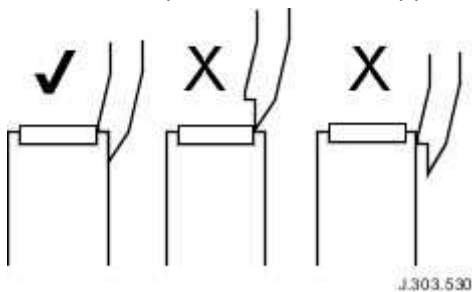
Attach the special tool 303-540/02 to 303-540.



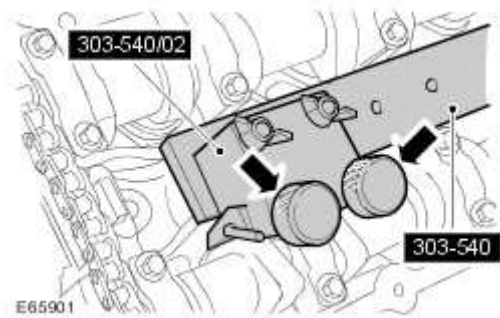
Secure with the 2 wing nuts.



25 . Position the special tool to the tappet as shown.



26 . Using the special tool, compress the valve spring.



27



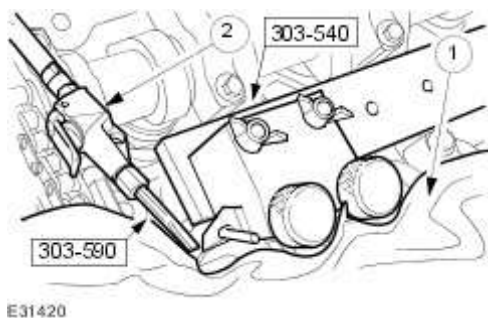
CAUTION: Do not use a magnet to remove shims. Failure to follow these instructions may result in damage to the vehicle.

NOTE:

Use the following formula to calculate the required shim thickness. Original shim thickness + measured shim clearance - desired clearance = required shim thickness.

Remove, clean and measure the shim.

- ▶ Surround the immediate working area with a cloth, to retain any loose shims displaced by the compressed air.
- ▶ Use the special tool 303-590, aimed at the edge of the shim, to lift it from the tappet. Note the position of each one.



28



CAUTION: Shims must be fitted with the size markings facing the tappet, not the camshaft.

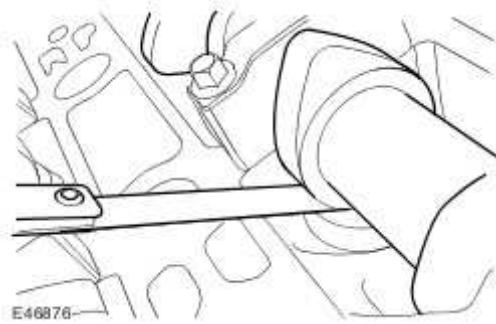


CAUTION: Do not use a magnet to install shims. Failure to follow these instructions may result in damage to the vehicle.

Install the new shim.

- ▶ Clean the components.
- ▶ Lubricate the shim with clean engine oil.
- ▶ Release and remove the special tools as required.

- 29 Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



- 30 . Repeat the above procedure for the remaining valves.
- 31 . Connect the battery ground cable and install the cover.
For additional information, refer to Specifications

Engine Front Cover (12.65.01)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to Specifications

- 2 . Recover the A/C refrigerant.

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 hood.

For additional information, refer to Hood (76.16.01)

- 5 Vehicles with secondary air injection: Remove the air control valve to exhaust manifold tube.

- For additional information, refer to Secondary Air Injection (AIR) Control Valve to Exhaust Manifold Tube

- 6 . Remove the coolant manifold.

For additional information, refer to Coolant Manifold - Vehicles With: Supercharger

- 7 . Remove the LH valve cover.

For additional information, refer to Valve Cover LH (12.29.43)

- 8 . Remove the RH valve cover.

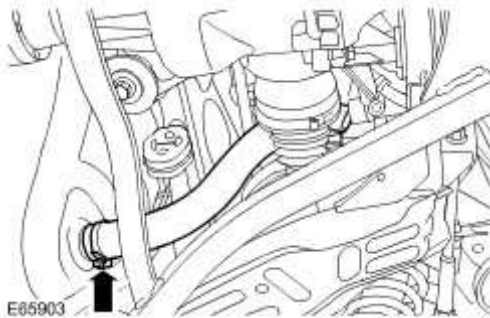
For additional information, refer to Valve Cover RH (12.29.44)

9 . Remove the crankshaft pulley.

For additional information, refer to Crankshaft Pulley (12.21.09)

10 . Remove the radiator bottom hose.

▶ Release the clip.



11 . Remove the power steering pump.

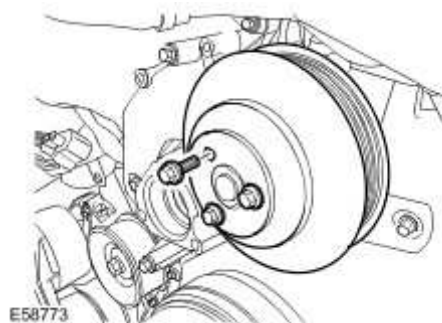
For additional information, refer to Power Steering Pump - 4.2L SC V8 - AJV8 (57.20.14)

12 . **NOTE:**

Restrain the pulley to aid the removal of the bolts.

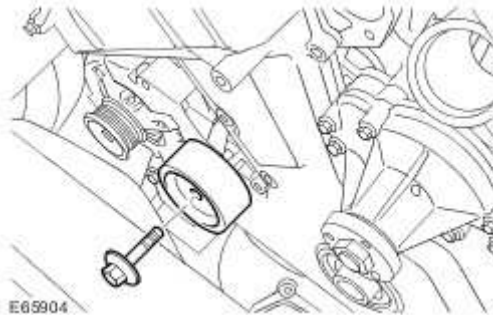
Remove the coolant pump pulley.

▶ Remove the 3 bolts.



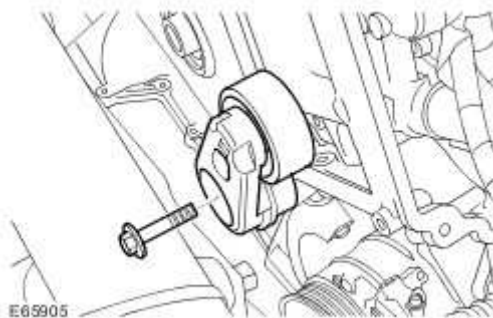
13 . Remove the accessory drive belt idler pulley.

▶ Remove the bolt.



14 . Remove the accessory drive belt tensioner.

▶ Remove the bolt.



15

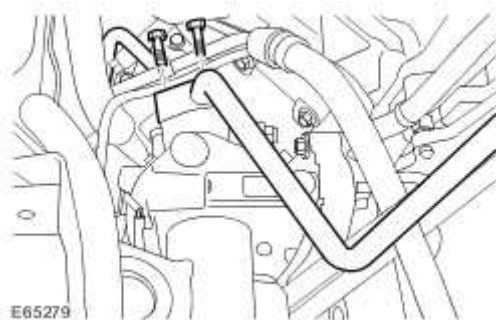


CAUTION: Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Disconnect the refrigerant lines from the A/C compressor.

▶ Remove the 2 bolts.

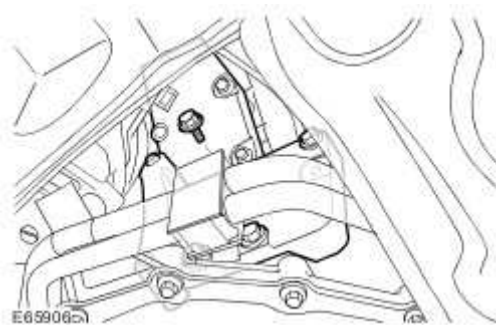
▶ Remove and discard the 2 O-ring seals.



16 . Position the A/C compressor aside to access the A/C compressor mounting bracket.

17 . Remove the A/C compressor mounting bracket.

▶ Remove the 4 bolts.



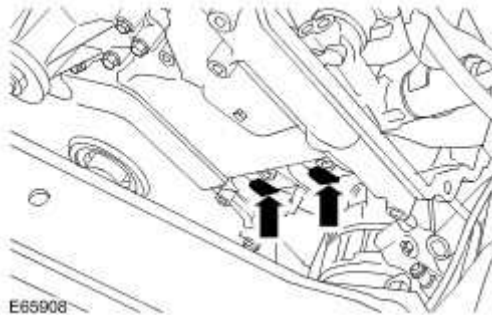
18 . Remove the power steering pump mounting bracket.

▶ Remove the 4 bolts.



19 . LH side: Release the wiring harness.

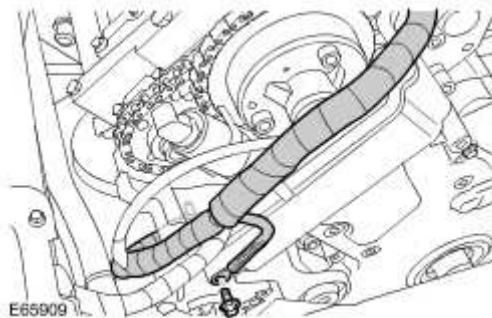
▶ Release the 2 clips.



20 . RH side: Release the wiring harness.

▶ Remove the bolt.

▶ Release the clip.

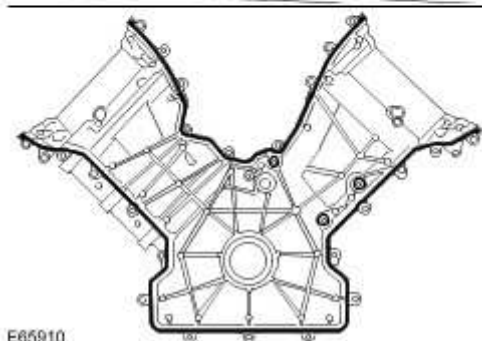
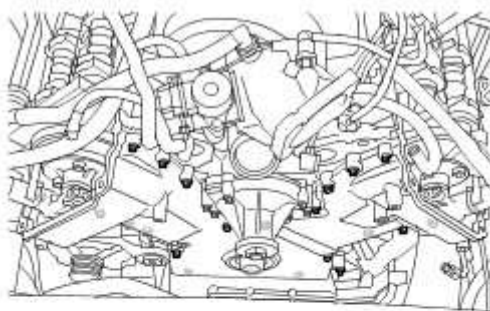


21 . Remove the engine front cover.

▶ Remove the 24 bolts.

▶ Remove and discard the 2 gaskets.

▶ Remove and discard the 3 O-ring seals.

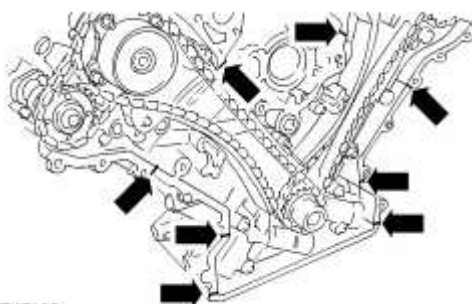


E65910

Installation

- 1 Install the engine front cover.

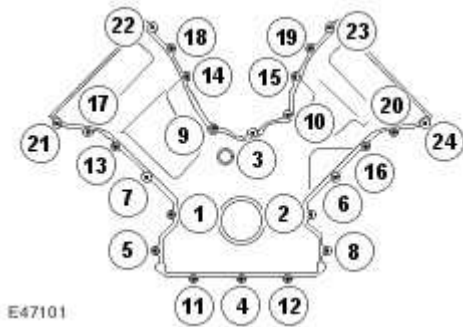
- ▶ Clean the component mating faces.
- ▶ Install the gaskets.
- ▶ Install the O-ring seals.
- ▶ Apply a bead of sealant 3 mm diameter, by 12 mm long, to the 8 places indicated.



E47100

2 Install the engine front cover bolts.

- ▶ Evenly and progressively tighten the bolts in the sequence shown to 12 Nm (9 lb.ft).



3 . RH side: Attach the wiring harness.

- ▶ Secure the clip.
- ▶ Tighten the bolt to 10 Nm (7 lb.ft).

4 . LH side: Attach the wiring harness.

- ▶ Secure the clips.

5 . Install the power steering pump mounting bracket.

- ▶ Tighten the bolts to 25 Nm (18 lb.ft).

6 . Install the A/C compressor mounting bracket.

- ▶ Tighten the bolts to 25 Nm (18 lb.ft).

7 .



CAUTION: Lubricate the new seals with clean refrigerant oil.

Connect the refrigerant lines.

- ▶ Clean the component mating faces.
- ▶ Install the new O-ring seals.
- ▶ Tighten the bolts to 9 Nm (7 lb.ft).

8 . Install the accessory drive belt tensioner.

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

9 . Install the accessory drive belt idler pulley.

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

10 . Install the coolant pump pulley.

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

11 . Install the power steering pump.

For additional information, refer to Power Steering Pump - 4.2L SC V8 - AJV8 (57.20.14)

12 . Install the radiator bottom hose.

- ▶ Secure the clip.

13 . Install the crankshaft pulley.

For additional information, refer to Crankshaft Pulley (12.21.09)

14 . Install the RH valve cover.

For additional information, refer to Valve Cover RH (12.29.44)

15 . Install the LH valve cover.

For additional information, refer to Valve Cover LH (12.29.43)

16 . Install the coolant manifold.

For additional information, refer to Coolant Manifold - Vehicles With: Supercharger

17 Vehicles with secondary air injection: Install the air control valve to exhaust manifold tube.

. For additional information, refer to Secondary Air Injection (AIR) Control Valve to Exhaust Manifold Tube

18 . Install the hood.

For additional information, refer to Hood (76.16.01)

19 . Recharge the A/C system.

20 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Engine Mount LH (12.45.01)

Removal

All vehicles

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 front wheel and tire.
For additional information, refer to Wheel and Tire (74.20.05)

- 4 . Remove the air deflector.
For additional information, refer to Air Deflector (76.11.41)

Left-hand drive vehicles

- 5 . **NOTE:**

Note the fitted position.

Remove the steering gear flexible coupling.

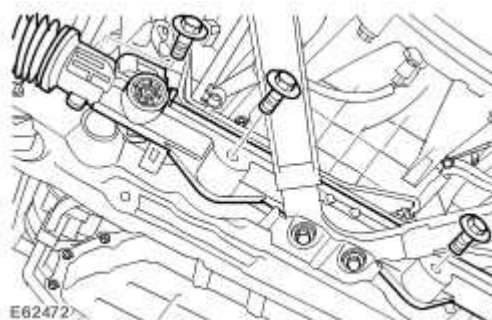


Remove and discard the 2 bolts.



6 . Release the steering gear.

► Remove the 3 bolts.

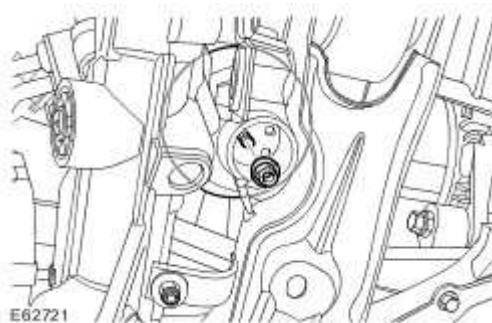


All vehicles

7 . Release the engine mount.

► Support the engine.

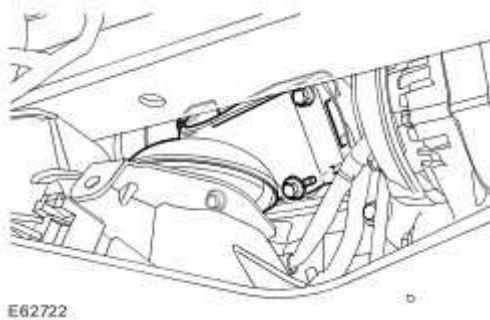
► Remove and discard the nut.



8 . Remove the engine mount and bracket.

▶ Raise the engine.

▶ Remove the 4 bolts.



9 . **NOTE:**

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

Remove the engine mount.

▶ Remove and discard the nut.



Installation

All vehicles

1 . Install the engine mount.

▶ Tighten the new nut to 55 Nm (41 lb.ft).

2 . Install the engine mount and bracket.

-  Clean the component mating faces.
-  Tighten the bolts to 45 Nm (33 lb.ft).
-  Lower the engine.
-  Tighten the new nut to 63 Nm (46 lb.ft).

Left-hand drive vehicles

3 . Secure the steering gear.

-  Tighten the bolts to 100 Nm (74 lb.ft).

4 . Install the steering gear flexible coupling.

-  Tighten the new bolts to 35 Nm (26lb.ft).

All vehicles

5 . Install the air deflector.

For additional information, refer to Air Deflector (76.11.41)

6 . Install the front wheel.

For additional information, refer to Wheel and Tire (74.20.05)

7 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Engine Mount RH (12.45.03)

Removal

All vehicles

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 air deflector.
For additional information, refer to Air Deflector (76.11.41)

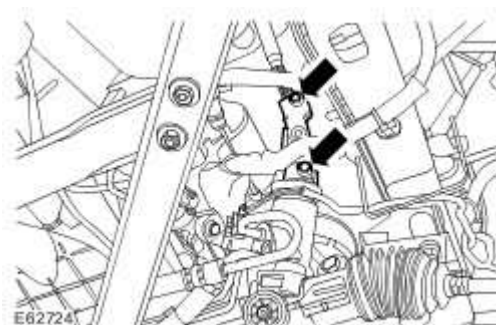
Right-hand drive vehicles

- 4 . **NOTE:**

Note the fitted position.

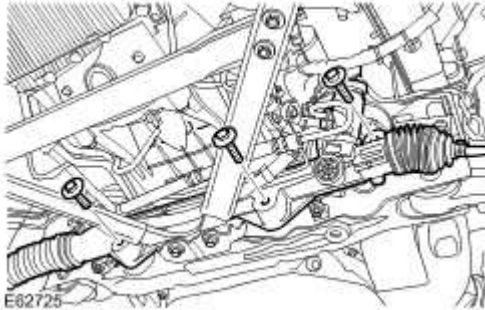
Remove the steering gear flexible coupling.

-  Remove and discard the 2 bolts.



5 . Release the steering gear.

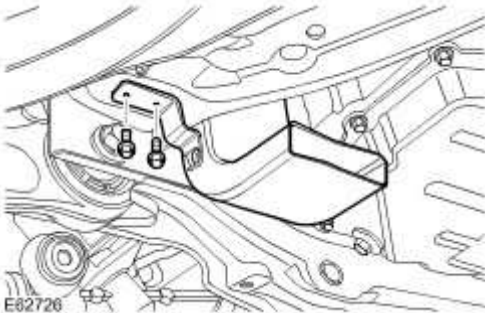
▶ Remove the 3 bolts.



All vehicles

6 . Remove the generator cooling duct.

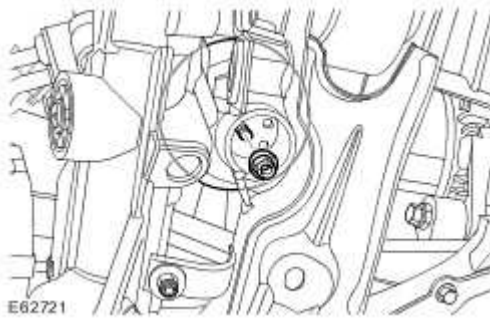
▶ Remove the 2 screws.



7 . Release the engine mount.

▶ Support the engine.

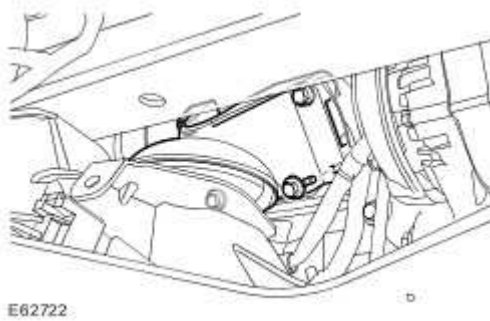
▶ Remove and discard the nut.



8 . Remove the engine mount and bracket.

► Raise the engine.

► Remove the 4 bolts.



9 . **NOTE:**

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

Remove the engine mount.

► Remove and discard the nut.



Installation

All vehicles

1 . Install the engine mount.

- ▶ Tighten the new nut to 55 Nm (41 lb.ft).

2 . Install the engine mount and bracket.

- ▶ Clean the component mating faces.
- ▶ Tighten the bolts to 45 Nm (33 lb.ft).
- ▶ Lower the engine.
- ▶ Tighten the new nut to 63 Nm (46 lb.ft).

3 . Install the generator cooling duct.

- ▶ Tighten the screws.

Right-hand drive vehicles

4 . Secure the steering gear.

- ▶ Tighten the bolts to 100 Nm (74 lb.ft).

5 . Install the steering gear flexible coupling.

 Tighten the new bolts to 35 Nm (26lb.ft).

All vehicles

6 . Install the air deflector.

For additional information, refer to Air Deflector (76.11.41)

7 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Exhaust Manifold LH - Vehicles With: Secondary Air Injection (AIR) (30.15.55)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to 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 level indicator and tube.

For additional information, refer to Oil Level Indicator and Tube

- 4 . Remove the exhaust system.

For additional information, refer to Exhaust System

- 5 . Remove the LH engine mount.

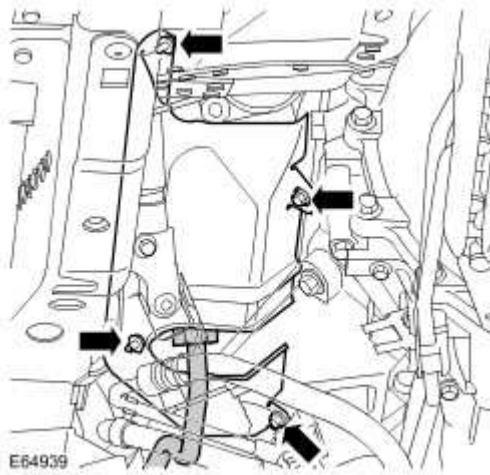
For additional information, refer to Engine Mount LH (12.45.01)

- 6 . Release the LH exhaust manifold heat shield.



Remove the 4 screws.

- 7 . Release the AIR tube from the LH exhaust manifold.

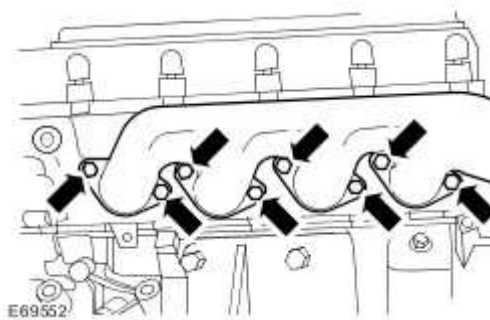


8 . Remove the LH exhaust manifold heat shield.

9 . Remove the exhaust manifold.

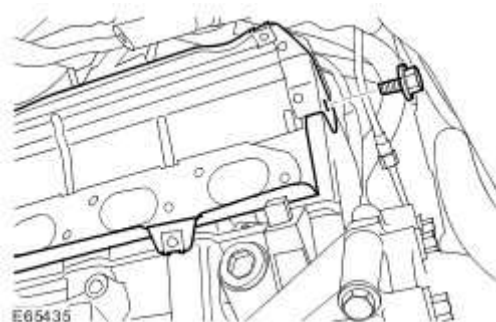
➤ Remove and discard the 8 bolts.

➤ Remove the 8 spacers.



10 . Remove and discard the exhaust manifold gasket.

➤ Remove the bolt.



Installation

1 . Install the exhaust manifold gasket.

▶ Clean the component mating faces.

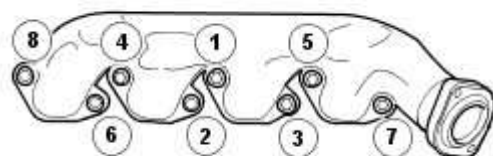
▶ Tighten the bolt to 50 Nm (37 lb.ft).

2 Install the exhaust manifold.

▶ Clean the component mating faces.

▶ Install the spacers.

▶ Evenly and progressively, tighten the new bolts in the sequence shown, to 24 Nm (18 lb.ft).



3 . Install the exhaust manifold heat shield.

4 . Attach the air tube.

 Tighten the union to 35 Nm (26 lb.ft).

5 . Secure the exhaust manifold heat shield.

 Tighten the screws.

6 . Install the LH engine mount.

For additional information, refer to Engine Mount LH (12.45.01)

7 . Install the exhaust system.

For additional information, refer to Exhaust System

8 . Install the oil level indicator and tube.

For additional information, refer to Oil Level Indicator and Tube

9 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Exhaust Manifold RH - Vehicles Without: Secondary Air Injection (AIR) (30.15.56)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to 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.

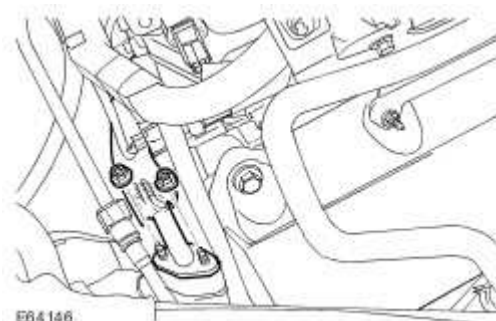
- 3 . Remove the intake air resonator.

For additional information, refer to Intake Air Resonator

- 4 . Release the EGR valve to exhaust manifold pipe.

▶ Remove the 2 nuts.

▶ Remove and discard the gasket.



- 5 . Remove the exhaust system.

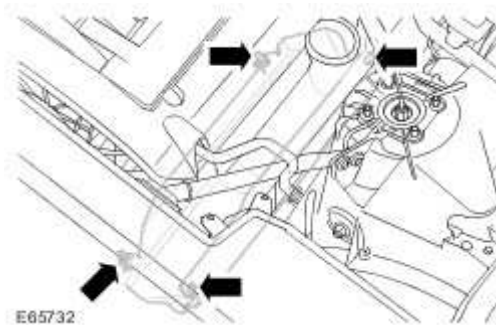
For additional information, refer to Exhaust System

6 . Remove the RH engine mount.

For additional information, refer to Engine Mount RH (12.45.03)

7 . Remove the RH heat shield.

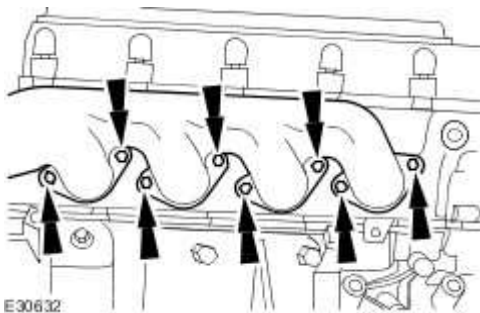
▶ Remove the 4 screws.



8 . Remove the exhaust manifold.

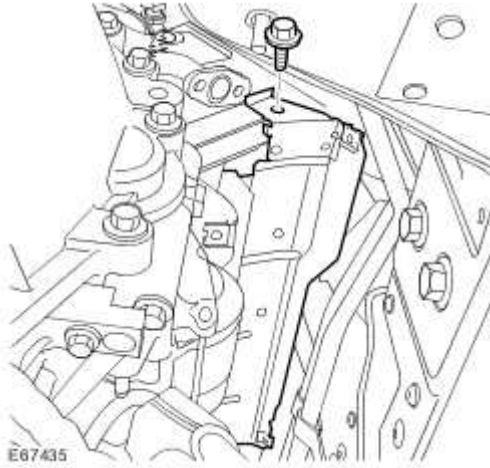
▶ Remove and discard the 8 bolts.

▶ Remove the 8 spacers.



9 . Remove and discard the exhaust manifold gasket.

▶ Remove the bolt.



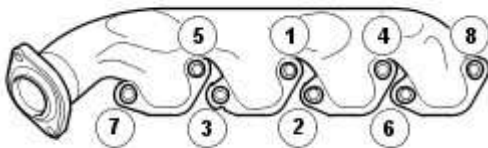
Installation

1 . Install the exhaust manifold gasket.

- ▶ Clean the component mating faces.
- ▶ Tighten the bolt to 50 Nm (37 lb.ft).

2 Install the exhaust manifold.

- ▶ Clean the component mating faces.
- ▶ Install the spacers.
- ▶ Evenly and progressively, tighten the new bolts in the sequence shown, to 24 Nm (18 lb.ft).



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3 . Install the heat shield.

 Tighten the screws.

4 . Install the RH engine mount.

For additional information, refer to Engine Mount RH (12.45.03)

5 . Install the exhaust system.

For additional information, refer to Exhaust System

6 . Attach the EGR valve to exhaust manifold pipe.

 Clean the component mating faces.

 Install a new gasket.

 Tighten the nuts to 25 Nm (18 lb.ft).

7 . Install the intake air resonator.

For additional information, refer to Intake Air Resonator

8 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Exhaust Manifold RH - Vehicles With: Secondary Air Injection (AIR) (30.15.56)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to 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.

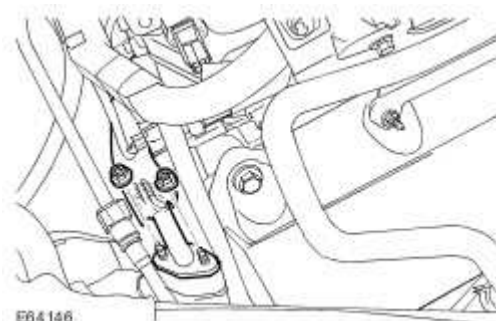
- 3 . Remove the intake air resonator.

For additional information, refer to Intake Air Resonator

- 4 . Release the EGR valve to exhaust manifold pipe.

▶ Remove the 2 nuts.

▶ Remove and discard the gasket.



- 5 . Remove the exhaust system.

For additional information, refer to Exhaust System

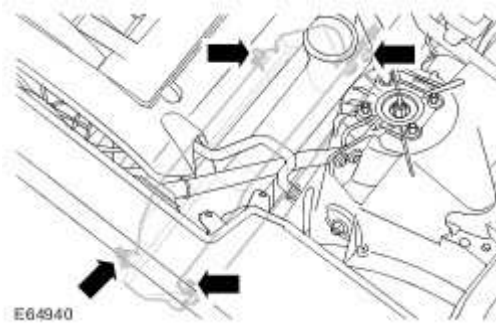
6 . Remove the RH engine mount.

For additional information, refer to Engine Mount RH (12.45.03)

7 . Release the RH exhaust manifold heat shield.

▶ Remove the 4 screws.

8 . Release the AIR tube from the RH exhaust manifold.

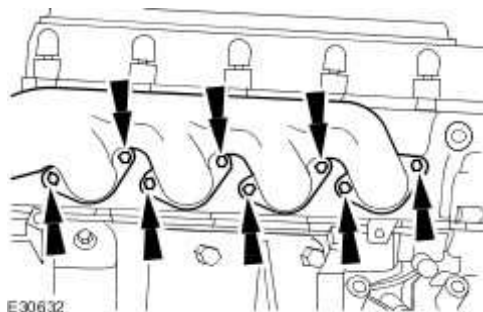


9 . Remove the RH exhaust manifold heat shield.

10 . Remove the exhaust manifold.

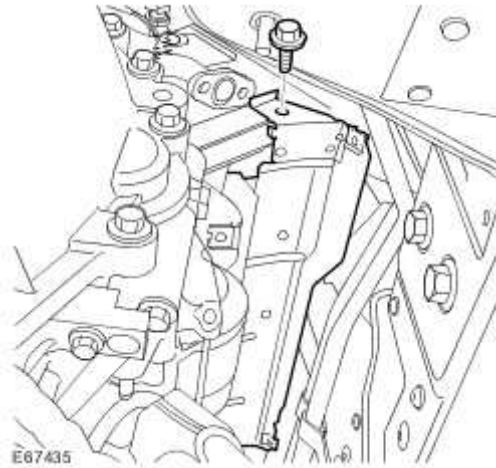
▶ Remove and discard the 8 bolts.

▶ Remove the 8 spacers.



11 . Remove and discard the exhaust manifold gasket.

- ▶ Remove the bolt.



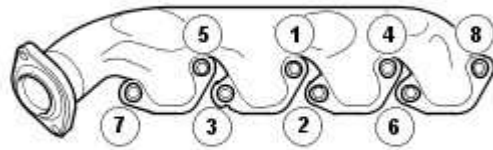
Installation

- 1 . Install the exhaust manifold gasket.

- ▶ Clean the component mating faces.
- ▶ Tighten the bolt to 50 Nm (37 lb.ft).

- 2 Install the exhaust manifold.

- ▶ Clean the component mating faces.
- ▶ Install the spacers.
- ▶ Evenly and progressively, tighten the new bolts in the sequence shown, to 24 Nm (18 lb.ft).



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3 . Install the exhaust manifold heat shield.

4 . Attach the air tube.

▶ Tighten the union to 35 Nm (26 lb.ft).

5 . Secure the exhaust manifold heat shield.

▶ Tighten the screws.

6 . Install the RH engine mount.

For additional information, refer to Engine Mount RH (12.45.03)

7 . Install the exhaust system.

For additional information, refer to Exhaust System

8 . Attach the EGR valve to exhaust manifold pipe.

▶ Clean the component mating faces.

▶ Install a new gasket.

▶ Tighten the nuts to 25 Nm (18 lb.ft).

9 . Install the intake air resonator.

For additional information, refer to Intake Air Resonator

10 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Flexplate (12.53.13)

Removal

1 . Remove the cover and disconnect the battery ground cable.

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 (44.20.01)

4



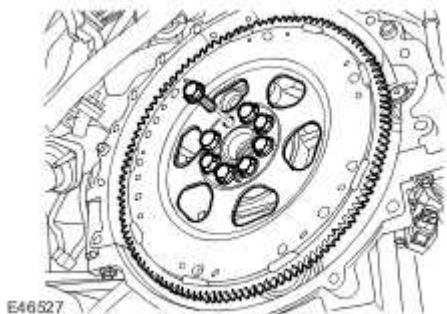
· **CAUTION: The bolts can only be used 3 times, mark the bolts with a center punch. If 2 punch marks are visible, discard the bolts.**

NOTE:

Prevent the flexplate from rotating.

Remove the torque converter flexplate.

 Remove the 8 bolts.



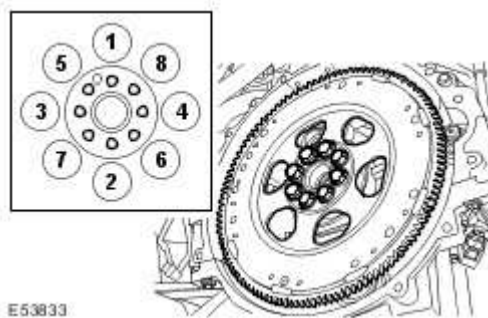
Installation

1 . NOTE:

Prevent the flexplate from rotating.

Install the torque converter flexplate.

- ▶ Clean the component mating faces.
- ▶ Tighten the bolts evenly in 2 stages to the sequence shown.
- ▶ Tighten the bolts to 15 Nm (11 lb ft).
- ▶ Tighten the bolts to 110 Nm (81 lb.ft).



2 . Install the transmission.

For additional information, refer to Transmission (44.20.01)

3 . Connect the battery ground cable and install the cover.

Oil Pan (12.60.44)

Removal

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

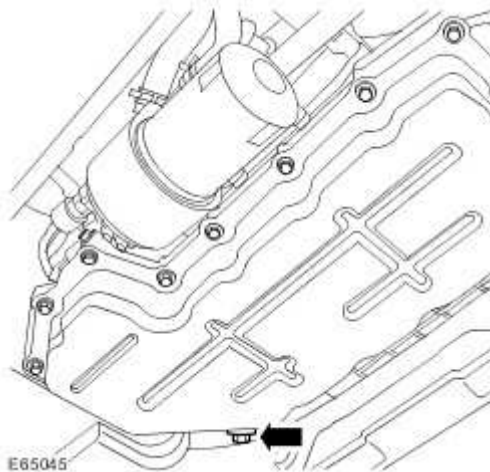
Raise and support the vehicle.

- 2 . Remove the engine undershield.
For additional information, refer to Air Deflector (76.11.41)

- 3 . Remove the oil pan drain plug.

► Position a container to collect the fluid.

► Discard the oil pan drain plug seal.

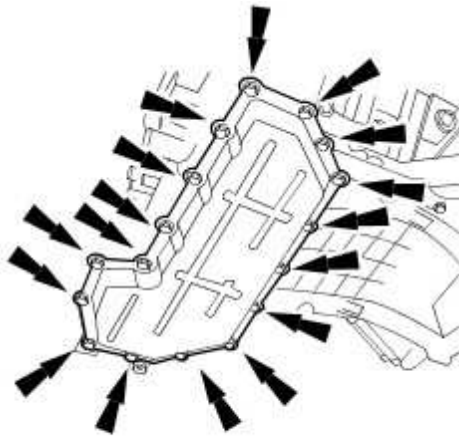


- 4 . Remove the oil pan.

► Position a container to collect the oil spillage.

► Remove the 17 bolts.

- ▶ Remove and discard the gasket.



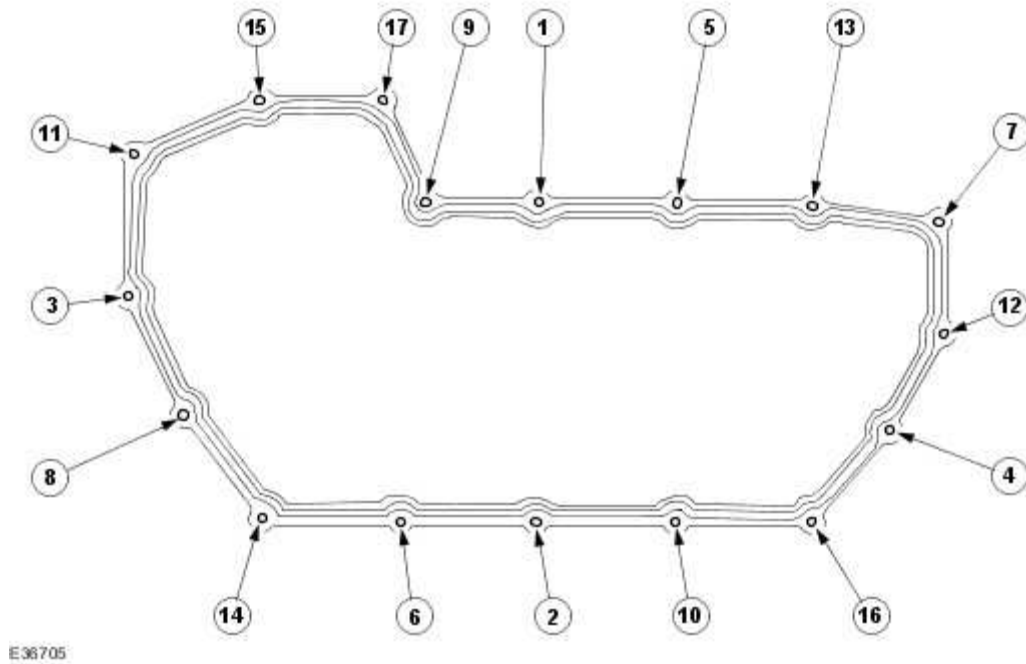
E31186

Installation

- 1 . Install the oil pan.

- ▶ Clean the components.
- ▶ Install the new gasket.
- ▶ Install the bolts, but do not tighten fully at this stage.

- 2 . Evenly and progressively tighten the bolts in the sequence shown to 12 Nm (9 lb.ft).



3 . Tighten the drain plug to 25 Nm (18 lb.ft).

▶ Install a new seal.

4 . Install the engine undershield.

For additional information, refer to Air Deflector (76.11.41)

5 . Fill the engine with the recommended oil to the correct level.

Oil Pump (12.60.26)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to 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 timing drive components.

For additional information, refer to Timing Drive Components (12.65.13)

- 4 . Remove the oil pan.

For additional information, refer to Oil Pan (12.60.44)

- 5 . **NOTE:**

The bolts will remain captive.

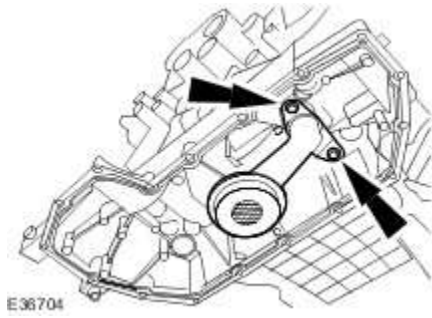
Remove the oil strainer pick-up assembly.



Remove the 2 bolts.

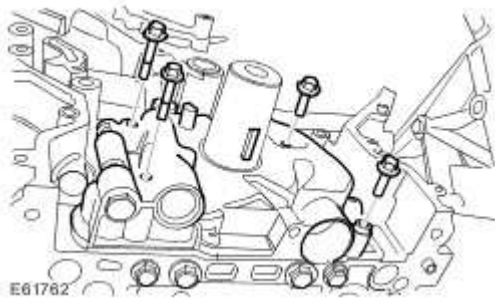


Remove and discard the O-ring seal.



6 . Remove the oil pump assembly.

- Remove the 4 bolts.
- Remove and discard the O-ring seal.



Installation

1 . Install the oil pump assembly.

- Clean the components mating faces.
- Install a new O-ring seal.
- Tighten the bolts to 12 Nm (9 lb.ft).

2 . Install the oil strainer pick-up assembly.

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

3 . Install the oil pan.

For additional information, refer to Oil Pan (12.60.44)

4 . Install the timing drive components.

For additional information, refer to Timing Drive Components (12.65.13)

5 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Timing Drive Components (12.65.13)

Special Service Tools



Camshaft setting/locking tool
303-530



Timing Setting tool
303-645



Timing chain tensioning tool
303-532

Removal

NOTE:

This procedure covers the removal and installation of the following components: timing chains, chain guides, tensioners and sprockets.

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 front cover.

For additional information, refer to Engine Front Cover (12.65.01)

- 4 . Remove the crankshaft position (CKP) sensor.

For additional information, refer to Crankshaft Position (CKP) Sensor (18.30.12)

5



- **CAUTION: Rotating the crankshaft in a counterclockwise direction may cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.**

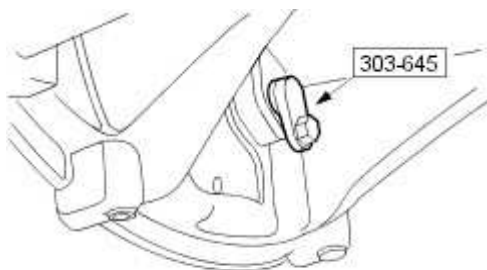


CAUTION: Rotate the crankshaft clockwise to position the engine to top dead center (TDC) number 1 cylinder.

Lock the crankshaft.

▶ Install the special tool.

▶ Install the screw.

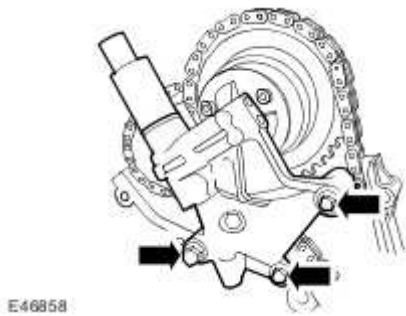


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6 . Remove the RH variable camshaft timing (VCT) control solenoid housing.

➤ Remove the 3 bolts.

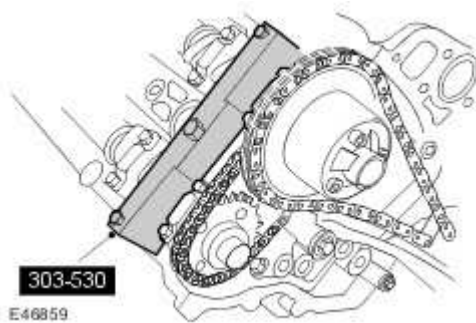
➤ Remove and discard the O-ring seals.



7 Install the special tool to the RH cylinder head.

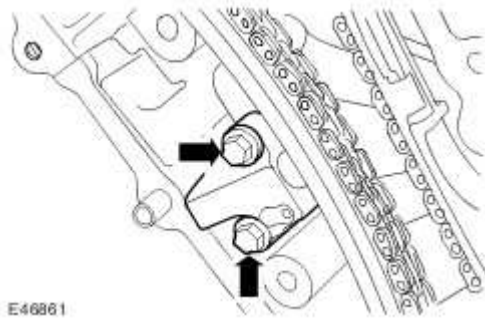
➤ Rotate the crankshaft until the flats on the camshafts are parallel with the cylinder head joint faces.

➤ Install the 3 bolts.



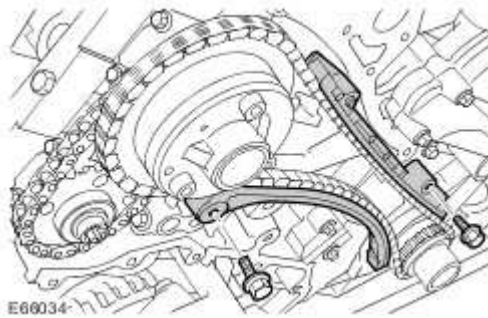
8 . Remove the RH primary timing chain tensioner.

➤ Remove the 2 bolts.

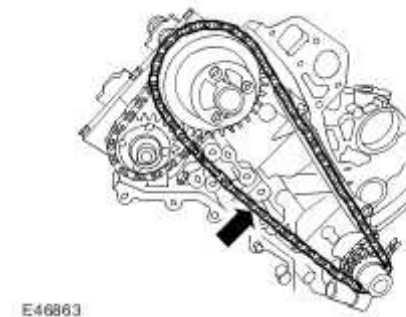


9 . Remove the RH upper and lower primary timing chain tensioner guides.

▶ Remove the 2 bolts.



10 . Remove the RH primary timing chain.

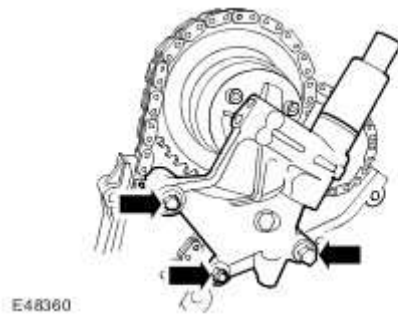


11 . Remove the LH variable camshaft timing (VCT) control solenoid housing.

▶ Remove the 2 bolts.

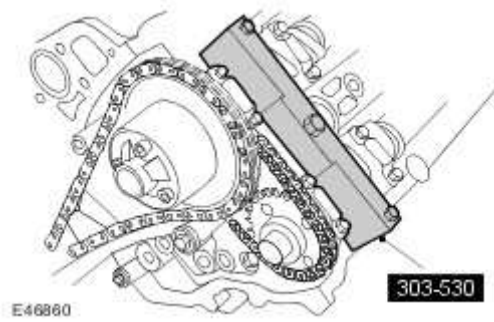
▶ Remove the nut.

▶ Remove and discard the O-ring seals.



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

▶ Install the 3 bolts.



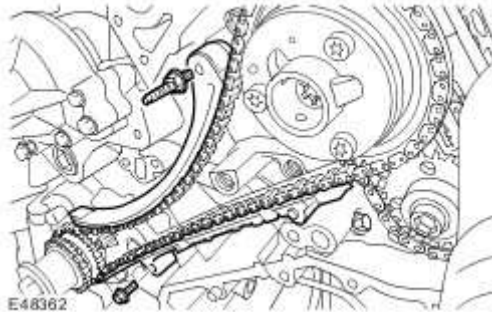
13 . Remove the LH primary timing chain tensioner.

▶ Remove the 2 bolts.

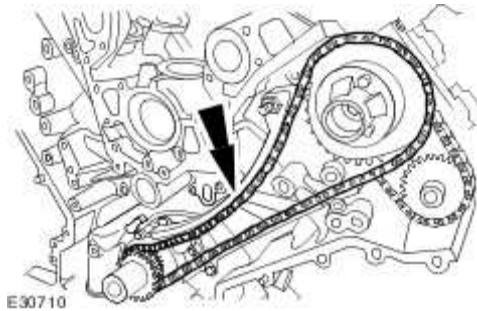


14 . Remove the LH upper and lower primary timing chain tensioner guides.

▶ Remove the 2 bolts.



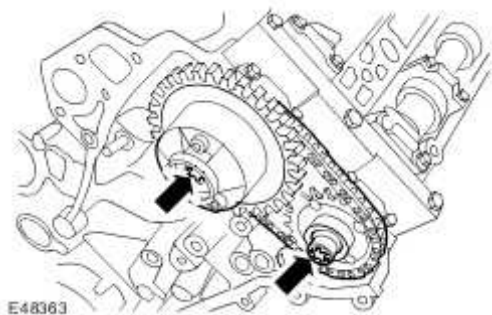
15 . Remove the LH primary timing chain.



16 .  **CAUTION: Discard the bolts.**

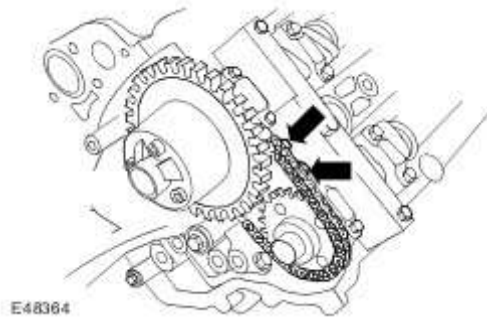
Release the LH camshaft sprocket assembly.

▶ Remove the 2 Torx bolts.



17 . Remove the LH secondary timing chain, tensioner and sprocket assembly.

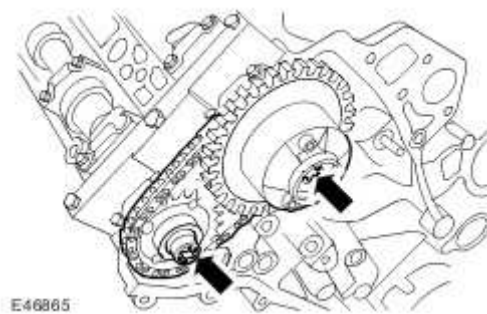
▶ Remove the 2 bolts.



18 .  **CAUTION: Discard the bolts.**

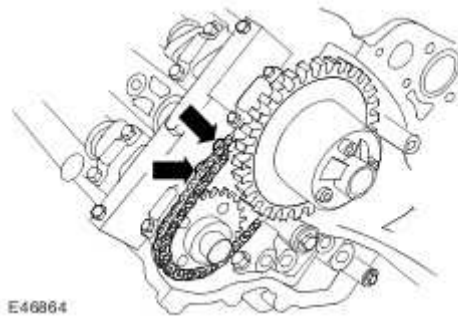
Release the RH camshaft sprocket assembly.

▶ Remove the 2 Torx bolts.



19 . Remove the RH secondary timing chain, tensioner and sprocket assembly.

▶ Remove the 2 retaining bolts.

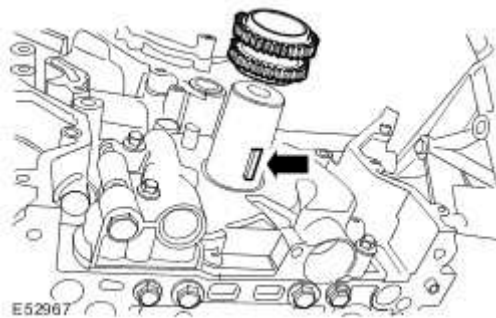


20 . NOTE:

Note the orientation of the crankshaft sprocket.

Remove the crankshaft sprocket.

▶ Remove the crankshaft sprocket key.



Installation

1 . Install the crankshaft sprocket.

▶ Clean the components.

▶ Install the crankshaft sprocket key.

2



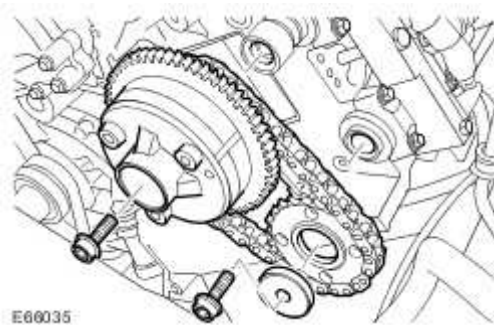
CAUTION: Make sure the secondary timing chain and camshaft sprockets are free to rotate.

NOTE:

LH illustration shown, RH is similar.

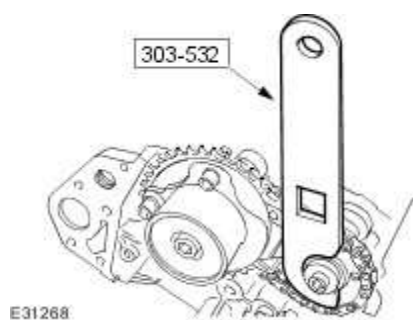
Install the LH secondary timing chain, tensioner and sprocket assembly.

- ▶ Clean the components.
- ▶ Install the Torx bolts, but do not tighten fully at this stage.



3 Install the special tool to the exhaust camshaft sprocket.

- ▶ Reposition the camshaft sprockets for the most advantageous position for use of the special tool.



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

- ▶ Tighten the bolts to 12 Nm.

5 Install the LH primary timing chain.

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

6 . Install the LH primary timing chain tensioner guides.

- ▶ Clean the components.
- ▶ Tighten the bolts to 12 Nm.

7



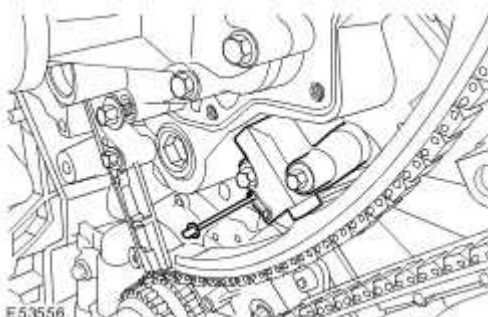
CAUTION: During timing chain tensioner compression, do not release the ratchet stem until the timing chain tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.

NOTE:

LH illustration shown, RH is similar.

Install the LH primary timing chain tensioner.

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



8



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



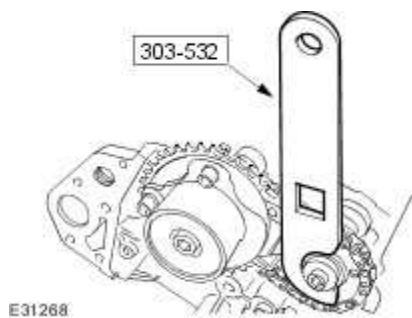
CAUTION: The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.



CAUTION: Make sure that new bolts are installed.

Install the special tool to the LH exhaust camshaft sprocket.

- ▶ Tighten the intake camshaft sprocket retaining bolt to 20 Nm + 90 deg.
- ▶ Tighten the exhaust camshaft sprocket retaining bolt to 20 Nm + 90 deg.



9 . Install the LH VCT control solenoid housing.

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

10



CAUTION: Make sure the secondary timing chain and camshaft sprockets are free to rotate.

Install the RH secondary timing chain, tensioner and sprocket assembly.

- ▶ Clean the components.
- ▶ Install the Torx bolts, but do not tighten fully at this stage.

11 . Install the RH secondary timing chain tensioner retaining bolts.

- ▶ Tighten the bolts to 12 Nm.

12 Install the RH primary timing chain.

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

13 . Install the RH primary timing chain tensioner guides.

- ▶ Tighten the bolts to 12 Nm.

14



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.

- ▶ Clean the components.
- ▶ Using 3 mm diameter metal rod, retain the chain tensioner piston.

▶ Tighten the bolts to 12 Nm.

▶ Remove the retaining rod.

15



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



CAUTION: 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.

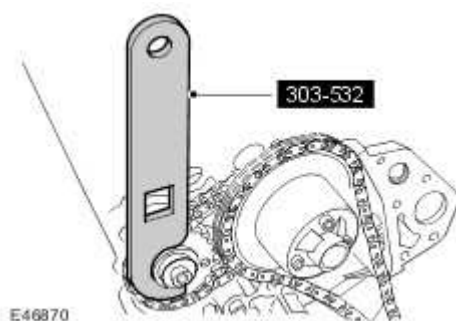


CAUTION: Make sure that new bolts are installed.

Install the special tool to the RH exhaust camshaft sprocket.

▶ Tighten the intake camshaft sprocket retaining bolt to 20 Nm + 90 deg.

▶ Tighten the exhaust camshaft sprocket retaining bolt to 20 Nm + 90 deg.



16 . Install the RH VCT control solenoid housing.

▶ Clean the components.

▶ Install the new O-ring seals.

 Tighten the new bolts to 22 Nm.

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

 Remove the 3 bolts.

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

 Remove the 3 bolts.

19 . Install the engine front cover.

For additional information, refer to Engine Front Cover (12.65.01)

20 . Remove the crankshaft locking tool.

 Remove the screw.

21 . Install the CKP sensor.

For additional information, refer to Crankshaft Position (CKP) Sensor (18.30.12)

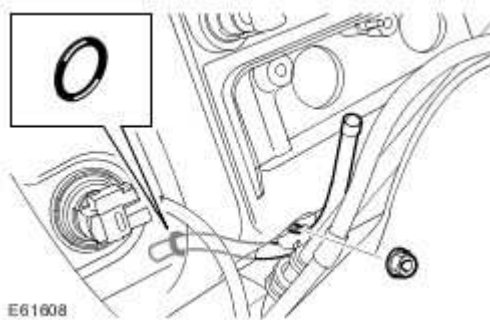
22 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

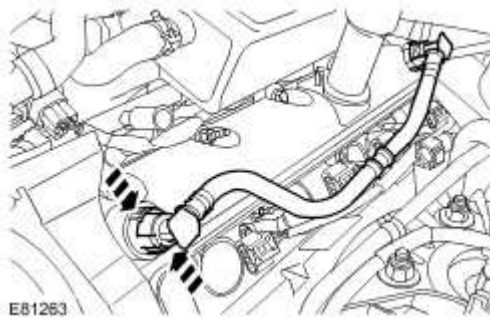
Valve Cover LH (12.29.43)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications
- 2 Remove the purge valve.
For additional information, refer to Evaporative Emission Canister Purge Valve - 4.2L SC V8 - AJV8 (17.15.30)
- 3 . Remove the ignition coil-on-plug.
For additional information, refer to Ignition Coil-On-Plug - 4.2L SC V8 - AJV8 (18.20.40)
- 4 . Remove the remaining ignition coil-on-plugs.
- 5 . Remove the oil level indicator and tube.
 - ▶ Remove the nut.
 - ▶ Remove and discard the O-ring seal.



- 6 . Remove the engine breather line.

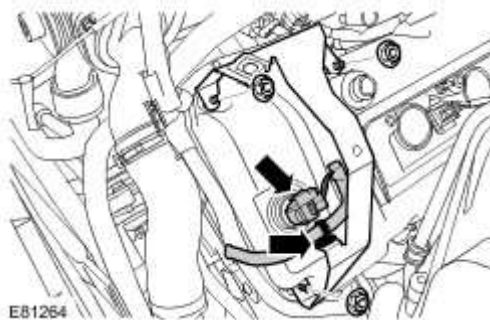


7 . Disconnect the variable camshaft timing (VCT) oil control solenoid electrical connector.

8 . Remove the engine cover bracket.

▶ Remove the 3 nuts.

▶ Release the wiring harness.

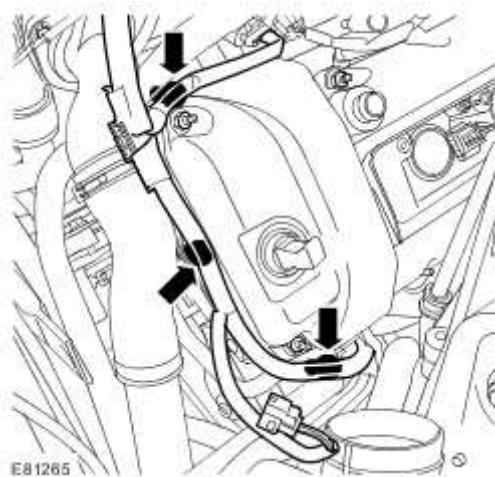


9 . Disconnect fuel line from the fuel rail.

For additional information, refer to Spring Lock Couplings

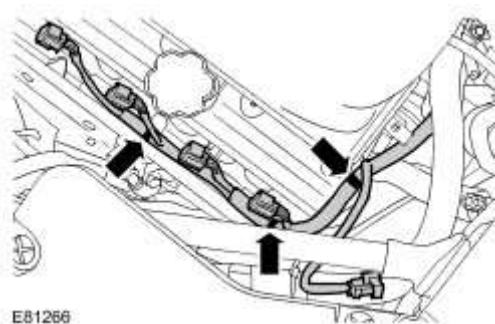
10 . Release the engine wiring harness.

▶ Release the 3 clips.



11 . Release the coil-on-plug wiring harness.

▶ Release the 3 clips.

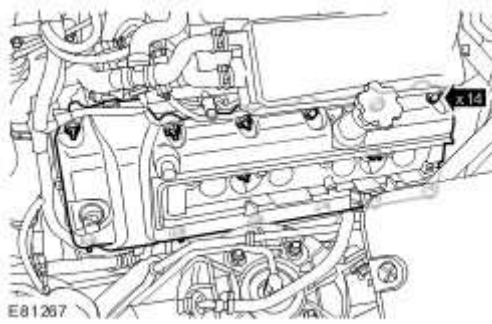


12 . **NOTE:**

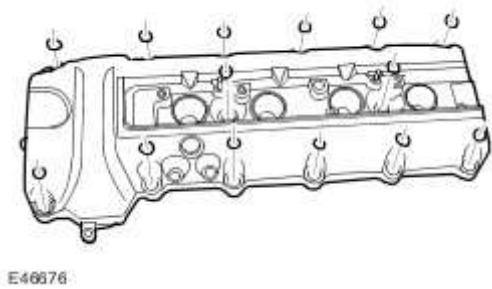
Note the fitted position of the retaining bolts prior to removal.

Remove the valve cover.

▶ Remove the 14 valve cover retaining bolts.



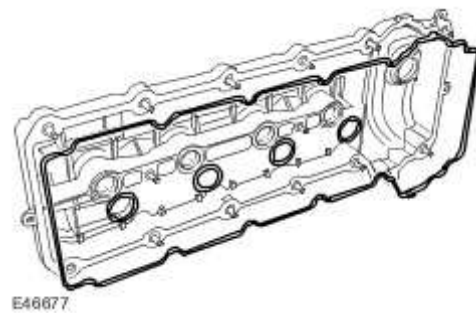
13 . Remove and discard the valve cover retaining bolt O-ring seals.



14 . Remove and discard the valve cover gasket.

▶ Carefully remove the sealant.

15 . Remove and discard the valve cover plug aperture seals.



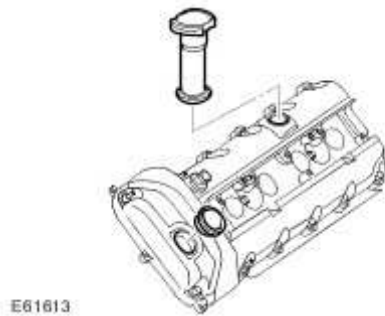
16 . Remove and discard the VCToil control solenoid seal.

17 . NOTE:

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

Remove the oil filler pipe.

▶ Remove and discard the O-ring seal.



Installation

1 . Install the oil filler pipe.

▶ Install a new O-ring seal.

2 . Install the new VCT oil control solenoid seal.

3 . Install the new valve cover plug aperture seals.

4 . Install a new valve cover gasket.

▶ Clean the components.

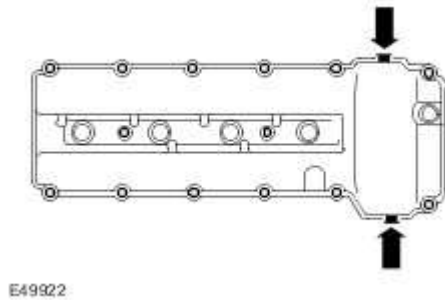
5 NOTE:

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.

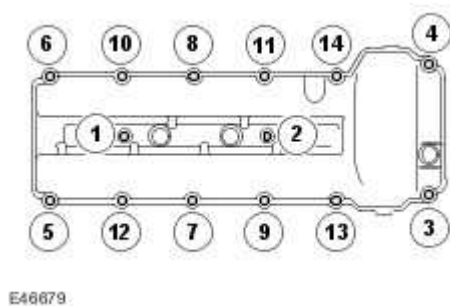
Install the valve cover.

- ▶ Clean the component mating faces.



6 . Install valve cover retaining bolts to their position previously noted.

- ▶ Install new valve cover bolt O-ring seals.
- ▶ Tighten the bolts to 12 Nm (9 lb.ft).
- ▶ Complete the tightening sequence as illustrated.



7 . Attach the coil-on-plug wiring harness.

- ▶ Secure with the clips.

8 . Attach the engine wiring harness.

 Secure with the clips.

9 . Install the engine cover bracket.

 Tighten the nuts to 6 Nm (4 lb.ft).

 Attach the wiring harness.

10 . Connect the VCT oil control solenoid electrical connector.

11 . Install the engine breather line.

12 . Install the oil level indicator and tube.

 Install a new O-ring seal.

 Tighten the nut to 6 Nm (4 lb.ft).

13 . Connect the fuel line.

For additional information, refer to Spring Lock Couplings

14 . Install the ignition coil-on-plug.

For additional information, refer to Ignition Coil-On-Plug - 4.2L SC V8 - AJV8 (18.20.40)

15 . Install the remaining ignition coil-on-plugs.

16 Install the purge valve.

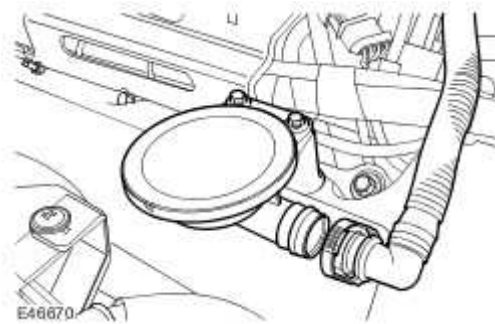
. For additional information, refer to Evaporative Emission Canister Purge Valve - 4.2L SC V8 - AJV8 (17.15.30)

- 17 . Connect the battery ground cable and install the cover.
For additional information, refer to Specifications

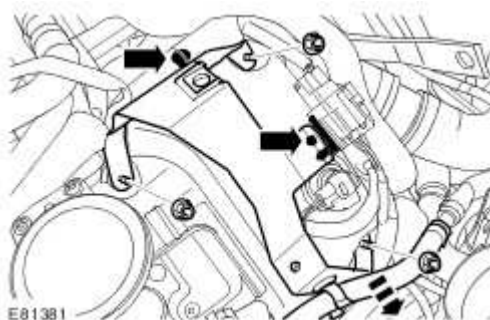
Valve Cover RH (12.29.44)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications
- 2 . Remove the ignition coil-on-plug.
For additional information, refer to Ignition Coil-On-Plug - 4.2L SC V8 - AJV8 (18.20.40)
- 3 . Remove the remaining ignition coil-on-plugs.
- 4 . Disconnect the positive crankcase ventilation (PCV) line.

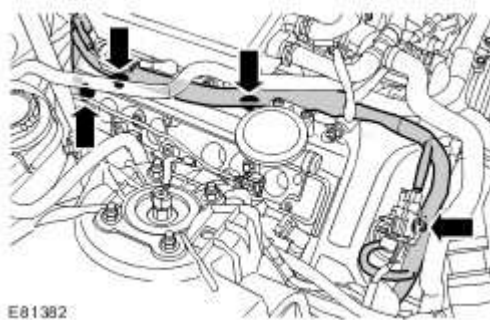


- 5 . Remove the engine cover bracket.
 - Remove the 3 nuts.
 - Release the 2 wiring harness clips.
 - Release the hose.



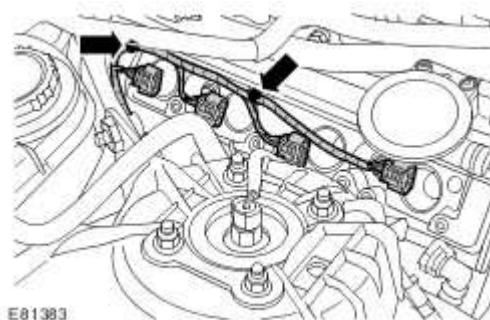
6 . Release the engine wiring harness.

▶ Release the 4 clips.

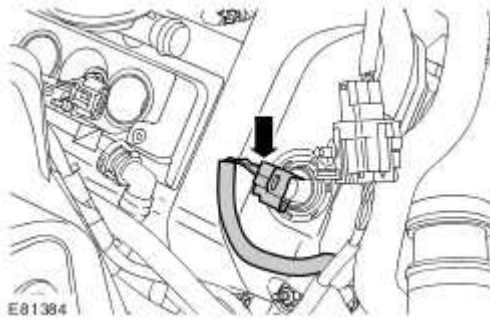


7 . Release the coil-on-plug wiring harness.

▶ Release the 2 clips.



8 . Disconnect the variable camshaft timing (VCT) oil control solenoid electrical connector.

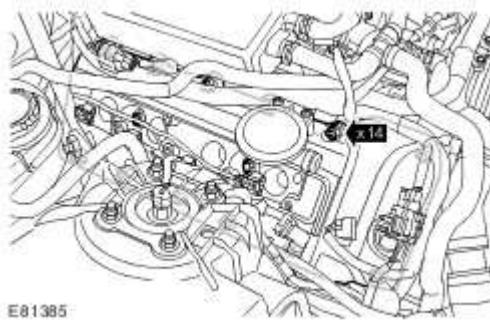


9 . NOTE:

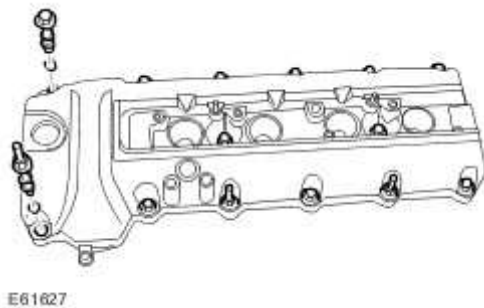
Note the fitted position of the retaining bolts prior to removal.

Remove the valve cover.

➤ Remove the 14 valve cover retaining bolts.



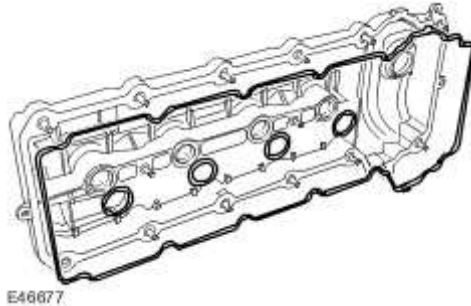
10 . Remove and discard the valve cover retaining bolt O-ring seals.



11 . Remove and discard the valve cover gasket.

▶ Carefully remove the sealant.

12 . Remove and discard the valve cover plug aperture seals.



13 . Remove and discard the VCToil control solenoid seal.

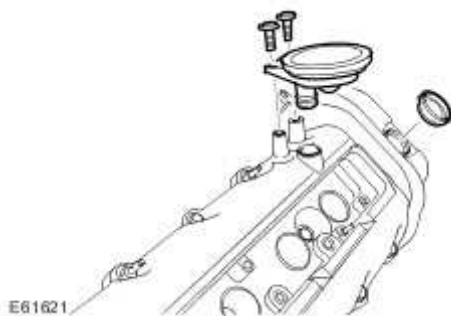
14 . **NOTE:**

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

Remove the PCV valve.

▶ Remove the 2 Torx screws.

▶ Remove and discard the O-ring seal.



Installation

1 . Install the PCV valve.

- ▶ Clean the component mating faces.
- ▶ Install a new O-ring seal.
- ▶ Tighten the Torx screws.

2 . Install the new VCT oil control solenoid seal.

3 . Install new valve cover plug aperture gaskets.

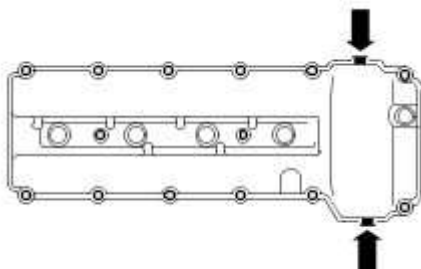
4 . Install a new valve cover gasket.

5 **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.

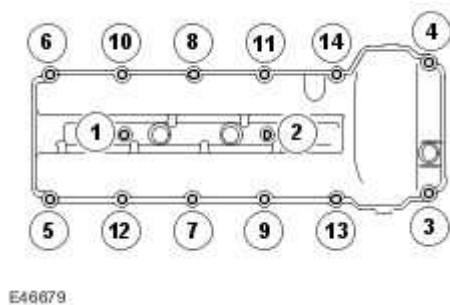
- ▶ Clean the component mating faces.



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6 . Install valve cover retaining bolts to their position previously noted.

- ▶ Install new valve cover bolt O-ring seals.
- ▶ Tighten the bolts to 12 Nm (9 lb.ft).
- ▶ Complete the tightening sequence as illustrated.



7 . Connect the VCT oil control solenoid electrical connector.

8 . Attach the coil-on-plug wiring harness.

- ▶ Secure with the clips.

9 . Attach the engine wiring harness.

- ▶ Secure with the clips.

10 . Install the engine cover bracket.

- ▶ Tighten the nuts to 6 Nm (4 lb.ft).
- ▶ Secure the wiring harness.
- ▶ Secure the hose.

11 . Connect the PCV line.

12 . Install the ignition coil-on-plug.

For additional information, refer to Ignition Coil-On-Plug - 4.2L SC V8 - AJV8 (18.20.40)

13 . Install the remaining ignition coil-on-plugs.

14 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Oil Filter Housing

Special Service Tools



Wrench, Oil filter
303-752

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 Air Deflector (76.11.41)

- 4 . Disconnect the engine oil temperature sensor electrical connector.



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



6 . NOTE:

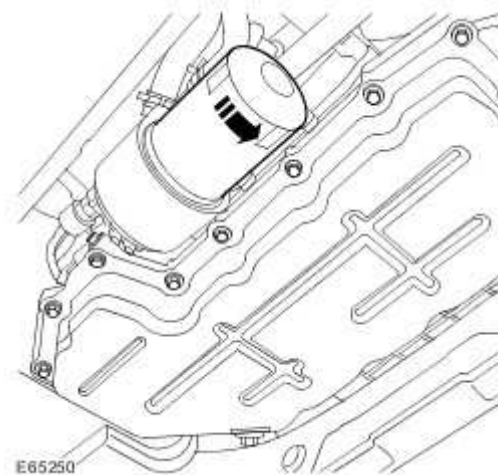
Some oil spillage is inevitable during this operation.

NOTE:

Clean the components general area prior to dismantling.

Remove the oil filter.

► Position a container to collect the fluid.



7

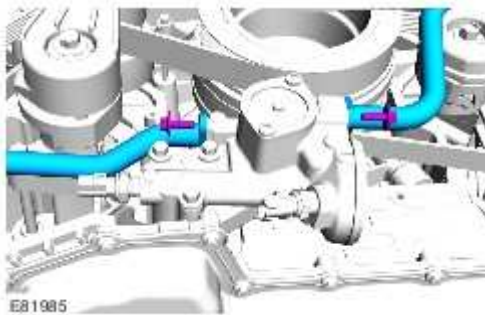


CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the 2 engine oil cooler lines.

▶ Remove the 2 bolts.

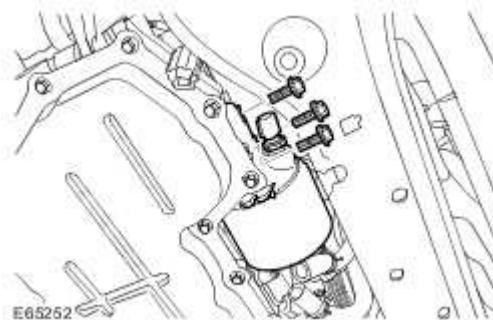
▶ Remove and discard the 2 O-ring seals.



8 . Remove the oil filter housing.

▶ Remove the 3 bolts.

▶ Remove and discard the O-ring seal.

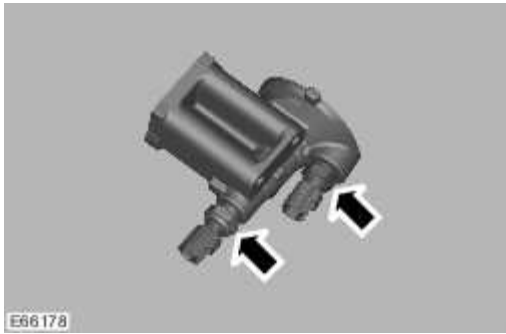


9 . **NOTE:**

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

Remove the engine oil temperature sensor.

10 . Remove the EOP sensor.



Installation

1 . Install the EOP sensor.

- ▶ Clean the components.
- ▶ Apply sealant of the correct specification to the sensor thread.
- ▶ Tighten the sensor to 15 Nm (11 lb.ft).

2 . Install the engine oil temperature sensor.

- ▶ Clean the components.
- ▶ Apply sealant of the correct specification to the sensor thread.
- ▶ Tighten the sensor to 15 Nm (11 lb.ft).

3 . Install the oil filter housing.

- ▶ Clean the component mating faces.
- ▶ Install a new O-ring seal.
- ▶ Tighten the bolts to 20 Nm (15 lb.ft).

4 . Connect the engine oil cooler lines.

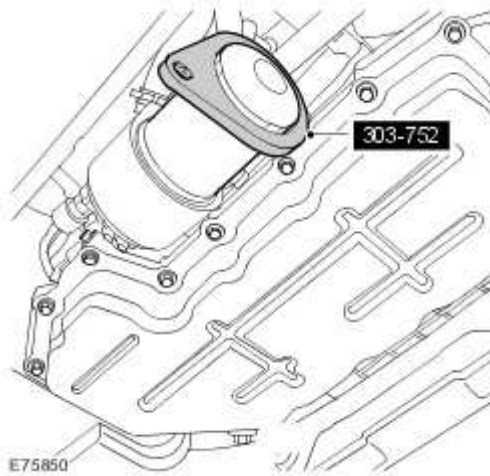
- ▶ Clean the component mating faces.

▶ Install new O-ring seals.

▶ Tighten the bolts to 7 Nm (5 lb.ft).

5 Using the special tool, install the oil filter.

▶ Lubricate the oil filter seal with clean engine oil and tighten to 18 Nm (13 lb.ft).



6 . Connect the EOP sensor electrical connector.

7 . Connect the engine oil temperature sensor electrical connector.

8 . Install the engine undershield.

For additional information, refer to Air Deflector (76.11.41)

9 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

10 . Check and top-up the engine oil.

Oil Level Indicator and Tube

Removal

1 . Remove the cover and disconnect the battery ground cable.

2 . Remove the engine cover.

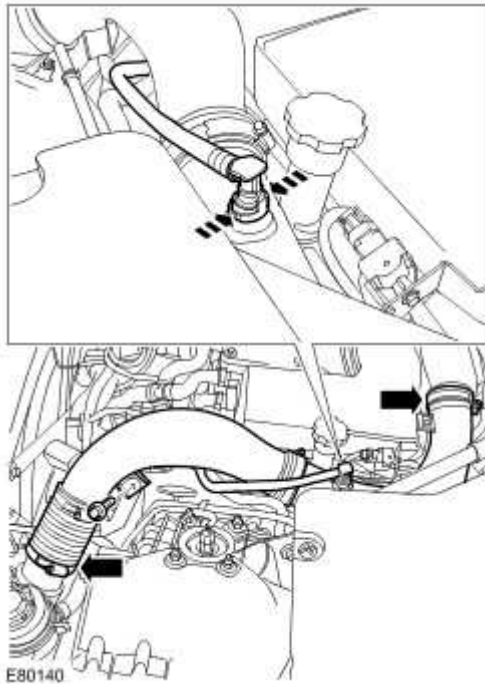
For additional information, refer to Engine Cover (76.11.35)

3 . Remove the LH intake air resonator.

➤ Remove the bolt.

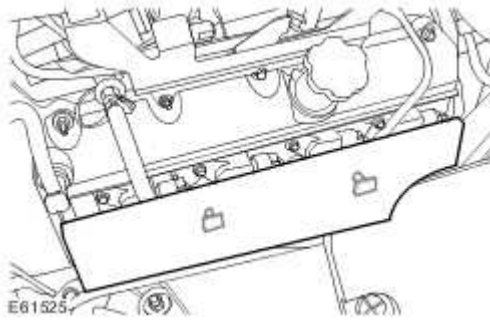
➤ Release the 2 clips.

➤ Disconnect the engine breather line.



4 . Remove the LH ignition coil-on-plug cover.

➤ Release the 2 clips.



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

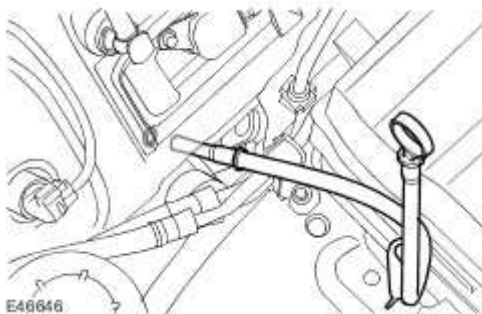
Raise and support the vehicle.

- 6 . Turn the steering on to full lock for access.

- 7 . Remove the oil level indicator and tube.

➤ Remove the nut.

➤ Discard the O-ring seal.



Installation

- 1 . With assistance, install the oil level indicator and tube.

- ▶ Clean the components.
- ▶ Install a new O-ring seal.
- ▶ Lubricate the O-ring seal with clean engine oil.
- ▶ Tighten the nut to 6 Nm (4 lb.ft).

2 . Install the LH ignition coil-on-plug cover.

3 . Install the intake air resonator.

- ▶ Secure with the clips.
- ▶ Tighten the bolt to 10 Nm (7 lb.ft).
- ▶ Connect the engine breather line.

4 . Install the engine cover.

For additional information, refer to Engine Cover (76.11.35)

5 . Connect the battery ground cable and install the cover.

Oil Cooler (12.60.68)

Removal

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

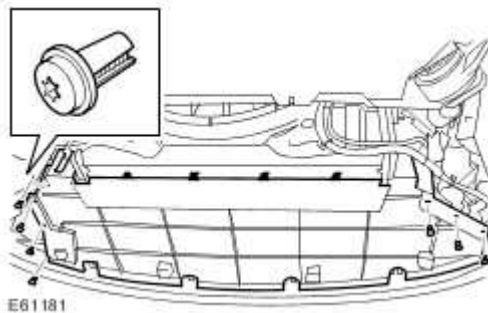
Raise and support the vehicle.

- 2 . Remove the radiator splash shield.
For additional information, refer to Radiator Splash Shield (76.22.90)

- 3 . Remove the front bumper air ducting.

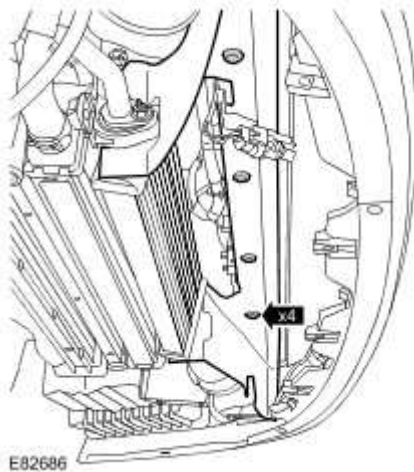
▶ Remove the 7 clips.

▶ Release the 4 clips.



- 4 . Remove the air deflector.

▶ Remove the 4 retainers.



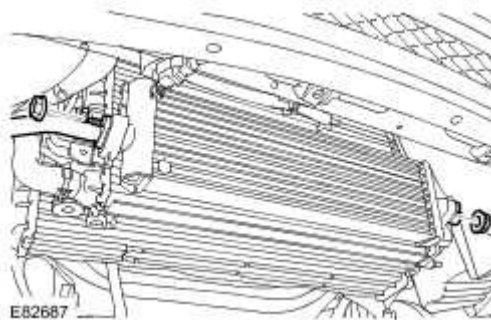
5



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 2 oil cooler lines.

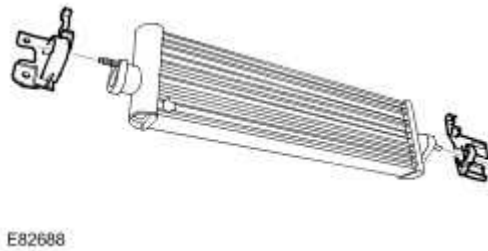
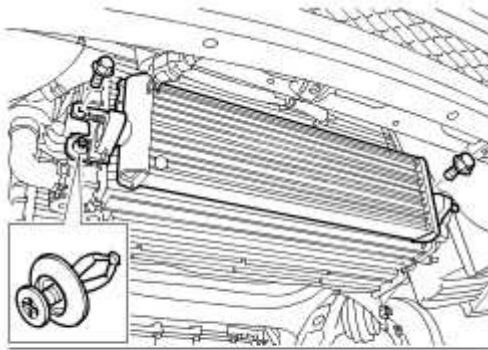
- Position a container to collect the engine oil.
- Remove the 2 nuts.
- Remove and discard the 2 O-ring seals.



6 . Remove the oil cooler.

- Remove the 2 bolts.

- Remove the retainer.
- Remove the 2 support brackets.



Installation

1 . Install the oil cooler.

- Install the support brackets.
- Tighten the bolts to 5 Nm (4 lb.ft).
- Install the retainer.

2 . Connect the oil cooler lines.

- Clean the components.
- Install new O-ring seals.
- Tighten the nuts to 7 Nm (5 lb.ft).

3 . Install the air deflector.

 Install the retainers.

4 . Install the front bumper air ducting.

 Secure with the clips.

5 . Install the radiator splash shield.

For additional information, refer to Radiator Splash Shield (76.22.90)

6 . Check and top-up the engine oil.

Twin Oil Coolers

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 radiator splash shield.
For additional information, refer to

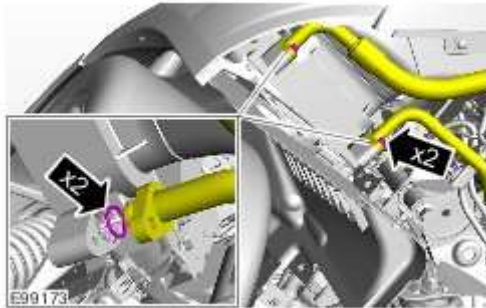
- 3  **CAUTION: Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.**

NOTE:

Right-hand shown, left-hand similar.

Disconnect the 2 oil cooler lines.

-  Position a container to collect the engine oil.
-  Remove the 2 nuts.
-  Remove and discard the 2 O-ring seals.
-  Remove the 2 brackets.

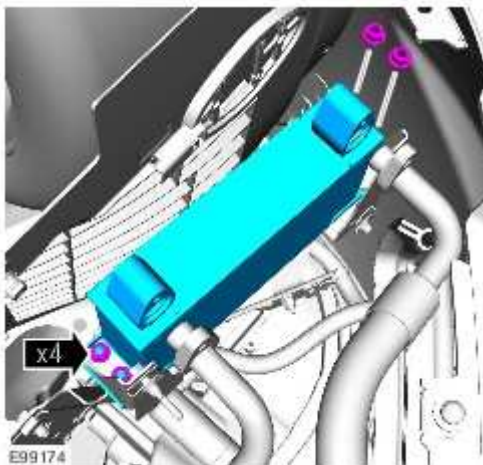


4 . NOTE:

Right-hand shown, left-hand similar.

Remove the oil cooler.

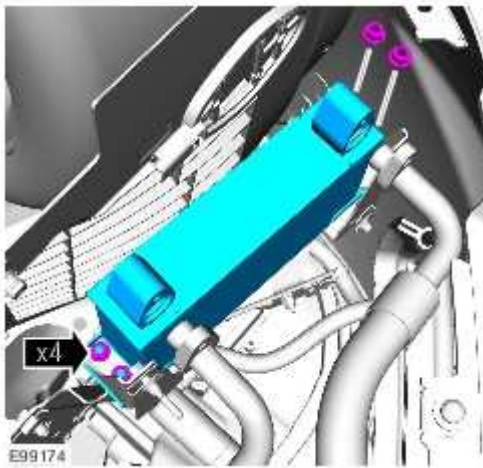
- Remove the 4 securing nuts.



Installation

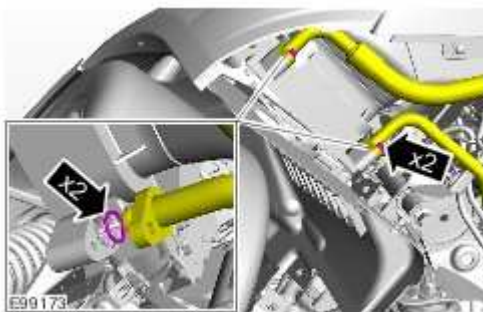
1 . Install the oil cooler.

- Install the support brackets.
- Install the retainer.
- Tighten to 5 Nm.



2 . Connect the oil cooler lines.

- Clean the components.
- Install new O-ring seals.
- Tighten to 7 Nm.



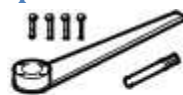
3 . Install the radiator splash shield.
For additional information, refer to

4 . Check and top-up the engine oil.

Disassembly

Engine

Special Service Tools



303-191

Crankshaft locking, main tool

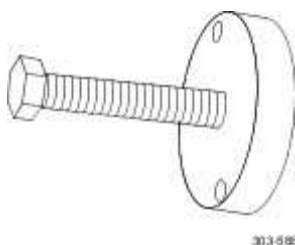
303-191



303-191-02

Adapter

303-191-02



303-588

Crankshaft pulley/damper remover

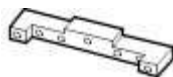
303-588



303-645

Crankshaft setting, main tool

303-645



303-530

Camshaft setting

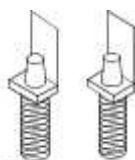
303-530



303D055

Crankshaft damper holding tool

303-D055



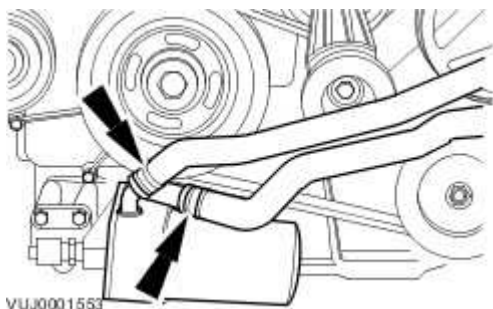
303535

Cylinder Bore Protectors

303-535

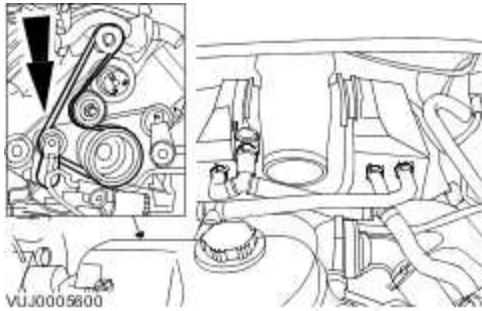
Disassembly

1 . Disconnect the oil cooler hoses.



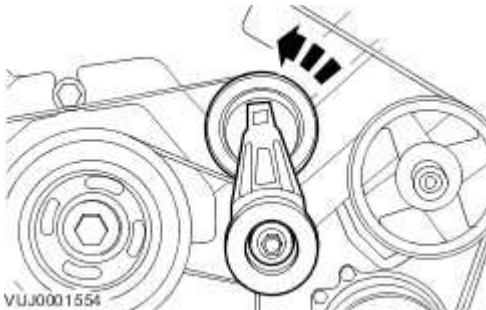
2 . Detach the supercharger belt.

- Use a 1/2 inch square drive bar to rotate the supercharger belt tensioner.
- Detach the supercharger belt.



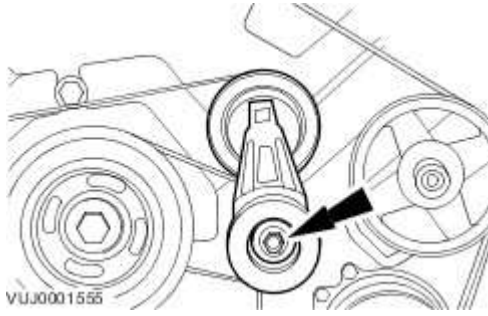
3 . Release the accessory drive belt tension.

- Use a 3/8 inch square drive bar to rotate the drive belt tensioner.
- Detach the accessory drive belt.

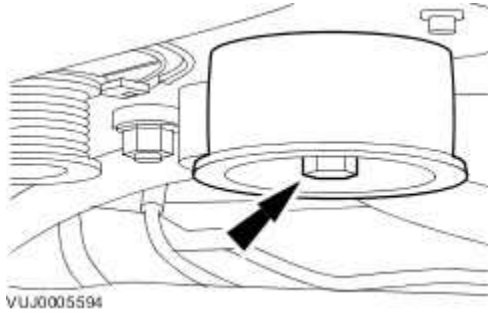


4 . Remove the accessory drive belt tensioner.

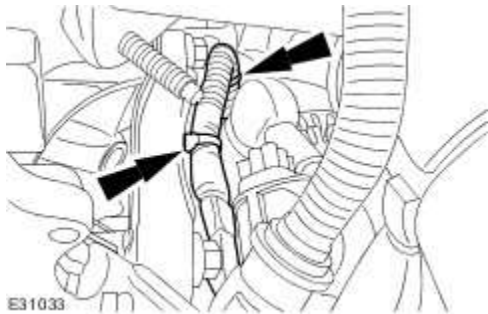
- Remove the accessory drive belt.



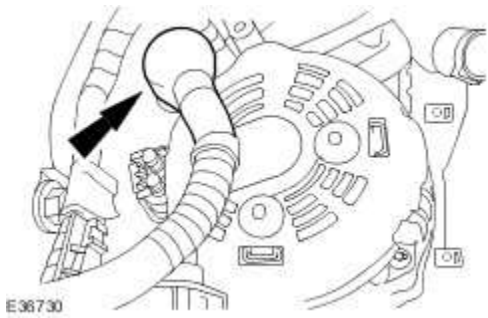
5 . Remove the accessory drive belt idler pulley.



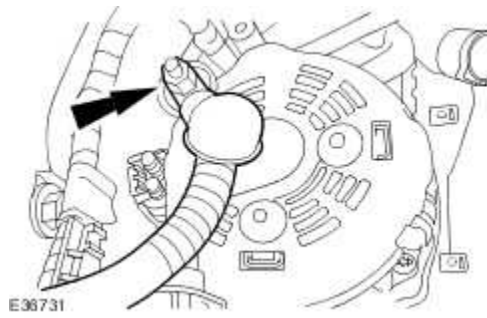
6 . Detach the wiring harness.



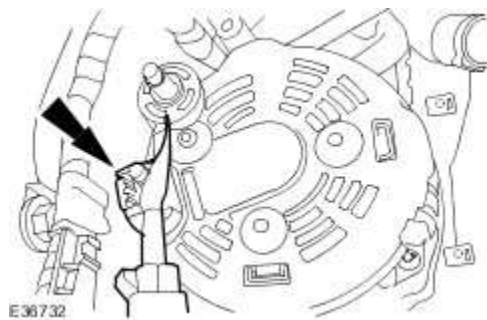
7 . Detach the generator battery positive cable protective cover.



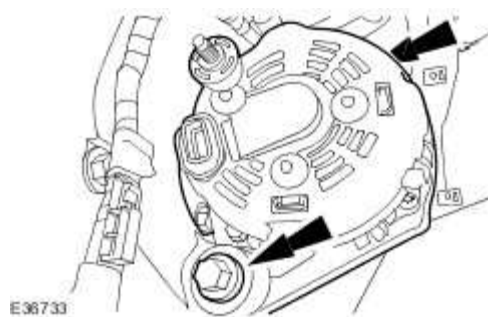
8 . Disconnect the generator battery positive cable.



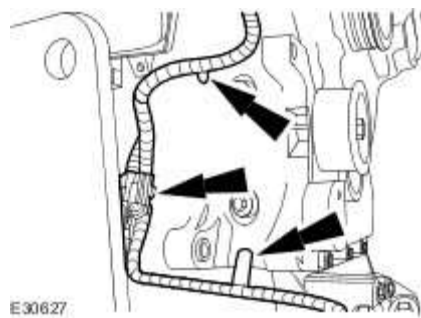
9 . Disconnect the generator electrical connector.



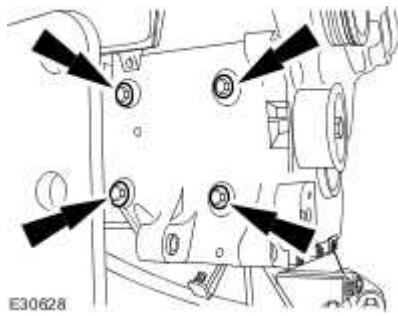
10 . Remove the generator.



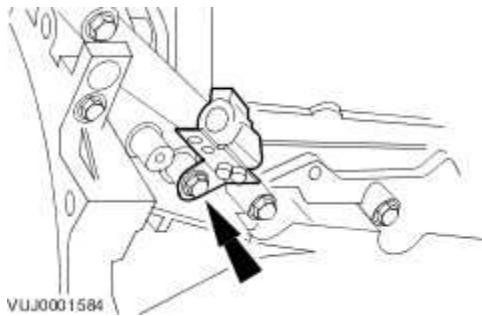
11 . Detach the engine wiring harness.



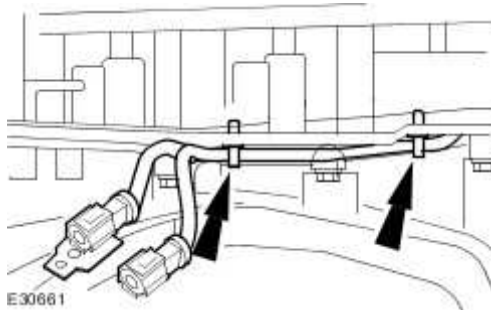
12 . Remove the generator mounting bracket.



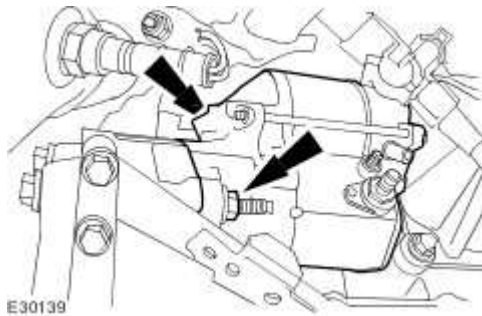
13 . Detach the right-hand oxygen sensor retaining bracket.



14 . Detach the engine wiring harness.



15 . Remove the starter motor.

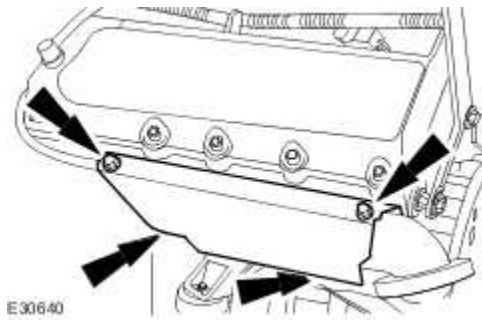


16 . Remove the oil level indicator and tube.

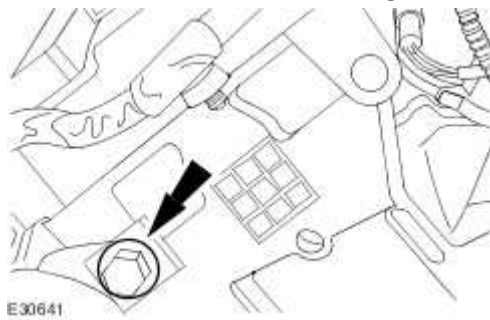
- Remove and discard the O-ring seal.



17 . Remove the heat shield.

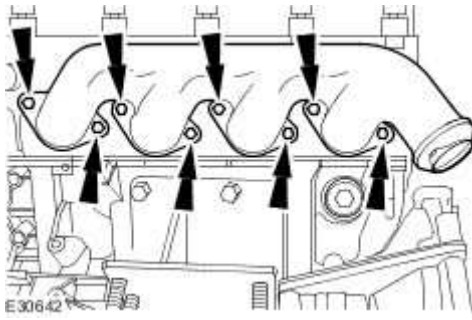


18 . Remove the heat shield retaining bolt.

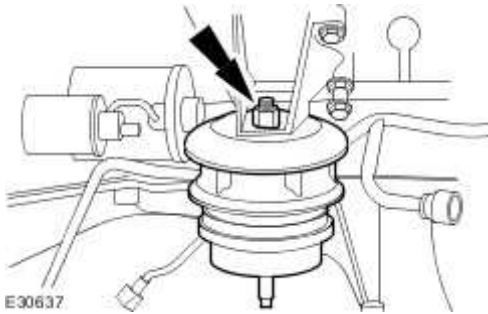


19 . Remove the left-hand exhaust manifold.

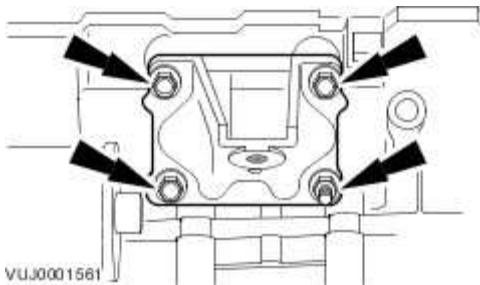
- Remove and discard the gasket.



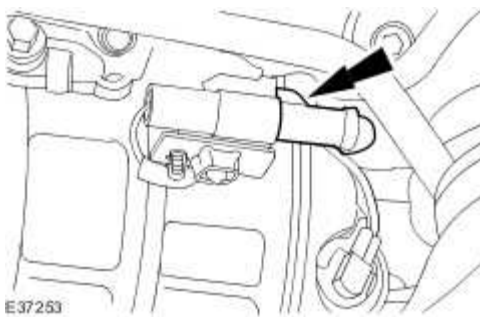
20 . Remove the left-hand engine mount.



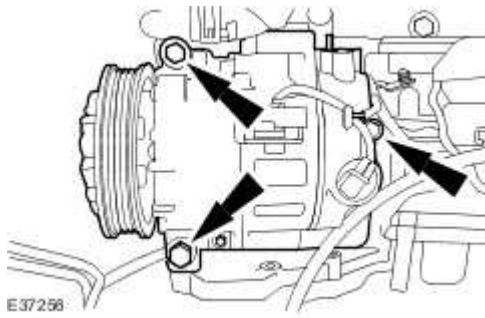
21 . Remove the left-hand engine mounting bracket.



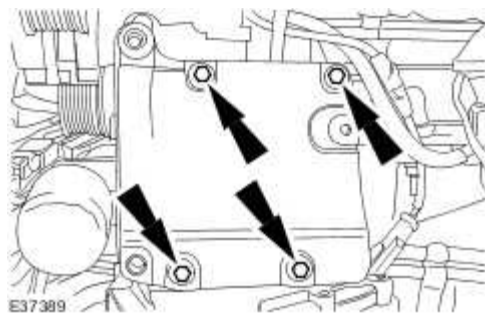
22 . Disconnect the A/C compressor electrical connector.



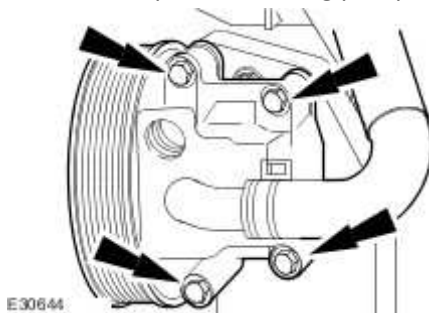
23 . Remove the A/C compressor.



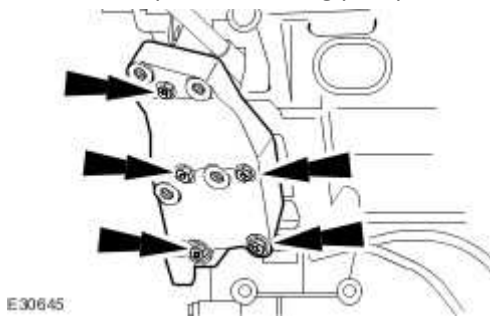
24 . Remove the air conditioning compressor mounting bracket.



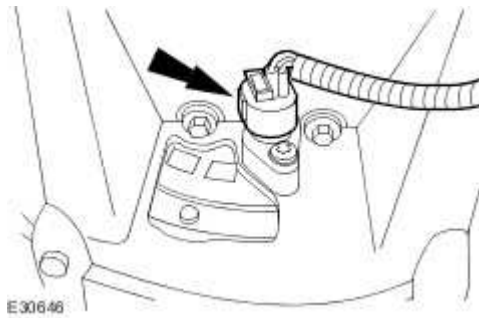
25 . Remove the power steering pump.



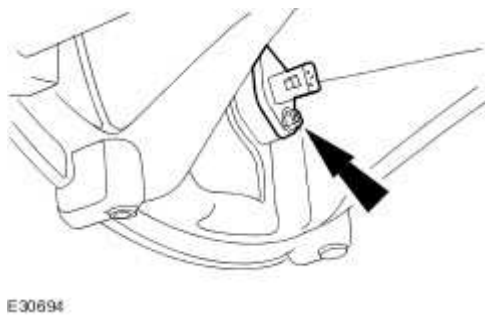
26 . Remove the power steering pump mounting bracket.



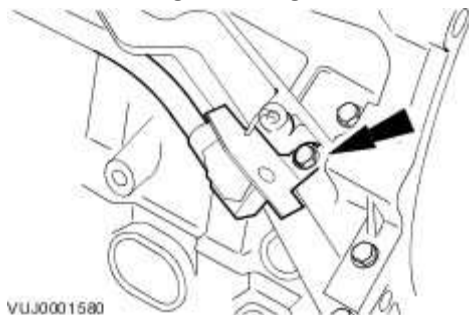
27 . Disconnect the crankshaft position sensor electrical connector.



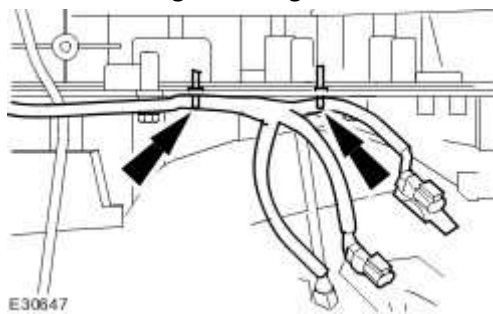
28 . Remove the crankshaft position sensor.



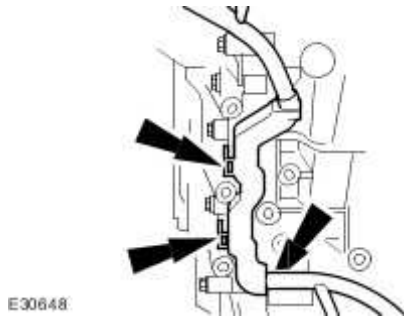
29 . Detach the engine wiring harness.



30 . Detach the engine wiring harness.

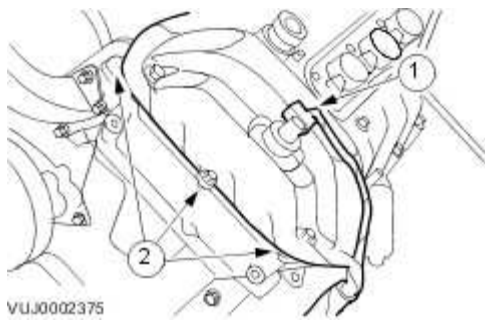


31 . Detach the engine wiring harness.

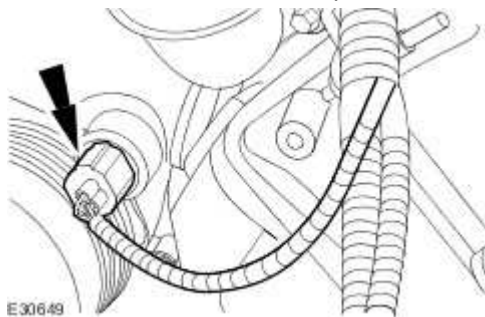


32 . Detach the engine wiring harness.

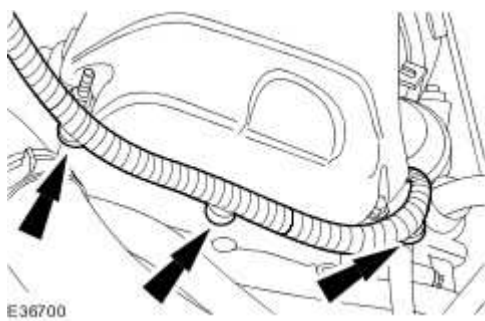
1. Disconnect the variable valve timing (VVT) solenoid electrical connector.
2. Detach the engine wiring harness.



33 . Disconnect the coolant temperature sensor electrical connector.

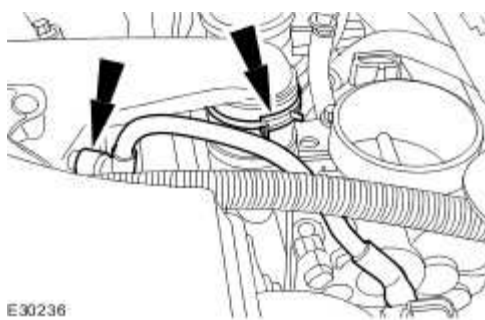


34 . Detach the engine wiring harness.



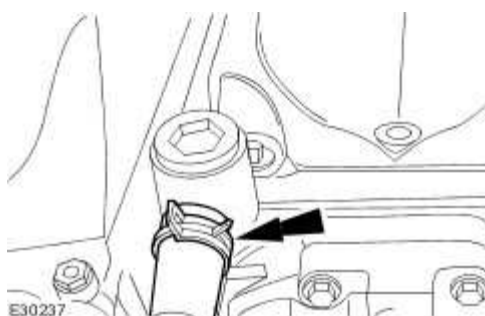
35 . Detach the hoses.

- Reposition the hose retaining clip.



36 . Detach the supercharger outlet pipe coolant hose.

- Cap the coolant ports.

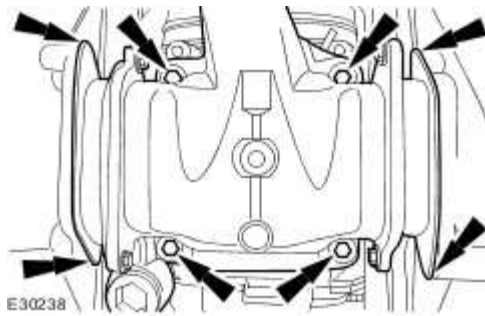


37 .



CAUTION: Make sure no foreign matter enters the supercharger.

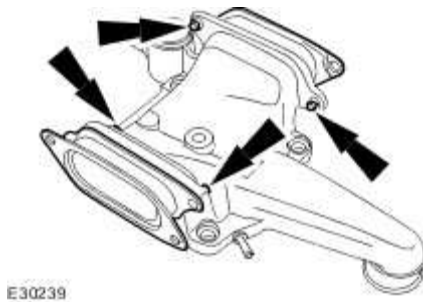
Remove the supercharger outlet pipe



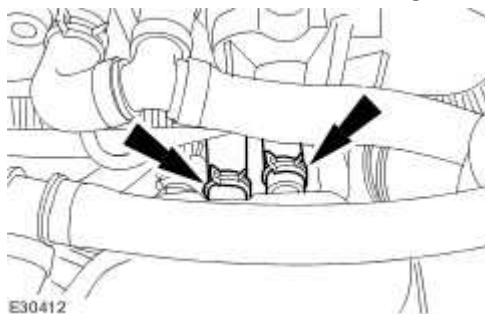
38 . Remove and discard the supercharger outlet pipe gasket.

39 . Remove and discard the supercharger outlet pipe retaining bolt seals.

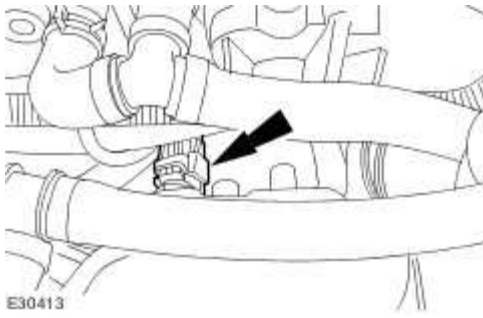
40 . Remove and discard the supercharger outlet pipe to charge air coolers ducts.



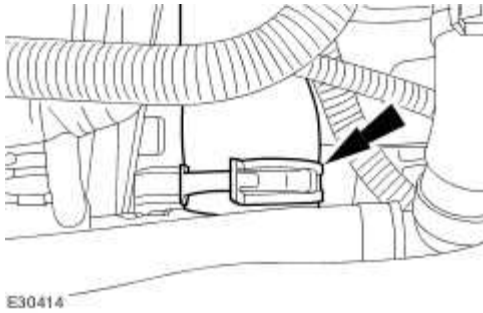
41 . Disconnect the thermostat housing hoses



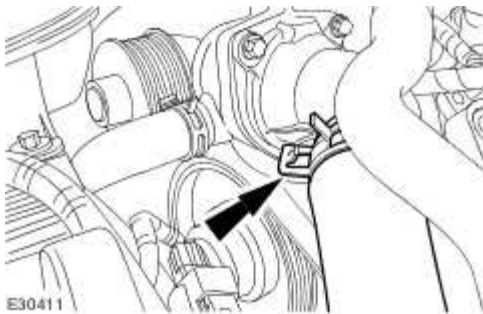
42 . Disconnect the coolant temperature sensor electrical connector.



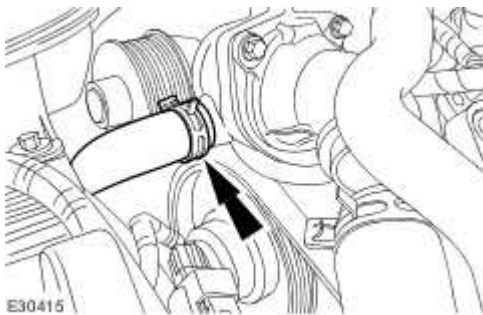
43 . Reposition the thermostat housing hose retaining clip.



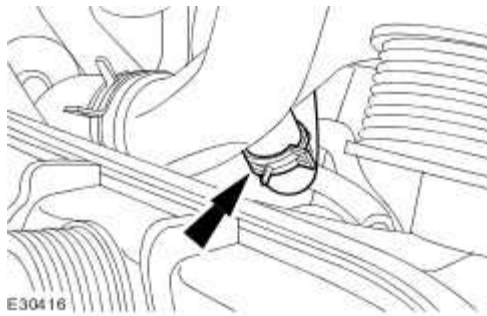
44 . Disconnect the hose.



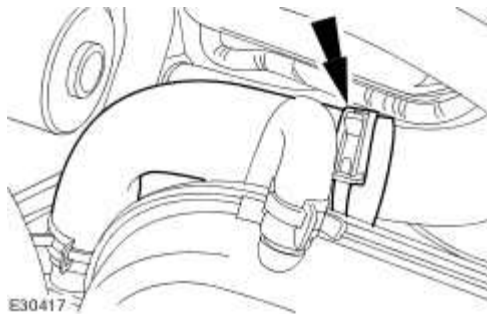
45 . Disconnect the hose.



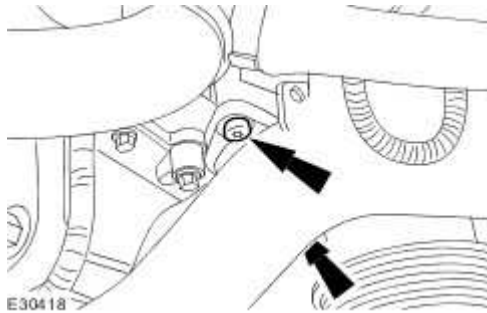
46 . Disconnect the hose.



47 . Disconnect the hose.

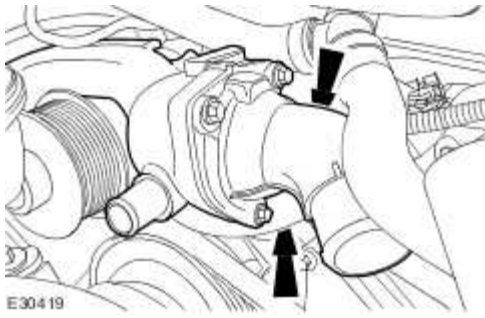


48 . Remove the thermostat housing retaining bolts.

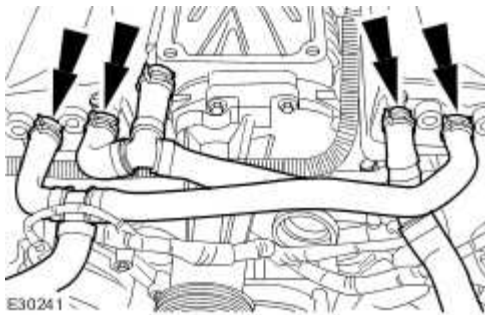


49 . Remove the thermostat housing.

- Remove and discard the thermostat housing O-ring seals.



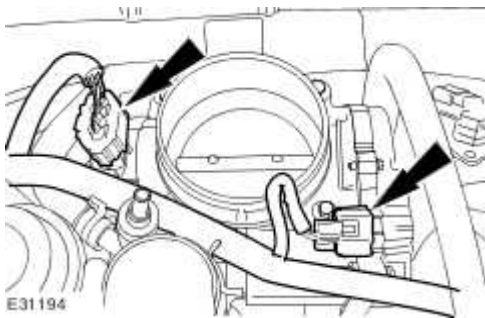
50 . Disconnect the charge air cooler coolant pipes.



51 . Disconnect the intake air temperature (IAT) sensor electrical connector.



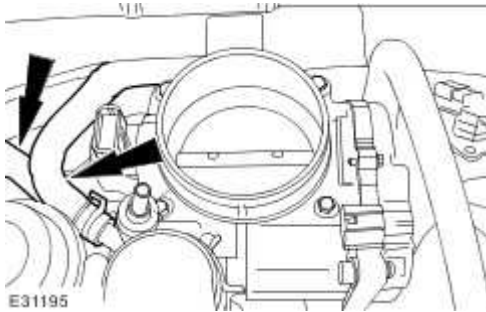
52 . Disconnect the electrical connectors.



53 . **NOTE:**

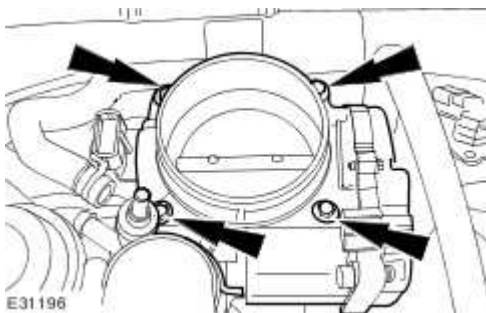
Cap the exposed ports.

Detach the coolant hose from the throttle body.

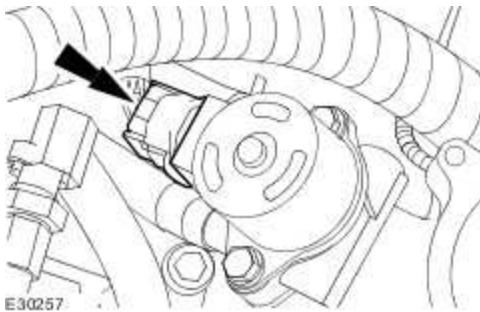


54 . Remove the throttle body.

- Remove and discard the gasket.



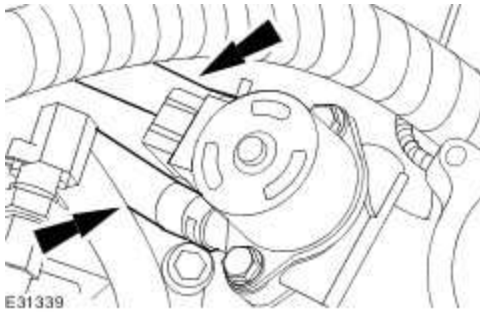
55 . Disconnect the exhaust gas recirculation (EGR) valve electrical connector.



56 . **NOTE:**

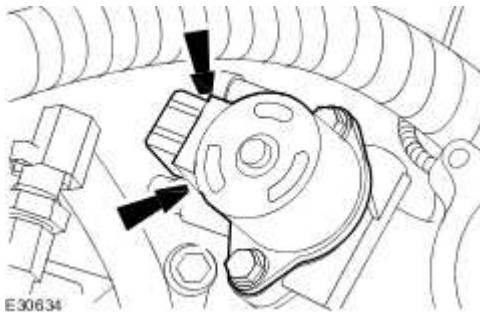
Cap the exposed ports.

Disconnect the coolant hoses.

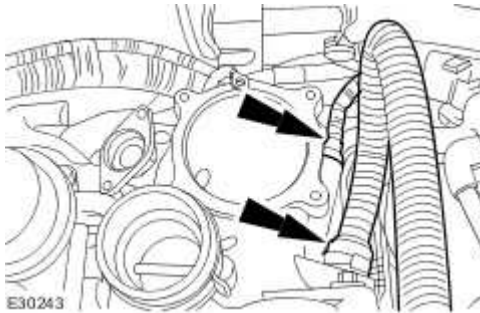


57 . Remove the EGR valve and the exhaust manifold to EGR valve tube.

- Remove the retaining bolts.
- Remove and discard the exhaust manifold to EGR valve tube gasket.
- Remove and discard the EGR valve to air intake elbow gasket.



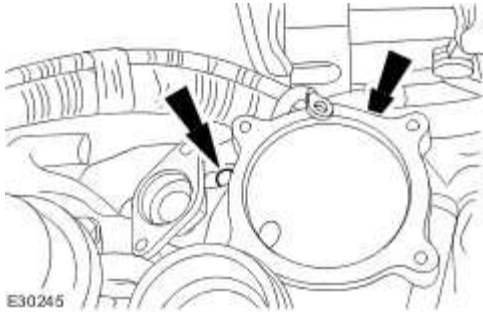
58 . Disconnect the air intake elbow pipes.



59 . **NOTE:**

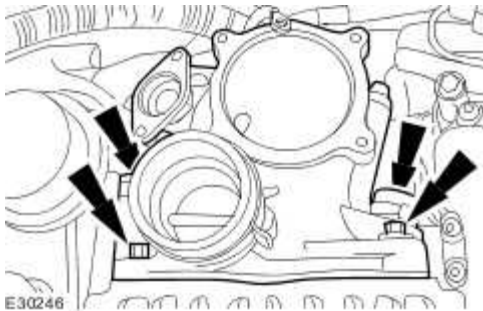
Make sure correct location of the ground strap is noted.

Remove the air intake elbow retaining bracket lower retaining bolts.



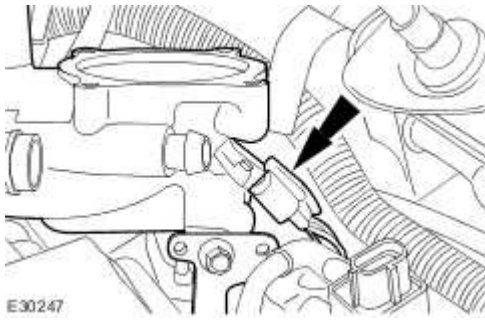
60 . Detach the air intake elbow.

- Remove and discard the gasket.
- Remove and discard the retaining bolt seals.



61 . Remove the air intake elbow.

- Disconnect the manifold absolute pressure (MAP) sensor.



62 . Remove the supercharger.



63 .  **CAUTION:** Make sure no foreign matter enters the cylinder head ports.

NOTE:

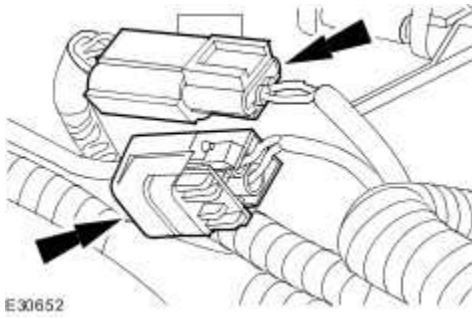
Right-hand shown, left-hand similar.

Remove the charge air coolers.

- Remove and discard the charge air cooler gasket.



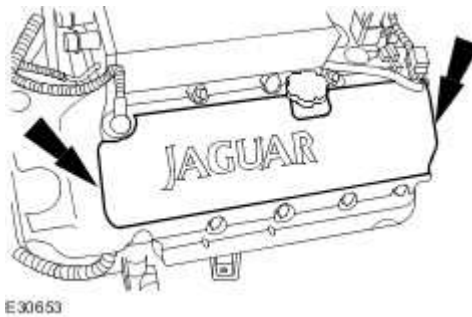
64 . Disconnect the knock sensor electrical connectors.



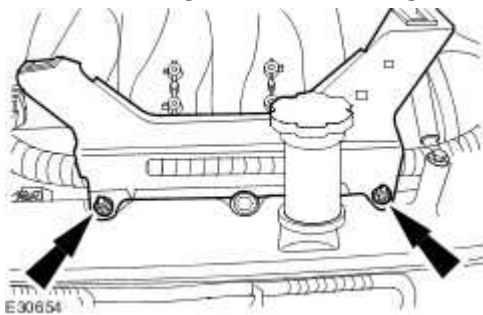
65 . **NOTE:**

Left-hand shown, right-hand similar.

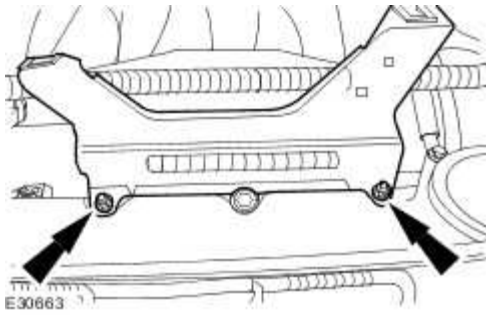
Remove the ignition coil cover.



66 . Remove the engine cover retaining bracket.



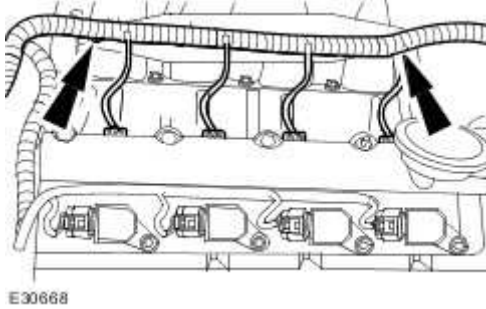
67 . Remove the engine cover retaining bracket.



68 . NOTE:

Right-hand shown, left-hand similar.

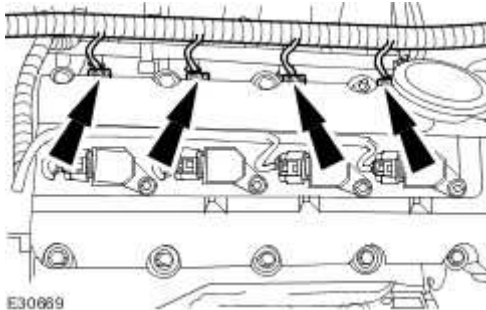
Detach the engine wiring harness.



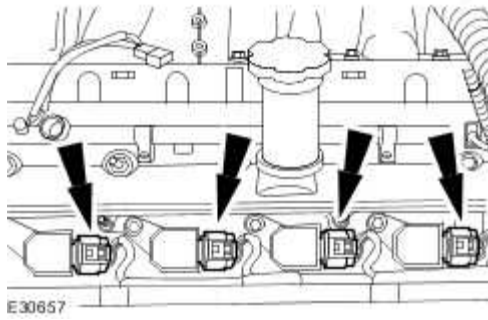
69 . NOTE:

Right-hand shown, left-hand similar.

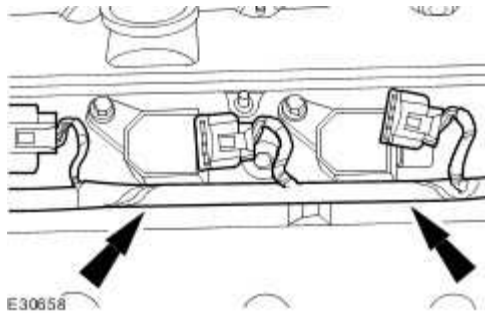
Disconnect the fuel injector electrical connectors.



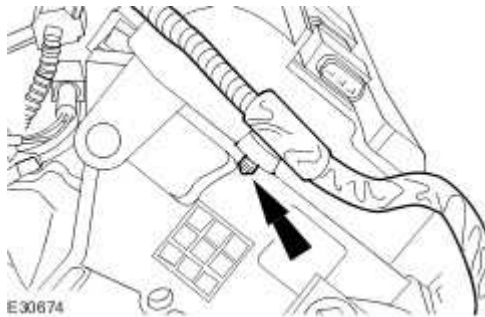
70 . Disconnect the ignition on-plug coil electrical connectors.



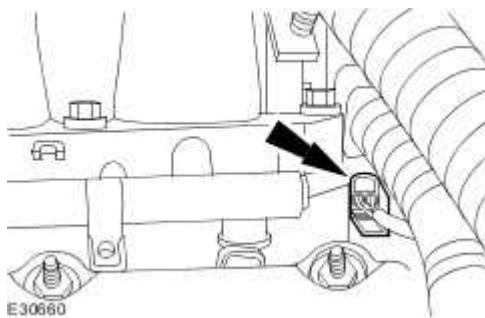
71 . Detach the engine wiring harness.



72 . Detach the engine wiring harness.



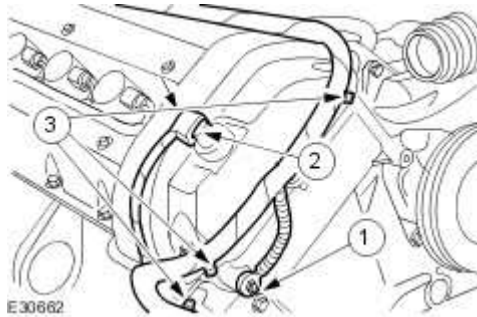
73 . Disconnect the camshaft position sensor electrical connector.



74 . Detach the engine wiring harness.

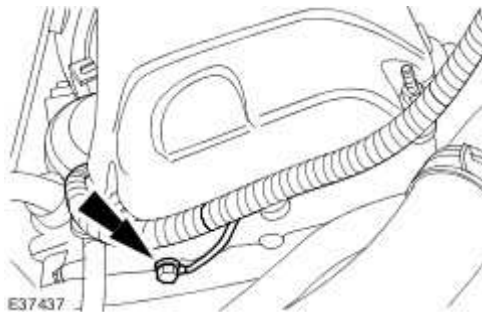
- Detach the ground cable.
- Disconnect the variable valve timing (VVT) solenoid electrical connector.

3. Detach the engine wiring harness.

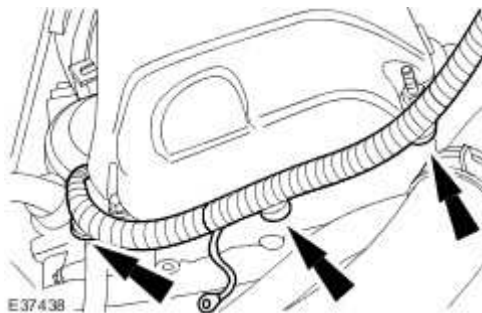


75 . Detach the engine wiring harness.

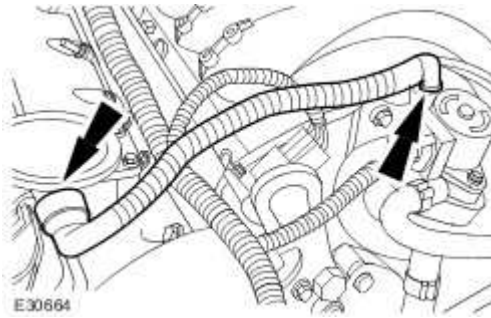
- Remove the retaining bolt.



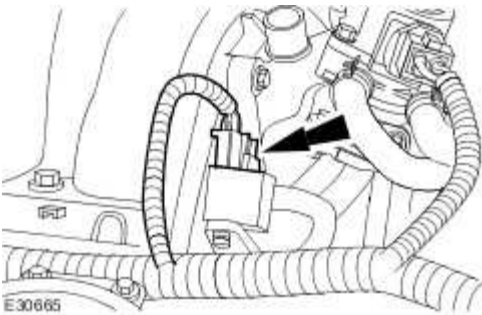
76 . Detach the engine wiring harness.



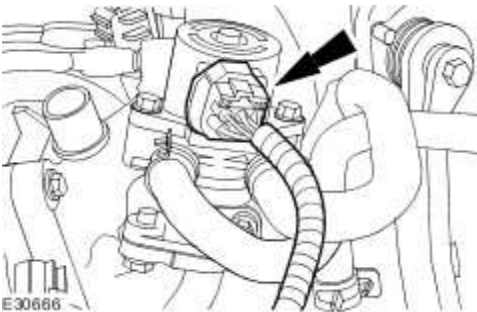
77 . Disconnect the positive crankcase ventilation pipe.



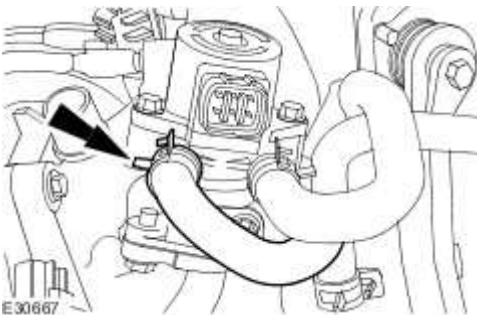
78 . Disconnect the fuel pressure regulator electrical connector.



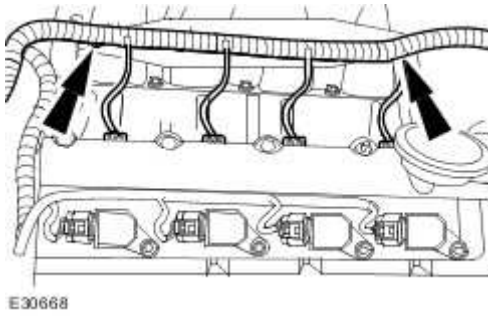
79 . Disconnect the exhaust gas recirculation valve electrical connector.



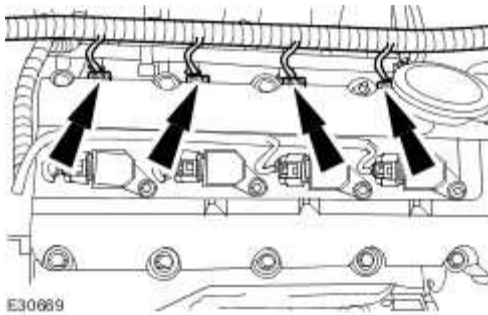
80 . Disconnect the exhaust gas recirculation valve coolant hose.



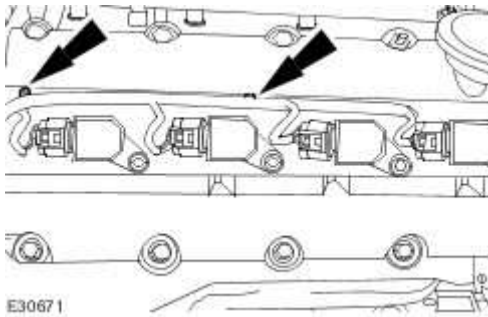
81 . Detach the engine wiring harness.



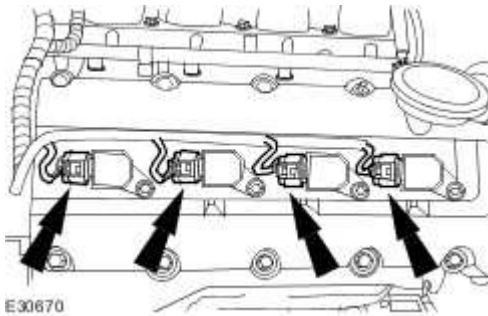
82 . Disconnect the fuel injector electrical connectors.



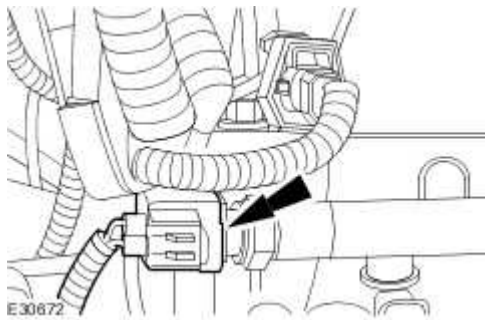
83 . Detach the engine wiring harness.



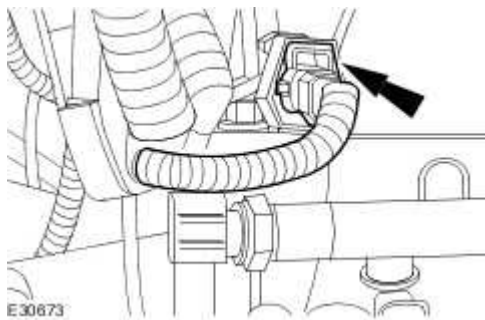
84 . Disconnect the ignition on-plug coil electrical connectors.



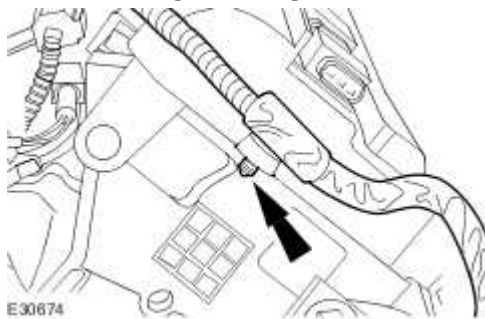
85 . Disconnect the fuel temperature sensor electrical connector.



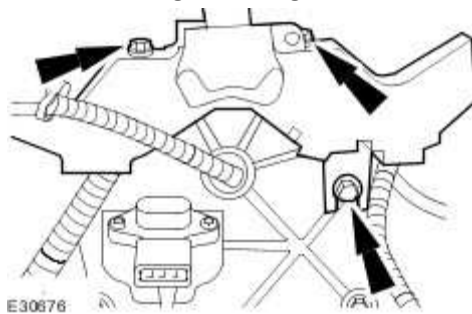
86 . Disconnect the camshaft position sensor electrical connector.



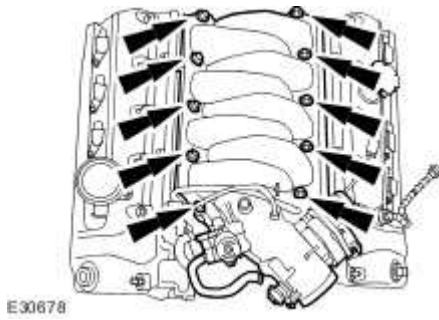
87 . Detach the engine wiring harness



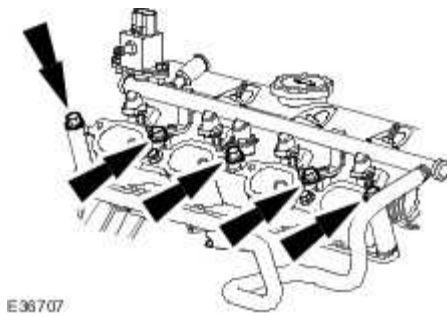
88 . Detach the engine wiring harness.



89 . Remove the intake manifold.



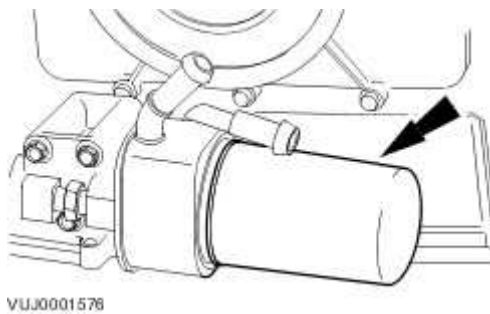
90 . Remove the lower intake manifold.



91 . **NOTE:**

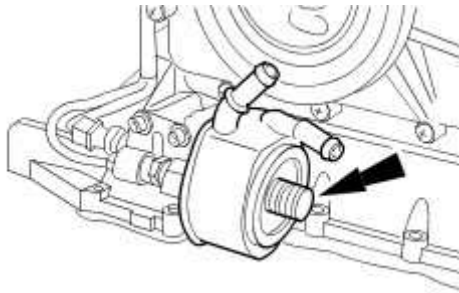
Place a suitable container underneath the filter to prevent oil spillage.

Remove the oil filter element.



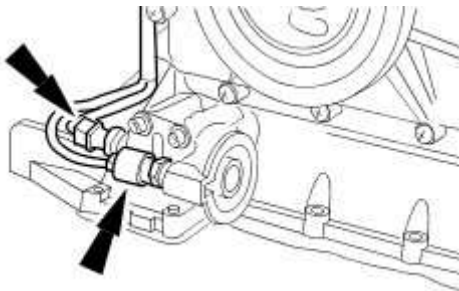
92 . Remove the oil cooler.

- Remove and discard the O-ring seal.



VUJ0001577

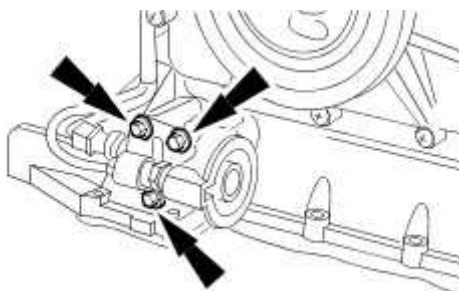
93 . Disconnect the oil pressure switch and oil temperature sensor electrical connectors.



VUJ0001578

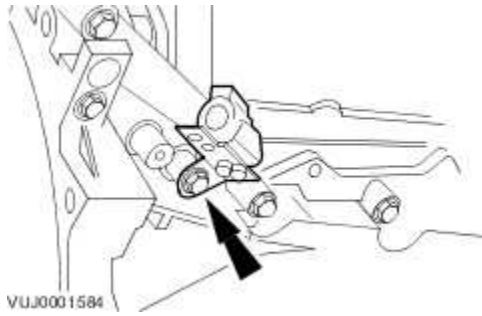
94 . Remove the oil filter housing.

- Remove and discard the O-ring seal.

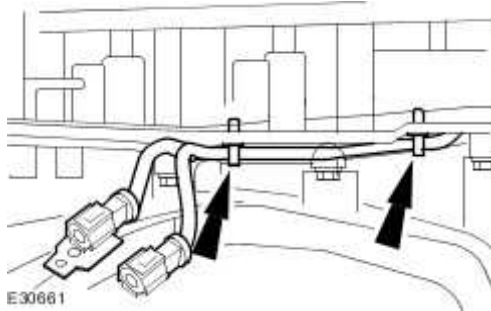


VUJ0001579

95 . Detach the right-hand oxygen sensor.

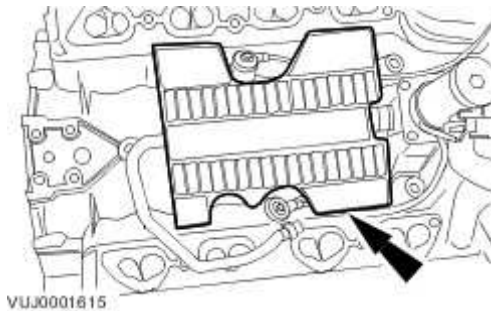


96 . Detach the engine wiring harness retaining clips.



97 . Remove the engine wiring harness

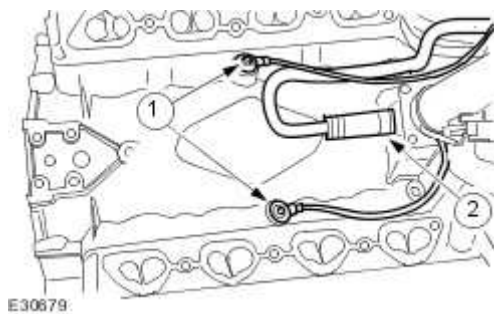
98 . Remove the noise and vibration insulating pad.



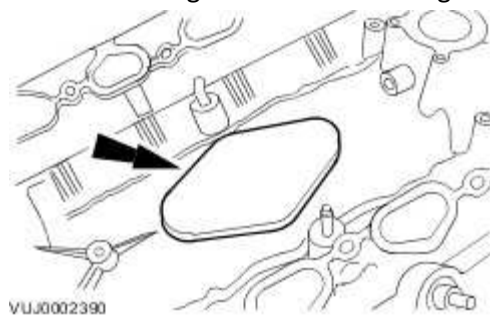
99 . Remove the intake manifold heater coolant hose.

4. Remove the knock sensors.

5. Remove the intake manifold heater coolant hose.

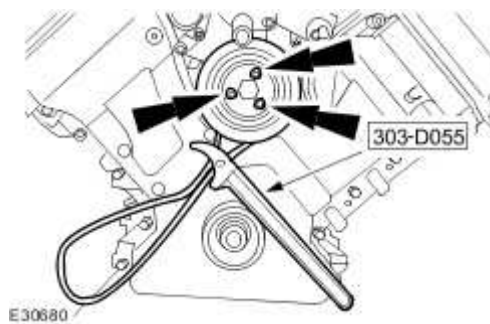


100 . Remove the engine block insulation grommet.



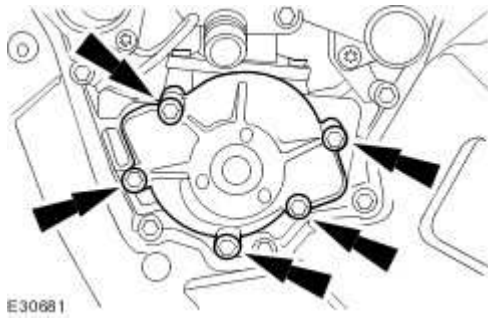
101 . Remove the water pump pulley.

- Using the special tool, retain the water pump pulley.



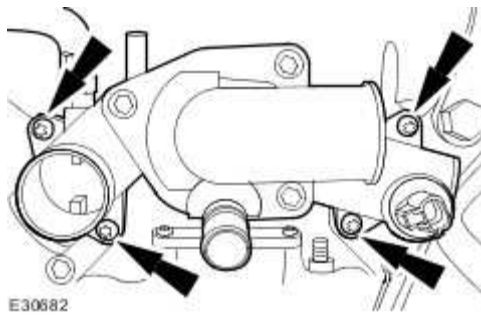
102 . Remove the water pump.

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



103 . Remove the thermostat housing.

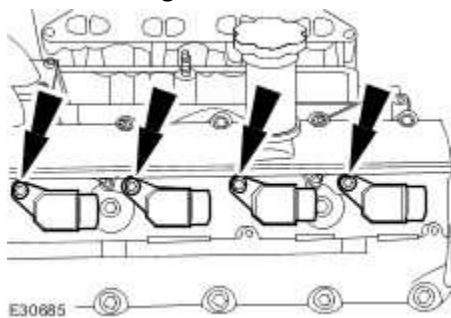
- Remove and discard the O-ring seals.



104 . **NOTE:**

Left-hand shown, right-hand similar

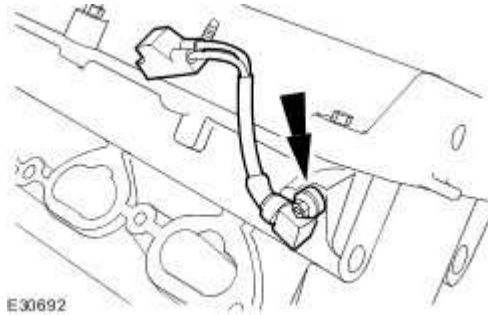
Remove the ignition coils.



105 . Remove the spark plugs.

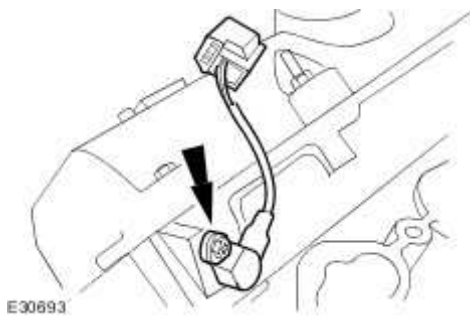
106 . Remove the right-hand camshaft position (CMP) sensor.

- Remove and discard the O-ring seal.



107 . Remove the left-hand camshaft position (CMP) sensor.

- Remove and discard the O-ring seal.



108



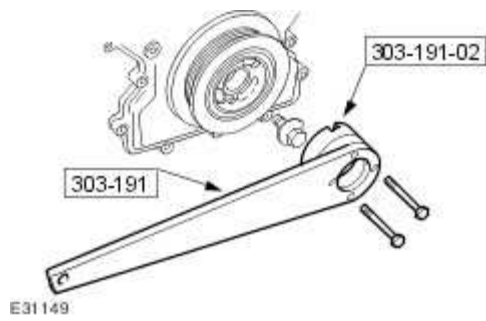
CAUTION: Under no circumstances should the crankshaft setting peg 303-645 be used in the following operations to lock the crankshaft.

NOTE:

The crankshaft retaining bolt will be very tight.

Using special tools, retain the crankshaft pulley.

- Remove and discard the crankshaft pulley bolt.



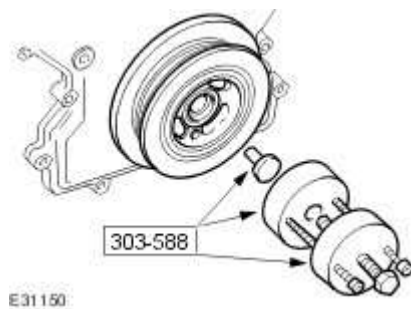
109 . Remove the special tools.

110 . **NOTE:**

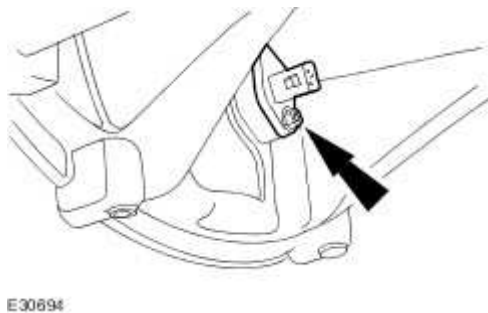
The crankshaft pulley will be very tight.

Using special tools, remove the crankshaft pulley.

- Collect the locking ring.
- Remove and discard the O-ring seal.



111 . Remove the crankshaft position (CKP) sensor.



112



CAUTION: Make sure the spark plugs are removed to enable the engine to rotate freely.

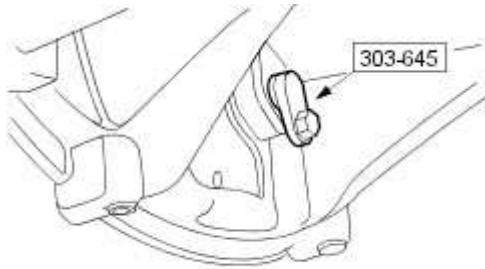


CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.



CAUTION: Rotate the crankshaft clockwise to position the engine to top dead center (TDC) No. 1 cylinder.

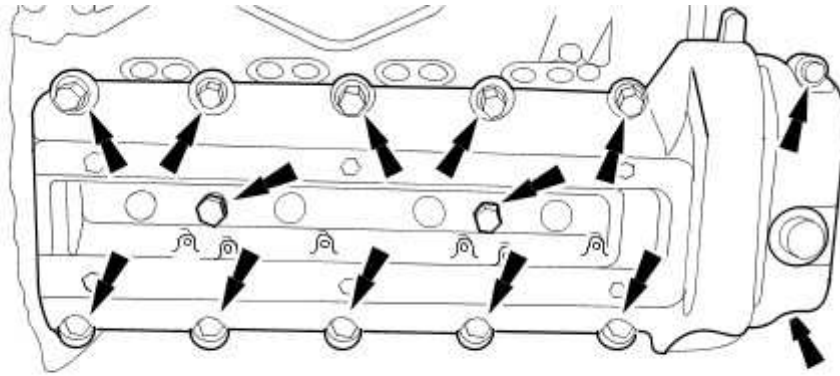
Install the special tool 303-645.



VUJ0002400

113 . Remove the right-hand valve cover.

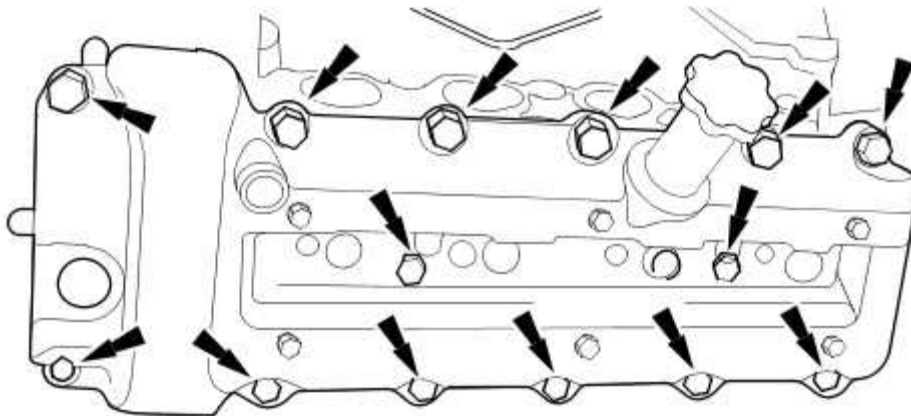
- Discard the valve cover gaskets.



E30696

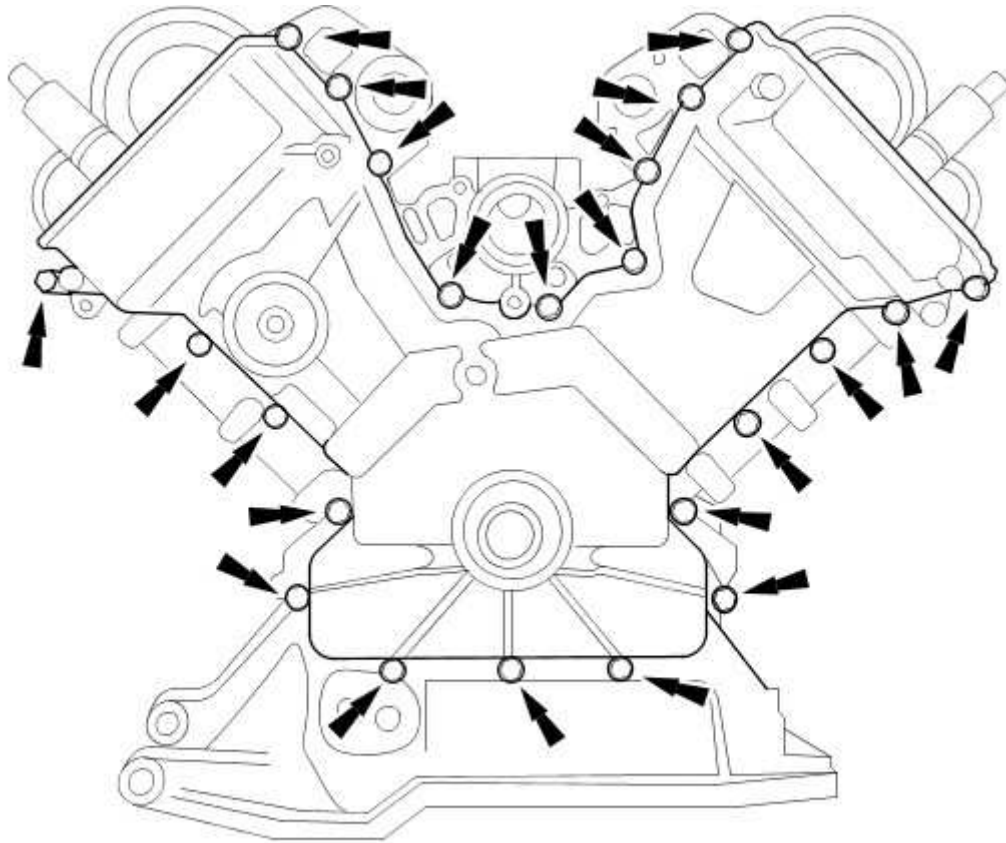
114 . Remove the left-hand valve cover.

- Discard the valve cover gaskets.



E30697

115 . Remove the engine front cover.



VUJ0002398

116 . Remove the right-hand variable camshaft timing oil control unit housing.

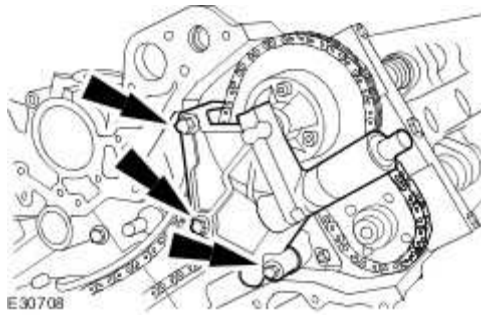
- Remove and discard the O-ring seals.



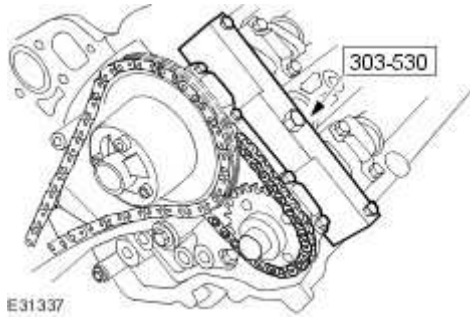
E30699

117 . Remove the left-hand variable camshaft timing oil control unit housing.

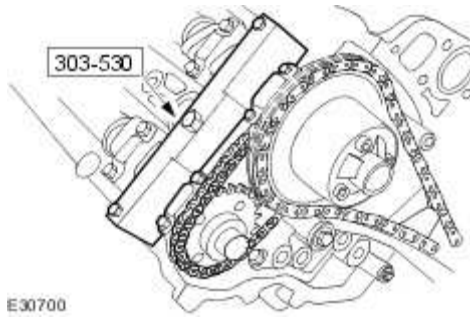
- Remove and discard the O-ring seals.



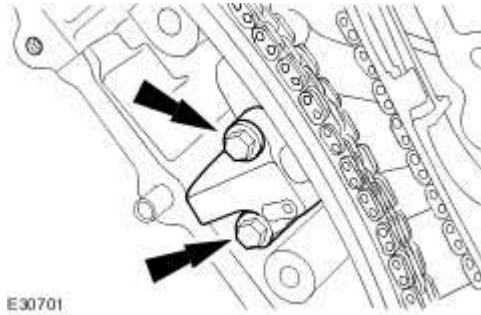
118 . Install the special tool to the left-hand cylinder head.



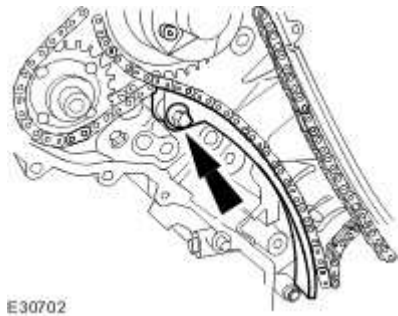
119 . Install the special tool to the right-hand cylinder head.



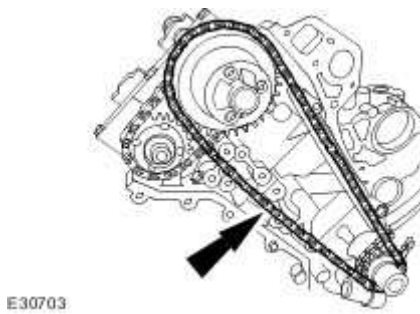
120 . Remove the primary timing chain tensioner assembly.



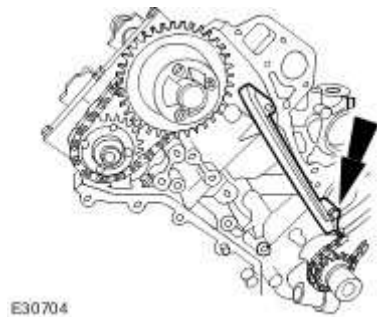
121 . Remove the primary timing chain tensioner guide.



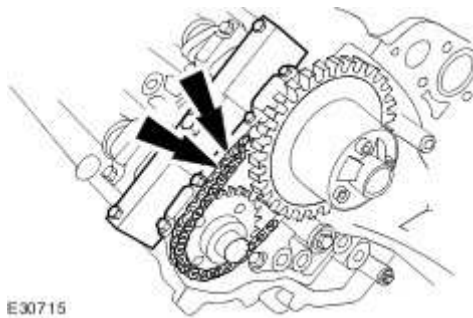
122 . Remove the primary timing chain.



123 . Remove the primary timing chain guide.

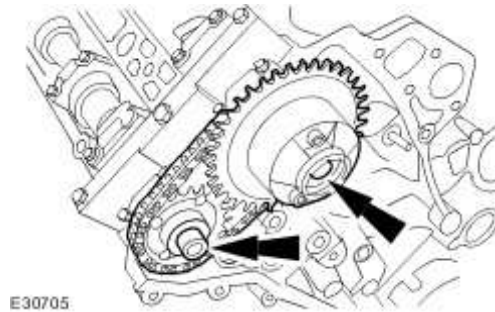


124 . Remove the secondary timing chain tensioner retaining bolts.

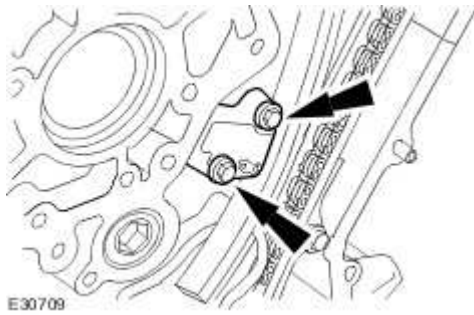


125 Remove the camshaft sprockets.

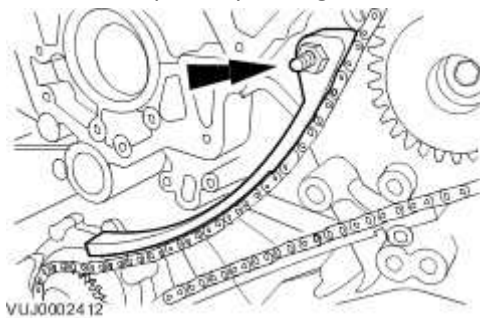
- Remove the secondary timing chain tensioner and secondary timing chain from the camshaft sprockets.



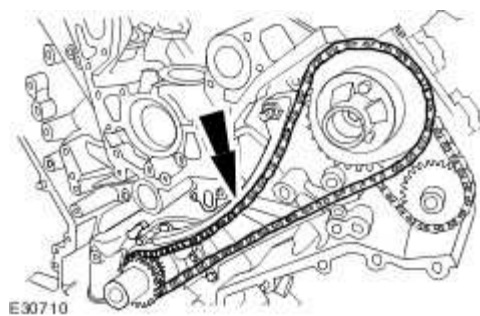
126 . Remove the primary timing chain tensioner assembly.



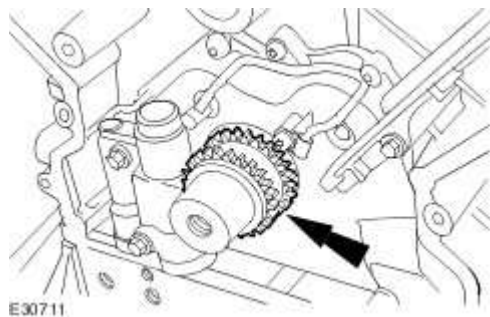
127 . Remove the primary timing chain tensioner guide.



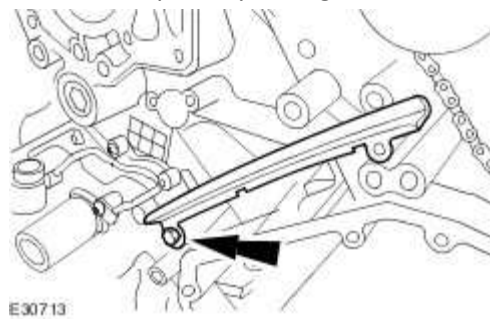
128 . Remove the primary timing chain.



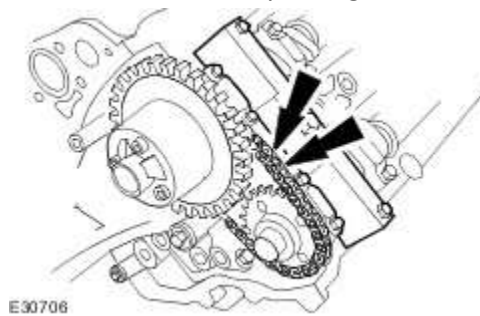
129 . Remove the crankshaft sprocket.



130 . Remove the primary timing chain tensioner guide.

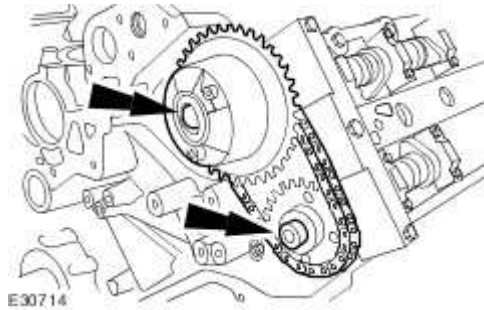


131 . Remove the secondary timing chain tensioner retaining bolts.

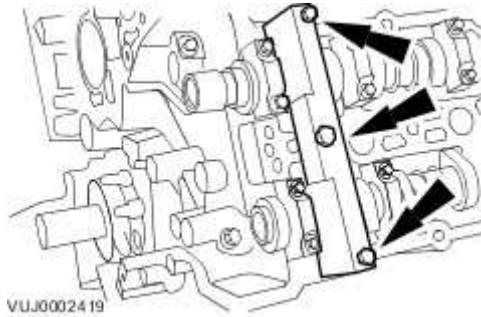


132 Remove the camshaft sprockets.

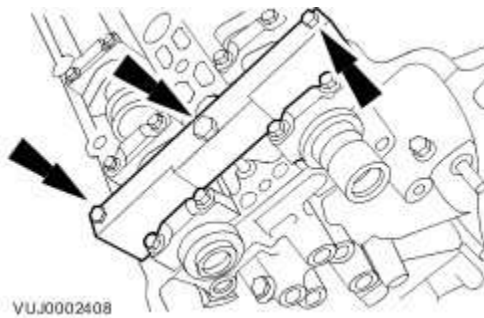
- Remove the secondary timing chain tensioner and secondary timing chain from the camshaft sprockets.



133 . Remove the camshaft setting tool.



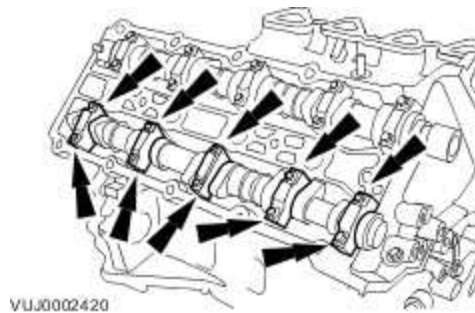
134 . Remove the camshaft setting tool.



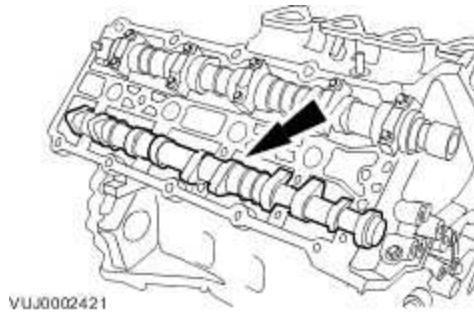
135 Remove the camshaft bearing caps.

- Remove the camshaft bearing cap retaining bolts evenly and in stages.
- Remove the camshaft bearing caps. Note their orientation and markings, each is

marked with its position (a number) and orientation (an arrow).

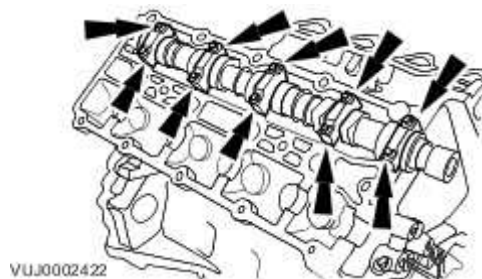


136 . Remove the right-hand exhaust camshaft.

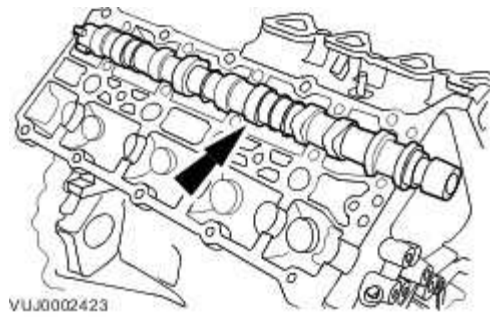


137 Remove the camshaft bearing caps.

- Remove the camshaft bearing cap retaining bolts evenly and in stages.
- Remove the camshaft bearing caps. Note their orientation and markings, each is marked with its position (a number) and orientation (an arrow).

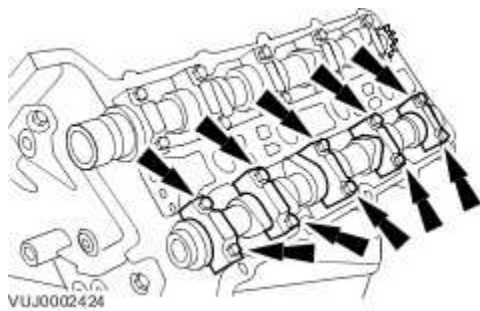


138 . Remove the right-hand intake camshaft.

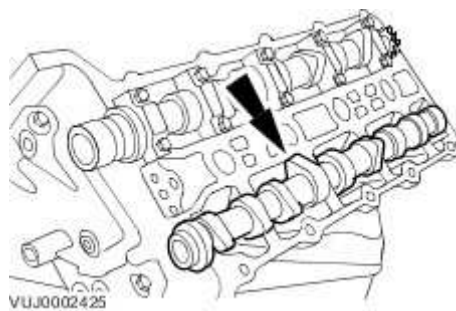


139 Remove the camshaft bearing caps.

- Remove the camshaft bearing cap retaining bolts evenly and in stages.
- Remove the camshaft bearing caps. Note their orientation and markings, each is marked with its position (a number) and orientation (an arrow).



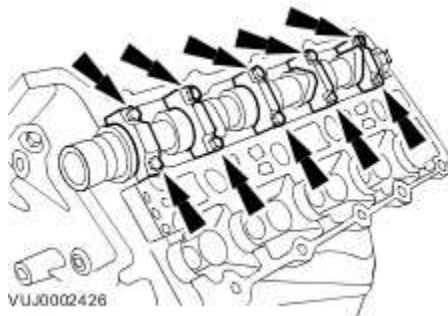
140 . Remove the left-hand exhaust camshaft.



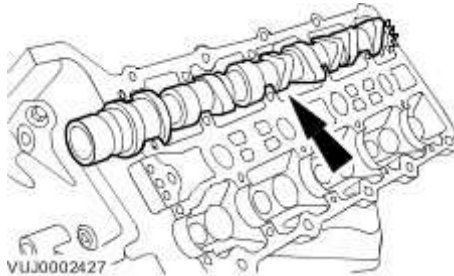
141 Remove the camshaft bearing caps.

- Remove the camshaft bearing cap retaining bolts evenly and in stages.
- Remove the camshaft bearing caps. Note their orientation and markings, each is

marked with its position (a number) and orientation (an arrow).



142 . Remove the left-hand inlet camshaft.



143



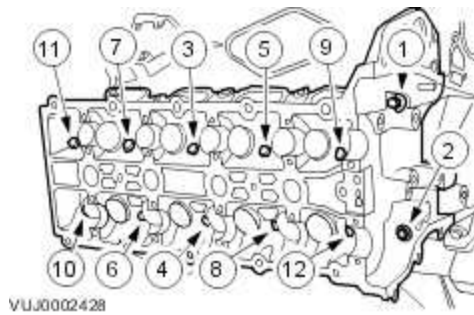
CAUTION: The bolts can only be used twice, mark the bolts with a center punch. If two punch marks are visible, discard the bolts.



CAUTION: 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.

Remove the right-hand cylinder head.

- Remove the bolts in the indicated sequence.
- Remove and discard the gasket.



144



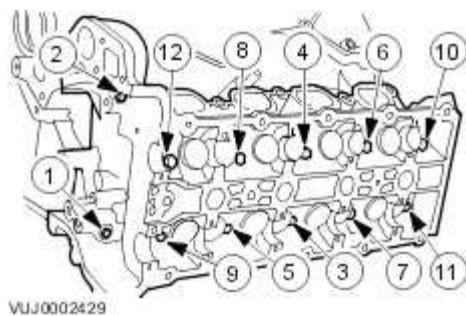
CAUTION: The bolts can only be used twice, mark the bolts with a center punch. If two punch marks are visible, discard the bolts.



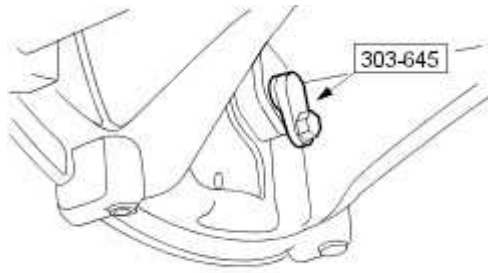
CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be removed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.

Remove the left-hand cylinder head.

- Remove the bolts in the indicated sequence.
- Remove and discard the gasket.



145 . Remove the crankshaft setting peg 303-645 from the crankshaft position sensor location.

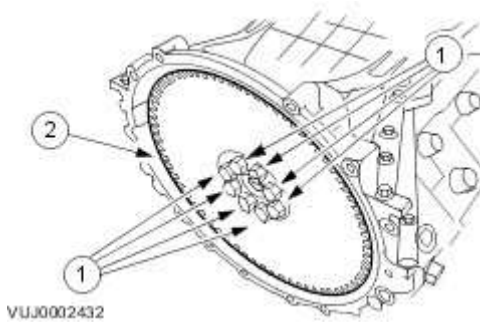


VUJ0002400

146 . Remove the flexplate.

6. Remove the flexplate retaining bolts.

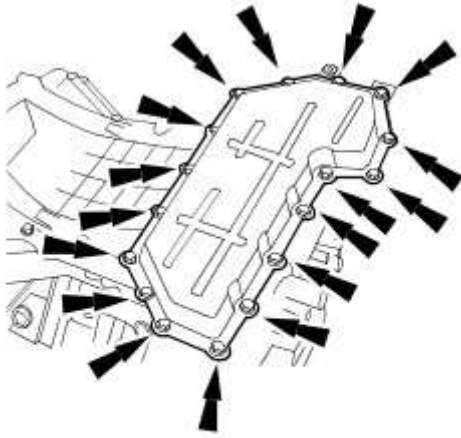
7. Remove the flexplate.



VUJ0002432

147 . Remove the lower oil pan.

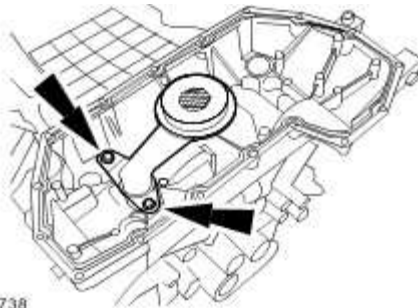
- Remove and discard the gasket.



VUJ0002433

148 . Remove the oil strainer.

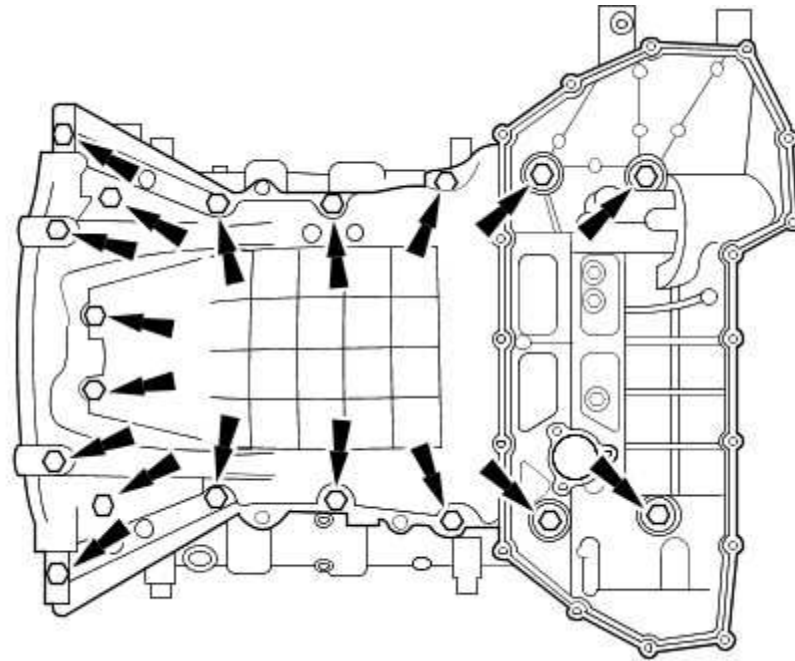
- Remove and discard the O-ring seal.



E30738

149 . Remove the upper oil pan.

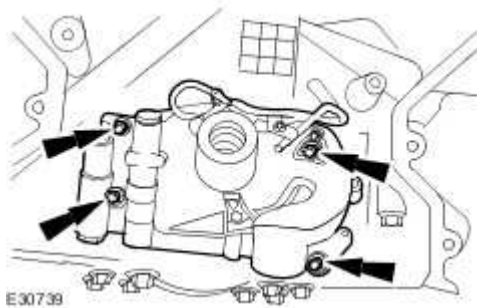
- Remove and discard the gasket.



VUJ0002435

150 . Remove the oil pump.

- Remove and discard the gasket.



E30739

151 Inspect the tops of the cylinder bores. As necessary remove ridge and carbon build up from each cylinder.

152 . Remove the piston cooling jets.

153



CAUTION: Pistons, connecting rods and connecting rod bearings should be

numbered to make sure they are reassembled in the same position.

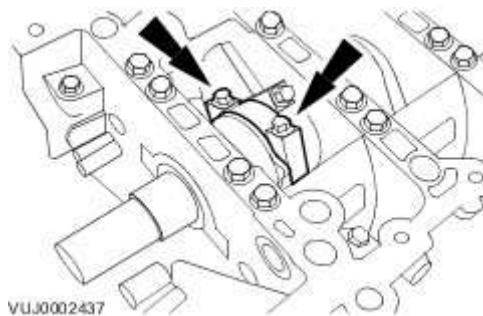
NOTE:

Mark the position of the connecting rod caps to the connecting rods to make sure of correct installation.

NOTE:

Discard the connecting rod bolts after removal.

Remove the connecting rod bolts, the connecting rod caps and the lower connecting rod bearings.

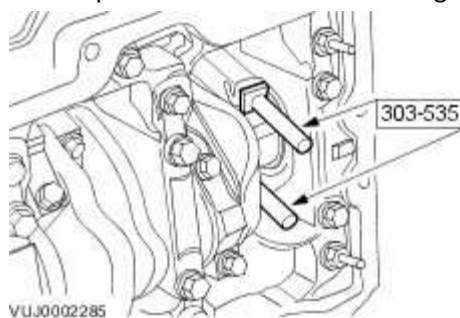


154



CAUTION: Use appropriate protection to prevent damage to the crankshaft bearing journals and cylinder bore surfaces.

Install special tools to the connecting rods.



155



CAUTION: Care should be taken not to damage the connecting rod and cap joint

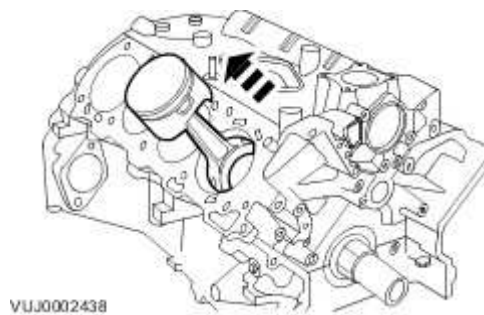
face surfaces or possible engine damage may occur. Avoid contaminating the fractured joint surfaces with dirt or grease.

NOTE:

Attach the connecting rods and caps after removal to avoid mismatch.

Remove the pistons.

- Rotate the crankshaft to locate pistons at the bottom of travel.
- Push the piston, connecting rod and upper bearing through the top of the cylinder.



156 . **NOTE:**

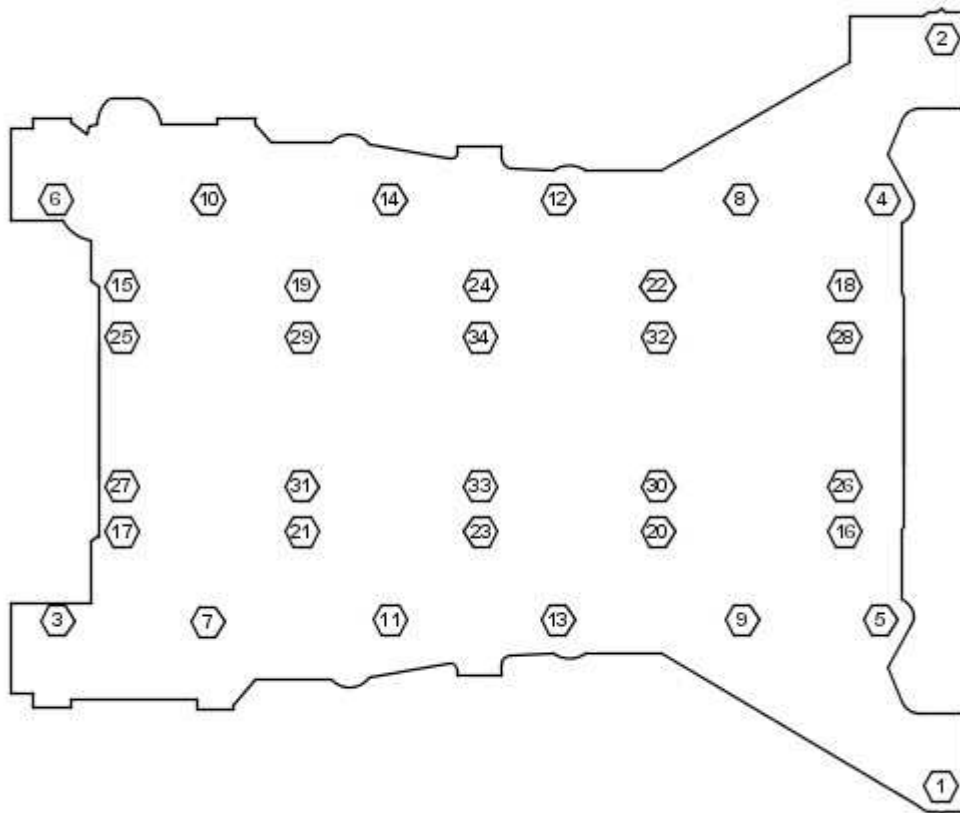
Remove the lower cylinder block bolts in the indicated sequence.

NOTE:

Mark the position of the upper and lower crankshaft main bearings for reassembly.

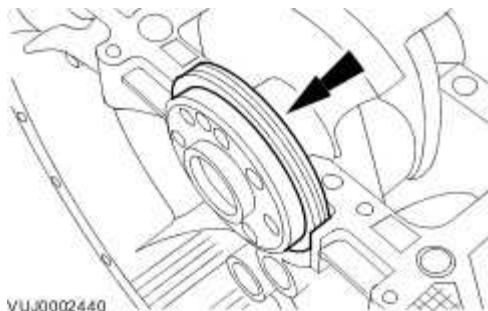
Remove the lower cylinder block.

- Remove the lower cylinder block retaining bolts in the indicated sequence.



VUJ0002439

157 . Discard the crankshaft rear main oil seal.



VUJ0002440

158

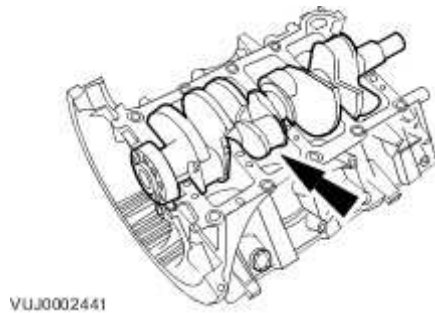


CAUTION: Avoid damage to any crankshaft bearing surfaces.

NOTE:

Never remove any pipe, plugs or dowels unless they are to be newly installed or the cylinder block is to be washed.

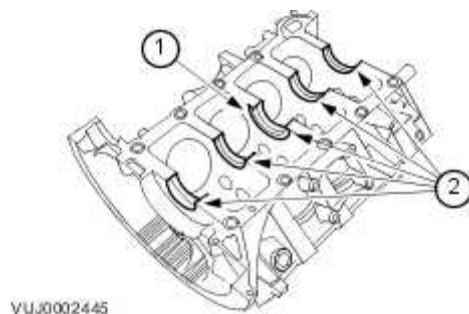
Remove the crankshaft.



159 . Remove the upper crankshaft main bearings.

8. Remove the upper crankshaft thrust washers.

9. Remove the upper crankshaft main bearings.



160 Clean the cylinder block with a soap and water solution. Dry the cylinder block completely with compressed air.

Cylinder Head (12.29.22)

Special Service Tools



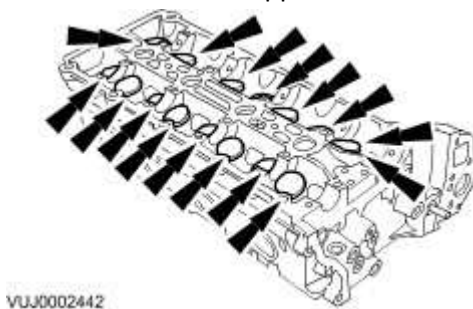
Valve Spring Compressor
303-252

Disassembly

- 1  **CAUTION:** Do not use a magnet to remove shims. Failure to follow these instructions may result in damage to the vehicle.

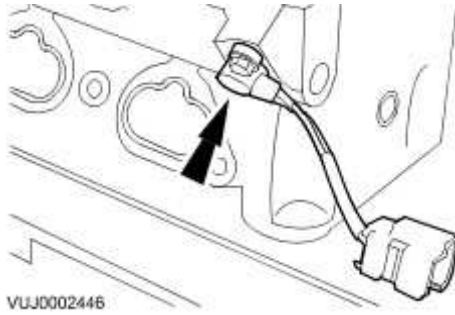
 **CAUTION:** If the cylinder head valve components are to be reused, mark the position of the valve components to make sure they are reassembled in the same position.

Remove the bucket tappet and shim assemblies.



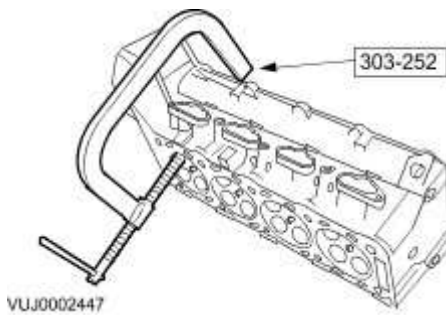
2 . Remove the camshaft position (CMP) sensor.

- Remove and discard the 'O' ring seal.



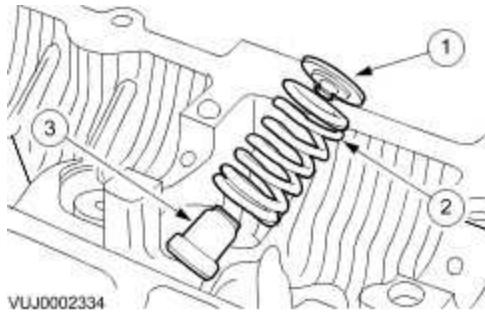
3 . Using the special tool, compress the valve springs.

- Remove the valve collets.



4 . Remove the valve spring retainers and valve springs.

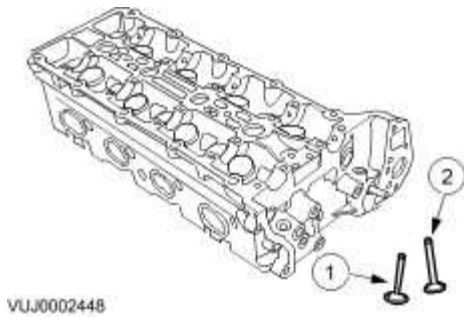
1. Remove the valve spring retainers.
2. Remove the valve springs.
3. Remove the valve stem oil seals.



5 . Remove the valves from the cylinder head.

4. Remove the intake valves.

5. Remove the exhaust valves.



6 Inspect the cylinder heads and related components. For additional information, refer to
 . <<303-00>>

7 . Remove the pipe plugs and alignment dowels as necessary to clean the cylinder heads.

Assembly

1



· **WARNING:** Eye protection is required during use of compressed air. Failure to follow

these instructions may result in personal injury.



CAUTION: The cylinder head surface finish is measured in microns. For correct head gasket sealing, avoid any contact of finish with metallic objects.

Clean gasket material, dirt and foreign material from cylinder heads. Wash with a suitable soap and water solution and dry the cylinder head completely using compressed air if pipe plugs have been removed.

2 . Install the pipe plugs and alignment dowels to cylinder heads.

- Apply pipe sealant to plugs prior to installation.

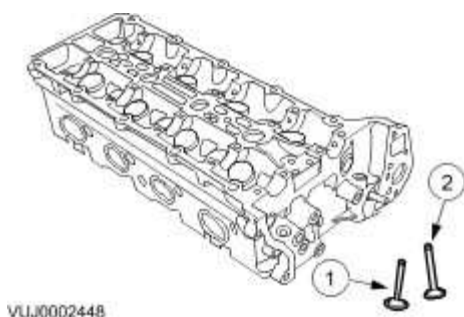
3 . **NOTE:**

Lubricate the valve stems before assembly.

Install the valves into the cylinder heads.

6. Install the intake valves.

7. Install the exhaust valves.

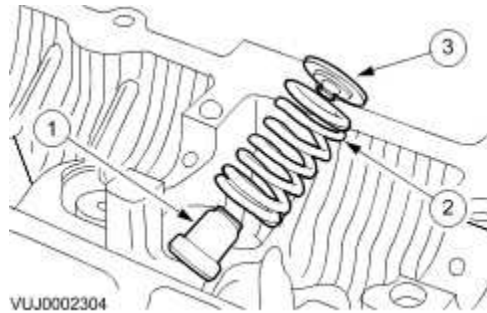


4 . Install the valve spring retainers and valve springs.

8. Install the valve stem oil seals.

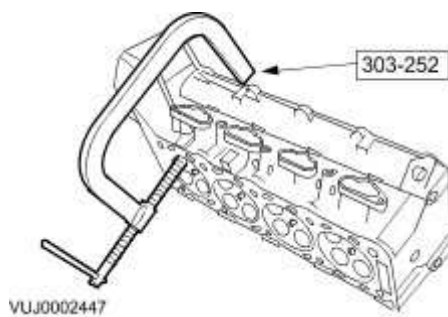
9. Install the valve springs.

10. Install the valve spring retainers.



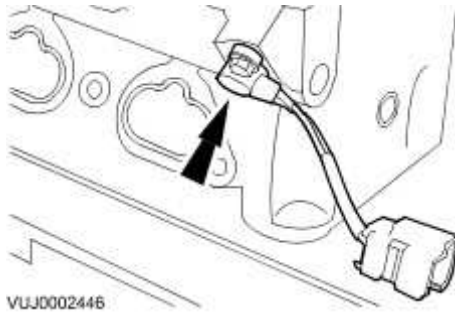
5 . Using the special tool, compress the valve springs.

- Install the valve collets.



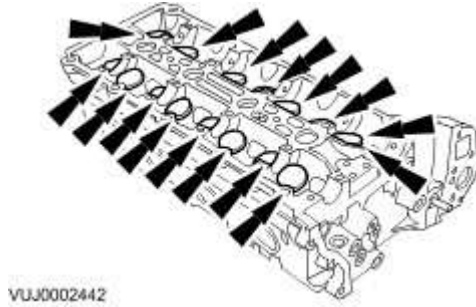
6 . Install the camshaft position (CMP) sensor.

- Install a new 'O' ring seal.
- Tighten to 7 Nm.



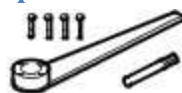
- 7
- 
CAUTION: Do not use a magnet to install shims. Failure to follow these instructions may result in damage to the vehicle.

Install the bucket tappet and shim assemblies.



Engine

Special Service Tools



303-191

Crankshaft locking, main tool

303-191



303-191-02

Adapter

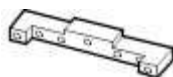
303-191-02



303-645

Crankshaft setting, main tool

303-645



303-530

Camshaft setting

303-530



303-532

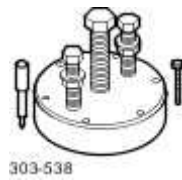
Timing chain tensioning tool
303-532



Cylinder Bore Protectors
303-535



Piston Ring Compressor
303-372



Crankshaft rear oil seal remover/replacer
303-538



Crankshaft front seal installer
303-538



303D055

Crankshaft damper holding tool
303-D055

Assembly

1



• **CAUTION:** Use only a plastic scraper when removing old gasket material.

Clean all the mating faces and reusable parts thoroughly and check for damage.

- If gasket material remains on the cylinder head after cleaning, use a plastic tipped scraper to remove remaining material.

2 . **NOTE:**

Never remove pipe plugs or alignment dowels unless they are to be serviced.

Reseal oil passage blanking plugs, as necessary.

3 . **NOTE:**

The main bearings are precision selective fit.

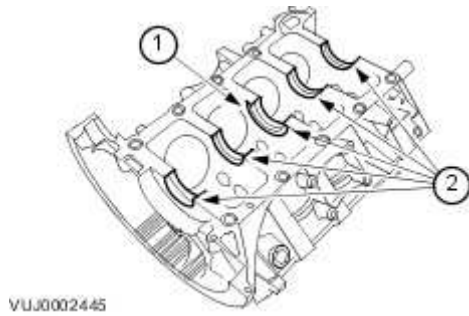
NOTE:

Lubricate the upper crankshaft main bearings and thrust washers.

Install the upper crankshaft main bearings.

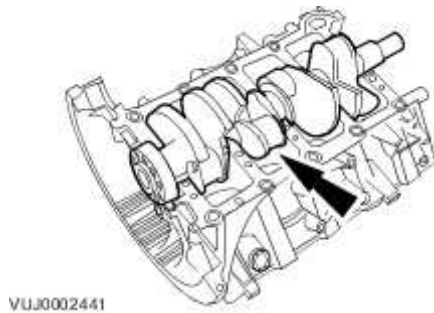
For additional information, refer to Camshaft Bearing Journal Clearance

1. Install the upper crankshaft thrust washers.
2. Install the upper crankshaft main bearings.



4.  **CAUTION:** Avoid damage to any crankshaft bearing surfaces.

Install the crankshaft.



5 **NOTE:**

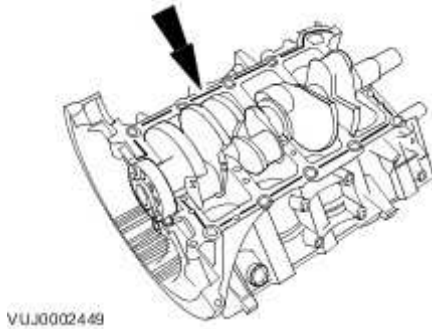
The main bearings are precision selective fit.

NOTE:

Install lower cylinder block and tighten bolts to specification within twenty minutes of applying sealer.

Apply a bead of sealant to the cylinder block housing.

- Use WSS-M4G320-A3-RTV sealant.



6



CAUTION: Make sure all dowels are fully seated into lower cylinder block prior to tightening the bolts.



CAUTION: Do not lubricate the lower cylinder block bolts.



CAUTION: Do not rotate crankshaft until all bolts are tightened to specification.



CAUTION: Bolts must be tightened within twenty minutes of applying sealer.

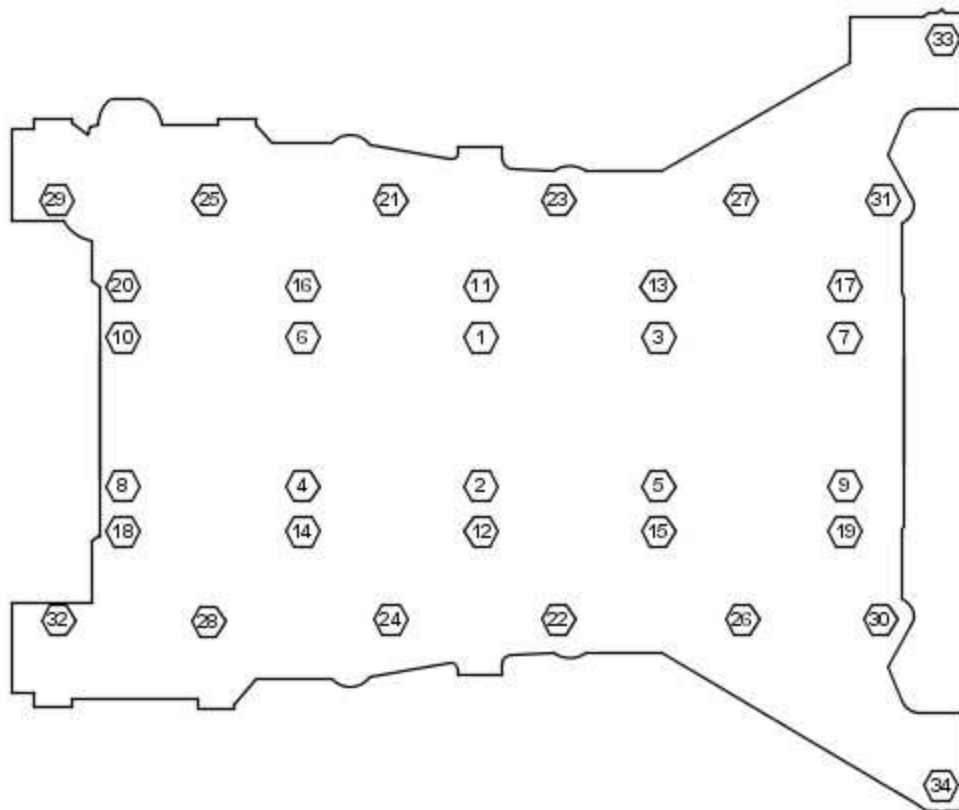


CAUTION: Tighten the bolts in the sequence shown.

Install the lower cylinder block to the upper cylinder block.

3. Tighten bolts 21 to 32 to 15 Nm
4. Tighten bolts 33 to 34 to 15 Nm
5. Tighten bolts 1 to 10 to 25 Nm

6. Tighten bolts 11 to 20 to 15 Nm
7. Tighten bolts 1 to 10 to 35 Nm +135°
8. Tighten bolts 11 to 20 to 20 Nm +150°
9. Tighten bolts 21 to 32 to 20 Nm +90°
10. Tighten bolts 33 to 34 to 20 Nm +150°



VUJ0002450

- 7 . Rotate the crankshaft to check correct operation.
- 8 . Remove excess sealant which may squeeze out at the front cover sealing surfaces.

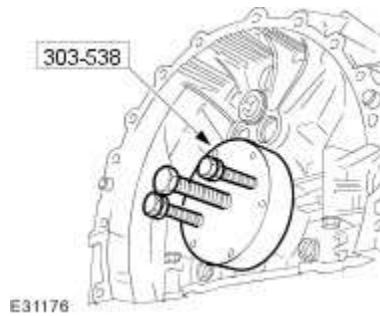
- 9 .  **CAUTION: Do not use any lubricant on the seal, the transit sleeve or the crankshaft.**

-  **CAUTION: Make sure all components are clean and dry.**

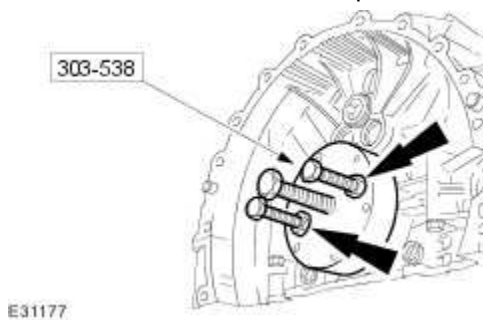
Make sure the transit sleeve is correctly in place and install the new seal over the crankshaft.

- 10 . Carefully remove the transit sleeve, leaving the seal in place.

- 11 . Install the special tool to the crankshaft.

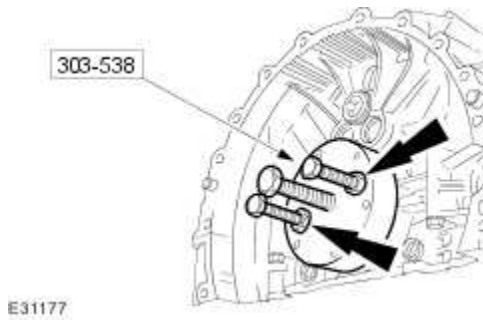


- 12 Reposition the nuts to hold the special tool against the crankshaft rear seal. Check that the
 . crankshaft rear seal and the special tool are parallel to the rear of the engine.



- 13 .  **CAUTION: Alternate nut tightening to correctly seat the crankshaft rear seal.**

Using the special tool, install the crankshaft rear seal.



14 . Remove the special tool from the crankshaft.

- Check that the seal is located correctly.

15



CAUTION: Use appropriate protection to prevent damage to the crankshaft bearing journals and cylinder bore surfaces.

Install special tools to the connecting rods.

- Position the crankshaft journal at the bottom of the stroke.

16



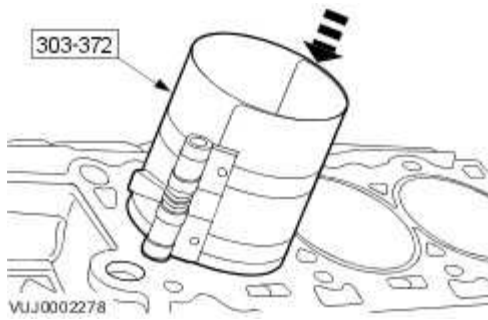
CAUTION: Make sure the piston rings are positioned at different positions opposite the thrust side of the piston before installation.



CAUTION: Install pistons with arrow to front of engine.

Using the special tool compress the rings and install the piston and connecting rod.

- Lubricate all piston components.



17



CAUTION: When assembling the connecting rods and connecting rod caps it is imperative that bearing slots and tangs be located on the same side of the connecting rods.



CAUTION: Connecting rod bolts are torqued to yield and must be replaced.



CAUTION: Bolts must be tightened equally.

NOTE:

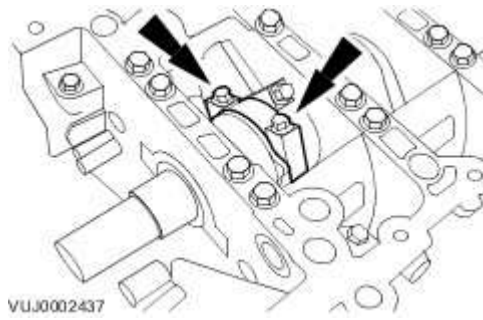
Remove the special tools from the connecting rods.

Position the connecting rod cap on the appropriate connecting rod.

11. Tighten to 10 Nm

12. Tighten to 30 Nm

13. Tighten to 90°



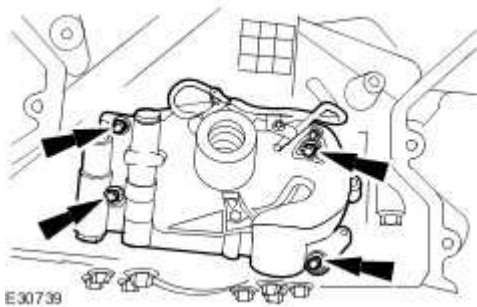
18 . Rotate the crankshaft to check correct operation.

19 . Install the piston cooling jets.

- Tighten to 9 Nm

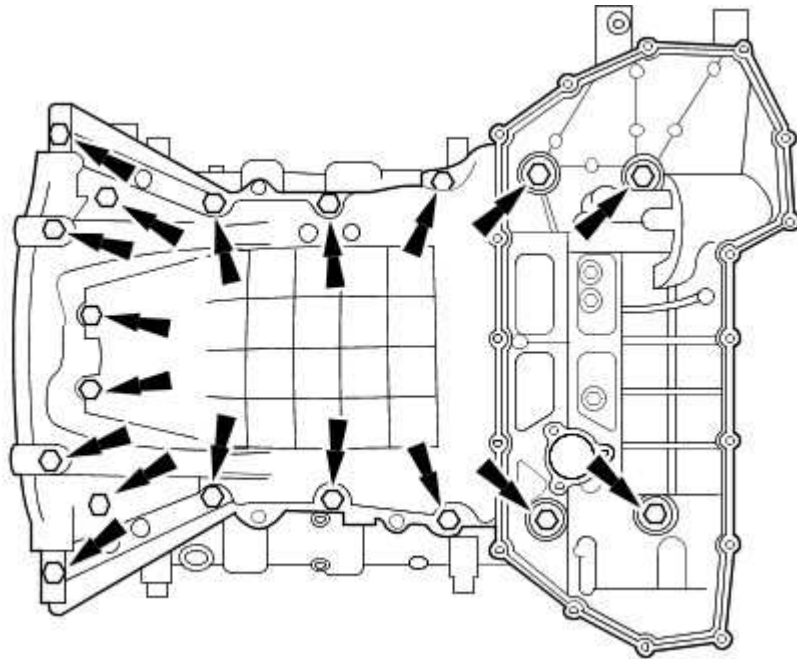
20 . Install the oil pump.

- Install a new gasket.
- Tighten to 12 Nm.



21 . Install the upper oil pan.

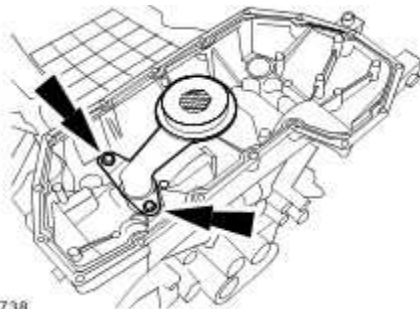
- Install a new gasket.
- Tighten to 21 Nm.



VUJ0002435

22 . Install the oil strainer.

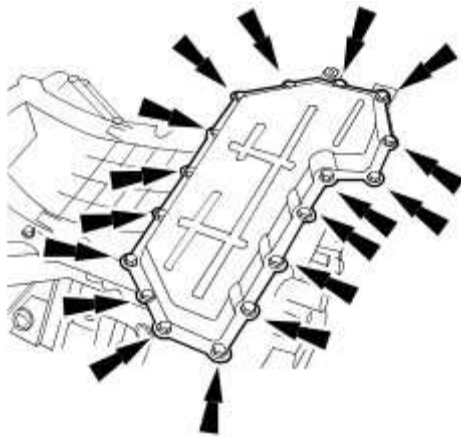
- Install a new O-ring seal.
- Tighten to 12 Nm.



E30738

23 . Install the oil pan.

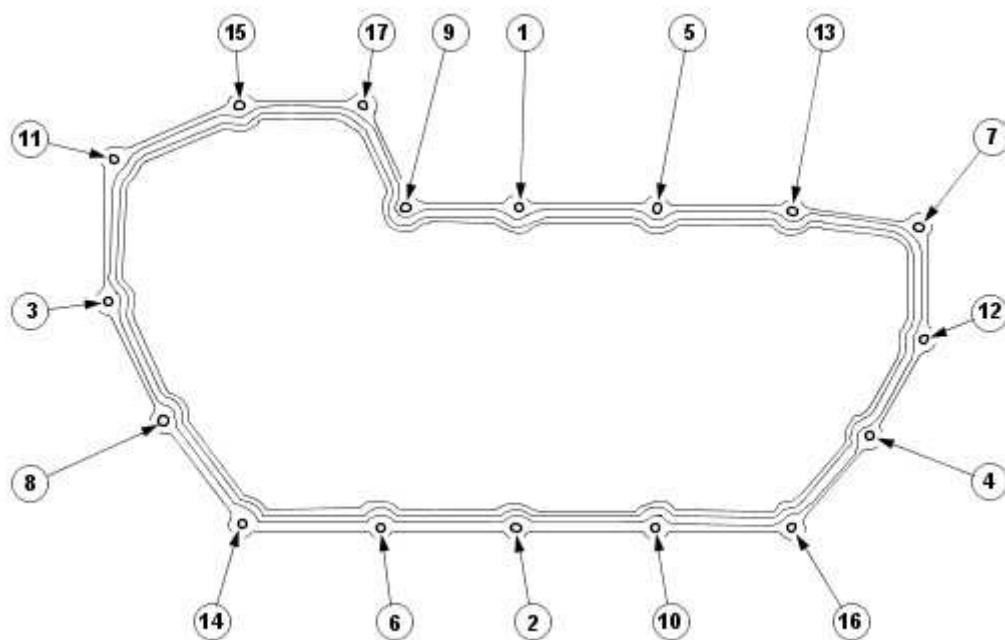
- Install a new gasket.
- Install, but do not fully tighten the retaining bolts.



VUJ0002433

24 Tighten to 12 Nm.

- Tighten in the sequence shown.
- A new oil pan is supplied with the drain plug installed. Check that the drain plug is tightened to 25 Nm.



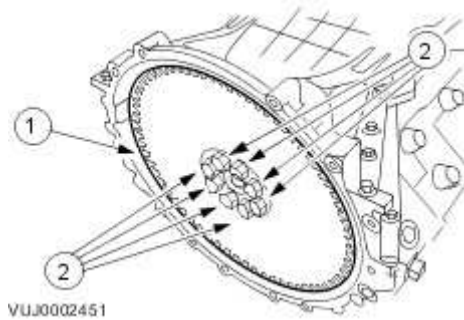
E36705

25 . Install the flexplate.

14. Install the flexplate.

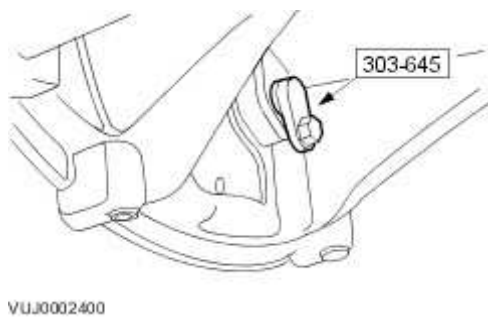
15. Install the flexplate retaining bolts.

- Tighten to 15 Nm.
- Tighten to 110 Nm.



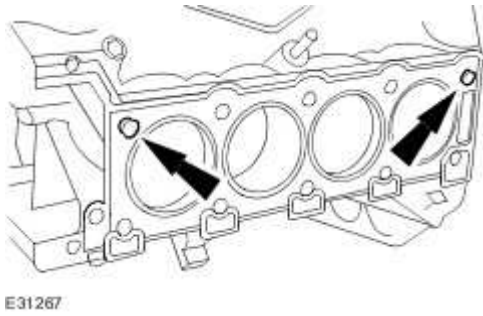
26 . Reposition the crankshaft.

- Install the crankshaft setting peg 303-645 to the crankshaft position sensor location.



27 . Install a new left-hand cylinder head gasket.

- Make sure the cylinder head dowels are correctly located.



28



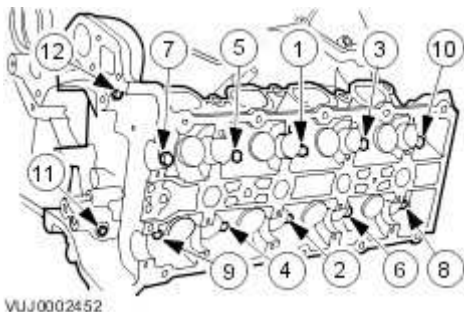
CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be installed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.



CAUTION: Tighten the bolts 1 to 10 in the sequence shown.

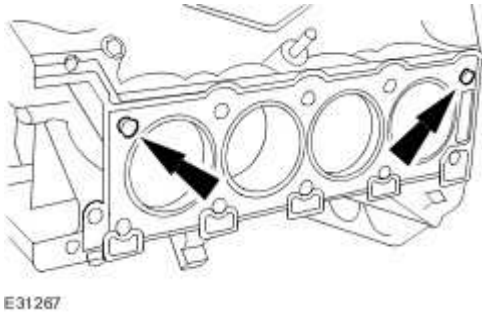
Install the left-hand cylinder head.

16. Tighten bolts 1 to 10 to 20 Nm.
17. Tighten bolts 1 to 10 to 35 Nm.
18. Tighten bolts 1 to 10 to 90°.
19. Tighten bolts 1 to 10 to 90°.
20. Tighten bolts 11 to 12 to 25 Nm.



29 . Install a new right-hand cylinder head gasket.

- Make sure the cylinder head dowels are correctly located.



E31267

30



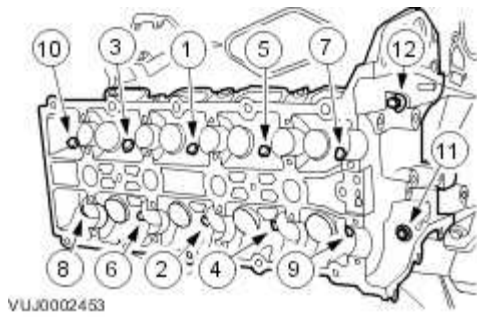
CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be installed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.



CAUTION: Tighten the bolts 1 to 10 in the sequence shown.

Install the right-hand cylinder head.

21. Tighten bolts 1 to 10 to 20 Nm.
22. Tighten bolts 1 to 10 to 35 Nm.
23. Tighten bolts 1 to 10 to 90°.
24. Tighten bolts 1 to 10 to 90°.
25. Tighten bolts 11 to 12 to 25 Nm.

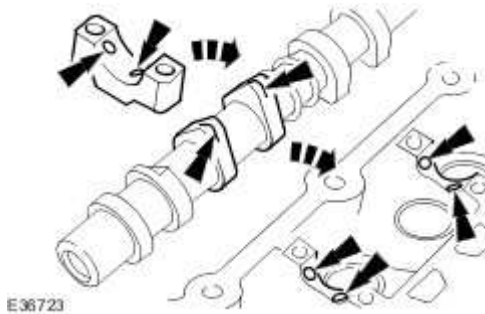


31 . NOTE:

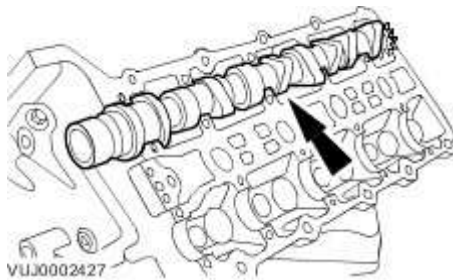
Make sure all components are clean.

Apply oil (EP-90) to the camshaft and bearing surfaces, as follows:

- To the upper face of each bearing surface in the cylinder head.
- To the upper face of each bearing surface in each bearing cap.
- On the cam lobes ONLY, not on the base circle area.



32 . Install the left-hand inlet camshaft.



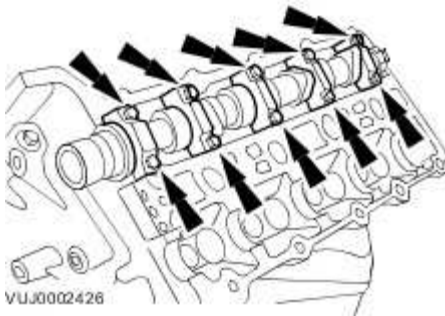
33 .



CAUTION: Alternate bolt tightening to correctly seat the camshaft bearing caps.

Install the camshaft bearing cap bolts evenly.

- Tighten to 10 Nm.

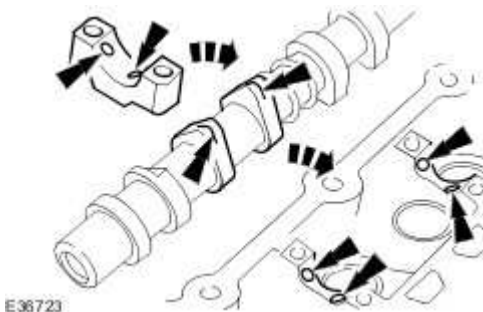


34 . **NOTE:**

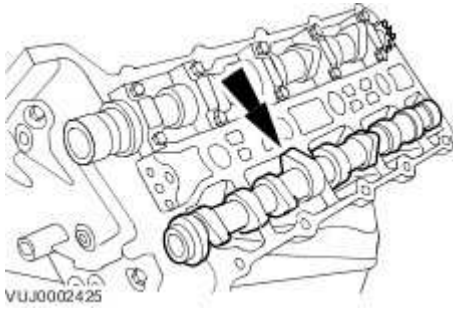
Make sure all components are clean.

Apply oil (EP-90) to the camshaft and bearing surfaces, as follows:

- To the upper face of each bearing surface in the cylinder head.
- To the upper face of each bearing surface in each bearing cap.
- On the cam lobes ONLY, not on the base circle area.



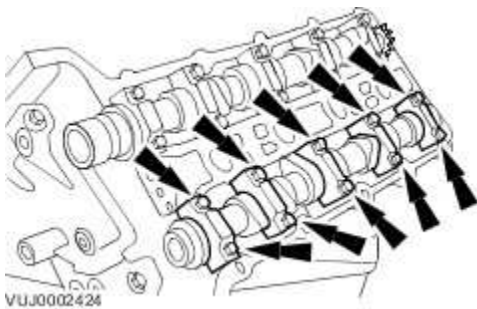
35 . Install the left-hand exhaust camshaft.



- 36 .  **CAUTION:** Alternate bolt tightening to correctly seat the camshaft bearing caps.

Install the camshaft bearing cap bolts evenly.

- Tighten to 10 Nm.

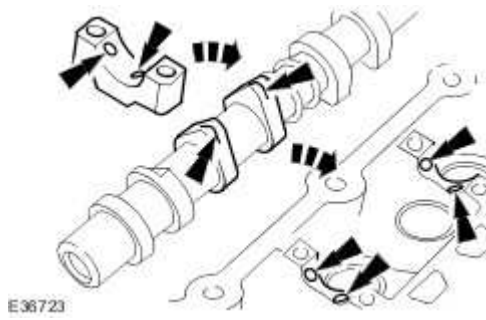


37 . **NOTE:**

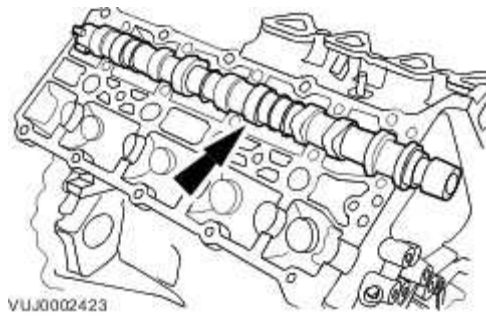
Make sure all components are clean.

Apply oil (EP-90) to the camshaft and bearing surfaces, as follows:

- To the upper face of each bearing surface in the cylinder head.
- To the upper face of each bearing surface in each bearing cap.
- On the cam lobes **ONLY**, not on the base circle area.



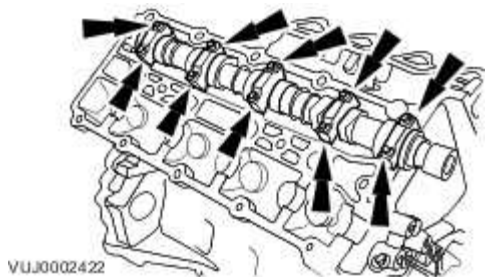
38 . Install the right-hand inlet camshaft.



39 .  **CAUTION:** Alternate bolt tightening to correctly seat the camshaft bearing caps.

Install the camshaft bearing cap bolts evenly.

- Tighten to 10 Nm.

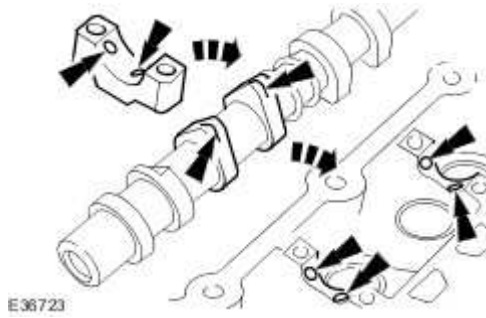


40 . **NOTE:**

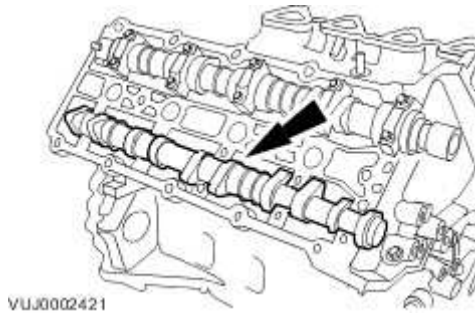
Make sure all components are clean.

Apply oil (EP-90) to the camshaft and bearing surfaces, as follows:

- To the upper face of each bearing surface in the cylinder head.
- To the upper face of each bearing surface in each bearing cap.
- On the cam lobes ONLY, not on the base circle area.



41 . Install the right-hand exhaust camshaft.



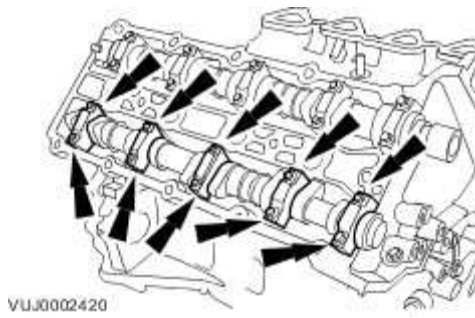
42 .



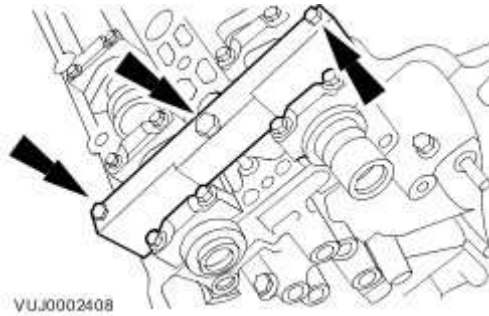
CAUTION: Alternate bolt tightening to correctly seat the camshaft bearing caps.

Install the camshaft bearing cap bolts evenly.

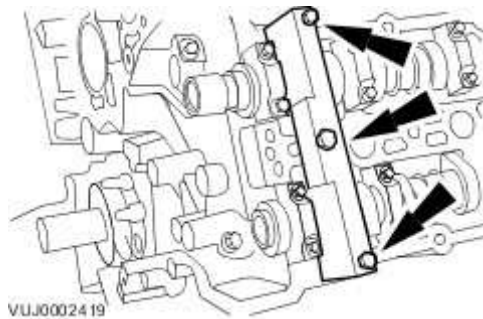
- Tighten to 10 Nm.



43 . Install the camshaft setting tool.



44 . Install the camshaft setting tool.



45



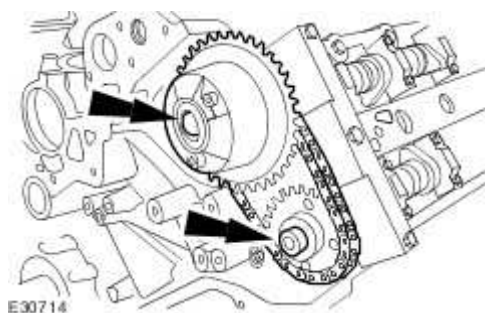
CAUTION: Do not tighten the camshaft sprocket retaining bolts.



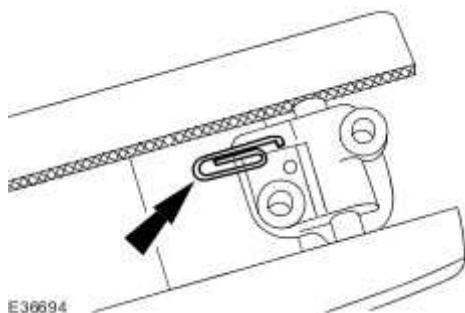
CAUTION: Make sure the secondary timing chain and camshaft sprockets are free to rotate.

Install the camshaft sprockets.

- Install the secondary timing chain tensioner and secondary timing chain to the camshaft sprockets.



46 . Using a suitable tool, retain the left-hand timing chain tensioner piston.

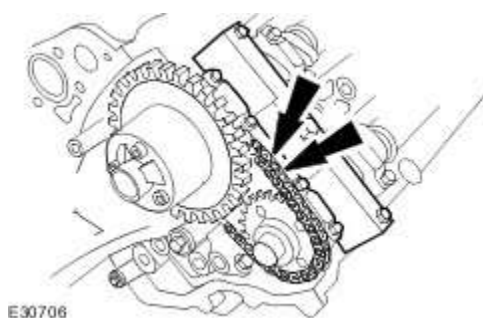


47 . Release the tension in the left-hand timing chain tensioner.

- Remove the retaining tool.

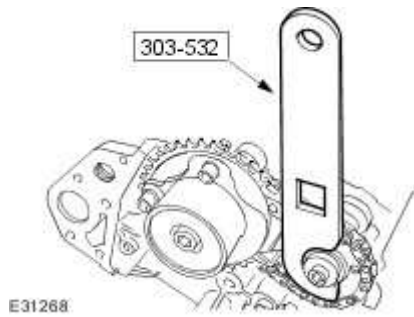
48 . Install the secondary timing chain tensioner.

- Tighten to 12 Nm.



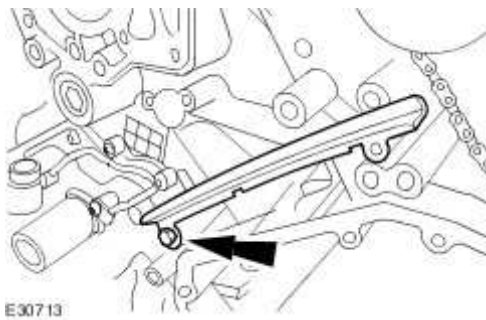
49 Install the timing chain tensioning tool 303-532 to the exhaust camshaft sprocket.

- Reposition the camshaft sprockets for the most advantageous position for use of the tool.

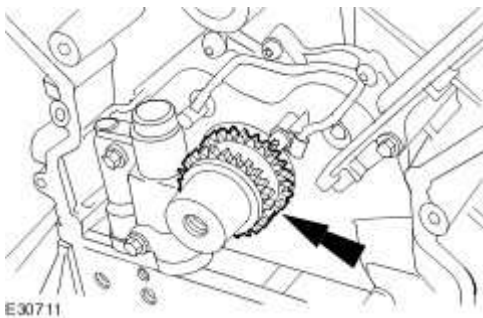


50 . Install the primary timing chain tensioner guide.

- Tighten to 12 Nm.



51 . Install the crankshaft sprocket.



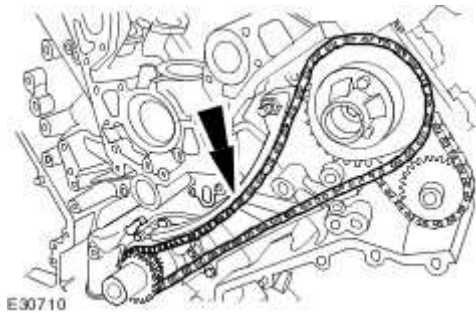
52



CAUTION: Make sure the timing chain slack is on the tensioned side of the timing chain.

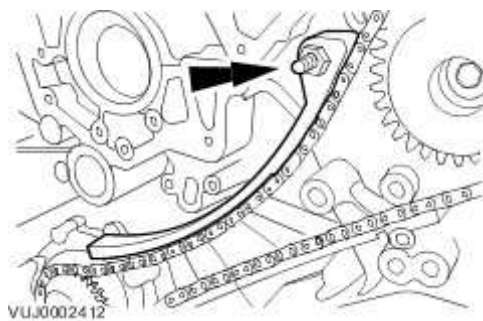
Install the primary timing chain.

- Install the primary chain over the crankshaft sprocket and the intake sprocket.



53 . Install the primary timing chain tensioner guide.

- Tighten to 12 Nm.

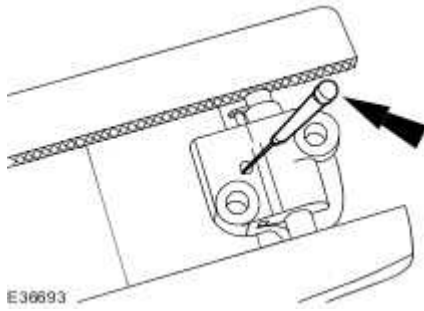


54



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.

Using a suitable tool, hold the left-hand timing chain tensioner ratchet lock mechanism away from the ratchet stem.



55 NOTE:

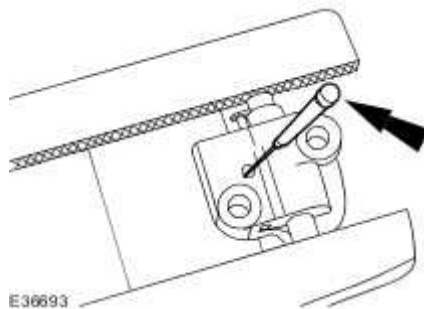
The timing chain tensioner piston should retract with minimal force. If binding occurs, reposition the timing chain tensioner to eliminate side loading.

Slowly compress the left-hand timing chain tensioner.

56 NOTE:

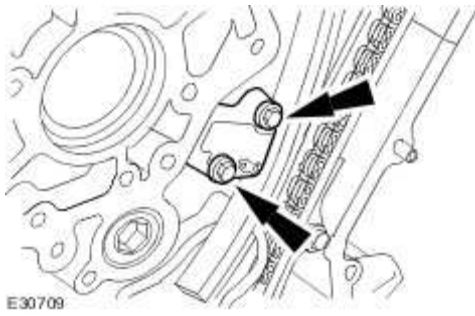
The retaining tool must remain in the timing chain tensioner until the timing chain tensioner is installed to the engine with the piston bottomed in the bore.

Using a suitable tool, retain the left-hand timing chain tensioner piston.



57 . Install the primary timing chain tensioner assembly.

- Tighten to 12 Nm.



58 . Release the tension in the left-hand timing chain tensioner.

- Remove the retaining tool.

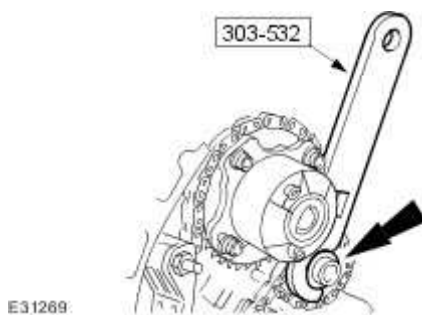
59



CAUTION: While applying the opposing force to sprocket and chain, tighten the sprocket bolt.

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

- Tighten to 20 Nm + 90 deg.



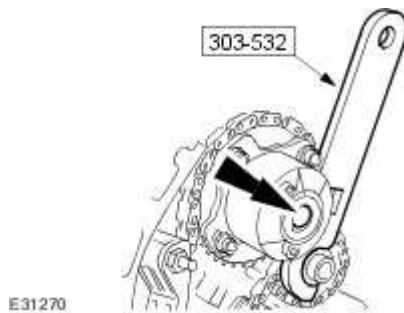
60



CAUTION: While applying the opposing force to sprocket and chain, tighten the sprocket bolt.

Using the special tool apply force to the tool in an anti-clockwise direction.

- Tighten to 20 Nm + 90 deg.



61



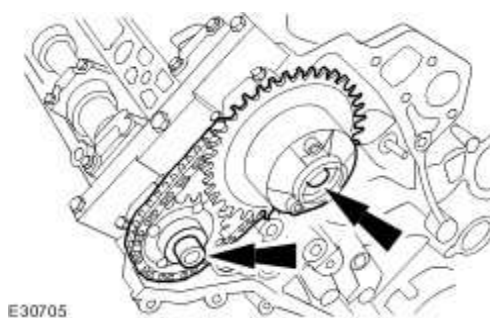
CAUTION: Do not tighten the camshaft sprocket retaining bolts.



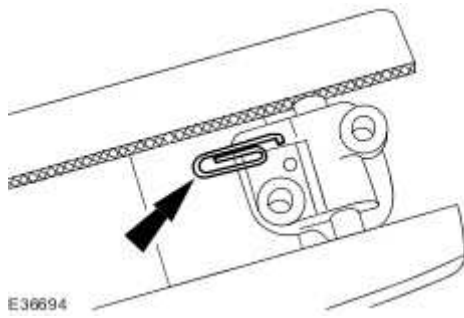
CAUTION: Make sure the secondary timing chain and camshaft sprockets are free to rotate.

Install the camshaft sprockets.

- Install the secondary timing chain tensioner and secondary timing chain to the camshaft sprockets.

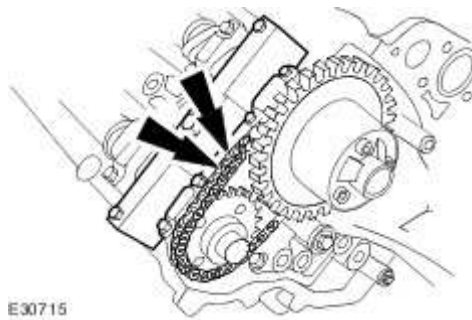


62 . Using a suitable tool, retain the right-hand timing chain tensioner piston.



63 . Install the secondary timing chain tensioner retaining bolts.

- Tighten to 12 Nm.

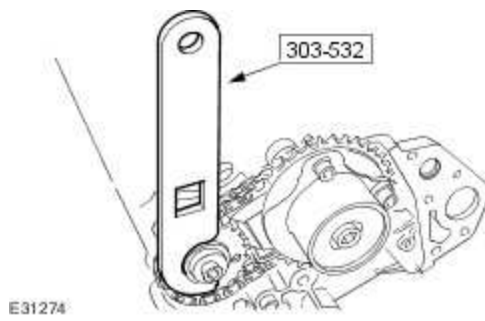


64 . Release the tension in the right-hand timing chain tensioner.

- Remove the retaining tool.

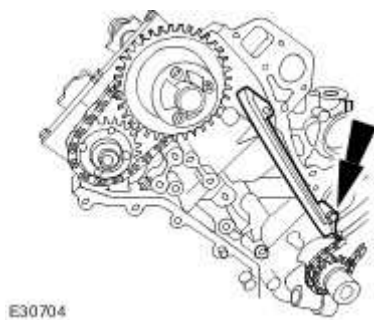
65 Install the timing chain tensioning tool 303-532 to the exhaust camshaft sprocket.

- Reposition the camshaft sprockets for the most advantageous position for use of the tool.



66 . Install the primary timing chain guide.

- Tighten to 12 Nm.



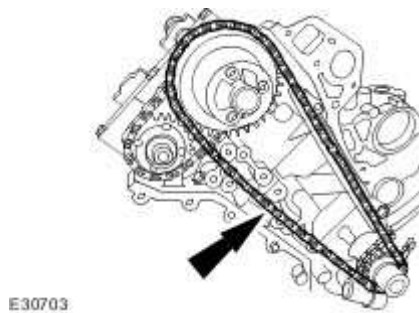
67



CAUTION: Make sure the timing chain slack is on the tensioned side of the timing chain.

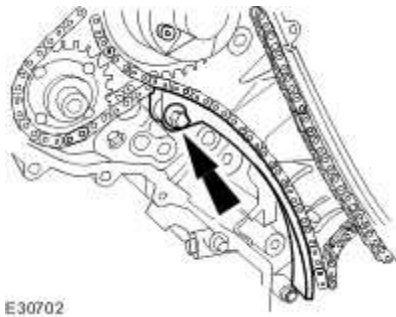
Install the primary timing chain.

- Install the primary chain over the crankshaft sprocket and the intake sprocket.



68 . Install the primary timing chain tensioner guide.

- Tighten to 12 Nm.

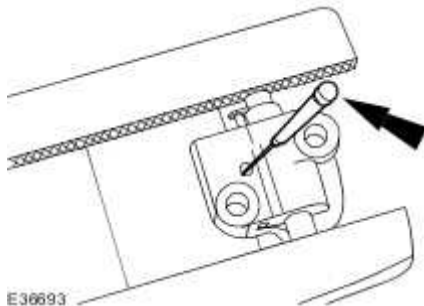


69



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.

Using a suitable tool, hold the right-hand timing chain tensioner ratchet lock mechanism away from the ratchet stem.



70 **NOTE:**

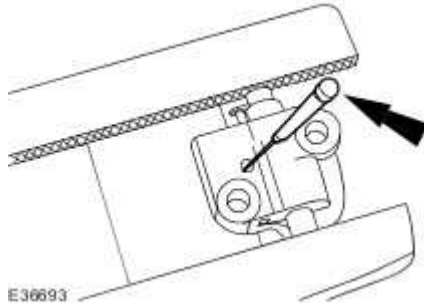
The timing chain tensioner piston should retract with minimal force. If binding occurs, reposition the timing chain tensioner to eliminate side loading.

Slowly compress the right-hand timing chain tensioner.

71 **NOTE:**

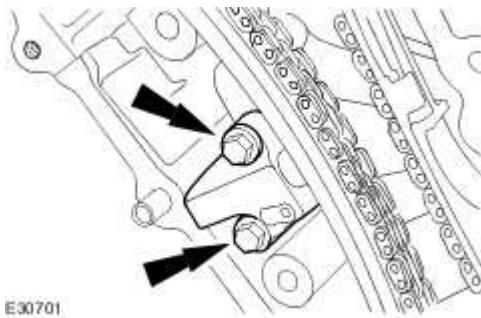
The retaining tool must remain in the timing chain tensioner until the timing chain tensioner is installed to the engine with the piston bottomed in the bore.

Using a suitable tool, retain the right-hand timing chain tensioner piston.



72 . Install the primary timing chain tensioner assembly.

- Tighten to 12 Nm.



73 . Release the tension in the right-hand timing chain tensioner.

- Remove the retaining tool.

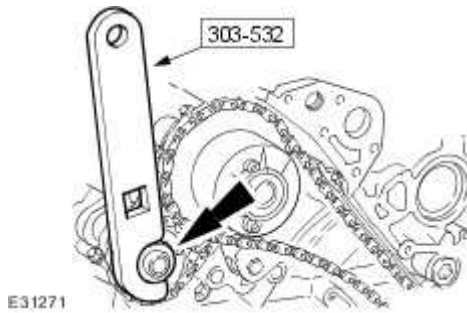
74



- **CAUTION: While applying the opposing force to sprocket and chain, tighten the sprocket bolt.**

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

- Tighten to 20 Nm + 90 deg.



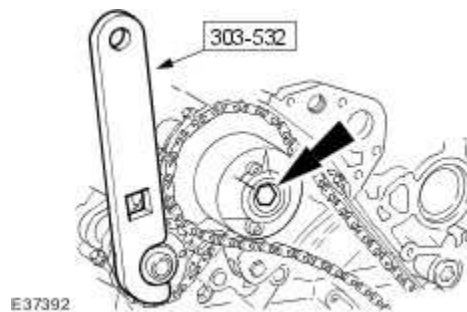
75



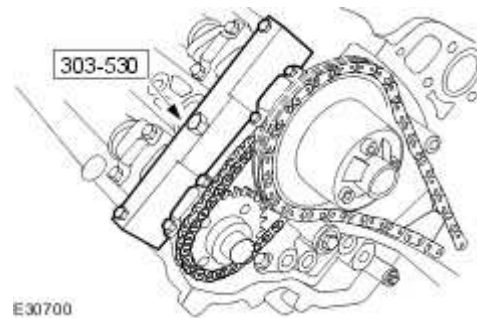
CAUTION: While applying the opposing force to sprocket and chain, tighten the sprocket bolt.

Using the special tool apply force to the tool in an anti-clockwise direction.

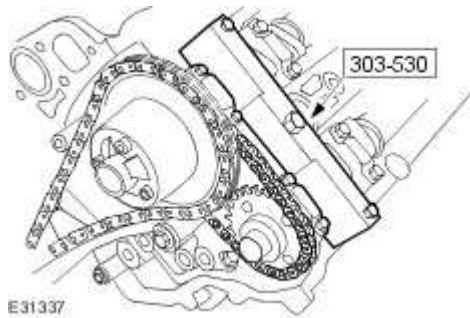
- Tighten to 20 Nm + 90 deg.



76 . Remove the special tool from the right-hand cylinder head.

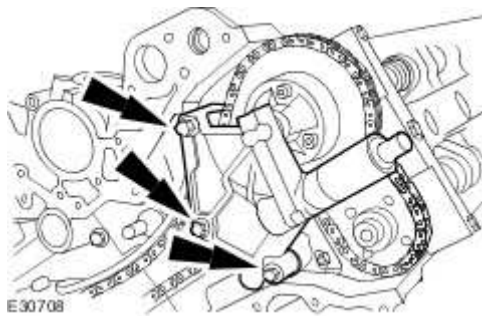


77 . Remove the special tool from the left-hand cylinder head.



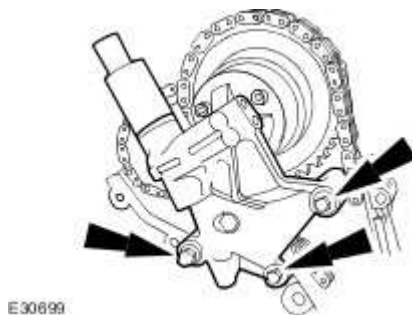
78 . Install the left-hand variable camshaft timing oil control unit housing.

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

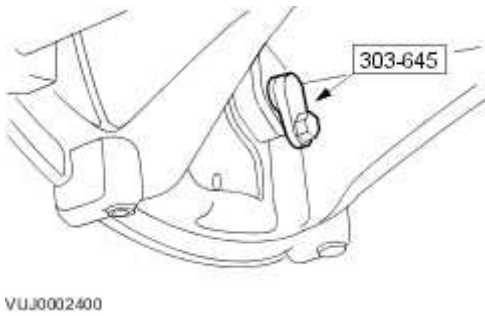


79 . Install the right-hand variable camshaft timing oil control unit housing.

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

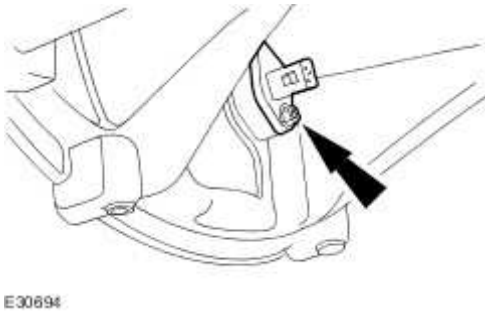


80 . Remove the special tool.



81 . Install the crankshaft position sensor.

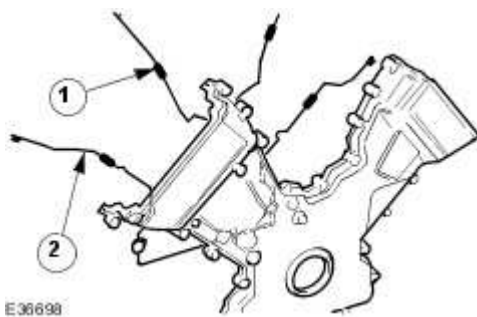
- Tighten to 10 Nm.



82 . Install new seals to the timing cover.

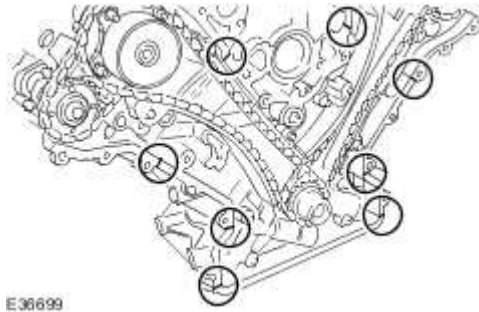
26. Install the new seal to the inner groove on the face of the timing cover.

27. Install the new seal to the outer groove on the face of the timing cover.



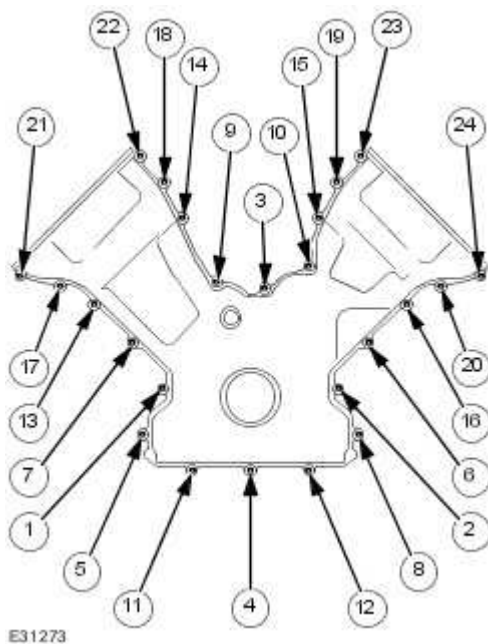
83 Apply sealant to the eight joints on the engine face.

- Sealant beads to be 3mm diameter and 12mm long. Cut the nozzle of the sealant tube to produce a 3 mm bead. (Install and tighten the securing bolts within twenty minutes of sealant application).



84 . Install the timing cover.

- Tighten in the sequence shown.
- Tighten to 13 Nm.



85 .

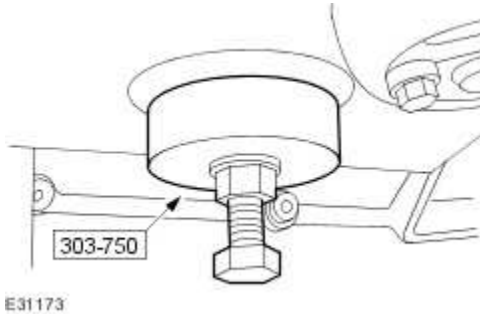


CAUTION: Make sure the crankshaft front seal mating faces are clean and dry.

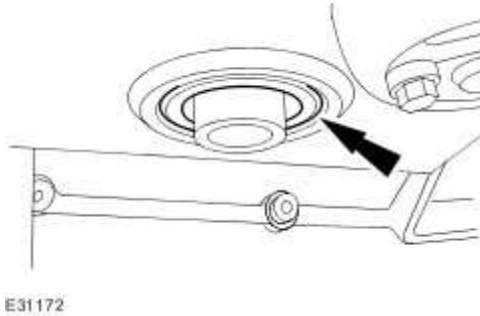


CAUTION: Do not remove the crankshaft front seal protector.

Using the special tool, install a new crankshaft front seal.



86 . Remove the crankshaft seal protector.



87 . Install a new O-ring seal to the crankshaft pulley.

- Lubricate the new O-ring.

