Workshop Service Manual for Range Rover Sport L320 2009-2013 Sec.3

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        - High Pressure Fuel Pump 2
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    - Specification
    - Description and Operation
        - Accessory Drive
    - Diagnosis and Testing
        - Accessory Drive
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        - Accessory Drive Belt
        - Accessory Drive Belt Idler Pulley
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- 303-05C: Accessory Drive - V8 S/C 5.0L Petrol
    - Specification
    - Description and Operation
        - Accessory Drive
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        - Accessory Drive
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        - Supercharger Belt Tensioner
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    - Description and Operation
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        - Overview
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    - Diagnosis and Testing
        - Starting System
    - Removal and Installation
        - Starter Motor
- 303-06B: Starting System - V8 5.0L Petrol/V8 S/C 5.0L Petrol
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    - Description and Operation
        - Starting System
    - Diagnosis and Testing
        - Starting System
    - Removal and Installation
        - Starter Motor
- 303-07A: Glow Plug System - TDV6 3.0L Diesel
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    - Description and Operation
        - Component Location
        - Overview
        - System Operation and Component Description
    - Diagnosis and Testing
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- 303-07B: Engine Ignition - V8 5.0L Petrol/V8 S/C 5.0L Petrol
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- 303-08A: Engine Emission Control - TDV6 3.0L Diesel
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        - Component Location
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  - Exhaust Gas Recirculation (EGR) Valve RH
  - Exhaust Gas Recirculation (EGR) Valve Outlet Tube LH
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- 303-08B: Engine Emission Control - V8 5.0L Petrol
  - Description and Operation
    - Engine Emission Control
  - Diagnosis and Testing
    - Engine Emission Control
- 303-08C: Engine Emission Control - V8 S/C 5.0L Petrol
  - Description and Operation
    - Engine Emission Control
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- 303-12A: Intake Air Distribution and Filtering - TDV6 3.0L Diesel
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  - Description and Operation
    - Component Location
    - Overview
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    - Air Cleaner Element (19.10.10)
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- 303-12B: Intake Air Distribution and Filtering - V8 5.0L Petrol
  - Specification
  - Description and Operation
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    - Air Cleaner Outlet Pipe RH
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- 303-12C: Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol
  - Specification
  - Description and Operation
    - Intake Air Distribution and Filtering
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    - Intake Air Distribution and Filtering
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    - Air Cleaner Outlet Pipe T-Connector
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- 303-13: Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol
  - Specification
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- 303-14A: Electronic Engine Controls - TDV6 3.0L Diesel
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    - Intake Air Temperature (IAT) Sensor (18.30.09)
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- 303-14B: Electronic Engine Controls - V8 5.0L Petrol
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  - Diagnosis and Testing
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    - Powertrain Control Module (PCM) Long Drive Cycle Self-Test
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    - Catalyst Monitor Sensor LH
    - Catalyst Monitor Sensor RH
    - Crankshaft Position (CKP) Sensor (18.30.12)
    - Engine Control Module (ECM) (18.30.03)
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    - Front Knock Sensor (KS) RH
    - Fuel Rail Pressure (FRP) Sensor
    - Heated Oxygen Sensor (HO2S) LH
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    - Manifold Absolute Pressure (MAP) Sensor (18.30.56)
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- 303-14C: Electronic Engine Controls - V8 S/C 5.0L Petrol
  - Specification
  - Description and Operation
    - Electronic Engine Controls
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  - General Procedures
    - Powertrain Control Module (PCM) Long Drive Cycle Self-Test
    - Powertrain Control Module (PCM) Short Drive Cycle Self-Test
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    - Camshaft Position (CMP) Sensor LH
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- Catalyst Monitor Sensor RH
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- Engine Control Module (ECM) (18.30.03)
- Engine Coolant Temperature (ECT) Sensor (18.30.10)
- Engine Oil Level Sensor (12.60.51)
- Front Knock Sensor (KS) LH
- Front Knock Sensor (KS) RH
- Fuel Rail Pressure (FRP) Sensor
- Heated Oxygen Sensor (HO2S) LH
- Heated Oxygen Sensor (HO2S) RH
- Manifold Absolute Pressure (MAP) Sensor (18.30.56)
- Mass Air Flow (MAF) Sensor (19.22.25)
- Rear Knock Sensor (KS) LH
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- Variable Valve Timing (VVT) Oil Control Solenoid LH
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- 307: Automatic Transmission/Transaxle
  - 307-01A: Automatic Transmission/Transaxle - TDV6 3.0L Diesel /V8 5.0L Petrol/V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission
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    - Removal and Installation
      - Input Shaft Seal
      - Extension Housing Seal
      - Transmission Control Module (TCM) and Main Control Valve Body
      - Transmission Fluid Pan, Gasket and Filter
      - Transmission Support Insulator
    - Removal
      - Transmission - V8 5.0L Petrol/V8 S/C 5.0L Petrol
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  - 307-01B: Automatic Transmission/Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD
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    - Removal and Installation
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      - Extension Housing Seal
      - Transmission Control Module (TCM) and Main Control Valve Body
      - Transmission Fluid Pan, Gasket and Filter
      - Transmission Support Insulator
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  - 307-02A: Transmission/Transaxle Cooling - TDV6 3.0L Diesel /V8 5.0L Petrol/V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission
    - Specification
    - Description and Operation
      - Transmission Cooling
    - Diagnosis and Testing
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      - Transmission Fluid Cooler - V8 5.0L Petrol/V8 S/C 5.0L Petrol

- Transmission Fluid Cooler - TDV6 3.0L Diesel
- Transmission Fluid Cooler Tubes - V8 5.0L Petrol/V8 S/C 5.0L Petrol
- Transmission Fluid Cooler Tubes - TDV6 3.0L Diesel

- 307-02B: Transmission/Transaxle Cooling - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD
  - Specification
  - Description and Operation
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    - Transmission Fluid Cooler Tubes - V8 5.0L Petrol/V8 S/C 5.0L Petrol
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- 307-05A: Automatic Transmission/Transaxle External Controls - TDV6 3.0L Diesel /V8 5.0L Petrol/V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission
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  - Description and Operation
    - External Controls
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- 307-05B: Automatic Transmission/Transaxle External Controls - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD
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    - Transmission Control Switch (TCS) Knob
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- 308: Manual Transmission/Transaxle, Clutch and Transfer Case
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    - Description and Operation
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      - Transfer Case Draining and Filling (41.20.04)
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      - Transfer Case (41.20.25) - V8 5.0L Petrol/V8 S/C 5.0L Petrol
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- 309: Exhaust System
    - 309-00A: Exhaust System - TDV6 3.0L Diesel
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        - Description and Operation
            - Exhaust System
            - Component Location
            - System Operation and Component Description
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    - 309-00B: Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol
        - Specification
        - Description and Operation
            - Exhaust System
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        - Description and Operation
            - Fuel Tank and Lines
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    - 310-01B: Fuel Tank and Lines - V8 5.0L Petrol/V8 S/C 5.0L Petrol
        - Specification
        - Description and Operation
            - Fuel Tank and Lines
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  - Speed Control
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  - Speed Control Sensor Adjustment
- Removal and Installation
  - Speed Control Deactivator Switch
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  - Speed Control Sensor
  - Speed Control Switch

- 310-03B: Speed Control - V8 5.0L Petrol/V8 S/C 5.0L Petrol
  - Specification
  - Description and Operation
    - Speed Control
  - Diagnosis and Testing
    - Speed Control
  - General Procedures
    - Speed Control Sensor Adjustment
  - Removal and Installation
    - Speed Control Deactivator Switch
    - Speed Control Module
    - Speed Control Sensor
    - Speed Control Switch

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Engine System - General Information - Engine TDV6 3.0L Diesel

Diagnosis and Testing

Principle of Operation

For a detailed description of the 3.0L Diesel engine, refer to the relevant Description and Operation section in the workshop manual. REFER to: (303-01A)

Engine (Description and Operation),
Engine (Description and Operation),
Engine (Description and Operation).

Inspection and Verification

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

Visual Inspection

Mechanical	Electrical
• Coolant level • Coolant leaks • Oil level • Oil leaks • Visibly damaged or worn parts • Loose or missing nuts or bolts	• Wiring harness • Electrical connector(s) • Injectors • Glow plugs • 5 volt sensor supply • Sensor(s) • Cooling fan control module and motor • Engine Control Module (ECM)

If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

3. If the concern is not visually evident, verify the symptom and refer to the relevant Symptom Chart. Symptom Charts have been separated into **Leaks** and **Noise Vibration and Harshness (NVH)** for ease of use. Alternatively, check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Charts

Symptom Chart, Leaks

Symptom	Possible Cause	Action
External coolant leaks	• Damaged hose(s) • Damaged expansion tank • Damaged radiator • Leaking seals/gaskets • Cracked/damaged casings	For cooling system checks, REFER to: Engine Cooling (303-03A, Diagnosis and Testing).
Internal coolant leaks Note: This may be indicated by the production of white smoke from the exhaust	• Leaking seals/gaskets • Cracked/damaged casings	For cooling system checks, REFER to: Engine Cooling (303-03A, Diagnosis and Testing).
Engine overheats	• Insufficient coolant • Insufficient oil • Pressure cap fault • Thermostat not opening • Coolant pump failure • Cooling fan failure	For cooling system checks, REFER to: Engine Cooling (303-03A, Diagnosis and Testing).
Engine takes too long to reach operating temperature	• Thermostat stuck open	For cooling system checks, REFER to: Engine Cooling (303-03A, Diagnosis and Testing).
External oil leaks	• Gaskets • Seals • Oil pipes • Oil filter • Oil cooler • Damaged/cracked casings • Crankcase ventilation system • Piston ring blow-by	Clean and confirm the area of the leak. Check the visual condition of oil carrying components. Check the crankcase ventilation system. Carry out a compression test, GO to Pinpoint Test A.

Internal oil leaks (leaks into coolant or combustion chamber) Note: This may be indicated by the production of blue smoke from the exhaust	• Gaskets • Seals • Damaged/cracked casings • Worn valve guides • Worn cylinder bores/pistons • Broken piston rings	Check for traces of oil in the coolant. Check for evidence of oil in the combustion chambers (deposits on the glow plugs, etc). Confirm oil consumption and vehicle usage with the owner/driver. Carry out an oil consumption test, GO to Pinpoint Test B.

Symptom Chart, NVH

 NOTE: As the checks suggested here are open to interpretation, they should be used as a guide only. Descriptions of noises, etc, are in general terms, so depend on a degree of experience on the part of the technician.

Symptom	Possible Cause	Action
Rattle/ticking from top of engine	• Valve gear noise • Camshaft bearing noise • Camshaft chain noise • Tensioner noise • Vacuum pump noise • High pressure fuel pump noise	Check the engine oil pressure, GO to Pinpoint Test C. . Check the function of the hydraulic tappets and the camshaft condition. Check the camshaft bearings, chains and tensioners. Check the vacuum pump, and high pressure fuel pump
Growl from top of engine	• High pressure fuel pump belt noise • High pressure fuel pump belt tensioner noise	Check the high pressure fuel pump belt and tensioner
Squeaking/Creaking/Squeal from front of engine	• Front End Accessory Drive (FEAD) belt • FEAD belt tensioner • Driven components on FEAD belt	Check the FEAD belt and driven components, REFER to: Accessory Drive (303-05A, Diagnosis and Testing).
Whine/Slap/Growl from front of engine	• Front End Accessory Drive (FEAD) belt • FEAD belt tensioner • Driven components on FEAD belt • Timing belt noise • Timing belt tensioner noise	Check the FEAD belt and driven components. Check the timing belt and tensioners
Knock from lower half of engine (often worse with a cold engine)	• Piston slap • Piston pin noise • Connecting rod bearing noise	Check the engine oil pressure, GO to Pinpoint Test C. . Check piston, cylinder bore, piston pin and connecting rod bearing for excess wear
Knock/Rumble from lower half of engine (often worse on overrun)	• Main bearing noise	Check the engine oil pressure, GO to Pinpoint Test C. . Check connecting rod bearing for excess wear
Misfire/Rough running	• Engine management system • Fuel charging and controls • Exhaust gas recirculation (EGR) system • Burnt/sticking valves • Worn valve guides • Worn cylinder bores/pistons • Broken piston	For engine management system tests, REFER to: Diagnostic Trouble Code (DTC) Index (100-00, Description and Operation). For fuel charging and controls systems tests, REFER to: Fuel Charging and Controls (303-04A, Diagnosis and Testing), Turbocharger (303-04B, Diagnosis and Testing). For EGR system tests, REFER to: Engine Emission Control (303-08A, Diagnosis and Testing). Carry out a compression test, GO to Pinpoint Test A. Check for excess wear in engine components

	• rings • Damaged/cracked casings	

DTC Index

For a complete list of all Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: Diagnostic Trouble Code (DTC) Index (100-00, Description and Operation).

Pinpoint Tests

NOTE: Where reference is made to 'suitable equipment', this refers to standard workshop equipment. Refer to the operating instructions for your own equipment when performing any tests.

PINPOINT TEST A : CHECK THE CYLINDER COMPRESSIONS	
WARNING: Only compression testers able to read the higher compression pressures found in diesel engines should be used. Failure to follow this instruction may result in personal injury.	
NOTE: Where possible, compression testing should be carried out on an engine at operating temperature.	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**
A1: CARRY OUT A DRY CYLINDER COMPRESSION TEST	
	1 Make sure the parking brake is applied and that the selector lever is in park.
	2 Set the ignition status to **OFF**.
	3 Remove the starter relay.
	4 Disconnect the starter motor solenoid connector.
	5 Connect a suitable remote starter device to the starter motor solenoid.
	6 Remove the glow plugs.
	7 Install adaptor 303-1131 in place of the glow plug in the first cylinder to be tested.
	8 Connect a suitable compression tester to the adaptor. See warning above.
	9 Using the remote starter device, crank the engine a minimum of five revolutions.
	10 Record the compression figure and the number of revolutions taken to reach it.
	11 Repeat steps 7 - 10 above for the remaining cylinders, cranking the engine for a similar number of revolutions each time.
	12 Compare the compression figures across all the cylinders.
	Are the compression figures within 10% of each other? **Yes** Unless the compression figures are universally very low (experience will indicate this), check for other causes for the customer complaint. **No** GO to A2.
A2: CARRY OUT A WET CYLINDER COMPRESSION TEST	
CAUTION: If engine oil is introduced into the cylinders, run the engine at 2,000 rpm for a minimum of ten minutes after completing testing to prevent damage to the catalytic converters. Failure to follow this instruction may result in damage to the vehicle.	
NOTE: There is a combustion chamber in the top of each piston. Make sure that the oil is not allowed to run into this chamber.	
	1 Using a suitable oil can with a flexible spout, introduce a small amount of clean engine oil into the cylinder just before testing, such that the oil is able to run between the piston and the cylinder bore.
	2 Repeat steps 7 - 10 from the test above, introducing oil into each cylinder just before testing.
	3 Compare the compression figures across all the cylinders.
	Is the compression figure higher than the dry test? **Yes** A higher figure following the introduction of oil may indicate a worn or damaged cylinder bore, piston and/or piston rings. Disassembly would be required to confirm this. **No** If the compression figure is unaffected by the introduction of oil, but the figure is still less than 90% of the other cylinders, this may indicate a burnt and/or sticking valve, leaking head gasket, etc. Disassembly would be required to confirm this. Clear any DTCs which may have been induced by the test.

PINPOINT TEST B : OIL CONSUMPTION TEST	
NOTE: Oil consumption will vary, depending on a number of factors. New engines will normally use more oil than 'run-in' engines, although a guideline would be to expect 16,000 Km (10,000 miles) per liter.	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**

B1: CHECK FOR EXCESSIVE OIL CONSUMPTION	
	1 Start the engine and allow it to run until it reaches normal operating temperature.
	2 Make sure the vehicle is parked on a level surface and set ignition status to **OFF**.
	3 Allow to settle for at least five minutes.
	4 Check the oil level.
	5 Correct the level, if necessary, and record the reading and mileage in the vehicle history.
	6 Make sure that the owner/driver is aware that a test is being carried out, and that they should not top-up their oil level for the duration of the test, but should check the level every 160-240 Km (100-150 miles).
	7 When the oil level reaches the **ADD** mark, the customer should bring the vehicle in to be checked.
	8 Top-up the oil to the level at the beginning of the test and record the amount of oil needed to do so, and the mileage covered in the course of the test.
	9 From this, the consumption can be calculated, and a decision made as to whether or not the consumption is considered excessive.
	Is the consumption excessive for the mileage and/or use? **Yes** Disassembly will be required to check the components indicated in the symptom chart. **No** No further action is required.

PINPOINT TEST C : CHECK THE ENGINE OIL PRESSURE	
NOTES:  Check and, if necessary, top-up the engine oil level before beginning this test.	
 Where reference is made to 'suitable equipment', this refers to standard workshop equipment. Refer to the operating instructions for your own equipment when performing any tests.	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**
C1: CHECK FOR LOW ENGINE OIL PRESSURE	
	1 Remove the oil pressure sensor.
	2 Connect a suitable oil pressure gauge in place of the oil pressure sensor.
	3 Start the engine and check for leaks at the gauge connection.
	4 Allow the engine to idle and monitor the oil pressure.
	5 Raise the engine speed to 2,500 rpm and monitor the oil pressure.
	Is the oil pressure less than 0.50 bar (7.25 psi) between idle and 2,500 rpm? **Yes** GO to C2. **No** GO to C3.
C2: CHECK FOR LOW ENGINE OIL PRESSURE AT ENGINE SPEEDS GREATER THAN 2,500 RPM	
	1 Raise the engine speed to above 2,500 rpm and monitor the oil pressure.
	Is the oil pressure less than 1.0 bar (14.5 psi) at engine speeds greater than 2,500 rpm? **Yes** Pressure this low may indicate a problem with: oil pump, filtering, clearances within the engine. Check if there are any other indications of engine faults (noise, etc), refer to the symptom chart above. **No** GO to C3.
C3: CHECK FOR HIGH ENGINE OIL PRESSURE	
	1 Monitor the engine oil pressure at varying engine speeds.
	Does the oil pressure reach 4.0 bar (58 psi)? **Yes** Pressure this high may indicate a blockage in the lubrication system. If this is not resolved, high oil pressure will lead to engine oil leaks and other failures. **No** If the oil pressure stays in the band between 0.50 bar (7.25 psi) and 1.0 bar (14.5 psi) this would be considered normal.

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Engine System - General Information - Engine V8 5.0L Petrol/V8 S/C 5.0L Petrol

Diagnosis and Testing

Special Tool(s)

303-1451  E136285	Oil pressure testing adaptor, 303-1451
303-871  E57919	Oil pressure testing gauge, 303-871

Principle of Operation

For a detailed description of the 5.0L engine, refer to the relevant Description and Operation sections in the workshop manual.
REFER to: Engine (303-01 Engine - 5.0L NA V8 - AJ133, Description and Operation) / Engine (303-01 Engine - 5.0L SC V8 - AJ133, Diagnosis and Testing).

Inspection and Verification

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

Visual Inspection

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, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

NOTES:

If an engine 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 engine.

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.
Difficult to start hot and cold	• Carry out general engine checks: - Compression test. Refer to component tests in this section. - Valve clearances - 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 - 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. • 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 - 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. • 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 - 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 Support (DTS)

DTC Index

For a complete list of all Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Engine Control Module (PCM) 5.0L V8 (100-00 General Information, Description and Operation).

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

NOTES:

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.

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 normal 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.

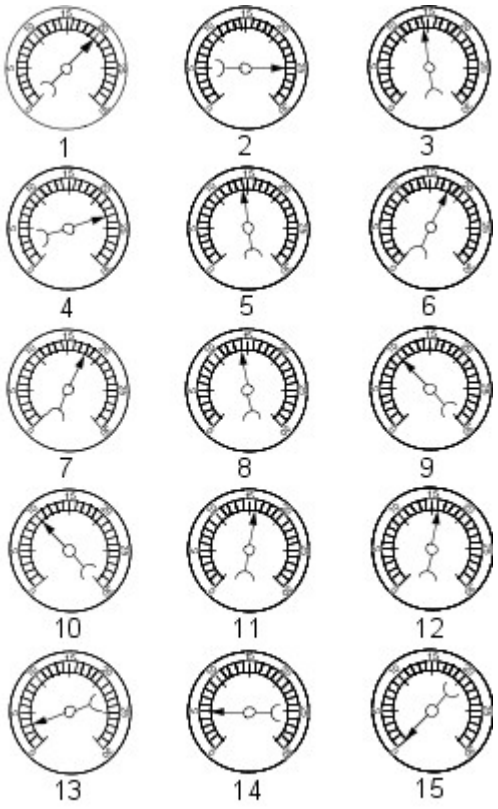
The reading should be steady. As necessary, adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust damper until needle moves easily without excessive flutter.

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.



VUJ0001694

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.

Engine Oil Pressure Check

NOTE: Prior to checking the engine oil pressure, a road test of 6 miles (10 kilometres), must be carried out. Do not attempt to attain engine normal operating temperature by allowing the engine to idle.

1. Disconnect the battery ground cable. Refer to section 414-00 - Charging System - General Information of the workshop manual
2. WARNINGS:

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

   Wear protective gloves.

   Remove the engine oil filter element
   REFER to: Oil Filter Element (303-01C, Removal and Installation).

NOTE: Ensure the oil filter element is not contaminated during this procedure

3. Install the oil filter element into special tool (Oil filter adapter number 303-1451)
4. Install the special tool (Oil filter adapter number 303-1451) to the engine. Torque: 25 Nm
5. Install the special tool (Oil pressure testing gauge, 303-871) and tighten the union
6. Connect the battery ground cable
7. Refer to owner hand book, check and top-up the engine oil if required
8. Start and run the engine
9. Note the oil pressure readings with the engine running at idle and 3500 RPM
10. Turn off the engine
11. Disconnect the battery ground cable
12. Remove the special tools
    1. Clean the components
13. Install the engine oil filter element
    REFER to: Oil Filter Element (303-01C, Removal and Installation).

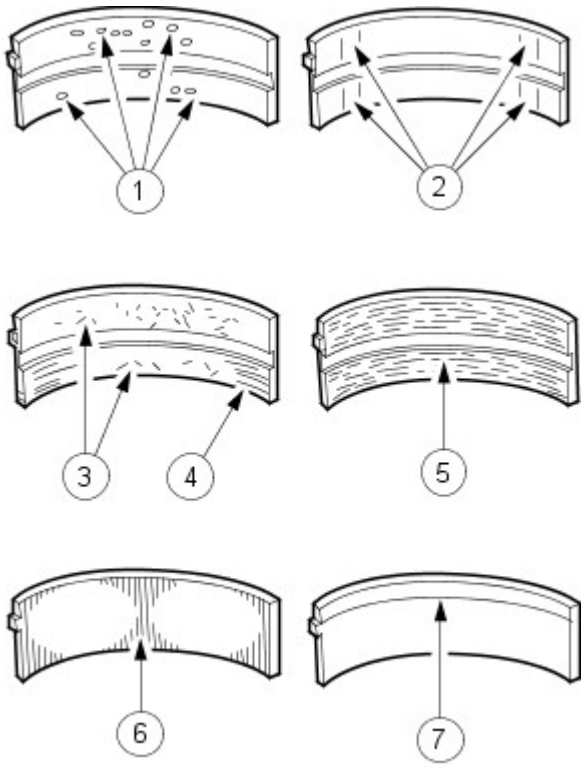
NOTE: Ensure the oil filter element is not contaminated during this procedure

14. Connect the battery ground cable
15. Refer to owner hand book, check and top-up the engine oil if required

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Engine System - General Information - Bearing Inspection

General Procedures



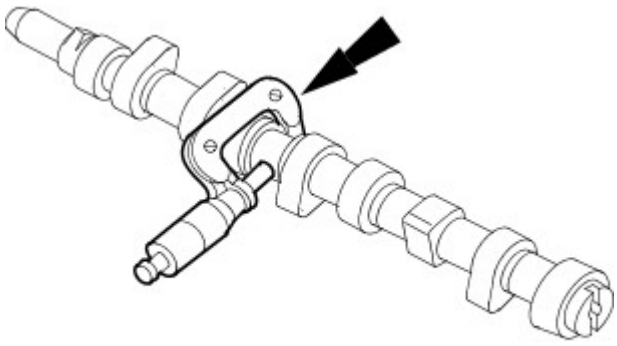
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1. Inspect bearings for the following defects.
    1. Cratering - fatigue failure
    2. Spot polishing - incorrect seating.
    3. Imbedded dirt engine oil.
    4. Scratching - dirty engine oil.
    5. Base exposed - poor lubrication.
    6. Both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

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Engine System - General Information - Camshaft Bearing Journal Diameter

General Procedures



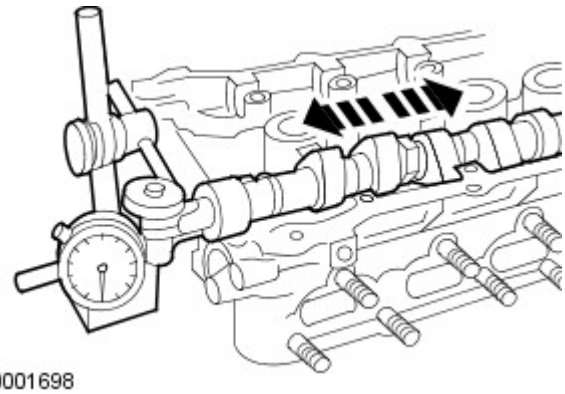
VUJ0001695

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.

Published: 11-May-2011

Engine System - General Information - Camshaft End Play

General Procedures



VUJ0001698

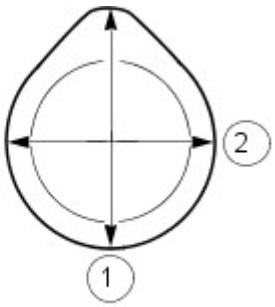
1. NOTE: Make sure that the camshaft is to specification.

   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.
     1. End play = maximum value minus minimum value.
   - If the measurement is out of specification, install new components.

Published: 11-May-2011

Engine System - General Information - Camshaft Lobe Lift

General Procedures



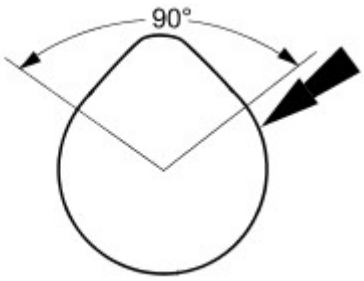
VUJ0001699

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

Published: 11-May-2011

Engine System - General Information - Camshaft Surface Inspection

General Procedures



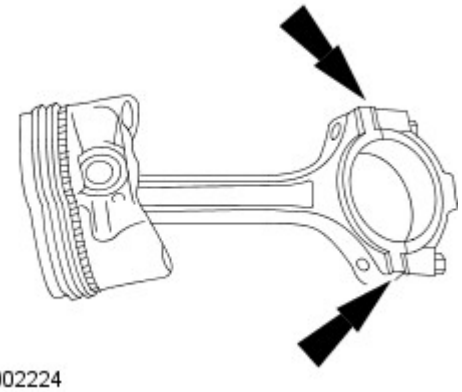
VUJ0001700

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

Published: 11-May-2011

Engine System - General Information - Connecting Rod Cleaning

General Procedures



VUJ0002224

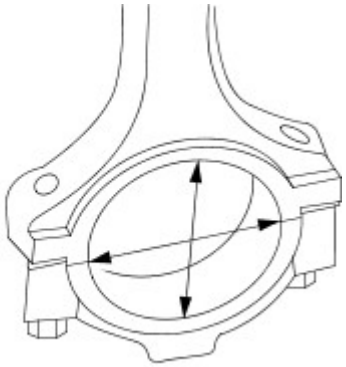
1. CAUTION: Do not use a caustic cleaning solution or damage to connecting rods may occur.

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

Published: 11-May-2011

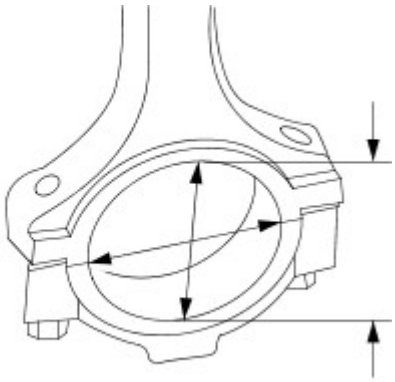
Engine System - General Information - Connecting Rod Large End Bore

General Procedures



VUJ0002223

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.



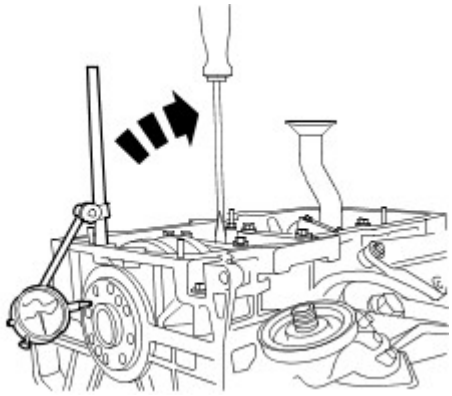
VUJ0002222

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

Published: 11-May-2011

Engine System - General Information - Crankshaft End Play

General Procedures



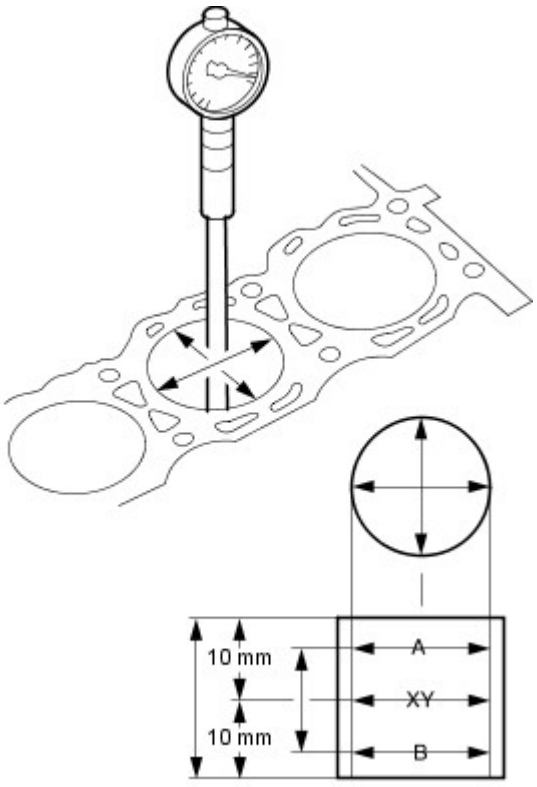
VUJ0002235

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.

Published: 11-May-2011

Engine System - General Information - Cylinder Bore Out-of-Round

General Procedures



VUJ0002234

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.

Published: 11-May-2011

Engine System - General Information - Exhaust Manifold Cleaning and Inspection

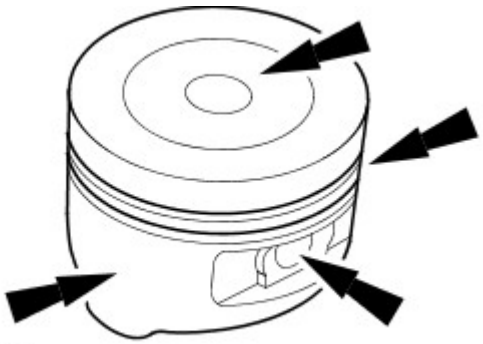
General Procedures

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.

Published: 11-May-2011

Engine System - General Information - Piston Inspection

General Procedures



VUJ0002233

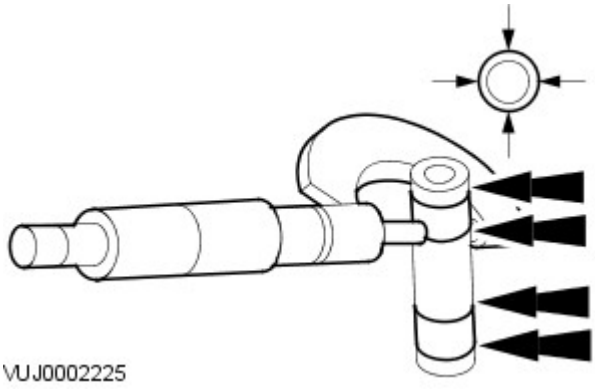
1. CAUTION: Do not use any aggressive cleaning fluid or a wire brush to clean the piston.

   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.

Published: 11-May-2011

Engine System - General Information - Piston Pin Diameter

General Procedures



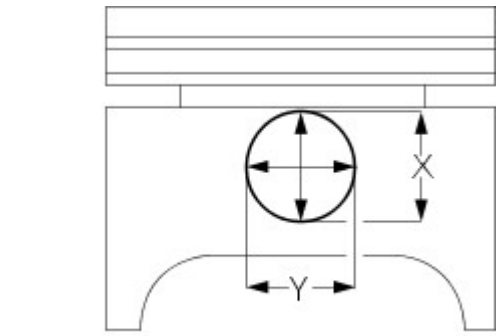
1. NOTE: The piston and piston pin are a matched pair. Do not mix up the components.

   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.

Published: 11-May-2011

Engine System - General Information - Piston Pin to Bore Diameter

General Procedures



VUJ0002232

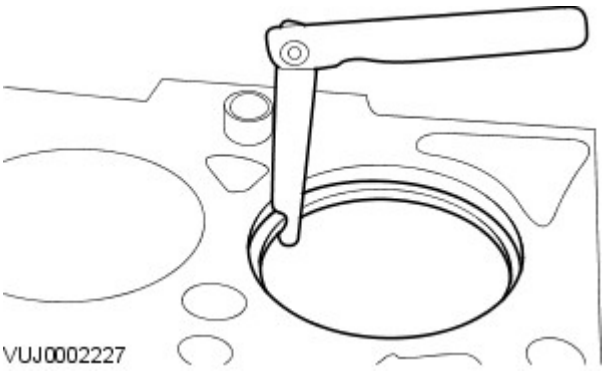
1. NOTE: The piston and piston pin form a matched pair. Do not mix up the components.

   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.

Published: 11-May-2011

Engine System - General Information - Piston Ring End Gap

General Procedures



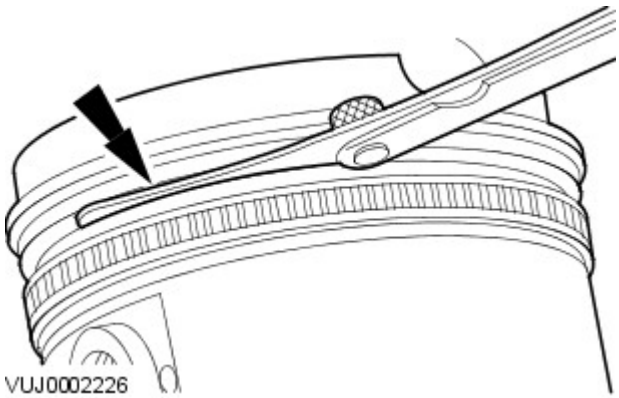
1. CAUTION: Do not mix up the piston rings. Install the piston rings in the same position and location.

   Using the Feeler Gauge, measure the piston ring gap.
   - The values given in the specification refer to a gauge ring used during production.

Published: 11-May-2011

Engine System - General Information - Piston Ring-to-Groove Clearance

General Procedures



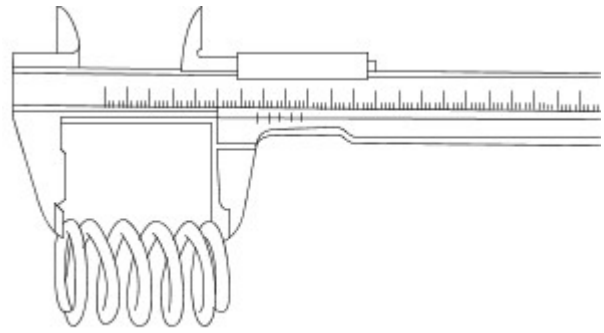
1. NOTE: The piston ring must protrude from the piston groove. To determine the piston ring clearance, insert the Feeler Gauge right to the back of the groove, behind the wear ridge.

   Using the Feeler Gauge, measure the piston ring clearance.

Published: 11-May-2011

Engine System - General Information - Valve Spring Free Length

General Procedures



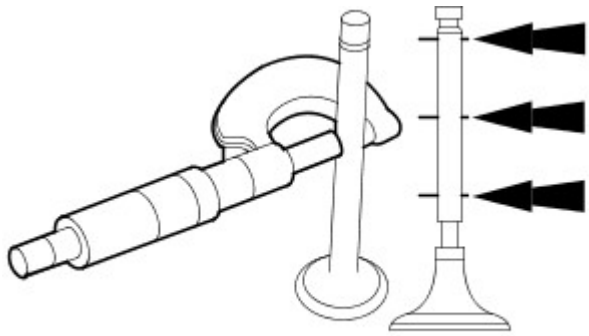
VUJ0002221

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

Published: 11-May-2011

Engine System - General Information - Valve Stem Diameter

General Procedures



VUJ0002220

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

Published: 02-Jun-2011

Engine System - General Information - Leakage Test Using Smoke Test Equipment

General Procedures

CAUTION: The compressed air line supply pressure must be between 3.5 and 12 bar (50 and 175 psi) for the smoke test equipment to function correctly. Do not exceed this pressure. Failure to follow this instruction may result in damage to the smoke test equipment.

NOTES:

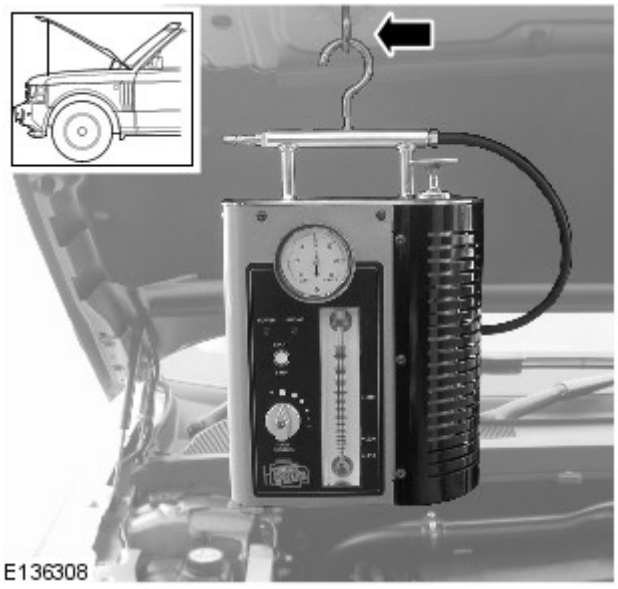
The vehicle battery must be in good condition and fully charged before carrying out this procedure.

On vehicles with 3.0L TDV6, it will be necessary to insert smoke at both air cleaner outlet pipes independently if the right hand turbocharger and associated hoses are to be tested.

In some cases it may be necessary to remove undertrays, trim or engine covers to obtain access to all potential leak locations.

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

For further information regarding operation of the test equipment refer to the manufacturers operators manual supplied with the kit.



1. WARNING: Use an additional support to prevent the hood from falling if the smoke test equipment is secured to the hood. Failure to follow this instruction may result in personal injury.

   Install the smoke test equipment to a suitable location under the hood.

2. Connect a suitable compressed air line to the smoke test equipment.

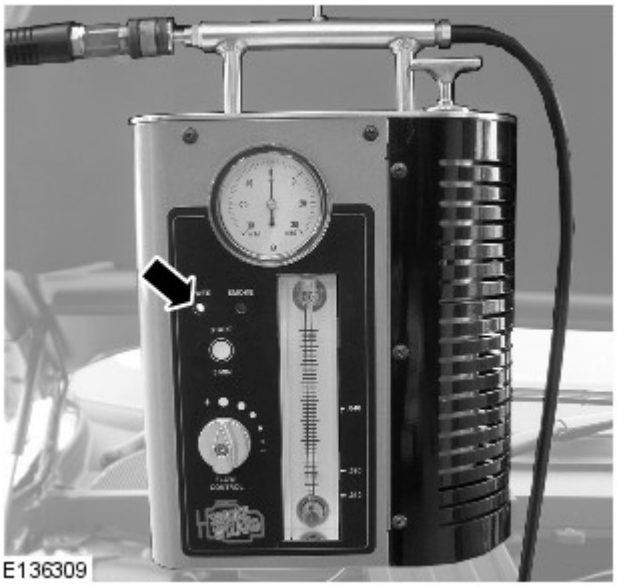
3. Connect the smoke test equipment positive power cable to the battery positive terminal.

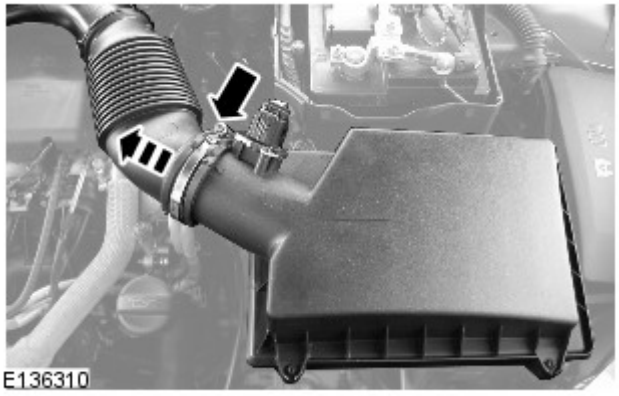
4. WARNING: Do not connect the smoke test equipment negative cable to the battery negative terminal.

   Connect the smoke test equipment negative cable to a suitable body ground point.

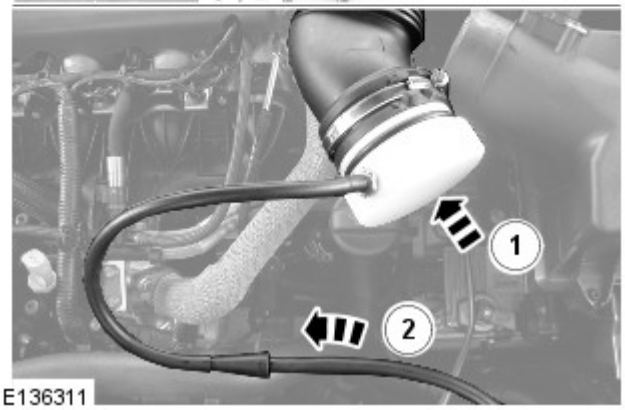
5. NOTE: A flashing green light indicates low battery voltage. In this case, place the battery on charge and make sure that the battery is fully charged before using the smoke test equipment.

   Observe the power indicator lamp on the smoke test equipment. Make sure that a continuous green light is displayed.


E136309


E136310





E136311

6. NOTES:

   In some cases it may be necessary to remove the air cleaner(s) to allow access to the air cleaner outlet pipes.

   In some cases it will be necessary to cap one of the air cleaner outlet pipes. Use the blanking caps supplied in the kit to cap the open orifice.

   Disconnect the air cleaner outlet pipe(s).

7. NOTE: Make sure the smoke test equipment adapter is a good fit to the air cleaner outlet pipe. This must be an air tight seal.

   Connect the smoke test equipment supply hose to the air cleaner outlet pipe.
   1. Install the appropriate adapter to the air cleaner outlet pipe.
   2. Connect the smoke test equipment supply hose to the adapter link hose.

8. NOTES:



The flow control valve must be in the fully open position.

Smoke is produced for 5 minutes. The smoke test equipment will automatically switch off after this period of time.

Switch the smoke test equipment on.

9. Remove the oil filler cap, and observe until a constant flow of smoke is visible leaving the oil filler orifice. Install the oil filler cap.

10. NOTE: The longer smoke is allowed to exit from a leak, the more fluorescent dye will be deposited at a leak location.

    Using the torch supplied in the kit set to white light, look for escaping smoke. Alternatively, use the ultraviolet light to look for fluorescent dye deposits at the source of a leak.

Published: 11-Nov-2011

Engine System - General Information - Cylinder Head Gasket Selection TDV6 3.0L Diesel

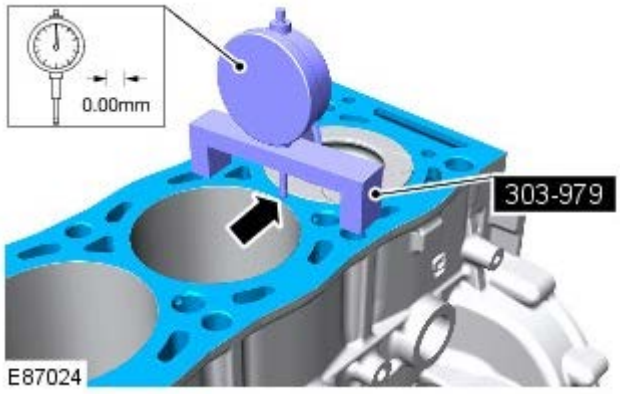
General Procedures

Special Tool(s)

	303-979 Measuring Bridge, Piston Protusion

Check

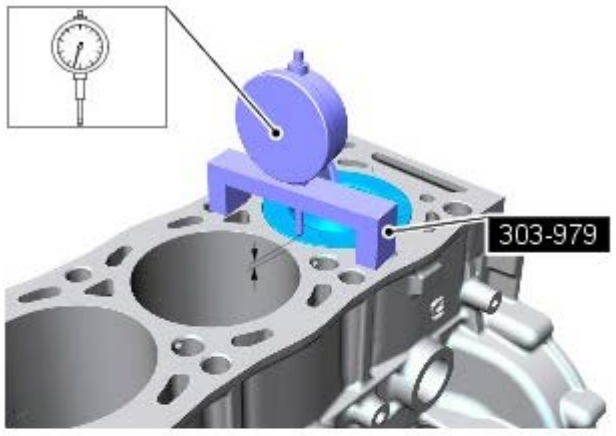
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



1. CAUTION: Make sure that the surface is clean and free of foreign material.

   Zero the gauge on the cylinder block machined face.

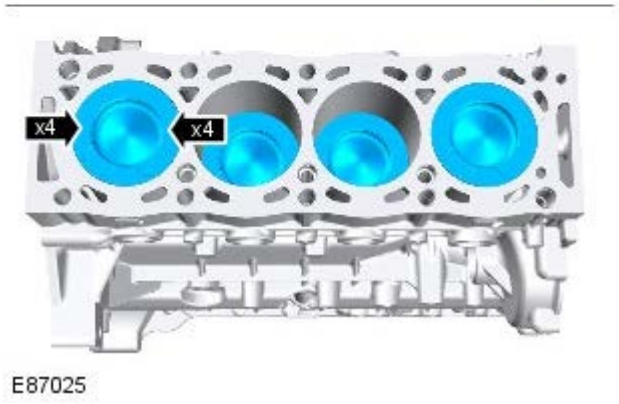
   Special Tool(s): 303-979



2. CAUTION: Make sure that the surface is clean and free of foreign material.

   NOTE: Note the dial gauge readings.

   Take 2 measurements on each piston crown.



3. Use the average piston protrusion measurement (taken from all piston measurements), to select the correct thickness cylinder head gasket.

Refer to: Specifications (303-01A, Specifications).

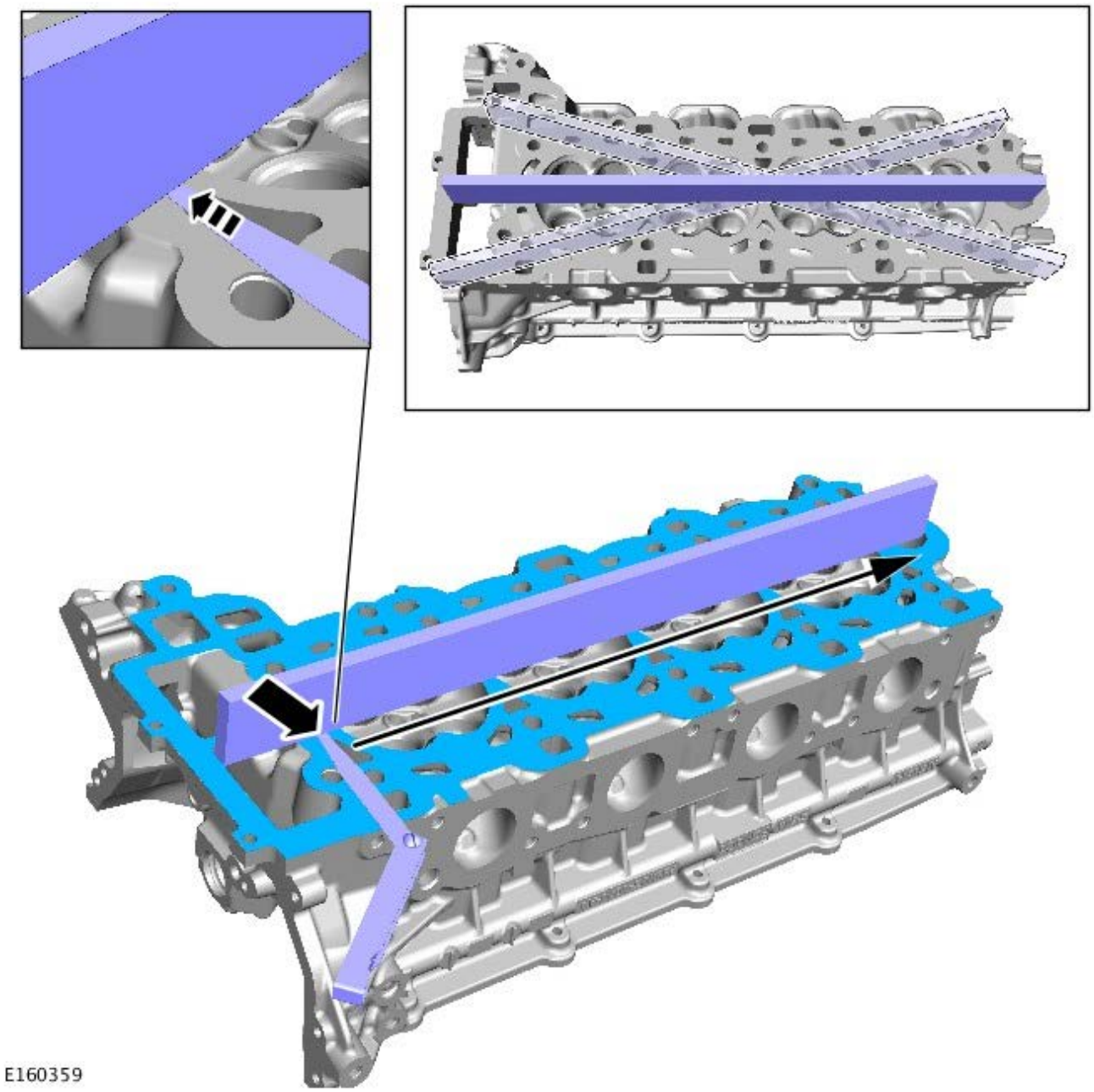
Published: 12-Sep-2013

Engine System - General Information - Cylinder Head Distortion

General Procedures

Activation

1. Using a suitable metallic straight edge and feeler gauge, measure the cylinder head face in the areas illustrated. **Note the maximum value**.



2. CAUTION: Machine the **minimum** thickness of material from the cylinder head to meet specification, then increase the thickness of the cylinder head gasket by one size.

   NOTES:

   Prior to having the cylinder head being machined, prior approval is required by Jaguar or Land Rover engineering.

   If the cylinder head requires machining, this must be carried out by a local engineering company.

   If the cylinder head exceeds the maximum value (0.2mm), the cylinder head must be machined.

This section contains no data

Published: 10-Feb-2014

Engine - TDV6 3.0L Diesel -

Engine Data

Engine Description	Engine Capacity	Maximum Engine Torque (EEC) (SAE)	Maximum Engine Power (EEC) (SAE)	Compression Ratio	Bore	Stroke
60° "Vee" • 6 Cylinder • 24 Valves	2993 ccm	600 Nm at 2000 RPM	180 kW at 4000 RPM	16.1:1 ± 0.5	84	90

Engine Firing Order

Firing Order
1:4:2:5:3:6

Glow Plug

Specification
9X2Q-6M090-AC

Lubricants, Fluids, Sealers and Adhesives

Description	Specification
Engine oil (EUR)	5W/30 – WSS–M2C934–B
Engine oil (ROW)	5W/30 – WSS–M2C913–B or C
Sealant	WSE–M4G323–A5
Core plug and stub pipe retainer	WSK-M2G349-A7
Jaguar premium cooling system fluid	WSS-M97B44-D

Capacities

Description	Liters
Engine oil initial fill	6.75
Engine oil service fill with oil filter change	5.9

Cylinder Head and Valve Train

Item	Specification
Valve guide inner diameter (mm)	5.980 ± 0.010
Intake valve effective length (mm) (tip to gauge line)	94.99mm +/- 0.15
Exhaust valve effective length (mm) (tip to gauge line)	94.45mm +/-0.15
Valve stem to guide clearance intake diametrical (mm)	0.027 - 0.063
Valve stem to guide clearance exhaust diametrical (mm)	0.037 - 0.073
Valve head diameter intake (mm)	27.8mm +/-0.1
Valve head diameter exhaust (mm)	25.2mm +/-0.1
Intake valve face angle (degrees)	44 deg 52 min +/-7min30sec
Exhaust valve face angle (degrees)	44 deg 52 min +/-7min30sec
Valve stem diameter intake (mm)	5.935±0.008
Valve stem diameter exhaust (mm)	5.925±0.008
Valve spring free length (mm) - inlet	38.9mm
Valve spring free length (mm) - exhaust	38.9mm
Valve spring installed height (mm) - inlet	31.22mm
Valve spring installed height (mm) - exhaust	31.22mm
Camshaft lobe max lift intake (mm)	3.75187mm
Camshaft lobe max lift exhaust (mm)	3.80999mm
Camshaft journal to cylinder head bearing surface clearance diametrical (mm)	0.040-0.090
Camshaft journal diameter - all positions	26.015±0.015
Bearing diameter - all positions	25.950±0.010
Camshaft journal maximum run out limit (mm)	0.030mm
Camshaft journal maximum out of round (mm) - all journals	0.010mm
Crankshaft end play	0.21 - 0.43 mm

Cylinder Head Gasket

Identification	Gasket Thickness (mm)	Piston Protrusion (mm)
2	1.17	0.552 - 0.603
3	1.22	0.604 - 0.655
4	1.27	0.656 - 0.707
5	1.32	0.708 - 0.760

Torque Specification

NOTE: A = refer to procedure for correct torque sequence

Description	Nm	lb-ft	lb-in
Piston cooling nozzle	10	7	-
Engine coolant drain plug	18	13	-
Cylinder head retaining bolts	**A**	-	-
Oil filter housing retaining bolts	10	7	-
Fuel injection pump cradle retaining bolts	23	17	-
Fuel injection pump to cradle retaining bolts	23	17	-

Fuel injection pump bracket to cradle retaining bolts	10	7	-
Fuel injection pump to bracket retaining bolts	10	7	-
Oil pump retaining bolts	10	7	-
Crankshaft rear oil seal housing retaining bolts	10	7	-
Oil pan retaining bolts M6	10	7	-
Oil pan retaining bolts M8	23	17	-
Oil pump pick up pipe retaining bolts	10	7	-
Engine oil level sensor retaining nuts	10	7	-
Crankshaft timing belt pulley retaining bolt	Stage 1 - 150 Stage 2 - 300 Stage 3 - 90 degrees	-Stage 1 - 111 Stage 2 - 221 Stage 3 - 90 degrees	-
Crankshaft position sensor (CKP) retaining bolt	5	-	44
Timing chain tensioner retaining bolts	10	7	-
Camshaft bearing cap retaining bolts	**A**	-	-
Timing belt idler pulley retaining bolt	45	33	-
Fuel injection pump belt rear cover retaining bolts	10	7	-
Fuel injection pump sprocket retaining nut	50	37	-
Coolant outlet pipe retaining bolts	10	7	-
Coolant pump retaining bolts	10	7	-
Timing belt tensioner retaining bolt	26	19	-
Engine lifting eye bolts	23	17	-
Camshaft rear end accessory drive (READ) pulley hub retaining bolt	Stage 1 - 80 Stage 2 - 80 degrees	Stage 1 - 59 Stage 2 - 80 degrees	-
Camshaft front timing pulley hub retaining bolt	80 + 80°	59 + 80 °	-
Camshaft READ pulley retaining bolt	23	17	-
Camshaft front timing pulley retaining bolt	23	17	-
Fuel injection pump timing belt tensioner bolt	23	17	-
Camshaft position sensor (CMP) retaining bolt	10	7	-
Intake manifold / camshaft cover retaining bolts	10	7	-
Brake vacuum pump retaining bolts	23	17	-
Engine oil pressure (EOP) switch	14	10	-
Glow plug	11	8	-
Fuel rail retaining bolts	23	17	-
Fuel rail bracket retaining bolts	23	17	-
Fuel injector retaining bolts	**A**	-	-
High pressure fuel line union nuts	**A**	-	-
High pressure fuel line bracket retaining bolts	9	-	80
Turbocharger assembly to exhaust manifold retaining nuts	24	18	-
Exhaust manifold to cylinder head retaining nuts	**A**	-	-
Exhaust manifold heatshield retaining bolts	11	8	-
Turbocharger heatshield retaining bolts	11	8	-
Exhaust gas recirculation (EGR) valve retaining bolts M6	10	7	-
Accessory drive belt idler pulley bracket retaining bolts	83	61	-
Timing belt covers retaining bolts	10	7	-
Engine mount bracket to engine retaining bolts	115	85	-
Exhaust cross over pipe retaining nuts	24	18	-
Engine coolant inlet pipe retaining bolts	10	7	-
Coolant pump pulley retaining bolts	25	18	-
Crankshaft pulley/vibration damper retaining bolts	25	18	-
Throttle body retaining threaded stud	10	7	-
Wiring harness retaining nuts	10	7	-
Vacuum hose assembly retaining bolts	10	7	-
Flexplate retaining bolts	**A**	-	-
Accessory drive component bracket retaining bolts	23	17	-
Power steering pump retaining bolts	23	17	-
Generator retaining bolts	47	35	-

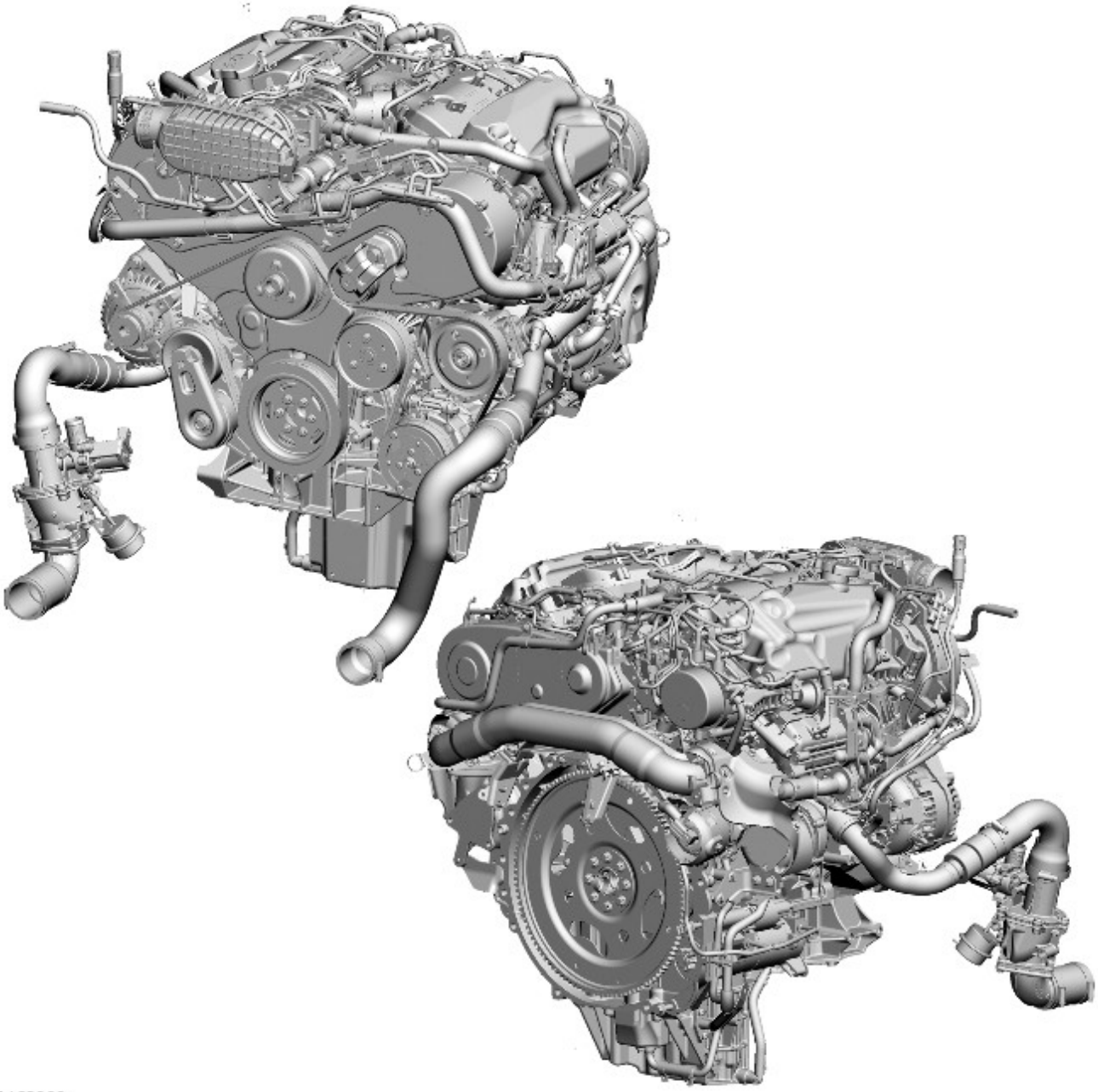
Accessory drive belt tensioner retaining bolt	47	35	-
Accessory drive belt idler pulley retaining bolt	47	35	-
Air conditioning compressor bracket retaining bolts	23	17	-
Air conditioning compressor retaining bolts	23	17	-

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Engine - Component Location

Description and Operation

External View



E120969

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Engine - Overview

Description and Operation

OVERVIEW

The 3.0 liter diesel engine is a V6 configuration unit with 2 banks of 3 cylinders arranged at 60 degrees to each other. There are 4 valves per cylinder, which are operated by 2 overhead camshafts per cylinder bank.

The cylinder block is cast in compacted graphite iron, which uses less material to produce compared to a conventional cast iron block. This provides reduced weight and length with superior structural capabilities.

The cylinder heads are cast aluminum with a moulded plastic camshaft cover with an integral air intake. The single-piece structural oil pan is high pressure die cast from aluminum. The exhaust manifolds are cast from an iron alloy. A moulded plastic acoustic cover is fitted over the upper engine to absorb engine-generated noise.

A low compression ratio of 16:1 contributes to improved emissions quality, quieter combustion and compatibility with the engine's unique forced induction system. For additional information refer to Intake Air distribution and Filtering.

The low compression ratio also means less heat build-up in the piston bowl and more efficient fuel burn, resulting in the production of lower levels of pollutants. It also assists with cold starting allowing a faster cranking speed.

The engine is available in two power output forms. The power difference is achieved by changes to the engine calibration within the ECM (engine control module) and other vehicle control modules.

 NOTE: It is not possible to re-configure a lower power output engine to the higher output specification.

Published: 12-Jul-2012

Engine - TDV6 3.0L Diesel - Engine - System Operation and Component Description

Description and Operation

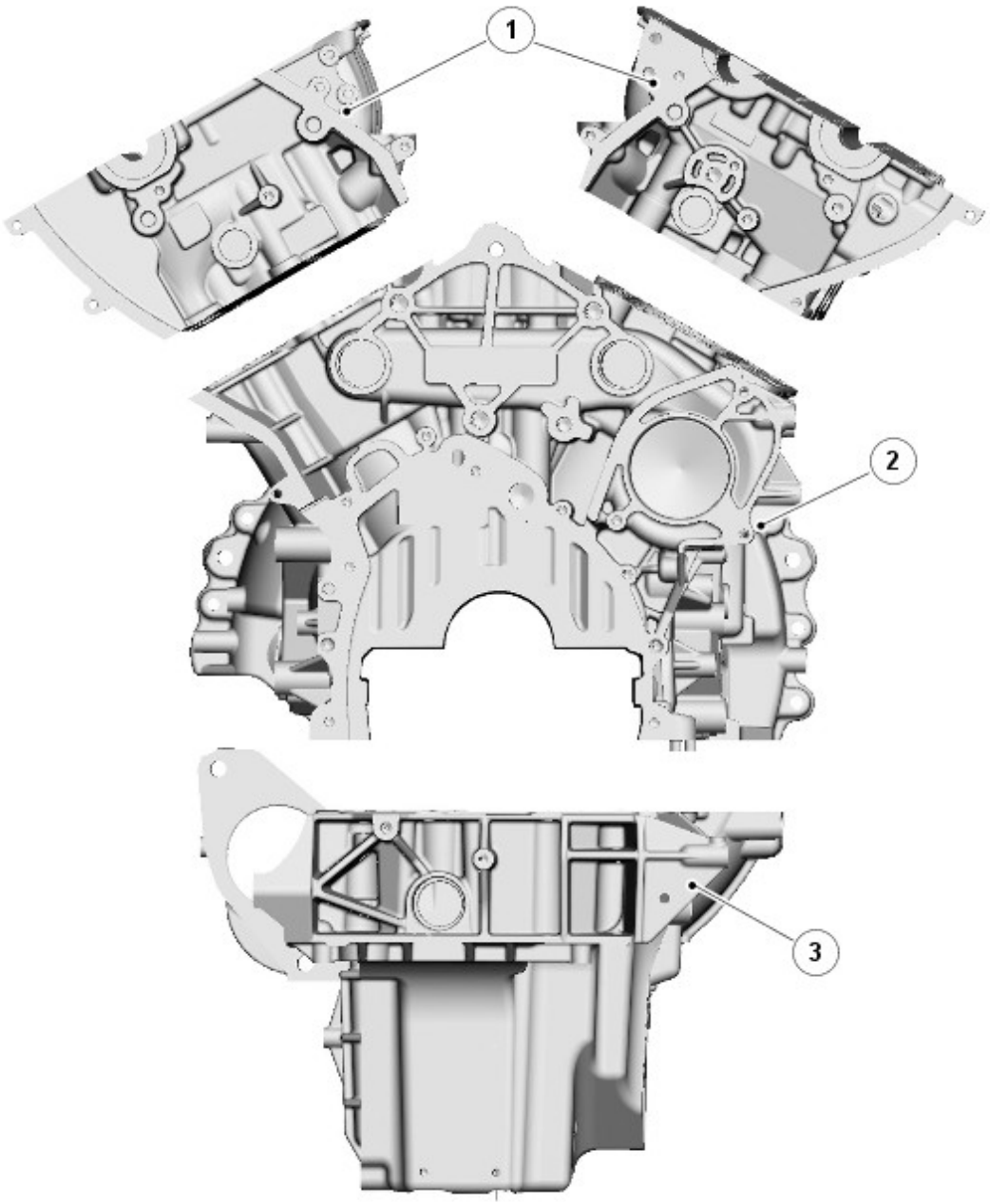
System Operation

OPERATION

Operation of the engine is controlled by the ECM (engine control module).
Refer to: Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

Component Description

ENGINE STRUCTURE



E120983

Item	Description
1	Cylinder heads
2	Cylinder block
3	Oil pan

CYLINDER BLOCK COMPONENTS

The cylinder block is a single cast construction with a hollow beam structure, cast from compact graphite iron. This

type of construction provides outstanding strength and durability and uses less material than a conventional cast iron block, therefore reducing engine weight and length.

The use of compact graphite iron allows the cross sectional areas of the casting to be reduced, compared with a conventional gray cast iron block. This ensures reduced engine weight and length, with higher structural capabilities.

To maintain the stiffness of the bottom end of the cylinder block and crankshaft system, the cylinder block has a deep skirt and bearing cap design. Each of the main bearing caps is double bolted at each side of the crankshaft bearing and cross bolted back to the cylinder block.

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

A tapping at the rear of the cylinder block connects a pipe to the turbochargers by means of banjo connections. Oil is supplied, under pressure via this tapping, from the oil pump to provide lubrication for the bearings of the turbochargers.

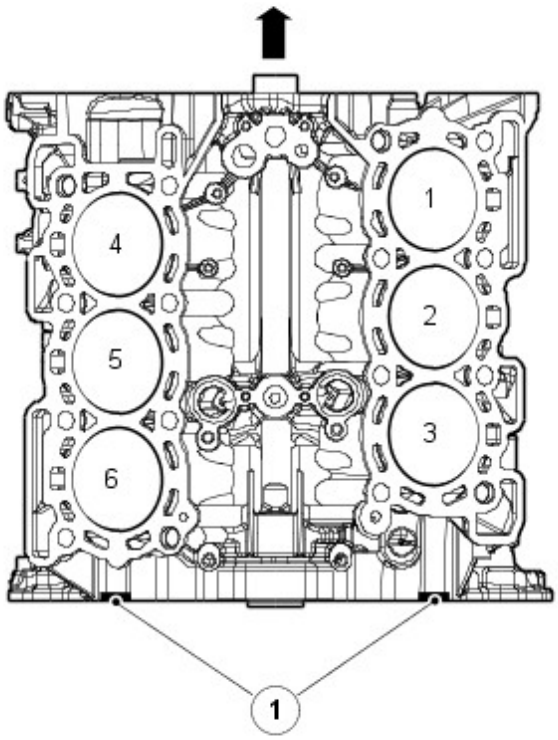
Cylinder cooling is achieved by coolant circulating through chambers in the cylinder block casting.

Two hollow metal dowels are used to locate the cylinder heads to the cylinder block, 1 on each side at the rear of the unit.

A port is included at the RH (right-hand) and LH (left-hand) side of the cylinder block, below each of the turbochargers, to connect the turbochargers oil return pipe to the oil pan.

Two coolant drain plugs are installed in the cylinder block; one is fitted in the rear RH side, and the other is fitted in the middle of the cylinder block on the LH side.

Engine Data



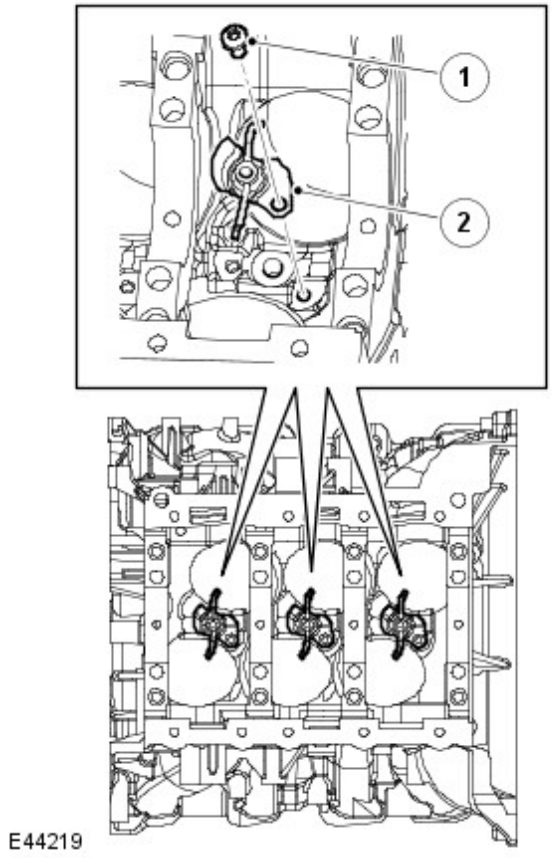
E44217

NOTE: Arrow indicates front of engine

Item	Description
1	Engine data locations

Engine data is marked at 2 locations at the back of the cylinder block. Component diameters are represented by alphabetical and numerical codes; keys to the codes are in the removal and installation section of this manual.

Piston Cooling Jets



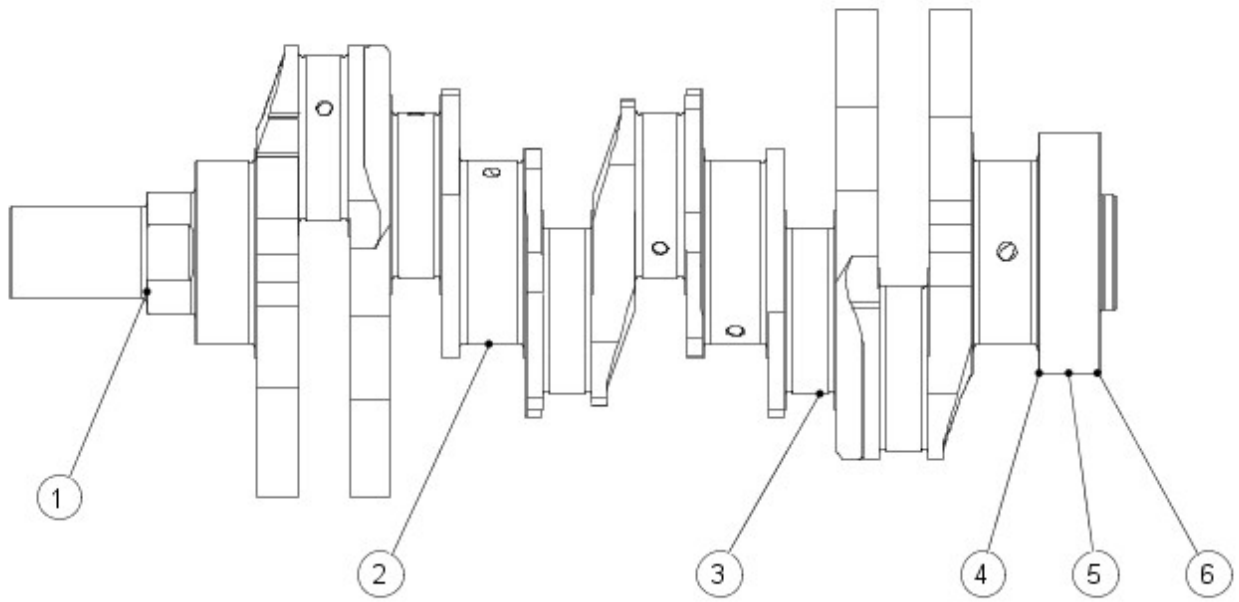
Item Description

1 Bolt

2 Cooling jet

Jets located in the cylinder block provide piston and piston pin lubrication and cooling. These jets spray oil on to the inside of the piston, the oil then flows through 2 internal wave shaped channels to help cool each piston crown.

CRANKSHAFT



Item Description

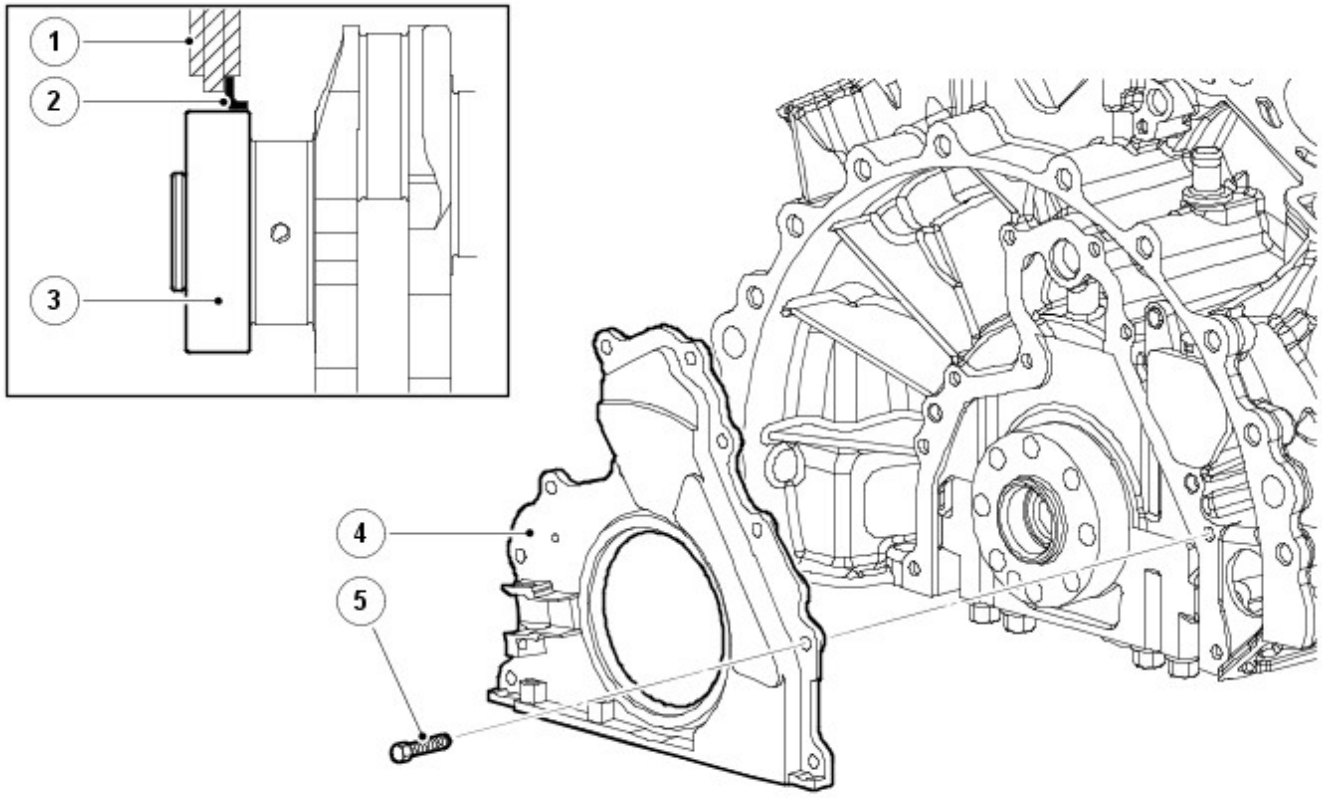
1 Oil pump drive

2 Main bearing Journal
3 Connecting rod bearing journal
4 Rear drive flange
5 Rear oil seal location
6 Trigger wheel location

The crankshaft is forged steel and fillet rolled with induction hardened journals, which run in 4 bearings with clamped 2 layer bearing shells. The upper and lower shells of bearing number 4 are flanged, which limits the end float of the crankshaft. The main bearing caps are double bolted and cross bolted to increase the strength and rigidity of the engine block.

The main bearings are aluminum/tin split plain selective bearings. An oil groove in the top half of each bearing transfers oil into the crankshaft for lubrication of the connecting rod bearings. The upper and lower shells of bearing number 4 contain integral thrust washers, which limits the end float of the crankshaft.

Rear Crankshaft Oil Seal



E44227

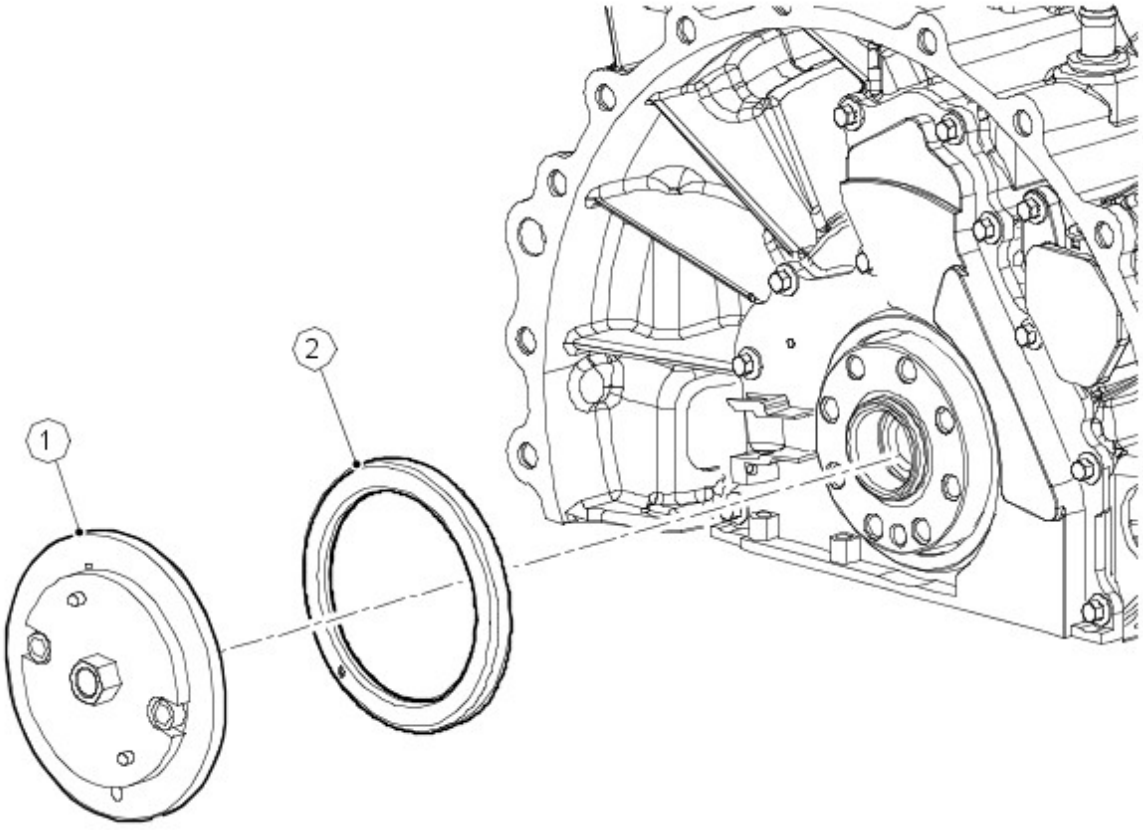
Item Description

1 Housing
2 Seal
3 Crankshaft
4 Rear oil seal retainer
5 Bolt (10 off)

The rear main oil seal and retainer assembly is a one-piece unit and is supplied with its own plastic fitting sleeve. The seal and retainer have 2 locating dowels, 10 fixing bolts and a rubber seal. In addition, the retainer has a location for the crankshaft position sensor. For additional information refer to 303-14A Electronic Engine Controls.

A torsional vibration crankshaft damper pulley is bolted to the front of the crankshaft.

Crankshaft Trigger Wheel



E52137

Item Description

1 Special Tool

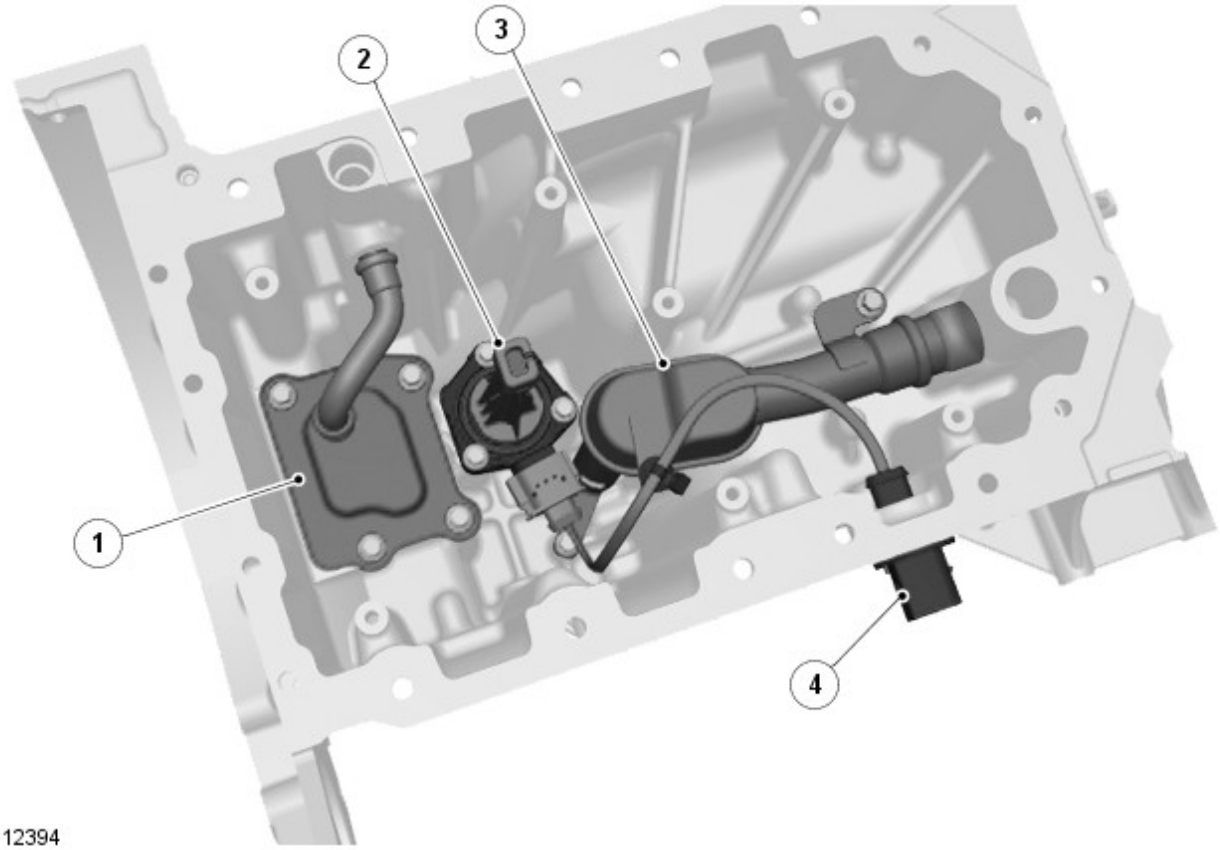
2 Trigger wheel

The crankshaft trigger wheel is located on the rear of the crankshaft. It is pressed onto the crank using a special tool, which also precisely aligns the trigger wheel for crankshaft position and timing.

The trigger wheel consists of 60 magnets minus 2 for ECM crankshaft position reference and synchronization. The magnets cannot be seen on the trigger wheel, which therefore can only be positioned using a special tool. For additional information refer to 303-14A Electronic Engine Controls.

If the trigger is removed for any reason, then a new trigger wheel must be fitted.

OIL PAN COMPONENTS



Item Description

1 Oil scavenge reservoir
2 Oil level and temperature sensor
3 Oil pick-up pipe
4 Oil level and temperature sensor connector

The structural oil pan is of a single piece die cast aluminum construction and is fitted to the lower cylinder block to stiffen the base structure of the engine, helping to reduce noise, vibration and harshness. The oil pan also incorporates an oil baffle plate to reduce oil foaming and splash.

The oil pan is secured to the cylinder block with 2 dowels, 2 locator pins for the gasket and 18 retaining bolts; 3 different lengths of bolts are used:

- M6 x 20 (6 off)
- M8 x 75 (4 off)
- M6 x 105 (8 off).

Iron inserts, cast into the main bearing supports of the stiffening frame, minimize main bearing clearance changes due to heat expansion.

A gasket seals the joint between the oil pan and the cylinder block.

An oil pick-up pipe with integral strainer locates in the oil pan to provide oil to the crankshaft driven oil pump.

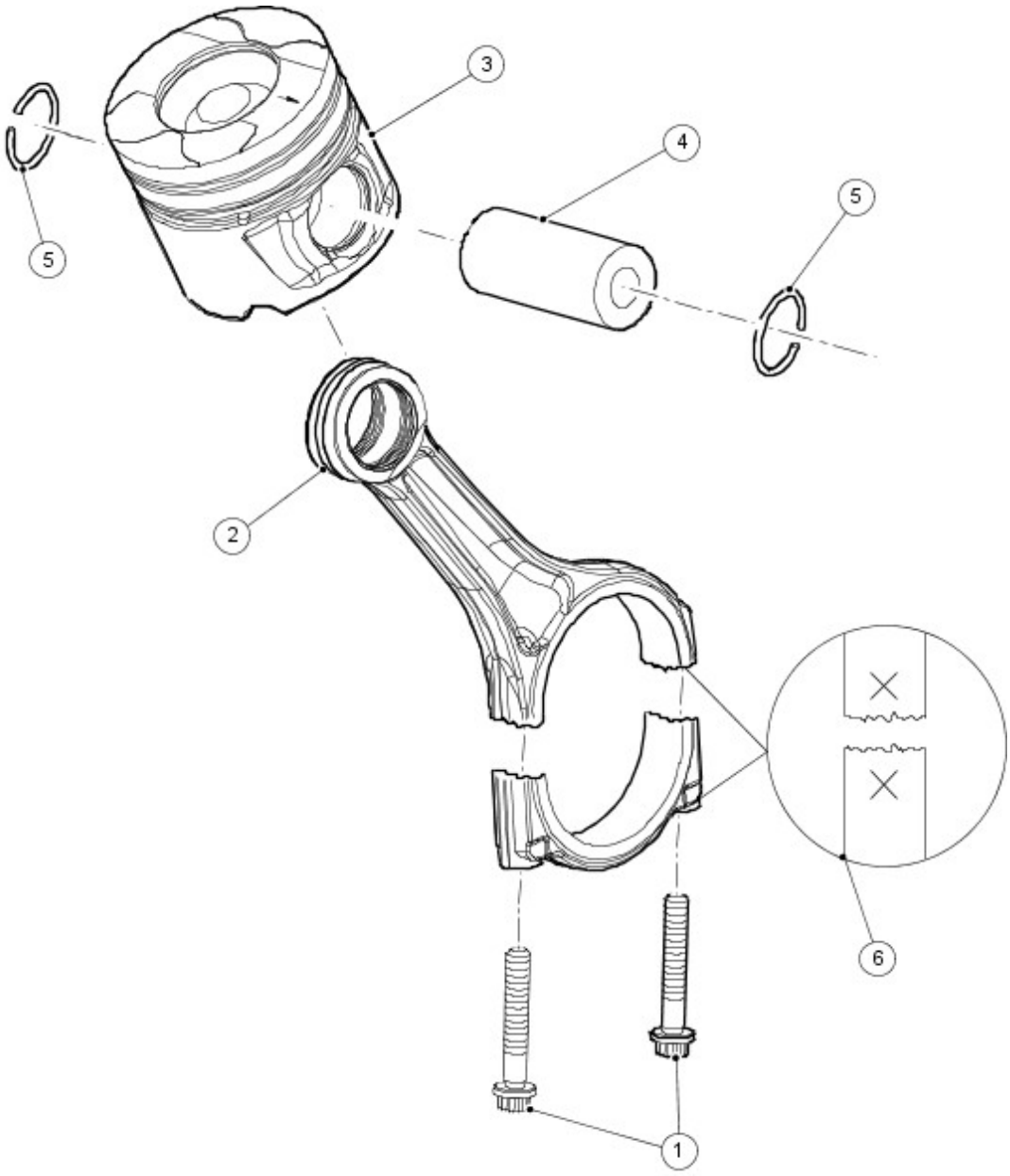
An ultrasonic sensor provides an electronic indication when the oil in the oil pan is low or high. This removes the requirement for the mechanical dipstick. An advantage in comparison with the static 'dipstick' method is that all marginal influences, for example vehicle being on a slope, lateral and longitudinal acceleration, are compensated for by averaging.

The values determined can be used to signal that the minimum oil level has been reached or to display the current oil level if required.

The sensor is mounted inside the oil pan where it sends an ultrasonic pulse vertically upward, it then measures the time for the pulse to be reflected back from the top surface of the oil.

Warnings will be displayed in the message center if the oil level is not maintained within the safe operating levels (minimum and maximum). A warning will also be displayed if there is a fault with the oil level monitoring system.

PISTON AND CONNECTING ROD ASSEMBLY



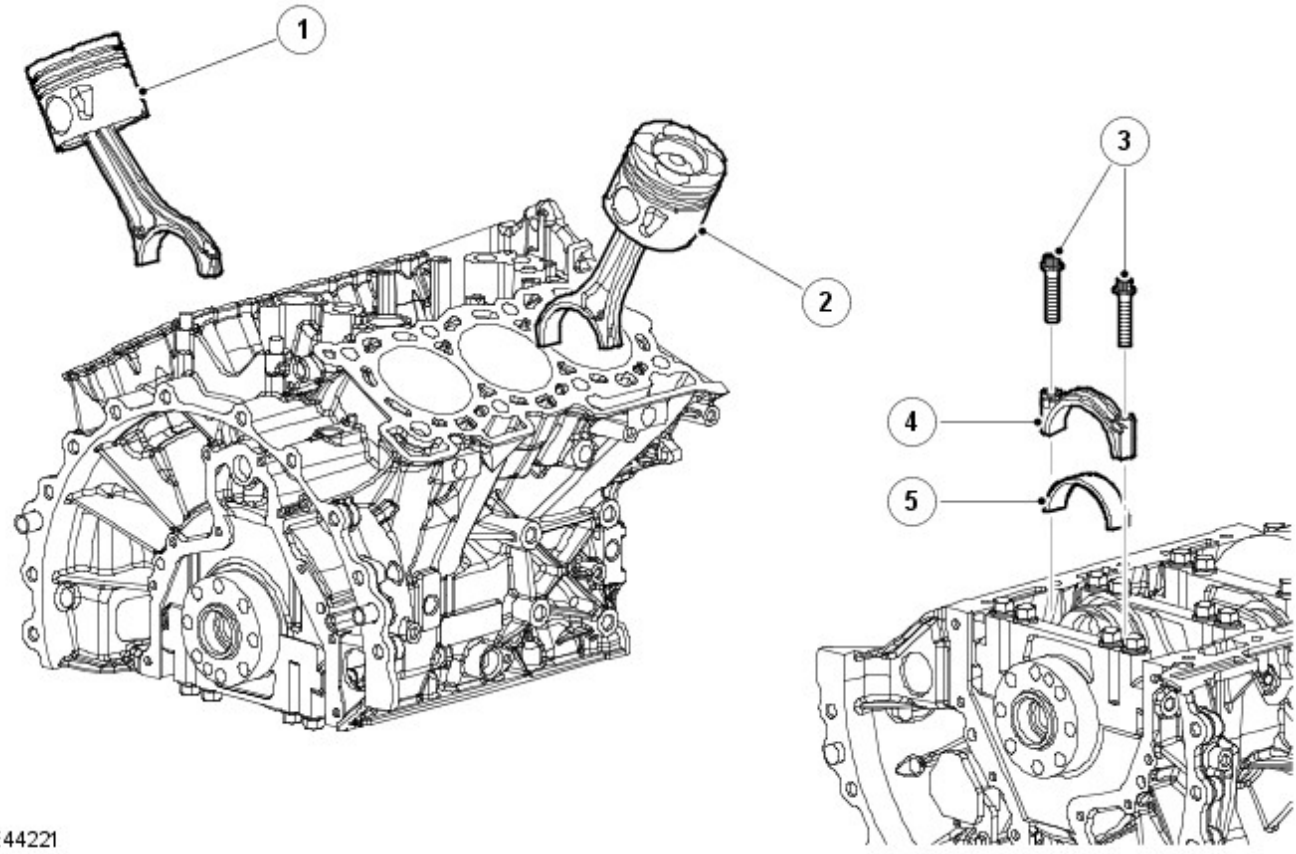
E52134

Item	Description
1	Connecting rod bolts (2 off)
2	Connecting rod
3	Piston
4	Piston pin
5	Circlips
6	Connecting rod identification

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 etched on adjoining sides of the joint to identify matching connecting rods and bearing caps. The selective connecting rod bearings are aluminum/tin split plain bearings. The connecting rod bearing is 'sputter coated', which is a manufacturing process that layers the bearing material to produce a higher load capacity for improved durability.

NOTE: The connecting rods are not selective.

Piston and Connecting Rod Orientation



Item Description

1 Piston and connecting rod assembly, cylinders 4-6
2 Piston and connecting rod assembly, cylinders 1-3
3 Bolts (12 off)
4 Connecting rod bearing cap (6 off)
5 Connecting rod lower bearing (6 off)

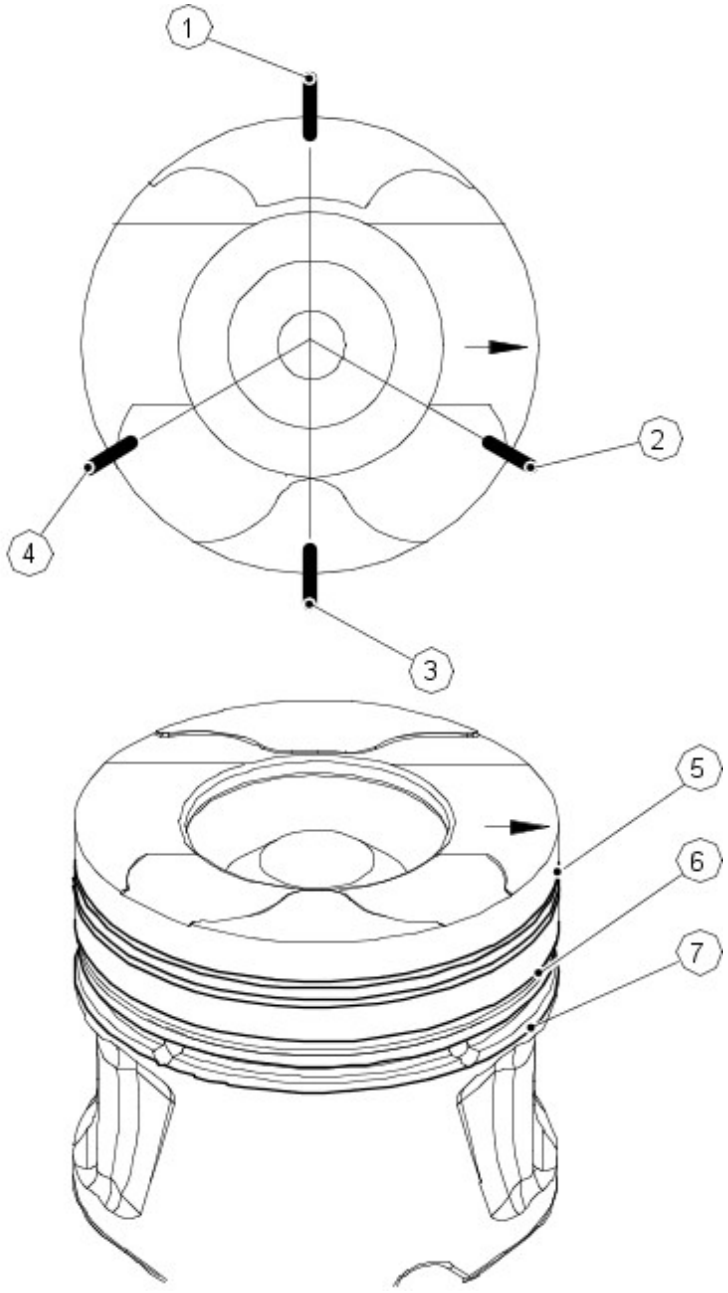
When installing a connecting rod, ensure the back of the connecting rod faces the center of the 'vee'.

The pistons are made from aluminum alloy and are fitted with 3 rings. The piston crown incorporates a pronounced bowl; this forms the combustion chamber, which promotes swirl and turbulence necessary for good combustion and improved emissions. In addition, the piston skirt has a molybdenum-coated surface, which counteracts scoring of the cylinder bore and piston.

The piston also incorporates a double wave gallery within the piston crown to enhance piston cooling. The pistons are supplied oil by means of spray jets located in the cylinder block oil gallery. These jets ensure optimum piston cooling to counteract the high temperatures generated by the combustion process.

Each piston is installed on a piston pin located in a aluminum/tin bushing in the connecting rod.

Piston Ring Orientation



E52133

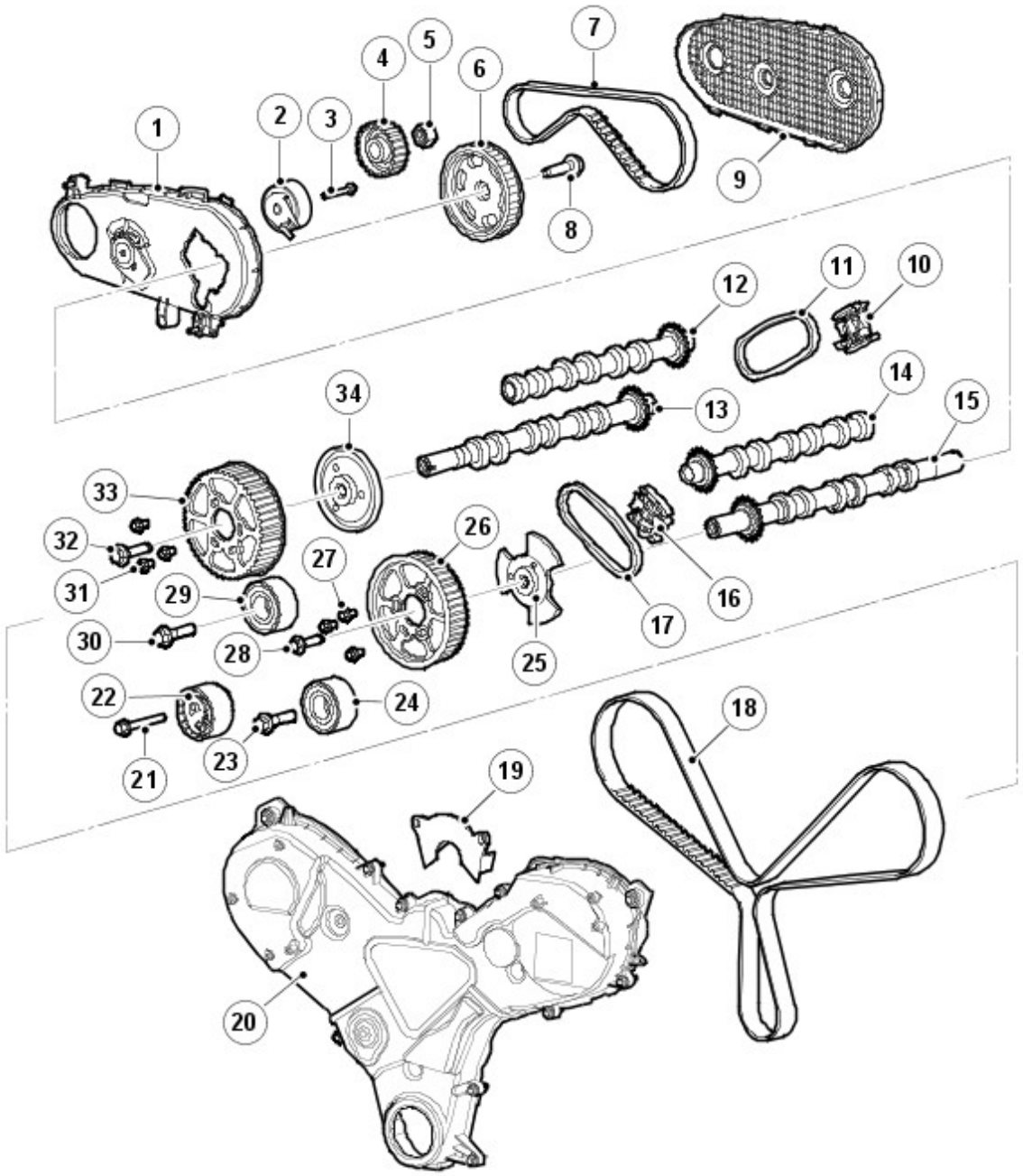
Item Description

1 Ring gap oil control
2 Ring gap upper compression
3 Spiral joint oil control
4 Ring gap lower compression
5 Upper compression ring
6 Lower compression ring
7 Oil control ring

When installing pistons ensure the arrows on the piston crowns all point to the front of the engine. All pistons are common single grade/single part number for all engines.

The piston top ring is a taper type and is fitted with the taper to the top of the piston. All rings marked 'top' are assembled with 'top' uppermost. All rings must be spaced evenly around the piston before installing. The circumference gap of the double bevelled oil control ring must be opposite the spiral control joint.

CAMSHAFT TIMING COMPONENTS



E94884

Item Description

1 Rear engine accessory drive rear cover
2 Rear engine accessory drive tensioner
3 Bolt
4 Fuel pump pulley
5 Nut
6 Rear engine accessory drive camshaft pulley
7 Rear engine accessory drive belt
8 Bolt
9 Rear engine accessory drive front cover
10 RH chain tensioner
11 RH timing chain
12 RH intake camshaft
13 RH exhaust camshaft
14 LH intake camshaft
15 LH exhaust camshaft
16 LH chain tensioner
17 LH timing chain
18 Timing belt
19 Front cover bridge
20 Primary drive cover

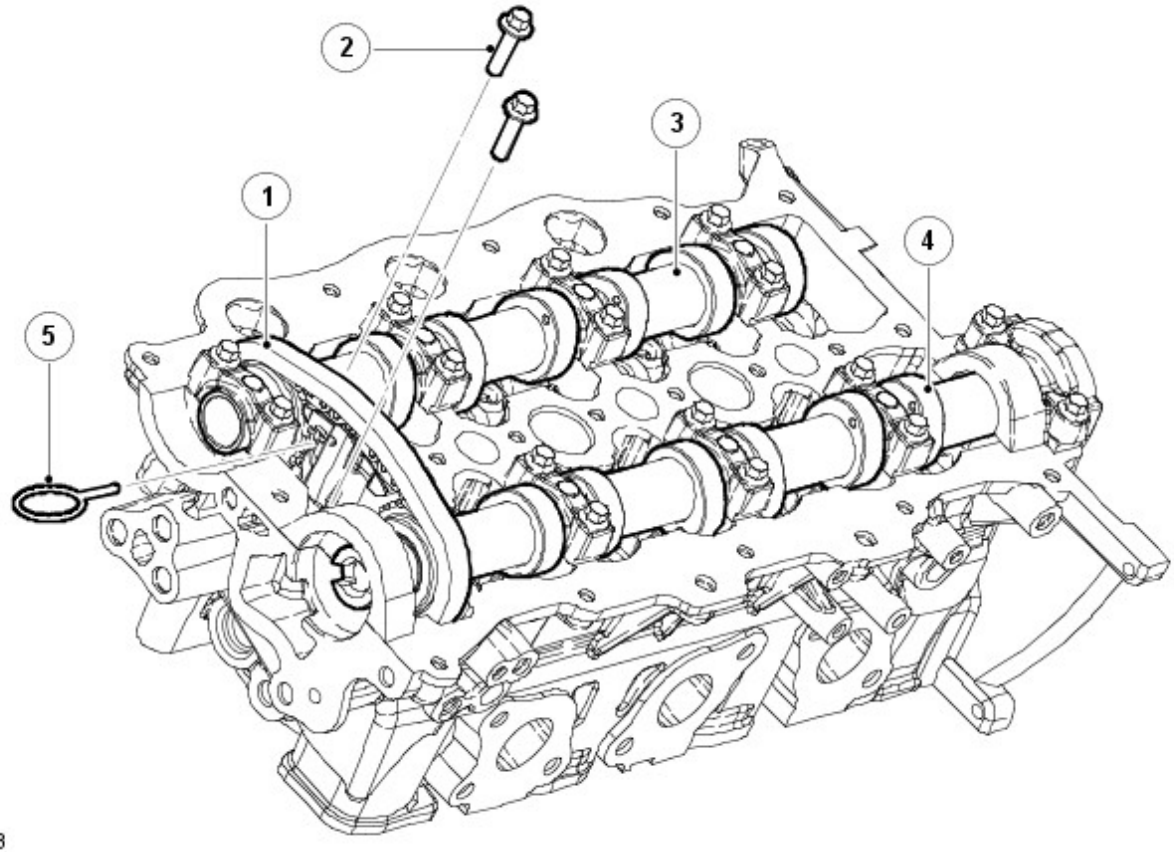
21 Bolt
22 Tensioner
23 Bolt
24 Idler
25 Camshaft hub
26 LH camshaft timing pulley
27 Bolt (3 off)
28 Bolt
29 Idler
30 Bolt
31 Bolt (3 off)
32 Bolt
33 RH camshaft timing pulley
34 Camshaft hub

Primary drive is provided by a single toothed belt from the crankshaft to the exhaust camshaft gears of each cylinder bank via 2 idler pulleys and a tensioner.

Timing belt adjustment is carried out by an eccentric type tensioner mounted on the RH front face of the cylinder block.

A primary drive cover is made up from 3 separate plastic mouldings. The covers are secured to the front of the cylinder block and cylinder heads with 15 bolts and 1 stud and nut. The 2 upper covers are partially sealed with a rubber seal.

Secondary Drive



E44233

Item	Description
1	Timing chain
2	Bolts
3	Intake camshaft
4	Exhaust camshaft
5	Tensioner firing pin

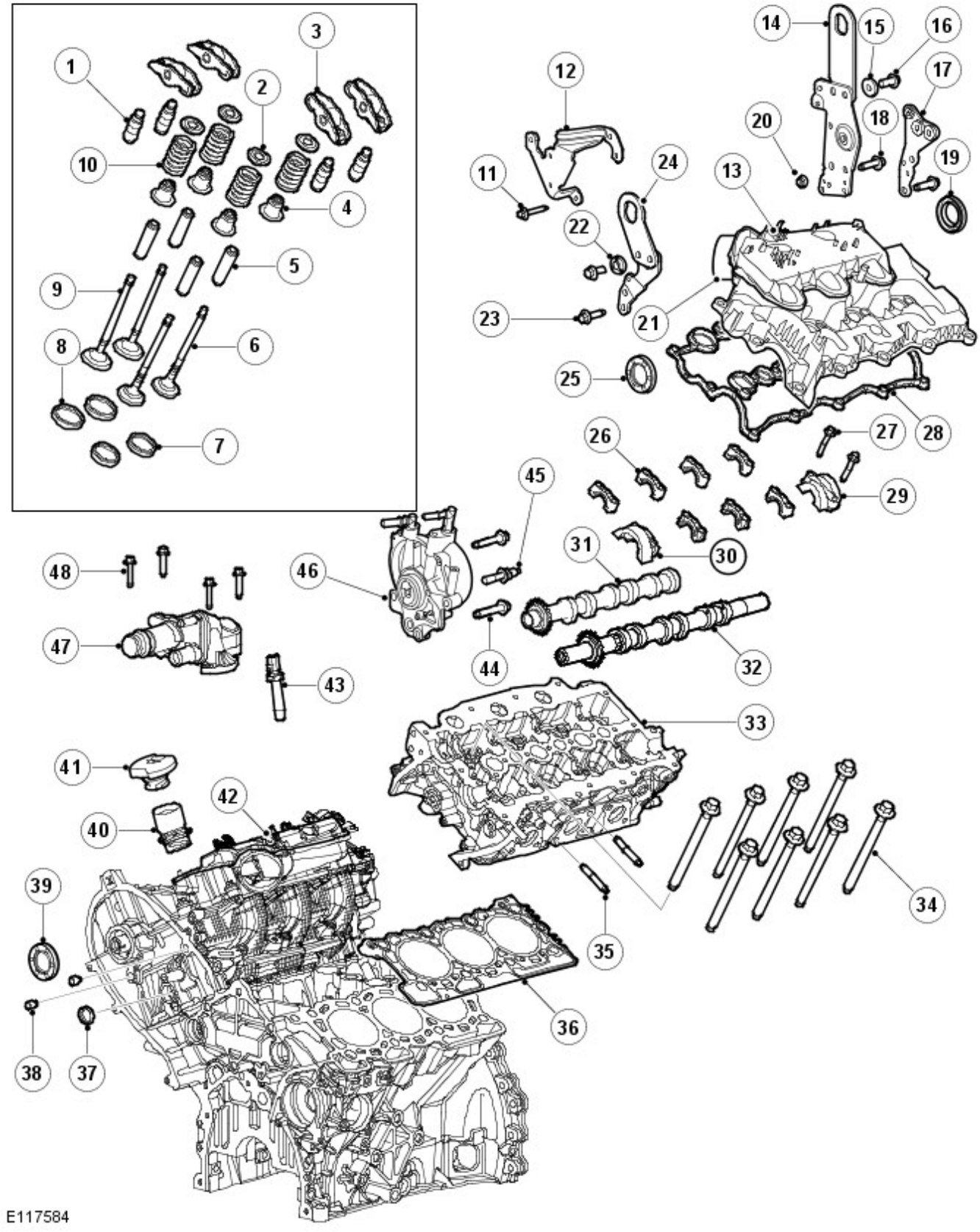
Secondary drive is provided by 2 short crossover chains, which transfer drive from the exhaust camshaft gears to the intake camshaft gears. The crossover drives are located at the rear of the RH cylinder bank and the front of the LH cylinder bank. This allows for a much shorter and simpler run for the main camshaft drive belt at the front of the engine.

Each crossover chain is tensioned via an automatic chain tensioner, which acts directly on the chains via a guide rail. The tensioners are located between the exhaust and intake camshafts at the front or rear of the cylinder head, depending on the cylinder bank.

The tensioner firing pin holds the automatic chain tensioner in a compressed state to aid installation.

CYLINDER HEAD COMPONENTS

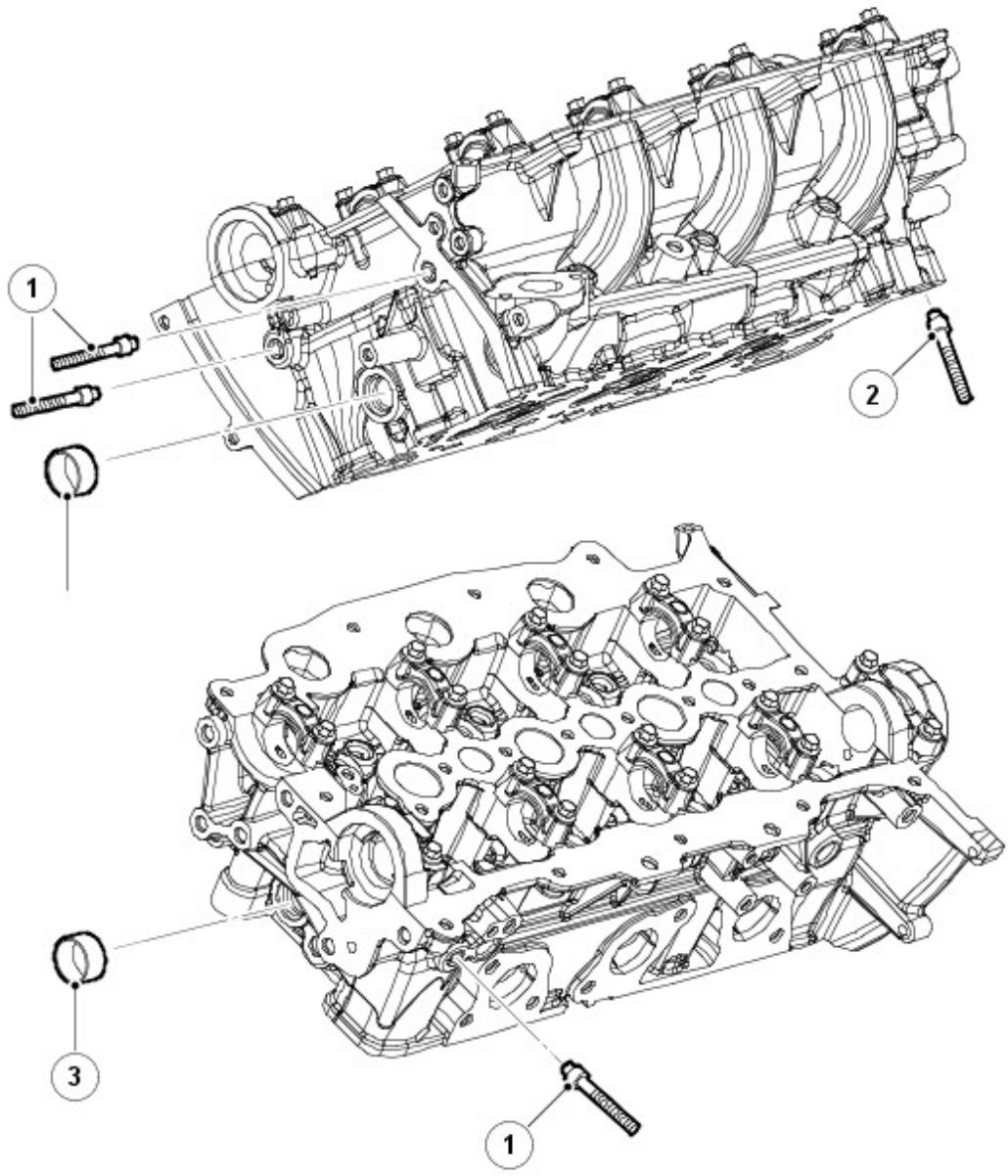
NOTE: LH cylinder head shown; RH cylinder head similar.



Item	Description
1	Hydraulic lash adjusters (12 off)
2	Valve spring retainers (12 off)

3 Roller rockers (12 off)
4 Valve stem seals (12 off)
5 Valve guides (12 off)
6 Exhaust valves (6 off)
7 Intake valve seats (6 off)
8 Exhaust valve seats (6 off)
9 Intake valves (6 off)
10 Valve springs (12 off)
11 Bolt
12 Bracket
13 Intake manifold
14 Lifting eye
15 Washer
16 Bolt
17 Bolt
18 Bolt
19 Seal
20 Cap
21 Intake manifold cover assembly
22 Washer
23 Bolt
24 Lifting eye
25 Seal
26 Camshaft bearing caps (7 off)
27 Bolts (18 off)
28 Gasket
29 Camshaft bearing cap and seal housing
30 Camshaft bearing cap and seal housing
31 Intake camshaft
32 Exhaust camshaft
33 Cylinder head
34 Cylinder head bolts (8 off)
35 Exhaust manifold studs (6 off)
36 Cylinder head gasket
37 Core plug
38 Plug
39 Seal
40 Oil filler tube
41 Oil filler cap
42 Intake manifold
43 Injectors (3 off)
44 Bolt (2 off)
45 Bolt
46 Tandem pump
47 Water outlet assembly
48 Bolt (4 off)

Cylinder Heads



E44236

Item Description

1 Studs
2 Bolts
3 Blanking plug

The aluminum gravity die cast cylinder heads are unique to each cylinder bank. Eight deep-seated bolts help reduce distortion and secure each cylinder head to the cylinder block. The cylinder head bolts are located beneath the camshafts, 4 under the intake camshaft and 4 under the exhaust camshaft. Two hollow dowels align each cylinder head with the cylinder block.

NOTE: The cylinder heads cannot be reworked.

The cylinder head gasket is a 3-layer, laminated steel type and is available in 5 different thicknesses. The choice of gasket thickness is dependent on the maximum piston protrusion. Gasket thickness is identified by serrations cut into the front end of the gasket.
Refer to: Specifications (303-01A Engine - TDV6 3.0L Diesel, Specifications).

The cylinder head has 4 ports machined at each cylinder location, 2 exhaust ports and 2 intake ports. One of the intake ports is helical and functions as a swirl port, the other is arranged laterally as a tangential port and functions as a charge port.

The camshafts are of a hollow steel tube construction, with pressed on sintered lobes. Each camshaft is retained by aluminum alloy caps, 5 for the exhaust camshafts and 4 for the intake camshafts. Location letters, A to I for the intake camshaft and R to Z for the exhaust camshaft, are marked on the outer faces of the caps for each cylinder head.

The LH cylinder bank exhaust camshaft is machined to accept a rear camshaft gear. The rear camshaft gear provides drive for the high-pressure fuel pump. For additional information refer to 303-04A Fuel Charging and Controls.

The exhaust camshaft gear of the LH cylinder head also incorporates a trigger wheel, which is used in conjunction with the camshaft sensor to measure engine position. For additional information refer to 303-14A Electronic Engine Controls.

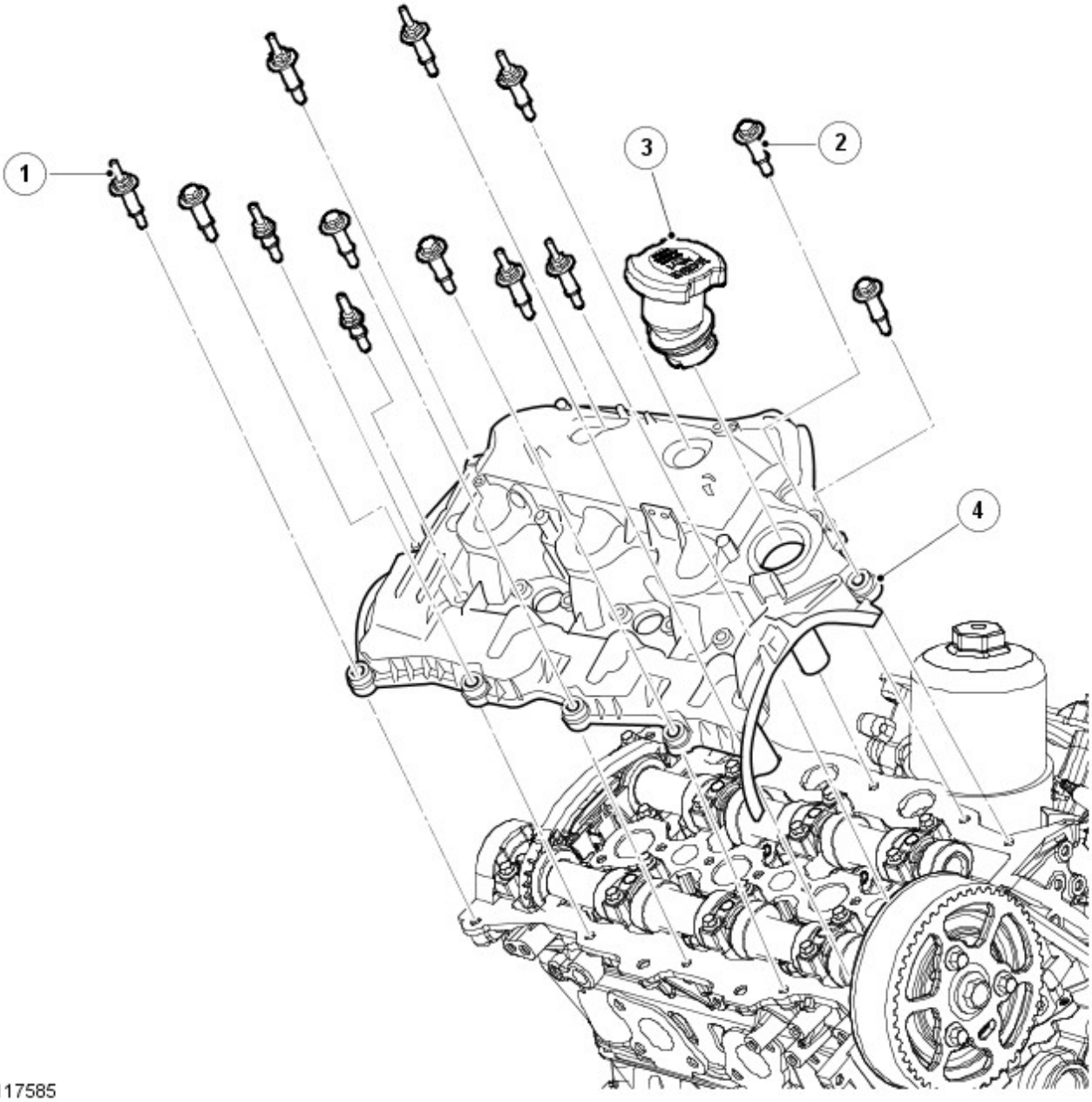
The RH cylinder head exhaust camshaft is machined at the rear end to provide a drive connection for the tandem pump.

The fuel injection nozzles are centrally mounted above each cylinder. For additional information refer to 303-04A Fuel Charging and Controls.

The glow plugs are arranged centrally on the intake side of the cylinder heads, between the 2 intake ports of each cylinder. For additional information refer to 303-07D Glow Plug System.

The engine lifting eyes are bolted to the cylinder head, 1 at the front and 2 at the rear, 1 per cylinder head.

Camshaft Covers



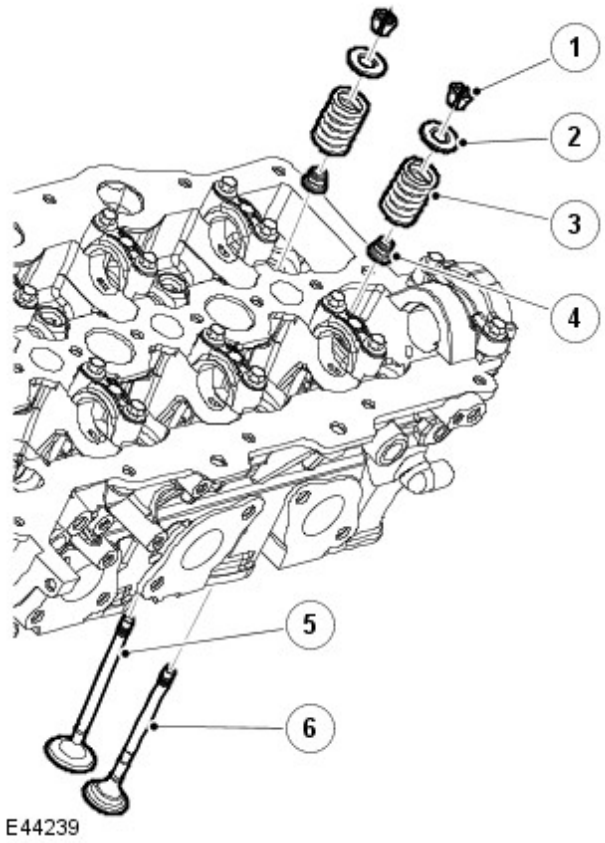
E117585

Item	Description
1	Stud bolt M6 x 40 (6 off)
2	Bolt M6 x 40 (7 off)
3	Oil filler cap
4	RH camshaft cover assembly

The camshaft covers are manufactured from vinyl ester composite. The RH bank camshaft cover incorporates an outlet for the full load engine breather and the engine oil filler cap. The LH bank camshaft cover incorporates an outlet for the part load engine breather. For additional information refer to 303-08A engine Emission Control.

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.

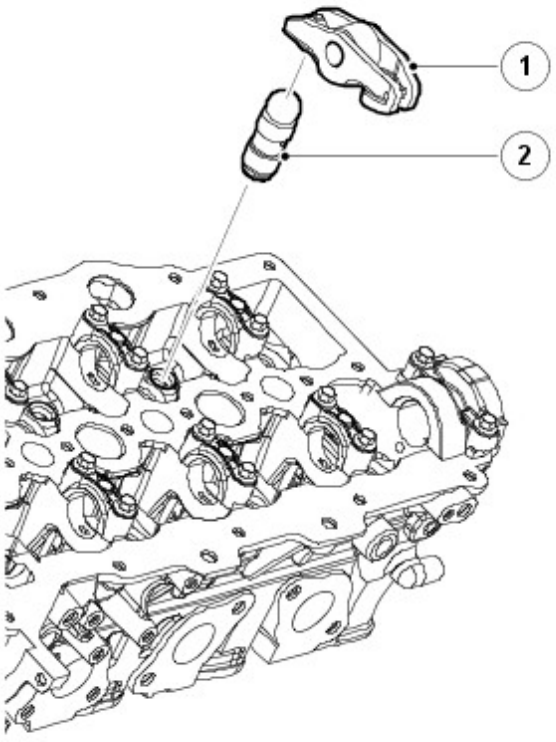
Intake and Exhaust Valves



Item	Description
1	Valve spring collet (24 off, 12 per cylinder head)
2	Valve spring retainer (24 off, 12 per cylinder head)
3	Valve spring (24 off, 12 per cylinder head)
4	Valve stem seal (24 off, 12 per cylinder head)
5	Intake valve (12 off, 6 per cylinder head)
6	Exhaust valve (12 off, 6 per cylinder head)

Each cylinder head incorporates 2 overhead camshafts operating 4 valves per cylinder via steel roller rockers with hydraulic lash adjusters.

Roller Rockers with Hydraulic Lash Adjusters



E44238

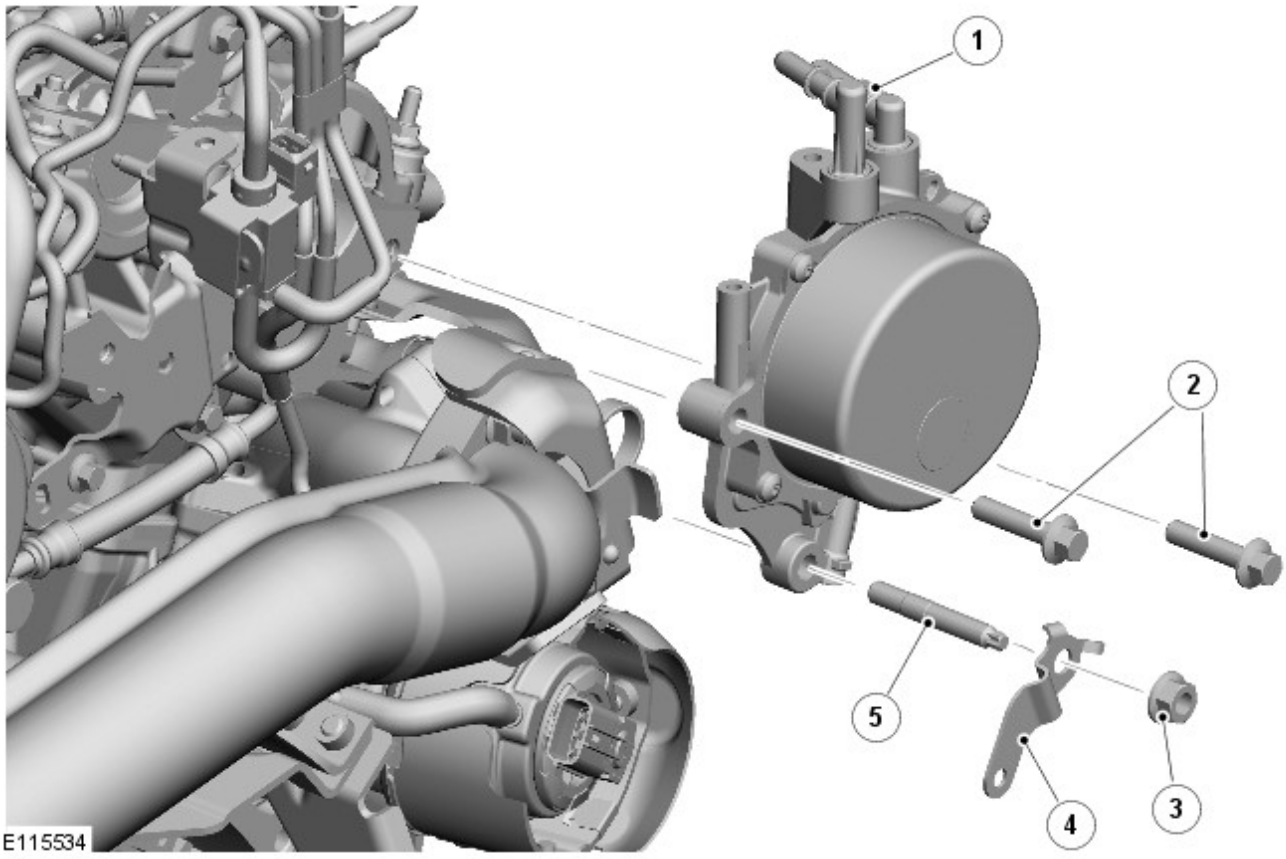
Item Description

1 Roller rocker (24 off, 12 per cylinder head)

2 Hydraulic lash adjuster (24 off, 12 per cylinder head)

The lightweight valve gear provides good 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.

Tandem Pump



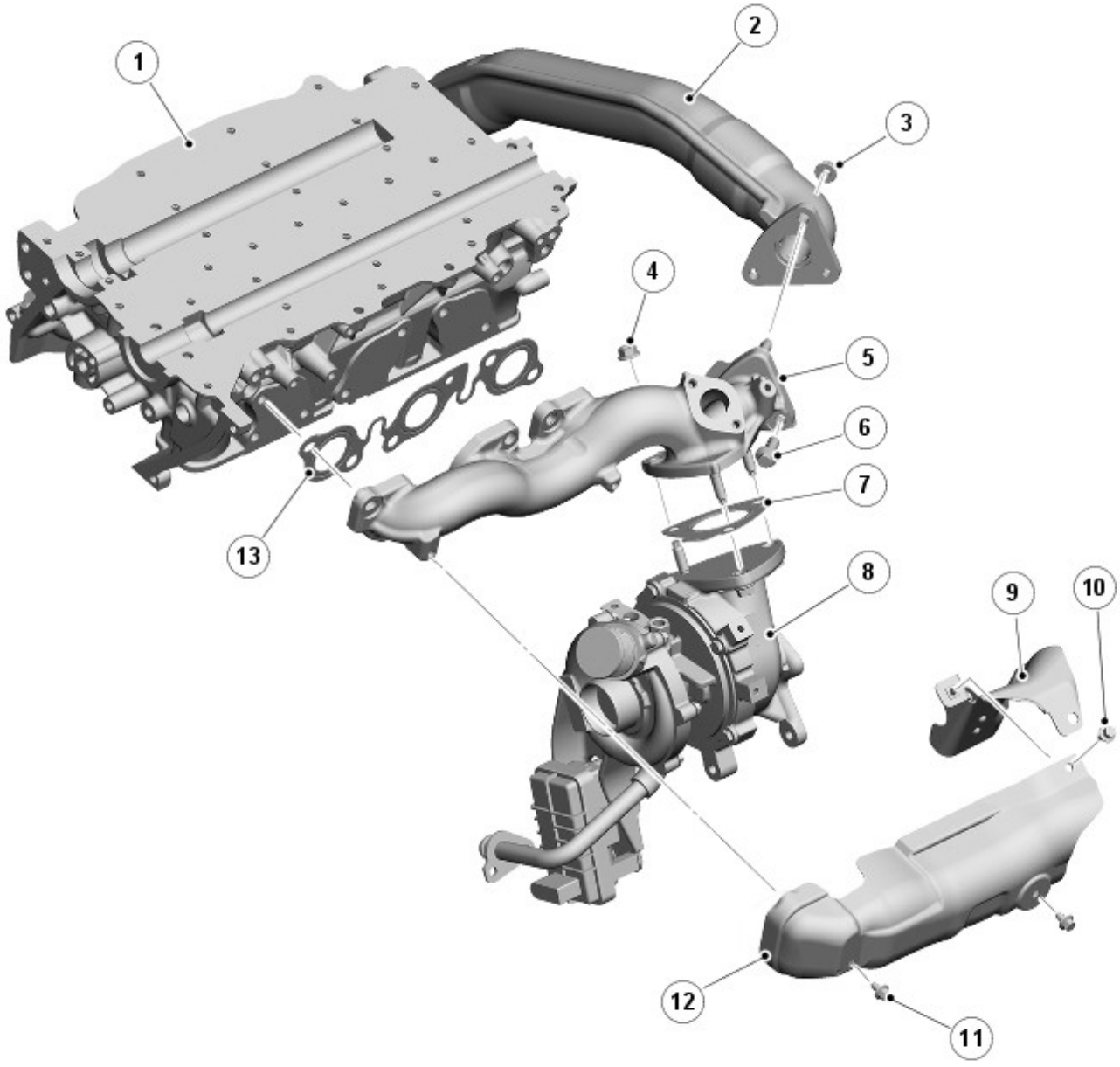
E115534

Item	Description
1	Tandem pump connections
2	Bolt (2 off)
3	Nut
4	Bracket (emission hose)
5	Stud

The tandem pump is a combined vacuum and oil scavenge pump. The scavenge pump is g-rotor type pump that drains oil from the secondary turbocharger to accommodate vehicle tilt. The pump is located at the rear of the RH side cylinder head and is driven from the exhaust camshaft.

Exhaust Manifolds

NOTE: LH exhaust manifold shown; RH exhaust manifold similar.



E115531

Item	Description
1	Cylinder head
2	Connecting pipe
3	Nut (2 off)
4	Nut (3 off)
5	Exhaust manifold
6	Bolt
7	Gasket
8	Turbocharger (primary turbocharger shown)

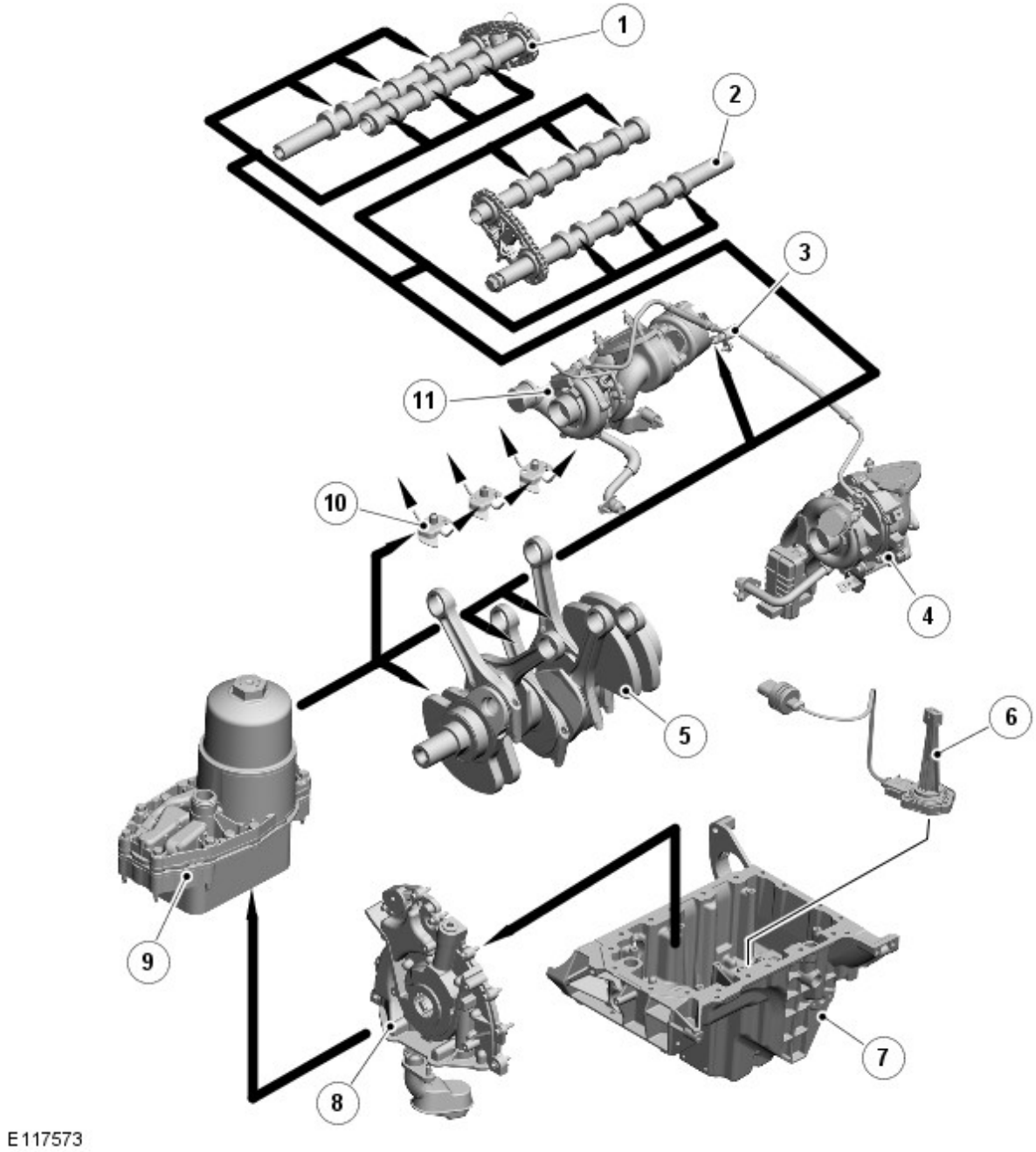
9 Manifold rear heat shield
10 Bolt
11 Bolt (2 off)
12 Manifold heat shield

The exhaust manifolds are cast from an iron alloy with a high nickel content giving excellent heat and corrosion resistance properties. They are sealed to the cylinder head by means of a steel gasket. Sacrificial plastic sleeves are used to align the manifolds. These sleeves must be changed when refitting the manifolds. Spacers on the securing bolts allow the manifolds to expand and retract with changes of temperature while maintaining the clamping loads.

Each manifold has a connection for the EGR (exhaust gas recirculation) transfer pipe.

The engine is fitted with twin variable geometry turbochargers, which fix to the exhaust manifolds by a 3-hole flange with a steel gasket.

LUBRICATION SYSTEM



Item Description

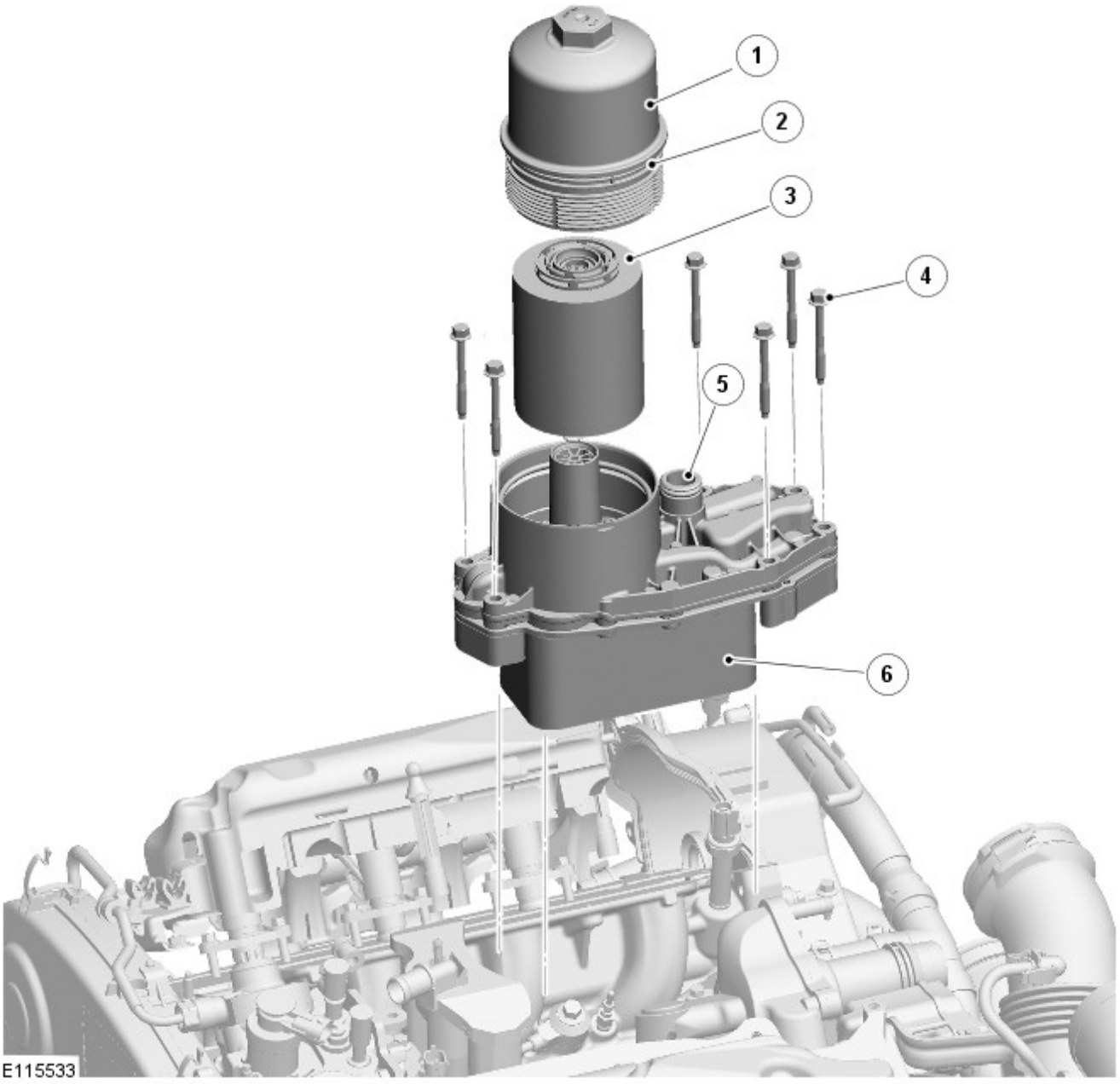
1 Inlet camshaft
2 Exhaust camshaft
3 Turbocharger oil supply
4 Primary turbocharger
5 Crankshaft and connecting rods
6 Oil level and temperature sensor
7 Oil pan

8 Oil pump
9 Oil cooler and filter assembly
10 Piston cooling jets
11 Secondary turbocharger

Oil is drawn from the oil pan and pressurized by the oil pump. The output from the oil pump is then filtered and distributed through internal oil passageways.

All moving parts are lubricated by pressure or splash oil. Pressurized oil is also provided for operation of the hydraulic adjusters and the timing gear chain tensioners.

Oil Cooler and Filter Assembly



Item	Description
1	Filter housing
2	'O' ring seal
3	Paper element
4	Retaining bolt (6 off)
5	Coolant outlet connection
6	Cooler assembly

The engine is lubricated by a force-feed oil circulation system with a full flow oil filter. The oil cooler forms a unit with the oil filter, which is mounted centrally in the middle of the cylinder block between the 2 banks of cylinders. The engine oil is cooled using the engine cooling system. This eliminates the need for an additional engine oil cooler remotely mounted.

Oil returns to the oil pan under gravity. Large drain holes through the cylinder heads and cylinder block ensure the

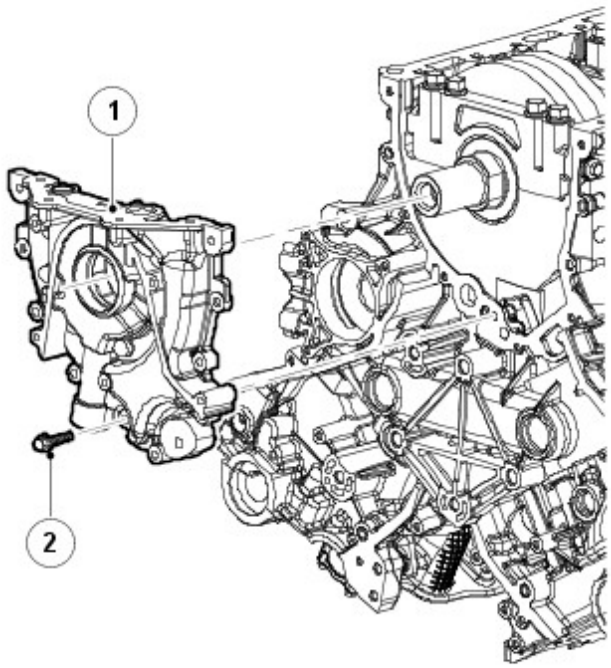
quick return of the oil, reducing the volume of oil required and enabling an accurate check of the contents soon after the engine stops.

System replenishment is through the oil filler cap on the RH camshaft cover.

The moulded composite 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.

NOTE: Fuel cooling is facilitated by a blast air fuel cooler in the return line to the fuel tank.

Oil Pump



E44230

Item	Description
1	Oil pump
2	Bolt (10 off)

The oil pump is a gear type pump and is bolted and dowelled to the front of the cylinder block. It is sealed by means of a rubber gasket, which is recessed into the oil pump housing. The pump inlet and outlet ports align with oil passages in the stiffening frame.

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 lb/in^2).

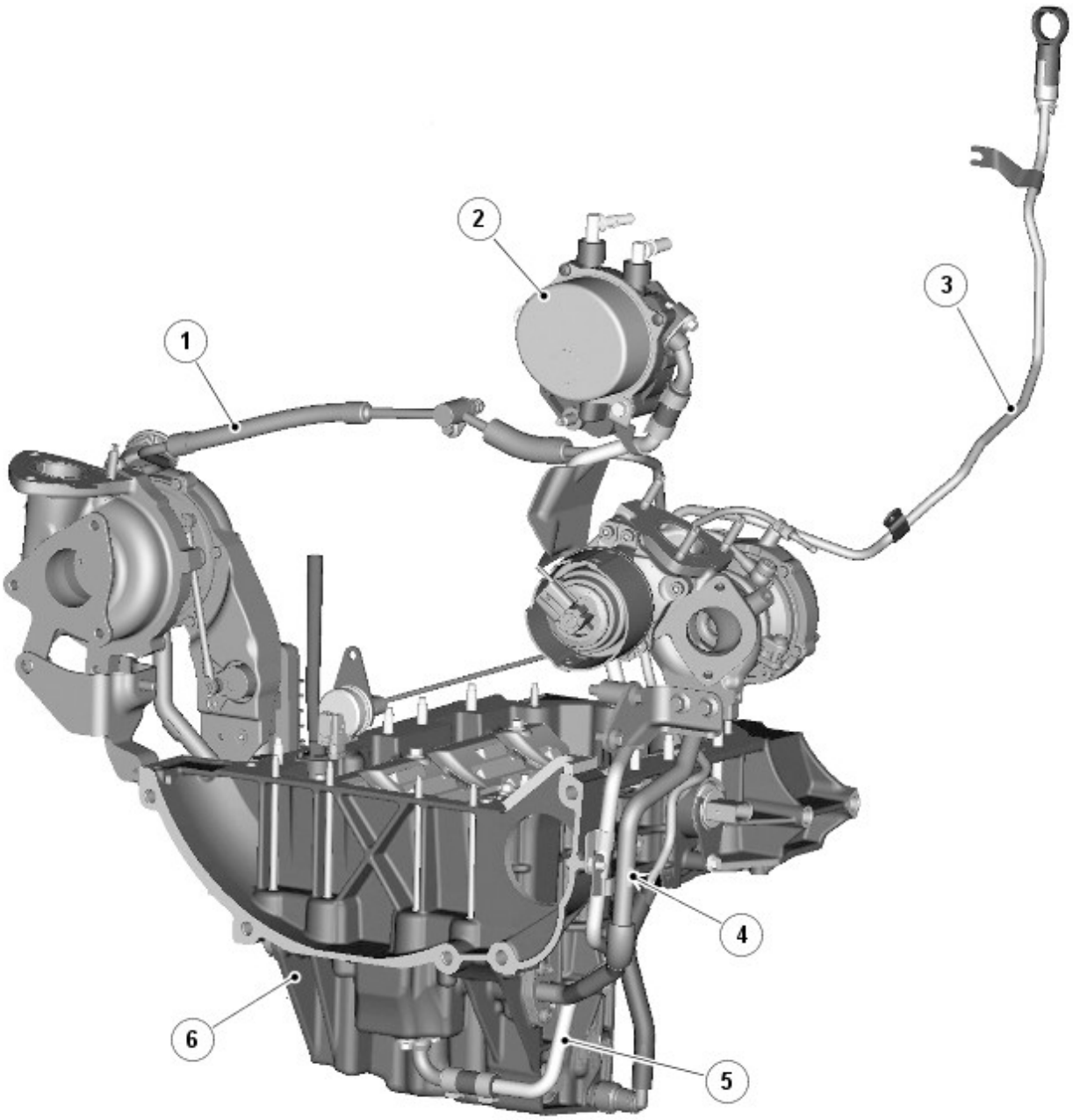
The front crankshaft oil seal is housed in the oil pump casing and is fitted such that its front face is 1 mm (0.04 in) under flush with the machined front face of the oil pump.

NOTE: The seal is not to be pushed all the way into the bore as this will block the seal drains.

Due to the wide range of inclines Land Rover vehicles operate across, the geometry of the oil pan has been configured to guarantee oil pick-up across all operating angles. An oil-scavenge system has been developed to guarantee excellent oil flow through the turbochargers on severe side-slopes. Whilst the 60-degree cylinder bank angle of a V6 engine allows the turbochargers to be packaged relatively higher in the vehicle, to obtain the best configuration for the V6 engine, the turbochargers must be sited much lower. At extreme angles, there is a risk they may be below the oil level on the oil pan, restricting oil return flow.

To overcome this, the engine uses:

- the oil pump to supply oil to the turbocharger bearings from the main oil reservoir (oil pan)
- a secondary reservoir to receive oil from the turbocharger bearings
- a tandem pump to urge oil to flow from the turbocharger bearings into the secondary reservoir and to pump the oil back from the secondary reservoir to the primary reservoir (oil pan)



E107569

Item Description

1 Turbocharger oil feed pipe
2 Tandem pump
3 Oil evacuation tube
4 Turbocharger oil return pipe
5 Oil scavenge pipe
6 Oil pan

An additional feature of this system is that the tandem pump used to pump oil back from the secondary reservoir can also be used as a source of vacuum for a vacuum operated system.

A semi-synthetic, low SAPS (sulphated ash, phosphorus and sulphur) oil is specified, which reduces the ash loading in the DPF (diesel particulate filter). Ash cannot be burnt off like soot so it remains in the DPF for life. Without the use of low SAPS oil, the DPF will not be a 'fit for life' component.

This low SAPS oil is also more resistant to temperature-related degradation than conventional mineral oil. It has lower viscosity at low temperatures and improved lubrication performance at higher temperatures.

Published: 03-Sep-2012

Engine - TDV6 3.0L Diesel - Engine

Diagnosis and Testing

Overview

For specific areas of the engine, refer to the general procedures in this section and the relevant section of the manual.

For testing of excessive smoke from exhaust, please refer to the **Pinpoint Tests** list below and complete the **Test Results** section as required.

Inspection and Verification

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

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

Visual Inspection

Mechanical	Electrical
• Engine oil level • Coolant level • Transmission fluid level • Fuel level • Coolant leaks • Oil leaks • Fuel leaks • Intake air system • Hose connections • Visibly damaged or worn parts • Loose or missing nuts or bolts • Fuel contamination/grade/quality • Sensor installation/condition • Viscous fan and solenoid • Active engine mounts, correct installation/damage • Charge air coolers • Turbochargers • General engine condition	• Fuses • Wiring harness • Electrical connector(s) • Injectors • Glow plugs • Active engine mounts • 5 volt sensor supply • Sensor(s) • Turbocharger actuators • Viscous fan solenoid • 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, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Excessive smoke from exhaust	• Oil passing through the turbocharger	• Carry out pinpoint tests GO to Pinpoint Test A.
Poor performance (off-boost)	• Low/Contaminated fuel • Restricted intake air system • General engine condition • Engine control module failure	Check the fuel level and condition. Draw off approximately 1 liter (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for restriction. Check the engine condition, compressions, etc if there are indications of a mechanical fault. Check for DTCs indicating a module fault
No boost	• Electrical connections and harnesses • Electrical connections and harnesses • Restricted intake air system • Charge air cooler restricted/leaking • Turbocharger actuator failure(s) • Turbocharger	Check the electrical connections and harnesses. Check the intake air system for restriction/leakage. Check the turbocharger actuators and circuits. Refer to the electrical guides. Check the turbochargers for wear. Disconnect the turbocharger intake and outlet pipework and turn the turbochargers by hand. Any roughness indicates a fault. Check any up and down movement in the turbocharger shafts. Excessive movement indicates a fault. If in doubt, compare the suspect unit with a new turbocharger. Check for DTCs indicating an actuator or module fault

	• failure(s) • Engine control module failure	
No boost/excessive noise	• Turbocharger failure(s)	Disconnect the turbocharger intake and outlet pipework and turn the turbochargers by hand. Any roughness indicates a fault. Check any up and down movement in the turbocharger shafts. Excessive movement indicates a fault. If in doubt, compare the suspect unit with a new turbocharger

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

NOTES:

If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component

Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer approved diagnostic system)

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests

Inspect connectors for signs of water ingress, and pins for damage and/or corrosion

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

Test Results

During the following pinpoint routine you will be asked to record certain information. The following table identifies the type of recorded information which will be required by dealer technical support for further advice if required. Please locally construct a template to record the information as shown in the table below

TDV6 3.0L DIESEL	Results
• A. Customer complaint • B. Description of the drive cycle • C. Description of weather conditions when symptoms observed	• A. ..... • B. ..... • C. .....
• Were the symptoms reproduced?	• YES • NO
• Was the check engine lamp illuminated?	• YES • NO
• Were there engine related warning messages displayed?	• YES • NO
• What were the engine related warning messages displayed?	• A. ..... • B. ..... • C. .....
• List all stored DTCs	• A. ..... • B. ..... • C. .....
• Did oil level need topping up, or was there too much oil in engine?	• Needed topping up • To much oil in engine
• Had LTB00358 already been carried out previously?	• YES • NO
• Was the one-way valve (LR028945) already installed?	• YES • NO
• Was the secondary turbocharger part number LR035869 previously installed to the vehicle?	• YES • NO
• Did the smoke test find a leakage?	• No leakage found • In air induction system • In exhaust system

• What was the pressure at the oil filler cap?	• A. At idle engine cold - Pressure = • B. At idle engine warm - Pressure = • C. At idle engine warm, secondary turbocharger operating - Pressure = • D. At 3000rpm - Pressure =
• Was there excessive blow-by? • What was the cause of the excessive blow-by?	• YES • NO • Cause of excessive blow-by was .....
• How many milliliters of oil were drained from the oil scavenge tank?	• Oil drained from the oil scavenge tank was .....ml

PINPOINT TEST A : TDV6 3.0L DIESEL EXCESSIVE SMOKE FROM EXHAUST	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**
A1: FOLLOW CUSTOMER INFORMATION TO REPRODUCE THE SYMPTOMS	
	1 Follow customer information. Carry out road test to reproduce the symptoms
	Can customer symptoms be reproduced? **Yes** If smoke is seen determine whether smoke is white, blue or blackProceed to next step **No** Proceed to next step
A2: ENGINE RELATED MESSAGES OR WARNING LAMPS	
	1 Check for engine related messages and warning lamps
	Are there engine related messages and warning lamps displayed? **Yes** Using the manufacturer approved diagnostic system check engine control module for additional DTCs and refer to relevant DTC index. Rectify these firstProceed to next step **No** Proceed to next step
A3: OIL VOLUME	
	1 Drain the engine oil into a measured container
	Record the total oil volume drainedRemove the oil filterCheck the oil filter element for damageRemove the oil filler capCheck the oil filler cap for damage. Replace if requiredCheck that the oil drain back valve is installed correctly and closes correctly. The oil drain back valve is situated in the bottom of the oil filter housingInstall new oil filter elementInstall new oil filter housing sealRefill engine oil with clean oil to the correct oil level. **DO NOT OVERFILL**Install oil filler capWere there any defects with the filter cap, filter element or oil drain back valve? **Yes** Rectify defects, then proceed to next step **No** Proceed to next step
A4: VACUUM CHECK	
	1 Vacuum check on the compressor shut off valve • Use a Mityvac device to apply a vacuum of at least 750 mmHg (1000 mbar or 15 psi) to the compressor shut off valve hose line • Observe the compressor shut-off valve arm for movement. It should move more than 10 mm. If compressor shut-off valve does not open install a new compressor shut-off valve • If vacuum decays over 10 seconds (or cannot generate a vacuum) use a smoke tester to find leak and repair • Remove Mityvac and return vacuum line to standard • Using the manufacturer approved diagnostic system check datalogger signal compressor shut off valve • Start the engine, allow to idle • Allow engine to idle for a further 4 minutes, the during this time the datalogger signal compressor shut off valve value should change, indicating the secondary turbocharger is operating

	Did the compressor shut-off valve operate during the above tests? **Yes** Proceed to next step **No** If it was not possible to create the required vacuum use a smoke tester to find leak and repairIf the compressor shut-off valve did not operate during the 4 minute idle test use the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control moduleProceed to next step
A5: SMOKE TEST AIR INDUCTION SYSTEM	
 E148051	**1** Using the manufacturer approved smoke leak detector, carry out a leak check of the air intake system
	Were air intake system leaks detected? **Yes** Refer to the workshop manual and rectify any leaks detected in the air intake systemThoroughly clean air induction system, remove intercooler, compressor shut off valve and clean & remove all oil from exhaust. Refer to TSB LTB00358. When the engine is restarted and run you must be satisfied that any smoke observed is not due to residual oil left in the system, (see below)Carry out a 30 minute road drive. Keep engine rpm below 1200 rpm and avoid hard acceleration. After 30 minutes stop the vehicle, switch off the engine and wait 15 minutes. Restart the engine drive away and, when safe to do so, accelerate uphill. During this acceleration it is important that the secondary turbo is activated. If a co-driver is available SDD may be used to monitor turbo shut off valve commanded position to ensure the valve opens. Otherwise engine speed will need to exceed 2800 rpm. Using manual gear selection may help to achieve higher engine speed without excessive road speed. Be aware of the rear view using mirrors. Look for excessive smoke from the exhaust. Return to the workshop and with the vehicle in Park raise the engine rpm to above 3200 rpm and hold it for 2 minutes. Observe whether or not there is smoke from the exhaust tail pipesContact dealer technical support for further advice if smoke still coming from the exhaust tail pipes **No** Proceed to next step
A6: INTAKE MANIFOLD BLOW-BY	
 E148055	**1** Modify a spare oil filler cap by drilling a 6mm hole in the center and connecting a Mityvac tool or pressure gauge • This test needs to be carried out on the vehicle while the engine is still cold. The vehicle in PARK with the handbrake applied • Connect the modified oil filler cap to the vehicle • Using the manufacturer approved diagnostic system check datalogger signal compressor shut off valve • Start the engine, allow to idle • Record the pressure value from the pressure gauge - Value should be approx atmospheric pressure • Allow engine to idle for a further 3 minutes, the during this time the datalogger signal compressor shut off valve value should change, indicating the secondary turbocharger is operating

	• Record the pressure value from the pressure gauge - Value should be approx atmospheric pressure • Raise the engine speed to 3000rpm • Record the pressure value from the pressure gauge with engine speed at 3000rpm - Value should now show a slight vacuum • Switch off the engine
	Was there a positive pressure value from the pressure gauge with engine speed at 3000rpm **Yes** Install the correct oil filler capCheck the engine for high manifold blow-by, check for low cylinder compression and restrictions in the breather systemThoroughly clean air induction system, remove intercooler, compressor shut off valve and clean & remove all oil from exhaust. Refer to TSB LTB00358. When the engine is restarted and run you must be satisfied that any smoke observed is not due to residual oil left in the system, (see below)Carry out a 30 minute road drive. Keep engine rpm below 1200 rpm and avoid hard acceleration. After 30 minutes stop the vehicle, switch off the engine and wait 15 minutes. Restart the engine drive away and, when safe to do so, accelerate uphill. During this acceleration it is important that the secondary turbo is activated. If a co-driver is available SDD may be used to monitor turbo shut off valve commanded position to ensure the valve opens. Otherwise engine speed will need to exceed 2800 rpm. Using manual gear selection may help to achieve higher engine speed without excessive road speed. Be aware of the rear view using mirrors. Look for excessive smoke from the exhaust. Return to the workshop and with the vehicle in Park raise the engine rpm to above 3200 rpm and hold it for 2 minutes. Observe whether or not there is smoke from the exhaust tail pipesContact dealer technical support for further advice if smoke still coming from the exhaust tail pipes **No** Proceed to next step
A7: OIL SCAVENGE TANK	
 E148053	**1** Check the oil scavenge pipe connector is correctly installed to the oil scavenge pump. Refer to picture, which shows the scavenge pipe fully disconnected
	Was more than 500ml of oil collected from the oil scavenge tank? **Yes** If the oil scavenge pump **has** previously been replaced on this vehicle, check the scavenge pipes are not blocked or restrictedIf the oil scavenge pump **has not** previously been replaced on this vehicle, replace the oil scavenge pump and check the scavenge pipes are not blocked or restrictedThoroughly clean air induction system, remove intercooler, compressor shut off valve and clean & remove all oil from exhaust. Refer to TSB LTB00358. When the engine is restarted and run you must be satisfied that any smoke observed is not due to residual oil left in the system, (see below)Carry out a 30 minute road drive. Keep engine rpm below 1200 rpm and avoid hard acceleration. After 30 minutes stop the vehicle, switch off the engine and wait 15 minutes. Restart the engine drive away and, when safe to do so, accelerate uphill. During this acceleration it is important that the secondary turbo is

	activated. If a co-driver is available SDD may be used to monitor turbo shut off valve commanded position to ensure the valve opens. Otherwise engine speed will need to exceed 2800 rpm. Using manual gear selection may help to achieve higher engine speed without excessive road speed. Be aware of the rear view using mirrors. Look for excessive smoke from the exhaust. Return to the workshop and with the vehicle in Park raise the engine rpm to above 3200 rpm and hold it for 2 minutes. Observe whether or not there is smoke from the exhaust tail pipes **No** Proceed to next step
A8: CHECK THE LATEST LEVEL CALIBRATION FILE IS LOADED TO THE ENGINE CONTROL MODULE.	
	1 Calibration Part Numbers **10MY:** AH22-12K532-PTK - High Power DPF, AH22-12K532-PSH - Low Power DPF, AH22-12K532-PCJ - High Power no DPF, **12MY:** CH22-12K532-PTD - Hi Flow DPF, CH22-12K532-PSD - Lo Flow DPF,
	Is the latest level calibration file is loaded to the engine control module? **Yes** Proceed to next step **No** Using the manufacturer approved diagnostic system, update the engine control module calibration file to the latest levelProceed to next step
A9: OIL IN EXHAUST OR CHARGED AIR SYSTEM	
	1 Check for oil contamination in the exhaust system and charged air system downstream of the primary turbocharger • Confirm if a primary turbocharger has recently be installed
	Is there oil contamination in the exhaust system and charged air system downstream of the primary turbocharger? **Yes** If a primary turbocharger **has** previously been replaced on this vehicle, contact dealer technical support for further adviceIf a primary turbocharger **has not** previously been replaced on this vehicle, replace the primary turbochargerThoroughly clean air induction system, remove intercooler, compressor shut off valve and clean & remove all oil from exhaust. Refer to TSB LTB00358. When the engine is restarted and run you must be satisfied that any smoke observed is not due to residual oil left in the system, (see below)Carry out a 30 minute road drive. Keep engine rpm below 1200 rpm and avoid hard acceleration. After 30 minutes stop the vehicle, switch off the engine and wait 15 minutes. Restart the engine drive away and, when safe to do so, accelerate uphill. During this acceleration it is important that the secondary turbo is activated. If a co-driver is available SDD may be used to monitor turbo shut off valve commanded position to ensure the valve opens. Otherwise engine speed will need to exceed 2800 rpm. Using manual gear selection may help to achieve higher engine speed without excessive road speed. Be aware of the rear view using mirrors. Look for excessive smoke from the exhaust. Return to the workshop and with the vehicle in Park raise the engine rpm to above 3200 rpm and hold it for 2 minutes. Observe whether or not there is smoke from the exhaust tail pipes **No** Allow an overnight drain of the oil from the oil scavenge tankCarry out a 30 minute road drive. Keep engine rpm below 1200 rpm and avoid hard acceleration. After 30 minutes stop the vehicle, switch off the engine and wait 15 minutes. Restart the engine drive away and, when safe to do so, accelerate uphill. During this acceleration it is important that the secondary turbo is activated. If a co-driver is available SDD may be used to monitor turbo shut off valve commanded position to ensure the valve opens. Otherwise engine speed will need to exceed 2800 rpm. Using manual gear selection may help to achieve

	higher engine speed without excessive road speed. Be aware of the rear view using mirrors. Look for excessive smoke from the exhaust. Return to the workshop and with the vehicle in Park raise the engine rpm to above 3200 rpm and hold it for 2 minutes. Observe whether or not there is smoke from the exhaust tail pipesContact dealer technical support for further advice if smoke still coming from the exhaust tail pipes

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Engine Oil Draining and Filling

General Procedures

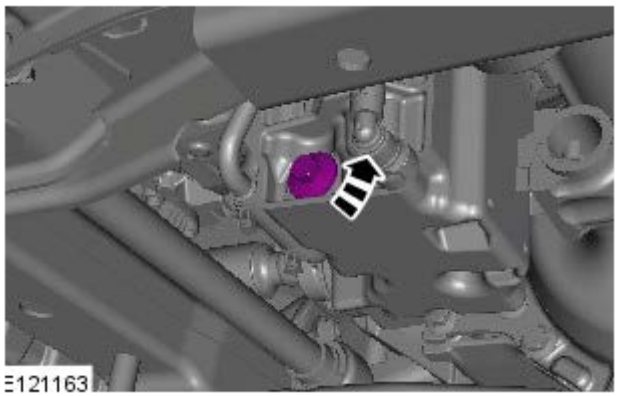
Draining

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

CAUTION: Make sure the engine is warm.

1. Refer to: Oil Filter Element (303-01A, Removal and Installation).
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.
3. Refer to: Engine Undershield (501-02, Removal and Installation).



4. WARNING: Observe due care when draining engine oil as the oil can be very hot.

   CAUTIONS:

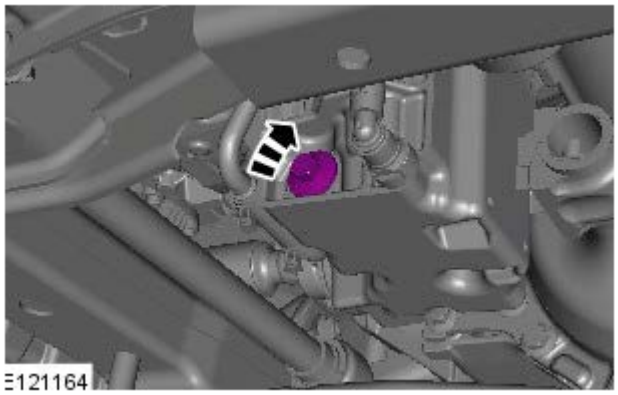
   Be prepared to collect escaping oil.

   Discard the bolt.

   Allow at least 10 minutes for the engine oil to drain.

   Drain the engine oil.

Filling

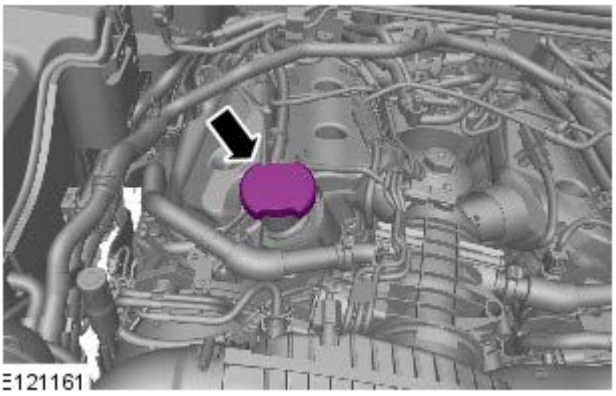


1. CAUTIONS:

   Make sure that the component is clean, free of foreign material and lubricant.

   Make sure that a new bolt is installed.

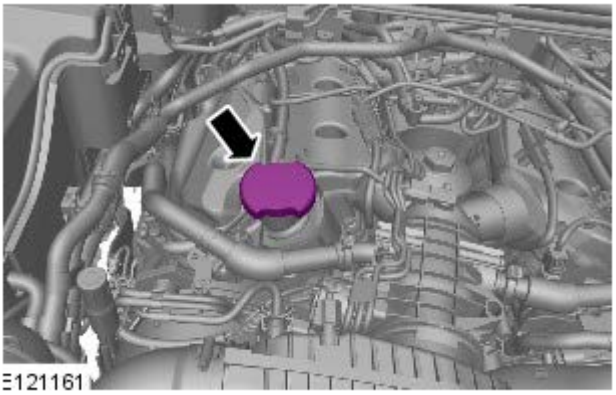
   Torque: 23 Nm
2. Refer to: Engine Undershield (501-02, Removal and Installation).
3. Lower the vehicle.
4. Refer to: Oil Filter Element (303-01A, Removal and Installation).
5. Fill the engine with oil.



6. CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum, before starting the engine. To check engine oil level follow steps 9-12.

   Clean any residual engine oil from the oil filler cap area.

7.



8.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

9. CAUTIONS:

   Make sure that the vehicle is parked on level ground.

   Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

   Make sure that the hood is open.

   NOTE: Allow 10 minutes from the engine switch off for the engine oil level to stabilize.

   - Turn the ignition on.

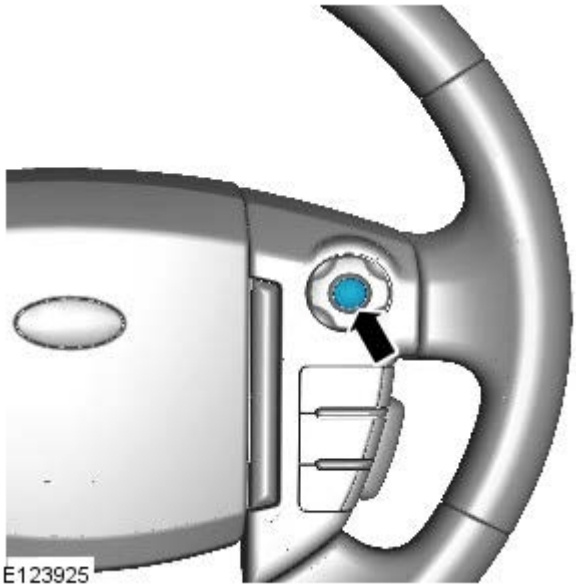
10.
   - Press the right-hand directional button to access the instrument cluster menu.



E123926

11.

- Press the right-hand OK button.



E123925

12.

- Press the right-hand directional button to access the Oil Level Display.



E123927

13.

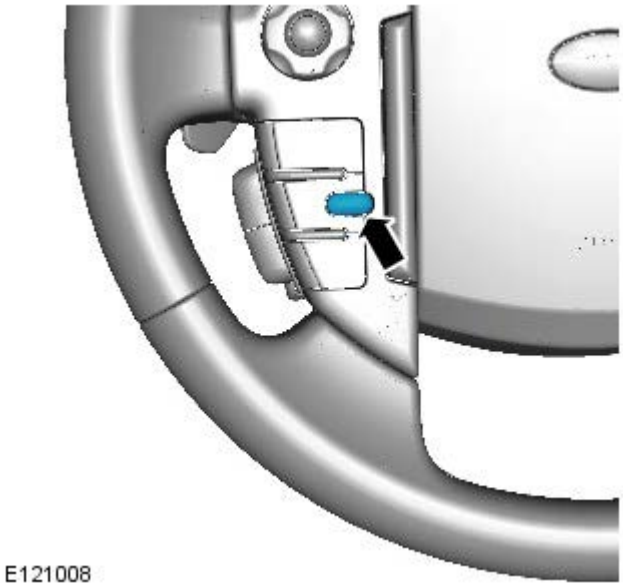
- Press the right-hand OK button and follow the instructions.



E123928

14.

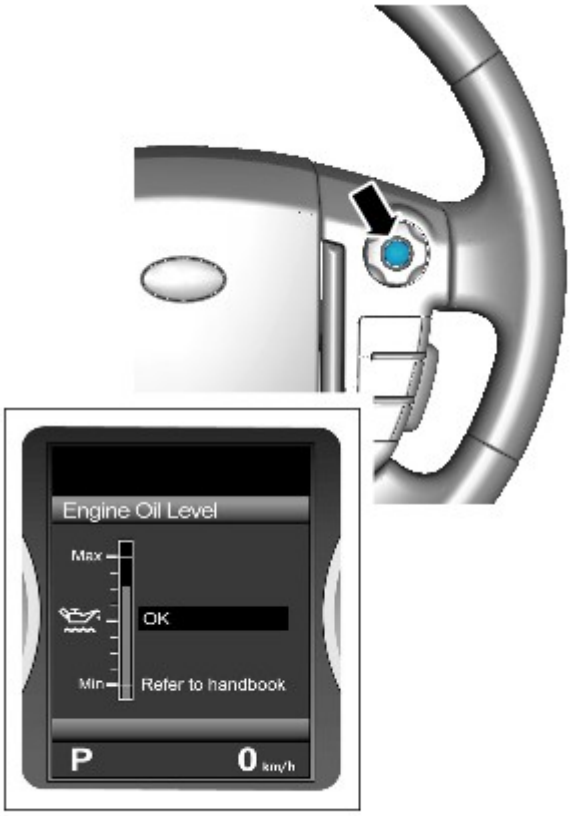
- Press the cruise control cancel button twice within 2 seconds.



E121008

15.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Take a reading from the level display and, if necessary, top up with oil as instructed.



E123929

16. Turn the ignition off.

17. NOTE: Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

- Turn the ignition on.

18.

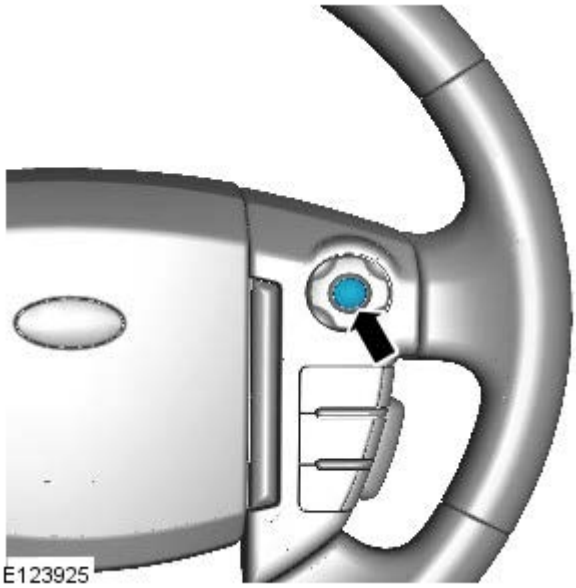
- Press the right-hand directional button to access the instrument cluster menu.



E123926

19.

- Press the right-hand OK button.



E123925

20.

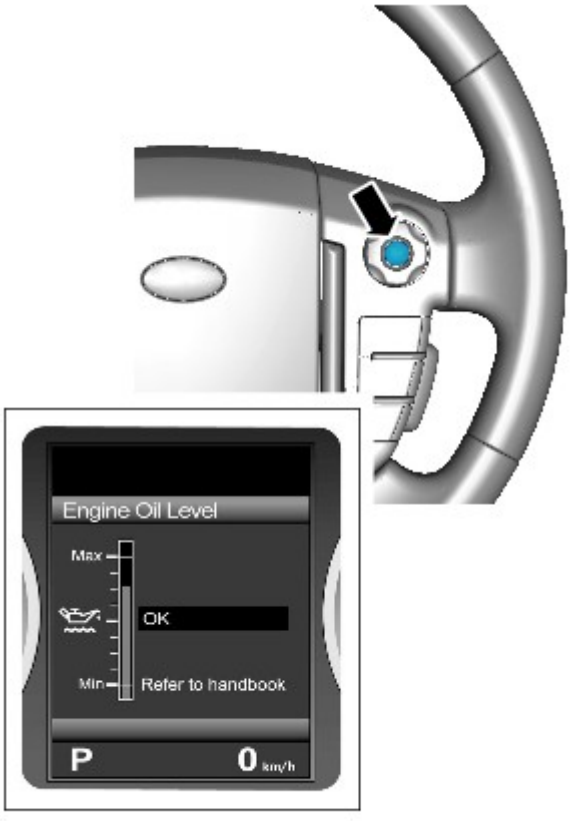
- Press the right-hand directional button to access the Oil Level Display.



E123927

21.

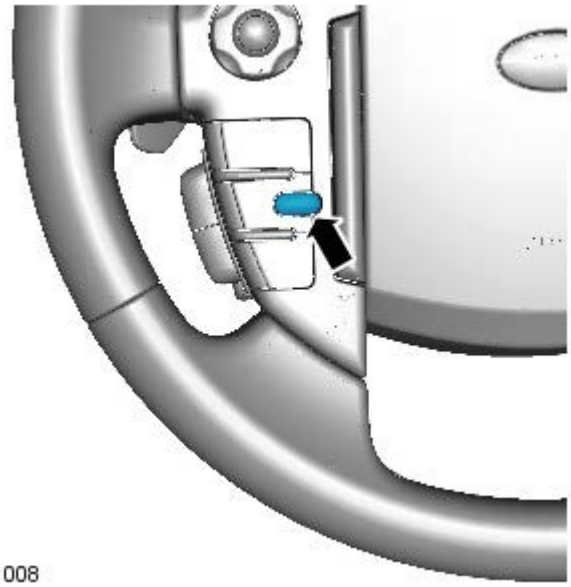
- Scroll through the trip menu to access the engine oil level display.



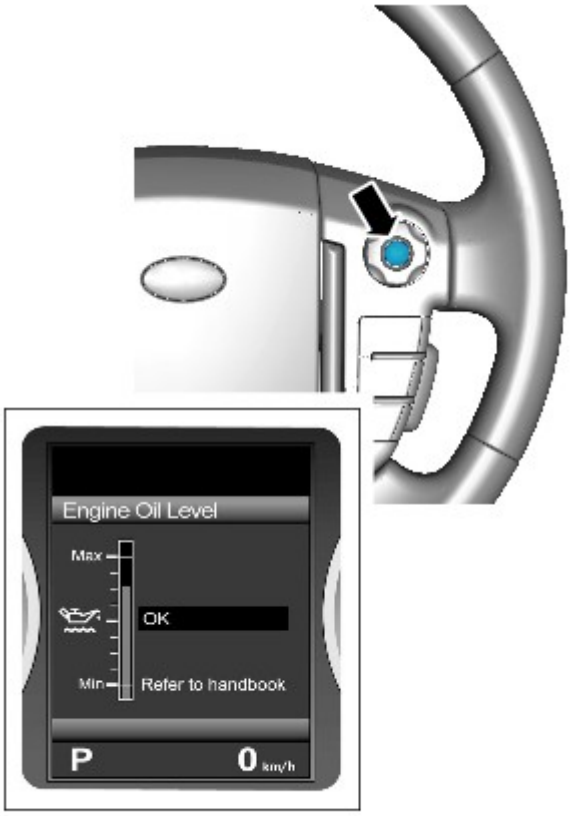
E123929

22.

- Press the cruise control cancel button twice within 2 seconds.



E121008



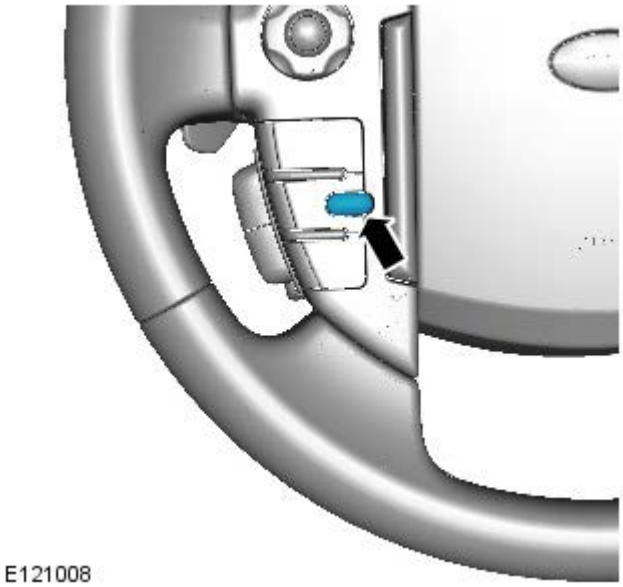
E123929

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

- The message center display will revert to the normal display in the trip computer.
- Scroll through the trip menu to access the engine oil level display.
- This display is now the live reading of the engine oil level.
- Take a reading from the level display and, if necessary, top up with oil as instructed.

24.

- Press and hold the cruise control cancel button for more than 2 seconds.



E121008

25.
- The message center display will revert to the normal display in the trip computer.

26. Turn the ignition off.

27. Turn the ignition on.



E123929

28. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- Scroll through the trip menu to access the engine oil level display.
- Make sure that the average oil level value has now been updated.

29. Refer to: Engine Cover - 3.0L V6 - TdV6 (501-05, Removal and Installation).

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Engine Oil Vacuum Draining and Filling

General Procedures

Special Tool(s)

 E129630	303-1484 Vacuum Pump, Oil Drain
 E129631	303-1484-01 Adapter for 303-1484

Draining

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

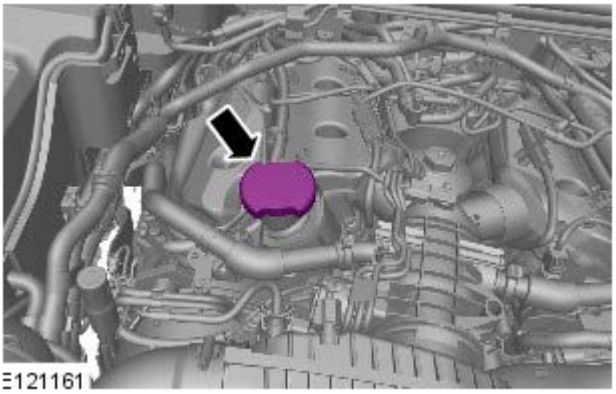
NOTES:

Make sure that the vehicle is parked on level ground.

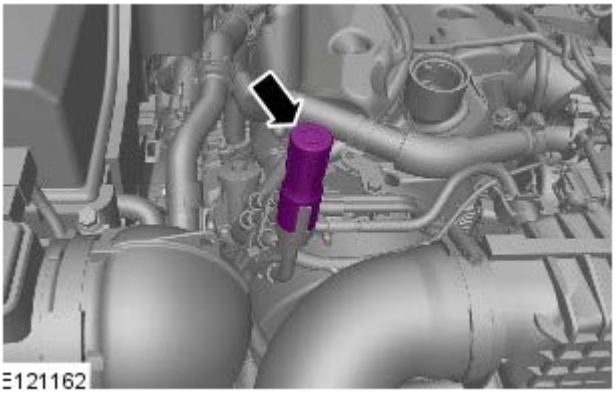
Clean the components general area prior to dismantling.

1. Refer to: Oil Filter Element (303-01 Engine - 3.0L V6 - TdV6, Removal and Installation).

2.

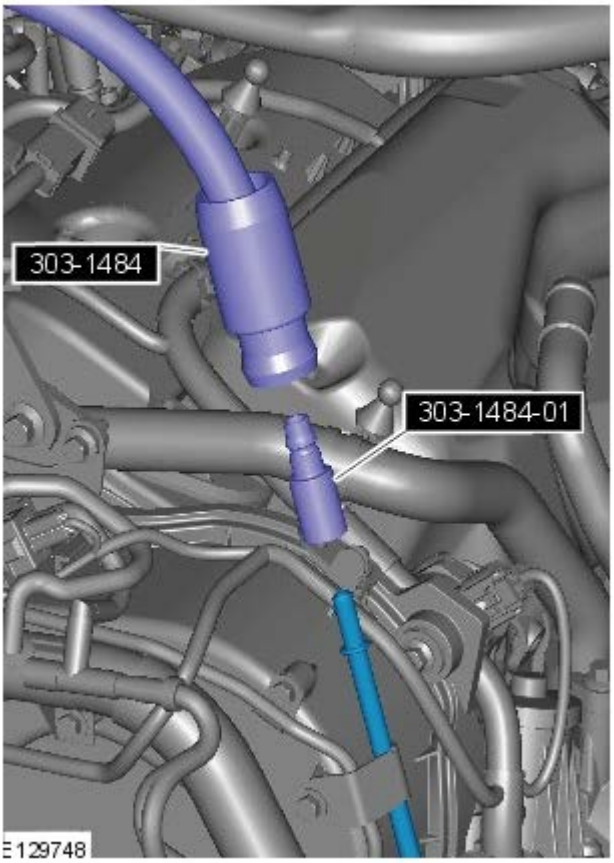

E121161

3. CAUTION: Allow 10 minutes from turning the engine off before starting oil extraction.


E121162

4.

- Using the oil vacuum pump drain the oil out through the oil extraction tube.



Special Tool(s): 303-1484, 303-1484-01

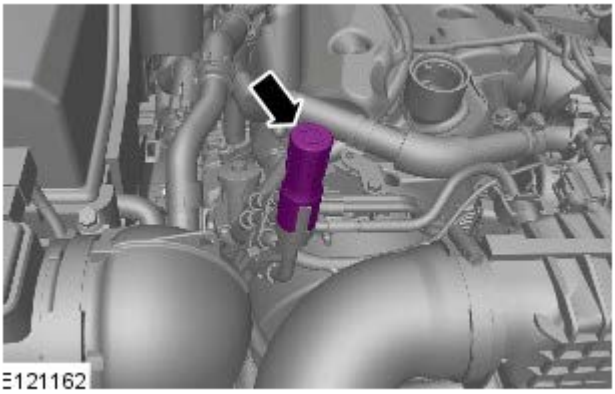
5.

- Remove the oil vacuum pump.

Filling

1. Refer to: Oil Filter Element (303-01 Engine - 3.0L V6 - TdV6, Removal and Installation).

2.

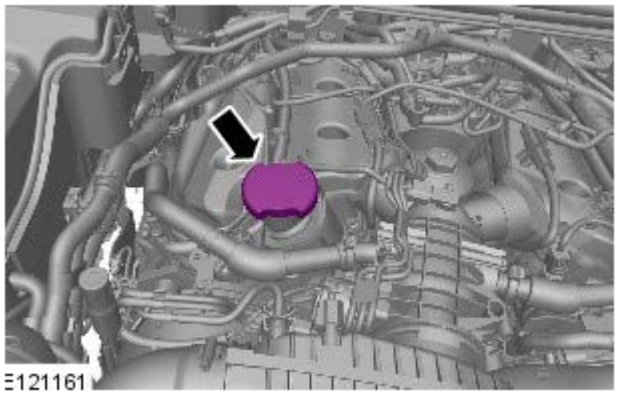


3. Fill the engine with oil.

4. CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum, before starting the engine. To check engine oil level follow steps 8-10.

   Clean any residual engine oil from the oil filler cap area.

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


E121161

6.
- Start the engine and allow to run for 10 minutes, stop the engine.
- Check for leaks.

7. CAUTIONS:

Make sure that the vehicle is parked on level ground.

Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

Make sure that the hood is open.

NOTE: Allow 10 minutes from the engine switch off for the engine oil level to stabilize.

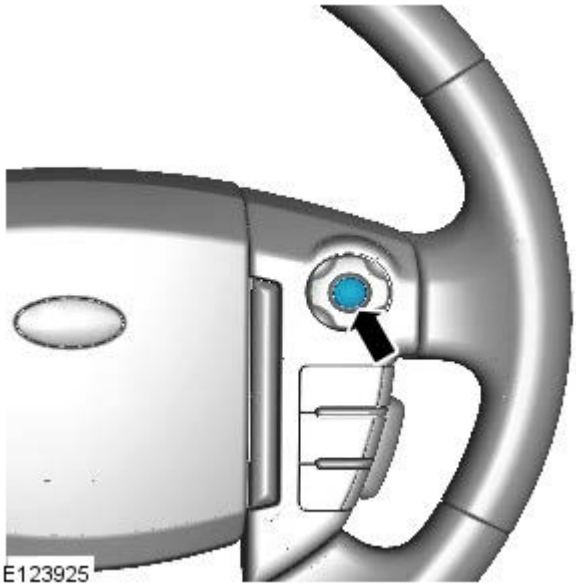
- Turn the ignition on.

8.
- Press the right-hand directional button to access the instrument cluster menu.



E123926

9.
- Press the right-hand OK button.



10.

- Press the right-hand directional button to access the Oil Level Display.



E123927

11.

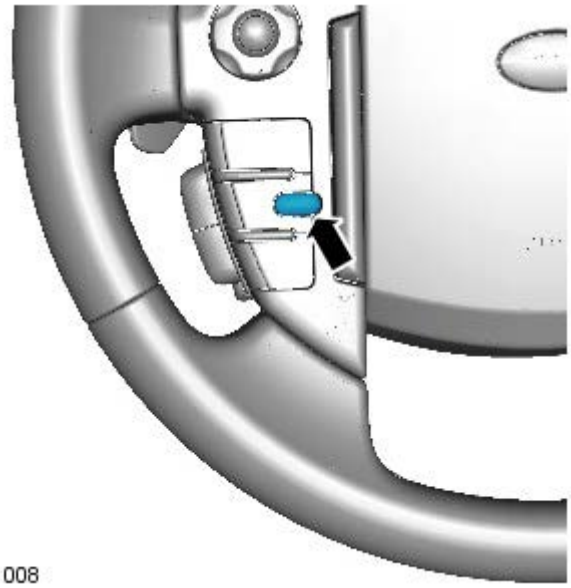
- Press the right-hand OK button and follow the instructions.



E123928

12.

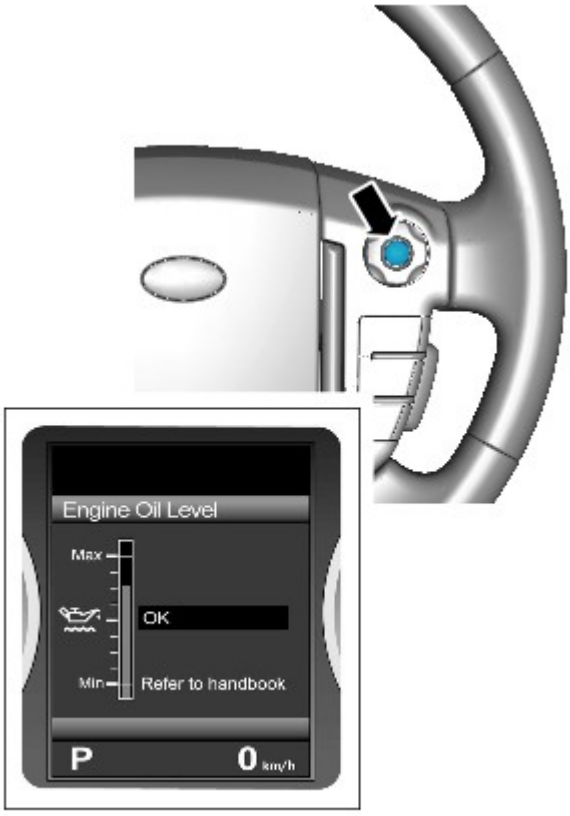
- Press the cruise control cancel button twice within 2 seconds.



E121008

13.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes, switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.



E123929

14. Turn the ignition off.

15. NOTE: Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

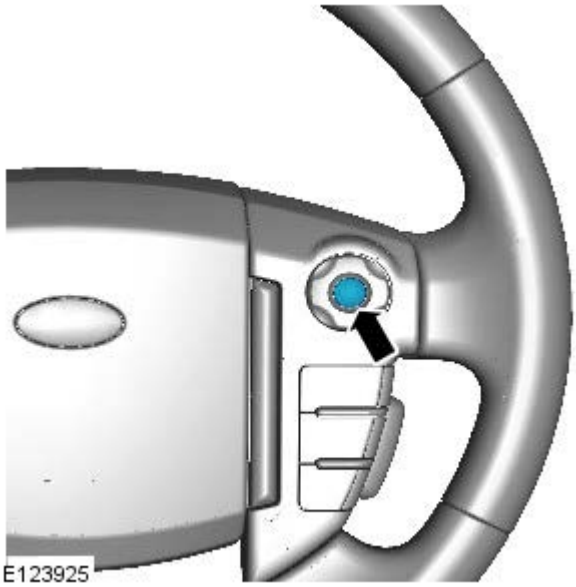
    Turn the ignition on.

16.
- Press the right-hand directional button to access the instrument cluster menu.



E123926

17.
- Press the right-hand OK button.



18.

- Press the right-hand directional button to access the Oil Level Display.



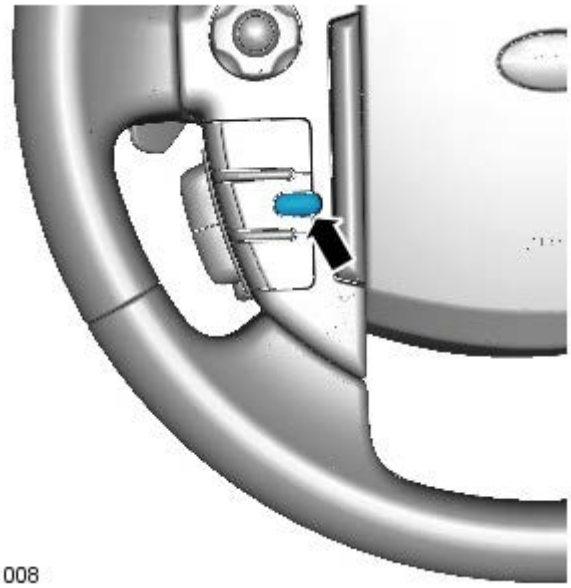
E123927

19.

- Press the right-hand OK button and follow the instructions.



E123928



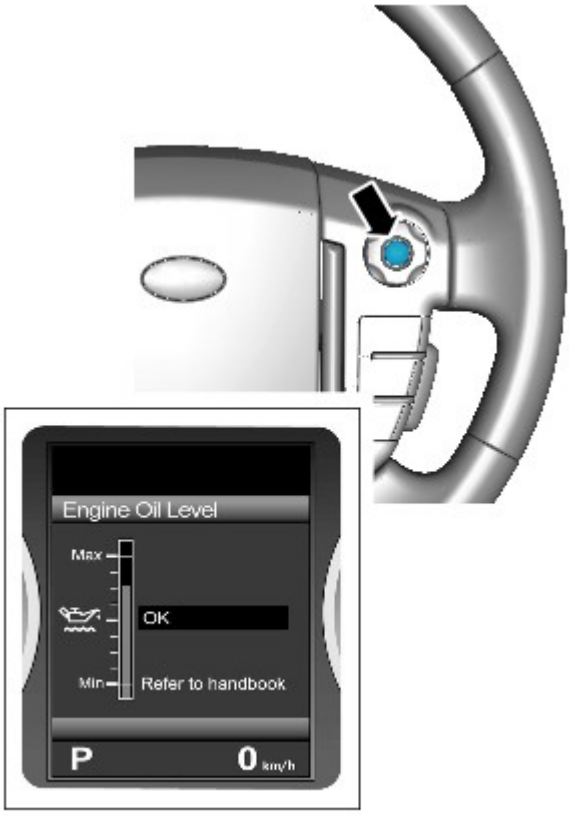
E121008

20.

- Press and hold the cruise control cancel button for more than 2 seconds.

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

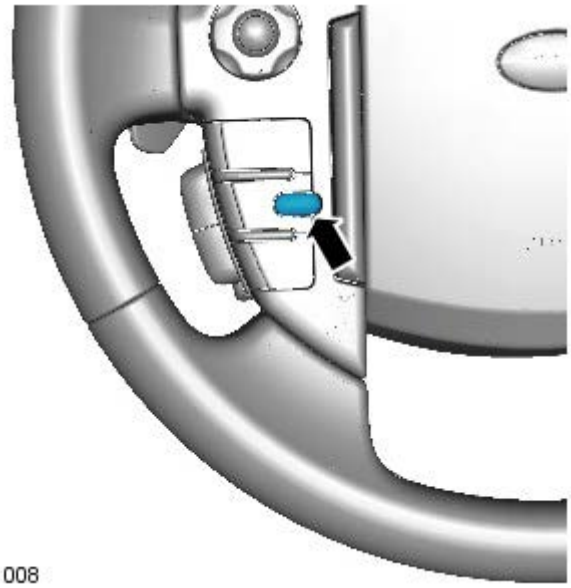
- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- This display is now the live reading of the engine oil level.
- Take a reading from the level display and, if necessary, top up with oil as instructed.



E123929

22.

- Press and hold the cruise control cancel button for more than 2 seconds.



E121008

23. The message center display will revert to the normal display in the trip computer.

24. Turn the ignition off.

25. Turn the ignition on.

26.

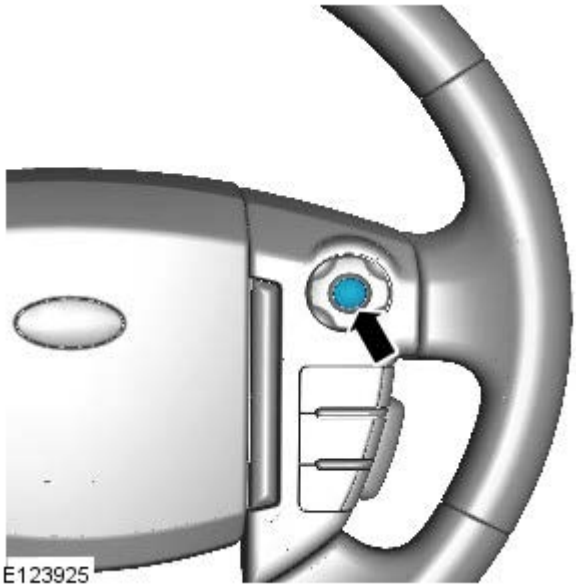
- Press the right-hand directional button to access the instrument cluster menu.



E123926

27.

- Press the right-hand OK button.



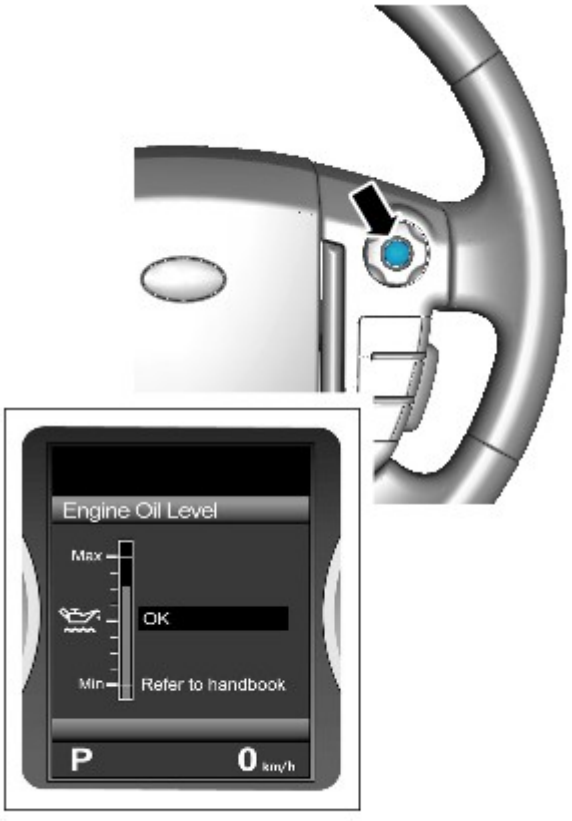
E123925

28.

- Press the right-hand directional button to access the Oil Level Display.



E123927



E123929

29. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
    - Press the right-hand OK button and follow the instructions.
    - Make sure that the average oil level value has now been updated.

30. Refer to: Engine Cover - 3.0L V6 - TdV6 (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 13-Jul-2011

Engine - TDV6 3.0L Diesel - Camshaft LH

Removal and Installation

Special Tool(s)

	303-1145/2 Remover, Camshaft Rear Pulley Bolt

Removal

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Rear End Accessory Drive (READ) (303-05, Removal and Installation).
3. Refer to: Timing Belt (303-01, Removal and Installation).
4. Install the special tool.



5. Install the special tool.



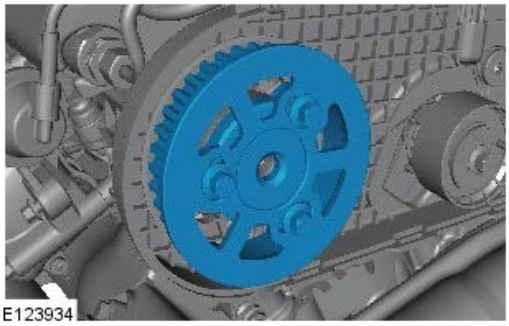
6. Using the special tool, remove the rear camshaft pulley retaining bolt.



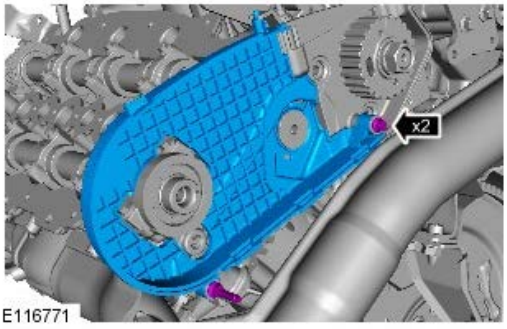
E123895

7. Remove the special tools.

8.

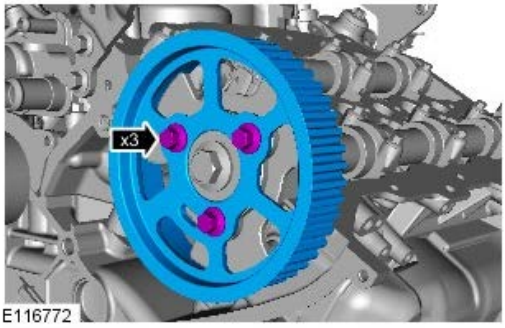

E123934

9.



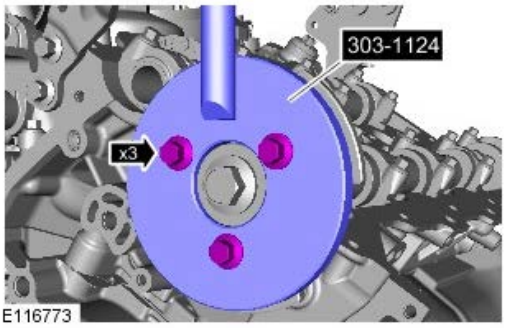
E116771

10.



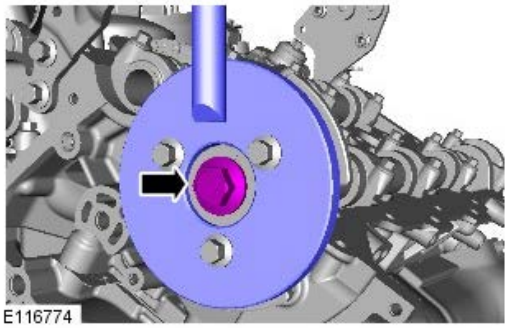
E116772

11. Install the special tool.

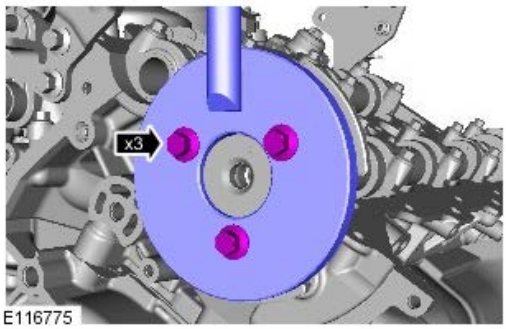


E116773

12.

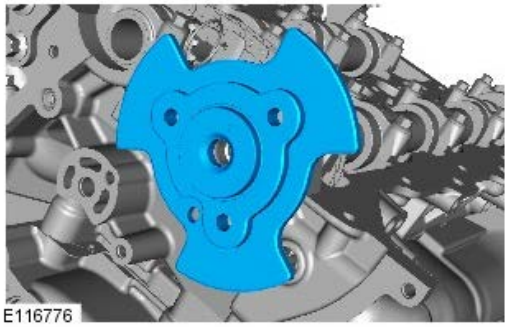

E116774

13. Remove the special tool.



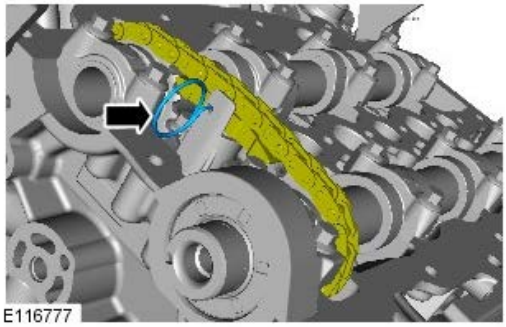
E116775

14.

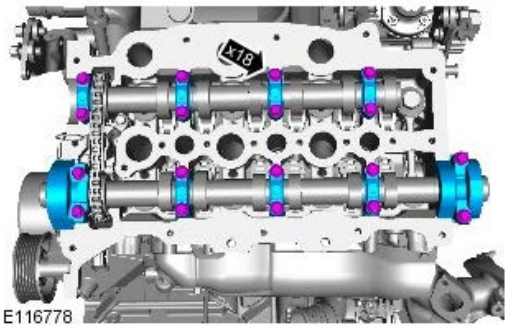

E116776

15.

- Reposition the secondary timing chain tensioner.
- Retain the secondary timing chain tensioner plunger.

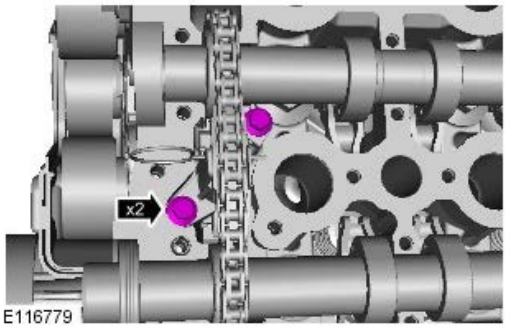

E116777

16. Remove the camshaft bearing caps evenly.



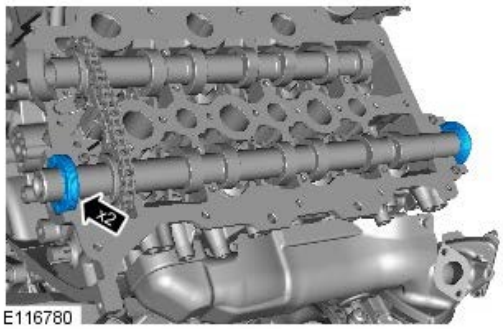
E116778

17.



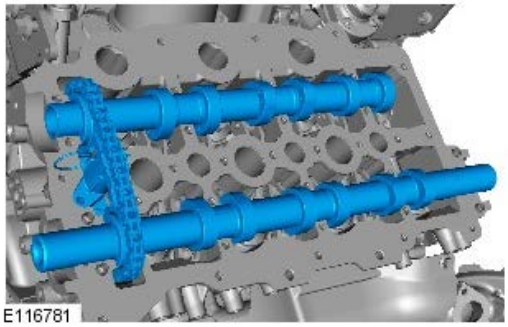
E116779

18. CAUTION: Discard the seals.

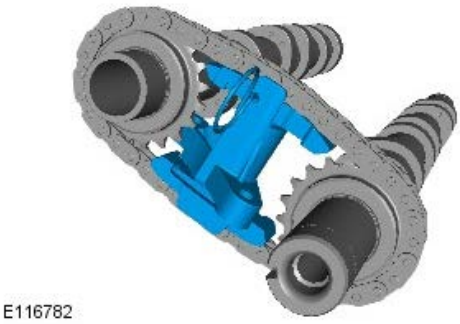


E116780

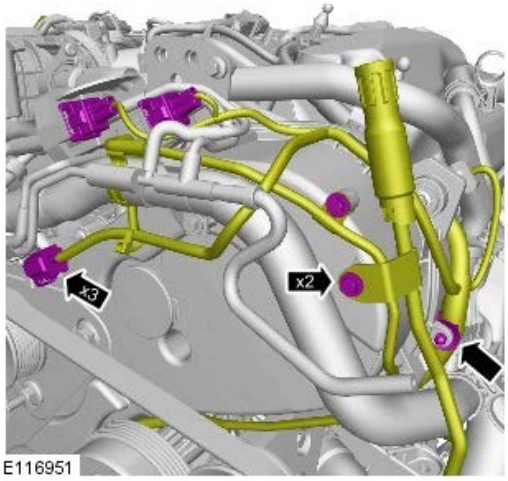
19.


E116781

20.


E116782

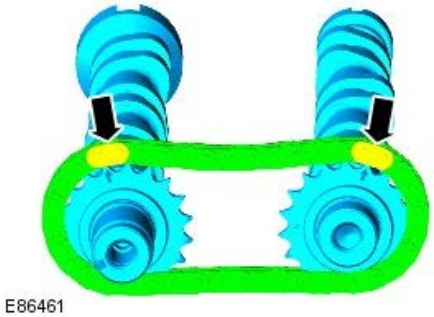
21.



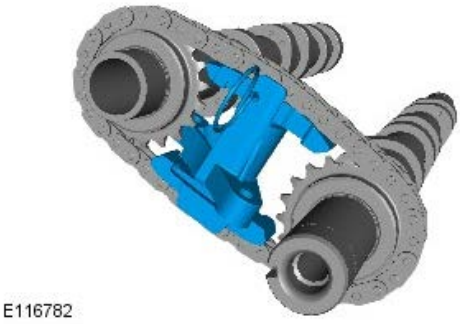
E116951

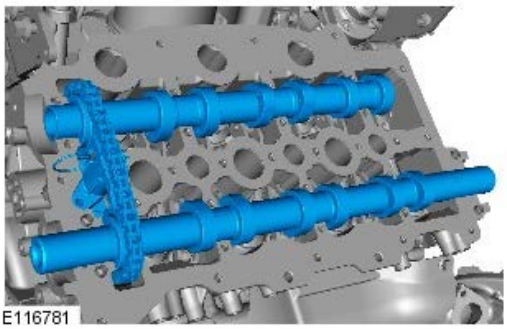
Installation

1. Install the secondary timing chain onto the camshafts.


E86461

2. Install the secondary timing chain tensioner assembly.


E116782


E116781

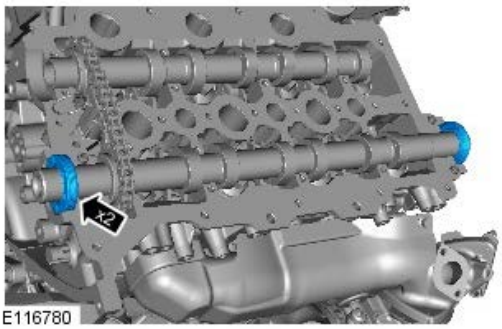
3. CAUTION: Make sure that the dots on the camshafts are aligned at the 12 o'clock position. Failure to follow this instruction may result in damage to the engine.

NOTES:

Lubricate the camshafts and the camshaft bearing caps with oil meeting Jaguar specification prior to installation.

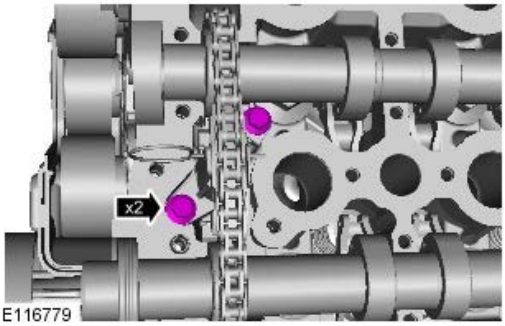
Use hypoid oil to lubricate the camshafts.

Install the camshafts.



E116780

4. NOTE: Install new seals.

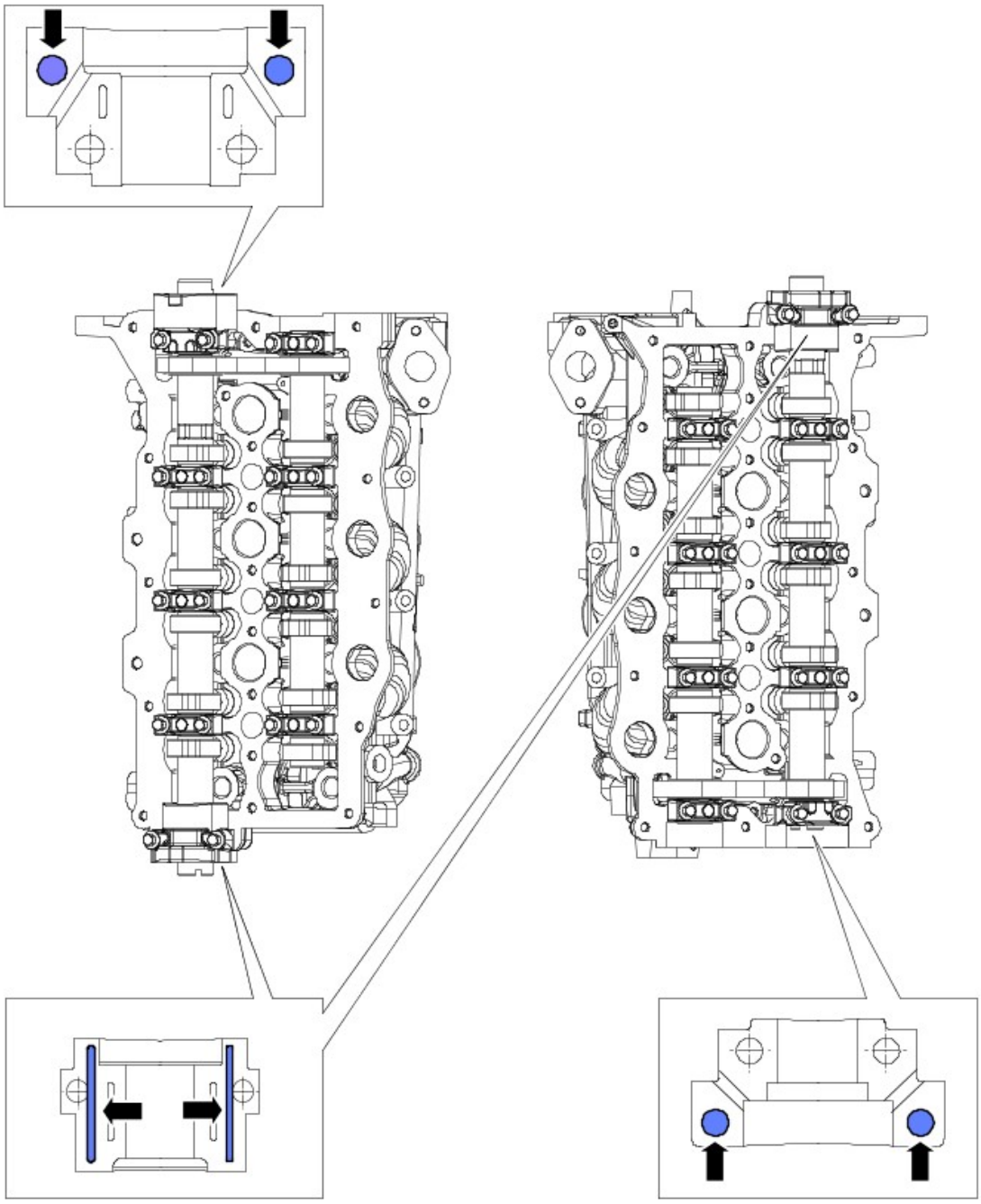


E116779

5. *Torque:* 10 Nm

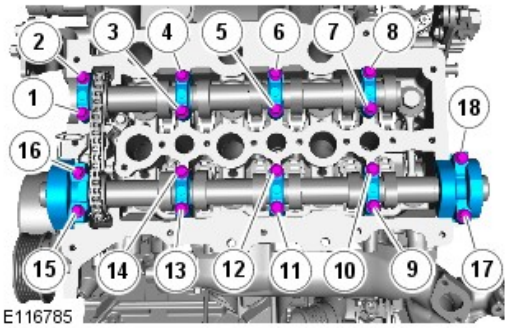
6.

- Apply Loctite 518 sealant to the exhaust camshaft seal bearing caps.
- Apply



E116784

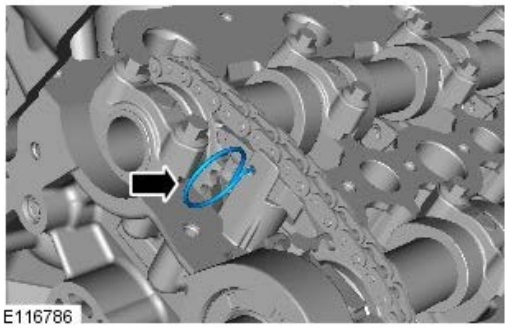
- Loctite 518 sealant, 2 mm wide, to the LH rear and RH front camshaft bearing caps.
- Apply Loctite 518 sealant, 7 mm diameter, to the LH front and RH rear camshaft bearing caps.



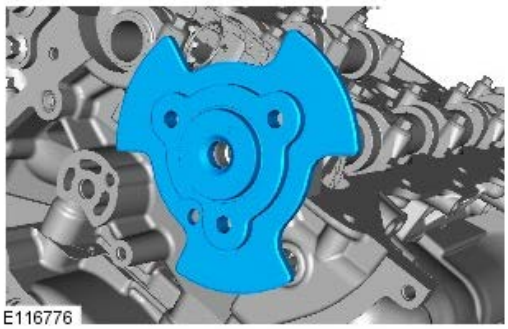
E116785

7. NOTE: Tighten the bolts in the indicated sequence.
   - Install the camshaft bearing caps in their original positions.
   - Stage 1: Bolts 1 to 14, 1 Nm.
   - Stage 2: Bolts 1 to 14, 5 Nm.
   - Stage 3: Bolts 1 to 14, 10 Nm.
   - Stage 4: Bolts 15 to 18, 1 Nm.
   - Stage 5: Bolts 15 to 18, 5 Nm.
   - Stage 6: Bolts 15 to 18, 10 Nm.

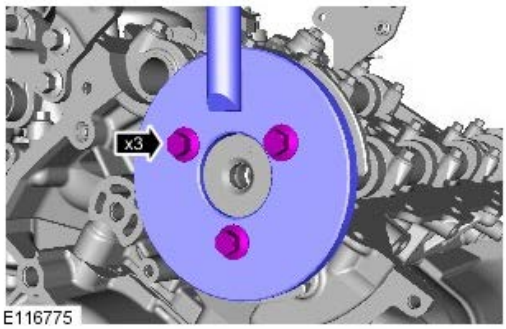
8. Remove the secondary timing chain tensioner retaining pin.



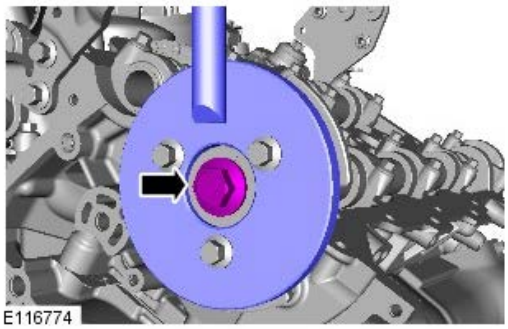
9.



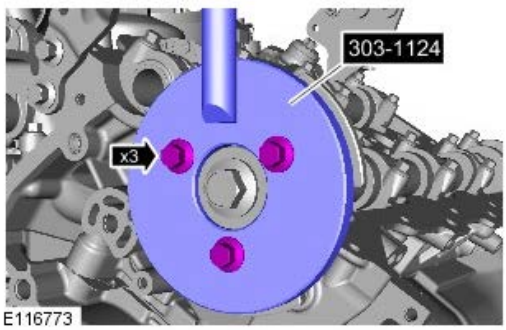
10. Install the special tool.



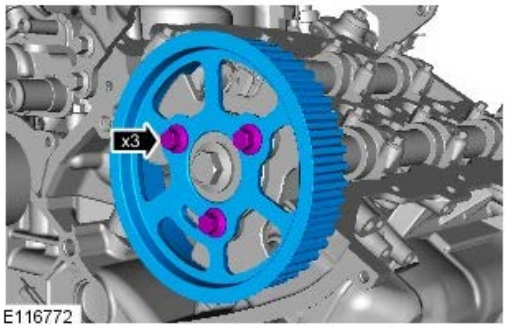
11. *Torque:*
    Stage 1:80 Nm
    Stage 2:80°



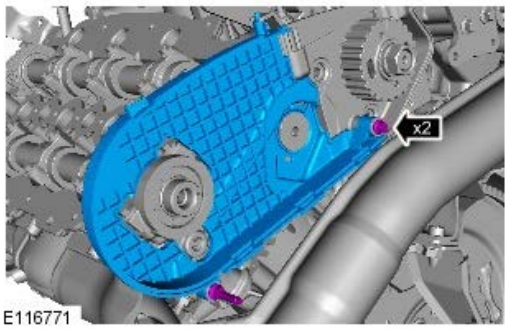
12. Remove the special tool.



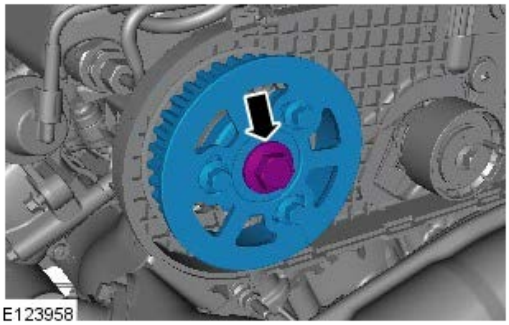
13. CAUTION: Only tighten the bolt finger-tight at this stage.



14. *Torque:* 10 Nm



15. CAUTION: Only tighten the bolt finger-tight at this stage.



16. Install the special tool.



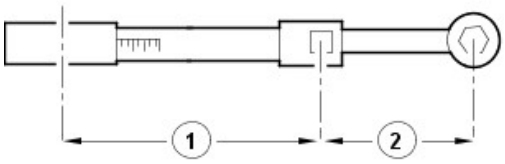
17. Install the special tool.



E123894

18. CAUTION: Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

    Calculate the setting for the torque wrench.



E37107



E123895

19. CAUTION: Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

    - Using the special tool, install the camshaft rear pulley retaining bolt.
    - *Special Tool(s):* 303-1145/2
    - *Torque:*
      Stage 1:80 Nm
      Stage 2:80°

20. Remove the special tools.
21. Refer to: Timing Belt (303-01, Removal and Installation).
22. Refer to: Rear End Accessory Drive (READ) (303-05, Removal and Installation).
23. Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Camshaft RH

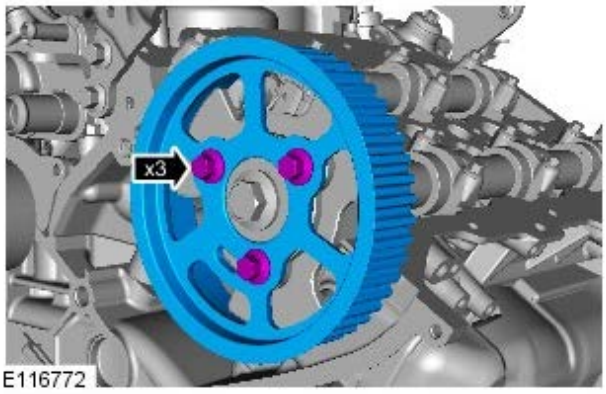
Removal and Installation

Special Tool(s)

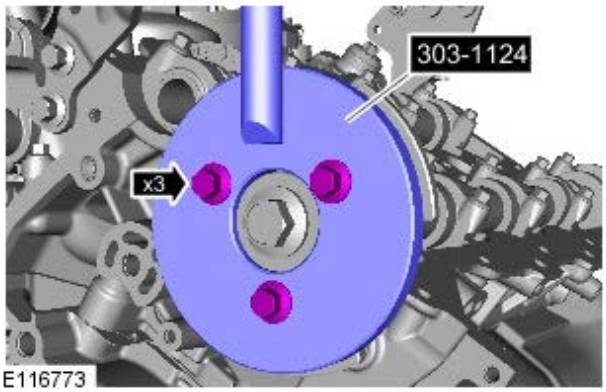
	303-1124 Holding Tool, Camshaft Front Pulley

Removal

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Brake Vacuum Pump - 3.0L Diesel (206-07, Removal and Installation).
3. Refer to: Valve Cover RH (303-01, Removal and Installation).
4. Refer to: Timing Belt (303-01, Removal and Installation).

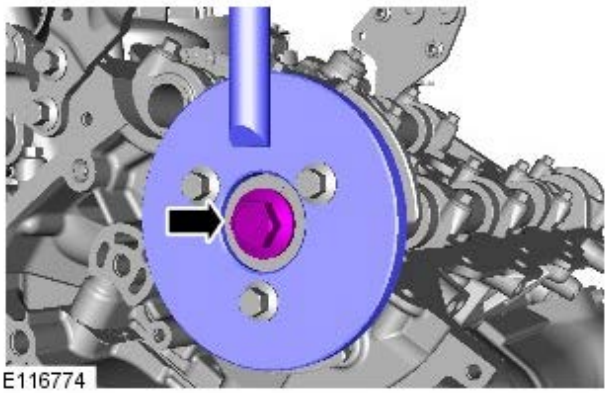


5. NOTE: LH illustration shown, RH is similar.

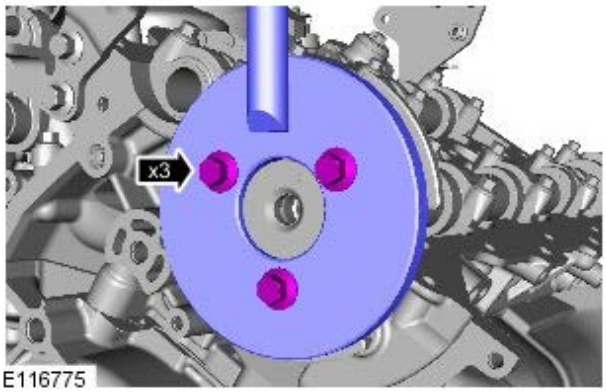


6. NOTE: LH illustration shown, RH is similar.

Special Tool(s): 303-1124

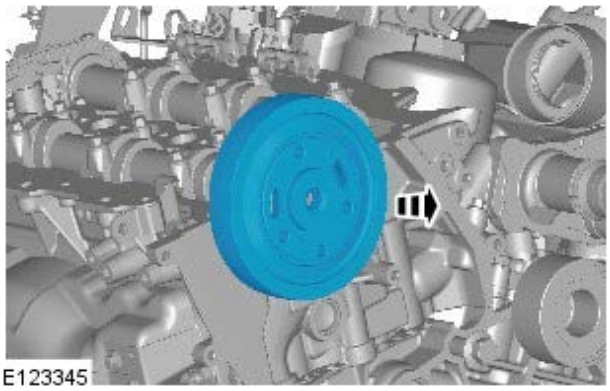


7. NOTE: LH illustration shown, RH is similar.

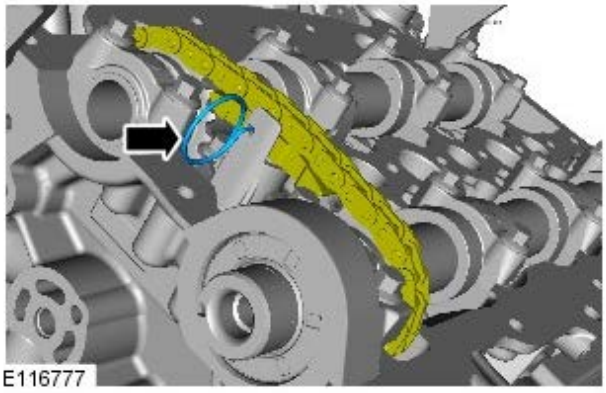


8. NOTE: LH illustration shown, RH is similar.

   Special Tool(s): 303-1124

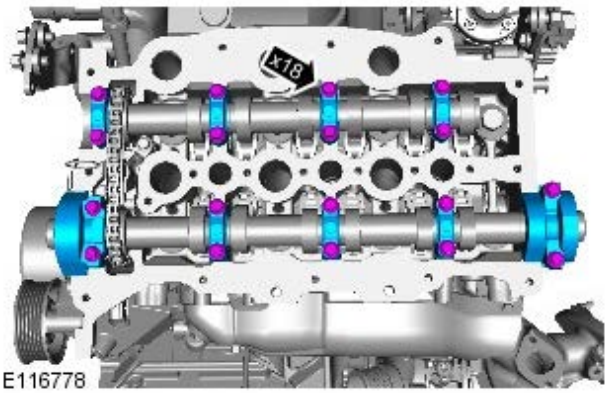


9.



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

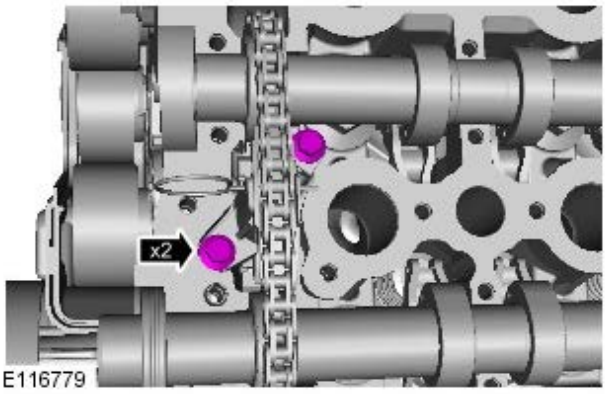
- Reposition the secondary timing chain tensioner.
- Retain the secondary timing chain tensioner plunger.



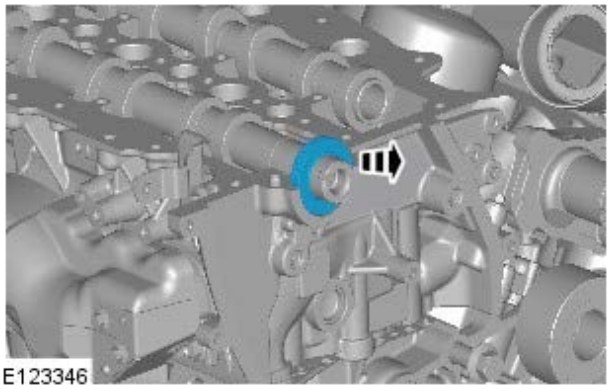
11. CAUTION: Evenly and progressively, release the camshaft bearing caps.

    NOTE: LH illustration shown, RH is similar.

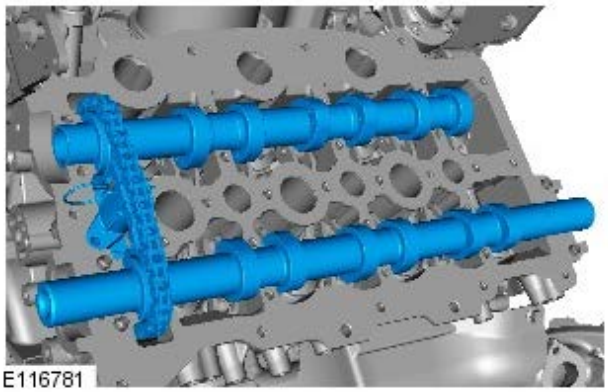
12. NOTE: LH illustration shown, RH is similar.



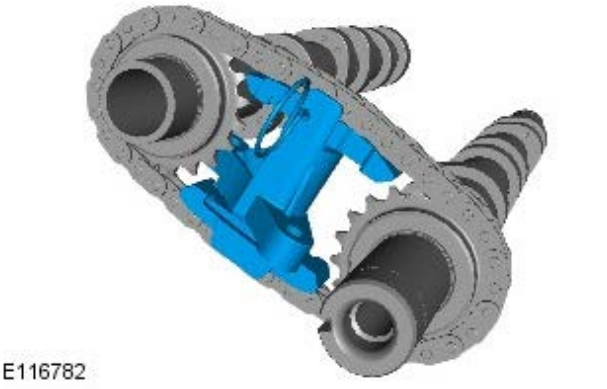
13. CAUTION: Discard the seals.



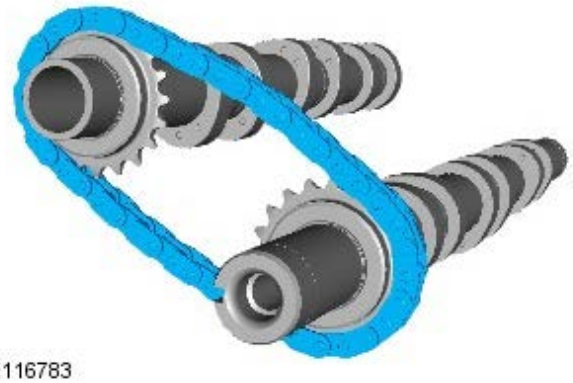
14. NOTE: LH illustration shown, RH is similar.



15.



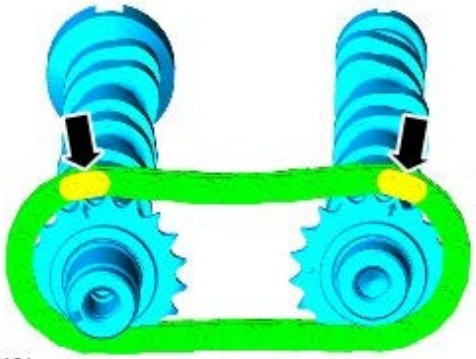
16.



E116783

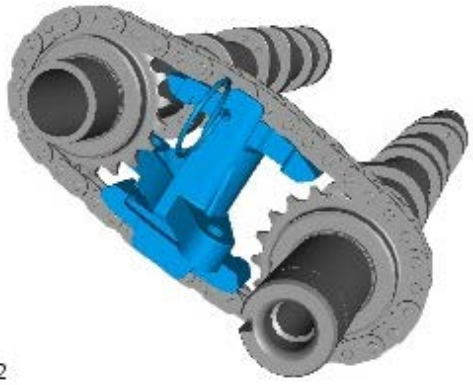
Installation

1.

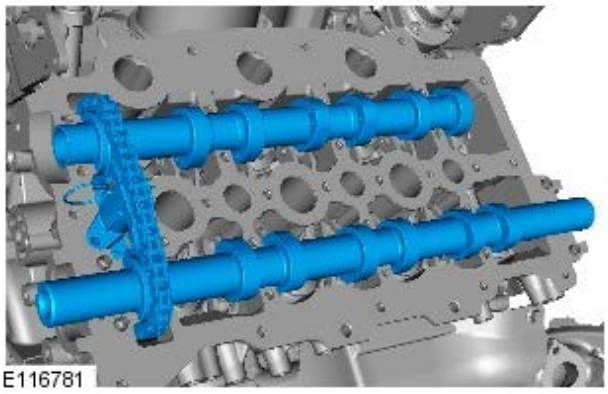


E86461

2.