88



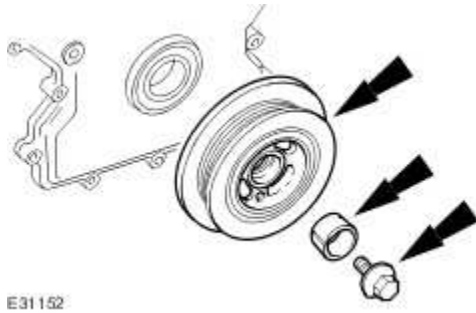
CAUTION: The screw thread in the crankshaft must be cleaned out before a new crankshaft pulley bolt is installed.



CAUTION: A new crankshaft pulley bolt must be used.

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

- Install the crankshaft pulley and locking ring to the crankshaft.



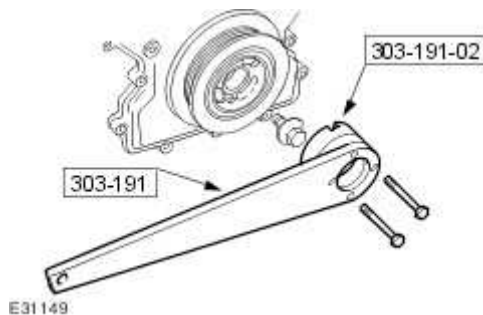
89



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

Using special tools, retain the crankshaft pulley.

- Tighten the crankshaft pulley retaining bolt to 375 Nm.



90 . Remove the special tools.

91 . Carry out a valve clearance check.

For additional information, refer to Valve Clearance Check (12.29.47)

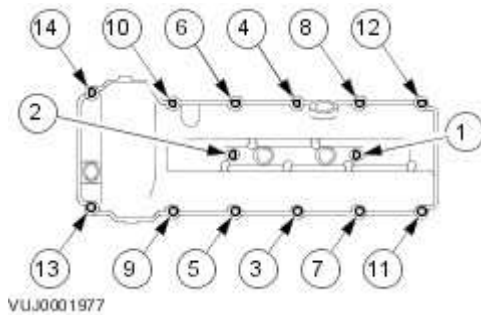
92 **NOTE:**

Apply an 8mm diameter bead of silicone gasket sealant on the two places where the

cylinder head and front cover join.

Install the left-hand valve cover.

- Install new valve cover gaskets.
- Tighten in the sequence shown.
- Tighten to 10 Nm.

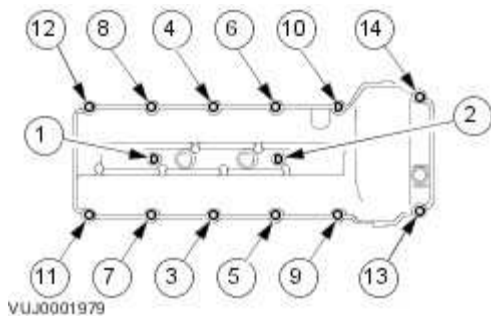


93 **NOTE:**

Apply an 8mm diameter bead of silicone gasket sealant on the two places where the cylinder head and front cover join.

Install the right-hand valve cover.

- Install new valve cover gaskets.
- Tighten in the sequence shown.
- Tighten to 10 Nm.

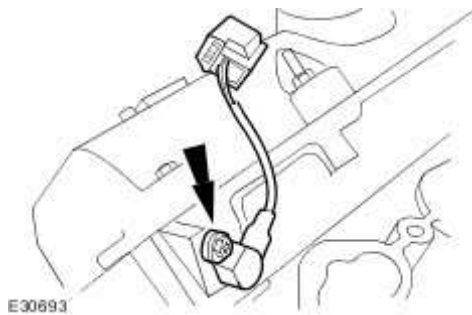


94 . Install the spark plugs.

- Tighten to 27 Nm.

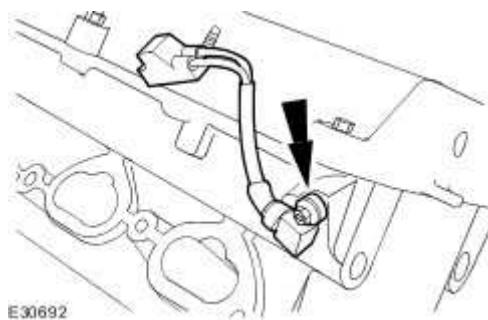
95 . Install the left-hand camshaft position (CMP) sensor.

- Install a new O-ring seal.
- Tighten to 7 Nm.



96 . Install the right-hand camshaft position (CMP) sensor.

- Install a new O-ring seal.
- Tighten to 7 Nm.

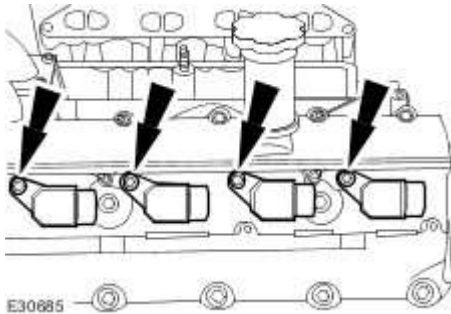


97 . **NOTE:**

Left-hand shown, right-hand similar

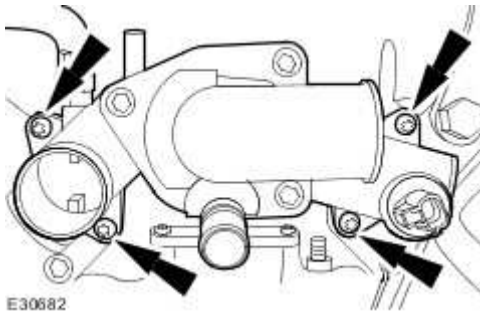
Install the ignition coils.

- Tighten to 5 Nm.



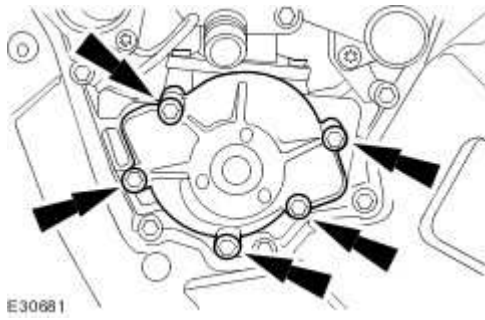
98 . Install the thermostat housing.

- Install new O-ring seals.
- Tighten to 10 Nm.



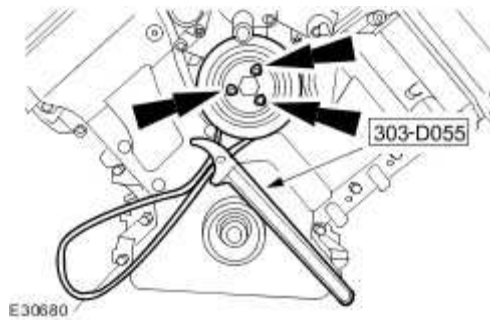
99 . Install the water pump.

- Install new O-ring seals and gaskets.
- Tighten to 12 Nm.

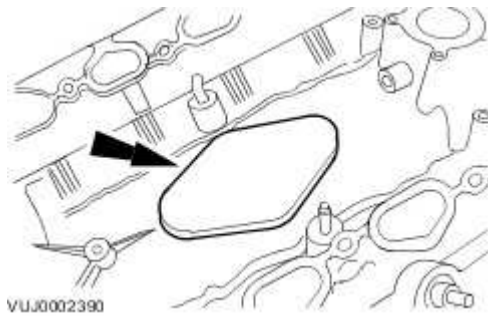


100 . Install the water pump pulley.

- Using special tool, retain the water pump pulley.
- Tighten to 10 Nm + 45°.



101 . Install the engine block insulation grommet.

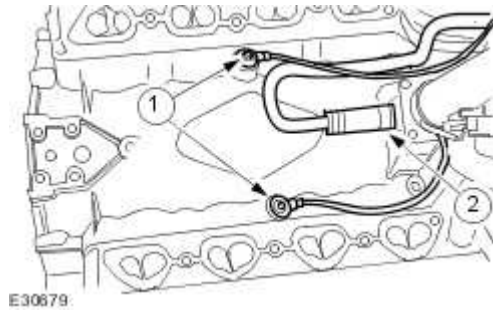


102 . Install the intake manifold heater coolant hose.

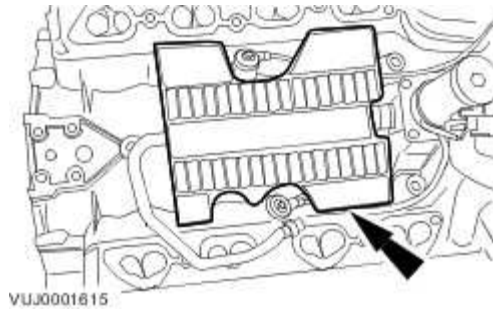
28. Install the knock sensors.

- Tighten to 20 Nm.

29. Install the intake manifold heater coolant hose.

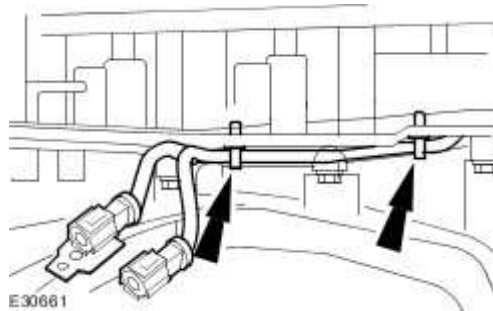


103 . Install the noise and vibration insulating pad.



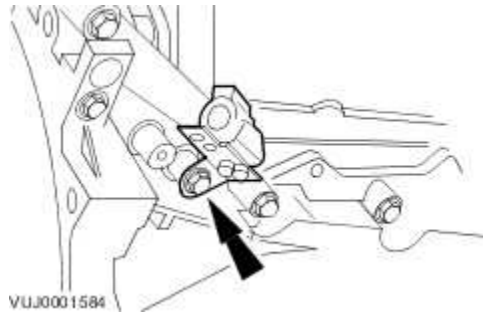
104 . Install the engine wiring harness.

105 . Attach the engine wiring harness retaining clips.



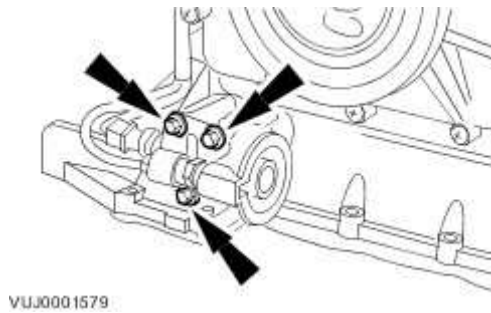
106 . Attach the right-hand oxygen sensor.

- Tighten to 10 Nm.

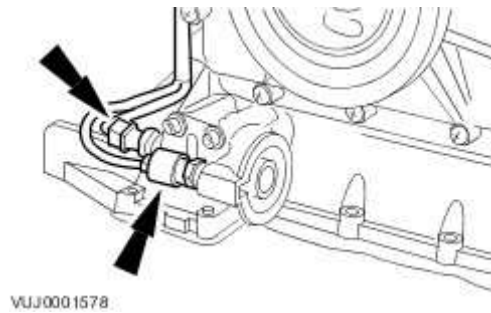


107 . Install the oil filter housing.

- Install a new O-ring seal.
- Tighten to 21 Nm.

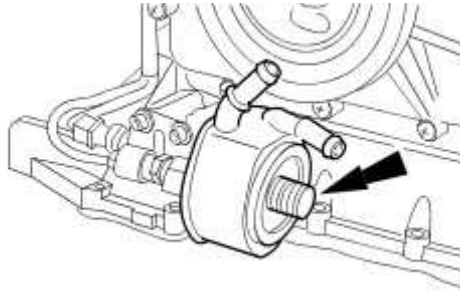


108 . Connect the oil pressure switch and oil temperature sensor electrical connectors.



109 . Install the oil cooler.

- Install a new O-ring seal.
- Tighten to 55 Nm.



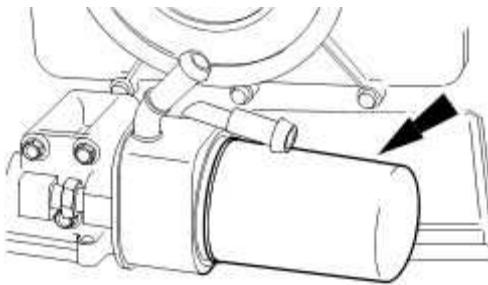
VUJ0001577

110 . **NOTE:**

Apply a suitable amount of clean engine oil to lubricate the oil filter O-ring seal.

Install a new oil filter.

- Tighten to 18 Nm.

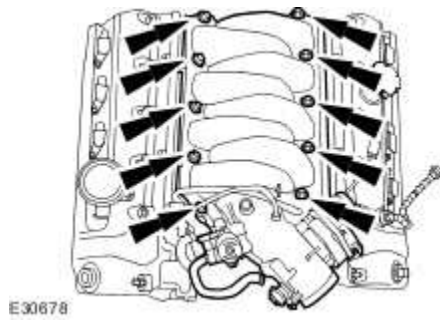


VUJ0001578

111 .

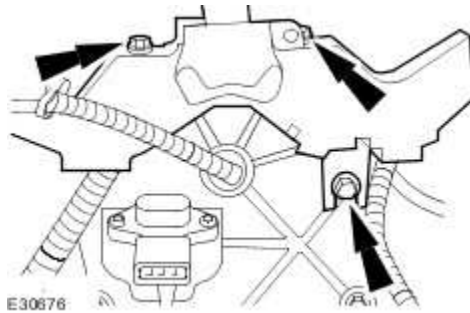
112 . Install the intake manifold.

- Tighten to 22 Nm.



113 . Attach the engine wiring harness.

- Tighten to 10 Nm.

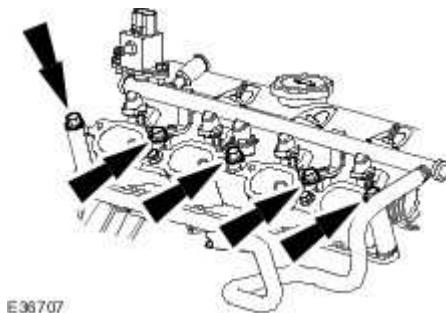


114 . **NOTE:**

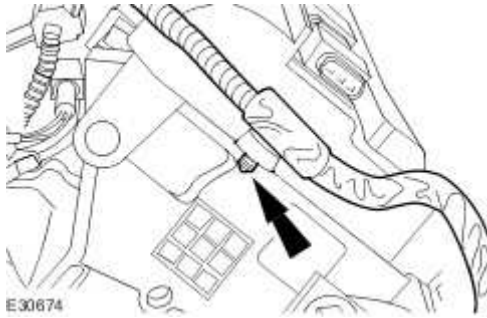
Left-hand shown, right-hand similar.

Install the lower intake manifold.

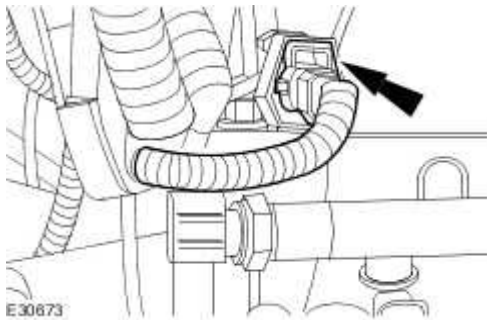
- Tighten to 22 Nm.



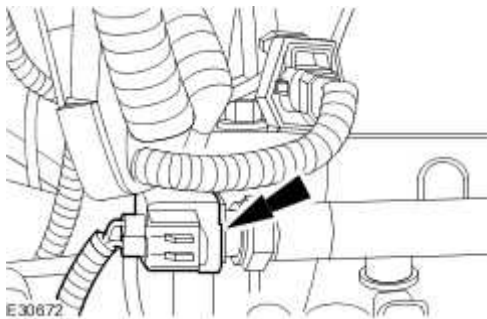
115 . Attach the engine wiring harness.



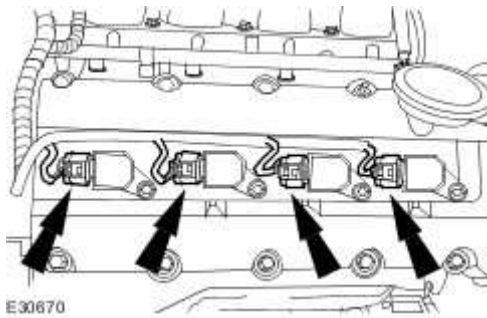
116 . Connect the camshaft position sensor electrical connector.



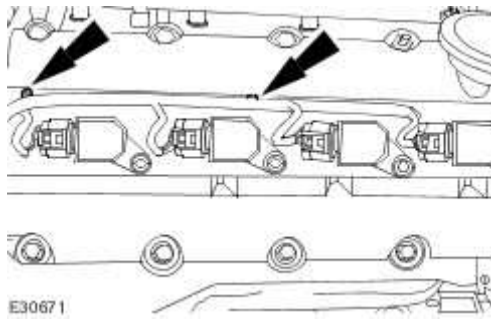
117 . Connect the fuel temperature sensor electrical connector.



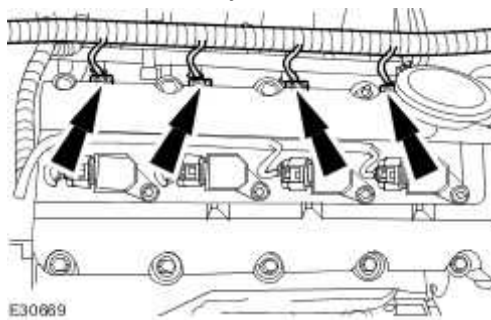
118 . Connect the ignition on-plug coil electrical connectors.



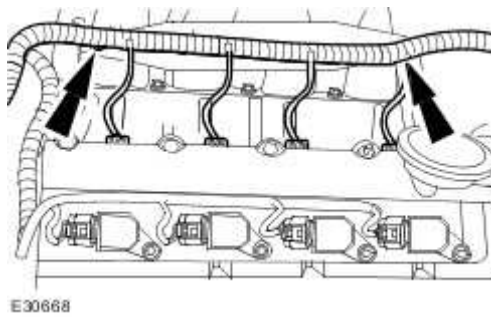
119 . Attach the engine wiring harness.



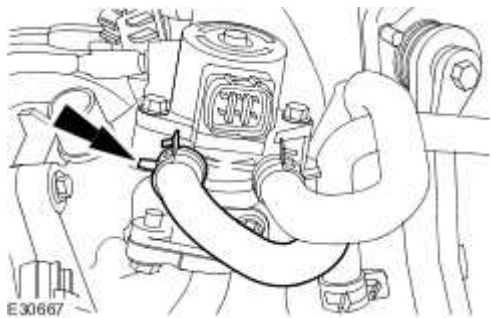
120 . Connect the fuel injector electrical connectors.



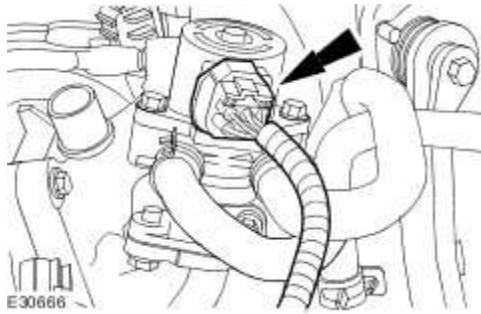
121 . Attach the engine wiring harness.



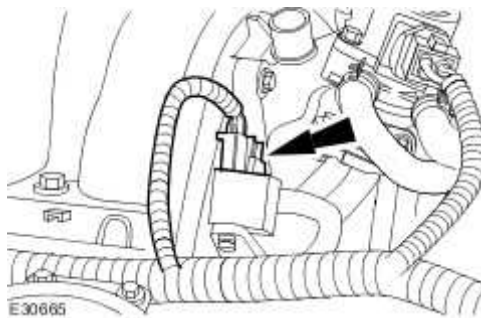
122 . Connect the exhaust gas recirculation valve coolant hose.



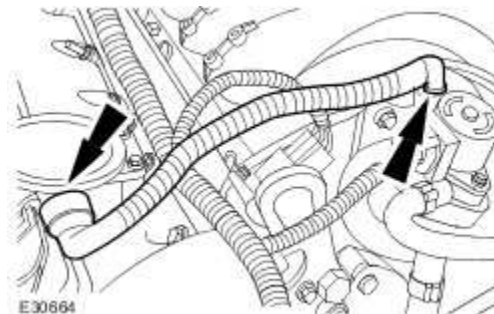
123 . Connect the exhaust gas recirculation valve electrical connector.



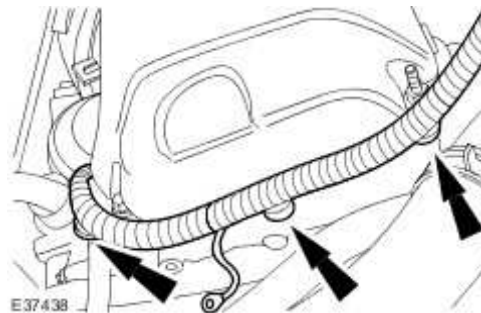
124 . Connect the fuel pressure regulator electrical connector.



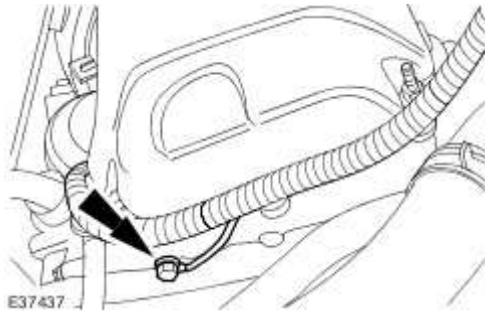
125 . Connect the positive crankcase ventilation pipe.



126 . Attach the engine wiring harness.



127 . Attach the engine wiring harness.

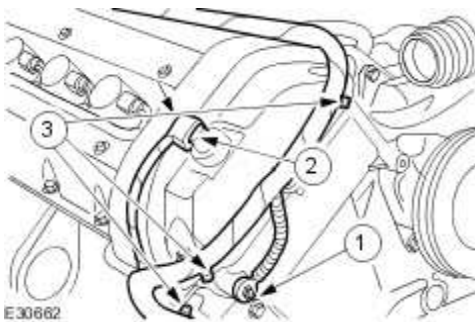


128 . Attach the engine harness.

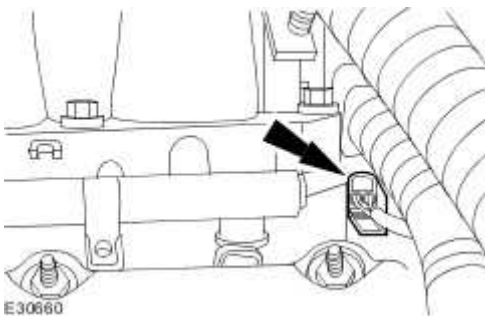
30. Connect the earth wire.

31. Connect the variable valve timing (VVT) solenoid electrical connector.

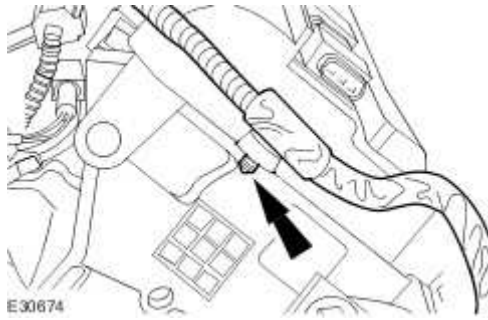
- Attach the engine harness.



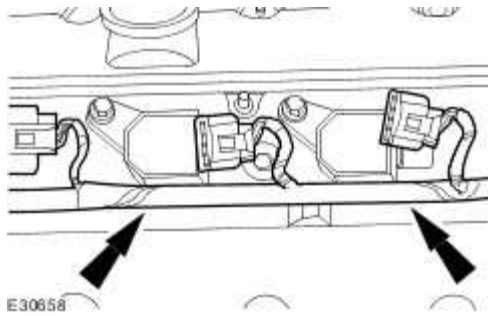
129 . Connect the camshaft position sensor electrical connector.



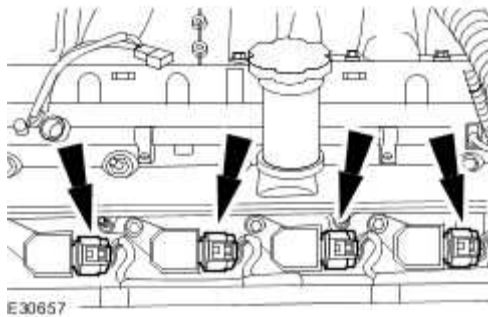
130 . Attach the engine wiring harness.



131 . Attach the engine wiring harness.



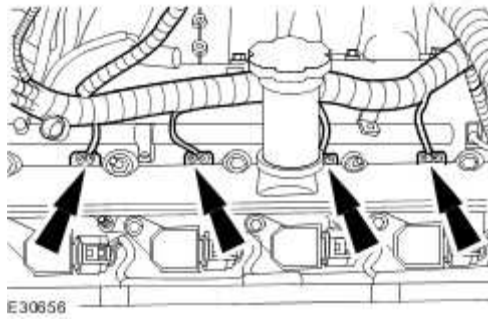
132 . Connect the ignition on-plug coil electrical connectors.



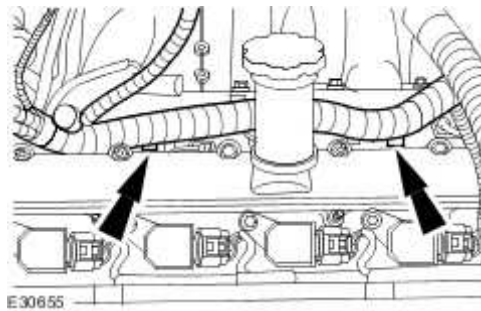
133 . **NOTE:**

Left-hand shown, right hand similar.

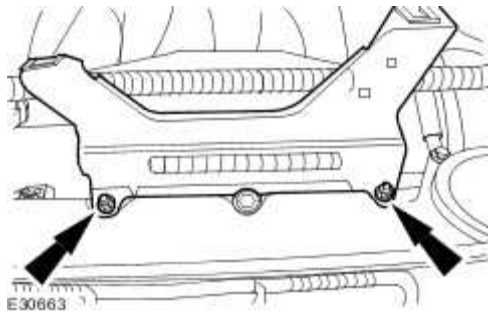
Connect the fuel injector electrical connectors.



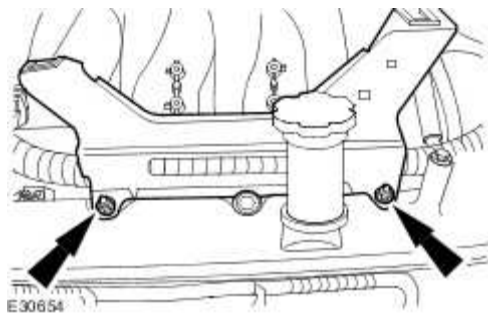
134 . Attach the engine wiring harness.



135 . Install the engine cover retaining bracket.



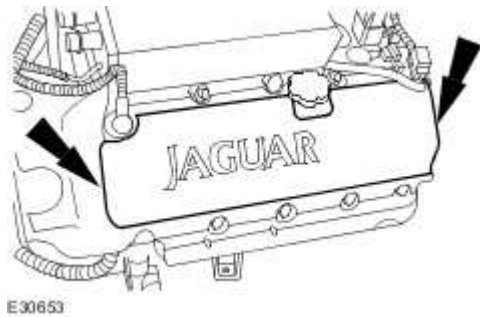
136 . Install the engine cover retaining bracket.



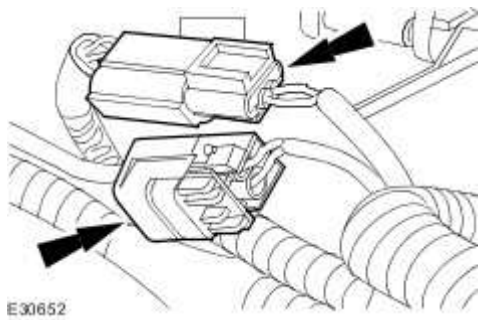
137 . **NOTE:**

Left-hand shown, right-hand similar.

Install the ignition coil cover.



138 . Connect the knock sensor electrical connectors.

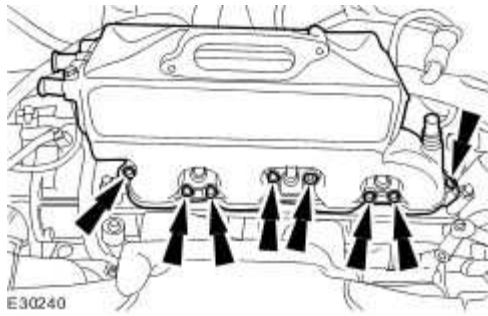


139 . **NOTE:**

Right-hand shown, left-hand similar.

Install the charge air coolers.

- Install a new charge air cooler gasket.
- Tighten to 13 Nm.

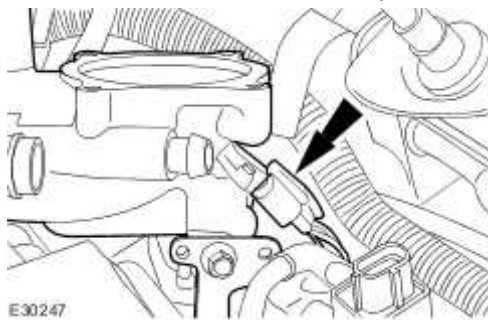


140 . Install the supercharger.

- Tighten to 24 Nm.

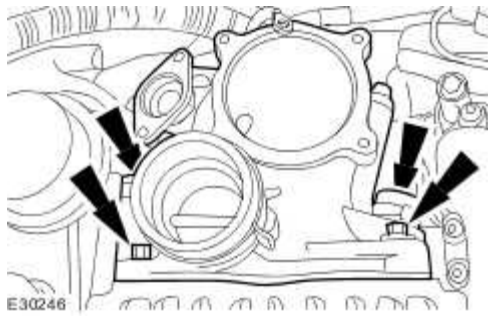


141 . Connect the manifold absolute pressure (MAP) sensor.



142 . Install the air intake elbow.

- Install a new gasket.
- Install new retaining bolt seals.
- Tighten to 24 Nm.

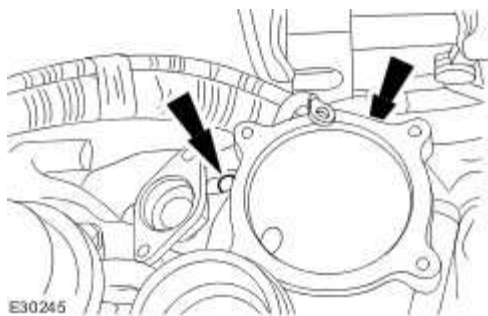


143 . **NOTE:**

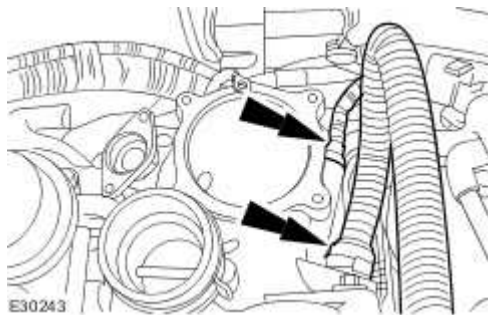
Make sure ground strap is correctly installed to the location noted.

Install the air intake elbow retaining bracket lower retaining bolts.

- Tighten to 20 Nm.



144 . Connect the air intake elbow pipes.



145

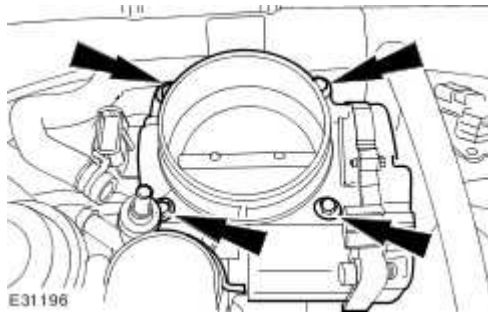


CAUTION: Do not attempt to clean the throttle body. The bore and the throttle

plate has a special coating applied during manufacture which should not be removed.

Install the throttle body.

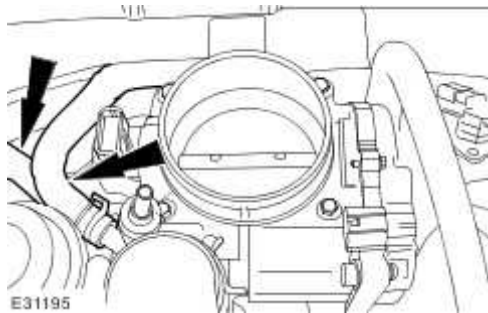
- Install a new throttle body gasket.
- Tighten to 10 Nm.



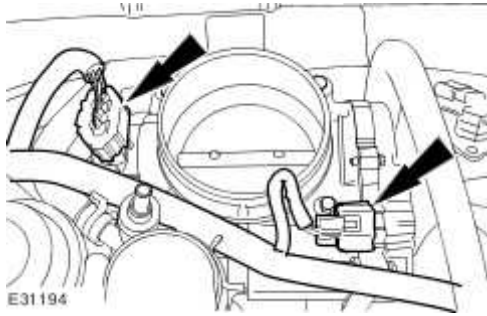
146 . **NOTE:**

Un-cap the coolant hose.

Attach the coolant hose to the throttle body.

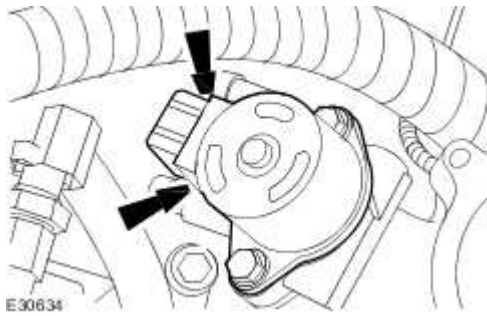


147 . Connect the electrical connectors.

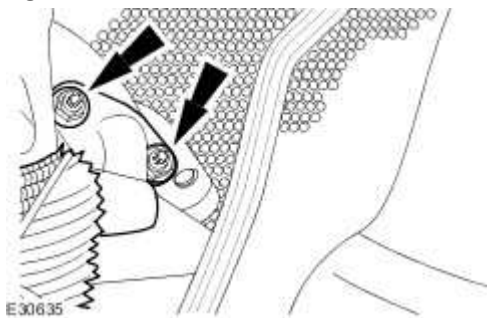


148 . Install the EGR valve and the exhaust manifold to EGR valve tube.

- Install a new exhaust manifold to EGR valve tube gasket.
- Install a new EGR valve to air intake elbow gasket.
- Tighten to 10 Nm.



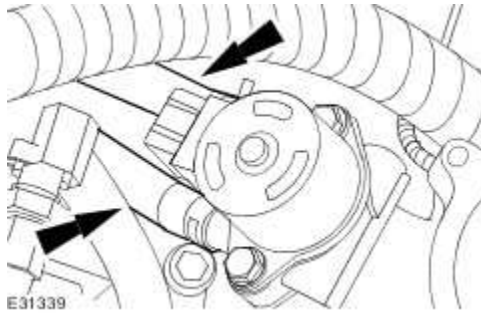
149 . Tighten to 21 Nm.



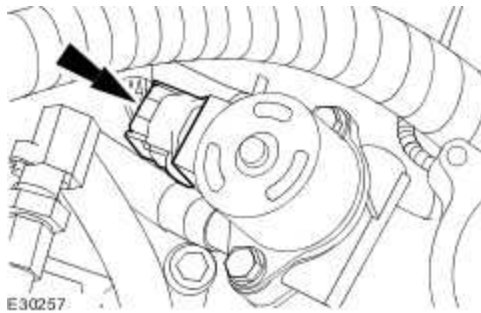
150 . **NOTE:**

Un-cap the exposed ports.

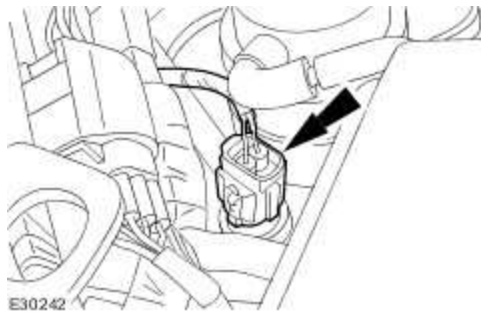
Connect the coolant hoses.



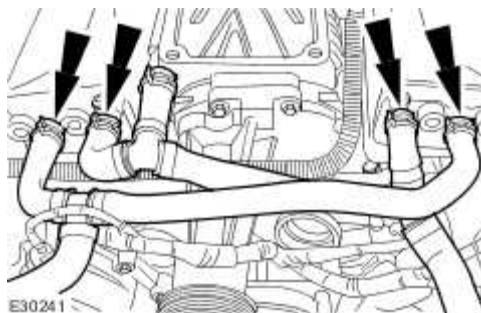
151 . Connect the exhaust gas recirculation (EGR) valve electrical connector.



152 . Connect the IAT sensor electrical connector.



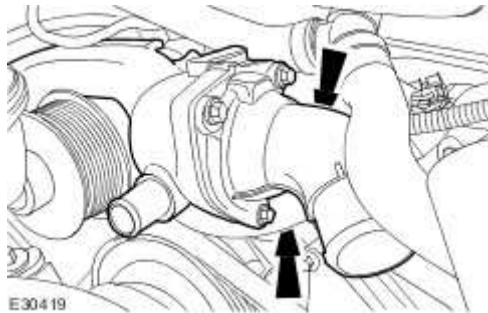
153 . Connect the charge air cooler coolant pipes.



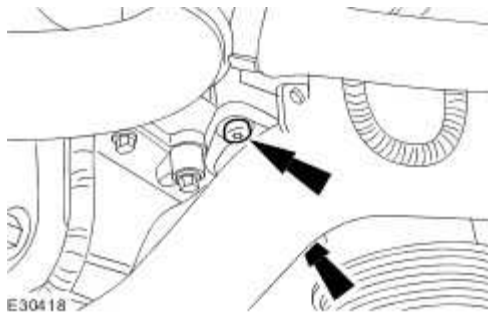
154 . Install new O-ring seals to the thermostat housing.

155 . Install thermostat housing.

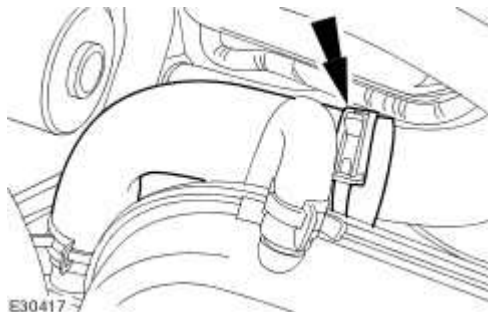
156 . Tighten to 10 Nm.



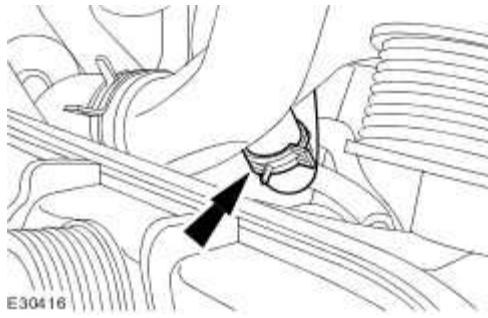
157 . Tighten to 10 Nm.



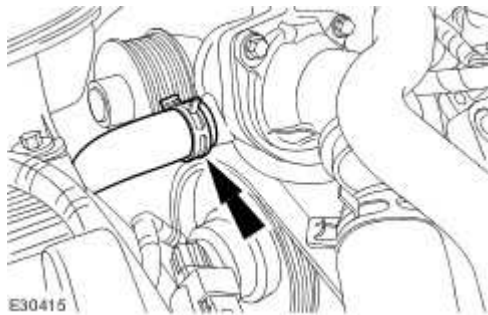
158 . Connect the hose.



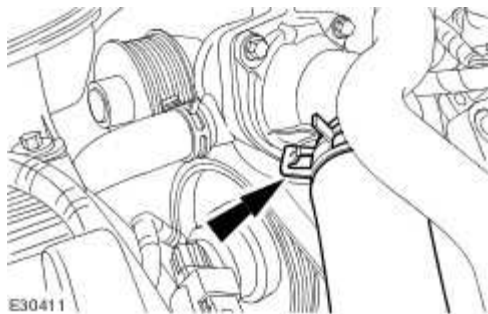
159 . Connect the hose.



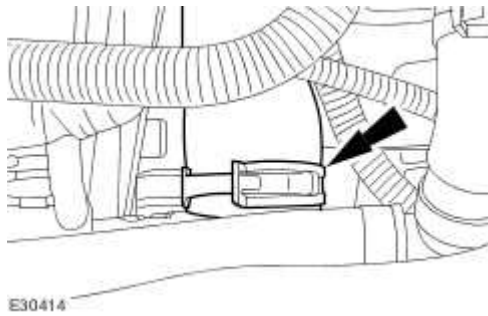
160 . Connect the hose.



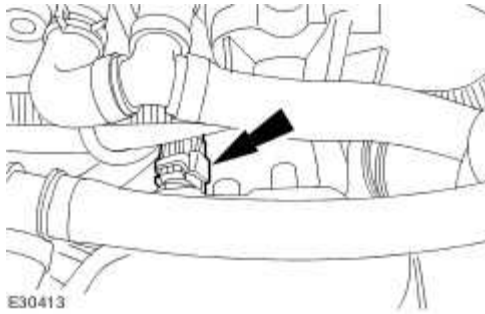
161 . Connect the hose.



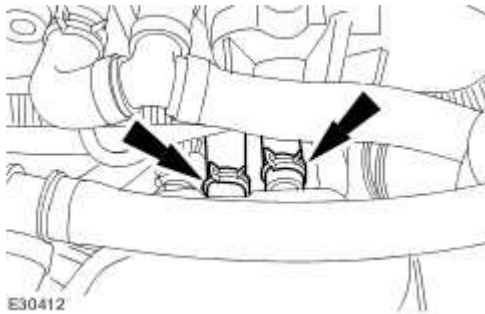
162 . Reposition the thermostat housing hose retaining clip.



163 . Connect the coolant temperature sensor electrical connector.

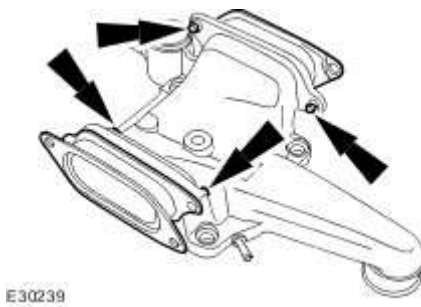


164 . Connect the thermostat housing hoses



165 . Install new supercharger outlet pipe to charge air coolers ducts.

- Tighten to 8 Nm.



166 . Install a new supercharger outlet pipe gasket.

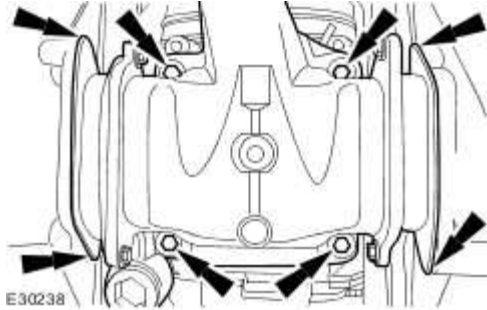
167 . Install new seals to the supercharger outlet pipe retaining bolts

168 .



CAUTION: Make sure no foreign matter enters the supercharger.

Install the supercharger outlet pipe



169 . **NOTE:**

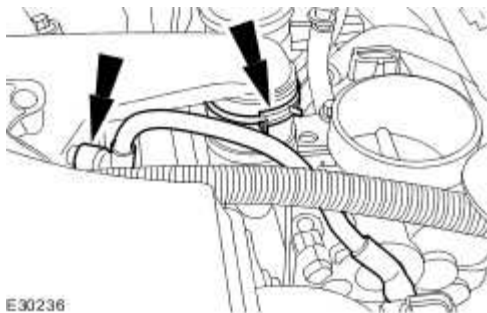
Un-cap the coolant ports.

Attach the supercharger outlet pipe coolant hose.

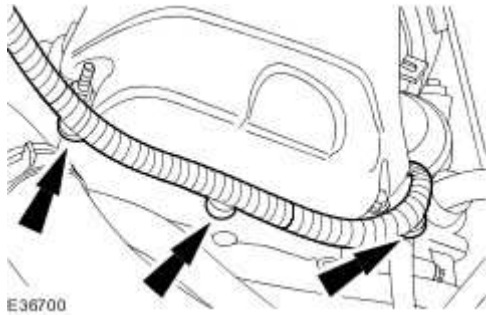


170 . Attach the hoses.

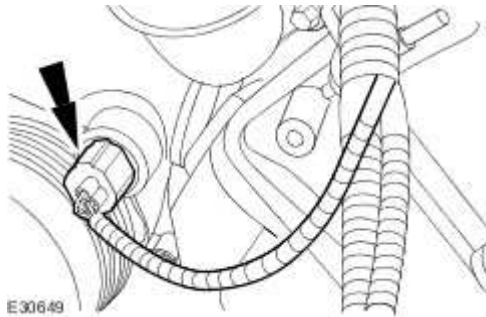
- Reposition the hose retaining clip.



171 . Attach the engine wiring harness.



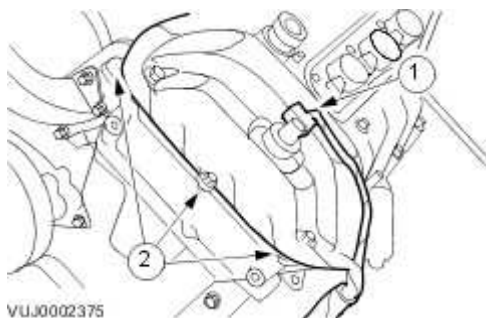
172 . Connect the coolant temperature sensor electrical connector.



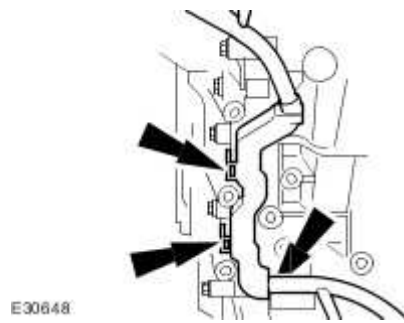
173 . Attach the engine wiring harness.

32. Connect the variable valve timing (VVT) solenoid electrical connector.

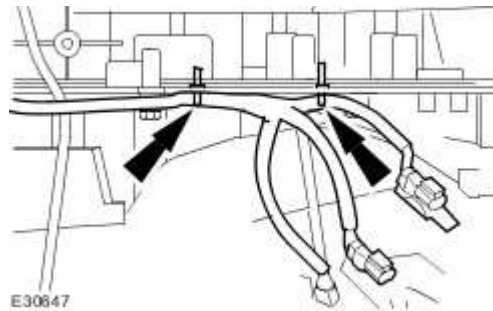
33. Attach the engine wiring harness.



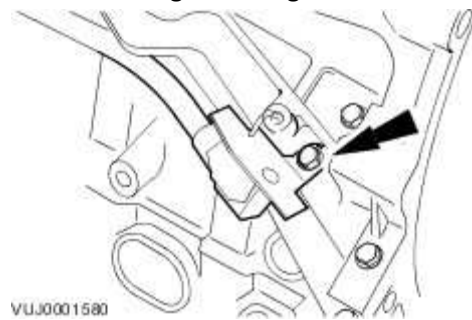
174 . Attach the engine wiring harness.



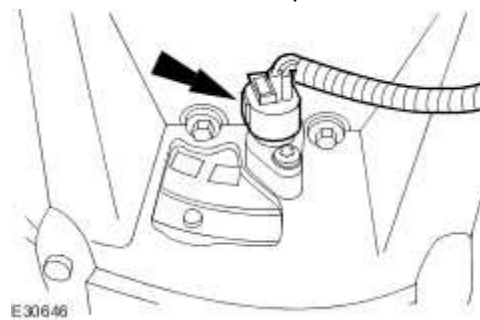
175 . Attach the engine wiring harness.



176 . Attach the engine wiring harness.

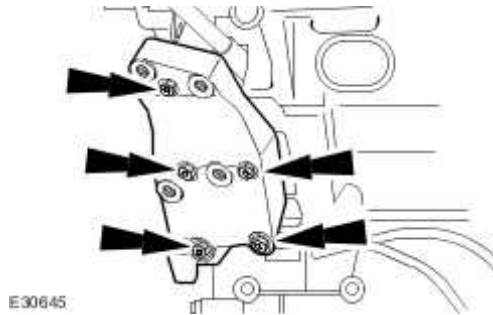


177 . Connect the crankshaft position sensor electrical connector.



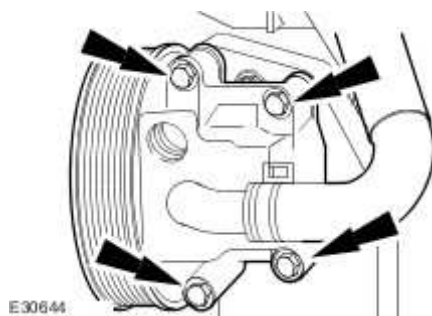
178 . Install the power steering pump mounting bracket.

- Tighten to 25 Nm.



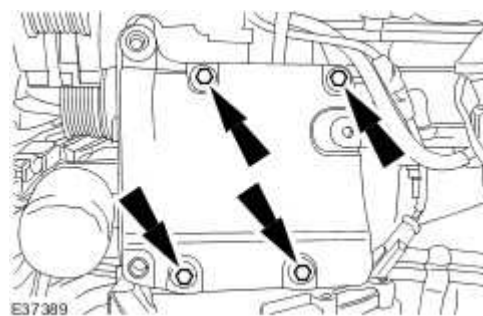
179 . Install the power steering pump.

- Tighten to 25 Nm.



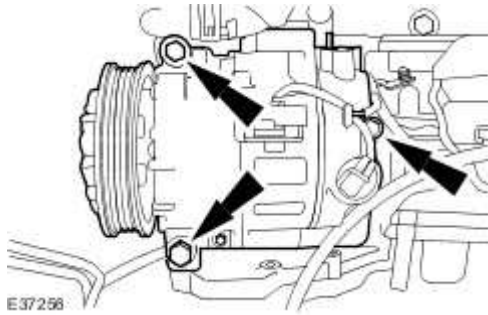
180 . Install the air conditioning compressor mounting bracket.

- Tighten to 25 Nm.

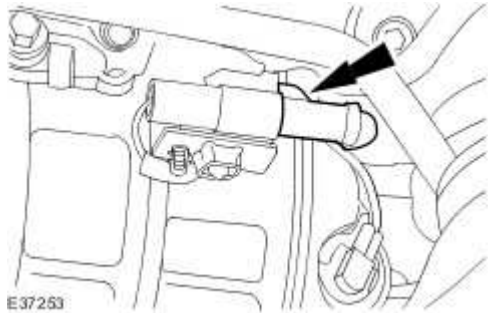


181 . Install the A/C compressor.

- Tighten to 25 Nm.

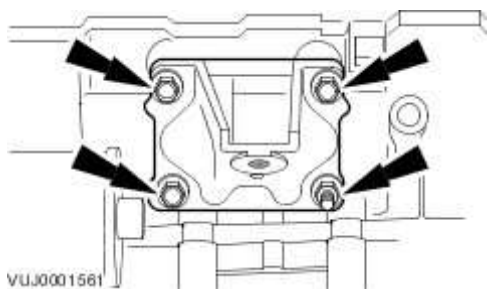


182 . Connect the air conditioning compressor electrical connector.



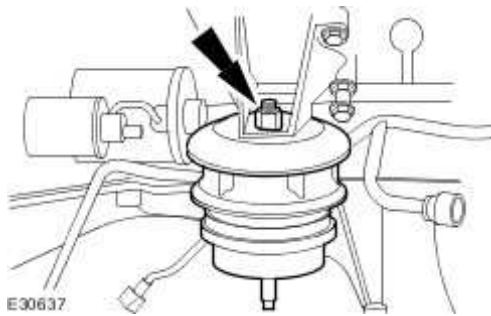
183 . Install the left-hand engine mounting bracket.

- Tighten to 25 Nm.



184 . Install the left-hand engine mount.

- Tighten to 43 Nm.



185



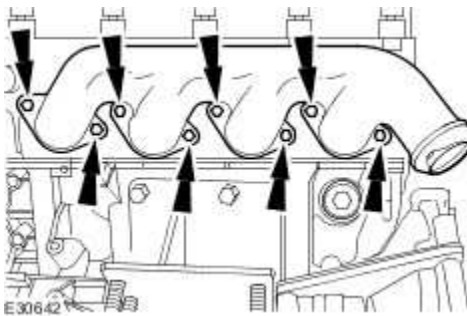
CAUTION: Make sure the exhaust manifold and gasket are correctly aligned to the cylinder head.



CAUTION: Make sure the exhaust manifold torque is checked after initial tighten.

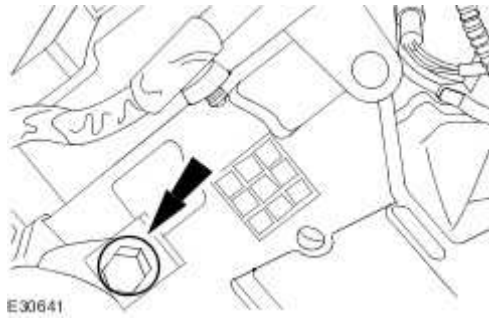
Install the left-hand exhaust manifold.

- Install a new gasket.
- Tighten to 20 Nm.



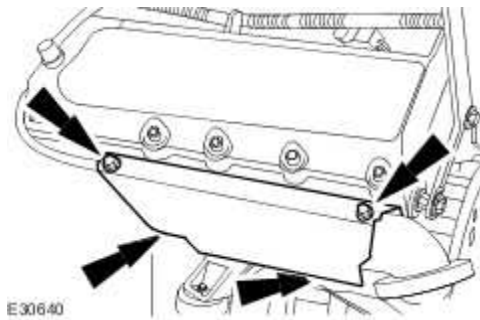
186 . Install the heat shield retaining bolt.

- Tighten to 50 Nm.



187 . Install the heat shield.

- Tighten to 3 Nm.



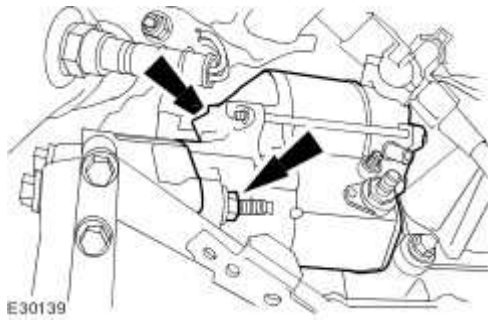
188 . Install the oil level indicator and tube.

- Install a new O-ring seal.
- Tighten to 6 Nm.

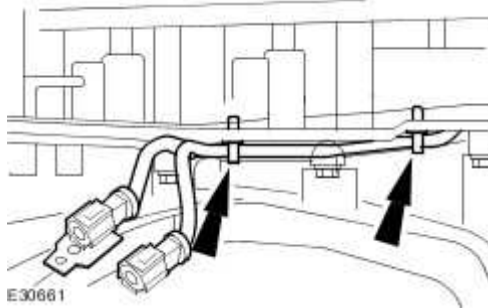


189 . Install the starter motor.

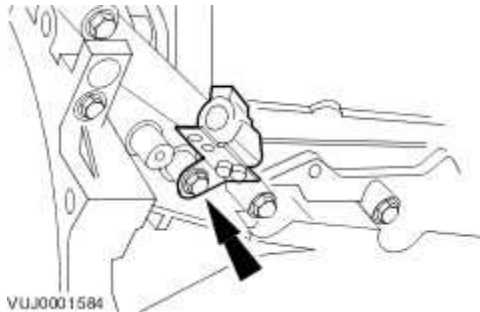
- Tighten to 45 Nm.



190 . Attach the engine wiring harness.

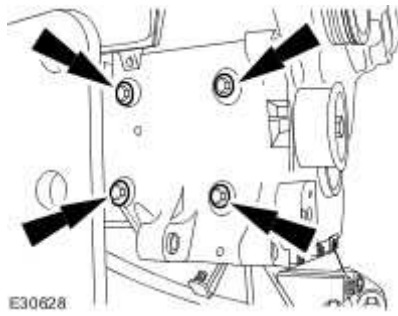


191 . Attach the right hand oxygen sensor retaining bracket.

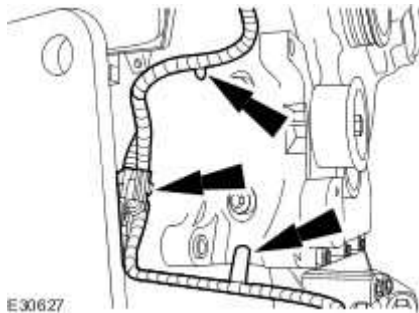


192 . Install the generator mounting bracket.

- Tighten to 45 Nm.

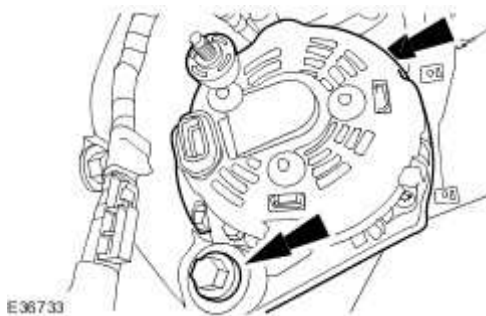


193 . Attach the engine wiring harness.

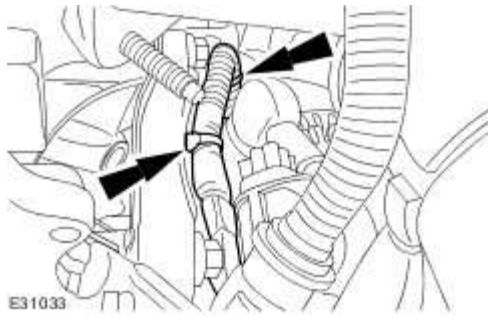


194 . Install the generator.

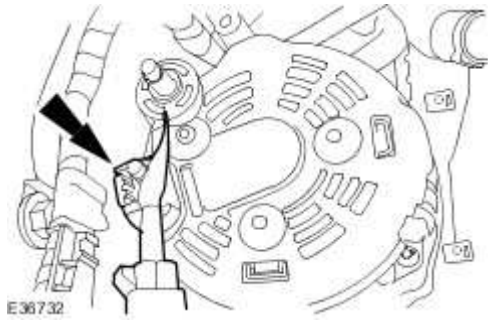
- Tighten the generator upper retaining bolt to 21 Nm.
- Tighten the generator lower retaining bolt to 40 Nm.



195 . Attach the wiring harness.

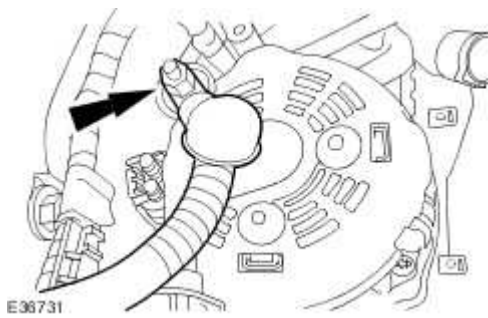


196 . Connect the generator electrical connector.

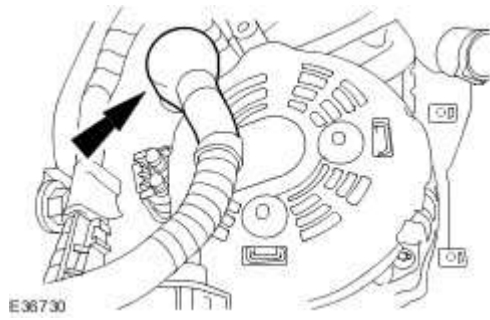


197 . Attach the generator battery positive cable.

- Tighten to 12 Nm

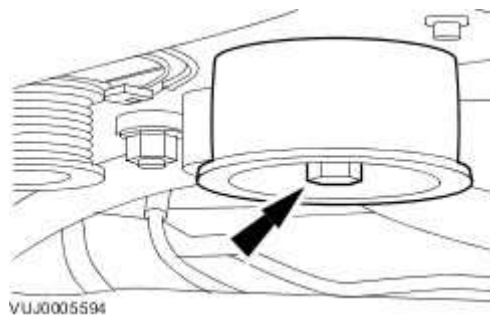


198 . Attach the generator battery positive cable protective cover.



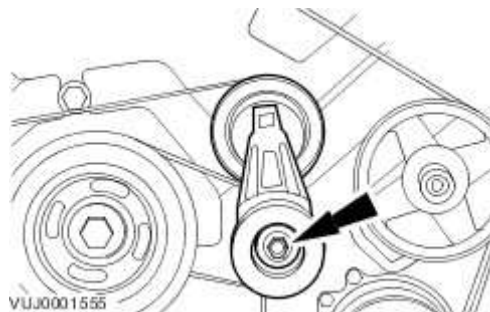
199 . Install the accessory drive belt idler pulley.

- Tighten to 25 Nm.



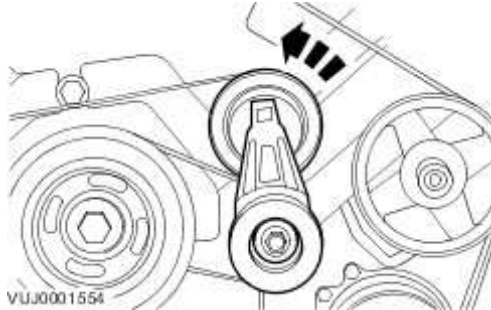
200 . Install the accessory drive belt tensioner.

- Install the accessory drive belt.
- Tighten to 45 Nm.



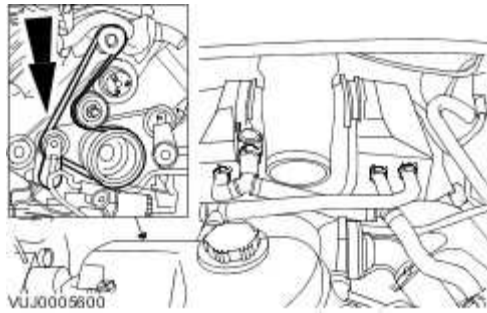
201 . Attach the accessory drive belt.

- Use a 3/8 inch square drive bar to rotate the drive belt tensioner.
- Attach the accessory drive belt.



202 . Install the supercharger belt.

- Use a 1/2 inch square drive bar to rotate the supercharger belt tensioner.



203 . Connect the oil cooler hoses.



303-01B : Engine – 4.2L NA V8 – AJV8

Specifications

Specifications

Engine Data

Engine Description	Engine Capacity	Maximum Engine Torque (DIN)	Maximum Engine Power (DIN)	Maximum Engine Torque (EC and SAE)	Maximum Engine Torque (EC and SAE)	Compression Ratio	Bore	Stroke
90° 'Vee' 8 Cylinder 32 Valves	4196 cm ³	420 Nm at 4100 RPM	300 BHP / 224 kW / 304 PS at 6000 RPM	410.8 Nm at 4100 RPM	293.5 BHP / 218.9 kW / 298 PS at 6000 RPM	11.0:1 ± 0.5:1	86.0 mm	90.3 mm

Engine Firing Order

Firing Order
1 : 2 : 7 : 3 : 4 : 5 : 6 : 8

Engine Valve Clearance (cold)

Intake Valve	Exhaust Valve
0.18 - 0.22 mm	0.23 - 0.27 mm

Spark Plugs

Specification	Spark Plug Gap
AJ8 4575	0.9 - 1.0 mm

Lubricants, Fluids, Sealers and Adhesives

Description	Specification
Core plug and stub pipe retainer	WSK-M2G349-A4
Engine oil, SAE 5W-30	WSS-M2C-913B
Sealant	WSE-M4G323-A4

Capacities

Description	Liters
Engine oil, initial fill	7.8
Engine oil, service fill with oil filter change	7.0

Cylinder head and Valvetrain

Item	Specification
Cylinder head maximum permitted warp (mm)	0.125
Valve guide inner diameter (mm)	5.00 - 5.02
Intake valve effective length (mm)	88.87 - 89.17
Exhaust valve effective length (mm)	88.40 - 88.70
Valve stem to guide clearance intake decimetrical (mm)	0.022 - 0.057
Valve stem to guide clearance exhaust decimetrical (mm)	0.030 - 0.065
Valve head diameter intake (mm)	34.8 - 35.0
Valve head diameter exhaust (mm)	30.8 - 31.0
Intake valve face angle (degrees)	45° 15' 30" ± 7° 30'
Exhaust valve face angle (degrees)	45° - 44° 45'
Valve stem diameter intake (mm)	4.963 - 4.978
Valve stem diameter exhaust (mm)	4.955 - 4.970
Valve spring free length (mm)	43.5 MAX
Valve spring installed height (mm)	33.20
Camshaft lobe lift intake (mm)	8.50
Camshaft lobe lift exhaust (mm)	8.50
Camshaft journal to cylinder head bearing surface clearance diametrical (mm)	* Front bearing 0.045 - 0.085 * Other bearings 0.055 - 0.075
Camshaft journal diameter standard runout	* Center bearing to outer bearings 0.07 * Other

limit (mm)	bearings to outer bearings 0.05
Camshaft journal diameter standard out of round (mm)	0.005

Torque Specifications

Description	Nm	lb-ft	lb-in
Camshaft bearing caps - bolt	10	7	88
Camshaft exhaust sprocket	A	-	-
Connecting rod to bearing cap - bolt	A	-	-
Coolant drain in engine block - plug M10 x 16	25	18	-
Crankshaft damper pulley - bolt	320	236	-
Cylinder head - bolt	A	-	-
Engine cover (top)	4	3	35
Engine cover (top) mounting bracket - nut	6	4	53
Engine mounting to engine mounting bracket - nut	48	35	-
Engine mounting to subframe - nut	63	46	-
Engine mounting bracket to engine - bolt	40	30	-
Engine wiring harness bracket - nut/bolt	10	7	88
Exhaust manifold - bolt	A	-	-
Exhaust manifold heat shield - bolt	3	2	27
Flexplate - bolt	A	-	-
Intake manifold - bolt	21	19	-
Lifting eye (front) - bolt	30	22	-
Lifting eye (rear) - bolt	40	30	-
Oil cooler to oil filter housing	58	43	-
Oil filter	17	12	-
Oil filter housing to engine - bolt	21	15	-
Oil level indicator tube - nut	6	4	53
Oil pan to oil pan body - bolt	A	-	-
Oil pan body to engine	A	-	-
Oil pan drain plug	23	17	-
Oil pump pick-up pipe to oil pan body - bolt	12	9	-
Oil pump to engine block - bolt	12	9	-
Oil pump to pick-up pipe - bolt	12	9	-
Piston cooling jet - bolt	9	7	80
Plug - M30 x 12 to engine block	50	37	-
Plug (flanged) - M30 - 1.5 x 20 to engine block	50	37	-

Primary timing chain tensioner - bolt	11	8	-
Primary timing chain tensioner, guide blade - bolt	11	8	-
Radio frequency interference suppressor to engine cover bracket - bolt	10	7	88
Secondary timing chain tensioner - bolt	11	8	-
Timing belt cover - bolt	A	-	-
Valve cover - bolt	A	-	-
Variable camshaft timing, oil control solenoid housing - bolt	21	15	-
Variable camshaft timing, oil control solenoid housing - nut	11	8	-
Variable camshaft timing sprocket - center bolt	A	-	-
A = refer to procedure for correct torque sequence			

Valve Clearance Adjustment (12.29.48)

Special Service Tools



Tappet hold-down tool
303-540



Tappet hold-down tool adaptor
303-540/02



Fan nozzle - air gun
303-590



CAUTION: Rotating the crankshaft in a counterclockwise direction may cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.



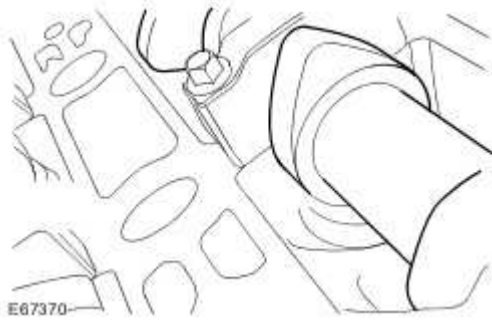
CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

1. Remove the cover and disconnect the battery ground cable.

2. Check the valve clearances.

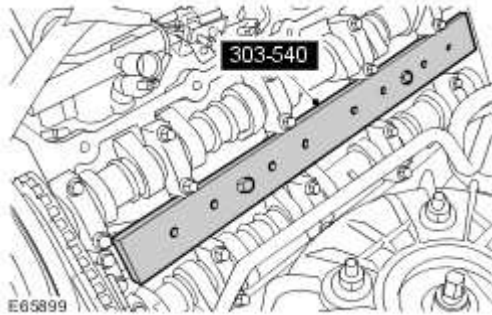
Valve Clearance Check (12.29.47)

3. Rotate the engine clockwise to position the camshaft lobe away from the valve tappet.



4. Install the special tool 303-540, to the cylinder head.

- Tighten the 2 bolts to 10 Nm (7 lb.ft).



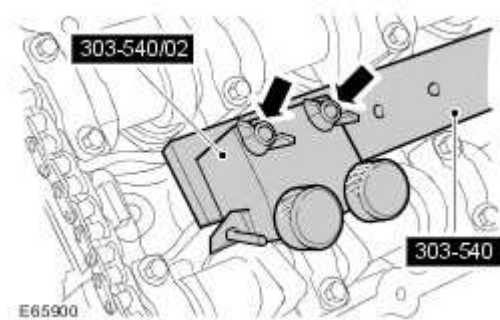
5.



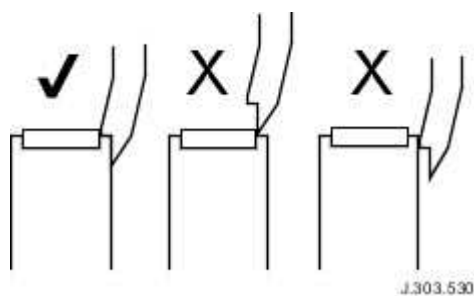
CAUTION: Do not rotate the crankshaft while the special tool 303-540/02 is attached to 303-540.

Attach the special tool 303-540/02 to 303-540.

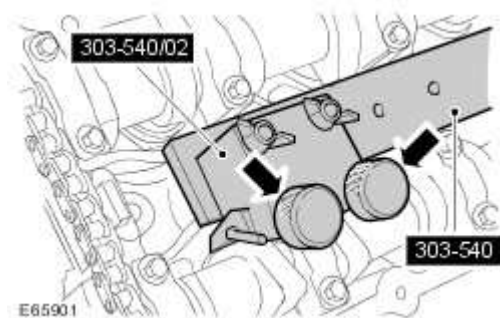
- Secure with the 2 wing nuts.



6. Position the special tool to the tappet as shown.



7. Using the special tool, compress the valve spring.



8.



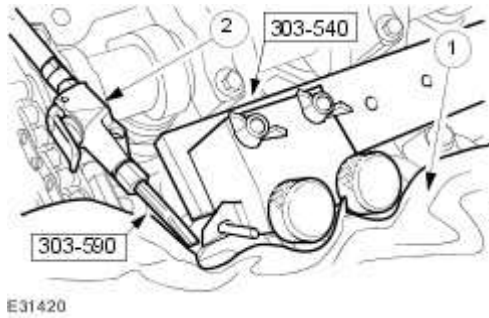
CAUTION: Do not use a magnet to remove shims. Failure to follow these instructions may result in damage to the vehicle.

NOTE:

Use the following formula to calculate the required shim thickness. Original shim thickness + measured shim clearance - desired clearance = required shim thickness.

Remove, clean and measure the shim.

- Surround the immediate working area with a cloth, to retain any loose shims displaced by the compressed air.
- Use the special tool 303-590, aimed at the edge of the shim, to lift it from the tappet. Note the position of each one.



9.



CAUTION: Shims must be fitted with the size markings facing the tappet, not the camshaft.

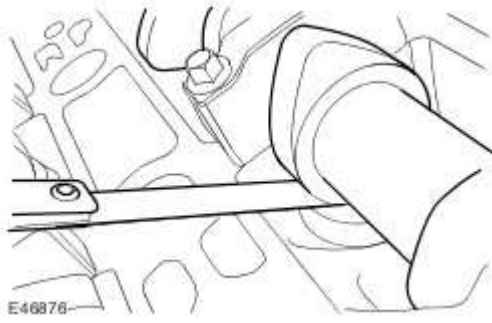


CAUTION: Do not use a magnet to install shims. Failure to follow these instructions may result in damage to the vehicle.

Install the new shim.

- Clean the components.
- Lubricate the shim with clean engine oil.
- Release and remove the special tools as required.

10. Using the feeler gauge set, measure the clearance between the camshaft and the valve tappet.



11. Repeat the above procedure for the remaining valves.

Valve Clearance Check (12.29.47)

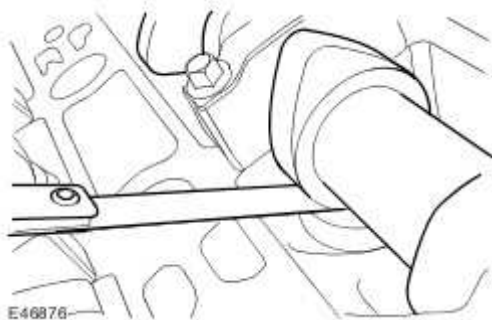


CAUTION: Rotating the crankshaft in a counterclockwise direction may cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.



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

1. Remove the cover and disconnect the battery ground cable.
2. Remove the LH valve cover.
[Valve Cover LH \(12.29.43\)](#)
3. Remove the RH valve cover.
[Valve Cover RH \(12.29.44\)](#)
4. Rotate the engine clockwise to position the camshaft lobe away from the valve tappet
5. Using the feeler gauge set, measure the clearance between the camshaft and the valve tappet.



6. Repeat the above procedure for the remaining 31 tappets.
7. Adjust the clearance as necessary.

8. For cylinder head data, refer to specifications.

9. Install the RH valve cover.

[Valve Cover RH \(12.29.44\)](#)

10. Install the LH valve cover.

[Valve Cover LH \(12.29.43\)](#)

11. Connect the battery ground cable and install the cover.

Engine Oil Draining and Filling

Special Service Tools



Wrench, Oil filter
303-752



WARNING: The spilling of hot engine oil is unavoidable during this procedure, care must be taken to prevent scalding.



CAUTION: Correct installation of the oil filler cap can be obtained by tightening the cap until an audible click is heard.

NOTE:

Clean the components general area prior to dismantling.

1. Remove the cover and disconnect the battery ground cable.
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.

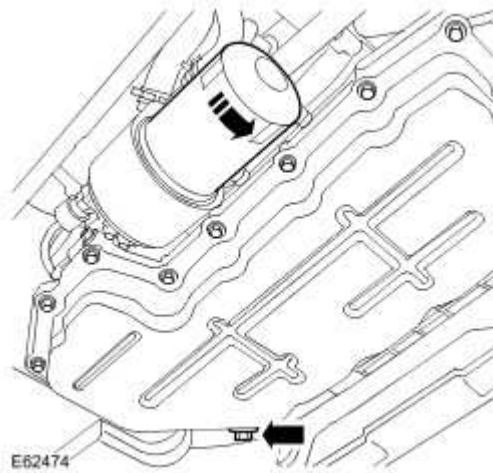
3. Remove the engine undershield.
Air Deflector (76.11.41)

4. Remove the oil pan drain plug.

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

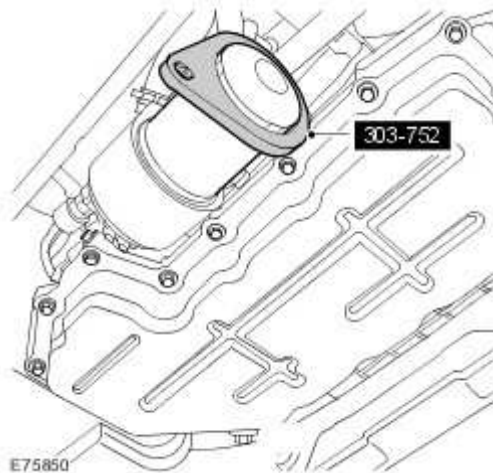
5. Remove the oil filter.

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



6. Using the special tool, install the oil filter.

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



7. Tighten the drain plug to 25 Nm (18 lb.ft).

- Install a new seal.

8. Fill the engine with oil.

9. Connect the battery ground cable and install the cover.

Specifications

10. Start engine and run at idle speed until the oil pressure warning light extinguishes.

- Stop the engine.
- Check for leaks.

11. Install the engine undershield.

Air Deflector (76.11.41)

12. Check and top-up the engine oil.

Engine

EXTERNAL VIEW



E63164

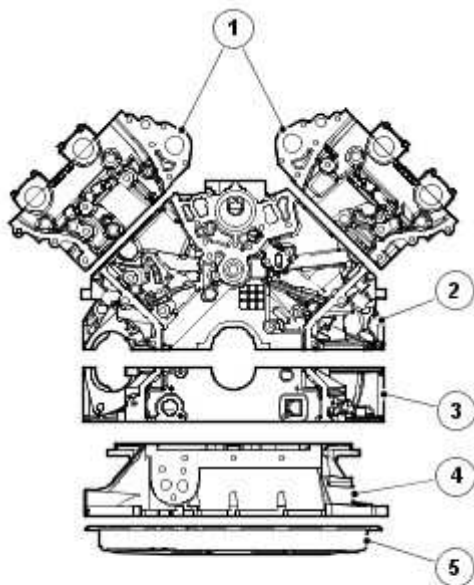
INTRODUCTION

The V8 petrol engine is a 4.2 liter, 8 cylinder, 90 degrees 'V' unit, with 4 valves per cylinder, operated by 2 overhead camshafts per cylinder head. The engine emissions comply with ECD4 (European Commission Directive) and US Federal Tier2 Bin 5 legislative requirements and employs catalytic

converters, electronic engine management control and positive crankcase ventilation to limit the emission of pollutants. The cooling system is a low volume, high velocity system. The Engine Control Module (ECM) controls the fuel injection system, the ignition system and the electric throttle.

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

Engine Structure



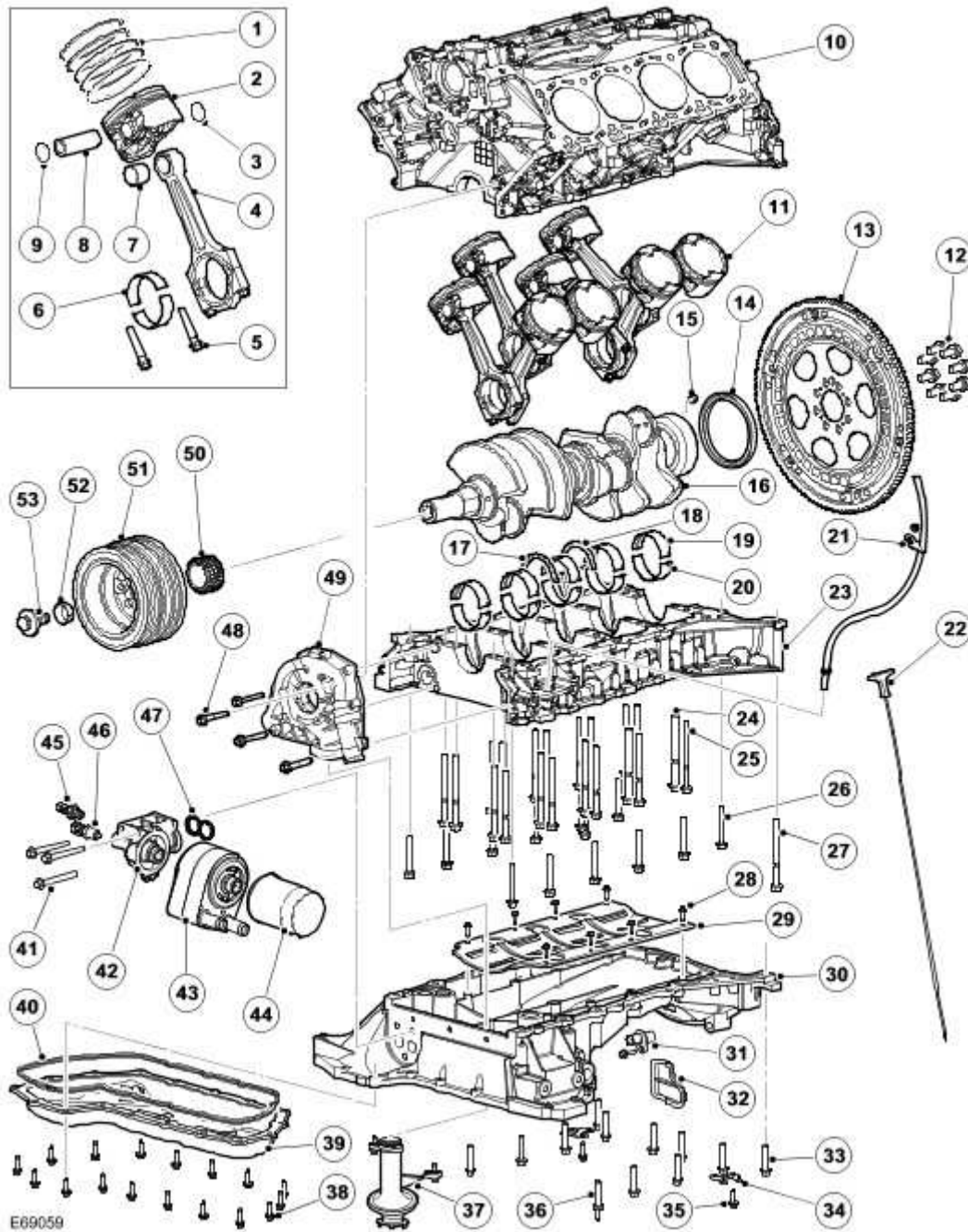
E71998

Item	Part Number	Description
1		Cylinder head (2 off)
2		Cylinder block
3		Bedplate
4		Structural sump
5		Sump pan

Technical Features

- An 8-cylinder 90-degree 'V' configuration liquid cooled aluminium cylinder block with cast iron liners
- Pistons are of open-ended skirt design, with two compression rings and a three-piece oil control ring
- Two aluminium cylinder heads, each incorporating two camshafts manufactured in chilled cast iron
- Four valves per cylinder
- Graded valve lifters (shimless)
- Top fed, 8-hole fuel injectors
- Engine front cover manufactured from aluminium, accommodating the crankshaft front oil seal
- Primary and secondary chain drive for the camshafts
- An aluminium bedplate
- A cast iron crankshaft
- Fracture-split connecting rods in sintered-forged steel
- A twin multi-vee belt, driving the front-end accessories
- Fabricated stainless steel twin skin exhaust manifolds
- An advanced engine management system incorporating electronic throttle control
- Meets with the fault handling requirements, as detailed in the European On-Board Diagnostic (EOBD) III, US Federal OBD and California OBDII legislation.

CYLINDER BLOCK COMPONENTS



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

5		Bolts (16 off)
6		Connecting rod bearing shells
7		Bearing
8		Gudgeon pin
9		Circlip
10		Cylinder block
11		Pistons
12		Bolts (8 off)
13		Flywheel
14		Seal
15		Dowel
16		Crankshaft
17		Thrust washer
18		Thrust washer
19		Bearing shells - upper
20		Bearing shells - lower
21		Oil level gage tube
22		Oil level gage
23		Bedplate
24		Bolts (10 off)
25		Bolts (10 off)
26		Bolts (12 off)
27		Bolt

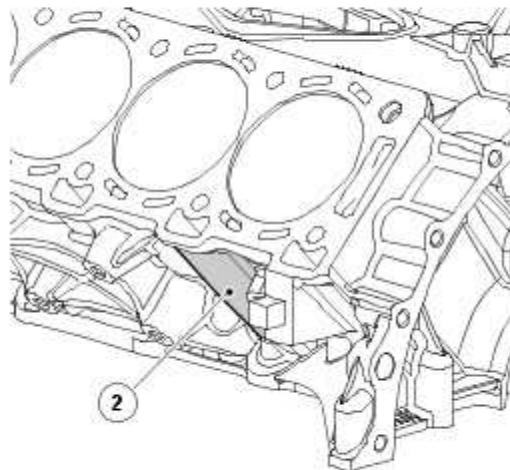
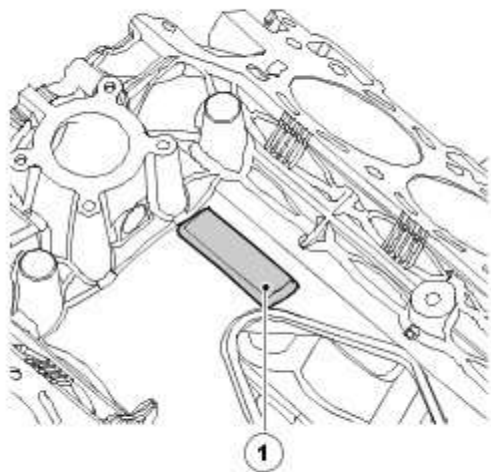
28		Bolts (8 off)
29		Windage tray
30		Sump
31		Crankshaft Position (CKP) sensor
32		Flange
33		Bolts (11 off)
34		Clip
35		Bolts (2 off)
36		Stud
37		Oil pick-up pipe
38		Bolts (17 off)
39		Sump pan
40		Gasket
41		Bolts (3 off)
42		Oil filter head assembly
43		Engine oil cooler
44		Oil filter
45		Oil pressure switch
46		Engine coolant temperature sensor
47		Seal
48		Bolts (4 off)
49		Oil pump
50		Crankshaft sprocket

51		Crankshaft pulley
52		Taper collet
53		Crankshaft bolt

Cylinder Block

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

Engine Data Locations



E43426

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

Engine data is marked at 3 locations, 2 on the cylinder block (shown) and 1 on the engine front cover,

which consists a label displaying the engine number. Component diameters are represented by alpha and numeric codes; keys to the codes are in the Service Repair Procedures (SRP) sections of this manual.

Connecting Rods and Pistons

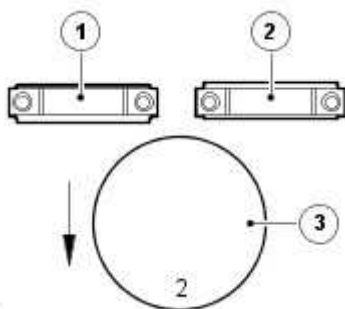


E43427

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

The pistons are of the open-ended skirt design with a dished crown. Three piston rings, two compression and one three-piece oil control ring, are installed on each piston. Each piston is installed on a gudgeon pin located in a bronze bushing in the connecting rod.

Connecting Rod and Piston Installation



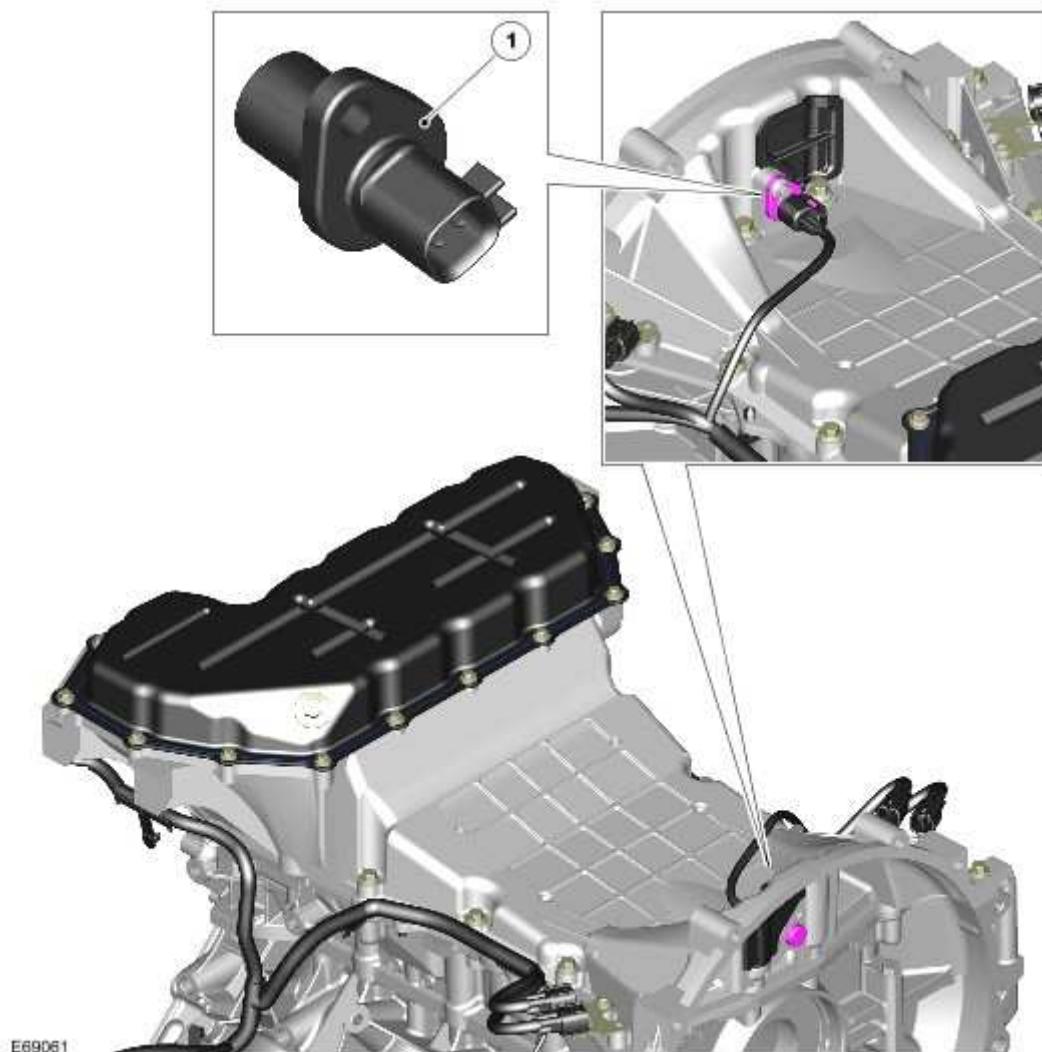
E43428

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

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

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

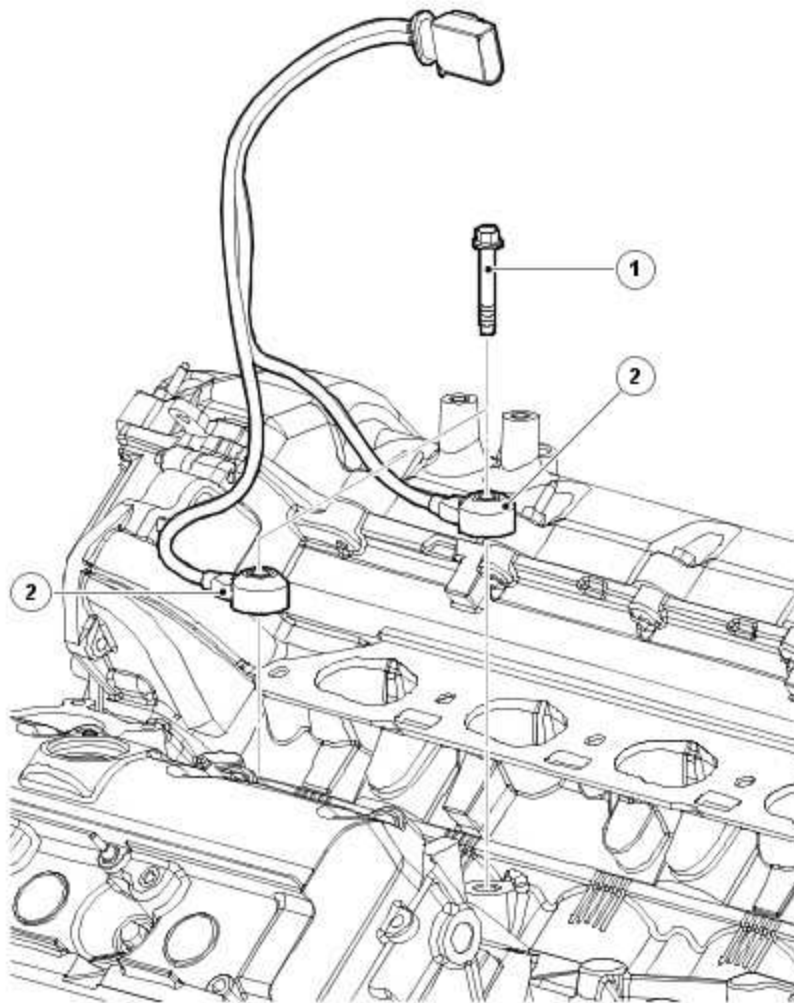
Crankshaft Position Sensor



Item	Part Number	Description
1		Crankshaft Position (CKP) sensor

The CKP sensor is installed at the rear of the sump. It is a variable reluctance sensor that provides an input of engine crankshaft speed and position. For additional information, For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - 4.2L)

Knock Sensors

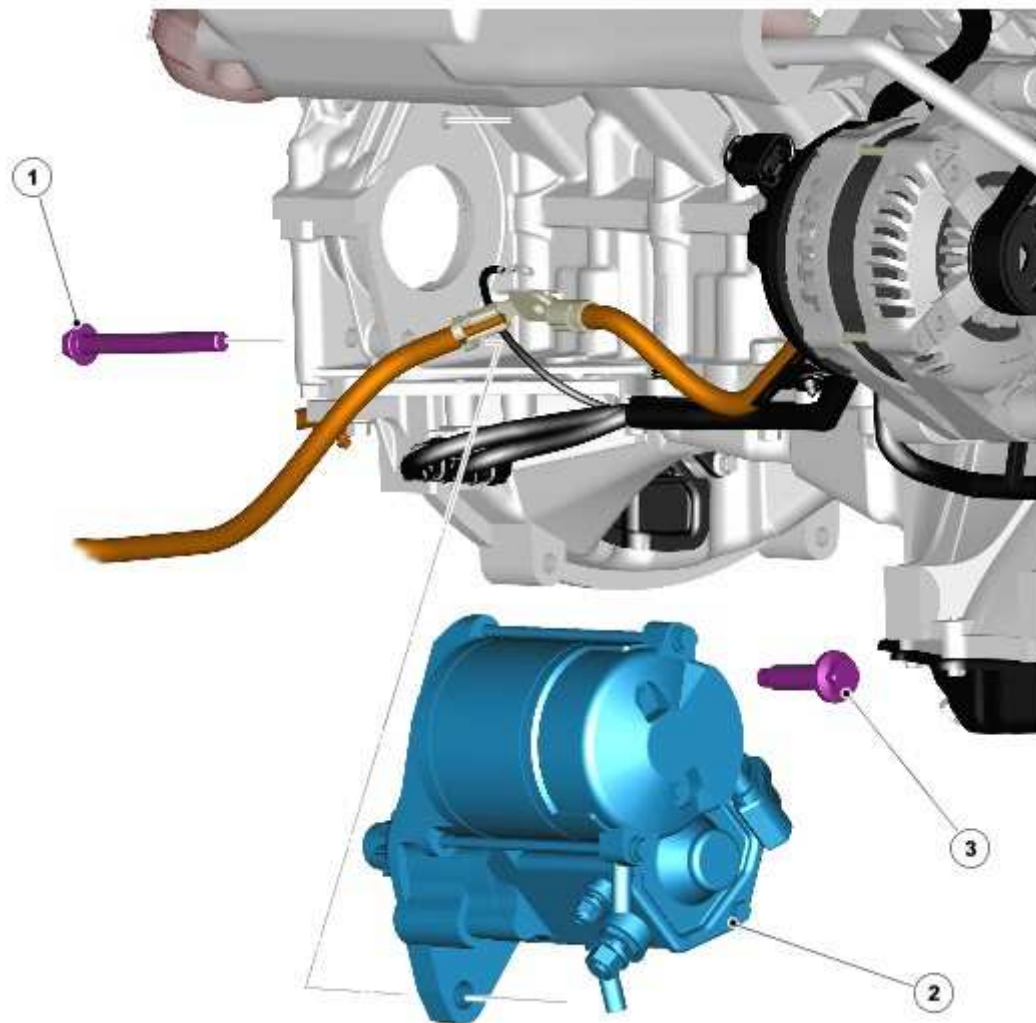


E43430

Item	Part Number	Description
1		Bolts (2 off)
2		Knock sensor

The knock sensors are installed in the cylinder block on the inboard side of each cylinder bank. They are piezo-electric sensors that provide inputs to detect and locate detonation during combustion. For additional information, For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - 4.2L)

Starter Motor

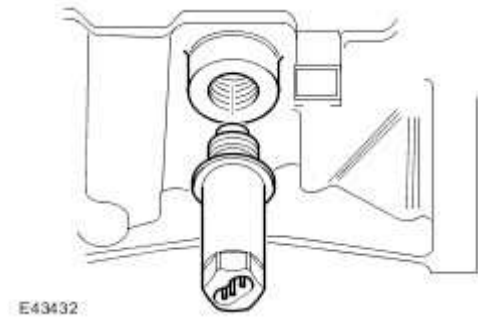


Item	Part Number	Description
1		Bolt
2		Starter motor
3		Bolt

The engine starter motor is installed at the rear right side of the engine, at the cylinder block to

bedplate split line. For additional information, For additional information, refer to Starting System (303-06 Starting System)

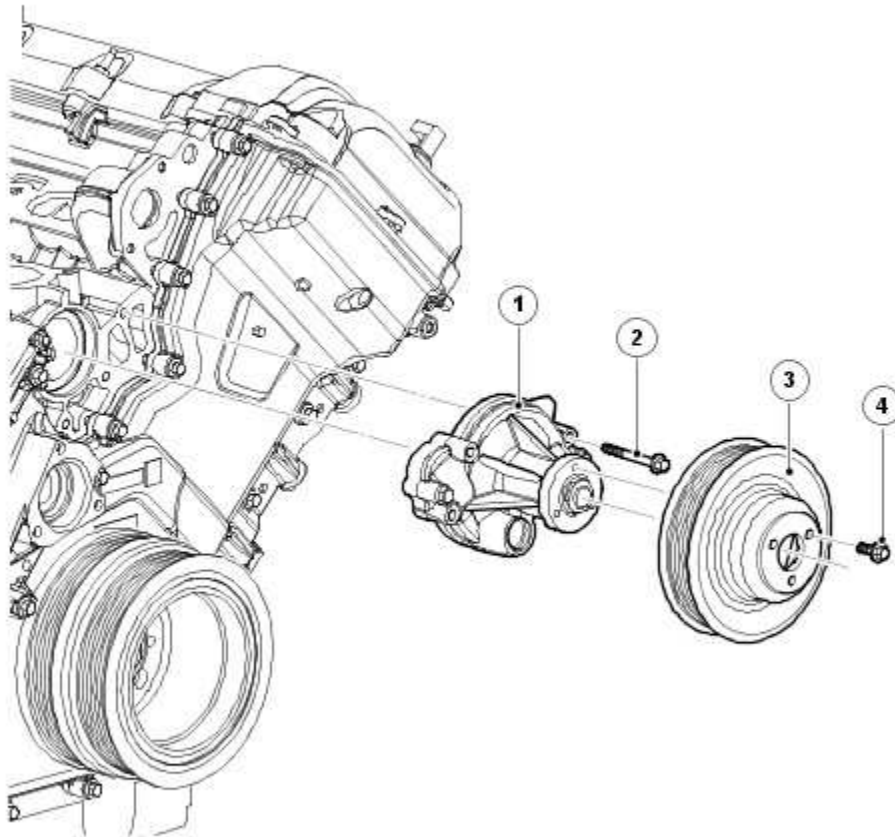
Coolant Drain Plug/Block Heater



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

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

Coolant Pump

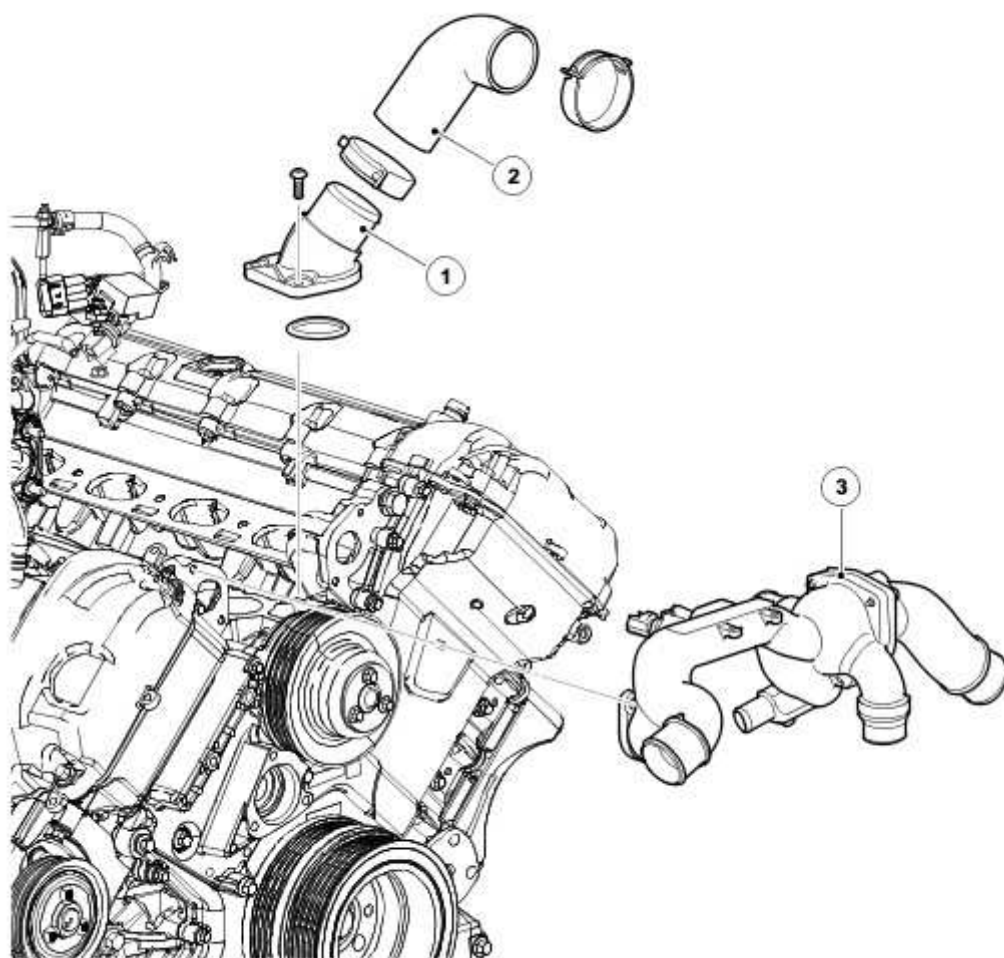


E43433

Item	Part Number	Description
1		Coolant pump
2		Bolts (4 off)
3		Pulley
4		Bolts (3 off)

The coolant pump is installed between the 2 cylinder banks, on the front face of the cylinder block.

Coolant Inlet and Outlet Assembly

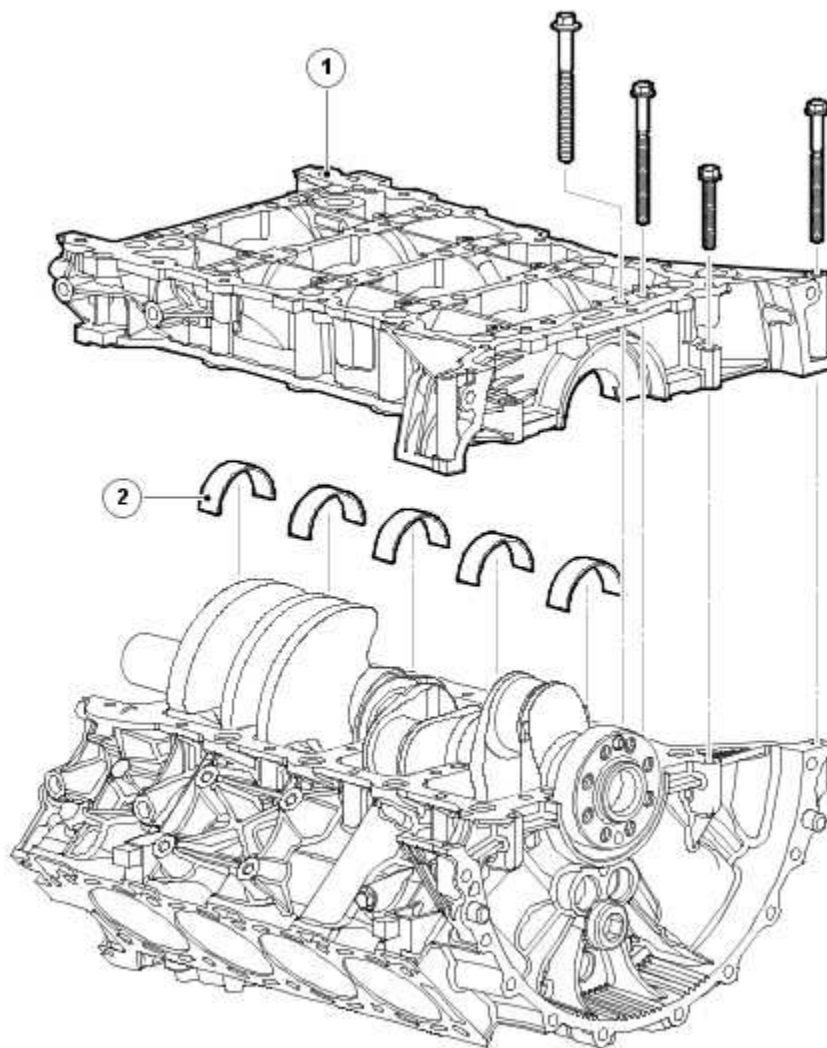


E56199

Item	Part Number	Description
1		Coolant outlet elbow
2		Coolant hose
3		Thermostat housing

The thermostat housing and coolant outlet duct are combined into an aluminium alloy coolant outlet assembly, which is installed between the 2 cylinder banks, immediately above the coolant pump. A hose connects the coolant outlet assembly to a coolant inlet housing attached to the coolant pump intake on the cylinder block. The thermostat controls the flow of coolant through the radiator.

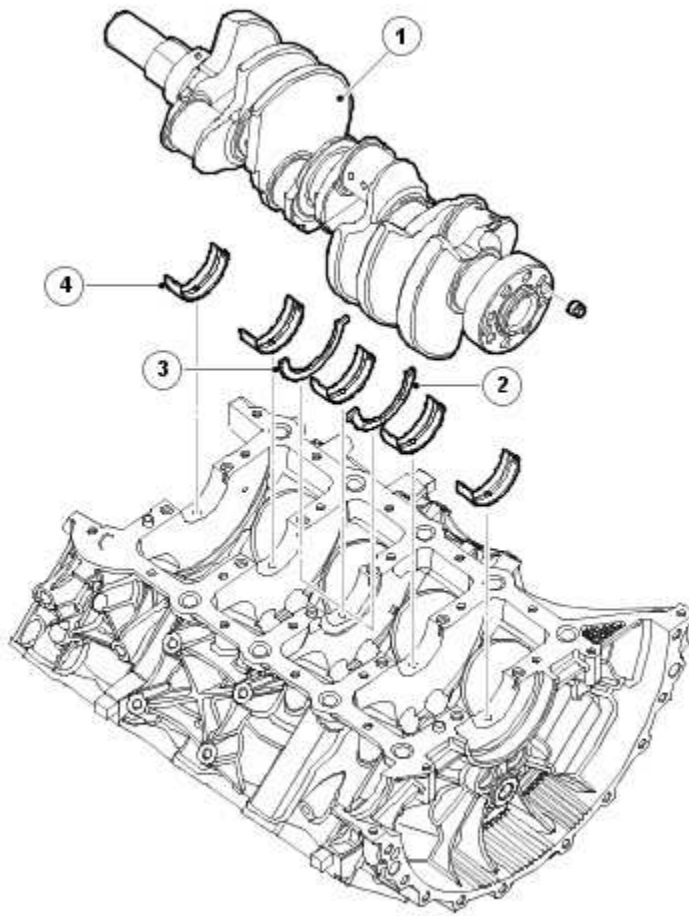
CRANKSHAFT AND SUMP COMPONENTS



E43435

Item	Part Number	Description
1		Bedplate
2		Main bearings - lower (5 off)

Crankshaft and Main Bearings



E43436

Item	Part Number	Description
1		Crankshaft
2		Thrust washer
3		Thrust washer
4		Main bearings - upper (5 off)

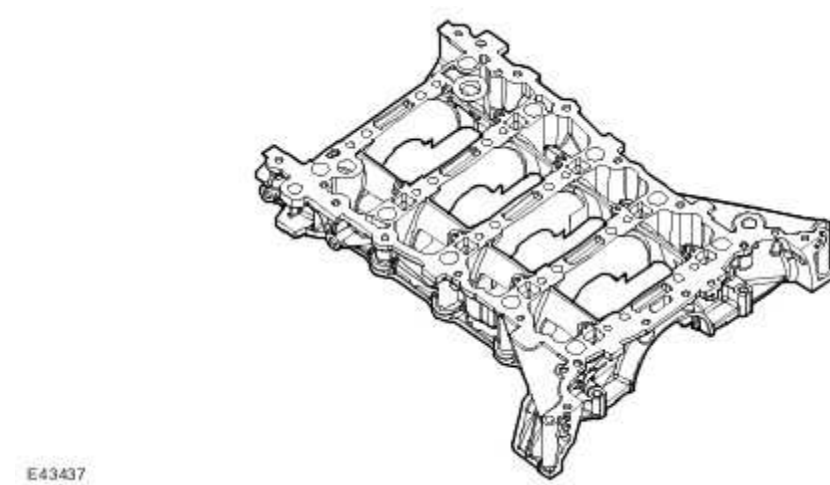
Six counter-balance weights ensure good vibration levels from the 4 throw, 5 bearing crankshaft. Manufactured in cast iron, the crankshaft also has undercut and rolled fillets for improved strength.

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

The main bearings are aluminium/tin split plain bearings. An oil groove in the upper half of each

bearing transfers the oil into the crankshaft for lubrication of the connecting rod bearings. An aluminium/tin thrust washer is installed each side of the top half of the centre main bearing.

Bedplate

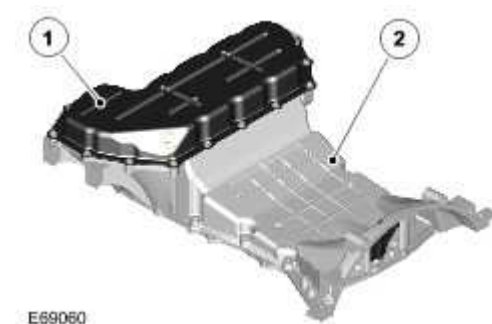


The bedplate is a structural casting bolted to the bottom of the cylinder block to retain the crankshaft. The use of a bedplate further improves rigidity. Iron inserts, cast into the main bearing supports of the bedplate, minimise main bearing clearance changes due to heat expansion.

Two hollow dowels align the bedplate with the cylinder block.

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

Sump



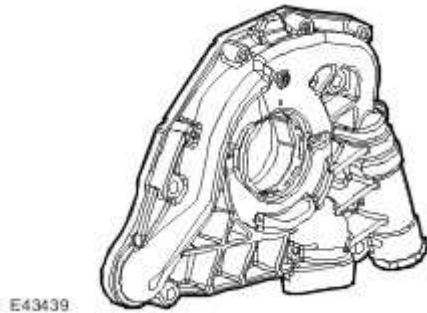
Item	Part Number	Description
1		Pressed steel oil pan
2		Aluminium alloy structural sump

The aluminium alloy structural sump is bolted to the bedplate. A windage tray attached to the underside of the bedplate isolates the oil pan from the disturbed air produced by the rotation of the crankshaft, to prevent oil aeration and improve oil drainage. A rubber plug at the rear of the

structural sump seals the port that provides access to the torque converter securing bolts. The engine oil drain plug is located in the pressed steel oil pan, which attaches to the underside of the aluminium alloy structural sump.

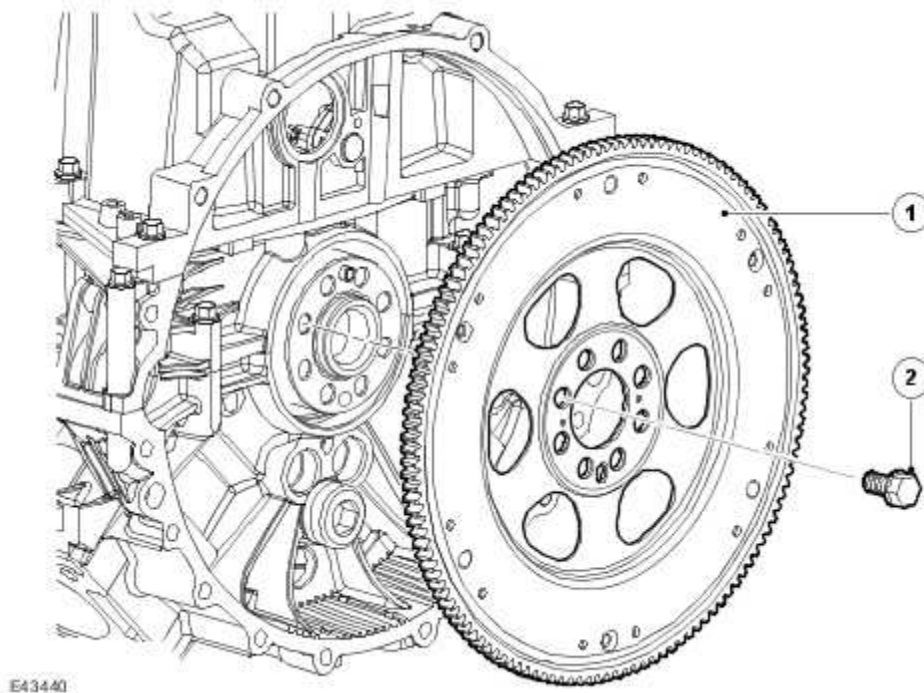
A bead of sealant seals the joint between the structural sump and the bedplate.

Oil Pump



The oil pump is installed on the crankshaft at the front of the engine. The pump outlet port aligns with oil passages in the bedplate (See lubrication section for more information).

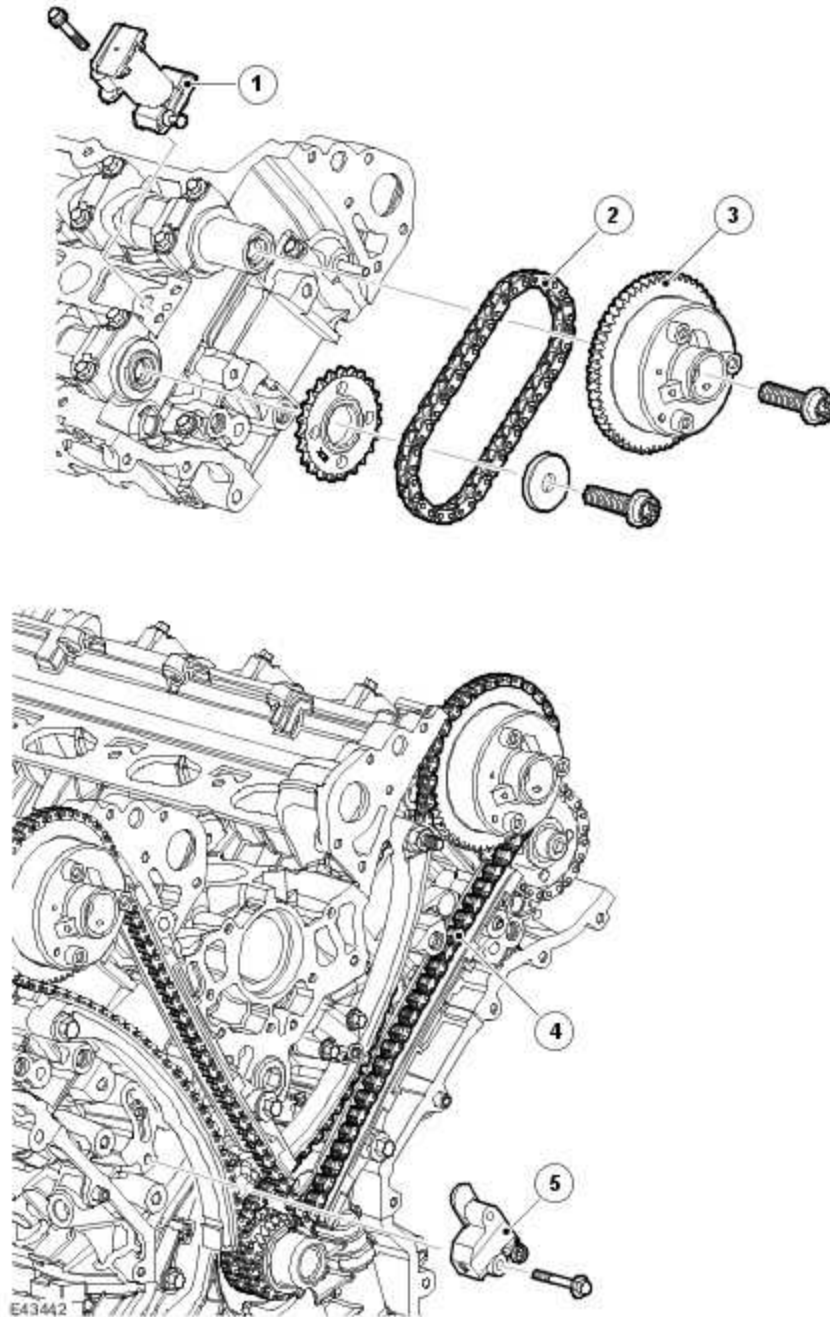
Starter Drive Plate



Item	Part Number	Description
1		Starter drive plate
2		Bolts (8 off)

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

CAMSHAFT TIMING COMPONENTS



Item	Part Number	Description
1		Secondary chain tensioner
2		Secondary chain

3		Variable valve timing unit
4		Primary chain
5		Primary chain tensioner

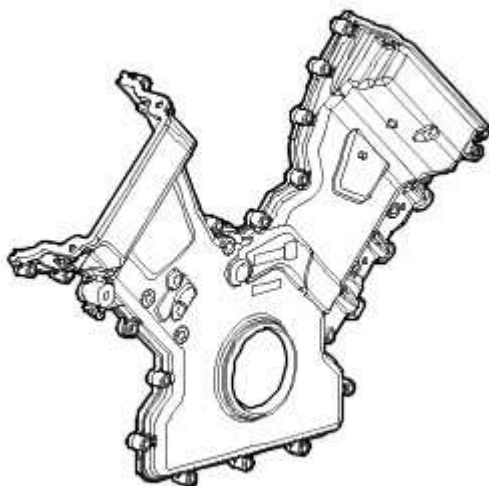
Timing Gear

Multiple link primary and single row secondary chains drive the camshafts of each cylinder bank. The primary chains transmit the drive from 2 sprockets on the crankshaft to variable valve timing units on the intake camshafts. The secondary chains transmit the drive from the variable valve-timing units to sprockets on the exhaust camshafts.

A key locates the 2 drive sprockets on the crankshaft. The crankshaft's torsional vibration damper retains the sprockets in position. The variable valve timing units and the exhaust camshaft sprockets are non-interference, non-keyed fits on their respective camshafts; the drive being transmitted by the face to face friction load produced by the valve timing unit/sprocket securing bolt.

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

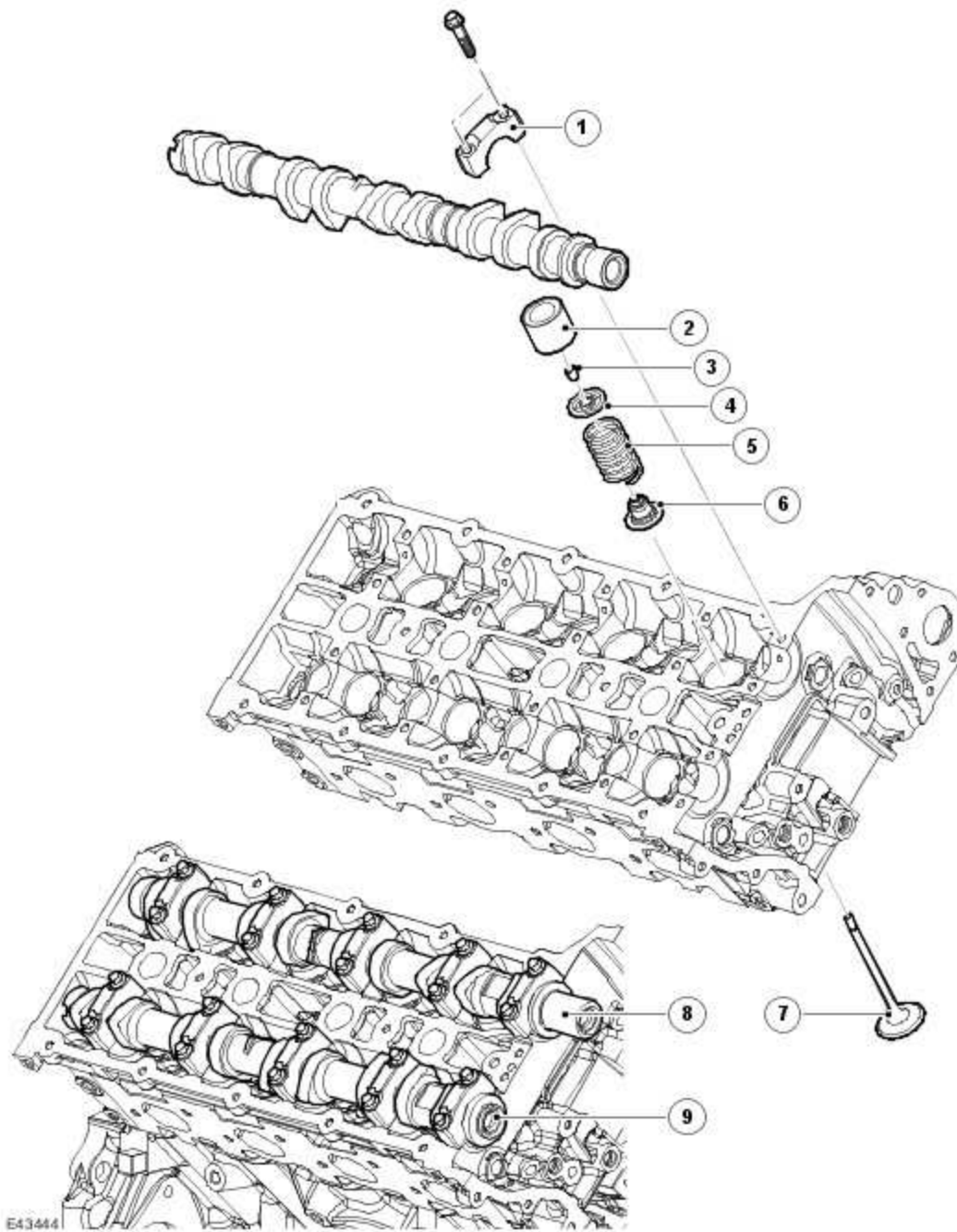
Timing Cover



E43443

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

CYLINDER HEAD COMPONENTS



Item	Part Number	Description
1		Camshaft bearing cap
2		Tappet (shimless)

3		Collet
4		Valve spring cap
5		Valve spring
6		Valve stem oil seal
7		Valve
8		Inlet camshaft
9		Exhaust camshaft

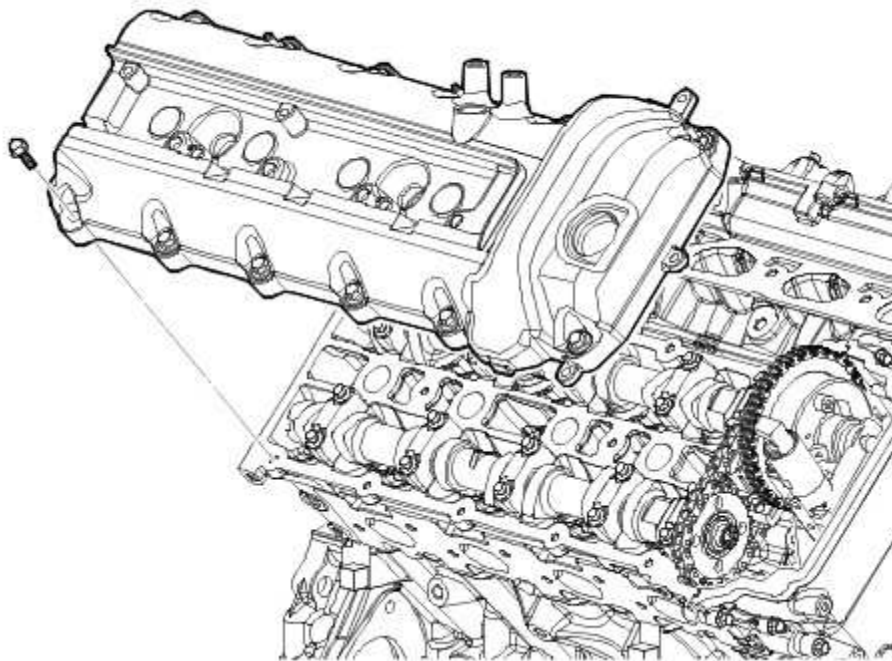
Cylinder Heads

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

The 14 mm (0.55 in) spark plugs, one per cylinder, locate in recesses down the centre line of each cylinder head.

The engine-lifting eyes are bolted to the cylinder heads, 2 on the rear (1 per head) and 1 at the front.

Camshaft Covers



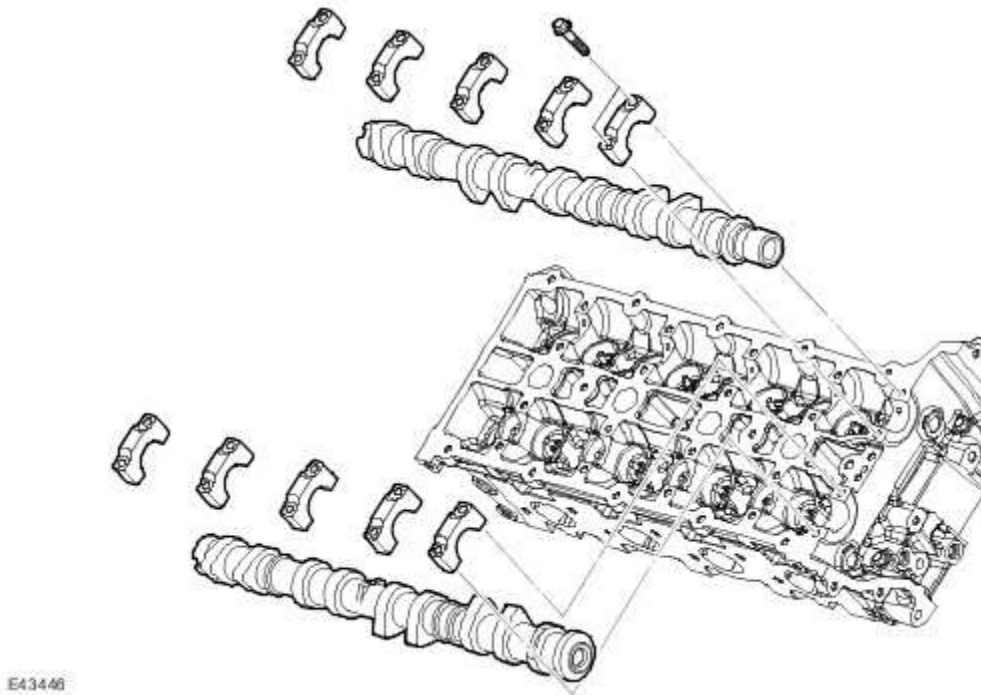
The camshaft covers are manufactured from thermo-plastic. The A bank camshaft cover incorporates an outlet for the part load engine breather and the Pressure Control Valve (PCV). The B bank camshaft cover incorporates an outlet for the full load engine breather and the engine oil filler cap. Identical oil separators are incorporated below the breather outlet in each cover. For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - 4.2L)

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

Cylinder Head Gasket

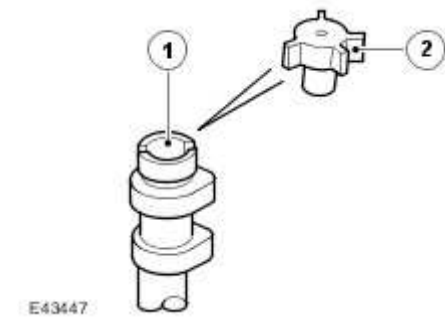
The multi-layered steel cylinder head gasket has cylinder specific water flow cross-sections for uniform coolant flow.

Camshafts



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

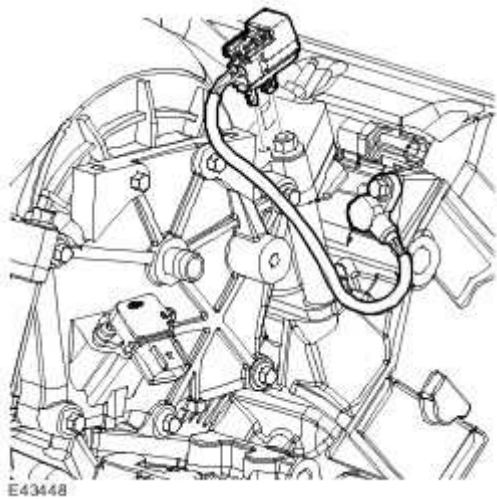
Sensor Ring



Item	Part Number	Description
1		Inlet camshaft
2		Sensor ring

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

Camshaft Position Sensor



The camshaft position sensors are installed in each cylinder head at the rear of the intake camshaft. It is a variable reluctance sensor that provides an input to the ECM regarding the position of the camshaft. For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - 4.2L)

Inlet and Exhaust Valves

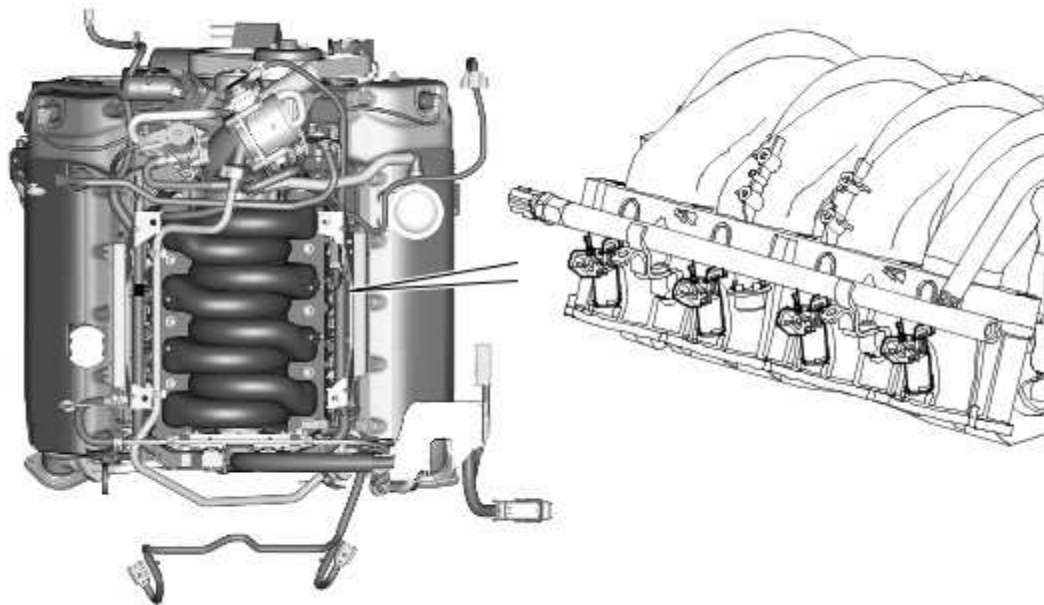
Each cylinder head incorporates dual overhead camshafts operating 4 valves per cylinder via solid shimless valve lifters.

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



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

Fuel Injectors



E43449

Eight, top fed, twelve-hole, fuel injectors are installed in the fuel rails. The injectors are electromagnetic solenoid valves controlled by the ECM. Two O-rings seal each injector to manifold interface. The fuel jets from the injectors are directed onto the back of the intake valves. For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - 4.2L)

VARIABLE VALVE TIMING (VVT)

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

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

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

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

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

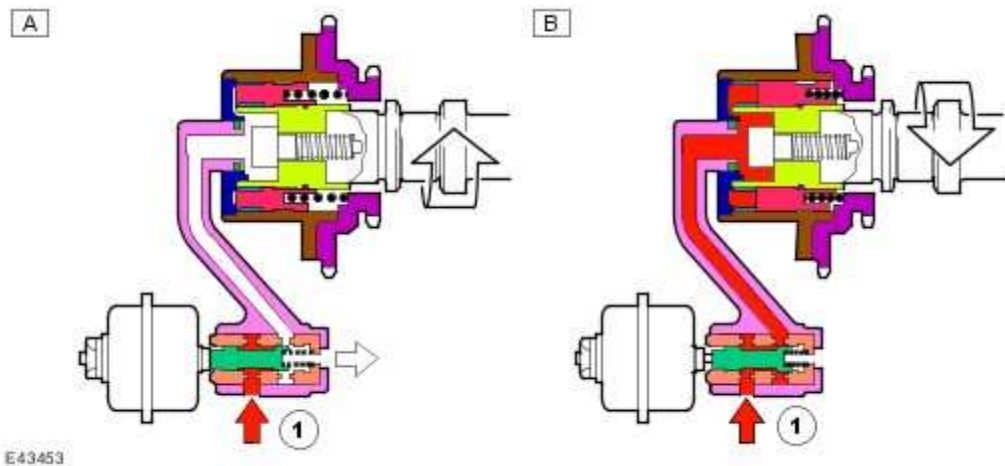
The ECM controls the VVT, using engine speed and load, and engine oil temperature signals to calculate the appropriate camshaft position. For additional information, For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - 4.2L)

The continuous VVT system provides the following advantages:

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

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

PRINCIPLES OF OPERATION - VARIABLE VALVE TIMING



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

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

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

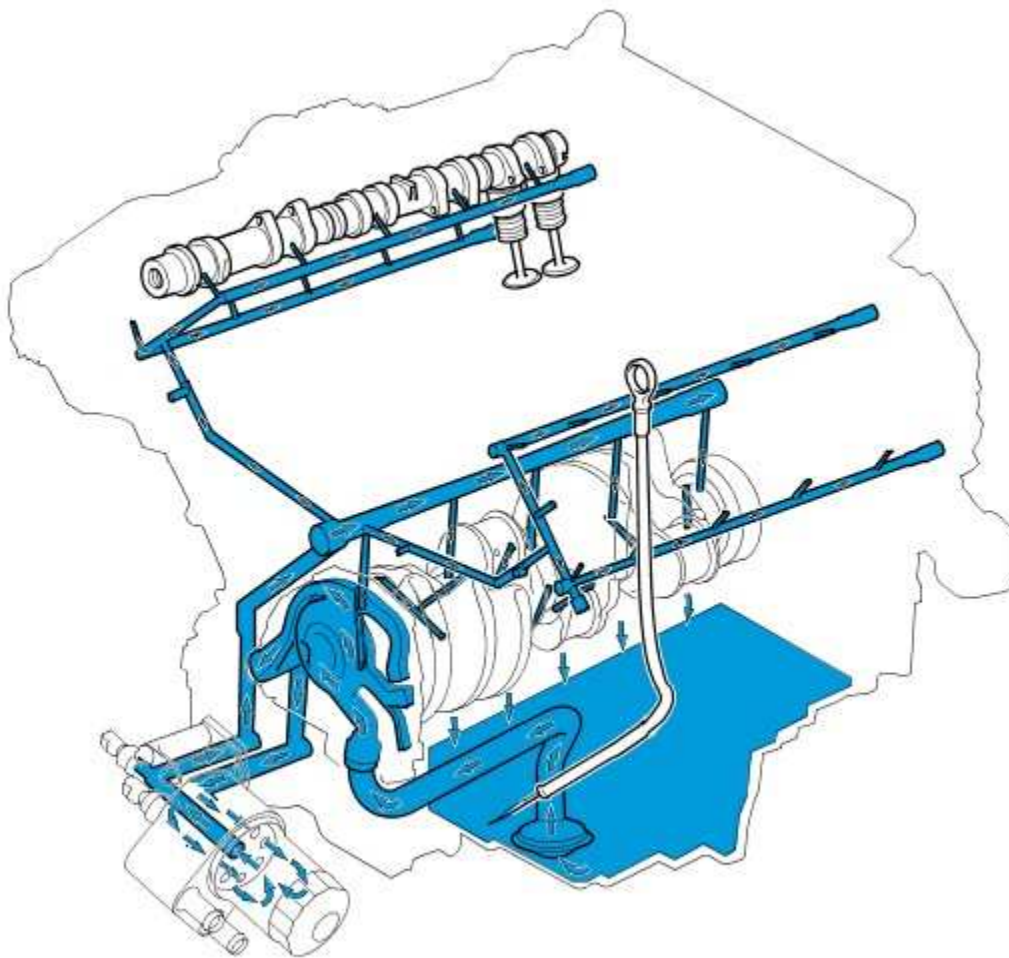
When directed by the ECM, the VVT unit will be set to the optimum position between full advance and retard for a particular engine speed and load. This is achieved when the ECM sends the energising signal to the oil control solenoid until the target position is met. At this point, the energizing signal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

Engine oil properties and temperature can affect the ability of the VVT mechanism to follow demand changes to the cam phase angle. At very low oil-temperatures, movement of the VVT mechanism is

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

The VVT does not operate when engine oil-pressure is below 1.25 bar (18 psi), as there is insufficient pressure to release the VVT unit's internal stopper pin. This usually occurs when the engine is shutting-down and the VVT has returned to the retarded position. The stopper pin locks the camshaft to the VVT unit to ensure camshaft stability during the next engine start-up.

LUBRICATION SYSTEM



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

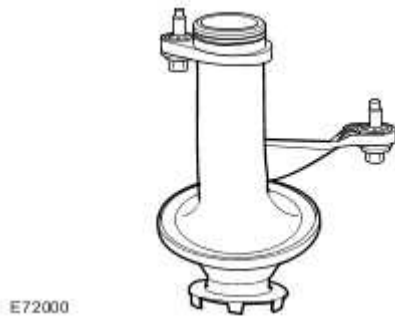
All moving parts are lubricated by pressure or splash oil. Pressurised oil is also provided for operation of the variable valve timing units and the timing gear chain tensioners.

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

System replenishment is through the oil filler cap on the LH camshaft cover.

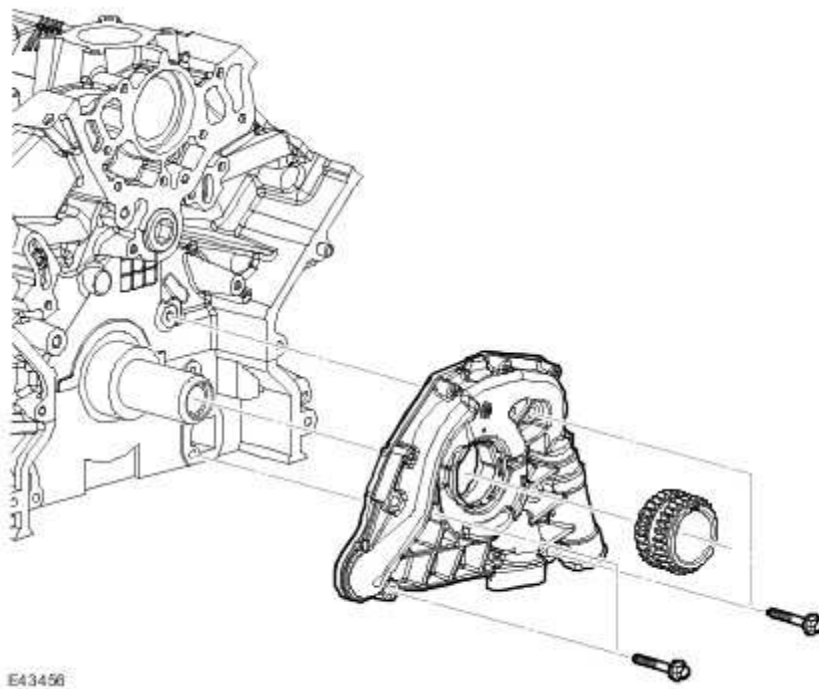
With the exception of the pump, all oil system components are installed on the structural sump.

Oil Pick-up



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

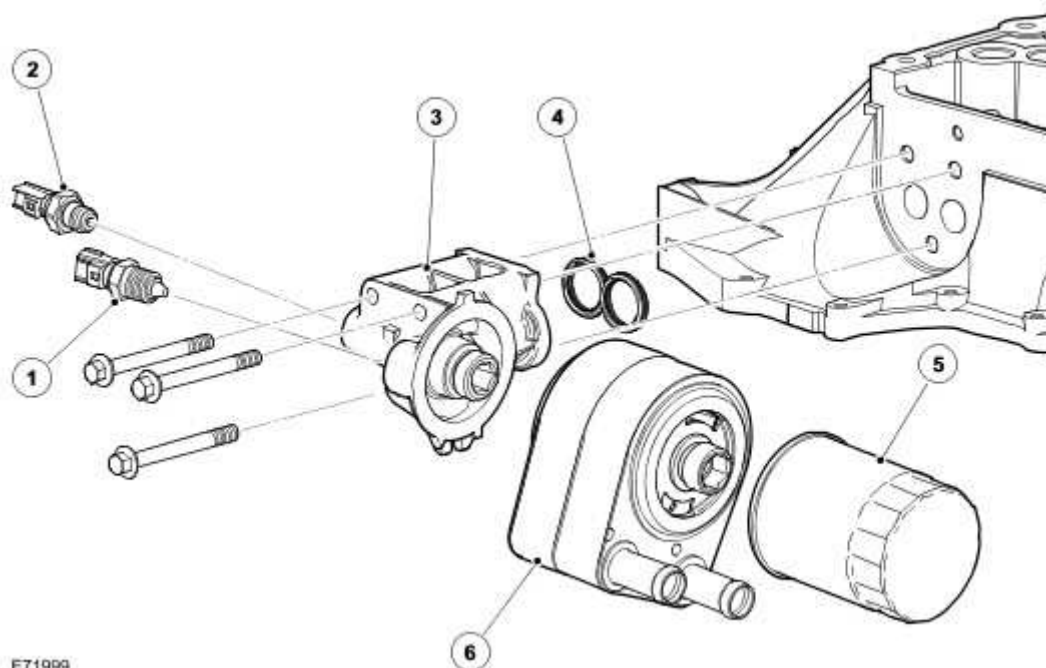
Oil Pump



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

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

Oil Filter Housing Assembly

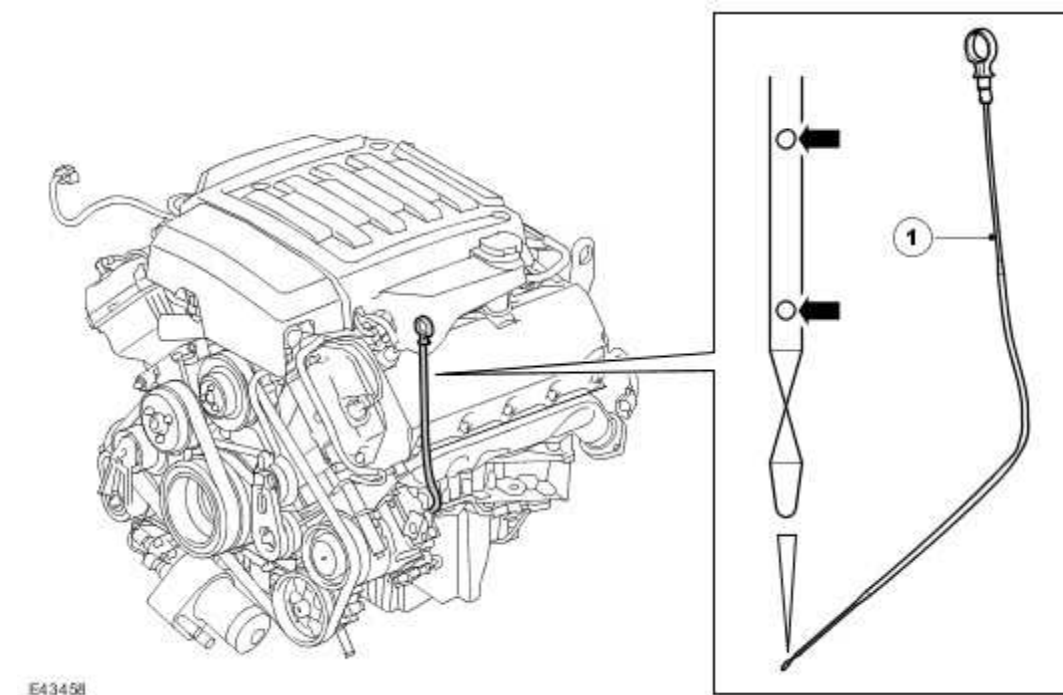


Item	Part Number	Description
1		Engine coolant temperature sensor
2		Oil pressure switch
3		Adapter
4		Seal
5		Filter
6		Engine oil cooler

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

The oil pressure switch connects a ground input to the instrument cluster when oil pressure is present. The switch operates at a pressure of 0.14 to 0.3 bar (2.0 to 4.5 psi).

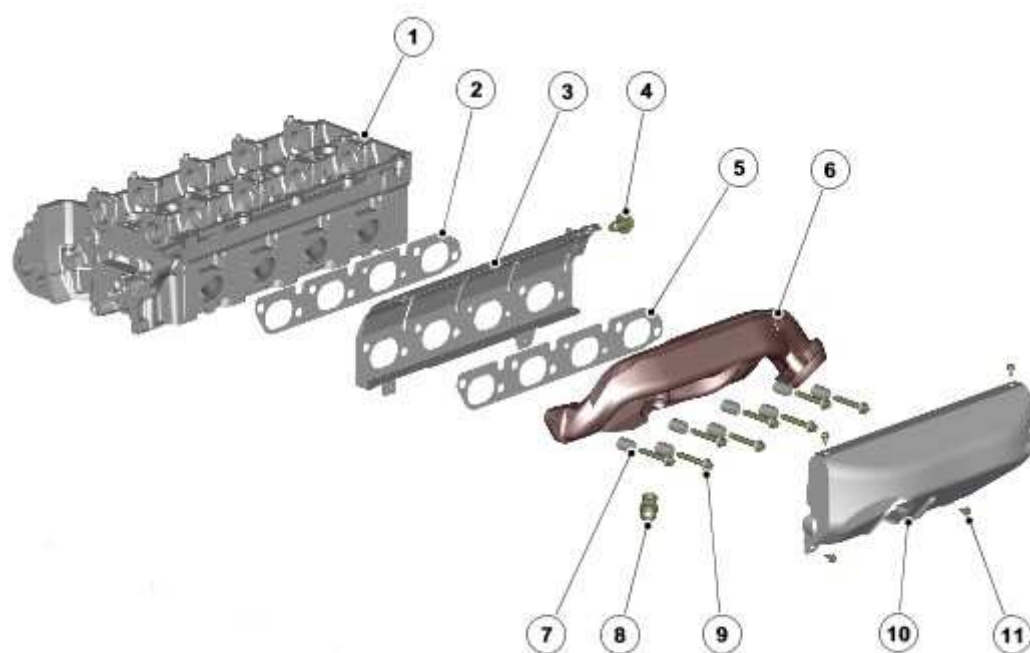
Oil Level Gauge



Item	Part Number	Description
1		Oil level gage

The oil level gage locates along the left side of the oil pan, supported in a tube installed in the sump. Two holes in the end of the gauge indicate the minimum and maximum oil levels. There is a difference of approximately 1.0 litres between the 2 levels.

EXHAUST MANIFOLD



E72001

Item	Part Number	Description
1		Cylinder head
2		Gasket
3		Heat shield
4		Bolt
5		Gasket
6		LH exhaust manifold
7		Spacer (8 off)
8		Connector for Secondary Air Injection (SAI)
9		Bolt (8 off)
10		Heat shield
11		Bolt (4 off)

The fabricated stainless steel twin skin exhaust manifolds are unique for each cylinder bank.

Each exhaust manifold assembly includes 2 metal gaskets, located either side of the inner heat shield, 2 heat shields and a connection for the Secondary Air Injection (SAI) system. For additional information, refer to Engine Emission Control (303-08 Engine Emission Control)

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

Engine

For additional information, refer to [<<303-00>>](#)

Crankshaft Main Bearing Carrier

Special Service Tools



Bolts and spacers
303-191-04



Holding Tool Crankshaft Pulley
303-893(LRT-12-080)



Remover, crankshaft seal
303-D121



Timing Setting tool
303-645



Camshaft setting/locking tool
303-530



Crankshaft rear oil seal remover/installer
303-538



Seal installer
303-750



Seal extractor
303-751



Crankshaft pulley locking tool adapter
303-191/02

Removal

- 1 . Disconnect the battery ground cable.
For additional information, refer to Specifications

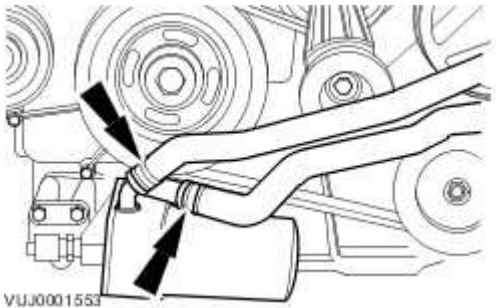
- 2  **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

- 3 . Remove the engine.
For additional information, refer to Engine (12.41.01)

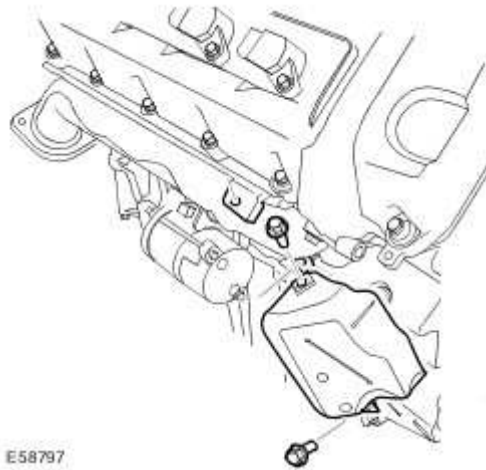
- 4 . Mount the engine to an engine stand.

- 5 . Disconnect the 2 oil cooler hoses.



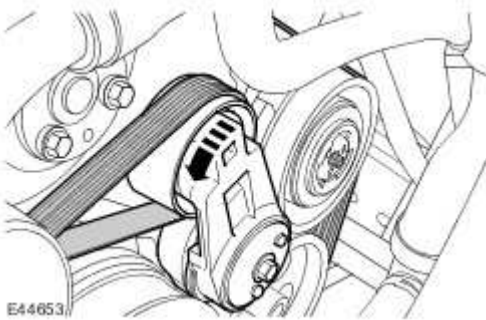
- 6 . Remove the exhaust manifold heat shield.

 Remove the 2 bolts.



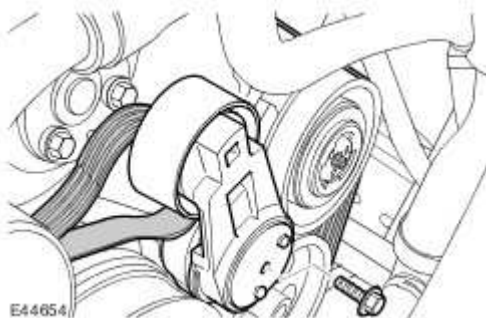
7 Release the accessory drive belt.

- ▶ Rotate the accessory drive belt tensioner counter-clockwise, using a 3/8 " drive wrench.



8 . Remove the accessory drive belt tensioner.

- ▶ Remove the bolt.



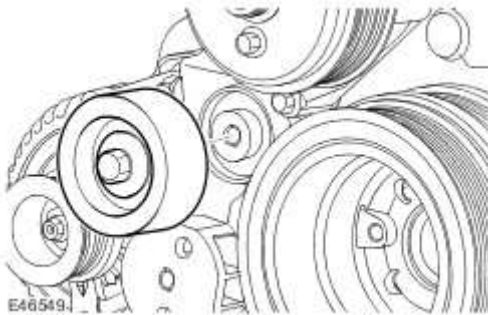
9 . NOTE:

Note the fitted position of the accessory drive belt.

Remove the accessory drive belt.

10 . Remove the accessory drive belt idler pulley.

▶ Remove the bolt.

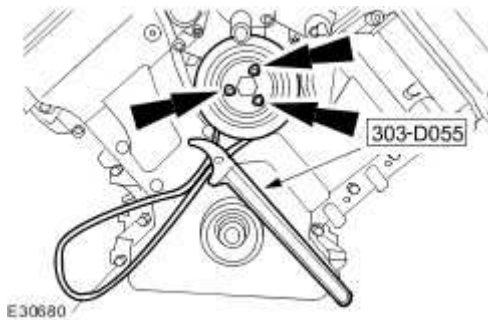


11 . NOTE:

Restrain the pulley to aid the removal of the bolts.

Using the special tool, remove the coolant pump pulley.

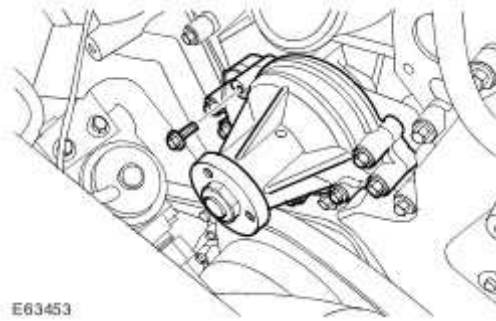
▶ Remove and discard the 3 bolts.



12 . Remove the coolant pump.

▶ Remove the 5 bolts.

▶ Remove and discard the gasket.



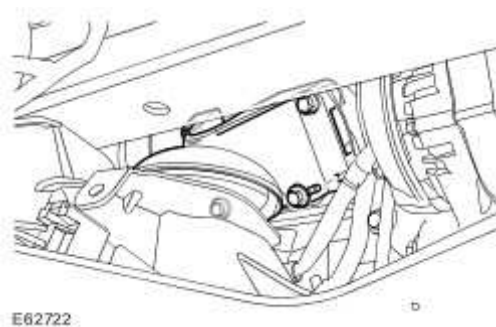
13 . **NOTE:**

Right-hand shown, left-hand similar.

Remove both the engine mounts and brackets.

▶ Remove the 4 bolts.

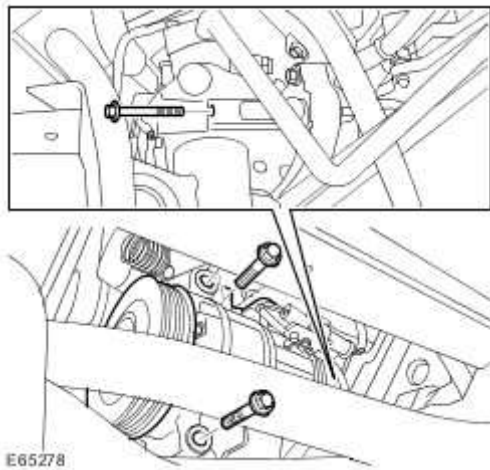
▶ Repeat the above procedure for the other side.



14 . Remove the air conditioning (A/C) compressor.

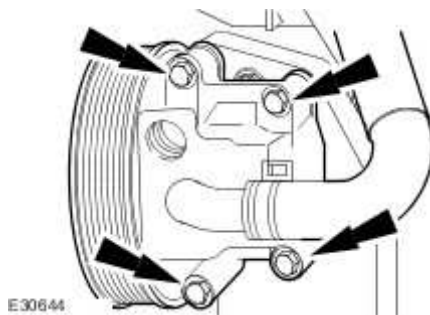
▶ Remove the 3 bolts.

▶ Disconnect the electrical connector.



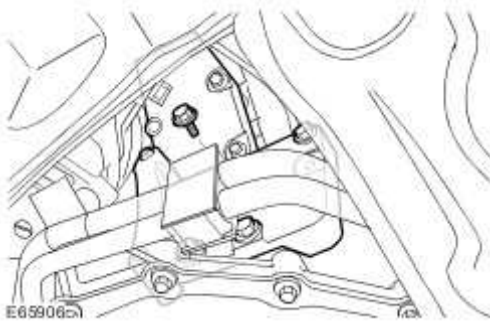
15 . Remove the power steering pump.

▶ Remove the 4 bolts.



16 . Remove the A/C compressor mounting bracket.

▶ Remove the 4 bolts.



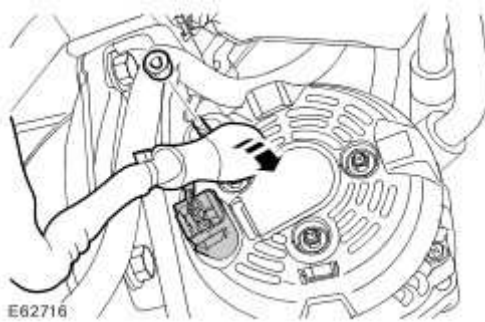
17 . Remove the power steering pump mounting bracket.

- ▶ Remove the 4 bolts.



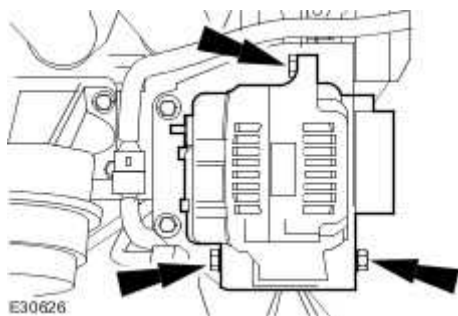
18 . Disconnect the battery positive cable and the generator electrical connector.

- ▶ Release the cover.
- ▶ Remove the nut.
- ▶ Disconnect the electrical connector.



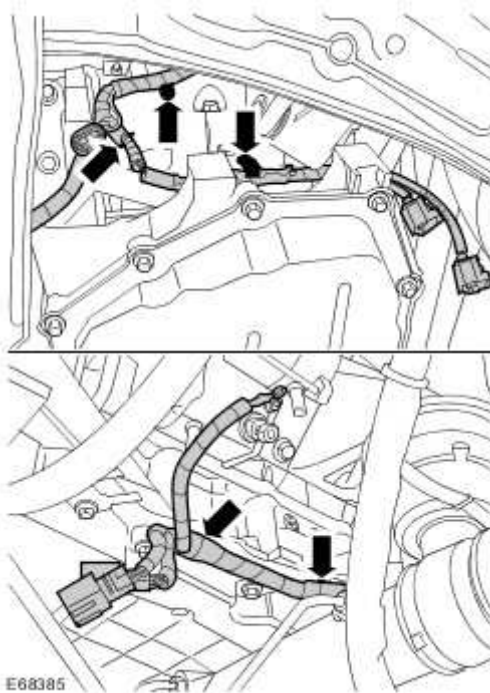
19 . Remove the generator.

- ▶ Remove the nut.
- ▶ Remove the nut and bolt.



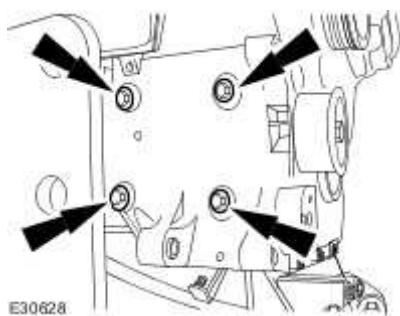
20 . RH side: Release the engine wiring harness.

▶ Release the 5 clips.



21 . Remove the generator mounting bracket.

▶ Remove the 4 bolts.



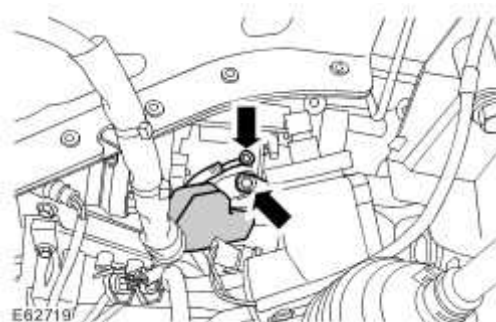
22 . Disconnect the battery positive cable.

▶ Release the cover.

▶ Remove the nut.

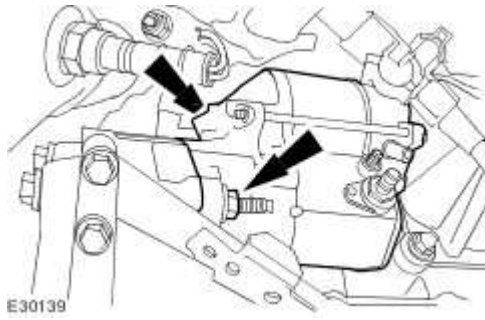
23 . Disconnect the starter motor solenoid electrical connector.

▶ Remove and discard the nut.



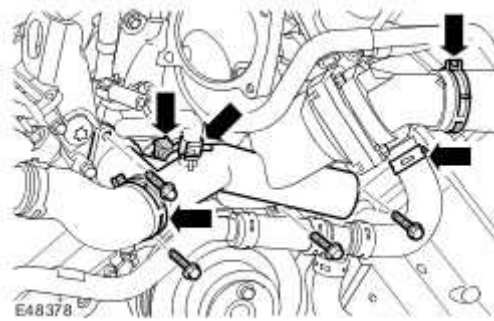
24 . Remove the starter motor.

▶ Remove the 2 bolts.



25 Remove the coolant manifold.

- ▶ Release the clips and disconnect the 4 coolant hoses.
- ▶ Remove the 4 bolts.
- ▶ Disconnect the engine coolant temperature (ECT) sensor electrical connector.



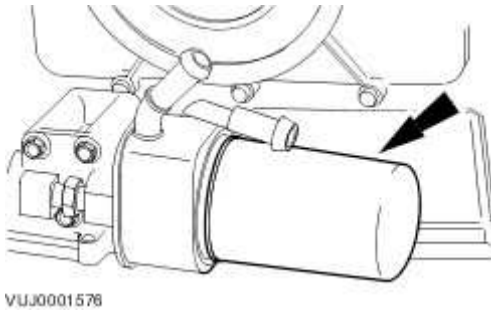
26 . **NOTE:**

Some oil spillage is inevitable during this operation.

NOTE:

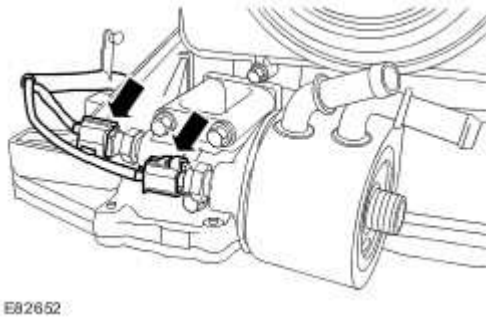
Clean the components general area prior to dismantling.

Remove the oil filter.



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

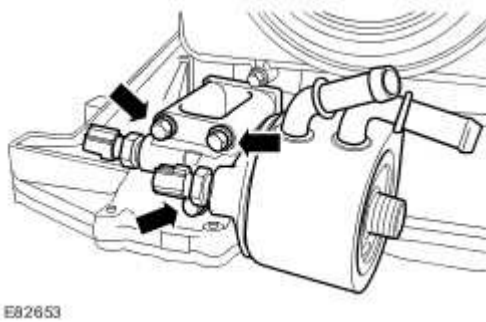
28 . Disconnect the engine oil temperature sensor electrical connector.



29 . Remove the oil filter housing.

▶ Remove the 3 bolts.

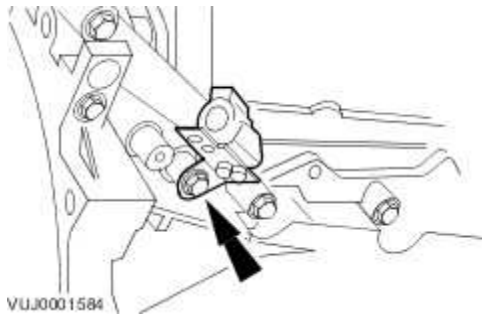
▶ Remove and discard the O-ring seal.



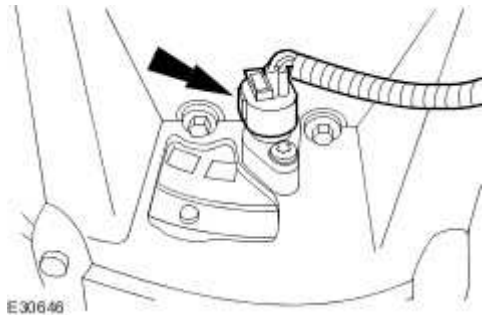
30 . **NOTE:**

Right-hand shown, left-hand similar.

Release the 2 heated oxygen sensor (HO2S) harness brackets.



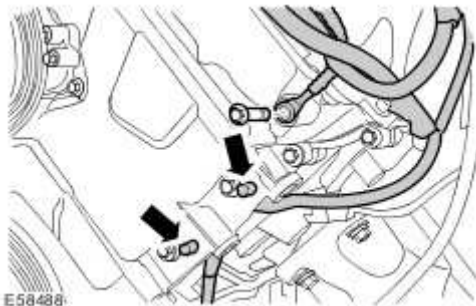
31 . Disconnect the crankshaft position (CKP) sensor electrical connector.



32 . Release the engine wiring harness.

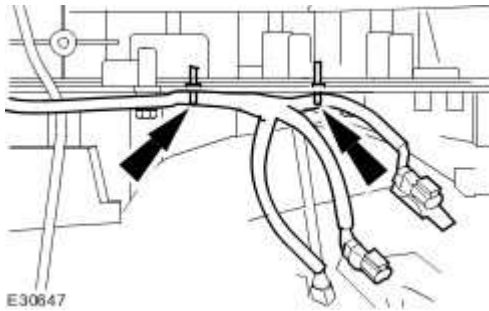
▶ Release the 2 clips.

▶ Remove the bolt.



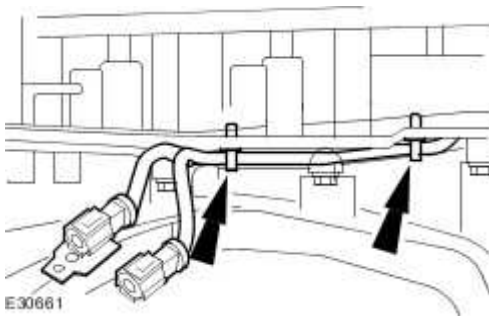
33 . Release the wiring harness from the LH side of the engine.

▶ Release the clips.



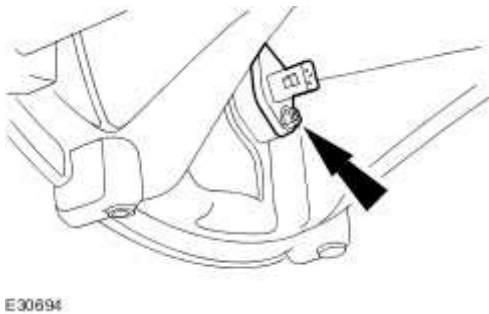
34 . Release the wiring harness from the RH side of the engine.

▶ Release the clips.



35 . Remove the CKP sensor.

▶ Remove the bolt.

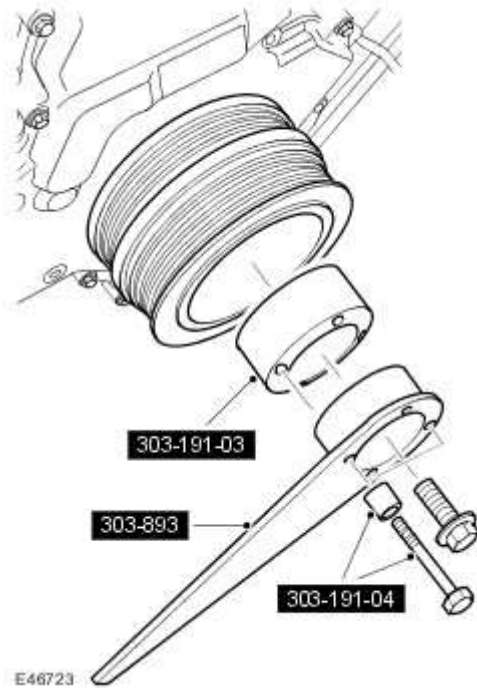


36



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.



37 . **NOTE:**

The crankshaft pulley retaining bolt will be very tight.

Using the special tools, remove the crankshaft pulley bolt.

▶ Discard the bolt.

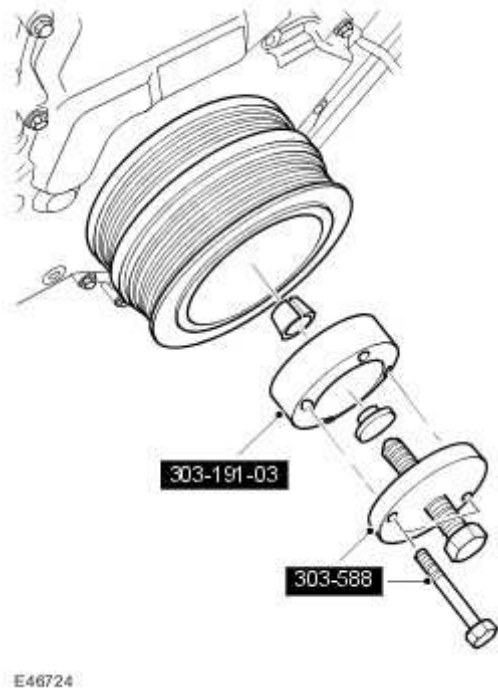
▶ Remove the special tools.

38 . **NOTE:**

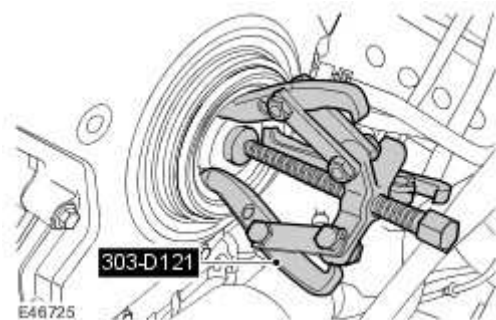
The crankshaft pulley will be very tight.

Using the special tools, remove the crankshaft pulley.

- ▶ Collect the locking ring.
- ▶ Remove the special tools.



39 . Using the special tool, remove and discard the crankshaft front seal.

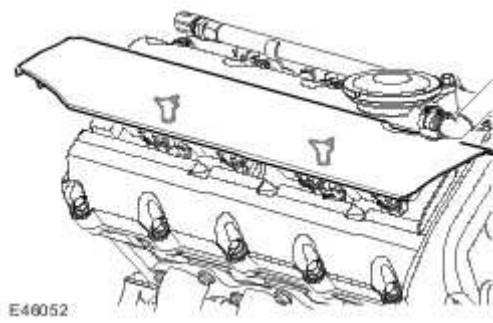


40 . **NOTE:**

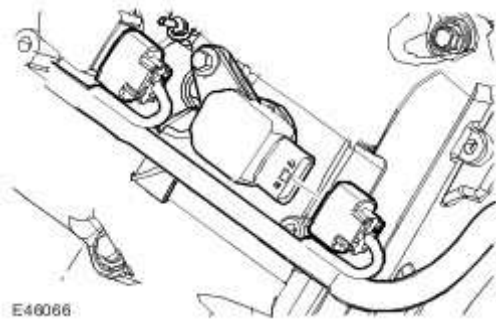
Right-hand shown, left-hand similar.

Remove both the ignition coil-on-plug covers.

- ▶ Release from the 2 clips.

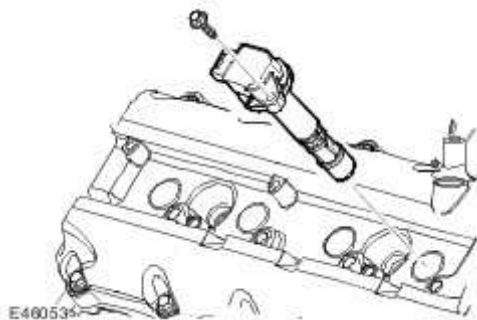


41 . Disconnect the RH ignition coil-on-plug electrical connector.



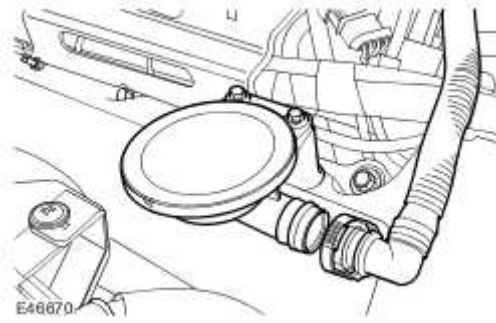
42 . Remove the RH ignition coil-on-plug.

- ▶ Remove the bolt.
- ▶ Remove and discard the seal.



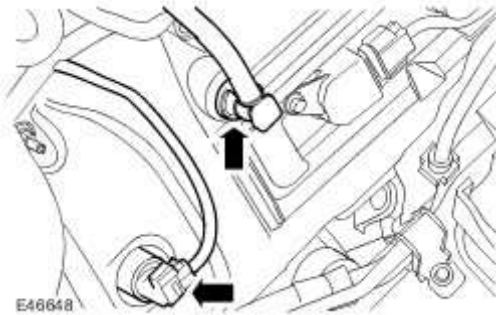
43 . Remove the remaining RH ignition coil-on-plugs.

44 . Disconnect the positive crankcase ventilation (PCV) line.

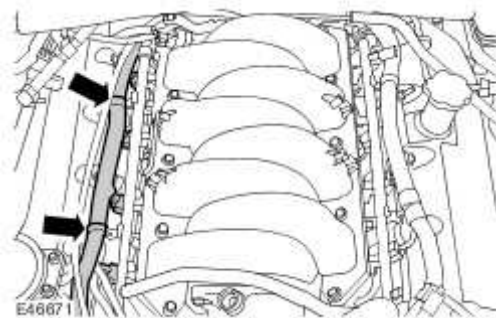


45 . Disconnect the LH variable camshaft timing (VCT) oil solenoid electrical connector.

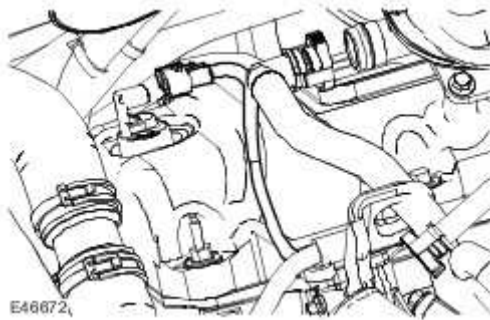
46 . Disconnect the valve cover breather hose.



47 . Release the engine wiring harness from the retaining bracket.



48 . Disconnect the RH variable camshaft timing (VCT) oil solenoid electrical connector.



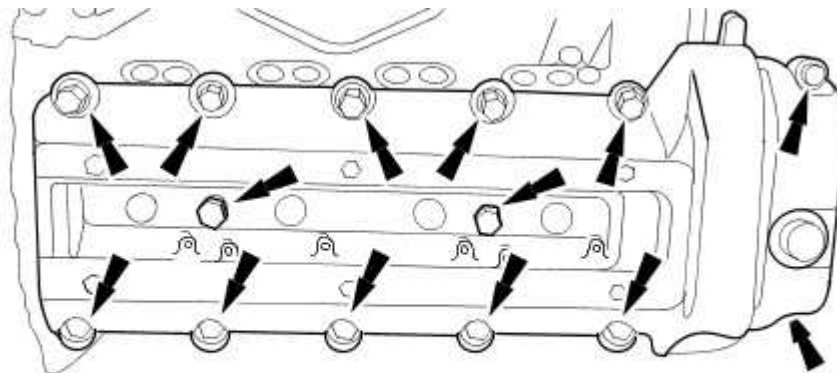
49 . **NOTE:**

Note the fitted position of the retaining bolts prior to removal.

Remove the RH valve cover.

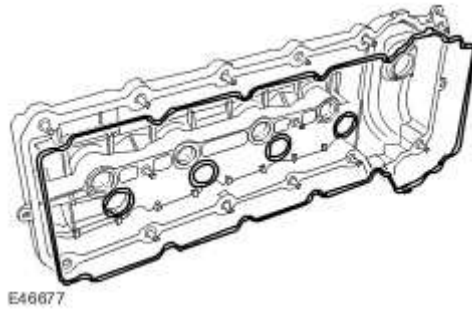
▶ Remove the 14 valve cover retaining bolts.

▶ Remove the engine cover bracket.

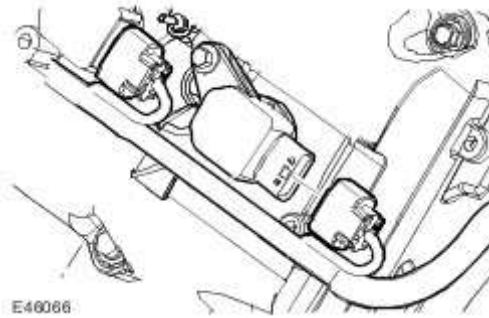


50 . Remove and discard the RH valve cover gaskets.

▶ Remove and discard the seals.

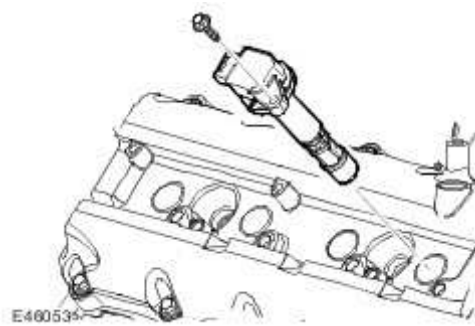


51 . Disconnect the LH ignition coil-on-plug electrical connector.



52 . Remove the LH ignition coil-on-plug.

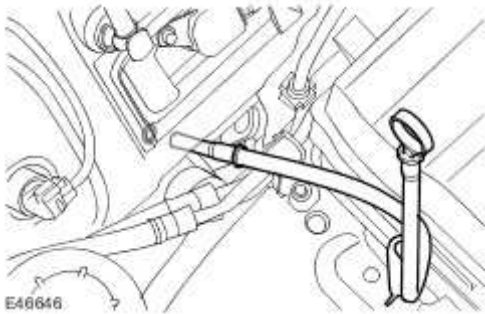
- ▶ Remove the bolt.
- ▶ Remove and discard the seal.



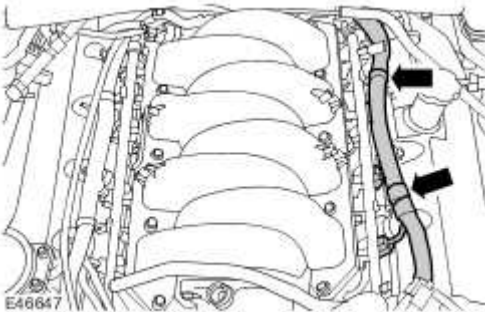
53 . Remove the remaining LH ignition coil-on-plugs.

54 . Remove the oil level indicator and tube.

- ▶ Remove the oil level indicator.
- ▶ Remove the nut.
- ▶ Remove the tube.
- ▶ Remove and discard the O-ring seal.



55 . Release the engine wiring harness from the retaining bracket.

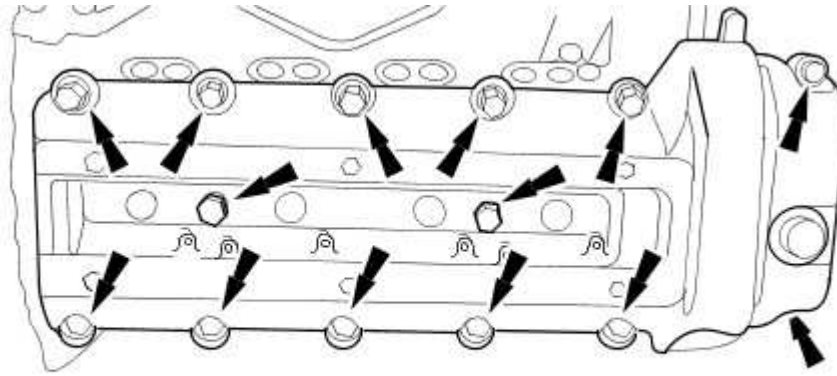


56 . **NOTE:**

Note the fitted position of the retaining bolts prior to removal.

Remove the LH valve cover.

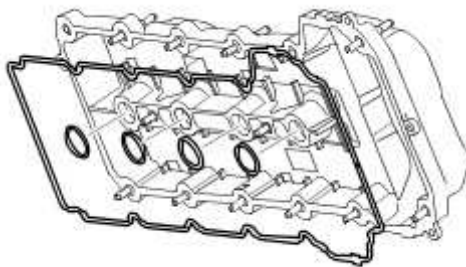
- ▶ Remove the 14 valve cover retaining bolts.



E30698

57 . Remove and discard the LH valve cover gaskets.

▶ Remove and discard the seals.



E46652

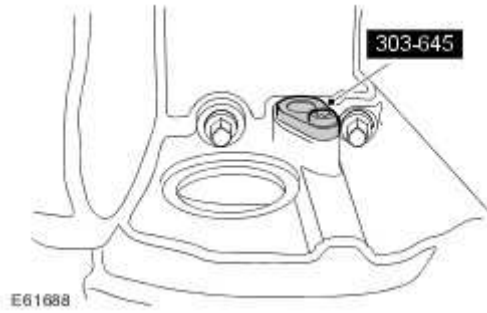
58 . **NOTE:**

Install the special tool to the crankshaft sensor aperture.

Lock the crankshaft.

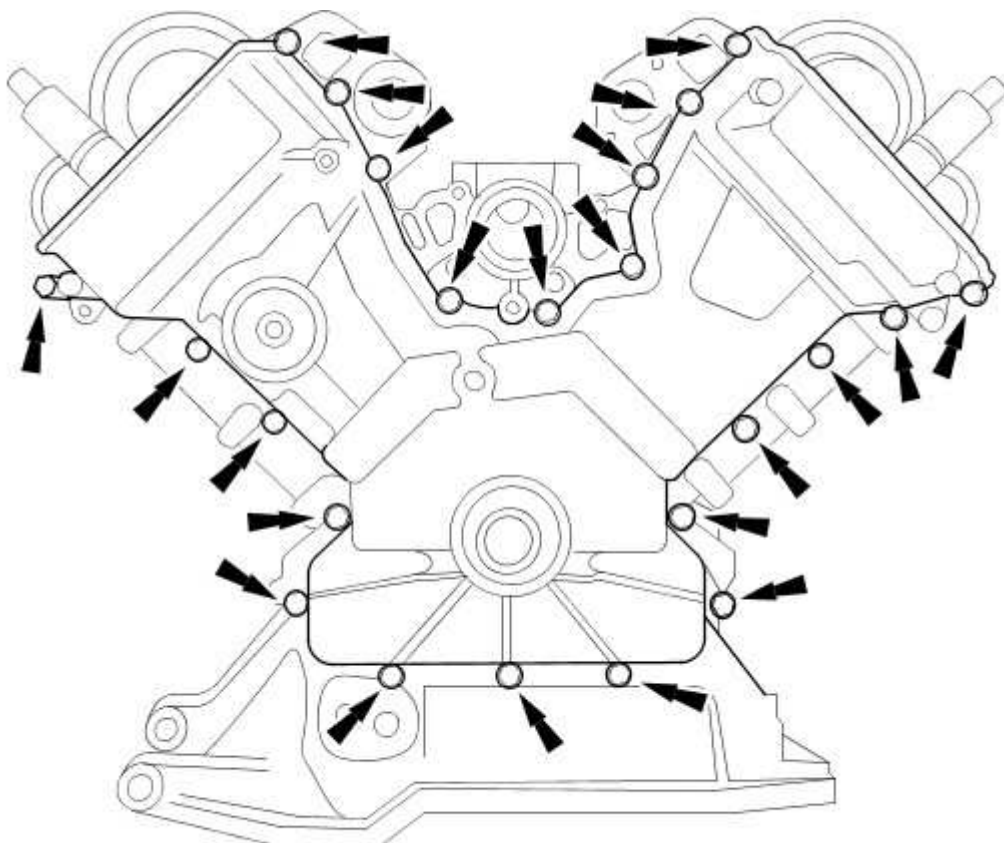
▶ Install the special tool.

▶ Install the bolt.



59 . Remove the engine front cover.

- ▶ Remove the 24 bolts.
- ▶ Remove and discard the gasket.
- ▶ Remove and discard the 3 O-ring seals.

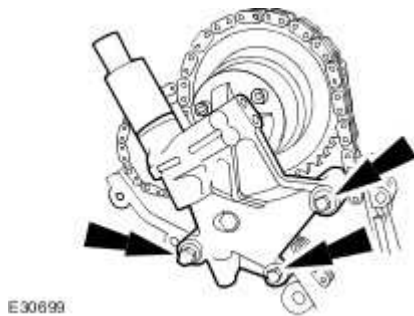


VUJ0002398

60 . Remove the RH VCT housing.

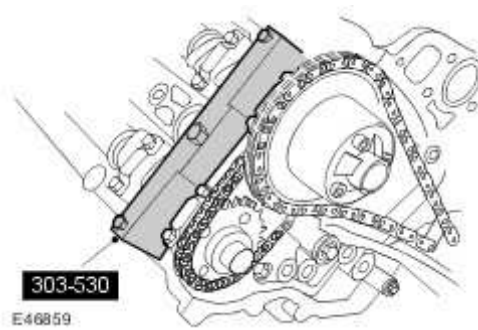
▶ Remove the 3 bolts.

▶ Remove and discard the O-ring seals.



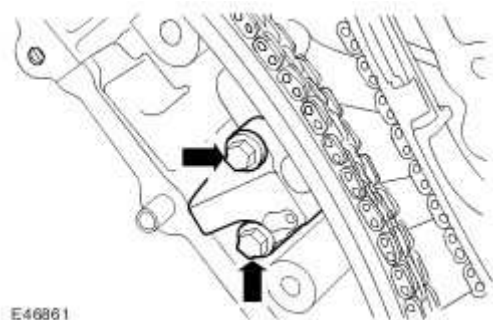
61 . Install the special tool to the RH cylinder head.

▶ Install the 3 bolts.



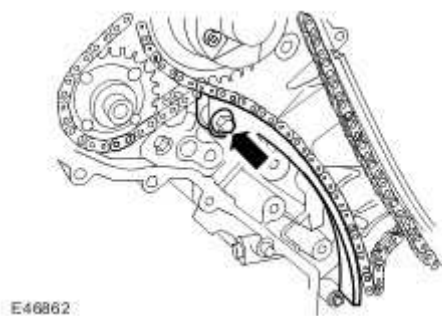
62 . Remove the RH primary timing chain tensioner assembly.

▶ Remove the 2 bolts.

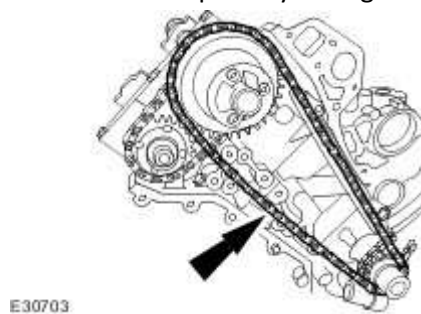


63 . Remove the RH primary timing chain tensioner guide.

▶ Remove the bolt.



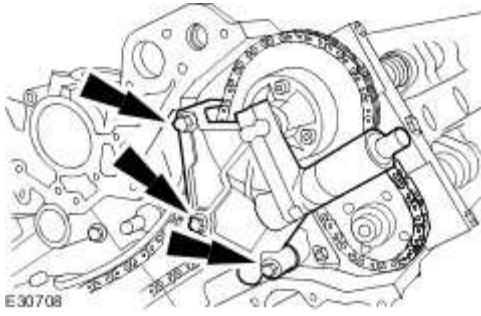
64 . Remove the RH primary timing chain.



65 . Remove the LH VCT housing.

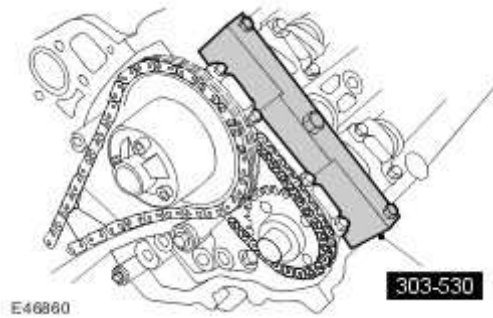
▶ Remove the 3 bolts.

▶ Remove and discard the O-ring seals.



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

▶ Install the 3 bolts.



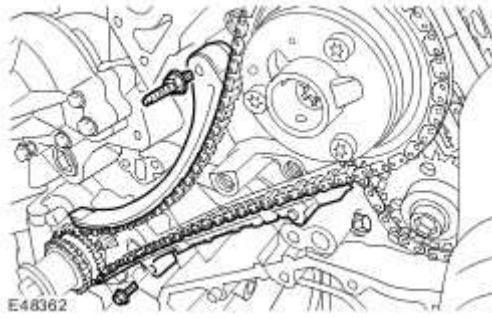
67 . Remove the LH primary timing chain tensioner.

▶ Remove the 2 bolts.

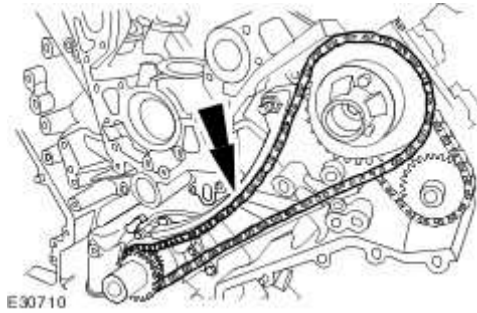


68 . Remove the LH upper and lower primary timing chain tensioner guides.

▶ Remove the 2 bolts.



69 . Remove the LH primary timing chain.

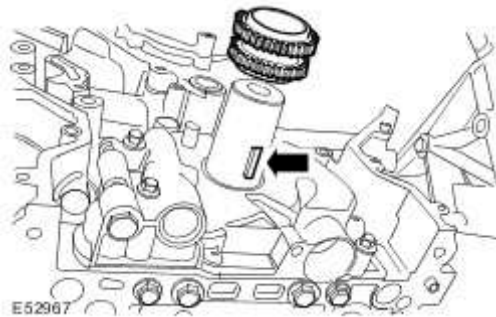


70 . **NOTE:**

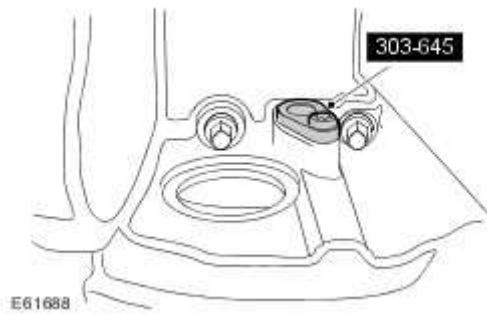
Note the orientation of the crankshaft sprocket.

Remove the crankshaft sprocket.

▶ Remove the crankshaft sprocket key.



71 . Remove the special tool.



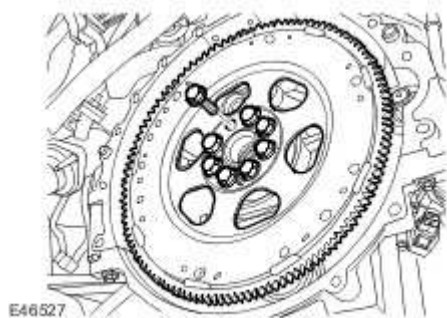
72



CAUTION: The bolts can only be used 3 times, mark the bolts with a center punch.
If 2 punch marks are visible, discard the bolts.

Remove the torque converter flexplate.

▶ Remove the 8 bolts.



73 .

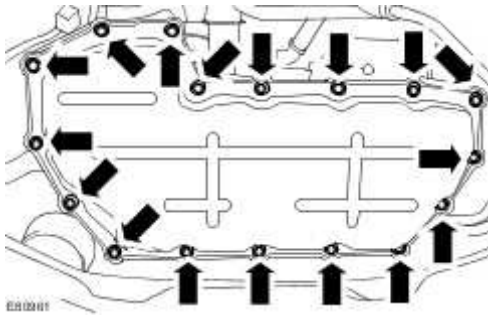


CAUTION: Note the position of the bolts, prior to removal.

Remove the oil pan.

▶ Remove the 17 bolts.

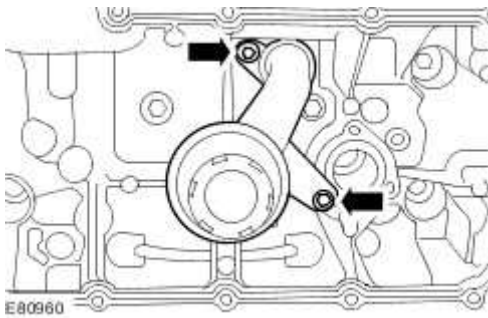
▶ Remove and discard the gasket.



74 . Remove the oil strainer pick-up assembly.

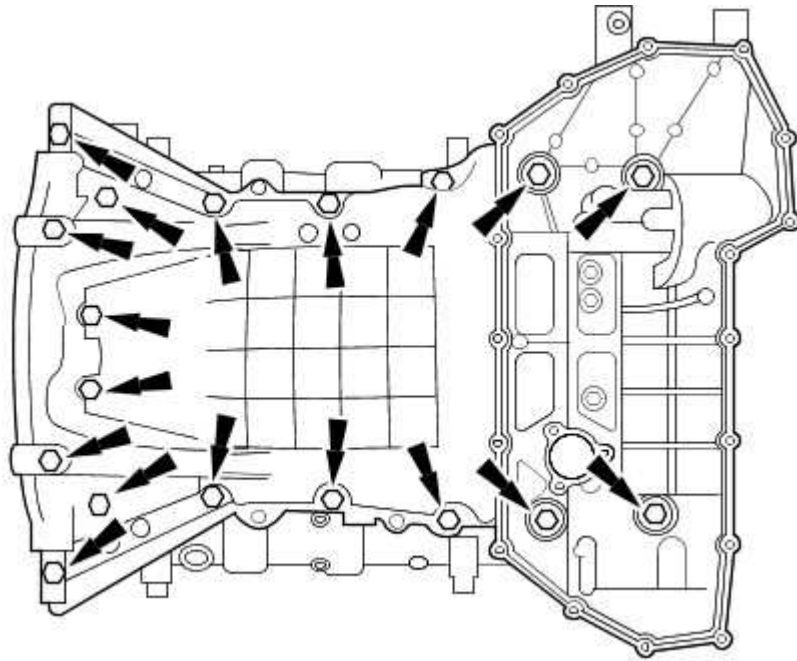
▶ Remove the 2 bolts.

▶ Remove and discard the O-ring seal.



75 . Remove the oil pan extension.

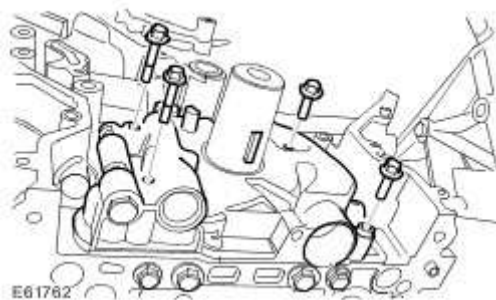
▶ Remove the 18 bolts.



VUJ0002435

76 . Remove the oil pump assembly.

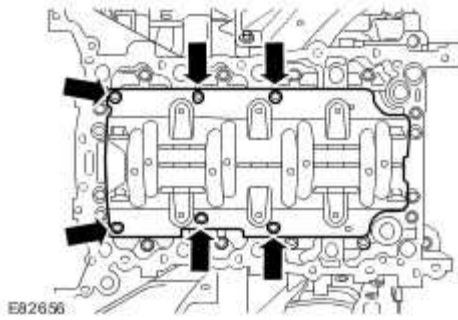
- ▶ Remove the 4 bolts.
- ▶ Remove and discard the gasket.
- ▶ Clean the component mating faces.



E61762

77 . Remove the baffle plate.

- ▶ Remove the 6 bolts.



78



WARNING: To make sure damage does not occur to the crankshaft and piston components, the engine must be inverted on the engine stand. Failure to follow this instruction may result in damage to the engine.

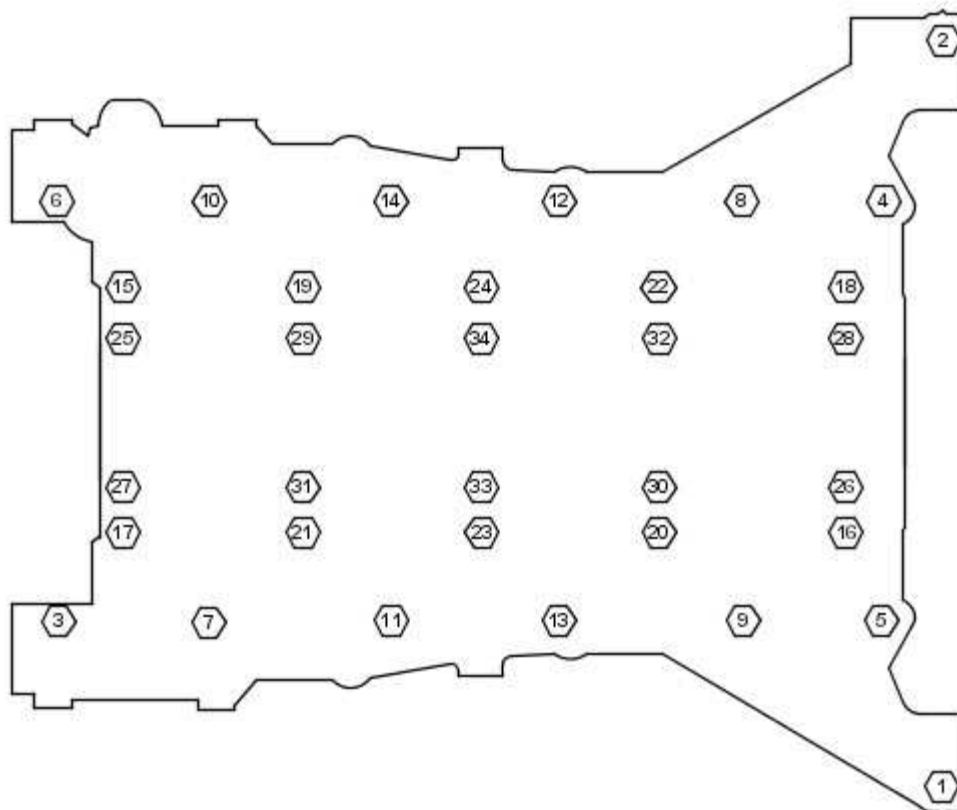
NOTE:

If the crankshaft main bearing carrier retaining bolts have been marked with a center punch dot, they must be discarded and new bolts installed.

Remove the crankshaft main bearing carrier.

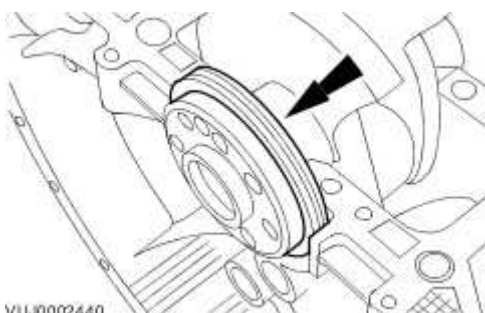


Remove the crankshaft main bearing carrier retaining bolts in the indicated sequence.



VUJ0002439

79 . Discard the crankshaft rear main oil seal.



VUJ0002440

Installation

1



CAUTION: Use only a plastic scraper when removing the sealing material.



CAUTION: If any new bolts are to be installed to retain the crankshaft main bearing carrier, pre-stress the retaining bolts by installing the crankshaft main bearing carrier without any sealant and tightening the new retaining bolts to the specified torque. Remove the crankshaft main bearing carrier once the bolts have been pre-stressed. Failure to follow this instruction may result in damage to the vehicle.

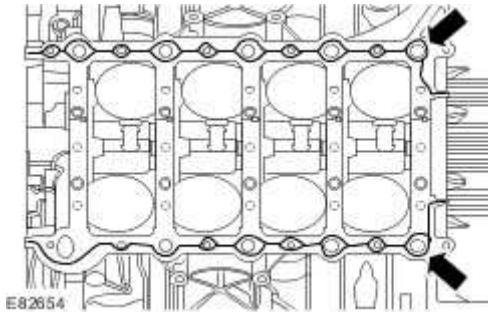
Clean all the mating faces and reusable parts thoroughly and check for damage.

2 NOTE:

Install the crankshaft main bearing carrier and tighten bolts to specification within twenty minutes of applying the sealant.

Apply a 2 mm (0.08in) bead of sealant to the cylinder block in the area shown.

 Use WSS-M4G323-A4-RTV sealant.

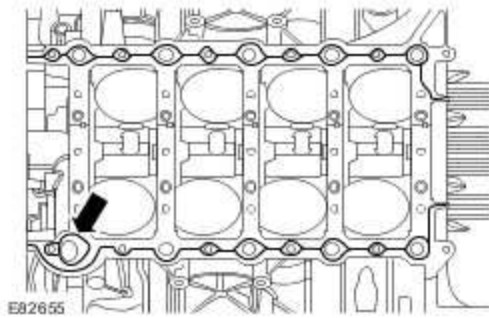


3 NOTE:

Install the crankshaft main bearing carrier and tighten bolts to specification within twenty minutes of applying the sealant.

Apply a 1 mm (0.039in) bead of sealant to the cylinder block in the area shown.

 Use WSS-M4G323-A4-RTV sealant.



- 4
-  **CAUTION:** Make sure all dowels are fully seated into the crankshaft main bearing carrier prior to tightening the bolts.

NOTE:

Do not lubricate the crankshaft main bearing carrier retaining bolts.

NOTE:

Do not rotate the crankshaft until all the retaining bolts are tightened to specification.

NOTE:

The retaining bolts must be tightened within twenty minutes of applying the sealant.

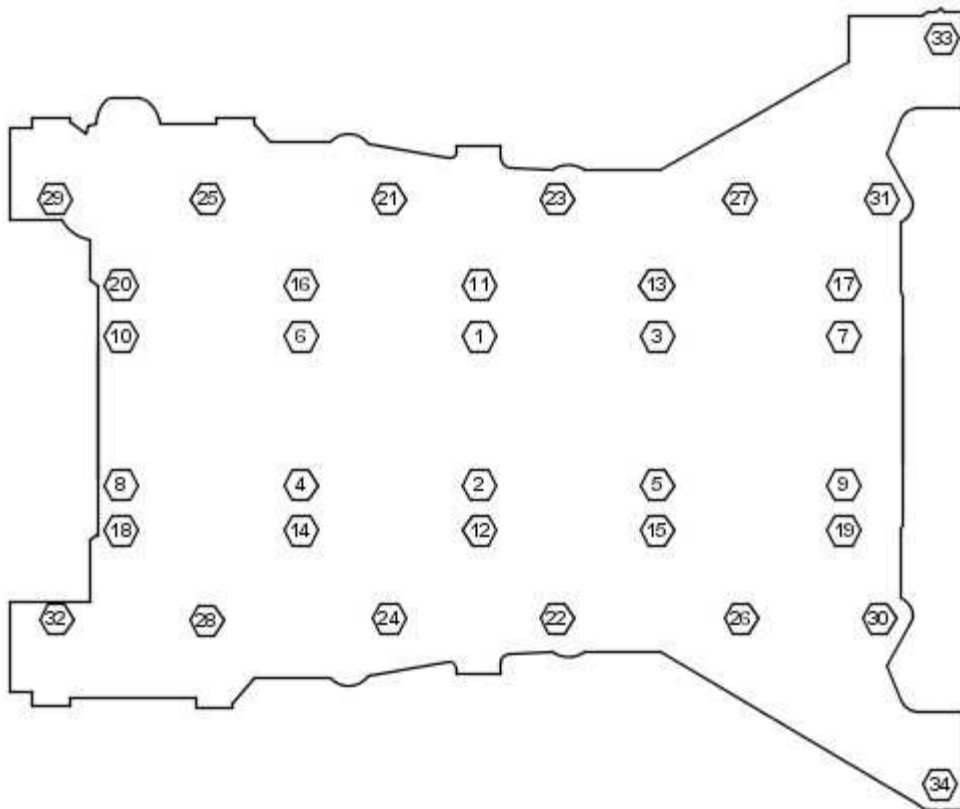
NOTE:

Tighten the retaining bolts in the sequence shown.

Install the crankshaft main bearing carrier to the cylinder block.

- 1) Stage 1: Bolts 21 to 32, tighten to 15 Nm (11 lb.ft).
- 2) Stage 2: Bolts 33 to 34, tighten to 15 Nm (11 lb.ft).
- 3) Stage 3: Bolts 1 to 10, tighten to 25 Nm (18 lb.ft).
- 4) Stage 4: Bolts 11 to 20, tighten to 15 Nm (11 lb.ft).

- 5) Stage 5: Bolts 1 to 10, tighten to 35 Nm (26 lb.ft), then a further 135 degrees.
- 6) Stage 6: Bolts 11 to 20, tighten to 20 Nm (15 lb.ft), then a further 150 degrees.
- 7) Stage 7: Bolts 21 to 32, tighten to 20 Nm (15 lb.ft), then a further 90 degrees.
- 8) Stage 8: Bolts 33 to 34, tighten to 20 Nm (15 lb.ft), then a further 150 degrees.
- 9) Stage 9: Center punch each of the bolt heads to indicate it has been reused.



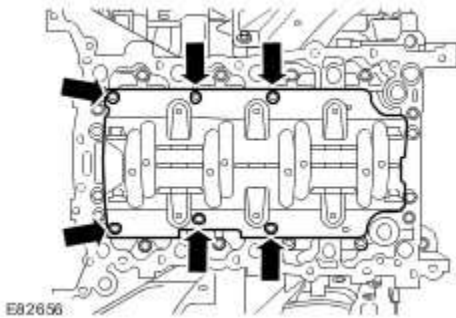
VUJ0002450

5 . Rotate the crankshaft to check correct operation.

6 . Remove excess sealant which may squeeze out at the front cover sealing surfaces.

7 . Install the baffle plate.

▶ Tighten the 6 bolts to 6 Nm (4 lb.ft).



8 NOTE:

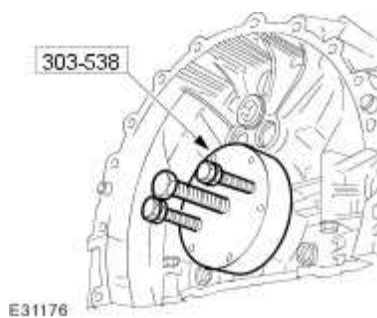
Carefully remove the transit sleeve, leaving the seal in place.

NOTE:

Make sure that the transit sleeve is correctly positioned and install the new seal over the crankshaft. Do not use any lubricant on the seal, the transit sleeve or the crankshaft.

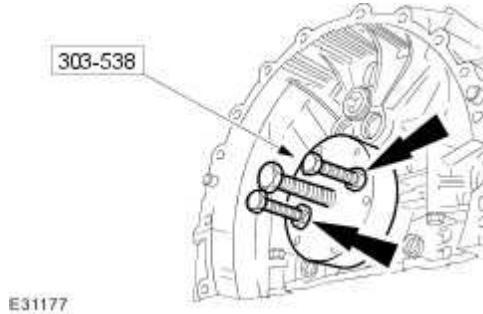
Using the special tool, position the crankshaft rear oil seal.

▶ Install the special tool to the crankshaft.



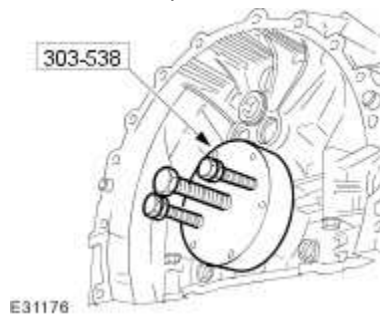
9.  **CAUTION: Alternate the nut tightening to correctly seat the crankshaft rear oil seal.**

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



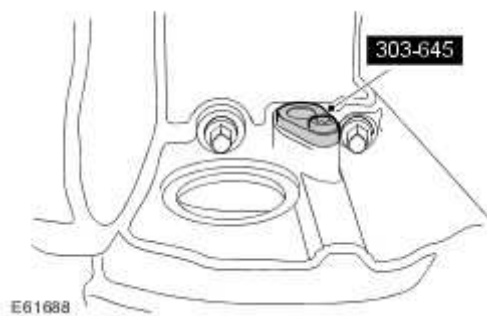
10.  **CAUTION: Make sure that the crankshaft rear oil seal is correctly located.**

Remove the special tool.



11. Install the special tool.

 Install the bolt.



12 . NOTE:

Install a new gasket.

Install the oil pump assembly.

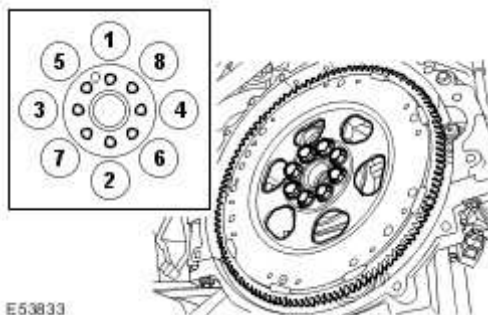
- ▶ Clean the component mating faces.
- ▶ Install the gasket.
- ▶ Tighten the bolts to 10 Nm (7 lb.ft).

13 . NOTE:

Prevent the flexplate from rotating.

Install the torque converter flexplate.

- ▶ Clean the component mating faces.
- ▶ Tighten the bolts evenly in 2 stages to the sequence shown.
- ▶ Tighten the bolts to 15 Nm (11 lb ft).
- ▶ Tighten the bolts to 110 Nm (81 lb.ft).



14 . NOTE:

Install a new O-ring seal.

Install the oil strainer pick-up assembly.

▶ Install the O-ring seal.

▶ Tighten the bolts to 12 Nm (9 lb.ft).

15 . Install the crankshaft sprocket.

▶ Clean the component mating faces.

▶ Install the crankshaft sprocket key.

16 Install the LH primary timing chain.

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

17 . Install the LH primary timing chain tensioner guides.

▶ Tighten the bolts to 12 Nm (9 lb.ft).

18



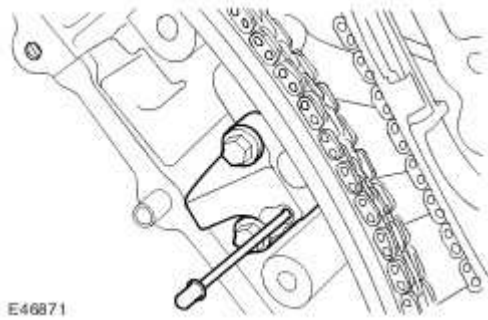
CAUTION: During timing chain tensioner compression, do not release the ratchet stem until the timing chain tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.

Install the LH primary timing chain tensioner.

▶ Using a 3 mm (0.118 in) diameter rod, retain the chain tensioner piston.

▶ Tighten the bolts to 12 Nm (9 lb.ft).

▶ Remove the retaining rod.



- 19 .  **CAUTION: Make sure that new bolts are installed.**

NOTE:

Install new O-ring seals.

Install the LH VCT control solenoid housing.

- ▶ Install the O-ring seals.
- ▶ Tighten the bolts to 22 Nm (16 lb.ft).
- ▶ Tighten the nut to 10 Nm (7 lb.ft).

- 20 Install the RH primary timing chain.

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

- 21 . Install the RH primary timing chain tensioner guide.

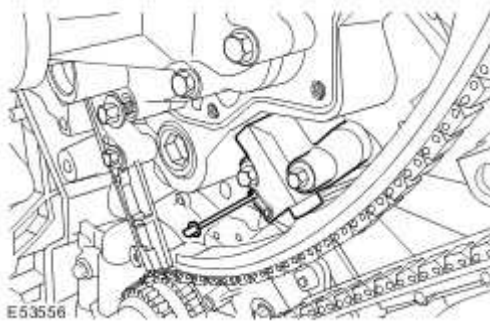
- ▶ Tighten the bolts to 12 Nm (9 lb.ft).

- 22  **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 a 3 mm (0.118 in) diameter rod, retain the chain tensioner piston.
- ▶ Tighten the bolts to 12 Nm (9 lb.ft).
- ▶ Remove the retaining rod.



23 . NOTE:

Install new O-ring seals.

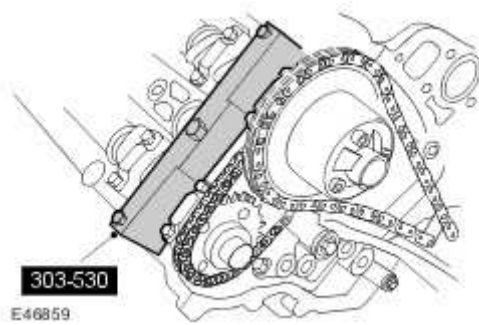
NOTE:

Make sure that new bolts are installed.

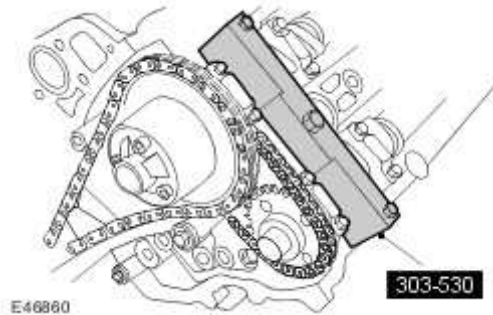
Install the RH VCT control solenoid housing.

- ▶ Install the O-ring seals.
- ▶ Tighten the bolts to 22 Nm (16 lb.ft).
- ▶ Tighten the nut to 10 Nm (7 lb.ft).

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

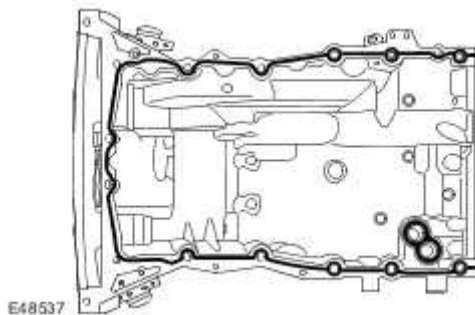


25 . Remove the special tool from the LH cylinder head.

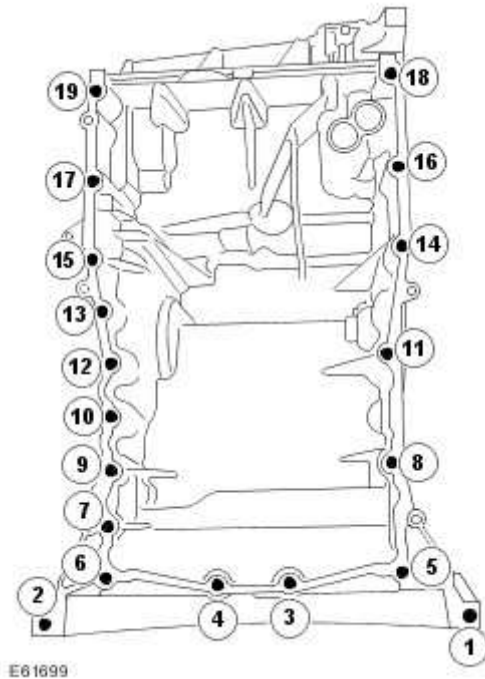


26 . Install the oil pan extension.

- ▶ Clean the component mating faces.
- ▶ Apply a 3 mm (0.118 in) diameter bead of sealant, to the area indicated.
- ▶ Install the bolts, but do not tighten fully at this stage.



27 . Tighten the oil pan bolts in the sequence shown to 20 Nm (15 lb.ft).



28 . Remove the special tool.

▶ Remove the bolt.



29 . Install the CKP sensor.

▶ Tighten the bolt to 8 Nm (6 lb.ft)

30 . Attach the wiring harness to the LH side of the engine

▶ Secure the clips.

31 . Attach the wiring harness to the RH side of the engine.

▶ Secure the clips.

32 . Install the power steering pump mounting bracket.

▶ Tighten the bolts to 25 Nm (18 lb.ft).

33 **NOTE:**

Install a new gasket.

NOTE:

Install a new O-ring seal.

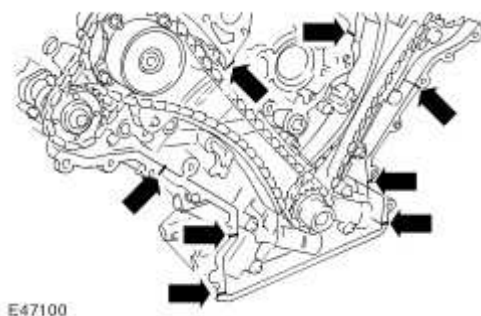
Install the engine front cover.

▶ Clean the component mating faces.

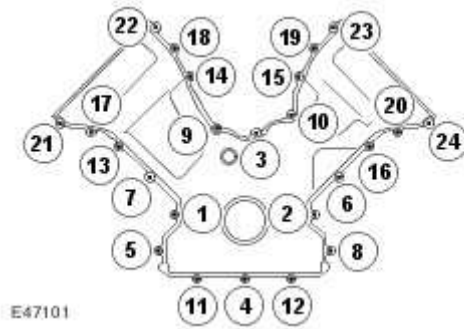
▶ Apply a 3 mm (0.118 in) diameter bead of sealant 12mm (0.47 in) long, to the 8 places indicated.

▶ Install the gasket.

▶ Install the O-ring seal.



34 . Evenly and progressively tighten the bolts in the sequence shown to 12 Nm (9 lb.ft).



35 . Attach the engine wiring harness.

▶ Secure the clips.

▶ Tighten the bolt to 10 Nm (7 lb.ft).

36 . **NOTE:**

Install new seals.

Install the LH valve cover plug aperture seals.

37 **NOTE:**

Install a new gasket.

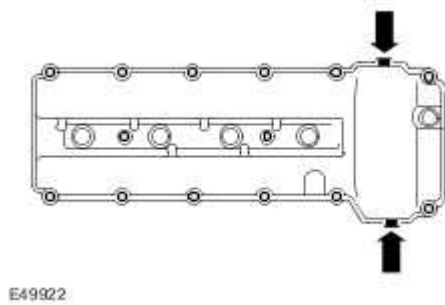
NOTE:

Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3 mm (0.118 in) diameter 12 mm (0.47 in) 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 LH valve cover.

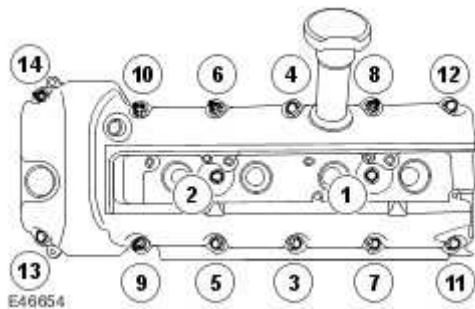
▶ Clean the component mating faces.

- ▶ Install the valve cover gasket.



- 38 . Install the LH valve cover bolts.

- ▶ Install the LH valve cover bolts to the positions previously noted.
- ▶ Tighten the bolts in the sequence shown to 12 Nm (9 lb.ft).



- 39 . Connect the LH VCT oil solenoid electrical connector.

- 40 . Attach the engine wiring harness to the retaining bracket.

- 41 . **NOTE:**

Install a new O-ring seal.

With assistance, install the oil level indicator and tube.

- ▶ Clean the component mating faces.
- ▶ Install the O-ring seal.
- ▶ Lubricate the O-ring seal with clean engine oil.
- ▶ Tighten the nut to 6 Nm (4 lb.ft).

42 . **NOTE:**

Install new O-ring seals.

Install the 4 LH ignition coil-on-plugs.

- ▶ Install the O-ring seals.
- ▶ Install the 4 ignition coil-on-plugs.
- ▶ Tighten the bolts to 6 Nm (4 lb.ft).

43 . Connect the 4 electrical connectors.

44 . Install the LH ignition coil-on-plug cover.

45 . **NOTE:**

Install new seals.

Install new RH valve cover plug aperture seals.

46 **NOTE:**

Install a new gasket.

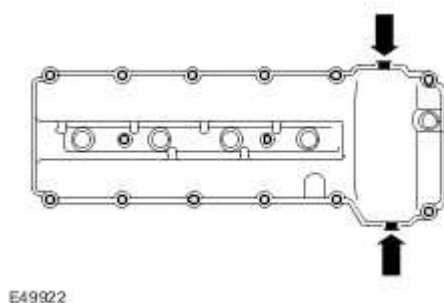
NOTE:

Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3 mm (0.118 in) diameter 12 mm (0.47 in) 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 RH valve cover.

► Clean the component mating faces.

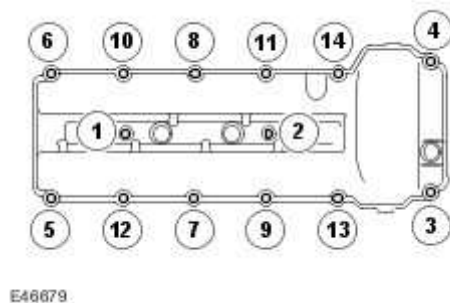
► Install the gasket.



47 . Install the RH valve cover bolts.

► Install the RH valve cover bolts to the positons previously noted.

► Tighten the bolts in the sequence shown to 12 Nm (9 lb.ft).



48 . **NOTE:**

Install new O-ring seals.

Install the 4 RH ignition coil-on-plugs.

- ▶ Install the O-ring seals.
- ▶ Install the 4 ignition coil-on-plugs.
- ▶ Tighten the bolts to 6 Nm (4 lb.ft).

49 . Connect the 4 electrical connectors.

50 . Connect the RH VCT oil solenoid electrical connector.

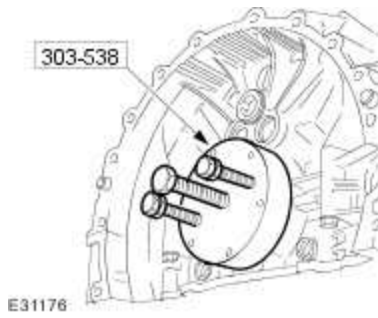
51 . Attach the engine wiring harness to the retaining bracket.

52 . Connect the PCV line to the RH valve cover.

53 . Clean the crankshaft pulley mating faces.

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

- ▶ Lubricate the seal with clean engine oil.
- ▶ Use the discarded crankshaft bolt with the special tool.
- ▶ Remove the special tools.



55 . Install the crankshaft pulley.

▶ Lubricate the seal with clean engine oil.

56 . Install the crankshaft pulley locking ring.

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

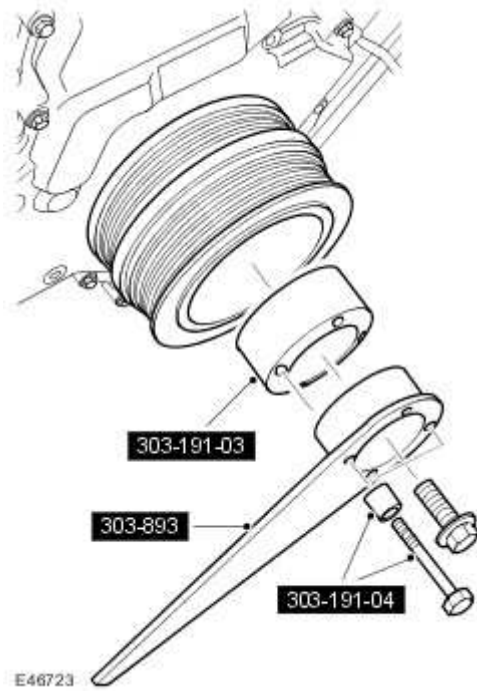
Install, but do not tighten, the new crankshaft pulley bolt.

58  **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, tighten the crankshaft pulley bolt.

▶ Tighten the crankshaft pulley bolt to 380 Nm (280 lb.ft).

▶ Remove the special tools.



59 . NOTE:

Install a new O-ring seal.

Install the oil filter housing.

- ▶ Clean the component mating faces.
- ▶ Install a new O-ring seal.
- ▶ Tighten the bolts to 20 Nm (15 lb.ft).

60 NOTE:

Install a new engine oil filter.

Install the engine oil filter.

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

61 . Connect the EOP sensor electrical connector.

62 . Connect the engine oil temperature sensor electrical connector.

63 . Install the starter motor.

- ▶ Clean the component mating faces.

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

64 . **NOTE:**

Install new O-ring seals.

Install the coolant manifold.

- ▶ Clean the components.

- ▶ Install the O-ring seals.

- ▶ Connect the 4 coolant hoses and install the clips.

- ▶ Attach the wiring harness bracket.

- ▶ Tighten the Torx screws to 10 Nm (7 lb.ft).

65 . Connect the starter motor solenoid electrical connector.

- ▶ Tighten the new nut to 7 Nm (5 lb.ft).

66 . Connect the battery positive cable to the starter motor.

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

- ▶ Secure the cover.

67 . Install the generator mounting bracket.

 Tighten the bolts to 25 Nm (18 lb.ft).

68 . RH side: Attach the wiring harness.

 Secure the clips.

69 . Install the generator.

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

 Tighten the nut and bolt to 40 Nm (30 lb.ft).

70 . Connect the battery positive cable and generator electrical connector.

 Tighten the nut to 12 Nm (9 lb.ft).

 Secure the cover.

71 . Install the exhaust manifold heat shield.

 Tighten the 2 bolts.

72 . Install the power steering pump mounting bracket.

 Tighten the bolts to 25 Nm (18 lb.ft).

73 . Install the A/C compressor mounting bracket.

 Tighten the bolts to 25 Nm (18 lb.ft).

74 . Install the power steering pump.

 Tighten the bolts to 25 Nm (18 lb.ft).

75 . Install the A/C compressor.

 Tighten the bolts to 25 Nm (18 lb.ft).

 Connect the electrical connector.

76 . Install both engine mounts and brackets.

 Clean the component mating faces.

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

 Repeat the above procedure for the other side.

77 . **NOTE:**

Install a new gasket.

Install the coolant pump.

 Clean the component mating faces.

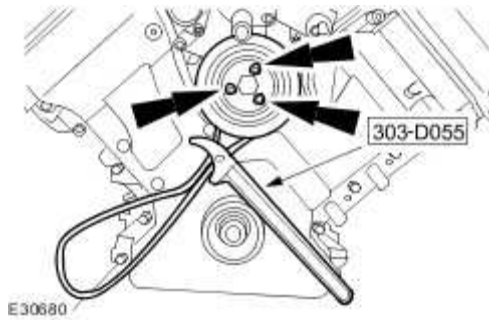
 Tighten the 5 bolts to 10 Nm (7 lb.ft).

78 . **NOTE:**

Make sure that new bolts are installed.

Using the special tool, install the coolant pump pulley.

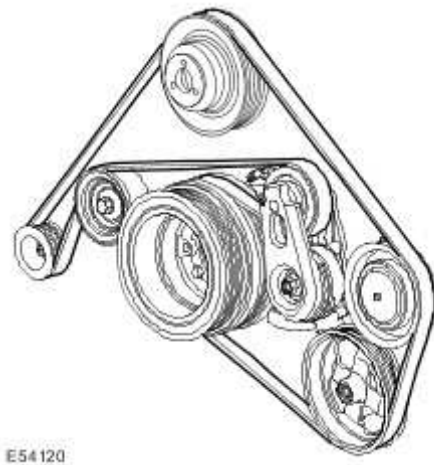
 Tighten the bolts to 25 Nm (18 lb.ft).



79 . Install the accessory drive belt idler pulley.

▶ Tighten the bolt to 25 Nm (18 lb.ft).

80 . Install the accessory drive belt.



81 . Install the accessory drive belt tensioner.

▶ Clean and inspect the drive pulleys for damage.

▶ Tighten the tensioner bolt to 40 Nm (30 lb.ft).

82 . Connect the oil cooler hoses.

83 . Remove the engine from the engine stand.

84 . Install the engine.

For additional information, refer to Engine (12.41.01)

85 . Connect the battery ground cable.

For additional information, refer to Specifications

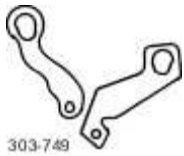
Removal

Engine (12.41.01)

Special Service Tools



Engine lifting brackets
303-536



Engine lifting brackets
303-749

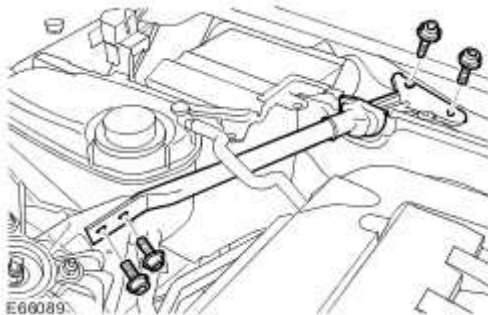
Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications
- 2 . Evacuate the A/C system.
- 3 . Remove the hood.
For additional information, refer to Hood (76.16.01)
- 4 . Remove the cowl vent screen.
For additional information, refer to Cowl Vent Screen (76.10.01)
- 5 . Remove the engine compartment braces.

 Release the grommet.

➤ Remove the 4 Torx bolts.

➤ Repeat the above procedure for the other side.



6 . Remove the throttle body.

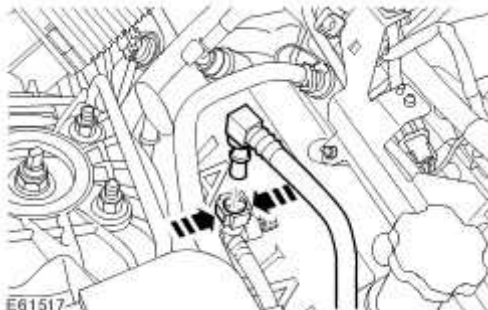
For additional information, refer to Throttle Body (19.70.04)

7 . Using the special tool, disconnect the fuel line.

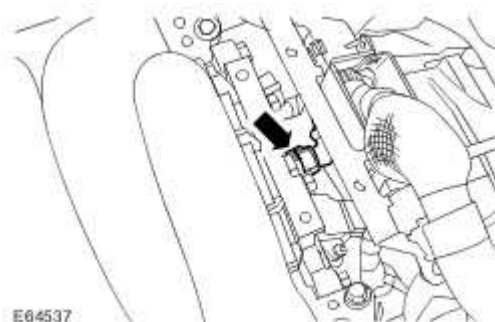
For additional information, refer to Spring Lock Couplings

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

Release the clip and disconnect the purge inlet line.

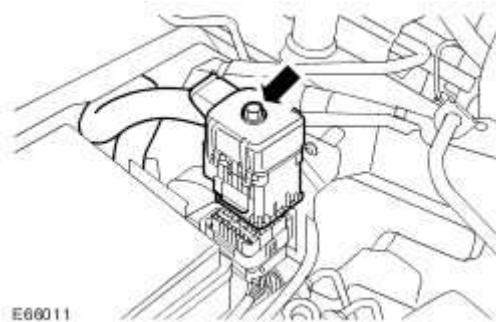


9 . Disconnect the brake booster vacuum hose from the intake manifold.



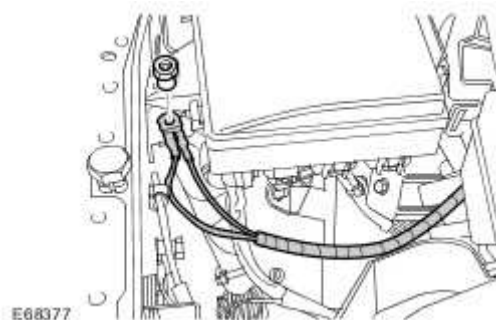
10 . Release and disconnect the engine wiring harness electrical connector.

▶ Fully loosen the bolt.



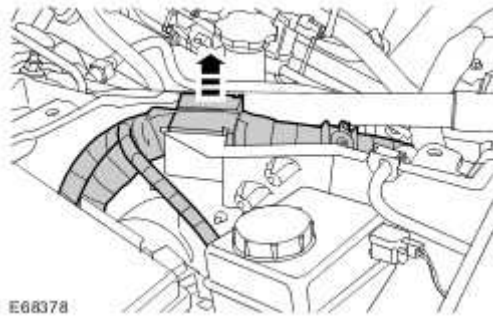
11 . Release the ground cable from the power distribution box bracket.

▶ Remove the nut.



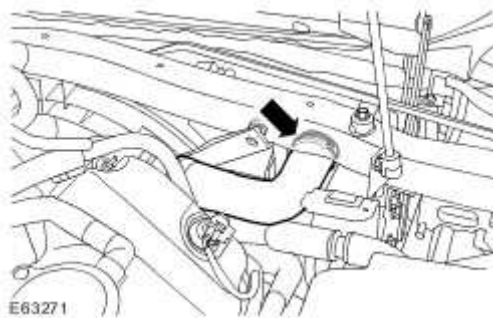
12 . Release the engine wiring harness from the engine compartment side wall.

▶ Release the grommet.



13 . Disconnect the radiator upper hose.

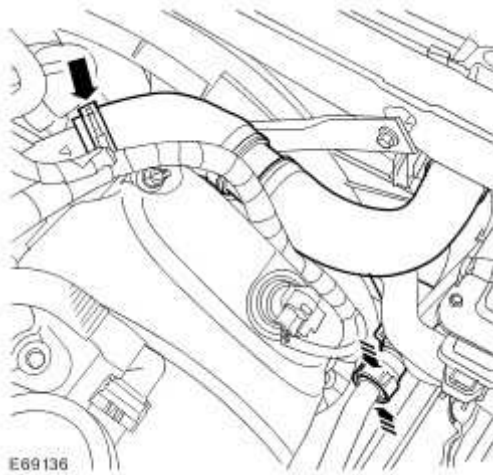
▶ Release the hose clip.



14 . Remove the radiator top hose.

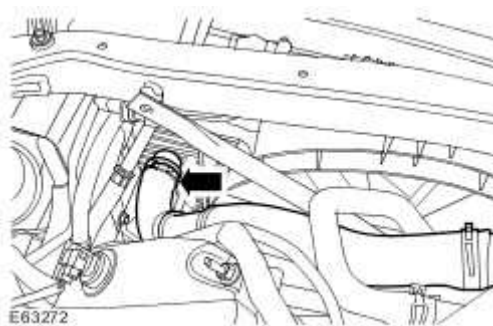
▶ Release the clip.

▶ Disconnect the quick release connector.



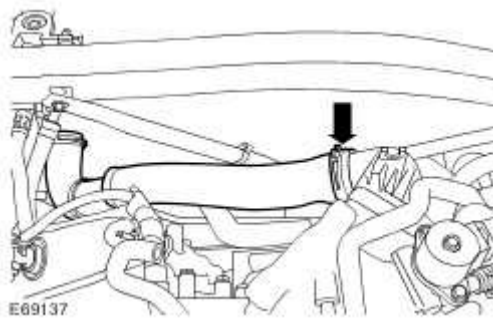
15 . Disconnect the radiator lower hose.

▶ Release the hose clip.



16 . Remove the radiator bottom hose.

▶ Release the clip.



17 . Release the power steering fluid reservoir.

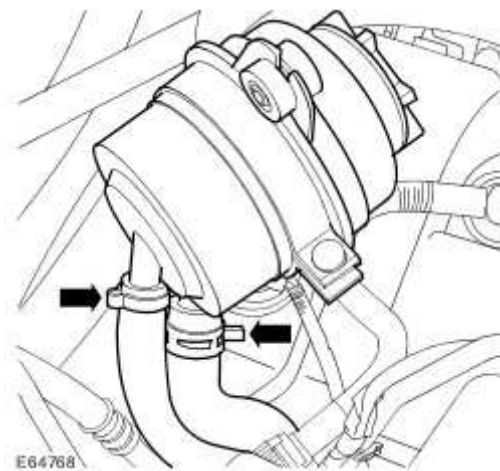
▶ Remove the 2 bolts.



18 . Disconnect the power steering supply hose.

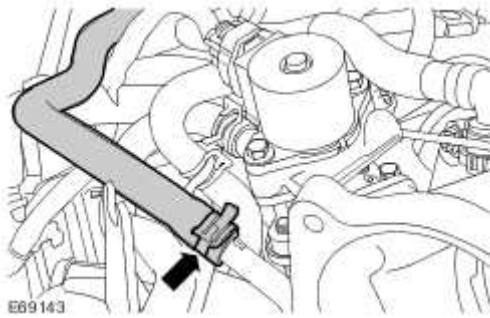
▶ Position a container to collect the fluid spillage.

▶ Release the hose clip.



19 . Disconnect the coolant expansion tank to thermostat housing coolant hose.

▶ Release the clip.



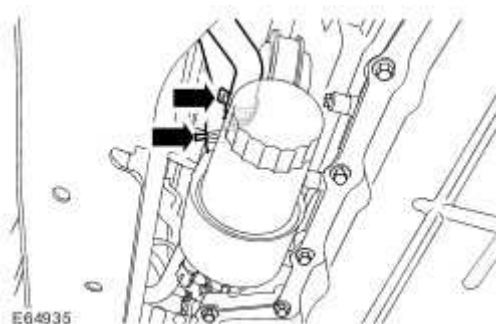
- 20  **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

- 21 . Remove the air deflector.
For additional information, refer to Air Deflector (76.11.41)

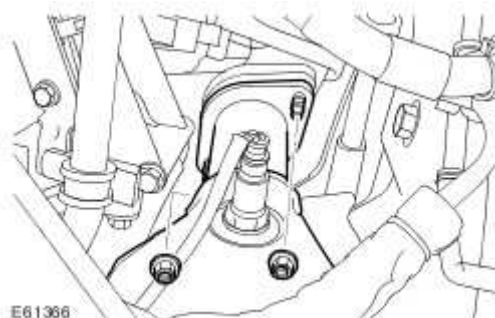
- 22 . Disconnect the coolant hoses from the engine oil cooler.

 Release the 2 clips.



- 23 . Disconnect the LH catalytic converter from the exhaust manifold.

 Remove and discard the 2 nuts.



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

▶ Remove and discard the 2 nuts.



25



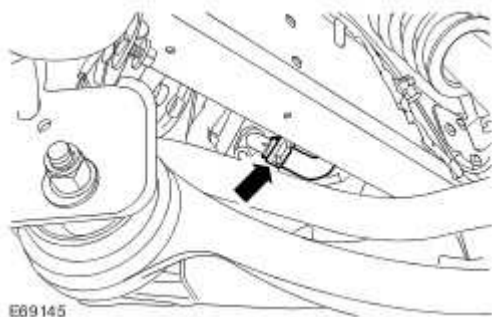
WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.



CAUTION: Always plug any open connections to prevent contamination.

Disconnect the low pressure line from the power steering pump.

▶ Release the clip.



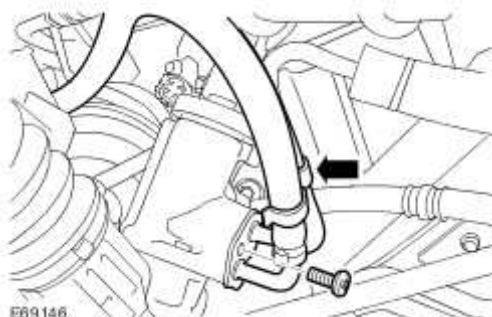
26 .



CAUTION: Always plug any open connections to prevent contamination.

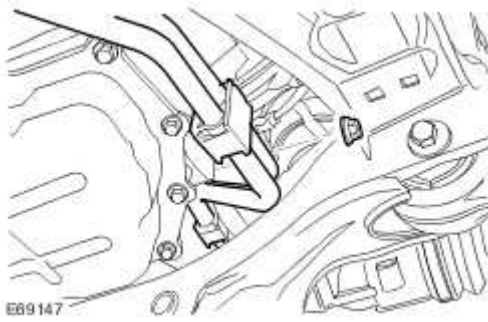
Disconnect the high pressure line from the power steering gear.

- ▶ Remove and discard the Torx bolt.
- ▶ Remove and discard the O-ring seal.
- ▶ Release from the clip.



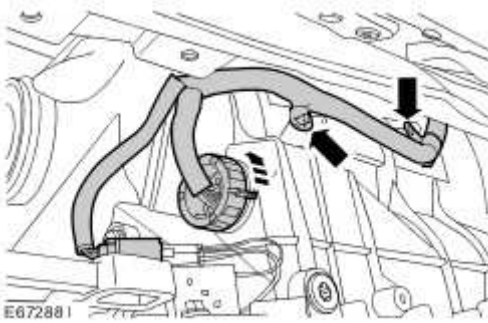
27 . Release the transmission fluid lines from the engine.

- ▶ Remove the nut.
- ▶ Release the clip.



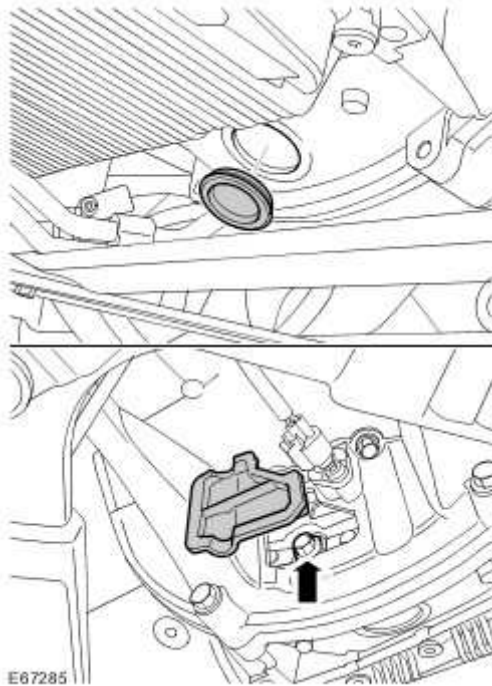
28 . Release the wiring harness from the RH side of the transmission.

- ▶ Disconnect the 2 electrical connectors.
- ▶ Carefully release the 2 clips.



29 . Release the flexplate.

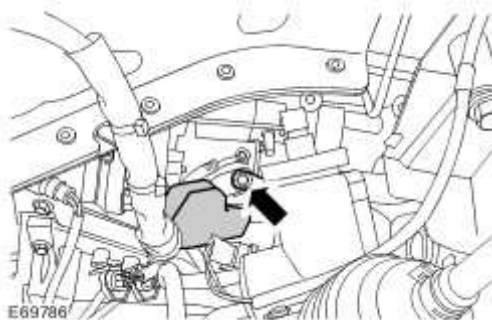
- ▶ Remove the access plugs.
- ▶ Rotate the crankshaft to access the retaining bolts.
- ▶ Remove and discard the 3 bolts.



30 . Disconnect the battery positive and generator cables.

▶ Release the cover.

▶ Remove the nut.



31

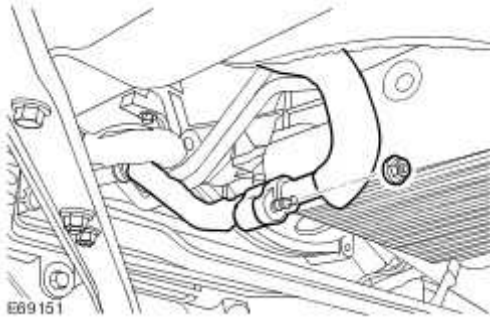


CAUTION: Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Disconnect the A/C high-pressure line from the intermediate joint.

▶ Remove the nut.

▶ Discard the O-ring seal.

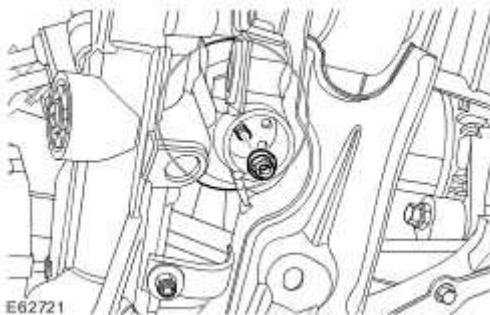


32 . **NOTE:**

RH illustration shown, LH is similar

Release the engine mounts.

▶ Remove and discard the 2 nuts.



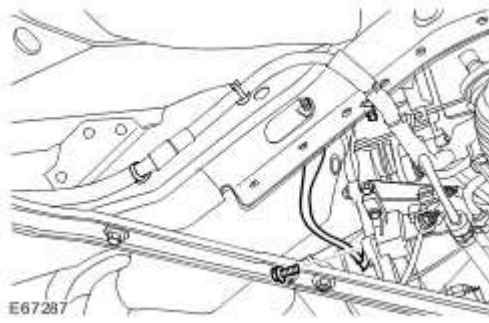
33



CAUTION: The transmission ground cable must be replaced if disconnected from the vehicle body.

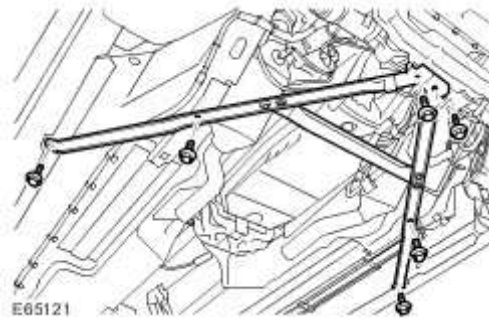
Disconnect the transmission ground cable.

▶ Remove the bolt.



34 . With assistance, remove the A-frame.

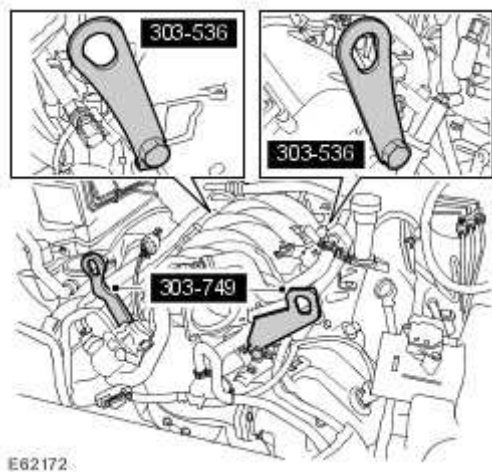
▶ Remove the 6 bolts.



35 . Lower the vehicle.

36 . Install the special tools to the engine.