E116782

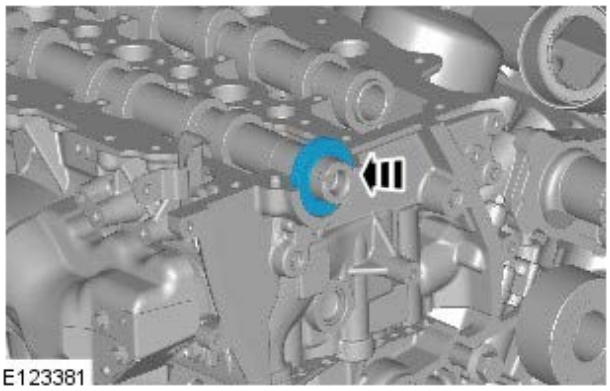


E116781

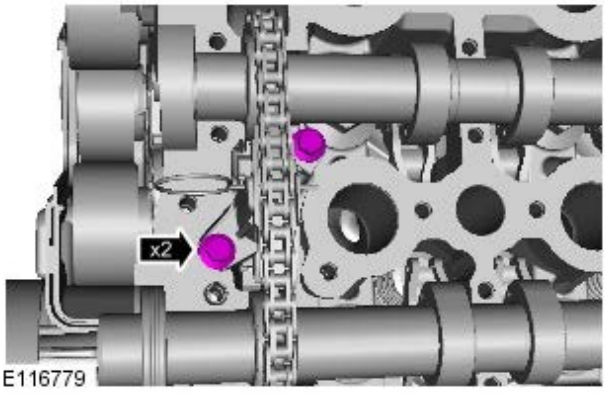
3. CAUTION: Make sure that the dots on the camshafts are aligned at the 12 o'clock position. Failure to follow this instruction may result in damage to the engine.

NOTE: Use hypoid oil to lubricate the camshafts.

4. NOTE: Install new seals.


E123381

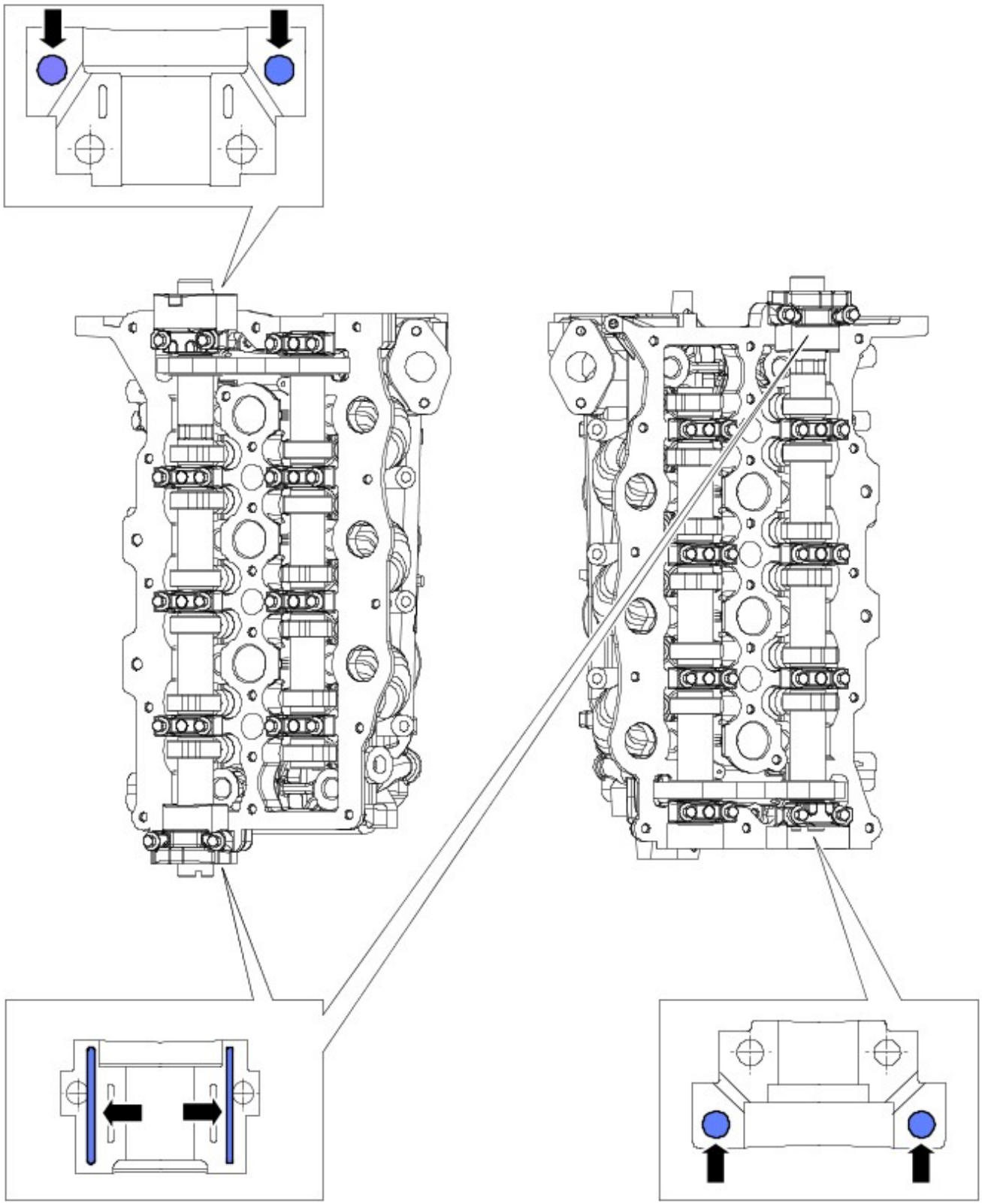
5. *Torque:* 10 Nm



E116779

6.

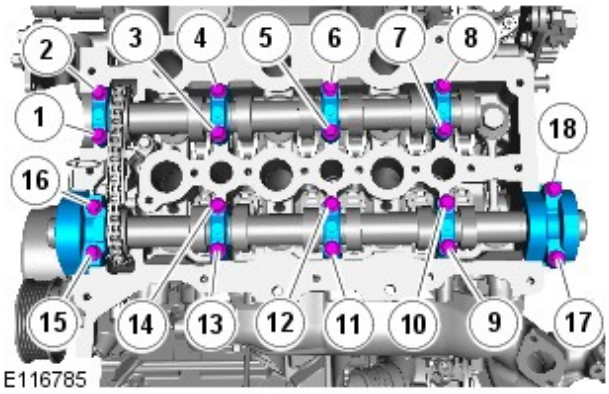
- Apply Loctite 518 sealant to the exhaust camshaft seal bearing caps.
- Apply Loctite 518 sealant, 2 mm wide, to the LH rear and RH front camshaft bearing caps.
- Apply Loctite 518 sealant, 7 mm diameter, to the LH front and RH rear camshaft bearing caps.



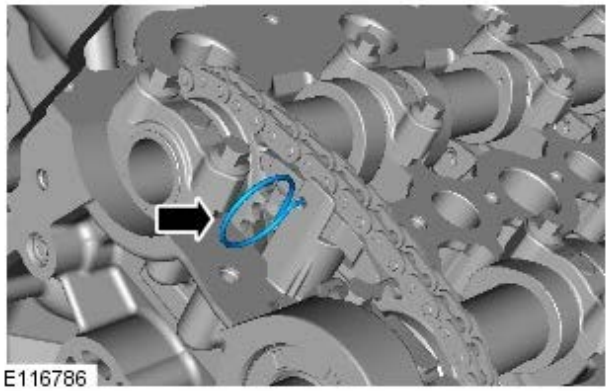
E116784

7. NOTE: Tighten the bolts in the indicated sequence.

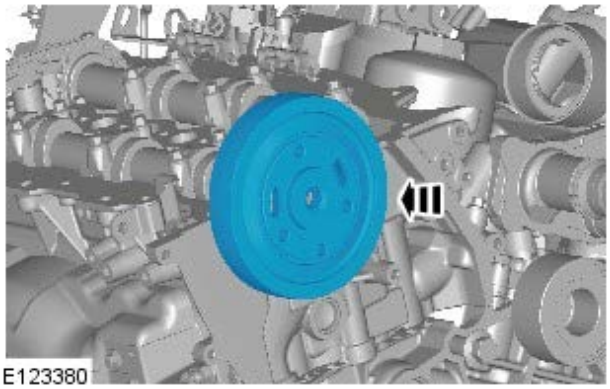
   - Install the camshaft bearing caps in their original positions.
   - Stage 1: Bolts 1 to 14, 1 Nm.
   - Stage 2: Bolts 1 to 14, 5 Nm.
   - Stage 3: Bolts 1 to 14, 10 Nm.
   - Stage 4: Bolts 15 to 18, 1 Nm.
   - Stage 5: Bolts 15 to 18, 5 Nm.
   - Stage 6: Bolts 15 to 18, 10 Nm.



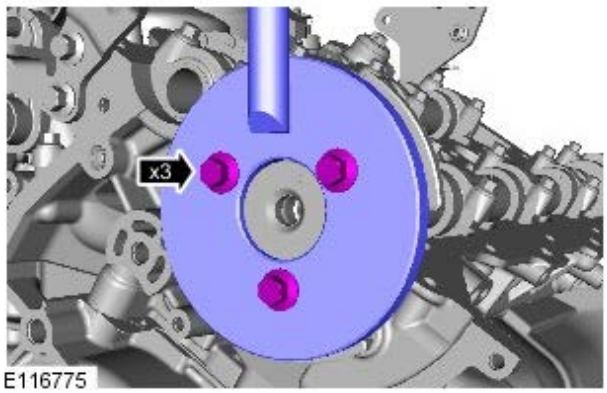
8.



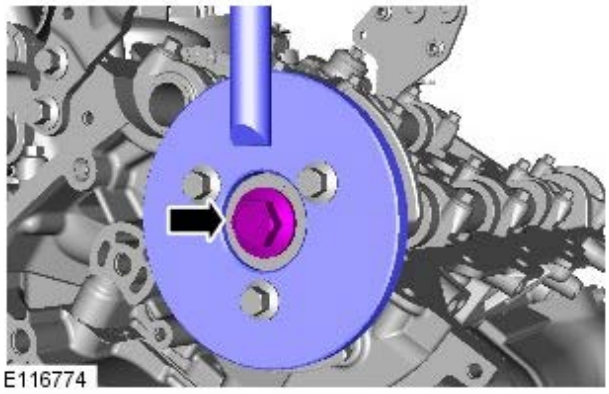
9.



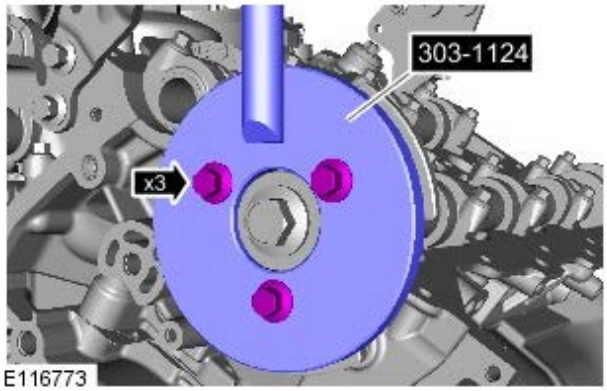
10. *Special Tool(s):* 303-1124



11. *Torque:*
    Stage 1: 80 Nm
    Stage 2: 80°

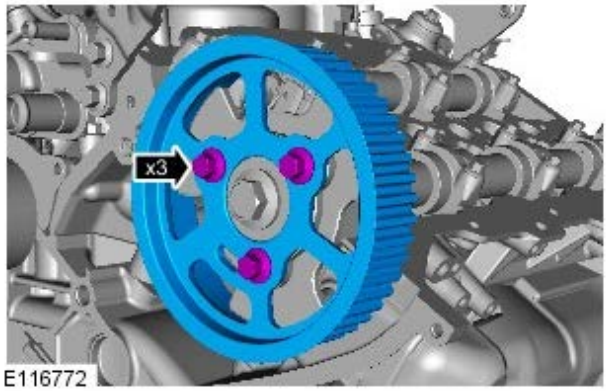

E116774

12. *Special Tool(s):* 303-1124



E116773

13. CAUTION: Only tighten the bolt finger-tight at this stage.



E116772

14. Refer to: Timing Belt (303-01, Removal and Installation).
15. Refer to: Valve Cover RH (303-01, Removal and Installation).
16. Refer to: Brake Vacuum Pump - 3.0L Diesel (206-07, Removal and Installation).
17. Refer to: Specifications (414-00, Specifications).

Published: 13-Jul-2011

Engine - TDV6 3.0L Diesel - Camshaft Front Seal

Removal and Installation

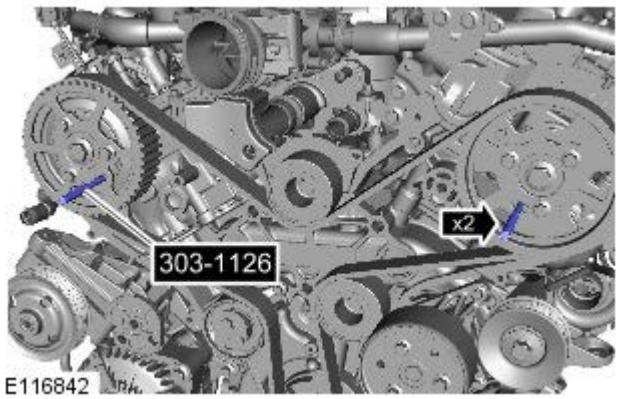
Special Tool(s)

	303-1118 Remover, Camshaft Seal
	303-1119 Installer, Camshaft Seal
	303-1124 Holding Tool, Camshaft Front Pulley
	303-1126 Timing Peg, Camshaft Pulley

Removal

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

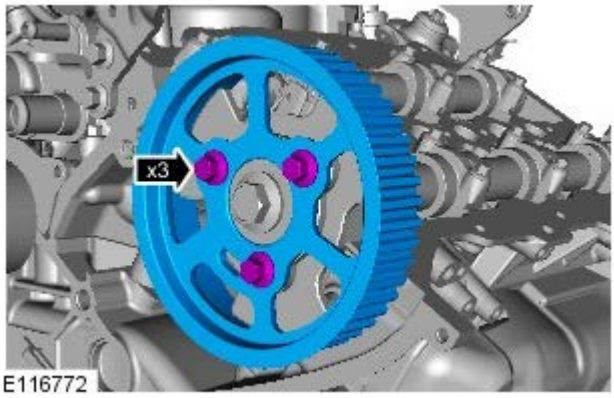
1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Timing Belt (303-01, Removal and Installation).



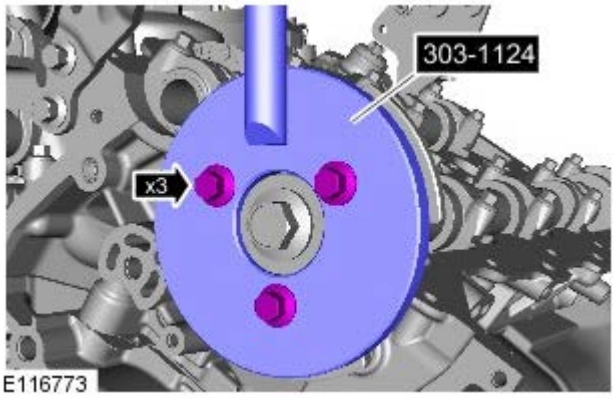
3. CAUTION: Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.

   Special Tool(s): 303-1126

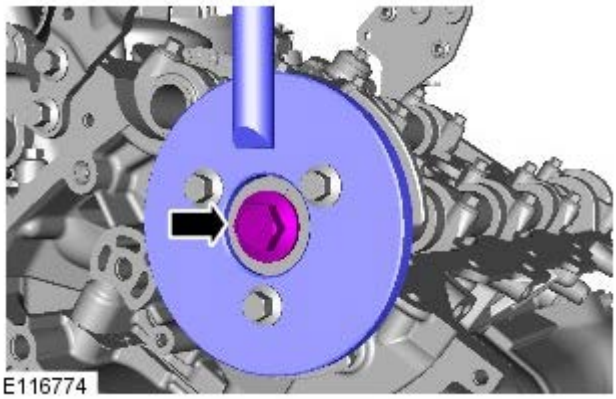
4.



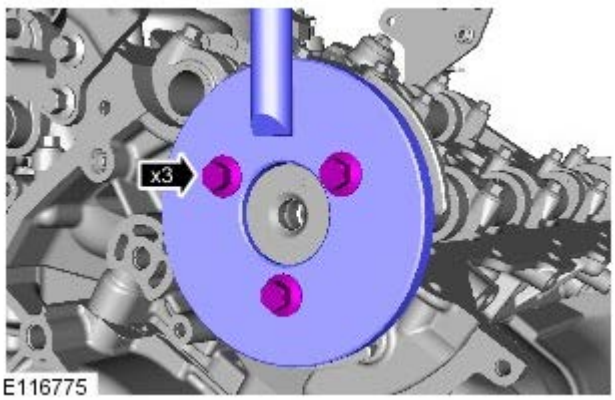
5. *Special Tool(s):* 303-1124



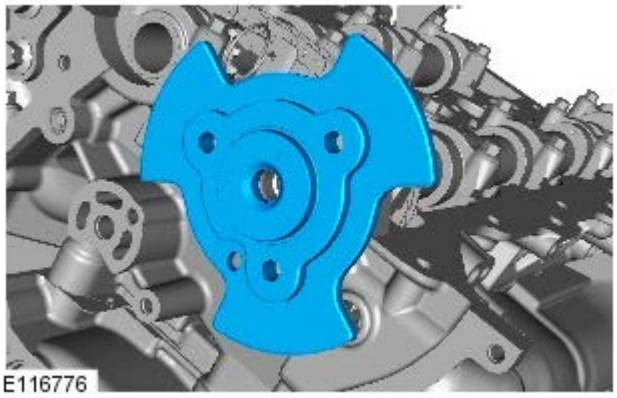
6.

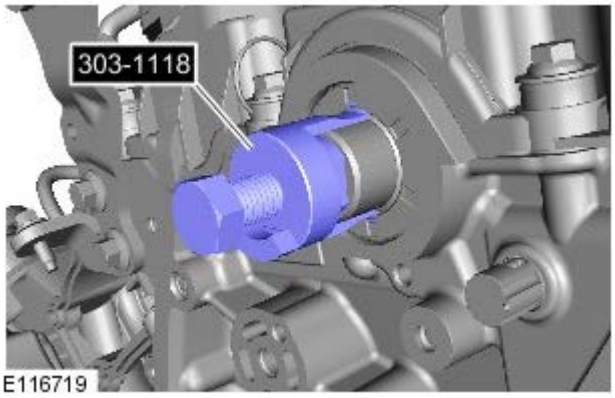


7. *Special Tool(s):* 303-1124



8.


E116776

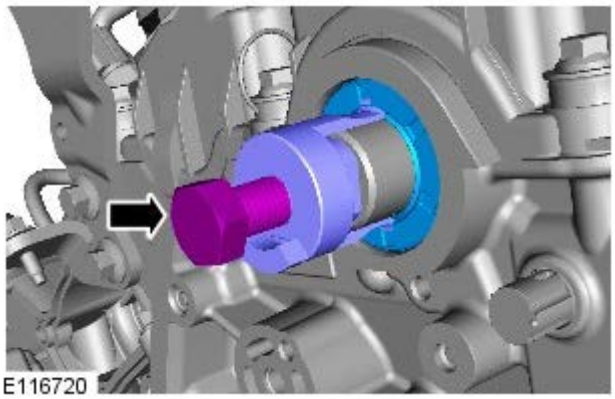


E116719

9. CAUTION: Make sure the special tool is correctly seated behind the camshaft seal. Failure to follow this instruction may result in damage to the special tool.

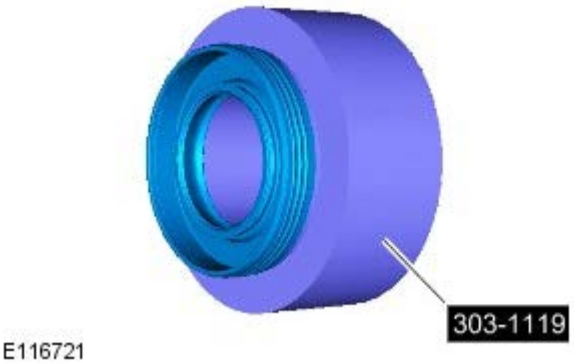
   Special Tool(s): 303-1118

10.


E116720

Installation

1. *Special Tool(s):* 303-1119

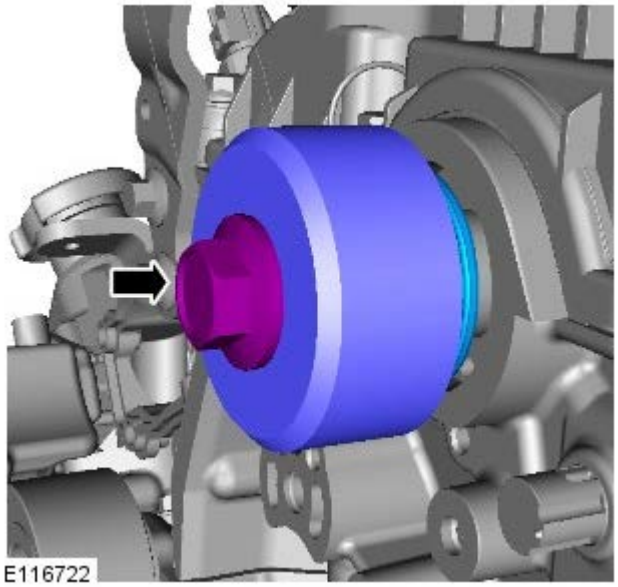


E116721

2. CAUTIONS:

   Make sure the seal is installed correctly.

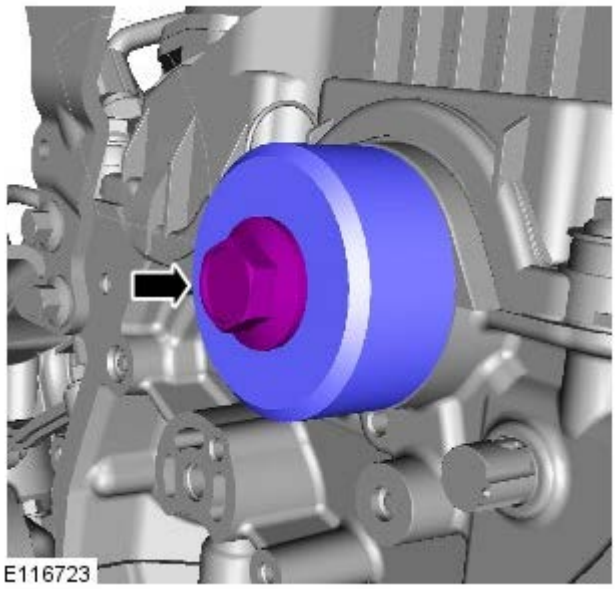
   Make sure that the mating faces are clean and free of corrosion and foreign material.


E116722

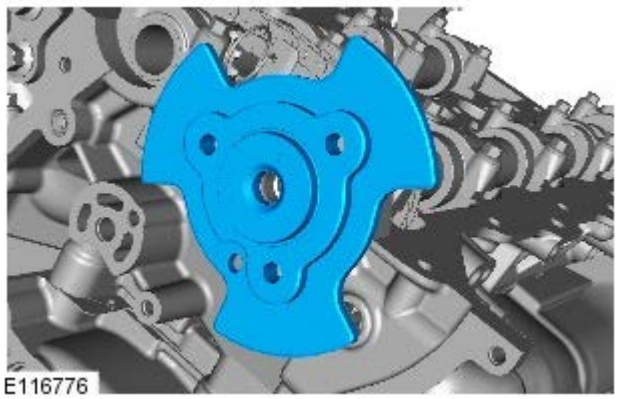
Do not use any lubricant on the camshaft front seal or the camshaft. Failure to follow this instruction may result in damage to the vehicle.

NOTE: Make sure that the seal is 1mm below the face of the cylinder head.

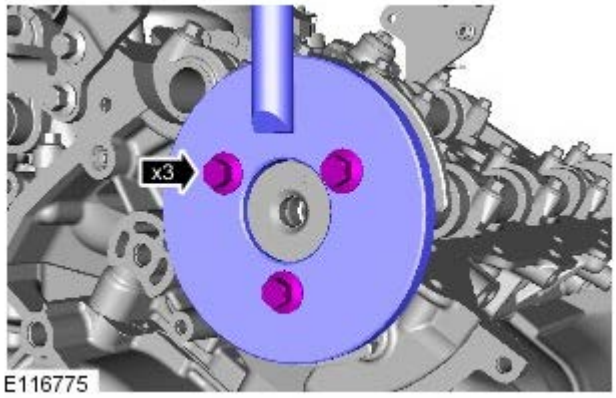
3. *Special Tool(s):* 303-1119


E116723

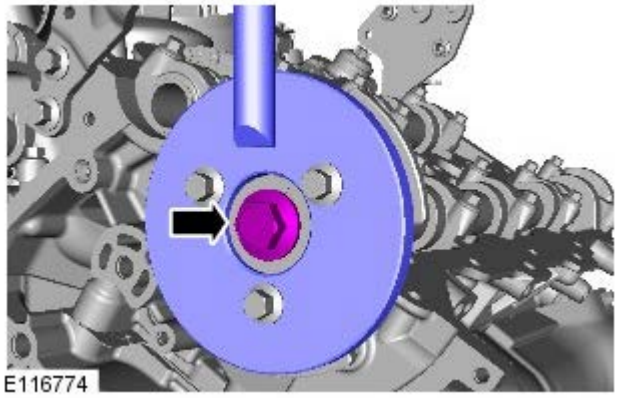
4.


E116776

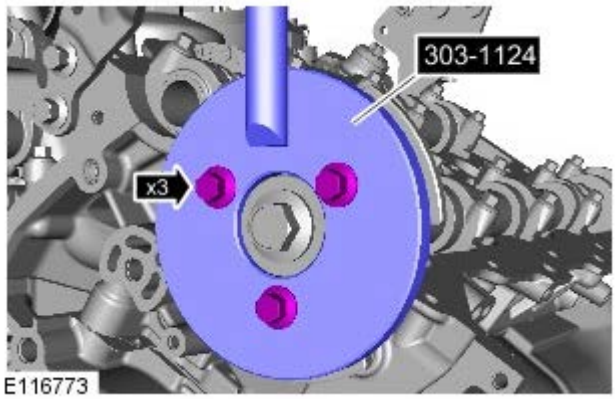
5. *Special Tool(s):* 303-1124



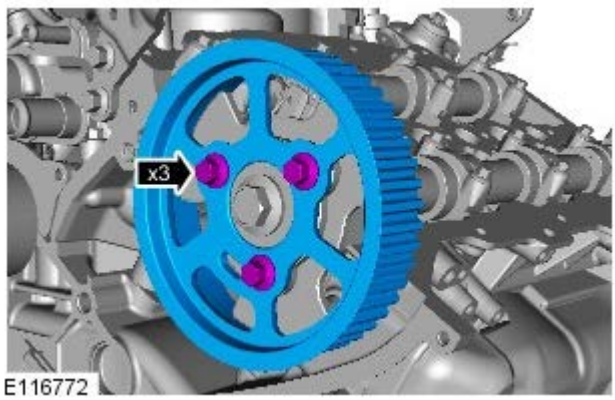
6. *Torque:*
   Stage 1:80 Nm
   Stage 2:80°



7. *Special Tool(s):* 303-1124

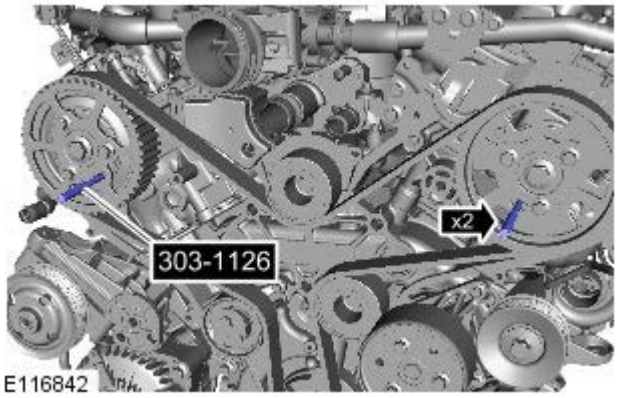


8. CAUTION: Only tighten the bolt finger-tight at this stage.



9. CAUTION: Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.

   Special Tool(s): 303-1126



10. Refer to: Timing Belt (303-01, Removal and Installation).

11. Refer to: Specifications (414-00, Specifications).

Published: 03-Jan-2014

Engine - TDV6 3.0L Diesel - Camshaft Rear Seal

Removal and Installation

Removal

1. Refer to: Rear End Accessory Drive (READ) (303-05A Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

2. Install the special tool.



3. Install the special tool.

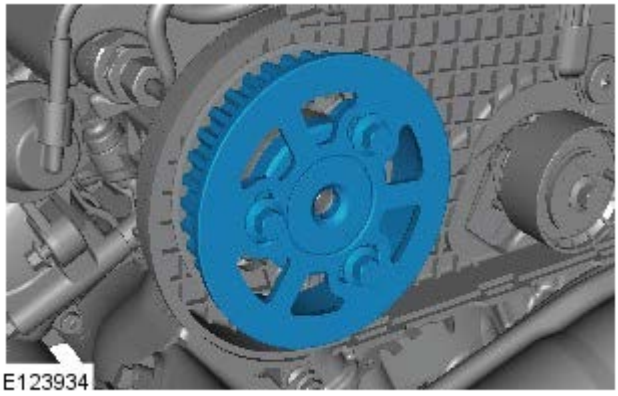


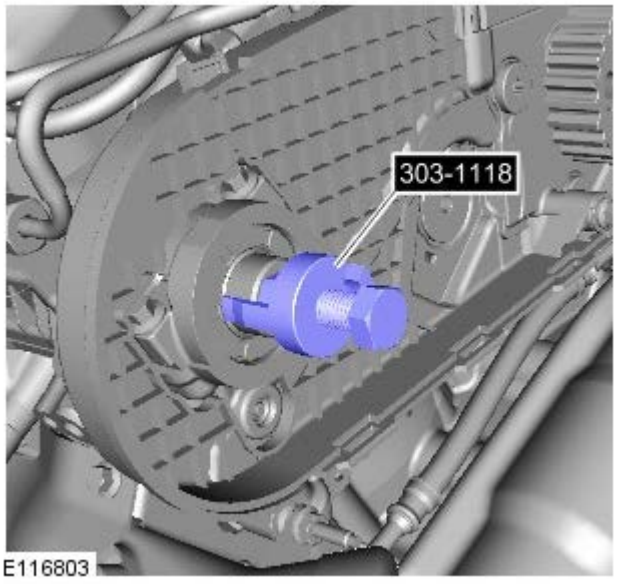
4. Using the special tool, remove the rear camshaft pulley retaining bolt.



5. Remove the special tools.

6.

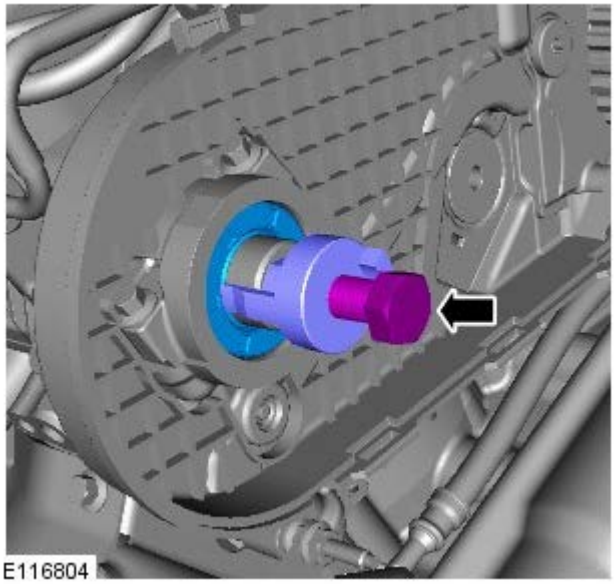




7. CAUTION: Make sure the special tool is correctly seated behind the camshaft seal. Failure to follow this instruction may result in damage to the special tool.

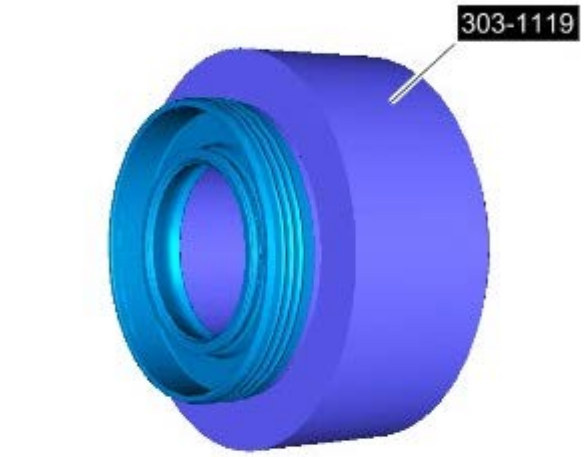
   Install the special tool.

8.

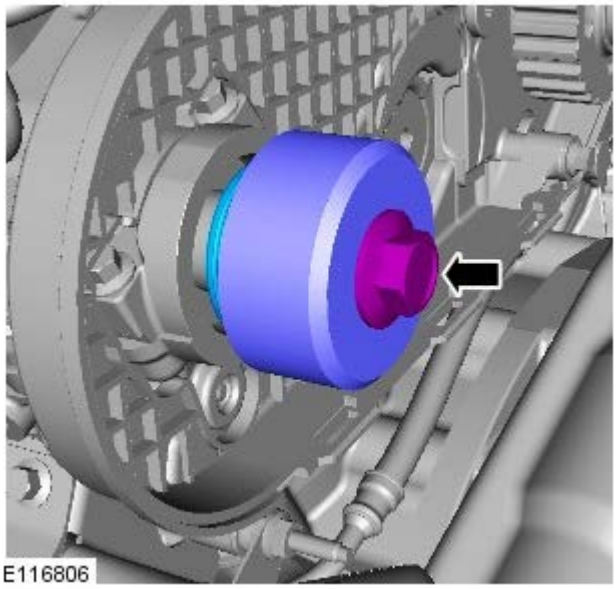

E116804

Installation

1. Install with the special tool.



E116805


E116806

2. CAUTIONS:

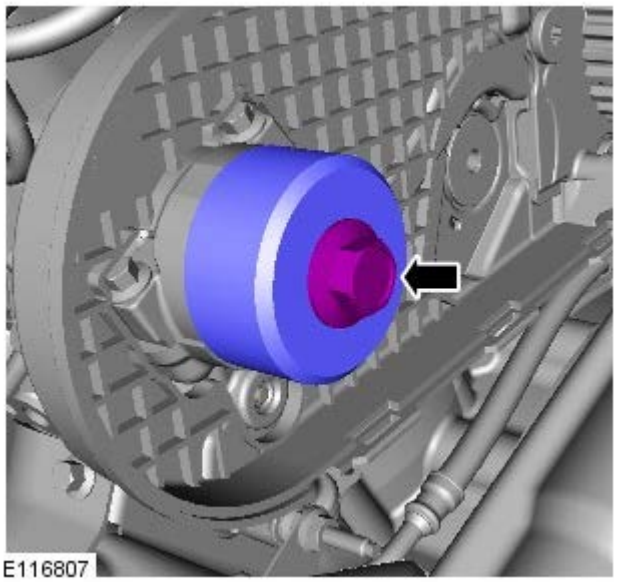
   Make sure the seal is installed correctly.

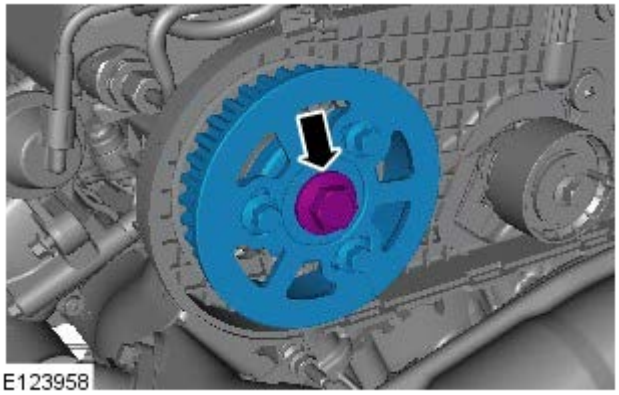
   Make sure that the mating faces are clean and free of corrosion and foreign material.

   Do not use any lubricant on the camshaft rear seal or the camshaft. Failure to follow this instruction may result in damage to the vehicle.

   NOTE: Make sure that the seal is 1mm below the face of the cylinder head.

3. Remove the special tool.





4. CAUTION: Only tighten the bolt finger-tight at this stage.

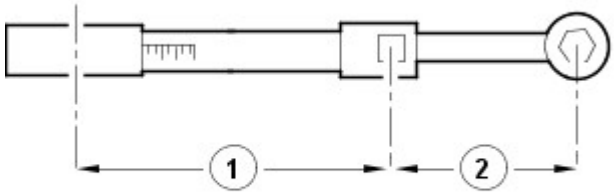
5. Install the special tool.



6. Install the special tool.



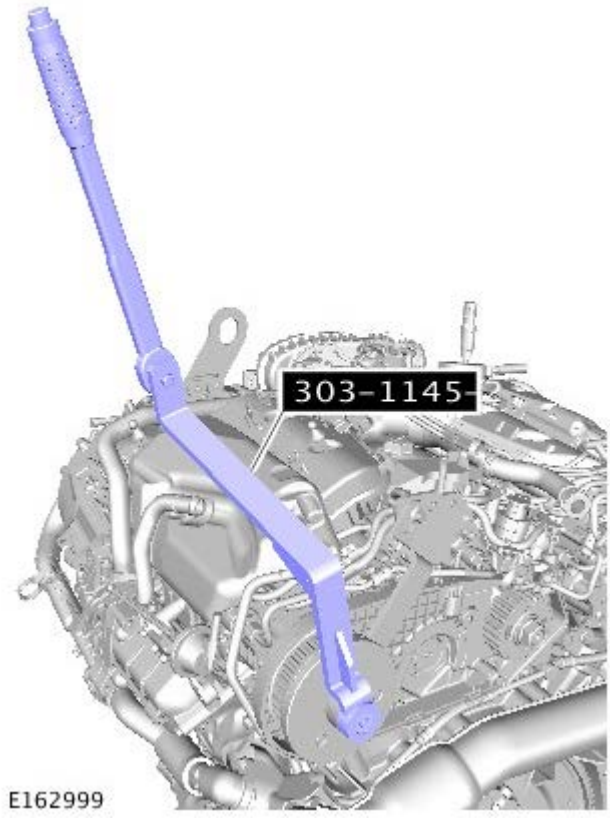
E123894



E37107

7. CAUTION: Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.
    - **Calculate the setting for the torque wrench using the following method:**
    - Stage 1: Multiply the required torque by the effective length of the torque wrench (1).
    - Stage 2: Add the effective length of the special tool (2) to the effective length of the torque wrench.
    - Stage 3: Divide the total of stage 1 by the total of stage 2.
    - Stage 4: Set the torque wrench to the figure arrived at in stage 3.

8. CAUTION: Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.
    - Using the special tool, install the camshaft rear pulley retaining bolt.
    - Stage one: Tighten to 80 Nm (59 lb/ft).
    - Stage two: Tighten a further 80 degrees.



9. Refer to: Rear End Accessory Drive (READ) (303-05A Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

10. Remove the special tools.

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Crankshaft Front Seal

Removal and Installation

Special Tool(s)

	303-1120 Remover, Crankshaft Front Seal
	303-1121 Installer, Crankshaft Seal
	303-1122 Installer, Crankshaft Front Seal

Removal

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

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-01, Specifications).

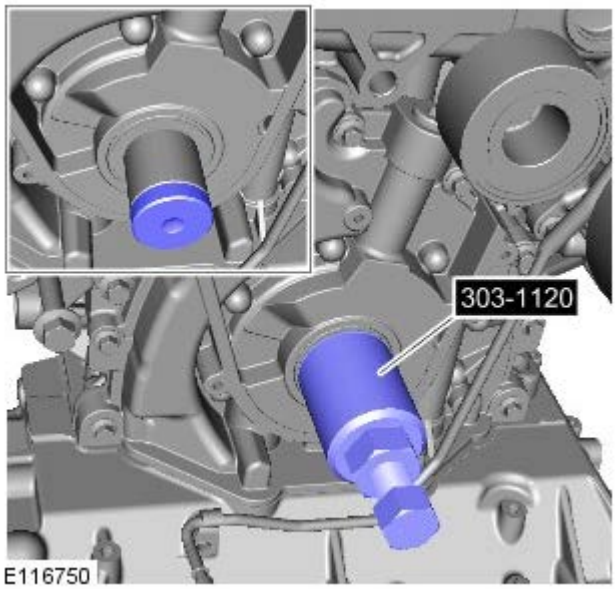
2. WARNING: Make sure to support the vehicle with axle stands.

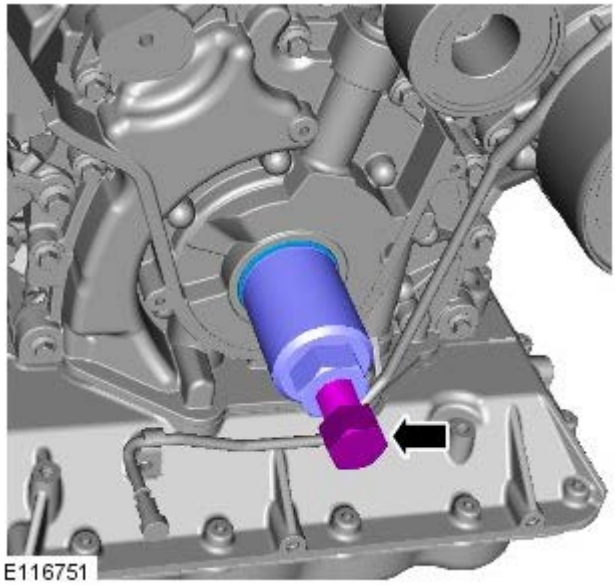
   Raise and support the vehicle.

3. Refer to: Crankshaft Pulley (303-01B, Removal and Installation).

4. Install the special tool.

   Special Tool(s): 303-1120

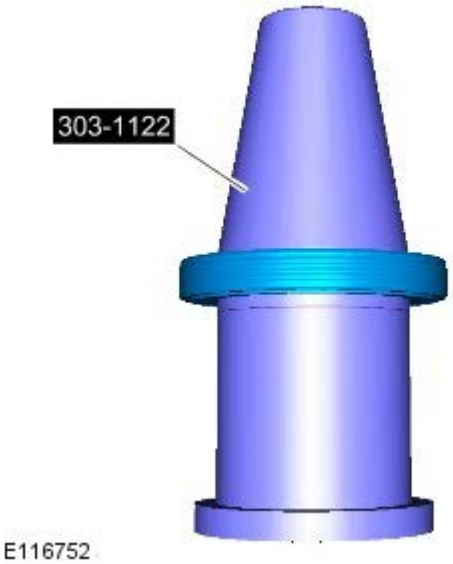




5. CAUTION: Discard the seal.

   Using the special tool, remove the crankshaft front seal.

Installation



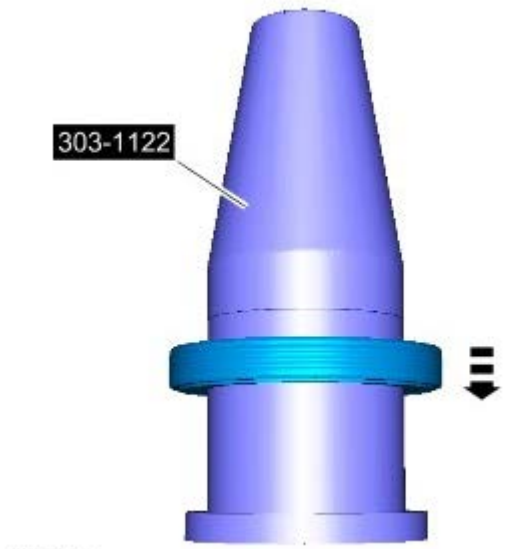
1. CAUTION: Do not use any lubricant on the crankshaft front seal, special tools or the crankshaft. Failure to follow this instruction may result in damage to the vehicle.

   NOTE: Make sure that all the component mating faces are clean.

   Install a new crankshaft front seal to the special tool.

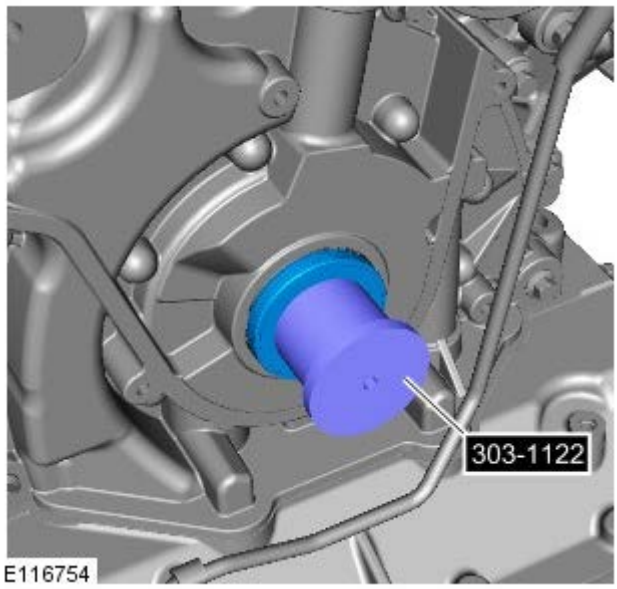
   Special Tool(s): 303-1122

2. Reposition the crankshaft front seal along the special tool.



E116753

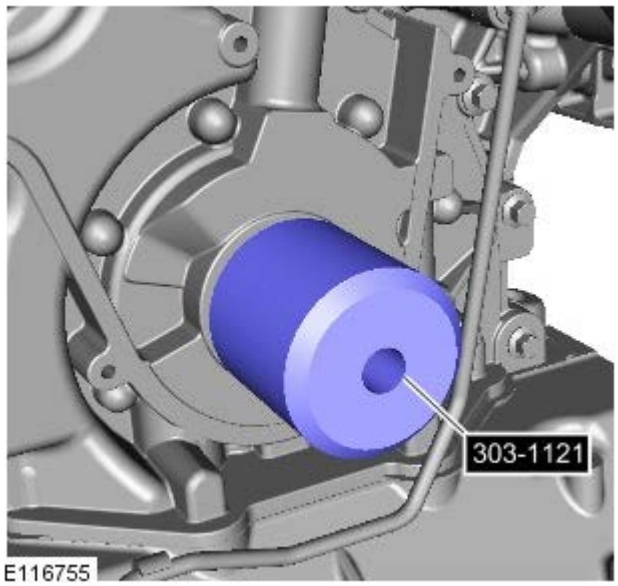
3. Install the special tool to the crankshaft.



E116754

4. Install the special tool to the crankshaft.

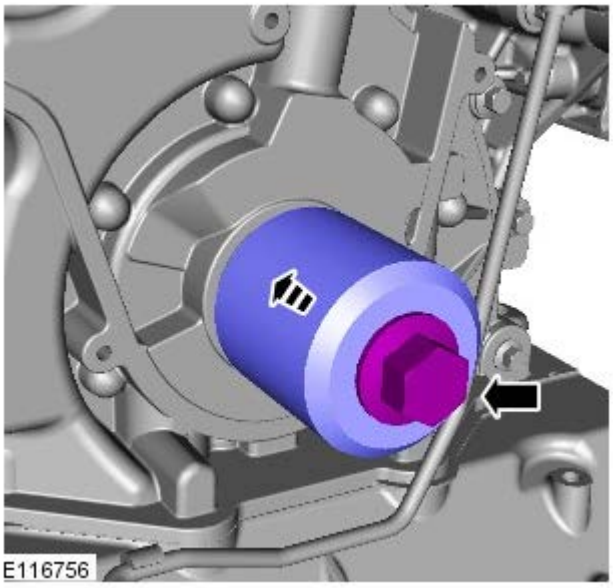
Special Tool(s): 303-1121



E116755

5. CAUTIONS:

Make sure the seal is installed correctly.



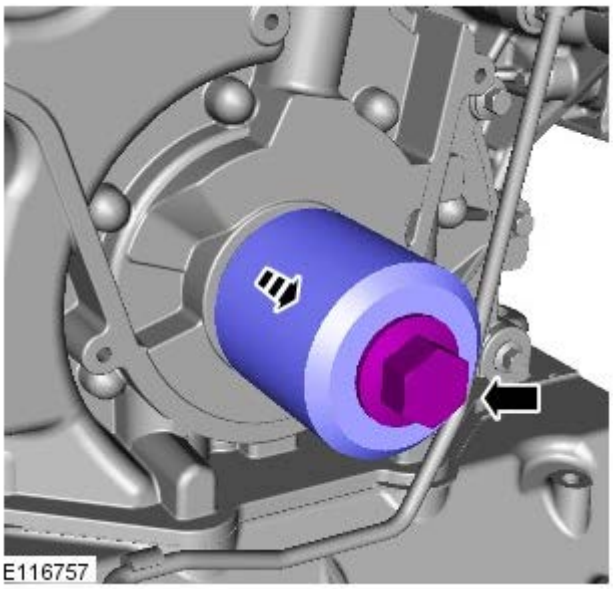
Make sure that the seal is seated 1mm under flush.

Discard the bolt.

Using the special tool, install the crankshaft front seal.

6. Remove the special tool.

   Special Tool(s): 303-1121



7. Refer to: Crankshaft Pulley (303-01B, Removal and Installation).

8. Connect the battery ground cable.

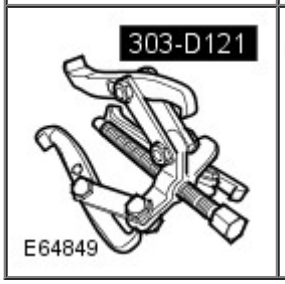
   Refer to: Specifications (414-01, Specifications).

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Crankshaft Pulley

Removal and Installation

Special Tool(s)

	303-1117 Timing Peg, Automatic Transmission
	303-1123 Locking Tool, Flywheel
	303-D121 Puller, General Purpose

Removal

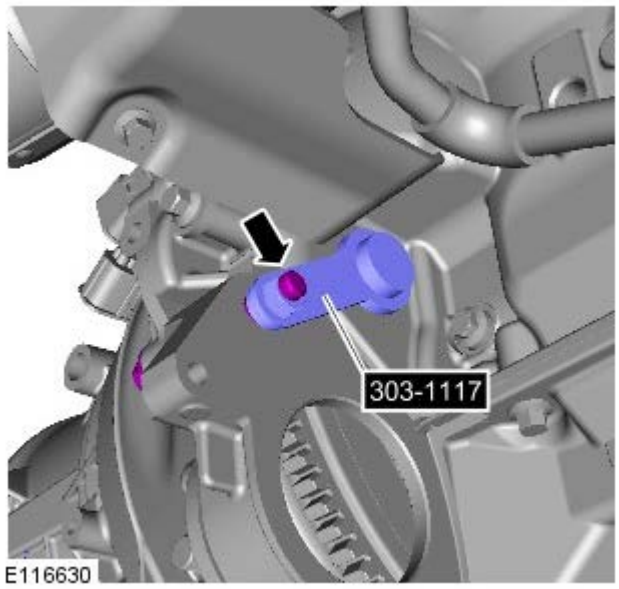
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

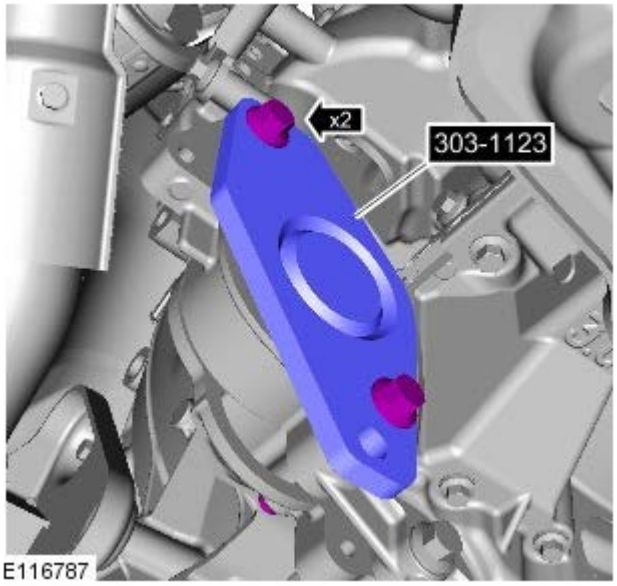
2. Refer to: Timing Belt (303-01, Removal and Installation).

3. Refer to: Cooling Fan (303-03, Removal and Installation).

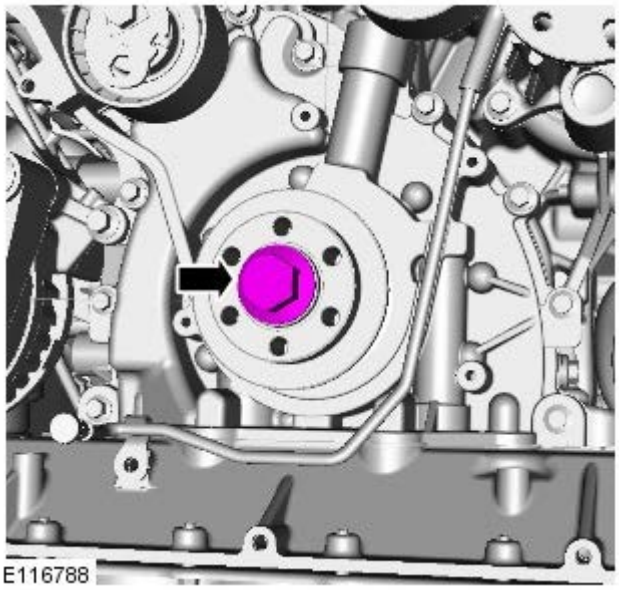
4.
   - Remove the special tool.
   - *Special Tool(s):* 303-1117



5.
   - Install the special tool.
   - *Special Tool(s):* 303-1123

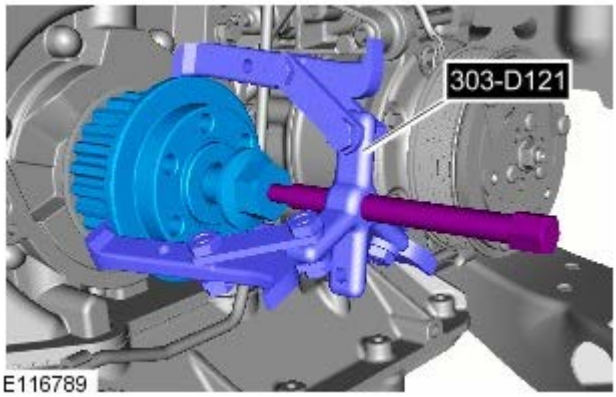


6.

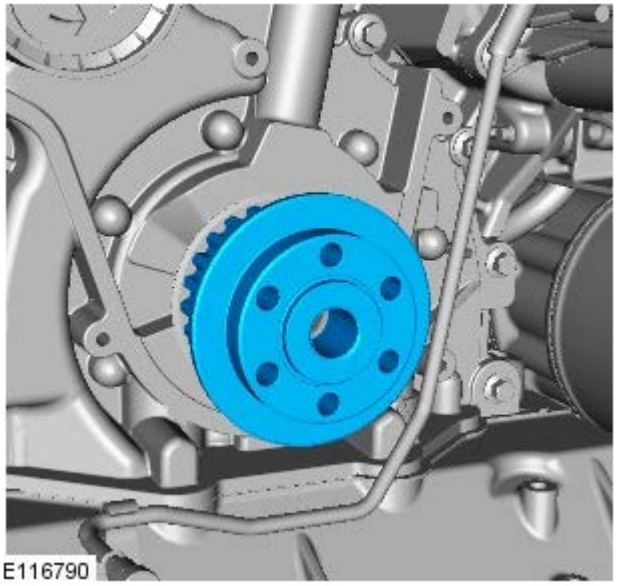


7.

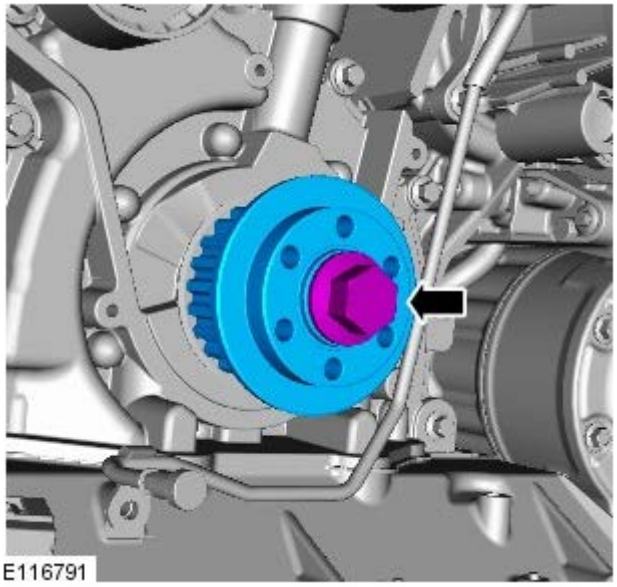
- Install the special tool.
- *Special Tool(s):* 303-D121



8. CAUTION: Discard the bolt.



Installation



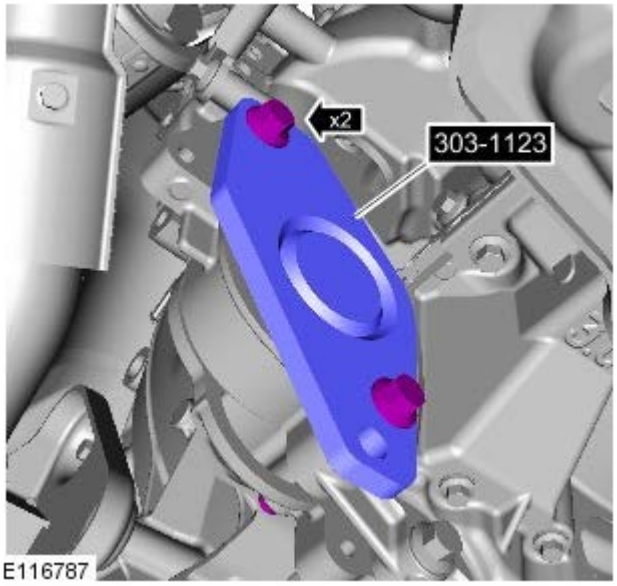
1. CAUTIONS:

   Make sure that the pulley washer is correctly seated before installing the pulley.

   Do not lubricate the components.

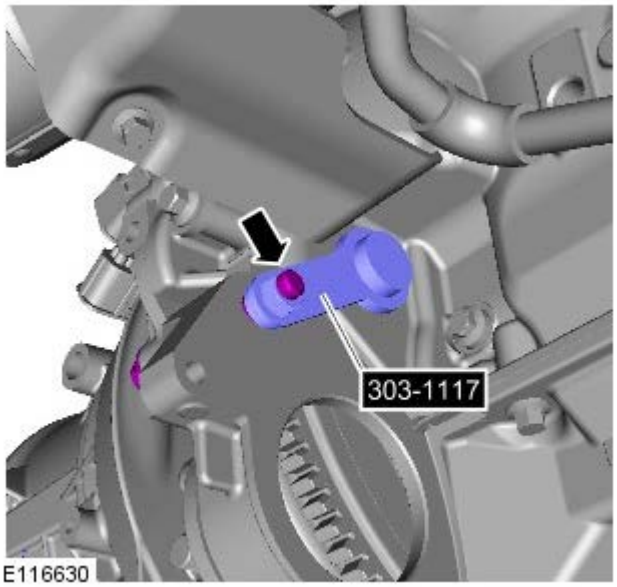
   Make sure that a new bolt is installed.

   Torque:
   Stage 1: 150 Nm
   Stage 2: 300 Nm
   Stage 3: 90°



2.
   - Remove the special tool.
   - *Special Tool(s):* 303-1123

3.
   - Install the special tool.
   - *Special Tool(s):* 303-1117



4. Refer to: Cooling Fan (303-03, Removal and Installation).
5. Refer to: Timing Belt (303-01, Removal and Installation).

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Crankshaft Rear Seal

Removal and Installation

Removal

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

1. Disconnect the battery ground cable.

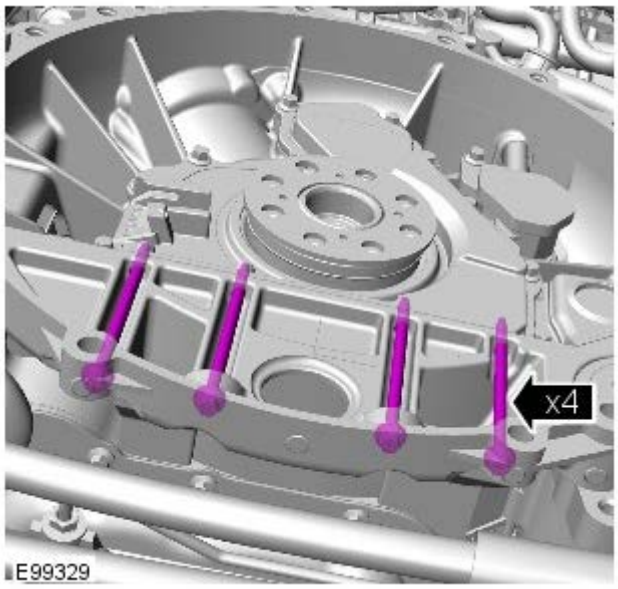
   Refer to: Specifications (414-01, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

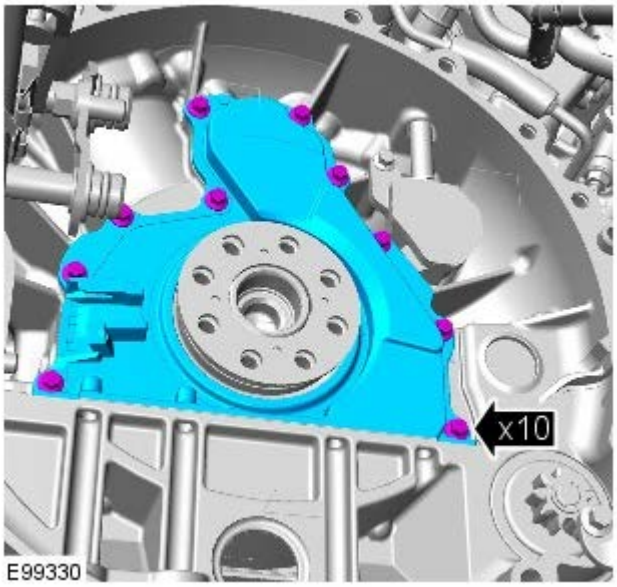
   Raise and support the vehicle.

3. Refer to: Crankshaft Position (CKP) Sensor Ring (303-14B, Removal and Installation).

4.

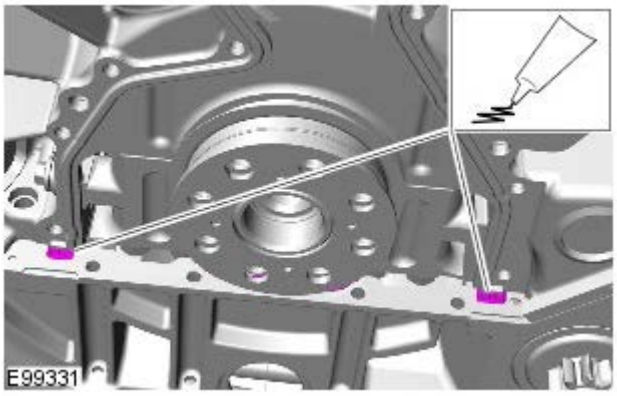


5. CAUTION: Discard the seal.



Installation

1. CAUTIONS:



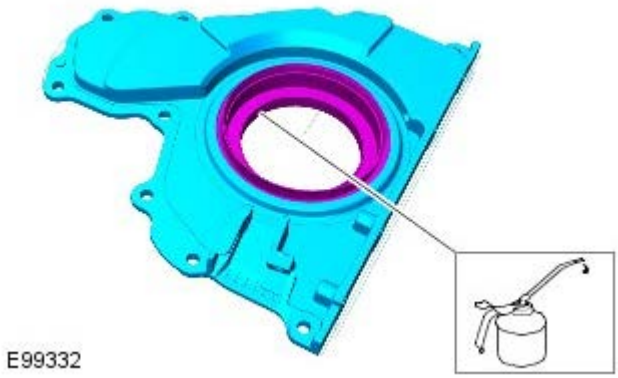
Make sure that the crankshaft rear oil seal is correctly located.

Make sure the crankshaft seal mating faces are clean and dry.

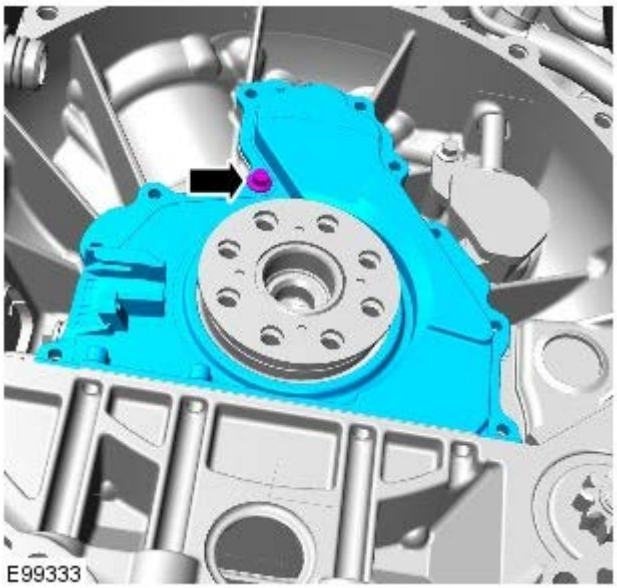
Apply an 8 mm bead of sealant to the cylinder block in the areas shown.

2.

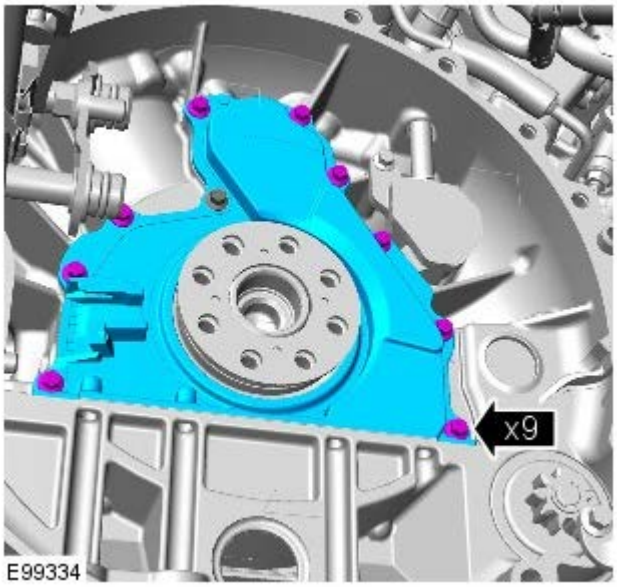
- Lubricate the oil seal.



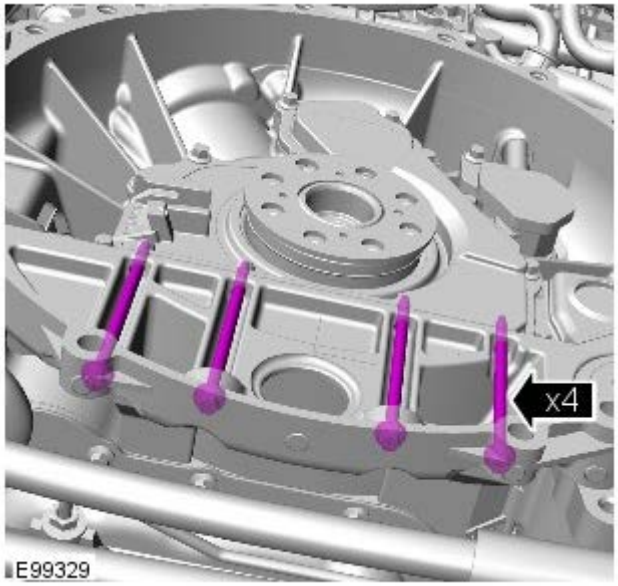
3. *Torque:* 10 Nm



4. *Torque:* 10 Nm



5. *Torque:* 10 Nm



6. Refer to: Crankshaft Position (CKP) Sensor Ring (303-14B, Removal and Installation).

7. Connect the battery ground cable.

   Refer to: Specifications (414-01, Specifications).

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Cylinder Head

Removal and Installation

Removal

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

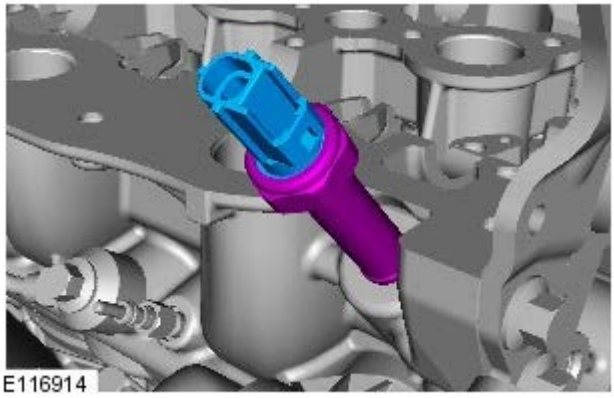
   Raise and support the vehicle.

3. Refer to: Camshaft LH (303-01 Engine - 3.0L V6 - TdV6, Removal and Installation).

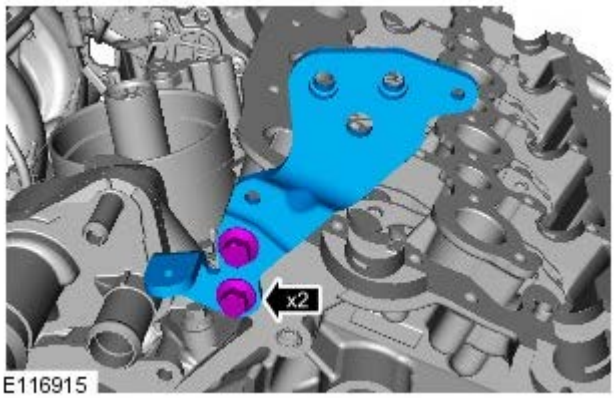
4. Refer to: Glow Plugs (303-07 Glow Plug System - 3.0L V6 - TdV6, Removal and Installation).

5. Refer to: Exhaust Manifold (303-01 Engine - 3.0L V6 - TdV6, Removal and Installation).

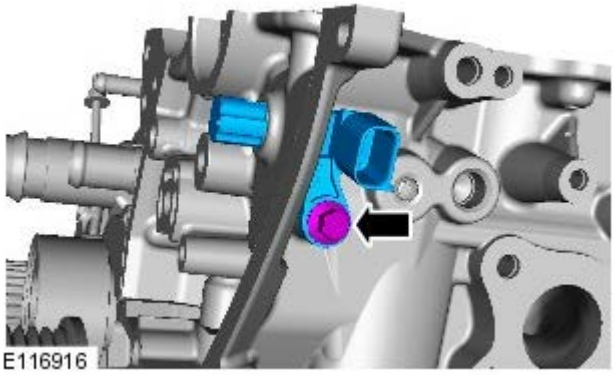
6.



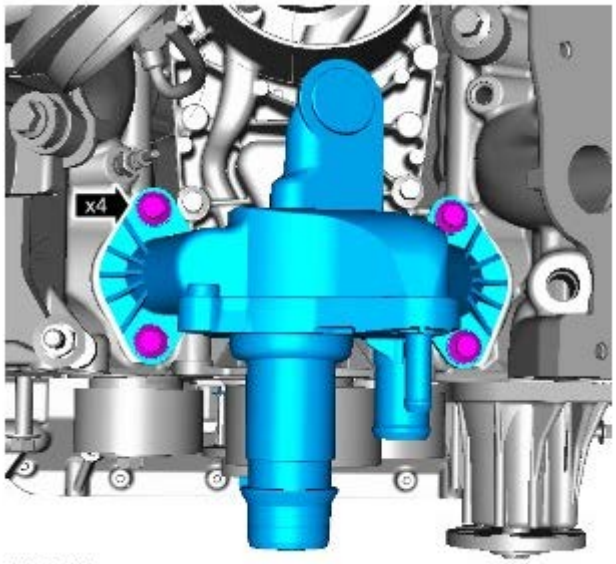
7.



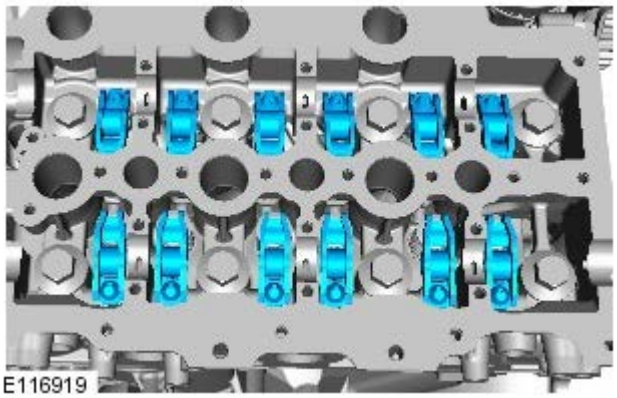
8.

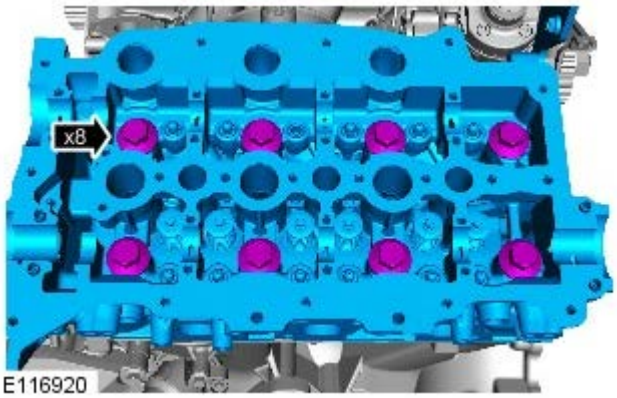


9.



10.





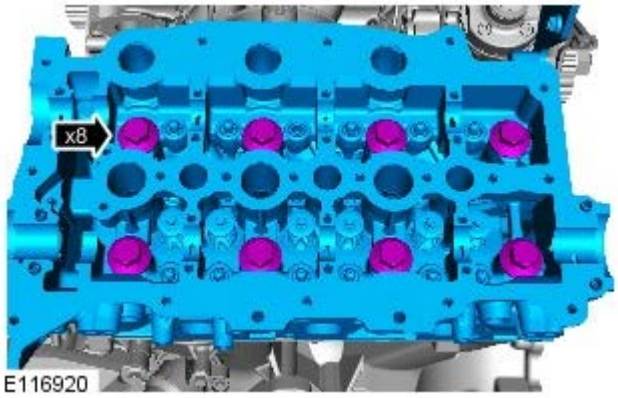
11. CAUTION: Discard the bolts.

NOTE: Discard the gasket.

Installation

1. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Clean and inspect the cylinder head and cylinder block.



2. CAUTIONS:

   Only tighten the bolts finger-tight at this stage.

   Make sure that new bolts are installed.

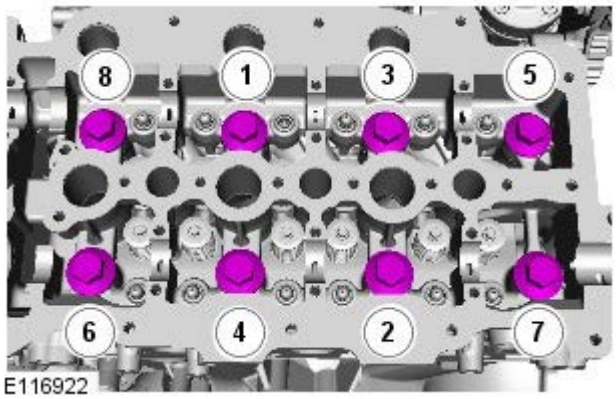
   Use care when installing the cylinder head. Damage to the cylinder block, cylinder head or cylinder head gasket may result.

   The head gasket must be installed over the cylinder block dowels.

   NOTES:

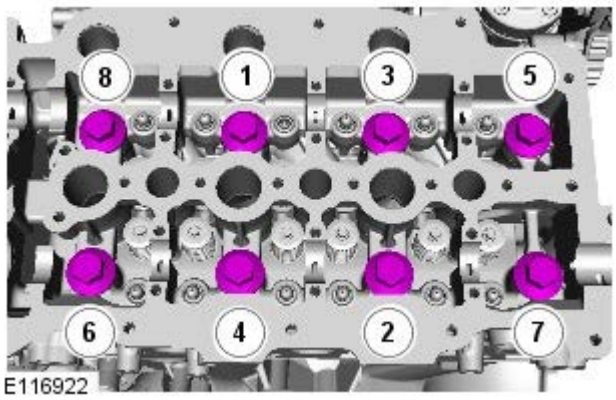
   Install a new gasket.

   No additional lubrication to the cylinder head bolts is required.



3. NOTE: Tighten the bolts in the indicated sequence.

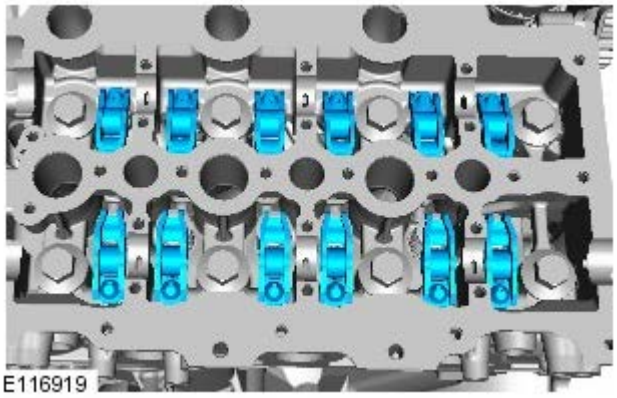
   - *Torque:* 80 Nm

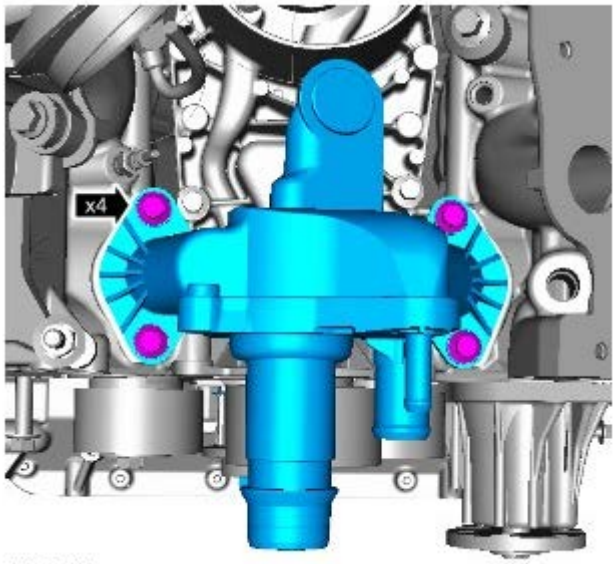


4. NOTE: Tighten the bolts in the indicated sequence.

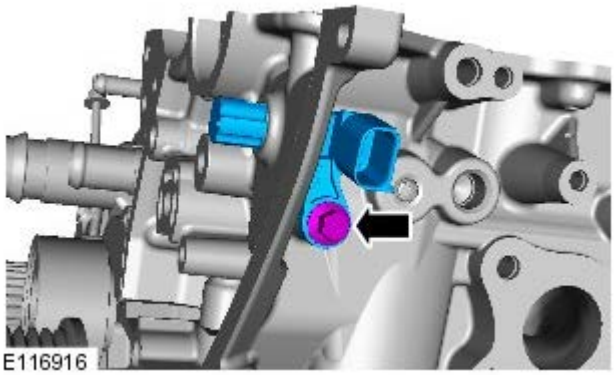
   - *Torque:* 180°

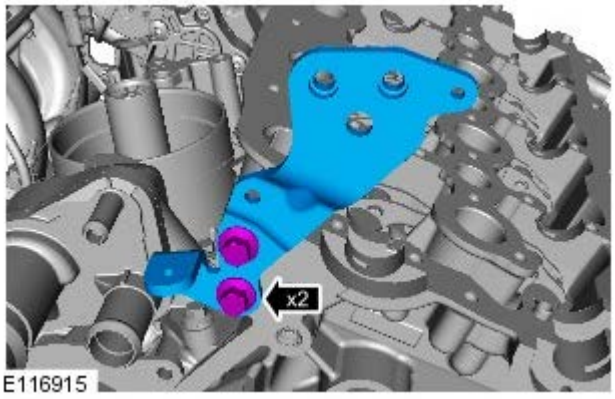
5. .


E116919



E116917


E116916



E116915

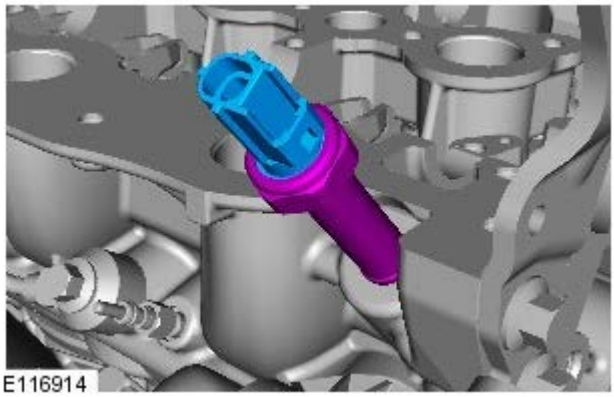
6. CAUTION: Install the new seals.

   Torque: 10 Nm

7. *Torque:* 10 Nm

8. *Torque:* 24 Nm

9. *Torque:* 14 Nm



10. Refer to: Exhaust Manifold (303-01 Engine - 3.0L V6 - TdV6, Removal and Installation).

11. Refer to: Glow Plugs (303-07 Glow Plug System - 3.0L V6 - TdV6, Removal and Installation).

12. Refer to: Camshaft LH (303-01 Engine - 3.0L V6 - TdV6, Removal and Installation).

13. Connect the battery ground cable.

    Refer to: Specifications (414-00 Charging System - General Information, Specifications).

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Engine Mount LH

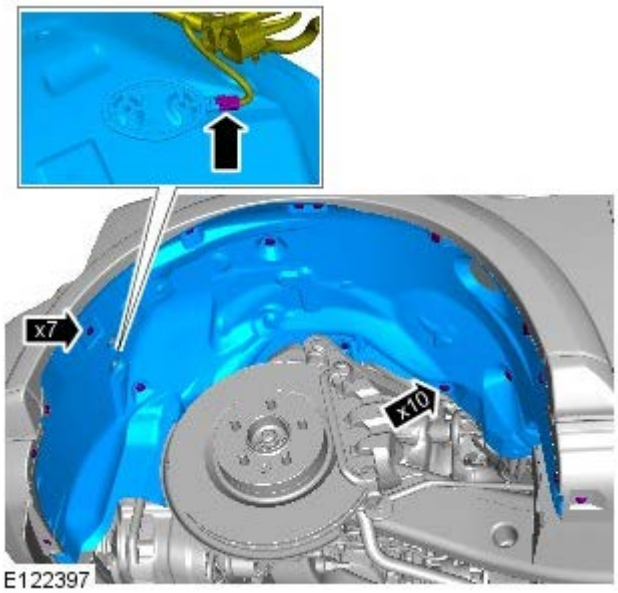
Removal and Installation

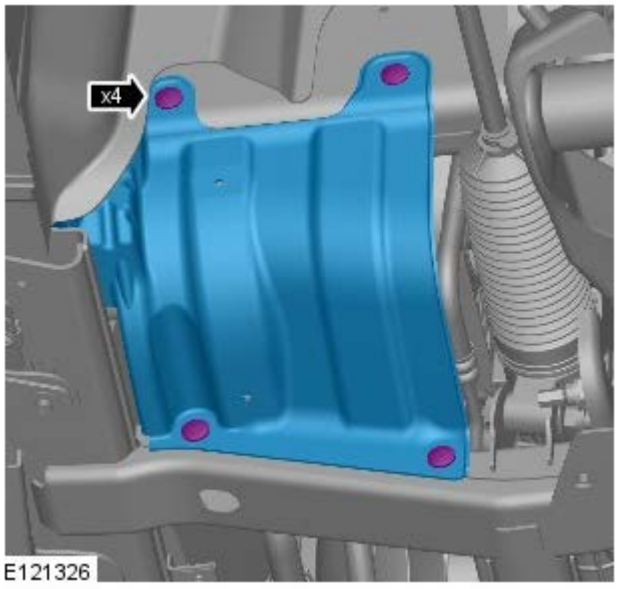
Removal

NOTE: Removal steps in this procedure may contain installation details.

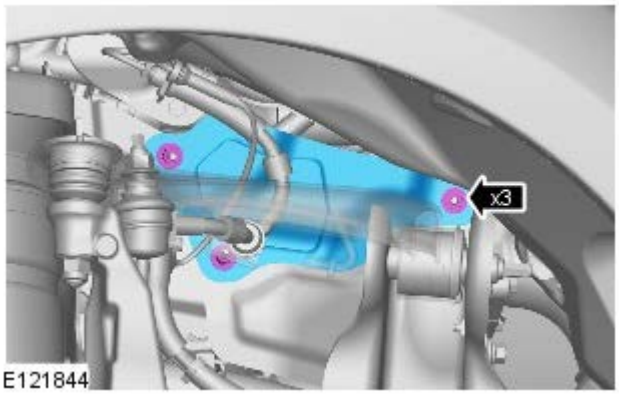
1. Refer to: Cooling Fan Shroud (303-03, Removal and Installation).
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.
3. Refer to: Catalytic Converter (309-00, Removal and Installation).
4. Remove the LH front wheel and tire.

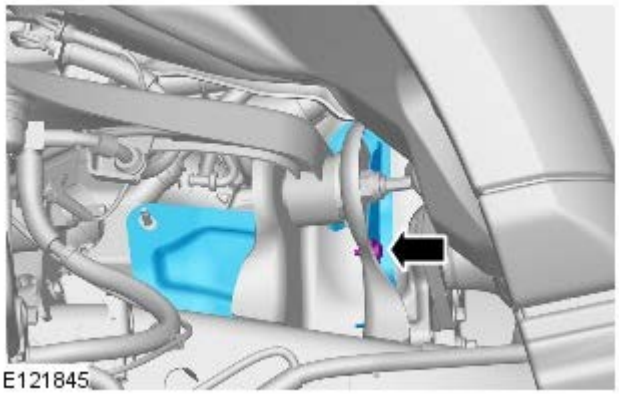
   Torque: 140 Nm
5. 

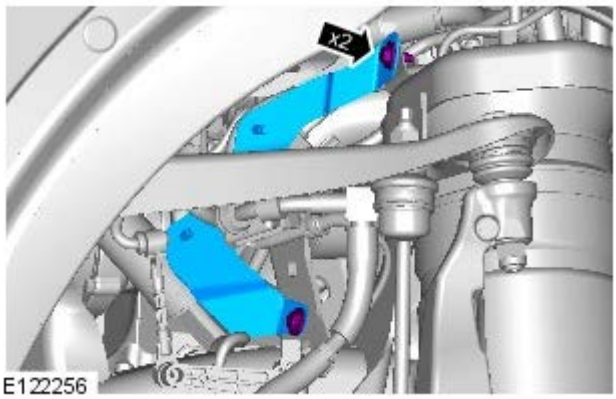
6. 

7. *Torque:* 9 Nm



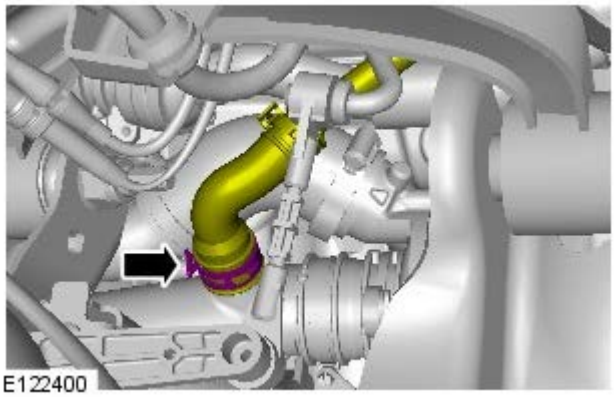
8. *Torque:* 9 Nm





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

   Torque: 9 Nm

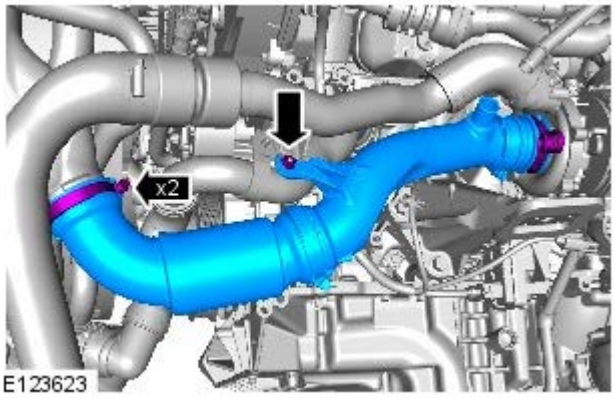


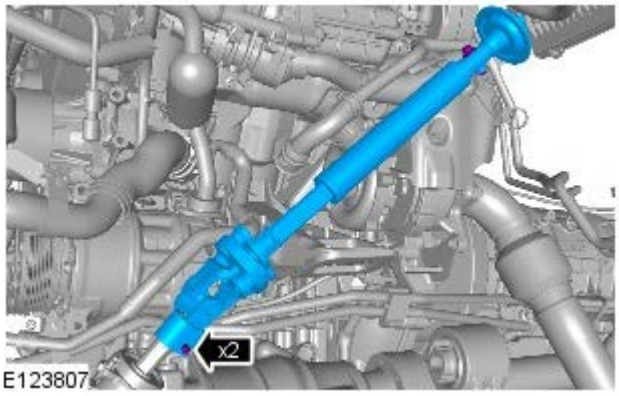
10. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

11. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

    NOTE: Engine shown removed for clarity.

    Torque: 10 Nm

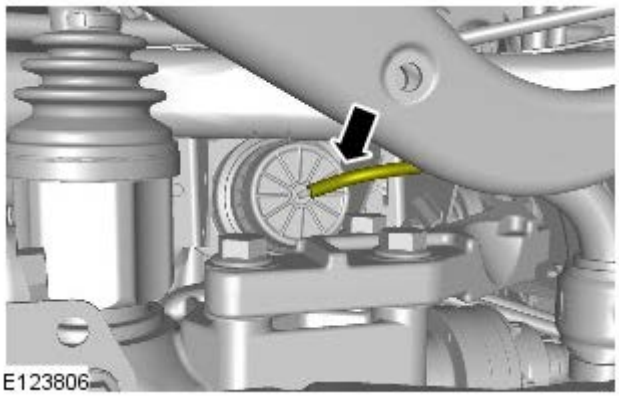




12. CAUTION: Make sure that new bolts are installed.

NOTE: Engine shown removed for clarity.

Torque: 30 Nm



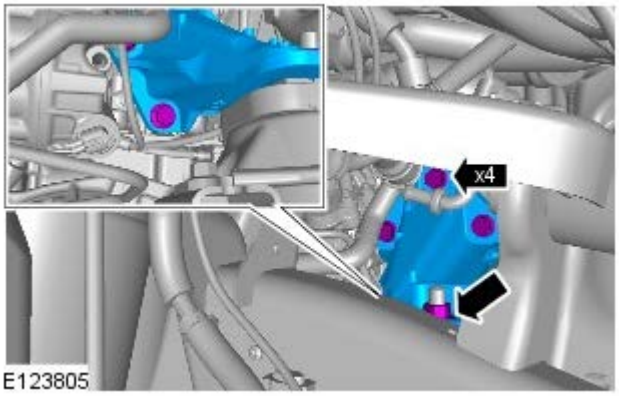
13. CAUTION: Make sure that all openings are sealed.

14. CAUTIONS:

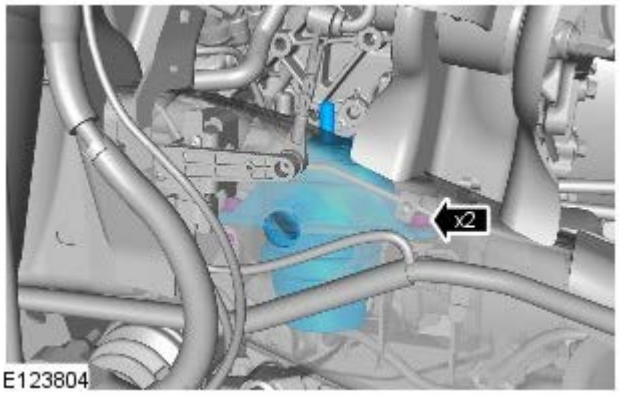
Use a wooden block to protect the oil pan when supporting the engine.

Protect the radiator during this operation.

Using a suitable hydraulic jack, raise and support the engine.



15. *Torque:*
Bolts 115 Nm
nut 90 Nm



16. *Torque:*
    Stage 1:45 Nm
    Stage 2:60°

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Engine Mount RH

Removal and Installation

Removal

NOTES:

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

Removal steps in this procedure may contain installation details.

1. Disconnect both battery cables.

   Refer to: Specifications (414-00, Specifications).

2. Refer to: Exhaust System (309-00, Removal and Installation).

3. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

4. Refer to: Generator (414-02, Removal and Installation).

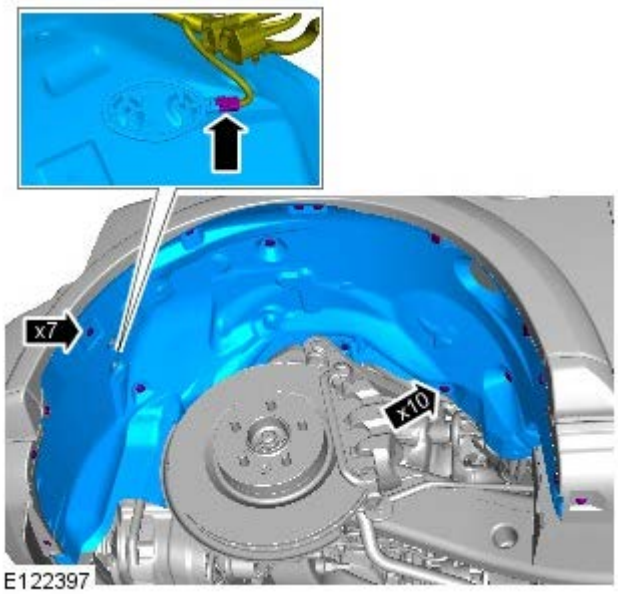
5. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

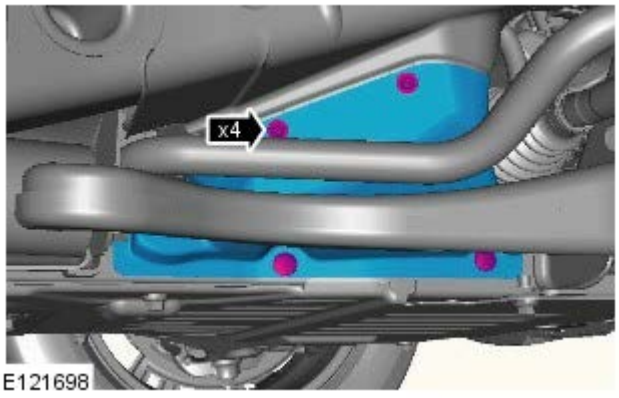
6. Remove the RH front wheel and tire.

   Torque: 140 Nm

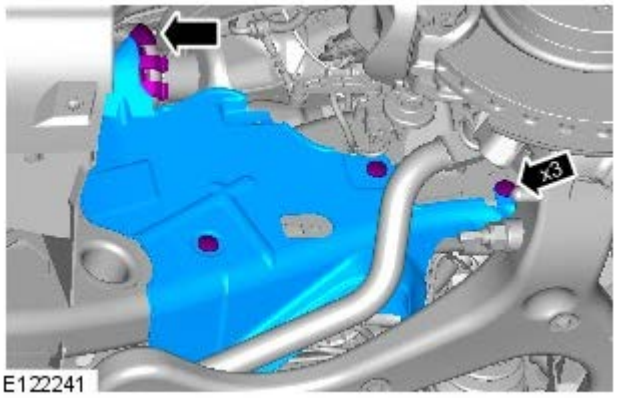
7.



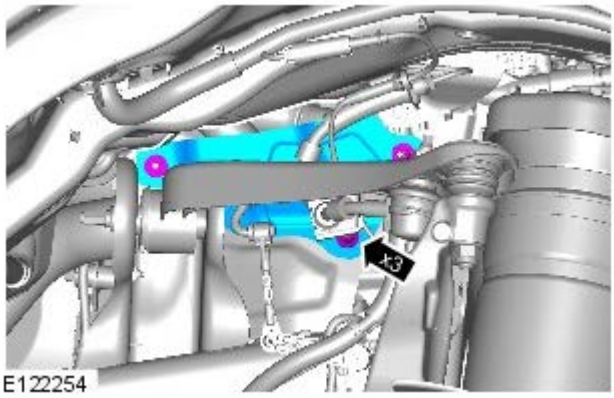
8.



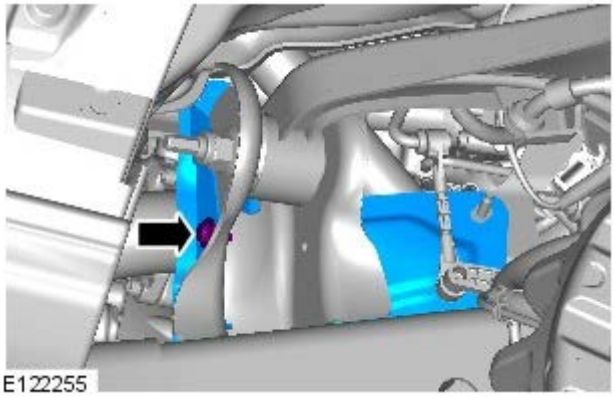
9.



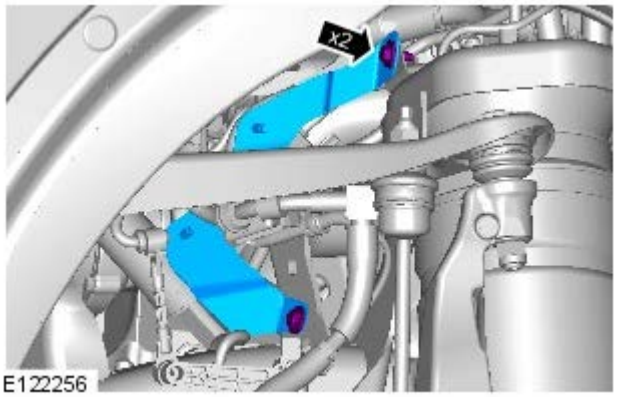
10. *Torque:* 9 Nm



11. *Torque:* 9 Nm

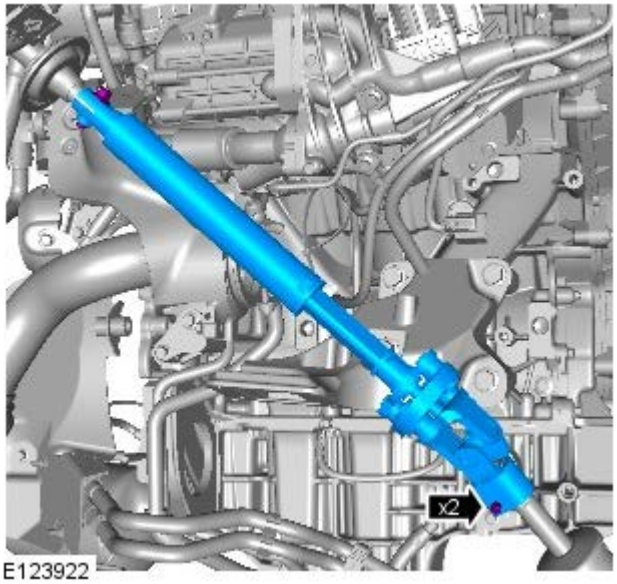


12. *Torque:* 9 Nm



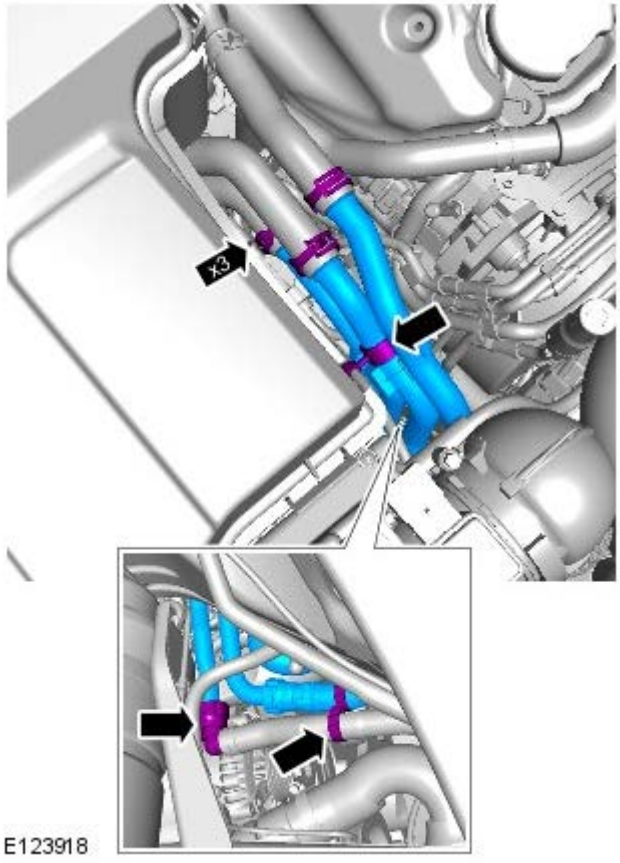
13. NOTE: Engine shown removed for clarity.

Torque: 30 Nm



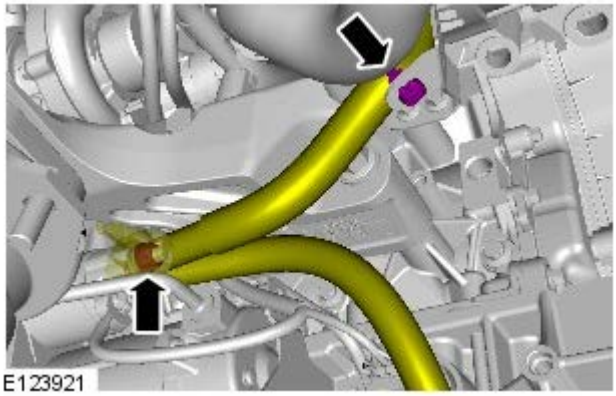
E123922

14.

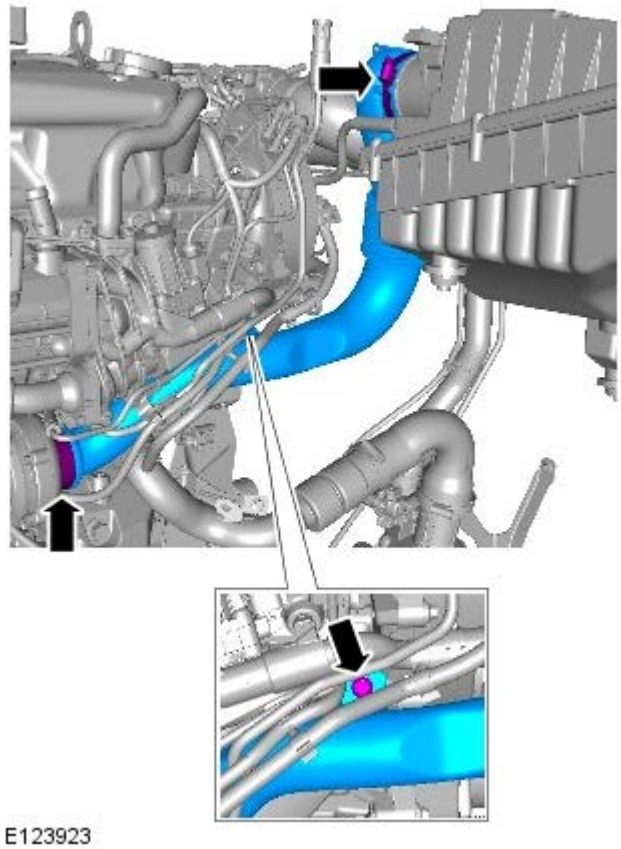


E123918

15. *Torque:* 10 Nm


E123921

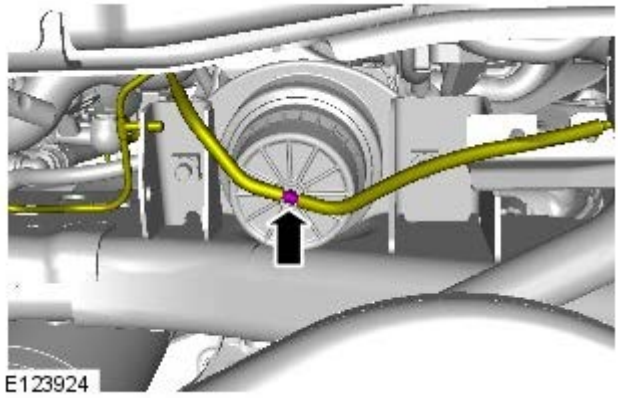
16. NOTE: Engine shown removed for clarity.



E123923

Torque: 10 Nm

17.



E123924

18. CAUTIONS:

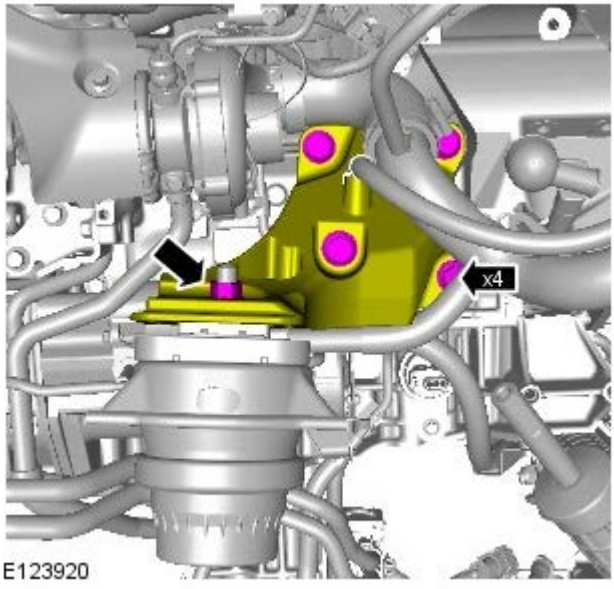
Use a wooden block to protect the oil pan when supporting the engine.

Protect the radiator during this operation.

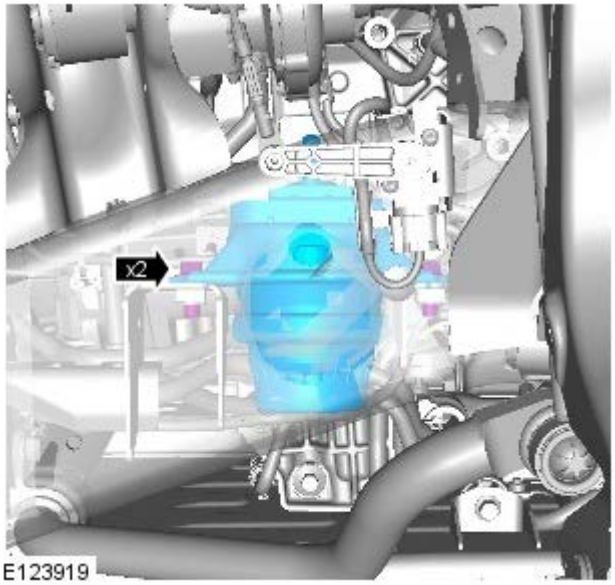
Using a suitable hydraulic jack, raise and support the engine.

19. NOTE: Engine shown removed for clarity.

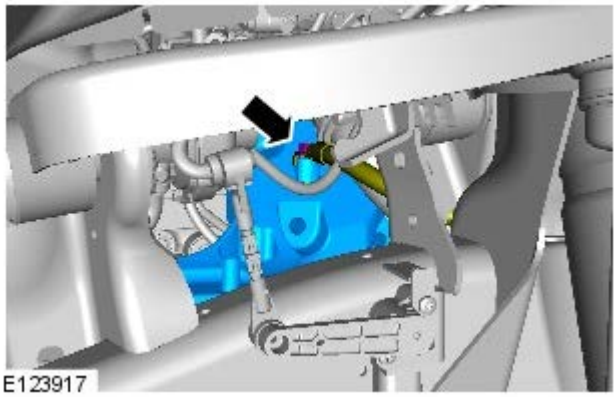
Torque:
Bolts 115 Nm
nut 90 Nm



20. *Torque:* 45 Nm



21. *Torque:* 10 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Exhaust Manifold

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

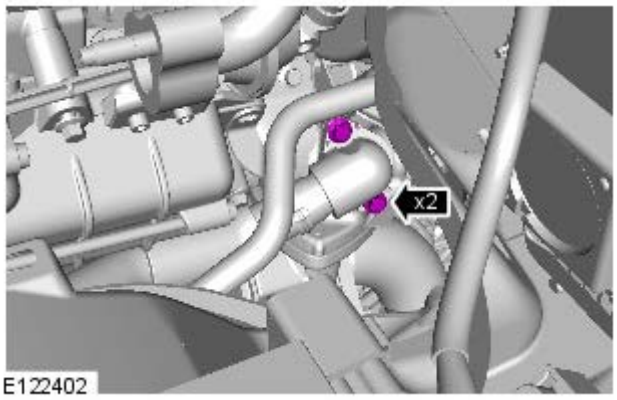
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

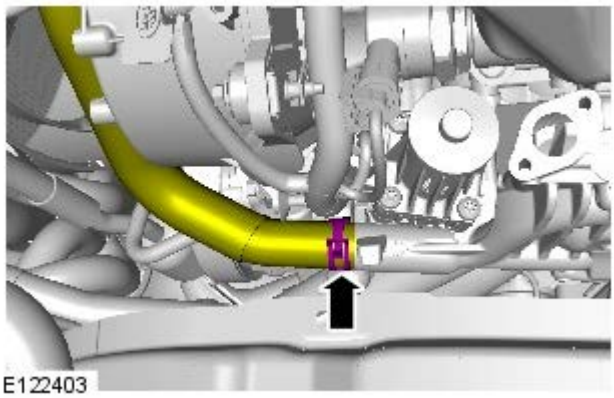
2. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

3. Refer to: Turbocharger LH (303-04, Removal and Installation).

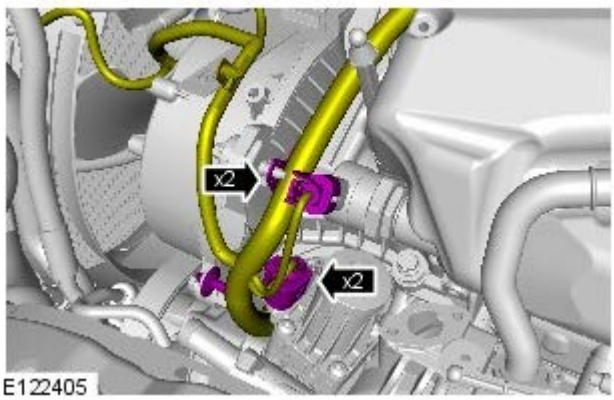
4.



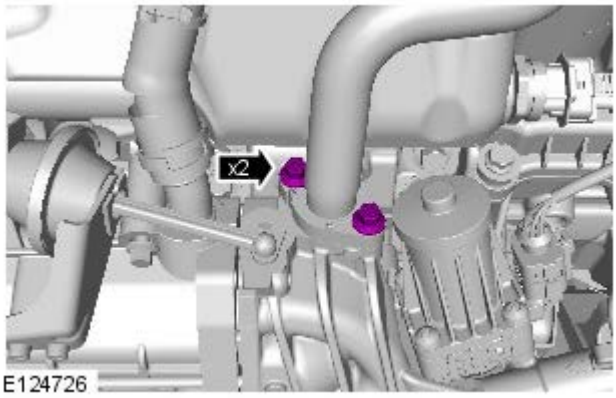
5.



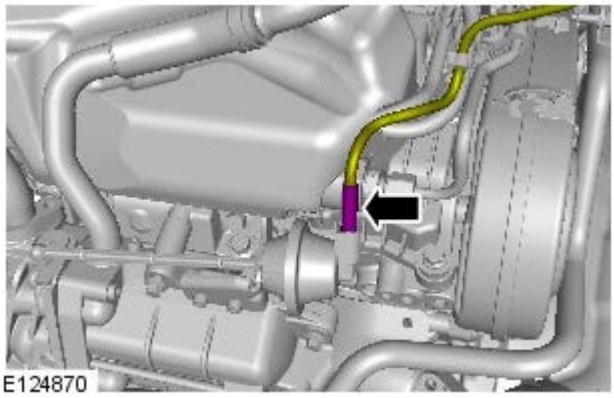
6.



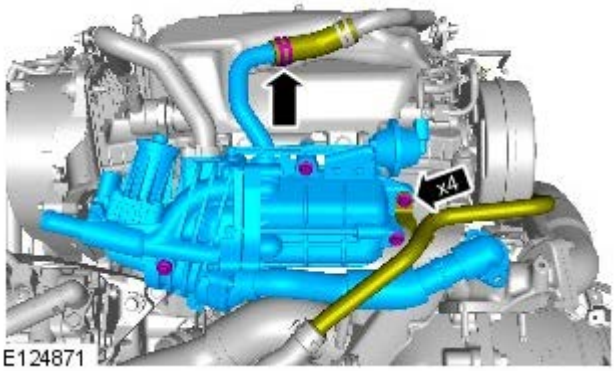
7. NOTE: RH illustration shown, LH is similar.



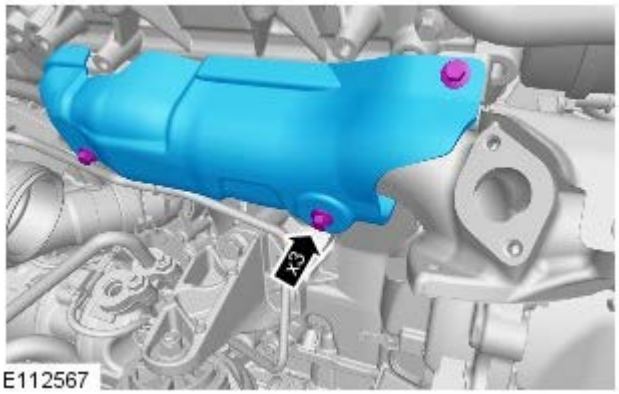
8.



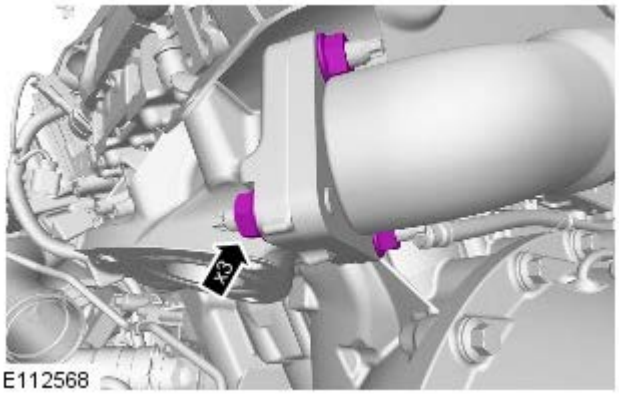
9. NOTE: Remove and discard the gasket.

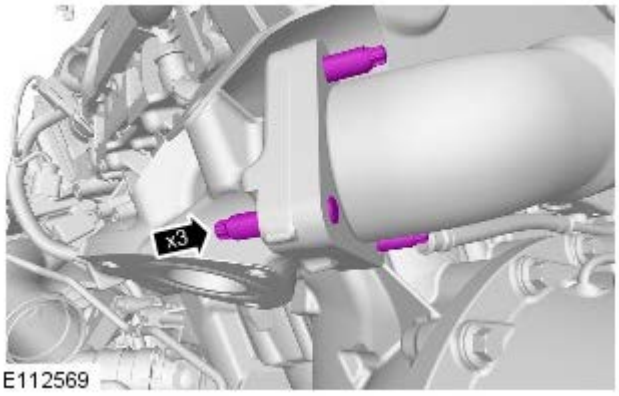


10.

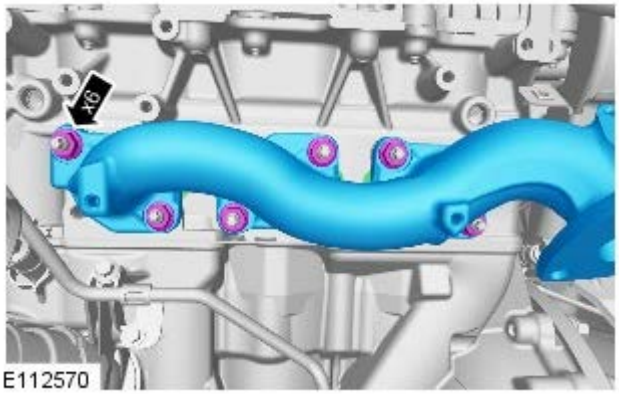


11. CAUTION: Discard the nuts.





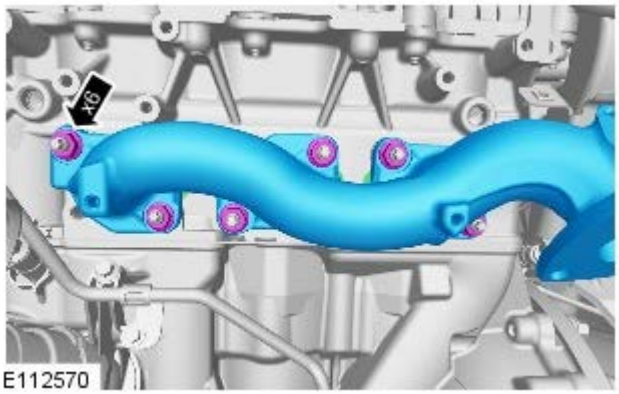
12. CAUTION: Discard the studs.



13. CAUTION: Discard the nuts.

NOTE: Discard the gasket.

Installation



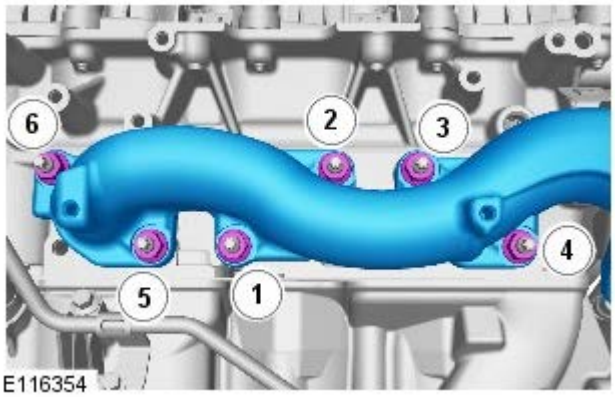
1. WARNING: Make sure that new nuts are installed.

CAUTION: Install the nuts finger tight before final tightening.

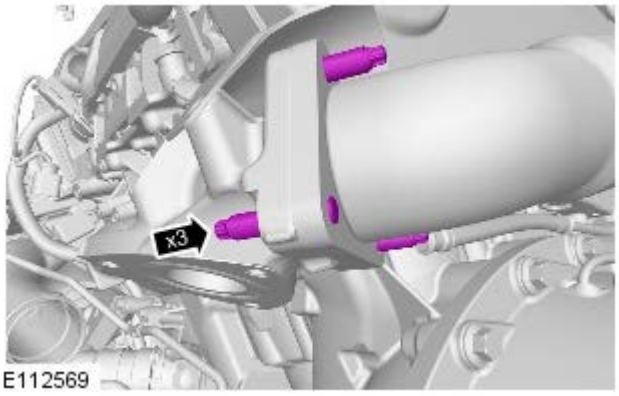
NOTE: Install a new gasket.

2. NOTE: Tighten the bolts in the indicated sequence.

Torque: 28 Nm



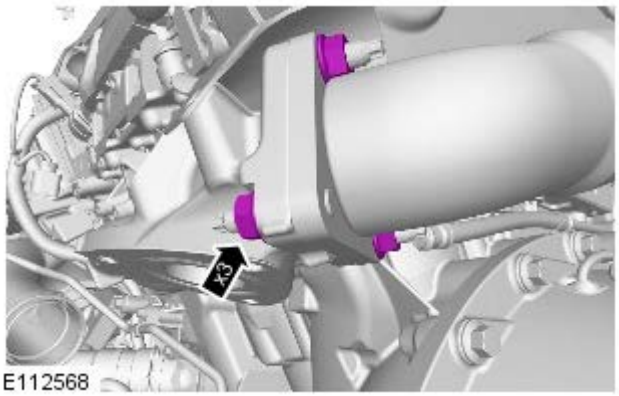
E116354



E112569

3. CAUTION: Install new studs.

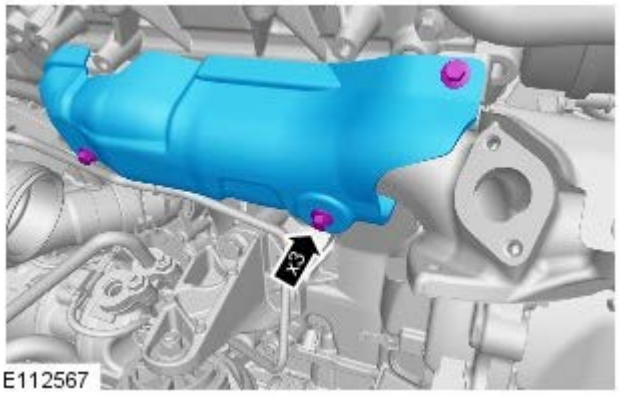
   Torque: 24 Nm



E112568

4. WARNING: Make sure that new nuts are installed.

   Torque: 24 Nm

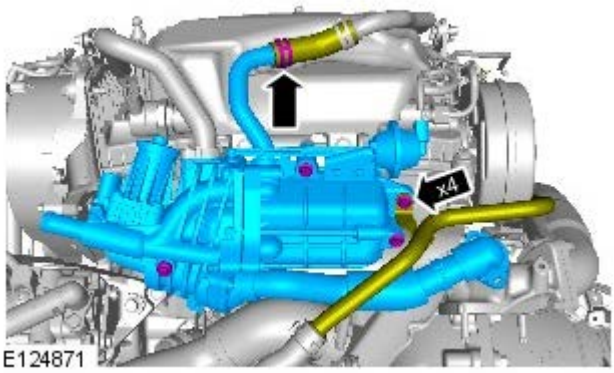


E112567

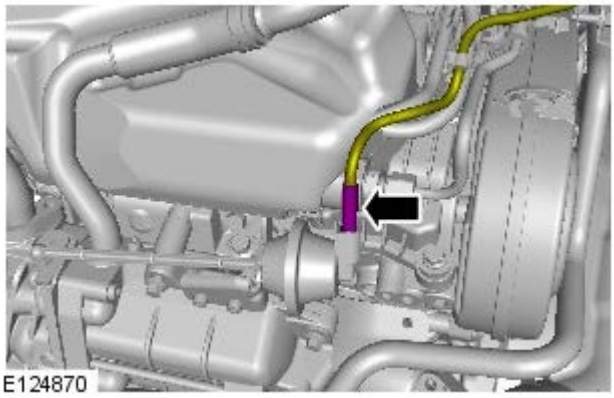
5. *Torque:* 10 Nm

6. NOTE: Install new gaskets.

   Torque: 10 Nm

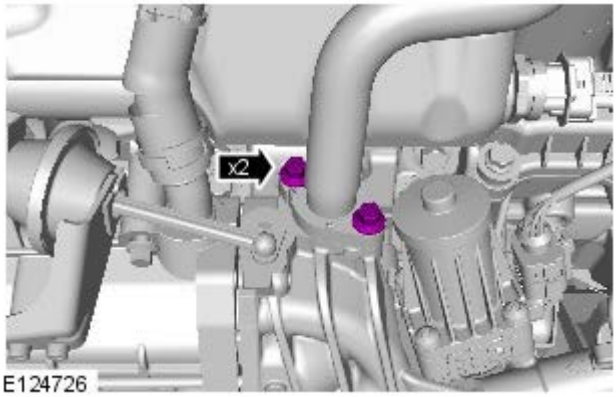


7.

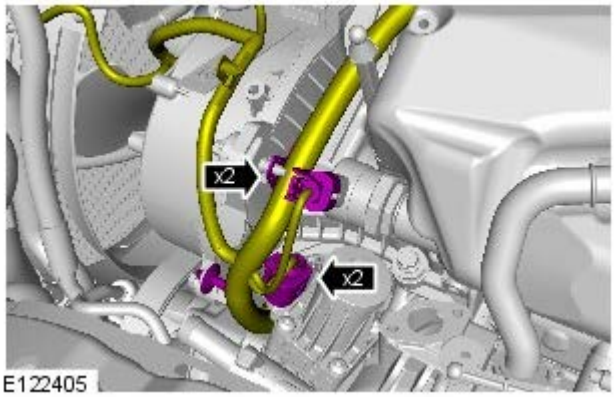


8. NOTE: RH illustration shown, LH is similar.

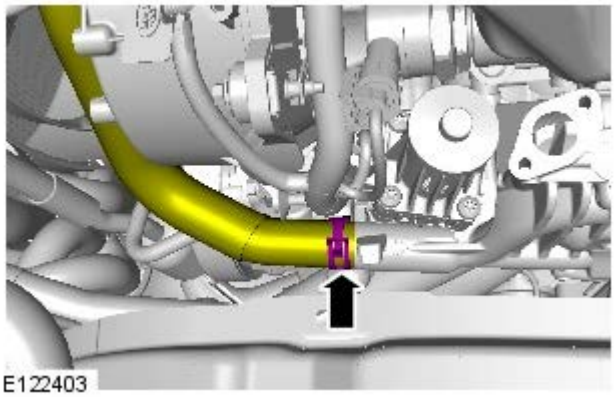
Torque: 10 Nm



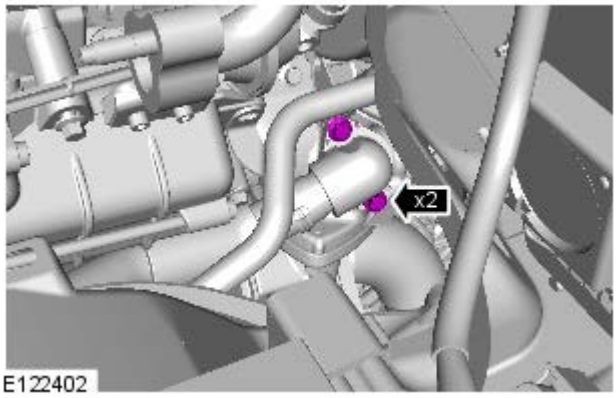
9.



10.



11. *Torque:* 10 Nm



12. Refer to: Turbocharger LH (303-04, Removal and Installation).
13. Connect the battery ground cable.

    Refer to: Specifications (414-00, Specifications).
14. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

Published: 24-May-2013

Engine - TDV6 3.0L Diesel - Exhaust Manifold Crossover Pipe

Removal and Installation

Removal

CAUTION: Take care when handling the cross-over pipe as damage to the insulating material may occur.

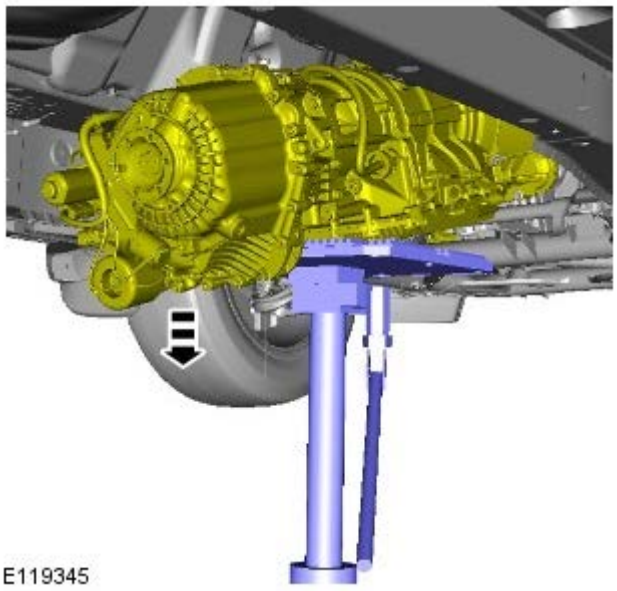
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

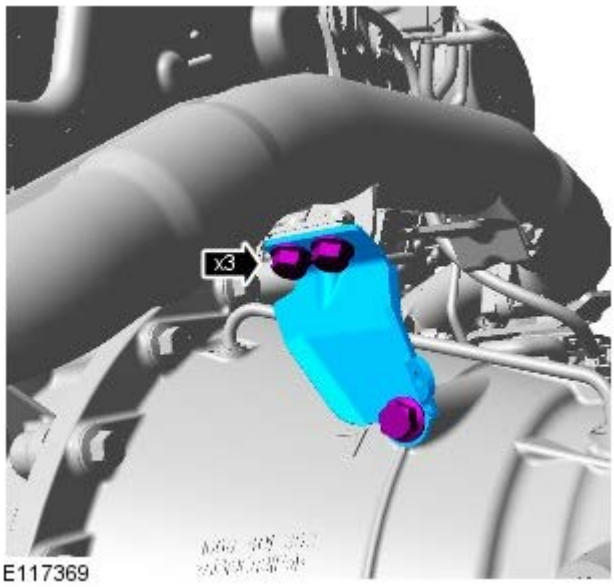
2. Refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

3. Refer to: Exhaust System (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

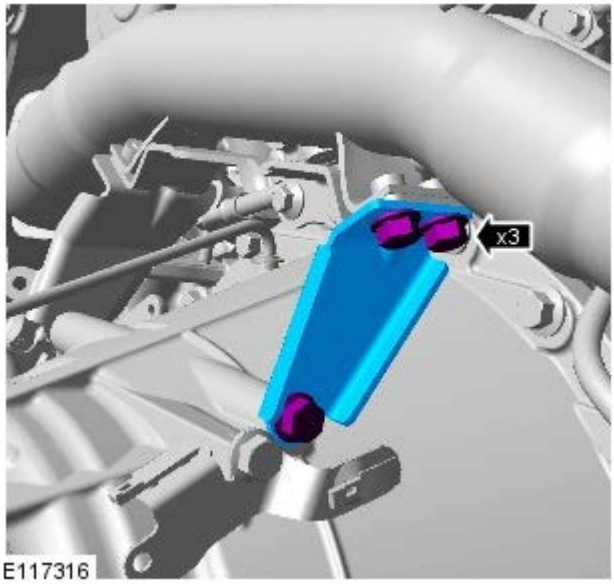
4. NOTE: The transmission is lowered for access.



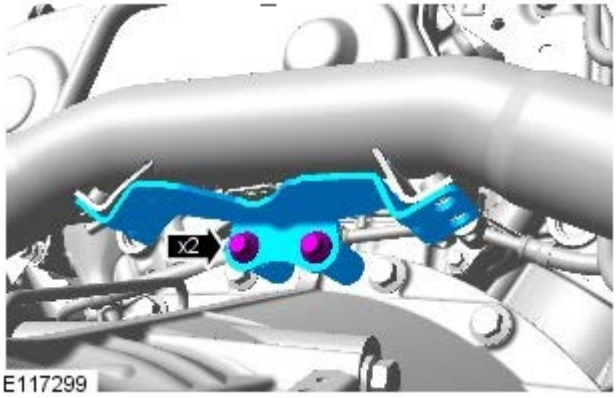
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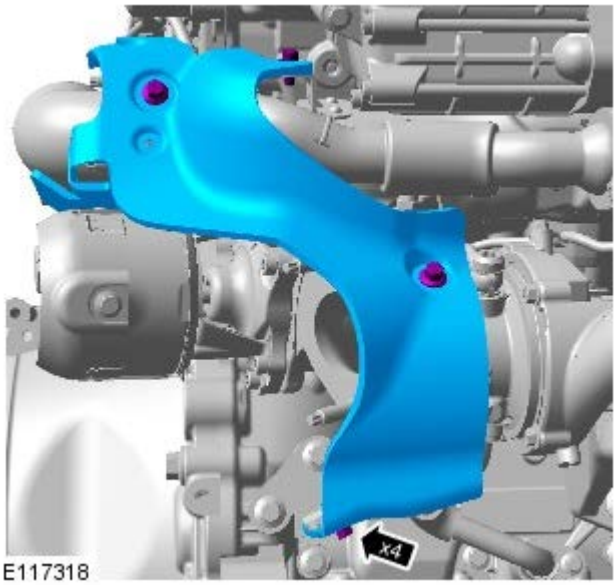
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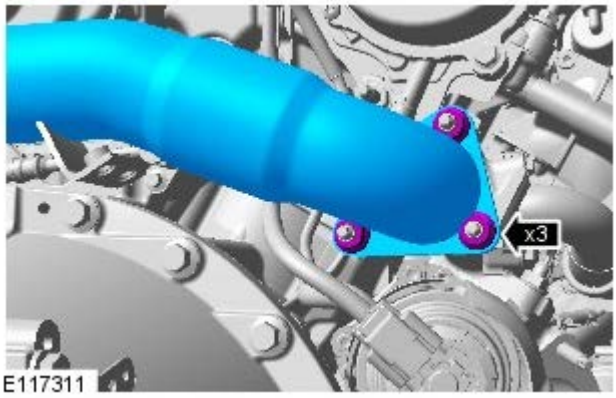
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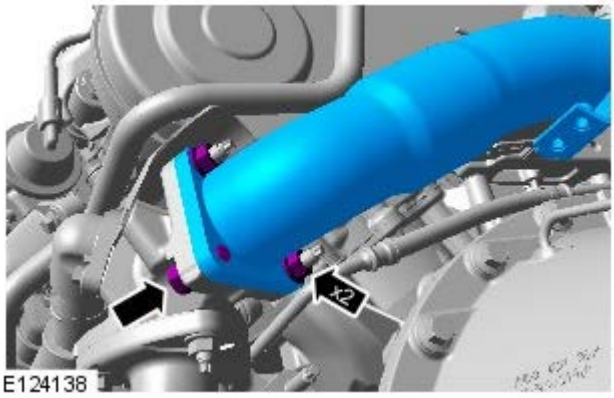
8.



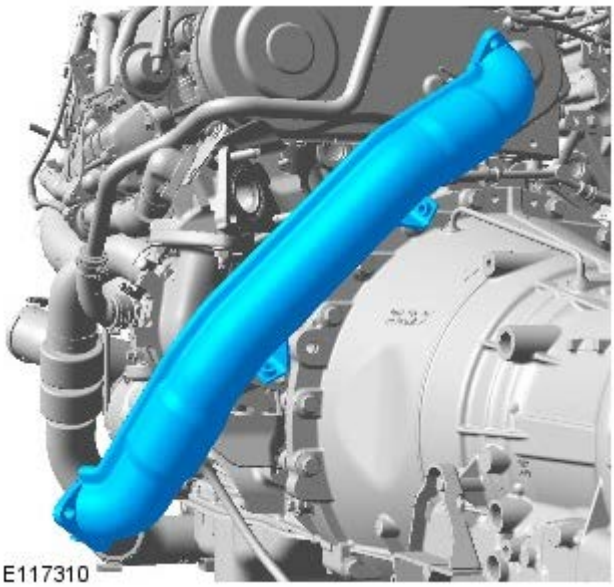
9. CAUTION: Discard the nuts.



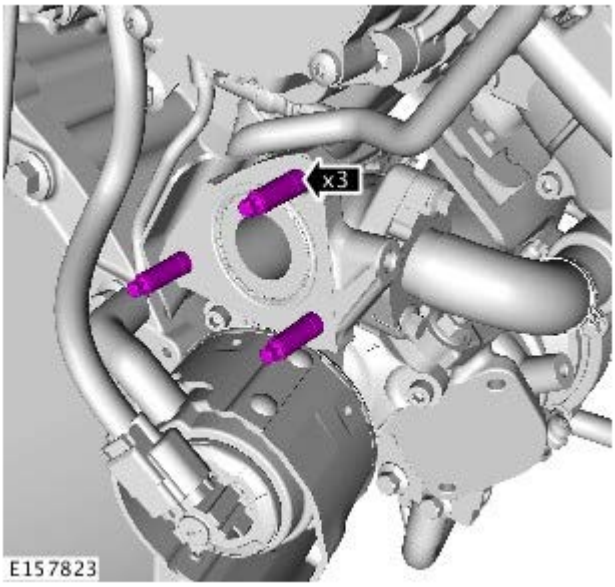
10. CAUTION: Discard the nuts and bolt.



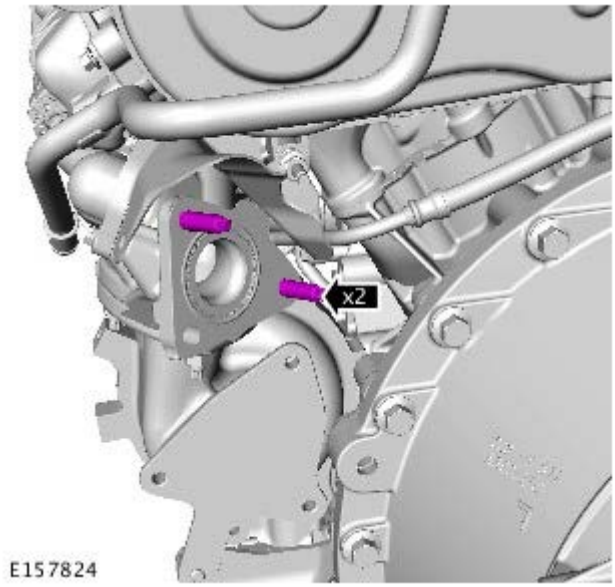
11.



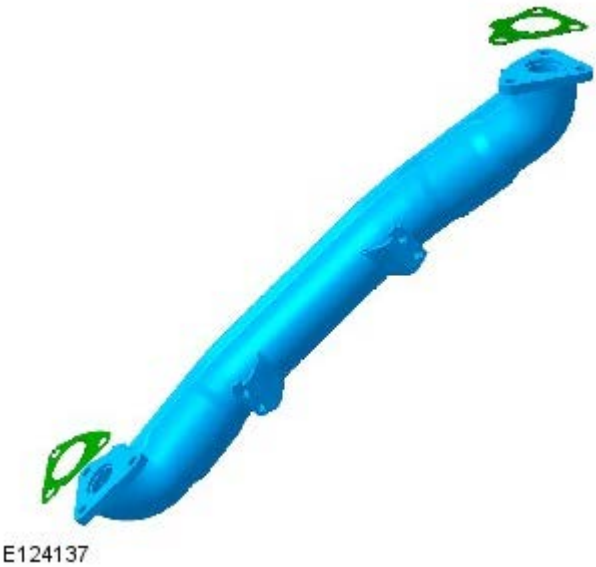
12. CAUTION: Discard the studs.



13. CAUTION: Discard the studs.



14. NOTE: Discard the gasket.

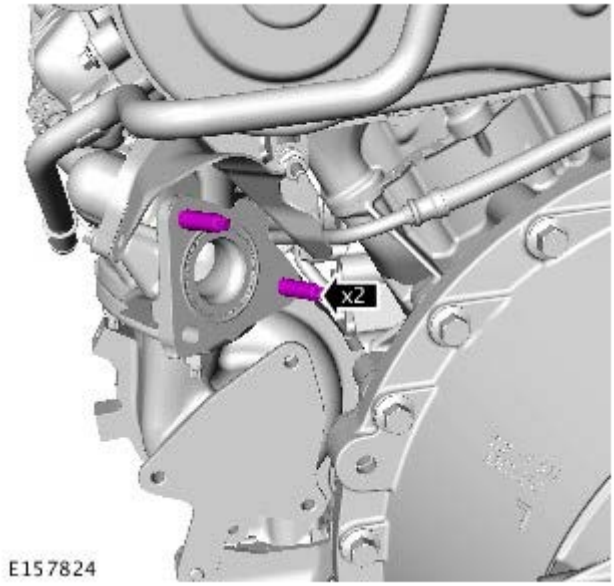


Installation

1. NOTE: Install new gaskets.



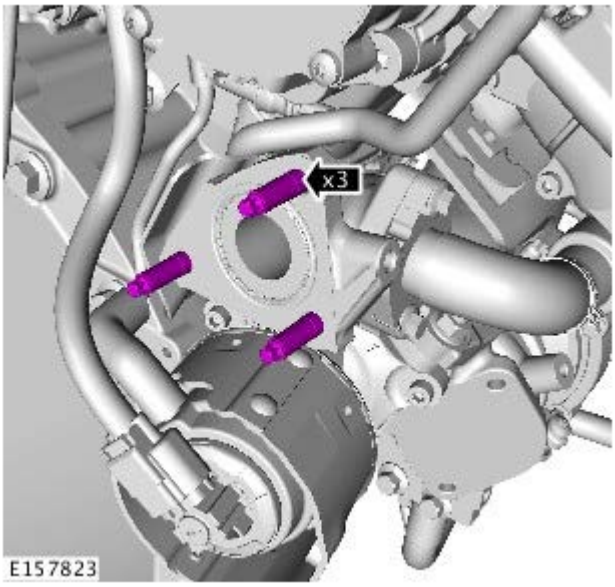
E124137



E157824

2. NOTE: New exhaust manifold retaining studs must be fitted if the old studs are removed.

   Torque: 13 Nm

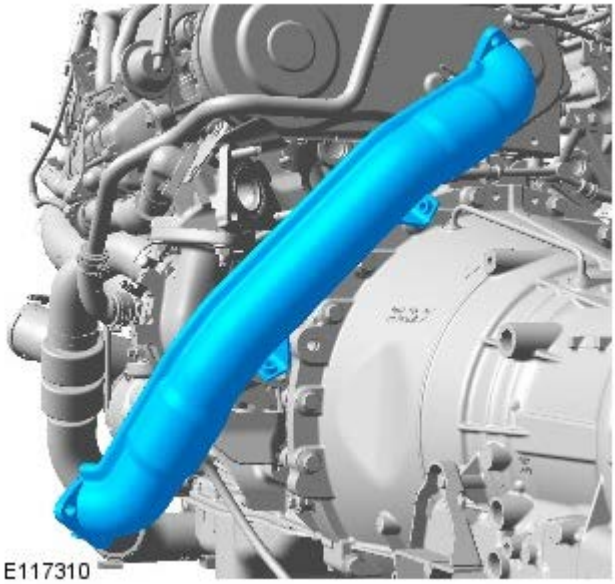


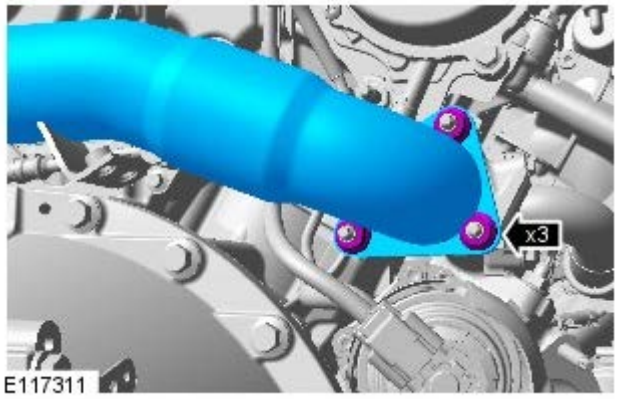
E157823

3. NOTE: New exhaust manifold retaining studs must be fitted if the old studs are removed.

   Torque: 13 Nm

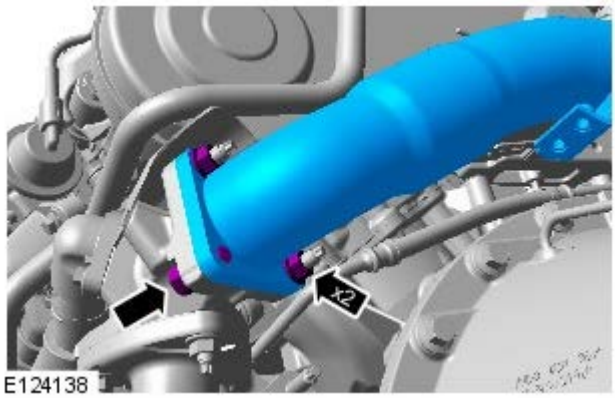
4.





5. WARNING: Make sure that new nuts are installed.

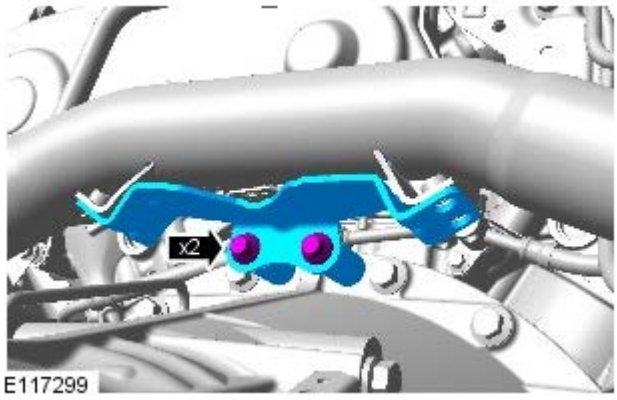
   CAUTION: Only tighten the nuts finger-tight at this stage.



6. CAUTIONS:

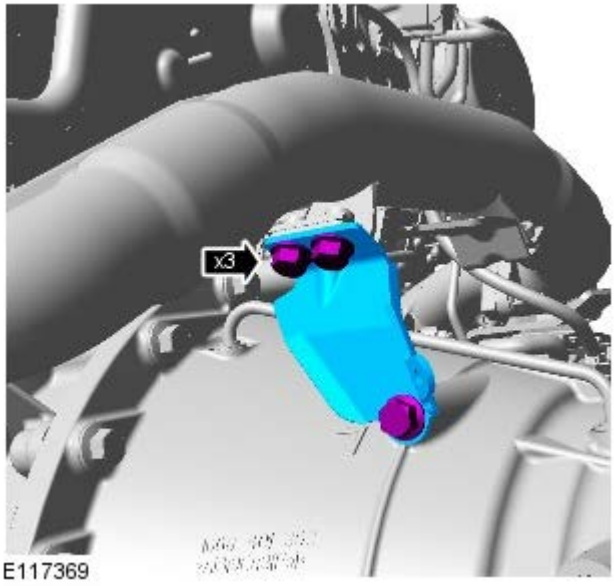
   Only tighten the nuts and bolt finger-tight at this stage.

   Make sure that new nuts and bolt are installed.

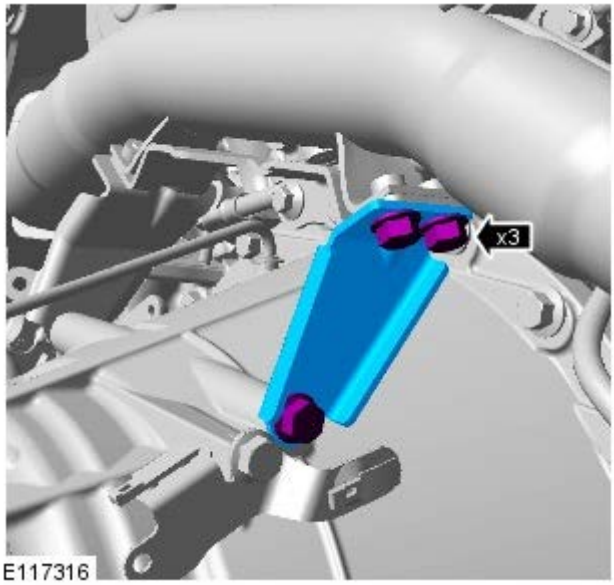


7. CAUTION: Only tighten the bolts finger-tight at this stage.

8. CAUTION: Only tighten the bolts finger-tight at this stage.

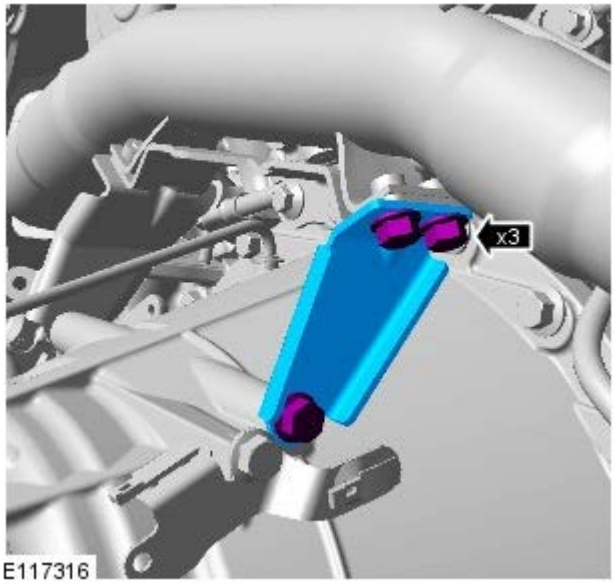


Check for correct alignment.



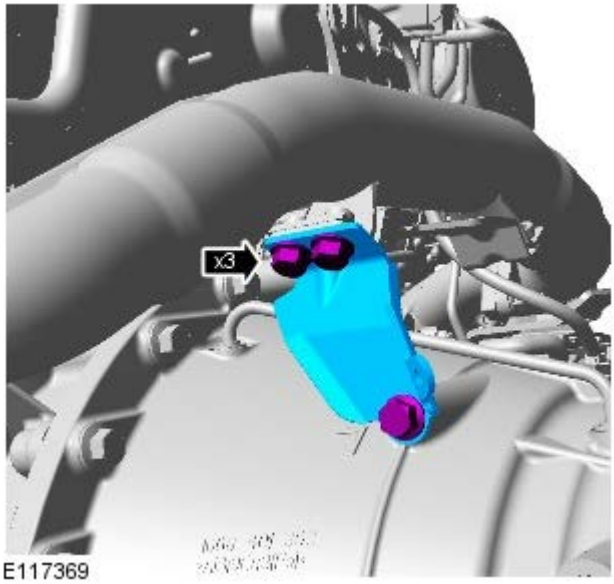
9. CAUTION: Only tighten the bolts finger-tight at this stage.

   Check for correct alignment.

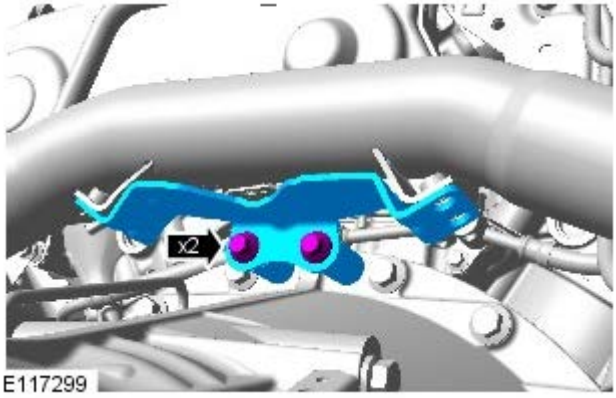


10. Remove the exhaust cross-over pipe RH support bracket.

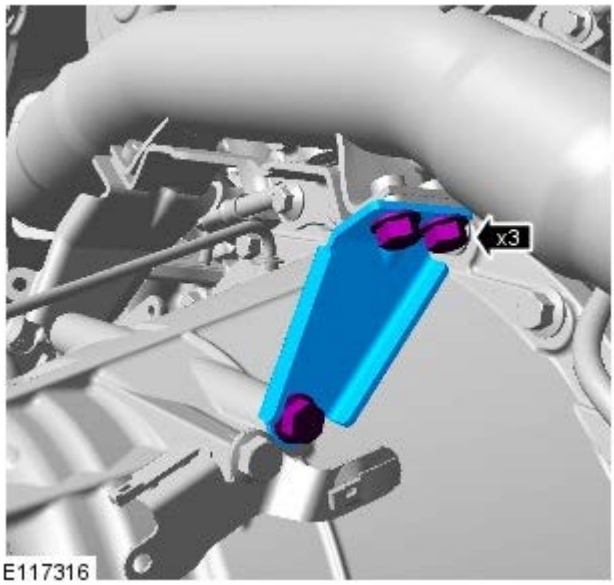
11. Remove the exhaust cross-over pipe LH support bracket.



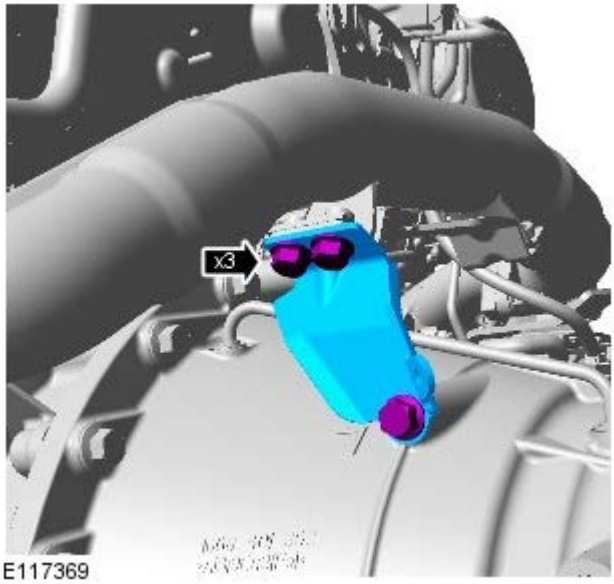
12. *Torque:* 23 Nm



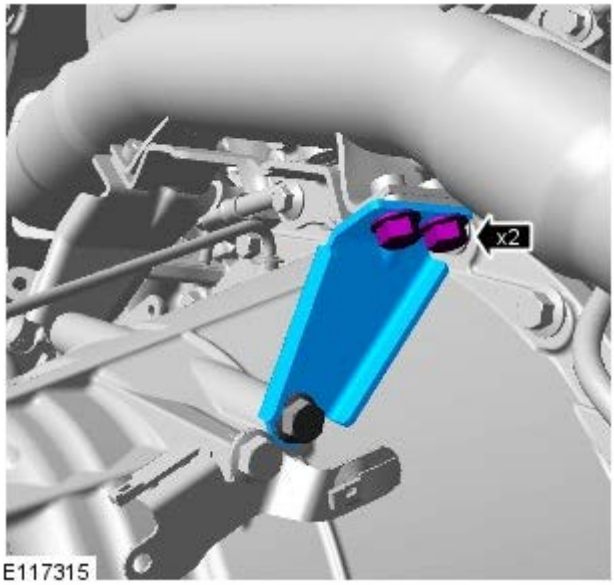
13. CAUTION: Only tighten the bolts finger-tight at this stage.



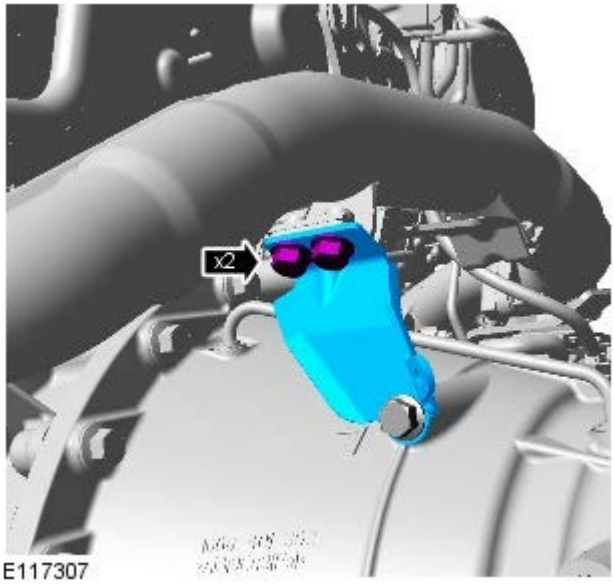
14. CAUTION: Only tighten the bolts finger-tight at this stage.



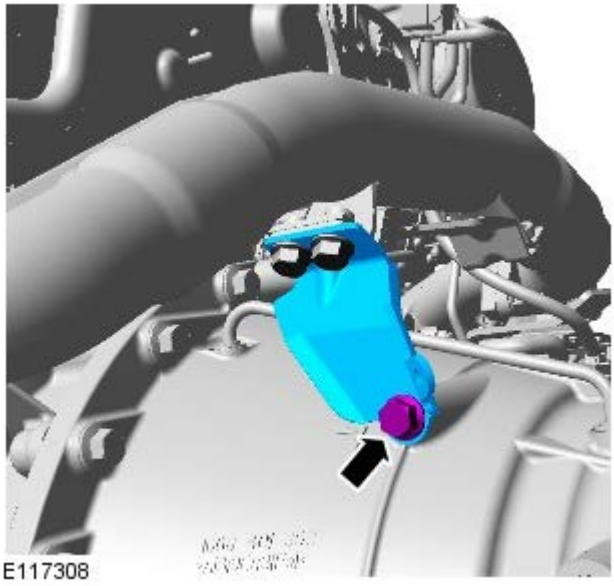
15. *Torque:* 23 Nm



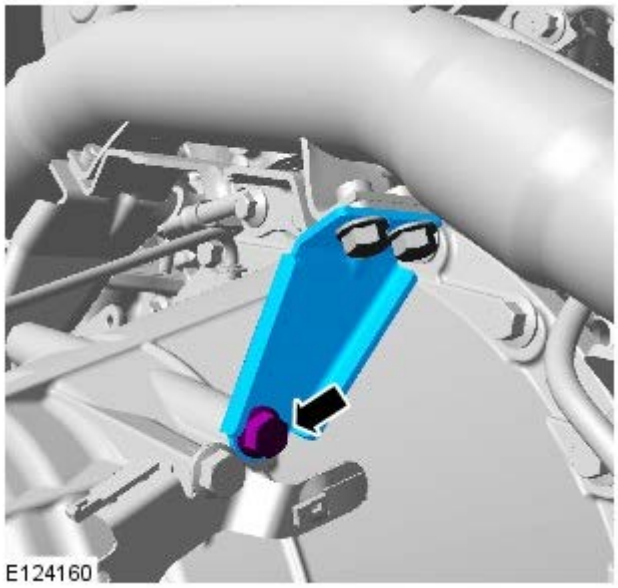
16. *Torque:* 23 Nm



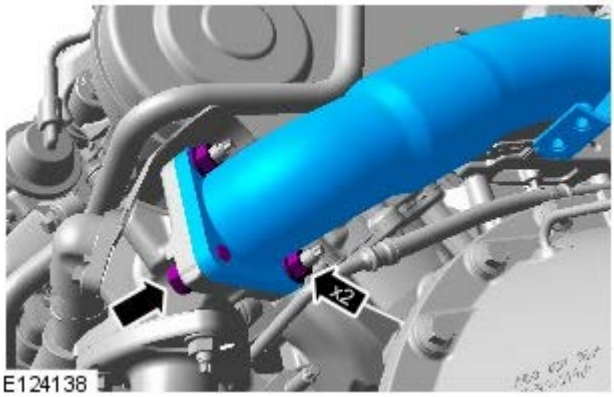
17. *Torque:* 23 Nm



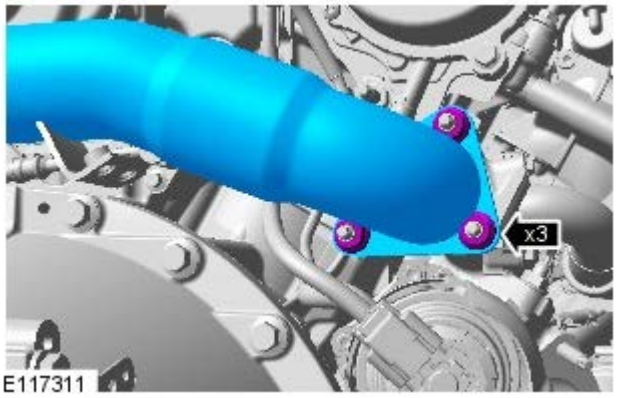
18. *Torque:* 23 Nm



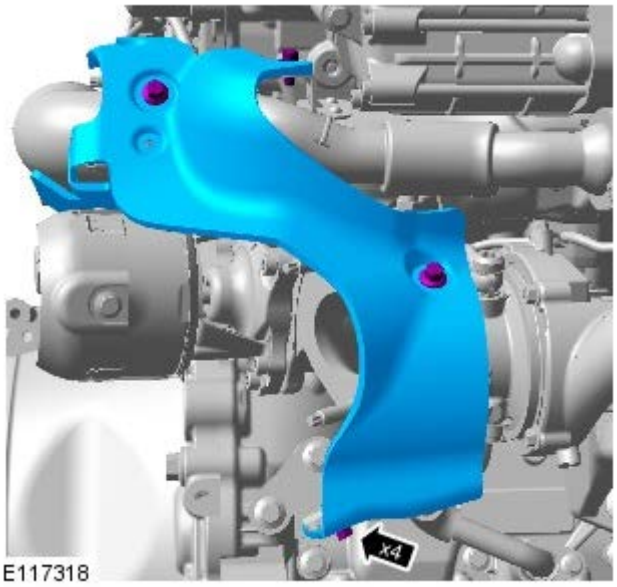
19. *Torque:* 23 Nm



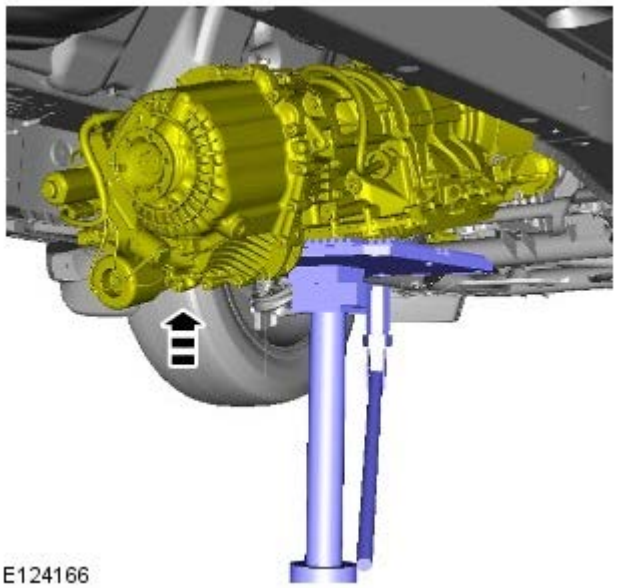
20. *Torque:* 23 Nm



21. *Torque:* 11 Nm



22.



23. Refer to: Exhaust System (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

24. Refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Flexplate

Removal and Installation

Special Tool(s)

	303-1123 Locking Tool, Flywheel

Removal

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

1. Disconnect the battery ground cable.

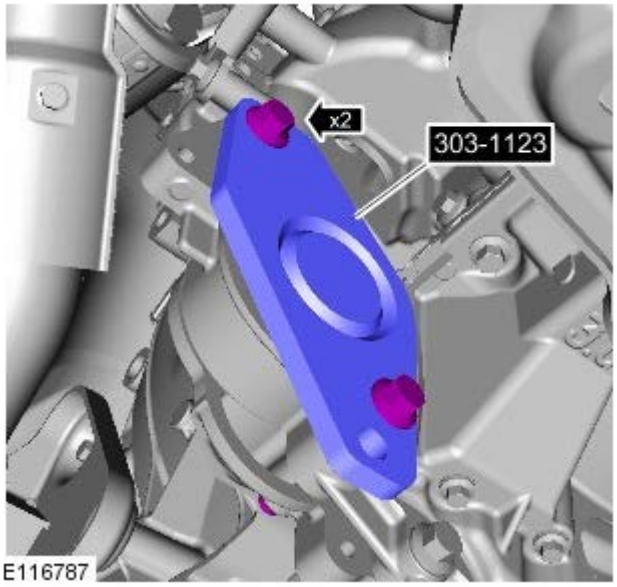
   Refer to: Specifications (414-01, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Starter Motor (303-06B, Removal and Installation).

4. Refer to: Transmission - 3.0L Diesel (307-01D, Removal).



5.
   - Install the special tool.
   - *Special Tool(s):* 303-1123

6. CAUTION: Discard the bolts.

   NOTE: Prevent the flexplate from rotating.



Installation

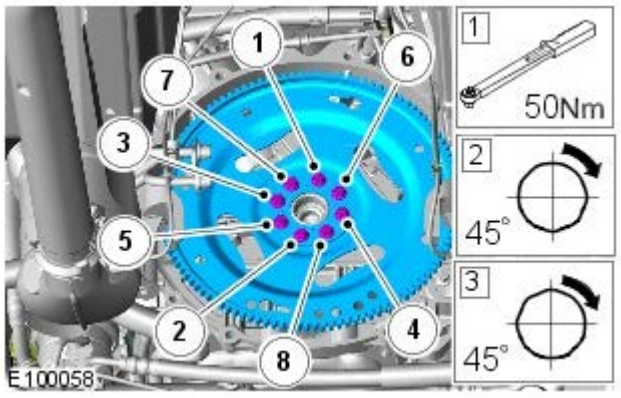
1. CAUTION: Make sure that new bolts are installed.

   NOTES:

   Make sure that all the component mating faces are clean.

   Loosely install all retaining bolts.

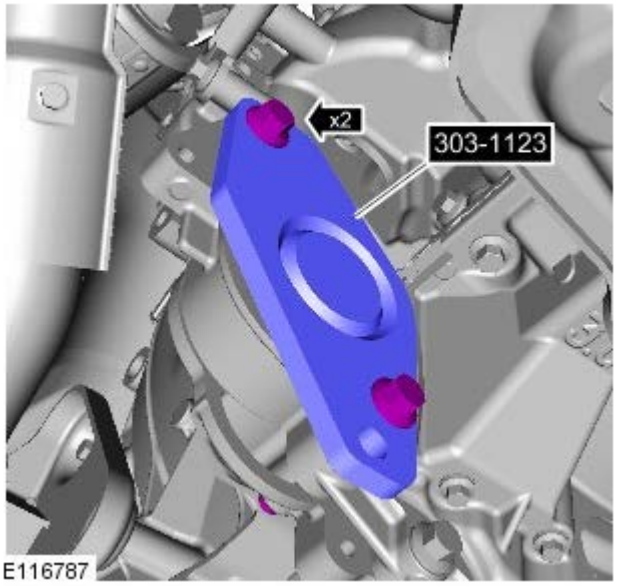
   - Prevent the flexplate from rotating.



2. CAUTION: Tighten the bolts evenly in the stages shown.

   - Stage 1: Tighten to 50 Nm.
   - Stage 2: Tighten to 45 degrees.
   - Stage 3: Tighten to 45 degrees.

3.
   - Remove the special tool.
   - *Special Tool(s):* 303-1123



4. Refer to: Transmission - 3.0L Diesel (307-01D, Installation).
5. Refer to: Starter Motor (303-06B, Removal and Installation).
6. Connect the battery ground cable.

   Refer to: Specifications (414-01, Specifications).

Published: 09-Jan-2012

Engine - TDV6 3.0L Diesel - Oil Cooler

Removal and Installation

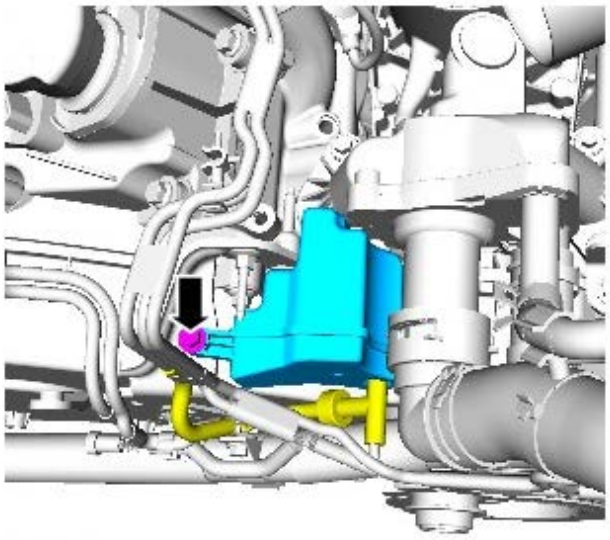
Removal

NOTES:

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

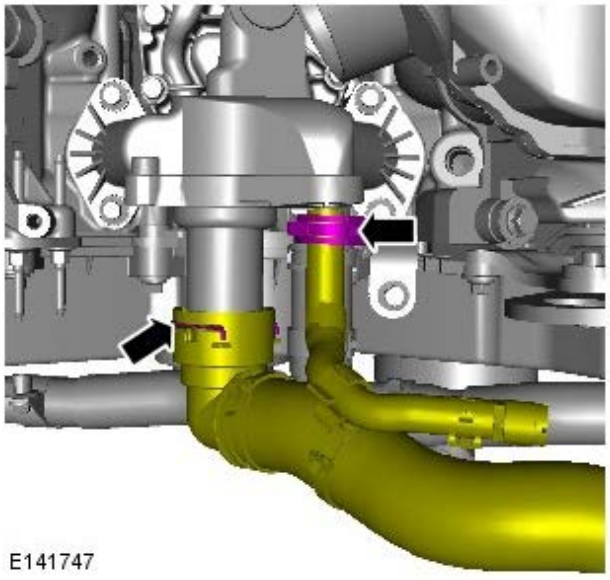
Some illustrations may show the engine removed for clarity.

1. Refer to: Specifications (414-01, Specifications).
2. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
3. Refer to: Glow Plugs (303-07B, Removal and Installation).
4.



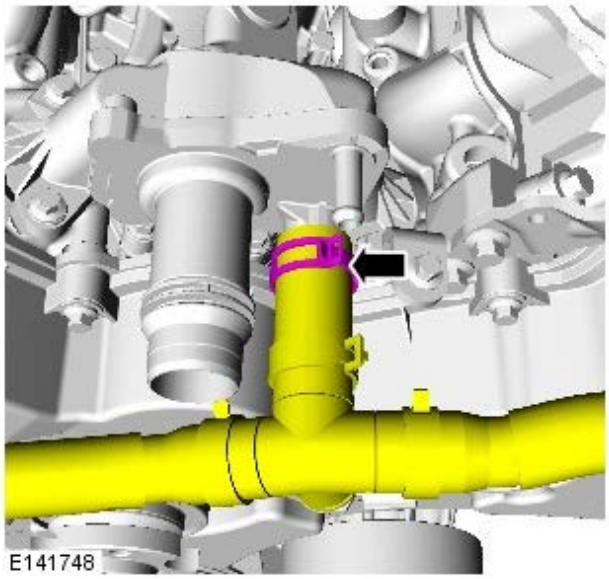
E141746

5.

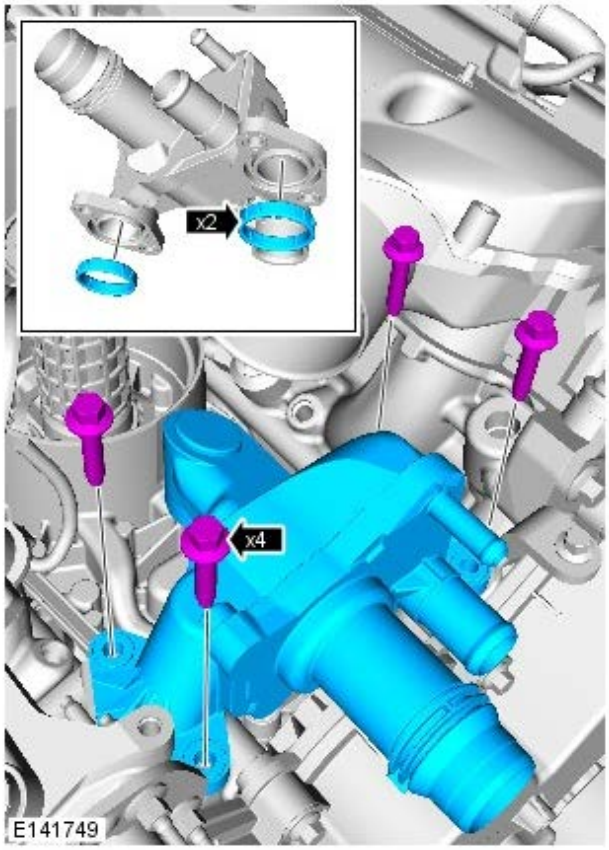


E141747

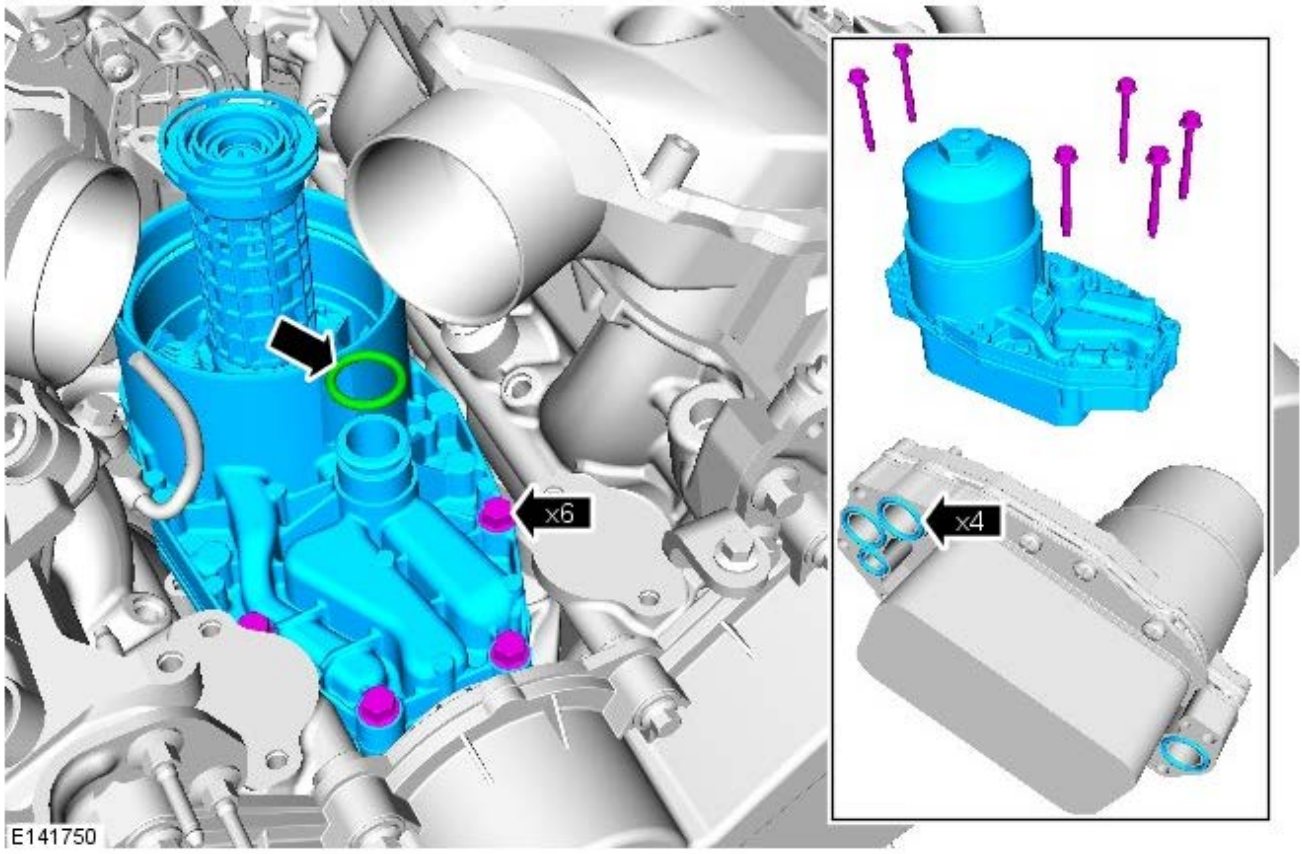
6.



7.



8.



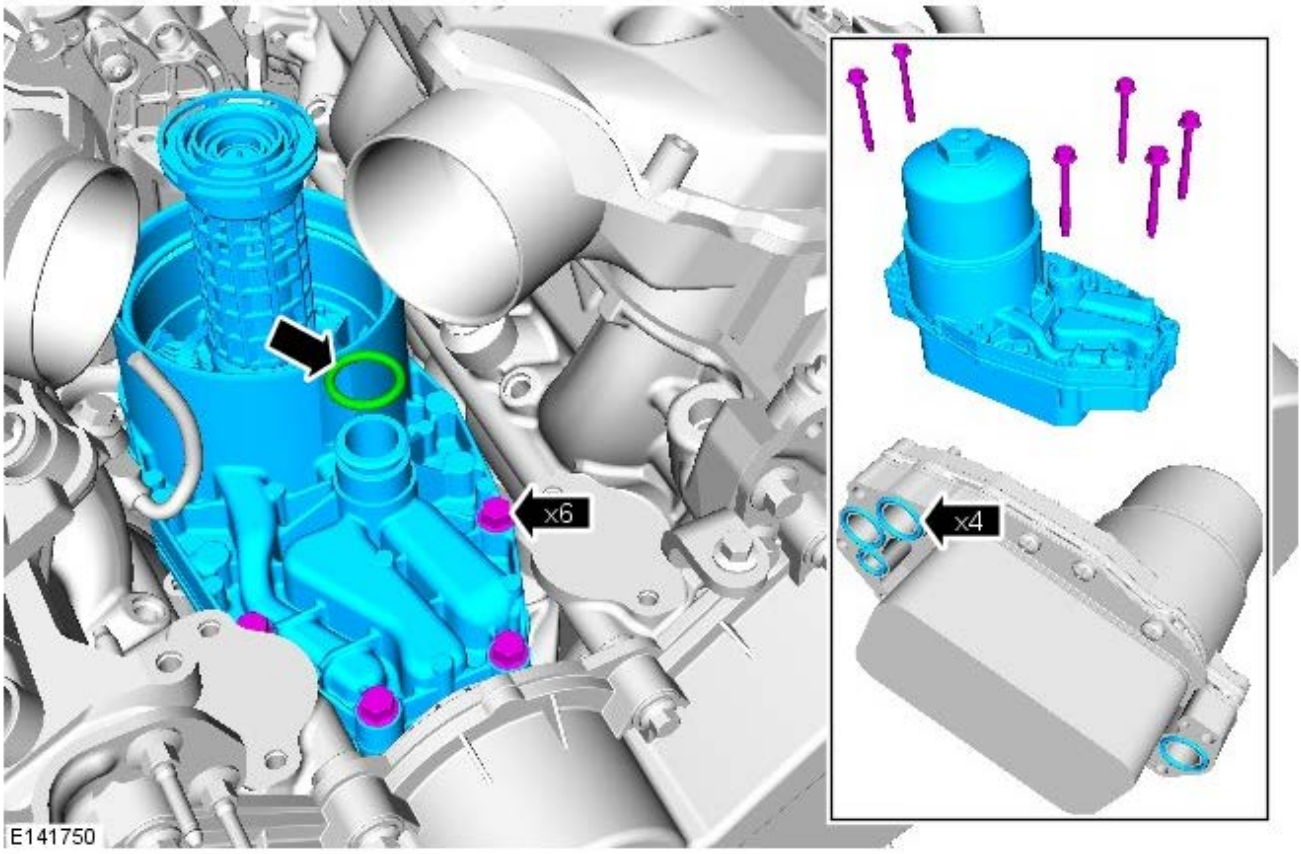
Installation

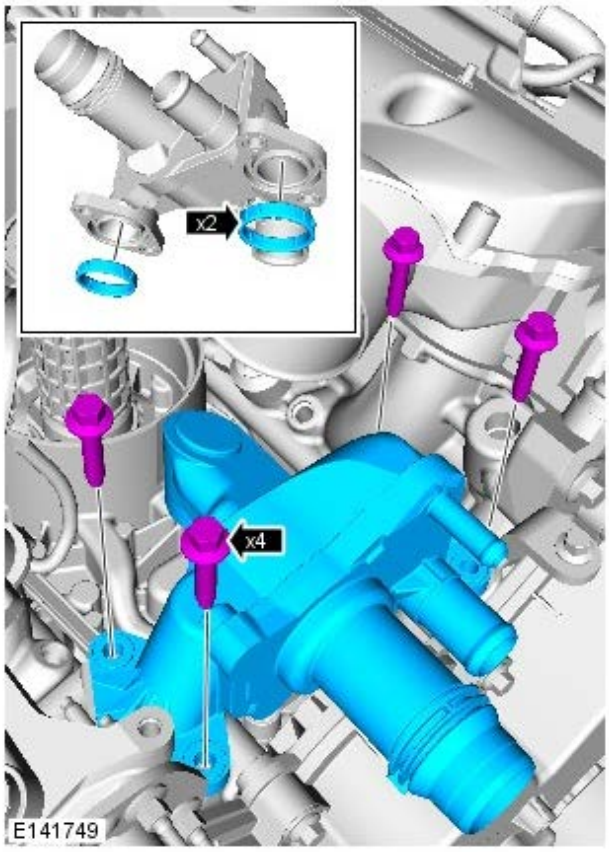
1. CAUTIONS:

   Install new o-ring seals

   Make sure that the mating faces are clean and free of foreign material.

   Torque: 10 Nm





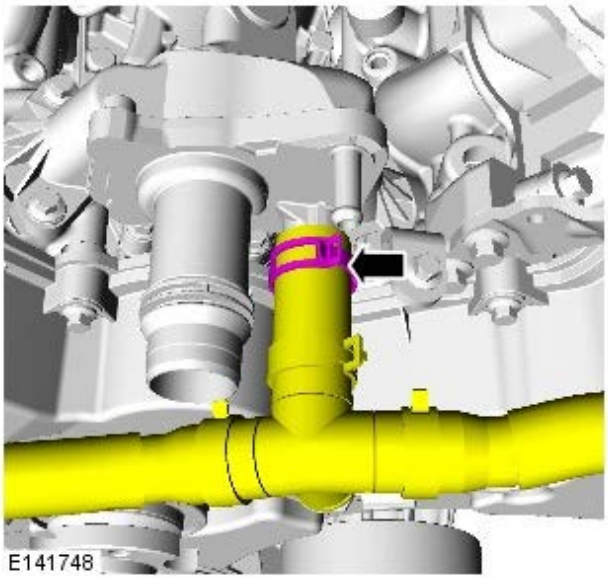
2. CAUTIONS:

Install new o-ring seals

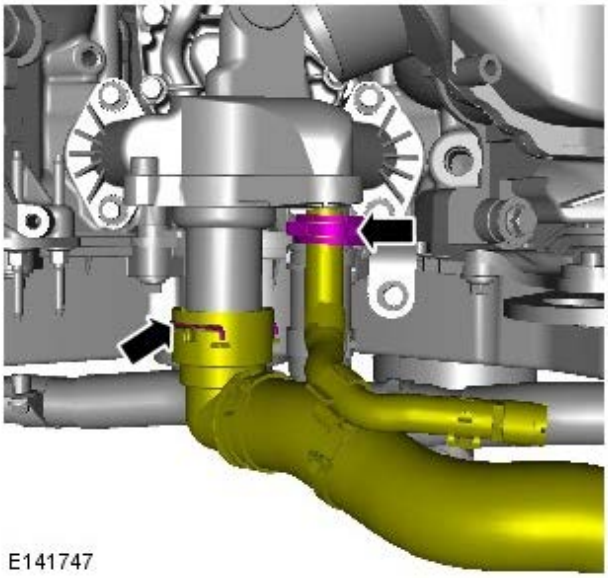
Make sure that the mating faces are clean and free of foreign material.

Torque: 10 Nm

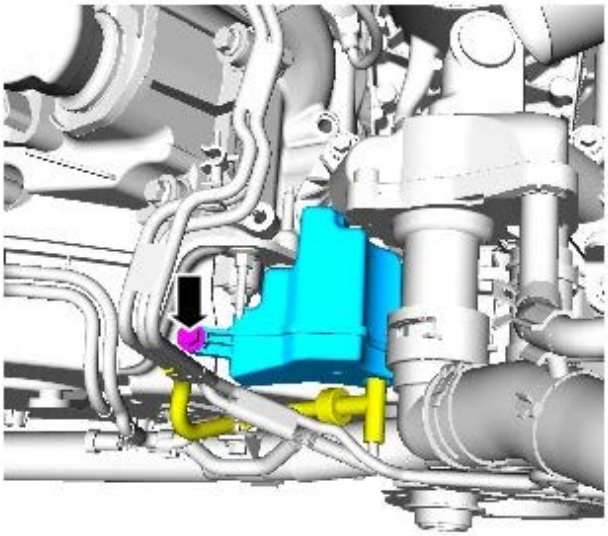
3.


E141748

4.


E141747

5. *Torque:* 10 Nm


E141746

6. Refer to: Glow Plugs (303-07B, Removal and Installation).
7. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
8. Refer to: Specifications (414-01, Specifications).

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Oil Filter Element

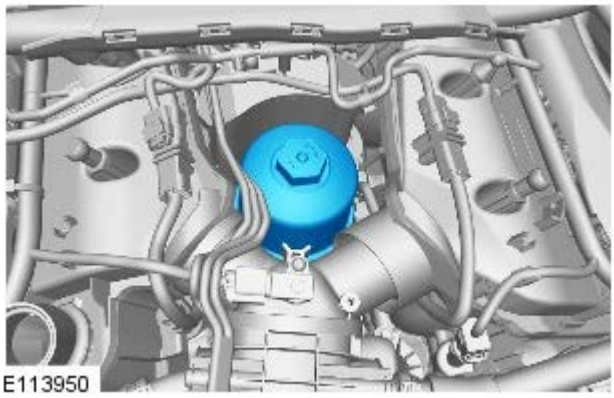
Removal and Installation

Removal

CAUTION: Make sure that the correct tools are used to remove and install the oil filter element cap.

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

1. Refer to: Engine Cover - 3.0L V6 - TdV6 (501-05 Interior Trim and Ornamentation, Removal and Installation).

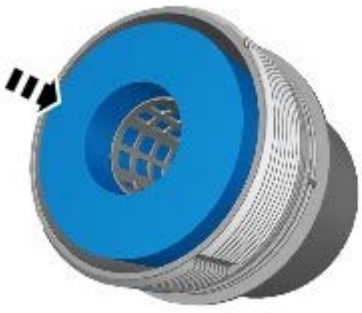

E113950

2.
   - Rotate the oil filter element housing six complete turns counter-clockwise.
   - Allow the engine oil to drain from the oil filter element housing for two minutes.
   - Remove the oil filter element housing.


E113951

3. NOTE: Remove and discard the O-ring seal.

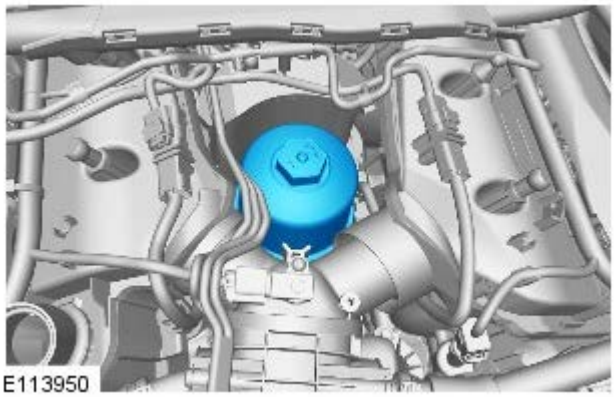
Installation


E113952

1. CAUTION: A new O-ring seal is to be installed.

   NOTE: Lubricate the O-ring seal with clean engine oil.

2. *Torque:* 28 Nm



3. Refer to: Engine Cover - 3.0L V6 - TdV6 (501-05 Interior Trim and Ornamentation, Removal and Installation).

4. Start and run the engine.

5. Check and top-up the engine oil.

Published: 22-Aug-2013

Engine - TDV6 3.0L Diesel - Oil Pan

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

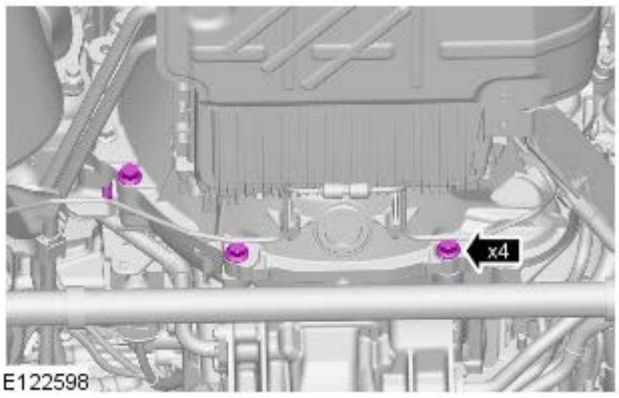
3. Refer to: Engine Oil Draining and Filling (303-01A Engine - TDV6 3.0L Diesel, General Procedures).

4. Refer to: Axle Assembly (205-03 Front Drive Axle/Differential, Removal and Installation).

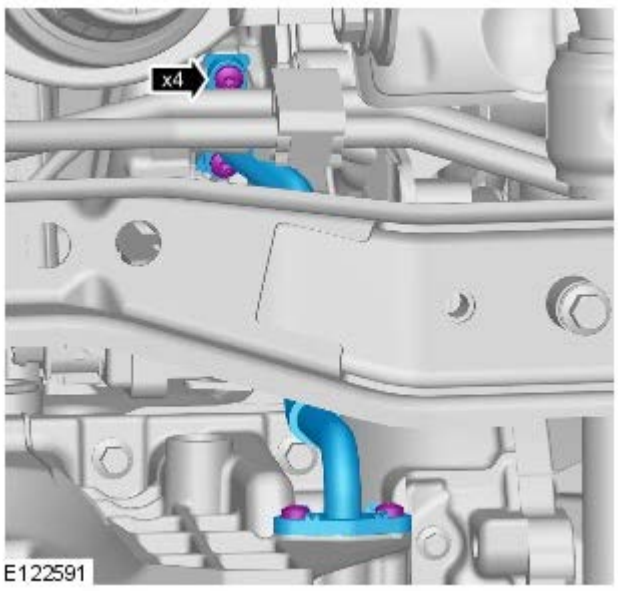
5. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

6. Vehicles with dynamic suspension.

   Refer to: Front Stabilizer Bar - V8 5.0L Petrol/V8 S/C 5.0L Petrol (204-06 Ride and Handling Optimization, Removal and Installation).



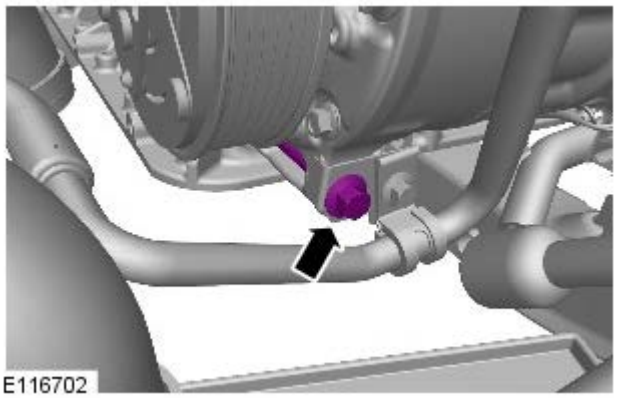
7. *Torque:*
   M10 40 Nm
   M8 24 Nm



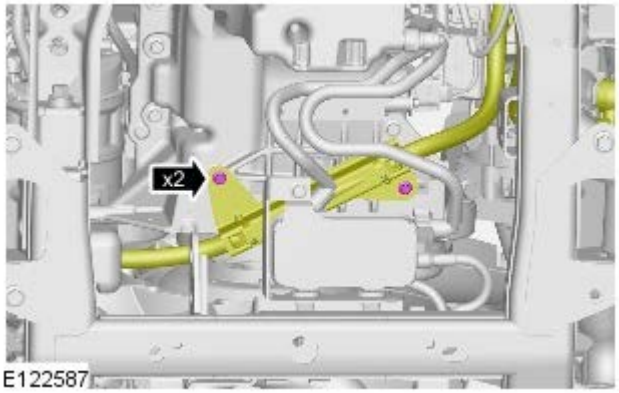
8. CAUTION: Make sure that the gaskets are correctly located.

   Torque: 10 Nm

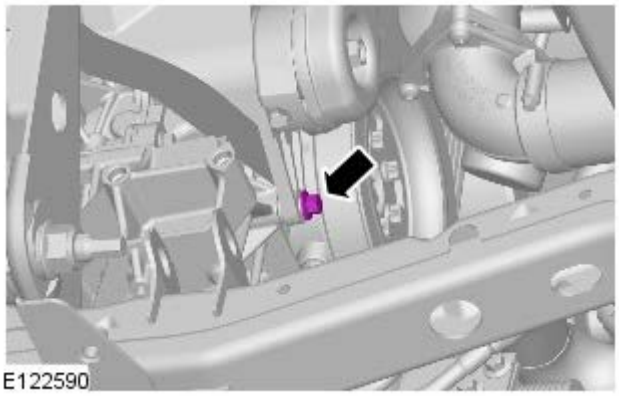
9. *Torque:* 25 Nm



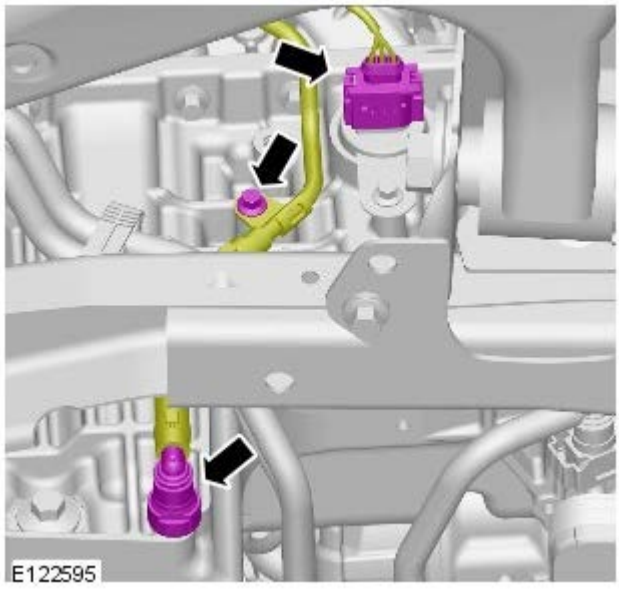
10. *Torque:* 10 Nm



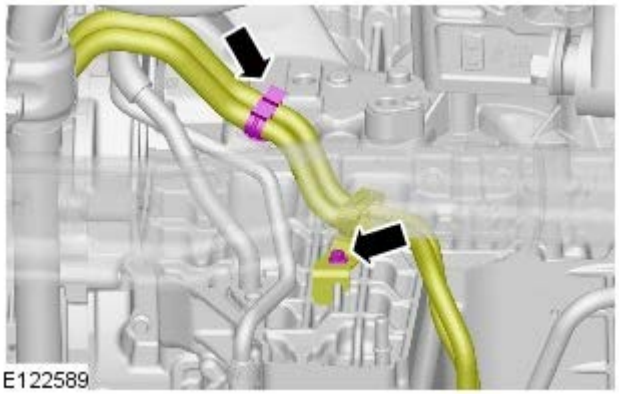
11. *Torque:* 24 Nm

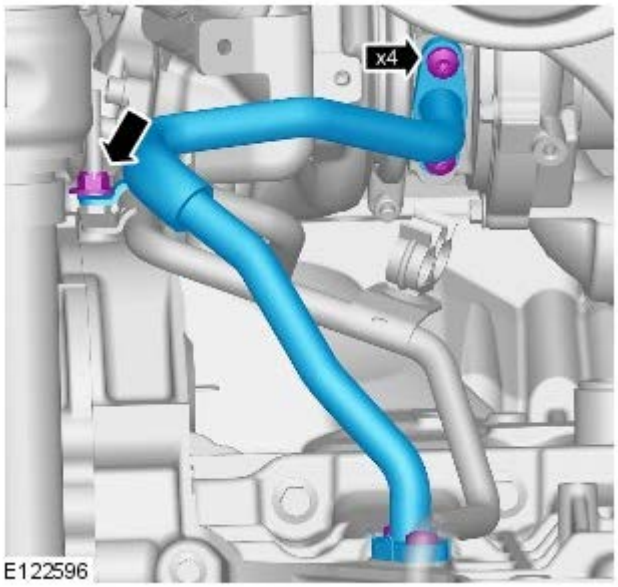


12. *Torque:* 10 Nm



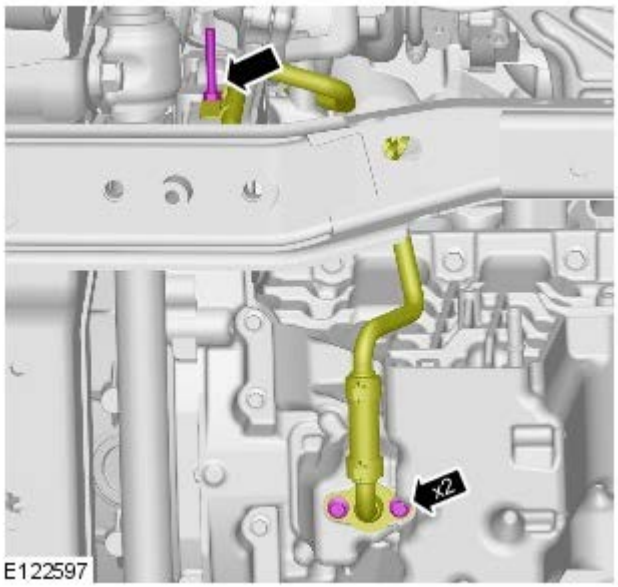
13. *Torque:* 10 Nm





14. CAUTION: Make sure that the gaskets are correctly located.

    Torque: 10 Nm

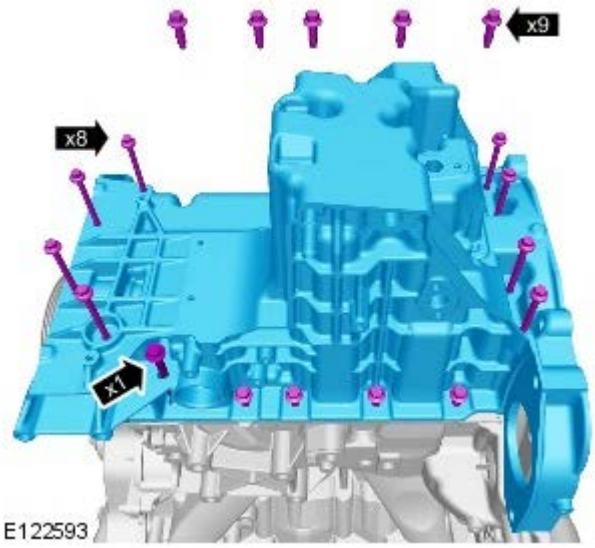


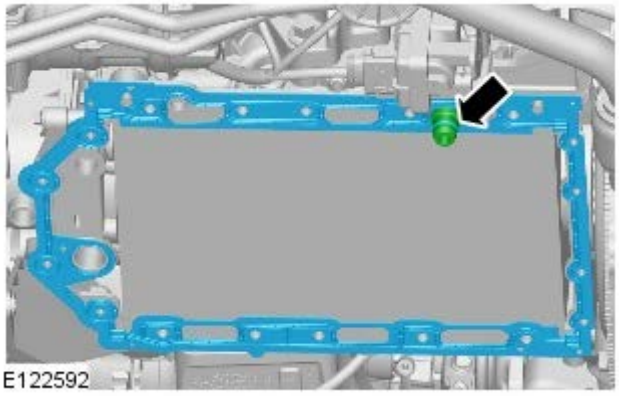
15. NOTE: Remove and discard the gasket.

    Torque: 10 Nm

16. CAUTION: Note the position of the bolts, prior to removal.

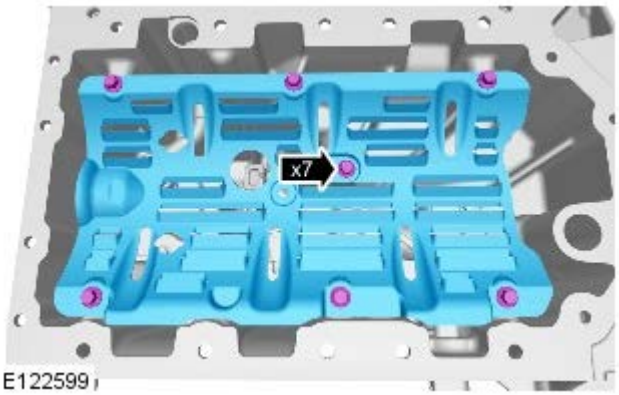
    Torque:
    M8 23 Nm
    M6 10 Nm





17. CAUTION: When removing this component be careful not to damage the plastic crankcase ventilation tube.

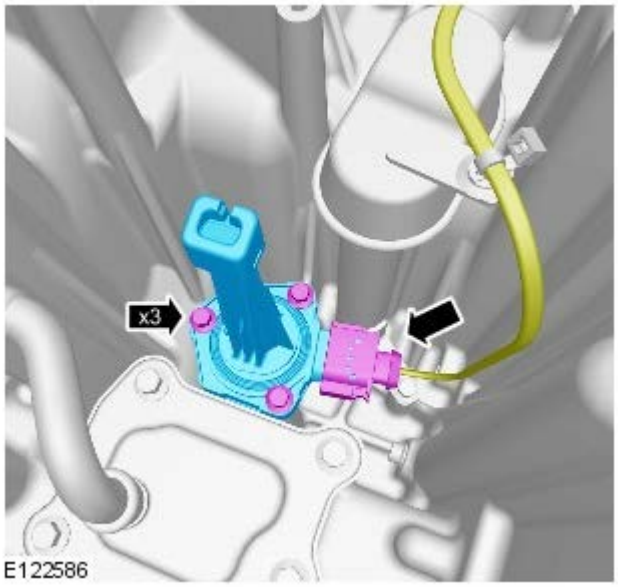
NOTE: Remove and discard the O-ring seal.

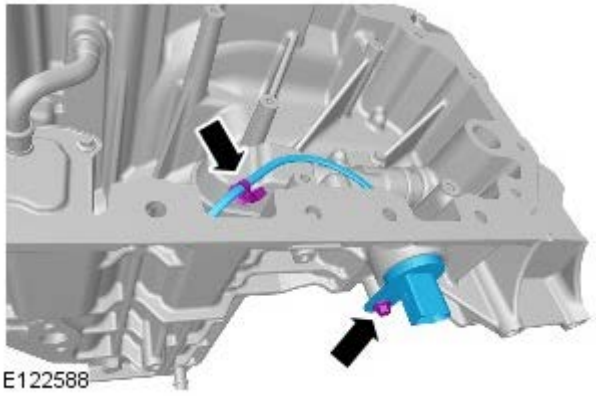


18. NOTE: Do not disassemble further if the component is removed for access only.

Torque: 10 Nm

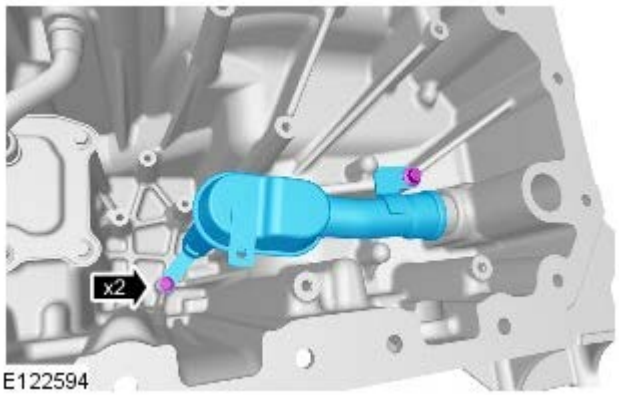
19. *Torque:* 10 Nm





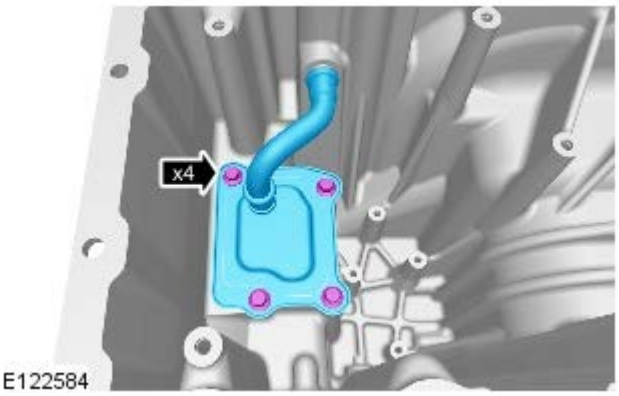
20. NOTE: Remove and discard the O-ring seal.

Torque: 10 Nm



21. NOTE: Remove and discard the O-ring seal.

Torque: 10 Nm



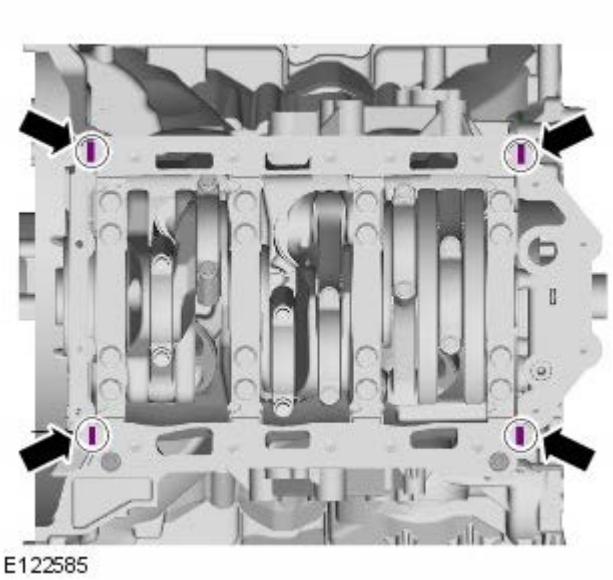
22. NOTES:

Remove and discard the O-ring seals.

Discard the gasket.

Torque: 10 Nm

Installation


E122585

1. CAUTIONS:

   Make sure that the mating faces are clean and free of corrosion and foreign material.

   Installation of the oil pan and tightening must be carried out within 7 minutes of applying the sealant.

   Apply an 8 mm bead of sealant to the cylinder block in the areas shown.

2. To install, reverse the removal procedure.

Published: 10-Feb-2014

Engine - TDV6 3.0L Diesel - Oil Pump

Removal and Installation

Removal

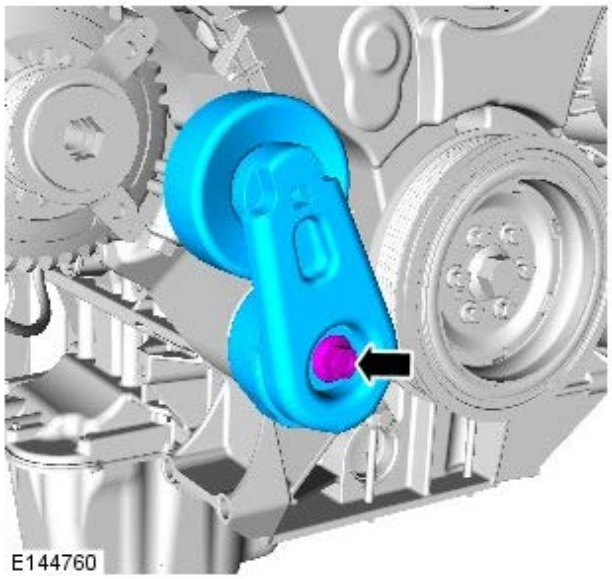
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

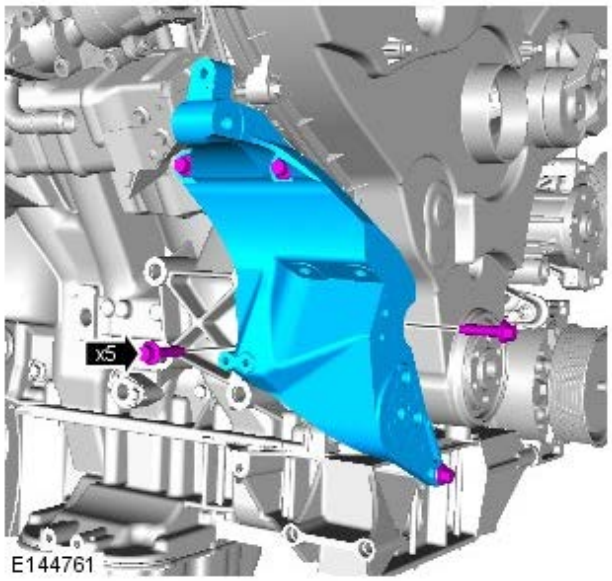
2. Remove the generator.

   Refer to: Generator (414-02 Generator and Regulator - TDV6 3.0L Diesel, Removal and Installation).

3. Remove the accessory drive belt tensioner.

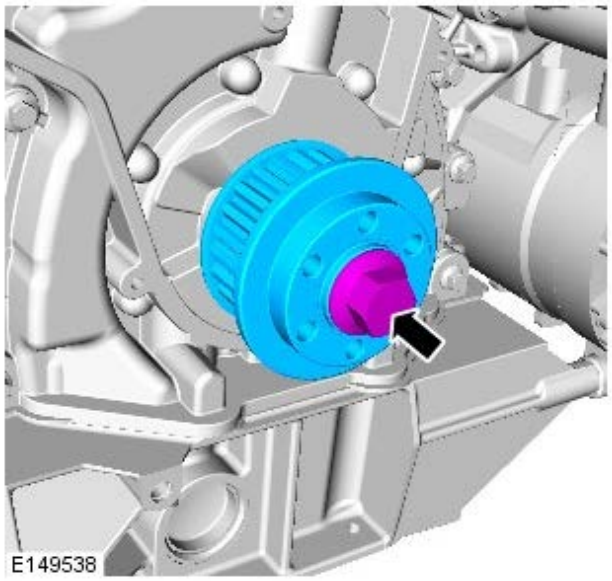


4. Remove the generator mounting bracket.



5. Refer to: Timing Belt (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

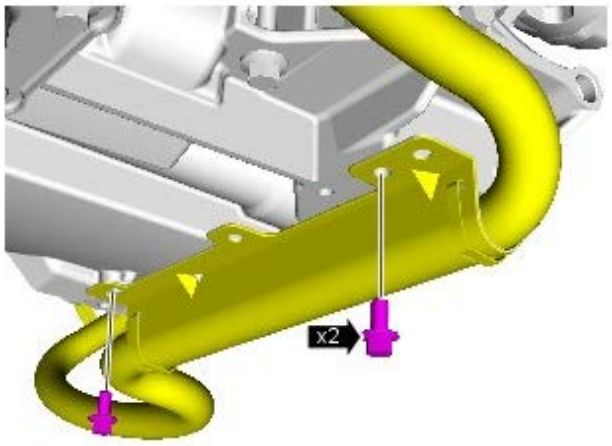
6. Remove the crankshaft pulley.



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

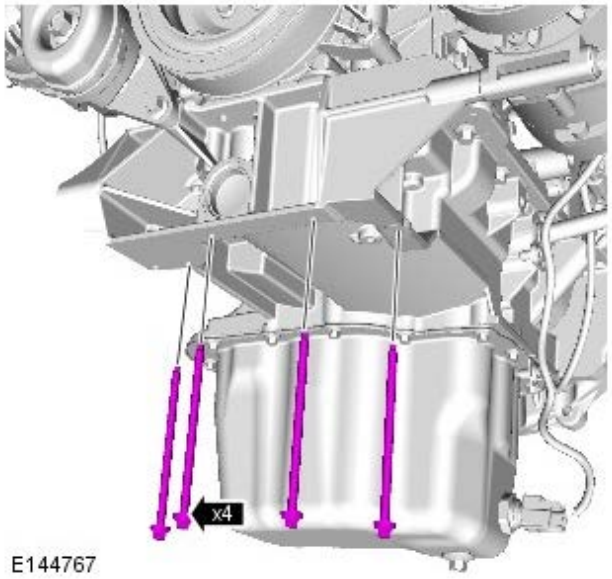
   Raise and support the vehicle.

8. Release the battery positive cable.



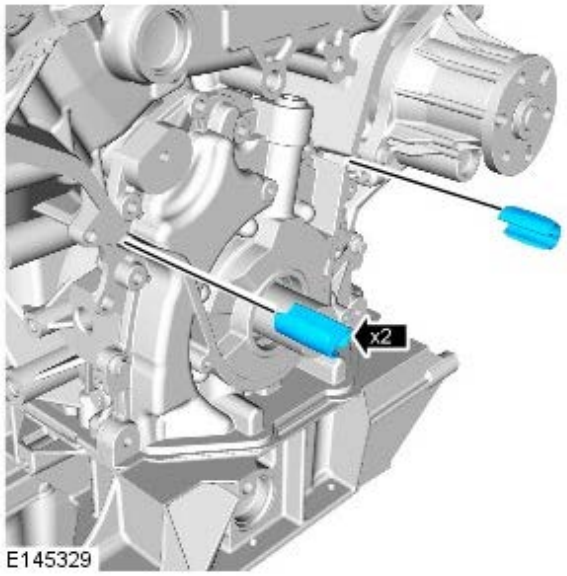
E144765

9. Remove the oil pump lower retaining bolts.

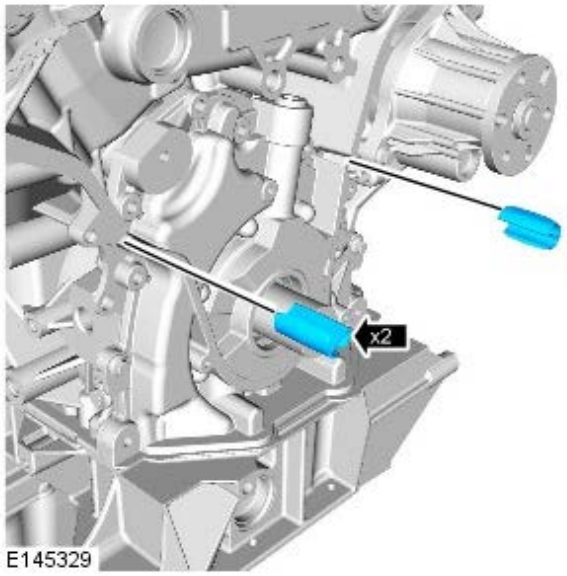


E144767

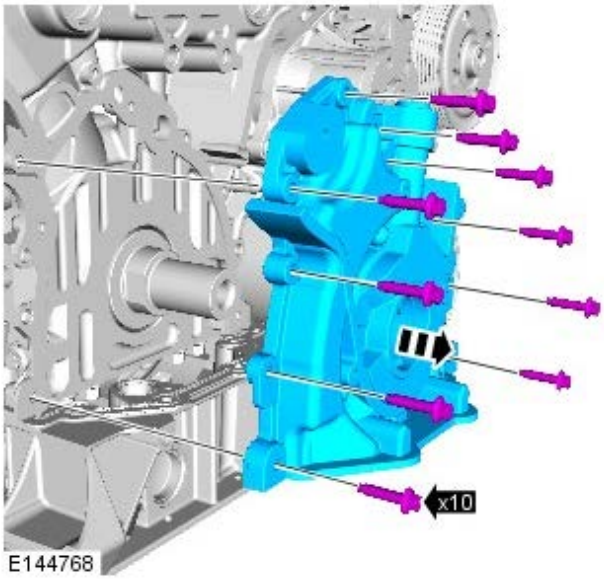
10. Remove the timing belt cover sealing strips.



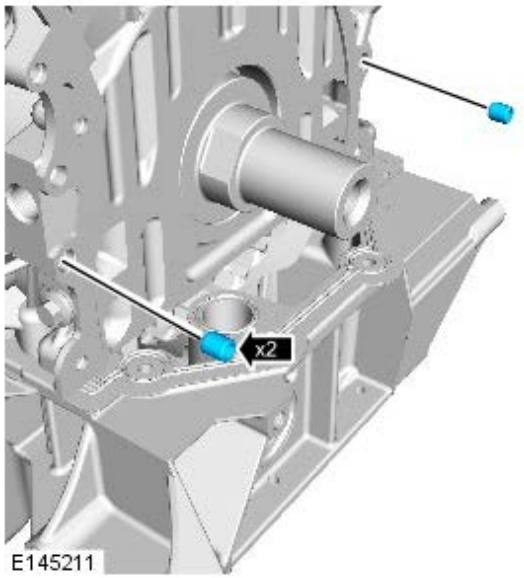
11. Remove the timing belt cover sealing strips.



12. Remove the oil pump.

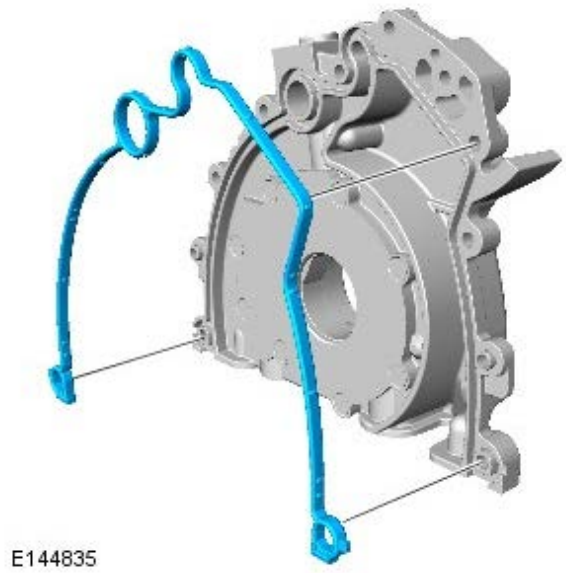


13. Remove the alignment dowels (if equipped).

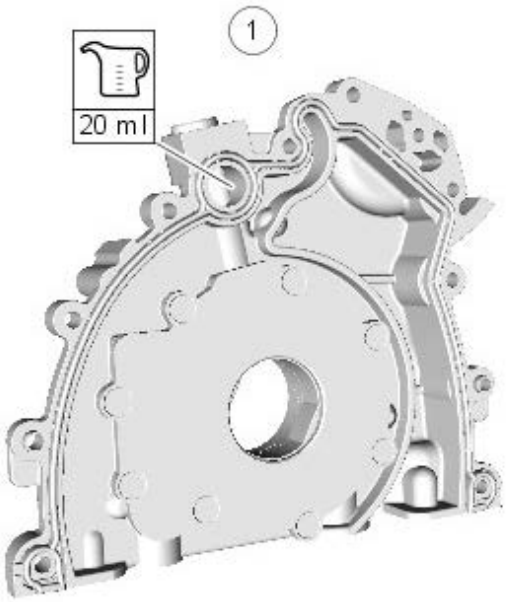


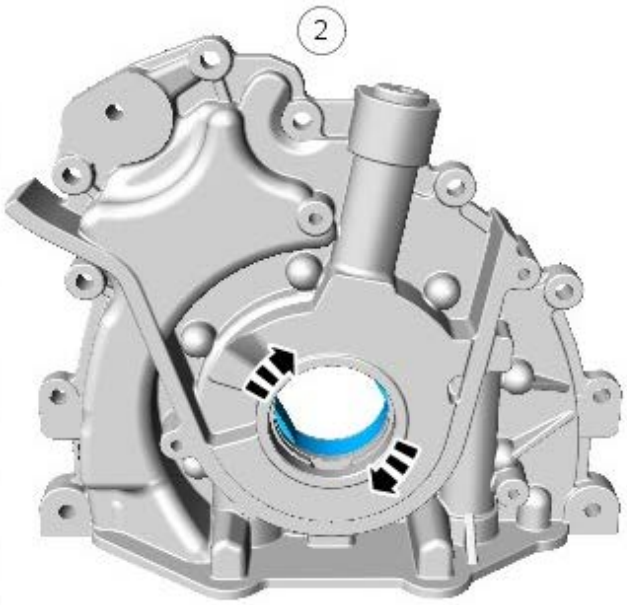
Installation

1. Install a new oil pump gasket.

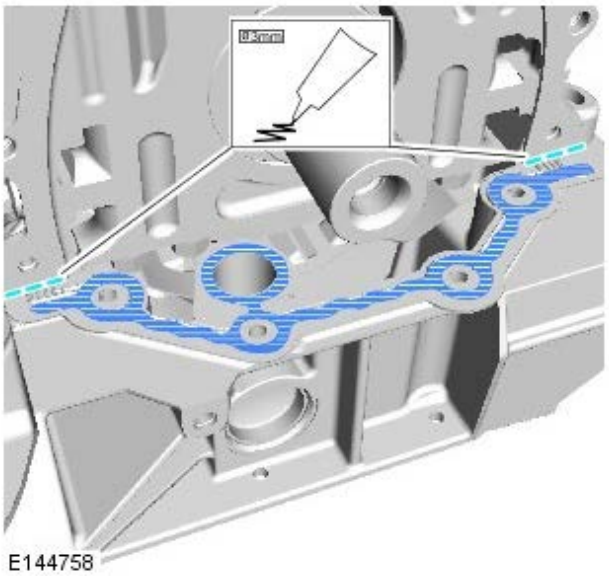


2. NOTE: **Prime the oil pump.**
   - Fill the orifice shown with 20 ml of engine oil.
   - Rotate the oil pump drive 2 complete turns.





E144763



E144758

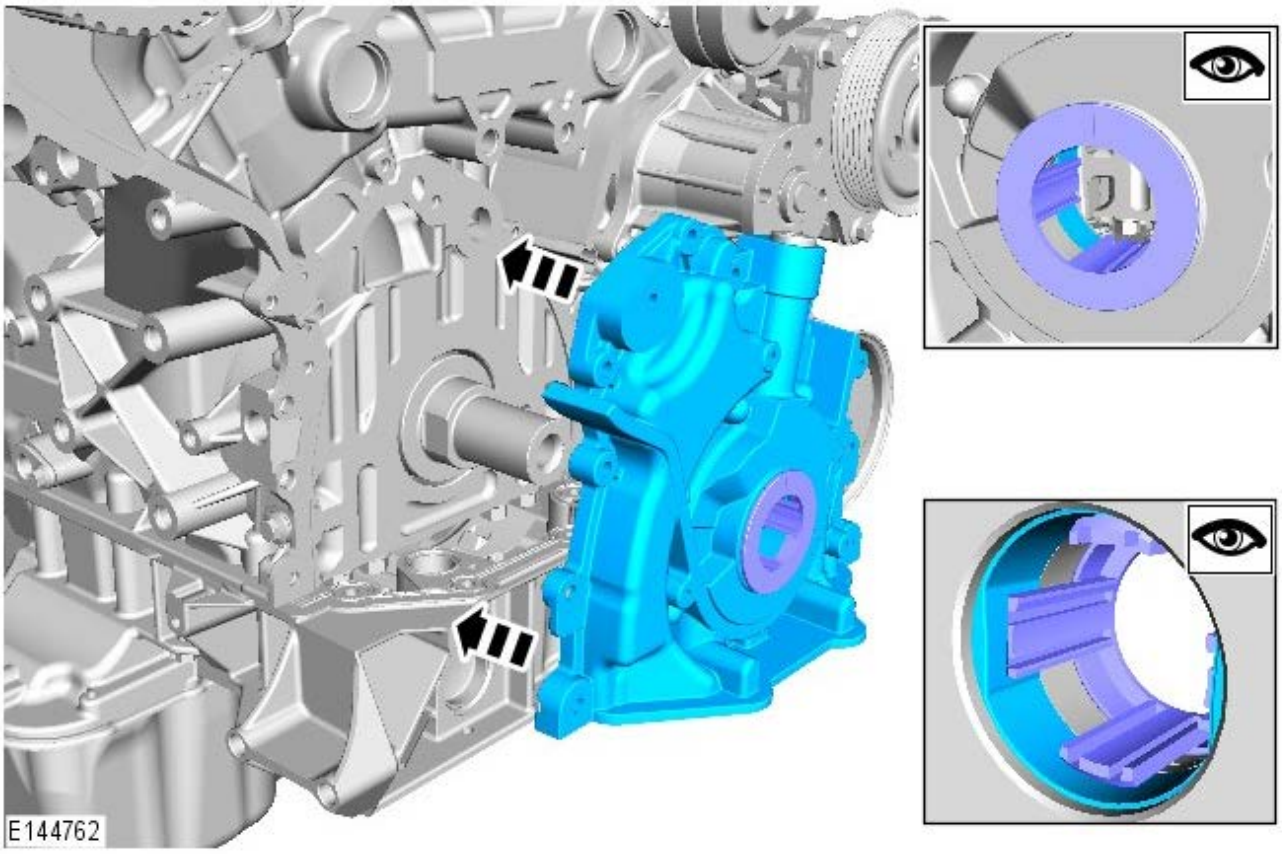
3. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Apply sealant WSE-M4G323-A5 in an 3mm bead to the two areas shown, also apply a smear of sealant to the gasket face as illustrated.

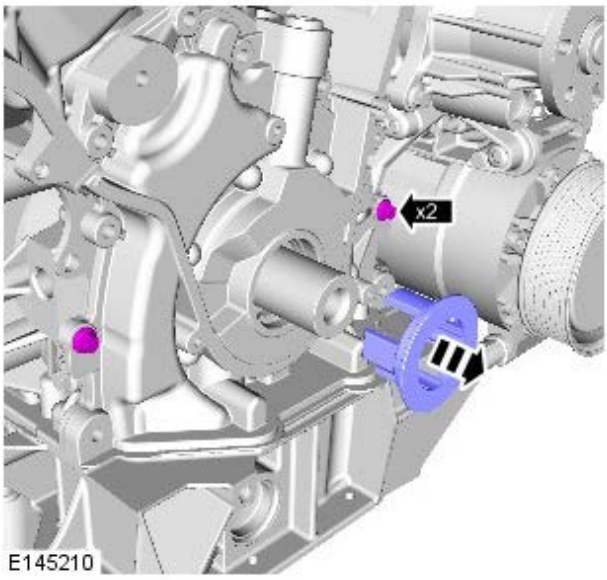
4. CAUTION: Make sure the base of the oil pump is aligned within 0.2 mm of the base of the engine block. Failure to follow this instruction may result in damage to the vehicle.

   NOTE: Vehicles fitted with oil pumps without dowels.

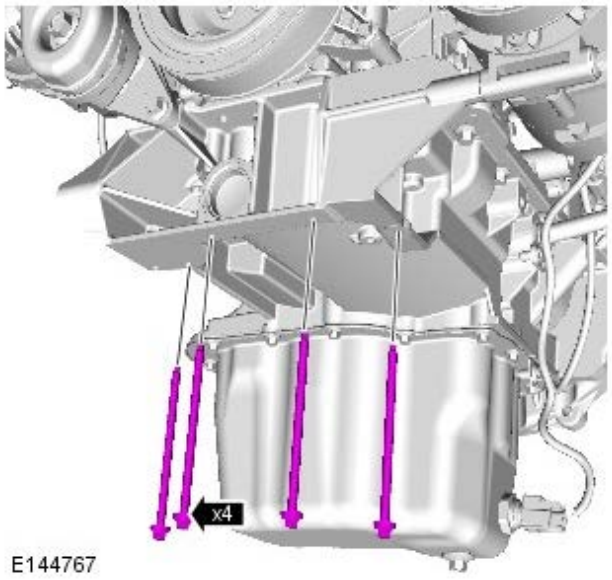
   Check the oil pump to engine block alignment.



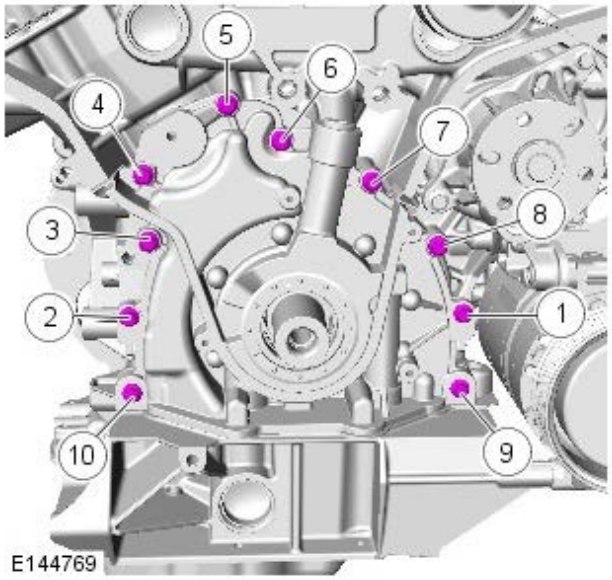
5. Install two bolts to the oil pump, only finger tighten at this stage.



6. Install the oil pump lower retaining bolts.



E144767

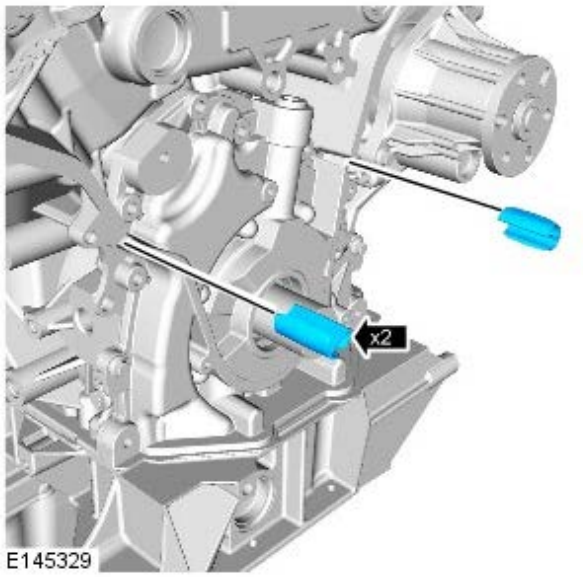


E144769

7. NOTE: Tighten the bolts in the sequence shown to 10 Nm .

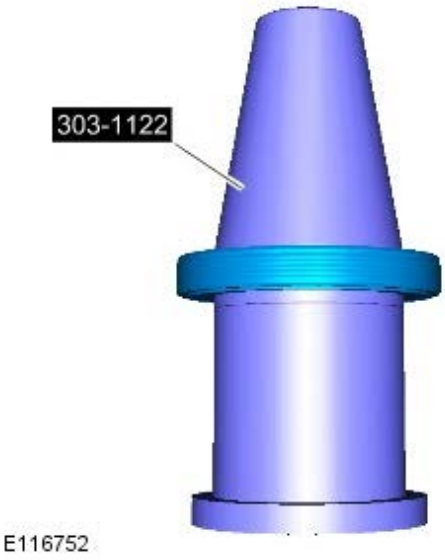
   Secure the oil pump.

8. Install the timing belt cover sealing strips.



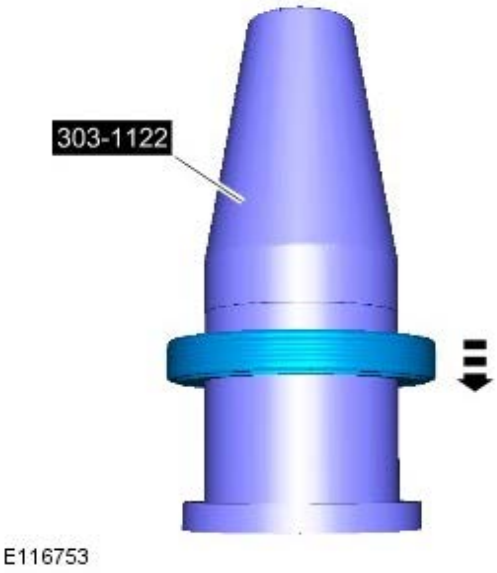
E145329

9. CAUTION: Do not use any lubricant on the crankshaft front seal, special tools or the crankshaft. Failure to follow this instruction may result in damage to the vehicle.



NOTE: Make sure all component mating faces are clean.

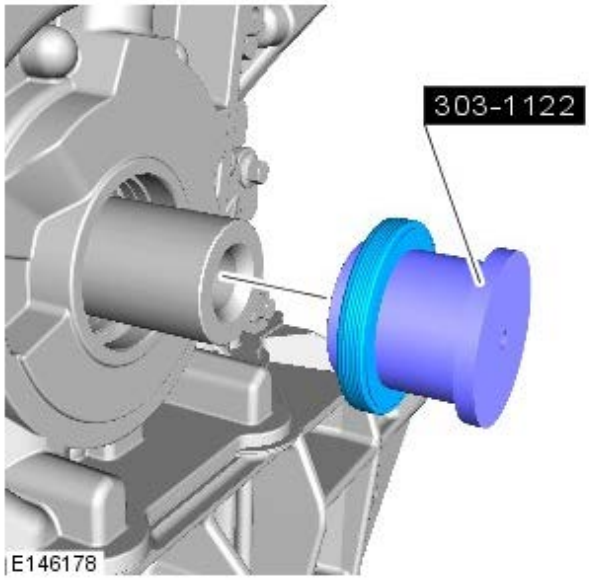
Install a new crankshaft front seal to the special tool.



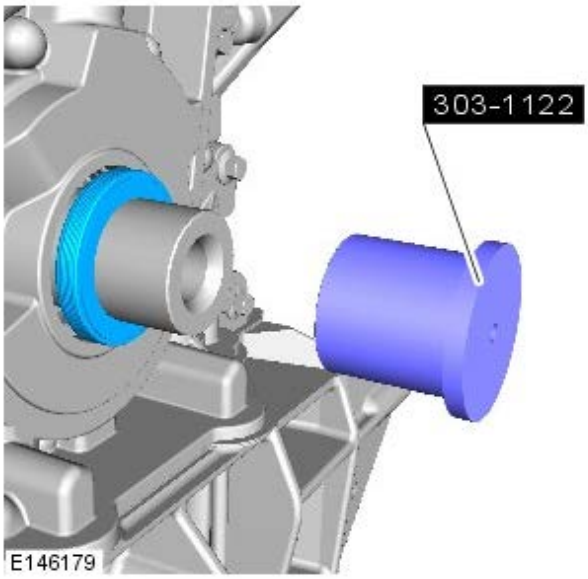
10. NOTE: Remove the sleeve from the special tool.

    Reposition the crankshaft front seal along the special tool.

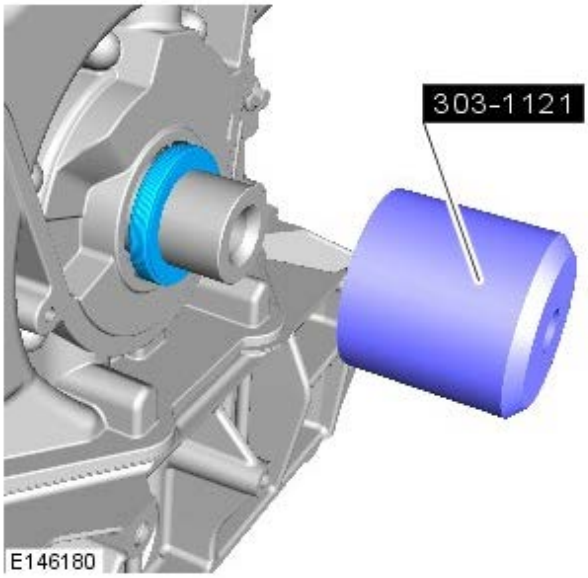
11. Install the special tool to the crankshaft.

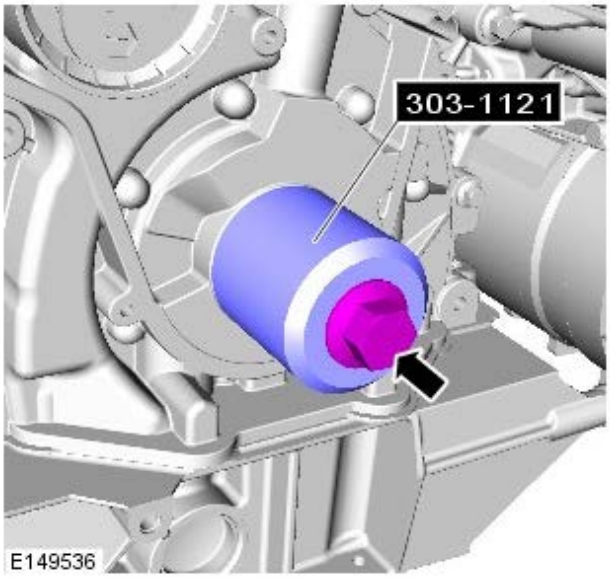


12. Remove the special tool from the crankshaft.



13. Install the special tool to the crankshaft.





14. NOTES:

Make sure the seal is installed correctly.