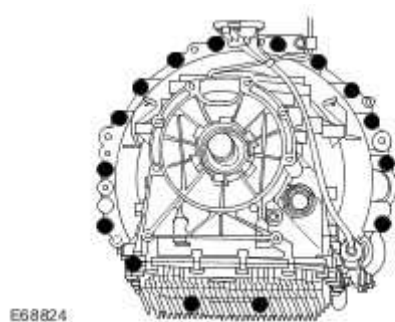
▶ Support the engine.



37.  **CAUTION:** Make sure the torque converter remains connected to the transmission.

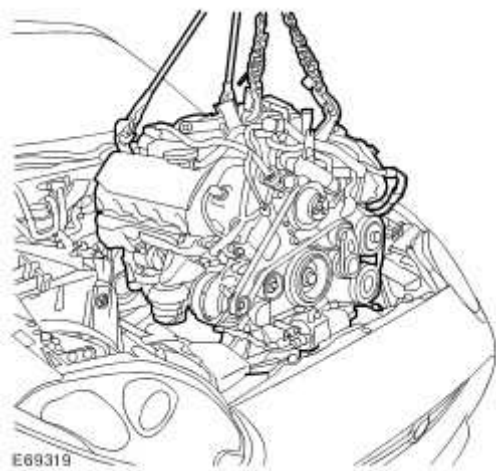
Release the transmission from the engine.

- ▶ Remove the 15 bolts.
- ▶ Support the transmission.



38.  **CAUTION:** Protect the suspension turrets to prevent damage upon engine removal.

With assistance, carefully remove the engine.



39 . Install the torque converter retainer.

Engine (12.41.01)

Installation

1 . Remove the torque converter retainer.

2 .  **CAUTION: Apply grease of the correct specification to the torque converter spigot.**

With assistance, carefully install the engine.

➤ Clean the component mating faces.

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

3 . Carefully lower the engine onto the engine mounts.

➤ Clean the components.

➤ Tighten the new nuts to 63 Nm (46 lb.ft).

4 . Remove the special tools.

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 . 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 access plugs.

7 . With assistance, install the A-frame.

- ▶ Tighten the bolts to 55 Nm (40 lb.ft).

8 . Connect the battery positive and generator cables.

- ▶ Tighten the nut to 10 Nm (7 lb.ft).
- ▶ Secure the cover.

9 . Attach the wiring harness.

- ▶ Connect the electrical connectors.
- ▶ Secure the clips.

10 . Attach the transmission fluid lines to the engine.

- ▶ Secure with the clip.
- ▶ Tighten the nut to 6 Nm (4 lb.ft).

11 . Connect the transmission ground cable.

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

12 .



CAUTION: Lubricate the new seals with clean refrigerant oil.

Connect the A/C high-pressure line intermediate joint.

- ▶ Clean the component mating faces.
- ▶ Install the new O-ring seals.
- ▶ Tighten the nut to 10 Nm (7 lb.ft).

13 . Attach the power steering gear high-pressure line.

- ▶ Clean the components.
- ▶ Install a new O-ring seal.
- ▶ Tighten the Torx bolt to 25 Nm (18 lb.ft).
- ▶ Secure in the clip.

14 . Connect the low pressure line to the power steering pump.

- ▶ Secure with the clip.

15 . Lower the vehicle.

16 . Connect the coolant expansion tank to thermostat housing coolant hose.

- ▶ Secure with the clip.

17 . Secure the power steering fluid reservoir.

- ▶ Tighten the bolts to 6 Nm (4 lb.ft).

18 . Connect the engine oil cooler, coolant hoses.

 Secure with the clips.

19 . Install the radiator bottom hose.

 Install the hoses and secure with the clips.

 Connect the hoses and secure with the clips.

20 . Install the radiator top hose.

 Connect the quick release connector.

 Connect the hoses and secure with the clips.

21 . Attach the engine wiring harness to the engine compartment side wall.

 Position and secure the grommet.

22 . Attach the ground cable to the power distribution box bracket.

 Tighten the nuts to 25 Nm (18 lb.ft).

23 . Connect the engine wiring harness electrical connector and secure with the captive bolt.

24 . Connect the brake booster vacuum hose to the intake manifold.

25 . Connect the purge inlet line.

26 . Connect the fuel line.

For additional information, refer to Spring Lock Couplings

27 . Install the throttle body.

For additional information, refer to Throttle Body (19.70.04)

28 . Install the engine compartment braces.

 Tighten the 4 Torx bolts to 25 Nm (18 lb.ft).

 Install the grommet.

 Repeat the above procedure for the other side.

29 . Install the cowl vent screen.

For additional information, refer to Cowl Vent Screen (76.10.01)

30 . Install the hood.

For additional information, refer to Hood (76.16.01)

31 . Recharge the A/C system.

32 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

33 . Install the air deflector.

For additional information, refer to Air Deflector (76.11.41)

34 . Refill and bleed the power steering.

For additional information, refer to Power Steering System Bleeding (57.15.02)

In vehicle repair

Special Service Tools



Camshaft setting/locking tool
303-530



Crankshaft locking tool
303-645



Timing chain tensioning tool
303-532



Tappet hold-down tool
303-540



Tappet hold-down tool adaptor
303-540/02



Fan nozzle - air gun
303-590

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 timing drive components.
For additional information, refer to Timing Drive Components (12.65.13)

- 4 . Remove the special tool from the LH cylinder head.

- 5  **CAUTION: Evenly and progressively, release the camshaft bearing caps.**

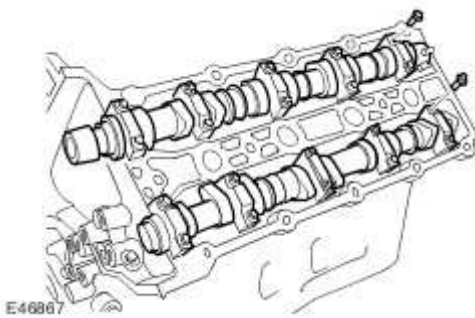
NOTE:

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.

6 . Remove the camshafts.



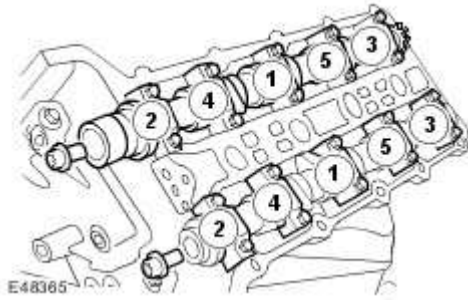
Installation

1 . Install the camshafts.

- ▶ Clean the component mating faces.
- ▶ Replace the valve shims, with the smallest shim available.
- ▶ Lubricate the journals and camshaft lobes.

2 Install the camshaft bearing caps.

- ▶ Clean the component mating faces.
- ▶ Evenly and progressively tighten the bolts in the sequence shown to 10 Nm (7 lb.ft).

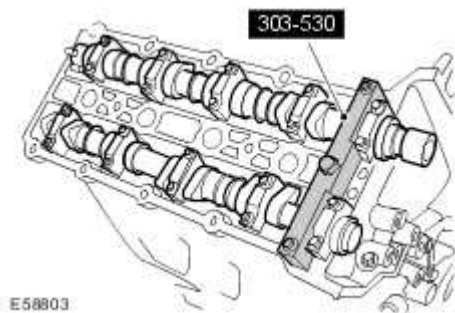


3 . NOTE:

RH illustration shown, LH is similar

Install the special tool to the LH cylinder head.

▶ Install the 3 bolts.



4 . NOTE:

Do not install the LH valve cover until valve clearance adjustment has been completed.

Install the timing drive components.

For additional information, refer to Timing Drive Components (12.65.13)

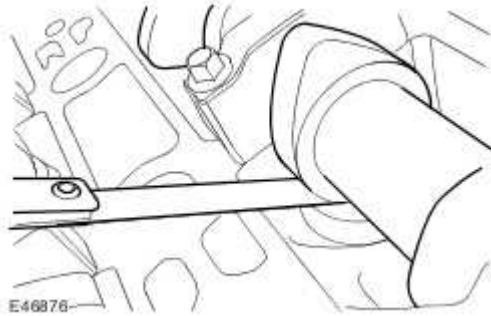
5 . For cylinder head data, refer to specifications.

For additional information, refer to Specifications

6 . Rotate the engine clockwise to position the camshaft lobe away from the valve tappet.

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

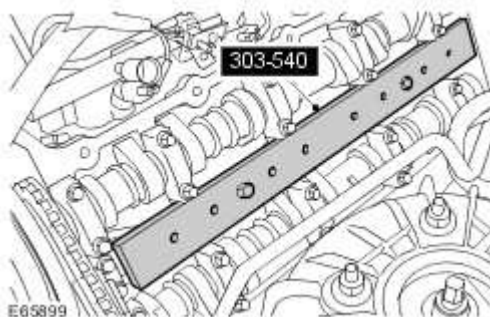
Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



8 . Repeat the above procedure for the remaining 15 shims.

9 . Install the special tool 303-540, to the cylinder head.

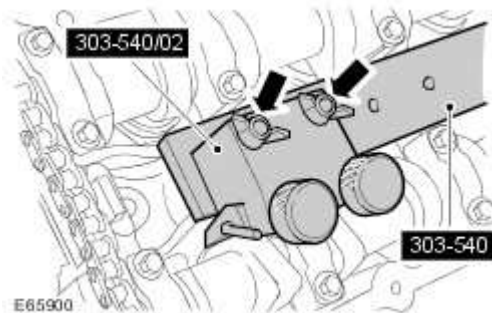
 Tighten the 2 bolts to 10 Nm (7 lb.ft).



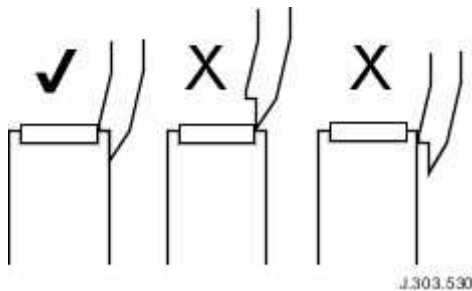
- 10  **CAUTION: Do not rotate the crankshaft while the special tool 303-540/02 is attached to 303-540.**

Attach the special tool 303-540/02 to 303-540.

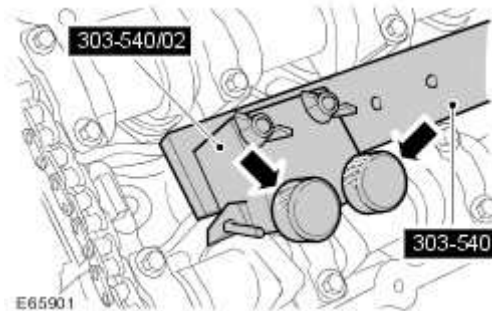
➤ Secure with the 2 wing nuts.



11 . Position the special tool to the tappet as shown.



12 . Using the special tool, compress the valve spring.



13



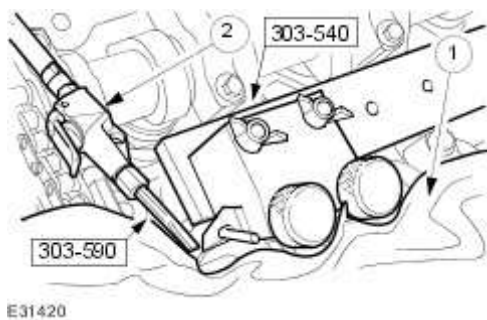
CAUTION: Do not use a magnet to remove shims. Failure to follow these instructions may result in damage to the vehicle.

NOTE:

Use the following formula to calculate the required shim thickness. Original shim thickness + measured shim clearance - desired clearance = required shim thickness.

Remove, clean and measure the shim.

- ▶ Surround the immediate working area with a cloth, to retain any loose shims displaced by the compressed air.
- ▶ Use the special tool 303-590, aimed at the edge of the shim, to lift it from the tappet. Note the position of each one.



14



CAUTION: Shims must be fitted with the size markings facing the tappet, not the camshaft.

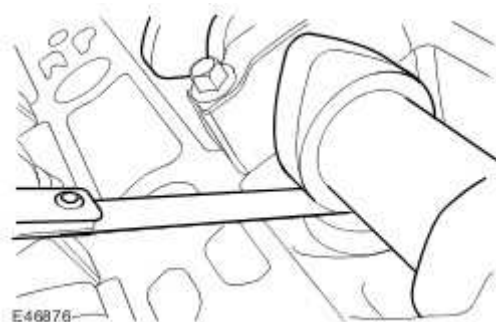


CAUTION: Do not use a magnet to install shims. Failure to follow these instructions may result in damage to the vehicle.

Install the new shim.

- ▶ Clean the components.
- ▶ Lubricate the shim with clean engine oil.
- ▶ Release and remove the special tools as required.

15 Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



16 . Repeat the above procedure for the remaining valves.

17 . Connect the battery ground cable and install the cover.
For additional information, refer to Specifications

Camshafts RH (12.13.18)

Special Service Tools



Camshaft setting/locking tool
303-530



Timing Setting tool
303-645



Timing chain tensioning tool
303-532



Tappet hold-down tool
303-540



Tappet hold-down tool adaptor
303-540/02



Fan nozzle - air gun
303-590

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 front cover.
For additional information, refer to Engine Front Cover (12.65.01)
- 4 . Remove the crankshaft position (CKP) sensor.
For additional information, refer to Crankshaft Position (CKP) Sensor (18.30.12)

- 5  **CAUTION: Rotating the crankshaft in a counterclockwise direction may cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.**

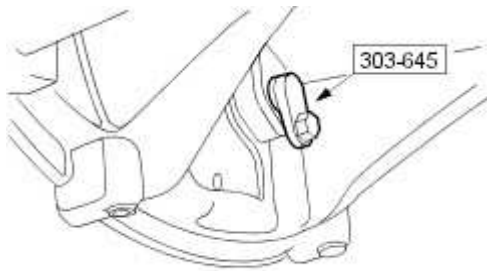


CAUTION: Rotate the crankshaft clockwise to position the engine to top dead center (TDC) number 1 cylinder.

Lock the crankshaft.

▶ Install the special tool.

▶ Install the screw.

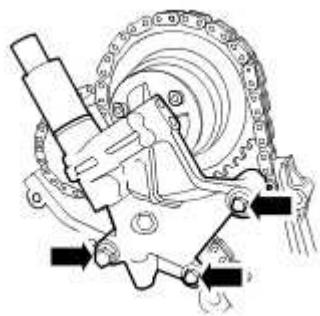


VUJ0002400

6 . Remove the RH variable camshaft timing (VCT) control solenoid housing.

▶ Remove the 3 bolts.

▶ Remove and discard the O-ring seals.

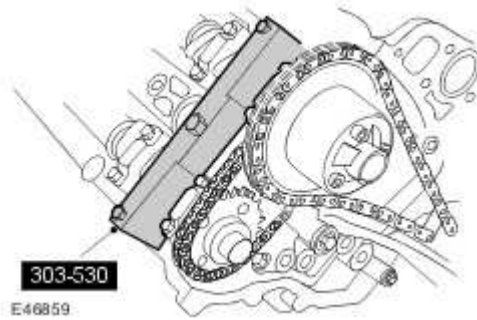


E46858

7 Install the special tool to the RH cylinder head.

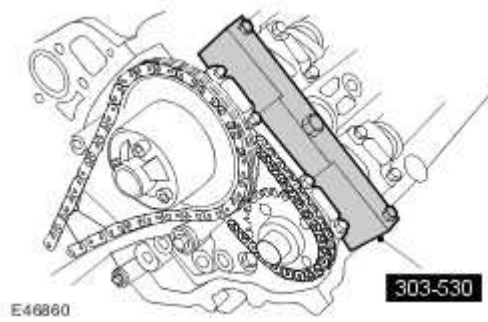
▶ Rotate the crankshaft until the flats on the camshafts are parallel with the cylinder head joint faces.

▶ Install the 3 bolts.



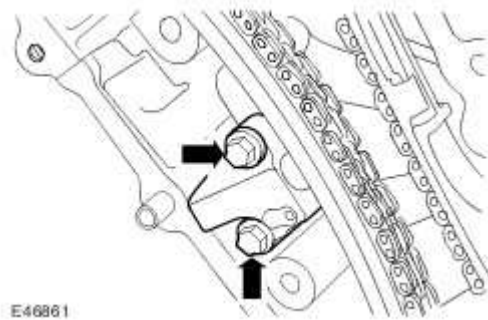
8 . Install the special tool to the LH cylinder head.

▶ Install the 3 bolts.



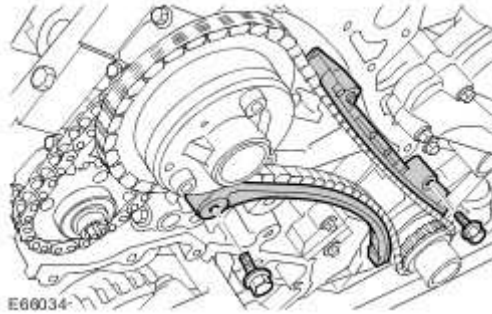
9 . Remove the RH primary timing chain tensioner.

▶ Remove the 2 bolts.

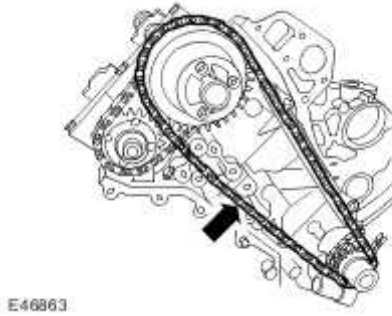


10 . Remove the RH upper and lower primary timing chain tensioner guides.

▶ Remove the 2 bolts.



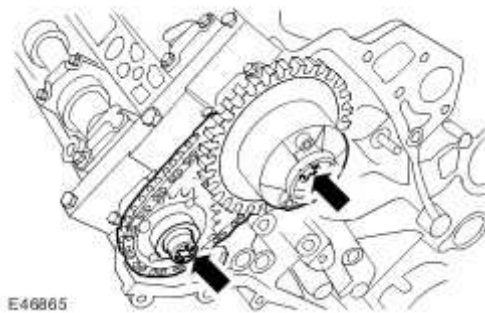
11 . Remove the RH primary timing chain.



12 .  **CAUTION: Discard the bolts.**

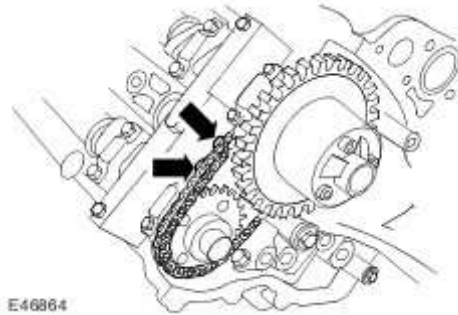
Release the RH camshaft sprocket assembly.

▶ Remove the 2 Torx bolts.



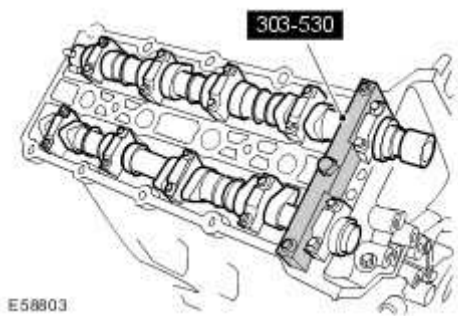
13 . Remove the RH secondary timing chain, tensioner and sprocket assembly.

▶ Remove the 2 retaining bolts.



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

▶ Remove the 3 bolts.



15



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

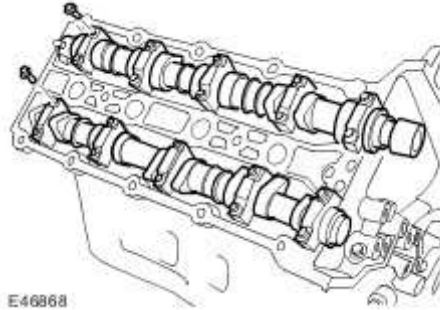
NOTE:

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.

16 . Remove the camshafts.



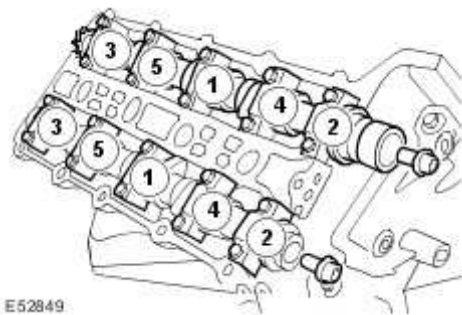
Installation

1 . Install the camshafts.

- ▶ Clean the component mating faces.
- ▶ Replace the valve shims, with the smallest shim available.
- ▶ Lubricate the journals and camshaft lobes.

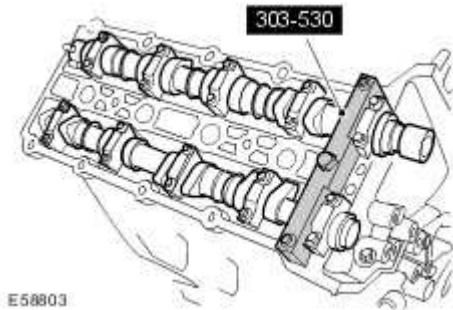
2 Install the camshaft bearing caps.

- ▶ Clean the component mating faces.
- ▶ Evenly and progressively tighten the bolts in the sequence shown to 10 Nm.



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

▶ Install the 3 bolts.



4  **CAUTION:** Make sure the secondary timing chain and camshaft sprockets are free to rotate.

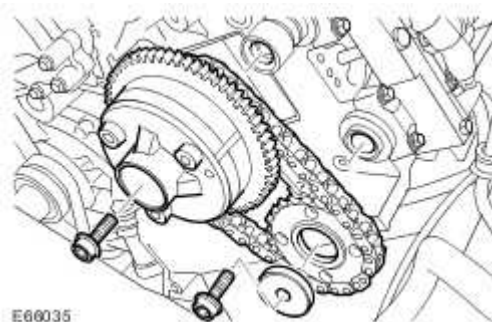
NOTE:

LH illustration shown, RH is similar.

Install the RH secondary timing chain, tensioner and sprocket assembly.

▶ Clean the components.

▶ Install the Torx bolts, but do not tighten fully at this stage.



5 . Install the RH secondary timing chain tensioner retaining bolts.

- ▶ Tighten the bolts to 12 Nm.

6 Install the RH primary timing chain.

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

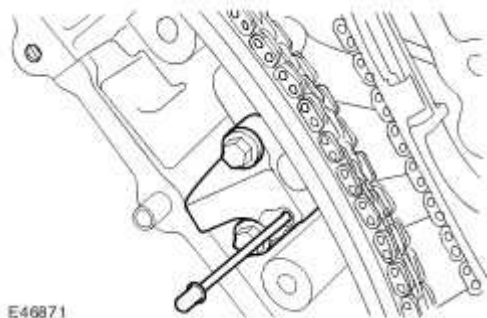
7 . Install the RH primary timing chain tensioner guides.

- ▶ Tighten the bolts to 12 Nm.

- 8
- ▶  **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.

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



9



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



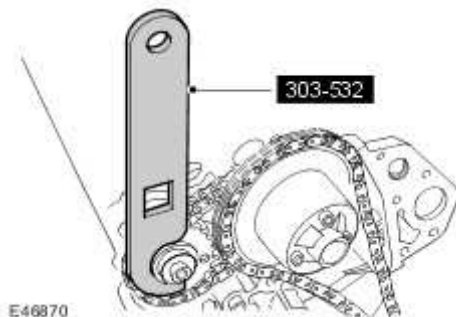
CAUTION: The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.



CAUTION: Make sure that new bolts are installed.

Install the special tool to the RH exhaust camshaft sprocket.

- ▶ Tighten the intake camshaft sprocket retaining bolt to 20 Nm + 90 deg.
- ▶ Tighten the exhaust camshaft sprocket retaining bolt to 20 Nm + 90 deg.



10 . Install the RH VCT control solenoid housing.

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

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

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

13 . Remove the crankshaft locking tool.

 Remove the screw.

14 . Install the CKP sensor.

For additional information, refer to Crankshaft Position (CKP) Sensor (18.30.12)

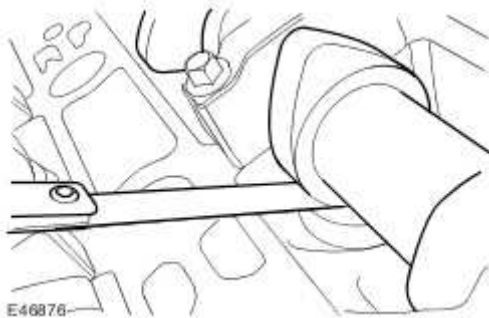
15 . For cylinder head data, refer to specifications.

For additional information, refer to Specifications

16 . Rotate the engine clockwise to position the camshaft lobe away from the valve tappet.

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

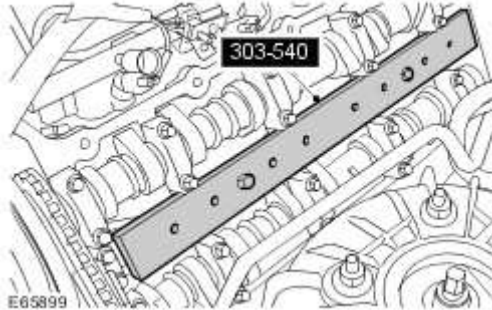
Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



18 . Repeat the above procedure for the remaining 15 shims.

19 . Install the special tool 303-540, to the cylinder head.

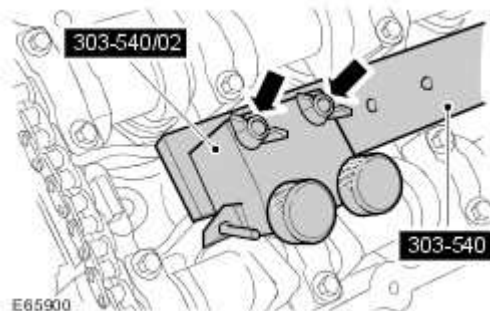
▶ Tighten the 2 bolts to 10 Nm.



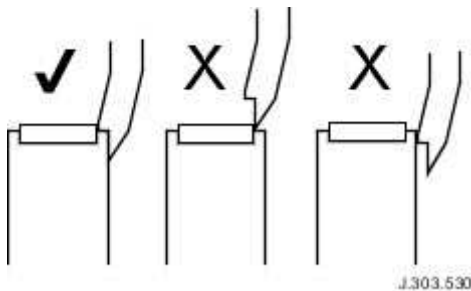
20  **CAUTION: Do not rotate the crankshaft while the special tool 303-540/02 is attached to 303-540.**

Attach the special tool 303-540/02 to 303-540.

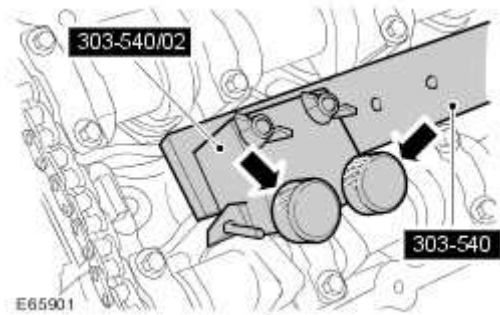
▶ Secure with the 2 wing nuts.



21 . Position the special tool to the tappet as shown.



22 . Using the special tool, compress the valve spring.



23



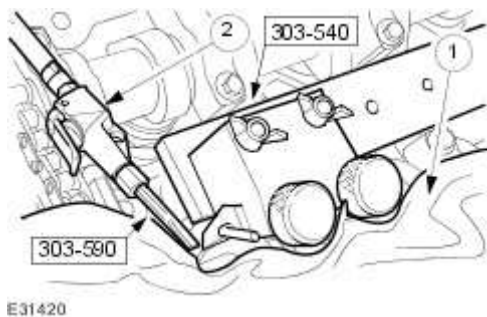
CAUTION: Do not use a magnet to remove shims. Failure to follow these instructions may result in damage to the vehicle.

NOTE:

Use the following formula to calculate the required shim thickness. Original shim thickness + measured shim clearance - desired clearance = required shim thickness.

Remove, clean and measure the shim.

- ▶ Surround the immediate working area with a cloth, to retain any loose shims displaced by the compressed air.
- ▶ Use the special tool 303-590, aimed at the edge of the shim, to lift it from the tappet. Note the position of each one.



24



CAUTION: Shims must be fitted with the size markings facing the tappet, not the camshaft.



CAUTION: Do not use a magnet to install shims. Failure to follow these instructions may result in damage to the vehicle.

Install the new shim.



Clean the components.

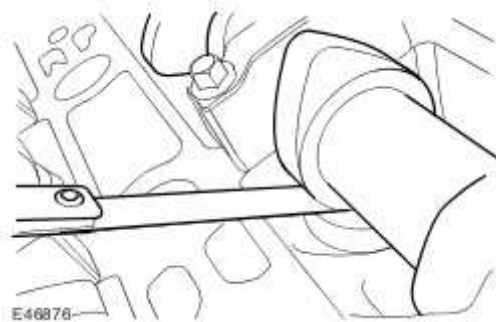


Lubricate the shim with clean engine oil.



Release and remove the special tools as required.

- 25 Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



- 26 . Repeat the above procedure for the remaining valves.

- 27 . Install the engine front cover.

For additional information, refer to Engine Front Cover (12.65.01)

- 28 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Crankshaft Front Seal (12.21.14)

Removal

- 1 . Remove the crankshaft pulley.

For additional information, refer to Crankshaft Pulley (12.21.09)

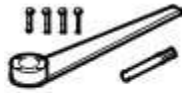
Installation

- 1 . Install the crankshaft pulley.

For additional information, refer to Crankshaft Pulley (12.21.09)

Crankshaft Pulley (12.21.09)

Special Service Tools



303-191

Crankshaft pulley locking tool

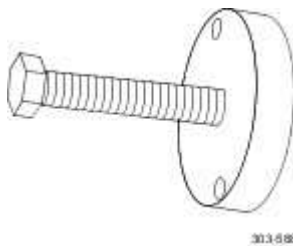
303-191



303-191-02

Crankshaft pulley locking tool adapter

303-191/02



303-588

Crankshaft pulley/damper remover

303-588



303-751

Seal extractor

303-751



303-750

Seal installer

303-750

Removal

1. Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications

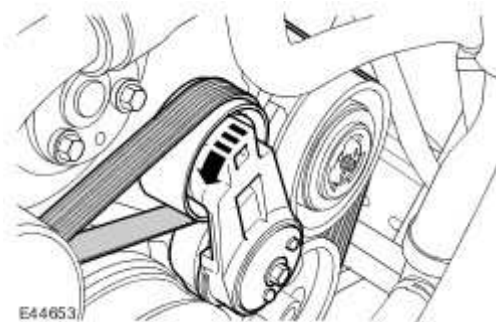
2.  **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

3. Remove the oil filter housing.
For additional information, refer to Oil Filter Housing

4. Release the accessory drive belt.

 Rotate the accessory drive belt tensioner counter-clockwise, using a 3/8 " drive wrench.



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

NOTE:

The crankshaft pulley retaining bolt will be very tight.

Using the special tool, retain the crankshaft front pulley.

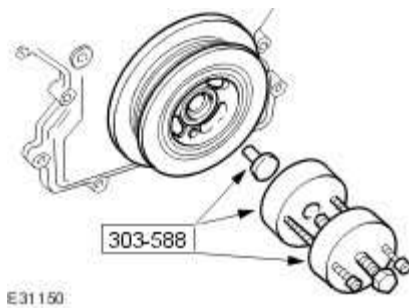
➤ Remove and discard the crankshaft pulley retaining bolt.

➤ Remove the special tools.

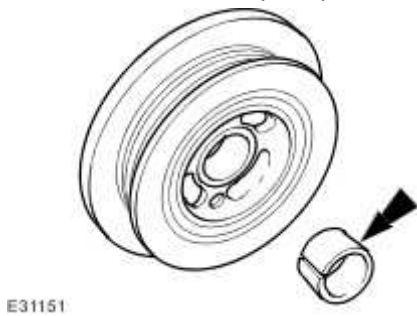
6 . Using the special tools, remove the crankshaft pulley.

➤ Collect the locking ring.

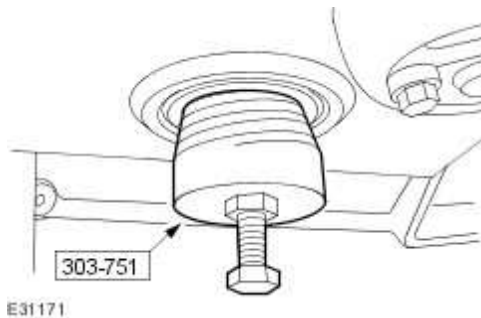
➤ Remove the special tools.



7 . Check the crankshaft pulley and locking ring for damage.



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



Installation

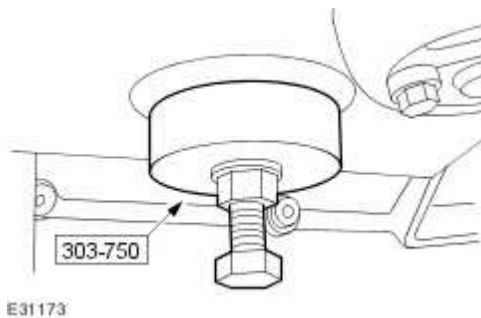
1.  **CAUTION:** Make sure the crankshaft seal mating faces are clean and dry.

 **CAUTION:** Do not remove the seal protector at this stage.

Using the special tool, install the crankshaft front seal.

- ▶ Clean the component mating faces.

2. Remove the seal protector.



3. Install the crankshaft pulley.

- ▶ Lubricate the seal with clean engine oil.
- ▶ Install the locking ring.

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, the new crankshaft pulley bolt.

5



- **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 (280 lb.ft).
- Remove the special tools.

6 . Attach the accessory drive belt.

7 . Install the oil filter housing.

For additional information, refer to Oil Filter Housing

8 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Crankshaft Rear Seal (12.21.20)

Special Service Tools



Crankshaft rear oil seal remover/installer
303-538

Removal

- 1 . Disconnect the battery ground cable.
For additional information, refer to 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.

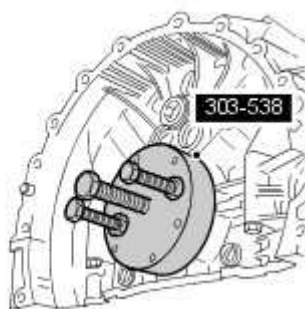
- 3 . Remove the torque converter flexplate.
For additional information, refer to Flexplate (12.53.13)

- 4 . Install the special tools.

▶ Install the 2 bolts.

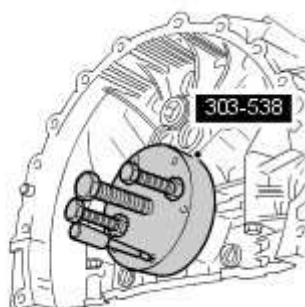
▶ Tighten the 2 nuts to retain the special tool.

E46613



5 . Using the special tool, pierce the seal to create holes for the 6 self-tapping screws.

E46614



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

- ▶ Install the 6 self-tapping screws.
- ▶ Adjust the 2 nuts.
- ▶ Tighten the center bolt.

E46615



Installation

1.  **CAUTION: Do not lubricate the components.**

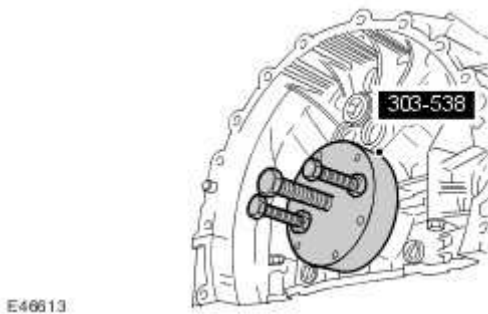
Partially install the crankshaft rear oil seal.

- ▶ Make sure the components are clean and dry.
- ▶ Carefully remove the transit sleeve, leaving the seal on the crankshaft.

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

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

- ▶ Tighten the special tool nuts evenly and progressively to fully install the seal.



3. Install the torque converter flexplate.
For additional information, refer to Flexplate (12.53.13)
4. Check and top-up the engine oil.
5. Connect the battery ground cable.
For additional information, refer to Specifications

Cylinder Head LH (12.29.02)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to 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 intake manifold.

For additional information, refer to Intake Manifold (30.15.01)

- 4 . Remove the timing drive components.

For additional information, refer to Timing Drive Components (12.65.13)

- 5 . Remove the special tool from the LH cylinder head.

6



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

NOTE:

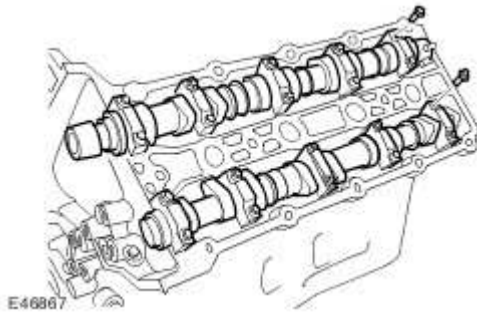
Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

Remove the camshaft bearing caps.



Remove the 20 bolts.

7 . Remove the camshafts.



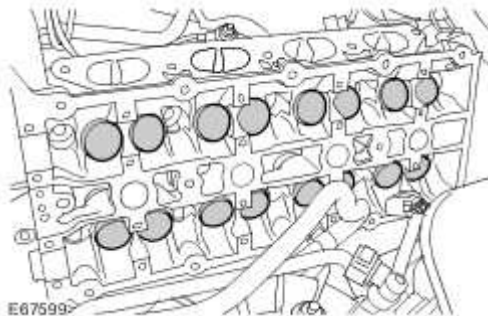
8 . **NOTE:**

Note the fitted position.

NOTE:

Make sure the shim remains with the tappet.

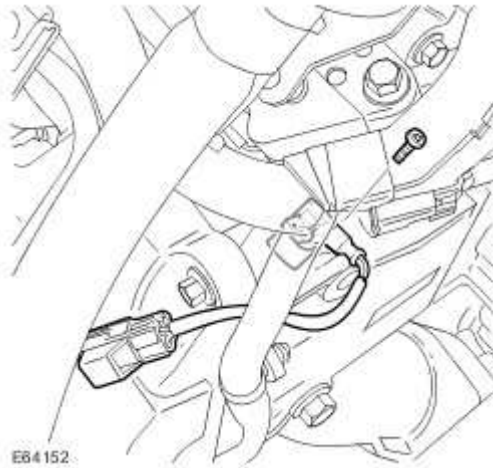
Remove the 16 tappets.



9 . Remove the CMP sensor.

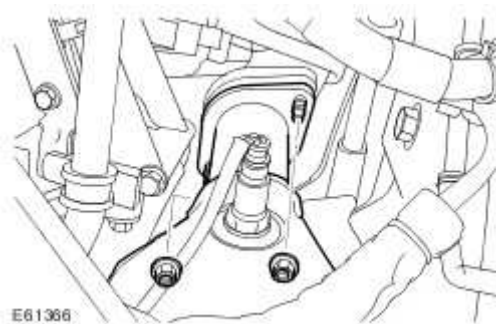
➤ Remove the Torx bolt.

➤ Remove and discard the O-ring seal.



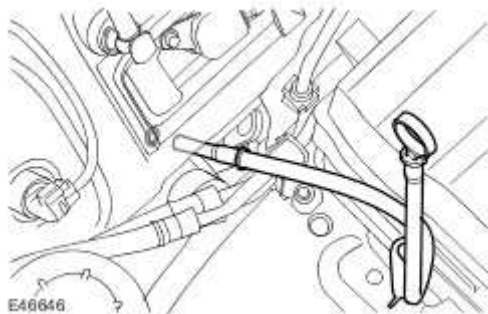
10 . Release the LH catalytic converter.

▶ Remove and discard the 2 nuts.



11 . Remove the oil level indicator and tube.

▶ Discard the O-ring seal.



12



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

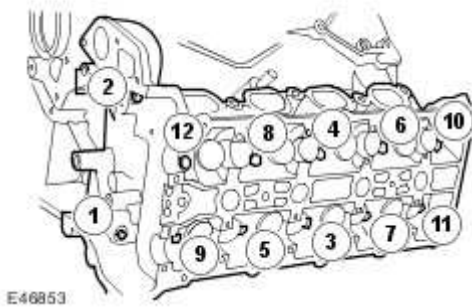


CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be removed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.

NOTE:

Remove the bolts in the indicated sequence.

Remove the 12 cylinder head bolts.



13



CAUTION: The cylinder head must not be placed mating face down. Failure to follow this instruction may result in damage to the vehicle.

With assistance remove the cylinder head.

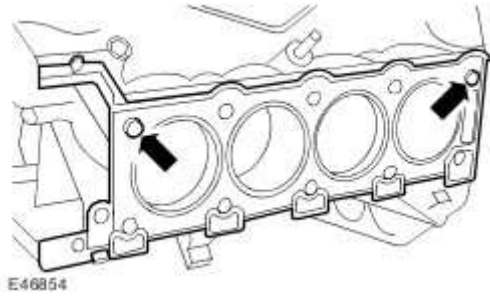
14 . Remove and discard the cylinder head gasket.



Clean the cylinder head locating dowels.



Clean and inspect the cylinder head and cylinder block.

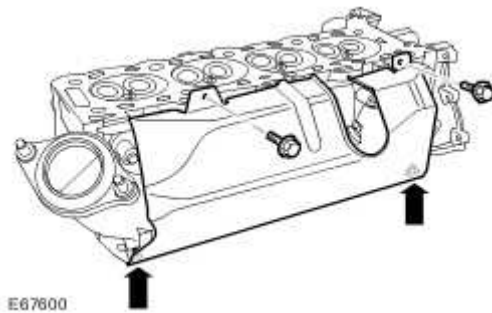


15 . NOTE:

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

Remove the LH heat shield.

▶ Remove the 4 screws.



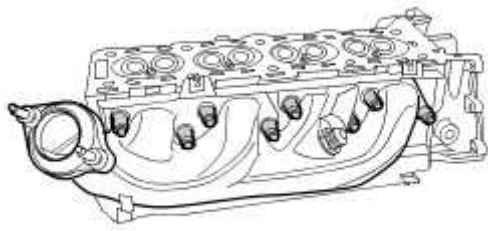
16 . NOTE:

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

Remove the exhaust manifold.

▶ Remove and discard the 8 bolts.

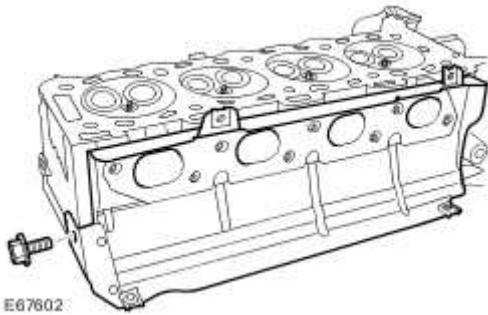
▶ Remove the 8 spacers.



E67601

17 . Remove and discard the exhaust manifold gasket.

▶ Remove the bolt.

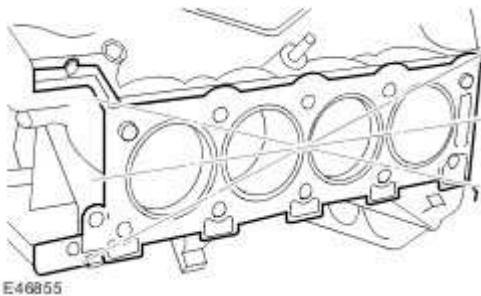


E67602

Installation

1 . Clean the component mating faces.

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



E46855

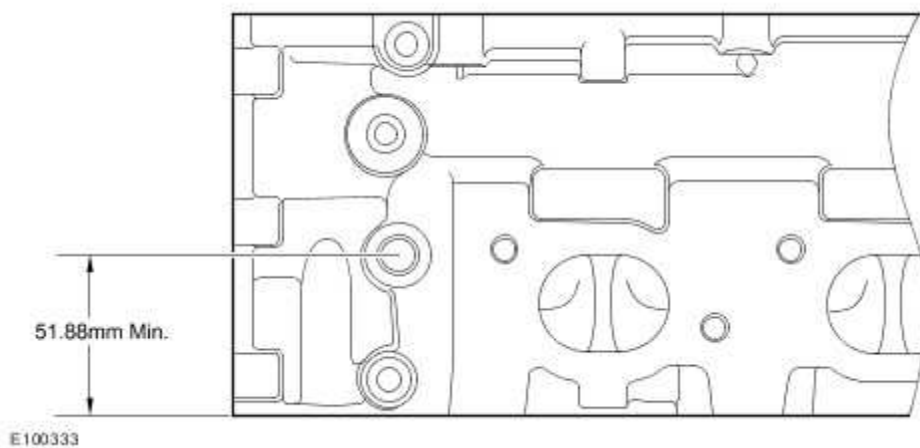
- 3 . For cylinder head face distortion data, refer to specifications.
For additional information, refer to Specifications

4 **NOTE:**

For cylinder head with distortion above the maximum allowance, the cylinder head material must be measured.

Measure the cylinder head material.

- ▶ Check measurement from the centre of the exhaust dowel to the cylinder head face as shown.
- ▶ If the measurement is less than 51.88 mm the cylinder head requires replacement.



- 5 . Install the exhaust manifold gasket.

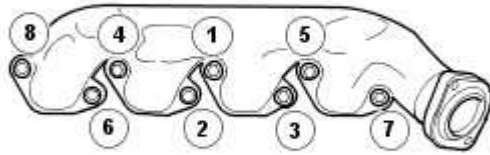
- ▶ Clean the component mating faces.
- ▶ Tighten the bolt to 50 Nm (37 lb.ft).

- 6 Install the exhaust manifold.

- ▶ Clean the component mating faces.

▶ Install the spacers.

▶ Evenly and progressively, tighten the new bolts in the sequence shown, to 24 Nm (18 lb.ft).



E65731

7 . Install the heat shield.

▶ Tighten the screws.

8 .



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

Install a new cylinder head gasket.

9 . With assistance install the cylinder head.

10 . **NOTE:**

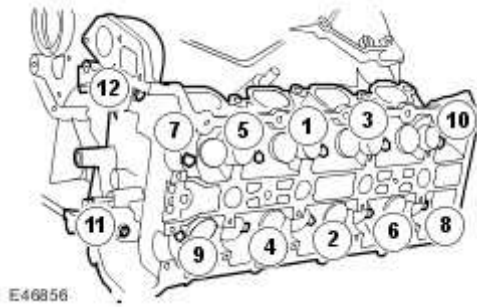
Tighten the bolts 1 to 10 in the sequence shown.

Install the cylinder head bolts.

▶ Lubricate the new cylinder head bolt threads with clean engine oil.

▶ Tighten the bolts 1 to 10 to 20 Nm (15 lb.ft).

- ▶ Tighten the bolts 1 to 10 to 35 Nm (26 lb.ft).
- ▶ 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 (18 lb.ft).



11 . Install the oil level indicator and tube.

- ▶ Clean the components.
- ▶ Install a new O-ring seal.
- ▶ Lubricate the O-ring seal with clean engine oil.

12 . Attach the catalytic coverter.

- ▶ Tighten the nuts to 40Nm (30 lb.ft).

13 . Install the CMP sensor.

- ▶ Clean the components.
- ▶ Install a new O-ring seal.
- ▶ Tighten the Torx bolt to 7 Nm (5 lb.ft).

14 . Install the tappets.

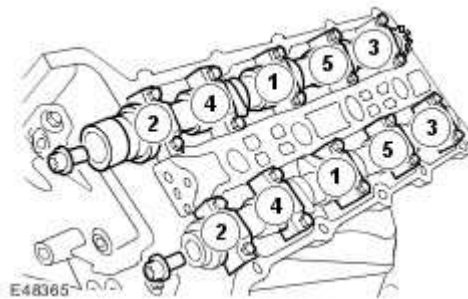
- ▶ Clean the components.
- ▶ Lubricate the components with clean engine oil.

15 . Install the camshafts.

- ▶ Clean the component mating faces.
- ▶ Lubricate the journals and camshaft lobes with clean engine oil.

16 Install the camshaft bearing caps.

- ▶ Clean the component mating faces.
- ▶ Evenly and progressively tighten the bolts in the sequence shown to 10 Nm (7 lb.ft).

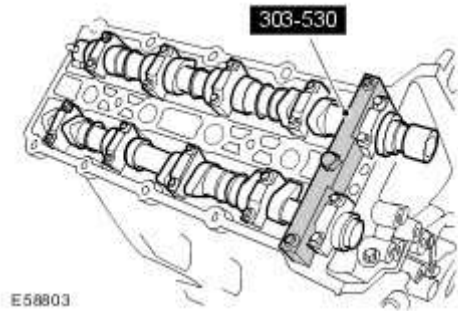


17 . **NOTE:**

RH illustration shown, LH is similar.

Install the special tool to the LH cylinder head.

- ▶ Install the 3 bolts.



18 . NOTE:

Do not install the LH valve cover until valve clearance adjustment has been completed.

Install the timing drive components.

For additional information, refer to Timing Drive Components (12.65.13)

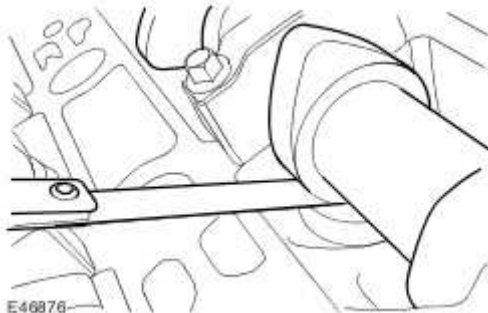
19 . Install the intake manifold.

For additional information, refer to Intake Manifold (30.15.01)

20 . Rotate the engine clockwise to position the camshaft lobe away from the valve tappet.

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

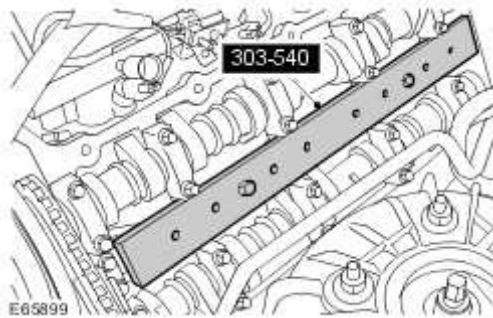
Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



22 . Repeat the above procedure for the remaining 15 shims.

23 . Install the special tool 303-540, to the cylinder head.

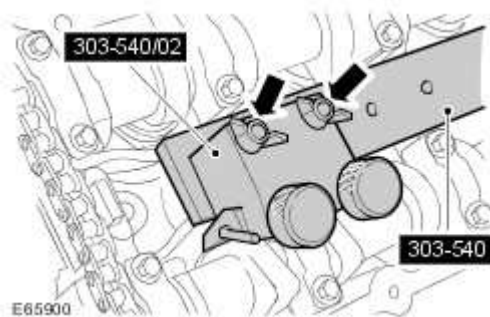
▶ Tighten the 2 bolts to 10 Nm (7 lb.ft).



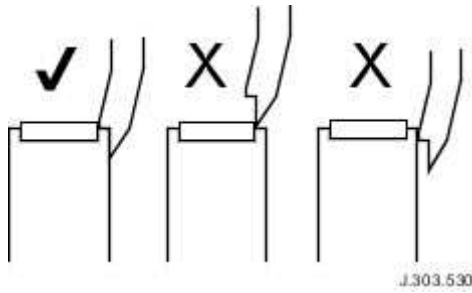
24  **CAUTION: Do not rotate the crankshaft while the special tool 303-540/02 is attached to 303-540.**

Attach the special tool 303-540/02 to 303-540.

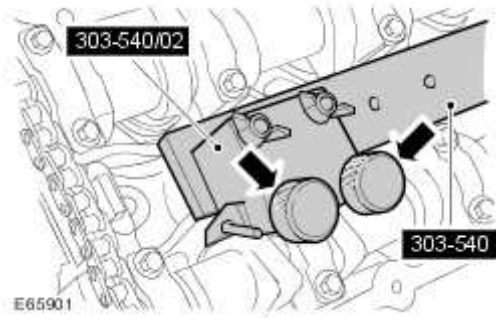
▶ Secure with the 2 wing nuts.



25 . Position the special tool to the tappet as shown.



26 . Using the special tool, compress the valve spring.



27



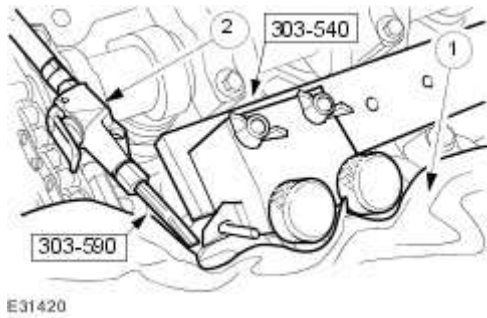
CAUTION: Do not use a magnet to remove shims. Failure to follow these instructions may result in damage to the vehicle.

NOTE:

Use the following formula to calculate the required shim thickness. Original shim thickness + measured shim clearance - desired clearance = required shim thickness.

Remove, clean and measure the shim.

- ▶ Surround the immediate working area with a cloth, to retain any loose shims displaced by the compressed air.
- ▶ Use the special tool 303-590, aimed at the edge of the shim, to lift it from the tappet. Note the position of each one.



28



CAUTION: Shims must be fitted with the size markings facing the tappet, not the camshaft.

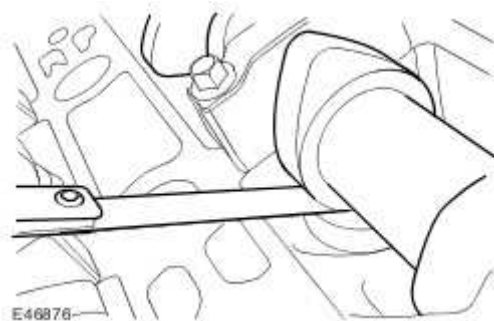


CAUTION: Do not use a magnet to install shims. Failure to follow these instructions may result in damage to the vehicle.

Install the new shim.

- ▶ Clean the components.
- ▶ Lubricate the shim with clean engine oil.
- ▶ Release and remove the special tools as required.

29 Using the feeler gauge set, measure the clearance between the camshaft and the valve shim.



30 . Repeat the above procedure for the remaining valves.

- 31 . Connect the battery ground cable and install the cover.
For additional information, refer to Specifications

Engine Front Cover (12.65.01)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to Specifications

- 2 . Recover the A/C refrigerant.

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 hood.

For additional information, refer to Hood (76.16.01)

- 5 Vehicles with secondary air injection: Remove the air control valve to exhaust manifold tube.

- For additional information, refer to Secondary Air Injection (AIR) Control Valve to Exhaust Manifold Tube

- 6 . Remove the thermostat housing.

For additional information, refer to Thermostat Housing - Vehicles Without: Supercharger

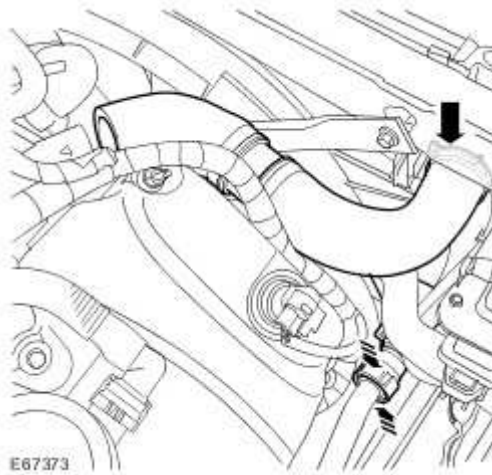
- 7 . Remove the radiator top hose.



Release the clip.



Disconnect the quick release connector.



8 . Remove the LH valve cover.

For additional information, refer to Valve Cover LH (12.29.43)

9 . Remove the RH valve cover.

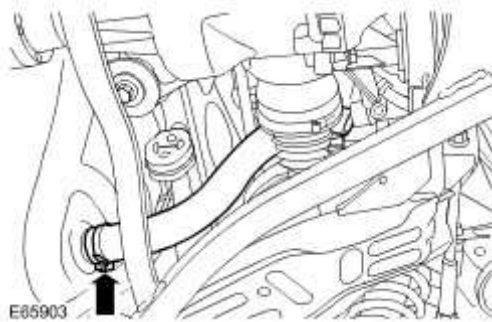
For additional information, refer to Valve Cover RH (12.29.44)

10 . Remove the crankshaft pulley.

For additional information, refer to Crankshaft Pulley (12.21.09)

11 . Remove the radiator bottom hose.

► Release the clip.



12 . Remove the power steering pump.

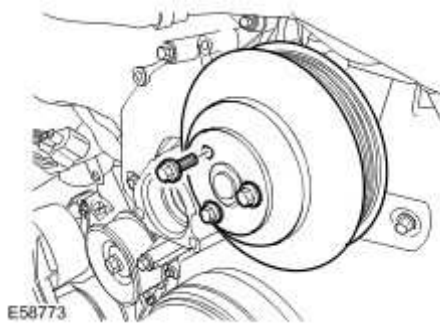
For additional information, refer to Power Steering Pump - 4.2L NA V8 - AJV8 (57.20.14)

13 . **NOTE:**

Restrain the pulley to aid the removal of the bolts.

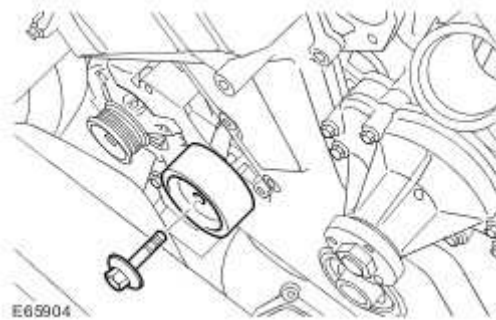
Remove the coolant pump pulley.

▶ Remove the 3 bolts.



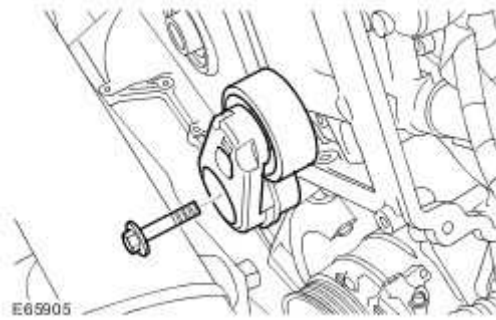
14 . Remove the accessory drive belt idler pulley.

▶ Remove the bolt.



15 . Remove the accessory drive belt tensioner.

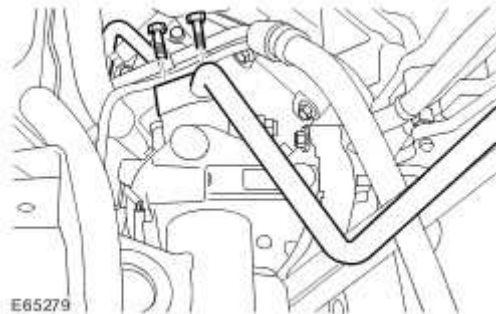
▶ Remove the bolt.



- 16 .  **CAUTION: Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.**

Disconnect the refrigerant lines from the A/C compressor.

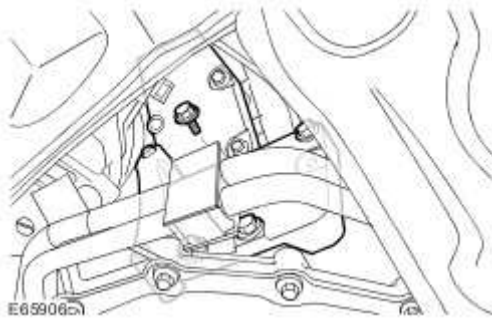
- ▶ Remove the 2 bolts.
- ▶ Remove and discard the 2 O-ring seals.



17 . Position the A/C compressor aside to access the A/C compressor mounting bracket.

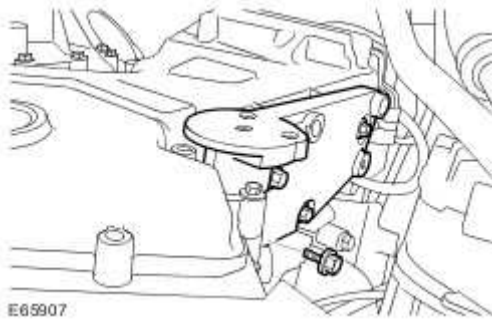
18 . Remove the A/C compressor mounting bracket.

- ▶ Remove the 4 bolts.



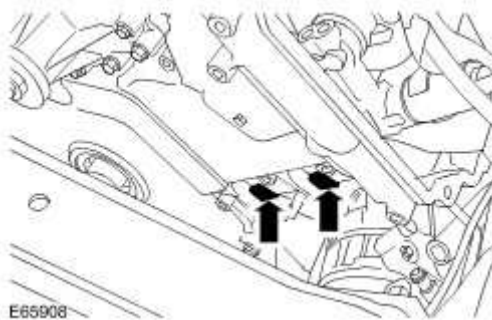
19 . Remove the power steering pump mounting bracket.

▶ Remove the 4 bolts.



20 . LH side: Release the wiring harness.

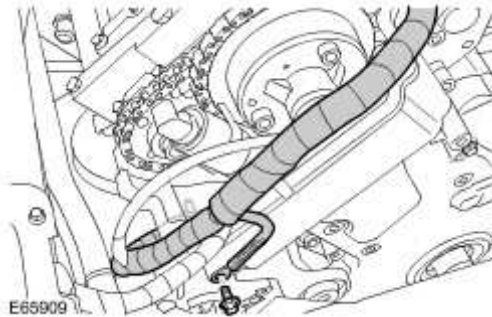
▶ Release the 2 clips.



21 . RH side: Release the wiring harness.

▶ Remove the bolt.

▶ Release the clip.

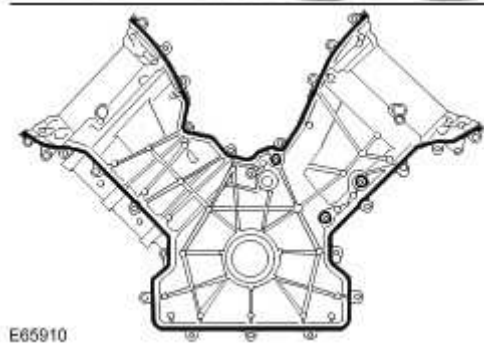
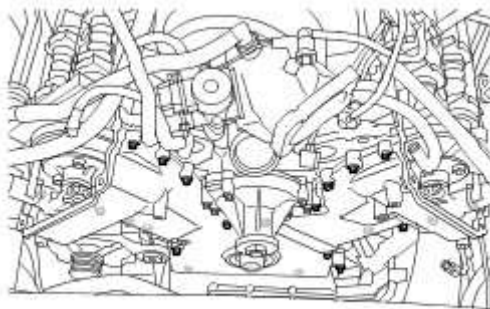


22 . Remove the engine front cover.

▶ Remove the 24 bolts.

▶ Remove and discard the 2 gaskets.

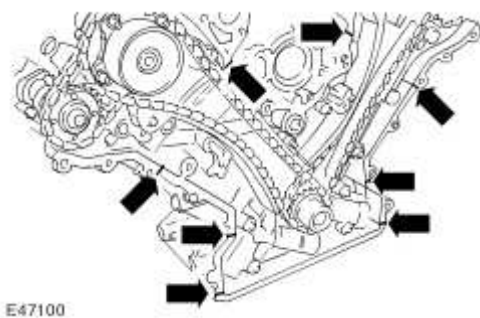
▶ Remove and discard the 3 O-ring seals.



Installation

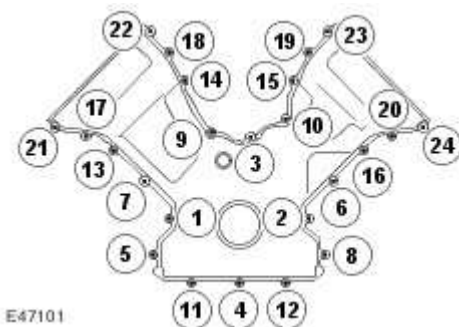
1 Install the engine front cover.

- ▶ Clean the component mating faces.
- ▶ Install the gaskets.
- ▶ Install the O-ring seals.
- ▶ Apply a bead of sealant 3 mm diameter, by 12 mm long, to the 8 places indicated.



2 Install the engine front cover bolts.

- ▶ Evenly and progressively tighten the bolts in the sequence shown to 12 Nm (9 lb.ft).



3 . RH side: Attach the wiring harness.

- ▶ Secure the clip.

▶ Tighten the bolt to 10 Nm (7 lb.ft).

4 . LH side: Attach the wiring harness.

▶ Secure the clips.

5 . Install the power steering pump mounting bracket.

▶ Tighten the bolts to 25 Nm (18 lb.ft).

6 . Install the A/C compressor mounting bracket.

▶ Tighten the bolts to 25 Nm (18 lb.ft).

7 .  **CAUTION: Lubricate the new seals with clean refrigerant oil.**

Connect the refrigerant lines.

▶ Clean the component mating faces.

▶ Install the new O-ring seals.

▶ Tighten the bolts to 9 Nm (7 lb.ft).

8 . Install the accessory drive belt tensioner.

▶ Tighten the bolt to 45 Nm (33 lb.ft).

9 . Install the accessory drive belt idler pulley.

▶ Tighten the bolt to 45 Nm (33 lb.ft).

10 . Install the coolant pump pulley.

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

11 . Install the power steering pump.

For additional information, refer to Power Steering Pump - 4.2L NA V8 - AJV8 (57.20.14)

12 . Install the radiator bottom hose.

 Secure the clip.

13 . Install the crankshaft pulley.

For additional information, refer to Crankshaft Pulley (12.21.09)

14 . Install the RH valve cover.

For additional information, refer to Valve Cover RH (12.29.44)

15 . Install the LH valve cover.

For additional information, refer to Valve Cover LH (12.29.43)

16 . Install the radiator top hose.

 Secure the clip.

 Connect the quick release connector.

17 . Install the thermostat housing.

For additional information, refer to Thermostat Housing - Vehicles Without: Supercharger

18 Vehicles with secondary air injection: Install the air control valve to exhaust manifold tube.

. For additional information, refer to Secondary Air Injection (AIR) Control Valve to Exhaust

Manifold Tube

19 . Install the hood.

For additional information, refer to Hood (76.16.01)

20 . Recharge the A/C system.

21 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Engine Mount LH (12.45.01)

Removal

All vehicles

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 front wheel and tire.
For additional information, refer to Wheel and Tire (74.20.05)

- 4 . Remove the air deflector.
For additional information, refer to Air Deflector (76.11.41)

Left-hand drive vehicles

- 5 . **NOTE:**

Note the fitted position.

Remove the steering gear flexible coupling.

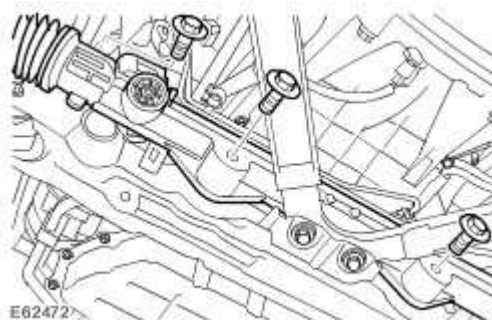


Remove and discard the 2 bolts.



6 . Release the steering gear.

► Remove the 3 bolts.

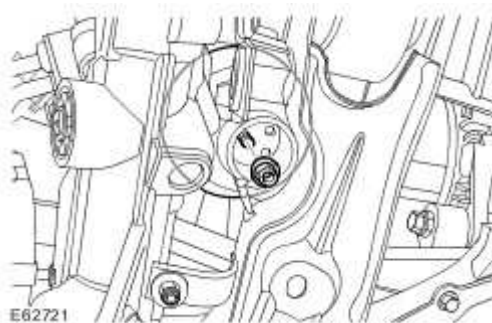


All vehicles

7 . Release the engine mount.

► Support the engine.

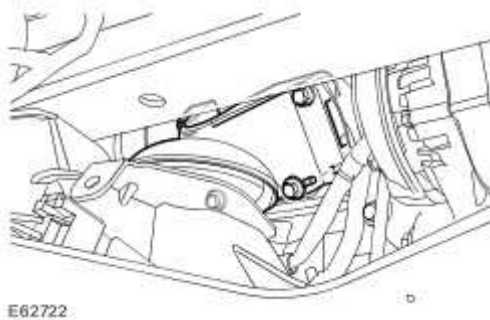
► Remove and discard the nut.



8 . Remove the engine mount and bracket.

▶ Raise the engine.

▶ Remove the 4 bolts.



9 . **NOTE:**

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

Remove the engine mount.

▶ Remove and discard the nut.



Installation

All vehicles

1 . Install the engine mount.

▶ Tighten the new nut to 55 Nm (41 lb.ft).

2 . Install the engine mount and bracket.

-  Clean the component mating faces.
-  Tighten the bolts to 45 Nm (33 lb.ft).
-  Lower the engine.
-  Tighten the new nut to 63 Nm (46 lb.ft).

Left-hand drive vehicles

3 . Secure the steering gear.

-  Tighten the bolts to 100 Nm (74 lb.ft).

4 . Install the steering gear flexible coupling.

-  Tighten the new bolts to 35 Nm (26lb.ft).

All vehicles

5 . Install the air deflector.

For additional information, refer to Air Deflector (76.11.41)

6 . Install the front wheel.

For additional information, refer to Wheel and Tire (74.20.05)

7 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Engine Mount RH (12.45.03)

Removal

All vehicles

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 air deflector.
For additional information, refer to Air Deflector (76.11.41)

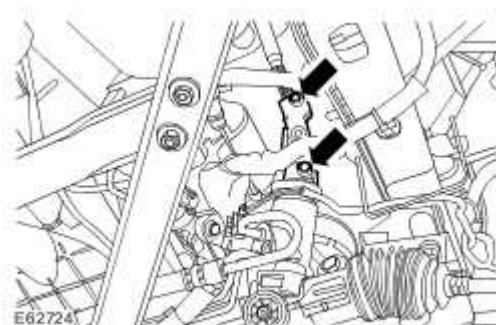
Right-hand drive vehicles

- 4 . **NOTE:**

Note the fitted position.

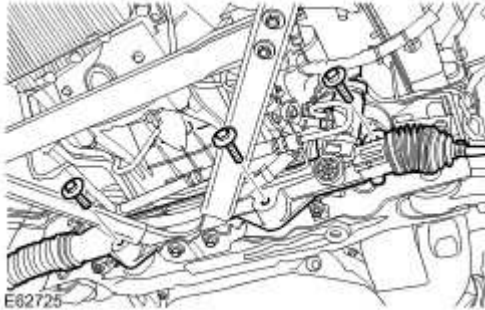
Remove the steering gear flexible coupling.

-  Remove and discard the 2 bolts.



5 . Release the steering gear.

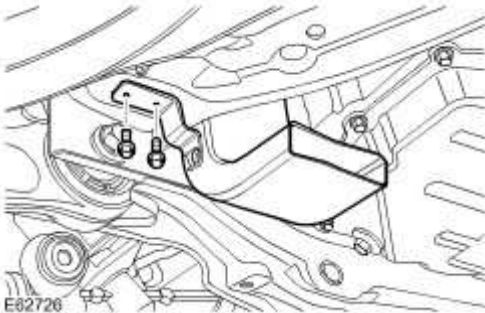
▶ Remove the 3 bolts.



All vehicles

6 . Remove the generator cooling duct.

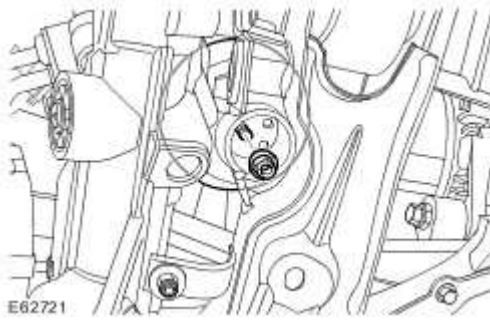
▶ Remove the 2 screws.



7 . Release the engine mount.

▶ Support the engine.

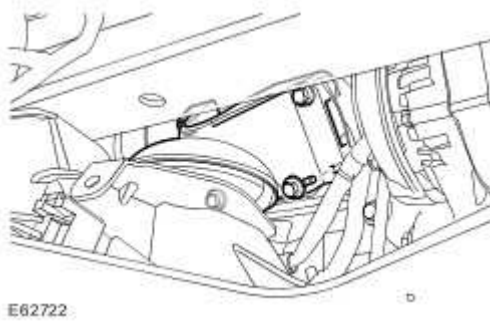
▶ Remove and discard the nut.



8 . Remove the engine mount and bracket.

► Raise the engine.

► Remove the 4 bolts.



9 . **NOTE:**

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

Remove the engine mount.

► Remove and discard the nut.



Installation

All vehicles

1 . Install the engine mount.

- ▶ Tighten the new nut to 55 Nm (41 lb.ft).

2 . Install the engine mount and bracket.

- ▶ Clean the component mating faces.
- ▶ Tighten the bolts to 45 Nm (33 lb.ft).
- ▶ Lower the engine.
- ▶ Tighten the new nut to 63 Nm (46 lb.ft).

3 . Install the generator cooling duct.

- ▶ Tighten the screws.

Right-hand drive vehicles

4 . Secure the steering gear.

- ▶ Tighten the bolts to 100 Nm (74 lb.ft).

5 . Install the steering gear flexible coupling.

 Tighten the new bolts to 35 Nm (26lb.ft).

All vehicles

6 . Install the air deflector.

For additional information, refer to Air Deflector (76.11.41)

7 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Exhaust Manifold LH - Vehicles Without: Secondary Air Injection (AIR) (30.15.55)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to 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 level indicator and tube.

For additional information, refer to Oil Level Indicator and Tube

- 4 . Remove the exhaust system.

For additional information, refer to Exhaust System

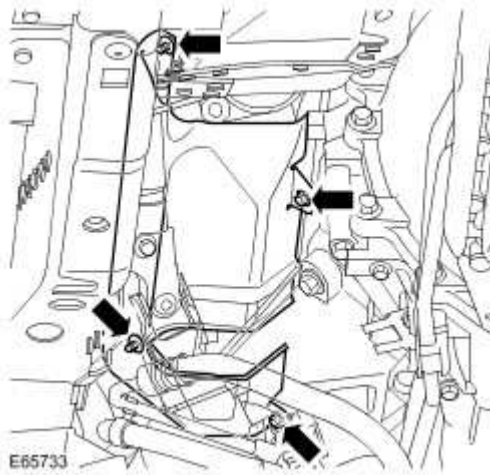
- 5 . Remove the LH engine mount.

For additional information, refer to Engine Mount LH (12.45.01)

- 6 . Remove the LH heat shield.



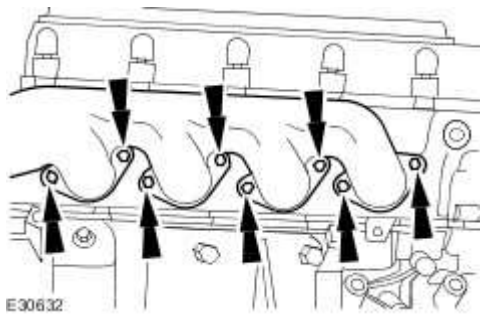
Remove the 4 screws.



7 . Remove the exhaust manifold.

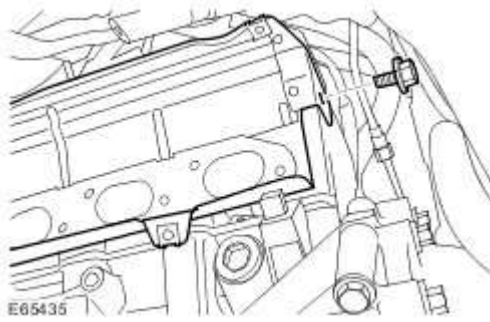
➤ Remove and discard the 8 bolts.

➤ Remove the 8 spacers.



8 . Remove and discard the exhaust manifold gasket.

➤ Remove the bolt.



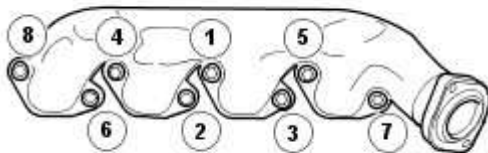
Installation

1 . Install the exhaust manifold gasket.

- ▶ Clean the component mating faces.
- ▶ Tighten the bolt to 50 Nm (37 lb.ft).

2 Install the exhaust manifold.

- ▶ Clean the component mating faces.
- ▶ Install the spacers.
- ▶ Evenly and progressively, tighten the new bolts in the sequence shown, to 24 Nm (18 lb.ft).



3 . Install the heat shield.

- ▶ Tighten the screws.

4 . Install the LH engine mount.

For additional information, refer to Engine Mount LH (12.45.01)

5 . Install the exhaust system.

For additional information, refer to Exhaust System

6 . Install the oil level indicator and tube.

For additional information, refer to Oil Level Indicator and Tube

7 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Exhaust Manifold LH - Vehicles With: Secondary Air Injection (AIR) (30.15.55)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to 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 level indicator and tube.

For additional information, refer to Oil Level Indicator and Tube

- 4 . Remove the exhaust system.

For additional information, refer to Exhaust System

- 5 . Remove the LH engine mount.

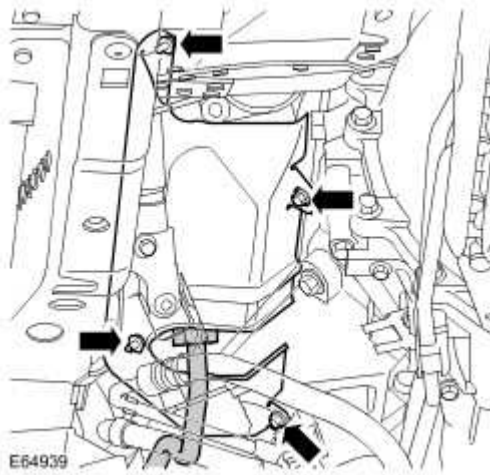
For additional information, refer to Engine Mount LH (12.45.01)

- 6 . Release the LH exhaust manifold heat shield.



Remove the 4 screws.

- 7 . Release the AIR tube from the LH exhaust manifold.

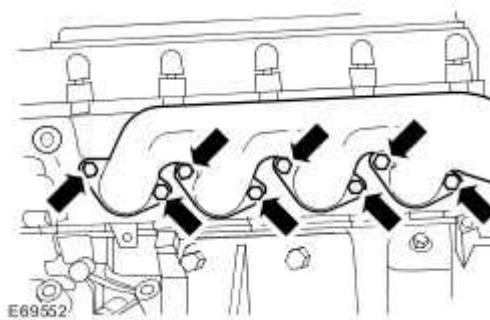


8 . Remove the LH exhaust manifold heat shield.

9 . Remove the exhaust manifold.

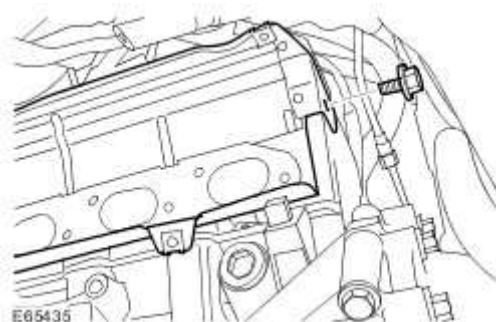
➤ Remove and discard the 8 bolts.

➤ Remove the 8 spacers.



10 . Remove and discard the exhaust manifold gasket.

➤ Remove the bolt.



Installation

1 . Install the exhaust manifold gasket.

▶ Clean the component mating faces.

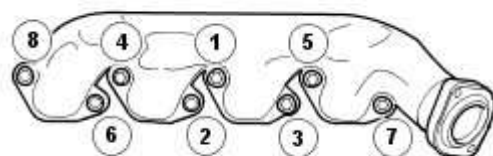
▶ Tighten the bolt to 50 Nm (37 lb.ft).

2 Install the exhaust manifold.

▶ Clean the component mating faces.

▶ Install the spacers.

▶ Evenly and progressively, tighten the new bolts in the sequence shown, to 24 Nm (18 lb.ft).



3 . Install the exhaust manifold heat shield.

4 . Attach the air tube.

 Tighten the union to 35 Nm (26 lb.ft).

5 . Secure the exhaust manifold heat shield.

 Tighten the screws.

6 . Install the LH engine mount.

For additional information, refer to Engine Mount LH (12.45.01)

7 . Install the exhaust system.

For additional information, refer to Exhaust System

8 . Install the oil level indicator and tube.

For additional information, refer to Oil Level Indicator and Tube

9 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Exhaust Manifold RH - Vehicles Without: Secondary Air Injection (AIR) (30.15.56)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to 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.

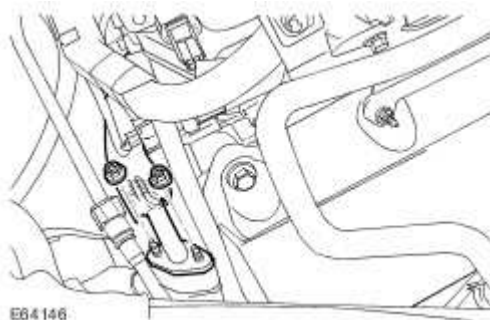
- 3 . Remove the engine cover.

For additional information, refer to Engine Cover (76.11.35)

- 4 . Release the EGR valve to exhaust manifold pipe.

▶ Remove the 2 nuts.

▶ Remove and discard the gasket.



- 5 . Remove the exhaust system.

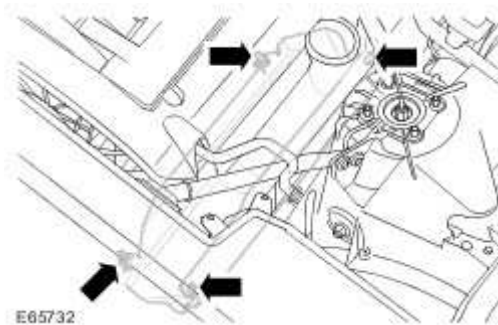
For additional information, refer to Exhaust System

6 . Remove the RH engine mount.

For additional information, refer to Engine Mount RH (12.45.03)

7 . Remove the RH heat shield.

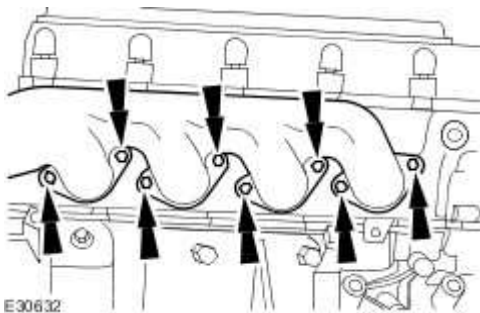
▶ Remove the 4 screws.



8 . Remove the exhaust manifold.

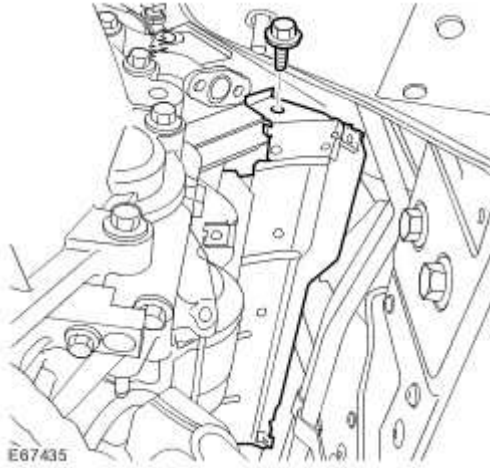
▶ Remove and discard the 8 bolts.

▶ Remove the 8 spacers.



9 . Remove and discard the exhaust manifold gasket.

▶ Remove the bolt.



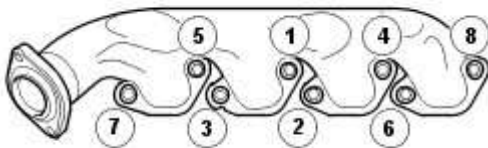
Installation

1 . Install the exhaust manifold gasket.

- ▶ Clean the component mating faces.
- ▶ Tighten the bolt to 50 Nm (37 lb.ft).

2 Install the exhaust manifold.

- ▶ Clean the component mating faces.
- ▶ Install the spacers.
- ▶ Evenly and progressively, tighten the new bolts in the sequence shown, to 24 Nm (18 lb.ft).



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3 . Install the heat shield.

 Tighten the screws.

4 . Install the RH engine mount.

For additional information, refer to Engine Mount RH (12.45.03)

5 . Install the exhaust system.

For additional information, refer to Exhaust System

6 . Attach the EGR valve to exhaust manifold pipe.

 Clean the component mating faces.

 Install a new gasket.

 Tighten the nuts to 25 Nm (18 lb.ft).

7 . Install the engine cover.

For additional information, refer to Engine Cover (76.11.35)

8 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Exhaust Manifold RH - Vehicles With: Secondary Air Injection (AIR) (30.15.56)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to 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.

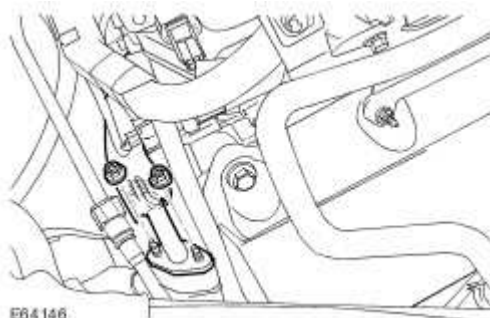
- 3 . Remove the engine cover.

For additional information, refer to Engine Cover (76.11.35)

- 4 . Release the EGR valve to exhaust manifold pipe.

▶ Remove the 2 nuts.

▶ Remove and discard the gasket.



- 5 . Remove the exhaust system.

For additional information, refer to Exhaust System

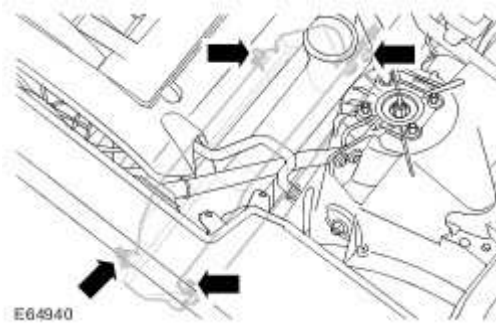
6 . Remove the RH engine mount.

For additional information, refer to Engine Mount RH (12.45.03)

7 . Release the RH exhaust manifold heat shield.

▶ Remove the 4 screws.

8 . Release the AIR tube from the RH exhaust manifold.

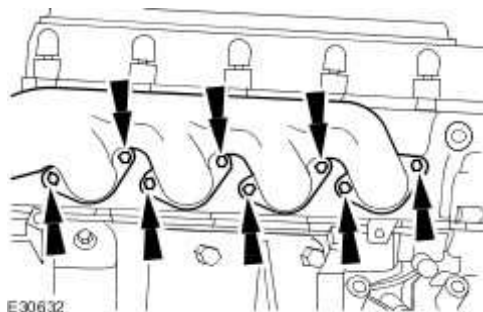


9 . Remove the RH exhaust manifold heat shield.

10 . Remove the exhaust manifold.

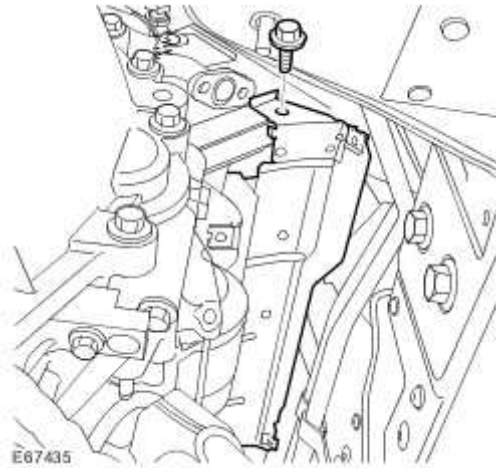
▶ Remove and discard the 8 bolts.

▶ Remove the 8 spacers.



11 . Remove and discard the exhaust manifold gasket.

- ▶ Remove the bolt.



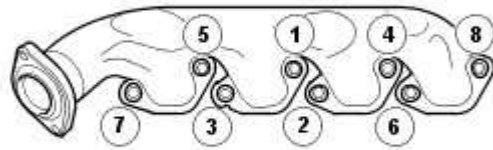
Installation

- 1 . Install the exhaust manifold gasket.

- ▶ Clean the component mating faces.
- ▶ Tighten the bolt to 50 Nm (37 lb.ft).

- 2 Install the exhaust manifold.

- ▶ Clean the component mating faces.
- ▶ Install the spacers.
- ▶ Evenly and progressively, tighten the new bolts in the sequence shown to 24 Nm (18 lb.ft).



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3 . Install the exhaust manifold heat shield.

4 . Attach the air tube.

▶ Tighten the union to 35 Nm (26 lb.ft).

5 . Secure the exhaust manifold heat shield.

▶ Tighten the screws.

6 . Install the RH engine mount.

For additional information, refer to Engine Mount RH (12.45.03)

7 . Install the exhaust system.

For additional information, refer to Exhaust System

8 . Attach the EGR valve to exhaust manifold pipe.

▶ Clean the component mating faces.

▶ Install a new gasket.

▶ Tighten the nuts to 25 Nm (18 lb.ft).

9 . Install the engine cover.

For additional information, refer to Engine Cover (76.11.35)

10 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Flexplate (12.53.13)

Removal

1 . Remove the cover and disconnect the battery ground cable.

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 (44.20.01)

4



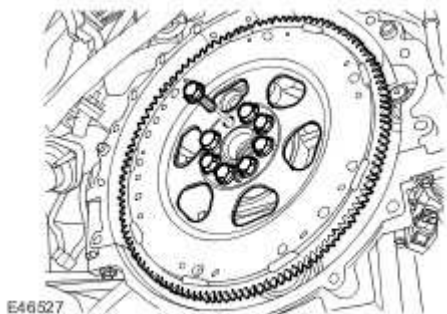
· **CAUTION: The bolts can only be used 3 times, mark the bolts with a center punch. If 2 punch marks are visible, discard the bolts.**

NOTE:

Prevent the flexplate from rotating.

Remove the torque converter flexplate.

 Remove the 8 bolts.



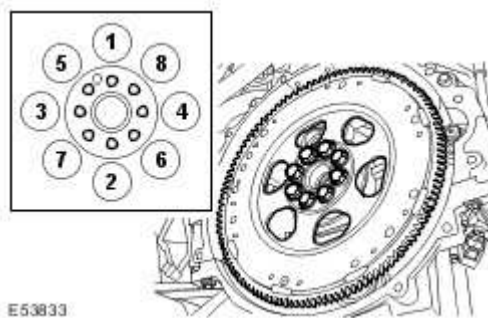
Installation

1 . NOTE:

Prevent the flexplate from rotating.

Install the torque converter flexplate.

- ▶ Clean the component mating faces.
- ▶ Tighten the bolts evenly in 2 stages to the sequence shown.
- ▶ Tighten the bolts to 15 Nm (11 lb ft).
- ▶ Tighten the bolts to 110 Nm (81 lb.ft).



2 . Install the transmission.

For additional information, refer to Transmission (44.20.01)

3 . Connect the battery ground cable and install the cover.

Intake Manifold (30.15.01)

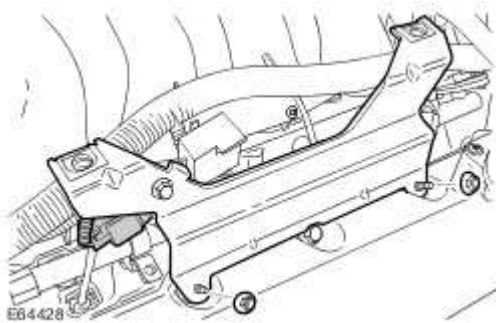
Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications

- 2 . Remove the throttle body.
For additional information, refer to Throttle Body (19.70.04)

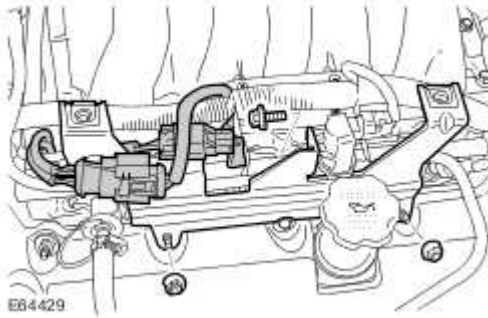
- 3 . Remove the RH engine cover bracket.

- Remove the 2 nuts.
- Disconnect the electrical connector.



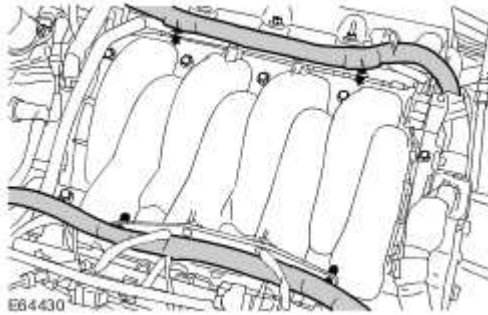
- 4 . Remove the LH engine cover bracket.

- Remove the 2 nuts.
- Release the 2 electrical connectors.
- Remove the purge valve bolt.



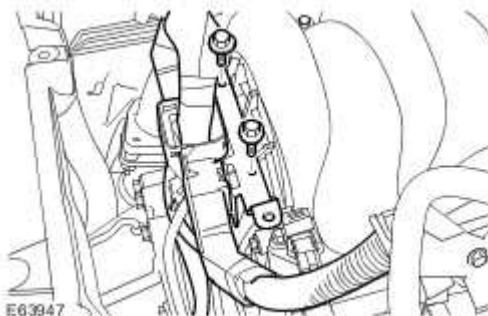
5 . Release the engine wiring harness from the intake manifold.

► Release the 4 clips.

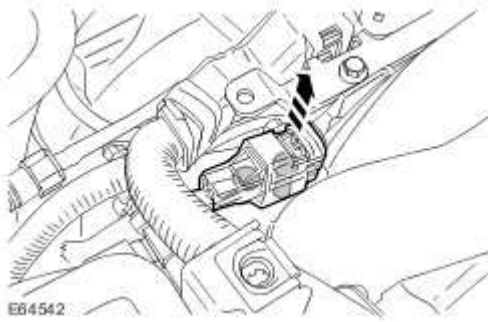


6 . Release the wiring harness from the rear of the engine.

► Remove the 2 bolts.



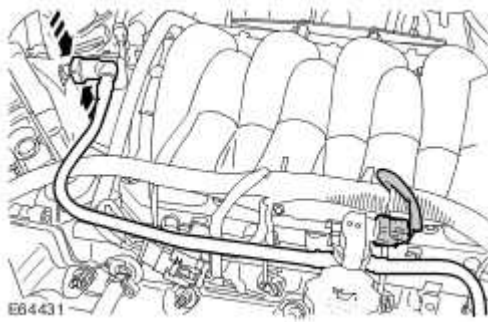
7 . Release the RH camshaft position (CMP) sensor electrical connector.



8 . Release the purge valve.

▶ Disconnect the quick release connector.

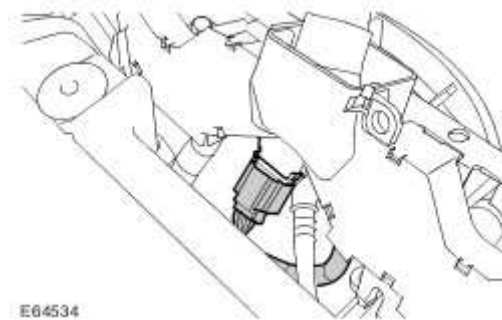
▶ Disconnect the electrical connector.



9 . Using the special tool, disconnect the fuel line.

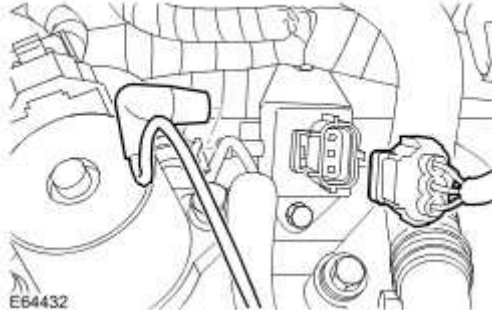
For additional information, refer to Spring Lock Couplings

10 . Disconnect the MAP sensor electrical connector.



11 . Disconnect the fuel rail pressure (FRP) sensor electrical connector.

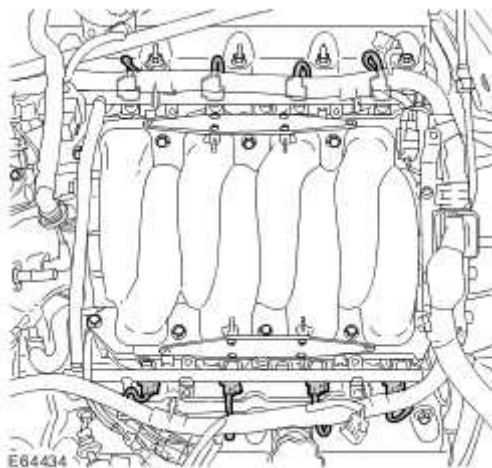
12 . Disconnect the FRP sensor vacuum line.



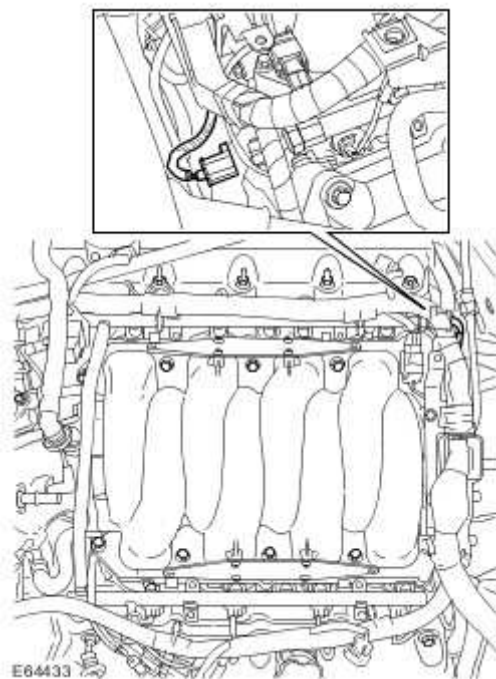
13 . Disconnect the knock sensors (KS) electrical connector.



14 . Disconnect the 8 fuel injector electrical connectors.



15 . Disconnect the fuel temperature sensor electrical connector.

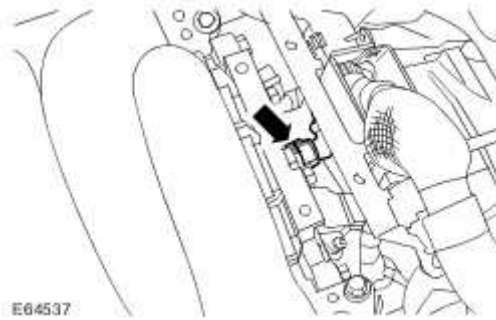


16 . Disconnect the throttle body elbow vacuum line.

17 . Disconnect the positive crankcase ventilation (PCV) line from the throttle body elbow.

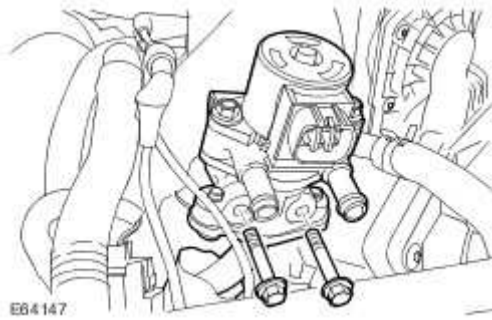


18 . Disconnect the brake booster vacuum hose from the intake manifold.



19 . Release the exhaust gas recirculation (EGR) valve.

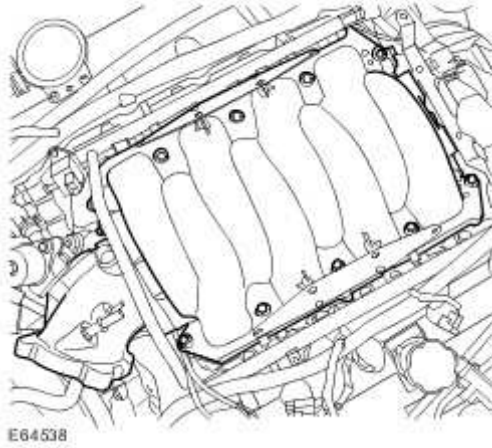
- ▶ Remove the 2 bolts.
- ▶ Remove and discard the gasket.



20 .  **CAUTION: Always plug any open connections to prevent contamination.**

Remove the intake manifold.

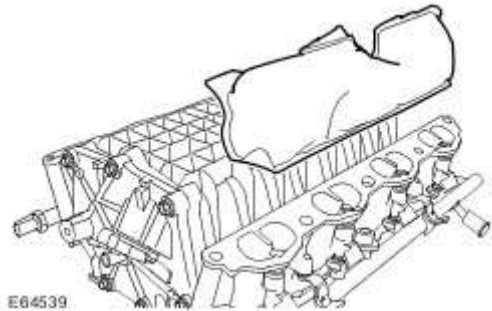
- ▶ Remove and discard the 2 gaskets.
- ▶ Remove the 10 bolts.



21 . NOTE:

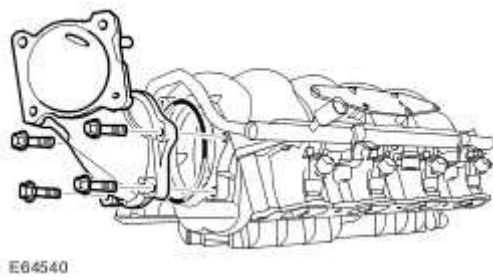
Do not disassemble further if the component is removed for access only.

Remove the foam pad.



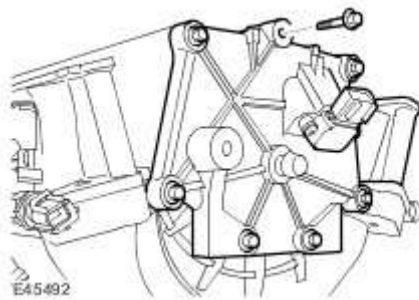
22 . Remove the throttle body elbow.

- ▶ Remove the 4 bolts.
- ▶ Remove and discard the O-ring seal.



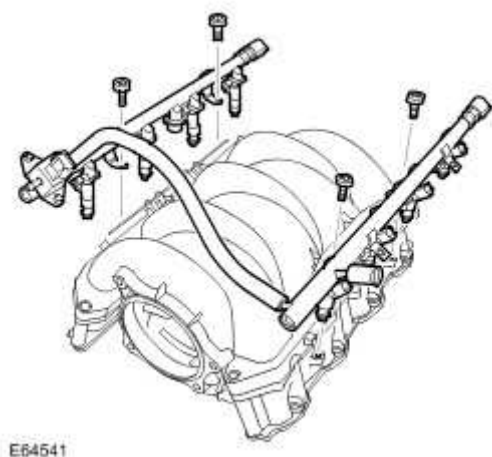
23 . Remove the intake manifold MAP sensor housing.

- ▶ Remove the 7 bolts.
- ▶ Remove and discard the O-ring seal.



24 . Remove the fuel injection supply manifold.

- ▶ Remove the 4 Torx bolts.
- ▶ Remove and discard the 8 O-ring seals.



25 . Remove the 2 intake manifold housings.

- ▶ Remove the 10 Torx screws.
- ▶ Remove and discard the 8 O-ring seals.



Installation

1 . Install the intake manifold housings.

- ▶ Clean the components.
- ▶ Install new O-ring seals.
- ▶ Tighten the Torx screws to 4 Nm (3 lb.ft).

2 . Install the fuel injection supply manifold.

- ▶ Clean the components.
- ▶ Install new O-ring seals.
- ▶ Tighten the Torx bolts to 10 Nm (7 lb.ft).

3 . Install the intake manifold MAP sensor housing.

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

4 . Install the throttle body elbow.

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

5 . Install the foam pad.

6 . Install the intake manifold.

- ▶ Clean the components.
- ▶ Install new gaskets.
- ▶ Evenly and progressively tighten the bolts to 20 Nm (15 lb.ft).

7 . Attach the EGR valve.

- ▶ Clean the components.

 Install a new gasket.

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

8 . Connect the brake booster vacuum hose.

9 . Connect the PCV line.

10 . Connect the throttle body elbow vacuum line.

11 . Connect the FRP sensor vacuum line.

12 . Connect the fuel temperature sensor electrical connector.

13 . Connect the fuel injector electrical connectors.

14 . Connect the KS electrical connector.

15 . Connect the FRP sensor electrical connector.

16 . Connect the MAP sensor electrical connector.

17 . Connect the fuel line.

For additional information, refer to Spring Lock Couplings

18 . Attach the purge valve.

 Connect the electrical connector.

 Connect the quick release connector.

19 . Attach the CMP sensor electrical connector.

20 . Attach the wiring harness.

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

21 . Install the LH engine cover bracket.

 Attach the purge valve, align the peg and tighten the bolt to 6 Nm (4 lb.ft).

 Secure the electrical connectors.

 Tighten the nuts to 6 Nm (4 lb.ft).

22 . Install the RH engine cover bracket.

 Connect the electrical connector.

 Tighten the nuts to 6 Nm (4 lb.ft).

23 . Install the throttle body.

For additional information, refer to Throttle Body (19.70.04)

24 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Oil Pan (12.60.44)

Removal

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

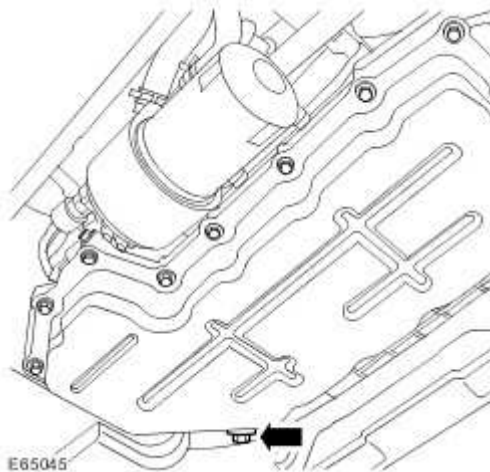
Raise and support the vehicle.

- 2 . Remove the engine undershield.
For additional information, refer to Air Deflector (76.11.41)

- 3 . Remove the oil pan drain plug.

► Position a container to collect the fluid.

► Discard the oil pan drain plug seal.

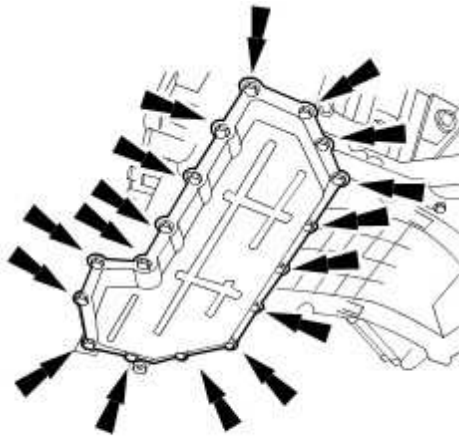


- 4 . Remove the oil pan.

► Position a container to collect the oil spillage.

► Remove the 17 bolts.

- ▶ Remove and discard the gasket.



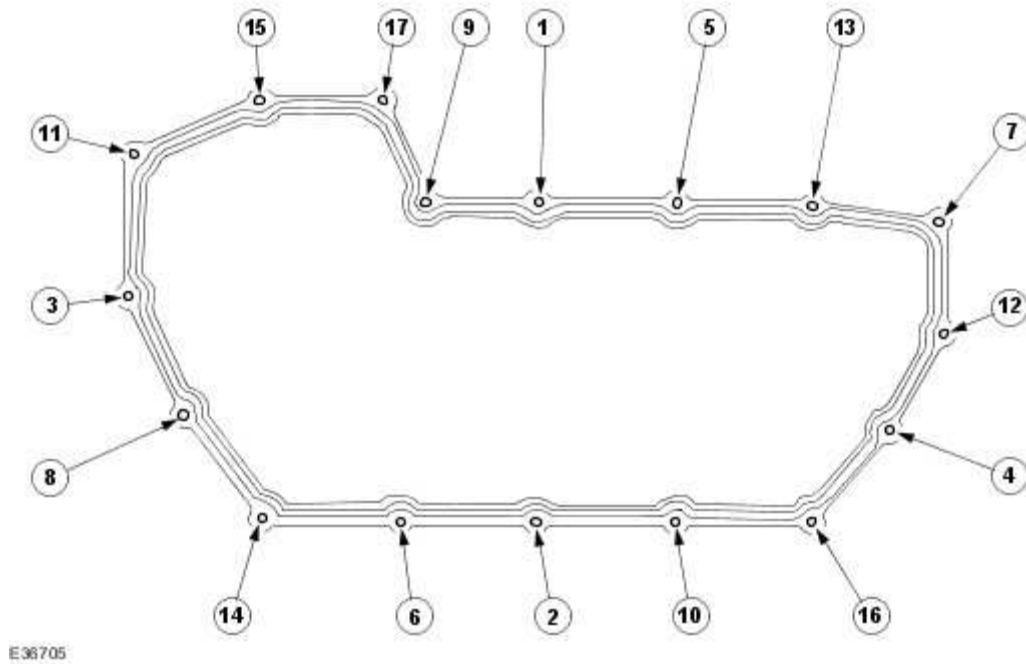
E31186

Installation

- 1 . Install the oil pan.

- ▶ Clean the components.
- ▶ Install the new gasket.
- ▶ Install the bolts, but do not tighten fully at this stage.

- 2 . Evenly and progressively tighten the bolts in the sequence shown to 12 Nm (9 lb.ft).



3 . Tighten the drain plug to 25 Nm (18 lb.ft).

▶ Install a new seal.

4 . Install the engine undershield.

For additional information, refer to Air Deflector (76.11.41)

5 . Fill the engine with the recommended oil to the correct level.

Oil Pump (12.60.26)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to 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 timing drive components.

For additional information, refer to Timing Drive Components (12.65.13)

- 4 . Remove the oil pan.

For additional information, refer to Oil Pan (12.60.44)

- 5 . **NOTE:**

The bolts will remain captive.

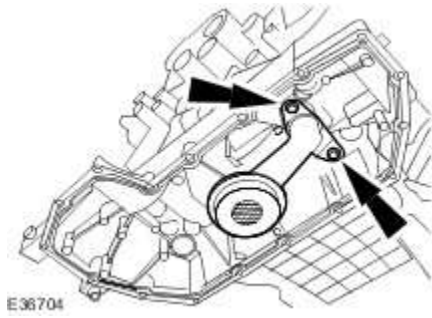
Remove the oil strainer pick-up assembly.



Remove the 2 bolts.

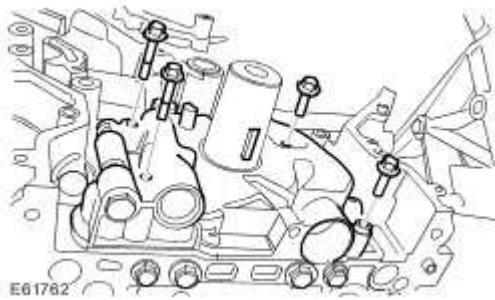


Remove and discard the O-ring seal.



6 . Remove the oil pump assembly.

- Remove the 4 bolts.
- Remove and discard the O-ring seal.



Installation

1 . Install the oil pump assembly.

- Clean the components mating faces.
- Install a new O-ring seal.
- Tighten the bolts to 12 Nm (9 lb.ft).

2 . Install the oil strainer pick-up assembly.

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

3 . Install the oil pan.

For additional information, refer to Oil Pan (12.60.44)

4 . Install the timing drive components.

For additional information, refer to Timing Drive Components (12.65.13)

5 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Timing Drive Components (12.65.13)

Special Service Tools



Camshaft setting/locking tool
303-530



Timing Setting tool
303-645



Timing chain tensioning tool
303-532

Removal

NOTE:

This procedure covers the removal and installation of the following components: timing chains, chain guides, tensioners and sprockets.

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 front cover.

For additional information, refer to Engine Front Cover (12.65.01)

- 4 . Remove the crankshaft position (CKP) sensor.

For additional information, refer to Crankshaft Position (CKP) Sensor (18.30.12)

5



- **CAUTION: Rotating the crankshaft in a counterclockwise direction may cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.**



CAUTION: Rotate the crankshaft clockwise to position the engine to top dead center (TDC) number 1 cylinder.

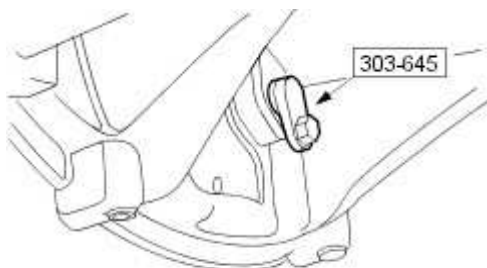
Lock the crankshaft.



Install the special tool.



Install the screw.

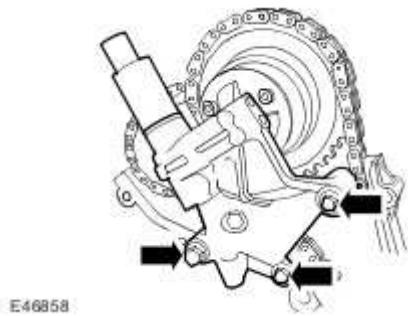


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6 . Remove the RH variable camshaft timing (VCT) control solenoid housing.

➤ Remove the 3 bolts.

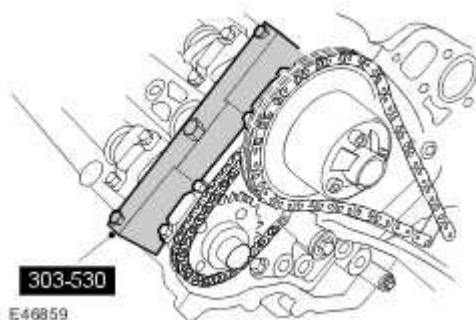
➤ Remove and discard the O-ring seals.



7 Install the special tool to the RH cylinder head.

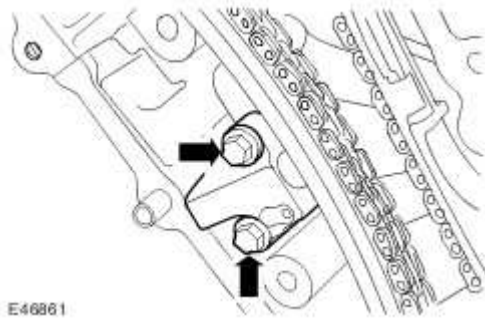
➤ Rotate the crankshaft until the flats on the camshafts are parallel with the cylinder head joint faces.

➤ Install the 3 bolts.



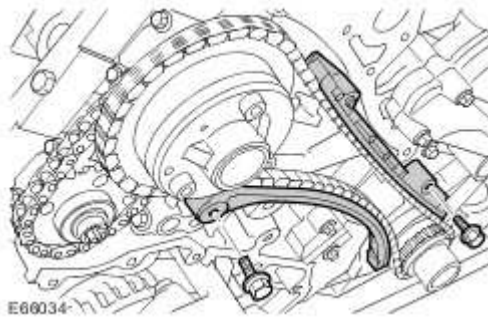
8 . Remove the RH primary timing chain tensioner.

➤ Remove the 2 bolts.

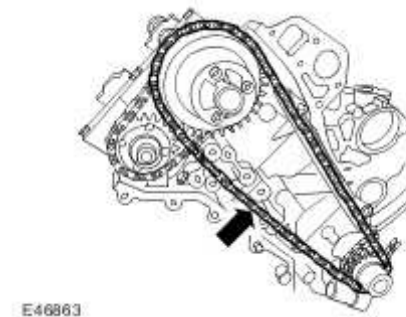


9 . Remove the RH upper and lower primary timing chain tensioner guides.

▶ Remove the 2 bolts.



10 . Remove the RH primary timing chain.

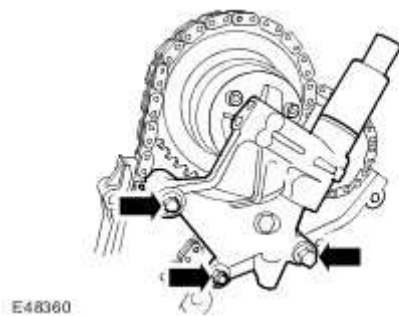


11 . Remove the LH variable camshaft timing (VCT) control solenoid housing.

▶ Remove the 2 bolts.

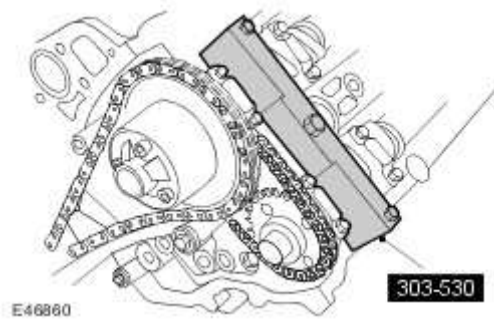
▶ Remove the nut.

▶ Remove and discard the O-ring seals.



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

▶ Install the 3 bolts.



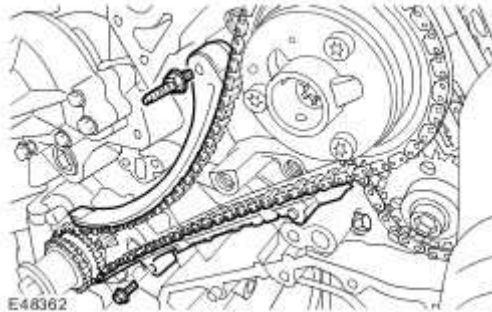
13 . Remove the LH primary timing chain tensioner.

▶ Remove the 2 bolts.

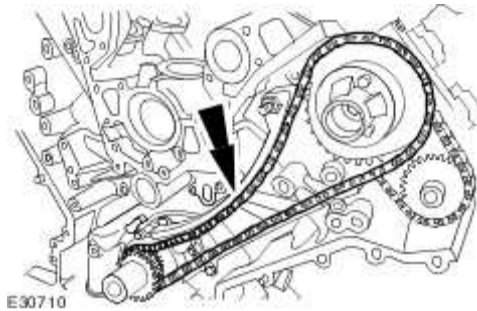


14 . Remove the LH upper and lower primary timing chain tensioner guides.

▶ Remove the 2 bolts.



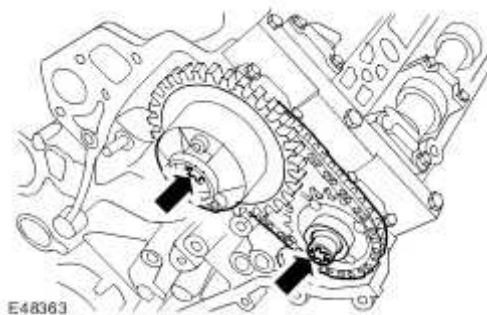
15 . Remove the LH primary timing chain.



16 .  **CAUTION: Discard the bolts.**

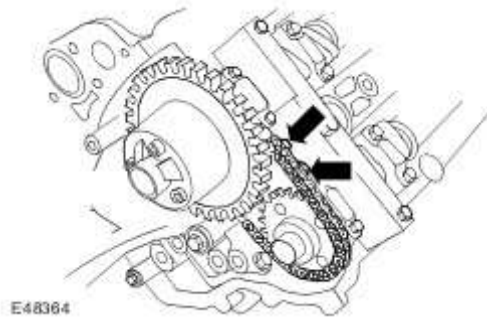
Release the LH camshaft sprocket assembly.

▶ Remove the 2 Torx bolts.



17 . Remove the LH secondary timing chain, tensioner and sprocket assembly.

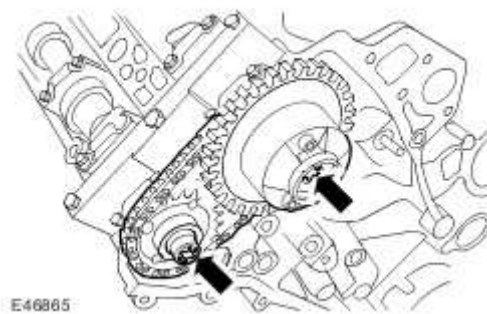
▶ Remove the 2 bolts.



18 .  **CAUTION: Discard the bolts.**

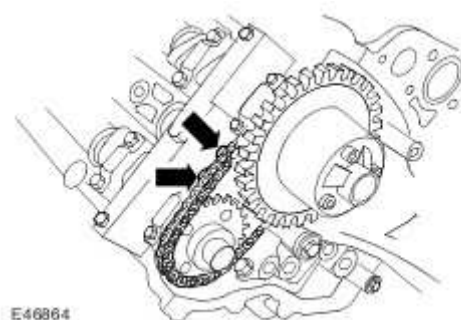
Release the RH camshaft sprocket assembly.

▶ Remove the 2 Torx bolts.



19 . Remove the RH secondary timing chain, tensioner and sprocket assembly.

▶ Remove the 2 retaining bolts.

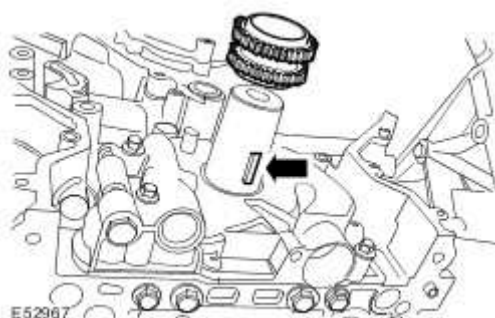


20 . NOTE:

Note the orientation of the crankshaft sprocket.

Remove the crankshaft sprocket.

▶ Remove the crankshaft sprocket key.



Installation

1 . Install the crankshaft sprocket.

▶ Clean the components.

▶ Install the crankshaft sprocket key.

2



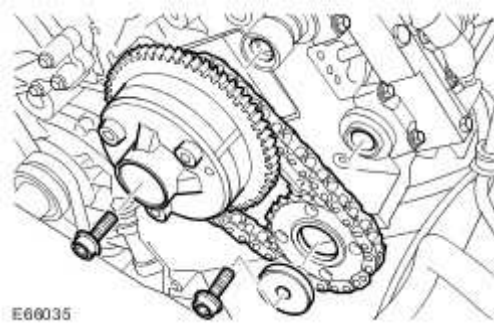
CAUTION: Make sure the secondary timing chain and camshaft sprockets are free to rotate.

NOTE:

LH illustration shown, RH is similar.

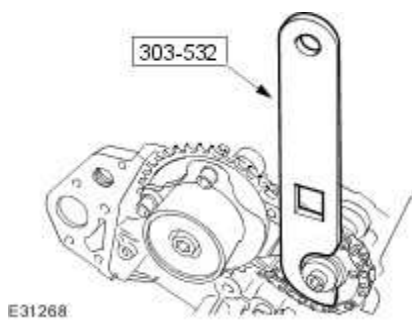
Install the LH secondary timing chain, tensioner and sprocket assembly.

- ▶ Clean the components.
- ▶ Install the Torx bolts, but do not tighten fully at this stage.



3 Install the special tool to the exhaust camshaft sprocket.

- ▶ Reposition the camshaft sprockets for the most advantageous position for use of the special tool.



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

- ▶ Tighten the bolts to 12 Nm.

5 Install the LH primary timing chain.

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

6 . Install the LH primary timing chain tensioner guides.

- ▶ Clean the components.
- ▶ Tighten the bolts to 12 Nm.

7



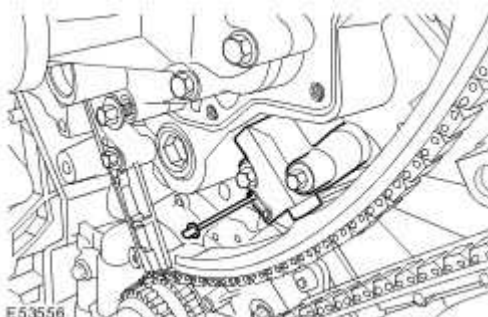
CAUTION: During timing chain tensioner compression, do not release the ratchet stem until the timing chain tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.

NOTE:

LH illustration shown, RH is similar.

Install the LH primary timing chain tensioner.

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



8



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



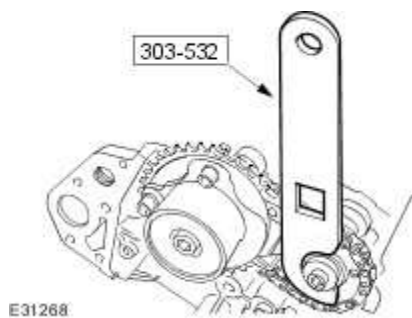
CAUTION: The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.



CAUTION: Make sure that new bolts are installed.

Install the special tool to the LH exhaust camshaft sprocket.

- ▶ Tighten the intake camshaft sprocket retaining bolt to 20 Nm + 90 deg.
- ▶ Tighten the exhaust camshaft sprocket retaining bolt to 20 Nm + 90 deg.



9 . Install the LH VCT control solenoid housing.

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

10



CAUTION: Make sure the secondary timing chain and camshaft sprockets are free to rotate.

Install the RH secondary timing chain, tensioner and sprocket assembly.

- ▶ Clean the components.
- ▶ Install the Torx bolts, but do not tighten fully at this stage.

11 . Install the RH secondary timing chain tensioner retaining bolts.

- ▶ Tighten the bolts to 12 Nm.

12 Install the RH primary timing chain.

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

13 . Install the RH primary timing chain tensioner guides.

- ▶ Tighten the bolts to 12 Nm.

14



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.

- ▶ Clean the components.
- ▶ Using 3 mm diameter metal rod, retain the chain tensioner piston.

▶ Tighten the bolts to 12 Nm.

▶ Remove the retaining rod.

15



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



CAUTION: 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.

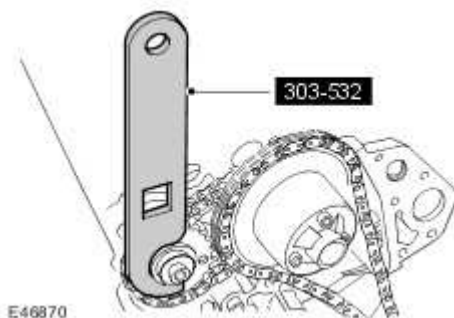


CAUTION: Make sure that new bolts are installed.

Install the special tool to the RH exhaust camshaft sprocket.

▶ Tighten the intake camshaft sprocket retaining bolt to 20 Nm + 90 deg.

▶ Tighten the exhaust camshaft sprocket retaining bolt to 20 Nm + 90 deg.



16 . Install the RH VCT control solenoid housing.

▶ Clean the components.

▶ Install the new O-ring seals.

 Tighten the new bolts to 22 Nm.

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

 Remove the 3 bolts.

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

 Remove the 3 bolts.

19 . Install the engine front cover.

For additional information, refer to Engine Front Cover (12.65.01)

20 . Remove the crankshaft locking tool.

 Remove the screw.

21 . Install the CKP sensor.

For additional information, refer to Crankshaft Position (CKP) Sensor (18.30.12)

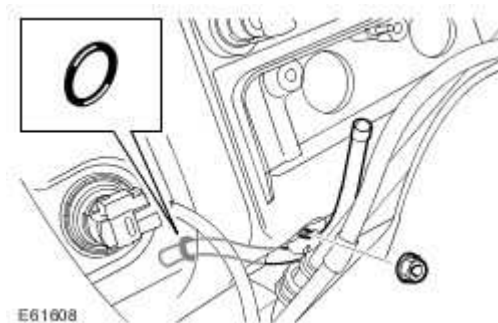
22 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

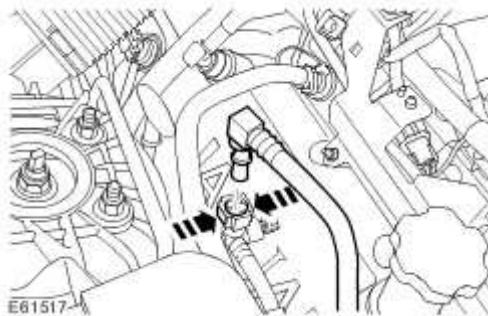
Valve Cover LH (12.29.43)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications
- 2 . Remove the ignition coil-on-plug.
For additional information, refer to Ignition Coil-On-Plug - 4.2L NA V8 - AJV8 (18.20.40)
- 3 . Remove the remaining ignition coil-on-plugs.
- 4 . Remove the oil level indicator and tube.
 - ▶ Remove the nut.
 - ▶ Remove and discard the O-ring seal.



- 5 . Release the clip and disconnect the purge inlet line.



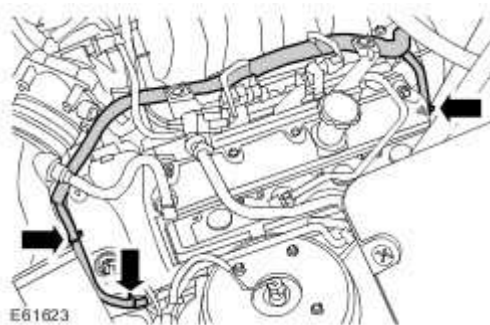
6 . Remove the engine cover bracket.

➤ Remove the 2 nuts.

➤ Position the bracket aside.

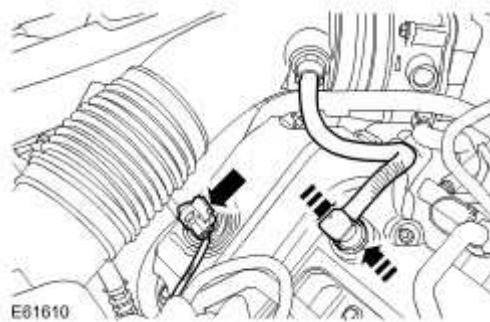


7 . Release the 3 wiring harness clips.



8 . Disconnect the variable camshaft timing (VCT) oil solenoid electrical connector.

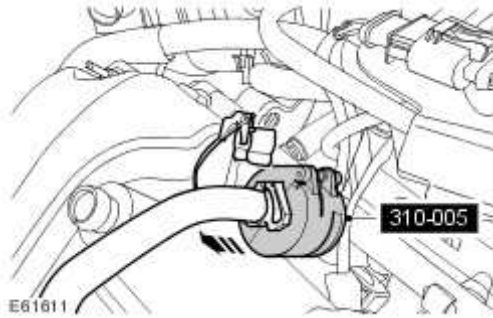
9 . Disconnect the valve cover breather hose.



10 . Using the special tool, disconnect the fuel line.

▶ Release the clip.

▶ Position an absorbent cloth to collect fluid spillage.

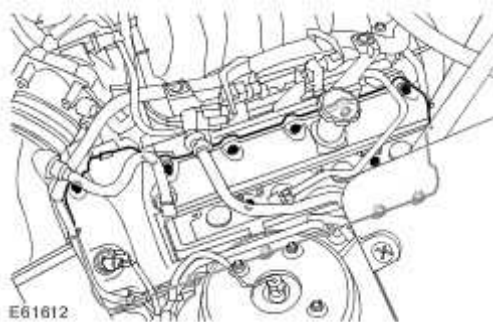


11 . **NOTE:**

Note the fitted position of the retaining bolts prior to removal.

Remove the valve cover assembly.

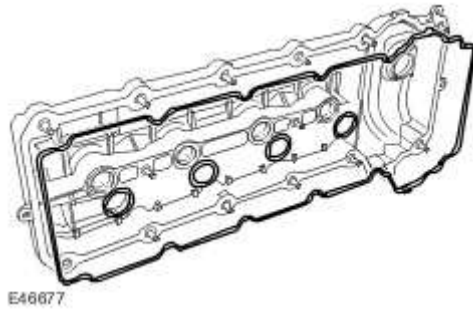
▶ Remove the 14 valve cover retaining bolts.



12 . Remove and discard the valve cover gasket.

▶ Carefully remove the sealant.

13 . Remove the valve cover plug aperture seals.



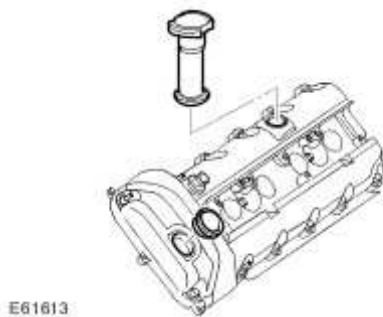
14 . Remove the VCT control solenoid seal.

15 . **NOTE:**

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

Remove the oil filler pipe.

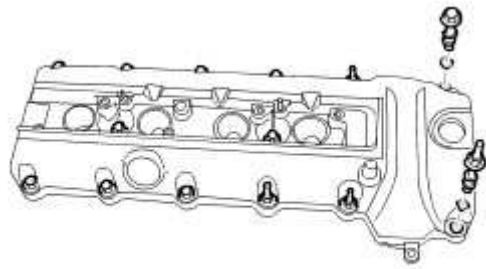
▶ Remove and discard the O-ring seal.



16 . **NOTE:**

Note the fitted position.

Remove the bolts, remove and discard the seals.



E61614

Installation

1 . NOTE:

Install the components to their original fitted positions.

Install the seals and bolts.

2 . Install the oil filler pipe.

▶ Install a new O-ring seal.

3 . Install new valve cover plug aperture seals.

4 . Install a new valve cover gasket.

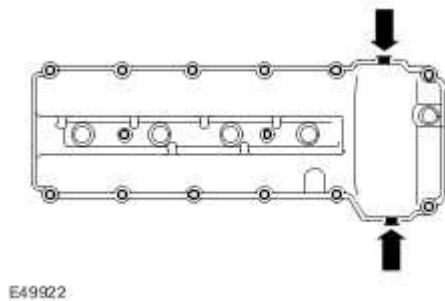
5 . Install the VCT control solenoid seal.

6 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.

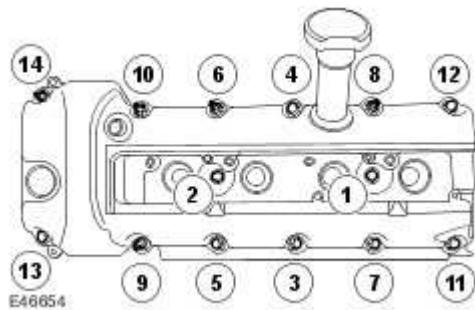
Install the valve cover.

- ▶ Clean the component mating faces.



7 . Install the valve cover retaining bolts.

- ▶ Complete the tightening sequence as illustrated.
- ▶ Tighten the bolts to 12 Nm (9 lb.ft).



8 . Install the engine cover mounting bracket.

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

9 . Connect the purge line.

10 . Install the oil level indicator and tube.

 Install a new O-ring seal.

 Tighten the nuts to 6 Nm (4 lb.ft).

11 . Connect the fuel line.

 Secure the clip.

12 . Connect the VCT oil solenoid electrical connector.

13 . Install the ignition coil-on-plug.

For additional information, refer to Ignition Coil-On-Plug - 4.2L NA V8 - AJV8 (18.20.40)

14 . Install the remaining ignition coil-on-plugs.

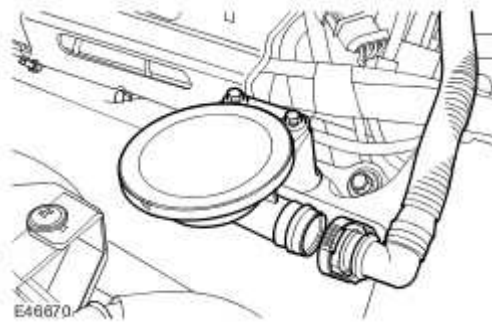
15 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

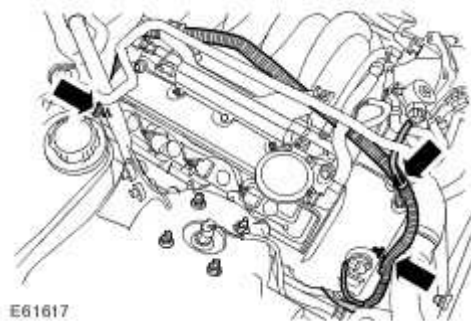
Valve Cover RH (12.29.44)

Removal

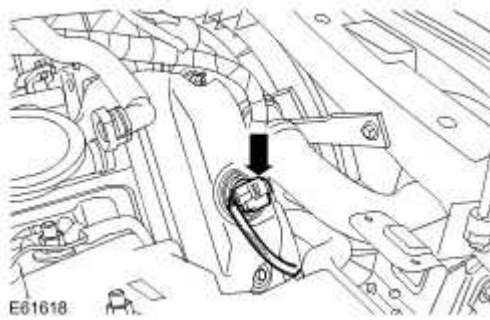
- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications
- 2 . Remove the ignition coil-on-plug.
For additional information, refer to Ignition Coil-On-Plug - 4.2L NA V8 - AJV8 (18.20.40)
- 3 . Remove the remaining ignition coil-on-plugs.
- 4 . Disconnect the positive crankcase ventilation (PCV) line.



- 5 . Release the 3 wiring harness clips.



- 6 . Disconnect the variable camshaft timing (VCT) oil solenoid electrical connector.



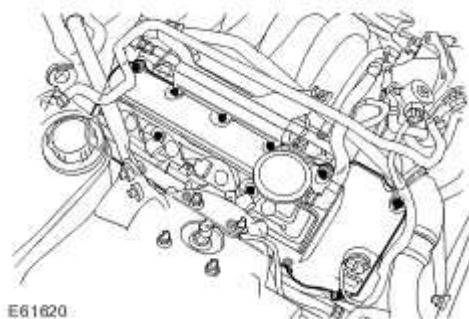
7 . Remove the engine cover bracket.

- Remove the 2 nuts.
- Position the bracket aside.



8 . Remove the valve cover assembly.

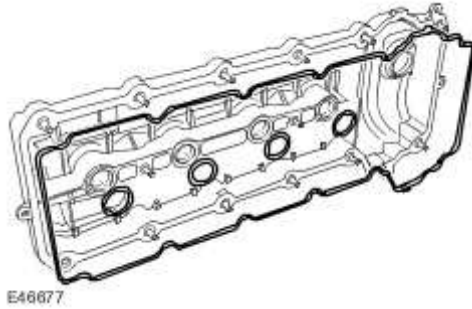
- Remove the 14 valve cover retaining bolts.



9 . Remove and discard the valve cover gasket.

▶ Carefully remove the sealant.

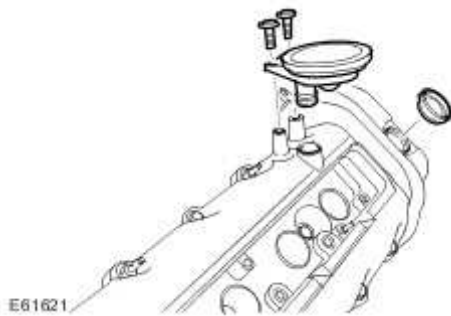
10 . Remove the valve cover plug aperture seals.



11 . Remove the VCTcontrol solenoid seal.

12 . Remove the PCV valve.

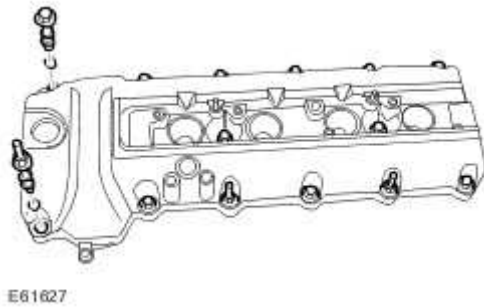
▶ Remove the 2 Torx screws.



13 . **NOTE:**

Note the fitted position.

Remove the bolts, remove and discard the seals.



Installation

1 . NOTE:

Install the components to their original fitted positions.

Install the seals and bolts.

2 . Install the PCV valve.

- ▶ Clean the component mating faces.
- ▶ Tighten the Torx screws.

3 . Install the VCT control solenoid seal.

4 . Install new valve cover plug aperture gaskets.

5 . Install a new valve cover gasket.

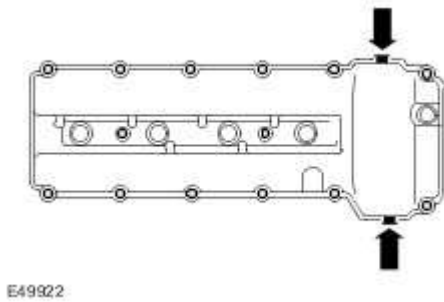
6 NOTE:

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

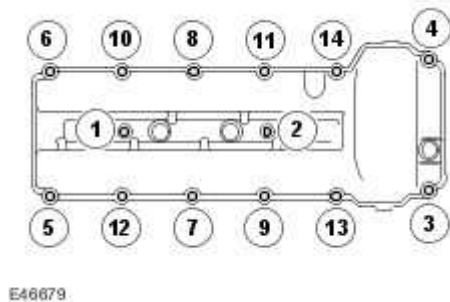
the sealant or the seals.

Install the valve cover.

► Clean the component mating faces.



7 . Evenly and progressively tighten the bolts in the sequence shown to 12 Nm (9 lb.ft).



8 . Connect the VCT oil solenoid electrical connector.

9 . Install the ignition coil-on-plugs.

For additional information, refer to Ignition Coil-On-Plug - 4.2L NA V8 - AJV8 (18.20.40)

10 . Install the remaining ignition coil-on-plugs.

11 . Install the engine cover mounting bracket.

 Tighten the nuts to 10 Nm (7 lb.ft).

12 . Connect the PCV line.

13 . Connect the battery ground cable and install the cover.
For additional information, refer to Specifications

Oil Filter Housing

Special Service Tools



Wrench, Oil filter
303-752

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 Air Deflector (76.11.41)
- 4 Drain the coolant.
 - For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8
- 5 . Disconnect the engine oil temperature sensor electrical connector.



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



7 . **NOTE:**

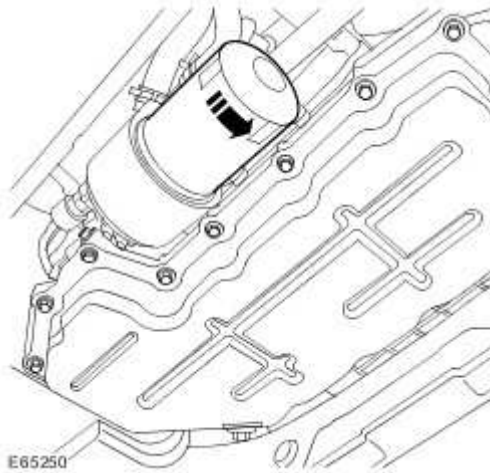
Some oil spillage is inevitable during this operation.

NOTE:

Clean the components general area prior to dismantling.

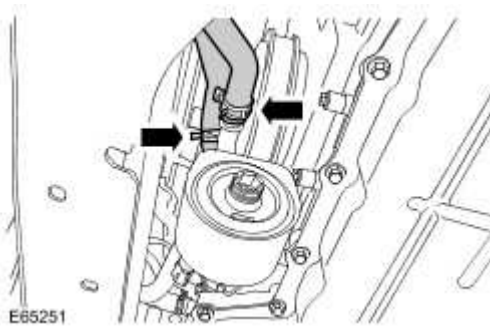
Remove the oil filter.

► Position a container to collect the fluid.



8 . Disconnect the 2 oil cooler hoses.

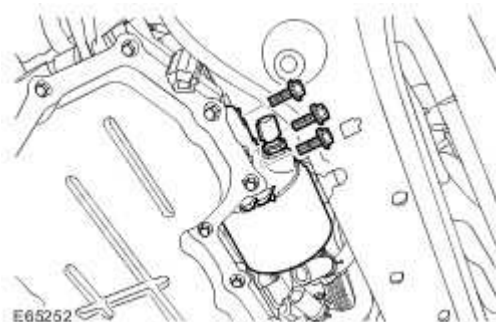
▶ Release the 2 clips.



9 . Remove the oil filter housing.

▶ Remove the 3 bolts.

▶ Remove and discard the O-ring seal.

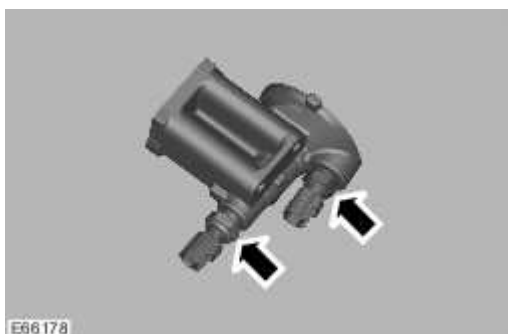


10 . NOTE:

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

Remove the engine oil temperature sensor.

11 . Remove the EOP sensor.



Installation

1 . Install the EOP sensor.

- ▶ Clean the components.
- ▶ Apply sealant of the correct specification to the sensor thread.
- ▶ Tighten the sensor to 15 Nm (11 lb.ft).

2 . Install the engine oil temperature sensor.

- ▶ Clean the components.
- ▶ Apply sealant of the correct specification to the sensor thread.
- ▶ Tighten the sensor to 15 Nm (11 lb.ft).

3 . Install the oil filter housing.

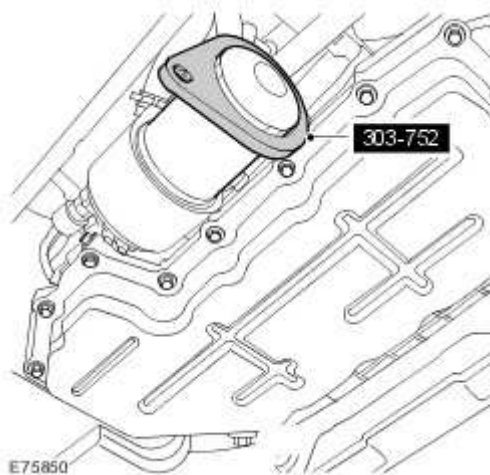
- ▶ Clean the component mating faces.
- ▶ Install a new O-ring seal.
- ▶ Tighten the bolts to 20 Nm (15 lb.ft).

4 . Connect the oil cooler hoses.

- ▶ Secure with the clips.

5 Using the special tool, install the oil filter.

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



6 . Connect the EOP sensor electrical connector.

7 . Connect the engine oil temperature sensor electrical connector.

8 . Install the engine undershield.

For additional information, refer to Air Deflector (76.11.41)

9 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

10 . Check and top-up the engine oil.

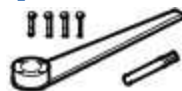
11 Top-up and bleed the coolant.

. For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8

Disassembly

Engine

Special Service Tools



303-191

Crankshaft locking, main tool

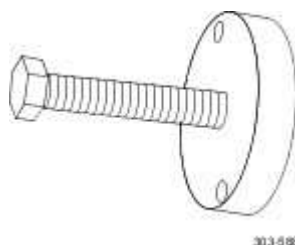
303-191



303-191-02

Adapter

303-191-02



303-588

Crankshaft pulley/damper remover

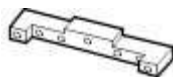
303-588



303-645

Crankshaft setting, main tool

303-645



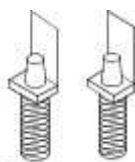
303-530

Camshaft setting
303-530



303D055

Crankshaft damper holding tool
303-D055

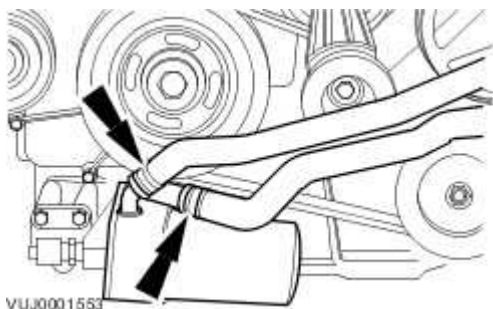


303535

Cylinder Bore Protectors
303-535

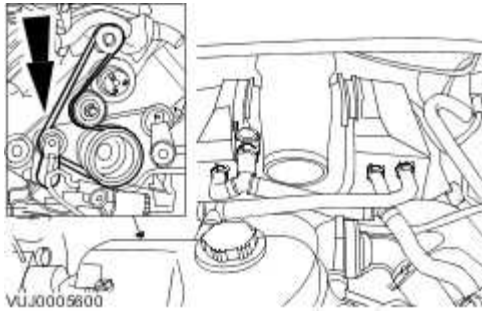
Disassembly

1 . Disconnect the oil cooler hoses.



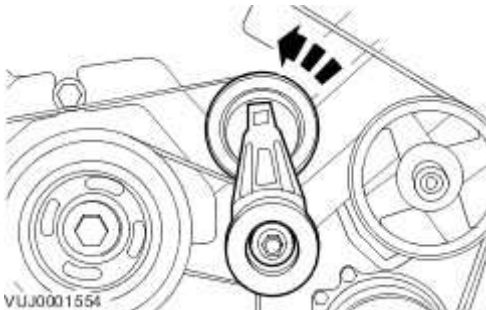
2 . Detach the supercharger belt.

- Use a 1/2 inch square drive bar to rotate the supercharger belt tensioner.
- Detach the supercharger belt.



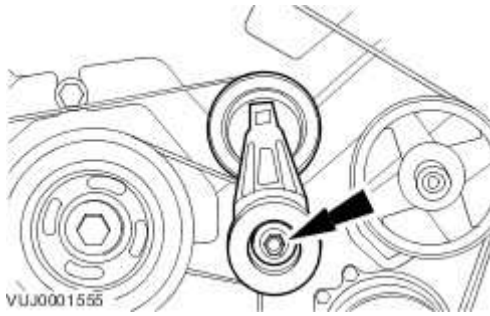
3 . Release the accessory drive belt tension.

- Use a 3/8 inch square drive bar to rotate the drive belt tensioner.
- Detach the accessory drive belt.

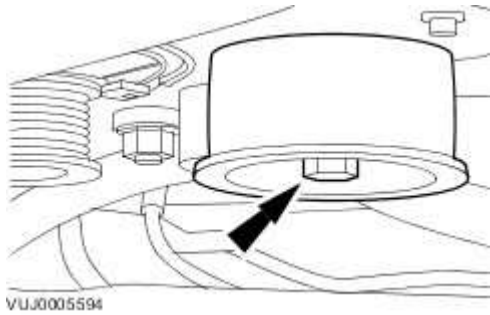


4 . Remove the accessory drive belt tensioner.

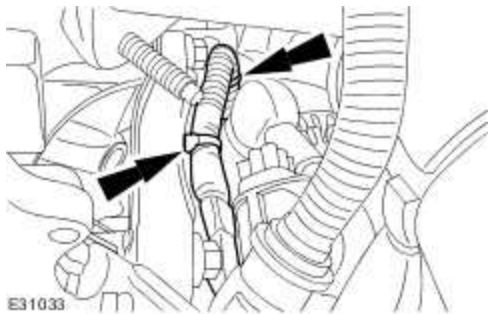
- Remove the accessory drive belt.



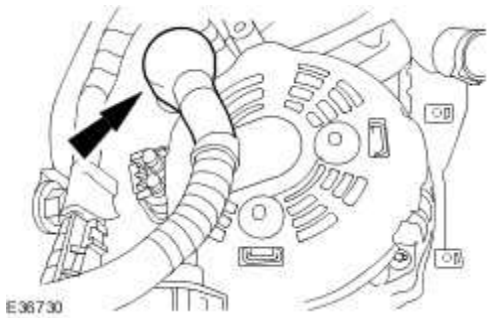
5 . Remove the accessory drive belt idler pulley.



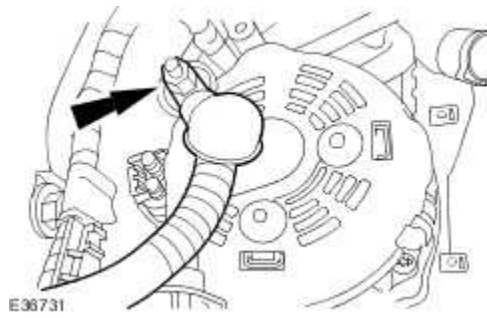
6 . Detach the wiring harness.



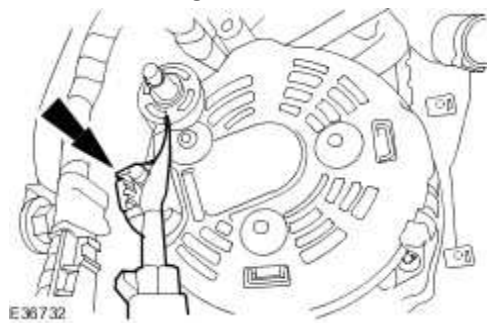
7 . Detach the generator battery positive cable protective cover.



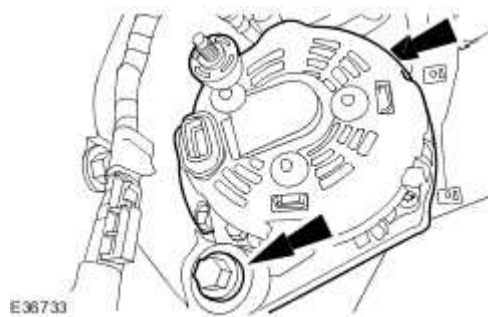
8 . Disconnect the generator battery positive cable.



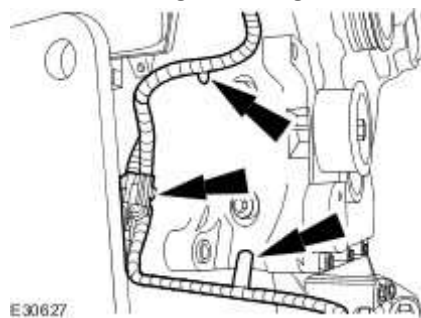
9 . Disconnect the generator electrical connector.



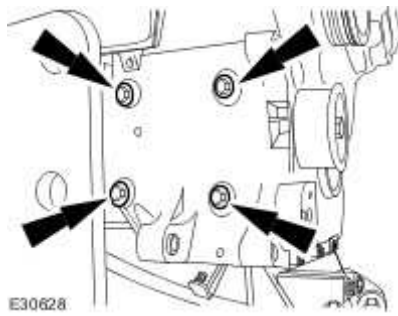
10 . Remove the generator.



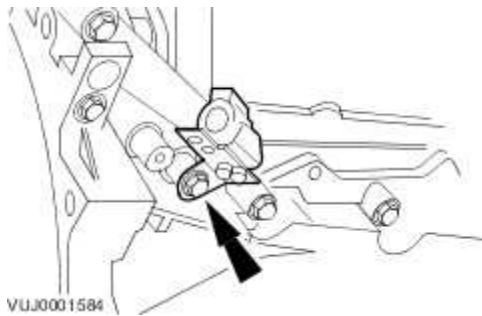
11 . Detach the engine wiring harness.



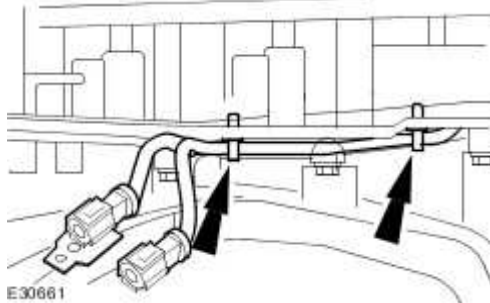
12 . Remove the generator mounting bracket.



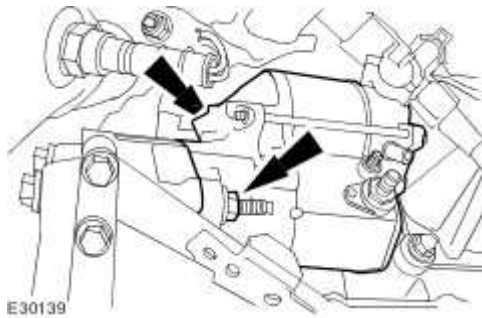
13 . Detach the right-hand oxygen sensor retaining bracket.



14 . Detach the engine wiring harness.



15 . Remove the starter motor.

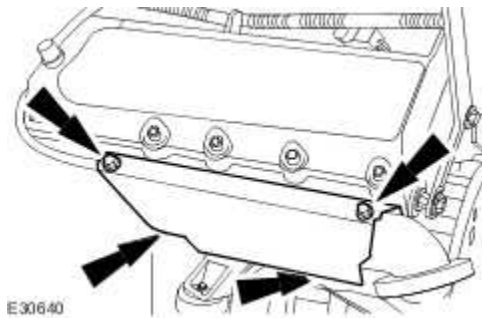


16 . Remove the oil level indicator and tube.

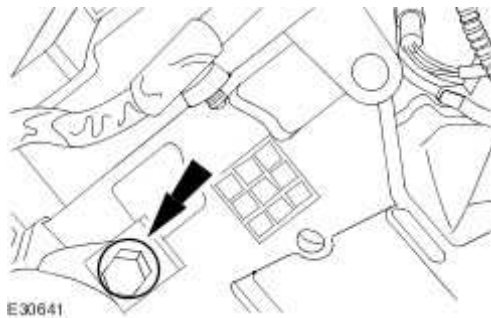
- Remove and discard the O-ring seal.



17 . Remove the heat shield.

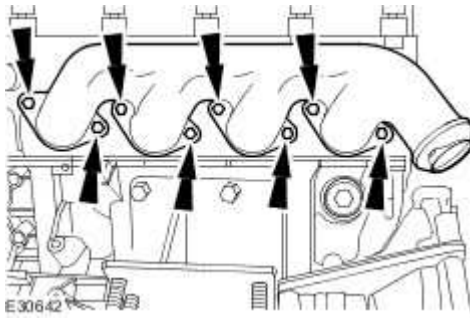


18 . Remove the heat shield retaining bolt.

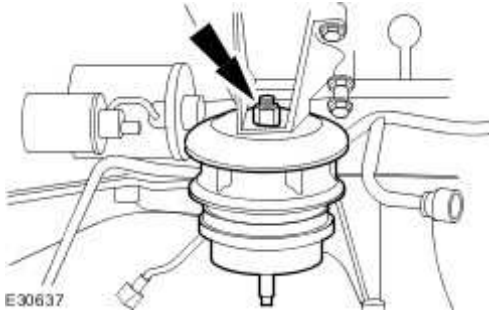


19 . Remove the left-hand exhaust manifold.

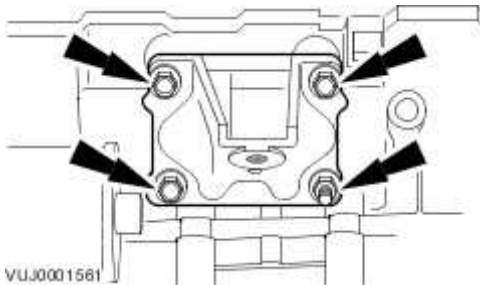
- Remove and discard the gasket.



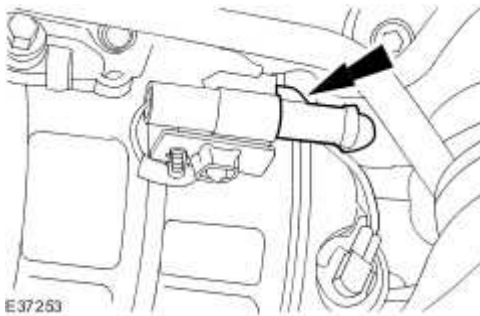
20 . Remove the left-hand engine mount.



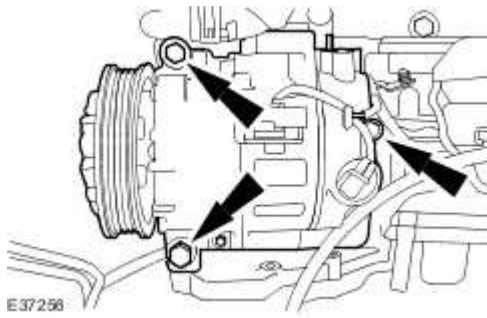
21 . Remove the left-hand engine mounting bracket.



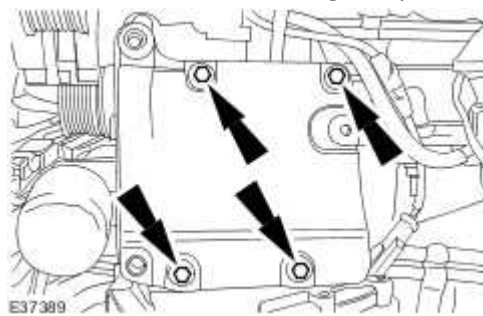
22 . Disconnect the A/C compressor electrical connector.



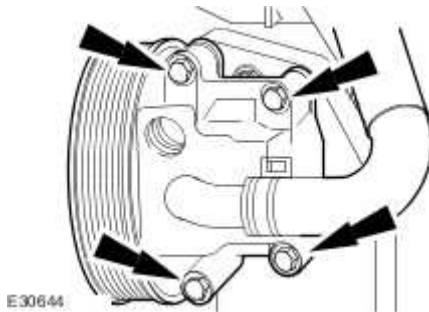
23 . Remove the A/C compressor.



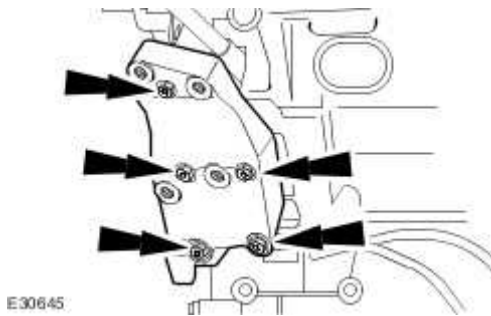
24 . Remove the air conditioning compressor mounting bracket.



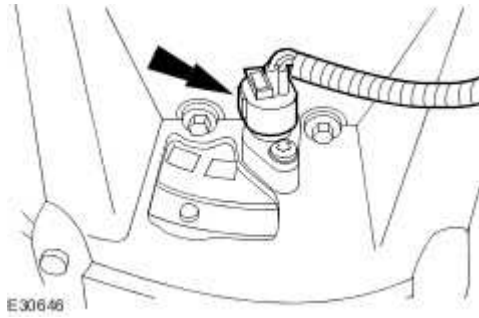
25 . Remove the power steering pump.



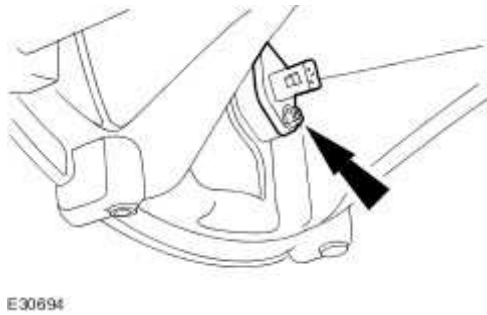
26 . Remove the power steering pump mounting bracket.



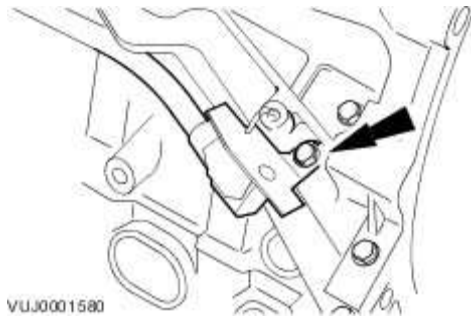
27 . Disconnect the crankshaft position sensor electrical connector.



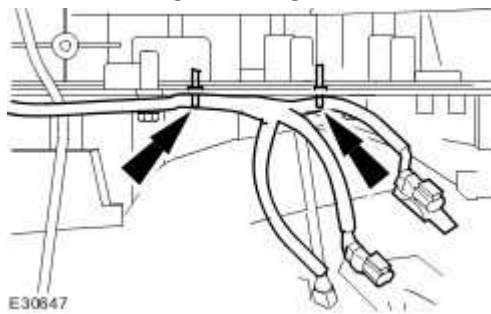
28 . Remove the crankshaft position sensor.



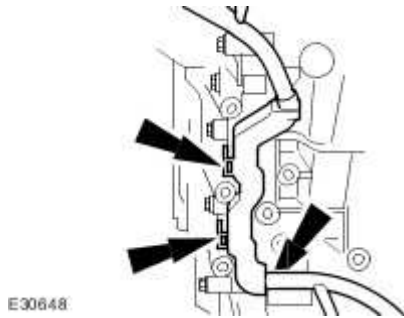
29 . Detach the engine wiring harness.



30 . Detach the engine wiring harness.

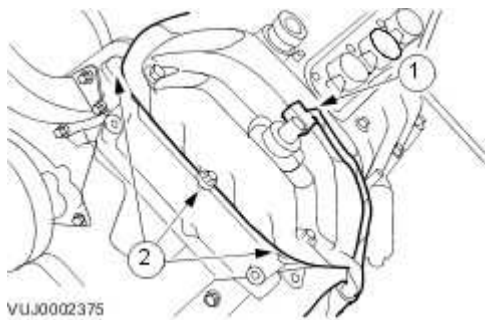


31 . Detach the engine wiring harness.

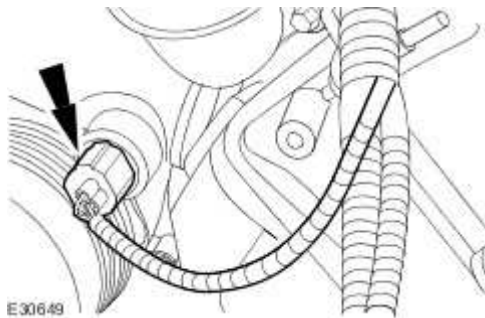


32 . Detach the engine wiring harness.

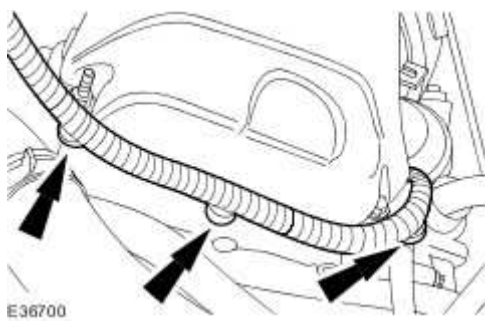
1. Disconnect the variable valve timing (VVT) solenoid electrical connector.
2. Detach the engine wiring harness.



33 . Disconnect the coolant temperature sensor electrical connector.

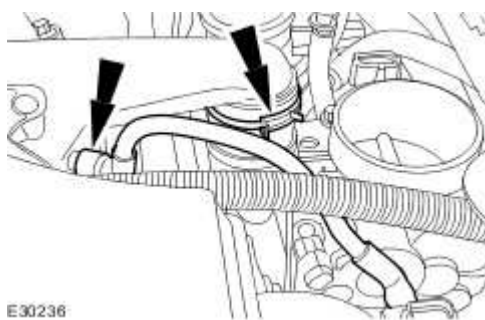


34 . Detach the engine wiring harness.



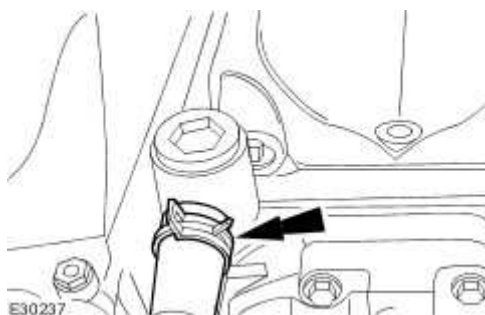
35 . Detach the hoses.

- Reposition the hose retaining clip.



36 . Detach the supercharger outlet pipe coolant hose.

- Cap the coolant ports.

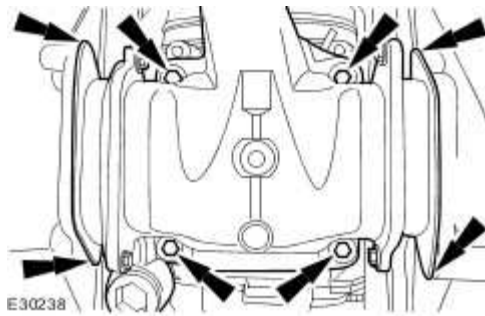


37 .



CAUTION: Make sure no foreign matter enters the supercharger.

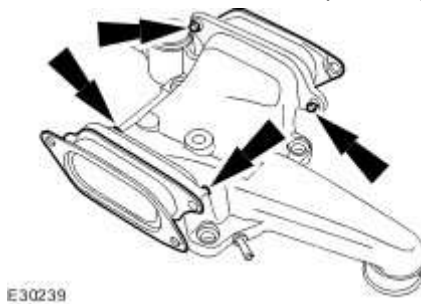
Remove the supercharger outlet pipe



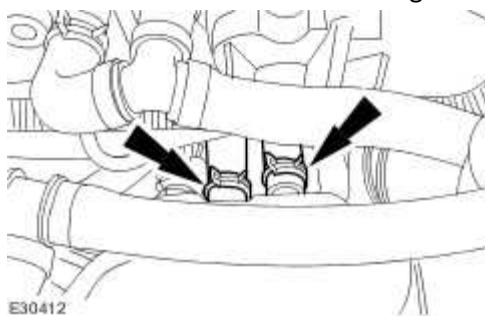
38 . Remove and discard the supercharger outlet pipe gasket.

39 . Remove and discard the supercharger outlet pipe retaining bolt seals.

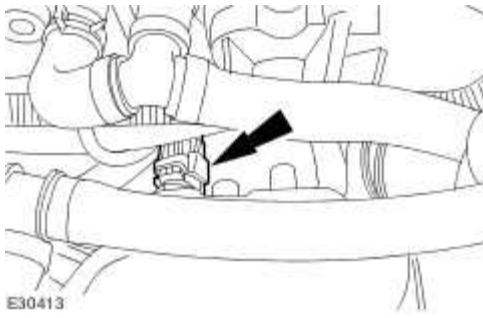
40 . Remove and discard the supercharger outlet pipe to charge air coolers ducts.



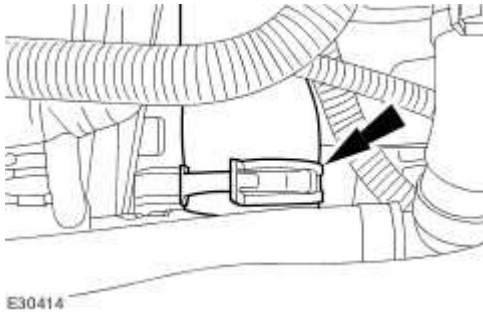
41 . Disconnect the thermostat housing hoses



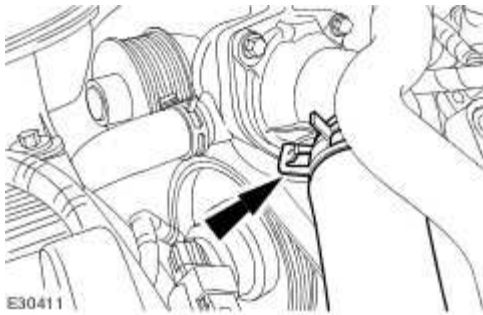
42 . Disconnect the coolant temperature sensor electrical connector.



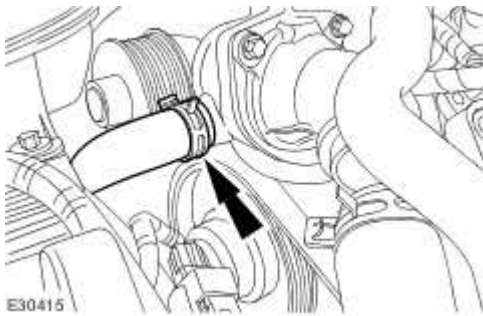
43 . Reposition the thermostat housing hose retaining clip.



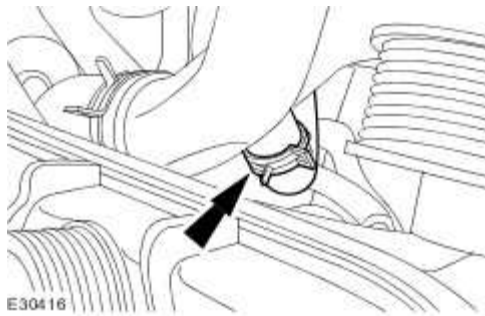
44 . Disconnect the hose.



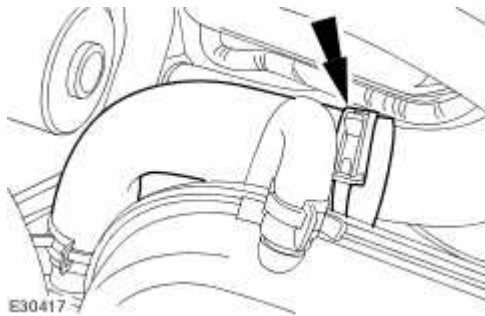
45 . Disconnect the hose.



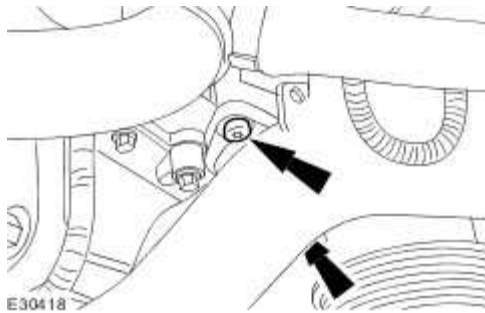
46 . Disconnect the hose.



47 . Disconnect the hose.

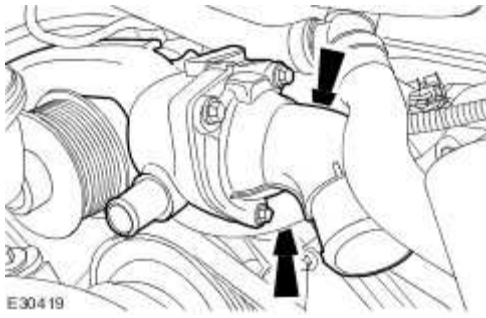


48 . Remove the thermostat housing retaining bolts.

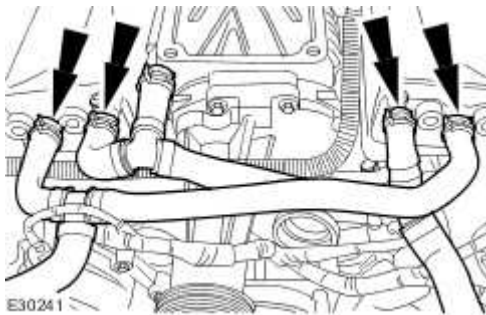


49 . Remove the thermostat housing.

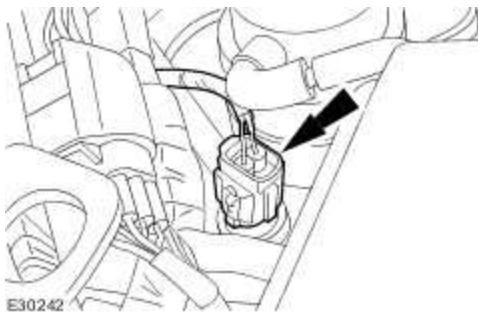
- Remove and discard the thermostat housing O-ring seals.



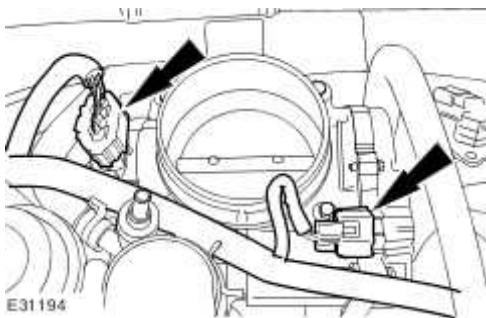
50 . Disconnect the charge air cooler coolant pipes.



51 . Disconnect the intake air temperature (IAT) sensor electrical connector.



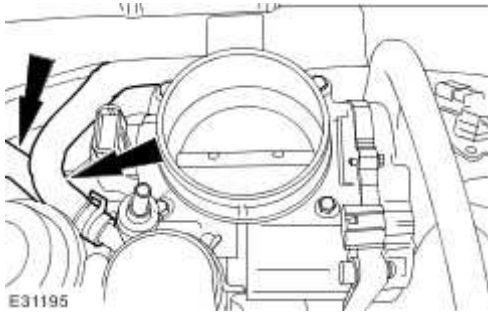
52 . Disconnect the electrical connectors.



53 . **NOTE:**

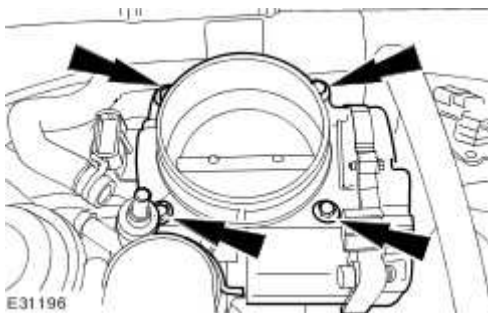
Cap the exposed ports.

Detach the coolant hose from the throttle body.

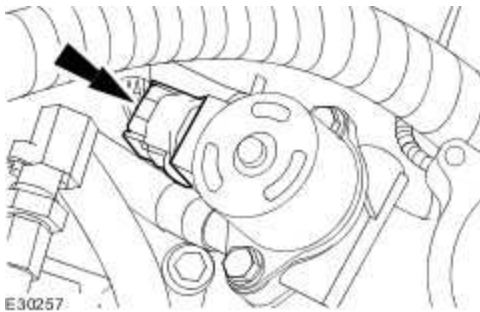


54 . Remove the throttle body.

- Remove and discard the gasket.



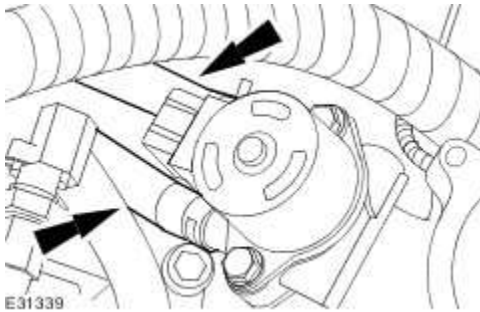
55 . Disconnect the exhaust gas recirculation (EGR) valve electrical connector.



56 . **NOTE:**

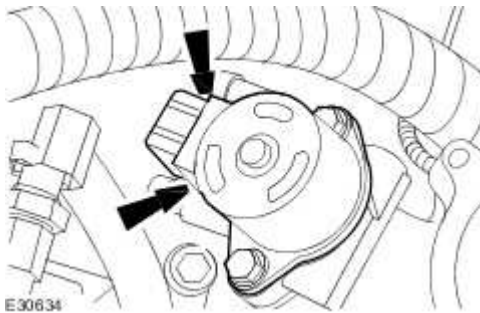
Cap the exposed ports.

Disconnect the coolant hoses.

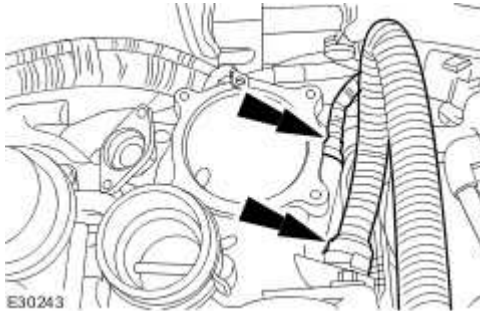


57 . Remove the EGR valve and the exhaust manifold to EGR valve tube.

- Remove the retaining bolts.
- Remove and discard the exhaust manifold to EGR valve tube gasket.
- Remove and discard the EGR valve to air intake elbow gasket.



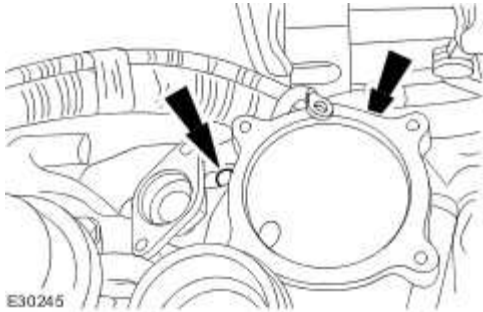
58 . Disconnect the air intake elbow pipes.



59 . **NOTE:**

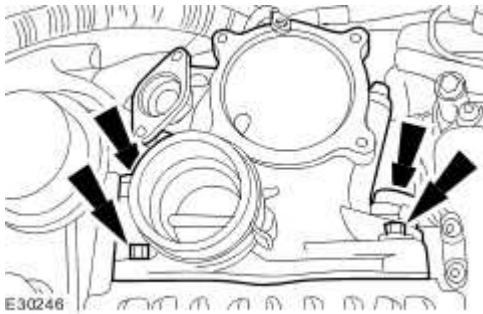
Make sure correct location of the ground strap is noted.

Remove the air intake elbow retaining bracket lower retaining bolts.



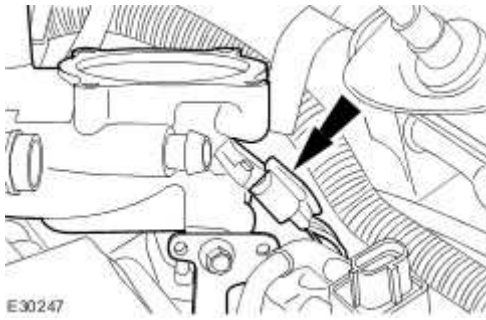
60 . Detach the air intake elbow.

- Remove and discard the gasket.
- Remove and discard the retaining bolt seals.



61 . Remove the air intake elbow.

- Disconnect the manifold absolute pressure (MAP) sensor.



62 . Remove the supercharger.



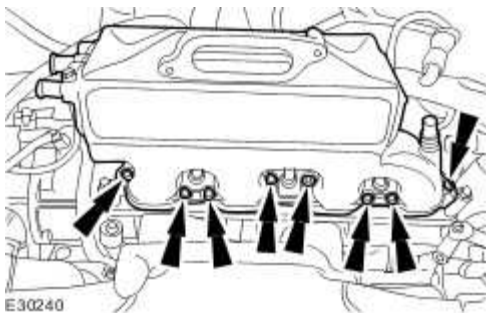
63 .  **CAUTION:** Make sure no foreign matter enters the cylinder head ports.

NOTE:

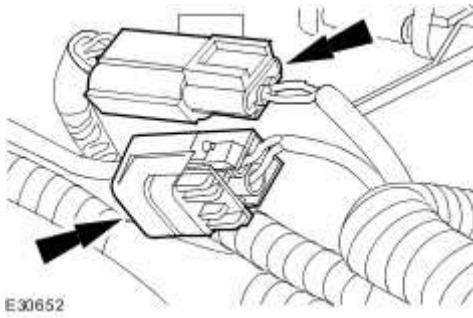
Right-hand shown, left-hand similar.

Remove the charge air coolers.

- Remove and discard the charge air cooler gasket.



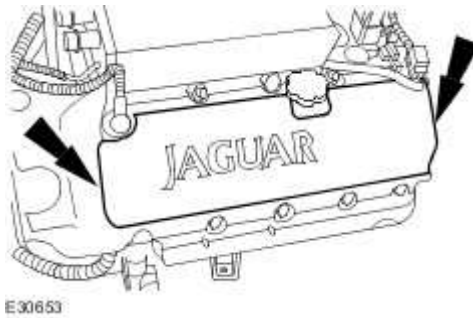
64 . Disconnect the knock sensor electrical connectors.



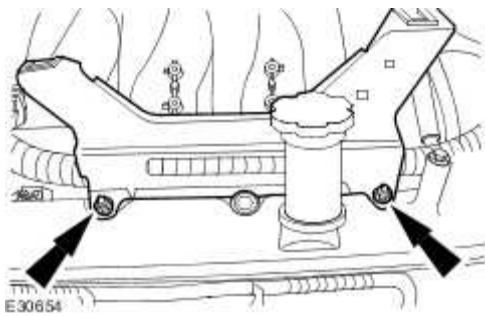
65 . **NOTE:**

Left-hand shown, right-hand similar.

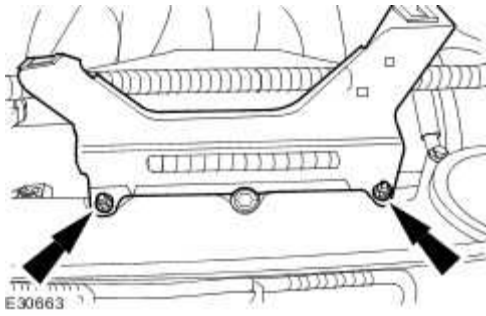
Remove the ignition coil cover.



66 . Remove the engine cover retaining bracket.



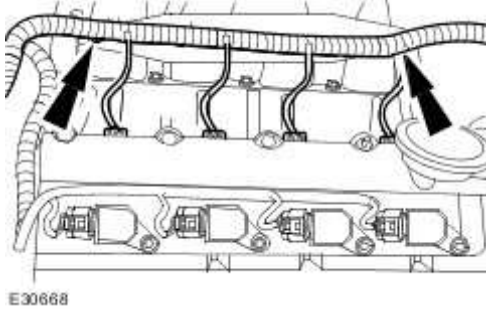
67 . Remove the engine cover retaining bracket.



68 . NOTE:

Right-hand shown, left-hand similar.

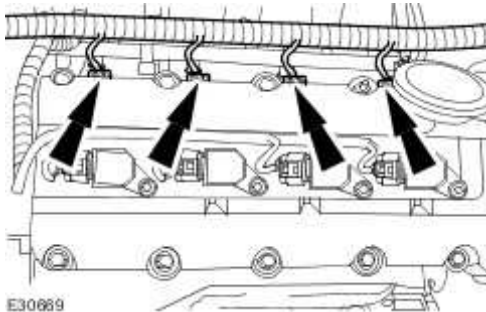
Detach the engine wiring harness.



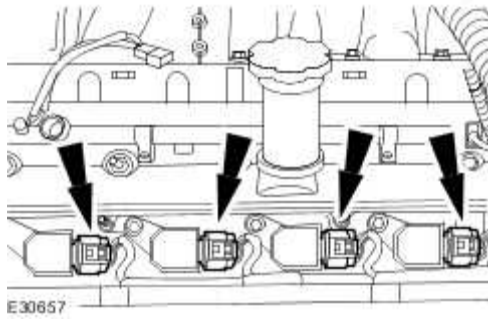
69 . NOTE:

Right-hand shown, left-hand similar.

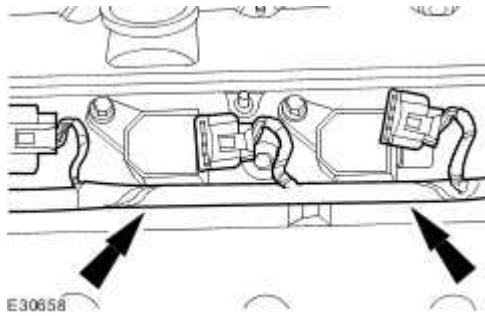
Disconnect the fuel injector electrical connectors.



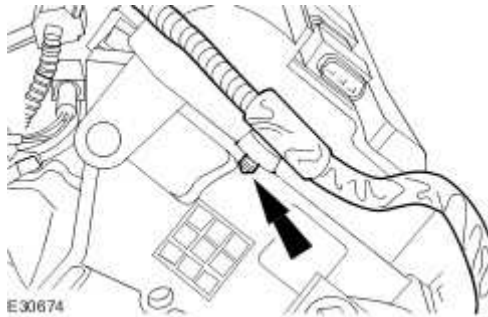
70 . Disconnect the ignition on-plug coil electrical connectors.



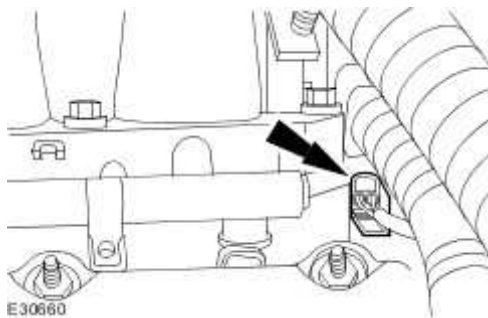
71 . Detach the engine wiring harness.



72 . Detach the engine wiring harness.



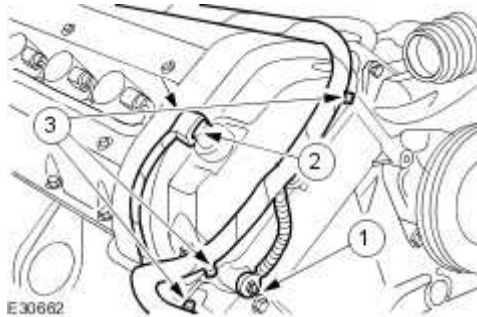
73 . Disconnect the camshaft position sensor electrical connector.



74 . Detach the engine wiring harness.

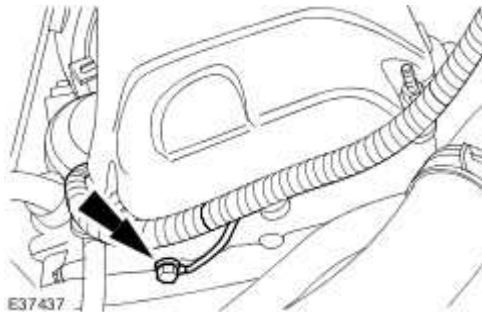
- Detach the ground cable.
- Disconnect the variable valve timing (VVT) solenoid electrical connector.

3. Detach the engine wiring harness.

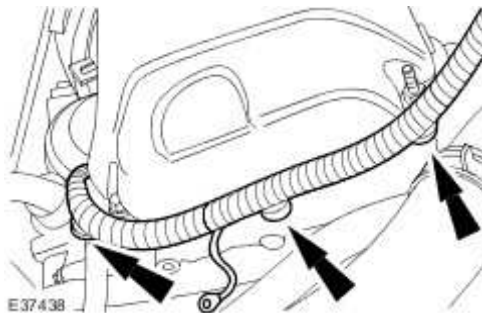


75 . Detach the engine wiring harness.

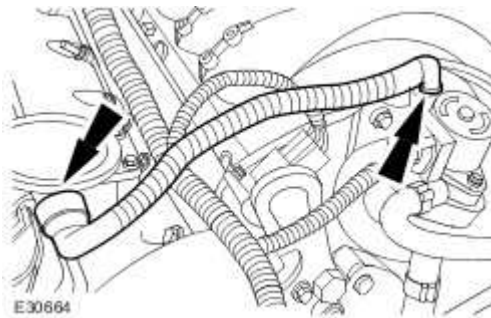
- Remove the retaining bolt.



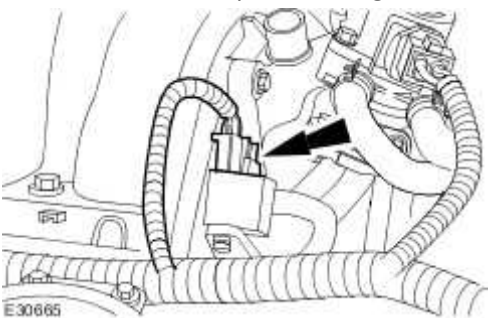
76 . Detach the engine wiring harness.



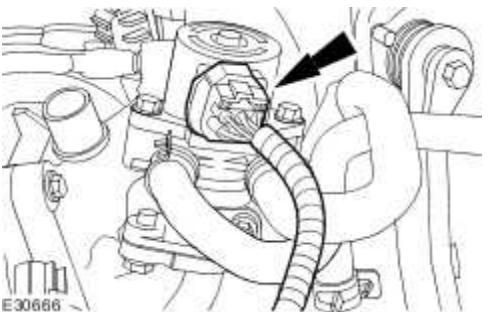
77 . Disconnect the positive crankcase ventilation pipe.



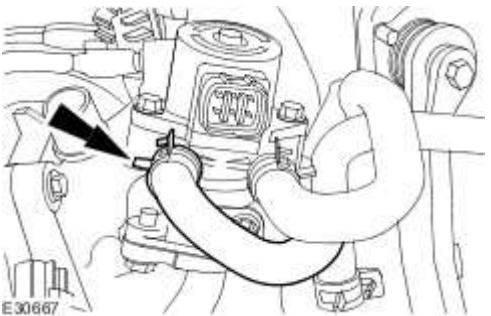
78 . Disconnect the fuel pressure regulator electrical connector.



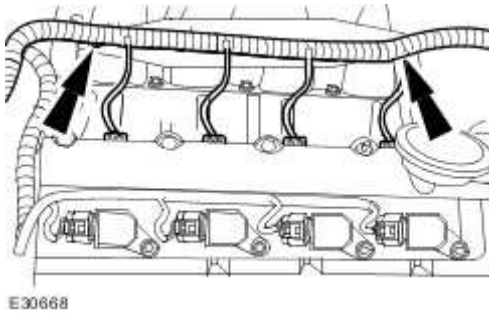
79 . Disconnect the exhaust gas recirculation valve electrical connector.



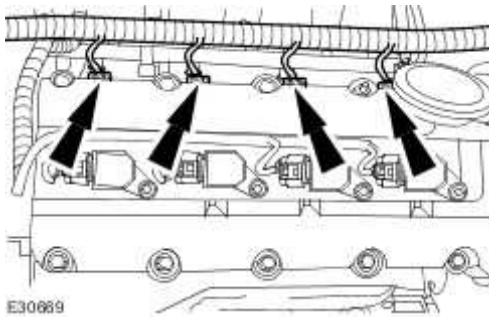
80 . Disconnect the exhaust gas recirculation valve coolant hose.



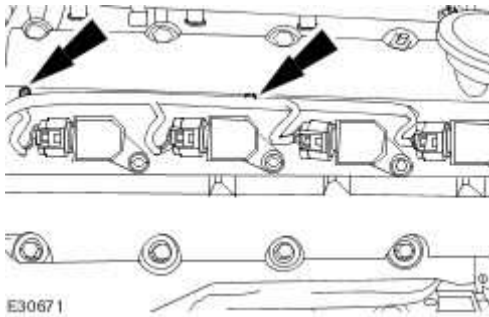
81 . Detach the engine wiring harness.



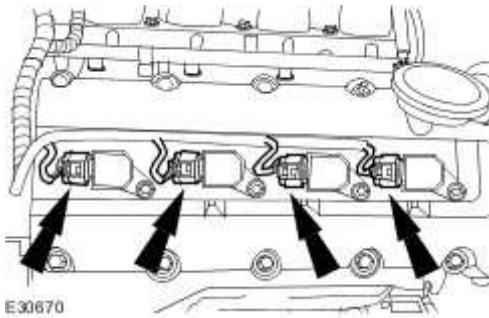
82 . Disconnect the fuel injector electrical connectors.



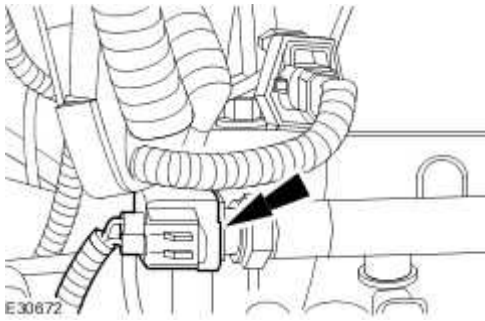
83 . Detach the engine wiring harness.



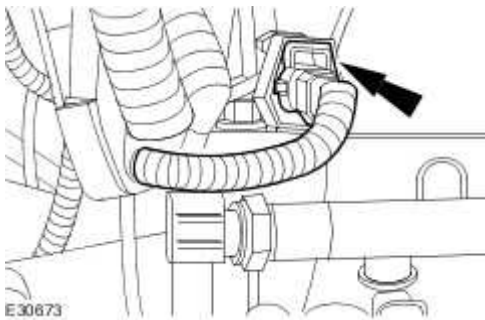
84 . Disconnect the ignition on-plug coil electrical connectors.



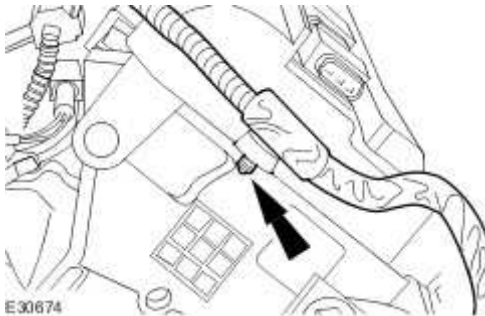
85 . Disconnect the fuel temperature sensor electrical connector.



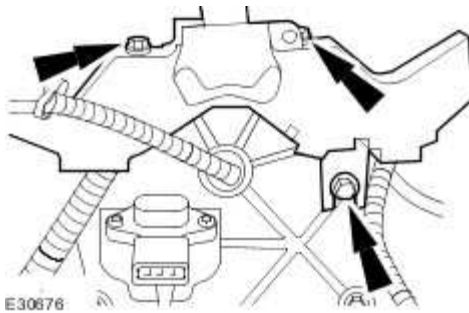
86 . Disconnect the camshaft position sensor electrical connector.



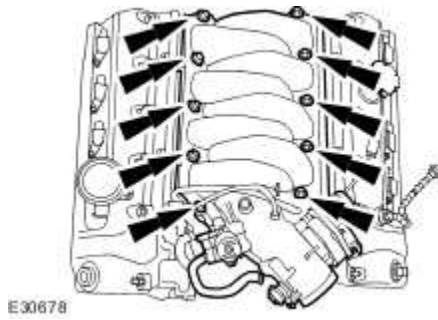
87 . Detach the engine wiring harness



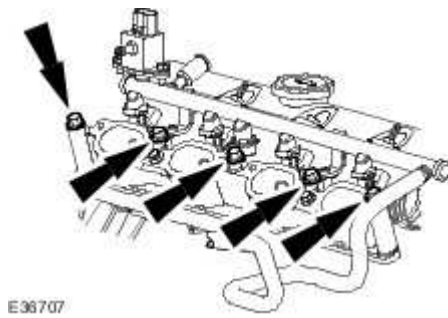
88 . Detach the engine wiring harness.



89 . Remove the intake manifold.



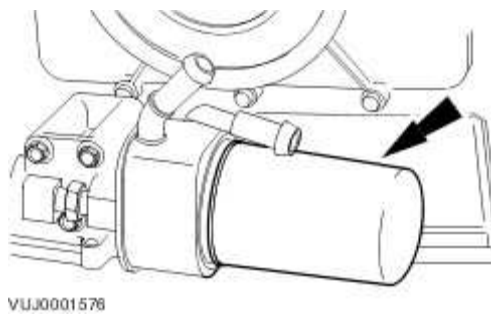
90 . Remove the lower intake manifold.



91 . **NOTE:**

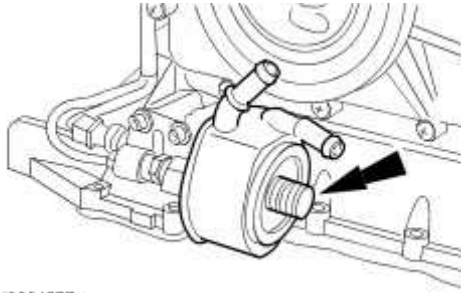
Place a suitable container underneath the filter to prevent oil spillage.

Remove the oil filter element.



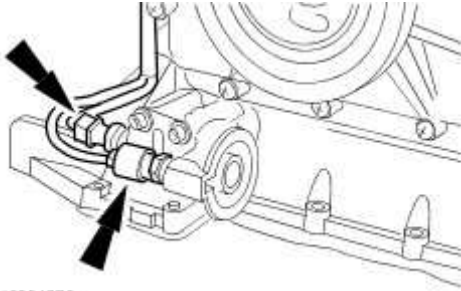
92 . Remove the oil cooler.

- Remove and discard the O-ring seal.



VUJ0001577

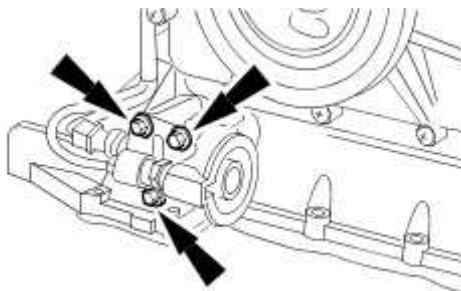
93 . Disconnect the oil pressure switch and oil temperature sensor electrical connectors.



VUJ0001578

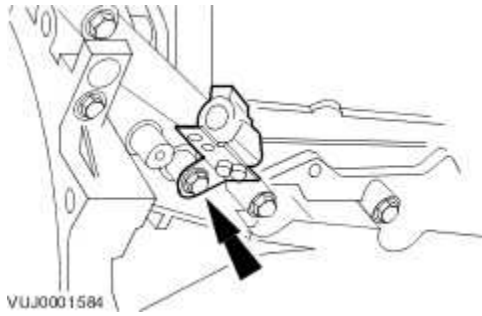
94 . Remove the oil filter housing.

- Remove and discard the O-ring seal.

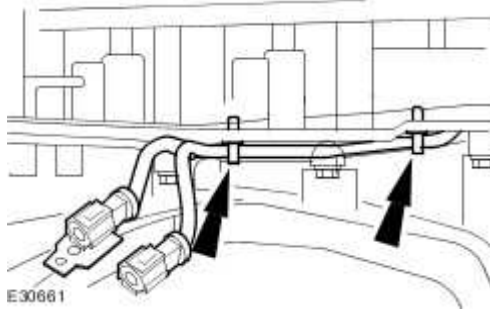


VUJ0001579

95 . Detach the right-hand oxygen sensor.

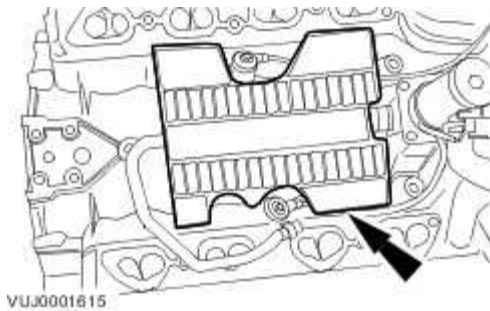


96 . Detach the engine wiring harness retaining clips.



97 . Remove the engine wiring harness

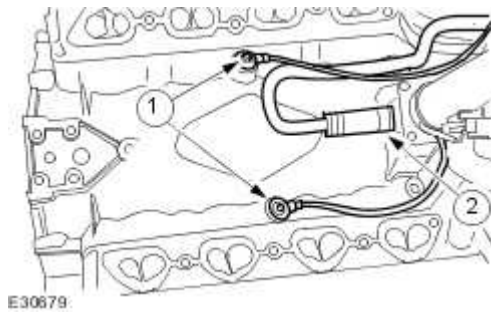
98 . Remove the noise and vibration insulating pad.



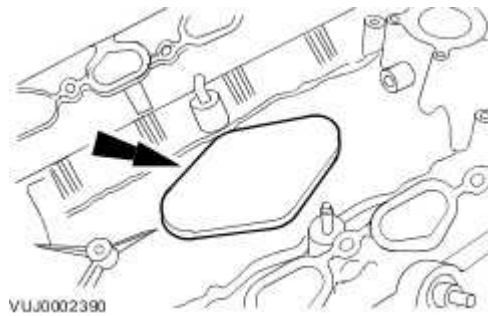
99 . Remove the intake manifold heater coolant hose.

4. Remove the knock sensors.

5. Remove the intake manifold heater coolant hose.

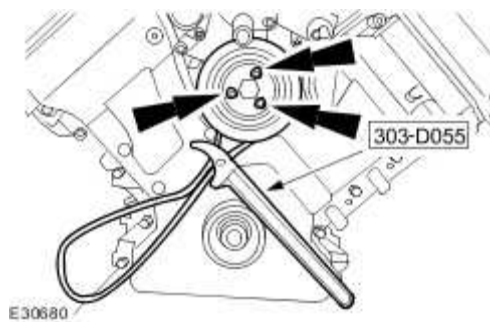


100 . Remove the engine block insulation grommet.



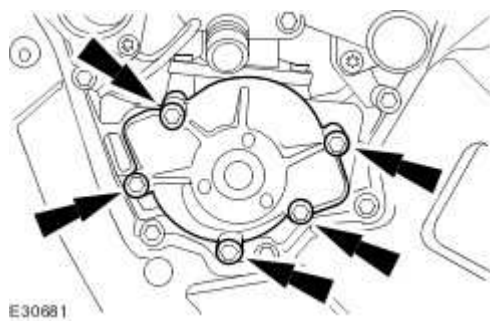
101 . Remove the water pump pulley.

- Using the special tool, retain the water pump pulley.



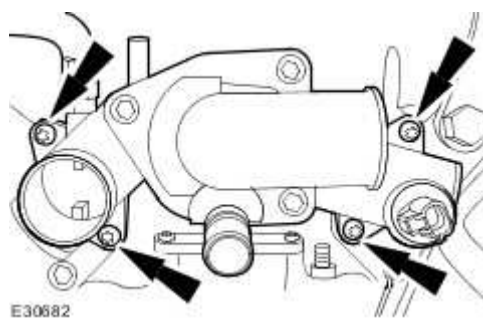
102 . Remove the water pump.

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



103 . Remove the thermostat housing.

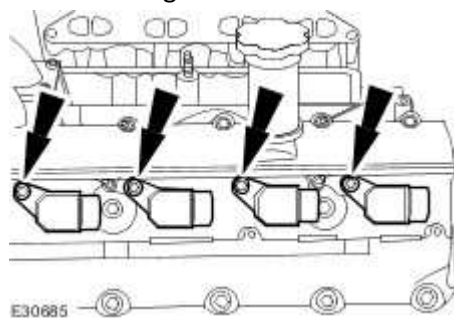
- Remove and discard the O-ring seals.



104 . **NOTE:**

Left-hand shown, right-hand similar

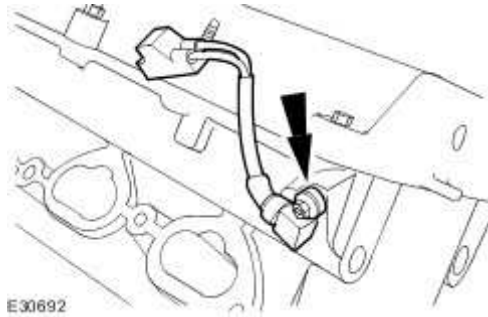
Remove the ignition coils.



105 . Remove the spark plugs.

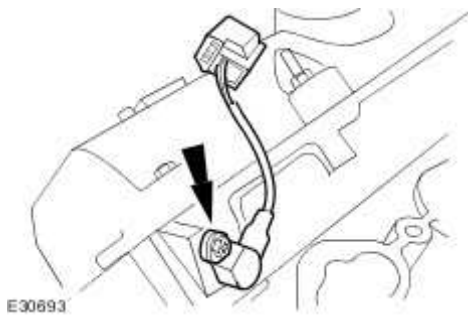
106 . Remove the right-hand camshaft position (CMP) sensor.

- Remove and discard the O-ring seal.



107 . Remove the left-hand camshaft position (CMP) sensor.

- Remove and discard the O-ring seal.



108



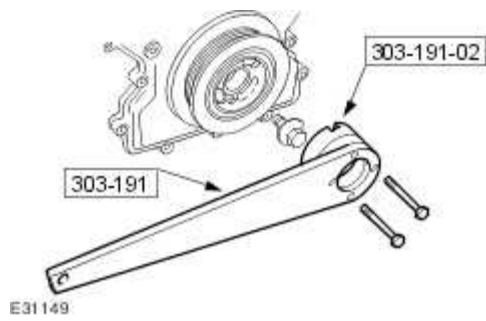
CAUTION: Under no circumstances should the crankshaft setting peg 303-645 be used in the following operations to lock the crankshaft.

NOTE:

The crankshaft retaining bolt will be very tight.

Using special tools, retain the crankshaft pulley.

- Remove and discard the crankshaft pulley bolt.



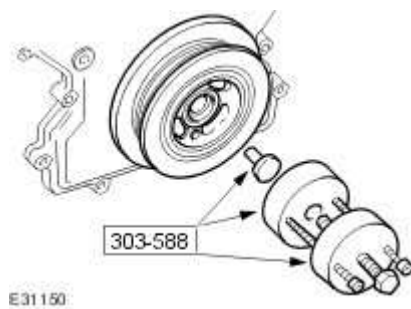
109 . Remove the special tools.

110 . **NOTE:**

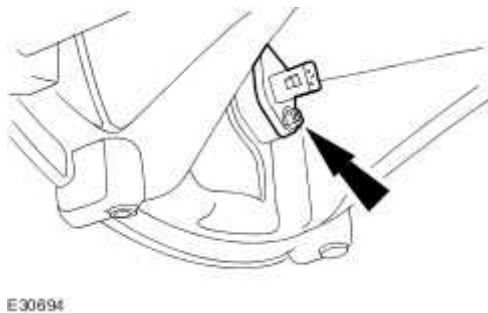
The crankshaft pulley will be very tight.

Using special tools, remove the crankshaft pulley.

- Collect the locking ring.
- Remove and discard the O-ring seal.



111 . Remove the crankshaft position (CKP) sensor.



112



CAUTION: Make sure the spark plugs are removed to enable the engine to rotate freely.

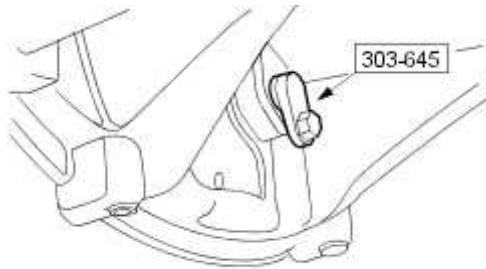


CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.



CAUTION: Rotate the crankshaft clockwise to position the engine to top dead center (TDC) No. 1 cylinder.

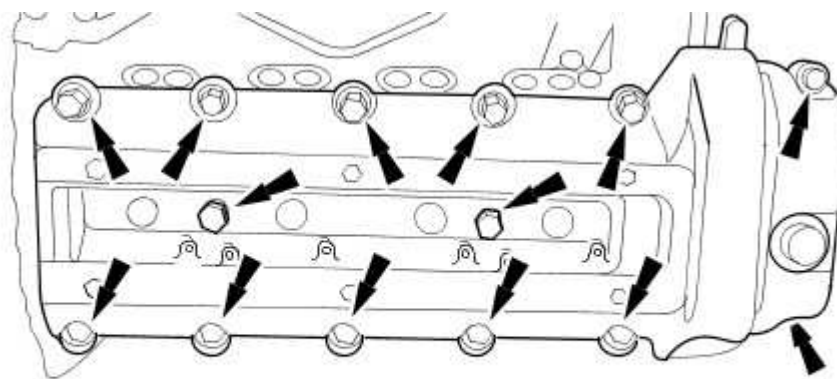
Install the special tool 303-645.



VUJ0002400

113 . Remove the right-hand valve cover.

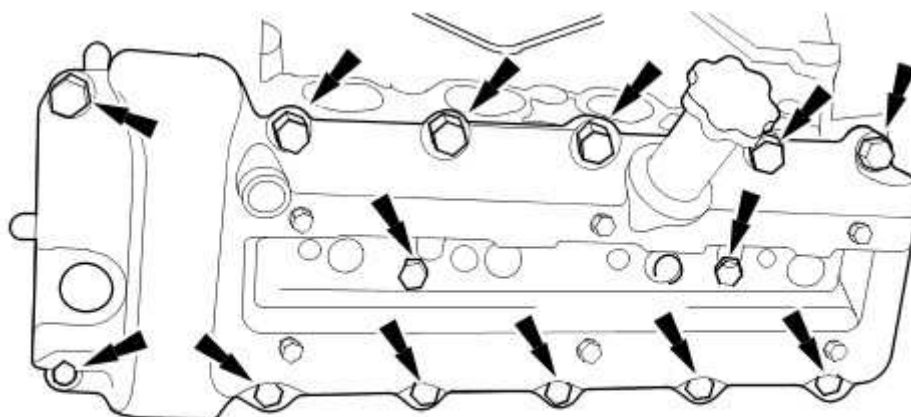
- Discard the valve cover gaskets.



E30696

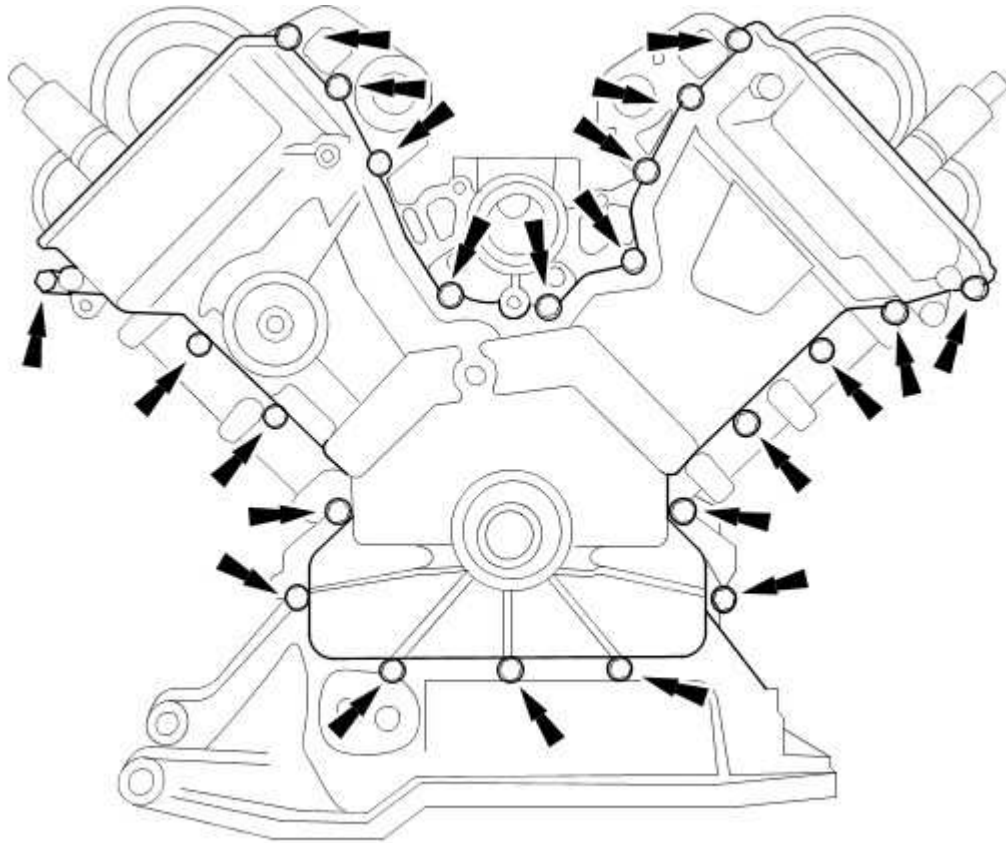
114 . Remove the left-hand valve cover.

- Discard the valve cover gaskets.



E30697

115 . Remove the engine front cover.



VUJ0002398

116 . Remove the right-hand variable camshaft timing oil control unit housing.

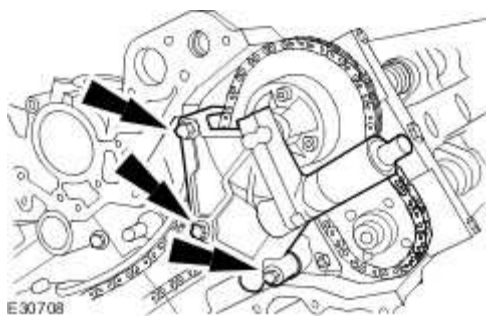
- Remove and discard the O-ring seals.



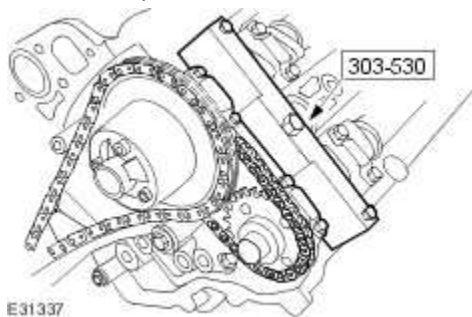
E30699

117 . Remove the left-hand variable camshaft timing oil control unit housing.

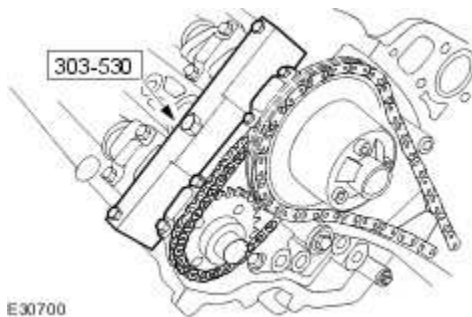
- Remove and discard the O-ring seals.



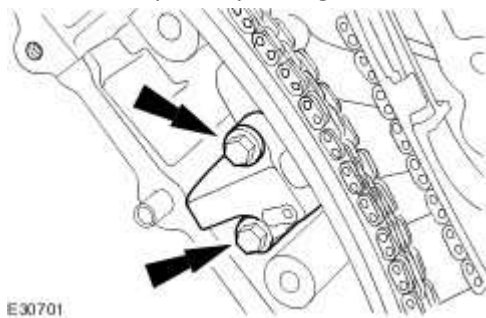
118 . Install the special tool to the left-hand cylinder head.



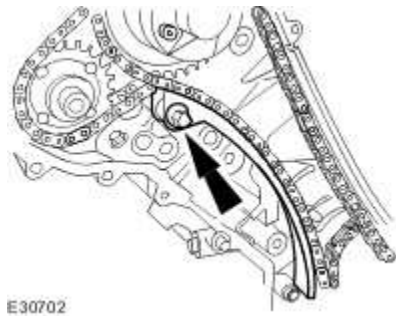
119 . Install the special tool to the right-hand cylinder head.



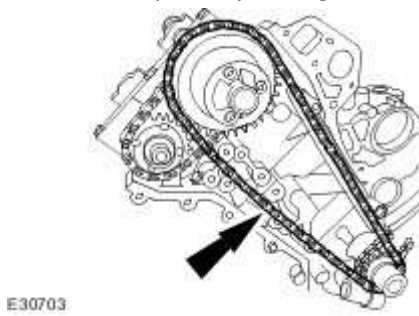
120 . Remove the primary timing chain tensioner assembly.



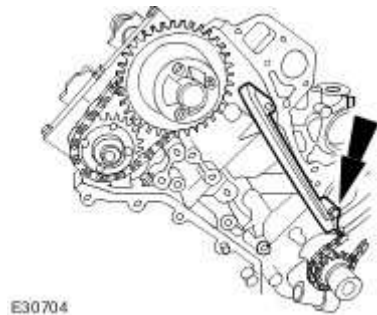
121 . Remove the primary timing chain tensioner guide.



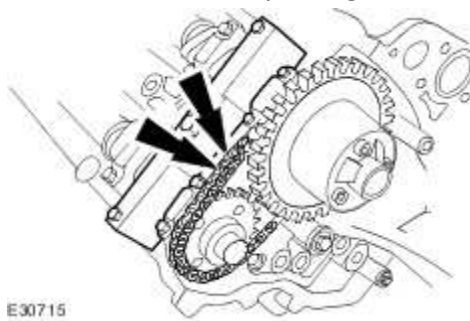
122 . Remove the primary timing chain.



123 . Remove the primary timing chain guide.

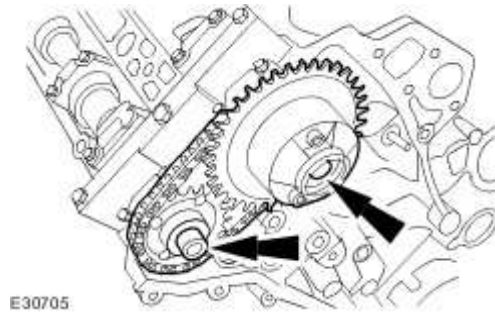


124 . Remove the secondary timing chain tensioner retaining bolts.

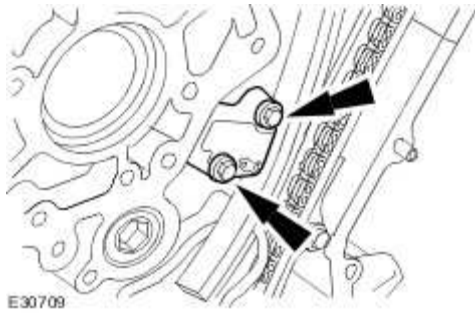


125 Remove the camshaft sprockets.

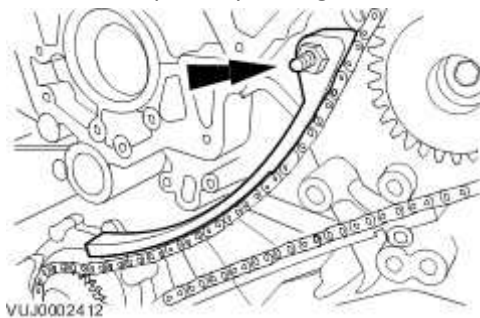
- Remove the secondary timing chain tensioner and secondary timing chain from the camshaft sprockets.



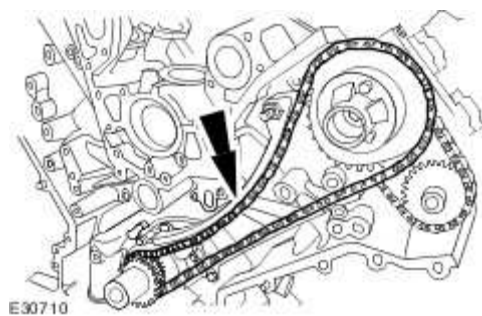
126 . Remove the primary timing chain tensioner assembly.



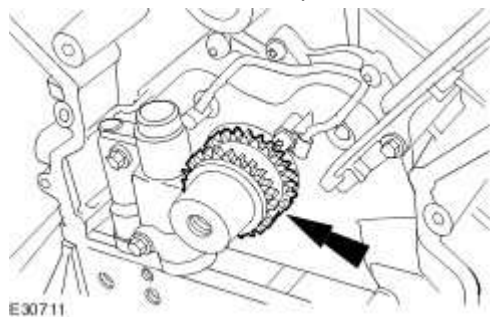
127 . Remove the primary timing chain tensioner guide.



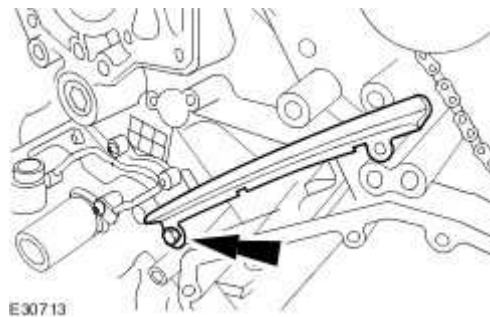
128 . Remove the primary timing chain.



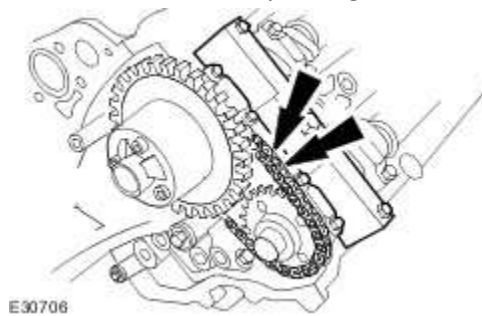
129 . Remove the crankshaft sprocket.



130 . Remove the primary timing chain tensioner guide.

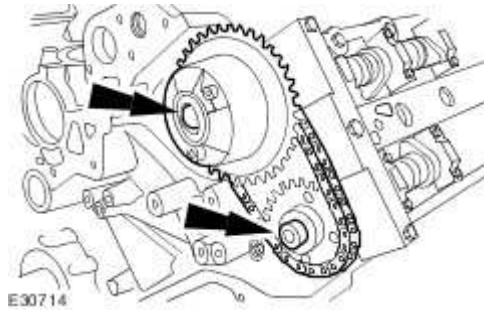


131 . Remove the secondary timing chain tensioner retaining bolts.

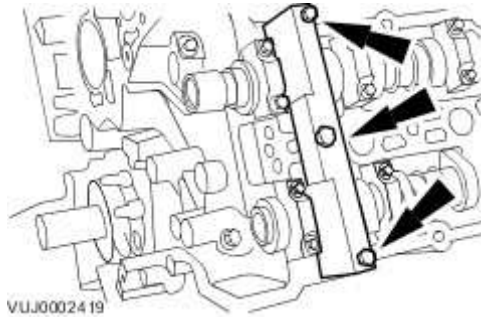


132 Remove the camshaft sprockets.

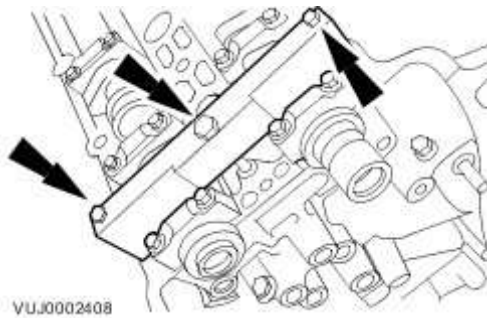
- Remove the secondary timing chain tensioner and secondary timing chain from the camshaft sprockets.



133 . Remove the camshaft setting tool.



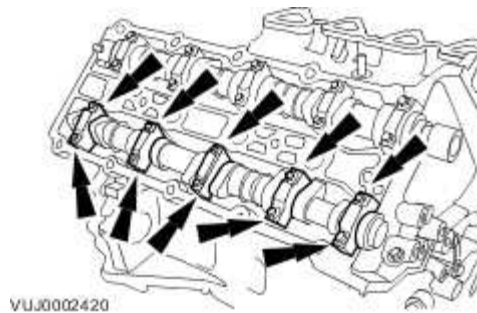
134 . Remove the camshaft setting tool.



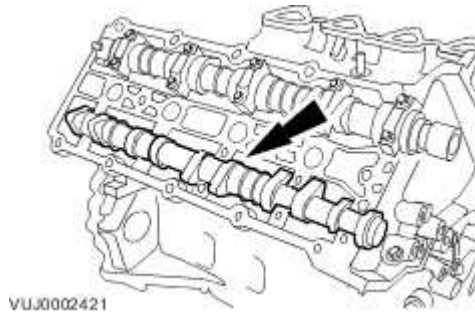
135 Remove the camshaft bearing caps.

- Remove the camshaft bearing cap retaining bolts evenly and in stages.
- Remove the camshaft bearing caps. Note their orientation and markings, each is

marked with its position (a number) and orientation (an arrow).

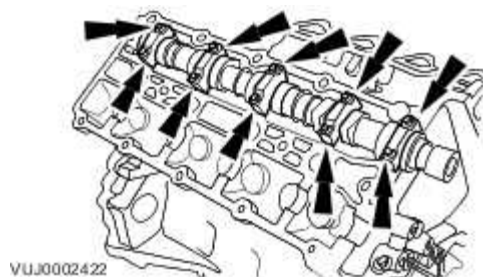


136 . Remove the right-hand exhaust camshaft.

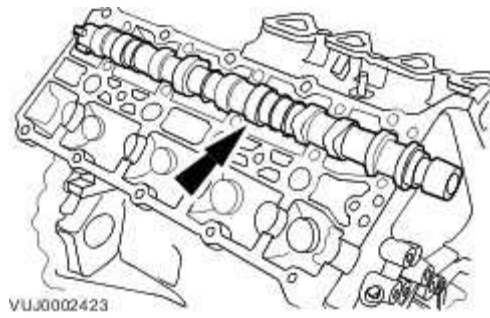


137 Remove the camshaft bearing caps.

- Remove the camshaft bearing cap retaining bolts evenly and in stages.
- Remove the camshaft bearing caps. Note their orientation and markings, each is marked with its position (a number) and orientation (an arrow).

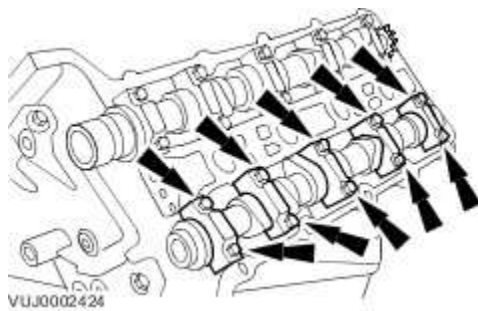


138 . Remove the right-hand intake camshaft.

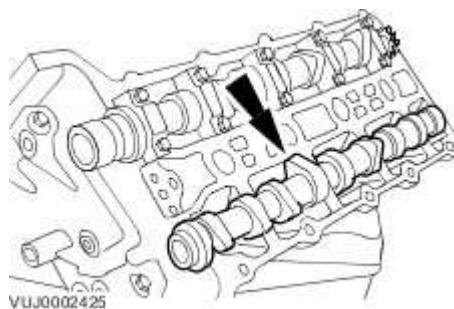


139 Remove the camshaft bearing caps.

- Remove the camshaft bearing cap retaining bolts evenly and in stages.
- Remove the camshaft bearing caps. Note their orientation and markings, each is marked with its position (a number) and orientation (an arrow).



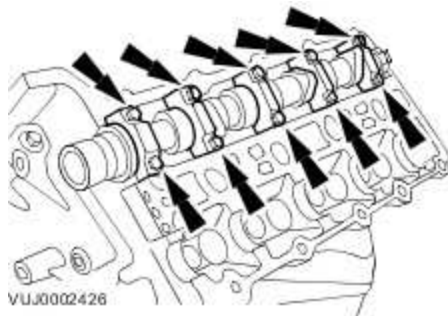
140 . Remove the left-hand exhaust camshaft.



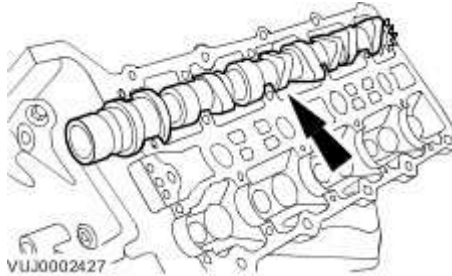
141 Remove the camshaft bearing caps.

- Remove the camshaft bearing cap retaining bolts evenly and in stages.
- Remove the camshaft bearing caps. Note their orientation and markings, each is

marked with its position (a number) and orientation (an arrow).



142 . Remove the left-hand inlet camshaft.



143



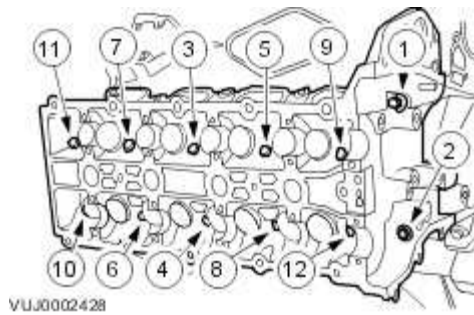
CAUTION: The bolts can only be used twice, mark the bolts with a center punch. If two punch marks are visible, discard the bolts.



CAUTION: 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.

Remove the right-hand cylinder head.

- Remove the bolts in the indicated sequence.
- Remove and discard the gasket.



144



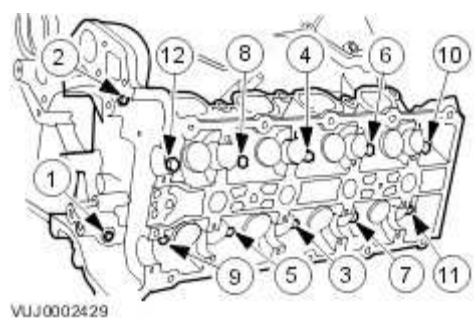
CAUTION: The bolts can only be used twice, mark the bolts with a center punch. If two punch marks are visible, discard the bolts.



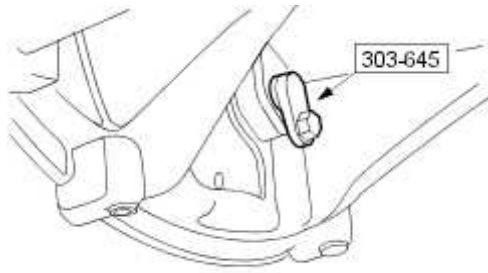
CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be removed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.

Remove the left-hand cylinder head.

- Remove the bolts in the indicated sequence.
- Remove and discard the gasket.



145 . Remove the crankshaft setting peg 303-645 from the crankshaft position sensor location.

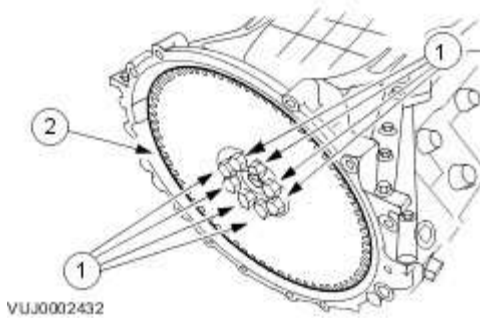


VUJ0002400

146 . Remove the flexplate.

6. Remove the flexplate retaining bolts.

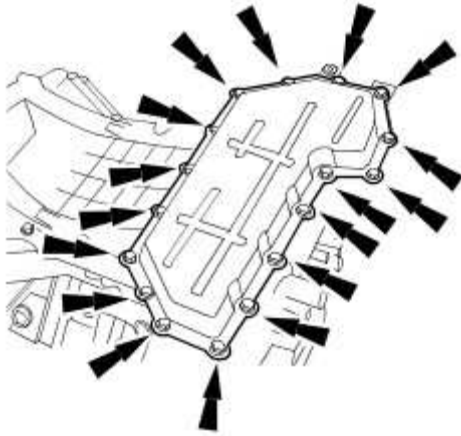
7. Remove the flexplate.



VUJ0002432

147 . Remove the lower oil pan.

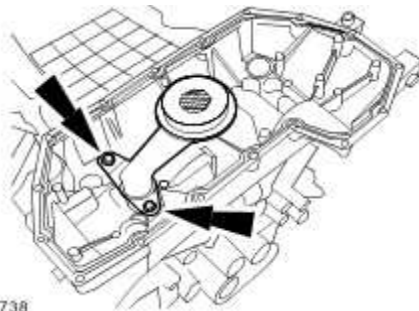
- Remove and discard the gasket.



VUJ0002433

148 . Remove the oil strainer.

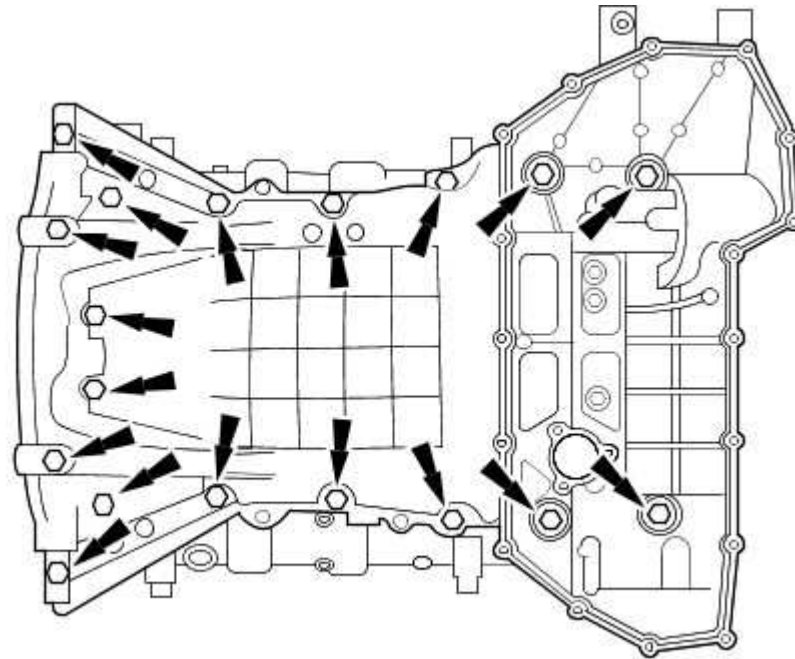
- Remove and discard the O-ring seal.



E30738

149 . Remove the upper oil pan.

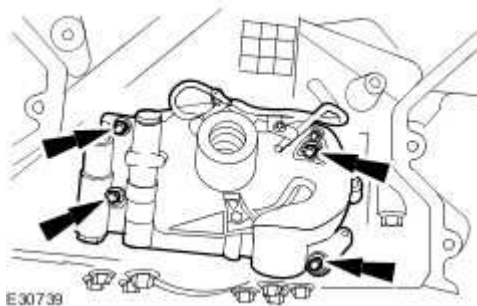
- Remove and discard the gasket.



VUJ0002435

150 . Remove the oil pump.

- Remove and discard the gasket.



E30739

151 Inspect the tops of the cylinder bores. As necessary remove ridge and carbon build up from each cylinder.

152 . Remove the piston cooling jets.

153



CAUTION: Pistons, connecting rods and connecting rod bearings should be

numbered to make sure they are reassembled in the same position.

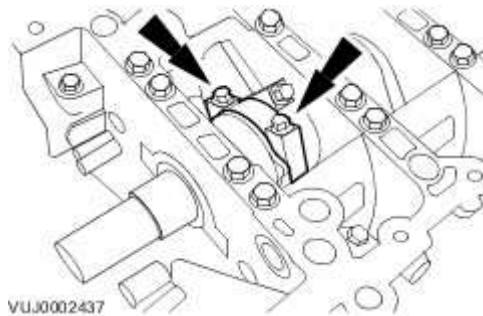
NOTE:

Mark the position of the connecting rod caps to the connecting rods to make sure of correct installation.

NOTE:

Discard the connecting rod bolts after removal.

Remove the connecting rod bolts, the connecting rod caps and the lower connecting rod bearings.

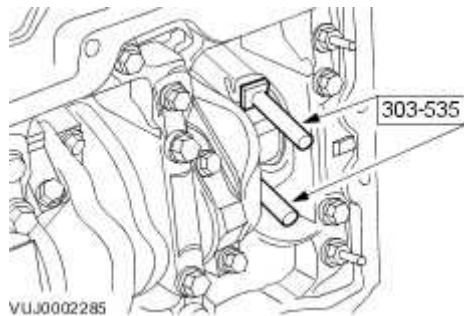


154



CAUTION: Use appropriate protection to prevent damage to the crankshaft bearing journals and cylinder bore surfaces.

Install special tools to the connecting rods.



155



CAUTION: Care should be taken not to damage the connecting rod and cap joint

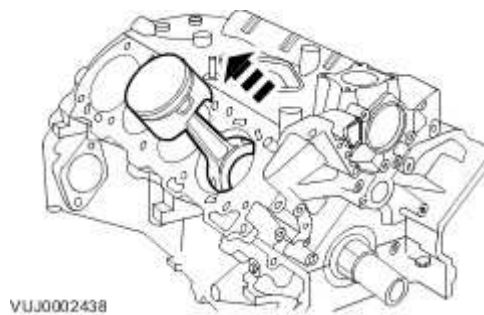
face surfaces or possible engine damage may occur. Avoid contaminating the fractured joint surfaces with dirt or grease.

NOTE:

Attach the connecting rods and caps after removal to avoid mismatch.

Remove the pistons.

- Rotate the crankshaft to locate pistons at the bottom of travel.
- Push the piston, connecting rod and upper bearing through the top of the cylinder.



156 . **NOTE:**

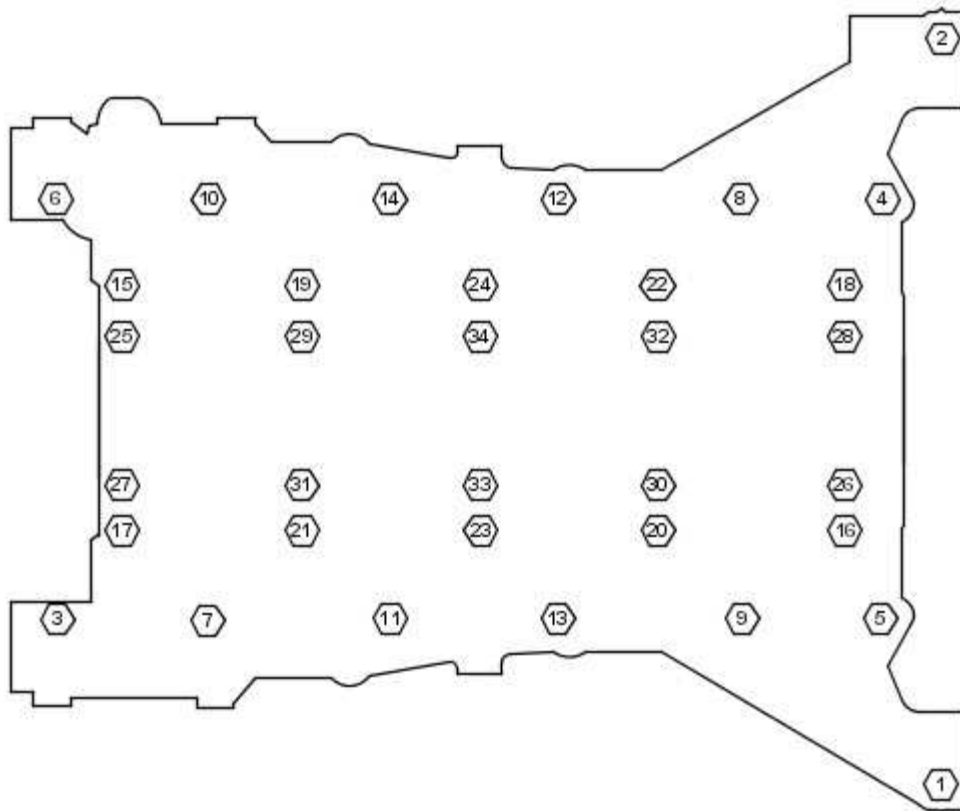
Remove the lower cylinder block bolts in the indicated sequence.

NOTE:

Mark the position of the upper and lower crankshaft main bearings for reassembly.

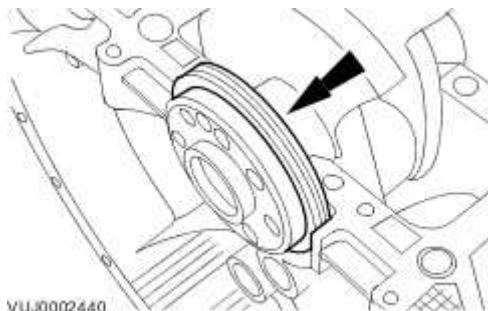
Remove the lower cylinder block.

- Remove the lower cylinder block retaining bolts in the indicated sequence.



VUJ0002439

157 . Discard the crankshaft rear main oil seal.



VUJ0002440

158

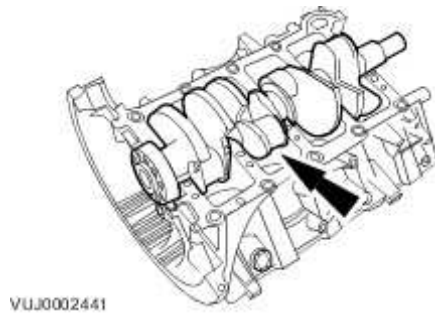


CAUTION: Avoid damage to any crankshaft bearing surfaces.

NOTE:

Never remove any pipe, plugs or dowels unless they are to be newly installed or the cylinder block is to be washed.

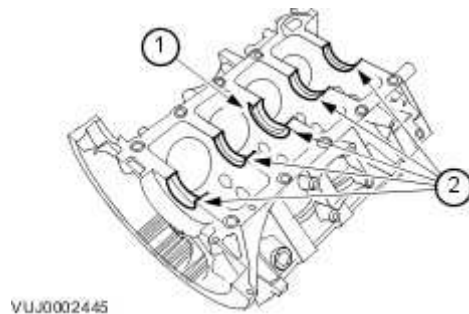
Remove the crankshaft.



159 . Remove the upper crankshaft main bearings.

8. Remove the upper crankshaft thrust washers.

9. Remove the upper crankshaft main bearings.



160 Clean the cylinder block with a soap and water solution. Dry the cylinder block completely with compressed air.

Cylinder Head (12.29.22)

Special Service Tools



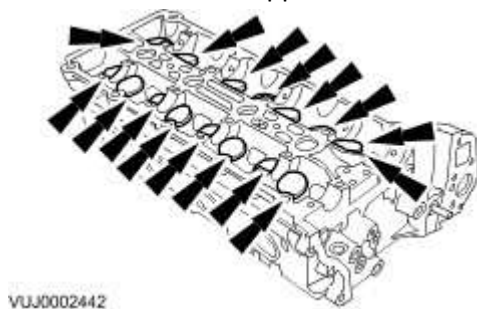
Valve Spring Compressor
303-252

Disassembly

- 1  **CAUTION:** Do not use a magnet to remove shims. Failure to follow these instructions may result in damage to the vehicle.

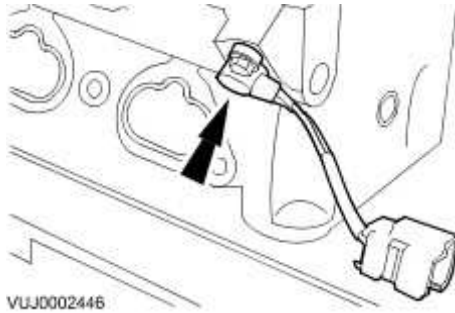
 **CAUTION:** If the cylinder head valve components are to be reused, mark the position of the valve components to make sure they are reassembled in the same position.

Remove the bucket tappet and shim assemblies.



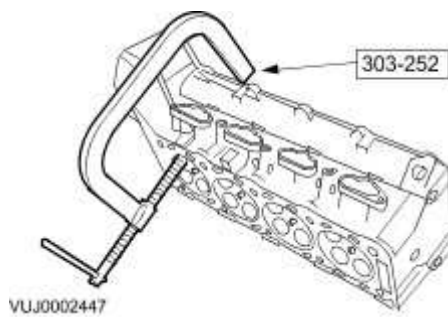
2 . Remove the camshaft position (CMP) sensor.

- Remove and discard the 'O' ring seal.



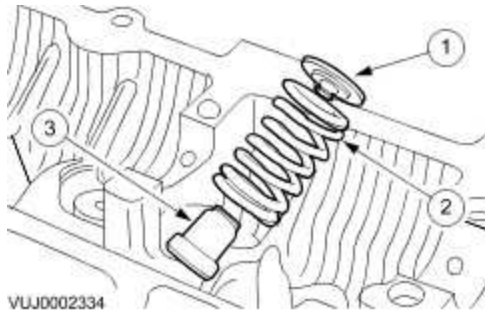
3 . Using the special tool, compress the valve springs.

- Remove the valve collets.



4 . Remove the valve spring retainers and valve springs.

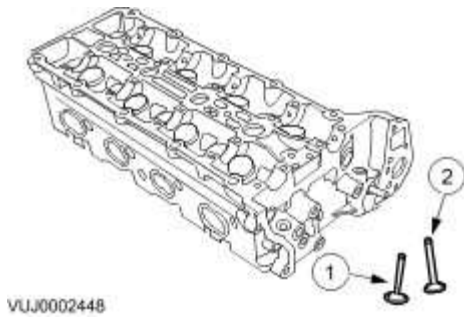
1. Remove the valve spring retainers.
2. Remove the valve springs.
3. Remove the valve stem oil seals.



5 . Remove the valves from the cylinder head.

4. Remove the intake valves.

5. Remove the exhaust valves.



6 Inspect the cylinder heads and related components. For additional information, refer to
 . <<303-00>>

7 . Remove the pipe plugs and alignment dowels as necessary to clean the cylinder heads.

Assembly

1  **WARNING:** Eye protection is required during use of compressed air. Failure to follow

these instructions may result in personal injury.



CAUTION: The cylinder head surface finish is measured in microns. For correct head gasket sealing, avoid any contact of finish with metallic objects.

Clean gasket material, dirt and foreign material from cylinder heads. Wash with a suitable soap and water solution and dry the cylinder head completely using compressed air if pipe plugs have been removed.

2 . Install the pipe plugs and alignment dowels to cylinder heads.

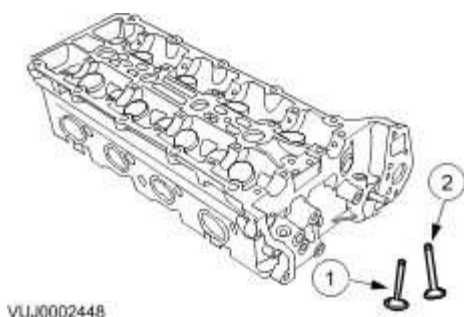
- Apply pipe sealant to plugs prior to installation.

3 . **NOTE:**

Lubricate the valve stems before assembly.

Install the valves into the cylinder heads.

6. Install the intake valves.
7. Install the exhaust valves.

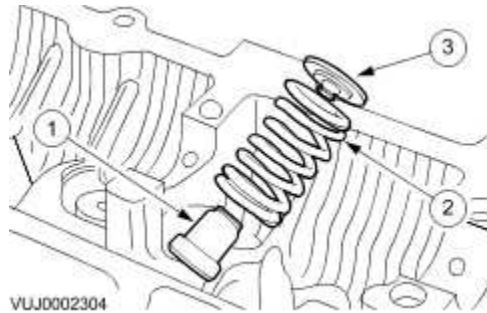


4 . Install the valve spring retainers and valve springs.

8. Install the valve stem oil seals.

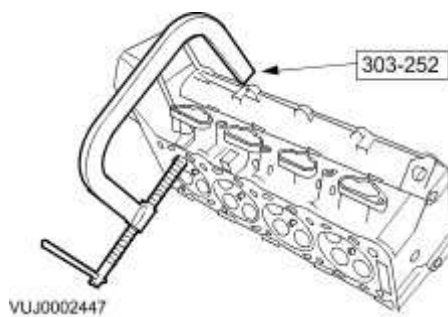
9. Install the valve springs.

10. Install the valve spring retainers.



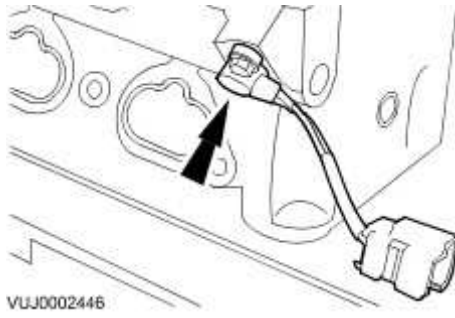
5 . Using the special tool, compress the valve springs.

- Install the valve collets.



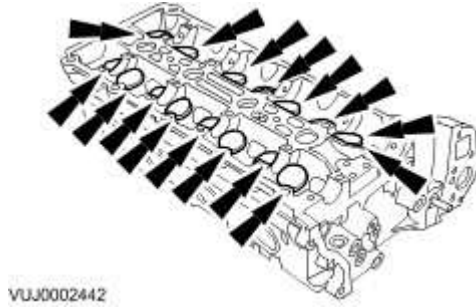
6 . Install the camshaft position (CMP) sensor.

- Install a new 'O' ring seal.
- Tighten to 7 Nm.



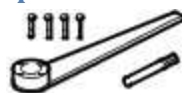
- 7
- 
CAUTION: Do not use a magnet to install shims. Failure to follow these instructions may result in damage to the vehicle.

Install the bucket tappet and shim assemblies.



Engine

Special Service Tools



303-191

Crankshaft locking, main tool

303-191



303-191-02

Adapter

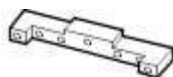
303-191-02



303-645

Crankshaft setting, main tool

303-645



303-530

Camshaft setting

303-530



303-532

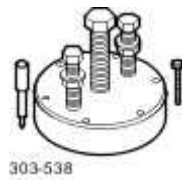
Timing chain tensioning tool
303-532



Cylinder Bore Protectors
303-535



Piston Ring Compressor
303-372



Crankshaft rear oil seal remover/replacer
303-538



Crankshaft front seal installer
303-538



303D055

Crankshaft damper holding tool
303-D055

Assembly

1



• **CAUTION:** Use only a plastic scraper when removing old gasket material.

Clean all the mating faces and reusable parts thoroughly and check for damage.

- If gasket material remains on the cylinder head after cleaning, use a plastic tipped scraper to remove remaining material.

2 . **NOTE:**

Never remove pipe plugs or alignment dowels unless they are to be serviced.

Reseal oil passage blanking plugs, as necessary.

3 . **NOTE:**

The main bearings are precision selective fit.

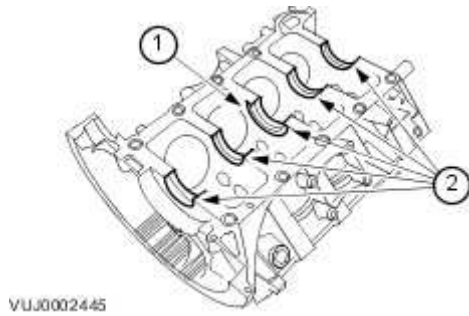
NOTE:

Lubricate the upper crankshaft main bearings and thrust washers.

Install the upper crankshaft main bearings.

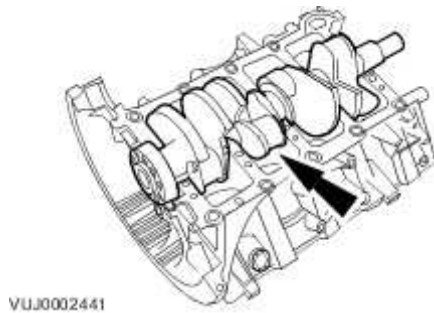
For additional information, refer to Camshaft Bearing Journal Clearance

1. Install the upper crankshaft thrust washers.
2. Install the upper crankshaft main bearings.



4.  **CAUTION:** Avoid damage to any crankshaft bearing surfaces.

Install the crankshaft.



5 **NOTE:**

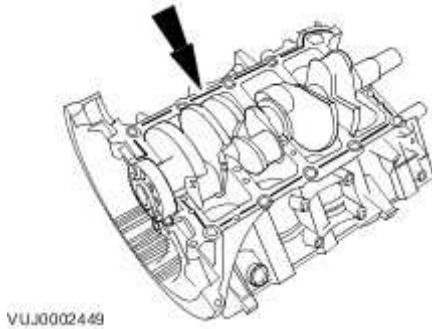
The main bearings are precision selective fit.

NOTE:

Install lower cylinder block and tighten bolts to specification within twenty minutes of applying sealer.

Apply a bead of sealant to the cylinder block housing.

- Use WSS-M4G320-A3-RTV sealant.



6



CAUTION: Make sure all dowels are fully seated into lower cylinder block prior to tightening the bolts.



CAUTION: Do not lubricate the lower cylinder block bolts.



CAUTION: Do not rotate crankshaft until all bolts are tightened to specification.



CAUTION: Bolts must be tightened within twenty minutes of applying sealer.

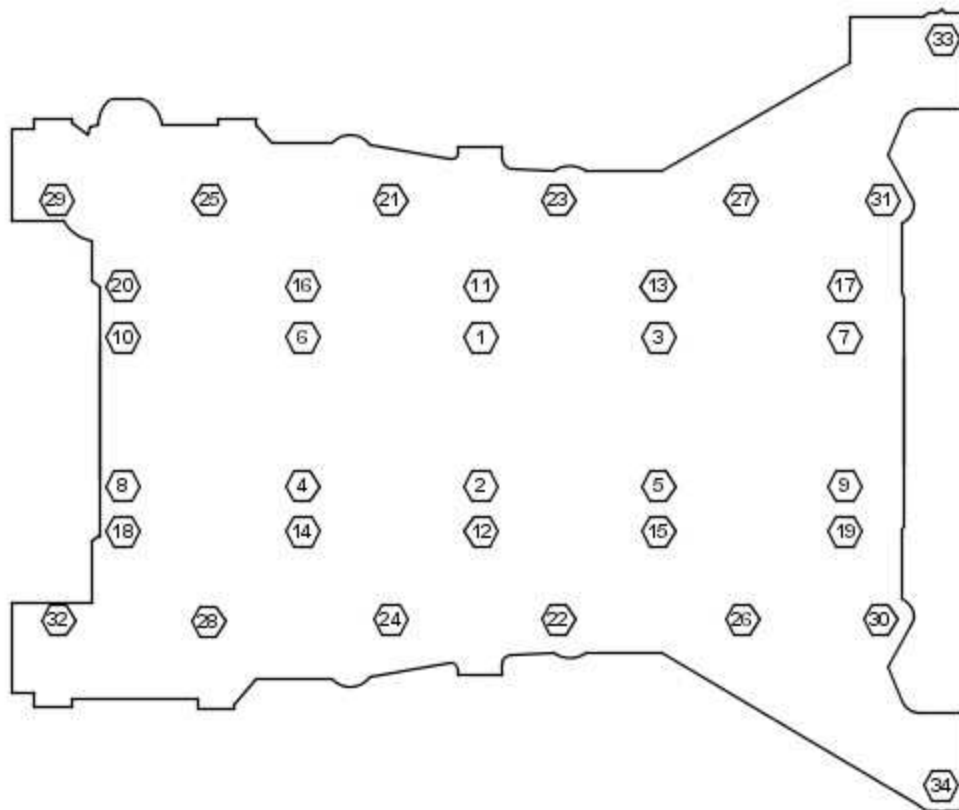


CAUTION: Tighten the bolts in the sequence shown.

Install the lower cylinder block to the upper cylinder block.

3. Tighten bolts 21 to 32 to 15 Nm
4. Tighten bolts 33 to 34 to 15 Nm
5. Tighten bolts 1 to 10 to 25 Nm

6. Tighten bolts 11 to 20 to 15 Nm
7. Tighten bolts 1 to 10 to 35 Nm +135°
8. Tighten bolts 11 to 20 to 20 Nm +150°
9. Tighten bolts 21 to 32 to 20 Nm +90°
10. Tighten bolts 33 to 34 to 20 Nm +150°



VUJ0002450

- 7 . Rotate the crankshaft to check correct operation.
- 8 . Remove excess sealant which may squeeze out at the front cover sealing surfaces.

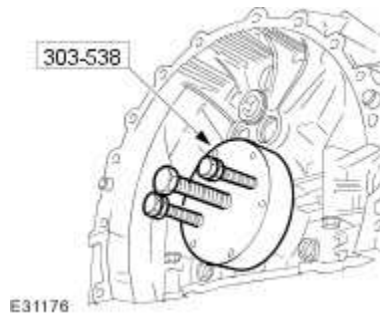
- 9 .  **CAUTION: Do not use any lubricant on the seal, the transit sleeve or the crankshaft.**

-  **CAUTION: Make sure all components are clean and dry.**

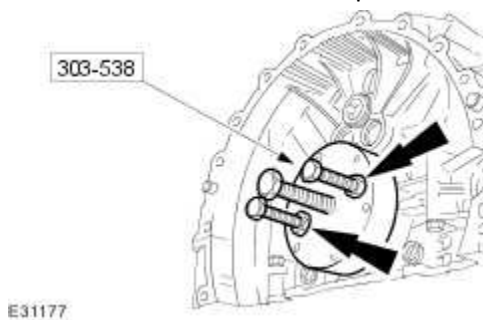
Make sure the transit sleeve is correctly in place and install the new seal over the crankshaft.

- 10 . Carefully remove the transit sleeve, leaving the seal in place.

- 11 . Install the special tool to the crankshaft.

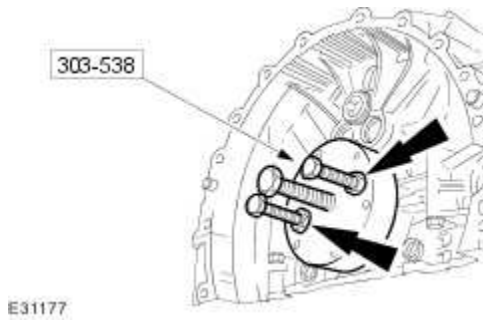


- 12 Reposition the nuts to hold the special tool against the crankshaft rear seal. Check that the
 . crankshaft rear seal and the special tool are parallel to the rear of the engine.



- 13 .  **CAUTION: Alternate nut tightening to correctly seat the crankshaft rear seal.**

Using the special tool, install the crankshaft rear seal.



14 . Remove the special tool from the crankshaft.

- Check that the seal is located correctly.

15



CAUTION: Use appropriate protection to prevent damage to the crankshaft bearing journals and cylinder bore surfaces.

Install special tools to the connecting rods.

- Position the crankshaft journal at the bottom of the stroke.

16



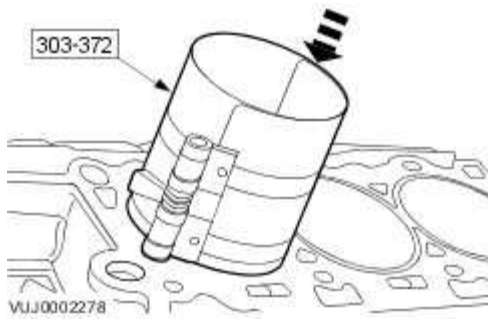
CAUTION: Make sure the piston rings are positioned at different positions opposite the thrust side of the piston before installation.



CAUTION: Install pistons with arrow to front of engine.

Using the special tool compress the rings and install the piston and connecting rod.

- Lubricate all piston components.



17



CAUTION: When assembling the connecting rods and connecting rod caps it is imperative that bearing slots and tangs be located on the same side of the connecting rods.



CAUTION: Connecting rod bolts are torqued to yield and must be replaced.



CAUTION: Bolts must be tightened equally.

NOTE:

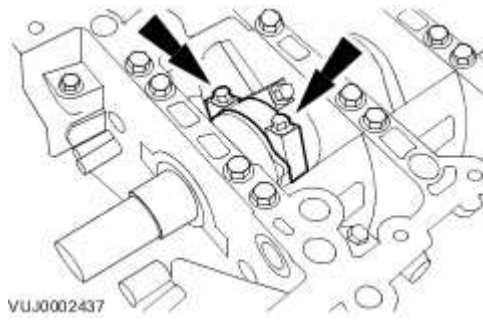
Remove the special tools from the connecting rods.

Position the connecting rod cap on the appropriate connecting rod.

11. Tighten to 10 Nm

12. Tighten to 30 Nm

13. Tighten to 90°



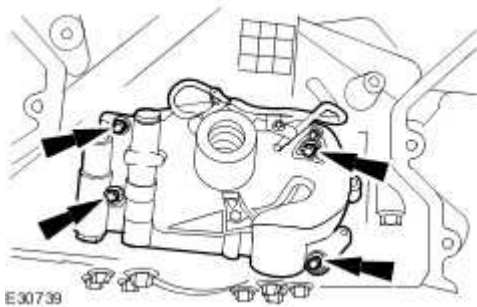
18 . Rotate the crankshaft to check correct operation.

19 . Install the piston cooling jets.

- Tighten to 9 Nm

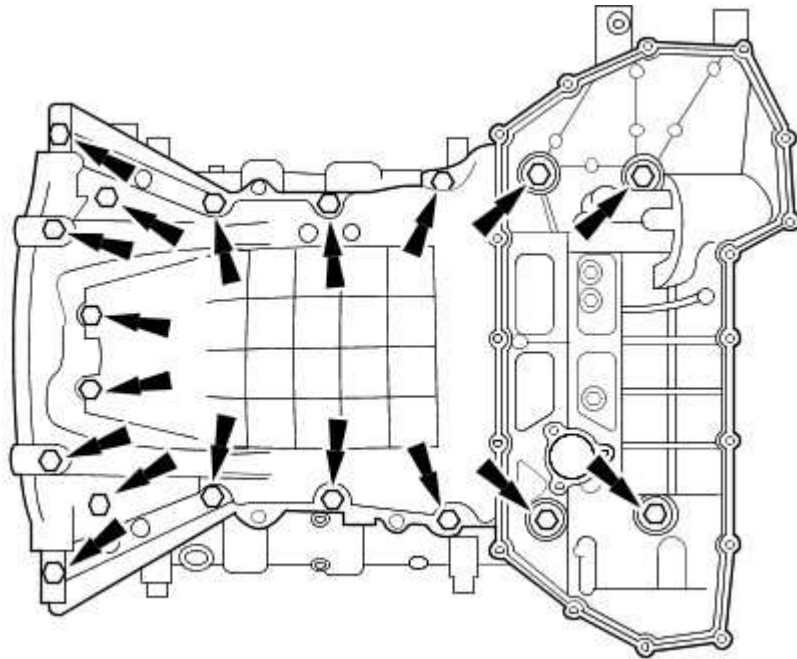
20 . Install the oil pump.

- Install a new gasket.
- Tighten to 12 Nm.



21 . Install the upper oil pan.

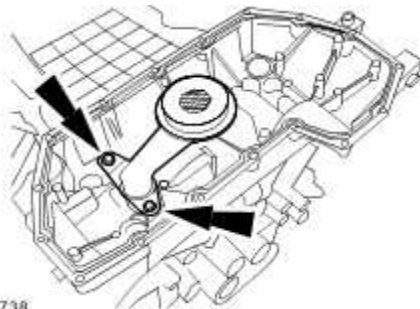
- Install a new gasket.
- Tighten to 21 Nm.



VUJ0002435

22 . Install the oil strainer.

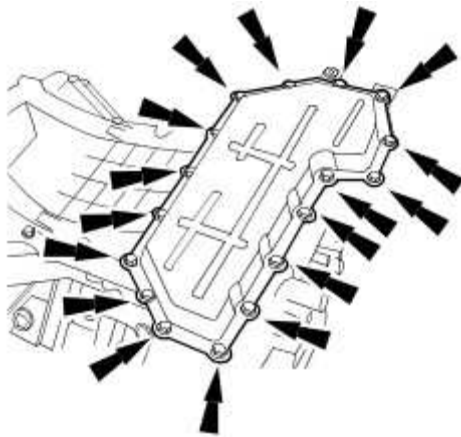
- Install a new O-ring seal.
- Tighten to 12 Nm.



E30738

23 . Install the oil pan.

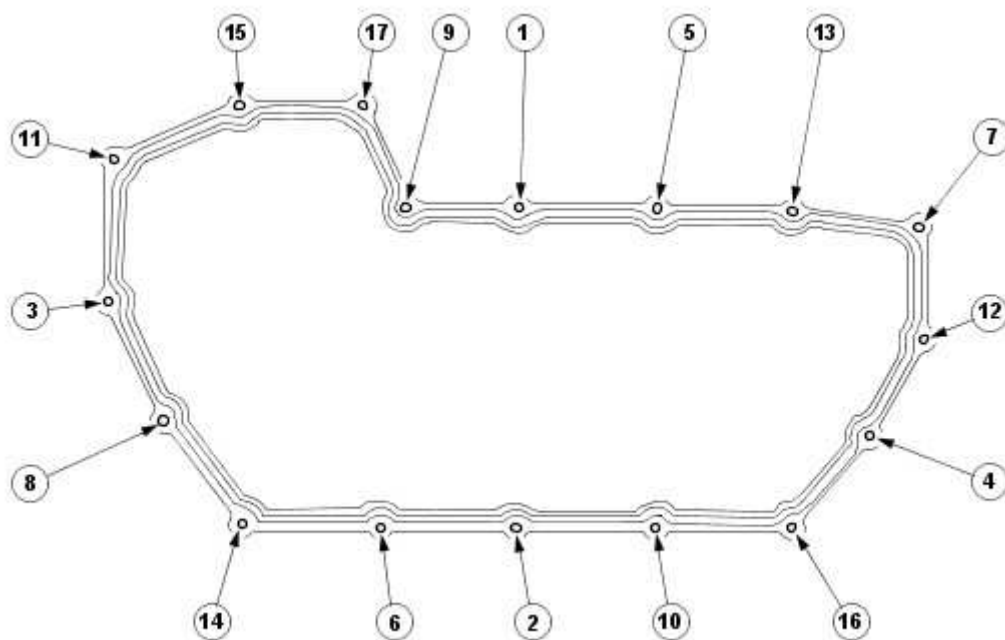
- Install a new gasket.
- Install, but do not fully tighten the retaining bolts.



VUJ0002433

24 Tighten to 12 Nm.

- Tighten in the sequence shown.
- A new oil pan is supplied with the drain plug installed. Check that the drain plug is tightened to 25 Nm.



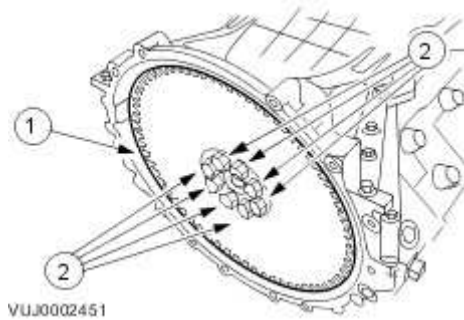
E36705

25 . Install the flexplate.

14. Install the flexplate.

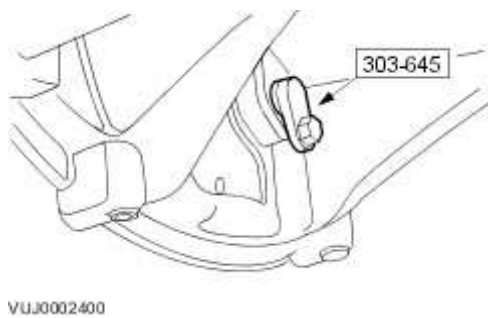
15. Install the flexplate retaining bolts.

- Tighten to 15 Nm.
- Tighten to 110 Nm.



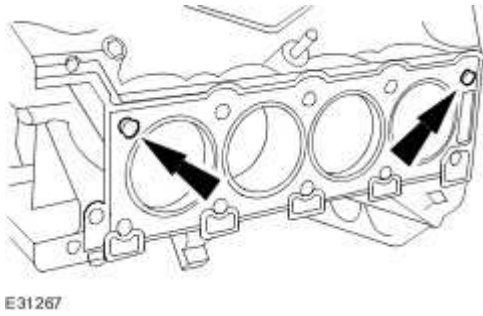
26 . Reposition the crankshaft.

- Install the crankshaft setting peg 303-645 to the crankshaft position sensor location.



27 . Install a new left-hand cylinder head gasket.

- Make sure the cylinder head dowels are correctly located.



28



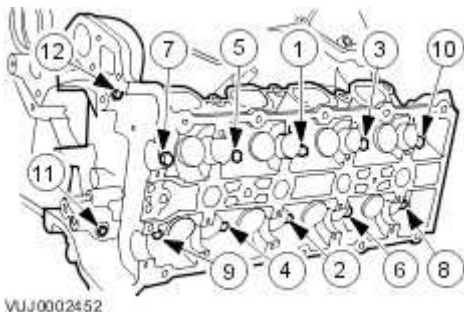
CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be installed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.



CAUTION: Tighten the bolts 1 to 10 in the sequence shown.

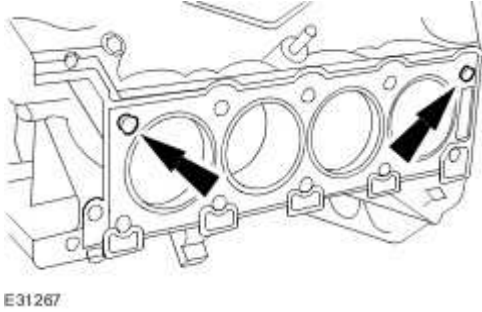
Install the left-hand cylinder head.

16. Tighten bolts 1 to 10 to 20 Nm.
17. Tighten bolts 1 to 10 to 35 Nm.
18. Tighten bolts 1 to 10 to 90°.
19. Tighten bolts 1 to 10 to 90°.
20. Tighten bolts 11 to 12 to 25 Nm.



29 . Install a new right-hand cylinder head gasket.

- Make sure the cylinder head dowels are correctly located.



30



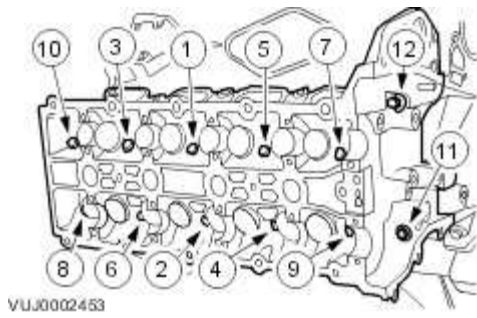
CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be installed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.



CAUTION: Tighten the bolts 1 to 10 in the sequence shown.

Install the right-hand cylinder head.

21. Tighten bolts 1 to 10 to 20 Nm.
22. Tighten bolts 1 to 10 to 35 Nm.
23. Tighten bolts 1 to 10 to 90°.
24. Tighten bolts 1 to 10 to 90°.
25. Tighten bolts 11 to 12 to 25 Nm.

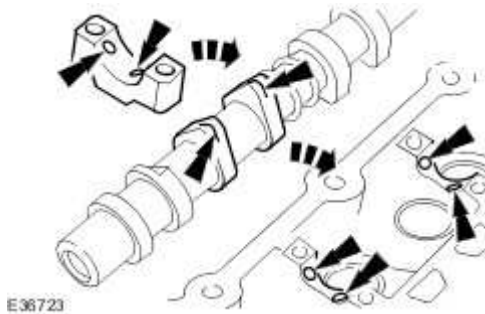


31 . NOTE:

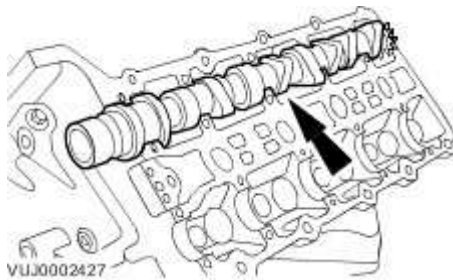
Make sure all components are clean.

Apply oil (EP-90) to the camshaft and bearing surfaces, as follows:

- To the upper face of each bearing surface in the cylinder head.
- To the upper face of each bearing surface in each bearing cap.
- On the cam lobes ONLY, not on the base circle area.



32 . Install the left-hand inlet camshaft.



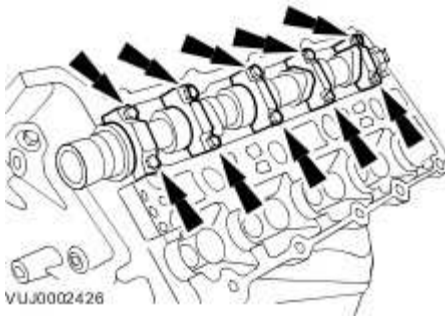
33 .



CAUTION: Alternate bolt tightening to correctly seat the camshaft bearing caps.

Install the camshaft bearing cap bolts evenly.

- Tighten to 10 Nm.

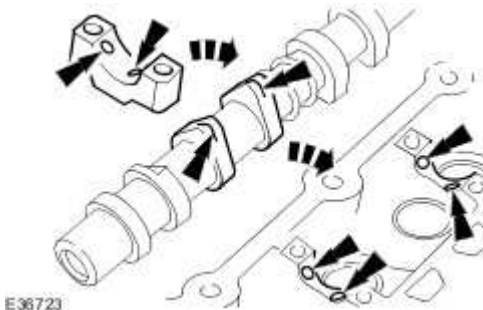


34 . **NOTE:**

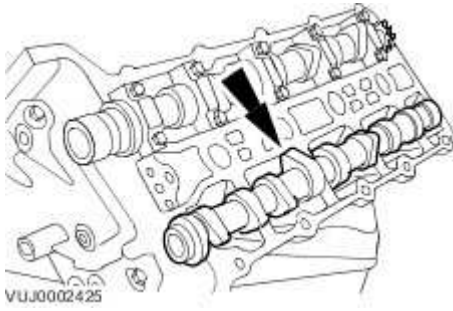
Make sure all components are clean.

Apply oil (EP-90) to the camshaft and bearing surfaces, as follows:

- To the upper face of each bearing surface in the cylinder head.
- To the upper face of each bearing surface in each bearing cap.
- On the cam lobes ONLY, not on the base circle area.



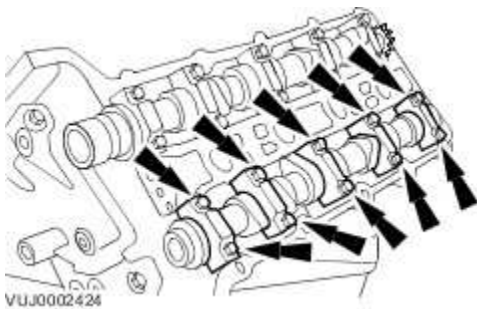
35 . Install the left-hand exhaust camshaft.



- 36 .  **CAUTION:** Alternate bolt tightening to correctly seat the camshaft bearing caps.

Install the camshaft bearing cap bolts evenly.

- Tighten to 10 Nm.

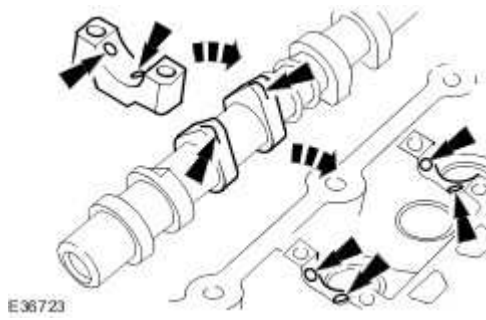


37 . **NOTE:**

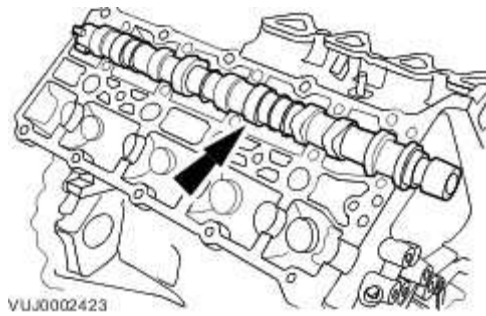
Make sure all components are clean.

Apply oil (EP-90) to the camshaft and bearing surfaces, as follows:

- To the upper face of each bearing surface in the cylinder head.
- To the upper face of each bearing surface in each bearing cap.
- On the cam lobes **ONLY**, not on the base circle area.



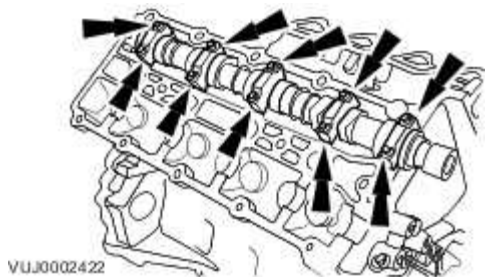
38 . Install the right-hand inlet camshaft.



39 .  **CAUTION:** Alternate bolt tightening to correctly seat the camshaft bearing caps.

Install the camshaft bearing cap bolts evenly.

- Tighten to 10 Nm.

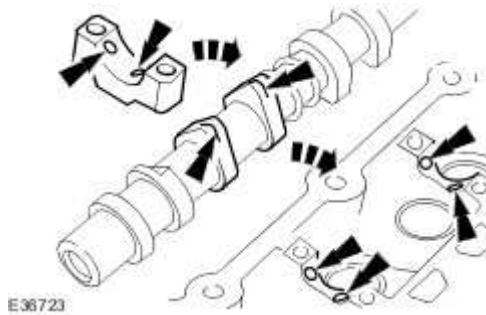


40 . **NOTE:**

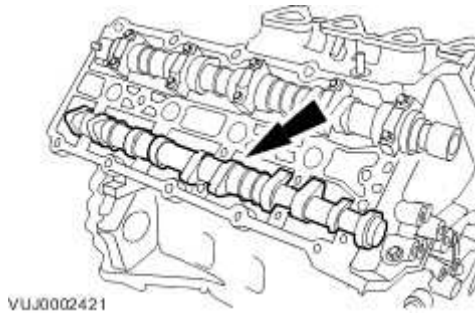
Make sure all components are clean.

Apply oil (EP-90) to the camshaft and bearing surfaces, as follows:

- To the upper face of each bearing surface in the cylinder head.
- To the upper face of each bearing surface in each bearing cap.
- On the cam lobes ONLY, not on the base circle area.



41 . Install the right-hand exhaust camshaft.



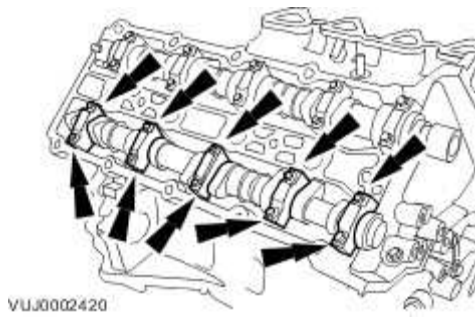
42 .



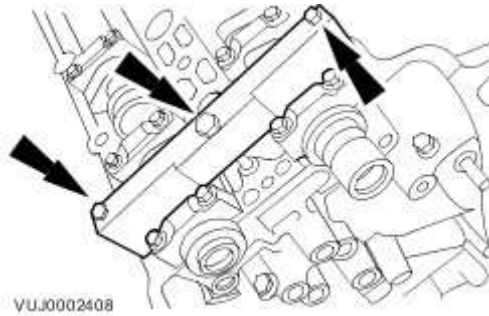
CAUTION: Alternate bolt tightening to correctly seat the camshaft bearing caps.

Install the camshaft bearing cap bolts evenly.

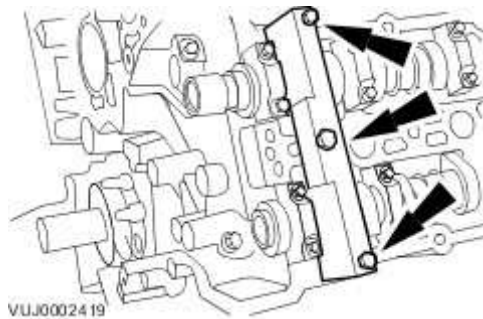
- Tighten to 10 Nm.



43 . Install the camshaft setting tool.



44 . Install the camshaft setting tool.



45



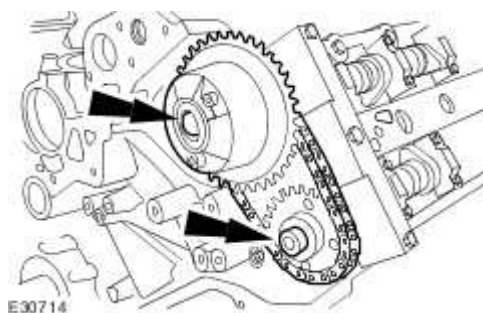
CAUTION: Do not tighten the camshaft sprocket retaining bolts.



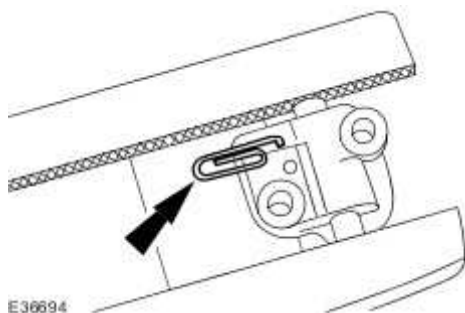
CAUTION: Make sure the secondary timing chain and camshaft sprockets are free to rotate.

Install the camshaft sprockets.

- Install the secondary timing chain tensioner and secondary timing chain to the camshaft sprockets.



46 . Using a suitable tool, retain the left-hand timing chain tensioner piston.

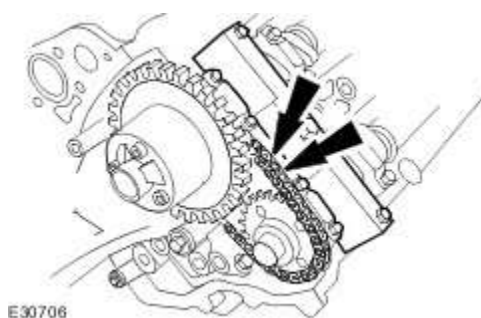


47 . Release the tension in the left-hand timing chain tensioner.

- Remove the retaining tool.

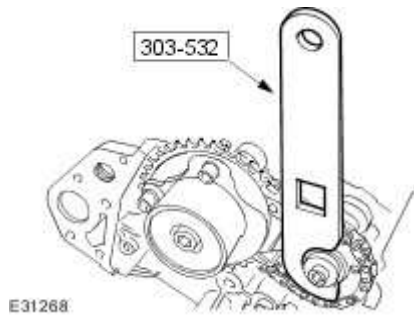
48 . Install the secondary timing chain tensioner.

- Tighten to 12 Nm.



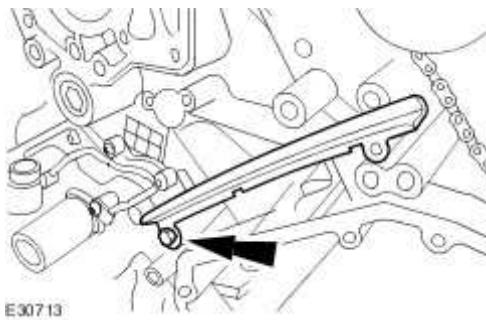
49 Install the timing chain tensioning tool 303-532 to the exhaust camshaft sprocket.

- Reposition the camshaft sprockets for the most advantageous position for use of the tool.

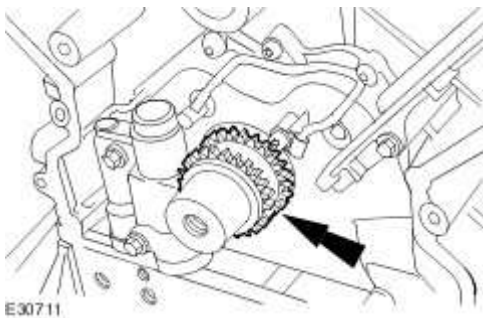


50 . Install the primary timing chain tensioner guide.

- Tighten to 12 Nm.



51 . Install the crankshaft sprocket.



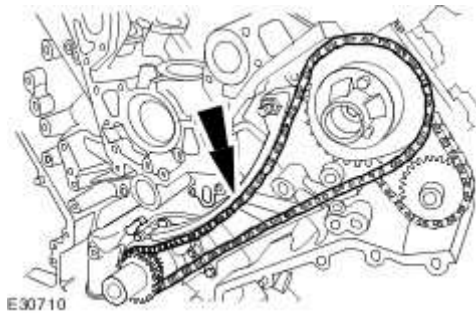
52



CAUTION: Make sure the timing chain slack is on the tensioned side of the timing chain.

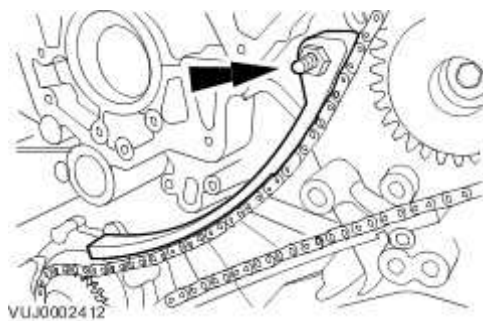
Install the primary timing chain.

- Install the primary chain over the crankshaft sprocket and the intake sprocket.



53 . Install the primary timing chain tensioner guide.

- Tighten to 12 Nm.

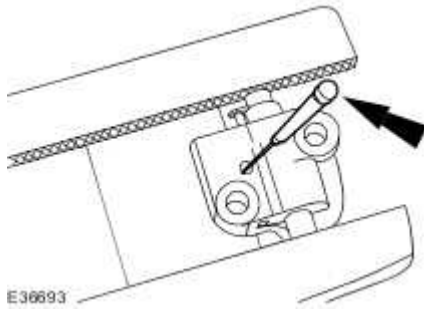


54



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.

Using a suitable tool, hold the left-hand timing chain tensioner ratchet lock mechanism away from the ratchet stem.



55 NOTE:

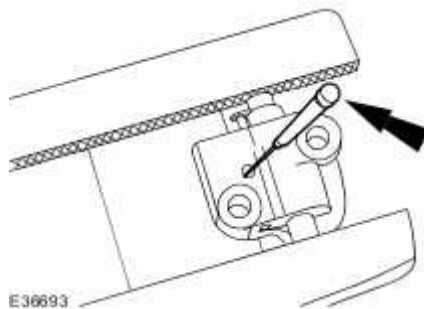
The timing chain tensioner piston should retract with minimal force. If binding occurs, reposition the timing chain tensioner to eliminate side loading.

Slowly compress the left-hand timing chain tensioner.

56 NOTE:

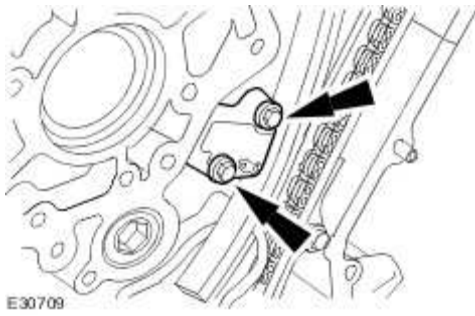
The retaining tool must remain in the timing chain tensioner until the timing chain tensioner is installed to the engine with the piston bottomed in the bore.

Using a suitable tool, retain the left-hand timing chain tensioner piston.



57 . Install the primary timing chain tensioner assembly.

- Tighten to 12 Nm.



58 . Release the tension in the left-hand timing chain tensioner.

- Remove the retaining tool.

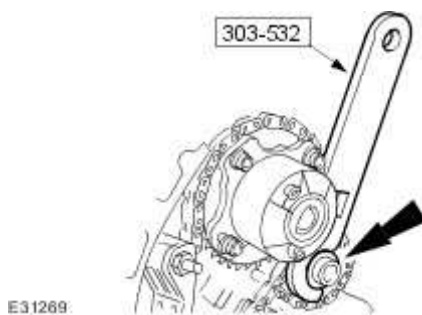
59



CAUTION: While applying the opposing force to sprocket and chain, tighten the sprocket bolt.

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

- Tighten to 20 Nm + 90 deg.



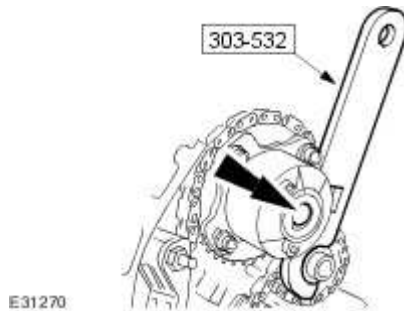
60



CAUTION: While applying the opposing force to sprocket and chain, tighten the sprocket bolt.

Using the special tool apply force to the tool in an anti-clockwise direction.

- Tighten to 20 Nm + 90 deg.



61



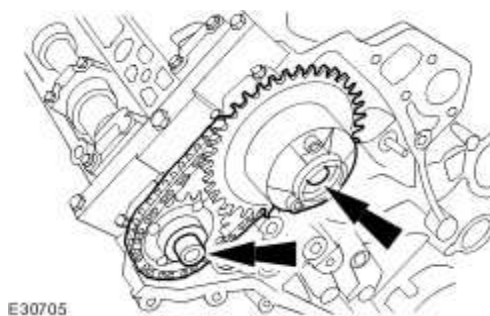
CAUTION: Do not tighten the camshaft sprocket retaining bolts.



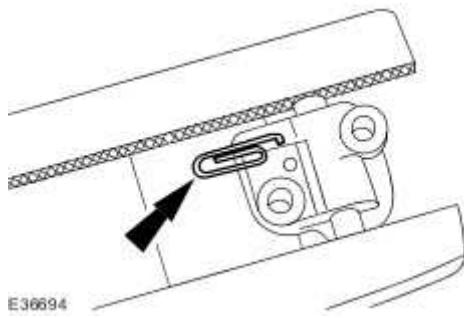
CAUTION: Make sure the secondary timing chain and camshaft sprockets are free to rotate.

Install the camshaft sprockets.

- Install the secondary timing chain tensioner and secondary timing chain to the camshaft sprockets.

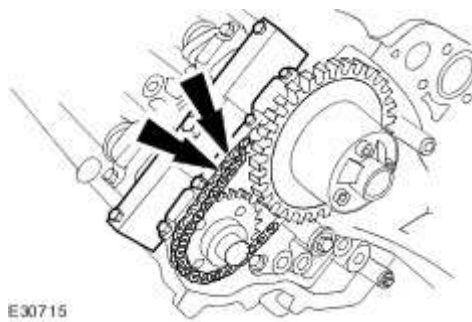


62 . Using a suitable tool, retain the right-hand timing chain tensioner piston.



63 . Install the secondary timing chain tensioner retaining bolts.

- Tighten to 12 Nm.

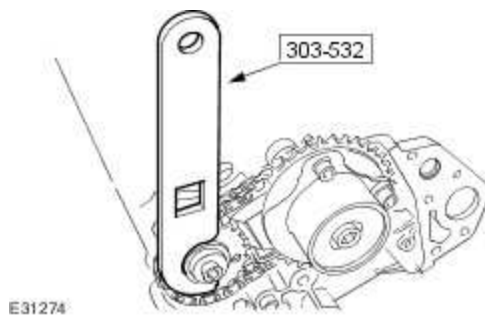


64 . Release the tension in the right-hand timing chain tensioner.

- Remove the retaining tool.

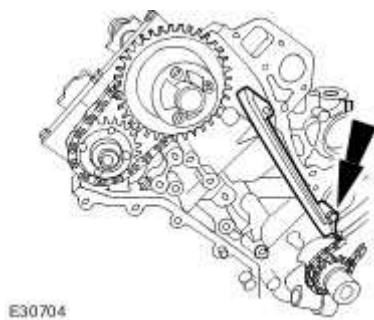
65 Install the timing chain tensioning tool 303-532 to the exhaust camshaft sprocket.

- Reposition the camshaft sprockets for the most advantageous position for use of the tool.



66 . Install the primary timing chain guide.

- Tighten to 12 Nm.



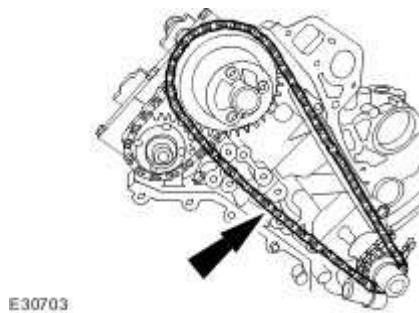
67



CAUTION: Make sure the timing chain slack is on the tensioned side of the timing chain.

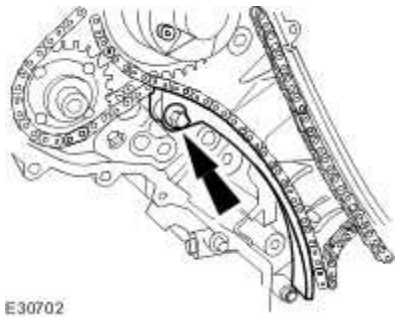
Install the primary timing chain.

- Install the primary chain over the crankshaft sprocket and the intake sprocket.



68 . Install the primary timing chain tensioner guide.

- Tighten to 12 Nm.

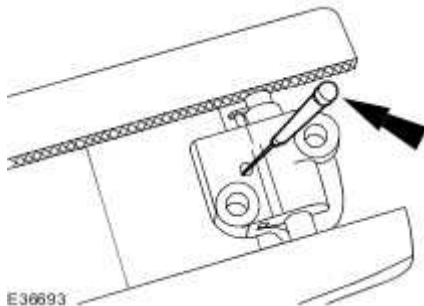


69



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.

Using a suitable tool, hold the right-hand timing chain tensioner ratchet lock mechanism away from the ratchet stem.



70 **NOTE:**

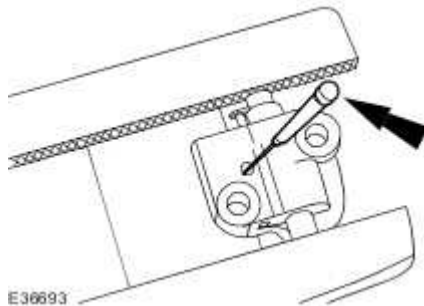
The timing chain tensioner piston should retract with minimal force. If binding occurs, reposition the timing chain tensioner to eliminate side loading.

Slowly compress the right-hand timing chain tensioner.

71 **NOTE:**

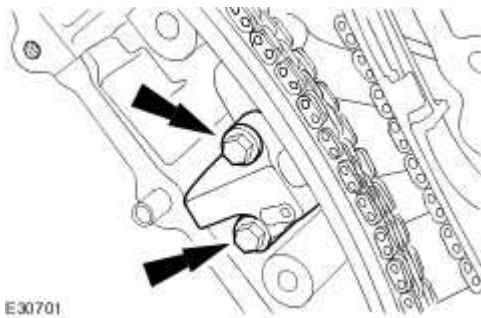
The retaining tool must remain in the timing chain tensioner until the timing chain tensioner is installed to the engine with the piston bottomed in the bore.

Using a suitable tool, retain the right-hand timing chain tensioner piston.



72 . Install the primary timing chain tensioner assembly.

- Tighten to 12 Nm.



73 . Release the tension in the right-hand timing chain tensioner.

- Remove the retaining tool.

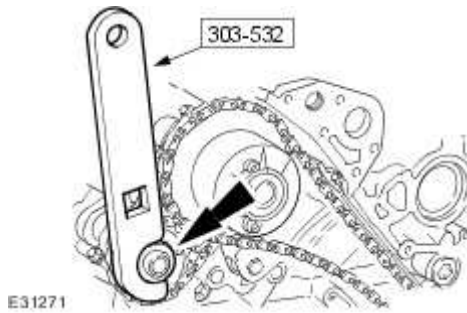
74



- **CAUTION:** While applying the opposing force to sprocket and chain, tighten the sprocket bolt.

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

- Tighten to 20 Nm + 90 deg.



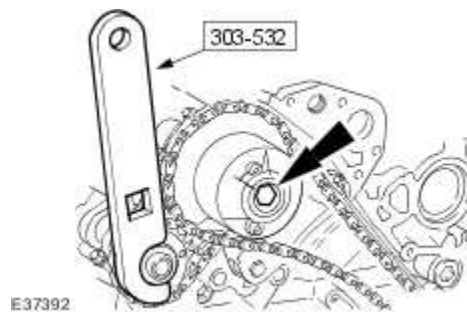
75



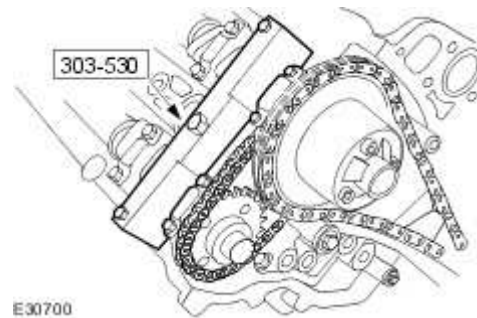
CAUTION: While applying the opposing force to sprocket and chain, tighten the sprocket bolt.

Using the special tool apply force to the tool in an anti-clockwise direction.

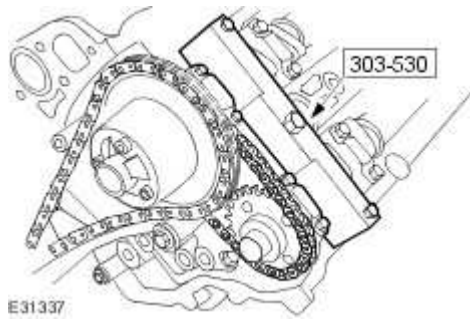
- Tighten to 20 Nm + 90 deg.



76 . Remove the special tool from the right-hand cylinder head.

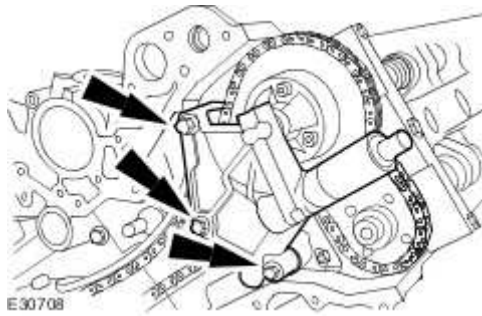


77 . Remove the special tool from the left-hand cylinder head.



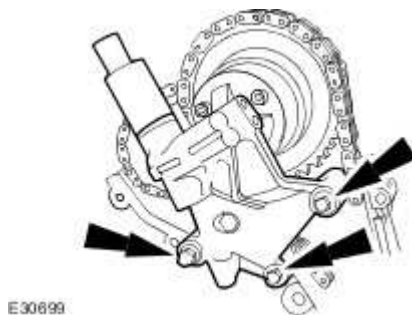
78 . Install the left-hand variable camshaft timing oil control unit housing.

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

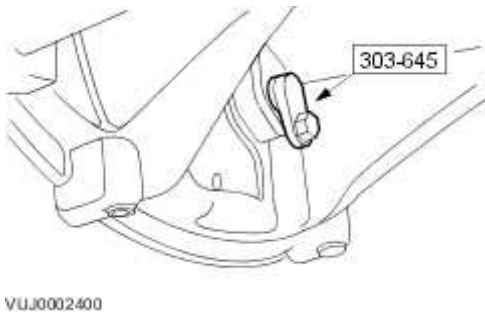


79 . Install the right-hand variable camshaft timing oil control unit housing.

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

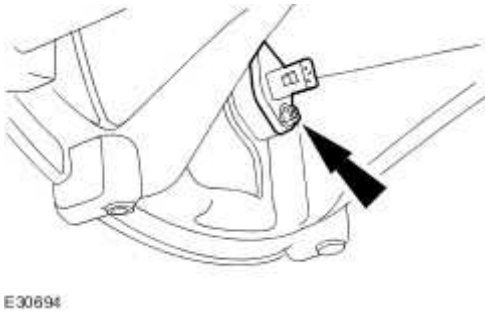


80 . Remove the special tool.



81 . Install the crankshaft position sensor.

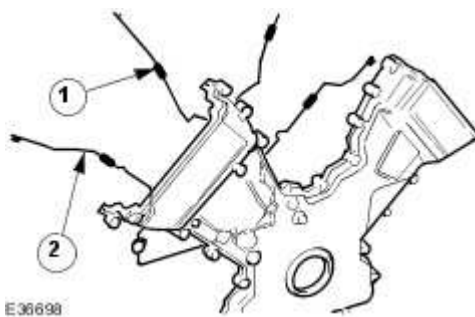
- Tighten to 10 Nm.



82 . Install new seals to the timing cover.

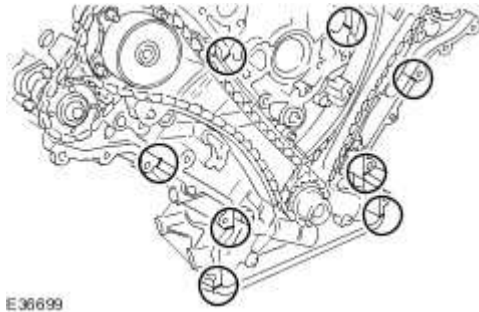
26. Install the new seal to the inner groove on the face of the timing cover.

27. Install the new seal to the outer groove on the face of the timing cover.



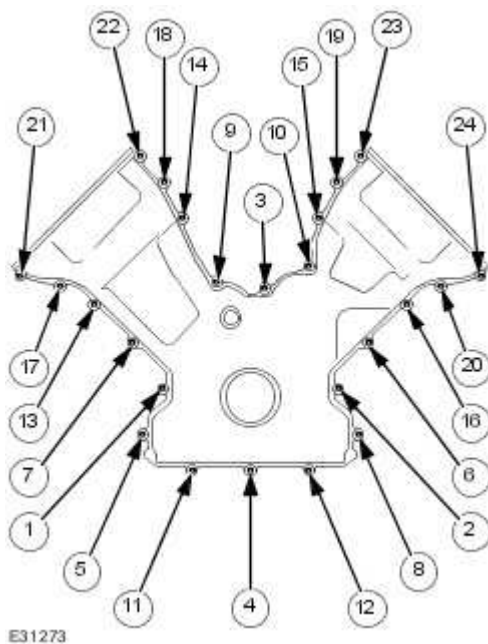
83 Apply sealant to the eight joints on the engine face.

- Sealant beads to be 3mm diameter and 12mm long. Cut the nozzle of the sealant tube to produce a 3 mm bead. (Install and tighten the securing bolts within twenty minutes of sealant application).



84 . Install the timing cover.

- Tighten in the sequence shown.
- Tighten to 13 Nm.



85 .

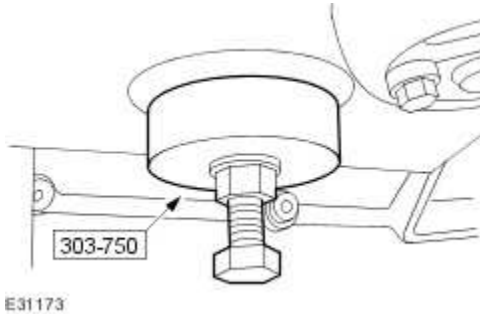


CAUTION: Make sure the crankshaft front seal mating faces are clean and dry.

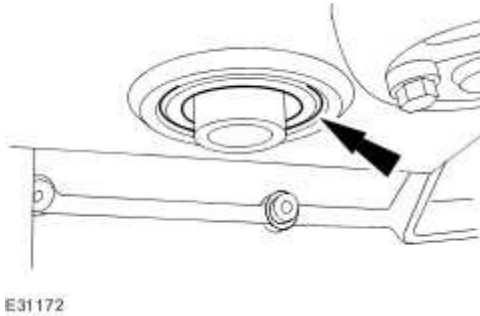


CAUTION: Do not remove the crankshaft front seal protector.

Using the special tool, install a new crankshaft front seal.



86 . Remove the crankshaft seal protector.



87 . Install a new O-ring seal to the crankshaft pulley.

- Lubricate the new O-ring.

88



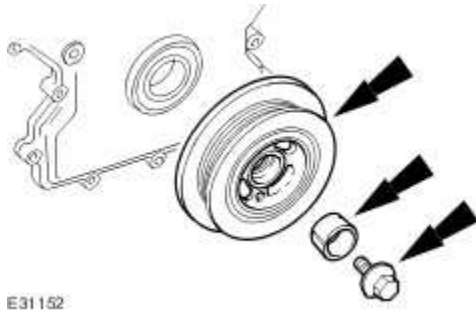
CAUTION: The screw thread in the crankshaft must be cleaned out before a new crankshaft pulley bolt is installed.



CAUTION: A new crankshaft pulley bolt must be used.

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

- Install the crankshaft pulley and locking ring to the crankshaft.



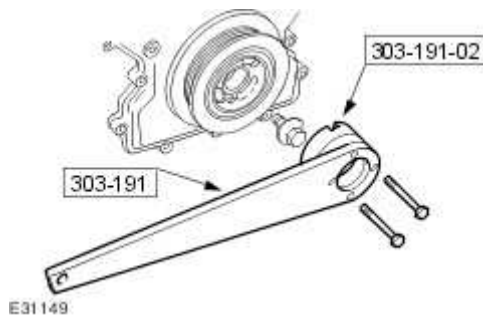
89



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

Using special tools, retain the crankshaft pulley.

- Tighten the crankshaft pulley retaining bolt to 375 Nm.



90 . Remove the special tools.

91 . Carry out a valve clearance check.

For additional information, refer to Valve Clearance Check (12.29.47)

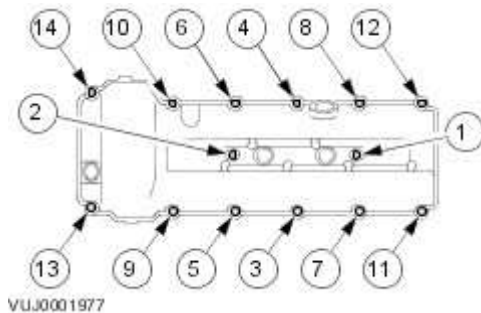
92 **NOTE:**

Apply an 8mm diameter bead of silicone gasket sealant on the two places where the

cylinder head and front cover join.

Install the left-hand valve cover.

- Install new valve cover gaskets.
- Tighten in the sequence shown.
- Tighten to 10 Nm.

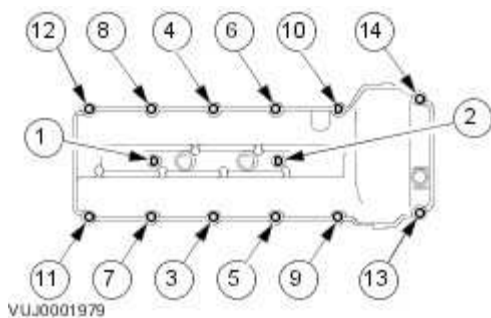


93 **NOTE:**

Apply an 8mm diameter bead of silicone gasket sealant on the two places where the cylinder head and front cover join.

Install the right-hand valve cover.

- Install new valve cover gaskets.
- Tighten in the sequence shown.
- Tighten to 10 Nm.

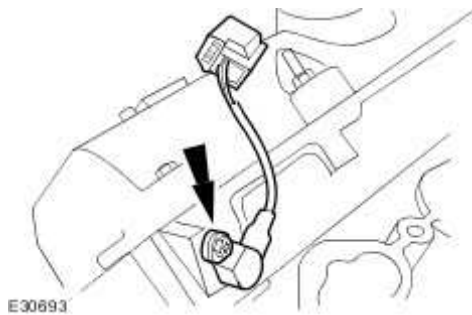


94 . Install the spark plugs.

- Tighten to 27 Nm.

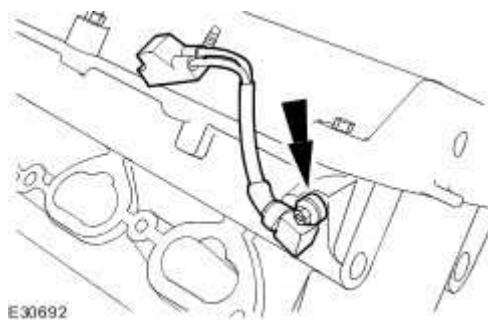
95 . Install the left-hand camshaft position (CMP) sensor.

- Install a new O-ring seal.
- Tighten to 7 Nm.



96 . Install the right-hand camshaft position (CMP) sensor.

- Install a new O-ring seal.
- Tighten to 7 Nm.

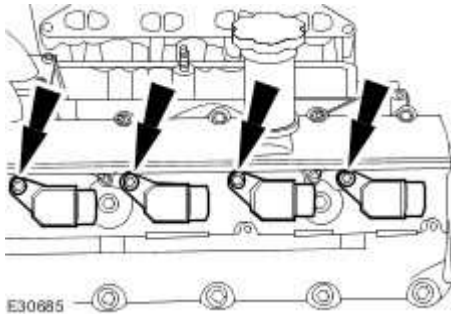


97 . **NOTE:**

Left-hand shown, right-hand similar

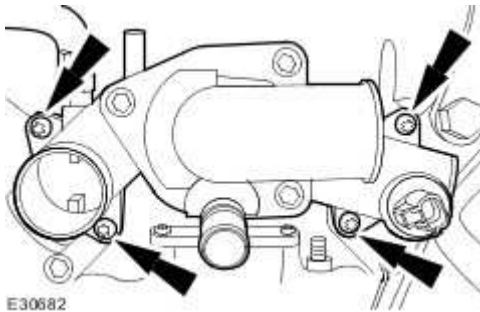
Install the ignition coils.

- Tighten to 5 Nm.



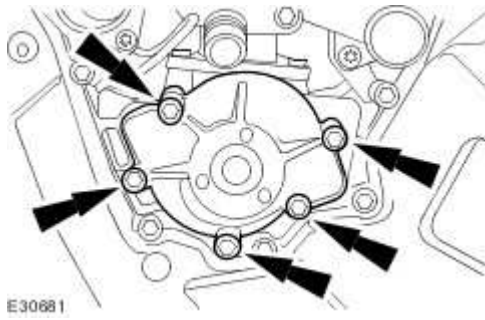
98 . Install the thermostat housing.

- Install new O-ring seals.
- Tighten to 10 Nm.



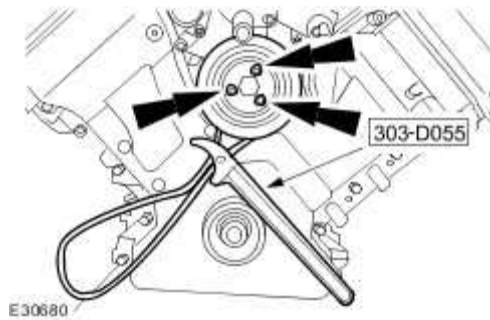
99 . Install the water pump.

- Install new O-ring seals and gaskets.
- Tighten to 12 Nm.

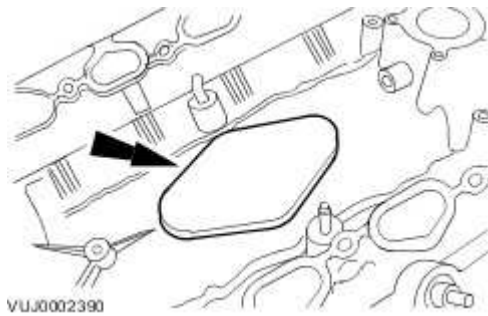


100 . Install the water pump pulley.

- Using special tool, retain the water pump pulley.
- Tighten to 10 Nm + 45°.



101 . Install the engine block insulation grommet.

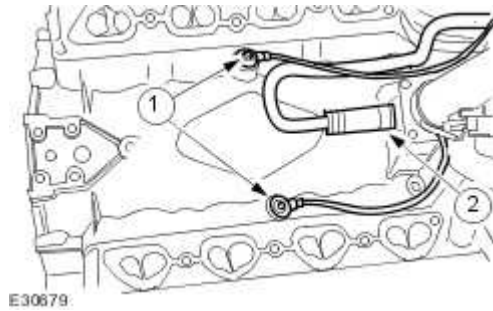


102 . Install the intake manifold heater coolant hose.

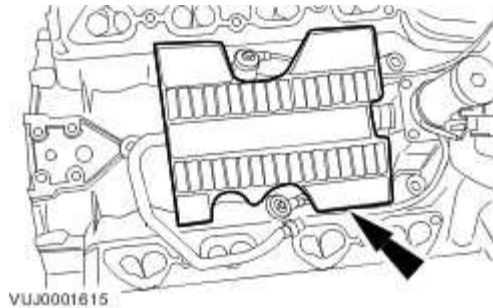
28. Install the knock sensors.

- Tighten to 20 Nm.

29. Install the intake manifold heater coolant hose.

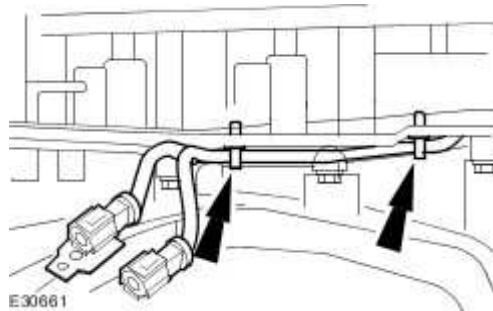


103 . Install the noise and vibration insulating pad.



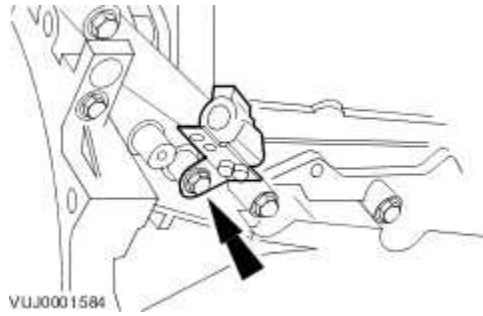
104 . Install the engine wiring harness.

105 . Attach the engine wiring harness retaining clips.



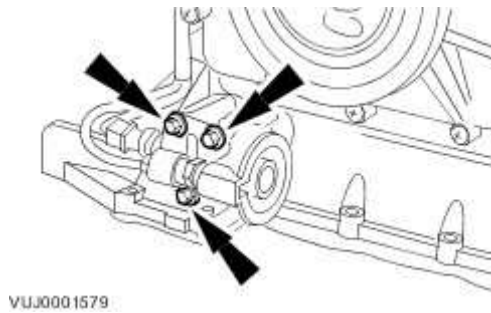
106 . Attach the right-hand oxygen sensor.

- Tighten to 10 Nm.

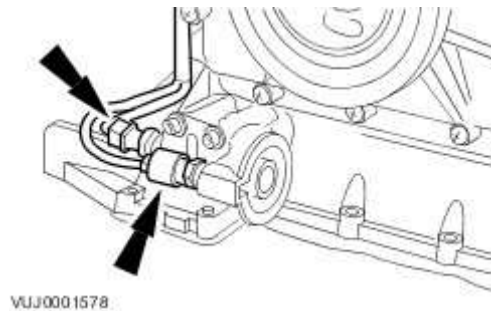


107 . Install the oil filter housing.

- Install a new O-ring seal.
- Tighten to 21 Nm.

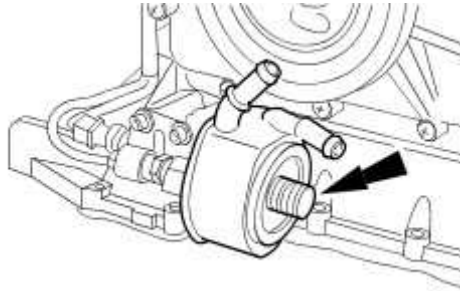


108 . Connect the oil pressure switch and oil temperature sensor electrical connectors.



109 . Install the oil cooler.

- Install a new O-ring seal.
- Tighten to 55 Nm.



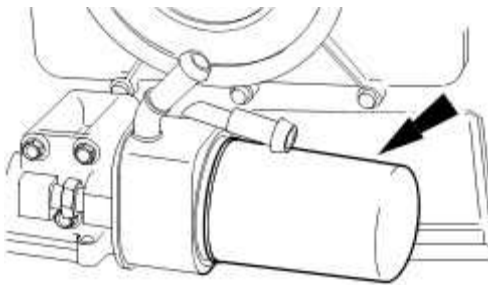
VUJ0001577

110 . **NOTE:**

Apply a suitable amount of clean engine oil to lubricate the oil filter O-ring seal.

Install a new oil filter.

- Tighten to 18 Nm.

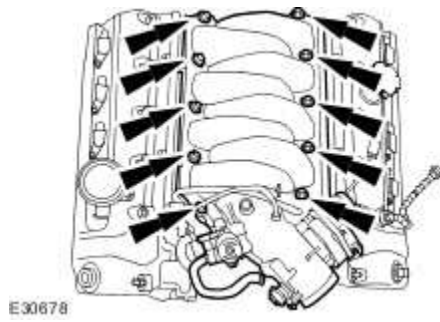


VUJ0001578

111 .

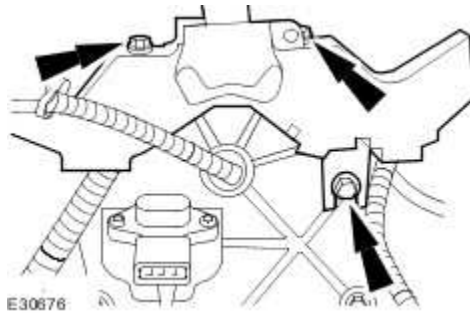
112 . Install the intake manifold.

- Tighten to 22 Nm.



113 . Attach the engine wiring harness.

- Tighten to 10 Nm.

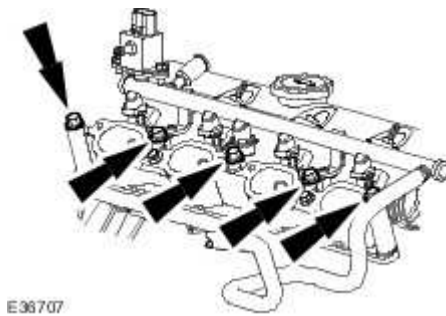


114 . **NOTE:**

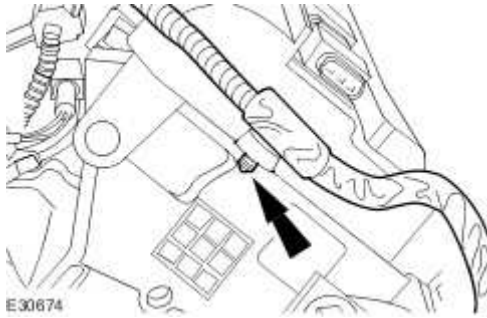
Left-hand shown, right-hand similar.

Install the lower intake manifold.

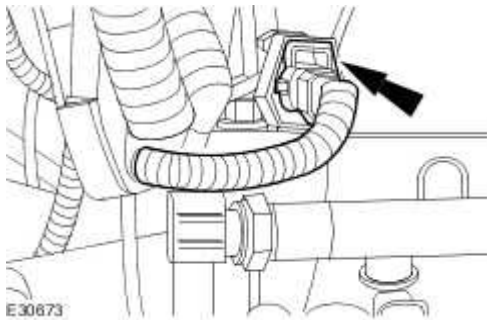
- Tighten to 22 Nm.



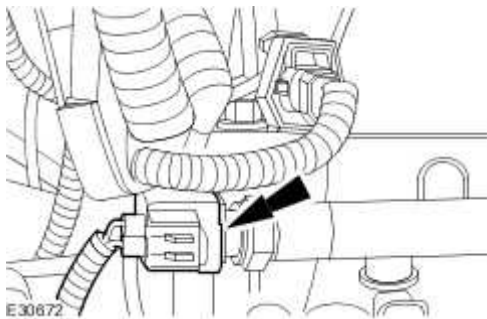
115 . Attach the engine wiring harness.



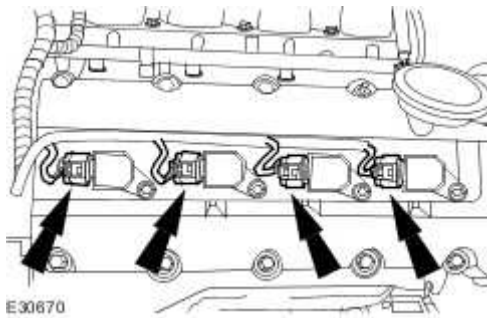
116 . Connect the camshaft position sensor electrical connector.



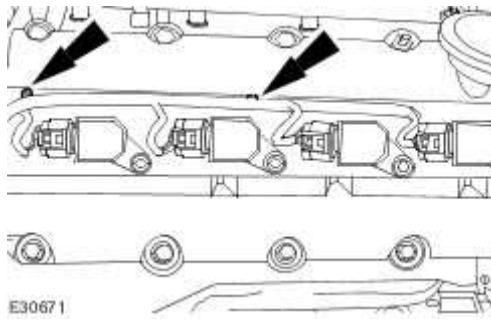
117 . Connect the fuel temperature sensor electrical connector.



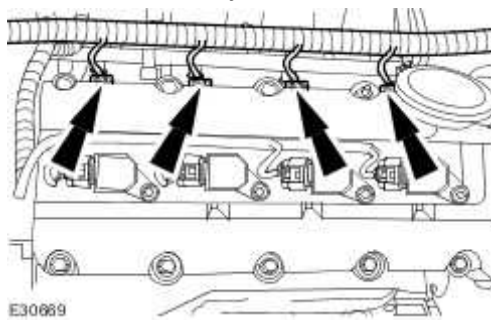
118 . Connect the ignition on-plug coil electrical connectors.



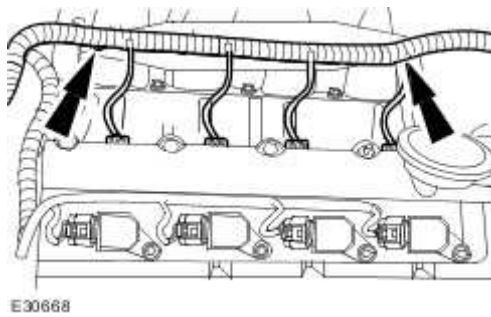
119 . Attach the engine wiring harness.



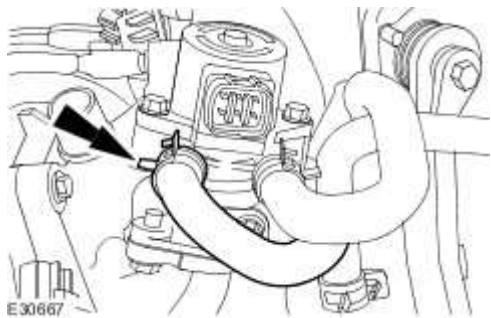
120 . Connect the fuel injector electrical connectors.



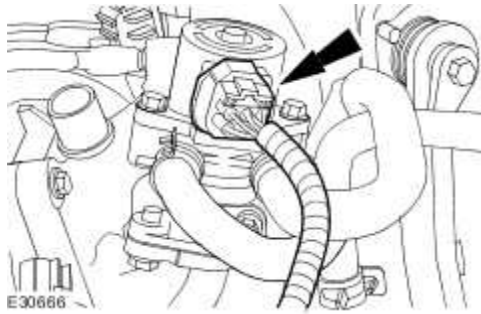
121 . Attach the engine wiring harness.



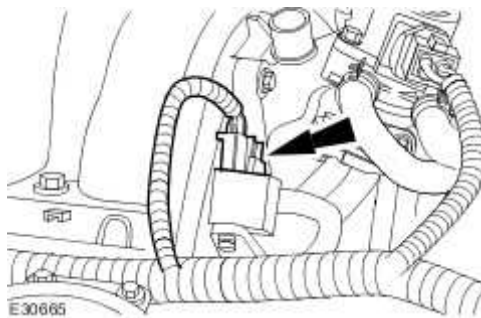
122 . Connect the exhaust gas recirculation valve coolant hose.



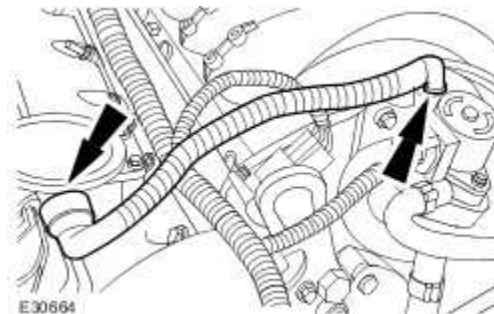
123 . Connect the exhaust gas recirculation valve electrical connector.



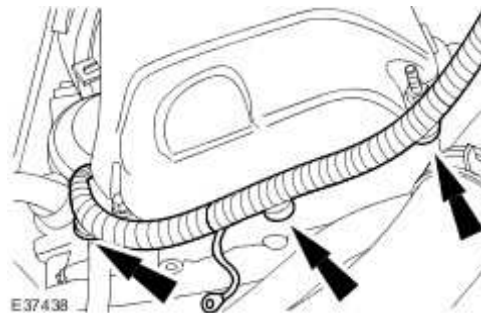
124 . Connect the fuel pressure regulator electrical connector.



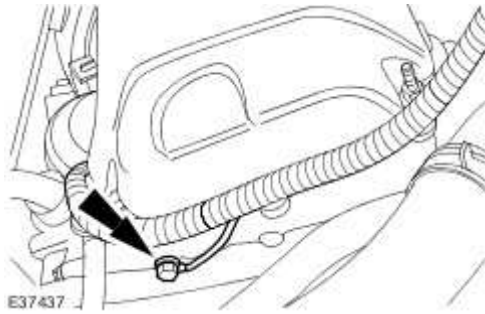
125 . Connect the positive crankcase ventilation pipe.



126 . Attach the engine wiring harness.



127 . Attach the engine wiring harness.

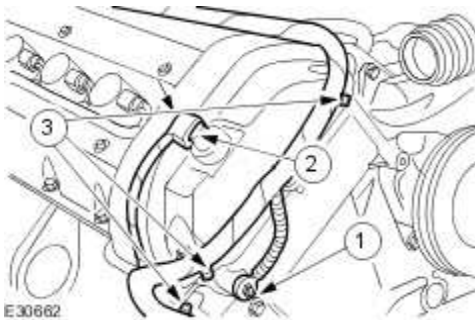


128 . Attach the engine harness.

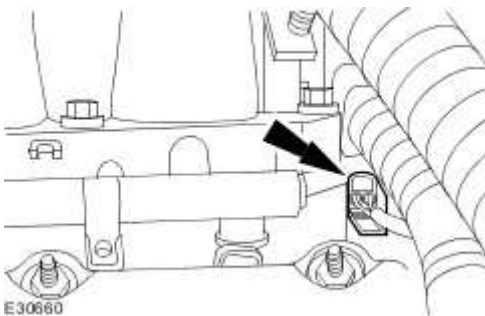
30. Connect the earth wire.

31. Connect the variable valve timing (VVT) solenoid electrical connector.

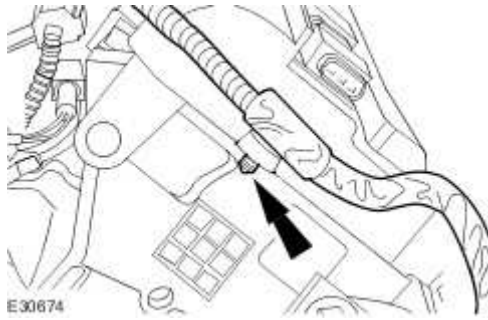
- Attach the engine harness.



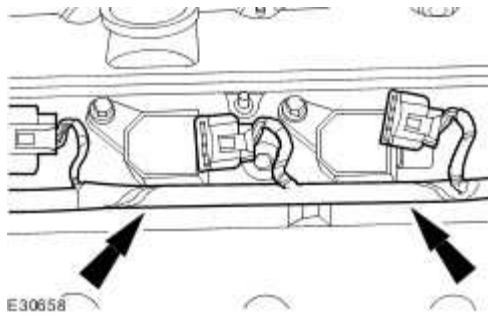
129 . Connect the camshaft position sensor electrical connector.



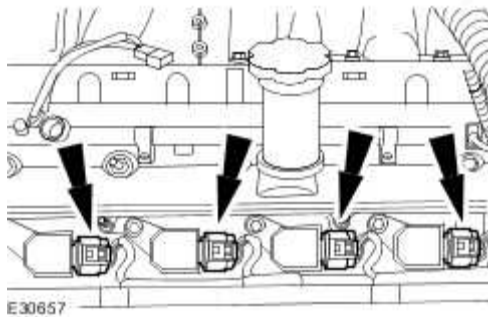
130 . Attach the engine wiring harness.



131 . Attach the engine wiring harness.



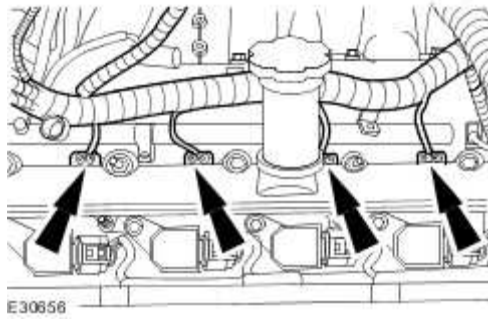
132 . Connect the ignition on-plug coil electrical connectors.



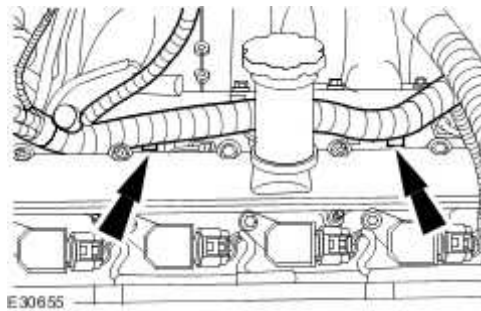
133 . **NOTE:**

Left-hand shown, right hand similar.

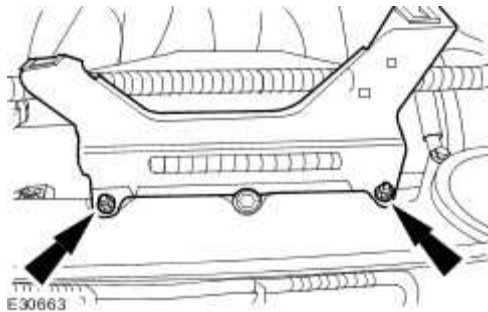
Connect the fuel injector electrical connectors.



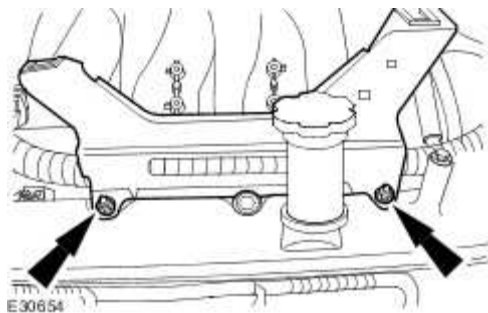
134 . Attach the engine wiring harness.



135 . Install the engine cover retaining bracket.



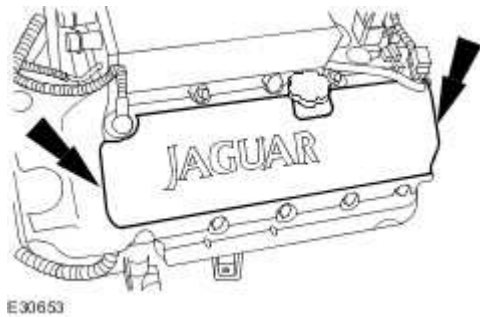
136 . Install the engine cover retaining bracket.



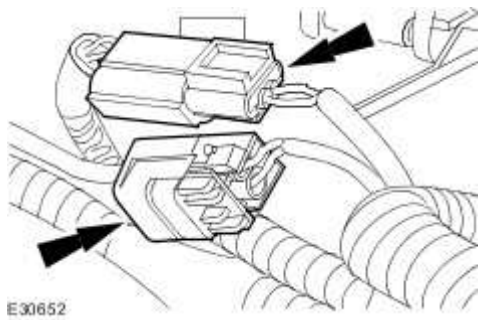
137 . **NOTE:**

Left-hand shown, right-hand similar.

Install the ignition coil cover.



138 . Connect the knock sensor electrical connectors.

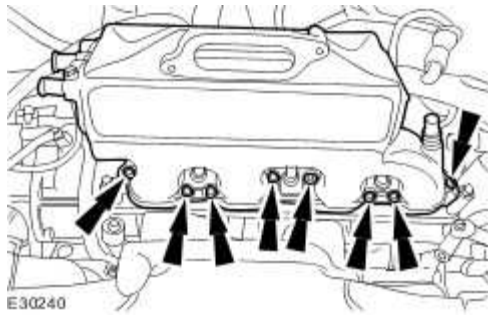


139 . **NOTE:**

Right-hand shown, left-hand similar.

Install the charge air coolers.

- Install a new charge air cooler gasket.
- Tighten to 13 Nm.

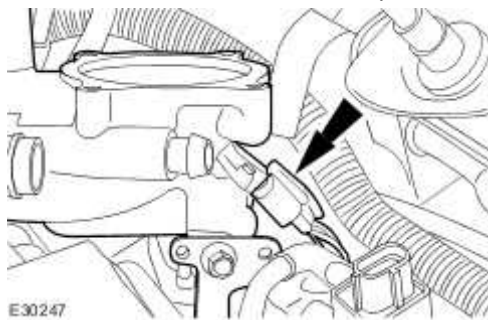


140 . Install the supercharger.

- Tighten to 24 Nm.

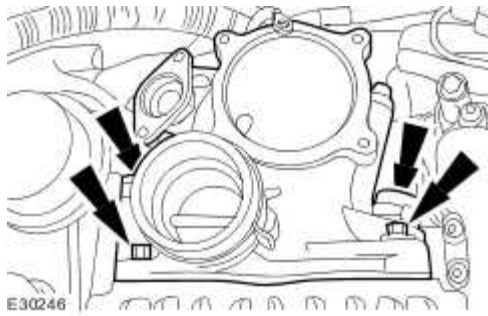


141 . Connect the manifold absolute pressure (MAP) sensor.



142 . Install the air intake elbow.

- Install a new gasket.
- Install new retaining bolt seals.
- Tighten to 24 Nm.

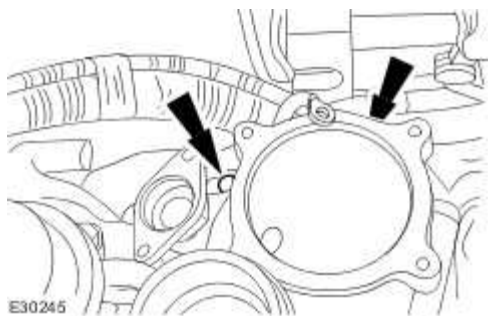


143 . **NOTE:**

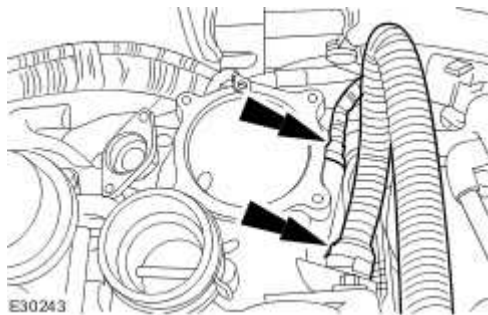
Make sure ground strap is correctly installed to the location noted.

Install the air intake elbow retaining bracket lower retaining bolts.

- Tighten to 20 Nm.



144 . Connect the air intake elbow pipes.



145

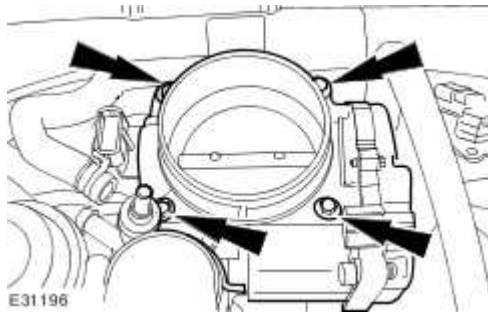


CAUTION: Do not attempt to clean the throttle body. The bore and the throttle

plate has a special coating applied during manufacture which should not be removed.

Install the throttle body.

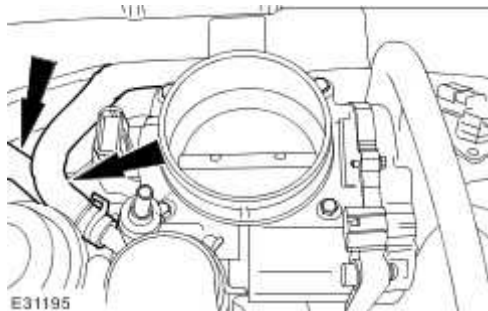
- Install a new throttle body gasket.
- Tighten to 10 Nm.



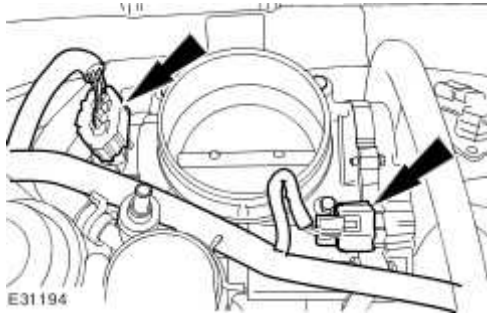
146 . **NOTE:**

Un-cap the coolant hose.

Attach the coolant hose to the throttle body.

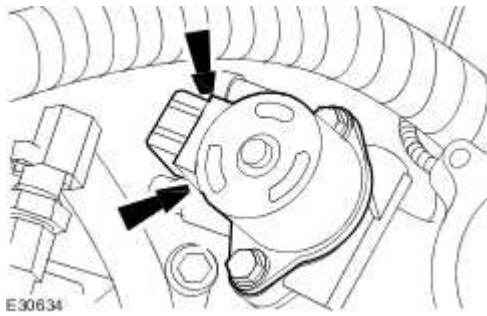


147 . Connect the electrical connectors.

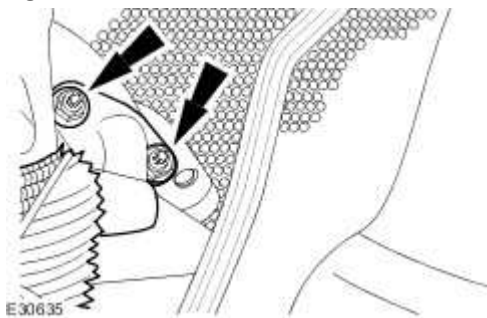


148 . Install the EGR valve and the exhaust manifold to EGR valve tube.

- Install a new exhaust manifold to EGR valve tube gasket.
- Install a new EGR valve to air intake elbow gasket.
- Tighten to 10 Nm.



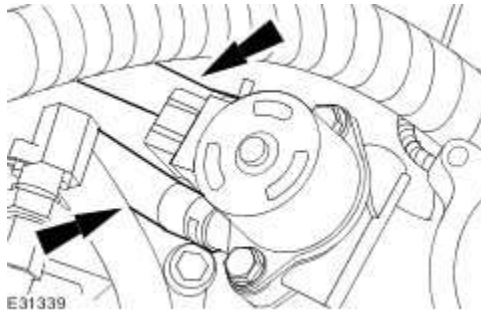
149 . Tighten to 21 Nm.



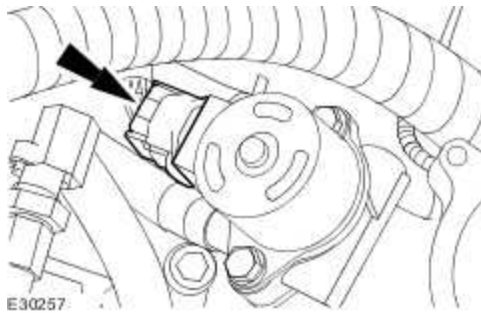
150 . **NOTE:**

Un-cap the exposed ports.

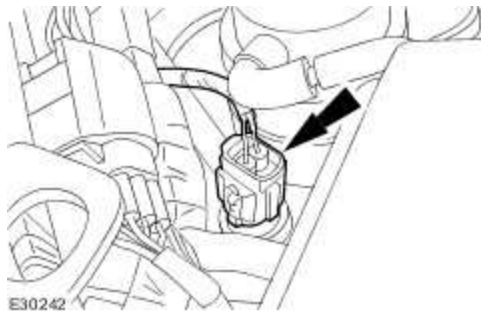
Connect the coolant hoses.



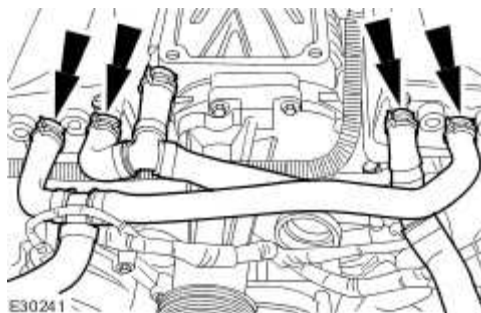
151 . Connect the exhaust gas recirculation (EGR) valve electrical connector.



152 . Connect the IAT sensor electrical connector.



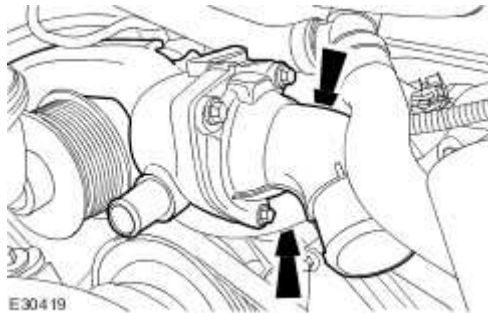
153 . Connect the charge air cooler coolant pipes.



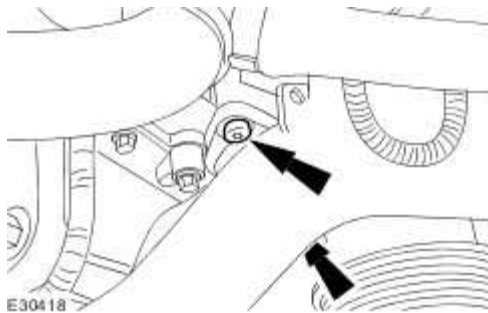
154 . Install new O-ring seals to the thermostat housing.

155 . Install thermostat housing.

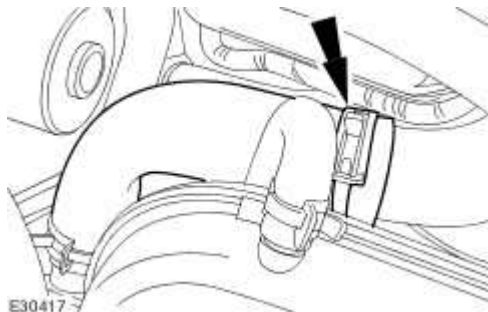
156 . Tighten to 10 Nm.



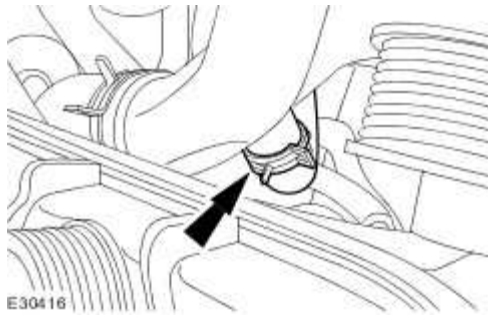
157 . Tighten to 10 Nm.



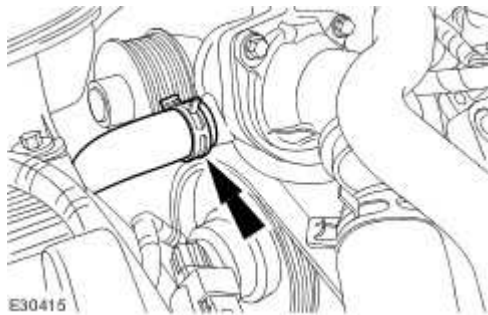
158 . Connect the hose.



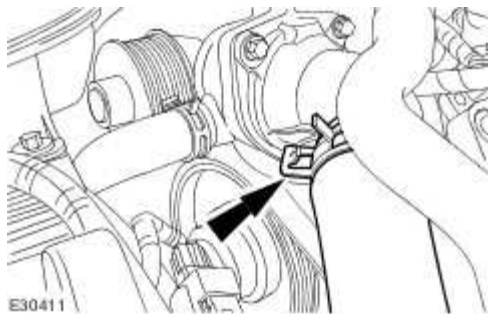
159 . Connect the hose.



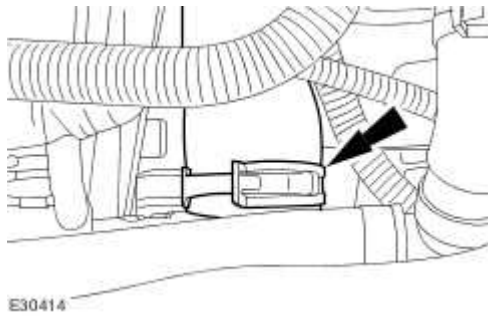
160 . Connect the hose.



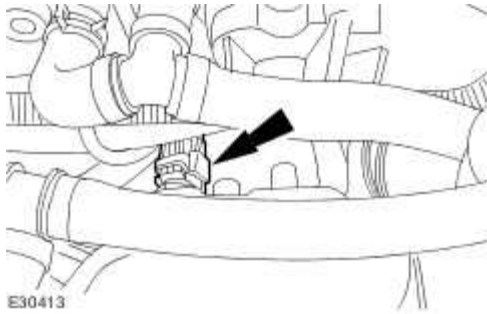
161 . Connect the hose.



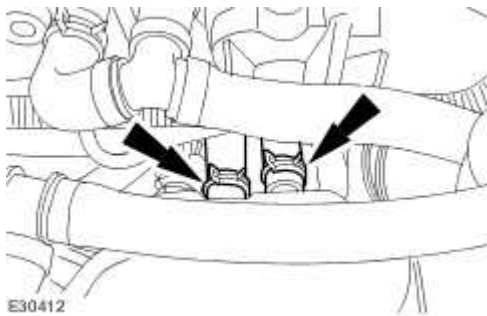
162 . Reposition the thermostat housing hose retaining clip.



163 . Connect the coolant temperature sensor electrical connector.

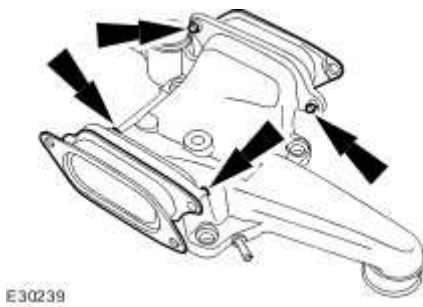


164 . Connect the thermostat housing hoses



165 . Install new supercharger outlet pipe to charge air coolers ducts.

- Tighten to 8 Nm.



166 . Install a new supercharger outlet pipe gasket.

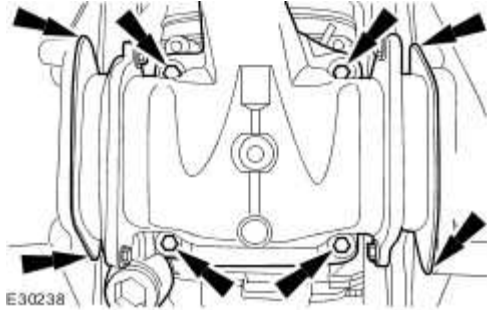
167 . Install new seals to the supercharger outlet pipe retaining bolts

168 .



CAUTION: Make sure no foreign matter enters the supercharger.

Install the supercharger outlet pipe



169 . **NOTE:**

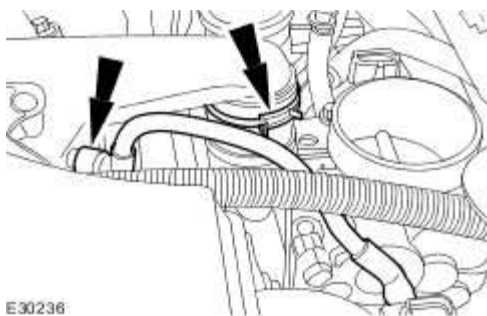
Un-cap the coolant ports.

Attach the supercharger outlet pipe coolant hose.

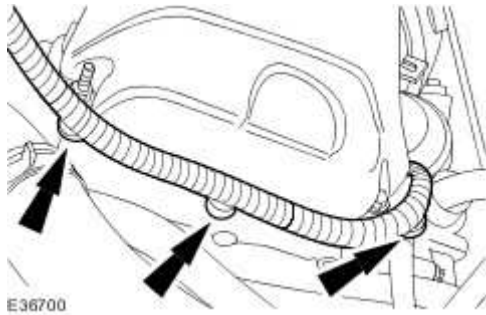


170 . Attach the hoses.

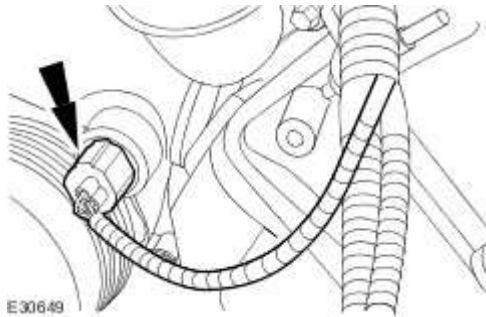
- Reposition the hose retaining clip.



171 . Attach the engine wiring harness.



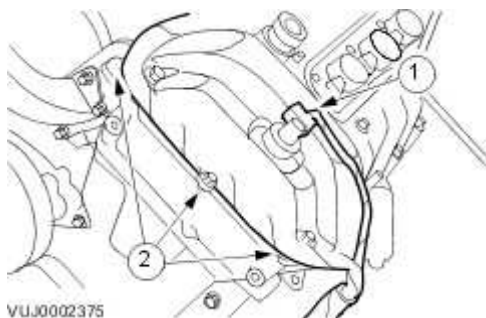
172 . Connect the coolant temperature sensor electrical connector.



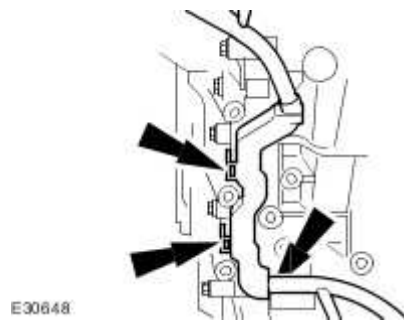
173 . Attach the engine wiring harness.

32. Connect the variable valve timing (VVT) solenoid electrical connector.

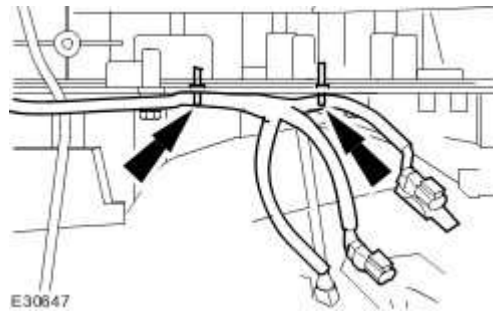
33. Attach the engine wiring harness.



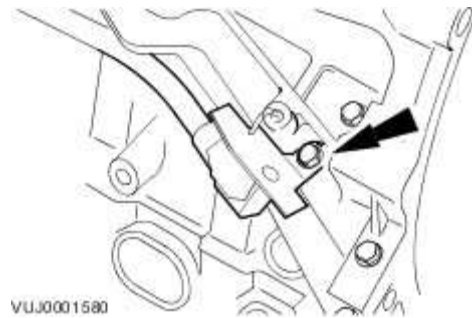
174 . Attach the engine wiring harness.



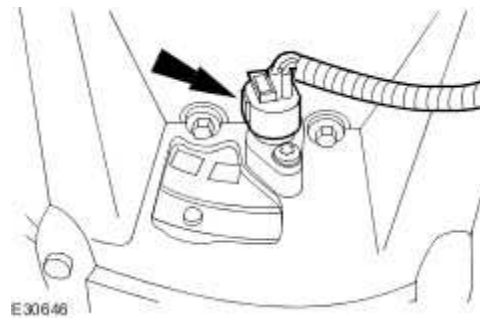
175 . Attach the engine wiring harness.



176 . Attach the engine wiring harness.

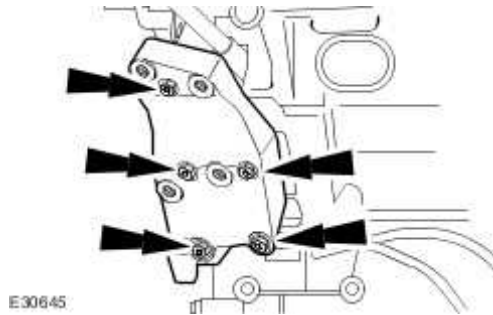


177 . Connect the crankshaft position sensor electrical connector.



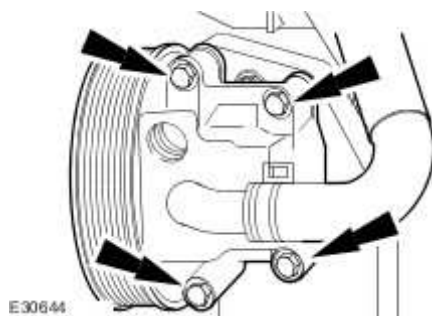
178 . Install the power steering pump mounting bracket.

- Tighten to 25 Nm.



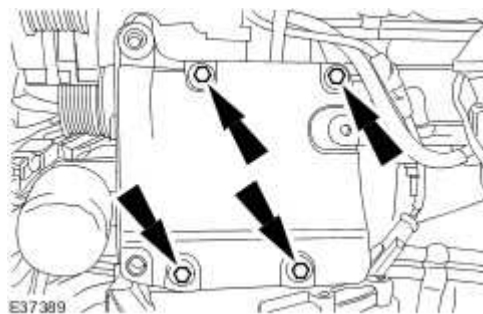
179 . Install the power steering pump.

- Tighten to 25 Nm.



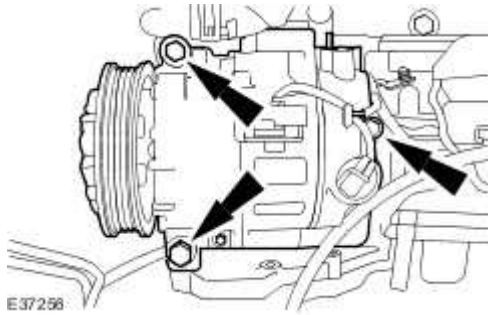
180 . Install the air conditioning compressor mounting bracket.

- Tighten to 25 Nm.

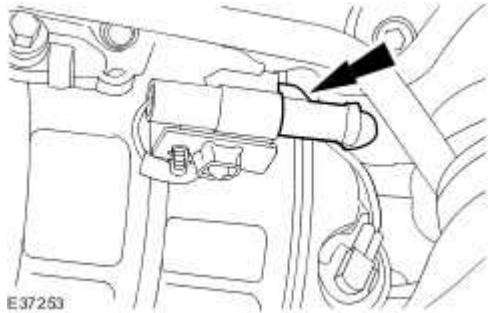


181 . Install the A/C compressor.

- Tighten to 25 Nm.

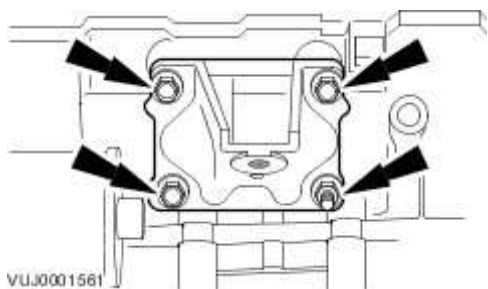


182 . Connect the air conditioning compressor electrical connector.



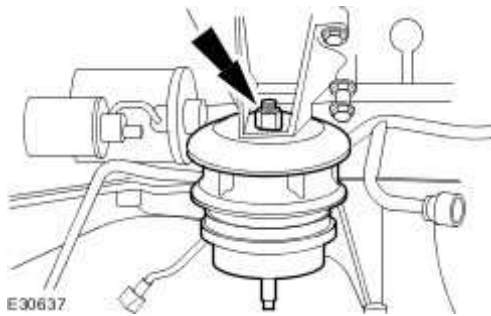
183 . Install the left-hand engine mounting bracket.

- Tighten to 25 Nm.



184 . Install the left-hand engine mount.

- Tighten to 43 Nm.



185



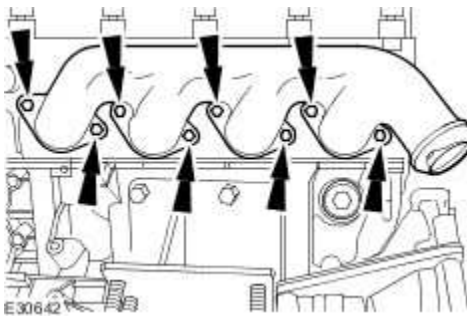
CAUTION: Make sure the exhaust manifold and gasket are correctly aligned to the cylinder head.



CAUTION: Make sure the exhaust manifold torque is checked after initial tighten.

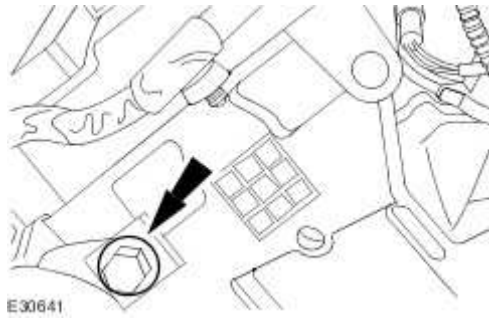
Install the left-hand exhaust manifold.

- Install a new gasket.
- Tighten to 20 Nm.



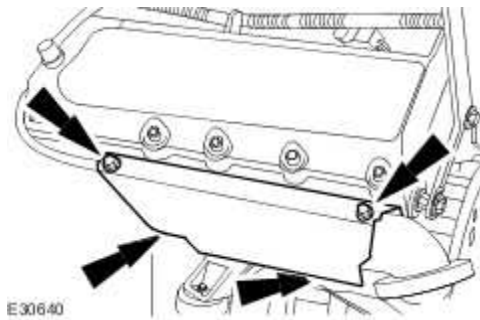
186 . Install the heat shield retaining bolt.

- Tighten to 50 Nm.



187 . Install the heat shield.

- Tighten to 3 Nm.



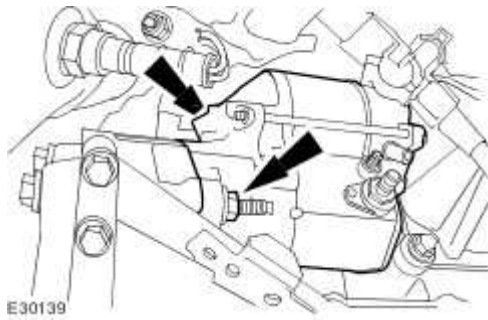
188 . Install the oil level indicator and tube.

- Install a new O-ring seal.
- Tighten to 6 Nm.

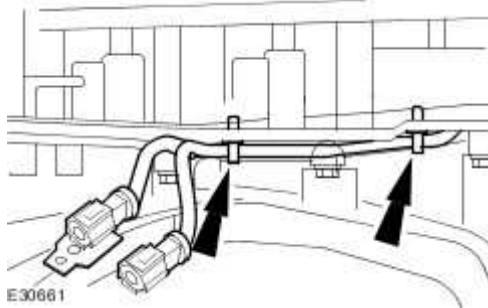


189 . Install the starter motor.

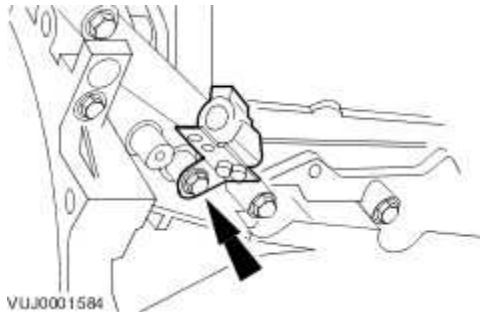
- Tighten to 45 Nm.



190 . Attach the engine wiring harness.

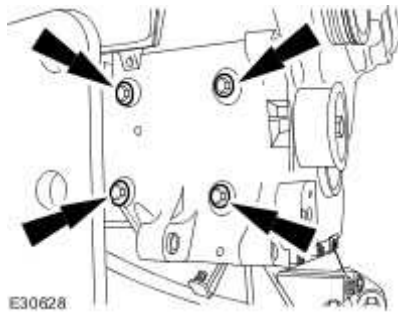


191 . Attach the right hand oxygen sensor retaining bracket.

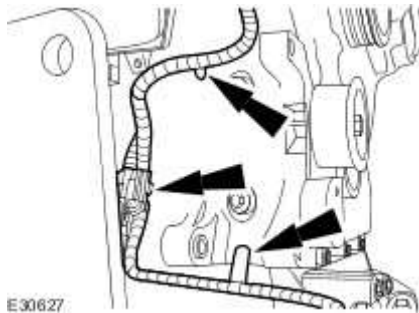


192 . Install the generator mounting bracket.

- Tighten to 45 Nm.

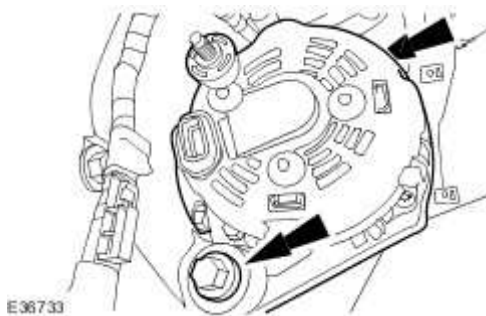


193 . Attach the engine wiring harness.

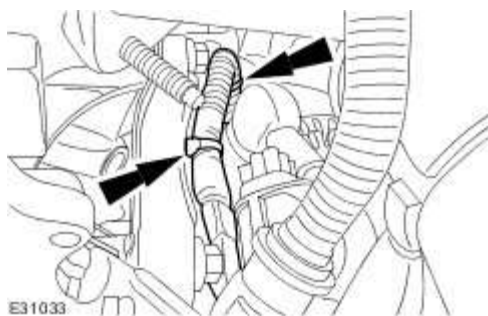


194 . Install the generator.

- Tighten the generator upper retaining bolt to 21 Nm.
- Tighten the generator lower retaining bolt to 40 Nm.



195 . Attach the wiring harness.

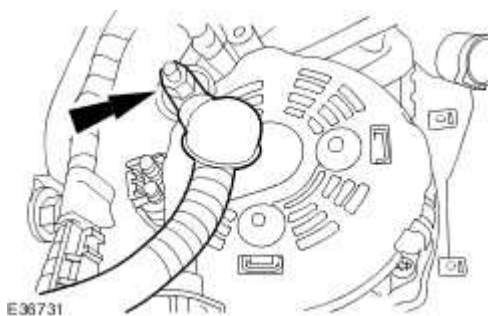


196 . Connect the generator electrical connector.

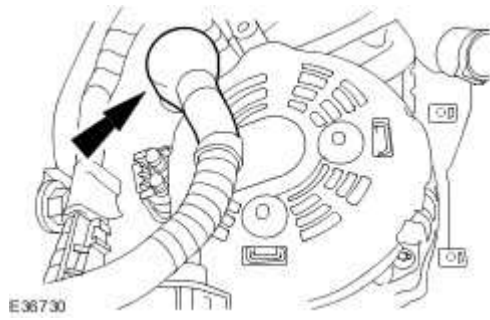


197 . Attach the generator battery positive cable.

- Tighten to 12 Nm

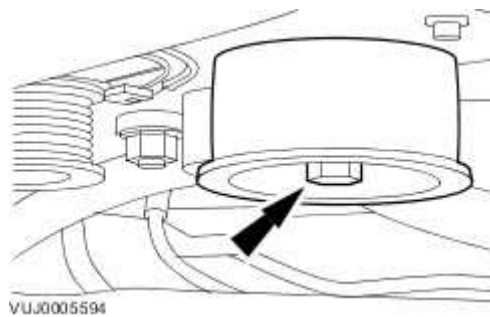


198 . Attach the generator battery positive cable protective cover.



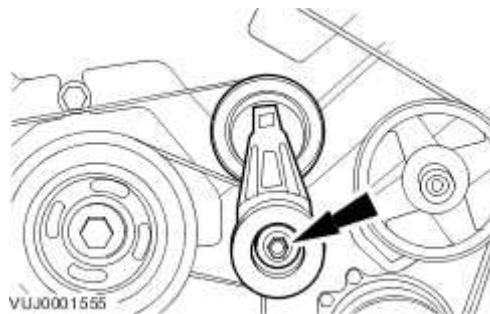
199 . Install the accessory drive belt idler pulley.

- Tighten to 25 Nm.



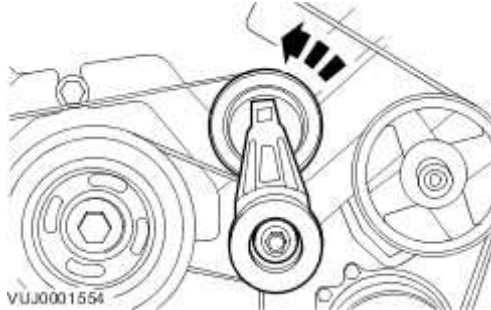
200 . Install the accessory drive belt tensioner.

- Install the accessory drive belt.
- Tighten to 45 Nm.



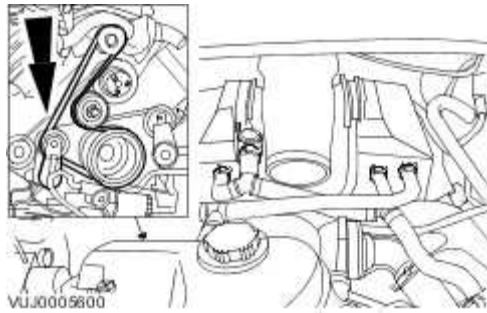
201 . Attach the accessory drive belt.

- Use a 3/8 inch square drive bar to rotate the drive belt tensioner.
- Attach the accessory drive belt.



202 . Install the supercharger belt.

- Use a 1/2 inch square drive bar to rotate the supercharger belt tensioner.



203 . Connect the oil cooler hoses.



303-03A : Engine Cooling – 4.2L NA V8 – AJV8/4.2L SC V8 – AJV8

Specifications

Specifications

Capacities

	Liters
Naturally aspirated models	9.5
Supercharged models	11.5

Lubricants, Fluids, Sealers and Adhesives

	Specifications
Coolant fluid	WSS M97B44-D
Coolant 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

NOTE:

The coolant is of the Organic Acid Technology (OAT) type and must not be mixed with other types of coolant.

General Specifications

Item	Specification
Cooling system type	Pressurised, thermostatically controlled with remote header tank
Radiator	Cross flow with integral transmission fluid cooler
Expansion tank	Remote - fitted with a bleed screw and low coolant level sensor
Pressure cap rating	1.2 bar (120 kPa) (17 lbf/in ²)
Thermostat:	
Starts to open	88° C (190° F)
Fully open	95° C (203° F)

Cooling fan	Electronically controlled
Coolant pump	Centrifugal flow impellor, belt driven from crankshaft
Low temperature radiator (Intercooler circuit)	Cross flow, single pass, located in front of A/C condenser
Auxiliary water pump (Intercooler circuit)	Centrifugal type, 35w 12V DC electric motor
Engine oil cooler (Supercharged models)	Twin oil-air coolers, connected in series

Torque Specifications

Item	Nm	lb-ft	lb-in
Block heater	56	41	-
Coolant drain in engine block - plug M10 x 16	25	18	-
Coolant expansion tank - bolt	7	5	62
Coolant inlet housing to engine - bolt	9	7	80
Coolant pump - bolt	8 + 90°	6 + 90°	71 + 90°
Coolant pump pulley - bolt	10 + 45°	7 + 45°	88 + 45°
Radiator upper mounting bracket - bolt - Naturally aspirated models	27	20	-
Radiator upper mounting bracket - bolt - Supercharged models	30	22	-
Thermostat to coolant outlet pipe assembly - bolt	4	3	35
Thermostat and coolant outlet pipe assembly to engine - bolt	9	7	80
Engine oil cooler support brackets	7	5	62
Oil cooler feed tubes	7	5	62
Oil cooler return tubes	7	5	62
Auxiliary water pump (Intercooler circuit) securing bolt	5	4	44

Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8



WARNING: Never remove the coolant pressure cap under any circumstances while the engine is operating. Failure to follow this instruction may result in personal injury.



WARNING: To avoid the possibility of personal injury, do not operate the engine with the hood open until the fan blades have been examined for cracks and separation. Failure to follow this instruction may result in personal injury.



CAUTION: 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 engine



CAUTION: Never remove the coolant pressure cap under any circumstances while the engine is operating. Failure to follow this instruction may result in damage to the engine.

1. Open the hood.

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: Release the cooling system pressure by slowly turning the coolant expansion tank cap a quarter of a turn. Cover the expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow this instruction may result in personal injury.

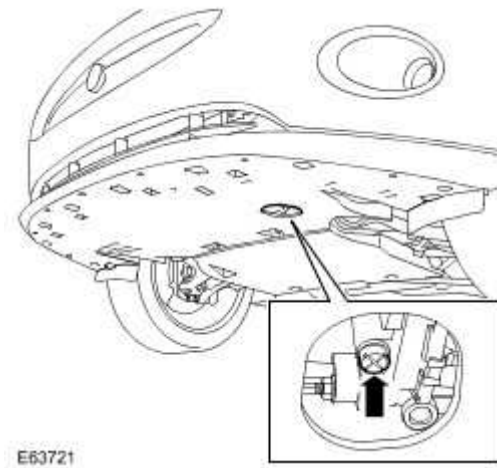
Release the cooling system pressure.

- Remove the coolant expansion tank cap.



4. Drain the coolant.

- Position a container to collect the fluid.
- Remove the drain plug.



5. Install the drain plug.

6. Loosen the coolant expansion tank bleed screw.



7.



CAUTION: Anti-freeze concentration must be maintained at 50%.

Refill the cooling system.

- When coolant runs from the expansion tank bleed point bubble-free, tighten the bleed screw.

8. Install the coolant expansion tank cap.

9. Set the heater controls to maximum.

10. Start the engine and idle until hot air is emitted at the face registers.

11. Switch the engine off and allow to cool.

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

13. Close the hood.

Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8



WARNING: Never remove the coolant pressure cap under any circumstances while the engine is operating. Failure to follow this instruction may result in personal injury.



WARNING: To avoid the possibility of personal injury, do not operate the engine with the hood open until the fan blades have been examined for cracks and separation. Failure to follow this instruction may result in personal injury.



CAUTION: 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 engine



CAUTION: Never remove the coolant pressure cap under any circumstances while the engine is operating. Failure to follow this instruction may result in damage to the engine.

1. Open the hood.

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.



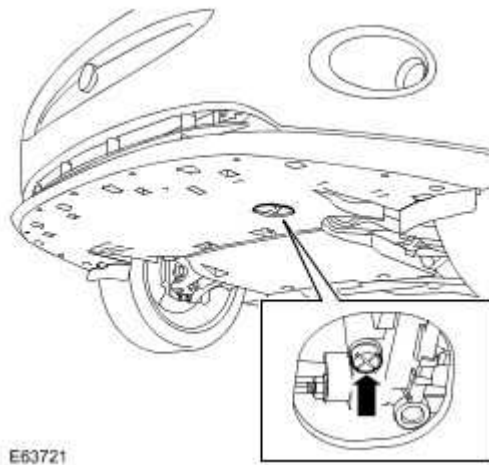
WARNING: Release the cooling system pressure by slowly turning the coolant expansion tank cap a quarter of a turn. Cover the expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow this instruction may result in personal injury.

Release the cooling system pressure.

- Remove the coolant expansion tank cap.



4. Drain the coolant.
 - Position a container to collect the fluid.
 - Remove the drain plug.



5. Install the drain plug.
6. Loosen the coolant expansion tank bleed screw.



7.



CAUTION: Anti-freeze concentration must be maintained at 50%.

Refill the cooling system.

- When coolant runs from the expansion tank bleed point bubble-free, tighten the bleed screw.

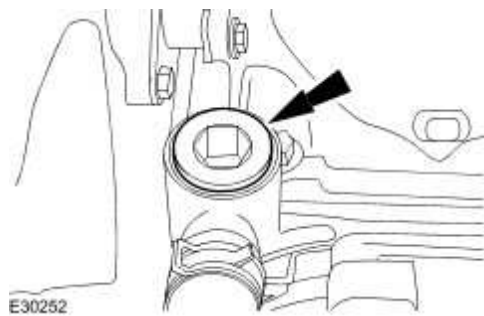
8. Install the coolant expansion tank cap.

9. Remove the engine cover.

[Engine Cover \(76.11.35\)](#)

10. Remove the supercharger coolant filler plug.

- Remove and discard the sealing washer.



11.



CAUTION: Coolant may spill from the supercharger fill port when the ignition is switched on.

Switch the ignition on.

12.



CAUTION: Do not allow the supercharger coolant pump to run dry for more than one minute. Failure to follow this instruction may result in damage to the vehicle.

Allow the supercharger pump to run and top-up the coolant through the supercharger fill port.

- Switch the ignition off.

13. Install the supercharger coolant fill plug and tighten to 45 Nm (33 lb.ft).

- Clean the components.
- Install a new sealing washer.

14. Install the engine cover.

[Engine Cover \(76.11.35\)](#)

15. Set the heater controls to maximum.
16. Start the engine and idle until hot air is emitted at the face registers.
17. Switch the engine off and allow to cool.
18. Check and top-up the coolant if required.
19. Close the hood.

Cooling System Draining and Vacuum Filling



WARNING: Never remove the coolant pressure cap under any circumstances while the engine is operating. Failure to follow this instruction may result in personal injury.



WARNING: To avoid the possibility of personal injury, do not operate the engine with the hood open until the fan blades have been examined for cracks and separation. Failure to follow this instruction may result in personal injury.



CAUTION: 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 engine.



CAUTION: Never remove the coolant pressure cap under any circumstances while the engine is operating. Failure to follow this instruction may result in damage to the engine.

NOTE:

Vehicles fitted with supercharged engines shown, V8 NA and V6 engines similar.

1. Set the heater controls to maximum HOT.
2. Open the hood.
- 3.



WARNING: Relieve the cooling system pressure by unscrewing the coolant pressure cap. Failure to follow this instruction may result in personal injury.

Remove the coolant expansion tank cap.



4.



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.

5. Remove the radiator undertray.

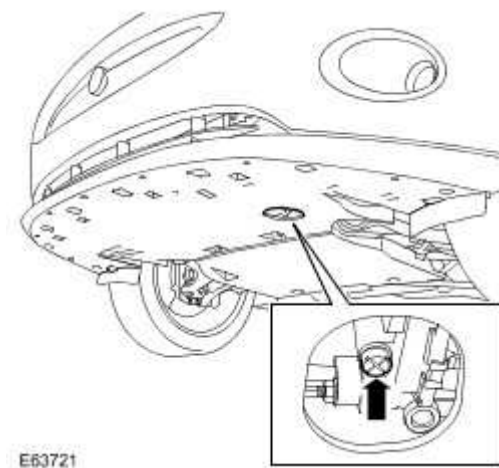
[Radiator Splash Shield \(76.22.90\)](#)

6. **NOTE:**

Remove and discard the O-ring seal.

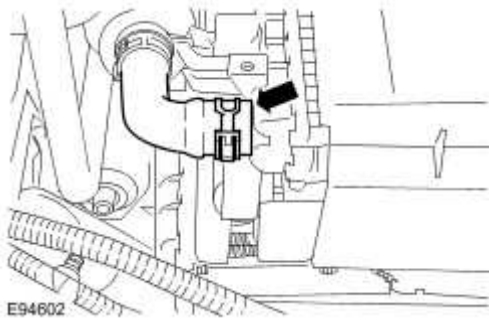
Remove the coolant drain plug.

- Drain the coolant into a suitable container.



7. Disconnect the coolant lower hose from the supercharger radiator.

- Release the clip.
- Allow the coolant to drain.



8.



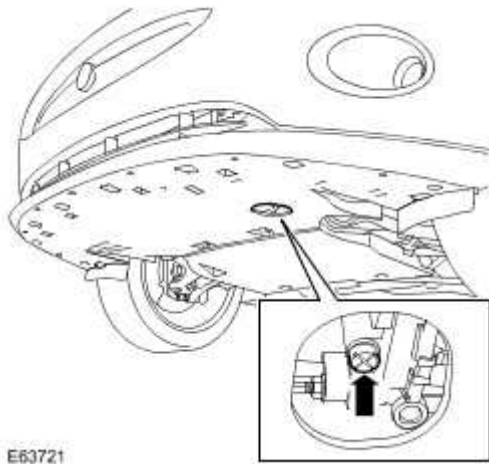
CAUTION: Do not over tighten the drain plug. Failure to follow this instruction may result in damage to the vehicle.

NOTE:

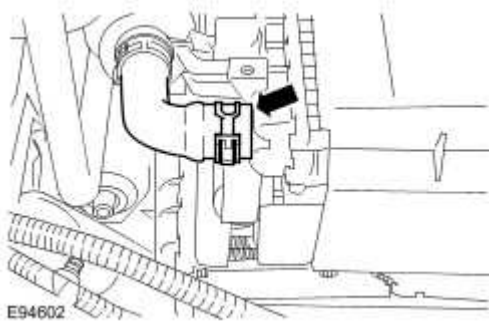
Install a new O-ring seal.

Install the drain plug.

- Remove the drain tray.



9. Connect the supercharger radiator lower coolant hose.



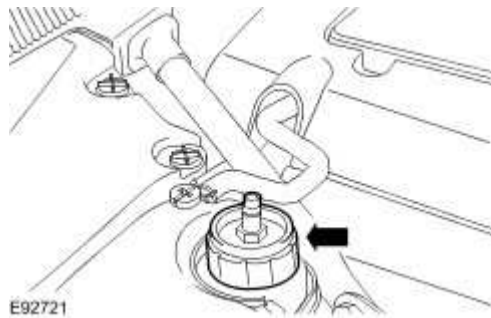
10. Install the radiator undertray.

Radiator Splash Shield (76.22.90)

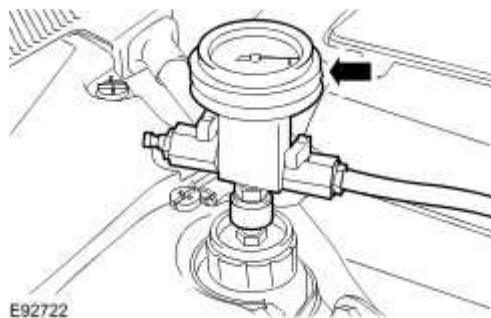
11. Lower the vehicle.

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

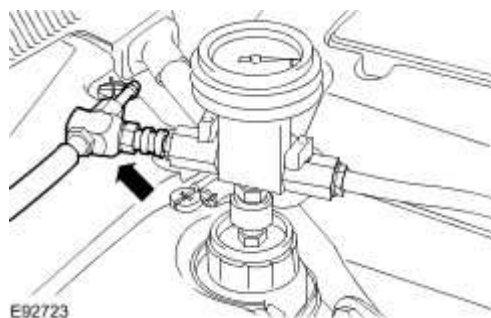
13. Install the cooling system vacuum refill adaptor to the expansion tank.



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



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



16. **NOTE:**

Make sure both valves are in the closed position on the vacuum filler gauge assembly.

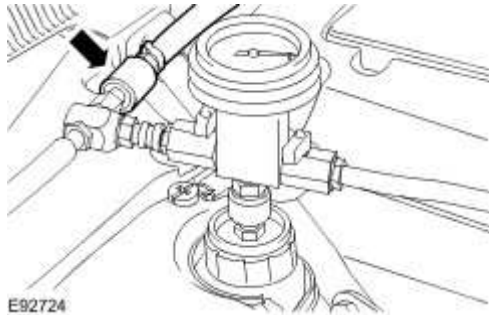
NOTE:

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

NOTE:

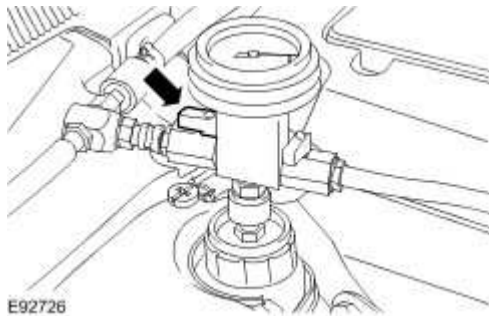
Small diameter or long airlines may restrict airflow to the coolant vacuum fill tool.

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



17. Position the evacuated air hose into a container.

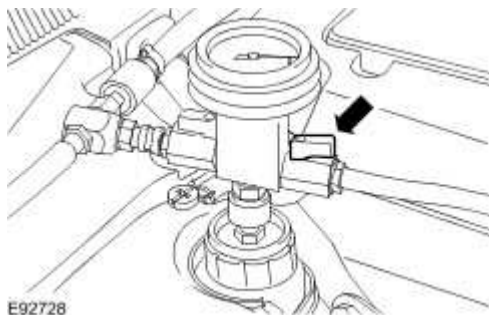
18. Open the air supply valve.



19. NOTE:

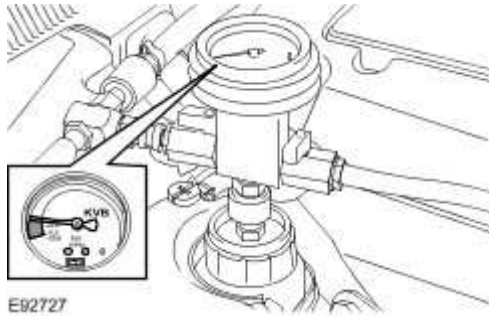
Make sure the coolant supply hose is positioned into a container of fifty percent mixture of Jaguar Premium Cooling System Fluid or equivalent, meeting Jaguar specification WSS M97B44-D and fifty percent water. Make sure no air can enter the coolant supply hose.

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

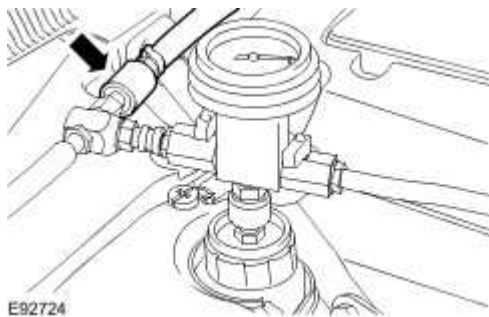


20. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.

- Allow the vacuum to rebuild.
- Close the air supply valve.
- Allow one minute to check the vacuum is held.



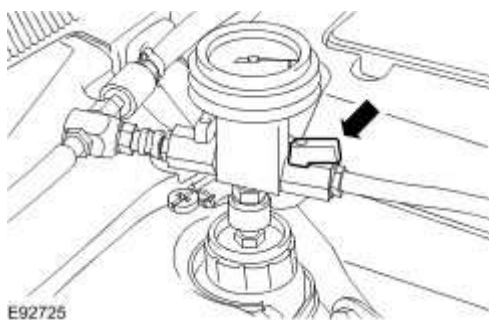
21. Disconnect the compressed air supply line.



22. **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.



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

24. Install the coolant expansion tank cap.

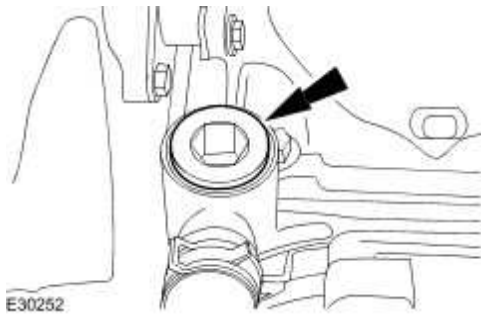


25. Remove the engine cover.

[Engine Cover \(76.11.35\)](#)

26. Remove the supercharger coolant fill plug.

- Remove and discard the sealing washer.



27.



CAUTION: Coolant may spill from the supercharger fill port when the ignition is switched on.

Switch the ignition on.

28.



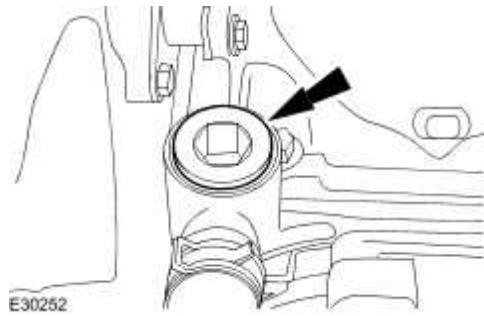
CAUTION: Do not allow the supercharger coolant pump to run dry for more than one minute. Failure to follow this instruction may result in damage to the vehicle.

Allow the supercharger pump to run and top-up the coolant through the supercharger fill port.

- Switch the ignition off.

29. Install the supercharger coolant fill plug.

- Clean the components.
- Install a new sealing washer.
- Tighten to 45 Nm (33 lb.ft).



30. Install the engine cover.

[Engine Cover \(76.11.35\)](#)

31.



CAUTION: Observe the engine temperature gauge. If the engine starts to over-heat switch off immediately and allow to cool. Failure to follow this instruction may cause damage to the vehicle.

Start the engine and idle until hot air is emitted at the face registers.

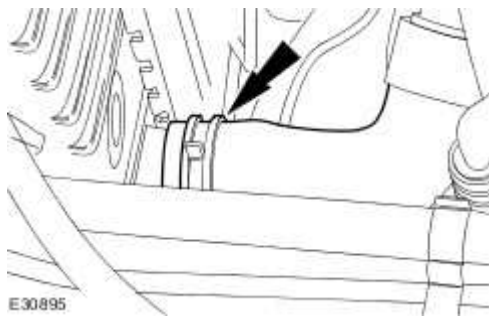
32. Switch the engine off and allow to cool.

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

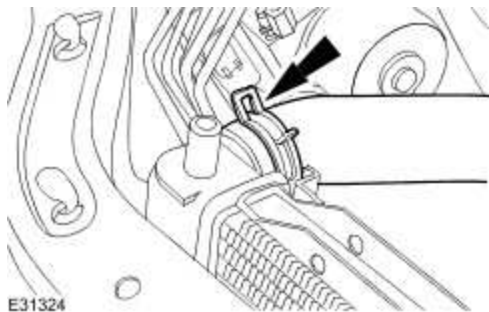
34. Close the hood.

Cooling System Flushing

1. Remove the air cleaner. <<303-12A>>
2. Remove the air cleaner. <<303-12B>>
3. Remove the thermostat.
4. Detach the lower coolant hose from the radiator and position to one side.



5. Detach the upper coolant hose from the radiator.



NOTE:

To remove rust, sludge and other foreign material from the cooling system, use Premium Cooling System flush, meeting Jaguar specification EGR-M14P7-A, which is safe for use with aluminium cooling systems. This cleaning restores cooling system efficiency and helps prevent overheating.

NOTE:

In severe cases where cleaning solvents will not properly clean the cooling system, it will be necessary to use the pressure flushing method using Cooling System Flusher, 164-R3670 to restore efficient operation.

NOTE:

A pulsating or reversed direction of flushing water will loosen sediment more quickly than a steady flow in the normal coolant flow direction.

NOTE:

Dispose of old coolant and flushing water contaminated with coolant and cleaning chemicals in accordance with local, state and federal laws.

6. Connect a hose pipe to the radiator upper coolant hose connection using a suitable connector.

7.



CAUTION: Radiator internal pressure must not exceed 100 kPa (14.5 psi). Failure to follow this instruction may cause damage to the radiator.

Flush the radiator using the hose pipe until the coolant flowing from the radiator lower coolant hose connection is clear.

8. Remove the hose pipe from the radiator upper coolant hose connection.

9. Connect a hose pipe to the upper coolant hose using a suitable connector.

10. Flush the engine using the hose pipe until the coolant flowing from the radiator lower coolant hose is clear.

11. Remove the hose pipe from the upper coolant hose connection.

12. Connect the upper coolant hose to the radiator.

13. Connect the lower coolant hose to the radiator.

14. Install the thermostat.

15. Fill the cooling system.

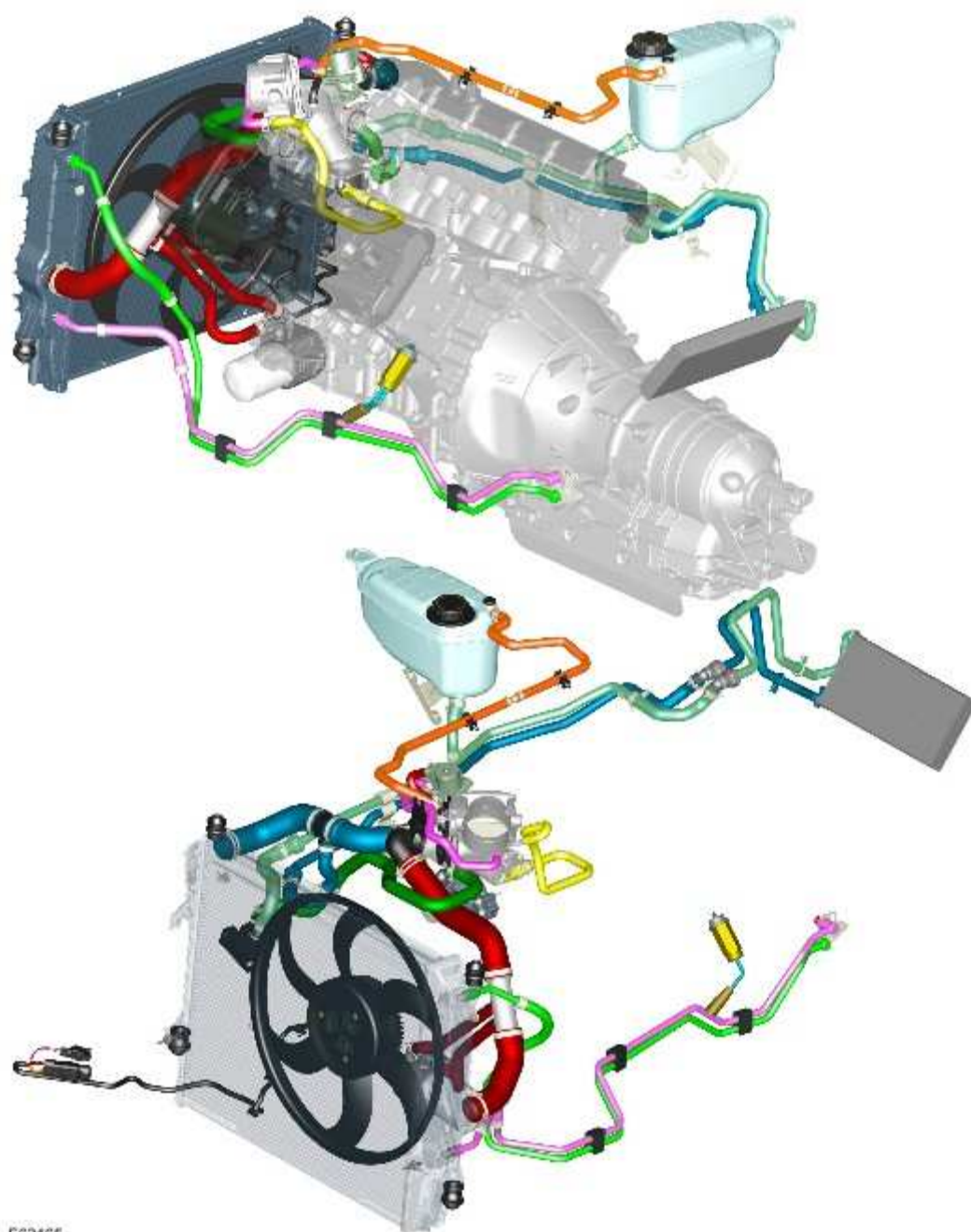
16. Install the air cleaner. <<303-12A>>

17. Install the air cleaner. <<303-12B>>

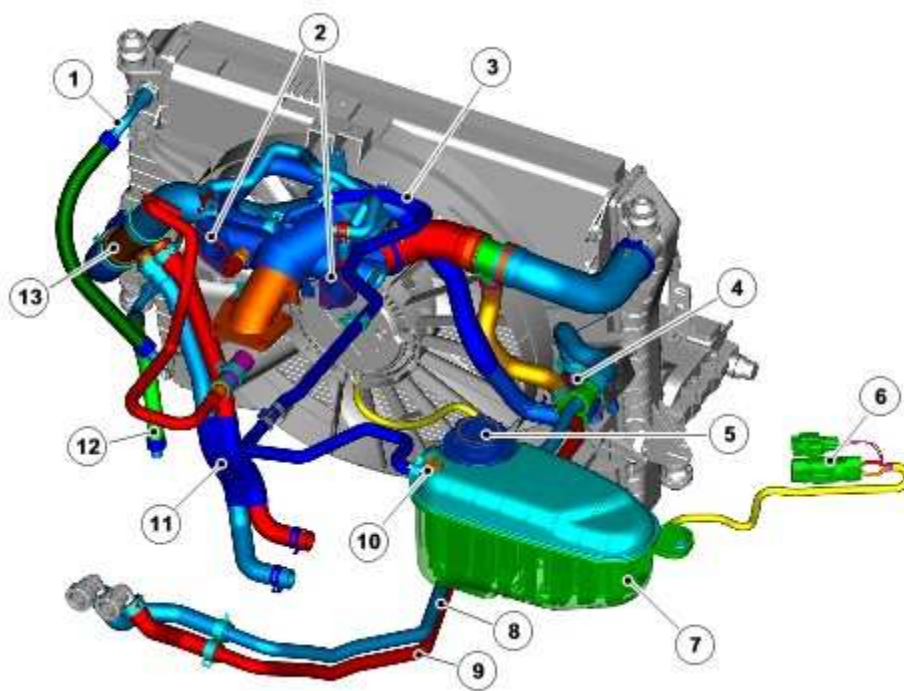
Description and operation

Engine Cooling - 4.2L NA V8 - AJV8

COMPONENT LOCATION



E63165



E77017

Item	Part Number	Description
1		Transmission oil cooler inlet
2		Engine coolant outlet
3		Vent hose
4		Auxiliary coolant flow pump
5		Cap
6		Fan harness connector
7		Expansion tank
8		Heater return pipe
9		Heater feed pipe
10		Bleed screw
11		Engine oil cooler connections
12		Transmission oil cooler outlet

13		Engine coolant inlet

INTRODUCTION



WARNING: Never remove the coolant pressure cap under any circumstances while the engine is operating. Failure to follow this instruction may result in personal injury. To avoid having scalding hot coolant or steam blow 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 turn and remove the coolant pressure cap (still with a cloth) from the coolant expansion tank. Failure to follow these instructions may result in personal injury.



WARNING: To avoid the possibility of personal injury, do not operate the engine with the hood open until the fan blades have been examined for cracks and separation. Failure to follow this instruction may result in personal injury.



WARNING: Remove fuse 38 from the Battery Junction Box (BJB) prior to performing any under hood service in the area of the cooling fan when the engine is hot, since the cooling fan motor could operate if the engine has been switched OFF. Failure to follow this instruction may result in personal injury.



CAUTION: The engine cooling system must be maintained with the correct concentration and type of anti-freeze solution to prevent corrosion and frost damage.



CAUTION: Never remove the coolant pressure cap under any circumstances while the engine is operating. Failure to follow this instruction may result in damage to the engine.

Engine cooling is via a low volume, high velocity system, which achieves a very fast warm up. The temperature of the combustion chambers is reduced along with a more even temperature distribution.

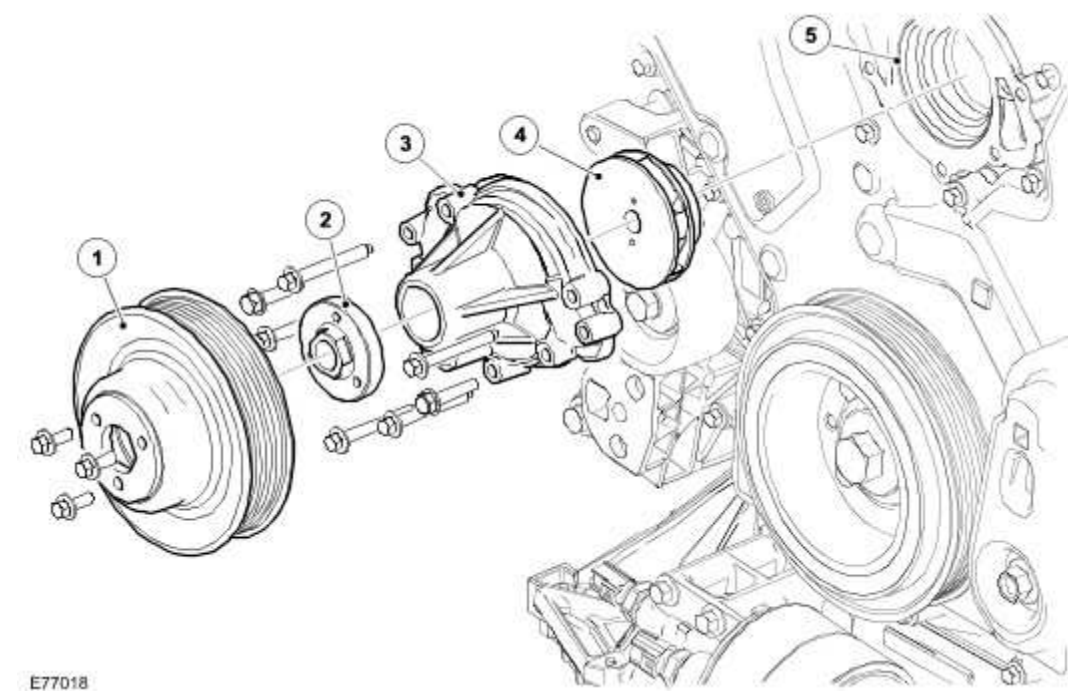
The coolant expansion tank has an integral bleed screw and coolant-level sensor. The auxiliary coolant-flow pump is fitted as standard.

The cooling-fan speed is controlled directly by the Engine Control Module (ECM) based on input data measured by the Engine Coolant Temperature (ECT) sensor, the climate control pressure-transducer and the transmission oil temperature sensor. The ECM processes this input data and outputs a Pulse Width Modulated (PWM) signal, which determines the fan speed. Should the output signal fall outside predetermined parameters, maximum fan-speed is initiated to protect the engine. High engine temperature is indicated by the illumination of the engine over-temperature warning light, located in the instrument cluster.

Where appropriate, to provide an extended period of engine cooling, the ECM continues to control the fan speed after the ignition has been turned off. For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - 4.2L)

A coolant drain plug is located at the rear of the cylinder block behind the starter motor.

COOLANT PUMP



Item	Part Number	Description
1		Pulley
2		Hub
3		Pump body

4		Impeller
5		Adapter casting

The coolant pump is fitted between the 2 cylinder banks, on the front face of the cylinder block.

The pump consists of a housing containing a shaft, with a shrouded plastic impeller on one end and a drive pulley on the other.

A pair of roller bearings supports the shaft in the housing. A seal behind the impeller prevents coolant from contaminating the bearings. Should this seal fail, coolant escapes from a witness hole in the housing indicating that immediate action is required.

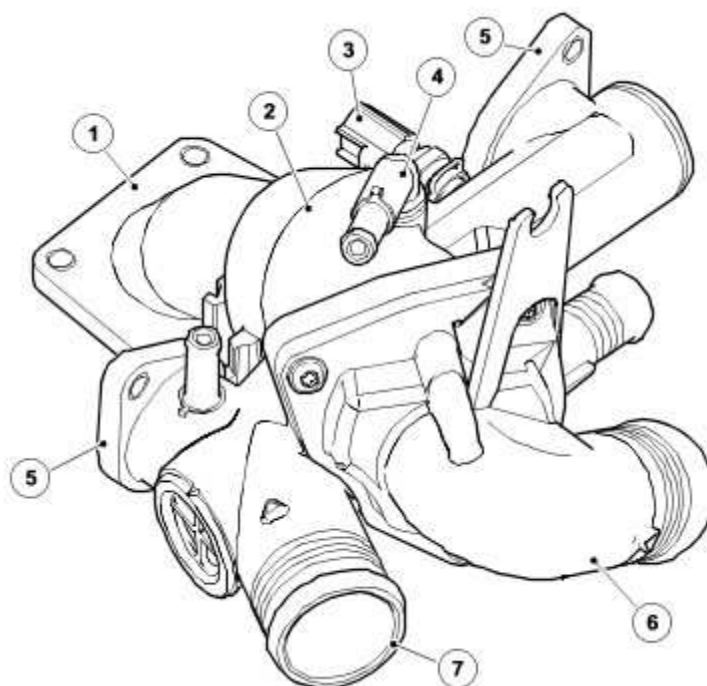
An O-ring and an aluminum-alloy gasket, seal the ports between the pump and the cylinder banks.

From the pump, coolant flows into each bank of the cylinder block. In each bank, approximately 50% of the coolant cools the cylinder bores and the remainder is diverted through the bypass gallery to the cylinder head.

With the thermostat closed, coolant returns directly to the pump through the bypass on the thermostat housing.

With the thermostat open, coolant returns to the pump via the radiator.

COOLANT OUTLET ASSEMBLY



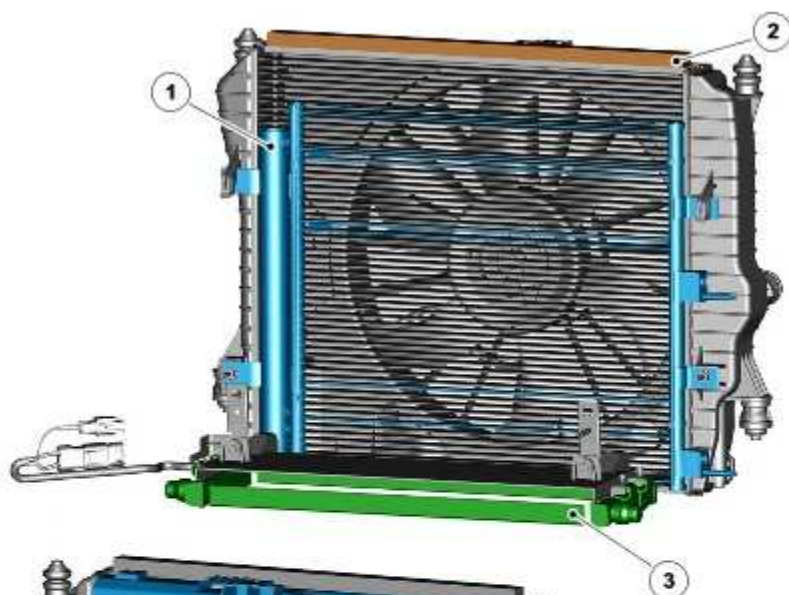
E77019

Item	Part Number	Description
1		Bypass to coolant pump
2		Thermostat housing
3		ECT sensor
4		Vent to expansion tank
5		Engine coolant outlet
6		Thermostat cover
7		Bottom hose connection

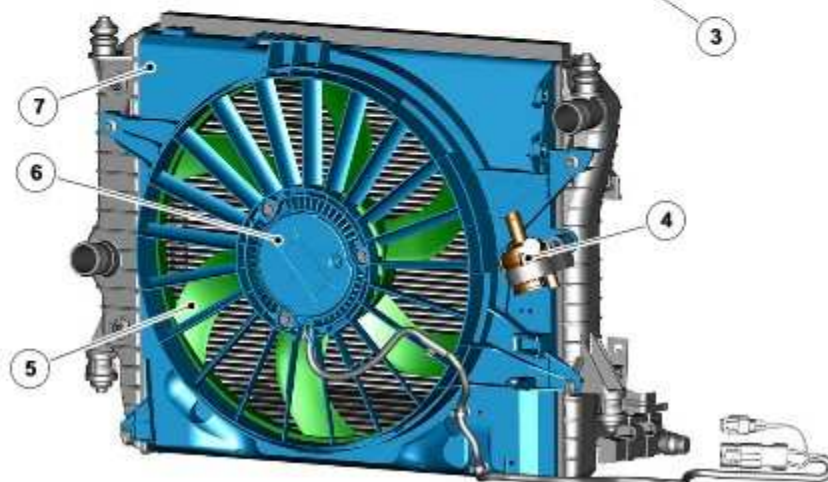
A coolant outlet plastic pipe connects to the outlet port of each cylinder head to provide a common connection point for the radiator top hose. It also incorporates the ECT sensor, which provides a signal representing coolant temperature at the cylinder heads. Controlling the coolant flow through the radiator, the thermostat starts to open at 80°C (176°F) to 84°C (183°F) and is fully open at 96°C (205°F). The outlet pipe has connections to supply the heater core and the bypass flow to the thermostat housing. An in-groove gasket seals each of the outlet-to-cylinder head joints. An aluminium gasket seals the ECT sensor to thermostat housing.

RADIATOR

A



B



E77020

Item	Part Number	Description
A		Front view
B		Rear view
1		Receiver dryer (condenser assembly)
2		Radiator assembly
3		Auxiliary radiator
4		Auxiliary coolant flow pump
5		Fan

6		Fan motor
7		Shroud

The cooling pack incorporates the radiator assembly with integral transmission oil cooler (located in the radiator outlet tank), an air conditioning condenser, and the twin fan and motor assembly.

The radiator is mounted on 4 rubber mounts, one on each end of the upper and lower face. A closing panel, which retains the radiator assembly, fits over the top of the radiator and is secured to the vehicle body.

COOLING FANS

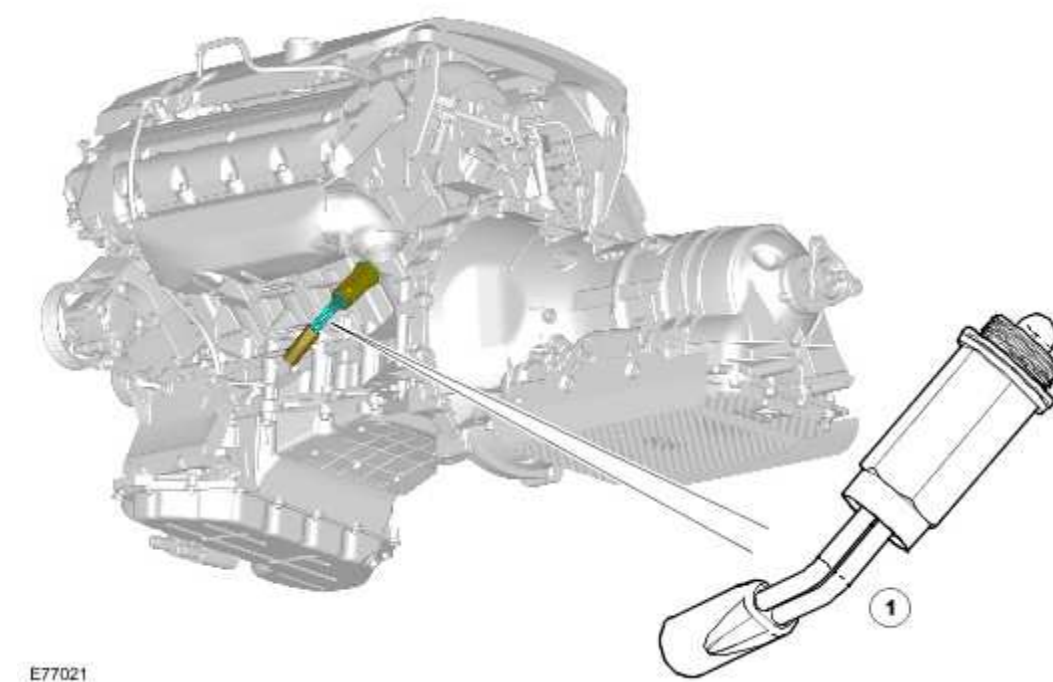
The 2 radiator cooling fans are mounted in a twin fan and motor assembly between the radiator and the engine.

The fan control module controls the fans dependent on the demand from the cooling system (temperature) or the air conditioning system (pressure).

The fan control module is located on the twin fan and motor shroud. The variable PWM module controls the fan speeds.

Under hot operating conditions, the fans may continue to operate for some time after the engine has been switched off, but will stop automatically when the coolant temperature has been sufficiently reduced. For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - 4.2L)

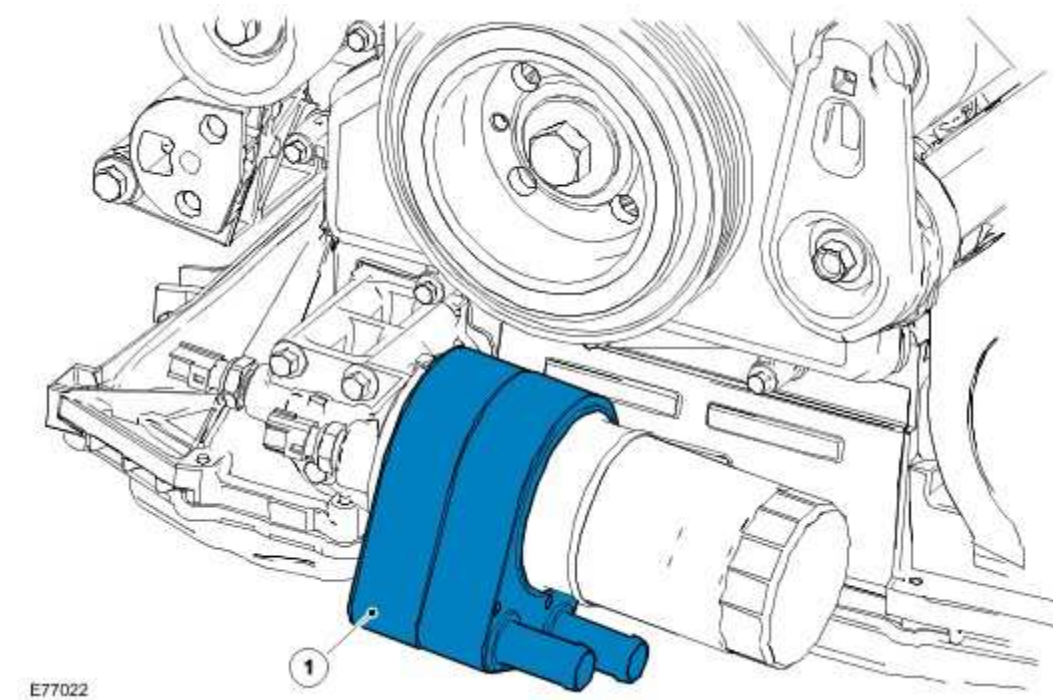
ENGINE BLOCK HEATER



Item	Part Number	Description
1		Engine block heater

For vehicle markets subject to very cold climate conditions, an engine block heater for connection to an external mains power supply, is fitted in place of the engine block drain plug.

ENGINE OIL COOLER



Item	Part Number	Description
1		Engine oil cooler

The engine oil cooler is a Modine oil to water type. The oil cooler is located at the front of the engine and is fitted between the oil filter housing and the oil filter.

The coolant supply for the engine oil cooler is through the radiator bottom hose.

COOLANT RECOVERY SYSTEM

A pressurized coolant expansion tank system is used which continuously separates the air from the cooling system and replenishes the system through the coolant expansion tank outlet hose, attached to the heater return hose.

A continuous vent from the engine and radiator to the coolant expansion tank prevents air locks from forming in the cooling system.

Manual bleed points are provided on the coolant reservoir.

The coolant expansion tank serves as the location for:

- Service fill
- Coolant expansion during warm-up
- Air separation during operation
- System pressurization by the coolant pressure cap
- The coolant expansion tank is designed to have approximately 0.5 to 1 liter of air when cold to allow for coolant expansion

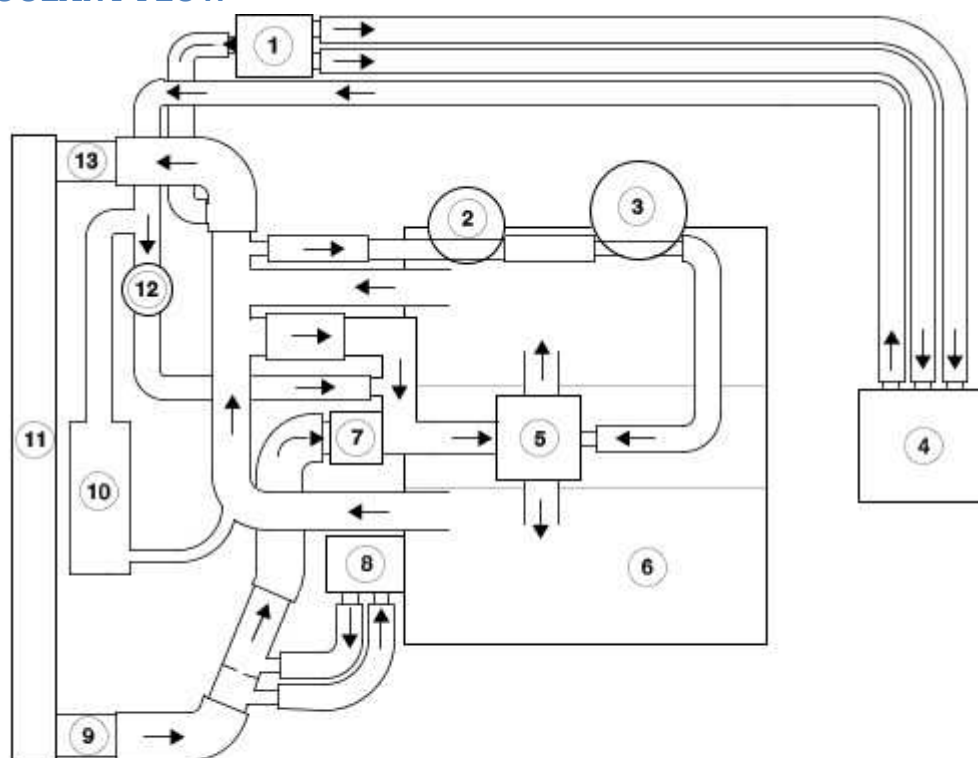
ENGINE COOLANT TEMPERATURE (ECT) SENSOR

The ECT sensor is located in the coolant outlet pipe and reacts to engine coolant temperature changes, providing an input to the ECM. The sensor is a Negative Temperature Coefficient (NTC) thermistor, decreasing in resistance as the temperature rises. For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - 4.2L)

ENGINE COOLANT

The long life engine coolant is formulated to last for 5 years or 240,000 km (150,000 miles). The coolant is silicate free and orange in color. The long life engine coolant must not be mixed with conventional engine coolant.

COOLANT FLOW



E30953

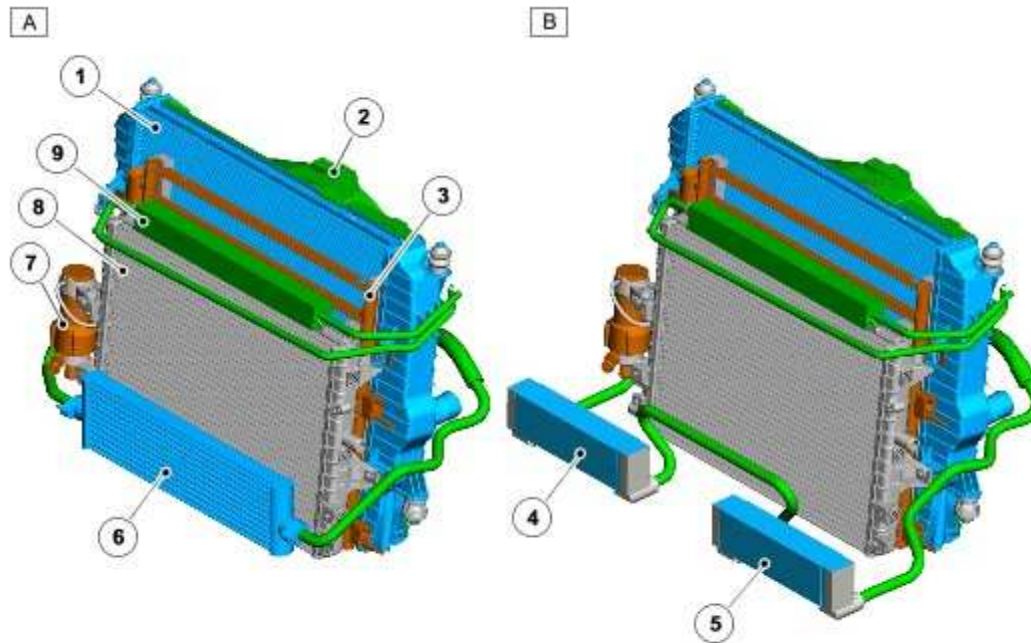
Item	Part Number	Description
1		Dual coolant flow valve
2		EGR valve
3		Throttle body
4		Heater core
5		Water pump
6		Engine bank (left-hand)
7		Thermostat
8		Engine oil cooler
9		Lower hose

10		Coolant expansion tank
11		Radiator
12		Auxiliary coolant flow pump
13		Upper hose

Engine Cooling - 4.2L SC V8 - AJV8

Authoring Template

COMPONENT LOCATION



E85539

Item	Part Number	Description
A		Single engine oil cooler variant
B		Twin engine oil cooler variant
1		Radiator assembly
2		Cooling fan shroud
3		Condenser
4		Right Hand (RH) engine oil cooler
5		Left Hand (LH) engine oil cooler
6		Engine oil cooler
7		Intercooler pump
8		Intercooler

OVERVIEW

The cooling system employed for the supercharged engine is very similar to the normally aspirated engine. The system 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 cooling module including common radiator, condenser, transmission oil cooler with additional water cooled, intake charge air radiator
- A passenger compartment heater matrix
- An engine driven coolant pump
- An electric coolant pump
- A thermostat
- An degas tank
- An electro-viscous cooling fan
- Transmission oil pipes
- Single or twin engine oil coolers
- Two charge air cooler assemblies (heat exchangers)
- Connecting hoses and pipes

ENGINE COOLING SYSTEM

A centrifugal pump mounted on the front of the engine and driven by an ancillary drive 'polyvee' belt circulates the coolant. The engine driven 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. The coolant then progresses down the 'top hose' to the heater pipe. The heater pipes lead to the bulkhead and return to the engine side of the thermostat.

The engine contains a conventional 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 thermostat housing 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 engine radiator is a cross-flow type with an aluminium matrix and has a drain tap on the lower RH rear face. There is an additional charge air radiator, located in front of the engine radiator, to support the water charge air coolers (heat exchangers) on the engine.

The coolant for the charge air cooling is driven by an electric pump at constant speed and is mounted

on the engine radiator end tank. This circuit shares the engine coolant via a vortex connection, in the engine to radiator hose. The lower engine 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 above the radiator. The radiator also incorporates 2 connections for the transmission oil pipes.

The top and bottom hoses are mounted to the inlet and outlet sides of the thermostat housing.

The degas tank is fitted forward of the LH suspension turret in the engine compartment. The degas 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 located behind the engine cooling radiator and is connected to the transmission via flexible hoses and metal pipes

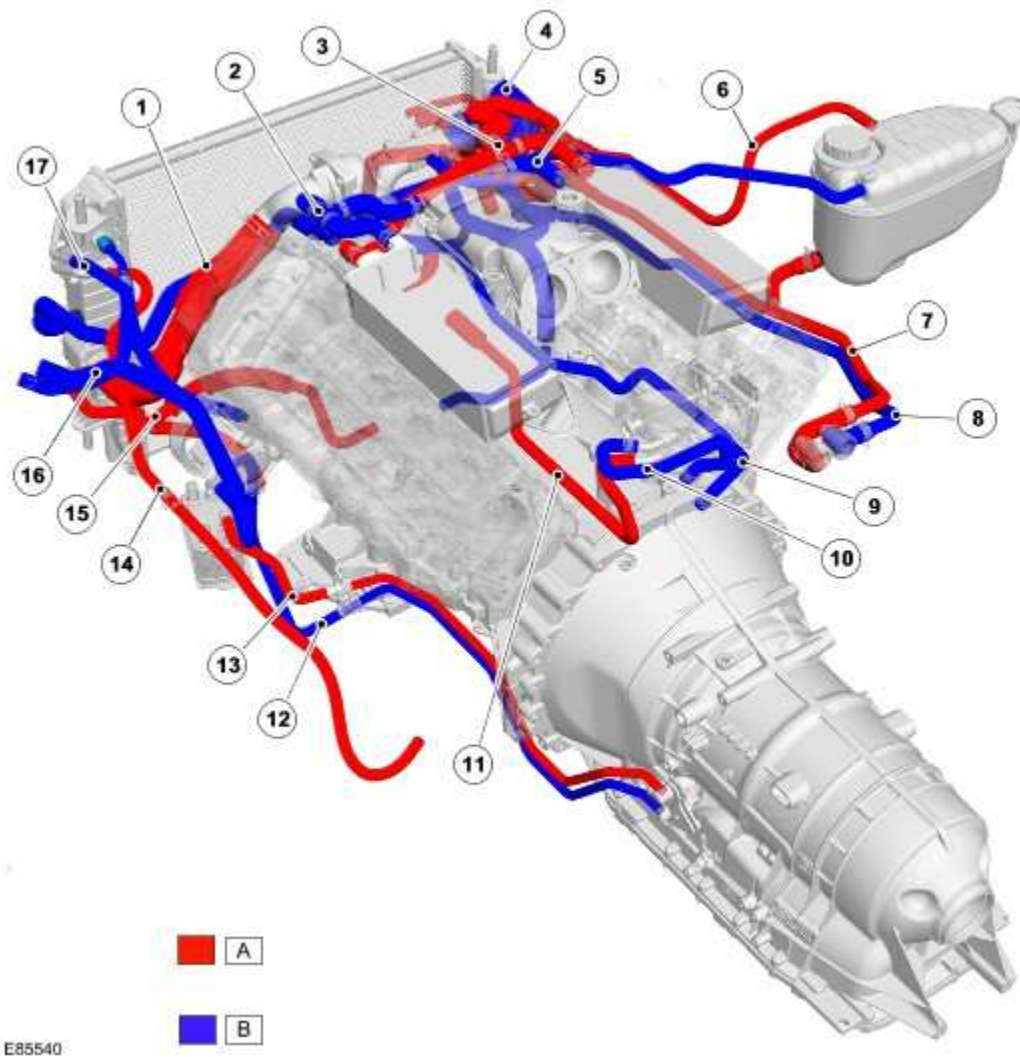
There are 2 variations of engine oil coolers available. One variant uses a single cooler located in front of the intercooler, whereas the second variant utilizes 2 coolers, 1 for each cylinder bank, also located in front of the intercooler.

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



Item	Part Number	Description
A		Hot coolant
B		Cold coolant
1		Radiator bottom hose
2		Hose assembly - Feed from intercooler radiator to LH and RH intercoolers
3		Hose assembly - Return from LH and RH intercoolers to intercooler radiator, via electric pump
4		Radiator top hose

5		Hose - Feed from RH intercooler to supercharger
6		Hose - Return from degas tank to intercooler radiator
7		Heater return pipe
8		Heater feed pipe
9		Hose - EGR coolant inlet
10		Hose - Feed to throttle heating assembly
11		Hose - Return from throttle heating assembly
12		Transmission oil cooler feed pipe
13		Transmission oil cooler return pipe
14		Hose - Power steering cooler return
15		Transmission oil cooler return pipe
16		Hose - Power steering cooler to reservoir feed
17		Hose - Power steering pump feed

When the engine is running the coolant pump is driven by the ancillary drive belt. This forces coolant to circulate around the engine and heater, 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 and the engine oil coolers begin 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 ECM via the Engine Coolant temperature (ECT) sensor located in the cylinder head. The ECM uses signals from this sensor to control the cooling fan operation and adjust fuelling according to engine temperature.

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 ECM operates the fan in response to inputs from the ECT sensor, the transmission oil temperature sensor, the A/C switch and the A/C pressure sensor.

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.

Engine Cooling

Principle of Operation

For a detailed description of the cooling system operation, refer to the relevant Description and Operation section of the workshop manual.

Engine Cooling - 4.2L NA V8 - AJV8

Inspection and Verification

1 . Verify the customer concern.

2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
- Leaks - Coolant expansion tank - Electric fan - Radiator	- Fuse - Wiring harness - Loose or corroded connector(s) - Engine Coolant Temperature (ECT) sensor

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 there are clear symptoms refer to the table below, alternatively, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Cause	Action
Coolant loss	- Hoses - Hose connections - Radiator - Coolant pump - Heater core - Gaskets - Engine casting cracks - Engine block core plugs	GO to Pinpoint Test G552274p1.
Engine overheating	- Engine coolant (level/condition) - Thermostat - Fan motor	GO to Pinpoint Test G552274p2.

	• Fan motor fuses and/or circuits • ECT sensor • Engine control module (ECM) • Fan speed module	
Engine not reaching normal operating temperature	• Thermostat • Electric fan • Fan speed module	• GO to Pinpoint Test G552274p3.

DTC Index



CAUTION: When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00.

NOTE:

Generic scan tools may not read the codes listed, or may read only five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give extra information read by the manufacturer approved diagnostic system).

NOTE:

When performing voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with a current calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE:

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE:

If DTCs 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.

DTC	Description	Possible Cause	Action
P011623	Engine Coolant Temperature (ECT) sensor circuit - range/performance - signal stuck low	• Low coolant level • ECT sensor sensing circuit - intermittent high resistance • Engine thermostat failure • ECT sensor failure	• Fill cooling system to correct level and specification. Specifications • Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check and install new engine thermostat as necessary. Thermostat - Vehicles Without: Supercharger (26.45.07) • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P011624	Engine Coolant Temperature (ECT) sensor circuit - range/performance - signal stuck high	• Low coolant level • ECT sensor sensing circuit - intermittent high resistance • Engine thermostat failure • ECT sensor failure	• Fill cooling system to correct level and specification. Specifications • Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check and install new engine thermostat as necessary. Thermostat - Vehicles Without: Supercharger (26.45.07) • Install a new ECT sensor as necessary. Engine Coolant

			Temperature (ECT) Sensor (18.30.10)
P011629	Engine Coolant Temperature (ECT) sensor circuit - range/performance - signal invalid	• Low coolant level • ECT sensor sensing circuit - intermittent high resistance • Engine thermostat failure • ECT sensor failure	• Fill cooling system to correct level and specification. Specifications • Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check and install new engine thermostat as necessary. Thermostat - Vehicles Without: Supercharger (26.45.07) • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P011700	Engine Coolant Temperature (ECT) sensor circuit - low input	• ECT sensor sensing circuit - short to power, high resistance, open circuit, disconnected • ECT sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P011800	Engine Coolant Temperature (ECT) sensor circuit - high input	• Engine overheat condition/cooling fan failure • ECT sensor sensing circuit - short to ground • ECT sensor failure	• Check for cooling fan circuit DTCs and refer to relevant action specified in DTC Index • Carry out any

			pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P012500	Insufficient coolant temperature for closed loop fuel control	• Low coolant level • ECT sensor sensing circuit - intermittent high resistance • Engine thermostat failure • ECT sensor failure	• Fill cooling system to correct level and specification. Specifications • Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check and install new engine thermostat as necessary. Thermostat - Vehicles Without: Supercharger (26.45.07) • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P012800	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	• Low/contaminated coolant • Thermostat • Cooling fan circuit(s)/module	GO to Pinpoint Test G552274p3.
P048023	Electric fan control circuit low	• Electric fan control circuit - short to ground, high resistance	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system
P048024	Electric fan control circuit high	Electric fan control circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P048309	Fan rationality check	- Cooling fan obstructed - Fan/motor damaged	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - CLEAR any obstruction and INSTALL a new fan as necessary. Cooling Fan Motor and Shroud - Vehicles Without: Supercharger (26.25.25)
P048316	Fan rationality check	Fan control module reports battery voltage less than nine volts	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - CHECK the battery condition - CHECK the charging system and fan circuits
P048317	Fan rationality check	Fan control module reports battery voltage greater than 18 volts	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - CHECK the charging system

			and fan circuits
P048397	Fan rationality check	Cooling fan jammed	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - CLEAR any obstruction and INSTALL a new fan as necessary. Cooling Fan Motor and Shroud - Vehicles Without: Supercharger (26.25.25)

Pinpoint Tests

PINPOINT TEST G552274p1 : LOSS OF COOLANT

G552274t2 : VISUAL INSPECTION

1. Visually inspect for loss of coolant. 2. Carry out a system pressure test. See component tests in this section.

- Is the engine cooling system leaking?

-> **Yes**

Rectify the leak as indicated by the test result. Top-up and fill the cooling system to the correct level with the correct specification fluid as necessary.

Specifications

Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8 TEST the system for correct operation.

-> **No**

Verify the customer complaint.

PINPOINT TEST G552274p2 : THE ENGINE OVERHEATS

G552274t3 : CHECK COOLANT

1. Check the coolant level and condition.

- **Does the system contain sufficient coolant of the correct specification?**

-> **Yes**

GO to Pinpoint Test G552274t1.

-> **No**

Top-up and fill the cooling system to the correct level with the correct specification fluid as necessary.

Specifications

Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8 Check for coolant loss. GO to Pinpoint Test G552274p1.

G552274t1 : CHECK COOLANT EXPANSION TANK PRESSURE CAP

1. Check the coolant expansion tank pressure cap for damage/correct operation. REFER to the coolant expansion tank pressure cap pressure test in this section.

- **Is the coolant expansion tank pressure cap operating correctly?**

-> **Yes**

GO to Pinpoint Test G552274t4.

-> **No**

INSTALL a new coolant expansion tank pressure cap. TEST the system for correct operation.

G552274t4 : CHECK THERMOSTAT

1. Check the thermostat for correct operation. REFER to the thermostat component test in this section.

- **Is the thermostat operating correctly?**

-> **Yes**

Check for correct operation of cooling fans, circuits, sensors, modules, etc.

Electronic Engine Controls

-> **No**

INSTALL a new thermostat.

Thermostat - Vehicles Without: Supercharger (26.45.07) TEST the system for correct operation.

PINPOINT TEST G552274p3 : THE ENGINE DOES NOT REACH NORMAL OPERATING TEMPERATURE

G552274t5 : CHECK THERMOSTAT

1. Check the thermostat for correct operation. REFER to the thermostat component test in this section.

- **Is the thermostat operating correctly?**

-> **Yes**

Check for correct operation of cooling fans, circuits, sensors, modules, etc.
Electronic Engine Controls

-> **No**

INSTALL a new thermostat.

Thermostat - Vehicles Without: Supercharger (26.45.07) TEST the system for correct operation.

Component Tests

Cooling System Pressure Test



WARNING: Never, under any circumstances, remove the coolant expansion tank pressure cap while the engine is operating. To avoid having scalding hot water or steam blow out of the cooling system, use extreme care when removing the coolant expansion tank pressure cap from a hot cooling system. Wait until the engine has cooled, then wrap a thick cloth around the coolant expansion tank 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 expansion tank pressure cap. Failure to follow these instructions may result in damage to the cooling system, engine and/or cause personal injury.

1 . Switch the engine off.

2 . Open the hood and install protective fender covers.

3 . Carefully remove the coolant expansion tank pressure cap from the coolant expansion tank to relieve pressure in the cooling system. Add coolant to coolant expansion tank as necessary.

4 . Install the pressure tester equipment to the cooling system following manufacturers instructions. Reinstall the coolant expansion tank pressure cap (if pressure test equipment is not installed to the coolant expansion tank).

5 . Pressurize the cooling system to the coolant expansion tank pressure cap lower limit.

6 . Observe the gauge reading for approximately two minutes. Pressure should not drop during this time.

➤ If system holds pressure, continue from step 8.

If the pressure drops, check the complete cooling system for leaks. Also refer to engine system

➤ checks if a leak cannot be located in the cooling system. Correct any leaks found and recheck the system.

7 . Release the system pressure and remove the pressure test equipment. Check the coolant level. Replenish as necessary with the correct coolant solution.
Specifications

8 . Check the radiator overflow hose for any obstructions which may block the flow of coolant either to or from the coolant expansion tank.

9 . Conduct the coolant expansion tank pressure cap pressure test in this section.

Coolant Expansion Tank Pressure Cap Pressure Test



WARNING: Never, under any circumstances, remove the coolant expansion tank pressure cap while the engine is operating. To avoid having scalding hot water or steam blow out of the cooling system, use extreme care when removing the coolant expansion tank pressure cap from a hot cooling system. Wait until the engine has cooled, then wrap a thick cloth around the coolant expansion tank 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 expansion tank pressure cap. Failure to follow these instructions may result in damage to the cooling system, engine and/or cause personal injury.

1 . Remove the expansion tank pressure cap from the coolant expansion tank.

2 . Use water to clean cap in area of rubber seal and vacuum relief valve. Following manufacturers instructions, install the coolant expansion tank pressure cap to the pressure tester.

3 . **NOTE:**

If the pressure tester is pressurised too quickly, an erroneous pressure reading may result.

Slowly pressurise the system until the pressure gauge reading stops increasing, and note highest pressure reading obtained.

4 . Release pressure and repeat Step 3 at least twice to make sure the pressure test reading is repeatable and within specification.

5 . If the pressure test gauge readings are not within specification, install a new coolant expansion tank pressure cap.

Thermostat Test

Remove the thermostat

Thermostat - Vehicles Without: Supercharger (26.45.07) Inspect for visible damage, note its opening temperature and immerse it in water. Heat the water until this temperature is reached. The thermostat should begin to open. If it does not begin to open, install a new thermostat.

Thermostat - Vehicles Without: Supercharger (26.45.07) If thermostat begins to open, continue to heat the water until the thermostat fully opens, 5.8 mm (0.2 in) or more off the seat. If it does not fully open, install a new thermostat.

Thermostat - Vehicles Without: Supercharger (26.45.07)

Radiator Leak Test - Removed from the Vehicle



CAUTION: Do not leak test an aluminium radiator in the same water that is used to leak test copper/brass radiators. Flux and caustic cleaners may be present in the test water which will corrode aluminium. If a separate tank is not available, drain and rinse the test tank before testing an aluminium radiator.

Clean the radiator before leak testing to prevent contamination of the test tank. Leak test the radiator in clean water with 138 kPa (20 psi) air pressure.

Coolant Expansion Tank (26.15.01)

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: Anti-freeze concentration must be maintained at 50%.



CAUTION: Correct installation of the coolant expansion tank cap can be obtained by tightening the cap until an audible click is heard.

1



- **WARNING:** Release the cooling system pressure by slowly turning the coolant expansion tank cap a quarter of a turn. Cover the expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow this instruction may result in personal injury.

Remove the coolant expansion tank cap.

- 2 . Clamp the relevant hoses, to minimise the coolant loss.

3



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

NOTE:

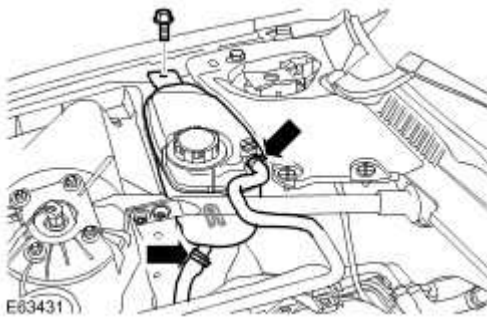
Some fluid spillage is inevitable during this operation.

Disconnect the 2 hoses from the coolant expansion tank.

- ▶ Position a container to collect spillage.
- ▶ Release the clips.

4 . Remove the coolant expansion tank.

- ▶ Remove the bolt.



Installation

1 . Install the coolant expansion tank.

- ▶ Install the bolt and tighten to 7 Nm (5 lb.ft).

2 . Disconnect the 2 hoses from the coolant expansion tank.

- ▶ Remove the container.
- ▶ Position and secure the clips.

3 . Remove the coolant hose clamps.

4 . Top-up the coolant.

5



- **CAUTION: Correct installation of the coolant expansion tank cap can be obtained by tightening the cap until an audible click is heard.**

Install the coolant expansion tank cap.

Cooling Fan Motor and Shroud - Vehicles With: Supercharger (26.25.25)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications

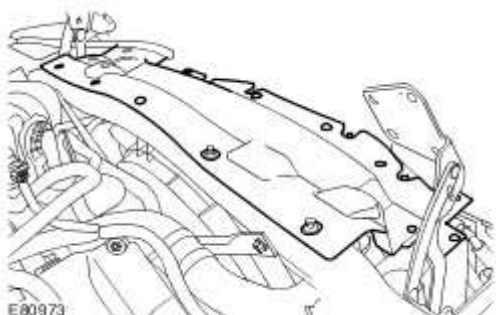
- 2 . Raise and support the vehicle.

- 3 . Remove the intake air resonator.
For additional information, refer to Intake Air Resonator

- 4 . Remove the hood.
For additional information, refer to Hood (76.16.01)

- 5 . Remove the fan cowl.

 Remove the 15 clips.



- 6 . Release the power steering fluid reservoir.

 Remove the 2 bolts.

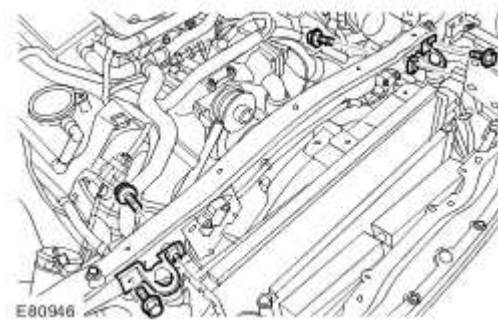


7 . Disconnect the 2 front impact sensor electrical connectors.



8 . Remove the radiator upper mountings.

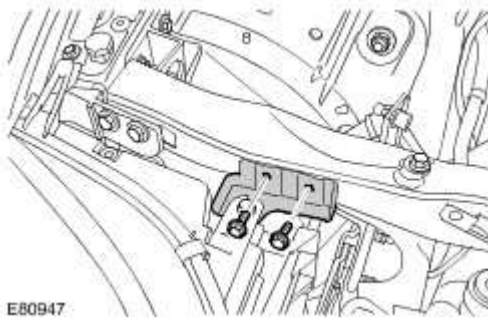
➤ Remove the 4 bolts.



9 . Release the headlamp to front crossmember bracket.

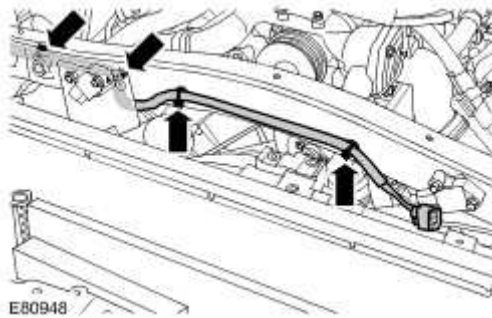
➤ Remove the 2 bolts.

➤ Repeat the above procedure for the other side.



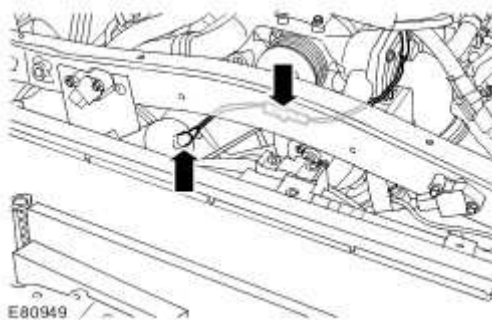
10 . Release the wiring harness.

▶ Release the 4 clips.



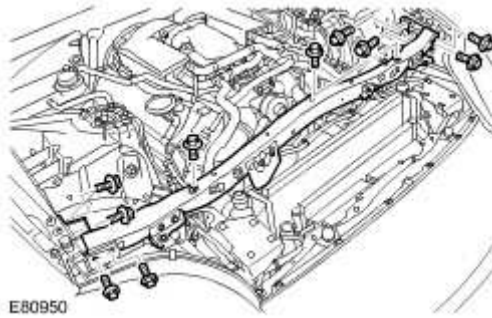
11 . Disconnect the secondary air injection (AIR) reservoir vacuum line.

▶ Release the clip.



12 . Remove the front crossmember.

▶ Remove the 10 bolts.



13 Drain the coolant.

- For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8

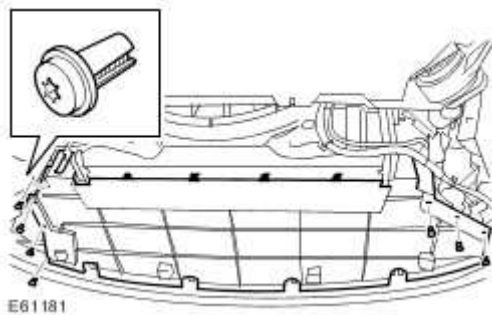
14 . Remove the radiator splash shield.

For additional information, refer to Radiator Splash Shield (76.22.90)

15 . Remove the front bumper air ducting.

▶ Remove the 7 clips.

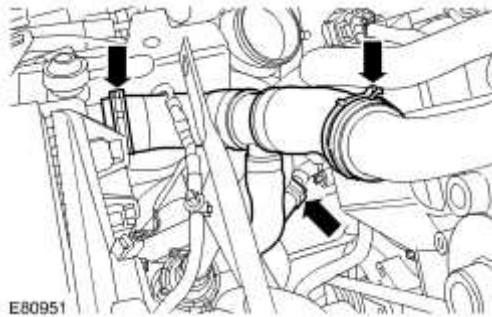
▶ Release the 4 clips.



16 . Remove the radiator top hose.

▶ Release the 2 clips.

▶ Disconnect the quick release connector.



17 . Release the auxiliary coolant pump.

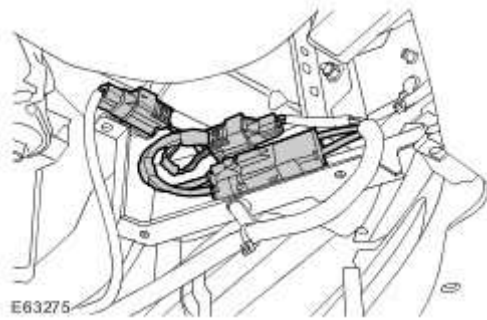
▶ Disconnect the electrical connector.

▶ Release from the rubber mounting.



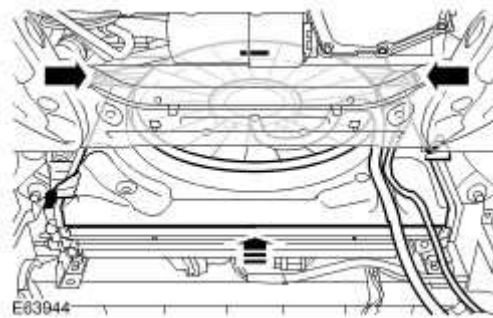
18 . Release the cooling fan motor and shroud.

▶ Disconnect the electrical connectors.



19 . Remove the cooling fan motor and shroud.

- ▶ Remove the 2 bolts.
- ▶ Release from the 3 retainers.



Installation

1 . Install the cooling fan motor and shroud.

- ▶ Secure in the retainers.
- ▶ Tighten the bolts.

2 . Secure the cooling fan motor and shroud.

- ▶ Connect the electrical connectors.

3 . Install the auxiliary coolant pump.

- ▶ Secure in the rubber mounting.
- ▶ Connect the electrical connector.

4 . Install the front bumper air ducting.

- ▶ Secure with the clips.

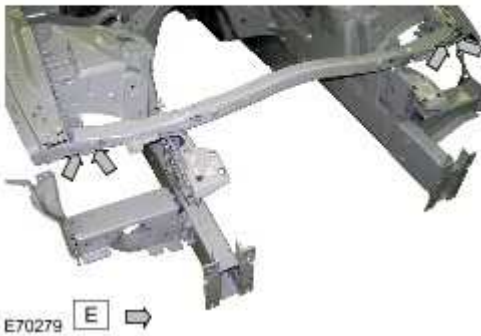
5 . Install the radiator top hose.

- ▶ Connect the quick release connector.
- ▶ Secure with the clips.

6 . Install the front crossmember.

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

7 . Tighten the front crossmember to apron panel front extension bolts to 20 Nm (15 lb.ft).



8 . Tighten the front crossmember to fender apron panel reinforcement bolts to 30 Nm (22 lb.ft).



9 . Tighten the front crossmember to front side member extension bolts to 25 Nm (18 lb.ft).



10 . Secure the headlamps.

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



11 . Connect the AIR reservoir vacuum line.

12 . Install the radiator splash shield.

For additional information, refer to Radiator Splash Shield (76.22.90)

13 . Attach the wiring harness.

▶ Secure the clips.

14 . Install the radiator upper mountings.

▶ Tighten the Torx bolts to 25 Nm (18 lb.ft).

15 . Connect the 2 front impact sensor electrical connectors.

16 . Secure the power steering fluid reservoir.

▶ Tighten the bolts to 6 Nm (4 lb.ft).

17 . Install the fan cowl.

 Secure with the clips.

18 . Install the hood.

For additional information, refer to Hood (76.16.01)

19 . Install the intake air resonator.

For additional information, refer to Intake Air Resonator

20 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

21 Top-up and bleed the coolant.

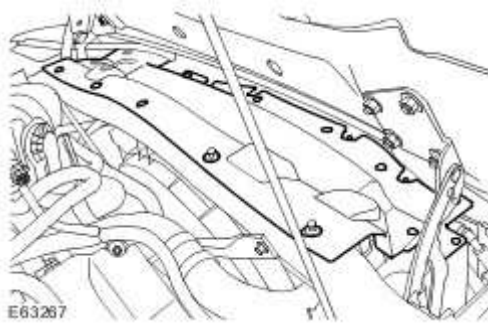
- . For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8
- AJV8

Radiator - Vehicles Without: Supercharger (26.40.01)

Removal

- 1 . Raise and support the vehicle.
- 2 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications
- 3 . Remove the fan cowl.

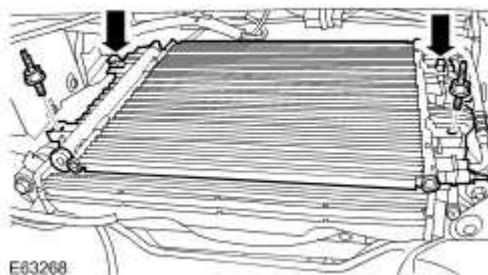
▶ Remove the 15 clips.



- 4 . Release the A/C condenser.

▶ Remove the 2 bolts.

▶ Release from the 2 retainers and tie aside.



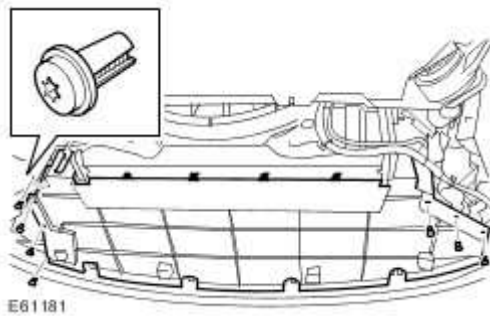
5 . Remove the radiator splash shield.

For additional information, refer to Radiator Splash Shield (76.22.90)

6 . Remove the front bumper air ducting.

➤ Remove the 7 clips.

➤ Release the 4 clips.



7



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 - 4.2L NA V8 - AJV8

8 . Remove the air intake duct.

➤ Release the breather hose.

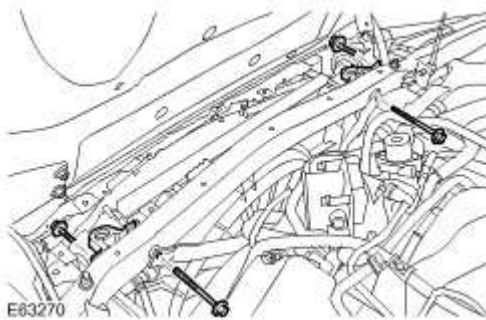
➤ Release the 2 clips.

➤ Remove the bolt.



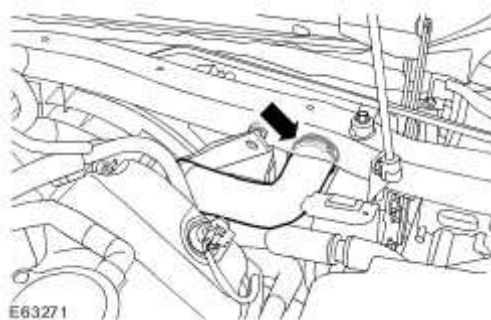
9 . Remove the radiator upper mountings.

▶ Remove the 4 bolts.



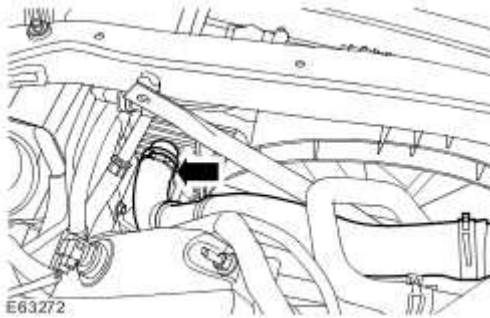
10 . Disconnect the radiator upper hose.

▶ Release the clip.



11 . Disconnect the radiator lower hose.

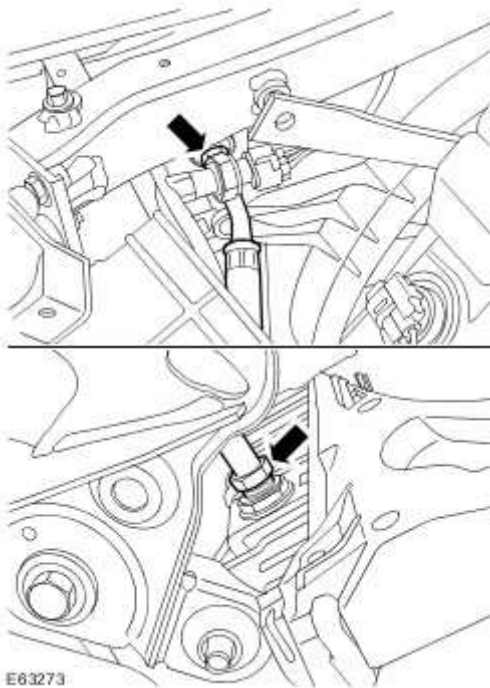
- ▶ Release the clip.



12.  **CAUTION: Always plug any open connections to prevent contamination.**

Disconnect the transmission cooler hoses.

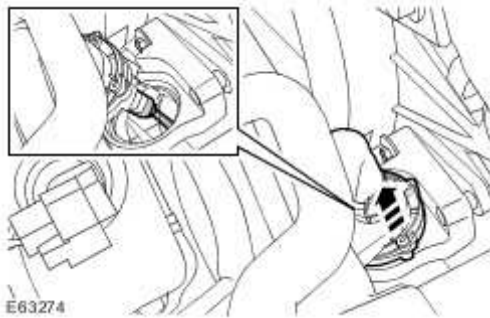
- ▶ Position a container to collect the fluid.
- ▶ Disconnect the 2 unions.
- ▶ Remove and discard both O-ring seals.



13 . Release the auxiliary coolant pump.

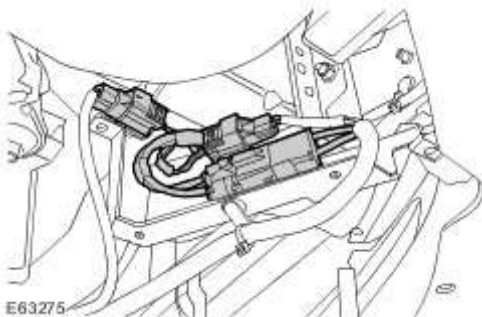
▶ Disconnect the electrical connector.

▶ Release from the rubber mounting.



14 . Release the radiator assembly.

▶ Disconnect the electrical connectors.



15 . **NOTE:**

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

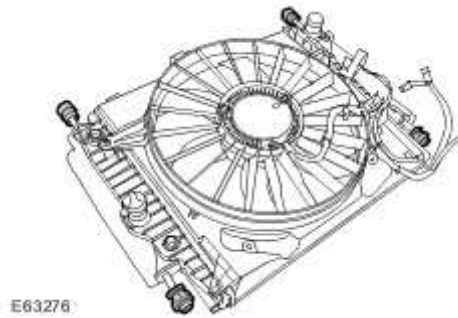
NOTE:

The radiator is removed from beneath the vehicle.

Remove the radiator assembly.

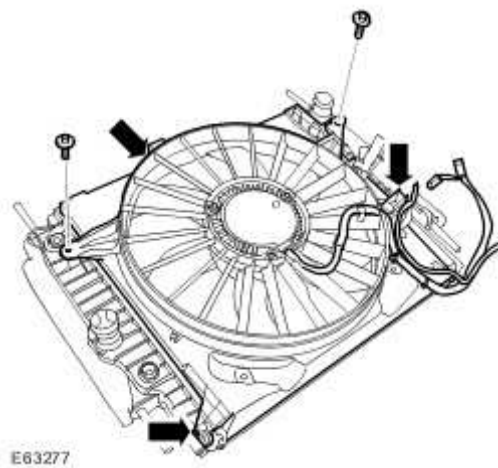
- ▶ Protect the elements from damage.
- ▶ Lift the radiator clear of its mountings.

16 . Remove the radiator rubber mountings



17 . Remove the cooling fan.

- ▶ Remove the 2 bolts.
- ▶ Release from the 3 retainers.



Installation

1 . Install the cooling fan.

▶ Secure in the retainers.

▶ Tighten the bolts.

2 . Install the radiator rubber mountings

3 . Install the radiator assembly.

▶ Protect the elements from damage.

▶ Lift the radiator onto its mountings.

4 . Secure the radiator assembly.

▶ Connect the electrical connectors.

5 . Install the auxiliary coolant pump.

▶ Secure in the rubber mounting.

▶ Connect the electrical connector.

6 . Connect the transmission cooler hoses.

▶ Install new O-ring seals.

▶ Tighten the unions to 20 Nm (15 lb.ft).

7 . Connect the radiator lower hose.

▶ Secure with the clip.

8 . Connect the radiator upper hose.

 Secure with the clip.

9 . Install the radiator upper mountings.

 Tighten the Torx bolts to 23 Nm (17 lb.ft).

10 . Install the air intake duct.

 Secure with the clips.

 Connect the breather hose.

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

11 Refill the cooling system.

. For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8

12 . Install the front bumper air ducting.

 Secure with the clips.

13 . Install the radiator splash shield.

For additional information, refer to Radiator Splash Shield (76.22.90)

14 . Secure the A/C condenser.

 Secure in the retainers.

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

15 . Install the fan cowl.

 Secure with the clips.

16 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

17 . Check and top-up the transmission fluid level.

For additional information, refer to Transmission Fluid Level Check

Radiator - Vehicles With: Supercharger (26.40.01)

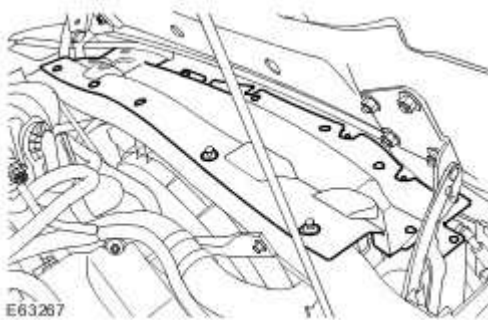
Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications

- 2 . Remove the intake air resonator.
For additional information, refer to Intake Air Resonator

- 3 . Remove the fan cowl.

▶ Remove the 15 clips.



- 4 . Release the trim panel.

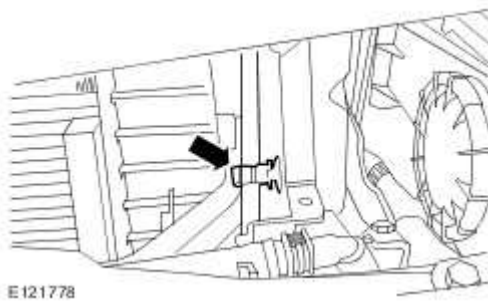
▶ Release the LH headlamp washer hose.

▶ Release the 2 wiring harness retaining clips.

▶ Remove the scrivet.



5 . Release the clip.



6 . Raise and support the vehicle.

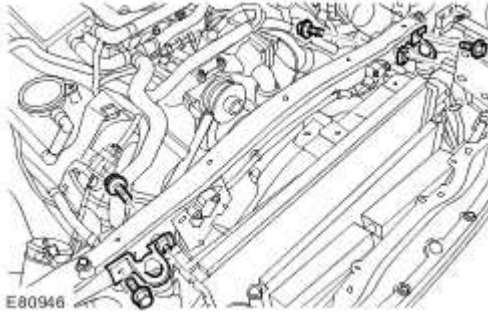
7 . Remove the air conditioning (A/C) condenser.

For additional information, refer to Condenser Core - 4.2L SC V8 - AJV8 (82.15.07)

8 . Lower the vehicle.

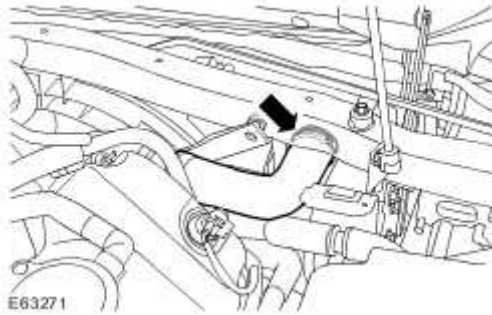
9 . Remove the radiator upper mountings.

▶ Remove the 4 bolts.



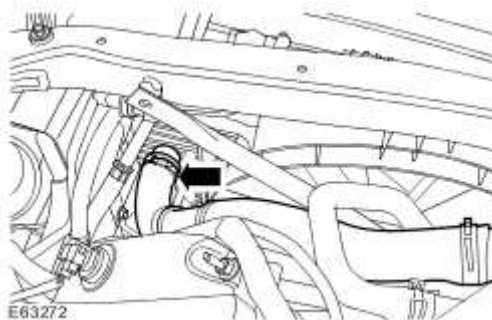
10 . Disconnect the radiator upper hose.

▶ Release the clip.



11 . Disconnect the radiator lower hose.

▶ Release the clip.



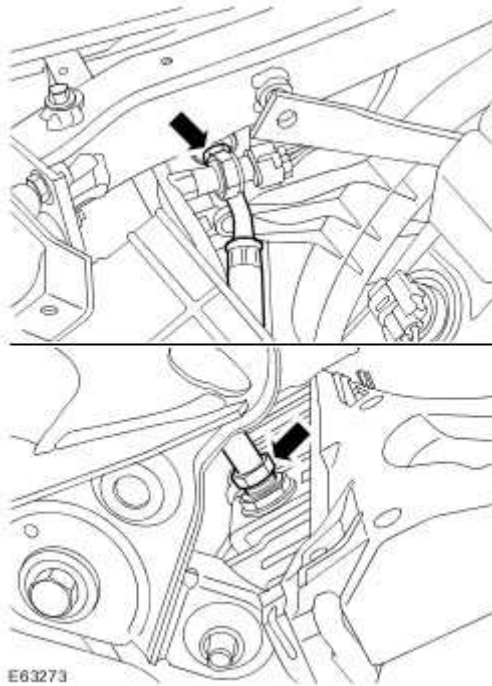
12 .



CAUTION: Always plug any open connections to prevent contamination.

Disconnect the 2 transmission cooler lines.

- ▶ Position a container to collect the fluid.
- ▶ Disconnect the 2 unions.
- ▶ Remove and discard both O-ring seals.



13 . Release the auxiliary coolant pump.

- ▶ Disconnect the electrical connector.
- ▶ Release from the rubber mounting.

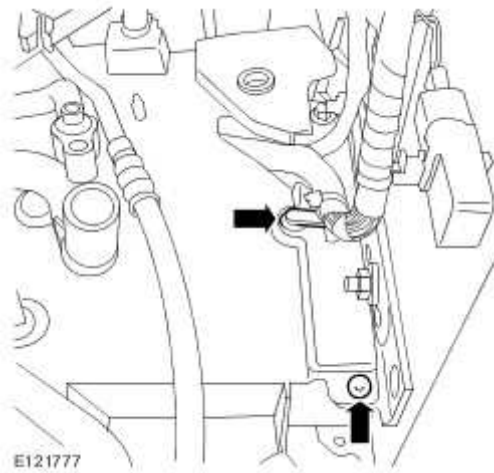


14 . Raise the vehicle.

15 . Remove the trim panel.

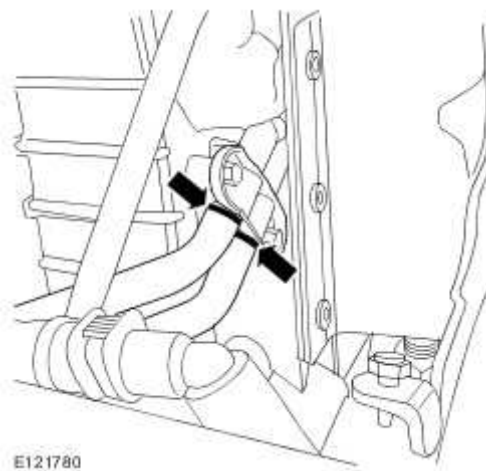
▶ Remove the scrivet.

▶ Release the wiring harness fir tree clip.



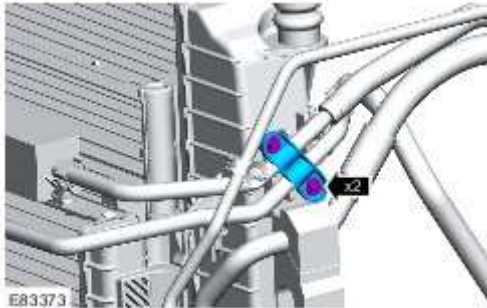
16 . Lower the vehicle.

17 . Mark the position of the power steering fluid cooler pipes.



18 . Release the power steering fluid cooler.

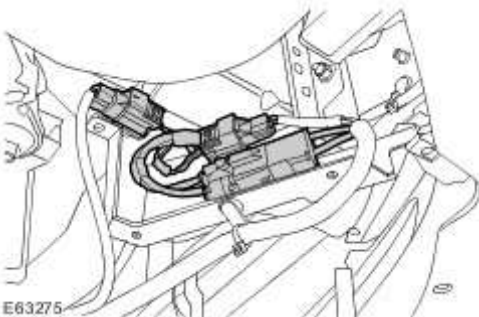
▶ Remove the 2 bolts.



19 . Raise the vehicle.

20 . Release the radiator assembly.

▶ Disconnect the 3 electrical connectors.



21 . **NOTE:**

The radiator is removed from beneath the vehicle.

Remove the radiator assembly.

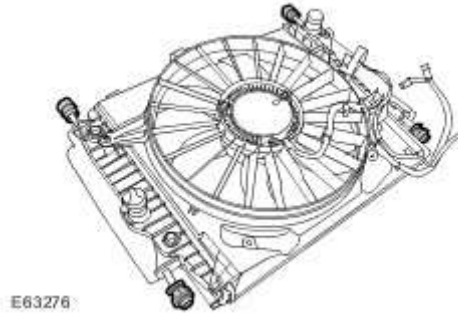
▶ Protect the elements from damage.

▶ Lift the radiator clear of its mountings.

22 . NOTE:

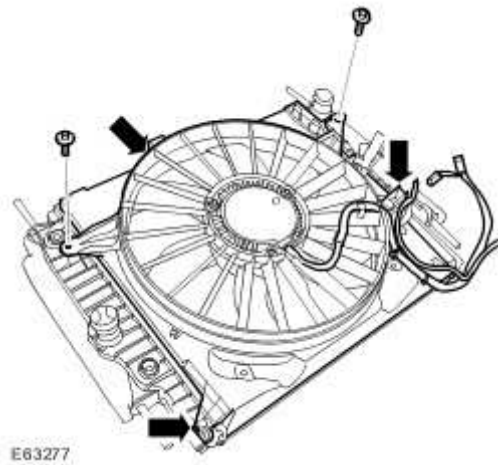
Do not disassemble further if the component is removed for access only.

Remove the radiator rubber mountings



23 . Remove the cooling fan.

- ▶ Remove the 2 bolts.
- ▶ Release from the 3 retainers.



Installation

- 1 . Install the cooling fan.

- ▶ Secure in the retainers.

- ▶ Tighten the bolts.

2 . Install the radiator rubber mountings

3 . Install the radiator assembly.

- ▶ Protect the elements from damage.

- ▶ Lift the radiator onto its mountings.

- ▶ Connect the electrical connectors.

4 . Lower the vehicle.

5 Attach the power steering fluid cooler.

- ▶ Align the power steering fluid cooler pipes clamp to the marks made previously.

- ▶ Tighten the bolts to 7 Nm (5 lb.ft).

6 . Install the auxiliary coolant pump.

- ▶ Secure in the rubber mounting.

- ▶ Connect the electrical connector.

7 . Connect the transmission cooler lines.

- ▶ Clean the components.

- ▶ Install new O-ring seals.

 Tighten the unions to 20 Nm (15 lb.ft).

8 . Connect the radiator lower hose.

 Secure with the clip.

9 . Connect the radiator upper hose.

 Secure with the clip.

10 . Install the radiator upper mountings.

 Tighten the Torx bolts to 23 Nm (17 lb.ft).

11 . Raise the vehicle.

12 . Install the trim panel.

 Install the scrivet.

 Secure the wiring harness.

13 . Install the A/C condenser.

For additional information, refer to Condenser Core - 4.2L SC V8 - AJV8 (82.15.07)

14 . Lower the vehicle.

15 . Secure the trim panel.

 Install the scrivet.

 Secure the 2 wiring harness clips.

 Secure the LH headlamp washer hose.

16 . Install the fan cowl.

 Secure with the clips.

17 . Install the intake air resonator.

For additional information, refer to Intake Air Resonator

18 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

19 . Check and top-up the transmission fluid level.

For additional information, refer to Transmission Fluid Level Check

Thermostat - Vehicles With: Supercharger (26.45.07)

Removal

1 . Remove the cover and disconnect the battery ground cable.

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 coolant.

· For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8

4 . Disconnect the thermostat housing coolant hose.

▶ Position an absorbent cloth to collect fluid spillage.

▶ Release the clip.

5 . Remove the thermostat housing.

▶ Remove the 3 bolts.

▶ Remove and discard the O-ring seal.



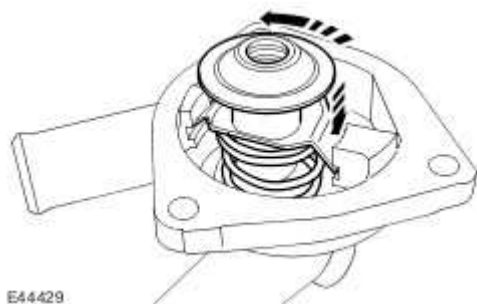
- 6 .  **WARNING: Eye protection must be worn.**

NOTE:

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

Release and remove the thermostat.

-  Position the thermostat housing in a vice.



Installation

- 1 . Install the thermostat.

-  Clean the components.

- 2 . Install the thermostat housing.

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

3 . Connect the thermostat housing coolant hose.

- ▶ Secure with the clip.

4 . Connect the battery ground cable and install the cover.

5 Top-up and bleed the coolant.

- . For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8

6 **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

Thermostat - Vehicles Without: Supercharger (26.45.07)

Removal



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



CAUTION: Anti-freeze concentration must be maintained at 50%.

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to Specifications

- 2 . Remove the engine cover.

For additional information, refer to Engine Cover (76.11.35)

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 - 4.2L NA V8

- AJV8

- 4 . Disconnect the thermostat housing coolant hose.

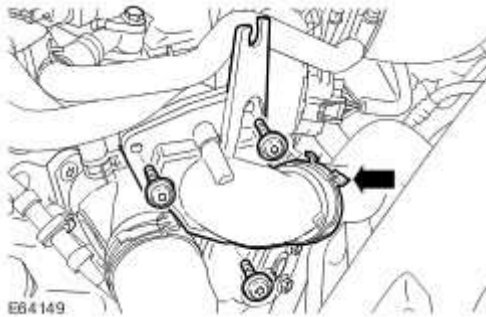


Release the clip.

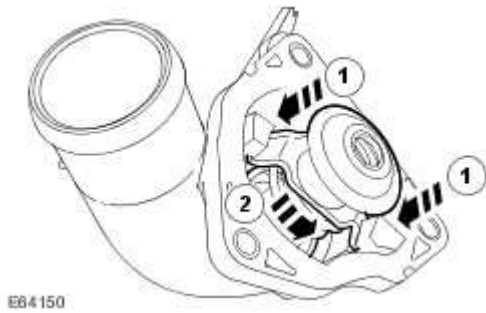
- 5 . Remove the thermostat housing.

➤ Remove the 3 Torx screws.

➤ Remove and discard the O-ring seal.



6 . Release and remove the thermostat.



Installation

1 . Install the thermostat.

2 . Install the thermostat housing.

➤ Clean the component mating faces.

➤ Install a new O-ring seal.

➤ Tighten the Torx screws to 4 Nm (3 lb.ft).

3 . Connect the thermostat housing coolant hose.

 Secure with the clip.

4 Refill the cooling system.

- . For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8

5 . Install the engine cover.

For additional information, refer to Engine Cover (76.11.35)

6 . Connect the battery ground cable and install the cover.

For additional information, refer to 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

Thermostat Housing - Vehicles Without: Supercharger

Removal



CAUTION: Anti-freeze concentration must be maintained at 50%.



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

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to Specifications

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.

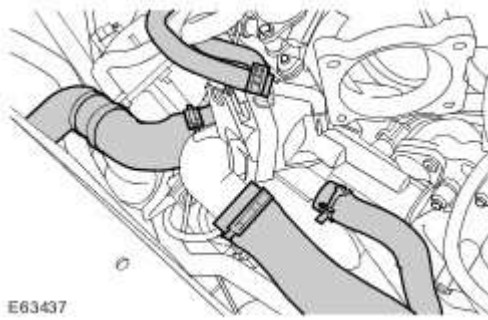
Drain the cooling system.

For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L NA V8
- AJV8

- 3 . Remove the throttle body.

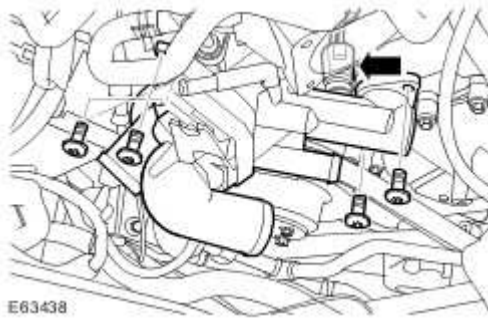
For additional information, refer to Throttle Body (19.70.04)

- 4 . Release the clips and disconnect the 5 coolant hoses.



5 . Remove the thermostat housing.

- ▶ Remove the 4 Torx bolts.
- ▶ Disconnect the ECT sensor electrical connector.

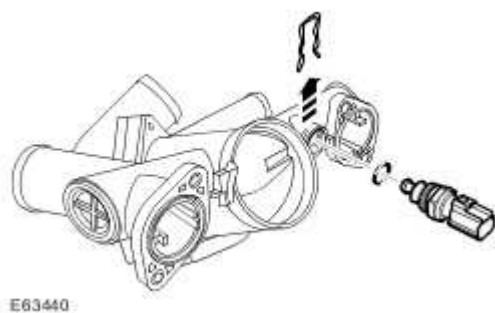


6 . **NOTE:**

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

Remove the ECT sensor.

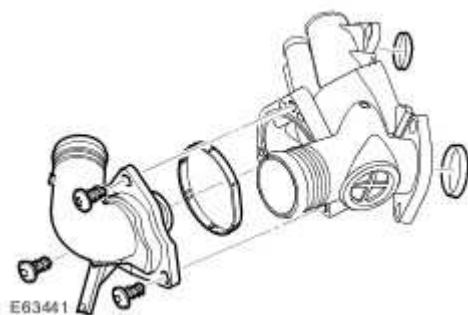
- ▶ Remove the retaining clip.



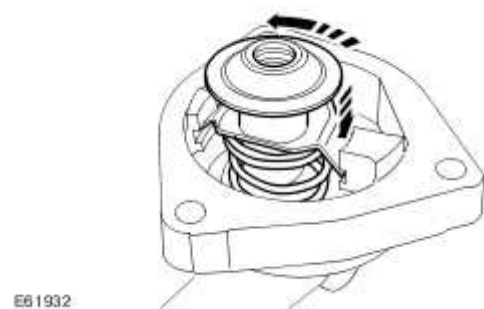
7 . Remove the thermostat.

► Remove the 3 screws.

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



9 . Release and remove the thermostat.



Installation

1 . Install the O-ring seals.

2 . Install the thermostat.

 Tighten the Torx screws to 4 Nm (3 lb.ft).

3 . Install the ECT sensor.

 Install the retaining clip.

4 . Install the thermostat housing.

 Connect and secure the electrical connector.

 Install the bolts and tighten to 10 Nm (7 lb.ft).

 Connect and secure the coolant hoses.

5 . Install the throttle body.

For additional information, refer to Throttle Body (19.70.04)

6 Refill the cooling system.

- . For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8

7 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Coolant Manifold - Vehicles With: Supercharger

Removal



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

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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.

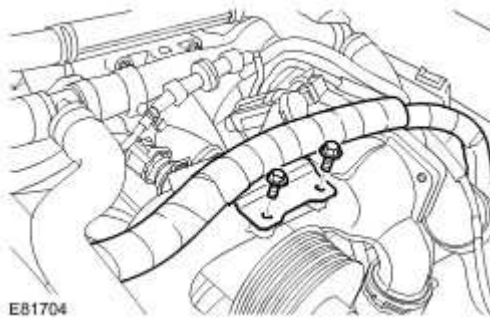
- 3 Drain the cooling system.
 - For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8

- 4 . Remove the supercharger belt.
For additional information, refer to Supercharger Belt (18.50.08)

- 5 . Release the engine wiring harness.



Remove the 2 bolts.



6 . Disconnect the coolant manifold to radiator hose.

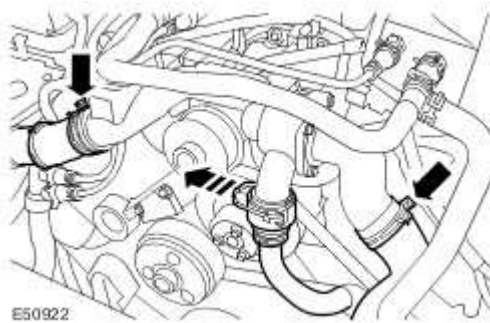
▶ Remove the clip.

7 . Disconnect the thermostat housing to radiator hose.

▶ Release the clip.

8 . Disconnect the coolant manifold to coolant reservoir hose.

▶ Release the clip.



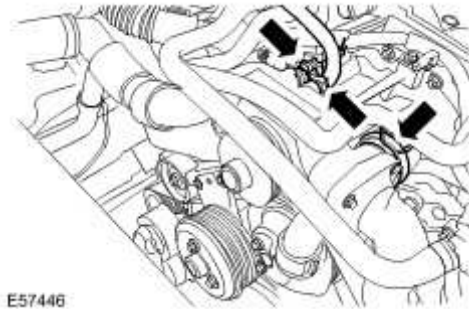
9 . Disconnect the coolant manifold bleed hose.

▶ Release the clip.

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

11 . Disconnect the cylinder block coolant hose.

▶ Release the clip.



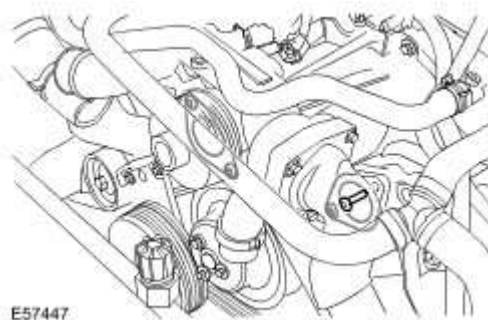
12



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.

Release the coolant manifold.

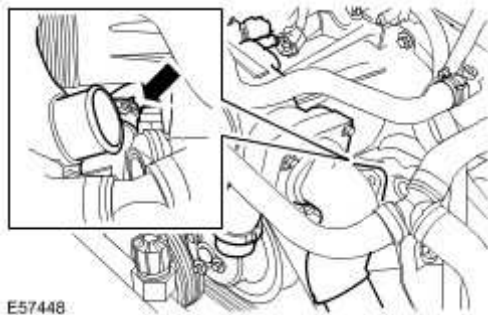
- ▶ Remove the 4 Torx screws.
- ▶ Position the wiring harness bracket aside.
- ▶ Remove and discard the 2 O-ring seals.



13 . Disconnect the coolant manifold rear hose.

▶ Rotate the coolant manifold.

▶ Release the clip.



14 . Remove the coolant manifold.

15 . **NOTE:**

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

Remove the ECT sensor.

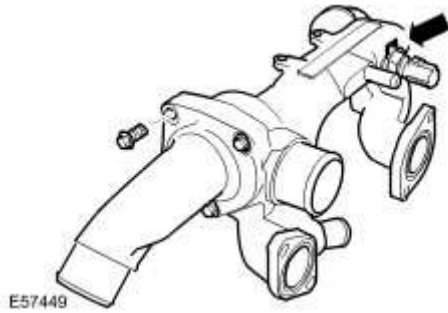
▶ Remove the clip.

▶ Remove and discard the O-ring seal.

16 . Remove the thermostat housing.

▶ Remove the 3 bolts.

▶ Discard the O-ring seal.



Installation

1 . Install the thermostat housing.

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

2 . Install the ECT sensor.

- ▶ Clean the component mating faces.
- ▶ Install a new O-ring seal.
- ▶ Secure with the clip.

3 . Install the coolant manifold.

- ▶ Clean the components.
- ▶ Install new O-ring seals.
- ▶ Connect the rear hose and secure with the clip.
- ▶ Connect the cylinder block hose and secure with the clip.
- ▶ Attach the wiring harness bracket.

 Tighten the Torx screws to 10 Nm (7 lb.ft).

4 . Connect the remaining coolant hoses.

 Secure with the clips.

5 . Connect the ECT sensor electrical connector.

6 . Attach the engine wiring harness.

 Tighten the bolts to 6 Nm (4 lb.ft).

7 . Install the supercharger belt.

For additional information, refer to Engine Cover (76.11.35)

8 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

9 Refill and bleed the cooling system.

- . For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8

Coolant Pump - Vehicles Without: Supercharger

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to Specifications

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.

Drain the cooling system.

For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8

- 3 . Remove the thermostat housing.

For additional information, refer to Thermostat Housing - Vehicles Without: Supercharger

- 4 . Loosen the 3 coolant pump pulley bolts.

- 5 . Release the accessory drive belt.

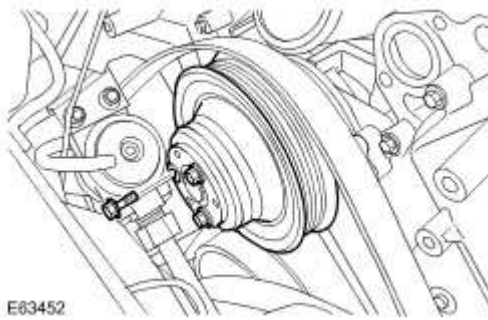


Release the tension from the belt.

- 6 . Remove the coolant pump drive pulley.



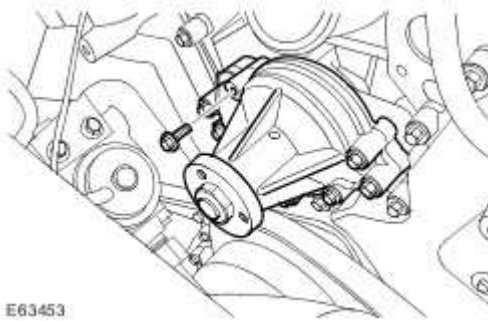
Remove the 3 bolts.



7 . Remove the coolant pump.

➤ Remove the 5 bolts.

➤ Discard the gasket.



Installation

1 . Install the coolant pump.

➤ Clean the component mating faces.

➤ Install a new gasket.

➤ Tighten the 5 bolts to 8 Nm (6 lb.ft), then a further 90 degrees.

2 . Install the coolant pump drive pulley.

➤ Install, and lightly tighten the bolts.

3 . Install the accessory drive belt.

4 . Tighten the pulley bolts to 10 Nm (7 lb.ft), then a further 45 degrees.

5 . Install the thermostat housing.

For additional information, refer to Thermostat Housing - Vehicles Without: Supercharger

6 Refill the cooling system.

- . For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8

7 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Coolant Pump - Vehicles With: Supercharger

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to 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 - 4.2L SC V8 - AJV8

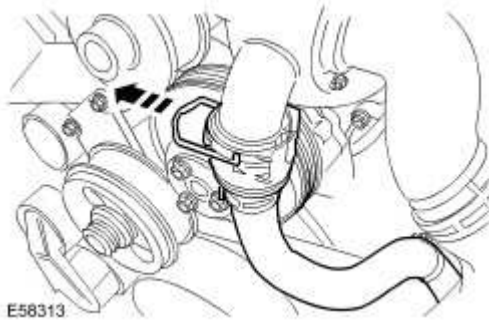
- 4 . Remove the accessory drive belt.

For additional information, refer to Accessory Drive Belt - 4.2L SC V8 - AJV8 (12.10.40)

- 5 . Disconnect the coolant manifold to coolant reservoir hose.



Release the clip.

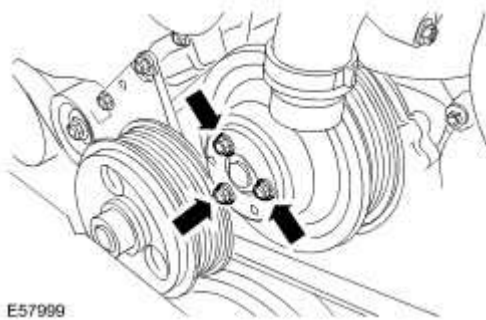


6 . NOTE:

Restrain the pulley to aid the removal of the bolts.

Remove the coolant pump pulley.

➤ Remove and discard the 3 bolts.



7



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

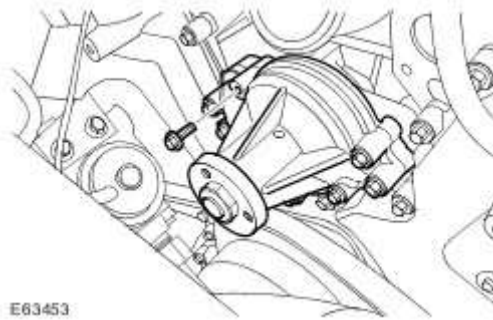
NOTE:

Some fluid spillage is inevitable during this operation.

Remove the coolant pump.

➤ Remove the 5 bolts.

- ▶ Discard the gasket.



Installation

1 . Install the coolant pump.

- ▶ Clean the component mating faces.
- ▶ Install a new gasket.
- ▶ Stage 1: Tighten the bolts to 8 Nm (6 lb.ft).
- ▶ Stage 2: Tighten a further 90 degrees.

2 . Install the coolant pump pulley.

- ▶ Stage 1: Tighten the bolts to 10 Nm (7 lb.ft).
- ▶ Stage 2: Tighten a further 45 degrees.

3 . Connect and secure the coolant hose.

- ▶ Clean the component mating faces.

4 . Install the accessory drive belt.

For additional information, refer to Accessory Drive Belt - 4.2L SC V8 - AJV8 (12.10.40)

5 Refill the cooling system.

- . For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8

6 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

303-03B : Supercharged Cooling – 4.2L NA V8 – AJV8/4.2L SC V8 – AJV8

Removal and installation

Coolant Pump

Removal

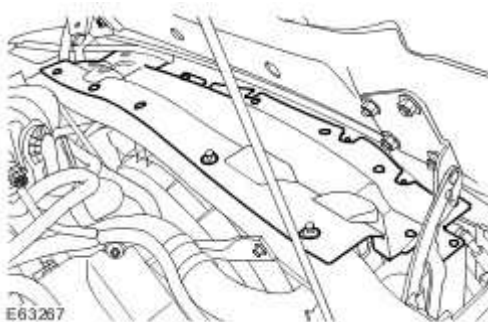
- 1  **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

- 2 Drain the coolant.
 - For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8

- 3 . Remove the fan cowl.

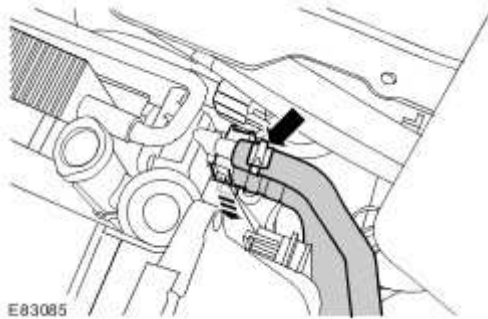
 Remove the 15 clips.



- 4 . Disconnect the 2 coolant hoses.

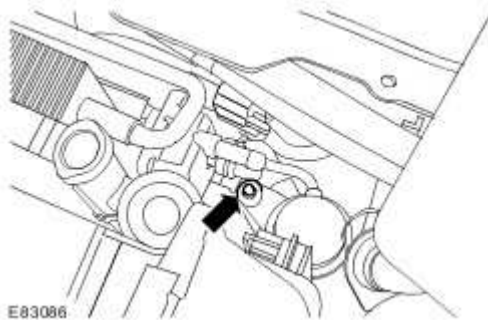
► Release the clip.

► Disconnect the quick release connector.



5 . Release the coolant pump.

► Remove the bolt.



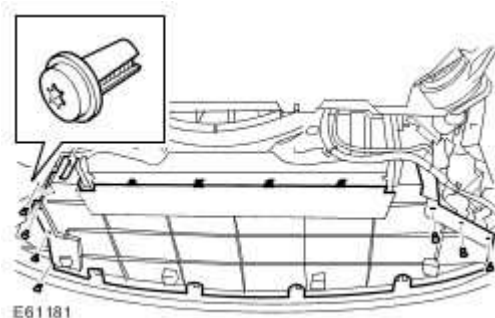
6 . Remove the radiator splash shield.

For additional information, refer to Radiator Splash Shield (76.22.90)

7 . Remove the front bumper air ducting.

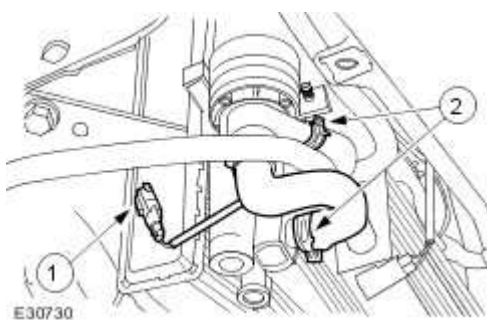
► Remove the 7 clips.

► Release the 4 clips.



8 . Remove the coolant pump.

- Disconnect the electrical connector.
- Release the clips and disconnect the 2 coolant hoses.



Installation

1 . Install the coolant pump.

- Clean the components.
- Connect the coolant hoses and secure with the clips.
- Connect the electrical connector.

2 . Install the front bumper air ducting.

- Secure with the clips.

3 . Install the radiator splash shield.

For additional information, refer to Radiator Splash Shield (76.22.90)

4 . Secure the coolant pump.

 Tighten the bolt to 5 Nm (4 lb.ft).

5 . Connect the coolant hoses.

 Secure with the clips.

6 . Install the fan cowl.

 Secure with the clips.

7 Refill and bleed the cooling system.

- . For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8

8 **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

Radiator

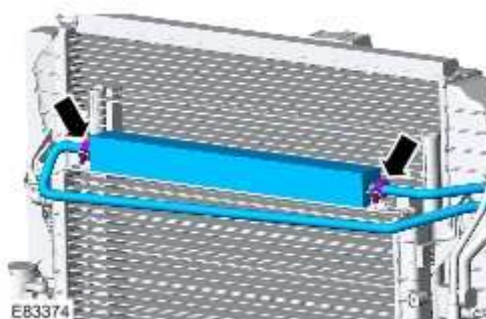
Removal

- 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 Drain the coolant.
 - For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8
- 3 . Vehicles with single oil cooler: Remove the oil cooler.
 - For additional information, refer to Oil Cooler (12.60.68)
- 4 . Vehicles with twin oil coolers: Remove the twin oil coolers.
 - For additional information, refer to Twin Oil Coolers
- 5 . Release the power steering fluid cooler.

 Release the 2 clips.



6 .

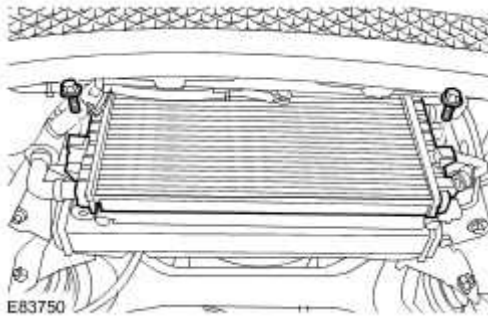


CAUTION: Protect the surrounding components.

Release the supercharger radiator.

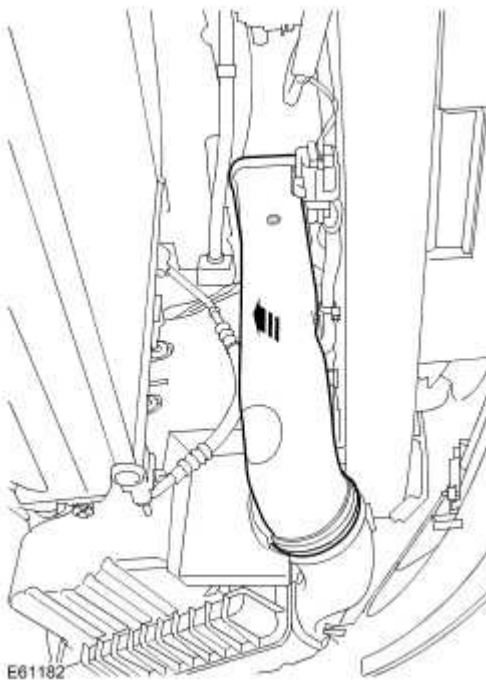
➤ Remove the 2 bolts.

➤ Tie the A/C condenser aside.



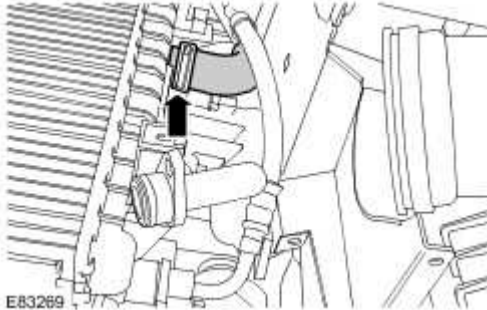
7 . Remove the intake air duct.

➤ Release the clip.



8 . LH side: Disconnect the supercharger radiator hose.

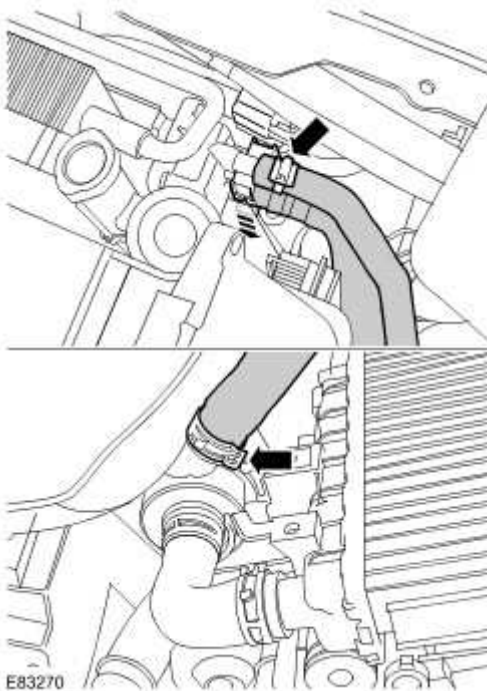
▶ Release the clip.



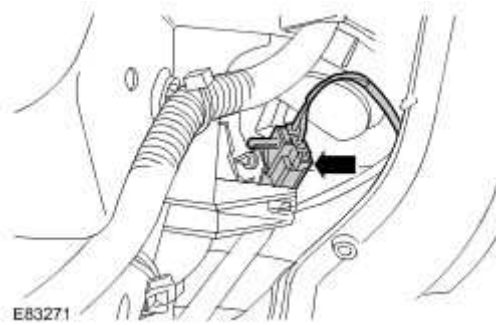
9 . RH side: Disconnect the 3 supercharger radiator hoses.

▶ Release the 2 clips.

▶ Disconnect the quick release connector.



10 . Disconnect the coolant pump electrical connector.



11 . Remove the supercharger radiator.