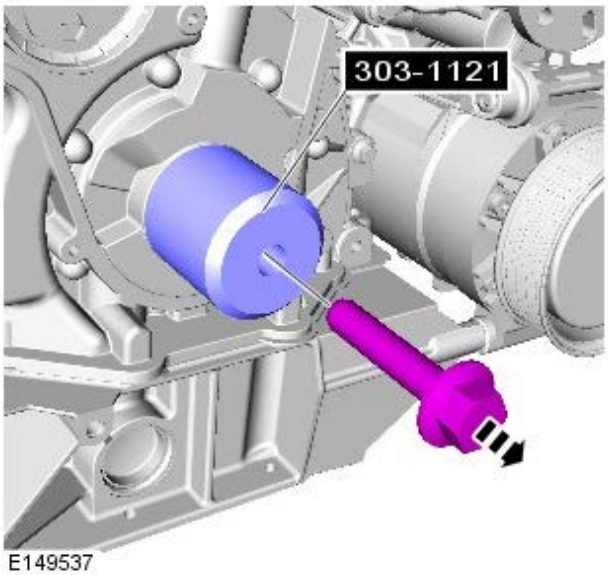
Use the crankshaft bolt with the service tool.

Install the special tool to the crankshaft.

15. NOTES:

Make sure the seal is installed correctly.

Wait 10 seconds before removing the



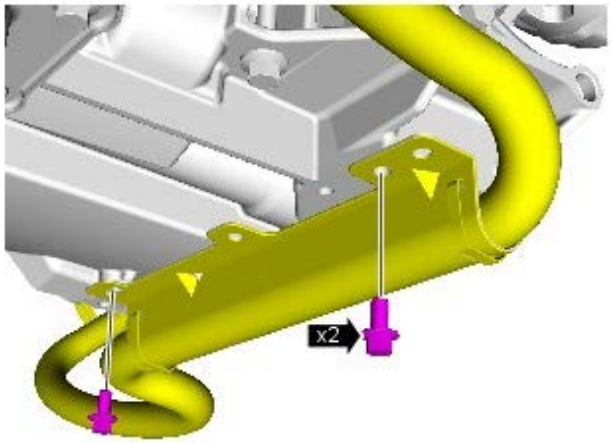
E149537

crankshaft seal installation tool.

Remove and discard the crankshaft pulley retaining bolt.

16. Install the battery positive cable.

Torque: 10 Nm



E144765

17. CAUTIONS:

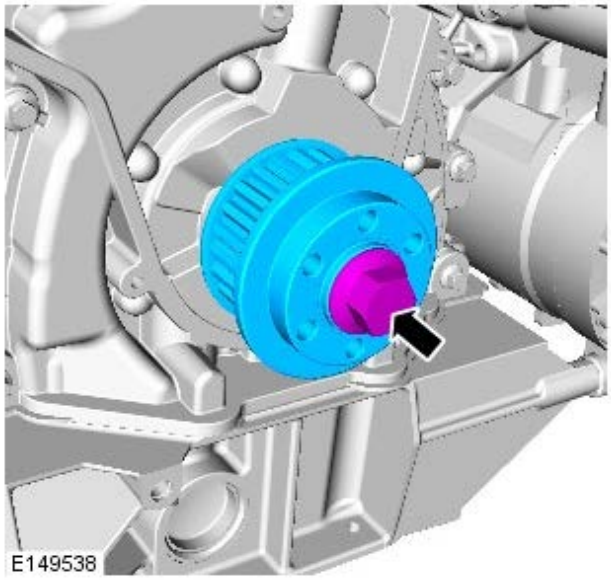
Make sure that the pulley washer is correctly seated before installing the pulley.

Do not lubricate the components.

Make sure that a new bolt is installed.

Install the crankshaft pulley.

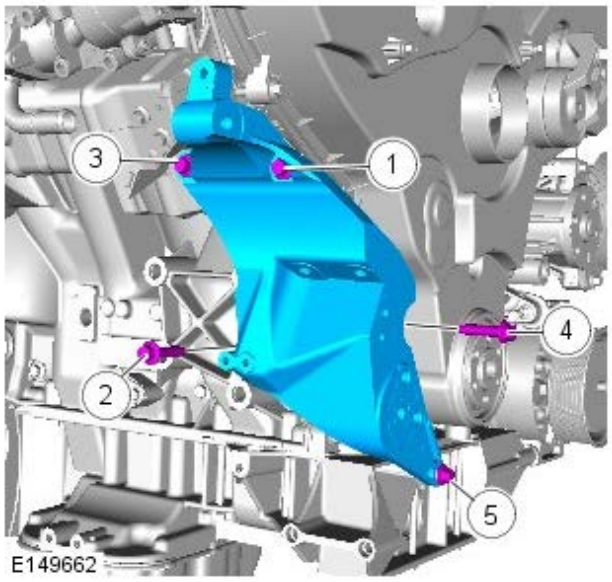
Torque:
Stage 1: 150 Nm
Stage 2: 300 Nm
Stage 3: 90°


E149538

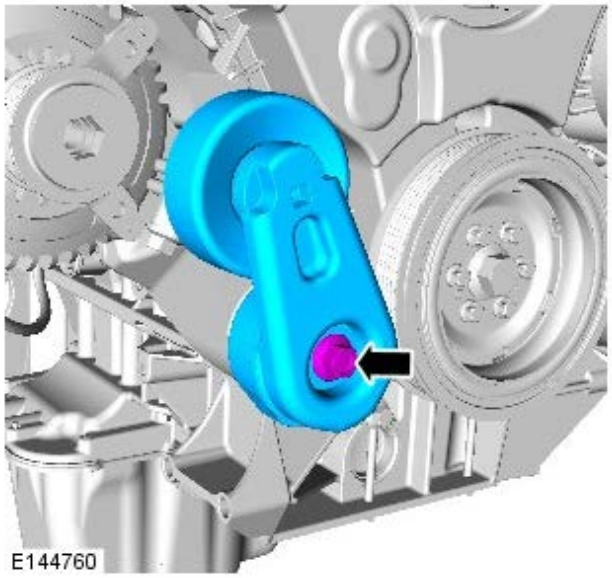
18. Refer to: Timing Belt (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

19. Tighten the bolts in the sequence shown.

Torque: 22 Nm



20. *Torque:* 45 Nm



21. Remove the generator.

    Refer to: Generator (414-02 Generator and Regulator - TDV6 3.0L Diesel, Removal and Installation).

22. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Timing Belt

Removal and Installation

Special Tool(s)

	303-1117 Timing Peg, Automatic Transmission
	303-1126 Timing Peg, Camshaft Pulley

Removal

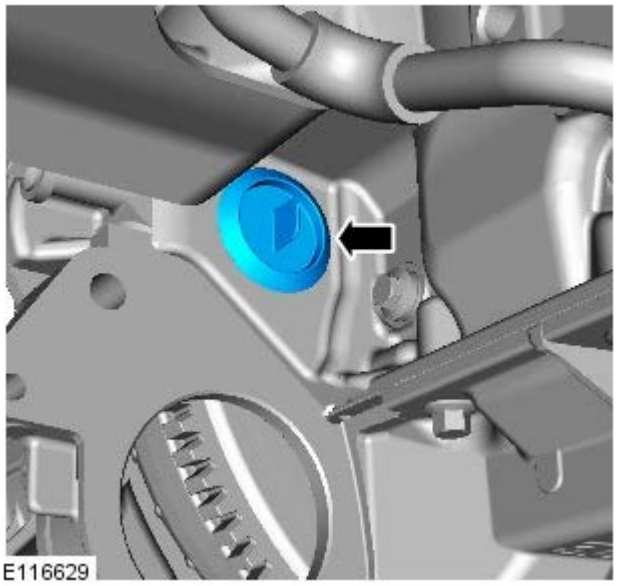
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Timing Cover (303-01 Engine - 3.0L V6 - TdV6, Removal and Installation).

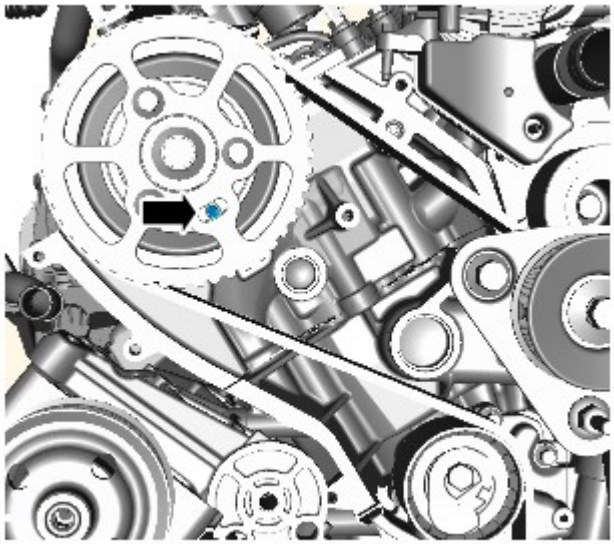
3. Refer to: Starter Motor (303-06 Starting System - 3.0L V6 - TdV6, Removal and Installation).

4.



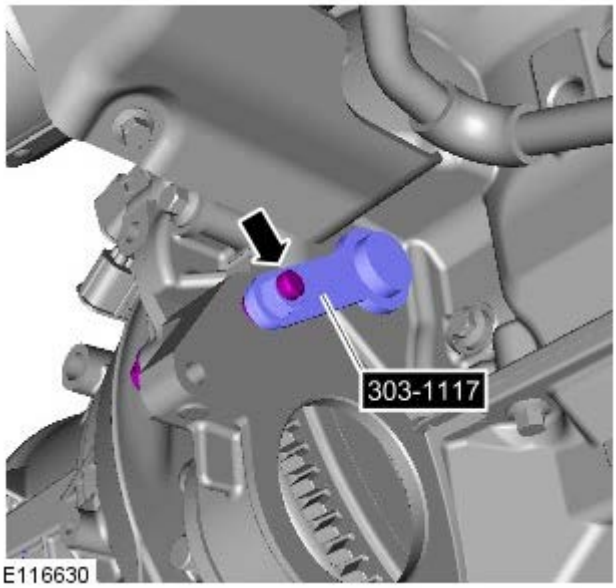
5. Rotate the crankshaft clockwise to align the crankshaft alignment hole in the flywheel or flexplate with the block aperture.

6. Check the camshaft pulley alignment holes are correctly aligned. If the alignment holes are not aligned, rotate the crankshaft one full turn clockwise.



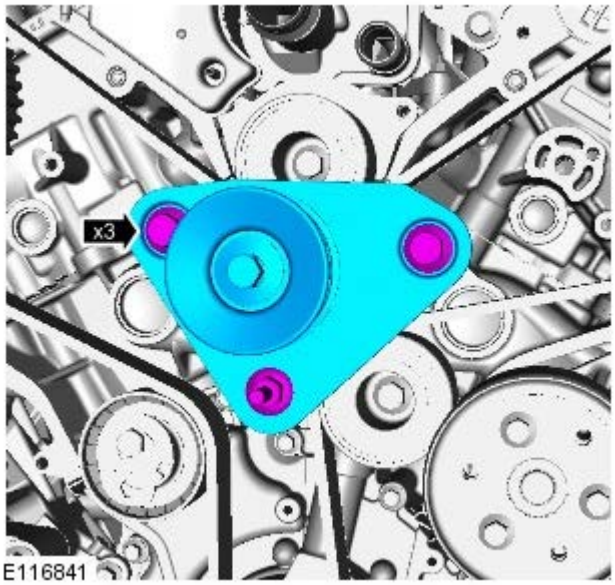
E116840

7. *Special Tool(s):* 303-1117



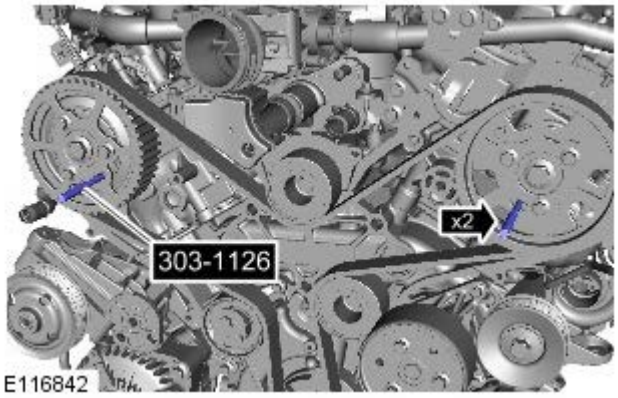
E116630

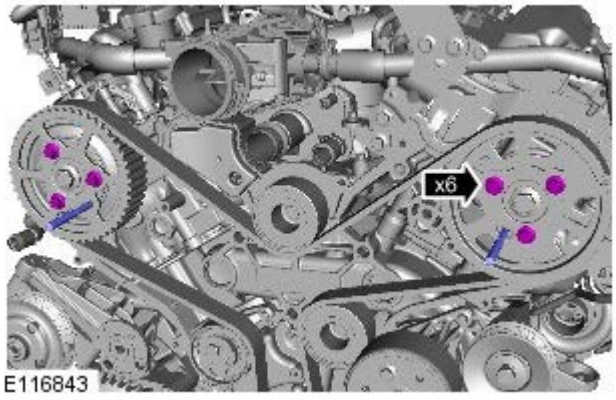
8.



E116841

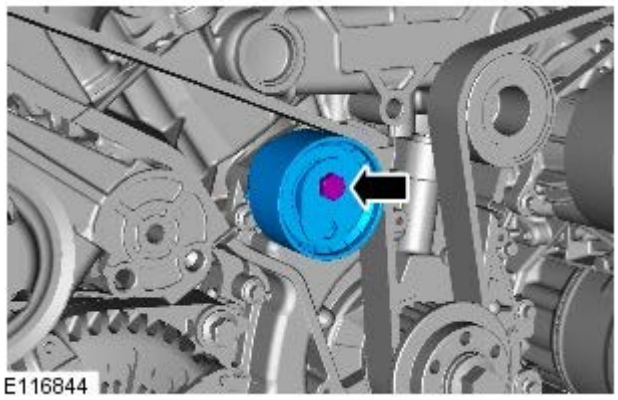
9. *Special Tool(s):* 303-1126





10. CAUTION: Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.

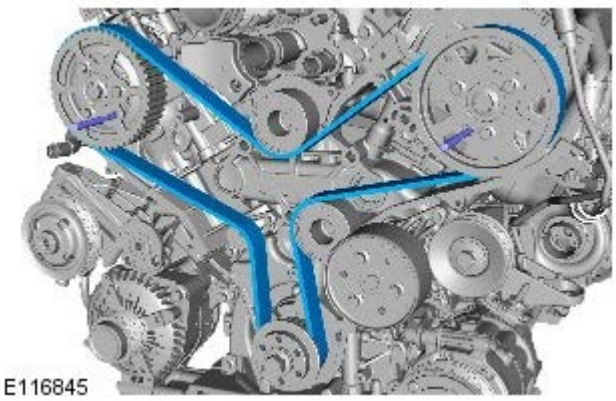
NOTE: Do not loosen the bolts more than 2 turns.



11. CAUTIONS:

Discard the component.

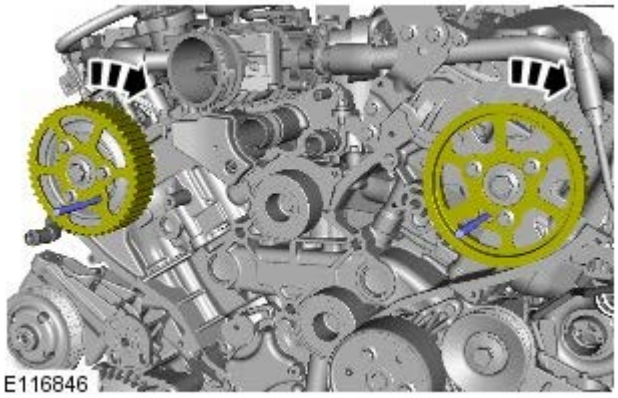
Discard the bolt.

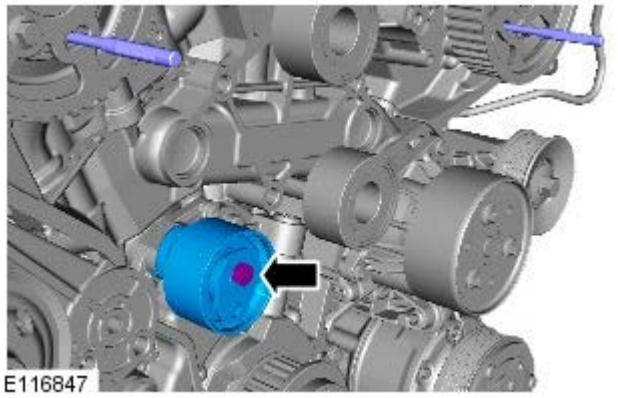


12. CAUTION: Discard the component.

Installation

1.

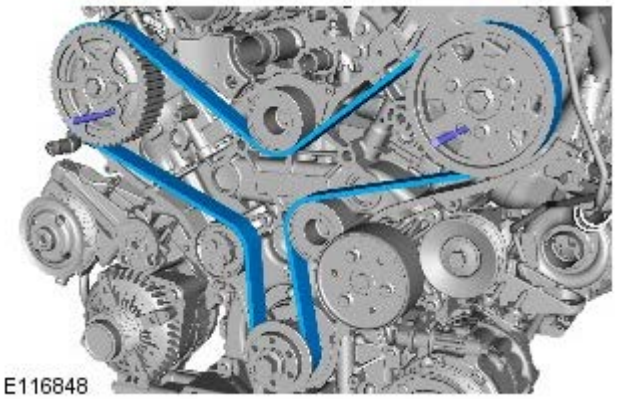

E116846


E116847

2. CAUTIONS:

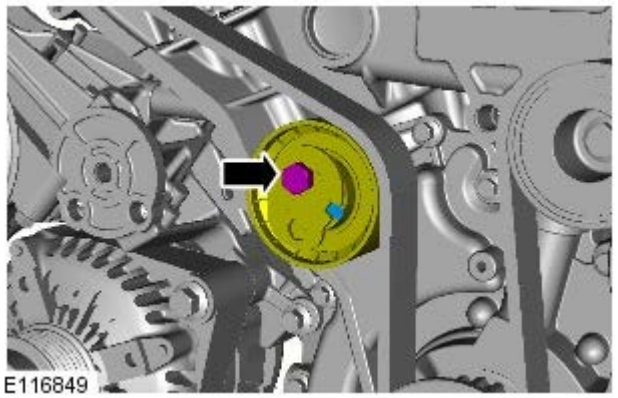
   Make sure that a new bolt is installed.

   Only tighten the bolts finger-tight at this stage.


E116848

3. CAUTION: Make sure the camshaft pulleys remain in the clockwise position.

   - Install the new timing belt.
   - Starting at the crankshaft pulley, install the timing belt in a counter-clockwise direction, in the sequence shown.
   - Stage one: Attach the timing belt to the crankshaft pulley.
   - Stage two: Attach the timing belt to the idler pulley.
   - Stage three: Attach the timing belt to the left-hand camshaft pulley.
   - Stage four: Attach the timing belt to the idler pulley.
   - Stage five: Attach the timing belt to the RH camshaft pulley.
   - Stage six: Attach the timing belt to the timing belt tensioner.

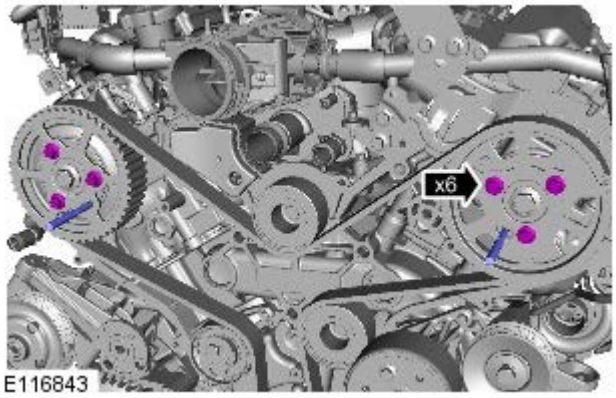

E116849

4. CAUTION: Make sure the timing belt tensioner window is aligned with the groove as illustrated.

   - Tension the timing belt.
   - Rotate the tensioner assembly counter-clockwise.
   - *Torque:* 26 Nm

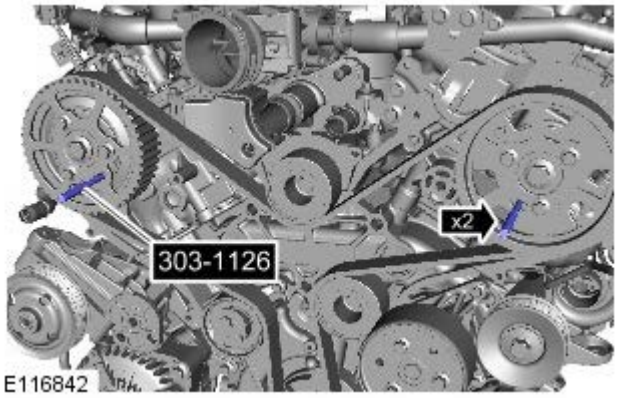
5. CAUTION: Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.

   - Using a suitable tool, counterhold the camshaft pulley center retaining bolts.

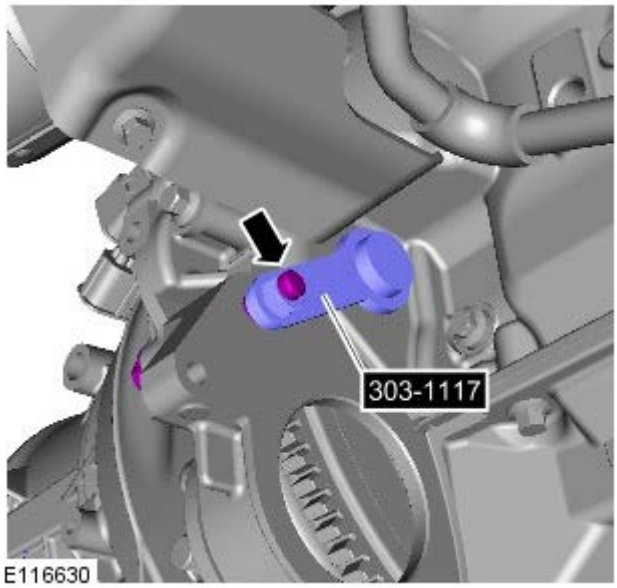


- *Torque:* 23 Nm

6. *Special Tool(s):* 303-1126



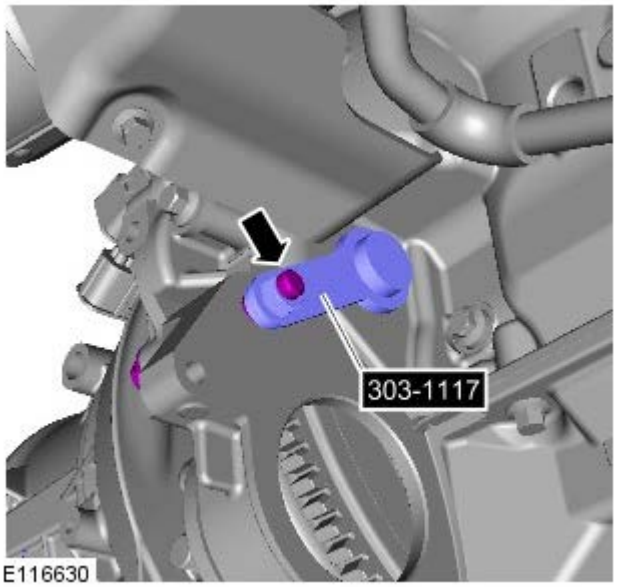
7. *Special Tool(s):* 303-1117



8. CAUTION: Only rotate the crankshaft clockwise.

   Rotate the engine two complete turns clockwise.

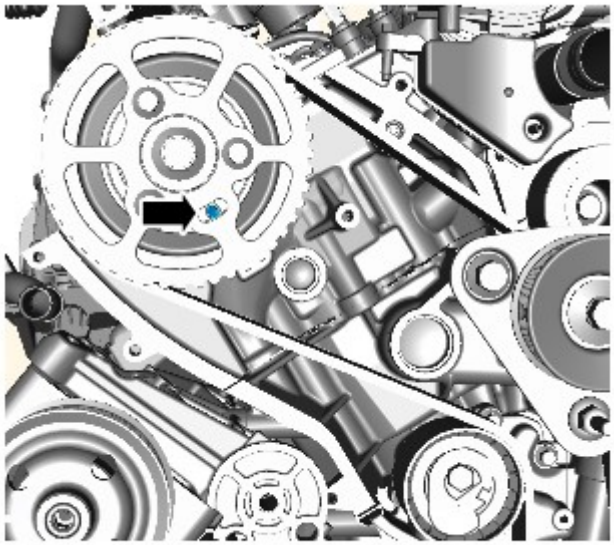
9. *Special Tool(s):* 303-1117



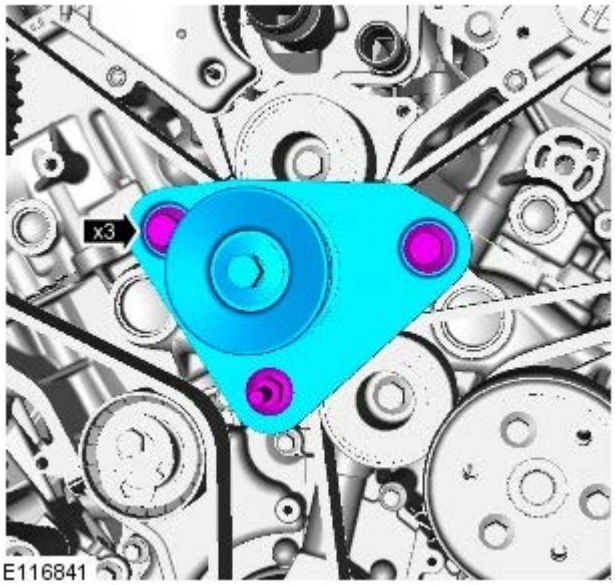
E116630

10.

- Install the special tools to the exhaust camshaft pulleys.
- If the special tool does not fit correctly, repeat the timing belt installation procedure.
- Remove the special tools from the camshaft pulleys.

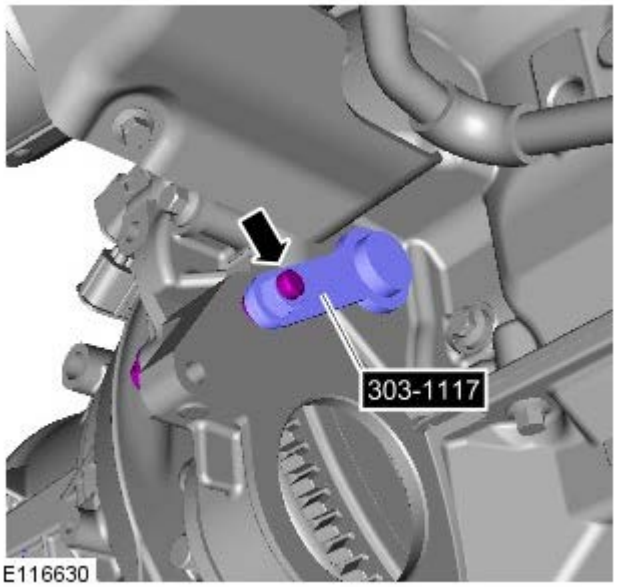

E116840

11. *Torque:* 80 Nm

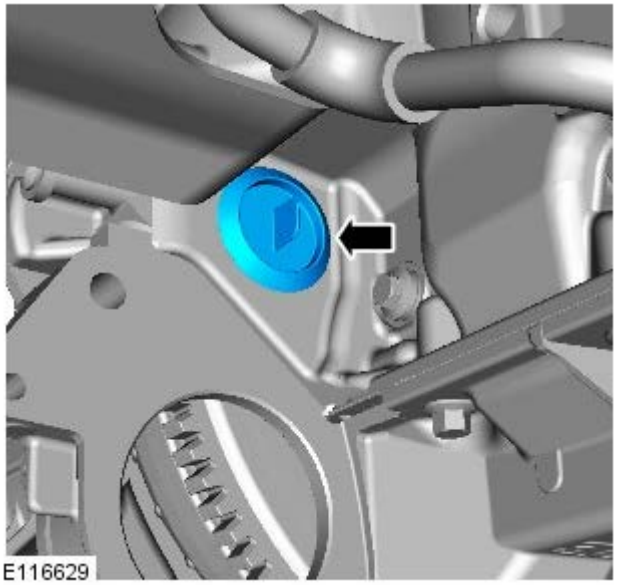


E116841

12. *Special Tool(s):* 303-1117



13.



14. Refer to: Starter Motor (303-06 Starting System - 3.0L V6 - TdV6, Removal and Installation).

15. Refer to: Timing Cover (303-01 Engine - 3.0L V6 - TdV6, Removal and Installation).

Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Timing Cover

Removal and Installation

Removal

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

1. Disconnect the battery ground cable.

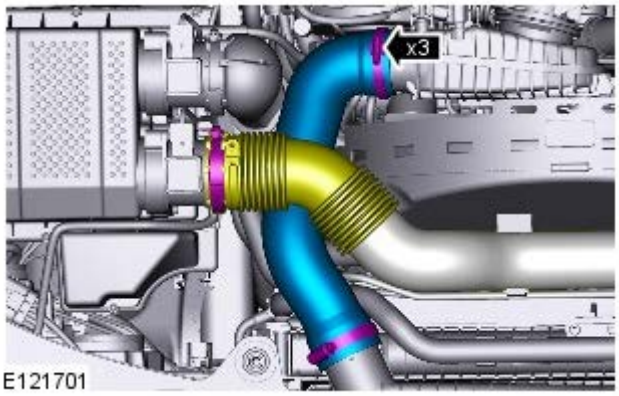
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

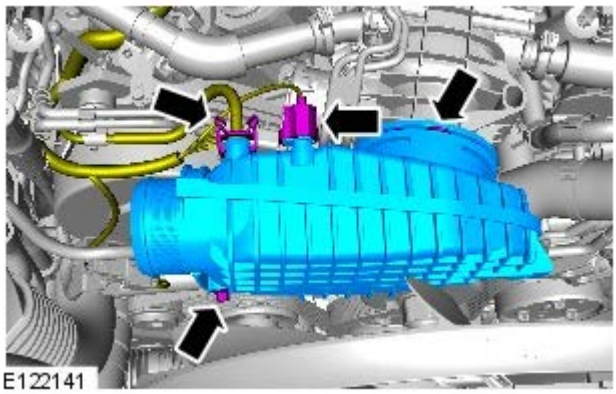
3. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).

4. Refer to: Cooling Fan (303-03, Removal and Installation).

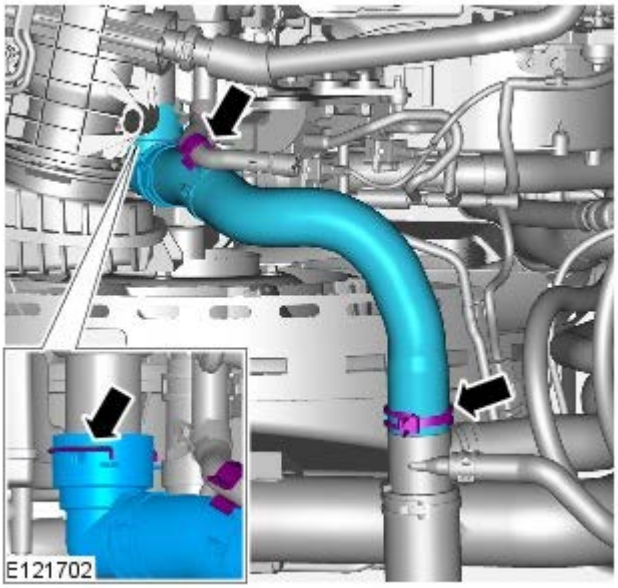
5.



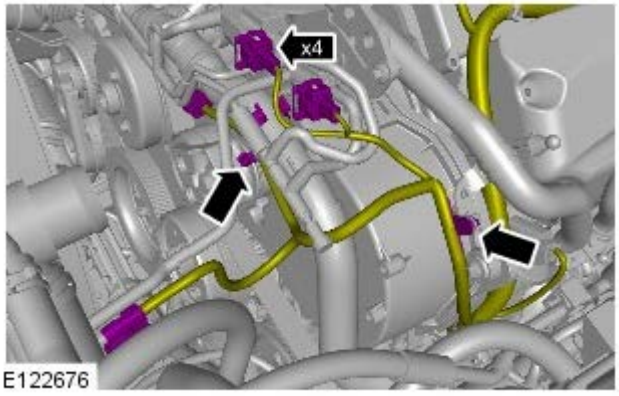
6. *Torque:* 10 Nm



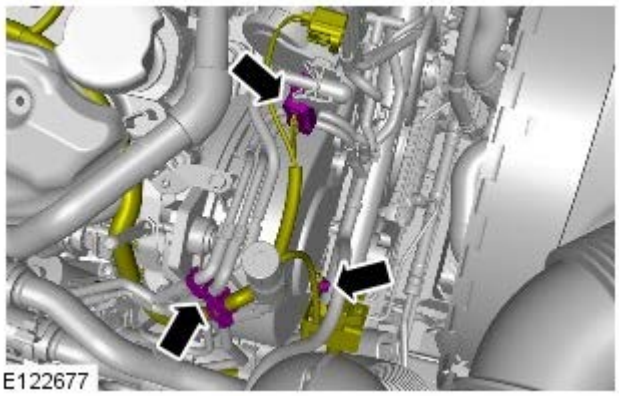
7.



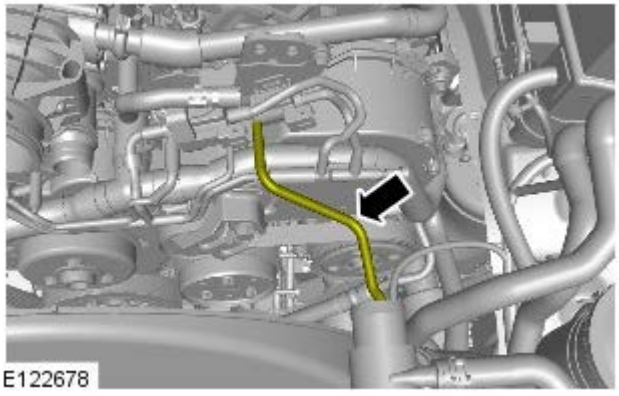
8.



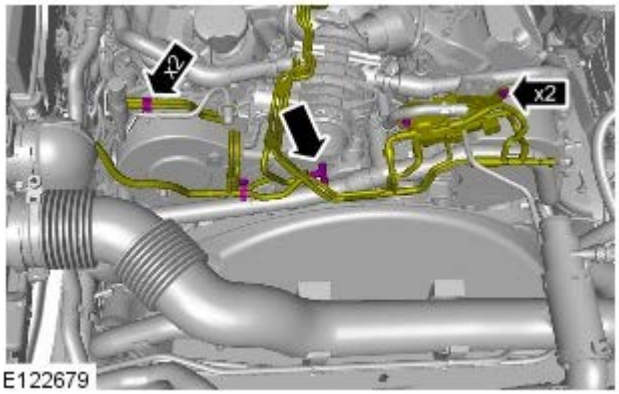
9. *Torque:* 3 Nm



10.

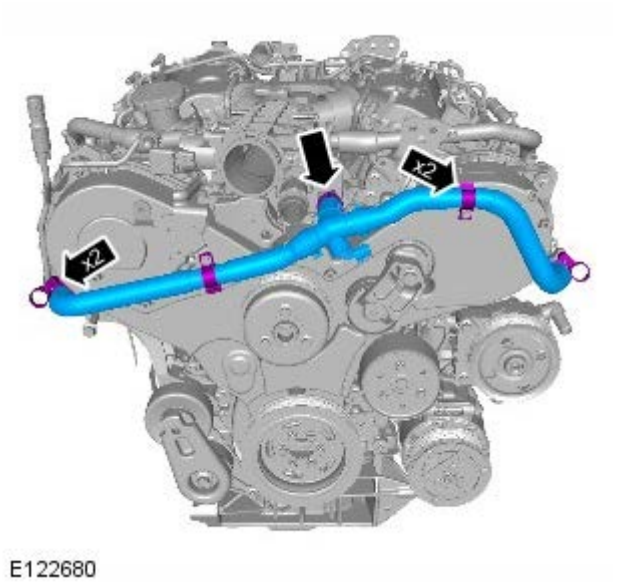


11. *Torque:* 8 Nm



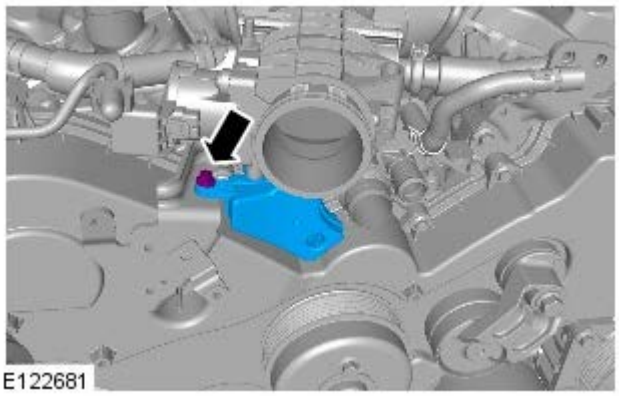
E122679

12. NOTE: Engine shown removed for clarity.

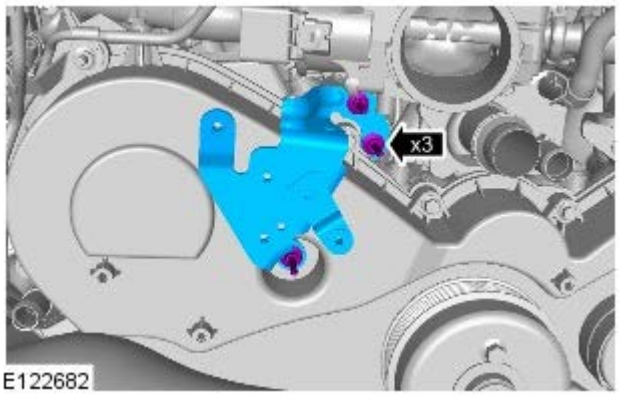


E122680

13. *Torque:* 8 Nm

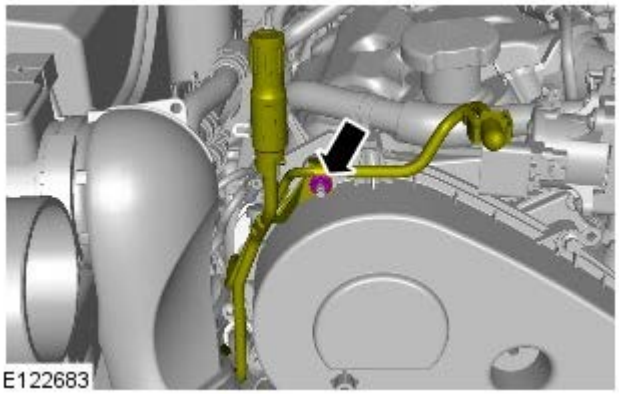

E122681

14. *Torque:* 8 Nm

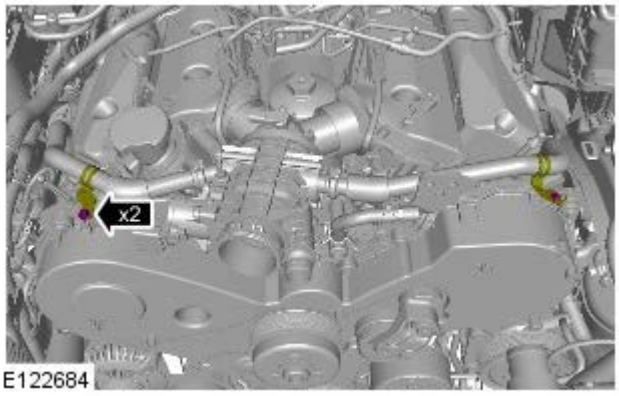


E122682

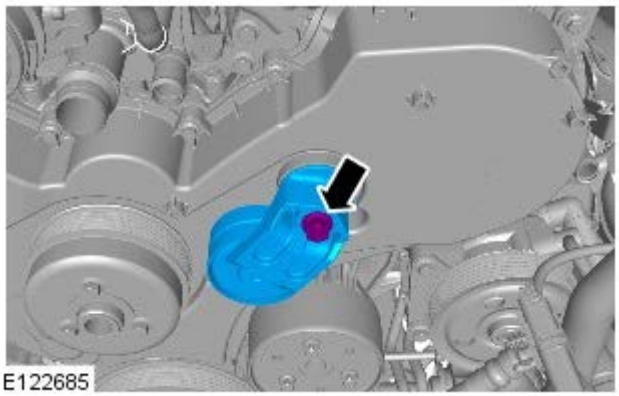
15. *Torque:* 8 Nm



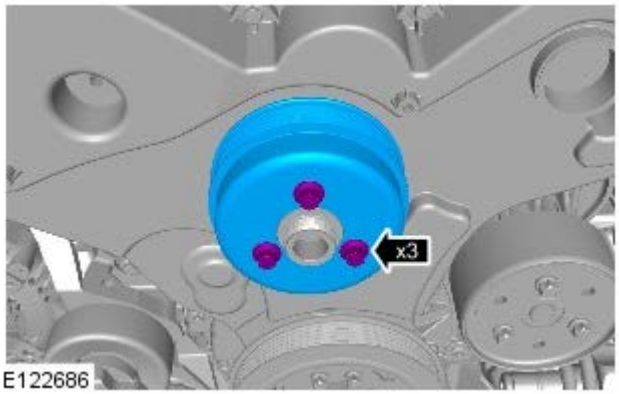
16. *Torque:* 5 Nm



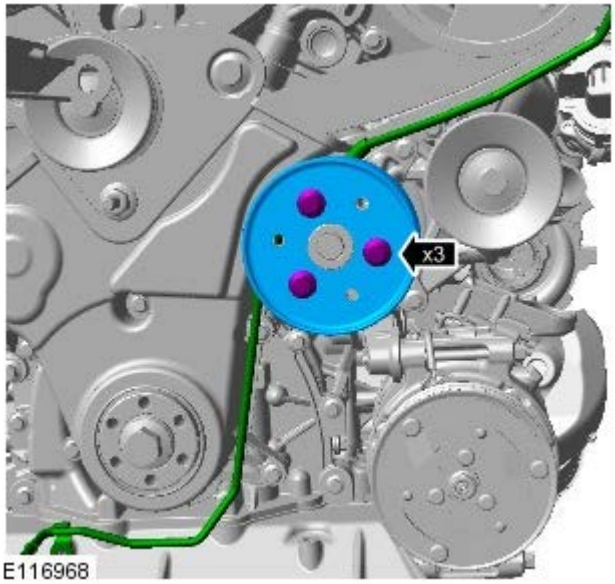
17. *Torque:* 47 Nm



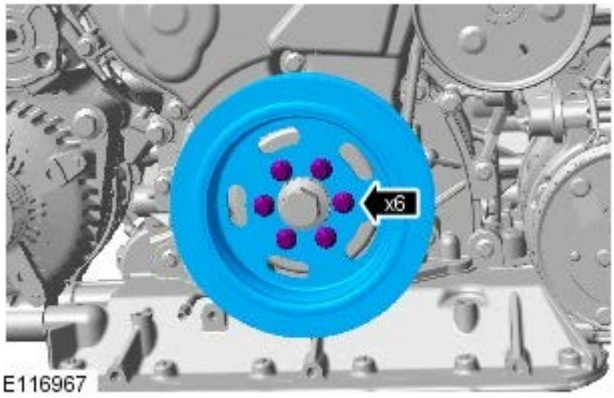
18. *Torque:* 24 Nm



19. *Torque:* 24 Nm

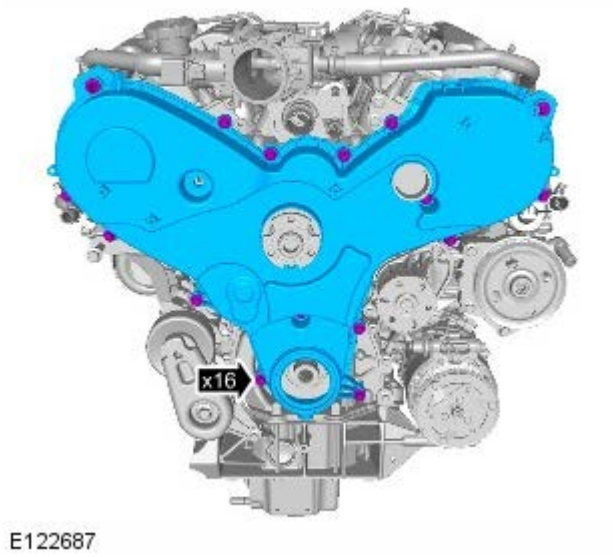


20. *Torque:* 25 Nm



21. NOTE: Engine shown removed for clarity.

Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.

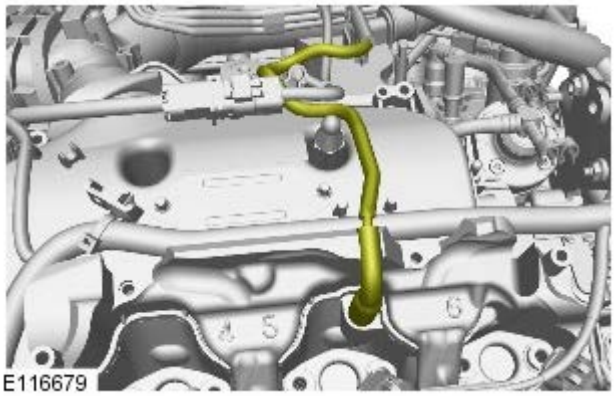
Published: 11-May-2011

Engine - TDV6 3.0L Diesel - Valve Cover LH

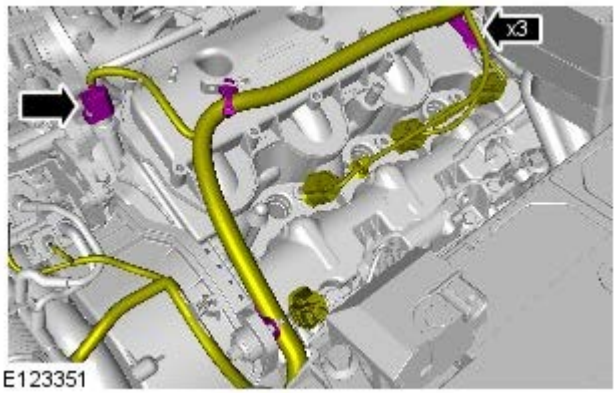
Removal and Installation

Removal

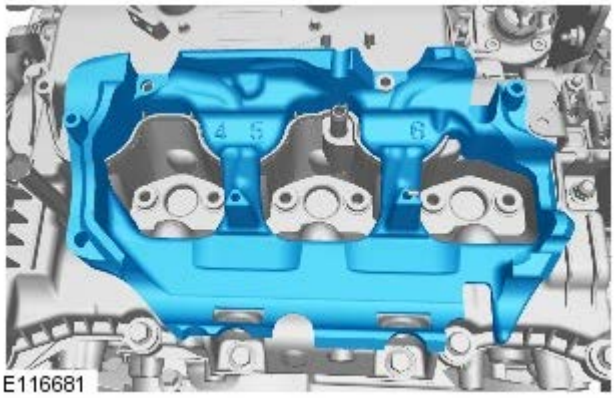
1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).
3. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
4. Refer to: Accessory Drive Belt (303-05, Removal and Installation).
5. Refer to: Fuel Rail LH (303-04, Removal and Installation).
6. Refer to: Intake Air Shutoff Throttle (303-04, Removal and Installation).
7. Refer to: Timing Cover (303-01, Removal and Installation).
8. Refer to: Fuel Injector (303-04, Removal and Installation).
9.



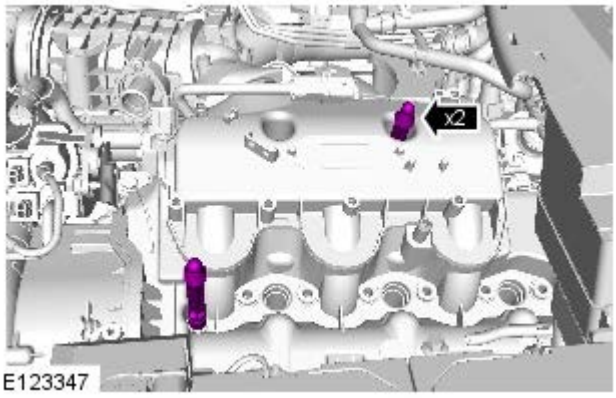
10.



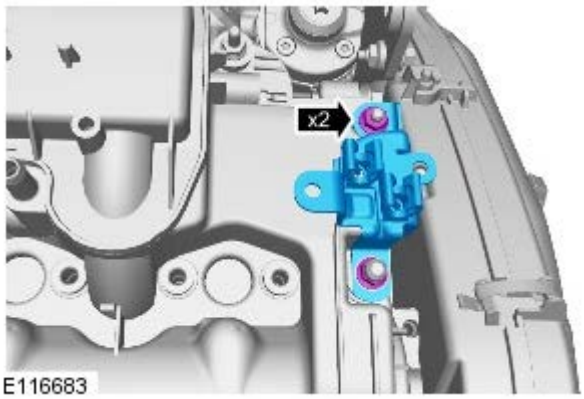
11.



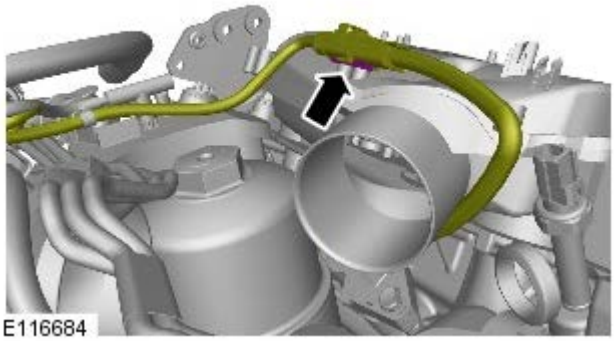
12.



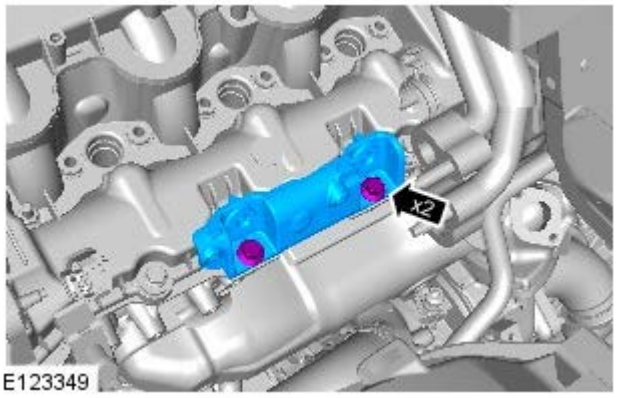
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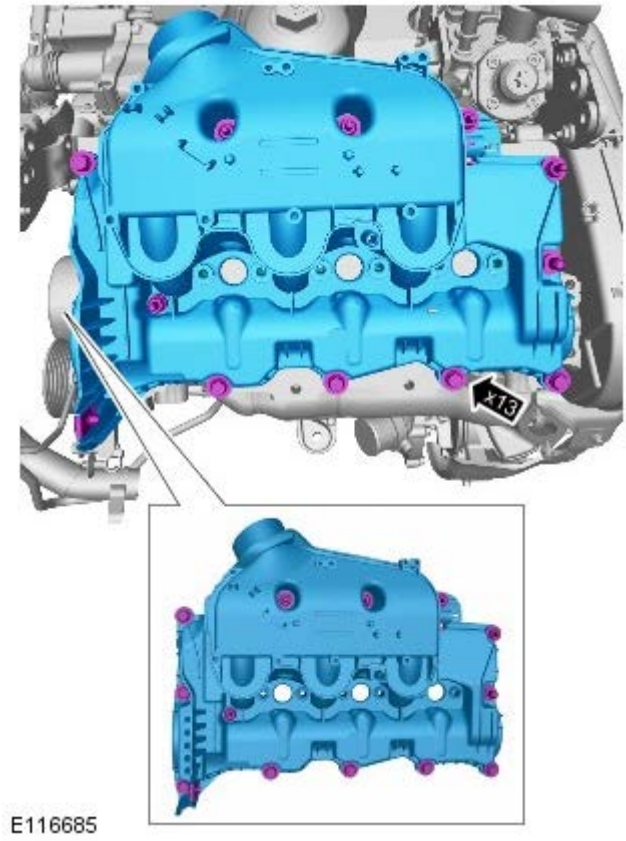


14.



15.





16. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

    NOTES:

    Discard the gasket.

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

Installation

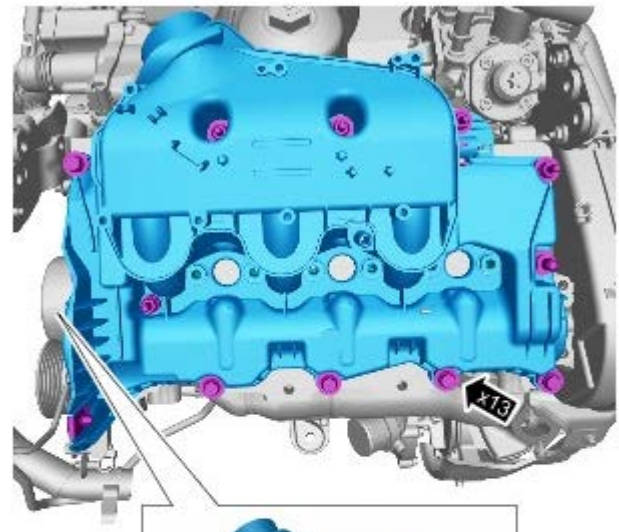
1. CAUTIONS:

   Make sure that the mating faces are clean and free of corrosion and foreign material.

   Install all the bolts finger tight before final tightening.

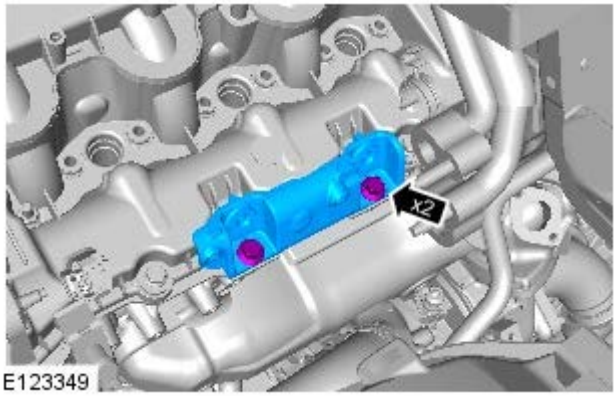
   NOTE: Install a new gasket.

   Torque: 10 Nm



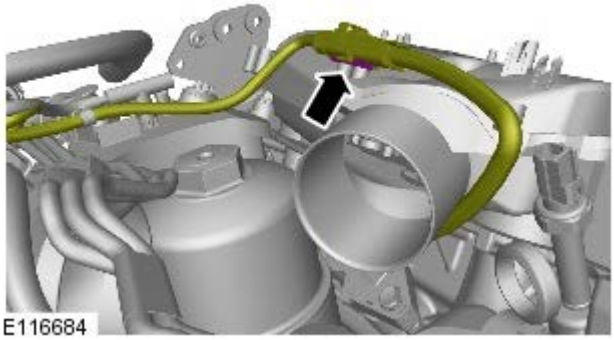
E116685

2. *Torque:* 23 Nm



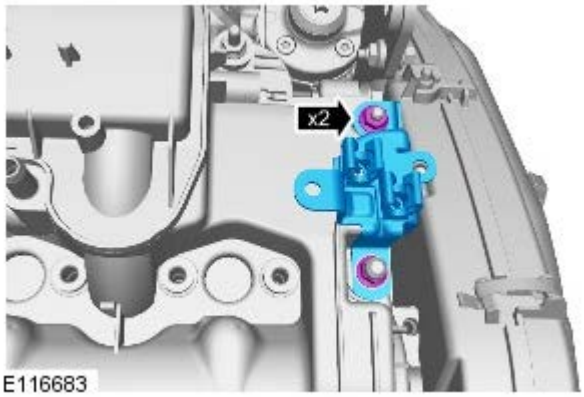
E123349

3.

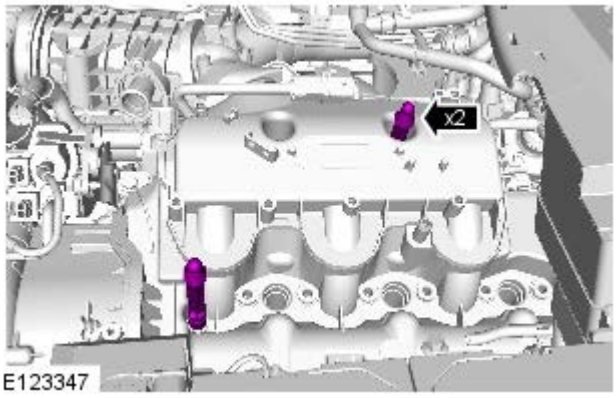


E116684

4. *Torque:* 10 Nm



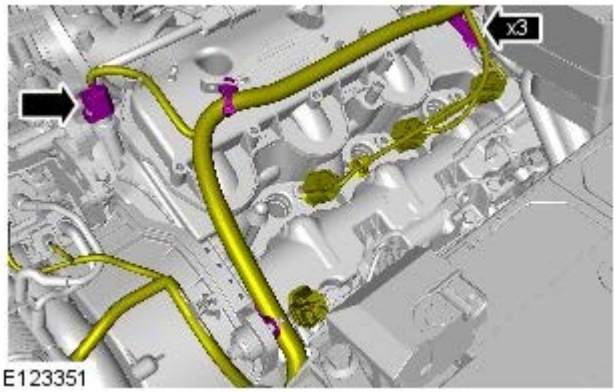
5. *Torque:* 5 Nm



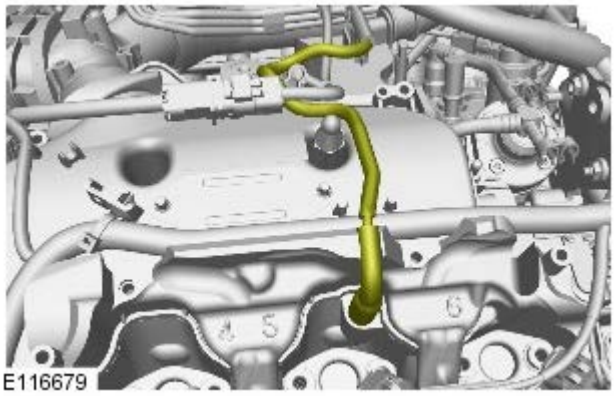
6.



7.



8.



9. Refer to: Fuel Injector (303-04, Removal and Installation).
10. Refer to: Timing Cover (303-01, Removal and Installation).
11. Refer to: Intake Air Shutoff Throttle (303-04, Removal and Installation).
12. Refer to: Fuel Rail LH (303-04, Removal and Installation).
13. Refer to: Accessory Drive Belt (303-05, Removal and Installation).
14. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
15. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).
16. Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

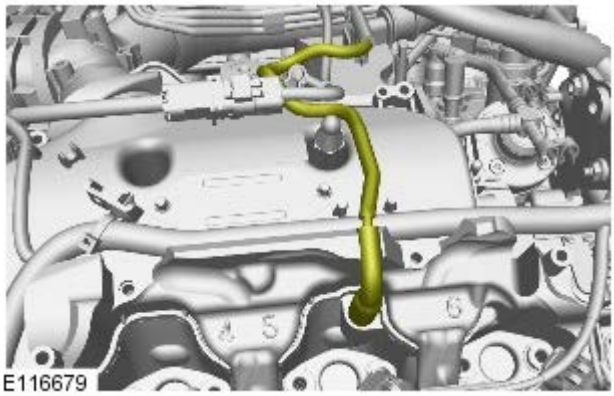
Engine - TDV6 3.0L Diesel - Valve Cover RH

Removal and Installation

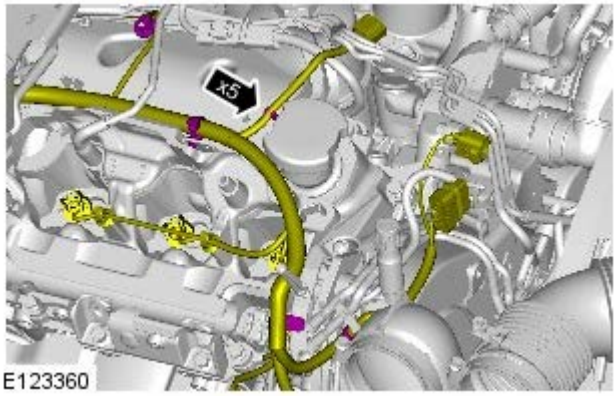
Removal

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

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Accessory Drive Belt (303-05, Removal and Installation).
3. Refer to: Fuel Rail RH (303-04, Removal and Installation).
4. Refer to: Intake Air Shutoff Throttle (303-04, Removal and Installation).
5. Refer to: Timing Cover (303-01, Removal and Installation).
6. Refer to: Fuel Injectors RH (303-04, Removal and Installation).
7.



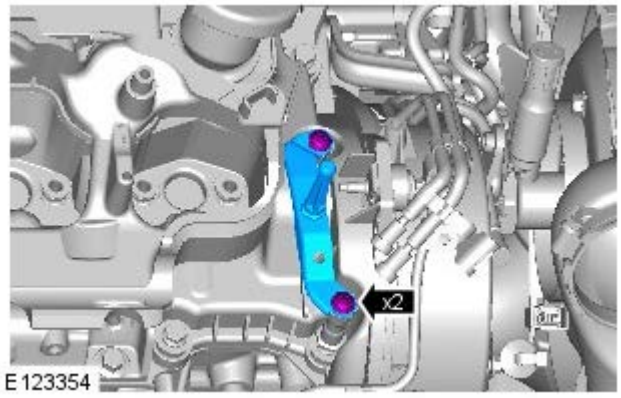
8.



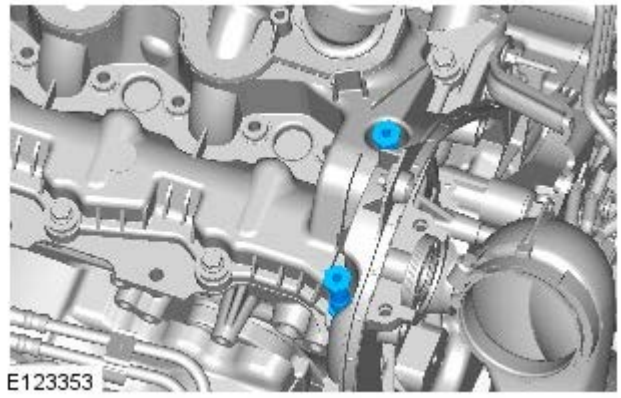
9.



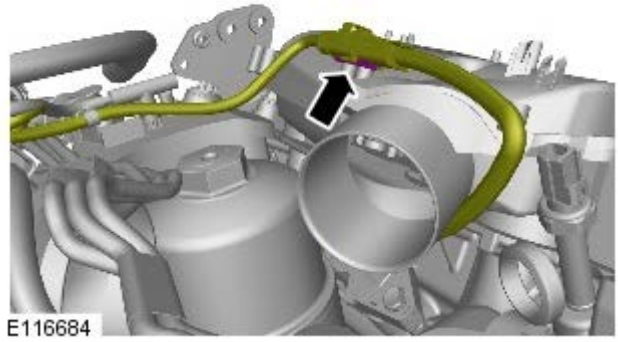
10.



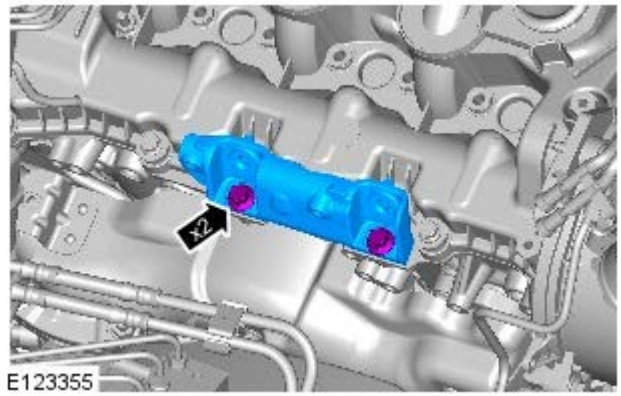
11.



12.

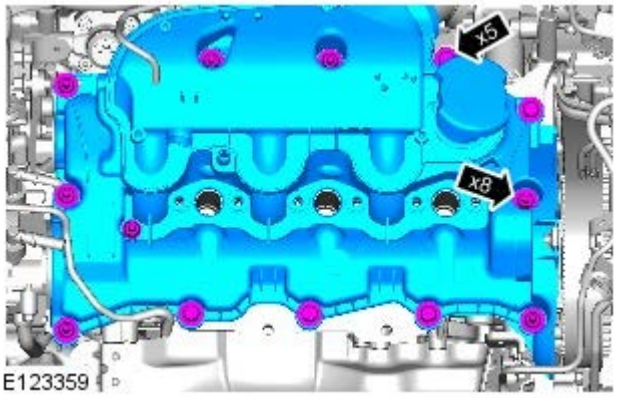


13.

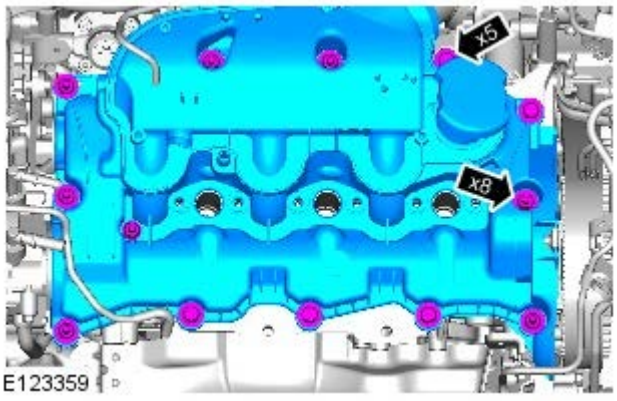


14. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

NOTE: Discard the gasket.



Installation



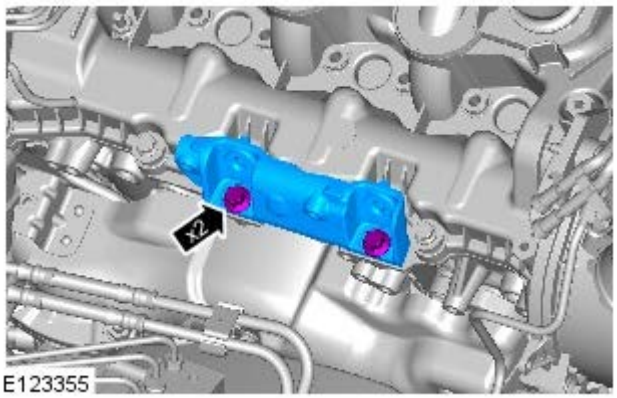
1. CAUTIONS:

   Make sure that the mating faces are clean and free of corrosion and foreign material.

   Install all the bolts finger tight before final tightening.

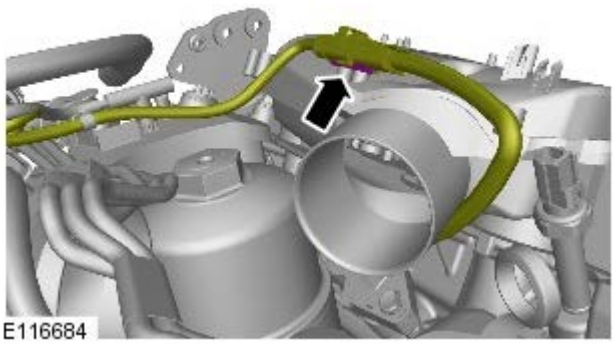
   NOTE: Install a new gasket.

   Torque: 10 Nm

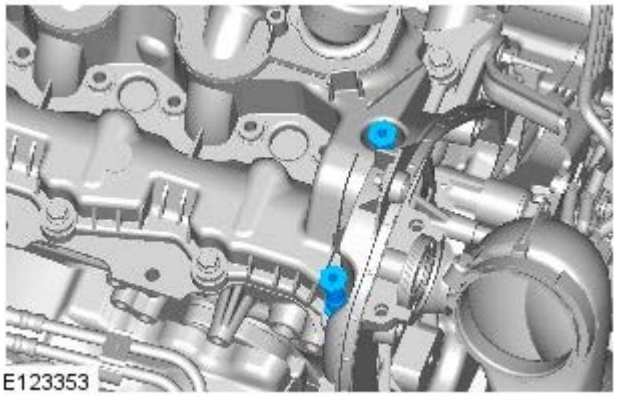


2. *Torque:* 23 Nm

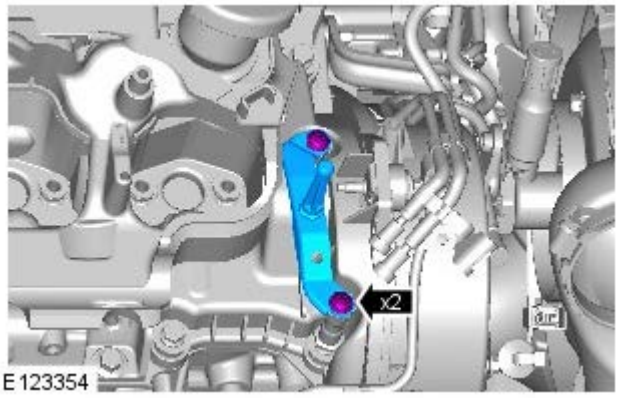
3.



4. *Torque:* 7 Nm



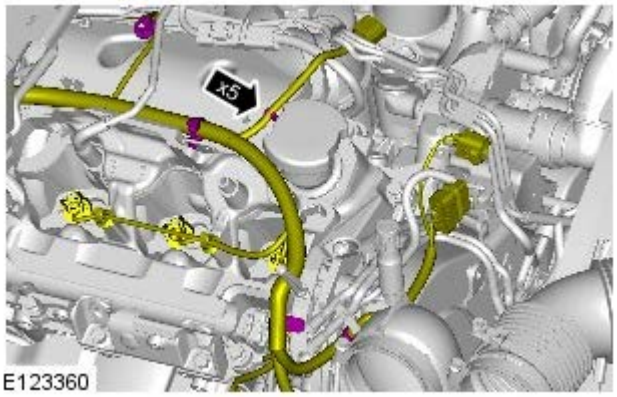
5. *Torque:* 7 Nm



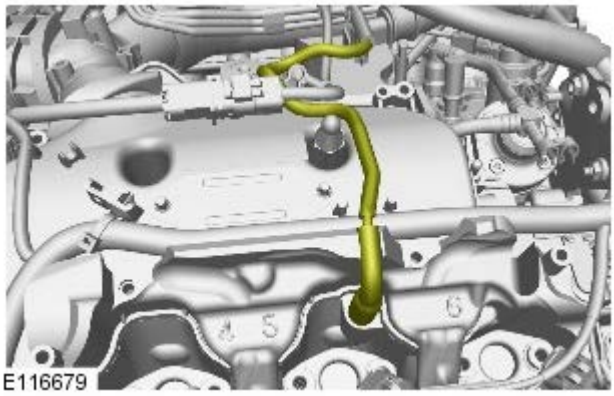
6.



7.



8.



9. Refer to: Fuel Injectors RH (303-04, Removal and Installation).
10. Refer to: Timing Cover (303-01, Removal and Installation).
11. Refer to: Intake Air Shutoff Throttle (303-04, Removal and Installation).
12. Refer to: Fuel Rail RH (303-04, Removal and Installation).
13. Refer to: Accessory Drive Belt (303-05, Removal and Installation).
14. Refer to: Specifications (414-00, Specifications).

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Engine - TDV6 3.0L Diesel - Engine

Removal

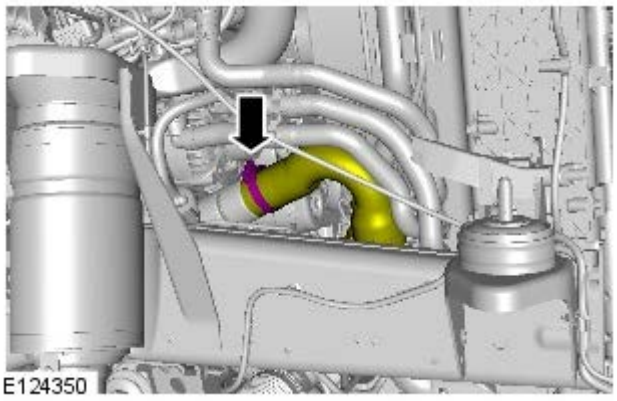
Special Tool(s)

 E54554	303-1129 Engine Lifting Brackets
 E116925	303-1497 Left-Hand Rear Engine Lifting Bracket

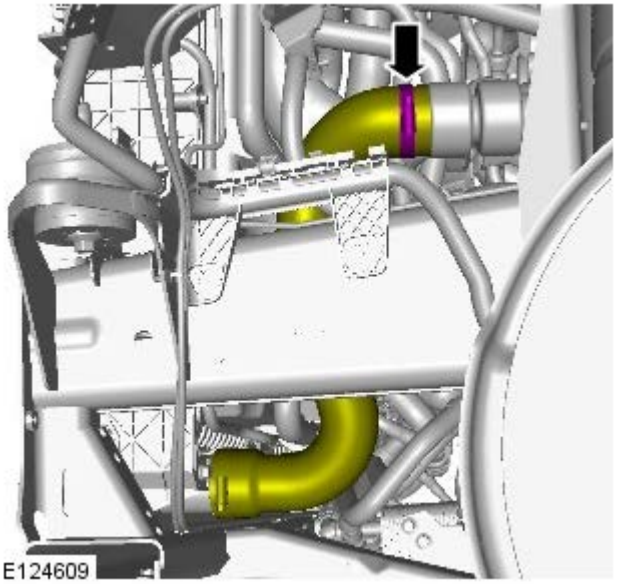
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Body - TDV6 2.7L Diesel/TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

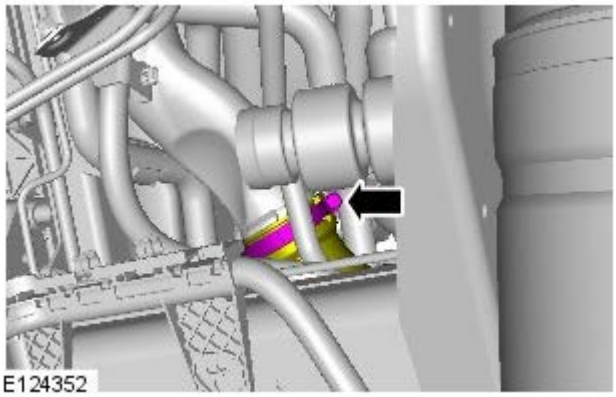
2. Refer to: Cooling Fan (303-03 Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).


E124350

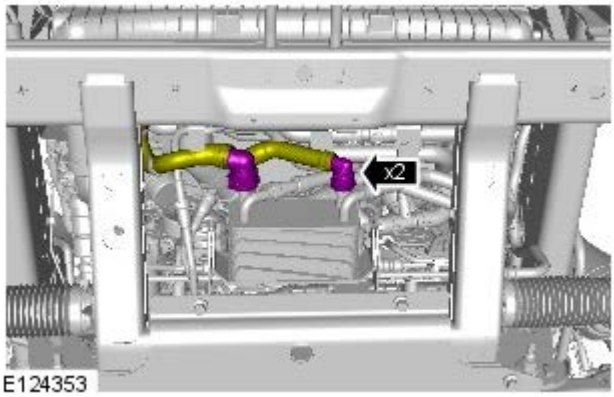
3. CAUTION: Make sure that all openings are sealed. Use new blanking caps.


E124609

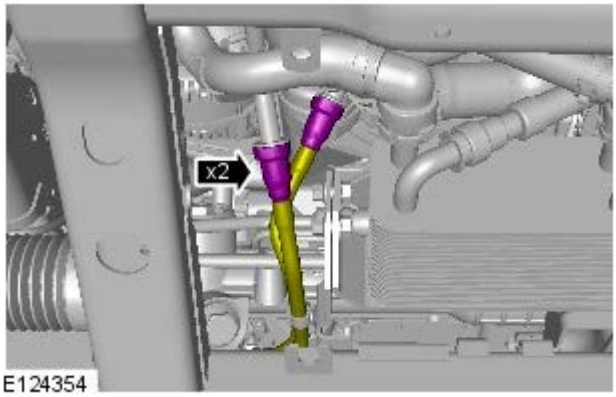
4. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



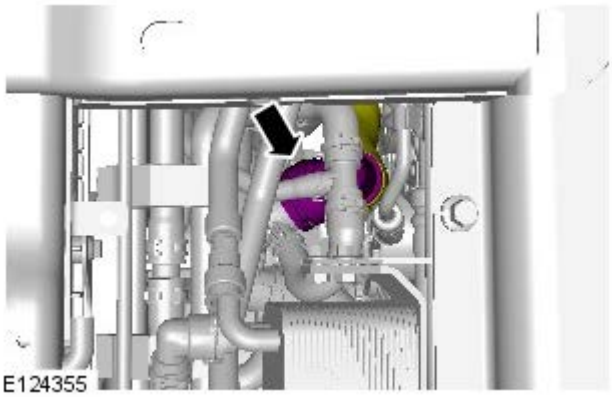
5. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



6. CAUTION: Be prepared to collect escaping coolant.

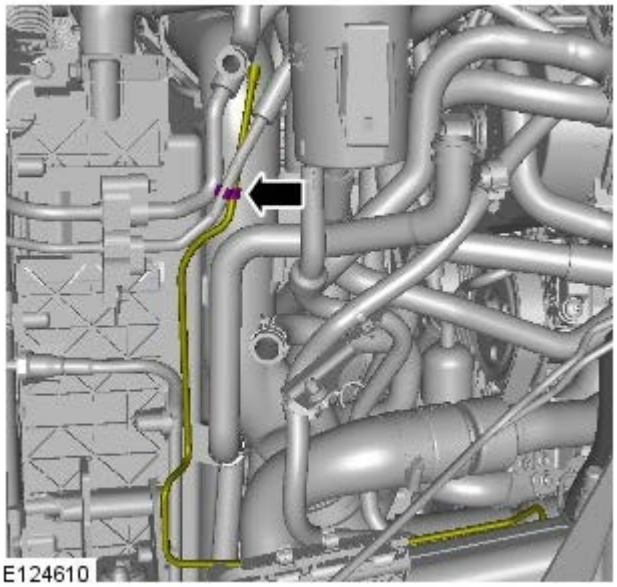


7. CAUTION: Be prepared to collect escaping coolant.

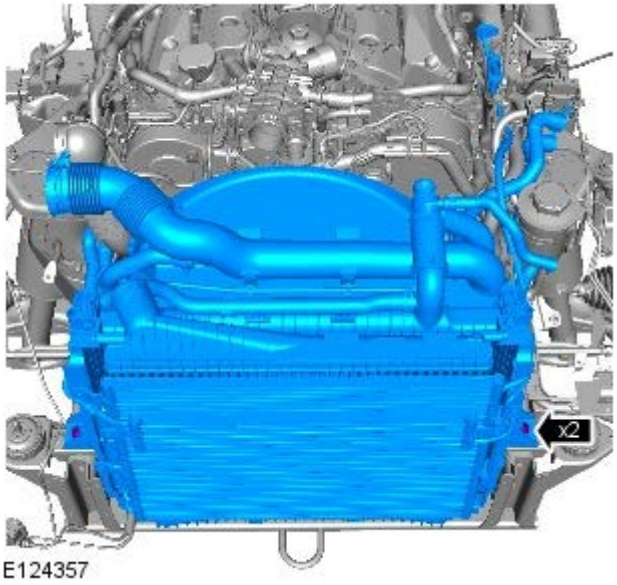


8. CAUTION: Be prepared to collect escaping coolant.

9.



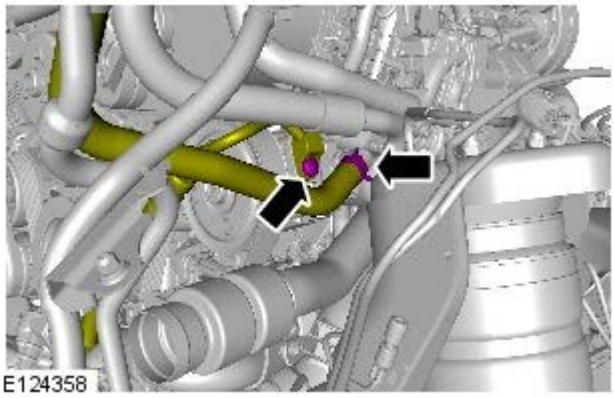
10.



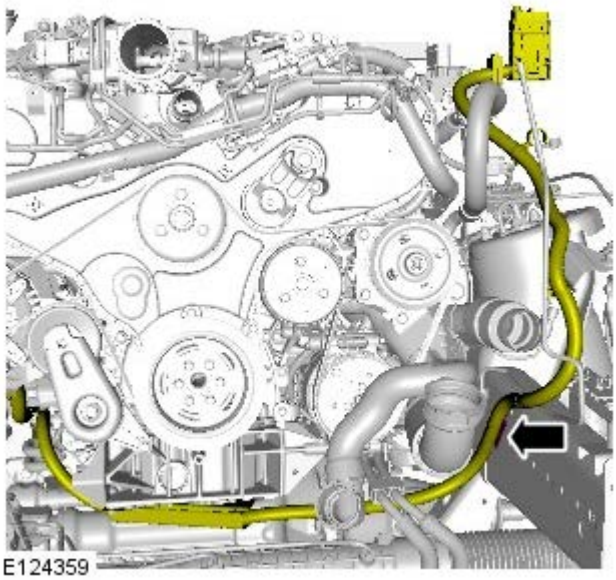
11. CAUTIONS:

Be prepared to collect escaping fluids.

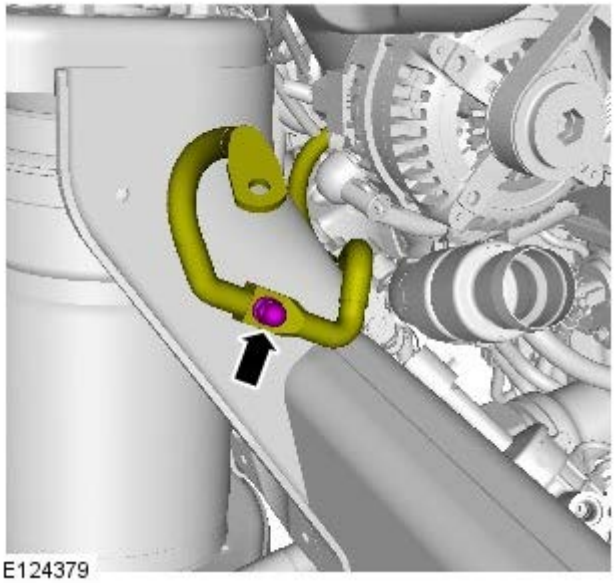
Make sure that all openings are sealed. Use new blanking caps.



12.

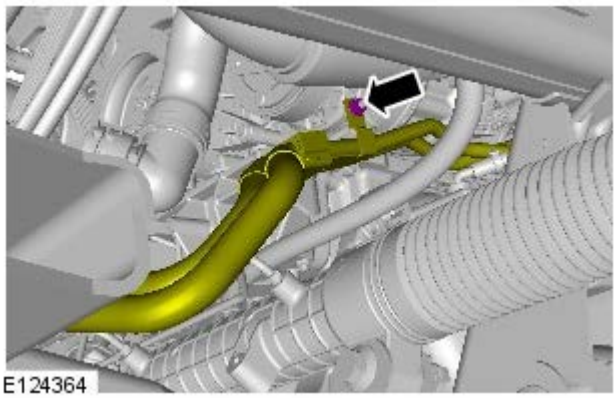

E124359

13.

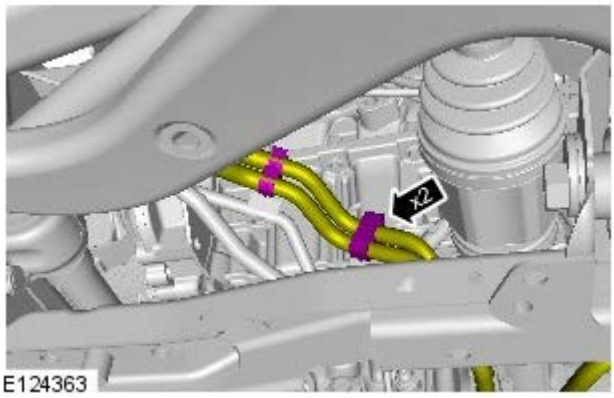

E124379

14. Refer to: Starter Motor (303-06 Starting System - TDV6 3.0L Diesel, Removal and Installation).

15.

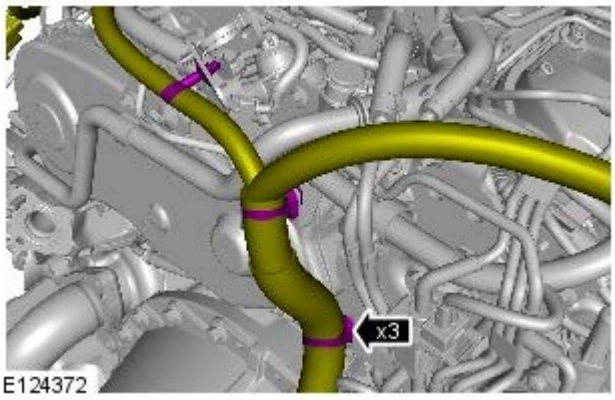

E124364

16.

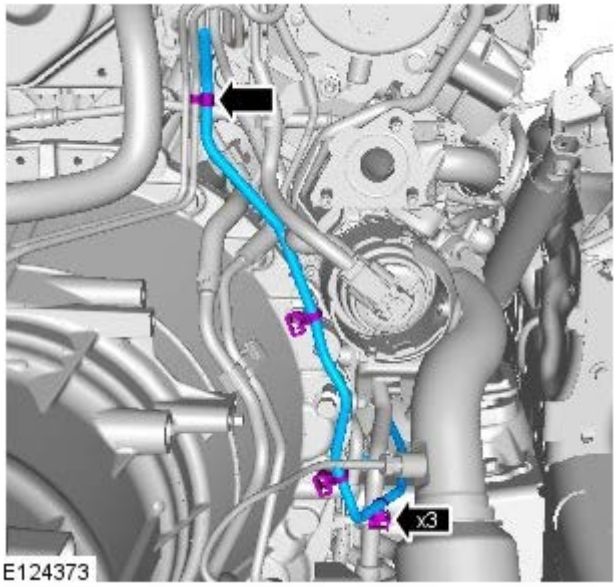


17. Refer to: Exhaust Manifold Crossover Pipe (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

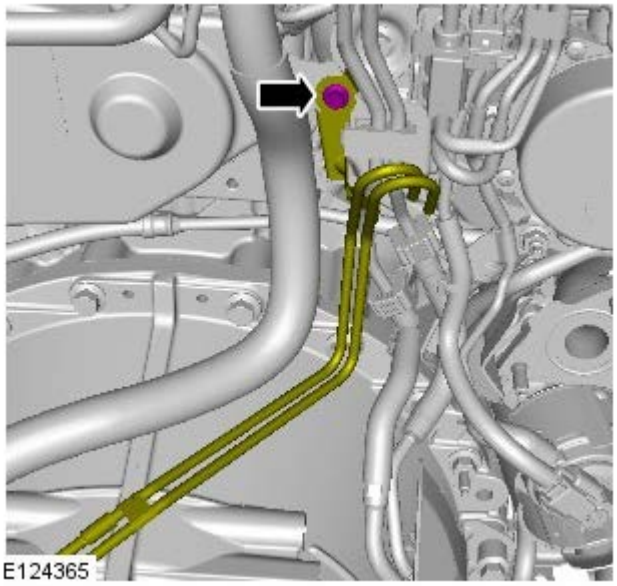
18.

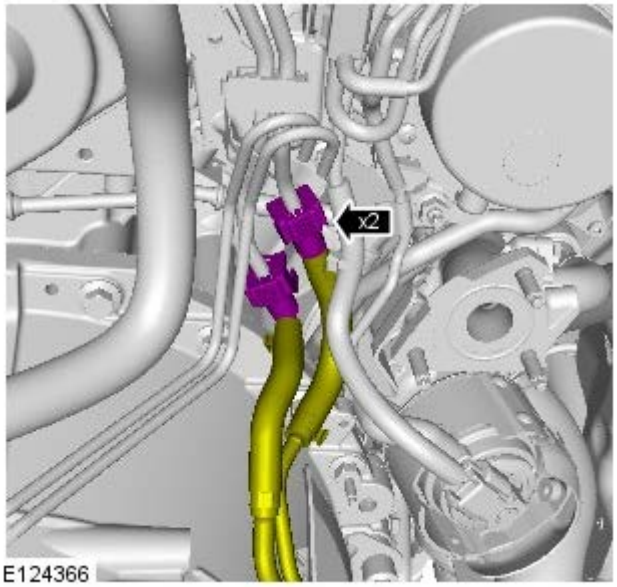


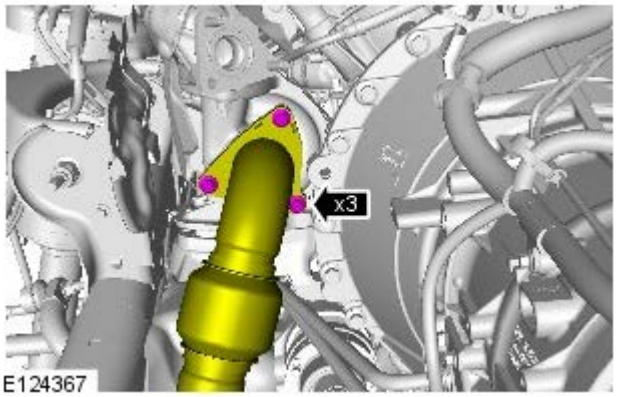
19.



20.







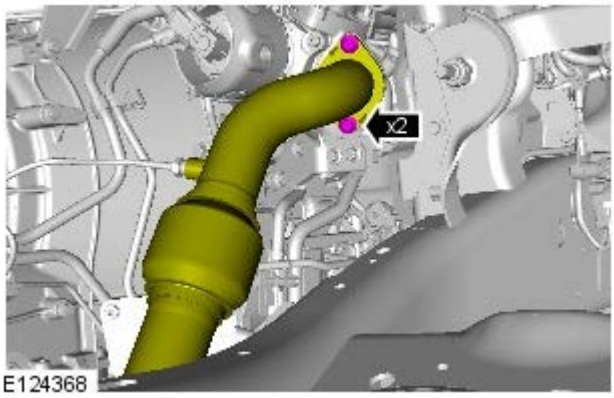
21. CAUTIONS:

    Be prepared to collect escaping fuel.

    Make sure that all openings are sealed. Use new blanking caps.

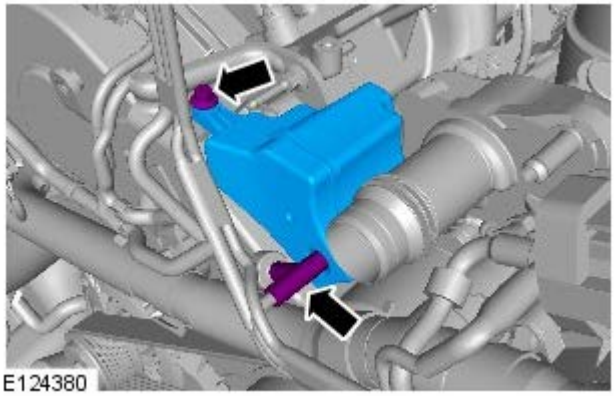
22. NOTE: Remove and discard the gasket.

23. NOTE: Remove and discard the gasket.

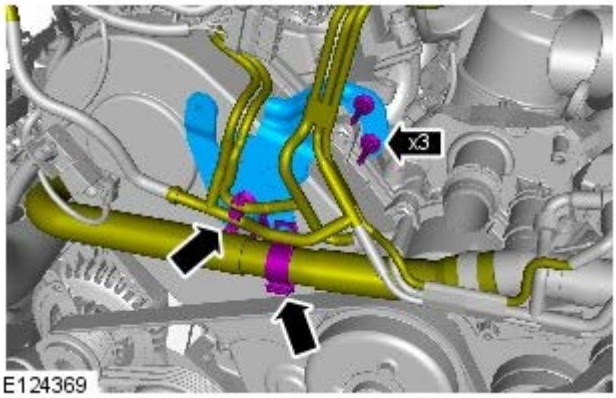


24. Refer to: Intake Air Shutoff Throttle (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

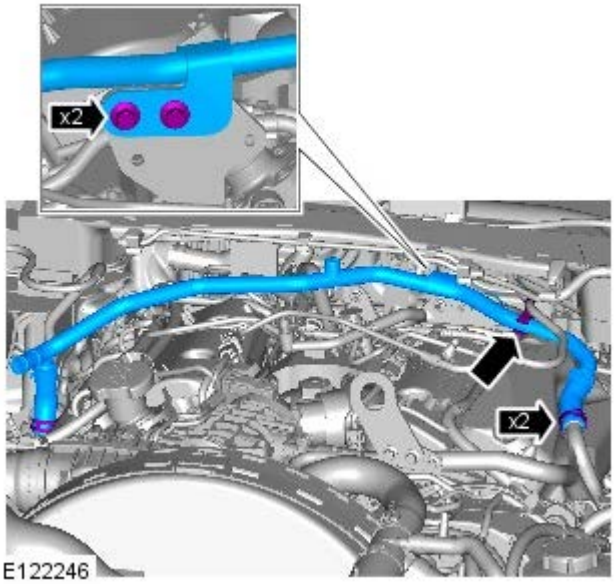
25.



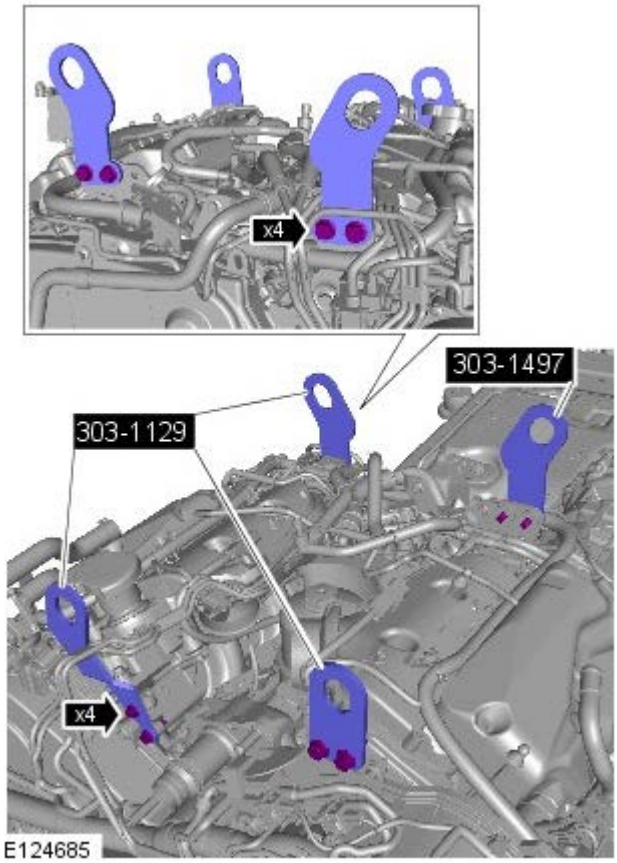
26.



27. CAUTION: Make sure that all openings are sealed.

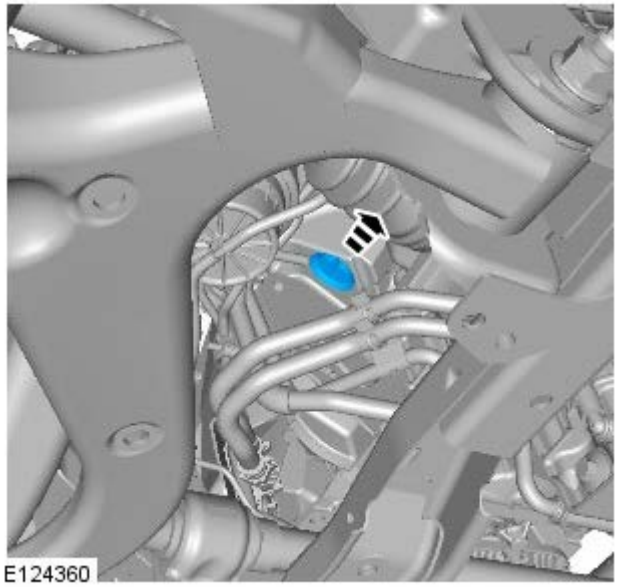


28. *Special Tool(s):* 303-1129, 303-1497

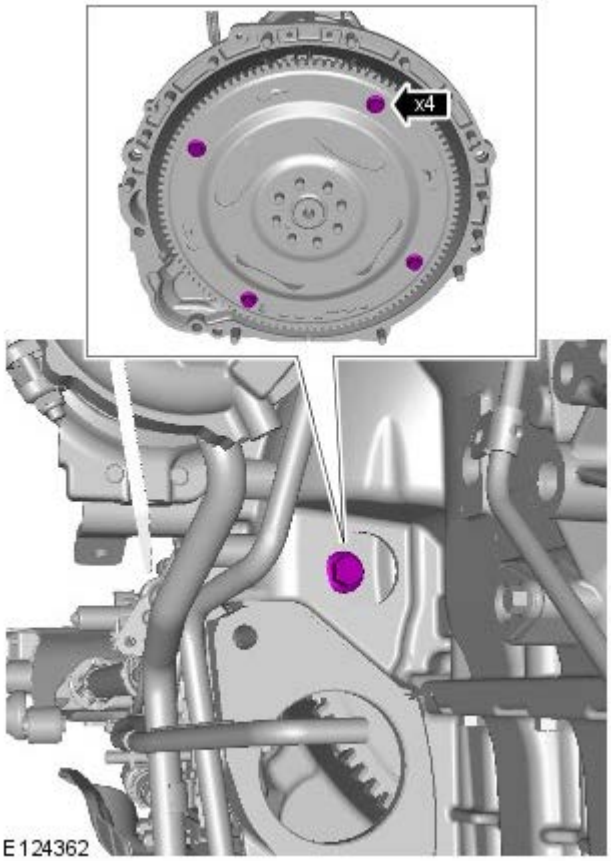


Torque:
M6 bolts 8 Nm
M8 bolts 22 Nm

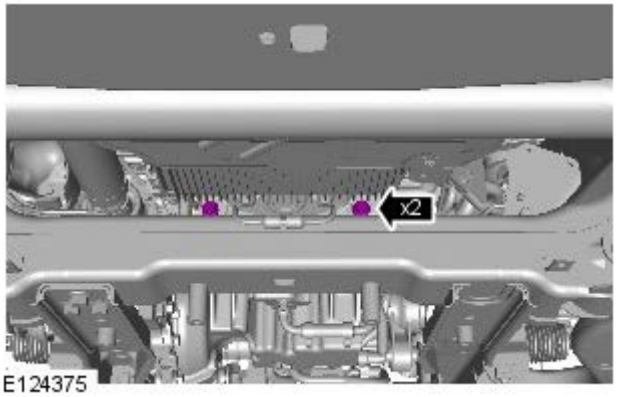
29.



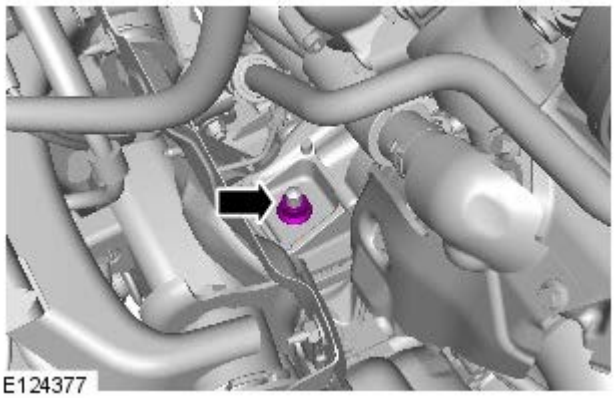
30. CAUTION: Discard the bolts.



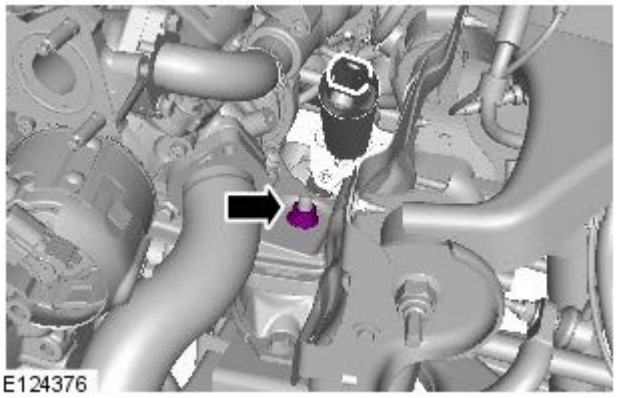
31.



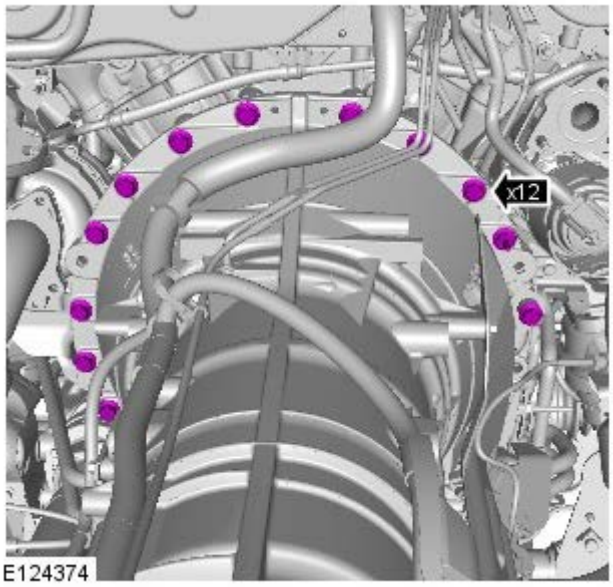
32.



33.



34. Using a suitable tool, support the transmission.

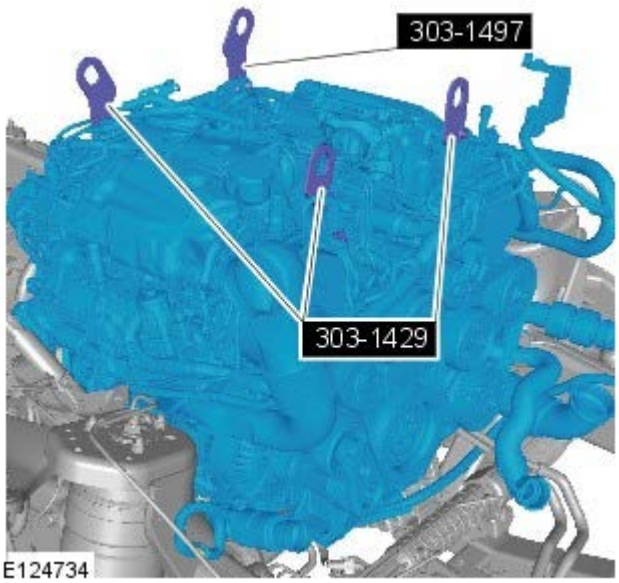


35. NOTES:

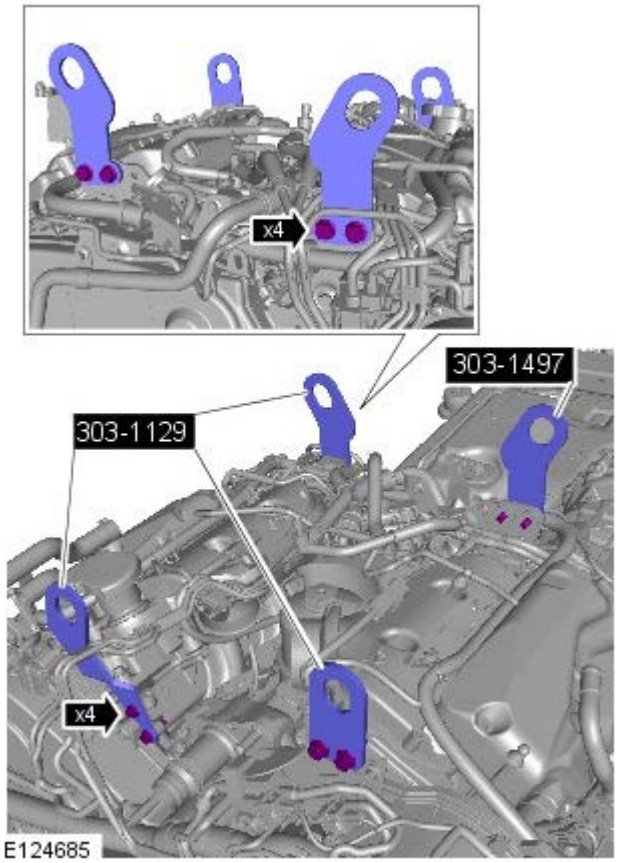
Note the routing of the battery positive cable.

Note the routing of the transmission wiring harness.

This step requires the aid of another technician.



36. *Special Tool(s):* 303-1129, 303-1497


x4
303-1497
303-1129
x4
E124685

Published: 06-Jun-2013

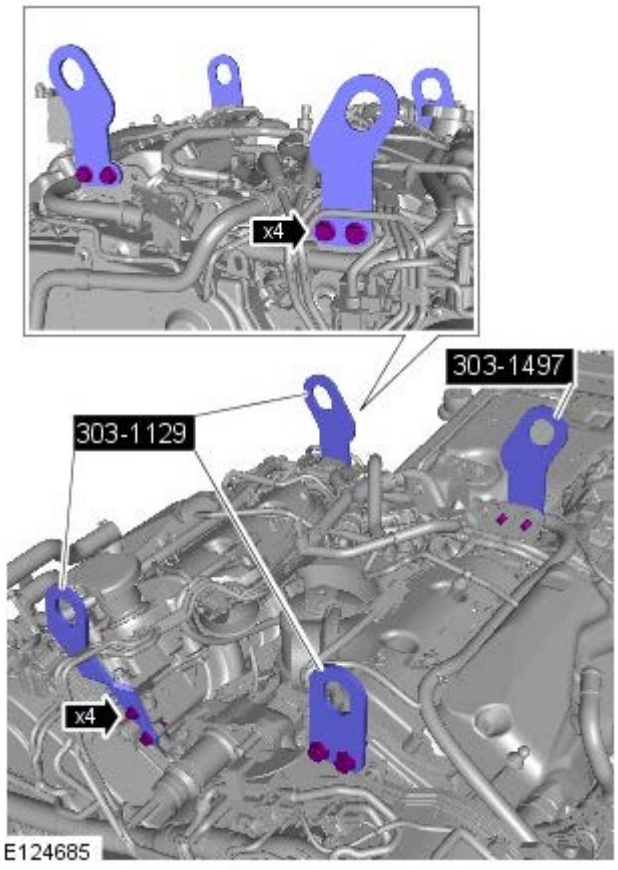
Engine - TDV6 3.0L Diesel - Engine

Installation

Special Tool(s)

 E54554	303-1129 Engine Lifting Brackets
 E116925	303-1497 Left-Hand Rear Engine Lifting Bracket

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



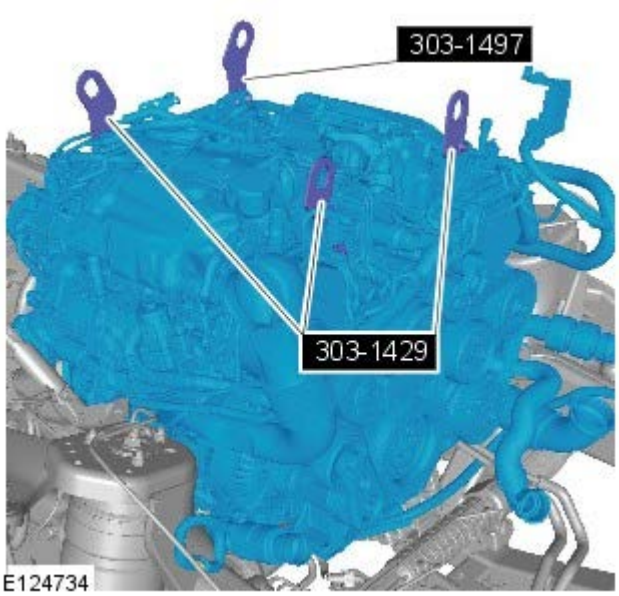
1. *Special Tool(s):* 303-1129, 303-1497
   Torque:
   M6 bolts 8 Nm
   M8 bolts 22 Nm

2. CAUTIONS:

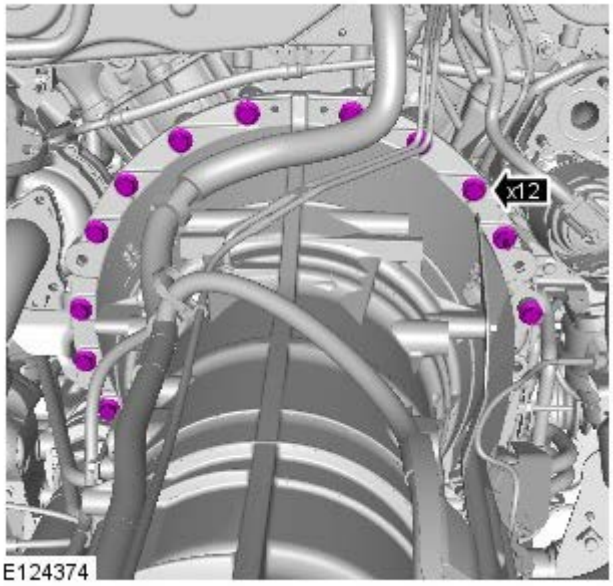
   Apply grease of the correct specification to the torque converter spigot.

   Make sure the torque converter is fully located into the oil pump drive.

   Make sure that the mating faces are clean and free of foreign material.

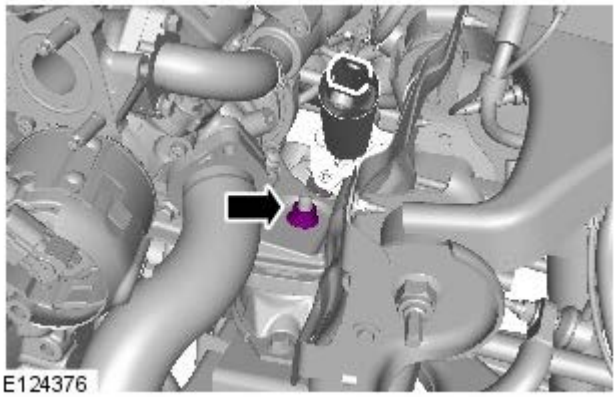


NOTE: This step requires the aid of another technician.



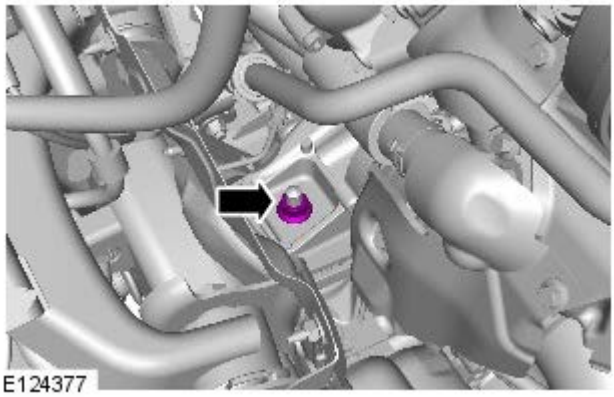
3. CAUTION: Make sure the torque converter remains connected to the transmission.

   Torque: 40 Nm

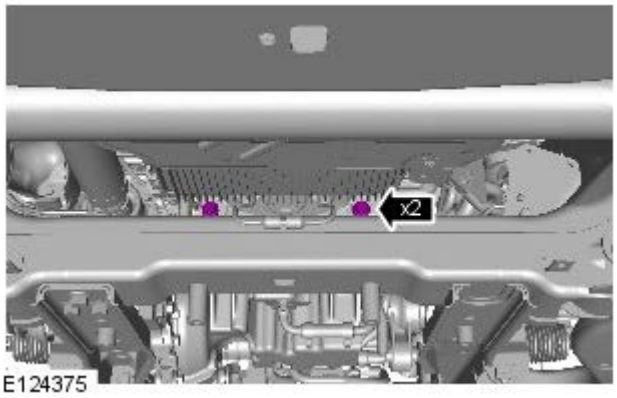


4. *Torque:* 90 Nm

5. *Torque:* 90 Nm



6. *Torque:* 40 Nm

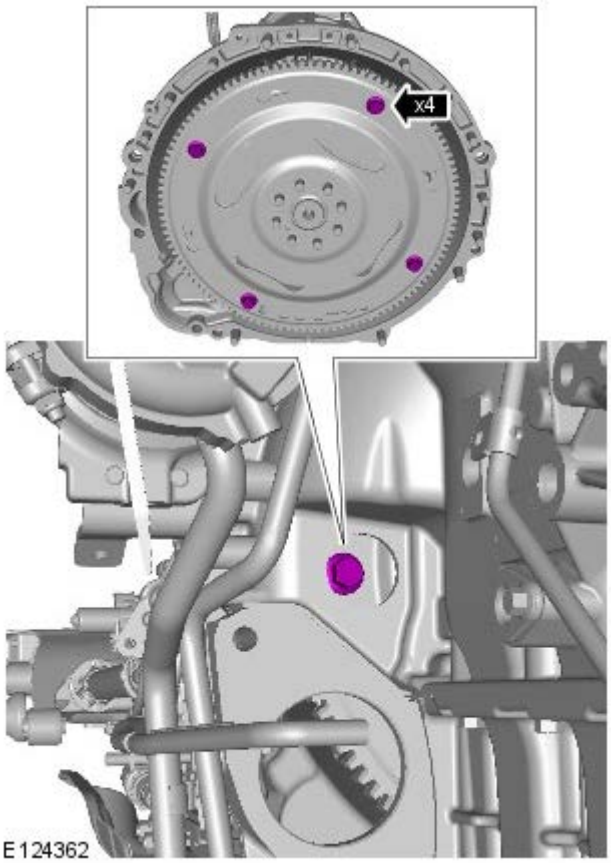


7. CAUTIONS:

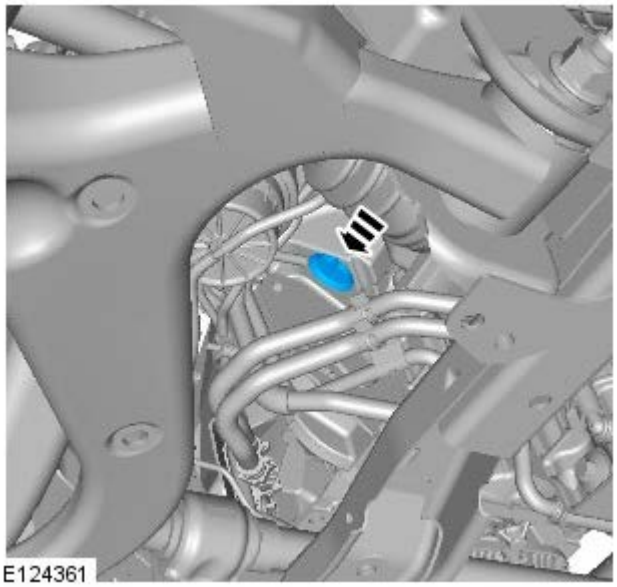
   Only rotate the crankshaft clockwise.

   Make sure that new bolts are installed.

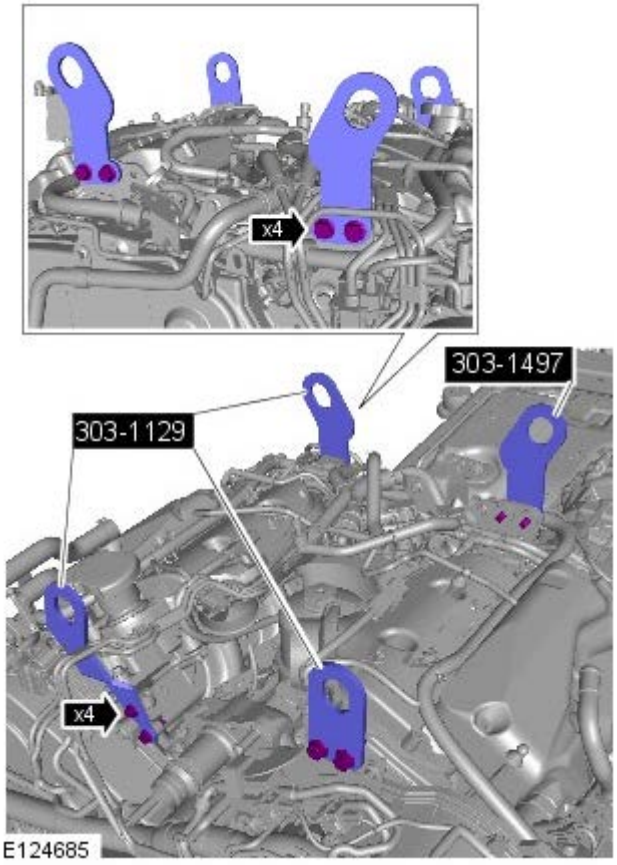
   Torque: 63 Nm



8.

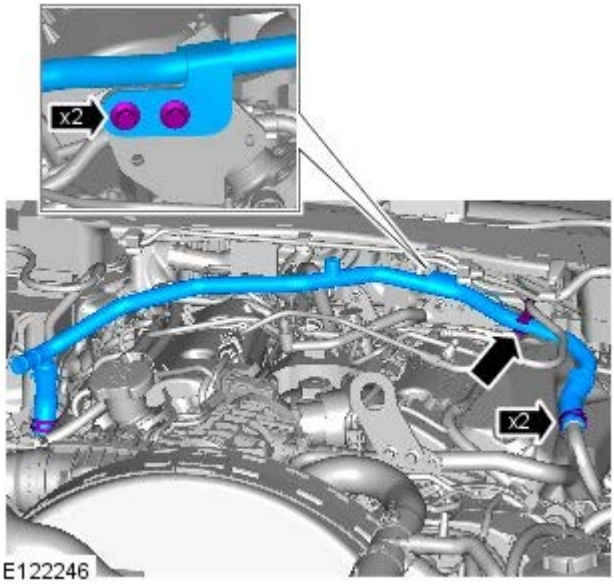


9. *Special Tool(s):* 303-1129, 303-1497

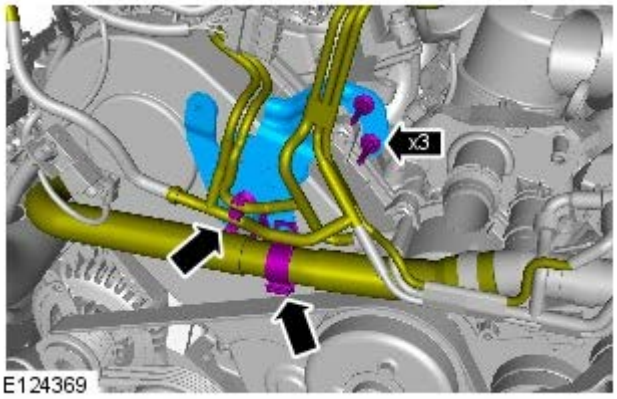


10. NOTE: Remove and discard the blanking caps.

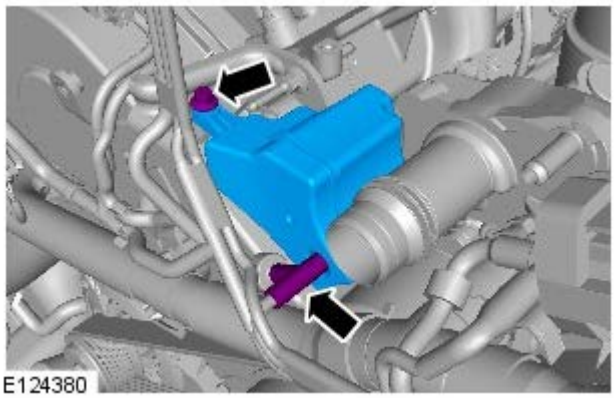
Torque: 10 Nm



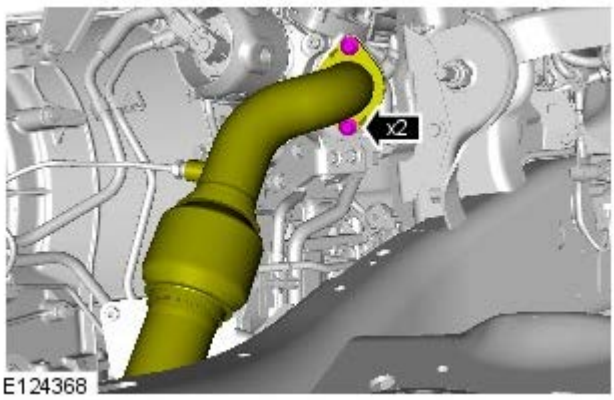
11. *Torque:* 8 Nm



12. *Torque:* 8 Nm



13. Refer to: Intake Air Shutoff Throttle (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

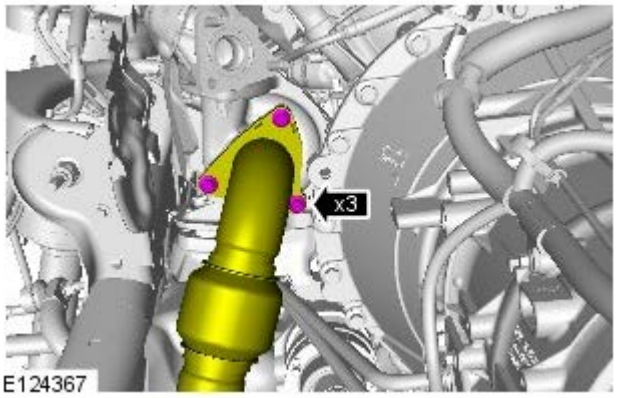


14. NOTES:

Make sure that all the component mating faces are clean.

Install a new gasket.

Torque: 28 Nm

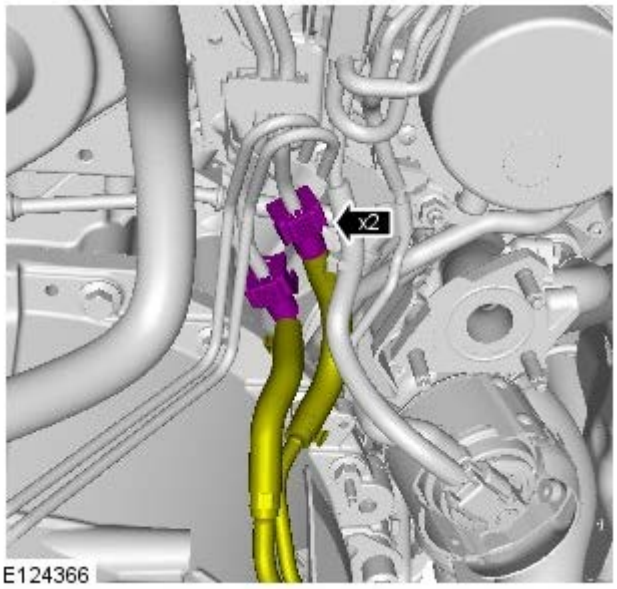


15. NOTES:

Make sure that all the component mating faces are clean.

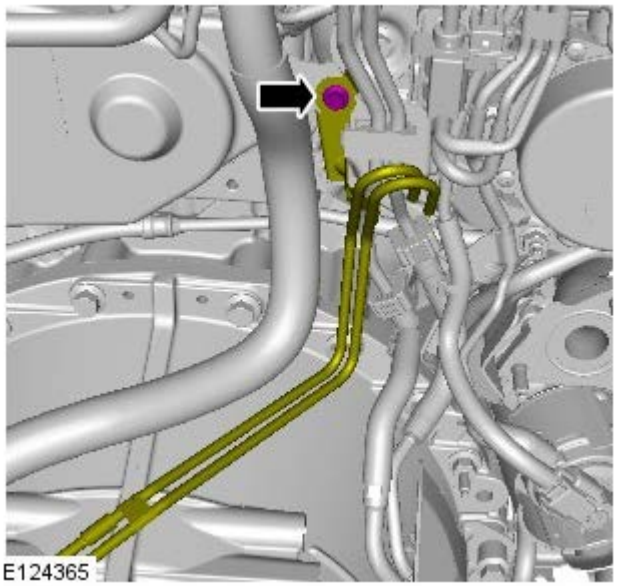
Install a new gasket.

Torque: 28 Nm

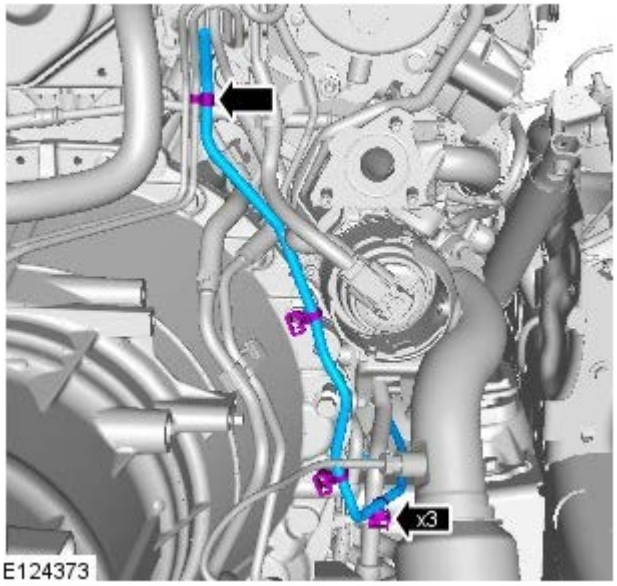


16. NOTE: Remove and discard the blanking caps.

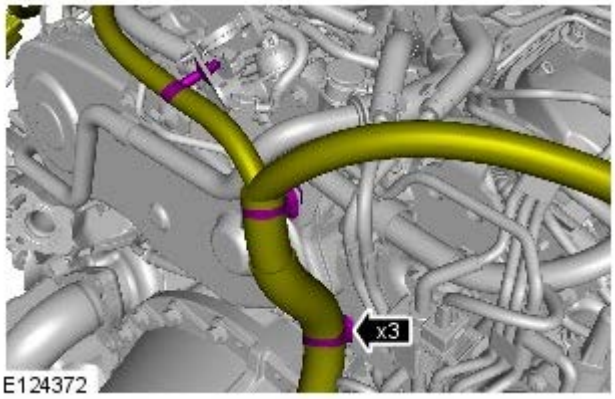
17. *Torque:* 7 Nm



18.

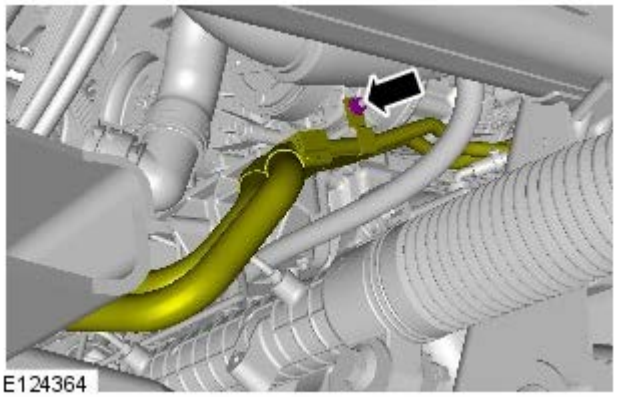


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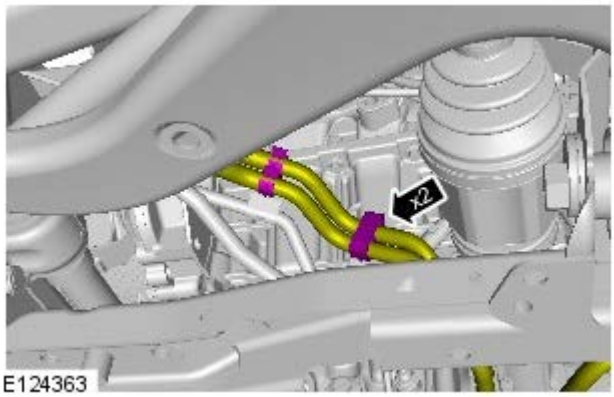


20. Refer to: Exhaust Manifold Crossover Pipe (303-01A Engine - TDV6 3.0L Diesel, Removal and Installation).

21. *Torque:* 10 Nm



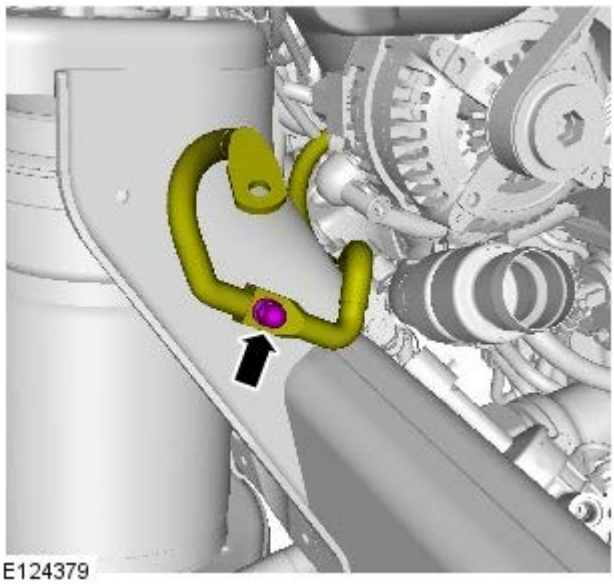
22.



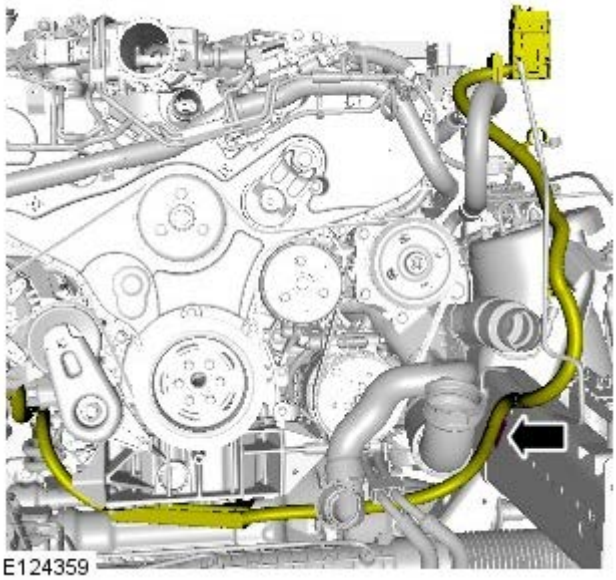
23. Refer to: Starter Motor (303-06 Starting System - TDV6 3.0L

Diesel, Removal and Installation).

24. *Torque:* 22 Nm

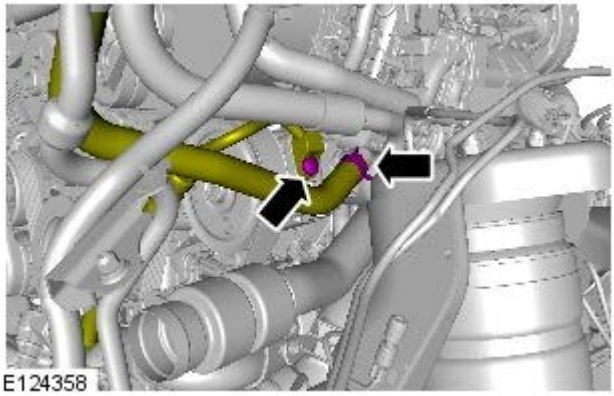

E124379

25.

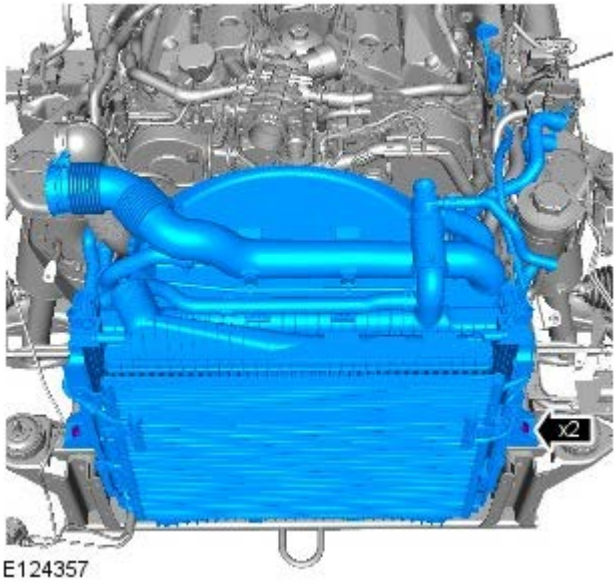

E124359

26. NOTE: Remove and discard the blanking caps.

Torque: 25 Nm

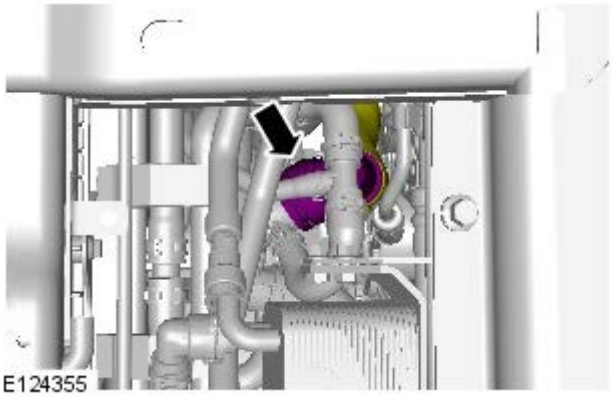

E124358

27. *Torque:* 15 Nm

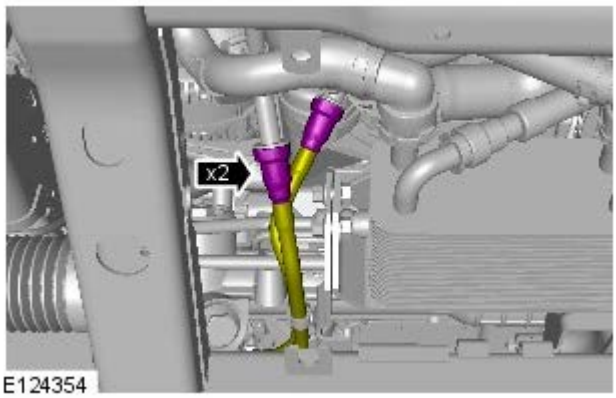


E124357

28.

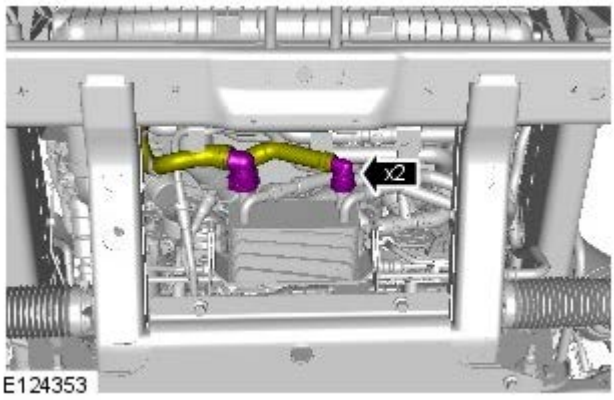

E124355

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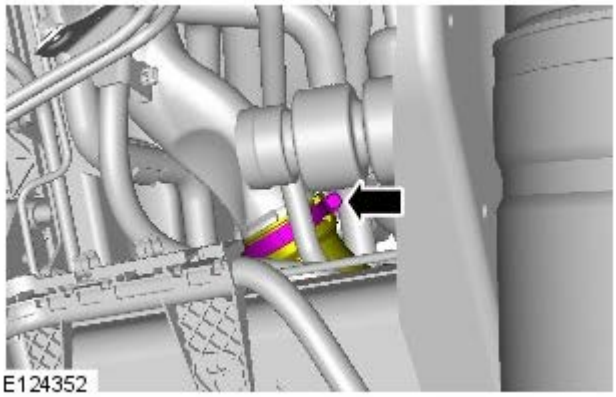
E124354

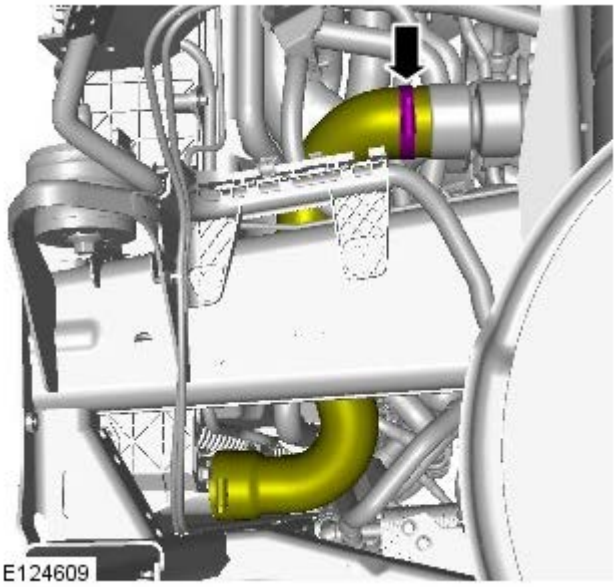
30.



E124353

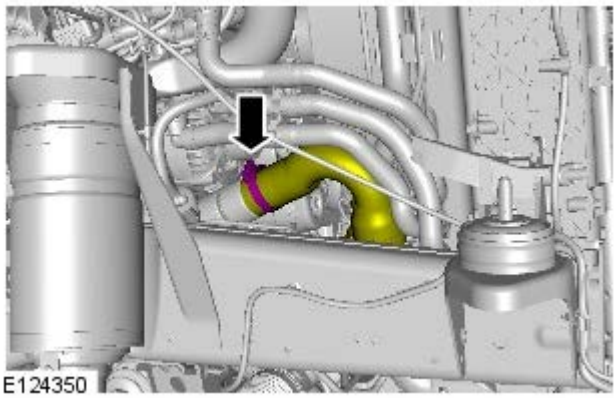
31. NOTE: Remove and discard the blanking caps.





32. NOTE: :Remove and discard the blanking caps.

    Torque: 5 Nm



33. NOTE: Remove and discard the blanking caps.

    Torque: 5 Nm

34. Refer to: Cooling Fan (303-03 Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).

35. Refer to: Body - TDV6 2.7L Diesel/TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

36. Refer to: Power Steering System Filling and Bleeding (211-00 Steering System - General Information, General Procedures).

Published: 21-Mar-2012

Engine - V8 5.0L Petrol -

Engine Data

Engine Description	Engine Capacity	Maximum Engine Torque (EEC)	Maximum Engine Power (EEC)	Compression Ratio	Bore	Stroke
• 90° "Vee" • 8 Cylinder • 32 Valves	4.999 ccm	510 Nm at 3.500 RPM	276 kW at 6.500 RPM	11.5 ± 0.5	92.5 mm	93 mm

Engine Firing Order

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

Engine Valve Clearance (cold)

Intake Valve	Exhaust Valve
N/A	0.25 mm ± 0.02

Spark Plugs

Specification	Spark Plug Gap
ILKR6C-10	1 mm

Lubricants, Fluids, Sealers and Adhesives

Description	Specification
Engine Oil	WSS-M2C925-A
Sealant	WSE-M4G323-A6
Core plug and stub pipe retainer	WSK-M2G349-A7

Capacities

Description	Liters
Engine oil, initial fill	9.5
Engine oil, service fill with oil filter change	8.0

Cylinder Head and Valve Train

Item	Specification
Cylinder head maximum permitted warp (mm) (flatnes specfication)	
overall	0.08
over 150x150 mm area	0.05
over 25x25 mm area	0.02
Valve guide inner diameter (mm)	5.51 ± 0.01
Intake valve effective length (mm) (tip to gauge line)	97.63 ± 0.1
Exhaust valve effective length (mm) (tip to gauge line)	94.39 ± 0.1
Valve stem to guide clearance intake diametrical (mm)	0.022 - 0.057
Valve stem to guide clearance exhaust diametrical (mm)	0.03 - 0.065
Valve head diameter intake (mm)	36 ± 0.1
Valve head diameter exhaust (mm)	30 ± 0.1
Intake valve face angle (degrees)	44.875 ± 0.125
Exhaust valve face angle (degrees)	44.875 ± 0.125
Valve stem diameter intake (mm)	5.4705 ± 0.0075
Valve stem diameter exhaust (mm)	5.4625 ± 0.0075
Valve spring free length (mm) - inlet	43.43
Valve spring free length (mm) - exhaust	46.1
Valve spring installed height (mm) - inlet	34.49
Valve spring installed height (mm) - exhaust	35.1
Camshaft lobe lift intake (mm)	5.5 (low) 10.53 (high)
Camshaft lobe lift exhaust (mm)	9.36
Camshaft journal to cylinder head bearing surface clearance diametrical (mm)	0.025 - 0.065
Camshaft journal diameter - all positions	26.965 ± 0.01
Bearing diameter - all positions	27.01 ± 0.01
Camshaft journal maximum run out limit (mm)	
Camshaft journals to end journals	0.03
Camshaft journals to adjacent journals	0.015
Camshaft journal maximum out of round (mm) - all journals	0.005

Torque Specifications

NOTE: **A = Refer to procedure for correct torque sequence.**

Description	Nm	lb-ft	lb-in
Engine cover mounting bolts	10	7	-
Accessory drive belt tensioner retaining bolt	40	30	-
Supercharger belt idler/tensioner bracket retaining bolts	25	18	-
Secondary drive belt idler retaining bolts	40	30	-
Power steering pump pulley retaining bolts	25	18	-
Power steering pump retaining bolts	25	18	-

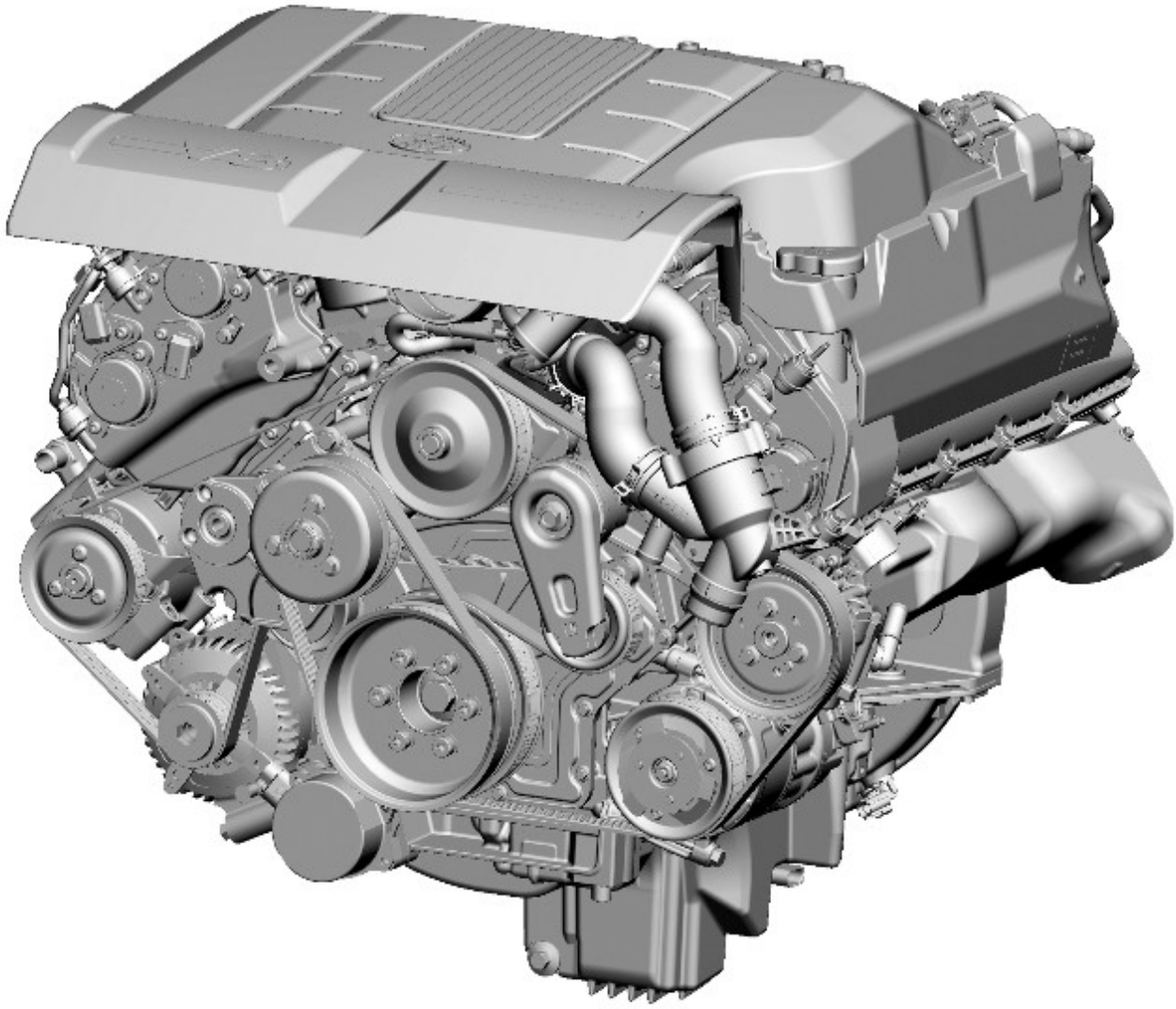
Power steering pump bracket to engine retaining bolts	25	18	-
Generator retaining bolts	48	35	-
Starter motor retaining bolts	40	30	-
Air conditioning compressor retaining bolts	25	18	-
Engine mounting to engine mounting bracket retaining nuts	100	74	-
Engine mounting to subframe retaining bolts	56	41	-
Engine mounting bracket to engine retaining bolts	45 + 60°	33 + 60°	-
Crankshaft damper pulley retaining LH threaded bolt	200 + 270°	148 + 180°	-
Flexplate retaining bolts	45 + 90°	33 + 90°	-
Exhaust manifold heat shield retaining bolts	**A**	-	-
Exhaust manifold retaining bolts	**A**	-	-
Engine wiring harness bracket retaining bolts	10	7	-
Coolant outlet pipe	10	7	-
Intercooler retaining bolts	25	18	-
Intake manifold retaining bolts	25	18	-
Oil Cooler retaining bolts	13	10	-
Knock sensor (KS) retaining bolt	20	14	-
Ignition coil retaining bolts	8	-	71
Spark plugs	20	15	-
Fuel rail retaining bolts	**A**	-	-
High pressure fuel pipe retaining bolts	**A**	-	-
High pressure fuel pump retaining bolts	12	9	-
Oil filter housing assembly retaining bolts	12	9	-
Oil filter cap	25	18	-
Lifting eye bolts	25 + 90°	18 + 90°	-
Manifold absolute pressure and temperature (MAPT) sensor sensor retaining bolts	5	-	44
Coolant pump retaining bolts	12	9	-
Variable valve timing (VVT) oil control solenoid retaining bolts	10	7	-
Camshaft position (CMP) sensor retaining bolts	10	7	-
Camshaft cover retaining bolts	13	10	-
Front upper timing cover retaining bolts	12	9	-
Front lower timing cover retaining bolts	**A**	-	-
Engine rear cover retaining bolts	**A**	-	-
VVT to camshaft retaining bolts	32	24	-
Camshaft bearing caps retaining bolts	11	8	-
Primary timing chain fixed guide retaining bolts	12	9	-
Primary timing chain tensioner retaining bolts	12	9	-
Primary timing chain tensioner guide blade retaining bolts	25	18	-
Auxiliary chain tensioner guide retaining bolts	21	15	-
Auxiliary chain fixed guide retaining bolt	12	9	-
Oil pump sprocket retaining bolt	21	15	-
Cylinder head retaining bolts	**A**	-	-
Engine oil level (EOL) sensor retaining bolt	12	9	-
Crankshaft position (CKP) sensor retaining bolt	10	7	-
Oil sump body to engine retaining bolts	25	18	-
Oil pan drain plug	24	18	-
Oil transfer tube to Oil pan body retaining bolts	11	8	-
Oil pump to engine block retaining bolts	25	18	-
Pick-up pipe to oil pump retaining bolts	12	9	-
Windage tray retaining bolts	25	18	-
Piston cooling jet retaining bolts	12	9	-
Engine block coolant draining plug	50	37	-
Cooling fan pulley	25	18	-
Connecting Rod bolts			
Stage 1	10	7	-
Stage 2	50	37	-
Main bearing cap			
M10 bolt Stage 1	25	18	-
M10 bolt Stage 2	57 + 70°	42 + 70°	-
M8 bolt Stage 1	15	11	-
M8 bolt Stage 2	33 + 75°	24 + 75°	-

Published: 24-Feb-2014

Engine - V8 5.0L Petrol - Engine

Description and Operation

EXTERNAL VIEW



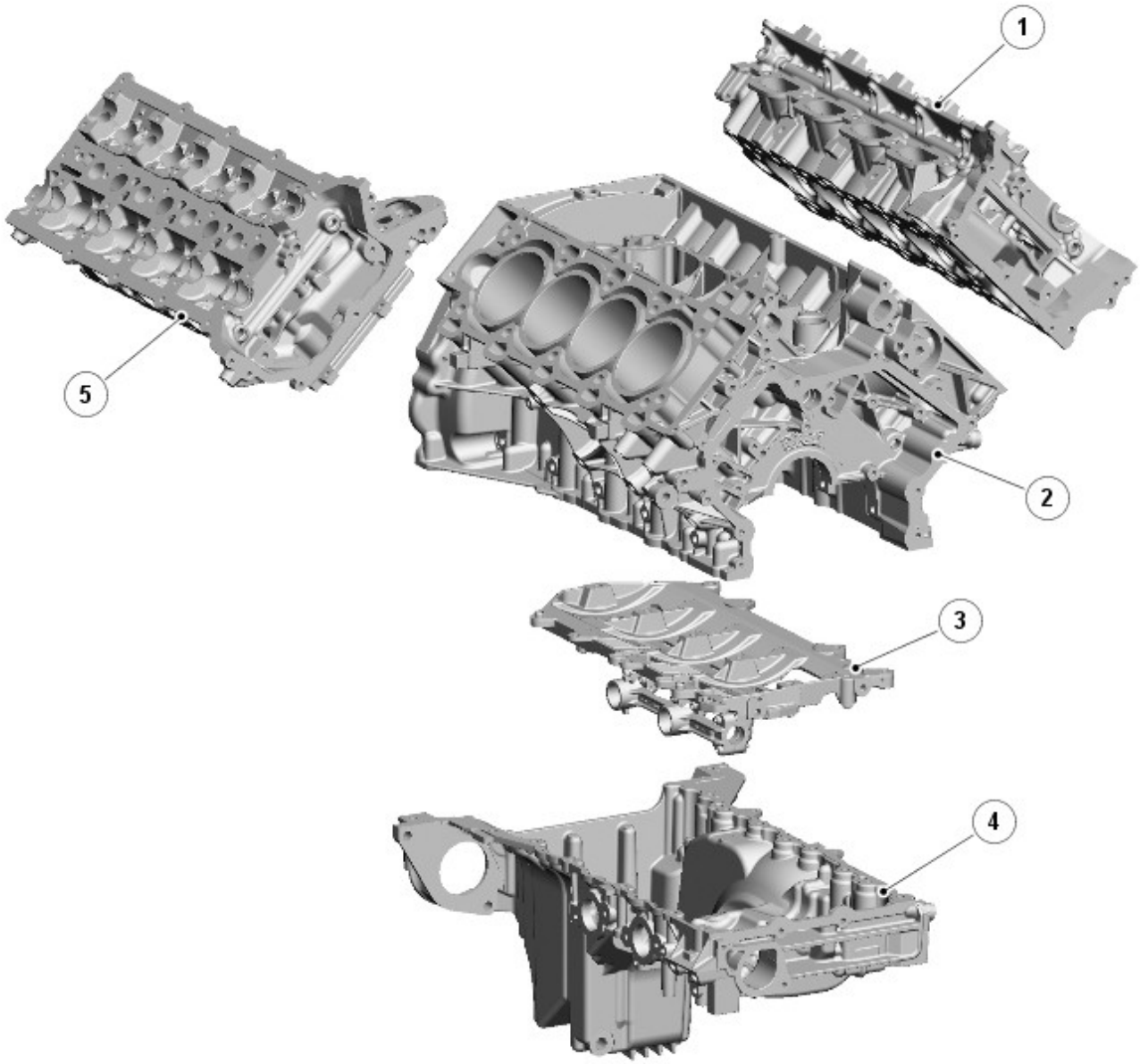
E121103

INTRODUCTION

The 5.0L NA (naturally aspirated) gasoline engine is a liquid cooled V8 unit featuring direct fuel injection, four overhead camshafts and four valves per cylinder. All four camshafts incorporate VCT (variable camshaft timing). The intake camshafts and valves also incorporate CPS (camshaft profile switching).

The main structural components of the engine are all manufactured from aluminum alloy. The engine is built around a very stiff, lightweight, enclosed V, deep skirt cylinder block. A structural windage tray is bolted to the bottom of the cylinder block to further improve the block stiffness, minimize NVH (noise, vibration and harshness) and help reduce oil foaming. To further enhance the stiffness of the lower engine structure, a heavily ribbed sump is installed. The sump also helps to reduce engine noise.

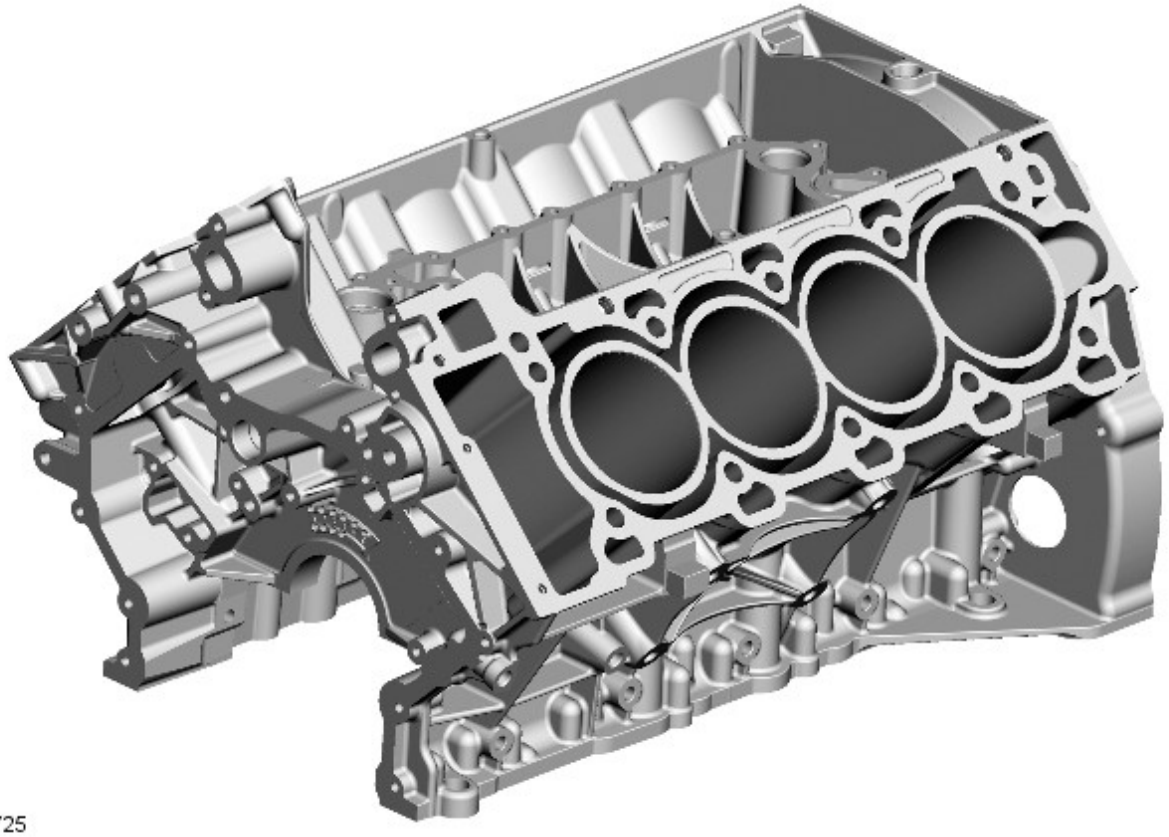
Engine Structure



E121104

Item	Part Number	Description
1	-	LH (left hand) cylinder head (bank B)
2	-	Cylinder block
3	-	Windage tray
4	-	Sump
5	-	RH (right hand) cylinder head (bank A)

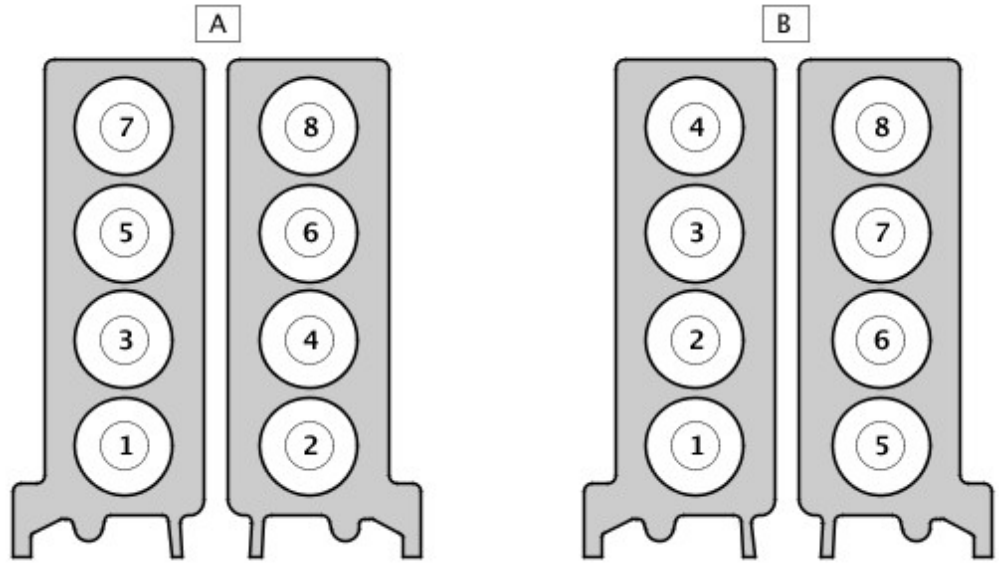
CYLINDER BLOCK



E106725

The cylinder block is a 90 degree configuration with cast-in iron cylinder liners and an open deck die-cast coolant jacket. The low volume coolant jacket gives good warm-up times and low piston noise levels. The longitudinal flow design of the coolant jacket, with a single cylinder head coolant transfer port in each bank, provides good rigidity and head gasket sealing.

Cylinder Numbering



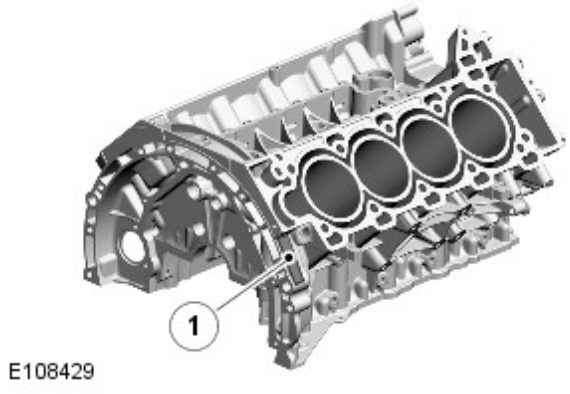
E163886

Item	Part Number	Description
A	-	ISO standard cylinder numbering
B	-	DIN standard cylinder numbering

ISO cylinder firing order 1,2,7,3,4,5,6,8

DIN cylinder firing order 1,5,4,2,6,3,7,8

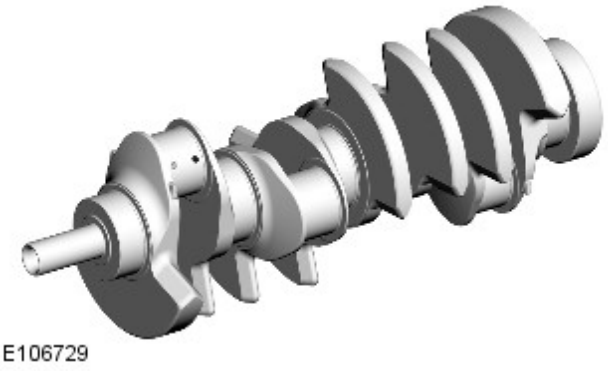
Engine Data Location



Item	Part Number	Description
1	-	Engine data location

Engine data is marked on the cylinder block at the rear of the RH cylinder bank.

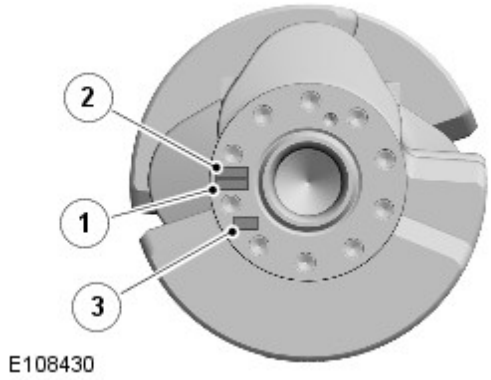
CRANKSHAFT



The crankshaft is made from spheroidal graphite cast iron, which, compared with grey cast iron, has higher mechanical strength, ductility and increased shock resistance. The undercut and rolled fillets also improve strength. Eight counter-balance weights ensure low vibration levels and the large, cross-drilled main bearing journals are designed to contribute to stiffness.

An oil groove in the upper half of each main bearing transfers the oil into the crankshaft for lubrication of the connecting rod bearings. A thrust washer is installed each side of the top half of the center main bearing.

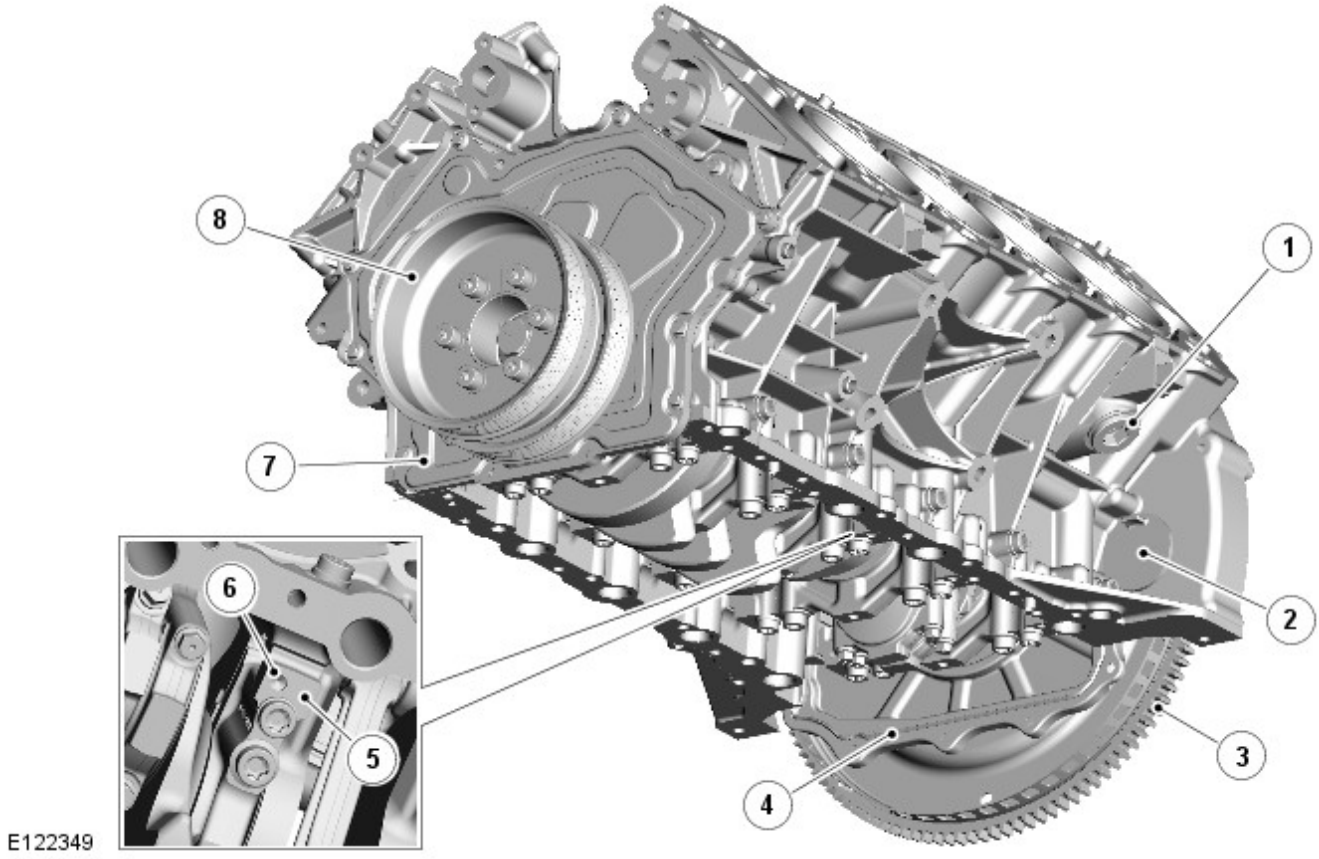
Crankshaft Data Location



Item	Part Number	Description
1	-	Pin journal classification and plant identification
2	-	Main journal classification
3	-	Date and time codes

The main bearings are numbered 1 to 5 starting from the front of the engine. There are five grades of main bearing available, each being color coded. Journal sizes are marked on the rear of the crankshaft.
For additional information, refer to: Camshaft Bearing Journal Diameter (303-00 Engine System - General Information, General Procedures).

Crankshaft Installation



Item	Part Number	Description
1	-	Coolant drain plug
2	-	Torque converter access plug
3	-	Drive plate
4	-	Rear cover
5	-	Main bearing cap
6	-	Identification mark
7	-	Front cover
8	-	Front pulley

The main bearing caps are made from cast iron and are cross bolted to increase rigidity. An identification mark on the bearing cap faces the front of the engine.

At the front of the crankshaft, a tuned torsional vibration damper is incorporated into the crankshaft front pulley. At the rear of the crankshaft a pressed steel drive plate, with a steel starter ring gear, is installed to transfer drive from the engine to the transmission. The reluctor ring for the CKP (crankshaft position) sensor is integrated into the perimeter of the drive plate.

The crankshaft seals are located in the front and rear covers.

PISTONS AND CONNECTING RODS



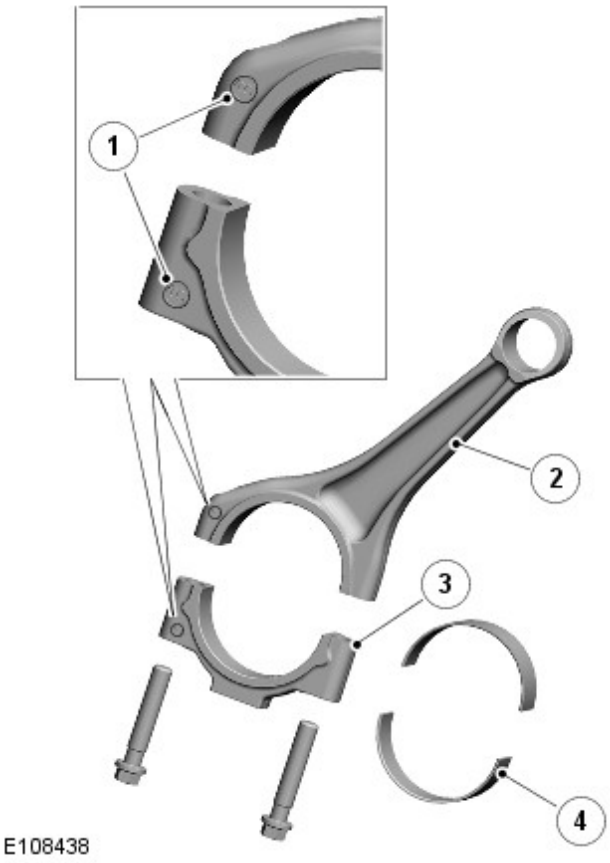
E115619

The diameter of each piston is graded and precisely matched to each cylinder bore to help reduce noise. In the vertical plane, the pistons have a slight barrel form, which helps to ensure a reliable oil film is maintained between the piston and the cylinder bore. A solid film lubricant coating is applied to both reaction faces of the piston to reduce wear and improve fuel economy.

A three-ring piston-sealing system is used. The steel top ring is treated with a PVD (physical vapor deposition) peripheral coating. PVD is a coating technique where material can be deposited with improved properties to ensure good cylinder bore compatibility and wear resistance. A Napier center ring helps cylinder pressure and oil management, while the three-piece oil control lower ring is produced from nitrided steel.

The connecting rods are forged from high strength steel. The cap is fracture-split from the rod to ensure precision re-assembly for bearing shell alignment. There are three grades of large end bearing available, each being color coded. For additional information, refer to: Connecting Rod Large End Bore (303-00 Engine System - General Information, General Procedures).

Cap Alignment with Connecting Rod

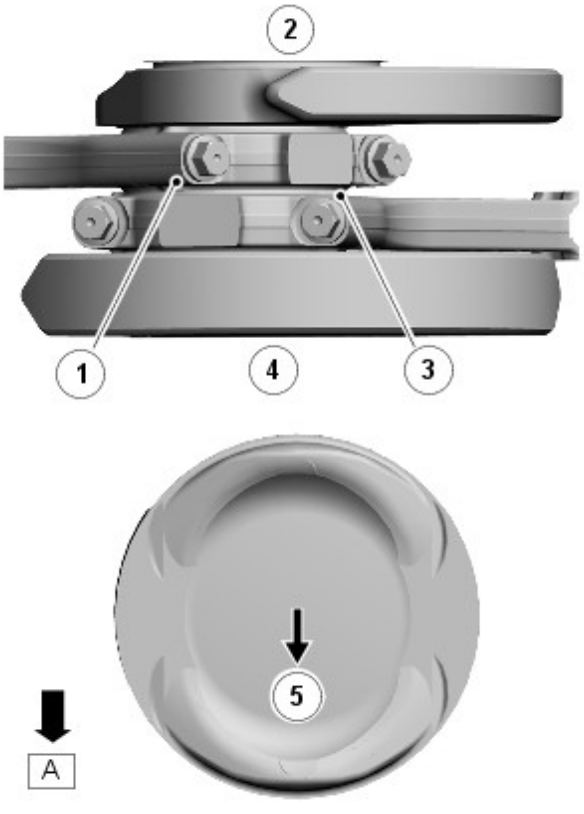


E108438

Item	Part Number	Description
1	-	Alignment marks
2	-	Connecting rod
3	-	Cap
4	-	Bearings

The correct alignment of the cap with the connecting rod is indicated by marks on adjacent faces of the two components.

Connecting Rod and Piston Orientation



E108439

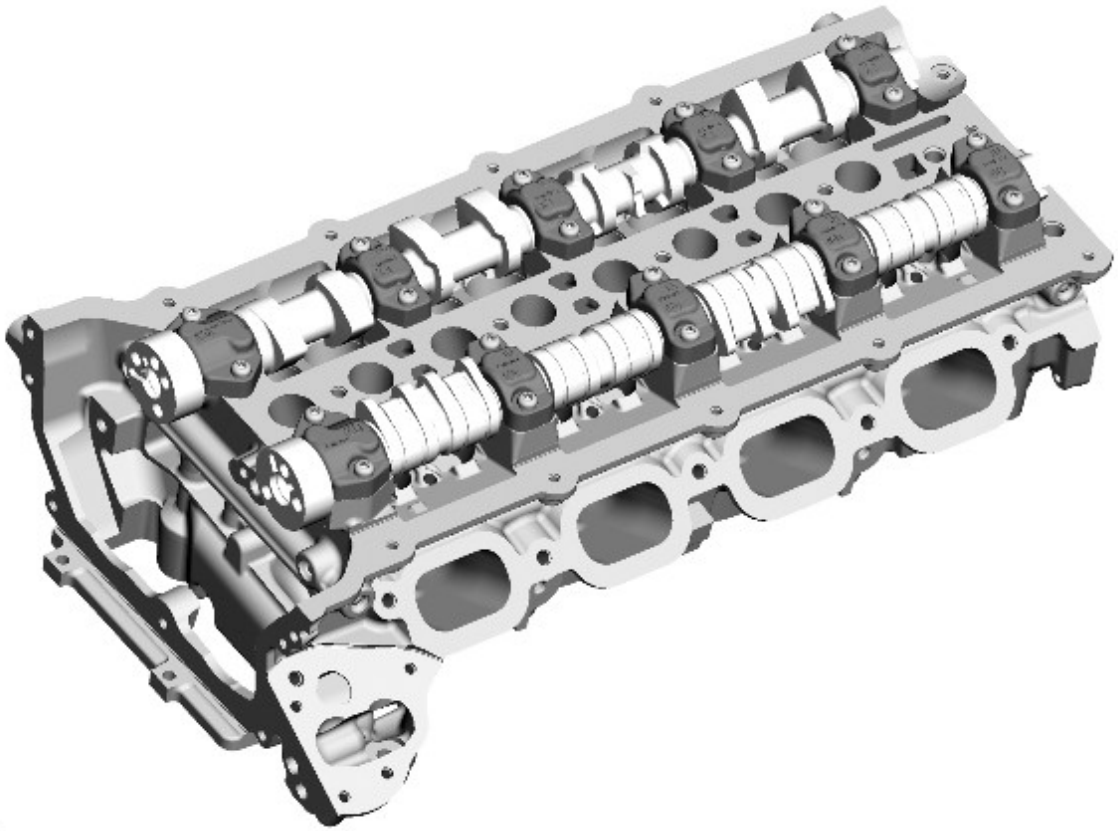
Item	Part Number	Description
A	-	Front of engine
1	-	Alignment mark
2	-	LH side (bank B)
3	-	Alignment mark
4	-	RH side (bank A)
5	-	Piston orientation arrow

The orientation of the connecting rods and pistons on the crankshaft are given below:

- Bank A - The arrow on the piston crown must face the front of the engine and the cap and connecting rod alignment marks must face the rear of the engine.
- Bank B - The arrow on the piston crown must face the front of the engine and the cap and connecting rod alignment marks must face the front of the engine.

CYLINDER HEADS

NOTE: RH (right-hand) (A bank) cylinder head shown, LH (left-hand) (B bank) cylinder head similar.



E106732

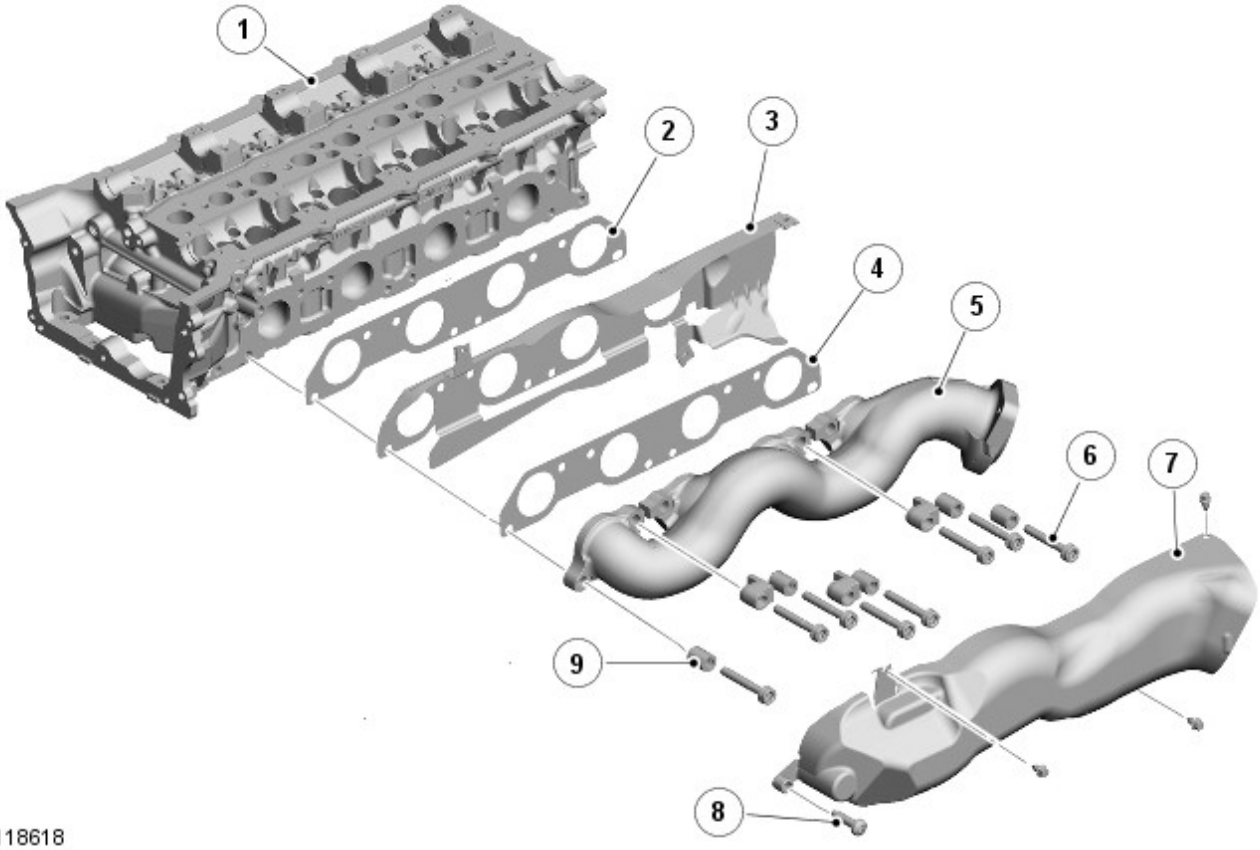
The cylinder heads are manufactured in gravity die cast aluminum alloy and are unique for each cylinder bank. Deep-seated bolts reduce distortion and secure the cylinder heads to the cylinder block.

Each cylinder is served by four valves. To help achieve the required gas-flow characteristics, these are arranged asymmetrically around the cylinder bore. Each cylinder has a centrally mounted fuel injector and spark plug.

The cylinder head gasket is of a multi-layer steel construction.

EXHAUST MANIFOLD

NOTE: LH (B bank) installation shown, RH (A bank) installation similar.

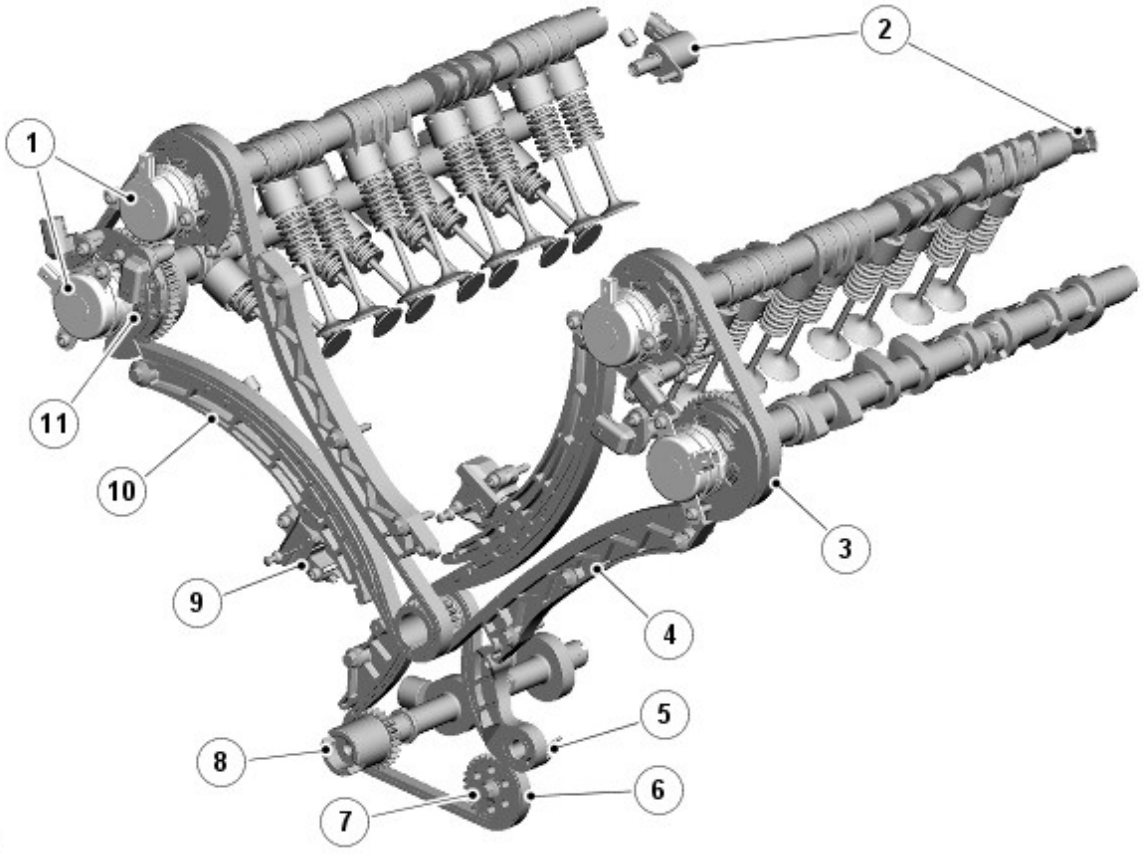


E118618

Item	Part Number	Description
1	-	Cylinder head
2	-	Gasket
3	-	Heat shield
4	-	Gasket
5	-	Exhaust manifold
6	-	Bolt (8 off)
7	-	Heat shield
8	-	Bolt (4 off)
9	-	Spacer (8 off)

The high SiMo (silicon molybdenum) cast iron exhaust manifolds are unique for each cylinder bank. Each exhaust manifold installation includes two metal gaskets and two heat shields. Spacers on the securing bolts allow the manifolds to expand and contract with changes of temperature while maintaining the clamping loads.

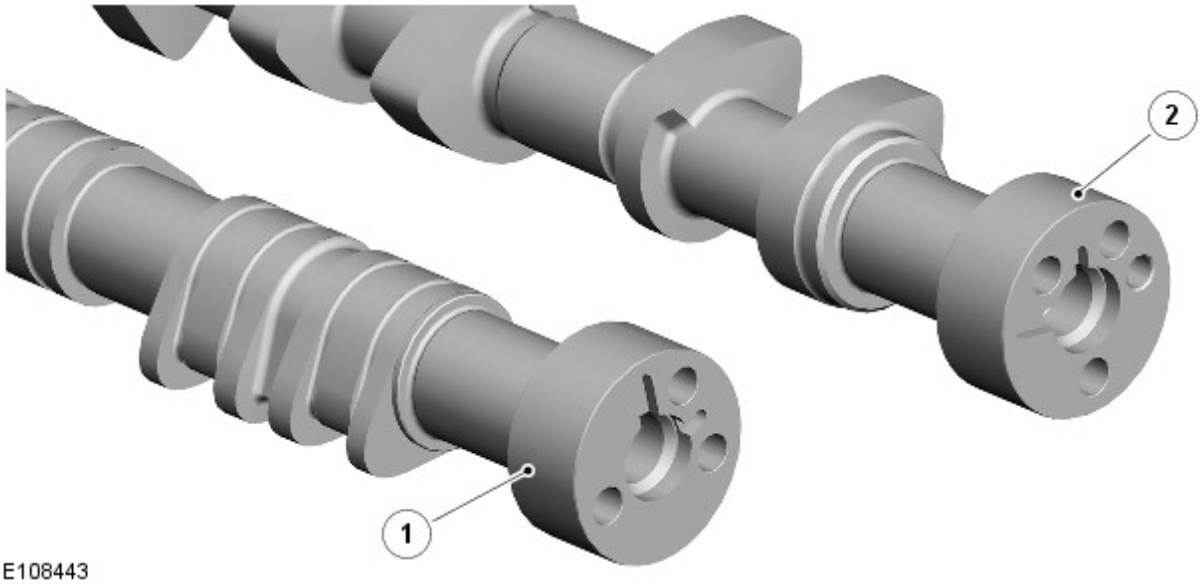
VALVE TRAIN



E106733

Item	Part Number	Description
1	-	VCT solenoids
2	-	CPS solenoids
3	-	Inverted tooth timing chain
4	-	Nylon chain guide
5	-	Auxiliary chain tensioner
6	-	Auxiliary drive chain
7	-	Oil pump drive
8	-	Auxiliary drive camshaft
9	-	Timing chain tensioner
10	-	Tensioner lever
11	-	VCT unit

Camshafts



E108443

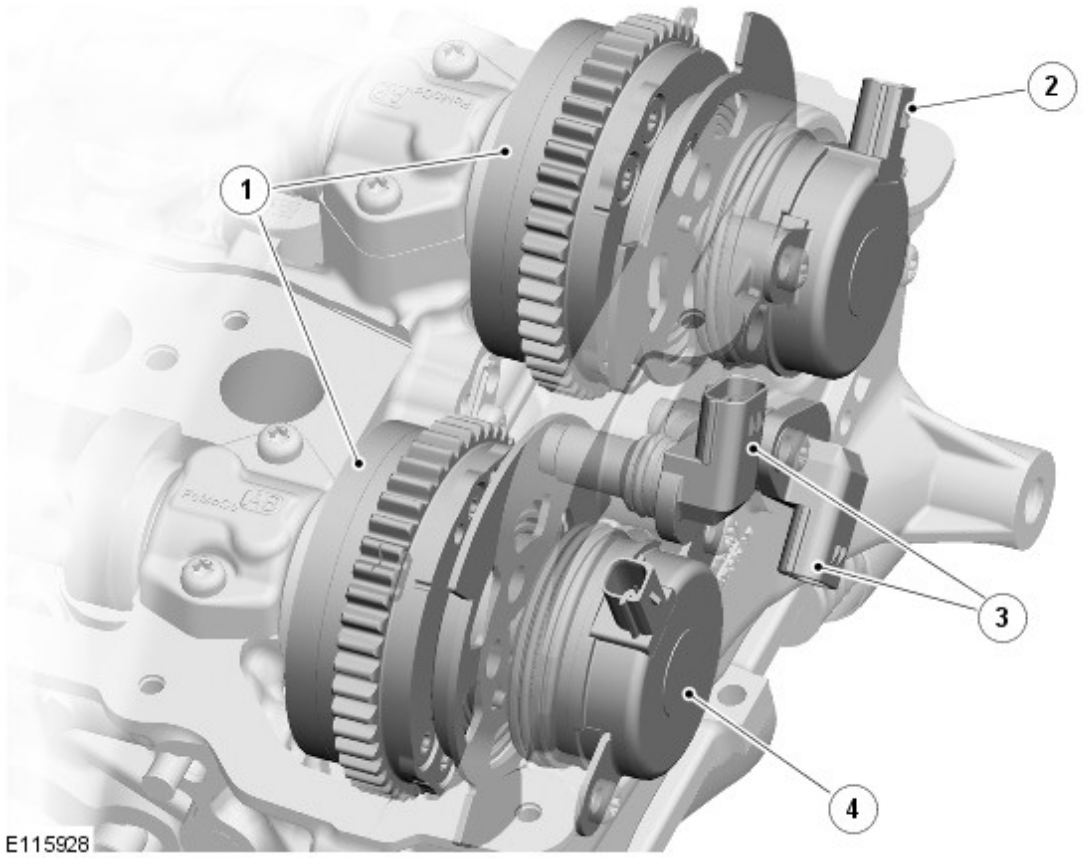
Item	Part Number	Description
1	-	Intake camshaft
2	-	Exhaust camshaft

The lightweight valve train provides good economy and noise levels and is chain driven from the crankshaft.

Double overhead camshafts on each cylinder head operate the valves. For each cylinder head, an inverted tooth timing chain transfers drive from the crankshaft to the VCT unit on the front of each camshaft. Graded tappets enable setting of exhaust valve clearances. Switchable tappets with hydraulic lash adjusters are installed on the intake valves.

Each timing chain has a hydraulic tensioner operated by engine oil pressure. The chain tensioners incorporate a ratchet mechanism, which maintains tension while the engine is stopped to eliminate start-up noise. The chains are lubricated with engine oil from jets located at the front of the engine block. Nylon chain guides control chain motion on the drive side.

Variable Camshaft Timing



Item	Part Number	Description
1	-	VCT units
2	-	Intake camshaft VCT solenoid
3	-	Camshaft position sensors
4	-	Exhaust camshaft VCT solenoid

The VCT system varies the timing of the intake and exhaust camshafts to deliver optimum engine power, efficiency and emissions. The timing of the intake camshafts has a range of 62 degrees of crankshaft angle. The timing of the exhaust camshafts has a range of 50 degrees of crankshaft angle.

In the base timing position:

- The intake camshafts are fully retarded.
- The exhaust camshafts are fully advanced.

VCT Operating Ranges

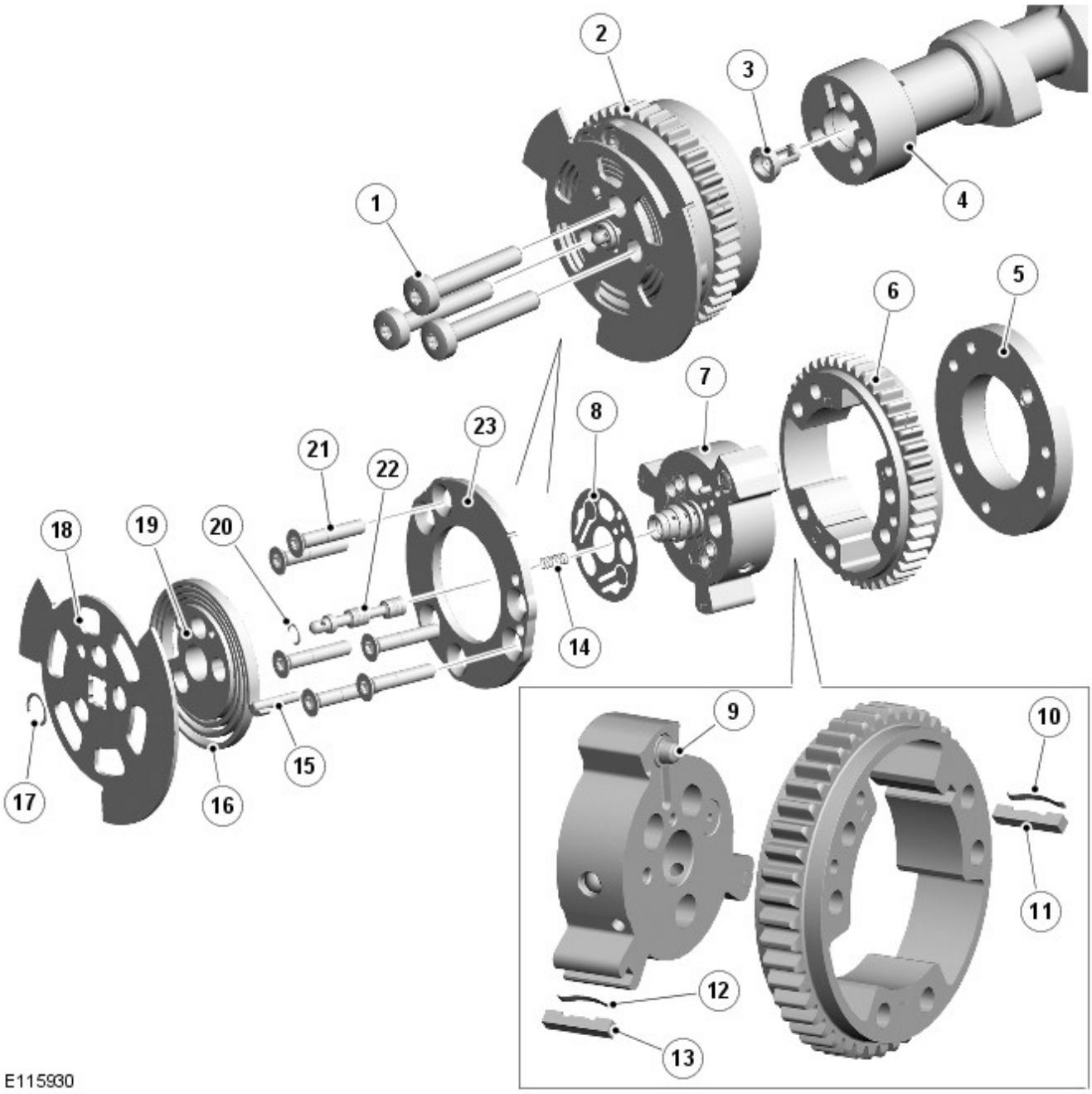
Camshaft	Valve Opens	Valve Closes
Intake - Low Lift	27 degrees BTDC (before top dead center) to 35 degrees ATDC (after top dead center)	187 to 249 degrees ATDC
Intake - High Lift	37 degrees BTDC to 25 degrees ATDC	213 to 275 degrees ATDC
Exhaust	244 to 194 degrees BTDC	6 to 56 degrees ATDC

The system consists of a VCT unit and a VCT solenoid for each camshaft. The ECM (engine control module) controls the system using PWM (pulse width modulation) signals to the VCT solenoids.

The torsional energy generated by the valve springs and the inertia of the valve train components are used to operate the system.

Variable Camshaft Timing Units

The VCT units change the position of the camshafts in relation to the timing chains.



Item	Part Number	Description
1	-	Bolt (3 off)
2	-	VCT unit
3	-	Filter
4	-	Camshaft
5	-	Inner plate
6	-	Housing and sprocket
7	-	Rotor assembly
8	-	Reed plate
9	-	Spring and lock pin
10	-	Spring (3 off)
11	-	Tip seal (3 off)
12	-	Spring (2 off)
13	-	Tip seal (2 off)
14	-	Spring
15	-	Dowel pin
16	-	Bias spring
17	-	Snap ring
18	-	Reluctor ring
19	-	Center plate
20	-	Snap ring

21	-	Screw (6 off)
22	-	Spool valve
23	-	Outer plate

Each VCT unit is attached to the camshaft by three bolts. A rotor assembly and a reed plate are installed inside a sprocket housing, which consists of a sprocket, an outer plate and an inner plate held together by six screws.

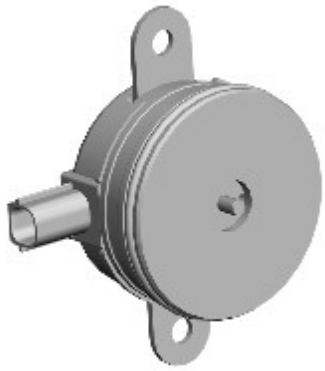
A reluctor ring, for the CMP (camshaft position) sensor, a center plate and a bias spring are installed at the front of the VCT unit. The ends of the bias spring locate on the center plate assembly and the sprocket housing, to give a turning moment to the camshaft in the advance direction. A snap ring locates the reluctor ring on to a sleeve installed in the center of the rotor assembly. The opposite end of the sleeve locates in a bore in the front face of the camshaft, which contains a filter.

A spring and spool valve are installed in the rotor assembly sleeve and retained by a snap ring. The spring keeps the spool valve in contact with the armature of the related VCT solenoid.

Each VCT unit is supplied with engine oil from an oil gallery in the cylinder head, through the camshaft front bearing cap and a bore in the center of the camshaft.

Variable Camshaft Timing Solenoids

The VCT solenoids control the position of the spool valves in the VCT units.



E115929

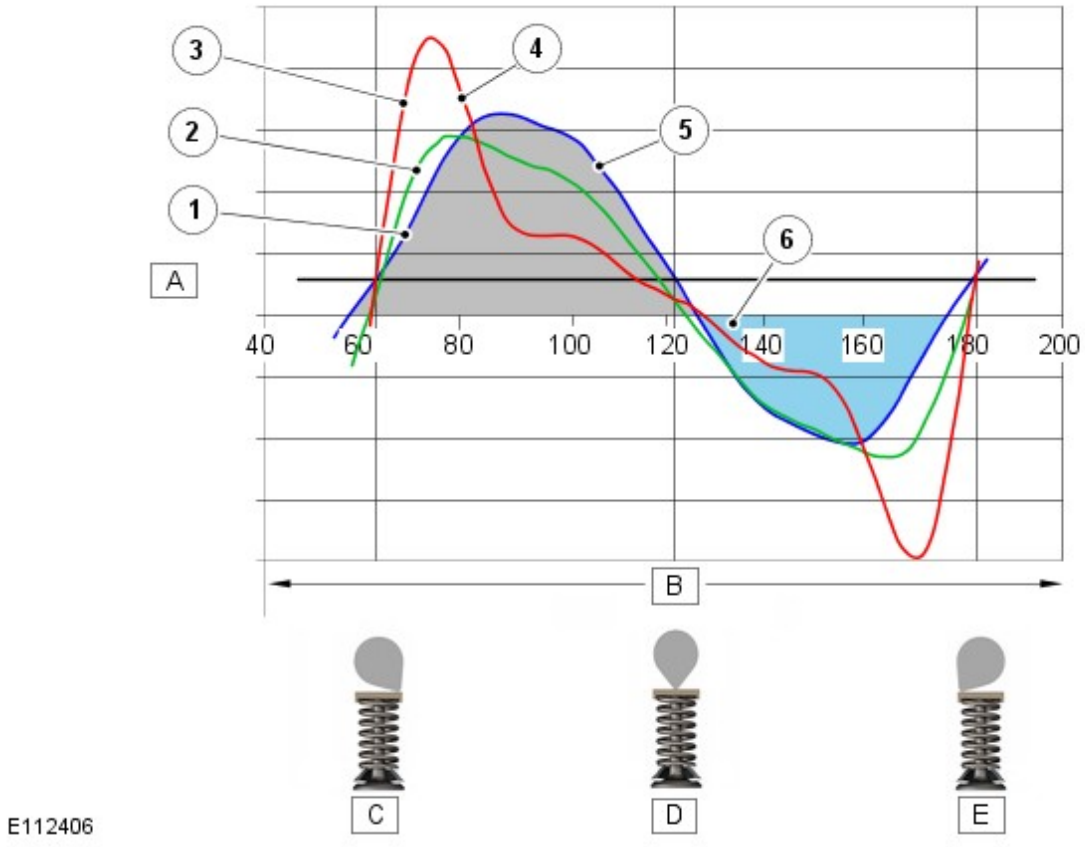
The VCT solenoids are installed in the front upper timing covers, immediately in front of their related VCT units. Each VCT solenoid is secured with two screws and sealed with an O-ring. A two pin electrical connector provides the interface with the engine harness.

Each VCT solenoid incorporates a spindle that acts on the spool valve in the related VCT unit to advance and retard the camshaft timing. The VCT solenoids operate independently and are controlled by a PWM signal from the ECM.

Variable Camshaft Timing Operation

When the engine is running, the compression and expansion of the valve springs causes momentary increases and decreases in the torque acting on the camshafts. These momentary changes of torque are sensed in the VCT units and used to change the camshaft timing.

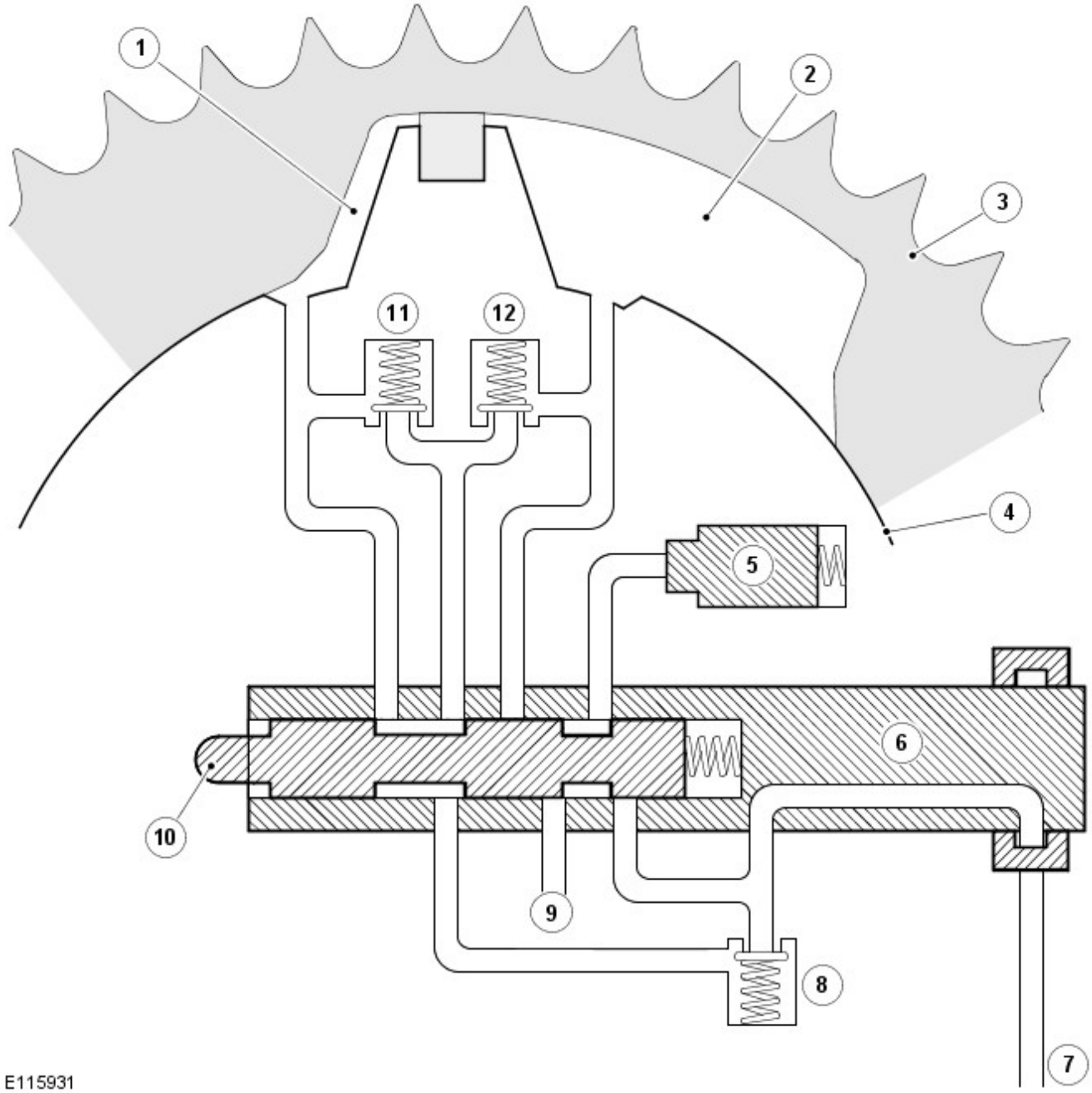
Camshaft Torsional Energy (For a Single Valve Event)



Item	Part Number	Description
A	-	Camshaft torque
B	-	Camshaft rotation (degrees)
C	-	Valve opening
D	-	Peak lift
E	-	Valve closing
1	-	1000 rev/min
2	-	4000 rev/min
3	-	7000 rev/min
4	-	Inertia effects from valve train rotating components
5	-	Force caused by valve spring
6	-	Bias torque from friction

Variable Camshaft Timing Unit Schematic - Base Timing

NOTE: Intake camshaft VCT unit shown. For exhaust camshaft VCT unit, read advance for retard and retard for advance.



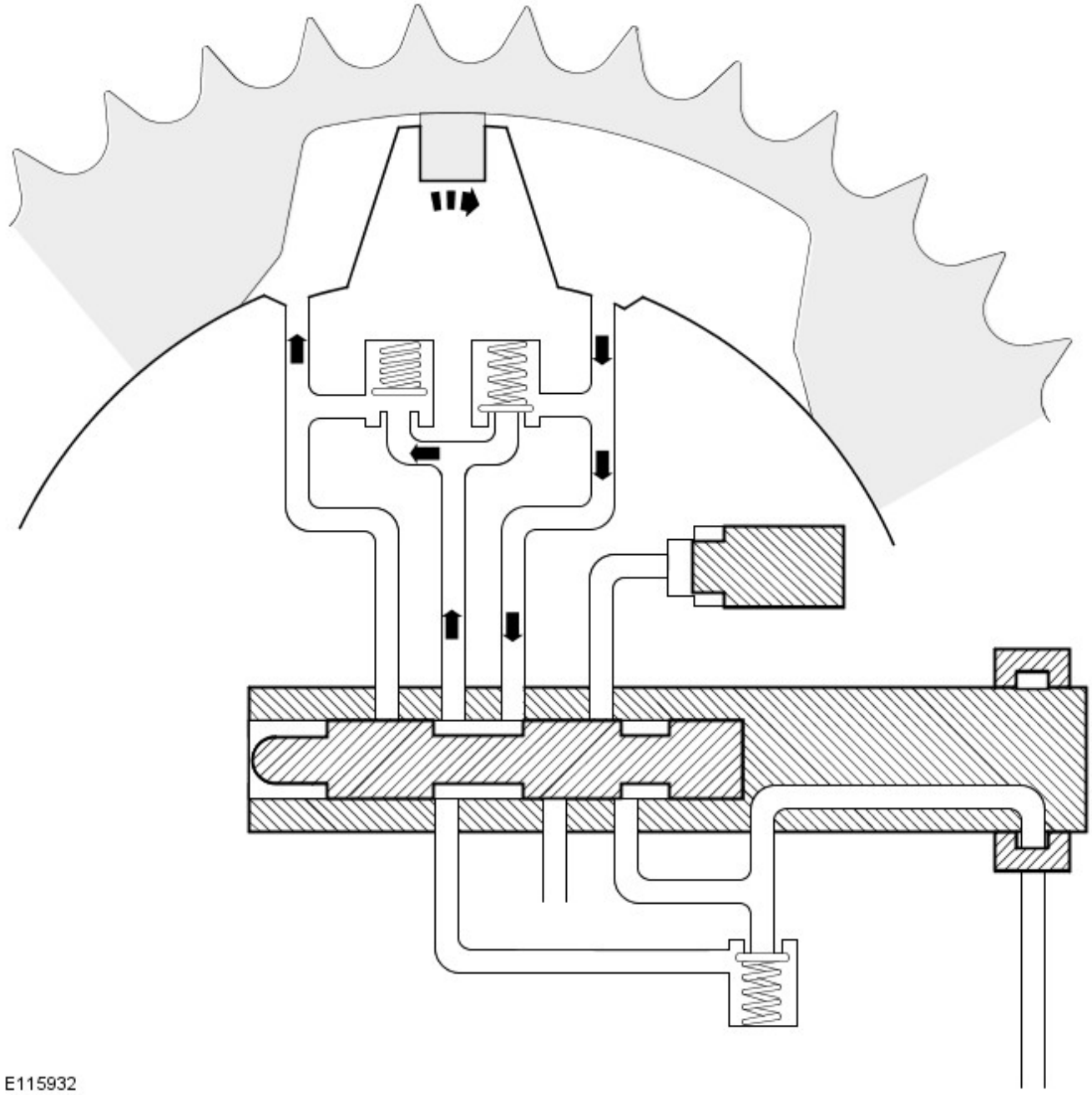
E115931

Item	Part Number	Description
1	-	Advance chamber
2	-	Retard chamber
3	-	Sprocket housing
4	-	Rotor assembly
5	-	Lock pin
6	-	Sleeve
7	-	Engine oil supply from camshaft
8	-	Inlet check valve
9	-	Lock pin drain
10	-	Spool valve
11	-	Advance check valve
12	-	Retard check valve

At engine start-up, once the engine oil pressure in the camshaft is sufficient to open the inlet check valve, engine oil flows across the spool valve, through the advance and retard check valves and into the advance and retard chambers. During the start cycle, the ECM signals the VCT solenoid to move the spool valve into the sleeve and connect the lock pin to inlet oil pressure. The inlet oil pressure causes the lock pin to retract from the inner plate and unlock the rotor assembly and camshaft from the sprocket housing.

There is a constant supply of oil to the VCT to ensure the unit remains filled during operation.

Variable Camshaft Timing Unit Schematic - Advance

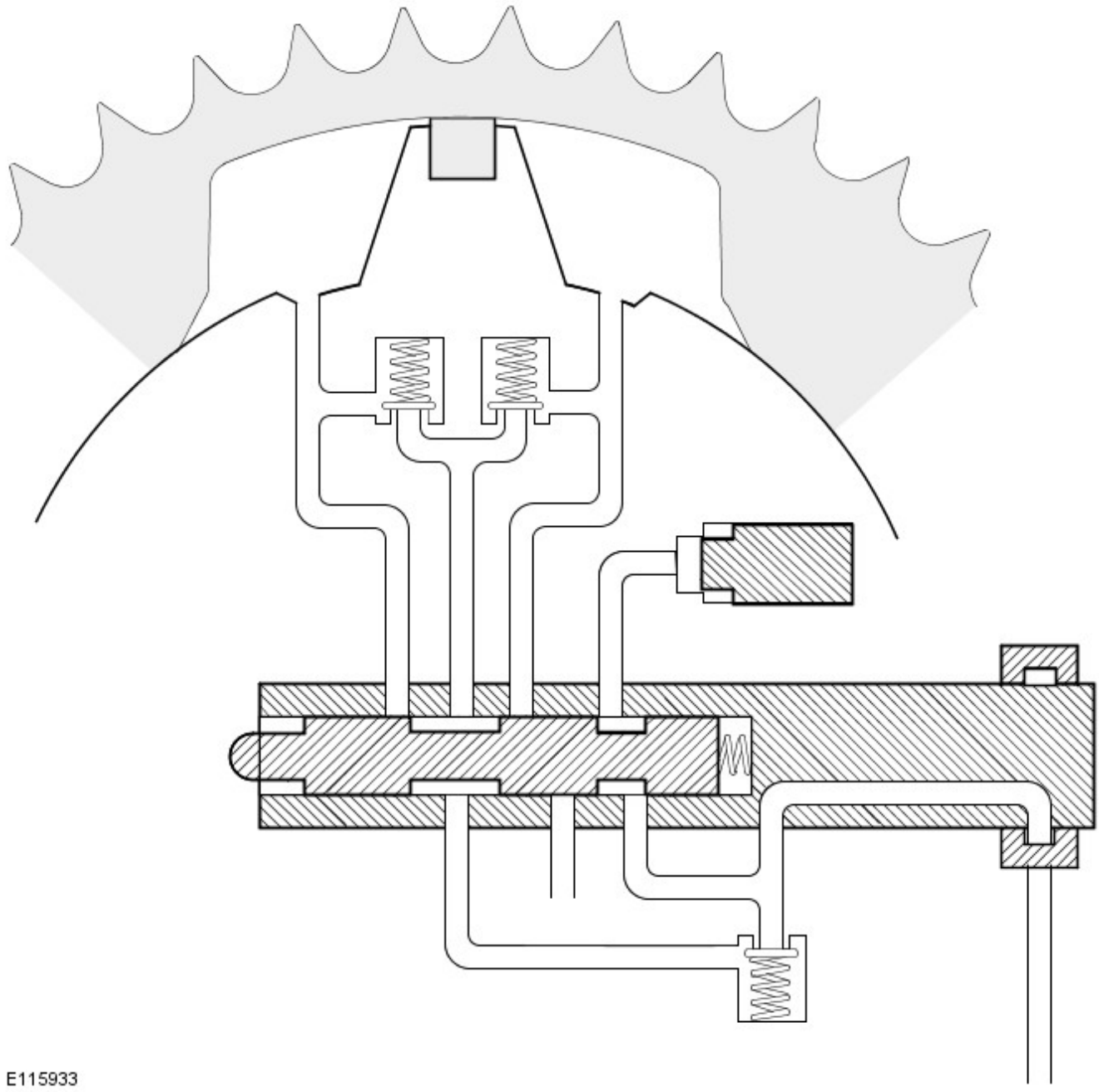


E115932

To advance the camshaft timing, the ECM adjusts the signal to the VCT solenoid to move the spool valve so that the advance chamber oil passage is closed and the retard chamber oil passage is connected to inlet oil.

Each momentary increase of the torque acting on the camshaft generates a pressure pulse in the retard chamber. Oil moves from the retard chamber, through the spool valve and the advance check valve to the advance chamber, to equalize the pressures in the two chambers. The displacement of oil from the retard chamber causes the rotor assembly to advance in relation to the sprocket housing. Each momentary decrease of torque acting on the camshaft also generates a pressure pulse in the advance chamber, but, with the advance chamber oil passage closed, no movement of oil between the advance and retard chambers occurs and the rotor assembly cannot move in the retard direction.

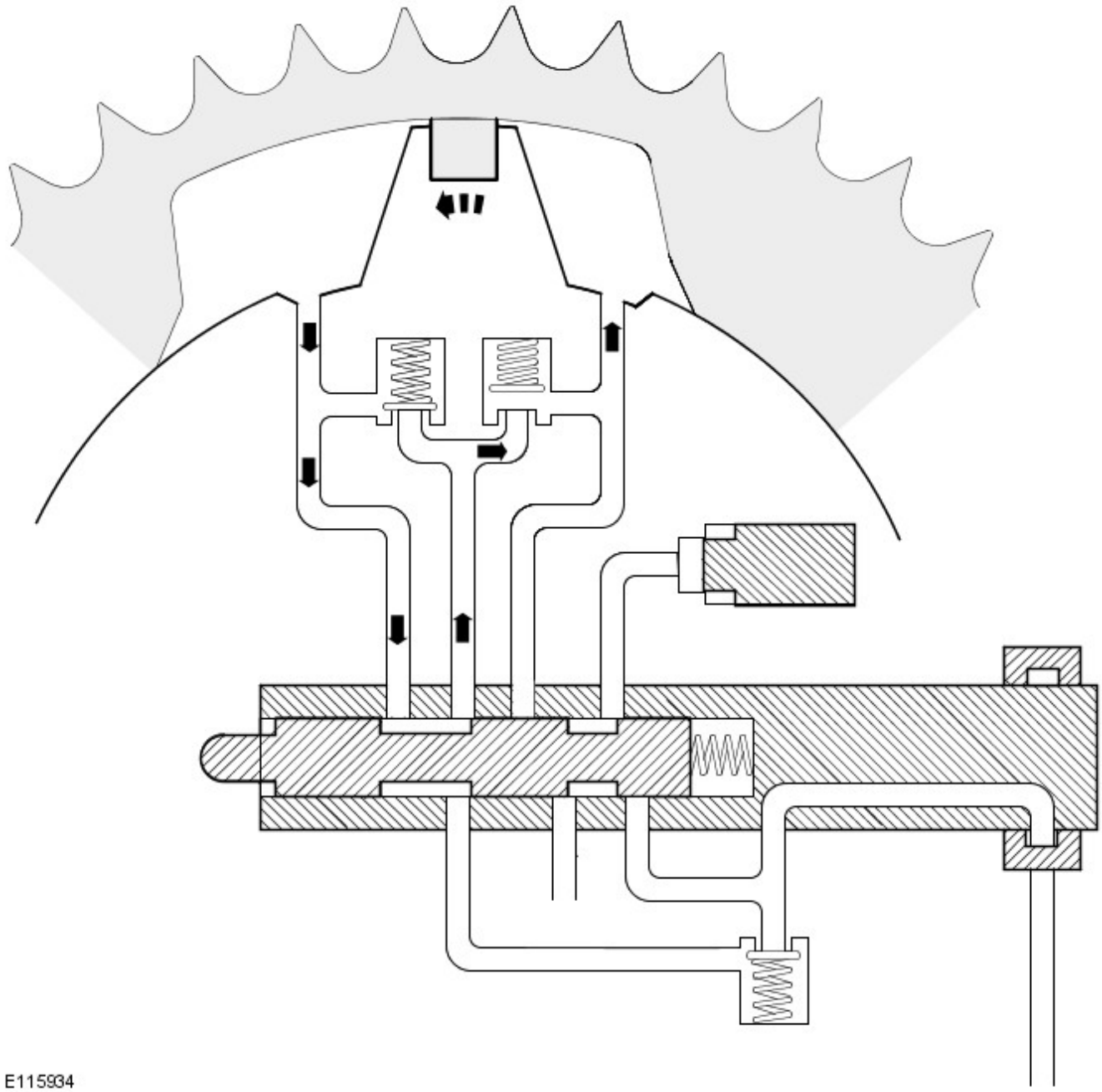
Variable Camshaft Timing Unit Schematic - Null



E115933

Once the camshaft has reached the required timing position the ECM adjusts the signal to the VCT solenoid to set the spool valve in the null position. In the null position, the advance and retard chamber oil passages are both closed by the spool valve and the rotor assembly is hydraulically locked to the sprocket housing.

Variable Camshaft Timing Unit Schematic - Retard

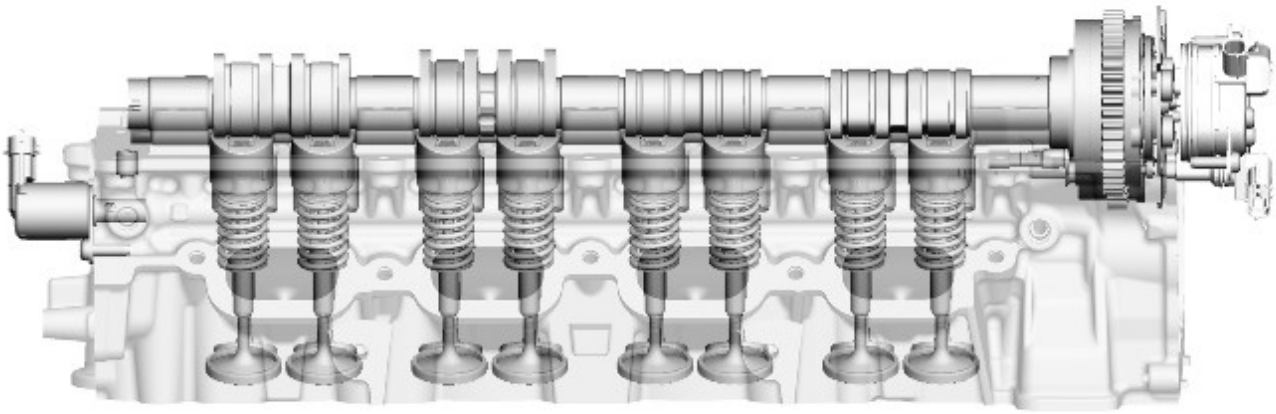


E115934

To retard the camshaft timing, the ECM adjusts the signal to the VCT solenoid to move the spool valve to close the retard chamber oil passage and connect the advance chamber oil passage to the inlet oil.

Each momentary decrease of the torque acting on the camshaft causes oil to transfer from the advance chamber, through the spool valve and the retard check valve to the retard chamber, and so retard the camshaft timing.

Camshaft Profile Switching

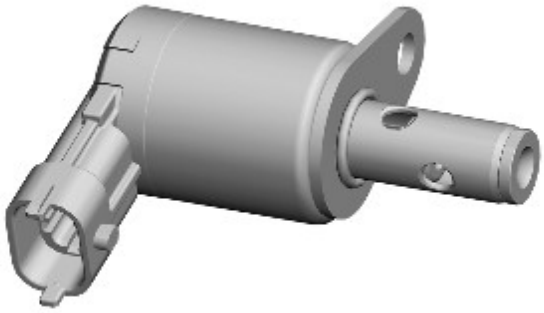


E106735

The CPS (camshaft profile switching) system switches the intake valves between two cam profiles which have different lift and period. The low lift profile improves driveability and emissions at lower engine speeds. The high lift profile improves power and torque output at higher engine speeds.

The intake camshafts have three lobes for each valve. The two outer lobes have identical profiles that produce the high lift of 10.53 mm (0.415 in.). The central lobe produces the low lift of 5.50 mm (0.217 in.). Switching between cam profiles is performed by a switchable tappet on each intake valve. The switchable tappets are operated by engine oil controlled by a CPS solenoid on each cylinder head. Operation of the CPS solenoids is controlled by the ECM.

Camshaft Profile Switching Solenoids



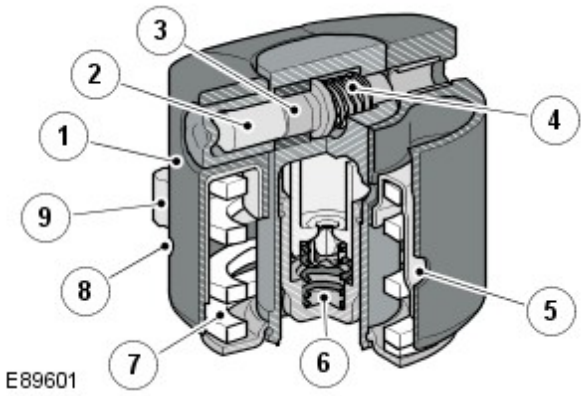
E115935

The CPS solenoids control the supply of engine oil pressure to the locking pins in the switchable tappets, to switch the tappets between the two cam profiles.

A CPS solenoid is installed on the rear of each cylinder block. Each CPS solenoid has a pintle installed in a sleeve, which incorporates oil inlet and outlet holes. The sleeve is installed at the junction of oil galleries in the cylinder head, with the oil inlet and outlet holes aligned with the galleries. Movement of the pintle in the sleeve controls a connection between the oil galleries. When the CPS solenoid is energized, the pintle connects an oil supply gallery to the gallery along the outboard side of the switchable tappets. When the CPS solenoid is de-energized, the oil gallery along the outboard side of the switchable tappets is connected to drain.

The CPS solenoids receive a fused battery supply from the main relay. The ECM switches a ground connection to operate the solenoids.

Switchable Tappets



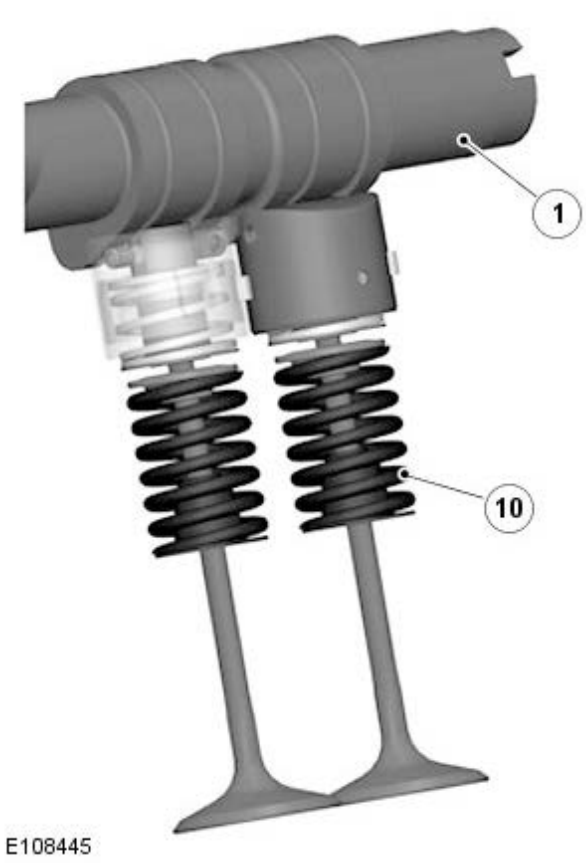
Item	Part Number	Description
1	-	Outer tappet
2	-	Outer locking pin
3	-	Inner locking pin
4	-	Return spring
5	-	Lash adjuster oil inlet
6	-	Lash adjuster
7	-	Lost motion spring
8	-	CPS oil inlet
9	-	Anti-rotation lug

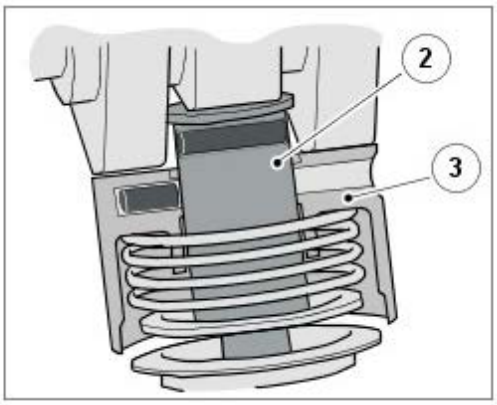
The switchable tappets are installed on the intake valves, in bores in the cylinder heads. The cylinder heads incorporate engine oil galleries along the inboard and outboard sides of the bores. The inboard oil galleries (between the tappets and the spark plug/fuel injector bores) supply an oil feed to the locking pins in the switchable tappets. The outboard oil galleries (over the inlet ports) supply an oil feed to the hydraulic lash adjusters in the switchable tappets.

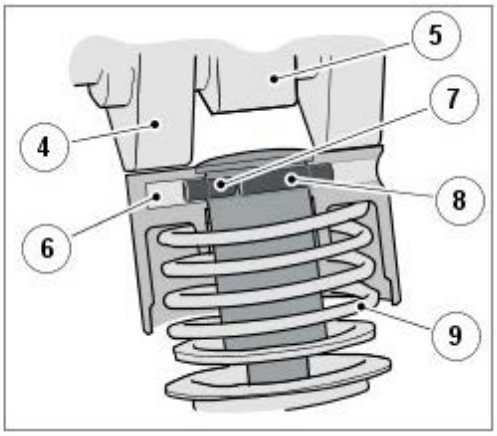
Each switchable tappet consists of inner and outer tappets, which can operate independently or be locked together by locking pins. A hydraulic lash adjuster on the bottom of the inner tappet locates on the intake valve stem.

In low lift, the intake valve lift is controlled by the inner tappets, which run on the center lobes of the intake camshafts. The outer tappets run on the outer lobes of the intake camshafts, and move up and down the inner tappets without affecting the valve lift. The lost motion springs keep the outer tappets in contact with the outer lobes. Movement of the inner tappets is transferred to the intake valves through the hydraulic lash adjusters.

In high lift, engine oil is supplied to the locking pins, which lock the outer tappets to the inner tappets. Intake valve lift is controlled by the outer tappets, which run on the outer lobes of the intake camshafts. Movement of the outer tappets is transferred to the intake valves through the locking pins, the inner tappets and the hydraulic lash adjusters.







Item	Part Number	Description
1	-	Intake camshaft
2	-	Inner tappet
3	-	Outer tappet
4	-	Outer cam profile (high lift)
5	-	Inner cam profile (low lift)
6	-	Locking pin oil pressure inlet
7	-	Outer locking pin
8	-	Inner locking pin
9	-	Outer tappet lost motion spring
10	-	Valve spring

Camshaft Profile Switching Operation

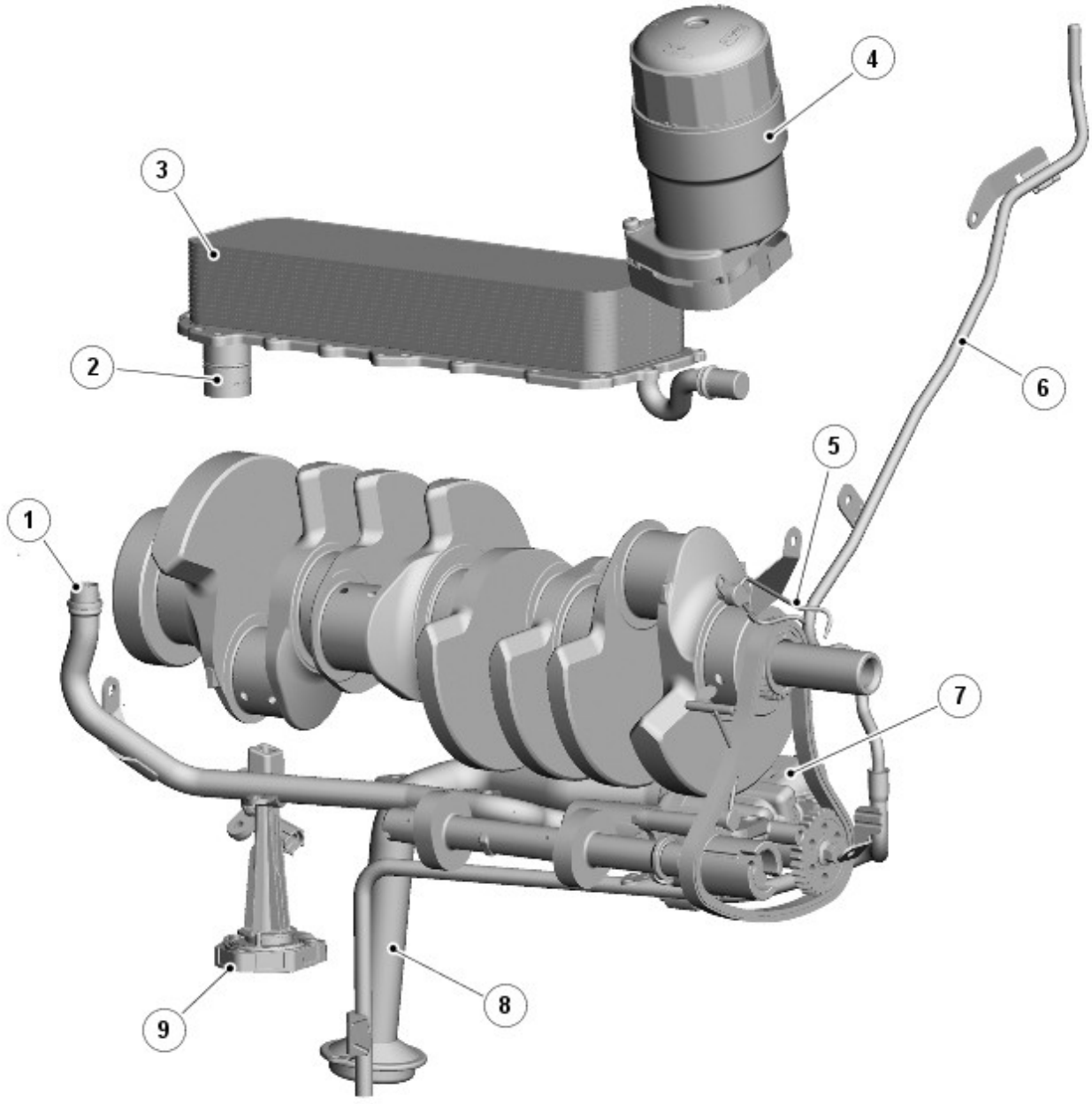
The switching point is speed and load dependent. This strategy ensures that switching occurs at air flow neutral points in the engine's operation and is imperceptible to the driver.

At engine speeds from idle up to the range of 2825 - 4250 rev/min (depending on engine load), the CPS solenoids are de-energized and the switchable tappets are set to low lift. At engine speeds above the 2825 - 4250 rev/min range, the CPS solenoids are energized by the ECM and the switchable tappets are set to high lift. There is a 200 rev/min hysteresis when switching from high lift to low lift with decreasing engine speed. Switching between lift settings occurs within one revolution of the camshaft.

Switching is only enabled at engine oil temperatures of 20 ºC (68 ºF) and above. At oil temperatures below 20 °C (68 ºF), CPS operation is disabled and the switchable tappets remain in the low lift setting. CPS operation is also disabled if a CPS solenoid fails. When CPS operation is disabled, engine speed is limited to 5000 rev/min.

The ECM can diagnose the operation of the CPS solenoids and store fault related DTC (diagnostic trouble code) if it detects a failure.

LUBRICATION SYSTEM



E118619

Item	Part Number	Description
1	-	Oil pump outlet tube
2	-	Anti-drain valve
3	-	Oil cooler
4	-	Oil filter
5	-	Timing chain lubrication jet (2 off)
6	-	Oil evacuation tube
7	-	Oil pump
8	-	Oil pick-up
9	-	Oil temperature and level sensor

The oil pump is attached to the underside of the windage tray. The input shaft of the oil pump is driven from the front of the crankshaft, by the auxiliary chain, at 0.87 engine speed.

The oil pump draws oil from the sump through a centrally mounted pick-up pipe. The oil is pressurized and pumped through an output tube to the cylinder block. After passing through an anti-drain valve and a plate type oil cooler, the oil is filtered by a replaceable cartridge installed on the front of the RH cylinder head.

The output from the oil filter is distributed through oil galleries in the cylinder heads and cylinder block. All moving parts are lubricated by pressure or splash oil. Pressurized oil is also provided for the VCT system, the CPS system, the timing chain tensioners and the timing chain lubrication jets.

The oil returns to the oil pan under gravity. Large drain holes through the cylinder heads and cylinder block ensure the rapid return of the oil to the sump. System replenishment is through the oil filler cap on the LH cylinder head cover.

An oil evacuation tube is installed to allow oil to be drawn from the sump. The upper end of the oil evacuation tube is

located under the oil filler cap.

An oil drain plug is installed in the RH side of the sump.

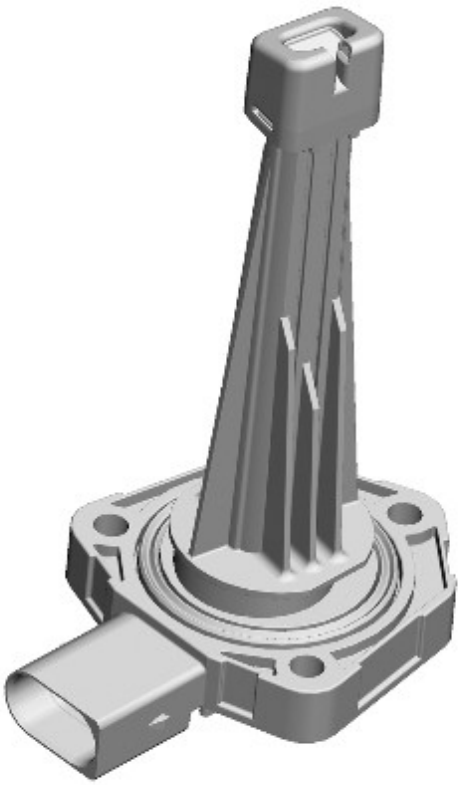
Oil Pump Nominal Operating Pressures

Engine Speed, rev/min	Temperature, °C (°F)	Pressure, bar (lbf/in^2)
Idle	20 (68)	2.0 (29.0)
1500	20 (68)	6.0 (87.0)
3000	40 (104)	6.2 (90.0)
3000	110 (230)	5.0 (72.5)
3000	130 (266)	4.0 (58.0)

Oil Level Monitoring

Oil level monitoring is provided by an oil level and temperature sensor that measures the oil level in the sump. The oil level can be displayed in the message center of the instrument cluster.

Oil Level and Temperature Sensor



E115936

The oil level and temperature sensor supplies the ECM with a signal containing the level and temperature of the oil in the sump. The oil level and temperature sensor is secured to the bottom of the sump with three screws and sealed with a gasket.

The oil level and temperature sensor sends an ultrasonic pulse vertically upward and measures the time taken for the pulse to be reflected back from the top surface of the oil. This time is compared with the time taken for an ultrasonic pulse to travel a reference distance within the oil level and temperature sensor to determine the oil level. The oil level reading is combined with the oil temperature reading and transmitted in a PWM signal to the ECM.

Oil Level and Temperature Sensor Specifications

Feature	Details
Power Source	Battery Voltage
Level Accuracy	±2 mm (±0.08 in.) at temperatures of -30 °C (-22 °F)) and above; (±4 mm (±0.16 in.) at temperatures below -30 °C (-22 °F))
Temperature Accuracy	±2 °C (±3.6 °F)
Operating Level Range	116 to 147 mm (4.57 to 5.79 in.)
Operating Temperature Range	-40 to 160 °C (-40 to 320 °F)

Oil Level Check

For additional information, refer to: Engine Oil Draining and Filling (303-01C, General Procedures).

For accuracy, oil level checks should be performed with the vehicle on level ground when the oil is hot. The vehicle needs to stand for approximately 10 minutes, after the engine is switched off, to allow the oil to drain back into the sump and the oil level to stabilize. The oil level system will not give a reading until the oil level has stabilized.

To check the oil level, make sure that the ignition is on, the engine stopped and the transmission is in P (park). Access the vehicle information and settings menu, then select **Oil Level Display** from the **Service Menu**. An **Engine Oil Level** sight glass will be displayed in the message center. The current oil level will be displayed in the sight glass. One of the following messages will also be displayed:

- If the oil level is within acceptable limits, the message **Level OK** is displayed.
- If the oil level is less than acceptable, a message advising how much oil to add is displayed e.g. **Add 1 Litre**, or **Add 1 Quart**, depending on the market.
- If the message **Overfilled** is displayed, the oil level must be reduced to within acceptable limits before starting the engine again.
- If the message **Not available** is displayed, the oil level is still stabilizing. Wait 10 minutes and then recheck level.



E121582

Published: 11-May-2011

Engine - V8 5.0L Petrol - Engine

Diagnosis and Testing

For additional information, refer to Diagnosis and Testing, Engine - 5.0L
REFER to: Engine - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133 (303-00, Diagnosis and Testing).

Published: 11-May-2011

Engine - V8 5.0L Petrol - Engine Oil Draining and Filling

General Procedures

Draining

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

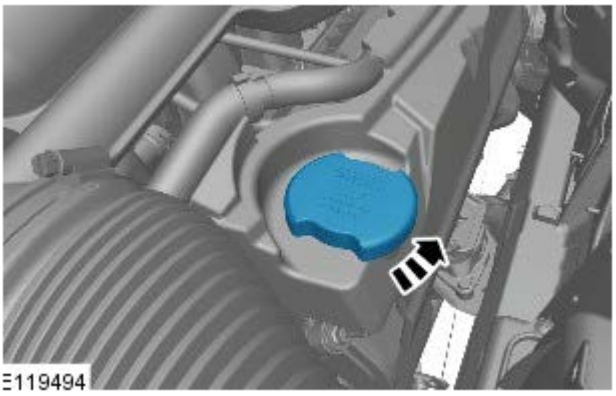
CAUTION: Correct installation of the oil filler cap can be obtained by tightening the cap until hard stop.

NOTE: Clean the components general area prior to dismantling.

1. CAUTION: Make sure the engine is warm.

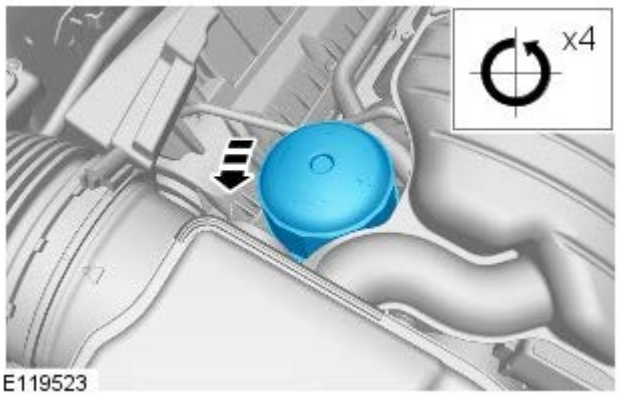
   Start the engine and allow to run for 10 minutes, stop the engine.

2.



3. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

4.

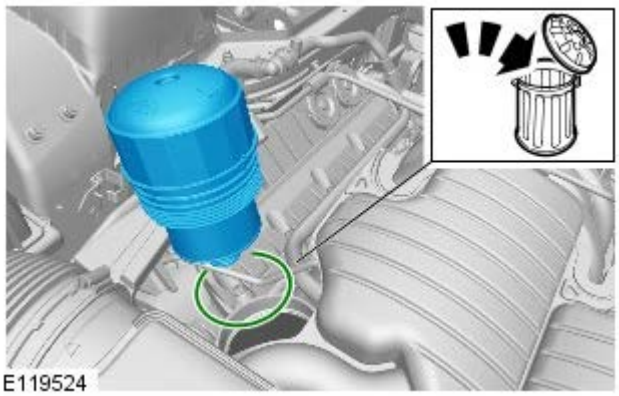


- Loosen the element cover 4 complete turns to allow engine oil to drain from the filter cover.
- Make sure that the O-ring seal is exposed.

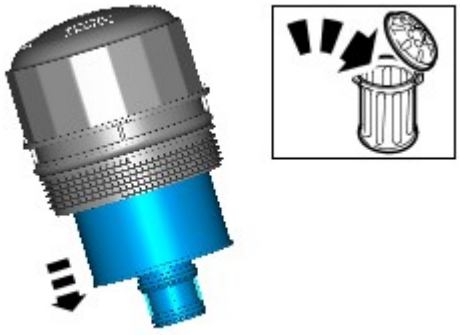
5. NOTES:

   Allow 10 minutes for the engine oil to drain from the oil filter housing.

   Remove and discard the O-ring seal.



6. Remove and discard the oil filter element.

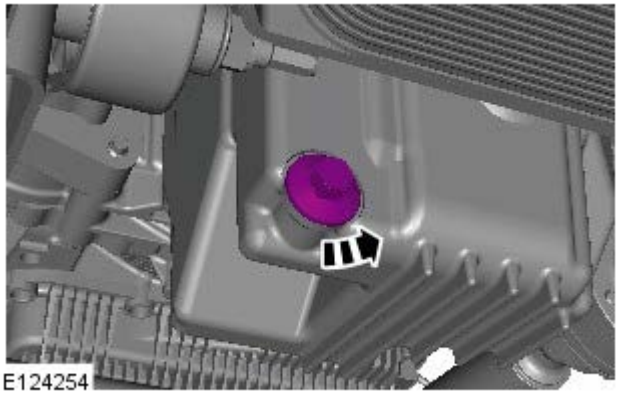


E107394

7. 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.

8. Refer to: Engine Undershield (501-02, Removal and Installation).



E124254

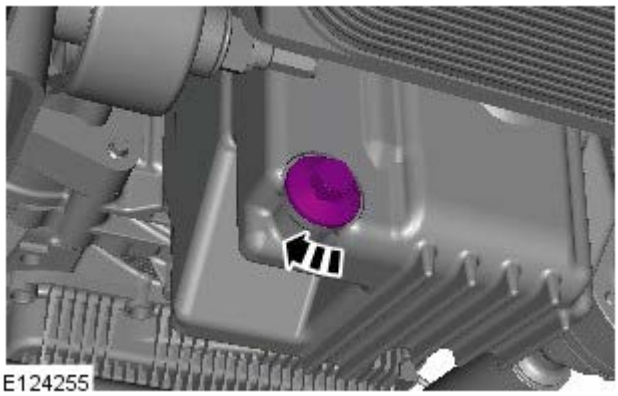
9. CAUTIONS:

   Be prepared to collect escaping oil.

   Allow at least 10 minutes for the engine oil to drain.

   NOTE: Discard the sealing washer.

Filling



E124255

1. CAUTION: Make sure that the area around the component is clean and free of foreign material.

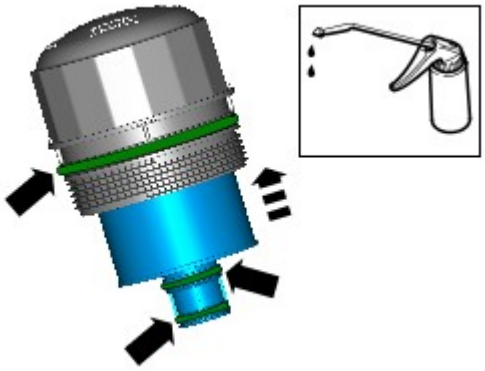
   NOTE: Install a new sealing washer.

   Torque: 24 Nm

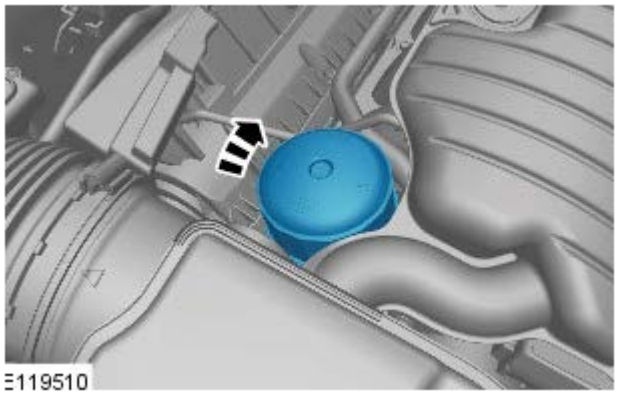
2. Refer to: Engine Undershield (501-02, Removal and Installation).

3. NOTE: Install new O-ring seals.

   Lubricate the oil filter element O-ring seal with clean engine oil.



E107727



E119510

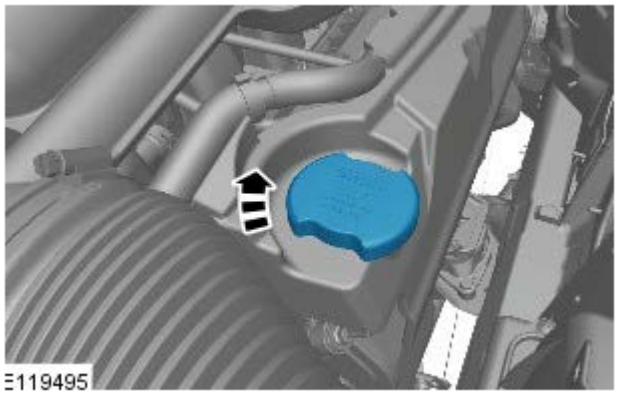
4. CAUTION: Tighten the component finger tight first.
   - *Torque:* 25 Nm

5. CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum (by following Steps 9-15), before starting the engine.
   - Fill the engine with oil - for filling values on vehicles without supercharger:

     Refer to: Specifications (303-01D, Specifications).
   - Fill the engine with oil - for filling values on vehicles with supercharger:

     Refer to: Specifications (303-01D, Specifications).
   - Clean any residual engine oil from the oil filler cap area.

6.



E119495

7. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.

   Follow the Steps 9-15 before starting the engine.

8.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

9. CAUTIONS:

Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

Make sure that the hood is open.

- Turn the ignition on.

10.

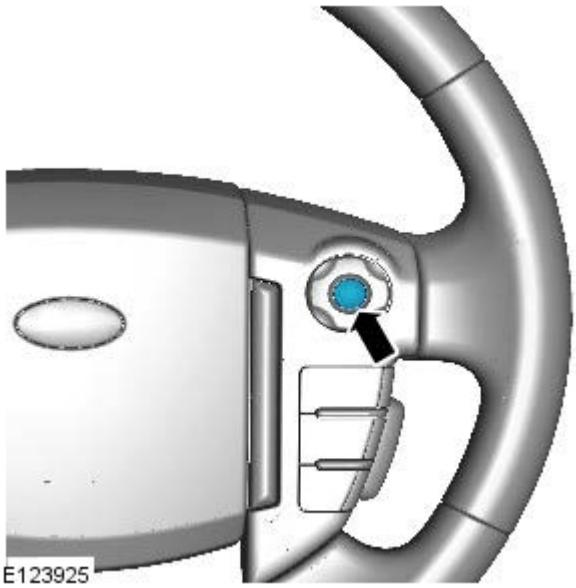
- Press the right-hand directional button to access the instrument cluster menu.



E123926

11.

- Press the right-hand OK button.



E123925

12.

- Press the right-hand directional button to access the Oil Level Display.



E123927

13.

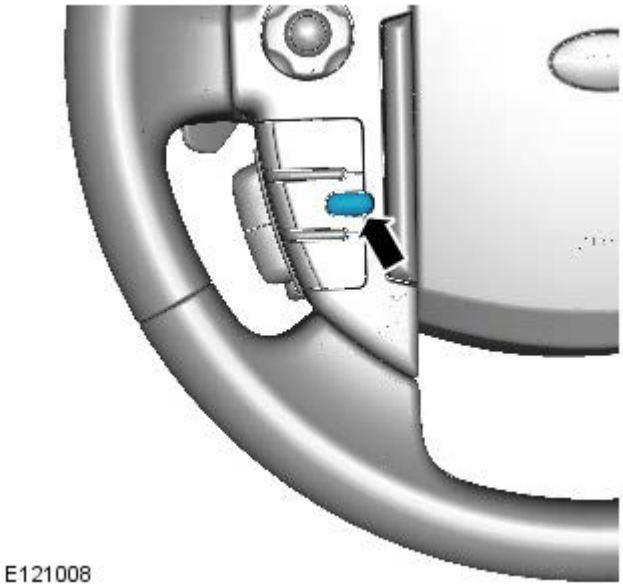
- Press the right-hand OK button and follow the instructions.



E123928

14.

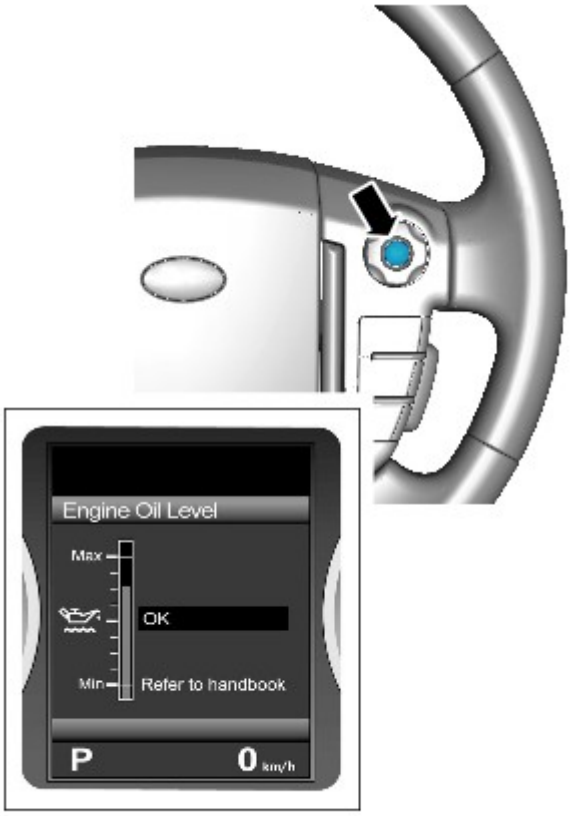
- Press the cruise control cancel button twice within 2 seconds.



E121008

15.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes (as indicated in Step 8), switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.



E123929

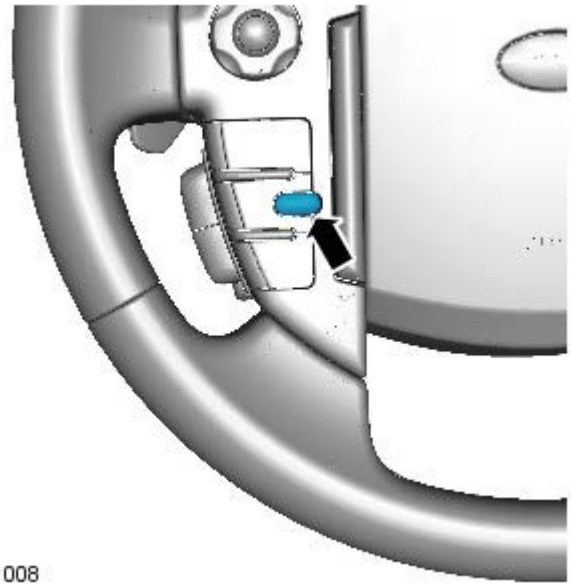
16. NOTE: If instructed to follow Steps 9-15 in a previous step, return to Step 8 and continue the procedure.

    Turn the ignition off.

17. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

18. NOTE: The following steps are to update the average oil level value.

    - Turn the ignition on.
    - Press and hold the cruise control cancel button for more than 2 seconds.



E121008

19.
- The message center display will revert to the normal display in the trip computer.

20. Turn the ignition off.

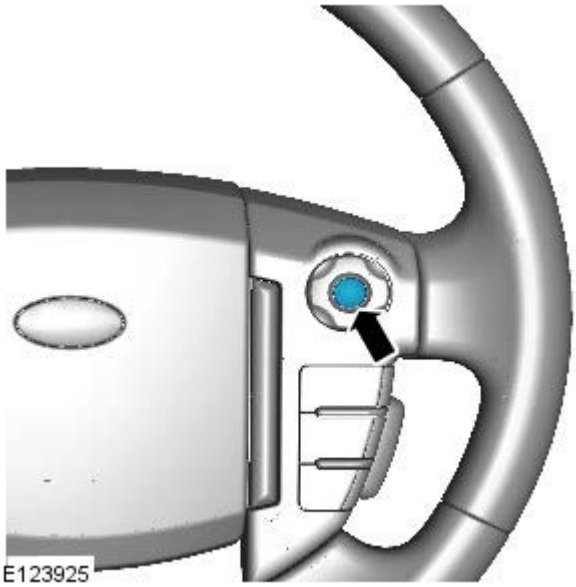
21. Turn the ignition on.

22.
- Press the right-hand directional button to access the instrument cluster menu.



E123926

23.
- Press the right-hand OK button.



24.

- Press the right-hand directional button to access the Oil Level Display.



E123927

25.

- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.



E123929

26. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

Published: 11-May-2011

Engine - V8 5.0L Petrol - Engine Oil Vacuum Draining and Filling

General Procedures

Special Tool(s)

 E129630	303-1484 Vacuum Pump, Oil Drain
 E129631	303-1484-01 Adapter for 303-1484

Draining

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 hard stop.

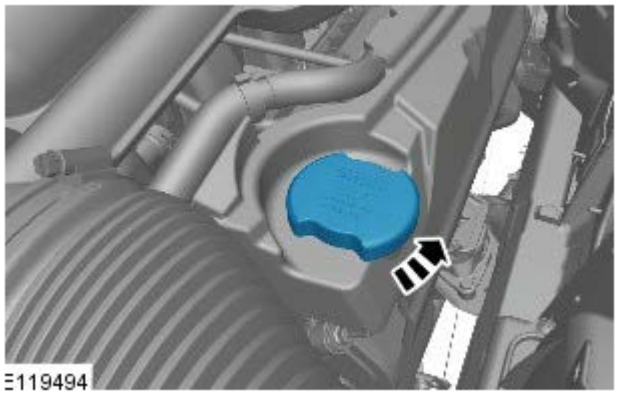
NOTES:

Make sure that the vehicle is parked on level ground.

Clean the components general area prior to dismantling.

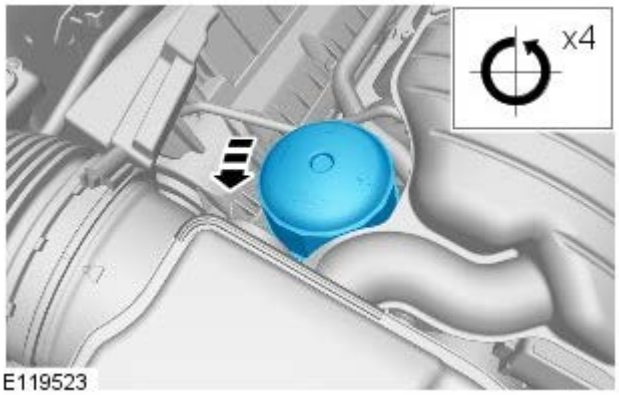
1.
- Start the engine and allow to run for 10 minutes, stop the engine.

2. CAUTION: Allow 10 minutes from turning the engine off before starting oil extraction.


E119494

3. Refer to: Engine Cover - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133 (501-05 Interior Trim and Ornamentation, Removal and Installation).

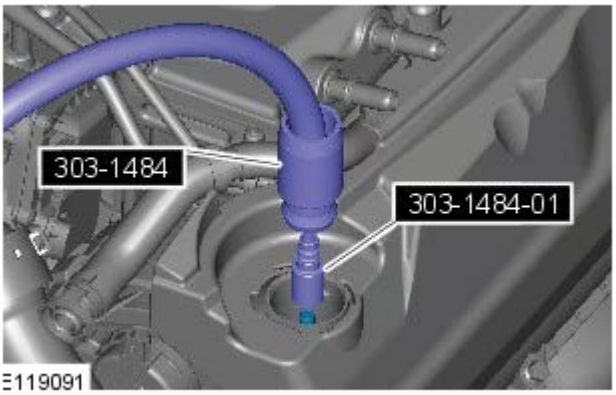
4.
- Loosen the element cover 4 complete turns to allow engine oil to drain from the filter cover.



5.

- Using the oil vacuum pump drain the oil out through the oil extraction tube.

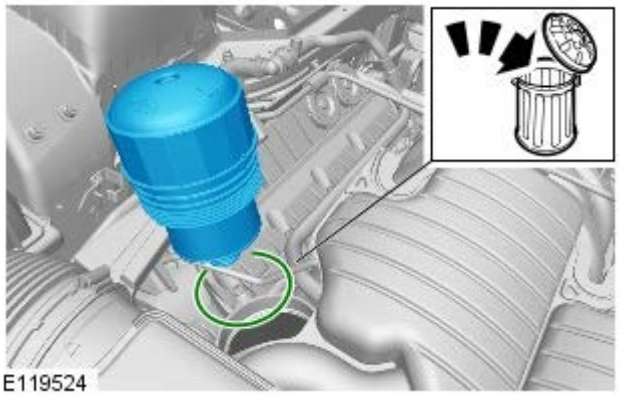
  Special Tool(s): 303-1484, 303-1484-01



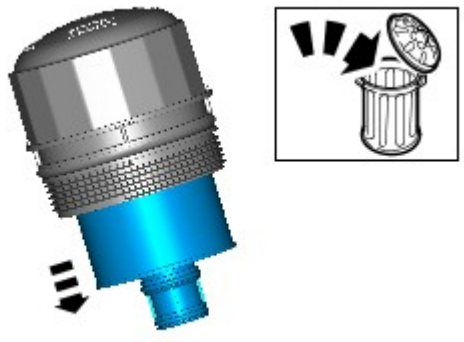
6.

- Remove the oil vacuum pump.

7.



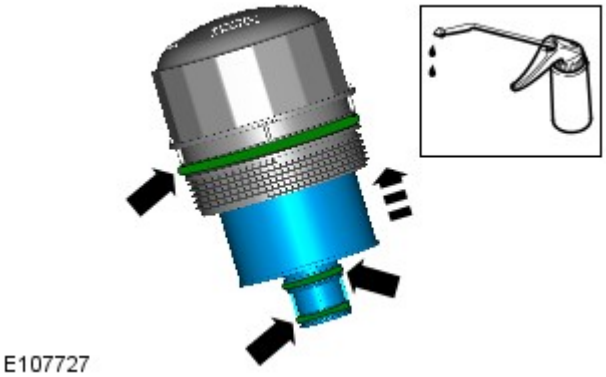
8. NOTE: Discard the O-ring seals.

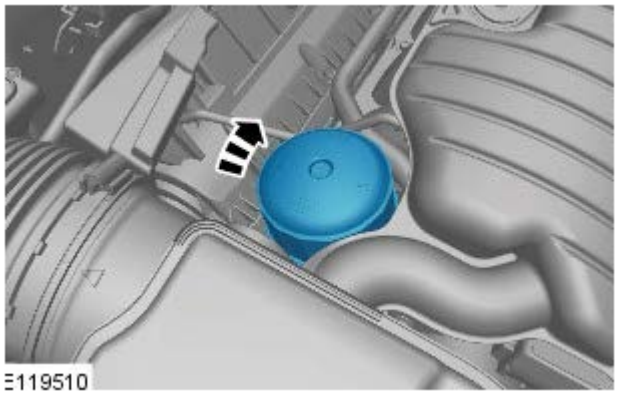


Filling

1. NOTE: Install new O-ring seals.

   Lubricate the oil filter element O-ring seal with clean engine oil.


E107727


E119510

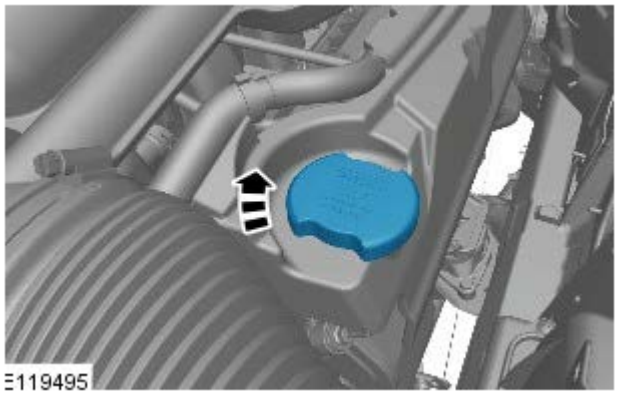
2. CAUTION: Tighten the component finger tight first.
   - *Torque:* 25 Nm

3. CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum (by following Steps 7-13), before starting the engine.
   - Fill the engine with oil - for filling values on vehicles without supercharger:

     Refer to: Specifications (303-01 Engine - 5.0L NA V8 - AJ133, Specifications).
   - Fill the engine with oil - for filling values on vehicles with supercharger:

     Refer to: Specifications (303-01 Engine - 5.0L NA V8 - AJ133, Specifications).
   - Clean any residual engine oil from the oil filler cap area.

4.


E119495

5. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.

   Follow the Steps 7-13 before starting the engine.

6.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

7. CAUTIONS:

Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

Make sure that the hood is open.

- Turn the ignition on.

8.

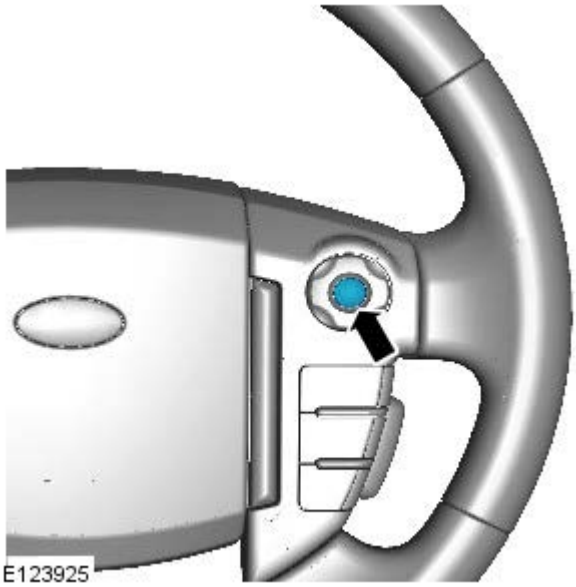
- Press the right-hand directional button to access the instrument cluster menu.



E123926

9.

- Press the right-hand OK button.



E123925

10.

- Press the right-hand directional button to access the Oil Level Display.



E123927

11.

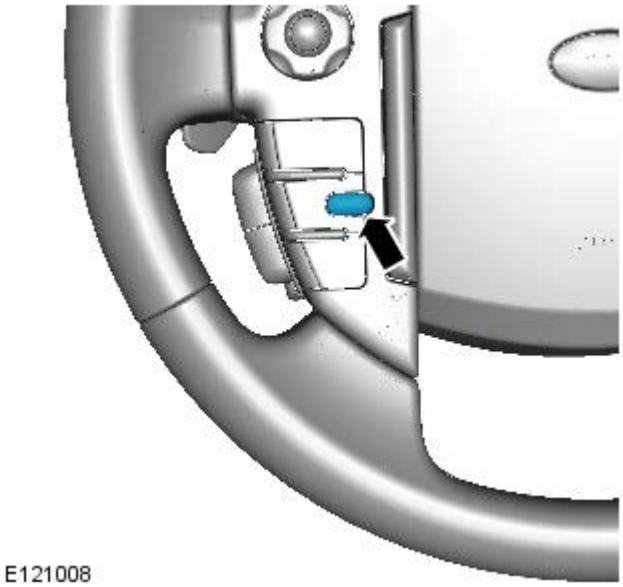
- Press the right-hand OK button and follow the instructions.



E123928

12.

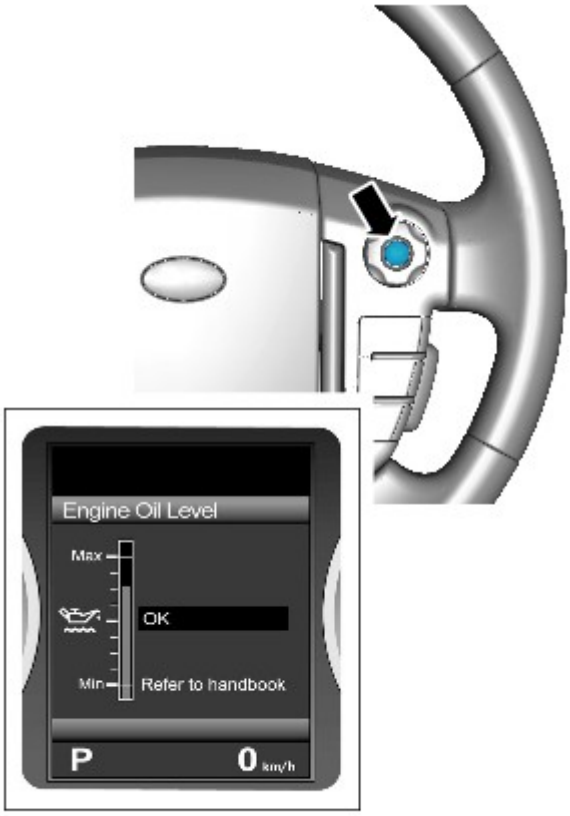
- Press the cruise control cancel button twice within 2 seconds.



E121008

13.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes (as indicated in Step 6), switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.



E123929

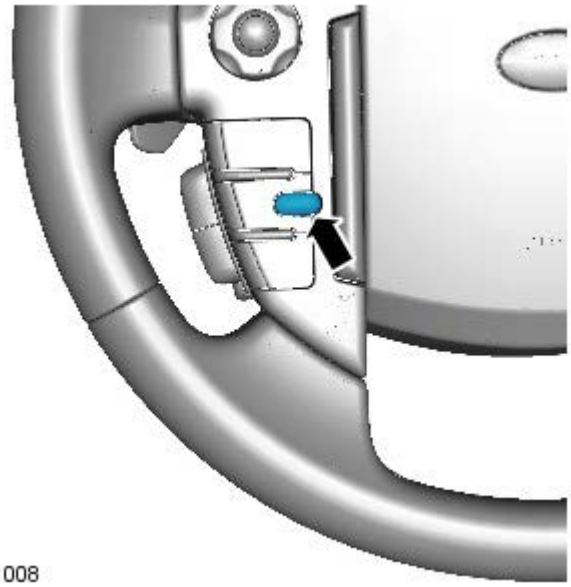
14. NOTE: If instructed to follow Steps 7-13 in a previous step, return to Step 6 and continue the procedure.

    Turn the ignition off.

15. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

16. NOTE: The following steps are to update the average oil level value.

    - Turn the ignition on.
    - Press and hold the cruise control cancel button for more than 2 seconds.



E121008

17.

- The message center display will revert to the normal display in the trip computer.

18. Turn the ignition off.

19. Turn the ignition on.

20.

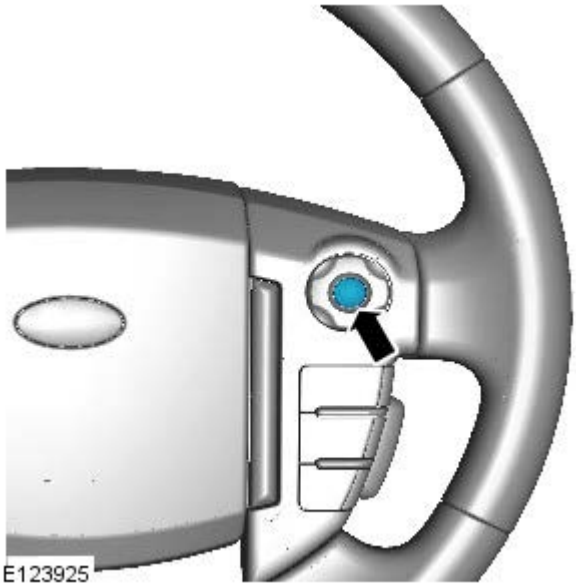
- Press the right-hand directional button to access the instrument cluster menu.



E123926

21.

- Press the right-hand OK button.



22.

- Press the right-hand directional button to access the Oil Level Display.



E123927

23.

- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.



E123929

24. Refer to: Engine Cover - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133 (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 16-Dec-2013

Engine - V8 5.0L Petrol - Fuel Pump Camshaft Timing Check

General Procedures

Special Tool(s)

 E115265	303-1447 Timing Tool
 E140377	JLR-303-1621 Alignment Tool, Fuel Pump Camshaft Timing

Check

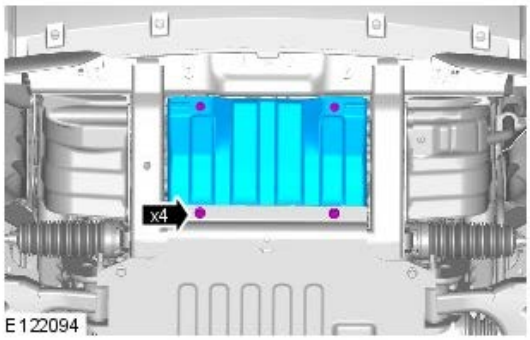
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-01 Battery, Mounting and Cables, Specifications).

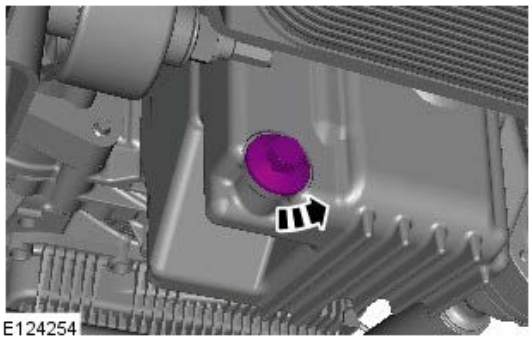
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

4. 

E122094

5. 
E124254

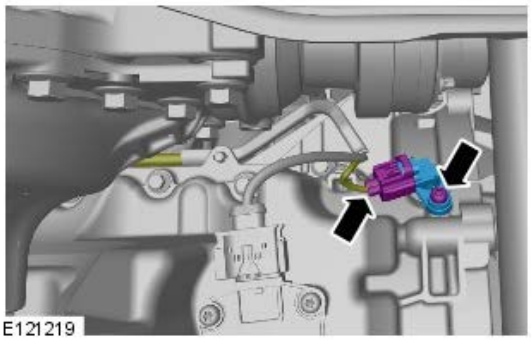
   CAUTION: Be prepared to collect escaping oil.

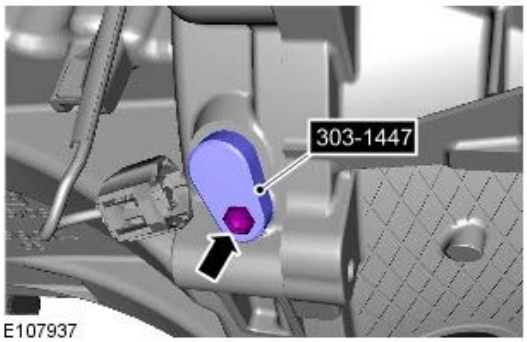
   NOTES:

   Discard the sealing washer.

   Collect the engine oil in a clean container.

6.


E121219



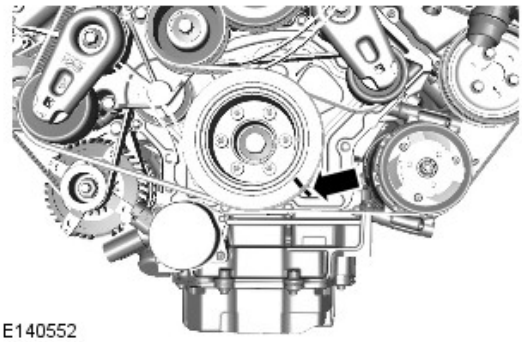
E107937

7. CAUTIONS:

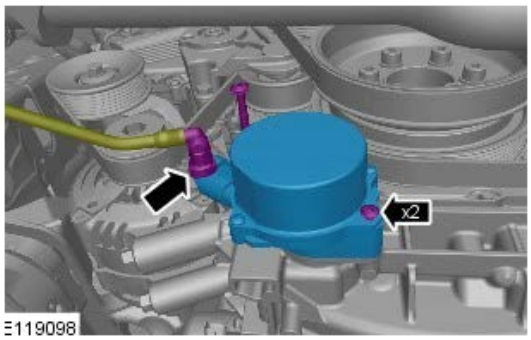
   Only rotate the crankshaft clockwise.

   Make sure that the crankshaft is fully locked.

   Install the Special Tool(s): 303-1447

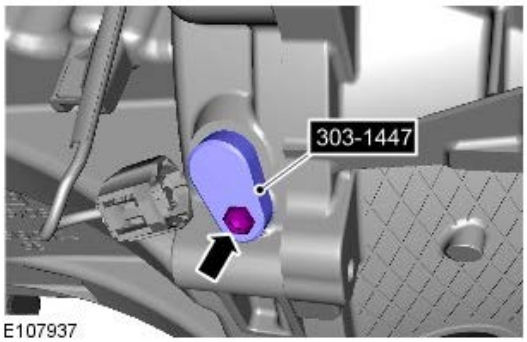

E140552

8. Using a suitable marker, mark the position of the crankshaft pulley as illustrated.



E119098

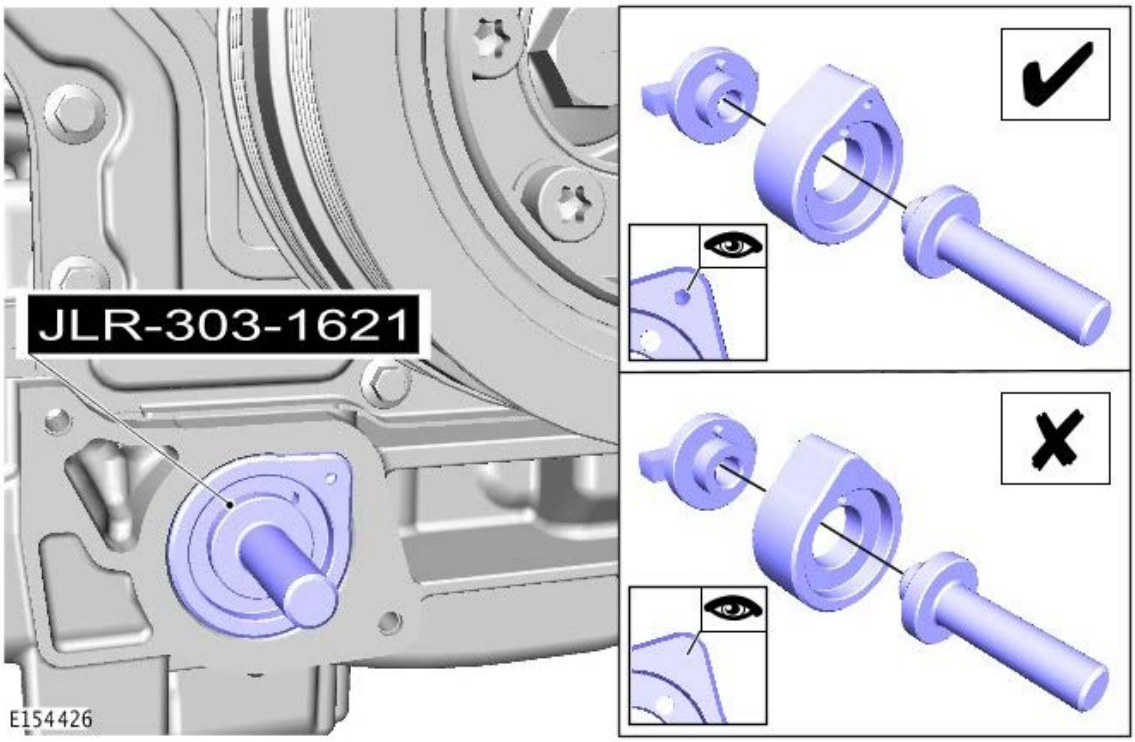
9. NOTE: Discard the seal.



E107937

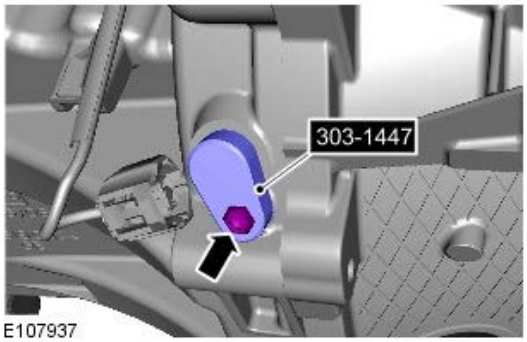
10. *Remove the Special Tool(s):* 303-1447

11. If required, carefully adjust the crankshaft position to allow correct



installation of the special tool.

Install the Special Tool(s): JLR-303-1621



12. CAUTION: Do not use excessive force when adjusting the crankshaft position.

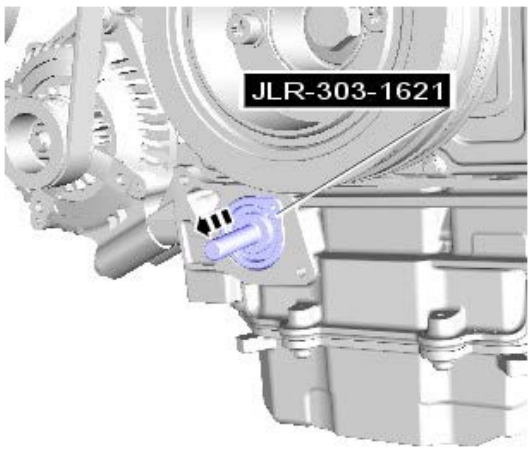
NOTE: If the crankshaft timing tool cannot be installed, adjustment of the fuel pump camshaft timing will be required.

- If required, carefully adjust the crankshaft position to allow correct installation of the special tool.

  Install the Special Tool(s): 303-1447
- If the crankshaft timing tool cannot be installed, adjustment of the fuel pump camshaft timing will be required.

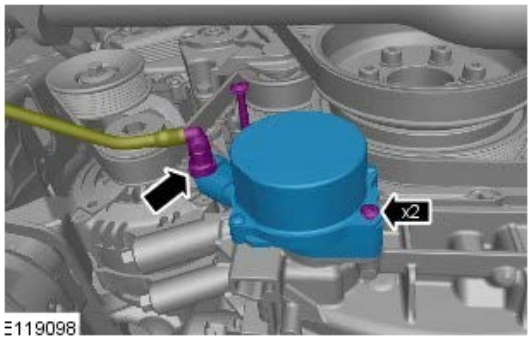
  Refer to: Fuel Pump Camshaft Timing Adjustment (303-01B Engine - V8 5.0L Petrol, General Procedures).

13. *Remove the Special Tool(s):* JLR-303-1621

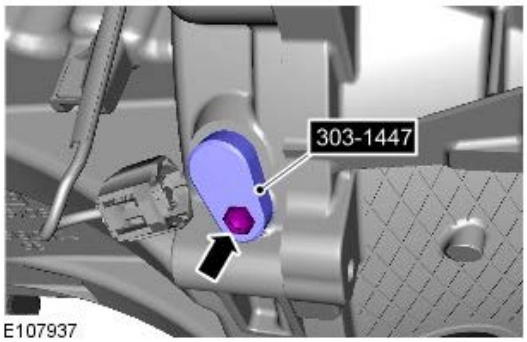


14. NOTE: Install a new seal.

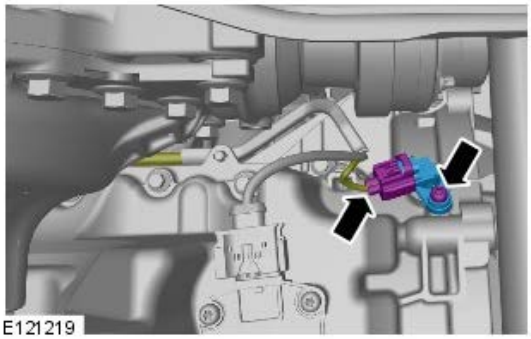
Torque: 12 Nm



15. *Remove the Special Tool(s):* 303-1447

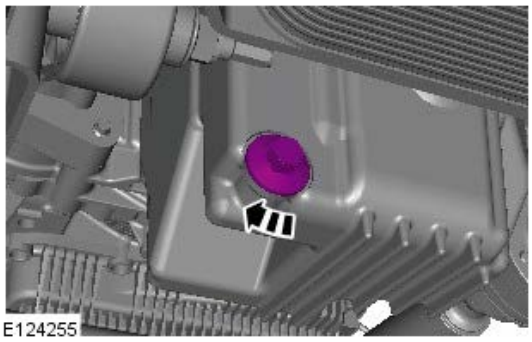


16. *Torque:* 10 Nm



17. NOTE: Install a new sealing washer.

Torque: 24 Nm



18. Connect the battery ground cable.

Refer to: Specifications (414-01 Battery, Mounting and Cables, Specifications).

19. CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum (by following Steps 22-28), before starting the engine.

- Fill the engine with oil - for filling values on vehicles without supercharger:

  Refer to: Specifications (303-01B Engine - V8 5.0L Petrol, Specifications).
- Fill the engine with oil - for filling values on vehicles with supercharger:

  Refer to: Specifications (303-01C Engine - V8 S/C 5.0L Petrol, Specifications).
- Clean any residual engine oil from the oil filler cap area.

20. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.

Follow the Steps 22-28 before starting the engine.

21.

- Start the engine and allow to run for 10 minutes, stop the engine.
- Check for leaks.

22. CAUTIONS:

Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

Make sure that the hood is open.

- Turn the ignition on.

23.

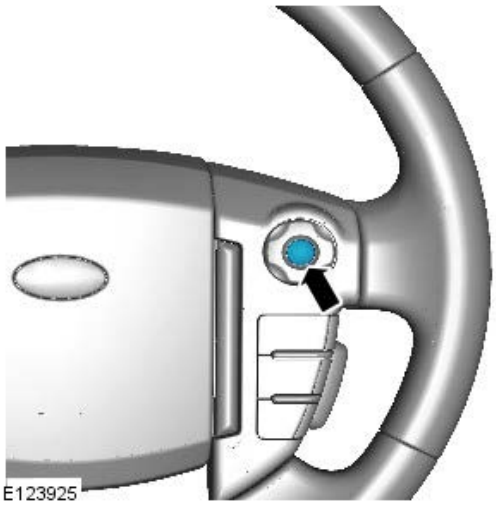
- Press the right-hand directional button to access the instrument cluster menu.



E123926

24.

- Press the right-hand OK button.



E123925

25.

- Press the right-hand directional button to access the Oil Level Display.



E123927

26.

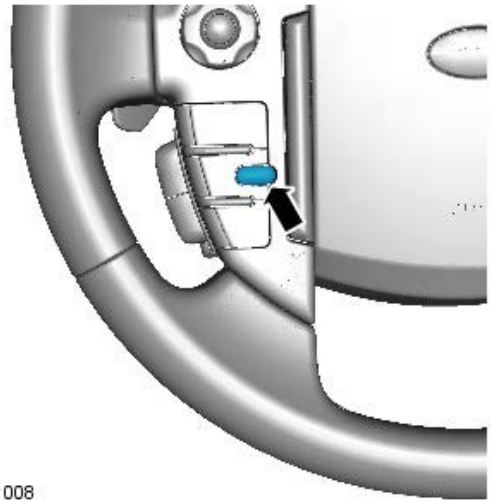
- Press the right-hand OK button and follow the instructions.



E123928

27.

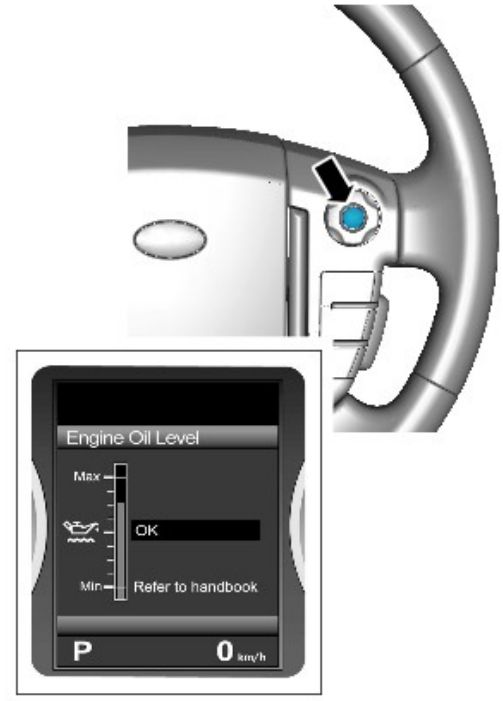
- Press the cruise control cancel button twice within 2 seconds.



E121008

28.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes (as indicated in Step 21), switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.

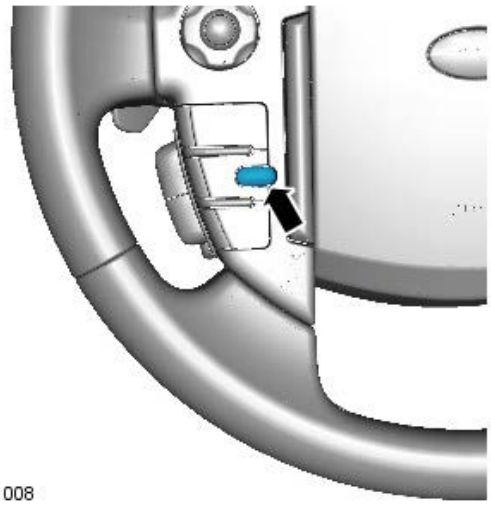


E123929

29. NOTE: If instructed to follow Steps 22-28 in a previous step, return to Step 21 and continue the procedure.

    Turn the ignition off.

30. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.



E121008

31. NOTE: The following steps are to update the average oil level value.

    - Turn the ignition on.
    - Press and hold the cruise control cancel button for more than 2 seconds.

32.

- The message center display will revert to the normal display in the trip computer.

33. Turn the ignition off.

34. Turn the ignition on.

35.

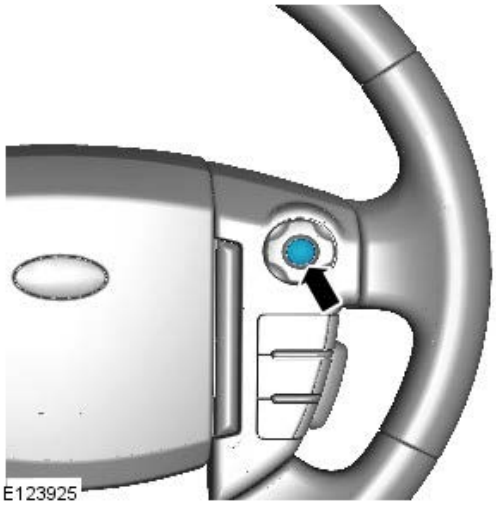
- Press the right-hand directional button to access the instrument cluster menu.



E123926

36.

- Press the right-hand OK button.



E123925

37.

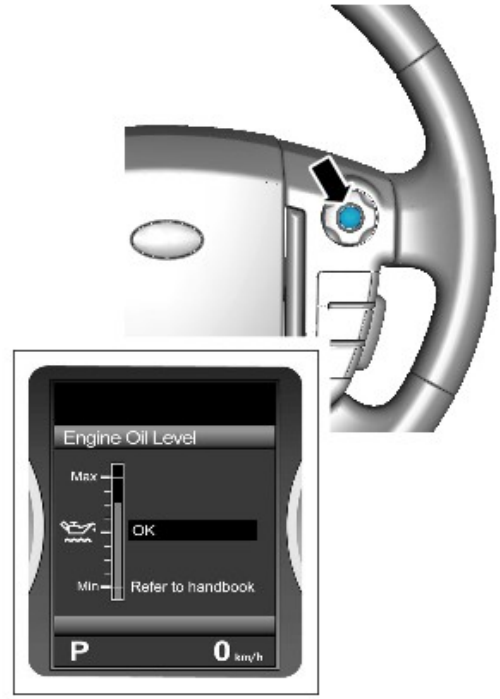
- Press the right-hand directional button to access the Oil Level Display.



E123927

38.

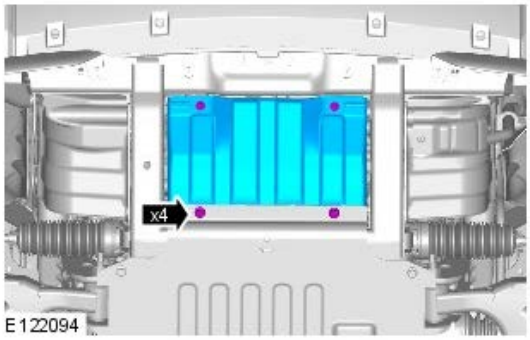
- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.



E123929

39. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

40. *Torque:* 10 Nm



E122094

Published: 08-Dec-2011

Engine - V8 5.0L Petrol - Fuel Pump Camshaft Timing Adjustment

General Procedures

Special Tool(s)

 E115265	303-1447 Timing Tool
 E140377	JLR-303-1613 Alignment Tool, Fuel Pump Camshaft Timing

Adjustment

1. Disconnect the battery ground cable.

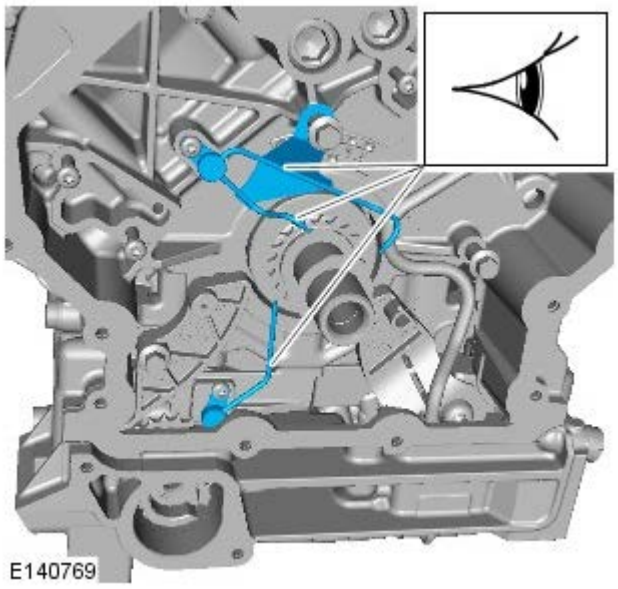
   Refer to: Specifications (414-01, Specifications).

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. Refer to: Fuel Pump Camshaft Timing Check (303-01D, General Procedures).

4. Refer to: Lower Timing Cover (303-01C, Removal and Installation).
   Refer to: Lower Timing Cover (303-01D, Removal and Installation).


E140769

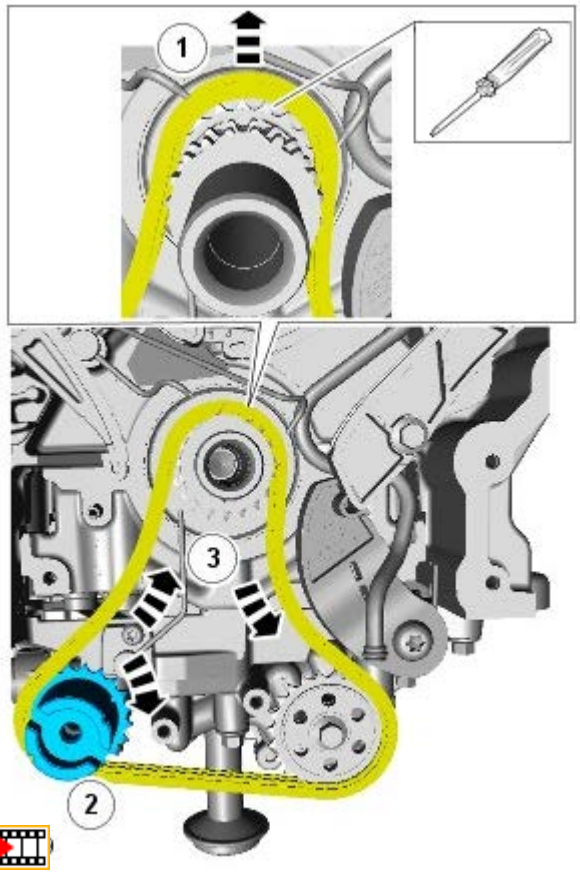
5. CAUTIONS:

   Make sure that the area around the component is clean and free of foreign material.

   Inspect the 3 timing chain oil nozzles for signs of damage, install as necessary.

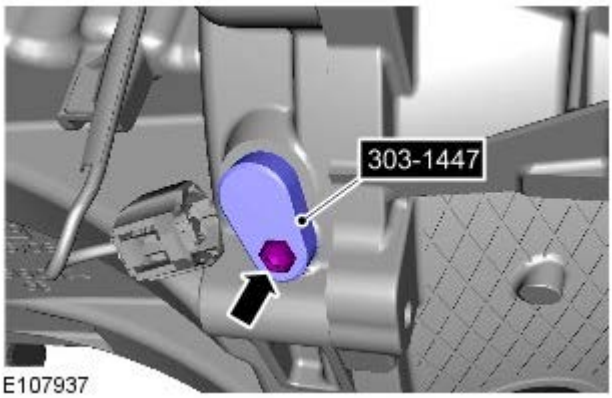
6. NOTE: **Using a suitable tie strap, position the tensioner to one side.**

   Special Tool(s): JLR-303-1613
   Torque: 12 Nm



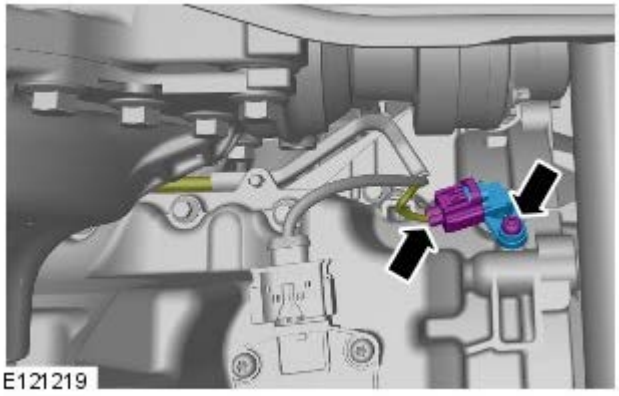
7. Refer to: Lower Timing Cover (303-01C, Removal and Installation).
   Refer to: Lower Timing Cover (303-01D, Removal and Installation).

8. *Remove the Special Tool(s):* 303-1447



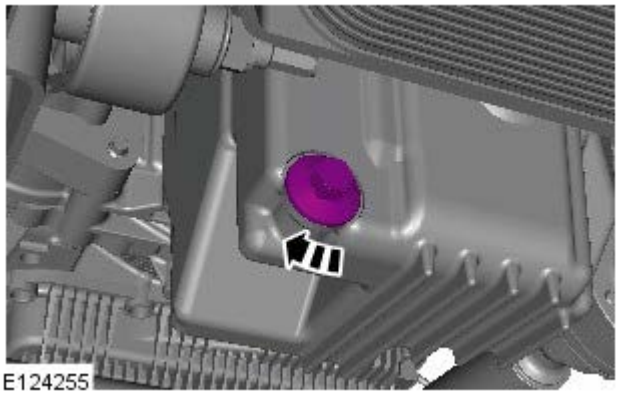
E107937

9. *Torque:* 10 Nm


E121219

10. NOTE: Install a new sealing washer.

Torque: 24 Nm


E124255

11. Connect the battery ground cable.

    Refer to: Specifications (414-01, Specifications).

12. CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum (by following Steps 15-21), before starting the engine.

    - Fill the engine with oil - for filling values on vehicles without supercharger:

      Refer to: Specifications (303-01C, Specifications).
    - Fill the engine with oil - for filling values on vehicles with supercharger:

      Refer to: Specifications (303-01D, Specifications).
    - Clean any residual engine oil from the oil filler cap area.

13. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.

    Follow the Steps 15-21 before starting the engine.

14.
    - Start the engine and allow to run for 10 minutes, stop the engine.
    - Check for leaks.

15. CAUTIONS:

    Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

    Make sure that the hood is open.

    - Turn the ignition on.

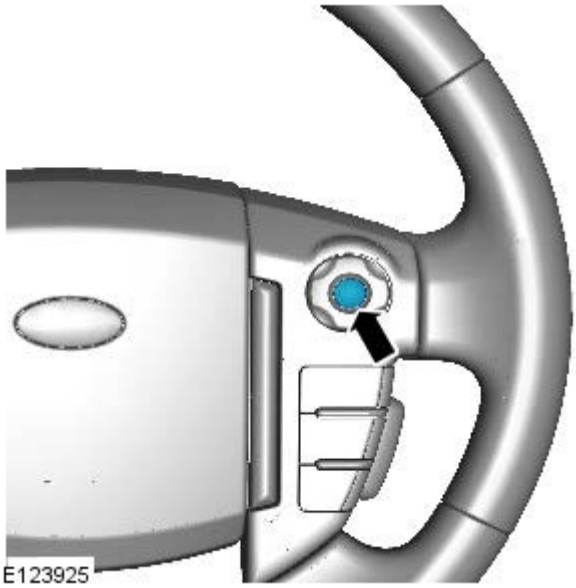
16.
    - Press the right-hand directional button to access the instrument cluster menu.



E123926

17.

- Press the right-hand OK button.



E123925

18.

- Press the right-hand directional button to access the Oil Level Display.



E123927

19.

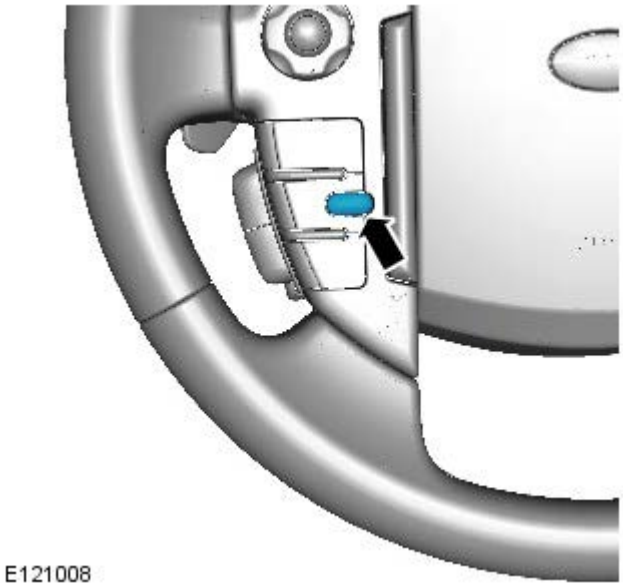
- Press the right-hand OK button and follow the instructions.



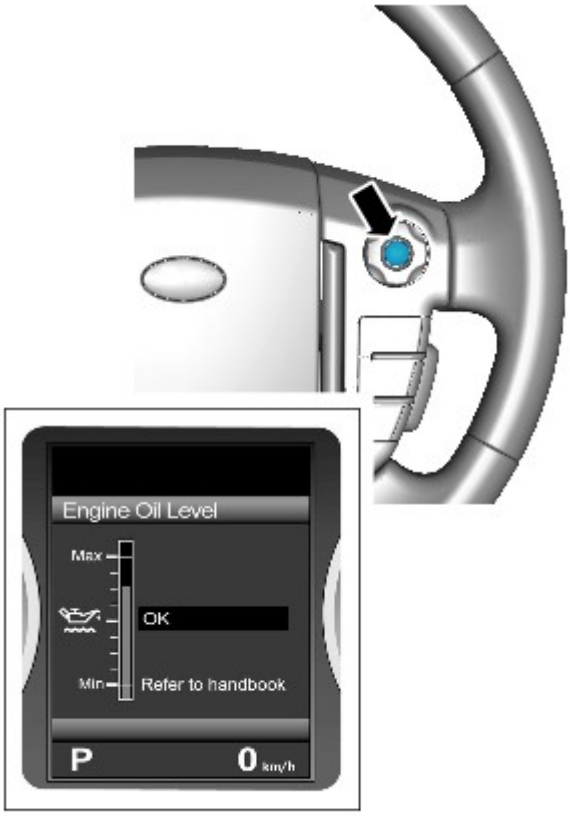
E123928

20.

- Press the cruise control cancel button twice within 2 seconds.



E121008



E123929

21.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes (as indicated in Step 14), switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.

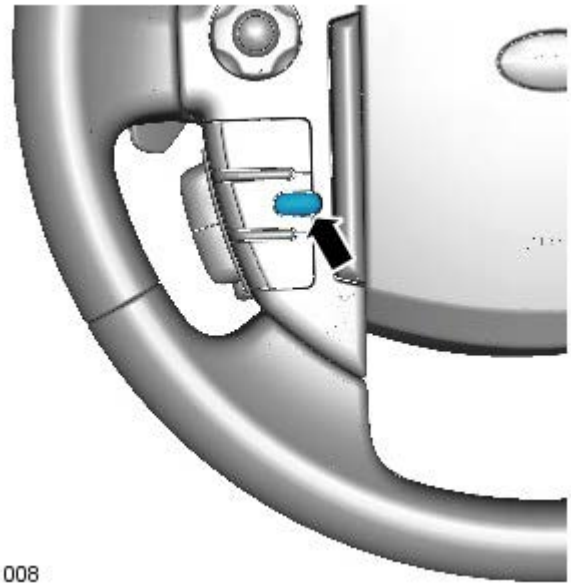
22. NOTE: If instructed to follow Steps 15-21 in a previous step, return to Step 14 and continue the procedure.

    Turn the ignition off.

23. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

24. NOTE: The following steps are to update the average oil level value.

    - Turn the ignition on.
    - Press and hold the cruise control cancel button for more than 2 seconds.



E121008

25.

- The message center display will revert to the normal display in the trip computer.

26. Turn the ignition off.

27. Turn the ignition on.

28.

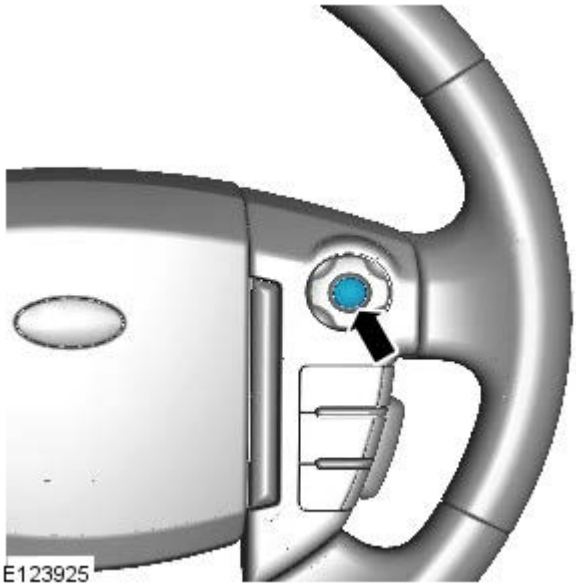
- Press the right-hand directional button to access the instrument cluster menu.



E123926

29.

- Press the right-hand OK button.



30.

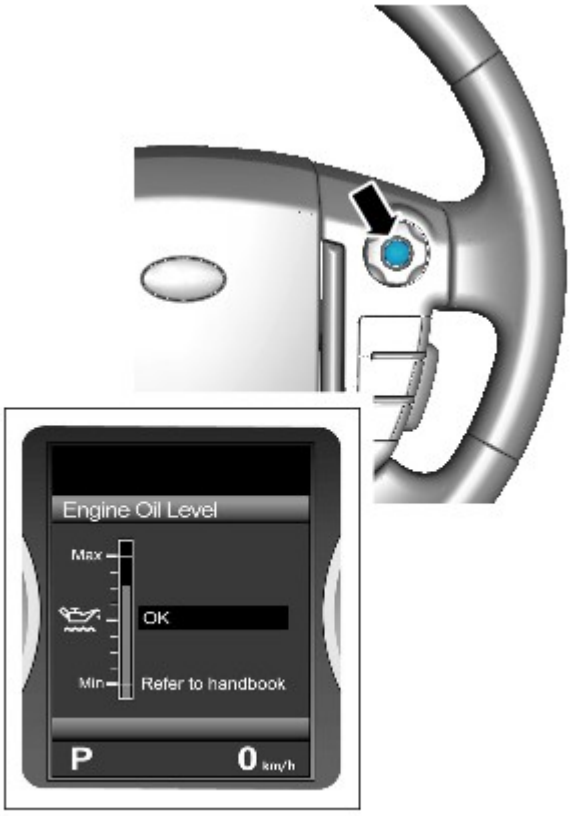
- Press the right-hand directional button to access the Oil Level Display.



E123927

31.

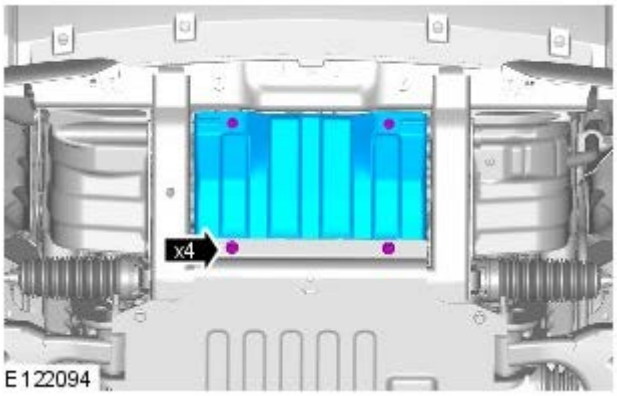
- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.



E123929

32. Refer to: Engine Undershield (501-02, Removal and Installation).

33. *Torque:* 10 Nm



E122094

Published: 11-May-2011

Engine - V8 5.0L Petrol - Camshaft LH

Removal and Installation

Removal

CAUTION: Make sure that the orientation and code on the top of the camshaft bearing caps is noted (along with the bank - A or B), so that on installation the components are installed to their original position. Failure to follow this instruction may cause damage to the vehicle.

NOTES:

Removal steps in this procedure may contain installation details.

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

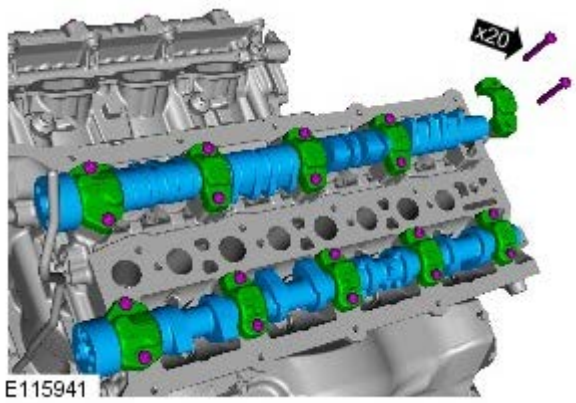
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Timing Drive Components (303-01, Removal and Installation).



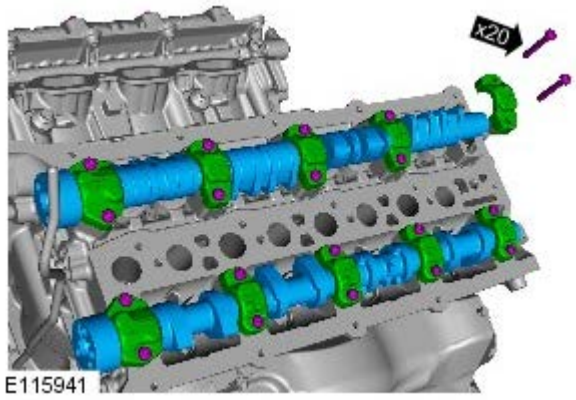
4. CAUTIONS:

   Rotate the camshafts until all the valves are at their minimum open point.

   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).

Installation



1. CAUTIONS:

   Prior to installing the camshafts, position the crankshaft 45 degrees ATDC cylinder 1A to prevent valve/piston collision.

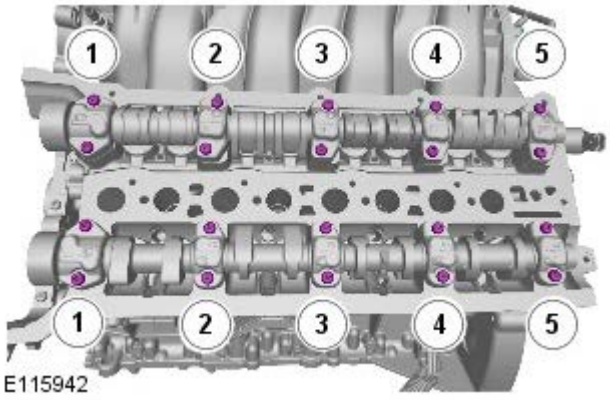
   Make sure that the camshafts and camshaft bearing caps are installed in their original locations.

   Evenly and progressively install and tighten the camshaft bearing caps.

   NOTE: Lubricate the camshafts and the camshaft bearing caps with EP90 oil (or 75/90 viscosity oil will suffice) prior to installation.

   Torque: 3 Nm

2. NOTE: Tighten the bolts in the indicated



sequence.

Torque: 12 Nm

3. CAUTION: Only rotate the crankshaft clockwise.

   Rotate the crankshaft untill the camshaft lobe on the valve being checked is 180 degrees from the maximum opening position.

4. NOTES:

   If the valve clearance is incorrect, continue to the next step. If the valve clearance is correct, continue to step 8.

   On vehicles without supercharger the inlet camshaft valve clearances cannot be checked.

   Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

5. CAUTIONS:

   Do not use a magnet to remove the tappet.

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

   Remove the tappet and measure the thickness.

6. NOTE: If a new tappet is installed then go back to step 1 of the install procedure.

   Install a new tappet if required.

7. Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

8. Refer to: Timing Drive Components (303-01, Removal and Installation).

9. Connect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Engine - V8 5.0L Petrol - Camshaft RH

Removal and Installation

Removal

CAUTION: Make sure that the orientation and code on the top of the camshaft bearing caps is noted (along with the bank - A or B), so that on installation the components are installed to their original position. Failure to follow this instruction may cause damage to the vehicle.

NOTES:

Removal steps in this procedure may contain installation details.

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

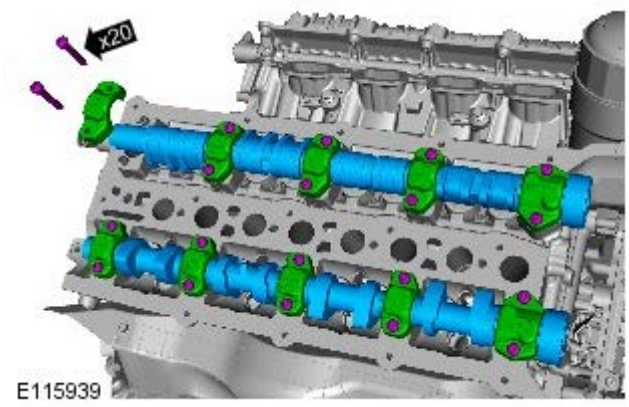
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Timing Drive Components (303-01, Removal and Installation).



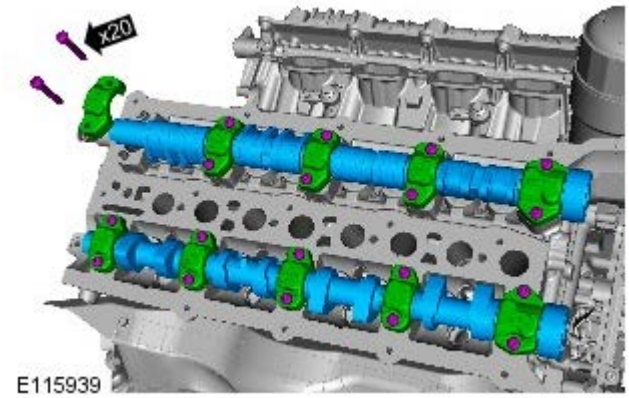
4. CAUTIONS:

   Rotate the camshafts until all the valves are at their minimum open point.

   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).

Installation



1. CAUTIONS:

   Prior to installing the camshafts, position the crankshaft 45 degrees ATDC cylinder 1A to prevent valve/piston collision.

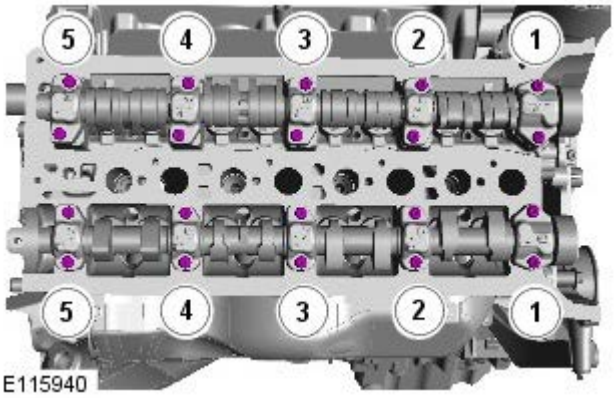
   Make sure that the camshafts and camshaft bearing caps are installed in their original locations.

   Evenly and progressively install and tighten the camshaft bearing caps.

   NOTE: Lubricate the camshafts and the camshaft bearing caps with EP90 oil (or 75/90 viscosity oil will suffice) prior to installation.

   Torque: 3 Nm

2. NOTE: Tighten the bolts in the indicated



sequence.

Torque: 12 Nm

3. CAUTION: Only rotate the crankshaft clockwise.

   Rotate the crankshaft untill the camshaft lobe on the valve being checked is 180 degrees from the maximum opening position.

4. NOTES:

   If the valve clearance is incorrect, continue to the next step. If the valve clearance is correct, continue to step 8.

   On vehicles without supercharger the inlet camshaft valve clearances cannot be checked.

   Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

5. CAUTIONS:

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

   Do not use a magnet to remove the tappet.

   Remove the tappet and measure the thickness.

6. NOTE: If a new tappet is installed then go back to step 1 of the install procedure.

   Install a new tappet if required.

7. Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

8. Refer to: Timing Drive Components (303-01, Removal and Installation).

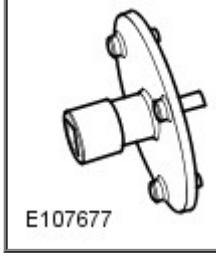
9. Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Engine - V8 5.0L Petrol - Crankshaft Front Seal

Removal and Installation

Special Tool(s)

 E107677	303-1434 Remover/Installer, Front Crankshaft Seal

Removal

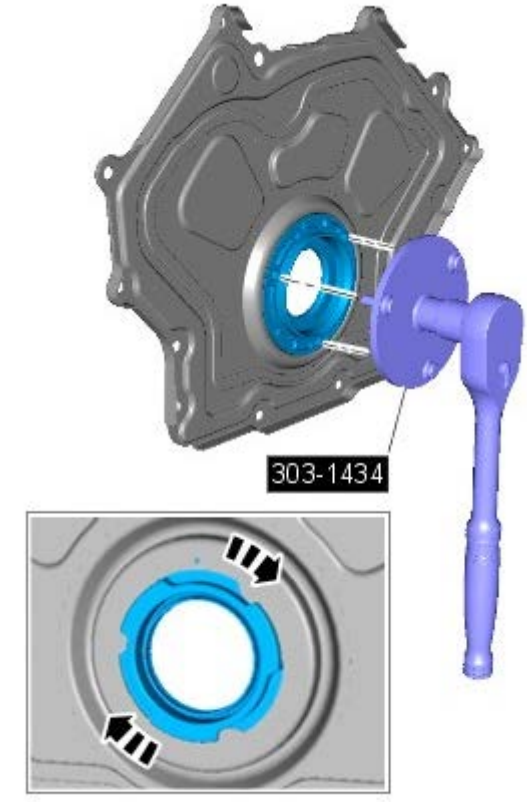
NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. Refer to: Crankshaft Pulley (303-01, Removal and Installation).

3. *Special Tool(s):* 303-1434
   Torque: 26 Nm



E112056

Installation

1. CAUTIONS:

   Do not over tighten the crankshaft front seal. Failure to follow this instruction may result in damage to the vehicle.

   Take extra care not to damage the seal.

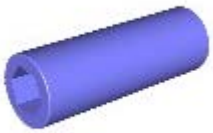
   To install, reverse the removal procedure.

Published: 20-Aug-2013

Engine - V8 5.0L Petrol - Crankshaft Pulley

Removal and Installation

Special Tool(s)

 E115256	303-1437 Crankshaft Damper Remover/Installer
 E115257	303-1438 Crankshaft Damper Bolt Remover/Installer
 E115258	303-1439 Crankshaft Damper Removal Plate
 E115259	303-1440 Crankshaft Damper Removal/Installation Stud
 E115260	303-1441 Crankshaft Damper Remover/Installer Body
 E119168	303-1500 Installer, Stretchy Belt

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

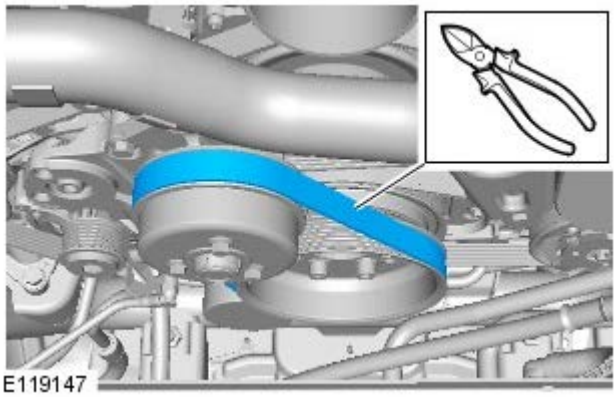
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

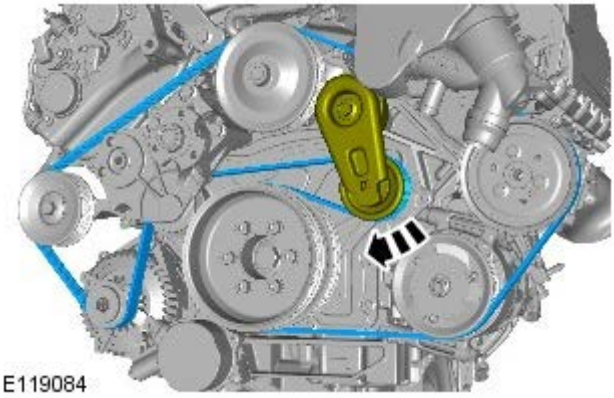
3. Refer to: Radiator - V8 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

4. Refer to: Starter Motor (303-06B Starting System - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

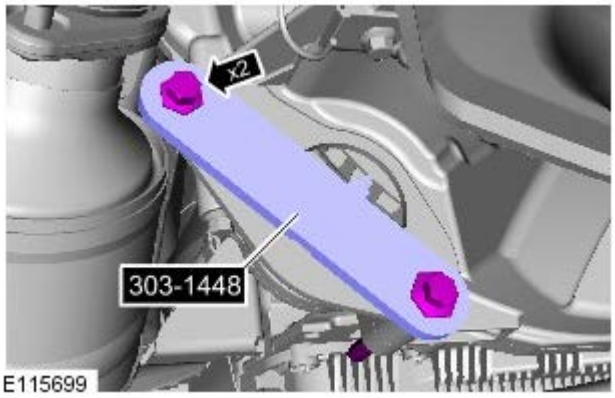
5.



6.

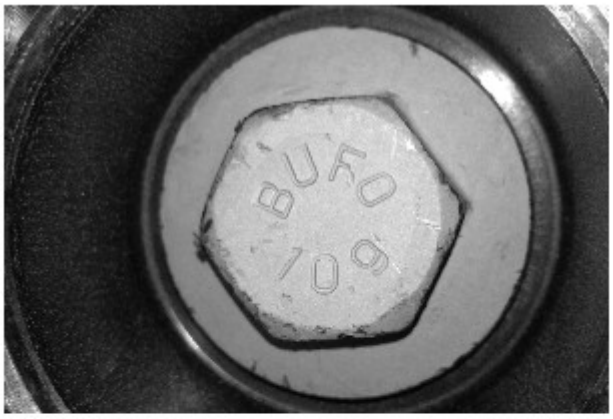


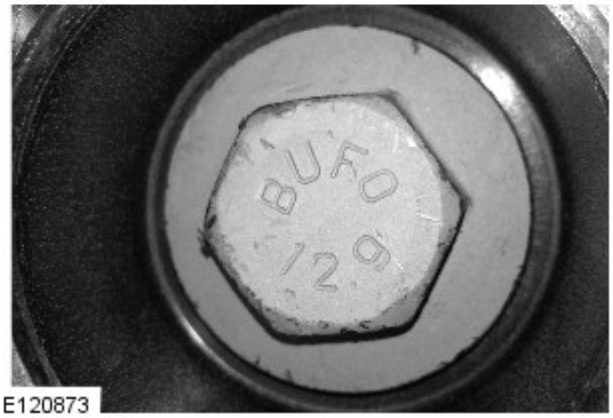
7. Install the special tool.



8. CAUTION: Before removing the crankshaft pulley bolt, note the numbers on the bolt head. If the bolt head shows 10.9, the bolt must be removed counter clockwise. If the bolt head shows 12.9, the bolt must be removed clockwise. Failure to follow this instruction may result in damage to the crankshaft.

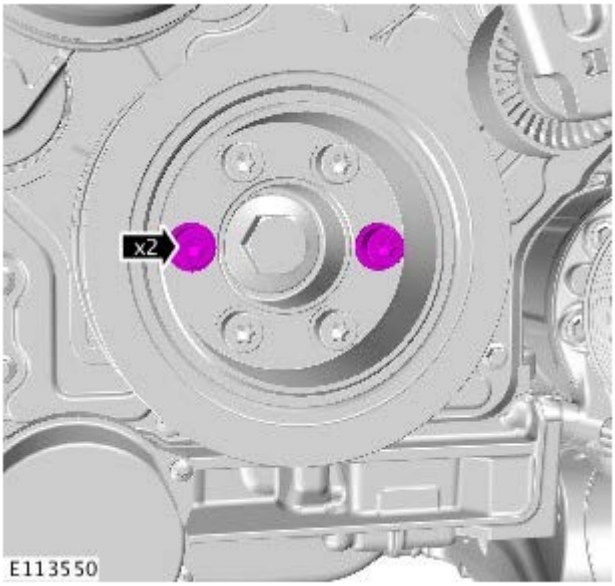
   Note the markings on the crankshaft pulley bolt.





E120873

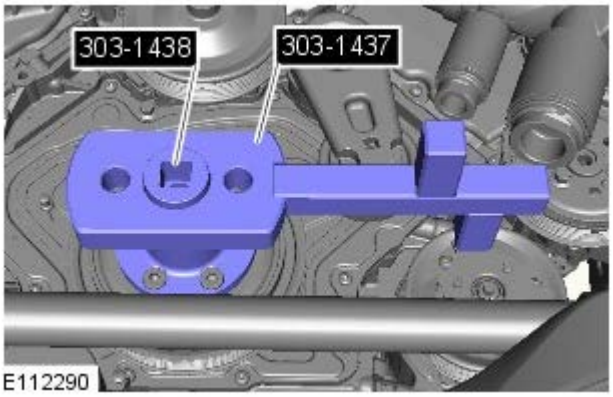
9.



E113550

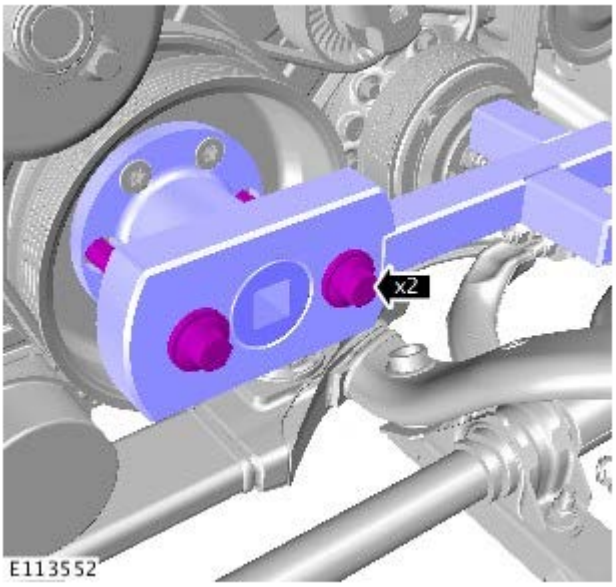
10. Install the special tool.

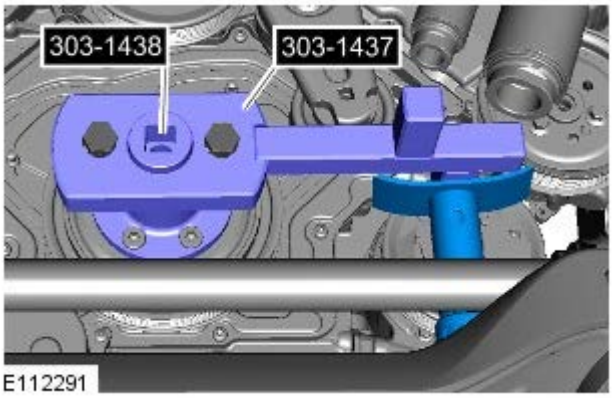
Special Tool(s): 303-1438, 303-1437



E112290

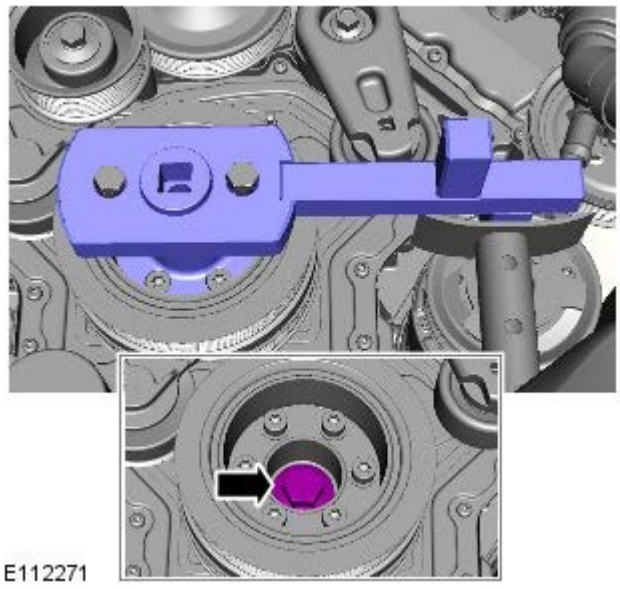
11. *Torque:* 65 Nm





12. NOTE: The graphic shows the tool position for LH thread only, RH thread will be the opposite.

    Using a suitable stand, support the special tool.



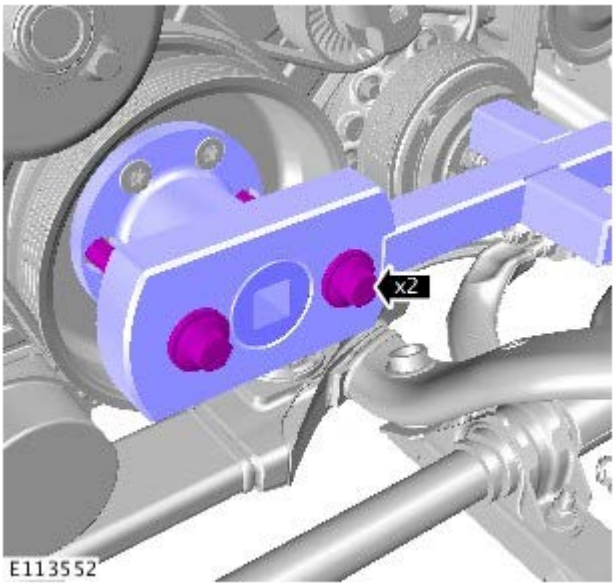
13. CAUTION: Discard the bolt.

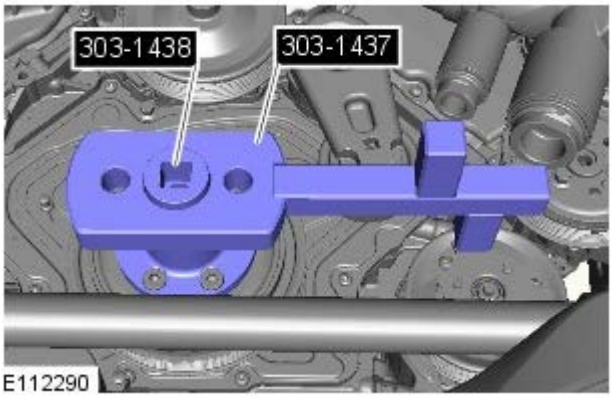
    NOTES:

    The thread is left handed.

    The crankshaft pulley bolt will be very tight.

14.

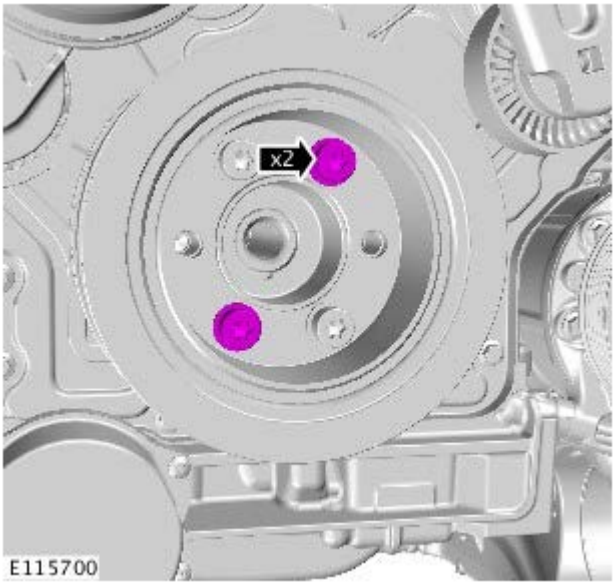




15. NOTE: If the crankshaft damper is fitted with an early RH thread crankshaft bolt then the pulley can be removed with a standard puller.

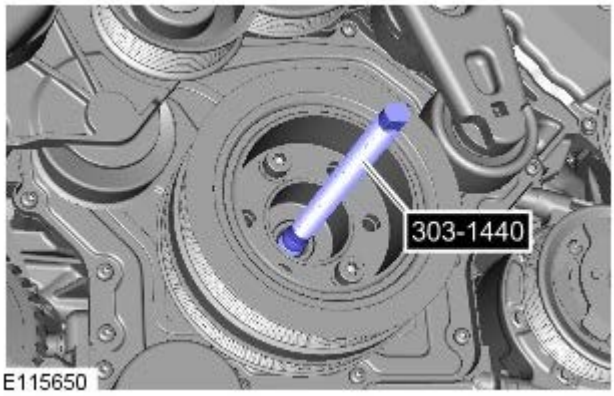
    Remove the special tool.

16.



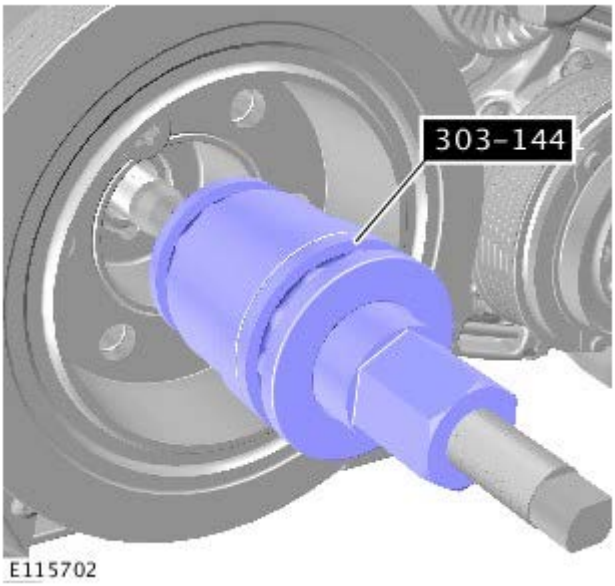
17. Install the special tool.

    Special Tool(s): 303-1440



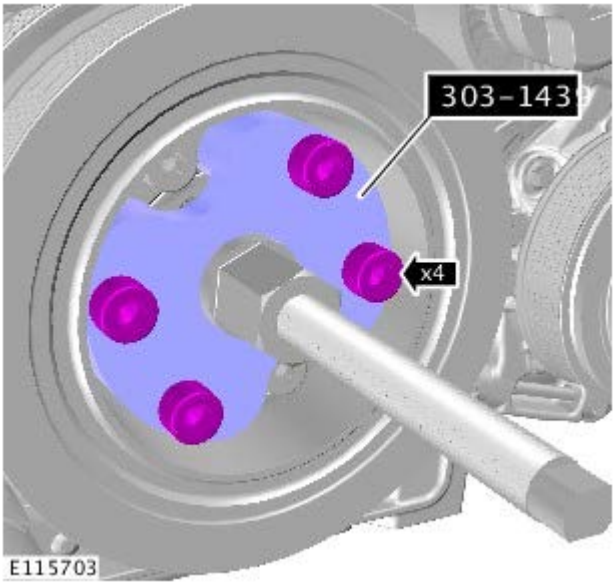
18. Install the special tool.

Special Tool(s): 303-1441

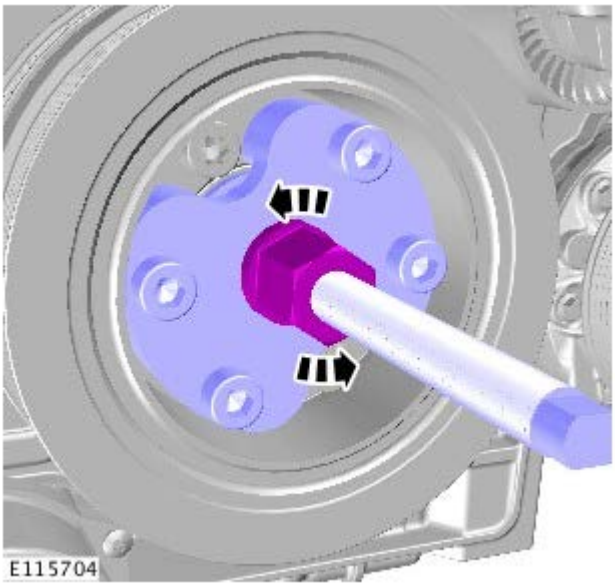


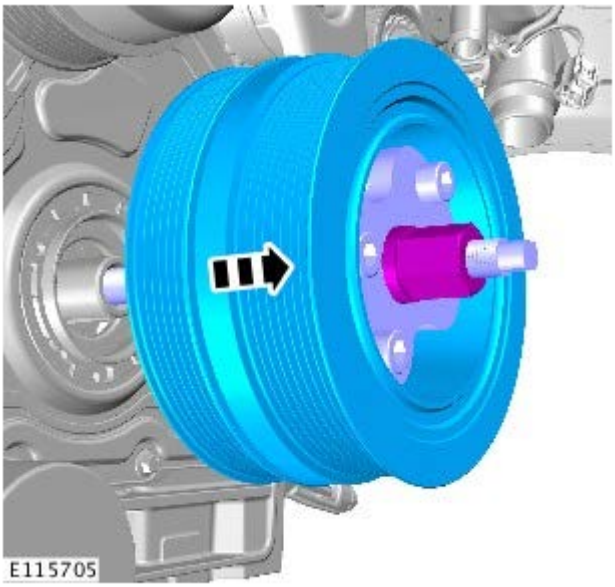
19. Install the special tool.

Special Tool(s): 303-1439



20.

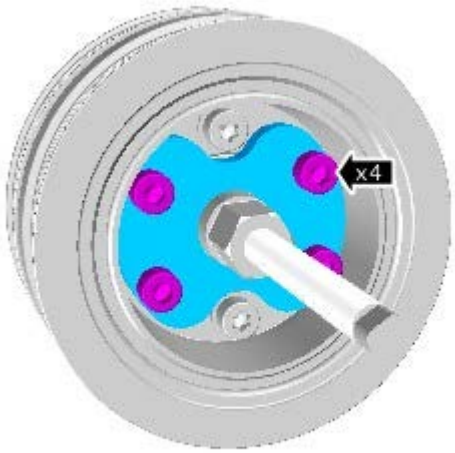




21. CAUTION: Discard the friction washer after removing the crankshaft pulley.

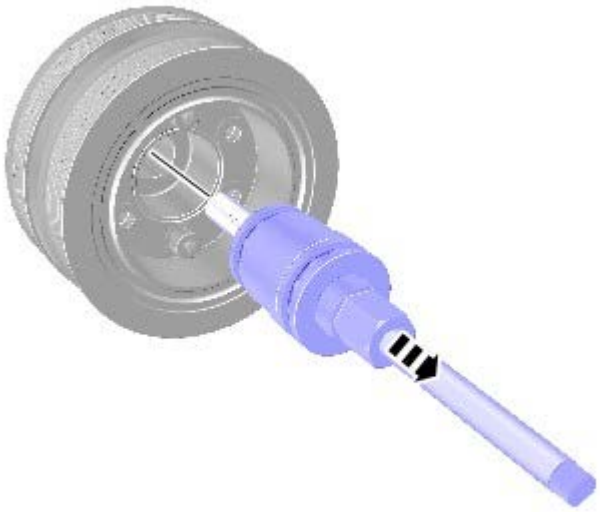
NOTE: Make sure to clean the threads in the end of the crankshaft and that the crank nose is free of any foreign materials.

22.



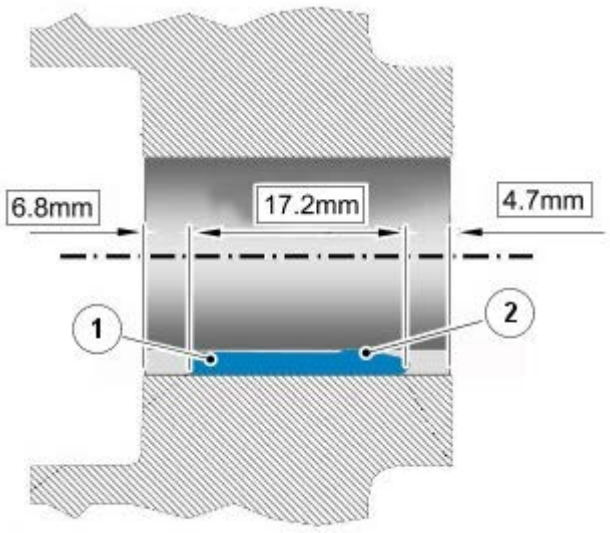
E115706

23.



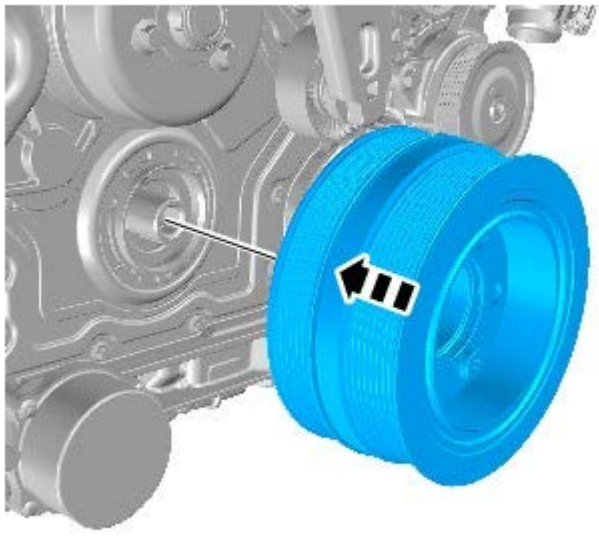
E115707

Installation



E115889

1.
- Apply RTV sealant to the crankshaft pulley keyway.
- Make sure that the RTV sealant is applied in a 2mm diameter bead.
- Make sure that when the RTV sealant is applied that the RTV sealant is level with the top of the keyway.



E112288

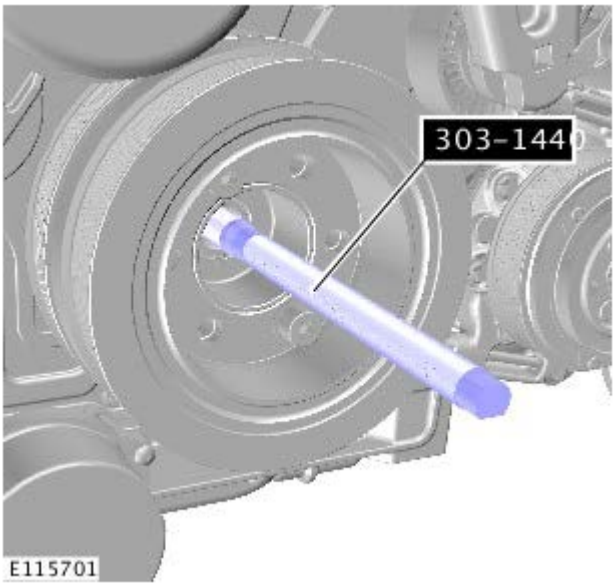
2. CAUTION: Install a new friction washer before installing the crankshaft pulley.

   NOTES:

   Make sure to clean the threads in the end of the crankshaft and that the crank nose is free of any foreign materials.

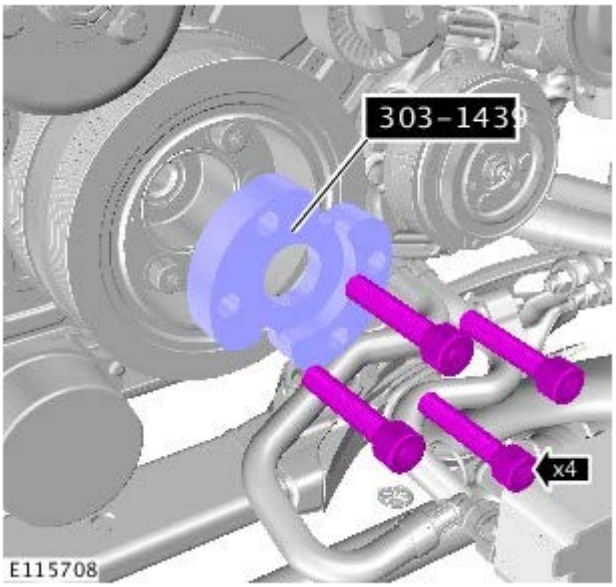
   Skip to step 11 for engines fitted with early RH thread crankshaft bolt.

3. Install the special tool.

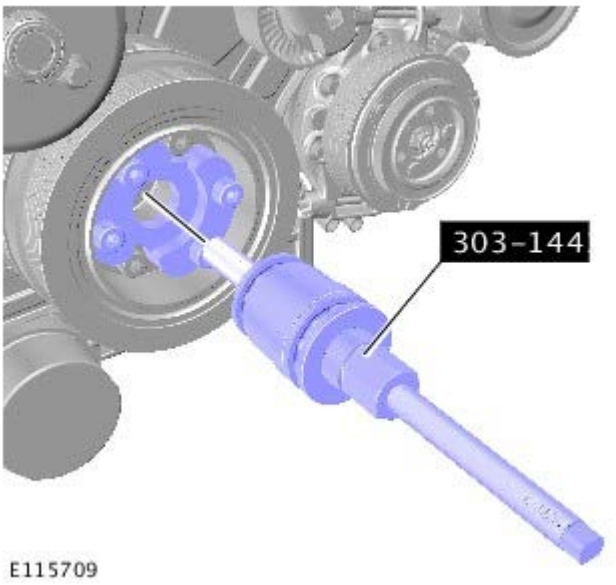


4. Install the special tool.

   Torque: 15 Nm



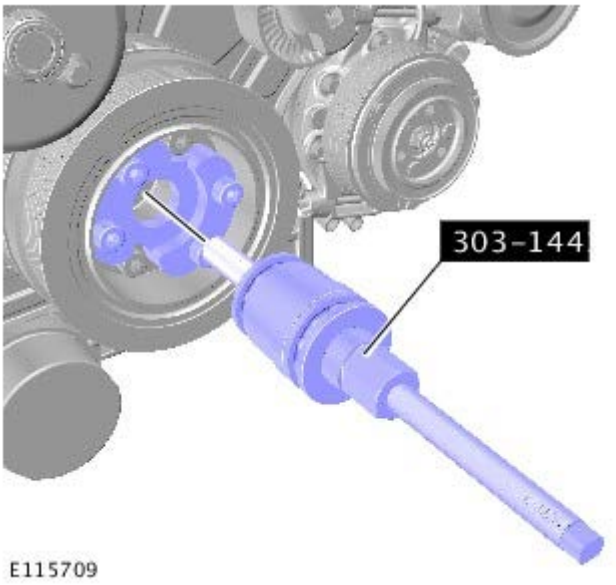
5. Install the special tool.



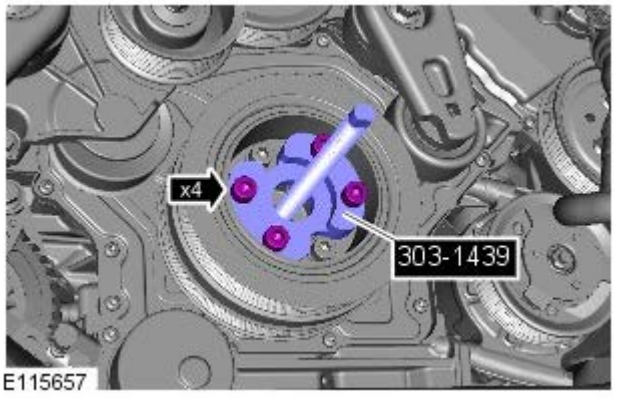
6. CAUTION: Rotate the crankshaft pulley installation tool anti-clockwise until the pulley is fully located, do not over tighten. Failure to do this may result in damge to the components.



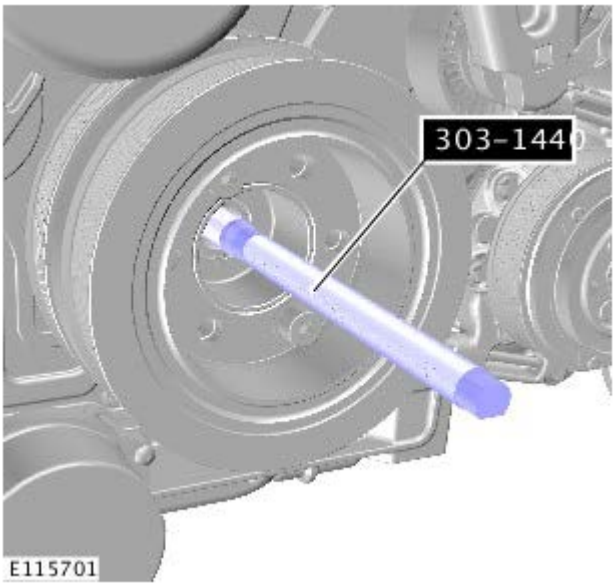
7. Remove the special tool.

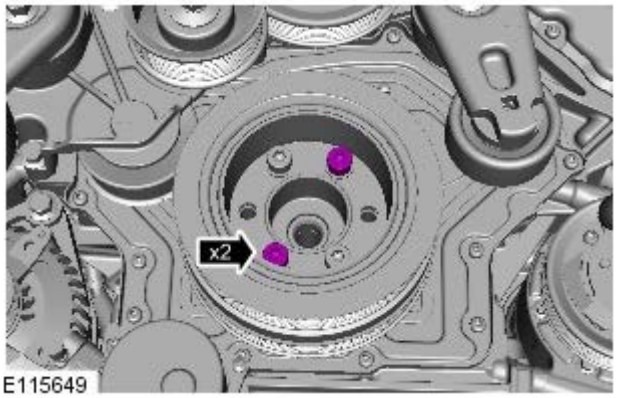


8. Remove the special tool.



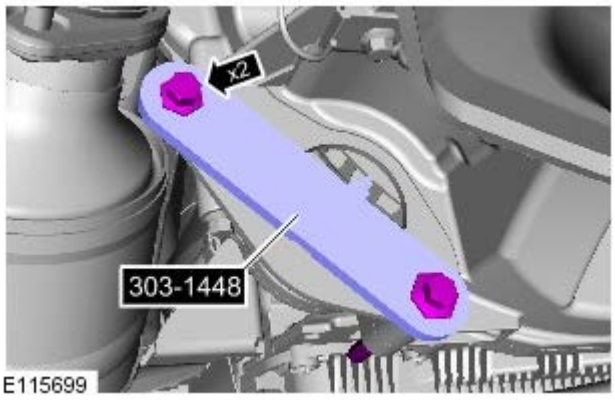
9. Remove the special tool.



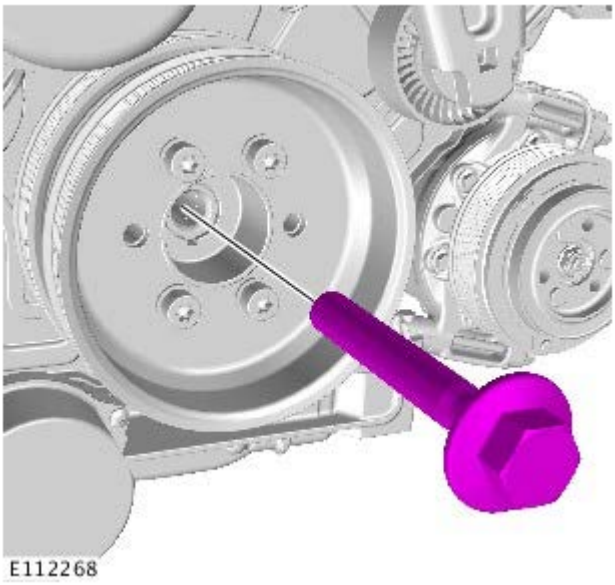


10. WARNING: Make sure that a new bolt is installed.
    - Apply loctite 270 to the thread of the bolts.
    - *Torque:* 65 Nm

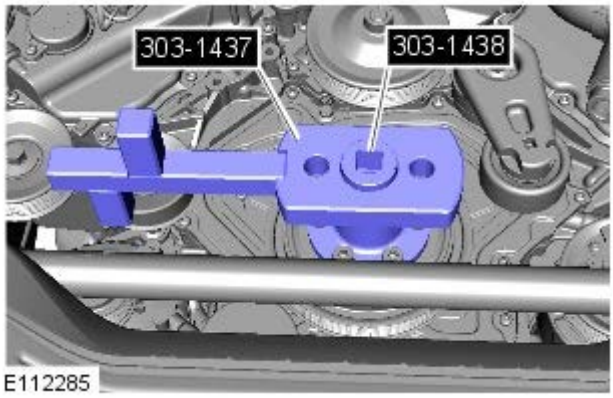
11. Remove the special tool.



12. WARNING: Make sure that a new bolt is installed.

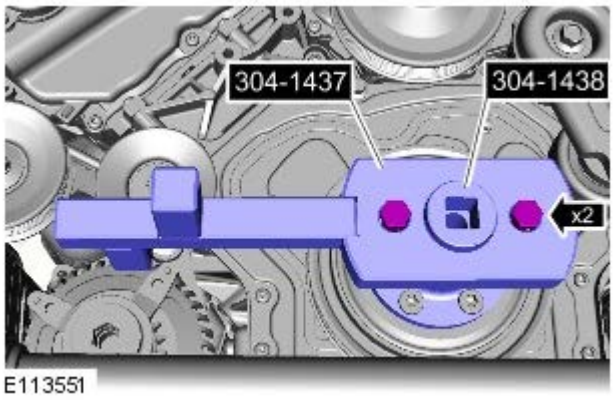

E112268

13. Install the special tool.



E112285

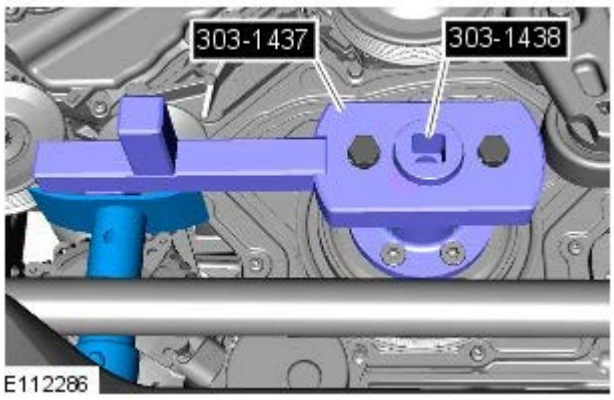
14. *Torque:* 65 Nm



E113551

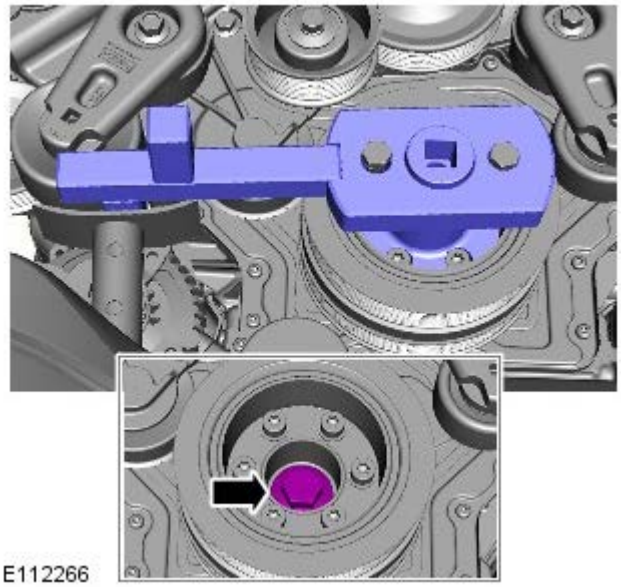
15. NOTE: The graphic shows the tool position for LH thread only, RH thread will be the opposite.

Using a suitable stand, support the special tool.

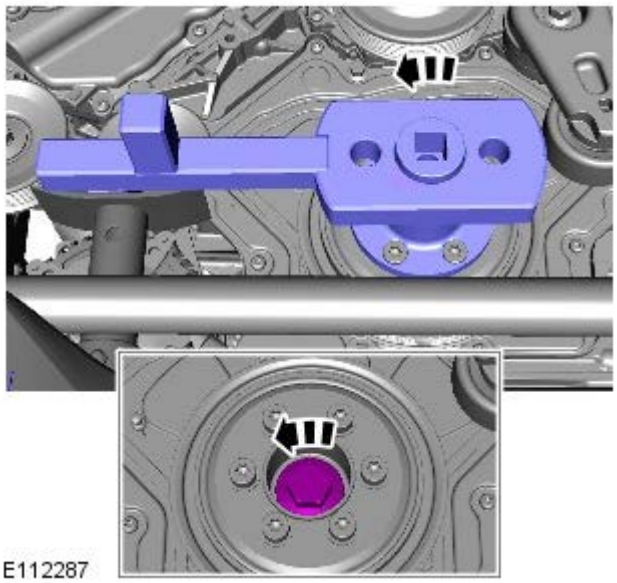


E112286

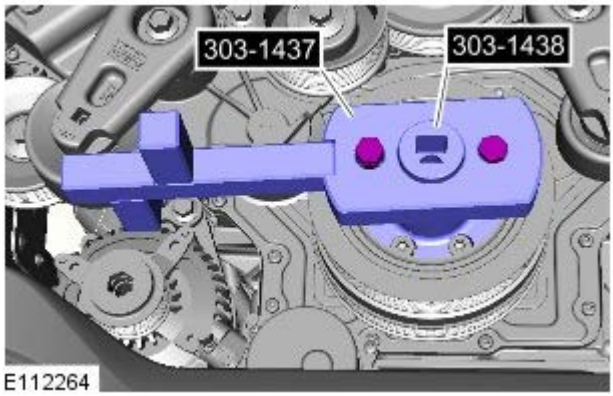
16. *Torque:* 200 Nm


E112266

17. NOTE: The use of a torque multiplyer capable of 600Nm will be required.
    - *Torque:* 270°
    - Make sure that the socket is turned through 270 degrees not the torque wrench.

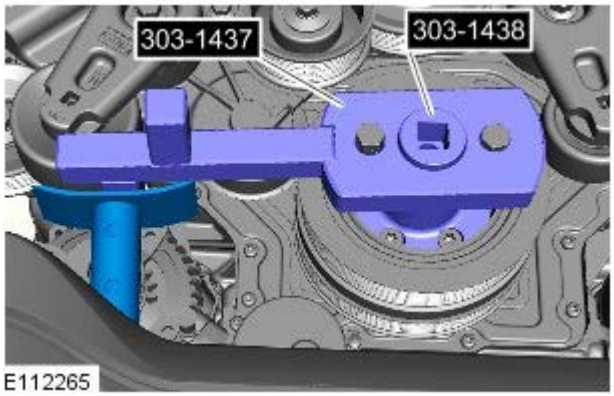

E112287

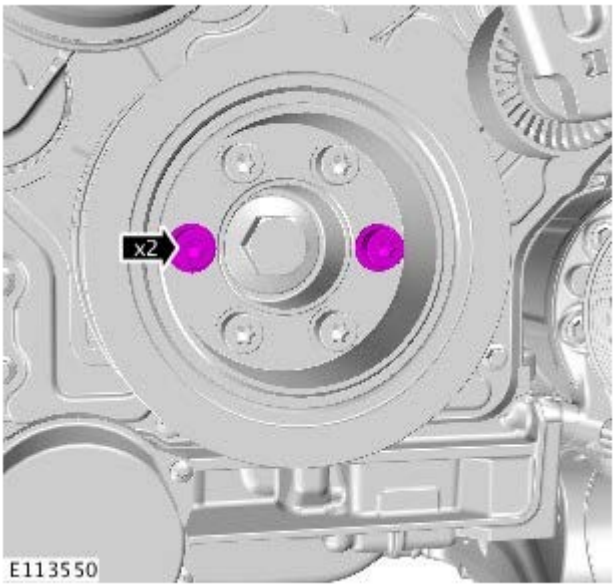
18.



E112264

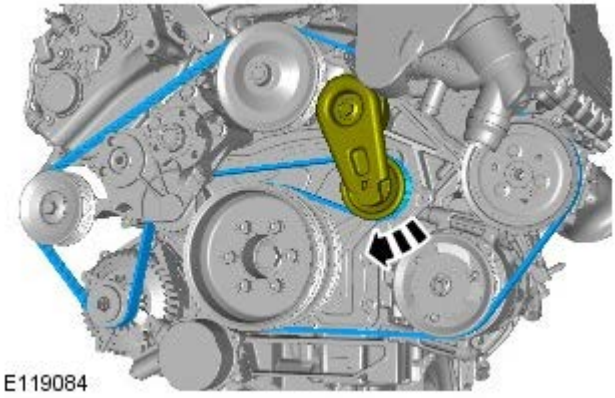
19. Remove the special tool.



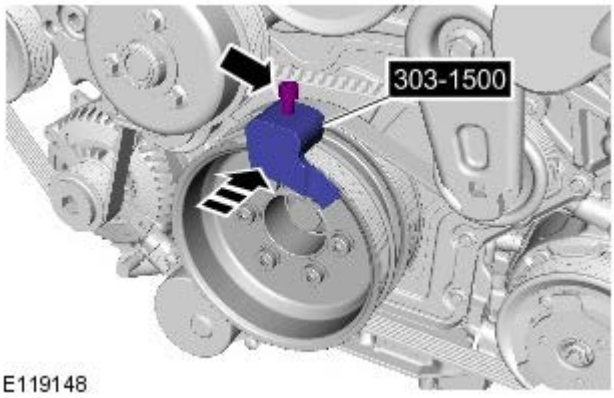


20. WARNING: Make sure that a new bolt is installed.
    - Apply loctite 270 to the thread of the bolts.
    - *Torque:* 65 Nm

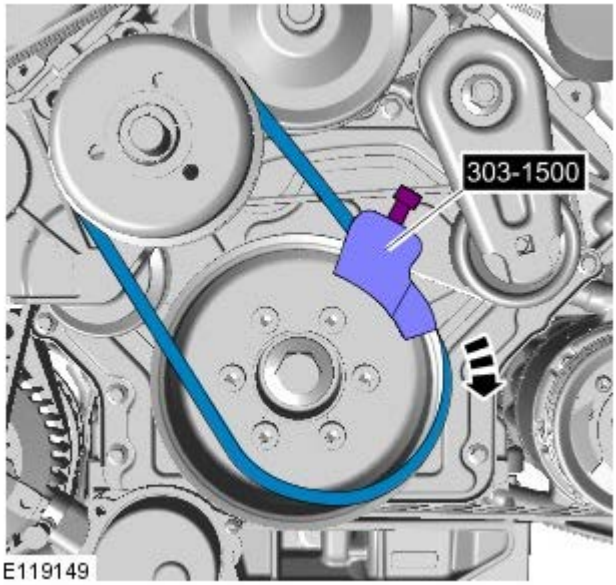
21.



22. *Special Tool(s):* 303-1500



23.
    - Install the cooling fan belt.
    - Install the tool at the 12 o clock position.
    - Rotate the engine clockwise twice, making



sure that the belt is seated on both pulleys correctly.
- Remove the special tool.

24. Refer to: Starter Motor (303-06B Starting System - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

25. Refer to: Radiator - V8 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

26. Connect the battery ground cable.

    Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Engine - V8 5.0L Petrol - Crankshaft Rear Seal

Removal and Installation

Special Tool(s)

 E107678	303-1442 Rear Crankshaft Seal Installer
 E107679	303-1443 Rear Crankshaft Cover Alignment Tool

Removal

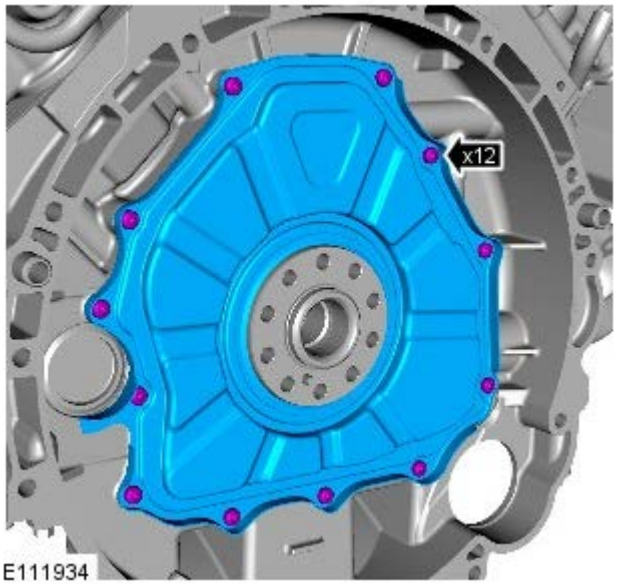
NOTES:

Removal steps in this procedure may contain installation details.

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

1. Refer to: Flexplate (303-01, Removal and Installation).

2.



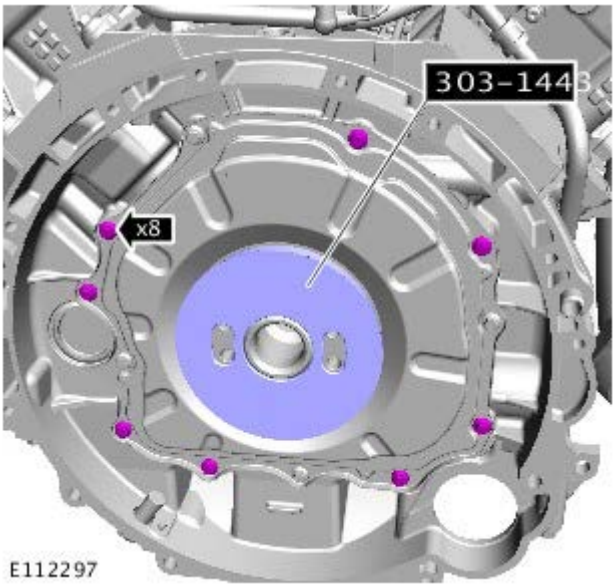
E111934

Installation

1. Install the special tool.

Special Tool(s): 303-1442, 303-1443

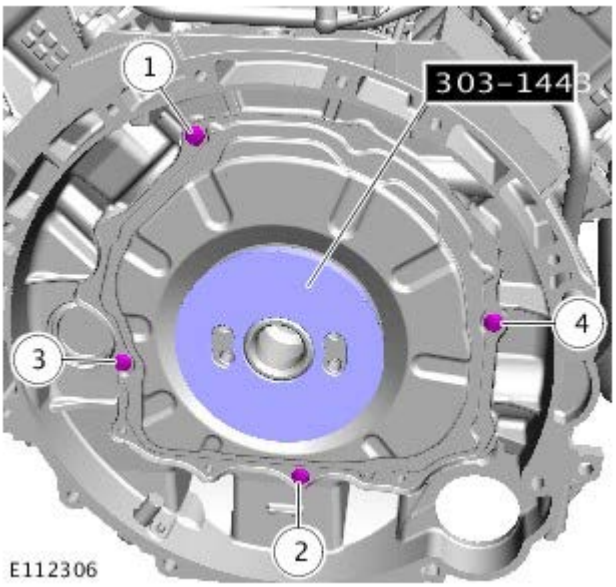




2. NOTE: Tighten the bolts in the indicated sequence.

   Torque: 11 Nm

3. *Torque:* 11 Nm



4. Refer to: Flexplate (303-01, Removal and Installation).

Published: 03-Jan-2014

Engine - V8 5.0L Petrol - Cylinder Head LH

Removal and Installation

Removal

NOTES:

Some illustrations may show the engine removed for clarity.

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

Removal steps in this procedure may contain installation details.

1. Remove the battery for access.

   Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

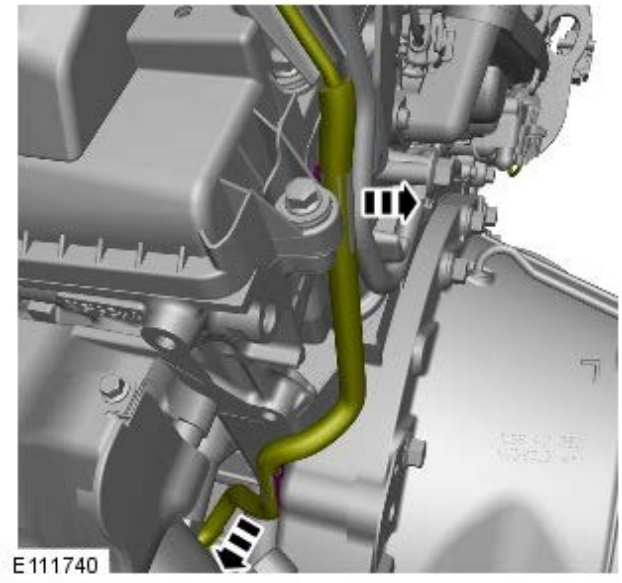
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

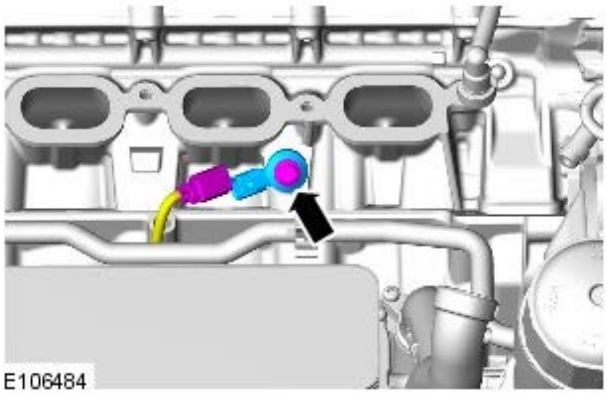
3. Refer to: Camshaft LH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

4. Refer to: Exhaust Manifold LH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

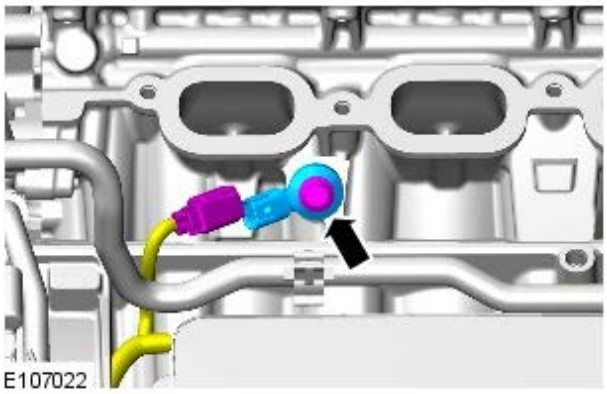
5.

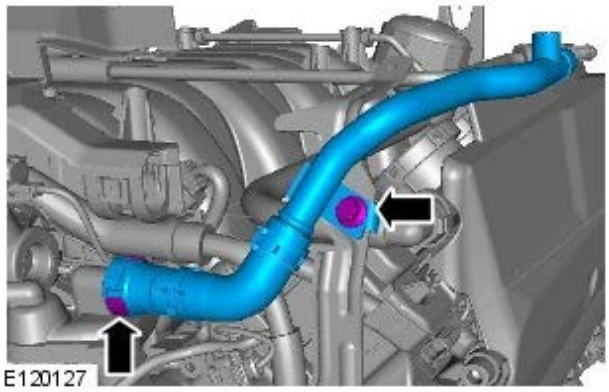


6.

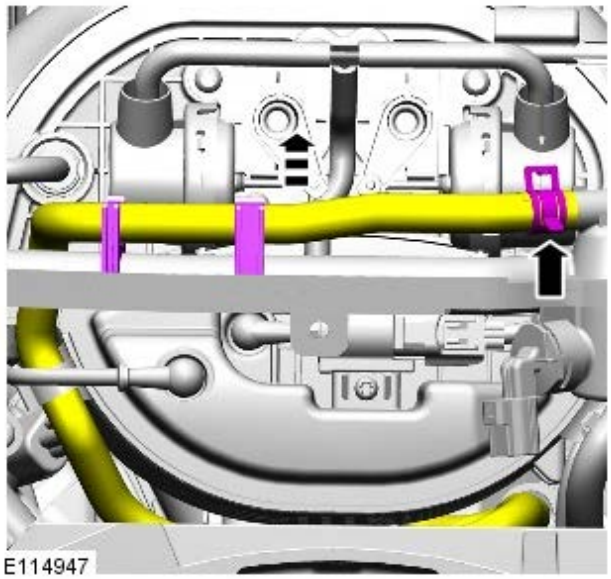


7.



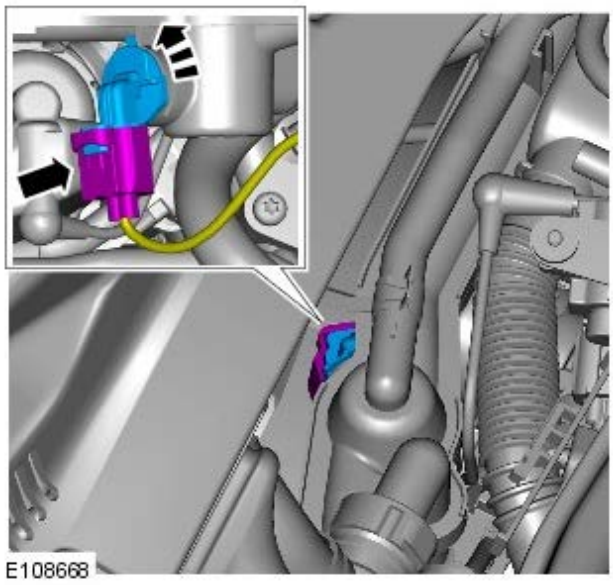


8. CAUTION: Be prepared to collect escaping coolant.

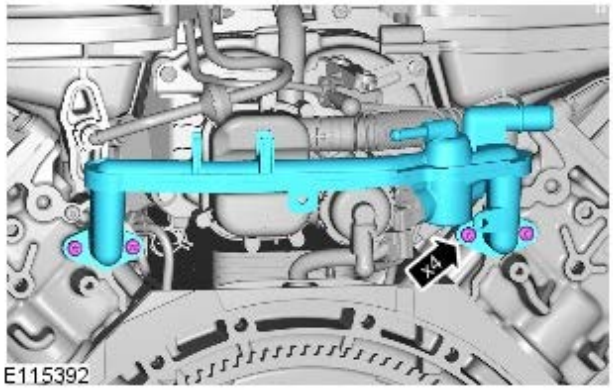


9. NOTE: Clamp the hose to minimize coolant loss.

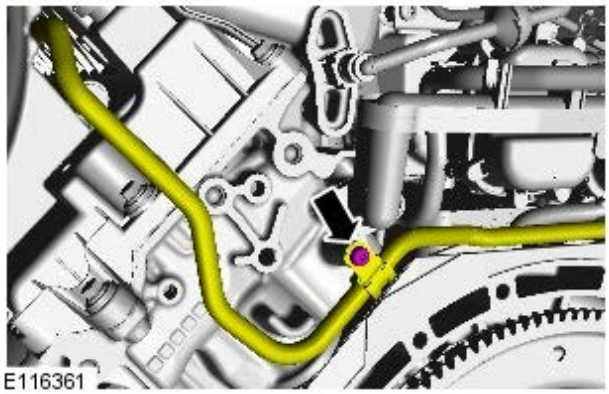
10.



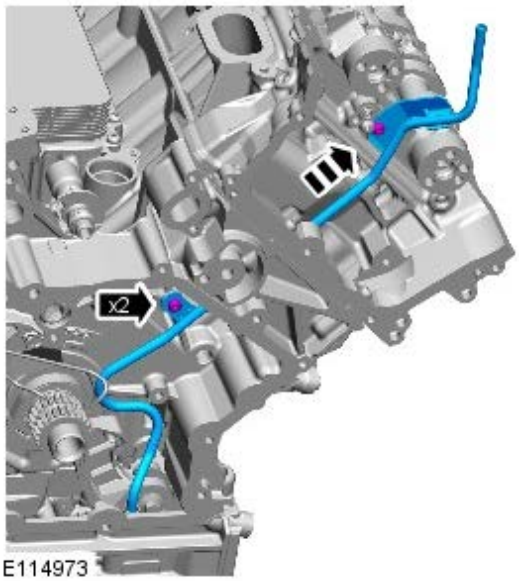
11. CAUTION: Discard the seals.



12.



13. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



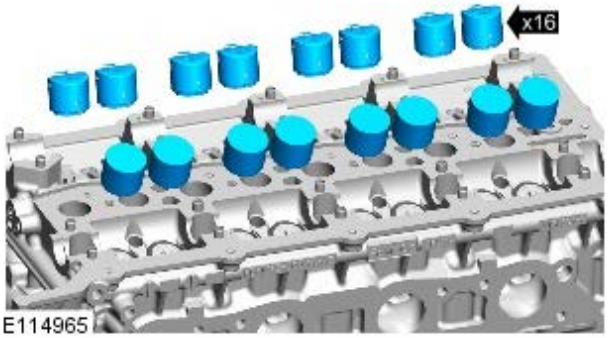
E114973

14. CAUTIONS:

If a new cylinder head has been installed then new tappets must be installed.

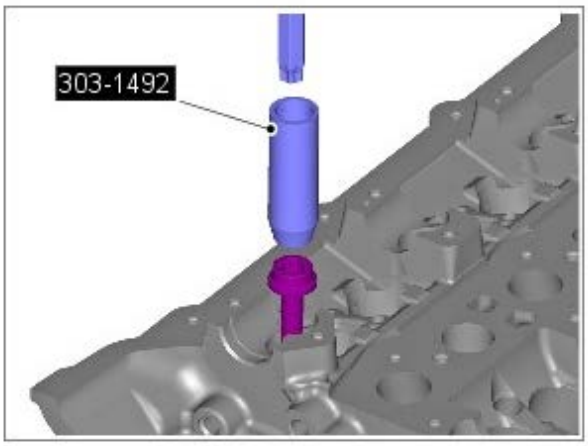
If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

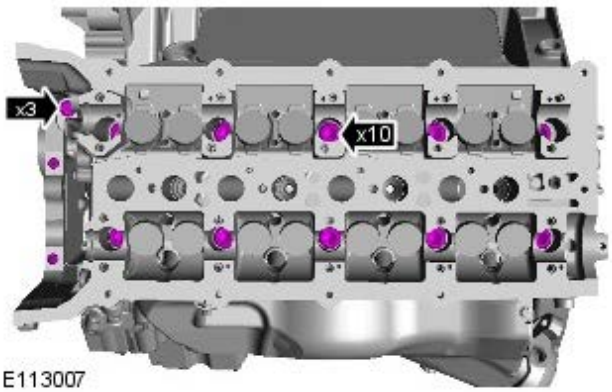
NOTE: Left-hand shown, right-hand similar.



E114965

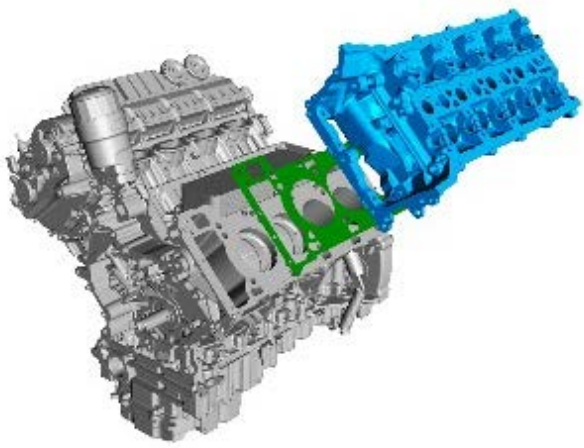
15.





E113007

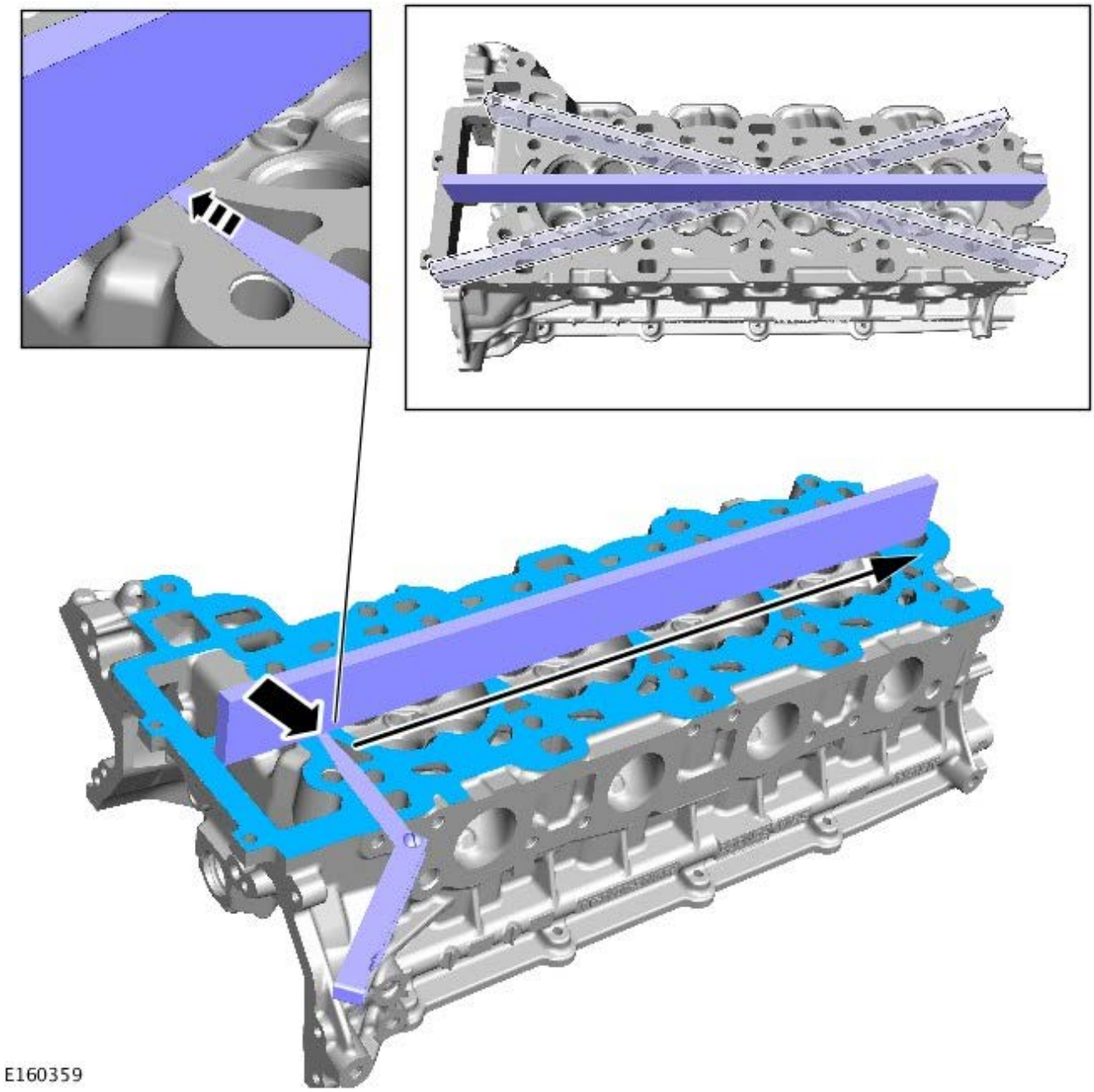
16.



E113006

Installation

1. Using a suitable metallic straight edge and feeler gauge, measure the cylinder head face in the areas illustrated. **Note the maximum value**.



2. CAUTION: Machine the **minimum** thickness of material from the cylinder head to meet specification, then increase the thickness of the cylinder head gasket by one size.

   NOTES:

   Prior to having the cylinder head being machined, prior approval is required by Jaguar or Land Rover engineering.

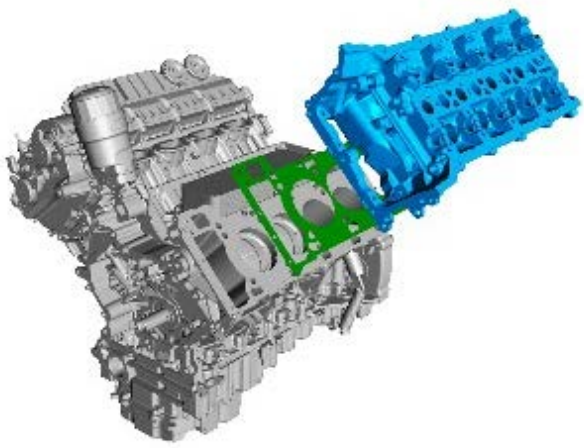
   If the cylinder head requires machining, this must be carried out by a local engineering company.

   If the cylinder head exceeds the maximum value (0.2mm), the cylinder head must be machined.

3. WARNING: Make sure care is taken when handling the cylinder head gasket.

   CAUTIONS:

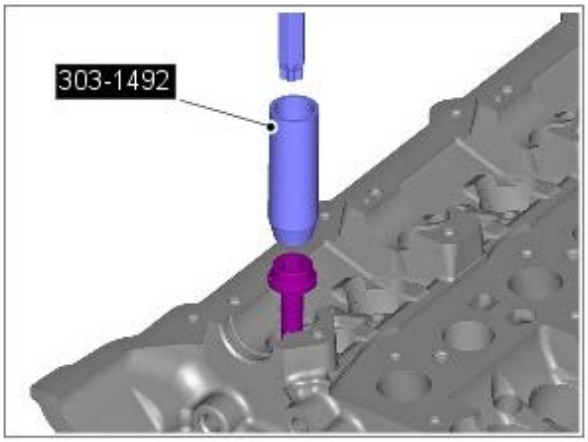
   The head gasket must be installed over the cylinder block dowels.



E113006

Make sure that the mating faces are clean and free of foreign material.

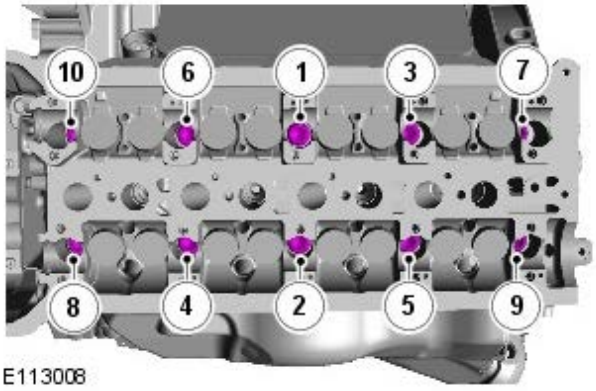
NOTE: Install a new cylinder head gasket.



4. CAUTION: Make sure that new cylinder head bolts are installed.

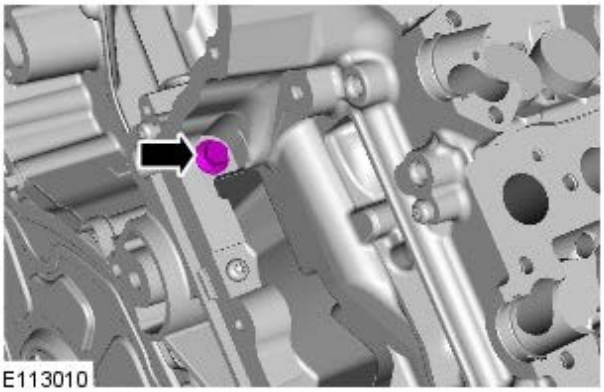
NOTE: Tighten the bolts in the indicated sequence.

Torque:
Stage 1:20 Nm
Stage 2:35 Nm
Stage 3:90 °
Stage 4:120 °



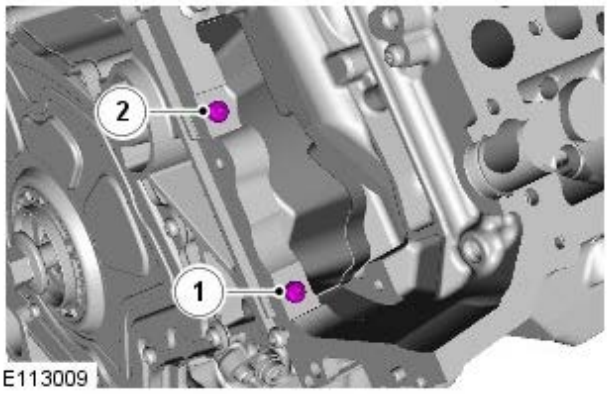
E113008

5. *Torque:* 25 Nm



E113010

6. NOTE: Tighten the bolts in the indicated sequence.



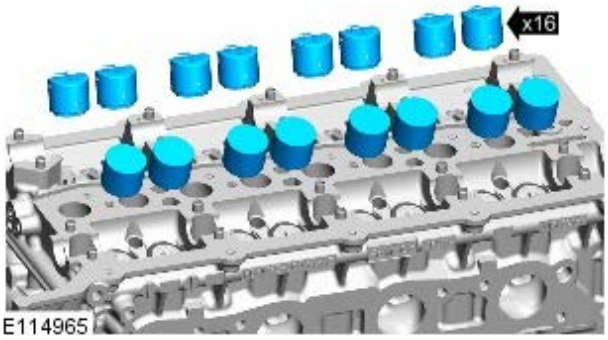
Torque: 12 Nm

7. CAUTIONS:

   If a new cylinder head has been installed then new tappets must be installed.

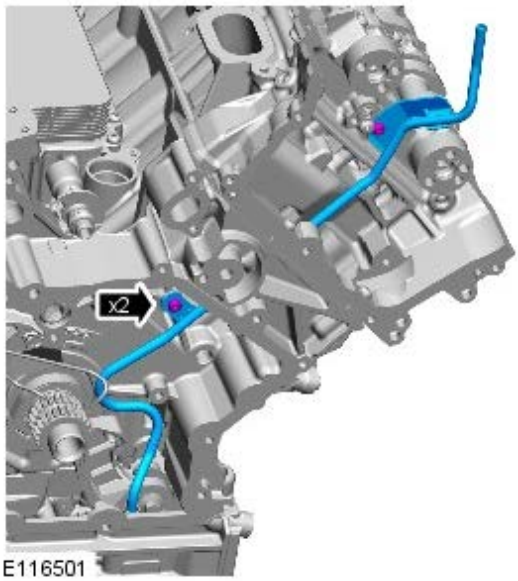
   If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

   Lubricate the valve tappets with clean engine oil.

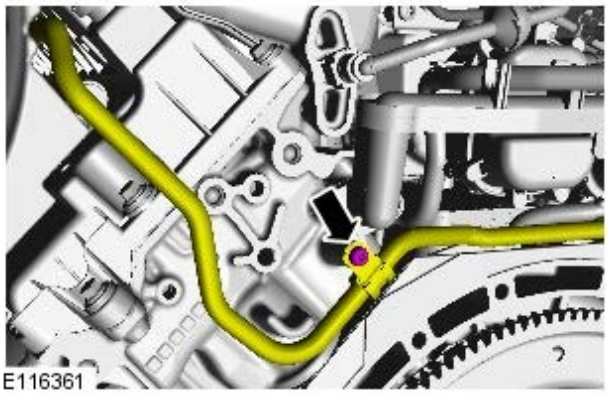


8. Refer to: Camshaft LH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

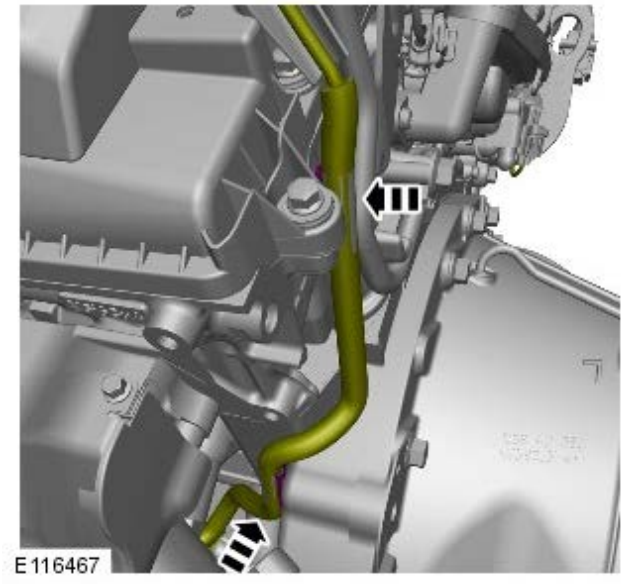
9. *Torque:* 12 Nm

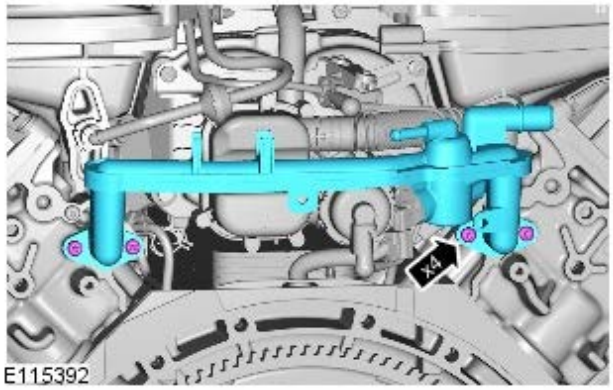


10. *Torque:* 10 Nm



11.

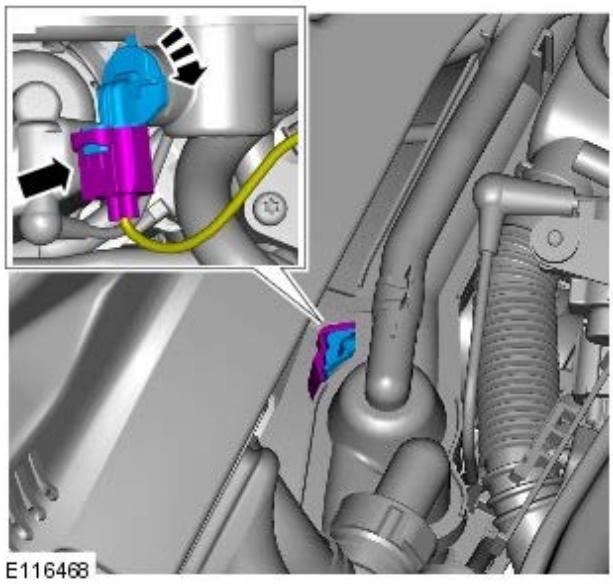




12. CAUTION: Install the new seals.

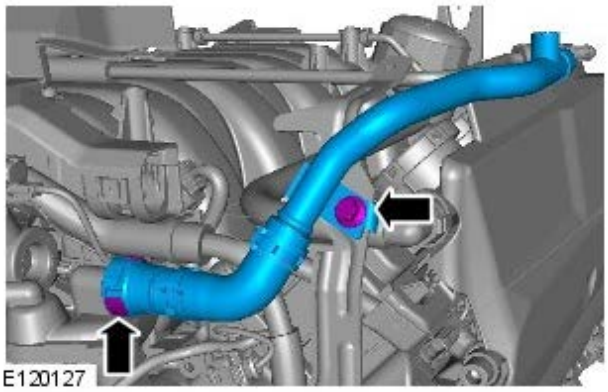
Torque: 10 Nm

13.

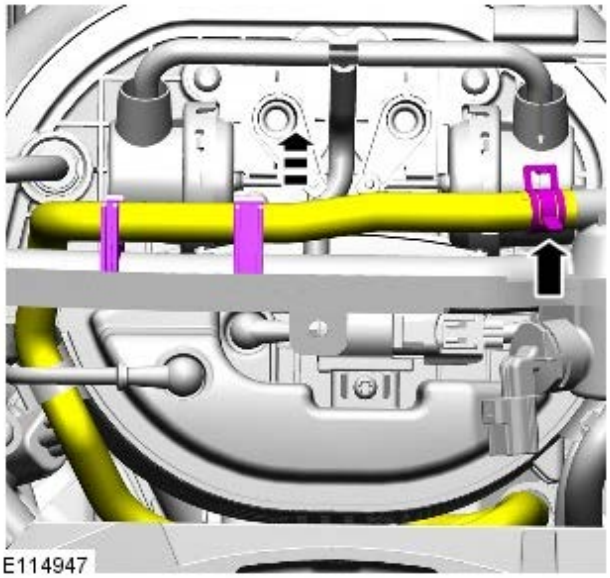


14. CAUTION: Be prepared to collect escaping coolant.

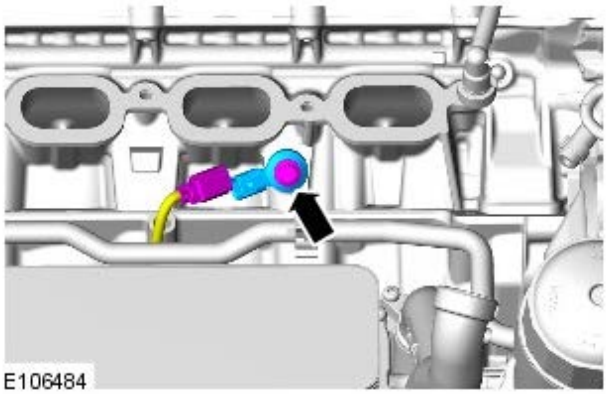
Torque: 10 Nm



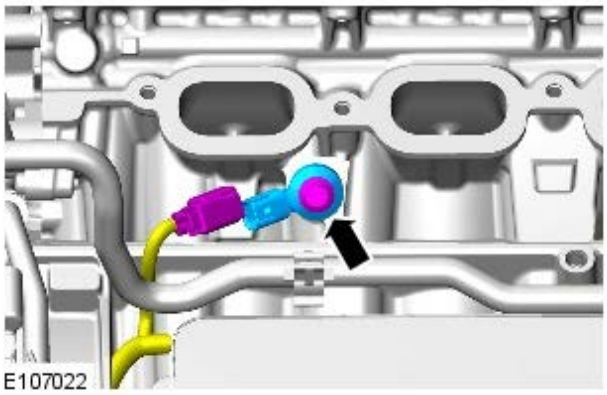
15.



16. *Torque:* 20 Nm



17. *Torque:* 20 Nm



18. Refer to: Exhaust Manifold LH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

19. Install the battery.

Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

Published: 03-Jan-2014

Engine - V8 5.0L Petrol - Cylinder Head RH

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

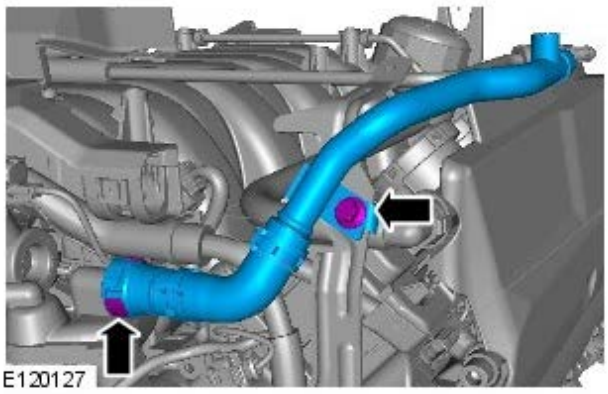
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

3. Refer to: Intake Manifold (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

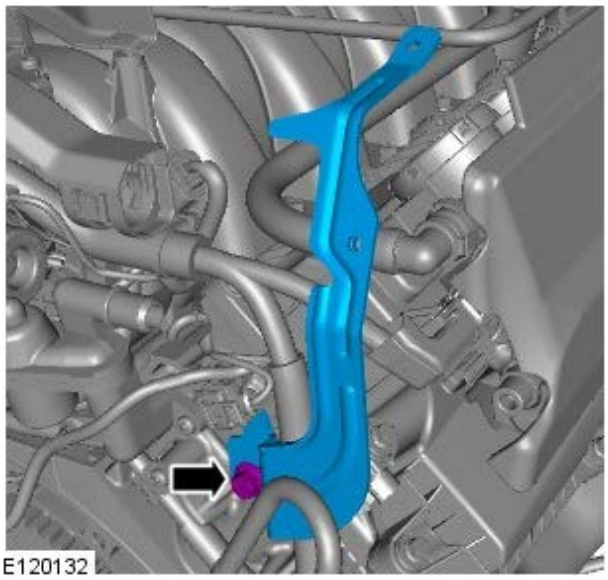
4. Refer to: Camshaft RH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

5. Refer to: Exhaust Manifold RH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

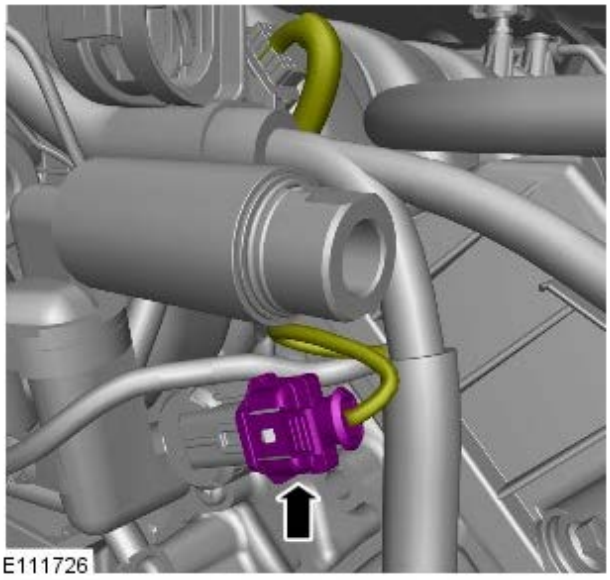


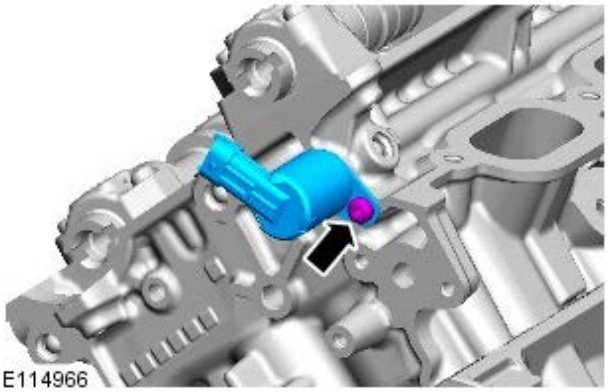
6. CAUTION: Be prepared to collect escaping coolant.

7.



8.





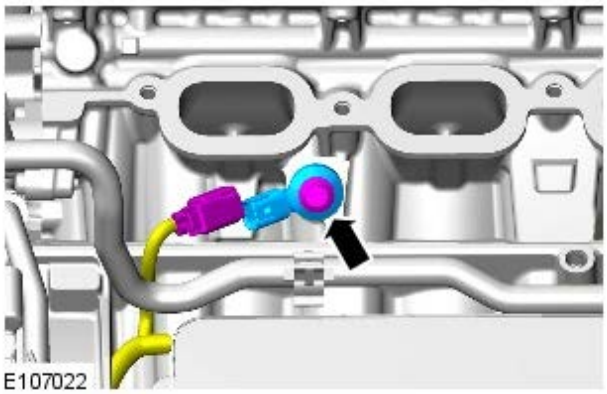
9. CAUTIONS:

   Discard the seal.

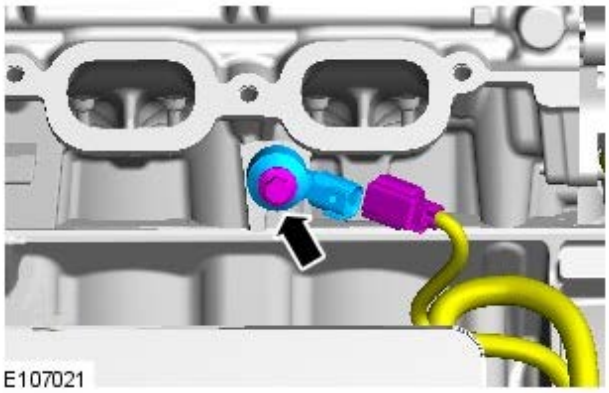
   LH illustration shown, RH is similar.

   NOTE: Engine shown removed for clarity.

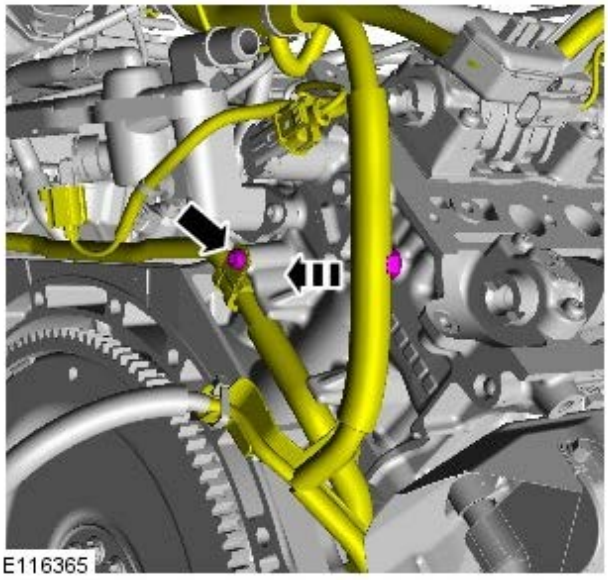
10.



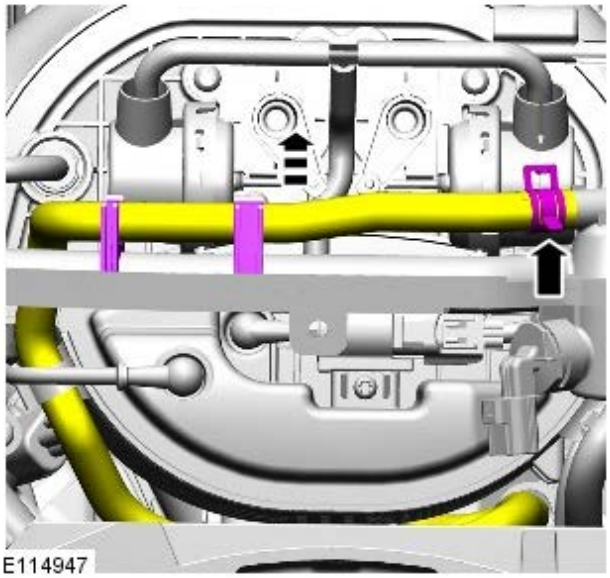
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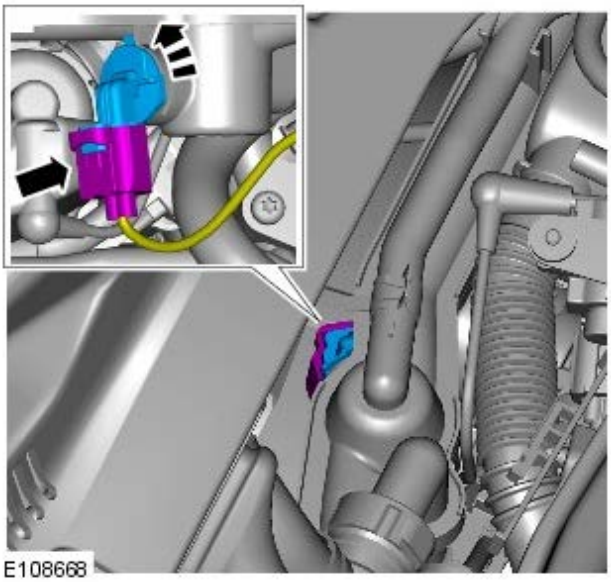
12.


E116365

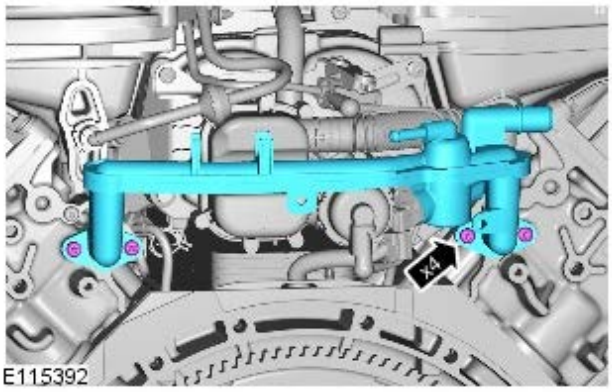
13. NOTE: Clamp the hose to minimize coolant loss.


E114947

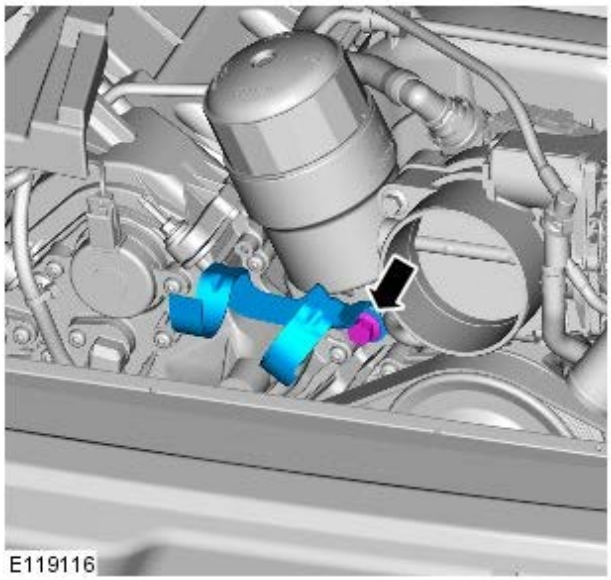
14.


E108668

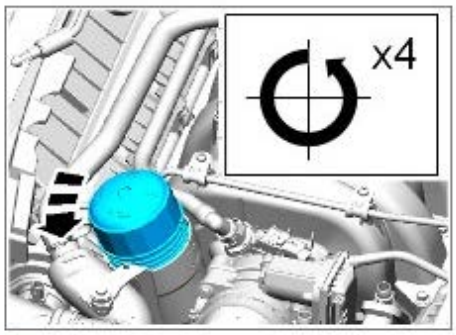
15. CAUTION: Discard the seals.

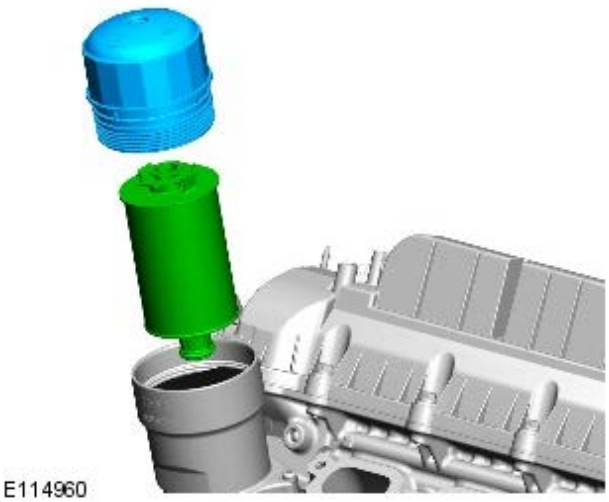


16.

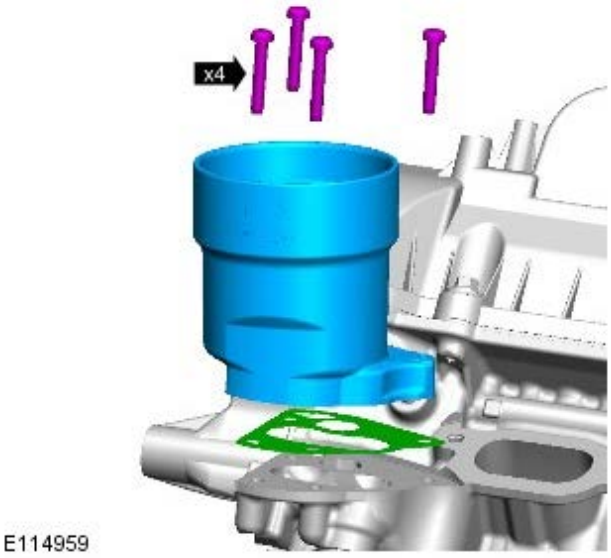


17. NOTE: Remove and discard the O-ring seal.

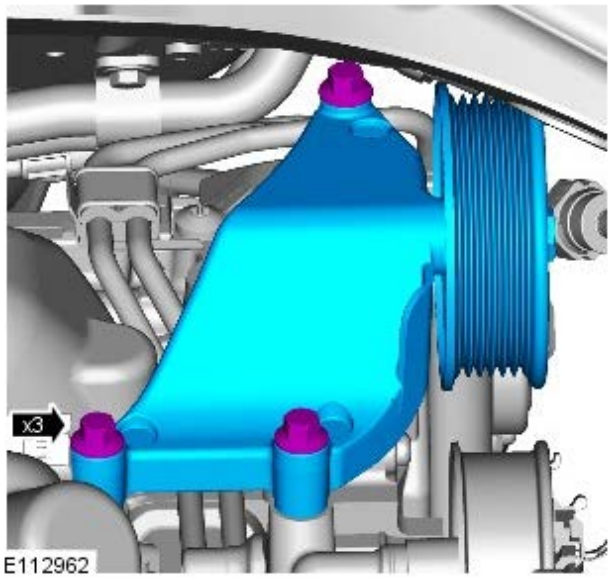




18. NOTE: Discard the gasket.



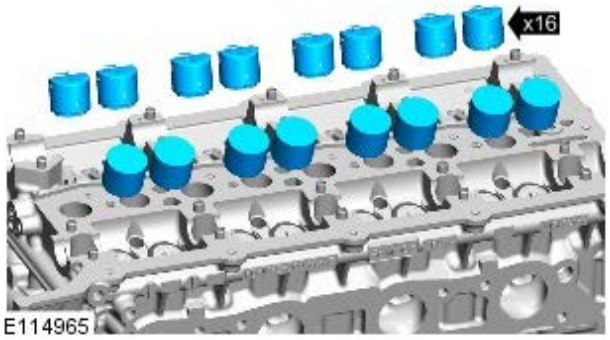
19.



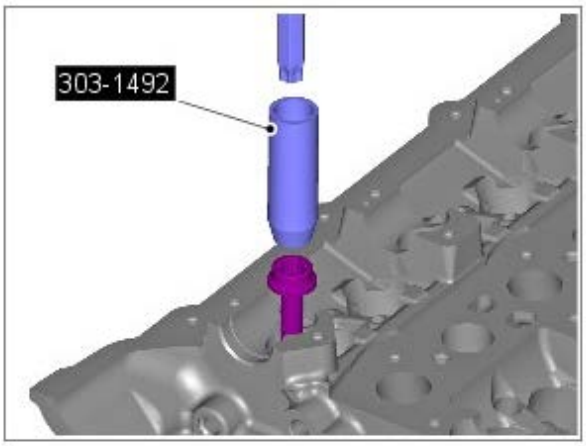
20. CAUTIONS:

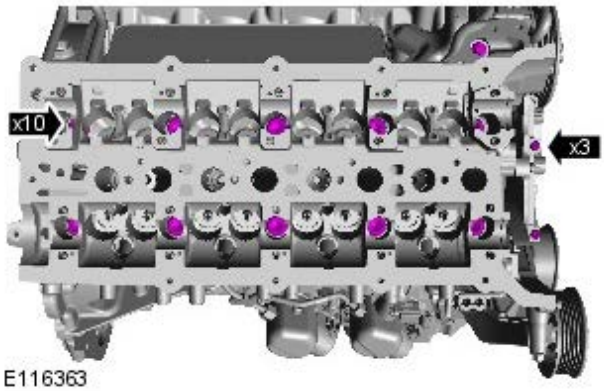
If a new cylinder head has been installed then new tappets must be installed.

If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.



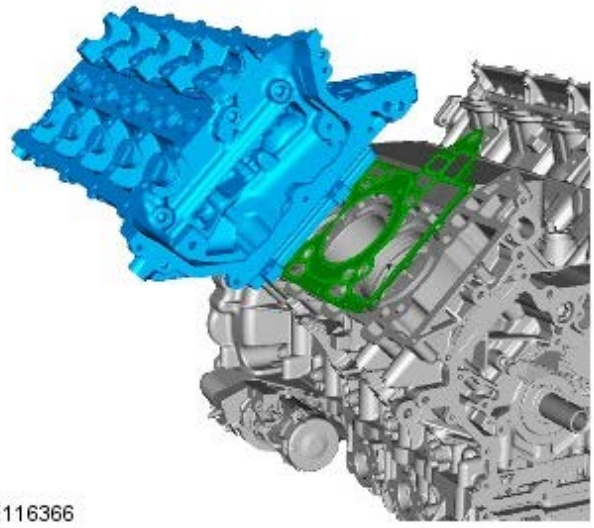
21. CAUTION: Discard the bolts.





E116363

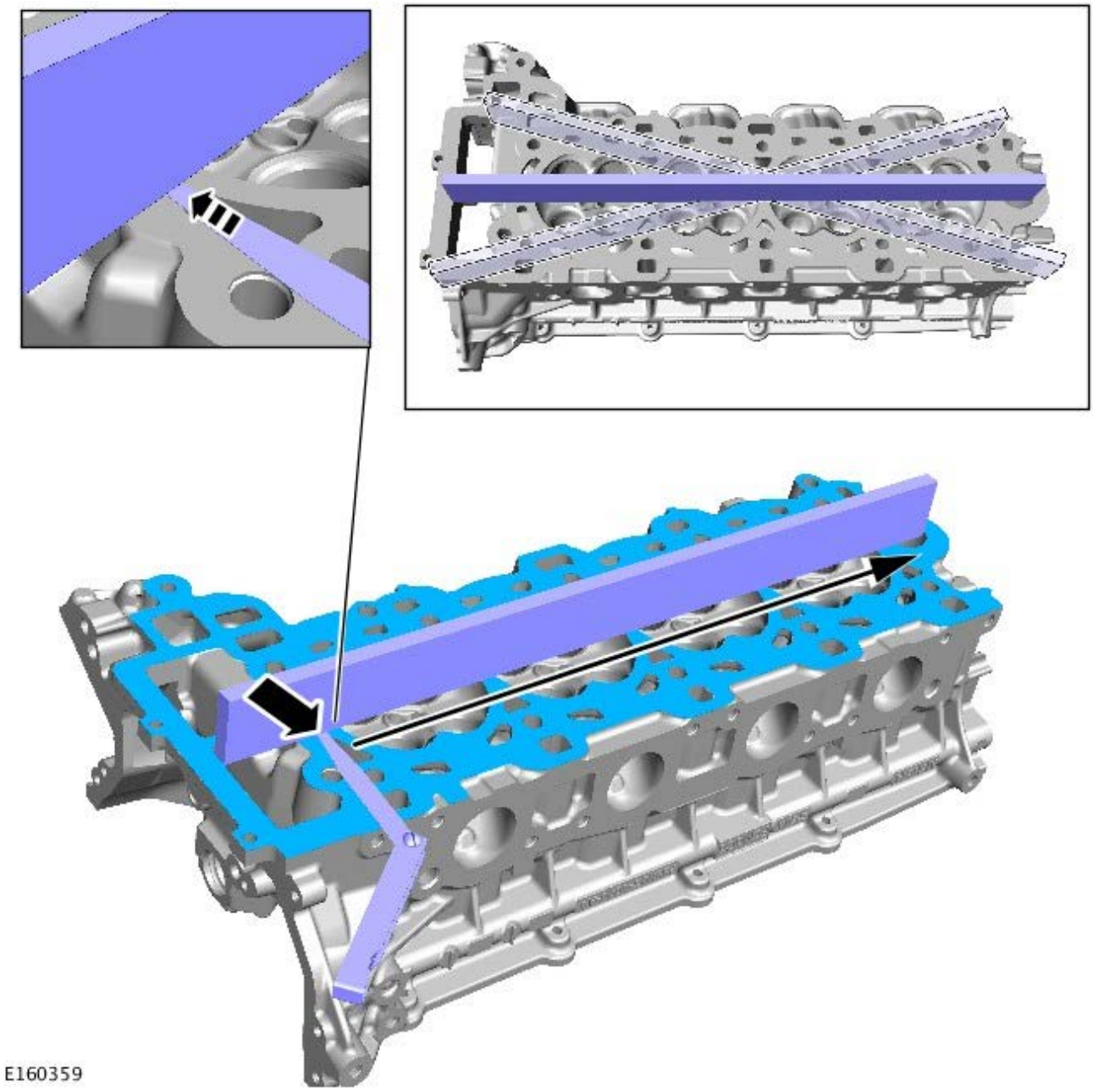
22. NOTE: Discard the gasket.



E116366

Installation

1. Using a suitable metallic straight edge and feeler gauge, measure the cylinder head face in the areas illustrated. **Note the maximum value**.



2. CAUTION: Machine the **minimum** thickness of material from the cylinder head to meet specification, then increase the thickness of the cylinder head gasket by one size.

   NOTES:

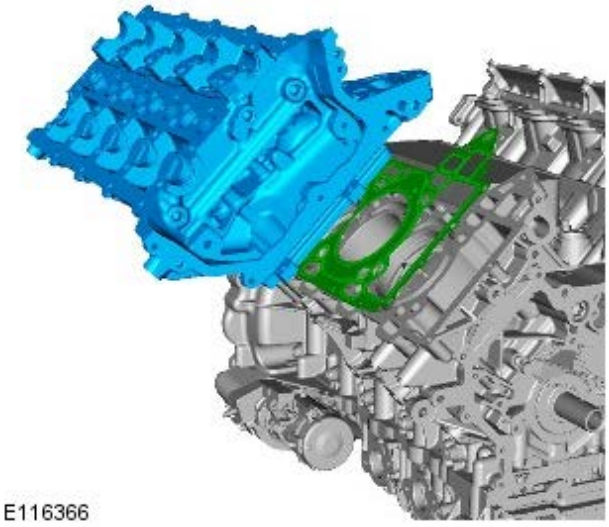
   Prior to having the cylinder head being machined, prior approval is required by Jaguar or Land Rover engineering.

   If the cylinder head requires machining, this must be carried out by a local engineering company.

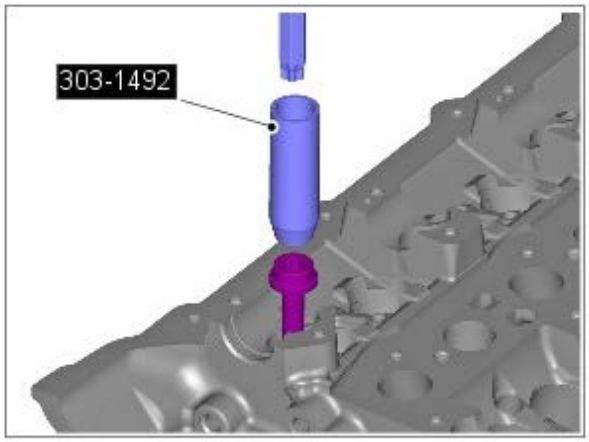
   If the cylinder head exceeds the maximum value (0.2mm), the cylinder head must be machined.

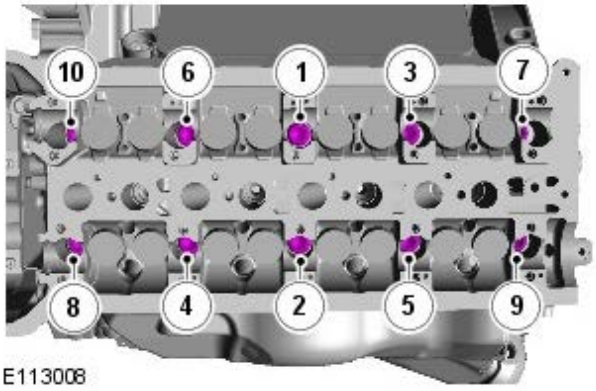
3. WARNING: Make sure care is taken when handling the cylinder head gasket.

   NOTE: Install a new gasket.



E116366





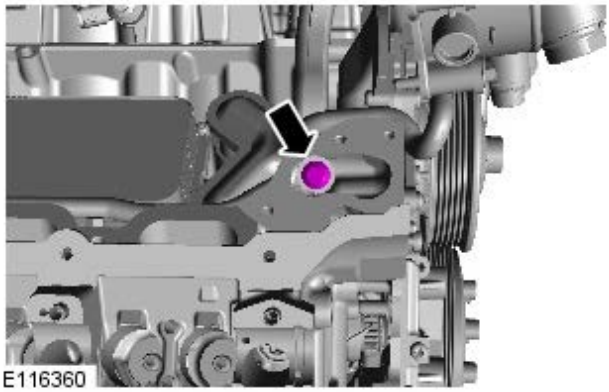
E113008

4. CAUTION: Make sure that new cylinder head bolts are installed.

NOTE: Tighten the bolts in the indicated sequence.

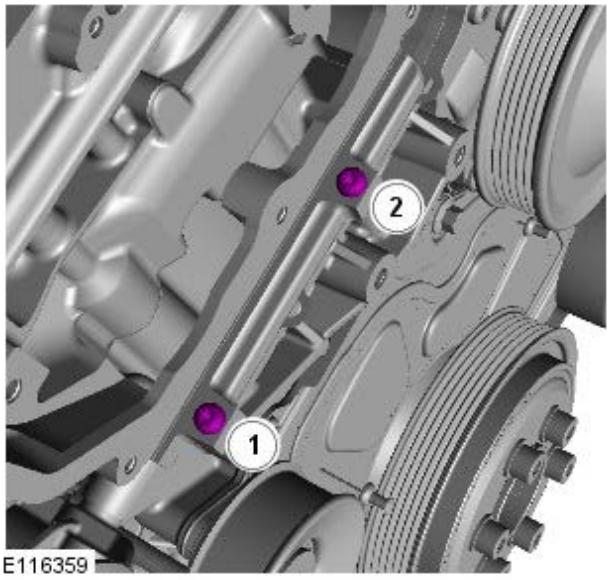
Torque:
Stage 1:20 Nm
Stage 2:35 Nm
Stage 3:90 °
Stage 4:120 °

5. *Torque:* 25 Nm



E116360

6. *Torque:* 12 Nm

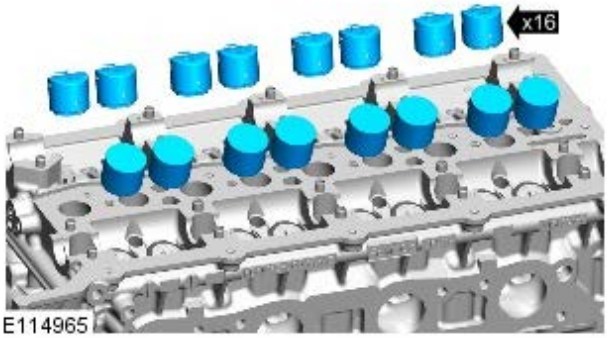


7. CAUTIONS:

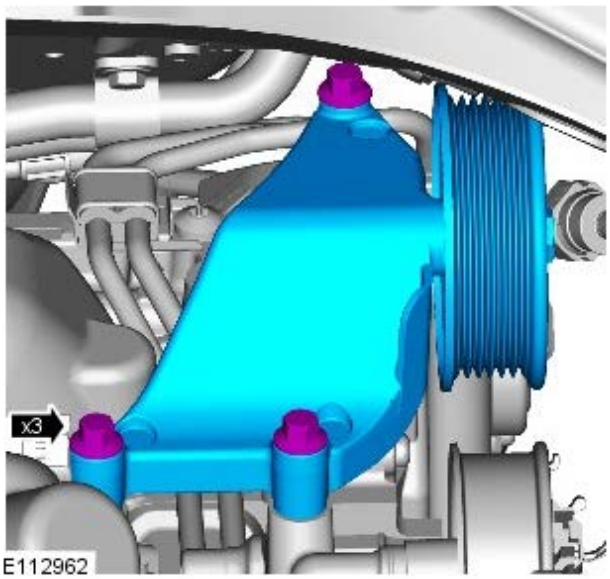
   If a new cylinder head has been installed then new tappets must be installed.

   If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

   Lubricate the valve tappets with clean engine oil.

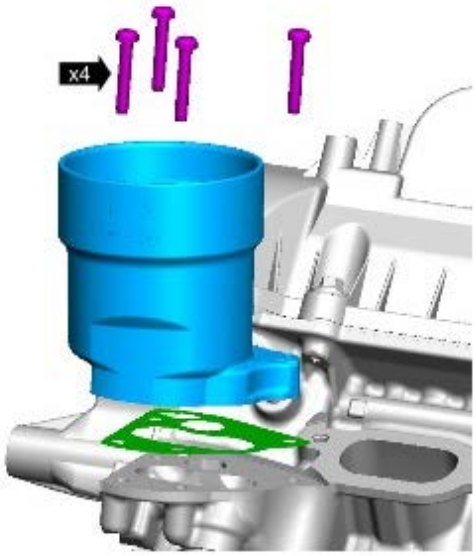


8. *Torque:* 25 Nm

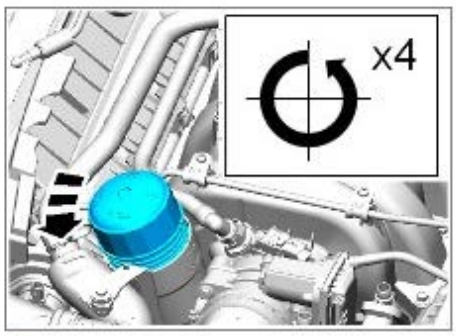


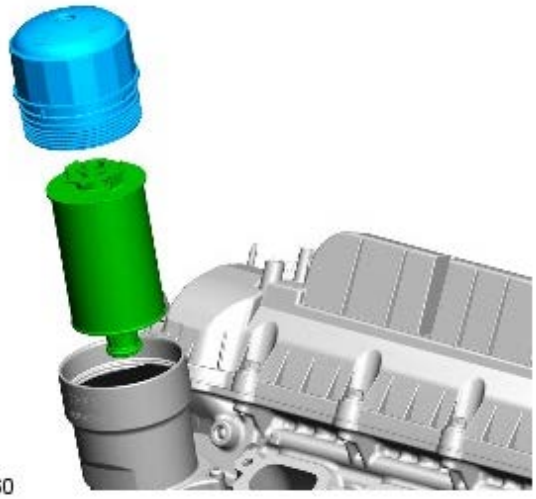
9. Refer to: Camshaft RH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

10. NOTE: Install a new gasket.



E114959



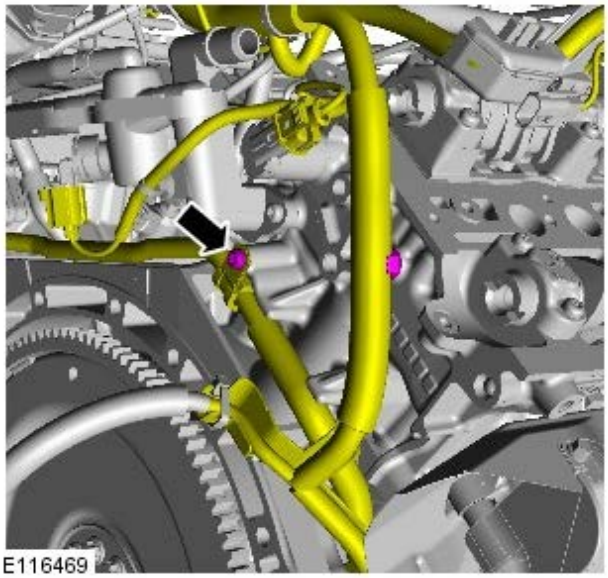


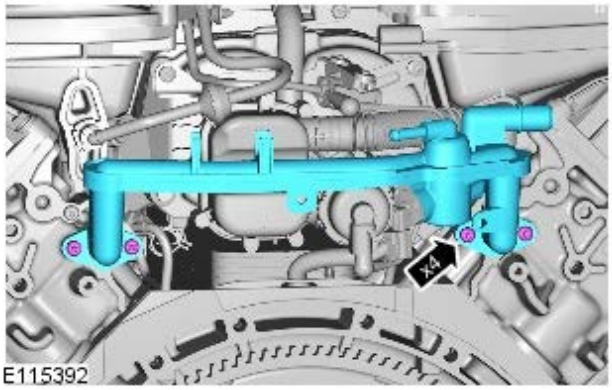
E114960

11. CAUTION: A new O-ring seal is to be installed.

NOTE: Install a new engine oil filter.

12. *Torque:* 12 Nm

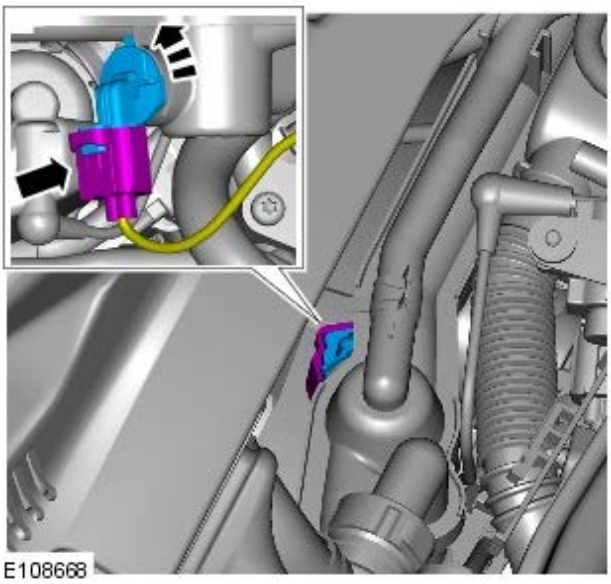




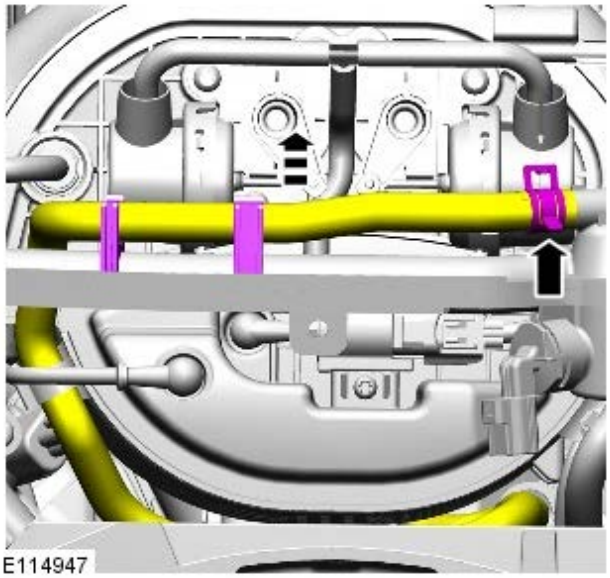
13. CAUTION: Install the new seals.

    Torque: 10 Nm

14.



15. NOTE: Clamp the hose to minimize coolant loss.

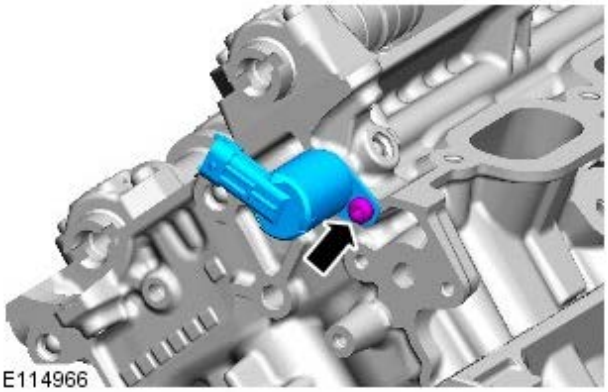


16. CAUTIONS:

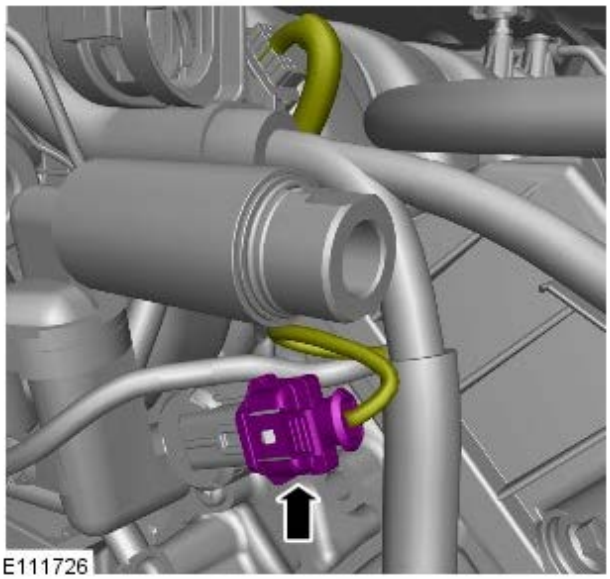
    Install a new seal.

    LH illustration shown, RH is similar.

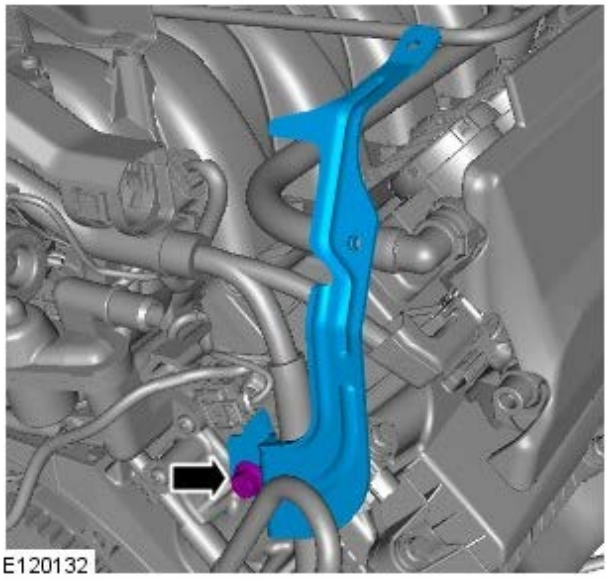
    Torque: 12 Nm

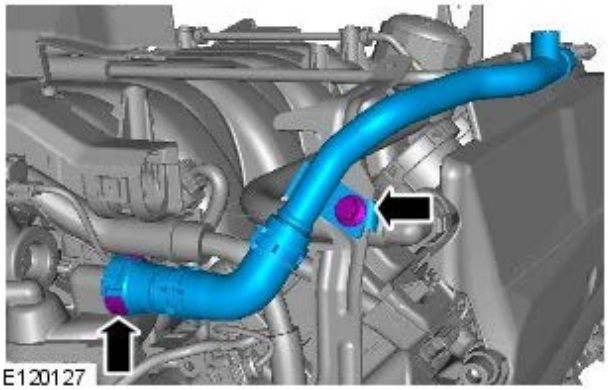


17.



18.

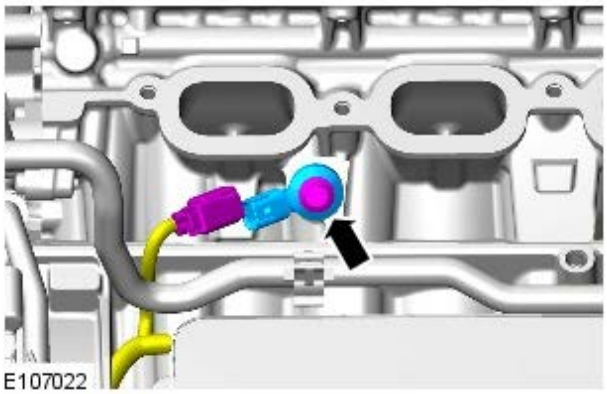




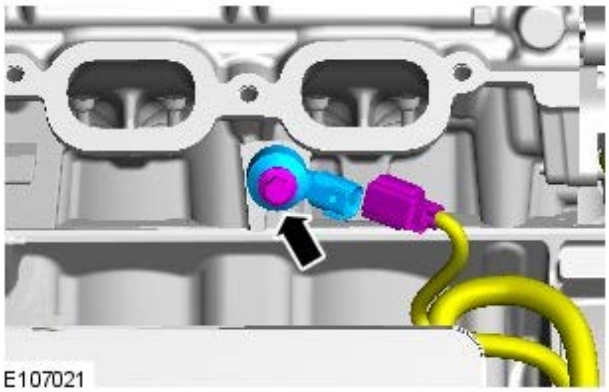
19. CAUTION: Be prepared to collect escaping coolant.

    Torque: 10 Nm

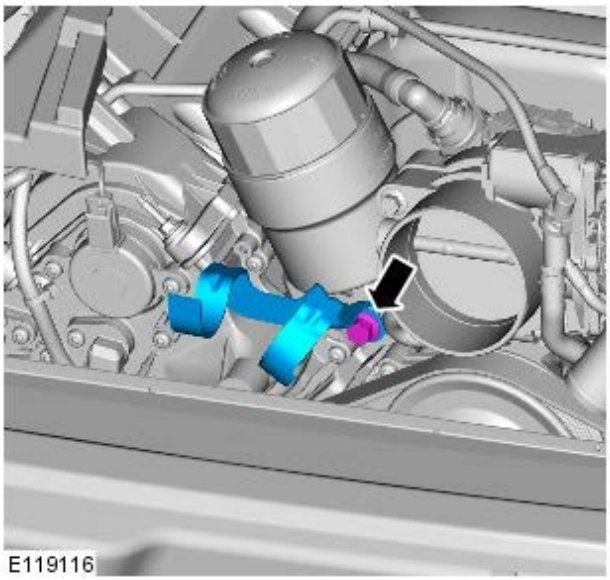
20. *Torque:* 20 Nm



21. *Torque:* 20 Nm



22. *Torque:* 25 Nm



23. Refer to: Exhaust Manifold RH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

24. Refer to: Intake Manifold (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

25. Connect the battery ground cable.

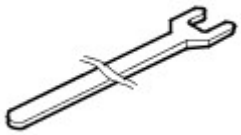
    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 11-May-2011

Engine - V8 5.0L Petrol - Engine Mount LH

Removal and Installation

Special Tool(s)

303-1142  E46076	303-1142 Viscous Coupling Wrench
303-1143  E55382	303-1143 Viscous Coupling Holding Tool

Removal

NOTES:

Some illustrations may show the engine removed for clarity.

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

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

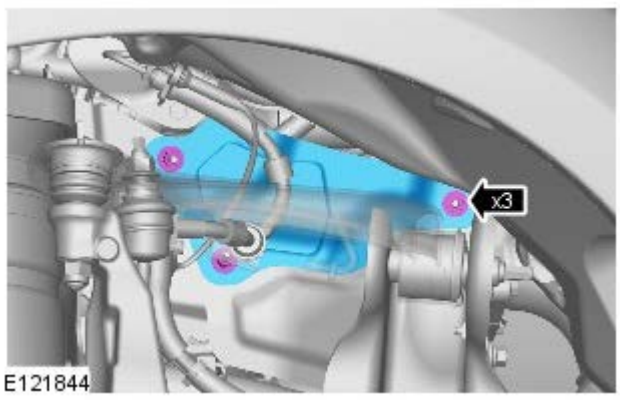
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

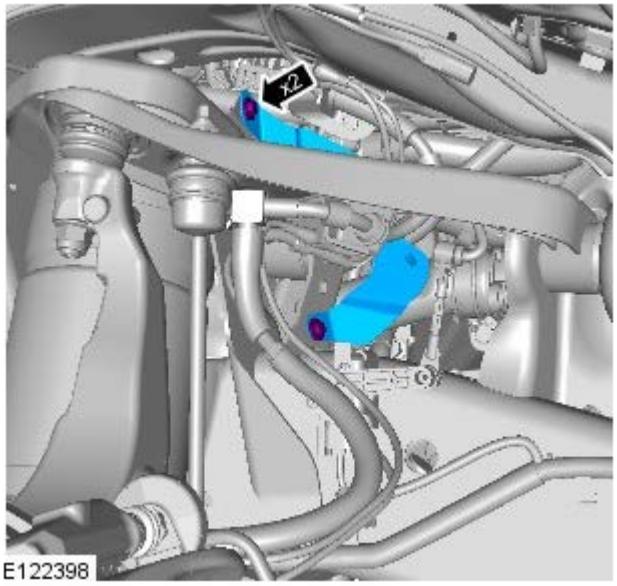
3. Refer to: Catalytic Converter LH (309-00, Removal and Installation).

4. Remove the LH front wheel and tire.

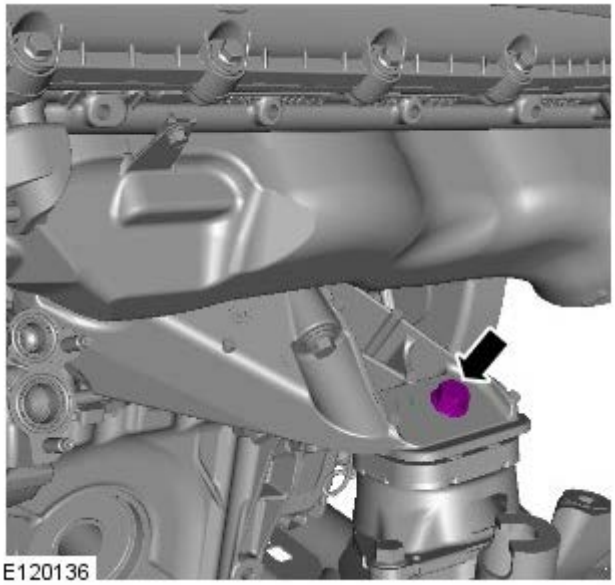
5.



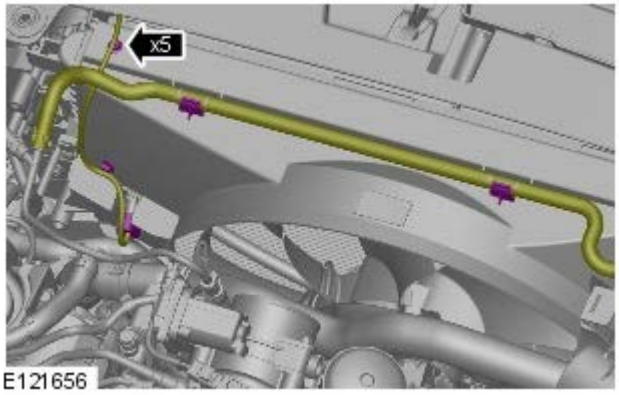
6.



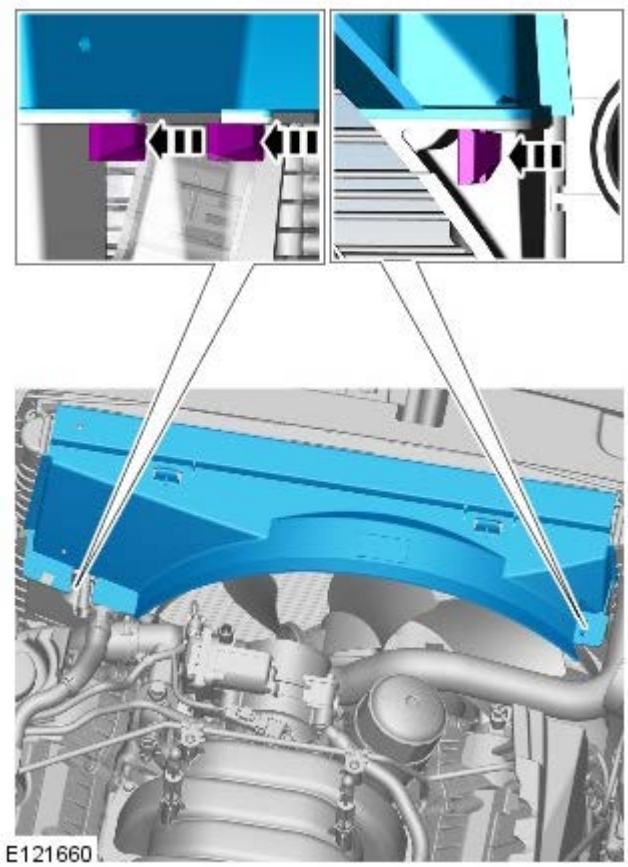
7.

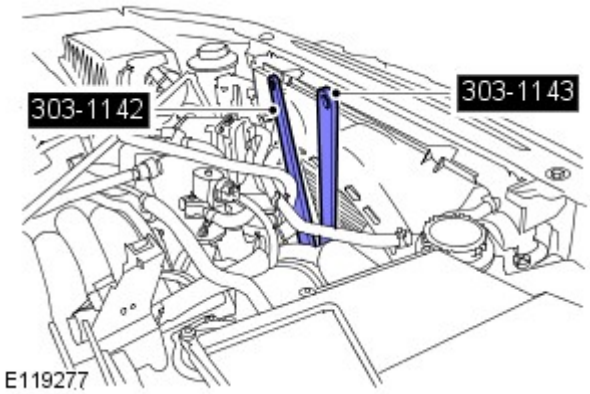


8.



9.





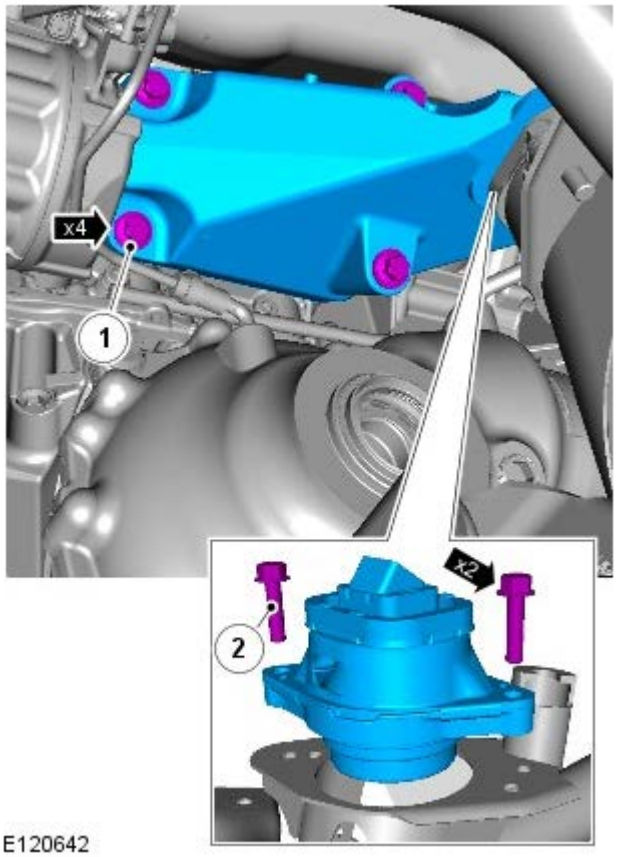
10. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

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

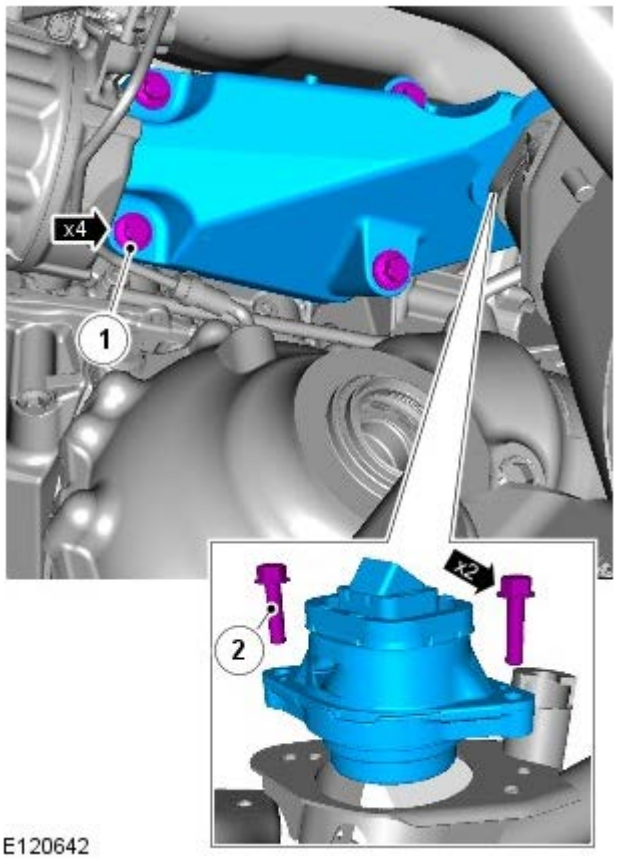
11. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

Using a suitable hydraulic jack, raise and support the engine.

12.



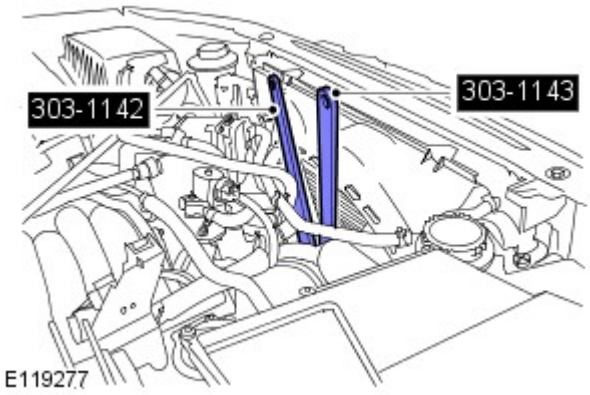
Installation



1.
- *Torque:*
  1 45 Nm
  1 60°
  2 56 Nm

2. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

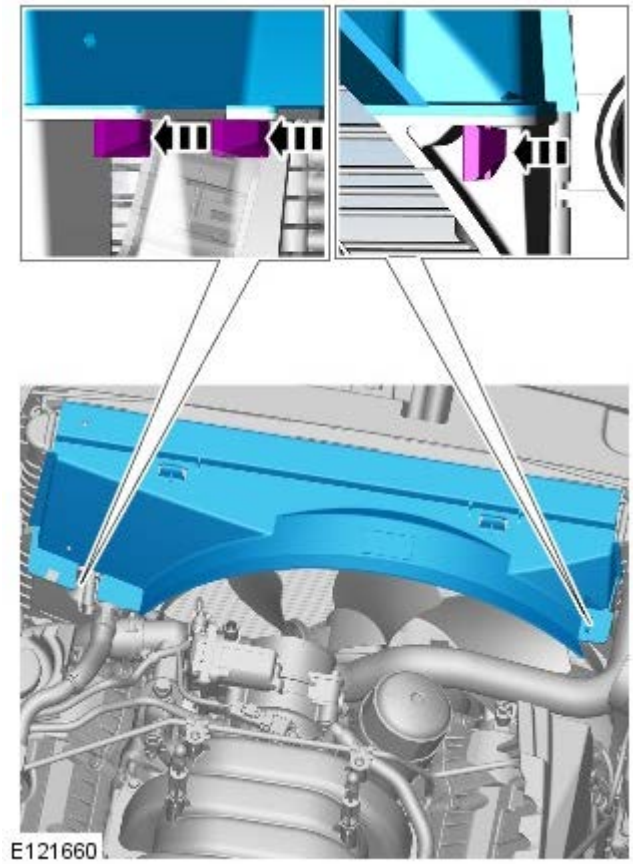
NOTE: Some variation in the illustrations may occur, but the essential information is always



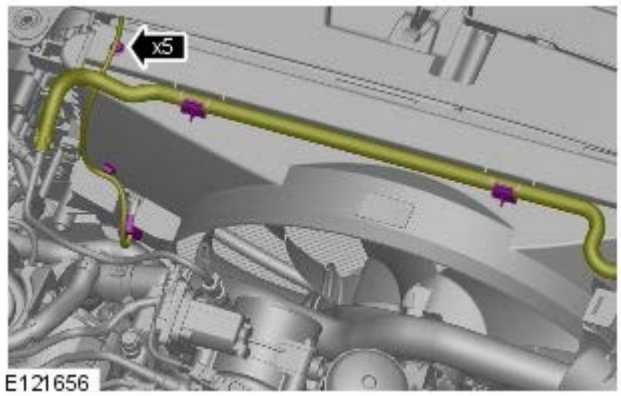
correct.

Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm

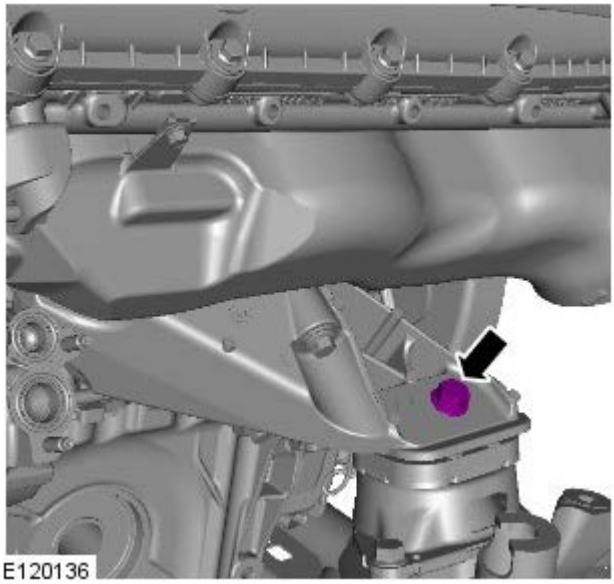
3.



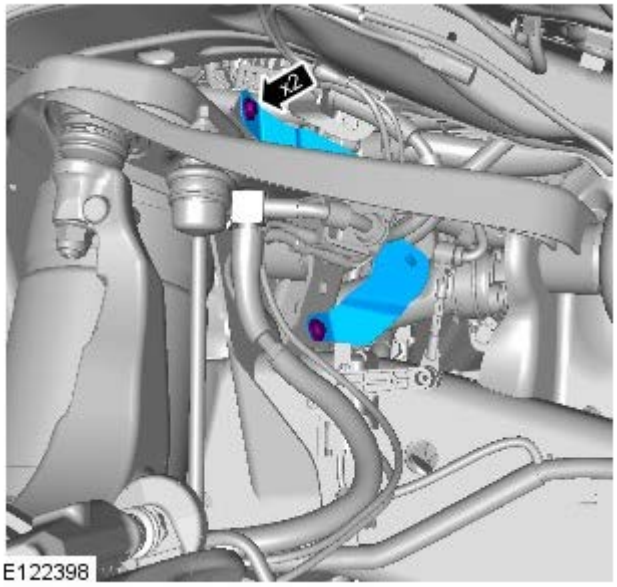
4.



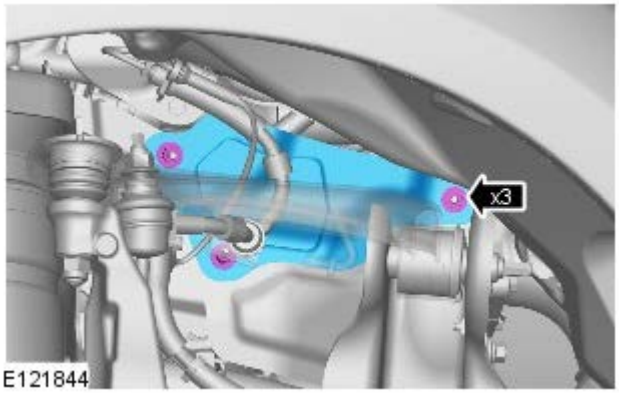
5. *Torque:* 100 Nm



6. *Torque:* 12 Nm



7. *Torque:* 12 Nm



8. Install the LH front wheel and tire.
9. Refer to: Catalytic Converter LH (309-00, Removal and Installation).
10. Lower the vehicle.
11. Disconnect the battery ground cable.

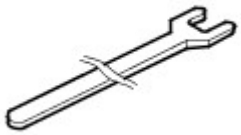
    Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Engine - V8 5.0L Petrol - Engine Mount RH

Removal and Installation

Special Tool(s)

303-1142  E46076	303-1142 Viscous Coupling Wrench
303-1143  E55382	303-1143 Viscous Coupling Holding Tool

Removal

NOTES:

Some illustrations may show the engine removed for clarity.

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

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Disconnect the battery ground cable.

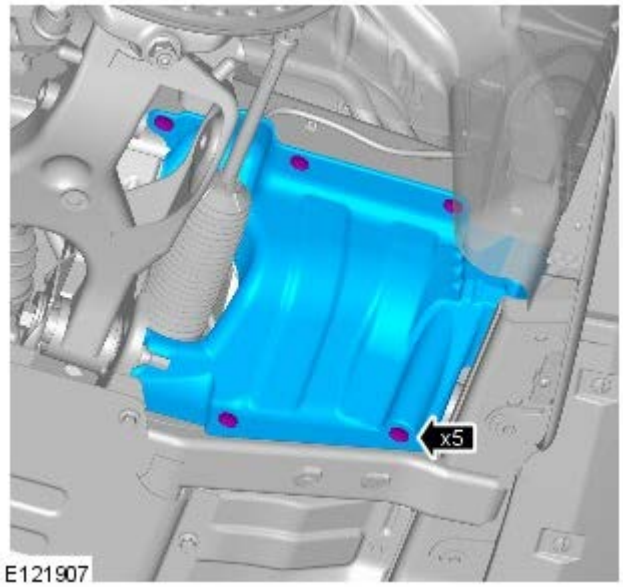
   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

3. Remove the RH front wheel and tire.

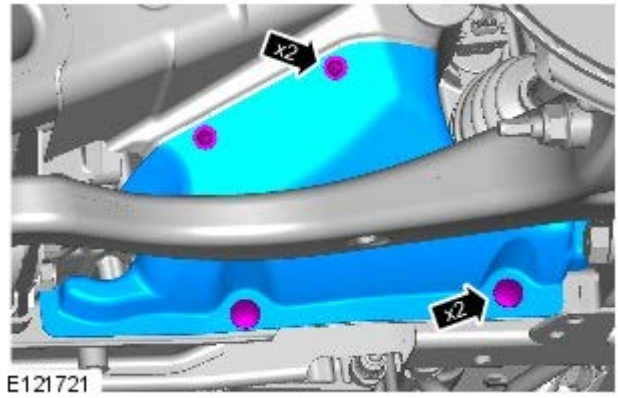
4. Refer to: Exhaust System (309-00 Exhaust System - 5.0L NA V8 - AJ133, Removal and Installation).

5. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12 Intake Air Distribution and Filtering - 5.0L NA V8 - AJ133, Removal and Installation).

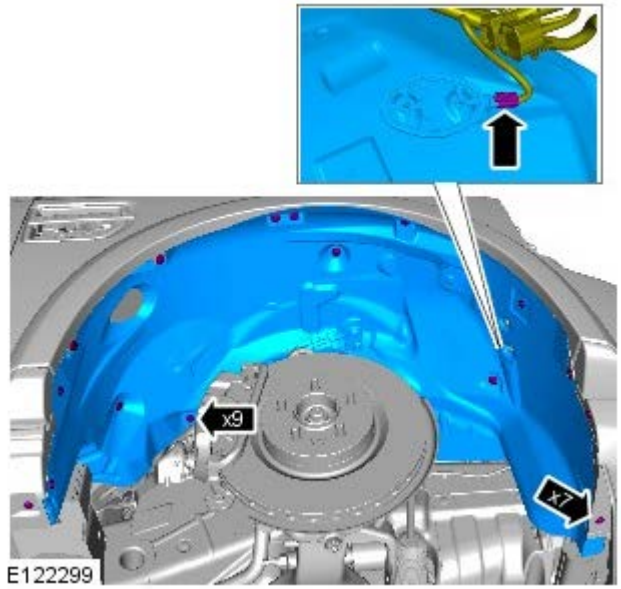
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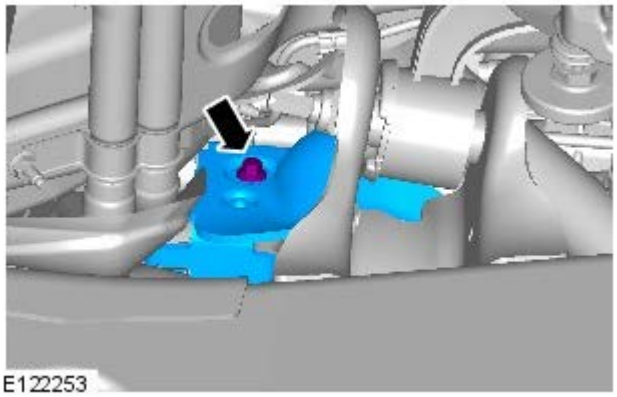
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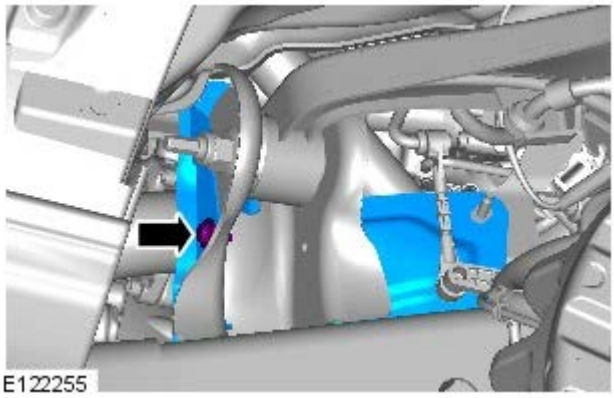
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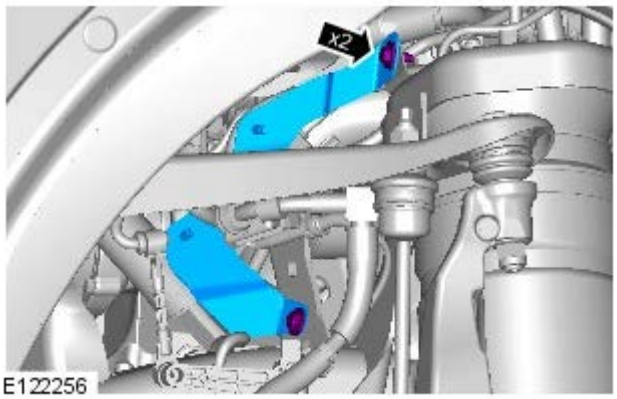
9.



10.



11.

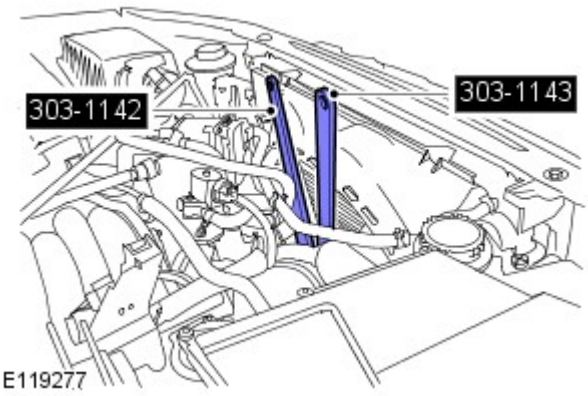


12. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

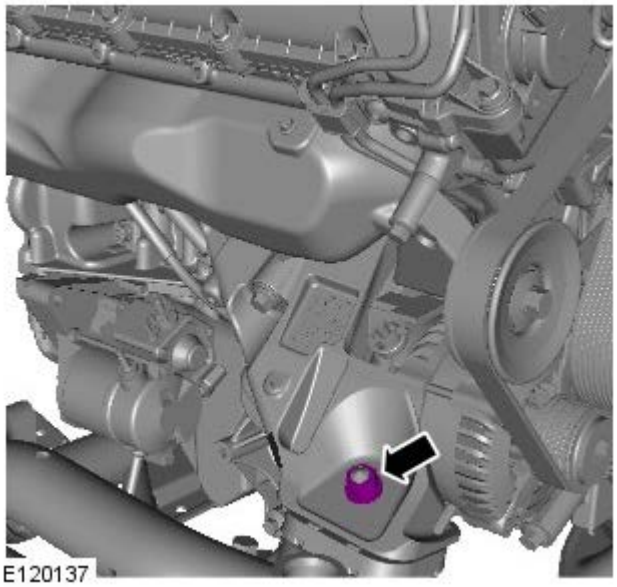
NOTES:

The thread is right handed.

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



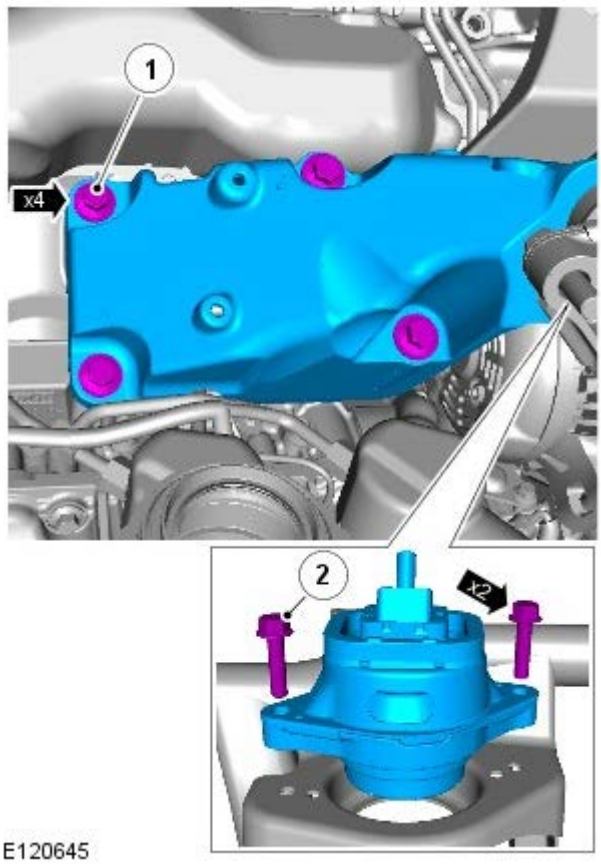
13.



14. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

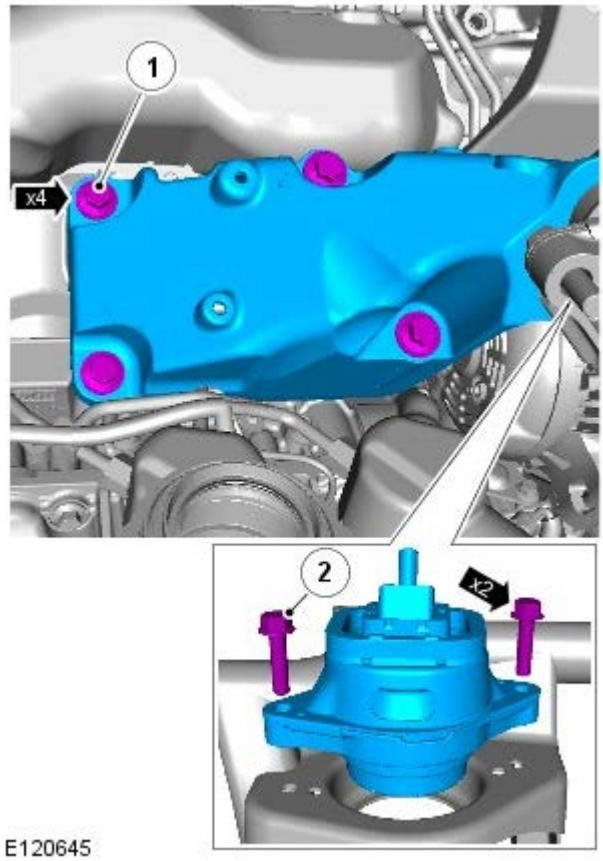
    Using a suitable hydraulic jack, raise and support the engine.

15.



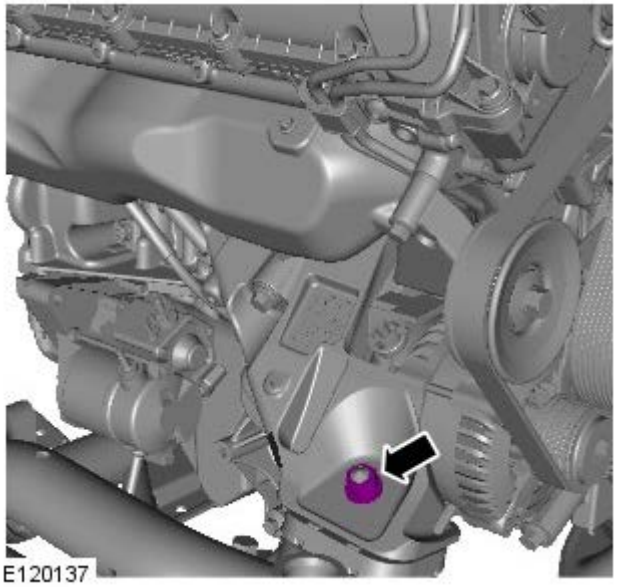
Installation

1. *Torque:*
   1 45 Nm
   1 60°
   2 56 Nm



E120645

2. *Torque:* 100 Nm


E120137

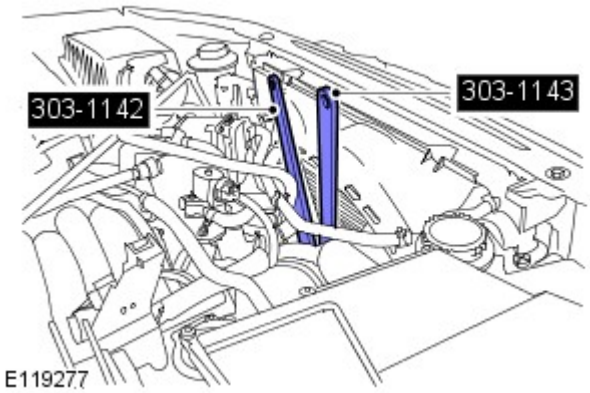
3. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

NOTES:

The thread is right handed.

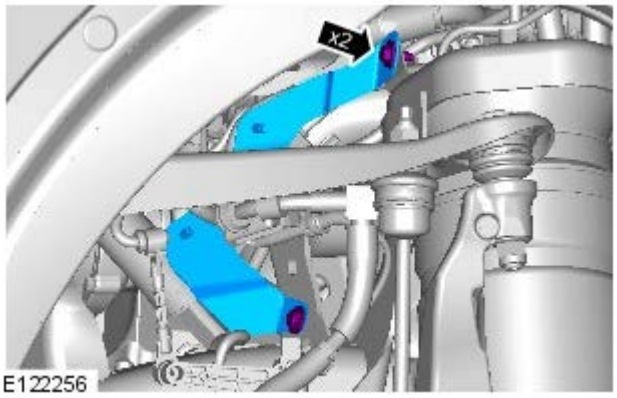
Some variation in the illustrations may occur, but the essential information is always correct.

Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm

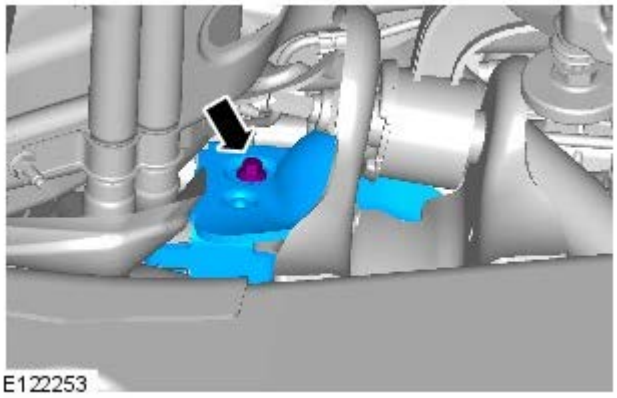


E119277

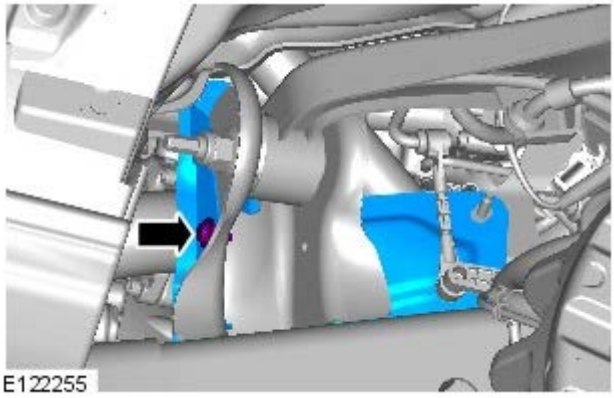
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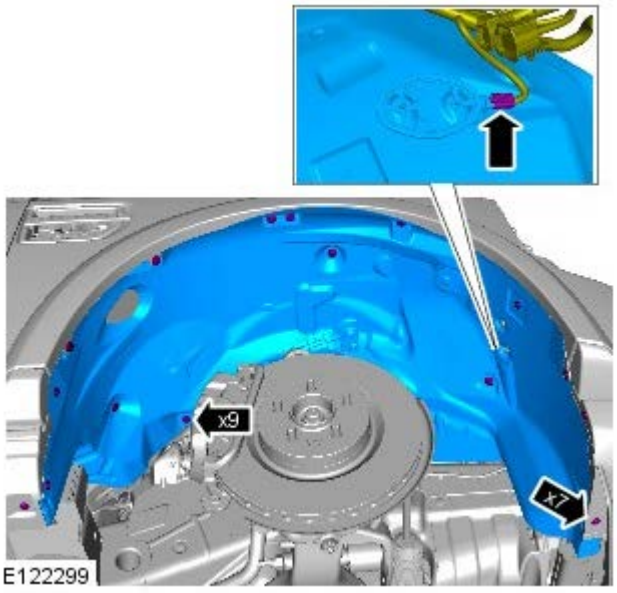
5.