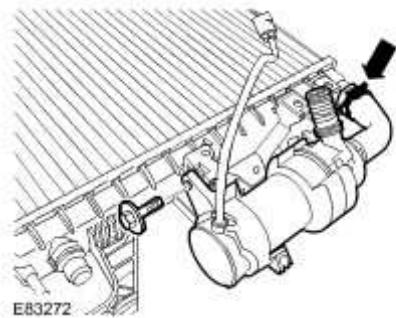
12 . **NOTE:**

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

Remove the coolant pump.

▶ Release the clip and disconnect the hose.

▶ Remove the bolt.



Installation

1 . Install the coolant pump.

▶ Connect the hose and secure with the clip.

▶ Tighten the bolt to 5 Nm (4 lb.ft).

2 . Install the supercharger radiator.

-  Connect the electrical connector.
-  Connect the hoses and secure with the clips.

3 . Install the intake air duct.

-  Secure the clip.

4 . Secure the supercharger radiator and A/C condenser.

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

5 . Attach the power steering fluid cooler.

-  Secure with the clips.

6 . Vehicles with twin oil coolers: Install the twin oil coolers.

For additional information, refer to Twin Oil Coolers

7 . Vehicles with single oil cooler: Install the oil cooler.

For additional information, refer to Oil Cooler (12.60.68)

8 Top-up and bleed the coolant.

- . For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8

303-04A : Fuel charging and controls – 4.2L SC V8 – AJV8

Specifications

Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Fuel rail bolts (NA models)	10	7	88
Fuel rail bolts (SC models)	21	15	-
Fuel rail pressure sensor	5	4	44
Fuel temperature sensor	7	5	62
Throttle body bolts	10	7	88

Fuel Charging and Controls

No Data Available

Fuel Injection Supply Manifold (19.60.13)

Special Service Tools



Fuel spring lock decoupling tool
310-D005

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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: 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.**



WARNING: 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.



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.

For additional information, refer to Spring Lock Couplings

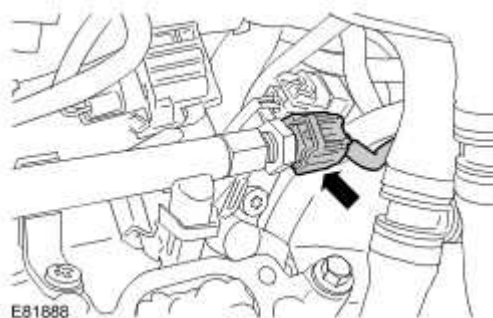
- 4 . Remove the LH charge air cooler.

For additional information, refer to Charge Air Cooler LH (18.50.19)

- 5 . Remove the RH charge air cooler.

For additional information, refer to Charge Air Cooler RH (18.50.18)

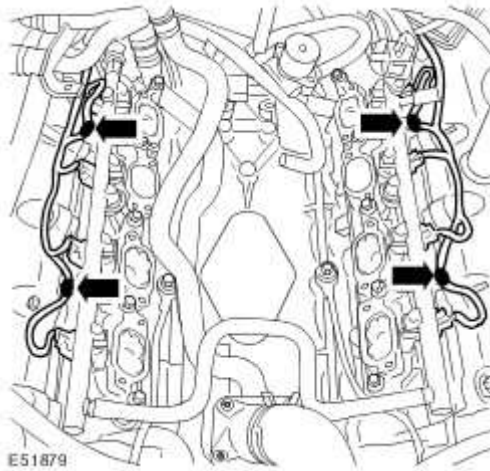
- 6 . Disconnect the fuel temperature sensor electrical connector.



- 7 . Release the fuel injector wiring harness.

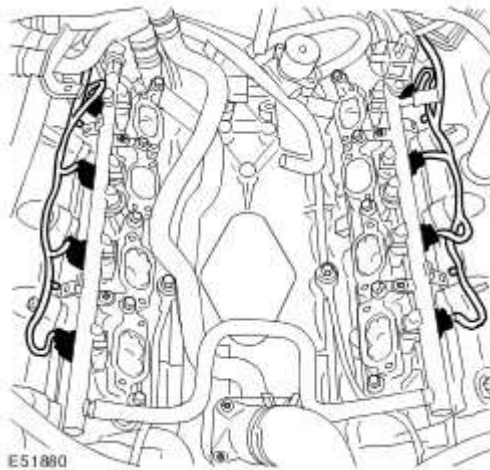


Release the 4 clips.



8 . Disconnect the fuel injector electrical connectors.

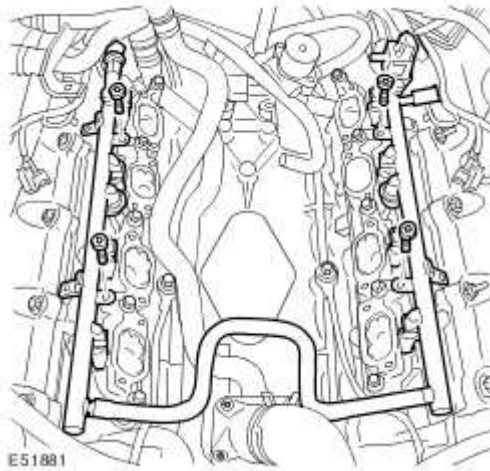
► Release the 8 clips.



9 . Remove the fuel injection supply manifold.

► Remove the 4 Torx screws.

► Remove and discard the fuel injector O-ring seals.

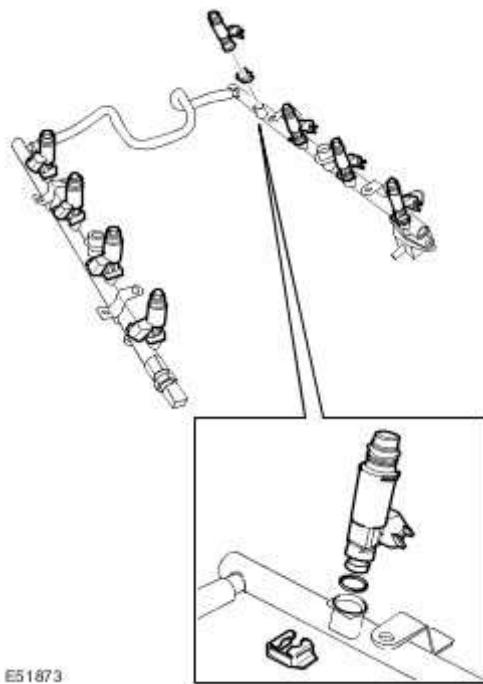


10 . **NOTE:**

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

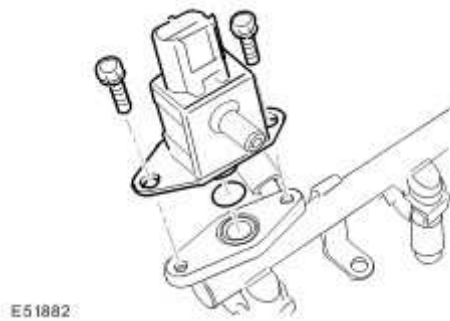
Release and remove the fuel injectors.

- ▶ Remove the 8 clips.
- ▶ Discard the O-ring seals.



11 . Remove the fuel pressure sensor.

- ▶ Remove the 2 bolts.
- ▶ Discard the O-ring seals.

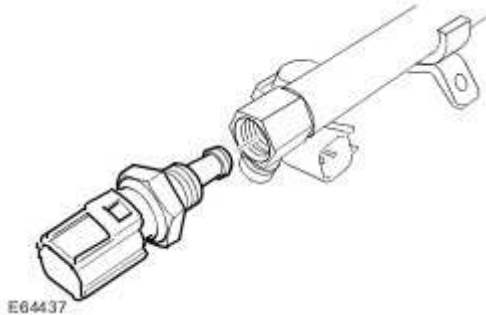


12



CAUTION: To prevent damage to components, use an additional wrench when loosening or tightening unions.

Remove the fuel temperature sensor.



Installation

1 . Install the fuel temperature sensor.

- ▶ Clean the component mating faces.
- ▶ Apply sealant to the sensor thread.
- ▶ Tighten the sensor to 7 Nm (5 lb.ft).

2 . Install the fuel pressure sensor.

- ▶ Clean the component mating faces.
- ▶ Install new O-ring seals.
- ▶ Tighten the bolts to 6 Nm (4 lb.ft).

3 . Install the fuel injectors.

- ▶ Clean the component mating faces.
- ▶ Install new O-ring seals.
- ▶ Secure with the clips.

4 . Install the fuel injection supply manifold.

- ▶ Clean the component mating faces.
- ▶ Install new O-ring seals.
- ▶ Tighten the Torx screws to 10 Nm (7 lb.ft).

5 . Attach the fuel injector wiring harness.

- ▶ Secure the clips.
- ▶ Connect the electrical connectors.

6 . Connect the fuel temperature sensor electrical connector.

7 . Install the RH charge air cooler.

For additional information, refer to Charge Air Cooler RH (18.50.18)

8 . Install the LH charge air cooler.

For additional information, refer to Charge Air Cooler LH (18.50.19)

9 . Connect the fuel line to the fuel rail.

For additional information, refer to Spring Lock Couplings

10 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

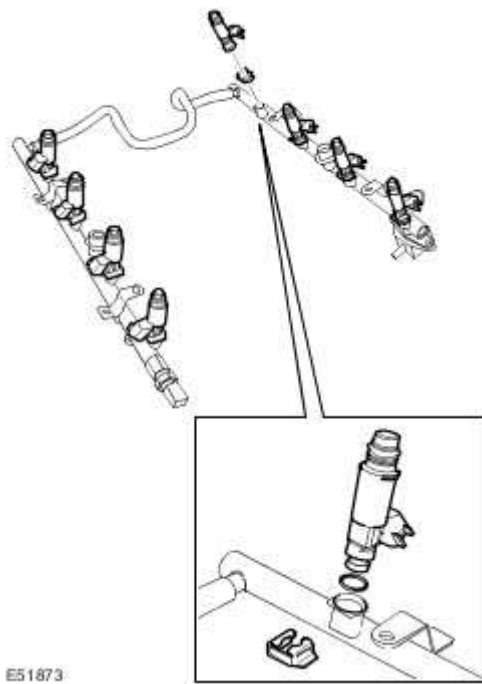
Fuel Injector (18.10.01)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
- 2 . Remove the fuel injection supply manifold.
For additional information, refer to Fuel Injection Supply Manifold (19.60.13)
- 3 . Remove the fuel injector.

➤ Remove the clip.

➤ Discard the O-ring seal.



Installation

- 1 . Install the fuel injector.
➤ Clean the component mating faces.

 Install a new O-ring seal.

 Secure with the clip.

2 . Install the fuel injection supply manifold.

For additional information, refer to Fuel Injection Supply Manifold (19.60.13)

3 . Connect the battery ground cable and install the cover.

Throttle Body (19.70.04)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications
- 2 . Remove the intake air resonator.
For additional information, refer to Intake Air Resonator
- 3 . Disconnect the throttle position (TP) sensor electrical connector.



- 4 .  **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: Always plug any open connections to prevent contamination.

NOTE:

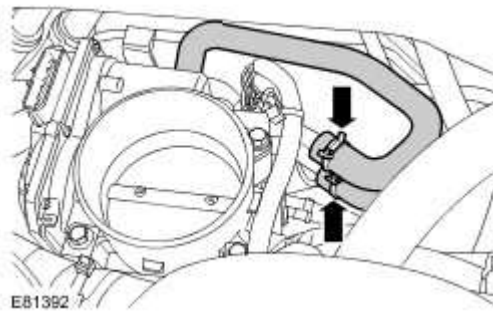
Position cloth to collect fluid spillage.

Disconnect the coolant hoses from the throttle body.



Clamp the throttle body coolant hoses to minimize coolant loss.

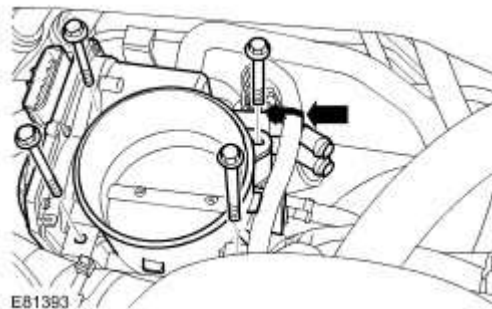
- ▶ Release the throttle body hose clips



5.  **CAUTION: Always plug any open connections to prevent contamination.**

Remove the throttle body.

- ▶ Release the wiring harness.
- ▶ Remove the 4 bolts.
- ▶ Remove and discard the throttle body gasket.



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).

▶ Attach the wiring harness.

2 . Connect the coolant hoses and secure with the clips.

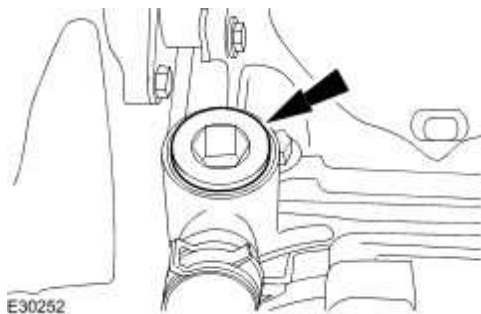
▶ Remove the hose clamps from the throttle body hoses.

3 . Connect the TP sensor electrical connector.

4 . Connect the battery ground cable and install the cover.
For additional information, refer to Specifications

5 . Remove the supercharger coolant fill plug.

▶ Remove and discard the sealing washer.



6  **CAUTION: Coolant may spill from the supercharger fill port when the ignition is switched on.**

Switch the ignition on.

7



- **CAUTION: Do not allow the supercharger coolant pump to run dry for more than one minute. Failure to follow this instruction may result in damage to the vehicle.**

Allow the supercharger pump to run and top-up the coolant through the supercharger fill port.

▶ Switch the ignition off.

8 . Install the supercharger coolant fill plug and tighten to 45 Nm (33 lb.ft).

▶ Clean the components.

▶ Install a new sealing washer.

9 . Switch the ignition off.

10 . Install the intake air resonator.

For additional information, refer to Intake Air Resonator

11 . Check and top-up the coolant.

303-04B : Fuel Charging and Controls – 4.2L NA V8 – AJV8

Specifications

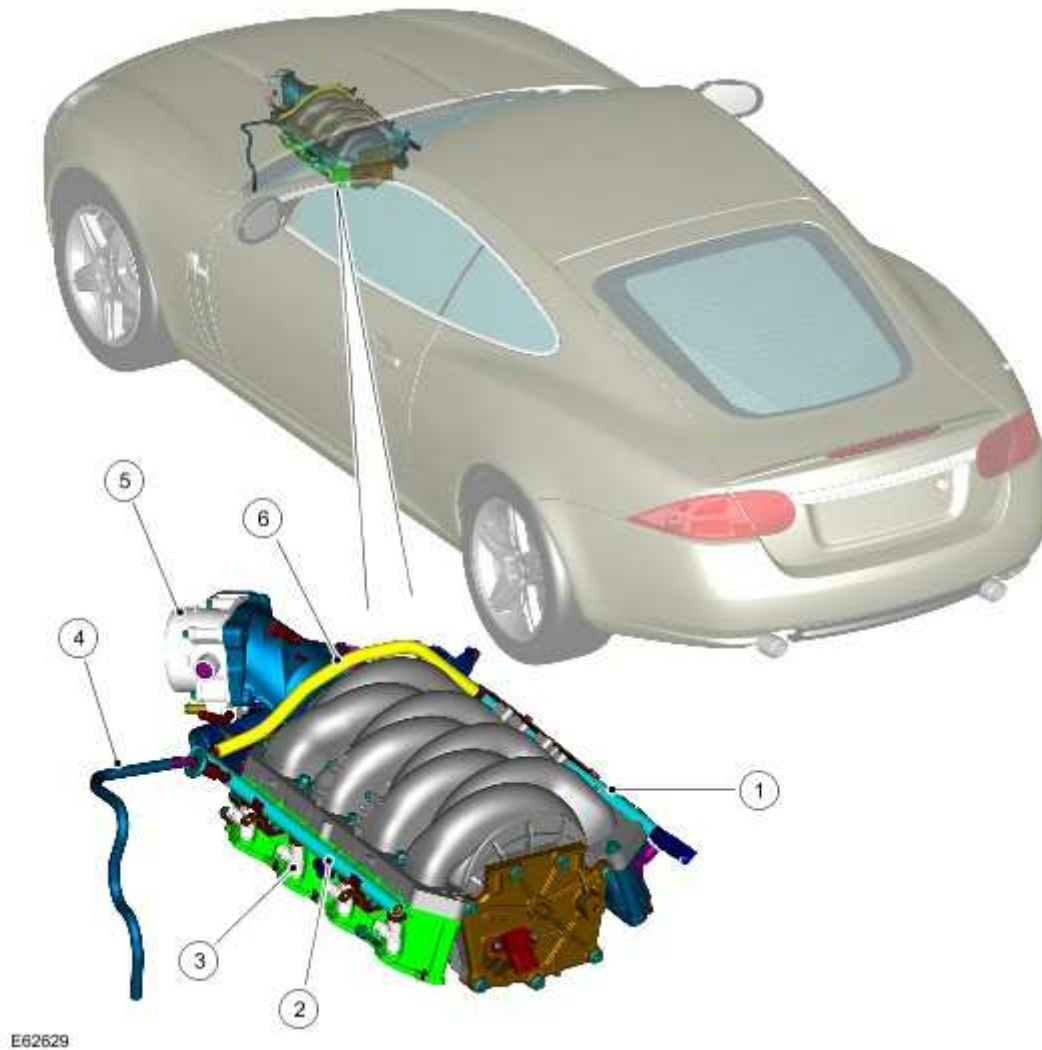
Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Fuel rail - bolt	10	7	88
Fuel rail pressure sensor	5	4	44
Fuel temperature sensor	7	5	62
Throttle body - bolt	10	7	88

Fuel Charging and Controls

COMPONENT LOCATIONS



Item	Part Number	Description
1		RH (right-hand) fuel rail
2		LH (left-hand) fuel rail
3		Injectors (8 off)
4		Fuel supply pipe

5		Electric throttle body
6		Fuel supply cross over pipe

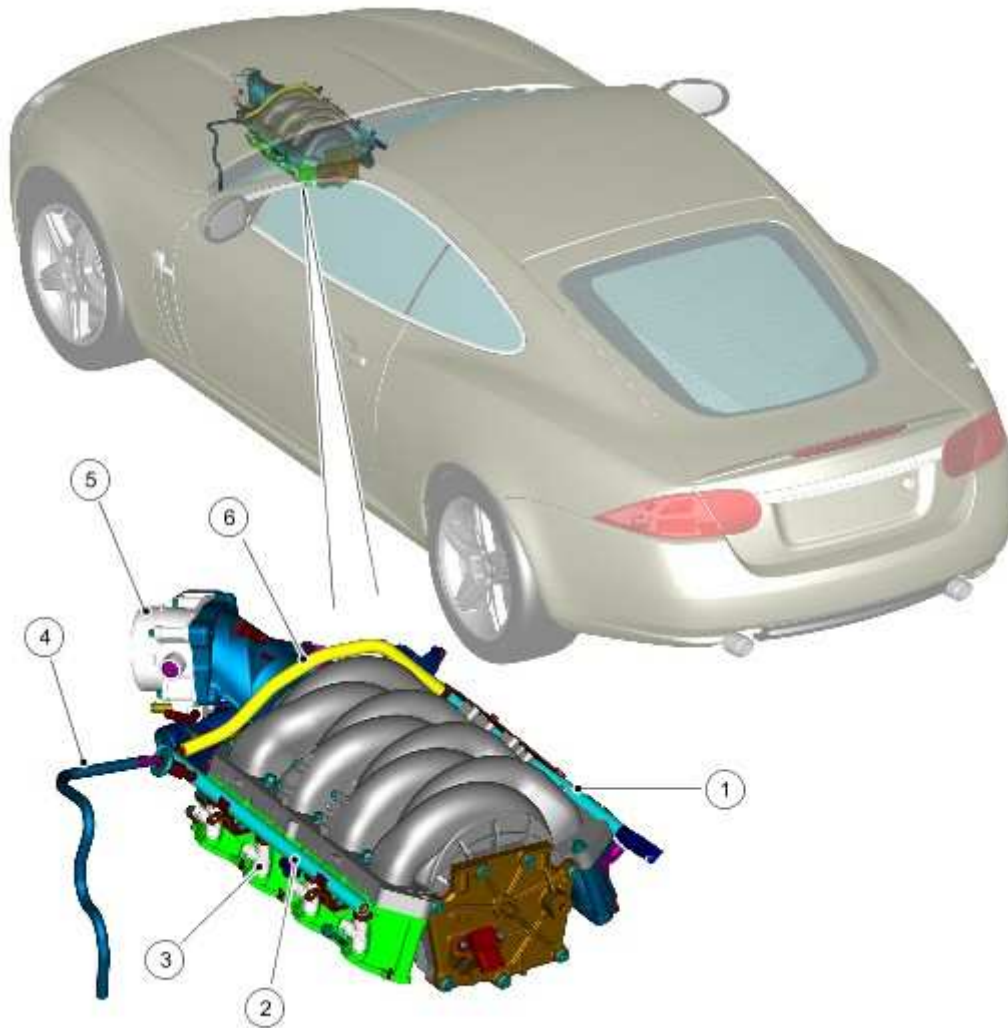
INTRODUCTION

The major components of the fuel charging and control system comprise a fuel pump and FPDM (fuel pump driver module) , fuel rails and eight injectors. The fuel pump supplies fuel from the tank, via a pipe routed along the side of the transmission, to the fuel rail. The fuel rail distributes the fuel equally to each of the 8 injectors. The fuel injectors, which are controlled by the Engine Management System (EMS), are installed in the fuel rails on each side of the air intake manifold. A cross over pipe connects the 2 fuel rails together at the front of the engine. For additional information, refer to Fuel Tank and Lines (310-01)

For additional information, refer to Electronic Engine Controls (303-14)

Fuel Charging and Controls

COMPONENT LOCATIONS



E62629

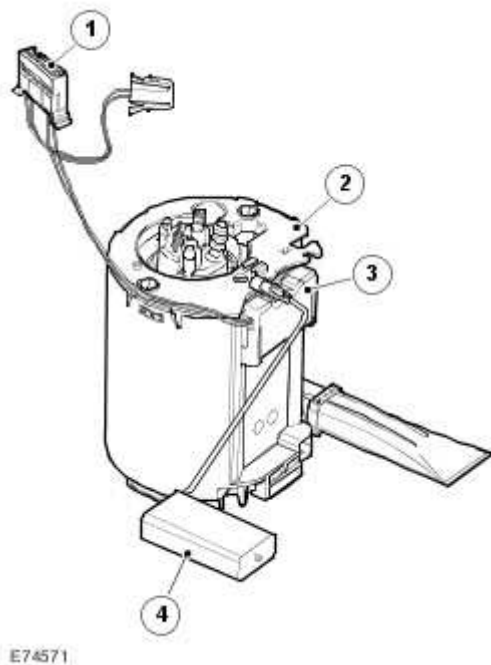
Item	Part Number	Description
1		RH fuel rail
2		LH fuel rail
3		Injectors (8 off)
4		Fuel supply pipe
5		Electric throttle body
6		Fuel supply cross over pipe

INTRODUCTION

The major components of the fuel charging and control system comprise a fuel pump and Fuel Pump Driver Module (FPDM), fuel rails and eight injectors. The fuel pump supplies fuel from the tank, via a pipe routed along the side of the transmission, to the fuel rail. The fuel rail distributes the fuel equally to each of the 8 injectors. The fuel injectors, which are controlled by the Engine Management System (EMS), are installed in the fuel rails on each side of the air intake manifold. A cross over pipe connects the 2 fuel rails together at the front of the engine. For additional information, refer to Fuel Tank and Lines (310-01 Fuel Tank and Lines)

For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - 4.2L)

FUEL PUMP

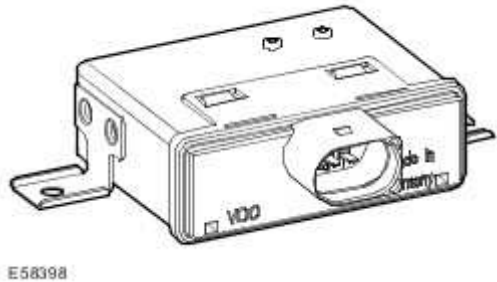


Item	Part Number	Description
1		Electrical connector
2		Fuel pump module
3		Fuel level sensor
4		Fuel level float

The fuel pump module is mounted in the RH side of the saddle type fuel tank and delivers fuel at

variable flow and pressure to the fuel rails, which supply fuel to all fuel injectors. The fuel pump operation is regulated by the FPDM, which is controlled by the EMS. For additional information, refer to Fuel Tank and Lines (310-01)

FUEL PUMP DRIVER MODULE

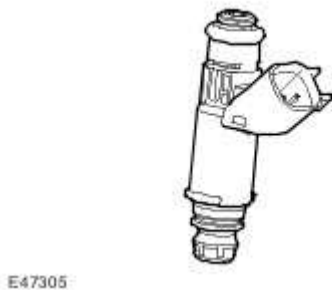


The Fuel Pump Driver Module (FPDM) is used to control the speed of the fuel pump based upon the fuel demand of the engine. The ECM controls the FPDM in response to inputs from the fuel rail pressure sensor, MAP and the Mass Air Flow (MAF)/Intake Air Temperature (IAT) sensor. The FPDM is located on the RH end of the charcoal cannister and is attached by 2 scrivet fasteners.

The ECM sends a PWM signal to the FPDM, the frequency of the signal determines the duty cycle of the pump. The PWM signal to the pump represents half the ON time of the pump. If the ECM transmits a 50% on time the drives the pump at 100%. If the ECM transmits a 5% ON time the FPDM drives the pump at 10%. The FPDM will only turn the fuel pump ON if it receives a valid signal between 4% and 50%. When The ECM requires the fuel pump to be turned OFF the ECM transmits a duty cycle signal of 75%.

The status of the FPDM is monitored by the ECM. Any errors can be retrieved from The ECM using Integrated Diagnostic System (IDS). The FPDM cannot be interrogated for diagnostic purposes.

INJECTORS

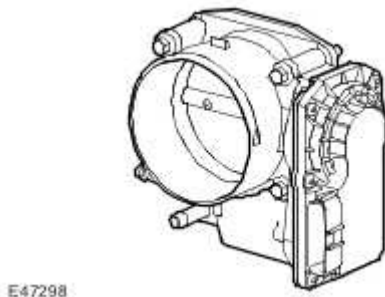


Eight, top fed, 12 hole, fuel injectors are installed in the fuel rails. Two 'O' rings seal each injector to the fuel rails and should be renewed whenever an injector is refitted to an engine. A small amount of engine oil can be applied to the 'O' rings to aid installation. No other form of lubrication should be used. The fuel jets from the injectors are directed onto the back of the intake valves.

The injectors are electromagnetic solenoid valves controlled by the ECM. Each injector contains a solenoid-operated needle valve, which is closed while the solenoid winding is de-energized. 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 intake tract onto the back of the intake valves. The ECM meters the amount of fuel injected by adjusting the time that the needle valve is open.

The injectors have a resistance of $13.8 \text{ Ohms} \pm 0.7 \text{ Ohms}$ @ 20 Degrees Celsius.

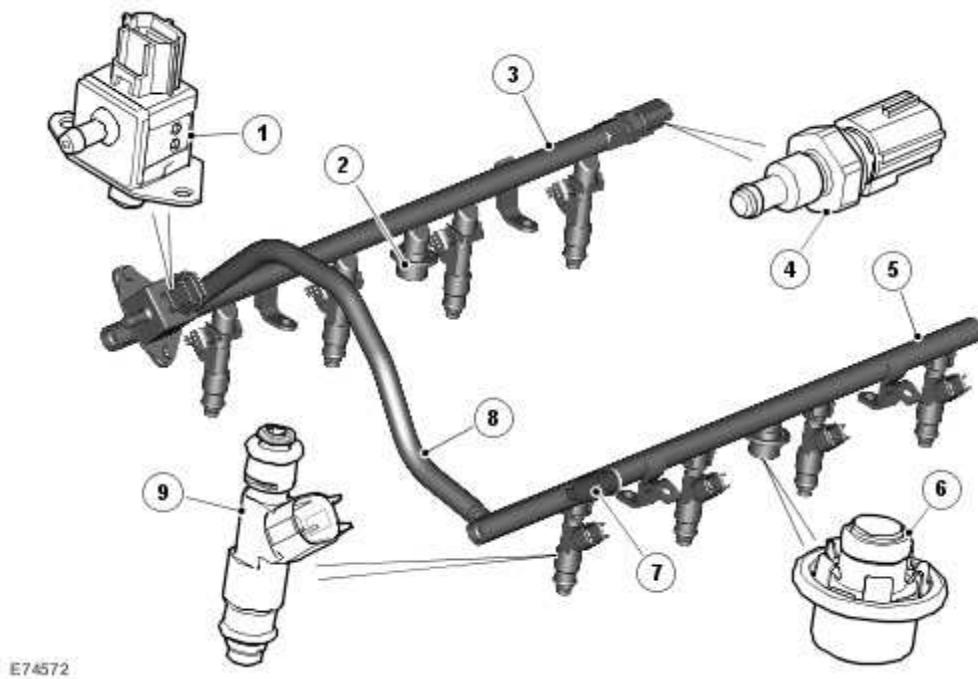
ELECTRIC THROTTLE



The electronic throttle body controls the engine torque and is located on the induction elbow at the rear of the engine. Its main components are an electronic throttle control valve, Accelerator Pedal Position (APP) sensor and the Engine Control Module (ECM).

The APP sensor determines the driver demand to control throttle opening. This value is received by the ECM and the throttle is then opened to the correct angle by means of an integral electric motor. 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 (303-14 Electronic Engine Controls - 4.2L)

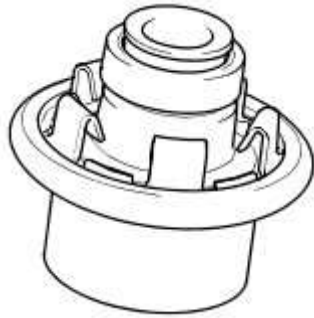
FUEL RAILS



Item	Part Number	Description
1		Fuel rail pressure sensor
2		Fuel rail pressure damper
3		Fuel rail
4		Fuel rail temperature sensor
5		Fuel rail
6		Fuel rail pressure damper
7		Fuel rail inlet
8		Fuel rail connection pipe
9		Fuel injector

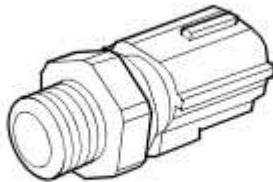
Each fuel rail maintains a fuel pressure of typically 4.5bar (65 psi), however, this pressure will vary depending on engine requirements; lower at idle, higher at full load. Four fuel injectors are installed in each cylinder head and are connected to the fuel rail. 'O' ring seals are used to seal the injectors to the fuel rails.

FUEL PRESSURE DAMPER



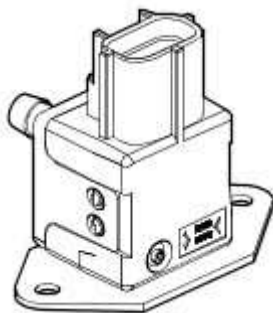
A fuel pressure damper is attached centrally to each of the fuel rails. The damper acts to damp pressure pulses from the fuel pump.

FUEL TEMPERATURE SENSOR



The fuel temperature sensor is located in the rear of the RH fuel rail. The sensor is an NTC sensor, which is connected to the ECM by two wires. For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - 4.2L)

FUEL RAIL PRESSURE SENSOR



The fuel pressure sensor continuously monitors the fuel pressure in the fuel rail, this value is used by the ECM to calculate the injector pulse-width required to deliver the correct mass of fuel per injection.

The ECM also uses this information to demand a specific fuel flow-rate from the fuel pump via the FPDM For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine

Controls - 4.2L)

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Fuel Charging and Controls - 4.2L NA V8 - AJV8/4.2L SC V8 - AJV8

Principle of Operation

For a detailed description of fuel charging and controls, refer to the relevant Description and Operation section of the workshop manual.

Fuel Charging and Controls

Inspection and Verification

1 . Verify the customer concern.

2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
- Fuel level - Fuel leaks - Damaged fuel lines - Damaged push connect fittings - Fuel contamination/grade/quality - Throttle body - Damaged fuel tank filler pipe cap - Damaged fuel tank filler pipe	- Fuses - Loose or corroded electrical connectors - Harnesses - Sensor(s) - Engine Control Module (ECM)

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 and there are clear symptoms refer to the Symptom Chart below, alternatively, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Cause	Action
Engine cranks, but does not fire	- 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 - For ignition system tests. Engine Ignition

		• For fuel system tests. Fuel Tank and Lines • Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls
Engine cranks and fires, but will not start	• Evaporative emissions purge valve • Fuel pump • Spark plugs • HT short to ground (tracking) check rubber boots for cracks/damage • Ignition system	• For purge valve tests. Evaporative Emissions • For fuel system tests. Fuel Tank and Lines • For ignition system tests. Engine Ignition
Difficult cold start	• 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. Specifications • Ensure the battery is in a fully charged and serviceable condition • Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls • For EGR system tests. Engine Emission Control • For fuel system tests. Fuel Tank and Lines • For purge valve tests. Evaporative Emissions
Difficult hot start	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system • EGR valve stuck open	• Check for injector leak, install new injector as necessary. Fuel Injector (18.10.01) • Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls

		• For purge valve tests. Evaporative Emissions • For fuel system tests. Fuel Tank and Lines • For ignition system tests. Engine Ignition • For EGR system tests. Engine Emission Control
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system • EGR valve stuck open	• Check for injector leak, install new injector as necessary. Fuel Injector (18.10.01) • Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls • For purge valve tests. Evaporative Emissions • For fuel system tests. Fuel Tank and Lines • For ignition system tests. Engine Ignition • For EGR system tests. Engine Emission Control
Engine stalls soon after start	• 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 • Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls • For ignition system tests. Engine Ignition • Check for blockage in air filter element and air intake system

		• Check for air leakage in air intake system • For fuel system tests. Fuel Tank and Lines
Engine hesitates/poor acceleration	• 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	• For fuel system tests. Fuel Tank and Lines • Check for injector leak, install new injector as necessary. Fuel Injector (18.10.01) • Check for air leakage in air intake system • Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls • Read DTCs and refer to the DTC Index in this section for throttle motor tests • Ensure accelerator pedal is free from restriction • For ignition system tests. Engine Ignition • For EGR system tests. Engine Emission Control • For transmission tests. Diagnostic Strategy
Engine backfires	• Fuel pump/lines • Air leakage • Electronic engine controls • Ignition system • Sticking variable camshaft timing (VCT) hub	• For fuel system tests. Fuel Tank and Lines • Check for air leakage in intake air system • Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls • For ignition system tests. Engine Ignition • Read DTCs and refer

		to DTC Index for VCT tests. Electronic Engine Controls
Engine surges	- Fuel pump/lines - Electronic engine controls - Throttle motor - Ignition system	- For fuel system tests. Fuel Tank and Lines - Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls - Read DTCs and refer to DTC Index in this section for throttle motor tests. - For ignition system tests. Engine Ignition
Engine detonates/knocks	- Electronic engine controls - Fuel pump/lines - Air leakage - Sticking VCT hub	- Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls - For fuel system tests. Fuel Tank and Lines - Check for air leakage in intake air system - Read DTCs and refer to DTC Index for VCT tests. Electronic Engine Controls
No throttle response	- Electronic engine controls - Throttle motor	- Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls - Read DTCs and refer to DTC Index in this section for throttle motor tests.
Poor throttle response	Breather system disconnected/restricted	Ensure the engine breather system is

	• Electronic engine control • Transmission malfunction • Traction control event • Air leakage	free from restriction and is correctly installed • Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls • For transmission system tests. Diagnostic Strategy • Check for air leakage in intake air system

DTC Index



CAUTION: When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00

NOTE:

If the control module/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 five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give extra information read by the manufacturer-approved diagnostic system).

NOTE:

When performing voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places and with a current calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE:

Check and rectify basic faults before beginning diagnostic routines that involve pinpoint tests.

NOTE:

If DTCs 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.

DTC	Description	Possible Cause	Action
P008700	Fuel rail/system pressure - too low	- Fuel rail pressure (FRP) sensor, sensing circuit - short to ground, open circuit - FRP sensor supply circuit - high resistance - FRP sensor failure - Fuel pump failure - Fuel line leak, restriction	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new FRP sensor as necessary. Fuel Rail Pressure (FRP) Sensor (18.30.98) - For fuel system tests. Fuel Tank and Lines
P008800	Fuel rail/system pressure - too high	- FRP sensor supply/sensing circuits - short to each other - FRP sensor sensing circuit - short to power - FRP sensor ground circuit - high resistance - FRP sensor failure - Restricted fuel line - Fuel pump short circuit to power	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new FRP sensor as necessary. Fuel Rail Pressure (FRP) Sensor (18.30.98) - For fuel system tests. Fuel Tank and Lines
P017100	System too lean (bank 1)	- Air intake leak between MAF sensor and cylinder head - Fuel filter, injector, system restriction - MAF sensor fault (low intake air flow) - Exhaust leak (forward of	- Check for leak from air intake system - For fuel system tests. Fuel Tank and Lines - Read DTCs and refer to DTC Index in this section for MAF sensor tests

		catalytic converter)	Check and rectify any exhaust leak prior to catalytic converter
P017200	System too rich (bank 1)	- Restricted air cleaner - Leaking fuel injector(s) - Engine oil contaminated with fuel (too many cold starts with vehicle subsequently not getting hot enough for long enough) - MAF sensor fault (high intake air flow)	- Check air cleaner element is free from restriction - Check for leaking injectors, install new injector(s) as necessary. Fuel Injector (18.10.01) - Check for contaminated engine oil, drain and refill engine oil as necessary. Engine Oil Draining and Filling - Read DTCs and refer to DTC Index in this section for MAF sensor tests
P017400	System too lean (bank 2)	- Air intake leak between MAF sensor and cylinder head - Fuel filter, injector, system restriction - MAF sensor fault (low intake air flow) - Exhaust leak (forward of catalytic converter)	- Check for leak from air intake system - For fuel system tests. Fuel Tank and Lines - Read DTCs and refer to DTC Index in this section for MAF sensor tests - Check and rectify any exhaust leak prior to catalytic converter
P017500	System too rich (bank 2)	- Restricted air cleaner - Leaking fuel injector(s) - Engine oil contaminated with fuel (too many cold starts with vehicle subsequently not getting hot enough for long enough) - MAF sensor fault (high intake air flow)	- Check air cleaner element is free from restriction - Check for leaking injectors, install new injector(s) as necessary. Fuel Injector (18.10.01) - Check for contaminated engine oil, drain and refill engine oil as

			necessary. Engine Oil Draining and Filling Read DTCs and refer to DTC Index in this section for MAF sensor tests
P020100	Cylinder 1 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new injector as necessary. Fuel Injector (18.10.01)
P020200	Cylinder 2 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new injector as necessary. Fuel Injector (18.10.01)
P020300	Cylinder 3 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new injector as necessary. Fuel Injector (18.10.01)
P020400	Cylinder 4 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new injector as necessary. Fuel Injector

			(18.10.01)
P020500	Cylinder 5 injector circuit - malfunction	• Injector circuit - short to ground, high resistance, disconnected • Injector failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new injector as necessary. Fuel Injector (18.10.01)
P020600	Cylinder 6 injector circuit - malfunction	• Injector circuit - short to ground, high resistance, disconnected • Injector failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new injector as necessary. Fuel Injector (18.10.01)
P020700	Cylinder 7 injector circuit - malfunction	• Injector circuit - short to ground, high resistance, disconnected • Injector failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new injector as necessary. Fuel Injector (18.10.01)
P020800	Cylinder 8 injector circuit - malfunction	• Injector circuit - short to ground, high resistance, disconnected • Injector failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new injector as necessary. Fuel Injector (18.10.01)
P131500	Persistent misfire	• ECM to ignition coil primary circuit fault (cylinder misfire detected)	• Check for cylinder misfire, ignition and injector DTCs and refer

		- DTC also flagged) - Fuel injector circuit fault(s) (injector DTCs also flagged) - Fuel delivery pressure low - Spark plug failure/fouled/incorrect gap - Cylinder compression low	- to the DTC Index - For fuel system tests. Fuel Tank and Lines - For spark plug tests. Engine Ignition - For cylinder compression tests. Engine
P131600	Misfire rate exceeds emissions thresholds	Misfire rate exceeds emissions thresholds	Check for individual cylinder misfire DTCs and refer to DTC Index in this section
P210129	Throttle actuator control motor circuit range/performance	Jammed throttle blade, gearing or motor	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body. Refer to the new module/component installation note at the top of the DTC Index
P210162	Throttle actuator control motor circuit range/performance	Jammed throttle blade, gearing or motor	Install a new throttle body. Refer to the new module/component installation note at the top of the DTC Index
P210164	Throttle actuator control motor circuit range/performance	Jammed throttle blade, gearing or motor	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body. Refer to the new module/component installation note at the top of the DTC Index
P210177	Throttle actuator motor control circuit range/performance	- Throttle blade stuck open - Intake air system leak	- Check for throttle related DTCs and refer to DTC Index in this section - Check intake air

			system for leaks
P210329	Throttle actuator motor control circuit high	- Throttle motor control circuit - short to power - ECM fault	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Refer to new module/component installation note at top of DTC Index
P210364	Throttle actuator motor control circuit high - signal plausibility failure	- Throttle motor control circuit - short to power - ECM fault	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Refer to new module/component installation note at top of DTC Index
P210500	Throttle actuator control system - forced engine shutdown	Throttle MIL request due to fuel cut	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P210629	Throttle actuator control system - forced limited power	Signal invalid	Install a new throttle body. Throttle Body (19.70.04) Refer to new module/component installation note at top of DTC Index
P210664	Throttle actuator control system - forced limited power	Signal plausibility failure	Install a new throttle body. Throttle Body (19.70.04) Refer to new module/component installation note at top of DTC Index

P211800	Throttle actuator motor control current range/performance	Throttle motor control circuit - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P211900	Throttle actuator control throttle body range/performance	Throttle spring faulty	Install a new throttle body. Throttle Body (19.70.04) Refer to new module/component installation note at top of DTC Index

Fuel Injection Supply Manifold (19.60.13)

Special Service Tools



Fuel spring lock decoupling tool
310-D005

Removal



WARNING: This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



WARNING: After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

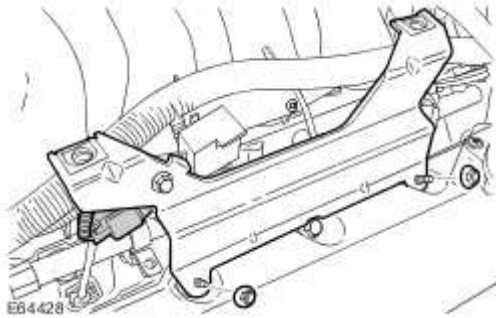


WARNING: Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications
- 2 . Remove the engine cover.
For additional information, refer to Engine Cover (76.11.35)

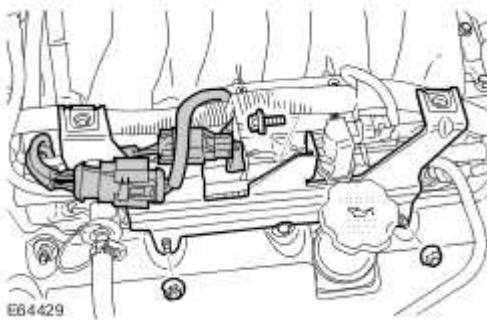
3 . Remove the engine RH cover bracket.

- Remove the 2 nuts.
- Disconnect the electrical connector.



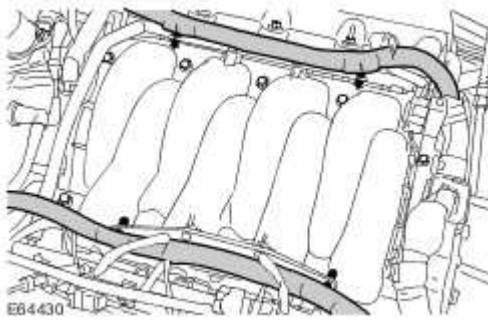
4 . Remove the engine LH cover bracket.

- Remove the 2 nuts.
- Release the 2 electrical connectors.
- Remove the purge valve bolt.



5 . Release the engine wiring harness.

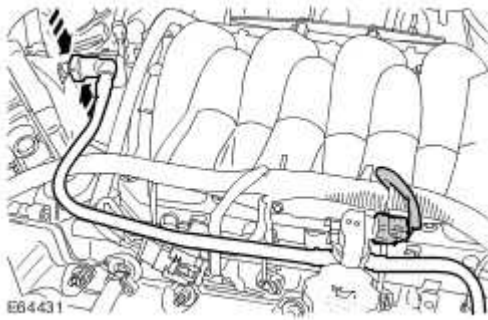
- Release the 4 clips.



6 . Release the purge valve.

▶ Disconnect the quick release connector.

▶ Disconnect the electrical connector.

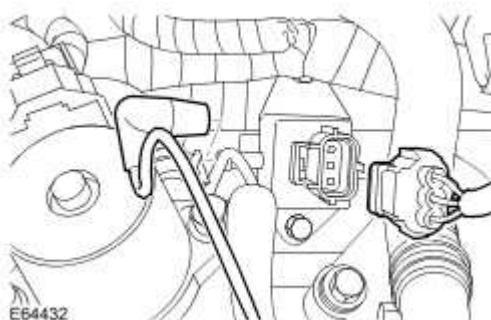


7 . Using the special tool, disconnect the fuel line.

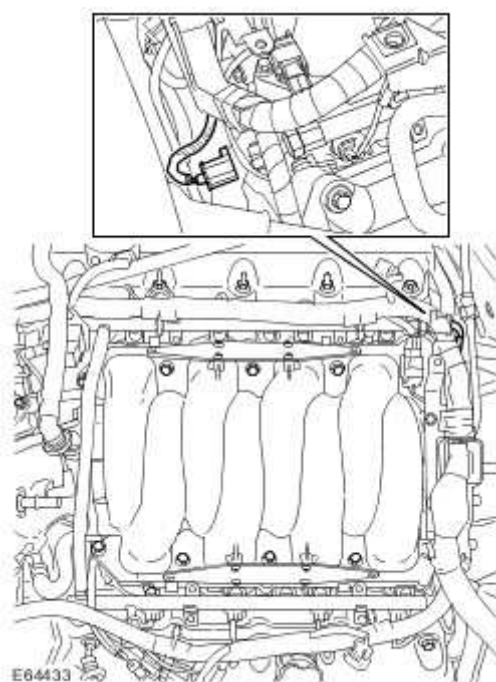
For additional information, refer to Spring Lock Couplings

8 . Disconnect the fuel rail pressure (FRP) sensor electrical connector.

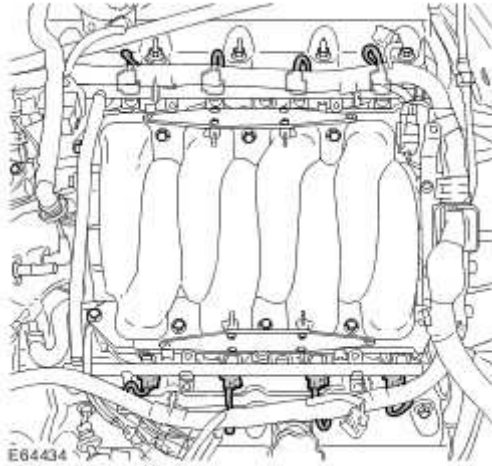
9 . Disconnect the FRP sensor vacuum line.



10 . Disconnect the fuel temperature sensor electrical connector.



11 . Disconnect the 8 fuel injector electrical connectors.



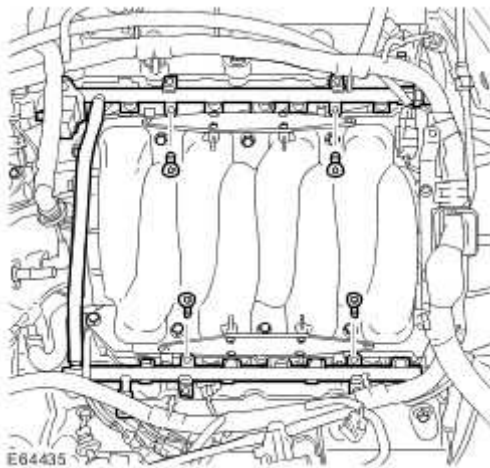
12



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 fuel injection supply manifold.

- Remove the 4 Torx bolts.
- Remove and discard the 8 O-ring seals.

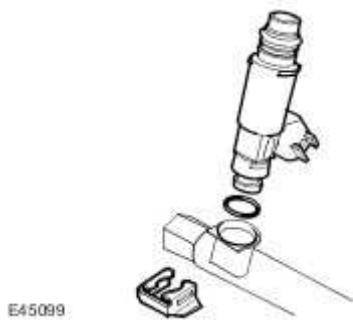


13 . **NOTE:**

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

Remove the fuel injector.

- ▶ Remove the clip.
- ▶ Remove and discard the O-ring seal.
- ▶ Repeat the above procedure for the remaining injectors.

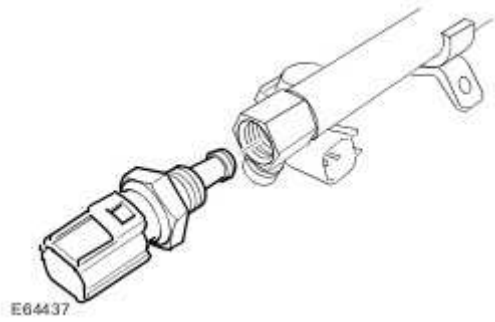


14 . Remove the FRP sensor.

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



15 . Remove the fuel temperature sensor.



Installation

1 . Install the fuel temperature sensor.

- Clean the components.
- Tighten the sensor to 7 Nm (5 lb.ft).

2 . Install the FRP sensor.

- Clean the components.
- Install new O-ring seals.
- Tighten the bolts to 5 Nm (4 lb.ft).

3 . Install the fuel injectors.

- Clean the components.
- Install new O-ring seals.
- Install the clips.

4 . Install the fuel injection supply manifold.

- Clean the components.
- Install new O-ring seals.

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

5 . Connect the fuel injector electrical connectors.

6 . Connect the fuel temperature sensor electrical connector.

7 . Connect the FRP sensor vacuum line.

8 . Connect the FRP sensor electrical connector.

9 . Connect the fuel line.

For additional information, refer to Spring Lock Couplings

10 . Attach the purge valve.

 Connect the electrical connector.

 Connect the quick release connector.

11 . Attach the engine wiring harness.

 Secure the clips.

12 . Install the LH engine cover bracket.

 Attach the purge valve, align the peg and tighten the bolt to 6 Nm (4 lb.ft).

 Secure the electrical connectors.

 Tighten the nuts to 6 Nm (4 lb.ft).

13 . Install the RH engine cover bracket.

 Connect the electrical connector.

 Tighten the nuts to 6 Nm (4 lb.ft).

14 . Install the engine cover.

For additional information, refer to Engine Cover (76.11.35)

15 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Fuel Injector (18.10.01)

Removal



WARNING: This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

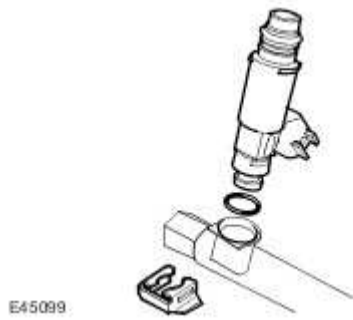


WARNING: After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.



WARNING: 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 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications
- 2 . Remove the fuel injection supply manifold.
For additional information, refer to Fuel Injection Supply Manifold (19.60.13)
- 3 . Remove the fuel injector.
 - Remove the clip.
 - Remove and discard the O-ring seal.



Installation

1 . Install the fuel injector.

- ▶ Clean the components.
- ▶ Install a new O-ring seal.
- ▶ Install the clip.

2 . Install the fuel injection supply manifold.

For additional information, refer to Fuel Injection Supply Manifold (19.60.13)

3 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Throttle Body (19.70.04)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications

- 2 . Remove the engine cover.
For additional information, refer to Engine Cover (76.11.35)

- 3 . Remove the air intake duct.

➤ Remove the bolt.

➤ Release the 2 clips.



- 4 . Disconnect the throttle position (TP) sensor electrical connector.



5



· **WARNING:** Since injury such as scalding could be caused by escaping steam or

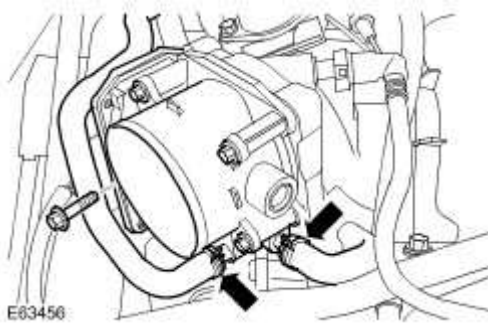
coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

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.



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.

- ▶ Remove the hose clamps from the throttle body hoses.

 Secure the throttle body hoses clips.

3 . Connect the TP sensor electrical connector.

4 . Install the air intake duct.

 Tighten the clips.

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

5 . Install the engine cover.

For additional information, refer to Engine Cover (76.11.35)

6 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

7 . Check and top-up the coolant.

303-05 : Accessory Drive – 4.2L NA V8 – AJV8/4.2L SV V8 – AJV8

Specifications

Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Accessory drive belt, tensioner - bolt	40	30	-
Accessory drive belt, idler pulley - bolt	25	18	-
Accessory drive belt - bolt (Supercharged models)	40	30	-

Accessory Drive - 4.2L NA V8 - AJV8

COMPONENT LOCATION



Item	Part Number	Description
1		Engine coolant pump
2		Power steering pump
3		Air Conditioning (A/C) compressor
4		Automatic tensioner
5		Crankshaft damper
6		Idler
7		Generator

8		Drive belt

INTRODUCTION

A single belt drives the following primary engine mounted accessories:

- Engine coolant pump
- Power steering pump
- Air Conditioning (A/C) compressor
- Generator.

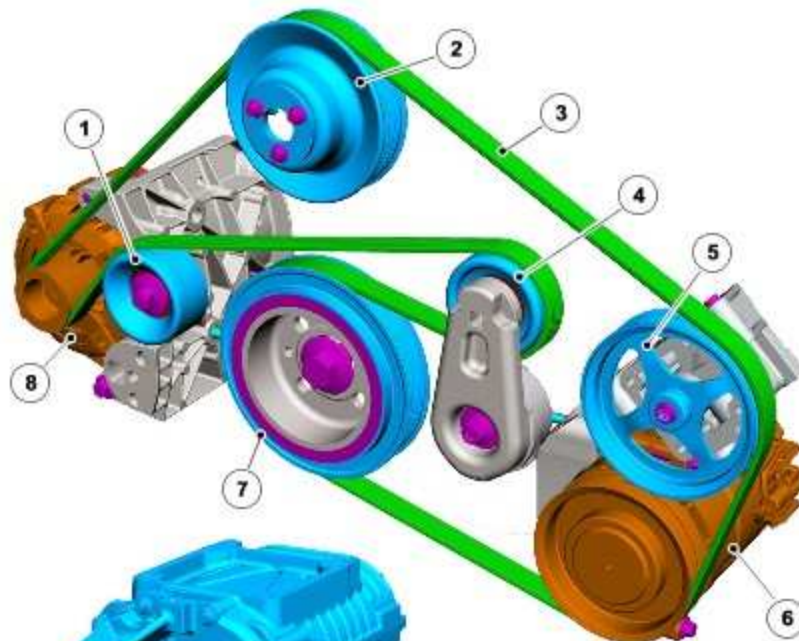
A secondary belt drives the engine driven cooling fan.

Both the primary and secondary belts are crankshaft driven with an automatic tensioner keeping the belt at the correct tension. The crankshaft incorporates a torsional vibration damper to absorb vibration and shock loads.

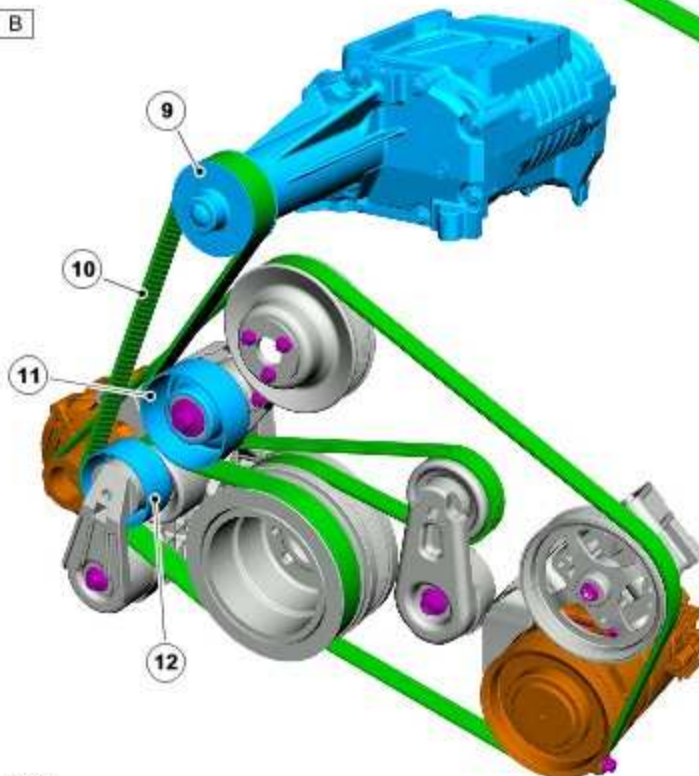
Accessory Drive - 4.2L SC V8 - AJV8

COMPONENT LOCATION

A



B



E84945

Item	Part Number	Description
A		Primary accessory drive
B		Secondary accessory drive
1		Routing idler
2		Coolant pump

3		Primary accessory drive belt
4		Primary tensioner assembly
5		Power steering pump
6		Air Conditioning (AC) compressor
7		Crankshaft pulley
8		Generator
9		Supercharger pulley
10		Secondary accessory drive belt
11		Routing idler
12		Secondary tensioner assembly

OVERVIEW

A single six-ribbed belt drives all the primary engine mounted accessories and a secondary single eight-ribbed belt drives the supercharger.

Both the primary and secondary belts are crankshaft driven via the torsional vibration damper.

An automatic tensioner, located on the Left Hand (LH) accessory-mounting bracket, keeps the primary accessory belt at the correct tension. A routing idler on the Right Hand (RH) accessory-mounting bracket increases the wrap angle around the generator pulley.

A second automatic tensioner, located on the generator mounting bracket, keeps the secondary accessory belt at the correct tension. A routing idler located on a timing cover mounting bracket increases the wrap angle around the supercharger pulley.

The automatic tensioner's consist of a routing idler on the end of a spring loaded pivot arm. The pivot arm can be turned counter-clockwise (viewed from the front of the engine) for removal and installation of the belt.

The torsional vibration damper incorporates compressed rubber between its inner and outer diameters to absorb vibration and shock loads.

Accessory Drive

Principle of Operation

For a detailed description of the Front End Accessory Drive (FEAD), refer to the relevant Description and Operation section in the workshop manual.

[Accessory Drive - 4.2L NA V8 - AJV8](#)

Inspection and Verification

- 1 . Verify the customer concern.
- 2 . Visually inspect for obvious signs of mechanical damage and system integrity.

Mechanical
• FEAD belt • FEAD belt tension • FEAD belt tensioner • FEAD belt pulleys

- 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 concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

FEAD belt noise or squeal

Possible Source(s):

- FEAD belt pulley(s)
- Lubricant or other contamination
- FEAD belt

Action(s) to take:

- DETERMINE where the noise is coming from. CHECK for pulley alignment, freedom of rotation and damage. REPAIR or INSTALL new parts as necessary.
[Accessory Drive Belt Idler Pulley - 4.2L NA V8 - AJV8 \(12.10.43\)](#)

- CHECK FEAD belt for contamination. If contaminated, INSTALL a new belt.
[Accessory Drive Belt - 4.2L NA V8 - AJV8 \(12.10.40\)](#)
- CHECK FEAD belt for correct application

FEAD belt does not hold tension

Possible Source(s):

- FEAD belt cracking or damaged
- Tensioner worn or damaged

Action(s) to take:

- INSPECT FEAD belt for cracking or damage. INSTALL a new belt as necessary.
[Accessory Drive Belt - 4.2L NA V8 - AJV8 \(12.10.40\)](#)
- CHECK FEAD belt tensioner for damage and correct operation. INSTALL a new FEAD belt tensioner as necessary.
[Accessory Drive Belt Tensioner - 4.2L NA V8 - AJV8 \(12.10.41\)](#)

Component Tests

FEAD belt tensioner

Static

The only checks required for the FEAD belt tensioner are for stick, grab or bind.

- 1 . Remove the drive belt in the area of the tensioner.
- 2 . Using the correct tool, rotate the tensioner from its relaxed position through its full stroke and back to the relaxed position to make sure there is no stick, grab or bind, and to make sure that there is tension on the tensioner spring.
- 3 . If the tensioner meets the above criteria, proceed to the dynamic test. If the tensioner does not meet the above criteria install a new tensioner.
[Accessory Drive Belt Tensioner - 4.2L NA V8 - AJV8 \(12.10.41\)](#)

Dynamic

The FEAD belt tensioner can be checked dynamically as follows:

- 1 . With the engine running, observe drive belt tensioner movement, the FEAD belt tensioner should move (respond) when the air conditioning clutch cycles (if equipped), the FEAD belt tensioner should move (respond) when the engine speed is increased rapidly. If the drive belt tensioner movement is erratic without air conditioning clutch cycling or engine acceleration, a

pulley or shaft may be bent, or distorted. Excessive drive belt rideout (uneven depth of grooves in the drive belt) can also cause excessive drive belt tensioner movement. Check condition by installing a known good belt.

[Accessory Drive Belt - 4.2L NA V8 - AJV8 \(12.10.40\)](#)

FEAD belt

1 . With the engine off, check routing of the drive belt.

[Accessory Drive - 4.2L NA V8 - AJV8](#)

2 . Inspect the drive belt tensioner wear indicator to confirm the drive belt is within operating range. Install a new drive belt as necessary .

[Accessory Drive Belt - 4.2L NA V8 - AJV8 \(12.10.40\)](#)

Accessory Drive Belt - 4.2L NA V8 - AJV8 (12.10.40)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to [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 cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

- 4 . Remove the air deflector.

For additional information, refer to [Air Deflector \(76.11.41\)](#)

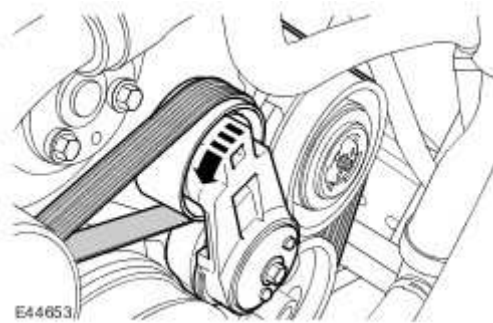
- 5 . Remove the air intake duct.

- ▶ Remove the bolt.
- ▶ Release the 2 clips.



- 6 Release the accessory drive belt.

- ▶ Rotate the accessory drive belt tensioner counter-clockwise, using a 3/8 " drive wrench.



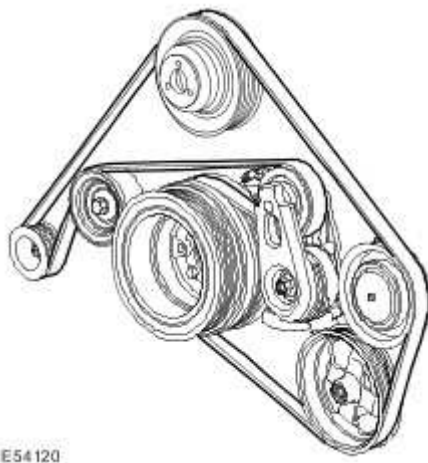
7 . NOTE:

Note the fitted position.

Remove the accessory drive belt.

Installation

- 1 . Install the accessory drive belt.



- 2 . Install the air intake duct.

- ▶ Tighten the clips.
- ▶ Tighten the bolt to 10 Nm (7 lb.ft).

- 3 . Install the air deflector.

For additional information, refer to [Air Deflector \(76.11.41\)](#)

- 4 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

- 5 . Connect the battery ground cable and install the cover.
For additional information, refer to [Specifications](#)

Accessory Drive Belt - 4.2L SC V8 - AJV8 (12.10.40)

Removal

1 . Remove the cover and disconnect the battery ground cable.

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 supercharger belt.

For additional information, refer to [Supercharger Belt \(18.50.08\)](#)

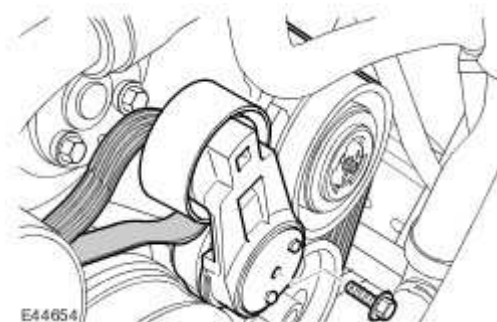
4 Release the accessory drive belt.

-  Rotate the accessory drive belt tensioner counter-clockwise, using a 3/8 " drive wrench.



5 . Remove the accessory drive belt tensioner.

-  Remove the bolt.



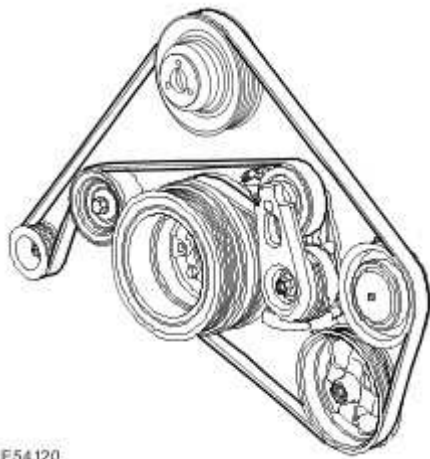
6 . NOTE:

Note the fitted position.

Remove the accessory drive belt.

Installation

- 1 . Install the accessory drive belt.



- 2 . Install the accessory drive belt tensioner.

- ▶ Clean and inspect the drive pulleys for damage.
- ▶ Tighten the tensioner bolt to 40 Nm (30 lb.ft).

- 3 . Install the supercharger belt.

For additional information, refer to [Supercharger Belt \(18.50.08\)](#)

- 4 . Connect the battery ground cable and install the cover.

Accessory Drive Belt Tensioner - 4.2L NA V8 - AJV8 (12.10.41)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)

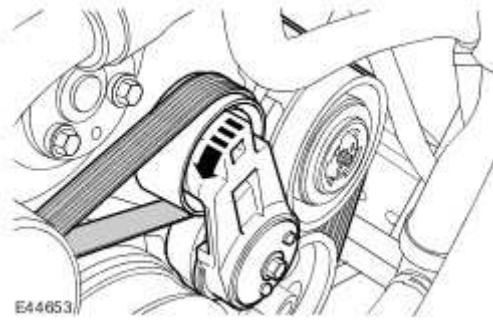
- 2  **WARNING: Do not work on or under a vehicle supported only by a jack.**
Always support the vehicle on safety stands.

Raise and support the vehicle.

- 3 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 4 . Remove the air intake duct.
 - ▶ Remove the bolt.
 - ▶ Release the 2 clips.

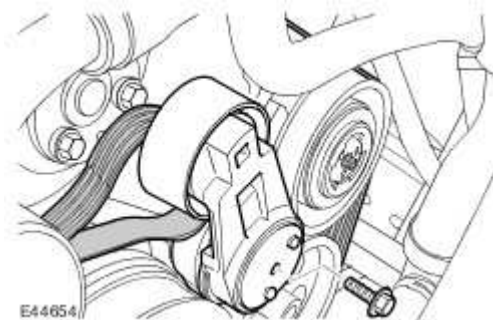


- 5 Release the accessory drive belt.
 - ▶ Rotate the accessory drive belt tensioner counter-clockwise, using a 3/8 " drive wrench.



6 . Remove the accessory drive belt tensioner.

- ▶ Remove the bolt.

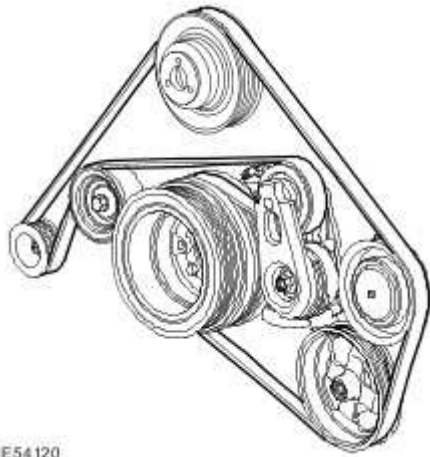


Installation

1 . Install the accessory drive belt tensioner.

- ▶ Clean and inspect the drive pulleys for damage.
- ▶ Tighten the tensioner bolt to 40 Nm (30 lb.ft).

2 . Install the accessory drive belt.



3 . Install the air intake duct.

- ▶ Tighten the clips.
- ▶ Tighten the bolt to 10 Nm (7 lb.ft).

4 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

5 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

Accessory Drive Belt Tensioner - 4.2L SC V8 - AJV8 (12.10.41)

Removal

1 . Remove the cover and disconnect the battery ground cable.

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 cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

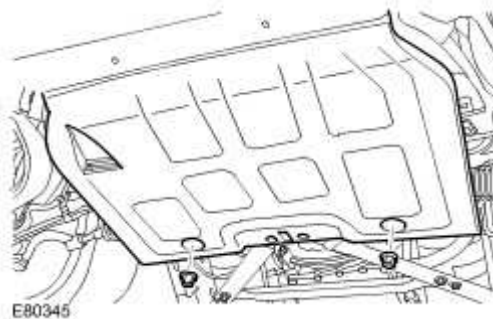
4 . Remove the radiator splash shield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

5 . Remove the air deflector.



Remove the 2 nuts.



6 Release the accessory drive belt.

•

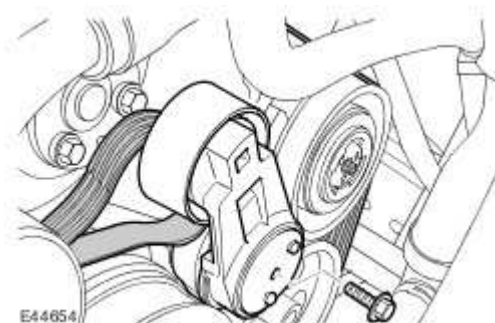


Rotate the accessory drive belt tensioner counter-clockwise, using a 3/8 " drive wrench.



7 . Remove the accessory drive belt tensioner.

- ▶ Remove the bolt.

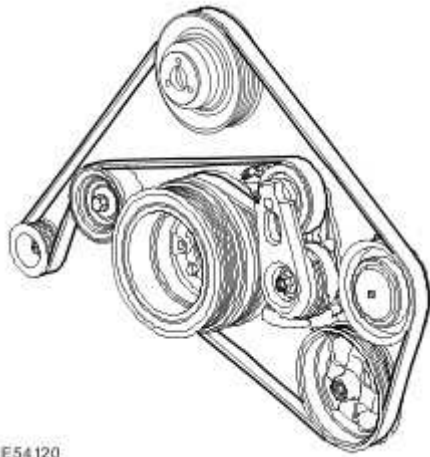


Installation

1 . Install the accessory drive belt tensioner.

- ▶ Clean and inspect the drive pulleys for damage.
- ▶ Tighten the tensioner bolt to 40 Nm (30 lb.ft).

2 . Attach the accessory drive belt.



3 . Install the air deflector.

▶ Tighten the nuts.

4 . Install the radiator splash shield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

5 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

6 . Connect the battery ground cable and install the cover.

Accessory Drive Belt Idler Pulley - 4.2L NA V8 - AJV8 (12.10.43)

Removal

All vehicles

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications

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

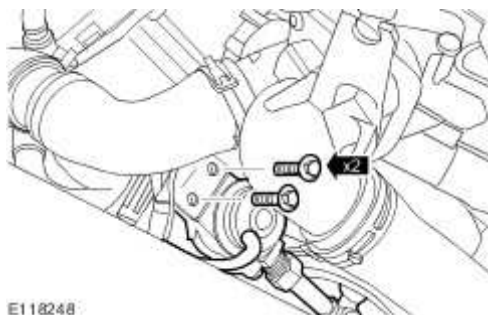
Raise and support the vehicle.

- 3 . Remove the accessory drive belt.
For additional information, refer to Accessory Drive Belt - 4.2L NA V8 - AJV8 (12.10.40)

Vehicles with secondary air injection (AIR)

- 4 . Release the AIR control valve.

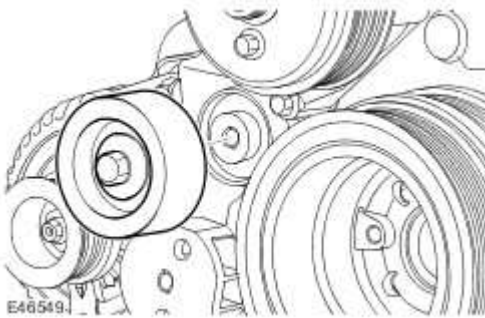
 Remove the 2 bolts.



All vehicles

- 5 . Remove the accessory drive belt idler pulley.

▶ Remove the bolt.



Installation

All vehicles

- 1 . Install the accessory drive belt idler pulley.

▶ Tighten the bolt to 25 Nm.

Vehicles with secondary air injection (AIR)

- 2 . Secure the AIR control valve.

▶ Tighten the 2 bolts to 25 Nm.

All vehicles

- 3 . Install the accessory drive belt.

For additional information, refer to Accessory Drive Belt - 4.2L NA V8 - AJV8 (12.10.40)

- 4 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Accessory Drive Belt Idler Pulley - 4.2L SC V8 - AJV8 (12.10.43)

Removal

All vehicles

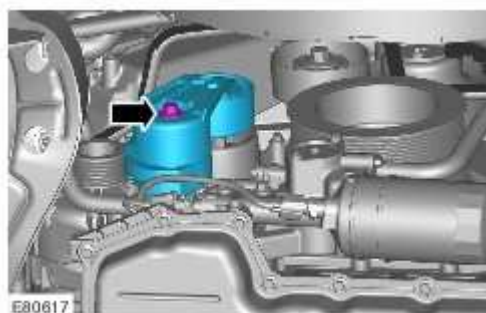
- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications

- 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 accessory drive belt.
For additional information, refer to Accessory Drive Belt - 4.2L SC V8 - AJV8 (12.10.40)
- 4 . Release the supercharger belt tensioner.

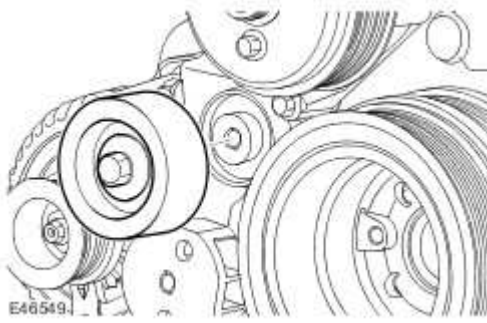
 Loosen the bolt.



Vehicles without secondary air injection (AIR)

- 5 . Remove the accessory drive belt idler pulley.

 Remove the bolt.



Vehicles with secondary air injection (AIR)

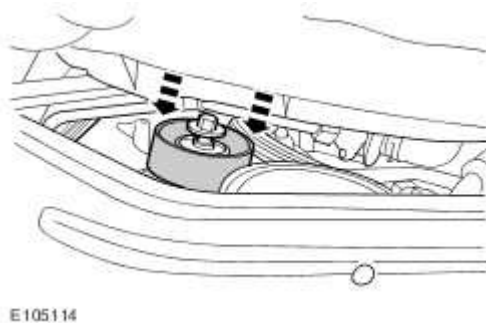
6



- **CAUTION:** Take care when removing the idler pulley, as damage to the secondary air injection pipes may occur.

Remove the accessory drive belt idler pulley.

- Loosen the bolt and pulley assembly by approximately 15 mm.
- Using suitable tools, apply gentle pressure to the pulley assembly until the pulley separates from the bolt.
- Remove the bolt.



Installation

Vehicles without secondary air injection (AIR)

- 1 . Install the accessory drive belt idler pulley.

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

Vehicles with secondary air injection (AIR)

2



- **CAUTION: Make sure that the pulley is correctly centred on the bolt prior to tightening the bolt, failure to follow this instruction may result in damage to the vehicle.**

Install the accessory drive belt idler pulley.

- ▶ Using a suitable tool, release the bolt from the new pulley assembly.
- ▶ Loosely install the pulley and bolt.
- ▶ Check that the pulley is correctly centered on the bolt.
- ▶ Tighten the bolt to 25 Nm (18 lb.ft).

All vehicles

- 3 . Secure the supercharger belt tensioner.

- ▶ Tighten the bolt to 40 Nm (30 lb.ft).

- 4 . Install the accessory drive belt.

For additional information, refer to Accessory Drive Belt - 4.2L SC V8 - AJV8 (12.10.40)

- 5 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Supercharger Belt (18.50.08)

Removal

1 . Remove the cover and disconnect the battery ground cable.

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

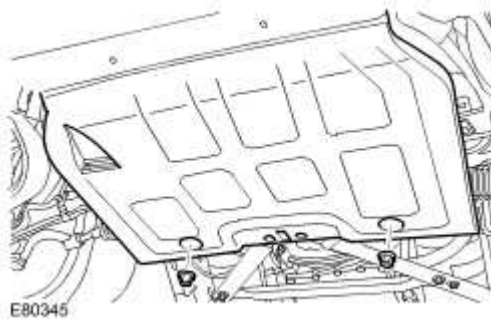
Raise and support the vehicle.

3 . Remove the radiator splash shield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

4 . Remove the air deflector.

- ▶ Remove the 2 nuts.



5 **NOTE:**

- Note the fitted position.

Release the supercharger belt.

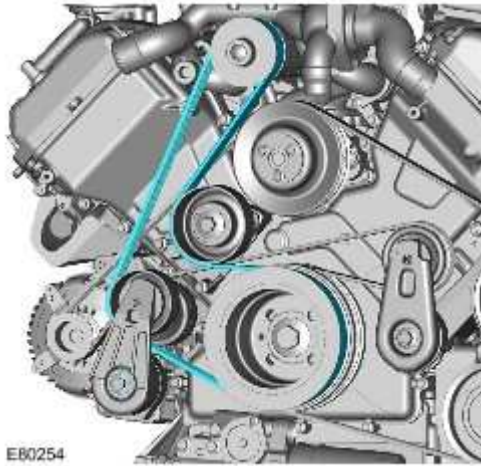
- ▶ Rotate the supercharger belt tensioner clockwise, using a 1/2 " drive wrench.



- 6 . Remove the supercharger belt.

Installation

- 1 . Install the supercharger belt.



- 2 . Install the air deflector.

▶ Tighten the nuts.

- 3 . Install the radiator splash shield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

- 4 . Connect the battery ground cable and install the cover.

Supercharger Belt Tensioner (18.50.24)

Removal

1 . Remove the cover and disconnect the battery ground cable.

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 intake air resonator.

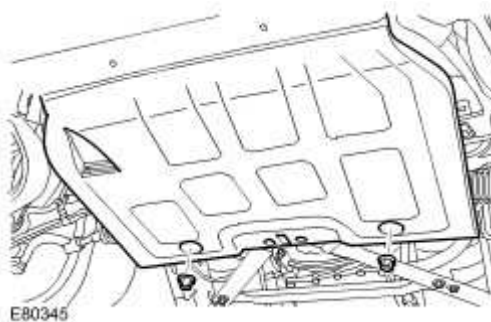
For additional information, refer to [Intake Air Resonator](#)

4 . Remove the radiator splash shield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

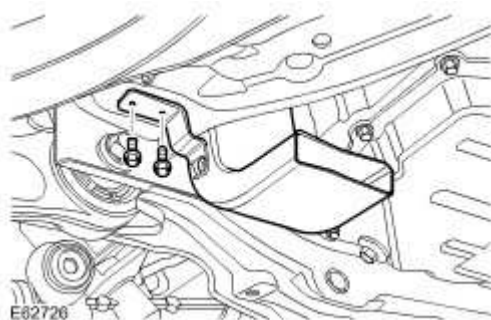
5 . Remove the air deflector.

 Remove the 2 nuts.



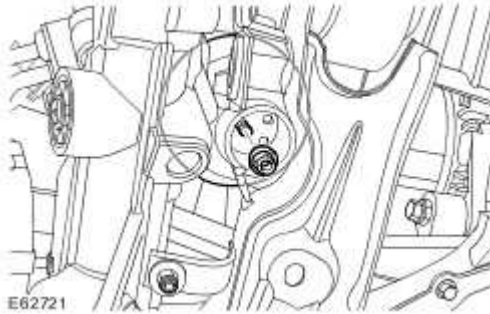
6 . Remove the generator cooling duct.

 Remove the 2 screws.



7 . Release the engine mounts.

- ▶ Support the engine.
- ▶ Remove and discard the 2 nuts.

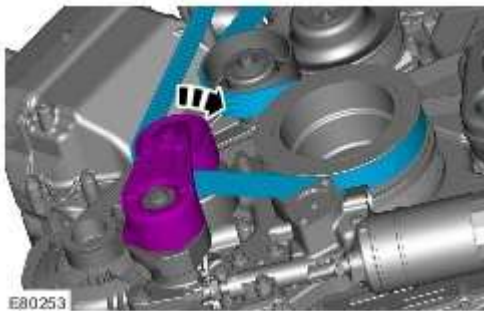


8 **NOTE:**

- Note the fitted position.

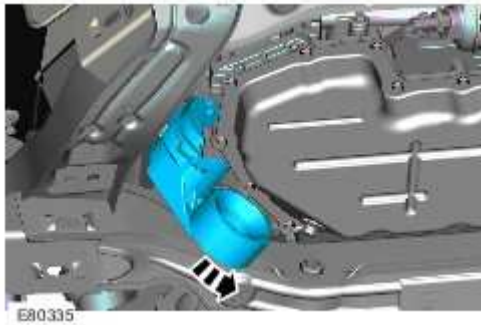
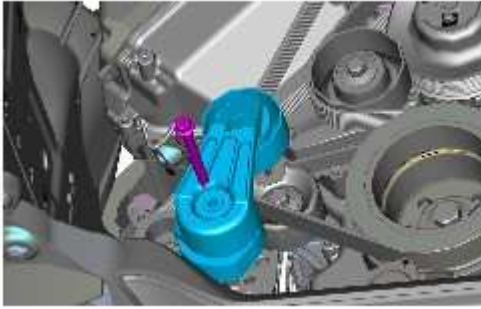
Release the supercharger belt.

- ▶ Rotate the supercharger belt tensioner clockwise, using a 1/2 " drive wrench.



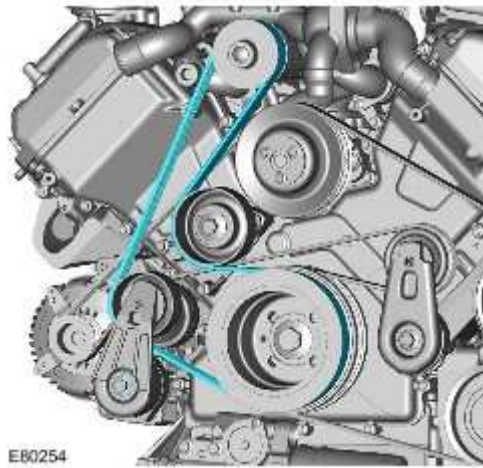
9 . Remove the supercharger belt tensioner.

- ▶ Raise the engine.
- ▶ Remove the bolt.
- ▶ Remove the O-ring seal.



Installation

- 1 . Install the supercharger belt tensioner.
 - ▶ Install the O-ring seal.
 - ▶ Tighten the bolt to 40 Nm (30 lb.ft).
 - ▶ Lower the engine onto its mounts.
- 2 . Secure the engine mounts.
 - ▶ Tighten the new nuts to 55 Nm (41 lb.ft).
- 3 . Attach the supercharger belt.



- 4 . Install the generator cooling duct.
▶ Tighten the screws.
- 5 . Install the air deflector.
▶ Tighten the nuts.
- 6 . Install the radiator splash shield.
For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)
- 7 . Install the intake air resonator.
For additional information, refer to [Intake Air Resonator](#)
- 8 . Connect the battery ground cable and install the cover.

Supercharger Belt Idler Pulley (18.50.09)

Removal

1 . Remove the cover and disconnect the battery ground cable.

- 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 cover.

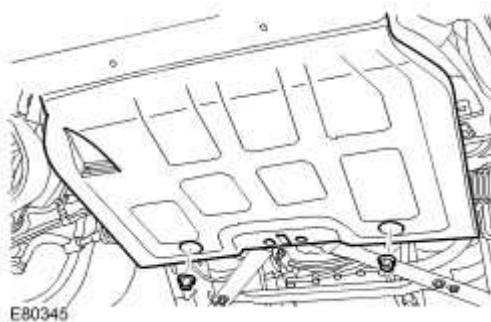
For additional information, refer to [Engine Cover \(76.11.35\)](#)

4 . Remove the radiator splash shield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

5 . Remove the air deflector.

- ▶ Remove the 2 nuts.

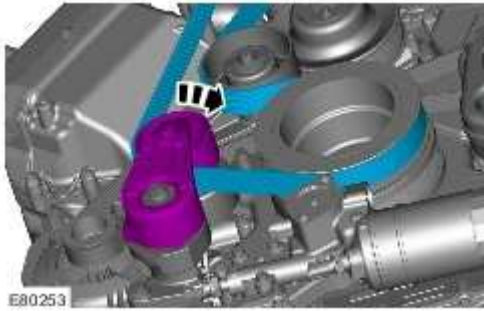


6 **NOTE:**

- Note the fitted position.

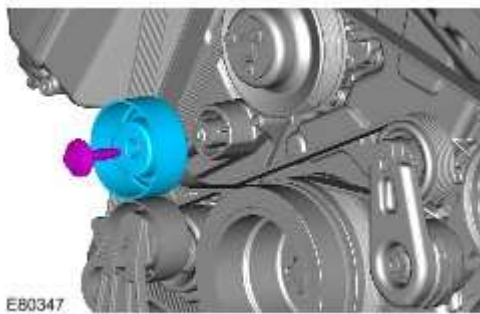
Release the supercharger belt.

- ▶ Rotate the supercharger belt tensioner clockwise, using a 1/2 " drive wrench.



7 . Remove the supercharger belt idler pulley.

► Remove the bolt.

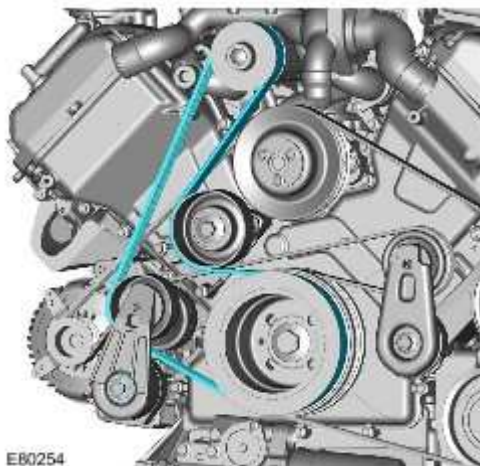


Installation

1 . Install the supercharger belt idler pulley.

► Tighten the bolt to 40 Nm (30 lb.ft).

2 . Attach the supercharger belt.



3 . Install the air deflector.

 Tighten the nuts.

4 . Install the radiator splash shield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

5 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

6 . Connect the battery ground cable and install the cover.

303-06 : Starting System – 4.2L NA V8 – AJV8/4.2L SV V8 – AJV8

Specifications

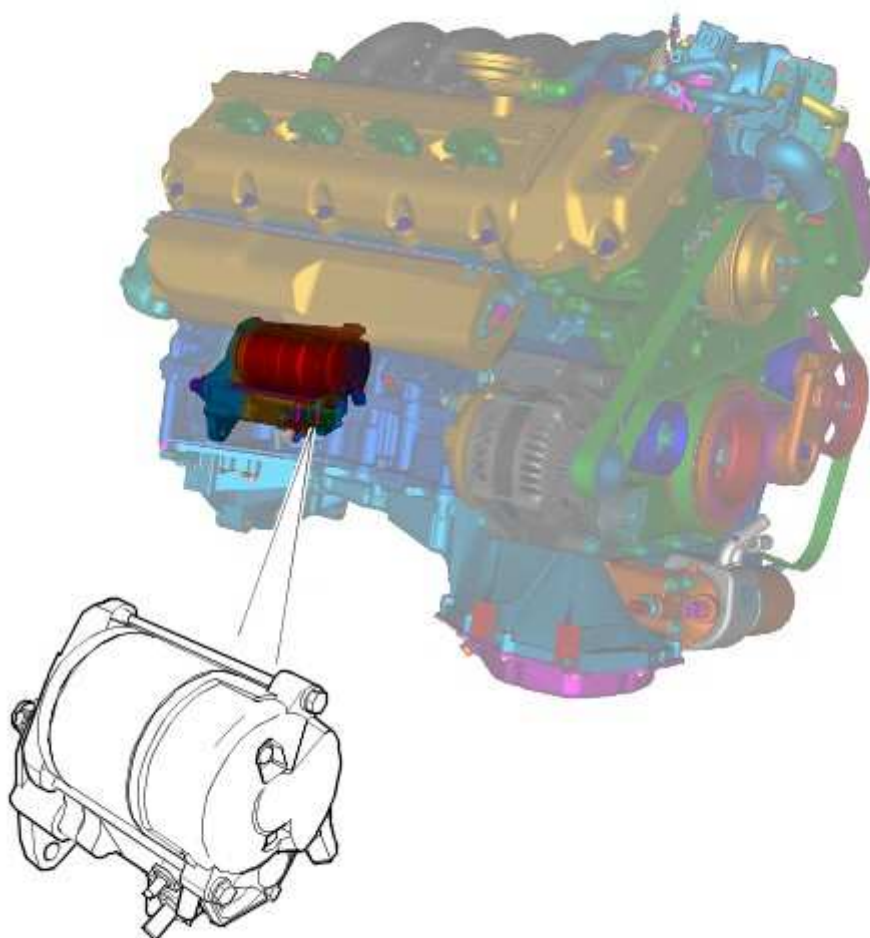
Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Keyless start control module to floor console bracket - screw	6	4	53
Keyless start control module, trim to floor console bracket - screw	6	4	53
Starter motor - bolt/stud	43	32	-
Solenoid terminal connector - nut	7	5	62

Starting System

COMPONENT LOCATION



E63812

INTRODUCTION

The starter motor is rated at 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 a series wound motor and an overrunning clutch.

The starter solenoid is energised by a signal from the Engine Control Module (ECM) when

the starter switch is pressed. When engine cranking is requested, the ECM checks that a valid mobilisation code has been received before granting the crank request. For additional information, refer to [Anti-Theft - Active](#) (419-01A Anti-Theft - Active)

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 right hand 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

Principle of Operation

For a detailed description of the starting system, refer to the relevant Description and Operation section in the workshop manual.

[Starting System](#)

[Anti-Theft - Passive](#)

Inspection and Verification

- 1 . Verify the customer concern.
- 2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
• Gear selector lever cable adjustment • Starter Motor • Battery	• Battery • Fuses • Wiring harness • Damaged, loose or corroded connectors • Starter relay • Engine Control Module (ECM)

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 concern 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 Cause	Action
The engine does not crank (starter motor does not turn)	• Gear selector not in P or N position • Battery • Harness/Connectors • Starter motor • Starter relay • Start switch • Transmission control module (TCM)	Make sure the gear selector is in the P or N position and correctly adjusted. Selector Lever Cable Adjustment (44.15.07) Check the battery condition and state of charge. Battery Check the starter motor and harness. Check for DTCs and refer to the DTC Index

	• Engine control module (ECM) • Engine seized	
The engine does not crank (starter motor does turn)	• Starter motor installation • Starter motor • Ring gear	Check the starter motor installation (fasteners tight, starter motor square to engine, etc). Check the ring gear teeth for damage, foreign objects, etc.
Engine cranks too slowly	• Battery • Harness/Connectors • Starter motor • Engine oil incorrect grade	Check the battery condition and state of charge. Battery Refer to the electrical circuit diagrams and test the starter motor and starter motor circuits
Engine cranks too fast	• Low engine compression	Check the engine compressions. Engine
Excessive starter motor noise	• Starter motor • Starter motor installation/casing • Ring gear	Check the starter motor installation (fasteners tight, motor square to engine, etc). Check the starter motor casing condition. Check the ring gear teeth for damage, foreign objects, etc.

DTC Index



CAUTION: When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00. Failure to follow this instruction may result in damage to the vehicle.

NOTE:

Generic scan tools may not read the codes listed, or may read only five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give additional information read by the manufacturer approved diagnostic system).

NOTE:

When performing voltage or resistance tests, always use a digital multimeter (DMM) accurate to 3 decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE:

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE:

If DTCs are recorded and, after performing the pinpoint tests, the fault is not present, an

intermittent concern may be the cause. Always check for loose connections and corroded terminals.

DTC	Description	Possible Cause	Action
P081700	Starter relay circuit (break wire)	Starter relay control circuit - high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P081A00	Starter relay circuit low	Starter relay control circuit - short to ground	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P081B00	Starter relay circuit high	Starter relay control circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
B100951	Ignition authorisation	- Faulty instrument cluster - Target SID re-synchronisation error following programming - CAN fault	Check ignition, power and ground supplies to CJB and instrument cluster. Re-synchronize ID by re-configuring the instrument cluster as a new module. Check CAN communications between instrument cluster and tester
B100962	Ignition authorisation signal compare failure	- Low speed CAN fault - CJB fault - Instrument cluster fault - Incorrect module installed (CJB/Instrument cluster) - Target SID synchronisation error following re-programming - Noise/EMC related error	Check CAN communications between CJB and instrument cluster. Check ignition, power and ground supplies to CJB and instrument cluster. Confirm correct module is installed. Re-synchronise ID by re-configuring the instrument cluster as a new module. Check CAN network for interference/EMC related issues
B100963	Ignition authorisation time-out	- CJB fault - Low speed CAN fault - Instrument cluster fault - Low battery voltage <9V	Check Power and Ground supplies to CJB and instrument cluster. Check CAN communications between CJB and instrument cluster. Check battery is in fully charged and serviceable condition, refer to the battery care manual

B100964	Ignition authorisation signal plausibility failure	• CJB fault • Low speed CAN fault • Instrument cluster fault	Check power and ground supplies to CJB and instrument cluster. Check CAN communications between CJB and instrument cluster
B100987	Ignition authorisation	• CJB fault • Low speed CAN fault • Instrument cluster fault • Low battery voltage <9V	Check power and ground supplies to CJB and instrument cluster. Check CAN network between CJB and instrument cluster. Check battery is fully charged and in serviceable condition, refer to the battery care manual
B100A51	Fuel pump authorisation target ID not stored	• RJB fault • Low speed CAN fault • Instrument cluster fault	Check power and ground supplies to RJB. Check CAN communications between RJB and instrument cluster. Check power and ground supplies to instrument cluster
B100A62	Fuel pump authorisation signal compare failure	• Low speed CAN fault • RJB fault • Instrument cluster fault • Incorrect module installed (RJB/Instrument cluster) • Write target SID synchronisation error following re-programming • Noise/EMC related error	Check CAN communications between RJB and instrument cluster. Check power and ground supplies to RJB and instrument cluster. Confirm correct module installed. Re-synchronise ID by re-configuring the RJB as a new module. Check CAN network for interference/EMC related issues
B100A63	Fuel Pump Authorisation Time Out	• RJB fault • Low speed CAN fault • Instrument cluster fault • Low battery voltage <9V	Check power and ground supplies to RJB and instrument cluster. Check CAN communications between RJB and instrument cluster. Check battery is in fully charged and serviceable condition, refer to the battery care manual
B100A64	Fuel Pump authorisation	• Write target SID synchronisation error following re-programming • RJB fault • Low speed CAN fault	Re-synchronise ID by re-configuring the RJB as a new module. Check ignition, power and ground supplies to RJB and instrument cluster. Check CAN network

			between RJB and instrument cluster
B100A87	Fuel pump authorisation	• RJB fault • Low speed CAN fault • Instrument cluster fault • Low battery voltage < 9 volts	Check power and ground supplies to RJB and instrument cluster. Check CAN network between RJB and instrument cluster. Check battery is fully charged and in serviceable condition, refer to the battery care manual
B100B67	Column lock ground authorisation	• Instrument cluster fault • Low speed CAN fault • RJB fault • Vehicle speed present when attempting to power steering column lock • Engine speed present when attempting to power steering column lock • Power mode status > four when attempting to perform lock action	Check power and ground supplies to RJB and instrument cluster. Check CAN network between RJB and instrument cluster. Check ABS, ECM and CJB for DTCs and refer to the relevant DTC Index
B100B87	Column lock ground authorisation	• Instrument cluster fault • Low speed CAN fault • RJB fault	Check power and ground supplies to RJB and instrument cluster. Check CAN network between RJB and instrument cluster
B100C67	Column lock supply authorisation	• Instrument cluster fault • Low speed CAN fault • CJB fault • Vehicle speed present when attempting to power steering column lock • Engine speed present when attempting to power steering column lock • Power mode status > four when attempting to perform lock action	Check power and ground supplies to CJB and instrument cluster. Check CAN network between CJB and instrument cluster. Check ABS, ECM and CJB for DTCs and refer to the relevant DTC Index
B100C87	Column lock supply authorisation	• Instrument cluster fault • Low speed CAN fault • CJB fault	Check power and ground supplies to CJB and instrument cluster. Check CAN network between CJB and instrument cluster

B100D51	Column lock authorisation	Not programmed	Check ignition, power and ground supplies to steering column lock and instrument cluster. Re-synchronise ID by re-configuring the steering column lock as a new module
B100D62	Column lock authorisation - signal compare failure	- CAN fault - Steering column lock fault - Instrument cluster fault - Incorrect module installed (Steering column lock/Instrument cluster) - Target ID synchronisation error following re-programming - Noise/EMC related error	Check CAN network between steering column lock and instrument cluster. Check power and ground supplies to steering column lock and instrument cluster. Confirm the correct modules are installed. Re-synchronize ID by re-configuring the steering column lock as new. Check CAN network for interference/EMC related issues
B100D64	Column lock authorisation - signal plausibility failure	- CAN fault - Steering column lock fault - Instrument cluster fault	Check CAN network to steering column lock. Check power and ground supplies to steering column lock and instrument cluster
B100D87	Column lock authorisation - missing message	- CAN fault - Steering column lock fault - Instrument cluster fault - Low voltage at steering column lock < 8V	Check CAN network between steering column lock and instrument cluster. Check power and ground supplies to steering column lock and instrument cluster
B100D96	Column lock authorisation	- CAN fault - Steering column lock fault - Instrument cluster fault - Low temperature < -30 ° - Low voltage at steering column lock < 8 volts - Restricted bolt movement	Check CAN network between steering column lock and instrument cluster. Check power and ground supplies to steering column lock and instrument cluster. Check there is no torque applied to the steering column/wheel
B102611	Steering column lock power circuit short to ground or over temperature	Circuit short to ground	Refer to the electrical circuit diagrams and test steering column lock power circuit for short to ground
B102612	Steering column lock ground circuit short to power	Steering column lock ground circuit - short to power	Refer to the electrical circuit diagrams and test steering column lock ground circuit for short to power

B102613	Steering column lock power circuit open load	• Circuit open	Refer to the electrical circuit diagrams and test steering column lock power circuit for high resistance
B102B67	Passive key authorisation signal incorrect after event	• CJB fault • Low speed CAN fault • Remote Keyless Entry (RKE) module fault • Write target SID synchronisation error following re-programming	Check power and ground supplies to CJB and RKE module. Check CAN communications between CJB and RKE module. Re-synchronise ID by re-configuring the RKE module as a new module
B102B87	Passive key authorisation missing message	• CJB fault • Low speed CAN fault • RKE module fault • Key fob battery low/battery contact issue • Interference from other RF signal • EMC/noise • Receiver fault • Receiver not programmed correctly • Serial communications fault (between receiver and RKE module) • Key fault • Passive antenna fault • Confirm placement of key within vehicle	Check power and ground supplies to CJB, RKE module and receiver. Check CAN communications between CJB and instrument cluster. Check key fob battery. Confirm vehicle surroundings, move vehicle. Check CAN network for interference/EMC related issues. Disconnect battery, then re-connect - confirm operation by re-programming keys. Check serial circuit between receiver and RKE module. Confirm spare key works. Refer to the electrical circuit diagrams and test circuits to all 3 antennas. Check whereabouts of key
B108A23	Start button stuck	• Signal stuck low	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
B108A29	Start button fault	• Signal invalid	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
B114011	Engine crank authorisation circuit short to ground or over temperature	• Engine crank authorisation circuit short to ground	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
B114013	Engine crank authorisation circuit open load	• Engine crank authorisation circuit high	Carry out any pinpoint tests associated with this DTC using the manufacturer

		resistance	approved diagnostic system
B1B0100	Key transponder - number of keys stored below minimum number required	• Operator only cycles one key during programming • Instrument cluster, start control unit or key loses power or circuit failure during programming • Faulty key • Unable to programme key due to noise/EMC related issues	Ensure all keys to be programmed are available. Check power and ground supplies to all relevant modules. Replace faulty key. Check CAN network for noise/EMC related issues
B1B0105	Key transponder - start control unit already programmed	• Error following start control unit replacement • Start control unit fault • LIN fault • Instrument cluster fault	Re-synchronize ID by re-configuring the start control unit as new module. Check power and ground supplies to start control unit and instrument cluster. Check LIN circuit between start control unit and instrument cluster
B1B0151	Key transponder - start control unit programming error	• LIN fault • Instrument cluster fault • Faulty key • Start control unit fault • Attempted to programme a non-default key	Check LIN circuit between start control unit and instrument cluster. Check power and ground supplies to start control unit and instrument cluster. Ensure new keys are from a known good source
B1B0155	Key transponder - transponder not programmed	• Un-programmed key inserted in start control unit • Non-default key inserted during key programming	Confirm correct keys are being used
B1B0162	Key transponder - start control unit challenge response error	• Instrument cluster fault • Start control unit fault • Incorrect module installed (instrument cluster/start control unit) • Error during or following the write target SID routine • Noise/EMC related issues	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Check power and ground supplies to start control unit and instrument cluster. Check correct modules are installed. Re-synchronize ID by re-configuring the start control unit as a new module. Check CAN network for

			interference/EMC related issues
B1B0164	Key transponder - transponder challenge response error	• LIN fault • Instrument cluster fault • Key fault • Start control unit fault • Error occurred during key programming	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Check LIN circuit between start control unit and instrument cluster. Check power and ground supplies to start control unit and instrument cluster. Confirm correct key operation. Re-run key programming
B1B0167	Key transponder - start control unit invalid response	• LIN fault • Instrument cluster fault • Key fault • Start control unit fault • Another key in close proximity • Attempted to programme a non default key • IPK Cold initialisation whilst in Ignition On state, without key being present in the SCU • Race condition caused by closing driver door and pressing start button within a small time window • Passive Key search function from last door closed and key inserted in the SCU	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Check LIN circuit between start control unit and instrument cluster. Check ignition, power and ground supplies to start control unit and instrument cluster. Confirm correct key operation. Confirm single key operation. Ensure new keys are from a known good source. Check for intermittent power and ground at instrument cluster. Design condition - advise customer of correct starting sequence. Design condition - determine customer transponder key usage
B1B0187	Key transponder - timer expired	• LIN fault • Instrument cluster fault • Start control unit fault	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Check LIN circuit between start control unit and instrument cluster. Check power and ground supplies to start control unit and instrument cluster
B1B3305	Target I.D. transfer - system	• CAN fault • ECM fault	Check CAN network between ECM and

	programming failures	- Instrument cluster fault - ECM or instrument cluster incorrectly configured	instrument cluster. Check ignition, power and grounds to ECM and instrument cluster. Re-synchronise ID by re-configuring the instrument cluster as a new module
B1B3362	Target I.D. transfer - signal compare failure	- CAN fault - ECM fault - Instrument cluster fault - Incorrect module installed (ECM/instrument cluster) - Synchronisation error following re-programming - Noise/EMC related error	Check CAN network between ECM and instrument cluster. Check ignition, power and grounds to ECM and instrument cluster. Check correct ECM and instrument cluster installed. Re-synchronise ID by re-configuring the instrument cluster as a new module. Check CAN network for interference/EMC related issues
B1B3364	Target I.D. transfer - signal plausibility failure	- CAN fault - ECM fault - Instrument cluster fault - Steering column lock status incomplete - Race condition caused by closing driver door and pressing start button within a small time window	Check CAN network between ECM and instrument cluster. Check ignition, power and grounds to ECM and instrument cluster. Check steering column lock operation. Design condition - advise customer of correct start sequence
B1B3387	Target I.D. transfer - missing message	- CAN fault - ECM fault - Instrument cluster fault - Low battery voltage	Check CAN network between ECM and instrument cluster. Check ignition, power and grounds to ECM and instrument cluster. Check battery is in fully charged and serviceable condition, refer to the battery care manual
U000188	High speed CAN communication bus	Vehicle CAN bus off condition	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U030000	Internal control module software incompatibility	Invalid configuration message is received	Re-configure the RJB using the manufacturer approved diagnostic system. Clear the

			DTC and retest. If the DTC is still logged suspect the steering column lock, refer to the new module installation note at the top of the DTC Index
U300049	Control Module	Internal electronic failure	Install a new steering column lock, refer to the new module installation note at the top of the DTC Index
U300087	Control Module	Missing message	Re-configure the RJB using the manufacturer approved diagnostic system. Check steering column lock for DTCs and refer to the DTC Index. Check CAN network integrity using the manufacturer approved diagnostic system
U300281	Vehicle Identification Number (VIN)	Vehicle/component mismatch. Corrupt VIN data being transmitted, module previously installed to other vehicle	Install original module, check for DTCs and refer to relevant DTC Index

Starter Motor (86.60.01)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to [Specifications](#)

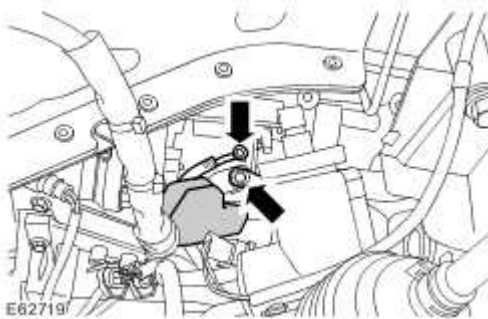
2



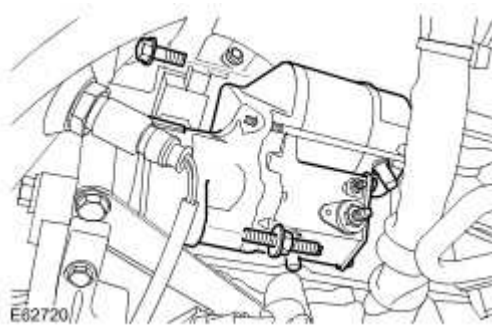
- **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

- 3 . Remove the RH engine mount.
- 4 . Disconnect the battery positive and generator cables.
 - ▶ Release the cover.
 - ▶ Remove the nut.



- 5 . Disconnect the starter motor solenoid electrical connector.
 - ▶ Remove and discard the nut.
- 6 . Remove the starter motor.
 - ▶ Remove the 2 bolts.



Installation

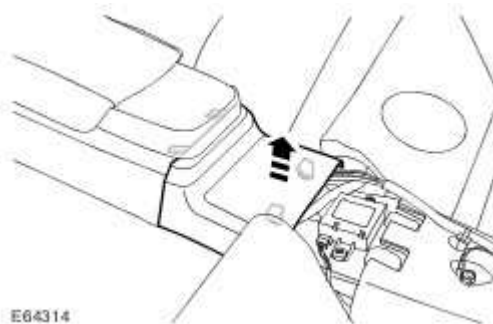
- 1 . Install the starter motor.
 - ▶ Clean the component mating faces.
 - ▶ Tighten the bolts to 45 Nm (33 lb.ft).
- 2 . Connect the starter motor solenoid electrical connector.
 - ▶ Tighten the new nut to 7 Nm (5 lb.ft).
- 3 . Connect the battery positive and generator cables.
 - ▶ Tighten the nut to 10 Nm (7 lb.ft).
 - ▶ Secure the cover.
- 4 . Install the RH engine mount.
- 5 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

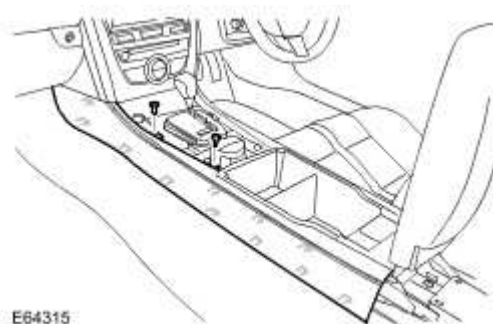
Start Control Unit

Removal

- 1 . Remove the rear seat armrest.
For additional information, refer to [Rear Seat Armrest \(76.70.39\)](#)
- 2 . Remove the floor console veneer trim panel.
For additional information, refer to [Floor Console Finish Panel \(76.47.26\)](#)
- 3 . Remove the floor console rear panel.
 - ▶ Carefully release the 2 clips.



- 4 . Remove the floor console side panel trim.
 - ▶ Remove the 2 Torx bolts.
 - ▶ Carefully release 11 clips.
 - ▶ Repeat the procedure and remove the opposite hand.

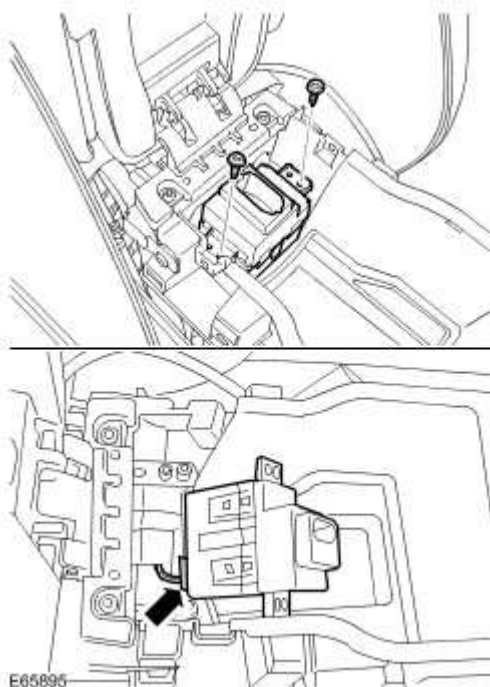


- 5 . Remove the keyless start control module trim cover.
 - ▶ Remove the 2 Torx screws.



6 . Remove the keyless start control module.

- ▶ Remove the 2 Torx screws.
- ▶ Disconnect the electrical connector.



Installation

1 . Install the keyless start control module.

- ▶ Connect the electrical connector.
- ▶ Install the Torx screws.

2 . Install the keyless start control module trim cover.

- ▶ Install the Torx screws.

3 . Install the floor console side panel trim.

- ▶ Carefully align and secure the clips.
- ▶ Tighten the Torx screws to 6 Nm (4 lb.ft).
- ▶ Install the opposite hand.

4 . Install the floor console rear panel.

- ▶ Align the lugs and secure the clips.

5 . Install the floor console veneer trim panel.

For additional information, refer to [Floor Console Finish Panel \(76.47.26\)](#)

6 . Install the rear seat armrest.

For additional information, refer to [Rear Seat Armrest \(76.70.39\)](#)

7 . Connect WDS to the vehicle and configure a new module.

303-07 : Engine Ignition – 4.2L NA V8 – AJV8/4.2L SC V8 – AJV8

Specifications

Specifications

Engine Firing Order

Firing Order
1 : 2 : 7 : 3 : 4 : 5 : 6 : 8

General Specifications

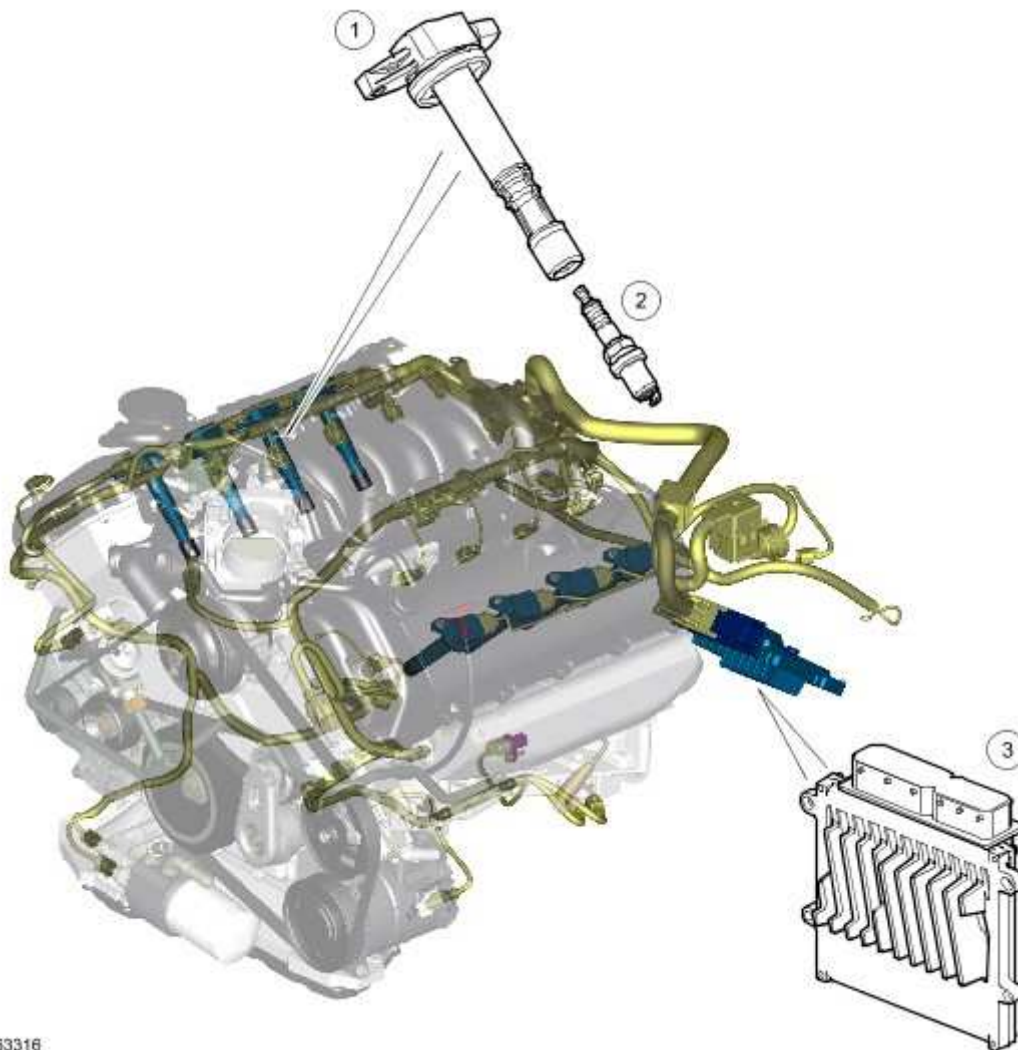
Item	Specification
Spark plug	AJ8 4575
Spark plug gap	0.9 - 1.0 mm

Torque Specifications

Item	Nm	lb-ft	lb-in
Ignition coil - bolt	5	4	44
Spark plug	28	21	-

Engine Ignition

COMPONENT LOCATION



E63316

Item	Part Number	Description
1	-	Ignition coils (8 off)
2		Spark plugs (8 off)
3	-	ECM

INTRODUCTION

The 4.2L engine ignition system has a single iridium tipped spark plug per cylinder, with each spark plug powered by an on-plug ignition coil. The ignition coils are directly driven by the ECM.

IGNITION COILS

Power for the ignition coils is supplied from the main relay and a fuse in the BJB. A capacitor is connected in parallel with the power supplies to the ignition coils to suppress RFI (radio frequency interference).

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. 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.

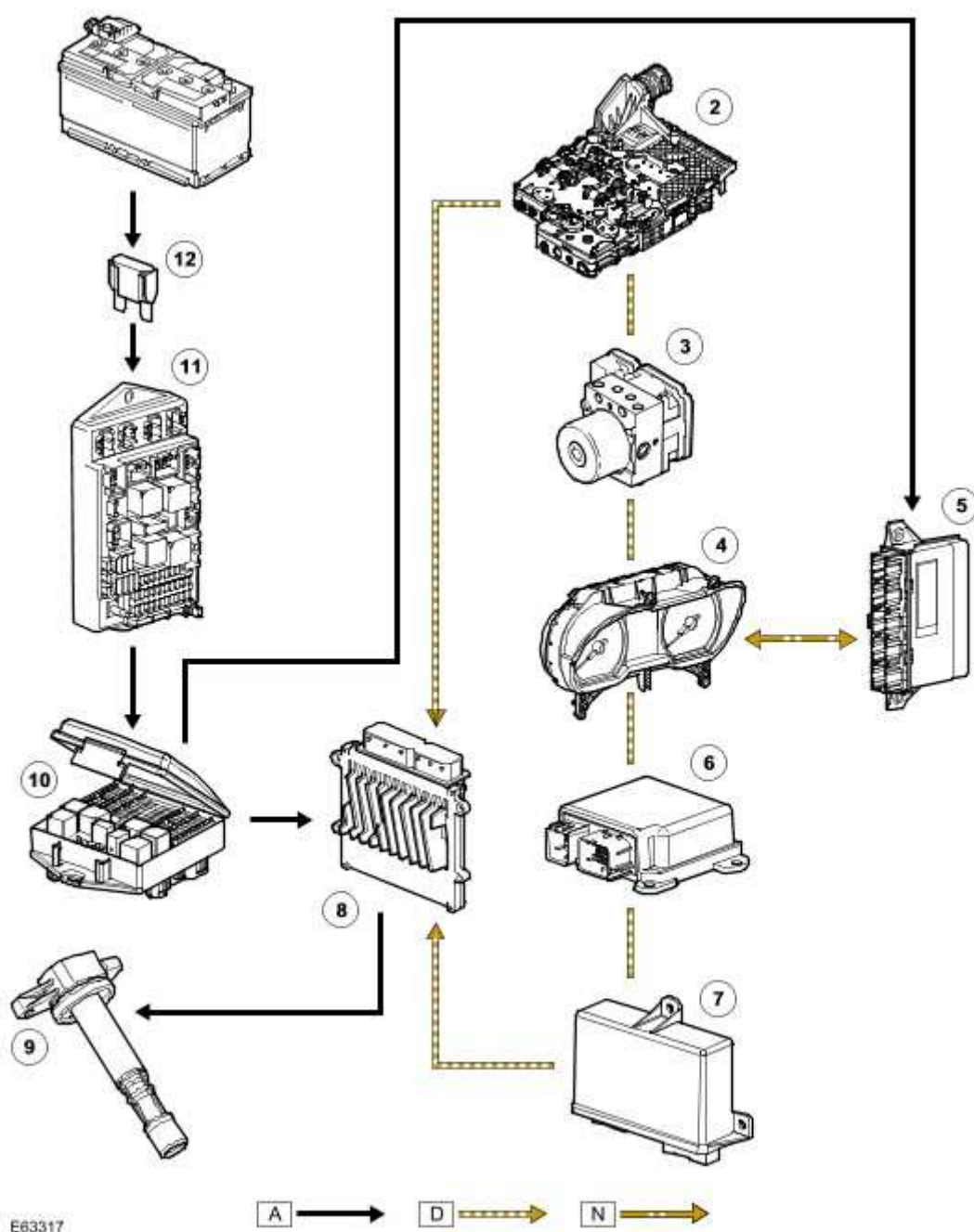
The ECM calculates the ignition timing for individual cylinders from:

- Engine speed.
- Camshaft position.
- Engine load.
- Engine temperature.
- The knock control function.
- The shift control function.
- The idle speed control function.

CONTROL DIAGRAM

NOTE:

A = Hardwired connections; D = High speed CAN bus; N=Medium speed CAN bus



Item	Part Number	Description
1	-	Battery
2		TCM
3		ABS control module
4		Instrument cluster
5		Keyless vehicle module
6		RCM
7		Park brake module
8	-	ECM

9	-	Ignition coils (8 off)
10	-	Auxiliary junction box
11	-	CJB
12	-	Mega fuse

Engine Ignition

Principle of Operation

For a detailed description of the Engine Ignition System, refer to the relevant Description and Operation section of the workshop manual.

[Engine Ignition](#)

Inspection and Verification

- 1 . Verify the customer concern.
- 2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
- Engine oil level - Cooling system coolant level - Fuel level - Fuel contamination/grade/quality	- Fuses - Wiring harness - Loose or corroded electrical connectors - Ignition coils - Sensor(s) - Engine Control Module (ECM)

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, refer to the Symptom Chart below, alternatively, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Cause	Action
Engine cranks, but does not fire	- Engine breather system disconnected/restricted - Engine ignition system - Fuel system - Electronic engine controls	- Ensure the engine breather system is free from restriction and is correctly installed - Read DTCs and refer to DTC Index in this section for engine ignition system tests

		- For fuel system tests. Fuel Tank and Lines - Read DTCs and refer to the DTC Index for electronic engine controls. Electronic Engine Controls
Engine cranks and fires, but will not start	- Evaporative emissions purge valve - Fuel pump - Spark plugs - HT short to ground (tracking) check rubber boots for cracks/damage - Ignition coil failure(s)	- For purge valve tests. Evaporative Emissions - For fuel system tests. Fuel Tank and Lines - For spark plug tests, GO to Pinpoint Test G553827p2. - For engine ignition coil circuit tests, check for DTCs and refer to the DTC Index
Difficult cold start	- 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 anti-freeze content. Specifications - Ensure the battery is in a fully charged and serviceable condition - Read DTCs and refer to DTC Index for electronic engine controls. Electronic Engine Controls - For EGR system tests. Engine Emission Control - For fuel system tests. Fuel Tank and

		Lines For purge valve tests. Evaporative Emissions
Difficult hot start	- Injector leak - Electronic engine controls - Purge valve - Fuel pump - Engine ignition system - EGR valve stuck open	- Check for leaking injectors - Read DTCs and refer to the DTC Index for electronic engine controls. Electronic Engine Controls - For purge valve tests. Evaporative Emissions - For fuel system tests. Fuel Tank and Lines - Read DTCs and refer to DTC Index in this section for engine ignition system tests - For EGR valve tests. Engine Emission Control
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	- Injector leak - Electronic engine controls - Purge valve - Fuel pump - Engine ignition system - EGR valve stuck open	- Check for leaking injectors - Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls - For purge valve tests. Evaporative Emissions - For fuel system tests. Evaporative Emissions - Read DTCs and refer to DTC Index

		in this section for engine ignition system tests For EGR valve tests. Engine Emission Control
Engine stalls soon after start	- Breather system disconnected/restricted - Electronic engine control - Engine ignition system - Air intake system restricted - Air leakage - Fuel lines	- Ensure the engine breather system is free from restriction and is correctly installed - Read DTCs and refer to DTC Index for electronic engine control. Electronic Engine Controls - Read DTCs and refer to DTC Index in this section for engine ignition system tests - Check for blockage in air filter element and air intake system - For fuel system tests. Fuel Tank and Lines
Engine hesitates/poor acceleration	- Fuel pressure, pump and lines - Injector leak - Air leakage - Electronic engine controls - Engine ignition system - EGR valve stuck open - Transmission malfunction - Restricted pedal travel (carpet, etc)	- For fuel system tests. Fuel Tank and Lines - Check for injector leak - Check for leakage from air intake system - Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls - Read DTCs and refer to DTC Index

		in this section for engine ignition system tests - For EGR system tests. Engine Emission Control - For transmission tests. Diagnostic Strategy - Ensure accelerator pedal is free from restriction
Engine backfires	- Fuel pump and lines - Air leakage - Electronic engine controls - Engine ignition system - Sticking Variable Camshaft Timing (VCT) hub	- For fuel system tests. Fuel Tank and Lines - Check for leakage in air intake system - Read DTCs and refer to DTC Index for electronic engine controls. Electronic Engine Controls - Read DTCs and refer to DTC Index in this section for engine ignition system tests - Read DTCs and refer to DTC Index for VCT tests. Electronic Engine Controls
Engine surges	- Fuel pump and lines - Electronic engine controls - Engine ignition system	- For fuel system tests. Fuel Tank and Lines - Read DTCs and refer to DTC Index for electronic engine controls. Electronic Engine Controls - Read DTCs and refer to DTC Index

		in this section for engine ignition system tests
Engine detonates/knocks	• Electronic engine controls • Fuel pump and lines • Air leakage • Sticking VCT hub	• Read DTCs and refer to DTC Index for electronic engine controls • For fuel system tests. Fuel Tank and Lines • Check for leakage from air intake system • Read DTCs and refer to DTC Index for VCT tests. Electronic Engine Controls
No throttle response	• Electronic engine controls	• Read DTCs and refer to DTC Index for electronic engine control tests
Poor throttle response	• 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 • Read DTCs and refer to DTC Index for electronic engine control tests. Electronic Engine Controls • For transmission tests. Diagnostic Strategy • Check for leakage from air intake system

DTC Index



CAUTION: When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00.

NOTE:

Generic scan tools may not read the codes listed, or may read only five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give extra information read by the manufacturer-approved diagnostic system).

NOTE:

When performing electrical voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE:

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE:

If DTCs are recorded and, after the pinpoint tests have been carried out, the fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

DTC	Description	Possible Cause	Action
P035100	Cylinder 1 ignition coil primary/secondary circuit	Engine ignition coil circuit - short to ground, power, open circuit	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035200	Cylinder 2 ignition coil primary/secondary circuit	Engine ignition coil circuit - short to ground, power, open circuit	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035300	Cylinder 3 ignition coil primary/secondary circuit	Engine ignition coil circuit - short to ground, power, open circuit	Carry out any pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system
P035400	Cylinder 4 ignition coil primary/secondary circuit	Engine ignition coil circuit - short to ground, power, open circuit	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035500	Cylinder 5 ignition coil primary/secondary circuit	Engine ignition coil circuit - short to ground, power, open circuit	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035600	Cylinder 6 ignition coil primary/secondary circuit	Engine ignition coil circuit - short to ground, power, open circuit	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035700	Cylinder 7 ignition coil primary/secondary circuit	Engine ignition coil circuit - short to ground, power, open circuit	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035800	Cylinder 8 ignition coil primary/secondary circuit	Engine ignition coil circuit - short to ground, power, open circuit	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P131500	Persistent misfire	- ECM to ignition coil primary circuit fault (cylinder misfire detected DTC also flagged) - Fuel injector circuit fault(s) (injector DTCs)	- Check for cylinder mis-fire, ignition and injector DTCs and refer to the DTC Index - For fuel system

		also flagged) - Fuel delivery pressure low - Spark plug failure/fouled/incorrect gap - Cylinder compression low	tests. Fuel Tank and Lines - For spark plug tests. Engine Ignition - For cylinder compression tests. Engine
P136700	Ignition amplifier group A	Ignition module/coil monitoring circuit - short to ground, short to power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P136800	Ignition amplifier group B	Ignition module/coil monitoring circuit - short to ground, short to power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system

Pinpoint Tests

PINPOINT TEST G553827p2 : CHECK SPARK PLUG RESISTANCE

G553827t9 : CHECK SPARK PLUG RESISTANCE

1. Remove the suspect spark plug(s). 2. Measure the resistance between:

Spark plug	Spark plug
Center electrode tip	HT contact

- Is the resistance between 8,000 and 12,000 ohms? (nominal 10,000 ohms)

-> Yes

Check ignition coil and circuits. Refer to the DTC Index for ignition coil and circuit tests.

-> **No**

INSTALL new spark plug(s). CLEAR the DTC and test the system for normal operation.

Spark Plugs - 4.2L NA V8 - AJV8 (18.20.02)

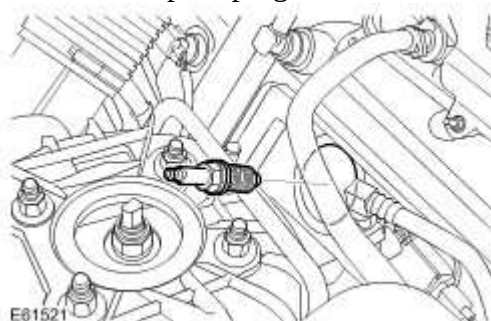
Removal

1. Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)
2. Remove the ignition coil-on-plugs.
For additional information, refer to [Ignition Coil-On-Plug - 4.2L NA V8 - AJV8 \(18.20.40\)](#)
3. Remove the remaining ignition coil-on-plugs.

4.  **WARNING: Eye protection must be worn.**

Clean the area surrounding the spark plugs.

5. Remove the spark plugs.



Installation

1. Install the spark plugs.
 Tighten the spark plugs to 28 Nm (21 lb.ft).
2. Install the remaining coil-on-plugs.
3. Install the ignition coil-on-plug.
For additional information, refer to [Ignition Coil-On-Plug - 4.2L NA V8 - AJV8](#)

(18.20.40)

- 4 . Connect the battery ground cable and install the cover.
For additional information, refer to [Specifications](#)

Spark Plugs - 4.2L SC V8 - AJV8 (18.20.02)

Removal

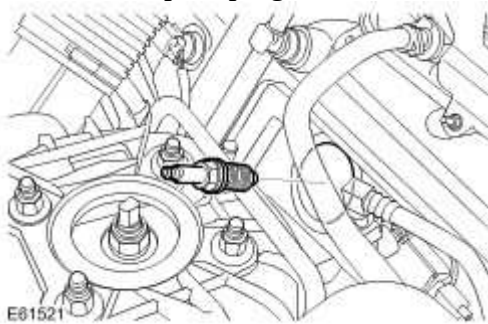
- 1 Remove the ignition coil-on-plugs.
 - For additional information, refer to [Ignition Coil-On-Plug - 4.2L SC V8 - AJV8 \(18.20.40\)](#)

- 2 Remove the remaining ignition coil-on-plugs.

- 3  **WARNING: Eye protection must be worn.**

Clean the area surrounding the spark plugs.

- 4 Remove the spark plugs.



Installation

- 1 Install the spark plugs.
 - ▶ Tighten the spark plugs to 25 Nm (18 lb.ft).
- 2 Install the remaining coil-on-plugs.
- 3 Install the ignition coil-on-plug.
 - For additional information, refer to [Ignition Coil-On-Plug - 4.2L SC V8 - AJV8 \(18.20.40\)](#)

Ignition Coil-On-Plug - 4.2L NA V8 - AJV8 (18.20.40)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)

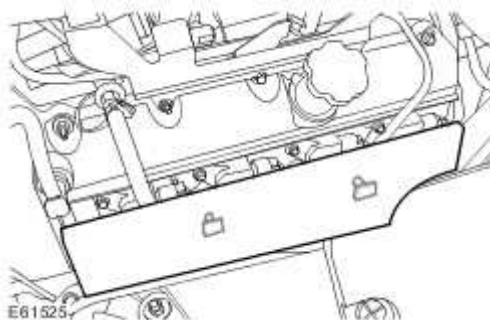
- 2 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)

- 3 . **NOTE:**
Left hand engine bank only.

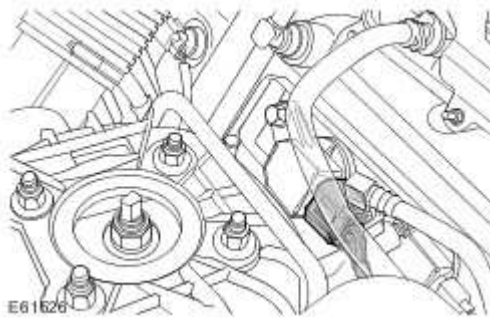
Remove the dipstick.



- 4 . Remove the ignition coil cover.
▶ Release from the 2 clips.

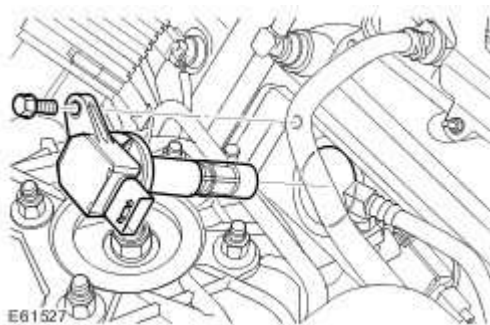


- 5 . Disconnect the ignition coil-on-plug electrical connector.



6 . Remove the ignition coil-on-plug.

▶ Remove the bolt.



Installation

1 . Install the ignition coil-on-plug.

▶ Tighten the bolt to 6 Nm (4 lb.ft).

2 . Connect and secure the electrical connector.

3 . Install the ignition coil-on-plug cover.

▶ Position and secure the clips.

4 . **NOTE:**

Left hand engine bank only.

Install the dipstick.

5 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

6 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

Ignition Coil-On-Plug - 4.2L SC V8 - AJV8 (18.20.40)

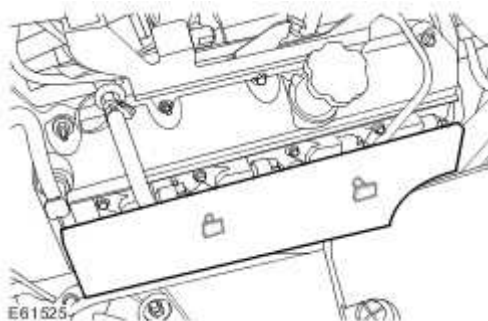
Removal

- 1 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 2 . Remove the intake air resonator.
For additional information, refer to [Intake Air Resonator](#)
- 3 . **NOTE:**
Left hand engine bank only.

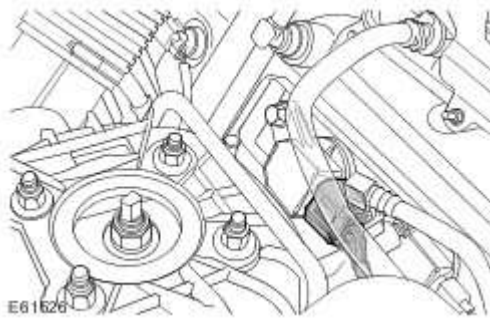
Remove the oil level indicator.



- 4 . Remove the ignition coil cover.
▶ Release from the 2 clips.

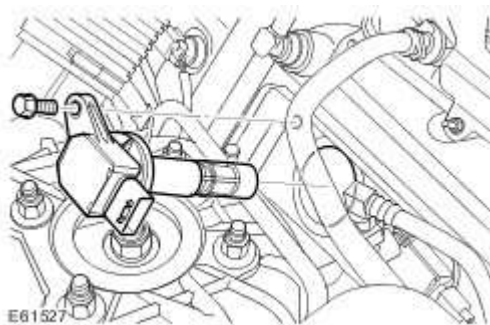


- 5 . Disconnect the ignition coil-on-plug electrical connector.



6 . Remove the ignition coil-on-plug.

▶ Remove the bolt.



Installation

1 . Install the ignition coil-on-plug.

▶ Tighten the bolt to 6 Nm (4 lb.ft).

▶ Connect the electrical connector.

2 . Install the ignition coil-on-plug cover.

▶ Position and secure the clips.

3 . **NOTE:**

Left hand engine bank only.

Install the oil level indicator.

4 . Install the intake air resonator.

For additional information, refer to [Intake Air Resonator](#)

5 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

303-08A : Engine Emission Control – 4.2L SC V8 – AJV8

Specifications

Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Exhaust gas recirculation (EGR) tube to EGR valve - bolt	21	15	-
EGR tube to exhaust manifold - nut	21	15	-
EGR valve to throttle body elbow - bolt	10	7	88
Positive crankcase ventilation (PCV) valve - screw	5	4	44
Secondary air injection, air pipe - union nut	35	26	-
Secondary air injection, blanking plug	35	26	-
Secondary air injection, control valve bracket to engine - bolt	8	6	71
Secondary air injection, manifold absolute pressure sensor to bonnet hinge panel - bolt	11	8	-
Secondary air injection, pump to bracket - nut	8	6	71

Engine Emission Control

For additional information, refer to [Engine Emission Control](#) (303-08 Engine Emission Control - Vehicles Without: Supercharger)

Engine Emission Control

No Data Available

Exhaust Gas Recirculation (EGR) Valve (17.45.01)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)
- 2 . Remove the throttle body.
For additional information, refer to [Throttle Body \(19.70.04\)](#)
- 3 . Disconnect the EGR valve electrical connector.

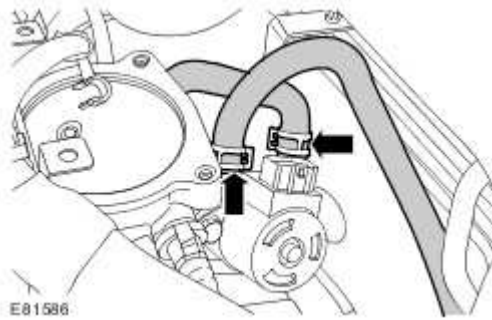


- 4  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

 **CAUTION:** Always plug any open connections to prevent contamination.

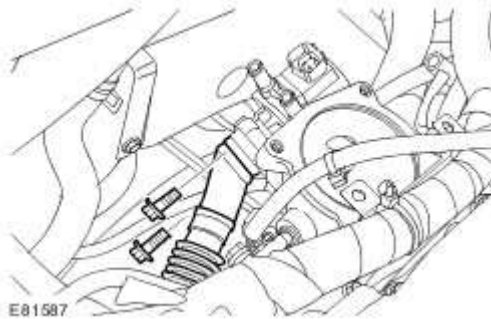
Disconnect the 2 EGR valve coolant hoses.

- Clamp the EGR coolant hose to minimize coolant loss.
- Release the 2 clips.



5 . Release the EGR valve to exhaust manifold pipe.

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

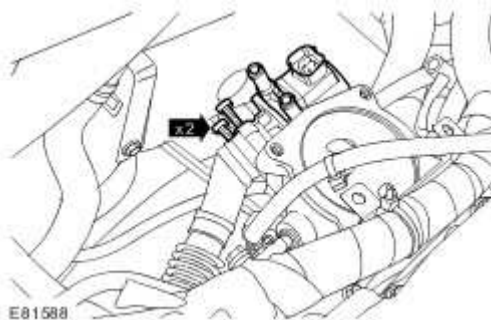


6 . **NOTE:**

The bolts will remain captive.

Remove the EGR valve.

- ▶ Remove the 2 Torx bolts.
- ▶ Remove and discard the gasket.



Installation

1 . Install the EGR valve.

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

2 . Attach the EGR valve to exhaust manifold pipe.

- ▶ Install a new gasket.
- ▶ Tighten the bolts to 21 Nm (15 lb.ft).

3 . Connect the coolant hoses and secure with the clips.

- ▶ Remove the coolant hose clamps.

4 . Connect the EGR valve electrical connector.

5 . Install the throttle body.

For additional information, refer to [Throttle Body \(19.70.04\)](#)

6 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

7 **NOTE:**

- For NAS vehicles only.

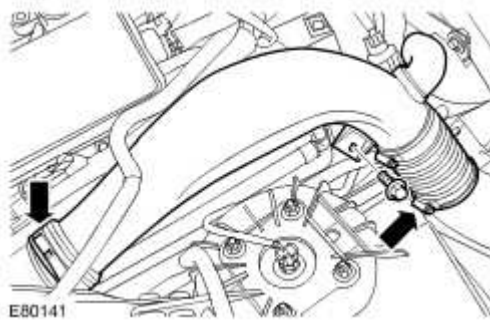
If required, carry out a long drive cycle.

For additional information, refer to [Powertrain Control Module \(PCM\) Long Drive Cycle Self-Test](#)

Positive Crankcase Ventilation (PCV) Valve

Removal

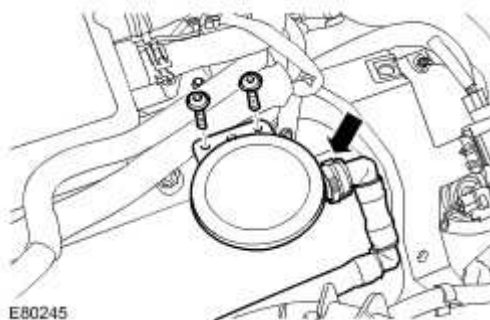
- 1 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 2 . RH side: Remove the intake air resonator.
 - ▶ Remove the bolt.
 - ▶ Release the 2 clips.



- 3 .  **CAUTION: Always plug any open connections to prevent contamination.**

Remove the positive crankcase ventilation (PCV) valve.

- ▶ Disconnect the PCV hose.
- ▶ Remove the 2 Torx screws.



Installation

- 1 . Install the PCV valve.

- ▶ Clean the components.
- ▶ Lubricate the seal with clean engine oil.
- ▶ Tighten the Torx screws.
- ▶ Connect the hose.

2 . Install the intake air resonator.

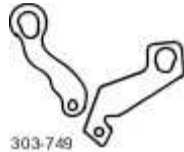
- ▶ Secure with the clips.
- ▶ Tighten the bolt to 10 Nm (7 lb.ft).

3 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

Secondary Air Injection (AIR) Control Valve to Exhaust Manifold Tube

Special Service Tools



Engine lifting brackets
303-749



Engine support bracket
303-021

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 coolant.
 - For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8
- 4 . Remove the hood.
For additional information, refer to Hood (76.16.01)

5 . Remove the front wheels and tires.

For additional information, refer to Wheel and Tire (74.20.05)

6 . Remove the intake air resonator.

For additional information, refer to Intake Air Resonator

7 . Remove the engine undershield.

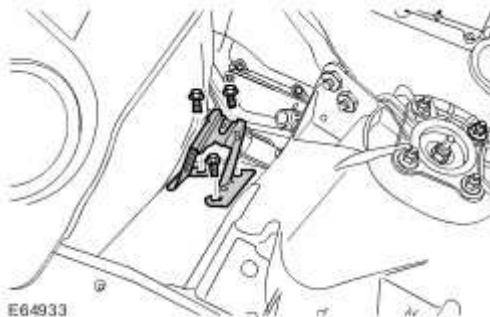
For additional information, refer to Air Deflector (76.11.41)

8 . Remove the coolant expansion tank.

For additional information, refer to Coolant Expansion Tank (26.15.01)

9 . Remove the coolant expansion tank support bracket.

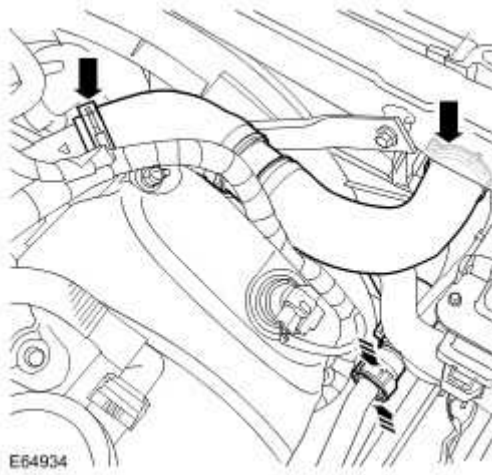
► Remove the 3 nuts.



10 . Remove the radiator top hose.

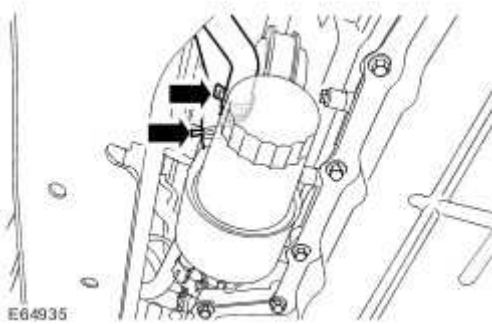
► Release the 2 clips.

► Disconnect the quick release connector.



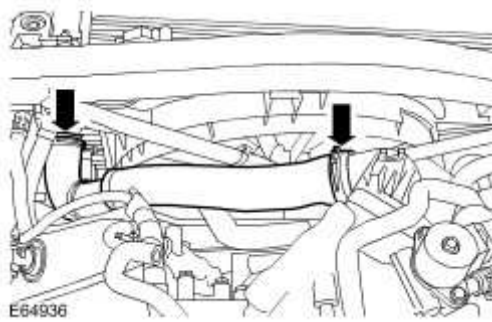
11 . Disconnect the coolant hoses from the engine oil cooler.

▶ Release the 2 clips.



12 . Remove the radiator bottom hose.

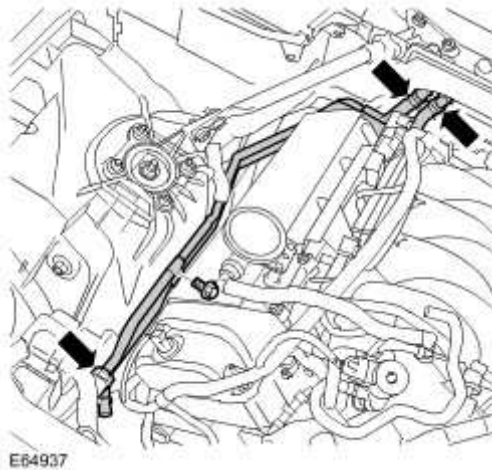
▶ Release the 2 clips.



13 . Remove the coolant rail.

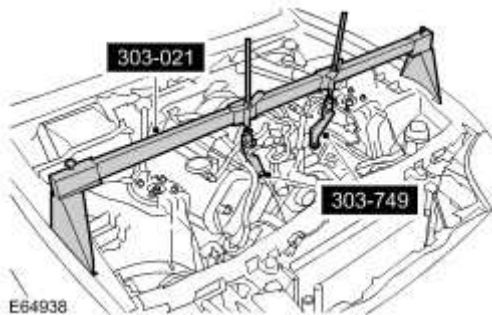
▶ Remove the bolt.

▶ Disconnect the 3 quick release connectors.



14 .  **CAUTION: Protect the paintwork during this operation.**

Using the special tools, support the engine.



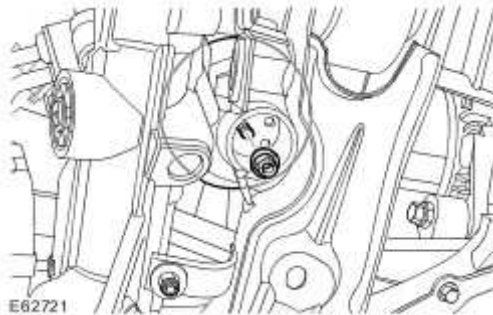
15 . **NOTE:**

RH illustration shown, LH is similar

Release the engine mounts.

▶ Remove and discard the 2 nuts.

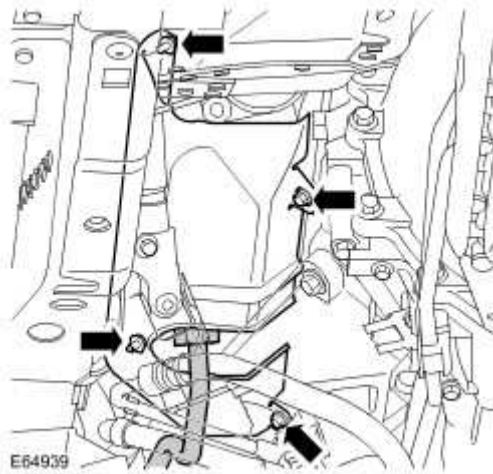
▶ Raise the engine.



16 . Release the RH exhaust manifold heat shield.

▶ Remove the 4 screws.

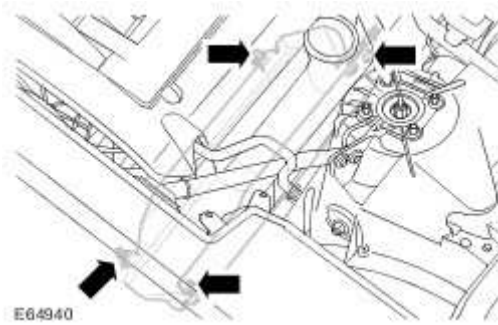
17 . Release the AIR tube from the RH exhaust manifold.



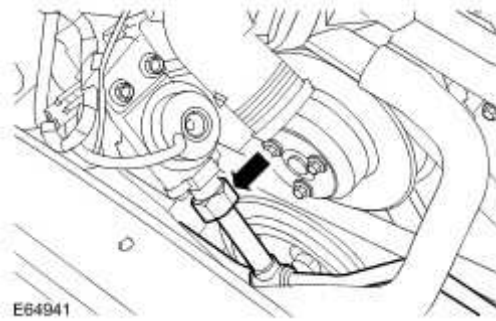
18 . Release the LH exhaust manifold heat shield.

▶ Remove the 4 screws.

19 . Release the AIR tube from the LH exhaust manifold.



20 . Release the AIR tube from the AIR control valve.



21 . Remove the AIR tube.

Installation

1 . Install the AIR tube.

2 . Attach the AIR tube to the exhaust manifolds.

▶ Tighten the unions to 35 Nm (26 lb.ft).

3 . Attach the AIR tube to the AIR control valve.

▶ Tighten the union to 35 Nm (26 lb.ft).

4 . Install the LH exhaust manifold heat shield.

 Tighten the screws.

5 . Install the RH exhaust manifold heat shield.

 Tighten the screws.

6 . Lower the engine onto its mounts.

 Tighten the new nuts to 63 Nm (46 lb.ft).

 Remove the special tools.

7 . Install the coolant rail.

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

 Connect the quick release connectors.

8 . Install the radiator bottom hose.

 Secure with the clips.

9 . Install the radiator top hose.

 Secure with the clips.

 Connect the quick release connector.

10 . Connect the engine oil cooler, coolant hoses.

 Secure with the clips.

11 . Install the coolant expansion tank support bracket.

 Tighten the nuts to 10 Nm (7 lb.ft).

12 . Install the coolant expansion tank.

For additional information, refer to Coolant Expansion Tank (26.15.01)

13 . Install the engine undershield.

For additional information, refer to Air Deflector (76.11.41)

14 . Install the intake air resonator.

For additional information, refer to Intake Air Resonator

15 . Install the front wheels and tires.

For additional information, refer to Wheel and Tire (74.20.05)

16 . Install the hood.

For additional information, refer to Hood (76.16.01)

17 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

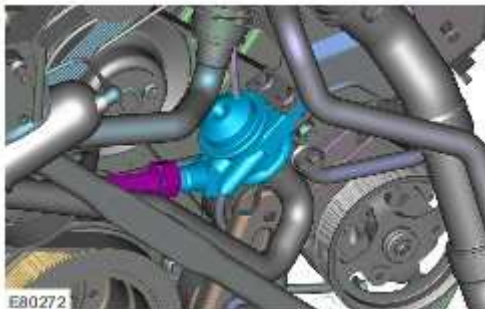
18 Top-up and bleed the coolant.

. For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L SC V8
- AJV8

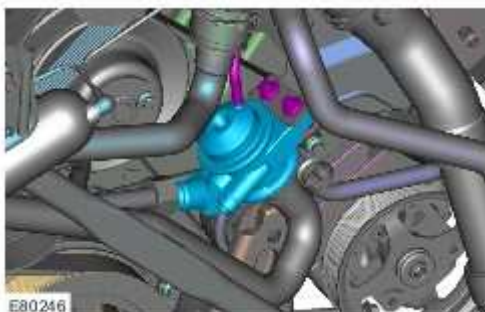
Secondary Air Injection (AIR) Control Valve

Removal

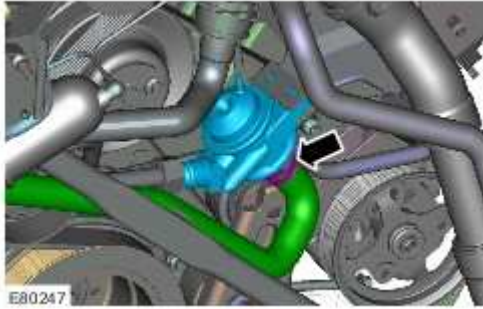
- 1 . Remove the cover and disconnect the battery ground cable.
- 2 . Remove the intake air resonator.
For additional information, refer to [Intake Air Resonator](#)
- 3 . Release the AIR tube from the AIR control valve.



- 4 . Release the AIR control valve.
 - ▶ Disconnect the vacuum hose.
 - ▶ Remove the 2 bolts.



- 5 . Remove the AIR control valve.
 - ▶ Release the clip and disconnect the hose.



Installation

- 1 . Attach the AIR control valve hose.
 - ▶ Secure with the clip.
- 2 . Secure the AIR control valve.
 - ▶ Tighten the bolts to 25 Nm (18 lb.ft).
 - ▶ Connect the vacuum hose.
- 3 . Attach the AIR tube to the AIR control valve.
 - ▶ Tighten the union to 35 Nm (26 lb.ft).
- 4 . Install the intake air resonator.
For additional information, refer to [Intake Air Resonator](#)
- 5 . Connect the battery ground cable and install the cover.
- 6 **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](#)

Secondary Air Injection (AIR) Pump

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to [Specifications](#)

- 2 . Remove the RH headlamp assembly.

For additional information, refer to [Headlamp Assembly \(86.41.33\)](#)

- 3 . Release the washer jet hose.



Remove the clip.

- 4 . Disconnect the AIR pump hose.

- 5 . Release the AIR pump.



Remove the 3 nuts.

- 6 . Remove the AIR pump.



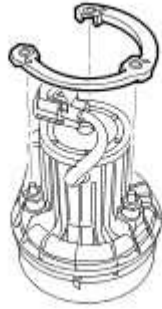
Disconnect the electrical connector.

- 7 . **NOTE:**

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

Remove the AIR pump bracket.

E64923



Installation

- 1 . Install the AIR pump bracket.
- 2 . Install the AIR pump.
 - ▶ Connect the electrical connector.
 - ▶ Tighten the nuts to 10 Nm (7 lb.ft).
 - ▶ Connect the hose.
- 3 . Attach the washer jet hose.
 - ▶ Secure with the clip.
- 4 . Install the RH headlamp assembly.
For additional information, refer to [Headlamp Assembly \(86.41.33\)](#)
- 5 . Connect the battery ground cable and install the cover.
For additional information, refer to [Specifications](#)
- 6 **NOTE:**
 - For NAS vehicles only.

If required, carry out a short drive cycle.
For additional information, refer to [Powertrain Control Module \(PCM\) Short Drive Cycle Self-Test](#)

Secondary Air Injection Manifold Absolute Pressure Sensor

No Data Available

303-08B : Engine Emission Control – 4.2L NA V8 – AJV8

Specifications

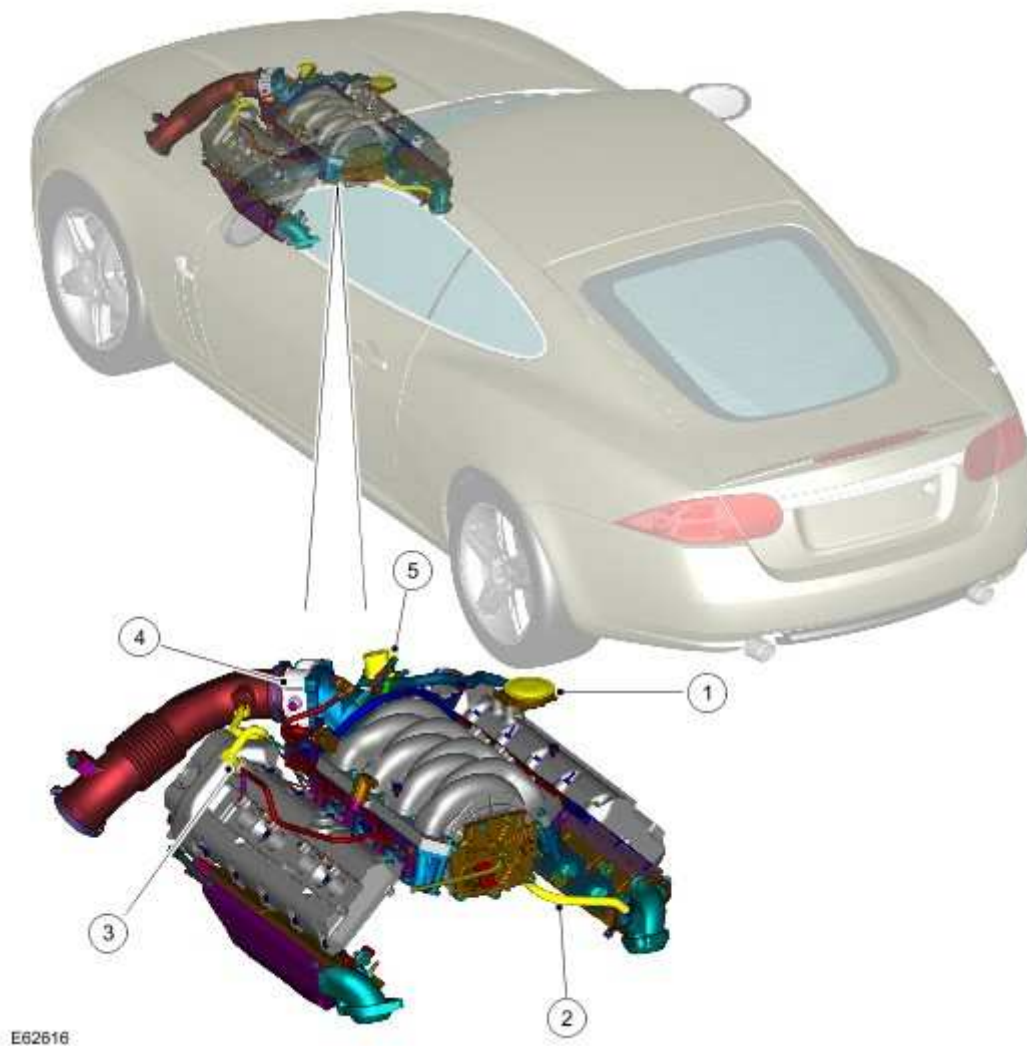
Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Exhaust gas recirculation (EGR) tube to EGR valve - bolt	21	15	-
EGR tube to exhaust manifold - nut	21	15	-
EGR valve to throttle body elbow - bolt	10	7	88
Positive crankcase ventilation (PCV) valve - screw	5	4	44
Secondary air injection, air pipe - union nut	35	26	-
Secondary air injection, blanking plug	35	26	-
Secondary air injection, control valve bracket to engine - bolt	8	6	71
Secondary air injection, manifold absolute pressure sensor to bonnet hinge panel - bolt	11	8	-
Secondary air injection, pump to bracket - nut	8	6	71

Engine Emission Control

COMPONENT LOCATION



Item	Part Number	Description
1		PCV (positive crankcase ventilation) valve
2		EGR (exhaust gas recirculation) gas transfer pipe
3		Part load valve
4		Electric throttle
5		EGR (exhaust gas recirculation) valve

INTRODUCTION

The engine emission control system comprises:

- EGR (exhaust gas recirculation) system
- Crankcase ventilation system

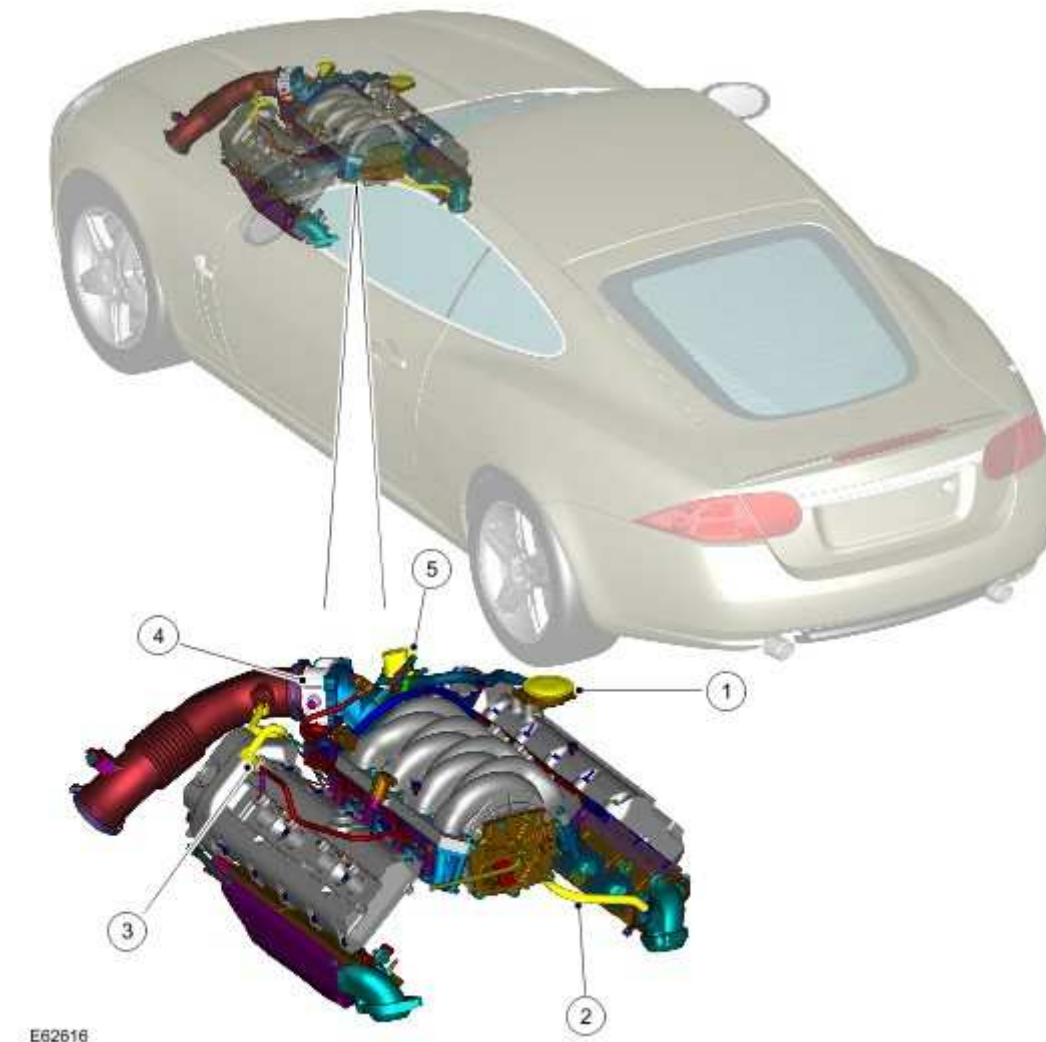
The EGR (exhaust gas recirculation) system is controlled by a PWM (pulse width modulation) signal from the ECM (engine control module) . The system comprises an EGR (exhaust gas recirculation) valve and a gas transfer pipe.

The crankcase ventilation system is ventilated through a part load and a full load breather. The part load breather is connected through a PCV (positive crankcase ventilation) valve, which prevents air flow back into the engine.

The engine emission control system also features a Secondary Air Injection (SAI) system, comprising a pump, solenoid control valve and associated pipes. The pumps operation is controlled by the engine management system. For additional information, refer to [Electronic Engine Controls](#) (303-14)

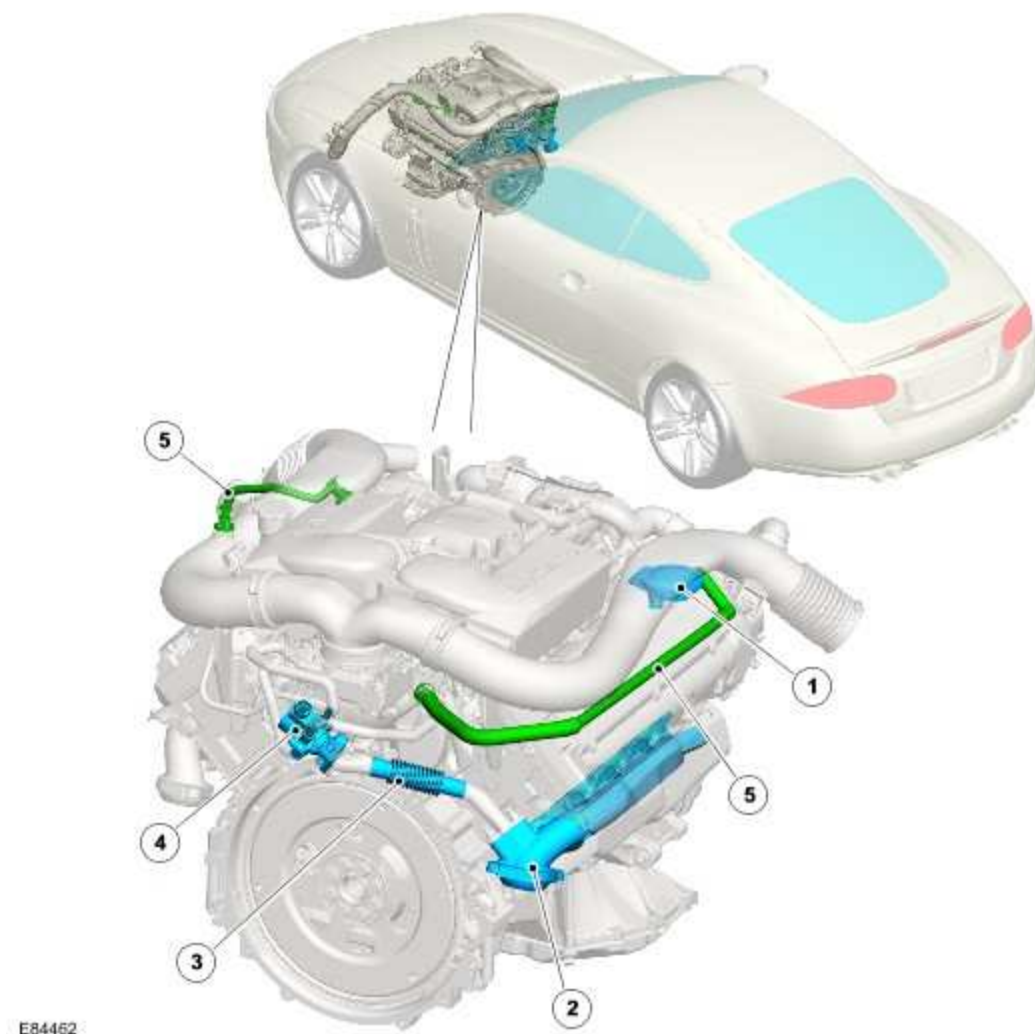
Engine Emission Control

COMPONENT LOCATION (NA)



Item	Part Number	Description
1		PCV valve
2		EGR gas transfer pipe
3		Part load valve
4		Electric throttle
5		EGR valve

COMPONENT LOCATION (SC)



E84462

Item	Part Number	Description
1		PCV valve
2		Exhaust manifold
3		EGR gas transfer pipe
4		EGR valve
5		Crankcase ventilation pipes

INTRODUCTION

The engine emission control system comprises:

- EGR system
- Crankcase ventilation system
- Secondary Air Injection (SAI) system

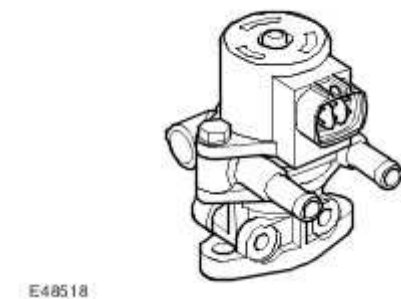
The EGR system is controlled by a PWM signal from the ECM. The system comprises an EGR valve and a gas transfer pipe.

The crankcase ventilation system is ventilated through a part load and a full load breather. The part load breather is connected through a PCV valve, which prevents air flow back into the engine.

The engine emission control system also features a Secondary Air Injection (SAI) system, comprising a pump, solenoid control valve and associated pipes. The pumps operation is controlled by the engine management system.

EGR SYSTEM

The EGR (exhaust gas recirculation) system is controlled by a PWM signal from the ECM (engine control module) . The system comprises an EGR (exhaust gas recirculation) valve and a gas transfer pipe.

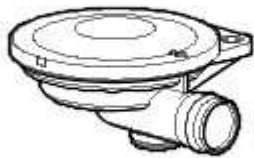


The EGR (exhaust gas recirculation) valve is a 4 pole 60 point stepper motor with an integral cooler unit which is mounted on the side of the induction elbow. The EGR (exhaust gas recirculation) valve receive four 12 Volt signals from the ECM (engine control module) . The EGR (exhaust gas recirculation) valve is cooled by the return coolant flow from the electric throttle.

The EGR (exhaust gas recirculation) valve is connected to the LH exhaust manifold via the gas transfer pipe.

CRANKCASE VENTILATION

The engine is ventilated through a part load and a full load breather. The part load breather is a flexible composite hose connected between the PCV (positive crankcase ventilation) valve mounted above the oil separator in the bank A camshaft cover and the induction elbow. The PCV (positive crankcase ventilation) valve prevents reverse flow into the crankcase.



E48519

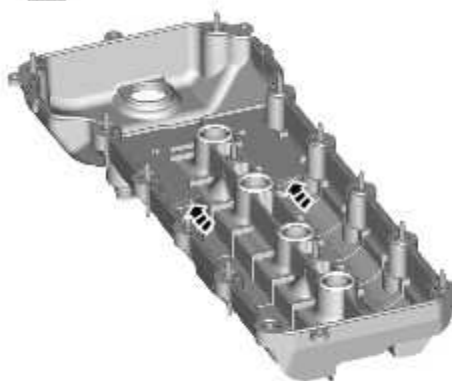
The full load breather is a flexible hose connected between the oil separator in the bank B camshaft cover and the air intake duct.

The ends of the breather hoses incorporate quick release connectors.

A



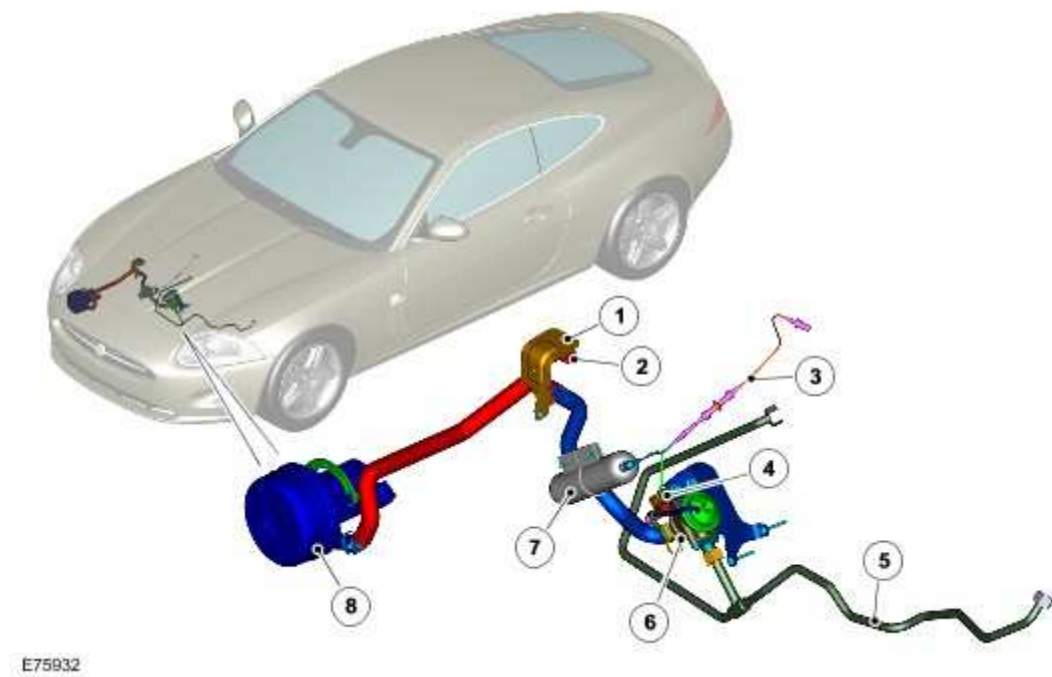
B



E50604

The oil separators consist of wire gauze packed into an open ended enclosure below the breather outlet in each camshaft cover.

SECONDARY AIR INJECTION COMPONENT LOCATION (NA SHOWN SC SIMILAR)



Item	Part Number	Description
1		SAI hose bracket
2		SAI pressure sensor (NAS only)
3		Vacuum pipe
4		SAI vacuum control valve
5		SAI to exhaust manifold pipe
6		SAI control valve
7		SAI Vacuum reservoir
8		SAI pump

SECONDARY AIR INJECTION

Secondary Air Injection (SAI) is fitted to the vehicle to reduce exhaust emissions to meet European Union (EU) Stage 4 and Federal Petrol Emission standards. The SAI system comprises:

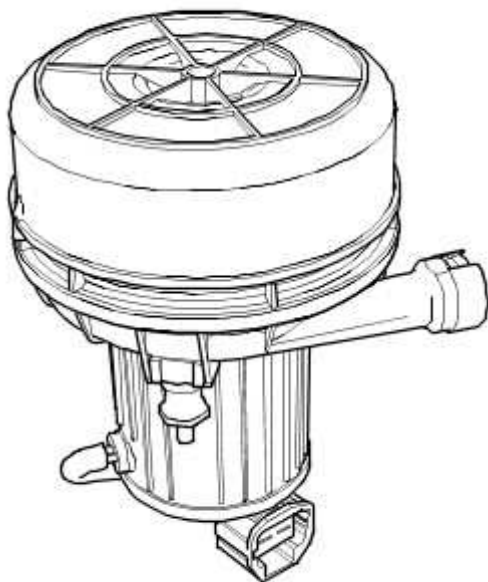
- SAI pump
- SAI valve
- Associated pipes
- SAI Absolute Pressure (MAP) sensor (NAS only)

The SAI pump is used to provide a supply of air into the exhaust manifolds during the cold start period of the engine. The SAI cycle lasts for up to 65 seconds. The hot unburnt fuel particles leaving the combustion chamber mix with the air injected into the exhaust manifolds and immediately combust.

This subsequent combustion of the unburnt and partially burnt carbon monoxide (CO) and hydrocarbon (HC) particles help to reduce the emission of these pollutants from the exhaust system. The additional heat generated in the exhaust manifold also provides rapid heating of the exhaust system catalytic converters. The additional oxygen which is delivered to the catalytic converters also generates an exothermic reaction which causes the catalytic converters to reach their optimum operating temperature and 'light off' quickly.

The catalytic converters only start to provide effective treatment of emission pollutants when they reach an operating temperature of approximately 250°C (482°F) and need to be between temperatures of 400°C (752°F) and 800°C (1472°F) for optimum efficiency. Consequently, the heat produced by the SAI 'afterburning' reduces the time delay before the catalysts reach an efficient operating temperature.

SAI Pump



E62274

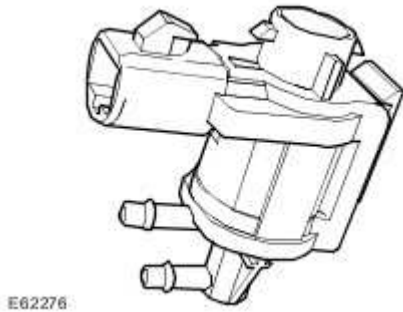
The sai pump is located behind the right-hand side of the front bumper cover. The pump is fitted on rubber mountings to help prevent noise which is generated by SAI pump operation. The SAI pump is powered from the vehicle battery by a dedicated relay and supplies approximately 10 to 15 kg/hr (22 to 33 lb/hr) of air when the engine is at idle speed and the ambient temperature is below 20°C (68°F).

Air is drawn into the SAI pump through vents in its front cover and is then passed through a non serviceable paper element filter. The air is delivered to the exhaust manifold on each side of the engine through a combination of plastic pipes and stainless steel tubes.

One second after the SAI pump is energized, the ECM switches on the SAI switching valve, which opens to allow vacuum from the SAI vacuum reservoir to be applied to the vacuum operated SAI control valve. When the vacuum is applied to the SAI control valve, it opens to allow the air from the SAI pump through to the exhaust manifolds.

When the ECM switches off the SAI switching valve, the vacuum supply to the SAI control valve is cut-off and the valve closes to prevent further air being injected into the exhaust manifolds. With an approximate five second delay after as the SAI switching valve is closed, the ECM removes power from the SAI pump relay, and this in turn stops the SAI pump from operating.

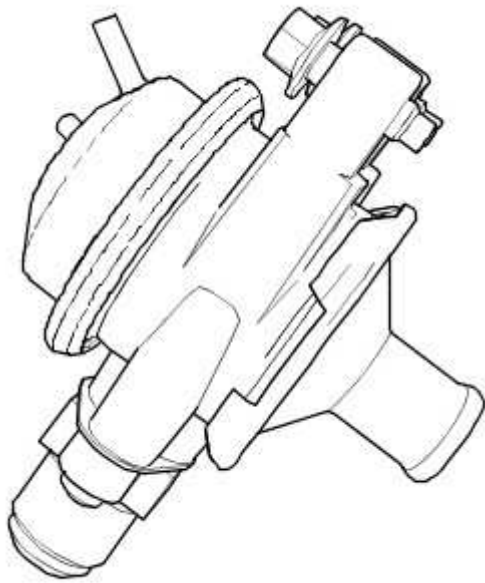
SAI Switching Valve



The ECM switches on the SAI switching valve with a one second delay after initiating SAI pump operation. When the SAI switching valve is open, a steady vacuum supply is allowed through to open the vacuum operated SAI control valve. When the ECM switches off the SAI switching valve, the valve closes and immediately shuts off the vacuum supply to the SAI control valve. The pump continues to operate for a further five seconds for system diagnostic purposes.

When the SAI switching valve is switched off, the vacuum supply line opens to atmosphere, and this causes the SAI switching valve to close automatically to prevent any further injection of air.

SAI control Valve



E62275

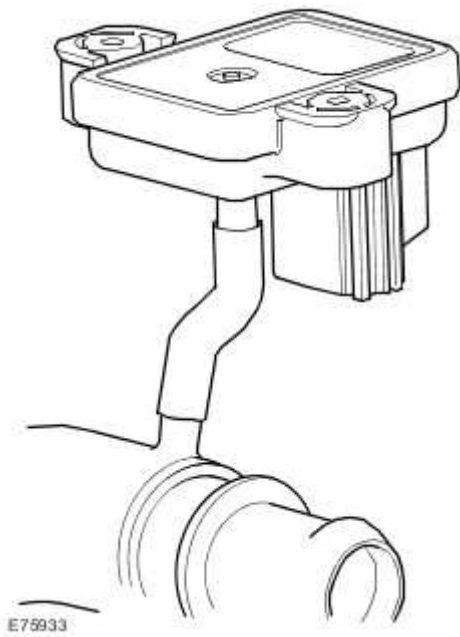
The injected air from the SAI pump is controlled by the SAI control valve. This allows the correct amount of air to be injected directly into the exhaust manifolds via tuned restrictors on each bank of cylinders. The SAI control valve prevents exhaust gasses from blowing back into the SAI pump.

The SAI control valve is assisted in operation by a vacuum source from the SAI vacuum reservoir located in the left hand side at the front of the engine. This assistance allows the actuation of the SAI control valve independently from the intake manifold vacuum levels available.

When the pressure in the exhaust system is higher than in the SAI system, the SAI control valve closes the circuit, and this protects the SAI system from exhaust gasses blowing back into the SAI system.

Vacuum to the SAI switching valve is provided from the intake manifold vacuum by the SAI vacuum reservoir. A small bore vacuum hose provides the vacuum route between the SAI vacuum reservoir and SAI switching valve. A further small bore vacuum hose is used to connect the SAI switching valve to the SAI control valve.

SAI Pressure Sensor - NAS only



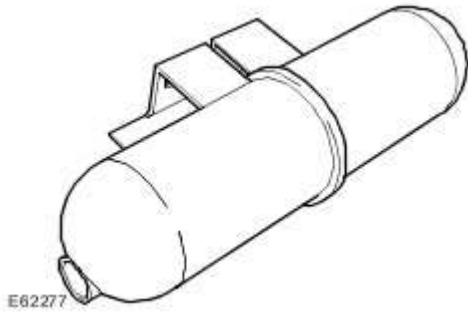
The SAI system is monitored by measuring the system pressure by using the SAI pressure sensor at several instances during its cycle of operation.

The SAI system pressure is measured before operation of the SAI pump. The SAI pump is then switched on and with a one second delay, the SAI switching valve is opened. After a stabilizing period, the system pressure is measured again, this time by taking the average of a one second duration of readings, and normalizing for variations in battery voltage and atmospheric pressure. If the system pressure measured at this time has not risen enough with respect to the initial SAI pressure reading then a failure will be flagged.

A second pressure measurement is made after the requirement for SAI into the exhaust system has expired, but continuing on from the same period of SAI pump operation, i.e. the pump is left running, against a closed SAI switching valve. Again this pressure measurement is the average of a one second duration of readings normalized for variations in battery voltage and atmospheric pressure. If the system pressure measured at this time has not risen enough or has risen too much with respect to the system pressure during normal operation of SAI then a failure will be flagged.

A final pressure reading is taken after the SAI system has been switched off to ensure the system shuts down.

SAI Vacuum Reservoir



The SAI vacuum reservoir is located on the LH side of the engine at the front.

The SAI vacuum reservoir is included in the vacuum supply line between the intake manifold and the SAI switching valve.

The SAI vacuum reservoir contains a one-way valve to stop vacuum leaking back towards the intake manifold side. The SAI vacuum reservoir holds a constant vacuum so that the SAI control valve opens as soon as the SAI switching valve is switched on.

Engine Emission Control

Principle of Operation

For a detailed description of the Engine Emission Control system, refer to the relevant Description and Operation section in the workshop manual.

[Engine Emission Control](#)

Inspection and Verification

- 1 . Verify the customer concern.
- 2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
- Engine breather hoses - Cyclone separator - Exhaust gas recirculation (EGR) pipes (check for cracks) - EGR valve	- Fuses - Wiring harness - Loose or corroded electrical connectors - Sensor(s) - Stepper motor(s) - Secondary air injection (AIR) pump - Secondary air injection (AIR) valve - Engine control module (ECM)

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, verify the customer concern and refer to the Symptom Chart below, alternatively, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Cause	Action
Engine cranks, but does not fire	Engine breather system disconnected/restricted	Ensure the engine breather system is free from restriction and is correctly

		installed
Difficult to start cold	Exhaust gas recirculation (EGR) valve stuck open	Read DTCs and refer to DTC Index in this section for EGR valve tests
Engine stalls soon after start	Breather system disconnected/restricted	Ensure the engine breather system is free from restriction and is correctly installed
Engine stops/stalls	EGR valve stuck open	Read DTCs and refer to DTC Index in this section for EGR valve tests
Poor idle quality	EGR valve stuck open	Read DTCs and refer to DTC Index in this section for EGR valve tests
Engine hesitates/poor acceleration	EGR valve stuck open	Read DTCs and refer to DTC Index in this section for EGR valve tests
Poor throttle response	Breather system disconnected/restricted	Ensure the engine breather system is free from restriction and is correctly installed
- Excessive fuel consumption - Excessive black smoke - Excessive emissions	- EGR valve stuck open - EGR system not operating - Engine breather system restricted	- Read DTCs and refer to DTC Index in this section for EGR system tests - Ensure the engine breather system is free from restriction and is correctly installed
Loud 'ticking' noise with engine running	EGR pipes cracked	Inspect the EGR pipes, paying particular attention to the ribbed sections. Replace as necessary
Engine oil leaks	Engine breather system restricted	Ensure the engine breather system is free from restriction and is correctly installed

DTC Index



CAUTION: When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00.

NOTE:

Generic scan tools may not read the codes listed, or may read only five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give extra information read by the manufacturer-approved diagnostic system).

NOTE:

When performing electrical voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE:

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE:

If DTCs are recorded and, after the pinpoint tests have been carried out, the fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

DTC	Description	Possible Causes	Action
P040100	EGR flow insufficient	- EGR valve incorrectly installed or loose - EGR valve stuck closed, blocked - EGR valve mechanical failure - EGR pipe blocked	- Check the installation and for restriction/mechanical failure of the EGR valve. Exhaust Gas Recirculation (EGR) Valve (17.45.01) - Check the EGR pipework for restriction
P041300	Secondary Air Injection (AIR) switching valve circuit open	AIR check valve control circuit high	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P041400	Secondary Air Injection (AIR) switching valve circuit	AIR check valve control circuit low	Carry out any pinpoint tests associated with this DTC using the

	shorted		manufacturer approved diagnostic system
P048900	Exhaust Gas Recirculation (EGR) control circuit low	EGR valve power supply circuit - short to ground, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P049000	Exhaust Gas Recirculation (EGR) control circuit high	EGR valve control circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P243100	Secondary air injection manifold absolute pressure sensor circuit range/performance	- Secondary air injection system leaks - Secondary air injection pump - Secondary air injection valve	- Check the secondary air injection system for leaks - Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P243200	Secondary air injection manifold absolute pressure sensor circuit low	Secondary air injection manifold absolute pressure sensor circuit - short to ground, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P243300	Secondary air injection manifold absolute pressure sensor circuit high	Secondary air injection manifold pressure (MAP) sensor circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P244400	Secondary air injection system pump stuck ON	Secondary air injection pump control circuit - short to ground	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P244500	Secondary air injection system pump stuck OFF	Secondary air injection pump control circuit -	Carry out any pinpoint tests associated with this DTC using the manufacturer approved

		short to power	diagnostic system

Exhaust Gas Recirculation (EGR) Valve (17.45.01)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)
- 2 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Disconnect the EGR valve electrical connector.

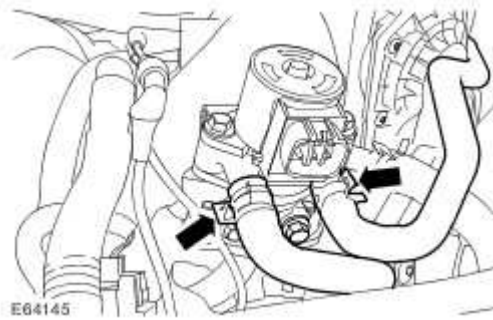


- 4  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

 **CAUTION:** Always plug any open connections to prevent contamination.

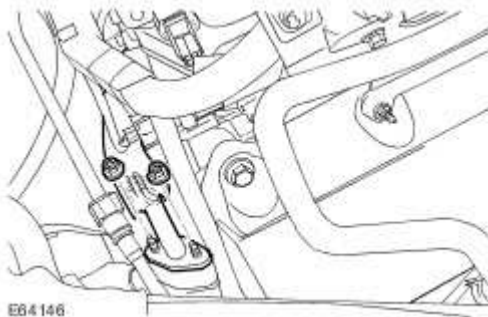
Disconnect the 2 EGR valve coolant hoses.

- Clamp the EGR coolant hoses to minimize coolant loss.
- Release the 2 clips.



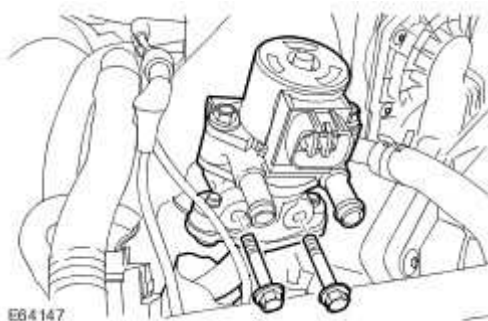
5 . Release the EGR valve to exhaust manifold pipe.

- ▶ Remove the 2 nuts.
- ▶ Remove and discard the gasket.



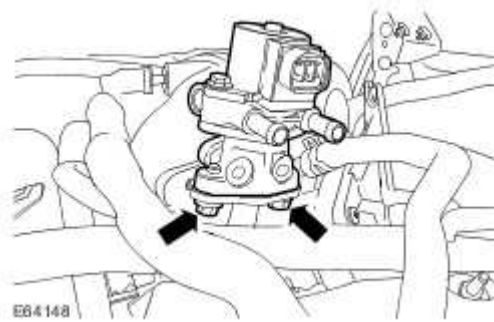
6 . Release the EGR valve from the throttle body elbow.

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



7 . Remove the EGR valve.

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



Installation

- 1 . Attach the EGR valve to the EGR valve pipe.
 - ▶ Clean the component mating faces.
 - ▶ Install a new gasket.
 - ▶ Tighten the bolts to 21 Nm (15 lb.ft).
- 2 . Attach the EGR valve to the throttle body elbow.
 - ▶ Clean the component mating faces.
 - ▶ Install a new gasket.
 - ▶ Tighten the bolts to 10 Nm (7 lb.ft).
- 3 . Attach the EGR valve to exhaust manifold pipe.
 - ▶ Clean the component mating faces.
 - ▶ Install a new gasket.
 - ▶ Tighten the nuts to 25 Nm (18 lb.ft).
- 4 . Connect the coolant hoses.
 - ▶ Secure with the clips.
- 5 . Connect the electrical connector.
- 6 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 7 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)
- 8 . Check and top-up the coolant.

Positive Crankcase Ventilation (PCV) Valve

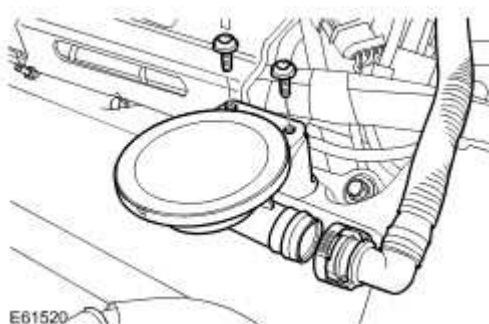
Removal

- 1 . Disconnect the battery ground cable.
For additional information, refer to [Specifications](#)
- 2 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)

- 3 .  **CAUTION: Always plug any open connections to prevent contamination.**

Remove the positive crankcase ventilation (PCV) valve.

- ▶ Disconnect the PCV hose.
- ▶ Remove the 2 Torx screws.
- ▶ Release the PCV valve.

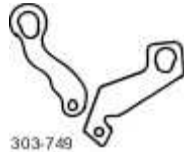


Installation

- 1 . Install the PCV valve.
 - ▶ Clean the components.
 - ▶ Lubricate the seal with clean engine oil.
 - ▶ Tighten the Torx screws.
- 2 . Install the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Connect the battery ground cable.
For additional information, refer to [Specifications](#)

Secondary Air Injection (AIR) Control Valve to Exhaust Manifold Tube

Special Service Tools



Engine lifting brackets
303-749



Engine support bracket
303-021

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 coolant.
 - For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8
- 4 . Remove the hood.
For additional information, refer to Hood (76.16.01)

5 . Remove the front wheels and tires.

For additional information, refer to Wheel and Tire (74.20.05)

6 . Remove the throttle body.

For additional information, refer to Throttle Body (19.70.04)

7 . Remove the engine undershield.

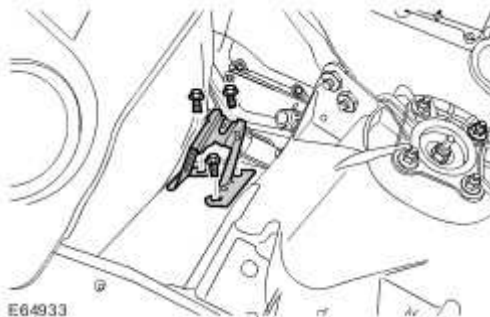
For additional information, refer to Air Deflector (76.11.41)

8 . Remove the coolant expansion tank.

For additional information, refer to Coolant Expansion Tank (26.15.01)

9 . Remove the coolant expansion tank support bracket.

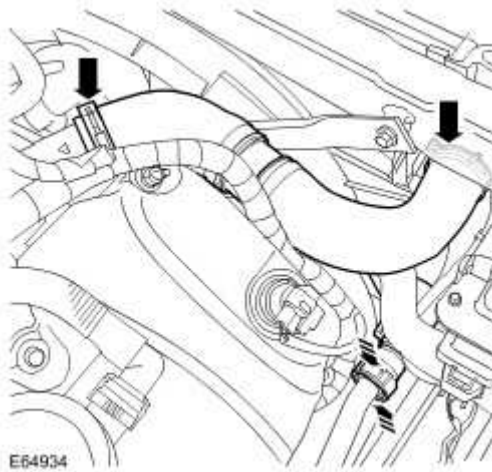
► Remove the 3 nuts.



10 . Remove the radiator top hose.

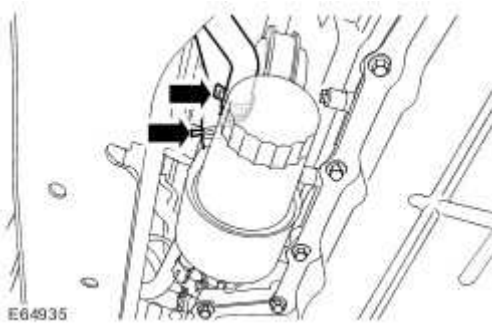
► Release the 2 clips.

► Disconnect the quick release connector.



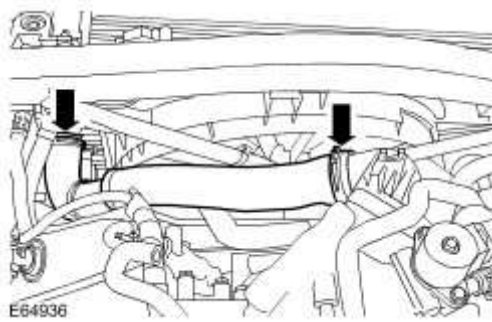
11 . Disconnect the coolant hoses from the engine oil cooler.

▶ Release the 2 clips.



12 . Remove the radiator bottom hose.

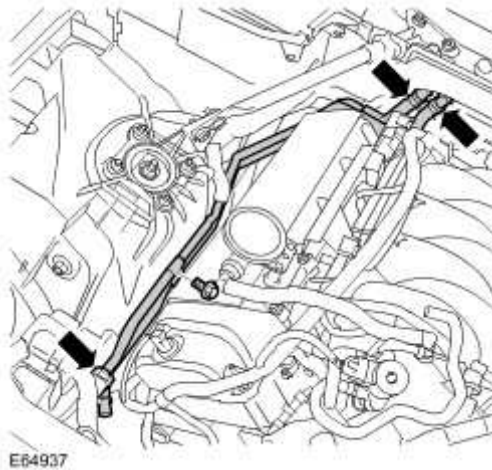
▶ Release the 2 clips.



13 . Remove the coolant rail.

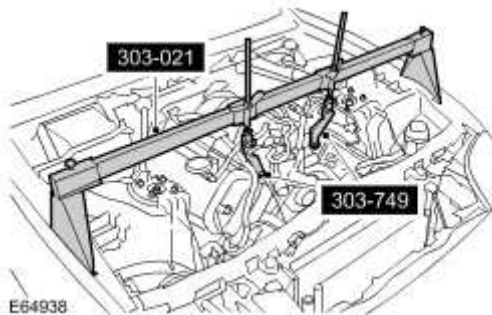
▶ Remove the bolt.

▶ Disconnect the 3 quick release connectors.



14 .  **CAUTION: Protect the paintwork during this operation.**

Using the special tools, support the engine.



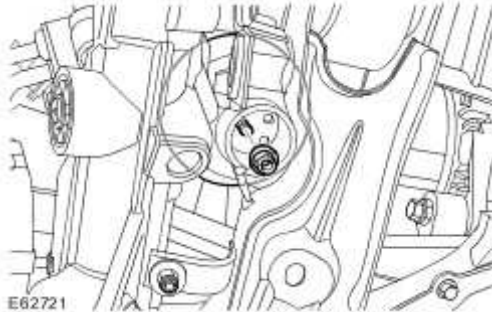
15 . **NOTE:**

RH illustration shown, LH is similar

Release the engine mounts.

▶ Remove and discard the 2 nuts.

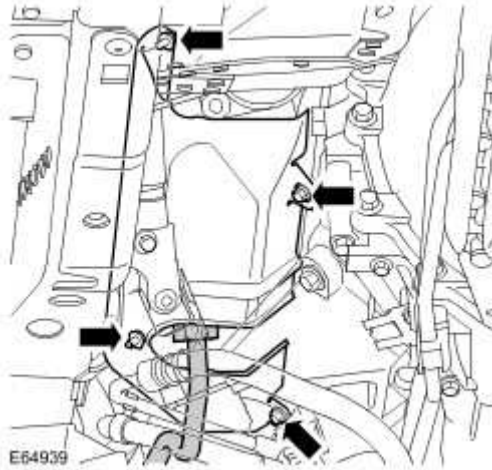
▶ Raise the engine.



16 . Release the RH exhaust manifold heat shield.

▶ Remove the 4 screws.

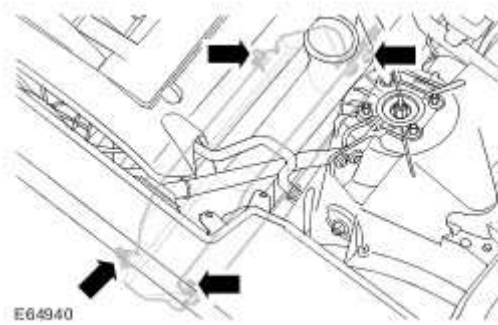
17 . Release the AIR tube from the RH exhaust manifold.



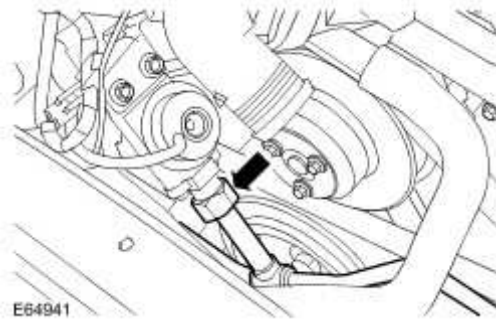
18 . Release the LH exhaust manifold heat shield.

▶ Remove the 4 screws.

19 . Release the AIR tube from the LH exhaust manifold.



20 . Release the AIR tube from the AIR control valve.



21 . Remove the AIR tube.

Installation

1 . Install the AIR tube.

2 . Attach the AIR tube to the exhaust manifolds.

▶ Tighten the unions to 35 Nm (26 lb.ft).

3 . Attach the AIR tube to the AIR control valve.

▶ Tighten the union to 35 Nm (26 lb.ft).

4 . Install the LH exhaust manifold heat shield.

 Tighten the screws.

5 . Install the RH exhaust manifold heat shield.

 Tighten the screws.

6 . Lower the engine onto its mounts.

 Tighten the new nuts to 63 Nm (46 lb.ft).

 Remove the special tools.

7 . Install the coolant rail.

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

 Connect the quick release connectors.

8 . Install the radiator bottom hose.

 Secure with the clips.

9 . Install the radiator top hose.

 Secure with the clips.

 Connect the quick release connector.

10 . Connect the engine oil cooler, coolant hoses.

 Secure with the clips.

11 . Install the coolant expansion tank support bracket.

 Tighten the nuts to 10 Nm (7 lb.ft).

12 . Install the coolant expansion tank.

For additional information, refer to Coolant Expansion Tank (26.15.01)

13 . Install the engine undershield.

For additional information, refer to Air Deflector (76.11.41)

14 . Install the throttle body.

For additional information, refer to Throttle Body (19.70.04)

15 . Install the front wheels and tires.

For additional information, refer to Wheel and Tire (74.20.05)

16 . Install the hood.

For additional information, refer to Hood (76.16.01)

17 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

18 Top-up and bleed the coolant.

. For additional information, refer to Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8

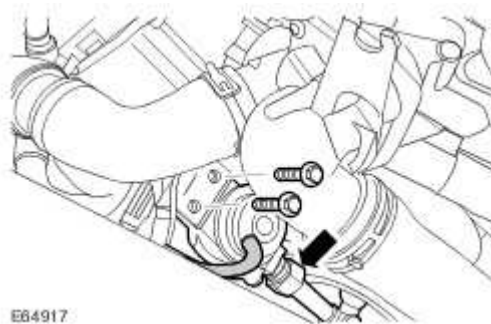
Secondary Air Injection (AIR) Control Valve

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)
- 2 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Remove the air intake duct.
 - ▶ Remove the bolt.
 - ▶ Release the 2 clips.

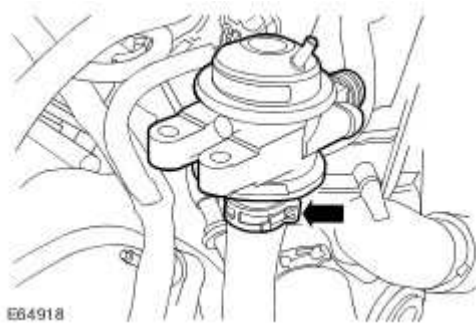


- 4 . Release the AIR tube from the AIR control valve.
- 5 . Release the AIR control valve.
 - ▶ Disconnect the vacuum hose.
 - ▶ Remove the 2 bolts.



- 6 . Remove the AIR control valve.

- ▶ Release the clip and disconnect the hose.



Installation

- 1 . Attach the AIR control valve hose.
 - ▶ Secure with the clip.
- 2 . Secure the AIR control valve.
 - ▶ Tighten the bolts to 25 Nm (18 lb.ft).
 - ▶ Connect the vacuum hose.
- 3 . Attach the AIR tube to the AIR control valve.
 - ▶ Tighten the union to 35 Nm (26 lb.ft).
- 4 . Install the air intake duct.
 - ▶ Tighten the clips.
 - ▶ Tighten the bolt to 10 Nm (7 lb.ft).
- 5 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 6 . Connect the battery ground cable and install the cover.

For additional information, refer to [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](#)

Secondary Air Injection (AIR) Pump

Removal

1



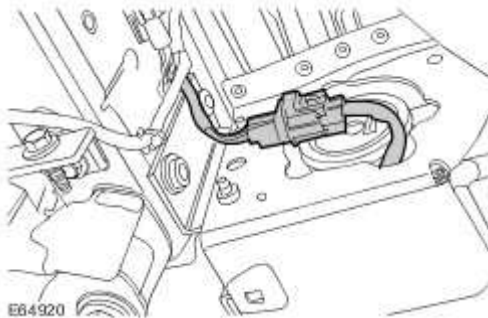
- **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

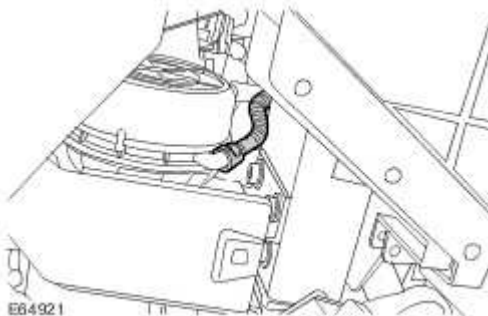
2 . Remove the radiator splash shield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

3 . Disconnect the AIR pump electrical connector.



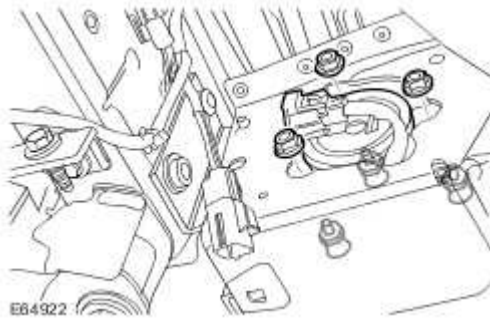
4 . Disconnect the AIR pump hose.



5 . Remove the AIR pump.



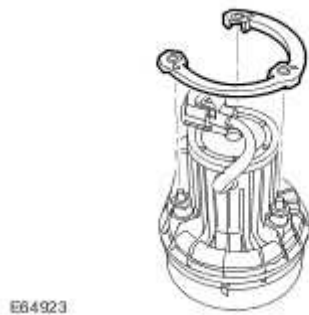
Remove the 3 nuts.



6 . NOTE:

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

Remove the AIR pump bracket.



Installation

1 . Install the AIR pump bracket.

2 . Install the AIR pump.

- ▶ Tighten the nuts to 10 Nm (7 lb.ft).
- ▶ Connect the hose.
- ▶ Connect the electrical connector.

3 . Install the radiator splash shield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

4 NOTE:

- For NAS vehicles only.

If required, carry out a short drive cycle.

For additional information, refer to [Powertrain Control Module \(PCM\) Short Drive Cycle Self-Test](#)

Secondary Air Injection Manifold Absolute Pressure Sensor

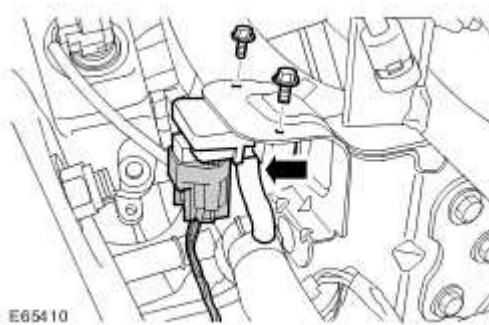
Removal

1 . Remove the secondary air injection manifold absolute pressure sensor.

▶ Disconnect the electrical connector.

▶ Remove the 2 screws.

▶ Disconnect the hose.



Installation

1 . To install, reverse the removal procedure.

303-12A : Intake Air Distribution and Filtering – 4.2L SC V8 – AJV8

Specifications

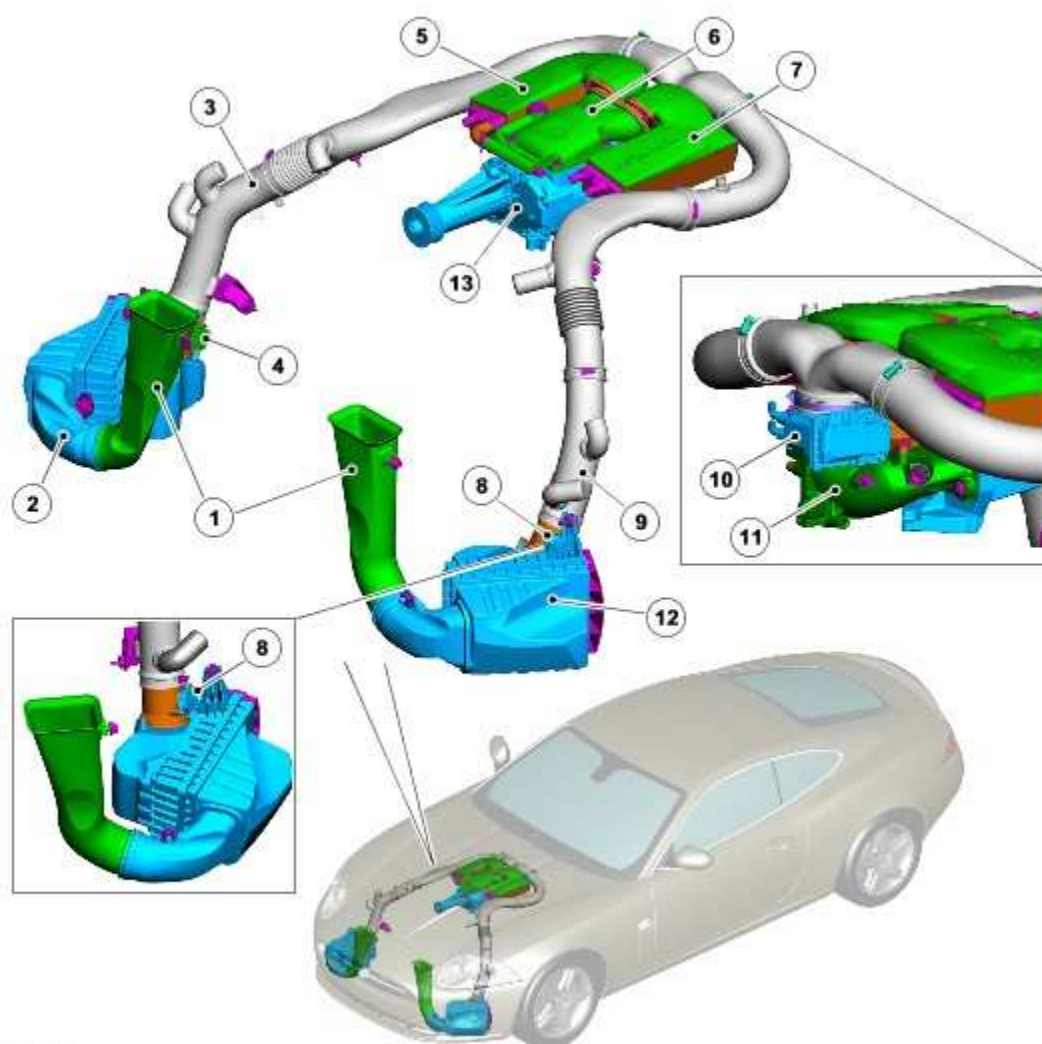
Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Air cleaner and MAF duct assy bracket to front crash structure	8	6	71
Air ducting band clamps	4	3	35
Air intake and resonator tube assy to engine	8	6	71
Air cleaner front support bracket	8	6	71
Resonator to dash and cowl panel	9	7	80

Intake Air Distribution and Filtering

COMPONENT LOCATION



E84147

Item	Part Number	Description
1		Dirty air intake
2		Air cleaner box
3		Clean air duct
4		Mass air flow sensor
5		RH bank charge air cooler
6		Supercharger outlet manifold
7		LH bank charge air cooler

8		Mass air flow sensor
9		Clean air duct
10		Electric throttle
11		Induction elbow
12		Air cleaner box
13		Supercharger

OVERVIEW

The engine air intake and distribution system comprises:

- Two air cleaner boxes
- Two air intakes
- Electric throttle
- A supercharger
- Two Mass Air Flow (MAF) sensors
- Two supercharger charge air coolers

Air is supplied to the supercharger via the 2 air cleaners, air cleaner outlet pipes, throttle body intake pipe, throttle body and induction elbow. The supercharger delivers pressurized air to two separate charge air cooler units mounted onto the cylinder bank it supplies. Pressurized cooled air is fed from the charge air coolers directly into each inlet port. The supercharger is attached to the three mounting bosses between the two cylinder heads. The supercharger has a filled for life internal lubrication system. The supercharger is positively aligned with the drive belt by a doweled mounting bracket.

A Mass Air flow sensor is fitted at the outlet of each air cleaner box. The sensor provides an input to the engine control module (ECM). The intake elbow directs the metered airflow from the throttle body outlet (underside of the throttle body) into the intake of the supercharger.

A supercharger by-pass valve assembly is located between the supercharger outlet and the induction elbow. A butterfly valve inside the assembly is opened by a diaphragm actuator operated by vacuum feed from the elbow. At closed or partially open throttle positions, the butterfly valve opens, allowing the airflow from the two charge air cooler inlets to be directed back to the supercharger inlet. This action inhibits the supercharging effect and reduces engine torque. Progressive opening of the throttle causes the by-pass valve to gradually close.

Each cylinder bank is fitted with a charge air cooler which supplies pressurized air to the four cylinders. The inlet ports to the two charge air coolers are connected to the supercharger via the supercharger outlet pipe consisting of adjustable metal ducts with bonded rubber seals. The charge air coolers are water cooled via a radiator and water pump.

Intake Air Distribution and Filtering

No Data Available

Air Cleaner (19.10.05)

Removal

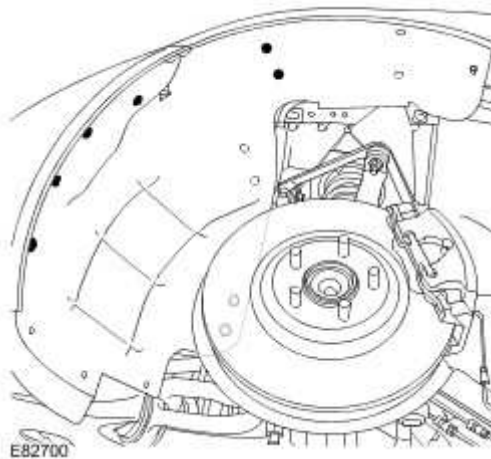
NOTE:

LH air cleaner procedure shown, RH is similar.

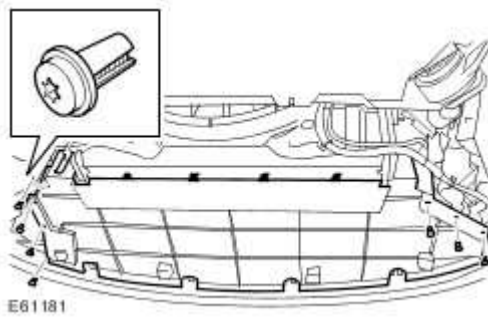
- 1  **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

- 2 . Remove the LH front wheel and tire.
For additional information, refer to [Wheel and Tire \(74.20.05\)](#)
- 3 . Remove the radiator splash shield.
For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)
- 4 . Release the front of the LH fender splash shield.
 - ▶ Remove the 8 Torx bolts.
 - ▶ Tie the splash shield aside.



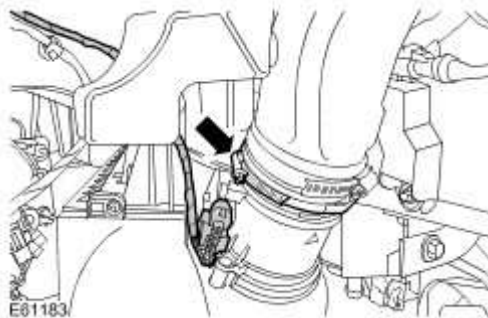
- 5 . Remove the front bumper air ducting.
 - ▶ Remove the 7 clips.
 - ▶ Release the 4 clips.



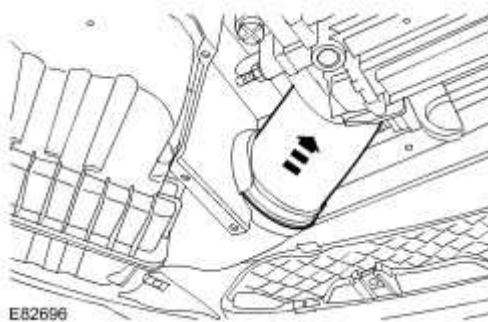
6 . Disconnect the intake air resonator.

▶ Release the clip.

7 . Disconnect the mass air flow (MAF) sensor electrical connector.



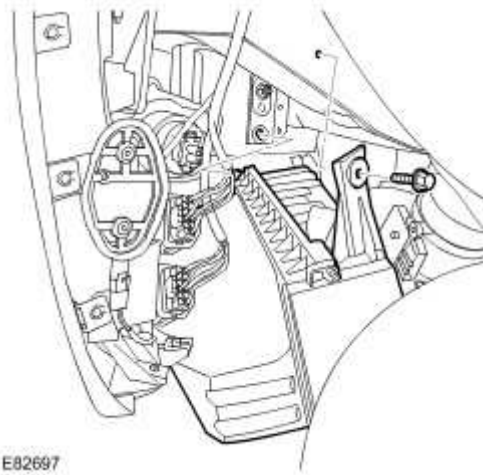
8 . Disconnect the intake air duct.



9 . Remove the air cleaner housing.

▶ Remove the bolt.

▶ Release from the locating grommet.

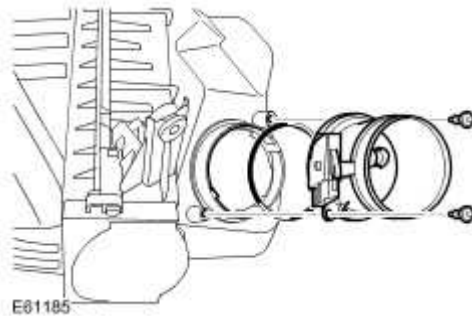


10 . NOTE:

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

Remove the mass air flow (MAF) sensor assembly.

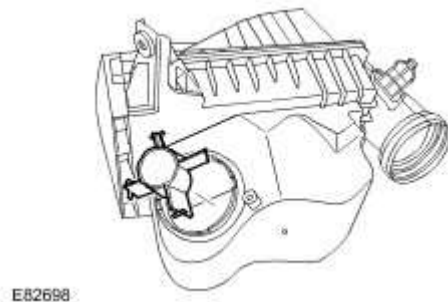
- Remove the 2 screws.
- Remove and discard the O-ring seal.



11 . NOTE:

Make sure that this component is installed to the noted removal position.

Remove the air cleaner insert.



Installation

- 1 . Install the air cleaner insert.
- 2 . Install the MAF sensor assembly.
 - ▶ Clean the components.
 - ▶ Install the O-ring seal.
 - ▶ Tighten the screws.
- 3 . Install the air cleaner housing.
 - ▶ Clean the components.
 - ▶ Secure in the grommet.
 - ▶ Tighten the bolt to 8 Nm (6 lb.ft)
- 4 . Connect the intake air duct.
- 5 . Connect the MAF sensor electrical connector.
- 6 . Connect the intake air resonator.
 - ▶ Clean the components.
 - ▶ Secure with the clip.
- 7 . Install the air ducting.
 - ▶ Install the clips.
 - ▶ Secure the clips.
- 8 . Secure the fender splash shield.
 - ▶ Tighten the Torx bolts.
- 9 . Install the radiator splash shield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)
- 10 . Install the wheel and tire.

For additional information, refer to [Wheel and Tire \(74.20.05\)](#)

Air Cleaner Element (19.10.08)

Removal

NOTE:

LH air cleaner element procedure shown, RH is similar.

1



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

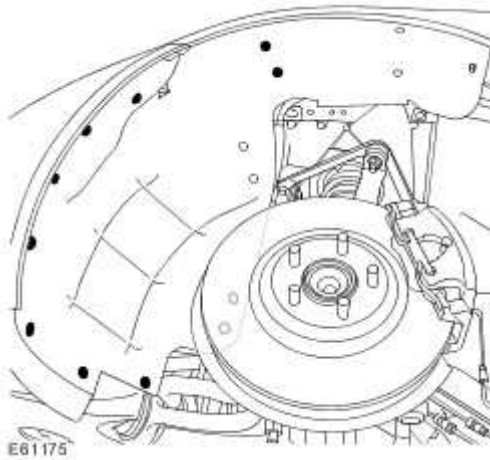
Raise and support the vehicle.

2 . Remove the LH front wheel and tire.

For additional information, refer to [Wheel and Tire \(74.20.05\)](#)

3 . Release the front of the fender splash shield.

- ▶ Remove the 11 Torx bolts.
- ▶ Tie the splash shield aside.

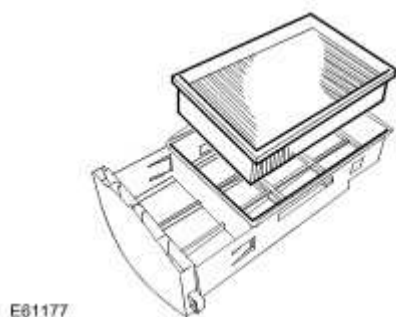


4 . Remove the air cleaner housing.

- ▶ Remove the 2 screws.



5 . Remove the air cleaner element.



Installation

1 . Install the air cleaner element.

▶ Clean the components.

2 . Install the air cleaner housing.

▶ Tighten the Torx screws.

3 . Install the fender splash shield.

▶ Tighten the Torx bolts.

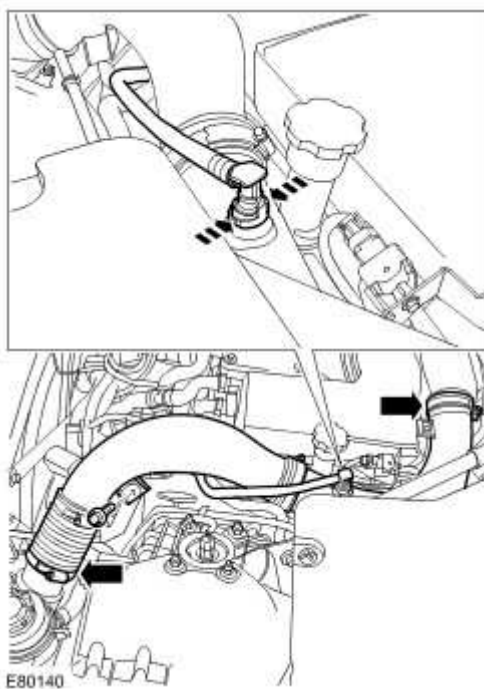
4 . Install the wheel and tire.

For additional information, refer to [Wheel and Tire \(74.20.05\)](#)

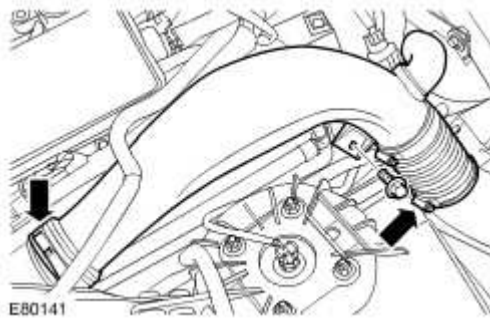
Intake Air Resonator

Removal

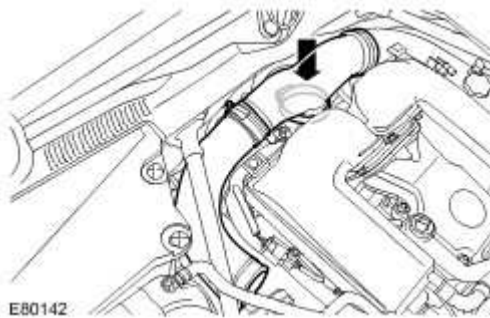
- 1 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 2 . LH side: Release the intake air resonator.
 - ▶ Remove the bolt.
 - ▶ Release the 2 clips.
 - ▶ Disconnect the engine breather line.



- 3 . RH side: Release the intake air resonator.
 - ▶ Remove the bolt.
 - ▶ Release the 2 clips.



- 4 . Remove the intake air resonator.
 - ▶ Release the clip.



Installation

- 1 . Install the intake air resonator.
 - ▶ Secure with the clips.
 - ▶ Tighten the bolts to 10 Nm (7 lb.ft).
 - ▶ Connect the engine breather line.
- 2 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

Charge Air Cooler LH (18.50.19)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to [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 supercharger.

For additional information, refer to [Supercharger \(18.50.15\)](#)

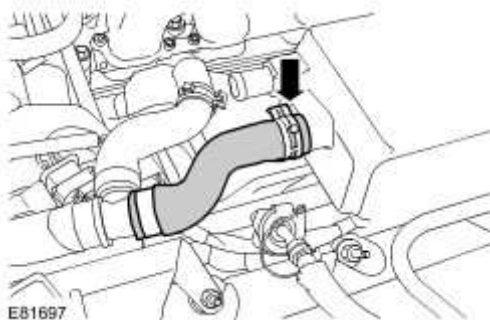
4



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

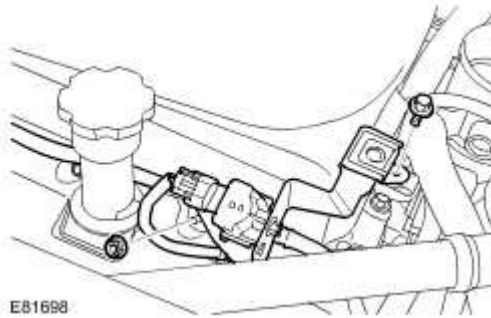
Disconnect the charge air cooler, coolant hose.

- ▶ Position an absorbent cloth to collect fluid spillage.
- ▶ Release the clip.



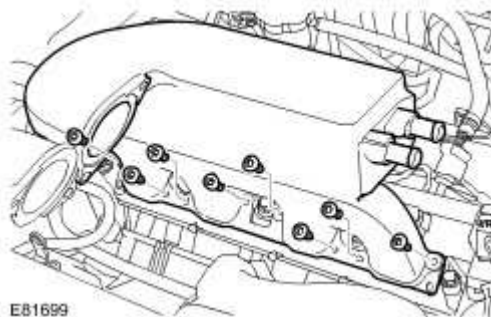
- 5 . Release the purge valve assembly.

- ▶ Remove the nut.
- ▶ Remove the bolt.



6 . Remove the charge air cooler.

- ▶ Remove the 8 Torx screws.
- ▶ Discard the gasket.



Installation

1 . Install the charge air cooler.

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

2 . Attach the purge valve.

- ▶ Tighten the bolt to 6 Nm (4 lb.ft).
- ▶ Tighten the nut to 6 Nm (4 lb.ft).

3 . Connect the charge air cooler, coolant hose.

- ▶ Secure with the clip.

4 . Install the supercharger.

For additional information, refer to [Supercharger \(18.50.15\)](#)

- 5 . Connect the battery ground cable and install the cover.
For additional information, refer to [Specifications](#)

Supercharger (18.50.15)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to [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 coolant manifold.

For additional information, refer to [Coolant Manifold - Vehicles With: Supercharger](#)

- 4 . Remove the throttle body elbow.

For additional information, refer to [Throttle Body Elbow \(19.70.28\)](#)

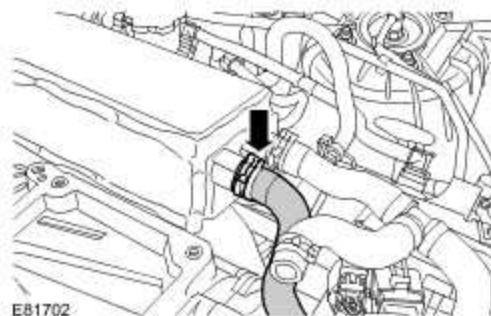
- 5 . Remove the supercharger outlet pipe.

For additional information, refer to [Supercharger Outlet Pipe \(18.50.16\)](#)

- 6 . Disconnect the charge air cooler, coolant hose.



Release the clip.



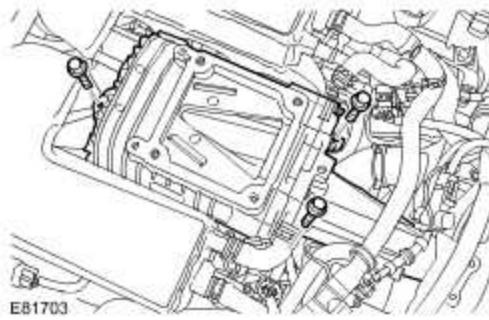
- 7 . **NOTE:**

This step requires the aid of another technician.

Remove the supercharger.



Remove the 3 bolts.



Installation

- 1 . Install the supercharger.
 - ▶ Clean the component mating faces.
 - ▶ Clean the locating dowels.
 - ▶ Tighten the bolts to 21 Nm (15 lb.ft).
- 2 . Connect the charge air cooler, coolant hose.
 - ▶ Secure with the clip.
- 3 . Install the supercharger outlet pipe.
For additional information, refer to [Supercharger Outlet Pipe \(18.50.16\)](#)
- 4 . Install the throttle body elbow.
For additional information, refer to [Throttle Body Elbow \(19.70.28\)](#)
- 5 . Install the coolant manifold.
For additional information, refer to [Coolant Manifold - Vehicles With: Supercharger](#)
- 6 . Connect the battery ground cable and install the cover.
For additional information, refer to [Specifications](#)
- 7 . Refill and bleed the cooling system.

Supercharger Outlet Pipe (18.50.16)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)

- 2 . Remove the intake air resonator.
For additional information, refer to [Intake Air Resonator](#)

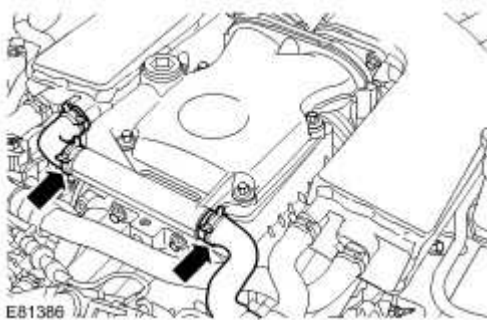
- 3 .  **CAUTION: Always plug any open connections to prevent contamination.**

NOTE:

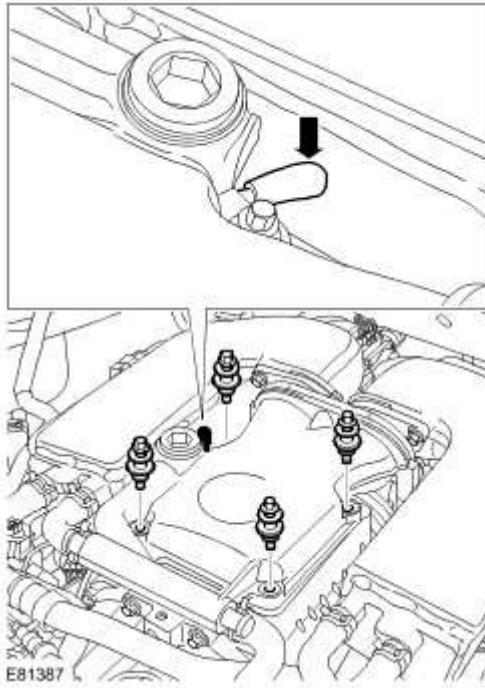
Position cloth to collect fluid spillage.

Disconnect the 2 supercharger outlet pipe coolant hoses.

- ▶ Clamp the hoses to minimize coolant loss.
- ▶ Release the 2 clips.



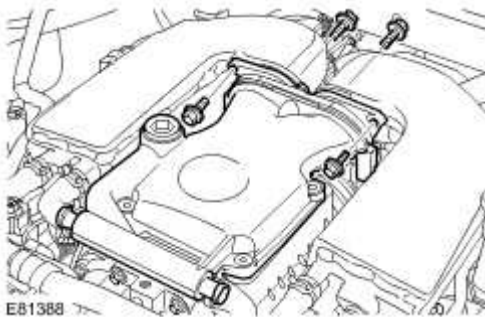
- 4 . Release the supercharger outlet pipe.
 - ▶ Remove the 4 bolts.
 - ▶ Remove and discard the 4 O-ring seals.
 - ▶ Disconnect the vacuum hose.



5.  **CAUTION: Always plug any open connections to prevent contamination.**

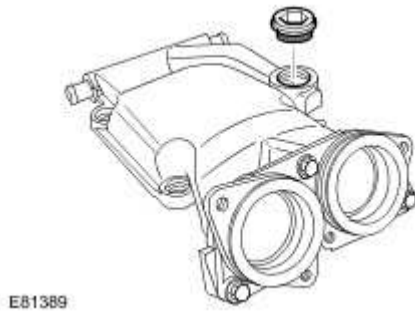
Remove the supercharger outlet pipe.

- ▶ Remove the 4 bolts.
- ▶ Remove and discard the gasket.



- 6 . Remove the supercharger coolant filler plug.

- ▶ Remove and discard the sealing washer.

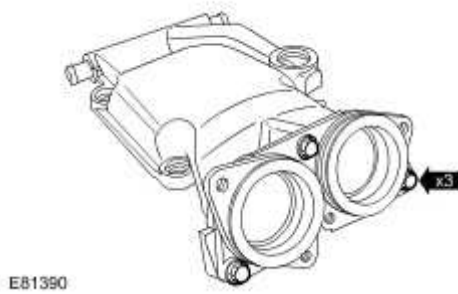


7 . NOTE:

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

Remove the spacer.

- ▶ Remove the 3 bolts.
- ▶ Remove and discard the 2 O-ring seals.



Installation

1 . Install the spacer.

- ▶ Clean the component mating faces.
- ▶ Install the new O-ring seals.
- ▶ Tighten the bolts to 16 Nm (12 lb.ft).

2 . Install the supercharger outlet pipe.

- ▶ Clean the component mating faces.
- ▶ Install a new gasket.
- ▶ Install new seals.
- ▶ Tighten the bolts to 9 Nm (7 lb.ft).
- ▶ Connect the vacuum hose.

3 . Connect the coolant hoses and secure with the clips.

 Remove the hose clamps.

4 . Install the intake air resonator.

For additional information, refer to [Intake Air Resonator](#)

5 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

6



- **CAUTION: Coolant may spill from the supercharger fill port when the ignition is switched on.**

Switch the ignition on.

7



- **CAUTION: Do not allow the supercharger coolant pump to run dry for more than one minute. Failure to follow this instruction may result in damage to the vehicle.**

Allow the supercharger pump to run and top-up the coolant through the supercharger fill port.

 Switch the ignition off.

8 . Install the supercharger coolant fill plug and tighten to 45 Nm (33 lb.ft).

 Clean the components.

 Install a new sealing washer.

9 . Switch the ignition off.

10 . Check and top-up the coolant.

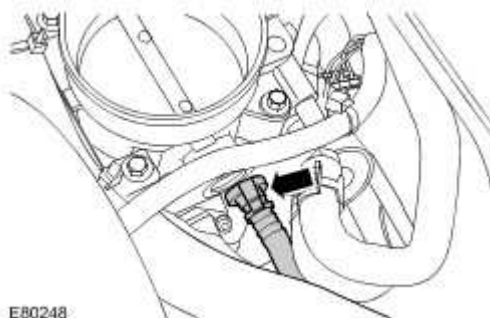
Throttle Body Elbow (19.70.28)

Removal

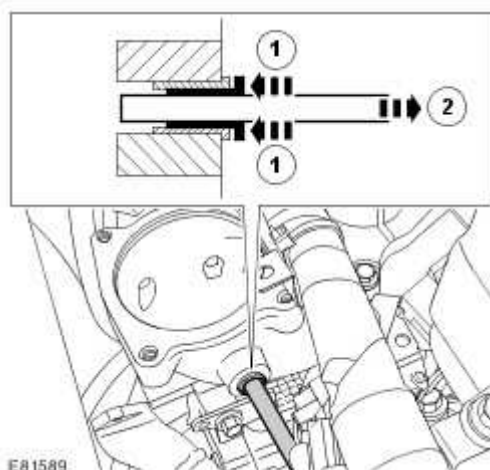


CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)
- 2 Remove the EGR valve.
 - For additional information, refer to [Exhaust Gas Recirculation \(EGR\) Valve \(17.45.01\)](#)
- 3 . Disconnect the purge outlet line.

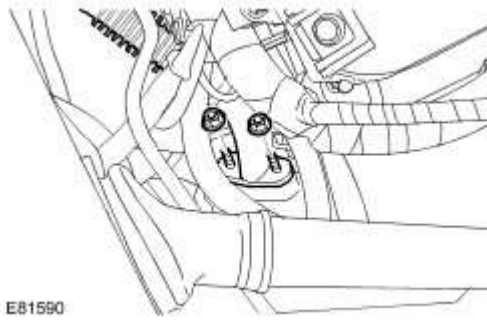


- 4 . Disconnect the brake booster vacuum hose quick release connector.

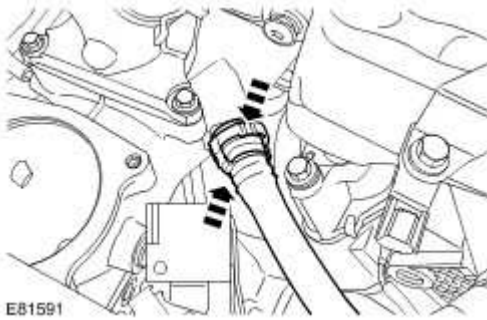


- 5 . Remove the EGR valve transfer pipe.
 - ▶ Remove the 2 nuts.

- ▶ Remove and discard the gasket.



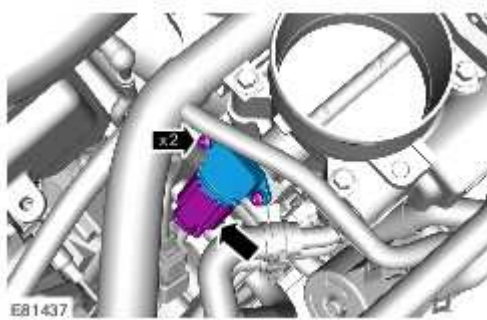
- 6 . Release the engine breather line.



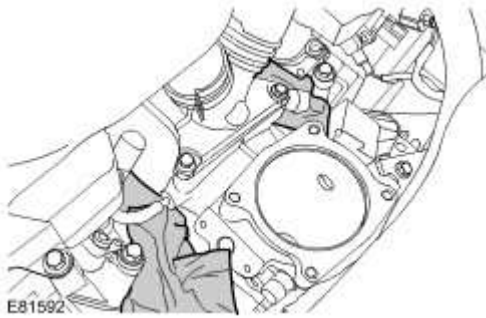
- 7 . Disconnect the manifold absolute pressure (MAP) sensor electrical connector.

- 8 . Remove the MAP sensor.

- ▶ Remove the 2 Torx screws.
- ▶ Remove and discard the O-ring seal.

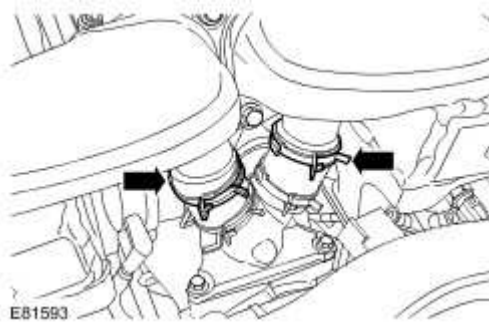


- 9 . Remove the NVH pads from each cylinder bank.



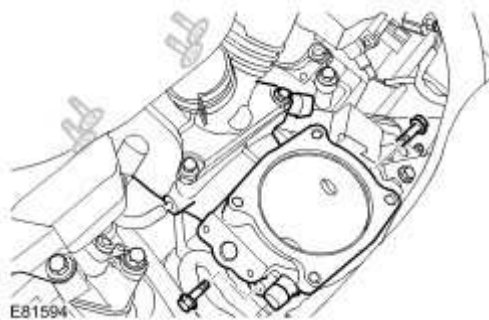
10 . Release the charge air coolers from the throttle body elbow.

- Release the 2 clips.



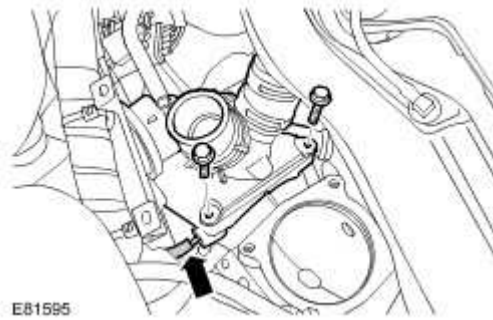
11 . Release the throttle body elbow.

- Remove the 4 Torx screws.
- Remove the 2 bolts.
- Remove and discard the gasket.



12 . Remove the supercharger pressure relief actuator.

- Disconnect the vacuum line.
- Remove the 2 bolts.
- Discard the O-ring seal.



13 . Remove the throttle body elbow.

Installation

1 . Install the throttle body elbow.

- ▶ Clean the component mating faces.

2 . Install the supercharger pressure relief actuator.

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

3 . Secure the throttle body elbow.

- ▶ Install a new gasket.
- ▶ Tighten the Torx screws to 25 Nm (18 lb.ft).
- ▶ Tighten the bolts to 25 Nm (18 lb.ft).

4 . Secure the charge air coolers to the throttle body elbow.

- ▶ Secure with the clips.

5 . Install the NVH pads on the cylinder banks.

6 . Install the MAP sensor.

- ▶ Clean the component mating faces.
- ▶ Install a new O-ring seal.
- ▶ Tighten the Torx screws.
- ▶ Connect the electrical connector.

7 . Connect the engine breather line.

8 . Install the EGR valve transfer pipe.

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

9 . Connect the brake booster vacuum hose quick release connector.

10 . Connect the purge outlet line.

11 Install the EGR valve.

- . For additional information, refer to [Exhaust Gas Recirculation \(EGR\) Valve \(17.45.01\)](#)

12 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

303-12B : Intake Air Distribution and Filtering – 4.2L NA V8 – AJV8

Specifications

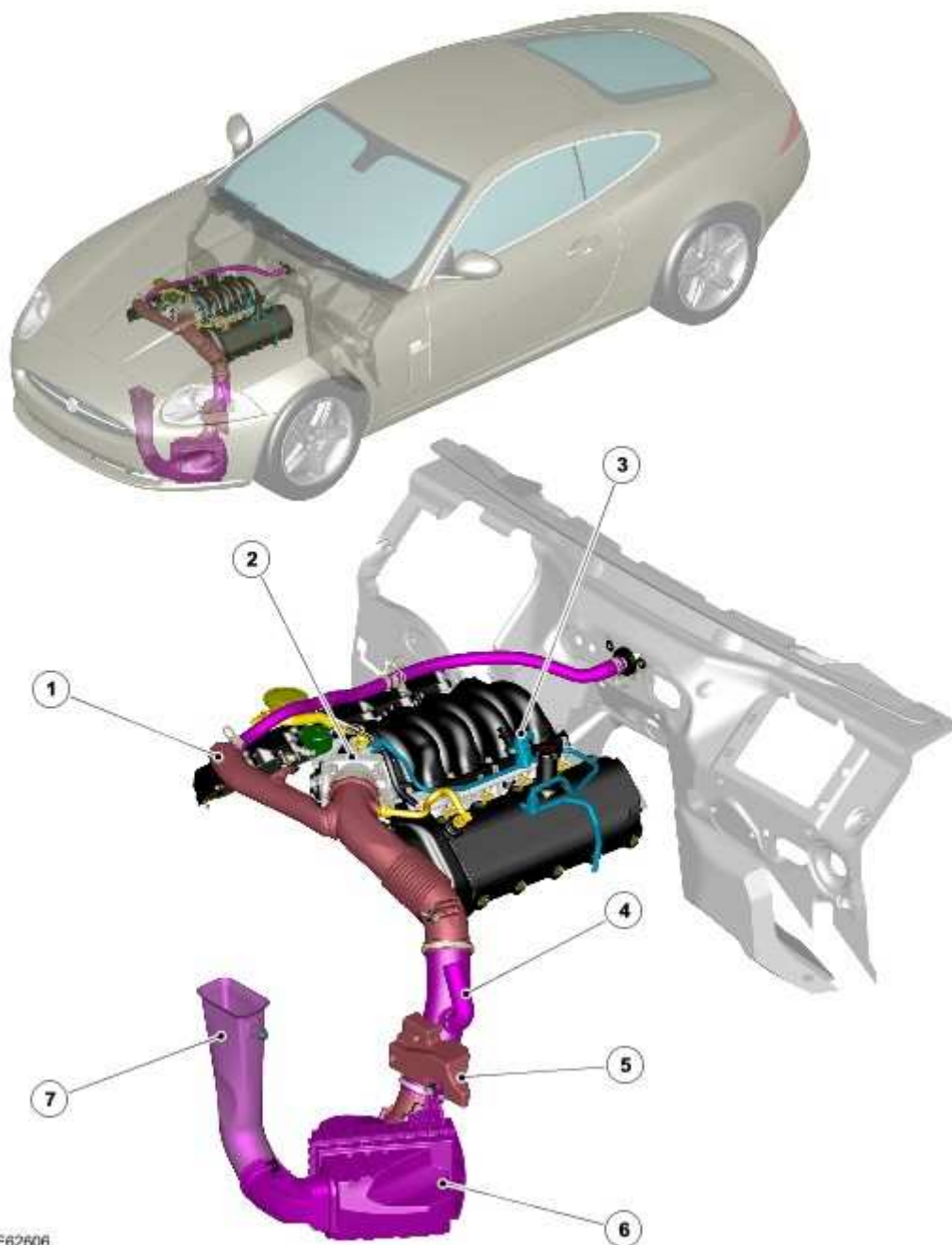
Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Air cleaner housing bracket - bolt	8	6	71
Air cleaner intake pipe bracket - bolt	8	6	71
Air cleaner outlet pipe bracket - bolt	8	6	71
Band clamp	4	3	35
Resonator to bulkhead - nut	9	7	80

Intake Air Distribution and Filtering

COMPONENT LOCATION



E62606

Item	Part Number	Description
1		Intake noise tube

2		Electric throttle
3		Air intake manifold
4		Resonator
5		Resonator
6		Air filter box
7		Clean air intake

INTRODUCTION

The 4.2 Liter V8 engine air intake and distribution system comprises:

- Air filter box
- Air intake
- Intake manifold
- Electronic throttle

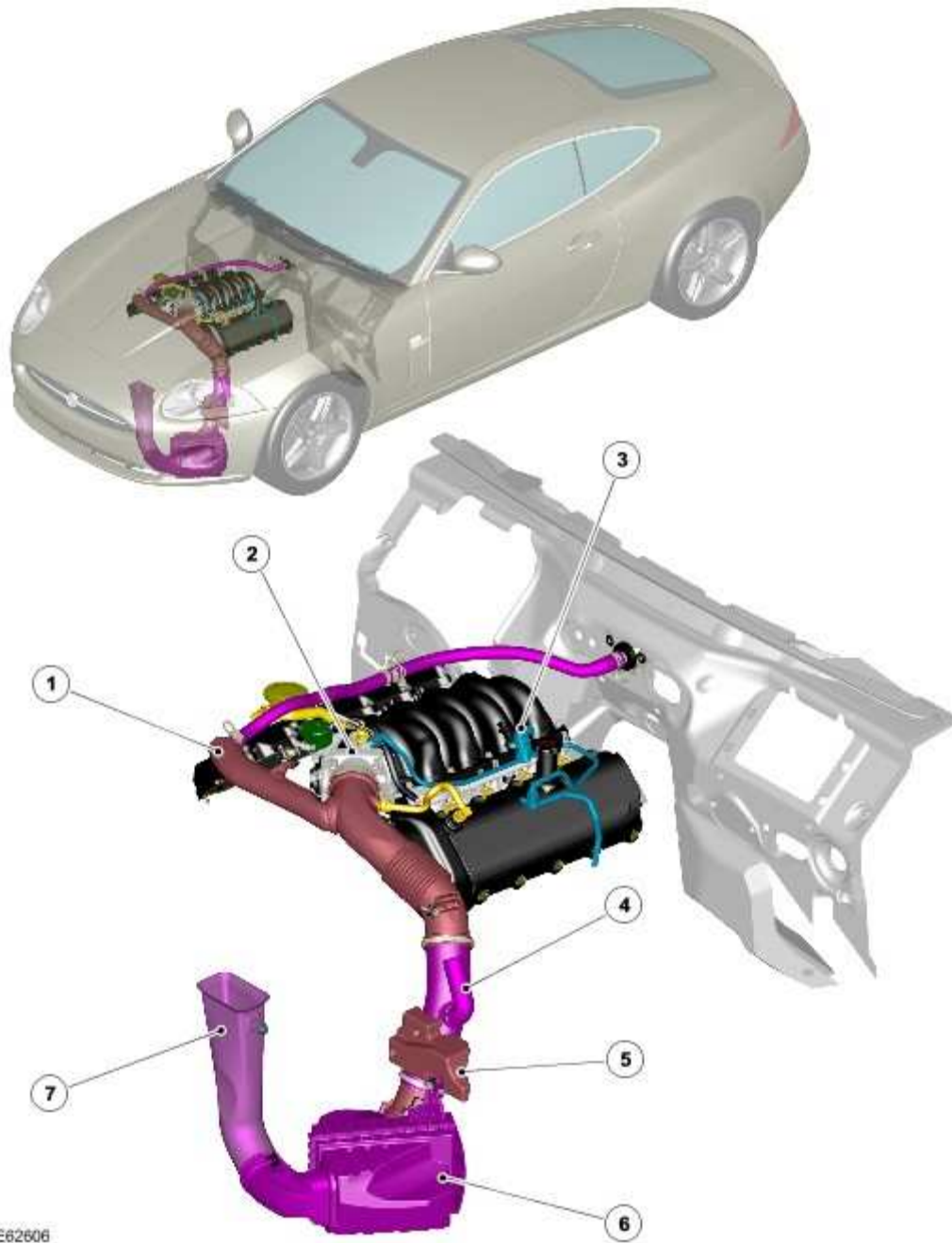
The air filter box is located in front of the LH (left-hand) front wheel, behind the wheel arch liner and contains a replaceable paper filter element.