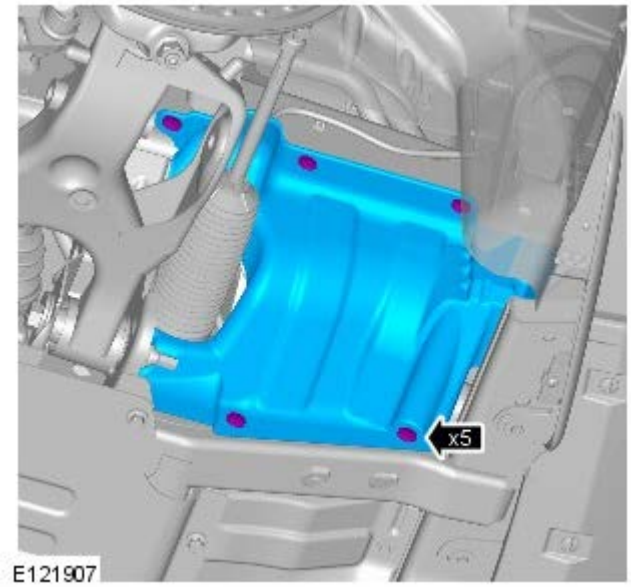
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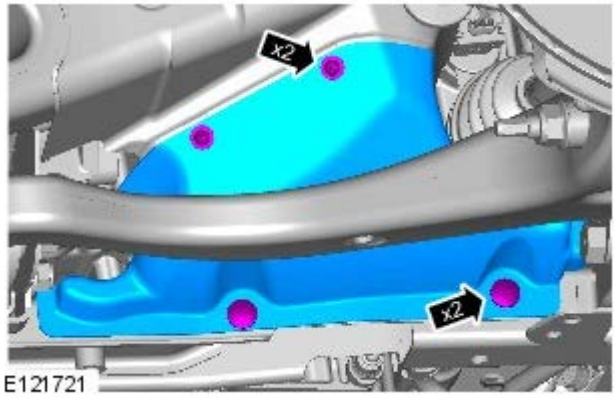
7.



8.



9.



10. Install the RH front wheel and tire.

11. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12 Intake Air Distribution and Filtering - 5.0L NA V8 - AJ133, Removal and Installation).

12. Refer to: Exhaust System (309-00 Exhaust System - 5.0L NA V8 - AJ133, Removal and Installation).

13. Connect the battery ground cable.

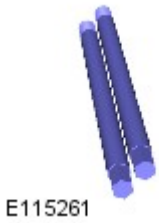
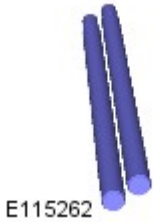
    Refer to: Specifications (414-00 Charging System - General Information, Specifications).

Published: 11-May-2011

Engine - V8 5.0L Petrol - Exhaust Manifold LH

Removal and Installation

Special Tool(s)

 E115261	303-1444-01 Exhaust Manifold Installation Guide Pins - Threaded
 E115262	303-1444-02 Exhaust Manifold Installation Guide Pins - Unthreaded

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

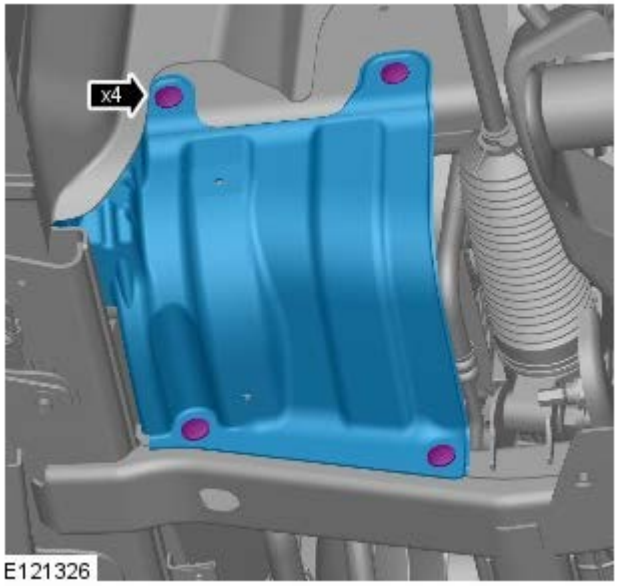
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

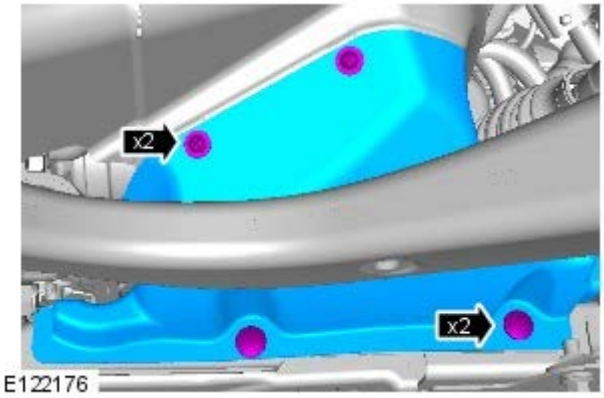
3. Refer to: Power Steering Pump - 5.0L (211-02 Power Steering, Removal and Installation).

4. Refer to: Exhaust System (309-00 Exhaust System - 5.0L, Removal and Installation).

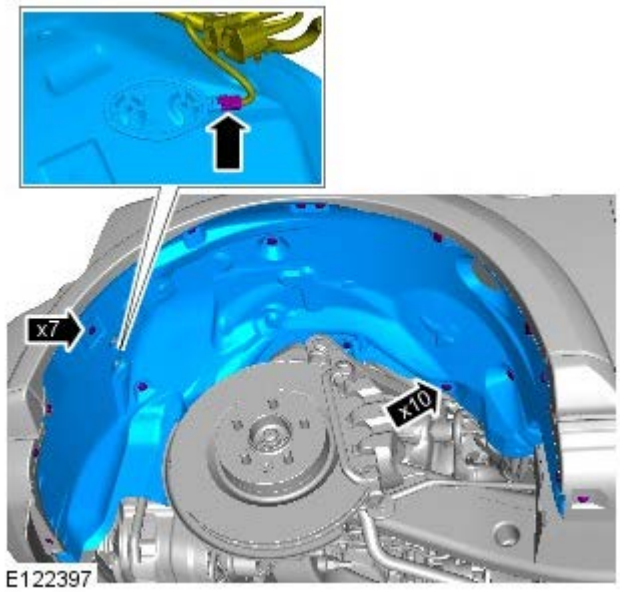
5.



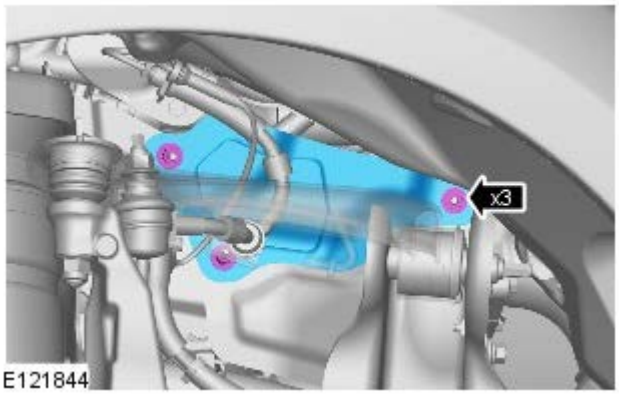
6.



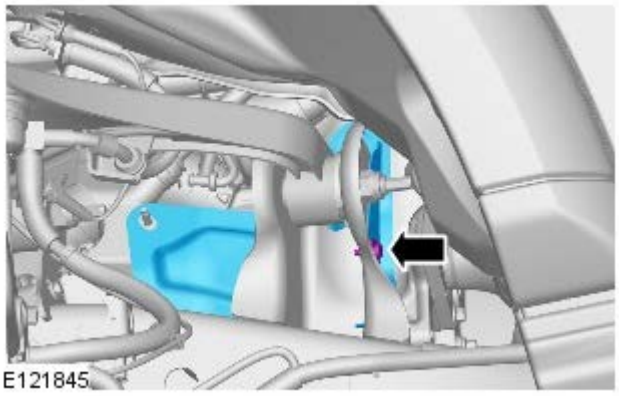
7.



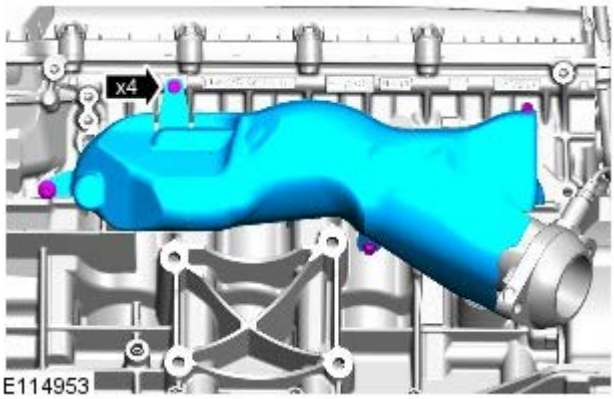
8.



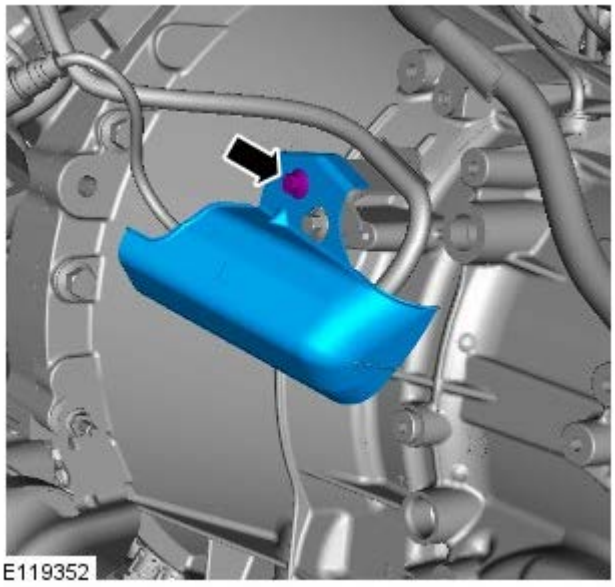
9.



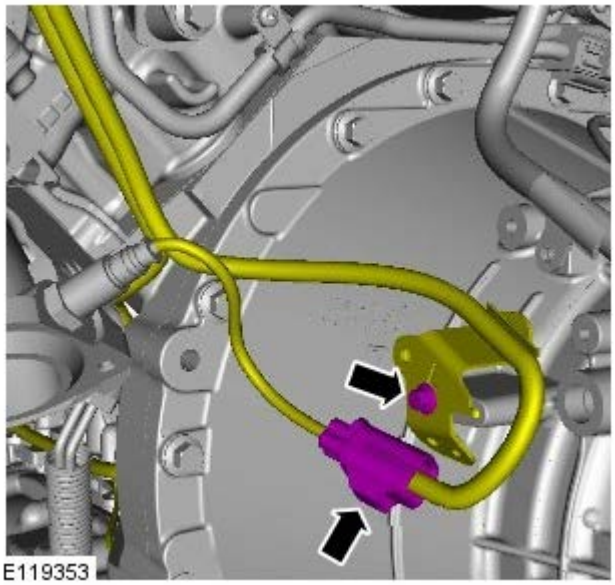
10.

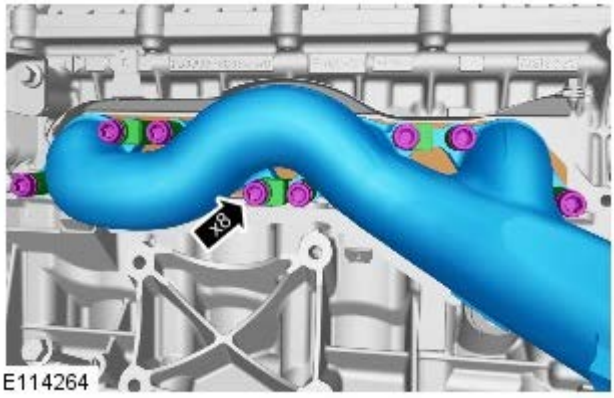


11.



12.





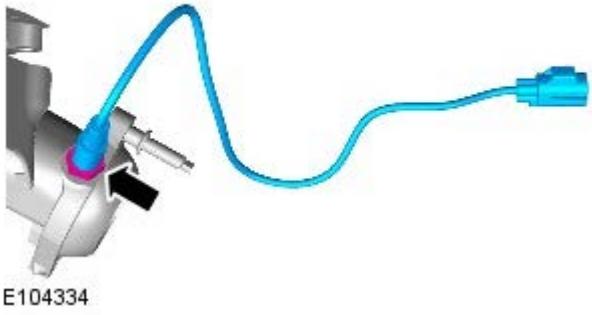
13. CAUTION: Discard the bolts.

    NOTES:

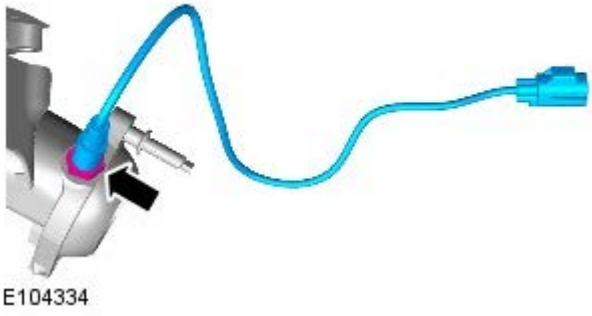
    Discard the gasket.

    Make sure that the position of the spacers is noted before removal of the manifold.

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



Installation



1. CAUTIONS:

    Make sure that the mating faces are clean and free of foreign material.

    Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.

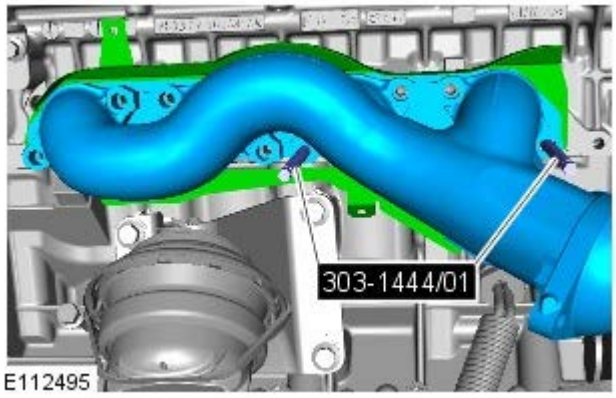
    If accidentally dropped or knocked install a new sensor.

    Make sure the catalyst monitor sensor wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or

driveshaft.

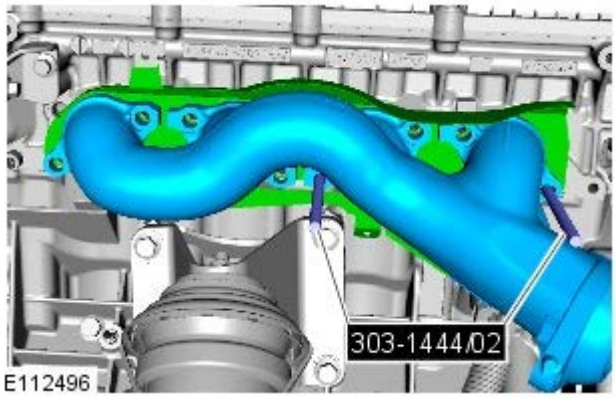
NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

Torque: 45 Nm



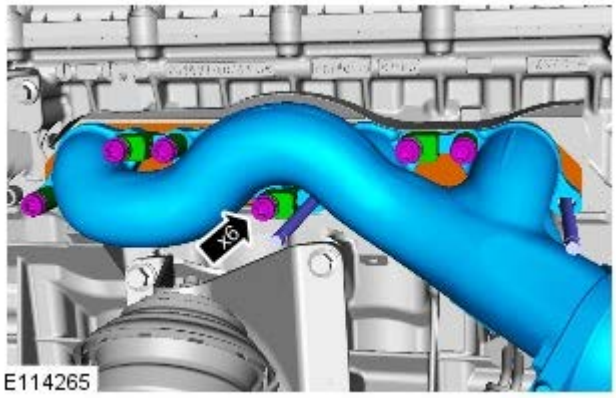
2. NOTE: Install a new gasket.

   Special Tool(s): 303-1444-01



3. NOTE: If a new cylinder head is installed use the special tools in the illustration.

   Special Tool(s): 303-1444-02

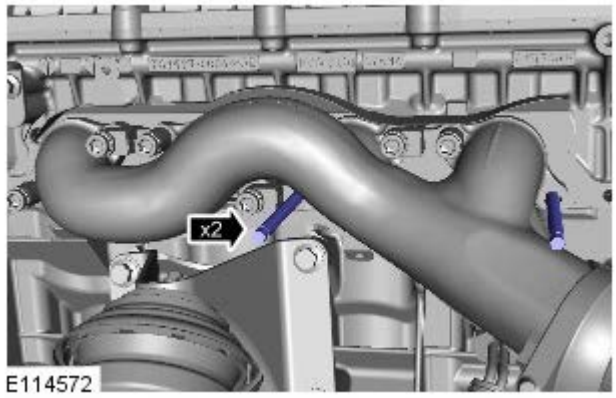


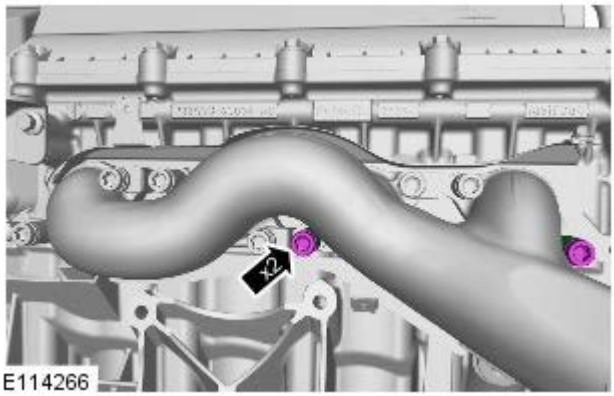
4. CAUTION: Make sure that new bolts are installed.

   NOTE: Install the spacers in the noted position.

   Torque: 10 Nm

5. Remove the special tool.

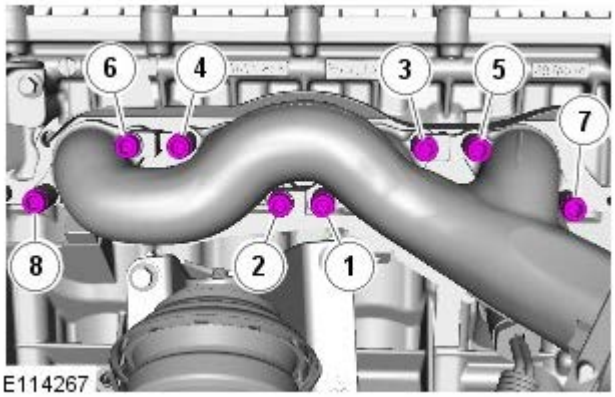




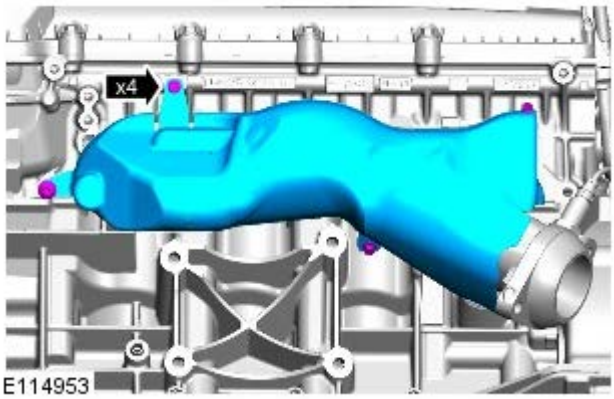
6. CAUTION: Make sure that new bolts are installed.

   NOTE: Install the spacers in the noted position.

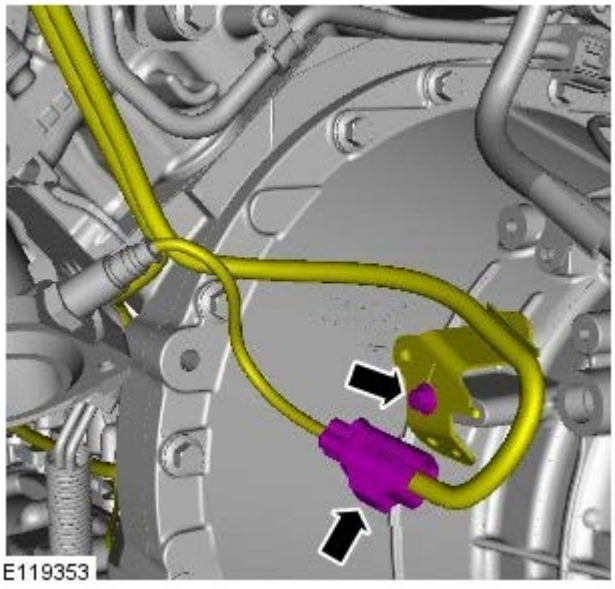
   Torque: 10 Nm



7. *Torque:* 18 Nm

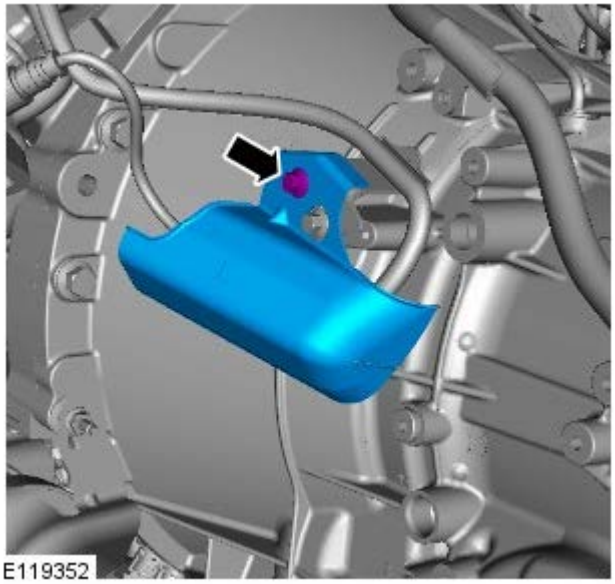


8. *Torque:* 3 Nm

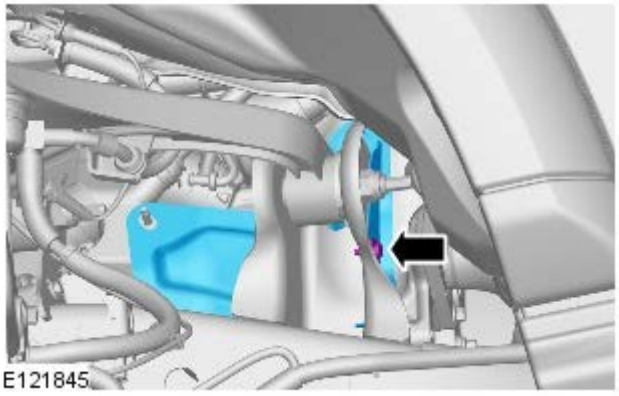


9. *Torque:* 10 Nm

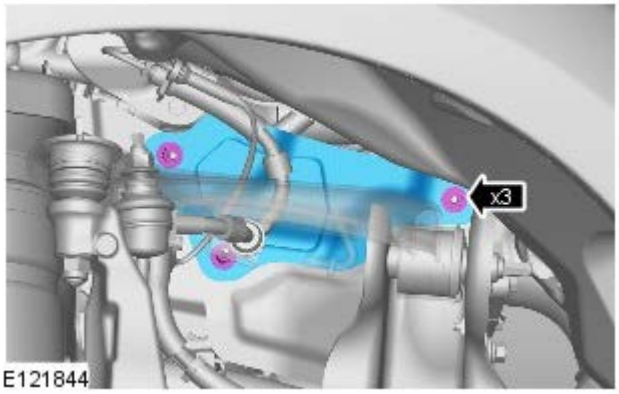
10. *Torque:* 10 Nm



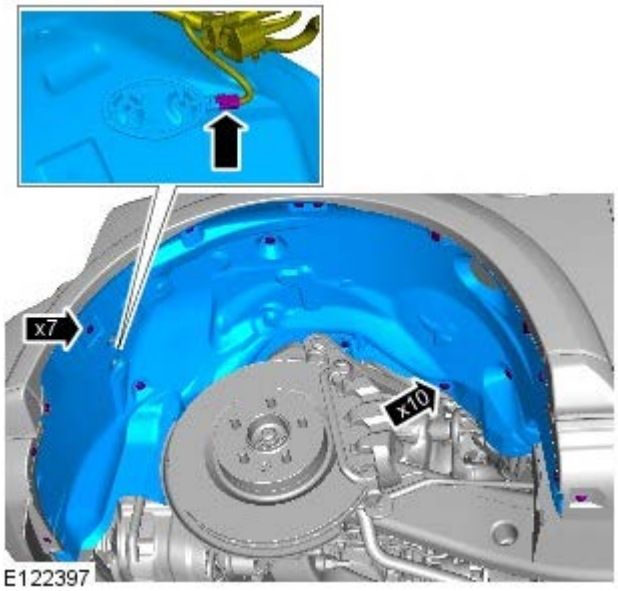
11.



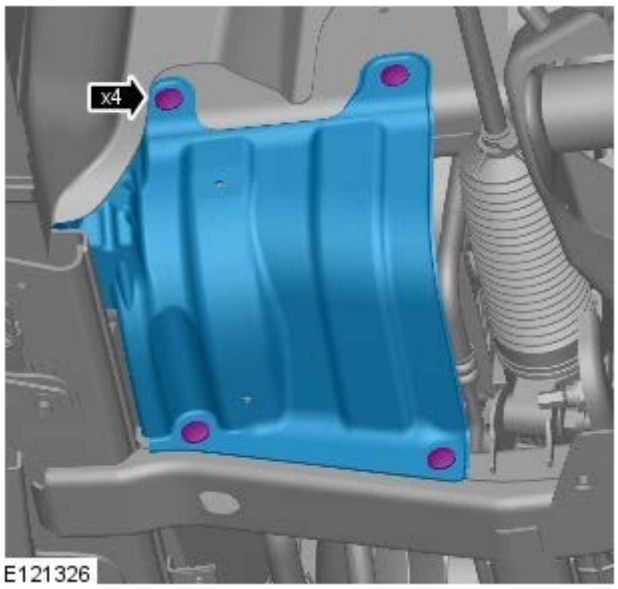
12.



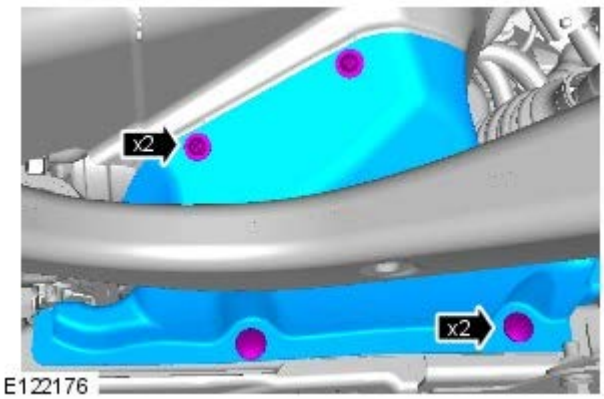
13.



14.



15.



16. Refer to: Exhaust System (309-00 Exhaust System - 5.0L, Removal and Installation).

17. Refer to: Power Steering Pump - 5.0L (211-02 Power Steering, Removal and Installation).

18. Install the battery.

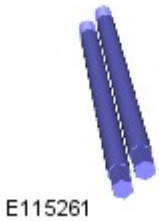
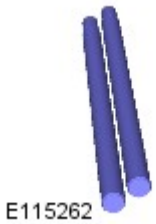
    Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

Published: 09-Aug-2013

Engine - V8 5.0L Petrol - Exhaust Manifold RH

Removal and Installation

Special Tool(s)

 E115261	303-1444-01 Exhaust Manifold Installation Guide Pins - Threaded
 E115262	303-1444-02 Exhaust Manifold Installation Guide Pins - Unthreaded

Removal

NOTES:

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

Some illustrations may show the engine removed for clarity.

All vehicles

1. Disconnect the battery ground cable.

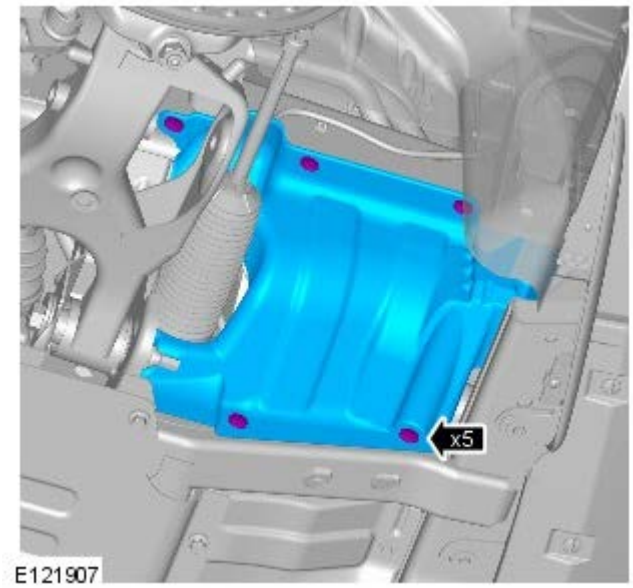
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

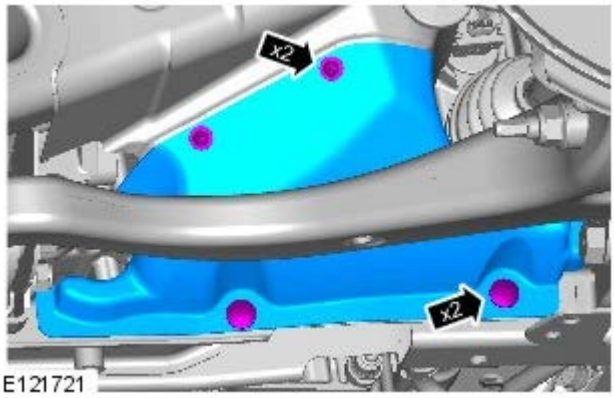
   Raise and support the vehicle.

3. Refer to: Exhaust System (309-00B Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

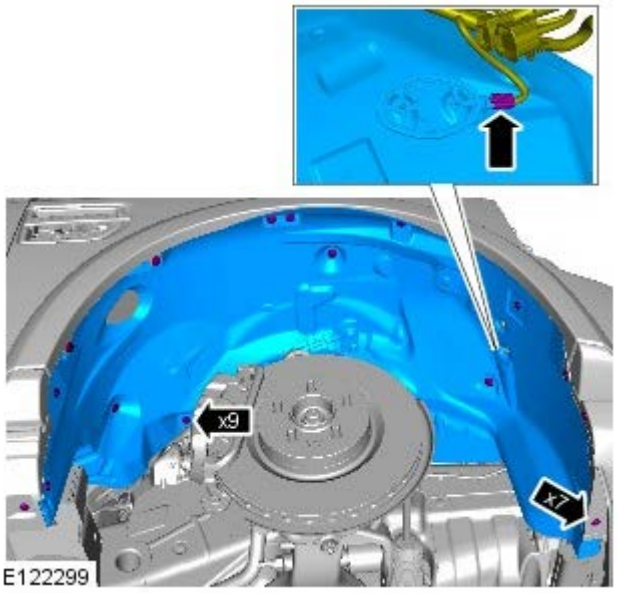
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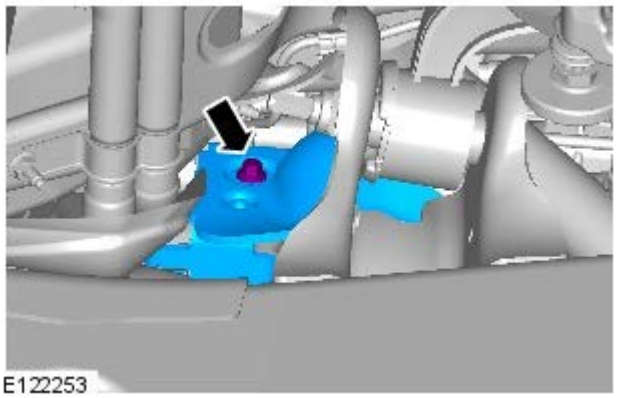
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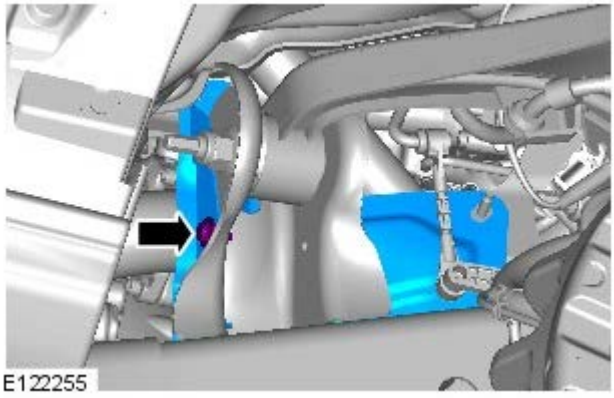
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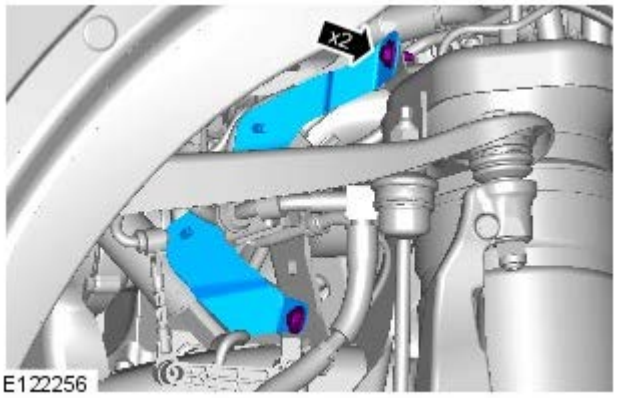
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8.

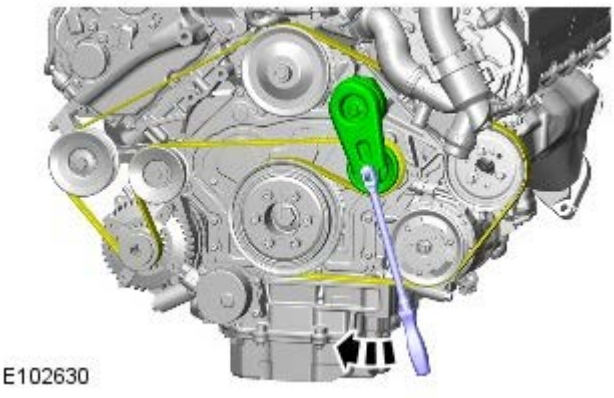


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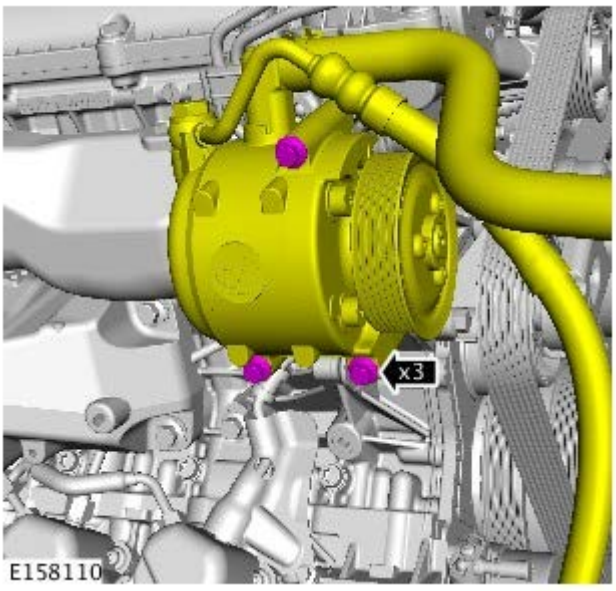


Vehicles with dynamic suspension

10.

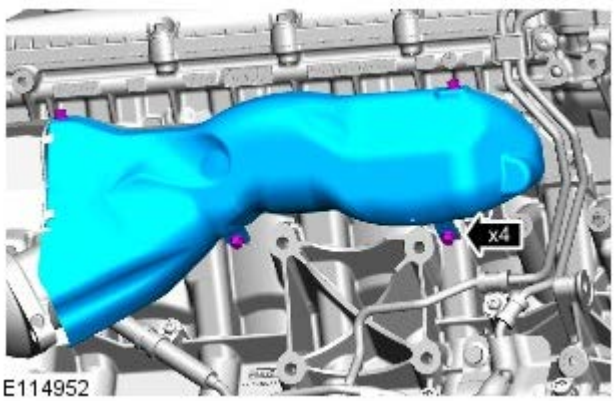


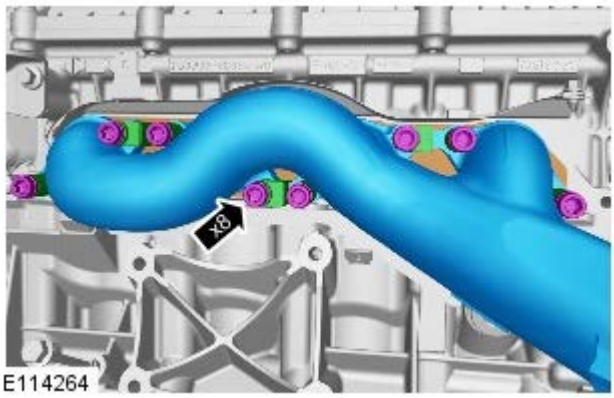
11.



All vehicles

12.





13. CAUTIONS:

    Discard the bolts.

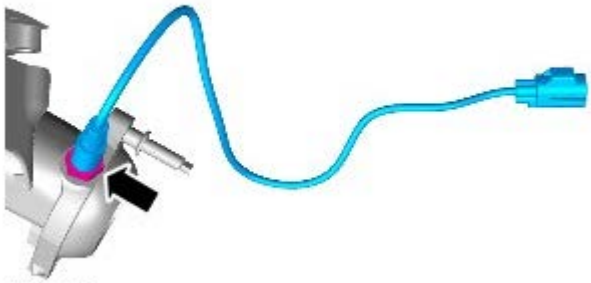
    LH illustration shown, RH is similar.

    NOTES:

    Discard the gasket.

    Make sure that the position of the spacers is noted before removal of the manifold.

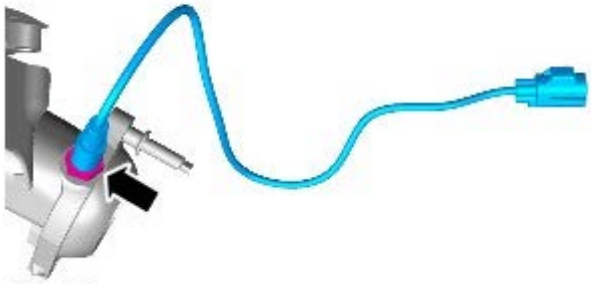
14. NOTE: Do not disassemble further if the component is removed for access only.

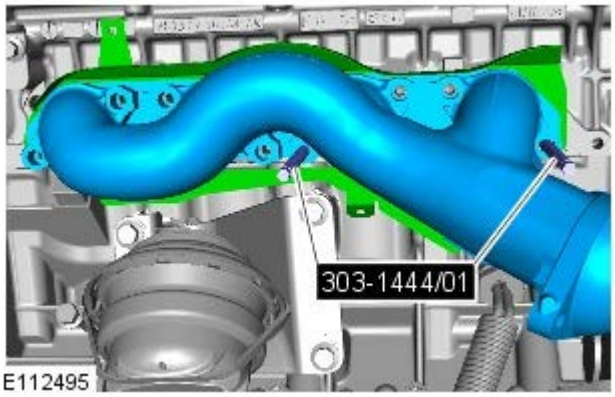


Installation

All vehicles

1. *Torque:* 45 Nm





2. CAUTION: LH illustration shown, RH is similar.

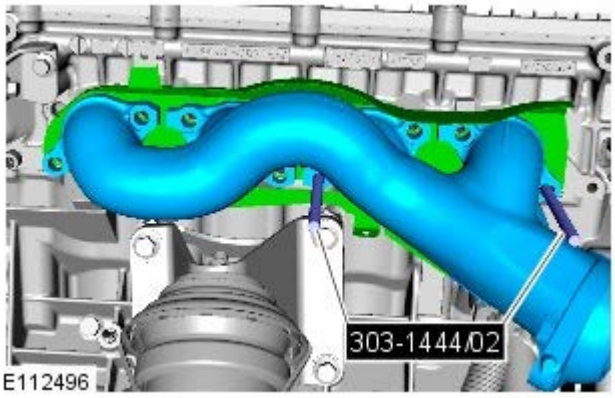
   NOTE: Install a new gasket.

   Install the special tool.

   Special Tool(s): 303-1444-01

3. CAUTION: LH illustration shown, RH is similar.

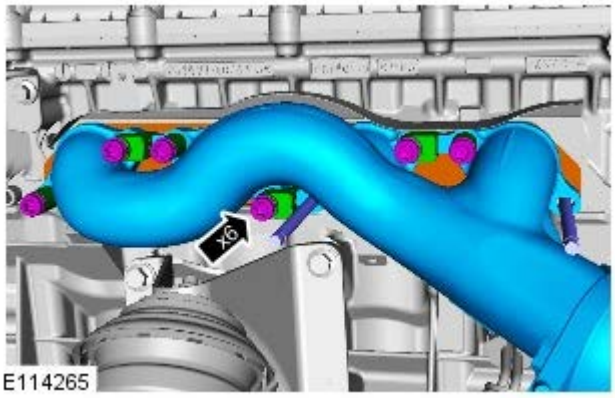
   NOTE: If a new cylinder head is installed use



the special tools in the illustration.

Install the special tool.

Special Tool(s): 303-1444-02



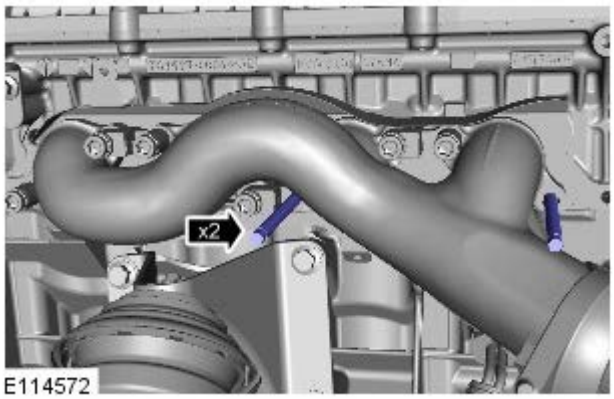
4. CAUTIONS:

   Make sure that new bolts are installed.

   LH illustration shown, RH is similar.

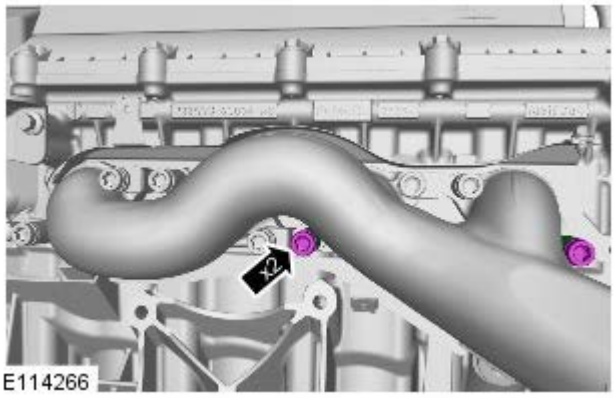
   NOTE: Install the spacers in the noted position.

   Torque: 10 Nm



5. CAUTION: LH illustration shown, RH is similar.

   Remove the special tool.



6. CAUTIONS:

   Make sure that new bolts are installed.

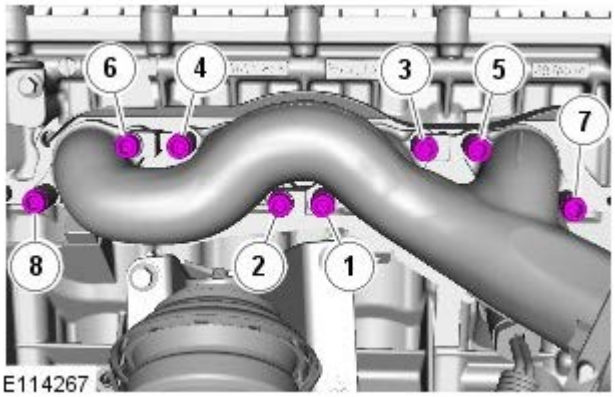
   LH illustration shown, RH is similar.

   NOTE: Install the spacers in the noted position.

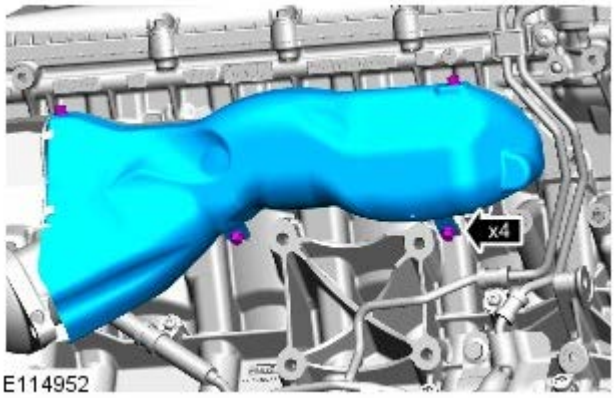
   Torque: 10 Nm

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

   Torque: 18 Nm

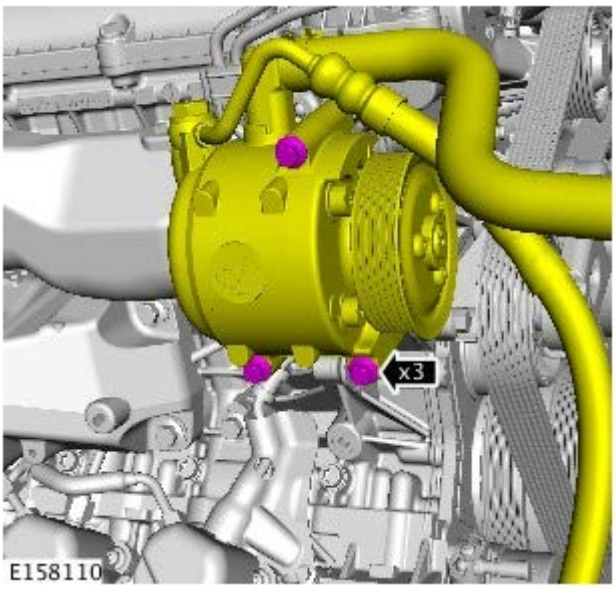


8.

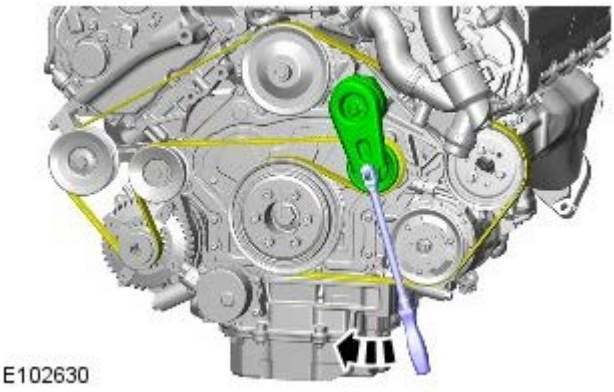


Vehicles with dynamic suspension

9. *Torque:* 22 Nm

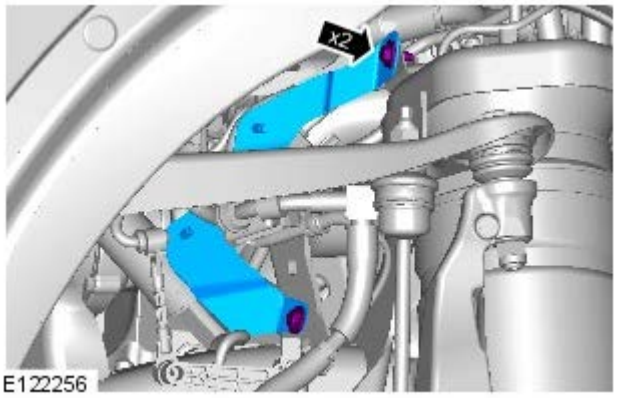


10.

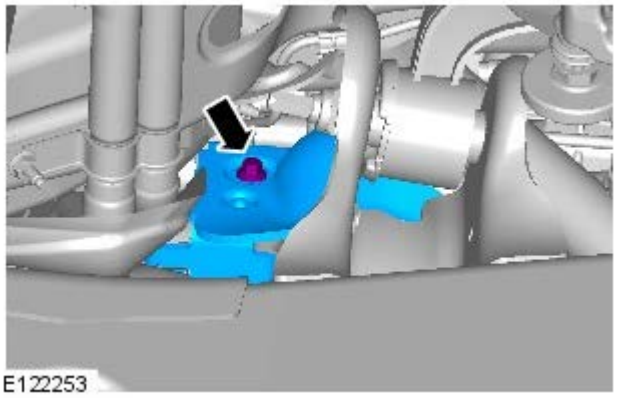


All vehicles

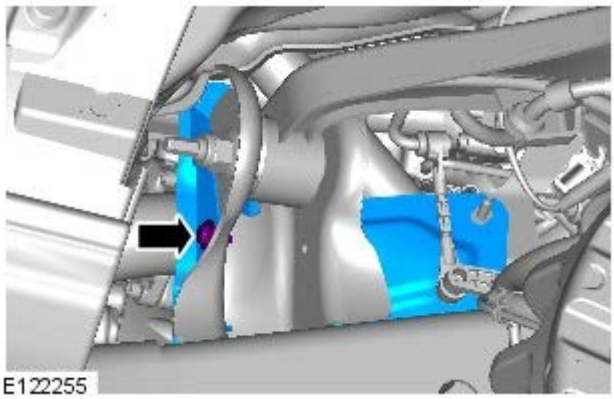
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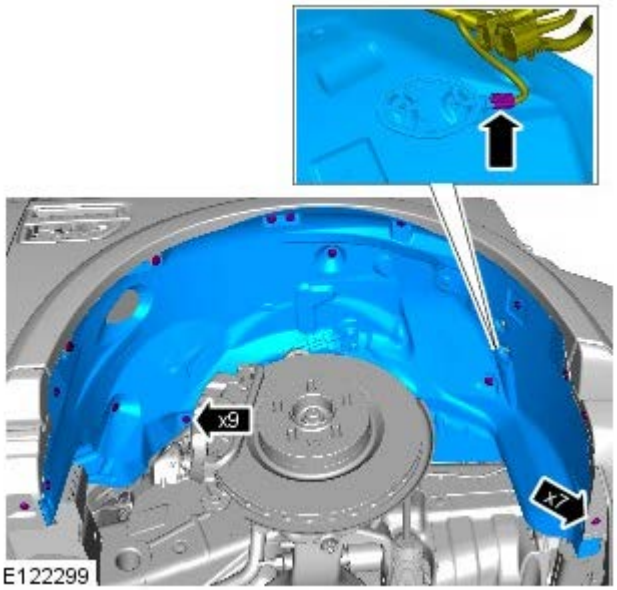
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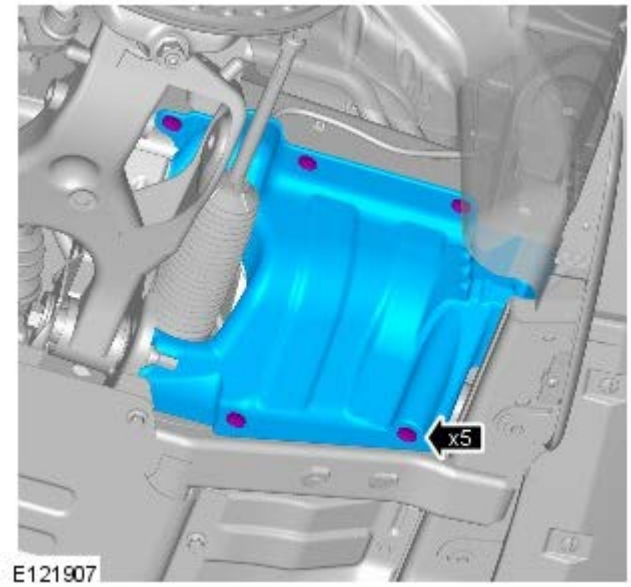
13.



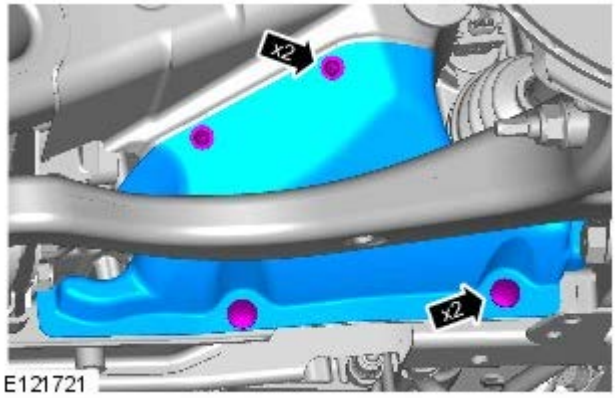
14.



15.



16.



17. Refer to: Exhaust System (309-00B Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

18. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 11-May-2011

Engine - V8 5.0L Petrol - Flexplate

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Transmission - 5.0L (307-01, Removal).



4. CAUTIONS:

   Install all the bolts finger tight before final tightening.

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

   Make sure that no components fall off during removal.

   Install the bolts in the noted position.

   NOTES:

   Make sure that the crankshaft is not rotated.

   Make sure the crankshaft and flexplate mating faces are clean before installation.

   Tighten the retaining bolts working diagonally.

   Torque:
   Stage 1: 45 Nm
   Stage 2: 90°

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine - V8 5.0L Petrol - Intake Manifold

Removal and Installation

Removal

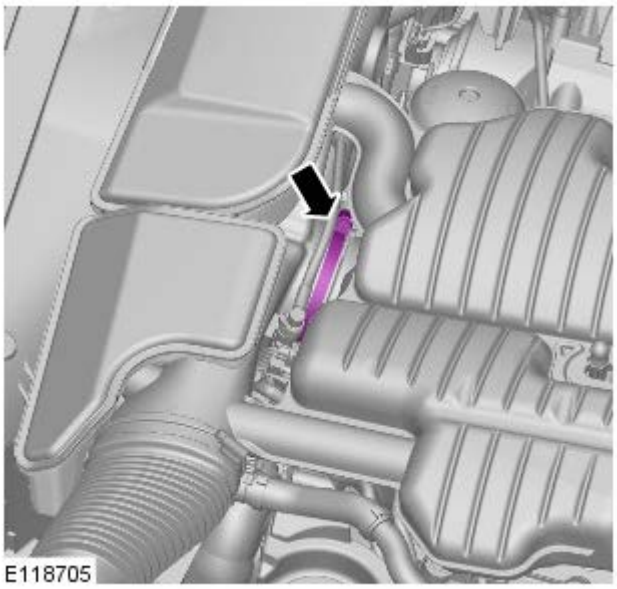
NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

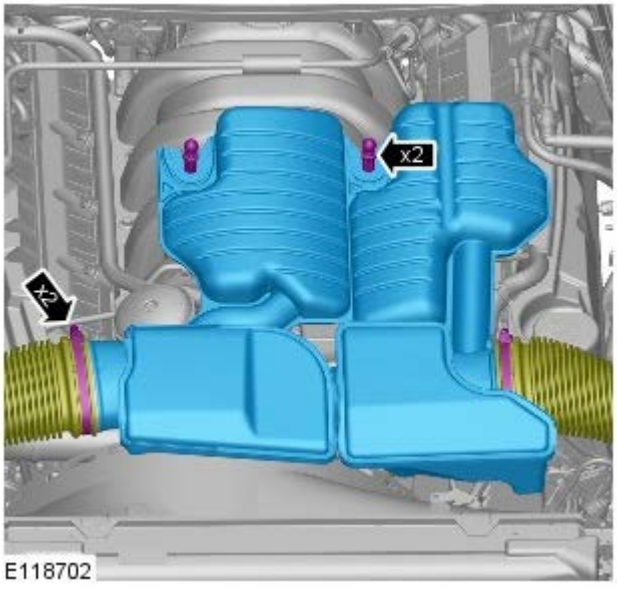
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

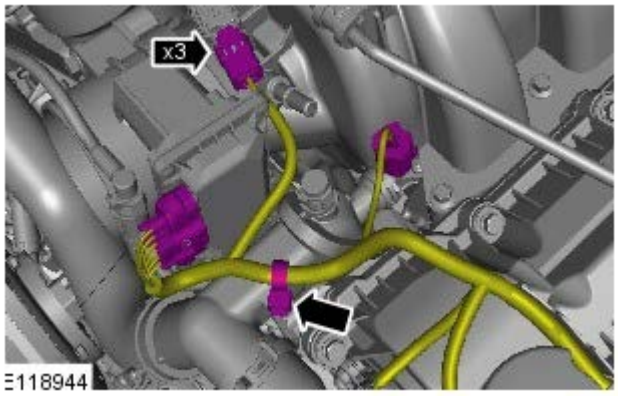
3.



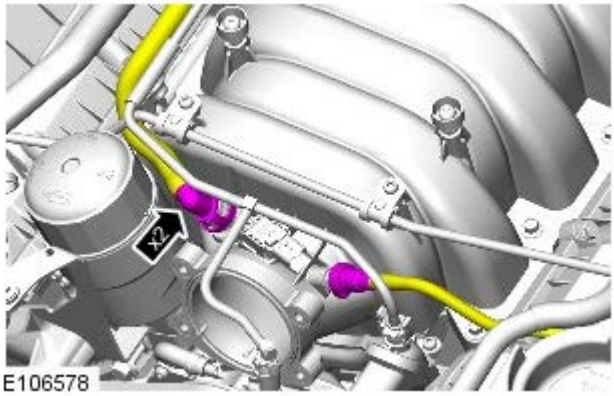
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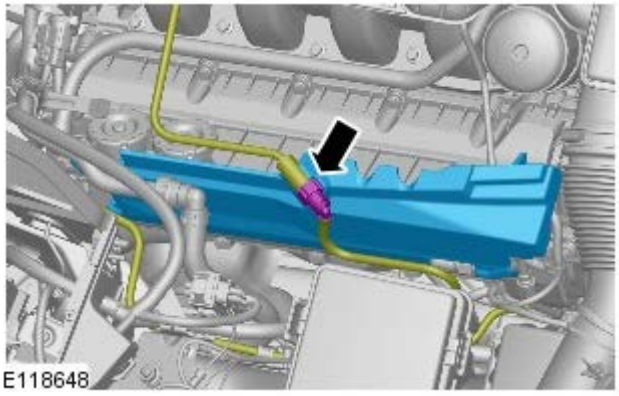
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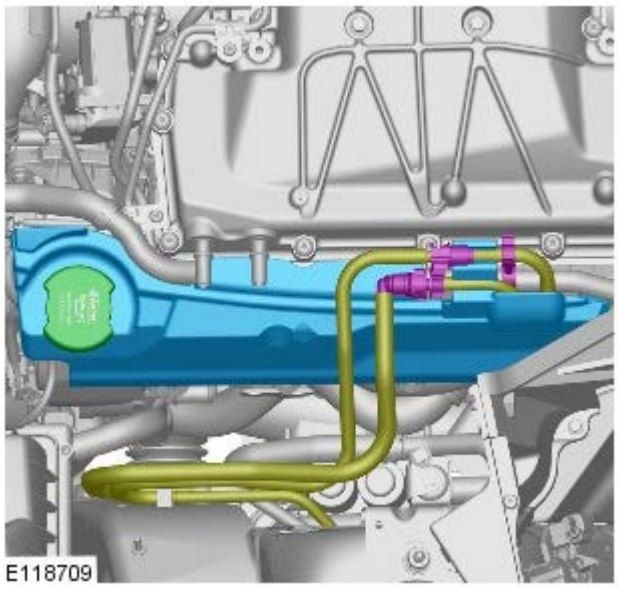
6.



7.

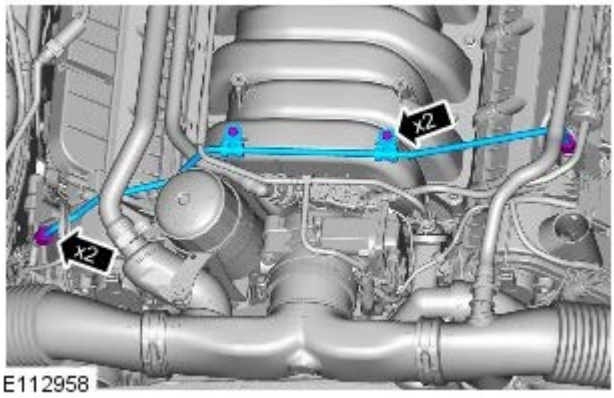


8.



9. CAUTIONS:

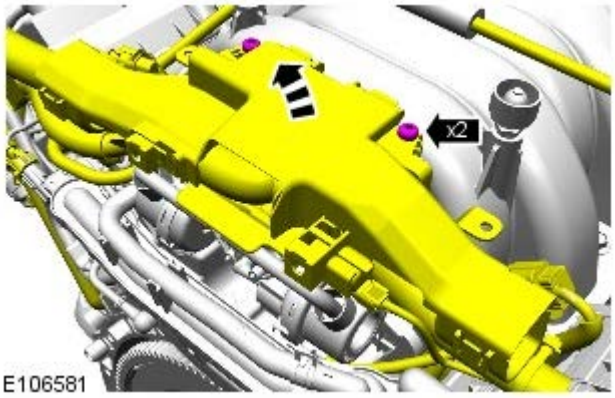




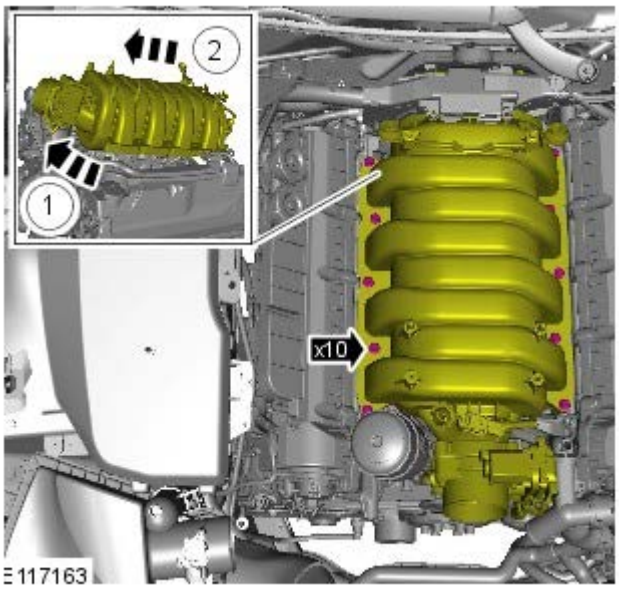
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

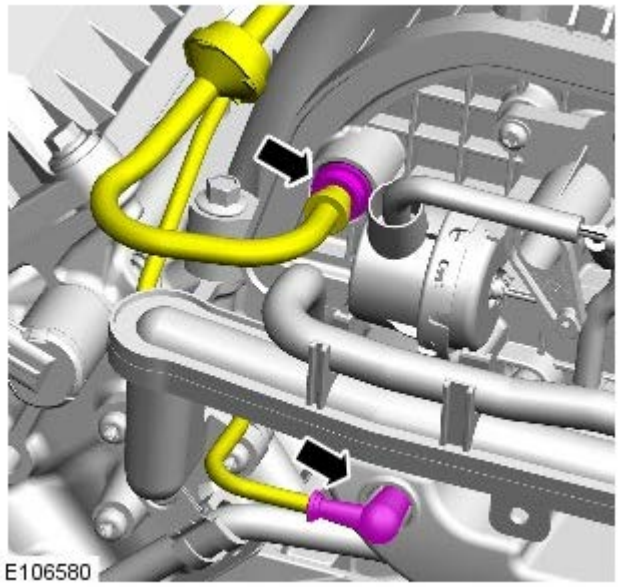
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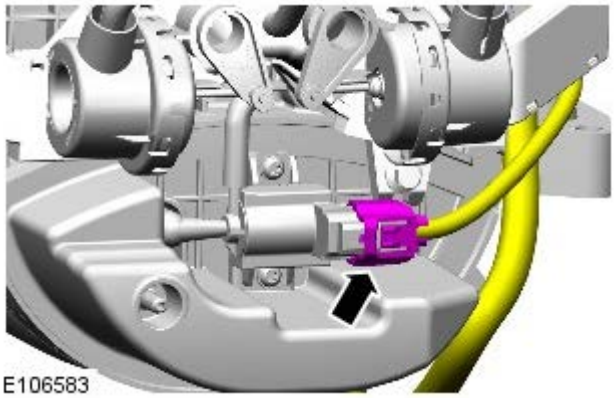
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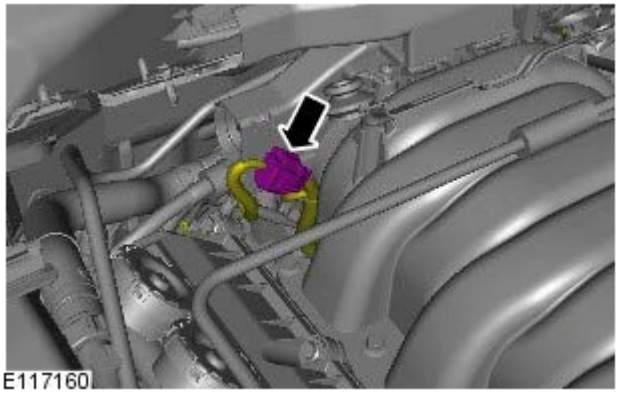
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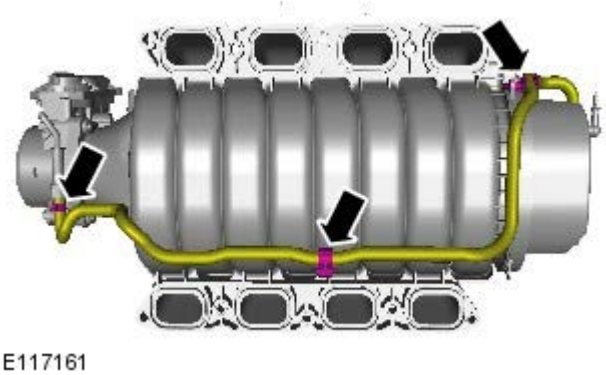
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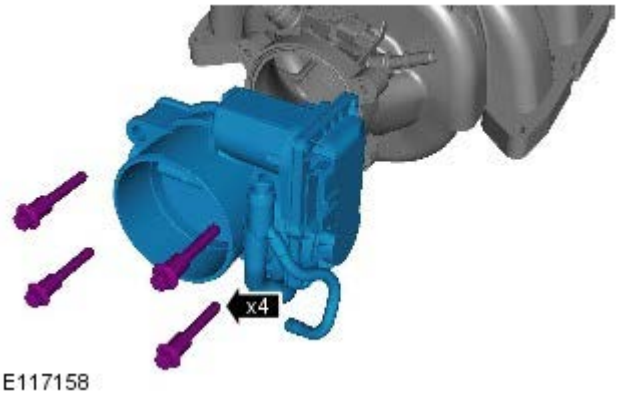
14.



15.

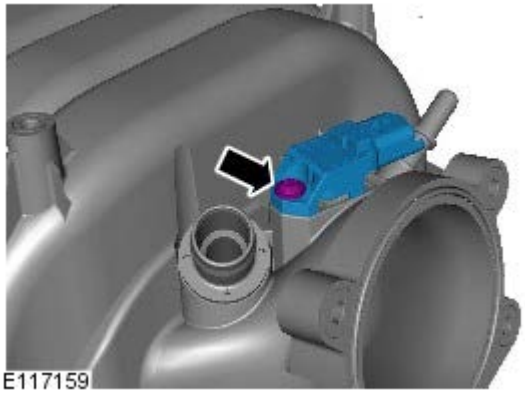


16. NOTE: Remove and discard the O-ring seal.

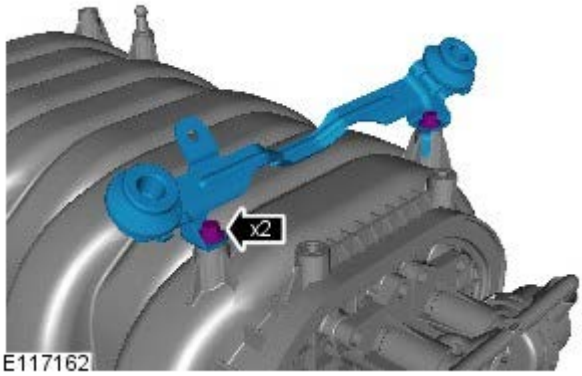


E117158

17.

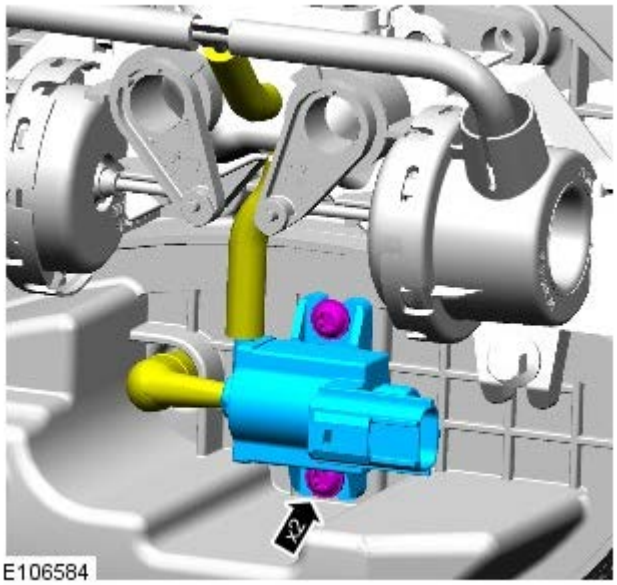

E117159

18.

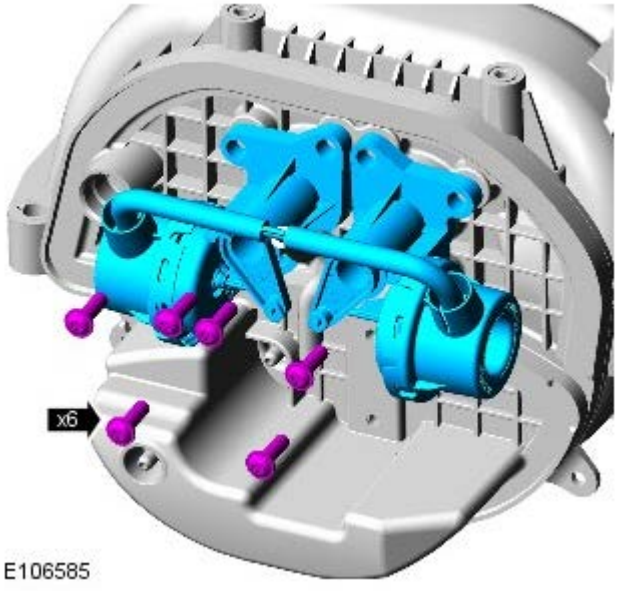


E117162

19.

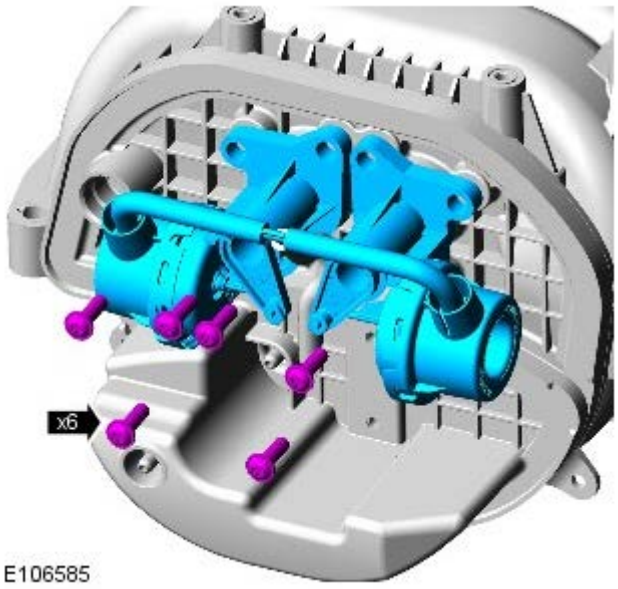

E106584

20.

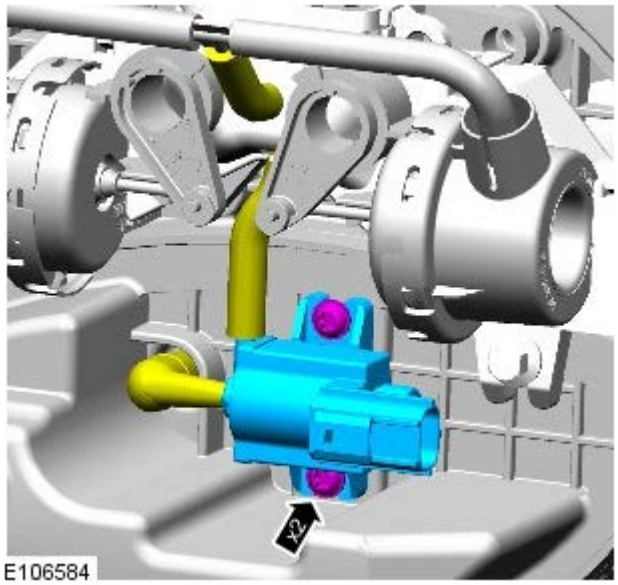


Installation

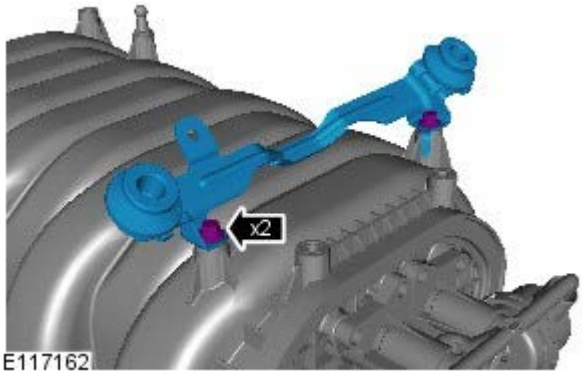
1. *Torque:* 5 Nm



2. *Torque:* 10 Nm

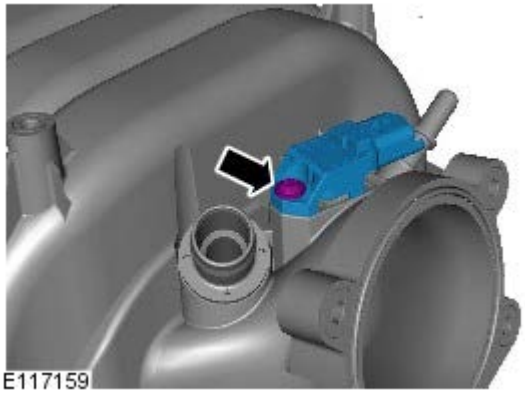


3. *Torque:* 10 Nm



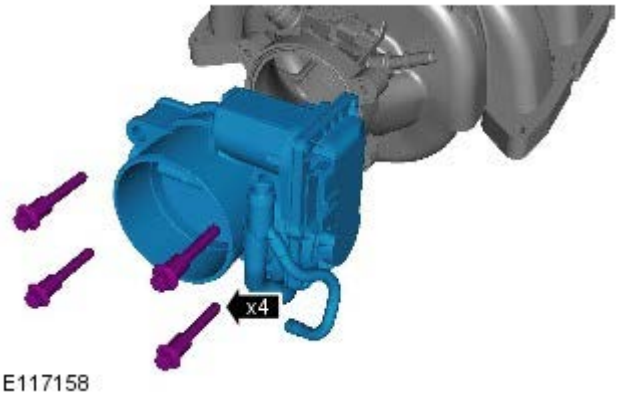
E117162

4. *Torque:* 5 Nm


E117159

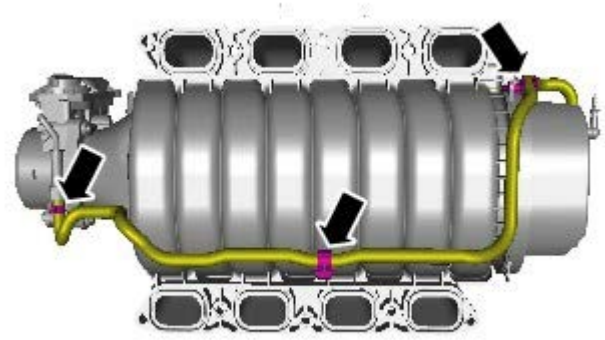
5. CAUTION: A new O-ring seal is to be installed.

Torque: 18 Nm



E117158

6.

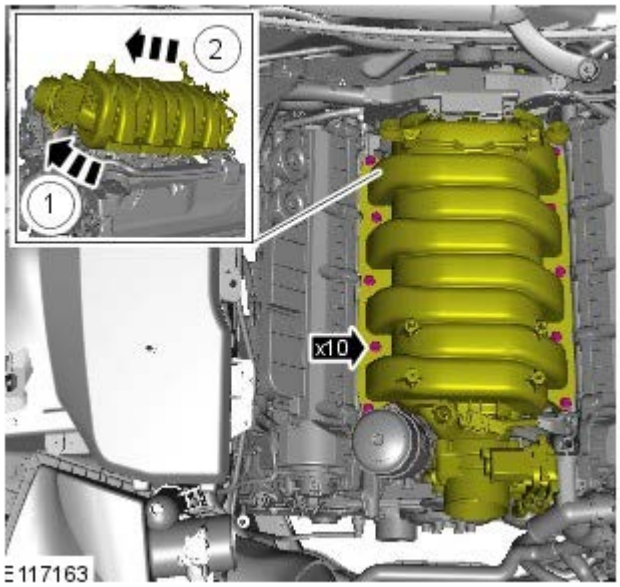

E117161

7. CAUTIONS:

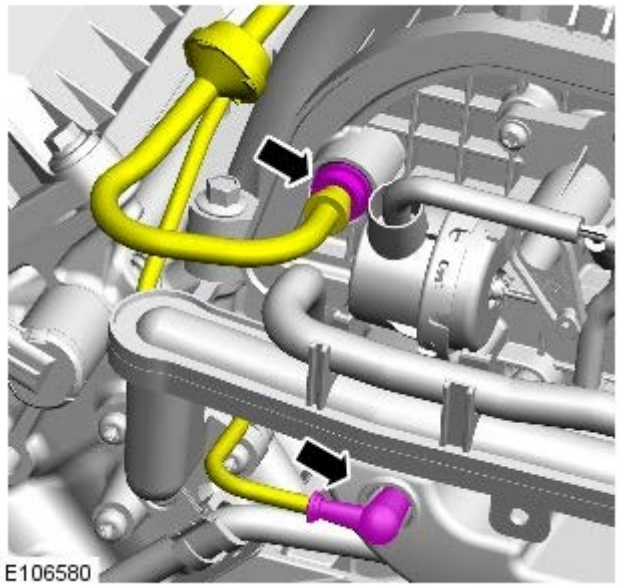
Make sure that the mating faces are clean and free of corrosion and foreign material.

Install new o-ring seals

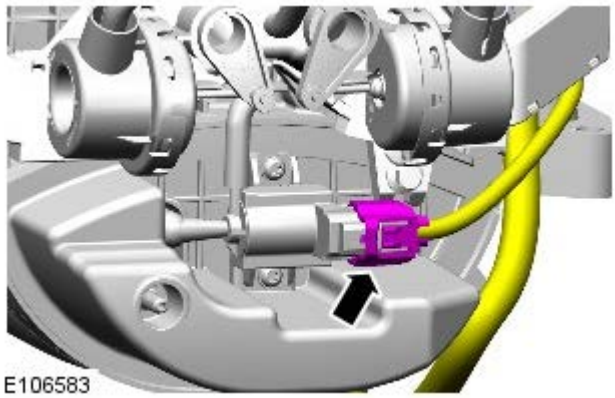
NOTE: Do not tighten at this stage.



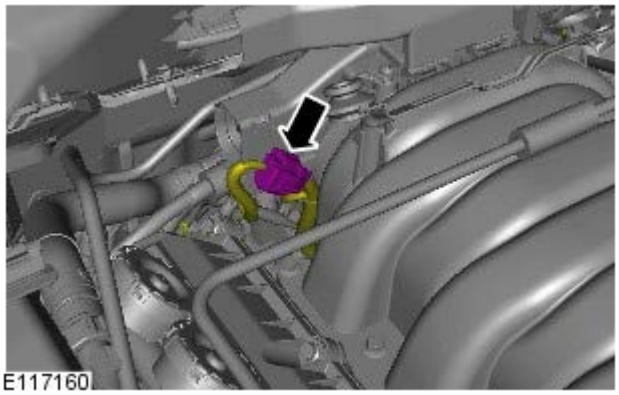
8.



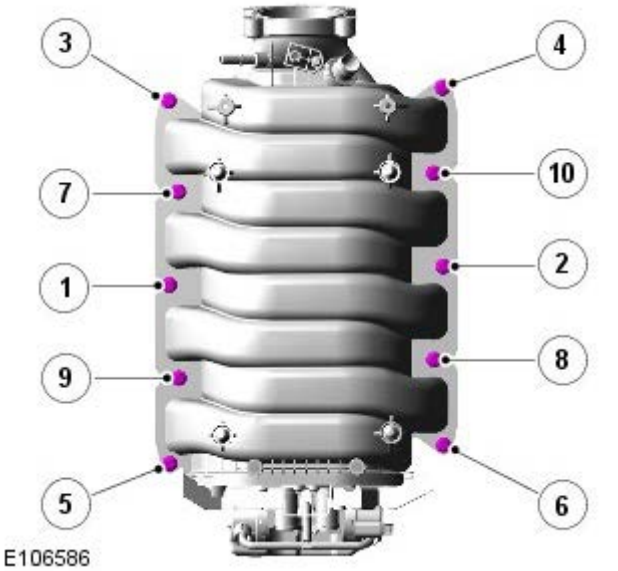
9.



10.

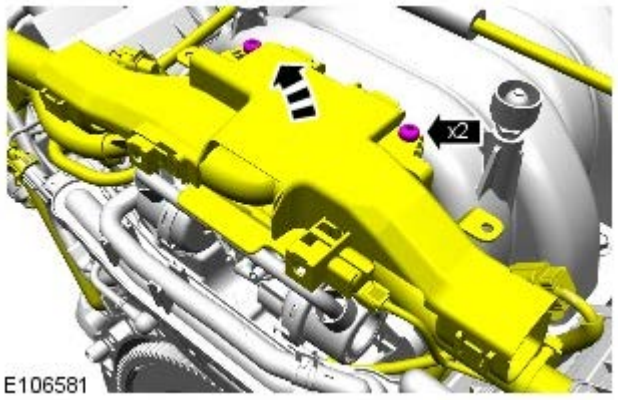

E117160

11. *Torque:* 25 Nm



E106586

12. *Torque:* 8 Nm

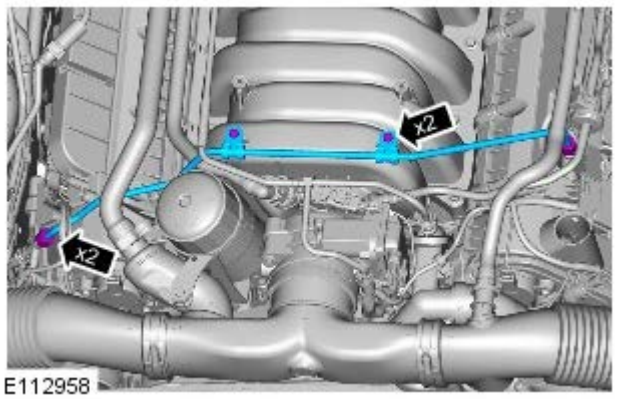


E106581

13. NOTES:

Do not tighten at this stage.

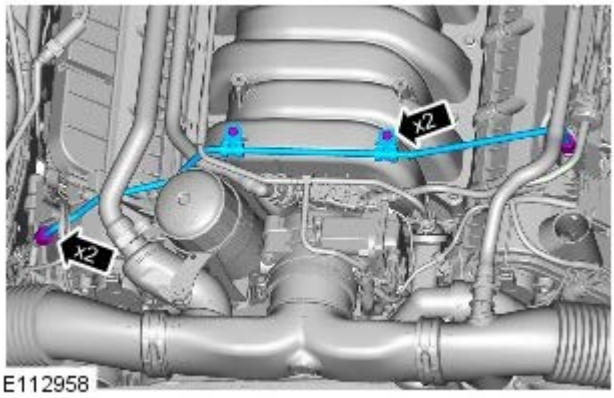
Remove and discard the blanking caps.



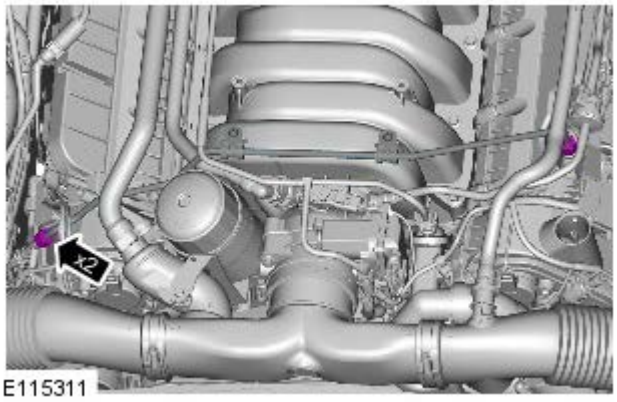
E112958

14.

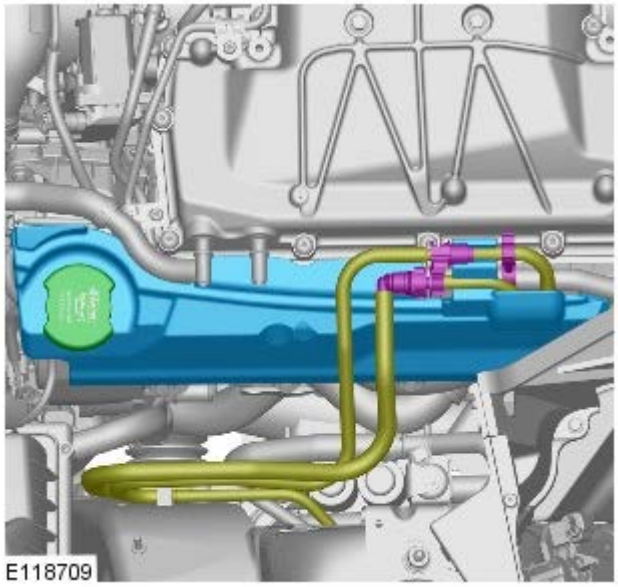
- *Torque:*
  Unions 21 Nm
  Bolts 8 Nm



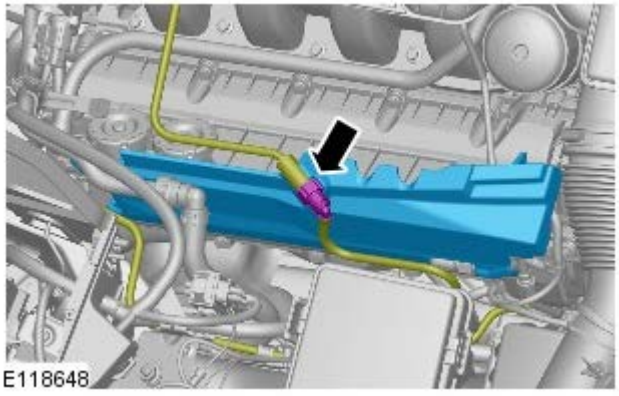
15. *Torque:* 21 Nm



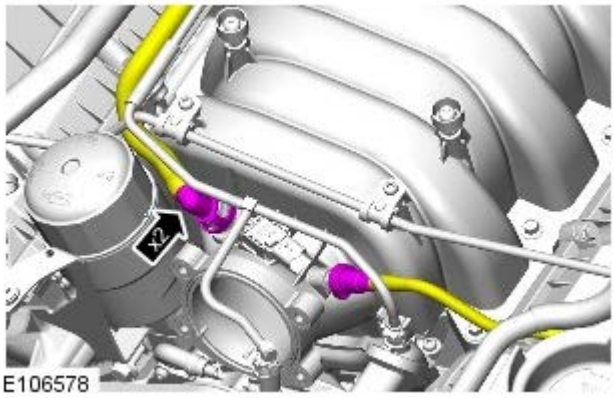
16.



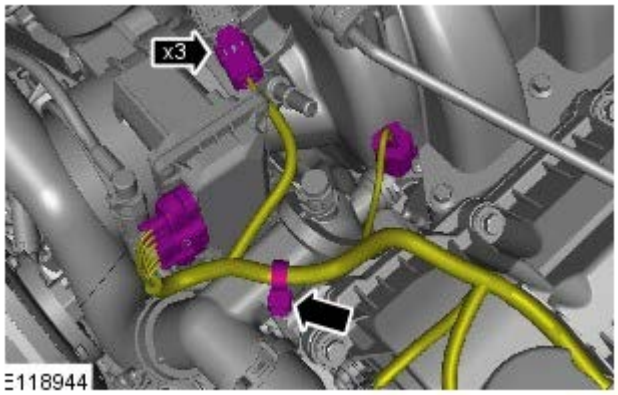
17.



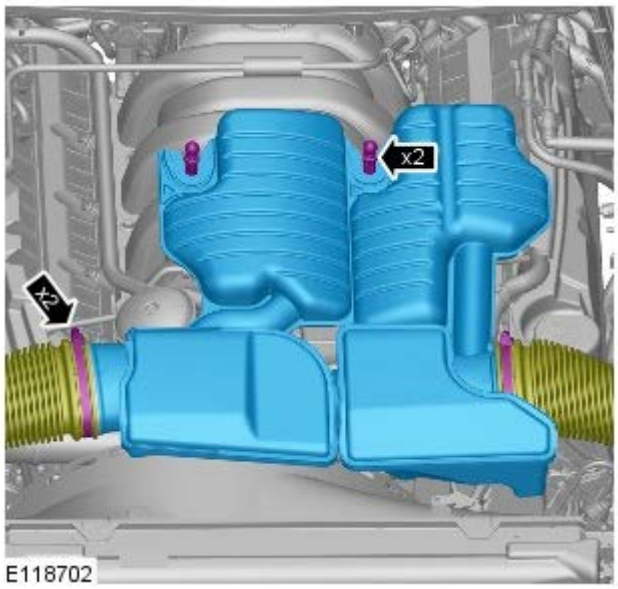
18.



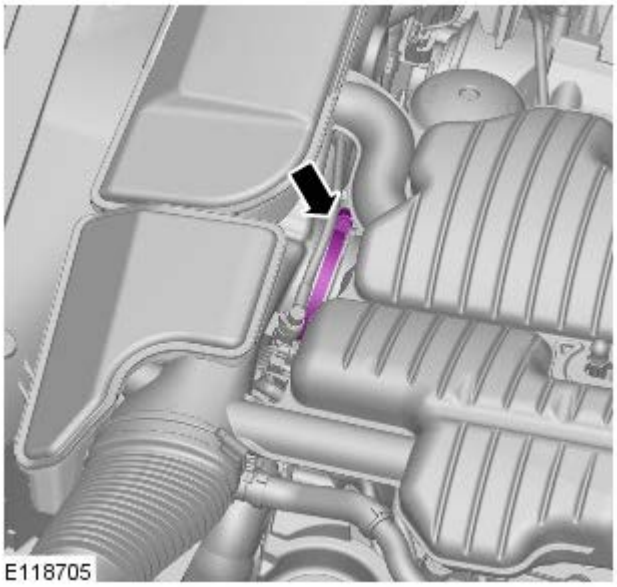
19.



20. *Torque:* 10 Nm



21. *Torque:* 3.5 Nm



22. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

23. Connect the battery ground cable.

    Refer to: Specifications (414-00, Specifications).

Published: 25-Nov-2013

Engine - V8 5.0L Petrol - Oil Cooler

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

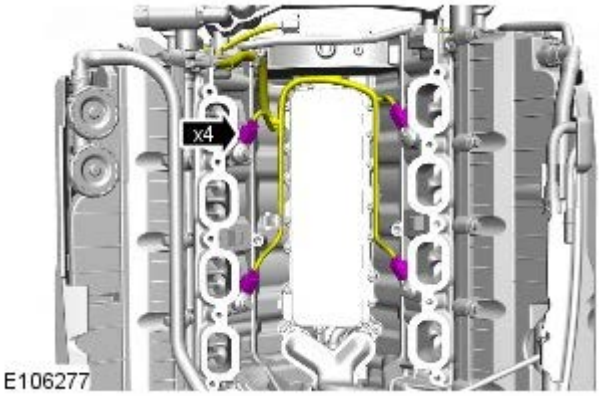
   Raise and support the vehicle.

3. Refer to: Engine Oil Draining and Filling (303-01B Engine - V8 5.0L Petrol, General Procedures).

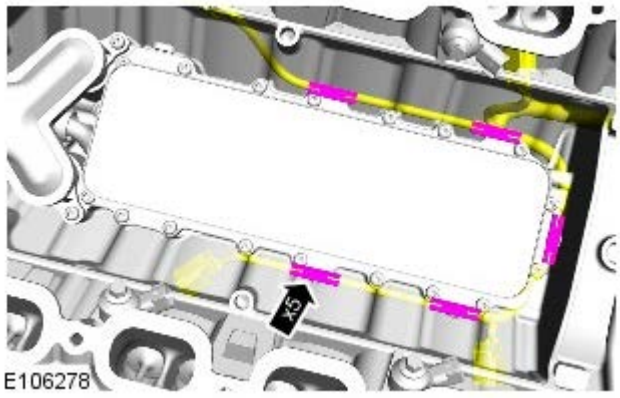
4. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

5. Refer to: Intake Manifold (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

6.



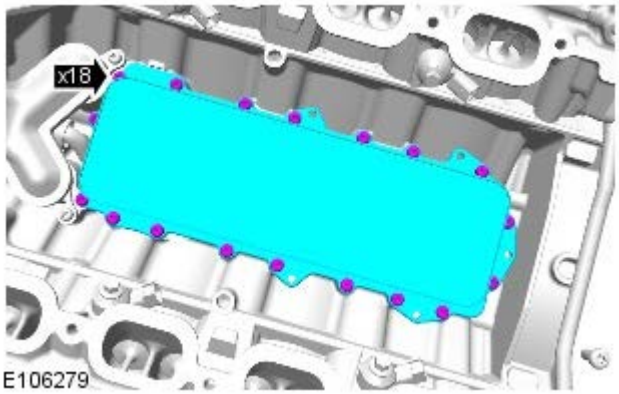
7.



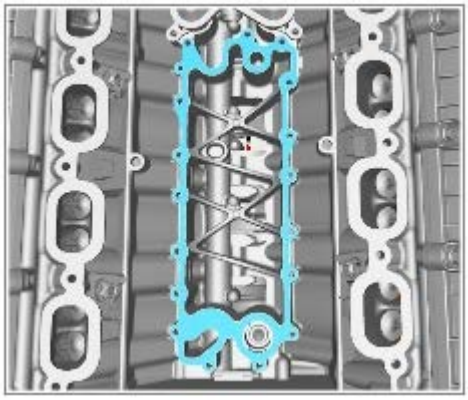
8. CAUTIONS:

   Be prepared to collect escaping oil.

   Be prepared to collect escaping coolant.

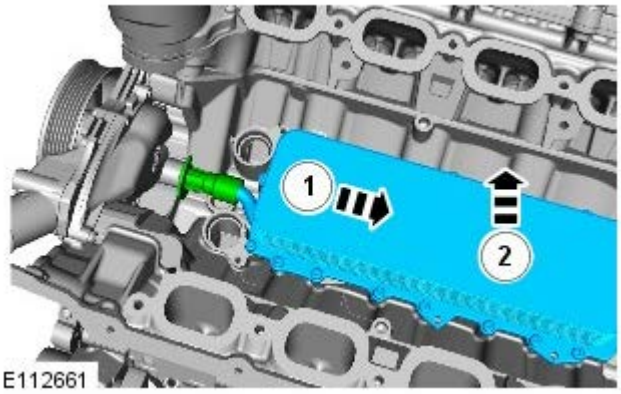


Torque: 13 Nm



9. CAUTION: Make sure that these components are installed to the noted removal position.

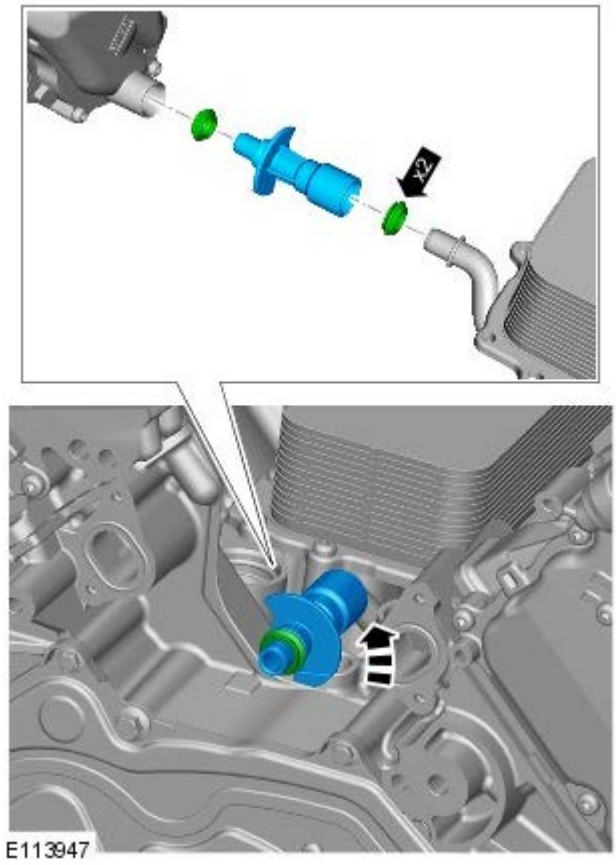
NOTE: Install a new gasket.



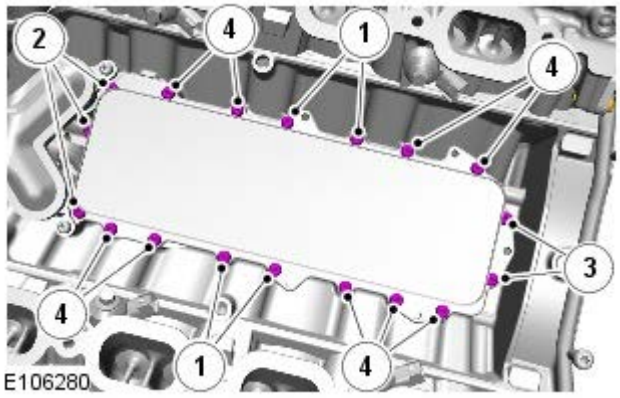
10. CAUTIONS:

Make sure that these components are installed to the noted removal position.

Install new o-ring seals



Installation



1. CAUTIONS:

   Install all the bolts finger tight before final tightening.

   Make sure that the area around the component is clean and free of foreign material.

   Install the new seals.

   NOTE: Tighten the bolts in the indicated sequence.

   To install, reverse the removal procedure.

Published: 11-May-2011

Engine - V8 5.0L Petrol - Oil Filter Element

Removal and Installation

Removal

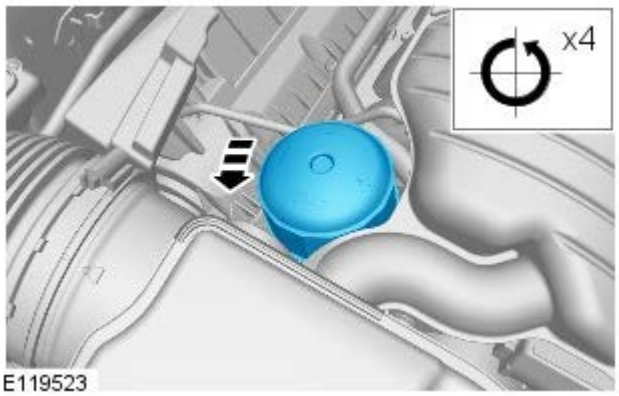
NOTES:

Removal steps in this procedure may contain installation details.

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

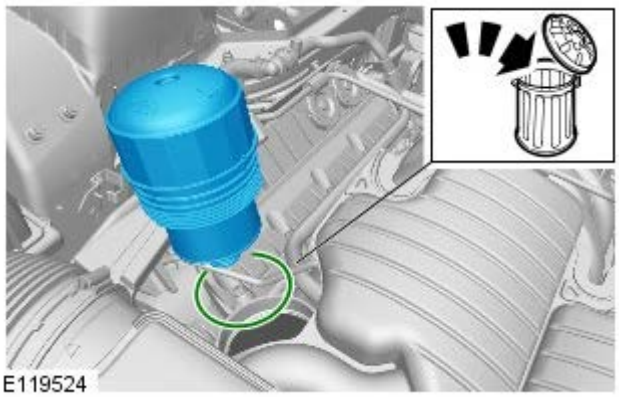
1. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

2.
   - Allow the engine oil to drain from the oil filter element housing for two minutes.



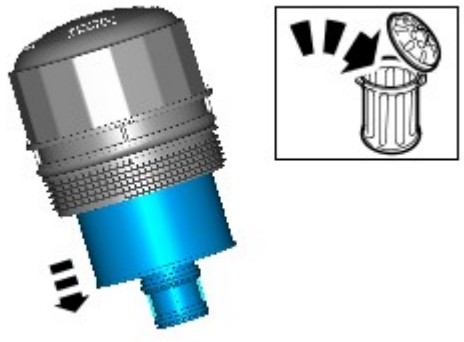
E119523

3.



E119524

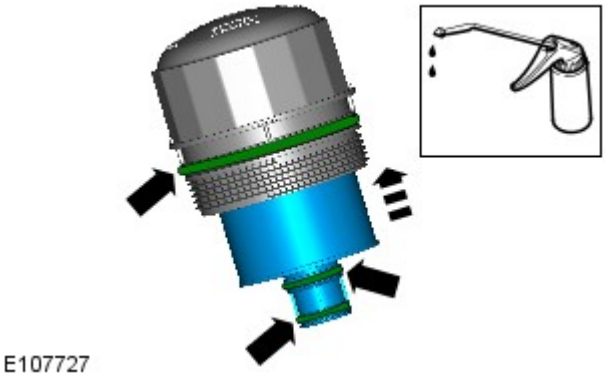
4.



E107394

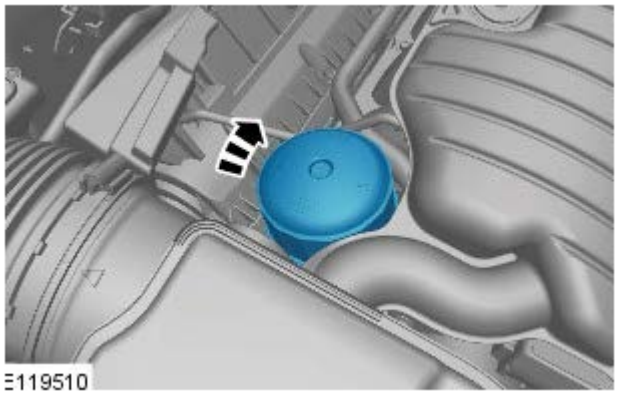
Installation

1.



E107727

2. *Torque:* 25 Nm



E119510

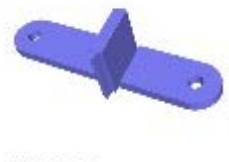
3. Check and top-up the engine oil.
4. Start and run the engine.
5. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

Published: 29-Nov-2011

Engine - V8 5.0L Petrol - Oil Pan Extension

Removal and Installation

Special Tool(s)

 E107676	303-1433 Lower Timing Cover Alignment tool
 E107678	303-1442 Rear Crankshaft Seal Installer
 E107679	303-1443 Rear Crankshaft Cover Alignment Tool
 E115266	303-1448 Locking Tool
 E119168	303-1500 Installer, Stretchy Belt

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

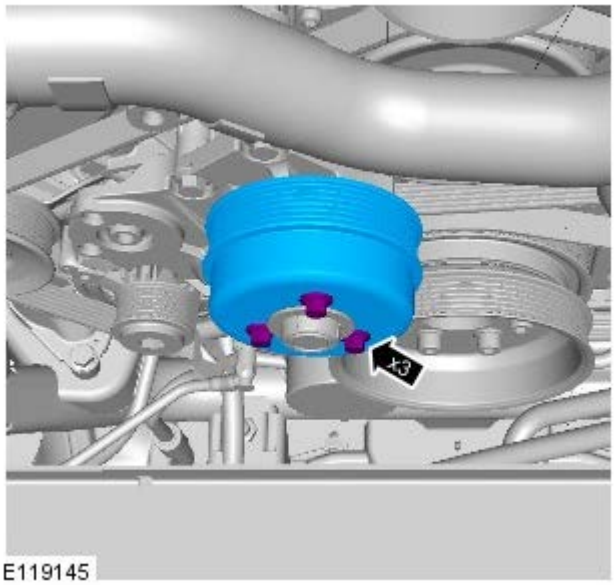
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

3. Refer to: Crankshaft Pulley (303-01 Engine - V8 5.0L Petrol, Removal and Installation).

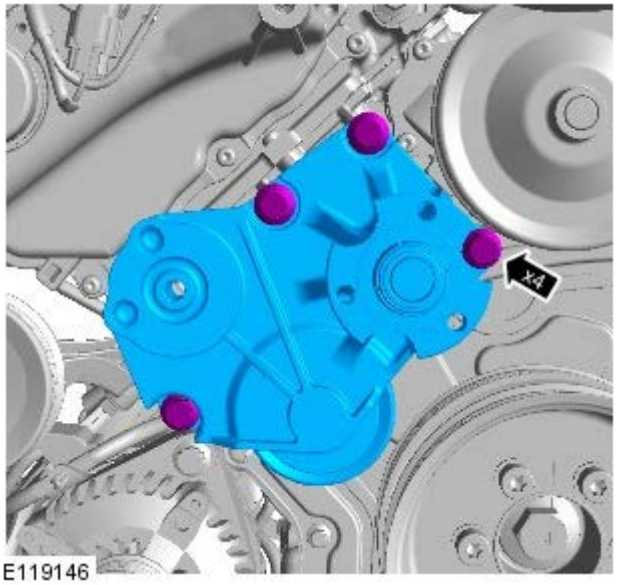
4. Refer to: Engine (303-01 Engine - V8 5.0L Petrol, Removal).

5.



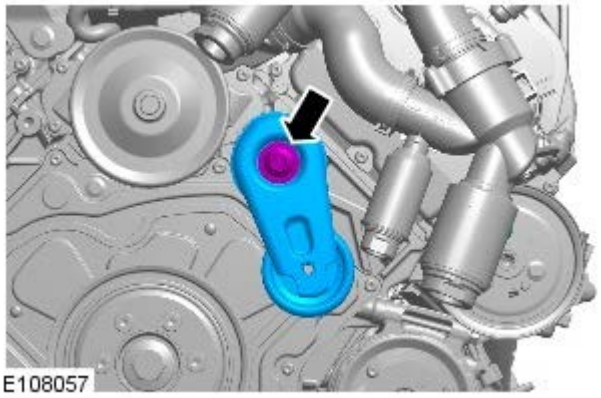
E119145

6.

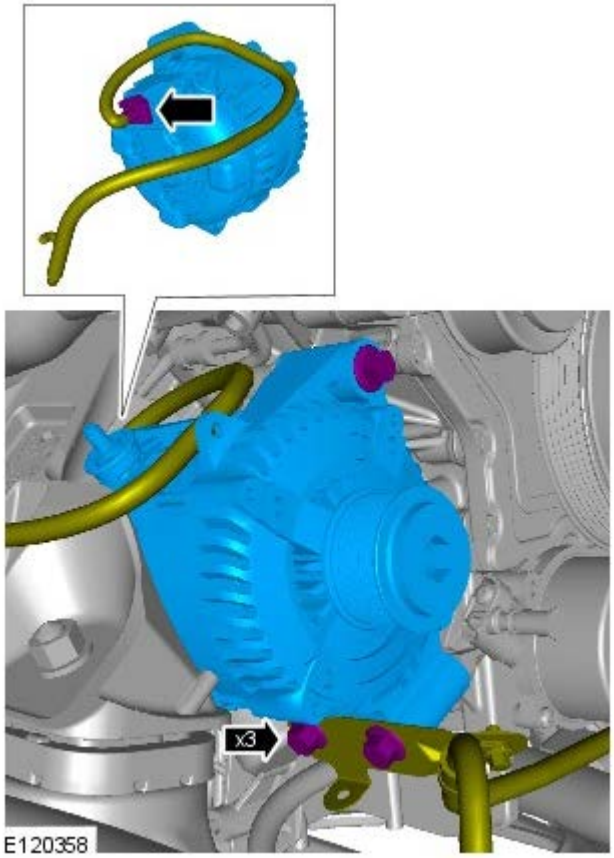


E119146

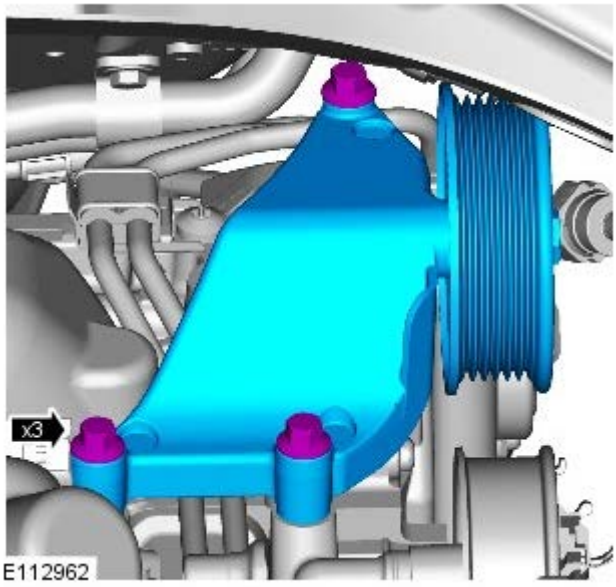
7.


E108057

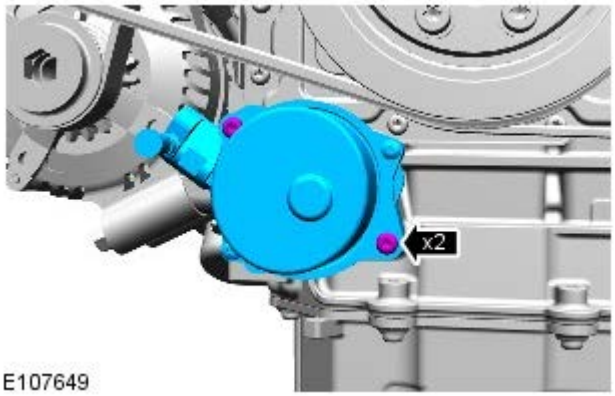
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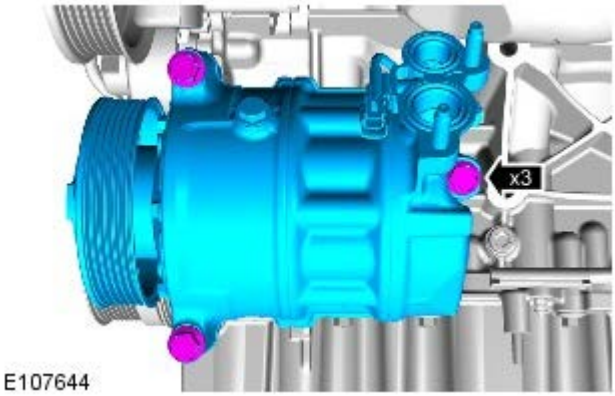
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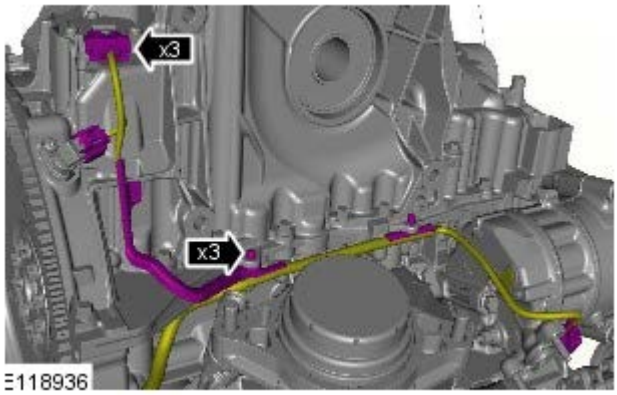
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11.

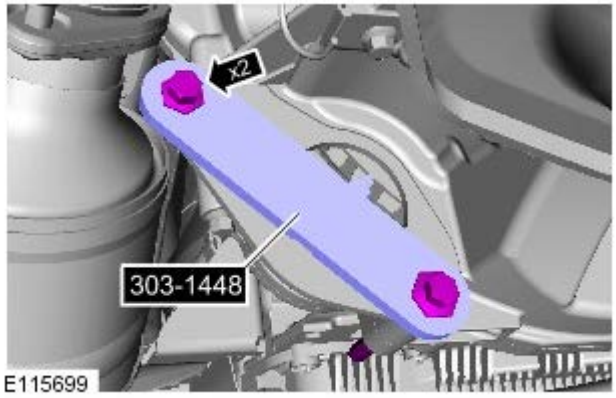


12.



13.

- Install the special tool.
- *Special Tool(s):* 303-1448



14. CAUTIONS:

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

Make sure that no components fall off during removal.

NOTES:

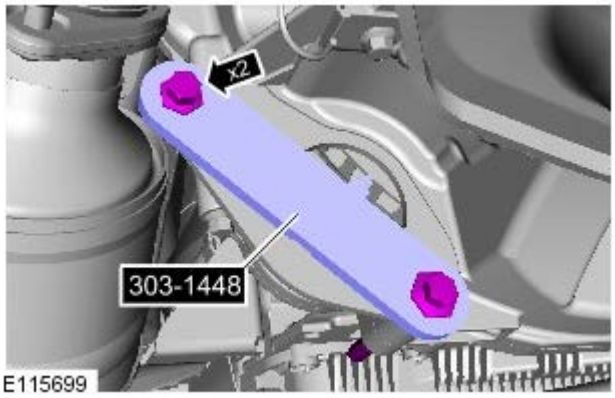
Make sure that the crankshaft is not rotated.

Make sure the crankshaft and flexplate mating faces are clean before installation.

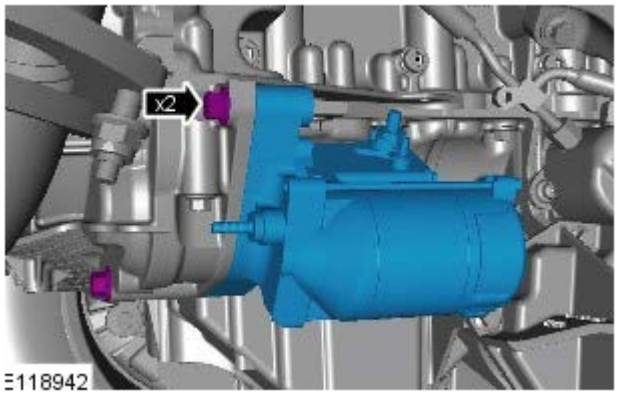


15.

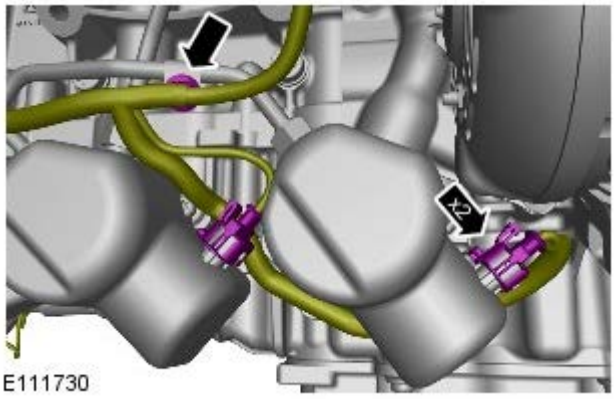
- Remove the special tool.
- *Special Tool(s):* 303-1448



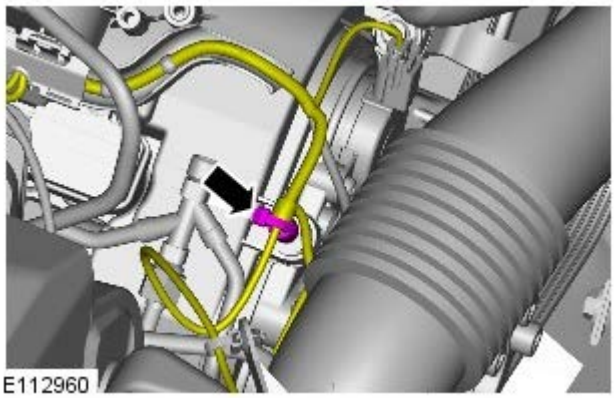
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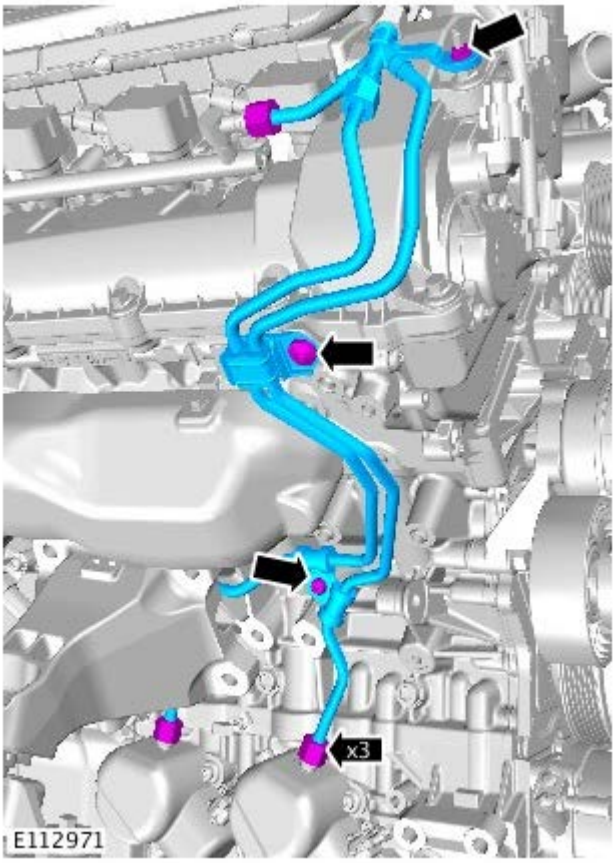
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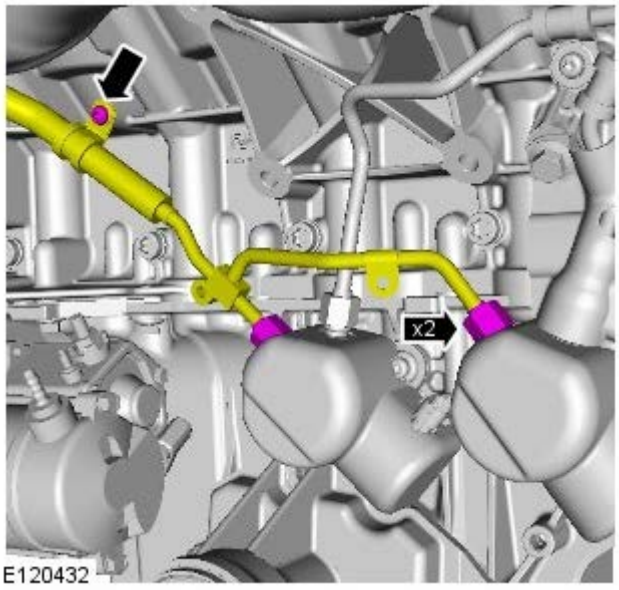
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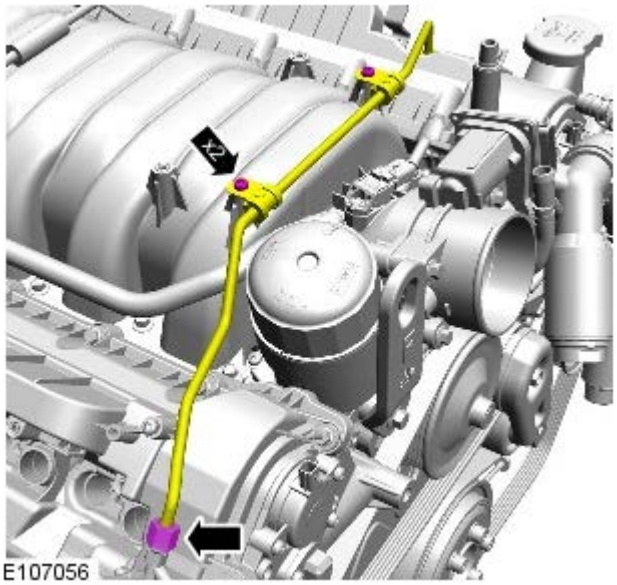
19.



20.



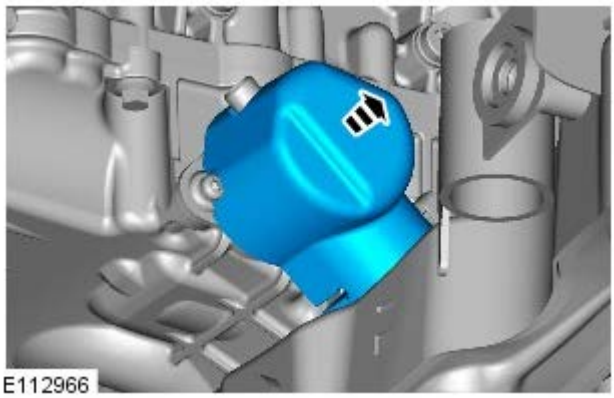
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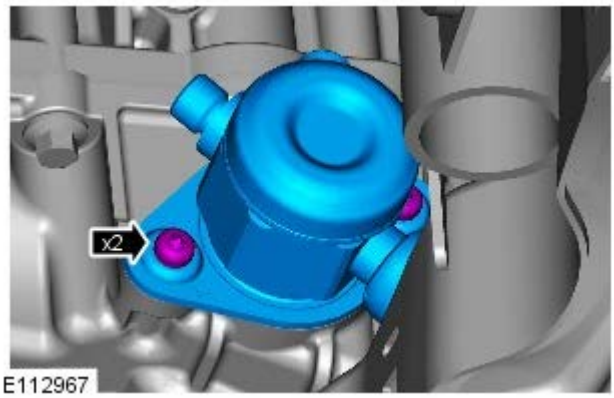


22. NOTE: The high-pressure fuel pumps are removed from the illustration for clarity.

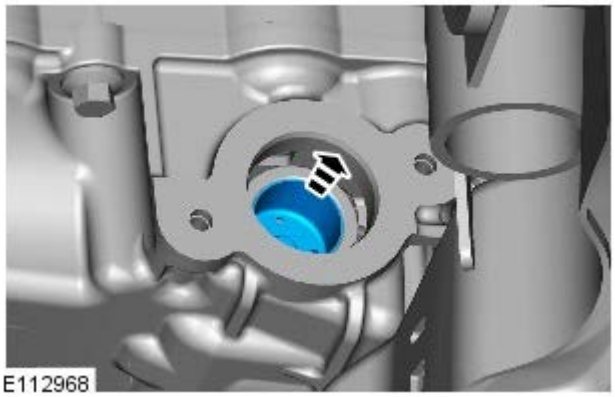
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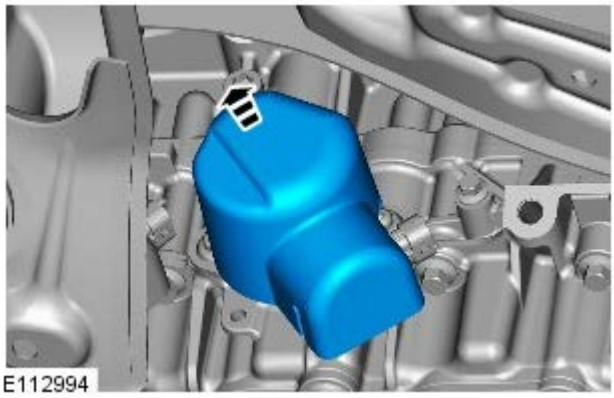
24. CAUTION: Be prepared to collect escaping fluids.



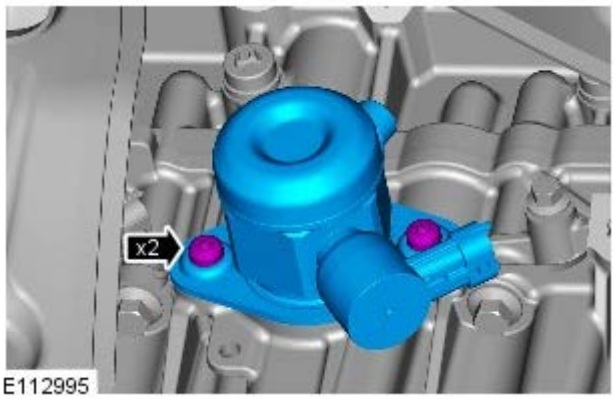
25. CAUTION: Be prepared to collect escaping fluids.



26.



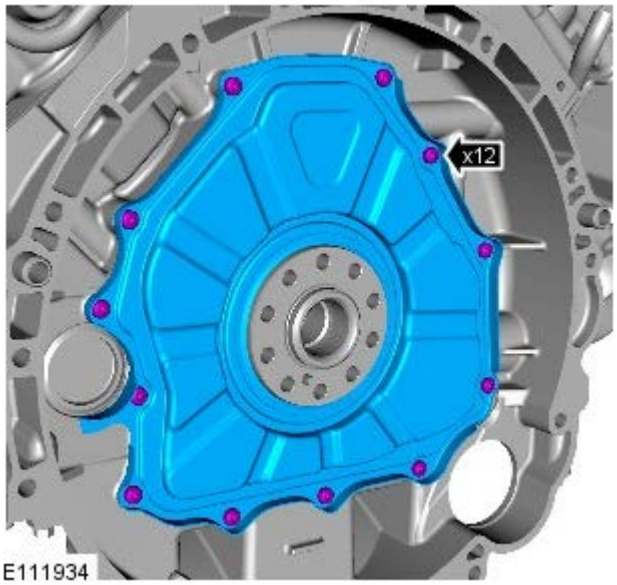
27. CAUTION: Be prepared to collect escaping fluids.



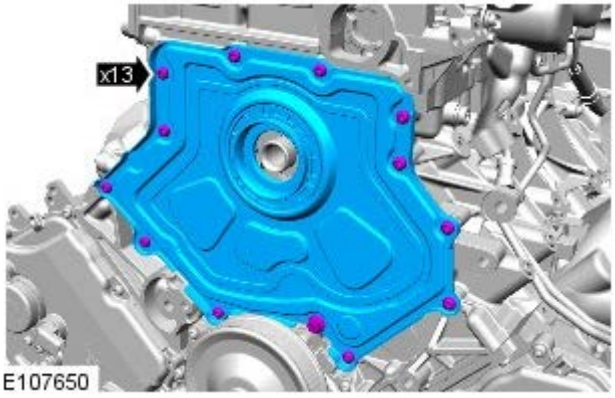
28. CAUTION: Be prepared to collect escaping fluids.



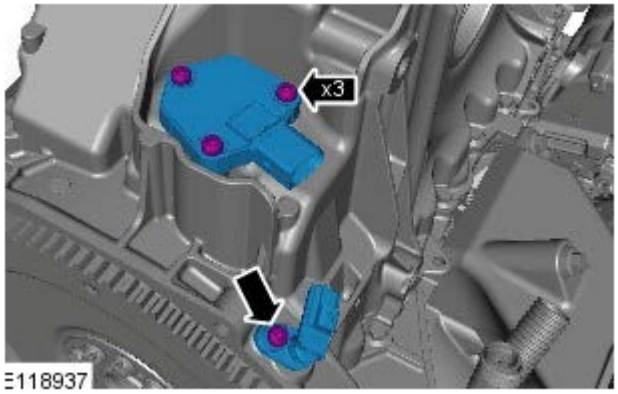
29.



30. NOTE: Discard component.



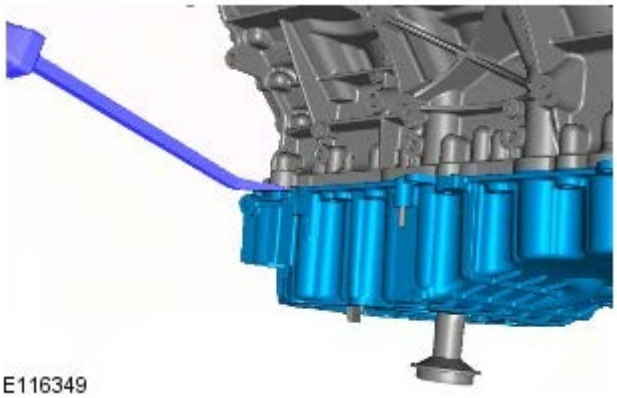
31.



32.



E118938


E116349

33. NOTE: Make sure to use the aluminium lug provided on the oil pan extension to lever against.



E118940

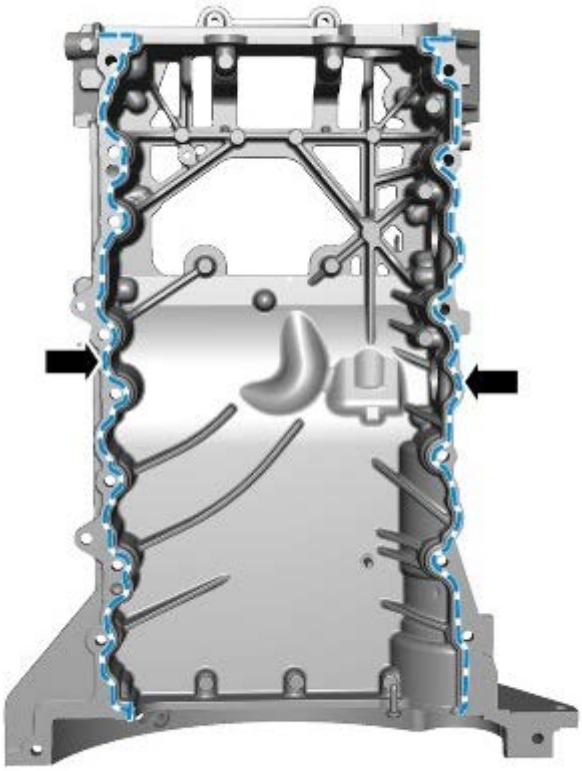
34. NOTE: Do not disassemble further if the component is removed for access only.

Installation

1. *Torque:* 10 Nm



E118940


E107654

2. CAUTIONS:

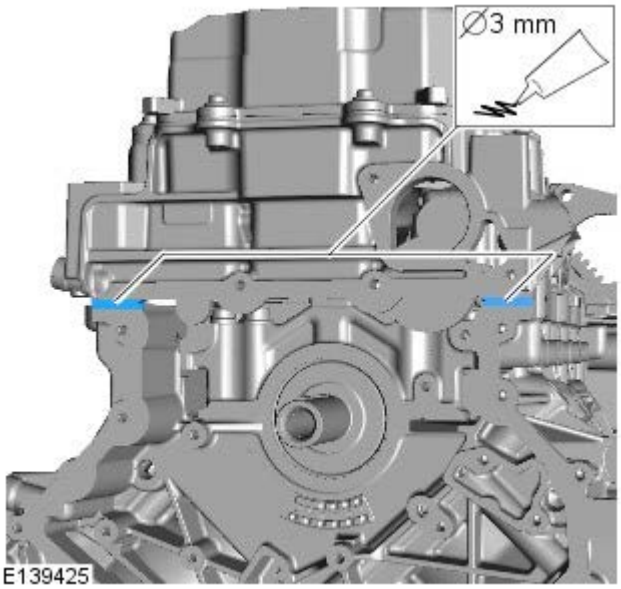
   Make sure that the mating faces are clean and free of foreign material.

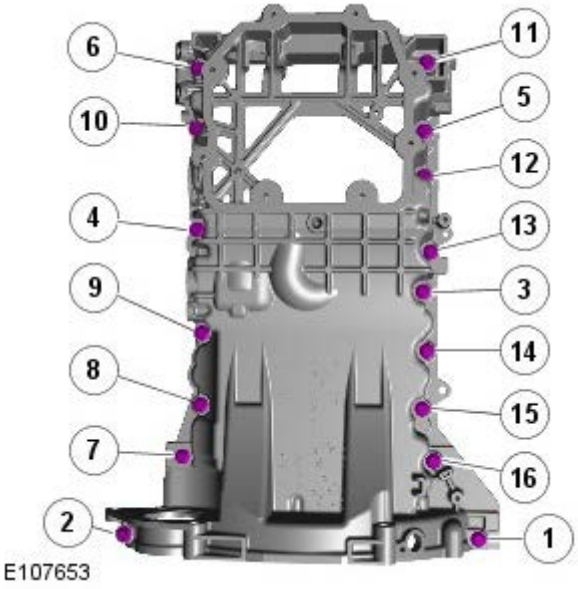
   Use only a plastic scraper when removing the sealing material.

   - Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

3. NOTE: Make sure that the mating faces are clean and free of foreign material.

   Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.





4. NOTE: Tighten the bolts in the indicated sequence.

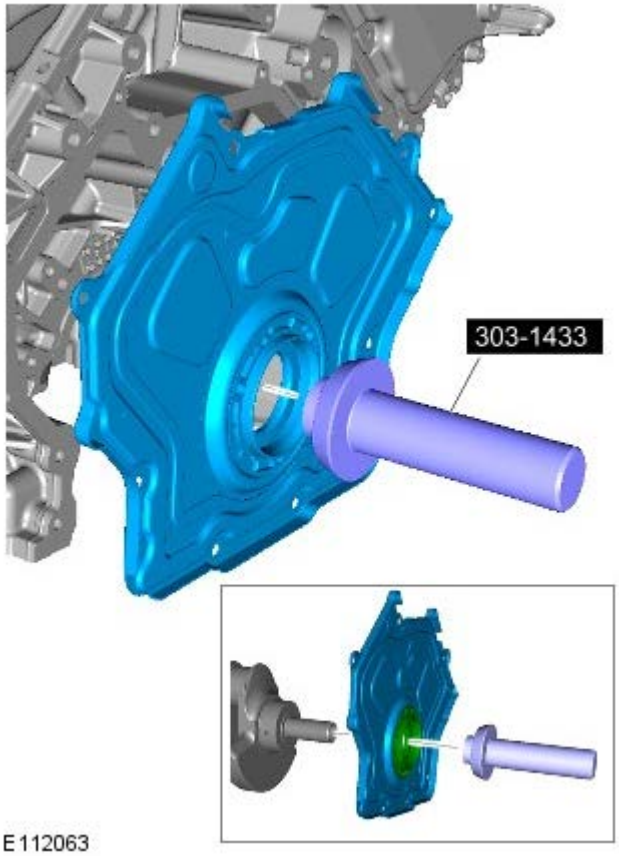
   Torque: 25 Nm

5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

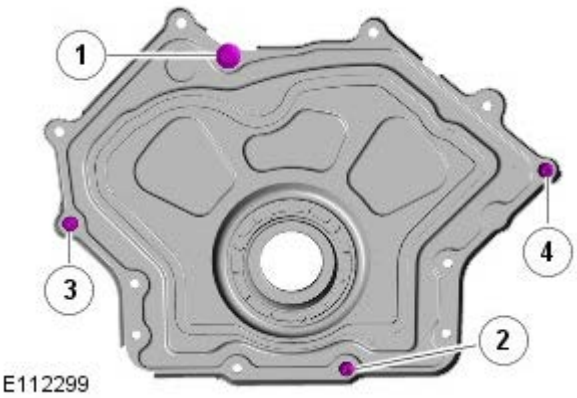
   NOTE: Install new lower timing cover.

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

   Special Tool(s): 303-1433



E112063



E112299

6. NOTE: Tighten the bolts in the indicated sequence.
   - *Torque:*
     M8 20 Nm
     M6 12 Nm

7. Remove the special tools.

8. *Torque:* 12 Nm

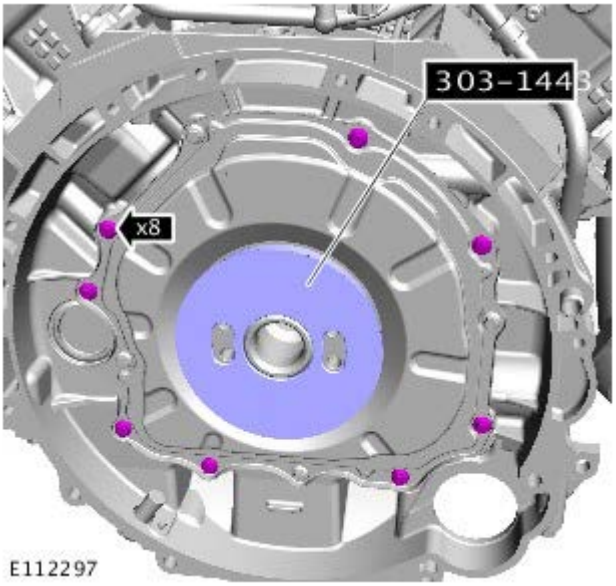


E112300

9.
   - *Special Tool(s):* 303-1442
   - *Special Tool(s):* 303-1443



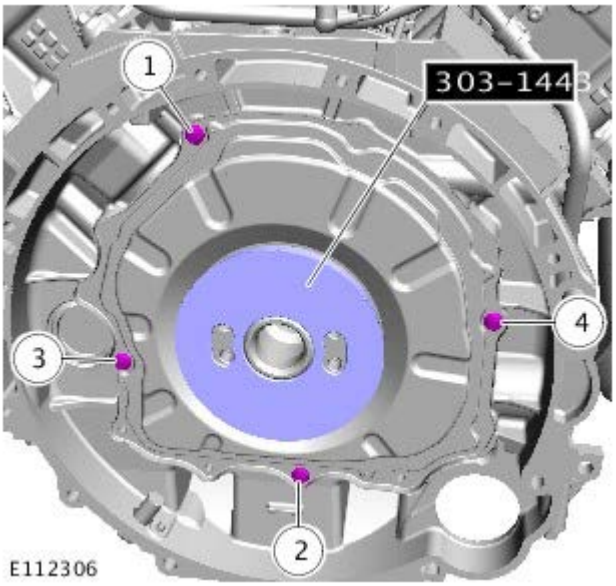
10. Remove the special tool.



11. NOTE: Tighten the bolts in the indicated sequence.

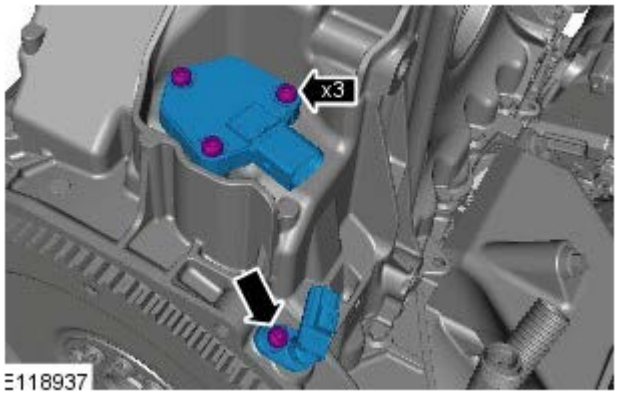
Torque: 11 Nm

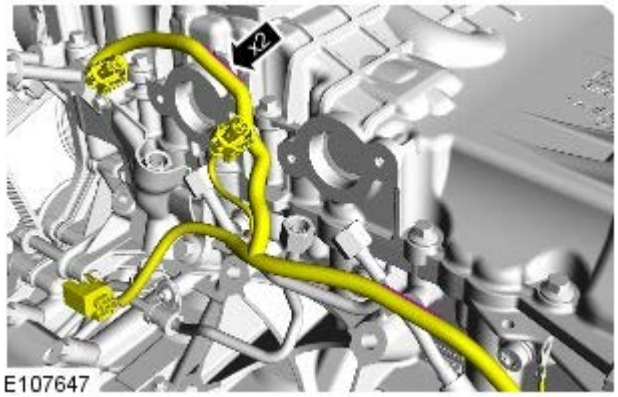
12. *Torque:* 11 Nm



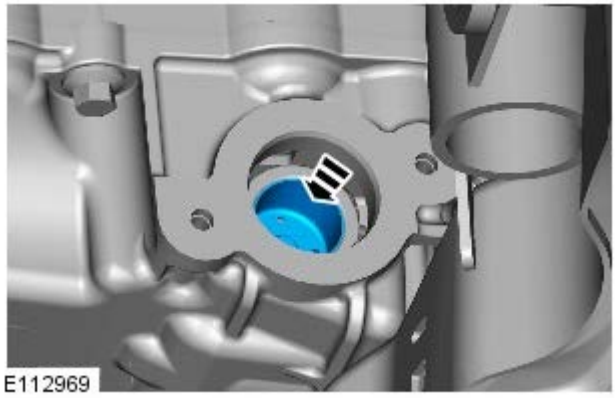
13.

- *Torque:* 11 Nm

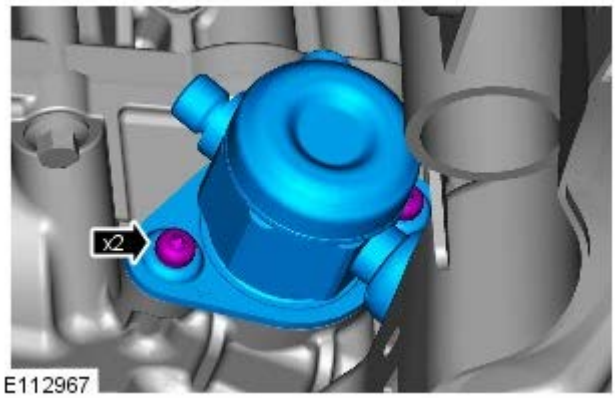




14. NOTE: The high-pressure fuel pumps are removed from the illustration for clarity.



15. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.

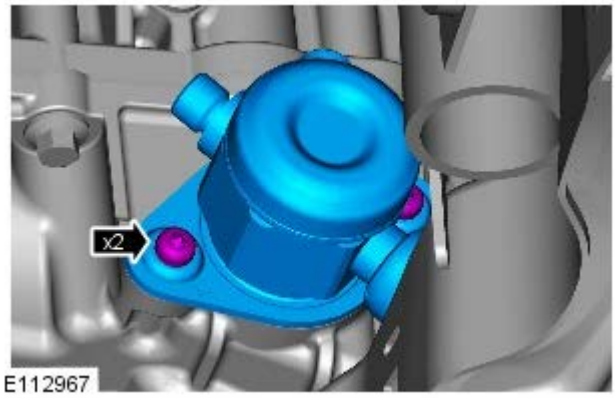


16. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

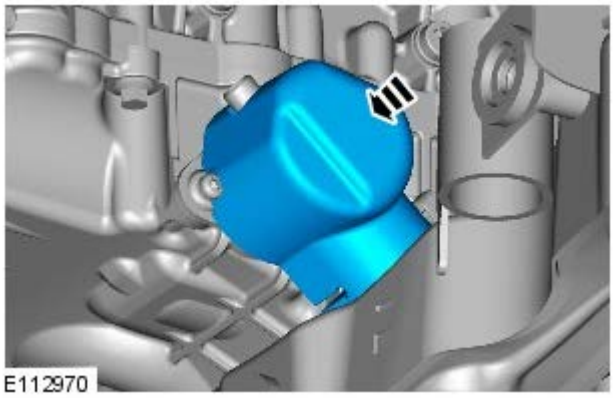
NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

- *Torque:* 11 Nm

17. Loosen the Torx screws half a turn each.



18.



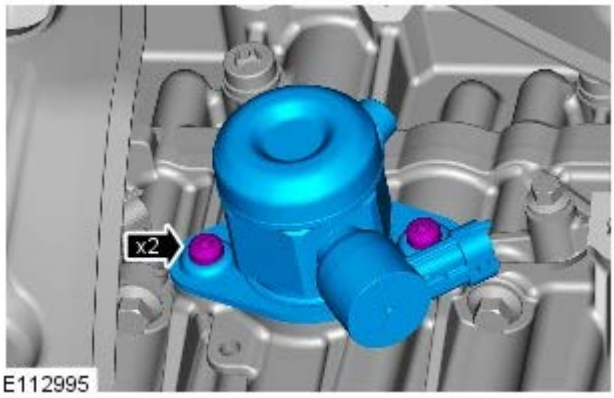
19. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.



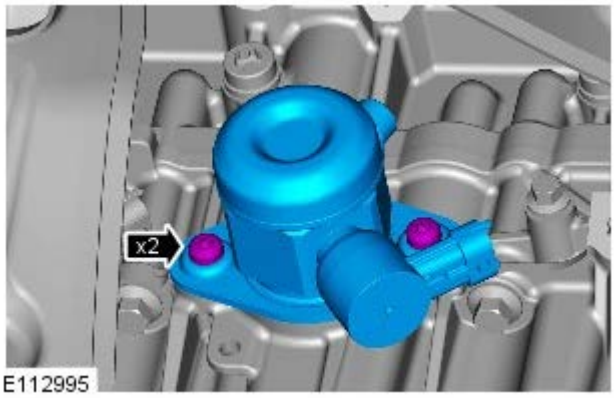
20. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

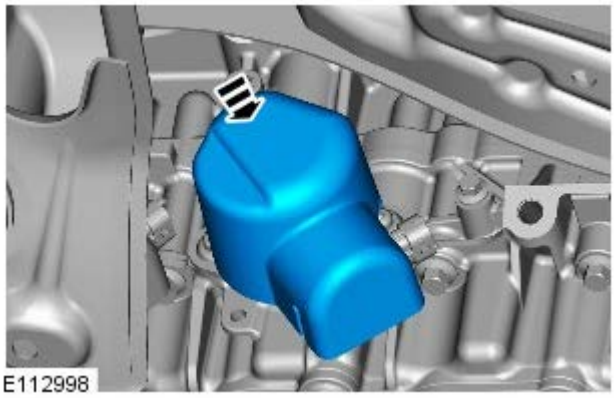
- *Torque:* 11 Nm



21. Loosen the Torx screws half a turn each.



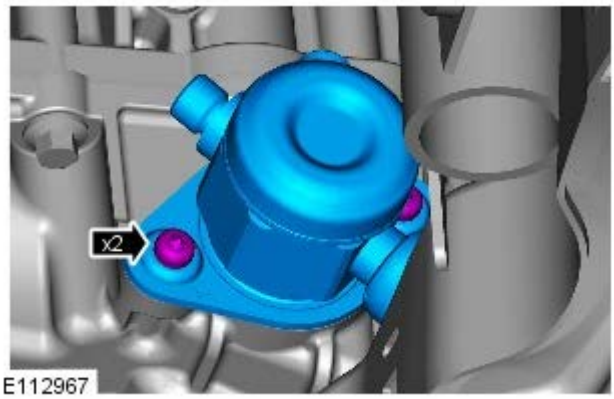
22.



23. CAUTION: Care must be taken when positioning the fuel rail high-pressure fuel pump cover to one side.

NOTE: Fuel rail high-pressure fuel pump cover shown removed for clarity.

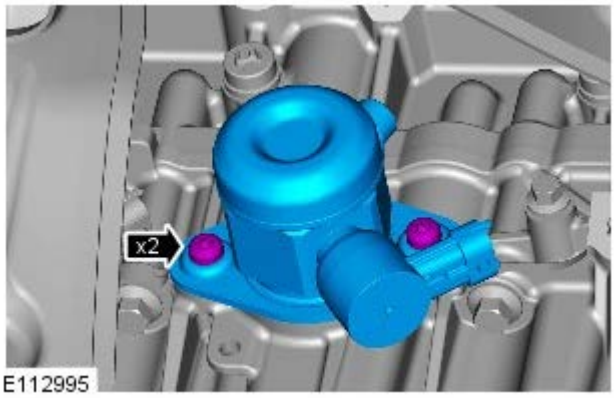
- *Torque:* 11 Nm



24. CAUTION: Care must be taken when positioning the fuel rail high-pressure fuel pump cover to one side.

NOTE: Fuel rail high-pressure fuel pump cover shown removed for clarity.

- *Torque:* 11 Nm

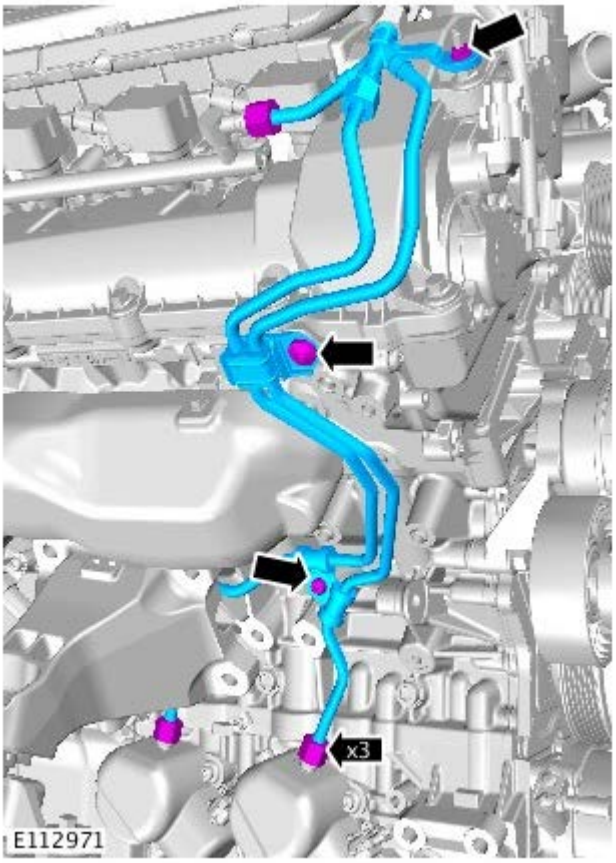


25. CAUTIONS:

Install new high-pressure fuel supply lines.

Lubricate only the union threads with clean engine oil.

NOTES:



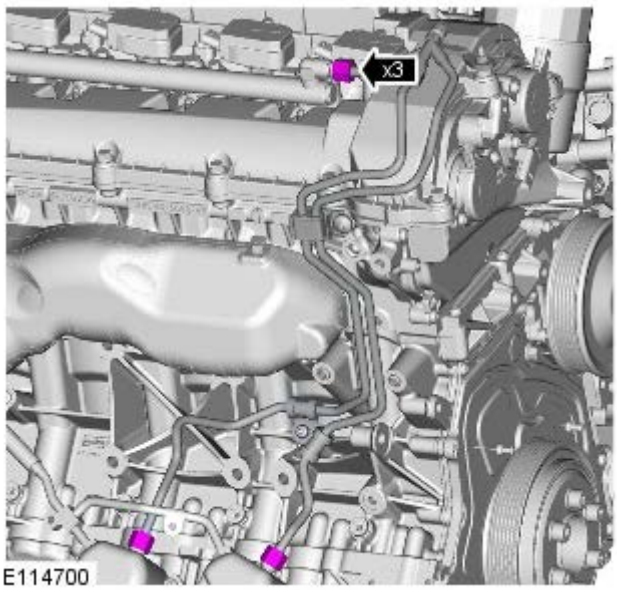
Remove and discard the blanking caps.

Install the bolt and unions fully finger tight before final tightening.

Do not fully tighten at this stage.

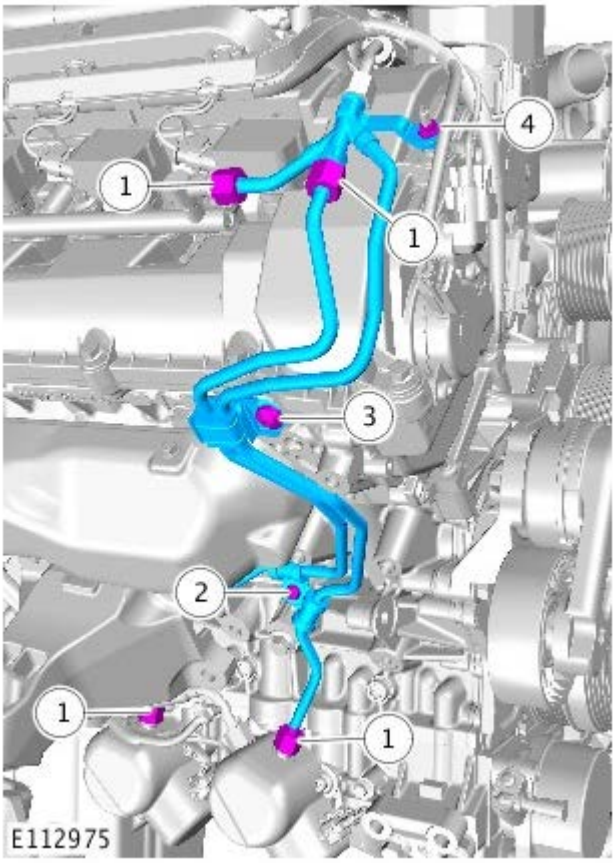
26.

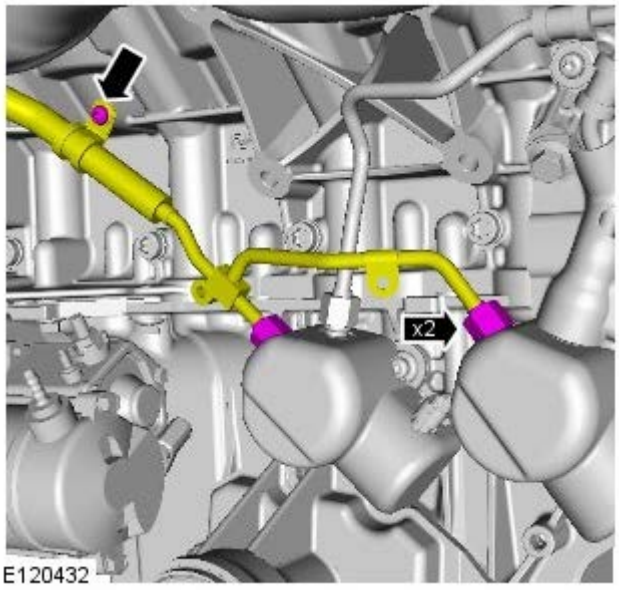
- *Torque:* 21 Nm



27.

- *Torque:*
  Unions (1) 21 Nm
  M6 (2) 11 Nm
  M8 (3) 25 Nm
  M5 nut (4) 6 Nm





28. NOTES:

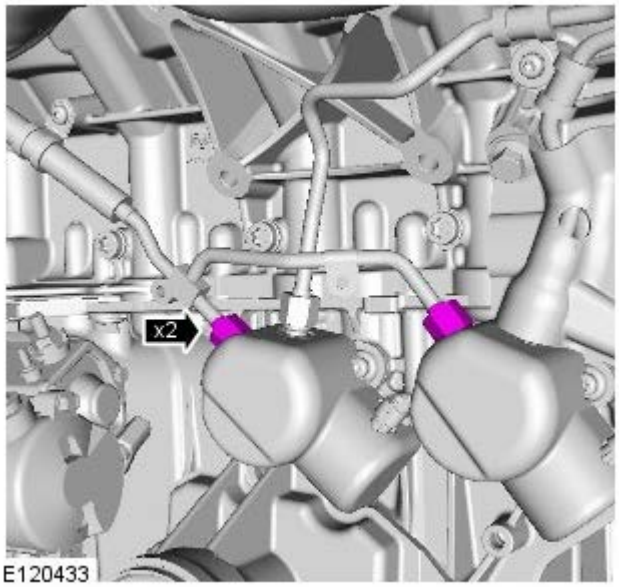
Install the bolt and unions finger tight before final tightening.

Remove and discard the blanking caps.

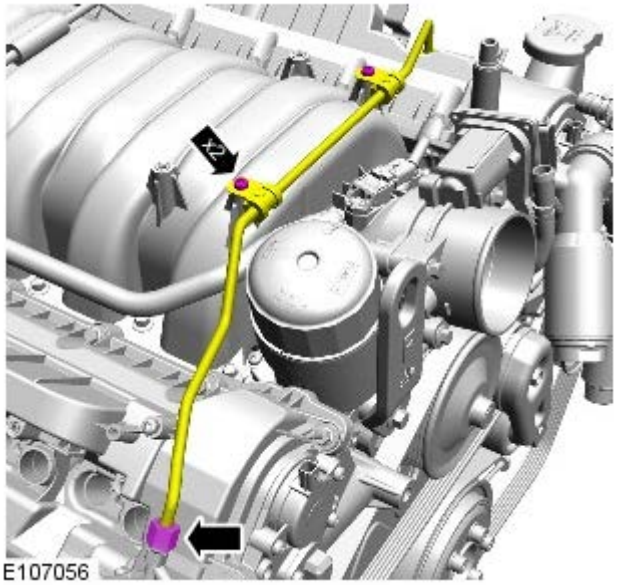
- *Torque:*
  Unions 21 Nm
  M6 11 Nm

29. CAUTION: Make sure that a new component is installed.

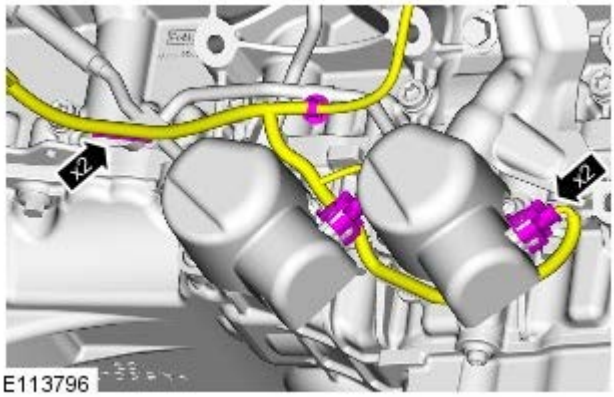
- *Torque:* 21 Nm



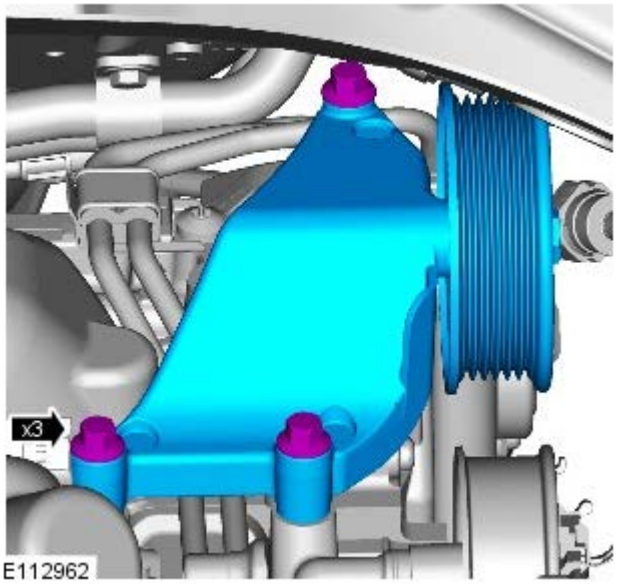
30. *Torque:*
    Unions 21 Nm
    M6 8 Nm



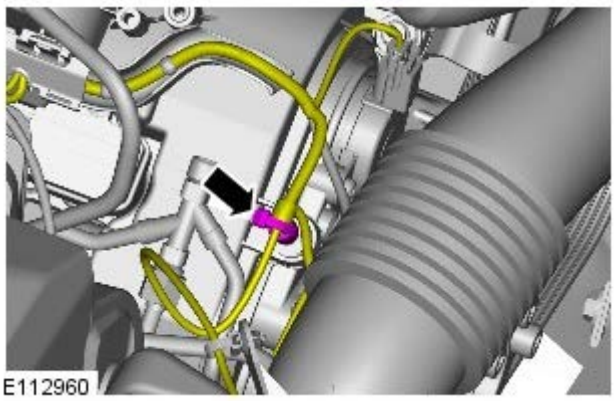
31.



32. *Torque:* 25 Nm

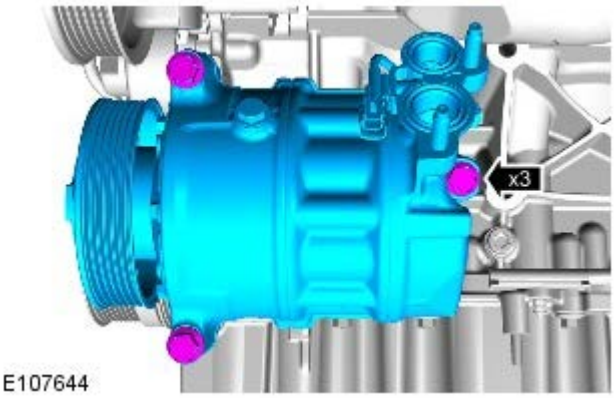


33.

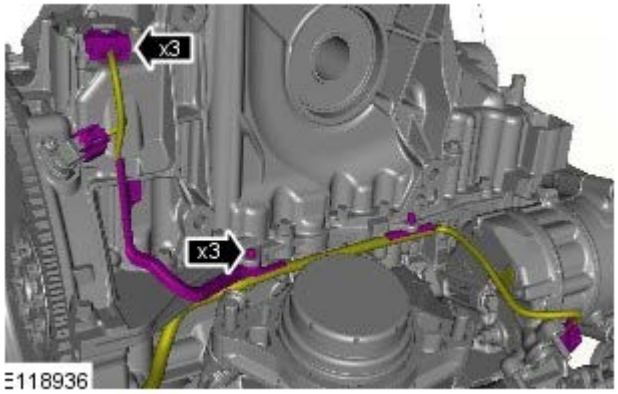


34. CAUTION: Install all the bolts finger tight before final tightening.

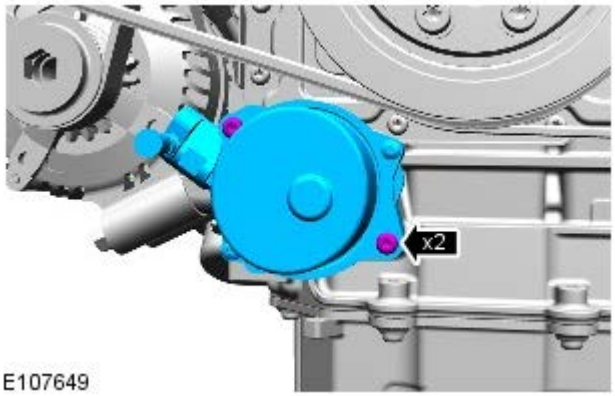
Torque: 25 Nm

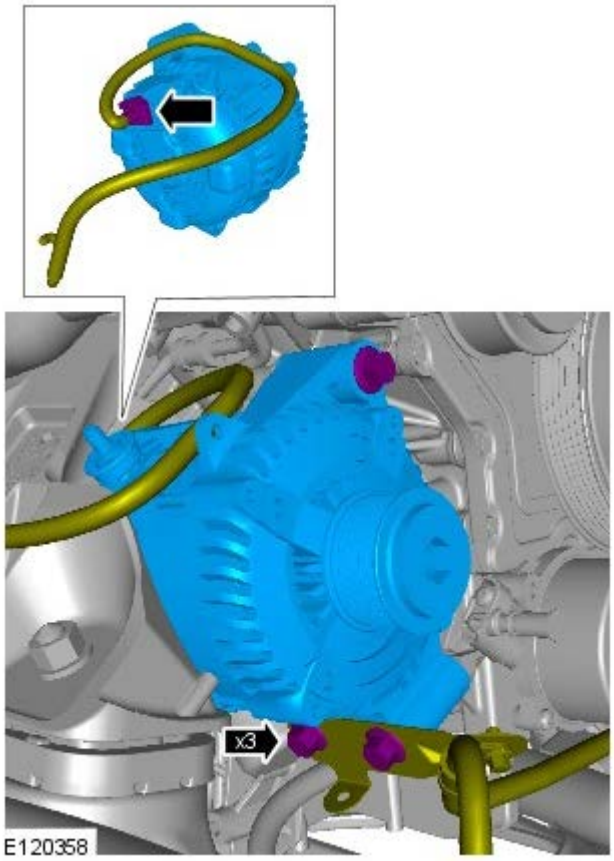


35.



36. *Torque:* 12 Nm





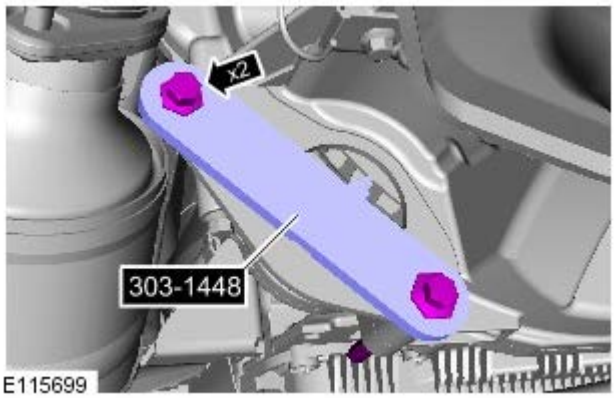
37. CAUTION: Install all the bolts finger tight before final tightening.

NOTE: Tighten the bolts in the indicated sequence.

Torque: 48 Nm

38.

- Install the special tool.
- *Special Tool(s):* 303-1448



39. CAUTIONS:

Install all the bolts finger tight before final tightening.

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



Install the bolts in the noted position.

NOTES:

Make sure that the crankshaft is not rotated.

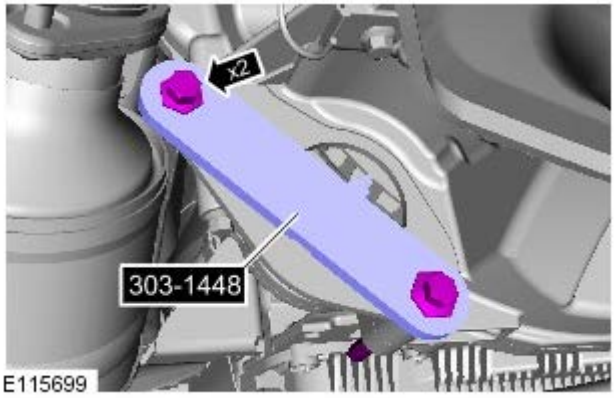
Make sure the crankshaft and flexplate mating faces are clean before installation.

Tighten the retaining bolts working diagonally.

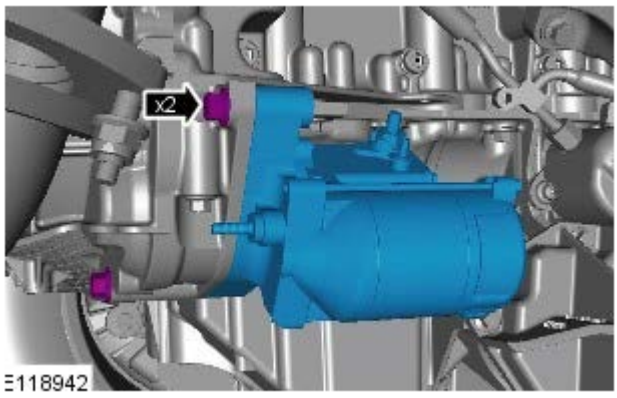
Torque:
Stage 1: 45 Nm
Stage 2: 90°

40.

- Remove the special tool.
- *Special Tool(s):* 303-1448

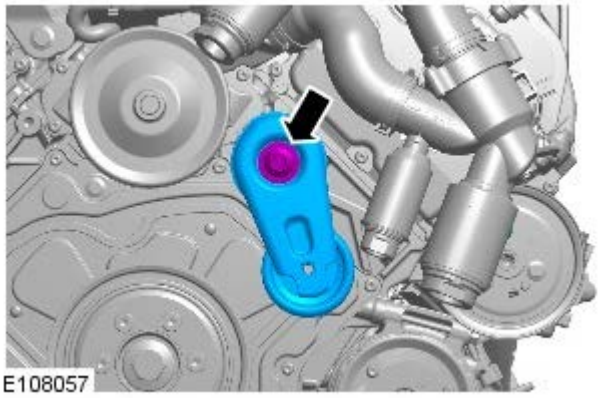


41. *Torque:* 48 Nm

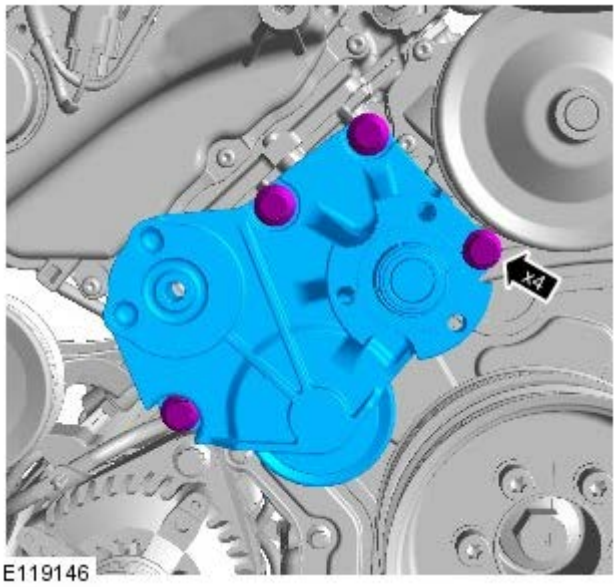


42. NOTE: Install the bolt finger tight before final tightening.

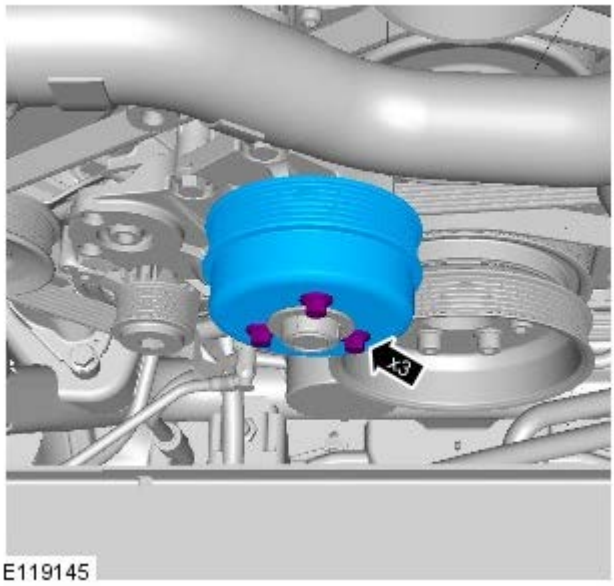
Torque: 40 Nm



43. *Torque:* 25 Nm

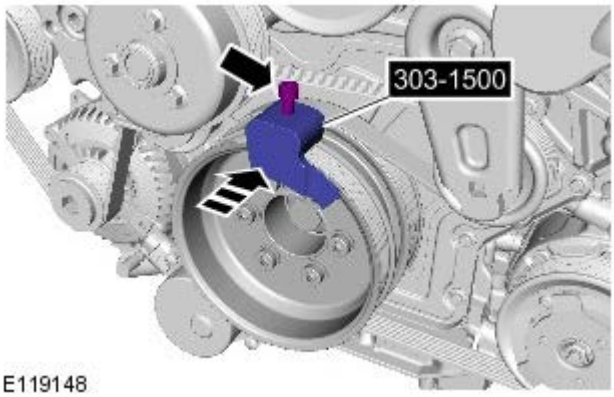


44. *Torque:* 25 Nm



45. Refer to: Crankshaft Pulley (303-01 Engine - V8 5.0L Petrol, Removal and Installation).

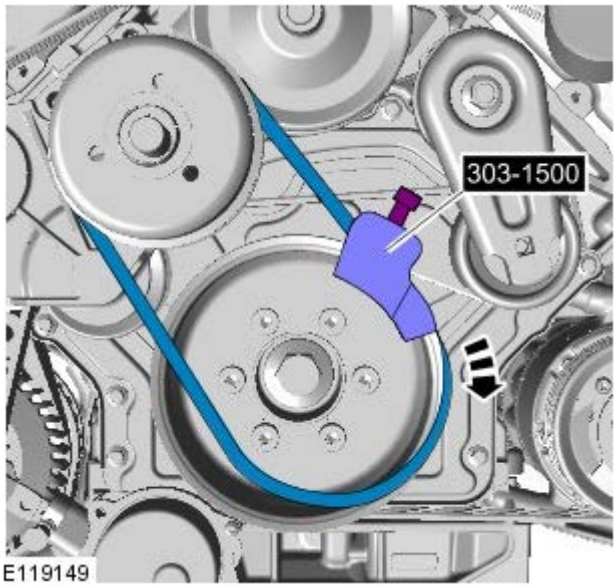
46. *Special Tool(s):* 303-1500



E119148

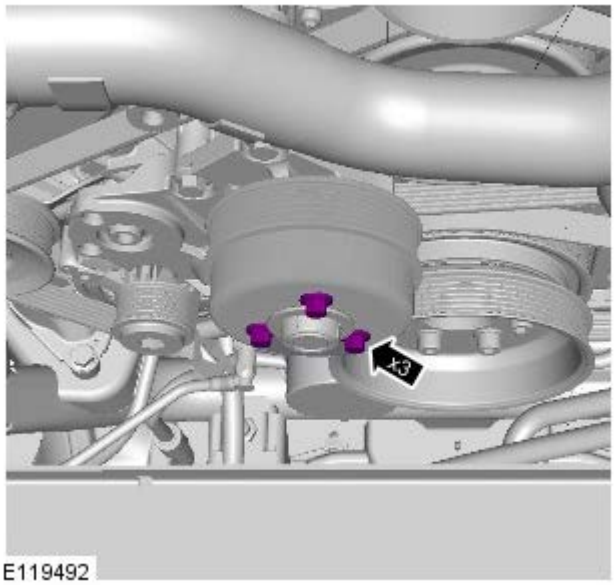
47.

- Install the cooling fan belt.
- Rotate the engine clockwise twice, making sure that the belt is seated on both pulleys correctly.
- Remove the special tool.



E119149

48. *Torque:* 25 Nm



E119492

49. Refer to: Engine (303-01 Engine - V8 5.0L Petrol, Installation).

50. Lower the vehicle.

51. Connect the battery ground cable.

    Refer to: Specifications (414-00, Specifications).

Published: 13-Oct-2011

Engine - V8 5.0L Petrol - Oil Pump

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

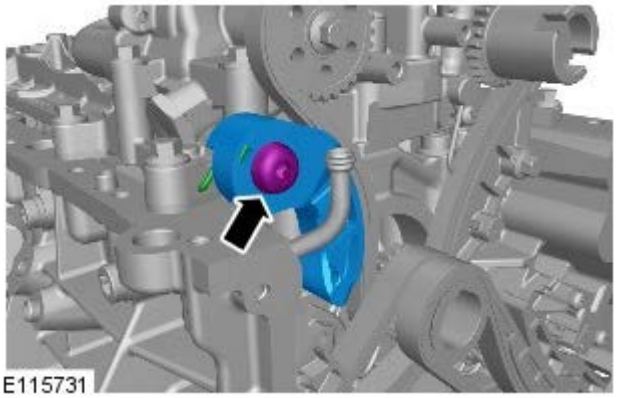
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

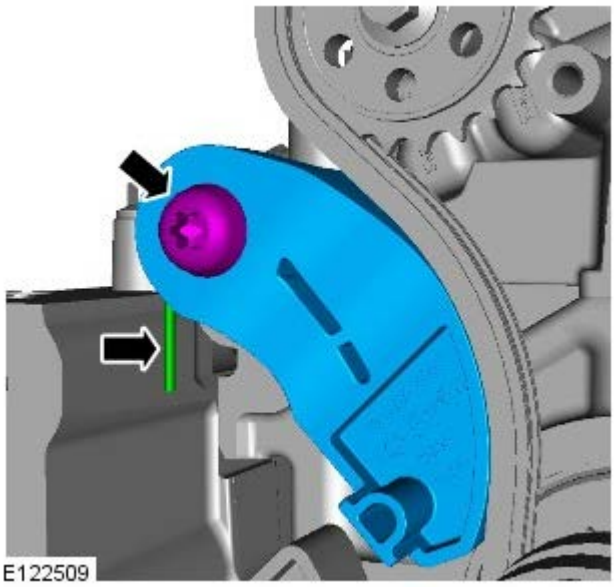
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Oil Pan Extension (303-01 Engine - V8 5.0L Petrol, Removal and Installation).

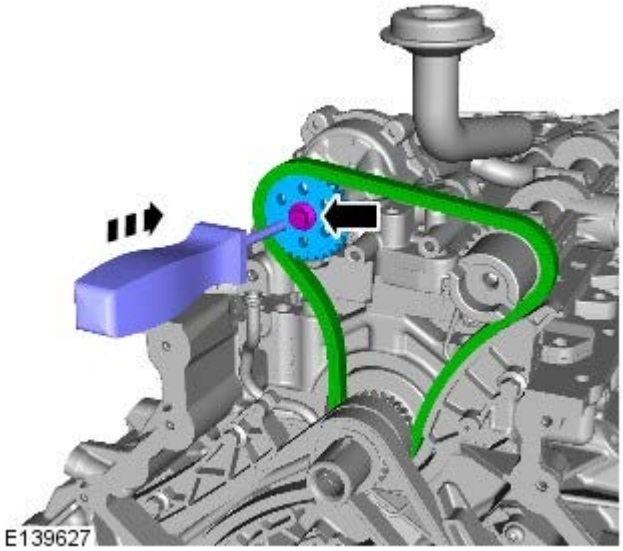


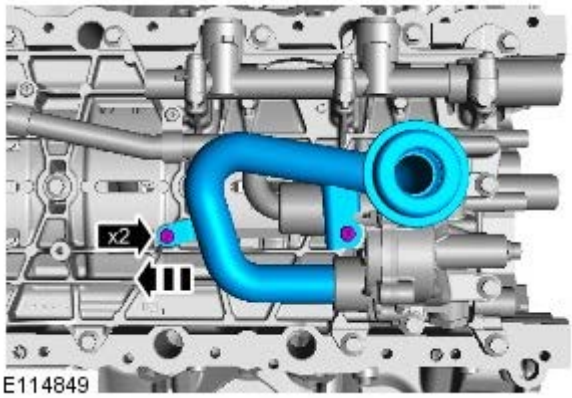
4. NOTE: Tsubaki timing drive only.



5. NOTE: INA timing drive only.

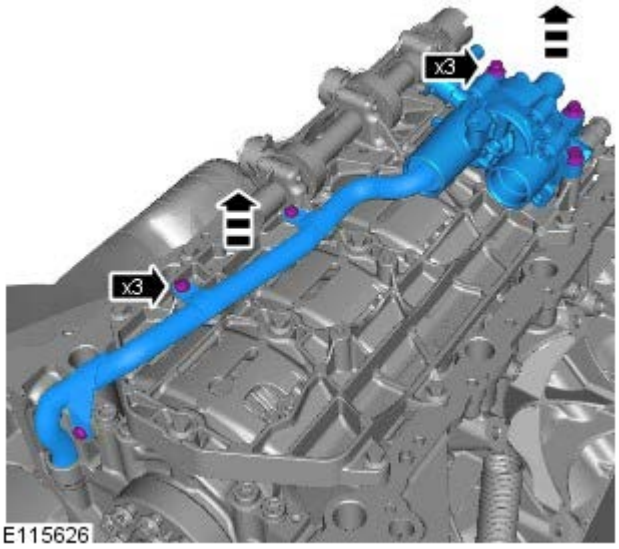
6.





7. NOTE: Remove and discard the O-ring seal.

8. CAUTION: Remove and discard the O-ring seals.



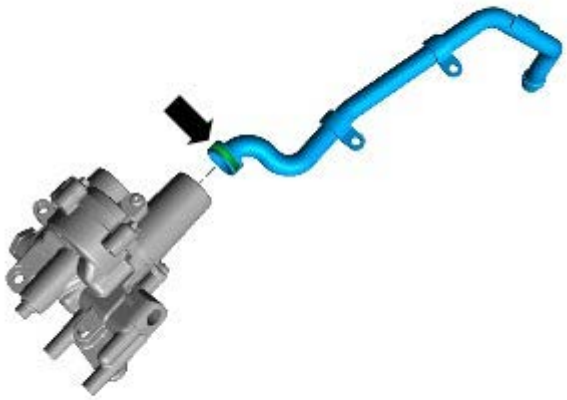
9. NOTE: Remove and discard the O-ring seal.



E139628

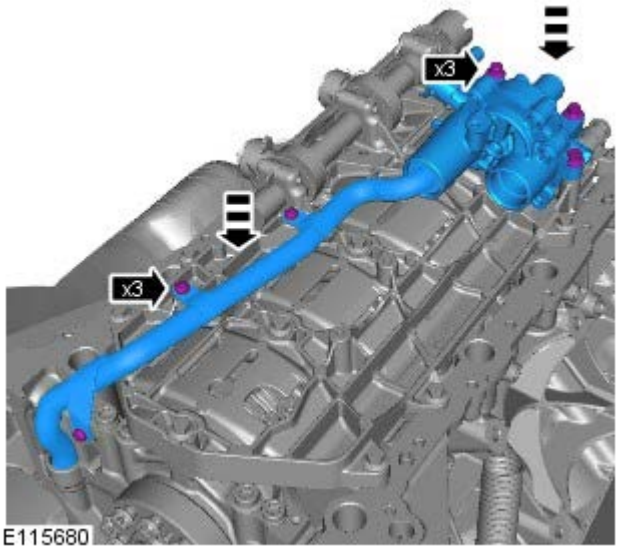
Installation

1. Lubricate and install the new O-ring seals.



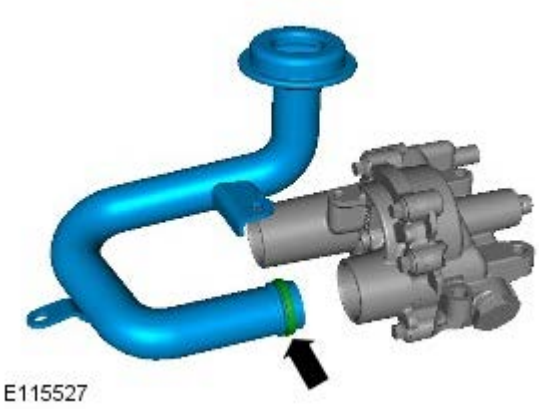
E139628

2. *Torque:*
   M8 25 Nm
   M6 12 Nm

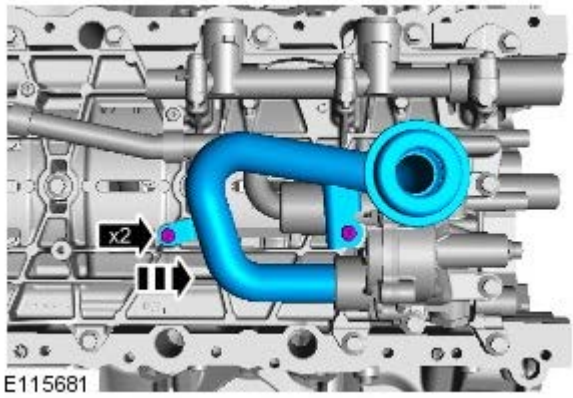


E115680

3. Lubricate and install a new O-ring seal.

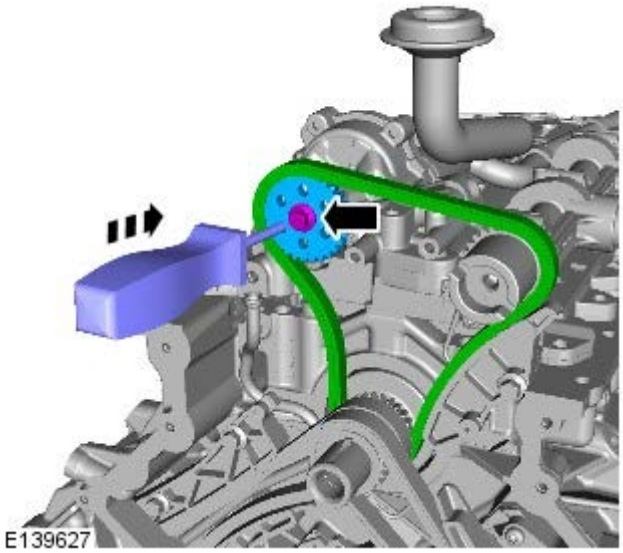

E115527

4. *Torque:* 12 Nm



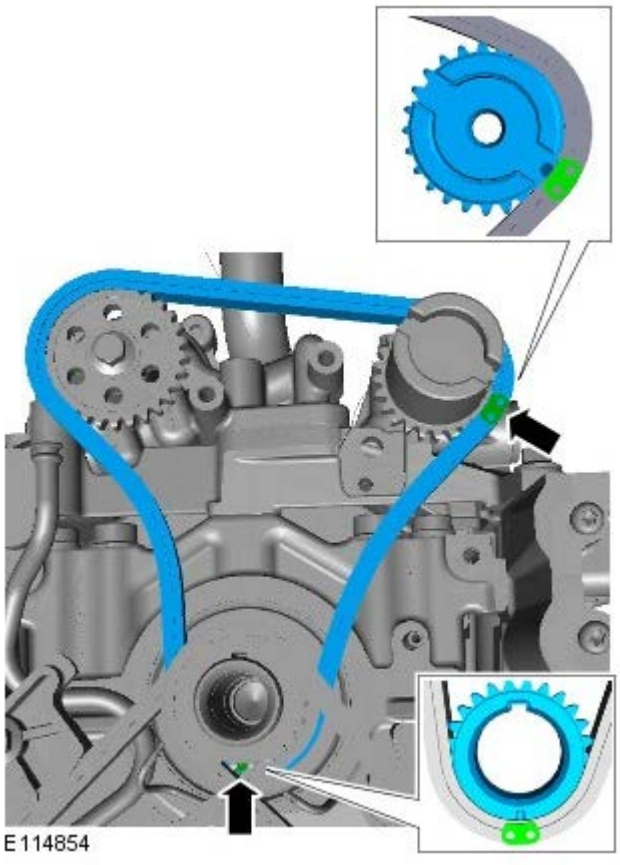
E115681

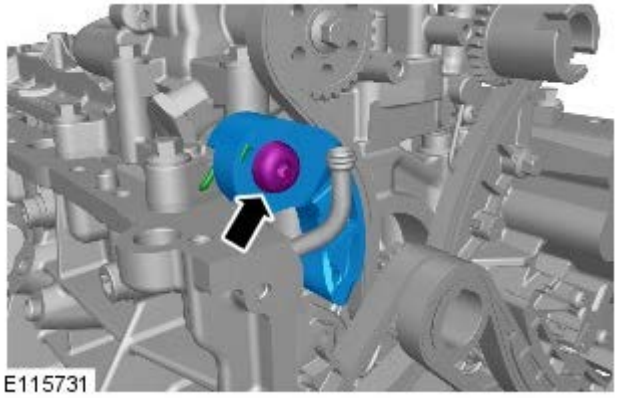
5. *Torque:* 21 Nm


E139627

6. NOTE: Tsubaki timing drive only.

   Install the lower timing chain making sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft and crankshaft sprocket markings.





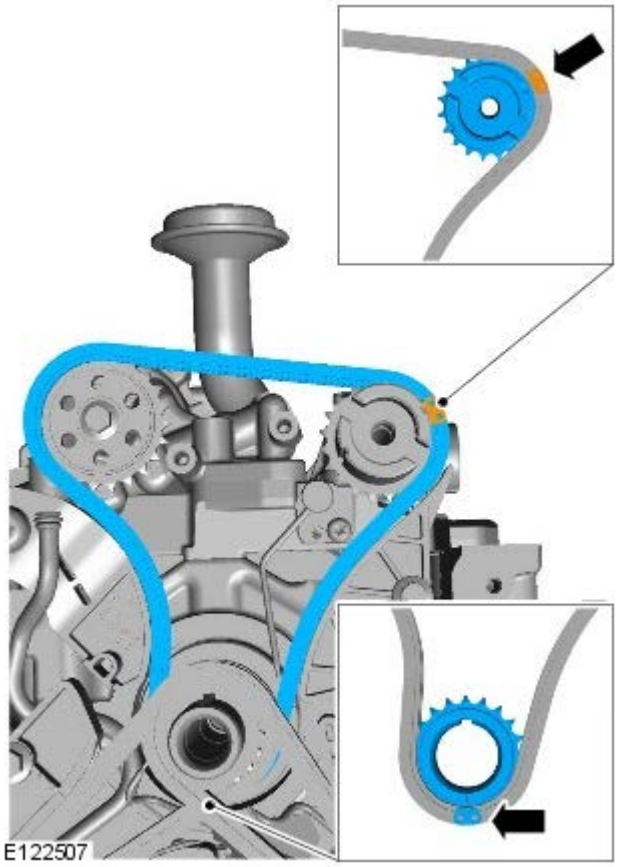
7. CAUTION: Make sure that the tensioner spring is correctly located.

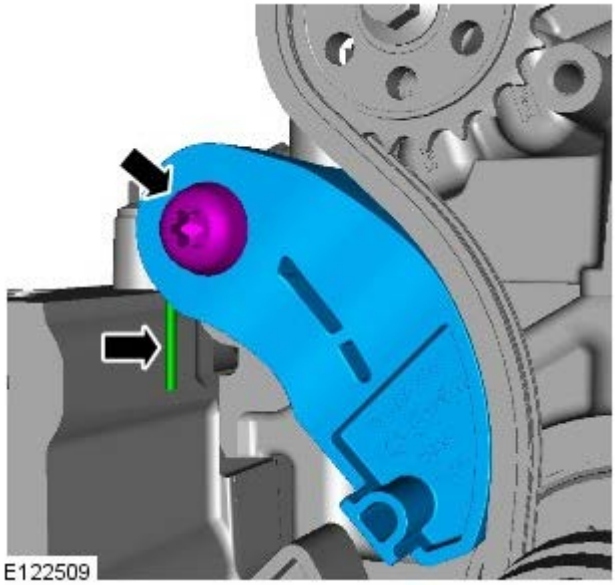
   NOTE: Tsubaki timing drive only.

   Torque: 21 Nm

8. NOTE: INA timing drive only.

   Install the lower timing chain making sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft and crankshaft sprocket markings.





9. CAUTION: Make sure that the tensioner spring is correctly located.

   NOTE: INA timing drive only.

   Torque: 21 Nm

10. Refer to: Oil Pan Extension (303-01 Engine - V8 5.0L Petrol, Removal and Installation).

11. Connect the battery ground cable.

    Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

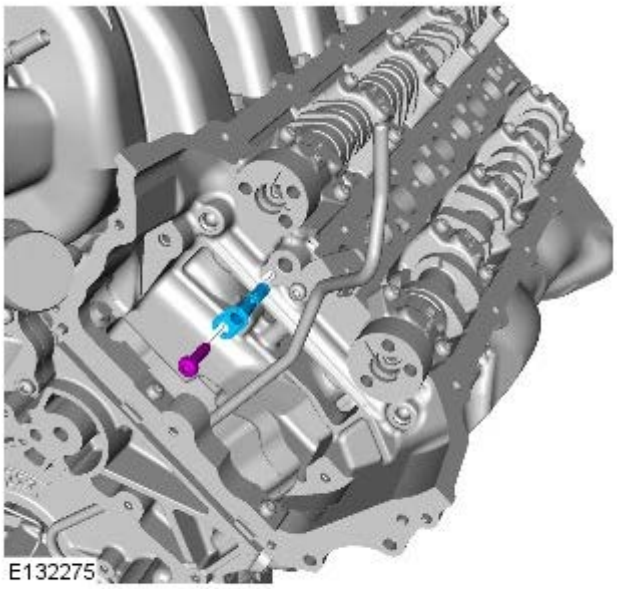
Engine - V8 5.0L Petrol - Oil Restrictor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Timing Drive Components - Assembly Part Number: INA Timing Drive (303-01D, Removal and Installation).
   Refer to: Timing Drive Components - Assembly Part Number: Tsubaki Timing Drive (303-01D, Removal and Installation).



2.
   - *Torque:* 7 Nm

Installation

1. To install, reverse the removal procedure.

Published: 25-Nov-2013

Engine - V8 5.0L Petrol - Timing Cover

Removal and Installation

Special Tool(s)

 E107676	303-1433 Lower Timing Cover Alignment tool

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

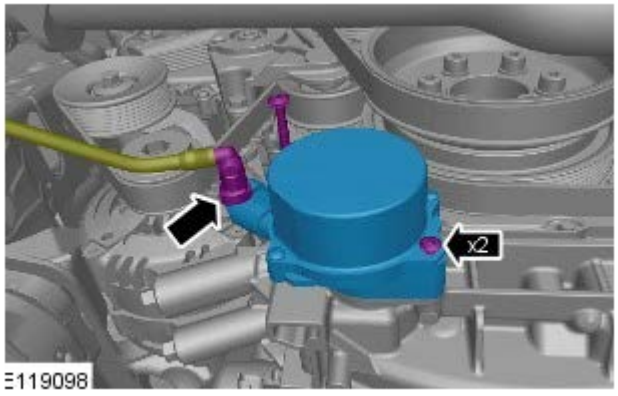
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

4. Refer to: Crankshaft Pulley (303-01B Engine - V8 5.0L Petrol, Removal and Installation).



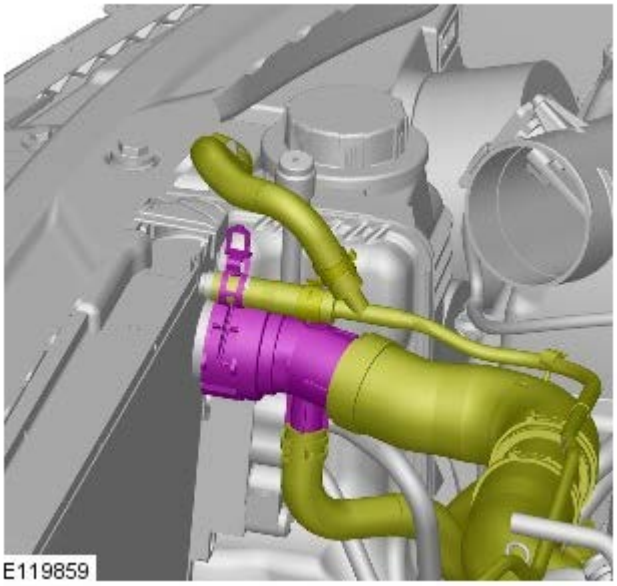
5. CAUTION: Be prepared to collect escaping oil.

   NOTE: Discard the seal.

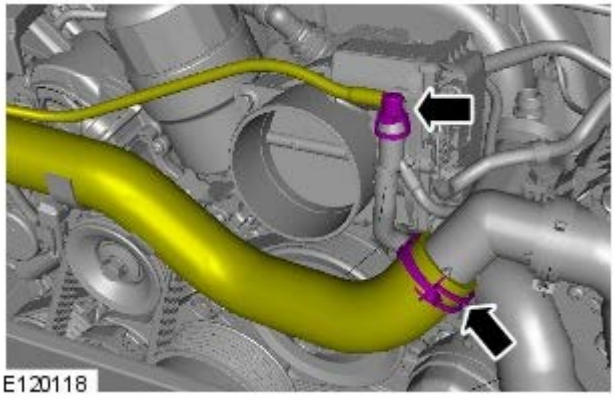
6. Refer to: Valve Cover LH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

7. Refer to: Valve Cover RH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

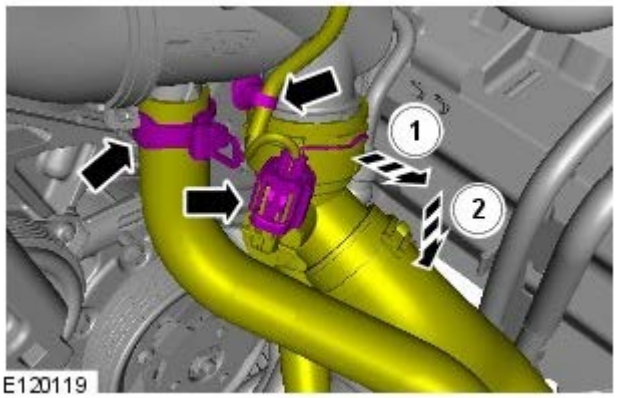
8.



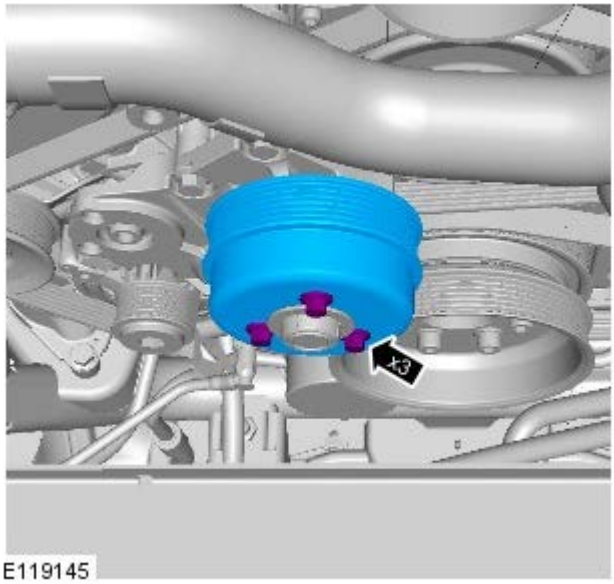
9.



10. CAUTION: Be prepared to collect escaping coolant.

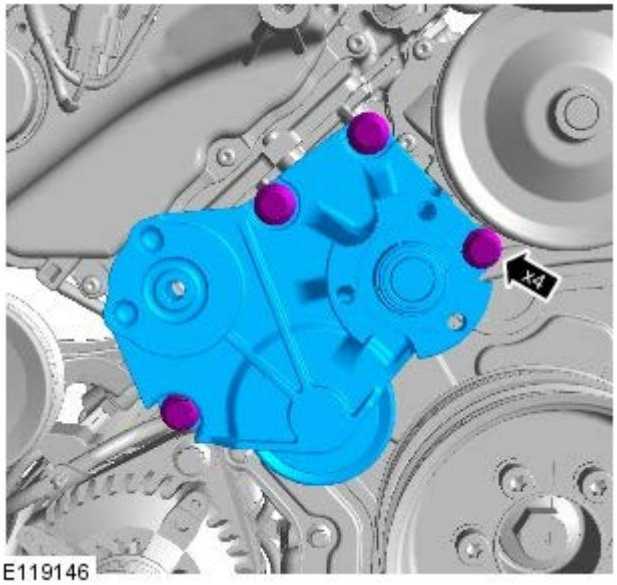


11.



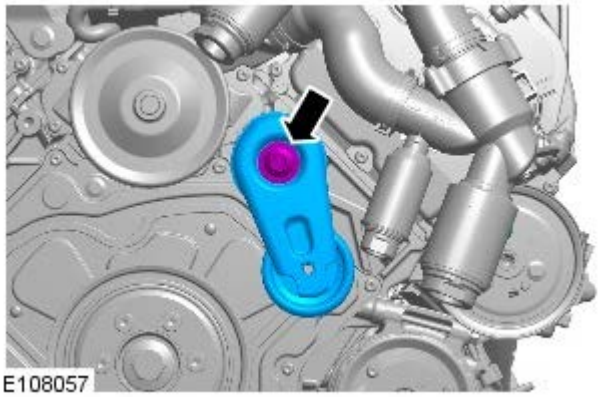
E119145

12.

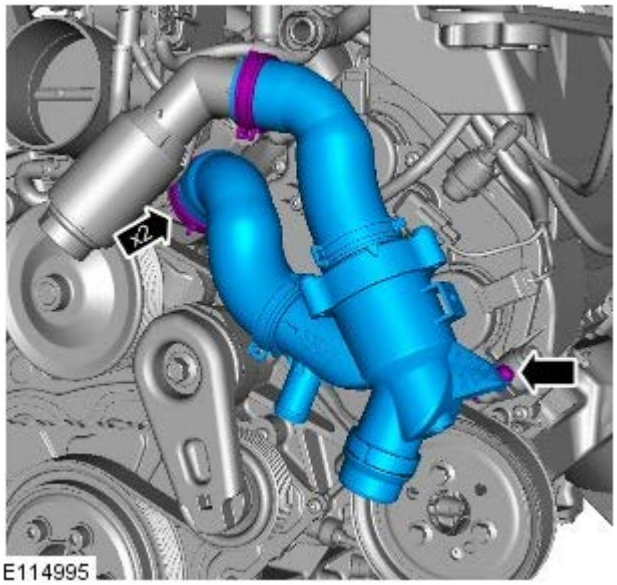


E119146

13.


E108057

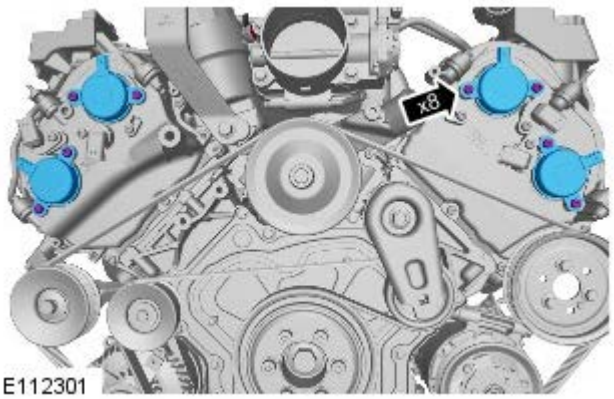
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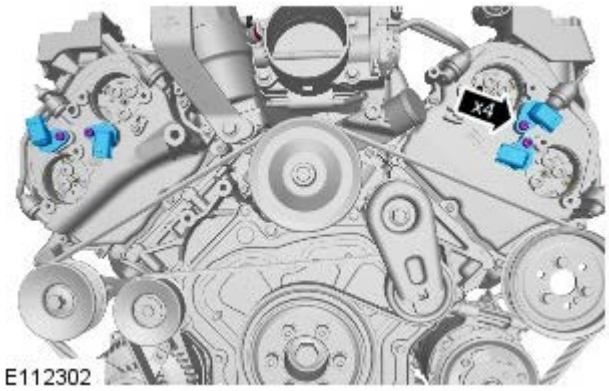
15.



16.



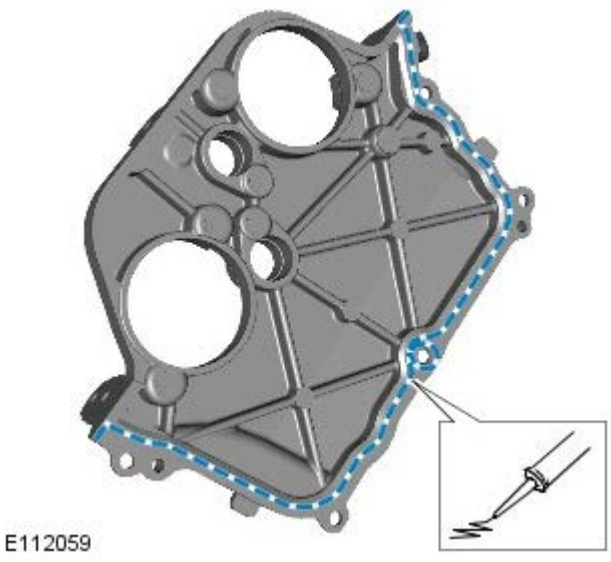
17.



18.



Installation



1. CAUTION: Make sure that the mating faces are clean and free of foreign material.
    - Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

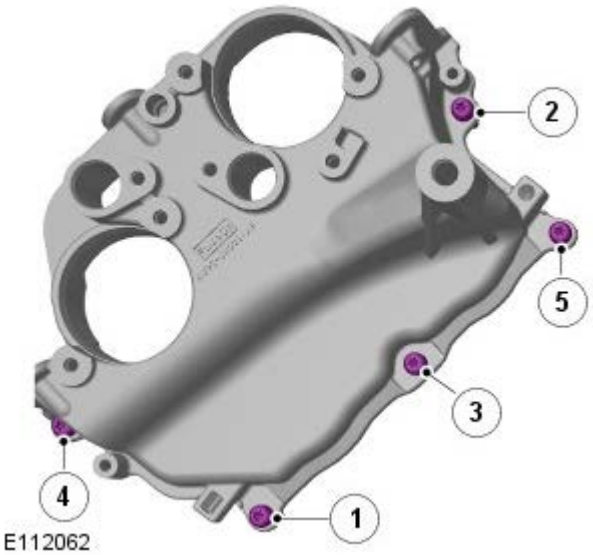
2. CAUTION: Make sure that the mating faces are clean and free of foreign material.
    - Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.



E112060



E112061



E112062

3. NOTE: Tighten the bolts in the indicated sequence.

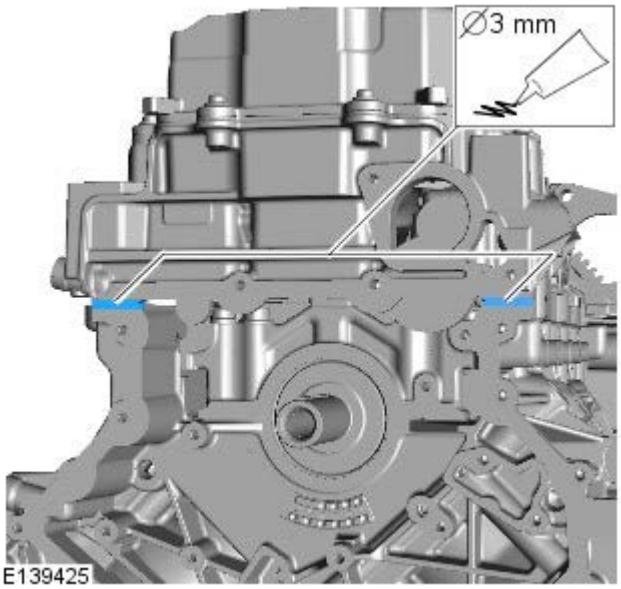
   Torque: 12 Nm

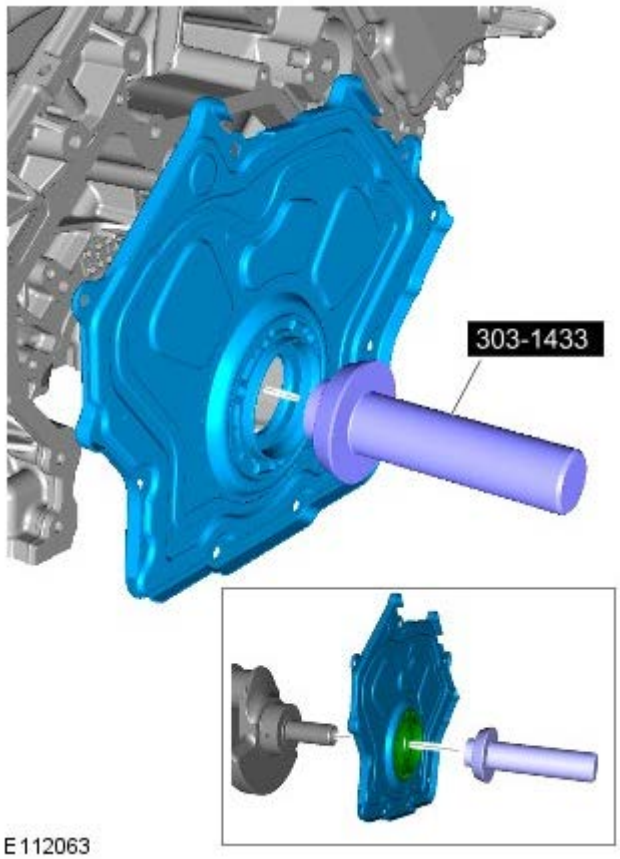
4. NOTE: Tighten the bolts in the indicated sequence.

   Torque: 12 Nm

5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

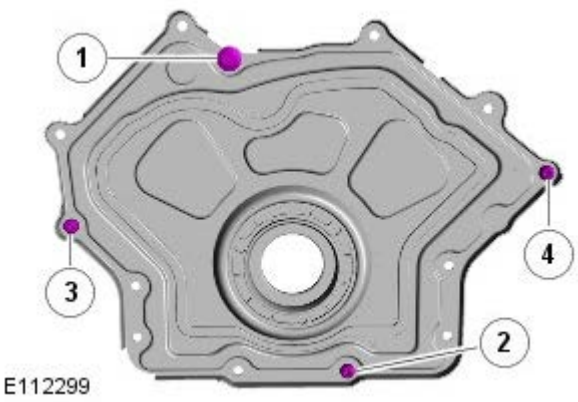




6. CAUTION: Make sure that the mating faces are clean and free of foreign material.

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

   Special Tool(s): 303-1433



7. *Torque:*
   M6 12 Nm
   M8 20 Nm

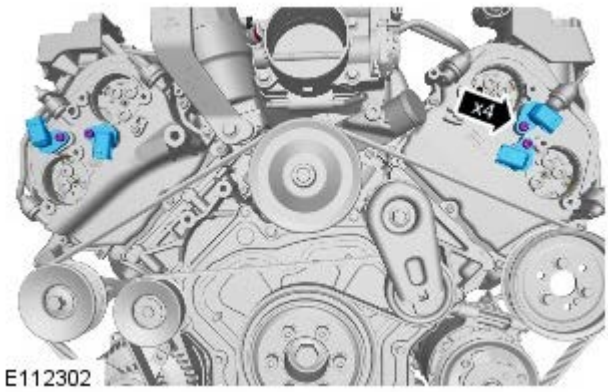
8. Remove the special tools.

9. *Torque:* 12 Nm



E112300

10. *Torque:* 12 Nm



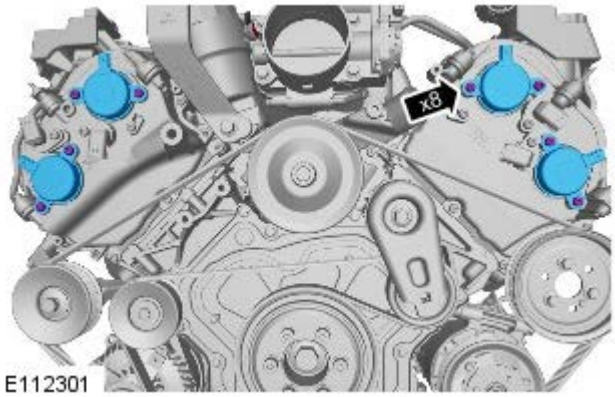
E112302

11. *Torque:* 25 Nm



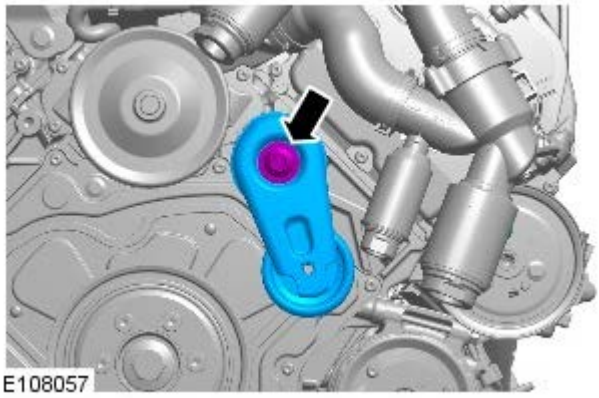
E116364

12. *Torque:* 12 Nm



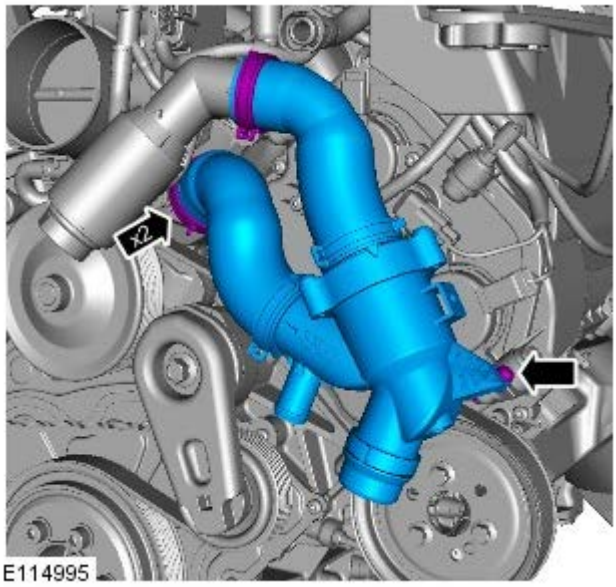
E112301

13. NOTE: Install the bolt finger tight before final tightening.

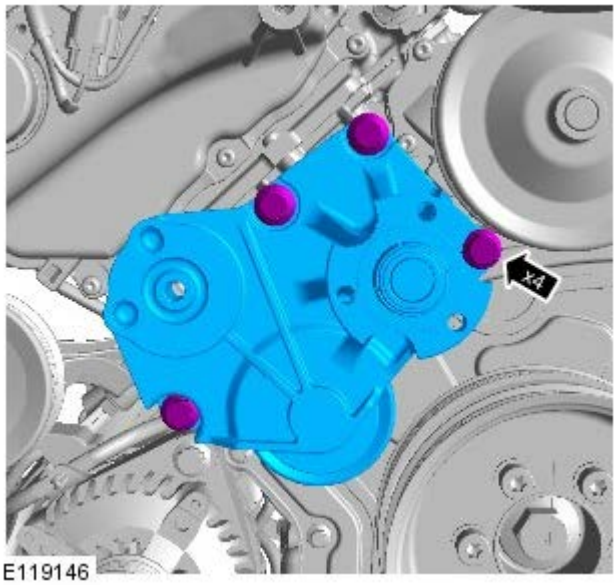


Torque: 40 Nm

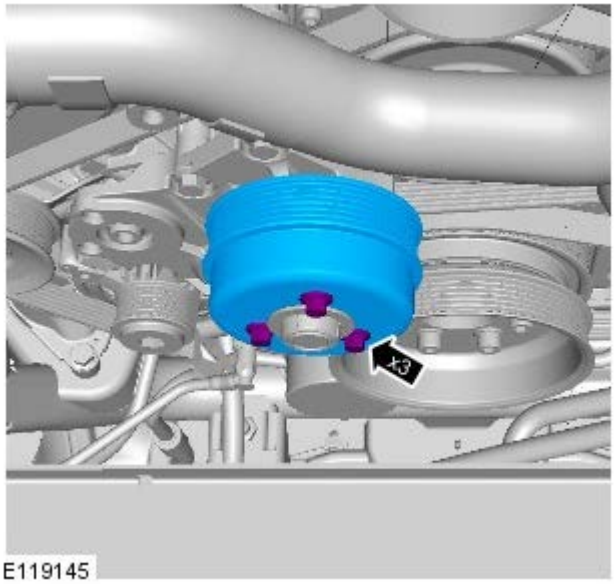
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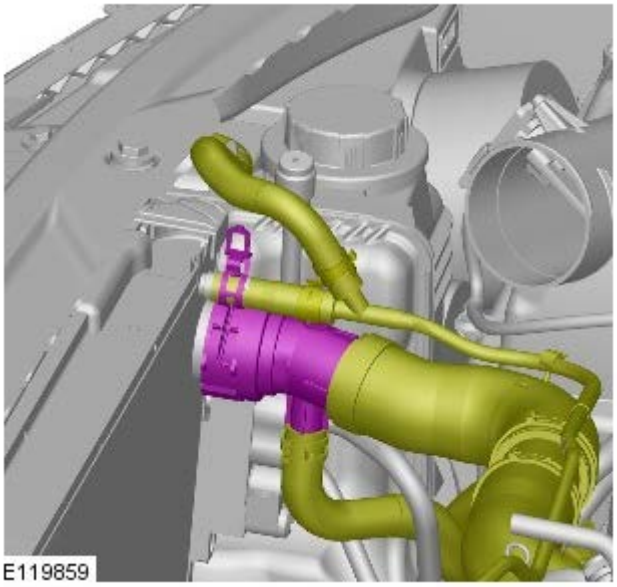
15. *Torque:* 25 Nm



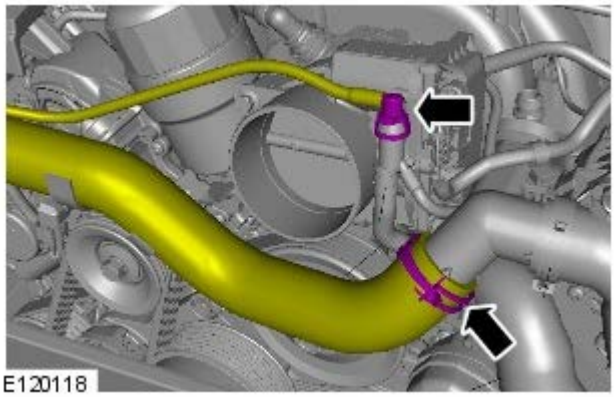
16. *Torque:* 25 Nm



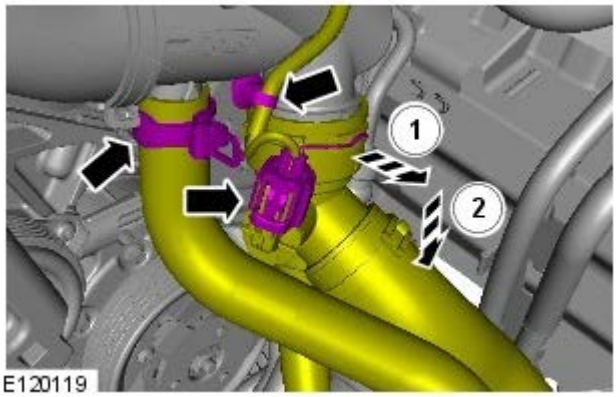
17.



18.

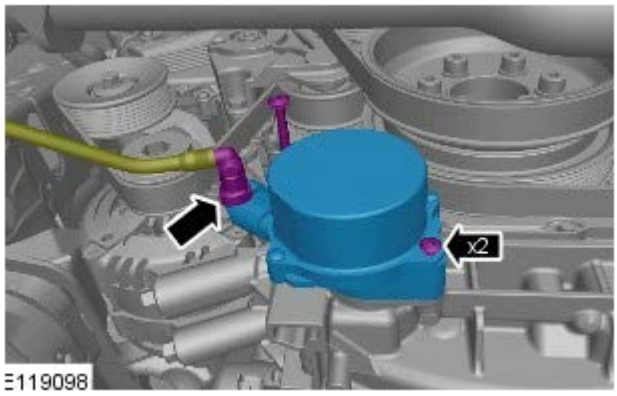


19.



20. Refer to: Valve Cover LH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

21. Refer to: Valve Cover RH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).



22. NOTE: Install a new seal.

    Torque: 12 Nm

23. Refer to: Crankshaft Pulley (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

24. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

25. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

26. Check and top up the engine oil.

Published: 07-Jun-2012

Engine - V8 5.0L Petrol - Timing Drive Components Assembly Part Number: INA Timing Drive

Removal and Installation

Special Tool(s)

 E115263	303-1445 Timing Tool – Camshaft Alignment
 E115265	303-1447 Timing Tool
 E115266	303-1448 Locking Tool
 E115270	303-1452 Camshaft Rotating Tool
 E115271	303-1482 Tensioner Tool

Removal

CAUTION: Check all timing components for wear and install new components if required.

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

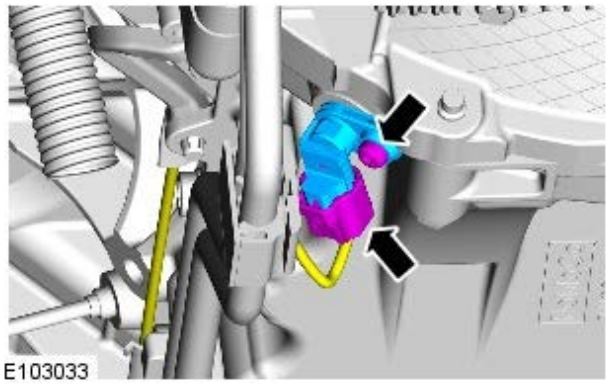
2. WARNING: Make sure to support the vehicle with axle

stands.

Raise and support the vehicle.

3. Refer to: Timing Cover (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

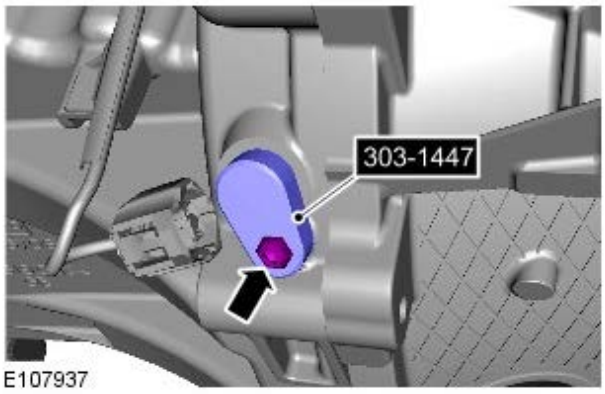
4.



5. CAUTION: Only rotate the crankshaft clockwise.

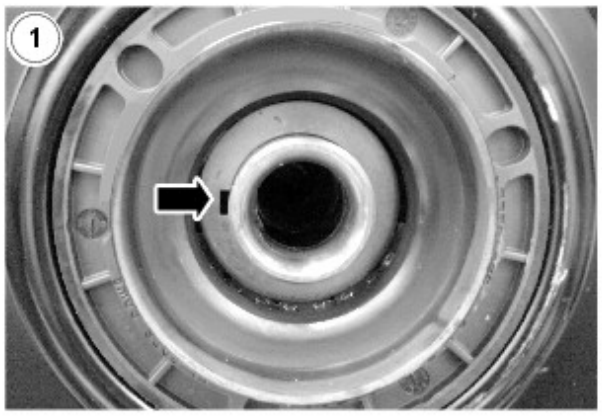
Install the special tool.

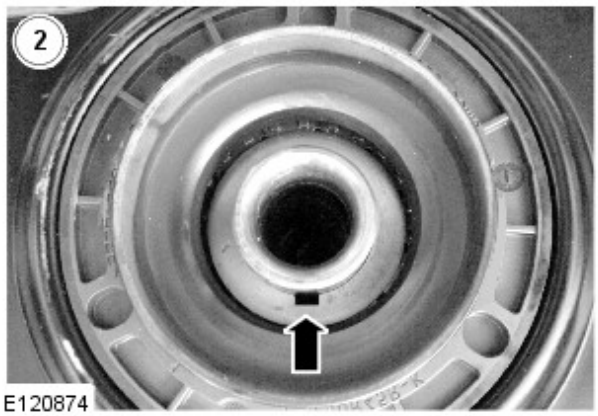
Special Tool(s): 303-1447



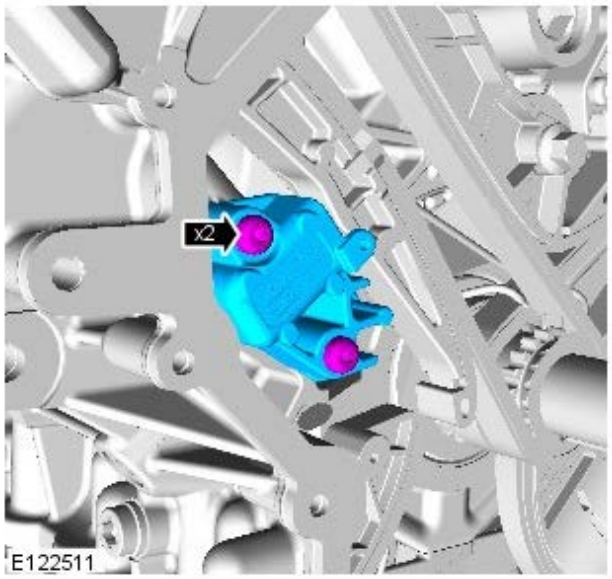
6. CAUTION: If the noted postion of the woodruff key is at the 9 o'clock position, then a new flexplate must be installed. If the woodruff key is in the 6 o'clock position then proceed with the next step.

Note the position of the crankshaft woodruff key.

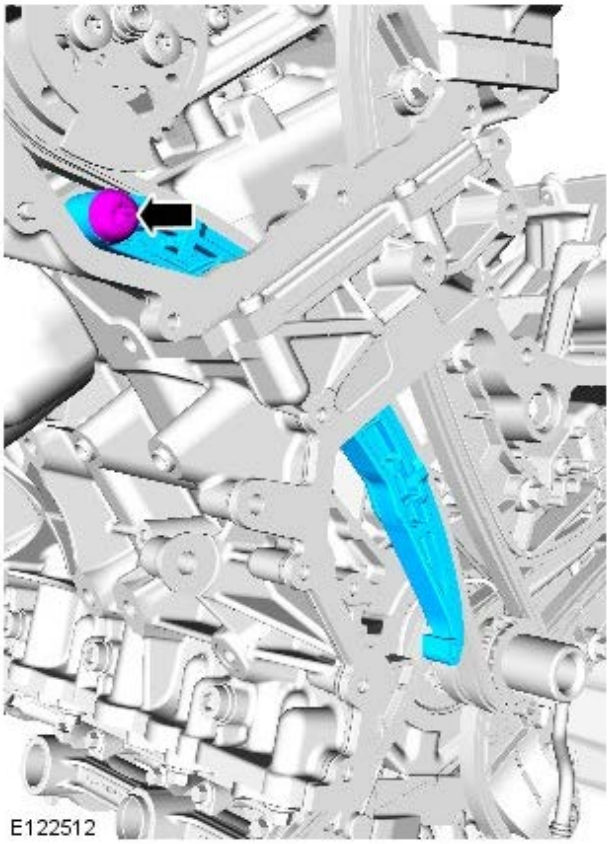




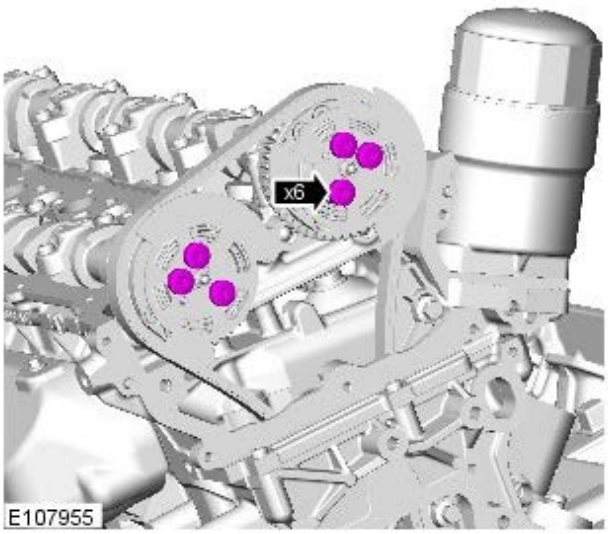
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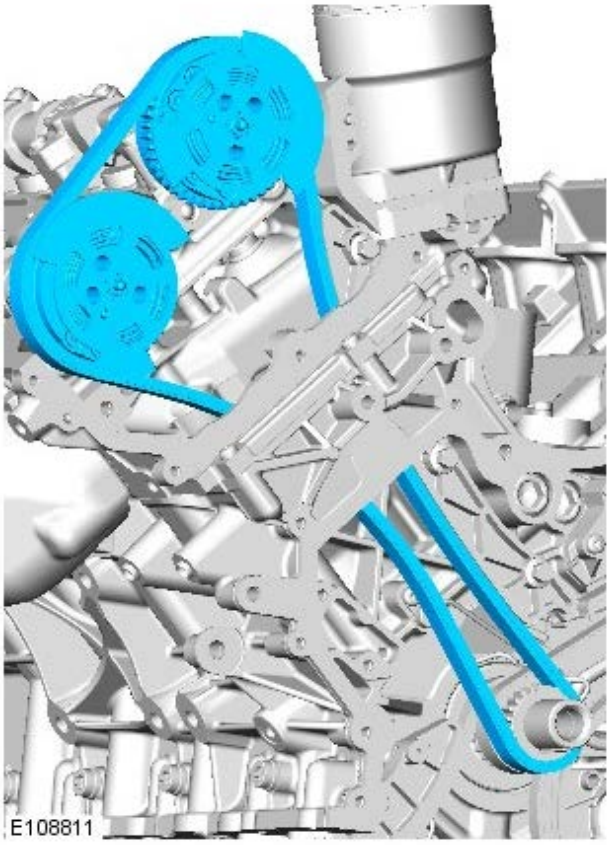


8.



9.

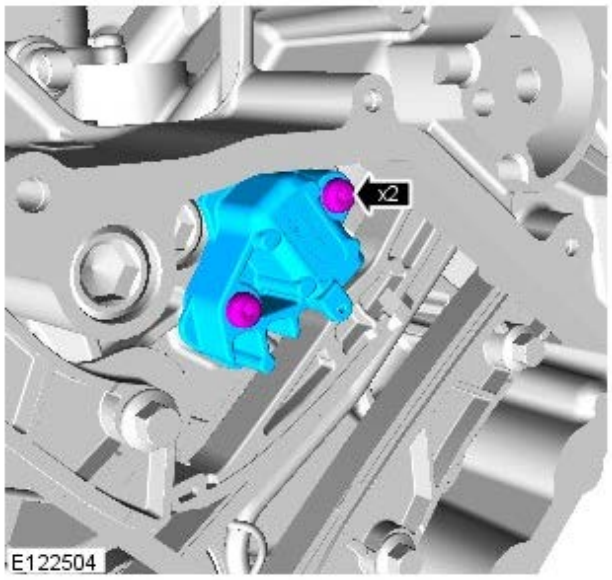




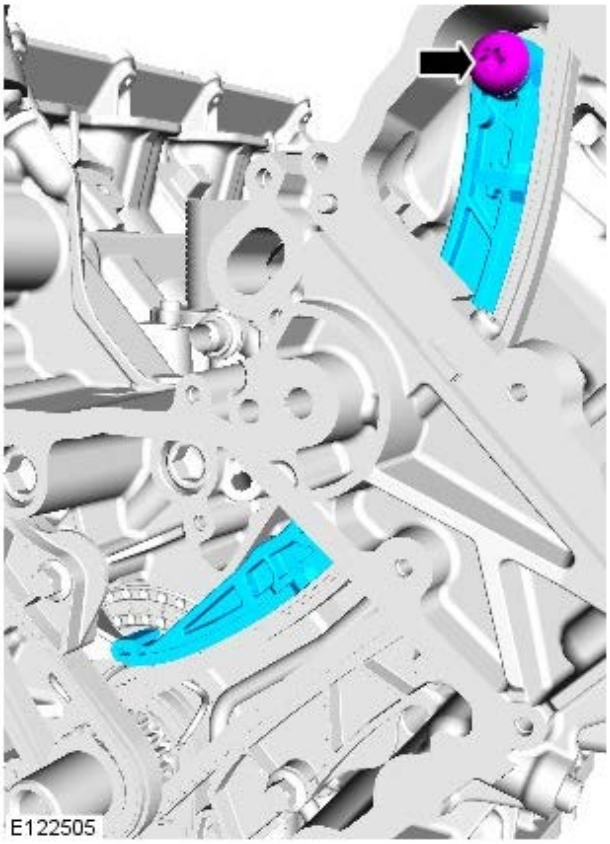
10. CAUTION: If the variable valve timing (VVT) units are knocked or dropped then the VVT must be replaced.

    Remove the timing chain with the VVT units.

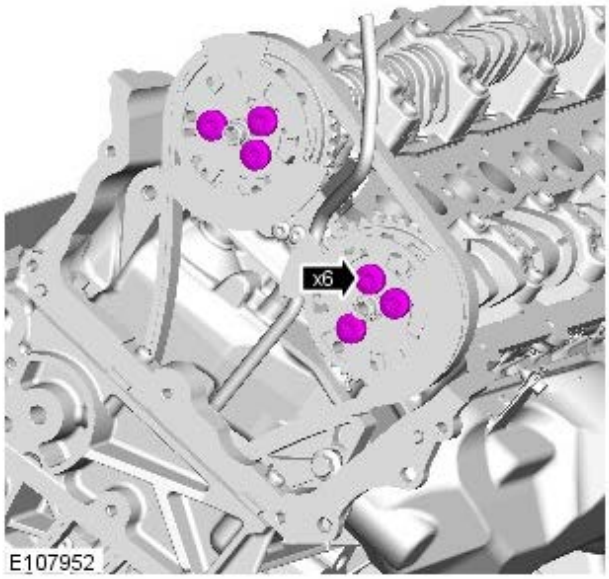
11.



12.

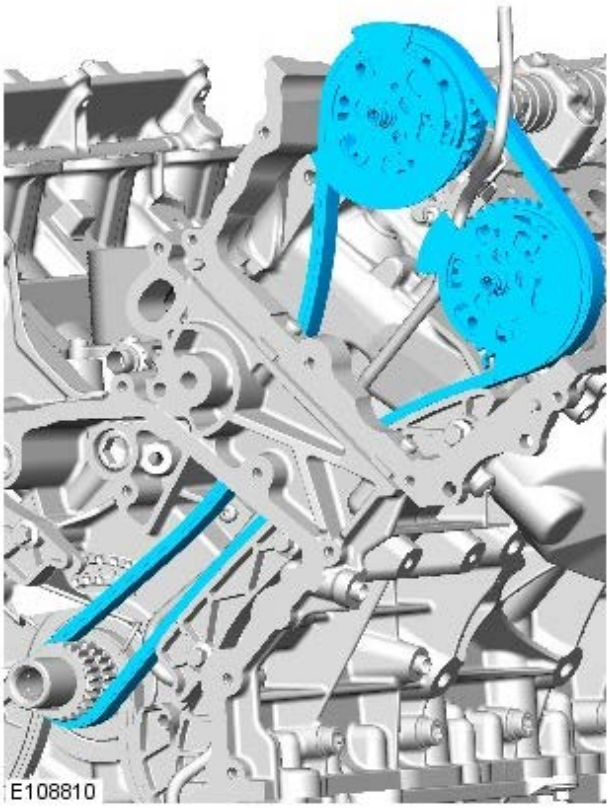


13.

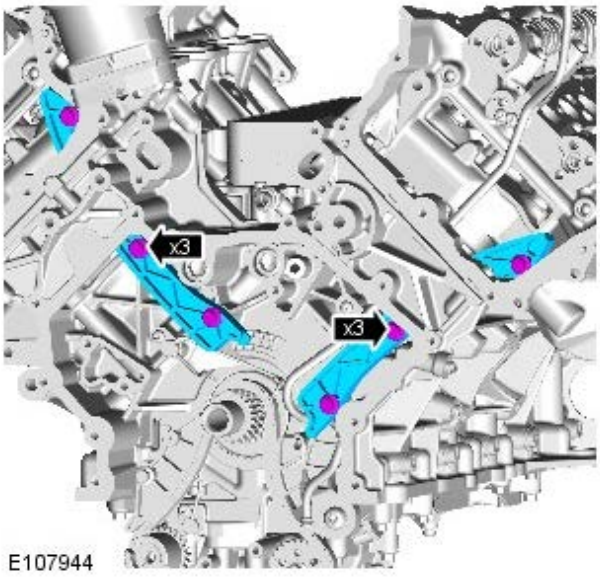


14. CAUTION: If the VVT is knocked or dropped then the VVT must be replaced.

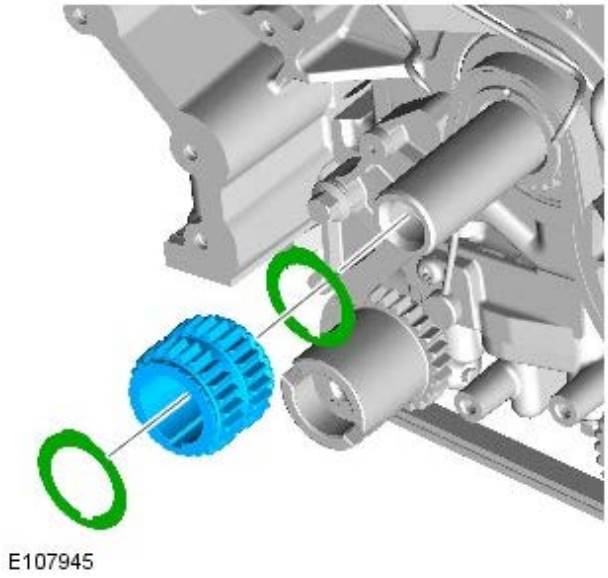
    Remove the timing chain with the VVT units.



15.

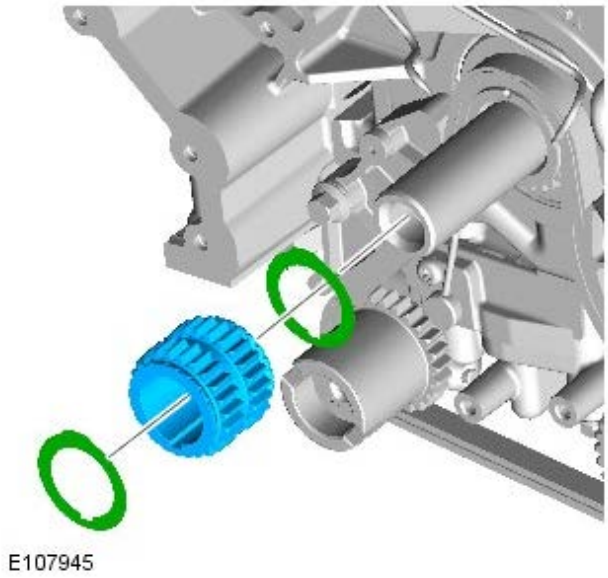


16. CAUTION: Discard the friction washer.

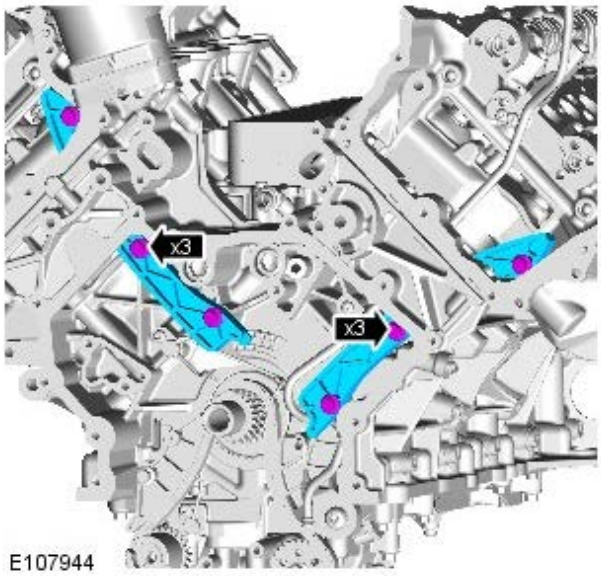


Installation

1. CAUTION: Install a new friction washer.

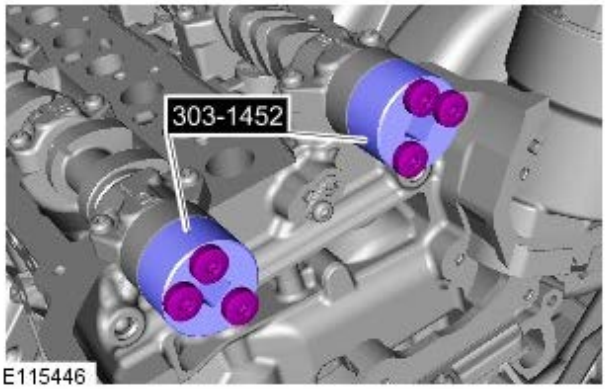


2. *Torque:* 12 Nm



3.

- Install the special tool to each Camshaft.
- *Special Tool(s):* 303-1452
- *Torque:* 10 Nm



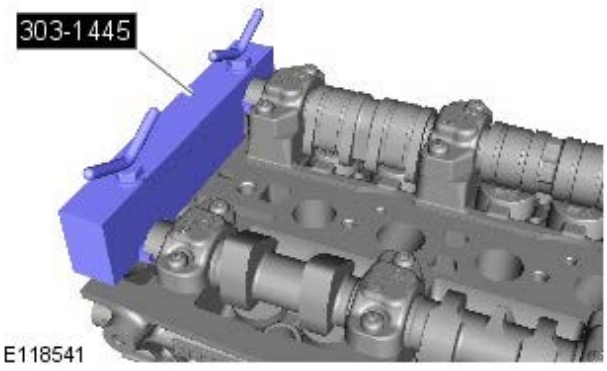
4.

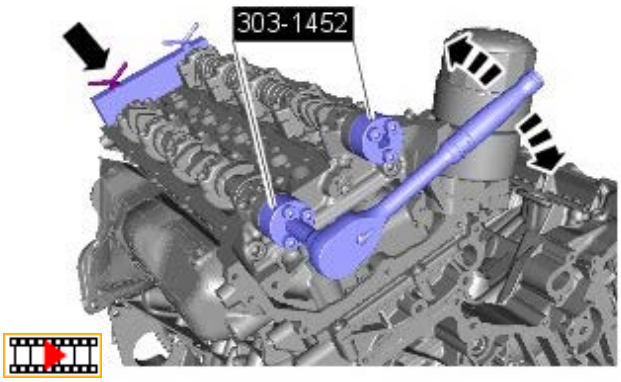
- Carefully rotate the camshafts if the position is not as shown.



5.

- Install the special tool 303-1445 to the rear of the camshafts making sure the key way's are correctly located into each slot on each of the camshafts.





6. CAUTIONS:

Do not overturn the camshafts.

Tighten the wing nuts finger tight. Failure to follow this instruction may result in damage to the components.

- Using a suitable tool, carefully rock the camshaft clockwise then anti-clockwise. Turn the special tool locking nuts until there is no movement left in camshafts.
- Repeat steps 3- 6 for the camshafts on the other cylinder head.

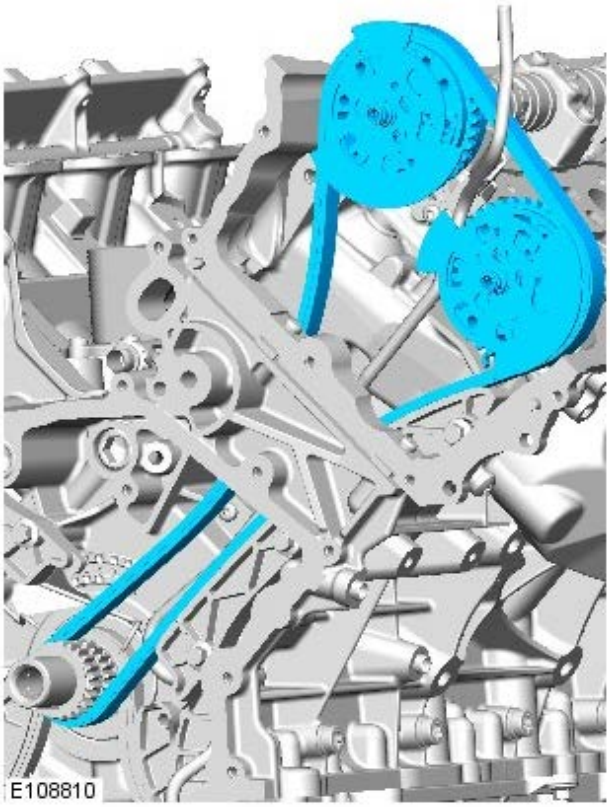
7. CAUTIONS:

Do not allow the camshaft to rotate.

If the VVT is knocked or dropped then the VVT must be replaced.

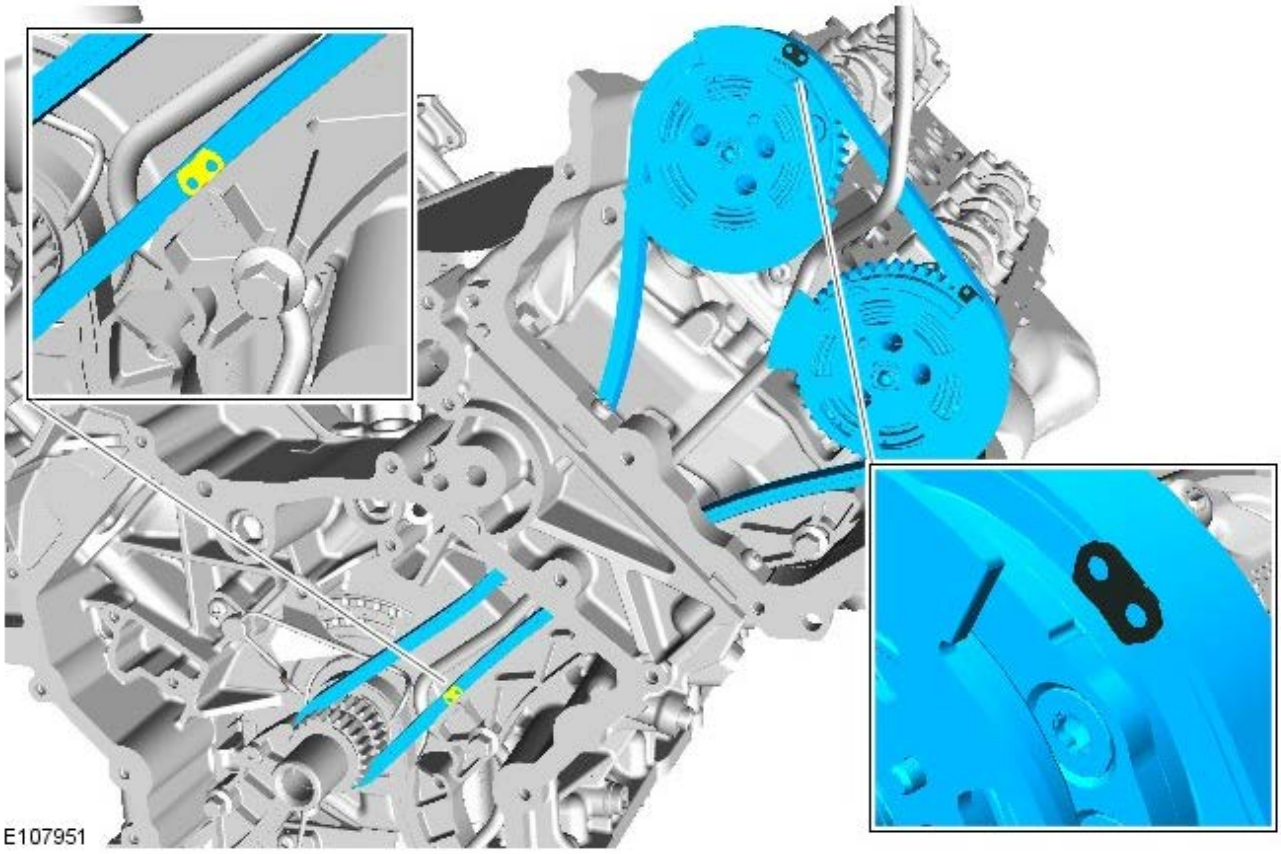
NOTE: Do not tighten at this stage.

- Install the timing chain with the variable valve timing (VVT) units.

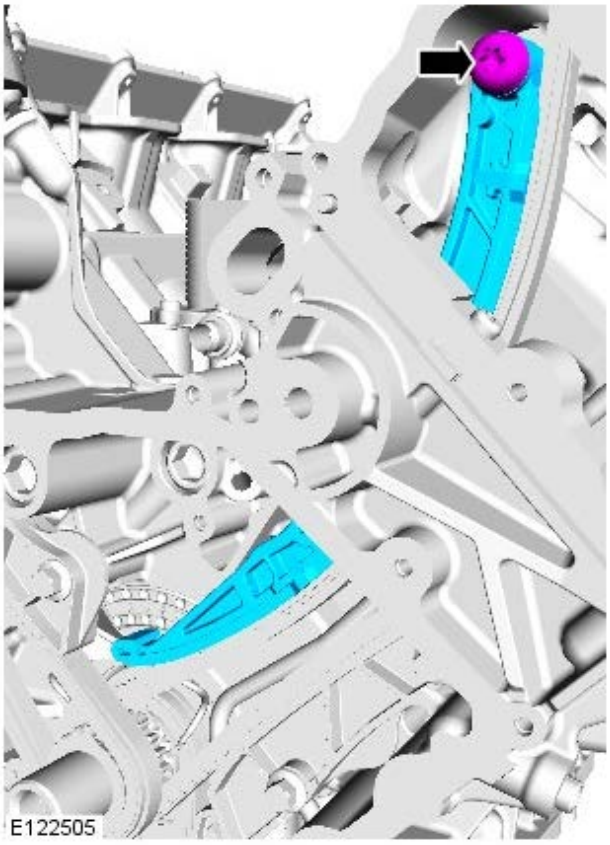


8.

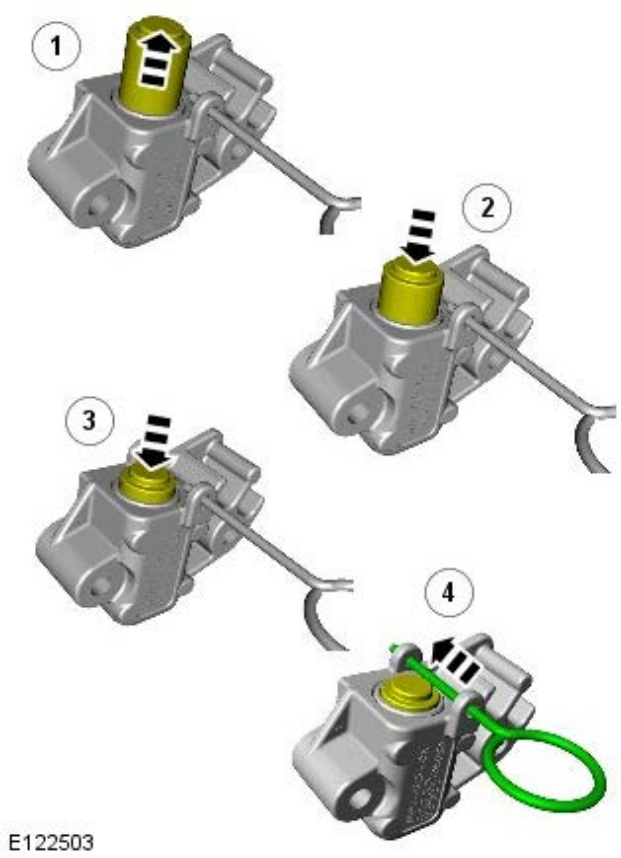
- Make sure that all the timing chain alignment marks are in the positions shown.



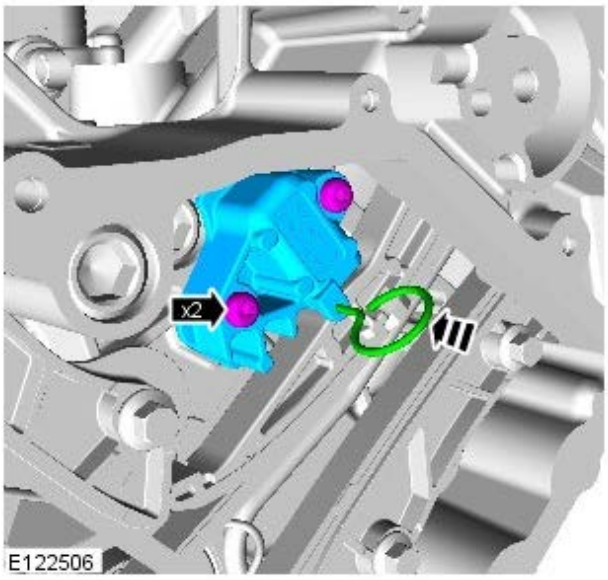
9. *Torque:* 25 Nm



10. Make sure the tensioner piston is fully extended. Then fully depress and lock the tensioner piston with the grenade pin before installation, failure to do this may result in damage to the engine.



E122503



E122506

11. CAUTION: Do not release the timing chain tensioner locking pin at this stage.

    Torque: 10 Nm

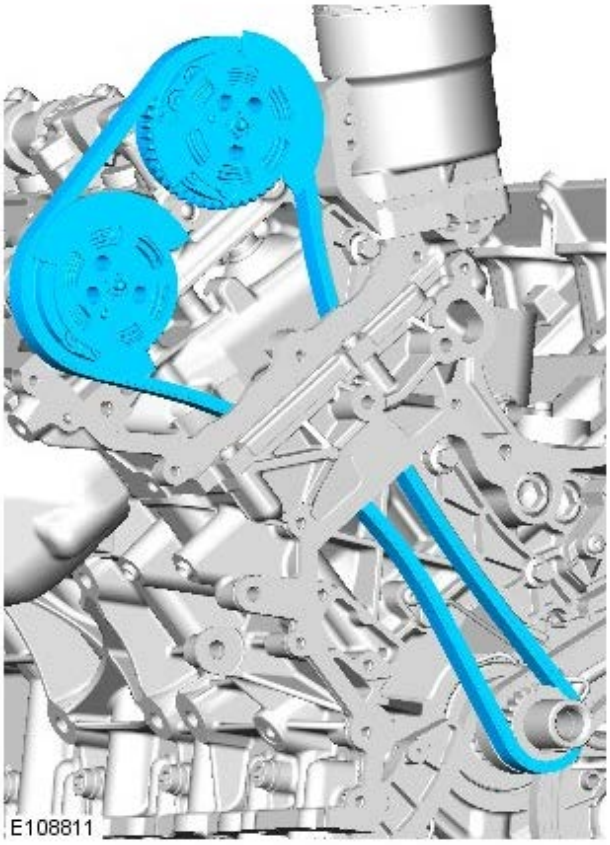
12. CAUTIONS:

    Do not allow the camshafts to rotate.

    If the VVT is knocked or dropped then the VVT must be replaced.

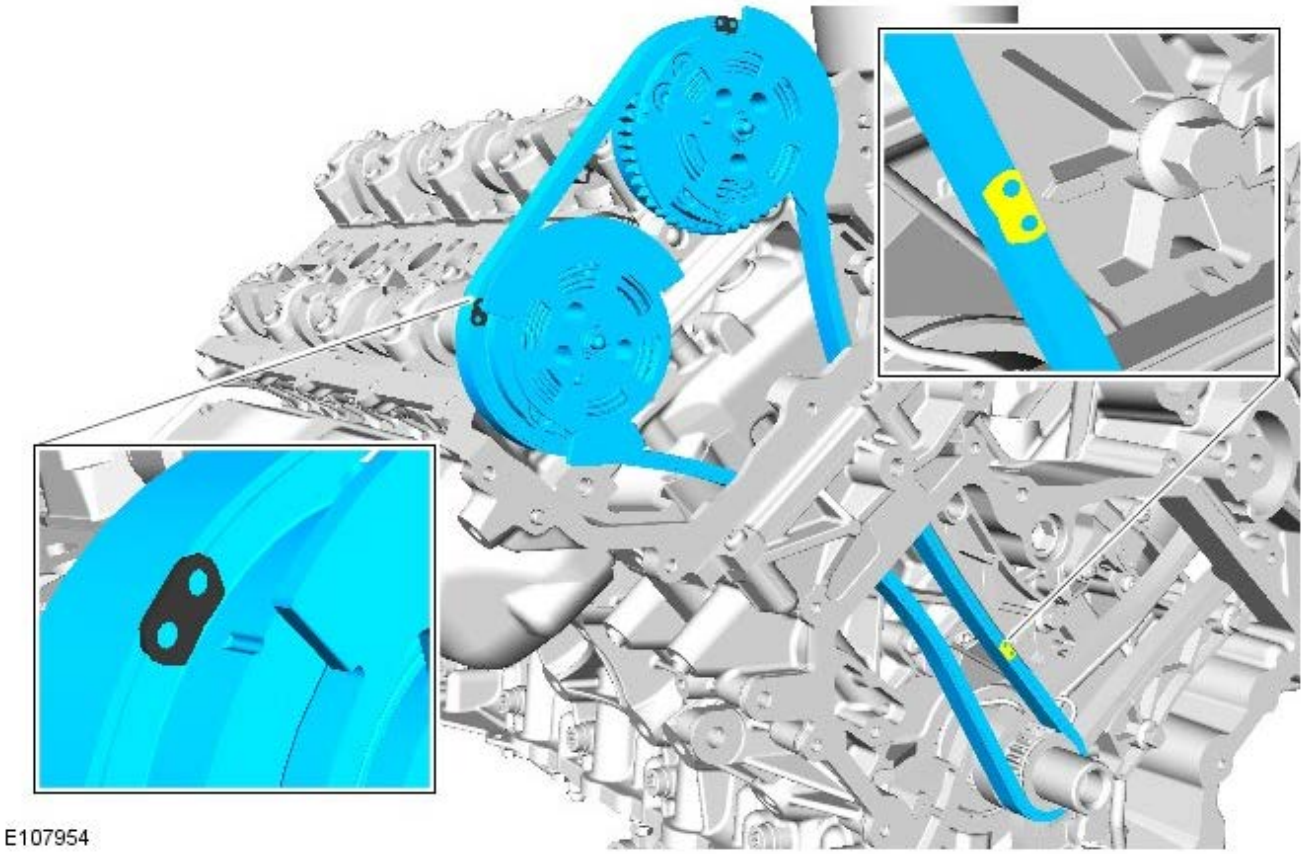
    NOTE: Do not tighten at this stage.

    - Install the timing chain with the VVT units.

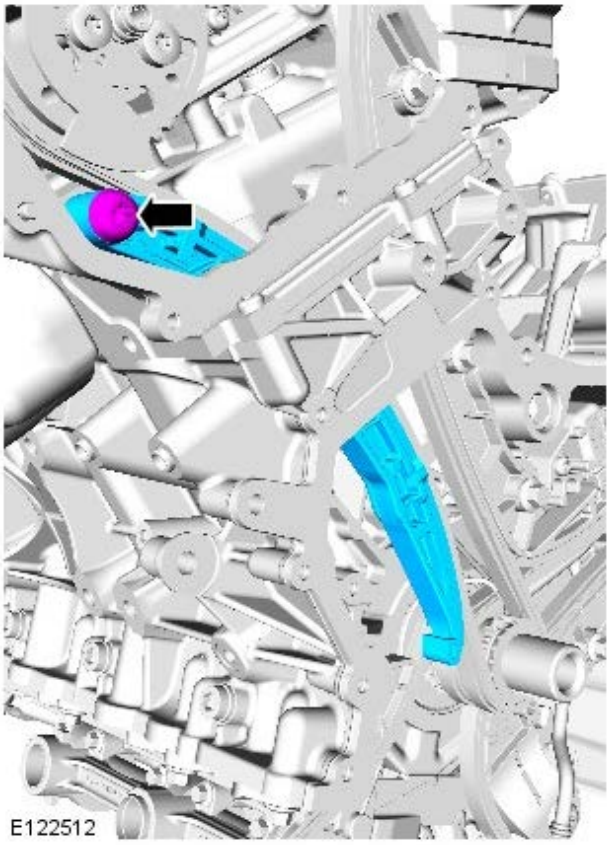


13.

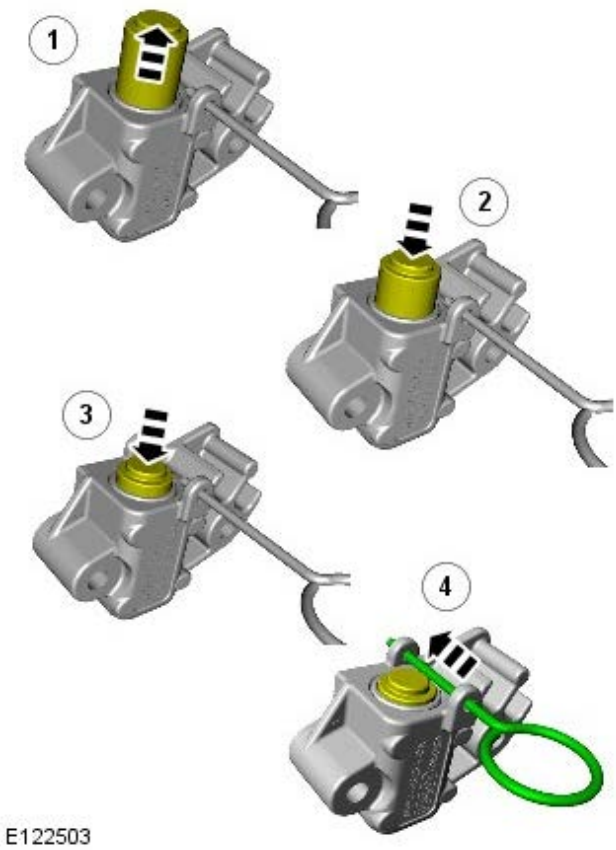
- Make sure that all the timing chain alignment marks are in the positions shown.



14. *Torque:* 25 Nm

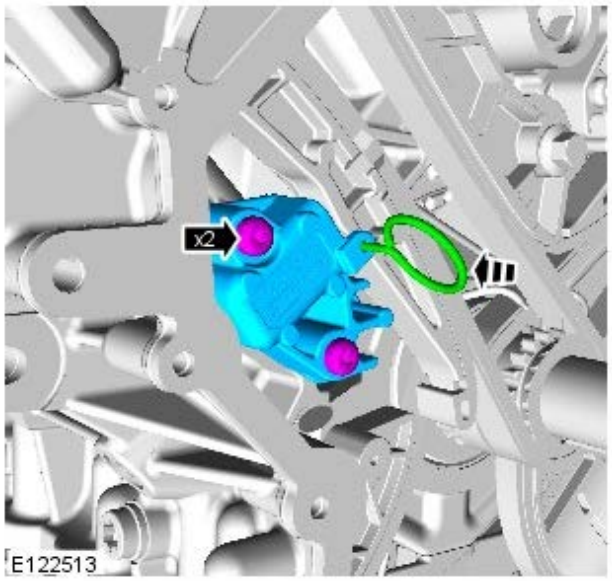


15. Make sure the tensioner piston is fully extended. Then fully depress and lock the tensioner piston with the grenade pin before installation, failure to do this may result in damage to the engine.

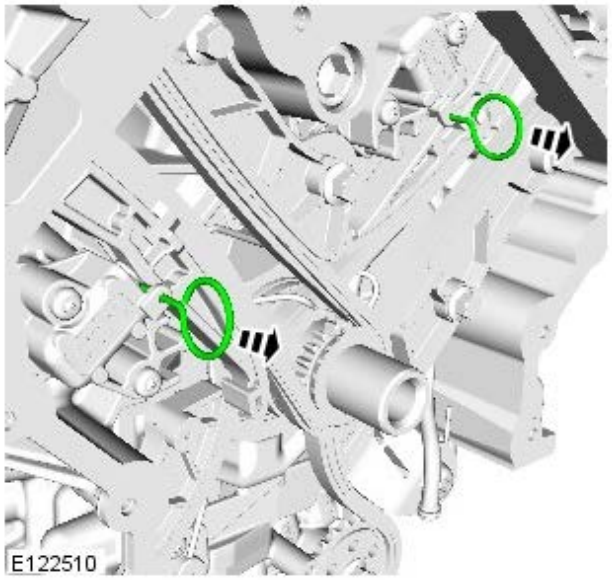


16. CAUTION: Do not release the timing chain tensioner locking pin at this stage.

Torque: 10 Nm



17.

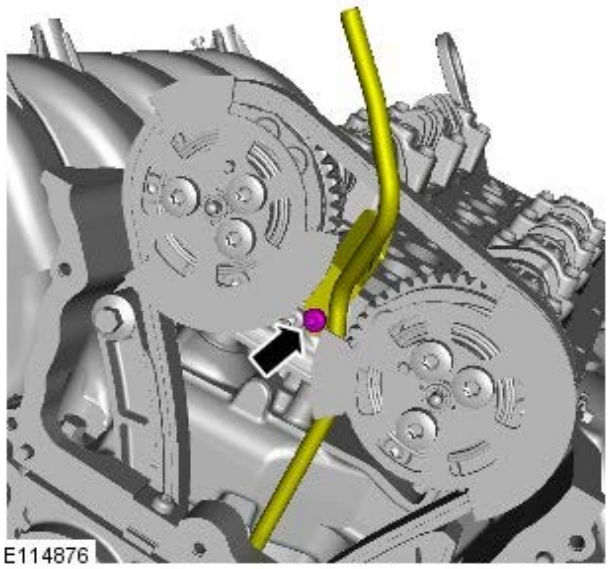


18. CAUTION: Do not use mechanical force.

Make sure that the tensioners are fully deployed.

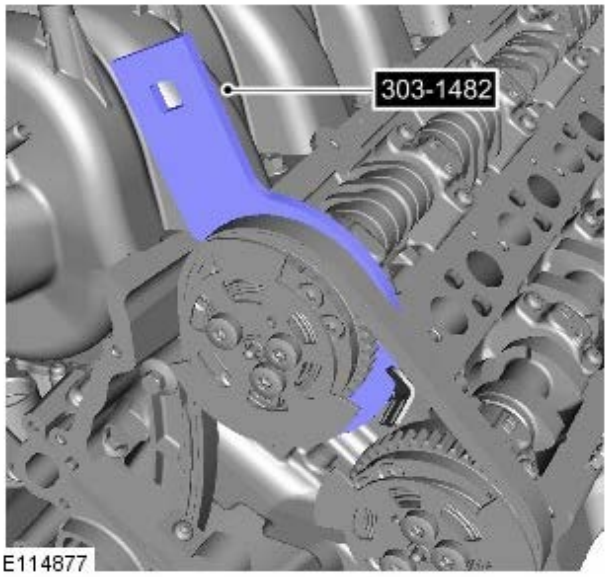
19.

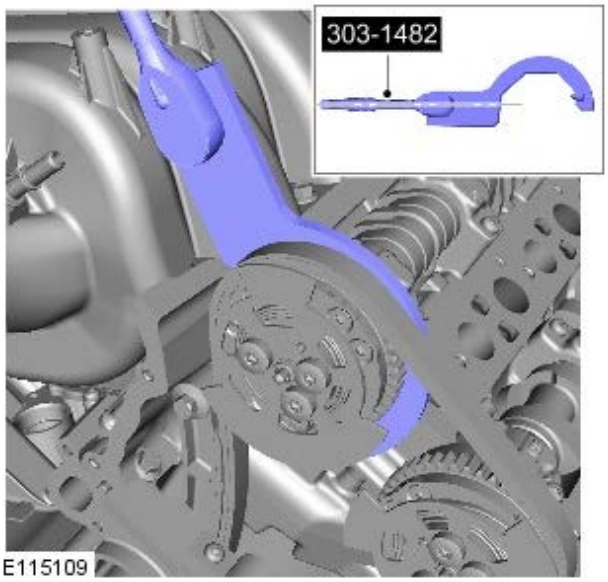
- Release and reposition the oil suction tube to one side.



20.

- Install the special tool.
- *Special Tool(s):* 303-1482



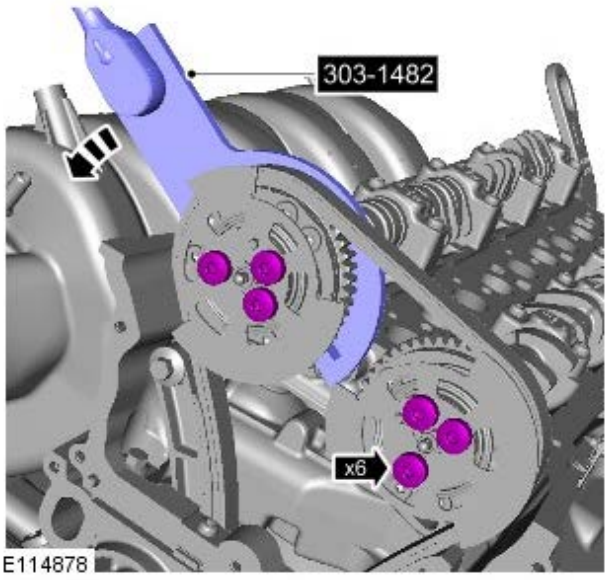


21. CAUTIONS:

Apply the torque to the end of the special tool.

Make sure that the torque wrench is aligned with the special tool as illustrated in the graphic.

- Install the torque wrench to the special tool.
- *Torque:* 35 Nm



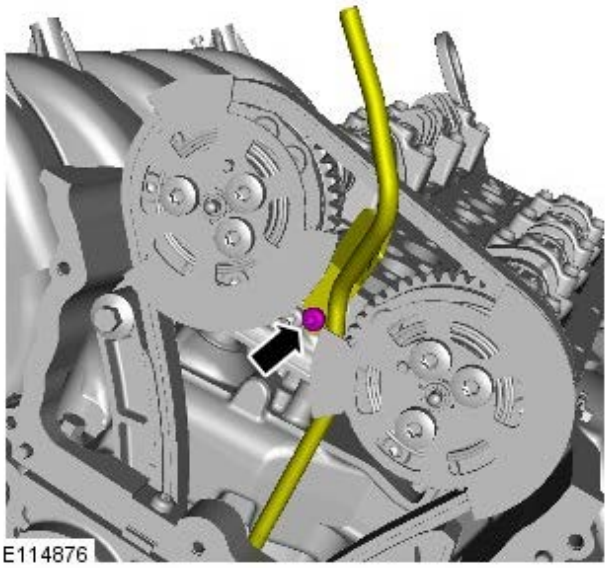
22. CAUTION: Make sure that the torque wrench does not move whilst tightening the VVT bolts.

NOTE: Make sure to tighten the exhaust VVT unit bolts first.

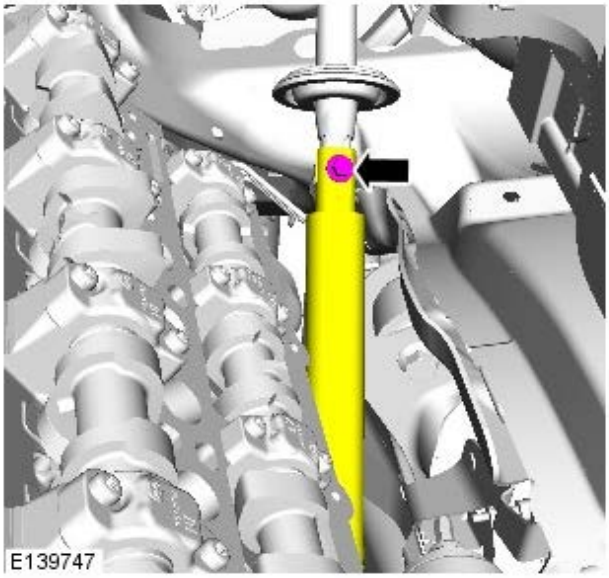
- *Torque:* 32 Nm
- *Special Tool(s):* 303-1482

23.

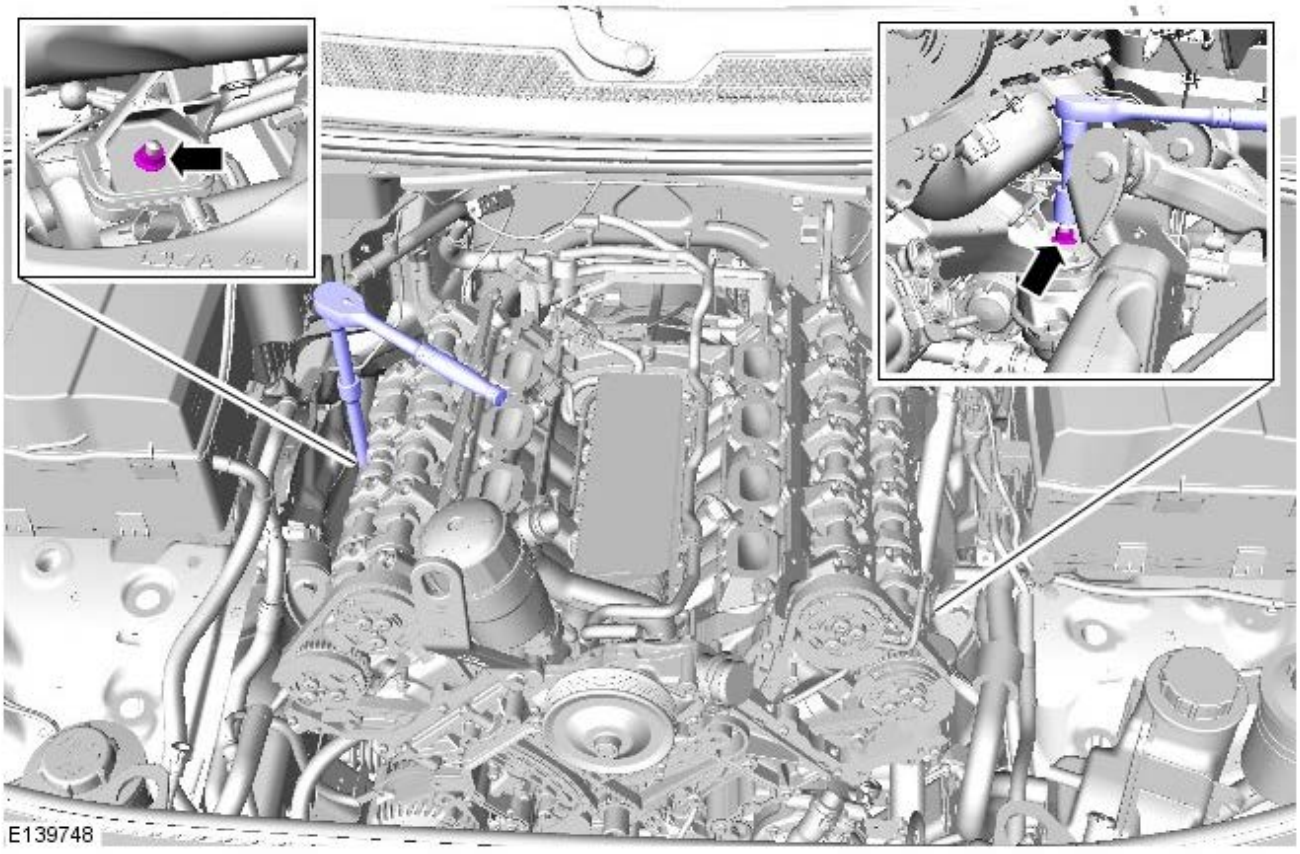
- Install the oil suction tube.
- *Torque:* 10 Nm



24.

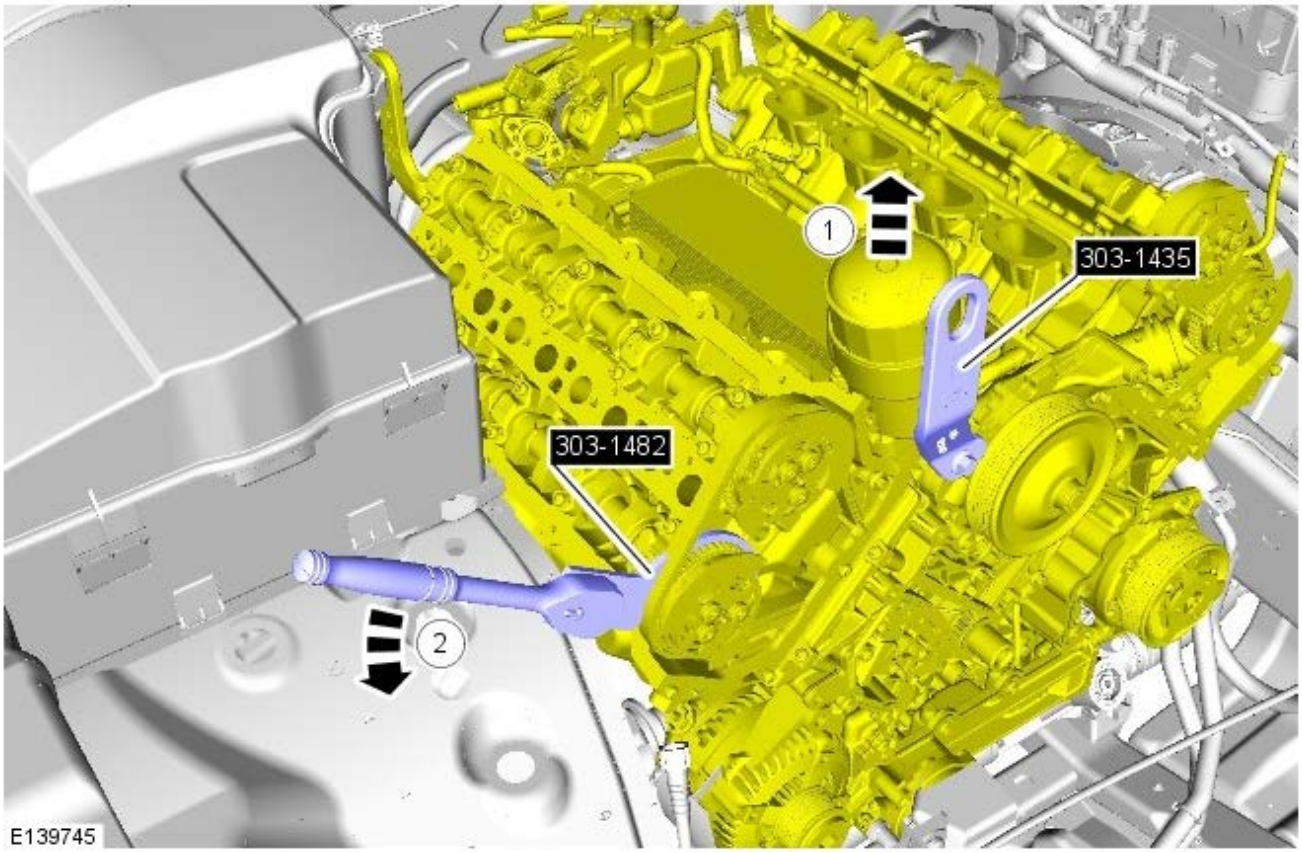


25.



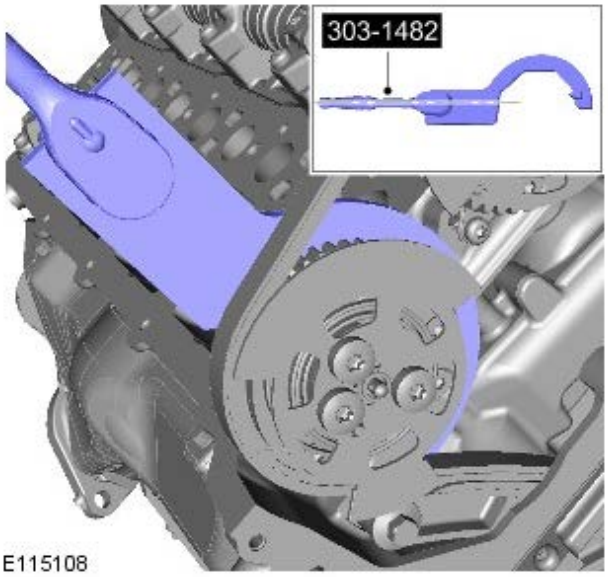
26.

- Raise and support the engine, then install the special tool.
- *Special Tool(s):* 303-1482



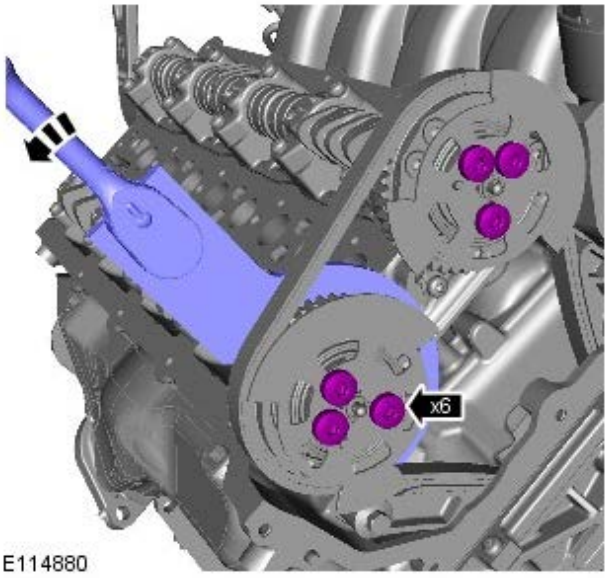
27. CAUTIONS:

Apply the torque to the end of the special tool.



Make sure that the torque wrench is aligned with the special tool as illustrated in the graphic.

- Install the torque wrench to the special tool.
- *Torque:* 35 Nm



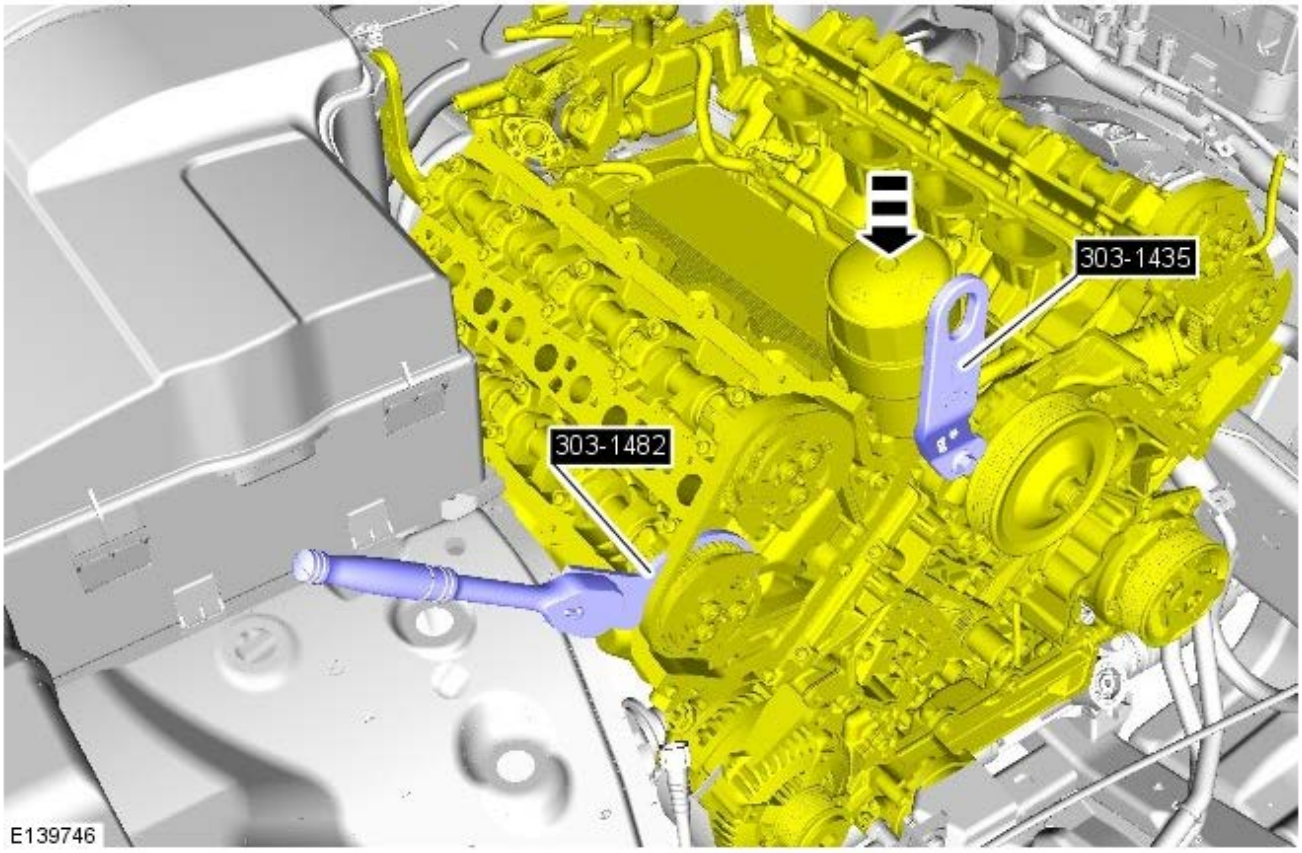
28. CAUTION: Make sure that the torque wrench does not move whilst tightening the VVT bolts.

NOTE: Make sure to tighten the inlet VVT unit bolts first.

Torque: 32 Nm

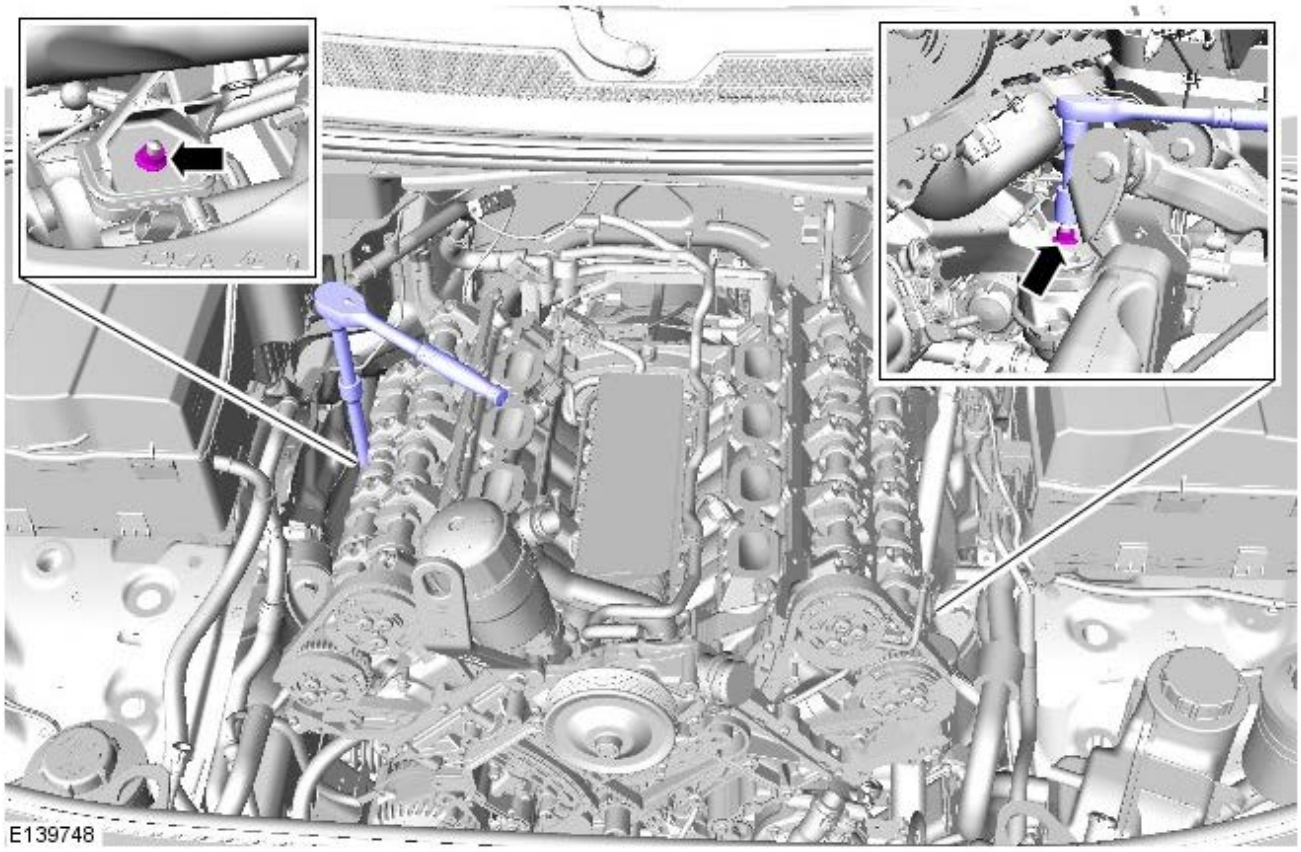
29.

- Remove the special tool and lower the engine.
- *Special Tool(s):* 303-1482



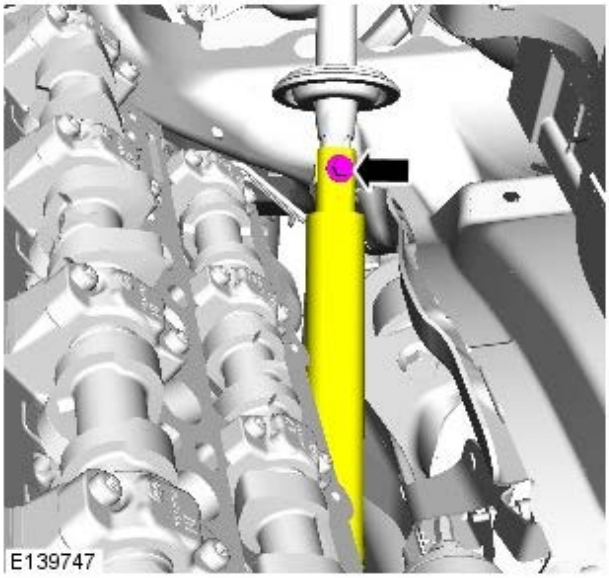
30.

- *Torque:* 100 Nm



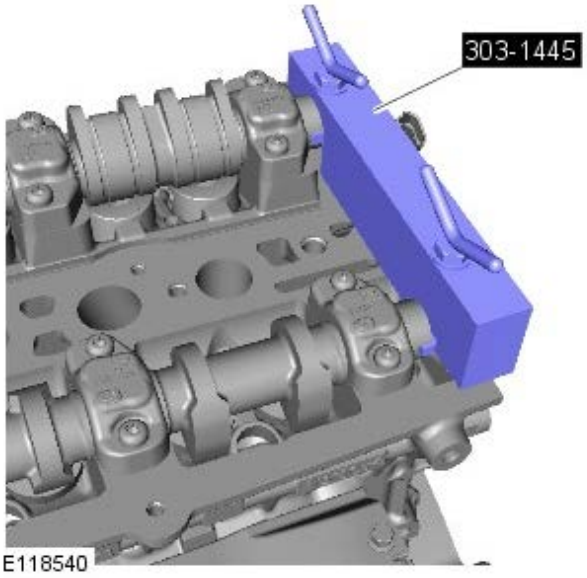
31.

- *Torque:* 20 Nm



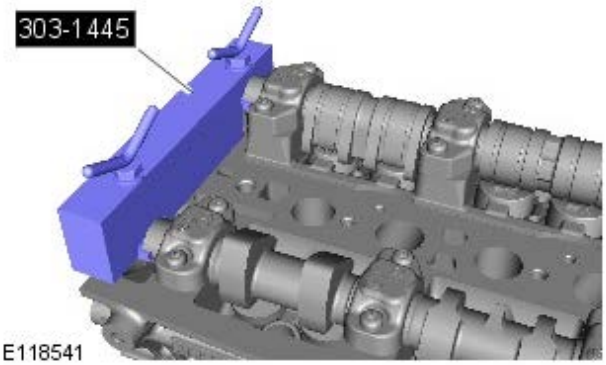
32.

- Remove the special tool.



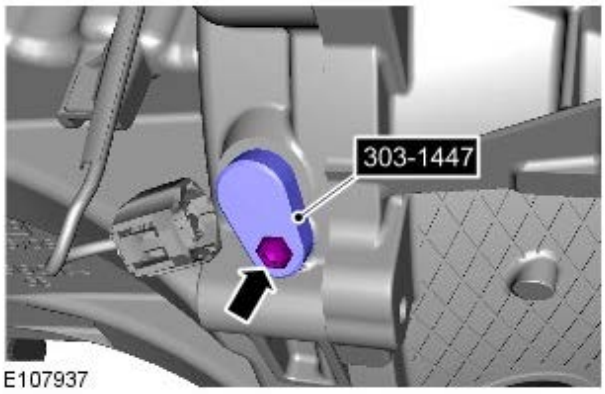
33.

- Remove the special tool.



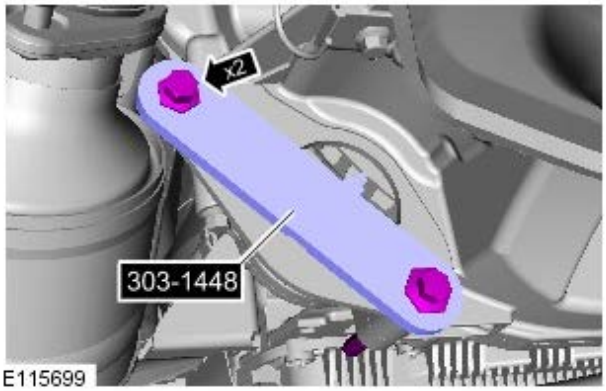
34.

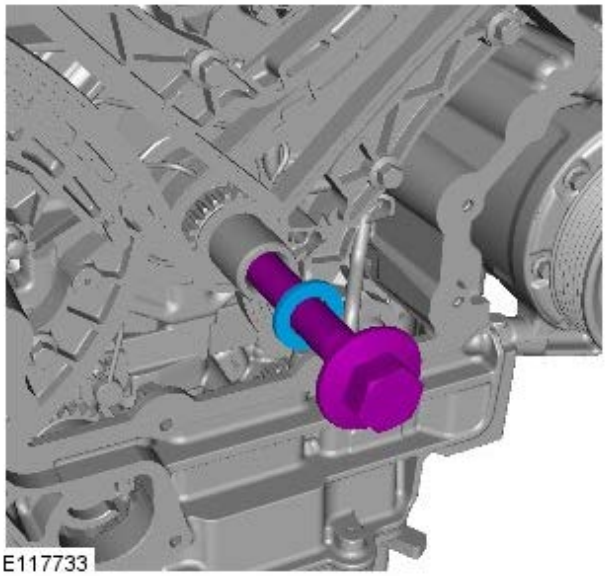
- Remove the special tool.
- *Special Tool(s):* 303-1447



35.

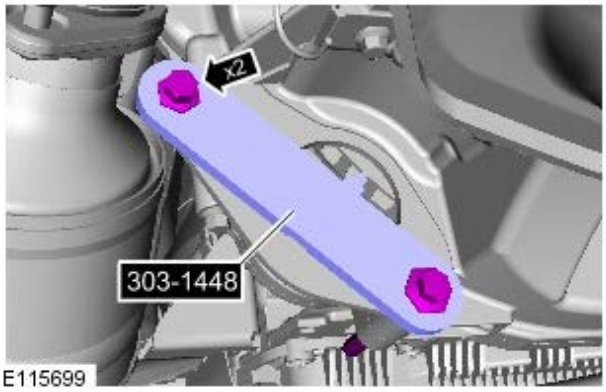
- Install the special tool.
- *Special Tool(s):* 303-1448





36. CAUTION: Install the crankshaft pulley bolt with an M16 washer to prevent damage to the crankshaft on installation.

Torque: 50 Nm

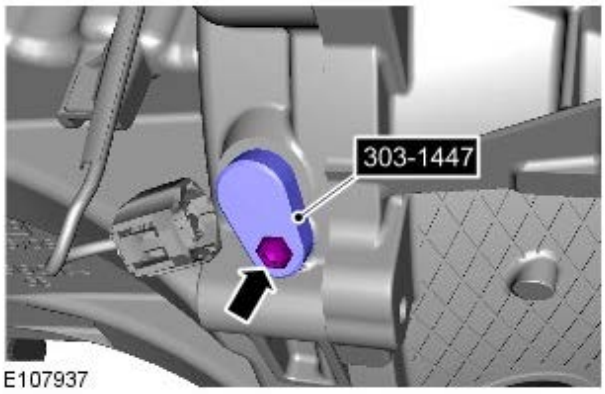


37.

- Remove the special tool.
- *Special Tool(s):* 303-1448

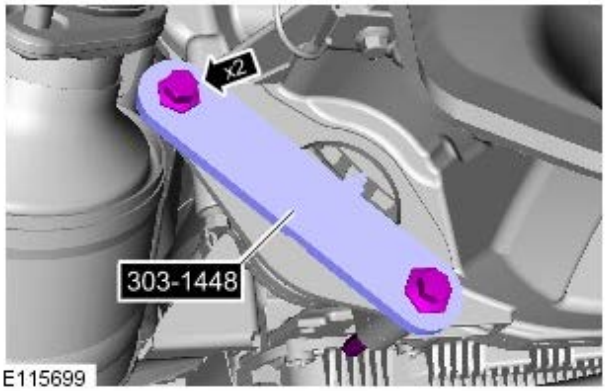
38. Rotate the engine two complete turns clockwise.

39. CAUTION: Only rotate the crankshaft clockwise.



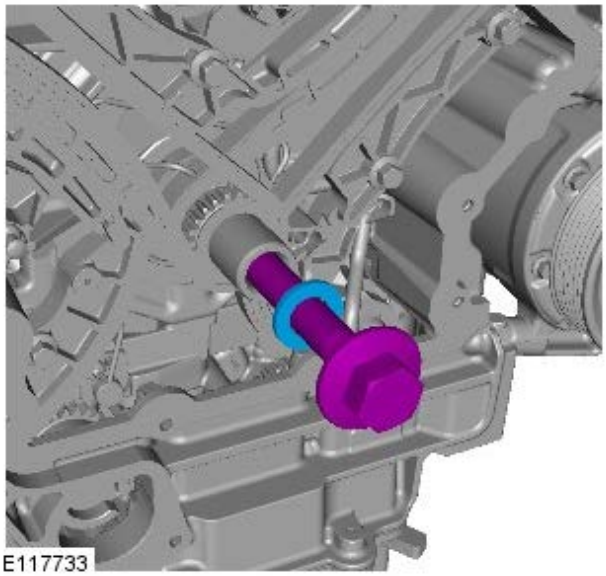
- Install the special tool.
- *Special Tool(s):* 303-1447

40.

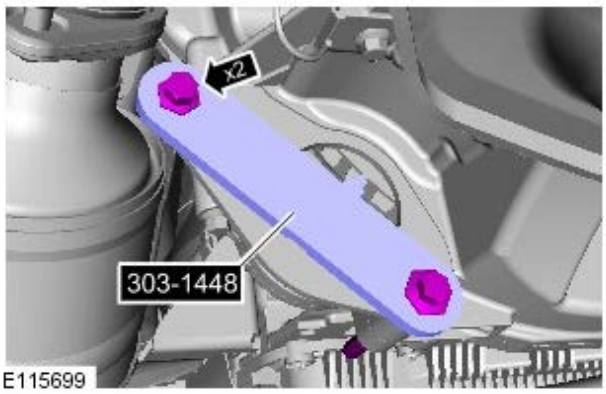


- Install the special tool.
- *Special Tool(s):* 303-1448

41.



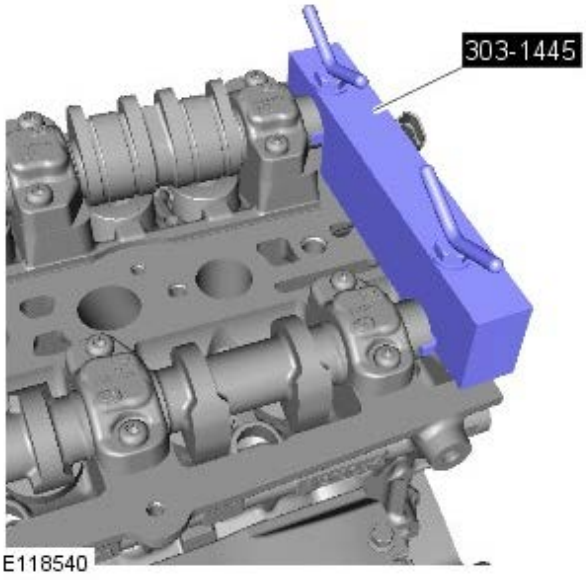
42.



- Remove the special tool.
- *Special Tool(s):* 303-1448

43. CAUTIONS:

If the special tool cannot be installed, return to

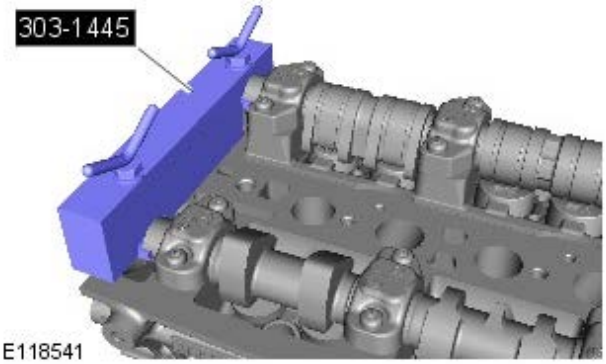


step 22 of the installation until the special tool 303-1445 is installed correctly.

If directed to step 22, make sure that the VVT unit retaining bolts are loosened prior to installing the special tool(s).

Install the special tool.

Special Tool(s): 303-1445

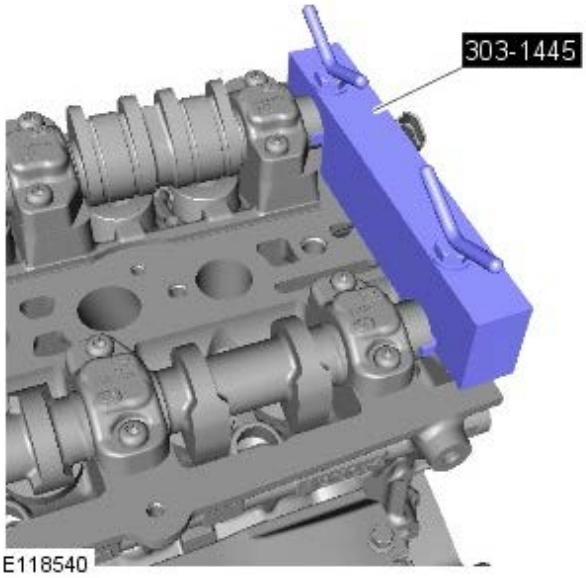


44. CAUTION: If the special tool cannot be installed, the timing chain installation steps must be repeated.

Install the special tool.

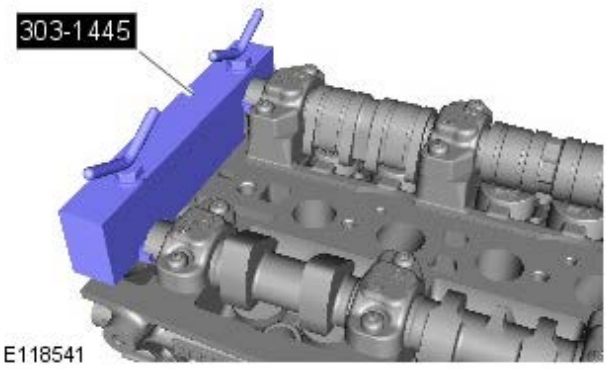
45.

- Remove the special tool.



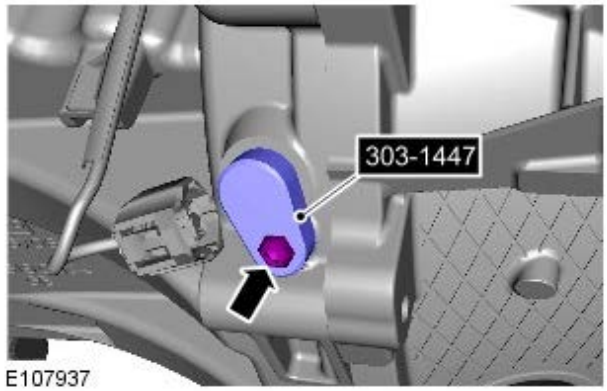
46.

- Remove the special tool.

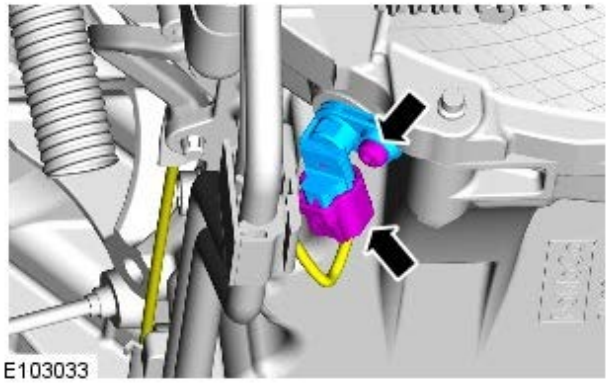


47.

- Remove the special tool.
- *Special Tool(s):* 303-1447



48. *Torque:* 10 Nm



49. Refer to: Timing Cover (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

50. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 02-Aug-2011

Engine - V8 5.0L Petrol - Timing Drive Components Assembly Part Number: Tsubaki Timing Drive

Removal and Installation

Special Tool(s)

 E115263	303-1445 Timing Tool – Camshaft Alignment
 E115265	303-1447 Timing Tool
 E115266	303-1448 Locking Tool
 E115270	303-1452 Camshaft Rotating Tool
 E115271	303-1482 Tensioner Tool

Removal

CAUTION: Check all timing components for wear and install new components if required.

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

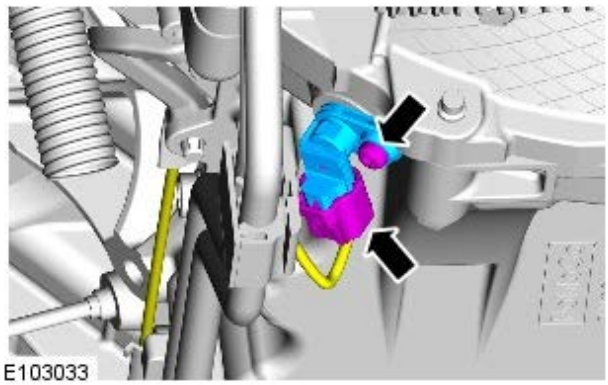
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

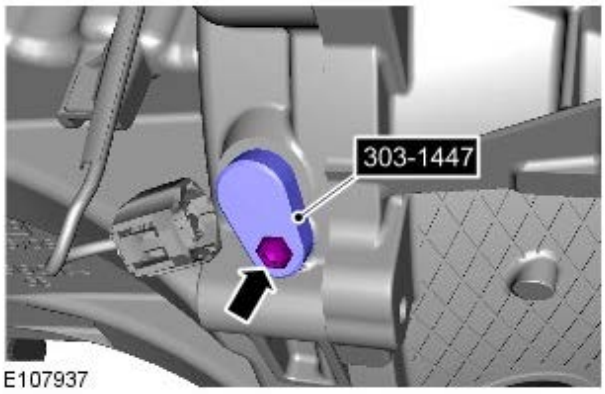
   Raise and support the vehicle.

3.



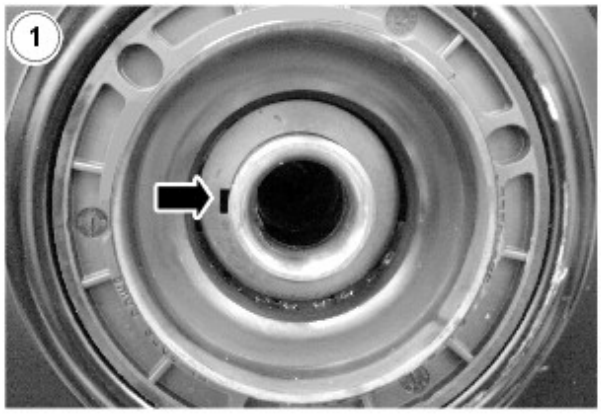
4. CAUTION: Only rotate the crankshaft clockwise.

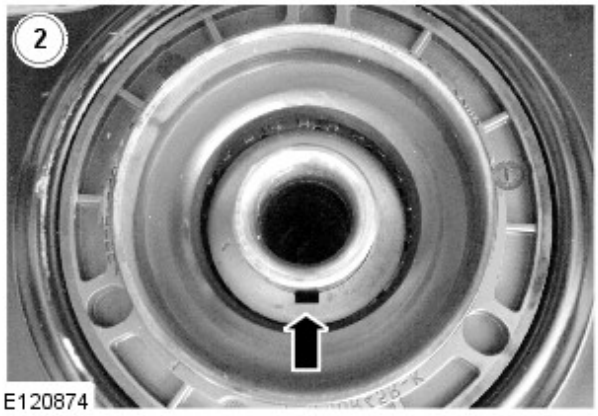
   Install the special tool.



5. CAUTION: If the noted postion of the woodruff key is at the 9 o'clock position, then a new flexplate must be installed. If the woodruff key is in the 6 o'clock position then proceed with the next step.

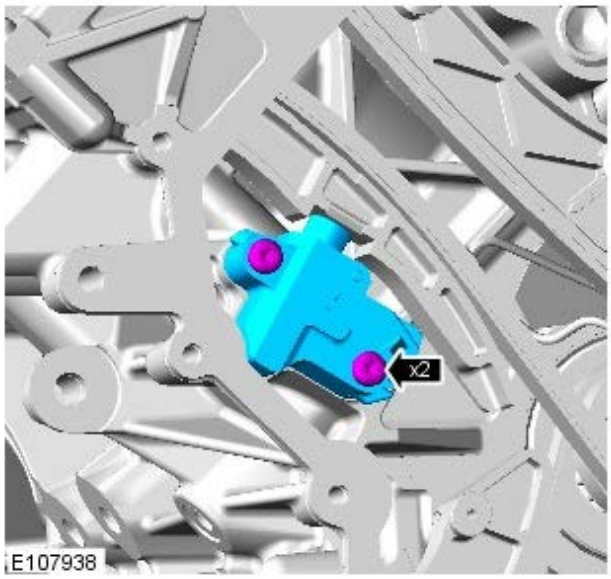
   Note the position of the crankshaft woodruff key.



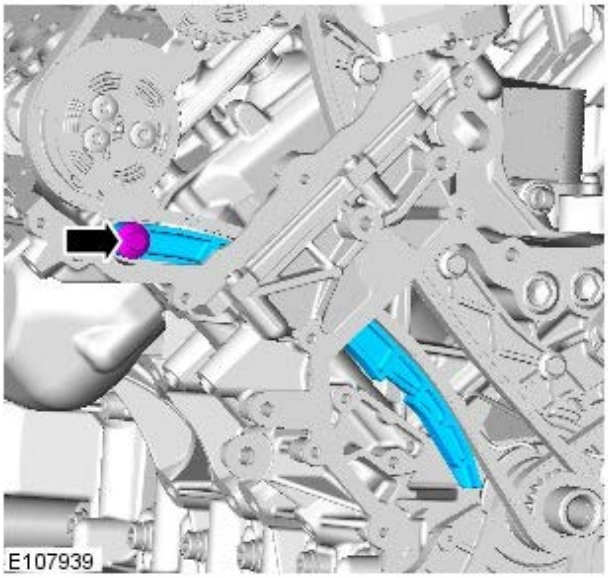


6. Refer to: Timing Cover (303-01 Engine - V8 5.0L Petrol, Removal and Installation).

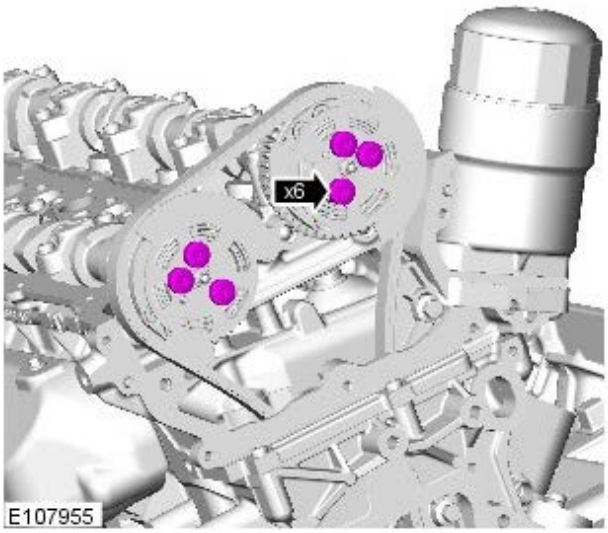
7.



8.

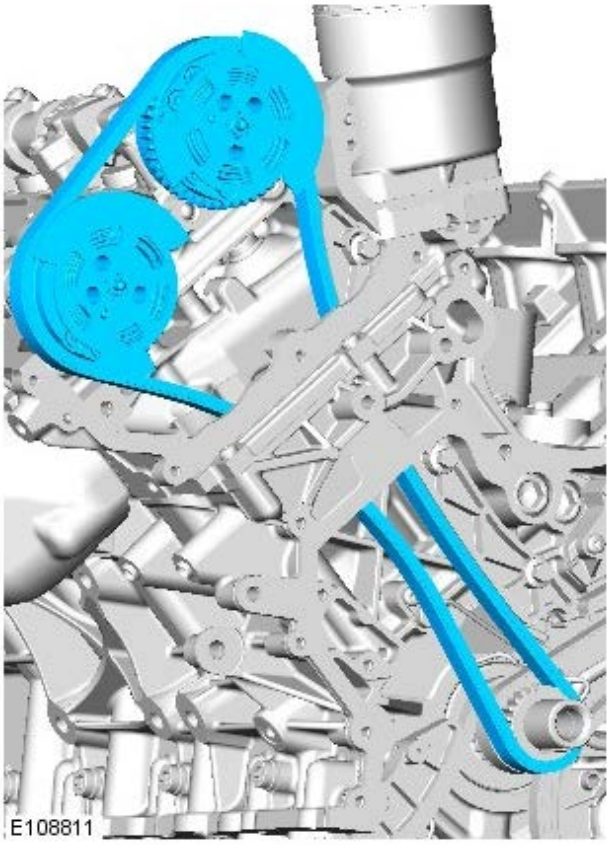


9.

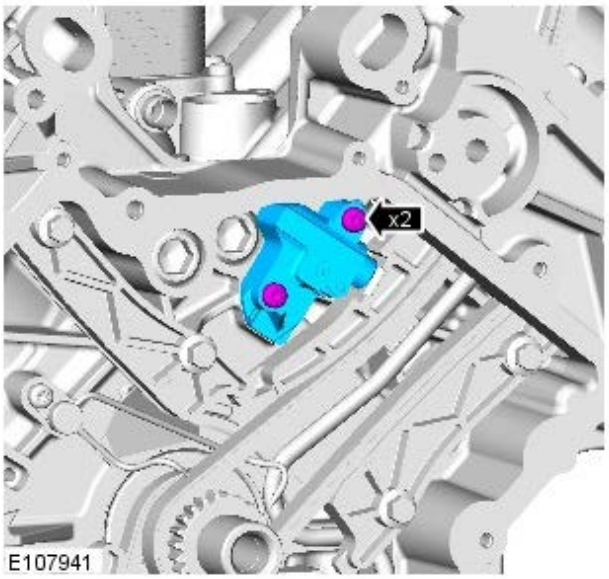


10. CAUTION: If the variable valve timing (VVT) units are knocked or dropped then the VVT must be replaced.

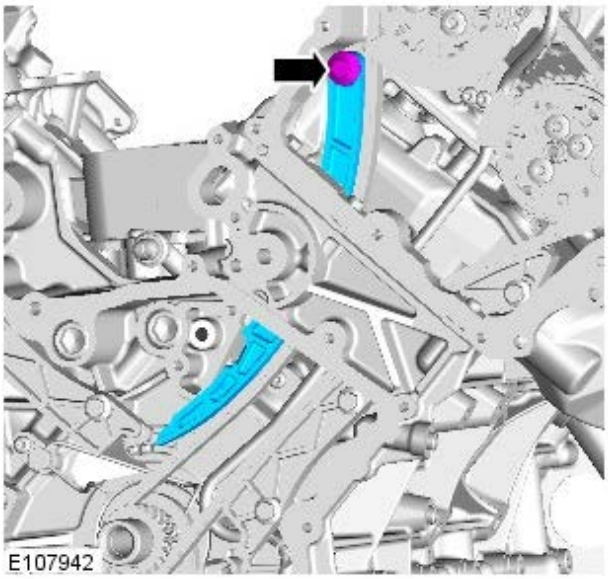
    Remove the timing chain with the VVT units.



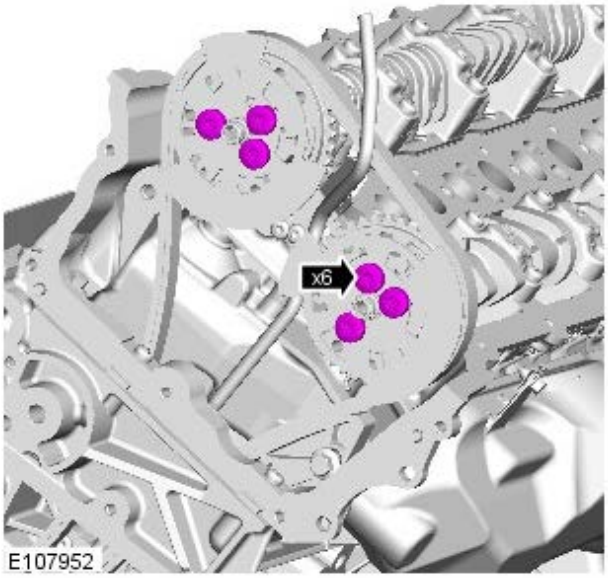
11.



12.

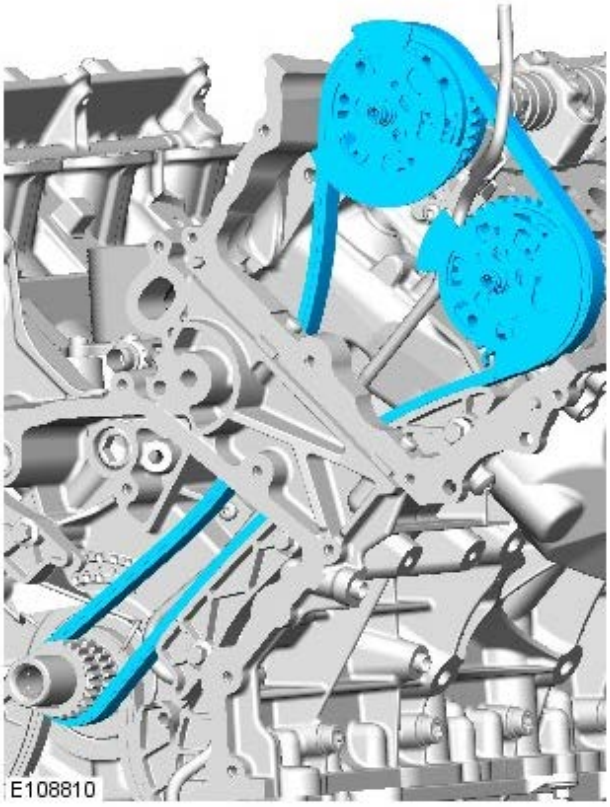


13.

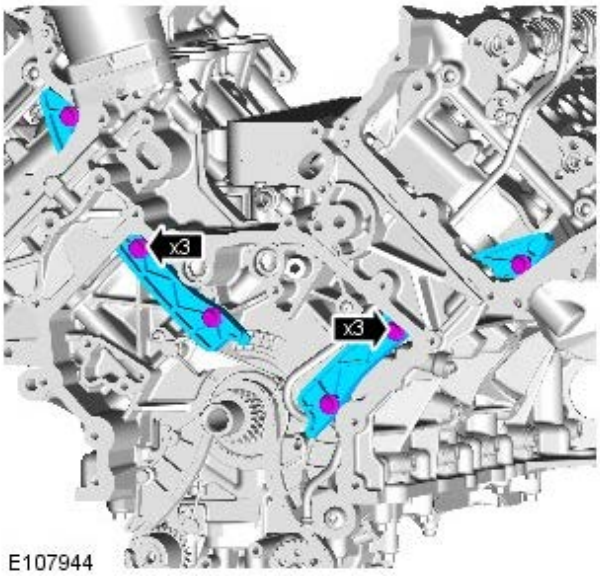


14. CAUTION: If the VVT is knocked or dropped then the VVT must be replaced.

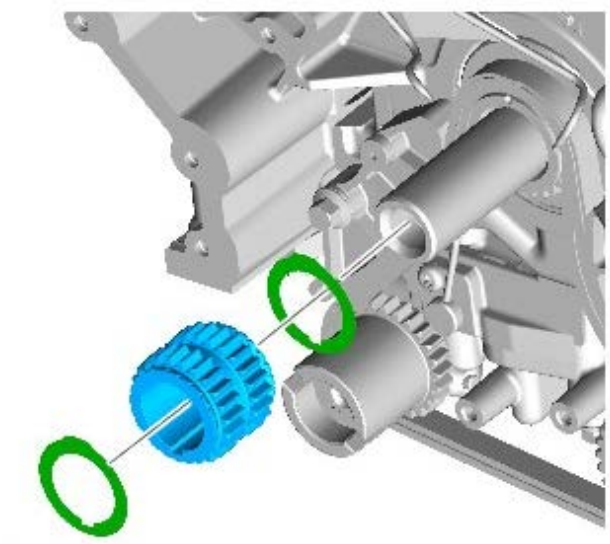
Remove the timing chain with the VVT units.



15.

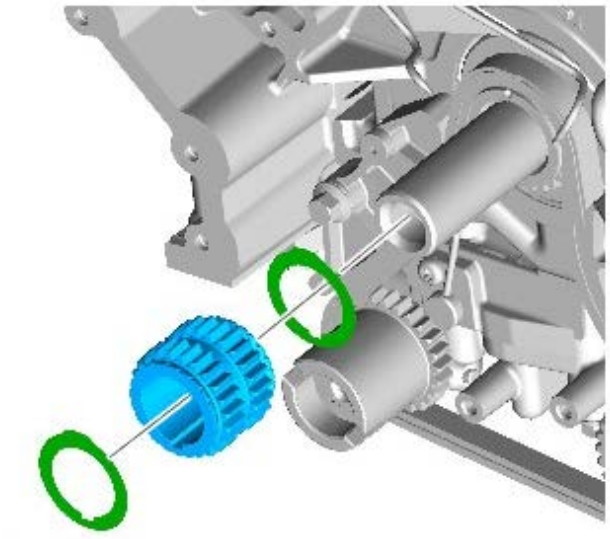


16. CAUTION: Discard the friction washers.



E107945

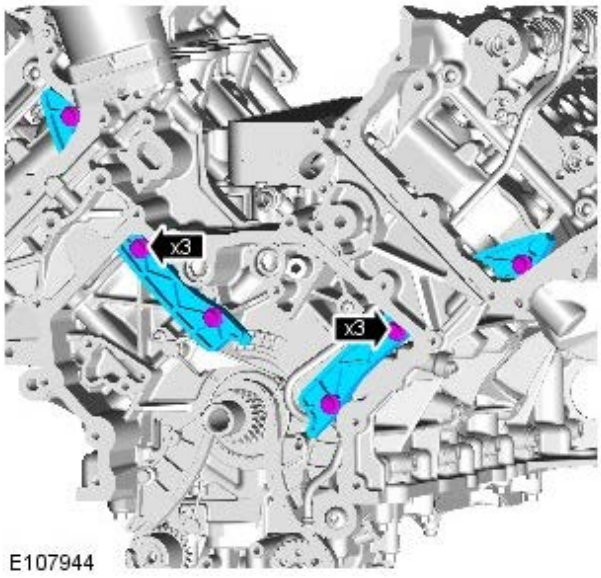
Installation



E107945

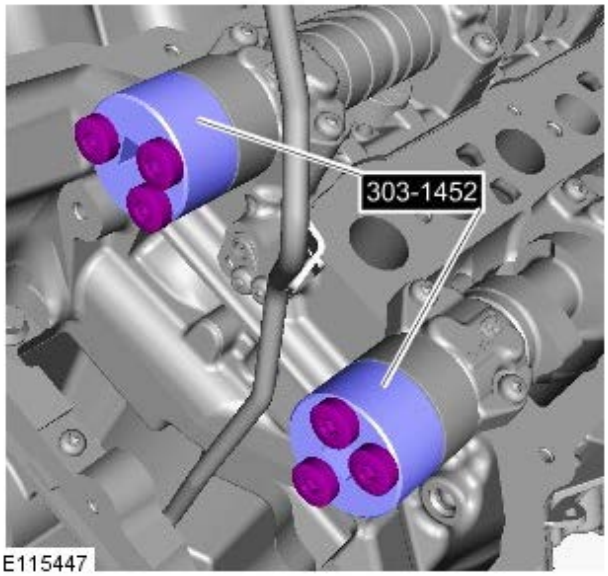
1. CAUTION: Install new friction washers.

2. *Torque:* 12 Nm



E107944

3.
   - Install the special tool to the LH bank Camshafts.
   - *Special Tool(s):* 303-1452
   - *Torque:* 10 Nm



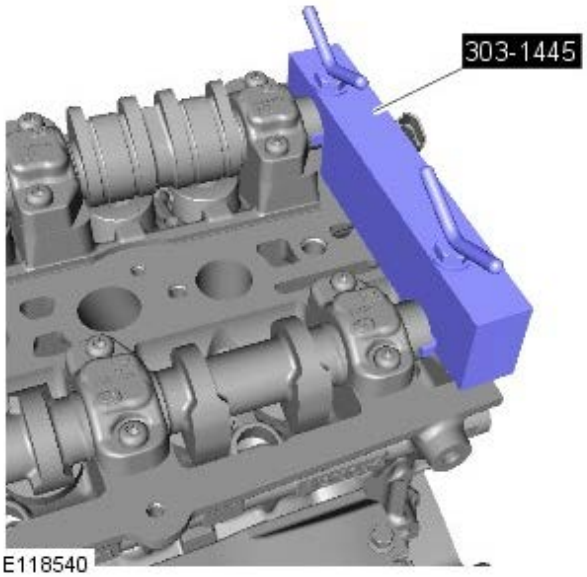
4.

- Carefully rotate the camshafts if the position is not as shown.



5.

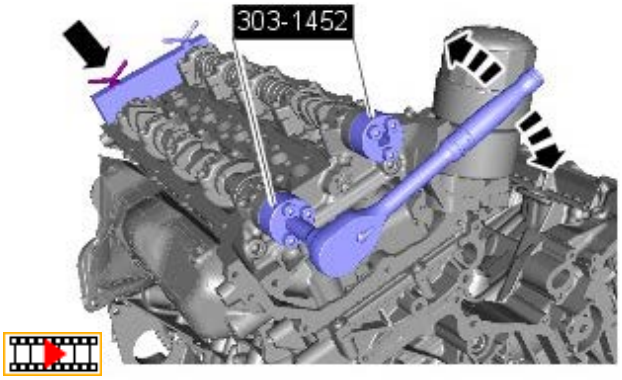
- Install the special tool 303-1445 to the rear of the camshafts making sure the key way's are correctly located into each slot on each of the camshafts.



6. CAUTIONS:

Do not overturn the camshafts.

Tighten the wing nuts finger tight. Failure to



follow this instruction may result in damage to the components.

- Using a suitable tool, carefully rock the camshaft clockwise then anti-clockwise. Turn the special tool locking nuts until there is no movement left in camshafts.
- Repeat steps 3- 6 for the camshafts on the other cylinder head.

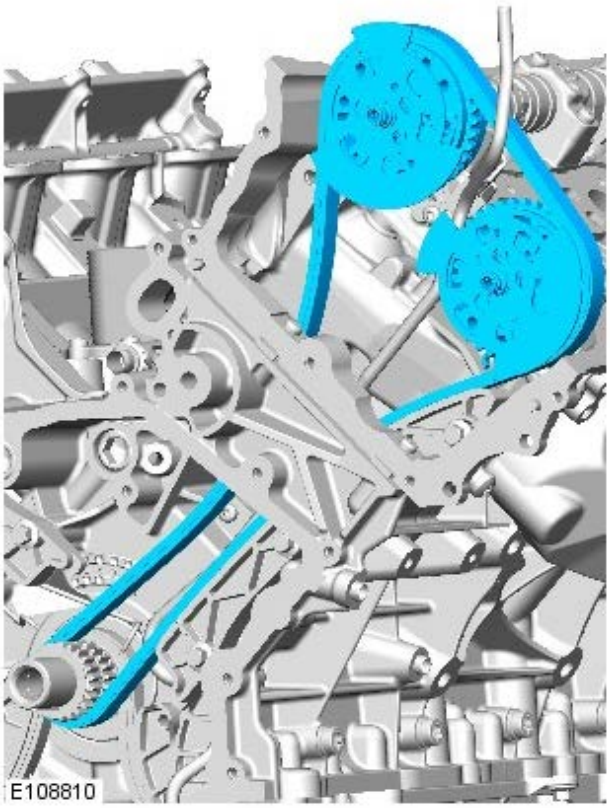
7. CAUTIONS:

Do not allow the camshaft to rotate.

If the VVT is knocked or dropped then the VVT must be replaced.

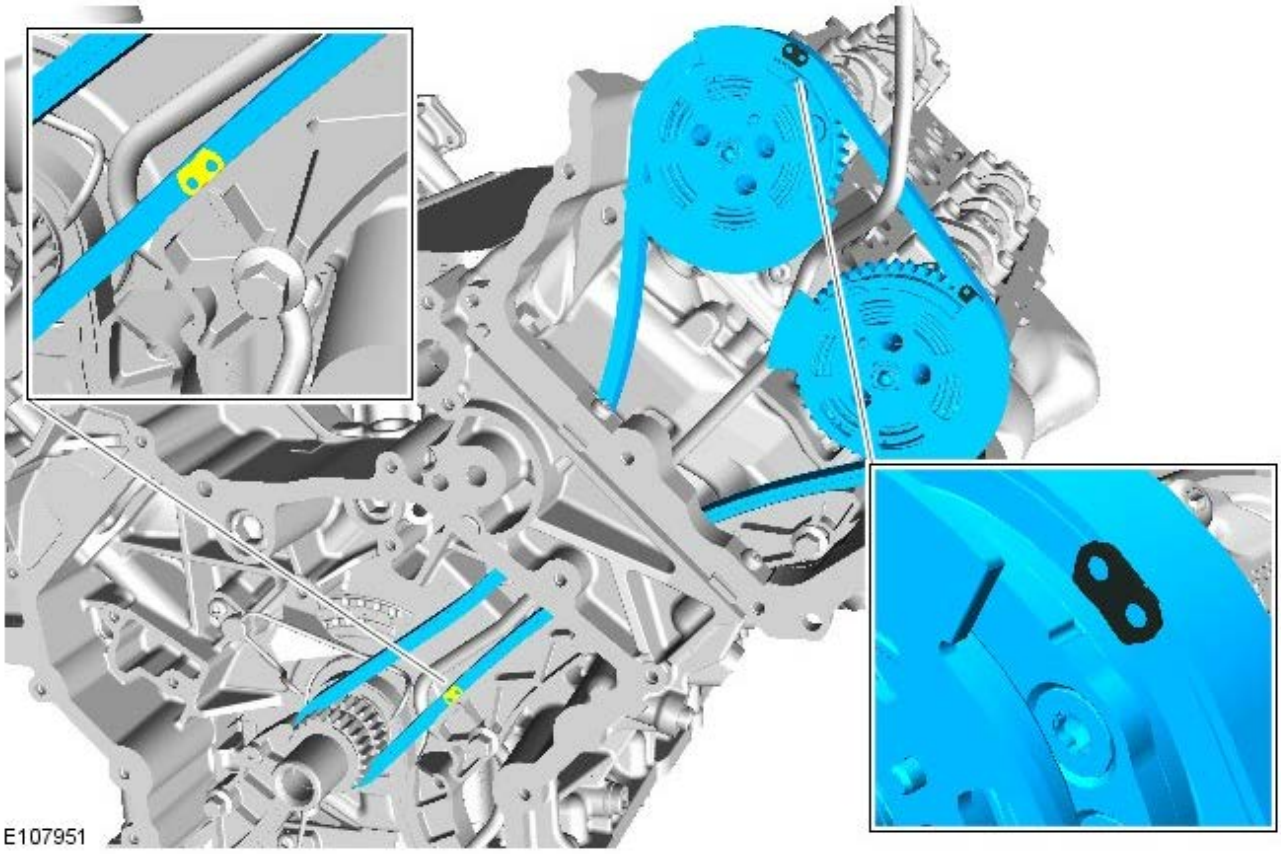
NOTE: Do not tighten at this stage.

- Install the timing chain with the variable valve timing (VVT) units.

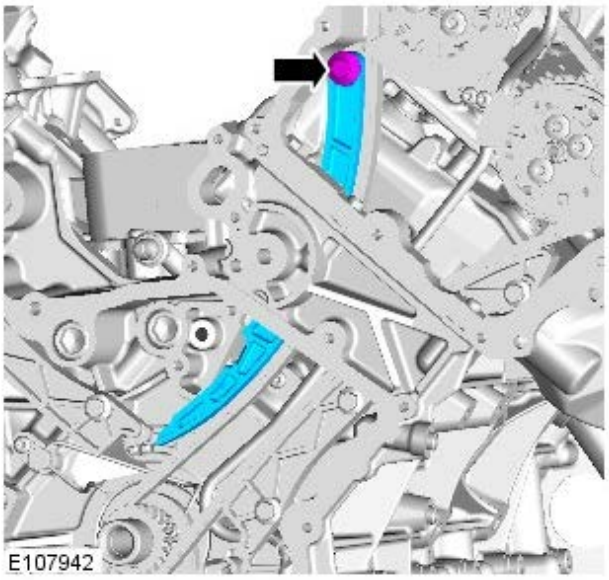


8.

- Make sure that all the timing chain alignment marks are in the positions shown.

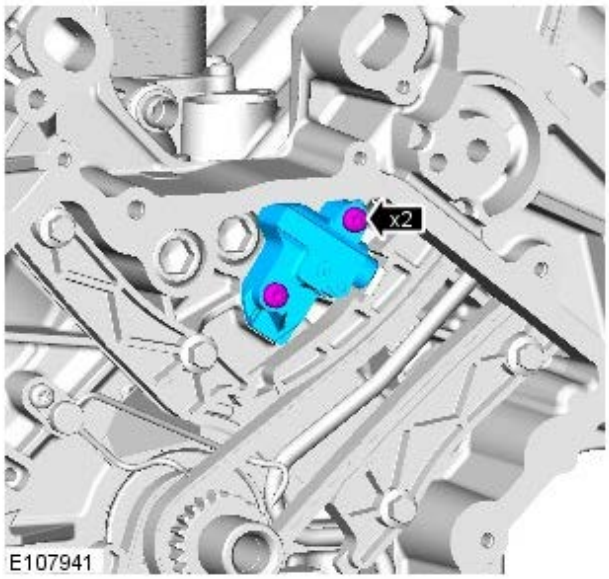


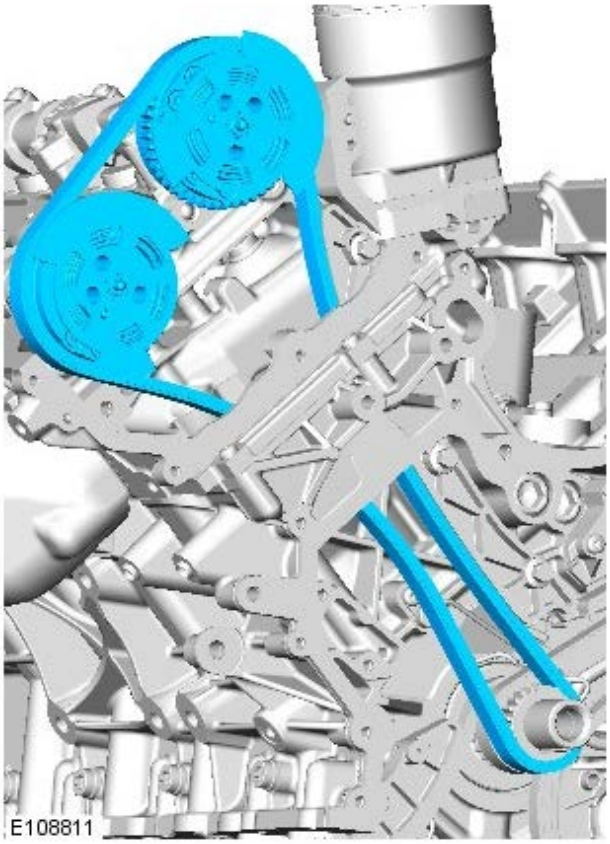
9. *Torque:* 25 Nm



10. CAUTION: Do not release the timing chain tensioner locking pin at this stage.

Torque: 10 Nm





11. CAUTIONS:

Do not allow the camshafts to rotate.

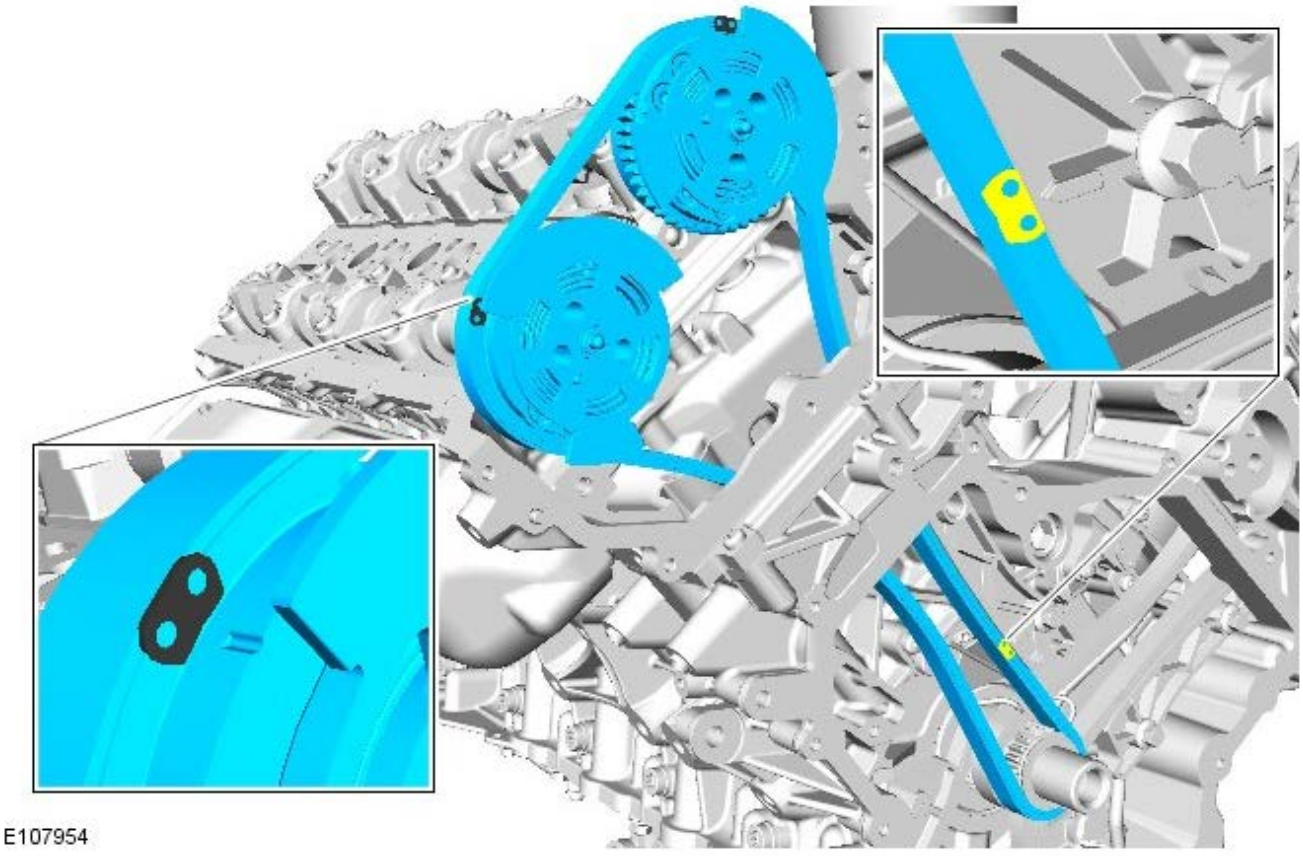
If the VVT is knocked or dropped then the VVT must be replaced.

NOTE: Do not tighten at this stage.

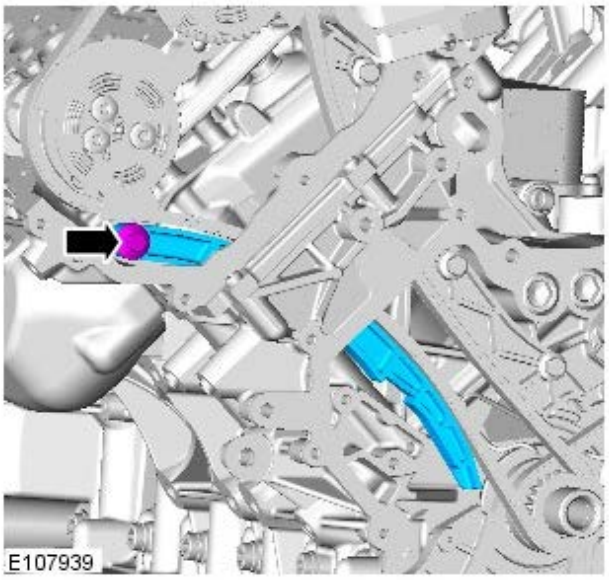
- Install the timing chain with the VVT units.

12.

- Make sure that all the timing chain alignment marks are in the positions shown.



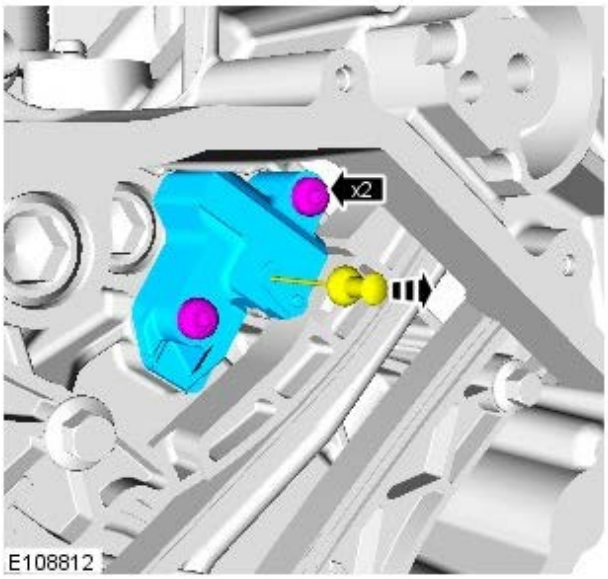
13. *Torque:* 25 Nm

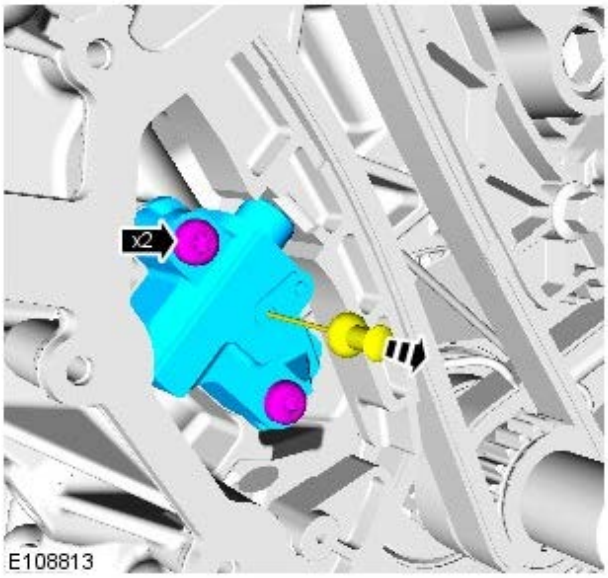


14. CAUTION: Do not use mechanical force.

Make sure that the tensioners are fully deployed.

Torque: 10 Nm

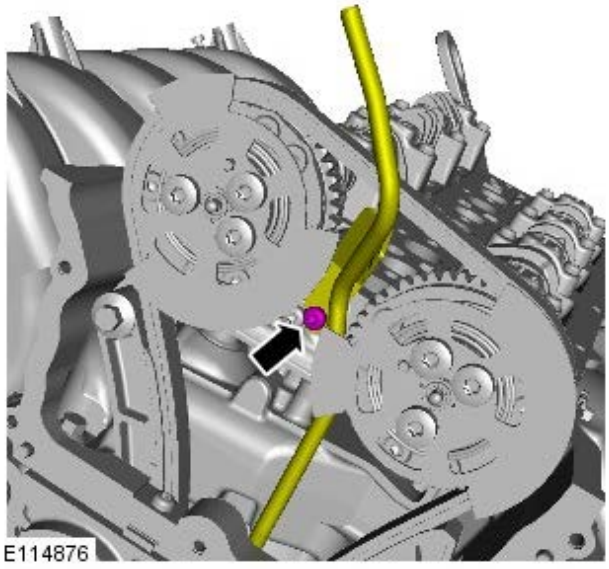




15. CAUTION: Do not use mechanical force.

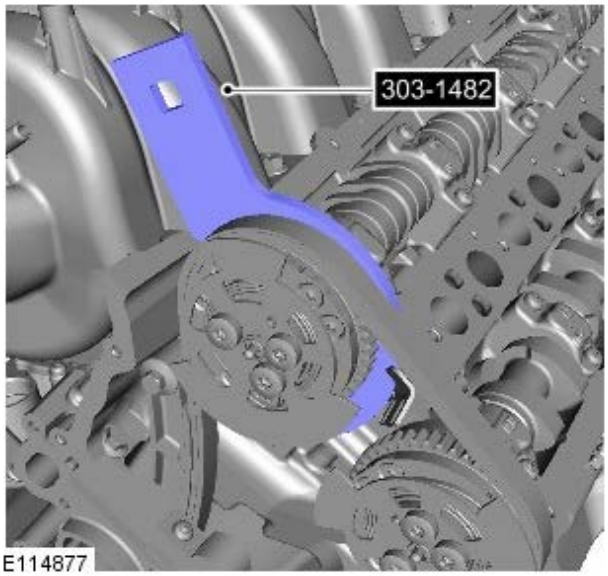
    Make sure that the tensioners are fully deployed.

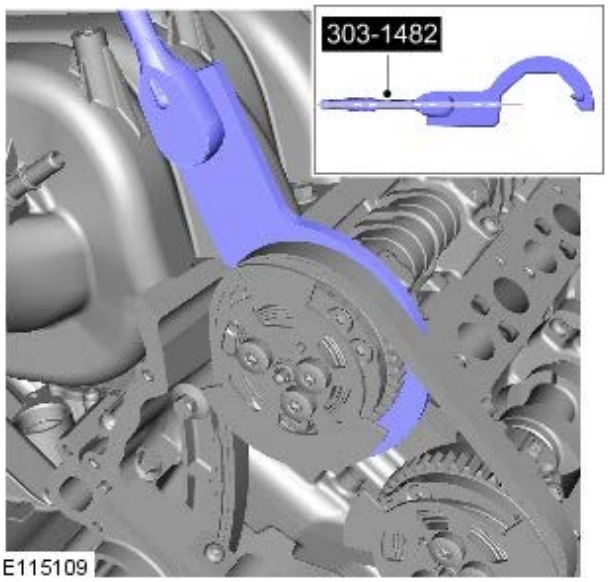
    Torque: 10 Nm



16.
- Release and reposition the oil suction tube to one side.

17.
- Install the special tool.
- *Special Tool(s):* 303-1482



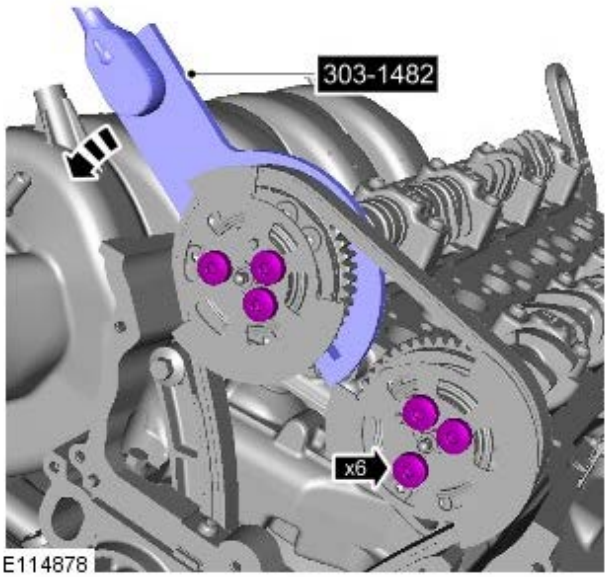


18. CAUTIONS:

Apply the torque to the end of the special tool.

Make sure that the torque wench is aligned with the special tool as illustrated in the graphic.

- Install the torque wrench to the special tool.
- *Torque:* 35 Nm



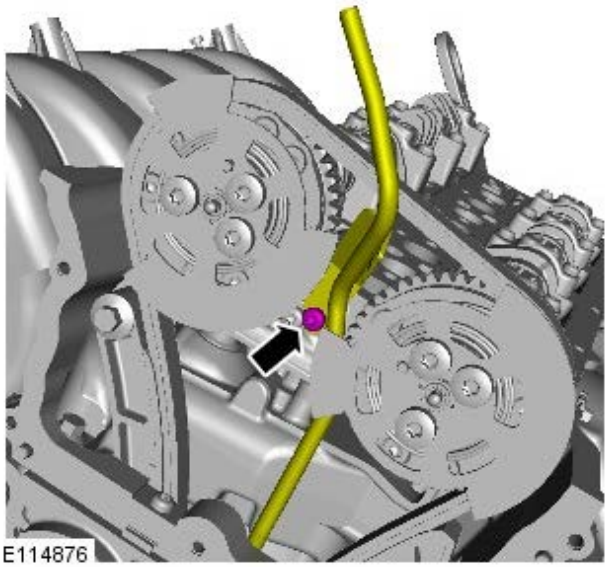
19. CAUTION: Make sure that the torque wrench does not move whilst tightening the VVT bolts.

NOTE: Make sure to tighten the exhaust VVT unit bolts first.

- *Torque:* 32 Nm
- *Special Tool(s):* 303-1482

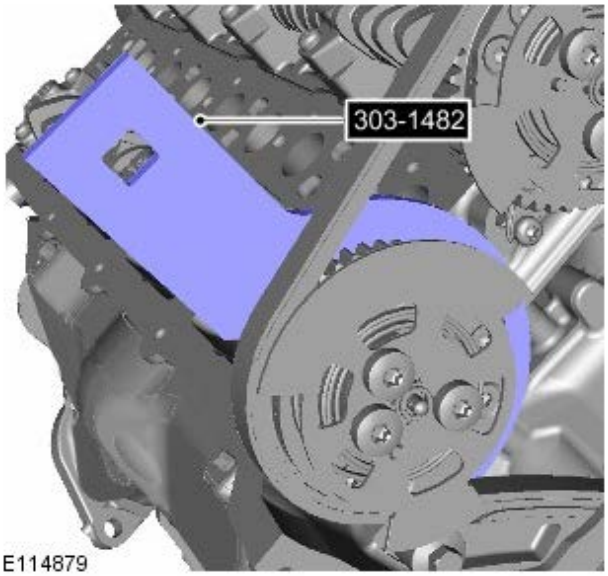
20.

- Install the oil suction tube.
- *Torque:* 10 Nm


E114876

21.

- Install the special tool.
- *Special Tool(s):* 303-1482



E114879

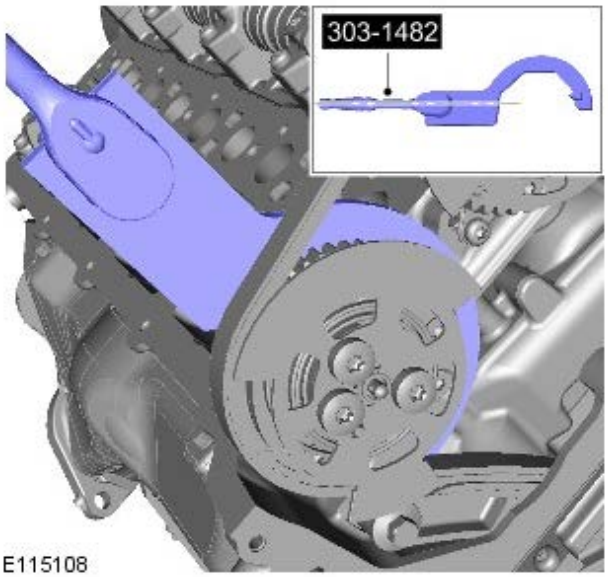
22. CAUTIONS:

Apply the torque to the end of the special tool.

Make sure that the torque wench is aligned with the special tool as illustrated in the graphic.

- Install the torque wrench to the special tool.

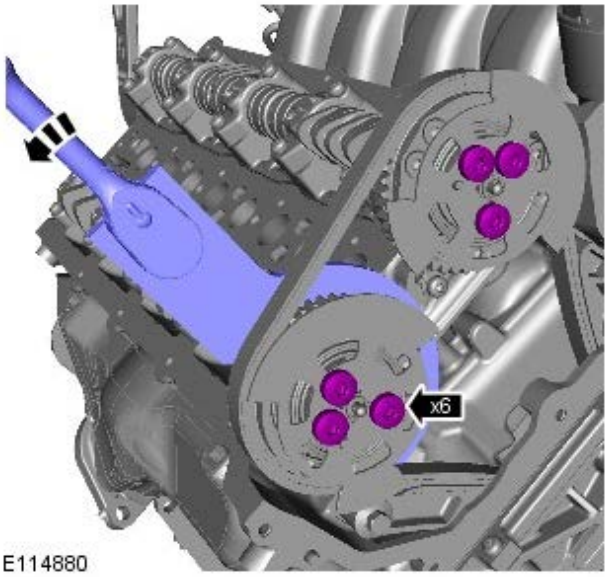
  Special Tool(s): 303-1482
- *Torque:* 35 Nm



E115108

23. CAUTION: Make sure that the torque wrench does not move whilst tightening the VVT bolts.

NOTE: Make sure to tighten the inlet VVT unit bolts first.

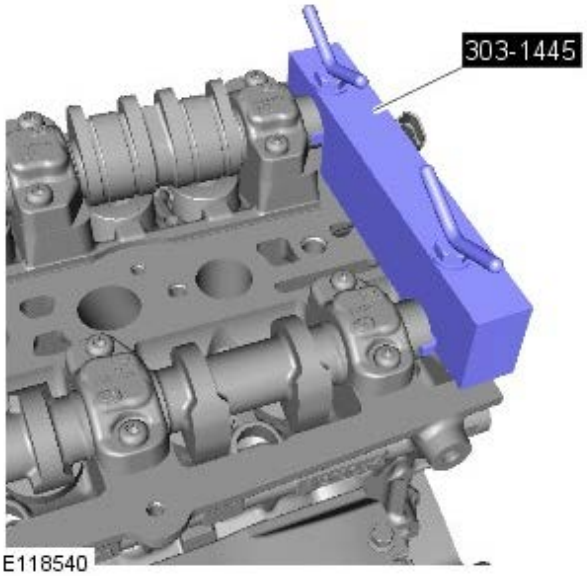


E114880

Torque: 32 Nm

24.

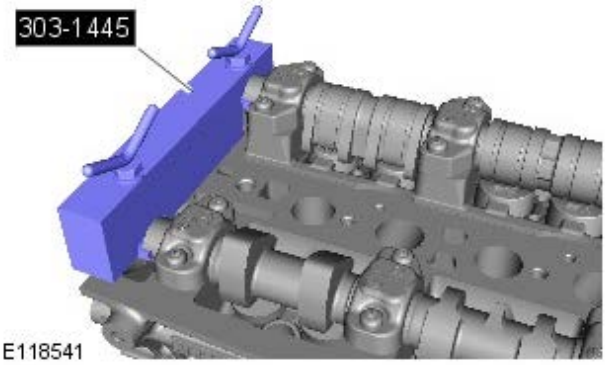
- Remove the special tool.



E118540

25.

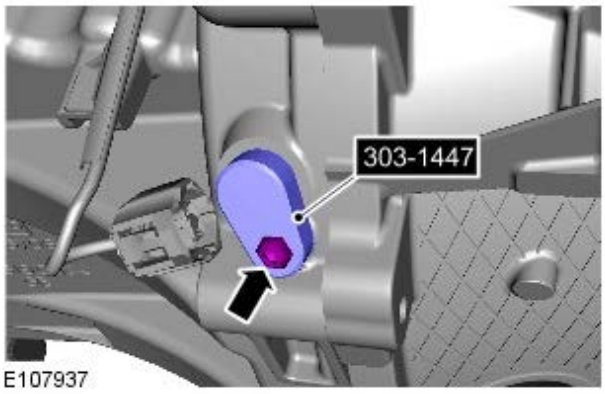
- Remove the special tool.



E118541

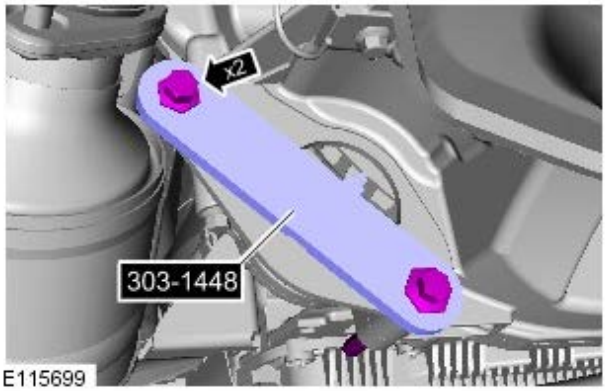
26.

- Remove the special tool.
- *Special Tool(s):* 303-1447



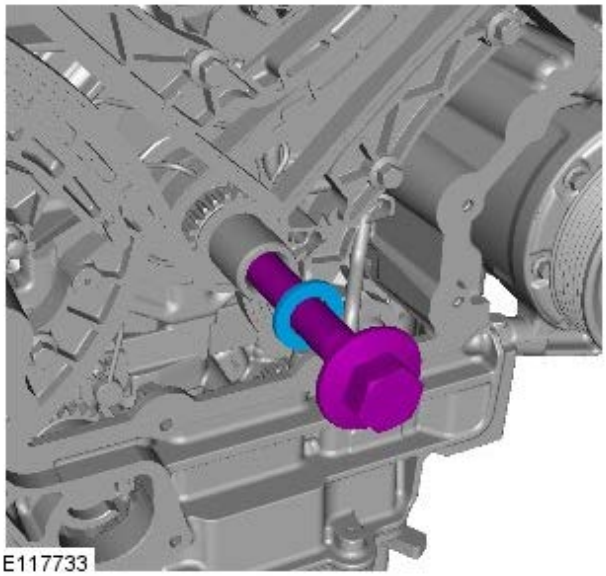
27.

- Install the special tool.
- *Special Tool(s):* 303-1448



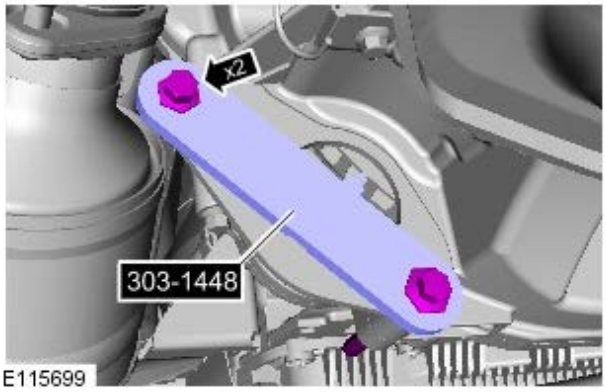
28. CAUTION: Install the crankshaft pulley bolt with an M16 washer to prevent damage to the crankshaft on installation.

Torque: 50 Nm



29.

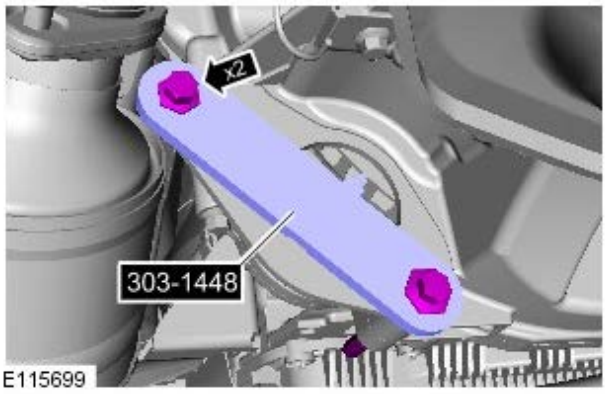
- Remove the special tool.
- *Special Tool(s):* 303-1448



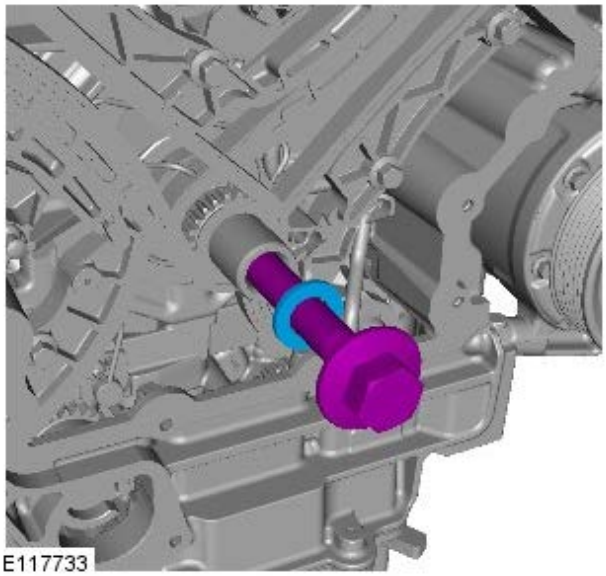
30. Rotate the engine two complete turns clockwise.

31.

- Install the special tool.
- *Special Tool(s):* 303-1448

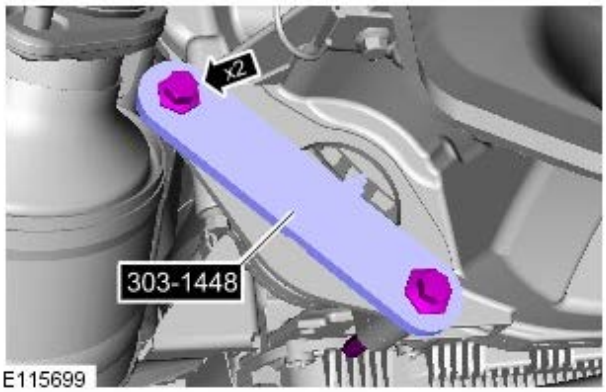


32.



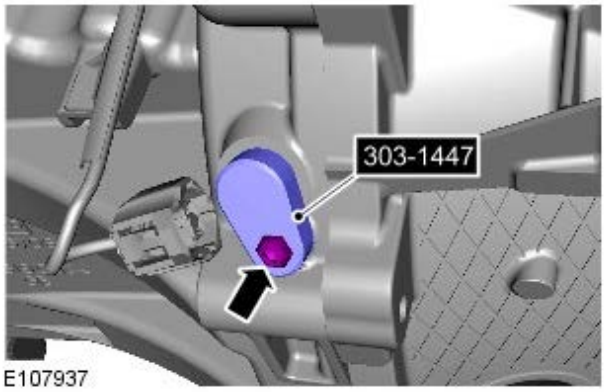
33.

- Remove the special tool.
- *Special Tool(s):* 303-1448



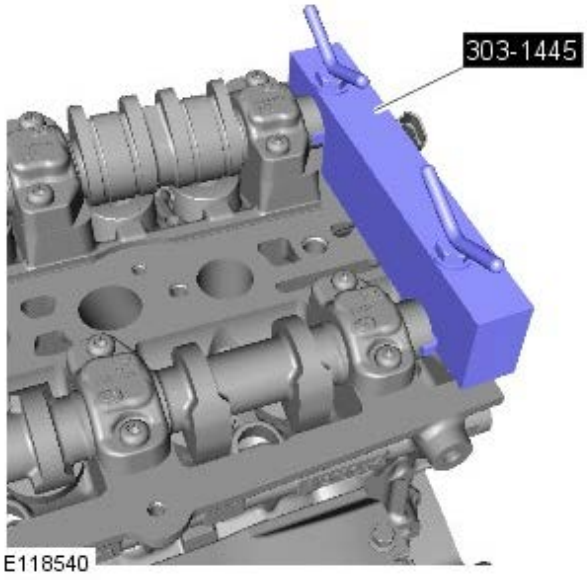
34. CAUTION: Only rotate the crankshaft clockwise.

- Install the special tool.
- *Special Tool(s):* 303-1447



35. CAUTIONS:

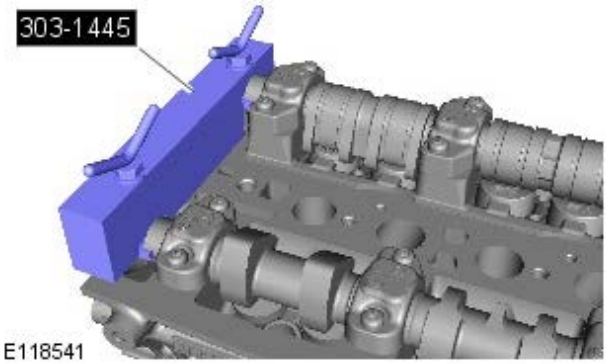
If the special tool cannot be installed, return to



step 22 of the installation until the special tool 303-1445 is installed correctly.

If directed to step 22, make sure that the VVT unit retaining bolts are loosened prior to installing the special tool(s).

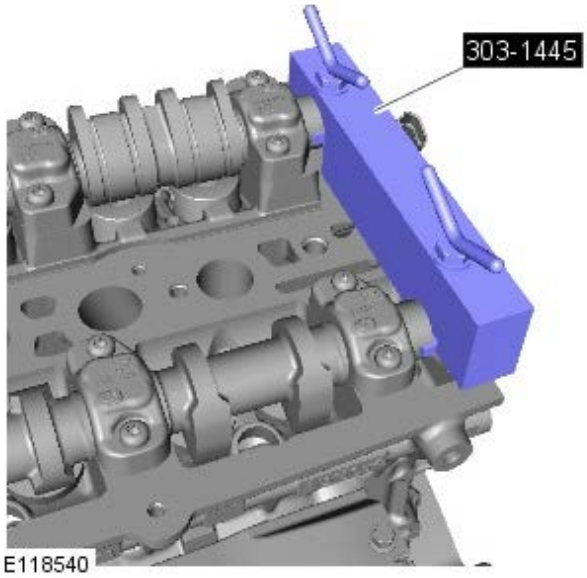
Install the special tool.



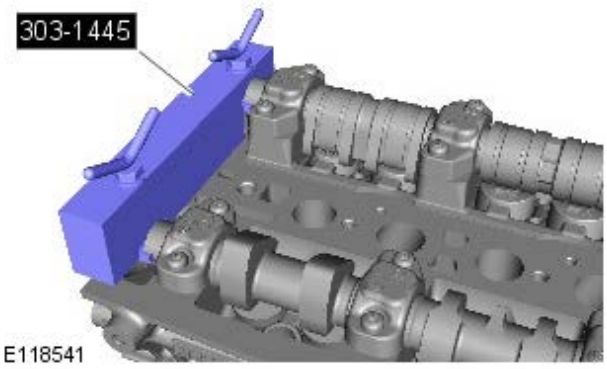
36. CAUTION: If the special tool cannot be installed, the timing chain installation steps must be repeated.

    Install the special tool.

37.
- Remove the special tool.

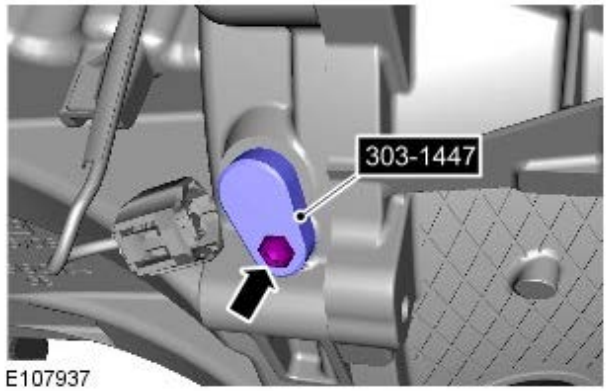


38.
- Remove the special tool.
- *Special Tool(s):* 303-1445

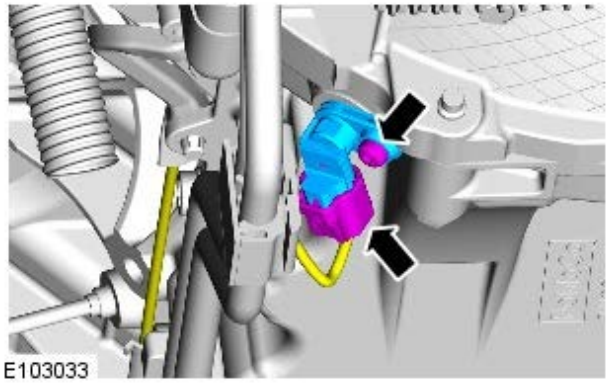


39.

- Remove the special tool.
- *Special Tool(s):* 303-1447



40. *Torque:* 10 Nm



41. Refer to: Timing Cover (303-01 Engine - V8 5.0L Petrol, Removal and Installation).

42. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 11-May-2011

Engine - V8 5.0L Petrol - Valve Cover LH

Removal and Installation

Special Tool(s)

 E116982	303-1446 Valve Cover Alignment Tool

Removal

NOTES:

Removal steps in this procedure may contain installation details.

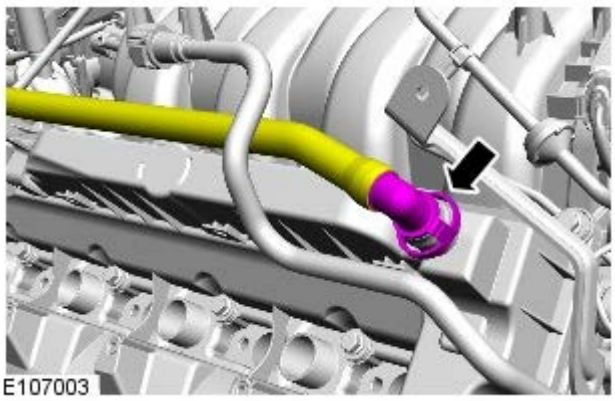
Some variation in the illustrations may occur, but the essential information is always correct.

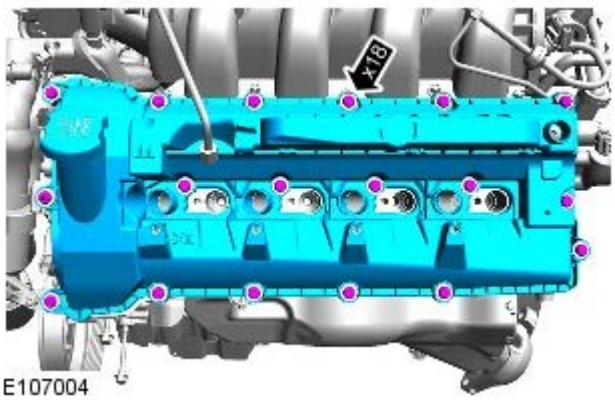
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. Refer to: Air Cleaner LH (303-12, Removal and Installation).

3. Refer to: Fuel Rail LH (303-04, Removal and Installation).

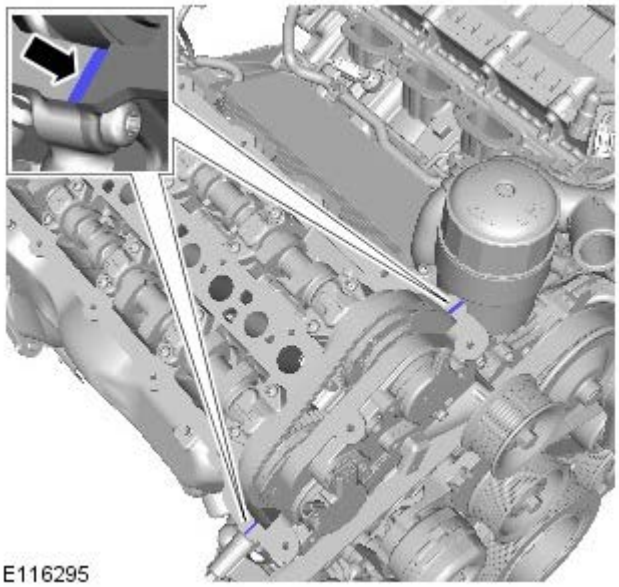
4. 
E107003

5. 
E107004

Installation

1. CAUTIONS:

   Use only a plastic scraper when removing the sealing material.


E116295

Use lint free cloth.

Make sure that the mating faces are clean and free of corrosion and foreign material.

Installation of the valve cover and tightening must be carried out within 7 minutes of applying the sealant.

NOTE: Apply two beads of silcone gasket sealant (Loctite 5901) as shown on the illustration. The application of the sealant must be 1.5mm 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.

To install, reverse the removal procedure.

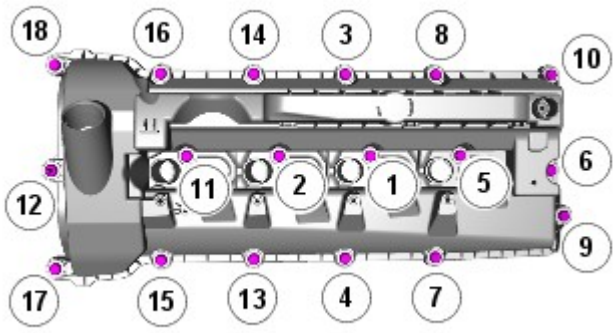
2. *Special Tool(s):* 303-1446



E116666

3. NOTE: Tighten the bolts in the indicated sequence.

Torque: 13 Nm



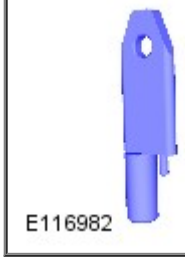
E107006

Published: 11-May-2011

Engine - V8 5.0L Petrol - Valve Cover RH

Removal and Installation

Special Tool(s)

 E116982	303-1446 Valve Cover Alignment Tool

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

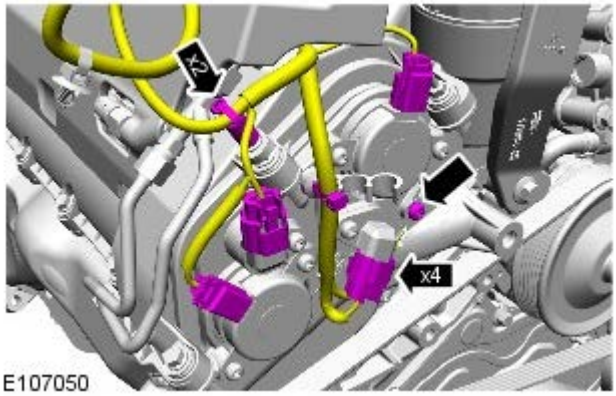
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12, Removal and Installation).

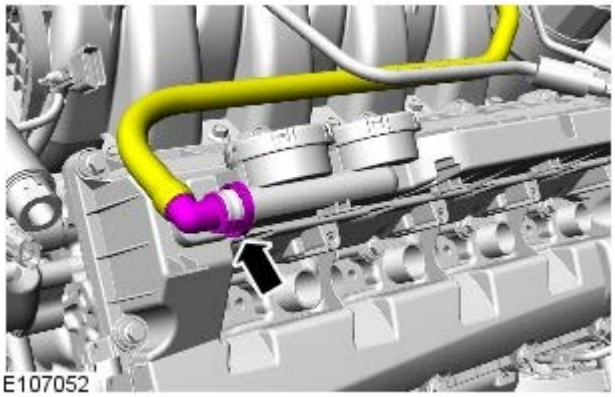
3. Refer to: Air Cleaner RH (303-12, Removal and Installation).

4. Refer to: Fuel Rail RH (303-04, Removal and Installation).

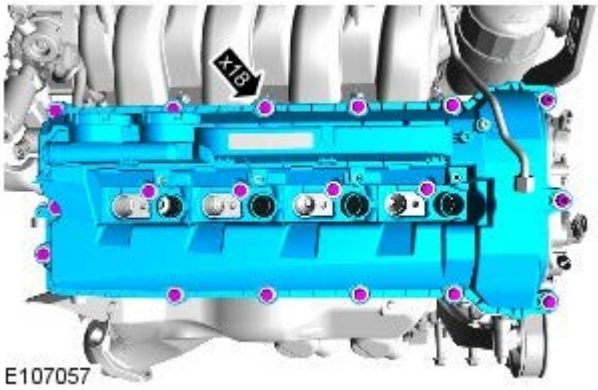
5.



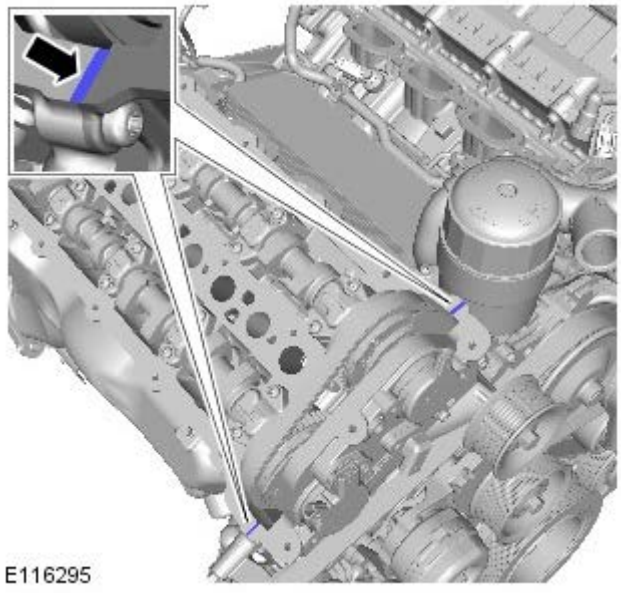
6.



7.



Installation



1. CAUTIONS:

   Use only a plastic scraper when removing the sealing material.

   Use lint free cloth.

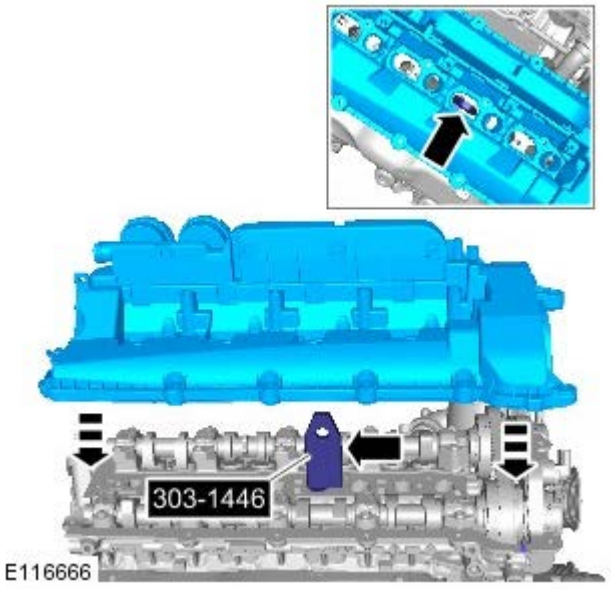
   Make sure that the mating faces are clean and free of corrosion and foreign material.

   Installation of the valve cover and tightening must be carried out within 7 minutes of applying the sealant.

   NOTE: Apply two beads of silcone gasket sealant (Loctite 5901) as shown on the illustration. The application of the sealant must be 1.5mm 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.

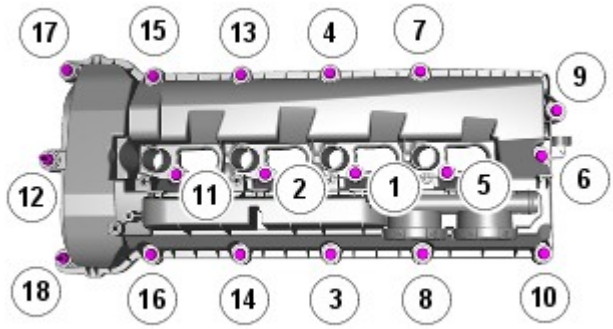
   To install, reverse the removal procedure.

2. *Special Tool(s):* 303-1446



3. NOTE: Tighten the bolts in the indicated sequence.

   Torque: 13 Nm



E107058

Published: 23-Jul-2011

Engine - V8 5.0L Petrol - Cylinder Block Oil Gallery Plug

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

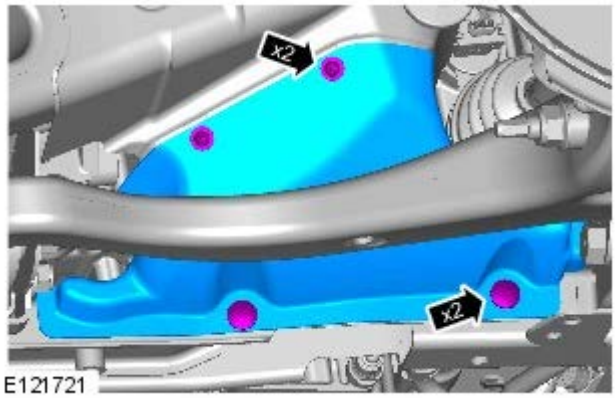
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

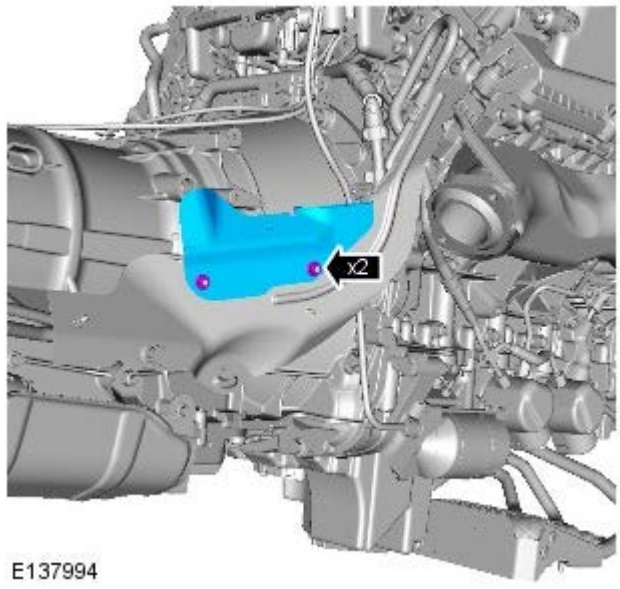
   Raise and support the vehicle.

3. Refer to: Catalytic Converter RH (309-00, Removal and Installation).

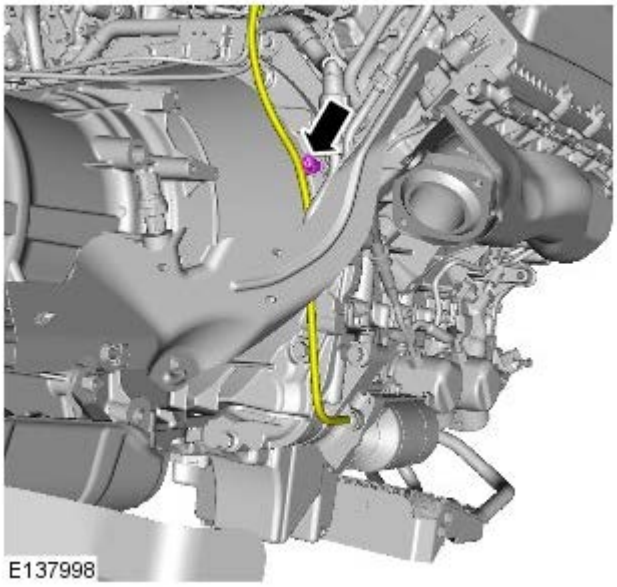
4.



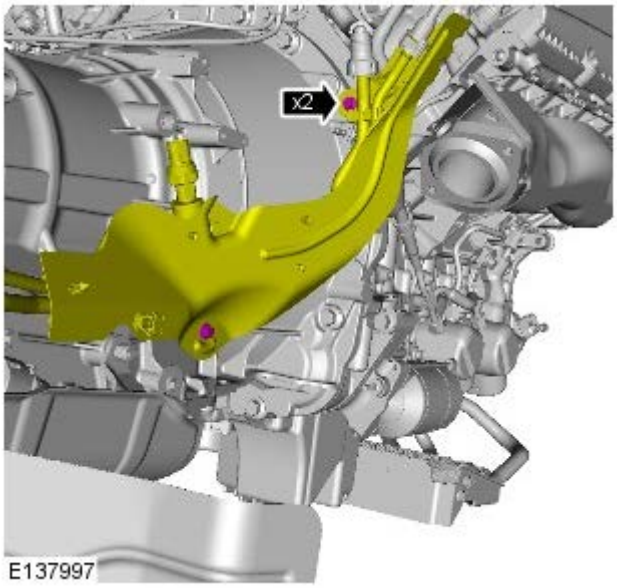
5.



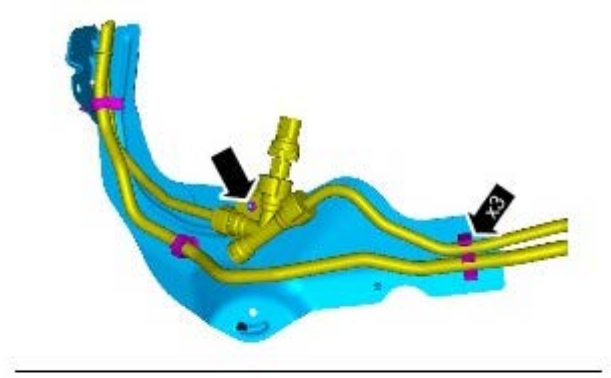
6.

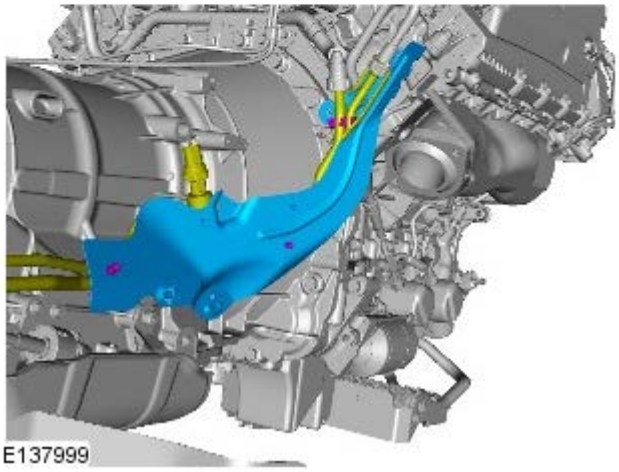


7. *Torque:* 10 Nm

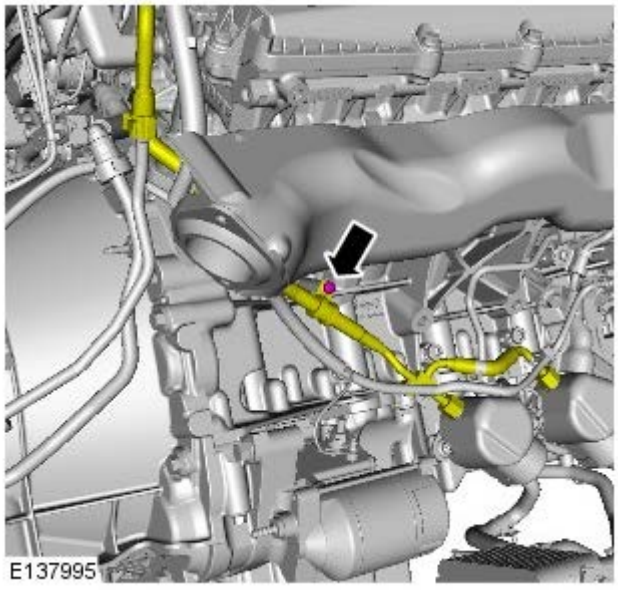


8. *Torque:* 10 Nm

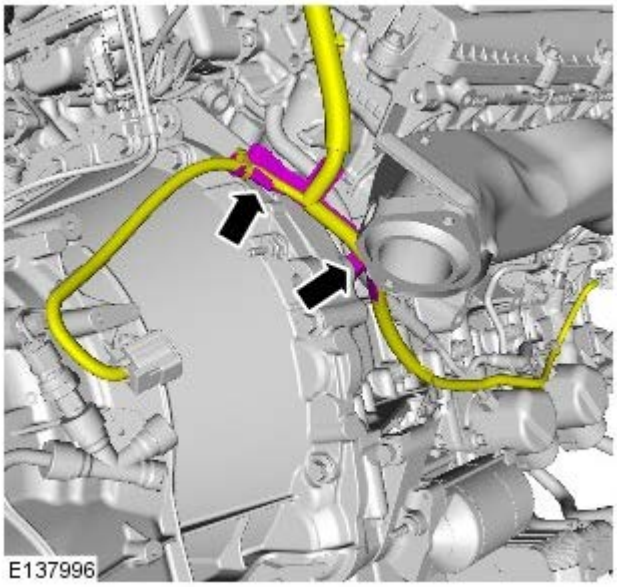


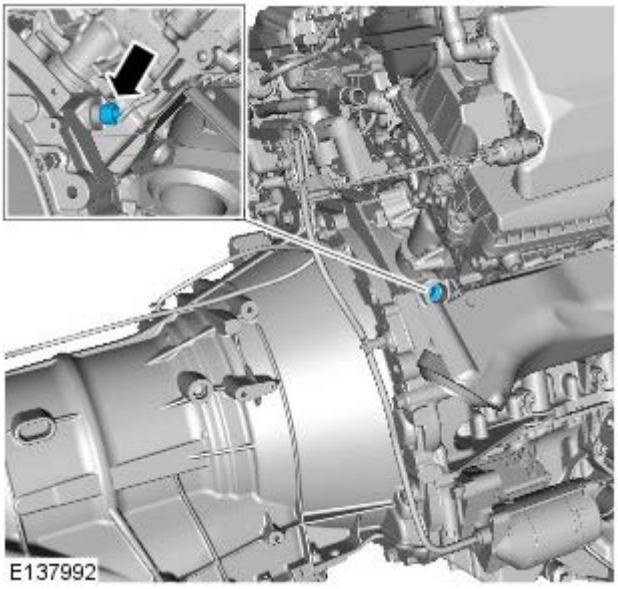


9. *Torque:* 12 Nm



10.





11. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

Torque:
Stage 1: 40 Nm
Stage 2: 180°

Installation

1. To install, reverse the removal procedure.

Published: 24-Oct-2011

Engine - V8 5.0L Petrol - Fuel Pump Camshaft Assembly Part Number: INA Timing Drive

Removal and Installation

Removal

NOTE: Some illustrations may show the engine removed for clarity.

1. Disconnect the battery ground cable.

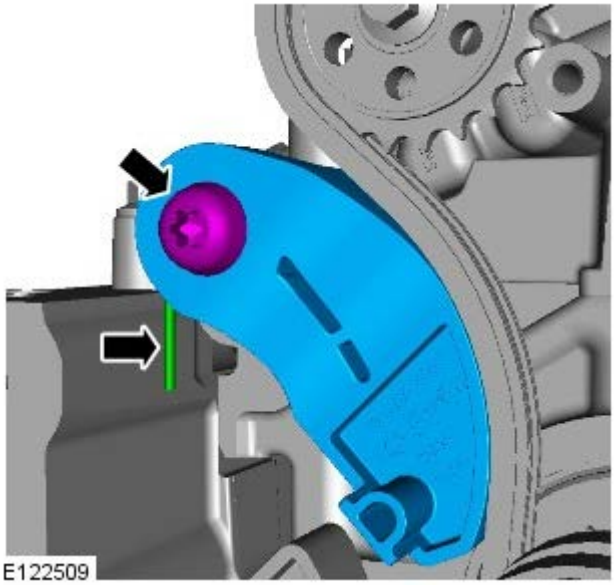
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

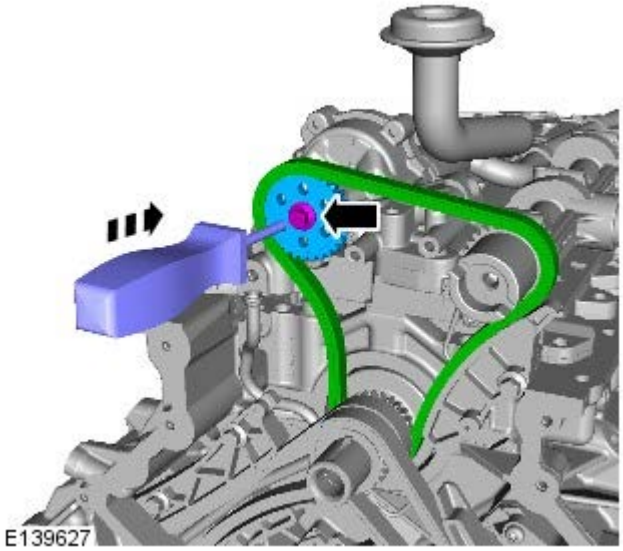
   Raise and support the vehicle.

3. Refer to: Oil Pan Extension (303-01C, Removal and Installation).

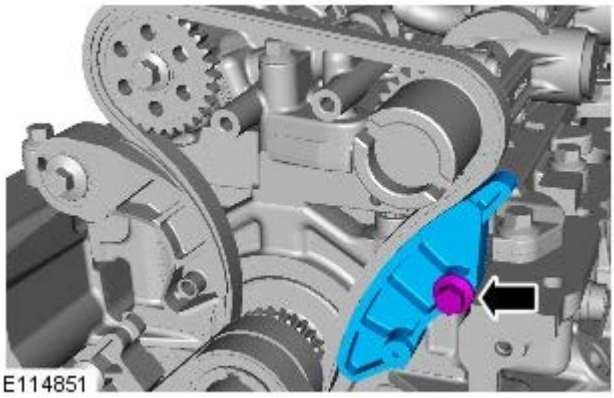
4.

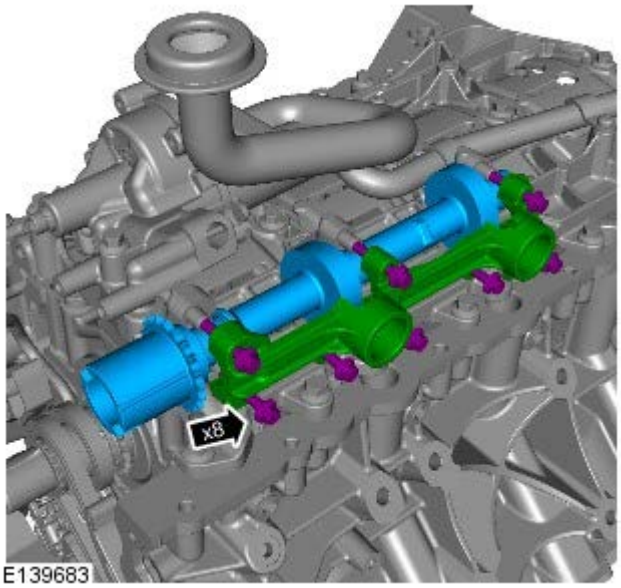


5.



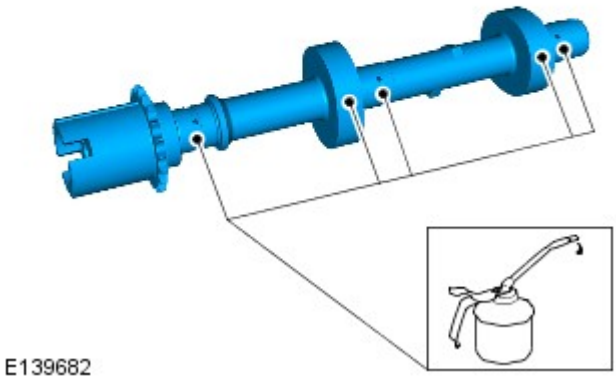
6.





7. CAUTION: Take extra care when removing the component, prevent damage to the mating faces.

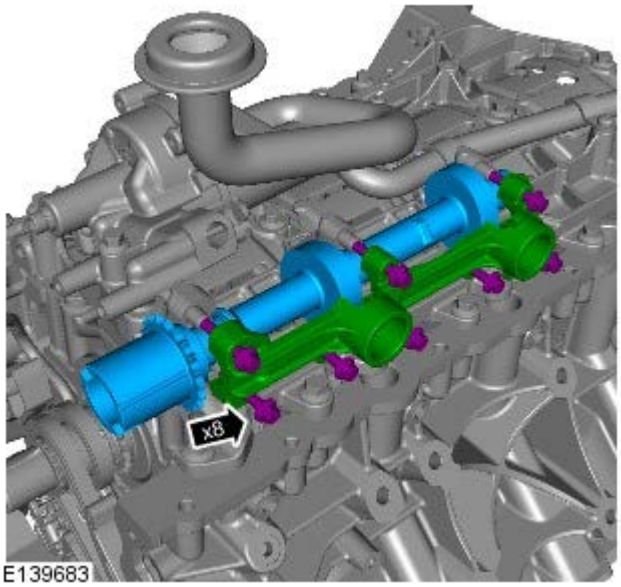
Installation



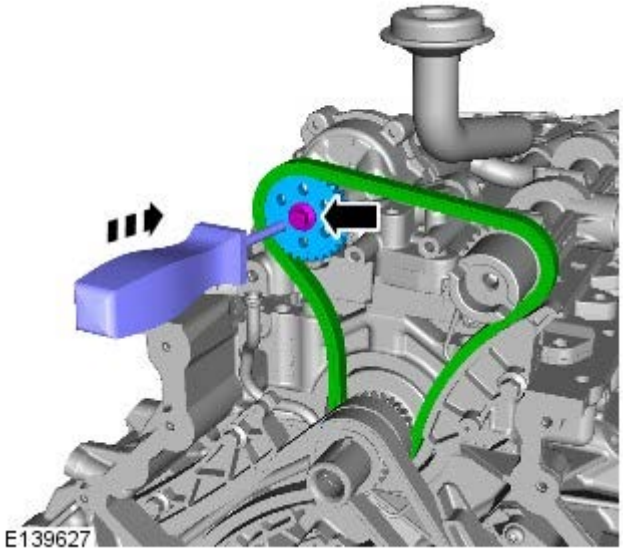
1. CAUTION: Make sure that the mating faces are clean and free of foreign material.

2. CAUTION: Take extra care not to damage the mating faces.

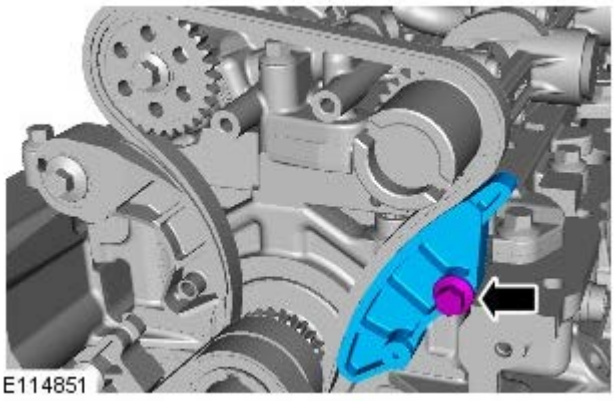
   Torque: 12 Nm



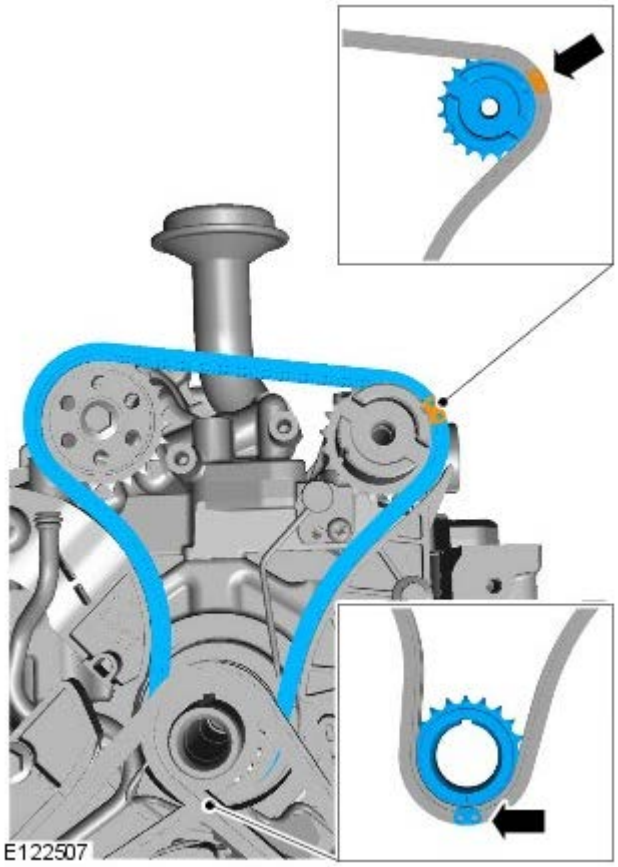
3. *Torque:* 21 Nm

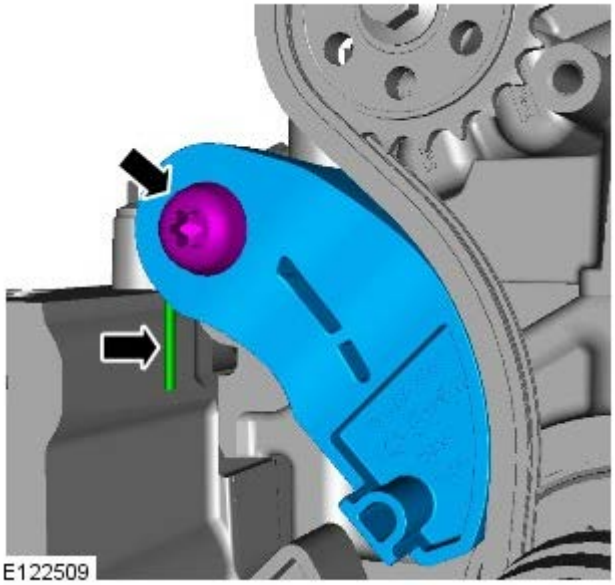


4. *Torque:* 12 Nm



5. Install the lower timing chain making sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft and crankshaft sprocket markings.





6. CAUTION: Make sure that the tensioner spring is correctly located.

   Torque: 21 Nm

7. Refer to: Oil Pan Extension (303-01C, Removal and Installation).

8. Connect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

Published: 24-Oct-2011

Engine - V8 5.0L Petrol - Fuel Pump Camshaft Assembly Part Number: Tsubaki Timing Drive

Removal and Installation

Removal

NOTE: Some illustrations may show the engine removed for clarity.

1. Disconnect the battery ground cable.

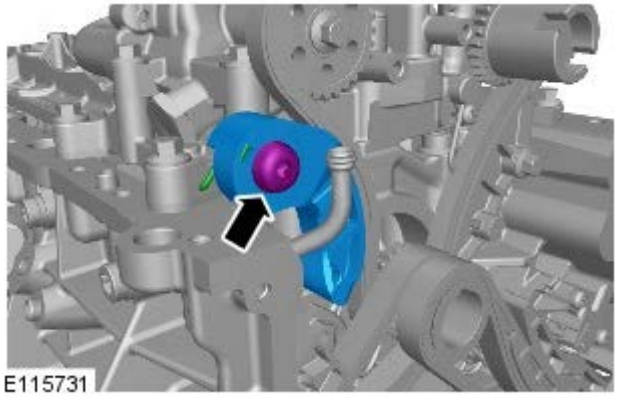
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

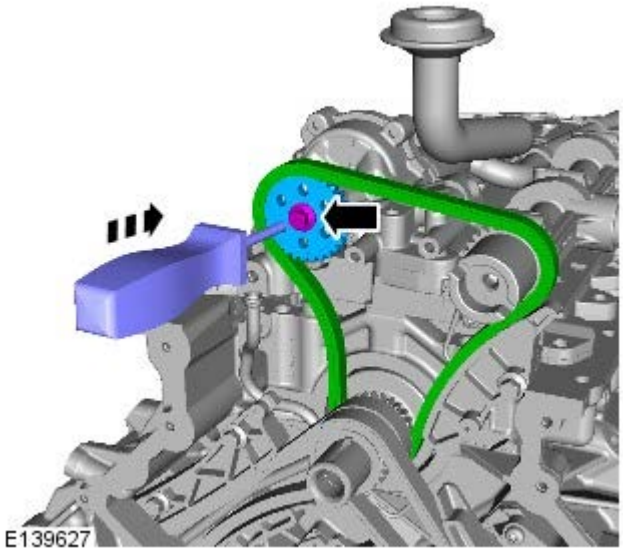
   Raise and support the vehicle.

3. Refer to: Oil Pan Extension (303-01C, Removal and Installation).

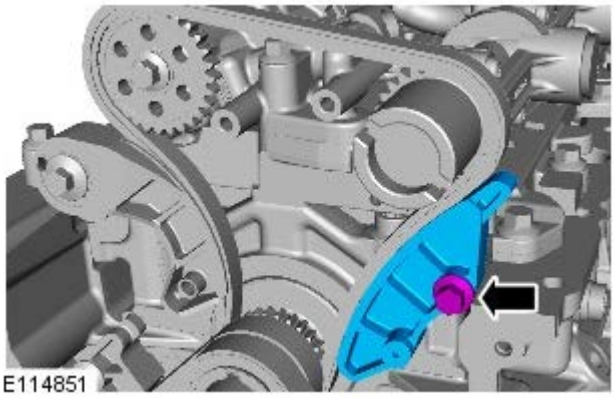
4.

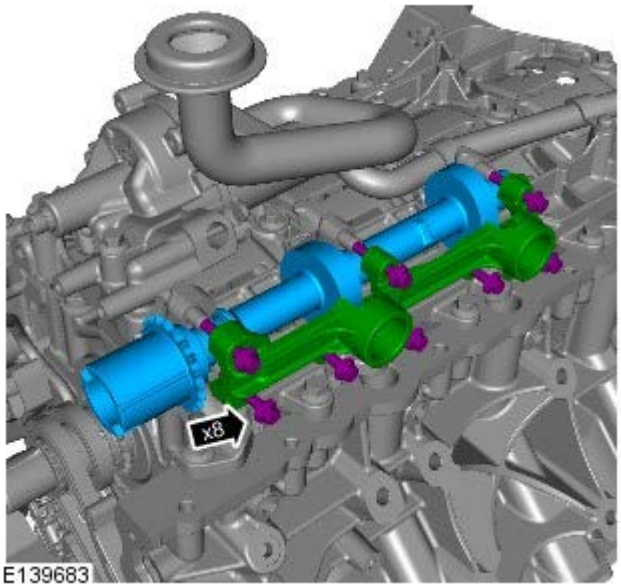


5.



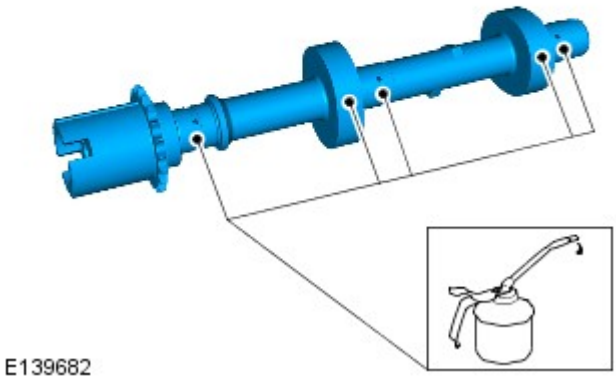
6.





7. CAUTION: Take extra care when removing the component, prevent damage to the mating faces.

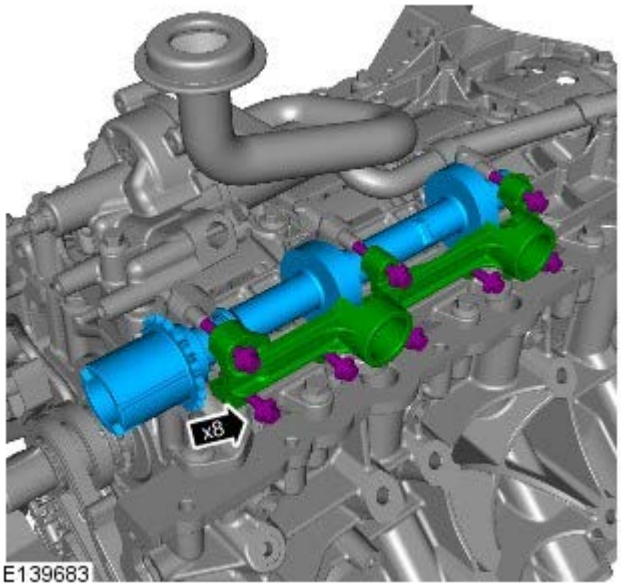
Installation



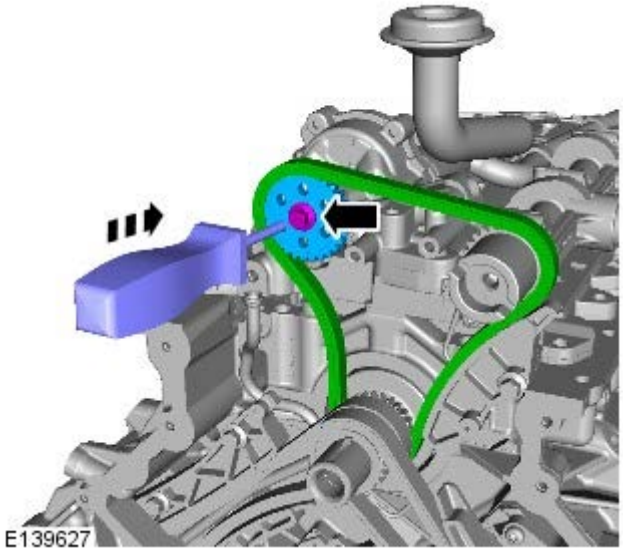
1. CAUTION: Make sure that the mating faces are clean and free of foreign material.

2. CAUTION: Take extra care not to damage the mating faces.

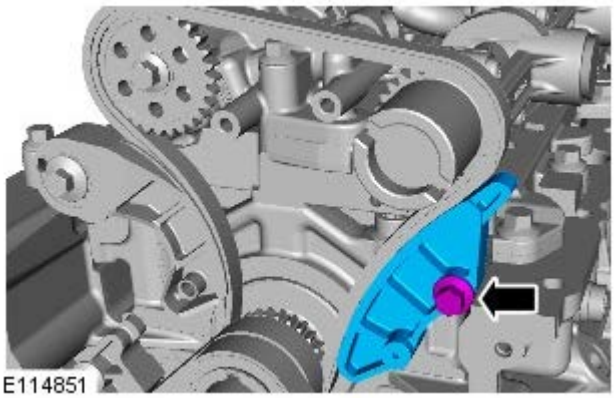
   Torque: 12 Nm



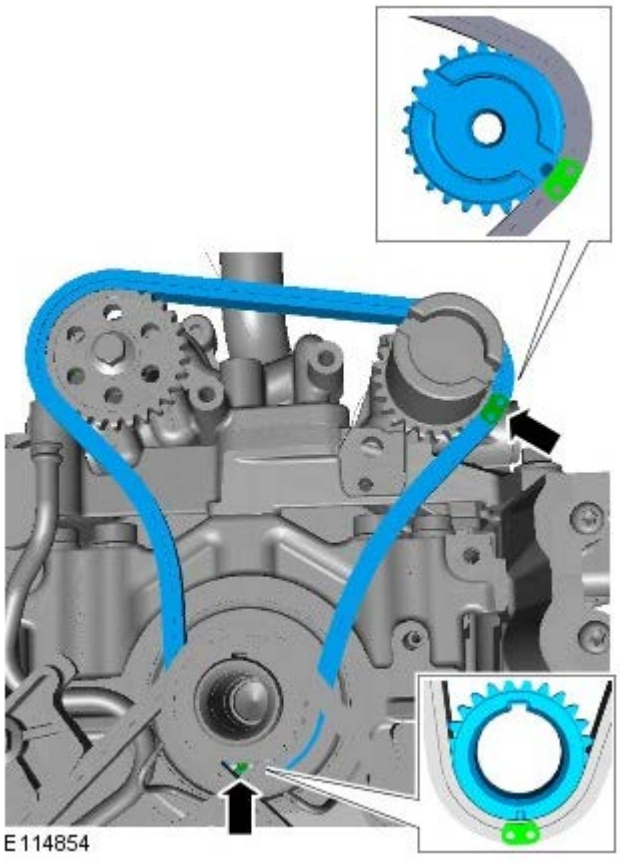
3. *Torque:* 21 Nm

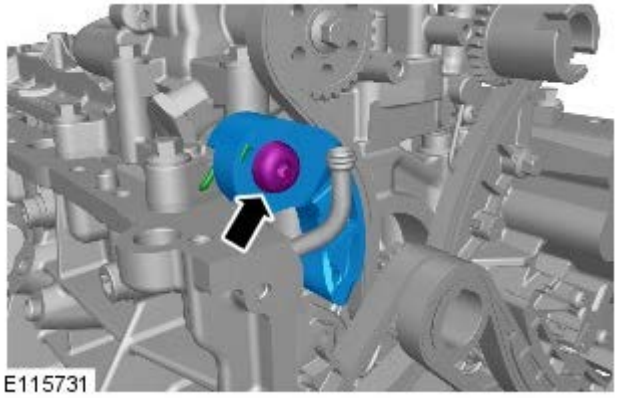


4. *Torque:* 12 Nm



5. Install the lower timing chain making sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft and crankshaft sprocket markings.





6. CAUTION: Make sure that the tensioner spring is correctly located.

   Torque: 21 Nm

7. Refer to: Oil Pan Extension (303-01C, Removal and Installation).

8. Connect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

Published: 08-Dec-2011

Engine - V8 5.0L Petrol - Lower Timing Cover

Removal and Installation

Special Tool(s)

 E107676	303-1433 Lower Timing Cover Alignment tool

Removal

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-01, Specifications).

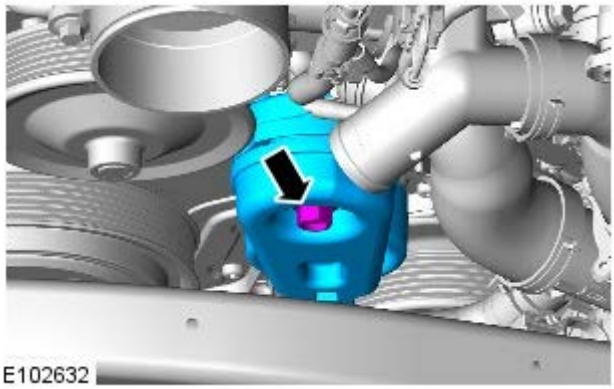
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Accessory Drive Belt (303-05C, Removal and Installation).

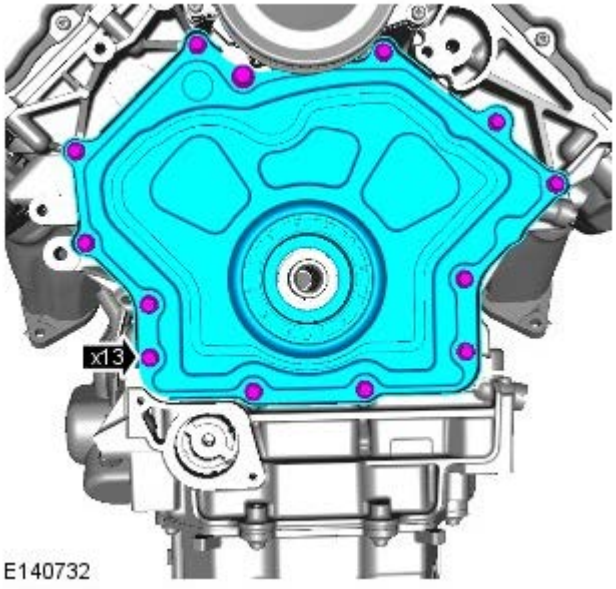
4. Refer to: Crankshaft Pulley (303-01C, Removal and Installation).

5.

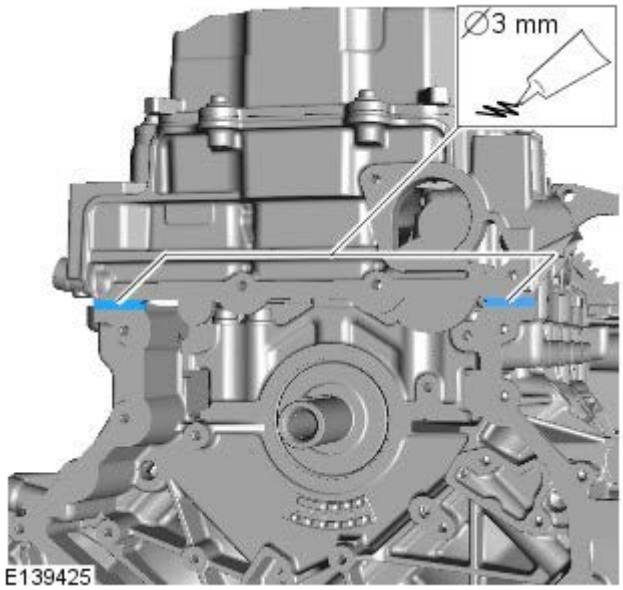

E102632

6. Refer to: Brake Vacuum Pump - V8 5.0L Petrol/V8 S/C 5.0L Petrol (206-07, Removal and Installation).

7.



Installation

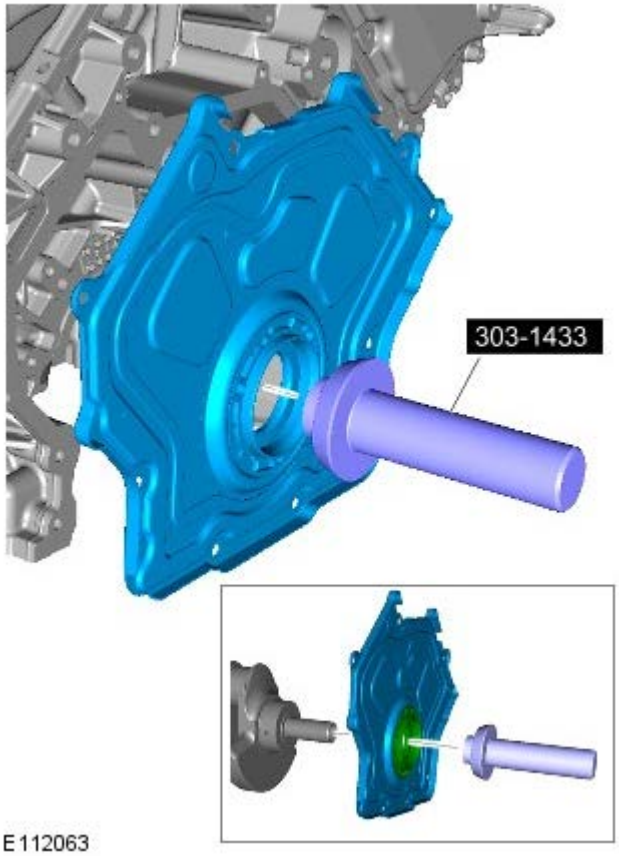


1. Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

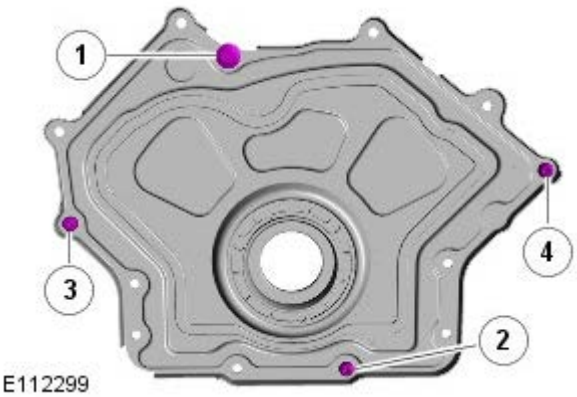
2. CAUTION: Make sure that the mating faces are clean and free of foreign material.

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

   Special Tool(s): 303-1433



E112063



E112299

3. NOTE: Tighten the bolts in the indicated sequence.

   Torque:
   M6 12 Nm
   M8 20 Nm



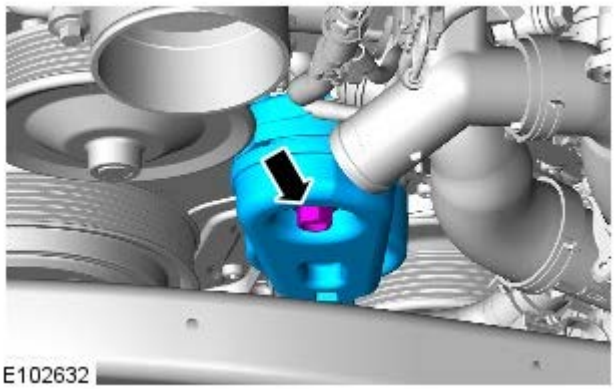
E112300

4. *Torque:* 12 Nm

5. Refer to: Brake Vacuum Pump - V8 5.0L Petrol/V8 S/C 5.0L Petrol (206-07, Removal and Installation).

6. NOTE: Install the bolt finger tight before final tightening.

   Torque: 40 Nm



7. Refer to: Accessory Drive Belt (303-05C, Removal and Installation).

8. Refer to: Crankshaft Pulley (303-01D, Removal and Installation).

9. Connect the battery ground cable.

   Refer to: Specifications (414-01, Specifications).

10. CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum (by following Steps 13-19), before starting the engine.

    - Fill the engine with oil - for filling values on vehicles without supercharger:

      Refer to: Specifications (303-01C, Specifications).
    - Fill the engine with oil - for filling values on vehicles with supercharger:

      Refer to: Specifications (303-01D, Specifications).
    - Clean any residual engine oil from the oil filler cap area.

11. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.

    Follow the Steps 13-19 before starting the engine.

12.
    - Start the engine and allow to run for 10 minutes, stop the engine.
    - Check for leaks.

13. CAUTIONS:

    Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

    Make sure that the hood is open.

    - Turn the ignition on.

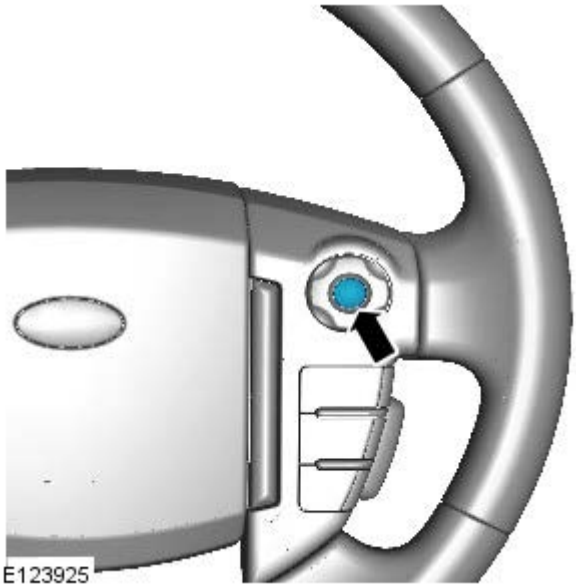
14.
    - Press the right-hand directional button to access the instrument cluster menu.



E123926

15.

- Press the right-hand OK button.



E123925

16.

- Press the right-hand directional button to access the Oil Level Display.



E123927

17.

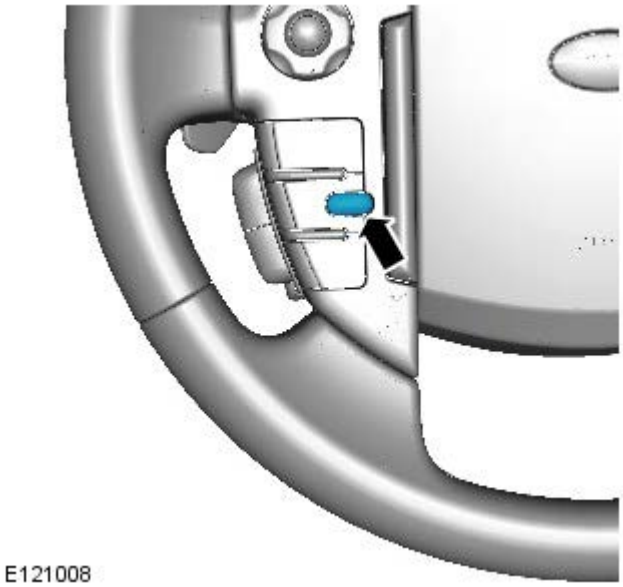
- Press the right-hand OK button and follow the instructions.



E123928

18.

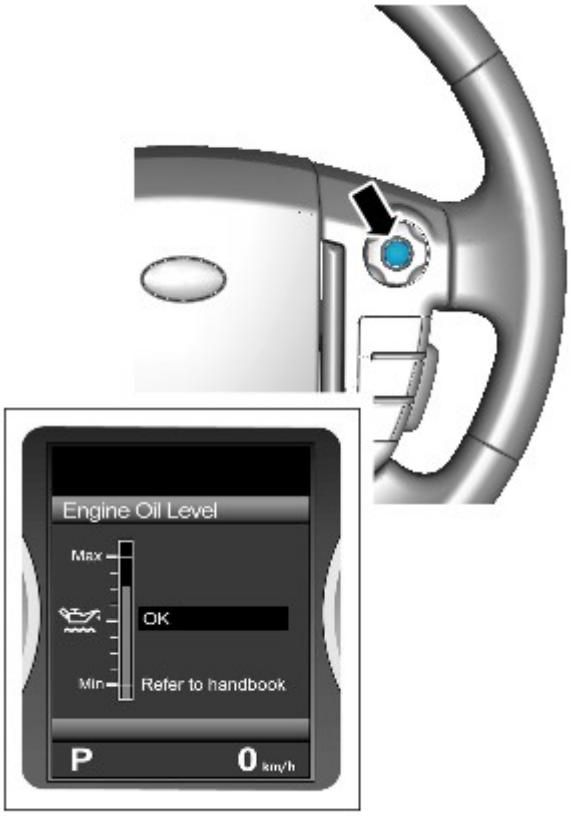
- Press the cruise control cancel button twice within 2 seconds.



E121008

19.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes (as indicated in Step 12), switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.



E123929

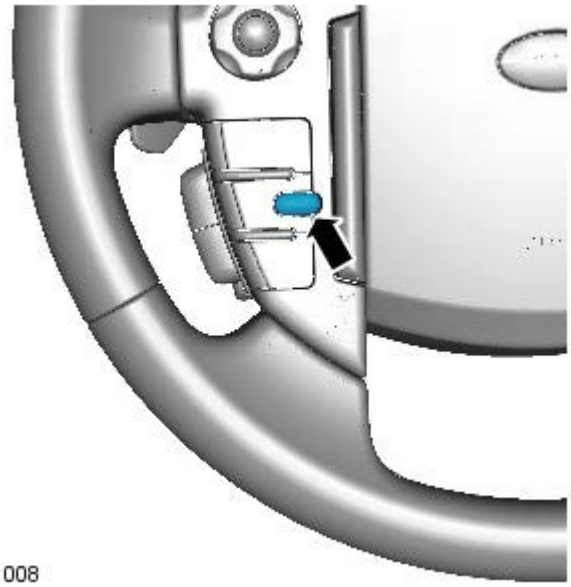
20. NOTE: If instructed to follow Steps 13-19 in a previous step, return to Step 12 and continue the procedure.

    Turn the ignition off.

21. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

22. NOTE: The following steps are to update the average oil level value.

    - Turn the ignition on.
    - Press and hold the cruise control cancel button for more than 2 seconds.



E121008

23.

- The message center display will revert to the normal display in the trip computer.

24. Turn the ignition off.

25. Turn the ignition on.

26.

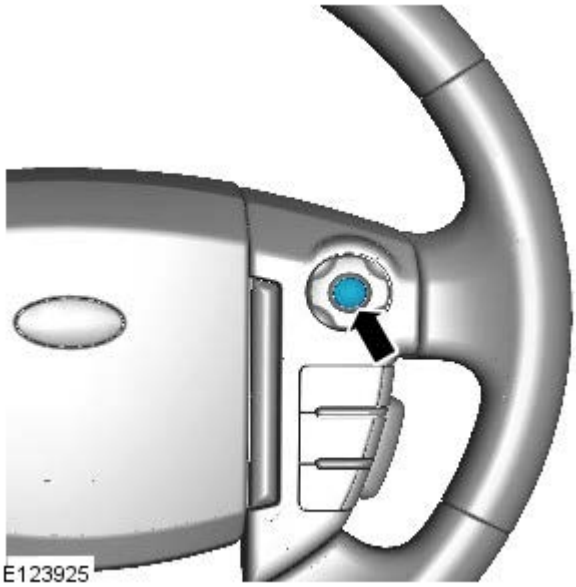
- Press the right-hand directional button to access the instrument cluster menu.



E123926

27.

- Press the right-hand OK button.



28.

- Press the right-hand directional button to access the Oil Level Display.



E123927

29.

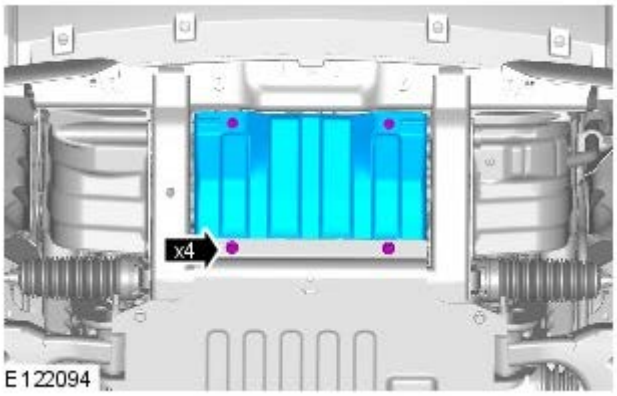
- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.



E123929

30. Refer to: Engine Undershield (501-02, Removal and Installation).

31. *Torque:* 10 Nm



E122094

Published: 04-Sep-2013

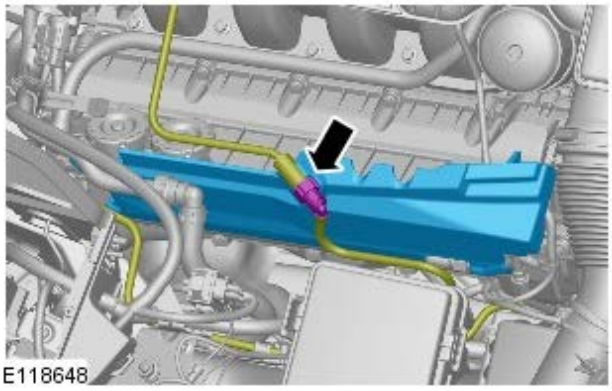
Engine - V8 5.0L Petrol - Timing Chain Tensioner Right

Removal and Installation

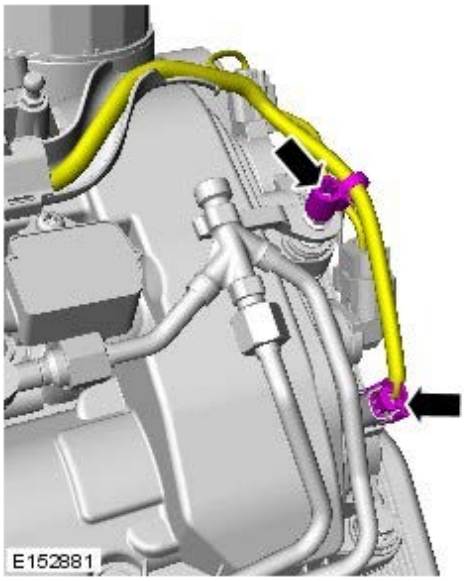
Removal

All vehicles

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Health and Safety Precautions (100-00, Description and Operation).
3. Refer to: Fuel System Pressure Release - V8 5.0L Petrol/V8 S/C 5.0L Petrol (310-00, General Procedures).
4. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05, Removal and Installation).
5.



6. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C, Removal and Installation).
7.

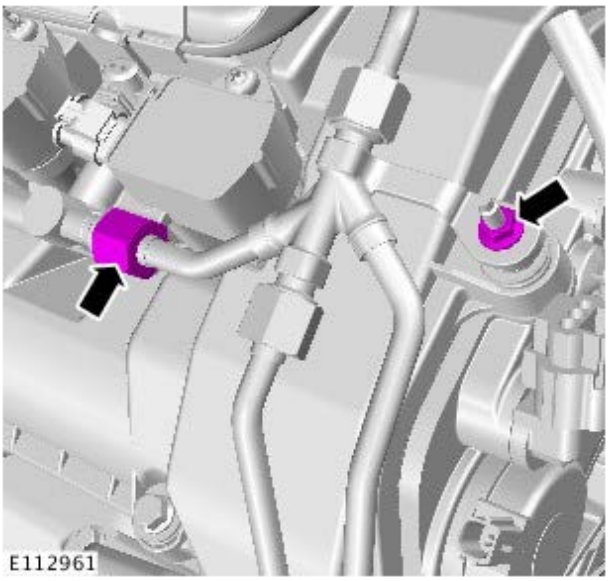


8. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

   CAUTIONS:

   Be prepared to collect escaping fuel.

   Make sure that all openings are sealed. Use



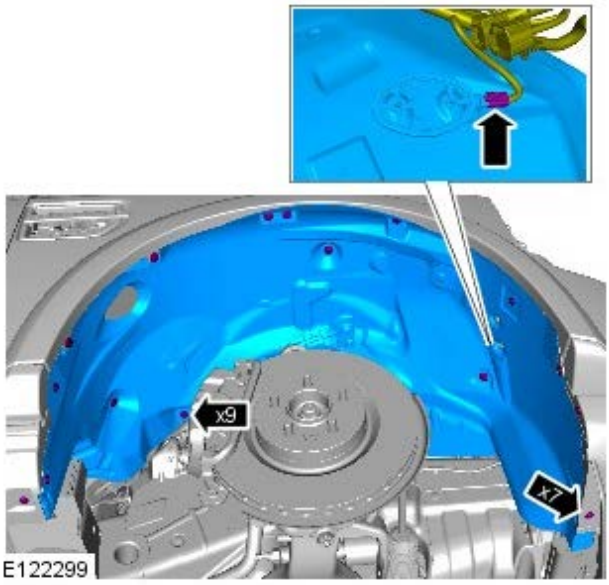
new blanking caps.

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

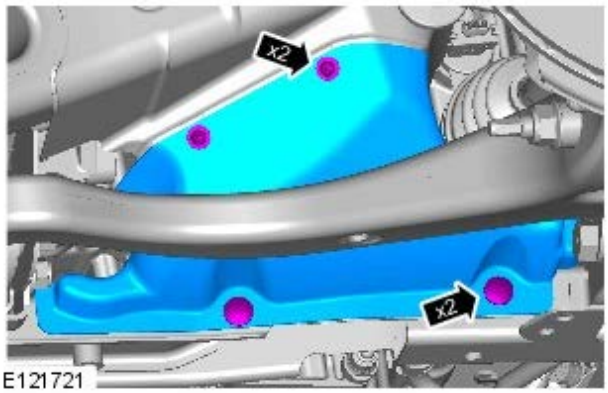
   Raise and support the vehicle.

10. Remove the front right wheel and tire.

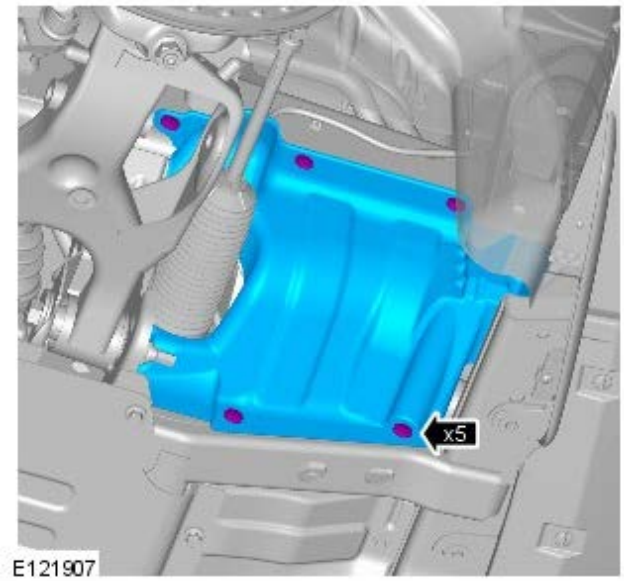
11.



12.



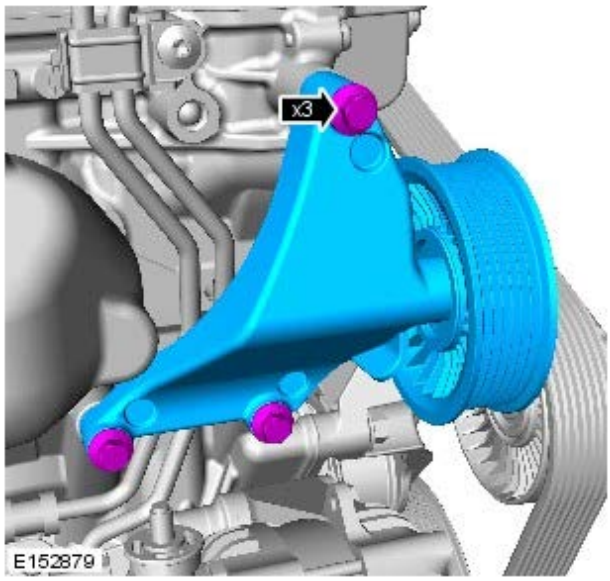
13.



14. Refer to: Generator (414-02C, Removal and Installation).

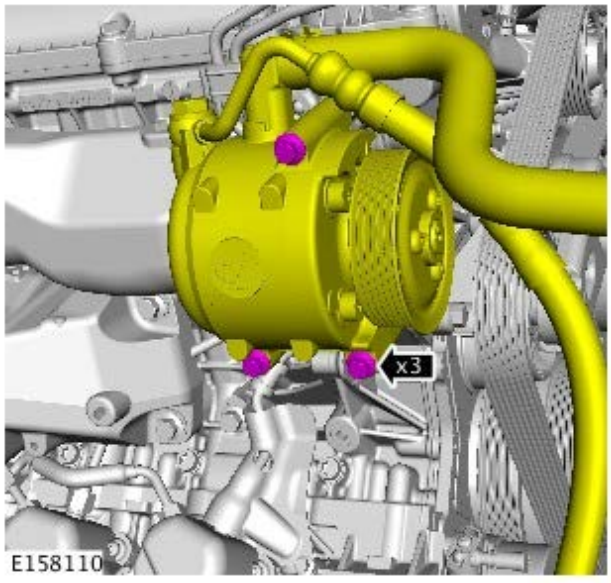
15. Refer to: Steering Column Lower Shaft (211-04, Removal and Installation).

16.

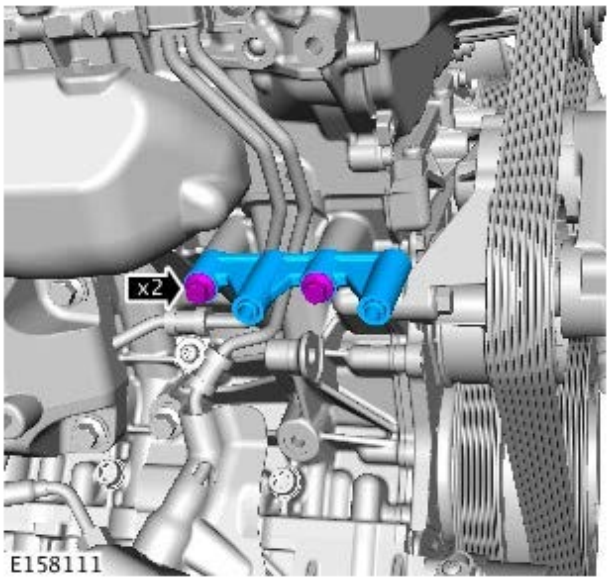


Vehicles with dynamic suspension

17.

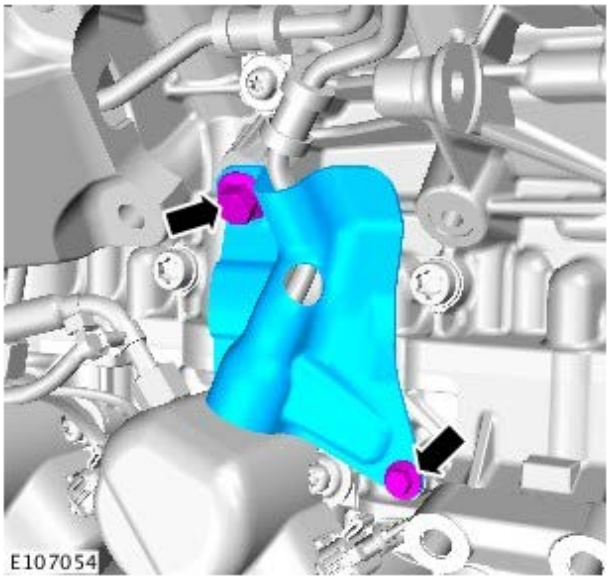


18.

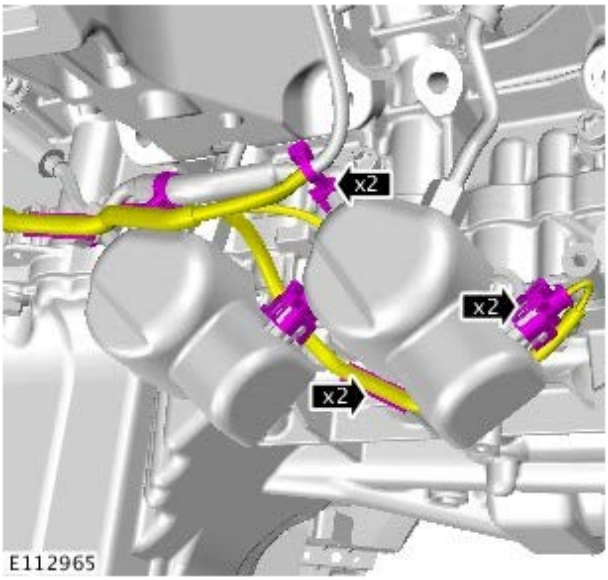


All vehicles

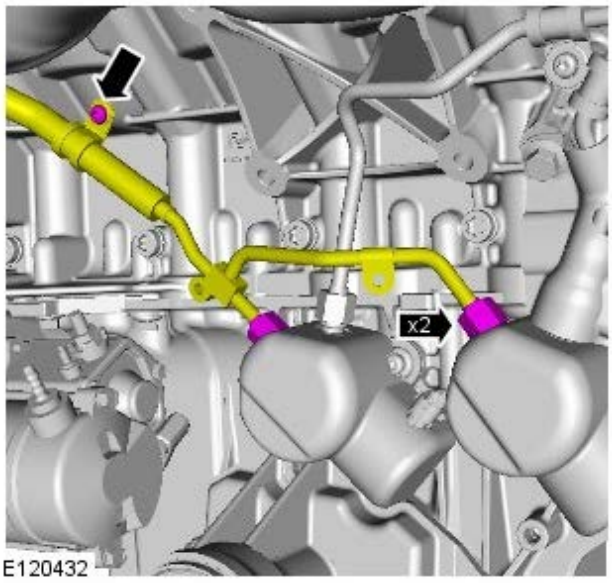
19.



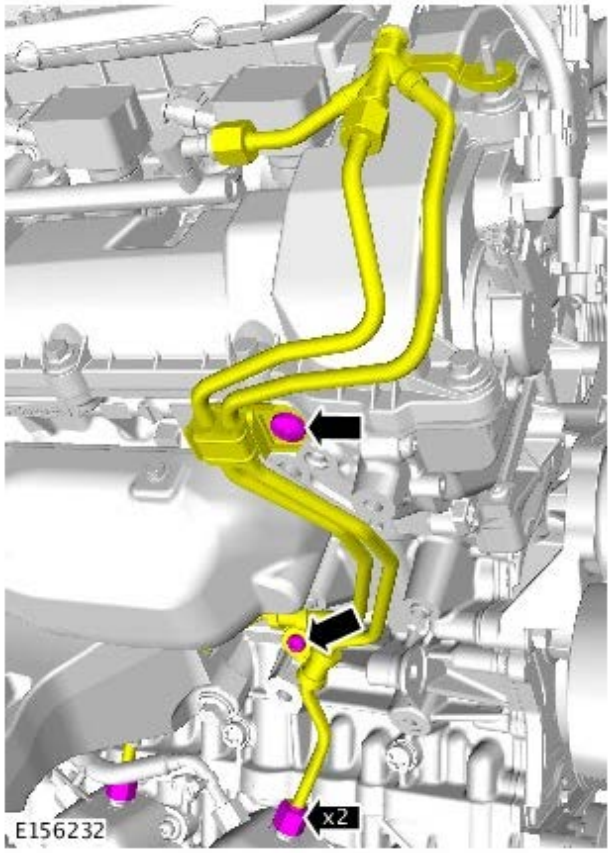
20.



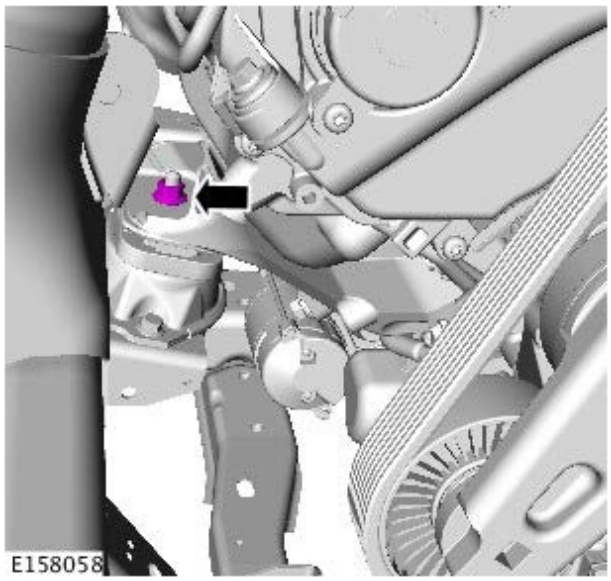
21.



22.

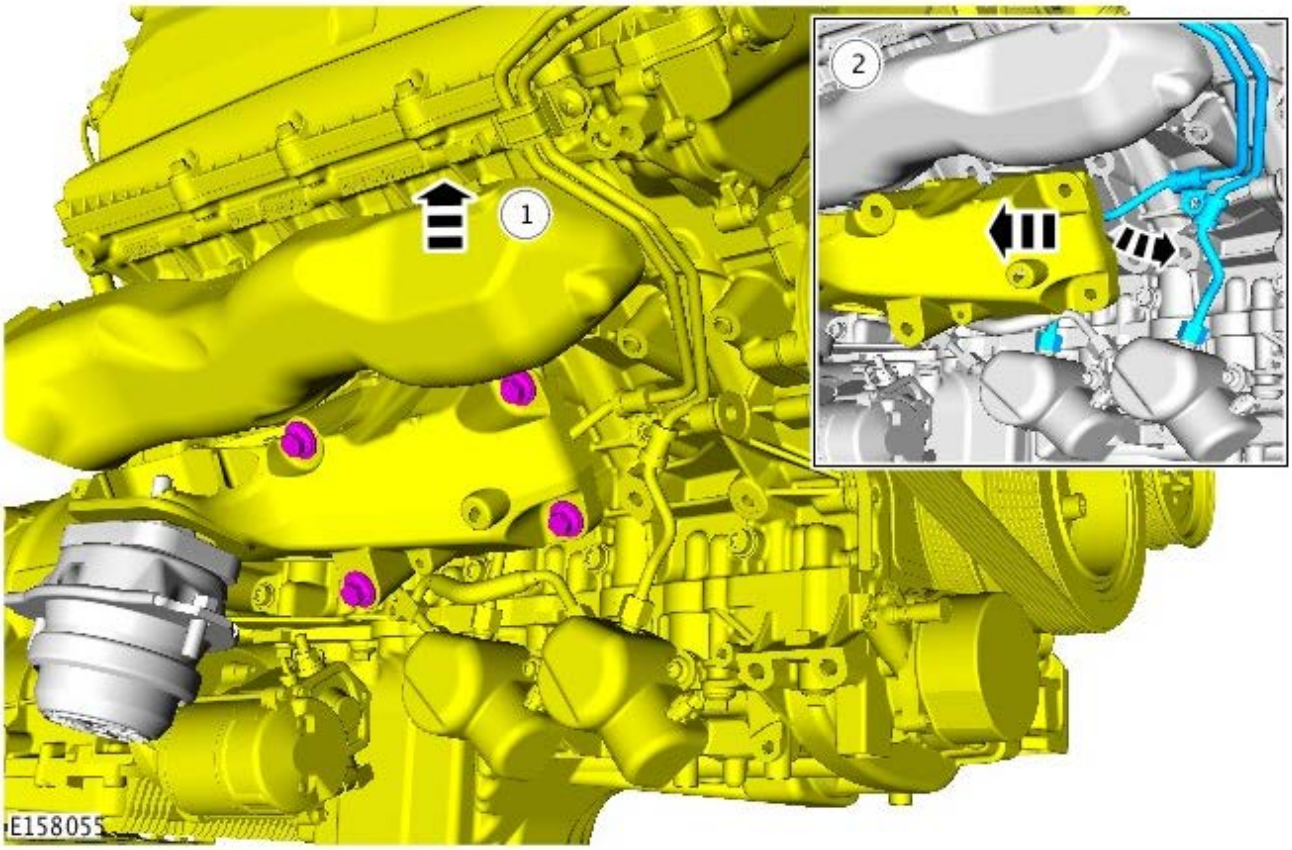


23.



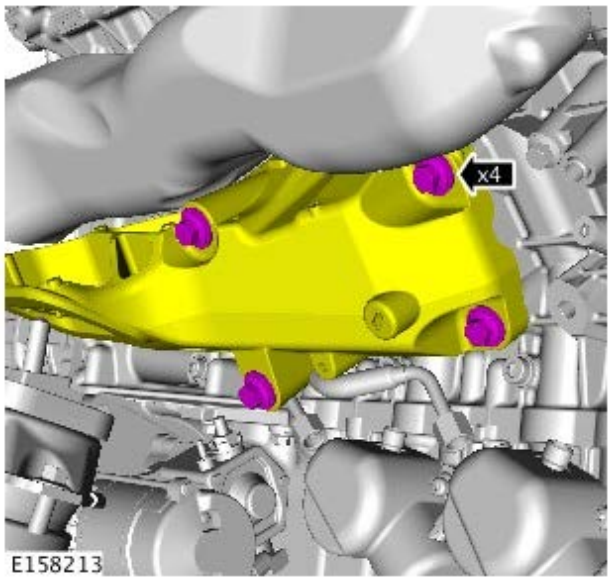
24. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

- Using a suitable hydraulic jack, raise and support the engine.
- Position the engine mount to one side for access to the fuel pipes.
- Remove the fuel pipes.

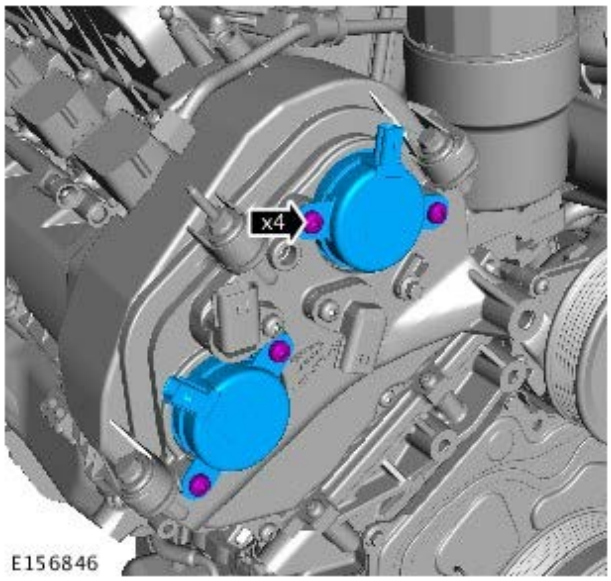


25. Carefully lower the engine onto the engine mounts.

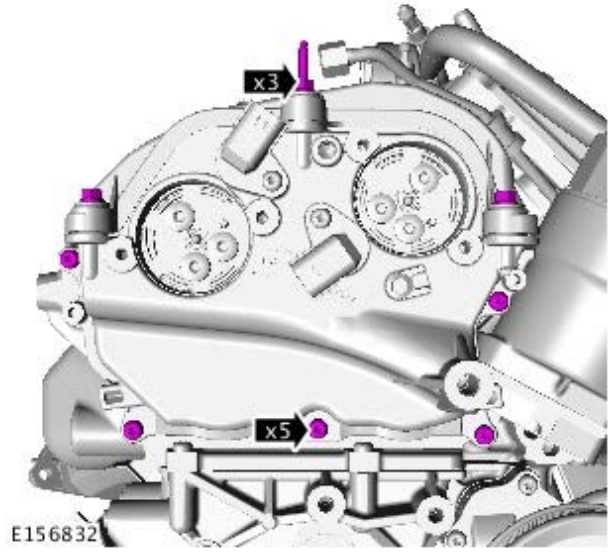
Torque: 20 Nm



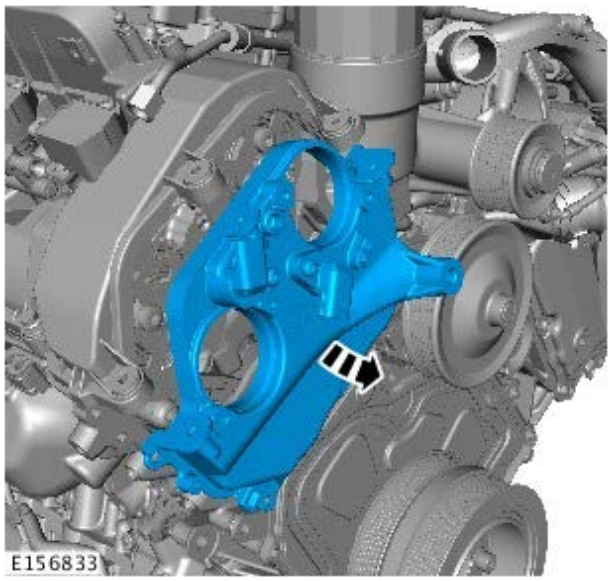
26.



27.

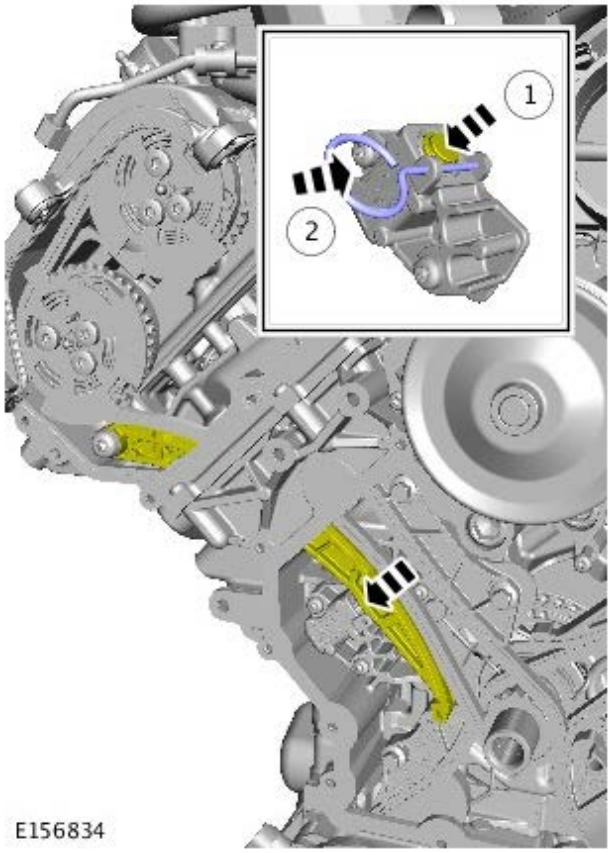


28.

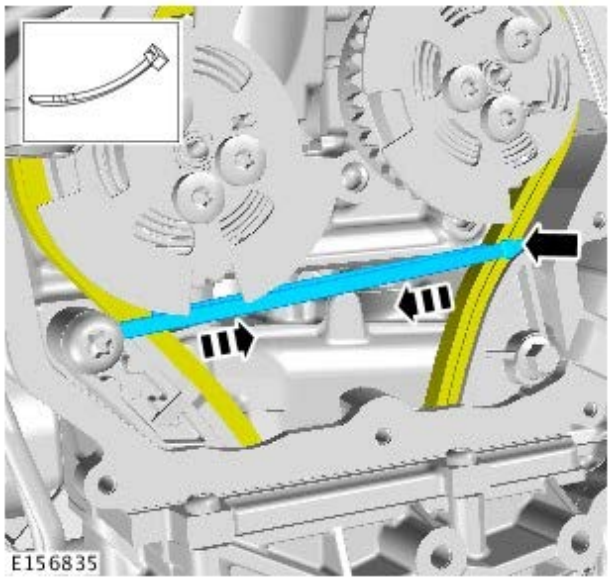


29. Refer to: Lower Timing Cover (303-01D, Removal and Installation).

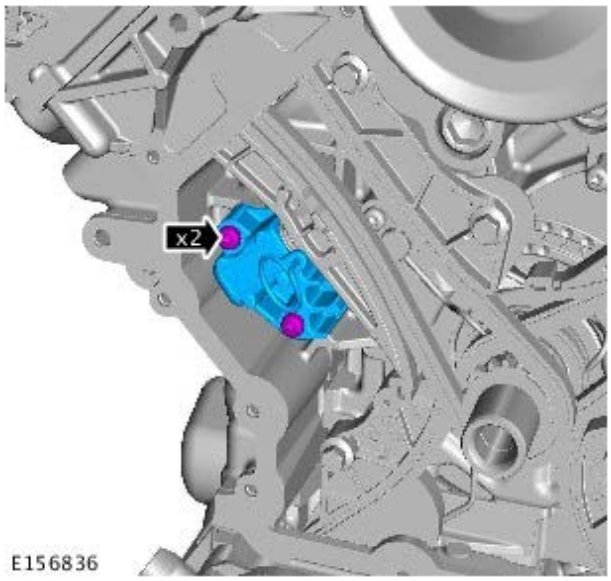
30.



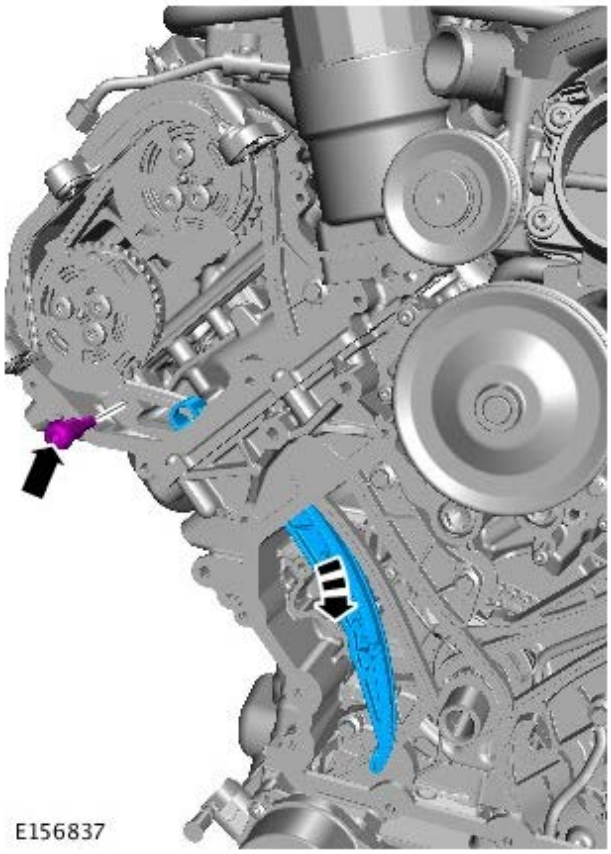
31. CAUTION: Make sure the tension is maintained on the timing chain.



32. *Torque:* 10 Nm



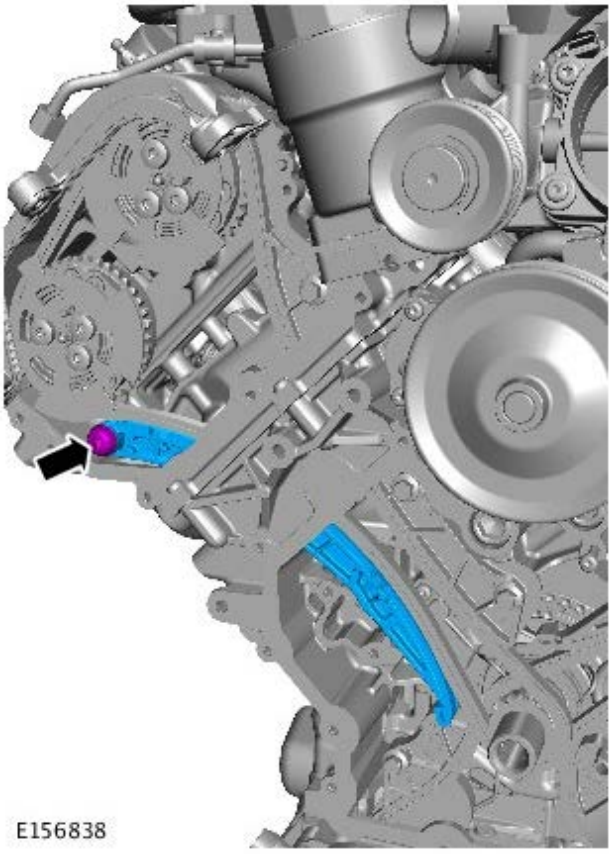
33.



Installation

All vehicles

1. *Torque:* 25 Nm

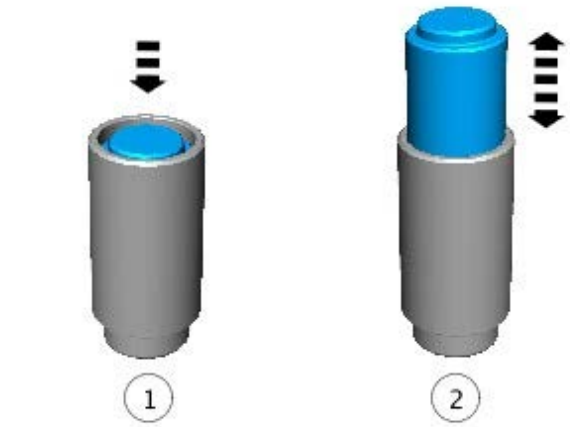


2. Remove cable tie from the timing chain.

3. NOTE: The piston is shown removed from tensioner for clarity.

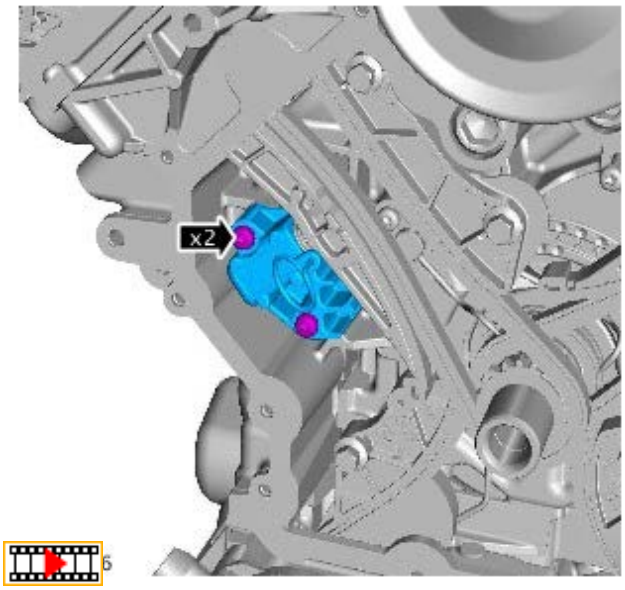
   Make sure the piston is fully compressed and free to

move before installing the grenade pin into the tensioner. Failure to do this may result in damage to the engine.

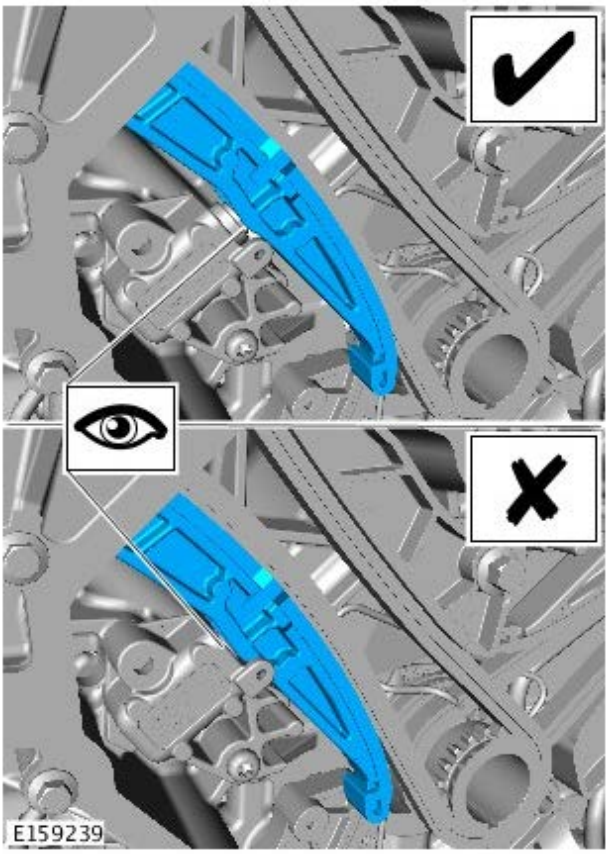


E159231

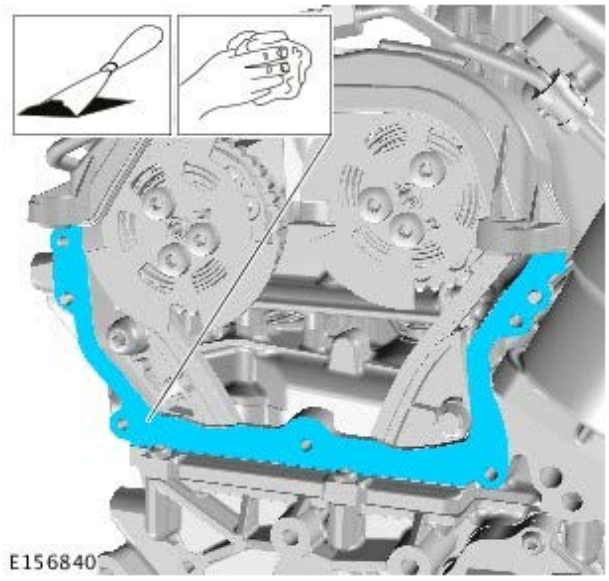
4.



5. CAUTION: Make sure when the tensioner is fully compressed the guide does not touch the tensioner body.

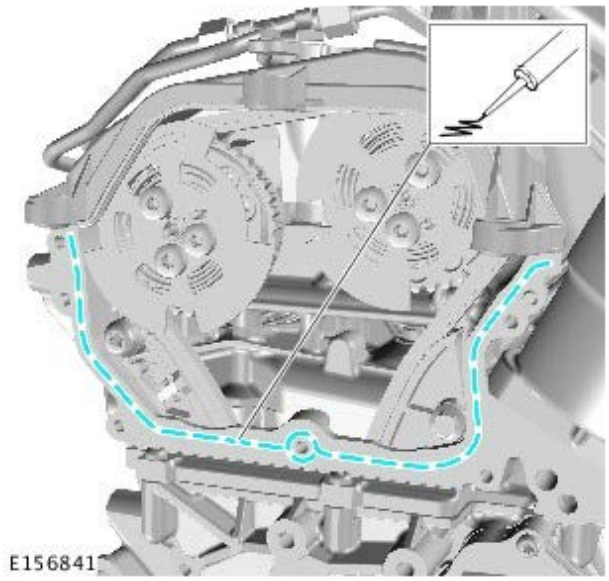


6. Refer to: Lower Timing Cover (303-01D, Removal and Installation).

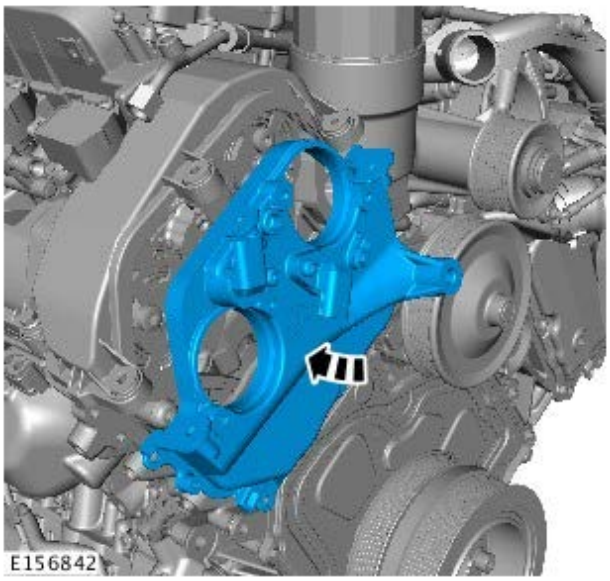


7. CAUTION: Make sure that the mating faces are clean and free of foreign material.

8. •Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

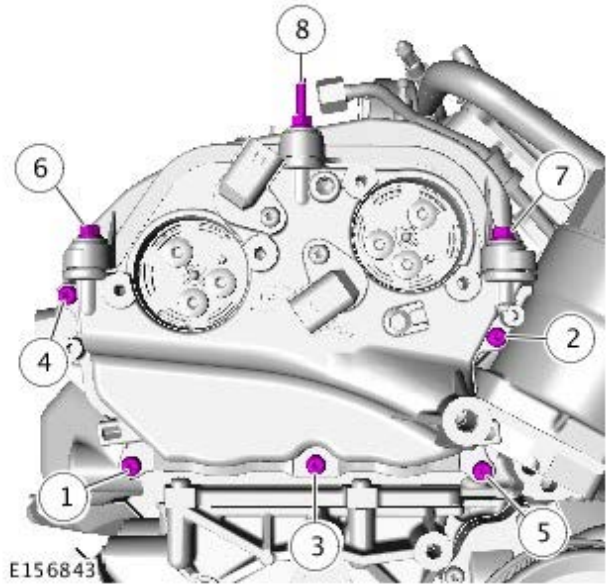


9.