Dirty air is drawn through the air intake which is located behind the radiator grill on the LH (left-hand) side and into the air filter box past the paper filter element. Clean air is then passed over the MAF (mass air flow) sensor located in the ducting directly behind the air filter box, through the electric throttle and up to the air intake manifold where it is distributed to the individual cylinders.

The intake manifold is located on top of the engine between the two engine banks. The manifold is manufactured from a composite material with metal insert fixings. The intake manifold comprises a central chamber with eight tracts leading to the inlet ports on the engine.

Intake Air Distribution and Filtering

COMPONENT LOCATION



E62606

Item	Part Number	Description
1		Intake noise tube
2		Electric throttle
3		Air intake manifold
4		Resonator

5		Resonator
6		Air filter box
7		Clean air intake

INTRODUCTION

The 4.2 Liter V8 engine air intake and distribution system comprises:

- Air filter box
- Air intake
- Intake manifold
- Electronic throttle

The air filter box is located in front of the LH front wheel, behind the wheel arch liner and contains a replaceable paper filter element.

Dirty air is drawn through the air intake which is located behind the radiator grill on the LH side and into the air filter box past the paper filter element. Clean air is then passed over the MAF sensor located in the ducting directly behind the air filter box, through the electric throttle and up to the air intake manifold where it is distributed to the individual cylinders.

The intake manifold is located on top of the engine between the two engine banks. The manifold is manufactured from a composite material with metal insert fixings. The intake manifold comprises a central chamber with eight tracts leading to the inlet ports on the engine.

Intake Air Distribution and Filtering

Principle of Operation

For a detailed description of the Intake Air Distribution and Filtering system, refer to the relevant Description and Operation section in the workshop manual.

[Intake Air Distribution and Filtering](#)

Inspection and Verification

- 1 . Verify the customer concern.
- 2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
- Hoses and ducts (damage/connections) - Air cleaner element (contaminated/blocked) - Restricted air intake - Seals and gaskets	- Mass Air Flow (MAF) sensor - Secondary Air Injection (AIR) Manifold Absolute Pressure (MAP) sensor - Throttle body - Harness (security/damage) - Connections (security/damage)

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, verify the customer concern and refer to the Symptom Chart below, alternatively, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Cause	Action
Vehicle does not start/hard starting/poor performance	- Restricted/blocked air intake - Restricted/blocked air cleaner element	- Ensure the air intake system is free from blockage and is correctly installed - Install a new air cleaner element as necessary. Air Cleaner Element (19.10.08)

Excessive intake noise	- Intake pipe disconnected/damaged after the air cleaner - Air cleaner assembly incorrectly assembled/damaged	- Check for correct installation and integrity of air intake system - Check for correct installation and integrity of the air cleaner assembly. Air Cleaner (19.10.05)

DTC Index



CAUTION: When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00.

NOTE:

Generic scan tools may not read the codes listed, or may read only five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give additional information read by the manufacturer-approved diagnostic system).

NOTE:

When performing electrical voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE:

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE:

If DTCs are logged 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.

DTC	Description	Possible Causes	Action
P010100	Mass Air Flow (MAF) circuit - range/performance	- Blocked air cleaner element - Leakage from air intake system - Engine breather leak - MAF sensor sensing circuit - high resistance, intermittent short to ground	- Check air cleaner element is free from restriction - Check for leak from air intake system, rectify as necessary - Ensure the engine breather system is

		- MAF sensor supply circuit - high resistance - MAF sensor failure	correctly installed and in serviceable condition - Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P010200	Mass Air Flow (MAF) circuit - low input	- MAF sensor supply circuit - short to ground, high resistance - MAF sensor ground circuit - high resistance - MAF sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P010300	Mass Air Flow (MAF) circuit - high input	- MAF sensor sensing circuit - short to power - MAF sensor ground circuit - high resistance - MAF sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P010600	Manifold Absolute Pressure (MAP) sensor - range/performance	- Intake manifold air leak (loose or missing component) - MAP sensor signal circuit fault - MAP sensor failure	- Check for correct installation and serviceability of intake manifold and associated components - Carry out any

			pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new MAP sensor as necessary. Manifold Absolute Pressure (MAP) Sensor (18.30.86)
P017100	System too lean (bank 1)	• Air intake leak between MAF sensor and cylinder head • Fuel filter, injector, system restriction • MAF sensor fault (low intake air flow) • Exhaust leak (forward of catalytic converter)	• Check for leak from air intake system • For fuel system tests. Fuel Tank and Lines • Read DTCs and refer to DTC Index in this section for MAF sensor tests • Check and rectify any exhaust leak prior to catalytic converter
P017200	System too rich (bank 1)	• Restricted air cleaner • Leaking fuel injector(s) • Engine oil contaminated with fuel (too many cold starts with vehicle subsequently not getting hot enough for long enough) • MAF sensor fault (high intake air flow)	• Check air cleaner element is free from restriction • Check for leaking injectors, install new injector(s) as necessary. Fuel Injector (18.10.01) • Check for contaminated engine oil, drain and refill engine oil as necessary. Engine Oil Draining and Filling • Read DTCs and refer to DTC Index in this section for

			MAF sensor tests
P017400	System too lean (bank 2)	• Air intake leak between MAF sensor and cylinder head • Fuel filter, injector, system restriction • MAF sensor fault (low intake air flow) • Exhaust leak (forward of catalytic converter)	• Check for leak from air intake system • For fuel system tests. Fuel Tank and Lines • Read DTCs and refer to DTC Index in this section for MAF sensor tests • Check and rectify any exhaust leak prior to catalytic converter
P017500	System too rich (bank 2)	• Restricted air cleaner • Leaking fuel injector(s) • Engine oil contaminated with fuel (too many cold starts with vehicle subsequently not getting hot enough for long enough) • MAF sensor fault (high intake air flow)	• Check air cleaner element is free from restriction • Check for leaking injectors, install new injector(s) as necessary. Fuel Injector (18.10.01) • Check for contaminated engine oil, drain and refill engine oil as necessary. Engine Oil Draining and Filling • Read DTCs and refer to DTC Index in this section for MAF sensor tests
P050600	Idle air control system RPM lower than expected	• Air intake restriction • Front End Accessory Drive (FEAD) overload (defective/seized component)	• Ensure the air intake system is free from restriction • Check the FEAD belt and components. Accessory Drive

P050700	Idle air control system RPM higher than expected	• Intake air leak between MAF sensor and engine • Engine crankcase breather leak	• Check for leakage and correct installation of air intake system • Check for leakage and correct installation of engine crankcase breather system

Air Cleaner (19.10.05)

Removal

- 1 . Disconnect the battery ground cable.

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 front wheel and tire.

For additional information, refer to [Wheel and Tire \(74.20.05\)](#)

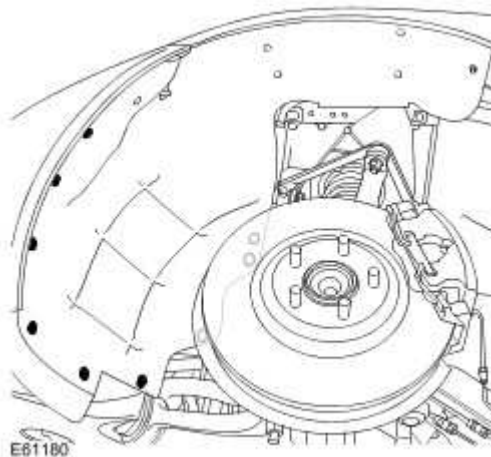
- 4 . Remove the radiator splash shield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

- 5 . Release the front of the LH fender splash shield.

- ▶ Remove the 8 Torx bolts.

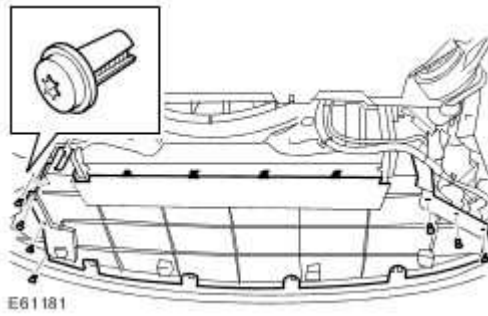
- ▶ Tie the splash shield aside.



- 6 . Remove the front bumper air ducting.

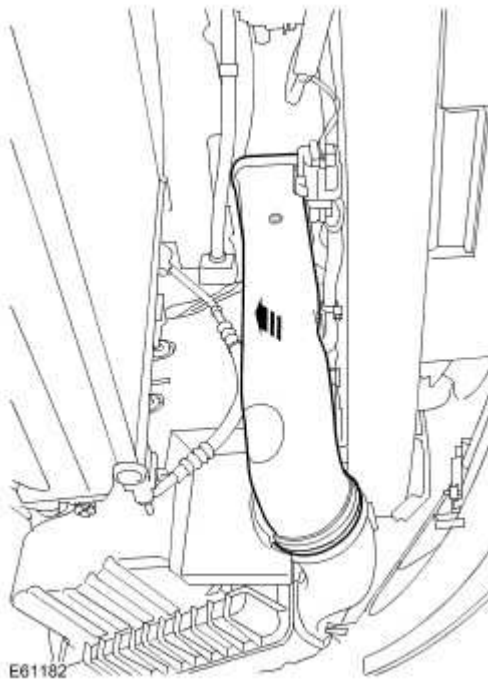
- ▶ Remove the 7 clips.

- ▶ Release the 4 clips.



7 . Remove the air intake duct.

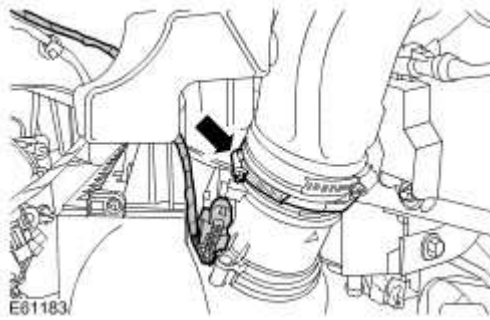
► Release the clip.



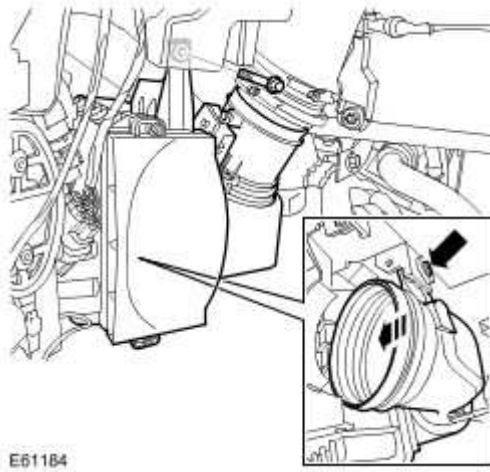
8 . Disconnect the mass air flow (MAF) sensor.

► Disconnect the electrical connector.

► Release the clip.



- 9 . Remove the air cleaner housing.
- ▶ Remove the bolt.
 - ▶ Release the clip.

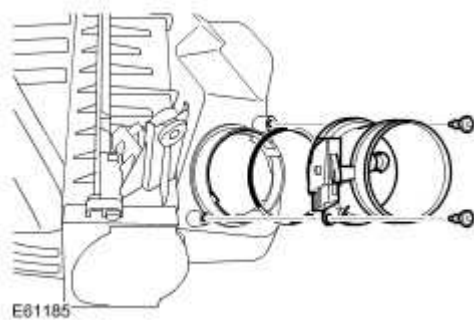


10 . **NOTE:**

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

Remove the mass air flow (MAF) sensor.

- ▶ Remove the 2 screws.
- ▶ Remove and discard the O-ring seal.



Installation

- 1 . Install the MAF sensor.
 - ▶ Clean the component mating faces.
 - ▶ Tighten the screws.
 - ▶ Install the new O-ring seals.
- 2 . Install the air cleaner housing.
 - ▶ Secure in the clip.
 - ▶ Tighten the bolt to 8 Nm (6 lb.ft)
- 3 . Install the air intake duct.
 - ▶ Secure in the clip.
- 4 . Connect the MAF sensor electrical connector.
- 5 . Install the air ducting.
 - ▶ Install the clips.
 - ▶ Secure the clips.
- 6 . Install the radiator splash shield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)
- 7 . Install the fender splash shield.
 - ▶ Tighten the Torx bolts.
- 8 . Install the wheel and tire.

For additional information, refer to [Wheel and Tire \(74.20.05\)](#)
- 9 . Connect the battery ground cable.

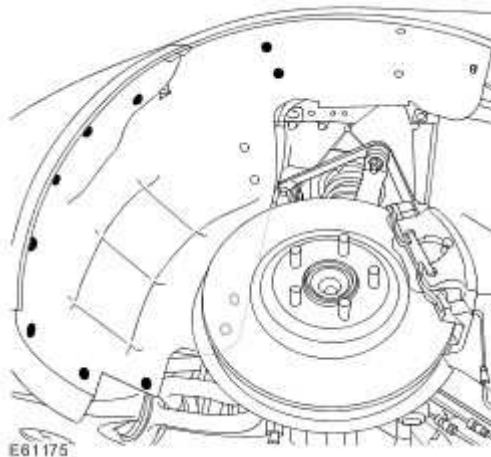
Air Cleaner Element (19.10.08)

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.

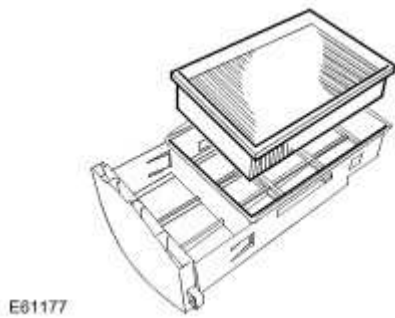
- 2 . Remove the LH front wheel and tire.
For additional information, refer to [Wheel and Tire \(74.20.05\)](#)
- 3 . Release the front of the fender splash shield.
 - ▶ Remove the 11 Torx bolts.
 - ▶ Tie the splash shield aside.



- 4 . Remove the air cleaner housing.
 - ▶ Remove the 2 screws.



5 . Remove the air cleaner element.



Installation

1 . Install the air cleaner element.

▶ Clean the components.

2 . Install the air cleaner housing.

▶ Tighten the Torx screws.

3 . Install the fender splash shield.

▶ Tighten the Torx bolts.

4 . Install the wheel and tire.

For additional information, refer to [Wheel and Tire \(74.20.05\)](#)

Air Cleaner Outlet Pipe (19.10.31)

Removal

- 1 . Disconnect the battery ground cable.

For additional information, refer to [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 front wheel and tire.

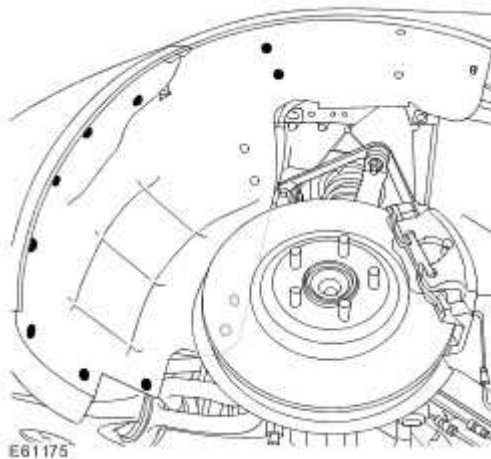
For additional information, refer to [Wheel and Tire \(74.20.05\)](#)

- 4 . Open the hood.

- 5 . Release the front of the fender splash shield.

▶ Remove the 11 Torx bolts.

▶ Tie the splash shield aside.



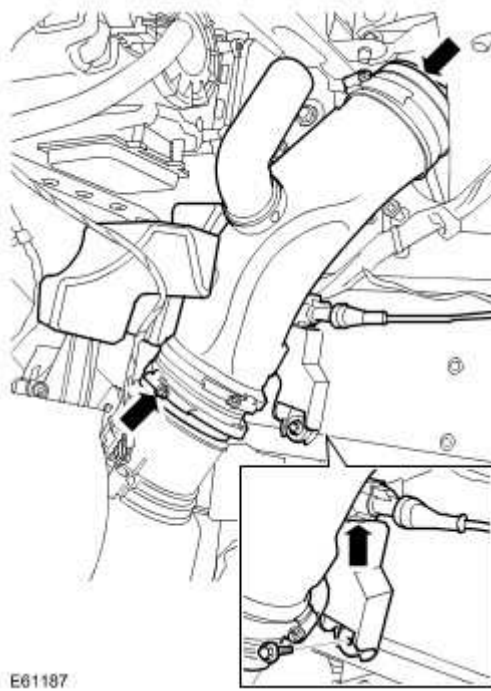
- 6 . Release and tie aside the power steering reservoir.

▶ Remove the 2 bolts.



7 . Remove the air cleaner outlet pipe.

- Remove the bolt.
- Release the 2 clips.
- Release the electrical connector.



Installation

1 . Install the air cleaner outlet pipe.

- Tighten the bolt to 8 Nm (6 lb.ft)
- Carefully secure the clips.
- Install the electrical connector.

2 . Install the power steering fluid reservoir.

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

3 . Install the fender splash shield.

 Tighten the Torx bolts.

4 . Install the wheel and tire.

For additional information, refer to [Wheel and Tire \(74.20.05\)](#)

5 . Connect the battery ground cable.

For additional information, refer to [Specifications](#)

303-13 : Evaporative Emission – 4.2L NA V8 – AJV8/4.2L SC V8 – AJV8

Specifications

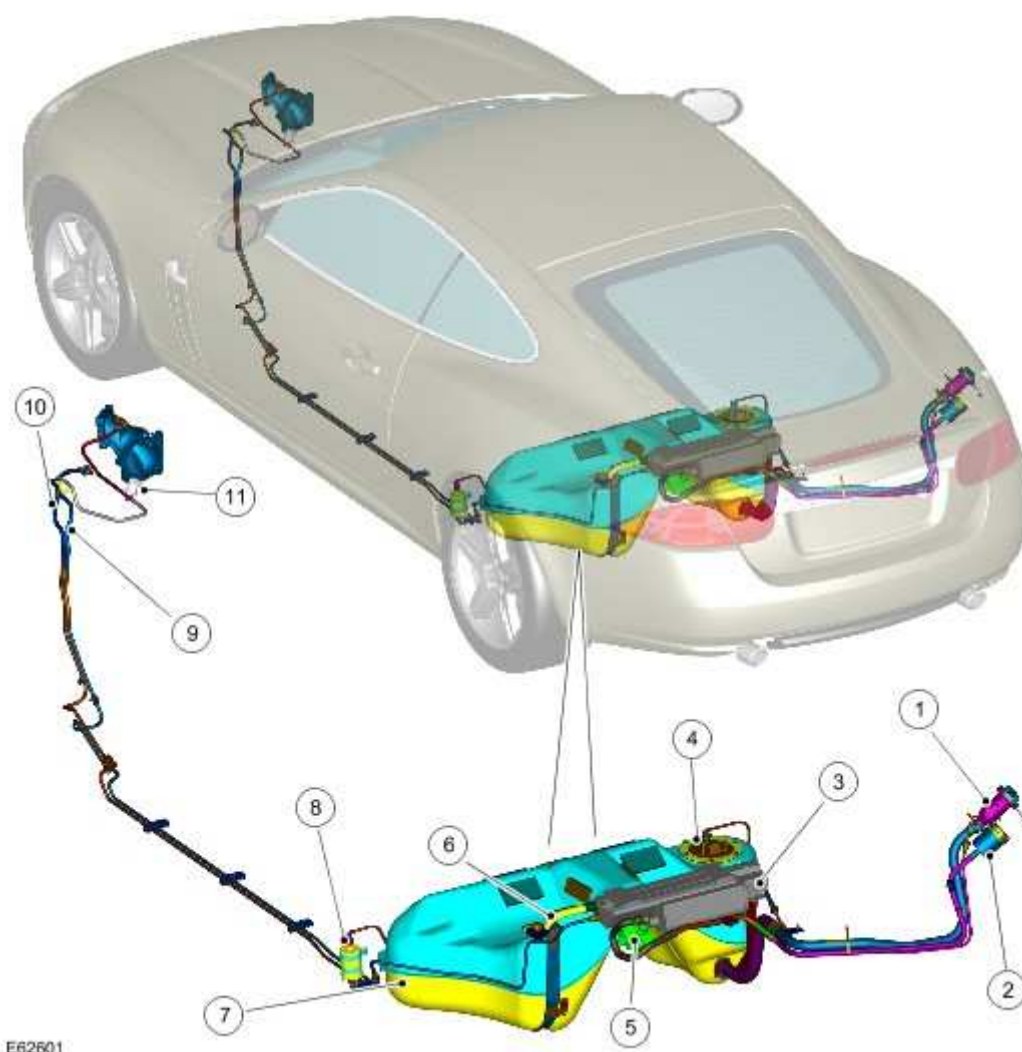
Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Evaporative emission, canister bracket to vehicle - nut	7	5	62
Purge valve to engine cover bracket - bolt	4	3	35
Vapour/fuel tube bracket to vehicle - bolt	9	7	80

Evaporative Emissions - 4.2L NA V8 - AJV8

COMPONENT LOCATION



Item	Part Number	Description
1	-	Fuel filler pipe/cap
2	-	DMTL pump filter (NAS only)
3	-	Charcoal canister
4	-	Fuel pump
5	-	DMTL pump (NAS only)

6	-	Breather hose from tank
7	-	Fuel tank
8		Fuel filter
9	-	Charcoal canister vent hose (All except NAS) or DMTL pump vent hose (NAS)
10	-	Fuel delivery hose
11	-	Purge valve

INTRODUCTION

The 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 pipe.

On NAS vehicles the vapor generated in the fuel tank 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.

DMTL

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.

DMTL Pump



The DMTL pump is connected to the atmospheric vent of the charcoal canister and incorporates 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.

The DMTL test is performed after the engine has stopped following a 10 minute run, providing that the vehicle fuel tank is between 15 and 85 percent full, the ambient temperature is above 0°C (32°F) and less than 40°C (104°F) and the vehicle was not started for at least 3hrs prior to this run.

The DMTL pump is driven to pressurize the fuel tank and the current is measured with the change-over valve in different states.

A comparison of the current draw in each state indicates the degree of any leak, and the ECM then sets the appropriate DTC.

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-energized 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 pressurize 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, 15 seconds after the engine has started, the ECM energizes the heating element in the pump to prevent condensation formation and possible incorrect readings. The heater remains energized until either the engine and ignition are off (if no DMTL test is running) or until after the DMTL test is completed."

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 (70 kPa (10.15 lbf/in²) derived from engine load calculations) is below 3047 m (10000 feet)
- The ambient temperature is between 0 and 40°C (32 and 104°F)
- The charcoal canister load factor is 2.5 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.

NOTE:

A leak test can be performed using IDS. 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 2nd major leak check or after refueling is detected.

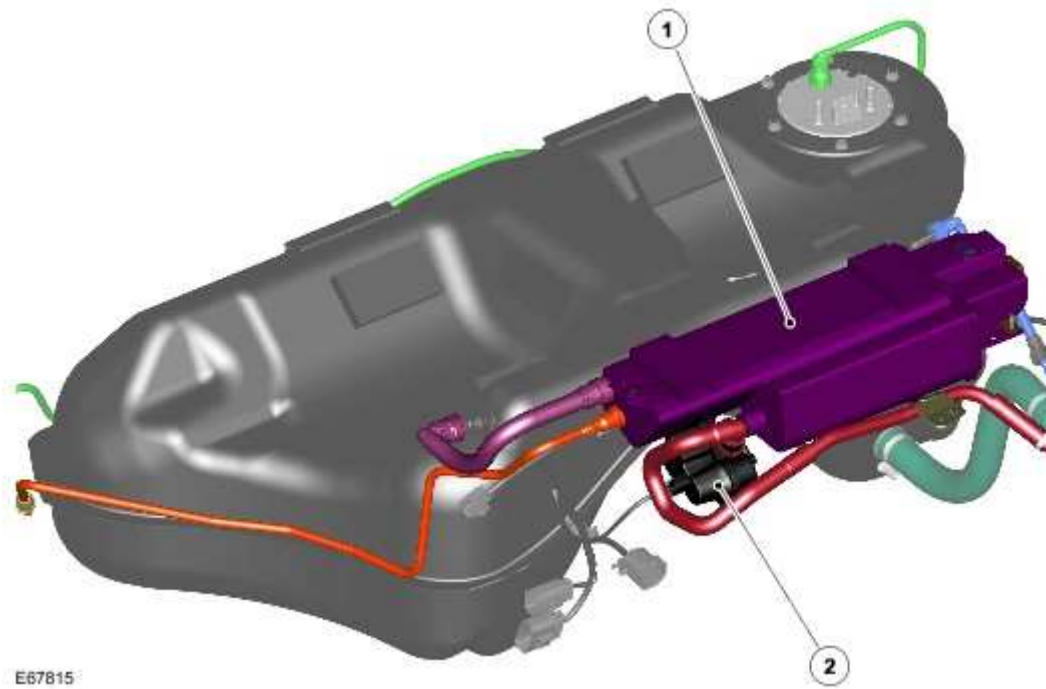
When the leak check is complete, the ECM stops the DMTL pump and opens (de-energizes) the normally open valve.

If the fuel filler cap is opened or refueling 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 60 and 600 seconds depending on the results and fuel tank level.

CHARCOAL CANNISTER



Item	Part Number	Description
1		Charcoal cannister
2		DMTL pump

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.

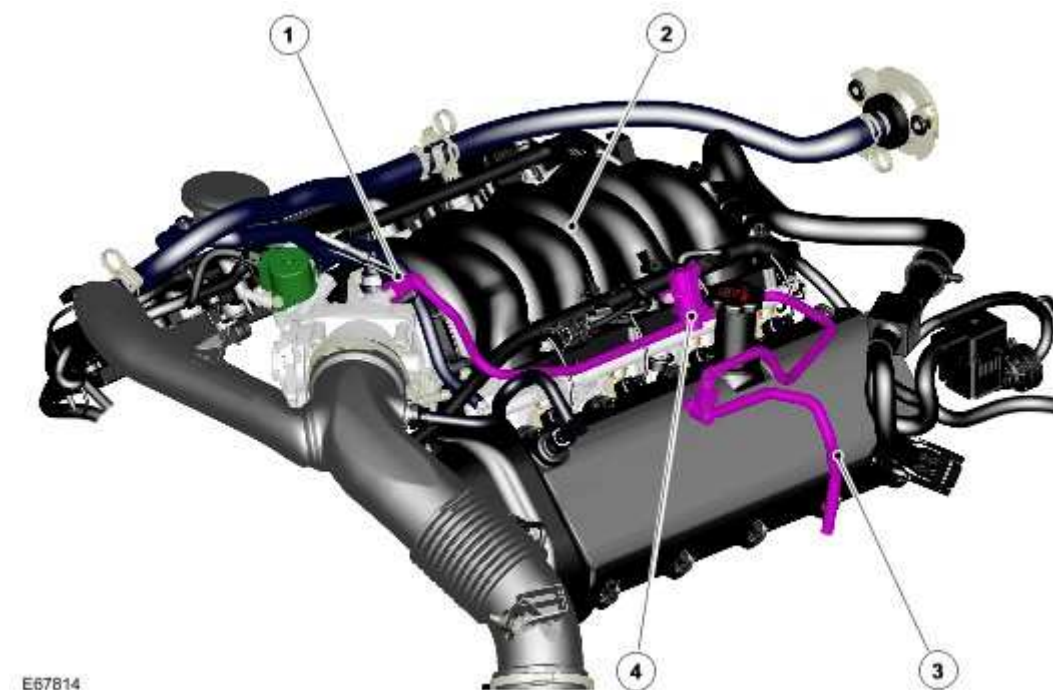
The canister on ROW vehicles has a capacity of 1400cc (85.4 in3).

The canister on NAS vehicles has a capacity of 3000cc (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.

PURGE VALVE



Item	Part Number	Description
1		Hose and connection-purge valve to electric throttle
2		Air intake manifold
3		Hose-charcoal cannister to purge valve
4		Purge valve

The purge valve is located LH side of the engine, on a bracket which is attached to the cylinder block. The purge hose is routed from the purge valve, along the left hand side of the air intake manifold, to the elbow assembly which locates the electric throttle. The purge valve is controlled by the Engine Control Module (ECM) and is operated when engine operating conditions are correct to allow purging of the charcoal canister. The purge valve is a solenoid operated valve which is closed when de-energized.

The purge hose is connected, at the right hand rear of the engine, 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 continues from the purge valve and is routed to a connection on the air intake elbow assembly. The hose is connected to the elbow with a quick release connector.

The purge valve is Pulse Width Modulated (PWM) at 10Hz by the ECM. At this high frequency, the pulses of purge gas flow into the inlet manifold in an almost a continuous flow. The valve operates between 7% and 100% duty or mark space ratio (% open time).

The atmospheric pressure at the air intake vent of the system is higher than the inlet manifold

pressure under all throttled engine running conditions. It is this pressure differential across the system that causes the air to flow through the air intake, through the purge system, and in to the engine.

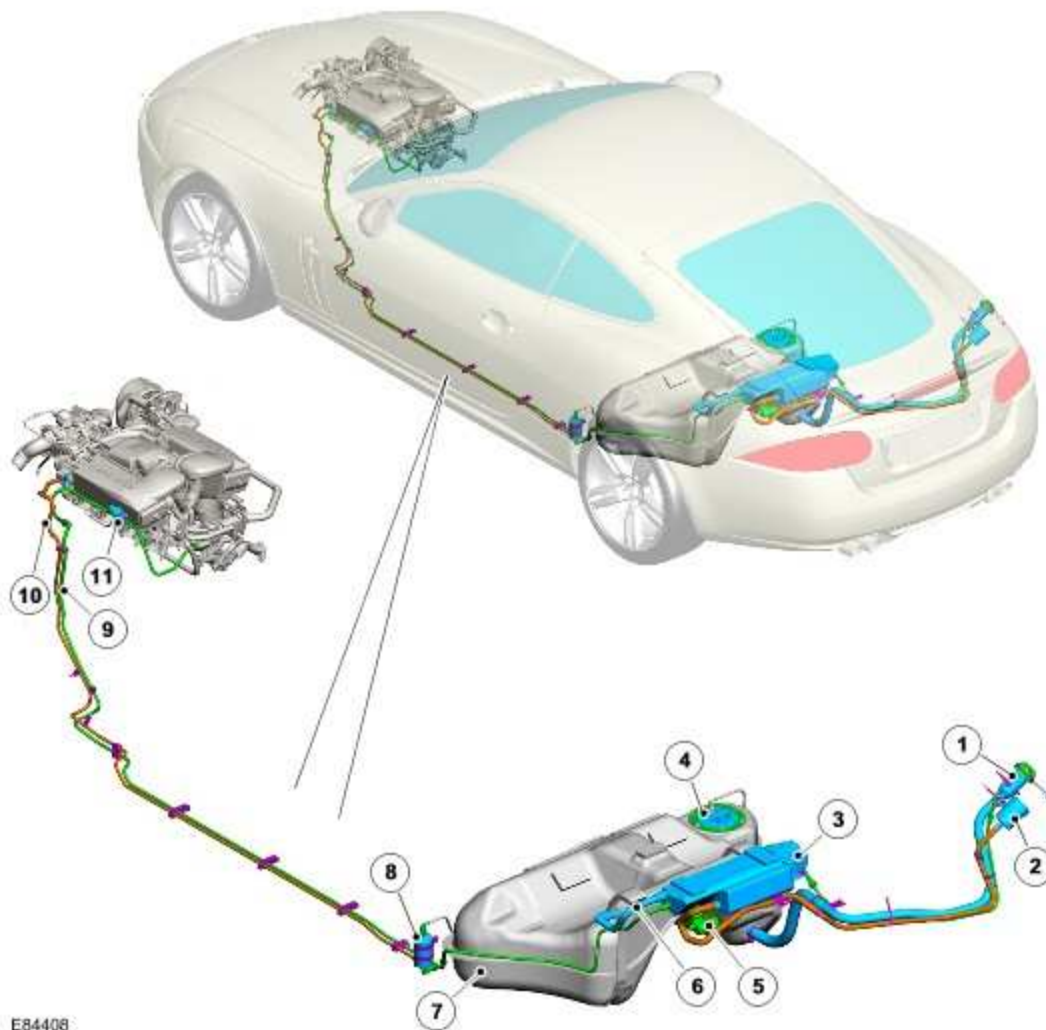
The ECM waits until the engine is running above 40°C (104°F) coolant temperature with closed loop fuel operational before the purging process is activated. Under these conditions the engine should be running smoothly with no warm up enrichment. The purge valve duty (and flow) is initially ramped slowly because the vapor concentration is unknown (a sudden increase in purge could cause unstable engine running or cause it to stall due to an extremely "rich" air/fuel mixture.). The concentration is then determined from the amount of adjustment that the closed loop fueling 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 known 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 valve atmospheric vent connection and its filter on NAS vehicles or, 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.

Evaporative Emissions - 4.2L SC V8 - AJV8

COMPONENT LOCATION



E84408

Item	Part Number	Description
1		Fuel filler pipe/cap
2		fuel tank leakage monitoring pump filter (NAS only)
3		Charcoal canister
4		Fuel pump
5		fuel tank leakage monitoring pump (NAS only)
6		Breather hose from tank
7		Fuel tank
8		Fuel filter

9		Charcoal canister vent hose (All except NAS) or fuel tank leakage monitoring pump vent hose (NAS)
10		Fuel delivery hose
11		Purge valve

OVERVIEW

The 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 pipe.

On NAS vehicles the vapor generated in the fuel tank 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.

FUEL TANK LEAKAGE MONITORING

The fuel tank leakage monitoring system is a legislative requirement for NAS vehicles. The fuel tank leakage monitoring system periodically checks the EVAP system and the fuel tank for leaks when the ignition is switched off. The fuel tank leakage monitoring system comprises the previously described components of the EVAP system with the additional of a fuel tank leakage monitoring pump and a fuel tank leakage monitoring filter.

Fuel Tank Leakage Monitoring Pump



The fuel tank leakage monitoring pump is connected to the atmospheric vent of the charcoal canister and incorporates a Positive Temperature Co-efficient (PTC) heating element, a normally open valve and a reference orifice. The fuel tank leakage monitoring 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 fuel tank leakage monitoring 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 fuel tank leakage monitoring pump by a hose.

The fuel tank leakage monitoring test is performed after the engine has stopped following a 10 minute run, providing that the vehicle fuel tank is between 15 and 85 percent full, the ambient temperature is above 0°C (32°F) and less than 40°C (104°F) and the vehicle was not started for at least 3hrs prior to this run.

The fuel tank leakage monitoring pump is driven to pressurize the fuel tank and the current is measured with the change-over valve in different states. A comparison of the current draw in each state indicates the degree of any leak, and the ECM then sets the appropriate DTC.

Fuel Tank Leakage Monitoring Operation

To check the fuel tank and the EVAP system for leaks, the ECM operates the fuel tank leakage monitoring 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-energized 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 pressurize 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, 15 seconds after the engine has started, the ECM energizes the heating element in the pump to prevent condensation formation and possible incorrect readings. The heater remains energized until either the engine and ignition are off (if no fuel tank leakage monitoring test is running) or until after the fuel tank leakage monitoring test is completed.

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 altitude is below 2500 m (8200 feet)
- The ambient temperature is between 4 and 35°C (32 and 104°F)
- The charcoal canister load factor is 2.5 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 20 minutes
- The battery voltage is between 11 and 14.5 volts
- The last engine off time was more than 20 minutes
- No errors are detected with the EVAP components, the ambient air temperature and the fuel level.

NOTE:

A leak test can be performed using the Jaguar recommended diagnostic tool. 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 14 major leak check or after refueling is not detected.

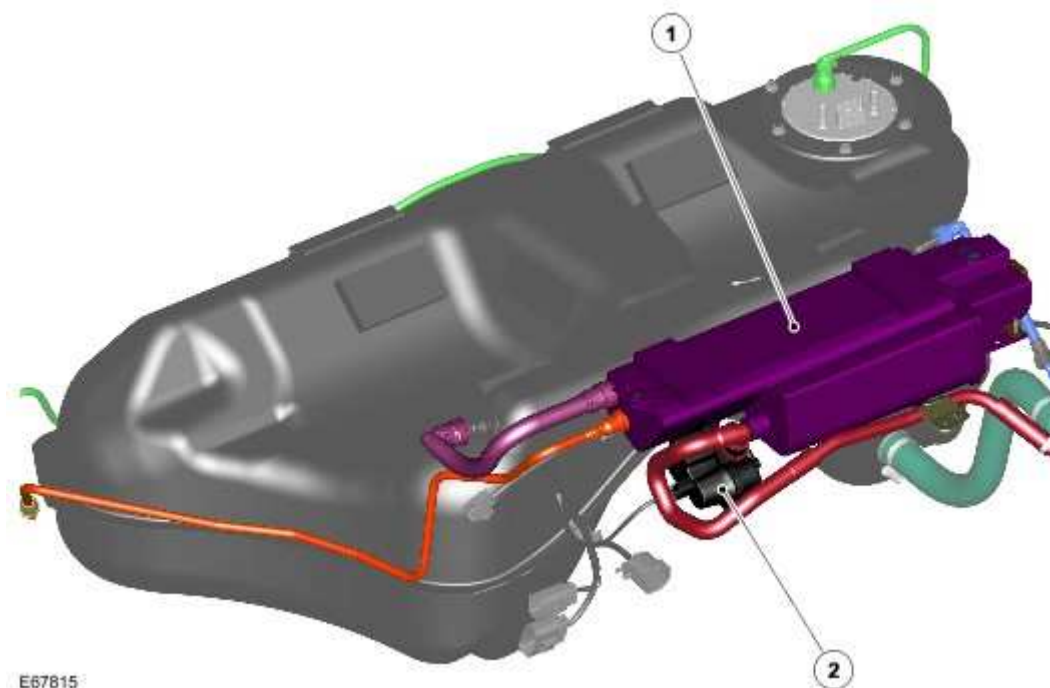
When the leak check is complete, the ECM stops the fuel tank leakage monitoring pump and opens (de-energizes) the normally open valve.

If the fuel filler cap is opened or refueling 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 60 and 600 seconds depending on the results and fuel tank level.

CHARCOAL CANNISTER



Item	Part Number	Description
1		Charcoal cannister
2		Fuel tank leakage monitoring pump

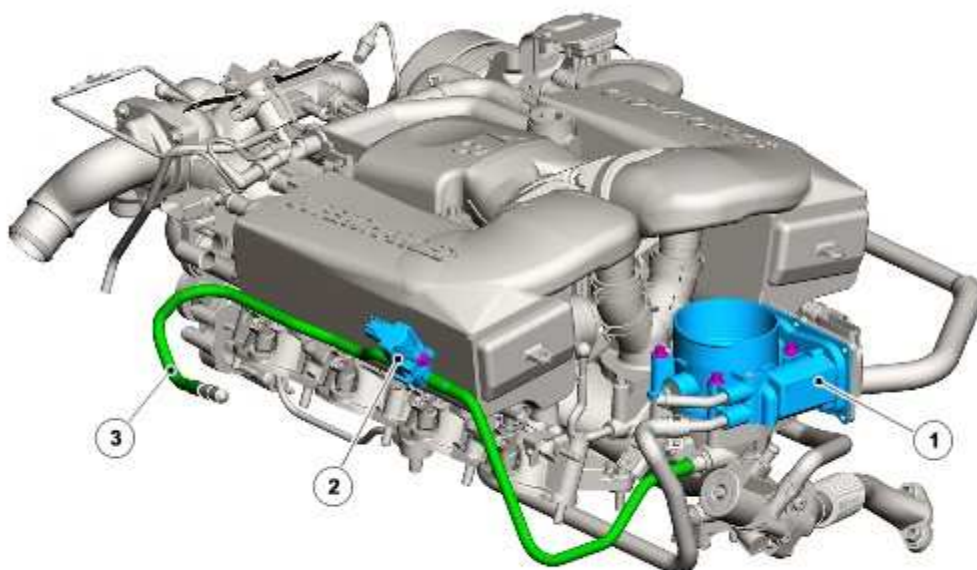
The charcoal canister is located in a central position, forward of the spare wheel. It is attached at the rear with two bolts which screw into the spare wheel carrier. At the front, the canister has two lugs which locate in the parking brake module support bracket.

Variant	Capacity
NAS	3000cc (183 in ³)
ROW	1400cc (85.4 in ³)

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 fuel tank leakage monitoring 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.

PURGE VALVE



E84409

Item	Part Number	Description
1		Electric throttle
2		Purge valve
3		Hose-charcoal cannister to purge valve

The purge valve is located LH side of the engine, on a bracket which is attached to the cylinder block. The purge hose is routed from the purge valve, along the left hand side of the air intake manifold, to the elbow assembly which locates the electric throttle. The purge valve is controlled by the Engine Control Module (ECM) and is operated when engine operating conditions are correct to allow purging of the charcoal canister. The purge valve is a solenoid operated valve which is closed when de-energized.

The purge hose is connected, at the right hand rear of the engine, 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 continues from the purge valve and is routed to a connection on the air intake elbow assembly. The hose is connected to the elbow with a quick release connector.

The purge valve is Pulse Width Modulated (PWM) at 10Hz by the ECM. At this high frequency, the pulses of purge gas flow into the inlet manifold in an almost a continuous flow. The valve operates between 7% and 100% duty or mark space ratio (% open time).

The atmospheric pressure at the air intake vent of the system is higher than the inlet manifold pressure under all throttled engine running conditions. It is this pressure differential across the system that causes the air to flow through the air intake, through the purge system, and in to

the engine.

The ECM waits until the engine is running above 40°C (104°F) coolant temperature with closed loop fuel operational before the purging process is activated. 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 unstable engine running or cause it to stall due to an extremely "rich" air/fuel mixture.). The concentration is then determined from the amount of adjustment that the closed loop fueling 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 known 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 fuel tank leakage monitoring valve atmospheric vent connection and its filter on NAS vehicles or, 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.

Evaporative Emissions

Principle of Operation

For a detailed description of the Evaporative emissions system, refer to the relevant Description and Operation section of the workshop manual.

[Evaporative Emissions - 4.2L NA V8 - AJV8](#)

Inspection and Verification

- 1 . Verify the customer concern.
- 2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
• Fuel filler cap and seal • Fuel filler neck • Diagnostic Monitoring of Tank Leakage (DMTL) fresh air filter (restriction, etc) • Fuel tank (leaks, damage, etc) • Fuel lines and joints, etc • Carbon canister • Purge valve • DMTL pump module	• Fuses • Connectors • Harnesses • Purge valve • DMTL pump

- 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, and there are clear symptoms, refer to the Symptom Chart below, alternatively, check for Diagnostic Trouble Codes (DTCs) then proceed to the DTC Index.
- 5 . **NOTE:**
On all vehicles equipped with Diagnostic Monitor Tank Leakage (DMTL), there is a requirement to blank off the ventilation port (large diameter stub pipe) of the DMTL module, to prevent mis-diagnosis when carrying out a smoke test.

Where K-Line, Vacutec or other proprietary smoke test equipment is available, it should be utilised to assist with Evaporative Emissions System leak diagnosis.

Symptom Chart

Symptom	Possible Cause	Action
Difficulty in filling fuel tank	Restriction in the vapor line between the fuel tank and the carbon canister outlet/atmospheric port	Check for restrictions/damage, etc (see visual inspection)
Fuel smell	- System leak - Purge valve inoperative	Check for leaks, check the purge valve operation. GO to Pinpoint Test G556798p1.
'Check Fuel Filler Cap' displayed on Message Center	Fuel filler cap missing/not tightened after refuelling	Check the fuel filler cap and seal

DTC Index



CAUTION: When probing connectors to take measurements in the course of the diagnostic tests, use the adaptor kit, part number 3548-1358-00.

NOTE:

If the module is suspect and the vehicle remains under the manufacturer warranty, refer to the Warranty Policy and Procedure manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module.

NOTE:

Generic scan tools may not read the codes listed, or may read only five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give additional information read by the manufacturer-approved diagnostic system).

NOTE:

When performing electrical voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE:

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE:

If DTCs 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.

DTC	Description	Possible Cause	Action
P044100	Incorrect purge flow	- Evaporative canister purge pipe restricted, leaking, disconnected - Evaporative canister vent restricted - Evaporative canister purge valve to engine pipe(s) restricted, leaking, disconnected - Evaporative canister purge valve failure	For basic checks. GO to Pinpoint Test G556798p1. Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P044700	Evaporative Emission (EVAP) system vent control circuit open	DMTL COV circuit - short to ground	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P044800	Evaporative Emission (EVAP) system vent control circuit shorted	DMTL COV circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P045600	Evaporative Emission (EVAP) system leak detected (very small leak)	DMTL system has detected a leak	Check the fuel system integrity (see visual inspection). Carry out K line or Vacutec tests to identify the leak
P045800	Evaporative Emission (EVAP) canister purge valve circuit low	- EVAP canister purge valve control circuit - short to ground, high resistance - EVAP canister purge valve failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new EVAP canister purge valve as necessary. Evaporative Emission Canister Purge Valve - 4.2L NA V8 - AJV8 (17.15.30)
P045900	Evaporative Emission (EVAP) canister purge valve circuit high	EVAP canister purge valve control circuit -	Carry out any pinpoint tests associated with this DTC using the

		short to power	manufacturer approved diagnostic system
P240100	Evaporative emission (EVAP) system leak detection pump control circuit low	DMTL pump circuit - short to ground	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P240200	Evaporative emission (EVAP) system leak detection pump control circuit high	DMTL pump circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P240429	Evaporative emission (EVAP) system leak detection pump sensing circuit range/performance	- DMTL reference leak - DMTL pump circuit - short to ground, power, high resistance - DMTL pipework blocked/leaking	Check the DMTL pipework. For DMTL pump tests, GO to Pinpoint Test G556798p4 .
P24042F	Evaporative emission (EVAP) system leak detection pump sensing circuit range/performance - signal erratic	- DMTL reference leak - DMTL pump circuit - short to ground, power, high resistance - DMTL pipework blocked/leaking	Check the DMTL pipework. For DMTL pump tests, GO to Pinpoint Test G556798p4 .
P240500	Evaporative emission (EVAP) system leak detection pump sensing circuit low	DMTL pump circuit - short to ground, power, high resistance	For DMTL pump tests, GO to Pinpoint Test G556798p4 .
P240600	Evaporative emission (EVAP) system leak detection pump sensing circuit high	DMTL pump circuit - short to ground, power, high resistance	For DMTL pump tests, GO to Pinpoint Test G556798p4 .
P240B00	Evaporative emission (EVAP) system leak detection pump heater circuit low	DMTL heater control circuit low	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P240C00	Evaporative emission (EVAP) system leak detection pump heater circuit high	DMTL heater control circuit high	Carry out any pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system
P245000	Evaporative emission (EVAP) system change-over valve (COV) performance/stuck open	DMTL system circuit - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P245100	Evaporative emission (EVAP) system change-over valve (COV) performance/stuck closed	DMTL system circuit - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system

Pinpoint Tests

PINPOINT TEST G556798p1 : EVAPORATIVE SYSTEM INCORRECT PURGE FLOW

G556798t1 : CHECK FUEL FILLER CAP INSTALLATION AND CONDITION OF CANISTER, PIPES AND CONNECTORS

1. Make sure that the fuel filler cap is correctly installed and tightened. 2. Check the condition of the carbon canister. 3. Check the condition of all accessible pipes and connectors in the vapor line.

- Are the canister and all pipes and connectors in good condition?

-> **Yes**

GO to Pinpoint Test [G556798t2](#).

-> **No**

REPAIR as necessary. CLEAR the DTC, test the system for normal operation.

G556798t2 : CHECK THAT THE PURGE VALVE IS OPERATING

1. Disconnect the vapor pipe from the inlet port of the evaporative purge valve. 2. **RUN** the engine for 2 minutes, making sure that the engine reaches normal operating temperature. 3. Check that the evaporative purge valve is operating, by touch or by sound (using a stethoscope, it will be possible to hear the valve operating).

- **Is the valve operating?**

-> **Yes**

CHECK for related DTCs. Refer to the DTC Index above.

-> **No**

CHECK the purge valve circuits. GO to Pinpoint Test [G556798p3](#).

PINPOINT TEST G556798p2 : CHANGE-OVER VALVE (COV) CONTROL CIRCUIT

G556798t3 : CHECK THE COV CONTROL CIRCUIT FOR SHORT CIRCUIT TO GROUND

1. Set ignition status to OFF. 2. Disconnect the DMTL electrical connector, CV011. 3. Measure the resistance between:

DMTL connector CV011, harness side	Battery
Pin 03	Negative terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test [G556798t4](#).

G556798t4 : CHECK THE COV CONTROL CIRCUIT FOR SHORT CIRCUIT TO POWER

1. Measure the resistance between:

DMTL connector CV011, harness side	Battery
Pin 03	Positive terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test [G556798t5](#).

G556798t5 : CHECK THE COV CONTROL CIRCUIT FOR HIGH RESISTANCE

1. Disconnect the ECM electrical connector, FL072. 2. Measure the resistance between:

DMTL connector CV011, harness side	ECM connector FL072, harness side
Pin 03	Pin 48

- **Is the resistance greater than 5 ohms?**

-> **Yes**

REPAIR the high resistance circuit. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

INSTALL a new DMTL assembly. If the DTC is repeated, refer to the new ECM installation notes at the top of the DTC Index.

PINPOINT TEST G556798p3 : PURGE VALVE CONTROL CIRCUIT

G556798t6 : CHECK THE POWER SUPPLY TO THE PURGE VALVE

1. Disconnect the purge valve connector, PI304. 2. Set ignition status to ON, engine OFF. 3. Measure the voltage between:

Purge valve connector PI304, harness side	Battery
Pin 01	Negative terminal

- **Is the voltage less than 10 volts?**

-> **Yes**

REPAIR the circuit between the purge valve and battery. This circuit includes harness splices and fuse 14 of the engine junction box. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test [G556798t7](#).

G556798t7 : CHECK THE PURGE VALVE CONTROL CIRCUIT FOR SHORT CIRCUIT TO GROUND

1. Set ignition status to OFF. 2. Measure the resistance between:

Purge valve connector PI304, harness side	Battery
Pin 02	Negative terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test [G556798t8](#).

G556798t8 : CHECK THE PURGE VALVE CONTROL CIRCUIT FOR SHORT CIRCUIT TO POWER

1. Measure the resistance between:

Purge valve connector PI304, harness side	Battery
Pin 02	Positive terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test [G556798t9](#).

G556798t9 : CHECK THE PURGE VALVE CONTROL CIRCUIT FOR HIGH RESISTANCE

1. Disconnect the ECM electrical connector, PI300. 2. Measure the resistance between:

Purge valve connector PI304, harness side	ECM connector PI300, harness side
Pin 02	Pin 92

- **Is the resistance greater than 5 ohms?**

-> **Yes**

REPAIR the high resistance circuit. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

INSTALL a new purge valve. Clear the DTC, test the system for normal operation. If the DTC is repeated, refer to the new ECM installation notes at the top of the DTC Index.

PINPOINT TEST G556798p4 : DIAGNOSTIC MONITORING OF FUEL TANK LEAKAGE (DMTL) PUMP CONTROL CIRCUIT

G556798t10 : CHECK THE POWER SUPPLY TO THE DMTL PUMP

1. Set the ignition status to OFF. 2. Disconnect the DMTL pump electrical connector, CV011.
3. Set ignition status to ON, engine OFF. 4. Measure the voltage between:

DMTL pump connector CV011, harness side	Battery
Pin 04	Negative terminal

- **Is the voltage less than 10 volts?**

-> **Yes**

REPAIR the circuit between the DMTL pump and battery. This circuit includes harness splice FLS05 and fuse 14 of the engine junction box. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test [G556798t11](#).

G556798t11 : CHECK THE DMTL PUMP CONTROL CIRCUIT FOR SHORT CIRCUIT TO GROUND

1. Set ignition status to OFF. 2. Measure the resistance between:

DMTL pump connector CV011, harness side	Battery
Pin 01	Negative terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test [G556798t12](#).

G556798t12 : CHECK THE DMTL PUMP CONTROL CIRCUIT FOR SHORT CIRCUIT TO POWER

1. Measure the resistance between:

DMTL pump connector CV011, harness side	Battery
Pin 01	Positive terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test [G556798t13](#).

G556798t13 : CHECK THE DMTL PUMP CONTROL CIRCUIT FOR HIGH RESISTANCE

1. Disconnect the ECM electrical connector, FL072. 2. Measure the resistance between:

DMTL pump connector CV011, harness side	ECM connector FL072, harness side
Pin 01	Pin 33

- **Is the resistance greater than 5 ohms?**

-> **Yes**

REPAIR the high resistance circuit. For additional information, refer to the wiring diagrams.

Clear the DTC, test the system for normal operation.

-> **No**

INSTALL a new DMTL pump. Clear the DTC, test the system for normal operation. If the DTC is repeated, refer to the new ECM installation note at the top of the DTC Index.

PINPOINT TEST G556798p5 : DIAGNOSTIC MONITORING OF FUEL TANK LEAKAGE (DMTL) HEATER CIRCUIT

G556798t14 : CHECK THE POWER SUPPLY TO THE DMTL PUMP

1. Set ignition status to OFF. 2. Disconnect the DMTL pump electrical connector, CV011. 3. Set ignition status to ON, engine OFF. 4. Measure the voltage between:

DMTL pump connector CV011, harness side	Battery
Pin 04	Negative terminal

- **Is the voltage less than 10 volts?**

-> **Yes**

REPAIR the circuit between the DMTL pump and battery. This circuit includes harness splice FLS05 and fuse 14 of the engine junction box. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test [G556798t15](#).

G556798t15 : CHECK THE DMTL HEATER CONTROL CIRCUIT FOR SHORT CIRCUIT TO GROUND

1. Set ignition status to OFF. 2. Measure the resistance between:

DMTL pump connector CV011, harness side	Battery
Pin 02	Negative terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test [G556798t16](#).

G556798t16 : CHECK THE DMTL HEATER CONTROL CIRCUIT FOR SHORT CIRCUIT TO POWER

1. Measure the resistance between:

DMTL pump connector CV011, harness side	Battery
Pin 02	Positive terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test [G556798t17](#).

G556798t17 : CHECK THE DMTL HEATER CONTROL CIRCUIT FOR HIGH RESISTANCE

1. Disconnect the ECM electrical connector, FL072. 2. Measure the resistance between:

DMTL pump connector CV011, harness side	ECM connector FL072, harness side
Pin 02	Pin 23

- **Is the resistance greater than 5 ohms?**

-> **Yes**

REPAIR the high resistance circuit. For additional information, refer to the wiring diagrams. Clear the DTC, test the system for normal operation.

-> **No**

INSTALL a new DMTL pump. Clear the DTC, test the system for normal operation. If the DTC is repeated, refer to the new ECM installation note at the top of the DTC Index.

Removal and installation

Evaporative Emission Canister - 4.2L NA V8 - AJV8/4.2L SC V8 - AJV8 (17.15.13)

Removal



WARNING: 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.

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 rear differential.

- For additional information, refer to [Axle Assembly - 4.2L NA V8 - AJV8/4.2L SC V8 - AJV8, Vehicles Without: Differential Drain Plug \(51.25.13\)](#)

3.



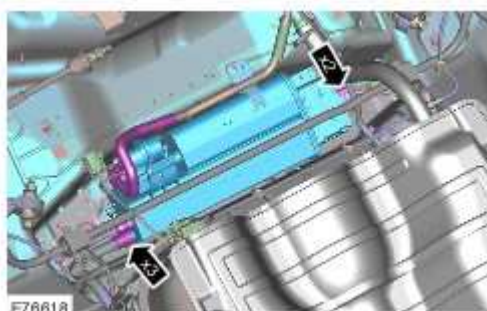
CAUTION: Always plug any open connections to prevent contamination.

NOTE:

Sub-frame shown removed for clarity.

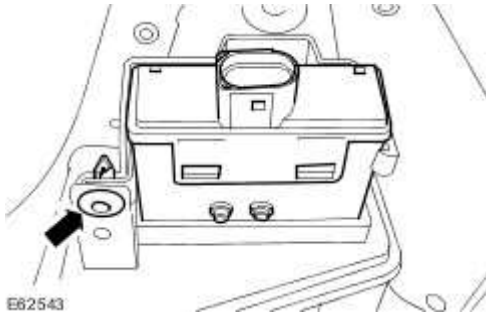
Disconnect the evaporative emissions canister.

- ▶ Disconnect the 3 lines.
- ▶ Disconnect the 2 electrical connectors.



4 . Remove the fuel pump driver module.

▶ Remove the clip.

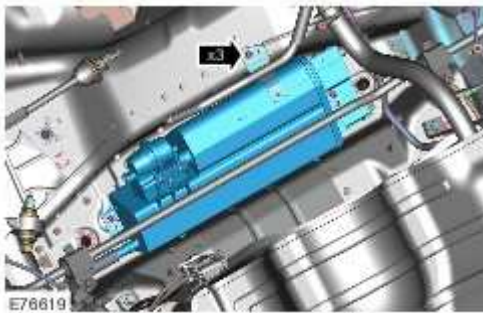


5 . **NOTE:**

Sub-frame shown removed for clarity.

Remove the evaporative emissions canister.

▶ Remove the 3 nuts.



Installation

1 . Install the evaporative emissions canister.

▶ Torque: 10 Nm (7 lb.ft)

2 . Install the fuel pump driver module.

3 . Connect the evaporative emissions canister.

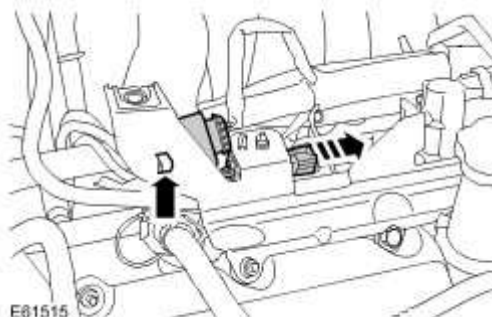
4 Install the rear differential.

- For additional information, refer to [Axle Assembly - 4.2L NA V8 - AJV8/4.2L SC V8 - AJV8, Vehicles Without: Differential Drain Plug \(51.25.13\)](#)

Evaporative Emission Canister Purge Valve - 4.2L NA V8 - AJV8 (17.15.30)

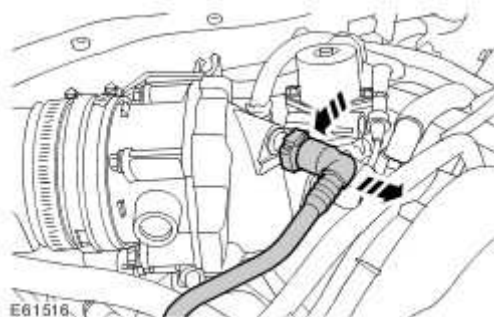
Removal

1. Disconnect the battery ground cable.
For additional information, refer to [Specifications](#)
2. Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
3. Release the 2 electrical connectors.



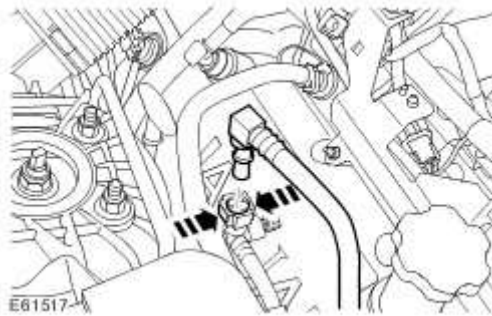
4.  **CAUTION: Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.**

Release the clip and disconnect purge outlet line at the intake elbow.



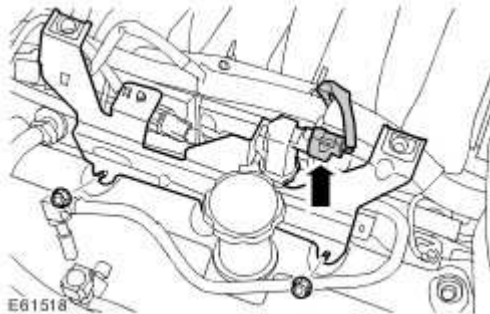
5.  **CAUTION: Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.**

Release the clip and disconnect the purge inlet line.



6 . Remove the purge valve assembly.

- ▶ Disconnect the electrical connector.
- ▶ Remove the 2 nuts.



7 . **NOTE:**

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

NOTE:

Note the fitted position.

Remove the purge valve.

- ▶ Remove the bolt.



Installation

- 1 . Install the purge valve, align the peg and tighten the bolt to 6 Nm (4 lb.ft).
- 2 . Install the purge valve.
 -  Connect the electrical connector.
 -  Tighten the nuts to 10 Nm (7 lb.ft).
- 3 . Connect the purge lines.
 -  Clean the component mating faces.
- 4 . Secure the electrical connectors.
- 5 . Install the engine cover.
 - For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 6 . Connect the battery ground cable.
 - For additional information, refer to [Specifications](#)

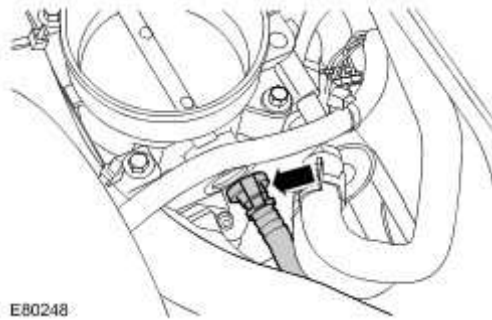
Evaporative Emission Canister Purge Valve - 4.2L SC V8 - AJV8 (17.15.30)

Removal

- 1 . Remove the intake air resonator.
For additional information, refer to [Intake Air Resonator](#)

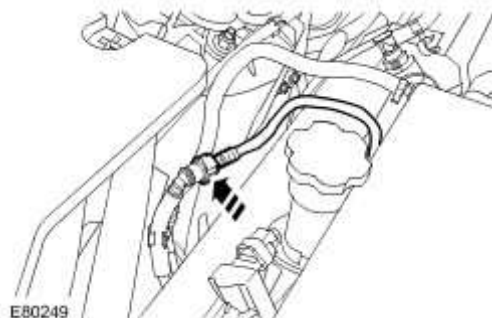
- 2  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the purge outlet line.



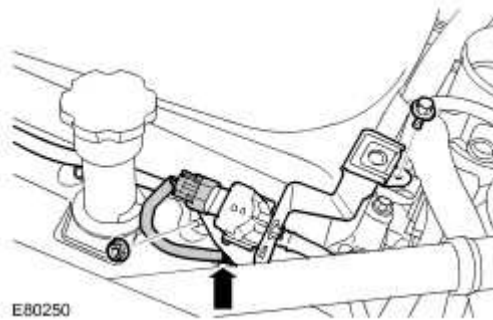
- 3  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the purge inlet line.



- 4 . Remove the purge valve assembly.
 - ▶ Disconnect the electrical connector.
 - ▶ Remove the nut.

- ▶ Remove the bolt.
- ▶ Release the wiring harness.



5 . NOTE:

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

NOTE:

Note the fitted position.

Remove the purge valve.

- ▶ Remove the bolt.



Installation

- 1 . Install the purge valve, align the peg and tighten the bolt to 6 Nm (4 lb.ft).
- 2 . Install the purge valve.
 - ▶ Attach the wiring harness.
 - ▶ Tighten the bolt to 6 Nm (4 lb.ft).
 - ▶ Tighten the nut to 6 Nm (4 lb.ft).
 - ▶ Connect the electrical connector.

3 . Connect the purge lines.



Clean the component mating faces.

4 . Install the intake air resonator.

For additional information, refer to [Intake Air Resonator](#)

303-14A : Electronic Engine Controls – 4.2L SC V8 – AJV8

Specifications

Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Camshaft position sensor - bolt	7	5	62
Catalyst monitor sensor	45	33	-
Crankshaft position sensor - screw	7	5	62
Engine control module	10	7	88
Fuel rail pressure sensor	5	4	44
Fuel temperature sensor	7	5	62
Heated oxygen sensor	45	33	-
Knock sensor - nut	20	15	-
Knock sensor - stud	10	7	88
Oil pressure sensor	15	11	-
Oil temperature sensor	15	11	-
Variable camshaft timing, oil control solenoid - bolt	10	7	88

Powertrain Control Module (PCM) Long Drive Cycle Self-Test



WARNING: Where possible, all road tests should be on well surfaced and dry roads. Always comply with speed limits and local traffic regulations.

NOTE:

This procedure is an overcheck only. If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

NOTE:

The vehicle must exceed 50mph (80 km/h) during the road test.

1. Connect the diagnostic equipment to the vehicle.
2. Follow on screen prompts and check for engine management fault codes.
3. Clear the fault codes following the on screen procedure.
4. Disconnect the diagnostic equipment from the vehicle.

5. **NOTE:**

Make sure cruise control is not engaged.

Carry out a road test and perform the following operations.

- Accelerate to 55 mph (88 km/h) in 5th gear and cruise for 2 minutes with the engine speed at or above 1800rpm.
- Lift off the throttle and allow the vehicle to decelerate until the engine speed is less than 1000 rpm.
- Stop the vehicle.
- Release brake, allow the vehicle to move with no throttle for 1 minute.
- Road test is now complete.

6. Connect the diagnostic equipment to the vehicle.

7. **NOTE:**

If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

Follow on screen prompts and check for engine management fault codes.

8. Disconnect the diagnostic equipment from the vehicle.

Powertrain Control Module (PCM) Short Drive Cycle Self-Test

NOTE:

This procedure is an overcheck only. If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

1. Connect the diagnostic equipment to the vehicle.
2. Follow on screen prompts and check for engine management fault codes.
3. Clear the fault codes following the on screen procedure.
4. Start the engine.
 - Allow the engine to idle for 30 seconds.
 - Raise the engine speed to 1500 rpm and hold for 3 minutes until a temperature of 70°C (158 °F) is achieved.
 - Allow the engine to idle for 30 seconds.
 - Switch off the engine.
5. **NOTE:**

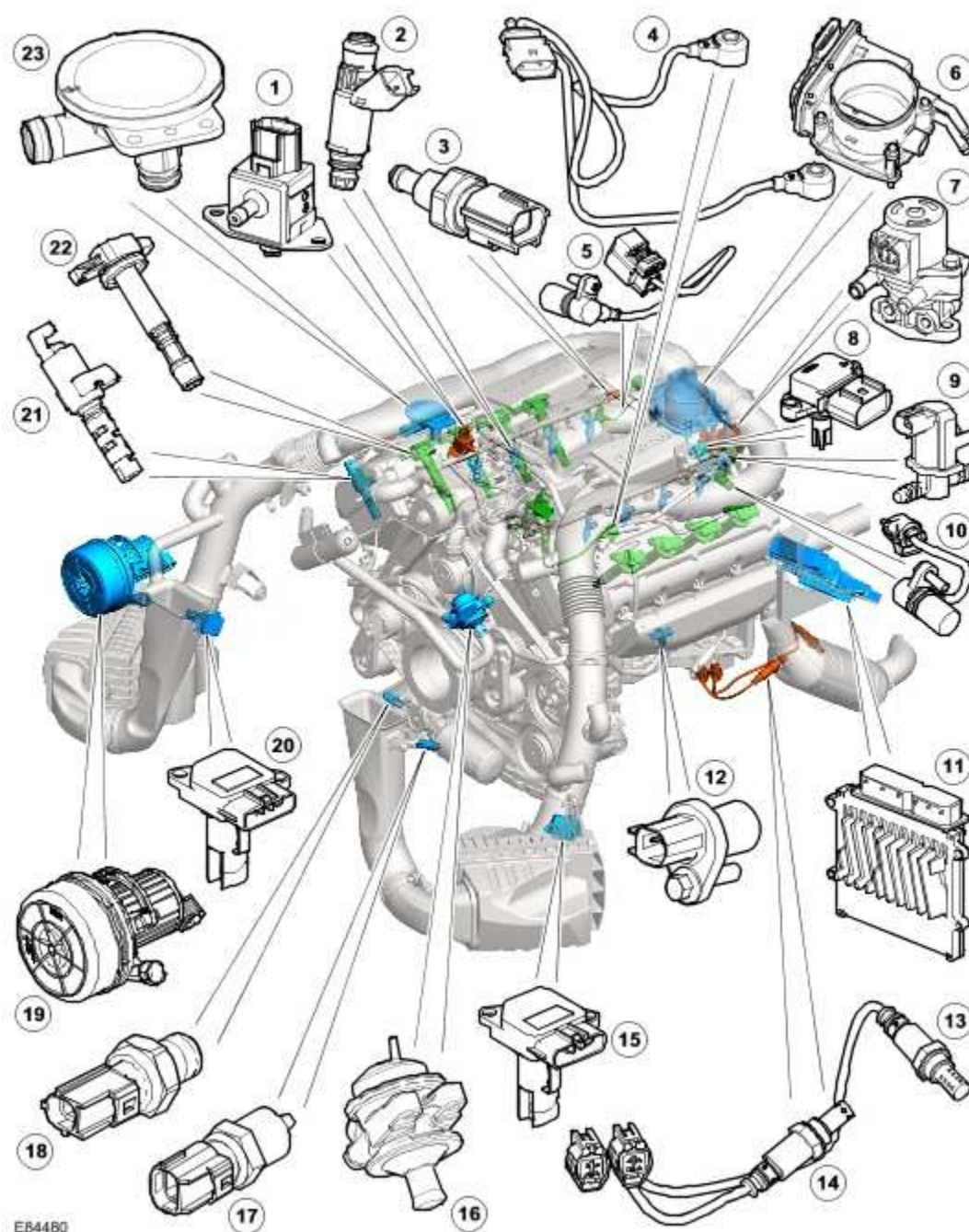
If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

Follow on screen prompts and check for engine management fault codes.

6. Disconnect the diagnostic equipment from the vehicle.

Electronic Engine Controls

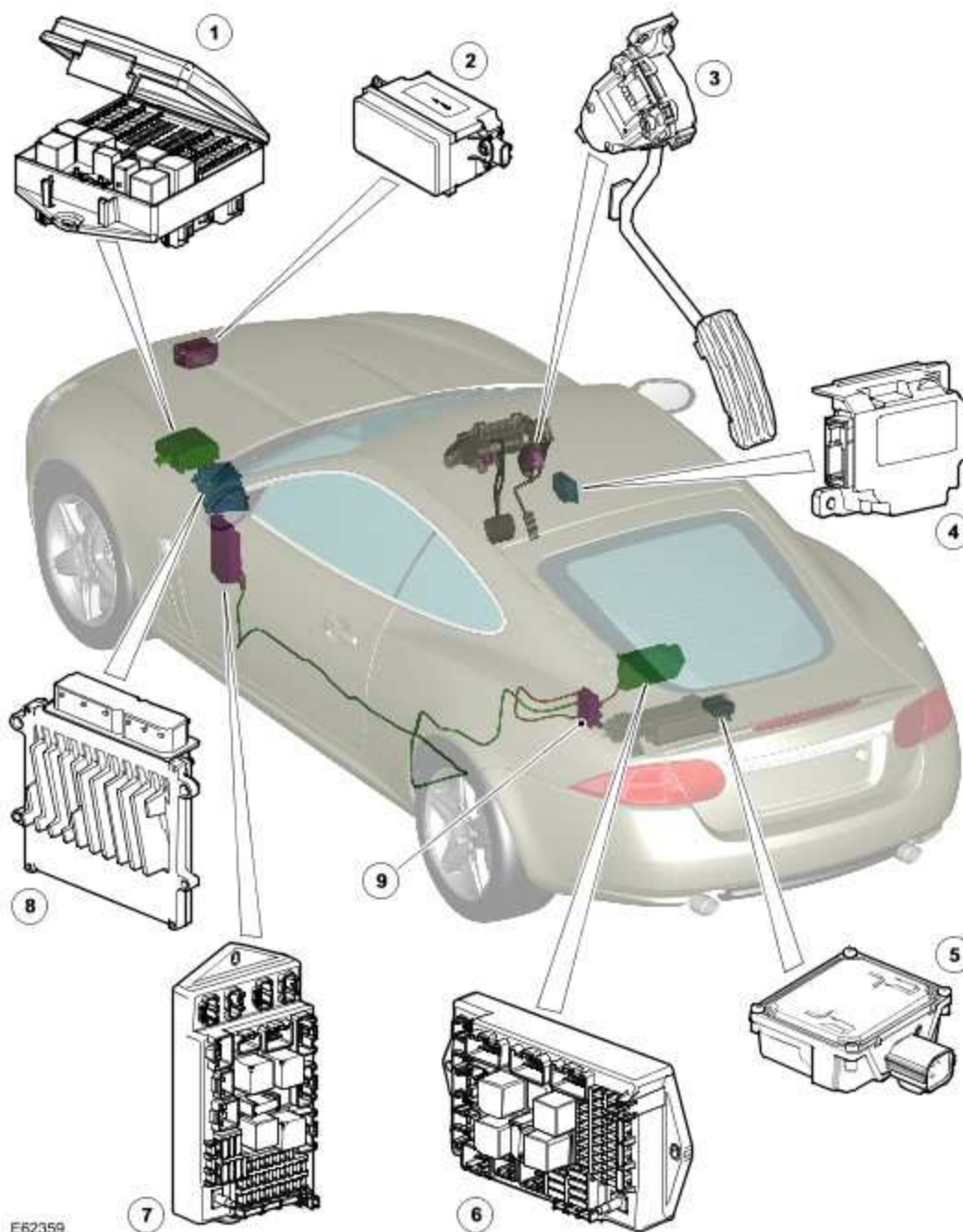
COMPONENT LOCATION SHEET 1 of 2



Item	Part Number	Description
1		Fuel rail pressure sensor

2		Injector
3		Fuel rail temperature sensor
4		Knock sensor
5		Camshaft Position (CMP) sensor
6		Electric throttle
7		Exhaust Gas Recirculation (EGR) valve
8		Manifold Absolute Pressure sensor
9		Purge valve
10		Camshaft Position (CMP) sensor
11		Engine Control Module (ECM)
12		Crankshaft Position (CKP) sensor
13		Downstream Heated Oxygen Sensor (HO2S)
14		Upstream Heated Oxygen Sensor (HO2S)
15		Mass Air Flow(MAF)/Intake Air Temperature (IAT) sensor
16		Secondary air injection valve
17		Oil temperature sensor
18		Oil pressure sensor
19		Secondary air injection pump
20		Mass Air Flow(MAF)/Intake Air Temperature (IAT) sensor
21		Variable valve timing solenoid
22		Ignition coil
23		Positive Crankcase Ventilation (PCV) valve

COMPONENT LOCATION SHEET 2 of 2



E62359

Item	Part Number	Description
1		Power distribution box
2		Adaptive speed control sensor (where fitted)
3		Accelerator Pedal Position (APP) sensor
4		Adaptive speed control module (where fitted)
5		Fuel Pump Driver Module (FPDM)
6		Auxiliary junction box
7		Central Junction Box (CJB)
8		Engine Control Module (ECM)

OVERVIEW

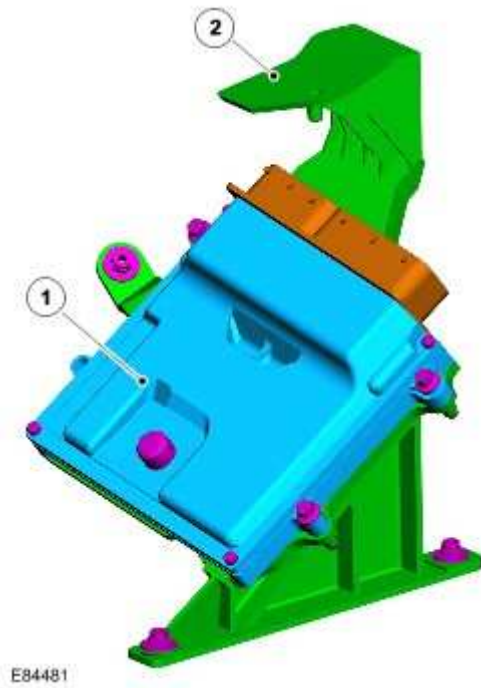
The V8 supercharged engine is controlled by an ECM. The Engine Management System (EMS) controls the following:

- Engine fueling
- Ignition timing
- Closed loop fueling
- Knock control
- Idle speed control
- Emission control
- On Board Diagnostic (OBD)
- Interface with the immobilization system
- Speed 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 eight 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 control modules. The EMS uses various sensors to determine the torque required from the engine. The EMS also interfaces with other vehicle electronic control modules's, via the CAN bus, to obtain additional information (e.g. road speed from the ABS control module). 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.).

ENGINE CONTROL MODULE (ECM)



Item	Part Number	Description
1		ECM
2		Mounting bracket

The ECM and bracket assembly are attached to the vehicle on the left hand side in the secondary bulkhead area using 3 m6 nuts, 2 off onto the longitudinal and 1 off to the wheel arch apron panel.

System ECM has the following inputs:

- RCM
- Park/neutral switch
- Ignition coil feedback x8
- Fuel rail temperature
- Fuel rail pressure
- Supercharger inlet pressure
- Mass air flow
- Engine speed
- Camshaft position x2
- Driver demand
- Brake pedal position switch
- Speed control switches
- Generator load
- Oxygen sensors pre catalyst x2
- Oxygen sensors post catalyst x2
- Throttle position
- Cooling fan speed
- Ignition switch position
- Knock sensors x2

- Manifold Absolute pressure (MAP)
- Intercooler temperature
- Coolant temperature
- Engine oil temperature

The ECM outputs to the following:

- Electric throttle Actuator
- Brake vacuum pump relay
- Ignition coils (x8)
- Oxygen sensor heaters (4)
- Fuel injectors (8)
- Purge Valve
- Engine Cooling Fan
- Fuel pump relay
- Starter Relay
- EMS Main Relay
- Electric Fan Control
- Generator Control
- Fuel tank leakage monitoring (NAS Only)
- Fuel Pump Driver Module (FPDM)

CRANKSHAFT POSITION SENSOR (CKP)



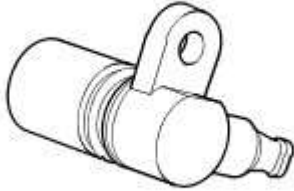
The crankshaft position sensor is mounted at the rear underside of the engine near the transmission bell housing. Connection between the sensor and the harness is via a link harness and a two-way connector. Both wires go directly to the ECM. The sensor produces the signal which enables the ECM to determine 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 degrees advance in timing will occur, as the electronics within the ECM uses the falling edge of the signal waveform as its reference / timing point for each tooth.

The reluctor is pressed into the flywheel and has a "tooth" pattern based on 36 teeth at 10° intervals and approximately 5° wide: one of the teeth is removed to provide a hardware reference mark which is 30 degrees BTDC No.1 cylinder. Because of the crankshaft sensor's orientation, the target wheel uses windows stamped into the face, rather than actual teeth.

The sensor operates by generating an output voltage caused by the change in magnetic field that occurs as the windows pass in front of the sensor. The output voltage varies with the speed of the windows passing the sensor, the higher the engine speed, the higher the output

voltage. Note that the output is also dependent on the air gap between the sensor and the teeth (the larger the gap, the weaker the signal, the lower the output voltage). The ECM transmits the engine speed to other vehicle control modules on CAN.

CAMSHAFT POSITION SENSOR (CMP)



E46332

Two sensors are located at the rear of the engine, in the cylinder head (one per bank), above the rear cylinders. The sensors are Variable Reluctor Sensor (VRS) type, producing four pulses for every two engine crankshaft revolutions. The sensing element is positioned between 0 and 2mm from the side of the cam gear wheel.

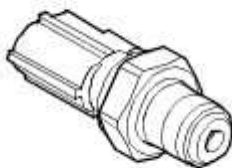
The camshaft timing wheel is a sintered component which has four teeth on it to enable the EMS to detect cylinder identification. The signal is used for:

- Cylinder recognition
- Enabling sequential fuel injection
- Knock control
- Cylinder identification for diagnostic purposes.

Failure symptoms include:

- Ignition timing reverting to the base mapping, with no cylinder correction.
- Active knock control is disabled, along with its diagnostic (Safe ignition map - loss of performance).
- Quick cam/crank synchronisation on start disabled.

ENGINE OIL TEMPERATURE SENSOR

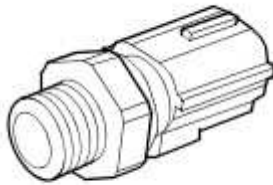


E46333

Oil temperature is monitored through a temperature sensor mounted in the oil system. This

component is a NTC. The sensor is mounted next to the oil pressure sensor at the front of the engine and locates into the oil filter bracket.

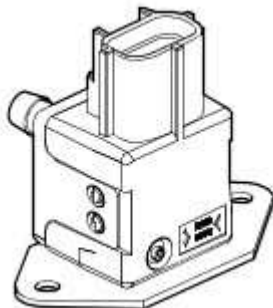
FUEL RAIL TEMPERATURE SENSOR



E47606

The fuel rail temperature sensor measures the temperature of the fuel in the fuel rail. This input is then used to deliver the correct quantity of fuel to the engine. The sensors operating range is -40 Degrees Celsius to 150 Degrees Celsius. The fuel rail temperature sensor is fitted on the rear of the right hand bank fuel rail.

FUEL RAIL PRESSURE SENSOR

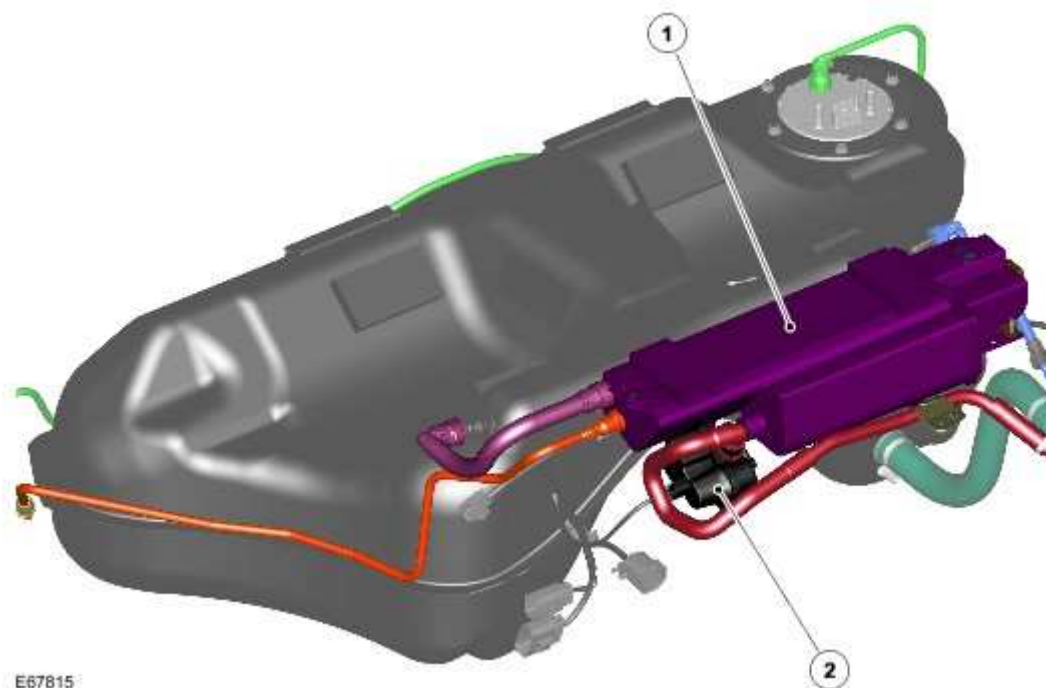


E58945

The fuel rail pressure sensor is located on top of the fuel rail adjacent to the fuel inlet. The fuel rail pressure sensor measures the pressure of the fuel in the fuel rail. This input is then used by the fuel pump control module to control the amount of fuel delivered to the fuel rail.

FUEL TANK LEAKAGE MONITORING - NAS ONLY

**Charcoal Canister with fuel tank leakage monitoring
Pump (NAS only)**

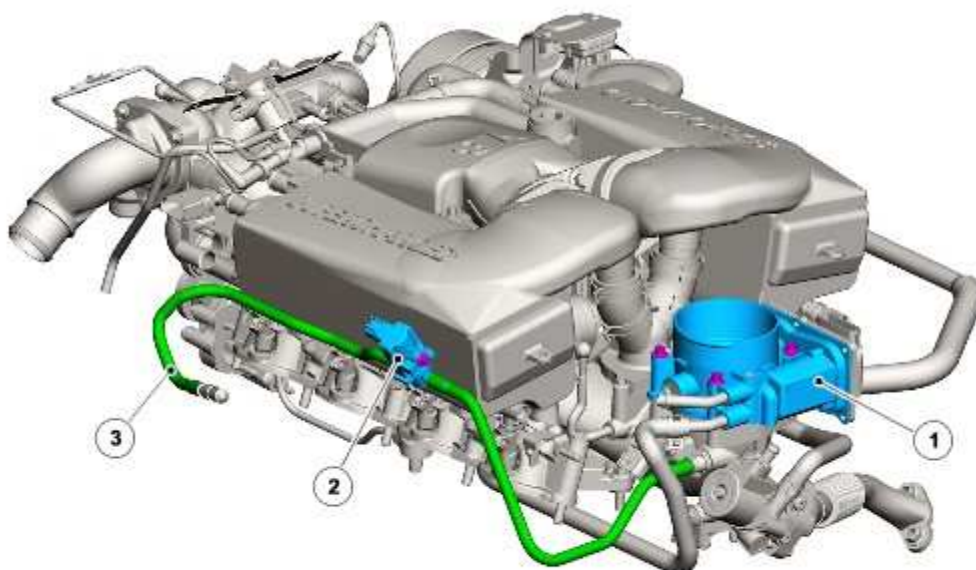


Item	Part Number	Description
1		Charcoal cannister
2		Fuel tank leakage monitoring pump

The fuel tank leakage monitoring system periodically checks the evaporative system and the fuel tank for leaks when the ignition is switched off. The fuel tank leakage monitoring pump is connected to the atmospheric vent of the charcoal cannister and incorporates a PTC heating element a normally open valve and a reference orifice. The fuel tank leakage monitoring 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. To check the fuel tank and EVAP system for leaks the ECM operates the fuel tank leakage monitoring pump and monitors the current draw. This is compared to a referenced figure established from the current draw when air is pumped through the reference orifice. For additional information, refer to [Evaporative Emissions - Vehicles With: Supercharger](#) (303-13 Evaporative Emissions)

PURGE VALVE

Purge Valve and Hoses location

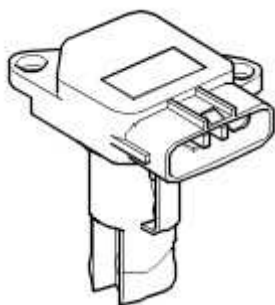


E84409

Item	Part Number	Description
1		Purge hose
2		Purge valve
3		Electric throttle

The purge valve is located on the LH side of the engine on a bracket which is attached to the cylinder head. The purge valve is a solenoid operated valve which is closed when de-energized. The purge valve is controlled by a 10Hz PWM signal from the ECM. When the engine operating conditions are correct, the ECM opens the purge valve which causes fuel vapor and fresh air to be drawn through the charcoal cannister. The fresh air is drawn through the charcoal cannister via the fuel tank leakage monitoring pump fresh air vent. For additional information, refer to [Evaporative Emissions - Vehicles With: Supercharger](#) (303-13 Evaporative Emissions)

MASS AIR FLOW/INLET AIR TEMPERATURE SENSOR (MAF/IAT)



E47308

Two MAF/IAT sensors are located in the clean air duct immediately after the air cleaner box.

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 “hot film” element. The ECM then uses this signal from the MAF to calculate the air mass flowing 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.

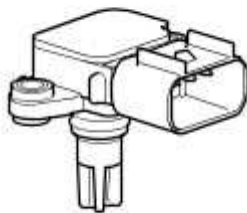
The following symptoms may be observed if the sensor fails:

- During driving the engine RPM might dip, before recovering.
- Difficulty in starting or start - stall.
- Poor throttle response / engine performance.
- Lambda control and idle speed control halted.
- Emissions incorrect.
- AFM signal offset

The sensor is integrated into the MAF 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 sensor changes as the sensor resistance changes, thus relating the air temperature to the voltage measured by the ECM.

The ECM stores a 25 Degrees Celsius default value for air temperature in the event of a sensor failure.

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP)- SUPERCHARGER INLET PRESSURE



E47588

The MAP sensor is located in the LH side of the throttle elbow.

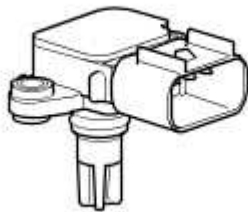
The MAP sensor provides a voltage proportional to the absolute pressure in the supercharger intake. This signal allows the load on the engine to be calculated and used within the internal calculations of the MAP. The sensor is located below the electric throttle on the induction

elbow.

The output signal from the MAP sensor, together with the CKP and IAT sensors, is used by the ECM to calculate the amount of air induced into the cylinders. This enables the ECM to determine ignition timing and fuel injection duration values.

If the MAP signal is missing, the ECM will substitute a default manifold pressure reading based on crankshaft speed and throttle angle. The engine will continue to run with reduced drivability and increased emissions, although this may not be immediately apparent to the driver. The ECM will store fault codes which can be retrieved using Land Rover recommended diagnostic tool.

MANIFOLD ABSOLUTE PRESSURE AND TEMPERATURE SENSOR (MAPT)

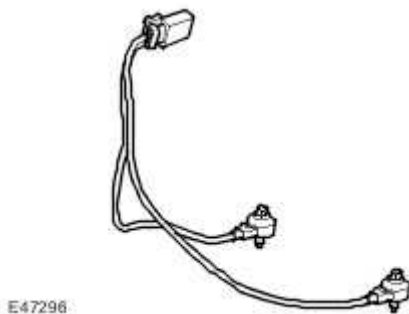


The MAPT is located to the front of the RH engine bank intercooler and is secured with a single bolt. The sensor measures the pressure and temperature of the inducted air prior to it entering the cylinders.

The sensor fits and seals using a radial 'O' ring seal directly to the inlet manifold.

The MAPT signal is used to retard the ignition timing relative to boost pressure. The intercooler temperature is used for air charge density calculations and for intercooler diagnostic purposes.

KNOCK SENSORS



The V8 EMS has two knock sensors located in the V of the engine, one per cylinder bank. The sensors are connected to the ECM via a twisted pair.

The knock sensors produce a voltage signal in proportion to the amount of mechanical vibration generated at each ignition point. Each sensor monitors the related cylinder bank.

The knock sensors incorporate a piezo-ceramic crystal. This crystal produces a voltage whenever an outside force tries to deflect it, (i.e. exerts a mechanical load on it). When the engine is running, the compression waves in the material of the cylinder block, caused by the combustion of the fuel/air mixture within the cylinders, deflect the crystal and produce an output voltage signal. The signals are supplied to the ECM, which compares them with 'mapped' signals stored in memory. From this, the ECM can determine when detonation occurs on individual cylinders. When detonation is detected, the ECM retards the ignition timing on that cylinder for a number of engine cycles, then gradually returns it to the original setting.

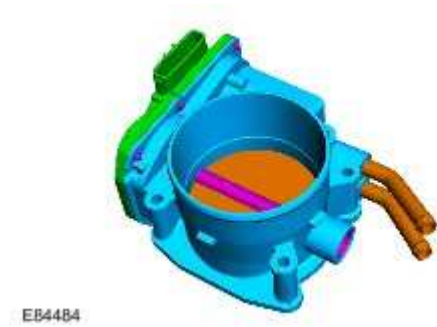
Care must be taken at all times to avoid damaging the knock sensors, but particularly during removal and fitting procedures. The recommendations regarding torque and surface preparation must be adhered to. The torque applied to the sensor and the quality of the surface preparation both have an influence over the transfer of mechanical noise from the cylinder block to the crystal.

The ECM uses the signals supplied by the knock sensors, in conjunction with the signal it receives from the camshaft sensor, to determine the optimum ignition point for each cylinder. The ignition point is set according to preprogrammed ignition maps stored within the ECM. The ECM is programmed to use ignition maps for 98 RON premium specification fuel. It will also function on 91 RON regular specification fuel and learn new adaptations. If the only fuel available is of poor quality, or the customer switches to a lower grade of fuel after using a high grade for a period of time, the engine may suffer slight pre-ignition for a short period. This amount of pre-ignition will not damage the engine. This situation will be evident while the ECM learns and then modifies its internal mapping to compensate for the variation in fuel quality. This feature is called adaption. The ECM has the capability of adapting its fuel and ignition control outputs in response to several sensor inputs.

The ECM will cancel closed loop control of the ignition system if the signal received from either knock sensor becomes implausible. In these circumstances the ECM will default to a safe ignition map. This measure ensures the engine will not become damaged if low quality fuel is used. The MIL will not illuminate, although the driver may notice that the engine 'pinks' in some driving conditions and displays a drop in performance and smoothness.

When a knock sensor fault is stored, the ECM will also store details of the engine speed, engine load and the coolant temperature.

ELECTRONIC THROTTLE



The V8 EMS incorporates an electric throttle control system. The electronic throttle body is located on the air intake manifold in the engine compartment. The system comprises three main components:

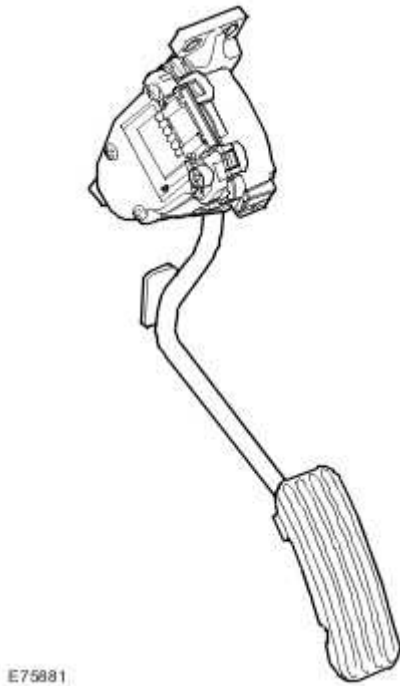
- Electronic throttle control valve
- APP
- ECM

When the accelerator pedal is depressed the APP sensor provides a change in the monitored signals. The ECM compares this against an electronic “map” and moves the electronic throttle valve via a PWM control signal which is in proportion to the EAPP angle signal. The system is required to:

- Regulate the calculated intake air load based on the accelerator pedal sensor input signals and programmed mapping.
- Monitor the drivers input request for cruise control operation.
- Automatically position the electronic throttle for accurate cruise control.
- Perform all dynamic stability control throttle control interventions.
- Monitor and carry out maximum engine and road speed cut out.
- Provide differing responses for differing Terrain response modes.

A software strategy within the ECM enables the throttle position to be calibrated each ignition cycle. When the ignition is turned ON, the ECM performs a self test and calibration routine on the electronic throttle by closing the throttle full, then opening again. This tests the default position springs.

Accelerator Pedal Position Sensor (APP)



The APP sensors are located on the accelerator pedal assembly.

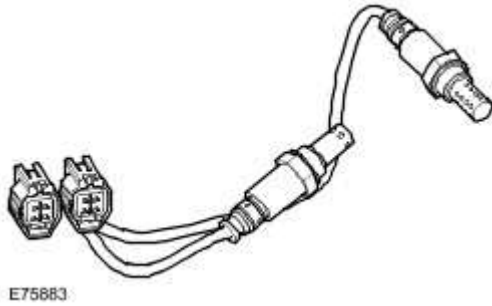
The APP sensors are used to determine the driver's request for vehicle speed, acceleration and deceleration. This value is used by the ECM and the throttle is opened to the correct angle by an electric motor integrated into the throttle body.

The APP sensor signals are checked for range and plausibility. Two separate reference voltages are supplied to the pedal. Should one sensor fail, the other is used as a 'limp – home' input. In limp home mode due to an APP signal failure the ECM will limit the maximum engine speed to 2000 rpm.

OXYGEN SENSORS

There are four oxygen sensors located in the exhaust system. Two upstream before the catalytic converter and two down stream after the catalytic converter. The sensor monitors 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.

Oxygen Sensors



The oxygen sensors need 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 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.

Heated 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 heated oxygen 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 $\lambda = 1$ is 300 to 500m volts. As the fuel mixture becomes richer ($\lambda < 1$) the voltage tends towards 900m volts and as it becomes leaner ($\lambda > 1$) 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 with a calibrated torque wrench For additional information, refer to [Specifications](#) (303-14)

. Care should be taken not to contaminate the sensor tip when anti-seize compound is used on the thread. Heated sensor signal pins are tinned and universal are gold plated. Mixing up sensors could contaminate the connectors and affect system performance.

Failure Modes

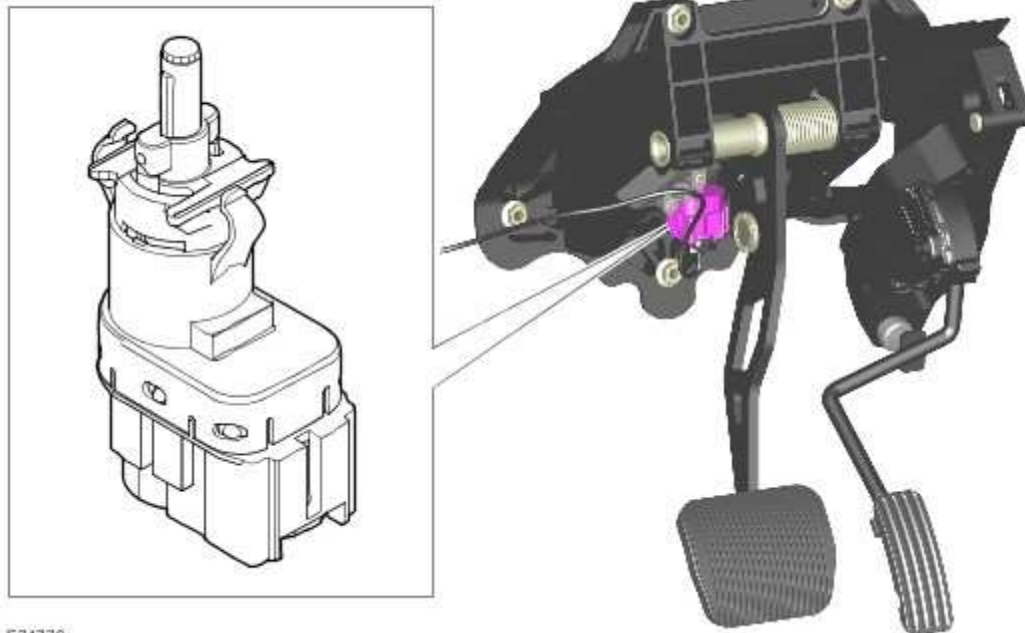
- Mechanical fitting & integrity of the sensor.
- Sensor open circuit / disconnected.
- Short circuit to vehicle supply or ground.
- Lambda ratio outside operating band.
- Crossed sensors bank A & B.
- Contamination from leaded fuel or other sources.
- Change in sensor characteristic.
- Harness damage.
- 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 fewer holes in the protection tube than the down stream sensors.

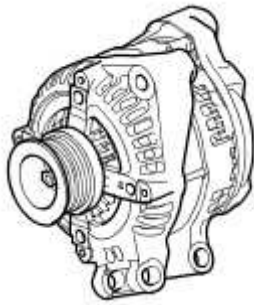
STOPLAMP SWITCH



The stoplamp switch is mounted on the brake pedal bracket and is connected to the vehicle harness via a 4 pin multiplug.

When the brake pedal is pressed, the switch contacts close allowing a hard wired signal feed to be sent to the ECM. A stoplamp switch status message is then sent from the ECM to the ABS module on the high speed CAN bus.

GENERATOR



The Generator has a multifunction 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 rechargeability, but at high temperatures the charge voltage must be restricted to prevent excessive gassing of the battery with consequent water loss.

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 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 cluster on the CAN bus to illuminate the charge warning lamp.

FUEL INJECTORS



The engine has 8 fuel injectors (one per cylinder), each injector is directly driven by the ECM. The injectors are fed by a common fuel rail as part of a 'return less' fuel system. The fuel rail pressure is regulated to 4.5 bar by a fuel pressure regulator which is integral to the fuel pump module, within the fuel tank. The injectors can be checked by resistance checks. There is a

fuel pressure test Schrader valve attached to the fuel rail on the front LH. The ECM monitors the output power stages of the injector drivers for electrical faults.

The injectors have a resistance of $13.8 \text{ Ohms} \pm 0.7 \text{ Ohms}$ @ 20 Degrees Celsius

IGNITION COILS



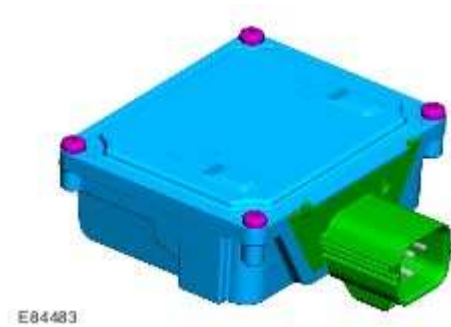
The engine is fitted with eight plug-top coils that are driven directly by the ECM. This means that the ECM, at the point where sufficient charge has built up, switches the primary circuit of each coil and a spark is produced in the spark plug. The positive supply to the coil is fed from a common fuse. 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 has a failure the feedback signal is not sent, causing the ECM to store a fault code appropriate to the failure.

The ECM calculates the dwell time depending on battery voltage and engine speed to ensure constant secondary energy. This ensures sufficient secondary (spark) energy is always available, without excessive primary current flow thus avoiding overheating or damage to the coils.

The individual cylinder spark timing is calculated from a variety of inputs:

- Engine speed and load.
- Engine temperature.
- Knock control.
- Auto gearbox shift control.
- Idle speed control.

FUEL PUMP CONTROL MODULE



The fuel pump control module is located in the rear LH quarter adjacent to the parking aid control module.

The fuel pump is control by the ECM. The ECM sends a PWM signal to the fuel pump control module from pin B20 of the ECM, the frequency of the signal determines the duty cycle of the pump. the PWM signal to the pump represents half the ON time of the pump. If the ECM transmits a 50% on time the fuel pump control module drives the pump at 100%. If the ECM transmits a 5% ON time the fuel pump control module drives the pump at 10%. The fuel pump control module will only turn the fuel pump ON if it receives a valid signal between 4% and 50%. When The ECM requires the fuel pump to be turned OFF the ECM transmits a duty cycle signal of 75%.

The status of the fuel pump control module is monitored by the ECM. Any errors can be retrieved from the ECM by the Jaguar recommended diagnostic tool. The fuel pump control module cannot be interrogated for diagnostic purposes.

The MAP controls the fuel pump control module in response to inputs from the fuel rail pressure sensor, MAP and the MAF/IAT sensor.

FUEL PUMP RELAY

The ECM controls the fuel pump relay which in turn controls the power supply to the fuel pump control module. The ECM energizes the relay ON with ignition ON.

COOLING FAN CONTROL

The ECM controls an electric cooling fan via a control module to provide engine cooling. The ECM supplies the fan with a PWM signal that controls the duty cycle of the fan, providing the correct amount of cooling fan speed and airflow.

VARIABLE VALVE TIMING (VVT)

Variable valve timing is used on the V8 engine to enhance low and high speed engine performance and idle speed quality.

For each inlet camshaft the VVT system comprises:

- VVT unit
- Valve timing solenoid

The VVT system alters the phase of the intake valves relative to the fixed timing of the exhaust valves, to alter:

- The mass of air flow to the cylinders.
- The engine torque response.
- Emissions.

The VVT unit uses a vane type device to control the camshaft angle. The system operates over a range of 48 degrees and is advanced or retarded to its optimum position within this range.

The VVT system is controlled by the ECM based on engine load and speed along with engine oil temperature to calculate the appropriate camshaft position.

The VVT system provides the following advantages:

- Reduced engine emissions and improved fuel consumption which in turn improves the engines internal EGR effect over a wider operating range.
- Enhanced full load torque characteristics.
- Improved fuel economy through optimized torque over the engine speed range.

Variable Valve Timing Unit



E47303

The VVT unit is a hydraulic actuator mounted on the end of the inlet camshaft. The unit advances or retards the camshaft timing to alter the camshaft to crankshaft phase. The ECM controls the VVT timing unit via a oil control solenoid. The oil control solenoid routes oil pressure to the advance or retard chambers either side of the vanes within the VVT unit.

The VVT unit is driven by the primary drive chain and rotates relative to the exhaust camshaft. When the ECM requests a retard in camshaft timing the oil control solenoid is energized which moves the shuttle valve in the solenoid to the relevant position allowing oil pressure to flow out of the advance chambers in the VVT unit whilst simultaneously allowing oil pressure into the retard chambers.

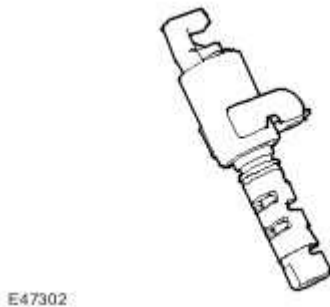
The ECM controls the advancing and retarding of the VVT unit based on engine load and speed. The ECM sends an energize signal to the oil control solenoid until the desired VVT position is achieved. When the desired VVT position is reached, the energizing signal is reduced to hold the oil control solenoid position and consequently desired VVT position. This function is under closed loop control and the ECM can sense any variance in shuttle valve oil pressure via the camshaft position sensor and can adjust the energizing signal to maintain the

shuttle valve hold position.

VVT operation can be affected by engine oil temperature and properties. At very low oil temperatures the movement of the VVT mechanism will be slow due to the high viscosity of the oil. While at high oil temperatures the low oil viscosity may impair the VVT operation at low oil pressures. The oil pump has the capacity to cope with these variations in oil pressure while an oil temperature sensor is monitored by the ECM to provide oil temperature feedback. At extremely high oil temperatures the ECM may limit the amount of VVT advance in order to prevent the engine from stalling when returning to idle speed.

VVT does not operate when engine oil pressure is below 1.25 bar. This is because there is insufficient pressure to release the VVT units internal stopper pin. This occurs when the engine is shut down and the VVT unit has returned to the retarded position. The stopper pin locks the VVT unit to the camshaft to ensure camshaft stability during the next start up.

Valve Timing Solenoid



Valve Timing Solenoid

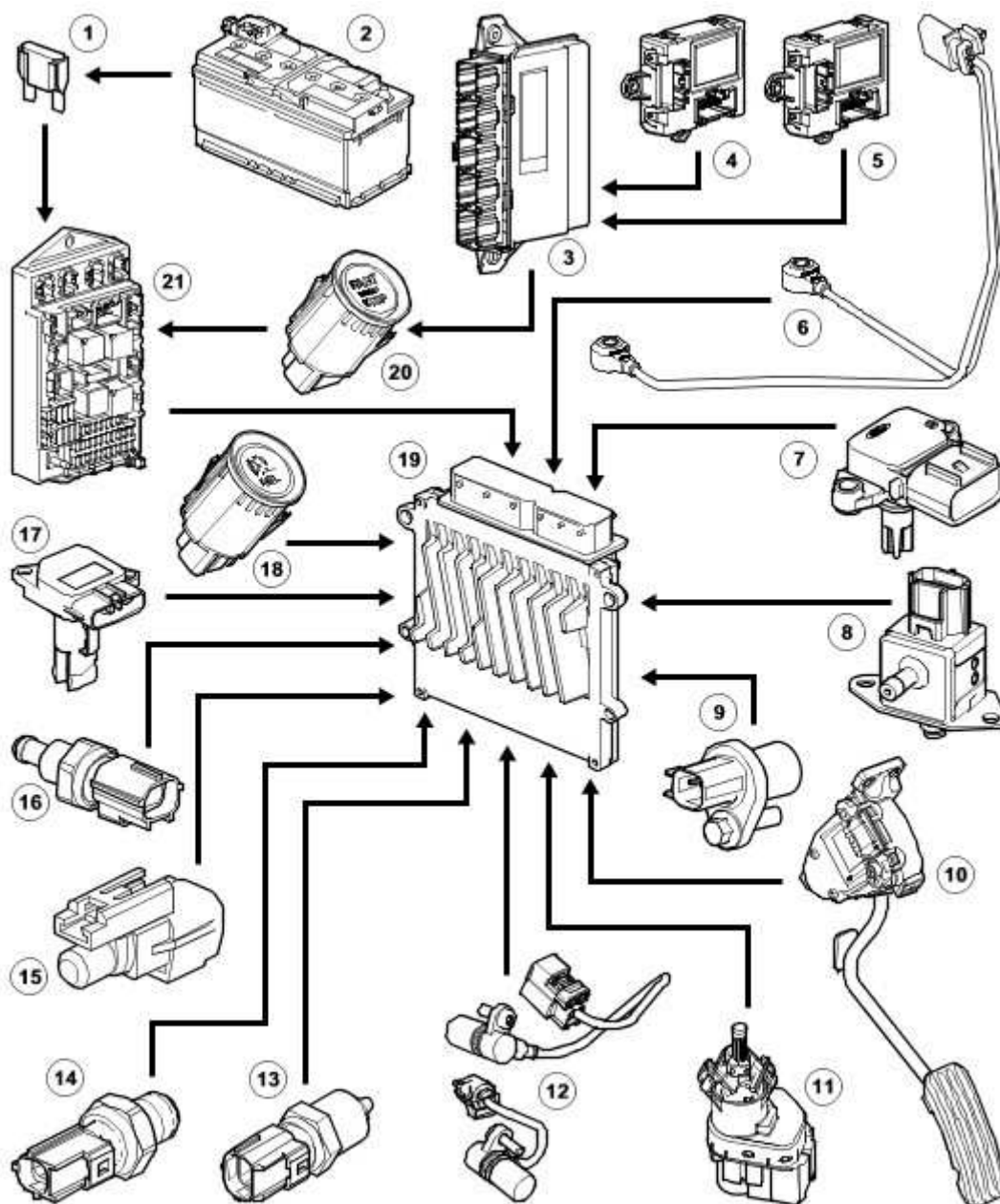
The valve timing solenoid controls the position of the shuttle valve in the bush carrier. A plunger on the solenoid extends when the solenoid is energized and retracts when the solenoid is de-energized.

When the valve timing solenoids are de-energized, the coil springs in the bush carriers position the shuttle valves to connect the valve timing units to drain. In the valve timing units, the return springs hold the ring pistons and gears in the retarded position. When the valve timing solenoids are energized by the ECM, the solenoid plungers position the shuttle valves to direct engine oil to the valve timing units. In the valve timing units, the oil pressure overcomes the force of the return springs and moves the gears and ring pistons to the advanced position. System response times are 1.0 second maximum for advancing and 0.7 second maximum for retarding. While the valve timing is in the retarded mode, the ECM produces a periodic lubrication pulse. This momentarily energizes the valve timing solenoids to allow a spurt of oil into the valve timing units. The lubrication pulse occurs once every 5 minutes.

CONTROL DIAGRAM SHEET 1 of 3

NOTE:

A = Hardwired connection



E62360

A →

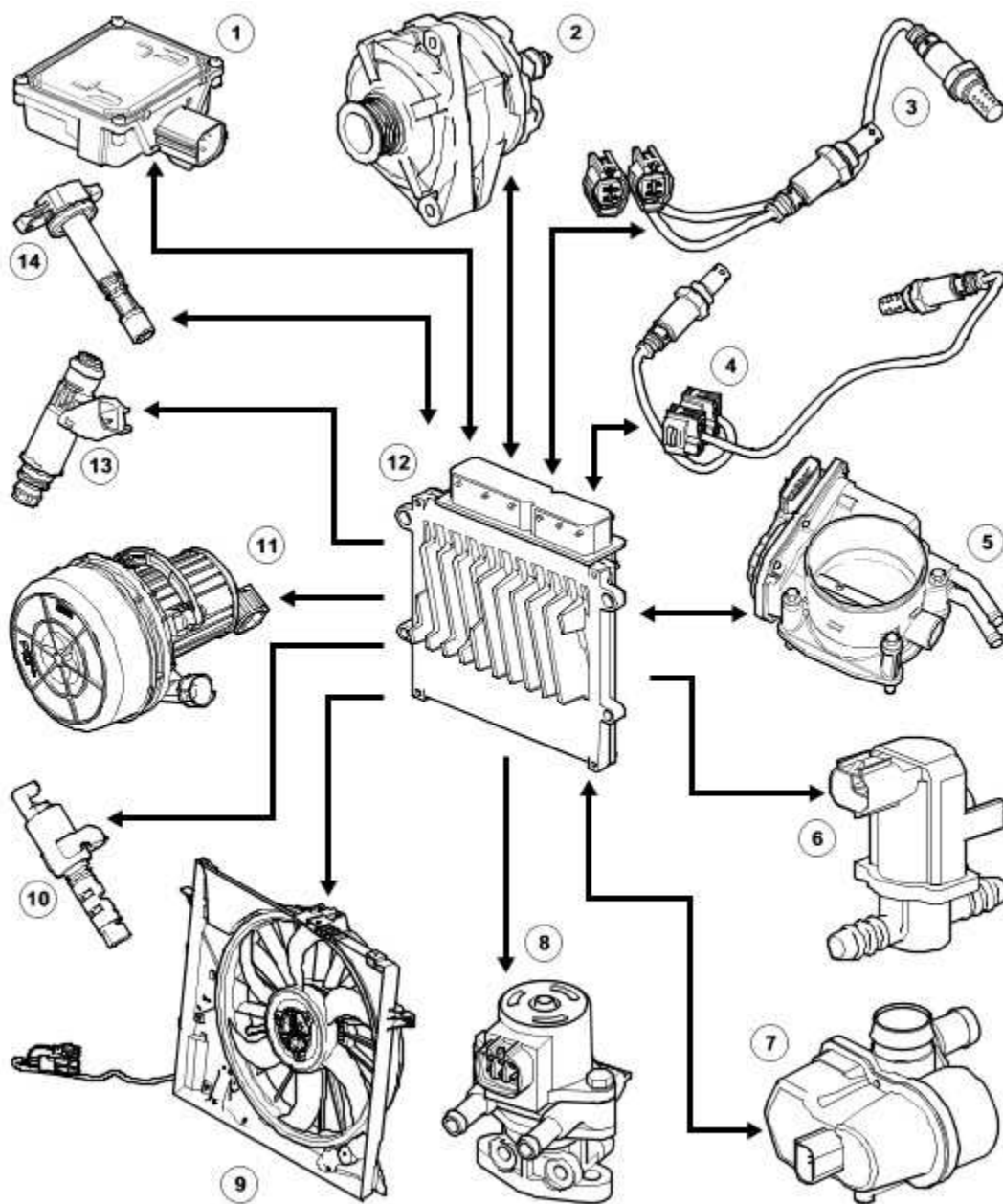
Item	Part Number	Description
1		Fuse
2		Battery
3		Keyless vehicle module
4		Door module
5		Door module
6		knock sensors
7		MAP sensor
8		Fuel rail pressure sensor

9		CKP sensor
10		APP
11		Stop lamp switch
12		CMP sensor
13		Engine coolant temperature sensor
14		Oil pressure sensor
15		Air temperature sensor
16		Fuel rail temperature sensor
17		MAF/IAT sensor
18		Automatic Speed Limiter switch
19		ECM
20		Start/Stop switch
21		Central Junction Box (CJB)

CONTROL DIAGRAM SHEET 2 of 3

NOTE:

A = Hardwired connection



EB4482

A →

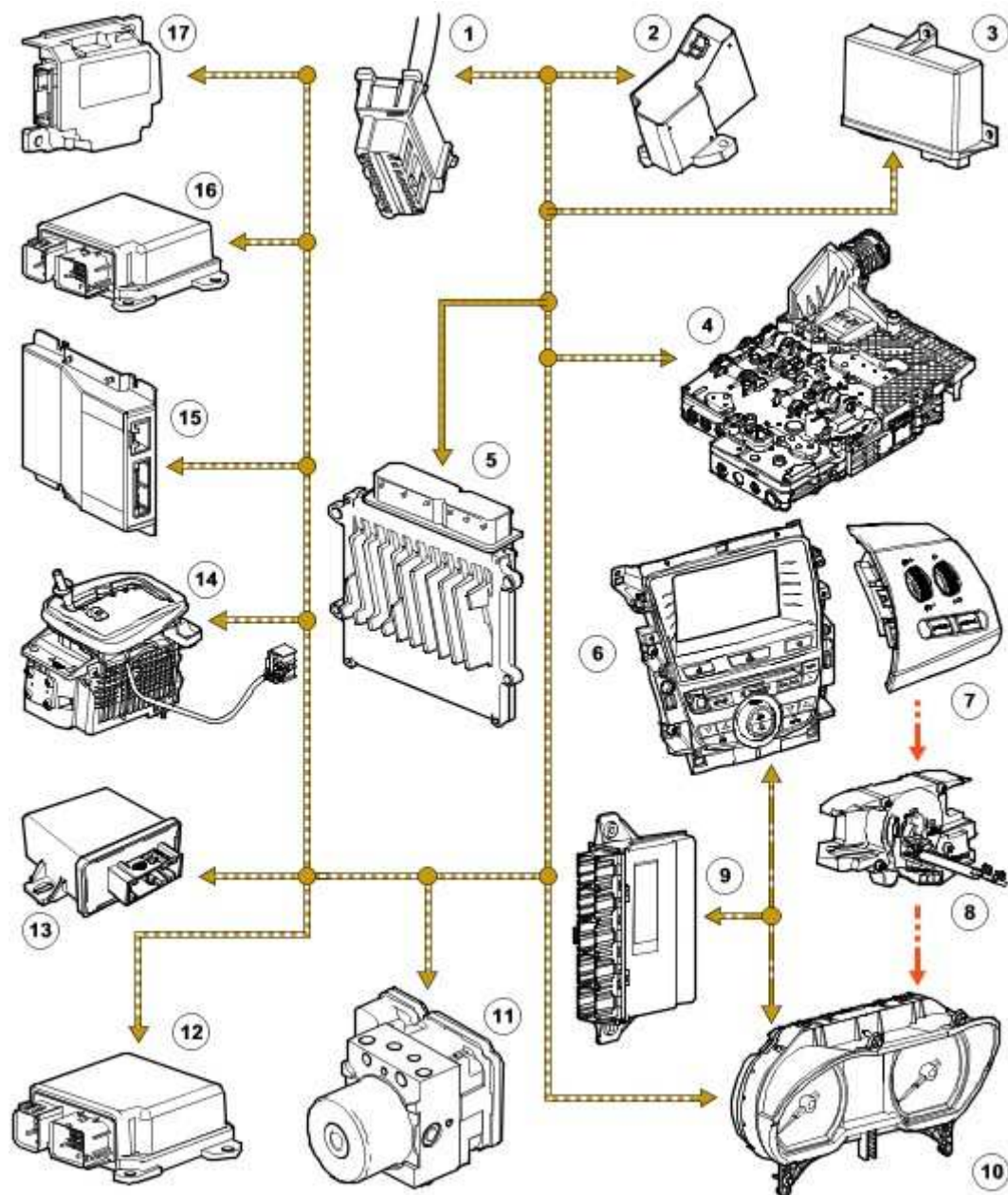
Item	Part Number	Description
1		FPDM
2		Generator
3		HO2S (upstream)
4		HO2S (downstream)
5		Electric throttle
6		Purge valve
7		fuel tank leakage monitoring pump
8		EGR valve

9		Engine cooling fan
10		VCT solenoid
11		Secondary air injection pump
12		ECM
13		Injector (8 off)
14		Ignition coil (8 off)

CONTROL DIAGRAM SHEET 3 of 3

NOTE:

D = High speed CAN bus; N=Medium speed CAN bus; O = LIN (local interconnect network) bus



E65886

Item	Part Number	Description
1		Diagnostic socket
2		Steering column lock
3		Park brake module
4		TCM
5		ECM
6		Integrated control panel
7		Steering wheel speed control switches
8		Rotary coupler

9		Keyless vehicle module
10		Instrument cluster
11		ABS control module
12		RCM
13		Adaptive front lighting system control module
14		Gear shift module
15		Adaptive Damping Control Module (ADCM)
16		Pedestrian protection module
17		Adaptive speed control module

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 adaptations associated with them are:

- The APP sensor
- The HO2S
- The MAF/IAT sensor
- The CKP sensor
- Electric throttle body.

Oxygen and MAF/AT Sensor

There are several adaptive maps associated with the fueling strategy. Within the fueling strategy the ECM calculates short-term adaptations and long term adaptations. The ECM will monitor the deterioration of the oxygen sensors 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.

Crankshaft Position Sensor

The characteristics of the signal supplied by the CKP 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 CKP 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 DTC, referred to as 'P' codes. The 'P' codes are defined by 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.

Electronic Engine Controls

Principle of Operation

For a detailed description of electronic engine controls, refer to the relevant Description and Operation section of the workshop manual.

[Electronic Engine Controls](#)

Inspection and Verification

- 1 . Verify the customer concern.
- 2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
- Engine oil level - Cooling system coolant level - Fuel level - Fuel contamination/grade/quality - Throttle body - Poly-vee belt	- Fuses - Wiring harness - Electrical connector(s) - Sensor(s) - Engine Control Module (ECM) - Transmission Control Module (TCM)

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, verify the customer concern and refer to the Symptom Chart below, alternatively, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Cause	Action
Engine non-start		
Engine does not crank	- Security system /Immobilizer engaged - Engine in shut-down mode - ECM relay - Battery - Park/Neutral switch - Starting system	- Check that the security system is disarmed - Read DTCs and refer to DTC Index in this section for ECM relay tests - Ensure the battery is in fully charged and

	• Engine seized	• serviceable condition • For Park/Neutral switch tests. External Controls • For starting system tests. Starting System • For engine system tests. Engine
Engine cranks, but does not fire	• Engine breather system disconnected/restricted • Ignition system • Fuel system • Electronic engine controls	• Ensure the engine breather system is free from restriction and is correctly installed • For ignition system tests. Engine Ignition • For fuel system tests. Fuel Charging and Controls • Read DTCs and refer to DTC Index in this section for electronic engine control tests
Engine cranks and fires, but will not start	• Evaporative emissions purge valve • Fuel pump • Spark plugs • Ignition coil failure(s)	• For purge valve tests. Evaporative Emissions • For fuel system tests. Fuel Tank and Lines • For ignition system tests. Engine Ignition
Difficult to start		
Difficult cold start	• Check engine coolant level/anti-freeze content • Battery • Electronic engine controls • Exhaust gas recirculation (EGR) valve stuck open • Fuel pump • Evaporative emissions purge valve	• Check the engine coolant level and condition. Specifications • Ensure the battery is in a fully charged and serviceable condition • Read DTCs and refer to DTC Index in this section for electronic engine control tests • For EGR valve tests. Engine Emission Control

		- For fuel system tests. Fuel Tank and Lines - For purge valve tests. Evaporative Emissions
Difficult hot start	- Injector leak - Electronic engine controls - Evaporative emissions purge valve - Fuel pump - Ignition system - EGR valve stuck open	- Carry out injector leak tests, install new injectors as necessary. Fuel Injector (18.10.01) - Read DTCs and refer to DTC Index in this section for electronic engine control tests - For purge valve tests. Evaporative Emissions - For fuel system tests. Fuel Tank and Lines - For ignition system tests. Engine Ignition - For EGR valve tests. Engine Emission Control
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	- Injector leak - Electronic engine controls - Evaporative emissions purge valve - Fuel pump - Ignition system - EGR valve stuck open	- Carry out injector leak tests, install new injectors as necessary. Fuel Injector (18.10.01) - Read DTCs and refer to DTC Index in this section for electronic engine control tests - For purge valve tests. Evaporative Emissions - For fuel system tests. Fuel Tank and Lines - For ignition system tests. Engine Ignition - For EGR valve tests. Engine Emission Control
Engine cranks too fast/slow	- Compressions high/low - Battery - Starting system	- Carry out compression tests. Engine - Ensure battery is in a

		fully charged and serviceable condition For starting system tests. Starting System
Engine stalls		
Engine stalls soon after start	- Breather system disconnected/restricted - ECM relay - Electronic engine controls - Ignition system - Air intake system restricted - Air leakage - Fuel lines	- Ensure the engine breather system is free from restriction and is correctly installed - Read DTCs and refer to DTC Index in this section for ECM relay tests - Read DTCs and refer to DTC Index in this section for electronic engine control tests - For ignition system tests. Engine Ignition - Check for blockage in air cleaner element and air intake system - Check for leakage in air intake system - For fuel system tests. Fuel Tank and Lines
Engine stalls on overrun	- ECM relay - Throttle position (TP) sensors	- Read DTCs and refer to DTC Index in this section for ECM relay tests - Read DTCs and refer to DTC Index in this section for TP sensor tests
Engine stalls at steady speed	- ECM relay - CKP sensor - TP sensors	Read DTCs and refer to DTC Index in this section for ECM relay, CKP, and TP sensor tests
Engine stalls with speed control enabled	ECM relay	Read DTCs and refer to DTC Index in this section for ECM relay

		tests
Engine stalls when manoeuvring	• ECM relay • TP sensors • Additional engine loads (PAS, air conditioning, etc) • Transmission malfunction • CAN malfunction	• Read DTCs and refer to DTC Index in this section for ECM relay, and TP sensor tests • Check for excessive loads being placed on the engine from PAS, air conditioning systems etc. • For transmission system tests. Diagnostic Strategy • For CAN network tests. Communications Network
Poor driveability		
Engine hesitates/poor acceleration	• Fuel pressure, fuel pump, fuel lines • Injector leak • Air leakage • Electronic engine controls • Ignition system • EGR valve stuck • Transmission malfunction • Restricted pedal travel (carpet, etc)	• For fuel system tests. Fuel Tank and Lines • Carry out fuel injector leak tests, install new injectors as necessary. Fuel Injector (18.10.01) • Check for leakage from air intake system • Read DTCs and refer to DTC Index in this section for electronic engine control tests • For ignition system tests. Engine Ignition • For EGR valve tests. Engine Emission Control • For transmission system tests. Diagnostic Strategy • Ensure accelerator pedal is free from restriction
Engine backfires	• Fuel pump, fuel lines • Air leakage • Electronic engine	• For fuel system tests. Fuel Tank and Lines • Check for leakage from

	controls • Ignition system • Sticking variable camshaft timing (VCT) hub	air intake system • Read DTCs and refer to DTC Index in this section for electronic engine control tests • For ignition system tests. Engine Ignition • Read DTCs and refer to DTC Index in this section for VCT system tests
Engine surges	• Fuel pump, fuel lines • Electronic engine controls • Ignition system	• For fuel system tests. Fuel Tank and Lines • Read DTCs and refer to DTC Index in this section for electronic engine control tests • For ignition system tests. Engine Ignition
Engine detonates/knocks	• Electronic engine controls • Fuel pump, fuel lines, fuel quality • Air leakage • Sticking VCT hub	• Read DTCs and refer to DTC Index in this section for electronic engine control tests • For fuel system tests. Fuel Tank and Lines • Check for leakage from air intake system • Read DTCs and refer to DTC Index in this section for VCT system tests
No throttle response	• Electronic engine controls	• Read DTCs and refer to DTC Index in this section for electronic engine control tests
Speed control inhibited or disabled	• Default mode enabled • Speed control, brake switch • Electronic engine controls • CAN fault	• Check message center for default message, read DTCs and refer to DTC Index • For speed control, and brake switch tests. Speed Control

		• Read DTCs and refer to DTC Index in this section for electronic engine control tests • For CAN network tests. Communications Network
Poor throttle response	• Breather system disconnected/restricted • Electronic engine controls • Transmission malfunction • Traction control event • Air leakage	• Ensure engine breather system is free from restriction and is correctly installed • Read DTCs and refer to DTC Index in this section for electronic engine control tests • For transmission system tests. Diagnostic Strategy • Check for leakage in air intake system
Engine defaults, warning light and messages. Refer to the owner handbook	• Park/Neutral switch • Electronic engine controls	• For Park/Neutral switch tests. External Controls • Read DTCs and refer to DTC Index in this section for electronic engine control tests

DTC Index



CAUTION: When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00.

NOTE:

If the module/component is suspect and the vehicle remains under the Manufacturers warranty, refer to the Warranty Policy and Procedure 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 five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to

identify the fault (the last two digits give additional information read by the manufacturer-approved diagnostic system).

NOTE:

When performing electrical voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE:

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE:

If DTCs 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.

DTC	Description	Possible Causes	Action
C003100	Left front wheel speed sensor	Invalid data received from ABS - left front wheel speed signal	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
C003400	Right front wheel speed sensor	Invalid data received from ABS - right front wheel speed signal	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
C003700	Left rear wheel speed sensor	Invalid data received from ABS - left rear wheel speed signal	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control -

			Stability Assist
C003A00	Right rear wheel speed sensor	Invalid data received from ABS - right rear wheel speed signal	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
P001100	Intake camshaft position - timing over-advanced (bank 1)	- Variable Camshaft Timing (VCT) circuit fault - Valve timing incorrectly set - Timing chain has slipped	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check the valve timing. Timing Drive Components (12.65.13)
P001200	Intake camshaft position - timing over-retarded (bank 1)	- Variable Camshaft Timing (VCT) circuit fault - Valve timing incorrectly set - Timing chain has slipped	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check the valve timing. Timing Drive Components (12.65.13)
P001600	Crankshaft position (CKP)/Camshaft position (CMP) sensor correlation, right hand bank	The relative positions of the CKP and CMP teeth are not correct Sensors incorrectly aligned on rebuild	Reset the sensor positions. Camshaft Position (CMP) Sensor LH

			(18.31.12) Camshaft Position (CMP) Sensor RH (18.31.11) Crankshaft Position (CKP) Sensor (18.30.12)
P001800	Crankshaft position (CKP)/Camshaft position (CMP) sensor correlation, left hand bank	- The relative positions of the CKP and CMP teeth are not correct - Sensors incorrectly aligned on rebuild	Reset the sensor positions. Camshaft Position (CMP) Sensor LH (18.31.12) Camshaft Position (CMP) Sensor RH (18.31.11) Crankshaft Position (CKP) Sensor (18.30.12) Timing Drive Components (12.65.13)
P002100	Intake camshaft position - timing over-advanced (bank 2)	- Variable Camshaft Timing (VCT) circuit fault - Valve timing incorrectly set - Timing chain has slipped	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check the valve timing. Timing Drive Components (12.65.13)
P002200	Intake camshaft position - timing over-retarded (bank 2)	- Variable Camshaft Timing (VCT) circuit fault - Valve timing incorrectly set	Carry out the pinpoint tests associated with this DTC using the

		Timing chain has slipped	manufacturer approved diagnostic system Check the valve timing. Timing Drive Components (12.65.13)
P002672	Variable Camshaft Timing (VCT) control solenoid (bank 1) circuit range/performance - actuator stuck open	- VCT solenoid fault - Oil contamination - VCT oil flow fault - VCT/Camshaft mechanical failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check the oil condition and flow - Check for mechanical failure of components
P002677	Variable Camshaft Timing (VCT) control solenoid (bank 1) circuit range/performance - commanded position not achievable	- VCT solenoid fault - Oil contamination - VCT oil flow fault - VCT/Camshaft mechanical failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check the oil condition and flow - Check for mechanical failure of components
P002872	Variable Camshaft Timing (VCT) control solenoid (bank 2) circuit range/performance - actuator stuck open	- VCT solenoid fault - Oil contamination - VCT oil flow fault - VCT/Camshaft	Carry out the pinpoint tests associated with this DTC using the

		mechanical failure	manufacturer approved diagnostic system • Check the oil condition and flow • Check for mechanical failure of components
P002877	Variable Camshaft Timing (VCT) control solenoid (bank 2) circuit range/performance - commanded position not achievable	• VCT solenoid fault • Oil contamination • VCT oil flow fault • VCT/Camshaft mechanical failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check the oil condition and flow • Check for mechanical failure of components
P003100	HO2S heater control circuit low (bank 1)	• HO2S heater circuit - circuit fault • HO2S heater failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P003200	HO2S heater control circuit high (bank 1)	• HO2S heater circuit - circuit fault • HO2S heater failure	• Carry out the pinpoint tests associated with this DTC using the

			manufacturer approved diagnostic system • Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P003600	Catalyst monitor sensor heater control circuit (bank 1)	• Catalyst monitor sensor heater circuit - circuit fault • Catalyst monitor sensor heater failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P005100	HO2S heater control circuit low (bank 2)	• HO2S heater circuit - circuit fault • HO2S heater failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P005200	HO2S heater control circuit high (bank 2)	• HO2S heater circuit - circuit fault • HO2S heater failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system • Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P005600	Catalyst monitor sensor heater control circuit (bank 2)	• Catalyst monitor sensor heater circuit - circuit fault • Catalyst monitor sensor heater failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P006900	Manifold absolute pressure (MAP)/Barometric pressure correlation	• MAP sensor failure • BARO sensor failure (internal ECM fault)	• Check for MAP sensor related DTCs and refer to the DTC Index in this section • Install a new ECM. Refer to new module/component installation Note at top of DTC Index
P007100	Ambient air temperature sensor range/performance	• Ambient temperature value missing from CAN bus	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system

P007200	Ambient air temperature sensor circuit low	• Ambient air temperature sensor circuit - high resistance • Ambient air temperature sensor circuit - short to ground	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P007300	Ambient air temperature sensor circuit high	• Ambient air temperature sensor circuit - short to power	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P007500	Variable Camshaft Timing (VCT) control circuit (bank 1)	• VCT control solenoid circuit - high resistance, disconnected • VCT solenoid failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new VCT control solenoid as necessary. Variable Camshaft Timing (VCT) Oil Control Solenoid (18.30.90)
P007600	Variable Camshaft Timing (VCT) control circuit low (bank 1)	• VCT control solenoid circuit - short to ground, disconnected • VCT solenoid failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system

			Install a new VCT control solenoid as necessary. Variable Camshaft Timing (VCT) Oil Control Solenoid (18.30.90)
P007700	Variable Camshaft Timing (VCT) control circuit high (bank 1)	- VCT control solenoid circuit - short to power - VCT solenoid failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new VCT control solenoid as necessary. Variable Camshaft Timing (VCT) Oil Control Solenoid (18.30.90)
P008100	Variable Camshaft Timing (VCT) control circuit (bank 2)	- VCT control solenoid circuit - high resistance, disconnected - VCT solenoid failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new VCT control solenoid as necessary. Variable Camshaft Timing (VCT) Oil Control Solenoid

			(18.30.90)
P008200	Variable Camshaft Timing (VCT) control circuit low (bank 2)	• VCT control solenoid circuit - short to ground, disconnected • VCT solenoid failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new VCT control solenoid as necessary. Variable Camshaft Timing (VCT) Oil Control Solenoid (18.30.90)
P008300	Variable Camshaft Timing (VCT) control circuit high (bank 2)	• VCT control solenoid circuit - short to power • VCT solenoid failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new VCT control solenoid as necessary. Variable Camshaft Timing (VCT) Oil Control Solenoid (18.30.90)
P008700	Fuel rail/system pressure - too low	• Fuel rail pressure (FRP) sensor, sensing circuit - short to ground, open circuit • FRP sensor supply circuit - high resistance	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved

		• FRP sensor failure • Fuel pump failure • Fuel line leak, restriction	diagnostic system • Install a new FRP sensor as necessary. Fuel Rail Pressure (FRP) Sensor (18.30.98) • For fuel system tests. Fuel Tank and Lines
P008800	Fuel rail/system pressure - too high	• FRP sensor supply/sensing circuits - short to each other • FRP sensor sensing circuit - short to power • FRP sensor ground circuit - high resistance • FRP sensor failure • Restricted fuel line • Fuel pump short circuit to power	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new FRP sensor as necessary. Fuel Rail Pressure (FRP) Sensor (18.30.98) • For fuel system tests. Fuel Tank and Lines
P009623	Intake Air Temperature Sensor 2 Circuit Range/Performance	NOTE: Intercooler air temperature sensor is integral to primary MAP sensor • Intercooler air temperature sensor circuit - short to ground	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Refer to electrical circuit diagrams and check Intercooler air temperature

			sensor circuit for short to ground
P009624	Intake Air Temperature Sensor 2 Circuit Range/Performance	NOTE: Intercooler air temperature sensor is integral to primary MAP sensor Intercooler air temperature sensor circuit - short to power	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Refer to electrical circuit diagrams and check Intercooler air temperature sensor circuit for short to power
P009629	Intake Air Temperature Sensor 2 Circuit Range/Performance	NOTE: Intercooler air temperature sensor is integral to primary MAP sensor Intercooler air temperature sensor circuit - high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Refer to electrical circuit diagrams and check Intercooler air temperature sensor circuit for high resistance
P009700	Intake Air Temperature Sensor 2 Circuit Low Input	NOTE: Intercooler air temperature sensor is integral to primary MAP sensor Intercooler air	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Refer

		temperature sensor circuit - short to ground, high resistance	to electrical circuit diagrams and check primary MAP sensor intercooler air temperature sensor circuit for short to ground, high resistance
P009800	Intake Air Temperature Sensor 2 Circuit High Input	NOTE: Intercooler air temperature sensor is integral to primary MAP sensor Intercooler air temperature sensor circuit - short to power	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Refer to the electrical circuit diagrams and check primary MAP sensor intercooler air temperature sensor circuit for short to power
P010100	Mass Air Flow (MAF) circuit - range/performance	- Blocked air cleaner element - Leakage from air intake system - Engine breather leak - MAF sensor sensing circuit - high resistance, intermittent short to ground - MAF sensor supply circuit - high resistance - MAF sensor failure	- Check air cleaner element is free from restriction - Check for leak from air intake system, rectify as necessary - Ensure the engine breather system is correctly installed and in serviceable condition - Carry out the pinpoint tests

			associated with this DTC using the manufacturer approved diagnostic system • Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P010200	Mass Air Flow (MAF) circuit - low input	• MAF sensor supply circuit - short to ground, high resistance • MAF sensor ground circuit - high resistance • MAF sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P010300	Mass Air Flow (MAF) circuit - high input	• MAF sensor sensing circuit - short to power • MAF sensor ground circuit - high resistance • MAF sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P010600	Manifold Absolute Pressure (MAP) sensor - range/performance	• Intake manifold air leak (loose or missing component)	• Check for correct installation and

		• MAP sensor signal circuit fault • MAP sensor failure	serviceability of intake manifold and associated components • Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new MAP sensor as necessary. Manifold Absolute Pressure (MAP) Sensor (18.30.86)
P010700	Manifold Absolute Pressure/Barometric Pressure Circuit Low Input	• MAP sensor signal circuit - short to ground	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P010800	Manifold Absolute Pressure/Barometric Pressure Circuit High Input	• MAP sensor signal circuit - short to power	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P010B00	Mass or Volume Air Flow B Circuit Range/Performance	• Blocked air cleaner element • Leakage from air intake system • Engine breather leak • MAF sensor 2 sensing circuit - high	• Check air cleaner element is free from restriction • Check for leak from air intake system, rectify

		resistance, intermittent short to ground • MAF sensor 2 supply circuit - high resistance • MAF sensor 2 failure	as necessary • Ensure the engine breather system is correctly installed and in serviceable condition • Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P010C00	Mass or Volume Air Flow Circuit 2 Low Input	• MAF sensor 2 supply circuit - short to ground, high resistance • MAF sensor 2 ground circuit - high resistance • MAF sensor 2 failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P010D00	Mass or Volume Air Flow Circuit 2 High Input	• MAF sensor 2 sensing circuit - short to power • MAF sensor 2 ground circuit - high resistance • MAF sensor 2 failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system

			Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P011123	Intake Air Temperature (IAT) sensor circuit - range/performance - signal stuck low	- IAT sensor sensing circuit - high resistance - IAT sensor failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P011124	Intake Air Temperature (IAT) sensor circuit - range/performance - signal stuck high	- IAT sensor sensing circuit - high resistance - IAT sensor failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P011129	Intake Air Temperature (IAT) sensor circuit - range/performance - signal invalid	- IAT sensor sensing circuit - high resistance - IAT sensor failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new

			MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P011200	Intake Air Temperature (IAT) sensor circuit - low input	• IAT sensor sensing circuit - high resistance, disconnected • IAT sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P011300	Intake Air Temperature (IAT) sensor circuit - high input	• IAT sensor sensing circuit - short to ground, short to power • IAT sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P011623	Engine Coolant Temperature (ECT) sensor circuit - range/performance - signal stuck low	• Low coolant level • ECT sensor sensing circuit - intermittent high resistance • Engine thermostat failure • ECT sensor failure	• Fill cooling system to correct level and specification. Specifications • Carry out the pinpoint tests associated with this DTC using the

			manufacturer approved diagnostic system • Check and install new engine thermostat as necessary. Thermostat - Vehicles With: Supercharger (26.45.07) • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P011624	Engine Coolant Temperature (ECT) sensor circuit - range/performance - signal stuck high	• Low coolant level • ECT sensor sensing circuit - intermittent high resistance • Engine thermostat failure • ECT sensor failure	• Fill cooling system to correct level and specification. Specifications • Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check and install new engine thermostat as necessary. Thermostat - Vehicles With: Supercharger (26.45.07) • Install a new ECT sensor as necessary. Engine Coolant

			Temperature (ECT) Sensor (18.30.10)
P011629	Engine Coolant Temperature (ECT) sensor circuit - range/performance - signal invalid	• Low coolant level • ECT sensor sensing circuit - intermittent high resistance • Engine thermostat failure • ECT sensor failure	• Fill cooling system to correct level and specification. Specifications • Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check and install new engine thermostat as necessary. Thermostat - Vehicles With: Supercharger (26.45.07) • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P011700	Engine Coolant Temperature (ECT) sensor circuit - low input	• ECT sensor sensing circuit - short to power, high resistance, open circuit, disconnected • ECT sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new ECT sensor as necessary. Engine Coolant

			Temperature (ECT) Sensor (18.30.10)
P011800	Engine Coolant Temperature (ECT) sensor circuit - high input	• Engine overheat condition/cooling fan failure • ECT sensor sensing circuit - short to ground • ECT sensor failure	• Check for cooling fan circuit DTCs and refer to relevant action specified in DTC Index • Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P012100	Throttle Position (TP) sensor circuits TP 1 and TP 2 - range/performance	• TP sensor sensing circuits TP 1 and TP 2 - short to battery, high resistance • TP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new throttle body as necessary. Throttle Body (19.70.04)
P012200	Throttle Position (TP) sensor circuit TP 1 - low input	• TP sensor sensing circuit TP 1 - short to ground, high resistance • TP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer

			approved diagnostic system • Install a new throttle body as necessary. Throttle Body (19.70.04)
P012300	Throttle Position (TP) sensor circuit TP 1 - high input	• TP sensor sensing circuit TP1 - short to power • TP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new throttle body as necessary. Throttle Body (19.70.04)
P012500	Insufficient coolant temperature for closed loop fuel control	• Low coolant level • ECT sensor sensing circuit - intermittent high resistance • Engine thermostat failure • ECT sensor failure	• Fill cooling system to correct level and specification. Specifications • Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check and install new engine thermostat as necessary. Thermostat - Vehicles With: Supercharger (26.45.07) • Install a new

			ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P012800	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	• Low/contaminated coolant • Thermostat • Cooling fan circuit(s)/module	• Drain and re-fill cooling system to correct level and specification. Specifications Cooling System Draining, Filling and Bleeding - 4.2L SC V8 - AJV8 • Check and install a new engine thermostat as necessary. Thermostat - Vehicles With: Supercharger (26.45.07) • Check for correct operation of cooling fan, check for DTCs and refer to DTC Index
P01311A	Heated Oxygen Sensor (H02S) circuit - low voltage (bank 1)	• Exhaust gas leakage • H02S variable/constant circuit - circuit fault, disconnected • H02S failure	• Check for and rectify any exhaust leak between cylinder head and catalytic converter (e.g. manifolds, EGR system etc.) • Carry out the pinpoint tests associated with

			this DTC using the manufacturer approved diagnostic system • Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P01321B	Heated Oxygen Sensor (HO2S) circuit - high voltage (bank 1)	• Exhaust gas leakage • HO2S variable/constant circuit - circuit fault, disconnected • HO2S failure	• Check for and rectify any exhaust leak between cylinder head and catalytic converter (e.g. manifolds, EGR system etc.) • Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P013300	Heated Oxygen Sensor (HO2S) circuit - slow response (bank 1)	• HO2S to ECM wiring shield high resistance • Exhaust leak • Fuel control system fault • HO2 sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check for and rectify any exhaust leak

			between cylinder head and catalytic converter (e.g. manifolds, EGR system etc.) - For fuel charging and controls tests. Fuel Charging and Controls - Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P013400	Heated Oxygen Sensor (HO2S) circuit - no activity detected (bank 1)	HO2S slow activation	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P013700	Catalyst monitor sensor circuit - low voltage (bank 1)	- Catalyst monitor sensor sensing circuit - short to ground, high resistance, disconnected - Catalyst monitor sensor failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P013800	Catalyst monitor sensor circuit - high voltage (bank 1)	- Catalyst monitor sensor sensing circuit - short to power - Catalyst monitor	Carry out the pinpoint tests associated with this DTC using

		sensor ground braided shield - high resistance • Catalyst monitor sensor failure	the manufacturer approved diagnostic system • Install new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P013900	Catalyst monitor sensor circuit - slow response (bank 1)	• Catalyst monitor sensor slow response	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P014000	Catalyst monitor sensor circuit - no activity detected (bank 1)	• Catalyst monitor sensing circuit - short to ground, short to power, high resistance, disconnected • Catalyst monitor sensor ground braided shield - high resistance • Catalyst monitor sensor - mechanical damage	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P014100	Catalyst monitor heater circuit (bank 1)	• Catalyst monitor sensor heater control circuit - high resistance • Catalyst monitor sensor heater failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system

			Install a new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P01511A	Heated Oxygen Sensor (HO2S) circuit - low voltage (bank 2)	- HO2S sensing circuit - short to ground, short to power, high resistance - HO2S failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P01521B	Heated Oxygen Sensor (HO2S) circuit - high voltage (bank 2)	- HO2S sensing circuit - short to ground, short to power, high resistance - HO2S failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P015300	Heated Oxygen Sensor (HO2S) circuit - slow response (bank 2)	- HO2S to ECM wiring shield high resistance - Exhaust leak - Fuel control system fault - HO2 sensor failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check for and rectify any

			exhaust leak between cylinder head and catalytic converter (e.g. manifolds, EGR system etc.) - For fuel system and controls tests. Fuel Charging and Controls - Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P015400	Heated Oxygen Sensor (HO2S) circuit - no activity detected (bank 2)	HO2S slow activation	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P015700	Catalyst monitor sensor circuit - low voltage (bank 2)	- Catalyst monitor sensor sensing circuit - short to ground, high resistance, disconnected - Catalyst monitor sensor failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P015800	Catalyst monitor sensor circuit - high voltage (bank 2)	Catalyst monitor sensor sensing circuit - short to power	Carry out the pinpoint tests associated with

		• Catalyst monitor sensor ground braided shield - high resistance • Catalyst monitor sensor failure	this DTC using the manufacturer approved diagnostic system • Install a new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P015900	Catalyst monitor sensor circuit - slow response (bank 2)	• Catalyst monitor sensor slow response	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P016000	Catalyst monitor sensor circuit - no activity detected (bank 2)	• Catalyst monitor sensing circuit - short to ground, short to power, high resistance, disconnected • Catalyst monitor sensor ground braided shield - high resistance • Catalyst monitor sensor - mechanical damage	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P016100	Catalyst monitor sensor heater circuit (bank 2)	• Catalyst monitor sensor heater control circuit malfunction	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic

			system
P017100	System too lean (bank 1)	• Air intake leak between MAF sensor and cylinder head • Fuel filter, injector, system restriction • MAF sensor fault (low intake air flow) • Exhaust leak (forward of catalytic converter)	• Check for leak from air intake system • For fuel system tests. Fuel Tank and Lines • Read DTCs and refer to DTC Index in this section for MAF sensor tests • Check and rectify any exhaust leak prior to catalytic converter
P017200	System too rich (bank 1)	• Restricted air cleaner • Leaking fuel injector(s) • Engine oil contaminated with fuel (too many cold starts with vehicle subsequently not getting hot enough for long enough) • MAF sensor fault (high intake air flow)	• Check air cleaner element is free from restriction • Check for leaking injectors, install new injector(s) as necessary. Fuel Injector (18.10.01) • Check for contaminated engine oil, drain and refill engine oil as necessary. Engine Oil Draining and Filling • Read DTCs and refer to DTC Index in this section for MAF sensor tests

P017400	System too lean (bank 2)	• Air intake leak between MAF sensor and cylinder head • Fuel filter, injector, system restriction • MAF sensor fault (low intake air flow) • Exhaust leak (forward of catalytic converter)	• Check for leak from air intake system • For fuel system tests. Fuel Tank and Lines • Read DTCs and refer to DTC Index in this section for MAF sensor tests • Check and rectify any exhaust leak prior to catalytic converter
P017500	System too rich (bank 2)	• Restricted air cleaner • Leaking fuel injector(s) • Engine oil contaminated with fuel (too many cold starts with vehicle subsequently not getting hot enough for long enough) • MAF sensor fault (high intake air flow)	• Check air cleaner element is free from restriction • Check for leaking injectors, install new injector(s) as necessary. Fuel Injector (18.10.01) • Check for contaminated engine oil, drain and refill engine oil as necessary. Engine Oil Draining and Filling • Read DTCs and refer to DTC Index in this section for MAF sensor tests
P018123	Engine Fuel Temperature (EFT) sensor circuit -	• EFT sensor sensing circuit - short to	• Carry out the pinpoint tests

	range/performance - signal stuck low	ground, short to power, high resistance • EFT sensor ground circuit - high resistance • EFT sensor failure	associated with this DTC using the manufacturer approved diagnostic system • Install a new EFT sensor as necessary. Fuel Temperature Sensor (18.30.99)
P018124	Engine Fuel Temperature (EFT) sensor circuit - range/performance - signal stuck high	• EFT sensor sensing circuit - short to ground, short to power, high resistance • EFT sensor ground circuit - high resistance • EFT sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new EFT sensor as necessary. Fuel Temperature Sensor (18.30.99)
P018129	Engine Fuel Temperature (EFT) sensor circuit - range/performance - signal invalid	• EFT sensor sensing circuit - short to ground, short to power, high resistance • EFT sensor ground circuit - high resistance • EFT sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new EFT sensor as necessary. Fuel Temperature Sensor (18.30.99)

P018200	Engine Fuel Temperature (EFT) sensor circuit - low input	• EFT sensor sensing circuit - short to ground • EFT sensor ground circuit - short circuit • EFT sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new EFT sensor as necessary. Fuel Temperature Sensor (18.30.99)
P018300	Engine Fuel Temperature (EFT) sensor circuit - high input	• EFT sensor sensing circuit - short to power, high resistance, disconnected • EFT sensor ground circuit - high resistance • EFT sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new EFT sensor as necessary. Fuel Temperature Sensor (18.30.99)
P019100	Fuel Rail Pressure (FRP) sensor circuit - range/performance	• FRP sensor range and performance	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P019200	Fuel Rail Pressure (FRP) sensor circuit - low input	• FRP sensor sensing circuit - short to ground, high resistance, disconnected	• Carry out the pinpoint tests associated with this DTC using the

		• FRP sensor 5V supply circuit - high resistance • FRP sensor failure	manufacturer approved diagnostic system • Install a new FRP sensor as necessary. Fuel Rail Pressure (FRP) Sensor (18.30.98)
P019300	Fuel Rail Pressure (FRP) sensor circuit - high input	• FRP sensor supply/sensing circuits - short circuit to each other • FRP sensor sensing circuit - short to power • FRP sensor ground circuit - high resistance • FRP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new FRP sensor as necessary. Fuel Rail Pressure (FRP) Sensor (18.30.98)
P019623	Engine Oil Temperature (EOT) sensor circuit - range/performance - signal stuck low	• EOT sensor sensing circuit - intermittent high resistance • EOT sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new EOT sensor as necessary. Oil Temperature Sensor (18.31.01)
P019624	Engine Oil Temperature (EOT) sensor circuit - range/performance - signal	• EOT sensor sensing circuit - intermittent high resistance	• Carry out the pinpoint tests associated with

	stuck high	EOT sensor failure	this DTC using the manufacturer approved diagnostic system Install a new EOT sensor as necessary. Oil Temperature Sensor (18.31.01)
P019629	Engine Oil Temperature (EOT) sensor circuit - range/performance - signal invalid	- EOT sensor sensing circuit - intermittent high resistance - EOT sensor failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new EOT sensor as necessary. Oil Temperature Sensor (18.31.01)
P019700	Engine Oil Temperature (EOT) sensor circuit - low input	- EOT sensor sensing circuit - short to ground - EOT sensor failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new EOT sensor as necessary. Oil Temperature Sensor (18.31.01)
P019800	Engine Oil Temperature	EOT sensor sensing	Carry out the

	(EOT) sensor circuit - high input	circuit - short to power, high resistance, disconnected EOT sensor failure	pinpoint tests associated with this DTC using the manufacturer approved diagnostic system Install a new EOT sensor as necessary. Oil Temperature Sensor (18.31.01)
P020100	Cylinder 1 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new injector as necessary. Fuel Injector (18.10.01)
P020200	Cylinder 2 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new injector as necessary. Fuel Injector (18.10.01)
P020300	Cylinder 3 injector circuit - malfunction	Injector circuit - short to ground, high resistance,	Carry out the pinpoint tests associated with

		- disconnected - Injector failure	this DTC using the manufacturer approved diagnostic system Install a new injector as necessary. Fuel Injector (18.10.01)
P020400	Cylinder 4 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new injector as necessary. Fuel Injector (18.10.01)
P020500	Cylinder 5 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new injector as necessary. Fuel Injector (18.10.01)
P020600	Cylinder 6 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	Carry out the pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system • Install a new injector as necessary. Fuel Injector (18.10.01)
P020700	Cylinder 7 injector circuit - malfunction	• Injector circuit - short to ground, high resistance, disconnected • Injector failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new injector as necessary. Fuel Injector (18.10.01)
P020800	Cylinder 8 injector circuit - malfunction	• Injector circuit - short to ground, high resistance, disconnected • Injector failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new injector as necessary. Fuel Injector (18.10.01)
P022200	Throttle Position (TP) sensor circuit TP 2 - low input	• TP sensor sensing circuit TP 2 - short to ground, high resistance • TP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new throttle body as

			necessary. Throttle Body (19.70.04)
P022300	Throttle Position (TP) sensor circuit TP 2 - high input	- TP sensor sensing circuit TP 2- short to power - TP sensor failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body as necessary. Throttle Body (19.70.04)
P022700	Accelerator Pedal Position (APP) sensor circuit APP 1 - low input	APP sensor circuit APP 1 - short to ground, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P022800	Accelerator pedal position (APP) sensor circuit APP 1 high input	APP sensor circuit APP 1 - short to power	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P023700	Turbocharger/Supercharger Boost Sensor A Circuit Low	Post supercharger MAP sensor circuit - short to ground, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Refer

			to electrical circuit diagrams and check Post supercharger MAP sensor circuit for short to ground, high resistance
P023800	Turbocharger/Supercharger Boost Sensor A Circuit High	Post supercharger MAP sensor circuit - short to power	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Refer to electrical circuit diagrams and check Post supercharger MAP sensor circuit for short to power
P023B13	Charge Air Cooler Coolant Pump Control Circuit Low	Charge air cooler coolant pump relay control circuit - open circuit	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P023C12	Charge Air Cooler Coolant Pump Control Circuit High	Charge air cooler coolant pump relay control circuit - short to power	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P030000	Random/multiple cylinder misfire detected	ECM to ignition coil primary circuit faults	If specific cylinder misfire

		(cylinder misfire detected DTCs also logged) • Fuel injector circuit fault(s) (injector DTCs also logged) • Ignition coil failure • Spark plug failure/fouled/incorrect gap • Fuel delivery pressure (low/high) • Fuel contamination • Fuel injectors restricted, leaking, continuously open • Cylinder compression low • Worn camshaft/broken valve springs • Valve clearance adjustment	or injector DTCs are also logged refer to the tests associated to those DTCs first • For ignition coil test. Engine Ignition • Check and install new sparkplugs as necessary. Spark Plugs - 4.2L SC V8 - AJV8 (18.20.02) • For fuel system tests. Fuel Tank and Lines • For injector tests. Fuel Charging and Controls • Check cylinder compressions. Engine • Check for worn/broken engine components and valve clearance adjustment. Engine Valve Clearance Adjustment (12.29.48)
P030100	Cylinder 1 misfire detected	Refer to P030000 possible causes	• Refer to P030000 actions
P030200	Cylinder 2 misfire detected	Refer to P030000 possible causes	• Refer to P030000

			actions
P030300	Cylinder 3 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P030400	Cylinder 4 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P030500	Cylinder 5 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P030600	Cylinder 6 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P030700	Cylinder 7 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P030800	Cylinder 8 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P031300	Misfire detected with low fuel	Misfire detected during low fuel level condition	- Check for fuel level sensor DTCs and refer to DTC Index - Add fuel, clear the DTC and test for normal operation
P031600	Engine misfire detected on startup	Misfire detected on first 1000 revs	Check for specific cylinder misfire DTCs and refer to the DTC Index
P032700	Knock sensor (KS) 1 circuit - low input (bank 1)	- Poor sensor contact with the cylinder block - KS circuit - short to ground	- Ensure a good electrical contact with the cylinder block - Carry out the

		• KS failure	pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new KS as necessary. Knock Sensor (KS) (18.30.69)
P032800	Knock sensor (KS) 1 circuit - high input (bank 1)	• Poor sensor contact with the cylinder block • KS circuit - high resistance, short to power • KS failure	• Ensure a good electrical contact with the cylinder block • Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new KS as necessary. Knock Sensor (KS) (18.30.69)
P033200	Knock sensor (KS) 2 circuit - low input (bank 2)	• Poor sensor contact with the cylinder block • KS circuit - short to ground • KS failure	• Ensure a good electrical contact with the cylinder block • Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new

			KS as necessary. Knock Sensor (KS) (18.30.69)
P033300	Knock sensor (KS) 2 circuit - high input (bank 2)	• Poor sensor contact with the cylinder block • KS circuit - high resistance, short to power • KS failure	• Ensure a good electrical contact with the cylinder block • Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new KS as necessary. Knock Sensor (KS) (18.30.69)
P033592	Crankshaft Position (CKP) sensor circuit - performance or incorrect operation	• CKP sensor circuit - short to ground, short to power, high resistance, disconnected • CKP sensor gap incorrect, foreign matter on sensor face, damaged teeth on rotor • CKP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CKP sensor for damage and check air gap (check at 90° intervals, should be no greater than 4.5mm) • Install a new CKP sensor as necessary. Crankshaft Position (CKP)

			Sensor (18.30.12)
P033594	Crankshaft Position (CKP) sensor circuit - unexpected operation	• CKP sensor circuit - short to ground, short to power, high resistance, disconnected • CKP sensor gap incorrect, foreign matter on sensor face, damaged teeth on rotor • CKP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CKP sensor for damage and check air gap (check at 90° intervals, should be no greater than 4.5mm) • Install a new CKP sensor as necessary. Crankshaft Position (CKP) Sensor (18.30.12)
P033600	Crankshaft Position (CKP) sensor circuit - range/performance	• CKP sensor circuit - short to ground, short to power, high resistance, disconnected • CKP sensor gap incorrect, foreign matter on sensor face, damaged teeth on rotor • CKP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CKP sensor for damage and check air gap (check at 90° intervals, should be no greater than 4.5mm) • Install a new CKP sensor as

			necessary. Crankshaft Position (CKP) Sensor (18.30.12)
P034092	Camshaft Position (CMP) sensor circuit (bank 1) - performance or incorrect operation	• CMP sensor circuit - short to ground, short to power, high resistance, disconnected • CMP sensor gap incorrect, foreign matter on sensor face, damaged rotor • CMP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CMP sensor for correct installation and damage • Install a new CMP sensor as necessary. Camshaft Position (CMP) Sensor RH (18.31.11)
P034094	Camshaft Position (CMP) sensor circuit (bank 1) - unexpected operation	• CMP sensor circuit - short to ground, short to power, high resistance, disconnected • CMP sensor gap incorrect, foreign matter on sensor face, damaged rotor • CMP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CMP sensor for correct installation and damage • Install a new CMP sensor as necessary. Camshaft Position (CMP) Sensor RH

			(18.31.11)
P034100	Camshaft Position (CMP) sensor circuit (bank 1) - range/performance	• CMP sensor circuit - short to ground, short to power, high resistance, disconnected • CMP sensor gap incorrect, foreign matter on sensor face, damaged rotor • CMP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CMP sensor for correct installation and damage • Install a new CMP sensor as necessary. Camshaft Position (CMP) Sensor RH (18.31.11)
P034592	Camshaft Position (CMP) sensor circuit (bank 2) - performance or incorrect operation	• CMP sensor circuit - short to ground, short to power, high resistance, disconnected • CMP sensor gap incorrect, foreign matter on sensor face, damaged rotor • CMP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CMP sensor for correct installation and damage • Install a new CMP sensor as necessary. Camshaft Position (CMP) Sensor LH (18.31.12)
P034594	Camshaft Position (CMP) sensor circuit (bank 2) - unexpected operation	• CMP sensor circuit - short to ground, short to power, high	• Carry out the pinpoint tests associated with

		resistance, disconnected • CMP sensor gap incorrect, foreign matter on sensor face, damaged rotor • CMP sensor failure	this DTC using the manufacturer approved diagnostic system • Check CMP sensor for correct installation and damage • Install a new CMP sensor as necessary. Camshaft Position (CMP) Sensor LH (18.31.12)
P034600	Camshaft Position (CMP) sensor circuit (bank 2) - range/performance	• CMP sensor circuit - short to ground, short to power, high resistance, disconnected • CMP sensor gap incorrect, foreign matter on sensor face, damaged rotor • CMP sensor failure	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CMP sensor for correct installation and damage • Install a new CMP sensor as necessary. Camshaft Position (CMP) Sensor LH (18.31.12)
P035100	Ignition coil 1 primary/secondary circuit	• Ignition module/coil circuits - short to ground, power, high resistance	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic

			system
P035200	Ignition coil 2 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035300	Ignition coil 3 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035400	Ignition coil 4 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035500	Ignition coil 5 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035600	Ignition coil 6 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer

			approved diagnostic system
P035700	Ignition coil 7 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035800	Ignition coil 8 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P040100	Exhaust Gas Recirculation (EGR) flow insufficient detected	- EGR valve incorrectly installed or loose - EGR pipe blocked - EGR valve stuck closed, blocked - EGR valve failure	For EGR system tests. Engine Emission Control
P041300	Secondary Air Injection (AIR) switching valve circuit open	AIR check valve control circuit high	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P041400	Secondary Air Injection (AIR) switching valve circuit shorted	AIR check valve control circuit low	Carry out the pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system
P042000	Catalyst system efficiency below threshold (bank 1)	• Catalyst failure due to overheating damage caused by misfire and/or lean combustion • Catalyst failure due to poisoning caused by excessive oil consumption and/or contaminated fuel	• Check for misfire/lean combustion DTCs and refer to DTC Index in this section • Check the oil and fuel condition/level. Check the catalytic converter for damage
P043000	Catalyst system efficiency below threshold (bank 2)	• Catalyst failure due to overheating damage caused by misfire and/or lean combustion • Catalyst failure due to poisoning caused by excessive oil consumption and/or contaminated fuel	• Check for misfire/lean combustion DTCs and refer to DTC Index in this section • Check the oil and fuel condition/level. Check the catalytic converter for damage
P044100	Evaporative Emission (EVAP) system incorrect purge flow	• Purge valve - range/performance	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P044700	Evaporative Emission (EVAP) system vent control circuit open	• DMTL COV circuit - short to ground	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system
P044800	Evaporative Emission (EVAP) system vent control circuit shorted	DMTL COV circuit - short to power	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P045600	Evaporative Emission (EVAP) system leak detected (very small leak)	DMTL system has detected a leak	For evaporative emissions tests. Evaporative Emissions
P045800	Evaporative Emission (EVAP) canister purge valve circuit low	- EVAP canister purge valve control circuit - short to ground, high resistance - EVAP canister purge valve failure	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new EVAP canister purge valve as necessary. Evaporative Emissions
P045900	Evaporative Emission (EVAP) canister purge valve circuit high	EVAP canister purge valve control circuit - short to power	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P046129	Fuel level sensor A circuit - range/performance - stuck	Fuel level sensor failure	For fuel level sensor pinpoint tests for this DTC.

			Fuel Tank and Lines
P04612F	Fuel level sensor A circuit - range/performance - signal erratic	Fuel level sensor failure	For fuel level sensor pinpoint tests for this DTC. Fuel Tank and Lines
P046200	Fuel level sensor A circuit - low input	Fuel level sensor failure	For fuel level sensor pinpoint tests for this DTC. Fuel Tank and Lines
P046300	Fuel level sensor A circuit - high input	Fuel level sensor failure	For fuel level sensor pinpoint tests for this DTC. Fuel Tank and Lines
P048023	Fan 1 control circuit low	Electric fan control circuit - short to ground, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P048024	Fan 1 control circuit high	Electric fan control circuit - short to power	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P048309	Fan rationality check	- Cooling fan difficult to turn/obstructed - Fan/Motor damaged	Carry out the pinpoint tests associated with this DTC using

			the manufacturer approved diagnostic system • CLEAR any obstruction and INSTALL a new fan as necessary. Cooling Fan Motor and Shroud - Vehicles With: Supercharger (26.25.25)
P048316	Fan rationality check	• Fan control module reports battery voltage less than nine volts	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • CHECK the battery condition • CHECK the charging system and fan circuits
P048317	Fan rationality check	• Fan control module reports battery voltage greater than 18 volts	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • CHECK the charging system and fan circuits

P048397	Fan rationality check	Cooling fan jammed	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - CLEAR any obstruction and INSTALL a new fan as necessary. Cooling Fan Motor and Shroud - Vehicles With: Supercharger (26.25.25)
P048900	Exhaust Gas Recirculation (EGR) control circuit low	EGR valve power supply circuit - short to ground, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P049000	Exhaust Gas Recirculation (EGR) control circuit high	EGR valve control circuit - short to power	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P050082	Vehicle speed sensor malfunction	Vehicle speed - invalid signal received over CAN	Check ABS for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist

P050086	Vehicle speed sensor malfunction	Vehicle speed - invalid signal received over CAN	Check ABS for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
P050162	Vehicle speed sensor - range/performance - signal plausibility failure	Vehicle speed - range performance	Check for ABS/TCM DTCs and refer to DTC Index for speed sensor tests. Anti-Lock Control - Stability Assist Diagnostic Strategy
P050400	Brake switch A/B correlation	The brake pressure reading does not agree with the brake light switch value	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P050401	Brake switch A/B correlation	- Brake switch high fault: Brake lights stuck on Gearshift interlock inoperative Speed control inoperative - Brake switch low fault: Brake lights inoperative Gearshift stuck in Park Reduced engine braking	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P050600	Idle air control system RPM lower than expected	- Air intake restriction - Front End Accessory Drive (FEAD) overload (defective/seized component)	- Ensure the air intake system is free from restriction - Check the FEAD belt and components.

			Accessory Drive
P050624	Idle air control system RPM lower than expected	• Air intake restriction • Front End Accessory Drive (FEAD) overload (defective/seized component)	• Ensure the air intake system is free from restriction • Check the FEAD belt and components. Accessory Drive
P050700	Idle air control system RPM higher than expected	• Intake air leak between MAF sensor and engine • Engine crankcase breather leak	• Check for leakage and correct installation of air intake system • Check for leakage and correct installation of engine crankcase breather system
P050723	Idle air control system RPM higher than expected	• Intake air leak between MAF sensor and engine • Engine crankcase breather leak	• Check for leakage and correct installation of air intake system • Check for leakage and correct installation of engine crankcase breather system
P050B84	Cold start ignition timing performance	• Cold start emission reduction strategy engine spark timing too retarded	• Check for any engine ignition related DTCs also logged and refer to the DTC Index

P050B85	Cold start ignition timing performance	Cold start emission reduction strategy engine spark timing too advanced	Check for any engine ignition related DTCs also logged and refer to the DTC Index
P05120C	Starter request circuit	Crank request circuit - high input	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P05120E	Starter request circuit	Crank request circuit - low input	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P051300	Incorrect immobilizer key	Security key invalid	Check for CAN network interference/E MC related error. Re-synchronise ID by re-configuring the ECM and instrument cluster as new modules
P056013	System voltage	Battery back-up malfunction	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic

			system
P056100	System voltage unstable	System voltage comparison	Check for sensor 5 volt supply related DTCs and refer to DTC Index in this section
P056200	System voltage low	Sensor 5 volt power supply circuit - low input	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P056300	System voltage high	Sensor 5 volt power supply circuit - high input	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P057501	Speed control cancel button fault	Speed control cancel button fault	Check speed control system for DTCs and refer to DTC Index
P059000	Speed control multi-function input B circuit stuck	Active speed limiter fault	Check speed control system for DTCs and refer to DTC Index
P060143	Internal control module memory check sum error - special memory failure	CPU communication - sub	Refer to new module/component installation Note at top of DTC Index

P060145	Internal control module memory check sum error - program memory failure	• CPU communication	• Refer to new module/component installation Note at top of DTC Index
P060442	Internal control module Random Access Memory (RAM) error - general memory failure	• Initial RAM test	• Refer to new module/component installation Note at top of DTC Index
P060443	Internal control module Random Access Memory (RAM) error - special memory failure	• Shut off RAM test	• Refer to new module/component installation Note at top of DTC Index
P060444	Internal control module Random Access Memory (RAM) error - data memory failure	• RAM check sum	• Refer to new module/component installation Note at top of DTC Index
P060445	Internal control module Random Access Memory (RAM) error - program memory failure	• Initial RAM test	• Refer to new module/component installation Note at top of DTC Index
P060500	Internal control module Read Only Memory (ROM) error	• EEPROM/flash checksum error	• Configure the module using the Jaguar approved diagnostic system
P060529	Internal control module Read Only Memory (ROM) error	• ROM error	• Refer to new module/component installation Note at top of DTC Index
P060542	Internal control module Read Only Memory (ROM) error - general memory failure	• ROM check sum	• Refer to new module/component installation Note at top of

			DTC Index
P060543	Internal control module Read Only Memory (ROM) error - special memory failure	Shut off ROM test	Refer to new module/component installation Note at top of DTC Index
P060544	Internal control module Read Only Memory (ROM) error - data memory failure	Initial ROM test	Refer to new module/component installation Note at top of DTC Index
P060545	Internal control module Read Only Memory (ROM) error - program memory failure	Continuous ROM test	Refer to new module/component installation Note at top of DTC Index
P060546	Internal control module Read Only Memory (ROM) error	Continuous ROM test	Refer to new module/component installation Note at top of DTC Index
P060548	Internal control module Read Only Memory (ROM) error - supervision software failure	Shut off ROM test	Refer to new module/component installation Note at top of DTC Index
P060564	Internal control module Read Only Memory (ROM) error	ROM error - sub	Refer to new module/component installation Note at top of DTC Index
P060600	ECM/PCM processor fault	Watchdog error	Refer to new module/component installation Note at top of DTC Index
P060601	ECM/PCM processor fault - general electrical failure	Controller test - sub	Refer to new module/component installation

			Note at top of DTC Index
P060604	ECM/PCM processor fault	System internal failures	Refer to new module/component installation Note at top of DTC Index
P060605	ECM/PCM processor fault - system programming failures	Throttle return spring failure (throttle body failure)	Refer to new module/component installation Note at top of DTC Index
P060641	ECM/PCM processor fault - general checksum failure	Watch dog timer fault - sub	Refer to new module/component installation Note at top of DTC Index
P060642	ECM/PCM processor fault - general memory failure	Error capturing instructions	Refer to new module/component installation Note at top of DTC Index
P060643	ECM/PCM processor fault - special memory failure	Duplication memory fault	Refer to new module/component installation Note at top of DTC Index
P060644	ECM/PCM processor fault - data memory failure	Duplication memory fault - sub	Refer to new module/component installation Note at top of DTC Index
P060645	ECM/PCM processor fault - program memory failure	Detection of write to internal ROM	Refer to new module/component installation Note at top of DTC Index
P060646	ECM/PCM processor fault - calibration/parameter	Detection of write to	Configure the module using

	memory failure	internal ROM - sub	the Jaguar approved diagnostic system
P060647	ECM/PCM processor fault	• Watch dog timer fault	• Configure the module using the Jaguar approved diagnostic system
P060648	ECM/PCM processor fault - supervision software failure	• Scheduling sequence check	• Configure the module using the Jaguar approved diagnostic system
P060649	ECM/PCM processor fault - internal electronic failure	• Controller test	• Refer to new module/component installation Note at top of DTC Index
P060700	Control module performance	• Sub - CPU watch dog	• Refer to new module/component installation Note at top of DTC Index
P060D00	Internal control module accelerator pedal position performance	• APS Communication	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P060E62	Internal control module throttle position performance - signal compare failure	• Throttle motor amplifier failure for valve sensor malfunction	• Refer to new module/component installation Note at top of DTC Index

P060E64	Internal control module throttle position performance - signal plausibility failure	TPS Communication	Refer to new module/component installation Note at top of DTC Index
P060A64	Internal control module monitoring processor performance	Internal control module monitoring processor performance	Clear the DTC and retest. If the DTC resets, refer to new module/component installation Note at top of DTC Index
P060A67	Internal control module monitoring processor performance	Internal control module monitoring processor performance	Clear the DTC and retest. If the DTC resets, refer to new module/component installation Note at top of DTC Index
P061000	Control module vehicle options error	Car configuration data mismatch	Re-configure the RJB using the manufacturer approved diagnostic system
P061A00	Internal control module torque performance	Pedal follower error	Refer to new module/component installation Note at top of DTC Index
P061A29	Internal control module torque performance - signal invalid	Absolute engine torque calculation failure - sub-processor	Refer to new module/component installation Note at top of DTC Index
P061A64	Internal control module torque performance - signal plausibility failure	Absolute engine torque calculation failure	Refer to new module/component installation Note at top of

			DTC Index
P061B29	Internal control module torque calculation performance - signal invalid	Absolute and dynamic engine torque calculation failure	Refer to new module/component installation Note at top of DTC Index
P061B64	Internal control module torque calculation performance - signal plausibility failure	Absolute and dynamic engine torque calculation failure	Refer to new module/component installation Note at top of DTC Index
P062700	Fuel pump A control circuit/open	Fuel pump control circuit fault (FPDM to fuel pump)	Refer to the electrical circuit diagrams and check the FPDM to Fuel Pump circuit for short to ground, power, open circuit
P062A00	Fuel pump A control circuit range/performance	Invalid fuel pump duty requested by the ECM	Refer to the electrical circuit diagrams and test the ECM to FPDM monitor circuit for short to ground, power, open circuit
P063000	VIN not programmed or incompatible - ECM/PCM	CCF to CAN VIN mismatch	Configure the module using the Jaguar approved diagnostic system, clear DTC and re-test, if DTC remains suspect the ECM. Refer to the new module/component installation note at the top

			of the DTC Index
P068773	EMS control relay control circuit high	EMS control relay malfunction	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P072186	Output speed sensor circuit range/performance	TCM Output shaft speed sensor error received	For transmission tests. Diagnostic Strategy
P08170D	Starter relay circuit (break wire)	Starter relay circuit (break wire)	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P081A0B	Starter relay circuit low	Starter relay circuit low	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P081B0C	Starter relay circuit high	Starter relay circuit high	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic

			system
P08510E	Park/Neutral switch input circuit low	Park/Neutral switch input circuit - low	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P08520C	Park/Neutral switch input circuit high	Park/Neutral switch input circuit - high	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P114723	Intake Air Temperature Sensor 2 Circuit Range/Performance	NOTE: Intercooler air temperature sensor is integral to primary MAP sensor Intercooler air temperature sensor circuit - short, open circuit	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Refer to electrical circuit diagrams and check Intercooler air temperature sensor circuit for short, open circuit
P114724	Intake Air Temperature Sensor 2 Circuit Range/Performance	NOTE: Intercooler air temperature sensor is integral to primary MAP sensor Intercooler air	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic

		temperature sensor circuit - short, open circuit	system. Refer to electrical circuit diagrams and check Intercooler air temperature sensor circuit for short, open circuit
P114729	Intake Air Temperature Sensor 2 Circuit Range/Performance	NOTE: Intercooler air temperature sensor is integral to primary MAP sensor Intercooler air temperature sensor circuit - short, open circuit	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Refer to electrical circuit diagrams and check Intercooler air temperature sensor circuit for short, open circuit
P125900	Immobilizer to ECM signal error	Incorrect ID received from instrument cluster	Re-configure the instrument cluster using the manufacturer approved diagnostic system
P131500	Persistent misfire	- ECM to ignition coil primary circuit fault (cylinder misfire detected DTC also flagged) - Fuel injector circuit fault(s) (injector DTCs also flagged) - Fuel delivery pressure low - Spark plug failure/fouled/incorrect	- Check for cylinder misfire, ignition and injector DTCs and refer to the DTC Index - For fuel system tests. Fuel Tank and Lines - For spark plug

		- t gap - Cylinder compression low	tests. Engine Ignition For cylinder compression tests. Engine
P131600	Misfire rate exceeds emissions thresholds	Misfire rate exceeds emissions thresholds	Check for individual cylinder misfire DTCs and refer to DTC Index in this section
P136700	Ignition amplifier group A	Ignition module/coil monitoring circuit - short to ground, short to power, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P136800	Ignition amplifier group B	Ignition module/coil monitoring circuit - short to ground, short to power, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P160300	EEPROM error	ECM fault	Refer to new module/component installation note at top of DTC Index
P162600	ECM electronic throttle monitoring/self test - torque monitoring problem	Dynamic torque monitoring error	Suspect the ECM, refer to new module/component installation note at top of

			DTC Index
P209600	Fuel trim too lean, bank 1	• Heated Oxygen Sensor (HO2S) fuel adaption - lean	• Check integrity and correct installation of air intake system • Check for any HO2S codes also logged and refer to DTC Index in this section
P209700	Fuel trim too rich, bank 1	• Heated Oxygen Sensor (HO2S) fuel adaption - rich	• Check integrity and correct installation of air intake system • Check for any HO2S codes also logged and refer to DTC Index in this section
P209800	Fuel trim too lean, bank 2	• Heated Oxygen Sensor (HO2S) fuel adaption - lean	• Check integrity and correct installation of air intake system • Check for any HO2S codes also logged and refer to DTC Index in this section
P209900	Fuel trim too rich, bank 2	• Heated Oxygen Sensor (HO2S) fuel adaption - rich	• Check integrity and correct installation of air intake system • Check for any HO2S codes also logged and refer to DTC Index in this

			section
P210129	Throttle actuator control motor circuit range/performance	Jammed throttle blade, gearing or motor	- Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body. Refer to the new module/component installation note at the top of the DTC Index
P210162	Throttle actuator control motor circuit range/performance	Jammed throttle blade, gearing or motor	Refer to the electrical circuit diagrams and test throttle actuator control motor circuit for short to ground, power, high resistance. Compare throttle position sensor 1 and 2 datalogger signals, if signals are comparable install a new throttle body. Throttle Body (19.70.04)
P210164	Throttle actuator control motor circuit range/performance	Jammed throttle blade, gearing or motor	Carry out the pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system • Install a new throttle body. Refer to the new module/component installation note at the top of the DTC Index
P210177	Throttle actuator motor control circuit range/performance	• Throttle blade stuck open • Intake air system leak	• Check for throttle related DTCs and refer to DTC Index in this section • Check intake air system for leaks
P210329	Throttle actuator motor control circuit high	• Throttle motor control circuit - short to power • ECM fault	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Refer to new module/component installation note at top of DTC Index
P210364	Throttle actuator motor control circuit high - signal plausibility failure	• Throttle motor control circuit - short to power • ECM fault	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Refer to new module/component installation note at top of

			DTC Index
P210500	Throttle actuator control system - forced engine shutdown	Throttle MIL request due to fuel cut	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P210629	Throttle actuator control system - forced limited power	Signal invalid	Install a new throttle body. Throttle Body (19.70.04) Refer to new module/component installation note at top of DTC Index
P210664	Throttle actuator control system - forced limited power	Signal plausibility failure	Install a new throttle body. Throttle Body (19.70.04) Refer to new module/component installation note at top of DTC Index
P211800	Throttle actuator motor control current range/performance	Throttle motor control circuit - short to ground, power, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P211900	Throttle actuator control throttle body range/performance	Throttle spring faulty	Install a new throttle body. Throttle Body (19.70.04) Refer to new module/component

			nent installation note at top of DTC Index
P212200	Accelerator pedal position (APP) sensor D circuit low input	APP sensor circuit 2 - low input	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P212300	Accelerator pedal position (APP) sensor D circuit high input	APP sensor circuit 2 - high input	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P213528	Accelerator pedal position (APP) sensor 1 and 2 voltage correlation	APP sensor circuit 1 and 2 range performance - sub-processor	Check APP sensor circuits 1 and 2 for short to ground, power and high resistance. Clear the DTCs and retest. If the code remains, replace the APP sensor
P213529	Accelerator pedal position (APP) sensor 1 and 2 voltage correlation	APP sensor - excessive difference between raw values of circuit 1 and 2 - sub-processor	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P213562	Accelerator pedal position	APP sensor circuit 1	Check APP

	(APP) sensor 1 and 2 voltage correlation	and 2 range performance - sub-processor	sensor circuits 1 and 2 for short to ground, power and high resistance. Clear the DTCs and retest. If the code remains, replace the APP sensor
P213564	Accelerator pedal position (APP) sensor 1 and 2 voltage correlation	APP sensor circuit 1 and 2 range performance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P222800	Barometric pressure circuit low input	BARO sensor failure (internal ECM fault)	Refer to new module/component installation note at top of DTC Index
P222900	Barometric pressure circuit high input	BARO sensor failure (internal ECM fault)	Refer to new module/component installation note at top of DTC Index
P240100	Evaporative emission (EVAP) system leak detection pump control circuit low	DMTL pump circuit - short to ground	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P240200	Evaporative emission (EVAP) system leak detection pump control circuit high	DMTL pump circuit - short to power	Carry out the pinpoint tests associated with this DTC using

			the manufacturer approved diagnostic system
P240429	Evaporative emission (EVAP) system leak detection pump sensing circuit range/performance	• DMTL reference leak • DMTL pump circuit - short to ground, power, high resistance • DMTL pipework blocked/leaking	• For evaporative emissions system tests. Evaporative Emissions
P24042F	Evaporative emission (EVAP) system leak detection pump sensing circuit range/performance - signal erratic	• DMTL reference leak • DMTL pump circuit - short to ground, power, high resistance • DMTL pipework blocked/leaking	• For evaporative emissions system tests. Evaporative Emissions
P240500	Evaporative emission (EVAP) system leak detection pump sensing circuit low	• DMTL pump circuit - short to ground, power, high resistance	• For evaporative emissions system tests. Evaporative Emissions
P240600	Evaporative emission (EVAP) system leak detection pump sensing circuit high	• DMTL pump circuit - short to ground, power, high resistance	• For evaporative emissions system tests. Evaporative Emissions
P240B00	Evaporative emission (EVAP) system leak detection pump heater circuit low	• DMTL heater control circuit low	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P240C00	Evaporative emission (EVAP) system leak detection pump heater circuit high	• DMTL heater control circuit high	• Carry out the pinpoint tests associated with this DTC using the manufacturer

			approved diagnostic system
P243100	Secondary air injection manifold absolute pressure sensor circuit range/performance	• Secondary air injection system leaks • Secondary air injection pump • Secondary air injection valve	• Check the secondary air injection system for leaks • Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P243200	Secondary air injection manifold absolute pressure sensor circuit low	• Secondary air injection manifold absolute pressure sensor circuit - short to ground, high resistance	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P243300	Secondary air injection manifold absolute pressure sensor circuit high	• Secondary air injection manifold pressure (MAP) sensor circuit - short to power	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P244400	Secondary air injection system pump stuck ON	• Secondary air injection pump control circuit - short to ground	• Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic

			system
P244500	Secondary air injection system pump stuck OFF	Secondary air injection pump control circuit - short to power	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P245000	Evaporative emission (EVAP) system change-over valve (COV) performance/stuck open	DMTL system circuit - short to ground, power, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P245100	Evaporative emission (EVAP) system change-over valve (COV) performance/stuck closed	DMTL system circuit - short to ground, power, high resistance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P260100	Coolant Pump Control Circuit Range/Performance	Coolant Pump Control Circuit Range/Performance	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Refer to electrical circuit diagrams and check coolant pump control circuit for short, open

			circuit
P261064	ECM/PCM Internal engine off timer performance	- ECT sensor fault - Ambient temperature sensor fault - Body processor module fault (time) - CAN error	Check for DTCs indicating a fault with any of the components listed, and refer to relevant DTC Index
P261087	ECM/PCM Internal engine off timer performance	- ECT sensor fault - Ambient temperature sensor fault - Body processor module fault (time) - CAN error	Check for DTCs indicating a fault with any of the components listed, and refer to relevant DTC Index
U007300	Control module communication bus off	CAN Link circuit malfunction	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U010100	Lost communication with TCM	CAN Link ECM/TCM network malfunction	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U010300	Lost communication with gear shift control module	CAN Link ECM/gear shift network malfunction	Carry out the pinpoint tests associated with this DTC using the manufacturer

			approved diagnostic system
U010400	Lost communication with speed control module	CAN Link ECM/speed control module network malfunction	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U012100	Lost communication with anti-lock brake system (ABS) control module	CAN Link ECM/ABS module network malfunction	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U012800	Lost communication with electronic parking brake control module	CAN Link ECM/Electronic parking brake signal missing network malfunction	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U015100	Lost communication with restraints control module/inertia switch	Lost communication - CAN or hardwired	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U01511F	Lost communication with restraints control module/inertia switch	Lost communication - SRS fault	Carry out the pinpoint tests associated with this DTC using

			the manufacturer approved diagnostic system
U015157	Lost communication with restraints control module/inertia switch	Lost communication - CAN fault	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U015500	Lost communication with instrument cluster	CAN Link ECM/instrument cluster network malfunction	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U016700	Lost communication with vehicle immobilizer	Security challenge response timeout	Carry out the pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U040208	Invalid data received from Transmission Control Module (TCM)	TCM engine speed control monitor	Check TCM for DTCs and refer to DTC Index. Diagnostic Strategy
U040264	Invalid data received from Transmission Control Module (TCM)	Actual gear position status	Check TCM for DTCs and refer to DTC Index. Diagnostic Strategy

U040267	Invalid data received from Transmission Control Module (TCM)	Selector lever position status	Check TCM for DTCs and refer to DTC Index. Diagnostic Strategy
U040281	Invalid data received from Transmission Control Module (TCM)	Output shaft speed signal	Check TCM for DTCs and refer to DTC Index. Diagnostic Strategy
U040282	Invalid Data Received From Transmission Control Module - TCM engine speed control monitor - plausibility (TCM alive counter)	- CAN Bus circuit fault - Circuit fault in supply voltage to transmission control module	Check the transmission control module for related stored DTCs. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network to the transmission control module. Refer to the electrical circuit diagrams and check the power and ground circuit to the transmission control module
U040283	Invalid data received from Transmission Control Module (TCM)	TCM engine speed control monitor - plausibility	Check TCM for DTCs and refer to DTC Index. Diagnostic Strategy
U040286	Invalid data received from Transmission Control Module (TCM)	TCM engine speed control monitor - rationality	Check TCM for DTCs and refer to DTC Index. Diagnostic Strategy
U040581	Invalid data received from speed control module	Invalid data received from speed control module	Check speed control module for DTCs and refer to DTC Index.

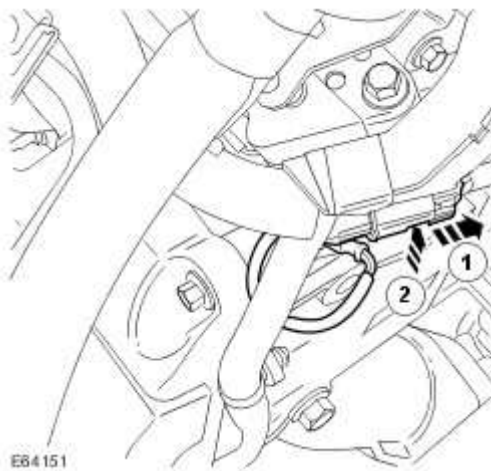
			Speed Control
U040583	Invalid data received from speed control module	Invalid data received from speed control module	Check speed control module for DTCs and refer to DTC Index. Speed Control
U04058F	Invalid data received from speed control module	Invalid data received from speed control module	Check speed control module for DTCs and refer to DTC Index. Speed Control
U041500	Invalid data received from Anti-lock Brake System (ABS) control module	Brake Position Switch	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
U041564	Invalid data received from Anti-lock Brake System (ABS) control module	Engine drag torque control monitoring - plausibility	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
U041567	Invalid data received from Anti-lock Brake System (ABS) control module	Engine drag torque control monitoring - rationality	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
U042386	Invalid data received from instrument cluster - signal	Battery voltage level	Check instrument

	invalid		cluster for DTCs and refer to DTC Index. Instrument Cluster
U042481	Invalid data received from instrument cluster	External ambient temperature	Check instrument cluster for DTCs and refer to DTC Index. Instrument Cluster
U042600	Invalid data received from vehicle immobilizer	Security code mismatch	Check CAN network between ECM and instrument cluster. Check power and grounds to ECM and instrument cluster. Check correct ECM and instrument cluster installed. Re-synchronise ID by re-configuring the ECM and instrument cluster as new modules
U206400	Warning indicator requested by another control module	Fuel Cut	Set ignition to ON, then OFF (wait 30 seconds), then ON (wait 4 seconds)
Removal and installation			

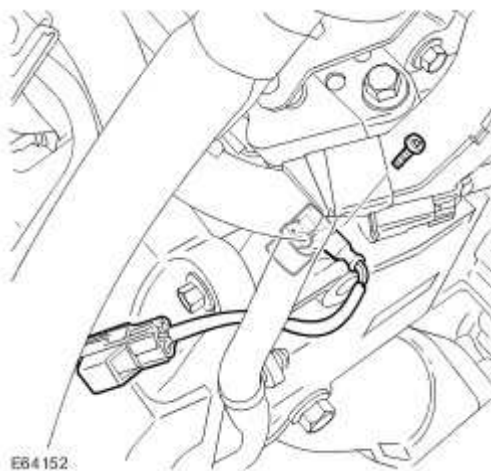
Camshaft Position (CMP) Sensor LH (18.31.12)

Removal

- 1 . Remove the intake air resonator.
For additional information, refer to [Intake Air Resonator](#)
- 2 . Disconnect the CMP sensor electrical connector.
▶ Slide the red connector latch to one side.



- 3 . Remove the CMP sensor.
▶ Remove the Torx bolt.
▶ Remove and discard the O-ring seal.



Installation

1 . Install the CMP sensor.

- ▶ Clean the components.
- ▶ Install a new O-ring seal.
- ▶ Tighten the Torx bolt to 7 Nm (5 lb.ft).
- ▶ Connect and secure the electrical connector.

2 . Install the intake air resonator.

For additional information, refer to [Intake Air Resonator](#)

Camshaft Position (CMP) Sensor RH (18.31.11)

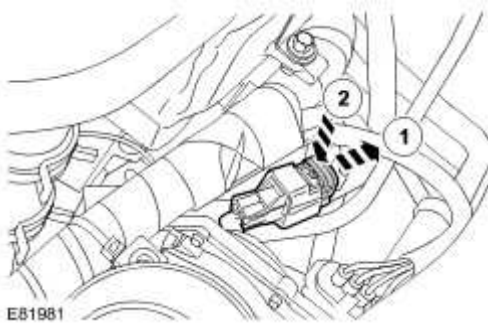
Removal

- 1 . Remove the intake air resonator.
For additional information, refer to [Intake Air Resonator](#)

- 2 . Release the engine wiring harness.
▶ Remove the 2 bolts.



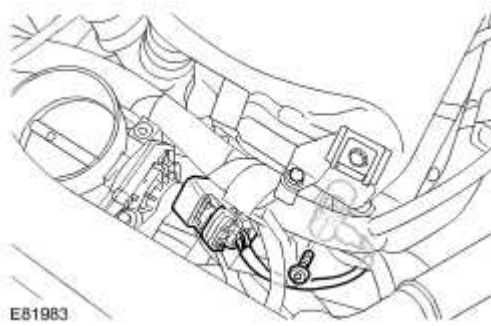
- 3 . Disconnect the CMP sensor electrical connector.
▶ Slide the red connector latch to one side.



- 4 . Release the CMP sensor electrical connector.
▶ Release the clip.

- 5 . Remove the CMP sensor.
▶ Remove the Torx bolt.

- ▶ Remove and discard the O-ring seal.



Installation

- 1 . Install the CMP sensor.
 - ▶ Clean the components.
 - ▶ Install a new O-ring seal.
 - ▶ Tighten the Torx bolt to 7 Nm (5 lb.ft).
 - ▶ Connect and secure the electrical connector.
- 2 . Attach the engine wiring harness.
 - ▶ Tighten the bolts to 10 Nm (7 lb.ft).
- 3 . Install the intake air resonator.

For additional information, refer to [Intake Air Resonator](#)

Catalyst Monitor Sensor (18.30.66)

Removal

1. Remove the cover and disconnect the battery ground cable.

For additional information, refer to [Specifications](#)

2



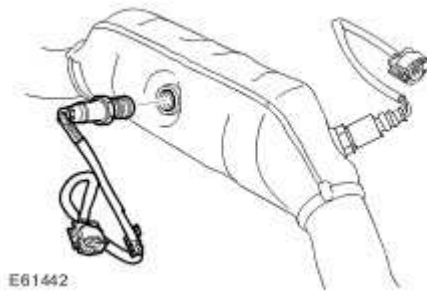
- **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

3. Remove the exhaust system.

For additional information, refer to [Catalytic Converter \(17.50.05\)](#)

4. Remove the catalyst monitor sensor.



Installation

1



- **WARNING: Make sure the H02S wiring harness is not twisted more than 180 degrees and is not in contact with the exhaust.**



- **CAUTION: Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.**

Install the catalyst monitor sensor and tighten to 45 Nm (33 lb.ft).

- Clean the component mating faces.
- Apply an anti-seize compound to the thread of the sensor.

2 . Install the exhaust system.

For additional information, refer to [Catalytic Converter \(17.50.05\)](#)

3 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

4 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](#)

Crankshaft Position (CKP) Sensor (18.30.12)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)

2



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

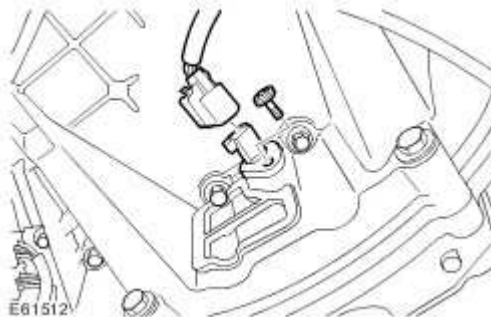
Raise and support the vehicle.

- 3 . **NOTE:**

Clean the components general area prior to dismantling.

Remove the crankshaft position (CKP) sensor.

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



Installation

- 1 . Install the CKP sensor.
 - ▶ Clean the component mating faces.
 - ▶ Tighten the Torx screw to 8 Nm (6 lb.ft).
 - ▶ Connect the electrical connector.
- 2 . Connect the battery ground cable and install the cover.
For additional information, refer to [Specifications](#)

Engine Control Module (ECM) (18.30.01)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)

- 2 . Remove the air intake cover.
▶ Remove the 4 clips.

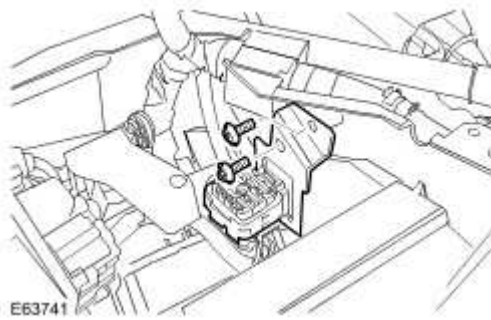


- 3 . Release the power distribution box and position aside.
▶ Remove the 2 Torx bolts.

- 4 . Disconnect the engine harness electrical connector.
▶ Loosen the bolt.



- 5 . Release the electrical connector.
▶ Remove the 2 Torx screws.
▶ Carefully tie the harness aside.

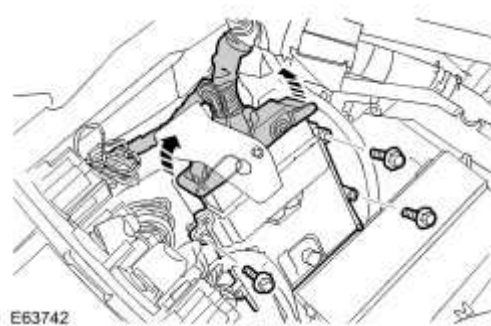


6 . NOTE:

RH illustration shown, LH is similar

Remove the engine control module (ECM).

- ▶ Remove the 3 bolts.
- ▶ Release and disconnect the 2 engine harness electrical connectors.



Installation

1 . Install the ECM.

- ▶ Tighten the bolts to 10 Nm (7 lb.ft).
- ▶ Connect the ECM electrical connectors.

2 . Install the electrical connector.

- ▶ Tighten the Torx screws.

3 . Connect and secure the electrical connector.

- ▶ Tighten the center bolt.

4 . Position and install the power distribution box.

- ▶ Tighten the Torx bolts to 8 Nm (6 lb.ft).

5 . Install the air intake cover.

 Carefully secure the clips.

6 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

7 . Using WDS, configure a new ECM.

Engine Coolant Temperature (ECT) Sensor (18.30.10)

Removal



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



CAUTION: Anti-freeze concentration must be maintained at 50%.

- 1 . Remove the cover and disconnect the battery ground cable.
- 2 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Disconnect the ECT sensor electrical connector.

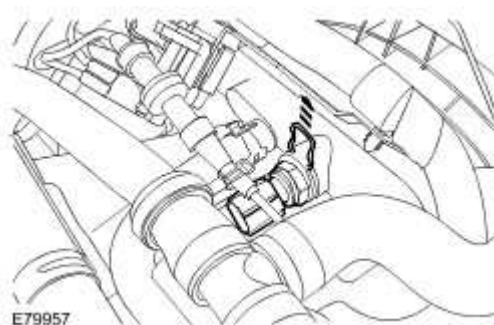
4



- **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 ECT sensor.

- Position an absorbent cloth to collect fluid spillage.
- Remove the retaining clip.
- Remove and discard the O-ring seal.



Installation

1 . Install the ECT sensor.

-  Install the O-ring seal.
-  Install the retaining clip.
-  Connect the electrical connector.

2 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

3 . Top-up the coolant.

4 . Connect the battery ground cable and install the cover.

Fuel Rail Pressure (FRP) Sensor (18.30.98)

Removal



WARNING: 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.

- 1 . Remove the cover and disconnect the battery ground cable.
- 2 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Disconnect the fuel rail pressure (FRP) sensor electrical connector.



4



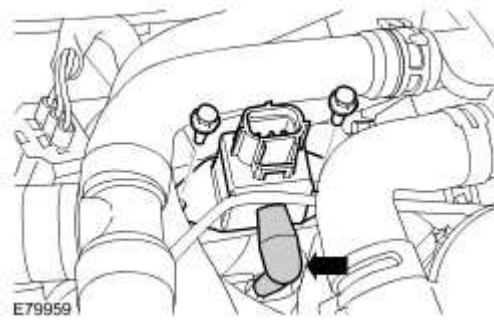
WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



CAUTION: Always plug any open connections to prevent contamination.

Remove the FRP sensor.

- Disconnect the vacuum line.
- Position an absorbent cloth to collect fluid spillage.
- Remove the 2 bolts.
- Remove and discard the 2 O-ring seals.



Installation

- 1  **WARNING:** After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

Install the FRP sensor.

- Clean the components.
- Install new O-ring seals.
- Tighten the bolts to 5 Nm (4 lb.ft).
- Connect the electrical connector.
- Connect the vacuum line.

- 2 . Install the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Connect the battery ground cable and install the cover.

Fuel Temperature Sensor (18.30.99)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to [Specifications](#)

- 2 . Remove the intake air resonator.

For additional information, refer to [Intake Air Resonator](#)

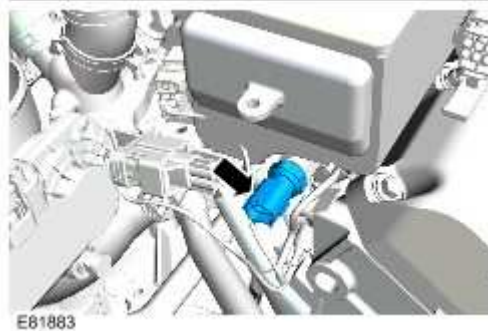
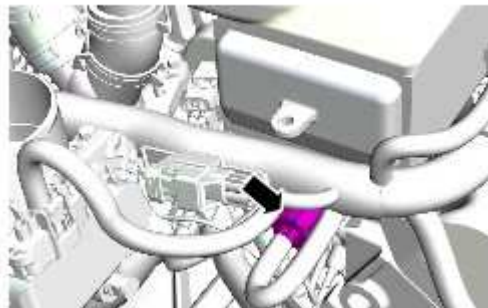
3



- **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 temperature sensor.

▶ Disconnect the electrical connector.



Installation

- 1 . Install the fuel temperature sensor.

▶ Clean the component mating faces.

▶ Apply sealant to the sensor thread.

 Tighten the sensor to 7 Nm (5 lb.ft).

 Connect the electrical connector.

2 . Install the intake air resonator.

For additional information, refer to [Intake Air Resonator](#)

3 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

Heated Oxygen Sensor (HO2S)

Removal

1. Remove the cover and disconnect the battery ground cable.

For additional information, refer to [Specifications](#)

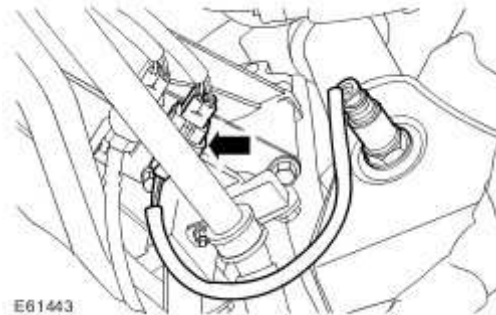
2.  **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

3. Release and disconnect the heated oxygen sensor (HO2S) electrical connector.

4.  **WARNING: Do not twist the HO2S wiring harness on removal. Failure to follow this instruction may result in damage to the component.**

Remove the HO2S.



Installation

1.  **WARNING: Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with the exhaust.**

 **CAUTION: Make sure the anti-seize compound does not contact the HO2S tip.**

Install the HO2S to the catalytic converter and tighten to 45 Nm (33 lb.ft).

 Clean the component mating faces.

 Apply an anti-seize compound to the thread of the sensor.

2 . Connect and secure the electrical connector.

3 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

4 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](#)

Knock Sensor (KS) (18.30.69)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to [Specifications](#)

2



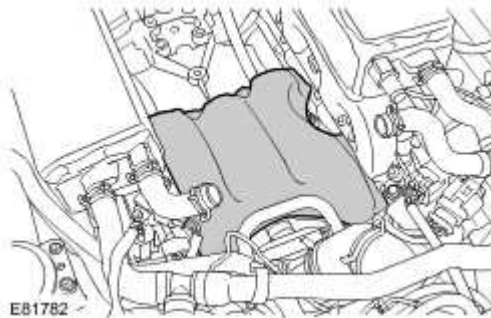
- **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

- 3 . Remove the supercharger.

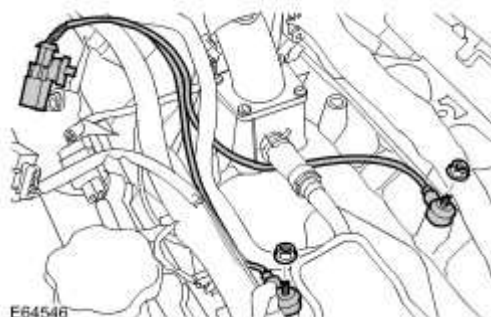
For additional information, refer to [Supercharger \(18.50.15\)](#)

- 4 . Remove the NVH pad.



- 5 . Remove the KS.

- ▶ Disconnect the electrical connector.
- ▶ Remove the 2 nuts.



Installation

1 . Install the KS.

 Tighten the nuts to 20 Nm (15 lb.ft).

 Connect the electrical connector.

2 . Install the NVH pad.

3 . Install the supercharger.

For additional information, refer to [Supercharger \(18.50.15\)](#)

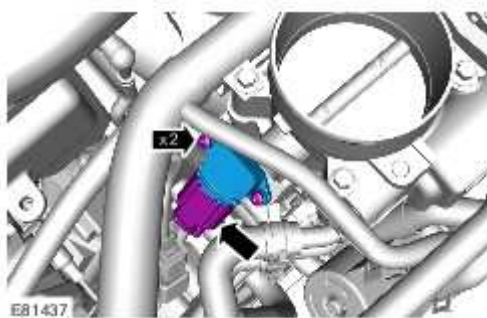
4 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

Manifold Absolute Pressure (MAP) Sensor (18.30.86)

Removal

- 1 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 2 . Remove the intake air resonator.
For additional information, refer to [Intake Air Resonator](#)
- 3 . Disconnect the MAP sensor electrical connector.
- 4 . Remove the MAP sensor.
 - ▶ Remove the 2 Torx screws.
 - ▶ Remove and discard the O-ring seal.



Installation

- 1 . Install the MAP sensor.
 - ▶ Clean the component mating faces.
 - ▶ Install a new O-ring seal.
 - ▶ Tighten the Torx screws.
 - ▶ Connect the electrical connector.
- 2 . Install the intake air resonator.
For additional information, refer to [Intake Air Resonator](#)
- 3 . Install the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)

4 **NOTE:**

- For NAS vehicles only.

If required, carry out a short drive cycle.

For additional information, refer to [Powertrain Control Module \(PCM\) Short Drive Cycle Self-Test](#)

Mass Air Flow (MAF) Sensor (18.30.15)

Removal

NOTE:

LH MAF sensor procedure shown, RH is similar.

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 air cleaner.

For additional information, refer to [Air Cleaner \(19.10.05\)](#)

Installation

1 . Install the air cleaner.

For additional information, refer to [Air Cleaner \(19.10.05\)](#)

2 **NOTE:**

- For NAS vehicles only.

If required, carry out a short drive cycle.

For additional information, refer to [Powertrain Control Module \(PCM\) Short Drive Cycle Self-Test](#)

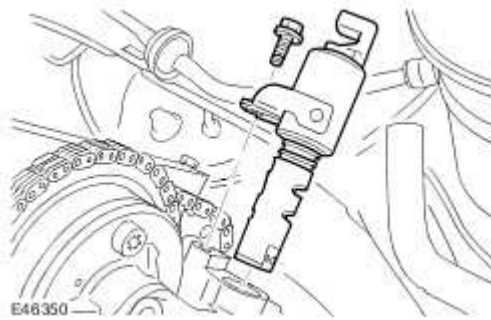
Variable Camshaft Timing (VCT) Oil Control Solenoid (18.30.90)

Removal

NOTE:

Removal of the RH is similar to this procedure.

- 1 . Remove the cover and disconnect the battery ground cable.
- 2 . Remove the LH valve cover.
For additional information, refer to [Valve Cover LH \(12.29.43\)](#)
- 3 . Remove the VCT oil control solenoid.
 - ▶ Remove the bolt.



Installation

- 1 . Install the VCT oil control solenoid.
 - ▶ Clean the components.
 - ▶ Tighten the bolt to 10 Nm (7 lb.ft).
- 2 . Install the LH valve cover.
For additional information, refer to [Valve Cover LH \(12.29.43\)](#)
- 3 . Connect the battery ground cable and install the cover.
- 4 **NOTE:**
 - For NAS vehicles only.

If required, carry out a short drive cycle.

For additional information, refer to [Powertrain Control Module \(PCM\) Short Drive Cycle Self-Test](#)

Brake Pedal Position (BPP) Switch

No Data Available

Oil Temperature Sensor (18.31.01)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to [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 [Radiator Splash Shield \(76.22.90\)](#)

- 4 . Remove the oil temperature sensor.

▶ Disconnect the electrical connector.



Installation

- 1 . Install the oil temperature sensor.

▶ Clean the components.
▶ Apply sealant of the correct specification to the sensor thread.
▶ Tighten the sensor to 15 Nm (11 lb.ft).
▶ Connect the electrical connector.

- 2 . Install the engine undershield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

- 3 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

Engine Oil Pressure (EOP) Sensor

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to [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 [Radiator Splash Shield \(76.22.90\)](#)

- 4 . Remove the EOP sensor.

▶ Disconnect the electrical connector.

Installation

- 1 . Install the EOP sensor.

▶ Clean the components.
▶ Apply sealant of the correct specification to the sensor thread.
▶ Tighten the sensor to 15 Nm (11 lb.ft).
▶ Connect the electrical connector.

- 2 . Install the engine undershield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

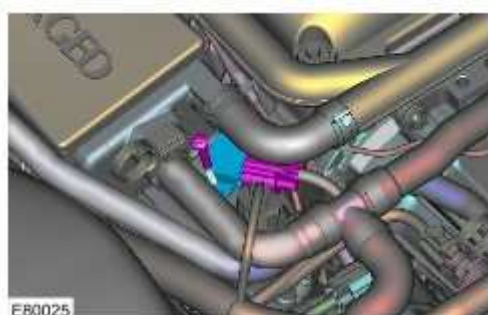
- 3 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

Intake Air Temperature (IAT) Sensor (18.30.52)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
- 2 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Disconnect the intake air temperature (IAT) sensor electrical connector.
- 4 . Remove the IAT sensor.
 - ▶ Remove the Torx screw.
 - ▶ Remove and discard the O-ring seal.



Installation

- 1 . Install the IAT sensor.
 - ▶ Clean the component mating faces.
 - ▶ Install a new O-ring seal.
 - ▶ Tighten the Torx screw.
 - ▶ Connect the electrical connector.
- 2 . Install the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Connect the battery ground cable and install the cover.

303-14B : Electronic Engine Controls – 4.2L NA V8 – AJV8

Specifications

Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Camshaft position sensor - bolt	7	5	62
Catalyst monitor sensor	45	33	-
Crankshaft position sensor - screw	7	5	62
Engine control module	10	7	88
Fuel rail pressure sensor	5	4	44
Fuel temperature sensor	7	5	62
Heated oxygen sensor	45	33	-
Knock sensor - nut	20	15	-
Knock sensor - stud	10	7	88
Oil pressure sensor	15	11	-
Oil temperature sensor	15	11	-
Variable camshaft timing, oil control solenoid - bolt	10	7	88

Powertrain Control Module (PCM) Long Drive Cycle Self-Test



WARNING: Where possible, all road tests should be on well surfaced and dry roads. Always comply with speed limits and local traffic regulations.

NOTE:

This procedure is an overcheck only. If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

NOTE:

The vehicle must exceed 50mph (80 km/h) during the road test.

1. Connect the diagnostic equipment to the vehicle.
2. Follow on screen prompts and check for engine management fault codes.
3. Clear the fault codes following the on screen procedure.
4. Disconnect the diagnostic equipment from the vehicle.

5. **NOTE:**

Make sure cruise control is not engaged.

Carry out a road test and perform the following operations.

- Accelerate to 55 mph (88 km/h) in 5th gear and cruise for 2 minutes with the engine speed at or above 1800rpm.
- Lift off the throttle and allow the vehicle to decelerate until the engine speed is less than 1000 rpm.
- Stop the vehicle.
- Release brake, allow the vehicle to move with no throttle for 1 minute.
- Road test is now complete.

6. Connect the diagnostic equipment to the vehicle.

7. **NOTE:**

If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

Follow on screen prompts and check for engine management fault codes.

8. Disconnect the diagnostic equipment from the vehicle.

Powertrain Control Module (PCM) Short Drive Cycle Self-Test

NOTE:

This procedure is an overcheck only. If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

1. Connect the diagnostic equipment to the vehicle.
2. Follow on screen prompts and check for engine management fault codes.
3. Clear the fault codes following the on screen procedure.
4. Start the engine.
 - Allow the engine to idle for 30 seconds.
 - Raise the engine speed to 1500 rpm and hold for 3 minutes until a temperature of 70°C (158 °F) is achieved.
 - Allow the engine to idle for 30 seconds.
 - Switch off the engine.
5. **NOTE:**

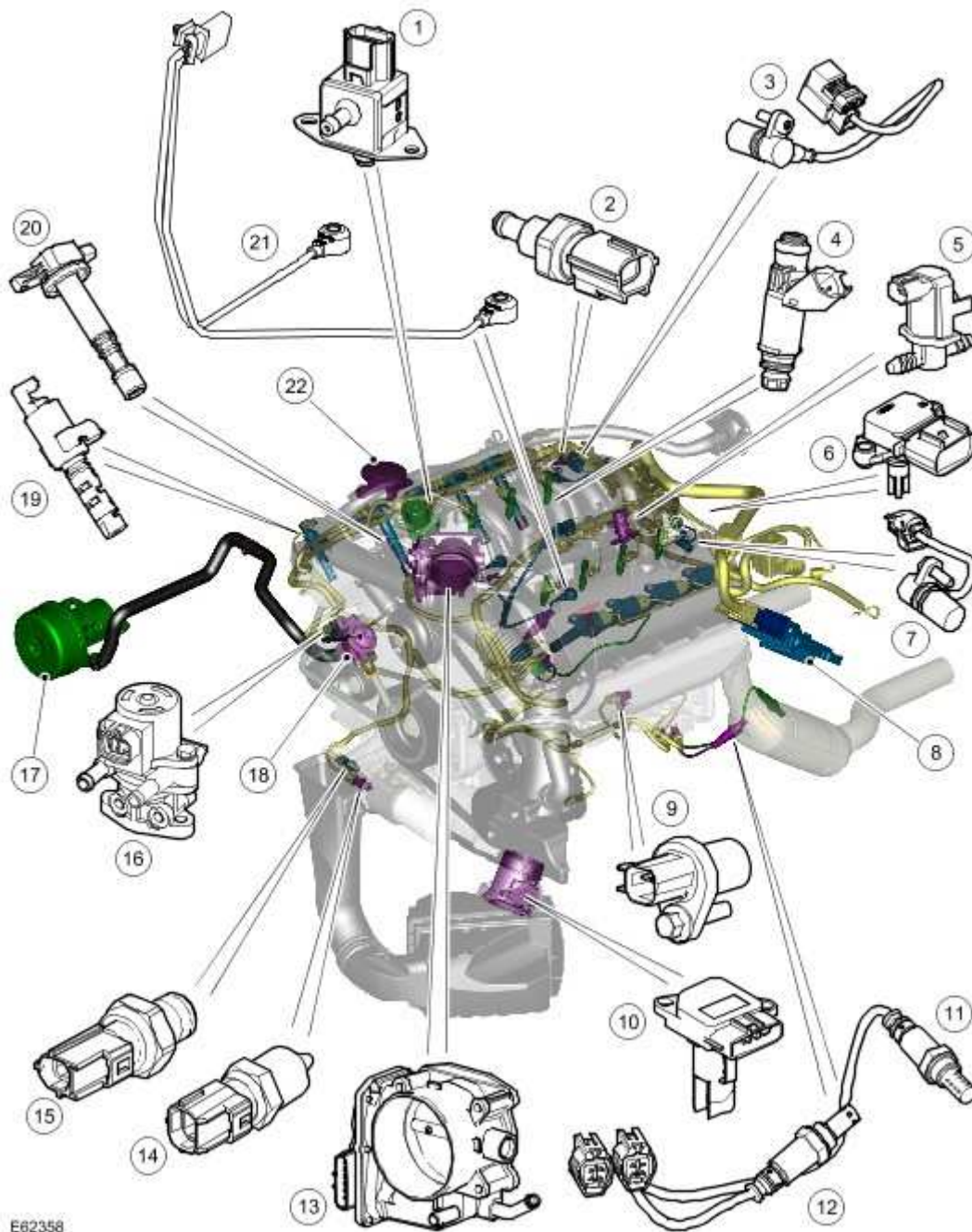
If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

Follow on screen prompts and check for engine management fault codes.

6. Disconnect the diagnostic equipment from the vehicle.

Electronic Engine Controls

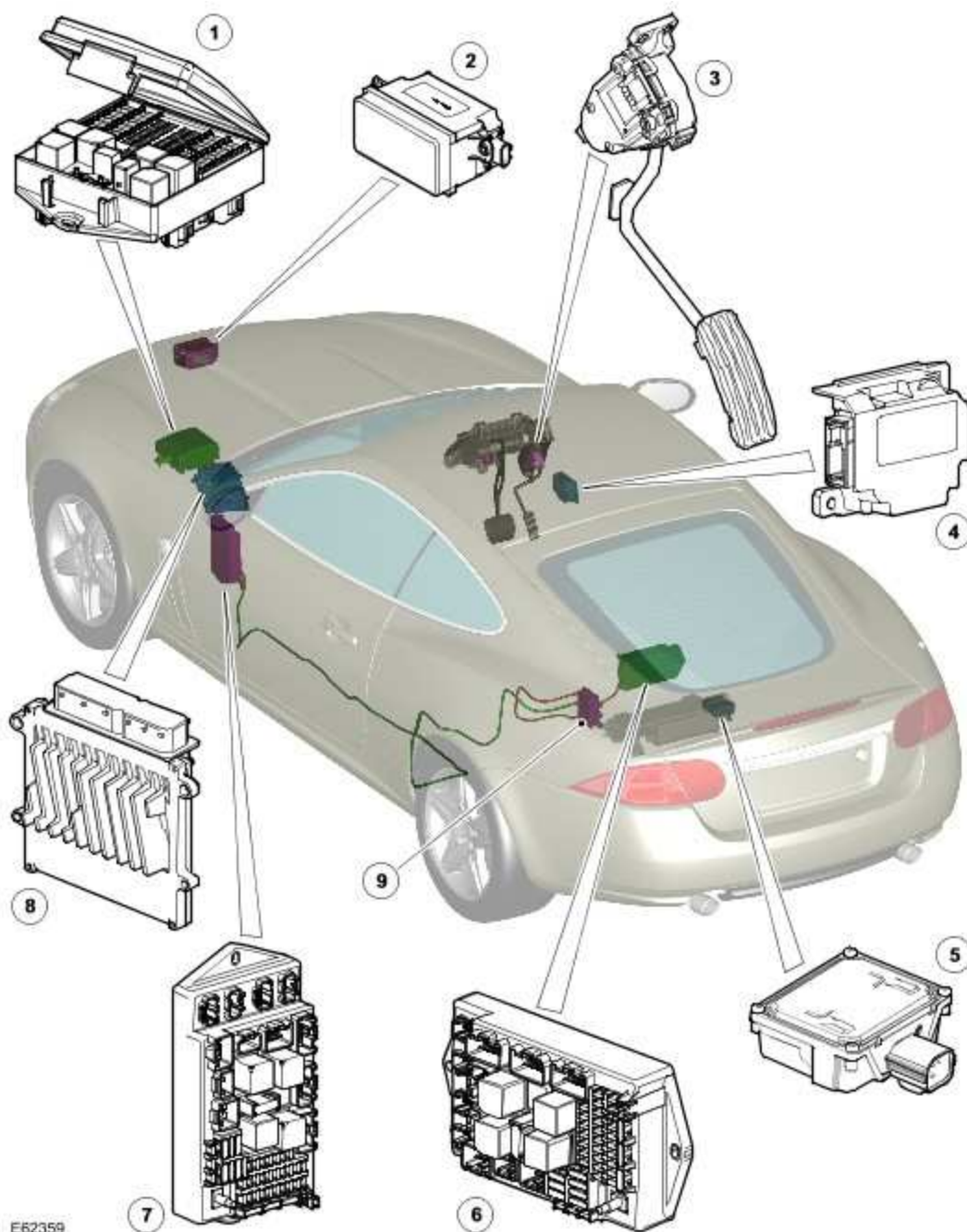
COMPONENT LOCATION SHEET 1 of 2



Item	Part Number	Description
1		Fuel rail pressure sensor

2		Fuel rail temperature sensor
3		CMP (camshaft position) sensor
4		Injector
5		Purge valve
6		MAP (manifold absolute pressure) sensor
7		CMP (camshaft position) sensor
8		ECM (engine control module)
9		CKP (crankshaft position) sensor
10		MAF (mass air flow) /IAT (intake air temperature) sensor
11		Downstream HO2S (heated oxygen sensor)
12		Upstream HO2S (heated oxygen sensor)
13		Electric throttle
14		Oil temperature sensor
15		Oil pressure sensor
16		EGR (exhaust gas recirculation) valve
17		Secondary air injection pump
18		Secondary air injection valve
19		Variable Valve timing solenoid
20		Ignition coil
21		Knock sensor
22		PCV (positive crankcase ventilation) valve

COMPONENT LOCATION SHEET 2 of 2



Item	Part Number	Description
1		Power distribution box
2		Adaptive speed control sensor (where fitted)
3		APP (accelerator pedal position) sensor
4		Adaptive speed control module (where fitted)
5		FPDM (fuel pump driver module)
6		Auxiliary junction box
7		CJB (central junction box)
8		ECM (engine control module)

INTRODUCTION

The V8 4.2 Liter naturally aspirated engine is controlled by an ECM (engine control module) 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

The ECM (engine control module) controls the engine fueling by providing sequential fuel injection to all cylinders. Ignition is controlled by a direct ignition system, provided by eight plug top coils. The ECM (engine control module) 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 (engine control module) uses a torque-based strategy to generate the torque required by the driver and other vehicle control modules. The EMS uses various sensors to determine the torque required from the engine. The EMS also interfaces with other vehicle electronic control modules's, via the CAN (controller area network) bus, to obtain additional information (e.g. road speed from the ABS (anti-lock brake system) control module). 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 comprises the following inputs:

- CMP (camshaft position) sensor
- CKP (crankshaft position) sensor
- Fuel rail pressure sensor
- MAF (mass air flow) sensor
- Knock sensors
- Fuel rail temperature sensor
- ECT (engine coolant temperature) sensor
- Engine oil temperature sensor
- MAP (manifold absolute pressure) sensor
- Electric throttle feedback sensor
- Secondary Air Injection (SAI) MAP (manifold absolute pressure) sensor
- APP (accelerator pedal position) sensor
- DMTL (NAS only)
- Cooling fan speed feedback.

- Heated Exhaust Gas Oxygen (HEGO) sensors
- Universal Heated Exhaust Gas Oxygen (UHEGO) sensors
- Brake switch
- Speed control cancel/suspend switch
- Automatic speed limiter switch
- Crank request signal
- IAT (intake air temperature) sensor
- External air temperature sensor

The EMS comprises the following outputs:

- Fuel injectors
- Ignition coils
- Engine cooling fan
- Electric throttle
- Electric fuel pump driver module
- VCT (variable camshaft timing) solenoids
- Purge valve
- EGR (exhaust gas recirculation) valve
- Secondary air injection pump
- Starter relay control

IGNITION MODES

The vehicle has a possible 4 ignition modes. The modes and systems that are active in each mode are detailed in the following table.

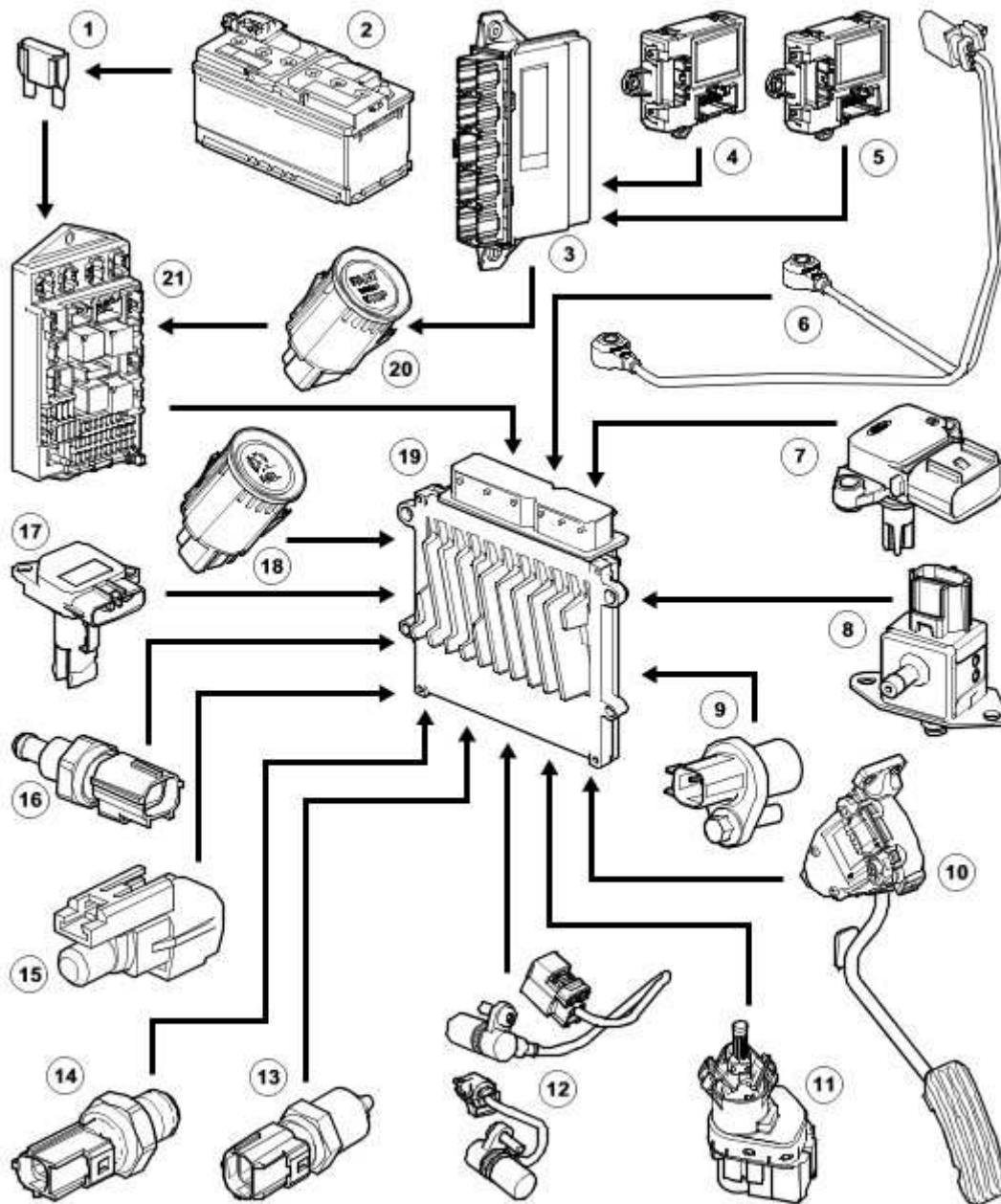
Ignition Mode	Off	Accessory (convenience)	On	Crank
Exterior lamps headlamps (dip only), approach lamps	Memory functions - Seat, steering column etc	Exterior lamps, fog lamps, direction indicator lamps	Stability controls	
Interior lighting	Manual seat adjustment, steering column	Convertible hood	Heated/cooled seats	
Preheat - timed in	Interior lighting	Wash/wipe	Adaptive speed control	
Electric park brake - On	Brake lights	HEVAC	Adaptive damping	
Instrument cluster - Stand by, Clock, Odometer	Exterior lighting auto headlamps, reversing lamps, side lamps, tail lamps	EMS	TPMS	
Hazard warning lamps	Infotainment previous condition (Preset volume), radio standby, phone standby, steering	Instrument cluster – dials and warnings, fuel gauge temperature gauge, lamp check	Pedestrian protection system	

	wheel switches			
Locking and Unlocking	Instrument cluster – message center, trip computer	Electric windows	Gearshift control & TCM (transmission control module)	
Security system	Horn	EPB – power to disengage (foot on break)	EPB – power to disengage	
	Cigar lighter/power socket	Restraints system check		

CONTROL DIAGRAM SHEET 1 of 3

NOTE:

A = Hardwired connection



E62360

A →

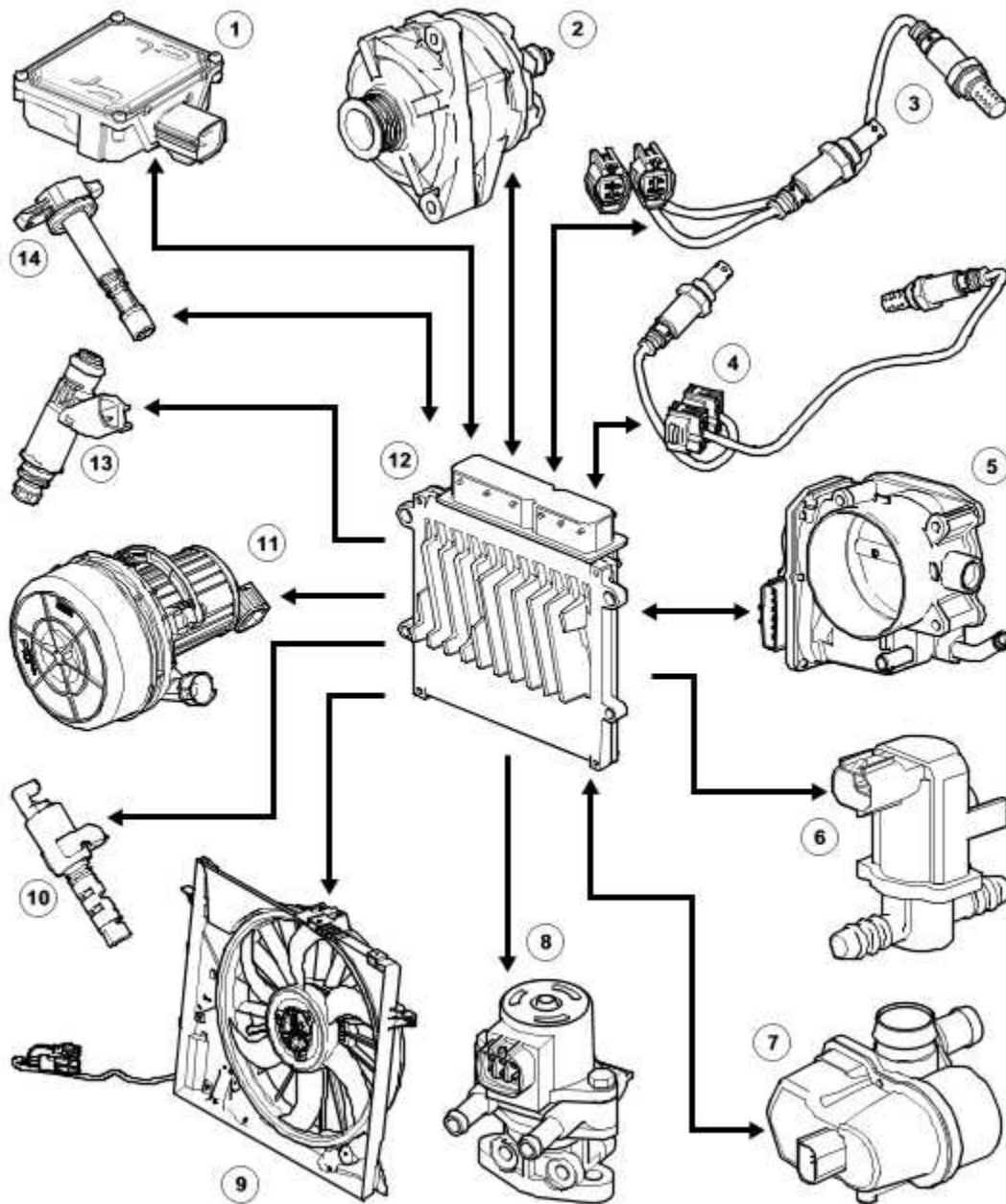
Item	Part Number	Description
1		Fuse
2		Battery
3		Keyless vehicle module
4		Door module
5		Door module
6		knock sensors
7		MAP (manifold absolute pressure) sensor
8		Fuel rail pressure sensor

9		CKP (crankshaft position) sensor
10		Stop lamp switch
11		Air temperature sensor
12		CMP (camshaft position) sensor
13		Engine coolant temperature sensor
14		Oil pressure sensor
15		APP (accelerator pedal position)
16		Fuel rail temperature sensor
17		MAF (mass air flow) /IAT (intake air temperature) sensor
18		Automatic Speed Limiter switch
19		ECM (engine control module)
20		Start/Stop switch

CONTROL DIAGRAM SHEET 2 of 3

NOTE:

A = Hardwired connection



E62361

A →

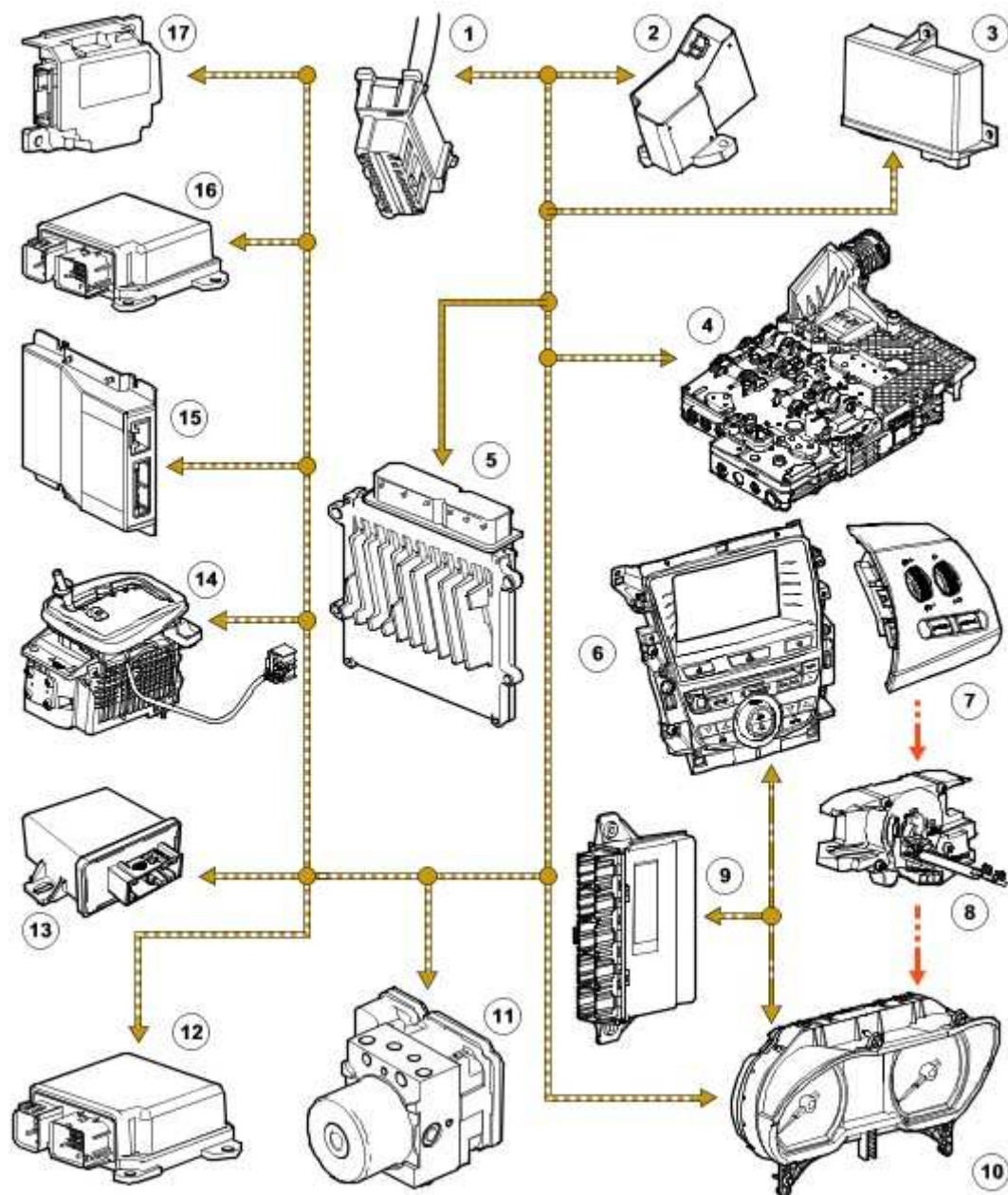
Item	Part Number	Description
1		FPDM (fuel pump driver module)
2		Generator
3		HO2S (heated oxygen sensor) (upstream)
4		HO2S (heated oxygen sensor) (downstream)
5		Electric throttle
6		Purge valve
7		DMTL pump
8		EGR (exhaust gas recirculation) valve

9		Engine cooling fan
10		VCT (variable camshaft timing) solenoid
11		Secondary air injection pump
12		ECM (engine control module)
13		Injector (8 off)
14		Ignition coil (8 off)

CONTROL DIAGRAM SHEET 3 of 3

NOTE:

D = High speed CAN (controller area network) bus; N=Medium speed CAN (controller area network) bus; O = LIN (local interconnect network) bus



E65886

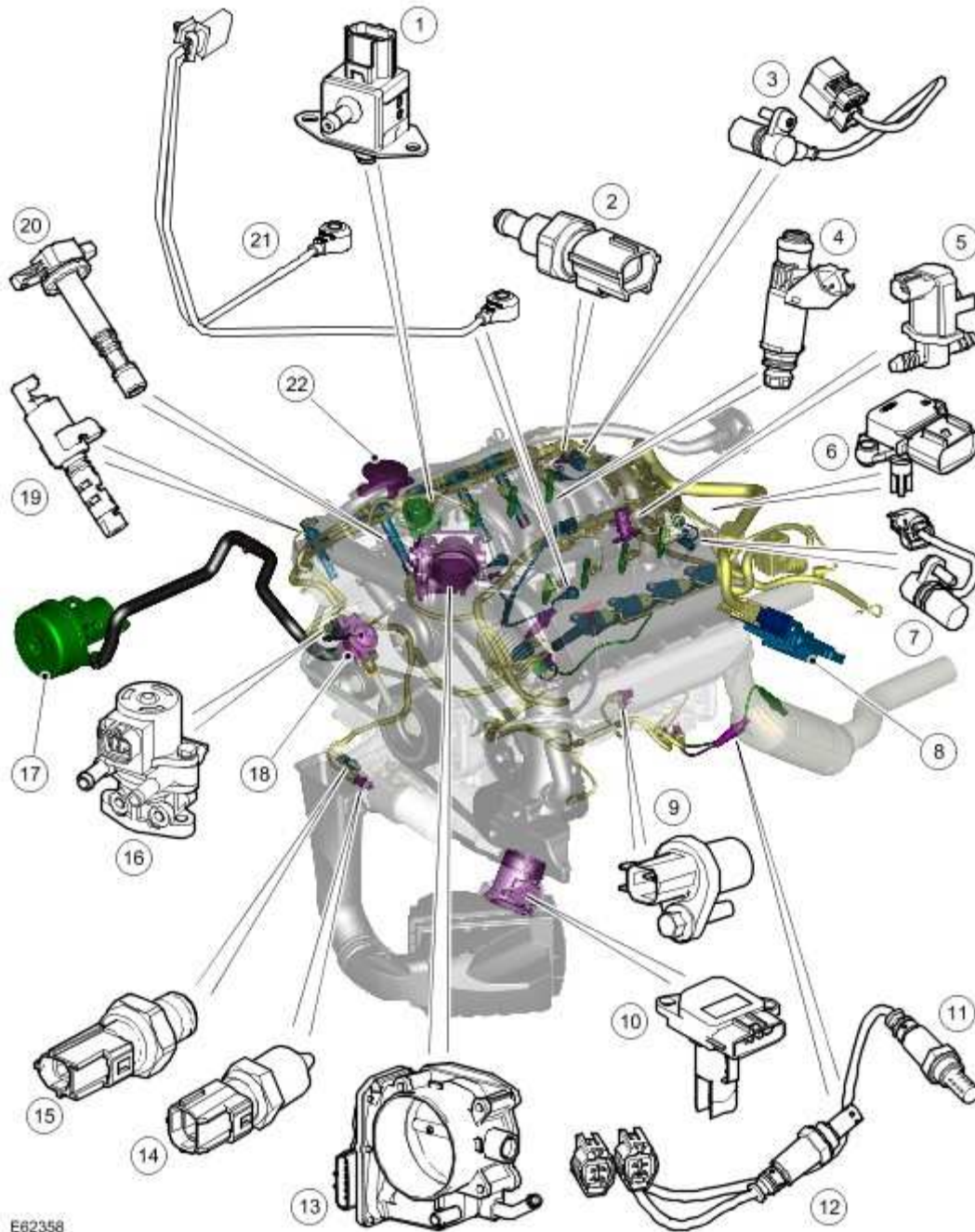


Item	Part Number	Description
1		Diagnostic socket
2		Steering column lock
3		Park brake module
4		TCM (transmission control module)
5		ECM (engine control module)
6		Integrated control panel
7		Steering wheel speed control switches
8		Rotary coupler

9		Keyless vehicle module
10		Instrument cluster
11		ABS (anti-lock brake system) control module
12		RCM (restraints control module)
13		Adaptive front lighting system control module
14		Gear shift module
15		Adaptive Damping Control Module (ADCM)
16		Pedestrian protection module
17		Adaptive speed control module

Electronic Engine Controls

COMPONENT LOCATION SHEET 1 of 2

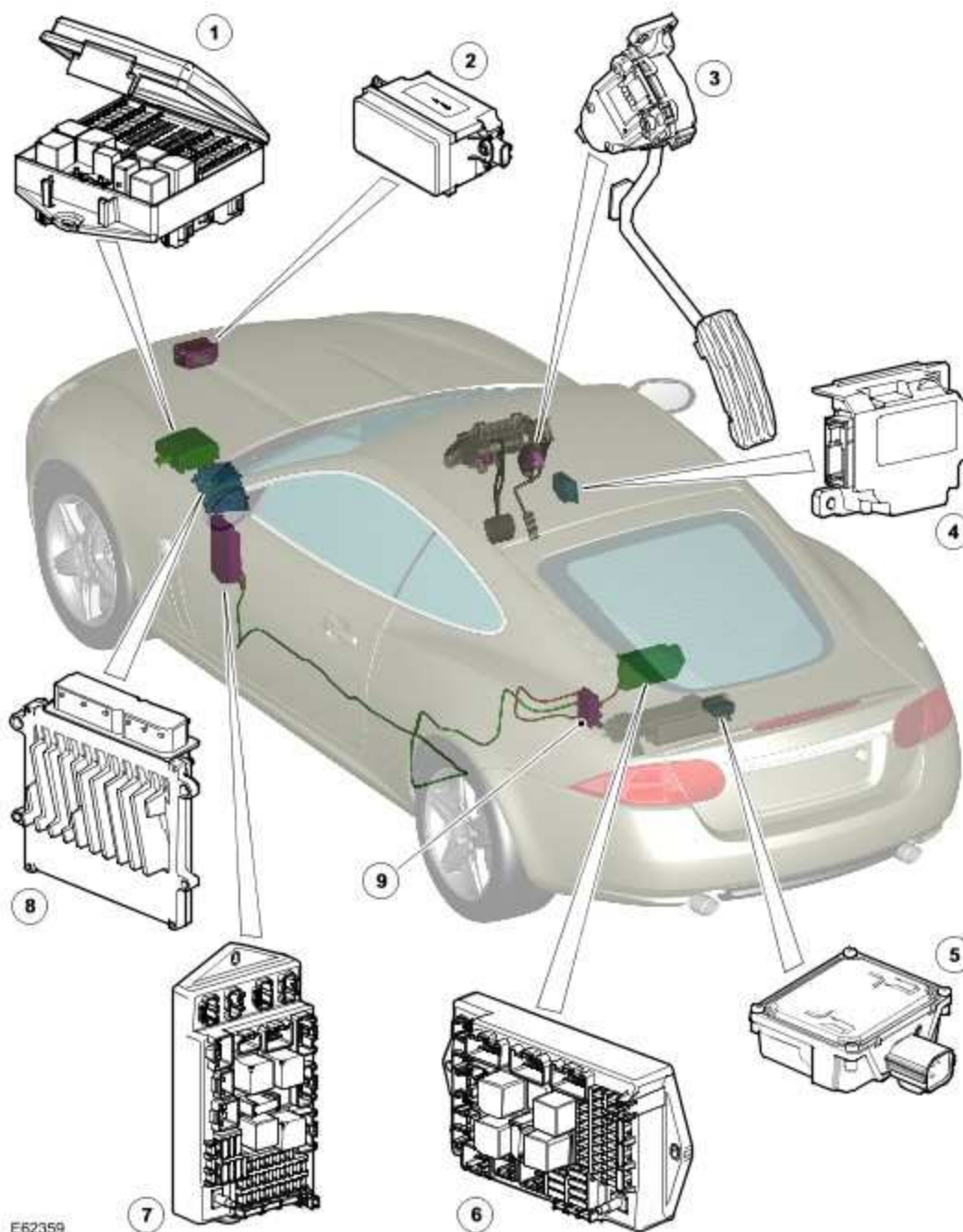


E62358

Item	Part Number	Description
1		Fuel rail pressure sensor
2		Fuel rail temperature sensor
3		Camshaft Position (CMP) sensor
4		Injector

5		Purge valve
6		Manifold Absolute Pressure sensor
7		Camshaft Position (CMP) sensor
8		Engine Control Module (ECM)
9		Crankshaft Position (CKP) sensor
10		Mass Air Flow(MAF)/Intake Air Temperature (IAT) sensor
11		Downstream Heated Oxygen Sensor (HO2S)
12		Upstream Heated Oxygen Sensor (HO2S)
13		Electric throttle
14		Oil temperature sensor
15		Oil pressure sensor
16		Exhaust Gas Recirculation (EGR) valve
17		Secondary air injection pump
18		Secondary air injection valve
19		Variable Valve timing solenoid
20		Ignition coil
21		Knock sensor
22		Positive Crankcase Ventilation (PCV) valve

COMPONENT LOCATION SHEET 2 of 2



E62359

Item	Part Number	Description
1		Power distribution box
2		Adaptive speed control sensor (where fitted)
3		Accelerator Pedal Position (APP) sensor
4		Adaptive speed control module (where fitted)
5		Fuel Pump Driver Module (FPDM)
6		Auxiliary junction box
7		Central Junction Box (CJB)
8		Engine Control Module (ECM)

INTRODUCTION

The V8 4.2 Liter naturally aspirated engine is controlled by an electronic Engine Management System (EMS). The 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

The ECM controls the engine fueling by providing sequential fuel injection to all cylinders. Ignition is controlled by a direct ignition system, provided by eight 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 control modules. The EMS uses various sensors to determine the torque required from the engine. The EMS also interfaces with other vehicle electronic control modules's, via the CAN bus, to obtain additional information (e.g. road speed from the ABS control module). 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 comprises the following inputs:

- CMP sensor
- CKP sensor
- Fuel rail pressure sensor
- MAF sensor
- Knock sensors
- Fuel rail temperature sensor
- ECT sensor
- Engine oil temperature sensor
- MAP sensor
- Electric throttle feedback sensor
- Secondary Air Injection (SAI) MAP sensor
- APP sensor
- DMTL (NAS only)
- Cooling fan speed feedback.
- Heated Exhaust Gas Oxygen (HEGO) sensors
- Universal Heated Exhaust Gas Oxygen (UHEGO) sensors

- Brake switch
- Speed control cancel/suspend switch
- Automatic speed limiter switch
- Crank request signal
- IAT sensor
- External air temperature sensor

The EMS comprises the following outputs:

- Fuel injectors
- Ignition coils
- Engine cooling fan
- Electric throttle
- Electric fuel pump driver module
- VCT solenoids
- Purge valve
- EGR valve
- Secondary air injection pump
- Starter relay control

IGNITION MODES

The vehicle has a possible 4 ignition modes. The modes and systems that are active in each mode are detailed in the following table.

Ignition Mode	Off	Accessory (convenience)	On	Crank
Exterior lamps headlamps – Dip only approach lamps	Memory functions seat, column etc	Exterior lamps fog lamps directional Indicators	Stability controls	
Interior lighting	Manual adjust seat column etc	Convertible hood	Heated/cooled Seat	
Preheat - timed in	Interior lighting	Wash/wipe	Adaptive speed control	
Electric park brake - On	Brake lights	HVAC	Adaptive damping	
Instrument cluster - stand by, clock, odometer	Exterior lighting auto headlamps, reversing lamps, side lamps, tail lamps	EMS	TPMS	
Hazard warning lamps	Auto infotainment previous condition (preset volume), radio standby, phone standby, steering wheel switches	Instrument cluster – dials and warnings fuel gauge temperature gauge lamp check	Pedestrian Protection system	
Locking and	Instrument cluster –	Windows	Gearshift	

unlocking	message center, trip computer		control & TCM
Security	Horn	EPB – power to disengage (foot on break)	EPB – power to disengage
	Cigar lighter/power socket	Restraints check	

COMPONENTS

Engine Control Module (ECM)

The ECM is located in the plenum area on the passenger side of the engine compartment attached to the bulkhead.

The ECM has the following inputs:

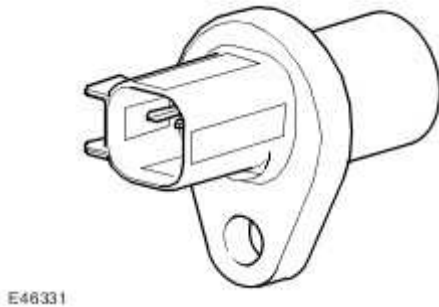
- RCM
- Park/neutral switch
- Ignition coil feedback x2
- Fuel rail temperature
- Mass air flow
- Engine speed
- Camshaft position x2
- Driver demand
- Brake pedal position switch
- Speed control switches
- Generator load
- Oxygen sensors pre catalyst x2
- Oxygen sensors post catalyst x2
- Throttle position
- Cooling fan speed
- Ignition switch position
- Knock sensors x2
- MAP
- Coolant temperature
- Engine oil temperature

The ECM outputs to the following:

- Throttle Actuator
- Brake vacuum pump relay
- Ignition coils (x8)
- Oxygen sensor heaters (4)
- Fuel injectors (8)
- Purge Valve
- Engine Cooling Fan

- Fuel pump relay
- Starter Relay
- EMS Main Relay
- Viscous Fan Control
- Generator Control
- Diagnostic Monitoring of Tank Leakage (DMTL) (NAS Only)
- E box fan

Crankshaft Position Sensor (CKP)

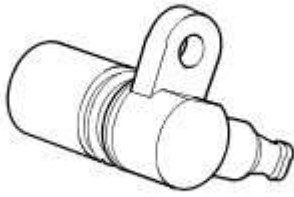


The crankshaft position sensor is mounted at the rear underside of the engine near the transmission bell housing. Connection between the sensor and the harness is via a link harness and a two-way connector. Both wires go directly to the ECM. The sensor produces the signal which enables the ECM to determine 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 degrees advance in timing will occur, as the electronics within the ECM uses the falling edge of the signal waveform as its reference / timing point for each tooth.

The reluctor is pressed into the flywheel and has a "tooth" pattern based on 36 teeth at 10° intervals and approximately 5° wide: one of the teeth is removed to provide a hardware reference mark which is 30 degrees BTDC (before top dead center) No.1 cylinder. Because of the crankshaft sensor's orientation, the target wheel uses windows stamped into the face, rather than actual teeth.

The sensor operates by generating an output voltage caused by the change in magnetic field that occurs as the windows pass in front of the sensor. The output voltage varies with the speed of the windows passing the sensor, the higher the engine speed, the higher the output voltage. Note that the output is also dependent on the air gap between the sensor and the teeth (the larger the gap, the weaker the signal, the lower the output voltage). The ECM transmits the engine speed to other vehicle control modules on CAN.

Camshaft Position Sensor (CMP)



E46332

Two sensors are located at the rear of the engine, in the cylinder head (one per bank), above the rear cylinders. The sensors are Variable Reluctor Sensor (VRS) type, producing four pulses for every two engine revolutions. The sensing element is positioned between 0 and 2mm from the side of the cam gear wheel.

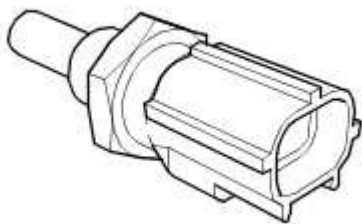
The camshaft timing wheel is a sintered component which has four teeth on it to enable the EMS to detect cylinder identification. The signal is used for:

- Cylinder recognition
- Enabling sequential fuel injection
- Knock control
- Cylinder identification for diagnostic purposes.

Failure symptoms include:

- Ignition timing reverting to the base mapping, with no cylinder correction.
- Active knock control is disabled, along with its diagnostic (Safe ignition map - loss of performance).
- Quick cam/crank synchronisation on start disabled.

Engine Coolant Temperature Sensor (ECT)



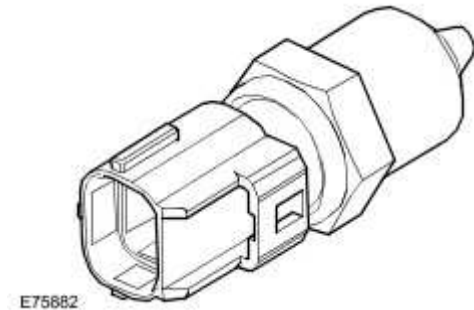
E47309

The sensor is located at the front of the engine in the water pipe below the throttle body. The ECT (engine coolant temperature) sensor is a thermistor used to monitor the engine coolant temperature. The engine coolant temperature sensor is vital to the correct running of the engine as a richer mixture is required at lower block temperatures for good quality starts and smooth running, leaning off as the temperature rises to maintain emissions and performance.

The sensor has an operating temperature range of -30 Degrees Celsius to 125 Degrees Celsius.

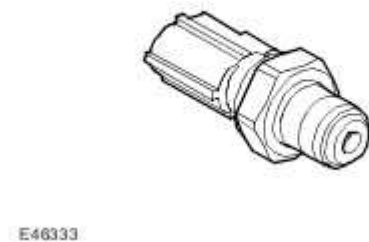
When a defective coolant sensor is detected, the ECM defaults to the oil temperature sensor value.

Engine Oil Temperature Sensor



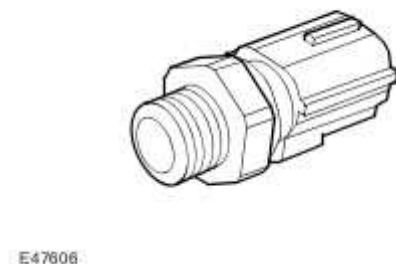
Oil temperature is monitored through a temperature sensor mounted in the oil system. This component is a NTC (negative temperature coefficient) type. The sensor is mounted next to the oil pressure sensor at the front of the engine and locates into the oil filter bracket.

Oil Pressure Sensor



The oil pressure sensor is located in the oil filter bracket adjacent to the oil temperature sensor. The sensor is hardwired to the instrument cluster and is used to illuminate the oil pressure warning indicator. The sensor switches on at pressures below 24.5kPa and is closed circuit at zero oil pressure.

Fuel Rail Temperature Sensor

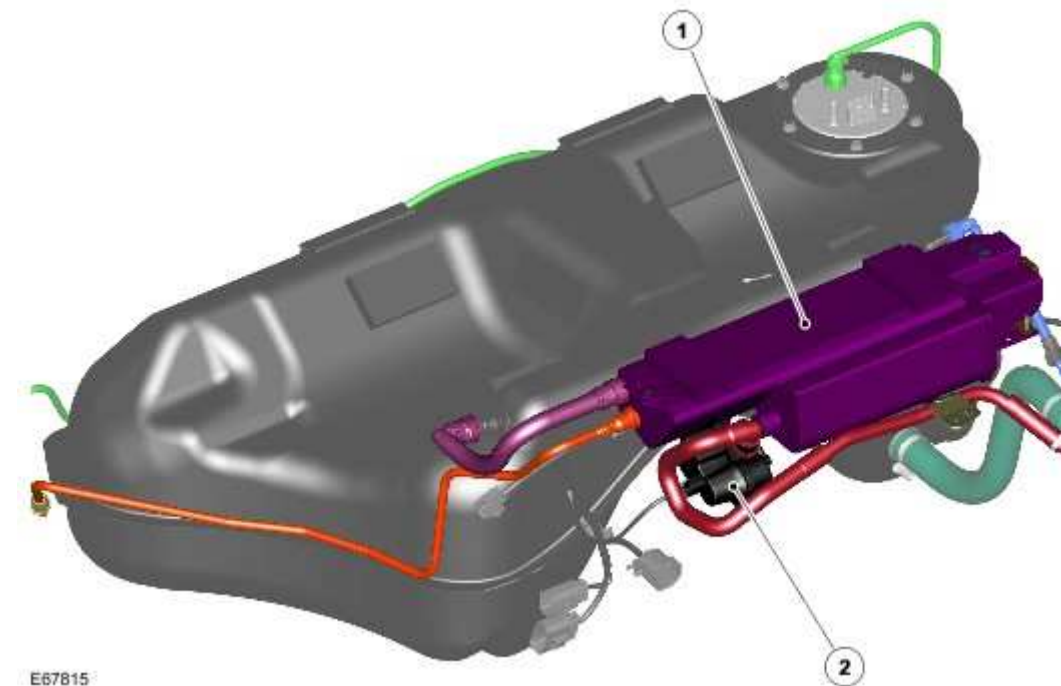


The fuel rail temperature sensor measures the temperature of the fuel in the fuel rail. This

input is then used to deliver the correct quantity of fuel to the engine. Operating Range -40 Degrees Celsius to 150 Degrees Celsius. The fuel rail temperature sensor is fitted on the rear of the right hand bank (bank A) fuel rail.

Diagnostic Monitoring of Tank Leakage (DMTL) - NAS ONLY

Charcoal Canister with DMTL Pump (NAS only)

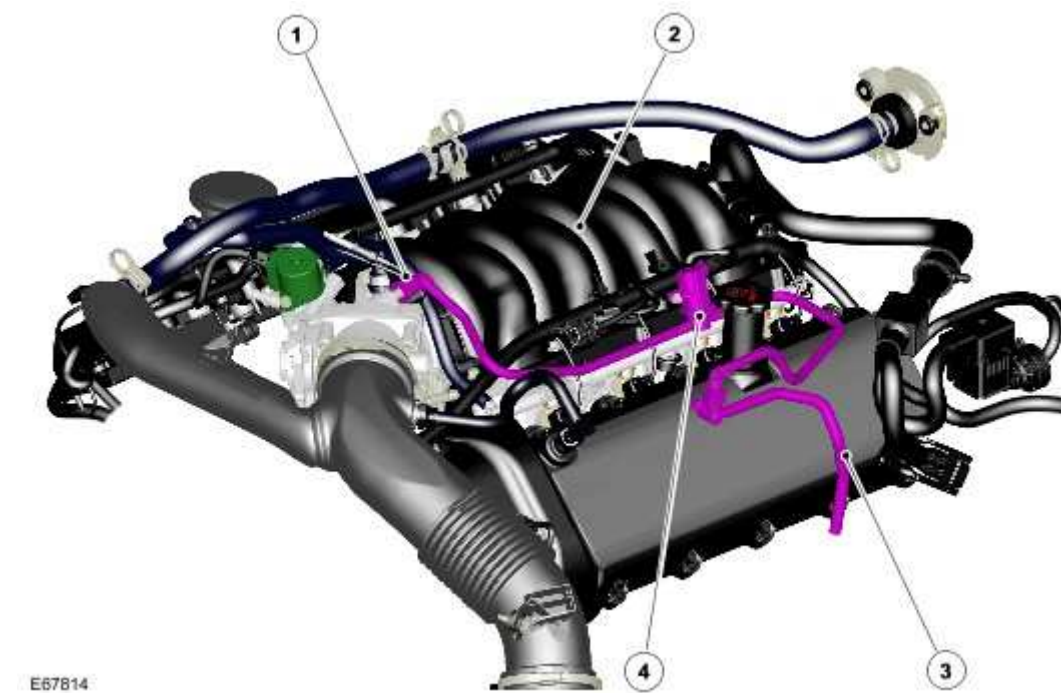


Item	Part Number	Description
1		Charcoal cannister
2		DMTL pump

The DMTL system periodically checks the evaporative system and the fuel tank for leaks when the ignition is switched off. The DMTL pump is connected to the atmospheric vent of the charcoal cannister and incorporates a 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. To check the fuel tank and EVAP system for leaks the ECM operates the DMTL pump and monitors the current draw. This is compared to a referenced figure established from the current draw when air is pumped through the reference orifice.

Purge Valve

Purge Valve and Hoses location



Item	Part Number	Description
1		Hose and connection-purge valve to electric throttle
2		Air intake manifold
3		Hose-charcoal cannister to purge valve
4		Purge valve

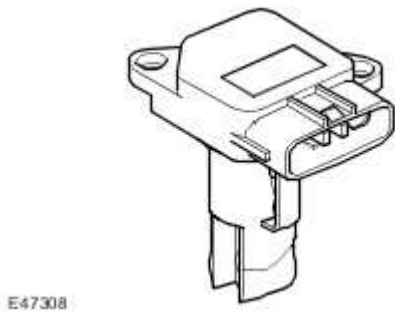
The purge valve is located LH side of the engine, on a bracket which is attached to the cylinder block. The purge hose is routed from the purge valve, along the left hand side of the air intake manifold, to the elbow assembly which locates the electric throttle.

The purge hose is connected, at the right hand rear of the engine, with a quick release coupling to the purge line which runs parallel with the fuel feed line and around the rear of the fuel tank to the charcoal cannister.

The purge hose continues from the purge valve and is routed to a connection on the air intake elbow assembly. The hose is connected to the elbow with a quick release connector.

The purge valve is a solenoid operated valve which is closed when de-energized. The purge valve is controlled by a 10Hz PWM signal from the ECM. When the engine operating conditions are correct, the ECM opens the purge valve which causes fuel vapor and fresh air to be drawn through the charcoal cannister. The fresh air is drawn through the charcoal cannister via the DMTL pump fresh air vent. For additional information, refer to [Evaporative Emissions](#) (303-13 Evaporative Emissions)

Mass Air Flow/Intake Air Temperature Sensor (MAF/IAT)



The air flow meter is located in the clean air duct immediately after the air filter box.

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 “hot film” element. The ECM then uses this signal from the MAF meter to calculate the air mass flowing into the engine.

The measured air mass flow is used in determining the fuel quantity to be injected in order to calculate the required 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.

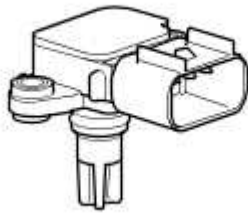
The following symptoms may be observed if the sensor fails:

- During driving the engine RPM might dip, before recovering.
- Difficulty in starting or start - stall.
- Poor throttle response / engine performance.
- Lambda control and idle speed control halted.
- Emissions incorrect.
- AFM signal offset

The IAT sensor is integrated into the MAF 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 sensor changes as the sensor resistance changes, thus relating the air temperature to the voltage measured by the ECM.

The ECM stores a 25°C default value for air temperature in the event of a sensor failure.

Manifold Absolute Pressure Sensor (MAP)



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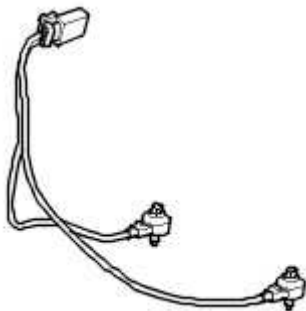
The MAP sensor provides a voltage proportional to the absolute pressure in the intake manifold. This signal allows the load on the engine to be calculated and used within the internal calculations of the ECM. The sensor is located on the rear of the air intake manifold.

The output signal from the MAP sensor, together with the CKP and IAT sensors, is used by the ECM to calculate the amount of air induced into the cylinders. This enables the ECM to determine ignition timing and fuel injection duration values.

The MAP sensor receives a 5V supply voltage from ECM and provides an analogue signal to the ECM, which relates to the absolute manifold pressure and allows the ECM to calculate engine load. The ECM provides a ground for the sensor.

If the MAP signal is missing, the ECM will substitute a default manifold pressure reading based on crankshaft speed and throttle angle. The engine will continue to run with reduced drivability and increased emissions, although this may not be immediately apparent to the driver. The ECM will store fault codes which can be retrieved using the Integrated Diagnostic System (IDS).

Knock Sensors



E47296

The V8 EMS has two knock sensors located in the V of the engine, one per cylinder bank. The sensors are connected to the ECM via a twisted pair.

The knock sensors produce a voltage signal in proportion to the amount of mechanical vibration generated at each ignition point. Each sensor monitors the related cylinder bank.

Care must be taken at all times to avoid damaging the knock sensors, but particularly during removal and fitting procedures. The recommendations regarding torque and surface preparation must be adhered to. The torque applied to the sensor and the quality of the surface preparation both have an influence over the transfer of mechanical noise from the cylinder

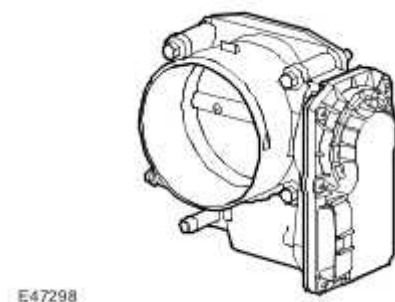
block to the crystal.

The knock sensors incorporate a piezo-ceramic crystal. This crystal produces a voltage whenever an outside force tries to deflect it, (i.e. exerts a mechanical load on it). When the engine is running, the compression waves in the material of the cylinder block, caused by the combustion of the fuel/air mixture within the cylinders, deflect the crystal and produce an output voltage signal. The ECM uses the signals supplied by the knock sensors, in conjunction with the signal it receives from the camshaft sensor, to determine the optimum ignition point for each cylinder. The ignition point is set according to preprogrammed ignition maps stored within the ECM. The ECM is programmed to use ignition maps for 98 RON premium specification fuel. It will also function on 91 RON regular specification fuel and learn new adaptations. If the only fuel available is of poor quality, or the customer switches to a lower grade of fuel after using a high grade for a period of time, the engine may suffer slight pre-ignition for a short period. This amount of pre-ignition will not damage the engine. This situation will be evident while the ECM learns and then modifies its internal mapping to compensate for the variation in fuel quality. This feature is called adaption. The ECM has the capability of adapting its fuel and ignition control outputs in response to several sensor inputs.

The ECM will cancel closed loop control of the ignition system if the signal received from either knock sensor becomes implausible. In these circumstances the ECM will default to a safe ignition map. This measure ensures the engine will not become damaged if low quality fuel is used. The MIL will not illuminate, although the driver may notice that the engine 'pinks' in some driving conditions and displays a drop in performance and smoothness.

When a knock sensor fault is stored, the ECM will also store details of the engine speed, engine load and the coolant temperature.

Electric Throttle



The V8 EMS incorporates an electric throttle control system. The electronic throttle body is located on the air intake manifold in the engine compartment. The system comprises three main components:

- Electronic throttle control valve
- APP sensor
- ECM

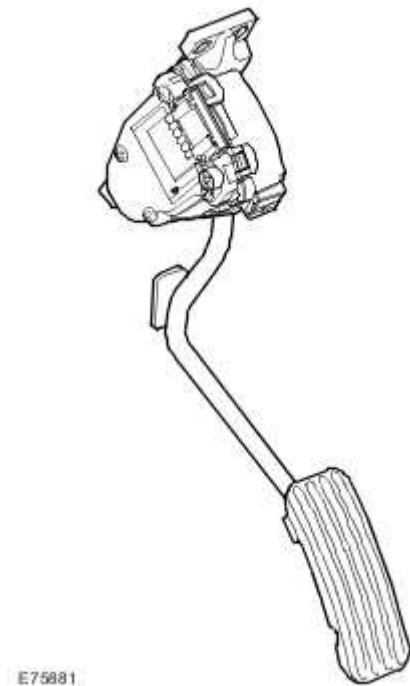
When the accelerator pedal is depressed the APP sensor provides a change in the monitored signals. The ECM compares this against an electronic “map” and moves the electronic throttle

valve via a PWM control signal which is in proportion to the APP angle signal. The system is required to:

- Regulate the calculated intake air load based on the accelerator pedal sensor input signals and programmed mapping.
- Monitor the drivers input request for cruise control operation.
- Automatically position the electronic throttle for accurate speed control.
- Perform all dynamic stability control throttle control interventions.
- Monitor and carry out maximum engine and road speed cut out.
- Provide differing responses for differing Terrain response modes.

A software strategy within the ECM enables the throttle position to be calibrated each ignition cycle. When the ignition is turned ON, the ECM performs a self test and calibration routine on the electronic throttle by closing the throttle full, then opening again. This tests the default position springs.

Accelerator Pedal Position Sensor (APP)

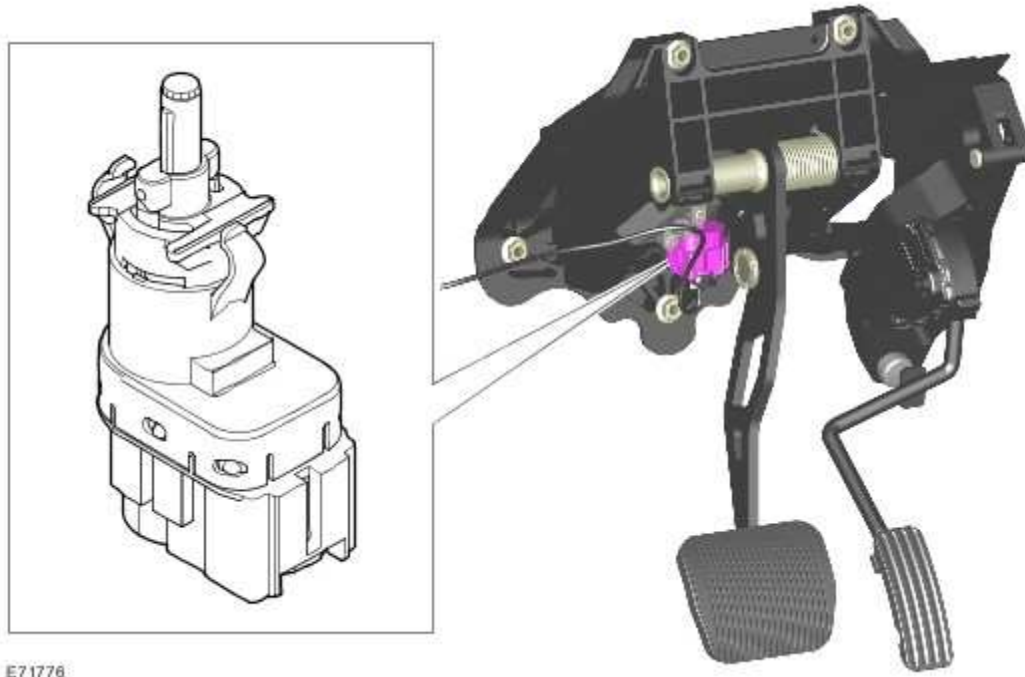


The APP sensors are located on the accelerator pedal assembly.

The APP sensors are used to determine the driver's request for vehicle speed, acceleration and deceleration. This value is used by the ECM and the throttle is opened to the correct angle by an electric motor integrated into the throttle body.

The APP sensor signals are checked for range and plausibility. Two separate reference voltages are supplied to the pedal. Should one sensor fail, the other is used as a 'limp – home' input. In limp home mode due to an APP signal failure the ECM will limit the maximum engine speed to 2000 rpm.

Stoplamp Switch



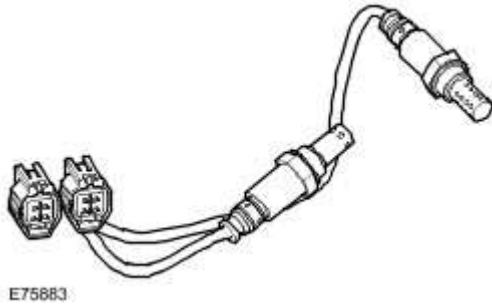
The stoplamp switch is mounted on the brake pedal bracket and is connected to the vehicle harness via a 4 pin multiplug.

When the brake pedal is pressed, the switch contacts close allowing a hard wired signal feed to be sent to the ECM. A stoplamp switch status message is then sent from the ECM to the ABS module on the high speed CAN bus.

Oxygen Sensors

There are four oxygen sensors located in the exhaust system. Two upstream before the catalytic converter and two down stream after the catalytic converter. The sensor monitors 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.

Oxygen Sensors



The oxygen sensors need 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 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 $\lambda = 1$ is 300 to 500m volts. As the fuel mixture becomes richer ($\lambda < 1$) the voltage tends towards 900m volts and as it becomes leaner ($\lambda > 1$) the voltage tends towards 0 volts.

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. The heater pins of HEGO and UHEGO sensor electrical connections are tinned and the signal pins are gold plated. Mixing up sensors could contaminate the connectors and affect system performance.

Failure Modes

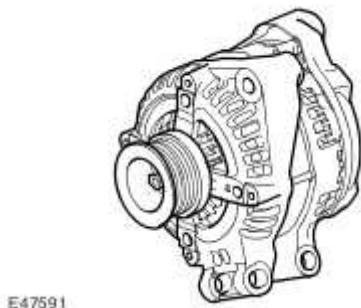
- Mechanical fitting & integrity of the sensor.
- Sensor open circuit / disconnected.
- Short circuit to vehicle supply or ground.
- Lambda ratio outside operating band.
- Crossed sensors bank A & B.
- Contamination from leaded fuel or other sources.
- Change in sensor characteristic.
- Harness damage.
- 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 holes around the end of the shroud, whereas the down stream sensors have holes arranged along the length the shroud.

Generator



The Generator has a multifunction 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 rechargeability, but at high temperatures the charge voltage must be restricted to prevent excessive gassing of the battery with consequent water loss.

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 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 send a message to the instrument pack on the CAN bus to illuminate the charge warning lamp.

Fuel Injectors



E47305

The engine has 8 fuel injectors (one per cylinder), each injector is directly driven by the ECM. The injectors are fed by a common fuel rail as part of a 'returnless' fuel system. The fuel rail pressure is regulated to 4.5 bar by a fuel pressure regulator which is integral to the fuel pump module, within the fuel tank. The injectors can be checked by resistance checks. There is a fuel pressure test Schrader valve attached to the fuel rail on the front LH side for fuel pressure testing purposes. The ECM monitors the output power stages of the injector drivers for electrical faults.

The injectors have a resistance of $13.8 \text{ Ohms} \pm 0.7 \text{ Ohms}$ @ 20 Degrees Celsius.

Ignition Coils



E47306

The V8 engine is fitted with eight plug-top coils that are driven directly by the ECM. This means that the ECM, at the point where sufficient charge has built up, switches the primary circuit of each coil and a spark is produced in the spark plug. The positive supply to the coil is fed from a common fuse. 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 has a failure the feedback signal is not sent, causing the ECM to store a fault code appropriate to the failure.

The ECM calculates the dwell time depending on battery voltage and engine speed to ensure constant secondary energy. This ensures sufficient secondary (spark) energy is always available, without excessive primary current flow thus avoiding overheating or damage to the coils.

The individual cylinder spark timing is calculated from a variety of inputs:

- Engine speed and load.
- Engine temperature.
- Knock control.
- Auto gearbox shift control.
- Idle speed control.

Fuel Pump Relay

The V8 engine has a returnless fuel system. The system pressure is maintained at a constant 4 bar (59 Psi), with no reference to intake manifold pressure. The fuel is supplied to the injectors from a fuel pump fitted within the fuel tank. The electrical supply to this fuel pump is controlled by the ECM via a relay and an Inertia Switch which will turn the fuel off upon a vehicle impact. 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.

Cooling Fan Control

The ECM controls an electric fan to provide engine cooling. The ECM supplies the fan with a PWM signal that controls the speed 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.

Variable Valve Control (VVC)

Variable valve timing is used on the V8 engine to enhance low and high speed engine performance and idle speed quality.

For each inlet camshaft the VVC system comprises:

- VVC unit
- Valve timing solenoid

The VVC system alters the phase of the intake valves relative to the fixed timing of the exhaust valves, to alter:

- The mass of air flow to the cylinders.
- The engine torque response.
- Emissions.

The VVC unit uses a vane type device to control the camshaft angle. The system operates over a range of 48 degrees and is advanced or retarded to its optimum position within this

range.

The VVC system is controlled by the ECM based on engine load and speed along with engine oil temperature to calculate the appropriate camshaft position.

The VVC system provides the following advantages:

- Reduced engine emissions and improved fuel consumption which in turn improves the engines internal EGR effect over a wider operating range.
- Enhanced full load torque characteristics.
- Improved fuel economy through optimized torque over the engine speed range.

Variable Valve Timing Unit



E47303

The VVC unit is a hydraulic actuator mounted on the end of the inlet camshaft. The unit advances or retards the camshaft timing to alter the camshaft to crankshaft phase. The ECM controls the VVC timing unit via a oil control solenoid. The oil control solenoid routes oil pressure to the advance or retard chambers either side of the vanes within the VVC unit.

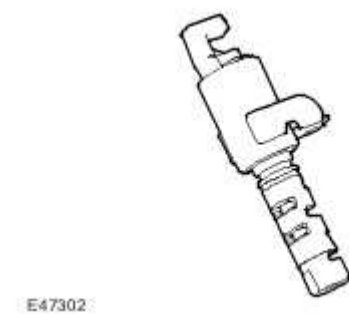
The VVC unit is driven by the primary drive chain and rotates relative to the exhaust camshaft. When the ECM requests a retard in camshaft timing the oil control solenoid is energized which moves the shuttle valve in the solenoid to the relevant position allowing oil pressure to flow out of the advance chambers in the VVC unit whilst simultaneously allowing oil pressure into the retard chambers.

The ECM controls the advancing and retarding of the VVC unit based on engine load and speed. The ECM sends an energize signal to the oil control solenoid until the desired VVC position is achieved. When the desired VVC position is reached, the energizing signal is reduced to hold the oil control solenoid position and consequently desired VVC position. This function is under closed loop control and the ECM can sense any variance in shuttle valve oil pressure via the camshaft position sensor and can adjust the energizing signal to maintain the shuttle valve hold position.

VVC operation can be affected by engine oil temperature and properties. At very low oil temperatures the movement of the VVC mechanism will be slow due to the high viscosity of the oil. While at high oil temperatures the low oil viscosity may impair the VVC operation at low oil pressures. The oil pump has the capacity to cope with these variations in oil pressure while an oil temperature sensor is monitored by the ECM to provide oil temperature feedback. At extremely high oil temperatures the ECM may limit the amount of VVC advance in order to prevent the engine from stalling when returning to idle speed.

VVC does not operate when engine oil pressure is below 1.25 bar. This is because there is insufficient pressure to release the VVC units internal stopper pin. This occurs when the engine is shut down and the VVC unit has returned to the retarded position. The stopper pin locks the VVC unit to the camshaft to ensure camshaft stability during the next start up.

Valve Control Solenoid

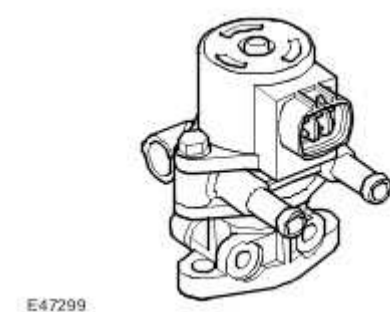


Valve Timing Solenoid

The valve timing solenoid controls the position of the shuttle valve in the bush carrier. A plunger on the solenoid extends when the solenoid is energized and retracts when the solenoid is de-energized.

When the valve timing solenoids are de-energized, the coil springs in the bush carriers position the shuttle valves to connect the valve timing units to drain. In the valve timing units, the return springs hold the ring pistons and gears in the retarded position. When the valve timing solenoids are energized by the ECM, the solenoid plungers position the shuttle valves to direct engine oil to the valve timing units. In the valve timing units, the oil pressure overcomes the force of the return springs and moves the gears and ring pistons to the advanced position. System response times are 1.0 second maximum for advancing and 0.7 second maximum for retarding. While the valve timing is in the retarded mode, the ECM produces a periodic lubrication pulse. This momentarily energizes the valve timing solenoids to allow a spurt of oil into the valve timing units. The lubrication pulse occurs once every 5 minutes.

Exhaust Gas Recirculation (EGR) Valve

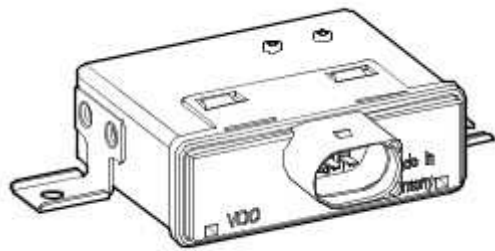


The EGR valve is an electrically controlled valve that allows burned exhaust gas to be

recirculated back into the engine. The EGR valve consists of a stepper motor that opens and closes the valve in steps. 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).

The EGR 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.

Fuel Pump Driver Module



The Fuel Pump Driver Module (FPDM) is located in the rear LH quarter adjacent to the parking aid control module.

The fuel pump is control by the ECM. The ECM sends a PWM signal to the FPDM, the frequency of the signal determines the duty cycle of the pump. The PWM signal to the pump represents half the ON time of the pump. If the ECM transmits a 50% on time the FPDM drives the pump at 100%. If the ECM transmits a 5% ON time the FPDM drives the pump at 10%. The FPDM will only turn the fuel pump ON if it receives a valid signal between 4% and 50%. When The ECM requires the fuel pump to be turned OFF the ECM transmits a duty cycle signal of 75%.

The status of the FPDM is monitored by the ECM. Any errors can be retrieved from the ECM using IDS. The FPDM cannot be interrogated for diagnostic purposes.

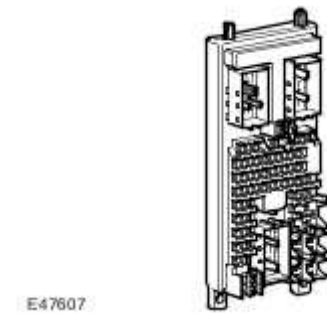
The MAP controls The FPDM in response to inputs from the fuel rail pressure sensor, MAP and the MAF/IAT sensor.

Fuel Rail Pressure Sensor



The fuel rail pressure sensor is located on top of the fuel rail adjacent to the fuel inlet. The fuel rail pressure sensor measures the pressure of the fuel in the fuel rail. This input is then used by the FPDM to control the amount of fuel delivered to the fuel rail. The fuel rail pressure sensor is a pressure transducer device. A vacuum pipe connects to the intake manifold for manifold pressure. The ECM receives a voltage from the FRP sensor which is proportional to the fuel pressure in the fuel injection supply manifold.

Central Junction Box



The ECM is connected to ignition switch I and II. When the ignition is turned on 12V is applied to the Ignition Sense input. The ECM then starts its power up routines and turns on the ECM main relay; the main power to the ECM and it's associated system components. When the ignition is turned OFF the ECM will maintain its powered up state for up to 20 minutes while it initiates its power down routine and on completion will turn off the ECM main relay. The ECM will normally power down in approximately 60 seconds, do not disconnect the battery until the ECM is completely powered down.

Secondary Air Injection

The secondary air injection system comprises:

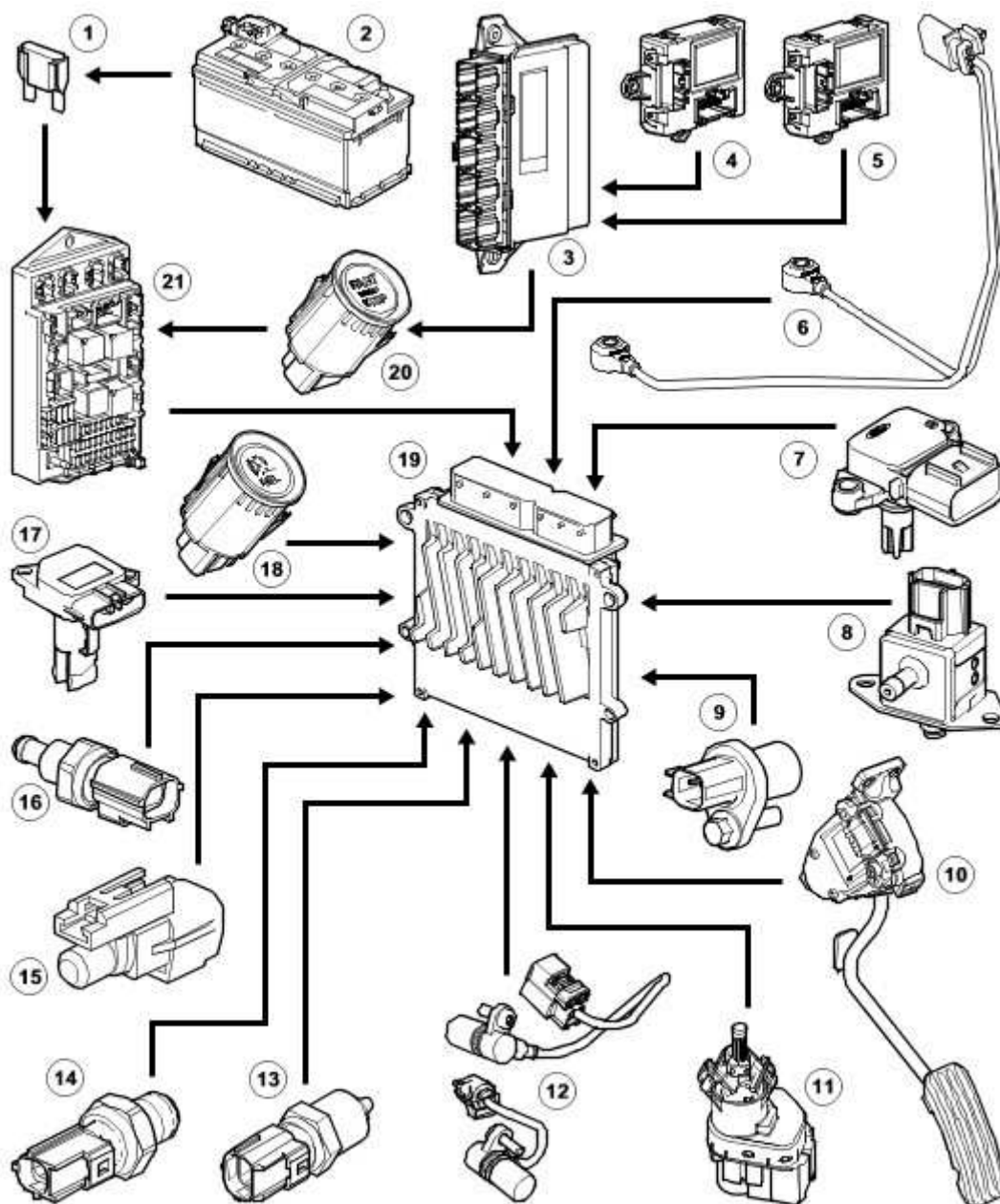
- SAI pump
- SAI valve
- Associated pipes
- SAI Manifold Absolute Pressure (MAP) sensor (NAS only)

The ECM controls the SAI pump and SAI valve with a PWM signal and on NAS vehicles measures the system pressure via the MAP sensor. For additional information, refer to [Engine Emission Control](#) (303-08 Engine Emission Control)

CONTROL DIAGRAM SHEET 1 of 3

NOTE:

A = Hardwired connection



E62360

A →

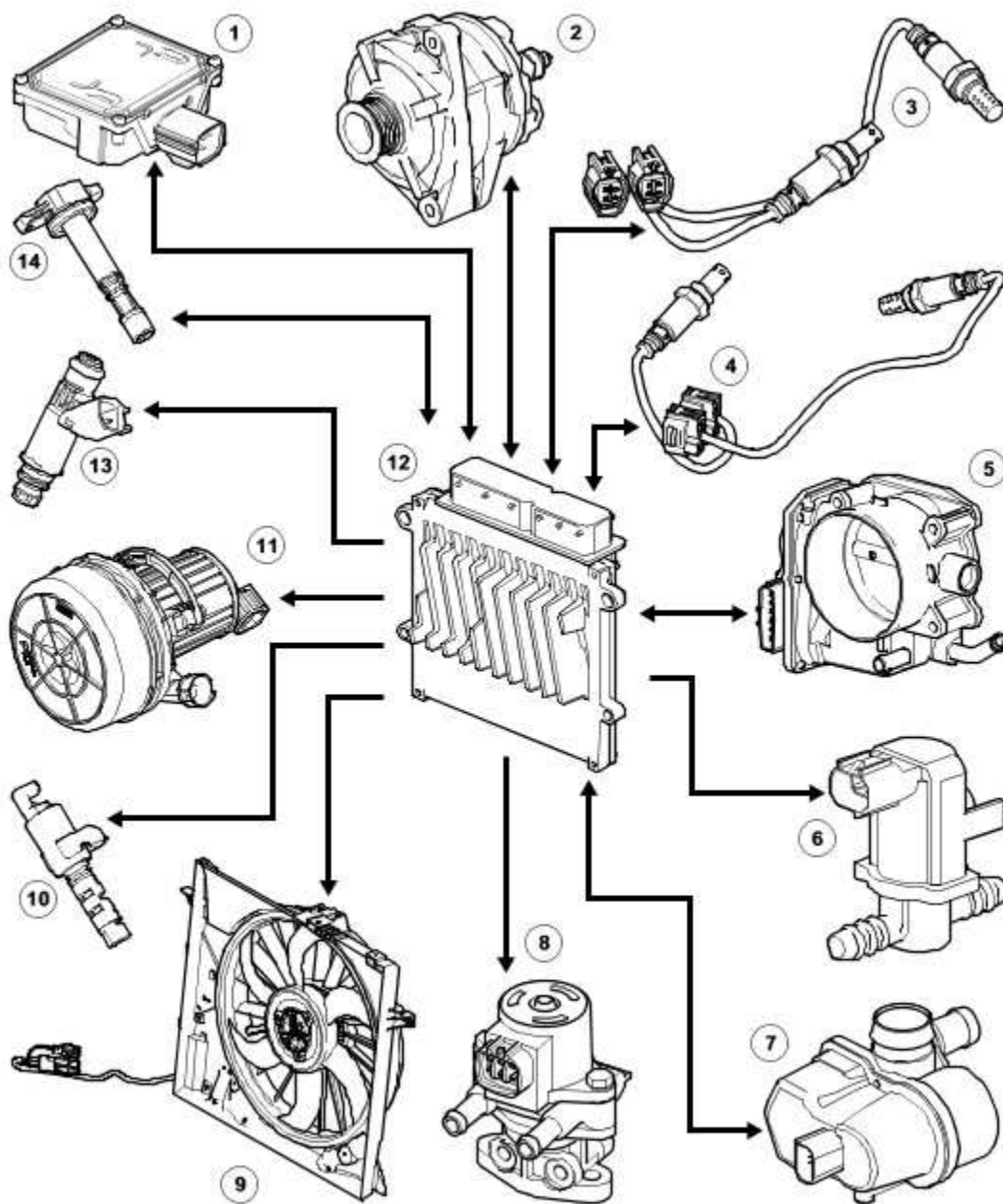
Item	Part Number	Description
1		Fuse
2		Battery
3		Keyless vehicle module
4		Door module
5		Door module
6		knock sensors
7		MAP sensor
8		Fuel rail pressure sensor

9		CKP sensor
10		APP
11		Stop lamp switch
12		CMP sensor
13		Engine coolant temperature sensor
14		Oil pressure sensor
15		Air temperature sensor
16		Fuel rail temperature sensor
17		MAF/IAT sensor
18		Automatic Speed Limiter switch
19		ECM
20		Start/Stop switch
21		Central Junction Box (CJB)

CONTROL DIAGRAM SHEET 2 of 3

NOTE:

A = Hardwired connection



E62361



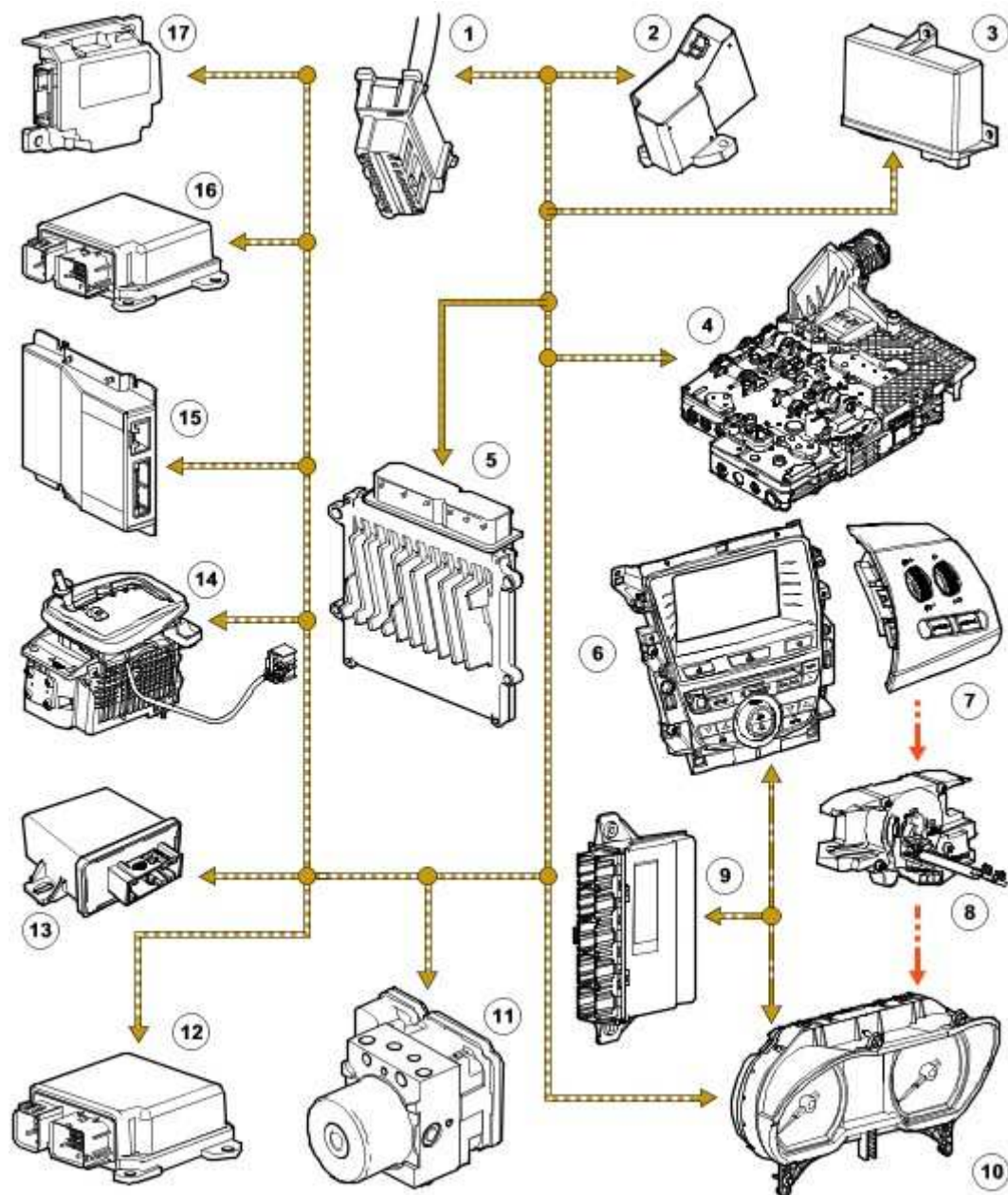
Item	Part Number	Description
1		FPDM
2		Generator
3		HO2S (upstream)
4		HO2S (downstream)
5		Electric throttle
6		Purge valve
7		DMTL pump
8		EGR valve

9		Engine cooling fan
10		VCT solenoid
11		Secondary air injection pump
12		ECM
13		Injector (8 off)
14		Ignition coil (8 off)

CONTROL DIAGRAM SHEET 3 of 3

NOTE:

D = High speed CAN bus; N=Medium speed CAN bus; O = LIN (local interconnect network) bus



E65886



Item	Part Number	Description
1		Diagnostic socket
2		Steering column lock
3		Park brake module
4		TCM
5		ECM
6		Integrated control panel
7		Steering wheel speed control switches
8		Rotary coupler

9		Keyless vehicle module
10		Instrument cluster
11		ABS control module
12		RCM
13		Adaptive front lighting system control module
14		Gear shift module
15		Adaptive Damping Control Module (ADCM)
16		Pedestrian protection module
17		Adaptive speed control module

PRINCIPLES OF 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 H02S
- 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 oxygen sensors (HEGO and UHEGO) 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 adaptations 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 CKP and assigns a roughness value to it. This roughness value can be viewed within the real time monitoring feature, using IDS. 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).

IDS Diagnostics

The ECM stores faults as DTC, referred to as 'P' codes. The 'P' codes are defined by OBD legislation and, together with their associated environmental and freeze frame data, can be read using a third party scan tool or IDS. IDS can also read real time data from each sensor,

the adaptive values currently being employed and the current fueling, ignition and idle settings.

Electronic Engine Controls

Principle of Operation

For a detailed description of electronic engine controls, refer to the relevant Description and Operation section of the workshop manual.

[Electronic Engine Controls](#)

Inspection and Verification

- 1 . Verify the customer concern.
- 2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
- Engine oil level - Cooling system coolant level - Fuel level - Fuel contamination/grade/quality - Throttle body - Poly-vee belt	- Fuses - Wiring harness - Electrical connector(s) - Sensor(s) - Engine Control Module (ECM) - Transmission Control Module (TCM)

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, verify the customer concern and refer to the Symptom Chart below, alternatively, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Cause	Action
Engine non-start		
Engine does not crank	- Security system /Immobilizer engaged - Engine in shut-down mode - ECM relay - Battery - Park/Neutral switch - Starting system	- Check that the security system is disarmed - Read DTCs and refer to DTC Index in this section for ECM relay tests - Ensure the battery is in fully charged and

	Engine seized	- serviceable condition - For Park/Neutral switch tests. External Controls - For starting system tests. Starting System - For engine system tests. Engine
Engine cranks, but does not fire	- Engine breather system disconnected/restricted - Ignition system - Fuel system - Electronic engine controls	- Ensure the engine breather system is free from restriction and is correctly installed - For ignition system tests. Engine Ignition - For fuel system tests. Fuel Charging and Controls - 4.2L NA V8 - AJV8/4.2L SC V8 - AJV8 - Read DTCs and refer to DTC Index in this section for electronic engine control tests
Engine cranks and fires, but will not start	- Evaporative emissions purge valve - Fuel pump - Spark plugs - Ignition coil failure(s)	- For purge valve tests. Evaporative Emissions - For fuel system tests. Fuel Tank and Lines - For ignition system tests. Engine Ignition
Difficult to start		
Difficult cold start	- Check engine coolant level/anti-freeze content - Battery - Electronic engine controls - Exhaust gas recirculation (EGR) valve stuck open - Fuel pump - Evaporative emissions	- Check the engine coolant level and condition. Specifications - Ensure the battery is in a fully charged and serviceable condition - Read DTCs and refer to DTC Index in this section for electronic engine control tests - For EGR valve tests.

	purge valve	Engine Emission Control - For fuel system tests. Fuel Tank and Lines - For purge valve tests. Evaporative Emissions
Difficult hot start	- Injector leak - Electronic engine controls - Evaporative emissions purge valve - Fuel pump - Ignition system - EGR valve stuck open	- Carry out injector leak tests, install new injectors as necessary. Fuel Injector (18.10.01) - Read DTCs and refer to DTC Index in this section for electronic engine control tests - For purge valve tests. Evaporative Emissions - For fuel system tests. Fuel Tank and Lines - For ignition system tests. Engine Ignition - For EGR valve tests. Engine Emission Control
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	- Injector leak - Electronic engine controls - Evaporative emissions purge valve - Fuel pump - Ignition system - EGR valve stuck open	- Carry out injector leak tests, install new injectors as necessary. Fuel Injector (18.10.01) - Read DTCs and refer to DTC Index in this section for electronic engine control tests - For purge valve tests. Evaporative Emissions - For fuel system tests. Fuel Tank and Lines - For ignition system tests. Engine Ignition - For EGR valve tests. Engine Emission Control
Engine cranks too fast/slow	- Compressions high/low - Battery	Carry out compression tests.

	Starting system	Engine - Ensure battery is in a fully charged and serviceable condition - For starting system tests. Starting System
Engine stalls		
Engine stalls soon after start	- Breather system disconnected/restricted - ECM relay - Electronic engine controls - Ignition system - Air intake system restricted - Air leakage - Fuel lines	- Ensure the engine breather system is free from restriction and is correctly installed - Read DTCs and refer to DTC Index in this section for ECM relay tests - Read DTCs and refer to DTC Index in this section for electronic engine control tests - For ignition system tests. Engine Ignition - Check for blockage in air cleaner element and air intake system - Check for leakage in air intake system - For fuel system tests. Fuel Tank and Lines
Engine stalls on overrun	- ECM relay - Throttle position (TP) sensors	- Read DTCs and refer to DTC Index in this section for ECM relay tests - Read DTCs and refer to DTC Index in this section for TP sensor tests
Engine stalls at steady speed	- ECM relay - CKP sensor - TP sensors	Read DTCs and refer to DTC Index in this section for ECM relay, CKP, and TP sensor tests

Engine stalls with speed control enabled	ECM relay	Read DTCs and refer to DTC Index in this section for ECM relay tests
Engine stalls when manoeuvring	- ECM relay - TP sensors - Additional engine loads (PAS, air conditioning, etc) - Transmission malfunction - CAN malfunction	- Read DTCs and refer to DTC Index in this section for ECM relay, and TP sensor tests - Check for excessive loads being placed on the engine from PAS, air conditioning systems etc. - For transmission system tests. Diagnostic Strategy - For CAN network tests. Communications Network
Poor driveability		
Engine hesitates/poor acceleration	- Fuel pressure, fuel pump, fuel lines - Injector leak - Air leakage - Electronic engine controls - Ignition system - EGR valve stuck - Transmission malfunction - Restricted pedal travel (carpet, etc)	- For fuel system tests. Fuel Tank and Lines - Carry out fuel injector leak tests, install new injectors as necessary. Fuel Injector (18.10.01) - Check for leakage from air intake system - Read DTCs and refer to DTC Index in this section for electronic engine control tests - For ignition system tests. Engine Ignition - For EGR valve tests. Engine Emission Control - For transmission system tests. Diagnostic Strategy - Ensure accelerator pedal is free from restriction

Engine backfires	- Fuel pump, fuel lines - Air leakage - Electronic engine controls - Ignition system - Sticking variable camshaft timing (VCT) hub	- For fuel system tests. Fuel Tank and Lines - Check for leakage from air intake system - Read DTCs and refer to DTC Index in this section for electronic engine control tests - For ignition system tests. Engine Ignition - Read DTCs and refer to DTC Index in this section for VCT system tests
Engine surges	- Fuel pump, fuel lines - Electronic engine controls - Ignition system	- For fuel system tests. Fuel Tank and Lines - Read DTCs and refer to DTC Index in this section for electronic engine control tests - For ignition system tests. Engine Ignition
Engine detonates/knocks	- Electronic engine controls - Fuel pump, fuel lines, fuel quality - Air leakage - Sticking VCT hub	- Read DTCs and refer to DTC Index in this section for electronic engine control tests - For fuel system tests. Fuel Tank and Lines - Check for leakage from air intake system - Read DTCs and refer to DTC Index in this section for VCT system tests
No throttle response	Electronic engine controls	Read DTCs and refer to DTC Index in this section for electronic engine control tests
Speed control inhibited or disabled	- Default mode enabled - Speed control, brake switch - Electronic engine	Check message center for default message, read DTCs and refer to DTC Index

	- controls - CAN fault	- For speed control, and brake switch tests. Speed Control - Read DTCs and refer to DTC Index in this section for electronic engine control tests - For CAN network tests. Communications Network
Poor throttle response	- Breather system disconnected/restricted - Electronic engine controls - Transmission malfunction - Traction control event - Air leakage	- Ensure engine breather system is free from restriction and is correctly installed - Read DTCs and refer to DTC Index in this section for electronic engine control tests - For transmission system tests. Diagnostic Strategy - Check for leakage in air intake system
Engine defaults, warning light and messages. Refer to the owner handbook	- Park/Neutral switch - Electronic engine controls	- For Park/Neutral switch tests. External Controls - Read DTCs and refer to DTC Index in this section for electronic engine control tests

DTC Index



CAUTION: When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00.

NOTE:

If the module/component is suspect and the vehicle remains under the Manufacturers warranty, refer to the Warranty Policy and Procedure 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 five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give additional information read by the manufacturer-approved diagnostic system).

NOTE:

When performing electrical voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE:

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE:

If DTCs 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.

DTC	Description	Possible Causes	Action
C003100	Left front wheel speed sensor	Invalid data received from ABS - left front wheel speed signal	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
C003400	Right front wheel speed sensor	Invalid data received from ABS - right front wheel speed signal	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
C003700	Left rear wheel speed sensor	Invalid data received from ABS - left rear wheel speed signal	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
C003A00	Right rear wheel speed sensor	Invalid data received from ABS - right rear	Check anti-lock control - stability assist module for

		wheel speed signal	DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
P001100	Intake camshaft position - timing over-advanced (bank 1)	- Variable Camshaft Timing (VCT) circuit fault - Valve timing incorrectly set - Timing chain has slipped	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check the valve timing. Timing Drive Components (12.65.13)
P001200	Intake camshaft position - timing over-retarded (bank 1)	- Variable Camshaft Timing (VCT) circuit fault - Valve timing incorrectly set - Timing chain has slipped	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check the valve timing. Timing Drive Components (12.65.13)
P001600	Crankshaft position (CKP)/Camshaft position (CMP) sensor correlation, right hand bank	The relative positions of the CKP and CMP teeth are not correct Sensors incorrectly aligned on rebuild	Reset the sensor positions. Camshaft Position (CMP) Sensor RH (18.31.11) Crankshaft Position (CKP) Sensor (18.30.12)
P001800	Crankshaft position (CKP)/Camshaft position (CMP) sensor correlation, left hand bank	The relative positions of the CKP and CMP teeth are not correct Sensors incorrectly aligned on rebuild	Reset the sensor positions. Camshaft Position (CMP) Sensor LH (18.31.12) Crankshaft Position (CKP) Sensor (18.30.12)
P002100	Intake camshaft position - timing over-advanced (bank 2)	- Variable Camshaft Timing (VCT) circuit fault - Valve timing incorrectly set	Carry out any pinpoint tests associated with this DTC using the manufacturer

		Timing chain has slipped	approved diagnostic system Check the valve timing. Timing Drive Components (12.65.13)
P002200	Intake camshaft position - timing over-retarded (bank 2)	- Variable Camshaft Timing (VCT) circuit fault - Valve timing incorrectly set - Timing chain has slipped	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check the valve timing. Timing Drive Components (12.65.13)
P002672	Variable Camshaft Timing (VCT) control solenoid (bank 1) circuit range/performance - actuator stuck open	- VCT solenoid fault - Oil contamination - VCT oil flow fault - VCT/Camshaft mechanical failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check the oil condition and flow - Check for mechanical failure of components
P002677	Variable Camshaft Timing (VCT) control solenoid (bank 1) circuit range/performance - commanded position not achievable	- VCT solenoid fault - Oil contamination - VCT oil flow fault - VCT/Camshaft mechanical failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check the oil condition and flow - Check for mechanical failure of components
P002872	Variable Camshaft	VCT solenoid fault	Carry out any

	Timing (VCT) control solenoid (bank 2) circuit range/performance - actuator stuck open	- Oil contamination - VCT oil flow fault - VCT/Camshaft mechanical failure	pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check the oil condition and flow - Check for mechanical failure of components
P002877	Variable Camshaft Timing (VCT) control solenoid (bank 2) circuit range/performance - commanded position not achievable	- VCT solenoid fault - Oil contamination - VCT oil flow fault - VCT/Camshaft mechanical failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check the oil condition and flow - Check for mechanical failure of components
P003100	HO2S heater control circuit low (bank 1)	- HO2S heater circuit - circuit fault - HO2S heater failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P003200	HO2S heater control circuit high (bank 1)	- HO2S heater circuit - circuit fault - HO2S heater failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)

P003600	Catalyst monitor sensor heater control circuit (bank 1)	• Catalyst monitor sensor heater circuit - circuit fault • Catalyst monitor sensor heater failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P005100	HO2S heater control circuit low (bank 2)	• HO2S heater circuit - circuit fault • HO2S heater failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P005200	HO2S heater control circuit high (bank 2)	• HO2S heater circuit - circuit fault • HO2S heater failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P005600	Catalyst monitor sensor heater control circuit (bank 2)	• Catalyst monitor sensor heater circuit - circuit fault • Catalyst monitor sensor heater failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install new catalyst monitor sensor as necessary. Catalyst Monitor

			Sensor (18.30.66)
P006900	Manifold absolute pressure (MAP)/Barometric pressure correlation	• MAP sensor failure • BARO sensor failure (internal ECM fault)	• Check for MAP sensor related DTCs and refer to the DTC Index in this section • Install a new ECM. Refer to new module/component installation Note at top of DTC Index
P007100	Ambient air temperature sensor range/performance	• Ambient temperature value missing from CAN bus	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P007200	Ambient air temperature sensor circuit low	• Ambient air temperature sensor circuit - high resistance • Ambient air temperature sensor circuit - short to ground	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P007300	Ambient air temperature sensor circuit high	• Ambient air temperature sensor circuit - short to power	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P007500	Variable Camshaft Timing (VCT) control circuit (bank 1)	• VCT control solenoid circuit - high resistance, disconnected • VCT solenoid failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new VCT control solenoid as necessary. Variable Camshaft

			Timing (VCT) Oil Control Solenoid (18.30.90)
P007600	Variable Camshaft Timing (VCT) control circuit low (bank 1)	• VCT control solenoid circuit - short to ground, disconnected • VCT solenoid failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new VCT control solenoid as necessary. Variable Camshaft Timing (VCT) Oil Control Solenoid (18.30.90)
P007700	Variable Camshaft Timing (VCT) control circuit high (bank 1)	• VCT control solenoid circuit - short to power • VCT solenoid failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new VCT control solenoid as necessary. Variable Camshaft Timing (VCT) Oil Control Solenoid (18.30.90)
P008100	Variable Camshaft Timing (VCT) control circuit (bank 2)	• VCT control solenoid circuit - high resistance, disconnected • VCT solenoid failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new VCT control solenoid as necessary. Variable Camshaft Timing (VCT) Oil Control Solenoid (18.30.90)

P008200	Variable Camshaft Timing (VCT) control circuit low (bank 2)	• VCT control solenoid circuit - short to ground, disconnected • VCT solenoid failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new VCT control solenoid as necessary. Variable Camshaft Timing (VCT) Oil Control Solenoid (18.30.90)
P008300	Variable Camshaft Timing (VCT) control circuit high (bank 2)	• VCT control solenoid circuit - short to power • VCT solenoid failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new VCT control solenoid as necessary. Variable Camshaft Timing (VCT) Oil Control Solenoid (18.30.90)
P008700	Fuel rail/system pressure - too low	• Fuel rail pressure (FRP) sensor, sensing circuit - short to ground, open circuit • FRP sensor supply circuit - high resistance • FRP sensor failure • Fuel pump failure • Fuel line leak, restriction	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new FRP sensor as necessary. Fuel Rail Pressure (FRP) Sensor (18.30.98) • For fuel system tests. Fuel Tank and Lines
P008800	Fuel rail/system	• FRP sensor	• Carry out any

	pressure - too high	supply/sensing circuits - short to each other • FRP sensor sensing circuit - short to power • FRP sensor ground circuit - high resistance • FRP sensor failure • Restricted fuel line • Fuel pump short circuit to power	pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new FRP sensor as necessary. Fuel Rail Pressure (FRP) Sensor (18.30.98) • For fuel system tests. Fuel Tank and Lines
P010100	Mass Air Flow (MAF) circuit - range/performance	• Blocked air cleaner element • Leakage from air intake system • Engine breather leak • MAF sensor sensing circuit - high resistance, intermittent short to ground • MAF sensor supply circuit - high resistance • MAF sensor failure	• Check air cleaner element is free from restriction • Check for leak from air intake system, rectify as necessary • Ensure the engine breather system is correctly installed and in serviceable condition • Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P010200	Mass Air Flow (MAF) circuit - low input	• MAF sensor supply circuit - short to ground, high resistance • MAF sensor ground circuit - high resistance	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved

		MAF sensor failure	diagnostic system Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P010300	Mass Air Flow (MAF) circuit - high input	- MAF sensor sensing circuit - short to power - MAF sensor ground circuit - high resistance - MAF sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P010600	Manifold Absolute Pressure (MAP) sensor - range/performance	- Intake manifold air leak (loose or missing component) - MAP sensor signal circuit fault - MAP sensor failure	- Check for correct installation and serviceability of intake manifold and associated components - Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new MAP sensor as necessary. Manifold Absolute Pressure (MAP) Sensor (18.30.86)
P011123	Intake Air Temperature (IAT) sensor circuit - range/performance - signal stuck low	- IAT sensor sensing circuit - high resistance - IAT sensor failure	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system

			Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P011124	Intake Air Temperature (IAT) sensor circuit - range/performance - signal stuck high	- IAT sensor sensing circuit - high resistance - IAT sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P011129	Intake Air Temperature (IAT) sensor circuit - range/performance - signal invalid	- IAT sensor sensing circuit - high resistance - IAT sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P011200	Intake Air Temperature (IAT) sensor circuit - low input	- IAT sensor sensing circuit - high resistance, disconnected - IAT sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)

P011300	Intake Air Temperature (IAT) sensor circuit - high input	• IAT sensor sensing circuit - short to ground, short to power • IAT sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new MAF sensor as necessary. Mass Air Flow (MAF) Sensor (18.30.15)
P011623	Engine Coolant Temperature (ECT) sensor circuit - range/performance - signal stuck low	• Low coolant level • ECT sensor sensing circuit - intermittent high resistance • Engine thermostat failure • ECT sensor failure	• Fill cooling system to correct level and specification. Specifications • Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check and install new engine thermostat as necessary. Thermostat - Vehicles Without: Supercharger (26.45.07) • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P011624	Engine Coolant Temperature (ECT) sensor circuit - range/performance - signal stuck high	• Low coolant level • ECT sensor sensing circuit - intermittent high resistance • Engine thermostat failure • ECT sensor failure	• Fill cooling system to correct level and specification. Specifications • Carry out any pinpoint tests associated with this DTC using the manufacturer

			approved diagnostic system • Check and install new engine thermostat as necessary. Thermostat - Vehicles Without: Supercharger (26.45.07) • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P011629	Engine Coolant Temperature (ECT) sensor circuit - range/performance - signal invalid	• Low coolant level • ECT sensor sensing circuit - intermittent high resistance • Engine thermostat failure • ECT sensor failure	• Fill cooling system to correct level and specification. Specifications • Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check and install new engine thermostat as necessary. Thermostat - Vehicles Without: Supercharger (26.45.07) • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P011700	Engine Coolant Temperature (ECT) sensor circuit - low input	• ECT sensor sensing circuit - short to power, high resistance, open circuit, disconnected • ECT sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P011800	Engine Coolant Temperature (ECT) sensor circuit - high input	• Engine overheat condition/cooling fan failure • ECT sensor sensing circuit - short to ground • ECT sensor failure	• Check for cooling fan circuit DTCs and refer to relevant action specified in DTC Index • Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P012100	Throttle Position (TP) sensor circuits TP 1 and TP 2 - range/performance	• TP sensor sensing circuits TP 1 and TP 2 - short to battery, high resistance • TP sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new throttle body as necessary. Throttle Body (19.70.04)
P012200	Throttle Position (TP) sensor circuit TP 1 - low input	• TP sensor sensing circuit TP 1 - short to ground, high resistance • TP sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new

			throttle body as necessary. Throttle Body (19.70.04)
P012300	Throttle Position (TP) sensor circuit TP 1 - high input	- TP sensor sensing circuit TP1 - short to power - TP sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body as necessary. Throttle Body (19.70.04)
P012500	Insufficient coolant temperature for closed loop fuel control	- Low coolant level - ECT sensor sensing circuit - intermittent high resistance - Engine thermostat failure - ECT sensor failure	- Fill cooling system to correct level and specification. Specifications - Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check and install new engine thermostat as necessary. Thermostat - Vehicles Without: Supercharger (26.45.07) - Install a new ECT sensor as necessary. Engine Coolant Temperature (ECT) Sensor (18.30.10)
P012800	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	- Low/contaminated coolant - Thermostat - Cooling fan	Drain and re-fill cooling system to correct level and specification. Specifications

		circuit(s)/module	Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8 - Check and install a new engine thermostat as necessary. Thermostat - Vehicles Without: Supercharger (26.45.07) - Check for correct operation of cooling fan, check for DTCs and refer to DTC Index
P01311A	Heated Oxygen Sensor (H02S) circuit - low voltage (bank 1)	- Exhaust gas leakage - H02S variable/constant circuit - circuit fault, disconnected - H02S failure	- Check for and rectify any exhaust leak between cylinder head and catalytic converter (e.g. manifolds, EGR system etc.) - Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P01321B	Heated Oxygen Sensor (H02S) circuit - high voltage (bank 1)	- Exhaust gas leakage - H02S variable/constant circuit - circuit fault, disconnected - H02S failure	- Check for and rectify any exhaust leak between cylinder head and catalytic converter (e.g. manifolds, EGR system etc.) - Carry out any pinpoint tests associated with this DTC using the

			manufacturer approved diagnostic system Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P013300	Heated Oxygen Sensor (HO2S) circuit - slow response (bank 1)	- HO2S to ECM wiring shield high resistance - Exhaust leak - Fuel control system fault - HO2 sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check for and rectify any exhaust leak between cylinder head and catalytic converter (e.g. manifolds, EGR system etc.) - For fuel charging and controls tests. Fuel Charging and Controls - 4.2L NA V8 - AJV8/4.2L SC V8 - AJV8 - Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P013400	Heated Oxygen Sensor (HO2S) circuit - no activity detected (bank 1)	HO2S slow activation	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P013700	Catalyst monitor sensor circuit - low voltage (bank 1)	- Catalyst monitor sensor sensing circuit - short to ground, high resistance, disconnected - Catalyst monitor sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install new catalyst

			monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P013800	Catalyst monitor sensor circuit - high voltage (bank 1)	• Catalyst monitor sensor sensing circuit - short to power • Catalyst monitor sensor ground braided shield - high resistance • Catalyst monitor sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P013900	Catalyst monitor sensor circuit - slow response (bank 1)	• Catalyst monitor sensor slow response	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P014000	Catalyst monitor sensor circuit - no activity detected (bank 1)	• Catalyst monitor sensing circuit - short to ground, short to power, high resistance, disconnected • Catalyst monitor sensor ground braided shield - high resistance • Catalyst monitor sensor - mechanical damage	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P014100	Catalyst monitor heater circuit (bank 1)	• Catalyst monitor sensor heater control circuit - high resistance • Catalyst monitor sensor heater failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new

			catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P01511A	Heated Oxygen Sensor (H02S) circuit - low voltage (bank 2)	• HO2S sensing circuit - short to ground, short to power, high resistance • HO2S failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P01521B	Heated Oxygen Sensor (H02S) circuit - high voltage (bank 2)	• HO2S sensing circuit - short to ground, short to power, high resistance • HO2S failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P015300	Heated Oxygen Sensor (H02S) circuit - slow response (bank 2)	• HO2S to ECM wiring shield high resistance • Exhaust leak • Fuel control system fault • HO2 sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check for and rectify any exhaust leak between cylinder head and catalytic converter (e.g. manifolds, EGR system etc.) • For fuel system and controls tests. Fuel Charging and Controls - 4.2L NA V8 - AJV8/4.2L

			SC V8 - AJV8 Install a new HO2S as necessary. Heated Oxygen Sensor (HO2S)
P015400	Heated Oxygen Sensor (HO2S) circuit - no activity detected (bank 2)	HO2S slow activation	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P015700	Catalyst monitor sensor circuit - low voltage (bank 2)	- Catalyst monitor sensor sensing circuit - short to ground, high resistance, disconnected - Catalyst monitor sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P015800	Catalyst monitor sensor circuit - high voltage (bank 2)	- Catalyst monitor sensor sensing circuit - short to power - Catalyst monitor sensor ground braided shield - high resistance - Catalyst monitor sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P015900	Catalyst monitor sensor circuit - slow response (bank 2)	Catalyst monitor sensor slow response	Carry out any pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system
P016000	Catalyst monitor sensor circuit - no activity detected (bank 2)	• Catalyst monitor sensing circuit - short to ground, short to power, high resistance, disconnected • Catalyst monitor sensor ground braided shield - high resistance • Catalyst monitor sensor - mechanical damage	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new catalyst monitor sensor as necessary. Catalyst Monitor Sensor (18.30.66)
P016100	Catalyst monitor sensor heater circuit (bank 2)	• Catalyst monitor sensor heater control circuit malfunction	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P017100	System too lean (bank 1)	• Air intake leak between MAF sensor and cylinder head • Fuel filter, injector, system restriction • MAF sensor fault (low intake air flow) • Exhaust leak (forward of catalytic converter)	• Check for leak from air intake system • For fuel system tests. Fuel Tank and Lines • Read DTCs and refer to DTC Index in this section for MAF sensor tests • Check and rectify any exhaust leak prior to catalytic converter
P017200	System too rich (bank 1)	• Restricted air cleaner • Leaking fuel injector(s) • Engine oil contaminated with fuel (too many cold starts with vehicle subsequently not getting hot enough for	• Check air cleaner element is free from restriction • Check for leaking injectors, install new injector(s) as necessary. Fuel Injector

		long enough) MAF sensor fault (high intake air flow)	(18.10.01) - Check for contaminated engine oil, drain and refill engine oil as necessary. Engine Oil Draining and Filling - Read DTCs and refer to DTC Index in this section for MAF sensor tests
P017400	System too lean (bank 2)	- Air intake leak between MAF sensor and cylinder head - Fuel filter, injector, system restriction - MAF sensor fault (low intake air flow) - Exhaust leak (forward of catalytic converter)	- Check for leak from air intake system - For fuel system tests. Fuel Tank and Lines - Read DTCs and refer to DTC Index in this section for MAF sensor tests - Check and rectify any exhaust leak prior to catalytic converter
P017500	System too rich (bank 2)	- Restricted air cleaner - Leaking fuel injector(s) - Engine oil contaminated with fuel (too many cold starts with vehicle subsequently not getting hot enough for long enough) - MAF sensor fault (high intake air flow)	- Check air cleaner element is free from restriction - Check for leaking injectors, install new injector(s) as necessary. Fuel Injector (18.10.01) - Check for contaminated engine oil, drain and refill engine oil as necessary. Engine Oil Draining and Filling - Read DTCs and refer to DTC Index

			in this section for MAF sensor tests
P018123	Engine Fuel Temperature (EFT) sensor circuit - range/performance - signal stuck low	• EFT sensor sensing circuit - short to ground, short to power, high resistance • EFT sensor ground circuit - high resistance • EFT sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new EFT sensor as necessary. Fuel Temperature Sensor (18.30.99)
P018124	Engine Fuel Temperature (EFT) sensor circuit - range/performance - signal stuck high	• EFT sensor sensing circuit - short to ground, short to power, high resistance • EFT sensor ground circuit - high resistance • EFT sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new EFT sensor as necessary. Fuel Temperature Sensor (18.30.99)
P018129	Engine Fuel Temperature (EFT) sensor circuit - range/performance - signal invalid	• EFT sensor sensing circuit - short to ground, short to power, high resistance • EFT sensor ground circuit - high resistance • EFT sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new EFT sensor as necessary. Fuel Temperature Sensor (18.30.99)
P018200	Engine Fuel Temperature (EFT) sensor circuit - low input	• EFT sensor sensing circuit - short to ground • EFT sensor ground circuit - short circuit • EFT sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system Install a new EFT sensor as necessary. Fuel Temperature Sensor (18.30.99)
P018300	Engine Fuel Temperature (EFT) sensor circuit - high input	- EFT sensor sensing circuit - short to power, high resistance, disconnected - EFT sensor ground circuit - high resistance - EFT sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new EFT sensor as necessary. Fuel Temperature Sensor (18.30.99)
P019100	Fuel Rail Pressure (FRP) sensor circuit - range/performance	FRP sensor range and performance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P019200	Fuel Rail Pressure (FRP) sensor circuit - low input	- FRP sensor sensing circuit - short to ground, high resistance, disconnected - FRP sensor 5V supply circuit - high resistance - FRP sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new FRP sensor as necessary. Fuel Rail Pressure (FRP) Sensor (18.30.98)
P019300	Fuel Rail Pressure (FRP) sensor circuit - high input	- FRP sensor supply/sensing circuits - short circuit to each other - FRP sensor sensing circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved

		• FRP sensor ground circuit - high resistance • FRP sensor failure	diagnostic system • Install a new FRP sensor as necessary. Fuel Rail Pressure (FRP) Sensor (18.30.98)
P019623	Engine Oil Temperature (EOT) sensor circuit - range/performance - signal stuck low	• EOT sensor sensing circuit - intermittent high resistance • EOT sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new EOT sensor as necessary. Oil Temperature Sensor (18.31.01)
P019624	Engine Oil Temperature (EOT) sensor circuit - range/performance - signal stuck high	• EOT sensor sensing circuit - intermittent high resistance • EOT sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new EOT sensor as necessary. Oil Temperature Sensor (18.31.01)
P019629	Engine Oil Temperature (EOT) sensor circuit - range/performance - signal invalid	• EOT sensor sensing circuit - intermittent high resistance • EOT sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new EOT sensor as necessary. Oil Temperature Sensor (18.31.01)
P019700	Engine Oil	• EOT sensor sensing	• Carry out any

	Temperature (EOT) sensor circuit - low input	- circuit - short to ground - EOT sensor failure	pinpoint tests associated with this DTC using the manufacturer approved diagnostic system Install a new EOT sensor as necessary. Oil Temperature Sensor (18.31.01)
P019800	Engine Oil Temperature (EOT) sensor circuit - high input	- EOT sensor sensing circuit - short to power, high resistance, disconnected - EOT sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new EOT sensor as necessary. Oil Temperature Sensor (18.31.01)
P020100	Cylinder 1 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new injector as necessary. Fuel Injector (18.10.01)
P020200	Cylinder 2 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new injector as necessary. Fuel Injector

			(18.10.01)
P020300	Cylinder 3 injector circuit - malfunction	• Injector circuit - short to ground, high resistance, disconnected • Injector failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new injector as necessary. Fuel Injector (18.10.01)
P020400	Cylinder 4 injector circuit - malfunction	• Injector circuit - short to ground, high resistance, disconnected • Injector failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new injector as necessary. Fuel Injector (18.10.01)
P020500	Cylinder 5 injector circuit - malfunction	• Injector circuit - short to ground, high resistance, disconnected • Injector failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new injector as necessary. Fuel Injector (18.10.01)
P020600	Cylinder 6 injector circuit - malfunction	• Injector circuit - short to ground, high resistance, disconnected • Injector failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system

			Install a new injector as necessary. Fuel Injector (18.10.01)
P020700	Cylinder 7 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new injector as necessary. Fuel Injector (18.10.01)
P020800	Cylinder 8 injector circuit - malfunction	- Injector circuit - short to ground, high resistance, disconnected - Injector failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new injector as necessary. Fuel Injector (18.10.01)
P022200	Throttle Position (TP) sensor circuit TP 2 - low input	- TP sensor sensing circuit TP 2 - short to ground, high resistance - TP sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body as necessary. Throttle Body (19.70.04)
P022300	Throttle Position (TP) sensor circuit TP 2 - high input	TP sensor sensing circuit TP 2- short to power	Carry out any pinpoint tests associated with this

		TP sensor failure	DTC using the manufacturer approved diagnostic system Install a new throttle body as necessary. Throttle Body (19.70.04)
P022700	Accelerator Pedal Position (APP) sensor circuit APP 1 - low input	APP sensor circuit APP 1 - short to ground, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P022800	Accelerator pedal position (APP) sensor circuit APP 1 high input	APP sensor circuit APP 1 - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P030000	Random/multiple cylinder misfire detected	- ECM to ignition coil primary circuit faults (cylinder misfire detected DTCs also logged) - Fuel injector circuit fault(s) (injector DTCs also logged) - Ignition coil failure - Spark plug failure/fouled/incorrect gap - Fuel delivery pressure (low/high) - Fuel contamination - Fuel injectors restricted, leaking, continuously open - Cylinder compression low - Worn camshaft/broken valve springs - Valve clearance	- If specific cylinder misfire or injector DTCs are also logged refer to the tests associated to those DTCs first - For ignition coil test. Engine Ignition - Check and install new sparkplugs as necessary. Spark Plugs - 4.2L NA V8 - AJV8 (18.20.02) - For fuel system tests. Fuel Tank and Lines - For injector tests. Fuel Charging and Controls - 4.2L NA V8 - AJV8/4.2L

		adjustment	SC V8 - AJV8 - Check cylinder compressions. Engine Valve Clearance Adjustment (12.29.48) - Check for worn/broken engine components and valve clearance adjustment.
P030100	Cylinder 1 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P030200	Cylinder 2 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P030300	Cylinder 3 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P030400	Cylinder 4 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P030500	Cylinder 5 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P030600	Cylinder 6 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P030700	Cylinder 7 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P030800	Cylinder 8 misfire detected	Refer to P030000 possible causes	Refer to P030000 actions
P031300	Misfire detected with low fuel	Misfire detected during low fuel level condition	- Check for fuel level sensor DTCs and refer to DTC Index - Add fuel, clear the DTC and test for normal operation
P031600	Engine misfire detected on startup	Misfire detected on first 1000 revs	Check for specific cylinder misfire DTCs and refer to the DTC Index
P032700	Knock sensor (KS) 1 circuit - low input (bank 1)	- Poor sensor contact with the cylinder block - KS circuit - short to	Ensure a good electrical contact with the cylinder

		- ground - KS failure	- block - Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new KS as necessary. Knock Sensor (KS) (18.30.69)
P032800	Knock sensor (KS) 1 circuit - high input (bank 1)	- Poor sensor contact with the cylinder block - KS circuit - high resistance, short to power - KS failure	- Ensure a good electrical contact with the cylinder block - Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new KS as necessary. Knock Sensor (KS) (18.30.69)
P033200	Knock sensor (KS) 2 circuit - low input (bank 2)	- Poor sensor contact with the cylinder block - KS circuit - short to ground - KS failure	- Ensure a good electrical contact with the cylinder block - Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new KS as necessary. Knock Sensor (KS) (18.30.69)
P033300	Knock sensor (KS) 2 circuit - high input (bank 2)	- Poor sensor contact with the cylinder block - KS circuit - high resistance, short to	Ensure a good electrical contact with the cylinder block

		- power - KS failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new KS as necessary. Knock Sensor (KS) (18.30.69)
P033592	Crankshaft Position (CKP) sensor circuit - performance or incorrect operation	- CKP sensor circuit - short to ground, short to power, high resistance, disconnected - CKP sensor gap incorrect, foreign matter on sensor face, damaged teeth on rotor - CKP sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check CKP sensor for damage and check air gap (check at 90° intervals, should be no greater than 4.5mm) - Install a new CKP sensor as necessary. Crankshaft Position (CKP) Sensor (18.30.12)
P033594	Crankshaft Position (CKP) sensor circuit - unexpected operation	- CKP sensor circuit - short to ground, short to power, high resistance, disconnected - CKP sensor gap incorrect, foreign matter on sensor face, damaged teeth on rotor - CKP sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Check CKP sensor for damage and check air gap (check at 90° intervals, should be no greater than 4.5mm) - Install a new CKP sensor as

			necessary. Crankshaft Position (CKP) Sensor (18.30.12)
P033600	Crankshaft Position (CKP) sensor circuit - range/performance	• CKP sensor circuit - short to ground, short to power, high resistance, disconnected • CKP sensor gap incorrect, foreign matter on sensor face, damaged teeth on rotor • CKP sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CKP sensor for damage and check air gap (check at 90° intervals, should be no greater than 4.5mm) • Install a new CKP sensor as necessary. Crankshaft Position (CKP) Sensor (18.30.12)
P034092	Camshaft Position (CMP) sensor circuit (bank 1) - performance or incorrect operation	• CMP sensor circuit - short to ground, short to power, high resistance, disconnected • CMP sensor gap incorrect, foreign matter on sensor face, damaged rotor • CMP sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CMP sensor for correct installation and damage • Install a new CMP sensor as necessary. Camshaft Position (CMP) Sensor RH (18.31.11)
P034094	Camshaft Position (CMP) sensor circuit (bank 1) - unexpected operation	• CMP sensor circuit - short to ground, short to power, high resistance, disconnected	• Carry out any pinpoint tests associated with this DTC using the manufacturer

		• CMP sensor gap incorrect, foreign matter on sensor face, damaged rotor • CMP sensor failure	approved diagnostic system • Check CMP sensor for correct installation and damage • Install a new CMP sensor as necessary. Camshaft Position (CMP) Sensor RH (18.31.11)
P034100	Camshaft Position (CMP) sensor circuit (bank 1) - range/performance	• CMP sensor circuit - short to ground, short to power, high resistance, disconnected • CMP sensor gap incorrect, foreign matter on sensor face, damaged rotor • CMP sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CMP sensor for correct installation and damage • Install a new CMP sensor as necessary. Camshaft Position (CMP) Sensor RH (18.31.11)
P034592	Camshaft Position (CMP) sensor circuit (bank 2) - performance or incorrect operation	• CMP sensor circuit - short to ground, short to power, high resistance, disconnected • CMP sensor gap incorrect, foreign matter on sensor face, damaged rotor • CMP sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CMP sensor for correct installation and damage • Install a new CMP sensor as necessary. Camshaft Position (CMP) Sensor LH (18.31.12)

P034594	Camshaft Position (CMP) sensor circuit (bank 2) - unexpected operation	• CMP sensor circuit - short to ground, short to power, high resistance, disconnected • CMP sensor gap incorrect, foreign matter on sensor face, damaged rotor • CMP sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CMP sensor for correct installation and damage • Install a new CMP sensor as necessary. Camshaft Position (CMP) Sensor LH (18.31.12)
P034600	Camshaft Position (CMP) sensor circuit (bank 2) - range/performance	• CMP sensor circuit - short to ground, short to power, high resistance, disconnected • CMP sensor gap incorrect, foreign matter on sensor face, damaged rotor • CMP sensor failure	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Check CMP sensor for correct installation and damage • Install a new CMP sensor as necessary. Camshaft Position (CMP) Sensor LH (18.31.12)
P035100	Ignition coil 1 primary/secondary circuit	• Ignition module/coil circuits - short to ground, power, high resistance	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035200	Ignition coil 2 primary/secondary circuit	• Ignition module/coil circuits - short to ground, power, high resistance	• Carry out any pinpoint tests associated with this DTC using the manufacturer

			approved diagnostic system
P035300	Ignition coil 3 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035400	Ignition coil 4 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035500	Ignition coil 5 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035600	Ignition coil 6 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035700	Ignition coil 7 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P035800	Ignition coil 8 primary/secondary circuit	Ignition module/coil circuits - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer

			approved diagnostic system
P040100	Exhaust Gas Recirculation (EGR) flow insufficient detected	• EGR valve incorrectly installed or loose • EGR pipe blocked • EGR valve stuck closed, blocked • EGR valve failure	• For EGR system tests. Engine Emission Control
P041300	Secondary Air Injection (AIR) switching valve circuit open	• AIR check valve control circuit high	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P041400	Secondary Air Injection (AIR) switching valve circuit shorted	• AIR check valve control circuit low	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P042000	Catalyst system efficiency below threshold (bank 1)	• Catalyst failure due to overheating damage caused by misfire and/or lean combustion • Catalyst failure due to poisoning caused by excessive oil consumption and/or contaminated fuel	• Check for misfire/lean combustion DTCs and refer to DTC Index in this section • Check the oil and fuel condition/level. Check the catalytic converter for damage
P043000	Catalyst system efficiency below threshold (bank 2)	• Catalyst failure due to overheating damage caused by misfire and/or lean combustion • Catalyst failure due to poisoning caused by excessive oil consumption and/or	• Check for misfire/lean combustion DTCs and refer to DTC Index in this section • Check the oil and fuel condition/level.

		contaminated fuel	Check the catalytic converter for damage
P044100	Evaporative Emission (EVAP) system incorrect purge flow	Purge valve - range/performance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P044700	Evaporative Emission (EVAP) system vent control circuit open	DMTL COV circuit - short to ground	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P044800	Evaporative Emission (EVAP) system vent control circuit shorted	DMTL COV circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P045600	Evaporative Emission (EVAP) system leak detected (very small leak)	DMTL system has detected a leak	For evaporative emissions tests. Evaporative Emissions
P045800	Evaporative Emission (EVAP) canister purge valve circuit low	- EVAP canister purge valve control circuit - short to ground, high resistance - EVAP canister purge valve failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new EVAP canister purge valve as necessary. Evaporative Emission Canister Purge Valve - 4.2L NA V8 - AJV8

			(17.15.30)
P045900	Evaporative Emission (EVAP) canister purge valve circuit high	EVAP canister purge valve control circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P046129	Fuel level sensor A circuit - range/performance - stuck	Fuel level sensor failure	For fuel level sensor pinpoint tests for this DTC. Fuel Tank and Lines
P04612F	Fuel level sensor A circuit - range/performance - signal erratic	Fuel level sensor failure	For fuel level sensor pinpoint tests for this DTC. Fuel Tank and Lines
P046200	Fuel level sensor A circuit - low input	Fuel level sensor failure	For fuel level sensor pinpoint tests for this DTC. Fuel Tank and Lines
P046300	Fuel level sensor A circuit - high input	Fuel level sensor failure	For fuel level sensor pinpoint tests for this DTC. Fuel Tank and Lines
P048023	Fan 1 control circuit low	Electric fan control circuit - short to ground, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P048024	Fan 1 control circuit high	Electric fan control circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer

			approved diagnostic system
P048309	Fan rationality check	• Cooling fan difficult to turn/obstructed • Fan/Motor damaged	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • CLEAR any obstruction and INSTALL a new fan as necessary. Cooling Fan Motor and Shroud - Vehicles Without: Supercharger (26.25.25)
P048316	Fan rationality check	• Fan control module reports battery voltage less than nine volts	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • CHECK the battery condition • CHECK the charging system and fan circuits
P048317	Fan rationality check	• Fan control module reports battery voltage greater than 18 volts	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • CHECK the charging system and fan circuits
P048397	Fan rationality check	• Cooling fan jammed	• Carry out any pinpoint tests associated with this DTC using the

			manufacturer approved diagnostic system • CLEAR any obstruction and INSTALL a new fan as necessary. Cooling Fan Motor and Shroud - Vehicles Without: Supercharger (26.25.25)
P048900	Exhaust Gas Recirculation (EGR) control circuit low	• EGR valve power supply circuit - short to ground, high resistance	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P049000	Exhaust Gas Recirculation (EGR) control circuit high	• EGR valve control circuit - short to power	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P050082	Vehicle speed sensor malfunction	• Vehicle speed - invalid signal received over CAN	• Check ABS for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
P050086	Vehicle speed sensor malfunction	• Vehicle speed - invalid signal received over CAN	• Check ABS for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
P050162	Vehicle speed sensor - range/performance - signal plausibility failure	• Vehicle speed - range performance	• Check for ABS/TCM DTCs and refer to DTC Index for speed sensor tests. Anti-Lock Control - Stability Assist

			Diagnostic Strategy
P050400	Brake switch A/B correlation	The brake pressure reading does not agree with the brake light switch value	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P050401	Brake switch A/B correlation	- Brake switch high fault: Brake lights stuck on Gearshift interlock inoperative Speed control inoperative - Brake switch low fault: Brake lights inoperative Gearshift stuck in Park Reduced engine braking	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P050600	Idle air control system RPM lower than expected	- Air intake restriction - Front End Accessory Drive (FEAD) overload (defective/seized component)	- Ensure the air intake system is free from restriction - Check the FEAD belt and components. Accessory Drive
P050624	Idle air control system RPM lower than expected	- Air intake restriction - Front End Accessory Drive (FEAD) overload (defective/seized component)	- Ensure the air intake system is free from restriction - Check the FEAD belt and components. Accessory Drive
P050700	Idle air control system RPM higher than expected	- Intake air leak between MAF sensor and engine - Engine crankcase breather leak	- Check for leakage and correct installation of air intake system - Check for leakage and correct installation of engine crankcase

			breather system
P050723	Idle air control system RPM higher than expected	- Intake air leak between MAF sensor and engine - Engine crankcase breather leak	- Check for leakage and correct installation of air intake system - Check for leakage and correct installation of engine crankcase breather system
P050B84	Cold start ignition timing performance	Cold start emission reduction strategy engine spark timing too retarded	Check for any engine ignition related DTCs also logged and refer to the DTC Index
P050B85	Cold start ignition timing performance	Cold start emission reduction strategy engine spark timing too advanced	Check for any engine ignition related DTCs also logged and refer to the DTC Index
P05120C	Starter request circuit	Crank request circuit - high input	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P05120E	Starter request circuit	Crank request circuit - low input	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P051300	Incorrect immobilizer key	Security key invalid	Check for CAN network interference/EMC related error. Re-synchronise ID by re-configuring the ECM and instrument cluster as new modules
P056013	System voltage	Battery back-up	Carry out any

		malfunction	pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P056100	System voltage unstable	System voltage comparison	Check for sensor 5 volt supply related DTCs and refer to DTC Index in this section
P056200	System voltage low	Sensor 5 volt power supply circuit - low input	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P056300	System voltage high	Sensor 5 volt power supply circuit - high input	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P057501	Speed control cancel button fault	Speed control cancel button fault	Check speed control system for DTCs and refer to DTC Index
P059000	Speed control multi-function input B circuit stuck	Active speed limiter fault	Check speed control system for DTCs and refer to DTC Index
P060143	Internal control module memory check sum error - special memory failure	CPU communication - sub	Refer to new module/component installation Note at top of DTC Index
P060145	Internal control module memory check sum error - program	CPU communication	Refer to new module/component installation Note at

	memory failure		top of DTC Index
P060442	Internal control module Random Access Memory (RAM) error - general memory failure	Initial RAM test	Refer to new module/component installation Note at top of DTC Index
P060443	Internal control module Random Access Memory (RAM) error - special memory failure	Shut off RAM test	Refer to new module/component installation Note at top of DTC Index
P060444	Internal control module Random Access Memory (RAM) error - data memory failure	RAM check sum	Refer to new module/component installation Note at top of DTC Index
P060445	Internal control module Random Access Memory (RAM) error - program memory failure	Initial RAM test	Refer to new module/component installation Note at top of DTC Index
P060500	Internal control module Read Only Memory (ROM) error	EEPROM/flash checksum error	Configure the module using the Jaguar approved diagnostic system
P060529	Internal control module Read Only Memory (ROM) error	ROM error	Refer to new module/component installation Note at top of DTC Index
P060542	Internal control module Read Only Memory (ROM) error - general memory failure	ROM check sum	Refer to new module/component installation Note at top of DTC Index
P060543	Internal control module Read Only Memory (ROM) error - special memory failure	Shut off ROM test	Refer to new module/component installation Note at top of DTC Index
P060544	Internal control module Read Only Memory (ROM) error - data memory failure	Initial ROM test	Refer to new module/component installation Note at

			top of DTC Index
P060545	Internal control module Read Only Memory (ROM) error - program memory failure	Continuous ROM test	Refer to new module/component installation Note at top of DTC Index
P060546	Internal control module Read Only Memory (ROM) error	Continuous ROM test	Refer to new module/component installation Note at top of DTC Index
P060548	Internal control module Read Only Memory (ROM) error - supervision software failure	Shut off ROM test	Refer to new module/component installation Note at top of DTC Index
P060564	Internal control module Read Only Memory (ROM) error	ROM error - sub	Refer to new module/component installation Note at top of DTC Index
P060600	ECM/PCM processor fault	Watchdog error	Refer to new module/component installation Note at top of DTC Index
P060601	ECM/PCM processor fault - general electrical failure	Controller test - sub	Refer to new module/component installation Note at top of DTC Index
P060604	ECM/PCM processor fault	System internal failures	Refer to new module/component installation Note at top of DTC Index
P060605	ECM/PCM processor fault - system programming failures	Throttle return spring failure (throttle body failure)	Refer to new module/component installation Note at top of DTC Index
P060641	ECM/PCM processor fault - general checksum failure	Watch dog timer fault - sub	Refer to new module/component installation Note at top of DTC Index

P060642	ECM/PCM processor fault - general memory failure	Error capturing instructions	Refer to new module/component installation Note at top of DTC Index
P060643	ECM/PCM processor fault - special memory failure	Duplication memory fault	Refer to new module/component installation Note at top of DTC Index
P060644	ECM/PCM processor fault - data memory failure	Duplication memory fault - sub	Refer to new module/component installation Note at top of DTC Index
P060645	ECM/PCM processor fault - program memory failure	Detection of write to internal ROM	Refer to new module/component installation Note at top of DTC Index
P060646	ECM/PCM processor fault - calibration/parameter memory failure	Detection of write to internal ROM - sub	Configure the module using the Jaguar approved diagnostic system
P060647	ECM/PCM processor fault	Watch dog timer fault	Configure the module using the Jaguar approved diagnostic system
P060648	ECM/PCM processor fault - supervision software failure	Scheduling sequence check	Configure the module using the Jaguar approved diagnostic system
P060649	ECM/PCM processor fault - internal electronic failure	Controller test	Refer to new module/component installation Note at top of DTC Index
P060700	Control module performance	Sub - CPU watch dog	Refer to new module/component installation Note at top of DTC Index
P060D00	Internal control module accelerator pedal position performance	APS Communication	Carry out any pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system
P060E62	Internal control module throttle position performance - signal compare failure	Throttle motor amplifier failure for valve sensor malfunction	Refer to new module/component installation Note at top of DTC Index
P060E64	Internal control module throttle position performance - signal plausibility failure	TPS Communication	Refer to new module/component installation Note at top of DTC Index
P060A64	Internal control module monitoring processor performance	Internal control module monitoring processor performance	Clear the DTC and retest. If the DTC resets, refer to new module/component installation Note at top of DTC Index
P060A67	Internal control module monitoring processor performance	Internal control module monitoring processor performance	Clear the DTC and retest. If the DTC resets, refer to new module/component installation Note at top of DTC Index
P061000	Control module vehicle options error	Car configuration data mismatch	Re-configure the RJB using the manufacturer approved diagnostic system
P061A00	Internal control module torque performance	Pedal follower error	Refer to new module/component installation Note at top of DTC Index
P061A29	Internal control module torque performance - signal invalid	Absolute engine torque calculation failure - sub-processor	Refer to new module/component installation Note at top of DTC Index
P061A64	Internal control module torque performance - signal plausibility failure	Absolute engine torque calculation failure	Refer to new module/component installation Note at top of DTC Index

P061B29	Internal control module torque calculation performance - signal invalid	Absolute and dynamic engine torque calculation failure	Refer to new module/component installation Note at top of DTC Index
P061B64	Internal control module torque calculation performance - signal plausibility failure	Absolute and dynamic engine torque calculation failure	Refer to new module/component installation Note at top of DTC Index
P062700	Fuel pump A control circuit/open	Fuel pump control circuit fault (FPDM to fuel pump)	Refer to the electrical circuit diagrams and check the FPDM to Fuel Pump circuit for short to ground, power, open circuit
P062A00	Fuel pump A control circuit range/performance	Invalid fuel pump duty requested by the ECM	Refer to the electrical circuit diagrams and test the ECM to FPDM monitor circuit for short to ground, power, open circuit
P063000	VIN not programmed or incompatible - ECM/PCM	CCF to CAN VIN mismatch	Configure the module using the Jaguar approved diagnostic system, clear DTC and re-test, if DTC remains suspect the ECM. Refer to the new module/component installation note at the top of the DTC Index
P068773	EMS control relay control circuit high	EMS control relay malfunction	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system

P072186	Output speed sensor circuit range/performance	TCM Output shaft speed sensor error received	For transmission tests. Diagnostic Strategy
P08170D	Starter relay circuit (break wire)	Starter relay circuit (break wire)	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P081A0B	Starter relay circuit low	Starter relay circuit low	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P081B0C	Starter relay circuit high	Starter relay circuit high	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P08510E	Park/Neutral switch input circuit low	Park/Neutral switch input circuit - low	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P08520C	Park/Neutral switch input circuit high	Park/Neutral switch input circuit - high	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P125900	Immobilizer to ECM signal error	Incorrect ID received from instrument cluster	Re-configure the instrument cluster using the

			manufacturer approved diagnostic system
P131500	Persistent misfire	- ECM to ignition coil primary circuit fault (cylinder misfire detected DTC also flagged) - Fuel injector circuit fault(s) (injector DTCs also flagged) - Fuel delivery pressure low - Spark plug failure/fouled/incorrect gap - Cylinder compression low	- Check for cylinder mis-fire, ignition and injector DTCs and refer to the DTC Index - For fuel system tests. Fuel Tank and Lines - For spark plug tests. Engine Ignition - For cylinder compression tests. Engine
P131600	Misfire rate exceeds emissions thresholds	Misfire rate exceeds emissions thresholds	Check for individual cylinder misfire DTCs and refer to DTC Index in this section
P136700	Ignition amplifier group A	Ignition module/coil monitoring circuit - short to ground, short to power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P136800	Ignition amplifier group B	Ignition module/coil monitoring circuit - short to ground, short to power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P160300	EEPROM error	ECM fault	Refer to new module/component installation note at top of DTC Index
P162600	ECM electronic	Dynamic torque	Suspect the ECM,

	throttle monitoring/self test - torque monitoring problem	monitoring error	refer to new module/component installation note at top of DTC Index
P209600	Fuel trim too lean, bank 1	Heated Oxygen Sensor (HO2S) fuel adaption - lean	- Check integrity and correct installation of air intake system - Check for any HO2S codes also logged and refer to DTC Index in this section
P209700	Fuel trim too rich, bank 1	Heated Oxygen Sensor (HO2S) fuel adaption - rich	- Check integrity and correct installation of air intake system - Check for any HO2S codes also logged and refer to DTC Index in this section
P209800	Fuel trim too lean, bank 2	Heated Oxygen Sensor (HO2S) fuel adaption - lean	- Check integrity and correct installation of air intake system - Check for any HO2S codes also logged and refer to DTC Index in this section
P209900	Fuel trim too rich, bank 2	Heated Oxygen Sensor (HO2S) fuel adaption - rich	- Check integrity and correct installation of air intake system - Check for any HO2S codes also logged and refer to DTC Index in this section
P210129	Throttle actuator control motor circuit range/performance	Jammed throttle blade, gearing or motor	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system

			Install a new throttle body. Refer to the new module/component installation note at the top of the DTC Index
P210162	Throttle actuator control motor circuit range/performance	Jammed throttle blade, gearing or motor	Refer to the electrical circuit diagrams and test throttle actuator control motor circuit for short to ground, power, high resistance. Compare throttle position sensor 1 and 2 datalogger signals, if signals are comparable install a new throttle body. Throttle Body (19.70.04)
P210164	Throttle actuator control motor circuit range/performance	Jammed throttle blade, gearing or motor	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body. Refer to the new module/component installation note at the top of the DTC Index
P210177	Throttle actuator motor control circuit range/performance	- Throttle blade stuck open - Intake air system leak	- Check for throttle related DTCs and refer to DTC Index in this section - Check intake air system for leaks

P210329	Throttle actuator motor control circuit high	- Throttle motor control circuit - short to power - ECM fault	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Refer to new module/component installation note at top of DTC Index
P210364	Throttle actuator motor control circuit high - signal plausibility failure	- Throttle motor control circuit - short to power - ECM fault	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Refer to new module/component installation note at top of DTC Index
P210500	Throttle actuator control system - forced engine shutdown	Throttle MIL request due to fuel cut	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P210629	Throttle actuator control system - forced limited power	Signal invalid	Install a new throttle body. Throttle Body (19.70.04) Refer to new module/component installation note at top of DTC Index
P210664	Throttle actuator control system - forced limited power	Signal plausibility failure	Install a new throttle body. Throttle Body (19.70.04) Refer to new module/component installation note at

			top of DTC Index
P211800	Throttle actuator motor control current range/performance	Throttle motor control circuit - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P211900	Throttle actuator control throttle body range/performance	Throttle spring faulty	Install a new throttle body. Throttle Body (19.70.04) Refer to new module/component installation note at top of DTC Index
P212200	Accelerator pedal position (APP) sensor D circuit low input	APP sensor circuit 2 - low input	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P212300	Accelerator pedal position (APP) sensor D circuit high input	APP sensor circuit 2 - high input	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P213528	Accelerator pedal position (APP) sensor 1 and 2 voltage correlation	APP sensor circuit 1 and 2 range performance - sub-processor	Check APP sensor circuits 1 and 2 for short to ground, power and high resistance. Clear the DTCs and retest. If the code remains, replace the APP sensor
P213529	Accelerator pedal position (APP) sensor 1 and 2 voltage	APP sensor - excessive difference between raw values of circuit 1 and	Carry out any pinpoint tests associated with this

	correlation	2 - sub-processor	DTC using the manufacturer approved diagnostic system
P213562	Accelerator pedal position (APP) sensor 1 and 2 voltage correlation	APP sensor circuit 1 and 2 range performance - sub-processor	Check APP sensor circuits 1 and 2 for short to ground, power and high resistance. Clear the DTCs and retest. If the code remains, replace the APP sensor
P213564	Accelerator pedal position (APP) sensor 1 and 2 voltage correlation	APP sensor circuit 1 and 2 range performance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P222800	Barometric pressure circuit low input	BARO sensor failure (internal ECM fault)	Refer to new module/component installation note at top of DTC Index
P222900	Barometric pressure circuit high input	BARO sensor failure (internal ECM fault)	Refer to new module/component installation note at top of DTC Index
P240100	Evaporative emission (EVAP) system leak detection pump control circuit low	DMTL pump circuit - short to ground	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P240200	Evaporative emission (EVAP) system leak detection pump control circuit high	DMTL pump circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system
P240429	Evaporative emission (EVAP) system leak detection pump sensing circuit range/performance	• DMTL reference leak • DMTL pump circuit - short to ground, power, high resistance • DMTL pipework blocked/leaking	• For evaporative emissions system tests. Evaporative Emissions
P24042F	Evaporative emission (EVAP) system leak detection pump sensing circuit range/performance - signal erratic	• DMTL reference leak • DMTL pump circuit - short to ground, power, high resistance • DMTL pipework blocked/leaking	• For evaporative emissions system tests. Evaporative Emissions
P240500	Evaporative emission (EVAP) system leak detection pump sensing circuit low	• DMTL pump circuit - short to ground, power, high resistance	• For evaporative emissions system tests. Evaporative Emissions
P240600	Evaporative emission (EVAP) system leak detection pump sensing circuit high	• DMTL pump circuit - short to ground, power, high resistance	• For evaporative emissions system tests. Evaporative Emissions
P240B00	Evaporative emission (EVAP) system leak detection pump heater circuit low	• DMTL heater control circuit low	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P240C00	Evaporative emission (EVAP) system leak detection pump heater circuit high	• DMTL heater control circuit high	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P243100	Secondary air injection manifold absolute pressure	• Secondary air injection system leaks • Secondary air injection	• Check the secondary air injection system for

	sensor circuit range/performance	pump Secondary air injection valve	leaks Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P243200	Secondary air injection manifold absolute pressure sensor circuit low	Secondary air injection manifold absolute pressure sensor circuit - short to ground, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P243300	Secondary air injection manifold absolute pressure sensor circuit high	Secondary air injection manifold pressure (MAP) sensor circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P244400	Secondary air injection system pump stuck ON	Secondary air injection pump control circuit - short to ground	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P244500	Secondary air injection system pump stuck OFF	Secondary air injection pump control circuit - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P245000	Evaporative emission (EVAP) system change-over valve (COV) performance/stuck open	DMTL system circuit - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system
P245100	Evaporative emission (EVAP) system change-over valve (COV) performance/stuck closed	DMTL system circuit - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P261064	ECM/PCM Internal engine off timer performance	- ECT sensor fault - Ambient temperature sensor fault - Body processor module fault (time) - CAN error	Check for DTCs indicating a fault with any of the components listed, and refer to relevant DTC Index
P261087	ECM/PCM Internal engine off timer performance	- ECT sensor fault - Ambient temperature sensor fault - Body processor module fault (time) - CAN error	Check for DTCs indicating a fault with any of the components listed, and refer to relevant DTC Index
U007300	Control module communication bus off	CAN Link circuit malfunction	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U010100	Lost communication with TCM	CAN Link ECM/TCM network malfunction	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U010300	Lost communication with gear shift control module	CAN Link ECM/gear shift network malfunction	Carry out any pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system
U010400	Lost communication with speed control module	CAN Link ECM/speed control module network malfunction	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U012100	Lost communication with anti-lock brake system (ABS) control module	CAN Link ECM/ABS module network malfunction	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U012800	Lost communication with electronic parking brake control module	CAN Link ECM/Electronic parking brake signal missing network malfunction	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U015100	Lost communication with restraints control module/inertia switch	Lost communication - CAN or hardwired	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U01511F	Lost communication with restraints control module/inertia switch	Lost communication - SRS fault	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U015157	Lost communication with restraints control module/inertia switch	Lost communication - CAN fault	Carry out any pinpoint tests associated with this DTC using the manufacturer approved

			diagnostic system
U015500	Lost communication with instrument cluster	CAN Link ECM/instrument cluster network malfunction	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U016700	Lost communication with vehicle immobilizer	Security challenge response timeout	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U040208	Invalid data received from Transmission Control Module (TCM)	TCM engine speed control monitor	Check TCM for DTCs and refer to DTC Index. Diagnostic Strategy
U040264	Invalid data received from Transmission Control Module (TCM)	Actual gear position status	Check TCM for DTCs and refer to DTC Index. Diagnostic Strategy
U040267	Invalid data received from Transmission Control Module (TCM)	Selector lever position status	Check TCM for DTCs and refer to DTC Index. Diagnostic Strategy
U040281	Invalid data received from Transmission Control Module (TCM)	Output shaft speed signal	Check TCM for DTCs and refer to DTC Index. Diagnostic Strategy
U040282	Invalid Data Received From Transmission Control Module - TCM engine speed control monitor -	- CAN Bus circuit fault - Circuit fault in supply voltage to transmission control module	Check the transmission control module for related stored DTCs. Using the manufacturer approved diagnostic system,

	plausibility (TCM alive counter)		complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network to the transmission control module. Refer to the electrical circuit diagrams and check the power and ground circuit to the transmission control module
U040283	Invalid data received from Transmission Control Module (TCM)	TCM engine speed control monitor - plausibility	Check TCM for DTCs and refer to DTC Index. Diagnostic Strategy
U040286	Invalid data received from Transmission Control Module (TCM)	TCM engine speed control monitor - rationality	Check TCM for DTCs and refer to DTC Index. Diagnostic Strategy
U040581	Invalid data received from speed control module	Invalid data received from speed control module	Check speed control module for DTCs and refer to DTC Index. Speed Control
U040583	Invalid data received from speed control module	Invalid data received from speed control module	Check speed control module for DTCs and refer to DTC Index. Speed Control
U04058F	Invalid data received from speed control module	Invalid data received from speed control module	Check speed control module for DTCs and refer to DTC Index. Speed Control
U041500	Invalid data received from Anti-lock Brake System (ABS) control module	Brake Position Switch	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control

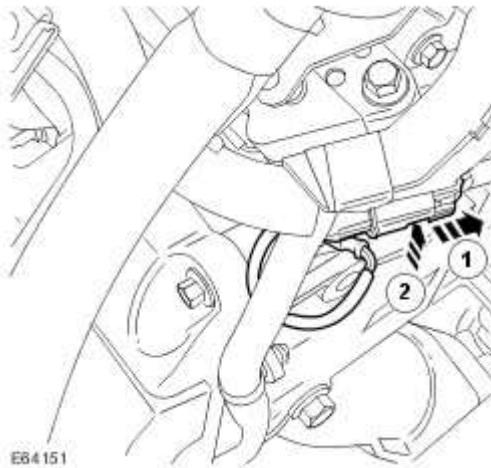
			- Stability Assist
U041564	Invalid data received from Anti-lock Brake System (ABS) control module	Engine drag torque control monitoring - plausibility	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
U041567	Invalid data received from Anti-lock Brake System (ABS) control module	Engine drag torque control monitoring - rationality	Check anti-lock control - stability assist module for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
U042386	Invalid data received from instrument cluster - signal invalid	Battery voltage level	Check instrument cluster for DTCs and refer to DTC Index. Instrument Cluster
U042481	Invalid data received from instrument cluster	External ambient temperature	Check instrument cluster for DTCs and refer to DTC Index. Instrument Cluster
U042600	Invalid data received from vehicle immobilizer	Security code mis-match	Check CAN network between ECM and instrument cluster. Check power and grounds to ECM and instrument cluster. Check correct ECM and instrument cluster installed. Re-synchronise ID by re-configuring the ECM and instrument cluster as new modules

U206400	Warning indicator requested by another control module	Fuel Cut	Set ignition to ON, then OFF (wait 30 seconds), then ON (wait 4 seconds)

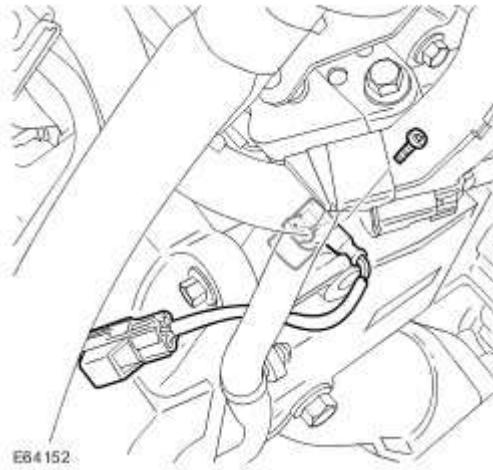
Camshaft Position (CMP) Sensor LH (18.31.12)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)
- 2 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Disconnect the CMP sensor electrical connector.
▶ Slide the red connector latch to one side.



- 4 . Remove the CMP sensor.
▶ Remove the Torx bolt.
▶ Remove and discard the O-ring seal.



Installation

- 1 . Install the CMP sensor.
 - ▶ Clean the components.
 - ▶ Install a new O-ring seal.
 - ▶ Tighten the Torx bolt to 7 Nm (5 lb.ft).
 - ▶ Connect and secure the electrical connector.
- 2 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

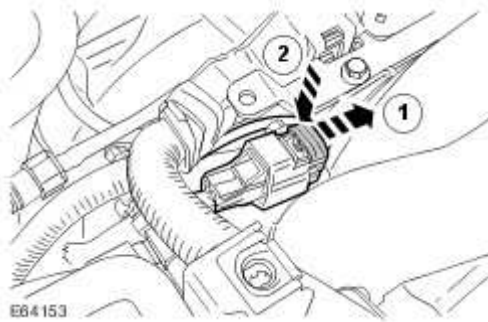
Camshaft Position (CMP) Sensor RH (18.31.11)

Removal

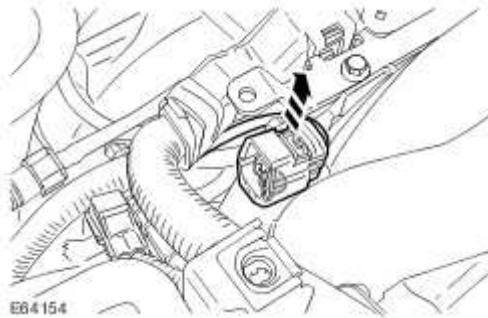
1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)

2 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)

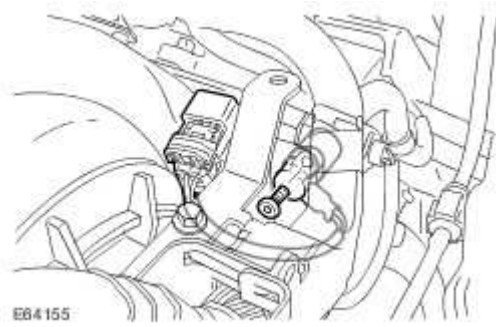
3 . Disconnect the CMP sensor electrical connector.
▶ Slide the red connector latch to one side.



4 . Release the CMP sensor electrical connector.



5 . Remove the CMP sensor.
▶ Remove the Torx bolt.
▶ Remove and discard the O-ring seal.



Installation

- 1 . Install the CMP sensor.
 - ▶ Clean the components.
 - ▶ Install a new O-ring seal.
 - ▶ Tighten the Torx bolt to 7 Nm (5 lb.ft).
 - ▶ Connect and secure the electrical connector.
- 2 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

Catalyst Monitor Sensor (18.30.66)

Removal

1. Remove the cover and disconnect the battery ground cable.

For additional information, refer to [Specifications](#)

2



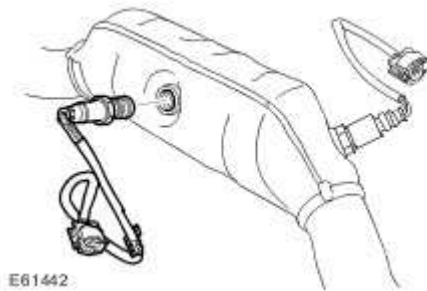
- **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

3. Remove the exhaust system.

For additional information, refer to [Catalytic Converter \(17.50.05\)](#)

4. Remove the catalyst monitor sensor.



Installation

1



- **WARNING: Make sure the H02S wiring harness is not twisted more than 180 degrees and is not in contact with the exhaust.**



- **CAUTION: Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.**

Install the catalyst monitor sensor and tighten to 45 Nm (33 lb.ft).

- Clean the component mating faces.
- Apply an anti-seize compound to the thread of the sensor.

2 . Install the exhaust system.

For additional information, refer to [Catalytic Converter \(17.50.05\)](#)

3 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

4 **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](#)

Crankshaft Position (CKP) Sensor (18.30.12)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)

2



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

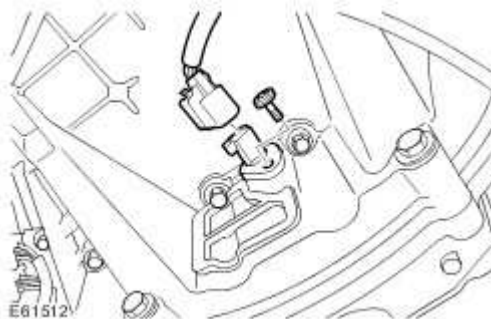
Raise and support the vehicle.

- 3 . **NOTE:**

Clean the components general area prior to dismantling.

Remove the crankshaft position (CKP) sensor.

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



Installation

- 1 . Install the CKP sensor.
 - ▶ Clean the component mating faces.
 - ▶ Tighten the Torx screw to 8 Nm (6 lb.ft).
 - ▶ Connect the electrical connector.
- 2 . Connect the battery ground cable and install the cover.
For additional information, refer to [Specifications](#)

Engine Control Module (ECM) (18.30.01)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)

- 2 . Remove the air intake cover.

▶ Remove the 4 clips.



- 3 . Release the power distribution box and position aside.

▶ Remove the 2 Torx bolts.

- 4 . Disconnect the engine harness electrical connector.

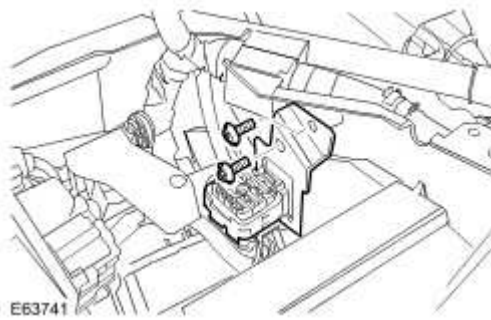
▶ Loosen the bolt.



- 5 . Release the electrical connector.

▶ Remove the 2 Torx screws.

▶ Carefully tie the harness aside.

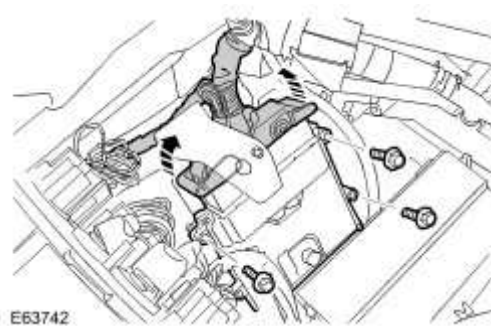


6 . NOTE:

RH illustration shown, LH is similar

Remove the engine control module (ECM).

- ▶ Remove the 3 bolts.
- ▶ Release and disconnect the 2 engine harness electrical connectors.



Installation

1 . Install the ECM.

- ▶ Tighten the bolts to 10 Nm (7 lb.ft).
- ▶ Connect the ECM electrical connectors.

2 . Install the electrical connector.

- ▶ Tighten the Torx screws.

3 . Connect and secure the electrical connector.

- ▶ Tighten the center bolt.

4 . Position and install the power distribution box.

- ▶ Tighten the Torx bolts to 8 Nm (6 lb.ft).

5 . Install the air intake cover.

 Carefully secure the clips.

6 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

7 . Using WDS, configure a new ECM.

Engine Coolant Temperature (ECT) Sensor (18.30.10)

Removal



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



CAUTION: Anti-freeze concentration must be maintained at 50%.

1. Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)

2

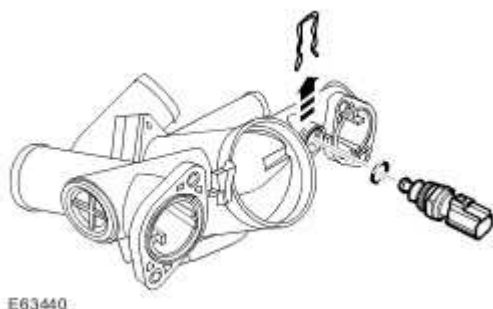


- **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

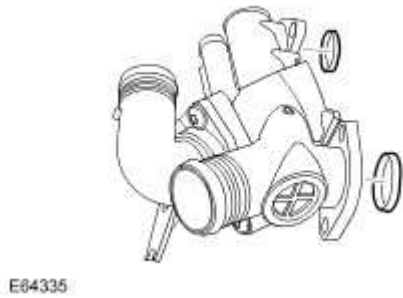
Drain the cooling system.

For additional information, refer to [Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8](#)

- 3 Remove the thermostat housing.
 - For additional information, refer to [Thermostat Housing - Vehicles Without: Supercharger](#)
4. Remove the ECT sensor.
 - ▶ Remove the retaining clip.
 - ▶ Remove and discard the O-ring seal.



5. Remove and discard the 2 O-ring seals.



Installation

- 1 . Install the O-ring seals.
- 2 . Install the ECT sensor.
 - ▶ Install the new O-ring seals.
 - ▶ Install the retaining clip.
- 3 Install the thermostat housing.
 - . For additional information, refer to [Thermostat Housing - Vehicles Without: Supercharger](#)
 - ▶ Connect and secure the electrical connector.
 - ▶ Install the bolts and tighten to 10 Nm (7 lb.ft).
- 4 Refill the cooling system.
 - . For additional information, refer to [Cooling System Draining, Filling and Bleeding - 4.2L NA V8 - AJV8](#)
- 5 . Connect the battery ground cable and install the cover.
 - For additional information, refer to [Specifications](#)

Fuel Rail Pressure (FRP) Sensor (18.30.98)

Removal



WARNING: 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.

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)
- 2 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Disconnect the fuel rail pressure (FRP) sensor electrical connector.



4



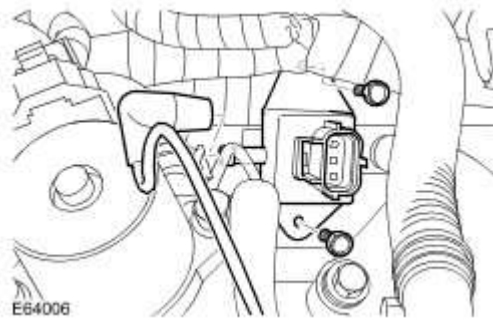
WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



CAUTION: Always plug any open connections to prevent contamination.

Remove the FRP sensor.

- ▶ Disconnect the vacuum line.
- ▶ Position an absorbent cloth to collect fluid spillage.
- ▶ Remove the 2 bolts.
- ▶ Remove and discard the 2 O-ring seals.



Installation

- 1  **WARNING:** After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

Install the FRP sensor.

- Clean the components.
- Install new O-ring seals.
- Tighten the bolts to 5 Nm (4 lb.ft).
- Connect the electrical connector.
- Connect the vacuum line.

- 2 . Install the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)
- 3 . Connect the battery ground cable and install the cover.
For additional information, refer to [Specifications](#)

Fuel Temperature Sensor (18.30.99)

Removal



WARNING: 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.

1. Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)

2. Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)

3



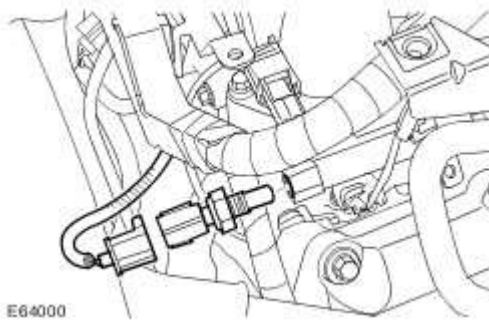
WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



CAUTION: Always plug any open connections to prevent contamination.

Remove the fuel temperature sensor.

- ▶ Disconnect the electrical connector.
- ▶ Position an absorbent cloth to collect fluid spillage.



Installation

1



WARNING: After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

Install the fuel temperature sensor.

- Clean the components.
- Tighten the sensor to 7 Nm (5 lb.ft).
- Connect the electrical connector.

2 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

3 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

Heated Oxygen Sensor (HO2S)

Removal

1. Remove the cover and disconnect the battery ground cable.

For additional information, refer to [Specifications](#)

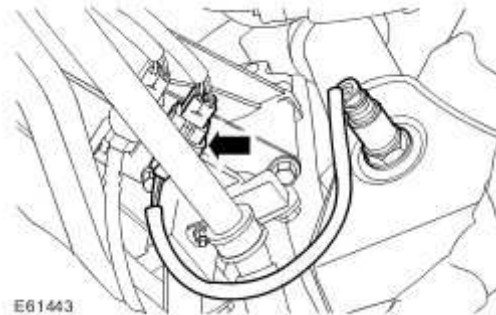
2.  **WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

Raise and support the vehicle.

3. Release and disconnect the heated oxygen sensor (HO2S) electrical connector.

4.  **WARNING: Do not twist the HO2S wiring harness on removal. Failure to follow this instruction may result in damage to the component.**

Remove the HO2S.



Installation

1.  **WARNING: Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with the exhaust.**

 **CAUTION: Make sure the anti-seize compound does not contact the HO2S tip.**

Install the HO2S to the catalytic converter and tighten to 45 Nm (33 lb.ft).

 Clean the component mating faces.

 Apply an anti-seize compound to the thread of the sensor.

2 . Connect and secure the electrical connector.

3 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

4 NOTE:

- For NAS vehicles only.

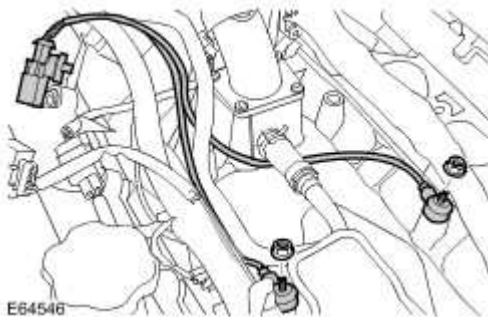
If required, carry out a long drive cycle.

For additional information, refer to [Powertrain Control Module \(PCM\) Long Drive Cycle Self-Test](#)

Knock Sensor (KS) (18.30.69)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)
- 2 . Remove the intake manifold.
For additional information, refer to
- 3 . Remove the KS.
 Remove the 2 nuts.



Installation

- 1 . Install the KS.
 Tighten the nuts to 20 Nm (15 lb.ft).
- 2 . Install the intake manifold.
For additional information, refer to
- 3 . Connect the battery ground cable and install the cover.
For additional information, refer to [Specifications](#)

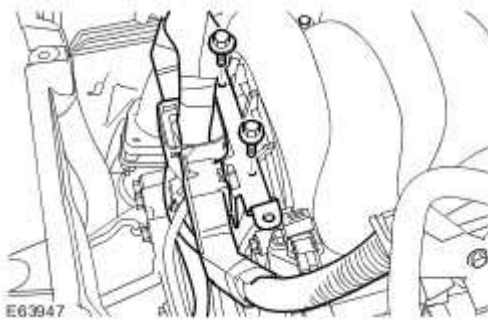
Manifold Absolute Pressure (MAP) Sensor (18.30.86)

Removal

1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)

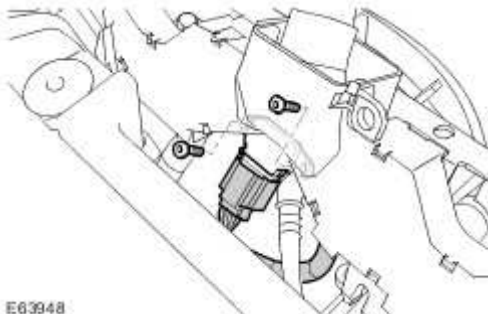
2 . Remove the engine cover.
For additional information, refer to [Engine Cover \(76.11.35\)](#)

3 . Release the wiring harness from the rear of the engine.
▶ Remove the 2 bolts.



4 . Disconnect the MAP sensor electrical connector.

5 . Remove the MAP sensor.
▶ Remove the 2 Torx screws.
▶ Remove and discard the O-ring seal.



Installation

1 . Install the MAP sensor.

- ▶ Clean the component mating faces.
- ▶ Install a new O-ring seal.
- ▶ Tighten the Torx screws.
- ▶ Connect the electrical connector.

2 . Attach the wiring harness.

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

3 . Install the engine cover.

For additional information, refer to [Engine Cover \(76.11.35\)](#)

4 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

5 **NOTE:**

- For NAS vehicles only.

If required, carry out a short drive cycle.

For additional information, refer to [Powertrain Control Module \(PCM\) Short Drive Cycle Self-Test](#)

Mass Air Flow (MAF) Sensor (18.30.15)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to [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 air cleaner assembly.

For additional information, refer to [Air Cleaner \(19.10.05\)](#)

Installation

- 1 . Install the air cleaner assembly.

For additional information, refer to [Air Cleaner \(19.10.05\)](#)

- 2 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

- 3 **NOTE:**

- For NAS vehicles only.

If required, carry out a short drive cycle.

For additional information, refer to [Powertrain Control Module \(PCM\) Short Drive Cycle Self-Test](#)

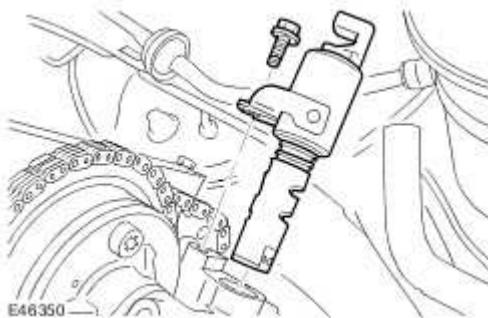
Variable Camshaft Timing (VCT) Oil Control Solenoid (18.30.90)

Removal

NOTE:

Removal of the RH is similar to this procedure.

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to [Specifications](#)
- 2 . Remove the LH valve cover.
For additional information, refer to [Valve Cover LH \(12.29.43\)](#)
- 3 . Remove the VCT oil control solenoid.
 - ▶ Remove the bolt.



Installation

- 1 . Install the VCT oil control solenoid.
 - ▶ Clean the components.
 - ▶ Tighten the bolt to 10 Nm (7 lb.ft).
- 2 . Install the LH valve cover.
For additional information, refer to [Valve Cover LH \(12.29.43\)](#)
- 3 . Connect the battery ground cable and install the cover.
For additional information, refer to [Specifications](#)

4 NOTE:

.

For NAS vehicles only.

If required, carry out a short drive cycle.

For additional information, refer to [Powertrain Control Module \(PCM\) Short Drive Cycle Self-Test](#)

Engine Oil Pressure (EOP) Sensor

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to [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 [Radiator Splash Shield \(76.22.90\)](#)

- 4 . Remove the EOP sensor.



Disconnect the electrical connector.

Installation

- 1 . Install the EOP sensor.



Clean the components.



Apply sealant of the correct specification to the sensor thread.



Tighten the sensor to 15 Nm (11 lb.ft).



Connect the electrical connector.

- 2 . Install the engine undershield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

- 3 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

Oil Temperature Sensor (18.31.01)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to [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 [Radiator Splash Shield \(76.22.90\)](#)

- 4 . Remove the oil temperature sensor.

▶ Disconnect the electrical connector.



Installation

- 1 . Install the oil temperature sensor.

▶ Clean the components.
▶ Apply sealant of the correct specification to the sensor thread.
▶ Tighten the sensor to 15 Nm (11 lb.ft).
▶ Connect the electrical connector.

- 2 . Install the engine undershield.

For additional information, refer to [Radiator Splash Shield \(76.22.90\)](#)

- 3 . Connect the battery ground cable and install the cover.

For additional information, refer to [Specifications](#)

Brake Pedal Position (BPP) Switch

Removal

NOTE:

The brake pedal position switch also functions as the speed control deactivator switch.

- 1 . Remove the BPP switch.

For additional information, refer to [Speed Control Deactivator Switch \(19.75.20\)](#)

Installation

- 1 . Install the BPP switch.

For additional information, refer to [Speed Control Deactivator Switch \(19.75.20\)](#)

307 : Automatic Transmission/Transaxle

307-01 : Automatic Transmission/Transaxle

Specifications

Specifications

Lubricants, Fluids, Sealers and Adhesives

	Specifications
High temperature grease	Molecote FB180 / Jaguar 8309
Transmission fluid	Shell M1375.4

Capacities

	Liters
Transmission fluid	9.5
Transmission fluid (Supercharged models)	10.0
Service fill	6.0

Torque Specifications

Item	Nm	lb-ft	lb-in
Crossmember to vehicle body - bolt	48	35	-
Fluid pan, gasket and filter - screw	8	6	71
Mass damper to crossmember - bolt	10	7	-
Output shaft flange - nut*	60	44	-
Selector lever to transmission - nut	12	9	-
Support insulator to crossmember - bolt	25	18	-
Support insulator to transmission - bolt	48	35	-
Flexplate to torque converter - screw	55	41	-
Torque converter housing to engine - bolt	48	35	-
Transmission control module (TCM) and Main control valve body - screw	8	6	71
Transmission fluid - drain plug	8	6	71

Transmission fluid - fill plug	A		-
Transmission heat shield	10	7	-

NOTE:

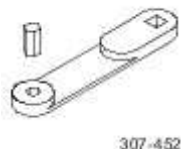
* New nut/bolt must be installed.

NOTE:

A = refer to the procedure for correct torque sequence.

Transmission Fluid Drain and Refill (44.24.02)

Special Service Tools



Adaptor
307-452



WARNING: Observe due care when draining, as the fluid can be very hot.



WARNING: Observe due care when working near a hot exhaust system.

1.

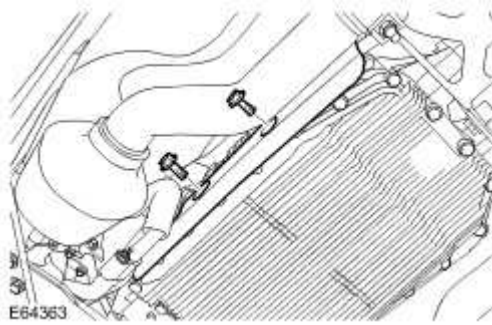


WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the RH transmission heat shield.

- Remove the 2 bolts.



3. Clean the area around the transmission fluid drain and filler plugs.

4. Place a container under the transmission.

5.



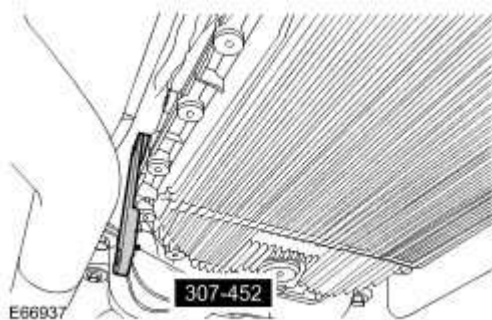
WARNING: Observe due care when draining, as the fluid can be very hot.



WARNING: Observe due care when working near a hot exhaust system.

Using the special tool, remove the transmission fluid filler/level plug.

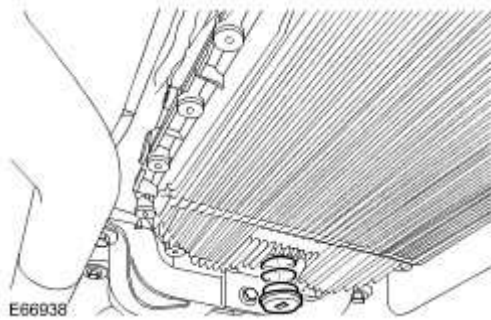
- Remove and discard the sealing washer.



6. Remove the transmission fluid drain plug.

- Remove and discard the sealing washer.

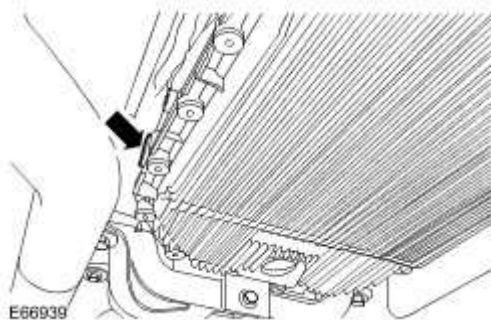
- Allow the fluid to drain.



7. Install the transmission fluid drain plug and tighten to 8 Nm (6 lb.ft).

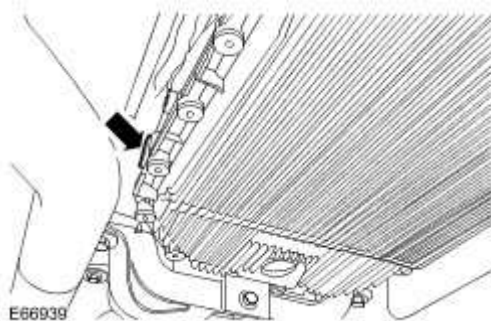
- Install a new sealing washer.

8. Add the correct transmission fluid, until a small thread of fluid runs from the filler/level hole.



9. Start and run the engine.

10. Add the correct transmission fluid, until a small thread of fluid runs from the filler/level hole.

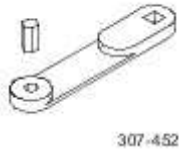


11. Check and top-up the transmission fluid level.

Transmission Fluid Level Check

Transmission Fluid Level Check

Special Service Tools



Adaptor
307-452



WARNING: Observe due care when draining, as the fluid can be very hot.



WARNING: Observe due care when working near a hot exhaust system.



CAUTION: The gearbox fluid level must only be checked when the temperature of the fluid is between 30 degrees and 50 degrees. The fluid level obtained will be incorrect if the reading is outside this temperature range.

1. The following steps must be observed before starting the transmission fluid level check and top-up.

- The vehicle must be on a horizontal ramp.
- The parking brake must be applied.
- The wheels must be chocked.

2.



CAUTION: Make sure the transmission fluid temperature is below 30 degrees before starting the fluid level check.

Connect WDS to the on-board diagnostic connector, to monitor the transmission fluid temperature.

3. Start the engine. Move the selector lever from 'P' through all gear positions, pausing in each gear position for 2-3 seconds and return to the 'P' position.

4.

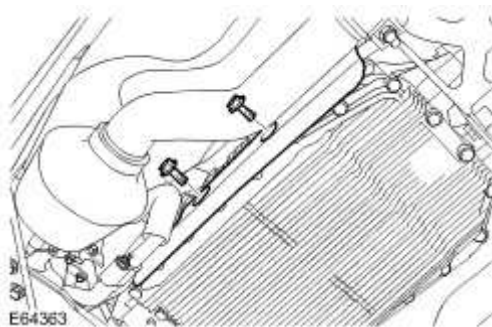


WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

5. Remove the RH transmission heat shield.

- Remove the 2 bolts.



6. Place a container under the transmission.

7.



WARNING: Observe due care when draining, as the fluid can be very hot.



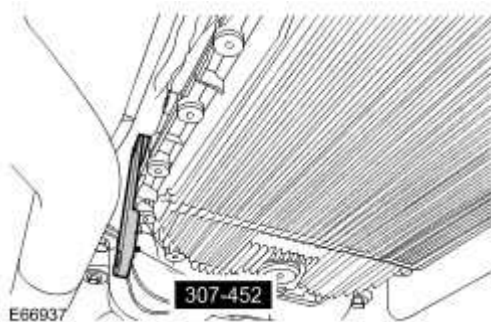
WARNING: Observe due care when working near a hot exhaust system.



CAUTION: The gearbox fluid level must only be checked when the temperature of the fluid is between 30 degrees and 50 degrees. The fluid level obtained will be incorrect if the reading is outside this temperature range.

Using the special tool, remove the transmission fluid filler/level plug.

- Clean the area around the filler/level plug.
- Remove and discard the sealing washer.



8. If no fluid loss is apparent when the filler/level plug is removed, with the engine at idle, continue to fill the transmission until a small thread of oil runs from oil filler/level hole.

9.

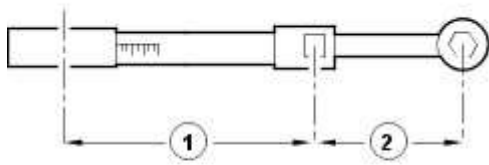


WARNING: Make sure the transmission fluid filler plug is tightened to the correct specification. The torque correction formula below must be followed to prevent damage to the transmission case.

Install the transmission fluid filler/level plug and tighten to 35 Nm (26 lb.ft).

- Install a new sealing washer.
- Step 1. Multiply 35 Nm by the effective length of the torque wrench (1).
- Step 2. Add the effective length of the special tool (2) to the effective length of the torque wrench (2).
- Step 3. Divide the total of step 1 by the total of step 2.

- Step 4. Set the torque wrench to the figure arrived at in step 3.



E37107

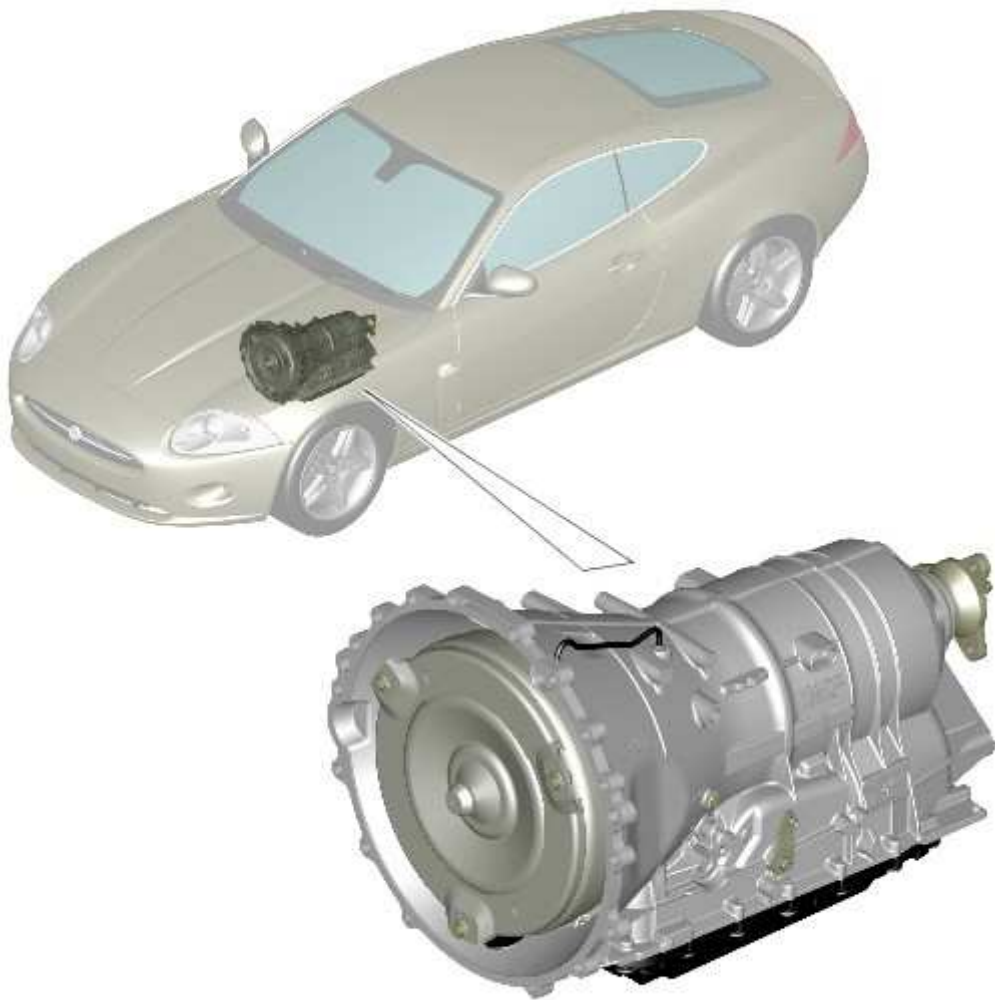
10. Install the transmission heat shield.

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

11. Disconnect WDS from the vehicle.

Transmission Description

COMPONENT LOCATION



E68066

INTRODUCTION

The ZF 6HP26 transmission is an electronically controlled, six speed unit. The transmission is manufactured by ZF Transmissions GmbH in Saarbrücken, Germany. This transmission represents the latest in automatic transmission technology and incorporates new features to enhance the transmission functionality:

- The hydraulic and electronic control elements of the transmission are now incorporated in a single unit located inside the transmission and is known as 'Mechatronic'

- Another new strategy is Adaptive Shift Strategy (ASIS). ASIS represents the continuous adaptation of shift changes to suit the driving style of the driver which can vary from sporting to economical. Further details of the ASIS function are contained in the 'Driving Modes' section.

On supercharged models, the transmission used is an uprated derivative of the 6HP26 transmission used in the 4.2L naturally aspirated model. The uprated transmission includes additional clutch plates to enable the transmission to manage the additional power output of the supercharged engine.

The transmission is controlled by a Transmission Control Module (TCM) which contains software to provide operation as a semi-automatic 'Jaguar Sequential Shift' transmission. The TCM allows the transmission to be operated as a conventional automatic unit by selecting P, R, N, D on the selector lever. Movement of the selector lever across the gate to the 'S' position puts the transmission into electronic 'Sport' mode. Two steering wheel paddles, when operated, puts the transmission into electronic manual 'Jaguar Sequential Shift' mode.

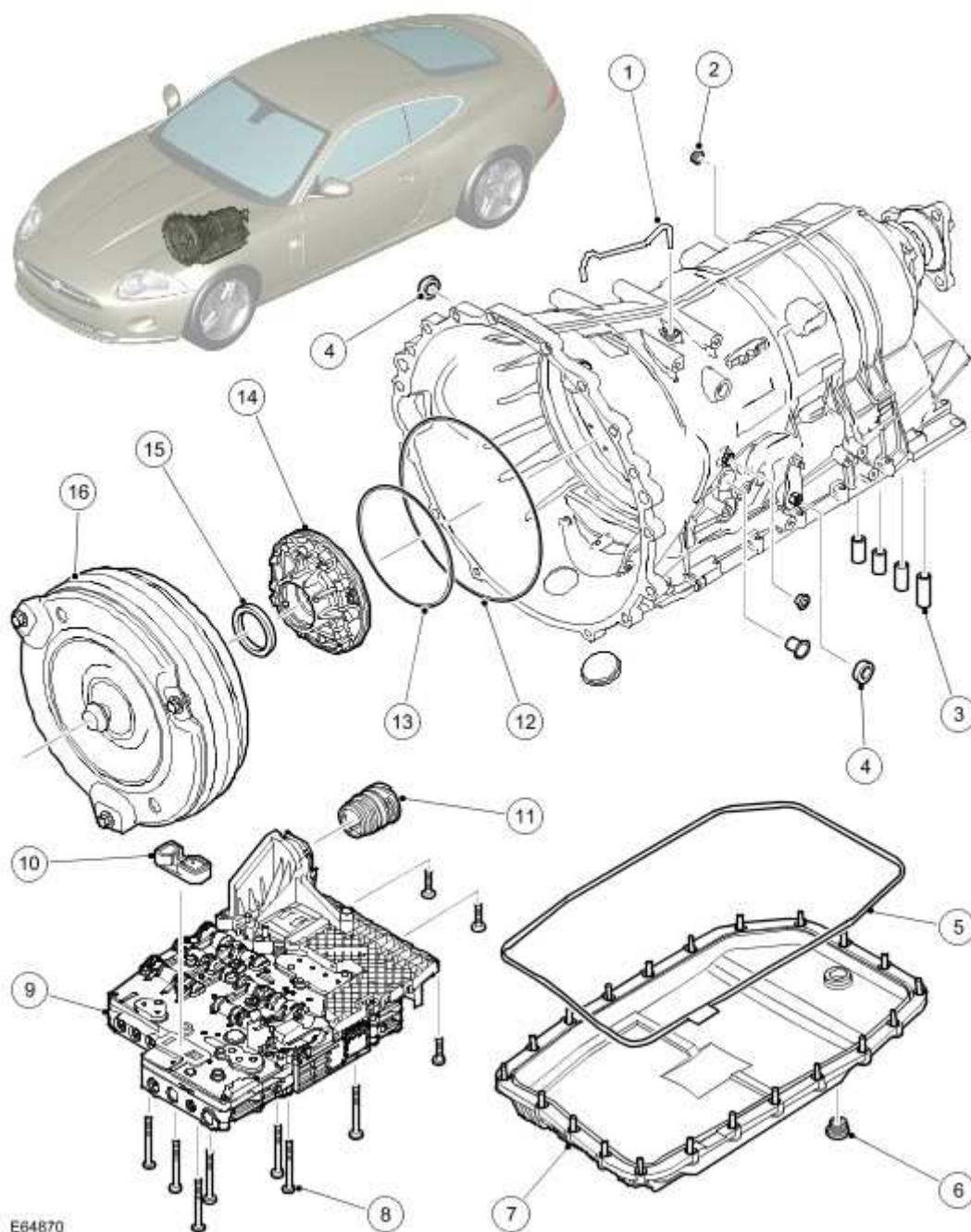
The 6HP26 transmission has the following features:

- Designed to be maintenance free
- Transmission fluid is 'fill for life'
- The torque converter features a controlled slip feature with electronically regulated control of lock-up, creating a smooth transition to the fully locked condition
- Shift programs controlled by the TCM
- Connected to the Engine Control Module (ECM) via the high speed Controller Area Network (CAN) bus for communications
- Default mode if major faults occur
- Diagnostics available from the TCM via the CAN

ZF 6HP26 Automatic Transmission – Exploded View

NOTE:

The transmission shown is exploded to the extent of the serviceable items



E64870

Item	Part Number	Description
1		Breather tube
2		Plug
3		Seal sleeves
4		Selector shaft seal
5		Gasket
6		Drain plug
7		Fluid pan and filter assembly
8		Torx screws

9		Mechatronic valve block
10		Element seal
11		Electrical connector – guide sleeve
12		O-ring
13		O-ring
14		Pump housing
15		Input shaft seal
16		Torque converter

The transmission comprises the main casing which houses all of the transmission components. The main case also incorporates an integral bell housing.

A fluid pan is attached to the lower face of the main case and is secured with bolts. The fluid pan is sealed to the main case with a gasket. Removal of the fluid pan allows access to the Mechatronic valve block. The fluid pan has a magnet located around the drain plug which collects any metallic particles present in the transmission fluid.

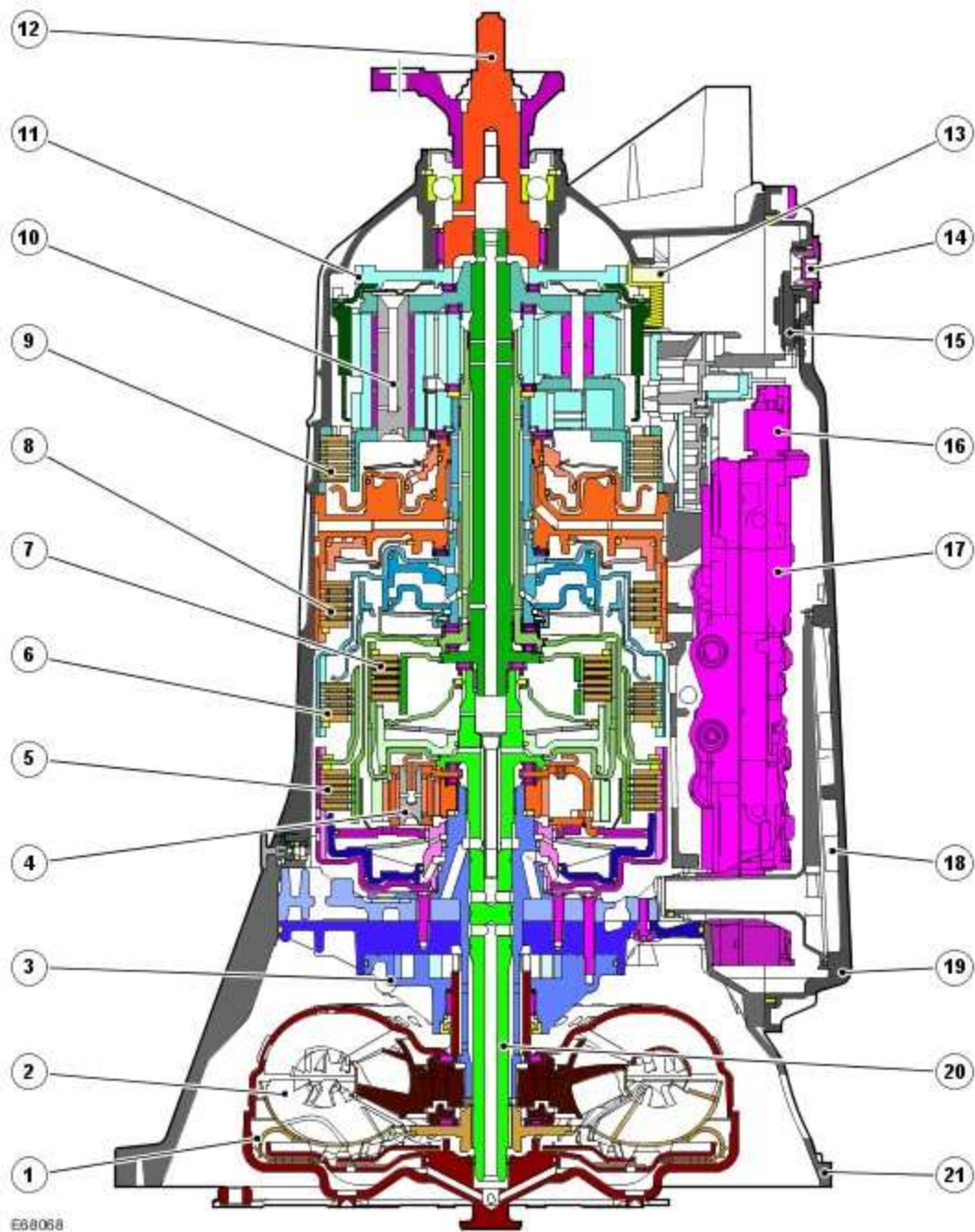
A fluid filter is located inside the fluid pan. If the transmission fluid becomes contaminated or after any service work, the fluid pan with integral filter must be replaced.

The integral bell housing provides protection for the torque converter assembly and also provides the attachment for the gearbox to the engine cylinder block. The torque converter is a non-serviceable assembly which also contains the lock-up clutch mechanism. The torque converter drives a crescent type pump via drive tangs. The fluid pump is located in the main case, behind the torque converter.

The main case contains the following major components:

- Input shaft
- Output shaft
- Mechatronic valve block which contains the solenoids, speed sensors and the TCM
- 3 rotating multiplate drive clutches
- 2 fixed multiplate brake clutches
- A single planetary gear train and a double planetary gear train.

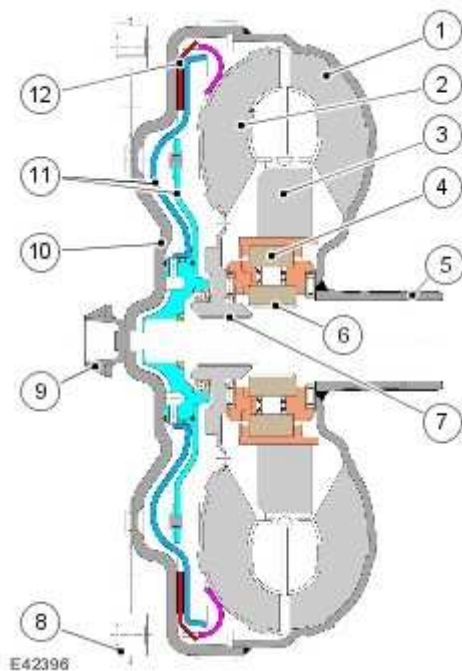
ZF 6HP26 Automatic Transmission – Sectional View



Item	Part Number	Description
1		Torque converter lock-up clutch
2		Torque converter
3		Fluid pump
4		Single planetary gearset
5		Clutch A
6		Clutch B
7		Clutch E
8		Brake C

9		Brake D
10		Double planetary gearset
11		Park lock gear
12		Output shaft
13		Park lock pawl
14		Drain plug
15		Magnet
16		Pressure regulator
17		Mechatronic valve block
18		Fluid filter
19		Fluid pan
20		Input shaft
21		Bell housing

TORQUE CONVERTER



Item	Part Number	Description
1		Impeller
2		Turbine
3		Stator
4		Freewheel
5		Torque converter hub

6		Stator shaft
7		Turbine shaft
8		Drive plate
9		Journal - Drive plate/crankshaft location
10		Torque converter cover
11		Lock-up clutch piston
12		Lock-up clutch plate

The torque converter is the coupling element between the engine and the transmission and is located in the bell housing, on the engine side of the transmission. The driven power from the engine crankshaft is transmitted hydraulically and mechanically through the torque converter to the transmission. The torque converter is connected to the engine by a drive plate.

The torque converter comprises an impeller, a stator and a turbine. The torque converter is a sealed unit with all components located between the converter housing cover and the impeller. The two components are welded together to form a sealed, fluid filled housing. With the impeller welded to the converter housing cover, the impeller is therefore driven at engine crankshaft speed.

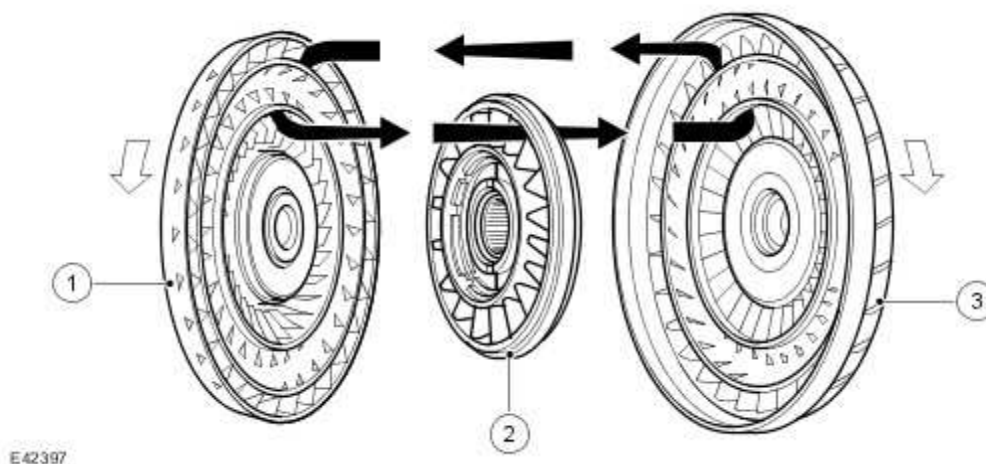
The converter housing cover has 4 threaded bosses which provide for attachment of the engine drive plate which is connected to the engine crankshaft. The threaded bosses also provide for location of special tools which are required to remove the torque converter from the bell housing.

Impeller

Fluid Flow

NOTE:

Typical torque converter shown



Item	Part Number	Description

1		Turbine
2		Stator
3		Impeller

When the engine is running the rotating impeller acts as a centrifugal pump, picking up fluid at its centre and discharging it at high velocity through the blades on its outer rim. The design and shape of the blades and the curve of the impeller body cause the fluid to rotate in a clockwise direction as it leaves the impeller. This rotation improves the efficiency of the fluid as it contacts the outer row of blades on the turbine.

The centrifugal force of the fluid leaving the blades of the impeller is passed to the curved inner surface of the turbine via the tip of the blades. The velocity and clockwise rotation of the fluid causes the turbine to rotate.

Turbine

The turbine is similar in design to the impeller with a continuous row of blades. Fluid from the impeller enters the turbine through the tip of the blades and is directed around the curved body of the turbine to the root of the blades. The curved surface redirects the fluid back in the opposite direction to which it entered the turbine, effectively increasing the turning force applied to the turbine from the impeller. This principle is known as torque multiplication.

When engine speed increases, turbine speed also increases. The fluid leaving the inner row of the turbine blades is rotated in an anti-clockwise direction due to the curve of the turbine and the shape of the blades. The fluid is now flowing in the opposite direction to the engine rotation and therefore the impeller. If the fluid was allowed to hit the impeller in this condition, it would have the effect of applying a brake to the impeller, eliminating the torque multiplication effect. To prevent this, the stator is located between the impeller and the turbine.

Stator

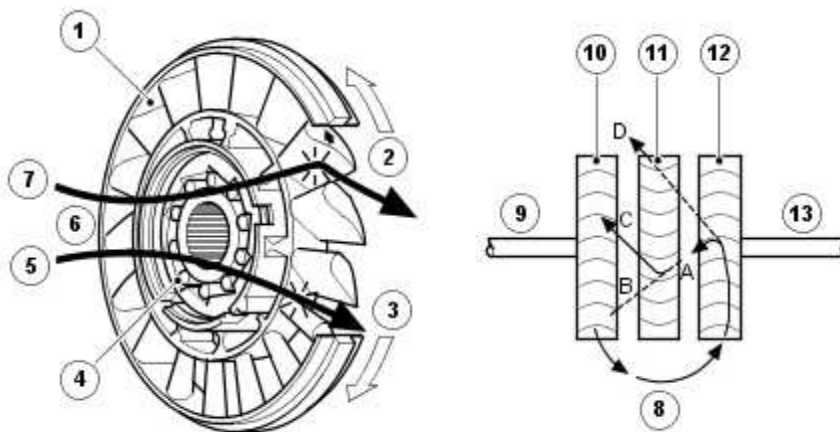
The stator is located on the splined transmission input shaft via a freewheel clutch. The stator comprises a number of blades which are aligned in an opposite direction to those of the impeller and turbine. The main function of the stator is to redirect the returning fluid from the turbine, changing its direction to that of the impeller.

The redirected fluid from the stator is directed at the inner row of blades of the impeller, assisting the engine in turning the impeller. This sequence increases the force of the fluid emitted from the impeller and thereby increases the torque multiplication effect of the torque converter.

Stator Functions

NOTE:

Typical stator shown



E42398

Item	Part Number	Description
1		Blades
2		Stator held – fluid flow redirected
3		Stator rotates freely
4		Roller
5		Converter at coupling speed
6		Fluid flow from turbine
7		Converter multiplying
8		Fluid flow from impeller
9		Drive from engine
10		Impeller
11		Stator
12		Turbine
13		Output to transmission

Refer to the 'Stator Functions' illustration

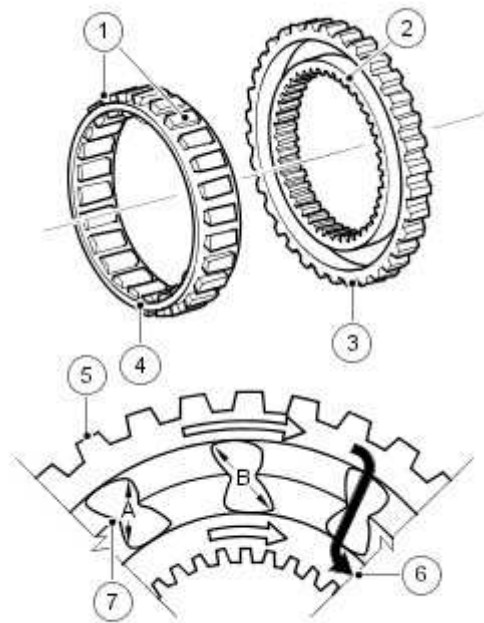
Fluid emitted from the impeller acts on the turbine. If the turbine is rotating at a slower speed than the fluid from the impeller, the fluid will be deflected by the turbine blades in the path 'A'. The fluid is directed at and deflected by the stator blades from path 'B' to path 'C'. This ensures that the fluid is directed back to the pump in the optimum direction. In this condition the sprag clutch is engaged and the force of the fluid on the stator blades assists the engine in rotating the impeller.

As the rotational speed of the engine and therefore the turbine increases, the direction of the fluid leaving the turbine changes to path 'D'. The fluid is now directed from the turbine to the opposite side of the stator blades, rotating the stator in the opposite direction. To prevent the stator from resisting the smooth flow of the fluid from the turbine, the sprag clutch releases, allowing the stator to rotate freely on its shaft.

When the stator becomes inactive, the torque converter no longer multiplies the engine torque. When the torque converter reaches this operational condition it ceases to multiply the engine torque and acts solely as a fluid coupling, with the impeller and the turbine rotating at approximately the same speed.

The stator uses a sprag type, one way, freewheel clutch. When the stator is rotated in a clockwise direction the sprags twist and are wedged between the inner and outer races. In this condition the sprags transfer the rotation of the outer race to the inner race which rotates at the same speed.

One Way Free Wheel Clutch – Typical



E42712

Item	Part Number	Description
1		Sprags
2		Inner race
3		Outer race
4		Sprag and cage assembly
5		Sprag outer race
6		Sprag inner race
7		Retaining ring

The free wheel clutch can perform three functions; hold the stator stationary, drive the stator and free wheel allowing the stator to rotate without a drive output. The free wheel clutch used in the 6HP26 transmission is of the sprag type and comprises an inner and outer race and a sprag and cage assembly. The inner and outer races are pressed into their related components with which they rotate. The sprag and cage assembly is located between the inner and outer races.

The sprags are located in a cage which is a spring which holds the sprags in the 'wedge' direction and maintains them in contact with the inner and outer races.

Referring to the illustration, the sprags are designed so that the dimension 'B' is larger than the distance between the inner and outer race bearing surfaces. When the outer race rotates in a clockwise direction, the sprags twist and the edges across the dimension 'B' wedge between the races, providing a positive drive through each sprag to the inner race. The dimension 'A' is smaller than the distance between the inner and outer race bearing surfaces. When the outer race rotates in an anti-clockwise direction, the dimension 'A' is too small to allow the sprags to wedge between the races, allowing the outer race to rotate freely.

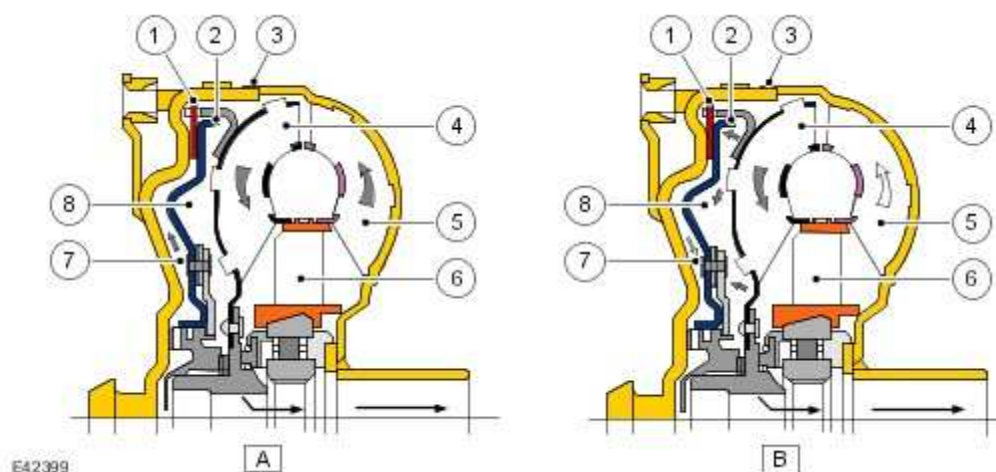
On the illustration shown, when the outer race is rotated in a clockwise direction, the sprags twist and are 'wedged' between the inner and outer races. The sprags then transfer the rotation of the outer race to the inner race, which rotates at the same speed.

Lock-Up Clutch Mechanism

The Torque Converter Clutch (TCC) is hydraulically controlled by an electronic pressure regulating solenoid (EPRS6) which is controlled by the TCM. This allows the torque converter to have 3 states of operation as follows:

- Fully engaged
- Controlled slip variable engagement
- Fully disengaged.

The TCC is controlled by two hydraulic spool valves located in the valve block. These valves are actuated by pilot pressure supplied via a solenoid valve which is also located in the valve block. The solenoid valve is operated by PWM signals from the TCM to give full, partial or no lock-up of the torque converter.



Item	Part Number	Description
A		Unlocked condition
B		Locked condition

1		Clutch plate
2		Clutch piston
3		Torque converter body
4		Turbine
5		Impeller
6		Stator
7		Piston chamber
8		Turbine chamber

The lock-up clutch is a hydro-mechanical device which eliminates torque converter slip, improving fuel consumption. The engagement and disengagement is controlled by the TCM to allow a certain amount of controlled 'slip'. This allows a small difference in the rotational speeds of the impeller and the turbine which results in improved shift quality. The lock-up clutch comprises a piston and a clutch friction plate.

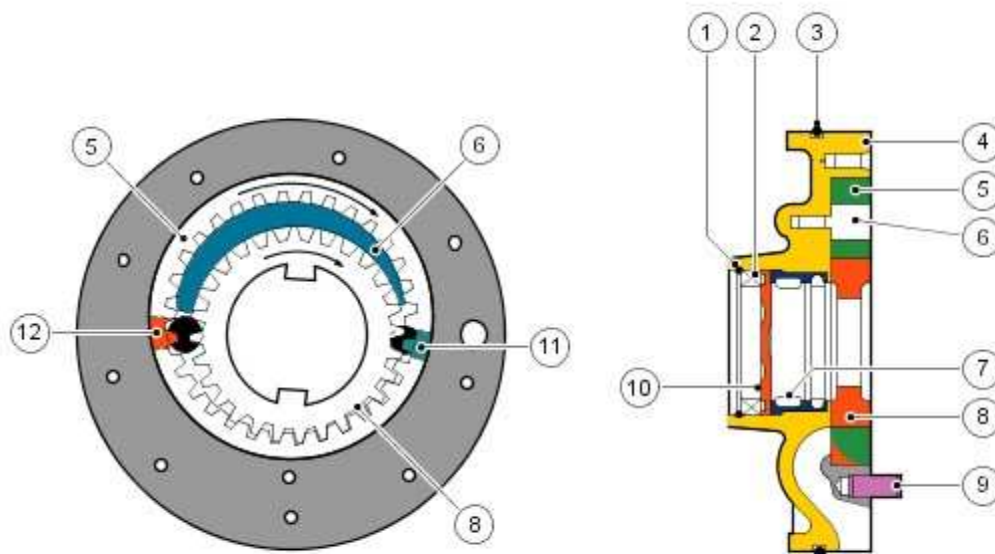
In the unlocked condition, the oil pressure supplied to the piston chamber and the turbine chamber is equal. Pressurized fluid flows through a drilling in the turbine shaft and through the piston chamber to the turbine chamber. In this condition the clutch plate is held away from the torque converter body and torque converter slip is permitted.

In the locked condition, the TCC spool valves are actuated by the electronic pressure regulating solenoid (EPRS6). The fluid flow in the unlocked condition is reversed and the piston chamber is vented. Pressurized fluid is directed into the turbine chamber and is applied to the clutch piston. The piston moves with the pressure and pushes the clutch plate against the torque converter body. As the pressure increases, the friction between the clutch plate and the body increases, finally resulting in full lock-up of the clutch plate with the body. In this condition there is direct mechanical drive from the engine crankshaft to the transmission planetary gear train.

FLUID PUMP

The fluid pump is an integral part of the transmission. The fluid pump is used to supply hydraulic pressure for the operation of the control valves and clutches, to pass the fluid through the transmission cooler and to lubricate the gears and shafts.

The 6HP26 fluid pump is a crescent type pump and is located between the intermediate plate and the torque converter. The pump has a delivery rate of 16 cm³ per revolution.



E42400

Item	Part Number	Description
1		Securing ring
2		Shaft oil seal
3		O-ring seal
4		Pump housing
5		Ring gear
6		Crescent spacer
7		Roller bearing
8		Impeller
9		Centring pin
10		Spring washer
11		Outlet port (high pressure)
12		Inlet port (low pressure)

The pump comprises a housing, a crescent spacer, an impeller and a ring gear. The housing has inlet and outlet ports to direct flow and is located in the intermediate plate by a centring pin. The pump action is achieved by the impeller, ring gear and crescent spacer.

The crescent spacer is fixed in its position by a pin and is located between the ring gear and the impeller. The impeller is driven by drive from the torque converter hub which is located on a needle roller bearing in the pump housing. The impeller teeth mesh with those of the ring gear. When the impeller is rotated, the motion is transferred to the ring gear which rotates in the same direction.

The rotational motion of the ring gear and the impeller collects fluid from the intake port in

the spaces between the teeth. When the teeth reach the crescent spacer, the oil is trapped in the spaces between the teeth and is carried with the rotation of the gears. The spacer tapers near the outlet port. This reduces the space between the gear teeth causing a build up of fluid pressure as the oil reaches the outlet port. When the teeth pass the end of the spacer the pressurized fluid is released into the outlet port.

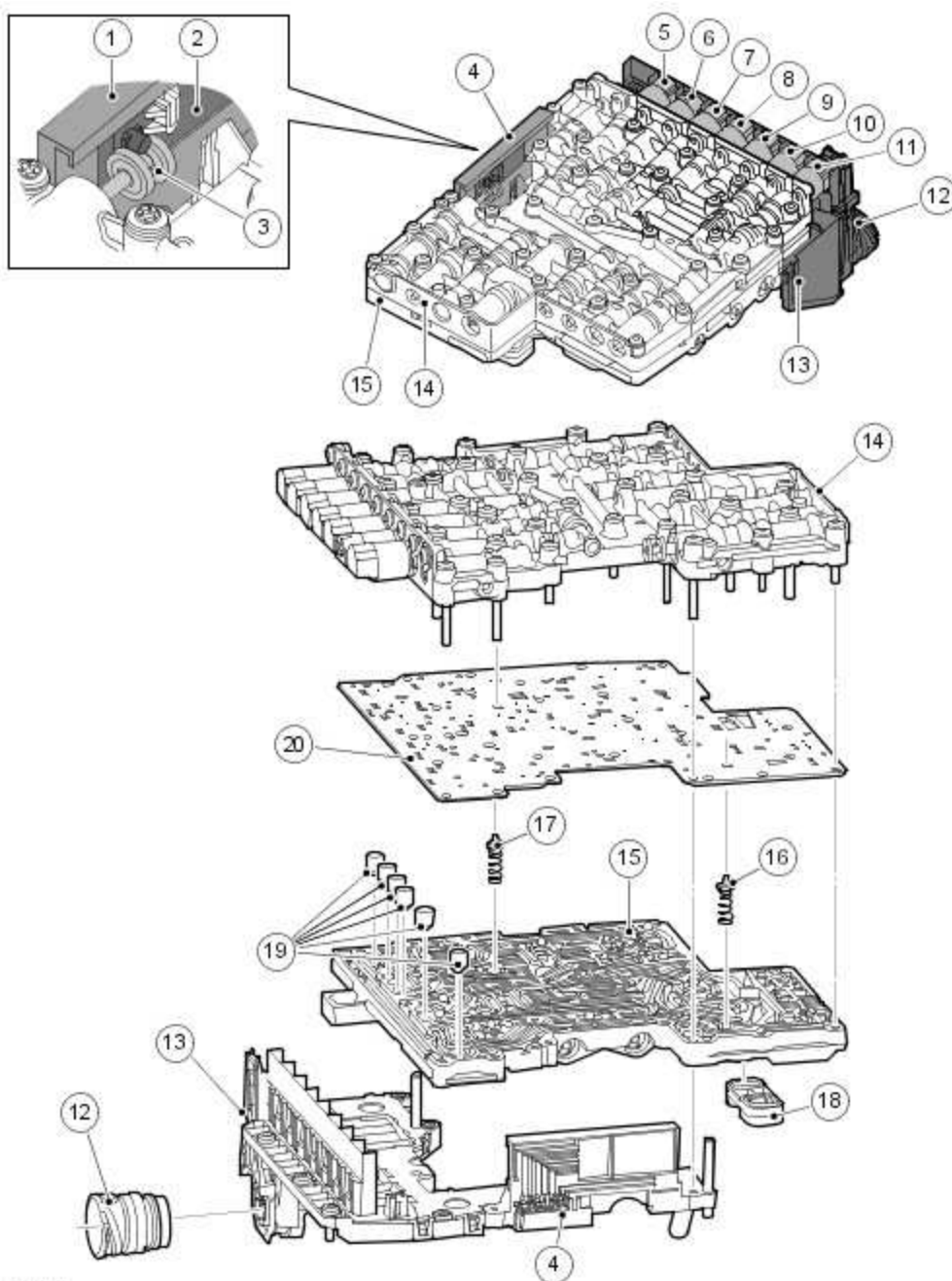
The fluid emerging from the outlet port is passed through the fluid pressure control valve. At high operating speeds the pressure control valve maintains the output pressure to the gearbox at a predetermined maximum level. Excess fluid is relieved from the pressure control valve and is directed, via the main pressure valve in the valve block, back to the pump inlet port. This provides a pressurized feed to the pump inlet which prevents cavitation and reduces pump noise.

MECHATRONIC VALVE BLOCK

The Mechatronic valve block is located in the bottom of the transmission and is covered by the fluid pan. The valve block houses the TCM, electrical actuators, speed sensors and control valves which provide all electro-hydraulic control for all transmission functions. The Mechatronic valve block comprises the following components:

- TCM
- 6 pressure regulator solenoids
- 1 shift control solenoid
- 1 damper
- 21 hydraulic spool valves
- Manually operated selector valve
- Temperature sensor
- Turbine speed sensor
- Output shaft speed sensor.

ZF 6HP26 Automatic Transmission – Mechatronic Valve Block

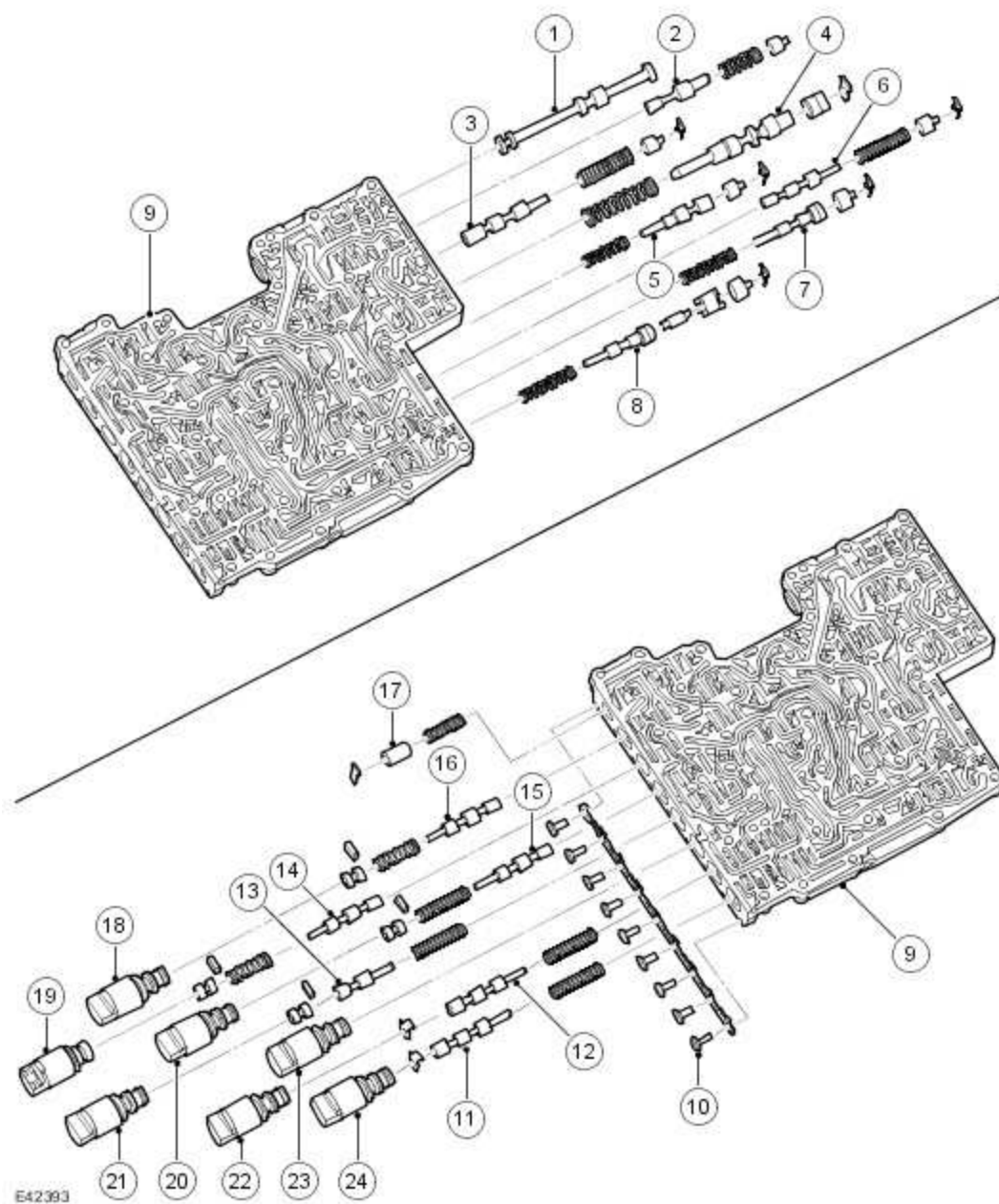


E42392

Item	Part Number	Description
1		Position switch
2		Sliding block
3		Selector spool valve
4		Position switch assembly
5		Electronic Pressure Regulator Solenoid (EPRS) 6
6		Solenoid valve 1
7		EPRS 4
8		EPRS 5

9		EPRS 3
10		EPRS 2
11		EPRS 1
12		Electrical connector
13		Transmission Control Module (TCM)
14		Valve housing
15		Valve plate
16		Torque converter retaining valve
17		Clutch return valve
18		Element seal
19		Pressure regulator dampers
20		Intermediate plate

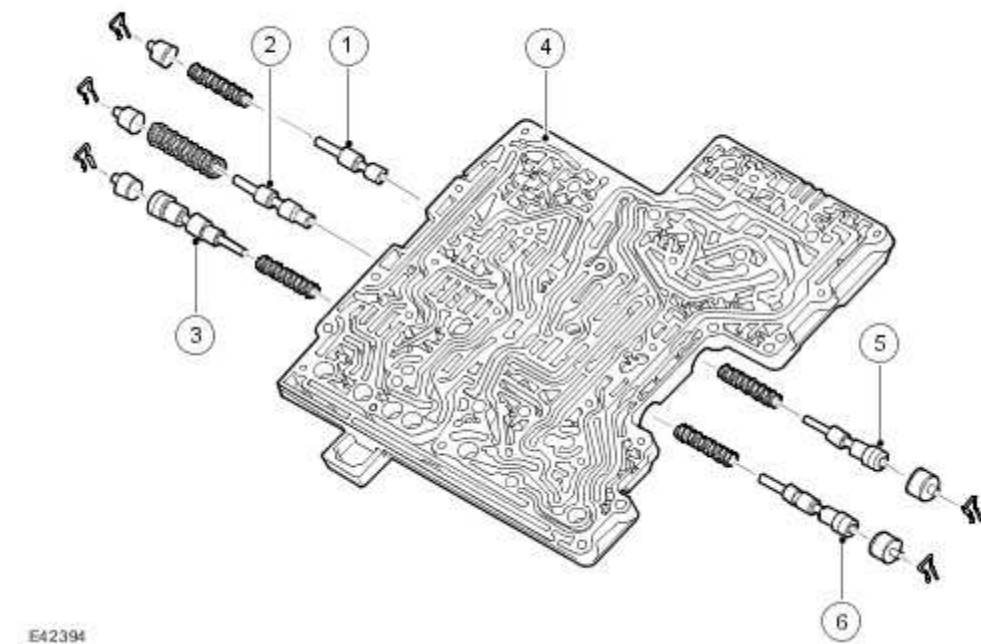
ZF 6HP26 Automatic Transmission – Valve Housing Components



Item	Part Number	Description
1		Selector spool valve
2		Lubricating valve
3		Torque converter pressure valve
4		System pressure valve
5		Torque converter clutch valve
6		Retaining valve – Clutch E
7		Clutch valve E
8		Clutch valve A

9		Valve housing
10		Bolts
11		Retaining valve – Clutch A
12		Retaining valve – Clutch B
13		Pressure reducing valve
14		Shift valve 1
15		Retaining valve – Brake D
16		Shift valve 2
17		Damper
18		Electronic Pressure Regulator Solenoid (EPRS) 6
19		Solenoid valve 1
20		EPRS 4
21		EPRS 5
22		EPRS 2
23		EPRS 3
24		EPRS 1

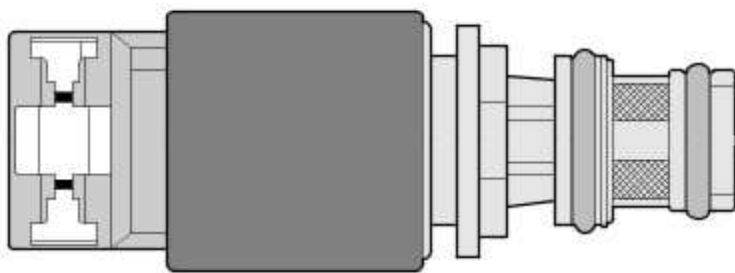
ZF 6HP26 Automatic Transmission – Valve Plate Components



Item	Part Number	Description
1		Retaining valve – Brake D2

2		Clutch valve – Brake D2
3		Clutch valve B
4		Valve plate
5		Clutch valve – Brake D1
6		Clutch valve – Brake C

Electronic Pressure Regulator Solenoids (EPRS)



E42713

Six Electronic Pressure Regulator Solenoids (EPRS) are located in the valve block. The solenoids are controlled by Pulse Width Modulation (PWM) signals from the TCM. The solenoids convert the electrical signals into hydraulic control pressure proportional to the signal to actuate the spool valves for precise transmission operation.

The following table shows EPRS and their associated functions:

EPRS	Function
1	Clutch A
2	Clutch B
3	Clutch C
4	Brake clutches D and E
5	System pressure control
6	Torque converter lock-up control

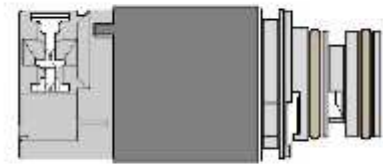
Solenoids EPRS 1, 3 and 6 supply a lower control pressure as the signal amperage increases and can be identified by a black connector cap. The TCM operates the solenoids using PWM signals. The TCM monitors engine load and clutch slip and varies the solenoid duty cycle accordingly. The solenoids have a 12 V operating voltage and a pressure range of 0 - 4.6 bar (0 - 67 lbf.in²).

Solenoids EPRS 2, 4 and 5 supply a higher control pressure as the signal amperage increases

and can be identified by a green connector cap. The solenoids are normally open, regulating flow solenoid valves. The TCM operates the solenoids using a PWM ground proportional to the required increasing or decreasing clutch pressures. The solenoids have a 12 V operating voltage and a pressure range of 4.6 - 0 bar (67 - 0 lbf.in²).

The resistance of the coil winding for the EPRS solenoids is 5.05 ohms at 20°C (68°F).

Control Solenoid



E42714

A shift control Solenoid Valve (SV) is located in the valve block. The solenoid is controlled by the TCM and converts electrical signals into hydraulic control signals to control clutch application.

The shift control solenoid is an open/closed, on/off solenoid which is controlled by the TCM switching the solenoid to earth. The TCM also supplies power to the solenoid. The TCM energises the solenoid in a programmed sequence for clutch application for gear ratio changes and shift control.

The resistance of the solenoid coil winding within the solenoid is between 26 to 30.4 ohms at 20°C (68°F).

Sensors

Speed Sensors

The turbine speed sensor and the output shaft speed sensor are Hall effect type sensors located in the Mechatronic valve block and are not serviceable items. The TCM monitors the signals from each sensor to determine the input (turbine) speed and the output shaft speed.

The turbine speed is monitored by the TCM to calculate the slip of the torque converter clutch and internal clutch slip. This signal allows the TCM to accurately control the slip timing during shifts and adjust clutch application or release pressure for overlap shift control.

The output shaft speed is monitored by the TCM and compared to engine speed signals received on the CAN bus from the ECM. Using a comparison of the two signals the TCM calculates the transmission slip ratio for plausibility and maintains adaptive pressure control.

Temperature Sensor

The temperature sensor is also located in the Mechatronic valve block. The TCM uses the temperature sensor signals to determine the temperature of the transmission fluid. These signals are used by the TCM to control the transmission operation to promote faster warm-up in cold conditions or to assist with fluid cooling by controlling the transmission operation when high fluid temperatures are experienced. If the sensor fails, the TCM will use a default value and a fault code will be stored in the TCM.

Damper

There is one damper located in the valve housing. The damper is used to regulate and dampen the regulated pressure supplied via EPRS 5. The damper is load dependent through modulation of the damper against return spring pressure.

The damper comprises a piston, a housing bore and a spring. The piston is subject to the pressure applied by the spring. The bore has a connecting port to the function to which it applies. Fluid pressure applied to the applicable component (i.e. a clutch) is also subjected to the full area of the piston, which moves against the opposing force applied by the spring. The movement of the piston creates an action similar to a shock absorber, momentarily delaying the build up of pressure in the circuit. This results in a more gradual application of clutches improving shift quality.

Spool Valves

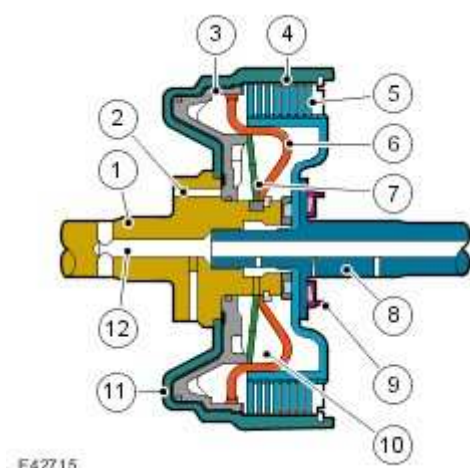
The valve block contains twenty one spool valves which control various functions of the transmission. The spool valves are of conventional design and are operated by fluid pressure.

Each spool valve is located in its spool bore and held in a default (unpressurized) position by a spring. The spool bore has a number of ports which allow fluid to flow to other valves and clutches to enable transmission operation. Each spool has a piston which is waisted to allow fluid to be diverted into the applicable ports when the valve is operated.

When fluid pressure moves a spool, one or more ports in the spool bore are covered or uncovered. Fluid is prevented from flowing or is allowed to flow around the applicable waisted area of the spool and into another uncovered port. The fluid is either passed through galleries to actuate another spool, operate a clutch or is returned to the fluid pan.

DRIVE CLUTCHES

Multiplate Drive or Brake Clutch – Typical



Item	Part Number	Description
1	-	Input shaft
2	-	Main pressure supply port
3	-	Piston
4	-	Cylinder – External plate carrier
5	-	Clutch plate assembly
6	-	Baffle plate
7	-	Diaphragm spring
8	-	Output shaft
9	-	Bearing
10	-	Dynamic pressure equalisation chamber
11	-	Piston chamber
12	-	Lubrication channel

There are 3 drive clutches and 2 brake clutches used in the 6HP26 transmission. Each clutch comprises one or more friction plates dependent on the output controlled. A typical clutch consists of a number of steel outer plates and inner plates with friction material bonded to each face.

On supercharged models, the uprated transmission includes additional clutch plates to enable the transmission to manage the additional power output of the supercharged engine.

The clutch plates are held apart mechanically by a diaphragm spring and hydraulically by dynamic pressure. The pressure is derived from a lubrication channel which supplies fluid to the bearings etc. The fluid is passed via a drilling in the output shaft into the chamber between the baffle plate and the piston. To prevent inadvertent clutch application due to pressure build up produced by centrifugal force, the fluid in the dynamic pressure equalisation chamber overcomes any pressure in the piston chamber and holds the piston off the clutch plate assembly.

When clutch application is required, main pressure from the fluid pump is applied to the piston chamber from the supply port. This main pressure overcomes the low pressure fluid

present in the dynamic pressure equalisation chamber. The piston moves, against the pressure applied by the diaphragm spring, and compresses the clutch plate assembly. When the main pressure falls, the diaphragm spring pushes the piston away from the clutch plate assembly, disengaging the clutch.

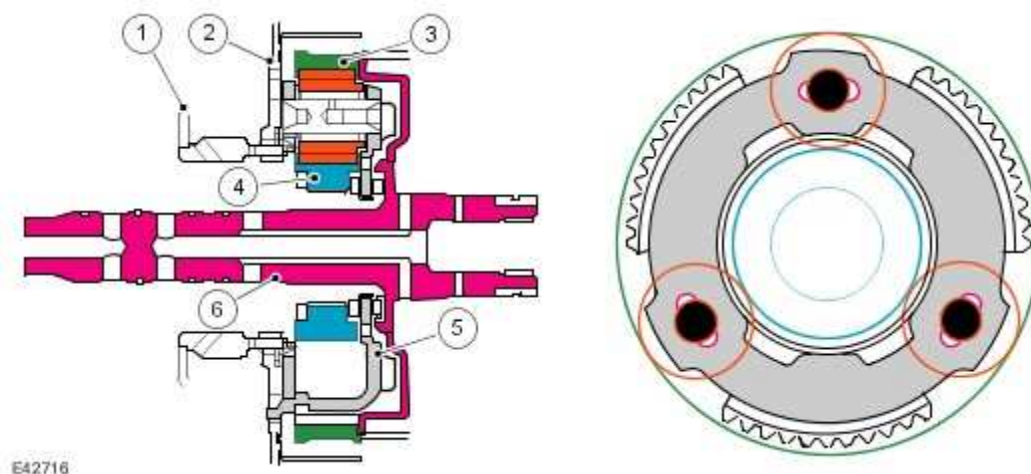
PLANETARY GEAR TRAINS

The planetary gear trains used on the 6HP26 transmission comprise a single web planetary gear train and a double web planetary gear train. These gear trains are known as Lepelletier type gear trains and together produce the 6 forward gears and the 1 reverse gear.

Single Web Planetary Gear Train

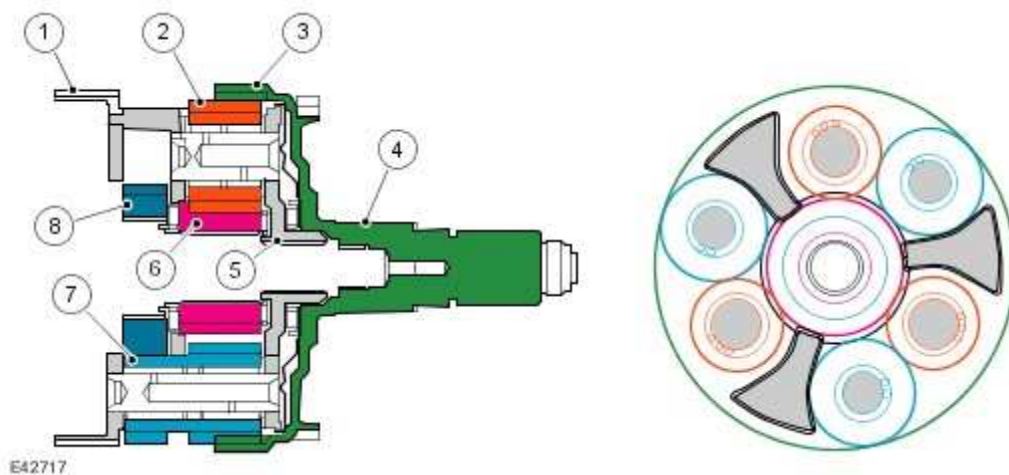
The single web planetary gear train comprises:

- 1 sunwheel
- 3 planetary gears
- 1 planetary gear carrier (spider)
- 1 ring gear or annulus



Item	Part Number	Description
1	-	Cylinder
2	-	Baffle plate
3	-	Ring gear
4	-	Sun gear
5	-	Planetary gear spider
6	-	Torque converter input shaft

Double Web Planetary Gear Train



Item	Part Number	Description
1	-	Planetary gear spider
2	-	Planetary gears (short)
3	-	Ring gear
4	-	Output shaft
5	-	Planetary gear carrier
6	-	Sunwheel
7	-	Double planetary gears (long)
8	-	Sunwheel

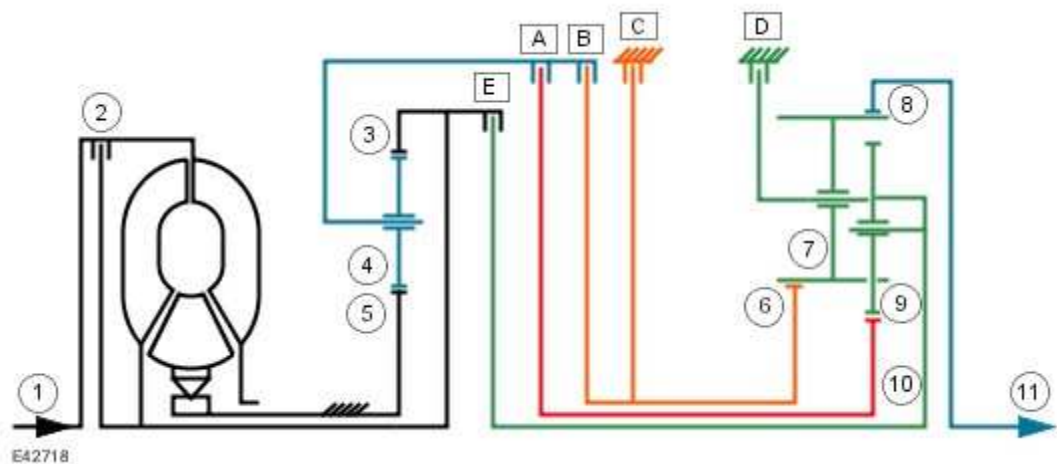
The double planetary gear train comprises:

- 2 sunwheels
- 3 short planetary gears
- 3 long planetary gears
- 1 planetary gear carrier
- 1 ring gear or annulus

POWER FLOWS

Operation of the transmission is controlled by the TCM which electrically activates various solenoids to control the transmission gear selection. The sequence of solenoid activation is based on programmed information in the module memory and physical transmission operating conditions such as vehicle speed, throttle position, engine load and selector lever position.

Powerflow Schematic



Item	Part Number	Description
1	-	Torque input from engine
2	-	Torque converter lock-up clutch
3	-	Single web planetary gear carrier
4	-	Single web planetary gears
5	-	Single web sunwheel 1
6	-	Double web sunwheel 2
7	-	Double web planetary gears - Long
8	-	Double web planetary gear carrier
9	-	Double web planetary gears - Short
10	-	Double web sunwheel 3
11	-	Torque output from transmission
A	-	Multiplate clutch
B	-	Multiplate clutch
C	-	Multiplate brake
D	-	Multiplate brake
E	-	Multiplate clutch

Engine torque is transferred, via operation of single or combinations of clutches to the 2 planetary gear trains. Both gear trains are controlled by reactionary inputs from brake clutches to produce the 6 forward gears and 1 reverse gear. The ratios are as follows:

Gear	1st	2nd	3rd	4th	5th	6th	Reverse
Ratio	4.171	2.340	1.521	1.143	0.867	0.691	3.403

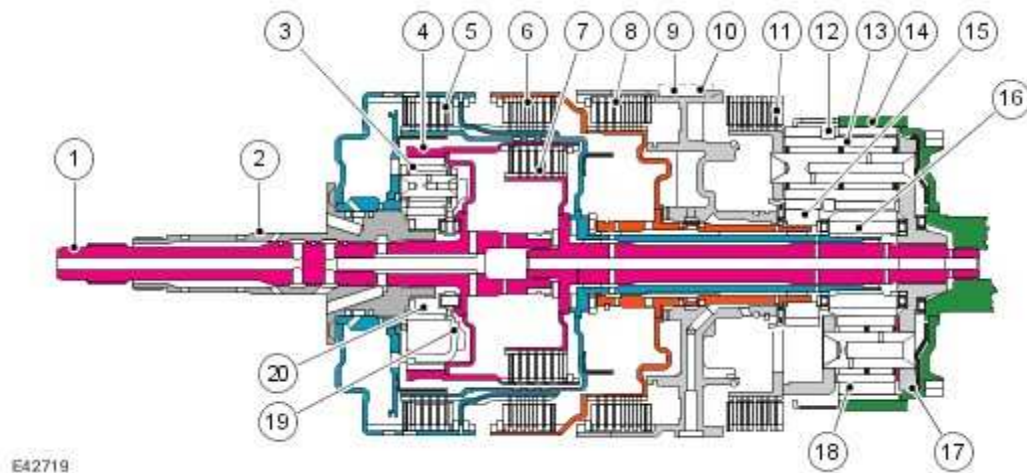
The following table shows which solenoids are activated to produce the required torque output from the transmission.

Gear Selector	Shift Control	Electronic Pressure	1	2	3	4	5	6

Lever Position	Solenoid Valve	Regulator Solenoids (EPRS)						
P	-	-	-	-	ON	-	-	-
R	-	-	ON	-	ON	-	-	-
N	-	-	-	-	ON	-	-	-
D 1	-	ON	-	-	ON	-	-	-
D 2	-	ON	-	ON	-	-	-	-
D 3	-	ON	ON	-	-	-	-	-
D 4	ON	ON	-	-	ON	-	-	-
D 5	ON	-	ON	-	ON	-	-	-
D 6	ON	-	-	ON	ON	-	-	-
ON = Active (pressure build up)								
OFF = Inactive								
-ON- = Inactive (pressure drain)								

[illegible]

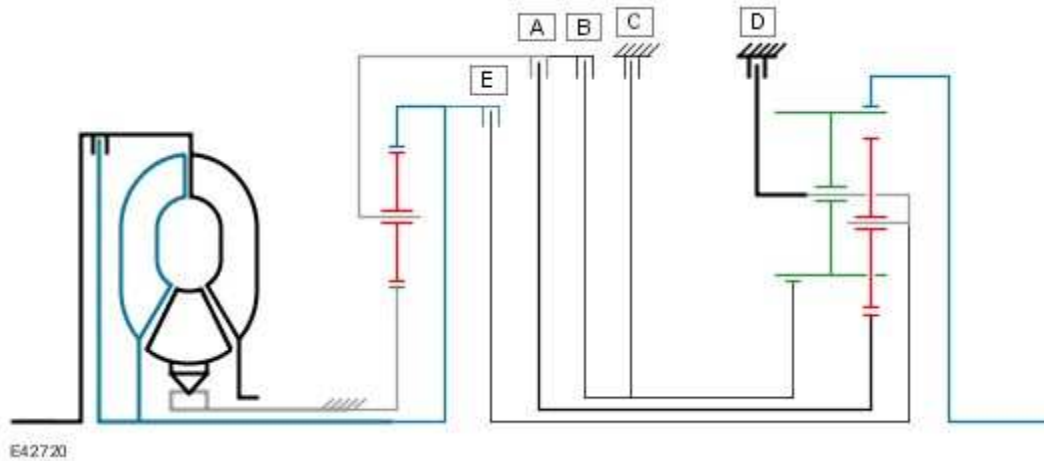
Shift Elements



Item	Part Number	Description
1	-	Turbine shaft
2	-	Stator shaft
3	-	Single web planetary gear train
4	-	Ring gear 1
5	-	Clutch A
6	-	Clutch B
7	-	Clutch E
8	-	Brake clutch C
9	-	Fixed connection to transmission housing
10	-	Shaft key
11	-	Brake clutch D
12	-	Double web planetary gear train
13	-	Planetary gears - Long
14	-	Ring gear 2
15	-	Sunwheel 2
16	-	Sunwheel 3
17	-	Double web planetary gear carrier
18	-	Planetary gears - short
19	-	Single web planetary gear carrier
20	-	Sunwheel 1

The shift elements are 3 rotating multiplate clutches (A, B and E) and 2 fixed multiplate brakes © and D). All shifts from 1st to 6th gears are power-on overlapping shifts. Overlapping shifts can be described as one of the clutches continuing to transmit drive at a lower main pressure until the next required clutch is able to accept the input torque.

The shift elements, clutches and brakes are actuated hydraulically. Fluid pressure is applied to the required clutch and/or brake, pressing the plates together and allowing drive to be transmitted through the plates. The purpose of the shift elements is to perform power-on shifts with no interruption to traction and smooth transition between gear ratios.



Power Flow 1st Gear

The gear selector lever and the manual selector valve spool are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to the ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

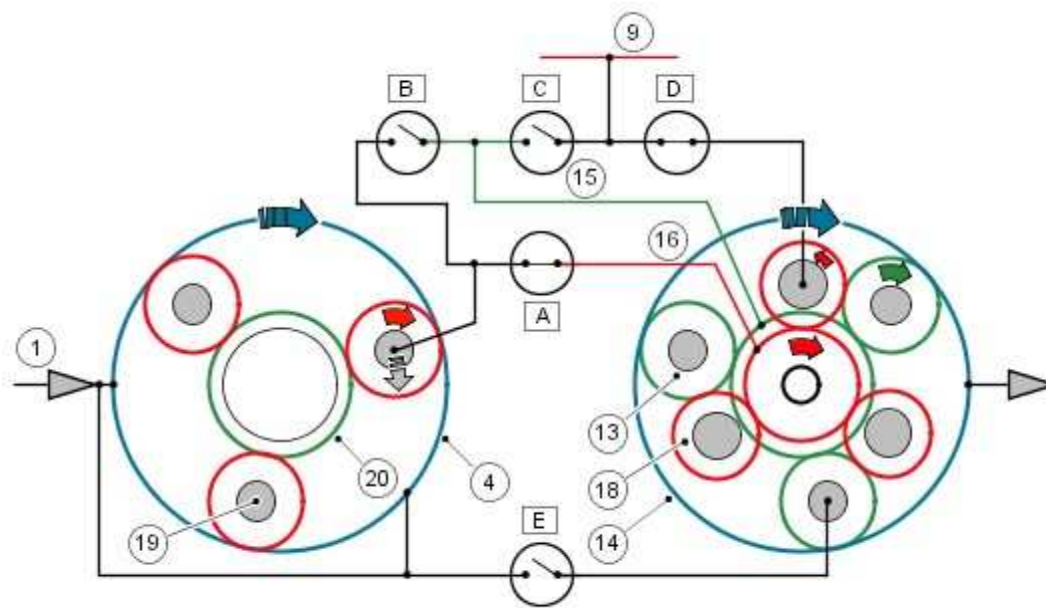
Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

The double web planetary gear train is locked against the transmission housing by brake 'D'. This allows ring gear 2 (output shaft) to be driven in the same direction as the engine via the long planetary gears.

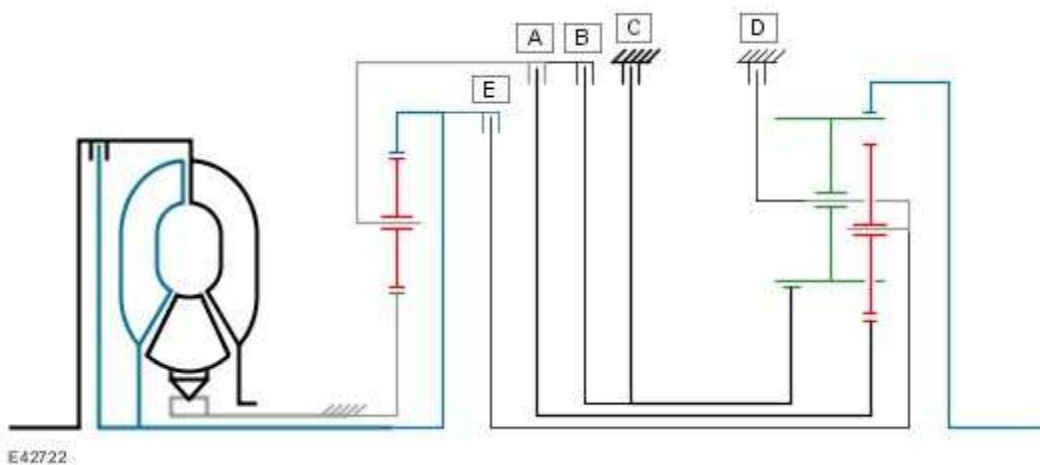
NOTE:

Refer to 'Shift Elements' illustration for key



E42721

Power Flow 2nd Gear



E42722

The gear selector lever and the manual selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to the ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

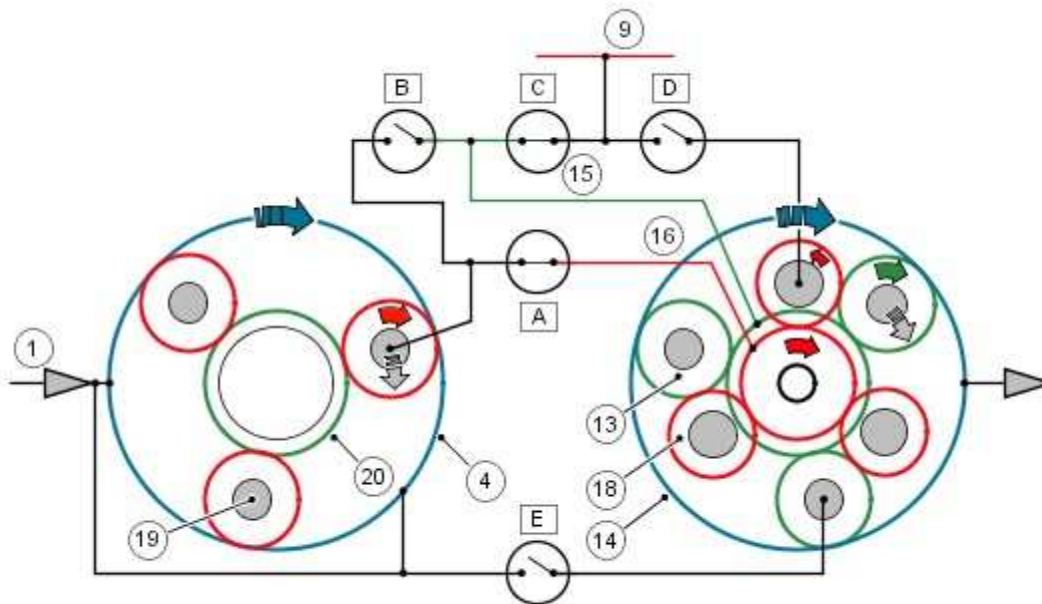
When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

Sunwheel 2 is locked to the transmission housing by brake clutch 'C'. The long planetary

gears, which are also meshed with the short planetary gears, roll around the fixed sunwheel 2 and transmit drive to the double web planetary gear train carrier and ring gear 2 in the direction of engine rotation.

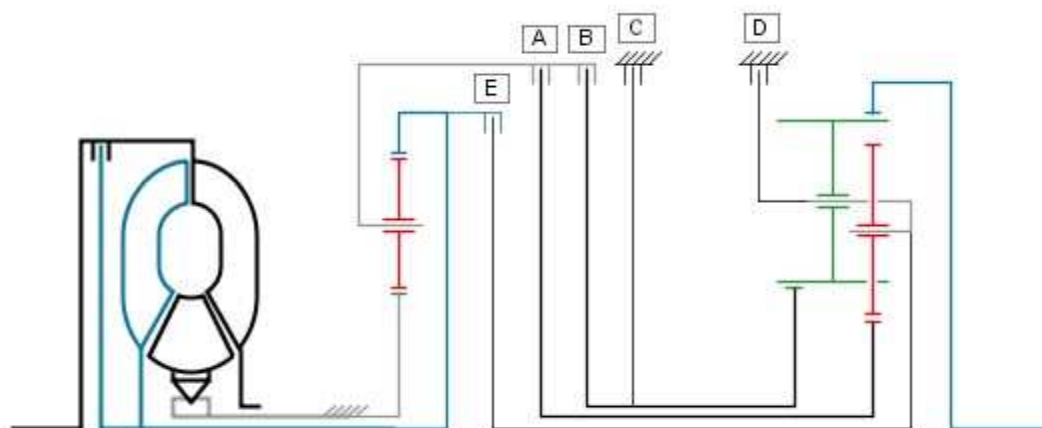
NOTE:

Refer to 'Shift Elements' illustration for key



E42723

Power Flow 3rd Gear



E42724

The gear selector lever and the manual selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to the ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier

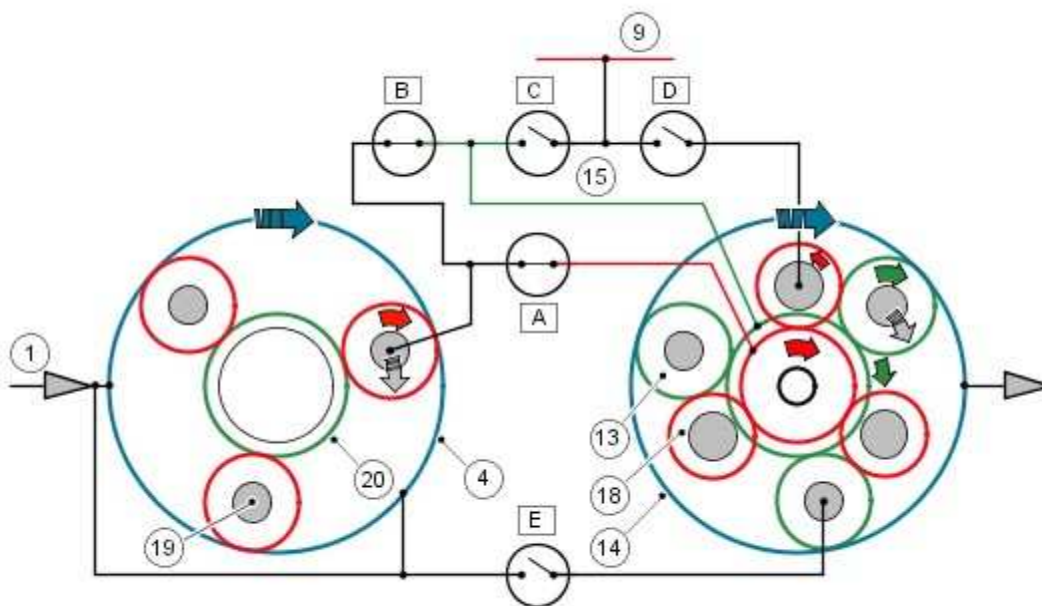
of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

Sunwheel 2 is driven via clutch 'B' which is engaged. The long planetary gears, which are also meshed with the short planetary gears, cannot roll around the fixed sunwheel 2 and transmit drive to the locked double web planetary gear train carrier in the direction of engine rotation.

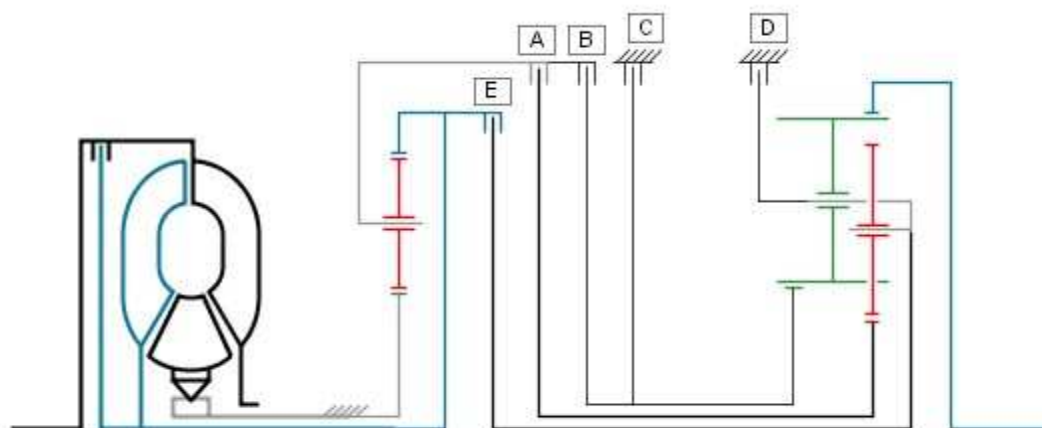
NOTE:

Refer to 'Shift Elements' illustration for key



E42725

Power Flow 4th Gear



E42726

The gear selector lever and the manual selector spool valve are in the 'D' position. Engine

torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

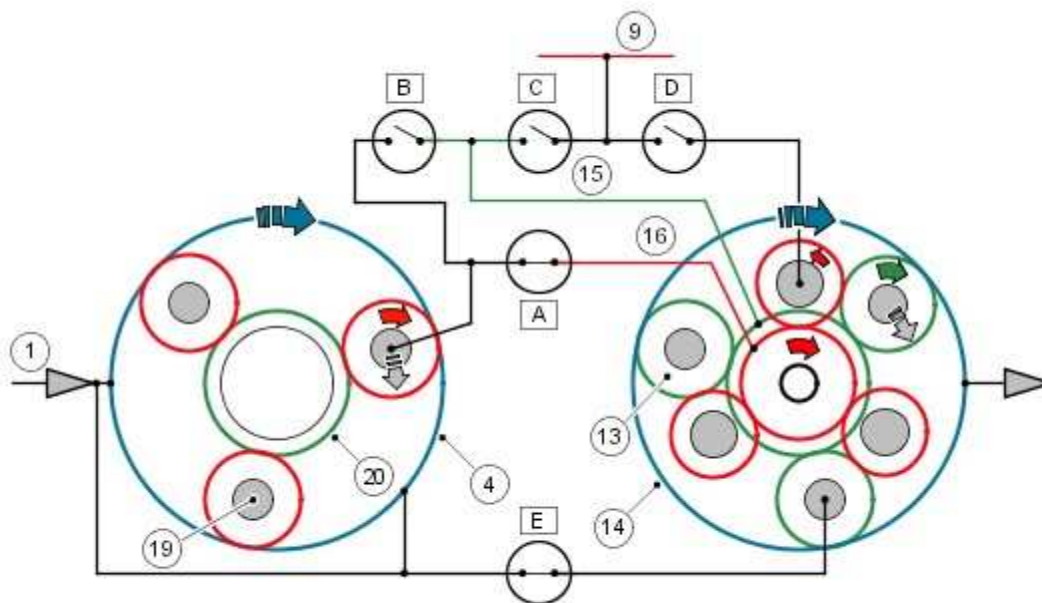
Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

The double web planetary gear carrier is driven via clutch 'E' which is engaged. The long planetary gears, which are also meshed with the short planetary gears, and the double web planetary gear carrier, drive ring gear 2 in the direction of engine rotation.

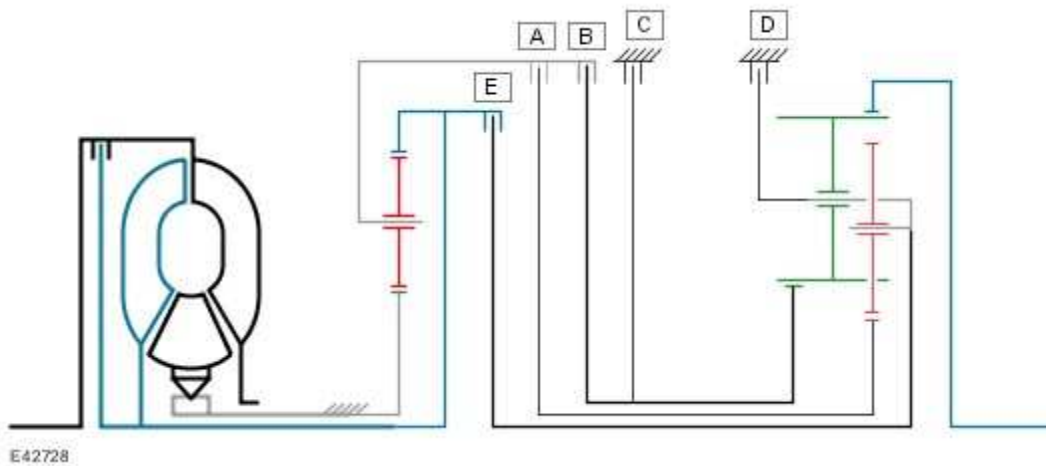
NOTE:

Refer to 'Shift Elements' illustration for key



E42727

Power Flow 5th Gear



The gear selector lever and the manual selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

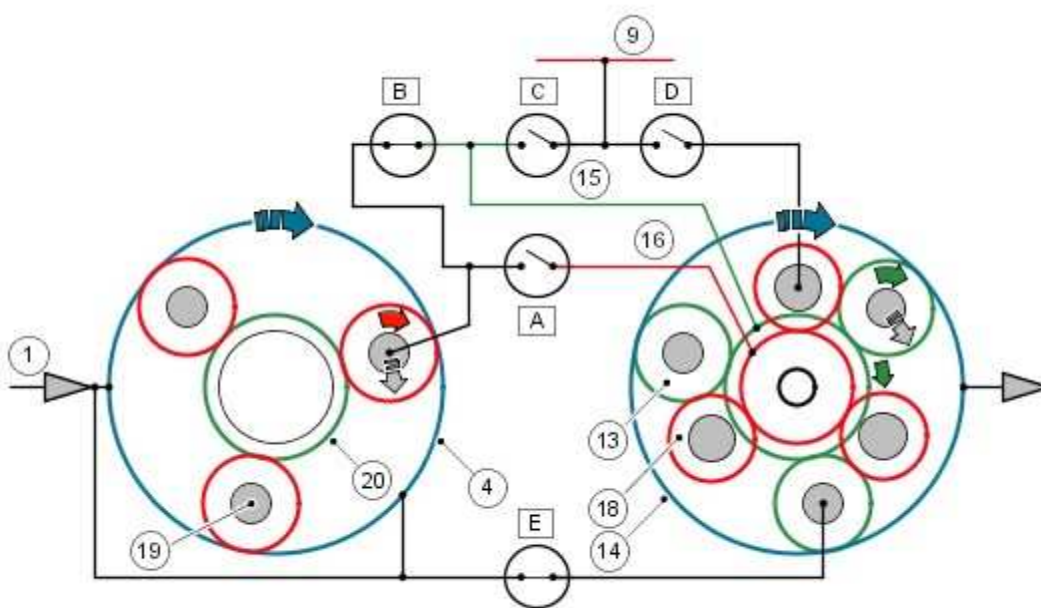
Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

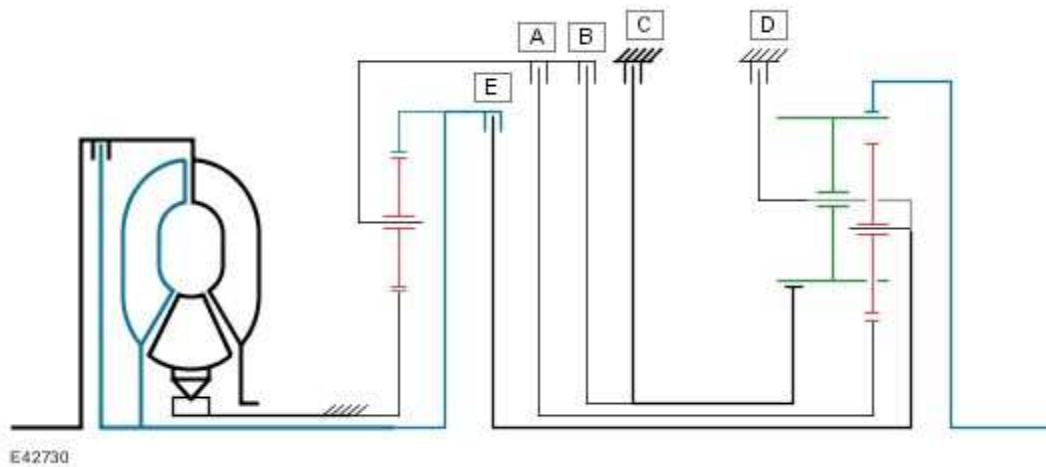
The long planetary gears, which are also meshed with the short planetary gears and the double web planetary gear carrier, drive ring gear 2 in the direction of engine rotation.

NOTE:

Refer to 'Shift Elements' illustration for key



Power Flow 6th Gear



The gear selector lever and the manual selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

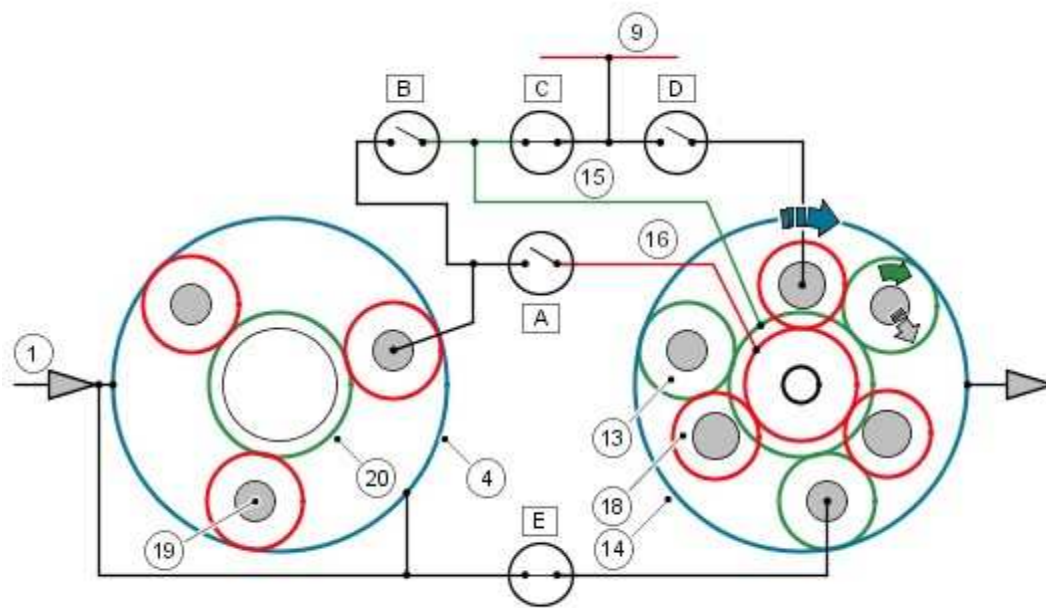
Clutches 'A' and 'B' are released, removing the effect of the single web planetary gear train.

Clutch brake 'C' is applied which locks sunwheel 2 to the transmission housing.

Clutch 'E' is engaged and drives the double web planetary gear carrier. This causes the long planetary gears to rotate around the fixed sunwheel 2 and transmit drive to ring gear 2 which is driven in the direction of engine rotation.

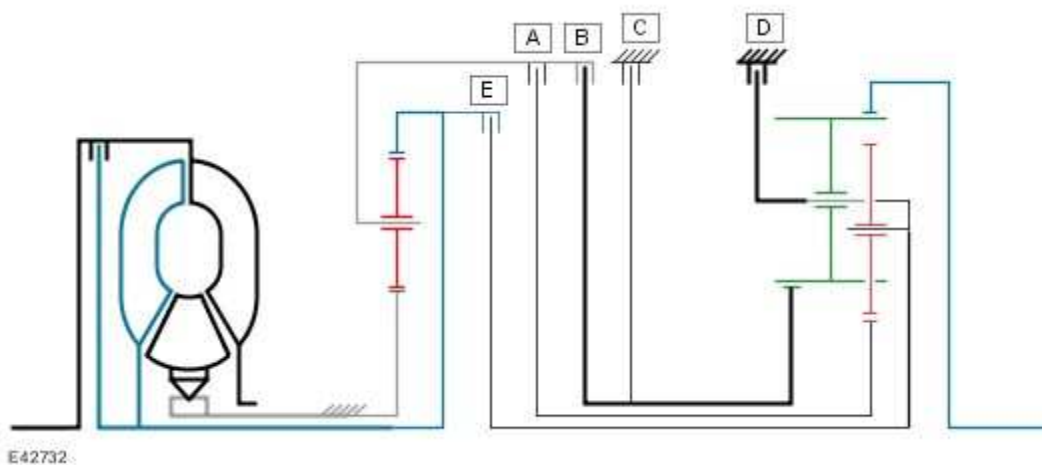
NOTE:

Refer to 'Shift Elements' illustration for key



E42731

Power Flow Reverse Gear



E42732

The gear selector lever and the manual selector spool valve are in the 'R' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears of the single web planetary gear train which rotate around the fixed sunwheel 1. This transmits the drive to the single web planetary gear carrier, the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

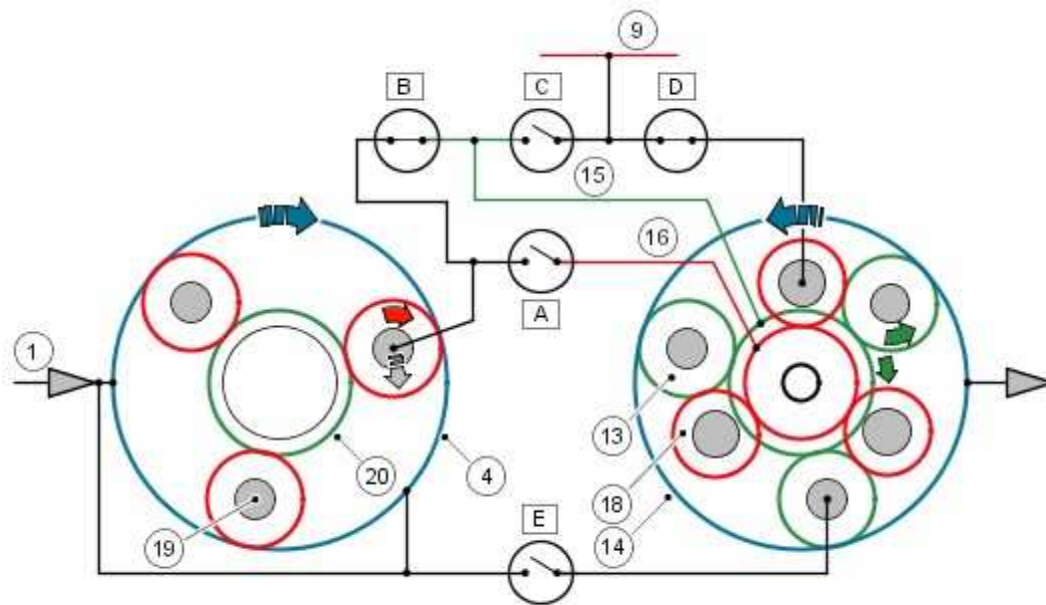
With clutch 'B' applied, sunwheel 2 in the double web planetary gear train is driven and meshes with the long planetary gears.

The double web planetary gear carrier is locked to the transmission housing by brake clutch

'D'. This allows ring gear 2 to be driven in the opposite direction to engine rotation by the long planetary gears.

NOTE:

Refer to 'Shift Elements' illustration for key



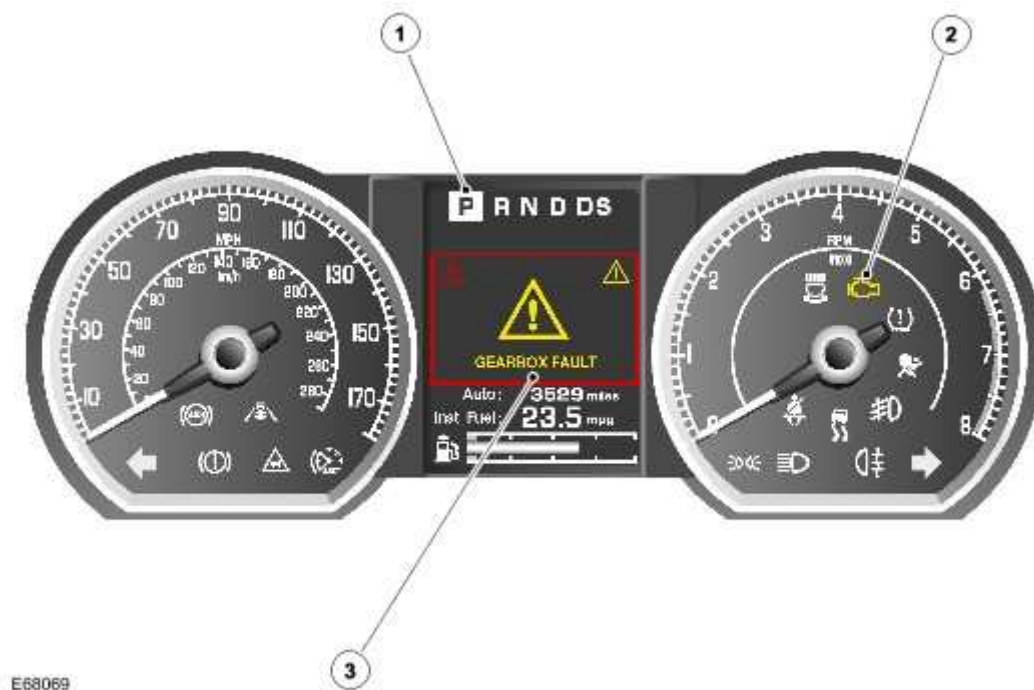
E42733

SELECTOR POSITION SWITCH

The Mechatronic valve block contains a position switch which is mechanically connected to the selector spool valve. The selector spool valve is connected by a selector shaft to the selector lever via a 'Bowden' selector cable.

The signals from the position switch are used by the TCM to determine the P, R, N or D selection made by the driver.

INSTRUMENT CLUSTER



Item	Part Number	Description
1	-	Transmission selected gear status
2	-	Malfunction Indicator Lamp (MIL)
3	-	Message centre

The instrument cluster is connected to the TCM via the high speed CAN bus. Transmission status is transmitted by the TCM and displayed to the driver in one of 2 displays in the instrument cluster. For additional information, refer to [Instrument Cluster](#) (413-01 Instrument Cluster)

Malfunction Indicator Lamp (MIL)

The MIL is located in the tachometer in the instrument cluster. Transmission related faults which may affect the vehicle emissions output will illuminate the MIL.

The MIL is illuminated by the ECM on receipt of a relevant fault message from the TCM on the high speed CAN. The nature of the fault can be diagnosed using the Integrated Diagnostic System (IDS) which reads the fault codes stored in the TCM memory.

Transmission Status Display

The transmission status display is located in a Liquid Crystal Display (LCD) at the top of the instrument cluster, between the speedometer and the tachometer. The LCD shows the selector lever position or the selected gear when in manual 'Jaguar Sequential Shift' mode.

The following table shows the displays and their descriptions.

Symbol	Description
P	Park selected
R	Reverse selected
N	Neutral selected
D	Drive selected
DS	Sport mode selected
1	1st gear selected (Manual 'Jaguar Sequential Shift' mode)
2	2nd gear selected (Manual 'Jaguar Sequential Shift' mode)
3	3rd gear selected (Manual 'Jaguar Sequential Shift' mode)
4	4th gear selected (Manual 'Jaguar Sequential Shift' mode)
5	5th gear selected (Manual 'Jaguar Sequential Shift' mode)
6	6th gear selected (Manual 'Jaguar Sequential Shift' mode)

Message Centre Display

The message centre is located in the lower centre of the instrument cluster. The message centre is a LCD to relay vehicle status and operating information to the driver and can display messages relating to a number of the vehicle systems. If a transmission fault occurs, the message centre will display the message 'GEARBOX FAULT'.

TRANSMISSION CONTROL MODULE (TCM)

The TCM is an integral part of the Mechatronic valve block which is located at the bottom of the transmission, within the fluid pan. The TCM is the main controlling component of the transmission.

The TCM processes signals from the transmission speed and temperature sensors, ECM and other vehicle systems. From the received signal inputs and pre-programmed data, the module calculates the correct gear, torque converter clutch setting and optimum pressure settings for gear shift and lock-up clutch control.

The TCM outputs signals to control the shift control solenoid valve and the Electronic Pressure Regulator Solenoids (EPRS) to control the hydraulic operation of the transmission.

The ECM supplies the engine management data on the high speed CAN bus system. The TCM requires engine data to efficiently control the transmission operation, for example; flywheel torque, engine speed, accelerator pedal angle, engine temperature etc.

The steering angle sensor and the ABS module also supply data to the TCM on the high speed CAN bus system. The TCM uses data from these systems to suspend gear changes when the vehicle is cornering and/or the ABS module is controlling braking or traction control.

The selector lever is connected to the automatic transmission and the position switch in the transmission by a Bowden cable. Movement of the selector lever moves the position switch

via the cable and the switch position informs the TCM of the selected position. The sport switch passes the sport selection to the TCM. 'Jaguar Sequential Shift' selections are sensed when the driver operates the steering wheel paddle switches. An additional switch provides a selector lever 'not in park' position signal. Once the selector lever position is confirmed, the TCM outputs appropriate information which is received by the instrument cluster to display the gear selection information in the message centre.

The Mechatronic valve block also contains the speed and temperature sensors. These are integral with the Mechatronic valve block and cannot be serviced individually. The speed sensors measure the transmission input and output speeds and pass signals to the TCM. The fluid temperature sensor is also located in the valve block and measures the fluid temperature of the transmission fluid in the fluid pan.

A 'not in park' switch is located in the selector lever mechanism. The switch is connected to the instrument cluster, Central Junction Box (CJB) and the ECM. The instrument cluster uses the park switch status to display the selector position. The ECM uses the status to allow starter motor operation only when the selector lever is in the Park or Neutral positions. The signal is also passed from the CJB to the TCM.

CONTROLLER AREA NETWORK (CAN)

The high speed CAN bus is used to connect the powertrain modules. The CAN bus is connected between the following electronic units:

High Speed CAN Bus

- TCM
- Instrument cluster
- Adaptive Damping Control Module (ADCM) - if fitted
- Steering angle sensor
- Electric park brake module
- Restraints control module
- Engine Control Module (ECM)
- ABS control module
- Adaptive front lighting control module - if fitted
- Adaptive cruise control module - if fitted
- Diagnostic socket.

The CAN bus allows a fast exchange of data between modules. The CAN bus comprises 2 wires which are identified as CAN high (H) and CAN low (L). The 2 wires are coloured yellow/black (H) and yellow/brown (L) and are twisted together to minimise electromagnetic interference (noise) produced by the CAN bus messages. For additional information, refer to [Communications Network](#) (418-00 Module Communications Network)

In the event of CAN bus failure, the following symptoms may be observed:

- Transmission operates in default (limp home) mode
- Torque converter lock-up clutch control is disabled

- Gear position indication in instrument cluster message centre inoperative (this will also occur with any transmission fault).

DRIVING MODES

There are a number of different driving modes of operation. Some can be selected by the driver and some are automatically initiated by the TCM during driving:

- Normal mode
- Sport mode
- Manual ('Jaguar Sequential Shift') mode
- Adaptive Shift Strategy (ASIS)
- Cruise mode
- Hill mode
- Default (Limp home) mode
- Reverse lock-out mode
- Cooling strategy
- Curve recognition mode
- Fast off recognition.

Normal Mode

Normal mode is automatically selected by the TCM on power up. In this mode all automatic and adaptive modes are active. Normal mode uses gear shift and lock-up maps to allow for vehicle operation which offers fuel consumption and emissions or driveability depending on the driving style. If the transmission is operated in sport or manual mode and the selector lever is moved to the 'D' position, normal mode is automatically resumed.

Sport Mode

The sport mode provides enhanced acceleration and responsiveness. In sport mode the TCM uses shift maps which allow the transmission to downshift more readily, hold gears for longer at higher engine speeds, and limits the transmission to the first five gears (6th gear is not used).

Sport mode is selected by moving the selector lever across the 'L' gate into the 'S' position. When the sport mode is first selected, if 6th gear is currently engaged, the TCM downshifts to 5th.

Manual ('Jaguar Sequential Shift') Mode

Manual mode allows the transmission to operate as a semi-automatic 'Jaguar Sequential Shift' unit. The driver can change up and down the 6 forward gears with the freedom of a manual transmission.

Shift maps are provided for manual mode to protect the engine at high engine speeds. The TCM will automatically change up to a higher gear ratio to prevent engine overspeed and change down to a lower gear ratio to avoid engine labouring and stalling.

When kickdown is requested the TCM downshifts at least 2 gears.

When the vehicle is stationary, to drive off the driver can select 1st , 2nd or 3rd gear. Any other gear selection will be rejected by the TCM.

When driving off, upshifts can be pre-selected by making + selections with the appropriate steering wheel upshift or downshift paddle for the number of upshifts required. The TCM then automatically performs a corresponding number of upshifts when the appropriate shift points are reached. So, for example, when starting off in 1st gear, if three upshift (+) selections are made in quick succession, the TCM will automatically change up through the box to 4th gear as the vehicle accelerates, without any further selections being made.

In manual mode a low gear can be selected to provide engine braking for descending a slope or continuous use of the brake pedal. The driver can prepare for the end of the descent by moving the selector lever to D. The TCM will maintain the low gear and only revert to automatic shift control when the throttle is opened and vehicle speed increases.

Adaptive Shift Strategy (ASIS)

The ASIS system is a new feature on automatic transmissions. With the TCM linked via the CAN bus to other vehicle systems, signals are received which can allow the TCM to calculate the way in which the vehicle is being driven. The type of signals include the following:

- Longitudinal and lateral acceleration
- Engine speed
- Engine torque
- Oil temperature
- Accelerator pedal position
- Wheel speed.

Using these signals, additional transmission control can be obtained. The TCM can calculate when the vehicle is cornering, all wheels are gripping, the driver is braking or if the driver is accelerating. This is the conventional 'Adaptive' transmission control. ASIS uses this system but adds the continuous adaptation of the gear changes to suit the individual driving style of the driver.

Cruise Mode

When speed control is activated, the TCM receives a cruise active message on the CAN bus. The TCM activates a speed control map which prevents locking and unlocking of the torque converter clutch and minimises up and down shifts.

Hill Mode

Hill mode is initiated by the TCM when the engine torque, received via ECM signals on the CAN bus, exceeds the theoretical load curve for normal operation. The TCM monitors this signal to determine when the vehicle is travelling up or down a steep gradient.

In hill mode the TCM adopts one of four shift maps, three uphill and one downhill. The shift map chosen depends on the severity of the slope as determined from the engine signals and the appropriate gear is selected to assist with the ascent or descent.

Hill mode can also be initiated when the vehicle is at very high altitudes or ambient temperatures.

Default (Limp Home) Mode

If a transmission fault is detected by the TCM, the TCM adopts a limp home mode strategy. 'GEARBOX FAULT' is displayed in the message centre and, if the fault has an effect on engine emissions, the MIL will also be illuminated.