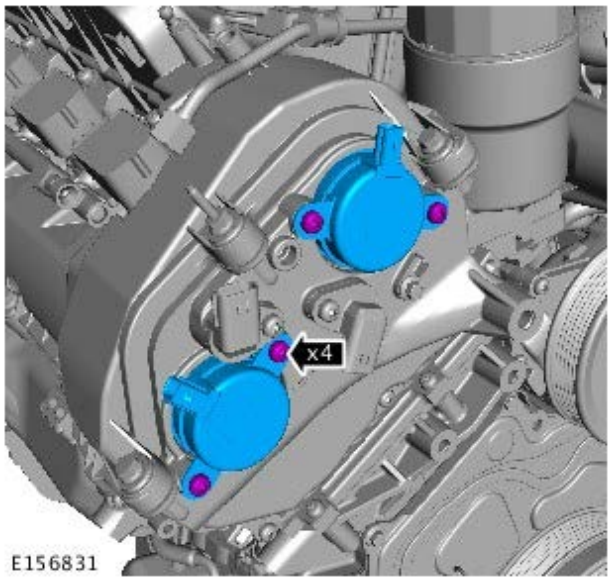


10. NOTE: Tighten bolts in the indicated sequence.

Torque: 12 Nm

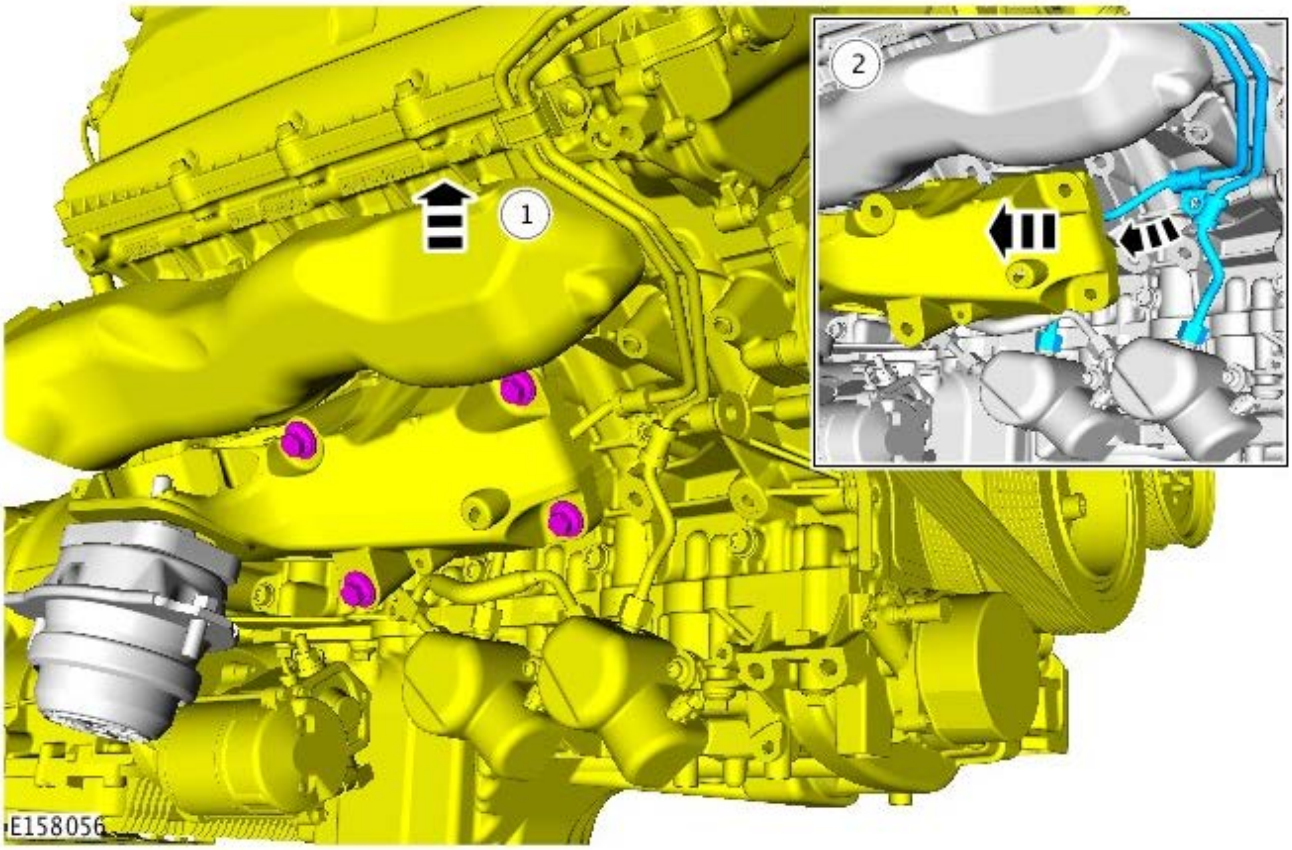


11. *Torque:* 12 Nm



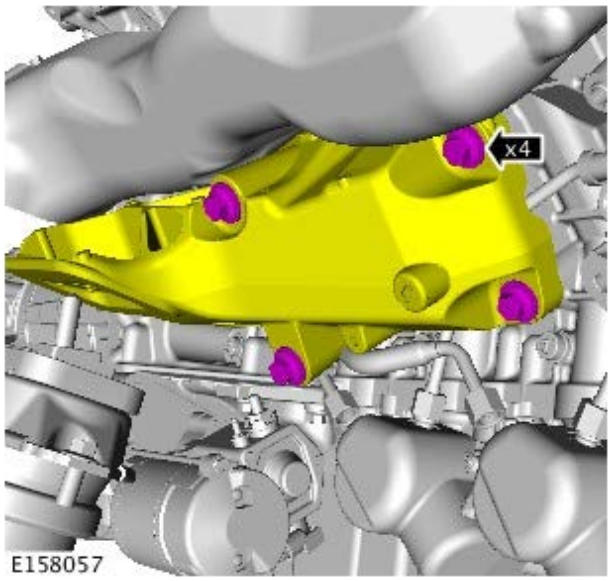
12. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

- Using a suitable hydraulic jack, raise and support the engine.
- Position the engine mount to one side for access to the fuel pipes.
- Install the fuel pipes.

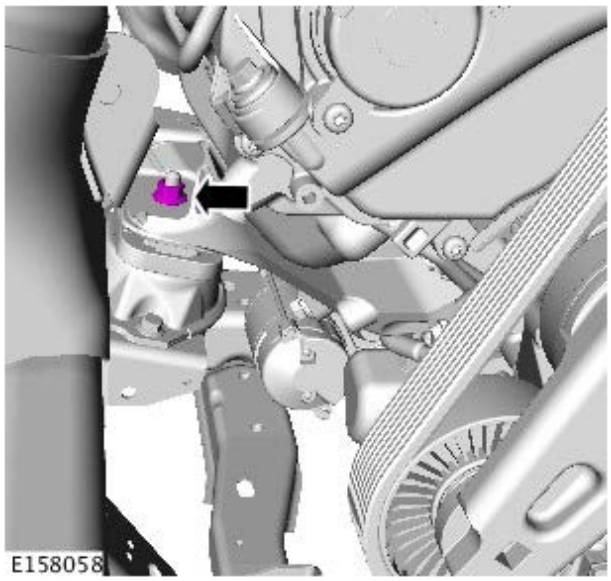


13. Carefully lower the engine onto the engine mounts.

Torque:
Stage 1: 45 Nm
Stage 2: 60°



14. *Torque:* 110 Nm



15. CAUTIONS:

Install new high-pressure fuel supply lines.

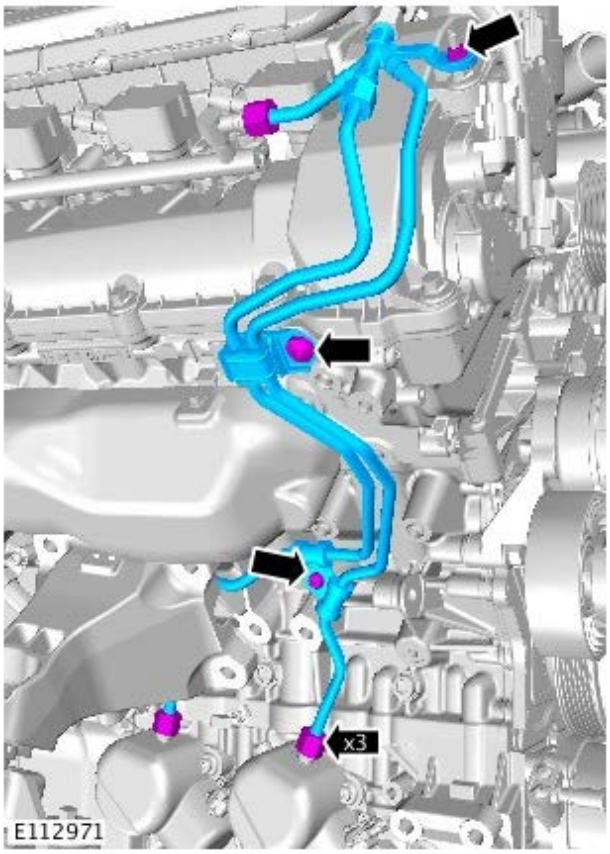
Lubricate only the union threads with clean engine oil.

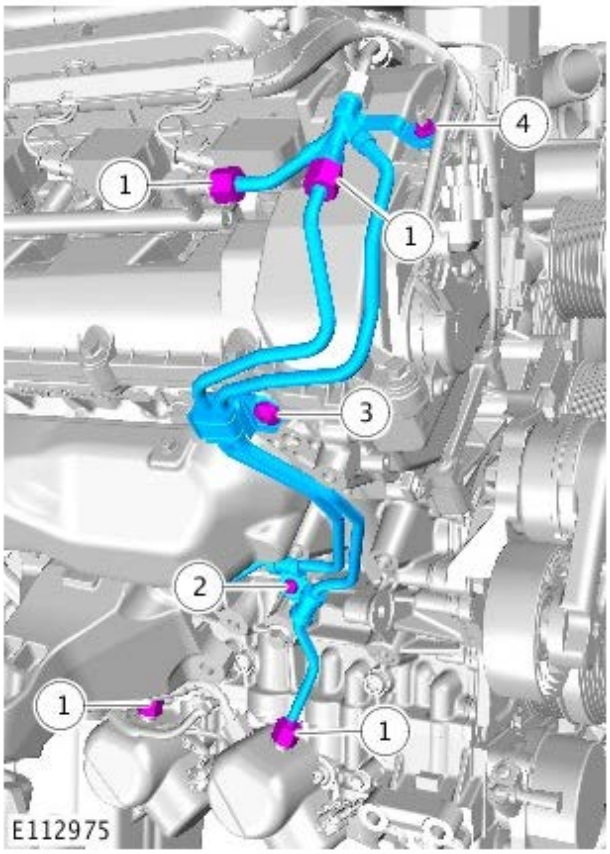
NOTES:

Remove and discard the blanking caps.

Install the bolt and unions fully finger tight before final tightening.

Do not fully tighten at this stage.





16. NOTE: Engine shown removed for clarity.

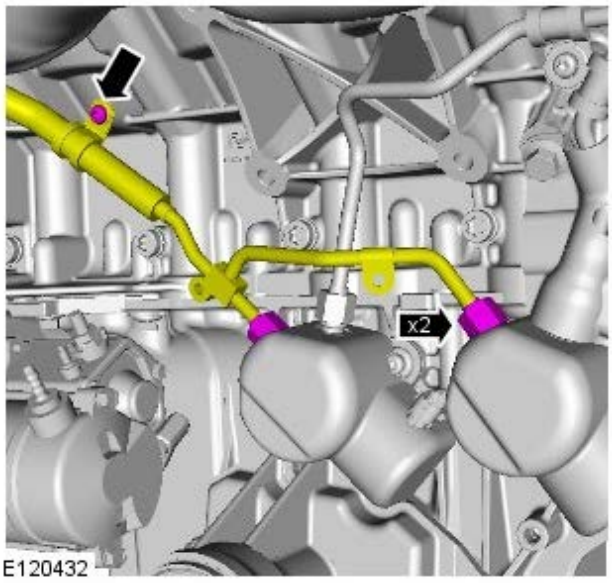
Torque:
Unions (1) 21 Nm
M6 (2) 11 Nm
M8 (3) 25 Nm
M5 nut (4) 6 Nm

17. NOTES:

Install the bolt and unions finger tight before final tightening.

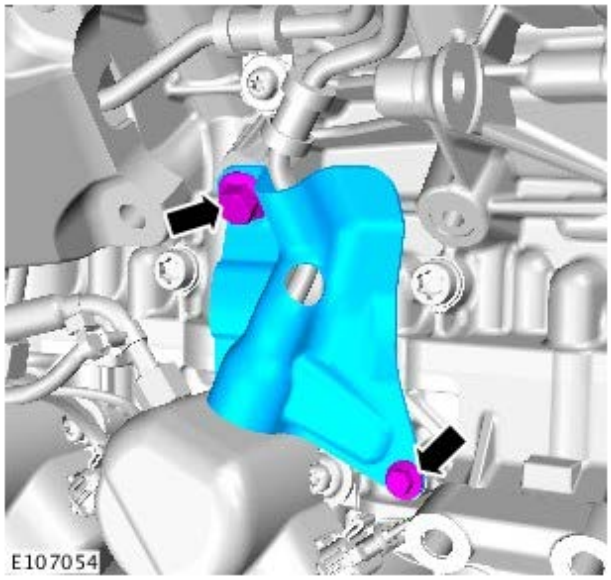
Remove and discard the blanking caps.

Torque:
Unions 21 Nm



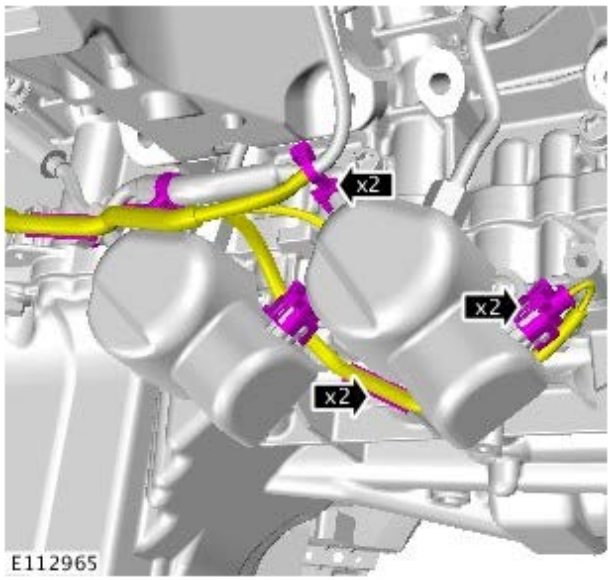
M6 11 Nm

18. The fuel pipe unions must be re-torqued after the fuel pipes have been completely installed.



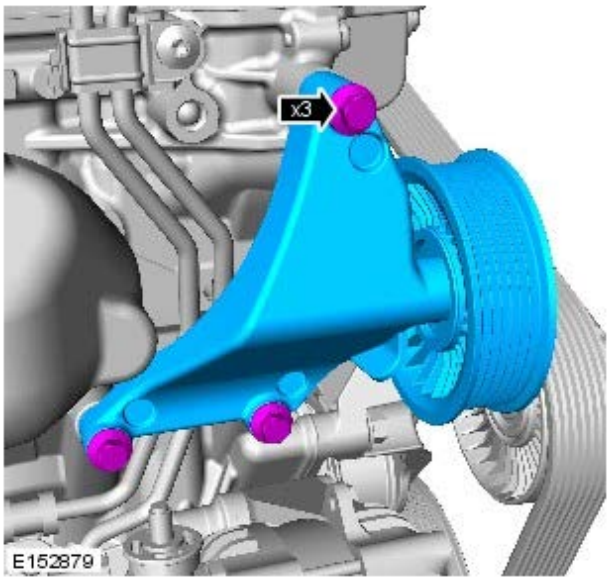
19. NOTE: Engine shown removed for clarity.

Torque:
M10 29 Nm
M6 11 Nm



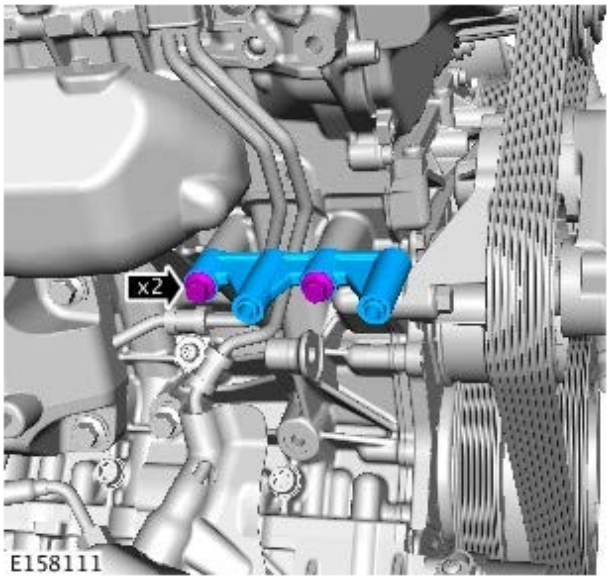
20. NOTE: Engine shown removed for clarity.

21. *Torque:* 25 Nm

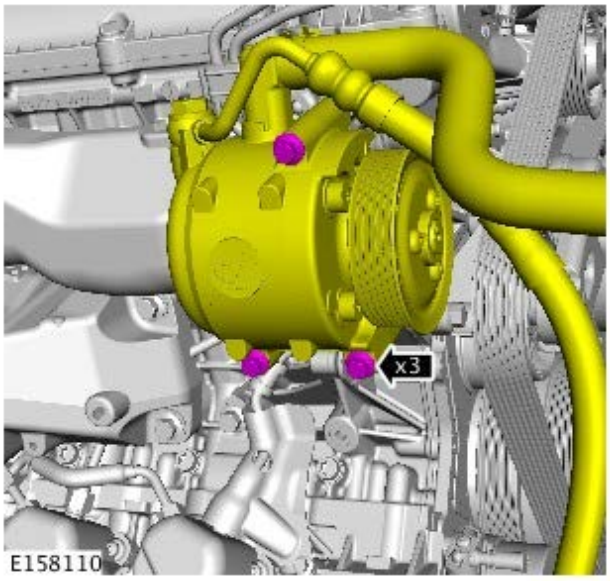


Vehicles with dynamic suspension

22. *Torque:* 25 Nm



23. *Torque:* 22 Nm



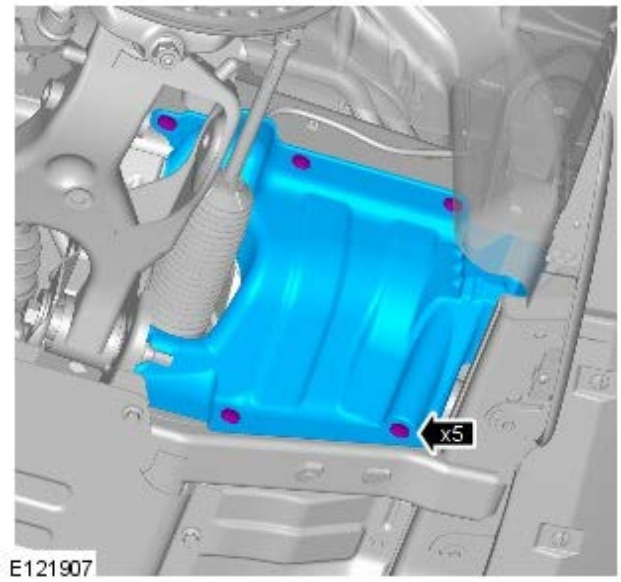
All vehicles

24. Refer to: Generator (414-02C, Removal and Installation).

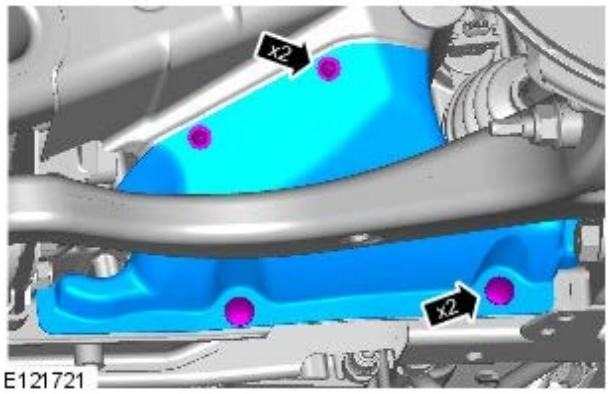
25. Refer to: Steering Column Lower Shaft (211-04, Removal and

Installation).

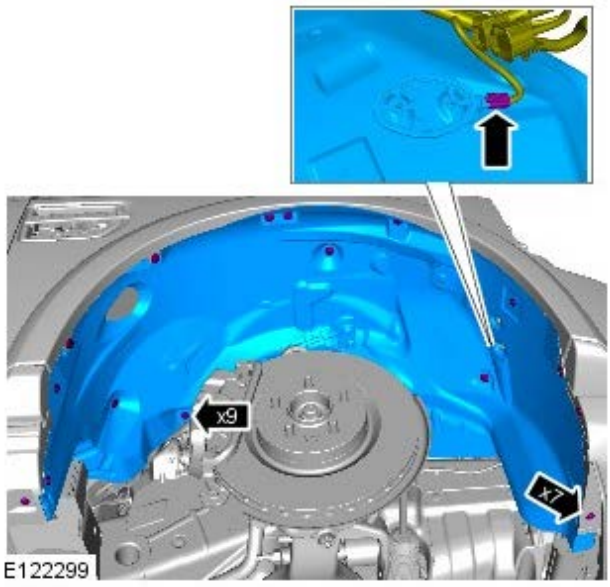
26.



27.



28.

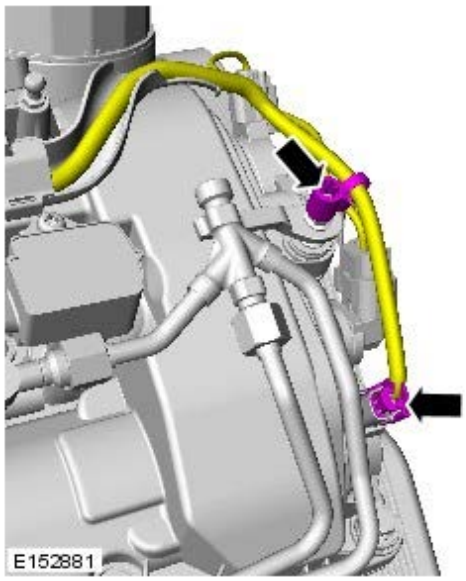


29. Lower the vehicle.

30. Install the front right wheel and tire.

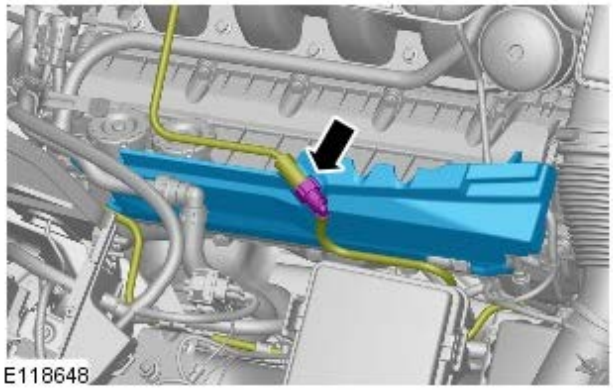
Torque: 140 Nm

31.



32. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C, Removal and Installation).

33.



34. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05, Removal and Installation).

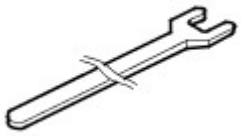
35. Refer to: Specifications (414-00, Specifications).

Published: 11-Nov-2011

Engine - V8 5.0L Petrol - Engine

Removal

Special Tool(s)

303-1142  E46076	303-1142 Viscous Coupling Wrench
303-1143  E55382	303-1143 Viscous Coupling Holding Tool

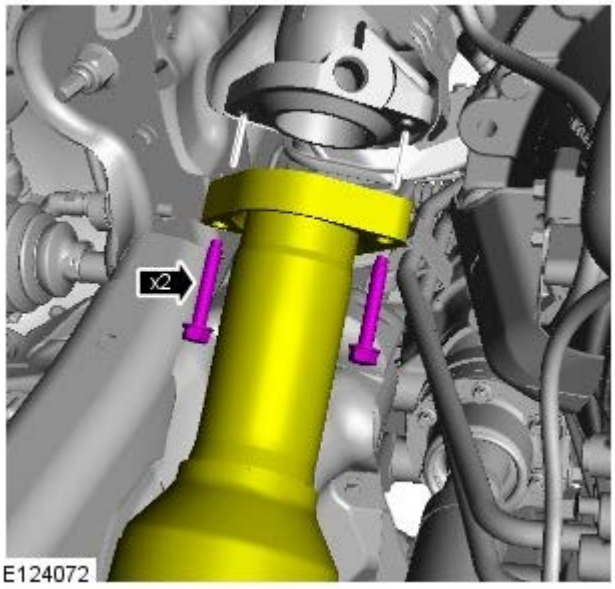
NOTES:

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

Removal steps in this procedure may contain installation details.

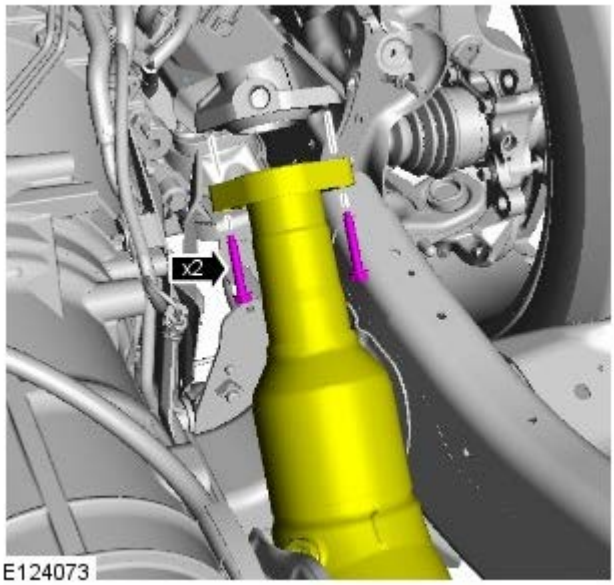
1. Refer to: Body - V8 5.0L Petrol (502-02, Removal and Installation).

2.

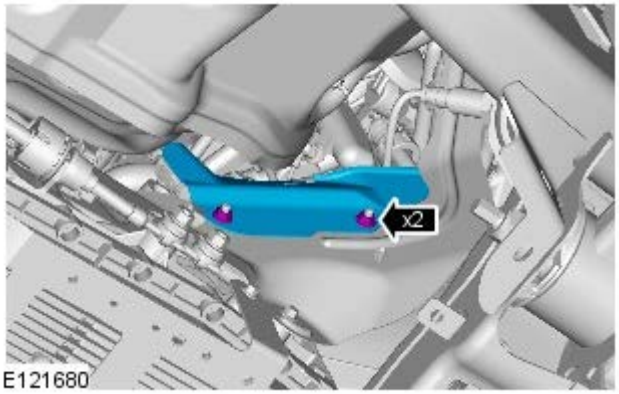


E124072

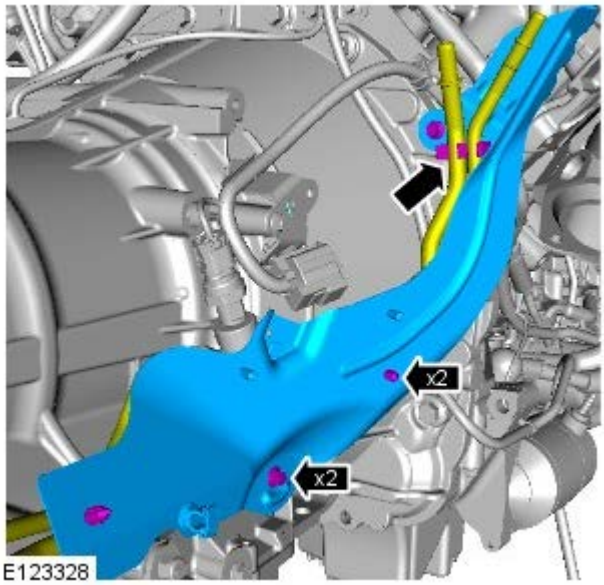
3.



4.

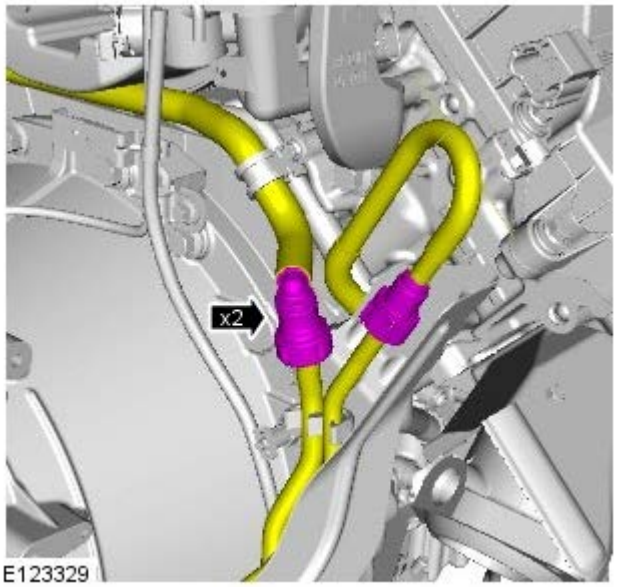


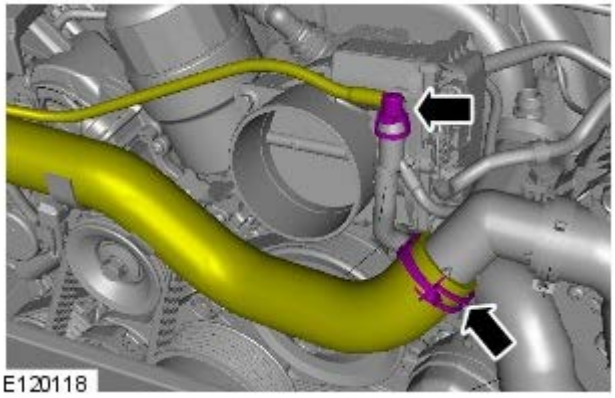
5.



6. 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.

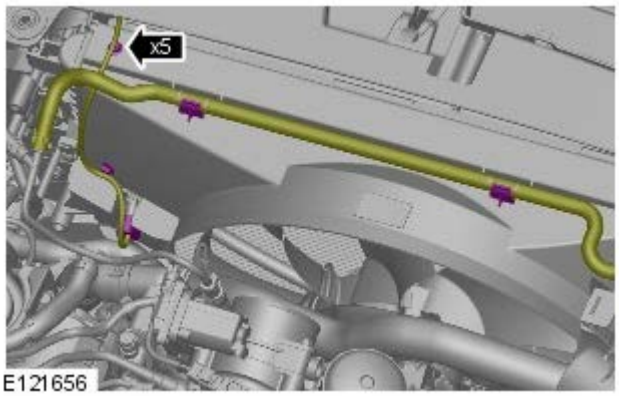
CAUTION: Be prepared to collect escaping fluids.



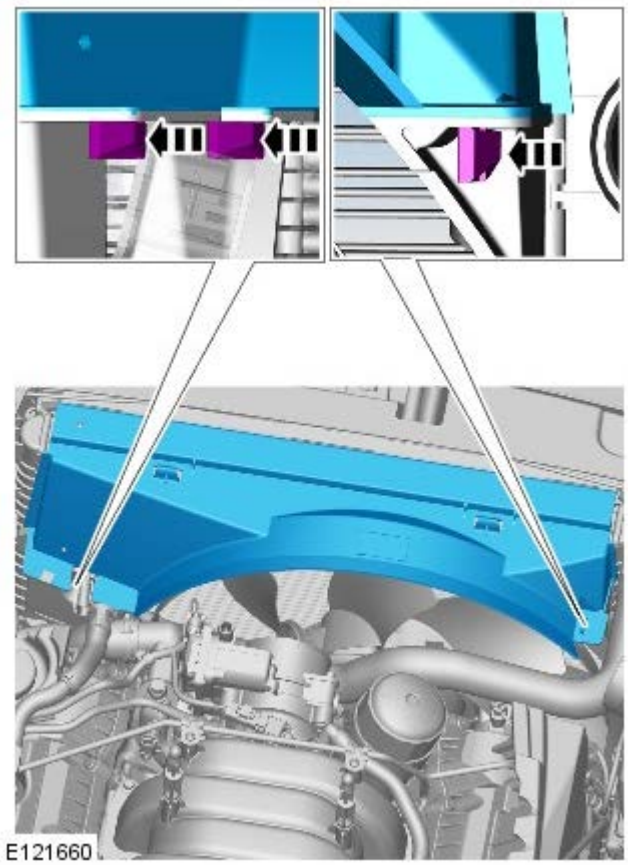


7. CAUTION: Be prepared to collect escaping coolant.

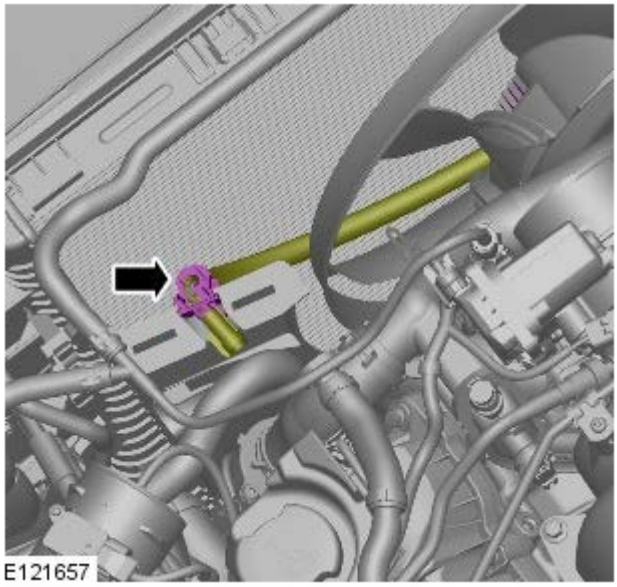
8.

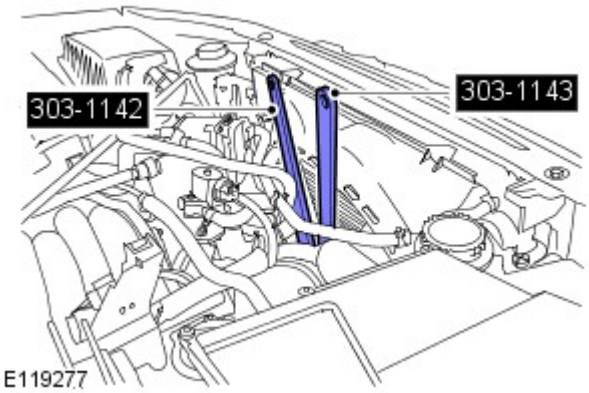


9.



10.





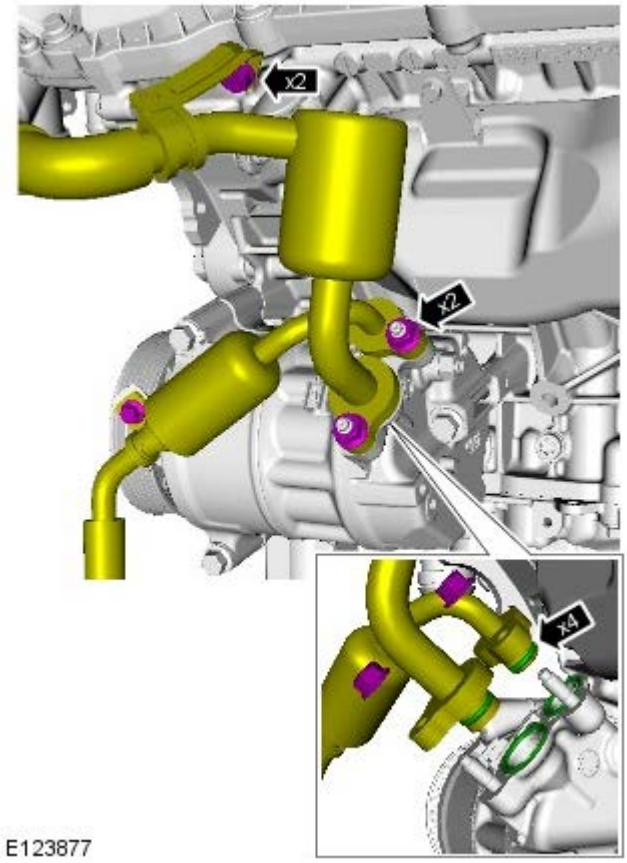
11. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

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

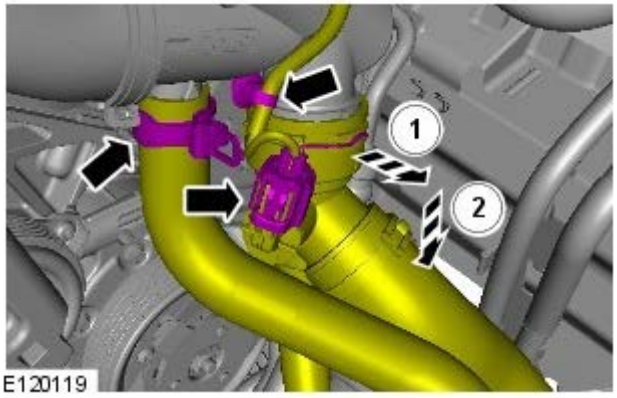
Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm

12.

- Remove and discard the 4 O-ring seals.



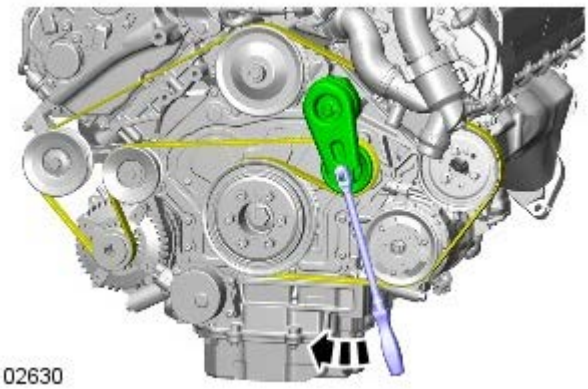
E123877



E120119

13. CAUTION: Be prepared to collect escaping coolant.

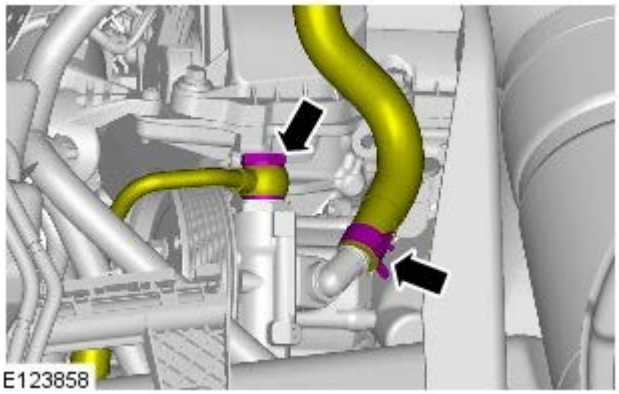
14.


E102630

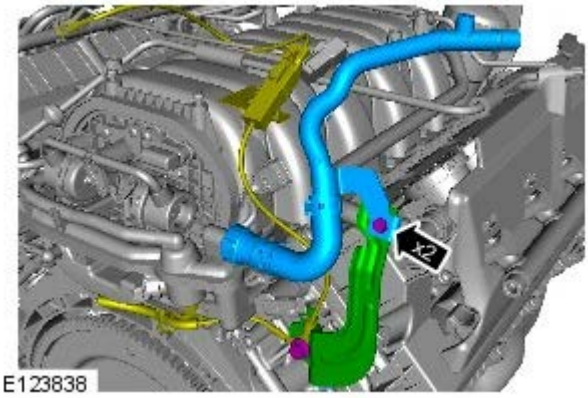
15. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

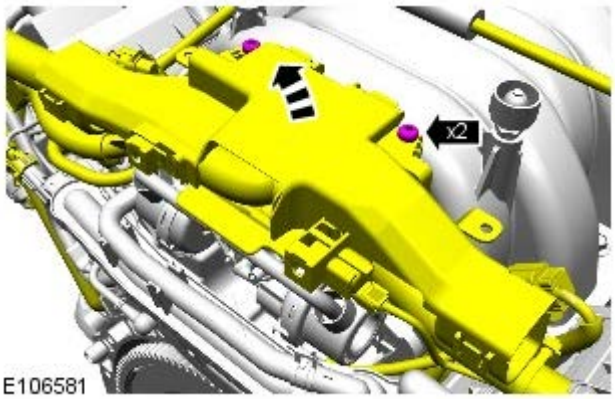
Torque: 25 Nm



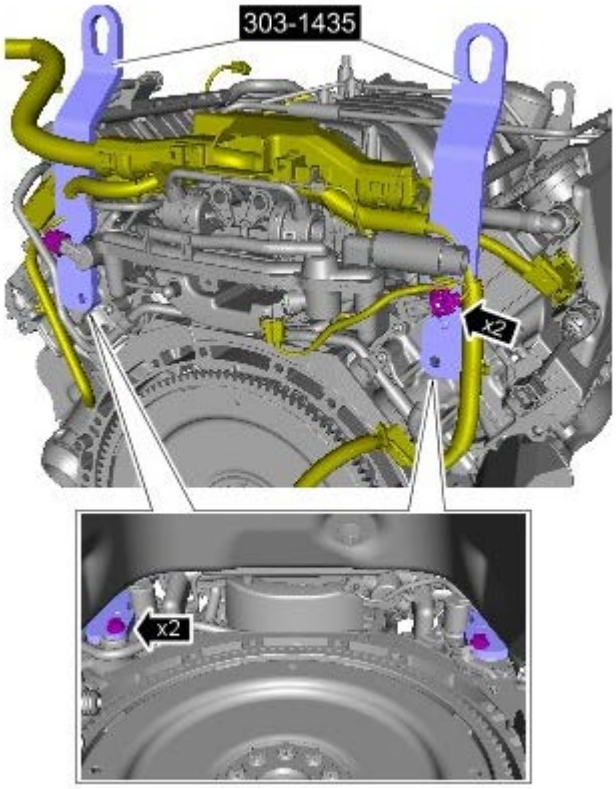
16.



17.

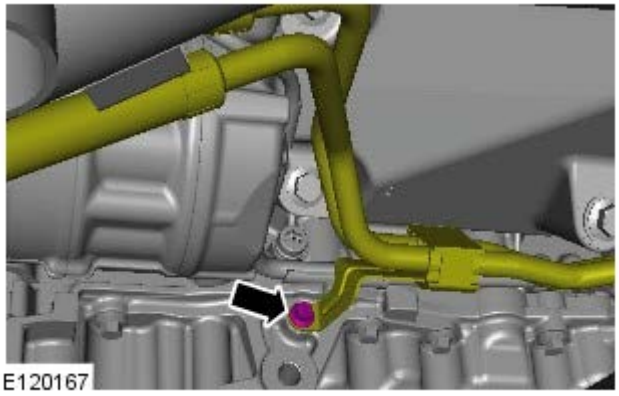


18. *Torque:* 25 Nm

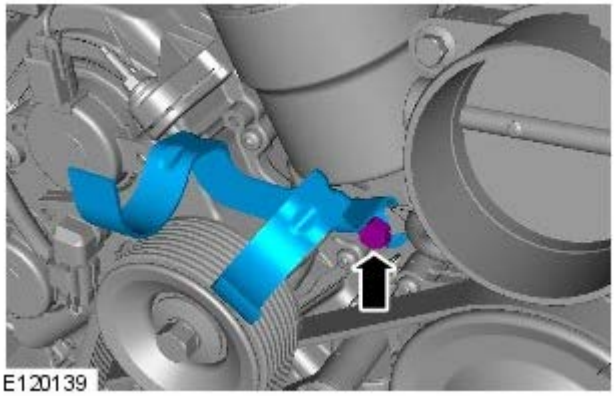


E117619

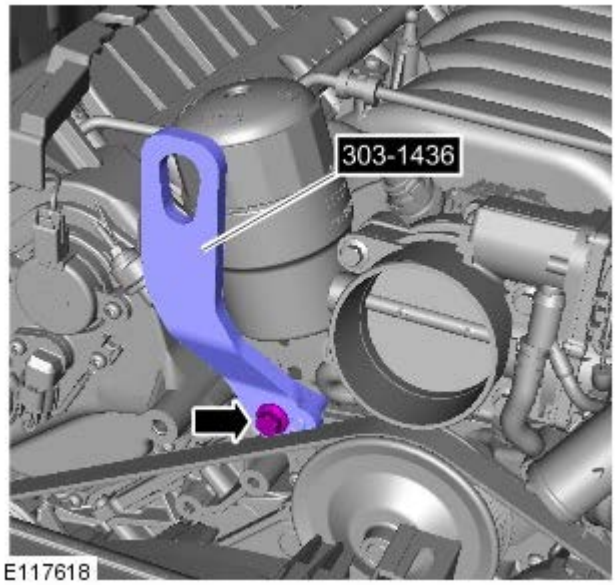
19.


E120167

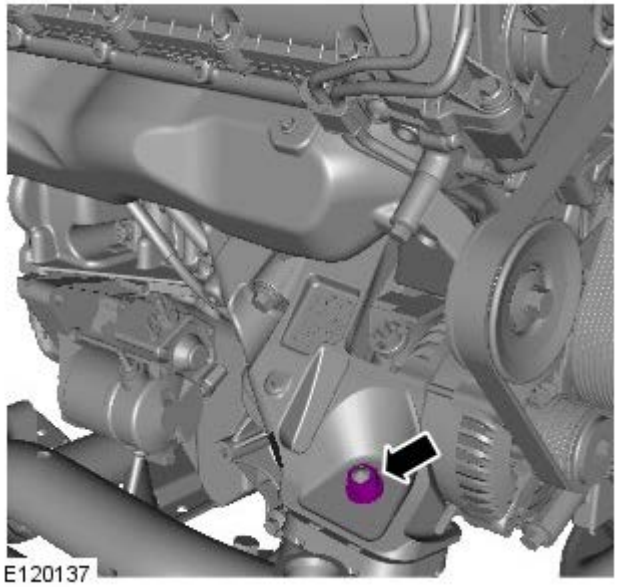
20.


E120139

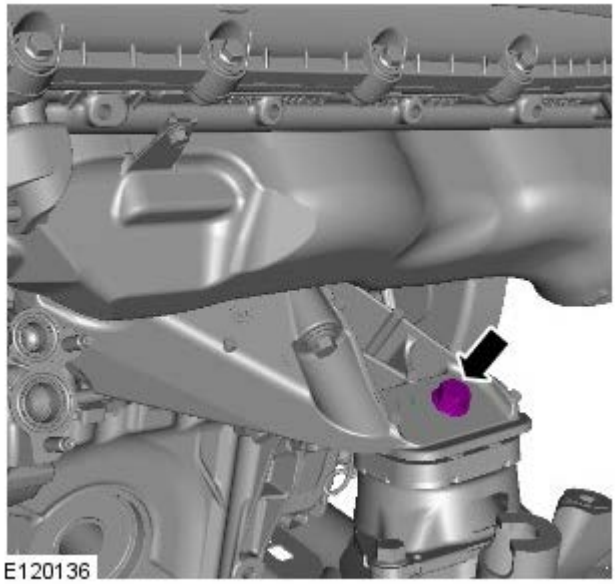
21. *Torque:* 25 Nm



22.

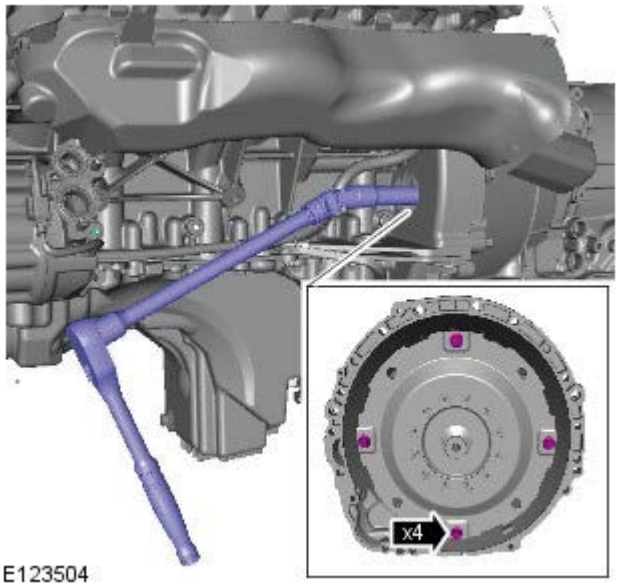


23.



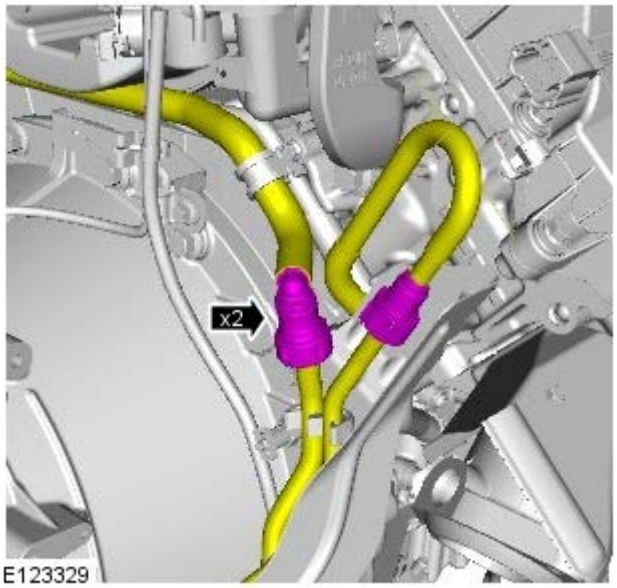
24. CAUTION: Only rotate the crankshaft clockwise.

- Mark the torque converter and flexplate when removing the last torque converter bolt. Make sure that the alignment mark is



E123504

visible through the inspection hole.

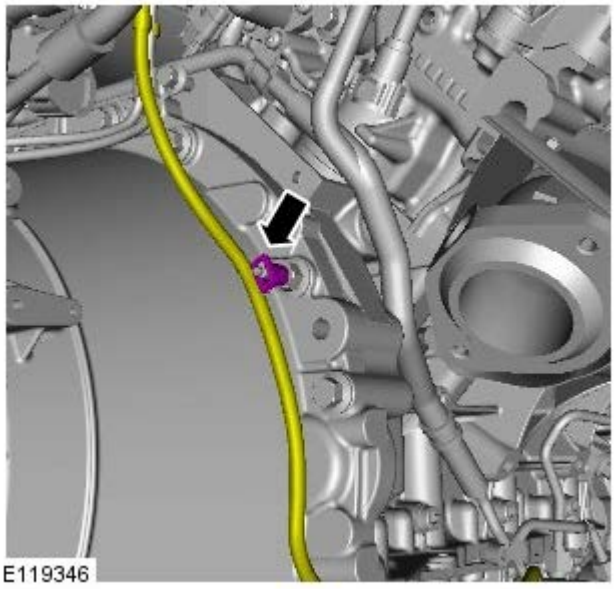


E123329

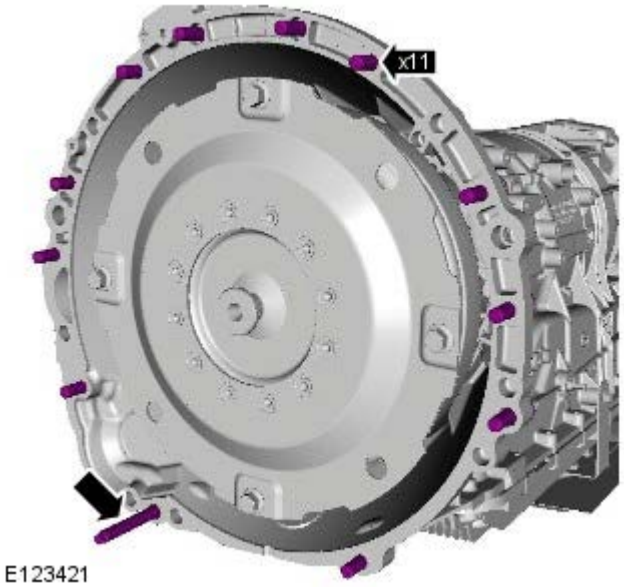
25. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

CAUTION: Be prepared to collect escaping fluids.

26.

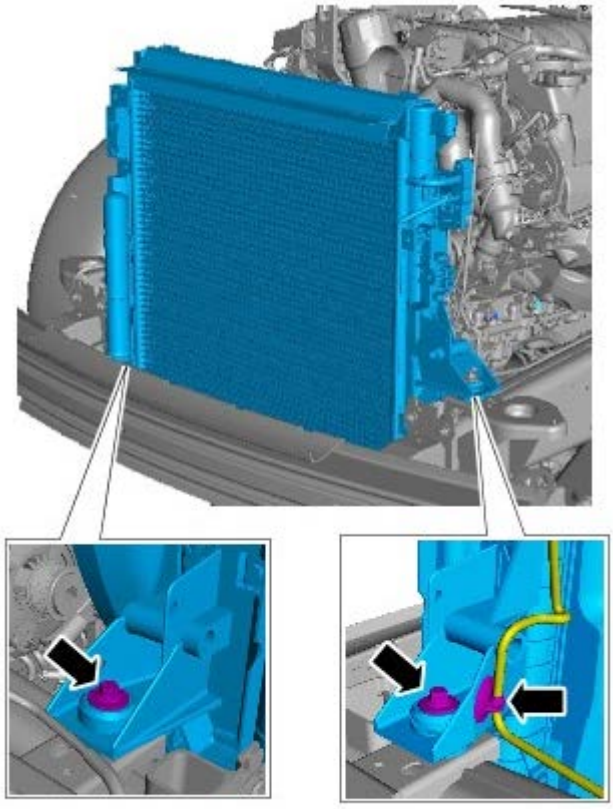

E119346

27.



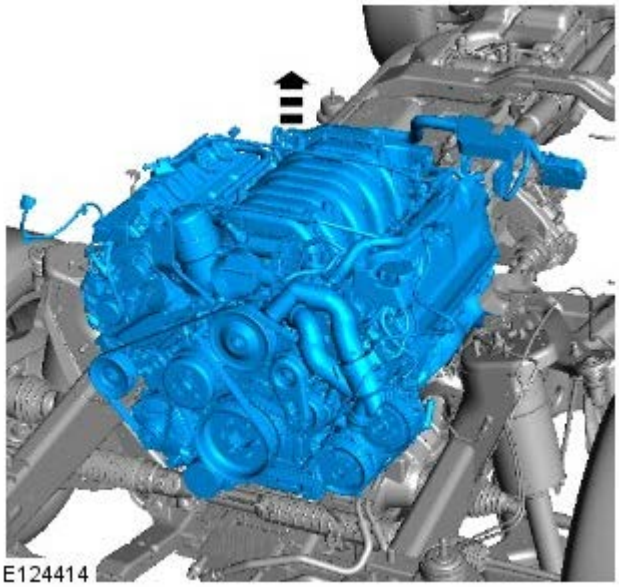
E123421

28.



E124068

29. NOTE: This step requires the aid of another technician.

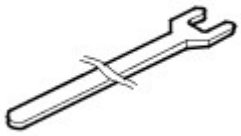

E124414

Published: 14-Nov-2011

Engine - V8 5.0L Petrol - Engine

Installation

Special Tool(s)

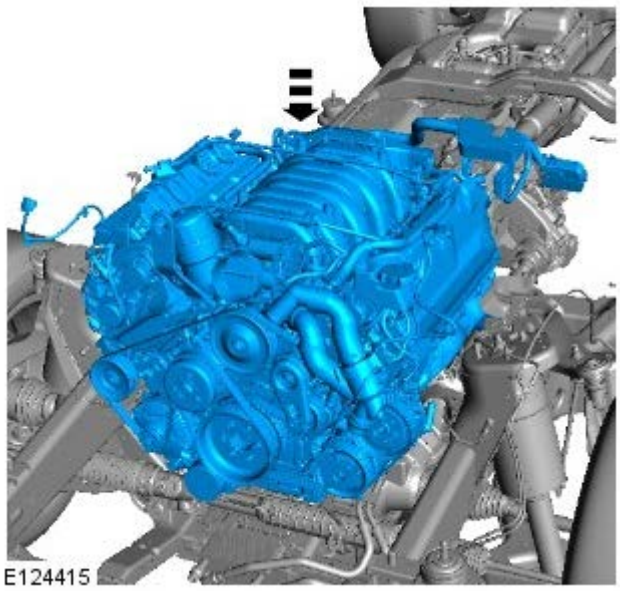
303-1142  E46076	303-1142 Viscous Coupling Wrench
303-1143  E55382	303-1143 Viscous Coupling Holding Tool

NOTES:

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

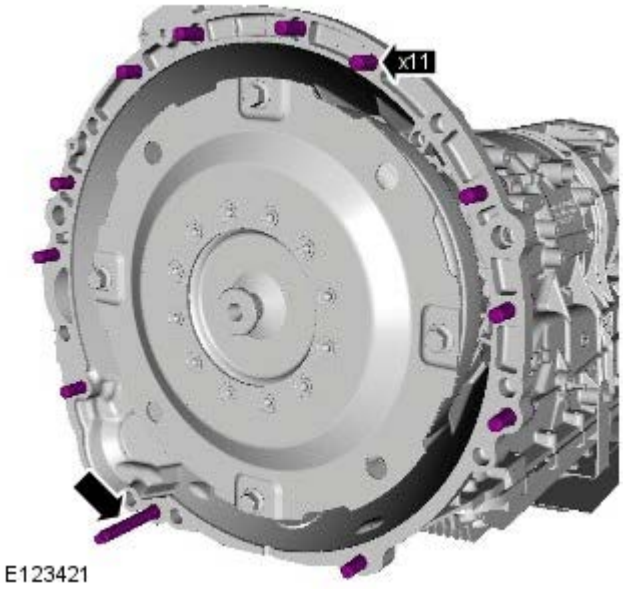
If a new engine is to be installed, remove the intake manifold to access the top transmission retaining bolts.

Some illustrations may show the engine removed for clarity.


E124415

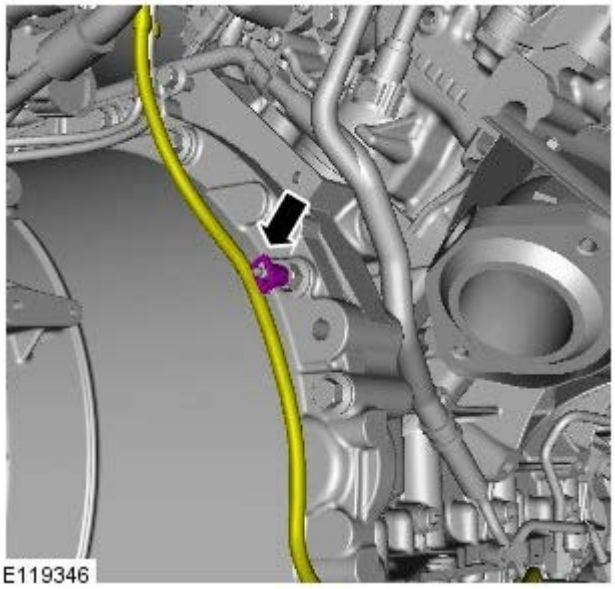
1. NOTE: This step requires the aid of another technician.

2. *Torque:* 40 Nm



E123421

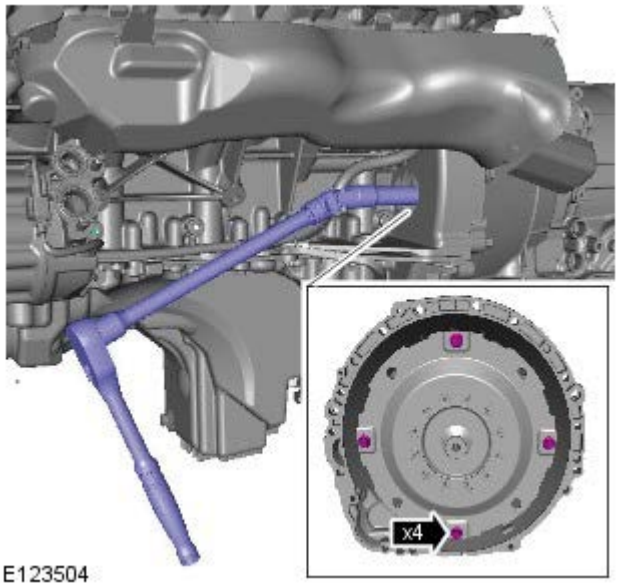
3.


E119346

4. CAUTION: Only rotate the crankshaft clockwise.

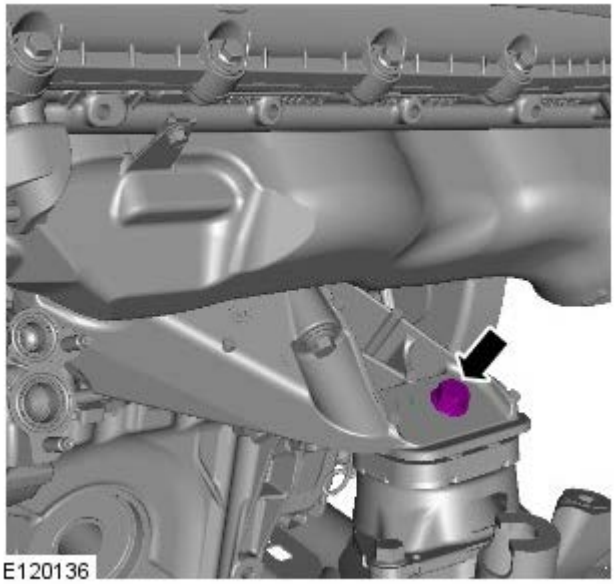
   - Make sure that the alignment mark is visible through the inspection hole on installation of the first torque converter bolt.

     Torque: 63 Nm

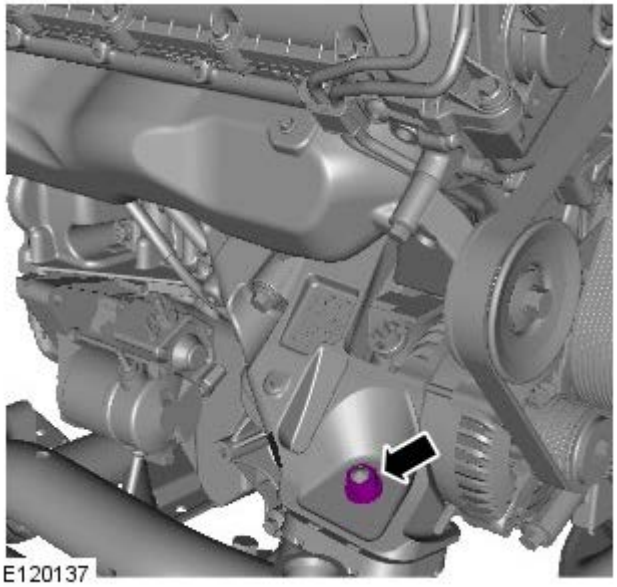


E123504

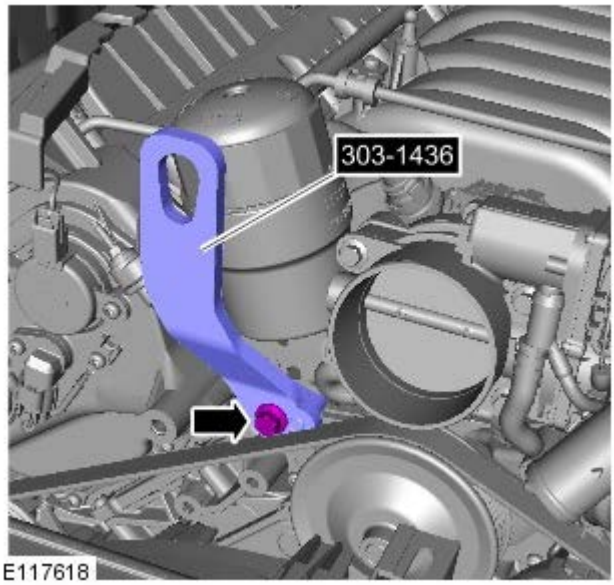
5. *Torque:* 100 Nm



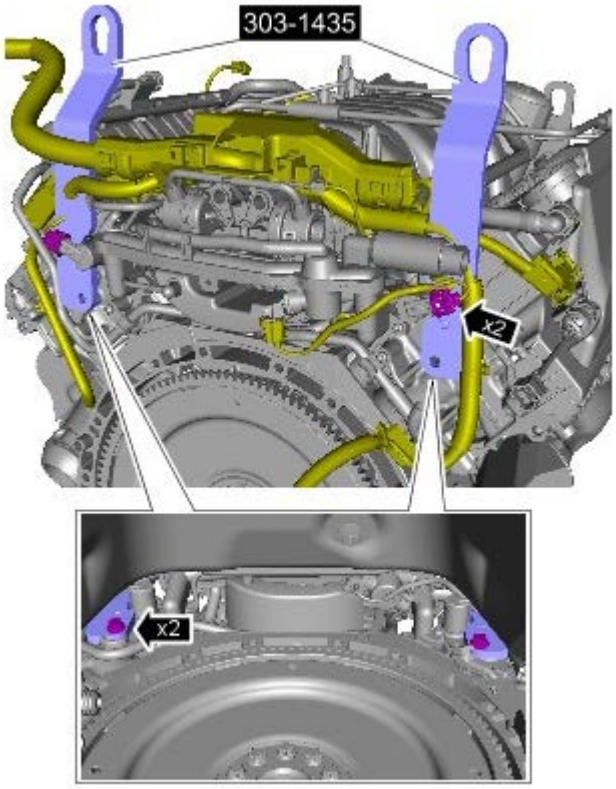
6. *Torque:* 100 Nm



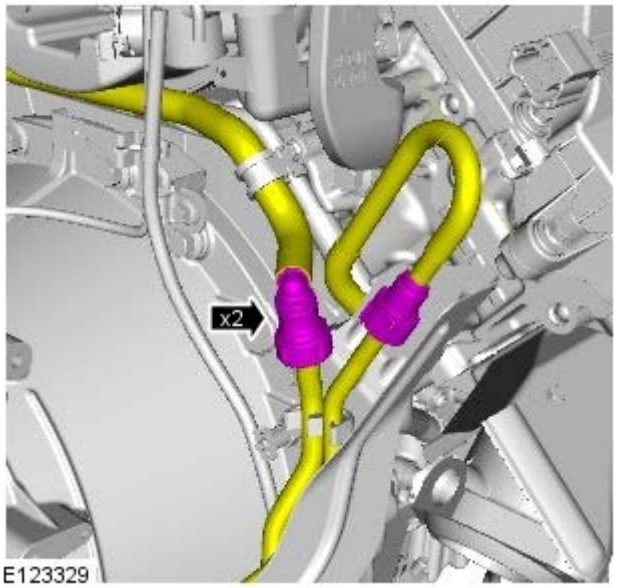
7. *Torque:* 25 Nm



8. *Torque:* 25 Nm



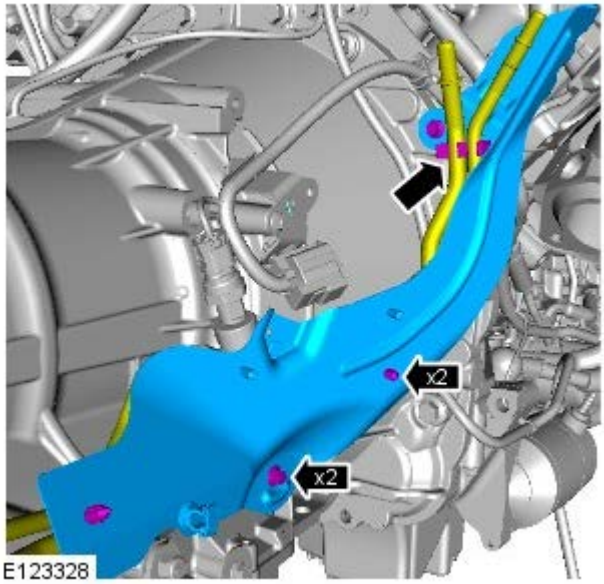
E117619



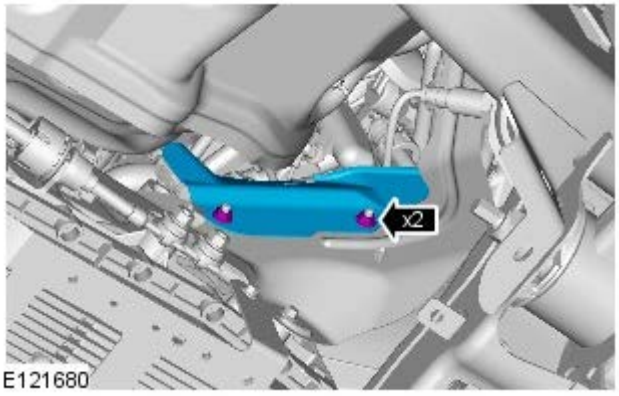
E123329

9. 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.

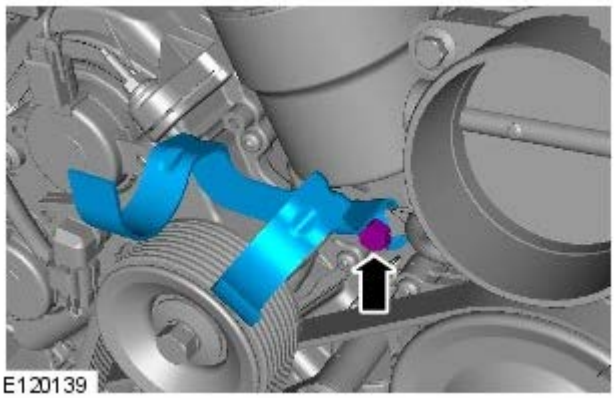
10. *Torque:* 10 Nm



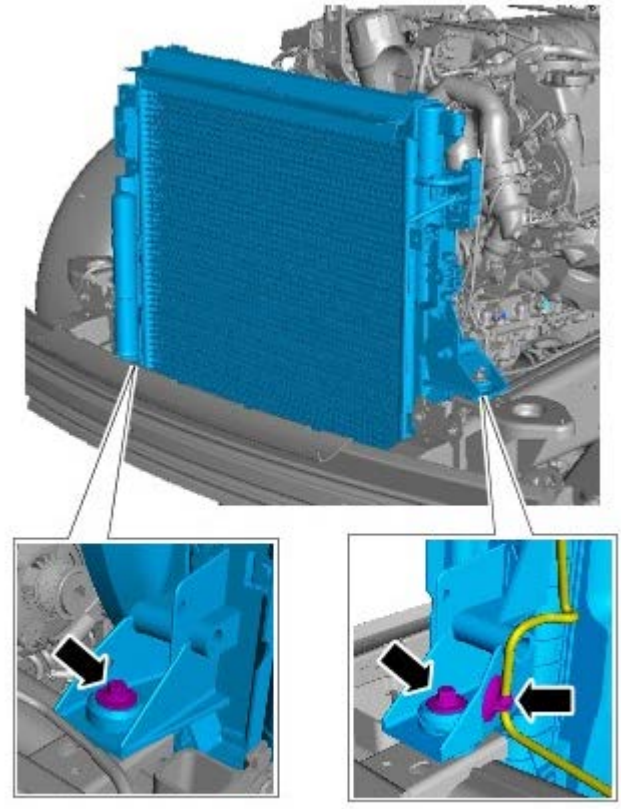
11. *Torque:* 10 Nm



12. *Torque:* 25 Nm

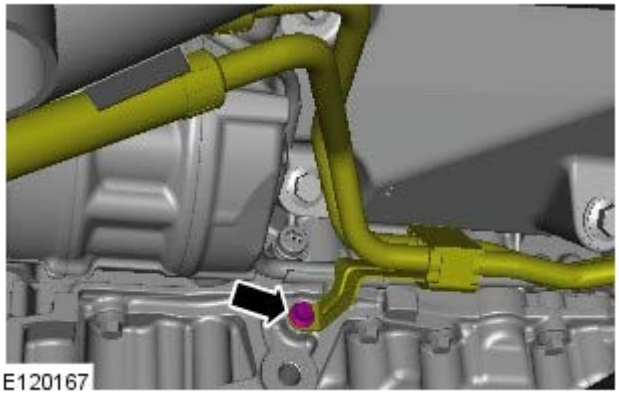


13. *Torque:* 25 Nm



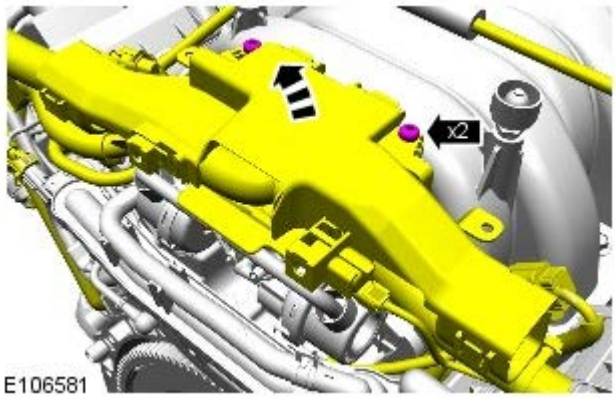
E124068

14. *Torque:* 12 Nm



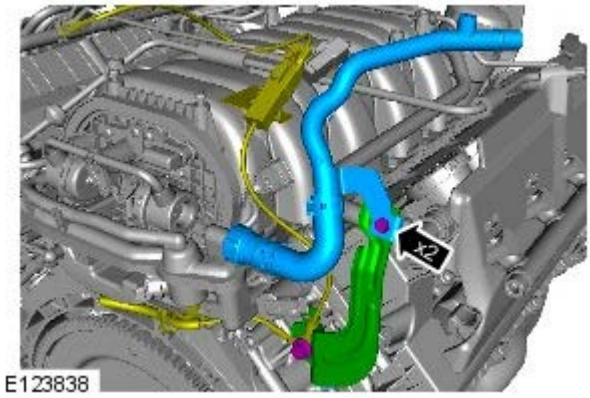
E120167

15. *Torque:* 10 Nm



E106581

16. *Torque:*
    M8 Bolt 25 Nm
    M6 Bolt 10 Nm

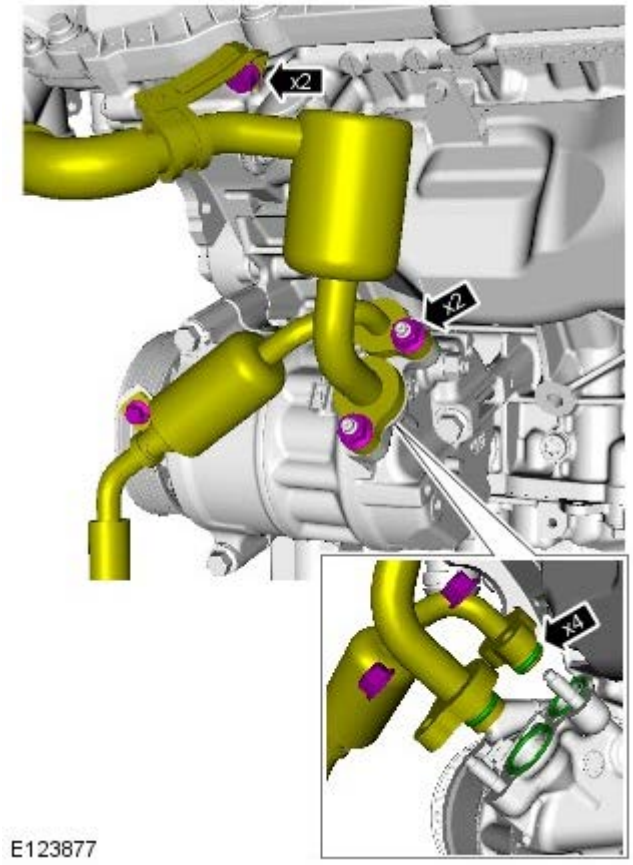


E123838

17.

- Remove and discard the 4 O-ring seals.

Torque:
M8 Nut 9 Nm
M8 Bolt 25 Nm
M6 bolt 10 Nm

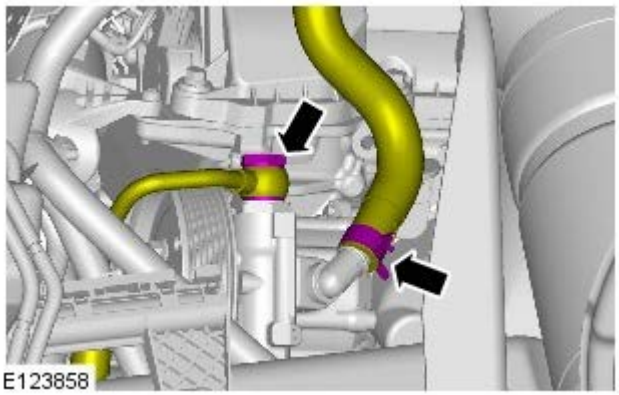


E123877

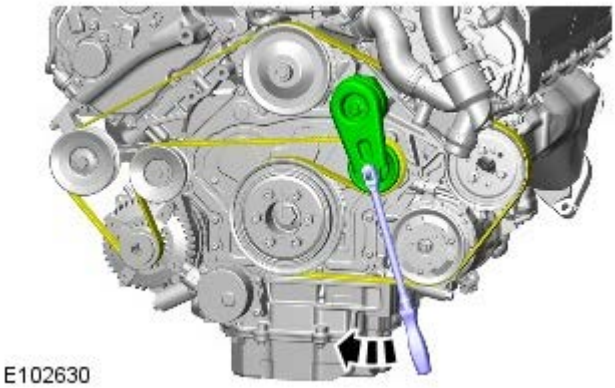
18. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

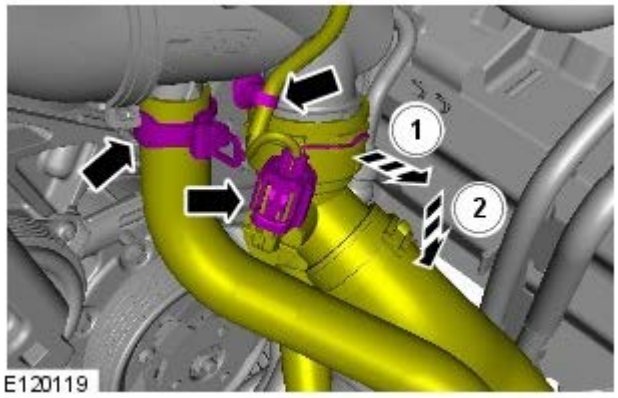
Torque: 25 Nm


E123858

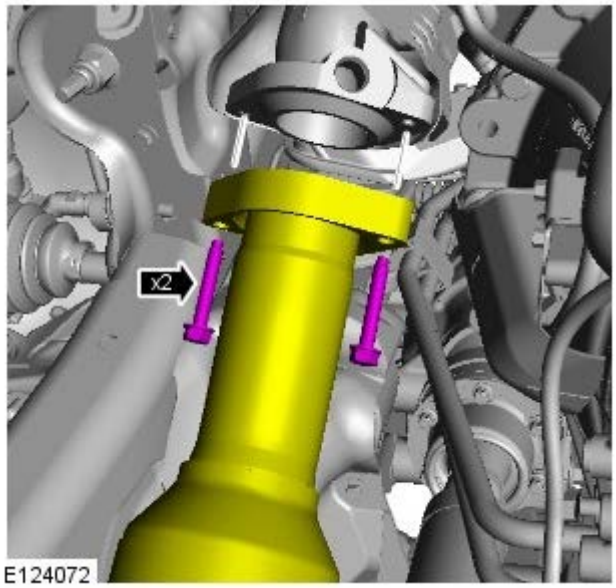
19.



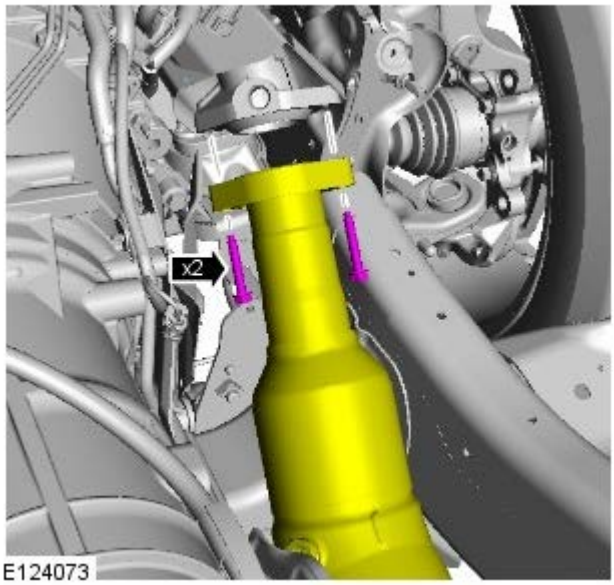
20. CAUTION: Be prepared to collect escaping coolant.

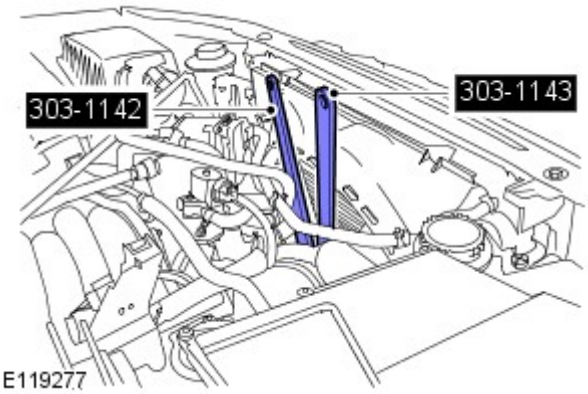


21. *Torque:* 22 Nm



22. *Torque:* 22 Nm

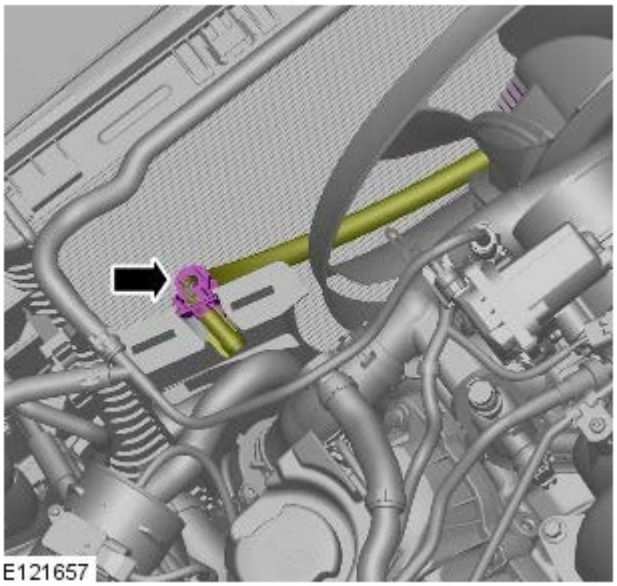




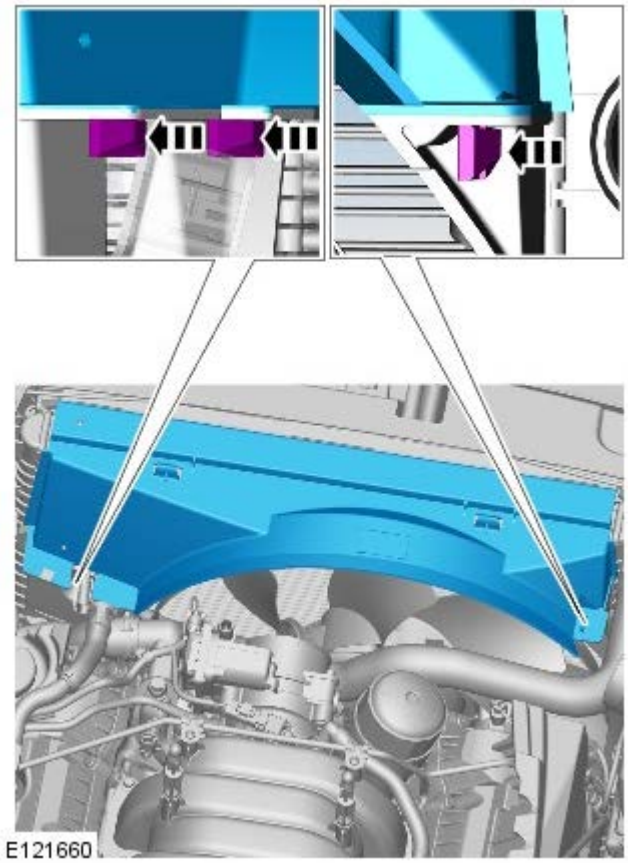
23. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm

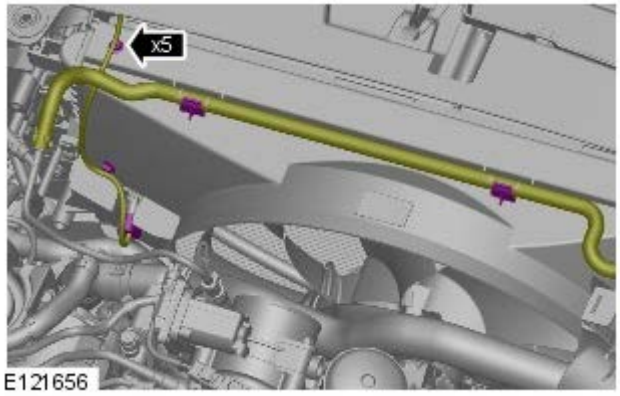
24.



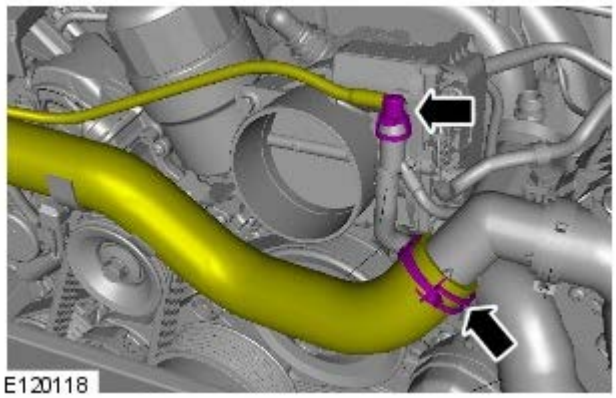
25.



26.



27.



28. Refer to: Body - 5.0L (502-02, Removal and Installation).

29. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

Published: 04-Apr-2012

Engine - V8 S/C 5.0L Petrol -

Engine Data

Engine Description	Engine Capacity	Maximum Engine Torque (EEC)	Maximum Engine Power (EEC)	Compression Ratio	Bore	Stroke
• 90° "Vee" • 8 Cylinder • 32 Valves	4.999 ccm	625 Nm at 2.500 - 5.500 RPM	375 kW at 6.000 - 6.500 RPM	9.5 ± 0.50	92.5 mm	93 mm

Engine Firing Order

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

Engine Valve Clearance (cold)

Intake Valve	Exhaust Valve
0.20 ±0.02	0.25 ±0.02

Spark Plugs

Specification	Spark Plug Gap
ILKR6C-10	1 mm

Lubricants, Fluids, Sealers and Adhesives

Description	Specification
Engine Oil	WSS-M2C925-A
Sealant	WSE-M4G323-A6
Core plug and stub pipe retainer	WSK-M2G349-A7

Capacities

Description	Liters
Engine oil, initial fill	9.65
Engine oil, service fill with oil filter change	8.0

Cylinder Head and Valve Train

Item	Specification
Cylinder head maximum permitted warp (mm) (flatnes specfication)	
overall	0.08
over 150x150 mm area	0.05
over 25x25 mm area	0.02
Valve guide inner diameter (mm)	5.51 ± 0.01
Intake valve effective length (mm) (tip to gauge line)	117.21 ± 0.1
Exhaust valve effective length (mm) (tip to gauge line)	94.39 ± 0.1
Valve stem to guide clearance intake diametrical (mm)	0.022 - 0.057
Valve stem to guide clearance exhaust diametrical (mm)	0.03 - 0.065
Valve head diameter intake (mm)	36 ± 0.1
Valve head diameter exhaust (mm)	30 ± 0.1
Intake valve face angle (degrees)	44.875 ± 0.125
Exhaust valve face angle (degrees)	44.875 ± 0.125
Valve stem diameter intake (mm)	5.4705 ± 0.0075
Valve stem diameter exhaust (mm)	5.4625 ± 0.0075
Valve spring free length (mm) - inlet	46.1
Valve spring free length (mm) - exhaust	46.1
Valve spring installed height (mm) - inlet	35.74
Valve spring installed height (mm) - exhaust	35.1
Camshaft lobe lift intake (mm)	10
Camshaft lobe lift exhaust (mm)	9.36
Camshaft journal to cylinder head bearing surface clearance diametrical (mm)	0.025 - 0.065
Camshaft journal diameter - all positions	26.965 ± 0.01
Bearing diameter - all positions	27.01 ± 0.01
Camshaft journal maximum run out limit (mm)	
Camshaft journals to end journals	0.03
Camshaft journals to adjacent journals	0.015
Camshaft journal maximum out of round (mm) - all journals	0.005

Torque Specifications

NOTE: **A = Refer to procedure for correct torque sequence.**

Description	Nm	lb-ft	lb-in
Engine cover mounting bolts	10	7	-
Accessory drive belt tensioner retaining bolt	40	30	-
Supercharger belt idler/tensioner bracket retaining bolts	25	18	-
Secondary drive belt idler retaining bolts	40	30	-
Power steering pump pulley retaining bolts	25	18	-
Power steering pump retaining bolts	25	18	-

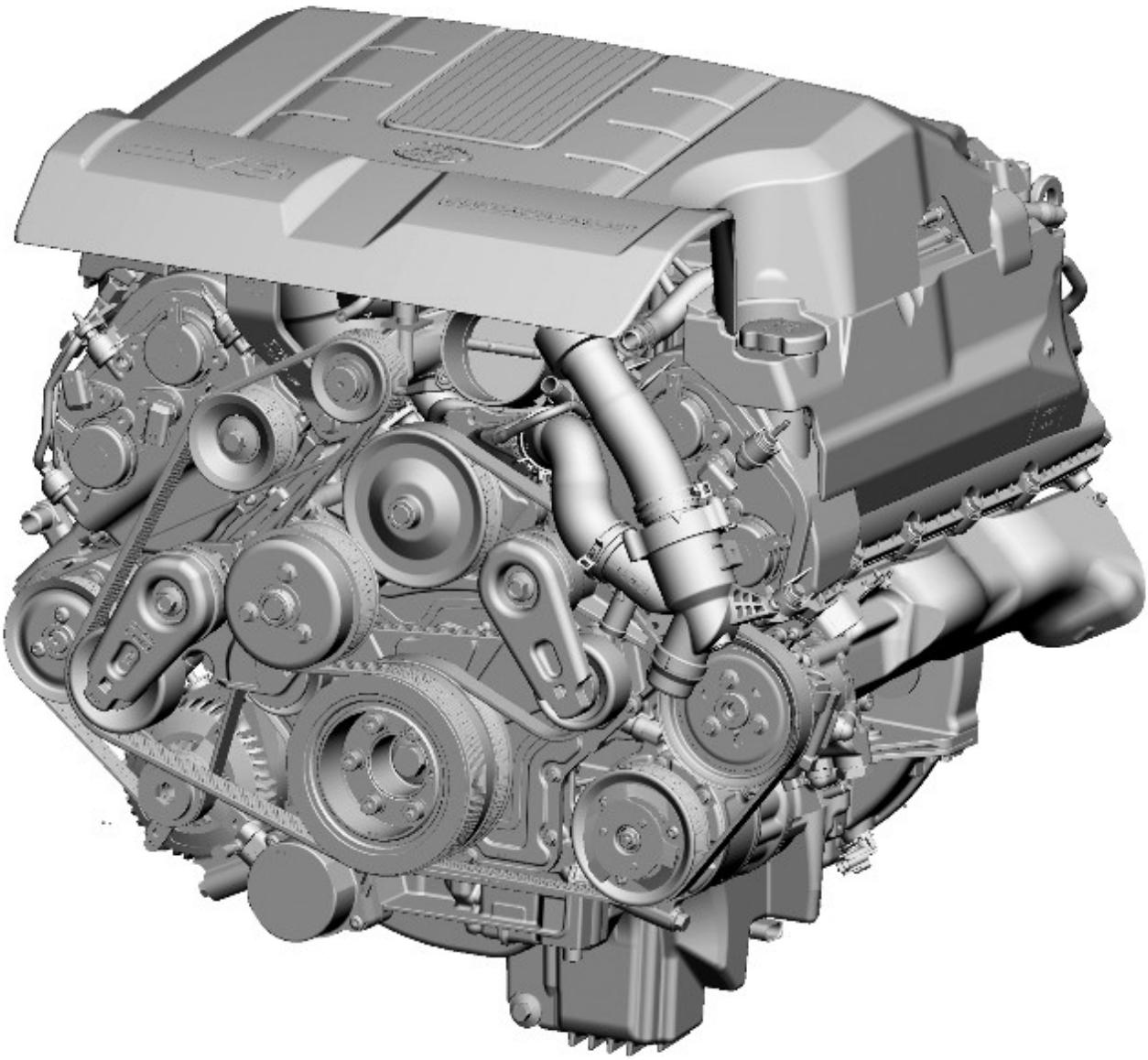
Power steering pump bracket to engine retaining bolts	25	18	-
Generator retaining bolts	48	35	-
Starter motor retaining bolts	40	30	-
Air conditioning compressor retaining bolts	25	18	-
Engine mounting to engine mounting bracket retaining nuts	100	74	-
Engine mounting to subframe retaining bolts	56	41	-
Engine mounting bracket to engine retaining bolts	45 + 60°	33 + 60°	-
Crankshaft damper pulley retaining LH threaded bolt	200 + 270°	148 + 180°	-
Flexplate retaining bolts	45 + 90°	33 + 90°	-
Exhaust manifold heat shield retaining bolts	**A**	-	-
Exhaust manifold retaining bolts	**A**	-	-
Engine wiring harness bracket retaining bolts	10	7	-
Coolant outlet pipe	10	7	-
Intercooler retaining bolts	25	18	-
Intake manifold retaining bolts	25	18	-
Oil Cooler retaining bolts	13	10	-
Knock sensor (KS) retaining bolt	20	14	-
Ignition coil retaining bolts	8	-	71
Spark plugs	20	15	-
Fuel rail retaining bolts	**A**	-	-
High pressure fuel pipe retaining bolts	**A**	-	-
High pressure fuel pump retaining bolts	12	9	-
Oil filter housing assembly retaining bolts	12	9	-
Oil filter cap	25	18	-
Lifting eye bolts	25 + 90°	18 + 90°	-
Manifold absolute pressure and temperature (MAPT) sensor sensor retaining bolts	5	-	44
Coolant pump retaining bolts	12	9	-
Variable valve timing (VVT) oil control solenoid retaining bolts	10	7	-
Camshaft position (CMP) sensor retaining bolts	10	7	-
Camshaft cover retaining bolts	13	10	-
Front upper timing cover retaining bolts	12	9	-
Front lower timing cover retaining bolts	**A**	-	-
Engine rear cover retaining bolts	**A**	-	-
VVT to camshaft retaining bolts	32	24	-
Camshaft bearing caps retaining bolts	11	8	-
Primary timing chain fixed guide retaining bolts	12	9	-
Primary timing chain tensioner retaining bolts	12	9	-
Primary timing chain tensioner guide blade retaining bolts	25	18	-
Auxiliary chain tensioner guide retaining bolts	21	15	-
Auxiliary chain fixed guide retaining bolt	12	9	-
Oil pump sprocket retaining bolt	21	15	-
Cylinder head retaining bolts	**A**	-	-
Engine oil level (EOL) sensor retaining bolt	12	9	-
Crankshaft position (CKP) sensor retaining bolt	10	7	-
Oil sump body to engine retaining bolts	25	18	-
Oil pan drain plug	24	18	-
Oil transfer tube to Oil pan body retaining bolts	11	8	-
Oil pump to engine block retaining bolts	25	18	-
Pick-up pipe to oil pump retaining bolts	12	9	-
Windage tray retaining bolts	25	18	-
Piston cooling jet retaining bolts	12	9	-
Engine block coolant draining plug	50	37	-
Cooling fan pulley	25	18	-
Connecting Rod bolts			
Stage 1	10	7	-
Stage 2	50	37	-
Main bearing cap			
M10 bolt Stage 1	25	18	-
M10 bolt Stage 2	57 + 70°	42 + 70°	-
M8 bolt Stage 1	15	11	-
M8 bolt Stage 2	33 + 75°	24 + 75°	-

Published: 24-Feb-2014

Engine - V8 S/C 5.0L Petrol - Engine

Description and Operation

EXTERNAL VIEW



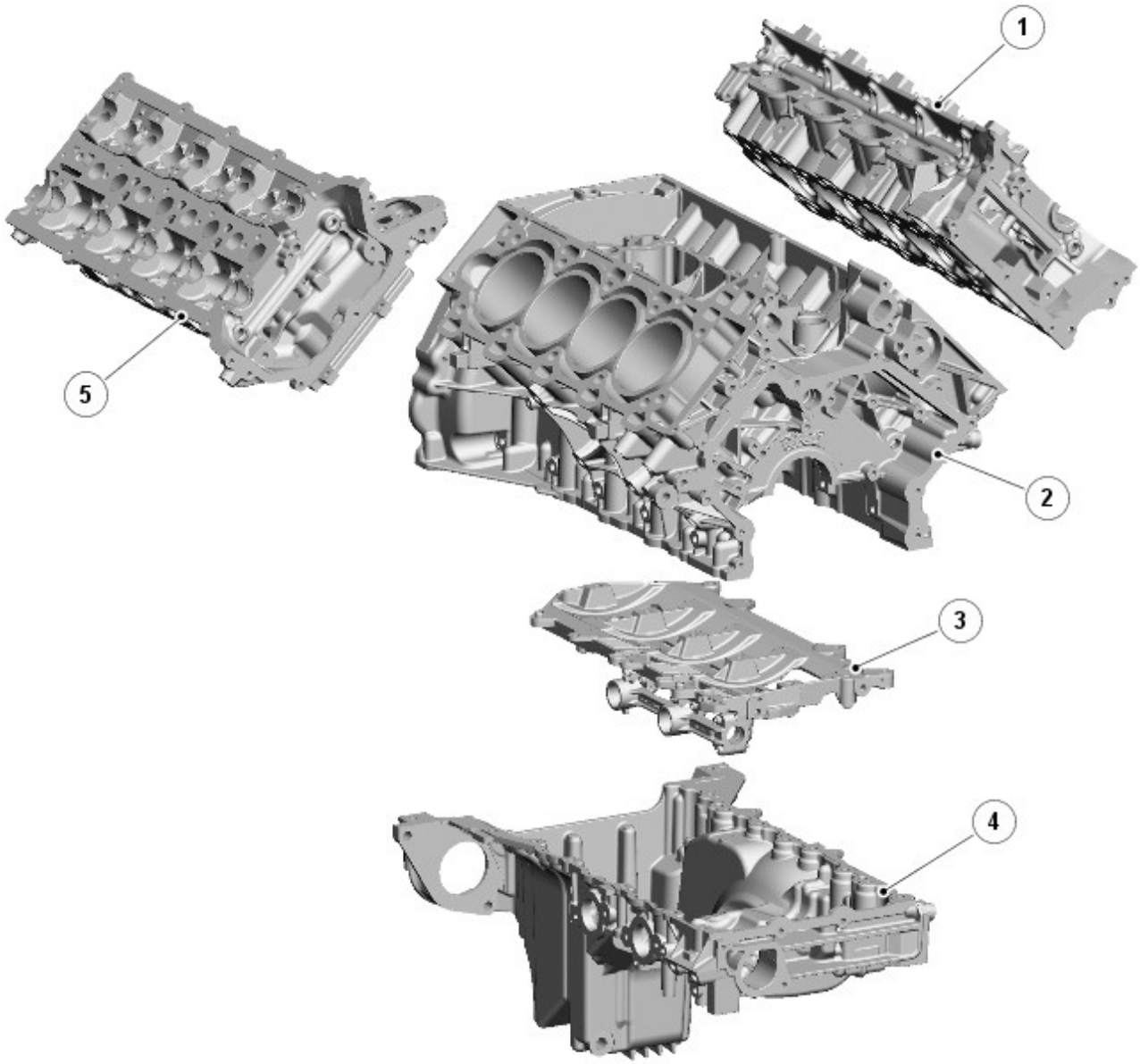
E121105

INTRODUCTION

The 5.0L SC (supercharger) gasoline engine is a liquid cooled V8 unit featuring direct fuel injection, four overhead camshafts and four valves per cylinder. All four camshafts incorporate VCT (variable camshaft timing).

The main structural components of the engine are all manufactured from aluminum alloy. The engine is built around a very stiff, lightweight, enclosed V, deep skirt cylinder block. A structural windage tray is bolted to the bottom of the cylinder block to further improve the block stiffness, minimize NVH (noise, vibration and harshness) and help reduce oil foaming. To further enhance the stiffness of the lower engine structure, a heavily ribbed sump is installed. The sump also helps to reduce engine noise.

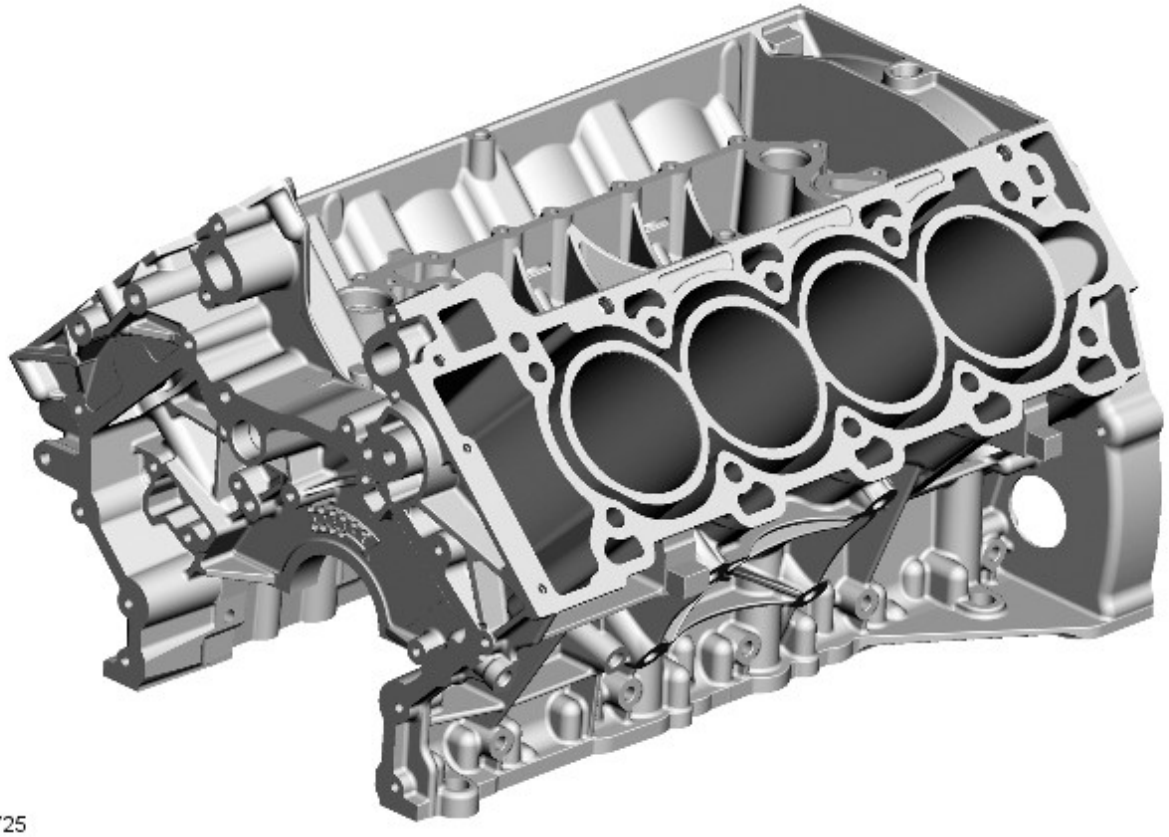
Engine Structure



E121104

Item	Part Number	Description
1	-	LH (left hand) cylinder head (bank B)
2	-	Cylinder block
3	-	Windage tray
4	-	Sump
5	-	RH (right hand) cylinder head (bank A)

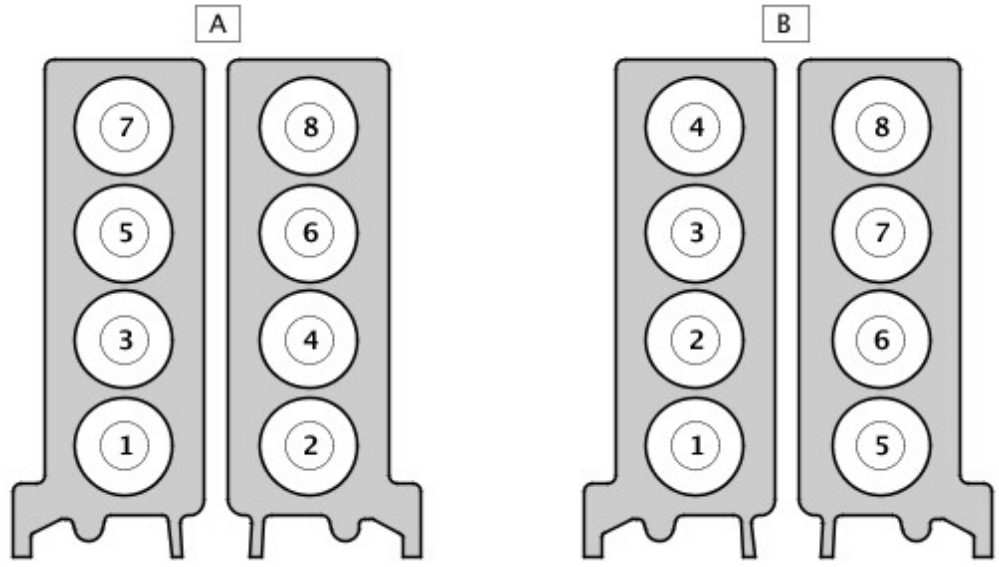
CYLINDER BLOCK



E106725

The cylinder block is a 90 degree configuration with cast-in iron cylinder liners and an open deck die-cast coolant jacket. The low volume coolant jacket gives good warm-up times and low piston noise levels. The longitudinal flow design of the coolant jacket, with a single cylinder head coolant transfer port in each bank, provides good rigidity and head gasket sealing.

Cylinder Numbering



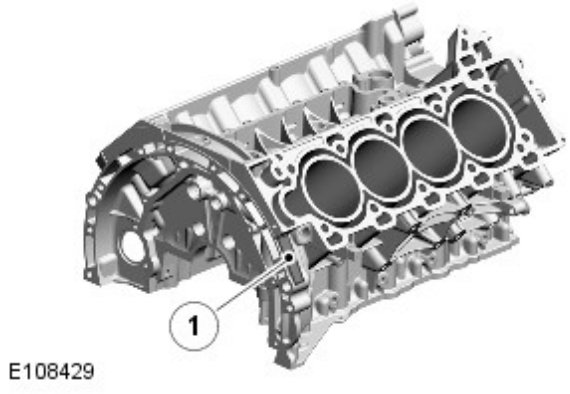
E163886

Item	Part Number	Description
A	-	ISO standard cylinder numbering
B	-	DIN standard cylinder numbering

ISO cylinder firing order 1,2,7,3,4,5,6,8

DIN cylinder firing order 1,5,4,2,6,3,7,8

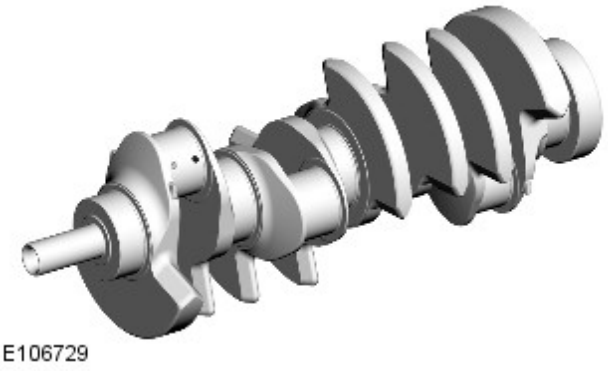
Engine Data Location



Item	Part Number	Description
1	-	Engine data location

Engine data is marked on the cylinder block at the rear of the RH cylinder bank.

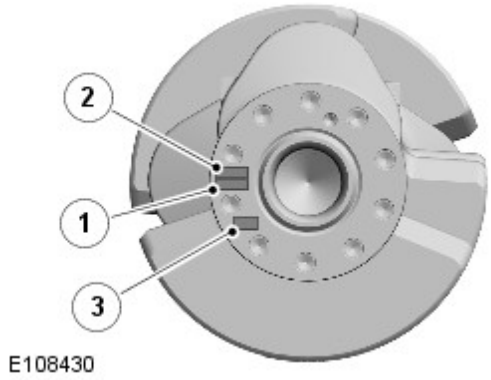
CRANKSHAFT



The crankshaft is made from spheroidal graphite cast iron, which, compared with grey cast iron, has higher mechanical strength, ductility and increased shock resistance. The undercut and rolled fillets also improve strength. Eight counter-balance weights ensure low vibration levels and the large, cross-drilled main bearing journals are designed to contribute to stiffness.

An oil groove in the upper half of each main bearing transfers the oil into the crankshaft for lubrication of the connecting rod bearings. A thrust washer is installed each side of the top half of the center main bearing.

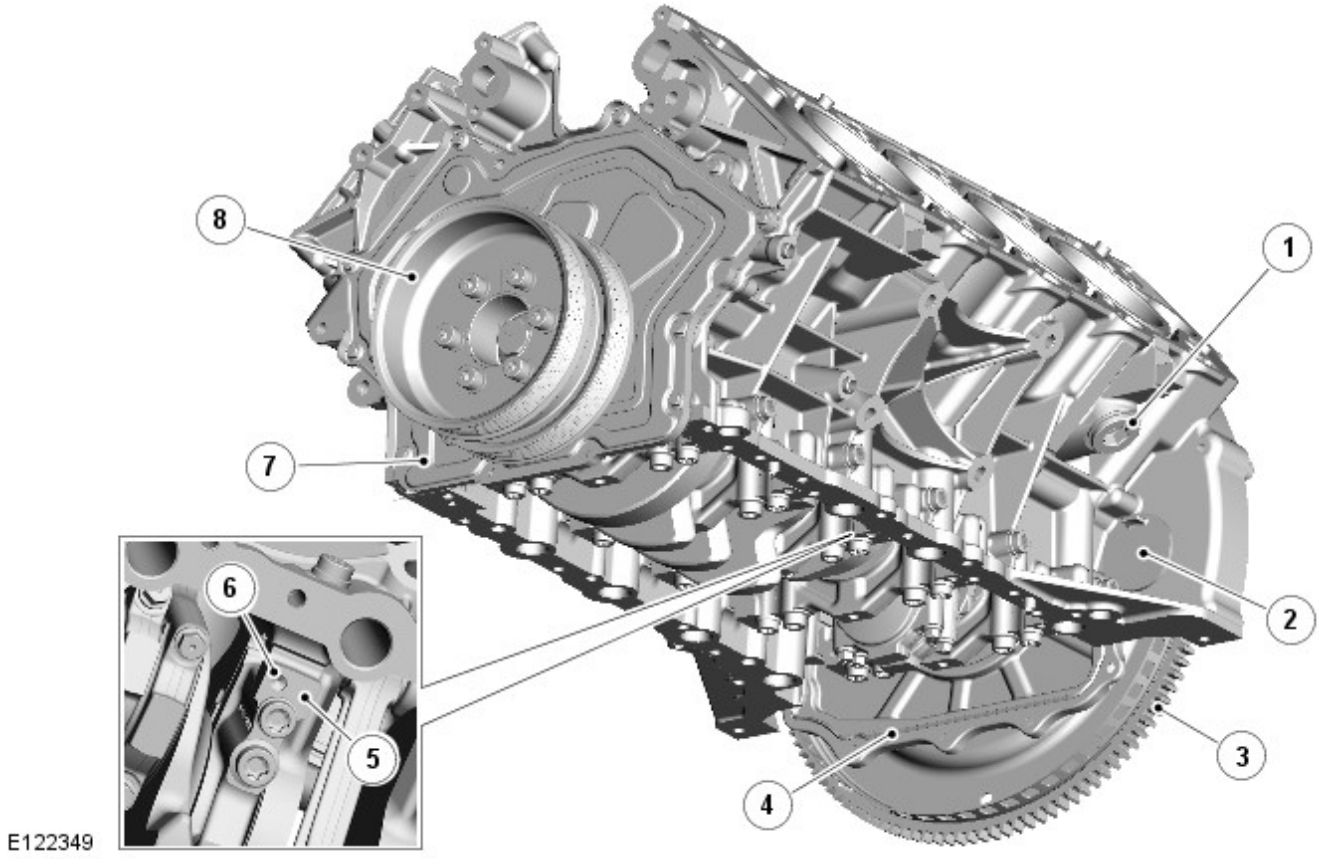
Crankshaft Data Location



Item	Part Number	Description
1	-	Pin journal classification and plant identification
2	-	Main journal classification
3	-	Date and time codes

The main bearings are numbered 1 to 5 starting from the front of the engine. There are five grades of main bearing available, each being color coded. Journal sizes are marked on the rear of the crankshaft.
For additional information, refer to: Camshaft Bearing Journal Diameter (303-00 Engine System - General Information, General Procedures).

Crankshaft Installation



Item	Part Number	Description
1	-	Coolant drain plug
2	-	Torque converter access plug
3	-	Drive plate
4	-	Rear cover
5	-	Main bearing cap
6	-	Identification mark
7	-	Front cover
8	-	Front pulley

The main bearing caps are made from cast iron and are cross bolted to increase rigidity. An identification mark on the bearing cap faces the front of the engine.

At the front of the crankshaft, a tuned torsional vibration damper is incorporated into the crankshaft front pulley. At the rear of the crankshaft a pressed steel drive plate, with a steel starter ring gear, is installed to transfer drive from the engine to the transmission. The reluctor ring for the CKP (crankshaft position) sensor is integrated into the perimeter of the drive plate.

The crankshaft seals are located in the front and rear covers.

PISTONS AND CONNECTING RODS



E116028

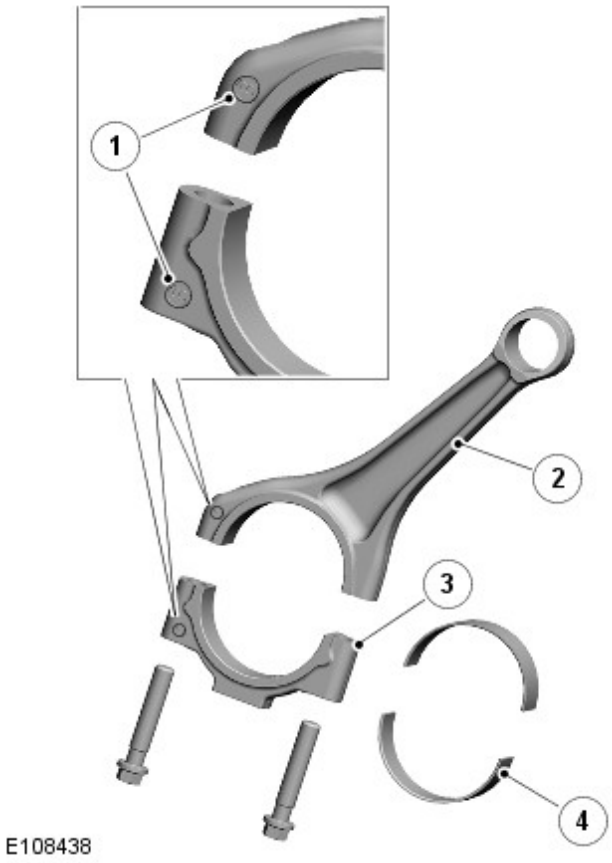
The diameter of each piston is graded and precisely matched to each cylinder bore to help reduce noise. In the vertical plane, the pistons have a slight barrel form, which helps to ensure a reliable oil film is maintained between the piston and the cylinder bore. A solid film lubricant coating is applied to both reaction faces of the piston to reduce wear and improve fuel economy.

A three-ring piston-sealing system is used. The steel top ring is treated with a PVD (physical vapor deposition) peripheral coating. PVD is a coating technique where material can be deposited with improved properties to ensure good cylinder bore compatibility and wear resistance. A Napier center ring helps cylinder pressure and oil management, while the three-piece oil control lower ring is produced from nitrided steel.

The pistons are cooled with engine oil from four piston cooling jets installed under the valley of the cylinder block. Each piston cooling jet sprays oil onto the underside of the two adjacent pistons, one from each cylinder bank.

The connecting rods are forged from high strength steel. The cap is fracture-split from the rod to ensure precision re-assembly for bearing shell alignment. There are three grades of large end bearing available, each being color coded. For additional information, refer to: Connecting Rod Large End Bore (303-00 Engine System - General Information, General Procedures).

Cap Alignment with Connecting Rod

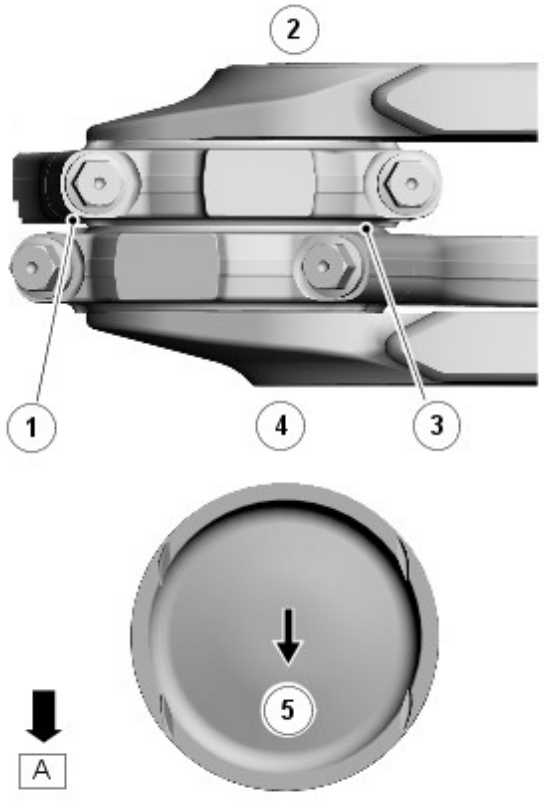


E108438

Item	Part Number	Description
1	-	Alignment marks
2	-	Connecting rod
3	-	Cap
4	-	Bearings

The correct alignment of the cap with the connecting rod is indicated by marks on adjacent faces of the two components.

Connecting Rod and Piston Orientation



E116029

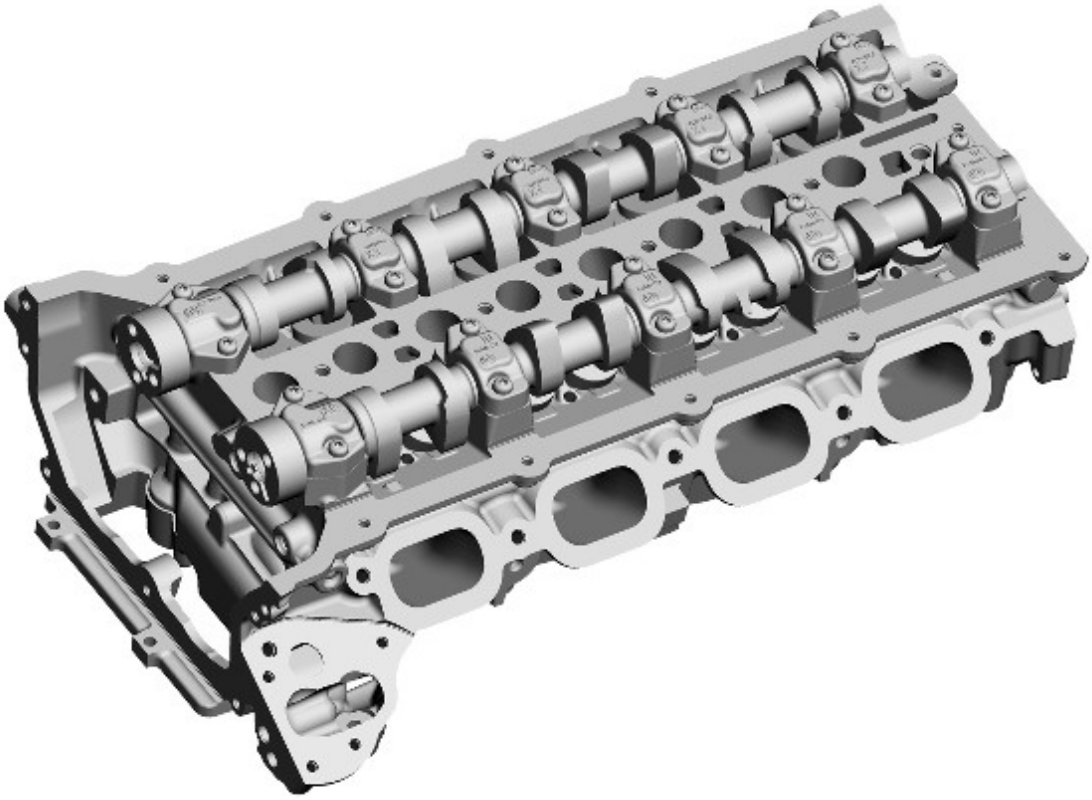
Item	Part Number	Description
A	-	Front of engine
1	-	Alignment mark
2	-	LH side (bank B)
3	-	Alignment mark
4	-	RH side (bank A)
5	-	Piston orientation arrow

The orientation of the connecting rods and pistons on the crankshaft are given below:

- Bank A - The arrow on the piston crown must face the front of the engine and the cap and connecting rod alignment marks must face the rear of the engine.
- Bank B - The arrow on the piston crown must face the front of the engine and the cap and connecting rod alignment marks must face the front of the engine.

CYLINDER HEADS

NOTE: RH (right-hand) (A bank) cylinder head shown, LH (left-hand) (B bank) cylinder head similar.



E116030

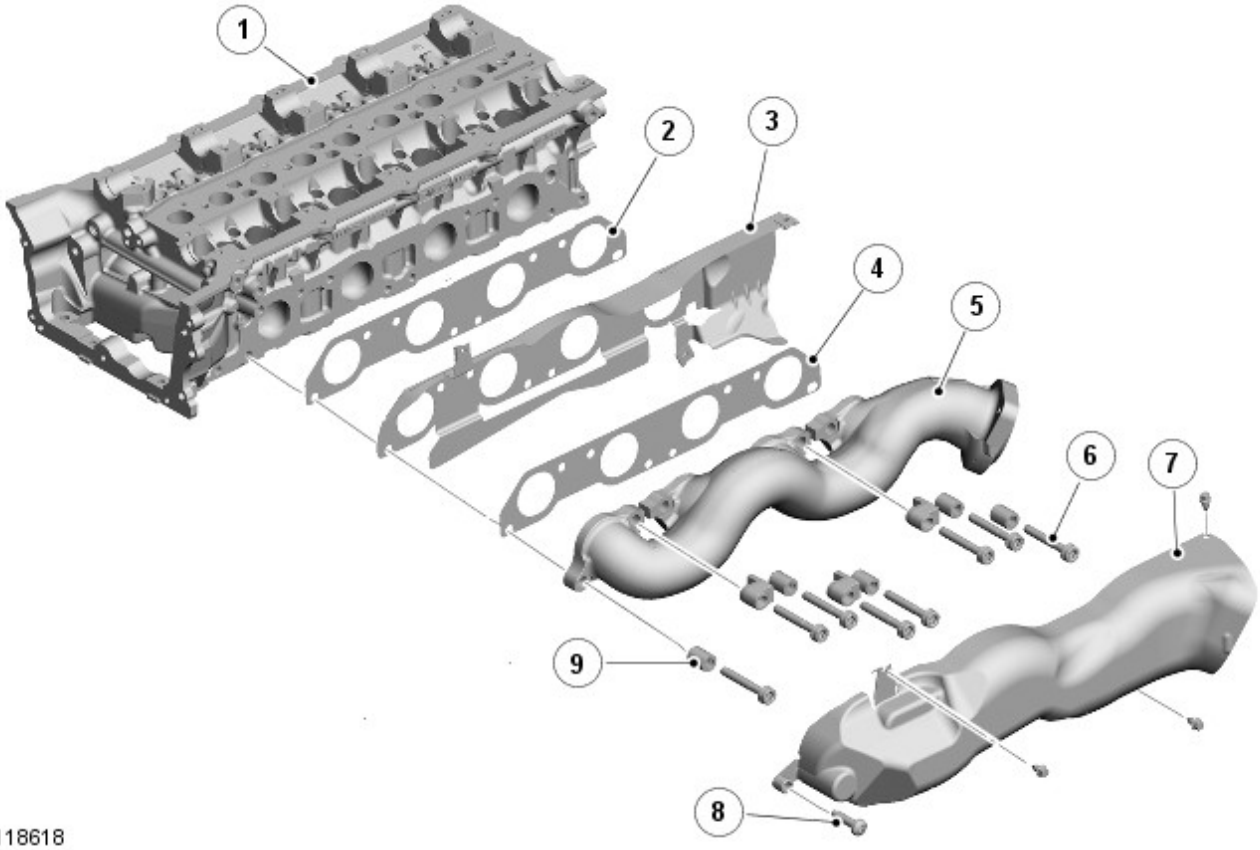
The cylinder heads are manufactured in gravity die cast aluminum alloy and are unique for each cylinder bank. Deep-seated bolts reduce distortion and secure the cylinder heads to the cylinder block.

Each cylinder is served by four valves. To help achieve the required gas-flow characteristics, these are arranged asymmetrically around the cylinder bore. Each cylinder has a centrally mounted fuel injector and spark plug.

The cylinder head gasket is of a multi-layer steel construction.

EXHAUST MANIFOLD

NOTE: LH (B bank) installation shown, RH (A bank) installation similar.

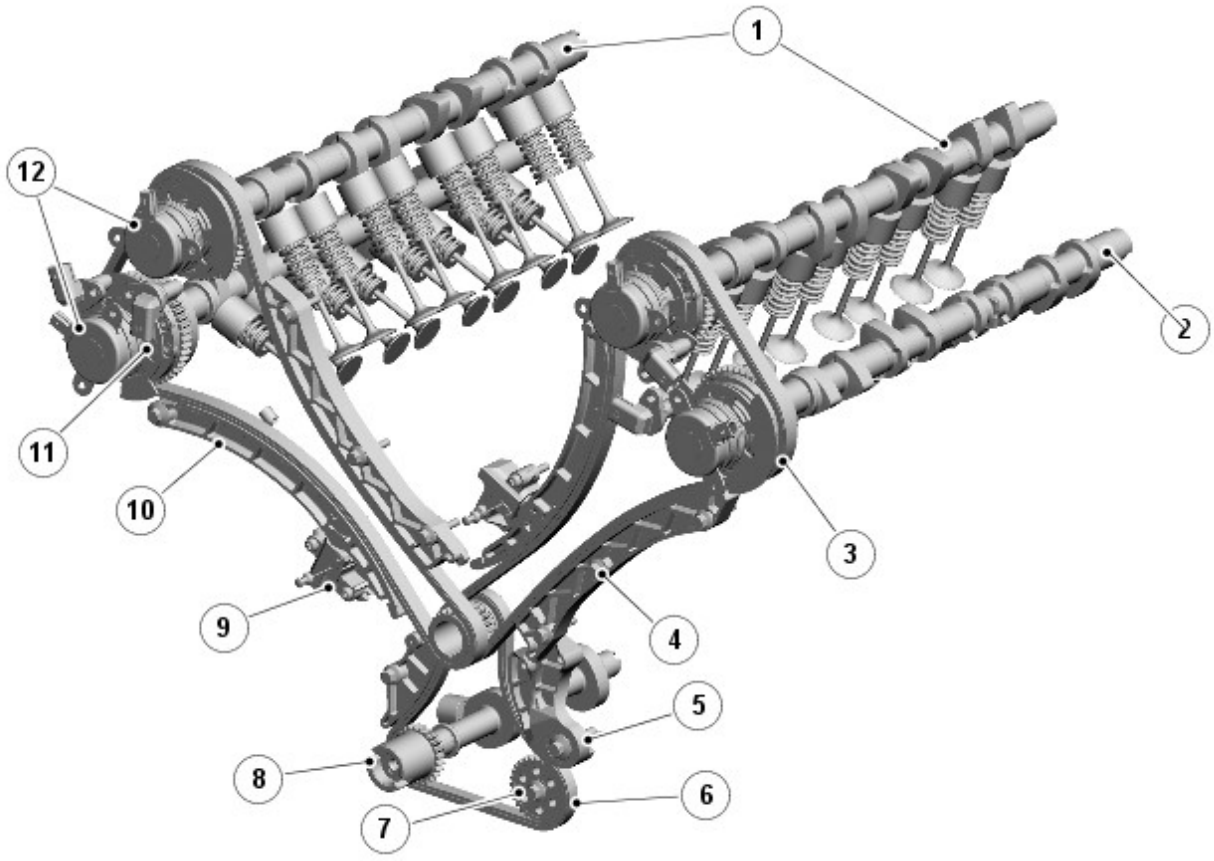


E118618

Item	Part Number	Description
1	-	Cylinder head
2	-	Gasket
3	-	Heat shield
4	-	Gasket
5	-	Exhaust manifold
6	-	Bolt (8 off)
7	-	Heat shield
8	-	Bolt (4 off)
9	-	Spacer (8 off)

The high SiMo (silicon molybdenum) cast iron exhaust manifolds are unique for each cylinder bank. Each exhaust manifold installation includes two metal gaskets and two heat shields. Spacers on the securing bolts allow the manifolds to expand and contract with changes of temperature while maintaining the clamping loads.

VALVE TRAIN



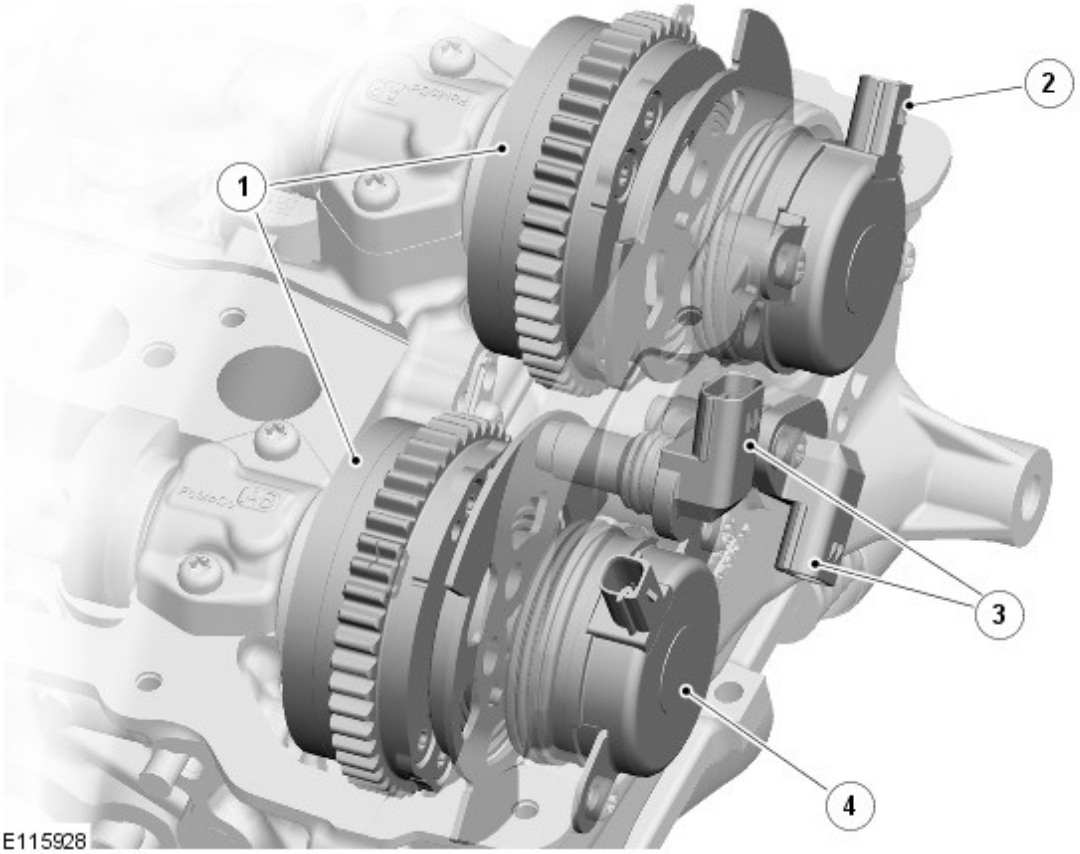
Item	Part Number	Description
1	-	Inlet camshafts
2	-	Exhaust camshaft
3	-	Inverted tooth timing chain
4	-	Nylon chain guide
5	-	Auxiliary chain tensioner
6	-	Auxiliary drive chain
7	-	Oil pump drive
8	-	Auxiliary drive camshaft
9	-	Timing chain tensioner
10	-	Tensioner lever
11	-	VCT unit
12	-	VCT solenoids

The lightweight valve train provides good economy and noise levels and is chain driven from the crankshaft.

Double overhead camshafts on each cylinder head operate the valves. For each cylinder head, an inverted tooth timing chain transfers drive from the crankshaft to the VCT unit on the front of each camshaft. Graded tappets enable setting of inlet and exhaust valve clearances.

Each timing chain has a hydraulic tensioner operated by engine oil pressure. The chain tensioners incorporate a ratchet mechanism, which maintains tension while the engine is stopped to eliminate start-up noise. The chains are lubricated with engine oil from jets located at the front of the engine block. Nylon chain guides control chain motion on the drive side.

Variable Camshaft Timing



Item	Part Number	Description
1	-	VCT units
2	-	Intake camshaft VCT solenoid
3	-	Camshaft position sensors
4	-	Exhaust camshaft VCT solenoid

The VCT system varies the timing of the intake and exhaust camshafts to deliver optimum engine power, efficiency and emissions. The timing of the intake camshafts has a range of 62 degrees of crankshaft angle. The timing of the exhaust camshafts has a range of 50 degrees of crankshaft angle.

In the base timing position:

- The intake camshafts are fully retarded.
- The exhaust camshafts are fully advanced.

VCT Operating Ranges

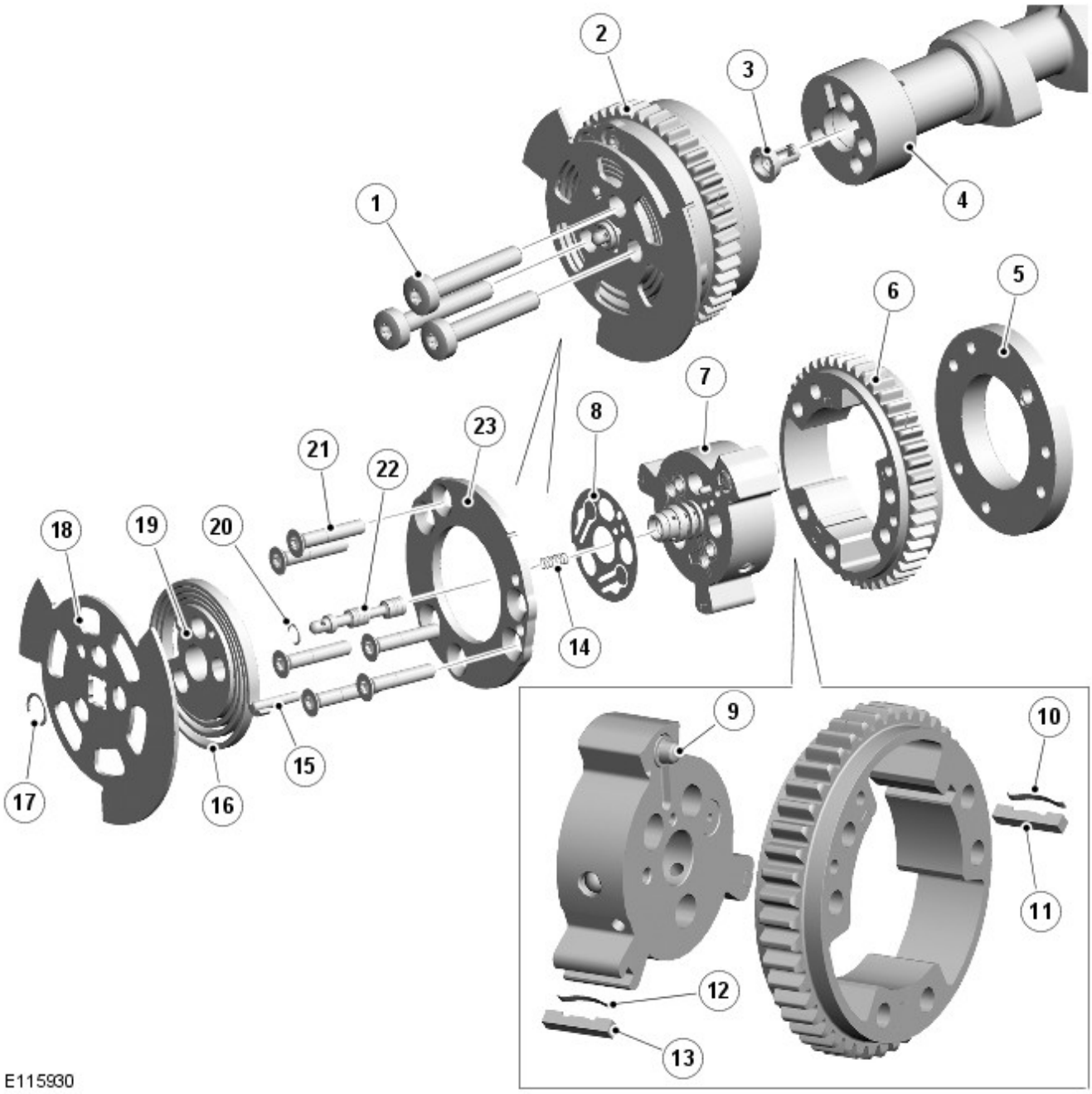
Camshaft	Valve Opens	Valve Closes
Intake	29 degrees BTDC (before top dead center) to 33 degrees ATDC (after top dead center)	207 to 269 degrees ATDC
Exhaust	244 to 194 degrees BTDC	6 to 56 degrees ATDC

The system consists of a VCT unit and a VCT solenoid for each camshaft. The ECM (engine control module) controls the system using PWM (pulse width modulation) signals to the VCT solenoids.

The torsional energy generated by the valve springs and the inertia of the valve train components are used to operate the system.

Variable Camshaft Timing Units

The VCT units change the position of the camshafts in relation to the timing chains.



Item	Part Number	Description
1	-	Bolt (3 off)
2	-	VCT unit
3	-	Filter
4	-	Camshaft
5	-	Inner plate
6	-	Housing and sprocket
7	-	Rotor assembly
8	-	Reed plate
9	-	Spring and lock pin
10	-	Spring (3 off)
11	-	Tip seal (3 off)
12	-	Spring (2 off)
13	-	Tip seal (2 off)
14	-	Spring
15	-	Dowel pin
16	-	Bias spring
17	-	Snap ring
18	-	Reluctor ring
19	-	Center plate
20	-	Snap ring

21	-	Screw (6 off)
22	-	Spool valve
23	-	Outer plate

Each VCT unit is attached to the camshaft by three bolts. A rotor assembly and a reed plate are installed inside a sprocket housing, which consists of a sprocket, an outer plate and an inner plate held together by six screws.

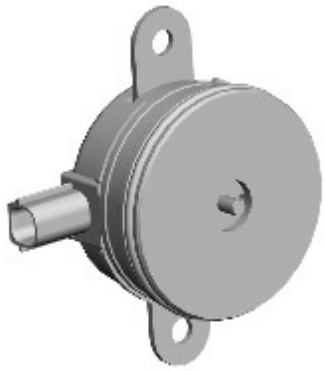
A reluctor ring, for the CMP (camshaft position) sensor, a center plate and a bias spring are installed at the front of the VCT unit. The ends of the bias spring locate on the center plate assembly and the sprocket housing, to give a turning moment to the camshaft in the advance direction. A snap ring locates the reluctor ring on to a sleeve installed in the center of the rotor assembly. The opposite end of the sleeve locates in a bore in the front face of the camshaft, which contains a filter.

A spring and spool valve are installed in the rotor assembly sleeve and retained by a snap ring. The spring keeps the spool valve in contact with the armature of the related VCT solenoid.

Each VCT unit is supplied with engine oil from an oil gallery in the cylinder head, through the camshaft front bearing cap and a bore in the center of the camshaft.

Variable Camshaft Timing Solenoids

The VCT solenoids control the position of the spool valves in the VCT units.



E115929

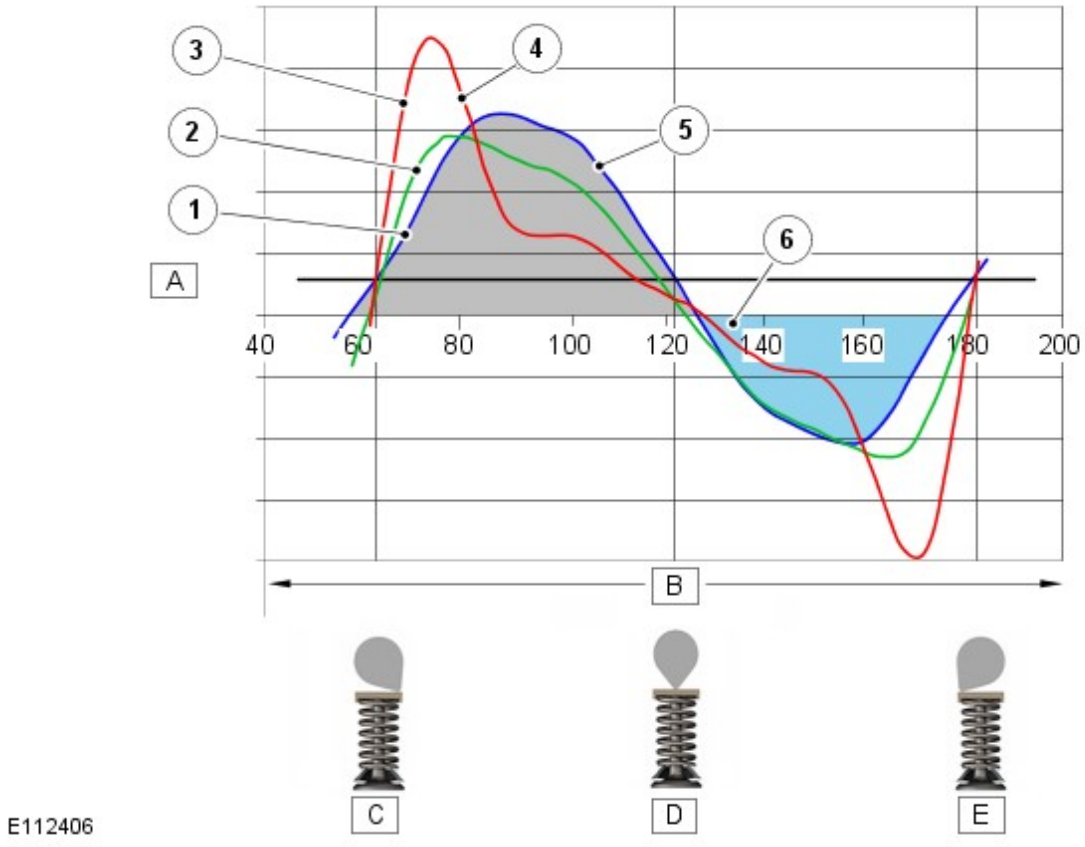
The VCT solenoids are installed in the front upper timing covers, immediately in front of their related VCT units. Each VCT solenoid is secured with two screws and sealed with an O-ring. A two pin electrical connector provides the interface with the engine harness.

Each VCT solenoid incorporates a spindle that acts on the spool valve in the related VCT unit to advance and retard the camshaft timing. The VCT solenoids operate independently and are controlled by a PWM signal from the ECM.

Variable Camshaft Timing Operation

When the engine is running, the compression and expansion of the valve springs causes momentary increases and decreases in the torque acting on the camshafts. These momentary changes of torque are sensed in the VCT units and used to change the camshaft timing.

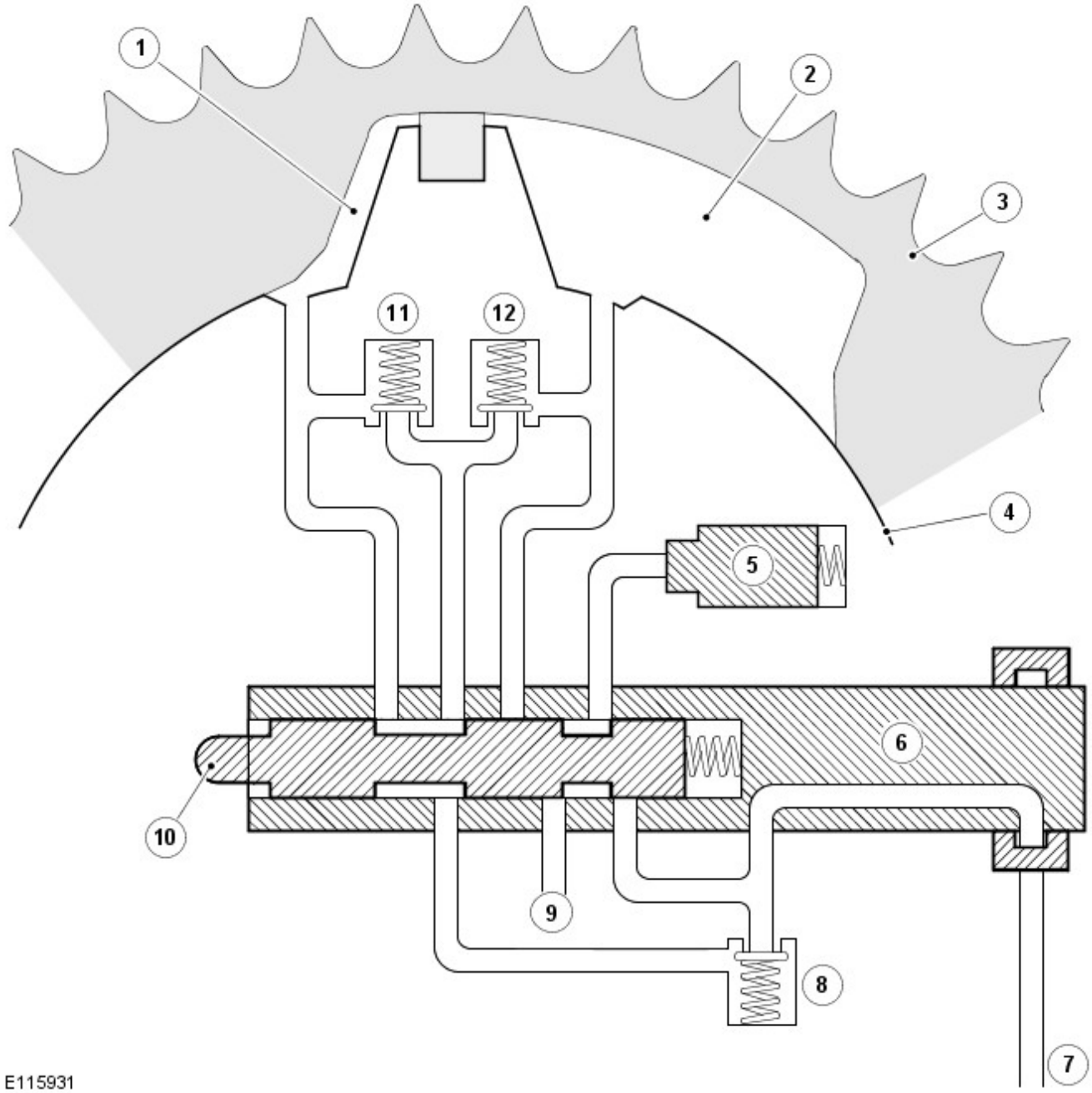
Camshaft Torsional Energy (For a Single Valve Event)



Item	Part Number	Description
A	-	Camshaft torque
B	-	Camshaft rotation (degrees)
C	-	Valve opening
D	-	Peak lift
E	-	Valve closing
1	-	1000 rev/min
2	-	4000 rev/min
3	-	7000 rev/min
4	-	Inertia effects from valve train rotating components
5	-	Force caused by valve spring
6	-	Bias torque from friction

Variable Camshaft Timing Unit Schematic - Base Timing

NOTE: Intake camshaft VCT unit shown. For exhaust camshaft VCT unit, read advance for retard and retard for advance.



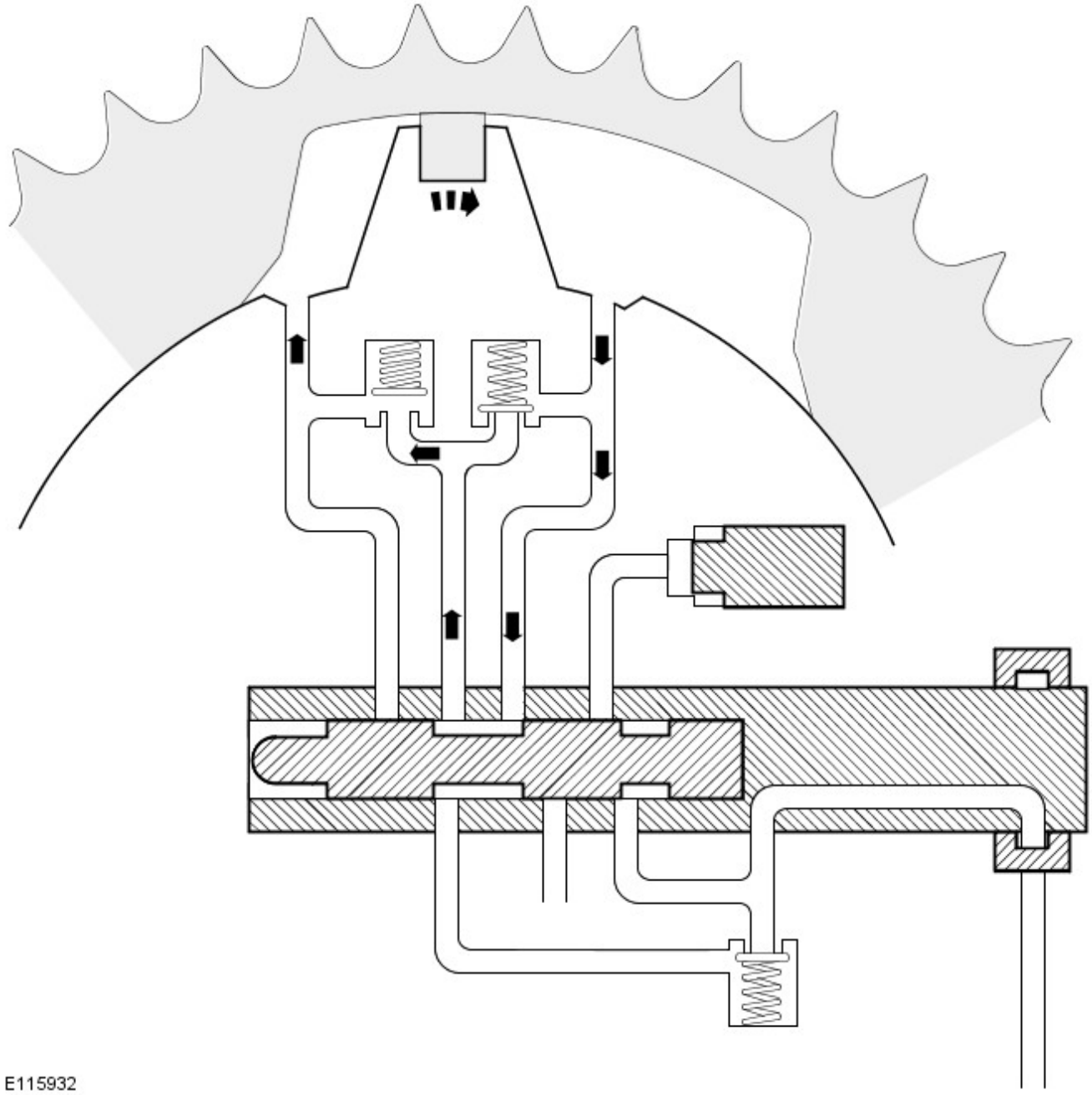
E115931

Item	Part Number	Description
1	-	Advance chamber
2	-	Retard chamber
3	-	Sprocket housing
4	-	Rotor assembly
5	-	Lock pin
6	-	Sleeve
7	-	Engine oil supply from camshaft
8	-	Inlet check valve
9	-	Lock pin drain
10	-	Spool valve
11	-	Advance check valve
12	-	Retard check valve

At engine start-up, once the engine oil pressure in the camshaft is sufficient to open the inlet check valve, engine oil flows across the spool valve, through the advance and retard check valves and into the advance and retard chambers. During the start cycle, the ECM signals the VCT solenoid to move the spool valve into the sleeve and connect the lock pin to inlet oil pressure. The inlet oil pressure causes the lock pin to retract from the inner plate and unlock the rotor assembly and camshaft from the sprocket housing.

There is a constant supply of oil to the VCT to ensure the unit remains filled during operation.

Variable Camshaft Timing Unit Schematic - Advance

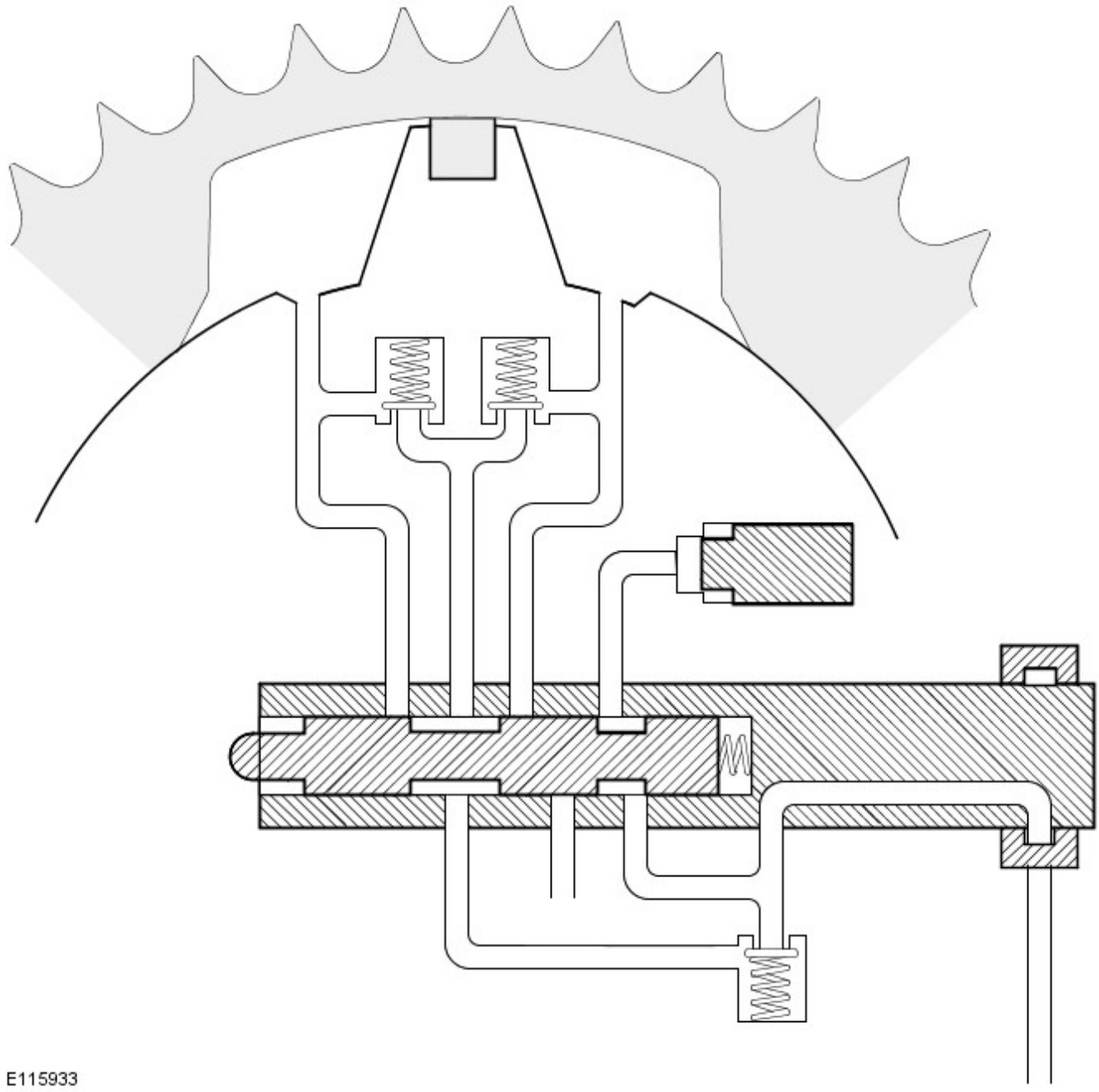


E115932

To advance the camshaft timing, the ECM adjusts the signal to the VCT solenoid to move the spool valve so that the advance chamber oil passage is closed and the retard chamber oil passage is connected to inlet oil.

Each momentary increase of the torque acting on the camshaft generates a pressure pulse in the retard chamber. Oil moves from the retard chamber, through the spool valve and the advance check valve to the advance chamber, to equalize the pressures in the two chambers. The displacement of oil from the retard chamber causes the rotor assembly to advance in relation to the sprocket housing. Each momentary decrease of torque acting on the camshaft also generates a pressure pulse in the advance chamber, but, with the advance chamber oil passage closed, no movement of oil between the advance and retard chambers occurs and the rotor assembly cannot move in the retard direction.

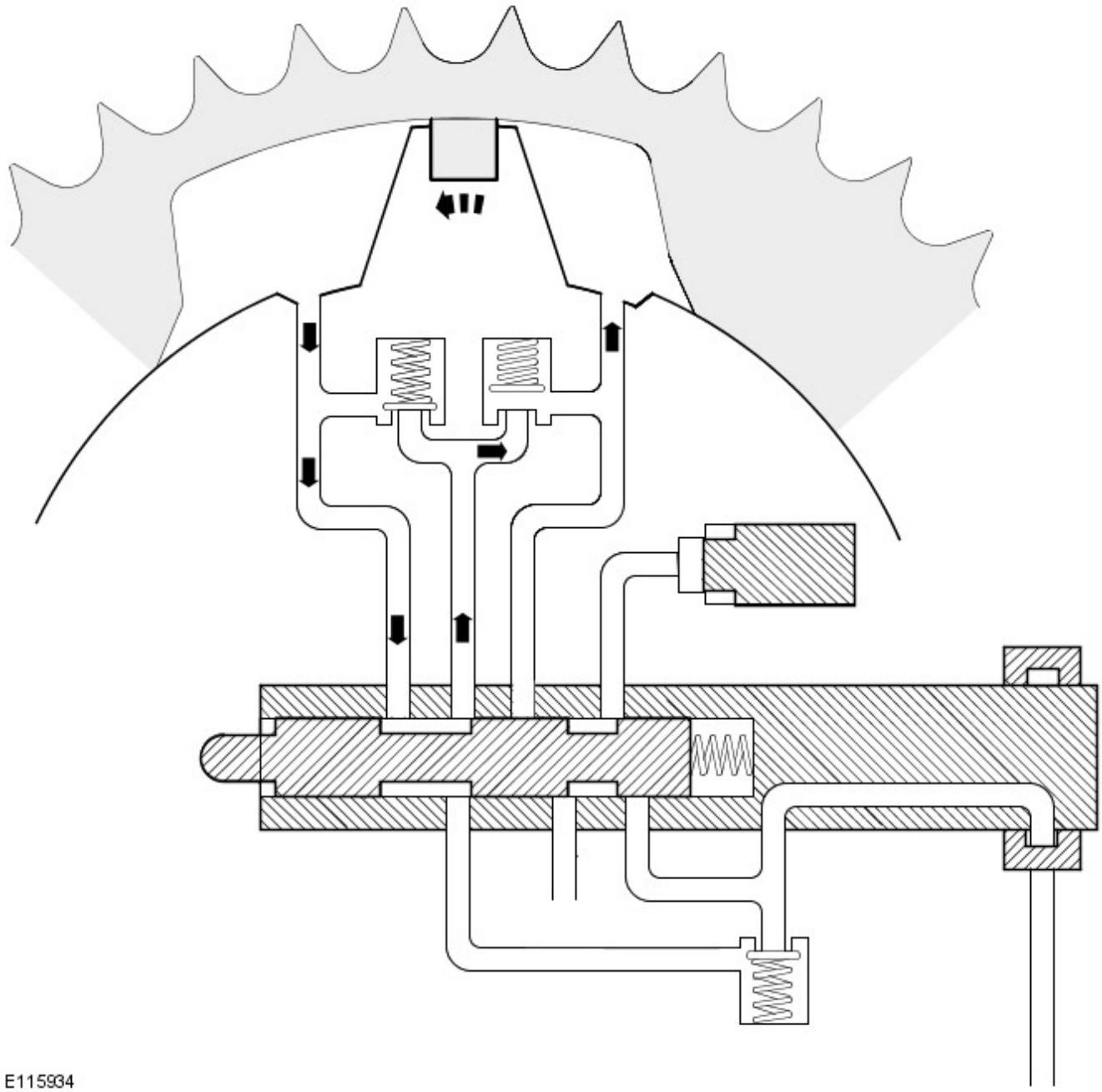
Variable Camshaft Timing Unit Schematic - Null



E115933

Once the camshaft has reached the required timing position the ECM adjusts the signal to the VCT solenoid to set the spool valve in the null position. In the null position, the advance and retard chamber oil passages are both closed by the spool valve and the rotor assembly is hydraulically locked to the sprocket housing.

Variable Camshaft Timing Unit Schematic - Retard

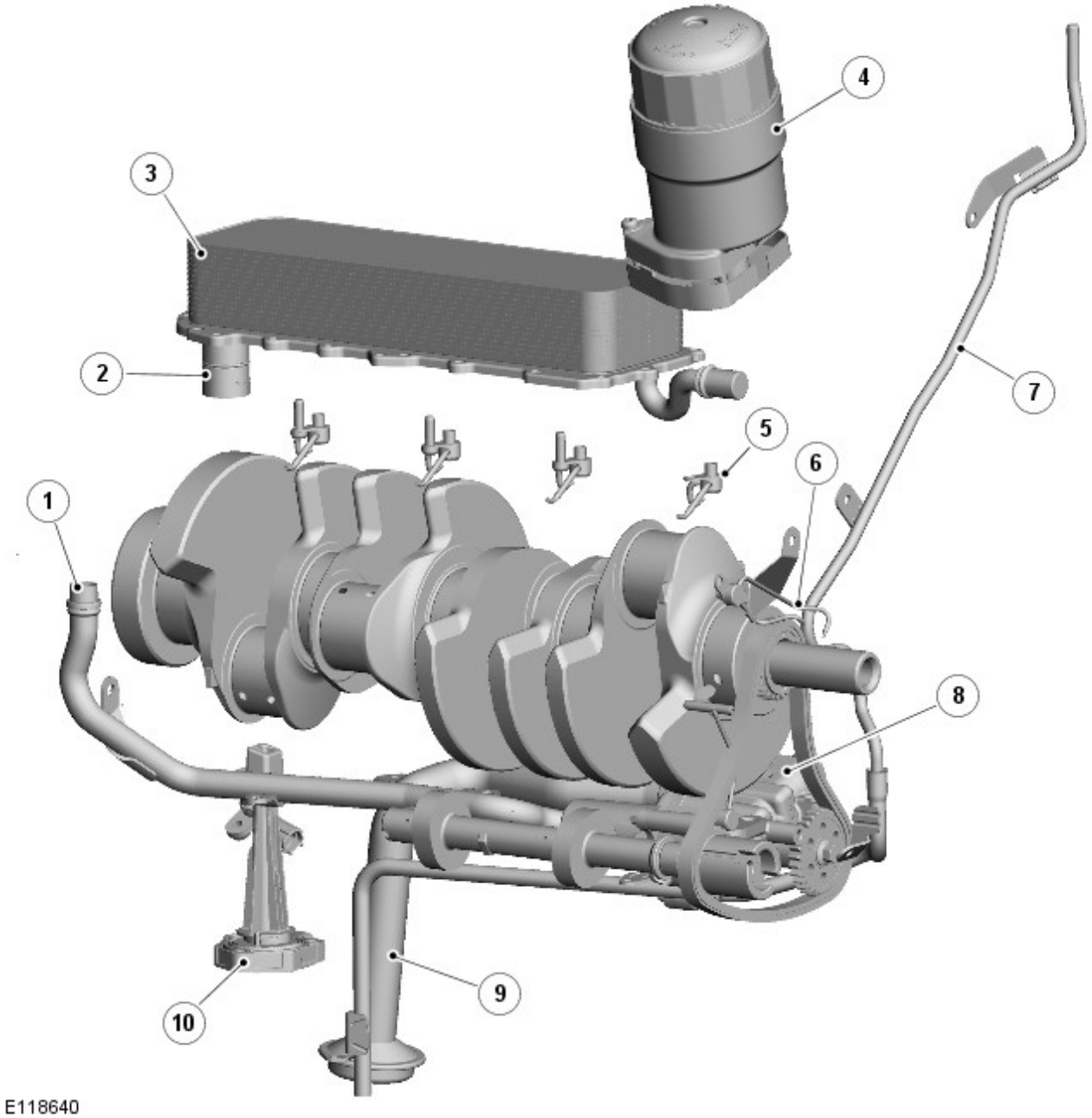


E115934

To retard the camshaft timing, the ECM adjusts the signal to the VCT solenoid to move the spool valve to close the retard chamber oil passage and connect the advance chamber oil passage to the inlet oil.

Each momentary decrease of the torque acting on the camshaft causes oil to transfer from the advance chamber, through the spool valve and the retard check valve to the retard chamber, and so retard the camshaft timing.

LUBRICATION SYSTEM



E118640

Item	Part Number	Description
1	-	Oil pump outlet tube
2	-	Anti-drain valve
3	-	Oil cooler
4	-	Oil filter
5	-	Piston cooling jet (4 off)
6	-	Timing chain lubrication jet (2 off)
7	-	Oil evacuation tube
8	-	Oil pump
9	-	Oil pick-up
10	-	Oil temperature and level sensor

The oil pump is attached to the underside of the windage tray. The input shaft of the oil pump is driven from the front of the crankshaft, by the auxiliary chain, at 0.87 engine speed.

The oil pump draws oil from the sump through a centrally mounted pick-up pipe. The oil is pressurized and pumped through an output tube to the cylinder block. After passing through an anti-drain valve and a plate type oil cooler, the oil is filtered by a replaceable cartridge installed on the front of the RH cylinder head.

The output from the oil filter is distributed through oil galleries in the cylinder heads and cylinder block. All moving parts are lubricated by pressure or splash oil. Pressurized oil is also provided for the VCT system, the timing chain tensioners, the piston cooling jets and the timing chain lubrication jets.

The oil returns to the oil pan under gravity. Large drain holes through the cylinder heads and cylinder block ensure the rapid return of the oil to the sump. System replenishment is through the oil filler cap on the LH cylinder head cover.

An oil evacuation tube is installed to allow oil to be drawn from the sump. The upper end of the oil evacuation tube is located under the oil filler cap.

An oil drain plug is installed in the RH side of the sump.

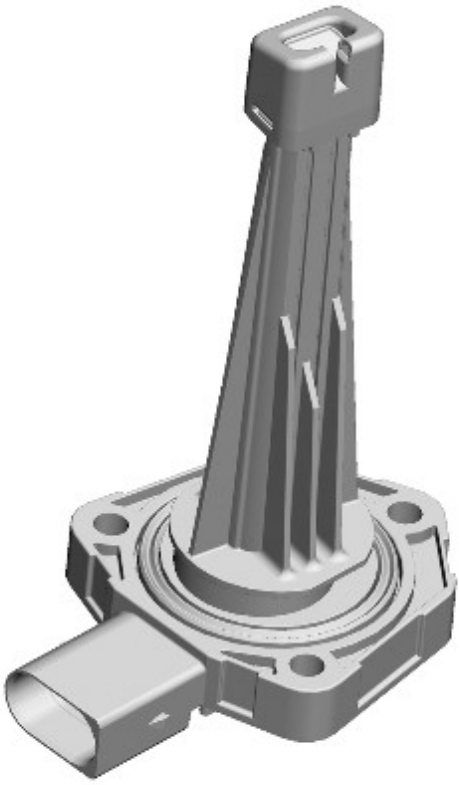
Oil Pump Nominal Operating Pressures

Engine Speed, rev/min	Temperature, °C (°F)	Pressure, bar (lbf/in^2)
Idle	20 (68)	2.0 (29.0)
1500	20 (68)	6.0 (87.0)
3000	40 (104)	6.2 (90.0)
3000	110 (230)	5.0 (72.5)
3000	130 (266)	4.0 (58.0)

Oil Level Monitoring

Oil level monitoring is provided by an oil level and temperature sensor that measures the oil level in the sump. The oil level can be displayed in the message center of the instrument cluster.

Oil Level and Temperature Sensor



E115936

The oil level and temperature sensor supplies the ECM with a signal containing the level and temperature of the oil in the sump. The oil level and temperature sensor is secured to the bottom of the sump with three screws and sealed with a gasket.

The oil level and temperature sensor sends an ultrasonic pulse vertically upward and measures the time taken for the pulse to be reflected back from the top surface of the oil. This time is compared with the time taken for an ultrasonic pulse to travel a reference distance within the oil level and temperature sensor to determine the oil level. The oil level reading is combined with the oil temperature reading and transmitted in a PWM signal to the ECM.

Oil Level and Temperature Sensor Specifications

Feature	Details
Power Source	Battery Voltage
Level Accuracy	±2 mm (±0.08 in.) at temperatures of -30 °C (-22 °F)) and above; (±4 mm (±0.16 in.) at temperatures below -30 °C (-22 °F))
Temperature Accuracy	±2 °C (±3.6 °F)
Operating Level Range	116 to 147 mm (4.57 to 5.79 in.)
Operating Temperature Range	-40 to 160 °C (-40 to 320 °F)

Oil Level Check

For additional information, refer to: Engine Oil Draining and Filling (303-01D, General Procedures).

For accuracy, oil level checks should be performed with the vehicle on level ground when the oil is hot. The vehicle needs to stand for approximately 10 minutes, after the engine is switched off, to allow the oil to drain back into the

sump and the oil level to stabilize. The oil level system will not give a reading until the oil level has stabilized.

To check the oil level, make sure that the ignition is on, the engine stopped and the transmission is in P (park). Access the vehicle information and settings menu, then select **Oil Level Display** from the **Service Menu**. An **Engine Oil Level** sight glass will be displayed in the message center. The current oil level will be displayed in the sight glass. One of the following messages will also be displayed:

- If the oil level is within acceptable limits, the message **Level OK** is displayed.
- If the oil level is less than acceptable, a message advising how much oil to add is displayed e.g. **Add 1 Litre**, or **Add 1 Quart**, depending on the market.
- If the message **Overfilled** is displayed, the oil level must be reduced to within acceptable limits before starting the engine again.
- If the message **Not available** is displayed, the oil level is still stabilizing. Wait 10 minutes and then recheck level.



E121582

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Engine

Diagnosis and Testing

For additional information, refer to Diagnosis and Testing, Engine - 5.0L.

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Engine Oil Draining and Filling

General Procedures

Draining

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 hard stop.

NOTE: Clean the components general area prior to dismantling.

1. CAUTION: Make sure the engine is warm.

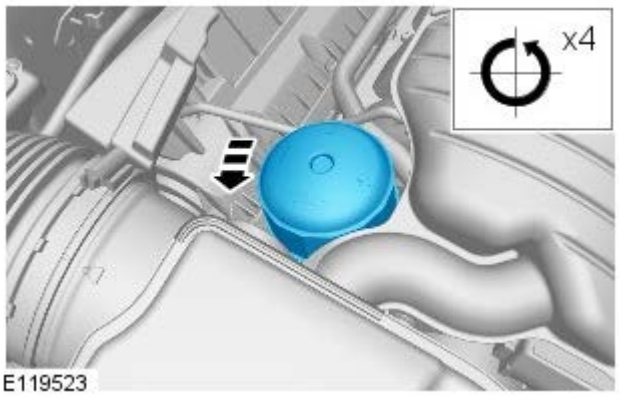
   Start the engine and allow to run for 10 minutes, stop the engine.

2.



3. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

4.

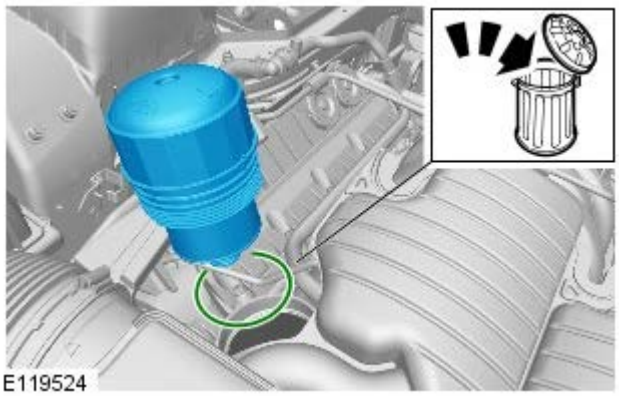


- Loosen the element cover 4 complete turns to allow engine oil to drain from the filter cover.
- Make sure that the O-ring seal is exposed.

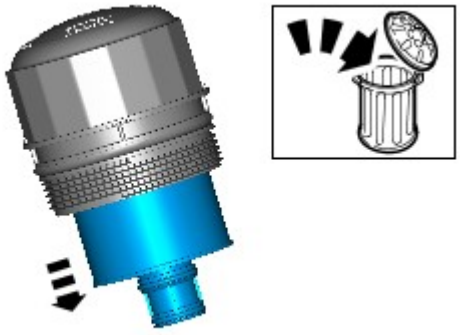
5. NOTES:

   Allow 10 minutes for the engine oil to drain from the oil filter housing.

   Remove and discard the O-ring seal.



6. Remove and discard the oil filter element.

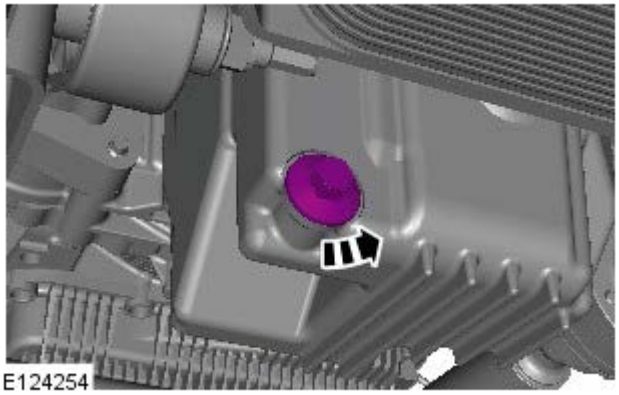


E107394

7. 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.

8. Refer to: Engine Undershield (501-02, Removal and Installation).



E124254

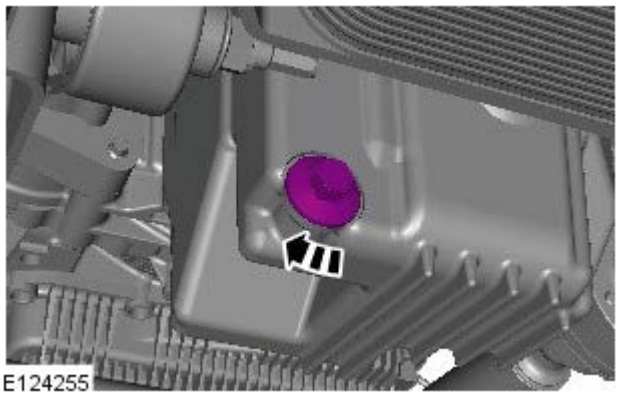
9. CAUTIONS:

   Be prepared to collect escaping oil.

   Allow at least 10 minutes for the engine oil to drain.

   NOTE: Discard the sealing washer.

Filling



E124255

1. CAUTION: Make sure that the area around the component is clean and free of foreign material.

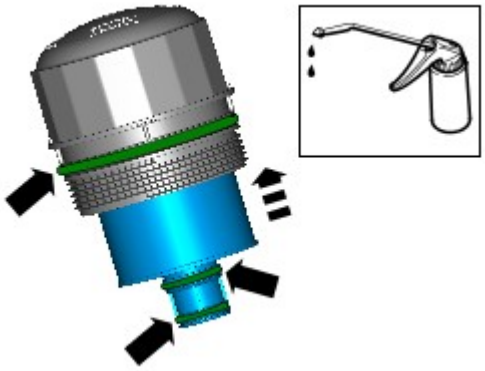
   NOTE: Install a new sealing washer.

   Torque: 24 Nm

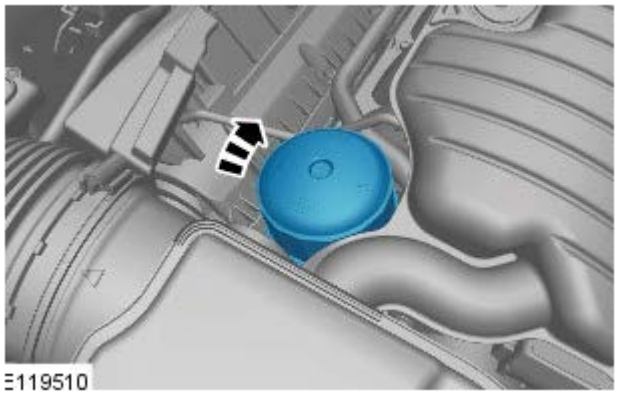
2. Refer to: Engine Undershield (501-02, Removal and Installation).

3. NOTE: Install new O-ring seals.

   Lubricate the oil filter element O-ring seal with clean engine oil.



E107727



E119510

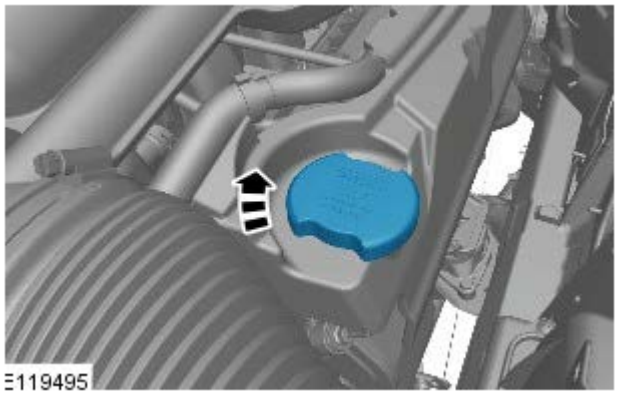
4. CAUTION: Tighten the component finger tight first.
   - *Torque:* 25 Nm

5. CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum (by following Steps 9-15), before starting the engine.
   - Fill the engine with oil - for filling values on vehicles without supercharger:

     Refer to: Specifications (303-01D, Specifications).
   - Fill the engine with oil - for filling values on vehicles with supercharger:

     Refer to: Specifications (303-01D, Specifications).
   - Clean any residual engine oil from the oil filler cap area.

6.



E119495

7. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.

   Follow the Steps 9-15 before starting the engine.

8.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

9. CAUTIONS:

Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

Make sure that the hood is open.

- Turn the ignition on.

10.

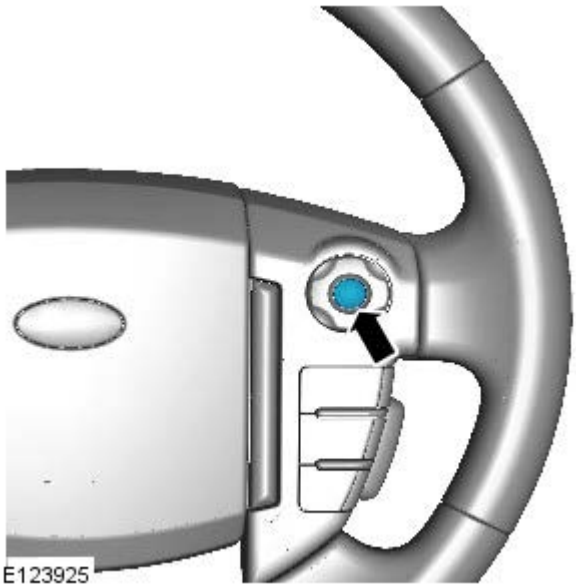
- Press the right-hand directional button to access the instrument cluster menu.



E123926

11.

- Press the right-hand OK button.



E123925

12.

- Press the right-hand directional button to access the Oil Level Display.



E123927

13.

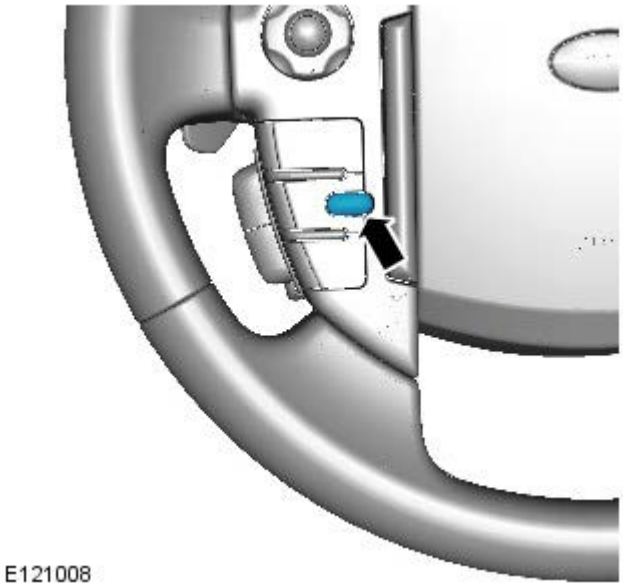
- Press the right-hand OK button and follow the instructions.



E123928

14.

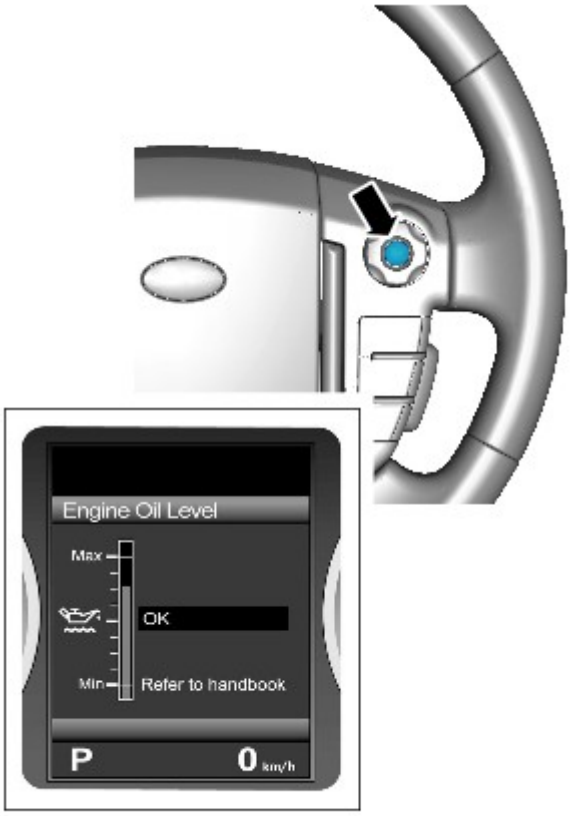
- Press the cruise control cancel button twice within 2 seconds.



E121008

15.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes (as indicated in Step 8), switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.



E123929

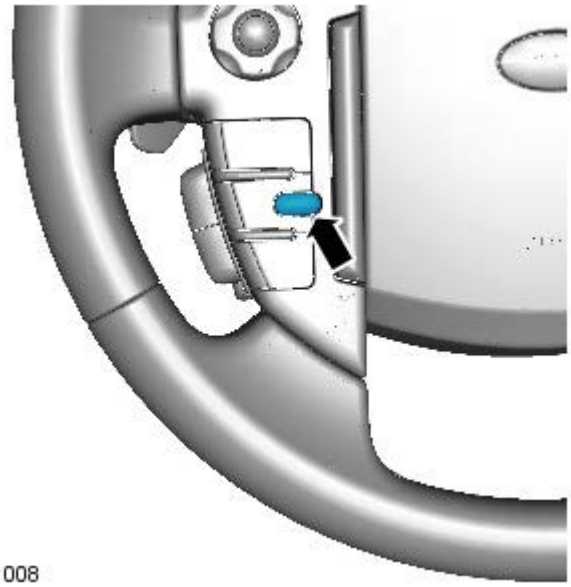
16. NOTE: If instructed to follow Steps 9-15 in a previous step, return to Step 8 and continue the procedure.

    Turn the ignition off.

17. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

18. NOTE: The following steps are to update the average oil level value.

    - Turn the ignition on.
    - Press and hold the cruise control cancel button for more than 2 seconds.



E121008

19.
- The message center display will revert to the normal display in the trip computer.

20. Turn the ignition off.

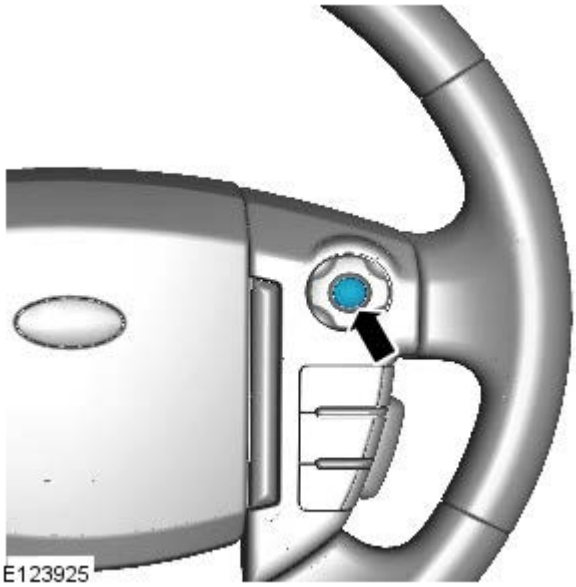
21. Turn the ignition on.

22.
- Press the right-hand directional button to access the instrument cluster menu.



E123926

23.
- Press the right-hand OK button.



24.

- Press the right-hand directional button to access the Oil Level Display.



E123927

25.

- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.



E123929

26. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Engine Oil Vacuum Draining and Filling

General Procedures

Special Tool(s)

 E129630	303-1484 Vacuum Pump, Oil Drain
 E129631	303-1484-01 Adapter for 303-1484

Draining

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 hard stop.

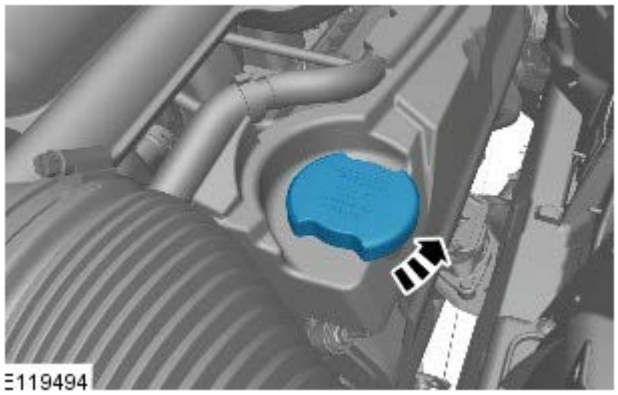
NOTES:

Make sure that the vehicle is parked on level ground.

Clean the components general area prior to dismantling.

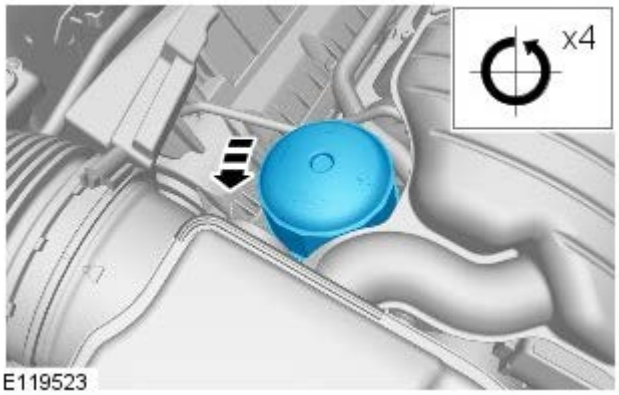
1.
- Start the engine and allow to run for 10 minutes, stop the engine.

2. CAUTION: Allow 10 minutes from turning the engine off before starting oil extraction.


E119494

3. Refer to: Engine Cover - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133 (501-05 Interior Trim and Ornamentation, Removal and Installation).

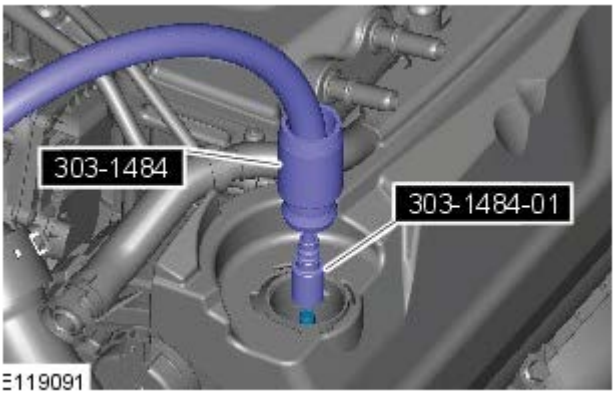
4.
- Loosen the element cover 4 complete turns to allow engine oil to drain from the filter cover.



5.

- Using the oil vacuum pump drain the oil out through the oil extraction tube.

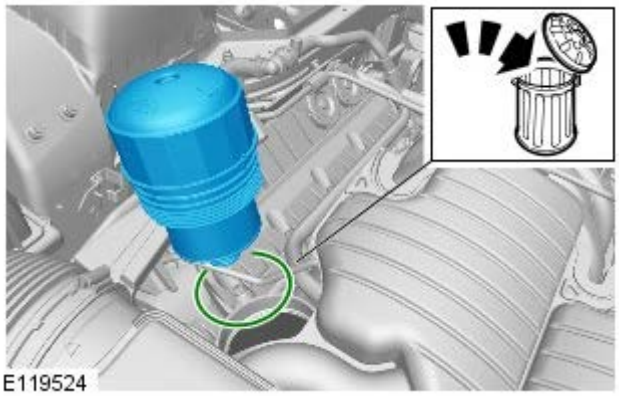
  Special Tool(s): 303-1484, 303-1484-01



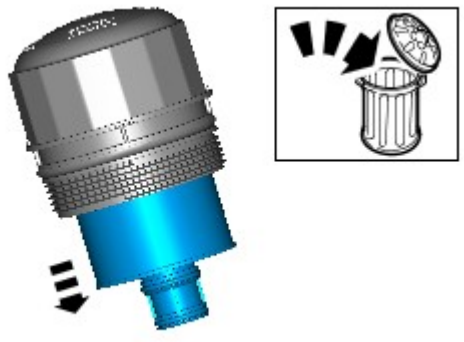
6.

- Remove the oil vacuum pump.

7.



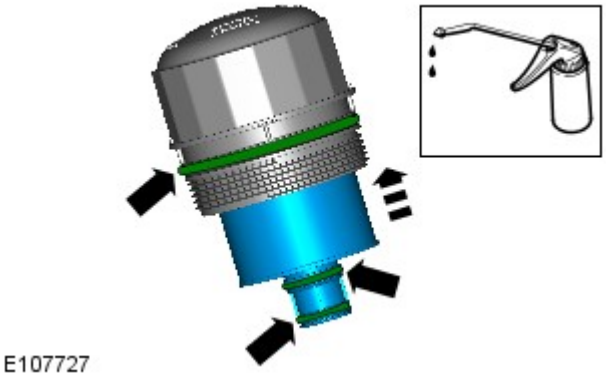
8. NOTE: Discard the O-ring seals.

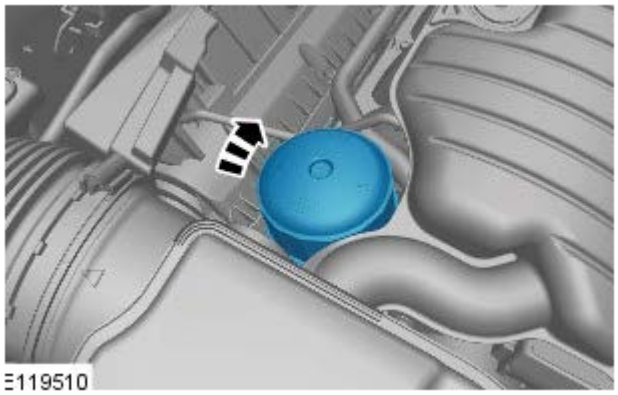


Filling

1. NOTE: Install new O-ring seals.

   Lubricate the oil filter element O-ring seal with clean engine oil.


E107727


E119510

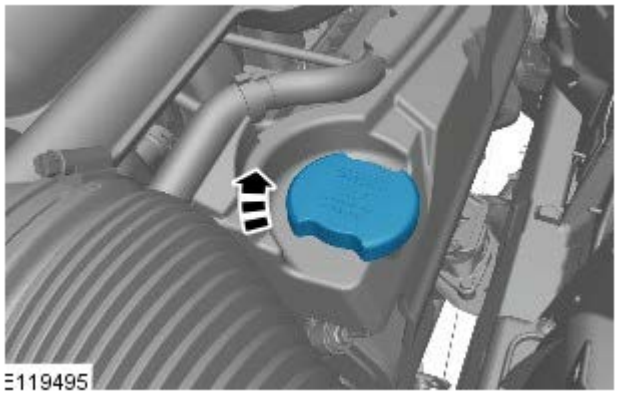
2. CAUTION: Tighten the component finger tight first.
   - *Torque:* 25 Nm

3. CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum (by following Steps 7-13), before starting the engine.
   - Fill the engine with oil - for filling values on vehicles without supercharger:

     Refer to: Specifications (303-01 Engine - 5.0L NA V8 - AJ133, Specifications).
   - Fill the engine with oil - for filling values on vehicles with supercharger:

     Refer to: Specifications (303-01 Engine - 5.0L NA V8 - AJ133, Specifications).
   - Clean any residual engine oil from the oil filler cap area.

4.


E119495

5. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.

   Follow the Steps 7-13 before starting the engine.

6.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

7. CAUTIONS:

Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

Make sure that the hood is open.

- Turn the ignition on.

8.

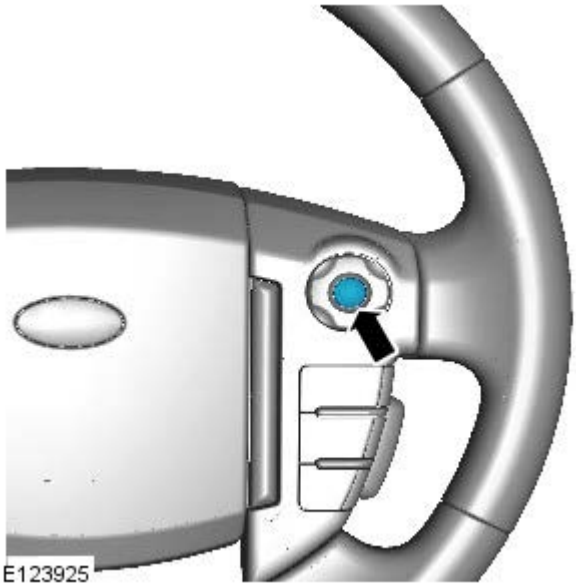
- Press the right-hand directional button to access the instrument cluster menu.



E123926

9.

- Press the right-hand OK button.



E123925

10.

- Press the right-hand directional button to access the Oil Level Display.



E123927

11.

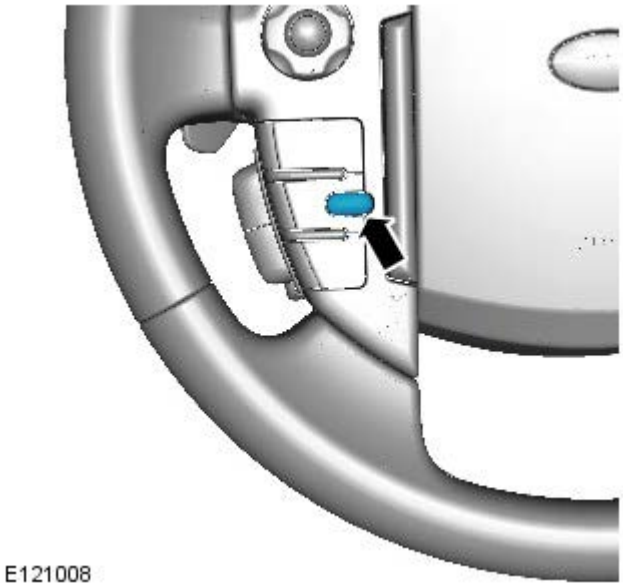
- Press the right-hand OK button and follow the instructions.



E123928

12.

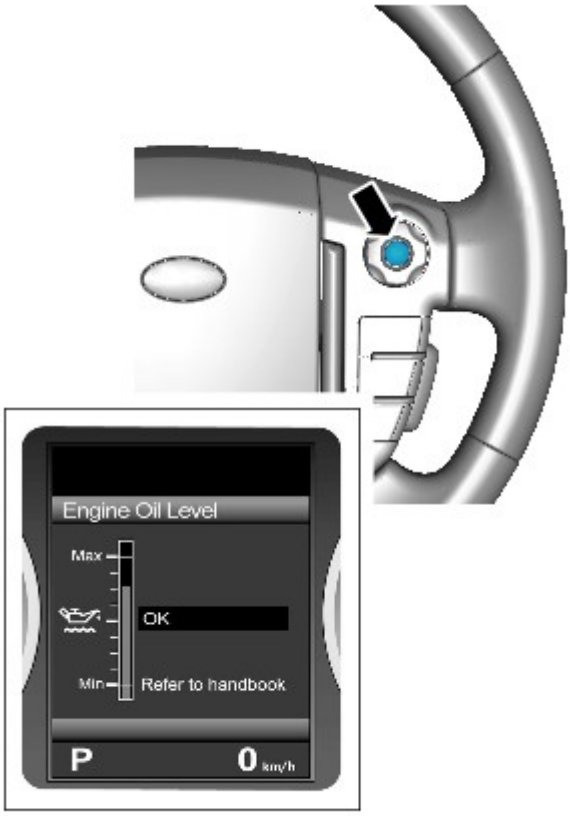
- Press the cruise control cancel button twice within 2 seconds.



E121008

13.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes (as indicated in Step 6), switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.



E123929

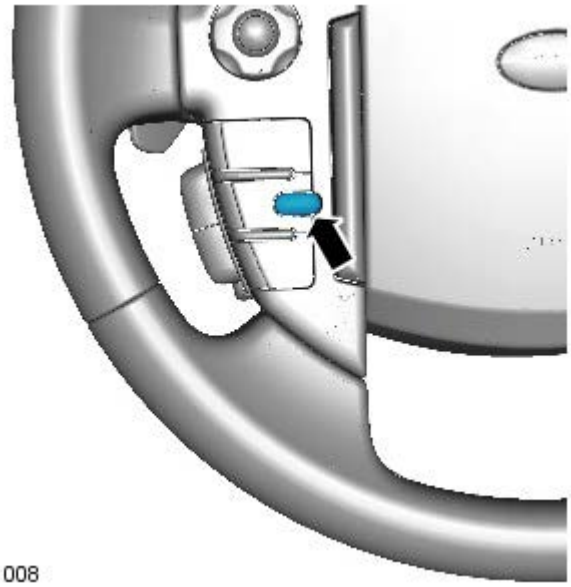
14. NOTE: If instructed to follow Steps 7-13 in a previous step, return to Step 6 and continue the procedure.

    Turn the ignition off.

15. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

16. NOTE: The following steps are to update the average oil level value.

    - Turn the ignition on.
    - Press and hold the cruise control cancel button for more than 2 seconds.



E121008

17.

- The message center display will revert to the normal display in the trip computer.

18. Turn the ignition off.

19. Turn the ignition on.

20.

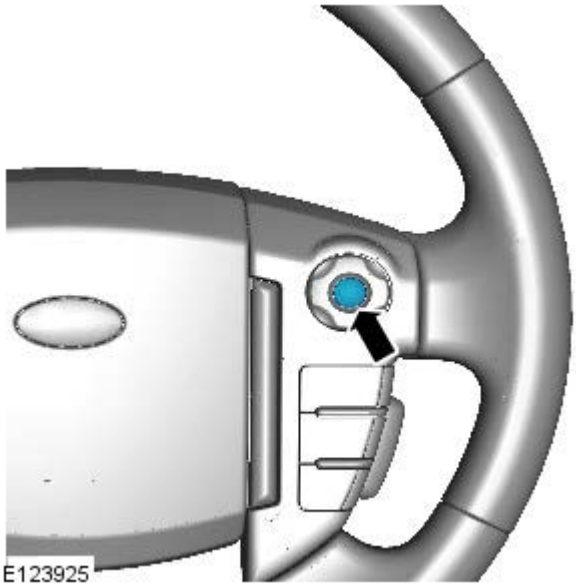
- Press the right-hand directional button to access the instrument cluster menu.



E123926

21.

- Press the right-hand OK button.



22.

- Press the right-hand directional button to access the Oil Level Display.



E123927

23.

- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.



E123929

24. Refer to: Engine Cover - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133 (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 16-Dec-2013

Engine - V8 S/C 5.0L Petrol - Fuel Pump Camshaft Timing Check

General Procedures

Special Tool(s)

 E115265	303-1447 Timing Tool
 E140377	JLR-303-1621 Alignment Tool, Fuel Pump Camshaft Timing

Check

1. Disconnect the battery ground cable.

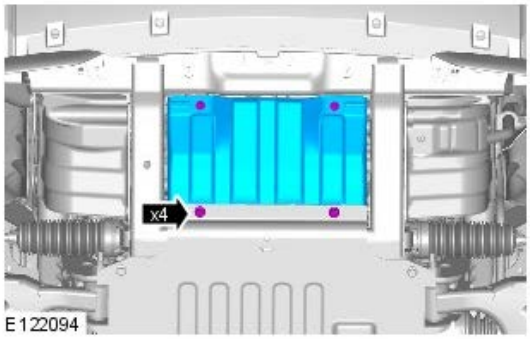
   Refer to: Specifications (414-01 Battery, Mounting and Cables, Specifications).

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. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

4.



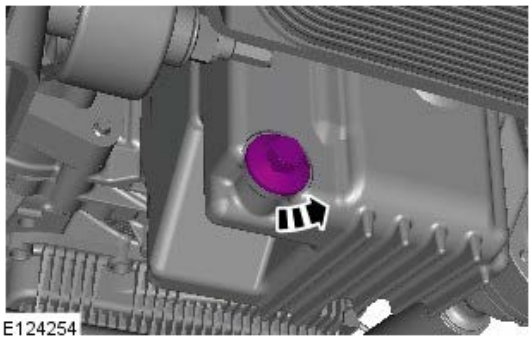
E122094

5. CAUTION: Be prepared to collect escaping oil.

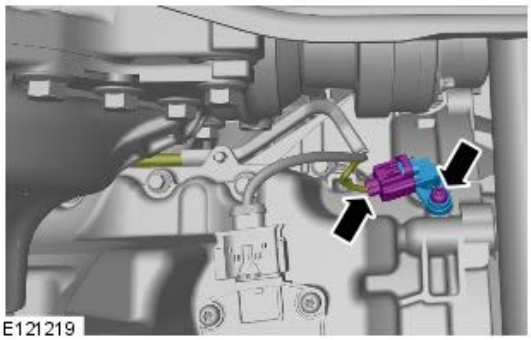
   NOTES:

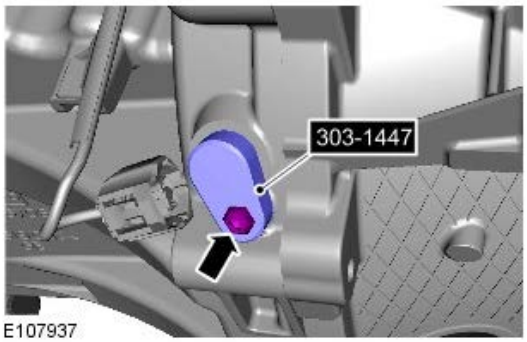
   Discard the sealing washer.

   Collect the engine oil in a clean container.


E124254

6.


E121219



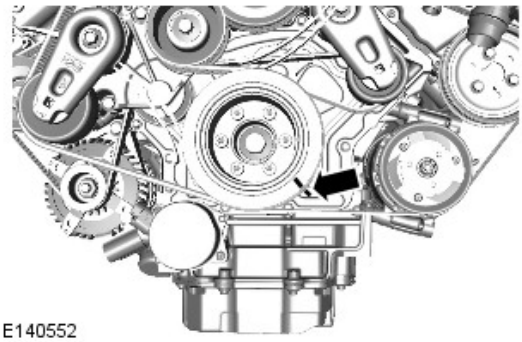
E107937

7. CAUTIONS:

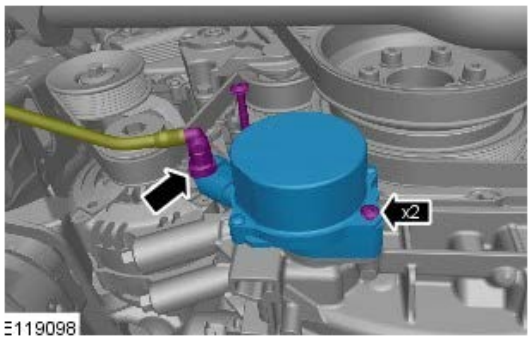
   Only rotate the crankshaft clockwise.

   Make sure that the crankshaft is fully locked.

   Install the Special Tool(s): 303-1447

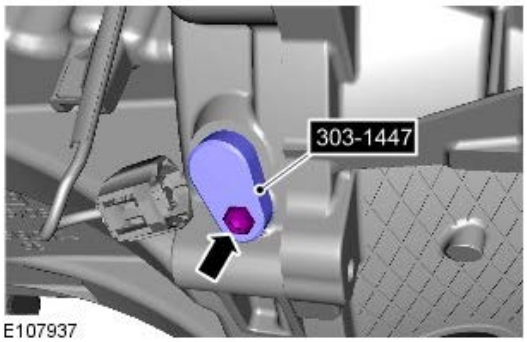

E140552

8. Using a suitable marker, mark the position of the crankshaft pulley as illustrated.



E119098

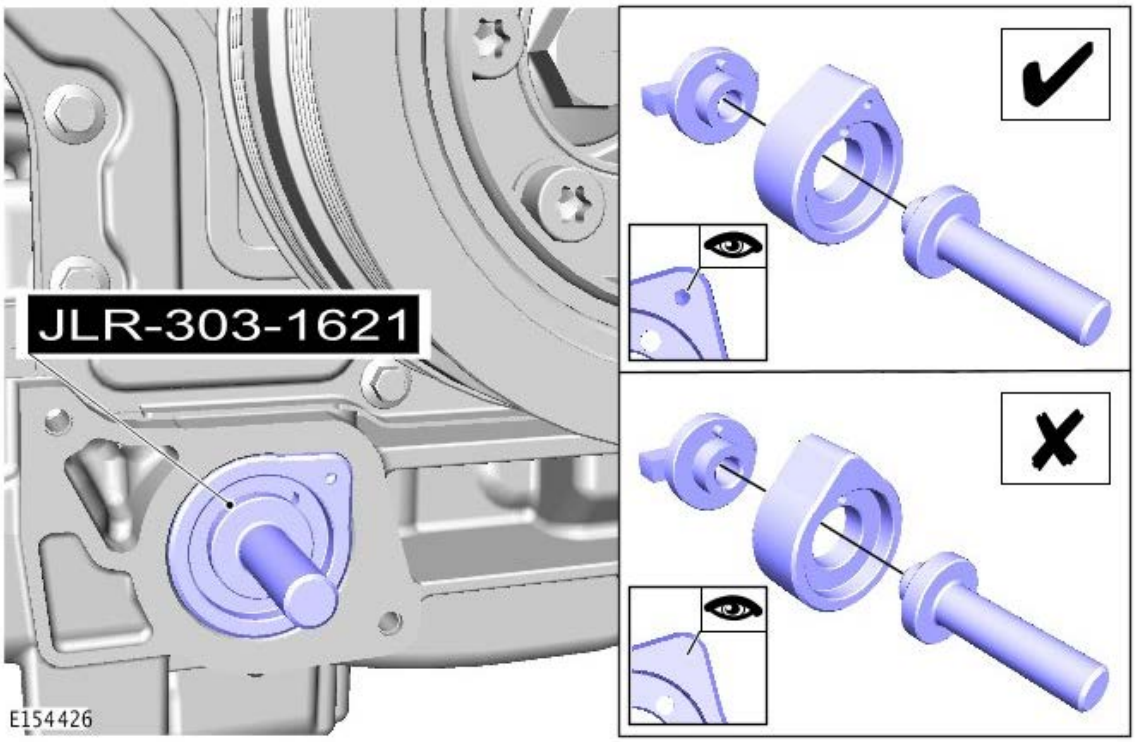
9. NOTE: Discard the seal.



E107937

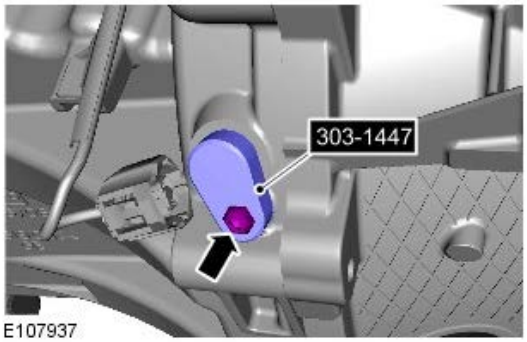
10. *Remove the Special Tool(s):* 303-1447

11. If required, carefully adjust the crankshaft position to allow correct



installation of the special tool.

Install the Special Tool(s): JLR-303-1621



12. CAUTION: Do not use excessive force when adjusting the crankshaft position.

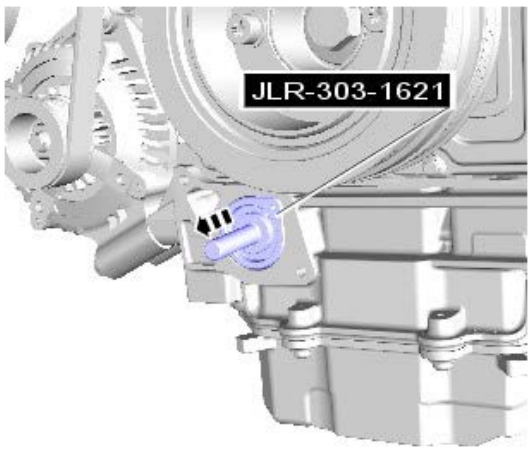
NOTE: If the crankshaft timing tool cannot be installed, adjustment of the fuel pump camshaft timing will be required.

- If required, carefully adjust the crankshaft position to allow correct installation of the special tool.

  Install the Special Tool(s): 303-1447
- If the crankshaft timing tool cannot be installed, adjustment of the fuel pump camshaft timing will be required.

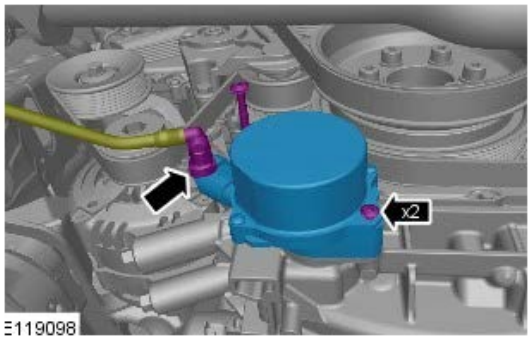
  Refer to: Fuel Pump Camshaft Timing Adjustment (303-01B Engine - V8 5.0L Petrol, General Procedures).

13. *Remove the Special Tool(s):* JLR-303-1621

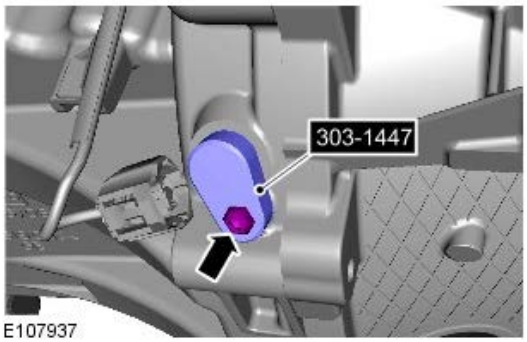


14. NOTE: Install a new seal.

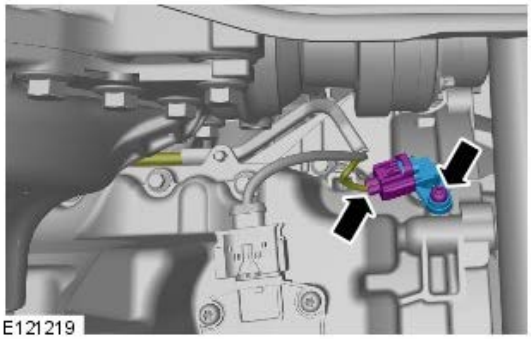
Torque: 12 Nm



15. *Remove the Special Tool(s):* 303-1447

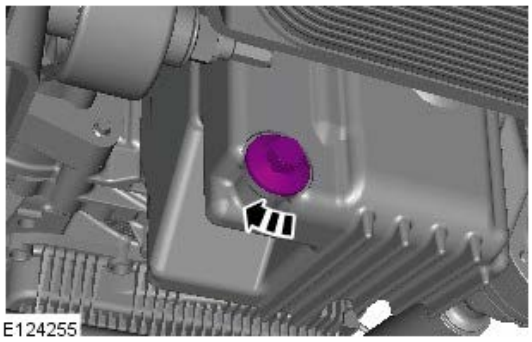


16. *Torque:* 10 Nm



17. NOTE: Install a new sealing washer.

Torque: 24 Nm



18. Connect the battery ground cable.

Refer to: Specifications (414-01 Battery, Mounting and Cables, Specifications).

19. CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum (by following Steps 22-28), before starting the engine.

- Fill the engine with oil - for filling values on vehicles without supercharger:

  Refer to: Specifications (303-01B Engine - V8 5.0L Petrol, Specifications).
- Fill the engine with oil - for filling values on vehicles with supercharger:

  Refer to: Specifications (303-01C Engine - V8 S/C 5.0L Petrol, Specifications).
- Clean any residual engine oil from the oil filler cap area.

20. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.

Follow the Steps 22-28 before starting the engine.

21.

- Start the engine and allow to run for 10 minutes, stop the engine.
- Check for leaks.

22. CAUTIONS:

Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

Make sure that the hood is open.

- Turn the ignition on.

23.

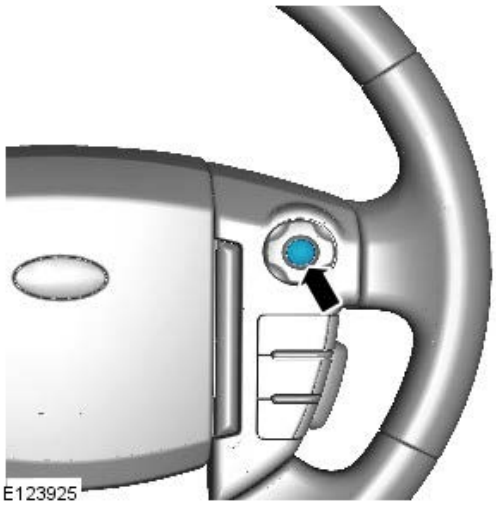
- Press the right-hand directional button to access the instrument cluster menu.



E123926

24.

- Press the right-hand OK button.



E123925

25.

- Press the right-hand directional button to access the Oil Level Display.



E123927

26.

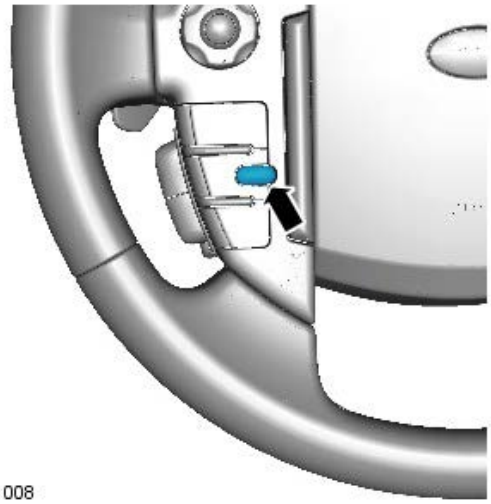
- Press the right-hand OK button and follow the instructions.



E123928

27.

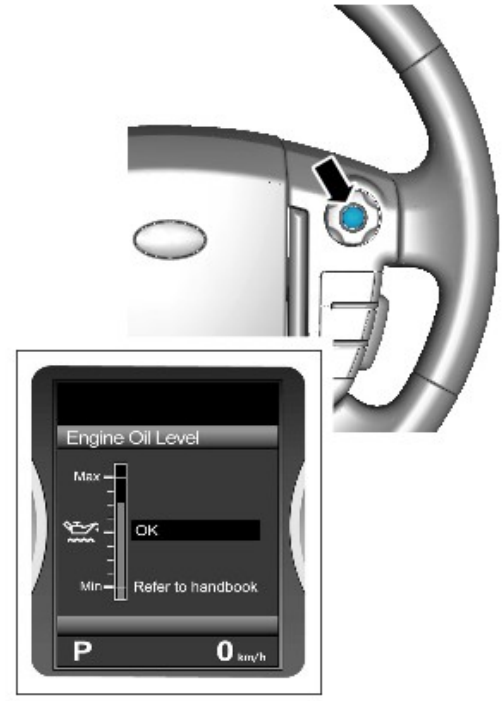
- Press the cruise control cancel button twice within 2 seconds.



E121008

28.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes (as indicated in Step 21), switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.

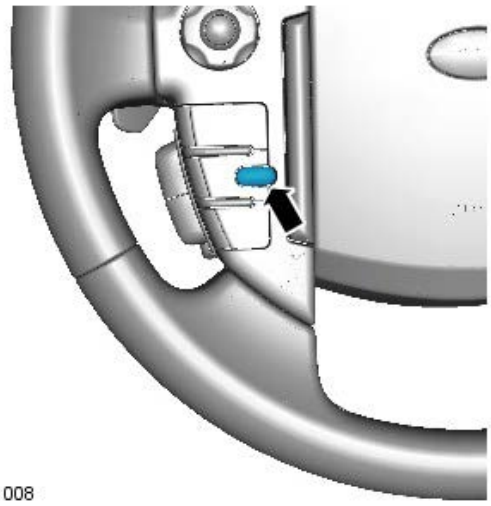


E123929

29. NOTE: If instructed to follow Steps 22-28 in a previous step, return to Step 21 and continue the procedure.

    Turn the ignition off.

30. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.



E121008

31. NOTE: The following steps are to update the average oil level value.

    - Turn the ignition on.
    - Press and hold the cruise control cancel button for more than 2 seconds.

32.

- The message center display will revert to the normal display in the trip computer.

33. Turn the ignition off.

34. Turn the ignition on.

35.

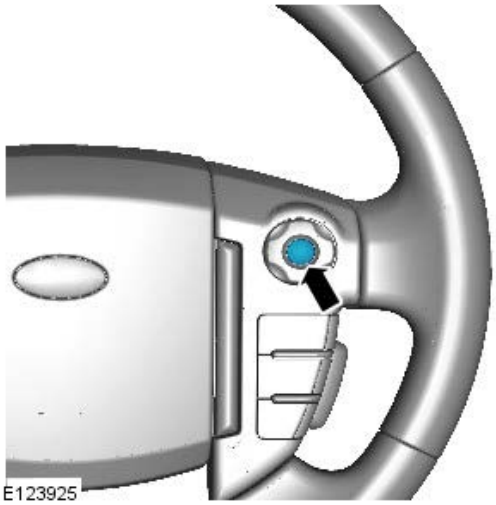
- Press the right-hand directional button to access the instrument cluster menu.



E123926

36.

- Press the right-hand OK button.



E123925

37.

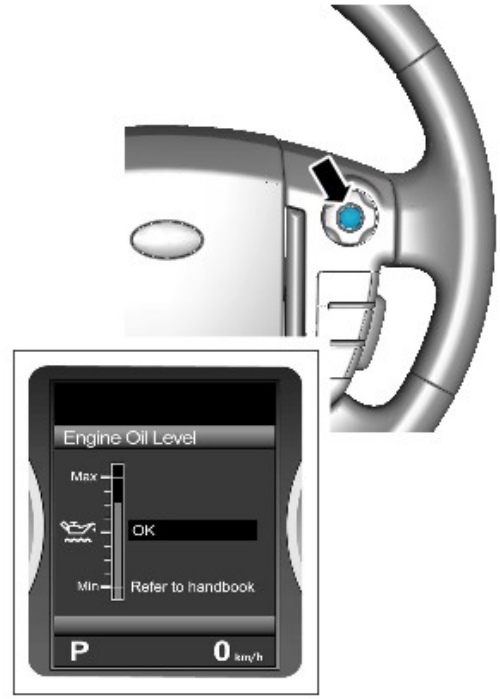
- Press the right-hand directional button to access the Oil Level Display.



E123927

38.

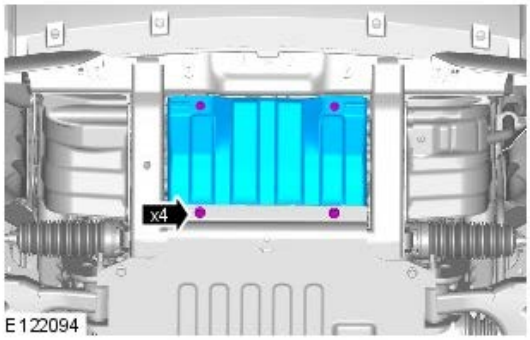
- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.



E123929

39. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

40. *Torque:* 10 Nm



E122094

Published: 08-Dec-2011

Engine - V8 S/C 5.0L Petrol - Fuel Pump Camshaft Timing Adjustment

General Procedures

Special Tool(s)

 E115265	303-1447 Timing Tool
 E140377	JLR-303-1613 Alignment Tool, Fuel Pump Camshaft Timing

Adjustment

1. Disconnect the battery ground cable.

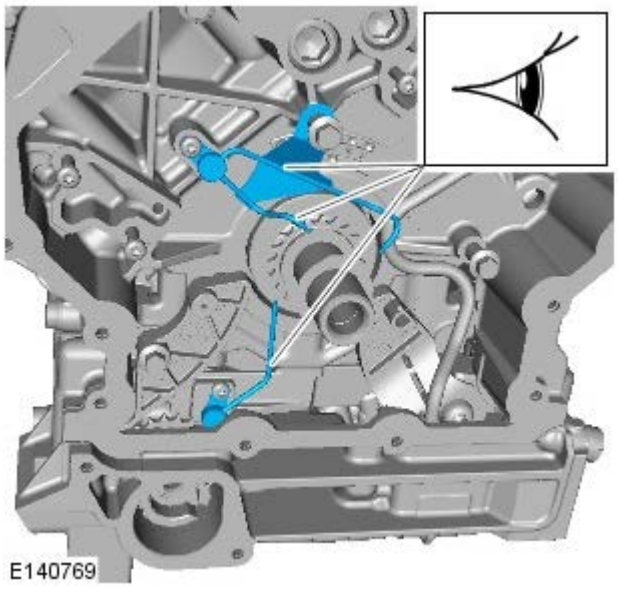
   Refer to: Specifications (414-01, Specifications).

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. Refer to: Fuel Pump Camshaft Timing Check (303-01D, General Procedures).

4. Refer to: Lower Timing Cover (303-01C, Removal and Installation).
   Refer to: Lower Timing Cover (303-01D, Removal and Installation).


E140769

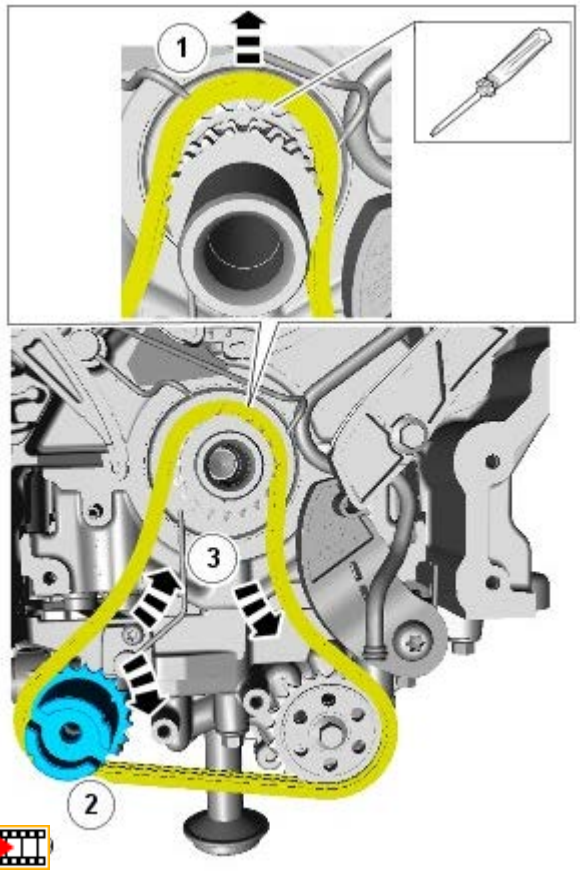
5. CAUTIONS:

   Make sure that the area around the component is clean and free of foreign material.

   Inspect the 3 timing chain oil nozzles for signs of damage, install as necessary.

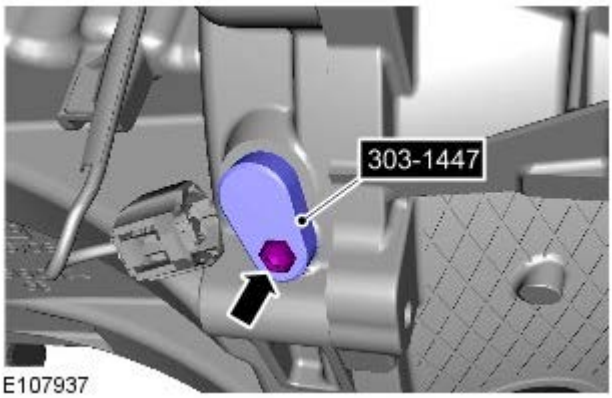
6. NOTE: **Using a suitable tie strap, position the tensioner to one side.**

   Special Tool(s): JLR-303-1613
   Torque: 12 Nm



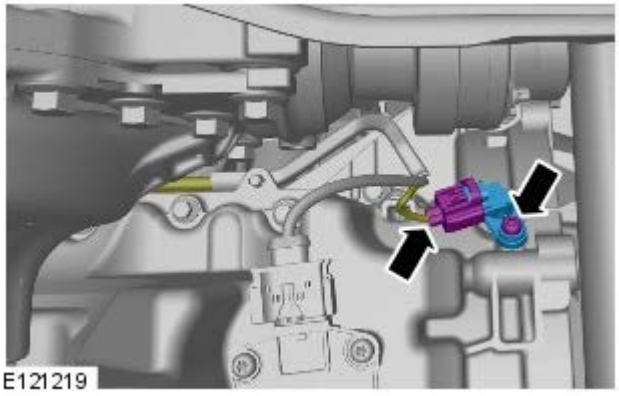
7. Refer to: Lower Timing Cover (303-01C, Removal and Installation).
   Refer to: Lower Timing Cover (303-01D, Removal and Installation).

8. *Remove the Special Tool(s):* 303-1447



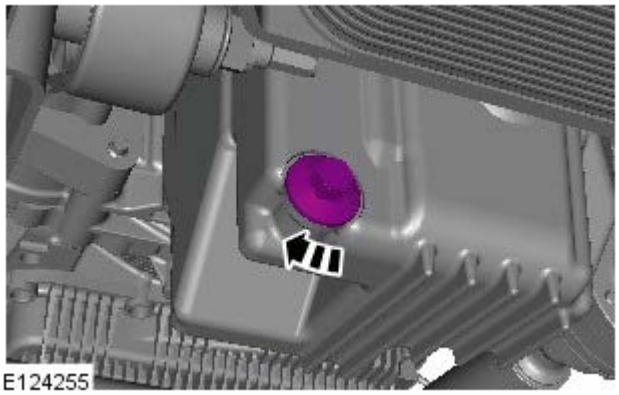
E107937

9. *Torque:* 10 Nm


E121219

10. NOTE: Install a new sealing washer.

Torque: 24 Nm


E124255

11. Connect the battery ground cable.

    Refer to: Specifications (414-01, Specifications).

12. CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum (by following Steps 15-21), before starting the engine.

    - Fill the engine with oil - for filling values on vehicles without supercharger:

      Refer to: Specifications (303-01C, Specifications).
    - Fill the engine with oil - for filling values on vehicles with supercharger:

      Refer to: Specifications (303-01D, Specifications).
    - Clean any residual engine oil from the oil filler cap area.

13. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.

    Follow the Steps 15-21 before starting the engine.

14.
    - Start the engine and allow to run for 10 minutes, stop the engine.
    - Check for leaks.

15. CAUTIONS:

    Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

    Make sure that the hood is open.

    - Turn the ignition on.

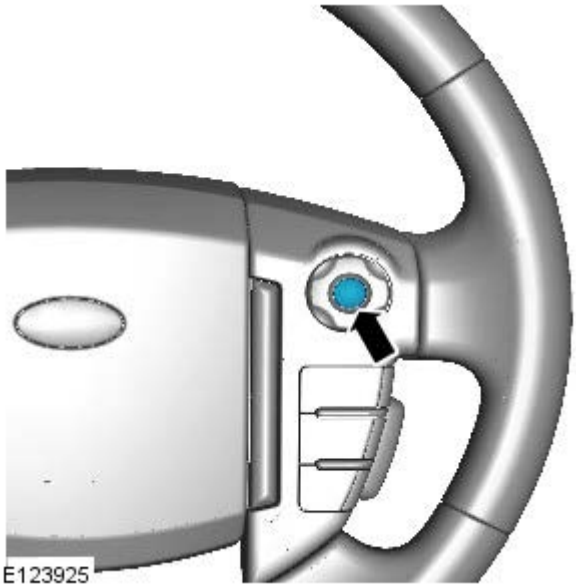
16.
    - Press the right-hand directional button to access the instrument cluster menu.



E123926

17.

- Press the right-hand OK button.



E123925

18.

- Press the right-hand directional button to access the Oil Level Display.



E123927

19.

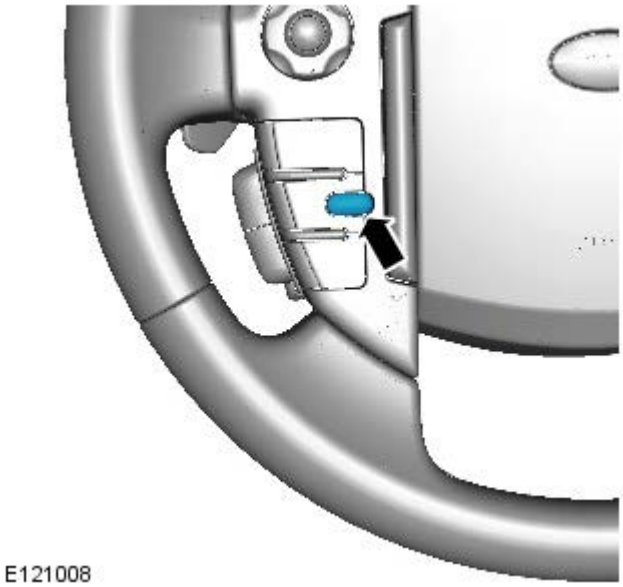
- Press the right-hand OK button and follow the instructions.



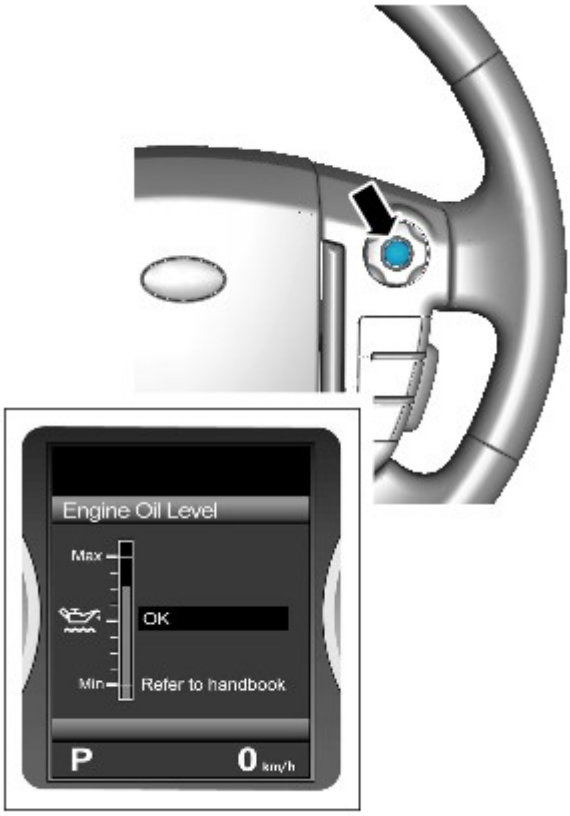
E123928

20.

- Press the cruise control cancel button twice within 2 seconds.



E121008



E123929

21.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes (as indicated in Step 14), switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.

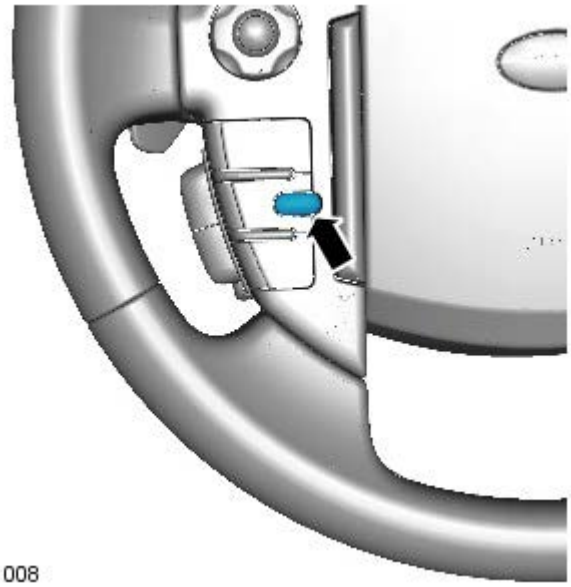
22. NOTE: If instructed to follow Steps 15-21 in a previous step, return to Step 14 and continue the procedure.

    Turn the ignition off.

23. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

24. NOTE: The following steps are to update the average oil level value.

    - Turn the ignition on.
    - Press and hold the cruise control cancel button for more than 2 seconds.



E121008

25.

- The message center display will revert to the normal display in the trip computer.

26. Turn the ignition off.

27. Turn the ignition on.

28.

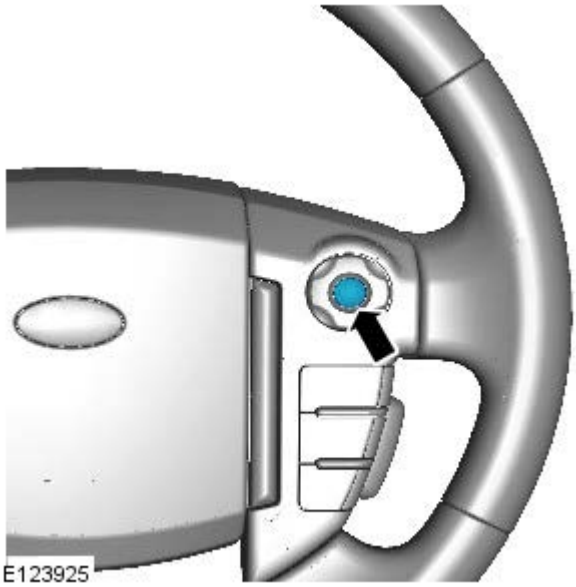
- Press the right-hand directional button to access the instrument cluster menu.



E123926

29.

- Press the right-hand OK button.



30.

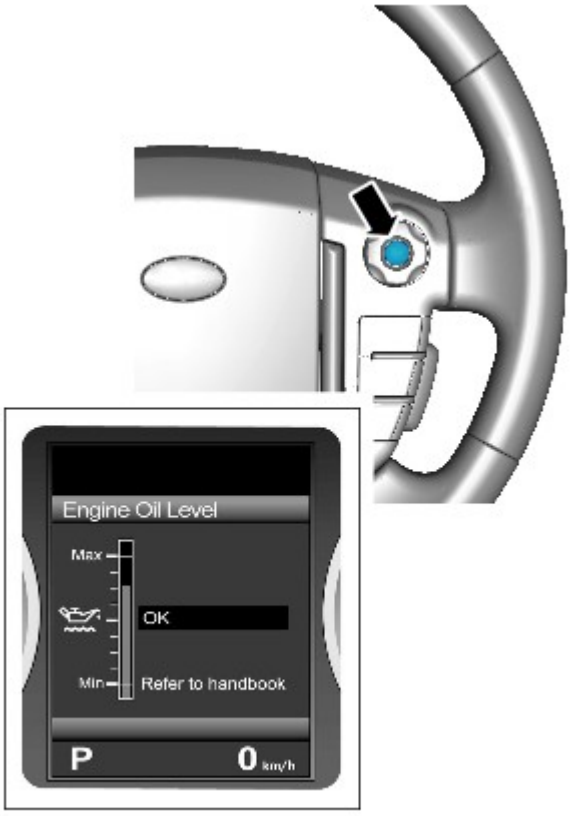
- Press the right-hand directional button to access the Oil Level Display.



E123927

31.

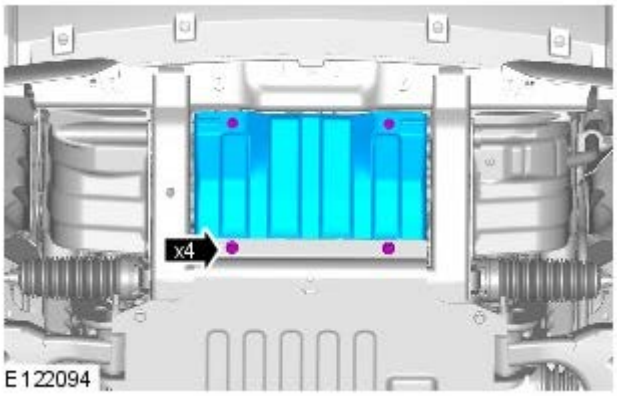
- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.



E123929

32. Refer to: Engine Undershield (501-02, Removal and Installation).

33. *Torque:* 10 Nm



E122094

Published: 15-Nov-2011

Engine - V8 S/C 5.0L Petrol - Camshaft LH

Removal and Installation

Removal

CAUTION: Make sure that the orientation and code on the top of the camshaft bearing caps is noted (along with the bank - A or B), so that on installation the components are installed to their original position. Failure to follow this instruction may cause damage to the vehicle.