In default mode, P, R and N functions operate normally (if the fault allows these selections) and the TCM locks the transmission in 3rd or 5th gear to allow the driver to take the vehicle to the nearest dealer. The torque converter lock-up clutch is disabled and reverse lock-out will not function.

If the vehicle is stopped and subsequently restarted in the default mode condition, the TCM operates normally until the fault which caused the condition is detected again.

If electrical power is lost and the transmission is operating in mechanical limp home mode, the selector lever will be locked in the 'N' or 'P' position by the shift interlock solenoid if moved from the 'D' position.

Reverse Lock-Out Mode

When the vehicle is travelling forwards, selecting reverse could cause transmission damage. To protect against this, reverse gear is prohibited if the vehicle is travelling forwards at a road speed of 5 mph (8 km/h) or higher.

Cooling Strategy

The purpose of the cooling strategy is to reduce engine and transmission temperatures during high load conditions. Under these conditions the engine and transmission may generate excessive heat.

If the transmission fluid temperature increases to 125°C (257°F) or higher, the TCM employs the cooling strategy. No message is displayed in the message centre for transmission overheat.

The strategy uses a specific shift and torque converter lock-up clutch map. This map allows torque converter clutch lock-up and gear shifts to operate outside of their normal operation. This will reduce the engine speed and/or slip in the torque converter, therefore reducing heat generated by the engine and the transmission.

If the transmission fluid temperature increases to 137°C (278°F) or higher, the transmission will use the default (limp home mode). If the temperature exceeds 140°C (284°F), CAN bus transmission is disabled.

The cooling strategy is cancelled when the transmission fluid temperature decreases to less than 120°C (248°F) or below.

Curve Recognition

Curve recognition is activated when high levels of lateral acceleration and/or steering angle are detected via the ABS module and steering angle sensor signals on the CAN bus. When this condition is detected, the TCM prevents the transmission from changing to a higher gear to assist with cornering. When the vehicle completes its manoeuvre, the transmission will shift to the correct ratio.

Fast Off Recognition

Fast off recognition is activated when the TCM detects that the driver has backed off the accelerator pedal quickly in a 'change of mind' manoeuvre. This is detected by monitoring for a high level of negative pedal angle from the engine control module signal on the CAN bus. If this condition is detected, the TCM holds the current gear ratio to allow the driver to complete his original action without the need for a downshift. The mode remains active for a predetermined time period or if the driving style remains passive.

TRANSMISSION FAULT STATUS

If the TCM detects a fault with the transmission system, it will enter a default mode to prevent further damage to the transmission and allow the vehicle to be driven.

When a fault is detected a CAN message is sent from the TCM and is received by the instrument cluster. The instrument cluster illuminates the MIL, if an emissions related fault occurs, and displays 'GEARBOX FAULT' in the message centre.

Some transmission faults may not illuminate the MIL or display a fault message, but the driver may notice a reduction in shift quality. For additional information, refer to [Transmission Description](#) (307-01 Automatic Transmission/Transaxle)

ENGINE SPEED AND TORQUE MONITORING

The ECM constantly supplies the TCM with information on engine speed and torque through messages on the CAN bus. The TCM uses this information to calculate the correct and appropriate timing of shift changes.

If the messages are not received by the ECM, the TCM will implement a back-up strategy to protect the transmission from damage and allow the vehicle to be driven.

In the event of an engine speed or torque signal failure, the transmission will adopt the electrical limp home mode with the transmission operating in a fixed gear.

TOWING FOR RECOVERY

The following procedure must be used to ensure that the vehicle is towed in a safe condition and damage to the vehicle transmission systems is prevented.

- Secure the towing attachment from the recovery vehicle to the towing eye of the vehicle to be recovered.
- Make sure that the parking brake is on. Press the start/stop button to switch the ignition on.
- Apply the footbrake and move the automatic transmission selector lever to the neutral position. If electrical power is not available, use the manual interlock release tab on the selector lever to move the lever to the neutral (N) position.
- Make sure that the Smart Key is placed in the start control module to ensure that the electric steering lock is disengaged and, if the stop lamps and turn signal indicators are required, the start/stop button is pressed and the ignition is on.
- Make sure that the parking brake is released before the vehicle is towed.
- The vehicle can only be towed for a maximum of 0.5 miles (0.8 km) at a maximum speed of 30 mph (48 km/h).

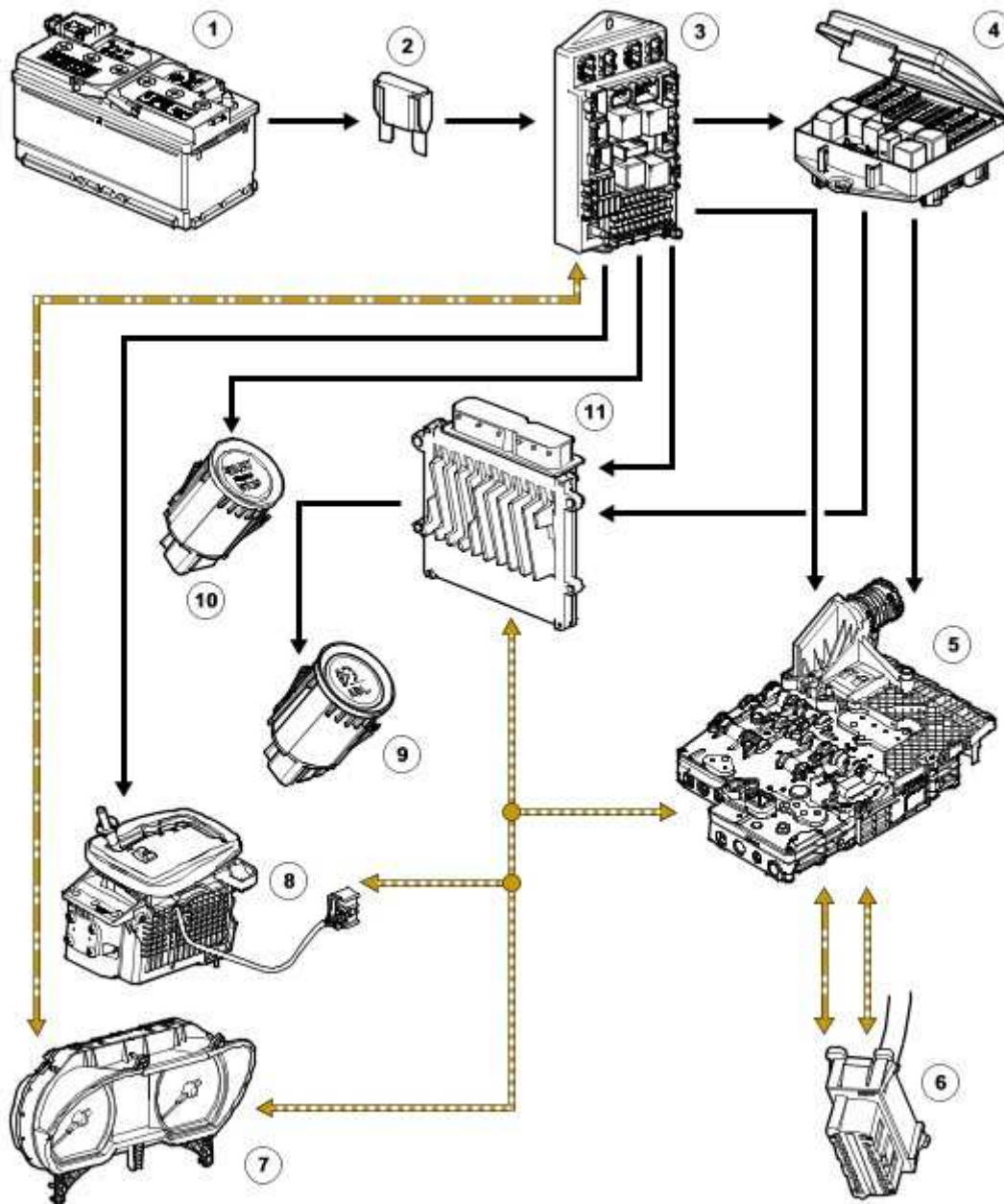


WARNING: Do not remove the Smart Key from the vehicle when the vehicle is being towed. The electric steering lock will be engaged preventing the steering from being turned. With the engine not running, the brake booster and power steering pump will be inoperative. Care must be taken to ensure the vehicle is manoeuvred and driven accordingly.

CONTROL DIAGRAM

NOTE:

A = Hardwired; **D** = High speed CAN Bus; **N** = Medium speed CAN Bus



E64871



Item	Part Number	Description
1		Battery
2		Megafuse (175A)
3		CJB
4		Power distribution box
5		TCM
6		Diagnostic socket
7		Instrument cluster
8		Transmission selector lever assembly

9		Automatic speed limiter switch
10		Stop/Start switch
11		ECM

Diagnostic Strategy

Principle of Operation

For a detailed description of the automatic transmission/transaxle, refer to the relevant Description and Operation section in the workshop manual.

Transmission Description

Fluid Level and Condition Check



CAUTION: The vehicle should not be driven if the fluid level is low as internal failure can result.

NOTE:

The transmission fluid temperature must not be allowed to exceed 50°C (122°F) whilst checking level. Should the temperature rise above this figure, abort the check and allow the transmission fluid to cool to below 30°C (86°F).

This vehicle is not equipped with a fluid level indicator. An incorrect level may affect the transmission operation and could result in transmission damage. To correctly check and add fluid to the transmission.

Transmission Fluid Level Check

High Fluid Level

A fluid level that is too high may cause the fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube and possible transmission damage. If an overfill condition is identified, with the engine at idle ensure the fluid temperature is within the specified range and allow the excess fluid to drain until a small thread of fluid runs from the filler/level plug hole.

Low Fluid Level

A low fluid level could result in poor transmission engagement, slipping, or damage. This could also indicate a leak in one of the transmission seals or gaskets.

Transmission Fluid Level Check

Adding Fluid



CAUTION: The use of any other type of transmission fluid other than that specified can result in transmission damage.

If fluid needs to be added, add fluid in 0.50 liter increments through the fill hole opening. Do not overfill the fluid. For fluid type, refer to the General Specification chart in this section.

Specifications

Fluid Condition Check

1 . Check the fluid level.

Transmission Fluid Level Check

2 . Observe the color and the odour of the fluid. The color under normal circumstances should be like honey, not brown or black.

3 . Allow the fluid to drip onto a facial tissue and examine the stain.

4 . If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.

NOTE: In the event of a transmission unit replacement for internal failure, the oil cooler and pipes must also be replaced.

Inspection and Verification

1 . Verify the customer concern.

2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical	Hydraulic
- Damaged shift mechanism/linkages - Damaged automatic transmission casing - Check the transmission selector lever cable for correct adjustment. Selector Lever Cable Adjustment (44.15.07)	- Blown fuse(s) - Damaged, loose or corroded connectors - Wiring harness	- Fluid level too high/low - Poor condition of fluid - Fluid leak

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 (DTCs) and refer to the DTC Index.

DTC Index



CAUTION: When probing connectors to take measurements in the course of the pinpoint

tests, use the adaptor kit, part number 3548-1358-00.

NOTE:

If the control module/transmission 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/transmission.

NOTE:

Generic scan tools may not read the codes listed, or may read only five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give additional information read by the manufacturer approved diagnostic system).

NOTE:

When performing electrical voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM 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 DTCs 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.

DTC	Description	Possible Cause	Action
P071100	Transmission Fluid	Transmission fluid temperature sensor	Install a new transmission control

	Temperature Sensor A Circuit Range/Performance	pins short circuit or fluid temperature rise rate too low	module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P093800	Transmission fluid temperature sensor range/performance	Transmission fluid temperature compared with module temperature fault	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P071300	Transmission fluid temperature sensor circuit high input	Both transmission fluid temperature sensor pins signal voltage too high	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P071200	Transmission fluid temperature sensor circuit low input	Both transmission fluid temperature sensor pins signal voltage too low	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P071000	Transmission fluid temperature sensor circuit open	Open circuit transmission fluid temperature sensor	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body

P070000	Transmission control system (MIL Request)	- No wheel speed information on CAN - TCM failure	Check for wheel speed related DTCs and refer to DTC Index. Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P062F00	Internal control module EEPROM error	EEPROM communication error	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P060100	Internal control module memory checksum error	- Software error - TCM failure	Re-configure the transmission using the manufacturer approved diagnostic system, clear DTC and re-test. If DTC remains, Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P072000	Output shaft speed sensor circuit	Transmission output shaft speed sensor circuit short to power	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P072122	Output shaft speed sensor circuit	Transmission output shaft speed sensor	Install a new transmission control module and main control valve body assembly, refer to the new

	range/performance	signal out of range	module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P021900	Engine overspeed condition	Engine speed signal received over CAN is too high	Check engine management DTCs and refer to DTC Index. Electronic Engine Controls
P071700	Turbine/input shaft speed sensor A circuit - short to power	Turbine/input shaft speed sensor A circuit - short to power	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P071600	Turbine/input shaft speed sensor A circuit failure or sensor out of range	Circuit short to ground, power, open circuit or signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P089700	Transmission fluid requires replacement due to excessive running time at maximum operating temperatures	- Low transmission fluid level - Blocked or damaged transmission fluid cooler	Drain and re-fill transmission fluid to correct level. Transmission Fluid Drain and Refill (44.24.02) Check for blocked or damaged transmission fluid cooler
P012100	Throttle/pedal position sensor A circuit range/performance	Pedal assembly faulty or does not have full range of movement	Ensure the accelerator pedal is free from restriction, check 'Accelerator Pedal Position received on CAN' datalogger signal (should be 100% when pedal fully depressed). Check for throttle/pedal position related DTCs and refer to DTC Index. Electronic Engine Controls

P070500	Transmission range sensor A circuit (PRNDL input)	Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P178300	Transmission over temperature condition	- Low transmission fluid level - Blocked or damaged transmission fluid cooler	Drain and re-fill transmission fluid to correct level. Transmission Fluid Drain and Refill (44.24.02) Check for blocked or damaged transmission fluid cooler
P056200	TCM supply voltage low	- Low battery charge - Harness fault	Ensure battery is in a fully charged and serviceable condition, refer to the battery care manual. Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. Also check for additional DTCs that could be associated to loss of power or ground feed and refer to DTC Index
P065700	Actuator supply voltage A - open circuit, range/performance	Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P065900	Actuator supply voltage A circuit high	Actuator (pressure control valves etc) supply voltage short to power	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve

			Body
P065800	Actuator supply voltage A circuit low	Actuator (pressure control valves etc) supply voltage short to ground	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P061300	TCM processor	Microprocessor control failure	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P074100	Torque converter clutch solenoid circuit range/performance or stuck off	Signal out of range	Install a new torque converter, refer to the new module/transmission installation note at the top of the DTC Index. Transmission (44.20.01)
P096200	Pressure control solenoid A control circuit low	Pressure control solenoid A short to ground	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P096014	Pressure control solenoid A control circuit low	Pressure control solenoid A short to ground, open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body

P074800	Pressure control solenoid A current out of range	Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P096300	Pressure control solenoid A control circuit high	Pressure control solenoid A control circuit short to power	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P096013	Pressure control solenoid A open circuit	Pressure control solenoid A open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P096600	Pressure control solenoid B control circuit low	Pressure control solenoid B short to ground	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P096414	Pressure control solenoid B control circuit low	Pressure control solenoid B short to ground, open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body

P077800	Pressure control solenoid B current out of range	Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P096700	Pressure control solenoid B control circuit high	Pressure control solenoid B control circuit short to power	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P096413	Pressure control solenoid B open circuit	Pressure control solenoid B open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P097000	Pressure control solenoid C control circuit low	Pressure control solenoid C short to ground	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P096814	Pressure control solenoid C control circuit low	Pressure control solenoid C short to ground, open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body

P079800	Pressure control solenoid C current out of range	Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P097100	Pressure control solenoid C control circuit high	Pressure control solenoid C control circuit short to power	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P096813	Pressure control solenoid C open circuit	Pressure control solenoid C open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P272000	Pressure control solenoid D control circuit low	Pressure control solenoid D short to ground	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P271814	Pressure control solenoid D control circuit low	Pressure control solenoid D short to ground, open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body

P271600	Pressure control solenoid D current out of range	Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P272100	Pressure control solenoid D control circuit high	Pressure control solenoid D control circuit short to power	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P271813	Pressure control solenoid D control circuit open circuit	Pressure control solenoid D control circuit open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P272900	Pressure control solenoid E control circuit low	Pressure control solenoid E short to ground	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P272714	Pressure control solenoid E control circuit low	Pressure control solenoid E short to ground, open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body

P272500	Pressure control solenoid E current out of range	Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P273000	Pressure control solenoid E control circuit high	Pressure control solenoid E control circuit short to power	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P272713	Pressure control solenoid E control circuit open circuit	Pressure control solenoid E control circuit open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P276400	Pressure control solenoid F control circuit low	Pressure control solenoid F short to ground	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P276100	Pressure control solenoid F control circuit low	Pressure control solenoid F short to ground, open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body

P275900	Pressure control solenoid F current out of range (high)	Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P276200	Pressure control solenoid F current out of range (low)	Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P276300	Pressure control solenoid F control circuit high	Pressure control solenoid F control circuit short to power	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P074000	Pressure control solenoid F control circuit open circuit	Pressure control solenoid F control circuit open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P075200	Solenoid valve A control circuit low	Solenoid valve A control circuit short to ground	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body

P075114	Solenoid valve A control circuit low	Solenoid valve A control circuit short to ground, open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P075300	Solenoid valve A control circuit high	Solenoid valve A control circuit short to power	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P075113	Solenoid valve A control circuit open circuit	Solenoid valve A control circuit open circuit	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index. Transmission Control Module (TCM) and Main Control Valve Body
P073000	Slip too high between input and output shaft speeds in any gear	- Low transmission fluid level - Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P073100	Slip too high between input and output shaft speeds in 1st gear	- Low transmission fluid level - Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index

P073200	Slip too high between input and output shaft speeds in 2nd gear	• Low transmission fluid level • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P073300	Slip too high between input and output shaft speeds in 3rd gear	• Low transmission fluid level • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P073400	Slip too high between input and output shaft speeds in 4th gear	• Low transmission fluid level • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P073500	Slip too high between input and output shaft speeds in 5th gear	• Low transmission fluid level • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P072900	Slip too high between input and output shaft speeds in 6th gear	• Low transmission fluid level • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index

P078000	Shift monitoring fault - input/output shaft speed ratio out of range during a shift (any gear). Relevant clutch does not open or close	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P078162	1-2 Shift - Comparison of input and output speed during a shift 1 to 2 (relevant clutch does not open or close)	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P078164	1-2 Shift - Comparison of input and output speed during a shift 1 to 2 (relevant clutch does not open or close)	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P078262	2-3 Shift - Comparison of input and output speed during a shift 2 to 3 (relevant clutch does not open or close)	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index

P078264	2-3 Shift - Comparison of input and output speed during a shift 2 to 3 (relevant clutch does not open or close)	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P078362	3-4 Shift - Comparison of input and output speed during a shift 3 to 4 (relevant clutch does not open or close)	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P078364	3-4 Shift - Comparison of input and output speed during a shift 3 to 4 (relevant clutch does not open or close)	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P078462	4-5 Shift - Comparison of input and output speed during a shift 4 to 5 (relevant clutch does not open or close)	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index

P078464	4-5 Shift - Comparison of input and output speed during a shift 4 to 5 (relevant clutch does not open or close)	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P082962	5-6 Shift - Comparison of input and output speed during a shift 5 to 6 (relevant clutch does not open or close)	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P082964	5-6 Shift - Comparison of input and output speed during a shift 5 to 6 (relevant clutch does not open or close)	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P078123	2-1 Shift - Comparison of input and output speeds during gear shift 2 to 1. Clutch does not open	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index

P078200	3-2 Shift - Comparison of input and output speeds during gear shift 3 to 2. Clutch does not open	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P078300	4-3 Shift - Comparison of input and output speeds during gear shift 4 to 3. Clutch does not open	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P078323	4-3 Shift - Comparison of input and output speeds during gear shift 4 to 3. Clutch does not open	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P078423	5-4 Shift - Comparison of input and output speeds during gear shift 5 to 4. Clutch does not open	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index

P072164	Output speed against turbine speed and wheel speed fault	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new Transmission Control Module. Refer to the new module/transmission installation note at the top of the DTC Index Transmission Control Module (TCM) and Main Control Valve Body
P082923	6-5 Shift - Comparison of input and output speeds during gear shift 6 to 5. Clutch does not open	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P056100	Power supply voltage out of range when engine running	• Low battery charge • Harness fault	Ensure battery is in a fully charged and serviceable condition, refer to the battery care manual. Check 'Battery Voltage at TCM' datalogger signal. Check for DTCs that could be associated to loss of power or ground feeds at TCM and refer to DTC Index
P085000	Starter inhibit signal fault	• Park/neutral switch input circuit fault • TCM failure	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system. After pinpoint test complete, re-test and if fault remains install a new transmission control module and main control valve body assembly, refer to the new

			module/transmission installation note at the top of the DTC Index
P060500	EPROM/FLASH checksum error	• Software fault • TCM failure	Re-configure the TCM using the manufacturer approved diagnostic system, re-test. If DTC remains, install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index
P066900	TCM internal temperature high	• Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index
P066800	TCM internal temperature low	• Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index
P064300	Sensor supply voltage fault high	• Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index
P064200	Sensor supply voltage fault low	• Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index
P060300	Loss of data in RAM fault	• Battery discharged • Transit relay installed • Battery isolation device installed • Harness fault	Ensure battery is fully charged and in a serviceable condition, refer to the battery care manual. Remove transit relay or any battery isolation device installed. Clear DTCs and re-test, if DTC remains check for additional

			DTCs and refer to DTC Index
P082600	Manual shift CAN request error	- Shift paddles not working. Instrument cluster LIN/CAN gateway failure - Shift paddle(s) failure	Check availability of speed control. If speed control is also inoperative, check instrument cluster for related DTCs and refer to DTC Index. Instrument Cluster If speed control is available, check the shift paddle functionality using the datalogger application on the manufacturer approved diagnostic system
P061300	Micro controller component faults	Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index
P050000	Vehicle speed signal not detected	Wheel speed sensor fault	Check anti-lock control - stability assist module and ECM for wheel speed sensor related DTCs and refer to DTC Index. Electronic Engine Controls
P050100	Vehicle speed sensor A range/performance	Wheel speed sensor fault	Check anti-lock control - stability assist module and ECM for wheel speed sensor related DTCs and refer to DTC Index. Electronic Engine Controls
P056300	Battery voltage too high when engine running	High battery charge, alternator fault	Check 'Battery Voltage at TCM' datalogger signal. Check for alternator/over charging related DTCs and refer to relevant DTC Index
P072127	Output shaft speed out of range	Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation

			note at the top of the DTC Index
P073600	Slip too high between input and output shaft speeds in reverse gear	• Low transmission fluid level • Blocked transmission fluid cooler • Worn clutches	Check and set transmission fluid to correct level. Transmission Fluid Level Check Ensure transmission fluid cooler is free from restriction. Clear DTC and re-test. If DTC remains, install a new transmission. Refer to the new module/transmission installation note at the top of the DTC Index
P061B61	TCM positive torque signal not valid	• Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index
P061B65	TCM positive torque signal not valid	• Signal out of range	Install a new transmission control module and main control valve body assembly, refer to the new module/transmission installation note at the top of the DTC Index
U040186	Invalid data received from ECM	• Engine speed value invalid	Check ECM for DTCs and refer to DTC Index. Electronic Engine Controls
U030055	Internal control module software incompatibility	• Mis-match between vehicle and TCM software levels	Re-configure the TCM with the latest level software using the manufacturer approved diagnostic system
U000188	High speed CAN communication Bus	• Vehicle CAN Bus off condition	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U202386	Fault received from external node	• Engine torque information	Check ECM for DTCs and refer to DTC Index. Electronic Engine Controls
U010387	Lost communications	• Missing message from	Carry out any pinpoint tests associated with this DTC using

	with gear selector lever	gear selector lever	the manufacturer approved diagnostic system
U015587	Lost communication with instrument cluster	CAN timeout instrument cluster	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U012887	Lost communication with parking brake module	CAN timeout parking brake module	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U010087	Lost communication with ECM	Missing message from ECM	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U012287	Lost communication with stability control module	CAN timeout stability control module (instrument cluster Off Bus)	Check instrument cluster for DTCs and refer to DTC Index
U041686	Invalid data received from Anti-lock control - stability assist module	Brake information	Check the anti-lock - stability assist system for DTCs and refer to the DTC Index.
U30004A	Control module	Mis-match between configuration data and calibrated data values	Re-configure the TCM using the manufacturer approved diagnostic system
U040462	Invalid data received from the gear selector lever - implausible position	Gear selector cable out of adjustment. Gear selector lever assembly fault	Check gear selector cable adjustment. Selector Lever Cable Adjustment (44.15.07)
U040464	Invalid data received from the gear selector lever - implausible signal	Gear selector cable out of adjustment. Gear selector lever assembly fault	Check gear selector cable adjustment. Selector Lever Cable Adjustment (44.15.07)
U040486	Invalid data received from the gear selector	Gear selector cable out of adjustment. Gear selector lever	Check gear selector cable adjustment. Selector Lever Cable Adjustment

	lever - general failure	assembly fault	(44.15.07)

Removal

Transmission (44.20.01)

Special Service Tools



Torque converter seal installer
308-246



Torque converter handles
307-139

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications

- 2 . Recover the A/C refrigerant.

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 driveshaft.
 - For additional information, refer to Driveshaft - 4.2L NA V8 - AJV8/4.2L SC V8 - AJV8

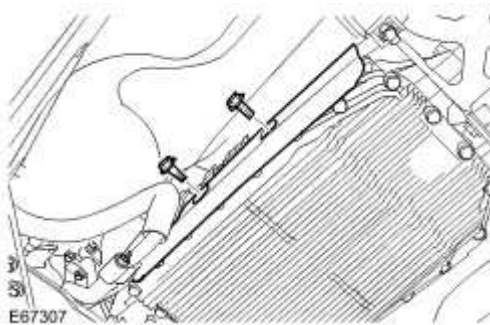
(47.15.01)

5 . **NOTE:**

LH illustration shown, RH is similar.

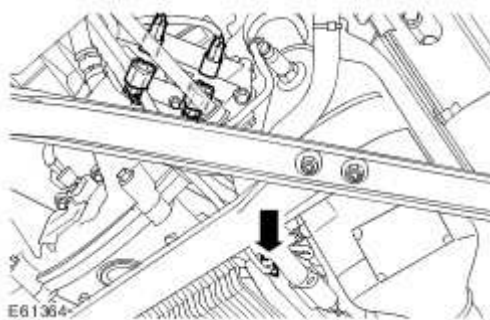
Remove the 2 transmission heat shields.

▶ Remove the 4 bolts.



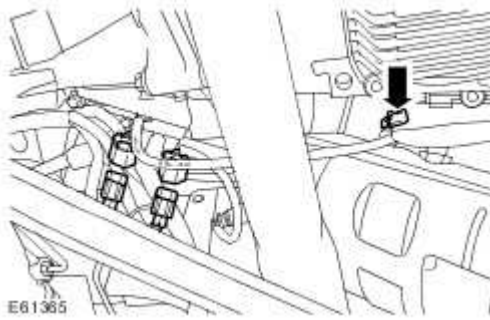
6 . Release and disconnect the 2 LH HO2S electrical connectors.

▶ Release the clip.



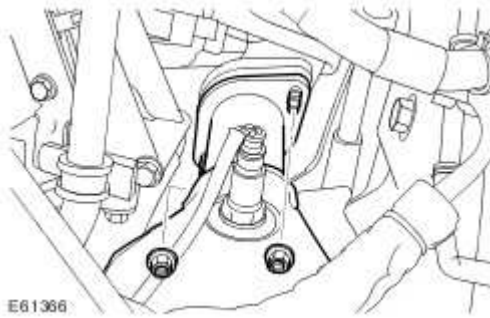
7 . Release and disconnect the 2 RH HO2S electrical connectors.

▶ Release the clip.



8 . Remove the LH catalytic converter.

► Remove and discard the 2 nuts.



9 . Remove the RH catalytic converter.

► Remove and discard the 2 nuts.



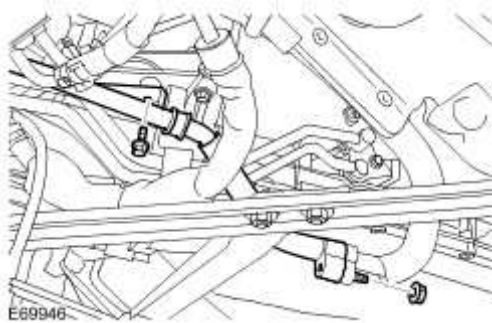
10



CAUTION: Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Remove the A/C pipe.

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



11 .



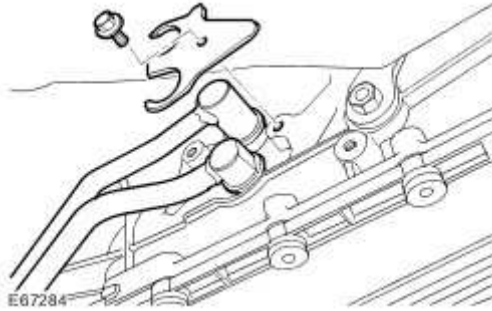
CAUTION: Always plug any open connections to prevent contamination.

NOTE:

Position cloth to collect fluid spillage.

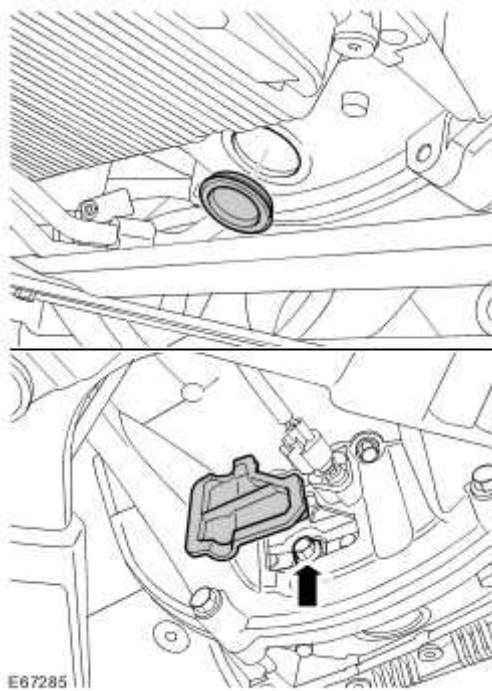
Release the transmission fluid lines.

- Remove the bolt.
- Remove and discard both O-ring seals.



12 . Release the flexplate.

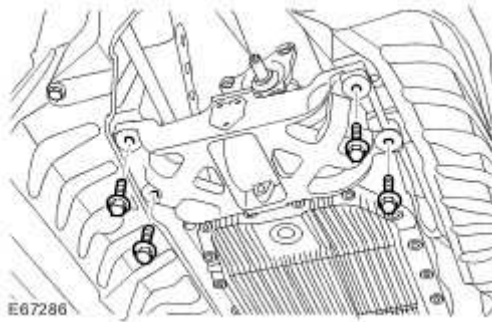
- ▶ Remove the access plugs.
- ▶ Rotate the crankshaft to access the retaining bolts.
- ▶ Remove the 3 bolts.



13 . Using a transmission jack, support the transmission.

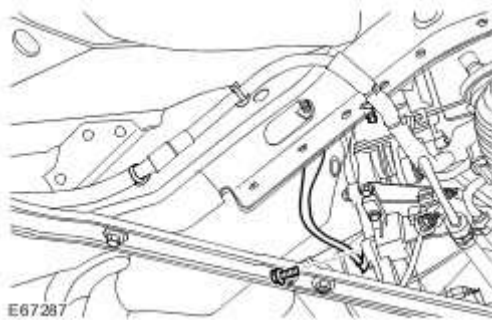
14 . Release the transmission support insulator.

▶ Remove the 4 bolts.



15 . Release the engine ground cable.

▶ Remove the bolt.



16



WARNING: Secure the transmission to the transmission jack.



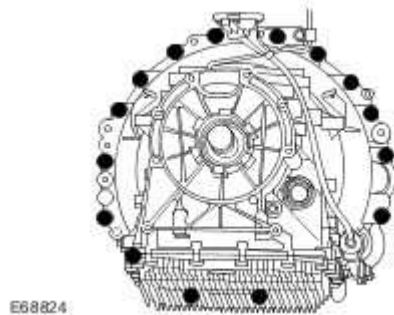
WARNING: Support the engine. The engine will fall forward when the transmission is removed.



CAUTION: Make sure the torque converter remains connected to the transmission.

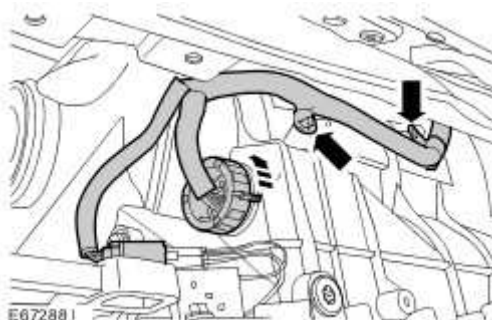
With assistance, release the transmission.

- ▶ Remove the 15 bolts.



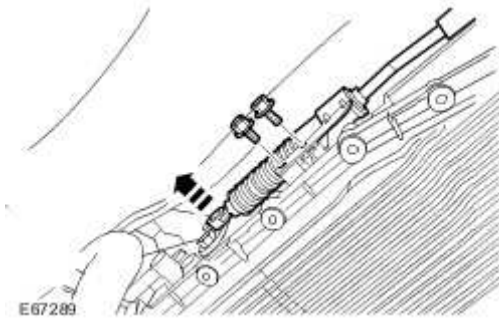
17 . Release the wiring harness from the RH side of the transmission.

- ▶ Disconnect the 2 electrical connectors.
- ▶ Carefully release the 2 clips.



18 . Release the selector cable.

- ▶ Release the clip.
- ▶ Remove the 2 bolts.



19 . Install the torque converter retainer.

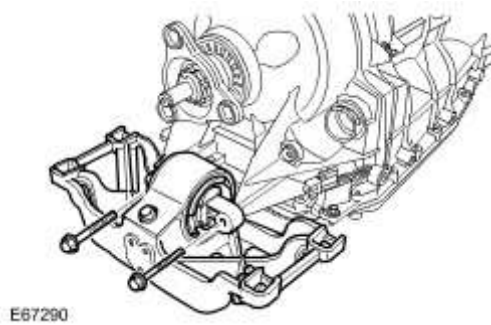
20 . **NOTE:**

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

Remove the transmission from the transmission jack.

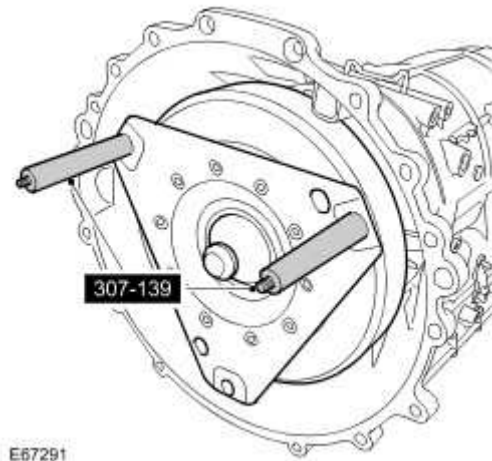
21 . Remove the transmission support insulator.

▶ Remove the 2 bolts.



22 . Remove the torque converter retainer.

23 . Using the special tools, remove the torque converter.



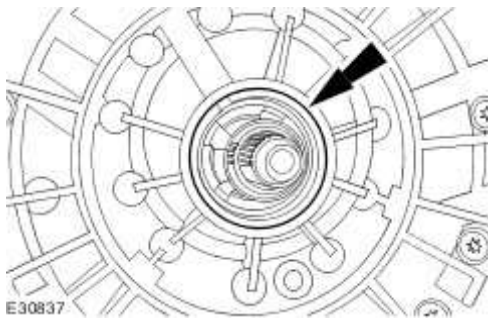
E67291

24



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

Carefully remove and discard the torque converter fluid seal.

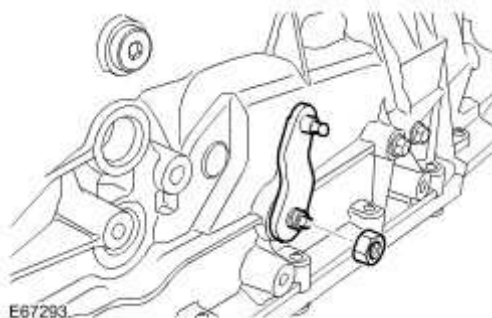


E30837

25 . Remove the selector lever.



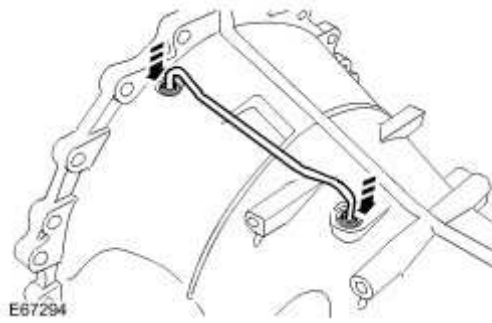
Remove the nut.



E67293

26 . Remove the transmission breather line.

▶ Carefully release the 2 clips.



Transmission (44.20.01)

Special Service Tools



Torque converter seal installer
308-246



Torque converter handles
307-139

Installation

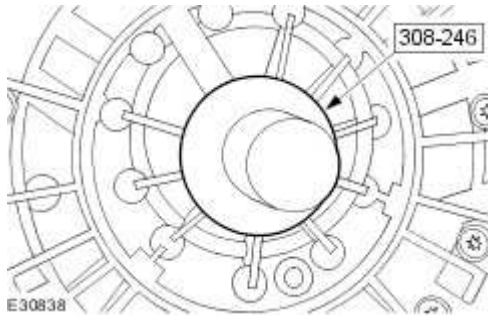
1 . Attach the transmission breather line.

2 . Attach the selector lever.

▶ Tighten the nut to 12 Nm (9 lb.ft).

3 . Using the special tool, install a new torque converter fluid seal.

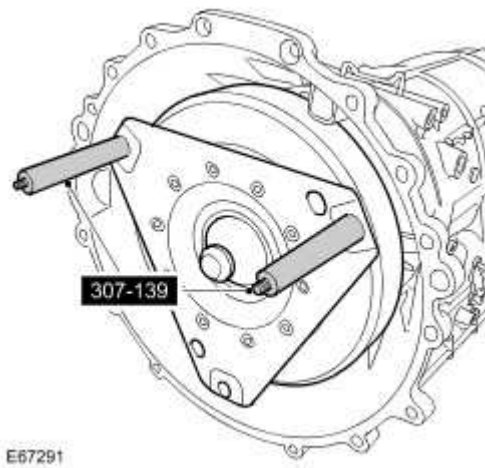
▶ Clean the seal register.



4 . Install the torque converter.

▶ Clean the seal contact area.

▶ Remove the special tools.



5 . Install the torque converter retainer.

6 . Install the transmission support insulator.

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

7 .



WARNING: Secure the transmission to the transmission jack.

Position the transmission to the transmission jack.

8 . Remove the torque converter retainer.

9 .  **CAUTION: Apply grease of the correct specification to the torque converter spigot.**

With assistance, install the transmission.

▶ Clean the component mating faces.

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

10 . Install the ground cable.

▶ Tighten the bolt to 45 Nm (33 lb.ft).

11 . Secure the transmission support insulator.

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

12 . Attach the wiring harness.

▶ Tighten the Torx screws.

▶ Connect the electrical connector.

13 . **NOTE:**

Do not fully tighten the locking nut at this stage.

Connect the selector cable to the transmission.

 Tighten the bolts to 6 Nm (4 lb.ft).

 Secure in the clip.

14 . 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 access plugs.

15 . Attach the transmission fluid lines.

 Clean the components.

 Install the new O-ring seals.

 Secure with the clip.

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

16 . Install the 2 transmission heat shields.

 Tighten the bolts to 6 Nm (4 lb.ft).

17 . Install the RH catalytic converter.

 Install and lightly tighten the nuts.

18 . Install the LH catalytic converter.

 Install and lightly tighten the nuts.

19 . Connect and secure the HO2S electrical connectors.

 Secure the 2 clips.

20 Install the driveshaft.

. For additional information, refer to Driveshaft - 4.2L NA V8 - AJV8/4.2L SC V8 - AJV8 (47.15.01)

21 . Tighten the catalytic converter to exhaust manifold clamps to 40 Nm (30 lb.ft).

22 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

23 . Check and top-up the transmission fluid level.

For additional information, refer to Transmission Fluid Level Check

24 . Fill the A/C system.

Extension Housing Seal (44.20.18)

Special Service Tools



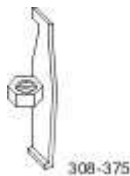
303D121

Crankshaft damper remover
303-D121



205053

Output shaft flange holding tool
205-053



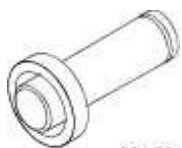
308-375

Seal remover input and output
308-375



100012

Slide hammer
100-012



204-264

Pinion seal replacer
204-264



Slide hammer adaptor
100-012-01



Transmission output flange socket
205-789

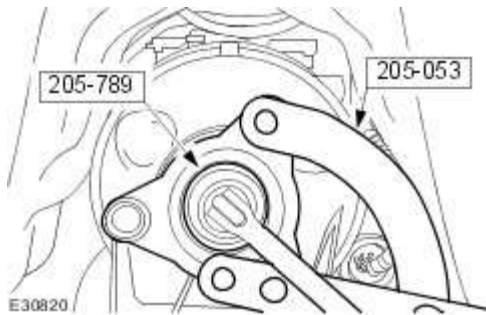
Removal

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

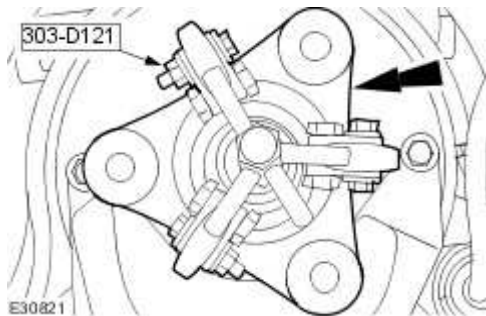
Raise and support the vehicle.

- 2 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to
- 3 Remove the driveshaft.
 - . For additional information, refer to Driveshaft - 4.2L NA V8 - AJV8/4.2L SC V8 - AJV8 (47.15.01)
- 4 . Release the transmission support insulator.
- 5 . Using the special tool, to hold the output flange, remove the retaining nut.

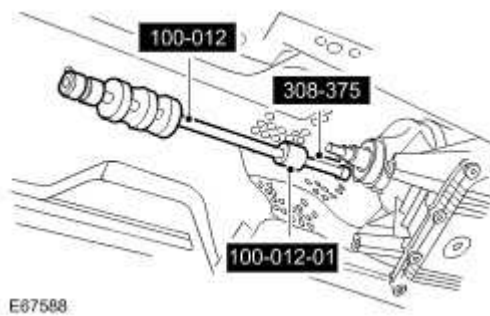
► Discard the nut.



6 . Using the special tool, remove the output flange.



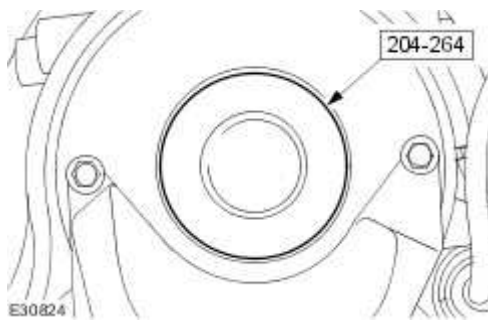
7 . Using the special tools, remove the extension housing seal.



Installation

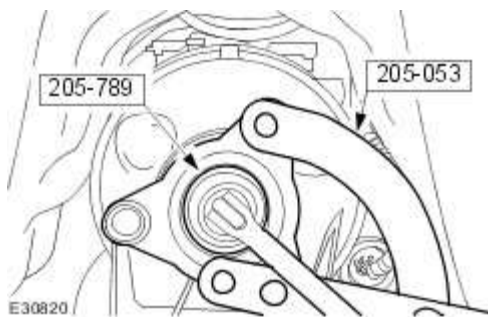
1 . Using the special tool, install a new extension housing seal.

► Clean the component mating faces.



2 . Using the special tools, install the output flange.

▶ Tighten the new nut to 60 Nm (44 lb.ft).



3 Install the driveshaft.

- . For additional information, refer to Driveshaft - 4.2L NA V8 - AJV8/4.2L SC V8 - AJV8 (47.15.01)

4 . Connect the battery ground cable and install the cover.

For additional information, refer to

5 . Install the transmission support insulator.

Transmission Fluid Pan, Gasket and Filter (44.24.07)

Removal

- 1 . Disconnect the battery ground cable.

For additional information, refer to 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 transmission.

For additional information, refer to Transmission Fluid Drain and Refill (44.24.02)

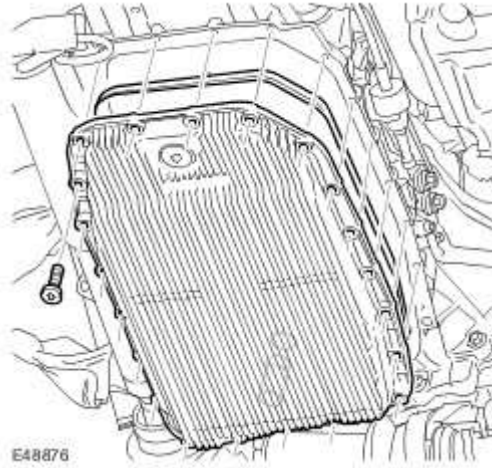
- 4 . Remove the fluid pan.

▶ Position a container to collect the fluid spillage.

▶ Remove the 21 Torx screws.

▶ Remove and if necessary, discard the seal.

▶ Discard the O-ring seal.



Installation

1 . Install the fluid pan.

- Clean the components.
- Install the seal.
- Install a new O-ring seal.
- Tighten the Torx screws to 8 Nm (6 lb.ft).

2 . Connect the battery ground cable.

For additional information, refer to Specifications

3 . Refill the transmission with fluid.

For additional information, refer to Transmission Fluid Drain and Refill (44.24.02)

Transmission Control Module (TCM) and Main Control Valve Body

Removal

NOTE:

The transmission control module (TCM) is part of the main control valve body and cannot be serviced separately.

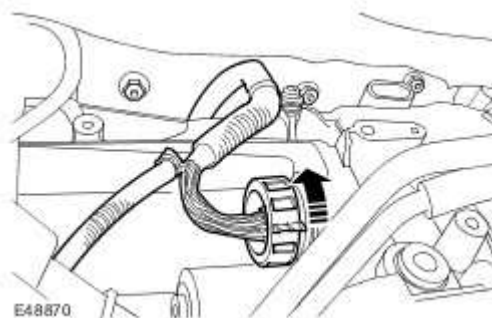
- 1 . Disconnect the battery ground cable.
For additional information, refer to Specifications

- 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.

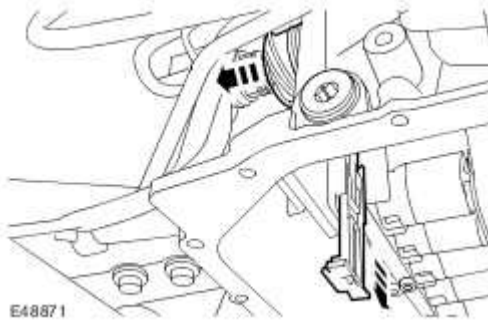
- 3 . Remove the fluid pan.
For additional information, refer to Transmission Fluid Pan, Gasket and Filter (44.24.07)

- 4 . Disconnect the electrical connector.



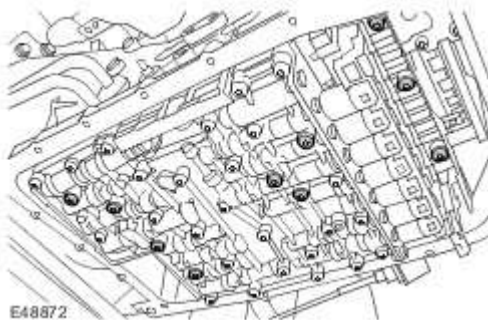
- 5 . Remove and discard the electrical connector sleeve.

- ▶ Release the retainer.

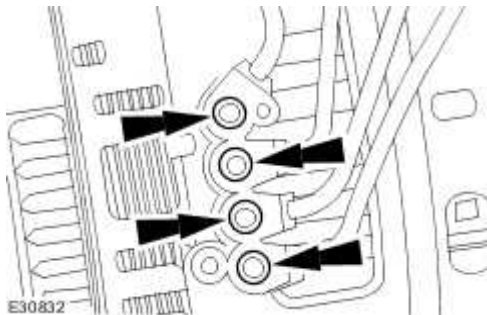


- 6 . Remove the TCM and valve body.

- ▶ Position a container to collect spillage.
- ▶ Remove the 10 Torx screws.



- 7 . Remove and discard the 4 O-ring seals.



- 8 . Remove the seal block.



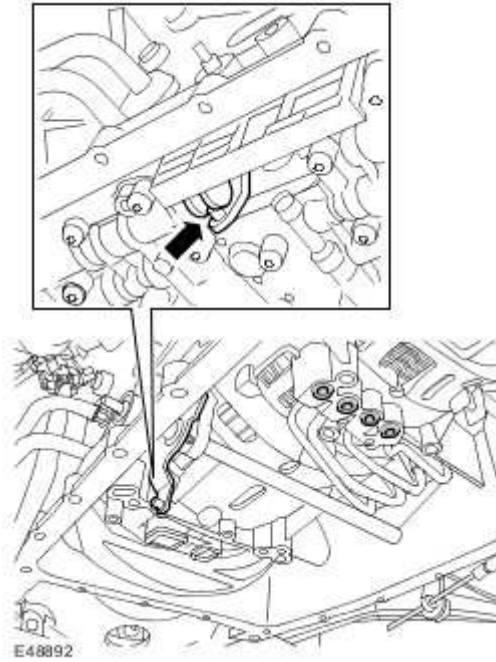
Installation

1.  **CAUTION:** Make sure that when fully fitted, all seals protrude by the same amount.

 **CAUTION:** Engage the selector lever with the groove in the piston rod.

Install the valve body.

- ▶ Clean the component mating faces.
- ▶ Install new seals.
- ▶ Install a new seal block.
- ▶ Tighten the Torx screws to 8 Nm (6 lb.ft).



2 . Install a new electrical connector sleeve.

➤ Secure with retainer.

3 . Connect the electrical connector.

4 . Install the fluid pan.

For additional information, refer to Transmission Fluid Pan, Gasket and Filter (44.24.07)

5 . Connect the battery ground cable.

For additional information, refer to Specifications

6 . Using WDS, calibrate a new TCM and valve body.

Transmission Support Insulator (12.45.04)

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.

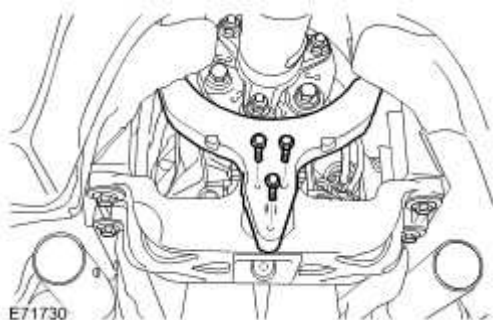
- 2 . Remove the exhaust system.
For additional information, refer to Exhaust System

- 3  **CAUTION:** During this procedure the transmission crossmember is removed, make sure the transmission is correctly supported to avoid damaging associated components.

Using a transmission jack, support the transmission.

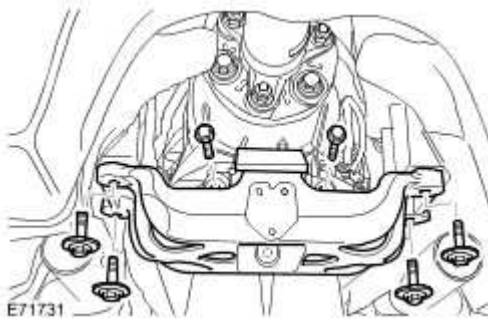
- 4 . Remove the transmission support crossmember damper.

➤ Remove the 3 bolts.



- 5 . Remove the transmission support crossmember.

➤ Remove the 6 bolts.



6 . NOTE:

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

Remove the transmission support insulator.

▶ Remove the 2 bolts.



Installation

1 . Install the transmission support insulator.

▶ Tighten the bolts to 25 Nm (18 lb.ft).

2 . Install the transmission support crossmember.

▶ Tighten the bolts to 48 Nm (35 lb.ft).

3 . Install the transmission support crossmember damper.

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

4 . Remove the transmission jack.

5 . Install the exhaust system.

For additional information, refer to Exhaust System

Selector Shaft Seal

Special Service Tools



Seal extractor

307-509-1(LRT-44-033/1)



Seal extractor

307-509-2(LRT-44-033/2)



Seal installer

307-509-3(LRT-44-033/3)

Removal

- 1 . Remove the cover and disconnect the battery ground cable.

For additional information, refer to Specifications

2



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

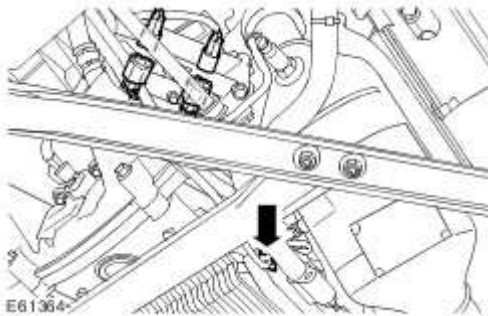
Raise and support the vehicle.

3 . Remove the exhaust system.

For additional information, refer to Exhaust System

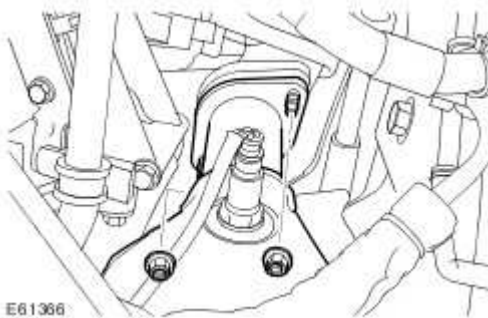
4 . Release and disconnect the 2 LH HO2S electrical connectors.

▶ Release the clip.



5 . Remove the LH catalytic converter.

▶ Remove and discard the 2 nuts.



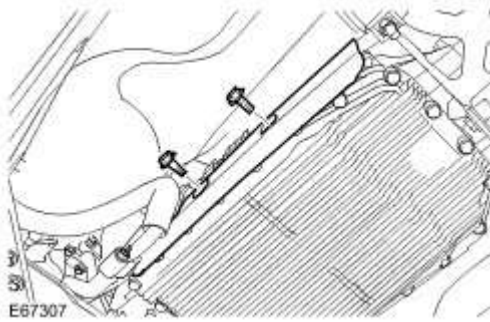
6 . Remove the LH catalyst heat shield.

▶ Remove the 2 bolts.

▶ Remove the nut.

7 . Remove the transmission casing LH heat shield.

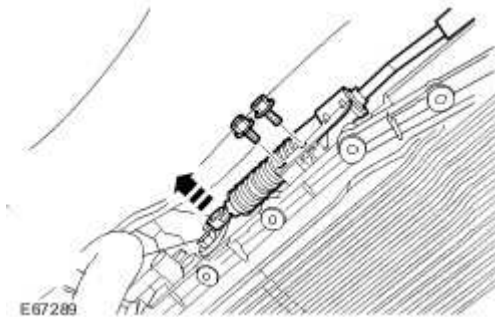
▶ Remove the 2 bolts.



8 . Release the selector cable.

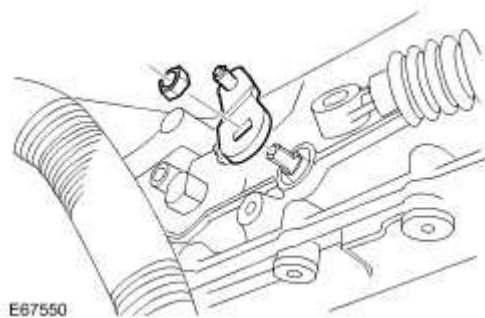
▶ Release the clip.

▶ Remove the 2 bolts.



9 . Remove the selector lever.

▶ Remove the nut.



10



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 selector shaft seal.

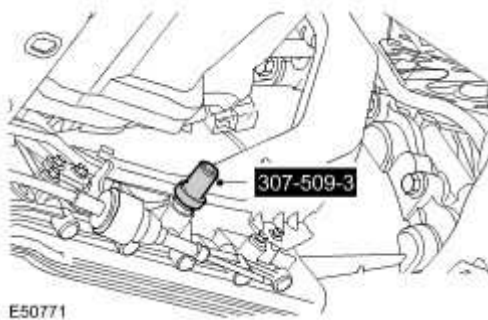
- ▶ Install 307-509-1 to the seal.
- ▶ Install 307-509-2 to 307-509-1 and extract the seal.



Installation

- 1 . Using 307-509-3, install the selector shaft seal.

- ▶ Clean the components.



- 2 . Install the selector lever.

 Tighten the nut to 12 Nm (9 lb.ft).

3 . Install the selector cable.

 Secure with the clip.

 Tighten the bolts to 6 Nm (4 lb.ft).

4 . Install the transmission heat shield.

 Tighten the bolts to 6 Nm (4 lb.ft).

5 . Install the LH catalyst heat shield.

 Install the nut and two bolts and tighten to 10 Nm (7 lb.ft).

6 . Install the LH catalytic converter.

 Install and lightly tighten the nuts.

7 . Connect and secure the HO2S electrical connectors.

 Carefully secure the clips.

8 . Install the exhaust system.

For additional information, refer to Exhaust System

9 . Tighten the catalytic converter to exhaust manifold clamps to 40 Nm (30 lb.ft).

10 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

307-02 : Transmission/Transaxle Cooling

Specifications

Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Fluid cooler tubes to radiator - union nuts	20	15	-
Fluid cooler tubes to transmission - bolt	23	17	-
Fluid cooler tubes support bracket - nut	10	7	88

Transmission Cooling



E66330

Item	Part Number	Description
1		Engine cooling radiator
2		Return pipe (to transmission)
3		Feed pipe (from transmission)

INTRODUCTION

The transmission cooler is integrated into the left hand end tank of the engine cooling radiator. The transmission fluid is cooled by the temperature differential between the transmission fluid and the engine coolant.

The fluid cooler is an aluminium cooler comprising louvred fins and plates. The plates allow a cross-flow of transmission fluid through the cooler. The fins are immersed in engine coolant on the 'cold' side of the radiator which provides cooling of the transmission fluid via heat transfer.

This fluid cooler design provides an advantage over an air-cooled cooler in that the fluid cooling is controlled with engine coolant temperature. Fluid temperature control is also improved when the vehicle is moving slowly or is stationary with the engine running.

Fluid is supplied from the transmission fluid pump into the lower connection of the cooler. After passing through the cooler, the fluid passes out of the upper connection and is returned to transmission fluid pan.

Transmission Cooling

Principle of Operation

For a detailed description of the automatic transmission cooling system, refer to the relevant Description and Operation section in the workshop manual.

Transmission Cooling

Inspection and Verification

- 1 . Verify the customer concern by operating the system.
- 2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical
• Feed and return tubes • Connections to the automatic transmission and the automatic transmission fluid cooler • Automatic transmission fluid level

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 concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

Condition	Possible Cause	Action
Over heating of the automatic transmission	Obstruction in the automatic transmission fluid cooler	• Flush out the automatic transmission fluid cooler with new automatic transmission fluid • If the flushing is unsuccessful, install a new radiator. Radiator - Vehicles Without: Supercharger (26.40.01)
Over heating of the automatic transmission	Obstruction in the automatic transmission fluid tubes	• Flush out the automatic transmission fluid cooler tubes with new automatic transmission fluid • If the flushing is unsuccessful install new automatic transmission fluid cooler tubes.

Loss of automatic transmission fluid	Connections to the automatic transmission and the automatic transmission fluid cooler	• Check the integrity of tubes, connections and seals • Check the torque of the tube fixings. Specifications
Loss of automatic transmission fluid	Leak at oil cooler	• Check the integrity of tubes, connections and seals • Check the torque of the tube fixings. Specifications • Check for automatic transmission fluid contamination of the engine coolant. INSTALL new radiator as necessary. Radiator - Vehicles Without: Supercharger (26.40.01)

307-05 : Automatic Transmission/Transaxle External Controls

Specifications

Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Paddle switch to steering wheel - bolt	3	2	27
Selector lever to floor console bracket - screw	7	5	62
Selector lever, cable bracket to transmission - bolt	8	6	71
Selector cable to selector lever abutment bracket - adjustment nut	23	17	-

Selector Lever Cable Adjustment (44.15.07)

1. Remove the rear seat armrest.

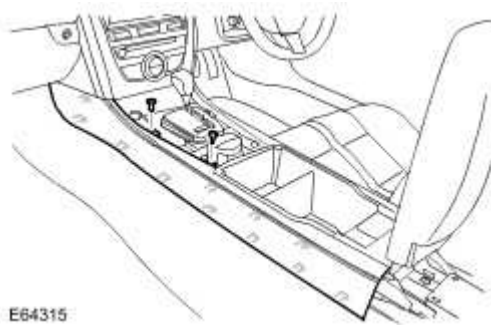
Rear Seat Armrest (76.70.39)

2. Remove the floor console veneer trim panel.

Floor Console Finish Panel (76.47.26)

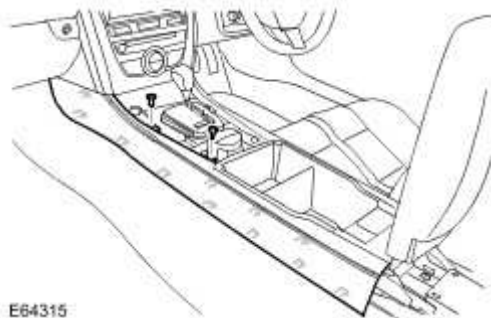
3. Remove the floor console rear panel.

- Carefully release the 2 clips.



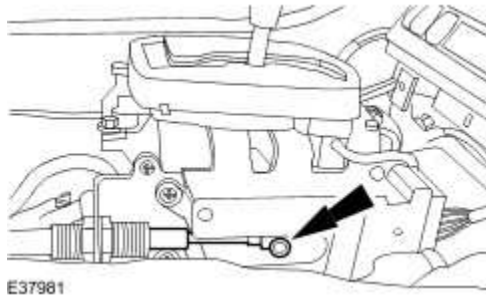
4. Remove the floor console side panel trim.

- Remove the 2 Torx bolts.
- Carefully release 11 clips.
- Repeat the procedure and remove the opposite hand.



5. Carefully disconnect the selector cable ball joint.

- Apply gentle pressure.

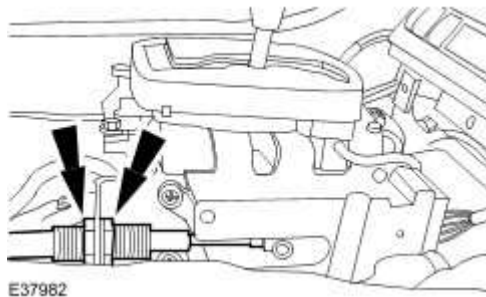


6. **NOTE:**

Use an additional wrench to prevent the component from rotating.

Release the gear selector cable at the abutment.

- Loosen the 2 locknuts.

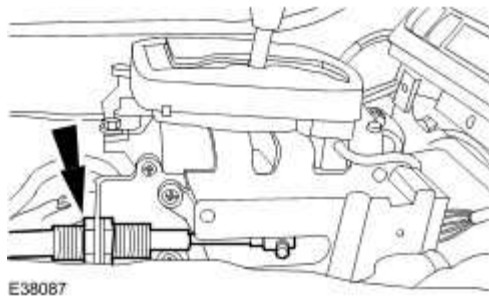


7. Fully extend the inner cable while supporting the outer, then retract the inner cable one detent.

8. Using the transmission selector lever, position to the REVERSE detent.

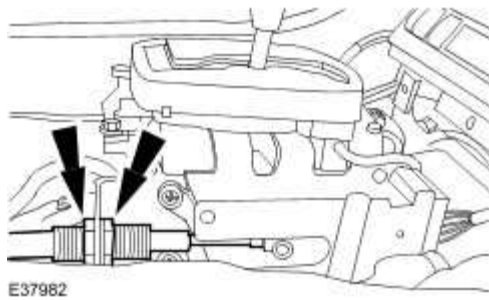
9. Install the gear selector cable to the floor console abutment.

- Position and lightly tighten the adjusting nuts.



10. Connect the selector cable ball joint.

- Adjust the cable, until the ball joint socket aligns with the ball, on the transmission selector lever.



11. **NOTE:**

Use an additional wrench to prevent the component from rotating.

Check the operation of the transmission selector lever through the gate and detents.

- If the adjustment is correct, tighten the locknuts to 20 Nm (14 lb.ft).

12. Install the floor console side panel trim.

- Carefully align and secure the clips.
- Tighten the Torx screws to 6 Nm (4 lb.ft).
- Install the opposite hand.

13. Install the floor console rear panel.

- Align the lugs and secure the clips.

14. Install the floor console veneer trim panel.

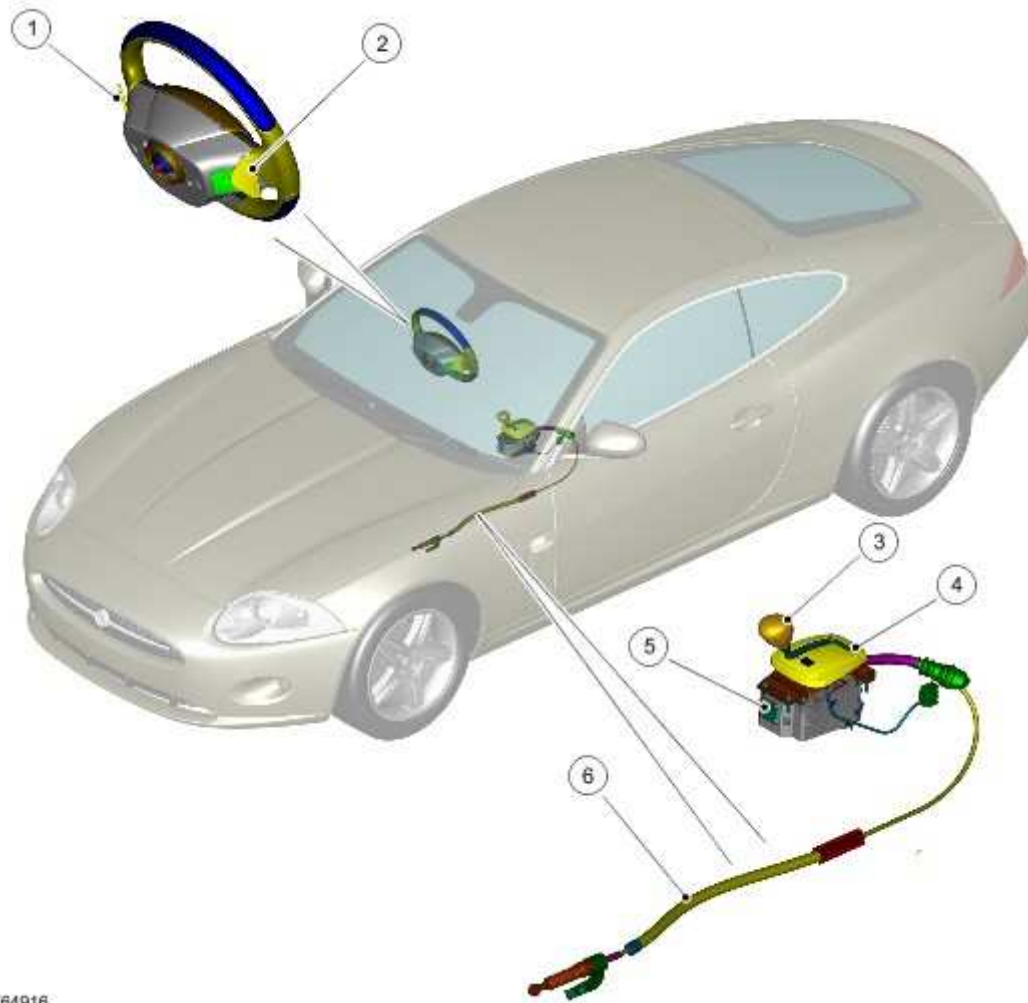
Floor Console Finish Panel (76.47.26)

15. Install the rear seat armrest.

Rear Seat Armrest (76.70.39)

External Controls

COMPONENT LOCATION



Item	Part Number	Description
1		Right Hand (RH) + gear change upshift paddle switch
2		Left Hand (LH) - gear change downshift paddle switch
3		Selector lever and gear knob
4		'L' gate
5		Selector lever mechanism assembly
6		Selector cable

INTRODUCTION

The Transmission Control Module (TCM) contains software to provide operation as a semi-automatic 'Jaguar Sequential Shift' transmission.

The TCM allows the transmission to be operated as a conventional automatic unit by selecting P, R, N, D on the selector lever. In this mode, the selector lever is linked, via the selector cable, to the transmission to provide a mechanical interface.

Movement of the selector lever across the 'L' gate to the 'S' position is sensed by a Hall effect proximity sensor located within the selector mechanism assembly, and puts the transmission into electronic 'Sport' mode.

Two gear change 'paddle' switches are fitted at the rear of the steering wheel and allow the driver to operate the transmission as a semi-automatic manual gearbox using the Jaguar Sequential Shift feature.

Selector Lever

9		Sliding block
10		Selector cable
11		Rotation bracket
12		Housing
13		Rocker
14		'L' gate chrome finisher
15		Selector Printed Circuit Board (PCB)
16		Solenoid interlock lever
17		Selector interlock lever

The transmission selector assembly is located in a central position in the floor console. The assembly is attached to a moulding in the floor console with four screws.

A park switch is located to the right of the lever and is operated when the lever is moved to the 'P' Park position. The lever is located in a slot in a rotary disc. The disc rotates with movement of the lever in the forward or back directions. The disk movement is detected by Hall sensors located on the selector PCB which correspond with the different selector positions.

Movement of the selector lever is passed to the transmission Mechatronic valve block via a lever located on the side of the transmission casing. The lever, in turn, moves a manually operated selector valve within the transmission valve block.

An interlock solenoid is located in the selector lever assembly. When energized, the solenoid engages an interlock lever preventing the selector lever from being moved. When the footbrake is applied, a signal from the brake switch de-energises the solenoid allowing the selector lever to be moved from the 'P' or 'N' position. This prevents the selector from being moved to the 'D' or 'R' position unintentionally and the application of the brakes also prevents the vehicle 'creeping' when the gear is engaged.

If electrical power to the selector lever is lost, the selector lever will be locked in the 'N' or 'P' position by the shift interlock solenoid if moved from the 'D' position. The selector lever will remain locked until electrical power to the selector lever is restored. There is no emergency interlock solenoid release mechanism on the selector lever.

Selections made using the selector lever are passed to the TCM in high speed Controller Area Network (CAN) bus messages. The park switch is hardwired to the instrument cluster and the Central Junction Box (CJB).

Paddle Switches

Each paddle switch has 3 connections; ground, illumination Pulse Width Modulation (PWM) supply and switch signal.

Pulling the LH downshift paddle (-) provides down changes and pulling the RH upshift (+) paddle provides up changes. The first operation of either paddle, after Sport mode is selected, puts the transmission into permanent manual 'Jaguar Sequential Shift' mode. Movement of the

selector lever back to the 'D' position, returns the transmission to conventional automatic operation. To reselect Sport mode from Manual mode, the selector lever must be first moved to the 'D' position and then returned to the 'S' position.

Temporary operation of manual mode can also be operated with the selector lever in the 'D' position. Operation of either the upshift or downshift paddles activates the manual mode operation. The current selected gear will displayed in the instrument cluster message center. If continued use of manual mode is required, move the selector lever to the 'S' position.

With the selector lever in the 'D' position, temporary manual mode will be maintained whilst the driver is accelerating, decelerating, cornering or continuing to request shifts via the paddles. The transmission will revert to automatic operation after a short period of driving at steady speed. Alternatively the RH upshift (+) paddle may be held for approximately one second to return directly to automatic operation in 'D'.

PRINCIPLES OF OPERATION

Selector Lever

The selector lever is located in a slot in the rotary disc which rotates with movement of the lever in the forward or back directions. The disc movement positions magnets located on the disc which are detected by Hall sensors located on the selector PCB which correspond with the different selector positions. The Hall sensors produce a signal relative to the lever position which is passed as a high speed CAN bus message to other system modules.

Paddle Switches

When the switch is operated, a ground for the switch contacts is completed via a resistor. The completed ground signal is passed via a hardwired connection to the steering wheel module. The module converts the switch signal into a Local Interconnect Network (LIN) bus message which in turn is passed to the instrument cluster, via the steering wheel clockspring. The instrument cluster converts the LIN message into a high speed CAN bus message which is broadcast to the TCM and other system modules.

External Controls

Principle of Operation

For a detailed description of the automatic transmission controls, refer to the relevant Description and Operation section in the workshop manual.

External Controls

Inspection and Verification

- 1 . Verify the customer concern.
- 2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
• Check for correct gear selector lever cable adjustment. Selector Lever Cable Adjustment (44.15.07) • Visibly damaged or worn components. • Loose or missing fasteners.	• Fuse(s). • Loose or corroded electrical connector(s).

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, verify the symptom and refer to the manufacturer approved diagnostic system, or pinpoint tests below.

Pinpoint Tests

PINPOINT TEST G561950p1 : GEAR SELECTOR LEVER ASSEMBLY CIRCUIT CHECKS

G561950t1 : CHECK FOR IGNITION SUPPLY TO THE GEAR SELECTOR LEVER ASSEMBLY

1. Disconnect the gear selector lever assembly electrical connector IP027. 2. Set the ignition status to ON, engine OFF. 3. Measure the voltage at IP027 Pin 1.

- Is the voltage greater than 10 Volts?

-> **Yes**

GO to Pinpoint Test G561950t2.

-> **No**

Repair the electrical circuit between the gear selector lever assembly electrical connector IP027 Pin 1 and the Central Junction Box (CJB). For additional information, refer to the electrical circuit diagrams. TEST the system for normal operation.

G561950t2 : CHECK THE GROUND SUPPLY TO THE GEAR SELECTOR LEVER ASSEMBLY

1. Set the ignition status to OFF. 2. Measure the resistance between the gear selector lever assembly electrical connector IP027 Pin 2 and GROUND.

- **Is the resistance less than 5 Ohms?**

-> **Yes**

GO to Pinpoint Test G561950t3.

-> **No**

Repair the circuit between the gear selector lever assembly electrical connector IP027 Pin 2 and GROUND. For additional information, refer to the electrical circuit diagrams. TEST the system for normal operation.

G561950t3 : CHECK FOR IGNITION SUPPLY TO THE PARK POSITION SWITCH

1. Set the ignition status to ON, engine OFF 2. Measure the voltage at IP027 Pin 4.

- **Is the voltage greater than 10 Volts?**

-> **Yes**

No fault has been identified with the gear selector lever assembly circuits. Check all connections for damaged and corroded pins. Check CAN network using manufacturer approved diagnostic system. TEST the system for normal operation.

-> **No**

Repair the electrical circuit between the gear selector lever assembly electrical connector IP027 Pin 4 and the Central Junction Box (CJB). For additional information, refer to the electrical circuit diagrams. TEST the system for normal operation.

PINPOINT TEST G561950p2 : GEAR SELECTOR PADDLE SWITCH TESTS

G561950t4 : GEAR SELECTOR PADDLE SWITCH TESTS

1. Check steering wheel speed control switches are functioning correctly.

- **Are the steering wheel speed control switches functioning correctly?**

-> **Yes**

Refer to the electrical circuit diagrams and test circuit between gear selector paddle switches and steering wheel audio switch.

-> **No**

Check the TCM and Instrument Cluster for related DTCs and refer to relevant DTC Index. Check the steering wheel speed and audio control switch circuits.

Speed Control

Audio System Refer to the electrical circuit diagrams and test the LIN circuit between the steering wheel audio switch and the instrument cluster.

Downshift Paddle Switch

Removal

- 1 . Remove the paddle gear selector lever.
For additional information, refer to Upshift Paddle Switch

Installation

- 1 . To install, reverse the removal procedure.

Selector Lever Assembly (44.15.04)

Removal

- 1 . Remove the rear seat armrest.

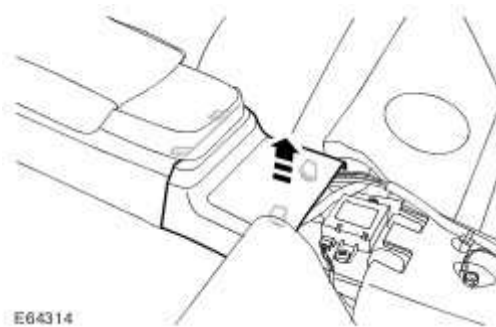
For additional information, refer to Rear Seat Armrest (76.70.39)

- 2 . Remove the floor console veneer trim panel.

For additional information, refer to Floor Console Finish Panel (76.47.26)

- 3 . Remove the floor console rear panel.

▶ Carefully release the 2 clips.

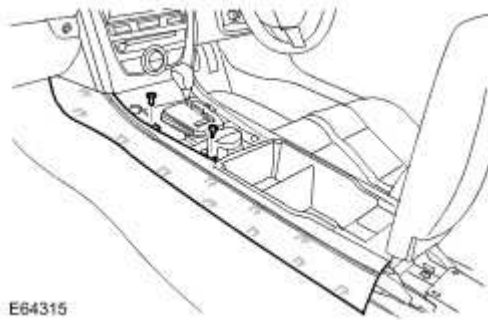


- 4 . Remove the floor console side panel trim.

▶ Remove the 2 Torx bolts.

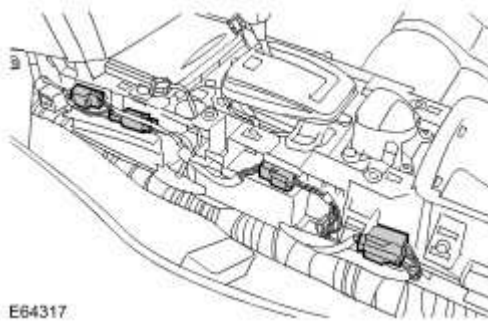
▶ Carefully release 11 clips.

▶ Repeat the procedure and remove the opposite hand.



5 . Release the LH side floor console electrical harness connector blocks.

▶ Carefully release the 4 clips.



6 . Disconnect the gear selector assembly electrical connector.

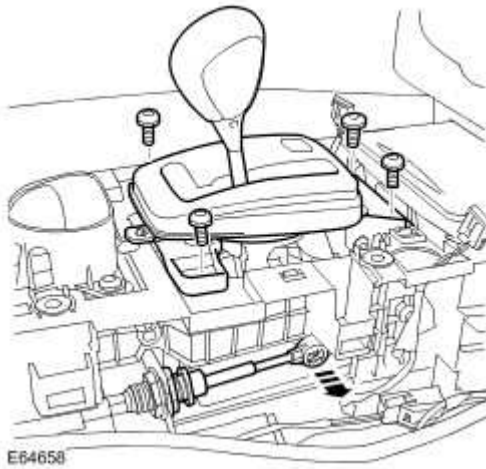


7 . Remove the gear selector assembly.

▶ Carefully disconnect the selector cable ball joint.

▶ Remove the 4 Torx bolts.

- ▶ Release the electrical harness.



Installation

- 1 . Install the gear selector assembly.

- ▶ Position the electrical harness.
- ▶ Install the Torx bolts and tighten to 6 Nm (4 lb.ft).
- ▶ Connect the selector cable ball joint.

- 2 . Connect the gear selector assembly electrical connector.

- 3 . Install the LH side floor console electrical harness connector blocks.

- ▶ Carefully align and secure the clips.

- 4 . Install the floor console side panel trim.

- ▶ Carefully align and secure the clips.
- ▶ Tighten the Torx screws to 6 Nm (4 lb.ft).

 Install the opposite hand.

5 . Install the floor console rear panel.

 Align the lugs and secure the clips.

6 . Install the floor console veneer trim panel.

For additional information, refer to Floor Console Finish Panel (76.47.26)

7 . Install the rear seat armrest.

For additional information, refer to Rear Seat Armrest (76.70.39)

Selector Lever Cable and Bracket (44.15.08)

Removal

- 1 . Remove the floor console.

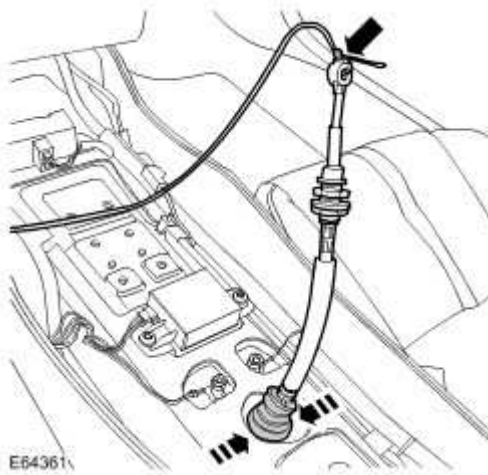
For additional information, refer to Floor Console (76.25.01)

2 . NOTE:

Connect a line to the transmission selector cable to aid installation.

Release the transmission selector lever cable.

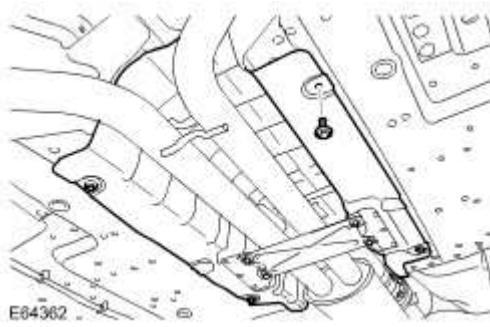
- ▶ Release the gaiter.
- ▶ Pass the gear selector cable through the vehicle floor.
- ▶ Tie the recovery line to the floor console ground nut.



- 3 . Raise and support the vehicle.

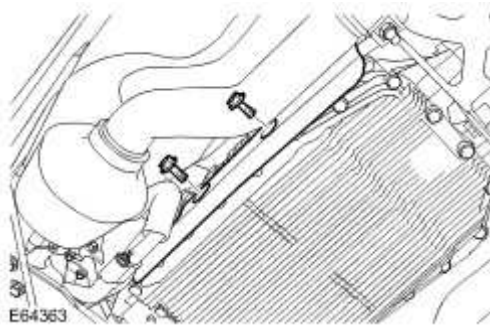
- 4 . Release the exhaust heat shield for access.

- ▶ Remove the 4 bolts.



5 . Position the LH side transmission casing heat shield aside.

➤ Remove the 2 bolts.



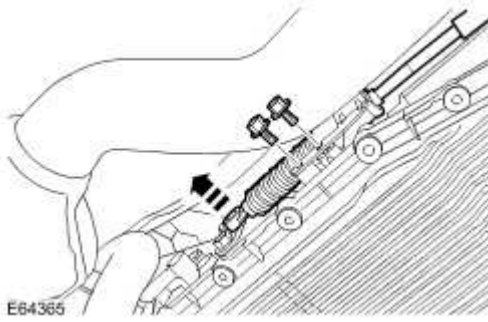
6 . Remove the selector cable and bracket.

➤ Carefully disconnect the selector cable ball joint.

➤ Remove the 2 bolts.

➤ Withdraw the cable.

➤ Disconnect the recovery line.



Installation

1 . Install the selector cable and bracket.

- ▶ Connect the recovery line to the transmission selector cable.
- ▶ Install the bolts and tighten to 10 Nm (7 lb.ft).
- ▶ Connect the selector cable ball joint.

2 . Install the LH side transmission casing heat shield.

- ▶ Install the bolts and tighten to 10 Nm (7 lb.ft).

3 . Install the exhaust heat shield.

- ▶ Install the bolts and tighten to 10 Nm (7 lb.ft).

4 . Install the transmission selector cable gaiter.

- ▶ Disconnect the recovery line.

5 . Install the floor console.

For additional information, refer to Floor Console (76.25.01)

Selector Lever Knob (44.15.06)

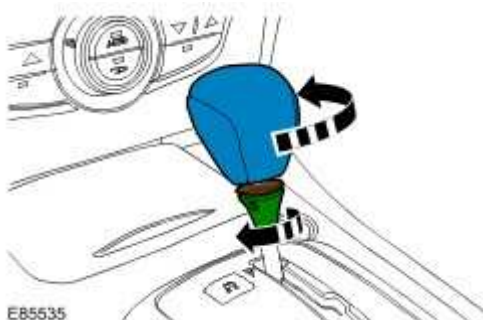
Removal

Vehicles without supercharger

- 1  **CAUTION:** Protect the surrounding trim from damage when changing the component.

Remove the selector lever knob.

- ▶ Carefully loosen the locking collar.
- ▶ Unscrew the knob.
- ▶ Remove the spacer.
- ▶ Remove the locking collar.



Vehicles with supercharger

- 2 . Remove the selector lever knob.



Installation

Vehicles with supercharger

1 . Install the selector lever knob.

- ▶ Clean the components.
- ▶ Apply threadlock if the selector lever knob is to be reused.

Vehicles without supercharger

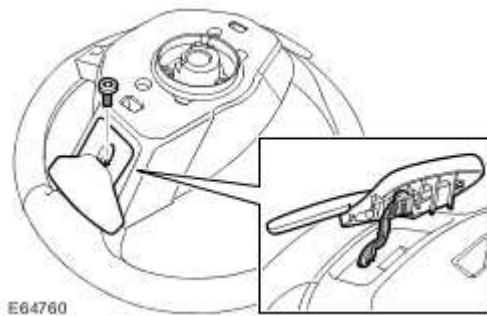
2 . Install the selector lever knob.

- ▶ Install the locking collar.
- ▶ Install the spacer.
- ▶ Align the knob and tighten the locking collar.

Upshift Paddle Switch

Removal

- 1 . Remove the paddle gear selector lever.
 - ▶ Remove the Torx bolt.
 - ▶ Release the assembly.
 - ▶ Disconnect the electrical connector.



Installation

- 1 . Install the paddle gear selector lever.
 - ▶ Connect and secure the electrical connector.
 - ▶ Tighten the Torx bolt to 3 Nm (2 lb.ft).

309 : Exhaust System

309-00 : Exhaust System

Specifications

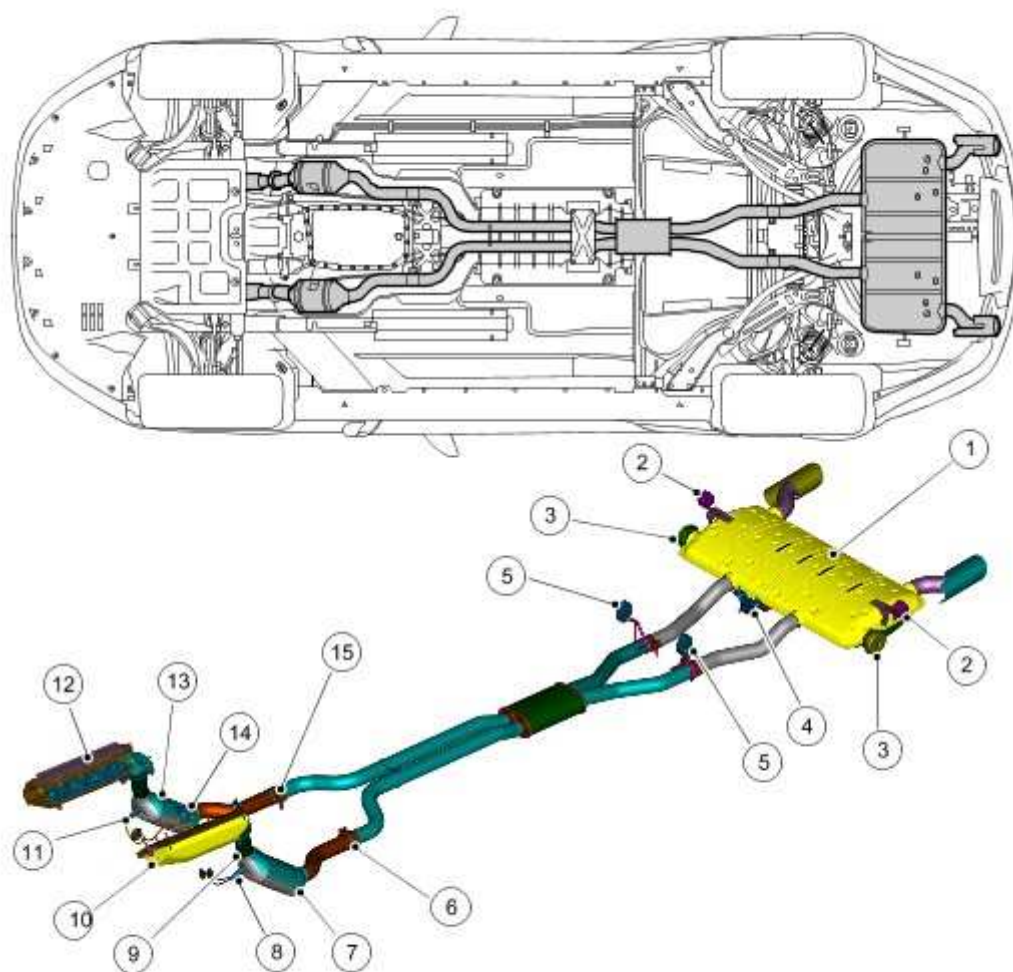
Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Catalytic converter to exhaust manifold - nut	40	30	-
Catalytic converter to exhaust manifold - stud	40	30	-
Catalytic converter to resonator pipe - clamp nut/bolt	50	37	-
Front muffler pipe to rear muffler pipe - clamp nut/bolt	50	37	-
Rear muffler front-hanger bracket to vehicle - bolt	25	18	-

Exhaust System - 4.2L NA V8 - AJV8

COMPONENT LOCATION



E62612

Item	Part Number	Description
1		Muffler
2		Mounting rubber
3		Semi Active Muffler (SAM) valve
4		Mounting rubber
5		Mounting rubber
6		LH front to rear section joint
7		LH catalyst

8		LH Down stream HO2S
9		LH Upstream HO2S
10		LH exhaust manifold
11		RH Upstream HO2S
12		RH exhaust manifold
13		RH catalyst
14		RH Downstream HO2S
15		RH front to rear section joint

INTRODUCTION

The 4.2L V8 exhaust system is fabricated from stainless steel and is supplied as four separate assemblies:

- A LH front section incorporating a catalytic converter
- A RH front section incorporating a catalytic converter
- A center section incorporating a silencer
- A rear section Including the main silencer box.

Each section of the exhaust system is available as a service replacement.

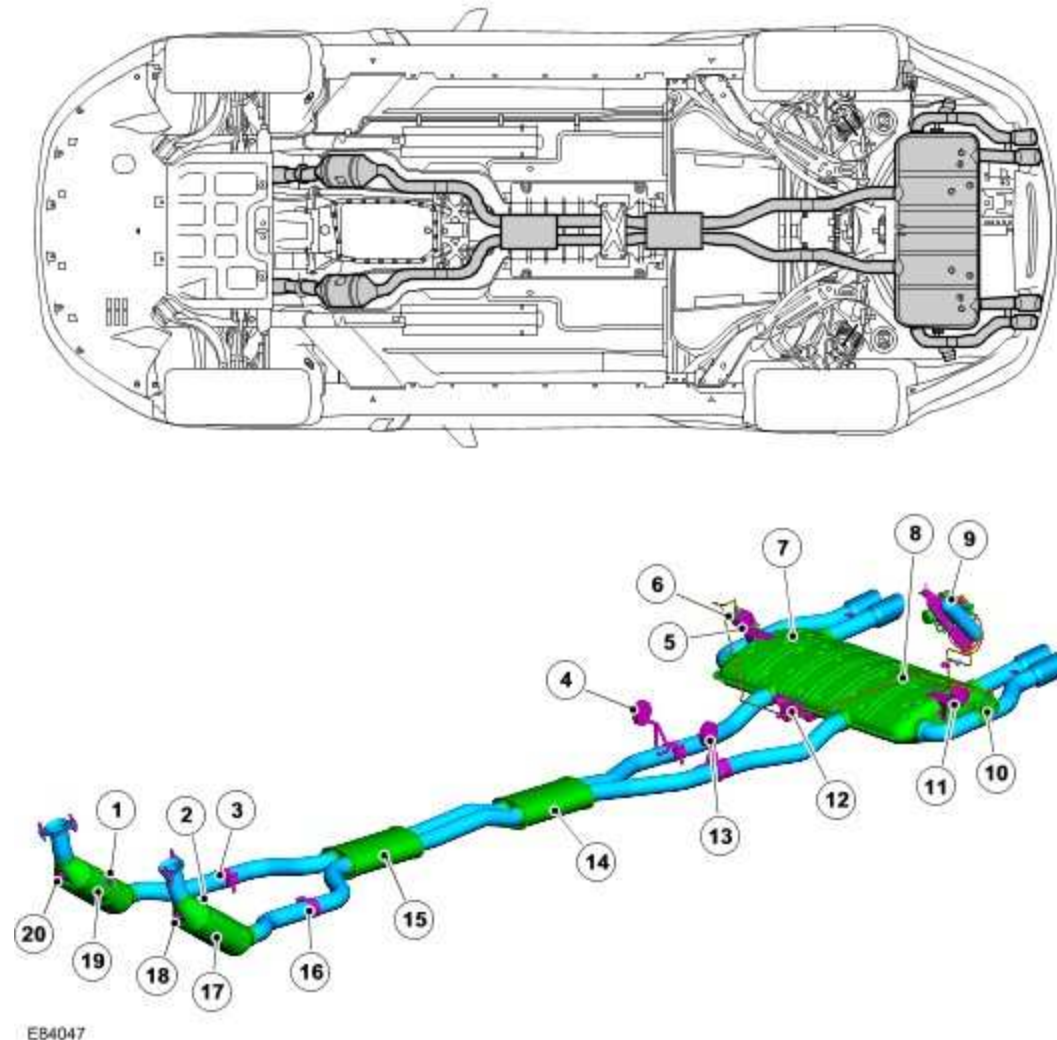
The exhaust system is attached to the underside of the body with five mounting rubbers, two on the center section and three on the rear muffler. The mounting rubbers attach to the exhaust system via stainless steel hangers and brackets. The mounting rubbers locate on corresponding hangers which are attached to the underside of the vehicle body. The system is routed along the center of the chassis before splitting near the rear differential prior to entering the main exhaust silencer at the rear of the vehicle.

To reduce the carbon monoxide and hydrocarbons content of the exhaust gases, a catalytic converter is integrated into each of the front pipes of the exhaust system.

The rear muffler unit includes a Semi Active Muffler (SAM) valve. This valve is operated by the pressure in the exhaust system. At low engine speed the valve is partially closed to provide a more refined noise quality. At higher engine speed the increased pressure within the exhaust system opens the valve to provide a more sporting noise. The SAM valve is non serviceable and the rear muffler is replaced as a complete assembly.

Exhaust System - 4.2L SC V8 - AJV8

COMPONENT LOCATION



Item	Part Number	Description
1		RH Post catalyst H02 sensor
2		LH Post catalyst H02 sensor
3		RH joint
4		RH rear hanger
5		RH muffler hanger bracket
6		RH active exhaust valve
7		Muffler
8		Vacuum control lines
9		Vacuum pump and reservoir
10		LH active exhaust valve

11		LH muffler hanger bracket
12		Muffler center hanger
13		LH rear hanger
14		Center silencer
15		Center silencer
16		LH joint
17		LH catalyst
18		LH pre catalyst H02 sensor
19		RH catalyst
20		RH Pre catalyst H02 sensor

OVERVIEW

The exhaust system is fabricated from stainless steel and is supplied as four separate assemblies:

- A LH front section incorporating a catalytic converter
- A RH front section incorporating a catalytic converter
- A center section incorporating 2 silencers
- A rear section including the main silencer box.

Each section of the exhaust system is available as a service replacement.

The exhaust system is attached to the underside of the body with five mounting rubbers, two on the center section and three on the rear muffler. The mounting rubbers attach to the exhaust system via stainless steel hangers and brackets. The mounting rubbers locate on corresponding hangers which are attached to the underside of the vehicle body. The system is routed along the center of the chassis before splitting near the rear differential prior to entering the main exhaust silencer at the rear of the vehicle.

To reduce the carbon monoxide and hydrocarbons content of the exhaust gases, a catalytic converter is integrated into each of the front pipes of the exhaust system.

ACTIVE EXHAUST SYSTEM

The rear muffler unit incorporates an active exhaust system. The active exhaust system is designed to give a more sporty sound and also reduces the back pressure in the exhaust system by opening a valve in the second exhaust outlet pipe.

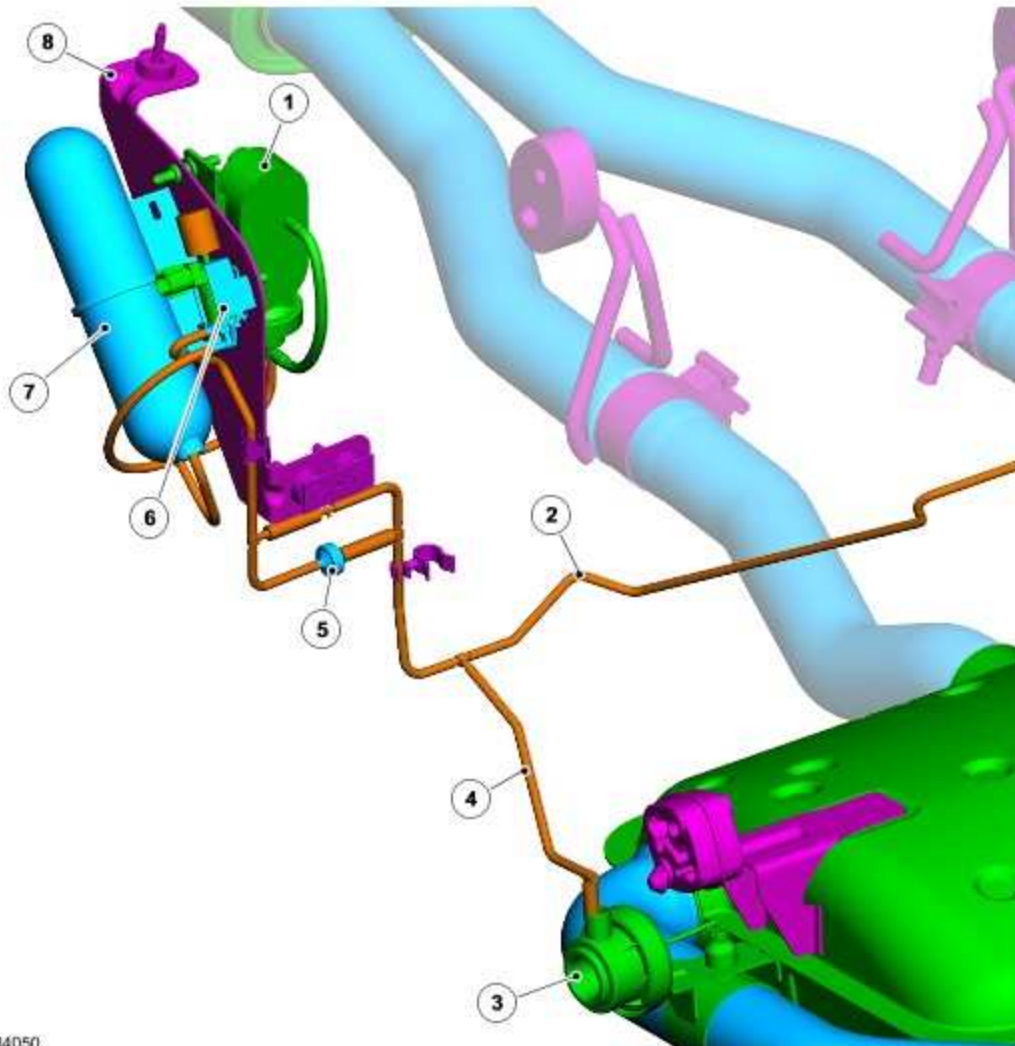
The active exhaust system is controlled by the ECM. The ECM controls a vacuum control valve which in turn applies a vacuum to the active exhaust valves. The vacuum system comprises:

- A vacuum reservoir
- A vacuum pump

- A control solenoid
- A Vacuum check/non return valve
- A vacuum restrictor valve located in the vacuum line just above the check valve

The vacuum restrictor valve allows air back into the vacuum lines to allow the active exhaust valves to open more slowly than they close.

Exhaust System Vacuum Control System



E84050

Item	Part Number	Description
1		Vacuum pump
2		Vacuum lines to RH active exhaust valve
3		Active exhaust valve
4		Vacuum lines to LH active exhaust valve
5		Vacuum check valve
6		Vacuum control valve
7		Vacuum reservoir

8		Mounting bracket

The active exhaust valves are opened in response to engine speed and throttle angle. At startup the valve is always opened to give an enhanced sound. The following table details when the valves are open and when they are closed.

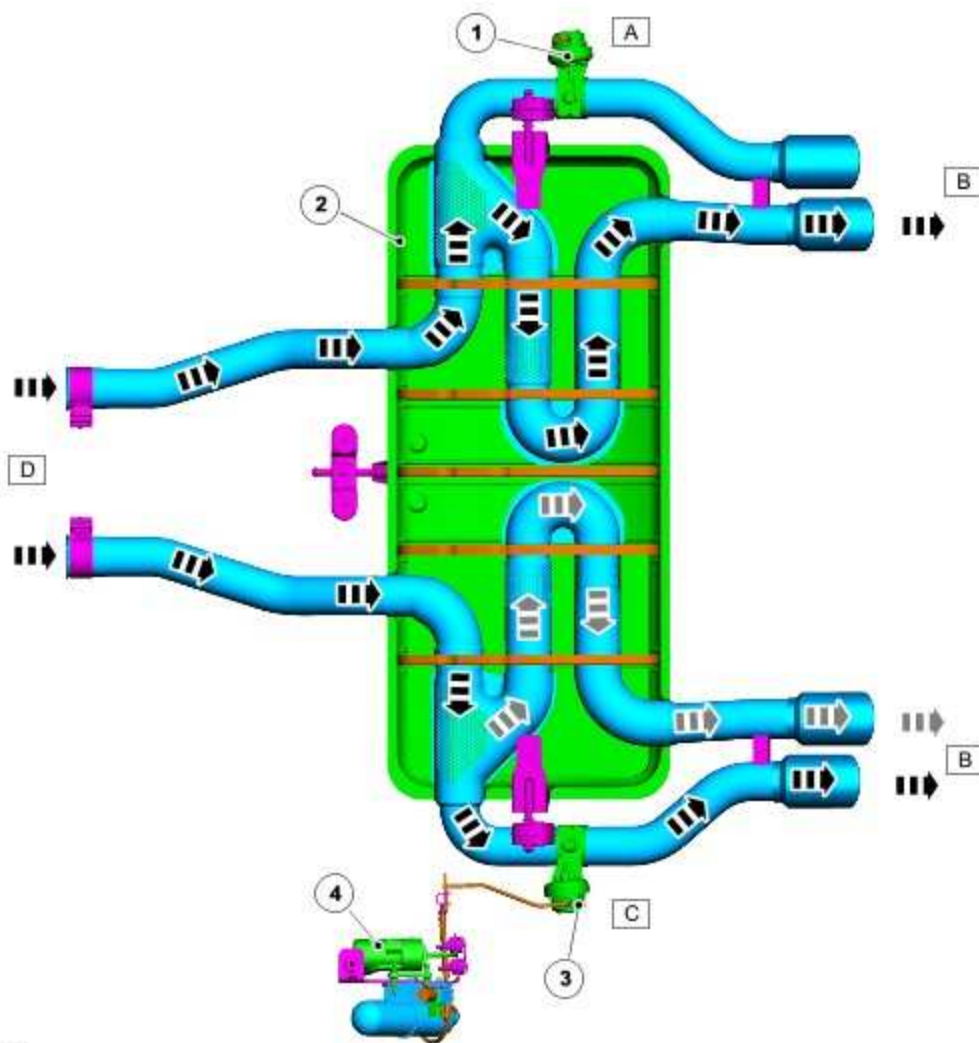
Throttle Angle%	Engine Speed RPM	500	1000	1500	2000	2500	3000	3500	4000>
0	Open	Closed	Closed	Closed	Closed	Closed	Closed	Open	
10	Open	Closed	Closed	Closed	Closed	Closed	Closed	Open	
20	Open	Closed	Closed	Closed	Closed	Closed	Closed	Open	
30	Open	Closed	Closed	Closed	Closed	Closed	Closed	Open	
40	Open	Closed	Closed	Closed	Closed	Closed	Closed	Open	
50	Open	Closed	Closed	Closed	Closed	Closed	Open	Open	
60	Open	Closed	Closed	Closed	Closed	Closed	Open	Open	
70	Open	Closed	Closed	Closed	Closed	Closed	Open	Open	
80	Open	Closed	Closed	Closed	Closed	Closed	Open	Open	
90	Open	Closed	Closed	Closed	Closed	Open	Open	Open	
100	Open	Closed	Closed	Closed	Closed	Open	Open	Open	

NOTE:

At engine speeds above 4000 RPM the valves are open independent of throttle angle.

The active exhaust valves are normally open until a vacuum is applied to them. The active exhaust valves are either open or closed they do not partially open.

Exhaust Gas Flow



E84048

Item	Part Number	Description
1		RH Active exhaust valve
2		Muffler
3		LH Active exhaust valve
4		Vacuum control assembly
A		Valve closed
B		Exhaust gas out
C		Valve open
D		Exhaust gas in

Exhaust System

Principle of Operation

For a detailed description of the exhaust system, refer to the relevant Description and Operation section in the workshop manual.

Exhaust System - 4.2L NA V8 - AJV8

Inspection and Verification

- 1 . Verify the customer concern by operating the system.
- 2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical
- Leaks - Metal fatigue - Pipes, mufflers and catalytic converters - Joints - Mountings - Clearance around components

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 concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

Symptom	Possible Cause	Action
Excessively noisy/leaking exhaust	Exhaust system/components	- Inspect exhaust system, refer to Visual Inspection above - Rectify leaks or Install new components as necessary. Refer to Removal and Installation instructions in this section
Exhaust excessively noisy at low speed	Exhaust sound enhancement valve stuck open	Install new muffler and tailpipe assembly. Muffler and Tailpipe (30.10.52)

Loss of power	• Restricted exhaust system • Exhaust sound enhancement valve stuck closed • Fuel system • Ignition system • Electronic engine control	• Install new exhaust components as necessary. Refer to Removal and Installation instructions in this section • For fuel system tests. Fuel Tank and Lines • For ignition system tests. Engine Ignition • For electronic engine control tests. Electronic Engine Controls

Catalytic Converter (17.50.05)

Removal



WARNING: Observe due care when working near a hot exhaust system.

- 1 . Disconnect the battery ground cable.
For additional information, refer to Specifications

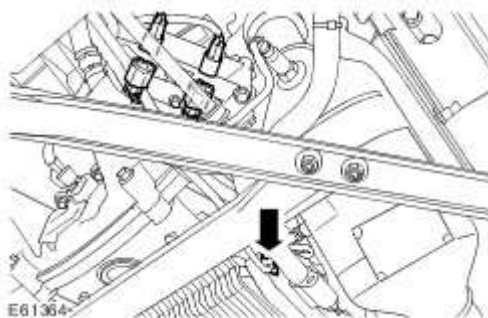
- 2  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- 3 . Remove the exhaust system.
For additional information, refer to Exhaust System

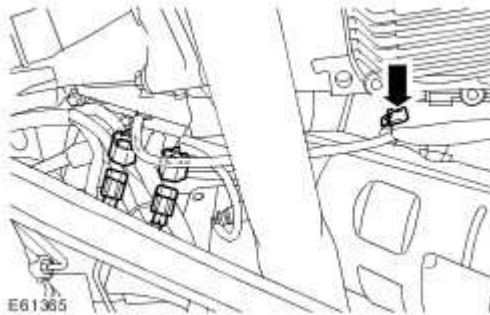
- 4 . Release and disconnect the 2 LH HO2S electrical connectors.

 Release the clip.



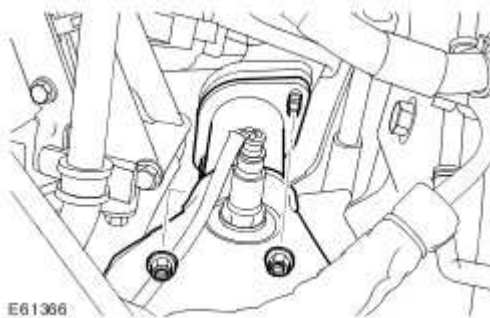
5 . Release and disconnect the 2 RH HO2S electrical connectors.

► Release the clip.



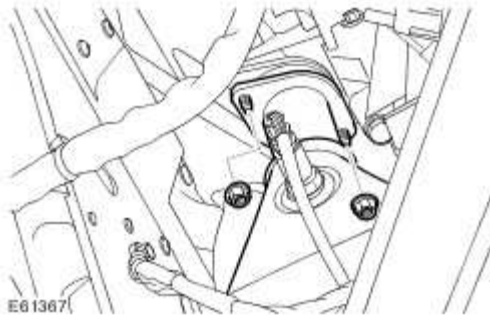
6 . Remove the LH catalytic converter.

► Remove and discard the 2 nuts.



7 . Remove the RH catalytic converter.

► Remove and discard the 2 nuts.



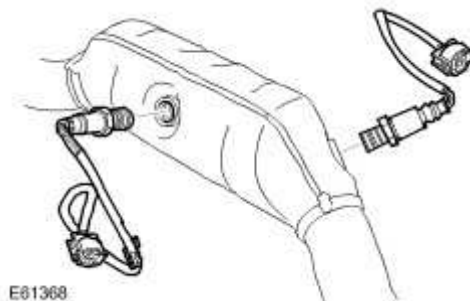
8 . NOTE:

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

NOTE:

Note the fitted position.

Remove the 4 HO2S from the catalytic converters.



Installation

- 1  **WARNING:** Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with the exhaust.

 **CAUTION:** Make sure the anti-seize compound does not contact the HO2S tip.



CAUTION: Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.

Install the HO₂S to the catalytic converters and tighten to 45 Nm (33 lb.ft).

- ▶ Clean the components mating faces.
- ▶ Apply anti-seize compound to the sensor threads.

2 . Install the RH catalytic converter.

- ▶ Install and lightly tighten the nuts.

3 . Install the LH catalytic converter.

- ▶ Install and lightly tighten the nuts.

4 . Install the exhaust system.

For additional information, refer to Exhaust System

5 . Connect and secure the HO₂S electrical connectors.

- ▶ Secure the 2 clips.

6 . Tighten the catalytic converter to exhaust manifold clamps to 40 Nm (30 lb.ft).

7 . Connect the battery ground cable.

For additional information, refer to Specifications

Exhaust System

Removal



WARNING: Observe due care when working near a hot exhaust system.

- 1 . Disconnect the battery ground cable.
For additional information, refer to 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 floor bracket.

 Remove and discard the 4 bolts.

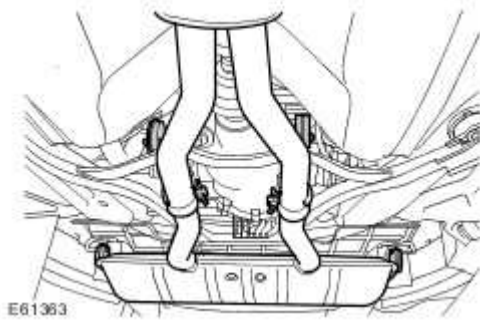


- 4 . Release the LH catalytic converter-to-muffler clamp.
- 5 . Release the RH catalytic converter-to-muffler clamp.



6 . With assistance, remove the exhaust system.

▶ Disconnect the 4 exhaust hangers.



Installation

1 . With assistance, install the exhaust system.

▶ Attach the exhaust hangers.

2 . Tighten the catalyst-to-muffler clamps.

▶ Tighten the nuts to 50 Nm (37 lb.ft).

3 . Install the bracket.

▶ Tighten the bolts to 25 Nm (18 lb.ft).

4 . Connect the battery ground cable.

For additional information, refer to Specifications

Front Muffler (30.10.18)

Removal



WARNING: Observe due care when working near a hot exhaust system.

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 floor bracket.

 Remove and discard the 4 bolts.

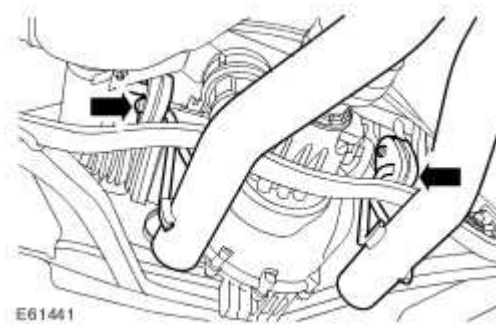


- 4 . Remove the rear muffler.
For additional information, refer to Muffler and Tailpipe (30.10.52)
- 5 . Release the 2 clamps.



6 . With assistance, remove the front muffler.

▶ Release the 2 exhaust hangers.



Installation

1 . Install the front muffler.

▶ Attach the exhaust hangers.

▶ Tighten the nuts to 50 Nm (37 lb.ft).

2 . Install the rear muffler.

For additional information, refer to Muffler and Tailpipe (30.10.52)

3 . Install the bracket.

▶ Tighten the bolts to 25 Nm (18 lb.ft).

- 4 . Connect the battery ground cable and install the cover.
For additional information, refer to Specifications

Muffler and Tailpipe (30.10.52)

Removal



WARNING: Observe due care when working near a hot exhaust system.

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications

2



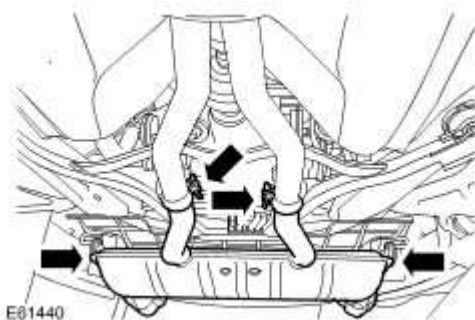
WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- 3 . With assistance, remove the rear muffler.

➤ Release the 2 clamps.

➤ Release the 2 exhaust hangers.



Installation

- 1 . Install the rear muffler.

➤ Tighten the nuts to 50 Nm (37 lb.ft).

 Attach the exhaust hangers.

- 2 . Connect the battery ground cable and install the cover.
For additional information, refer to Specifications

Exhaust Sound Enhancement Vacuum Pump

Removal

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

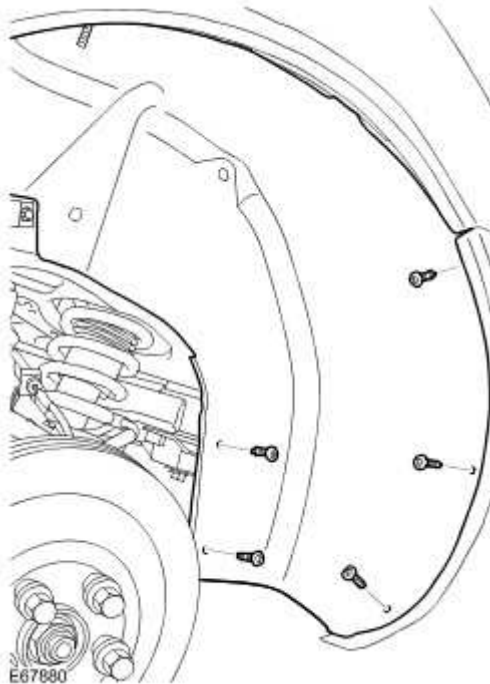
Raise and support the vehicle.

- 2 . Remove the LH rear wheel and tire.
For additional information, refer to Wheel and Tire (74.20.05)

- 3 . Release the rear lower edge of the LH fender splash shield.

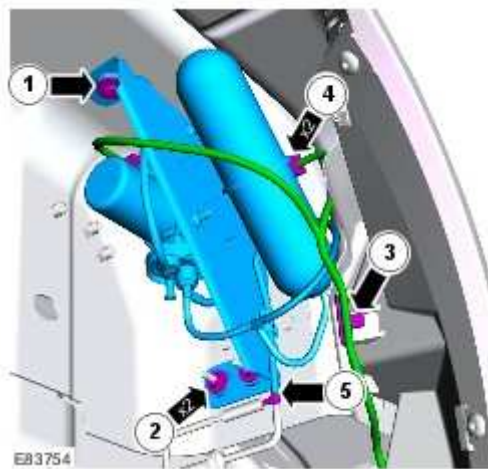
➤ Remove the 5 Torx screws.

➤ Tie the splash shield aside.



4 . Remove the exhaust sound enhancement vacuum pump assembly.

- Remove the bolt.
- Remove the 2 nuts.
- Release the wiring harness clip.
- Disconnect the 2 electrical connectors.
- Disconnect the vacuum line.



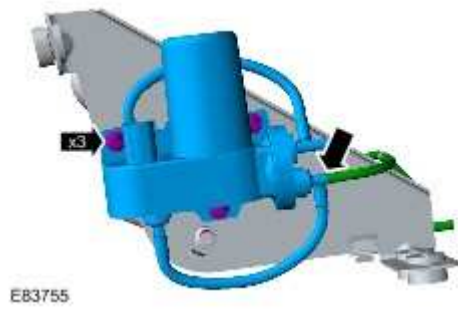
5 .  **CAUTION:** Note the fitted position of the component prior to removal.

NOTE:

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

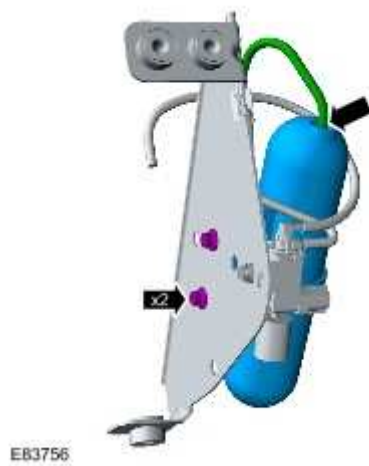
Remove the exhaust sound enhancement vacuum pump.

- Release from the 3 rubber mountings.
- Disconnect the vacuum line.



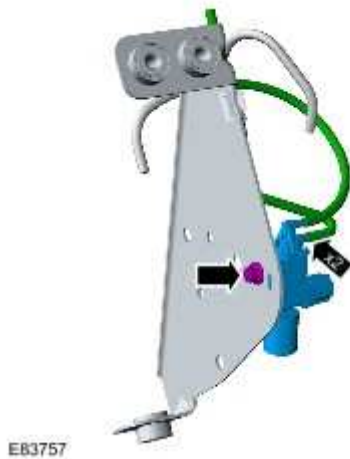
6 . Remove the exhaust sound enhancement vacuum reservoir.

- Remove the 2 bolts.
- Disconnect the vacuum line.



7 . Remove the exhaust sound enhancement solenoid.

- Remove the bolt.
- Disconnect the 2 vacuum lines.



Installation

1 . Install the exhaust sound enhancement solenoid.

- Tighten the bolt.
- Connect the vacuum lines.

2 . Install the exhaust sound enhancement vacuum reservoir.

- Tighten the bolts to 7 Nm (5 lb.ft).
- Connect the vacuum line.

3 . Install the exhaust sound enhancement vacuum pump.

- Connect the vacuum line.
- Secure with the rubber mountings.

4 . Install the exhaust sound enhancement vacuum pump assembly.

- Connect the vacuum line.
- Tighten the nuts to 7 Nm (5 lb.ft).

- ▶ Tighten the bolt to 7 Nm (5 lb.ft)
- ▶ Connect the electrical connectors.
- ▶ Attach the wiring harness.

5 . Secure the fender splash shield.

- ▶ Tighten the Torx bolts.

6 . Install the wheel and tire.

For additional information, refer to Wheel and Tire (74.20.05)

310 : Fuel System

310-00 : Fuel System – General Information

Specifications

Specifications



Fuel System Pressure Release (19.50.02)

Special Service Tools



310012

Fuel Pressure Gauge
310-012 (JD209)

1.



WARNING: Place the vehicle in a quarantined area and arrange "No Smoking/Petrol Fumes" signs about the vehicle.



WARNING: Before any work is carried out on the fuel system, ground the vehicle to earth and maintain the ground connection until the work is complete.



WARNING: 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.



WARNING: The fuel system remains pressurized for a long time after the ignition is switched off. The fuel pressure must be relieved before attempting any repairs. Failure to follow these instructions may result in personal injury.



WARNING: After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow these instructions may result in personal injury.



WARNING: This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



WARNING: If taken internally do not induce vomiting, seek immediate medical attention. Failure to follow these instructions may result in personal injury.



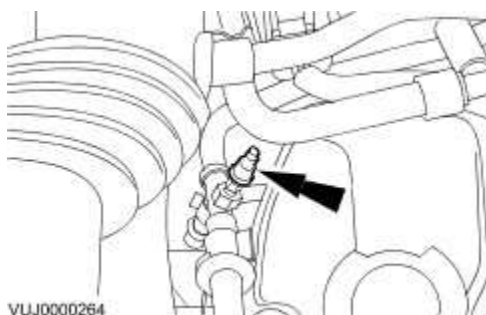
WARNING: If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek medical attention.



WARNING: Wash hands thoroughly after handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

Disconnect the battery ground cable.

2. Remove the fuel system pressure relief valve cap.

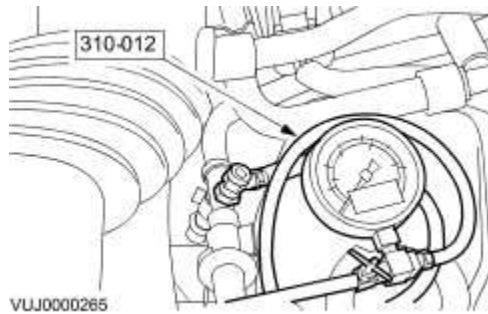


3.



WARNING: Make sure the tap of the special tool is rotated fully clockwise before installing the special tool to the fuel system pressure relief valve. Failure to follow these instructions may result in personal injury.

Install the special tool to the fuel system pressure relief valve.

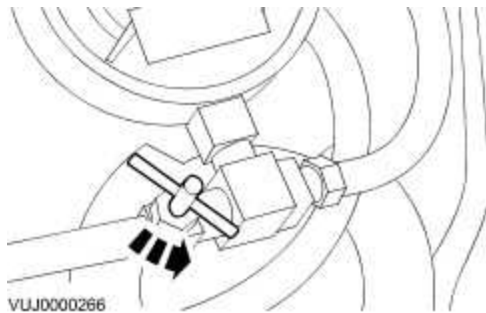


4. NOTE:

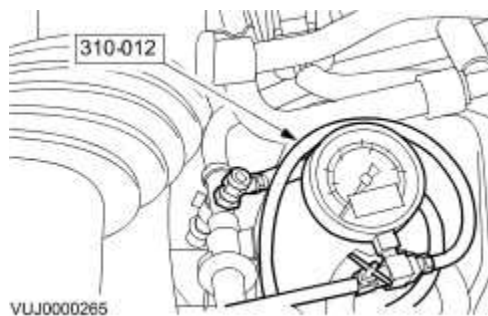
When relieving the fuel system pressure, catch any displaced fuel in a suitable container.

Relieve the fuel system pressure.

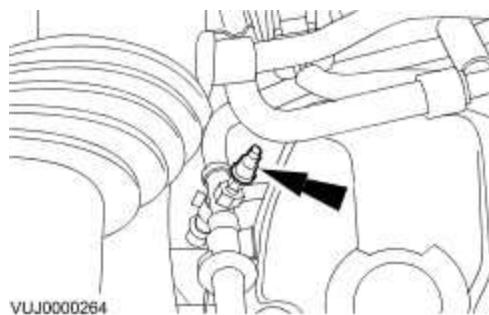
- Rotate the tap of the special tool fully counterclockwise.



5. Remove the special tool from the fuel system pressure relief valve.



6. Install the fuel system pressure relief valve cap.



7. Connect the battery ground cable.

Fuel Tank Draining

Special Service Tools



Fuel drain adaptor
310-154



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



WARNING: 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.



WARNING: 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.



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



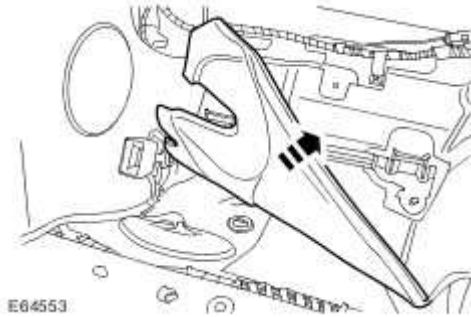
CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

1. Remove the cover and disconnect the battery ground cable.

2. Remove the rear RH seat cushion cover.

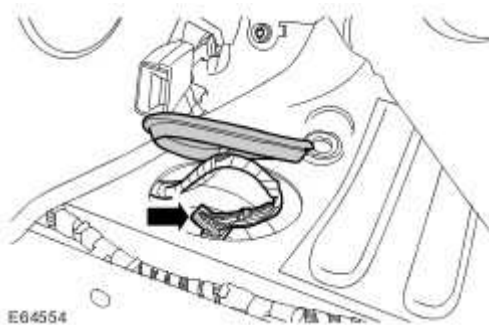
- Release the 2 clips.

3. Position the underseat sound deadner, to gain access to the fuel tank grommet.



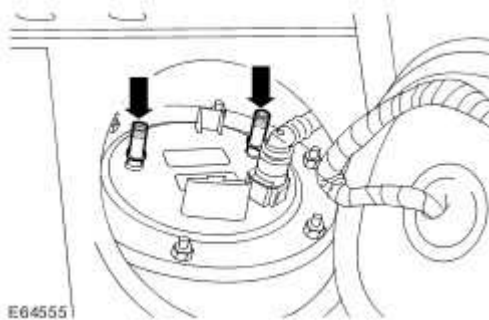
4. Remove the rubber grommet.

- Disconnect the electrical connector.



5. Cut the sealing plug from the top of the 2 drain ports.

- Disconnect the electrical connector.



6. Connect the fuel tank drain equipment ground cable to the vehicle.

7. Remove the fuel from the tank, via the 2 drain ports, to drain the left and right sides of the fuel tank.

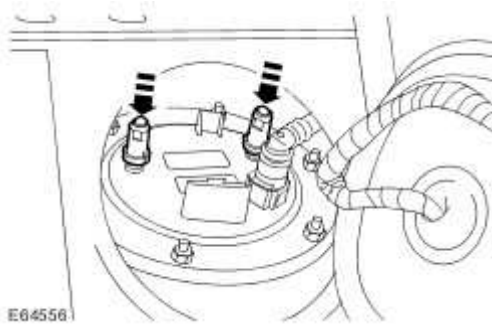
8. Remove the fuel drain equipment.

9.



WARNING: After the fuel tank drain is complete always fit the sealing covers over the drain ports. Failure to do so will mean that fuel vapour can escape.

Install the drain port sealing covers.



10. Install the grommet.

- Connect and secure the electrical connector.

11. Position the sound deadner.

12. Install the RH rear seat cushion.

- Carefully secure the clips.

13. Refill the fuel tank.

14. Connect the battery ground cable and install the cover.

Quick Release Coupling

Disconnect

1.



WARNING: Place the vehicle in a quarantined area and arrange "No Smoking/Petrol Fumes" signs about the vehicle.



WARNING: Before any work is carried out on the fuel system, ground the vehicle to earth and maintain the ground connection until the work is complete.



WARNING: 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.



WARNING: 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.



WARNING: The fuel system remains pressurized for a long time after the ignition is switched off. The fuel pressure must be relieved before attempting any repairs. Failure to follow these instructions may result in personal injury.



WARNING: After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow these instructions may result in personal injury.



WARNING: This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



WARNING: If taken internally do not induce vomiting, seek immediate medical attention. Failure to follow these instructions may result in personal injury.



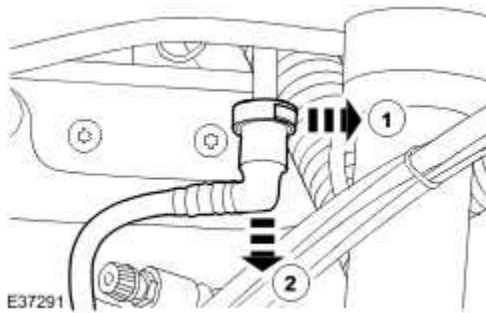
WARNING: If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek medical attention.



WARNING: Wash hands thoroughly after handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

Relieve the fuel system pressure.

2. Disconnect the quick release fitting.
 1. Release the retaining clip.
 2. Disconnect the quick release fitting.



Connect

1. To connect, reverse the disconnect procedure.

Quick Release Coupling - Push Connect

Disconnect

1.



WARNING: Place the vehicle in a quarantined area and arrange "No Smoking/Petrol Fumes" signs about the vehicle.



WARNING: Before any work is carried out on the fuel system, ground the vehicle to earth and maintain the ground connection until the work is complete.



WARNING: 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.



WARNING: 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.



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

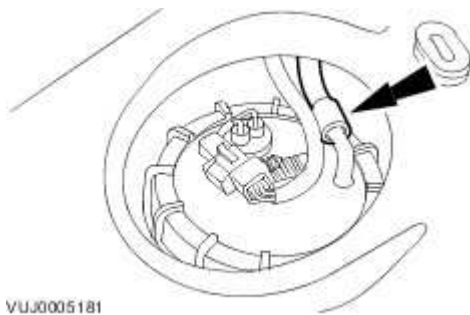


WARNING: Wash hands thoroughly after handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

Relieve the fuel system pressure.

2. Disconnect the push connect fitting.

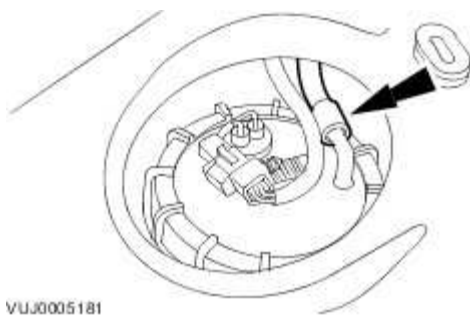
- Press the collar.
- Disconnect the push connect fitting.



Connect

1. To connect.

- Support the male stub.
- Push the connector fitting onto the stub until an audible click can be heard.
- Check the connection by a gentle tug test.



Spring Lock Couplings

Special Service Tools



Fuel spring lock decoupling tool 310-D005



WARNING: Place the vehicle in a quarantined area and arrange "No Smoking/Petrol Fumes" signs about the vehicle.



WARNING: Before any work is carried out on the fuel system, ground the vehicle to earth and maintain the ground connection until the work is complete.



WARNING: 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.



WARNING: The fuel system remains pressurized for a long time after the ignition is switched off. The fuel pressure must be relieved before attempting any repairs. Failure to follow these instructions may result in personal injury.



WARNING: After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.



WARNING: This procedure involves fuel handling. Be prepared for fuel spillage at all times

and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



WARNING: If taken internally, do not induce vomiting, seek immediate medical attention. Failure to follow these instructions may result in personal injury.



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



WARNING: Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

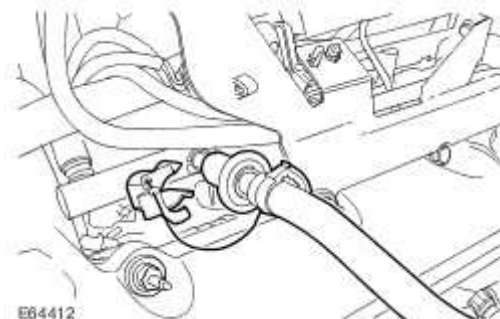


WARNING: Make sure the garter spring snaps over the male end of the spring lock coupling.

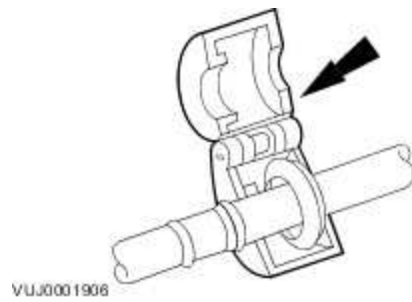


CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

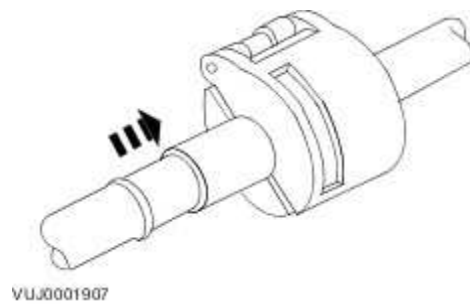
1. Release the fuel line safety clip.



2. Install the special tool.

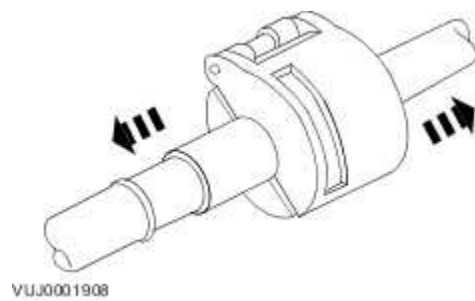


3. Close the special tool and push it into the female end of the spring lock coupling.

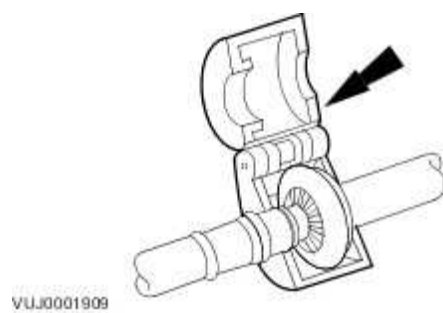


4. Disconnect the spring lock coupling.

- Position an absorbent cloth to collect fluid spillage.

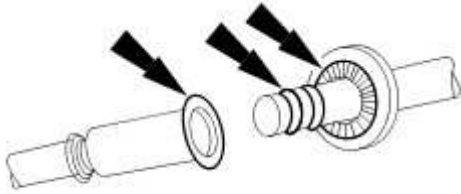


5. Remove the special tool.



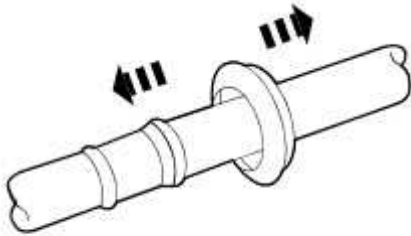
6. Connect the spring lock coupling.

- Clean the components.
- Install new O-ring seals.
- Install a new garter spring.



VUJ0001910

7. Check the spring lock coupling, to make sure it is correctly connected.



E31440

8. Attach the fuel line safety clip.

310-01 : Fuel Tank and Lines

Specifications

Specifications

General Specifications

Item	
Fuel system type	Electronic - returnless
Fuel tank construction	Stainless steel pressings
Fuel filter	Located in the fuel delivery line, forward of the fuel tank
Fuel tank sender unit	Mounted on the body of the fuel pump
Fuel Pump:	
Type/location	Electric - submersible - located in the fuel tank
Operating pressure	3.8 bar - 55 lbf/in ²
Maximum output at 11.5 volts	4.8 bar - 69 lbf/in ²

Capacities

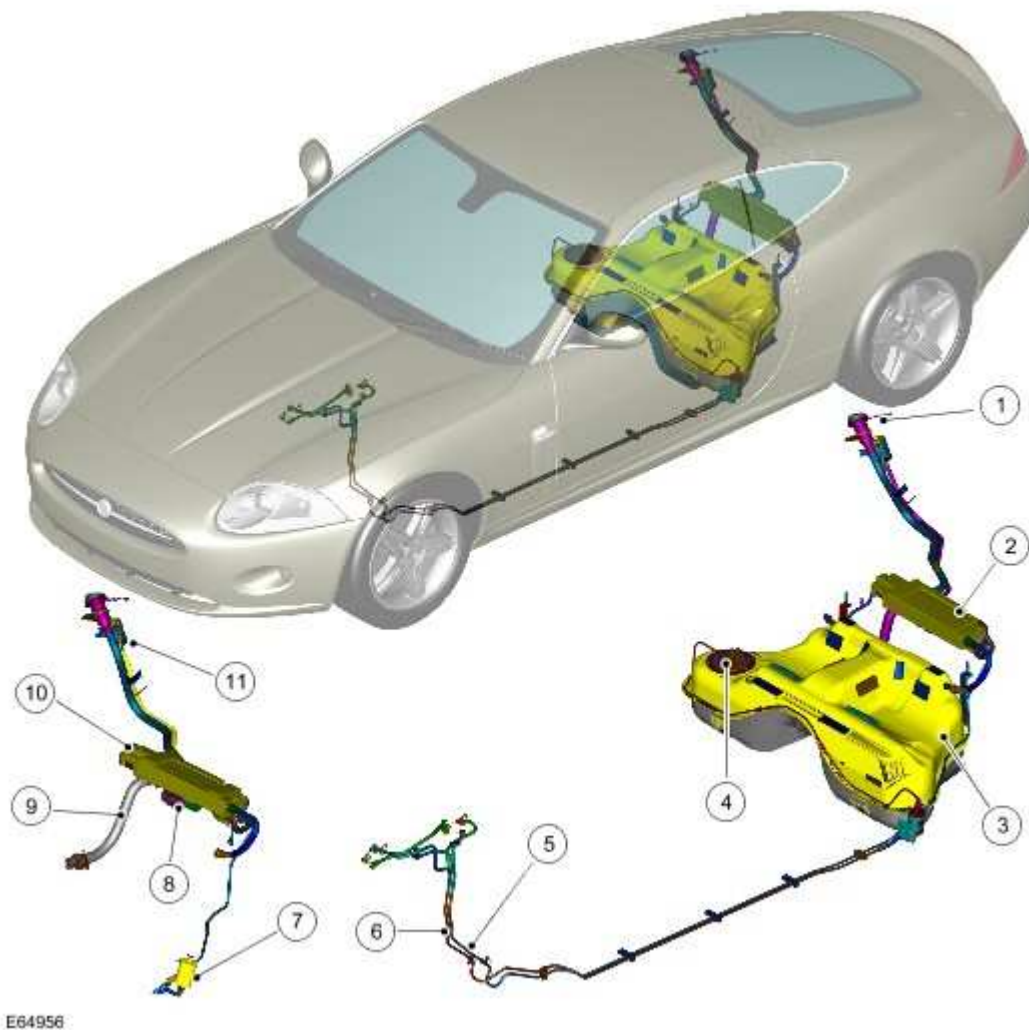
	Liters
Fuel tank capacity	71.1 (total) / 70.6 (useable)

Torque Specifications

Item	Nm	lb-ft	lb-in
Fuel filter to bracket - bolt	7	5	62
Fuel filter bracket to vehicle - nut	7	5	62
Fuel tank filler pipe bracket to vehicle	7	5	62
Fuel tank strap to vehicle - bolt	35	26	-
Fuel/vapor tube bracket to vehicle - bolt	9	7	80

Fuel Tank and Lines

COMPONENT LOCATION



E64956

Item	Part Number	Description
1		Filler cap and lanyard
2		Charcoal cannister assembly
3		Fuel tank
4		Fuel pump module assembly

5		Pipe - Fuel pump to engine (feed)
6		Pipe - EVAP charcoal canister to purge valve
7		Fuel filter
8		DMTL Pump (NAS only)
9		Fuel filler pipe
10		FPDM
11		DMTL filter

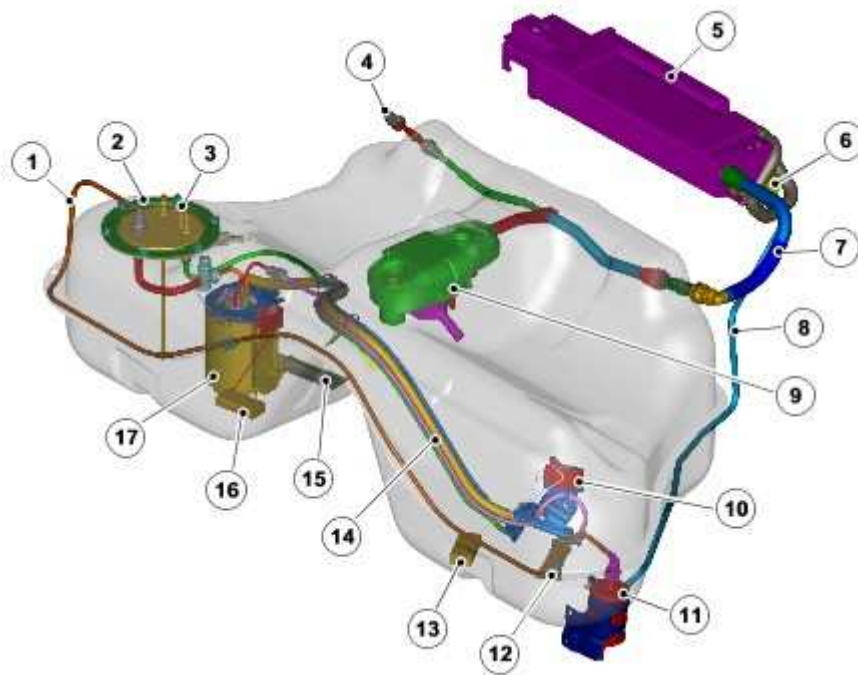
INTRODUCTION

The major components of the 4.2L V8 fuel system comprise

- Stainless steel saddle type fuel tank
- Fuel pump
- Fuel filler pipes
- Fuel level sensors
- Fuel delivery pipes.

The fuel system uses an electronic returnless fuel system which comprises a pump module mounted in the fuel tank to deliver fuel at variable flow and pressure to the fuel rails which supply fuel to all fuel injectors. The fuel pump operation is regulated by a Fuel Pump Driver Module (FPDM) which is controlled by the engine management system. The control module regulates the flow and pressure supplied by controlling the operation of the fuel pump using a PWM output. For additional information, refer to Fuel Charging and Controls (303-04 Fuel Charging and Controls - 4.2L)
For additional information, refer to Evaporative Emissions (303-13 Evaporative Emissions)
For additional information, refer to Electronic Engine Controls (303-14 Electronic Engine Controls - 4.2L)

FUEL TANK



E75934

Item	Part Number	Description
1		Fuel supply to engine
2		Fuel pump flange
3		Fuel pump flange electrical connection
4		Liquid vapor separator vent hose
5		Charcoal cannister
6		DMTL pump
7		EVAP hose
8		Purge valve hose
9		Liquid vapor separator (including Roll Over Valve)
10		LH fuel level sensor
11		Fuel filter
12		LH jet pump

13		LH fuel level sensor float
14		Internal fuel transfer pipes
15		RH jet pump
16		RH fuel level sensor float
17		Fuel pump module

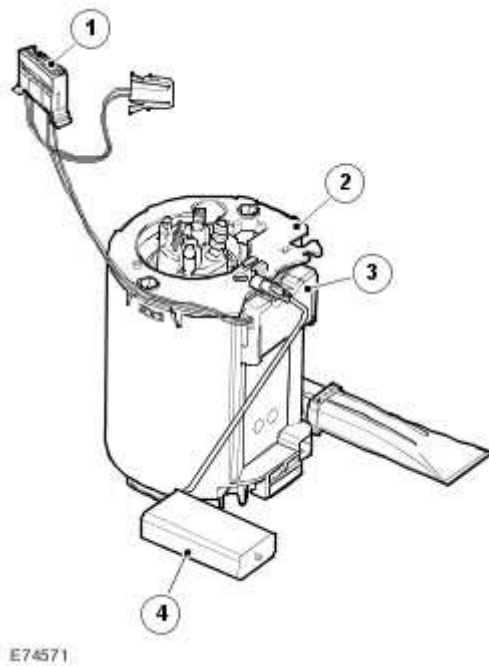
The fuel tank is a saddle type tank made of stainless steel pressings. The tank is located forward of the rear suspension and is mounted using two metal straps. The tank is a sealed unit with the only internal access being via the pump module flange aperture on the top of the tank.

The flange assembly comprises a pump module flange which contains all external pipe and electrical connections for the tank internal components, a collar and a clamp. The flange is fitted with a seal which locates in the tank aperture. An arrow on the flange must be aligned between two molded lines on the tank, adjacent to the pump module flange aperture, to obtain the correct orientation. The collar is located over the flange and is secured with the clamp. The flange, seal, collar and clamp arrangement meets the sealing requirements of LEV2 emissions.

The flange has a five pin external connector which provides for electrical connections for the level sensors, a common ground for the sensors and the fuel pump. This connector is wired to three push fit connectors on the underside of the flange. A quick release connector provides for the connection of the fuel feed pipe and breather.

The fuel pump module is mounted on a bayonet fitting at the base of the fuel tank. The module locks into position by rotating the module clockwise into the bayonet. The module comprises the fuel pump, the RH jet pump, the pump inlet filter, a second fine mesh filter which mounts into the carrier and an over pressure valve (PRV). The pump module, fuel filter and level sensors are available as serviceable components, the individual assembly components are not available separately.

FUEL PUMP MODULE



Item	Part Number	Description
1		Electrical connector
2		Fuel pump module
3		Fuel level sensor
4		Level sensor float

The fuel pump module is attached to the base of the fuel tank by the bayonet fitting. The pump module flange has three electrical connectors; one for the fuel pump motor and one for each of the fuel level sensors. All are connected to the external electrical connector via the connectors on the underside of the fuel pump module flange.

The pump module has a maximum rated flow of 180 liters/hour (47.55 US gallons/hour) and an output pressure of 5.0 bar (72.5 lbf/in²).

The fuel pump is energized by the fuel pump relay which is located in the Battery Junction Box (BJB) and the fuel pump control module which is located in the left hand side of the luggage compartment. The relay and control module are controlled by the engine control module. The relay is energized at all times when the ignition switch is in ignition position II.

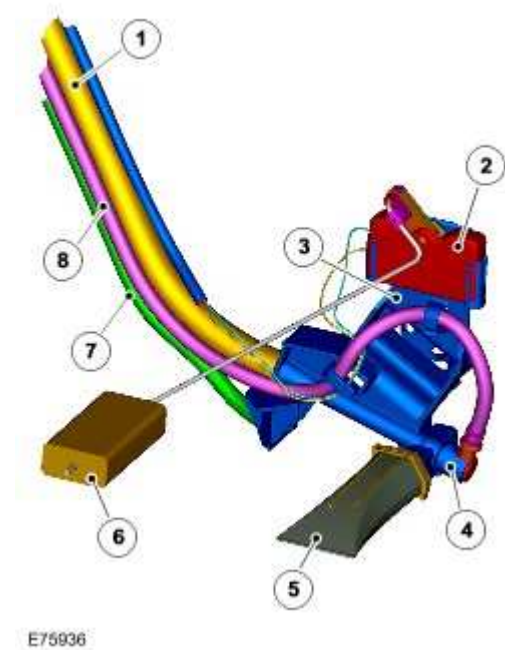
A 60 micron fine mesh, pump inlet filter is attached to the pump inlet port at the bottom of the pump. The filter is located vertically at the side of the pump to ensure that a portion of the filter is

off the base of the swirl pot to prevent premature blocking of the filter.

A second, serviceable fine mesh filter is located in-line. This provides additional filtration to the fuel before it is passed to the fuel rail. The filter has an electrical connection which is attached to ground to prevent electrostatic build-up.

FUEL LEVEL SENSORS

Left Hand Fuel Level Sensor

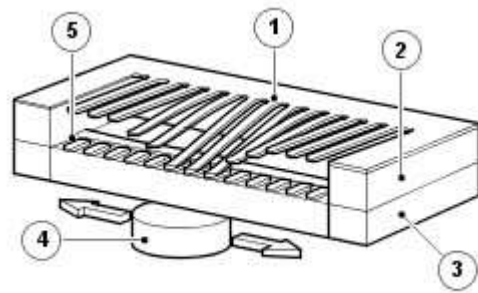


Item	Part Number	Description
1		Fuel transfer pipe
2		Fuel level sensor
3		Sensor mounting bracket
4		Jet pump
5		Filter
6		Fuel level sensor float
7		Fuel drain transfer pipe
8		Fuel transfer pipe

Two fuel level sensors are installed in either side of the saddle tank. One is mounted on the fuel pump module, the other is mounted on a separate bracket in the other side of the fuel tank. The sensors are a Magnetic Passive Position Sensor (MAPPS) which provide a variable resistance to ground for the output from the fuel gage. The sensor is sealed from the fuel preventing contamination of the contacts, increasing reliability. The front and rear fuel level sensors are connected to the external electrical connector on the flange via the connectors on the underside of the fuel pump module flange.

The sensor comprises a series of 51 film resistors mounted in an arc on a ceramic surface. The resistors are wired in series with individual contacts. A soft magnetic foil with 51 flexible contacts is mounted a small distance above the film resistors. A magnet, located below the ceramic surface, is attached to the sender unit float arm. As the float arm moves, the magnet follows the same arc as the film resistors. The magnet pulls the flexible contacts onto the opposite film resistor contacts forming an electrical circuit.

Sensor Operating Principle



E44504

Item	Part Number	Description
1		Magnetic foil
2		Spacer
3		Ceramic surface
4		Magnet
5		Resistance film

The film resistors are arranged in a linear arc with resistance ranging from 51.2 to 992.11 Ohms. The electrical output signal is output proportional to the amount of fuel in the tank and the position of the float arm. The measured resistance is processed by the instrument cluster to implement an anti-slosh function. This monitors the signal and updates the fuel gage pointer position at regular intervals, preventing constant pointer movement caused by fuel movement in the tank due to cornering or braking.

A warning lamp is incorporated in the instrument cluster and illuminates when the fuel level is at or below 10 liters (2.64 US gallons).

The fuel level sender signal is converted into a CAN message by the instrument cluster as a direct interpretation of the fuel tank contents in liters. The ECM uses the CAN message to store additional OBD P Codes for misfire detection when the fuel level is below a predetermined capacity.

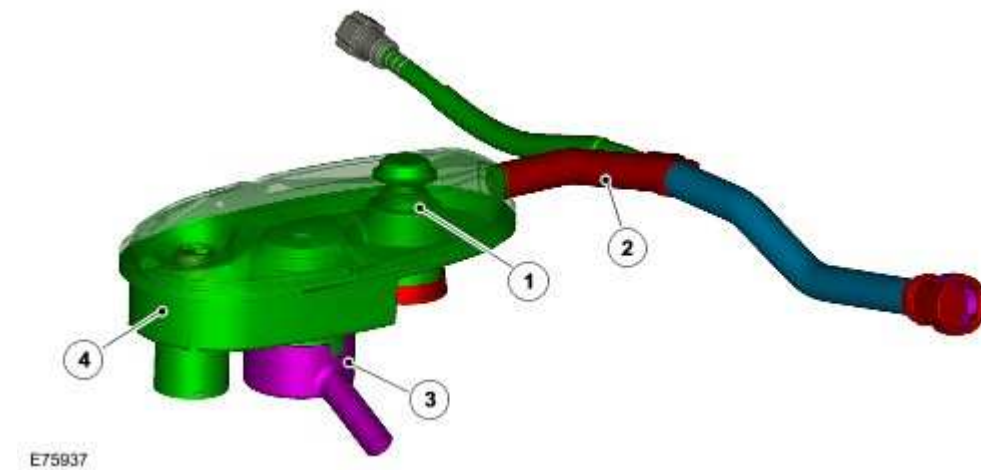
JET PUMPS

The fuel system incorporates two jet pumps. The LH jet pump is located on the fuel level sensor carrier on the LH side of the fuel tank. The RH jet pump is located in the swirl pot below the fuel pump. Both jet pumps operate on a venturi effect created by the fuel at pump output pressure passing through the jet pump. This draws additional fuel from the tank through ports in the jet pump body, delivering additional fuel to the swirl pot.

The jet pump is connected via a pipe from a three-way connection in the fuel pump. The LH jet pump collects fuel from the LH side of the tank and transfers it into the swirl pot, ensuring a constant supply of fuel to the pump. The jet pump has a jet nozzle of 0.5 mm diameter.

The RH jet pump operates at pump output pressure and delivers some of the fuel at pump pressure from the LH side of the tank. The jet pump has a jet nozzle of 0.5 mm diameter.

LIQUID VAPOR SEPARATOR (LVS)



Item	Part Number	Description
1		Roll over valve
2		Fuel vapor vent hoses
3		Fuel Level Vent Valve (FLVV)

4		Liquid Vapor Separator (LVS)

The Liquid Vapor Separator (LVS) separates any liquid from the vapor and drains back into the tank via the Fuel Level Vent Valve (FLVV) which is located on the underside of the LVS.

A single Roll Over Valve (ROV) is located in the liquid vapor separator. The separator is attached to the upper half of the fuel tank and is connected via a pipe and T piece to the charcoal canister breather outlet and the tank vent breather outlet. The ROV contains a non-return valve which closes in the event of the vehicle overturning, preventing liquid fuel escaping from the tank via the breather pipe.

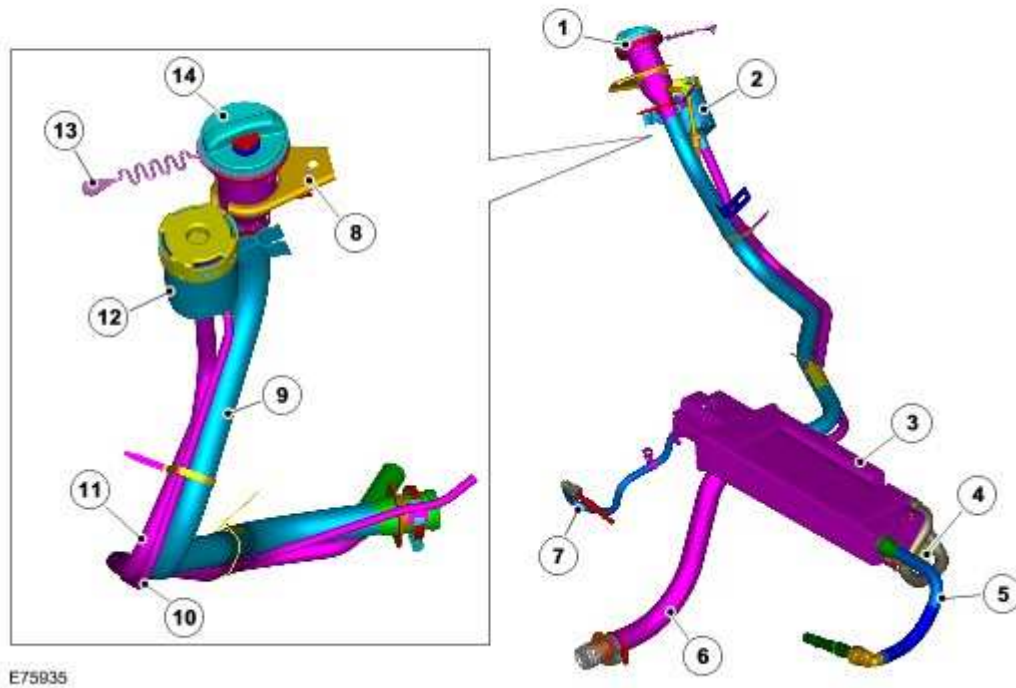
FUEL LEVEL VENT VALVE (FLVV)

The main purpose of the FLVV is to control the fill volume of the tank. During filling, vapor is passed via the FLVV to the LVS. The vapor then passes from the LVS to the vent connection via a corrugated tube. The vent connection is connected to the charcoal canister which stores the fuel vapor. During filling, when the tank reaches its full level, the FLVV closes and prevents fuel vapor passing through to the LVS. This causes the pressure in the tank to rise which in turn causes the pump filling nozzle to turn off.

FUEL FILTER

The fuel filter is located on a bracket on the LH side of the fuel tank. The bracket is secured by a single bolt.

FUEL FILLER PIPE ASSEMBLY



Item	Part Number	Description
1		Fuel filter
2		DMTL fresh air filter
3		Charcoal cannister
4		DMTL pump
5		LVS breather hose
6		Fuel filler pipe
7		Fuel tank vent hose
8		Bracket

9		Fuel filler pipe
10		FLVV pipe
11		DMTL fresh air pipe
12		DMTL fresh air filter
13		Filler cap lanyard
14		Filler cap

The fuel filler head is positioned at the rear of the vehicle, above the right hand rear wheel. The filler head is covered by a molded plastic cover which is electrically locked when the vehicle is locked. The filler cap is a conventional screw in type which is secured to the vehicle with a lanyard.

The filler head is a stainless steel fabrication which is secured to the vehicle body by a bracket.

Connections on the rear of the filler head allow for the connection of the fuel tank breather pipe from the fuel tank flange, the fuel filler pipe to the tank and the charcoal canister breather pipe.

The fuel tank breather pipe has a quick release fitting and connects to the breather pipe from the fuel tank flange.

The fuel filler pipe locates in a short flexible hose attached to the tank and is secured with worm drive clamps. The canister breather pipe is routed alongside the fuel filler pipe and attaches to the canister with a quick release coupling.

A fourth pipe is also routed alongside the fuel filler pipe and provides air ventilation for the charcoal canister. On all petrol vehicles, except NAS vehicles, the pipe is connected to the air pump port on the charcoal canister with a quick release coupling and connects to an insect trap at the fuel filler head. On NAS vehicles fitted with a DMTL pump, the pipe connects to the pump vent port and is also connected to a filter which is attached to the filler head.

FUEL LINES

The fuel lines are single piece construction from the fuel filter to the fuel rails in the engine compartment.

Fuel Tank and Lines

Principle of Operation

For a detailed description of the fuel tank and lines, refer to the relevant Description and Operation section in the workshop manual.

Fuel Tank and Lines

Inspection and Verification

1 . Verify the customer concern.

2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
- Fuel leaks - Damaged fuel lines - Damaged push connect fittings - Fuel level - Fuel contamination/grade/quality - Damaged fuel tank filler pipe cap - Damaged fuel tank filler pipe	- Fuses - Loose or corroded electrical connectors - Harnesses - Fuel Pump Driver Module (FPDM) - Rear Junction Box (RJB) - Fuel pump relay - Engine Control Module (ECM)

3 . If an obvious cause for an observed or reported symptom is found, correct the cause (if possible) before proceeding to the next step.

4 . If the cause is not visually evident, verify the symptom and refer to the Symptom Chart below, alternatively, check for Diagnostic Trouble Codes (DTCs) and proceed to the DTC Index.

Symptom Chart

Symptom	Possible Cause	Action
Engine cranks, but does not fire	- Engine breather system disconnected/restricted - Ignition system - Fuel system - Electronic engine controls	- Ensure the engine breather system is free from restriction and is correctly installed - For ignition system tests. Engine Ignition - For fuel system tests. Read DTCs and refer to DTC Index in this section - For electronic engine control tests.

		Electronic Engine Controls
Engine cranks and fires, but will not start	• Evaporative emissions purge valve • Fuel pump • Spark plugs • Ignition coil failure(s)	• For purge valve tests. Evaporative Emissions • For fuel pump tests. Check for DTCs and refer to DTC Index in this section • For ignition system tests. Engine Ignition
Difficult cold start	• Check engine coolant level/anti-freeze content • Battery • Electronic engine controls • Exhaust gas recirculation (EGR) valve stuck open • Fuel pump • Evaporative emissions purge valve	• Check the engine coolant level and condition. Specifications • Ensure the battery is in a fully charged and serviceable condition • For electronic engine control tests. Electronic Engine Controls • For EGR valve tests. Engine Emission Control • For fuel system tests. Read DTCs and refer to DTC Index in this section • For purge valve tests. Evaporative Emissions
Difficult hot start	• Injector leak • Electronic engine controls • Evaporative emissions purge valve • Fuel pump • Ignition system • EGR valve stuck open	• Carry out injector leak tests, install new injectors as necessary. Fuel Injector (18.10.01) • For electronic engine control tests. Electronic Engine Controls • For purge valve tests. Evaporative Emissions • For fuel system tests. Read DTCs and refer to DTC Index in this section • For ignition system tests. Engine Ignition • For EGR valve tests. Engine Emission Control
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	• Injector leak • Electronic engine controls • Evaporative emissions purge valve • Fuel pump	• Carry out injector leak tests, install new injectors as necessary. Fuel Injector (18.10.01) • For electronic engine control tests.

	• Ignition system • EGR valve stuck open	Electronic Engine Controls • For purge valve tests. Evaporative Emissions • For fuel system tests. Read DTCs and refer to DTC Index in this section • For ignition system tests. Engine Ignition • For EGR valve tests. Engine Emission Control
Engine stalls soon after start	• Breather system disconnected/restricted • ECM relay • Electronic engine controls • Ignition system • Air intake system restricted • Air leakage • Fuel lines	• Ensure the engine breather system is free from restriction and is correctly installed • For ECM relay tests. Electronic Engine Controls • For electronic engine control tests. Electronic Engine Controls • For ignition system tests. Engine Ignition • Check for blockage in air cleaner element and air intake system • Check for leakage in air intake system • For fuel line tests. GO to Pinpoint Test G830073p9.
Engine hesitates/poor acceleration	• Fuel pressure, fuel pump, fuel lines • Injector leak • Air leakage • Electronic engine controls • Ignition system • EGR valve stuck • Transmission malfunction • Restricted pedal travel (carpet, etc)	• For fuel pressure tests. GO to Pinpoint Test G830073p8. For fuel line tests. GO to Pinpoint Test G830073p9. For fuel pump tests. Read DTCs and refer to DTC Index in this section • Carry out fuel injector leak tests, install new injectors as necessary. Fuel Injector (18.10.01) • Check for leakage from air intake system • For electronic engine control tests. Electronic Engine Controls • For ignition system tests. Engine Ignition • For EGR valve tests.

		Engine Emission Control - For transmission system tests. Diagnostic Strategy - Ensure accelerator pedal is free from restriction
Engine backfires	- Fuel pump, fuel lines - Air leakage - Electronic engine controls - Ignition system - Sticking variable camshaft timing (VCT) hub	- For fuel pump tests. Read DTCs and refer to DTC Index in this section. For fuel line tests. GO to Pinpoint Test G830073p9. - Check for leakage from air intake system - For electronic engine control tests. Electronic Engine Controls - For ignition system tests. Engine Ignition - For VCT system tests. Electronic Engine Controls
Engine surges	- Fuel pump, fuel lines - Electronic engine controls - Ignition system	- For fuel pump tests. Read DTCs and refer to DTC Index in this section. For fuel line tests. GO to Pinpoint Test G830073p9. - For electronic engine control tests. Electronic Engine Controls - For ignition system tests. Engine Ignition
Engine detonates/knocks	- Electronic engine controls - Fuel pump, fuel lines, fuel quality - Air leakage - Sticking VCT hub	- For electronic engine control tests. Electronic Engine Controls - For fuel pump tests. Read DTCs and refer to DTC Index in this section. For fuel line tests. GO to Pinpoint Test G830073p9. - Check for leakage from air intake system - For VCT system tests. Electronic Engine Controls

DTC Index



CAUTION: When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00.

NOTE:

If a module or component is suspect, and the vehicle remains under the Manufacturers warranty, refer to the Warranty Policy and Procedure 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 five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give extra information read by the manufacturer-approved diagnostic system).

NOTE:

When performing electrical voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE:

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE:

If DTCs 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.

DTC	Description	Possible Cause	Action
P008700	Fuel rail/system pressure - too low	Fuel rail pressure (FRP) sensor, sensing circuit - short to ground, open circuit	Carry out any pinpoint tests associated with this DTC using the manufacturer

		• FRP sensor supply circuit - high resistance • FRP sensor failure • Fuel pump failure • Fuel line leak, restriction	approved diagnostic system • Install a new FRP sensor as necessary. Fuel Rail Pressure (FRP) Sensor (18.30.98) • Check for logged fuel pump DTCs and refer to DTC index • Check for fuel line leaks/restrictions and rectify as necessary. GO to Pinpoint Test G830073p9.
P008800	Fuel rail/system pressure - too high	• FRP sensor supply/sensing circuits - short to each other • FRP sensor sensing circuit - short to power • FRP sensor ground circuit - high resistance • FRP sensor failure • Restricted fuel line • Fuel pump short circuit to power	• Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system • Install a new FRP sensor as necessary. Fuel Rail Pressure (FRP) Sensor (18.30.98) • Check for fuel leaks/restrictions and rectify as necessary. GO to Pinpoint Test G830073p9. • Check for logged fuel pump DTCs and refer to DTC index
P017100	System too lean (bank 1)	• Air intake leak between MAF sensor and cylinder head • Fuel filter, injector, system restriction • MAF sensor fault (low intake air flow) • Exhaust leak (forward of catalytic converter)	• Check for leak from air intake system • Check fuel system is free from restriction • For MAF sensor tests. Electronic Engine Controls • Check and rectify any exhaust leak prior to catalytic converter
P017400	System too lean (bank 2)	• Air intake leak between MAF sensor and cylinder head • Fuel filter, injector, system restriction	• Check for leak from air intake system • Check fuel system is free from restriction • For MAF sensor tests.

		- MAF sensor fault (low intake air flow) - Exhaust leak (forward of catalytic converter)	Electronic Engine Controls Check and rectify any exhaust leak prior to catalytic converter
P030000	Random/multiple cylinder misfire detected	- ECM to ignition coil primary circuit faults (cylinder misfire detected DTCs also logged) - Fuel injector circuit fault(s) (injector DTCs also logged) - Ignition coil failure - Spark plug failure/fouled/incorrect gap - Fuel delivery pressure (low/high) - Fuel contamination - Fuel injectors restricted, leaking, continuously open - Cylinder compression low - Worn camshaft/broken valve springs - Valve clearance adjustment	- If specific cylinder misfire or injector DTCs are also logged refer to the tests associated to those DTCs first. Electronic Engine Controls - For ignition coil test. Electronic Engine Controls - Check and install new spark plugs as necessary. Spark Plugs - 4.2L NA V8 - AJV8 (18.20.02) - Check for logged fuel system DTCs and refer to relevant DTC Index. Fuel Charging and Controls - 4.2L NA V8 - AJV8/4.2L SC V8 - AJV8 Electronic Engine Controls Fuel Tank and Lines - For injector tests. Fuel Charging and Controls - 4.2L NA V8 - AJV8/4.2L SC V8 - AJV8 - Check cylinder compressions. Engine - Check for worn/broken engine components and valve clearance adjustment. Valve Clearance Check (12.29.47)
P046129	Fuel level sensor A circuit - range/performance - signal invalid	- Fuel level sensor A circuits - intermittent short circuit, high resistance - Fuel level sensor failure	For fuel level sensor tests. GO to Pinpoint Test G830073p3.

P04612F	Fuel level sensor A circuit range/performance - signal erratic	- Fuel level sensor circuits - intermittent short circuit, high resistance - Fuel level sensor failure	For fuel level sensor tests. GO to Pinpoint Test G830073p3.
P046200	Fuel level sensor A circuit - low input	- Fuel level sensor circuits - intermittent short to ground, high resistance - Fuel level sensor failure	For fuel level sensor tests. GO to Pinpoint Test G830073p3.
P046300	Fuel level sensor A circuit - high input	- Fuel level sensor circuits - intermittent short to power - Fuel level sensor failure	For fuel level sensor tests. GO to Pinpoint Test G830073p3.
P062700	Fuel pump A control circuit/open	Fuel pump control circuit fault (FPDM to fuel pump)	Refer to the electrical circuit diagrams and check the FPDM to Fuel Pump circuit for short to ground, power, open circuit
P062A00	Fuel pump A control circuit range/performance	Invalid fuel pump duty requested by the ECM	For ECM to FPDM circuit tests. GO to Pinpoint Test G830073p5.

Pinpoint Tests

PINPOINT TEST G830073p3 : FUEL LEVEL SENDER(S) CIRCUIT RANGE/PERFORMANCE

G830073t6 : CHECK THE SIGNAL CIRCUIT BETWEEN THE RJB AND FUEL LEVEL SENDER 'A' FOR SHORT CIRCUIT TO GROUND

1. Disconnect the fuel pump module electrical connector, CA127. 2. Measure the resistance between:

Fuel pump module connector CA127, harness side	Battery
Pin 02	Negative terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t7.

G830073t7 : CHECK THE SIGNAL CIRCUIT BETWEEN THE RJB AND FUEL LEVEL SENDER 'A' FOR SHORT CIRCUIT TO POWER

1. Measure the resistance between:

Fuel pump module connector CA127, harness side	Battery
Pin 02	Positive terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t8.

G830073t8 : CHECK THE SIGNAL CIRCUIT BETWEEN THE RJB AND FUEL LEVEL SENDER 'B' FOR SHORT CIRCUIT TO GROUND

1. Measure the resistance between:

Fuel pump module connector CA127, harness side	Battery
Pin 06	Negative terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t9.

G830073t9 : CHECK THE SIGNAL CIRCUIT BETWEEN THE RJB AND FUEL LEVEL SENDER 'B' FOR SHORT CIRCUIT TO POWER

1. Measure the resistance between:

Fuel pump module connector CA127, harness side	Battery
Pin 06	Positive terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t10.

G830073t10 : CHECK THE SIGNAL RETURN CIRCUIT BETWEEN THE RJB AND FUEL LEVEL SENDERS FOR SHORT CIRCUIT TO GROUND

1. Measure the resistance between:

Fuel pump module connector CA127, harness side	Battery
Pin 5	Negative terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t11.

G830073t11 : CHECK THE SIGNAL RETURN CIRCUIT BETWEEN THE RJB AND FUEL LEVEL SENDERS FOR SHORT CIRCUIT TO POWER

1. Measure the resistance between:

Fuel pump module connector CA127, harness side	Battery
Pin 5	Positive terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t12.

G830073t12 : CHECK THE FUEL LEVEL SENDER 'B' RESISTANCE AT EMPTY

1. Drain the fuel tank.

Fuel Tank Draining 2. Measure the resistance between:

Fuel pump module connector CA127, component side	Fuel pump module connector CA127, component side
Pin 05	Pin 06

- **Is the resistance 51 ± 2 ohms?**

-> **Yes**

GO to Pinpoint Test G830073t13.

-> **No**

INSTALL a new fuel tank.

Fuel Tank (19.55.01) CLEAR the DTC, test the system for normal operation.

G830073t13 : CHECK THE FUEL LEVEL SENDER 'B' RESISTANCE AT FULL

1. Remove the fuel tank. 2. Invert fuel tank to set sensor float to it's highest position. 3. Measure the resistance between:

Fuel pump module connector CA127, component	Fuel pump module connector CA127, component

side	side
Pin 05	Pin 06

- Is the resistance 1000 ± 8 ohms?

-> **Yes**

GO to Pinpoint Test G830073t14.

-> **No**

INSTALL a new fuel tank.

Fuel Tank (19.55.01) CLEAR the DTC, test the system for normal operation.

G830073t14 : CHECK THE FUEL LEVEL SENDER 'A' RESISTANCE AT EMPTY

1. Correct fuel tank orientation. 2. Remove the fuel pump module.

Fuel Pump Module (19.45.08) 3. Move the sender float to it's lowest position. 4. Measure the resistance between:

Fuel pump module connector CA127, component side	Fuel pump module connector CA127, component side
Pin 01	Pin 02

- Is the resistance 51 ± 2 ohms?

-> **Yes**

GO to Pinpoint Test G830073t15.

-> **No**

INSTALL a new fuel level sender.

Fuel Level Sender CLEAR the DTC, test the system for normal operation.

G830073t15 : CHECK THE FUEL LEVEL SENDER 'A' RESISTANCE AT FULL

1. Move the sender float to it's highest position. 2. Measure the resistance between:

Fuel pump module connector CA127, component side	Fuel pump module connector CA127, component side
Pin 01	Pin 02

- Is the resistance 1000 ± 8 ohms?

-> **Yes**

GO to Pinpoint Test G830073t16.

-> **No**

INSTALL a new fuel level sender.

Fuel Level Sender CLEAR the DTC, test the system for normal operation.

G830073t16 : CHECK THE SIGNAL CIRCUIT BETWEEN THE RJB AND FUEL LEVEL SENDER 'A' FOR HIGH RESISTANCE

1. Disconnect the RJB electrical connector, CA070. 2. Measure the resistance between:

RJB connector CA070, harness side	Fuel pump module connector CA127, harness side
Pin 13	Pin 02

- Is the resistance greater than 5 ohms?

-> **Yes**

REPAIR the high resistance circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t17.

G830073t17 : CHECK THE SIGNAL CIRCUIT BETWEEN THE RJB AND FUEL LEVEL SENDER 'B' FOR HIGH RESISTANCE

1. Measure the resistance between:

RJB connector CA070, harness side	Fuel pump module connector CA127, harness side
Pin 12	Pin 06

- Is the resistance greater than 5 ohms?

-> **Yes**

REPAIR the high resistance circuit. For additional information, refer to the wiring diagrams. CLEAR the

DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t45.

G830073t45 : CHECK THE SIGNAL RETURN CIRCUIT BETWEEN THE RJB AND FUEL LEVEL SENDER 'A' FOR HIGH RESISTANCE

1. Measure the resistance between:

RJB connector CA070, harness side	Fuel pump module connector CA127, harness side
Pin 04	Pin 01

- **Is the resistance greater than 5 ohms?**

-> **Yes**

REPAIR the high resistance circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t18.

G830073t18 : CHECK THE SIGNAL RETURN CIRCUIT BETWEEN THE RJB AND FUEL LEVEL SENDER 'B' FOR HIGH RESISTANCE

1. Measure the resistance between:

RJB connector CA070, harness side	Fuel pump module connector CA127, harness side
Pin 04	Pin 05

- **Is the resistance greater than 5 ohms?**

-> **Yes**

REPAIR the high resistance circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

CHECK for DTCs indicating another cause of the complaint.

Electronic Engine Controls

PINPOINT TEST G830073p5 : ECM TO FPDM MONITOR AND CONTROL CIRCUITS

G830073t22 : CHECK THE ECM TO FPDM MONITOR CIRCUIT FOR SHORT CIRCUIT TO GROUND

1. Set ignition status to OFF. 2. Disconnect the FPDM electrical connector, CA125. 3. Measure the resistance between:

FPDM connector CA125, harness side	Battery
Pin 04	Negative terminal

- Is the resistance less than 10,000 ohms?

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t23.

G830073t23 : CHECK THE ECM TO FPDM MONITOR CIRCUIT FOR SHORT CIRCUIT TO POWER

1. Measure the resistance between:

FPDM connector CA125, harness side	Battery
Pin 04	Positive terminal

- Is the resistance less than 10,000 ohms?

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t24.

G830073t24 : CHECK THE ECM TO FPDM CONTROL CIRCUIT FOR SHORT CIRCUIT TO GROUND

1. Measure the resistance between:

FPDM connector CA125, harness side	Battery
Pin 03	Negative terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t25.

G830073t25 : CHECK THE ECM TO FPDM CONTROL CIRCUIT FOR SHORT CIRCUIT TO POWER

1. Measure the resistance between:

FPDM connector CA125, harness side	Battery
Pin 03	Positive terminal

- **Is the resistance less than 10,000 ohms?**

-> **Yes**

REPAIR the short circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t26.

G830073t26 : CHECK THE ECM TO FPDM MONITOR CIRCUIT FOR HIGH RESISTANCE

1. Disconnect the ECM electrical connector, FL072. 2. Measure the resistance between:

FPDM connector CA125, harness side	ECM connector FL072, harness side

Pin 04	Pin 21

- **Is the resistance greater than 5 ohms?**

-> **Yes**

REPAIR the high resistance circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t27.

G830073t27 : CHECK THE ECM TO FPDM CONTROL CIRCUIT FOR HIGH RESISTANCE

1. Measure the resistance between:

FPDM connector CA125, harness side	ECM connector FL072, harness side
Pin 03	Pin 20

- **Is the resistance greater than 5 ohms?**

-> **Yes**

REPAIR the high resistance circuit. For additional information, refer to the wiring diagrams. CLEAR the DTC, test the system for normal operation.

-> **No**

CHECK for DTCs indicating a module fault.

Electronic Engine Controls

PINPOINT TEST G830073p8 : CHECK THE FUEL SYSTEM PRESSURE

G830073t39 : CHECK THE PUMP ACTIVITY

1. Remove the rear seat cushion.

Rear Seat Cushion (76.70.37) 2. Set ignition status to ON, engine OFF. 3. Listen for pump noise.

- **Can the fuel pump be heard running?**

-> **Yes**

GO to Pinpoint Test G830073t40.

-> **No**

CHECK for DTCs.

Electronic Engine Controls

G830073t40 : CHECK THE FUEL SYSTEM PRESSURE

1.



WARNING: This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

Make sure the vehicle is in **Park** and apply the parking brake. 2. Set ignition status to OFF 3. **NOTE:**

Place suitable absorbent material around the Schraeder valve to absorb any spillage when connecting the gauge set.

Connect adapter and gauge assembly 310-116 to the fuel Schraeder valve. Remove the absorbent material and dispose of safely. 4.



Disconnect and plug the vacuum hose from the pressure regulator. 5. Open the valve on the fuel pressure gauge 310-116. 6. Set ignition status to ON, engine OFF. 7. Record the fuel pressure reading.

- **Is the fuel pressure 3.8 bar (55.11 lb/in²). A slow decay to approximately 3 bar should occur over one minute.**

-> **Yes**

GO to Pinpoint Test G830073t41.

-> **No**

CHECK for DTCs.

Electronic Engine Controls

G830073t41 : CHECK THE FUEL SYSTEM PRESSURE WITH THE ENGINE CRANKING

1. Apply footbrake and press start button. 2. Record the fuel pressure reading when engine cranking.

- Is the fuel pressure 3.8 bar (55.11 lb/in²) nominal.

-> **Yes**

GO to Pinpoint Test G830073t42.

-> **No**

CHECK for DTCs.

Electronic Engine Controls

G830073t42 : CHECK THE FUEL SYSTEM PRESSURE WITH THE ENGINE IDLING (WHERE POSSIBLE)

1. With engine running.

- Is the fuel pressure 3.8 bar (55.11 lb/in²)

-> **Yes**

CHECK for DTCs and symptoms indicating another cause of the problem.

Electronic Engine Controls

-> **No**

CHECK the fuel pump module power and ground circuits.

PINPOINT TEST G830073p9 : CHECK THE FUEL LINES

G830073t43 : CHECK THE FUEL LINES FOR RESTRICTIONS

1.



WARNING: This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

Detach the fuel line from the fuel rail and from the fuel pump module. 2. Using an air line gently blow through the line checking for blockages or restrictions.

- Is a blockage or restriction evident?

-> **Yes**

CLEAR/REPAIR the blocked or restricted fuel line and test the system for normal operation.

-> **No**

GO to Pinpoint Test G830073t44.

G830073t44 : CHECK THE FUEL TANK LINES FOR RESTRICTIONS

1. Remove the fuel pump module locking ring.

Fuel Pump Module (19.45.08) 2. Detach the fuel lines from the fuel pump module. 3. Using an air line gently blow through the tank lines checking for blockages or restrictions.

- **Is a blockage or restriction evident?**

-> **Yes**

CLEAR/REPAIR the blocked or restricted fuel line and test the system for normal operation.

-> **No**

CHECK for DTCs and symptoms indicating another cause for the problem.

Electronic Engine Controls

Fuel Filter (19.25.02)

Removal



WARNING: 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.



WARNING: 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.

1. Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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:** The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



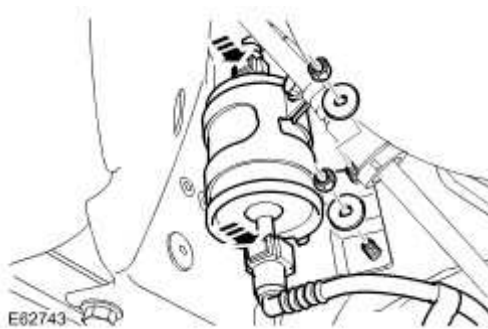
CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

NOTE:

Note the fitted position.

Remove the fuel filter.

- ▶ Position a container to collect spillage.
- ▶ Remove the nut.
- ▶ Disconnect the 2 fuel lines.



4 . Remove the fuel filter bracket.

- ▶ Remove the bolt.



Installation

1 . Attach the fuel filter support bracket.

▶ Install the bolt and tighten to 10 Nm (7 lb.ft).

2 . Install the fuel filter.

▶ Clean the component mating faces.

▶ Connect the fuel lines.

▶ Tighten the nut to 10 Nm (7 lb.ft).

3 . Connect the battery ground cable and install the cover.

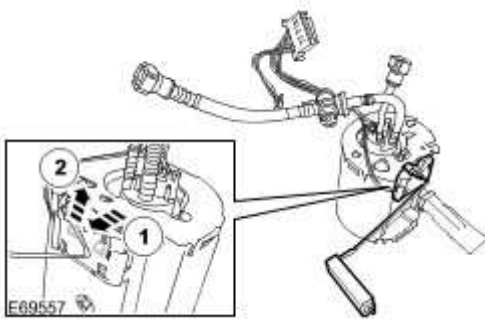
For additional information, refer to Specifications

Fuel Level Sender

Removal

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications
- 2 . Remove the fuel pump module.
For additional information, refer to Fuel Pump Module (19.45.08)
- 3 . Remove the fuel level sender unit.

▶ Carefully release the 2 clips.



Installation

- 1 . Install the fuel level sender unit.
- 2 . Install the fuel pump module.
For additional information, refer to Fuel Pump Module (19.45.08)
- 3 . Connect the battery ground cable and install the cover.
For additional information, refer to Specifications

Fuel Pump Module (19.45.08)

Removal



WARNING: 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.



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



WARNING: 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.



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

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to 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 . With assistance, remove the fuel tank.
For additional information, refer to Fuel Tank (19.55.01)
- 4 . Remove the fuel pump and sender cover locking ring.

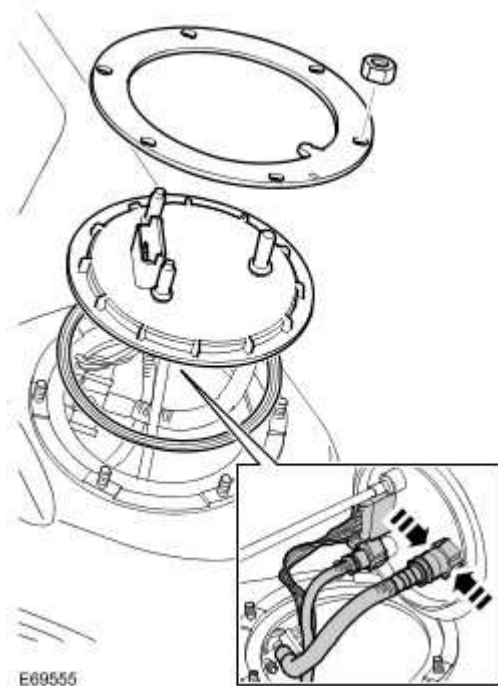
▶ Remove the 6 nuts.

5 . Remove the fuel pump and sender cover.

▶ Disconnect the electrical connector.

▶ Disconnect the 2 fuel lines.

6 . Remove and discard the seal.



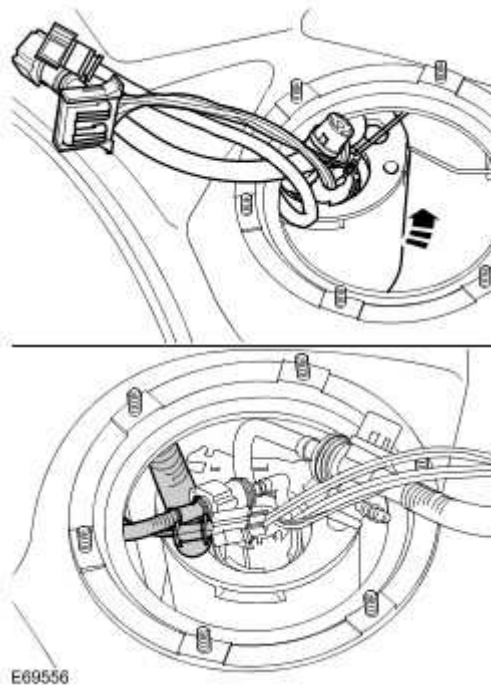
7

⚠ **WARNING:** The fuel tank is manufactured from stainless steel. Hand and arm protection must be used when removing parts from the inside of the tank, to prevent any injury.

⚠ **WARNING:** Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

Remove the fuel pump module.

- ▶ Rotate the pump module counter-clockwise.
- ▶ Disconnect the 2 fuel lines.
- ▶ Disconnect the electrical connector.

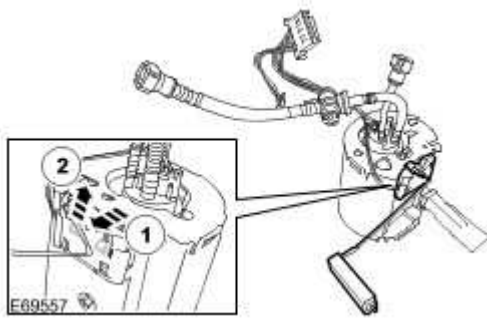


8 . NOTE:

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

Remove the fuel level sender unit.

- ▶ Carefully release the 2 clips.



Installation

1 . Install the fuel level sender unit.

2



WARNING: The fuel tank is manufactured from stainless steel. Hand and arm protection must be used when removing parts from the inside of the tank, to prevent any injury.



WARNING: Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

Install the fuel pump module.

- Connect the hoses.
- Connect and secure the electrical connector.

3 . Install the new O-ring seals.

- Clean the components mating faces.

4 . Install the fuel pump and sender cover.

- Disconnect the electrical connector.

 Disconnect the 2 fuel lines.

5 . Install the fuel pump and sender cover locking ring.

 Tighten the nut to 10 Nm (7 lb.ft).

6 . With assistance, install the fuel tank.

For additional information, refer to Fuel Tank (19.55.01)

7 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Fuel Tank (19.55.01)

Removal



WARNING: Before any work is carried out on the fuel system, ground the vehicle to earth and maintain the ground connection until the work is complete.



WARNING: 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.

- 1 . Remove the cover and disconnect the battery ground cable.
For additional information, refer to Specifications

- 2 . Drain the fuel tank.
For additional information, refer to Fuel Tank Draining

3

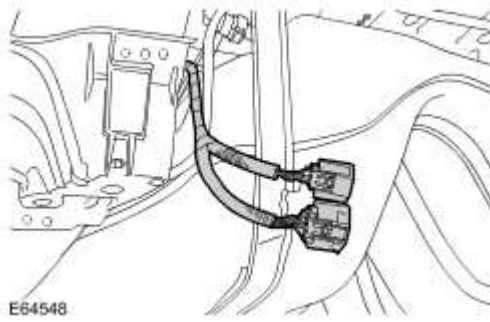


- **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- 4 . Remove the rear sub-frame assembly.
For additional information, refer to Rear Subframe (64.25.01)

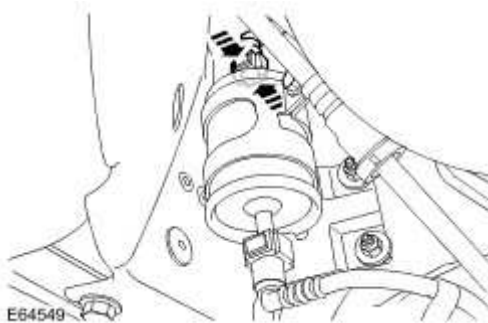
- 5 . Release the 2 electrical connectors.



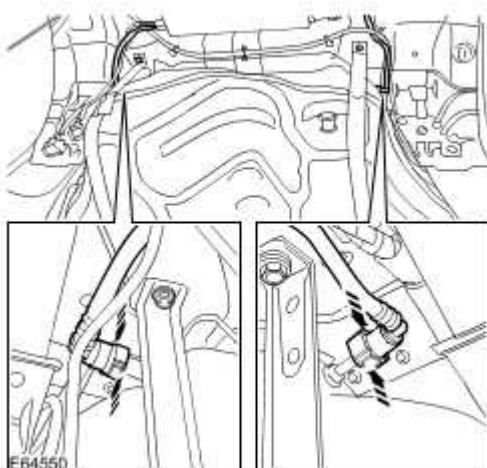
- 6 .  **WARNING:** The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

Disconnect the fuel filter.

-  Release the fuel supply line.



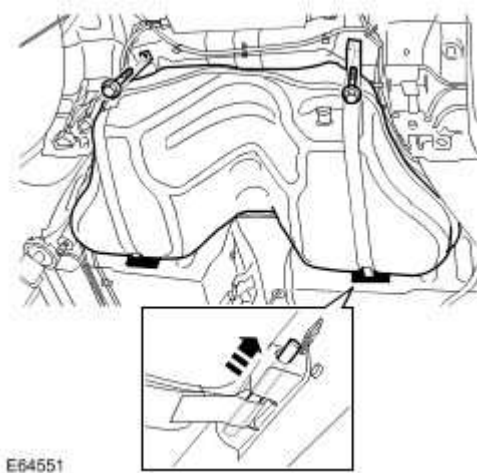
- 7 . Release the fuel filler neck and the evaporative emissions breather hoses.



8 . Using a transmission jack, support the fuel tank.

► Remove the 2 bolts.

► Remove the 2 retaining pins.



9 . Remove the fuel tank.

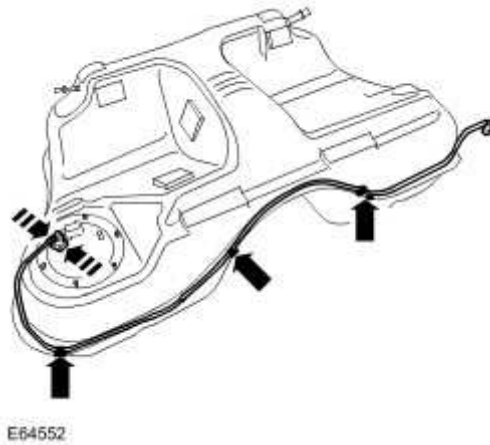
10 . **NOTE:**

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

Remove the fuel line.

▶ Release the 3 clips.

▶ Disconnect the fuel line.



Installation

1 . Install the fuel line.

▶ Carefully secure the clips.

2 . Install the fuel tank.

▶ Using a transmission jack, position and support the fuel tank.

3 . Install the fuel tank straps.

▶ Install the retaining pins.

▶ Tighten the bolts to 25 Nm (18 lb.ft).

4 . Install the fuel filler neck and the evaporative emissions breather hoses.

5 . Secure the electrical connectors.

6 . Connect the fuel filter.

7 . Install the rear sub-frame.

For additional information, refer to Rear Subframe (64.25.01)

8 . Refill the fuel tank.

For additional information, refer to Fuel Tank Draining

9 . Connect the battery ground cable and install the cover.

For additional information, refer to Specifications

Fuel Tank Filler Pipe (19.55.33)

Removal



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



WARNING: 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.



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



WARNING: 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.



WARNING: After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

- 1 . Disconnect the battery ground cable.
For additional information, refer to Specifications

- 2 . Open the fuel filler door and remove the 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.

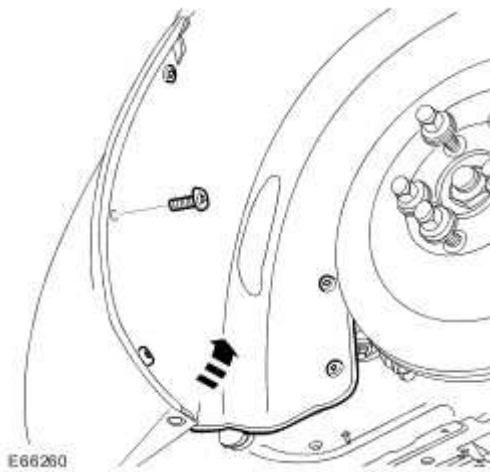
4 . Remove the LH rear wheel and tire.

For additional information, refer to Wheel and Tire (74.20.05)

5 . Release the rear lower edge of the rear fender splash shield.

➤ Remove the 5 Torx bolts.

➤ Tie the splash shield aside.



6 . Release the fuel tank filler pipe.

➤ Release the clip.

7 . Release the breather hose.

➤ Release the clip.

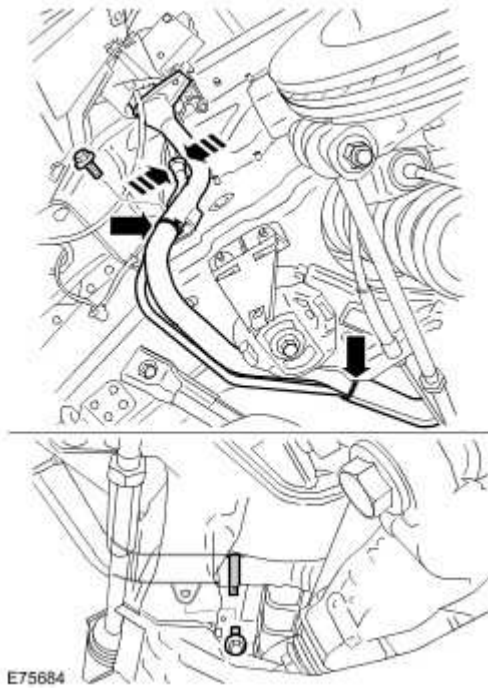
8 . **NOTE:**

Note the fitted position of the locating pegs.

Remove the fuel filler neck assembly.

➤ Remove the 2 bolts.

➤ Remove the 2 clips.



Installation

1 . NOTE:

Align to the position noted on removal.

Install the fuel filler neck assembly.

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

➤ Install the clips.

2 . Install the breather pipes.

 Release the clip.

3 . Install the fuel tank filler pipe.

 Secure the clip.

4 . Install the fender splash shield.

 Tighten the Torx bolts.

5 . Install the wheel and tire assembly.

For additional information, refer to Wheel and Tire (74.20.05)

6 . Install the fuel filler cap and close the fuel filler door.

7 . Connect the battery ground cable.

For additional information, refer to Specifications

310-02 : Acceleration Control

Specifications

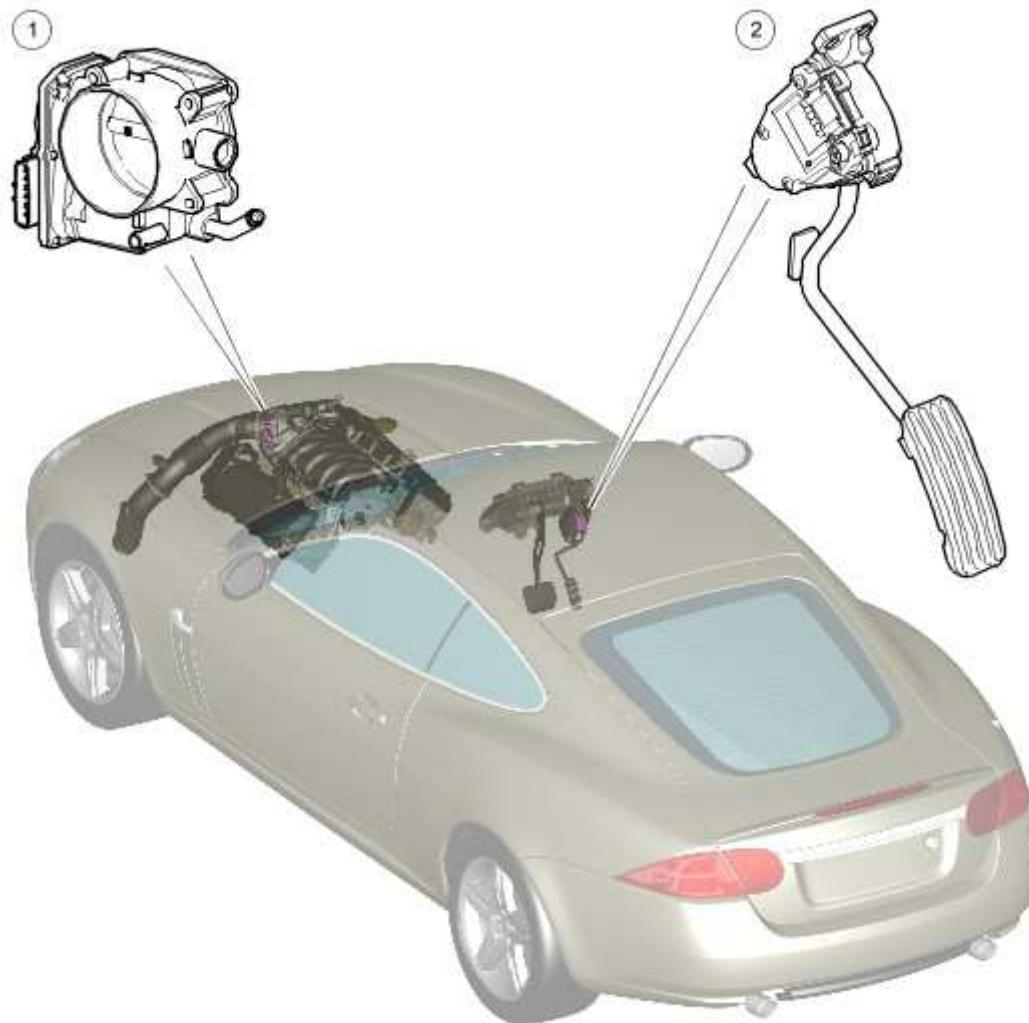
Specifications

Torque Specifications

Item	Nm	lb-ft	lb-in
Accelerator pedal to bracket - screw	10	7	-

Acceleration Control

COMPONENT LOCATION



E62624

Item	Part Number	Description
1		Electric throttle
2		APP sensor

INTRODUCTION

Acceleration control for the 4.2 Liter engine is achieved via an electronic throttle drive by wire system. The throttle is electronically connected to the ECM and the ECM then controls the fueling for the relevant throttle demand signal from the APP sensor.

Acceleration Control

Principle of Operation

For a detailed description of the acceleration control systems, refer to the relevant Description and Operation section in the workshop manual.

Acceleration Control

Inspection and Verification

- 1 . Verify the customer concern by operating the system.
- 2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
• Accelerator pedal • Throttle body	• Fuses • Wiring harness • Electrical connector(s) • Sensor(s) • Engine Control Module (ECM)

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 concern is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index



CAUTION: When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00.

NOTE:

If a module or component is suspect, and the vehicle remains under the Manufacturers warranty, refer to the Warranty Policy and Procedure 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 five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give additional information read by the manufacturer-approved diagnostic system).

NOTE:

When performing electrical voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE:

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE:

If DTCs 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.

DTC	Description	Possible Cause	Action
P012100	Throttle Position (TP) sensor circuits TP 1 and TP 2 - range/performance	- TP sensor sensing circuits TP 1 and TP 2 - short to power, high resistance - TP sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body as necessary. Throttle Body (19.70.04)
P012200	Throttle Position (TP) sensor circuit TP 1 - low input	- TP sensor sensing circuit TP 1 - short to ground, high resistance - TP sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body as necessary. Throttle Body (19.70.04)
P012300	Throttle Position (TP) sensor circuit TP 1 - high input	TP sensor sensing circuit TP1 - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system

		TP sensor failure	Install a new throttle body as necessary. Throttle Body (19.70.04)
P022200	Throttle Position (TP) sensor circuit TP 2 - low input	- TP sensor sensing circuit TP 2 - short to ground, high resistance - TP sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body as necessary. Throttle Body (19.70.04)
P022300	Throttle Position (TP) sensor circuit TP 2 - low input	- TP sensor sensing circuit TP 2- short to power - TP sensor failure	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body as necessary. Throttle Body (19.70.04)
P022700	Accelerator Pedal Position (APP) sensor circuit APP 1 - low input	APP sensor circuit APP 1 - short to ground, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P022800	Accelerator pedal position (APP) sensor circuit APP 1 high input	APP sensor circuit APP 1 - short to power	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P210129	Throttle actuator control motor circuit range/performance	Jammed throttle blade, gearing or motor	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body. Refer to the new module/component installation note at the top of the DTC Index
P210162	Throttle actuator control motor circuit range/performance	Jammed throttle blade, gearing or motor	Refer to the electrical circuit diagrams and test throttle actuator control motor circuit for short to ground, power, high resistance. Compare throttle position sensor 1 and 2 datalogger signals, if signals are comparable install a new throttle body.

			Throttle Body (19.70.04)
P210164	Throttle actuator control motor circuit range/performance	Jammed throttle blade, gearing or motor	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Install a new throttle body. Refer to the new module/component installation note at the top of the DTC Index
P210177	Throttle actuator motor control circuit range/performance (commanded position not reachable)	- Throttle blade stuck open - Intake air system leak	- Check for throttle related DTCs and refer to DTC Index in this section - Check intake air system for leaks
P210329	Throttle actuator motor control circuit high	- Throttle motor control circuit - short to power - ECM fault	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Refer to new module installation Note at top of DTC Index
P210364	Throttle actuator motor control circuit high - signal plausibility failure	- Throttle motor control circuit - short to power - ECM fault	- Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system - Refer to new module installation Note at top of DTC Index
P210500	Throttle actuator control system - forced engine shutdown	Throttle MIL request due to fuel cut	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P210629	Throttle actuator control system - forced limited power	Signal invalid	Install a new throttle body. Throttle Body (19.70.04) Refer to the new module/component installation note at the top of the DTC Index
P210664	Throttle actuator control system - forced	Signal plausibility	Install a new throttle body. Throttle Body (19.70.04) Refer

	limited power	failure	to the new module/component installation note at the top of the DTC Index
P211800	Throttle actuator motor control current range/performance	Throttle motor control circuit - short to ground, power, high resistance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P211900	Throttle actuator control throttle body range/performance - spring	Throttle spring faulty	Install a new throttle body. Throttle Body (19.70.04) Refer to the new module/component installation note at the top of the DTC Index
P212200	Accelerator pedal position (APP) sensor D circuit low input	APP sensor circuit 2 - low input	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P212300	Accelerator pedal position (APP) sensor D circuit high input	APP sensor circuit 2 - high input	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P213528	Accelerator pedal position (APP) sensor 1 and 2 voltage correlation	APP sensor circuit 1 and 2 range performance - sub-processor	Check APP sensor circuits 1 and 2 for short to ground, power and high resistance. Clear the DTCs and retest. If the code remains, replace the APP sensor
P213529	Accelerator pedal position (APP) sensor 1 and 2 voltage correlation	APP sensor - excessive difference between raw values of circuit 1 and 2 - sub-processor	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
P213562	Accelerator pedal position (APP) sensor 1 and 2 voltage correlation	APP sensor circuit 1 and 2 range performance - sub-processor	Check APP sensor circuits 1 and 2 for short to ground, power and high resistance. Clear the DTCs and retest. If the code remains, replace the

			APP sensor
P213564	Accelerator pedal position (APP) sensor 1 and 2 voltage correlation	APP sensor circuit 1 and 2 range performance	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system

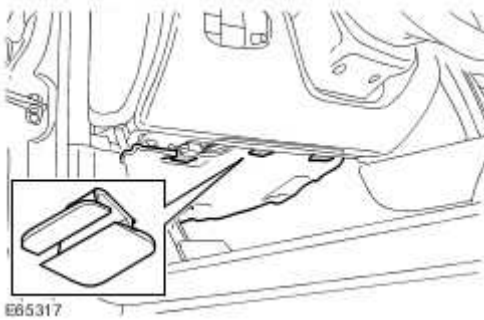
Accelerator Pedal (19.20.01)

Removal

- 1  **CAUTION: Removal of the clips is a delicate procedure, damage will occur if any force is used.**

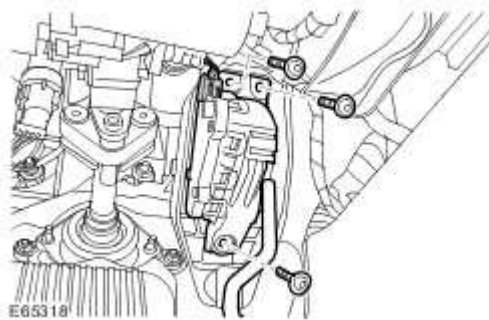
Remove the driver's side footwell trim panel.

- ▶ Carefully release the 3 clips.



- 2 . Remove the throttle pedal assembly.

- ▶ Remove the 3 Torx screws.
- ▶ Disconnect the electrical connector.



Installation

- 1 . Install the throttle pedal assembly.

 Connect the electrical connector.

 Install the Torx screws.

2 . Install the driver's side footwell trim panel.

 Carefully align and secure the clips.

310-03 : Speed Control

Specifications

Specifications

General Specifications

Speed control sensor - vertical alignment	$90^{\circ} \pm 0.75^{\circ}$

Torque Specifications

Item	Nm	lb-ft	lb-in
Speed control module - nut	5	4	44
Speed control sensor - bolt	5	4	44
Speed control sensor, adjustment - lock nut	5	4	44
Speed control switch.	-	-	-

Speed Control Sensor Adjustment

Special Service Tools



Inclinometer
501-F007

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 front bumper cover.
Front Bumper Cover (76.22.78)

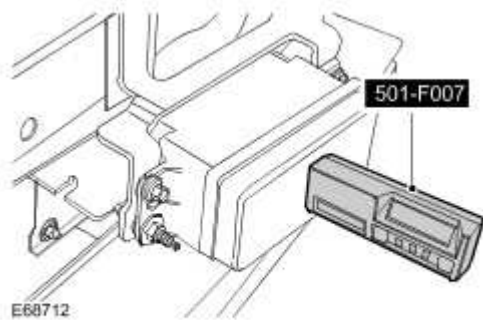
3.



CAUTION: Drive the vehicle on to a flat, level surface.

Position the vehicle on a smooth level surface and settle the suspension.

4. Using the special tool, check the speed sensor is level, (+/- 0.5 degree).



5. NOTE:

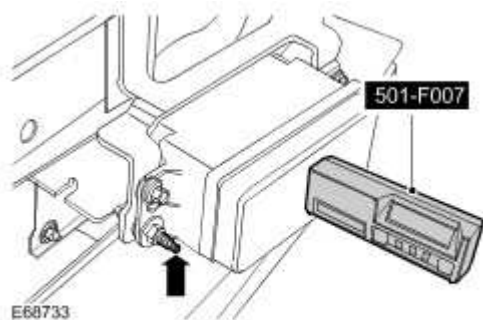
The speed sensor has no mechanical horizontal adjustment.

NOTE:

Do not release the lock nut.

Using the special tool, set the speed control sensor.

- Rotate the vertical adjuster.
- Adjust using an internal Torx Bit.



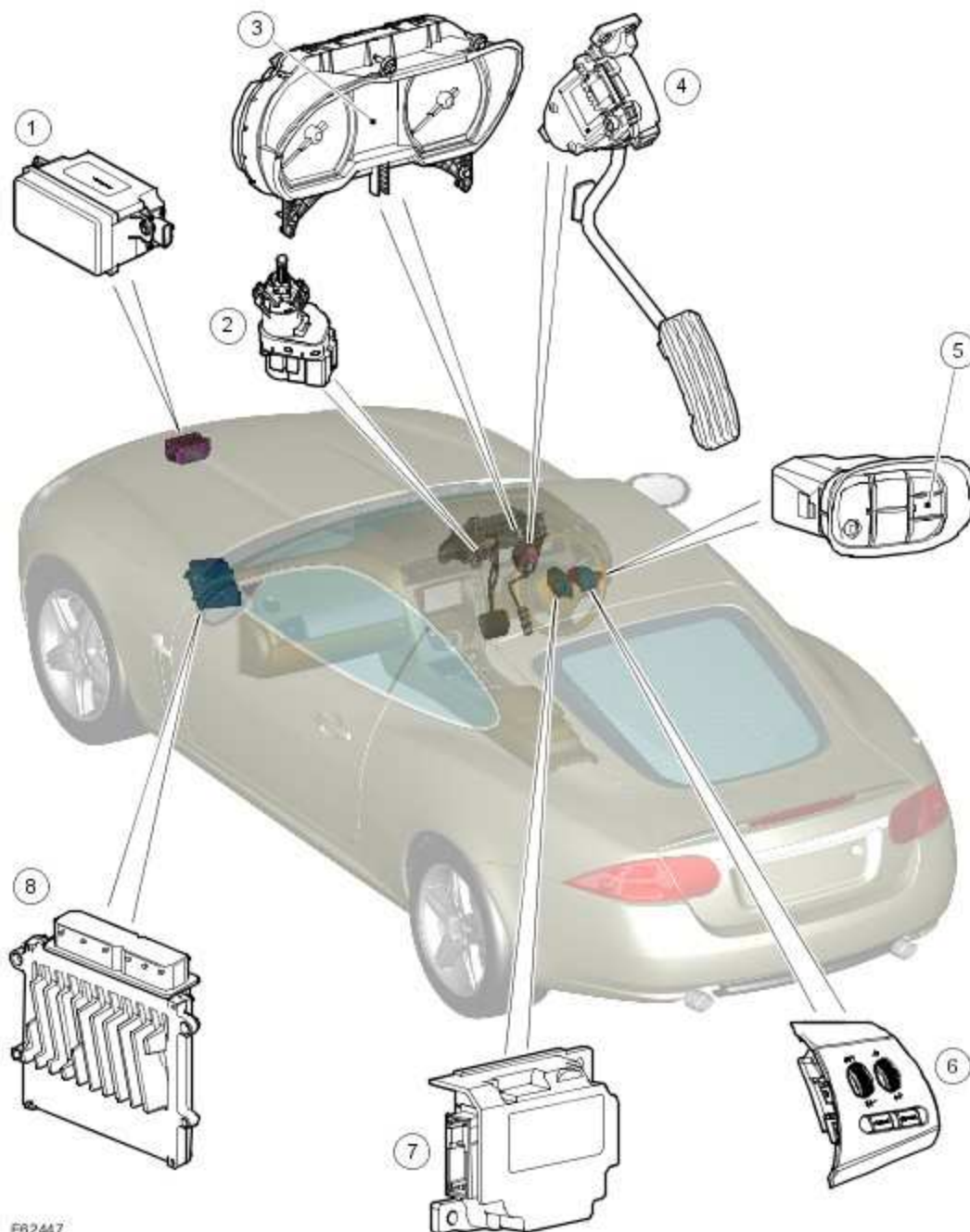
6. Install the front bumper cover.
Front Bumper Cover (76.22.78)

Control

COMPONENT LOCATION

NOTE:

RHD shown, LHD similar



Item	Part Number	Description
1		Adaptive speed control sensor (Adaptive speed control only)
2		Brake switch
3		Instrument cluster warning lamps and icons
4		APP sensor
5		Forward alert switch (adaptive speed control system only)
6		Steering wheel mounted speed control switches
7		Adaptive speed control module (adaptive speed control system only)
8		ECM

INTRODUCTION

There are two variants of speed control available, a standard system and an adaptive system. The standard system maintains a set speed selected by the driver until operation is suspended or cancelled by a further input from the driver and is controlled by the ECM. The adaptive system includes the same functionality as the standard system, but also has the ability to:

- Reduce vehicle speed, to less than the set speed, in order to maintain a selected distance behind a slower moving vehicle
- Accelerate the vehicle back to the set speed, once the way ahead is clear, after reducing the set speed because of a slower moving vehicle
- Alert the driver when the vehicle comes within a given distance of a slower moving vehicle

The standard system and the adaptive system both have the following components:

- A set +/- switch
- A RESUME switch
- A CANCEL switch

Both systems also use:

- The ECM.
- The brake switch.
- The APP sensor.

The adaptive system incorporates the following additional components:

- An adaptive speed control module
- An adaptive speed control sensor
- A forward alert switch
- A Time gap switch

SPEED CONTROL

The speed control system is integrated with the engine management system and uses fueling intervention to automatically maintain a set vehicle speed. Once engaged, the system can also be used to accelerate the vehicle without using the accelerator pedal. The speed control system comprises the following components:

- Resume/Suspend switch
- '+' and '-' (set/accelerate and decelerate)
- Clock spring

The speed control system also uses inputs from the brake pedal switch, the APP sensor, the ECM and the ABS Control Module.

The speed control is operated by the driver using only the steering wheel switches. When speed control is active, the ECM controls the electronic throttle to adjust the fuel supply as required to maintain the set speed.

The minimum set speed for speed control is 20 mph (32 (km/h). Speed control is automatically suspended if the following conditions apply:

- Vehicle speed falls below 20 mph (32 km/h).
- The brake pedal is pressed.
- The cancel button is pressed.
- Neutral, park or reverse gear is selected.
- The difference between actual speed and the set speed is too great.
- When the vehicle speed reaches a maximum speed of 120 mph (192 kph).
- If the accelerator pedal is used to accelerate beyond the set speed for too long.

SPEED CONTROL SWITCHES



Item	Part Number	Description
1		Set speed adjustment
2		Cancel switch
3		Resume switch

There are three speed control switches:

- Speed adjustment
- Cancel
- Resume

The speed control switches are located on the RH (Right-hand) side of the steering wheel. The switches are connected via fly leads to the clock spring. The speed control switches are resistive ladder type switches which vary the resistance of a 5 volt signal sent to them. The signal is returned along a Lin bus to the instrument cluster. The instrument cluster routes the control signals to the ECM on the MS CAN.

Speed control is engaged by rotating the speed adjustment switch to the + or - positions. Once engaged the speed can be varied by the speed adjustment switches. Each press of the speed adjustment switch will increase or decrease the set speed in steps of 1 mph (2 kph).

ADAPTIVE SPEED CONTROL

The adaptive speed control system comprises the following components:

- Adaptive Speed Control Sensor
- Adaptive Speed Control module
- Steering wheel control switches
- ECM
- Electric throttle
- ABS module and pump
- Adaptive Speed Control warning lamp (in the instrument cluster)

The adaptive speed control system uses a forward looking radar sensor to scan the road ahead, looking for objects that are moving at a different rate to itself. When a target is identified the adaptive speed control system will monitor the time gap between it and the target vehicle. When that gap falls below a set driver selected level the adaptive speed control system will intervene slowing the vehicle by backing off the throttle and/ or applying the brakes, until the correct gap is attained. The driver can chose between four gap settings, 1, 1.4, 1.8 and 2.2 seconds.

The system will detect but not react to the following:

- Vehicles in the oncoming lane
- Stationary vehicles
- Pedestrians
- Vehicles not in the same lane

Adaptive speed control is active when the vehicle is moving. Adaptive Speed Control only functions when a set speed is entered in normal speed control mode. The adaptive speed control system only intervenes with the set speed when it detects a target vehicle, and then only if the minimum time gap is breached.

It is important to note that the system is intended for use in limited driving situations, does not remove control and responsibility from the driver, and at all times can be quickly overridden. The adaptive speed control system is not a collision warning system and will not react to stationary objects. The system does not operate below a minimum speed of approximately 32 km/h (20 mph) since it is unsuitable for use in cities or congested traffic. The system is best suited to main roads/ highways with gradual bends.

The ECM, throttle body and throttle control are unchanged from those used for non Adaptive Speed Control variants.

RADAR SENSING

The adaptive speed control system is based on the use of a front mounted radar sensor. The sensor transmits a 1.5° wide beam forward of the vehicle and detects the returning signals reflected off other vehicles and objects ahead.

The 1.5° wide radar beam is mechanically scanned at a rate of 10 sweeps/second across a total arc of 15° centered on the longitudinal axis of the vehicle. The radar operates at millimetric wavelengths (76 - 77 GHz) and transmits a frequency modulated continuous wave signal at a relatively low power level (no high power pulses).

With the ignition switched ON, the adaptive speed control module is powered up but no radar transmissions are emitted until the vehicle is in motion.

The radar sensor detects three primary parameters of objects within the scanned arc. These are:

- Range
- Relative velocity
- Angle

Range

the radar sensor detects the presence and ranges of different vehicles and objects within the scanned arc up to a distance of approximately 130 meters. The transmitted signal frequency changes continuously in a cyclic pattern (modulation). This means that, in the time taken for the signal wave front, to travel to and from a target vehicle (or other object), the transmission frequency will have changed. The difference between the received signal frequency and the new transmission frequency is proportional to the distance between the transmitting vehicle and the target vehicle.

Relative Velocity

when the signal is reflected off a vehicle moving at a different speed (opening or closing gap) an effect known as the Doppler shift causes an extra frequency modulation to be imposed on the signal. This Doppler frequency varies with the relative speed of the vehicle being followed, enabling the system to differentiate between vehicles traveling at different speeds and also between moving vehicles and stationary objects.

Angle

Using a narrow angle beam to scan horizontally enables the system to distinguish between vehicles in different lanes and between vehicles and roadside objects.

FOLLOW MODE

A set speed is selected in the normal speed control manner and this speed is maintained until a slower vehicle is encountered in the lane ahead. When the vehicle ahead comes within the effective range of the radar sensor, the system identifies it as a target vehicle and an icon is illuminated on the instrument cluster to indicate that the system is in "follow mode". When the distance between the two vehicles closes to a set time gap, the adaptive speed control system closes the throttle and if necessary applies the brakes to maintain the set time gap. Follow mode is effectively a closed loop system. If several vehicles are ahead, the closest vehicle is chosen as the target to follow. If the target vehicle moves out of radar range, or if either vehicle changes lane or drops below the minimum operating speed, the system exits follow mode and the follow mode icon is extinguished. The adaptive speed control system will only raise its speed to the originally set speed, it will not accelerate past this speed to maintain a time gap.

Driver operation of the foot brake or control switches will immediately cancel adaptive speed control.

When the vehicle is in follow mode the follow mode warning indicator is illuminated in the instrument cluster and the current gap setting will be displayed in the message center.



Item	Part Number	Description
1		Follow mode warning indicator

SYSTEM RESTRICTIONS

The adaptive speed control system is only intended to provide enhanced speed control as described above in certain restricted conditions.

The following points should be noted:

- Automatic braking is limited to approximately 30% of full pressure (0.3G deceleration) and is intended to provide a smooth, gradual deceleration in follow mode conditions. Harsh braking by the target vehicle or following the target vehicle down to very low speeds or to a halt will require driver override of the brakes.
- While the radar sensor detects moving and stationary targets for assessment of the environment ahead, the system does not react to or provide any control in situations other than follow mode conditions. Stationary or slow moving vehicles (below 10 km/h), pedestrians, objects on the road and oncoming vehicles in the same lane are not recognized.



WARNING: It must be emphasized that the adaptive speed control system is not a collision warning or avoidance system and that, other than the limited conditions of follow mode, driver intervention will be necessary to control the vehicle speed.

In follow mode, some situations may cause target ambiguities for the detection system. These situations include:

- The nearby presence of a third vehicle when driving on a line slightly offset to the target vehicle
- Vehicles edging into the lane ahead which are not detected by the system until they have moved into the radar beam.

On the approach to, or exit from a bend, a target vehicle may be lost or a new target acquired as vehicles ahead change their angular position with respect to the radar sensor. On a straight road, if the sensing vehicle is in follow mode below its selected set speed, losing the target vehicle will cause the sensing vehicle to accelerate to this set speed. This acceleration is undesirable either on, or entering a bend when the target is suddenly lost, and in this situation the system inhibits the resumption of the set speed.

The speed control system compares vehicle speed data from the ABS system with the relative speed of an external object as detected by the radar sensor to ascertain whether the object is stationary or not.

NOTE:

If tires are fitted which are different in diameter from those specified for the vehicle, the vehicle speed calculated by the ABS will not be the true road speed. This situation may cause stationary objects to be falsely identified as moving vehicles and result in automatic

deceleration on a clear road.

ADAPTIVE SPEED CONTROL SWITCHES



Item	Part Number	Description
1		Set speed adjustment switch
2		Time gap switch
3		Cancel switch
4		Resume switch

The Adaptive Speed control system is controlled from the steering wheel switches. The switches are the same as used for normal speed control with the addition of an extra time gap setting switch. The time gap setting switch allows the driver to adjust the time gap to one of four pre-set time gaps. The selected time gap is displayed in the vehicle message center.

The time gap will return to the default gap (the third setting) each time the ignition is cycled.

ADAPTIVE SPEED CONTROL MODULE

The Adaptive Speed Control module, located on the bottom of the RH (right-hand) A pillar. The control module is connected to the other vehicle systems via the high speed CAN bus. Signals from the Adaptive Speed Control forward looking radar sensor are received on a dedicated CAN bus between the two modules.

ADAPTIVE SPEED CONTROL RADAR SENSOR

The adaptive speed control radar sensor is mounted centrally behind the front bumper. The sensor is connected to the Adaptive Speed Control, module via a private CAN bus. If the unit is replaced in service the unit must be re-aligned vertically.

Horizontal alignment is achieved by putting the sensor in service mode via IDS. The vehicle is then driven for a short period while the sensor calibrates itself. Calibration is complete when the 'follow' icon in the instrument cluster stops flashing.

FORWARD ALERT

The forward alert system utilizes the Adaptive Speed Control system components. Forward alert is turned on and off independently of Adaptive Speed Control, via a switch mounted in the lower outboard knee bolster switchpack. Forward alert will notify the driver by means of a chime, and warning indicator in the instrument cluster and indication in the message center, when a target vehicle comes into range. The system will NOT use throttle or brake intervention to slow the vehicle.



Item	Part Number	Description
1		Forward alert switch

The forward alert switch is connected to the instrument cluster in a resistive ladder with the luggage compartment opening switch and the fuel filler flap switch. The instrument cluster sends the forward alert information to the Adaptive speed control module on the CAN bus.

NOTE:

This system is intended as a driver aid and should be used as such. The system is NOT a

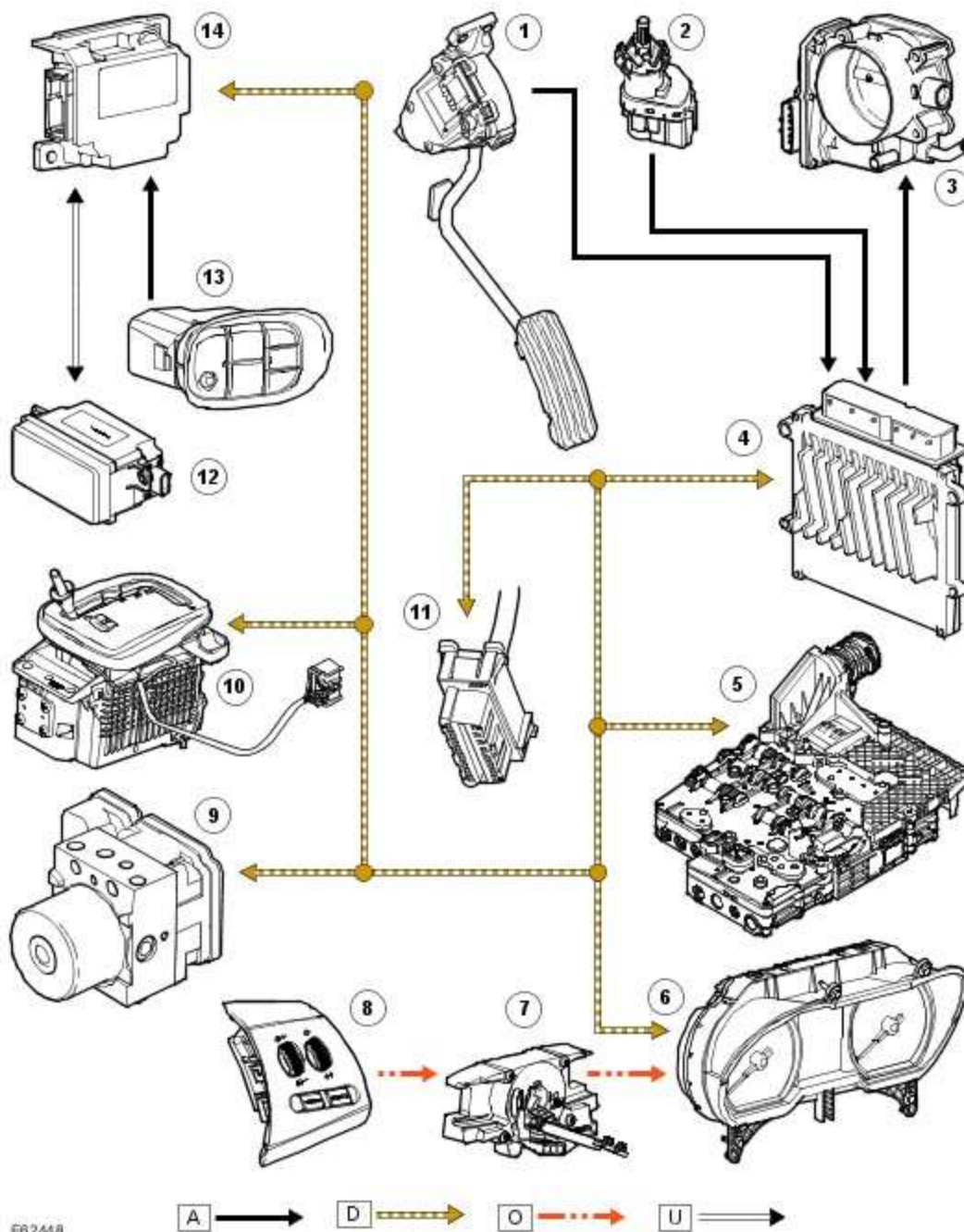
collision warning or avoidance device.

The system sensitivity can be adjusted in the same manner as the Adaptive Speed Control, via the steering wheel mounted switches. Each adjustment is accompanied by a message in the message center.

CONTROL DIAGRAM

NOTE:

A = Hardwired connection; D = High speed CAN bus; O = LIN (local interconnect network) bus; U = Private CAN



Item	Part Number	Description
1		APP sensor
2		Brake switch
3		Electric throttle
4		ECM
5		TCM
6		Instrument cluster
7		Clock spring
8		Steering wheel speed control switches
9		ABS module
10		Transmission selector lever
11		Diagnostic socket
12		Adaptive speed control sensor (adaptive speed control system only)
13		Forward alert switch (adaptive speed control system only)
14		Adaptive speed control module (adaptive speed control system only)

Speed Control

Principles of Operation

There are two options of speed control available, adaptive speed control and non-adaptive speed control. For a detailed description of the speed control systems, refer to the relevant Description and Operation section in the workshop manual.

Speed Control

Inspection and Verification

1 . Verify the customer concern.

2 . Visually inspect for obvious signs of damage and system integrity.

Mechanical	Electrical
- Speed control sensor - Ensure the speed control sensor is free from obstructions - Speed control module	- Fuses - Wiring harness - Electrical connector(s) - Steering wheel switches - Brake switch - Speed control sensor - Speed control module - Engine Control Module (ECM)

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, verify the symptom and refer to the Symptom Chart, alternatively, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Speed Control Sensor Adjustment (vehicles with adaptive system installed)

An incorrectly aligned speed control sensor can cause incorrect system operation. Before starting any repair work on the speed control system, on vehicles with the adaptive system installed, check the adjustment of the speed control sensor.

Speed Control Sensor Adjustment

Symptom Chart

Symptom	Possible Cause	Action
Speed control inhibited	Default mode enabled	Check for Network related DTCs that could be caused by power failure to

or disabled	• Supply voltage to speed control module • Supply voltage to speed control sensor • Steering wheel speed control switch(s) • Steering wheel speed control switch circuit • Throttle sensors • Brake switch	the module or sensor and refer to DTC Index. Communications Network • For steering wheel speed control switch and circuit tests. GO to Pinpoint Test G831824p9. • For engine throttle position sensor tests. Electronic Engine Controls Electronic Engine Controls • For brake switch tests. GO to Pinpoint Test G831824p10.
Unable to regulate/adjust vehicle speed	• Steering wheel switch malfunction	• For speed control switch circuit tests. GO to Pinpoint Test G831824p9.
Unable to cancel speed control from steering wheel	• Steering wheel switch malfunction	• For speed control switch circuit tests. GO to Pinpoint Test G831824p9.
Unable to cancel speed control from brake pedal	• Brake switch malfunction	• For brake switch tests. GO to Pinpoint Test G831824p10.

DTC Index



CAUTION: When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00

NOTE:

If a module or component is suspect, and the vehicle remains under the Manufacturers warranty, refer to the Warranty Policy and Procedure 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 five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give extra information read by the manufacturer-approved diagnostic

system).

NOTE:

When performing voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places and with a current calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

NOTE:

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

NOTE:

If DTCs 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.

DTC	Description	Possible Cause	Action
B1A84-81	Car configuration data	RJB reporting invalid car configuration parameters	Re-configure RJB using manufacturer approved diagnostic system and re-test.
C1A67-54	Speed control sensor alignment angle - out of range	Speed control sensor out of alignment	Carry out speed control sensor adjustment procedure. Speed Control Sensor Adjustment
C1A67-81	Speed control sensor - Yaw rate sensor	Yaw rate voltage - out of range	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
C1A67-87	Speed control sensor - Missing data	Incorrect or missing data from speed control sensor	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
C1A67-96	Speed control sensor - Internal sensor failure	Internal hardware failure	Install a new speed control sensor. Speed Control Sensor

C1A67-97	Speed control sensor - reduced visibility	• Sensor reduced visibility	This DTC will be cleared automatically when environmental conditions allow
C1A67-98	Speed control sensor - temperature high	• Speed control sensor internal temperature exceeded threshold	This DTC will be cleared automatically when environmental conditions allow
P174E-81	ABS wheel speed correlation - active speed output error	• Follow speed is miscalculated to too high a value	Using the manufacturer approved diagnostic system, clear the DTC and re-test. If the DTC is logged contact Dealer Technical Support.
U0001-88	High speed CAN communication Bus	• Vehicle CAN Bus off condition	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U0100-00	Lost communications with ECM	• ECM missing message	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U0101-00	Lost communications with TCM	• TCM missing message	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U0121-00	Lost communication with ABS	• ABS missing message	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U0128-00	Lost communications with parking brake module	• Parking brake missing message	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U0155-00	Lost communications with instrument cluster	• Instrument cluster missing message	Carry out any pinpoint tests associated with this DTC using the manufacturer approved diagnostic system
U0300-	Internal control module software	• Invalid configuration	Re-configure the RJB using the manufacturer approved diagnostic

00	incompatibility	message is received	system. Clear DTCs and re-test. If DTC still logged, suspect speed control module. Refer to new module installation note at top of DTC Index
U0300-55	Control module software incompatibility - module configuration failure	RJB - at least one of the car configuration parameters is not configured	Re-configure the RJB using the manufacturer approved diagnostic system. Clear DTCs and re-test.
U0401-00	Invalid data received from ECM - ECM cancel fault	ECM did not respond properly to speed control cancel or auto brake cancel request	Check ECM for DTCs and refer to DTC Index. Electronic Engine Controls Electronic Engine Controls
U0401-67	Invalid data received from ECM - ECM resume fault	ECM did not respond properly to speed control resume request	Check ECM for DTCs and refer to DTC Index. Electronic Engine Controls Electronic Engine Controls
U0401-81	Invalid data received from ECM - speed control inhibited by ECM	Speed control inhibited by ECM	Check ECM for DTCs and refer to DTC Index. Electronic Engine Controls Electronic Engine Controls
U0415-81	Invalid data received from ABS	Stability assist fault	Check ABS module for DTCs and refer to DTC Index. Anti-Lock Control - Stability Assist
U0417-67	Invalid data received from parking brake module - parking brake apply acknowledge	Parking brake module did not respond properly to apply request	Check parking brake module for DTCs and refer to DTC Index. Parking Brake
U0417-81	Invalid data received from parking brake module	Speed control inhibited by parking brake module	Check parking brake module for DTCs and refer to DTC Index. Parking Brake
U0422-00	Invalid data received from CJB	CJB message not updated	Check CJB for DTCs and refer to DTC Index. Communications Network
U0423-	Invalid data received	Instrument cluster not	Check instrument cluster for DTCs

81	from instrument cluster	enabled for adaptive speed control	and refer to DTC Index. Instrument Cluster
U0443-00	Invalid data received from RJB	RJB message not updated	Check RJB for DTCs and refer to DTC Index. Communications Network
U1A00-88	Private CAN Bus circuit	Private CAN Bus off condition	Refer to wiring diagrams and test Private CAN Bus circuit between speed control module and speed control sensor for circuit faults
U1A14-49	CAN initialisation failure	Internal electronic failure	Install a new speed control module, refer to the new module installation note at the top of the DTC Index. Speed Control Module - Vehicles Without: Adaptive Speed Control (19.75.26)
U2101-00	Control module configuration incompatible	Data sent from RJB is invalid	Re-configure RJB using manufacturer approved diagnostic tool, clear DTC and re-test. If DTC remains check RJB for DTCs and refer to DTC Index. Communications Network
U3000-41	Control module	- Internal micro controller error - Checksum fault	Install a new speed control module, refer to new module installation note at top of DTC Index
U3000-42	Control module	Internal RAM test fault	Install a new speed control module, refer to new module installation note at top of DTC Index
U3000-49	Control module	Internal control module failure	Install a new speed control module, refer to the new module installation note at the top of the DTC Index

Pinpoint Tests

PINPOINT TEST G831824p9 : SPEED CONTROL SWITCH CIRCUIT TESTS

G831824t29 : CHECK THE STEERING WHEEL SPEED CONTROL SWITCH FOR OPEN CIRCUIT

1. Disconnect the battery negative terminal.

Battery (86.15.01) 2. Wait two minutes for the system to become safe. 3. Disconnect the speed control switch connector SW009. 4. Measure the resistance between:

speed control switch connector SW009, pin 02, component side

speed control switch connector SW009, pin 03, component side

- **Is the resistance 4310 ohms?**

-> **Yes**

GO to Pinpoint Test G831824t23.

-> **No**

INSTALL a new speed control switch assembly.

Speed Control Switch (19.75.25) TEST the system for normal operation.

G831824t23 : CHECK THE STEERING WHEEL SPEED CONTROL RESUME SWITCH CIRCUIT

1. Measure the resistance between:

speed control switch connector SW009, pin 02, component side

speed control switch connector SW009, pin 03, component side 2. Operate the **RESUME** switch.

- **Does the resistance switch between 4310 ohms and 2110 ohms when the switch is operated?**

-> **Yes**

GO to Pinpoint Test G831824t24.

-> **No**

INSTALL a new speed control switch assembly.

Speed Control Switch (19.75.25) TEST the system for normal operation.

G831824t24 : CHECK THE STEERING WHEEL SPEED CONTROL SET+ SWITCH CIRCUIT

1. Measure the resistance between:

speed control switch connector SW009, pin 02, component side

speed control switch connector SW009, pin 03, component side 2. Operate the **SET+** switch.

- **Does the resistance switch between 4310 ohms and 1110 ohms when the switch is operated?**

-> **Yes**

GO to Pinpoint Test G831824t25.

-> **No**

INSTALL a new speed control switch assembly.

Speed Control Switch (19.75.25) TEST the system for normal operation.

G831824t25 : CHECK THE STEERING WHEEL SPEED CONTROL HEADWAY REDUCTION SWITCH CIRCUIT

1. Measure the resistance between:

speed control switch connector SW009, pin 02, component side

speed control switch connector SW009, pin 03, component side 2. Operate the **HEADWAY REDUCTION** switch.

- **Does the resistance switch between 4310 ohms and 600 ohms when the switch is operated?**

-> **Yes**

GO to Pinpoint Test G831824t26.

-> **No**

INSTALL a new speed control switch assembly.

Speed Control Switch (19.75.25) TEST the system for normal operation.

G831824t26 : CHECK THE STEERING WHEEL SPEED CONTROL HEADWAY INCREASE SWITCH CIRCUIT

1. Measure the resistance between:

speed control switch connector SW009, pin 02, component side

speed control switch connector SW009, pin 03, component side 2. Operate the **HEADWAY INCREASE** switch.

- **Does the resistance switch between 4310 ohms and 300 ohms when the switch is operated?**

-> **Yes**

GO to Pinpoint Test G831824t27.

-> **No**

INSTALL a new speed control switch assembly.

Speed Control Switch (19.75.25) TEST the system for normal operation.

G831824t27 : CHECK THE STEERING WHEEL SPEED CONTROL SET- SWITCH CIRCUIT

1. Measure the resistance between:

speed control switch connector SW009, pin 02, component side

speed control switch connector SW009, pin 03, component side 2. Operate the **SET-** switch.

- **Does the resistance switch between 4310 ohms and 120 ohms when the switch is operated?**

-> **Yes**

GO to Pinpoint Test G831824t28.

-> **No**

INSTALL a new speed control switch assembly.

Speed Control Switch (19.75.25) TEST the system for normal operation.

G831824t28 : CHECK THE STEERING WHEEL SPEED CONTROL CANCEL SWITCH CIRCUIT

1. Measure the resistance between:

speed control switch connector SW009, pin 02, component side

speed control switch connector SW009, pin 03, component side 2. Operate the **CANCEL** switch.

- **Does the resistance switch between 4310 ohms and zero ohms when the switch is operated?**

-> **Yes**

GO to Pinpoint Test G831824t30.

-> **No**

INSTALL a new speed control switch assembly.

Speed Control Switch (19.75.25) TEST the system for normal operation.

G831824t30 : CHECK THE STEERING WHEEL SPEED CONTROL SWITCH CIRCUIT FOR OPEN CIRCUIT

1. Measure the resistance between:

speed control switch connector SW009, pin 02, harness side

steering wheel audio control switch connector SW004, pin 02, harness side

- **Is the resistance greater than 5 ohms?**

-> **Yes**

REPAIR the circuit speed control switch connector SW009, pin 02 to clockspring connector SW004, pin 02. For additional information, refer to the wiring diagrams. TEST the system for normal operation.

-> **No**

GO to Pinpoint Test G831824t1.

G831824t1 : CHECK THE STEERING WHEEL SPEED CONTROL SWITCH FOR OPEN CIRCUIT

1. Measure the resistance between:

speed control switch connector SW009, pin 03, harness side

steering wheel audio control switch connector SW004, pin 03, harness side

- **Is the resistance greater than 5 ohms?**

-> **Yes**

REPAIR the circuit speed control switch connector SW009, pin 02 to clockspring connector SW004, pin 02. For additional information, refer to the wiring diagrams. TEST the system for normal operation.

-> **No**

No fault has been identified with the speed control switch or circuit, check integrity of connections. Refer to the electrical circuit diagrams and test the LIN circuit between the steering wheel audio switch and the instrument cluster. Test the steering wheel audio switch.

Audio System

PINPOINT TEST G831824p10 : BRAKE SWITCH CIRCUIT TEST

G831824t33 : CHECK THE BRAKE SWITCH FUNCTION, WITH THE BRAKE PEDAL RELEASED

1. Set ignition status to OFF. 2. Disconnect the brake switch connector CA142. 3. Measure the resistance between:

Brake switch connector CA142, pin 02 component side

Brake switch connector CA142, pin 03 component side

- **Is the resistance greater than 5 ohms?**

-> **Yes**

INSTALL a new brake switch.

Speed Control Deactivator Switch (19.75.20) TEST the system for normal operation.

-> **No**

GO to Pinpoint Test G831824t34.

G831824t34 : CHECK THE BRAKE SWITCH FUNCTION, WITH THE BRAKE PEDAL DEPRESSED

1. Measure the resistance between:

Brake switch connector CA142, pin 02 component side

Brake switch connector CA142, pin 03 component side

- **Is the resistance greater than 10,000 ohms?**

-> **Yes**

GO to Pinpoint Test G831824t35.

-> **No**

INSTALL a new brake switch.

Speed Control Deactivator Switch (19.75.20) TEST the system for normal operation.

G831824t35 : CHECK THE BRAKE SWITCH GROUND CIRCUIT FOR OPEN CIRCUIT

1. Measure the resistance between:

Brake switch connector CA142, pin 03

GROUND

- **Is the resistance greater than 5 ohms?**

-> **Yes**

REPAIR the circuit between the brake switch connector CA142, pin 03 and GROUND. For additional information, refer to the wiring diagrams. TEST the system for normal operation.

-> **No**

GO to Pinpoint Test G831824t36.

G831824t36 : CHECK THE ECM TO BRAKE SWITCH CIRCUIT FOR OPEN CIRCUIT

1. Disconnect the ECM connector, FL072. 2. Measure the resistance between:

ECM connector FL072, pin 40

Brake switch connector CA142, pin 02

- **Is the resistance greater than 5 ohms?**

-> **Yes**

GO to Pinpoint Test G831824t4.

-> **No**

No fault is indicated with the brake switch or circuit. Check the integrity of all connections and TEST the system for normal operation.

G831824t4 : CHECK THE ECM TO BRAKE SWITCH CIRCUIT FOR OPEN CIRCUIT

1. Disconnect intermediate electrical connector FL002. 2. Measure the resistance between:

ECM connector FL072, pin 40

Intermediate electrical connector FL002, pin 13

- **Is the resistance greater than 5 ohms?**

-> **Yes**

REPAIR the circuit between the ECM connector FL072, pin 40 and intermediate electrical connector FL002, pin 13. For additional information, refer to the wiring diagrams. TEST the system for normal operation.

-> **No**

GO to Pinpoint Test G831824t5.

G831824t5 : CHECK THE ECM TO BRAKE SWITCH CIRCUIT FOR OPEN CIRCUIT

1. Measure the resistance between:

Brake switch connector CA142, pin 02

Intermediate electrical connector FL002, pin 13

- **Is the resistance greater than 5 ohms?**

-> Yes

REPAIR the circuit between the brake switch connector CA142, pin 02 and intermediate electrical connector FL002, pin 13. For additional information, refer to the wiring diagrams. TEST the system for normal operation.

-> No

No fault is indicated with the brake switch or circuit. Check the integrity of all connections and TEST the system for normal operation.

Speed Control Deactivator Switch (19.75.20)

Removal

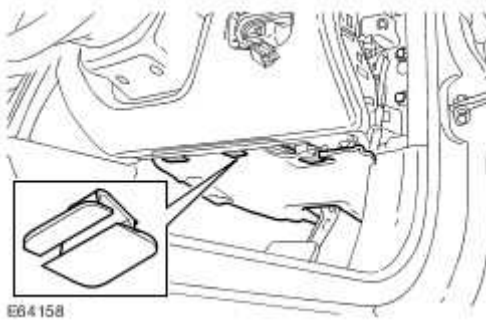
NOTE:

This component also functions as the brake pedal switch.

- 1  **CAUTION: Removal of the clips is a delicate procedure, damage will occur if any force is used.**

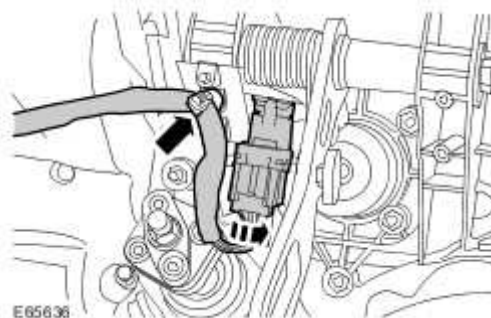
Remove the driver's side footwell trim panel.

- ▶ Carefully release the 3 clips.



- 2 . Release the brake switch.

- ▶ Rotate clockwise approximately 30 degrees.
- ▶ Carefully release the clip.
- ▶ Disconnect the electrical connector.



Installation



CAUTION: During installation of the brake switch, make sure the brake pedal is not depressed at any time. Depressing the pedal may cause: poor operation of the brake light switch and brake lights, diagnostic trouble codes to be logged and/or failure of the vehicle to start.

- 1 . Install the brake switch.
 - ▶ Connect the electrical connector.
 - ▶ Secure the clip.
- 2 . Install the driver's side footwell trim panel.
 - ▶ Carefully align and secure the clips.

Speed Control Module - Vehicles Without: Adaptive Speed Control (19.75.26)

Removal

NOTE:

The speed control module is part of the ECM.

- 1 . Remove the ECM.

For additional information, refer to Engine Control Module (ECM) (18.30.01)

Installation

- 1 . Install the ECM.

For additional information, refer to Engine Control Module (ECM) (18.30.01)

Speed Control Module - Vehicles With: Adaptive Speed Control (19.75.26)

Removal

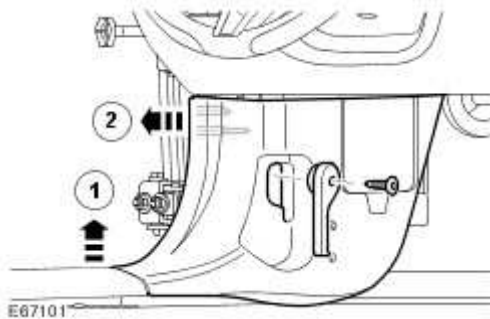
NOTE:

This component is mounted to the rear of the RH A-pillar.

1 . NOTE:

LH illustration shown, RH is similar.

Remove the RH cowl side trim panel.



2 . Remove the adaptive speed control module.



Installation

1 . To install, reverse the removal procedure.

Speed Control Sensor

Removal

1 . Connect WDS to the vehicle and up-load the relevant data.

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 bumper cover.

For additional information, refer to Front Bumper Cover (76.22.78)

4 . Remove the speed control sensor.



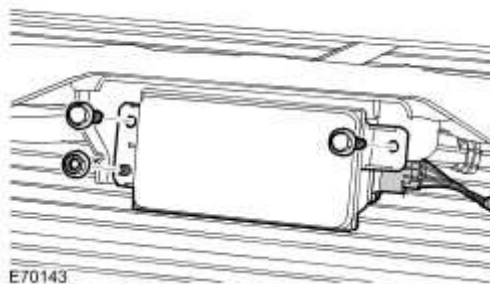
Remove the 2 bolts.



Remove the nut.



Disconnect the electrical connector.



Installation

1 Install the speed control sensor.

.

- ▶ Tighten the bolts to 5 Nm (4lb.ft).
- ▶ Install the speed sensor level adjustment lock nut and tighten to 5 Nm (4lb.ft).
- ▶ Connect the electrical connector.

2 . Check and adjust the speed sensor leveling.

For additional information, refer to Speed Control Sensor Adjustment

3 . With assistance, install the front bumper cover.

For additional information, refer to Front Bumper Cover (76.22.78)

4 . Using WDS download the data previously up-loaded.

Speed Control Switch (19.75.25)

Removal

NOTE:

Removal and installation of the speed control switch is shown in the steering wheel procedure.

- 1 . Remove the steering wheel.

For additional information, refer to Steering Wheel (57.60.01)

Installation

- 1 . Install the steering wheel.

For additional information, refer to Steering Wheel (57.60.01)