NOTES:

Removal steps in this procedure may contain installation details.

Some illustrations may show the engine removed for clarity.

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

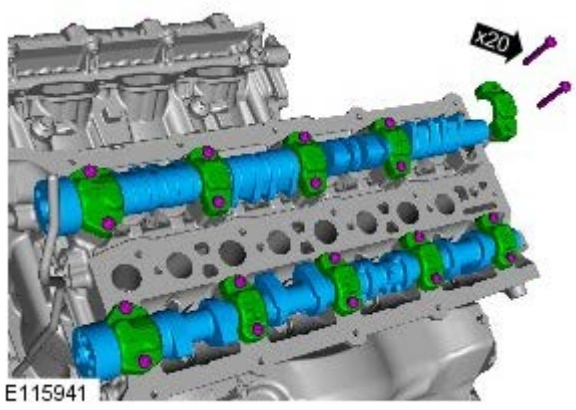
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Timing Drive Components - Assembly Part Number: INA Timing Drive (303-01D, Removal and Installation).



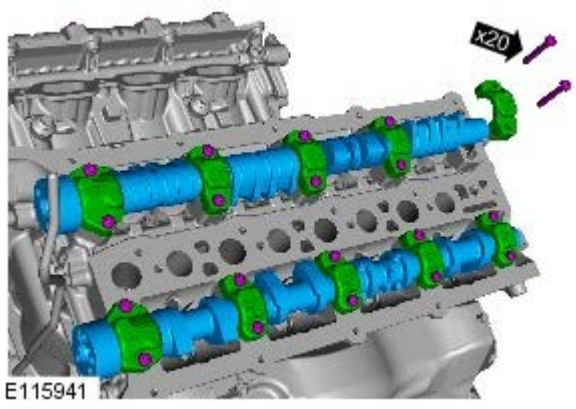
4. CAUTIONS:

   Rotate the camshafts until all the valves are at their minimum open point.

   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).

Installation



1. CAUTIONS:

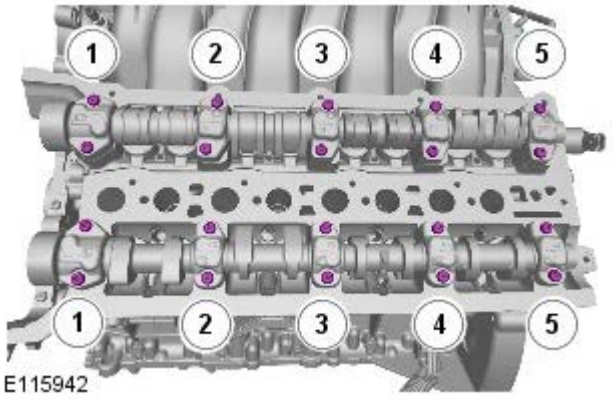
   Prior to installing the camshafts, position the crankshaft 45 degrees ATDC cylinder 1A to prevent valve/piston collision.

   Make sure that the camshafts and camshaft bearing caps are installed in their original locations.

   Evenly and progressively install and tighten the camshaft bearing caps.

   NOTE: Lubricate the camshafts and the camshaft bearing caps with EP90 oil (or 75/90 viscosity oil will suffice) prior to installation.

   Torque: 3 Nm



2. NOTE: Tighten the bolts in the indicated sequence.

   Torque: 12 Nm

3. CAUTION: Only rotate the crankshaft clockwise.

   Rotate the crankshaft untill the camshaft lobe on the valve being checked is 180 degrees from the maximum opening position.

4. NOTES:

   If the valve clearance is incorrect, continue to the next step. If the valve clearance is correct, continue to step 8.

   On vehicles without supercharger the inlet camshaft valve clearances cannot be checked.

   Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

5. CAUTIONS:

   Do not use a magnet to remove the tappet.

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

   Remove the tappet and measure the thickness.

6. NOTE: If a new tappet is installed then go back to step 1 of the install procedure.

   Install a new tappet if required.

7. Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

8. Refer to: Timing Drive Components - Assembly Part Number: INA Timing Drive (303-01D, Removal and Installation).

9. Connect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Camshaft RH

Removal and Installation

Removal

CAUTION: Make sure that the orientation and code on the top of the camshaft bearing caps is noted (along with the bank - A or B), so that on installation the components are installed to their original position. Failure to follow this instruction may cause damage to the vehicle.

NOTES:

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

Removal steps in this procedure may contain installation details.

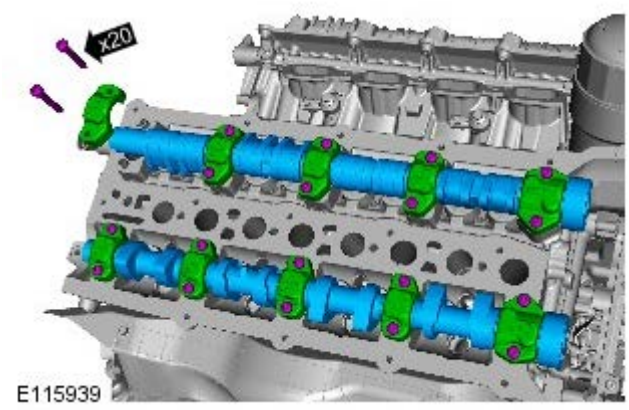
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Timing Drive Components - Assembly Part Number: INA Timing Drive (303-01, Removal and Installation).



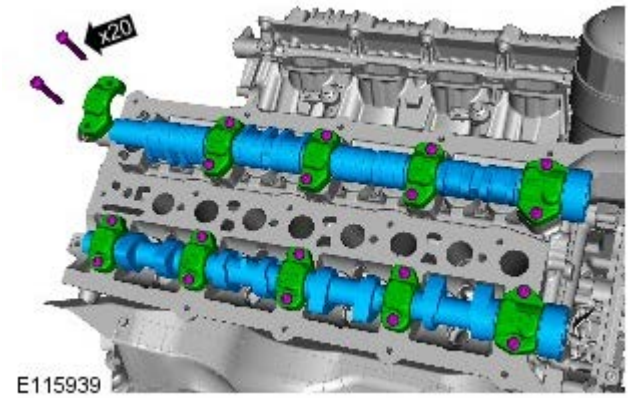
4. CAUTIONS:

   Rotate the camshafts until all the valves are at their minimum open point.

   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).

Installation



1. CAUTIONS:

   Prior to installing the camshafts, position the crankshaft 45 degrees ATDC cylinder 1A to prevent valve/piston collision.

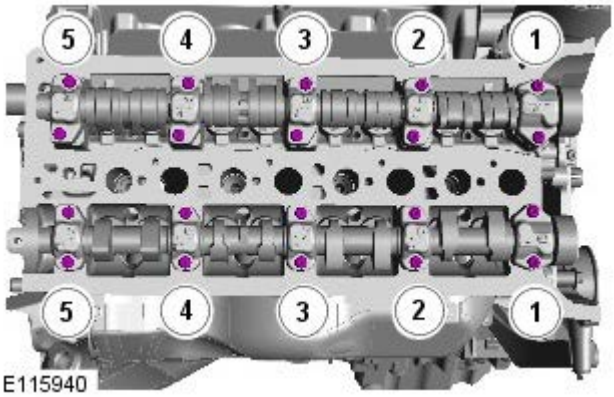
   Make sure that the camshafts and camshaft bearing caps are installed in their original locations.

   Evenly and progressively install and tighten the camshaft bearing caps.

   NOTE: Lubricate the camshafts and the camshaft bearing caps with EP90 oil (or 75/90 viscosity oil will suffice) prior to installation.

   Torque: 3 Nm

2. NOTE: Tighten the bolts in the indicated



sequence.

Torque: 12 Nm

3. CAUTION: Only rotate the crankshaft clockwise.

   Rotate the crankshaft untill the camshaft lobe on the valve being checked is 180 degrees from the maximum opening position.

4. NOTES:

   If the valve clearance is incorrect, continue to the next step. If the valve clearance is correct, continue to step 8.

   On vehicles without supercharger the inlet camshaft valve clearances cannot be checked.

   Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

5. CAUTIONS:

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

   Do not use a magnet to remove the tappet.

   Remove the tappet and measure the thickness.

6. NOTE: If a new tappet is installed then go back to step 1 of the install procedure.

   Install a new tappet if required.

7. Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

8. Refer to: Timing Drive Components - Assembly Part Number: INA Timing Drive (303-01, Removal and Installation).

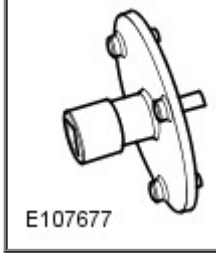
9. Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Crankshaft Front Seal

Removal and Installation

Special Tool(s)

 E107677	303-1434 Remover/Installer, Front Crankshaft Seal

Removal

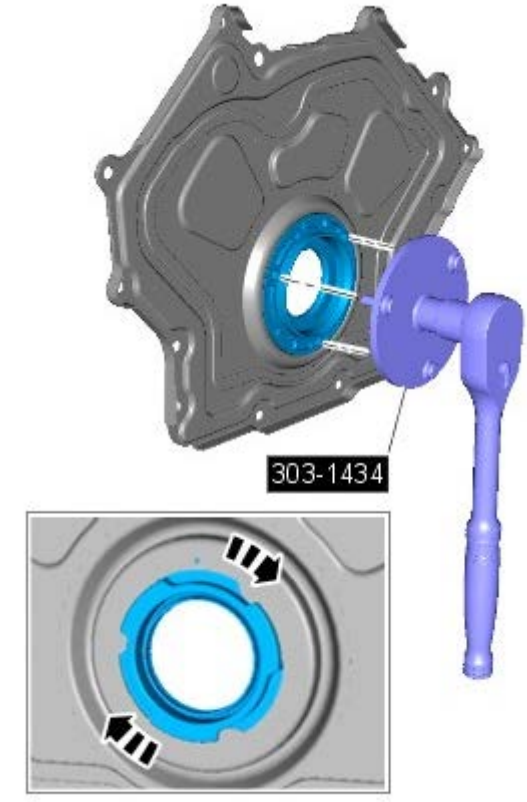
NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. Refer to: Crankshaft Pulley (303-01, Removal and Installation).

3. *Special Tool(s):* 303-1434
   Torque: 26 Nm



E112056

Installation

1. CAUTIONS:

   Do not over tighten the crankshaft front seal. Failure to follow this instruction may result in damage to the vehicle.

   Take extra care not to damage the seal.

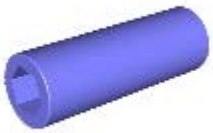
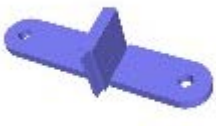
   To install, reverse the removal procedure.

Published: 20-Aug-2013

Engine - V8 S/C 5.0L Petrol - Crankshaft Pulley

Removal and Installation

Special Tool(s)

 E115256	303-1437 Crankshaft Damper Remover/Installer
 E115257	303-1438 Crankshaft Damper Bolt Remover/Installer
 E115258	303-1439 Crankshaft Damper Removal Plate
 E115259	303-1440 Crankshaft Damper Removal/Installation Stud
 E115260	303-1441 Crankshaft Damper Remover/Installer Body
 E115266	303-1448 Locking Tool

Removal

NOTE: Removal steps in this procedure may contain installation details.

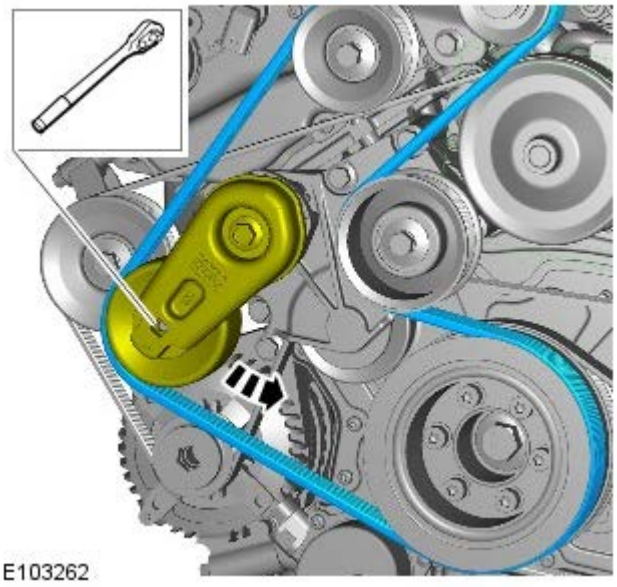
1. Refer to: Specifications (414-00, Specifications).
2. WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

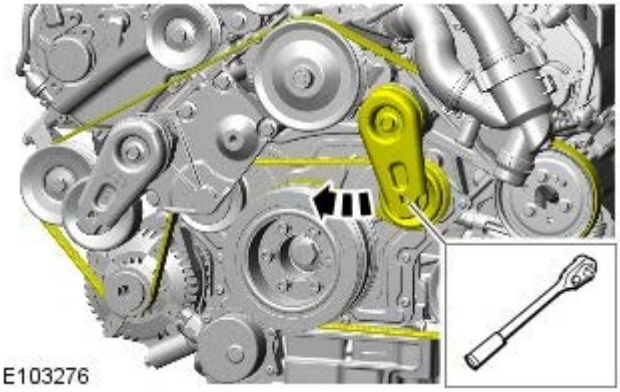
3. Refer to: Radiator - V8 S/C 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

4. Refer to: Starter Motor (303-06B Starting System - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

5.

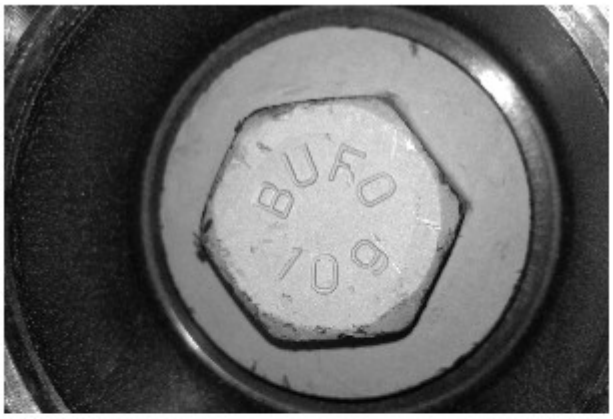


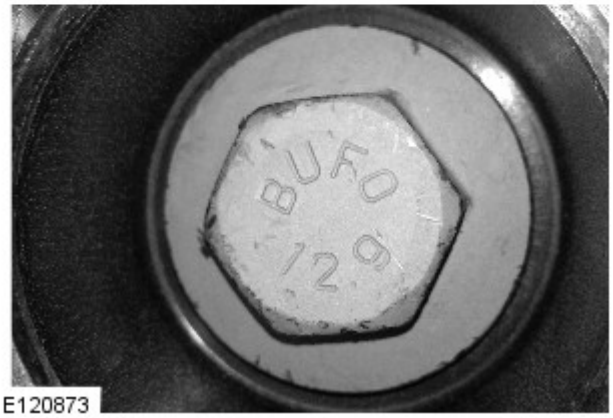
6.



7. CAUTION: Before removing the crankshaft pulley bolt, note the numbers on the bolt head. If the bolt head shows 10.9, the bolt must be removed counter clockwise. If the bolt head shows 12.9, the bolt must be removed clockwise. Failure to follow this instruction may result in damage to the crankshaft.

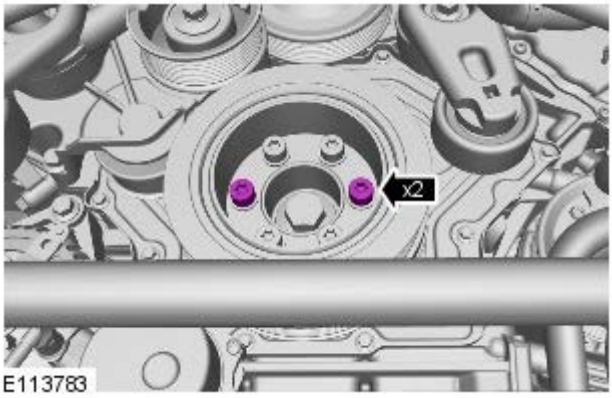
   Note the markings on the crankshaft pulley bolt.





E120873

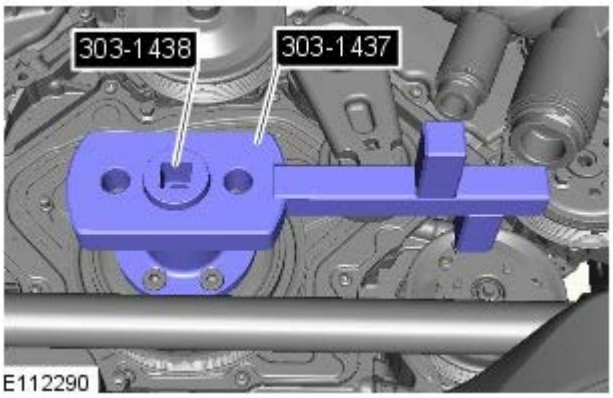
8.



E113783

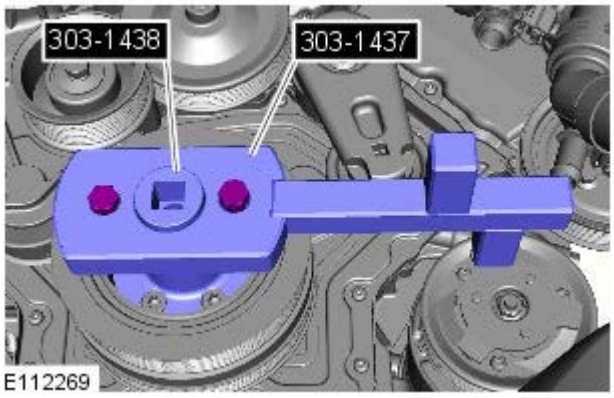
9. Install the special tool.

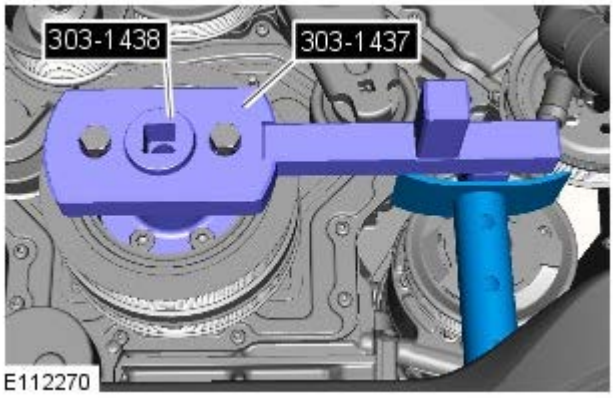
   Special Tool(s): 303-1437, 303-1438



E112290

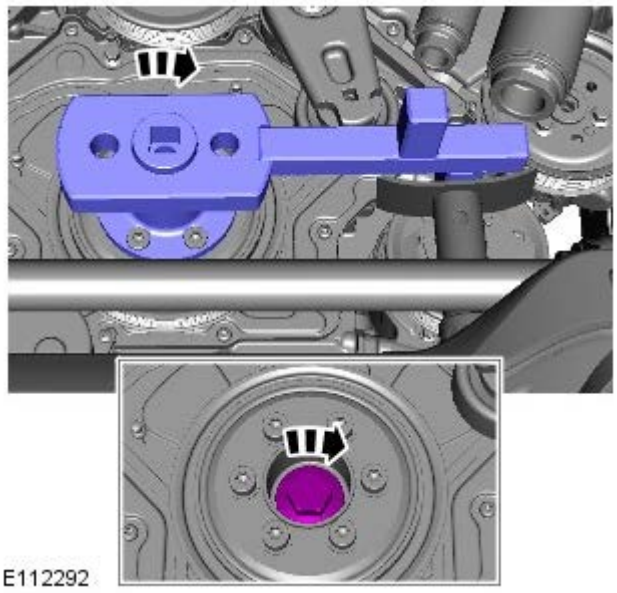
10. *Torque:* 65 Nm





11. NOTE: The graphic shows the tool position for LH thread only, RH thread will be the opposite.

    Using a suitable stand, support the special tool.

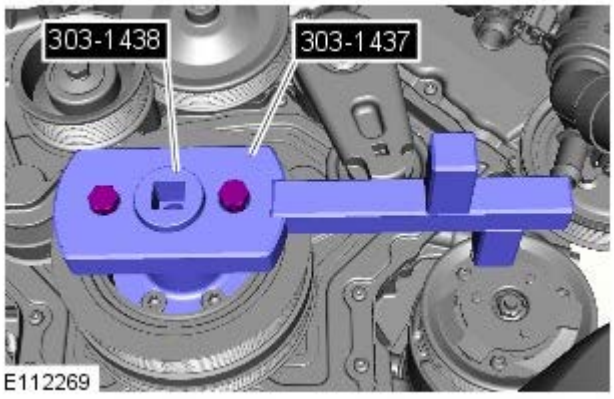


12. NOTES:

    The crankshaft pulley bolt will be very tight.

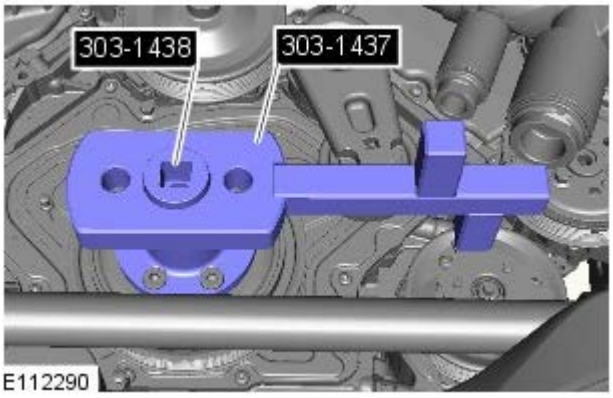
    Discard the bolt after removal.

    The graphic shows the step for LH thread only, RH thread will be the opposite.



13.

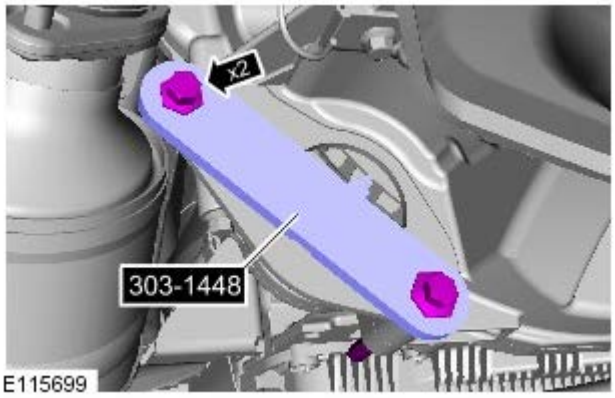
14. NOTE: If the crankshaft damper is fitted with an early RH thread crankshaft bolt then the pulley can be removed with a standard puller.



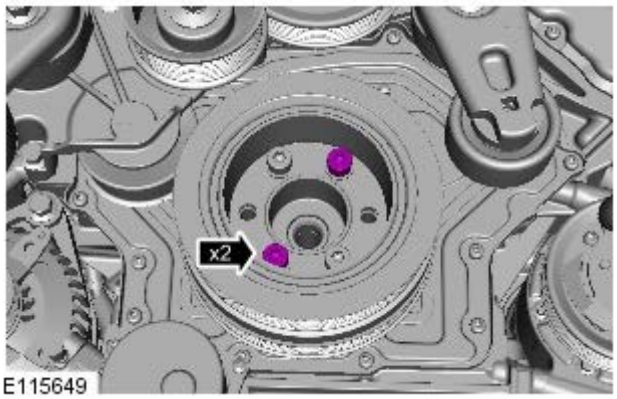
Remove the special tool.

15. Install the special tool.

Special Tool(s): 303-1448

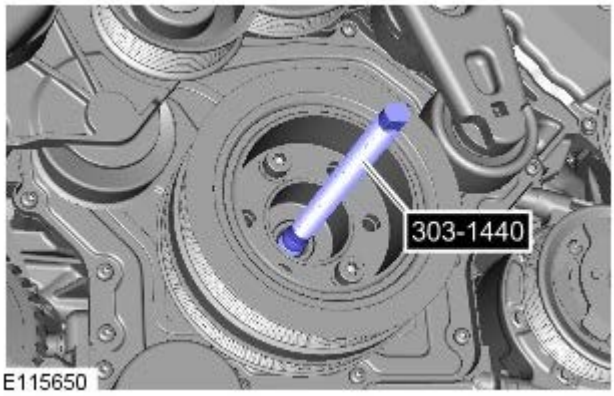


16.



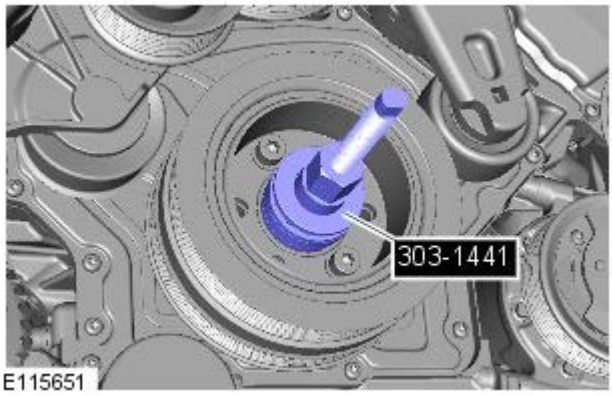
17. Install the special tool.

Special Tool(s): 303-1440



18. Install the special tool.

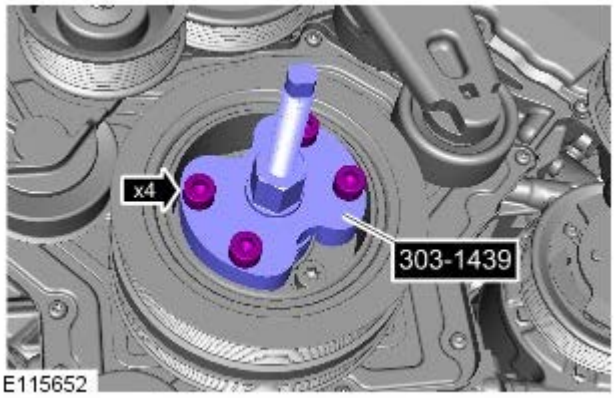
Special Tool(s): 303-1441



E115651

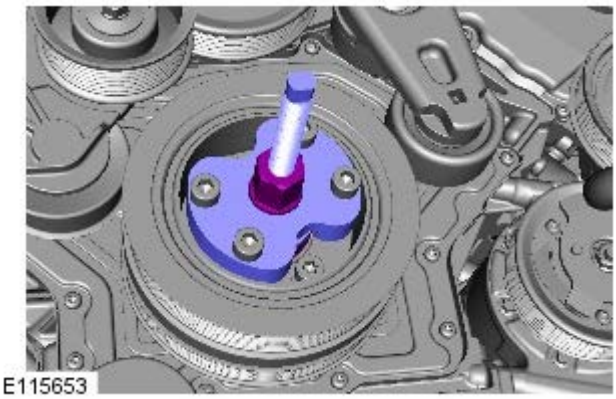
19. Install the special tool.

Special Tool(s): 303-1439



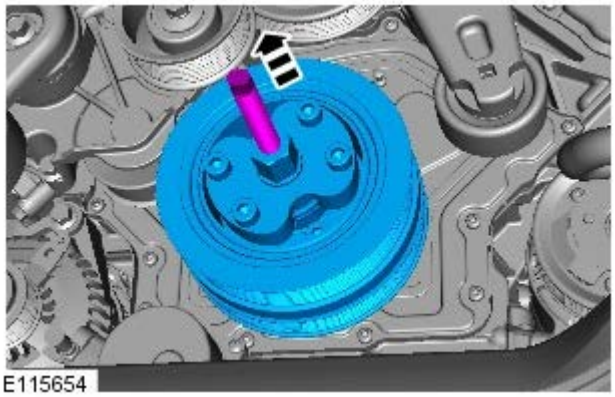
E115652

20.

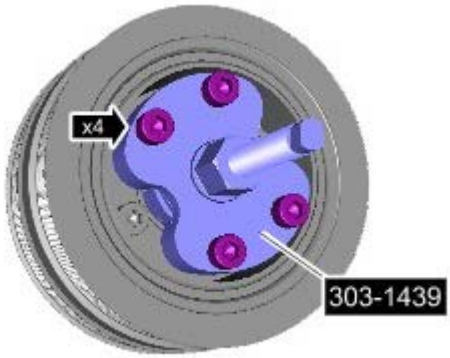

E115653

21. CAUTION: Discard the friction washer after removing the crankshaft pulley.

NOTE: Make sure to clean the threads in the end of the crankshaft and that the crank nose is free of any foreign materials.


E115654

22.



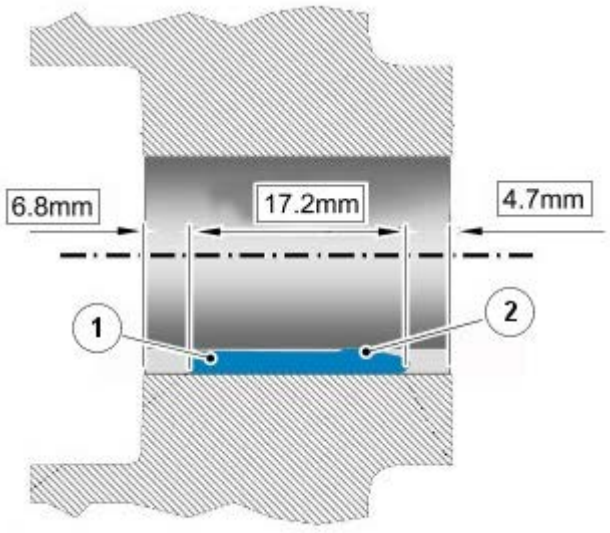
E115655

23.



E115656

Installation



E115889

1.

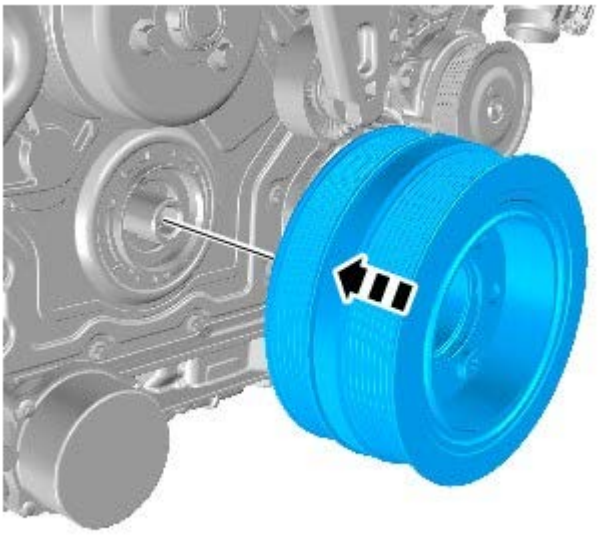
- Apply RTV sealant to the crankshaft pulley keyway.
- Make sure that the RTV sealant is applied in a 2mm diameter bead.
- Make sure that when the RTV sealant is applied that the RTV sealant is level with the top of the keyway.

2. CAUTION: Install a new friction washer before installing the crankshaft pulley.

NOTES:

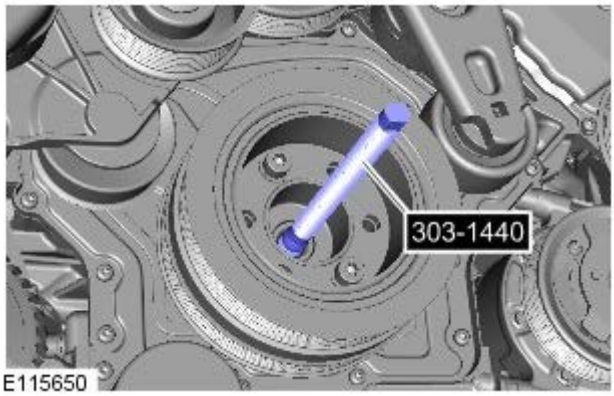
Make sure to clean the threads in the end of the crankshaft and that the crank nose is free of any foreign materials.

Skip to step 11 for engines fitted with early RH thread crankshaft bolt.



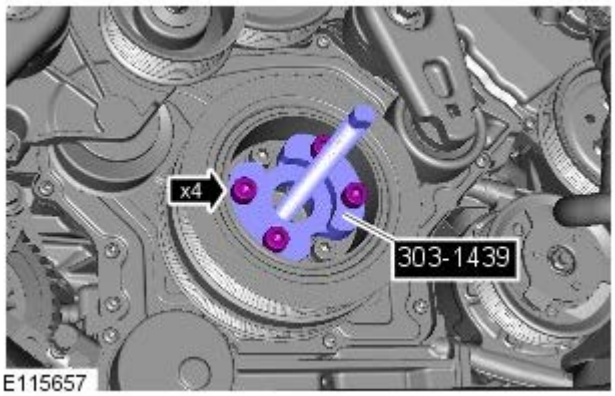
E112288

3. Install the special tool.



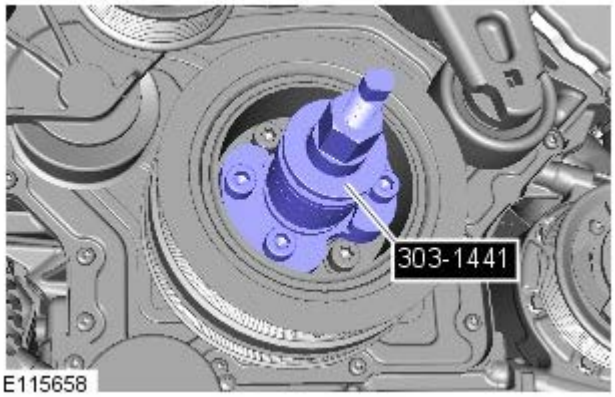
E115650

4. Install the special tool.



E115657

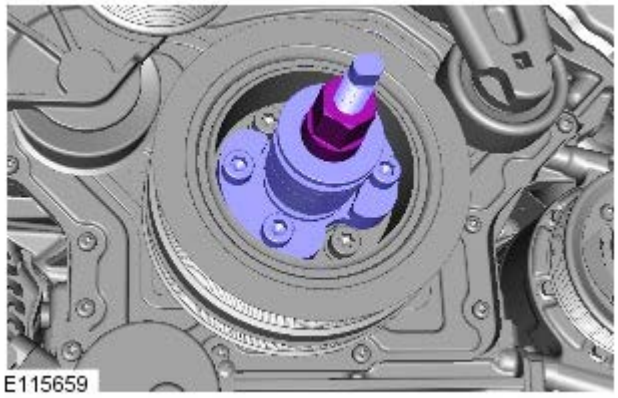
5. Install the special tool.



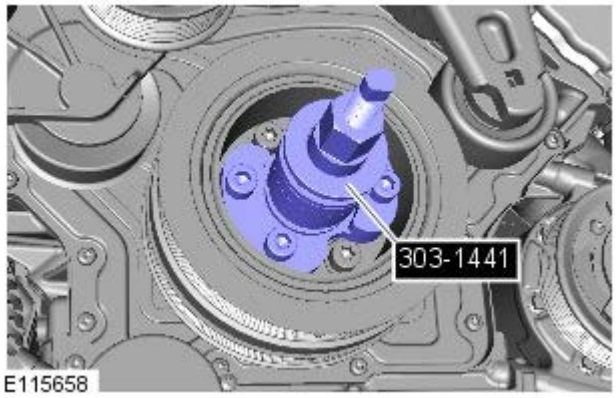
E115658

6. CAUTION: Rotate the crankshaft pulley installation tool anti-clockwise until the pulley is fully located, do not over tighten. Failure to do this

may result in damge to the components.

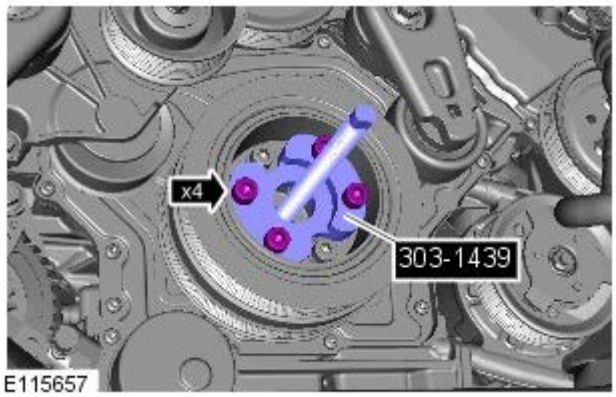

E115659

7. Remove the special tool.



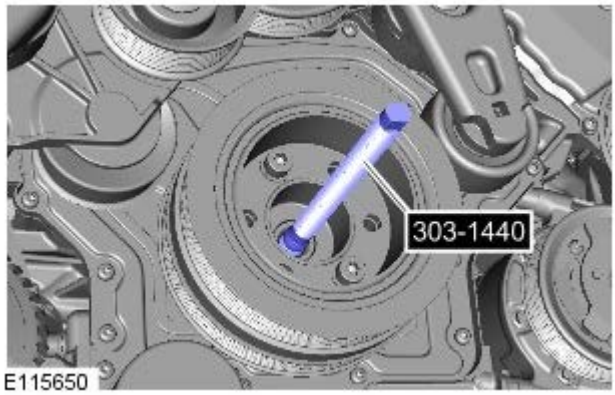
E115658

8.
   - Remove the special tool.



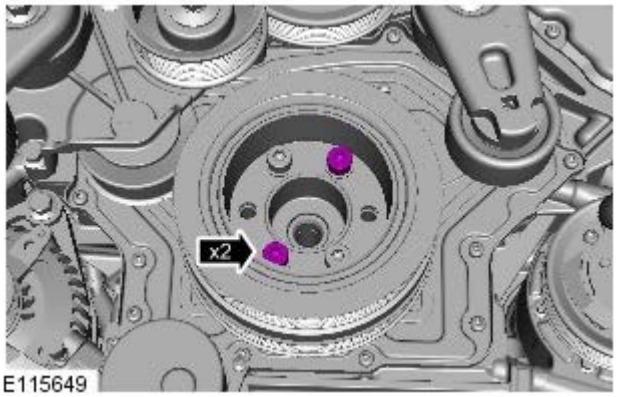
E115657

9. Remove the special tool.

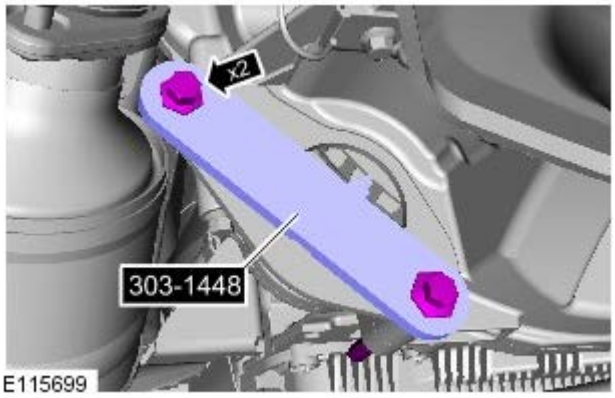


E115650

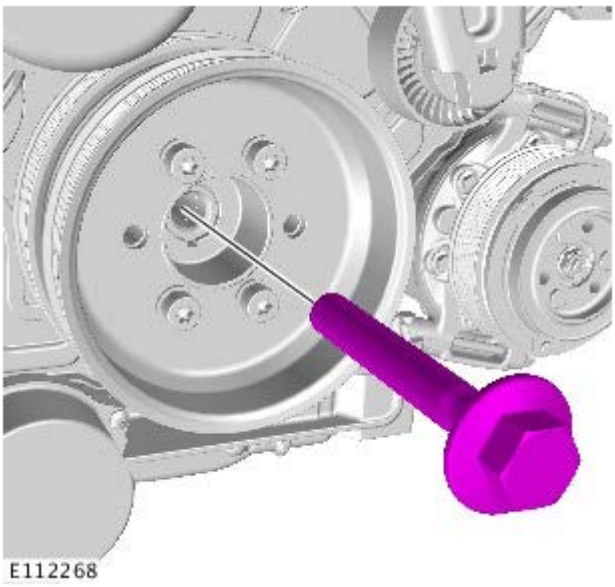
10. WARNING: Make sure that a new bolt is installed.
    - Apply loctite 270 to the thread of the bolts.
    - *Torque:* 65 Nm



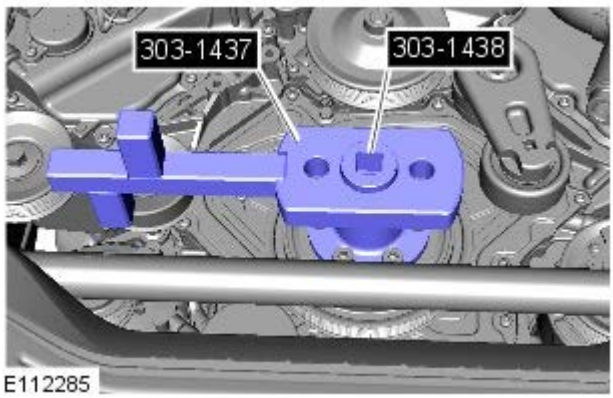
11. Remove the special tool.



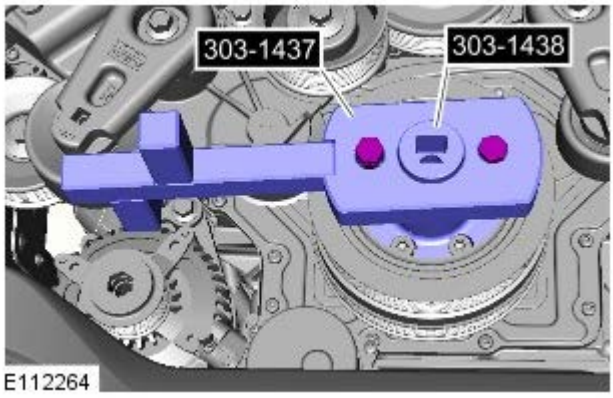
12. WARNING: Make sure that a new bolt is installed.

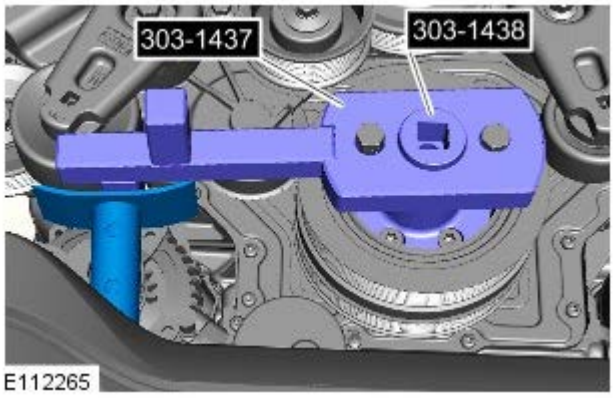


13. Install the special tool.



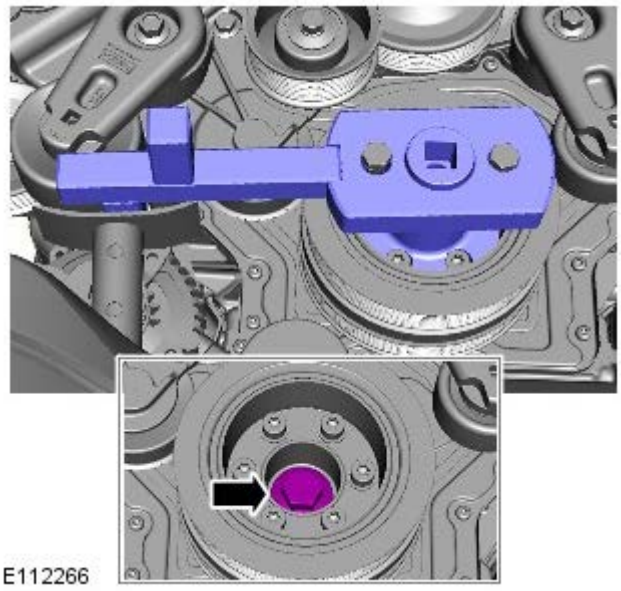
14. *Torque:* 65 Nm





15. NOTE: The graphic shows the tool position for LH thread only, RH thread will be the opposite.

    Using a suitable stand, support the special tool.

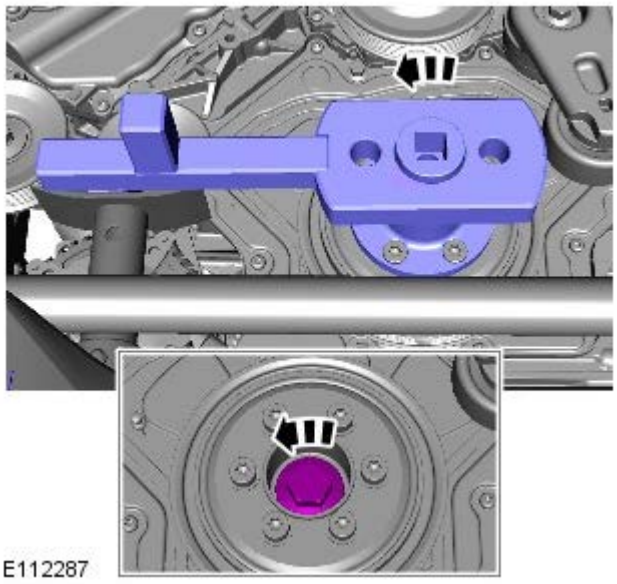


16. NOTE: The graphic shows the tool position for LH thread only, RH thread will be the opposite.

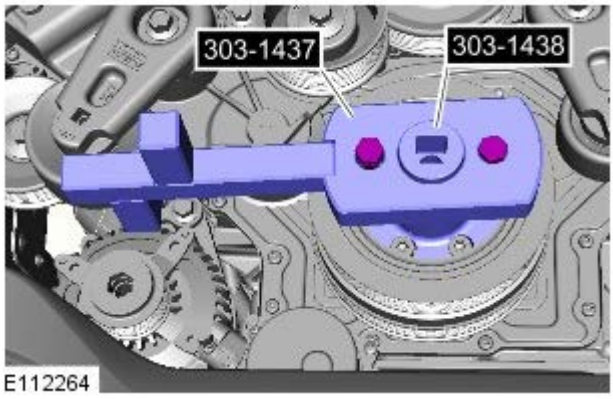
    Torque: 200 Nm

17. NOTE: The use of a torque multiplyer capable of 600Nm will be required.

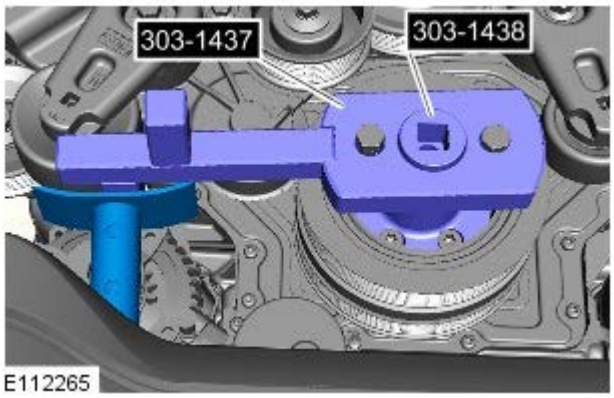
    - *Torque:* 270°
    - Make sure that the socket is turned through 270 degrees not the torque wrench.



18.

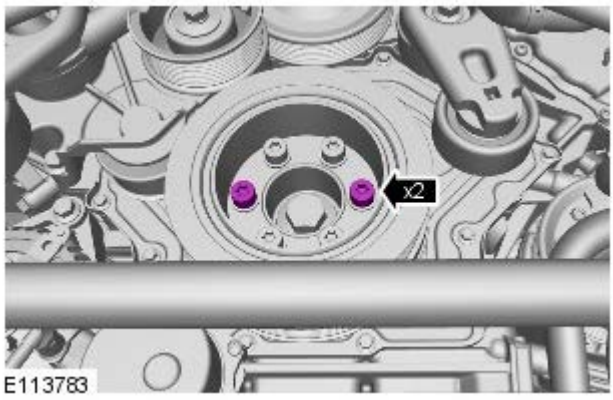


19. Remove the special tool.

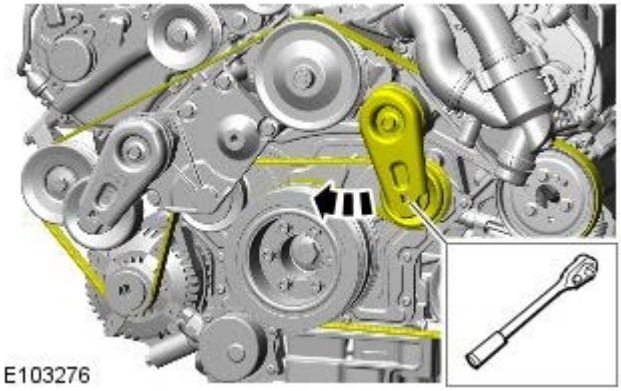


20. WARNING: Make sure that a new bolt is installed.

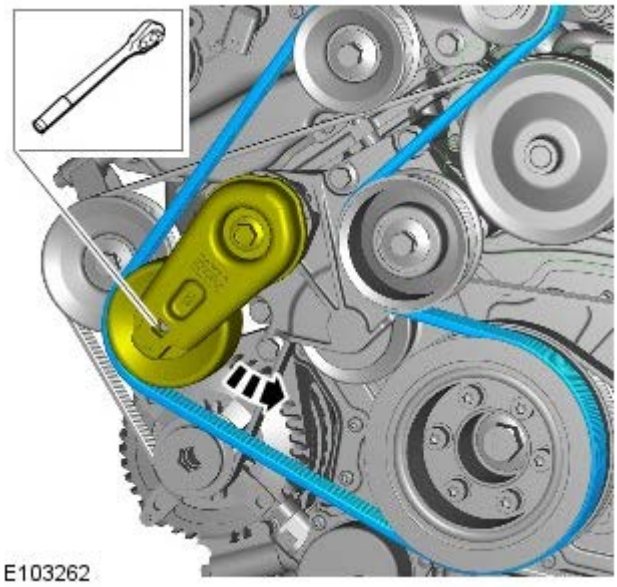
- Apply loctite 270 to the thread of the bolts.
- *Torque:* 65 Nm



21.



22.



23. Refer to: Starter Motor (303-06B Starting System - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

24. Refer to: Radiator - V8 S/C 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

25. Connect the battery ground cable.

    Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Crankshaft Rear Seal

Removal and Installation

Special Tool(s)

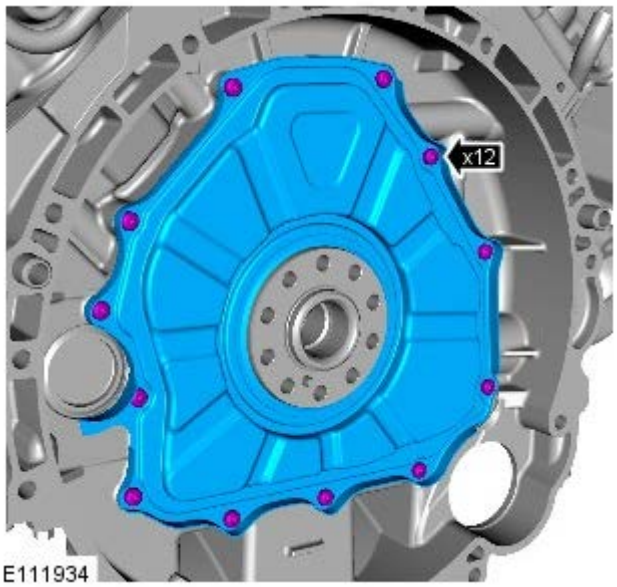
 E107678	303-1442 Rear Crankshaft Seal Installer
 E107679	303-1443 Rear Crankshaft Cover Alignment Tool

Removal

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

1. Refer to: Flexplate (303-01, Removal and Installation).

2.

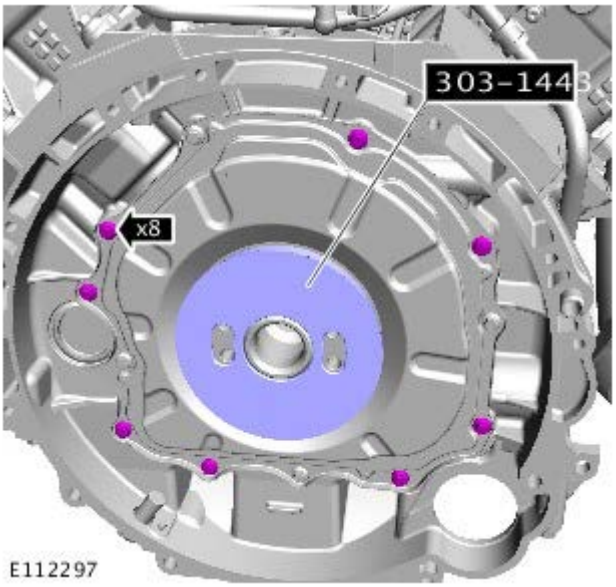


Installation

1. Install the special tool.

Special Tool(s): 303-1442, 303-1443

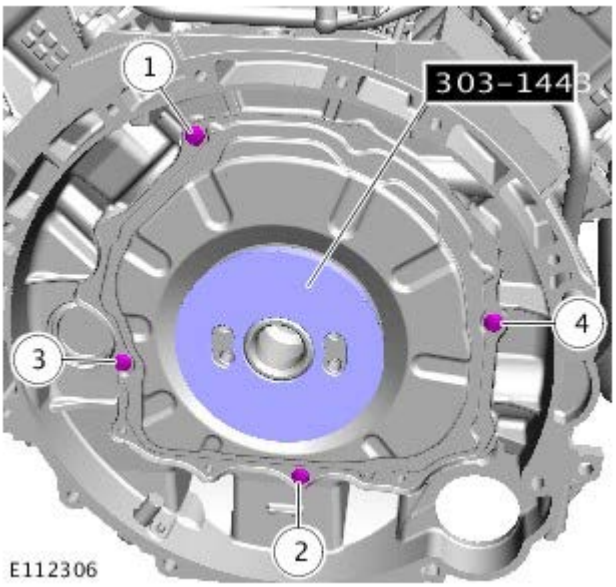




2. NOTE: Tighten the bolts in the indicated sequence.

   Torque: 11 Nm

3. *Torque:* 11 Nm



4. Refer to: Flexplate (303-01, Removal and Installation).

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Cylinder Head LH

Removal and Installation

Removal

NOTES:

Some illustrations may show the engine removed for clarity.

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

Removal steps in this procedure may contain installation details.

1. Remove the battery for access.

   Refer to: Specifications (414-00, Specifications).

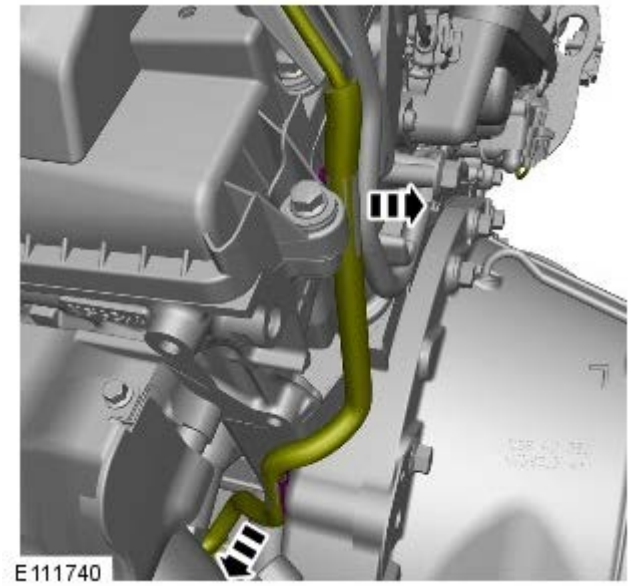
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

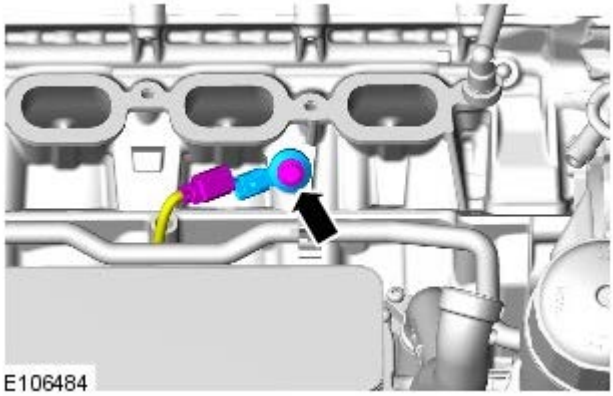
3. Refer to: Camshaft LH (303-01, Removal and Installation).

4. Refer to: Exhaust Manifold LH (303-01, Removal and Installation).

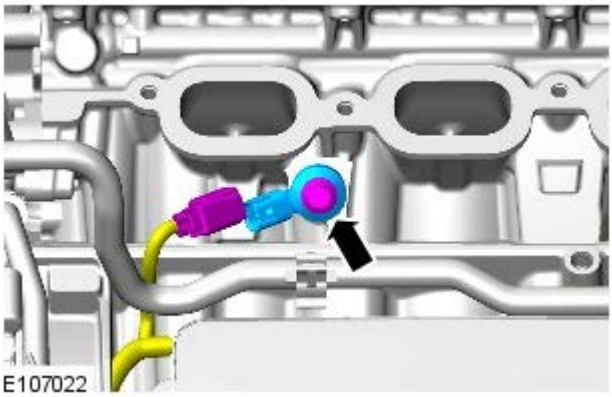
5.

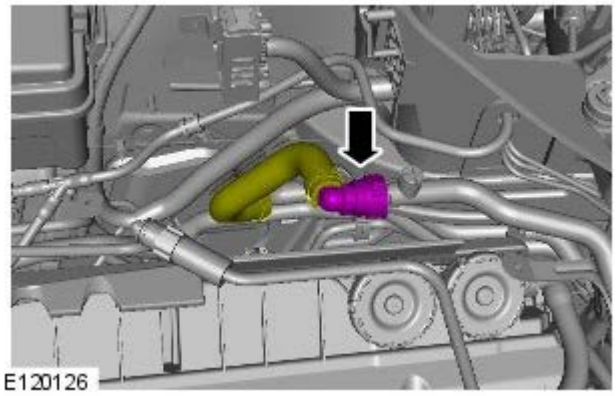


6.

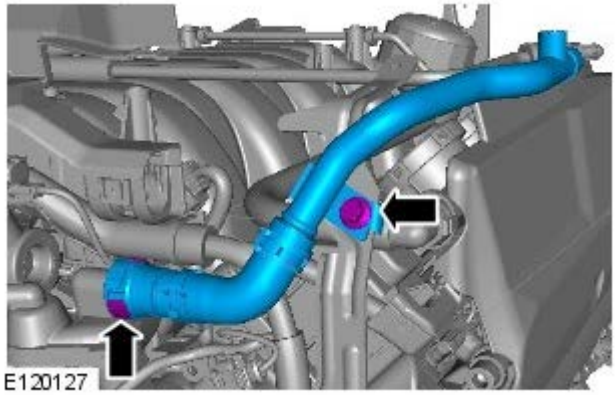


7.

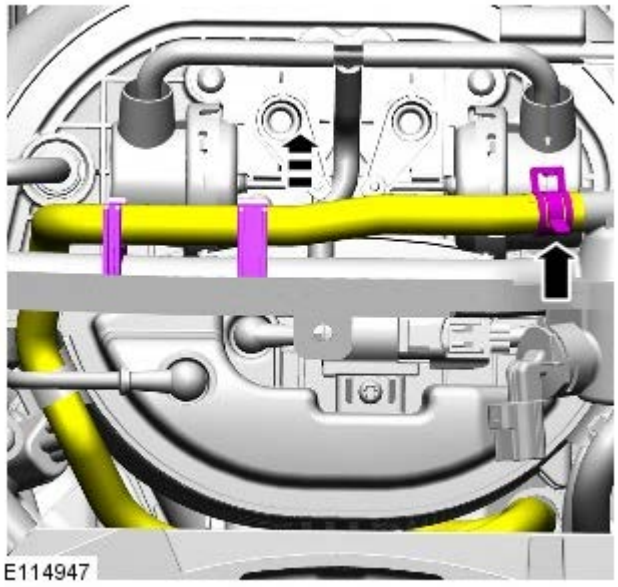




8. CAUTION: Be prepared to collect escaping coolant.

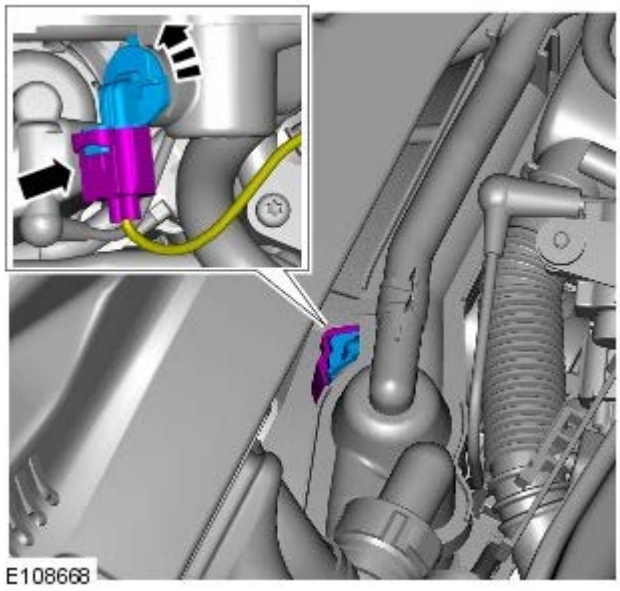


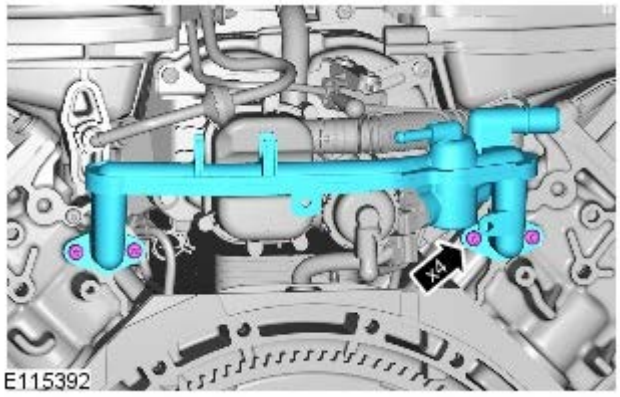
9. CAUTION: Be prepared to collect escaping coolant.



10. NOTE: Clamp the hose to minimize coolant loss.

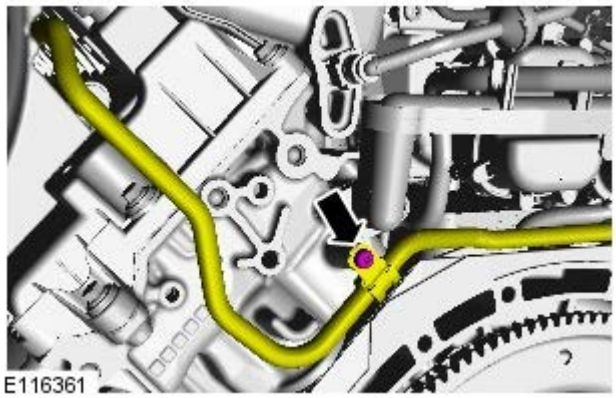
11.



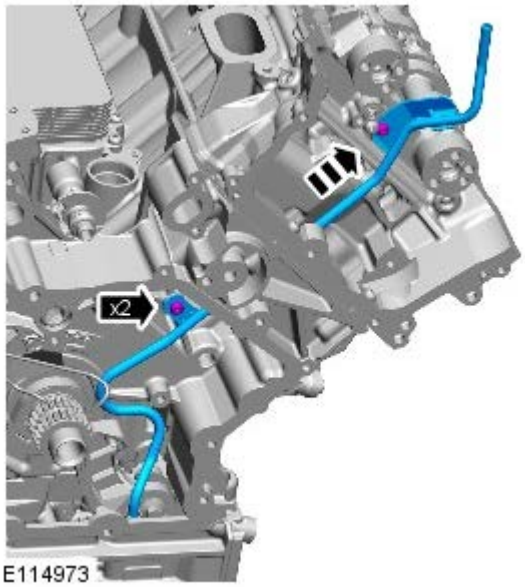


12. CAUTION: Discard the seals.

13.



14. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

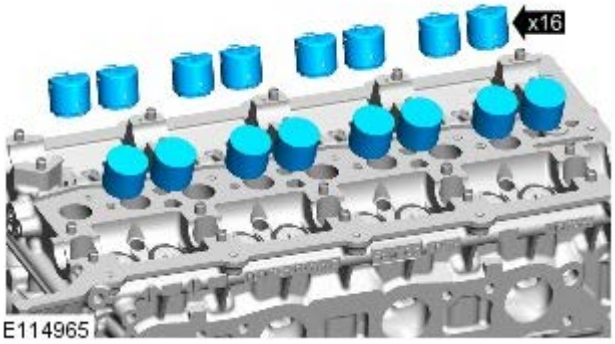


15. CAUTIONS:

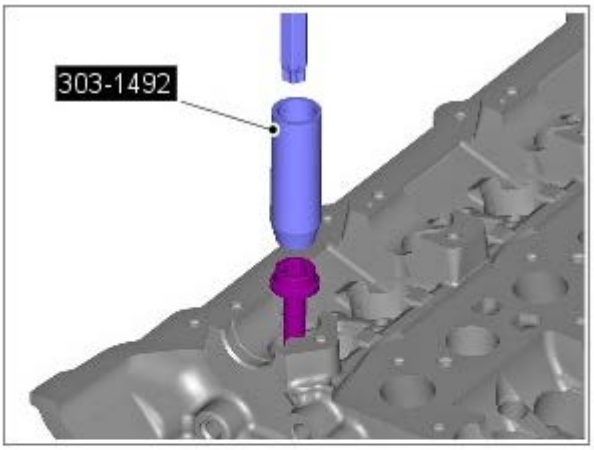
If a new cylinder head has been installed then new tappets must be installed.

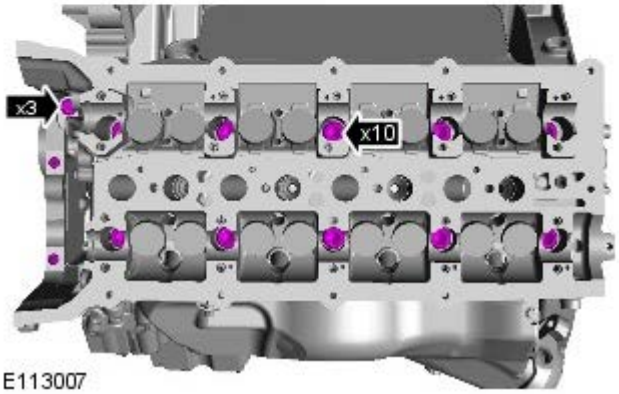
If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

NOTE: Left-hand shown, right-hand similar.

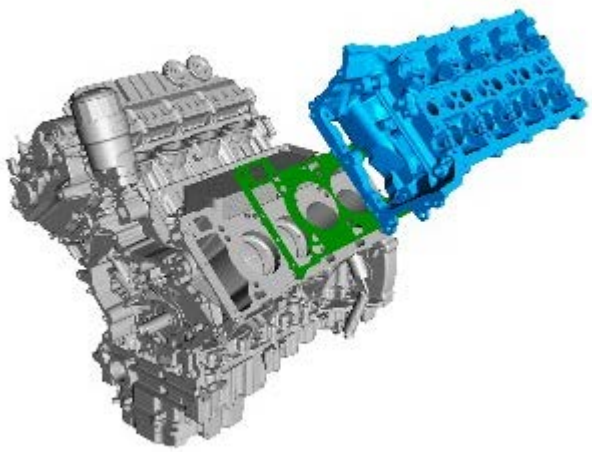


16.



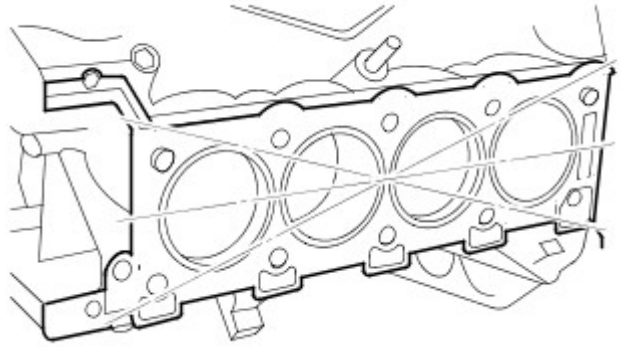


17.



E113006

Installation



E46855

1. CAUTION: An acceptable flatness of the cylinder head is 0.1mm.

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

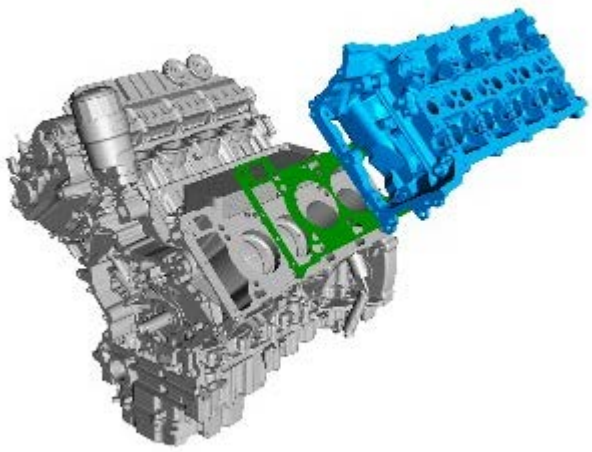
2. WARNING: Make sure care is taken when handling the cylinder head gasket.

   CAUTIONS:

   The head gasket must be installed over the cylinder block dowels.

   Make sure that the mating faces are clean and free of foreign material.

   NOTE: Install a new cylinder head gasket.

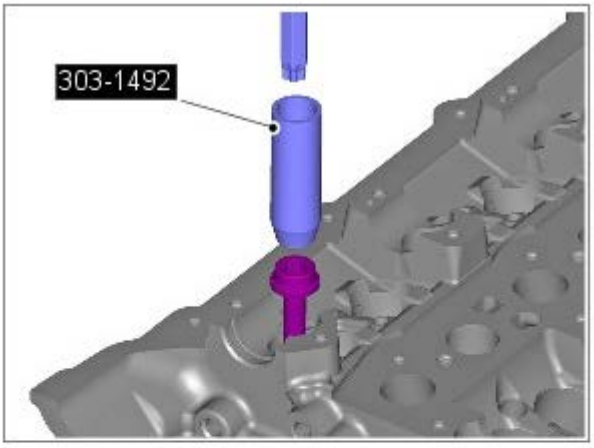


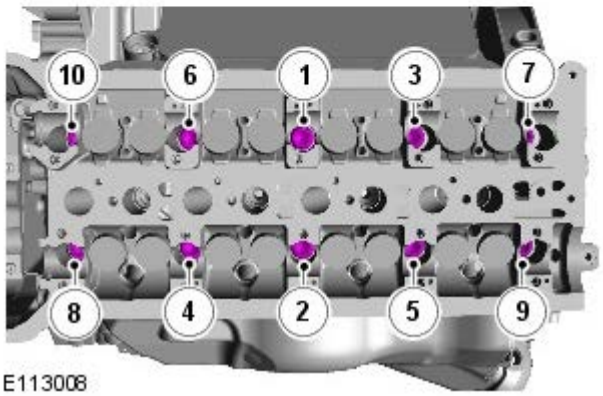
E113006

3. CAUTION: Make sure that new cylinder head bolts are installed.

   NOTE: Tighten the bolts in the indicated sequence.

   Torque: 20 Nm

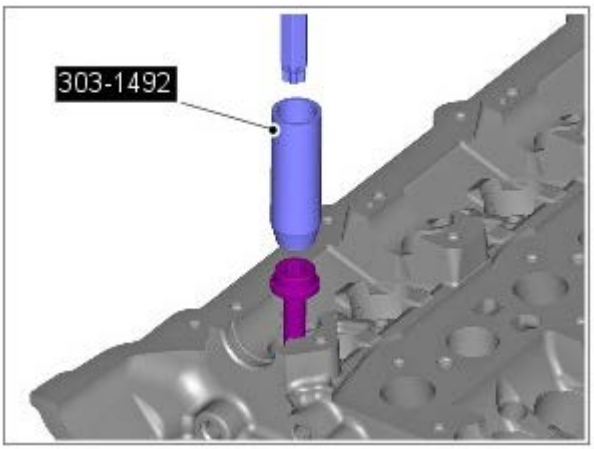


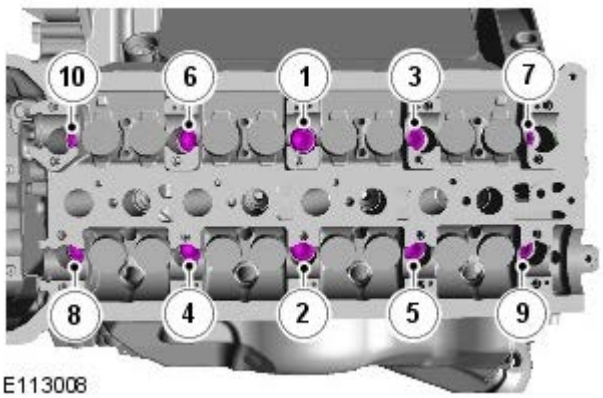


E113008

4. NOTE: Tighten the bolts in the indicated sequence.

   Torque: 35 Nm

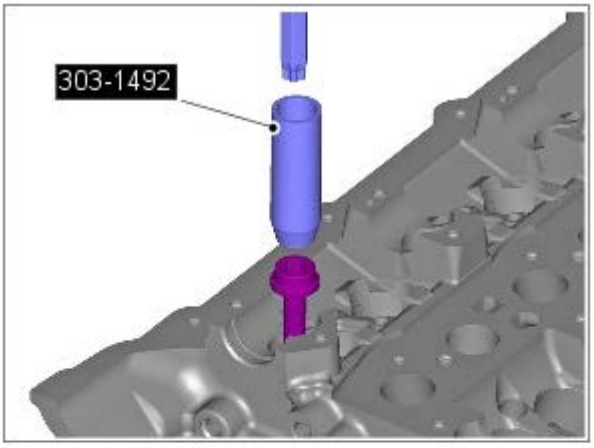


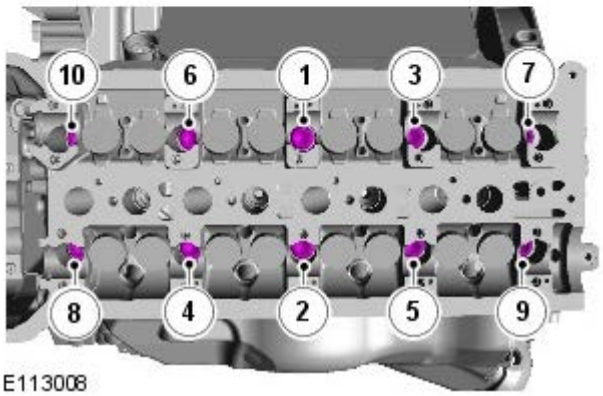


E113008

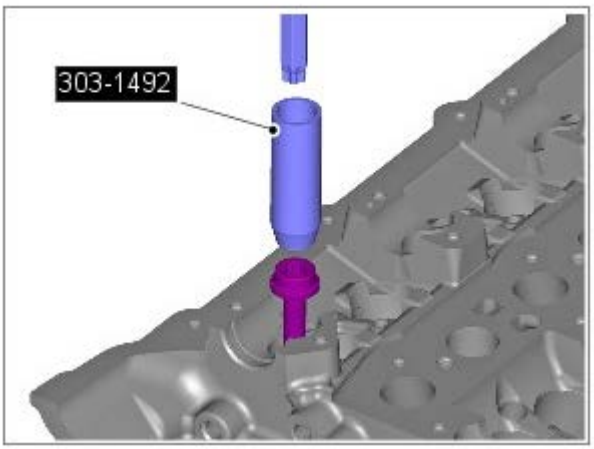
5. NOTE: Tighten the bolts in the indicated sequence.

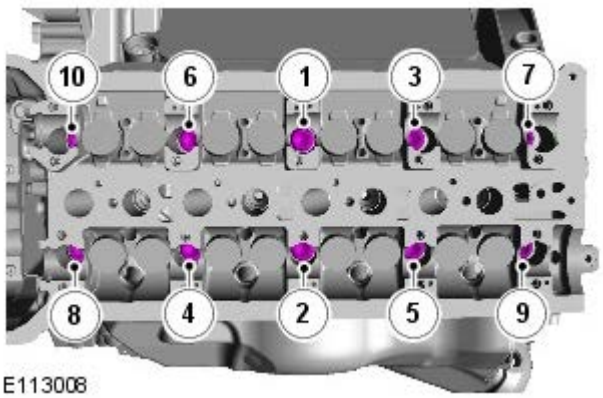
   Tighten the bolts 1 to 10, a further 90 degrees.





E113008



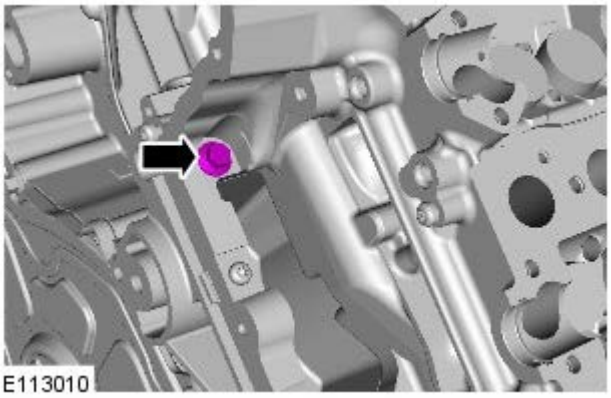


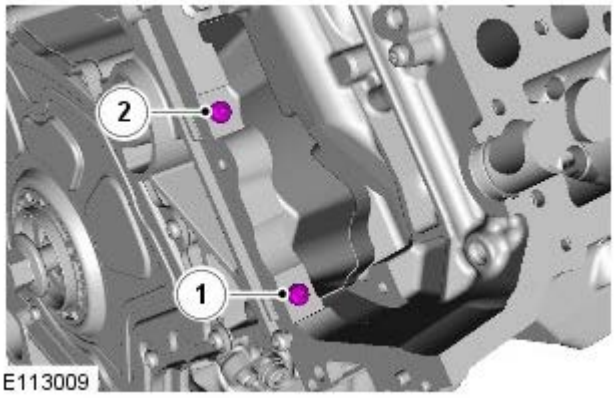
E113008

6. NOTE: Tighten the bolts in the indicated sequence.

   Tighten the bolts 1 to 10, a further 120 degrees.

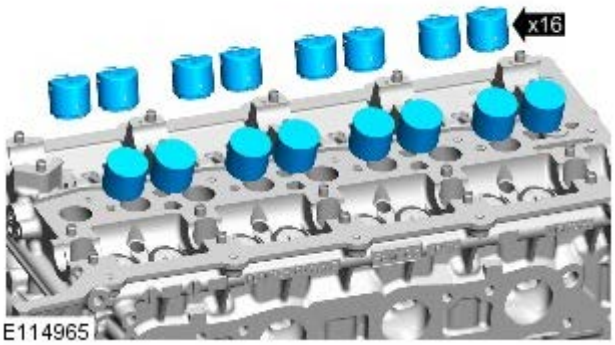
7. *Torque:* 25 Nm





8. NOTE: Tighten the bolts in the indicated sequence.

   Torque: 12 Nm



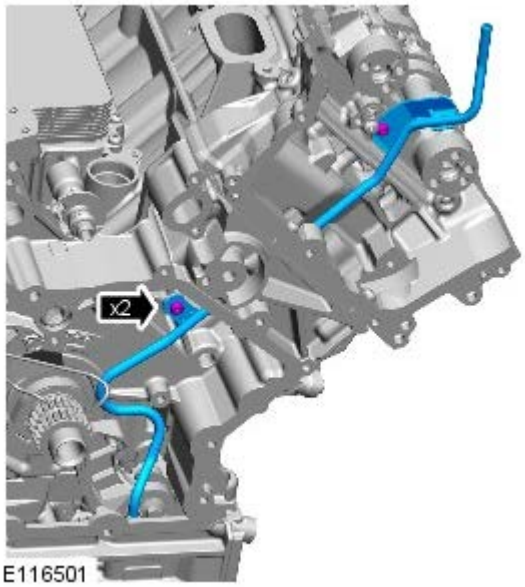
9. CAUTIONS:

   If a new cylinder head has been installed then new tappets must be installed.

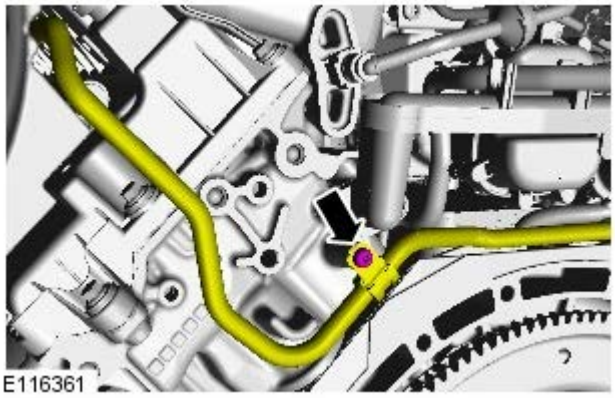
   If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

   Lubricate the valve tappets with clean engine oil.

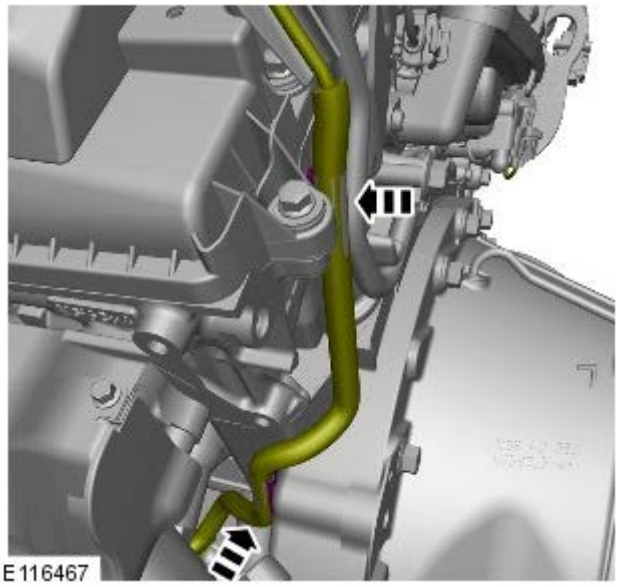
10. *Torque:* 12 Nm



11. *Torque:* 10 Nm

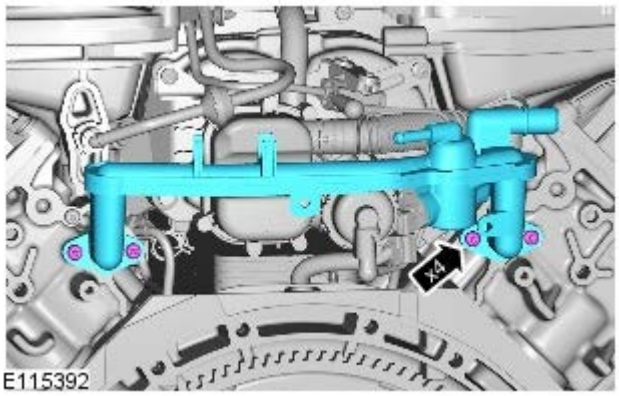


12.

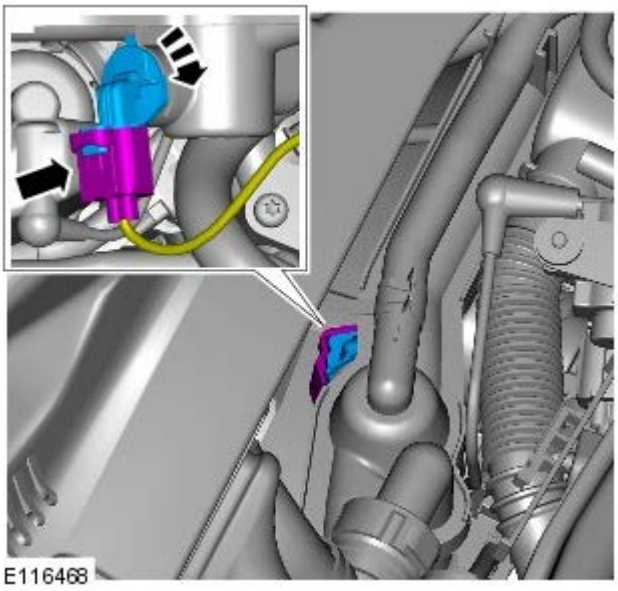


13. CAUTION: Install the new seals.

Torque: 10 Nm

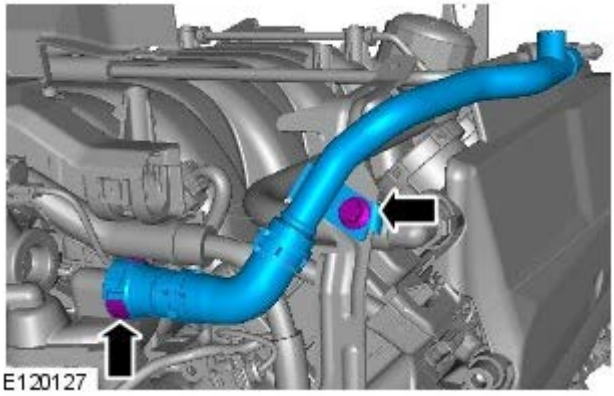


14.

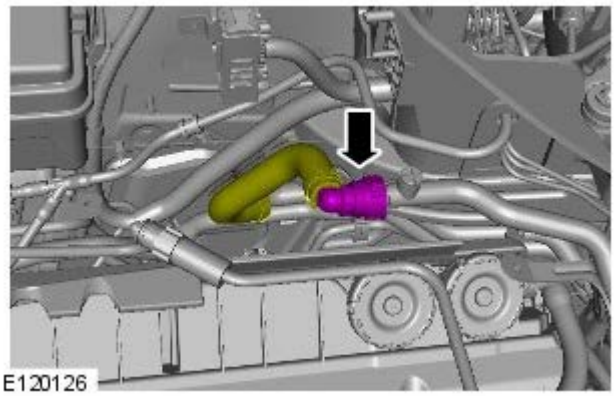

E116468

15. CAUTION: Be prepared to collect escaping coolant.

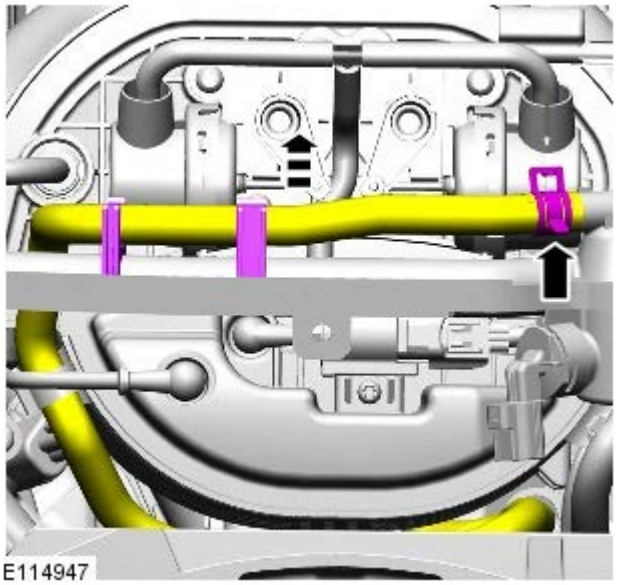
    Torque: 10 Nm


E120127

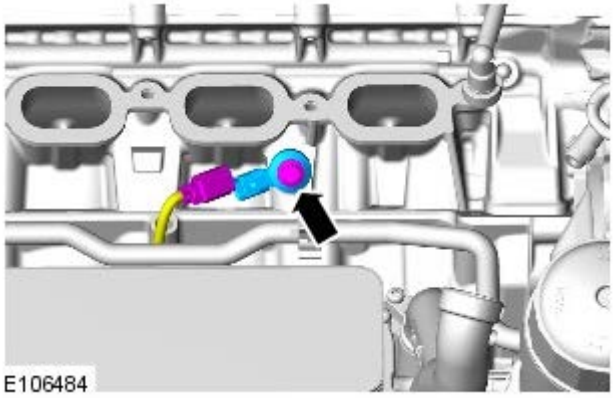
16.


E120126

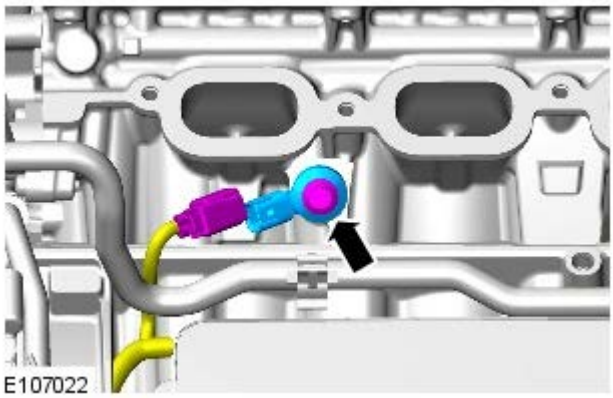
17.



18. *Torque:* 20 Nm



19. *Torque:* 20 Nm



20. Refer to: Exhaust Manifold LH (303-01, Removal and Installation).

21. Refer to: Camshaft LH (303-01, Removal and Installation).

22. Install the battery.

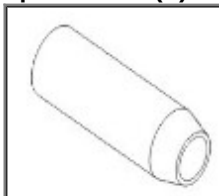
    Refer to: Specifications (414-00, Specifications).

Published: 02-Jan-2014

Engine - V8 S/C 5.0L Petrol - Cylinder Head RH

Removal and Installation

Special Tool(s)

 E129632	303-1492 Guide Sleeve, Cylinder Head Bolt

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

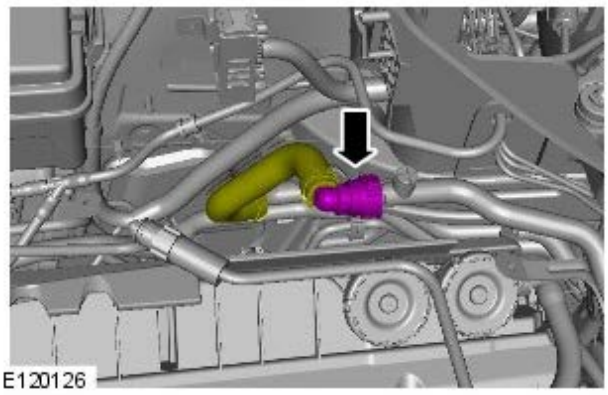
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

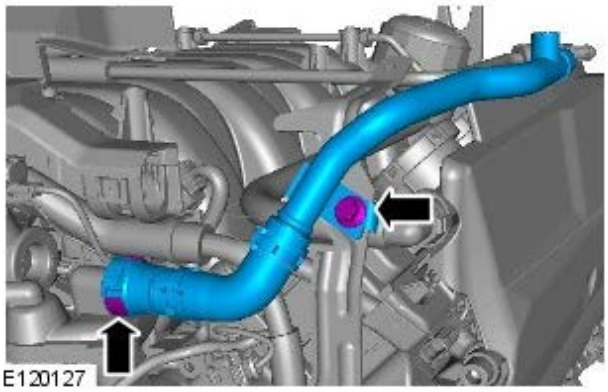
4. Refer to: Camshaft RH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

5. Refer to: Exhaust Manifold RH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

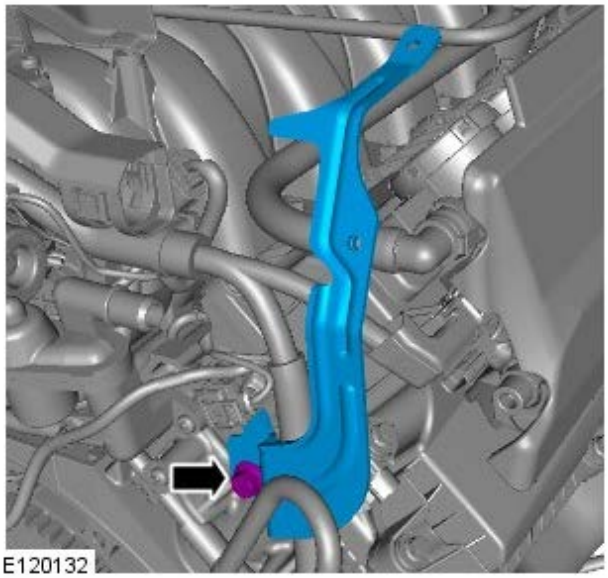

E120126

6. CAUTION: Be prepared to collect escaping coolant.

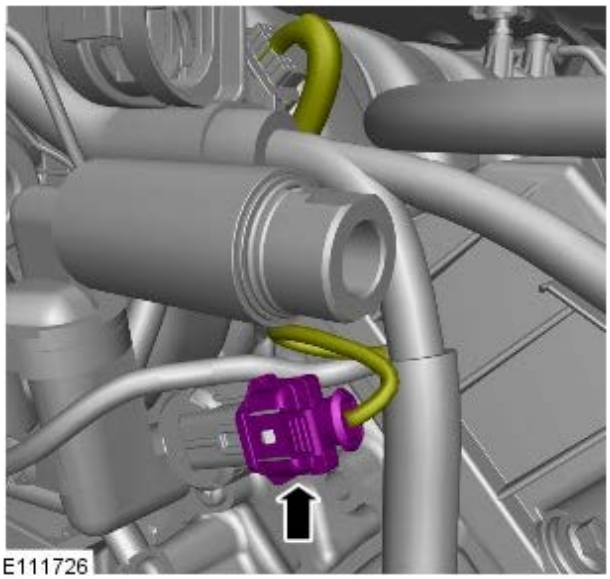
7. CAUTION: Be prepared to collect escaping coolant.



8.



9.

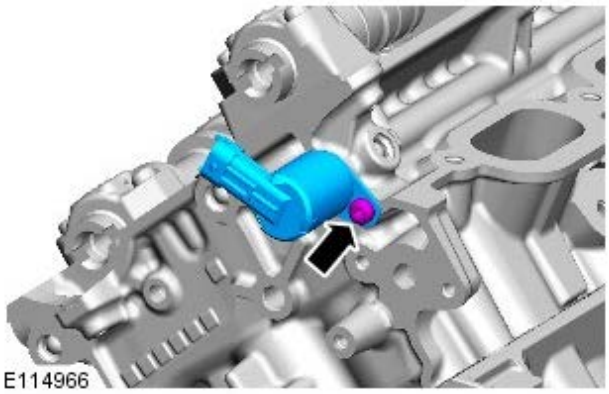


10. CAUTIONS:

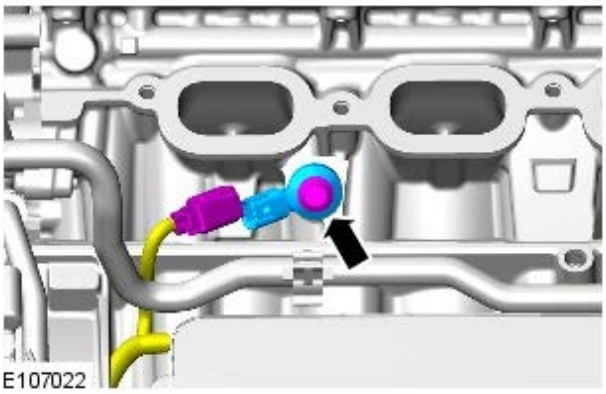
Discard the seal.

LH illustration shown, RH is similar.

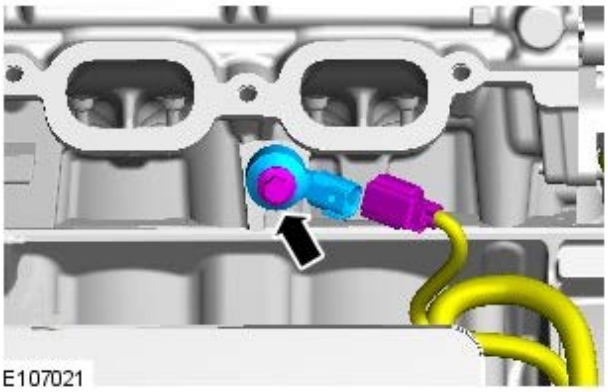
NOTE: Engine shown removed for clarity.



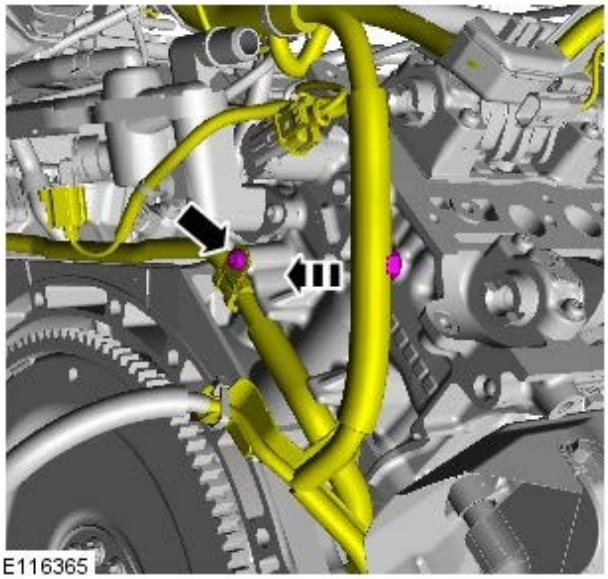
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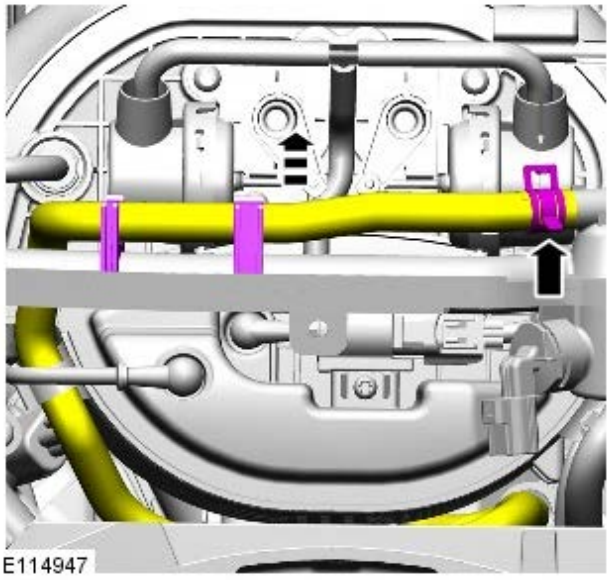
12.



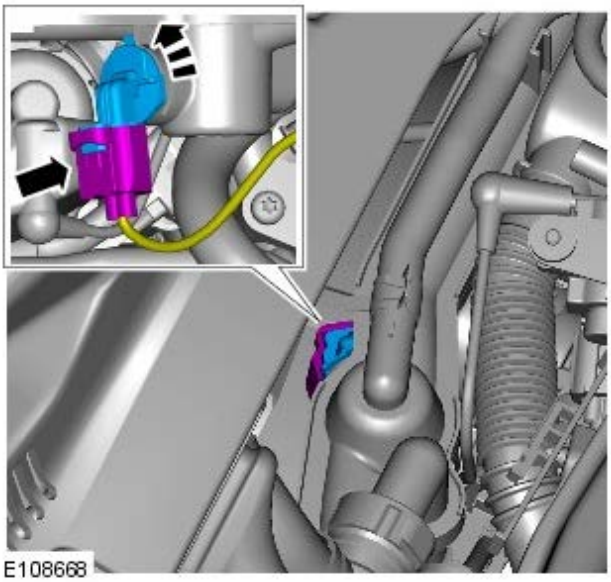
13.



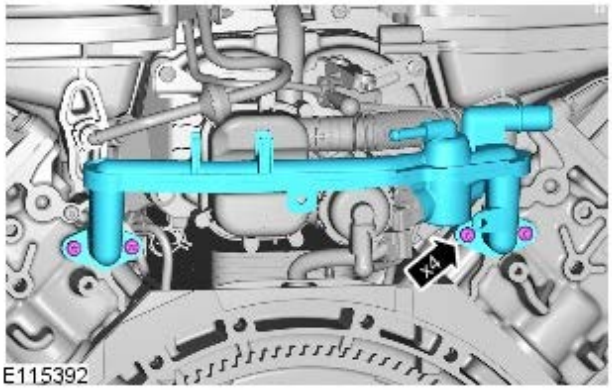
14. NOTE: Clamp the hose to minimize coolant loss.



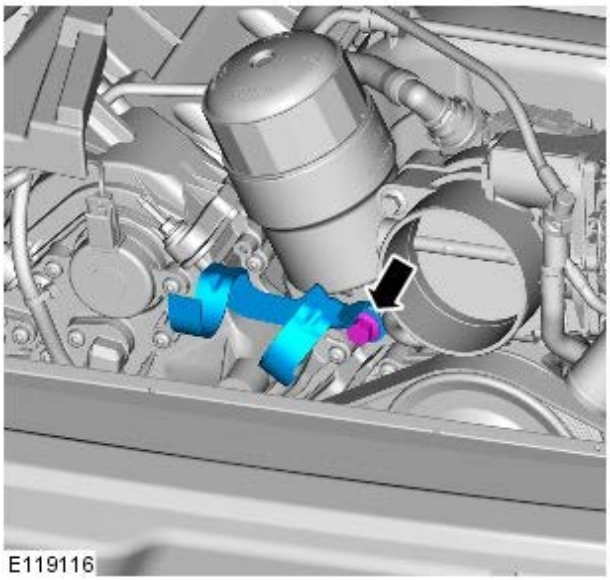
15.



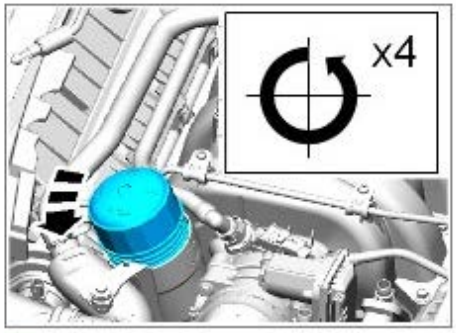
16. CAUTION: Discard the seals.

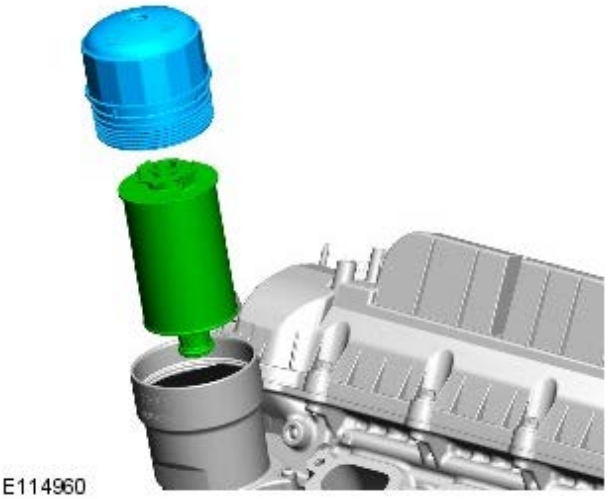


17.

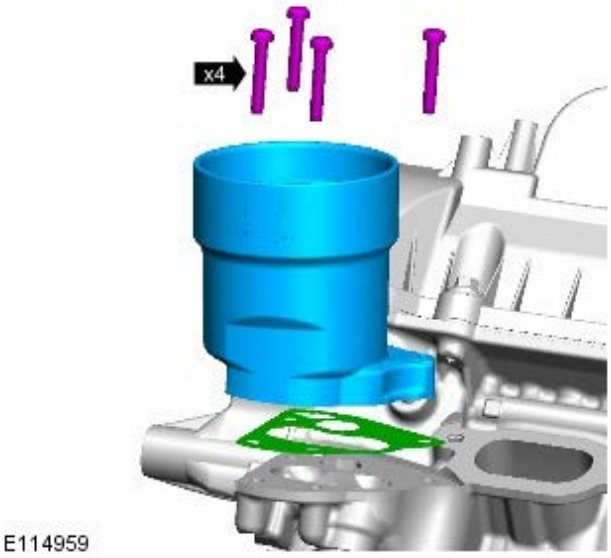


18. NOTE: Remove and discard the O-ring seal.

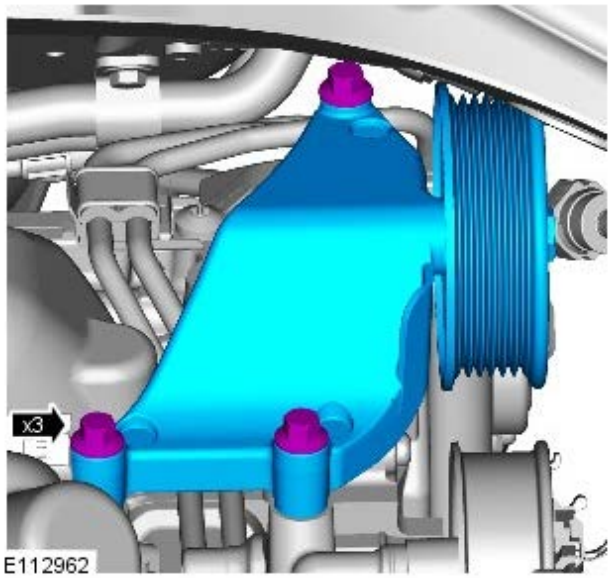




19. NOTE: Discard the gasket.



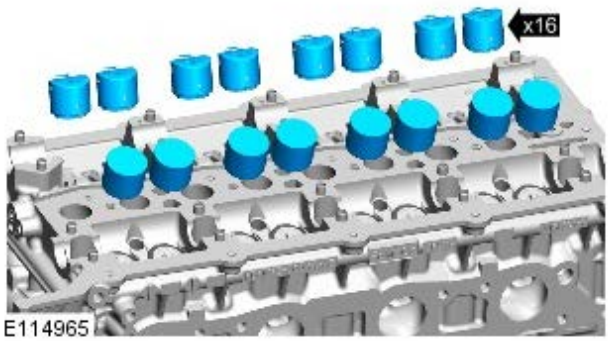
20.



21. CAUTIONS:

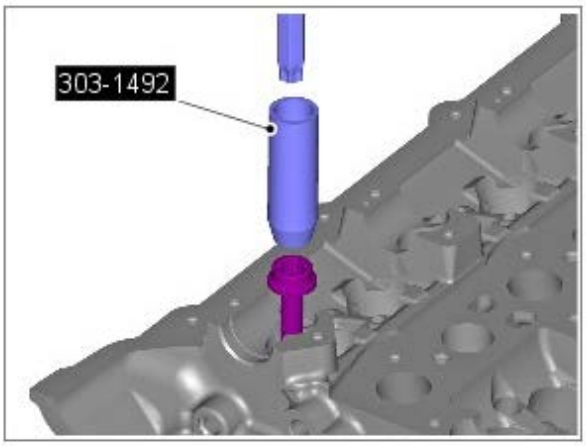
If a new cylinder head has been installed then new tappets must be installed.

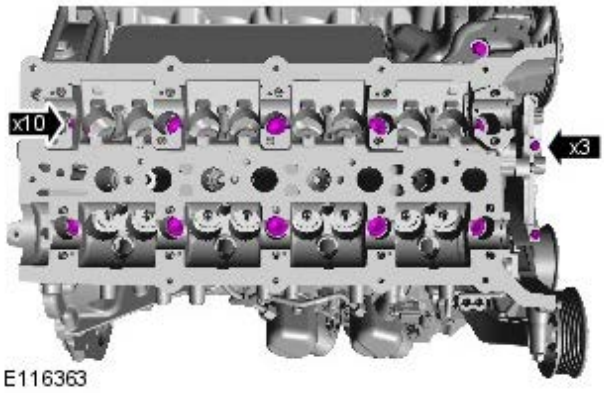
If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.



22. CAUTION: Discard the bolts.

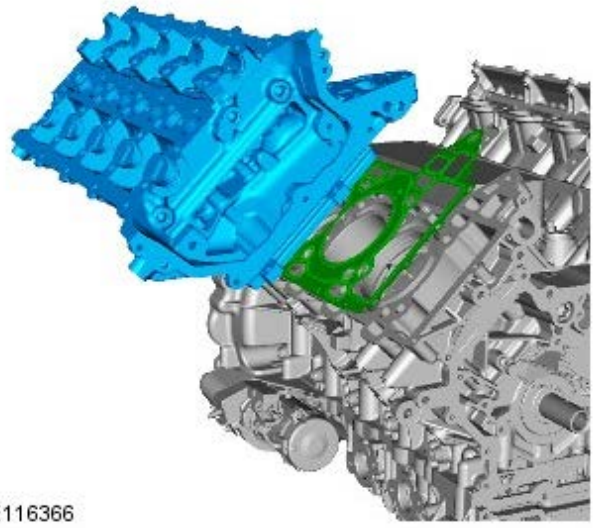
Special Tool(s): 303-1492





E116363

23. NOTE: Discard the gasket.



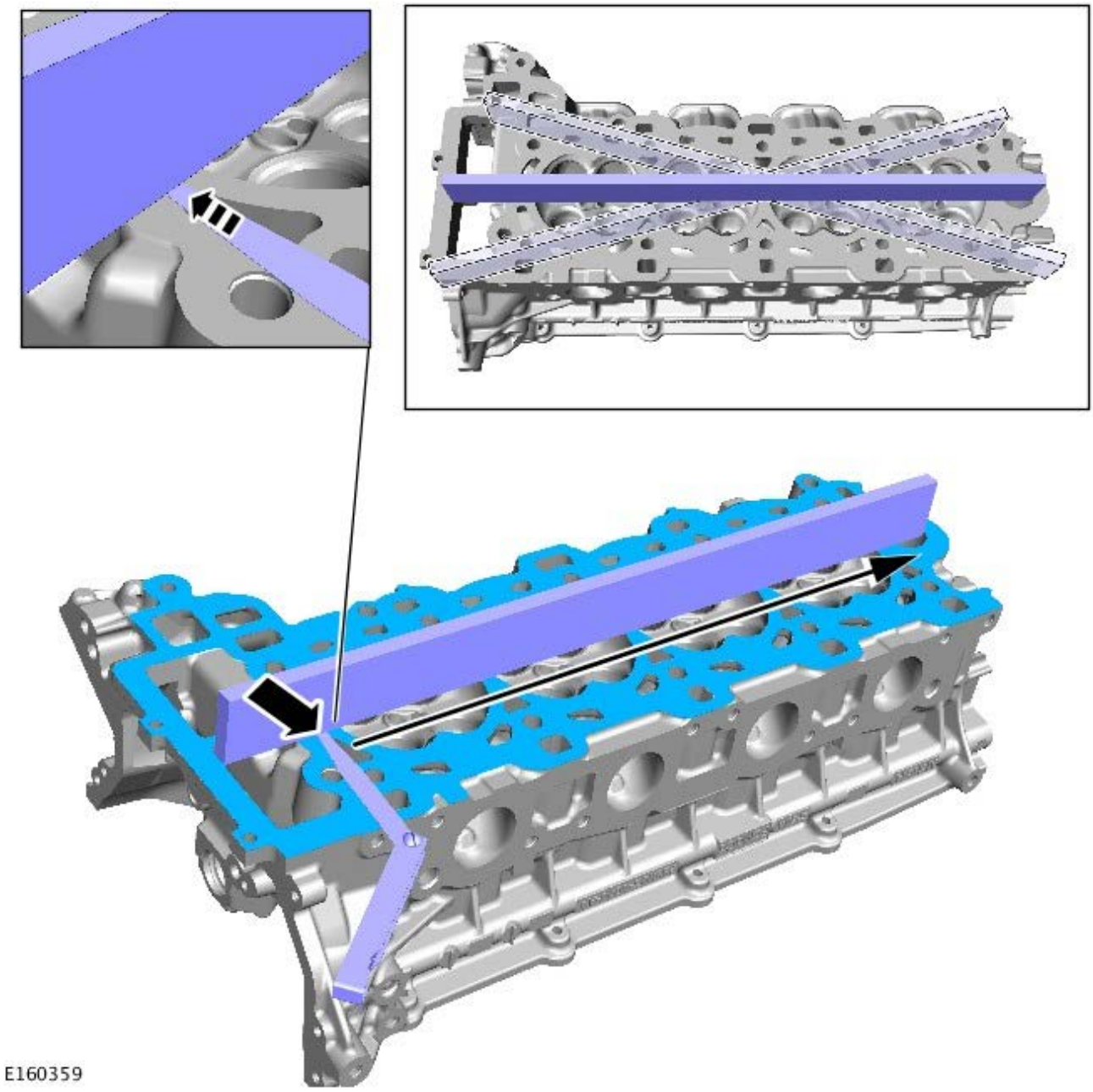
E116366

Installation

1. CAUTION: An acceptable flatness of the cylinder head is 0.1mm.

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

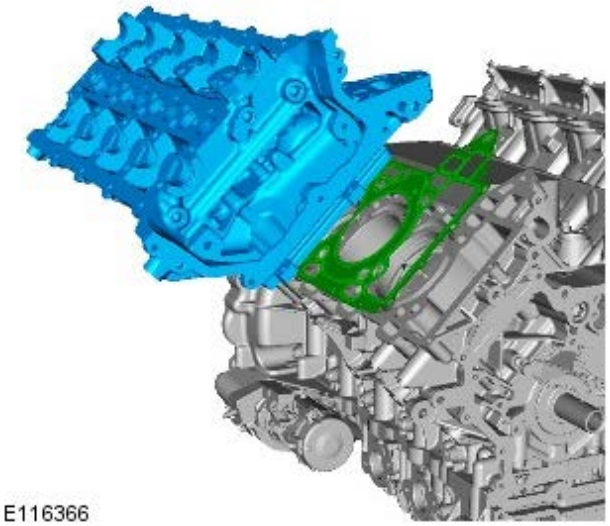
   Check cylinder head face for distortion, across the center and from corner to corner.



E160359

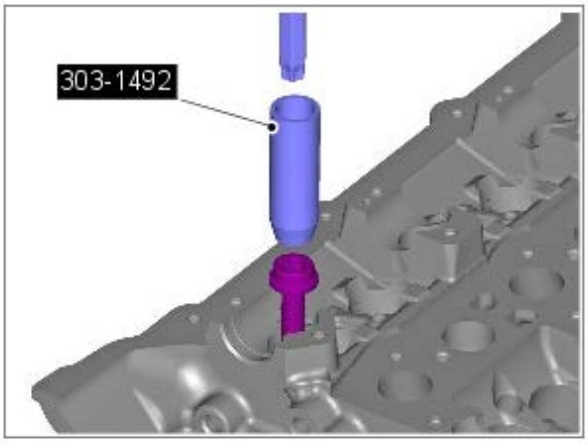
2. WARNING: Make sure care is taken when handling the cylinder head gasket.

NOTE: Install a new gasket.

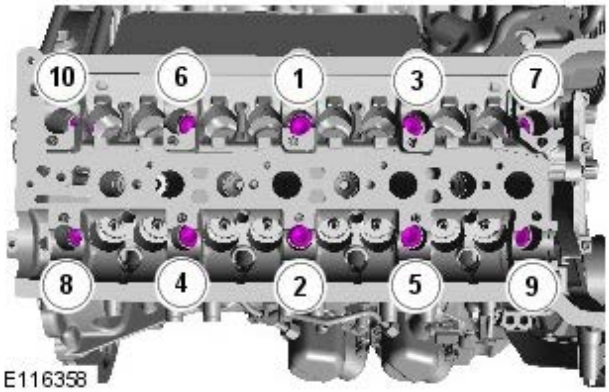


E116366

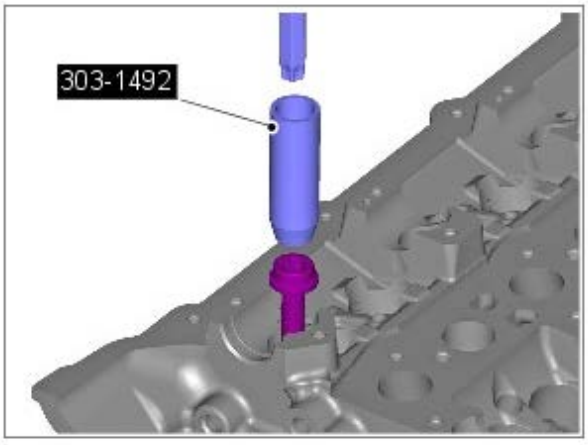
3. CAUTION: Make sure that new cylinder head bolts are installed.

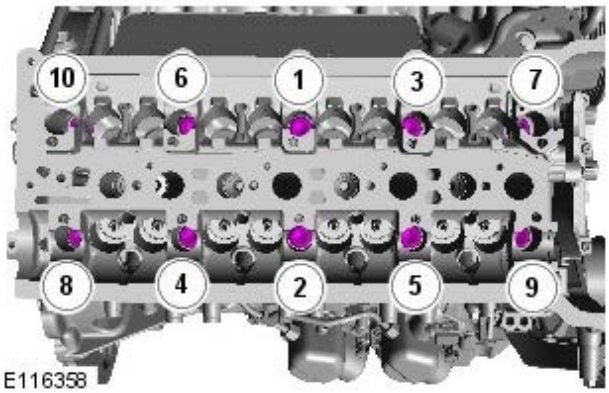


Special Tool(s): 303-1492
Torque: 20 Nm



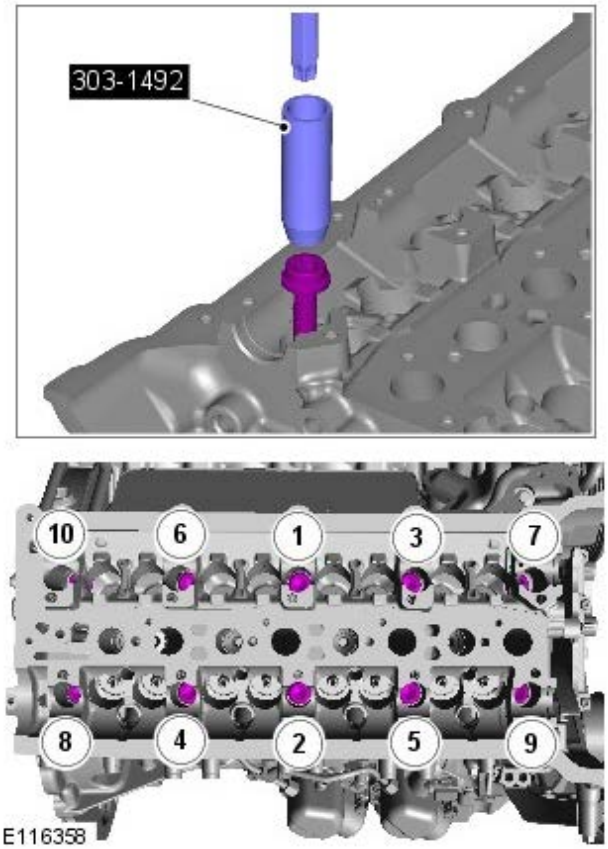
4. *Special Tool(s):* 303-1492
Torque: 35 Nm





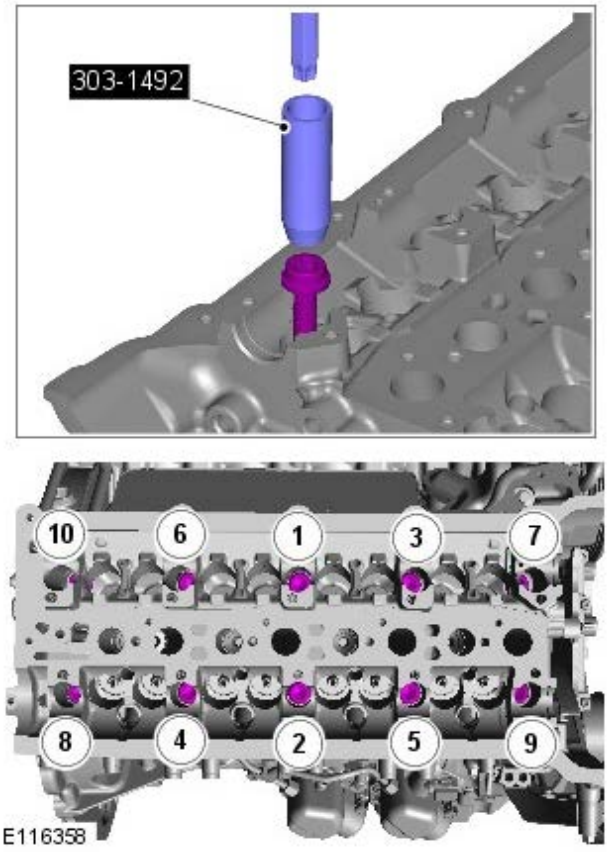
5. Tighten the bolts 1 to 10, a further 90 degrees.

Special Tool(s): 303-1492

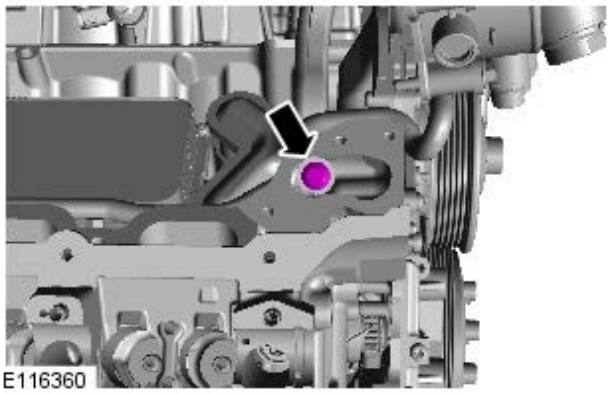


6. Tighten the bolts 1 to 10, a further 120 degrees.

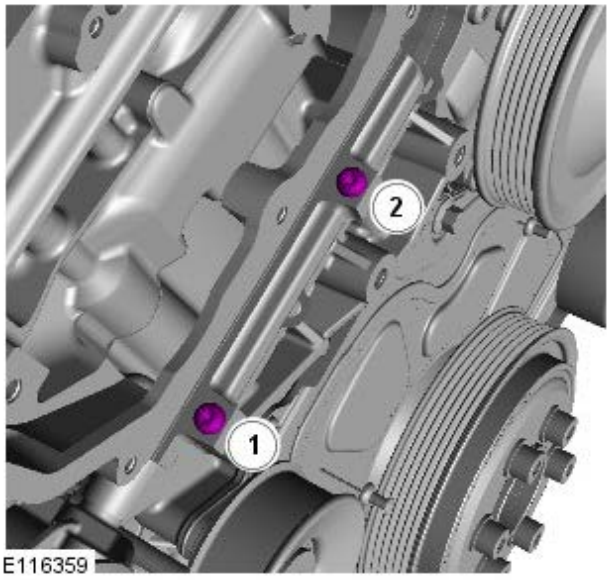
   Special Tool(s): 303-1492



7. *Torque:* 25 Nm



8. *Torque:* 12 Nm

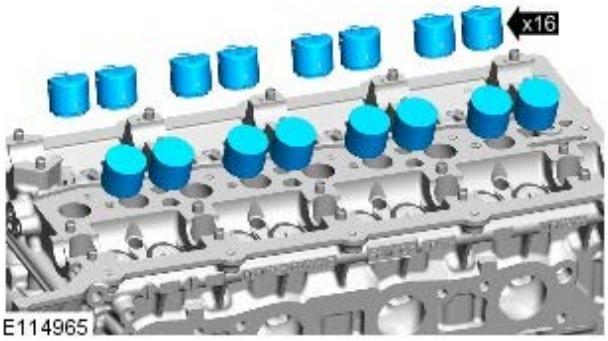


9. CAUTIONS:

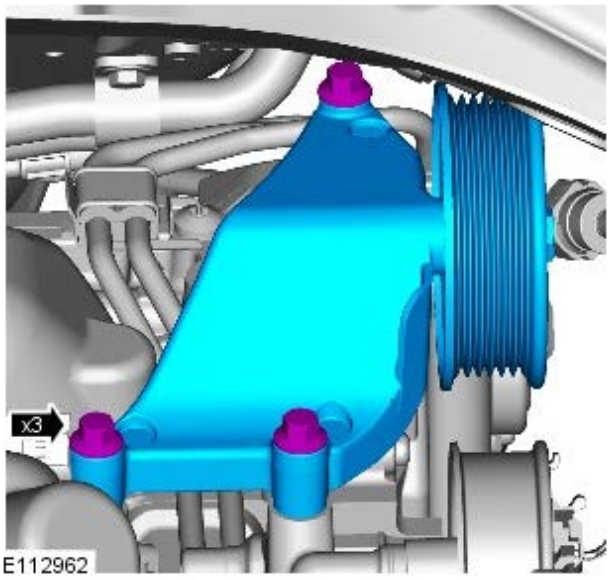
   If a new cylinder head has been installed then new tappets must be installed.

   If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

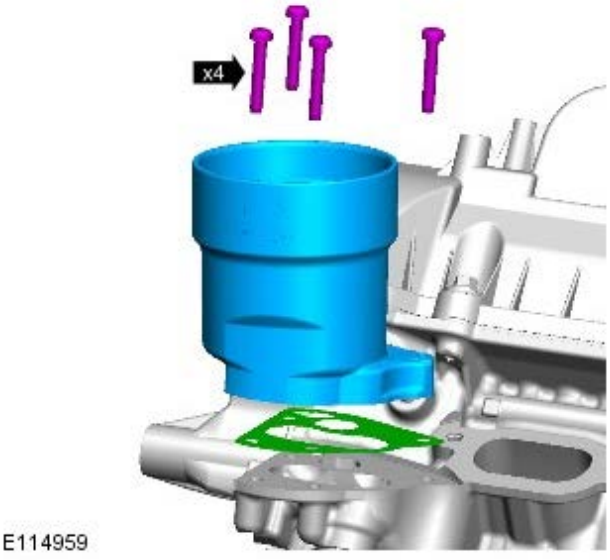
   Lubricate the valve tappets with clean engine oil.



10. *Torque:* 25 Nm



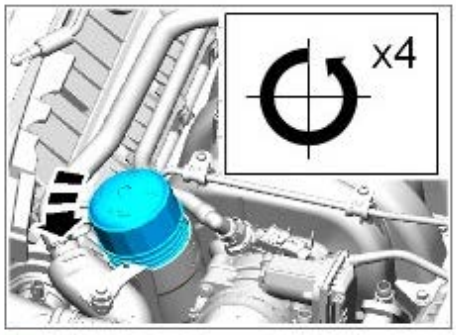
11. Refer to: Camshaft RH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

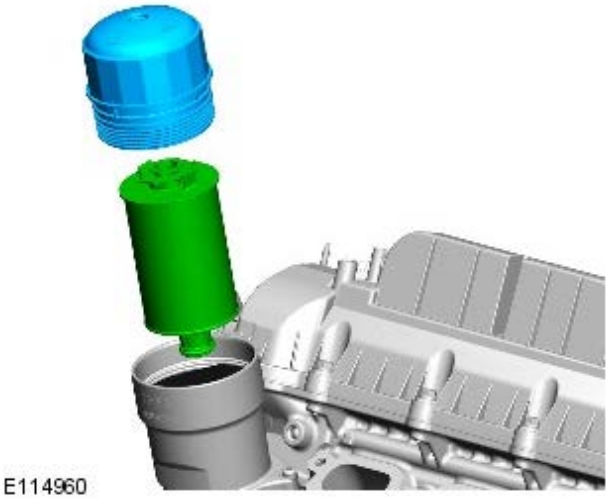


12. NOTE: Install a new gasket.

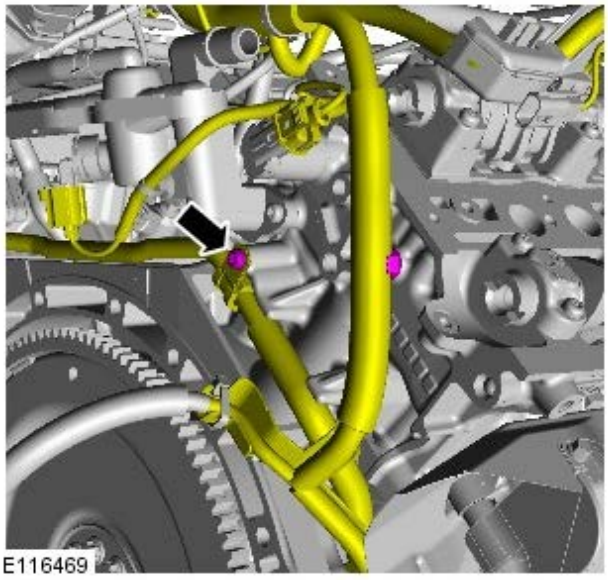
13. CAUTION: A new O-ring seal is to be installed.

NOTE: Install a new engine oil filter.



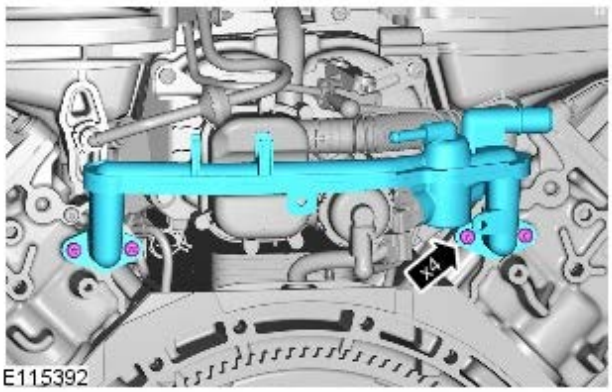


14. *Torque:* 12 Nm

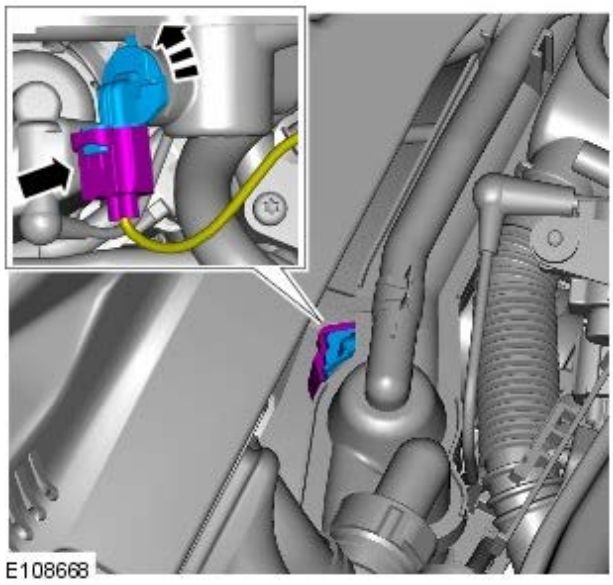


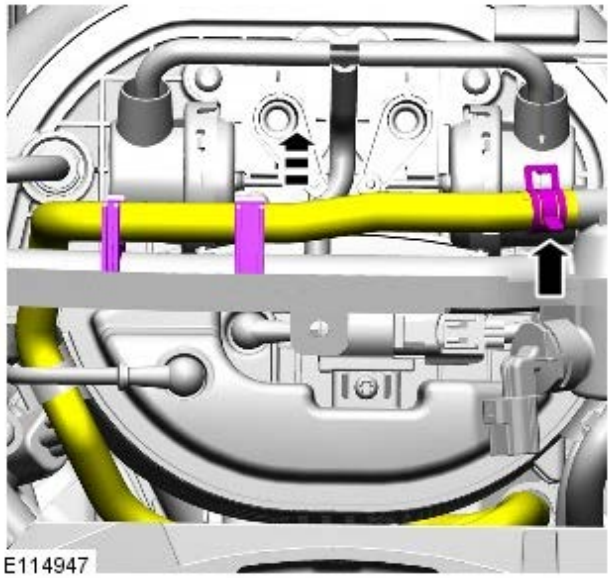
15. CAUTION: Install the new seals.

Torque: 10 Nm

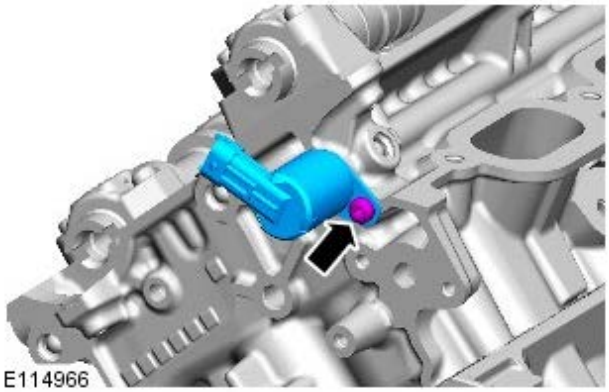


16.





17. NOTE: Clamp the hose to minimize coolant loss.



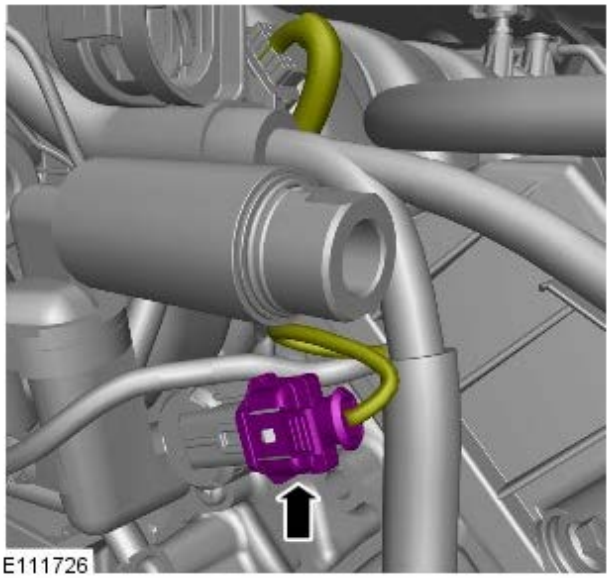
18. CAUTIONS:

Install a new seal.

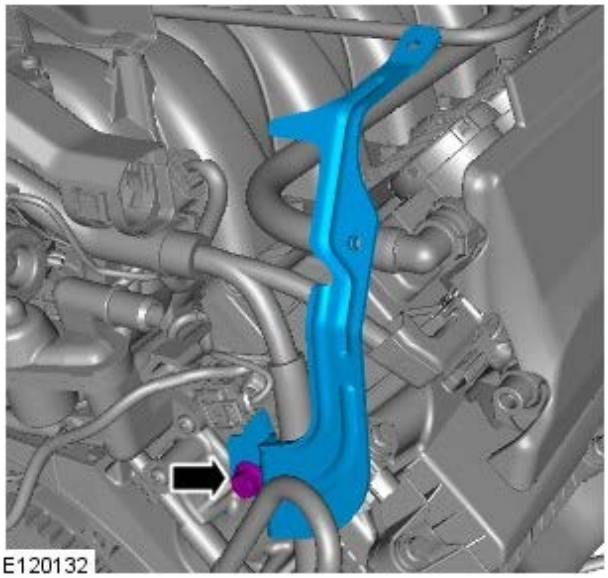
LH illustration shown, RH is similar.

Torque: 12 Nm

19.

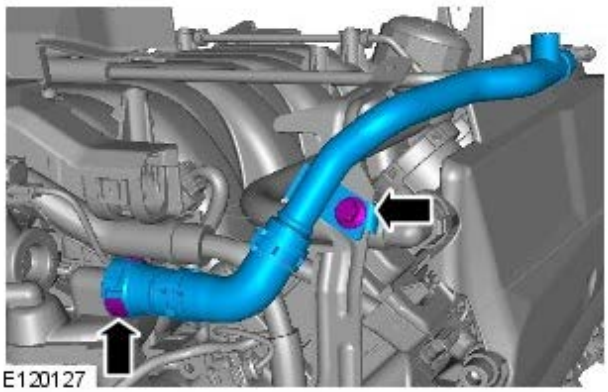


20.

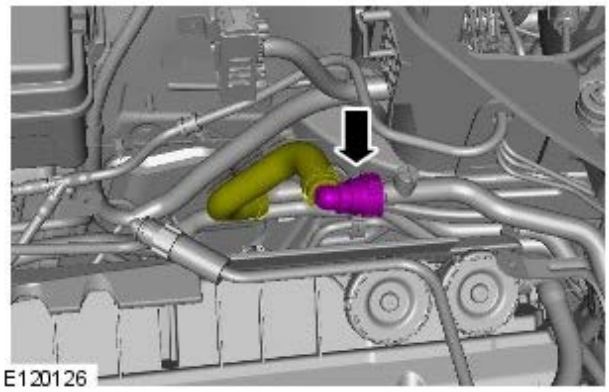


21. CAUTION: Be prepared to collect escaping coolant.

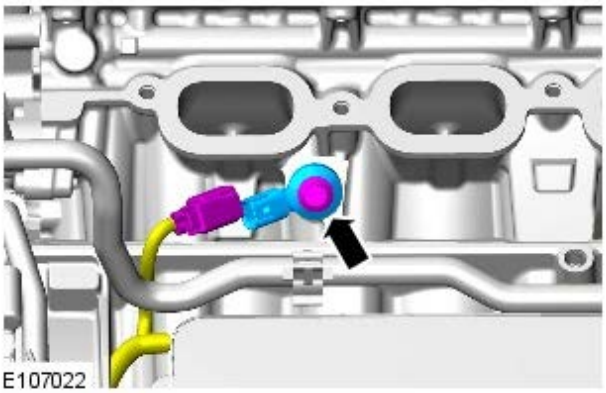
Torque: 10 Nm



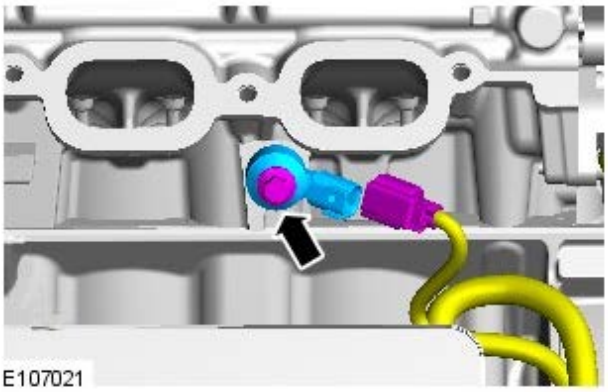
22.



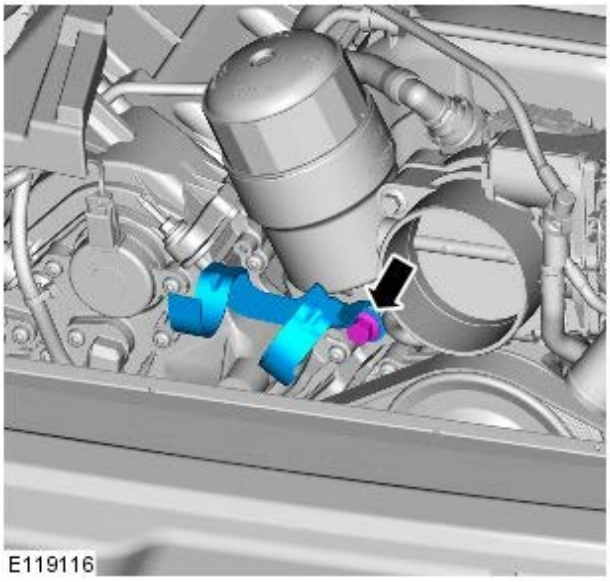
23. *Torque:* 20 Nm



24. *Torque:* 20 Nm



25. *Torque:* 25 Nm



26. Refer to: Exhaust Manifold RH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

27. Refer to: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

28. Connect the battery ground cable.

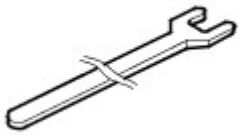
    Refer to: Specifications (414-00 Charging System - General Information, Specifications).

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Engine Mount LH

Removal and Installation

Special Tool(s)

303-1142  E46076	303-1142 Viscous Coupling Wrench
303-1143  E55382	303-1143 Viscous Coupling Holding Tool

Removal

NOTES:

Some illustrations may show the engine removed for clarity.

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

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

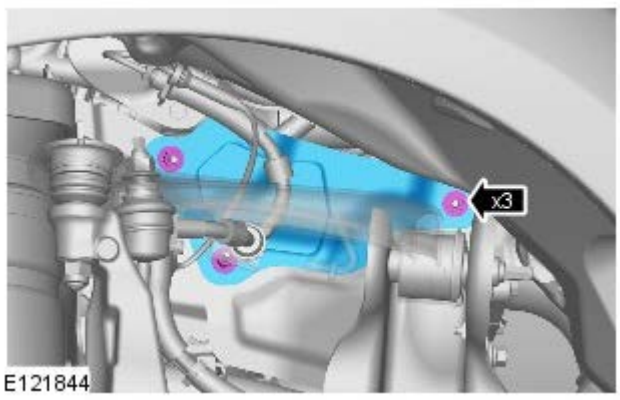
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

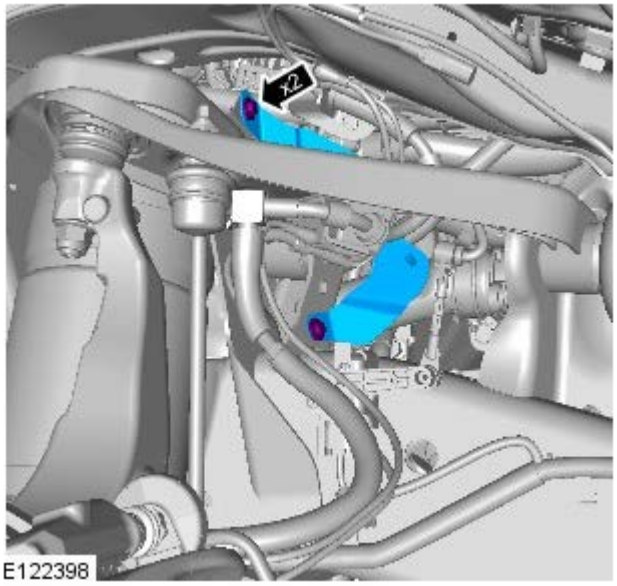
3. Refer to: Catalytic Converter LH (309-00, Removal and Installation).

4. Remove the LH front wheel and tire.

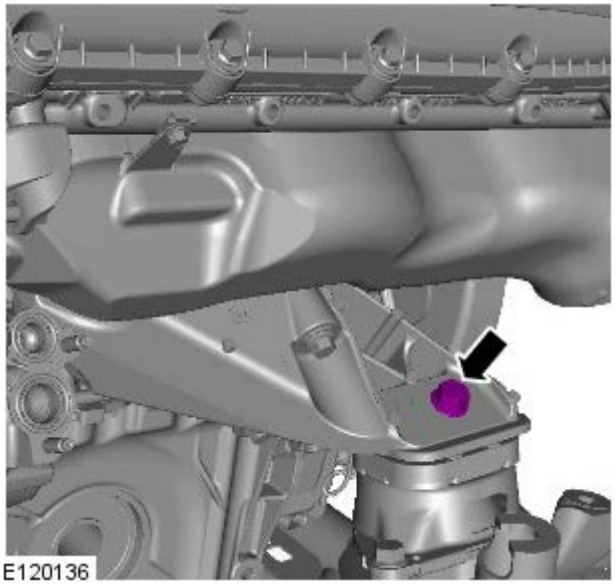
5.



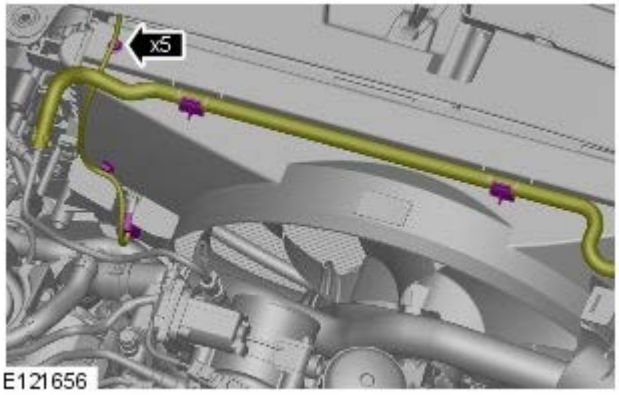
6.



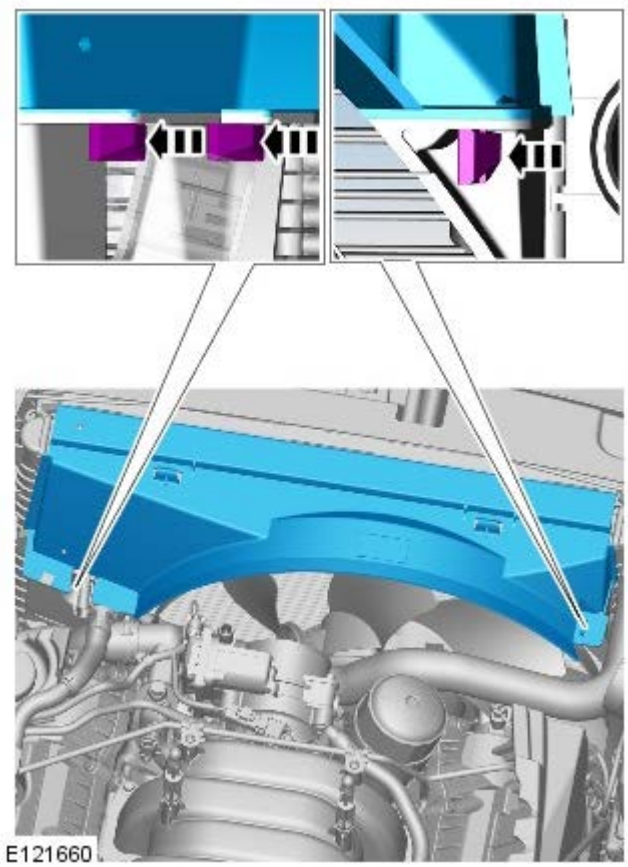
7.

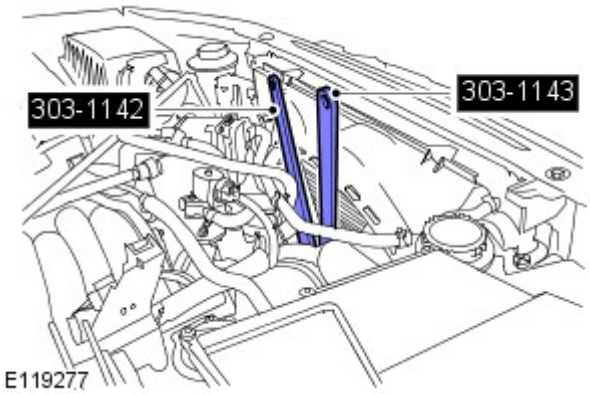


8.



9.





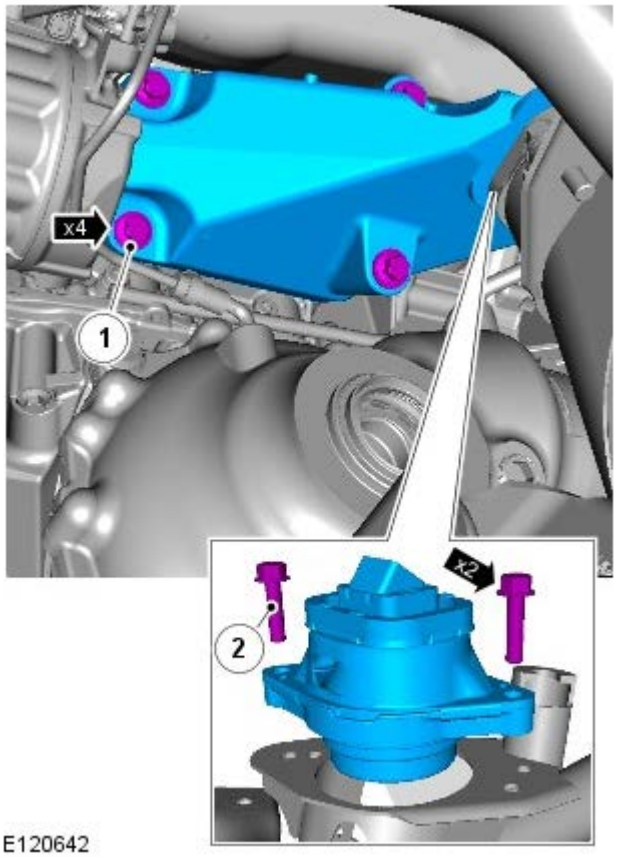
10. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

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

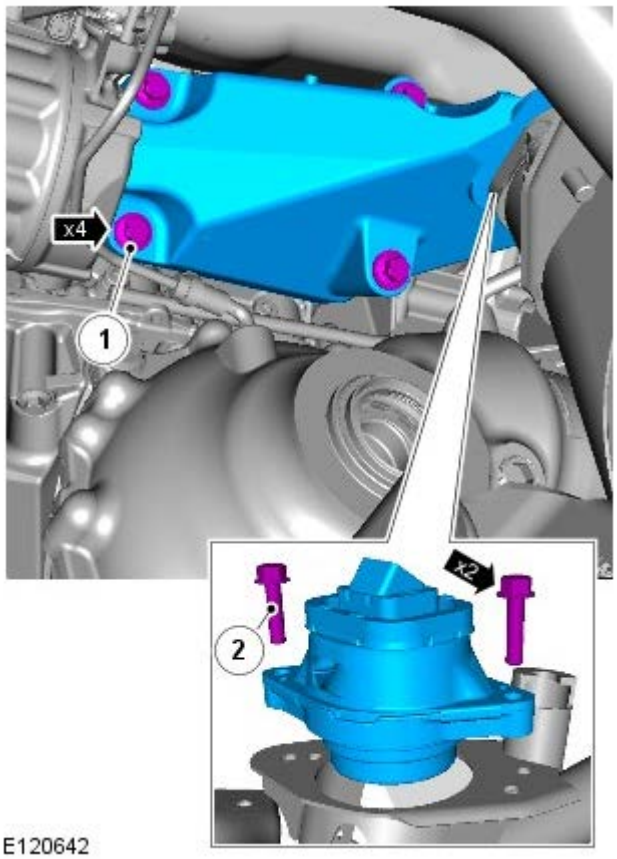
11. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

Using a suitable hydraulic jack, raise and support the engine.

12.



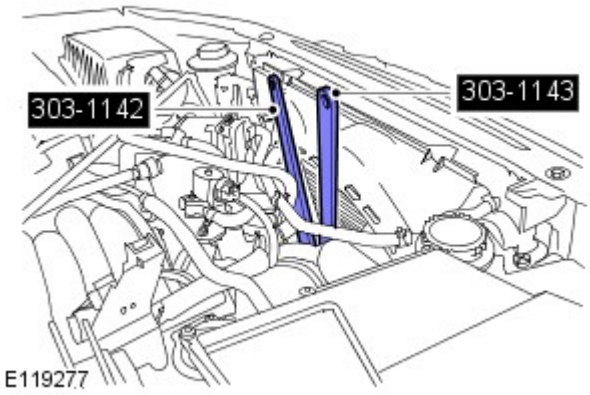
Installation



1.
- *Torque:*
  1 45 Nm
  1 60°
  2 56 Nm

2. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

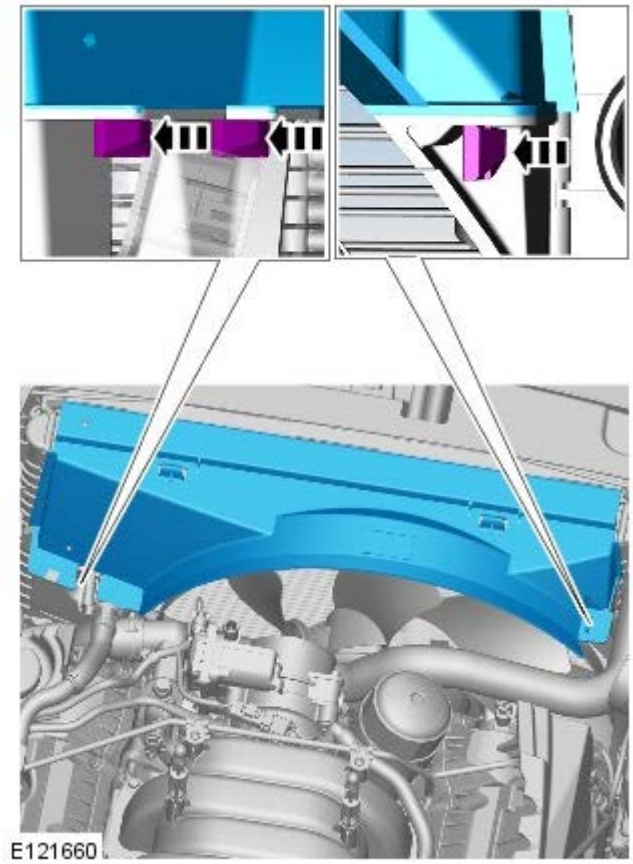
NOTE: Some variation in the illustrations may occur, but the essential information is always



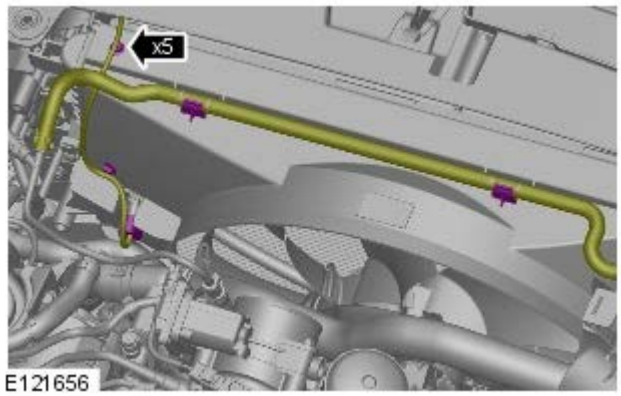
correct.

Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm

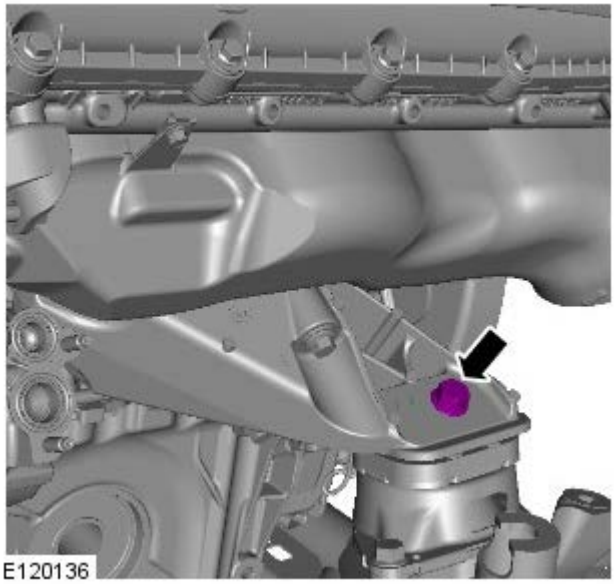
3.



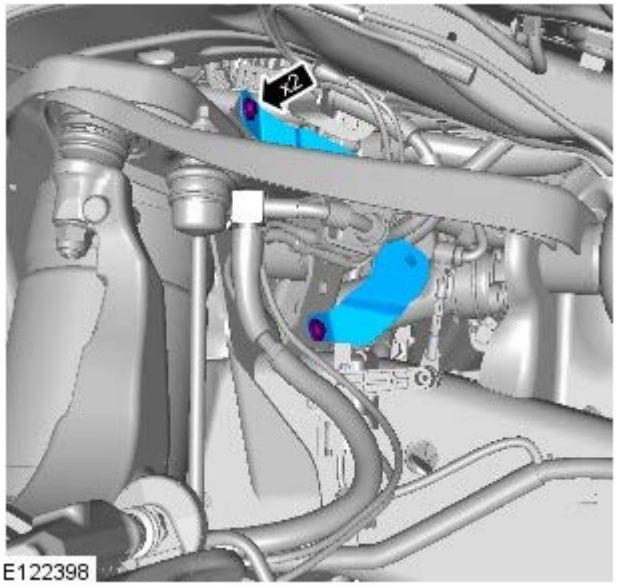
4.



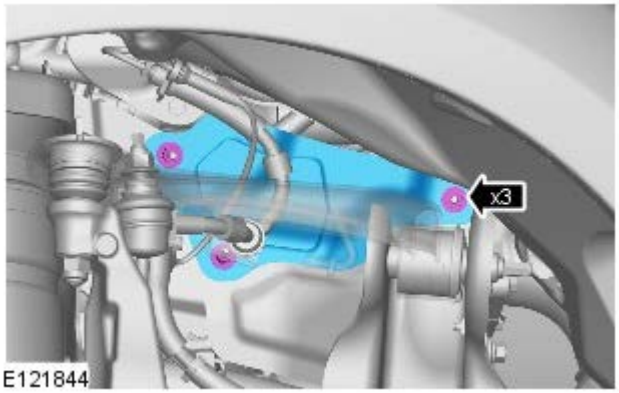
5. *Torque:* 100 Nm



6. *Torque:* 12 Nm



7. *Torque:* 12 Nm



8. Install the LH front wheel and tire.
9. Refer to: Catalytic Converter LH (309-00, Removal and Installation).
10. Lower the vehicle.
11. Disconnect the battery ground cable.

    Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Engine Mount RH

Removal and Installation

Special Tool(s)

	303-1142 Viscous Coupling Wrench
	303-1143 Viscous Coupling Holding Tool

Removal

NOTES:

Some illustrations may show the engine removed for clarity.

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

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Disconnect the battery ground cable.

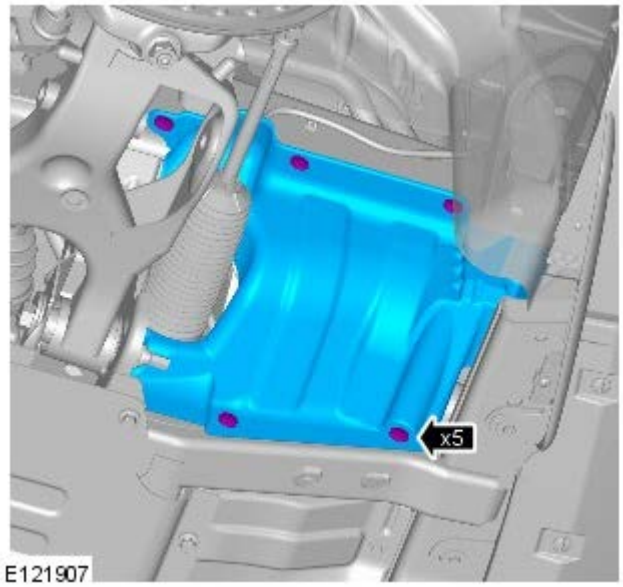
   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

3. Remove the RH front wheel and tire.

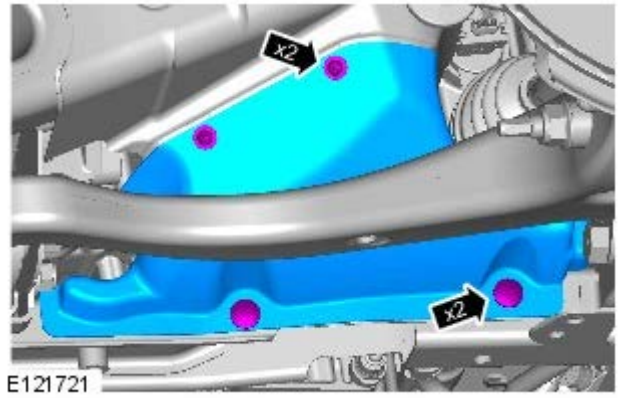
4. Refer to: Exhaust System (309-00 Exhaust System - 5.0L NA V8 - AJ133, Removal and Installation).

5. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12 Intake Air Distribution and Filtering - 5.0L NA V8 - AJ133, Removal and Installation).

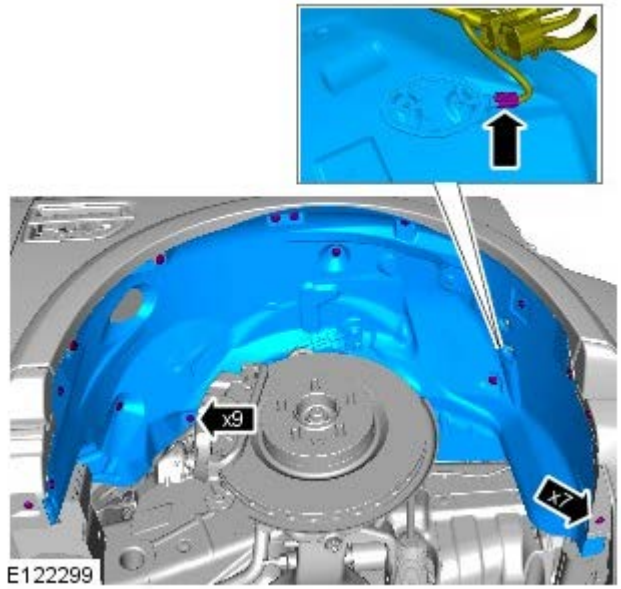
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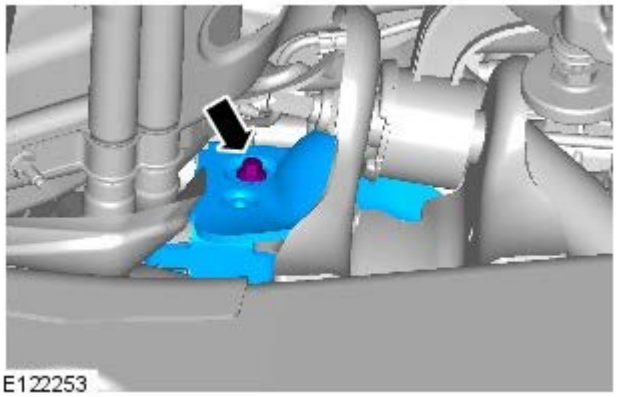
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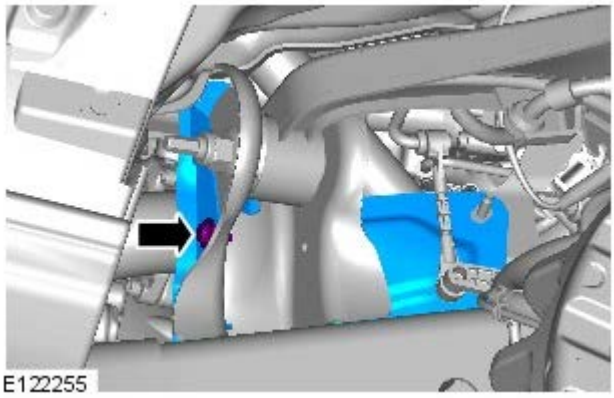
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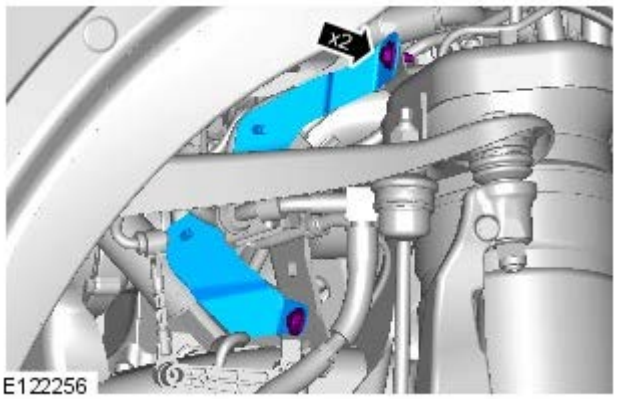
9.



10.



11.

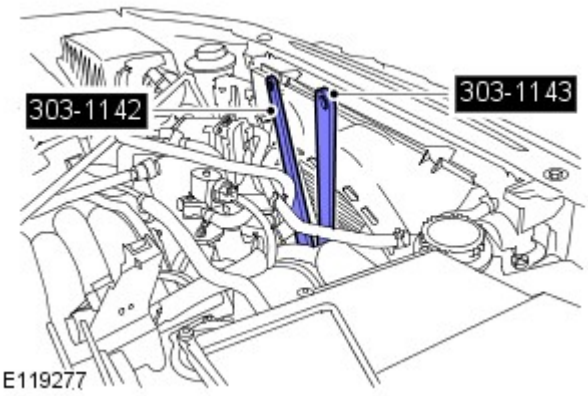


12. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

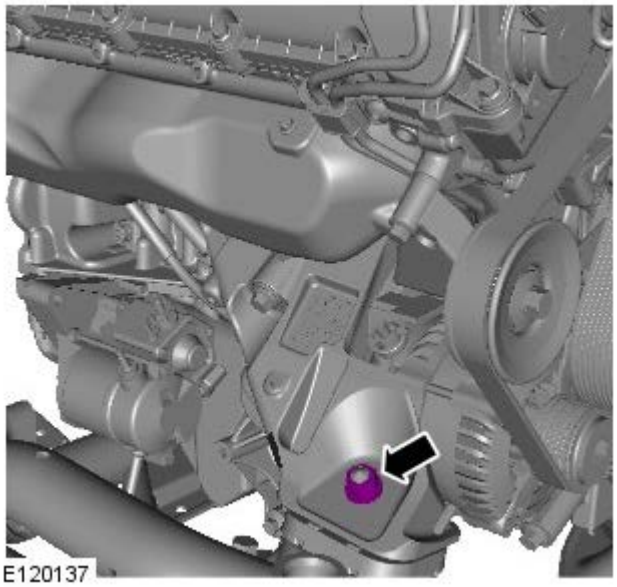
NOTES:

The thread is right handed.

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



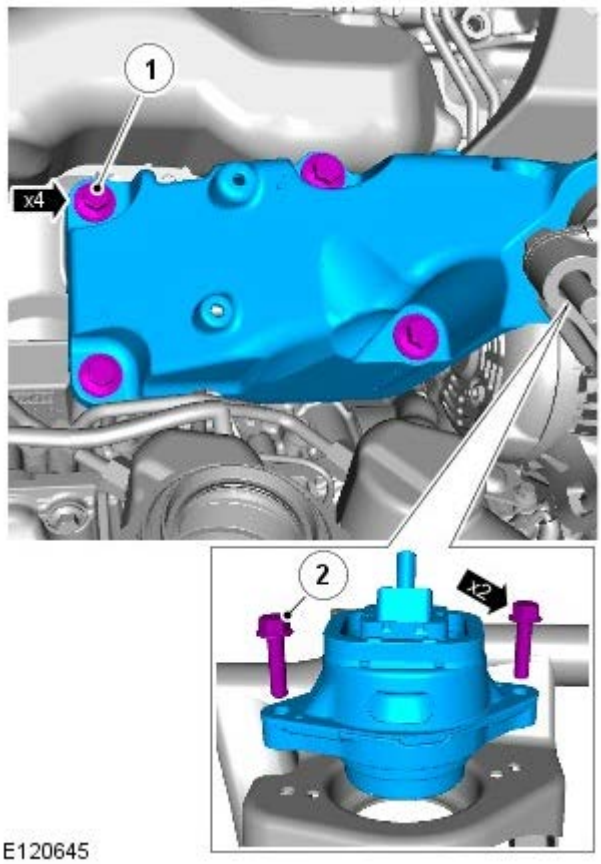
13.



14. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

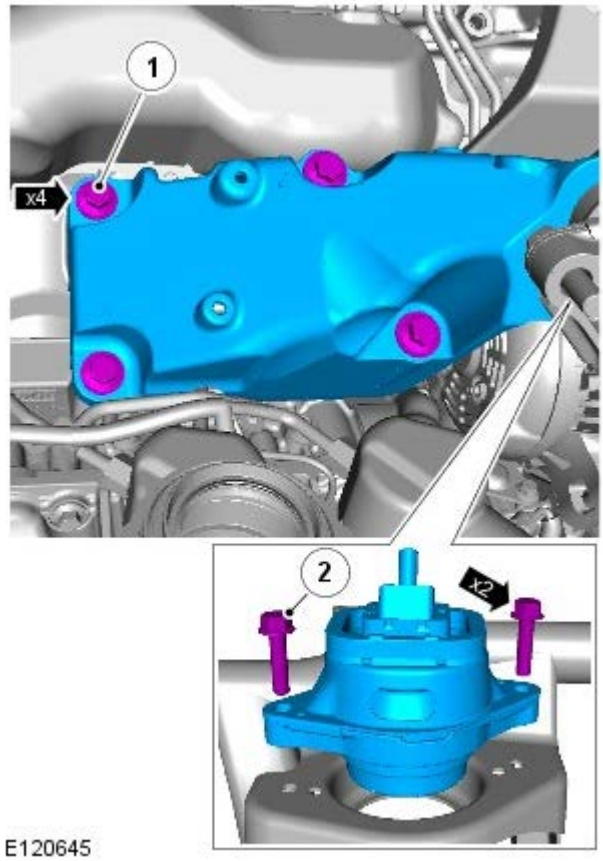
    Using a suitable hydraulic jack, raise and support the engine.

15.



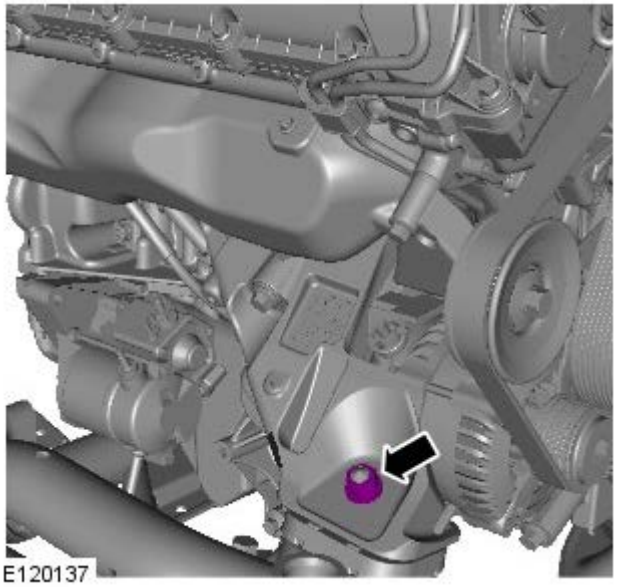
Installation

1. *Torque:*
   1 45 Nm
   1 60°
   2 56 Nm



E120645

2. *Torque:* 100 Nm


E120137

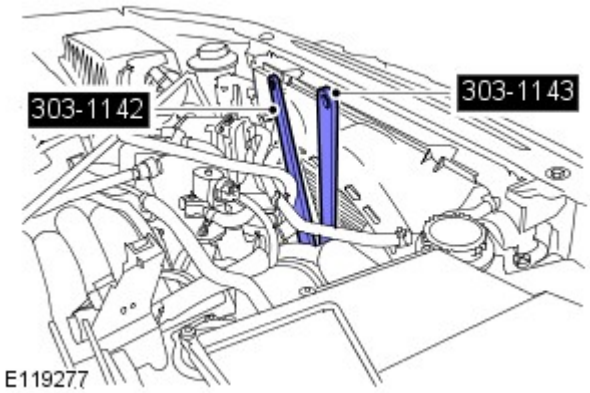
3. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

NOTES:

The thread is right handed.

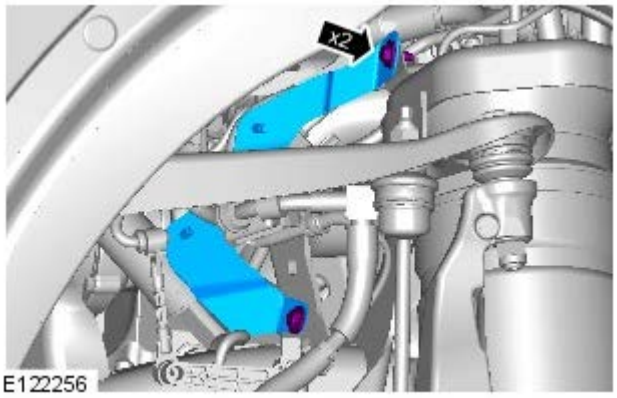
Some variation in the illustrations may occur, but the essential information is always correct.

Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm

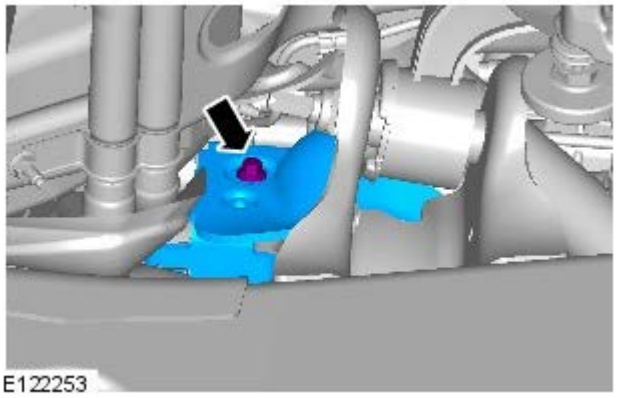


E119277

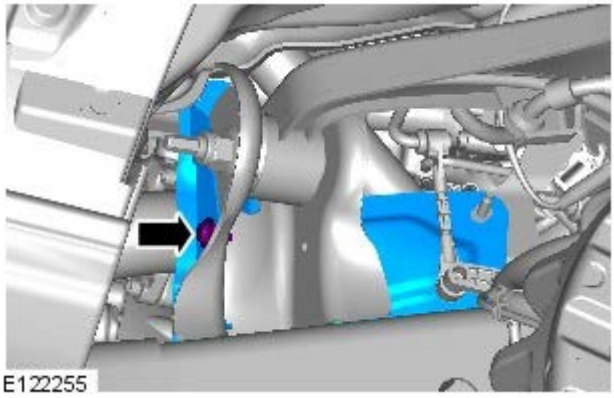
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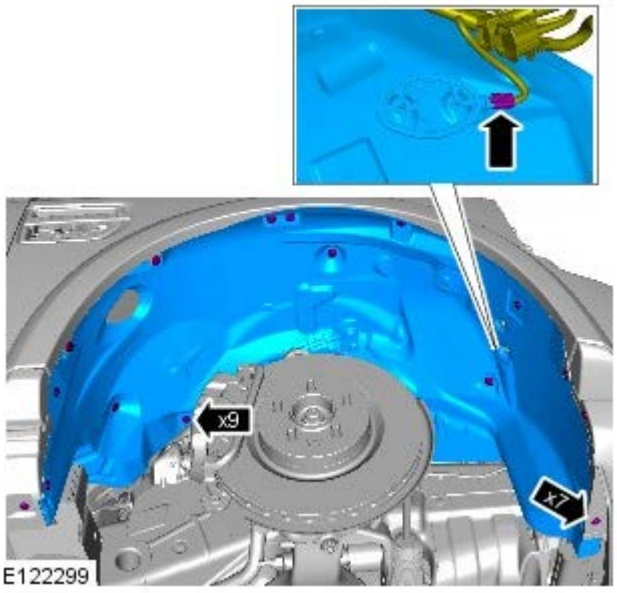
5.



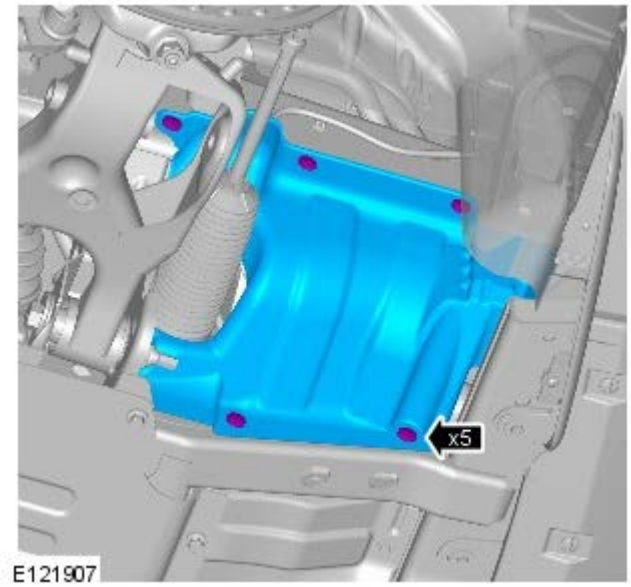
6.



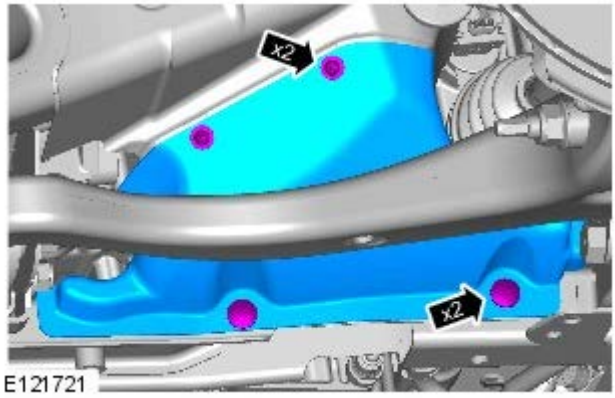
7.



8.



9.



10. Install the RH front wheel and tire.

11. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12 Intake Air Distribution and Filtering - 5.0L NA V8 - AJ133, Removal and Installation).

12. Refer to: Exhaust System (309-00 Exhaust System - 5.0L NA V8 - AJ133, Removal and Installation).

13. Connect the battery ground cable.

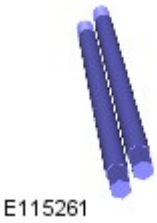
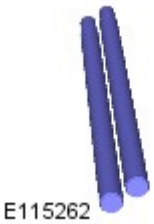
    Refer to: Specifications (414-00 Charging System - General Information, Specifications).

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Exhaust Manifold LH

Removal and Installation

Special Tool(s)

 E115261	303-1444-01 Exhaust Manifold Installation Guide Pins - Threaded
 E115262	303-1444-02 Exhaust Manifold Installation Guide Pins - Unthreaded

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

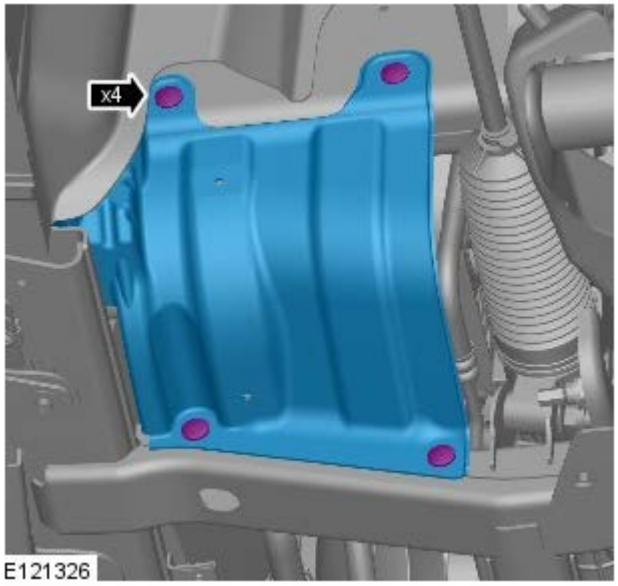
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

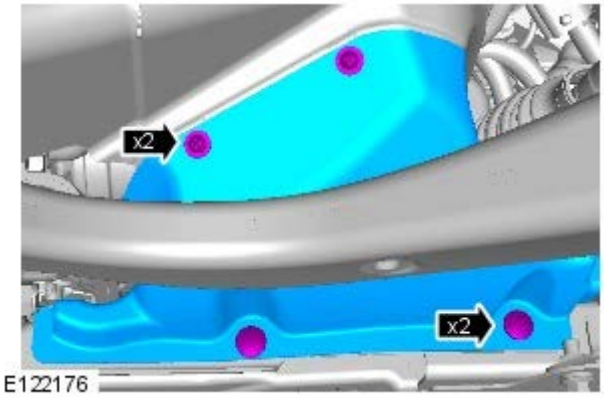
3. Refer to: Power Steering Pump - 5.0L (211-02 Power Steering, Removal and Installation).

4. Refer to: Exhaust System (309-00 Exhaust System - 5.0L, Removal and Installation).

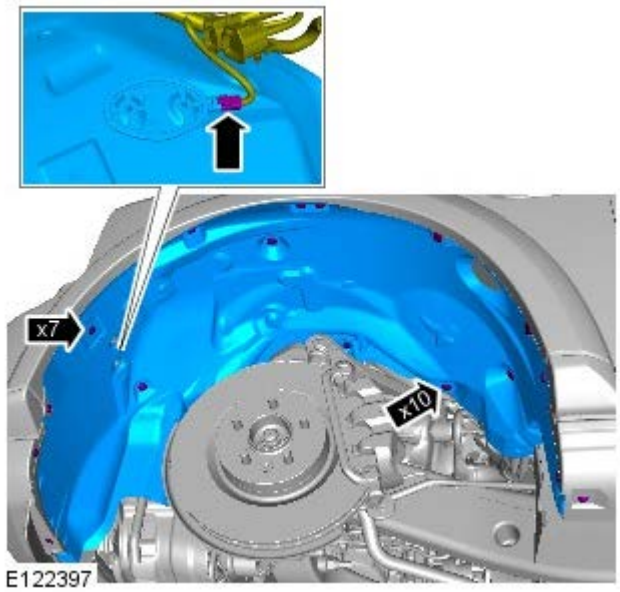
5.



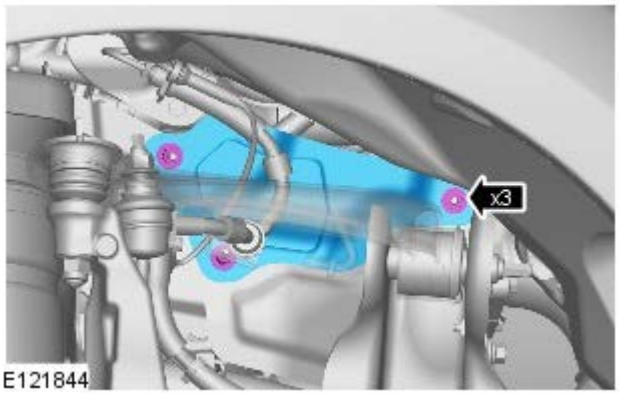
6.



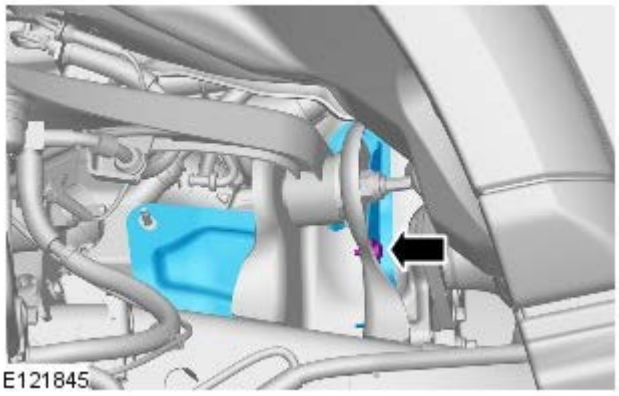
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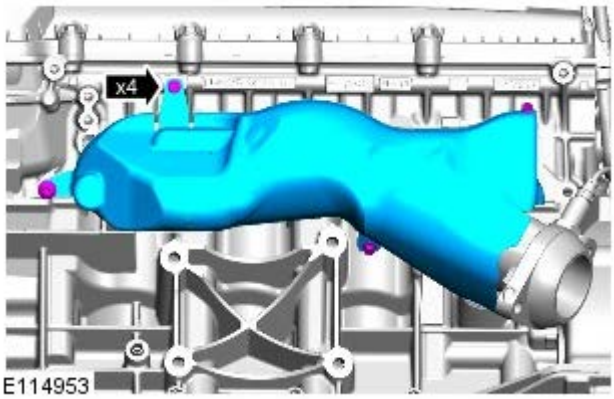
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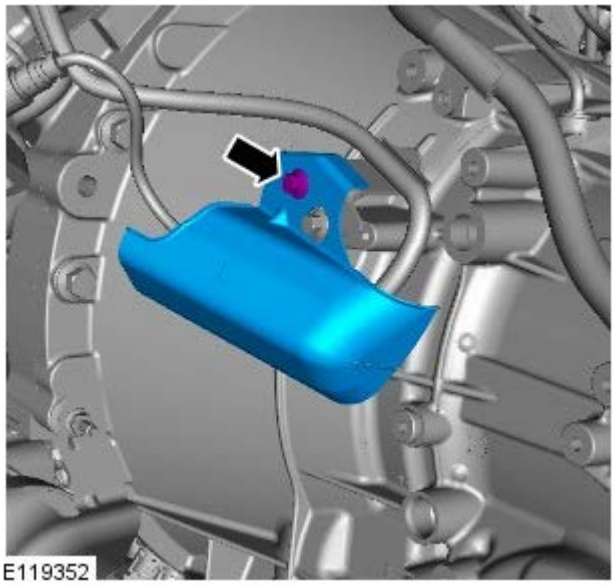
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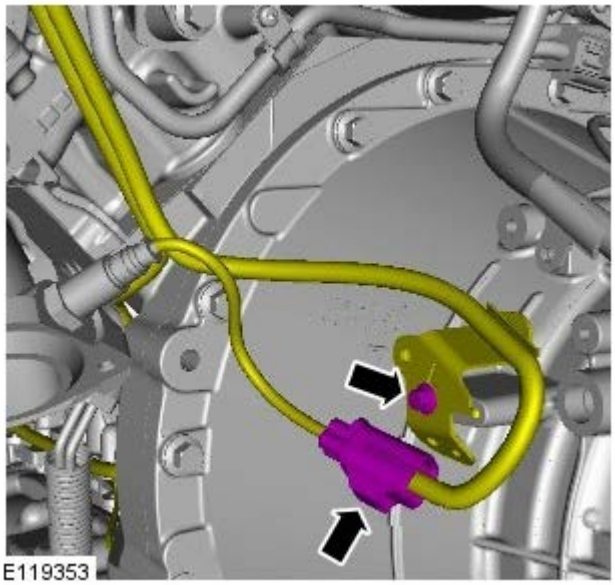
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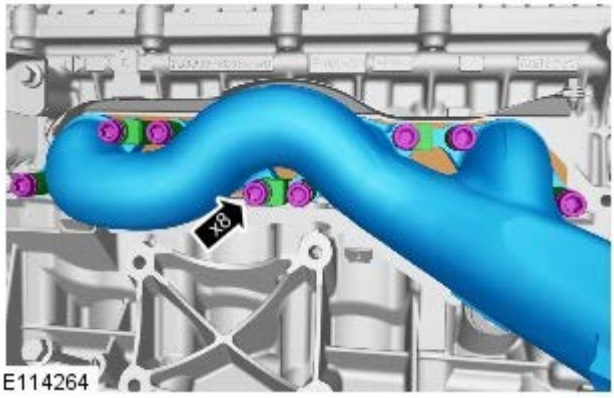


11.



12.





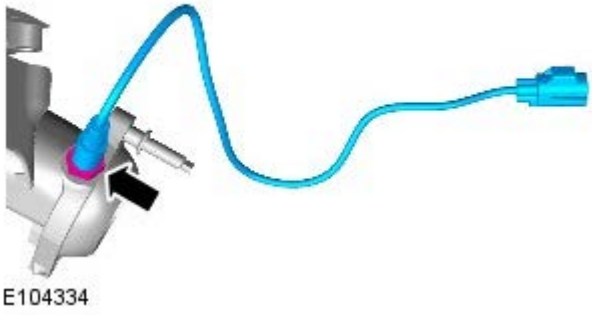
13. CAUTION: Discard the bolts.

    NOTES:

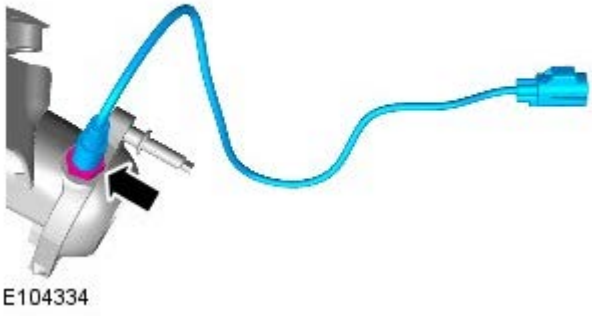
    Discard the gasket.

    Make sure that the position of the spacers is noted before removal of the manifold.

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



Installation



1. CAUTIONS:

    Make sure that the mating faces are clean and free of foreign material.

    Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.

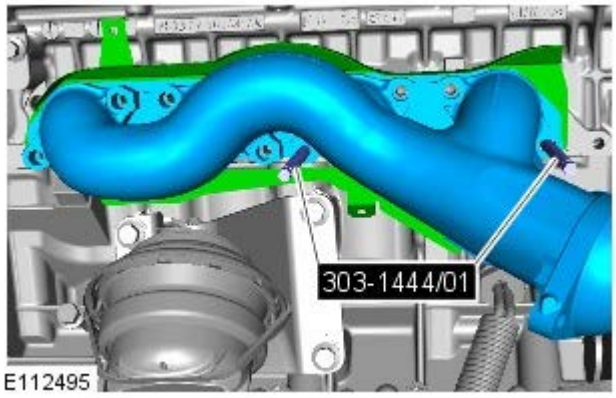
    If accidentally dropped or knocked install a new sensor.

    Make sure the catalyst monitor sensor wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or

driveshaft.

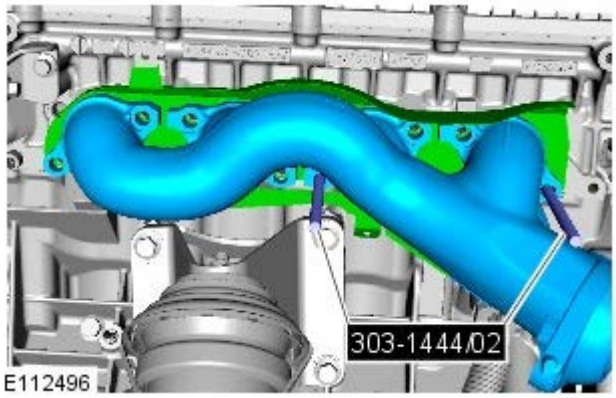
NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

Torque: 45 Nm



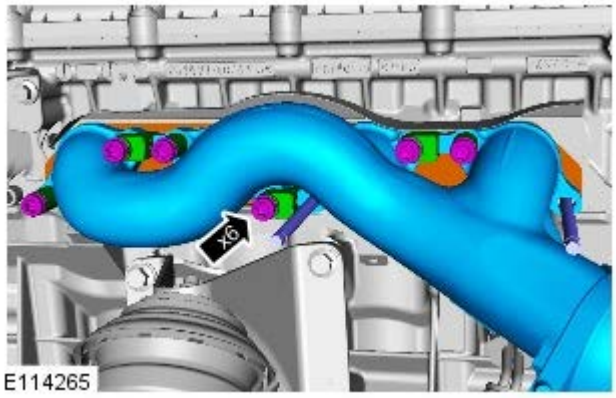
2. NOTE: Install a new gasket.

   Special Tool(s): 303-1444-01



3. NOTE: If a new cylinder head is installed use the special tools in the illustration.

   Special Tool(s): 303-1444-02

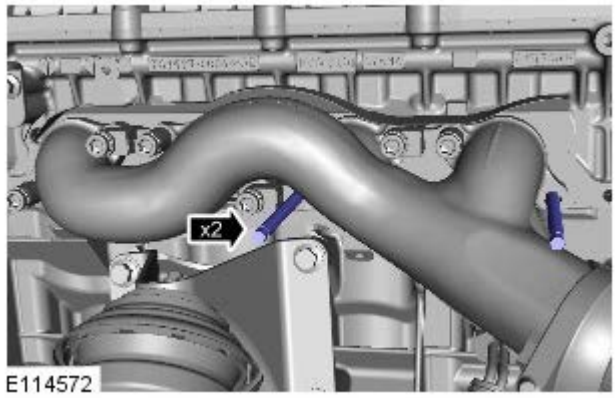


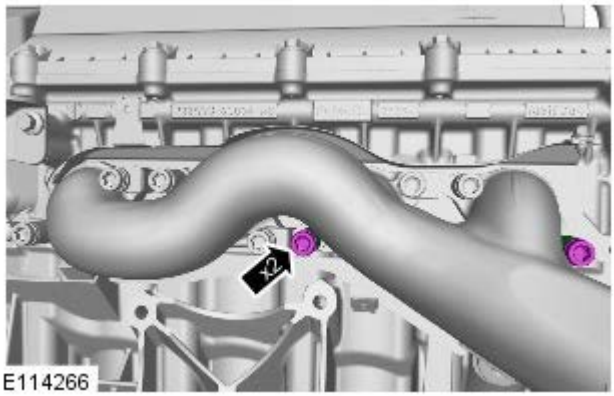
4. CAUTION: Make sure that new bolts are installed.

   NOTE: Install the spacers in the noted position.

   Torque: 10 Nm

5. Remove the special tool.

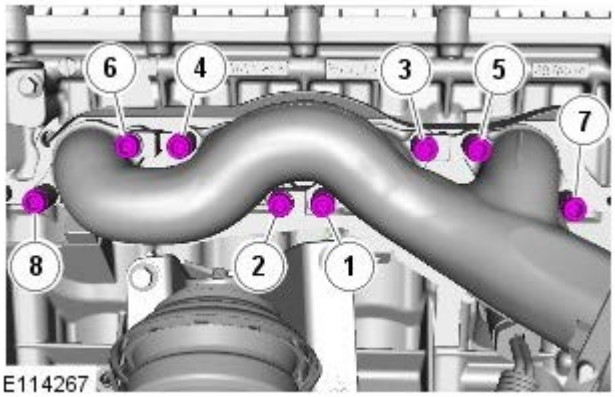




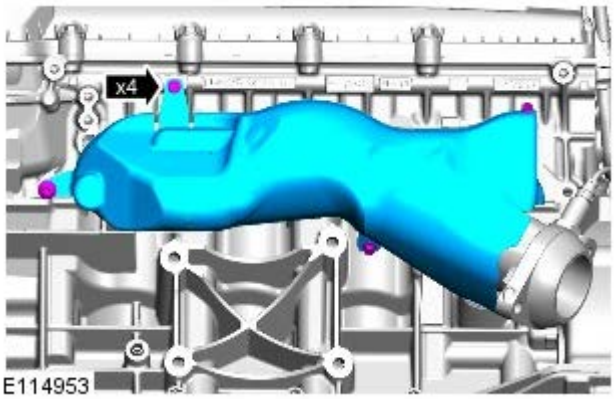
6. CAUTION: Make sure that new bolts are installed.

   NOTE: Install the spacers in the noted position.

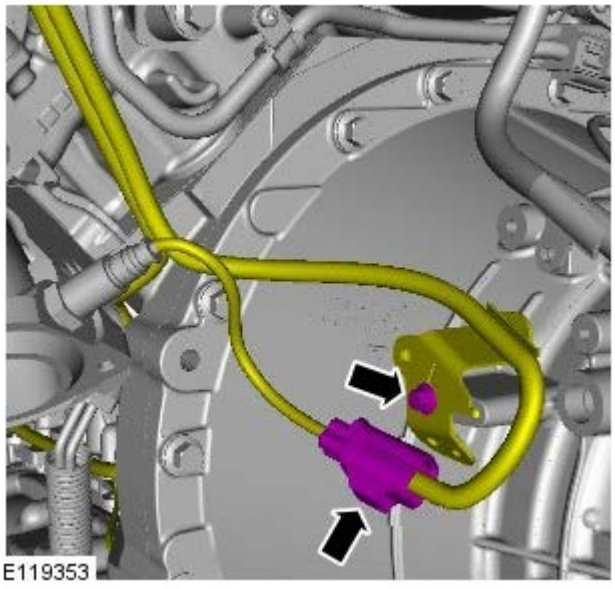
   Torque: 10 Nm



7. *Torque:* 18 Nm

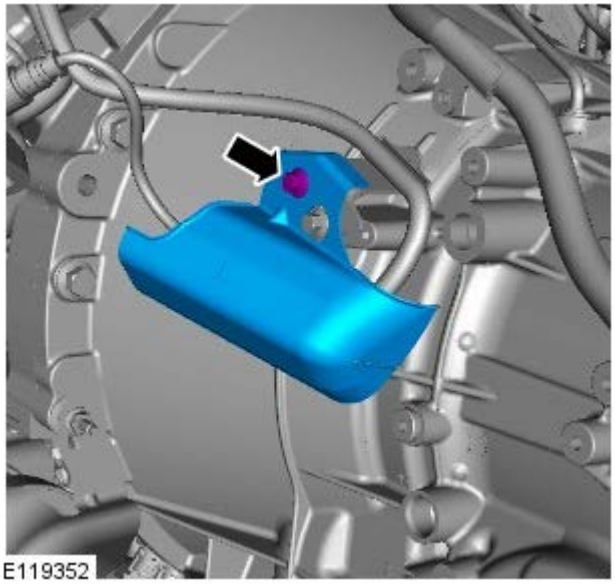


8. *Torque:* 3 Nm

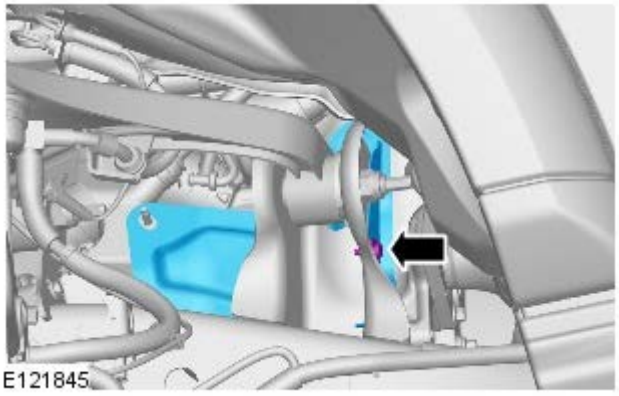


9. *Torque:* 10 Nm

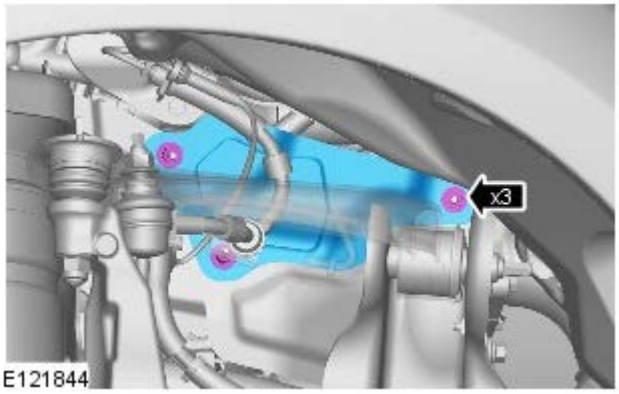
10. *Torque:* 10 Nm



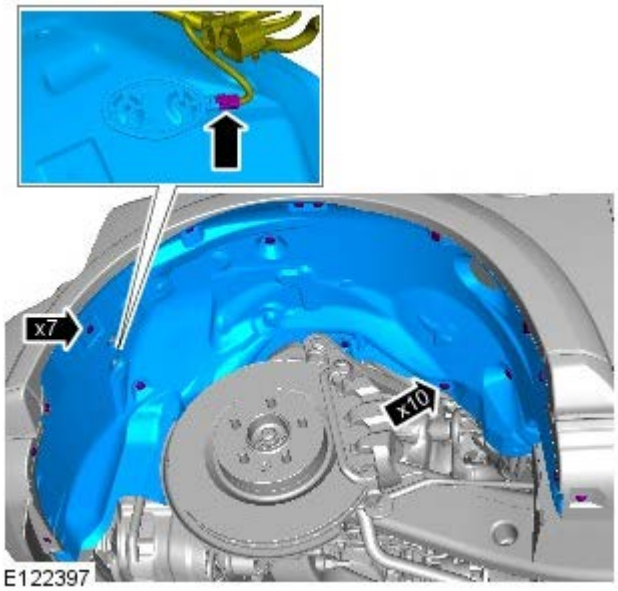
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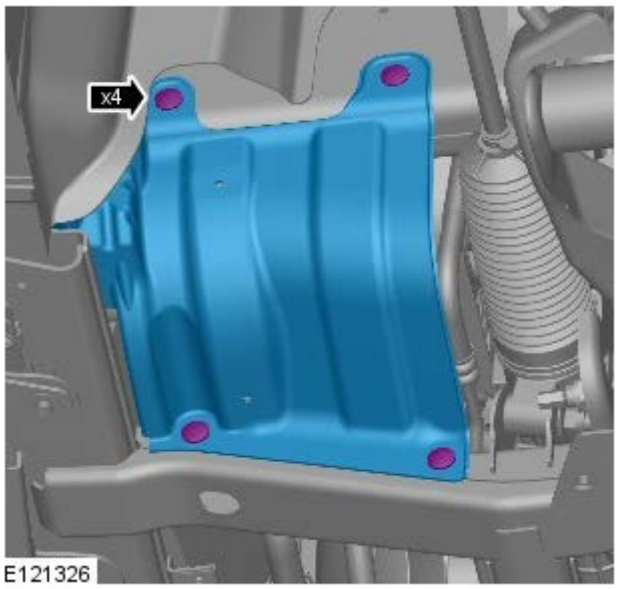
12.



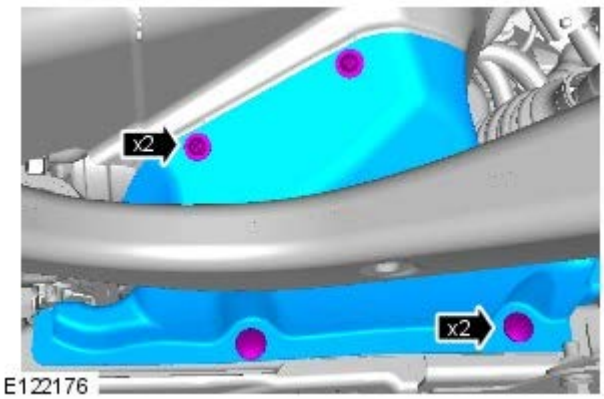
13.



14.



15.



16. Refer to: Exhaust System (309-00 Exhaust System - 5.0L, Removal and Installation).

17. Refer to: Power Steering Pump - 5.0L (211-02 Power Steering, Removal and Installation).

18. Install the battery.

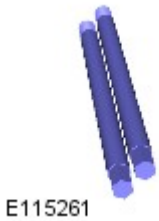
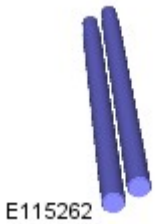
    Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

Published: 09-Aug-2013

Engine - V8 S/C 5.0L Petrol - Exhaust Manifold RH

Removal and Installation

Special Tool(s)

 E115261	303-1444-01 Exhaust Manifold Installation Guide Pins - Threaded
 E115262	303-1444-02 Exhaust Manifold Installation Guide Pins - Unthreaded

Removal

NOTES:

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

Some illustrations may show the engine removed for clarity.

All vehicles

1. Disconnect the battery ground cable.

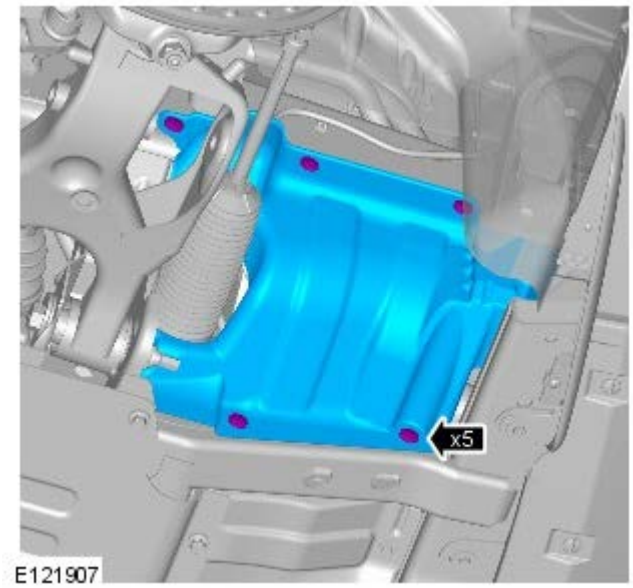
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

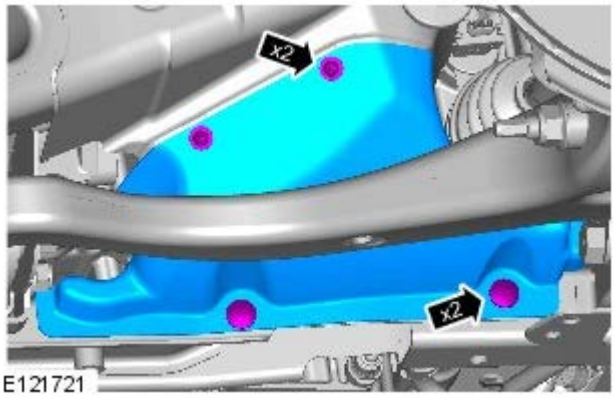
   Raise and support the vehicle.

3. Refer to: Exhaust System (309-00B Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

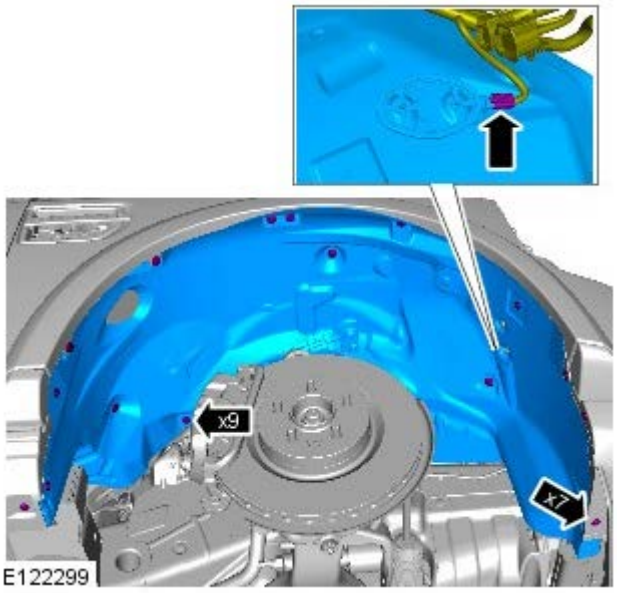
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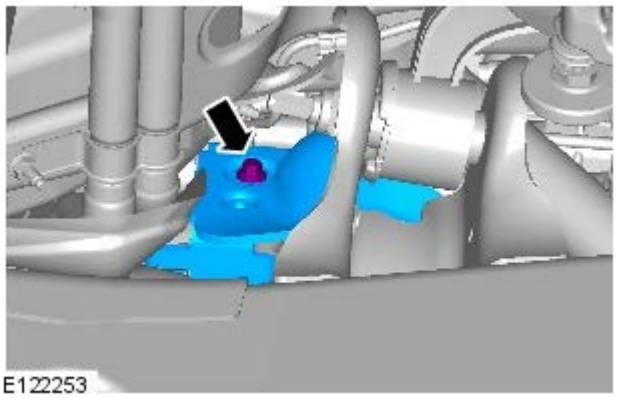
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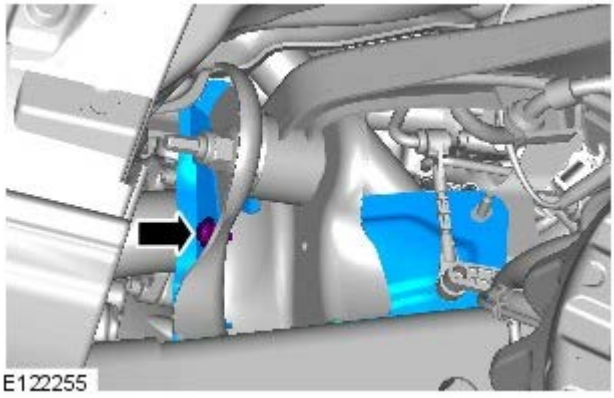
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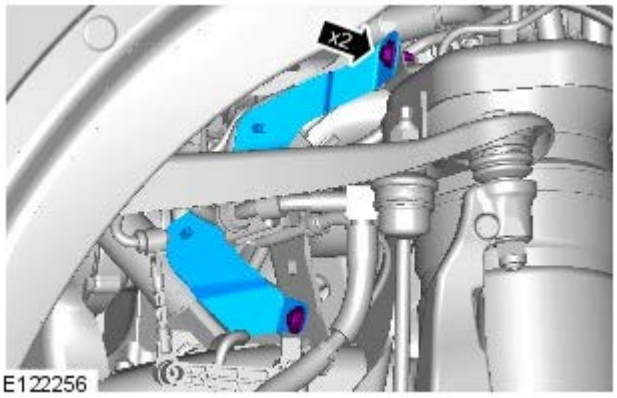
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8.

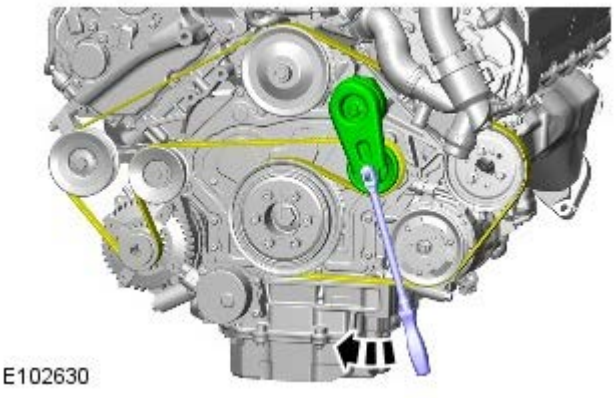


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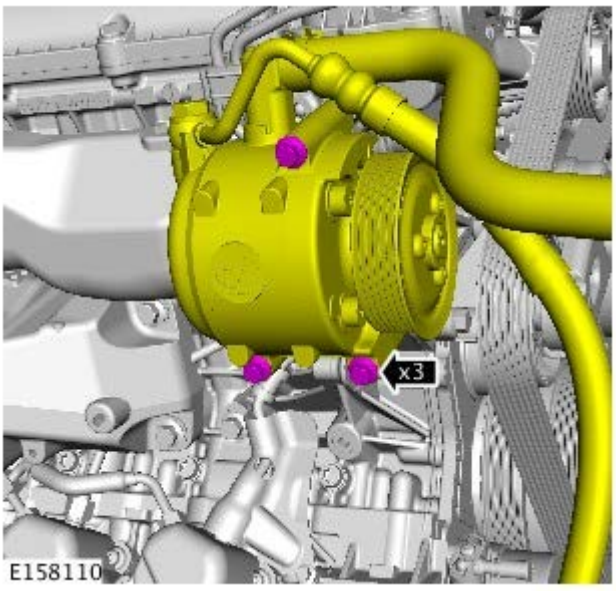


Vehicles with dynamic suspension

10.

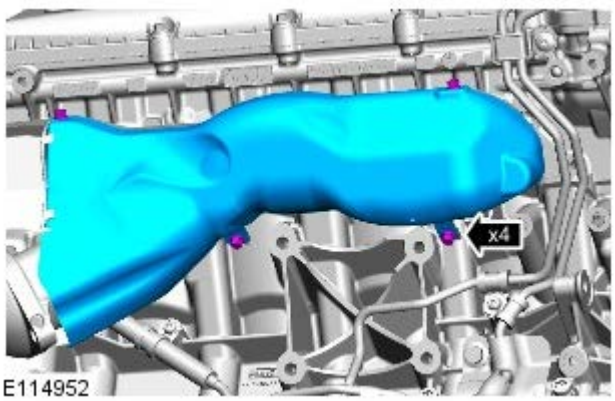


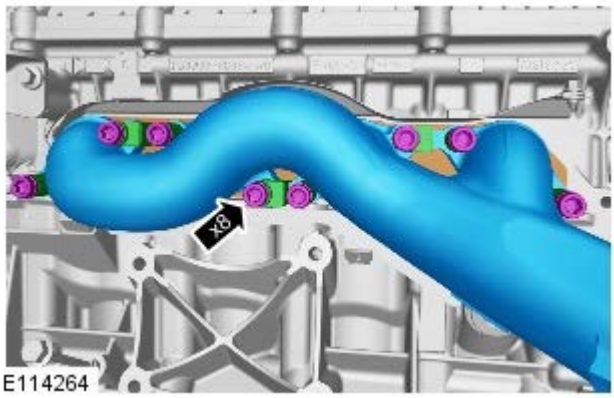
11.



All vehicles

12.





13. CAUTIONS:

    Discard the bolts.

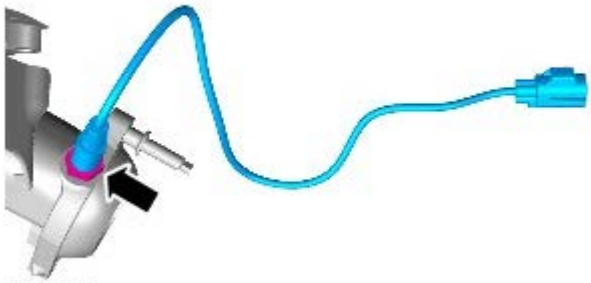
    LH illustration shown, RH is similar.

    NOTES:

    Discard the gasket.

    Make sure that the position of the spacers is noted before removal of the manifold.

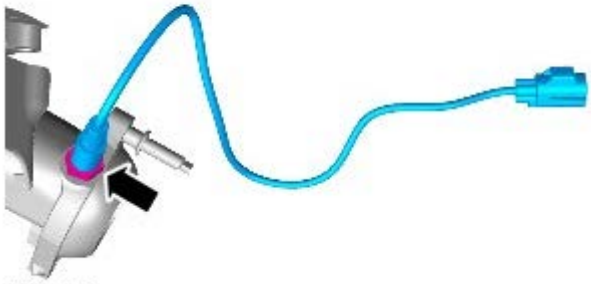
14. NOTE: Do not disassemble further if the component is removed for access only.

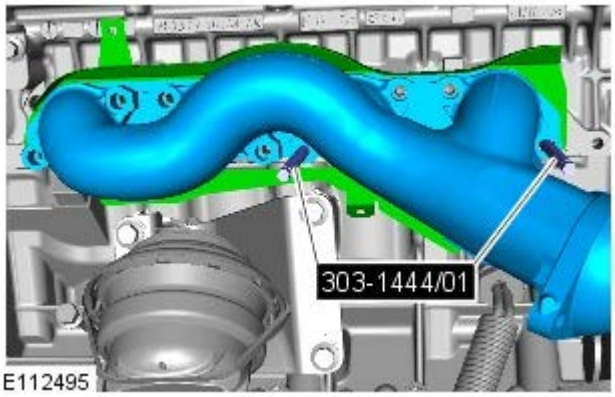


Installation

All vehicles

1. *Torque:* 45 Nm





2. CAUTION: LH illustration shown, RH is similar.

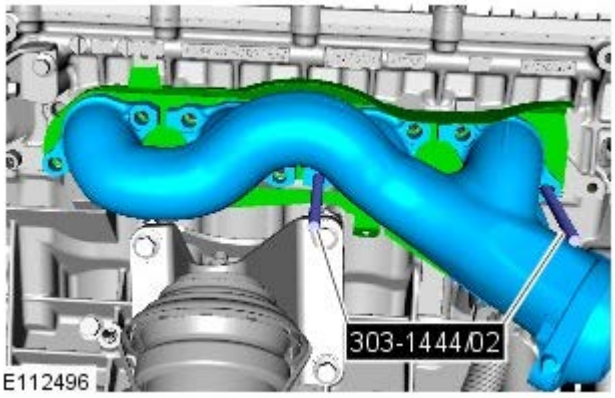
   NOTE: Install a new gasket.

   Install the special tool.

   Special Tool(s): 303-1444-01

3. CAUTION: LH illustration shown, RH is similar.

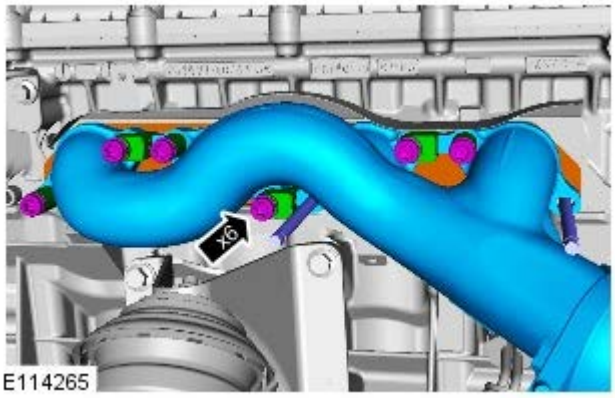
   NOTE: If a new cylinder head is installed use



the special tools in the illustration.

Install the special tool.

Special Tool(s): 303-1444-02



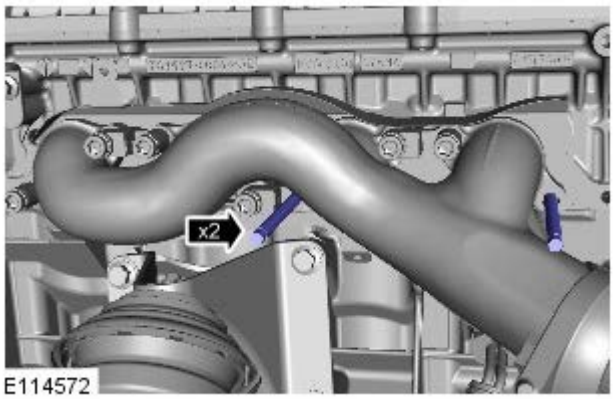
4. CAUTIONS:

   Make sure that new bolts are installed.

   LH illustration shown, RH is similar.

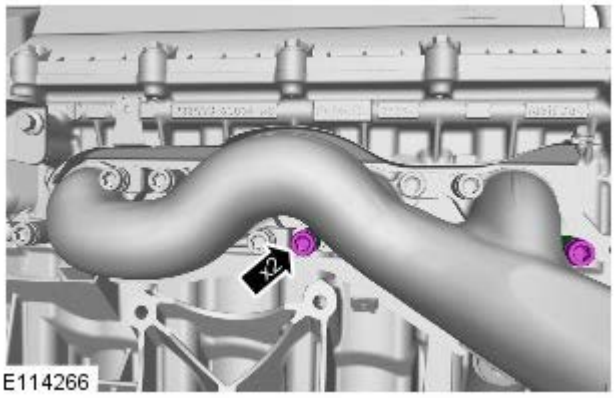
   NOTE: Install the spacers in the noted position.

   Torque: 10 Nm



5. CAUTION: LH illustration shown, RH is similar.

   Remove the special tool.



6. CAUTIONS:

   Make sure that new bolts are installed.

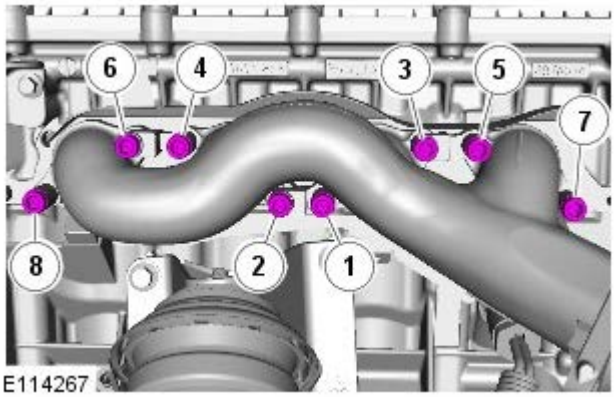
   LH illustration shown, RH is similar.

   NOTE: Install the spacers in the noted position.

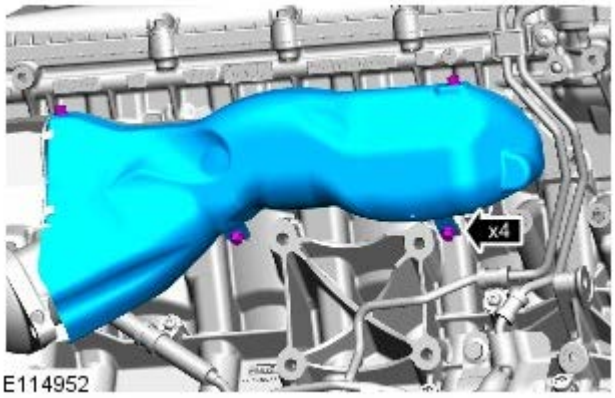
   Torque: 10 Nm

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

   Torque: 18 Nm

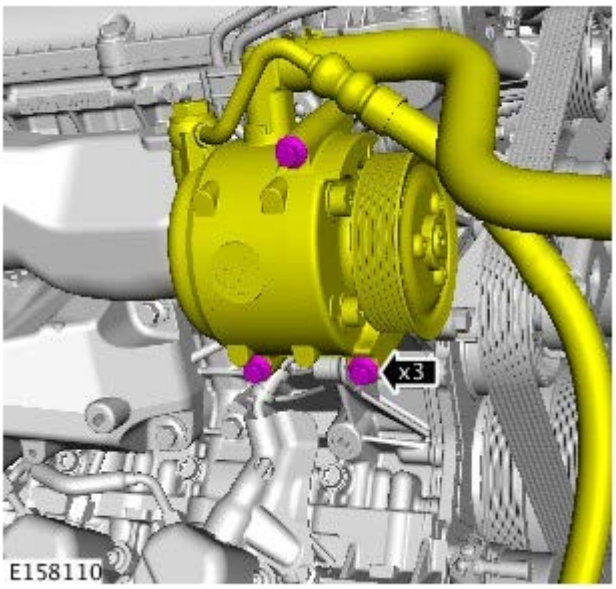


8.

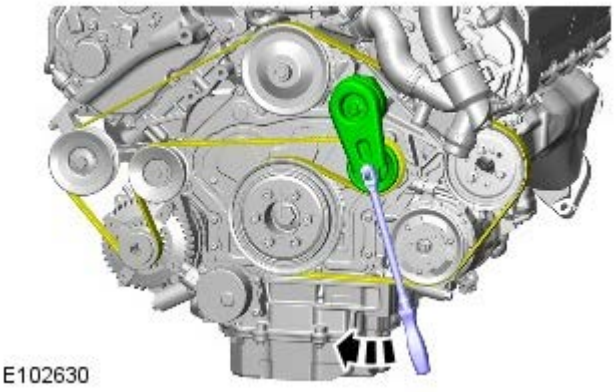


Vehicles with dynamic suspension

9. *Torque:* 22 Nm

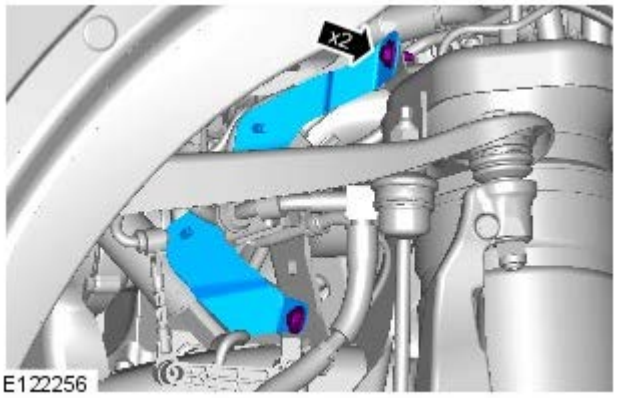


10.

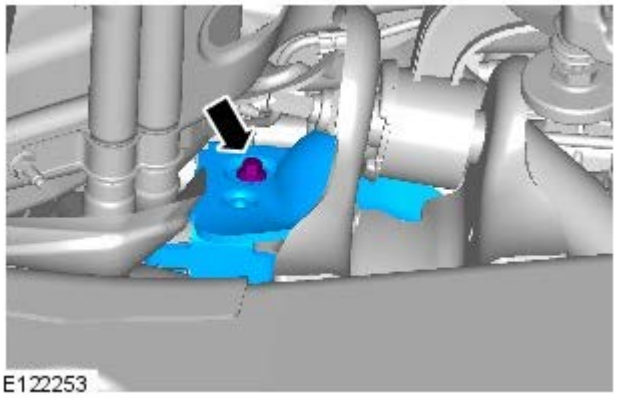


All vehicles

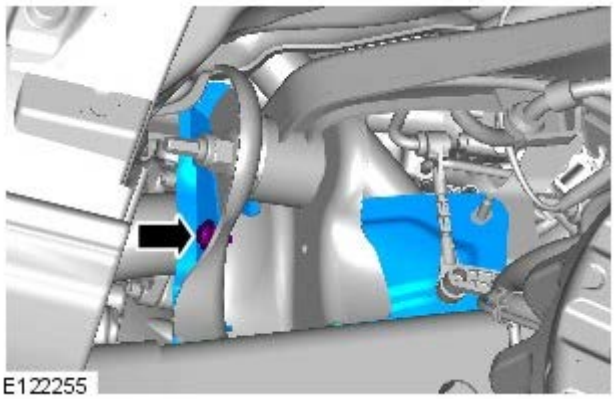
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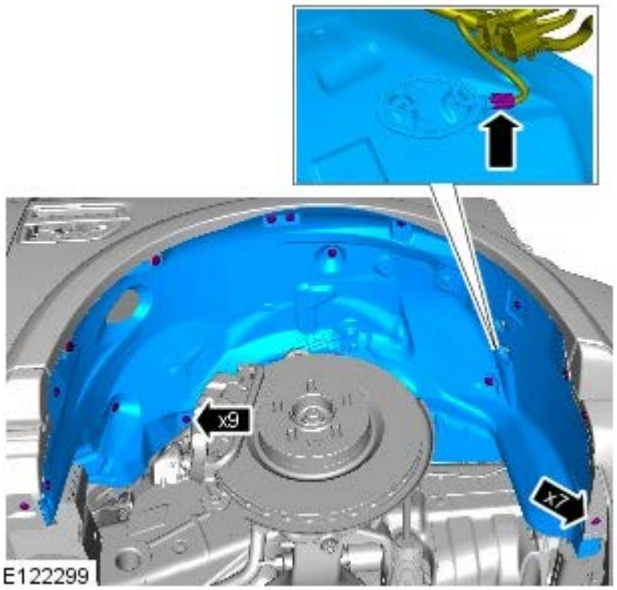
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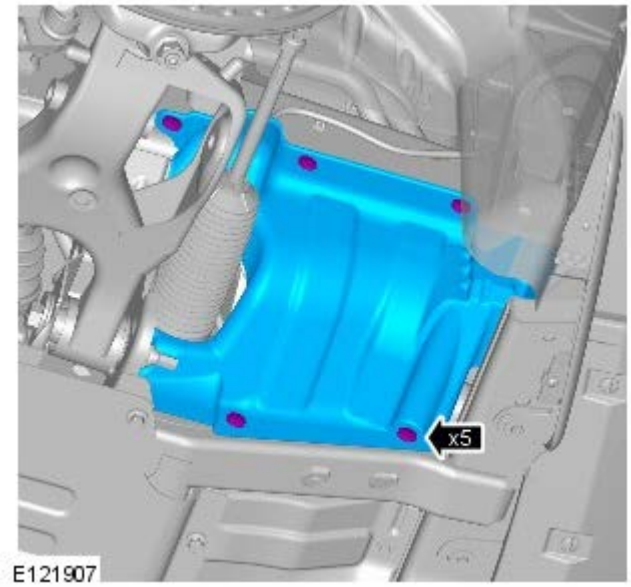
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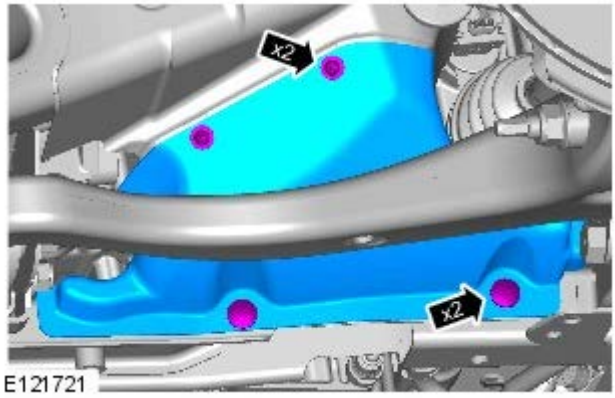
14.



15.



16.



17. Refer to: Exhaust System (309-00B Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

18. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Flexplate

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Transmission - 5.0L (307-01, Removal).



4. CAUTIONS:

   Install all the bolts finger tight before final tightening.

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

   Make sure that no components fall off during removal.

   Install the bolts in the noted position.

   NOTES:

   Make sure the crankshaft and flexplate mating faces are clean before installation.

   Make sure that the crankshaft is not rotated.

   Tighten the retaining bolts working diagonally.

   Torque:
   Stage 1: 45 Nm
   Stage 2: 90°

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Oil Cooler

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

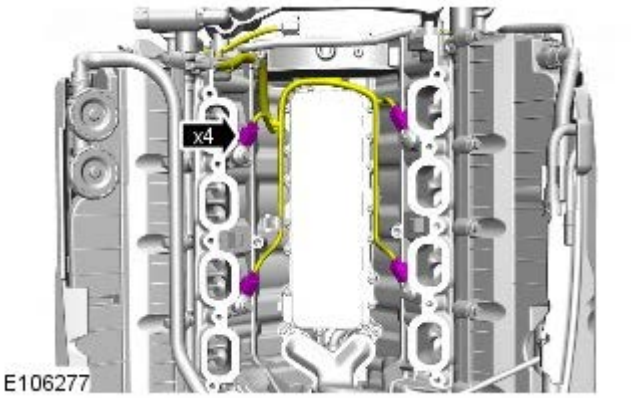
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

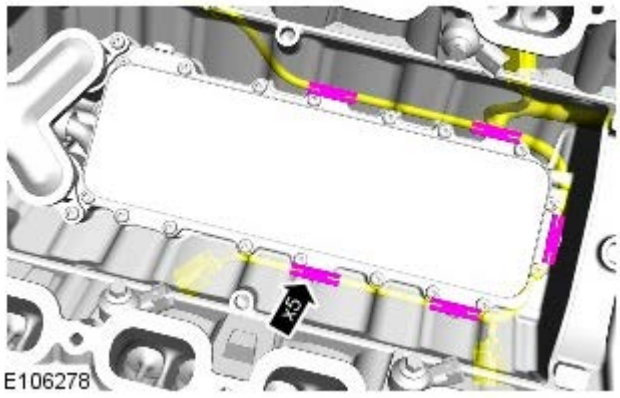
3. Refer to: Engine Oil Draining and Filling (303-01 Engine - 5.0L NA V8 - AJ133, General Procedures).

4. Refer to: Supercharger (303-12 Intake Air Distribution and Filtering - 5.0L SC V8 - AJ133, Removal and Installation).

5.



6.

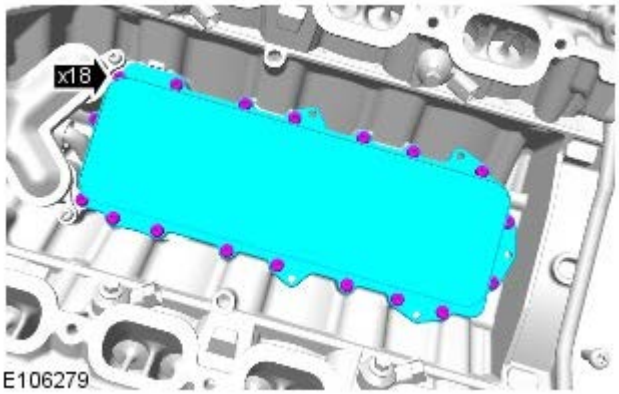


7. CAUTIONS:

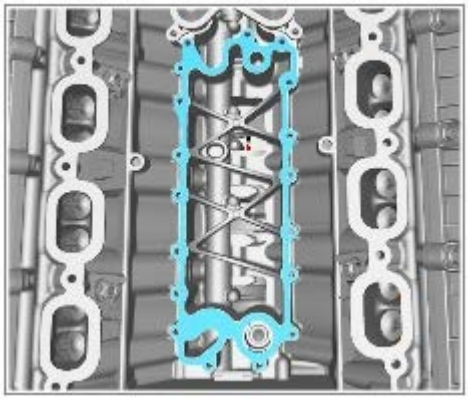
   Be prepared to collect escaping oil.

   Be prepared to collect escaping coolant.

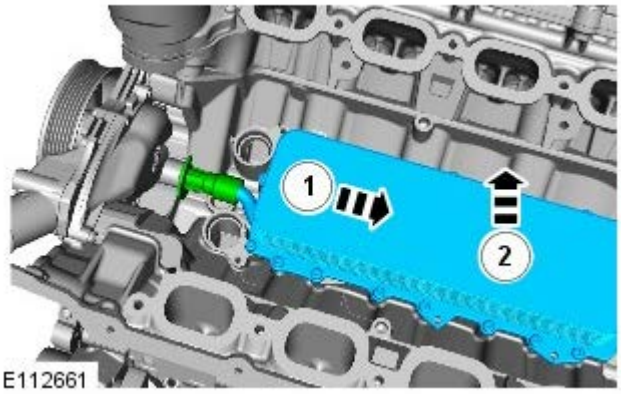
   Torque: 13 Nm



8. CAUTION: Make sure that these components are installed to the noted removal position.



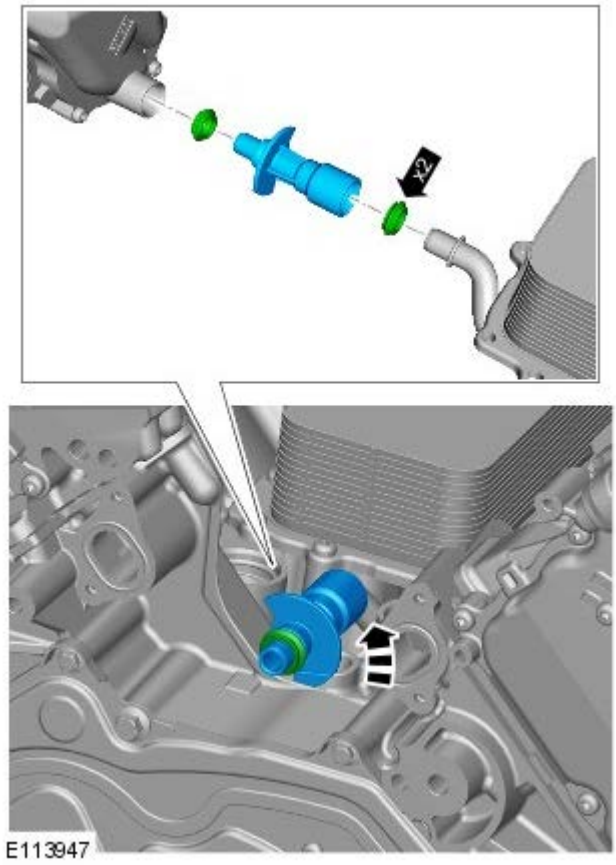
NOTE: Install a new gasket.



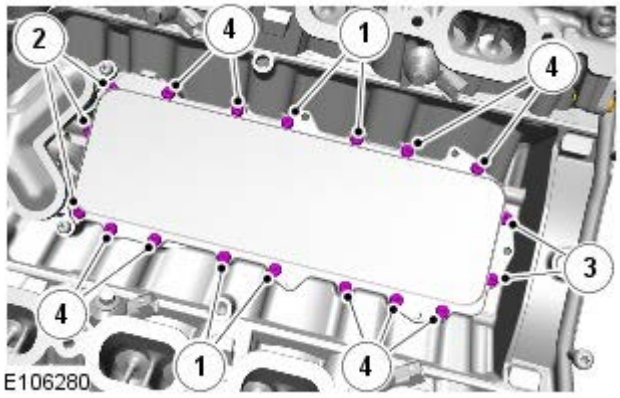
9. CAUTIONS:

Make sure that these components are installed to the noted removal position.

Install new o-ring seals



Installation



1. CAUTIONS:

   Install all the bolts finger tight before final tightening.

   Make sure that the area around the component is clean and free of foreign material.

   Install the new seals.

   NOTE: Tighten the bolts in the indicated sequence.

   To install, reverse the removal procedure.

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Oil Filter Element

Removal and Installation

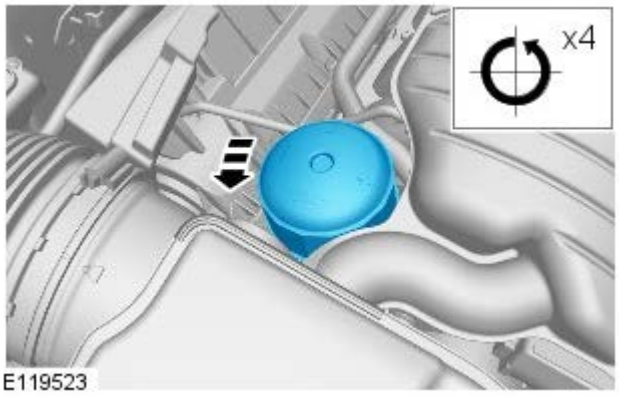
Removal

CAUTION: Make sure that the correct tools are used to remove and install the oil filter element cap.

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

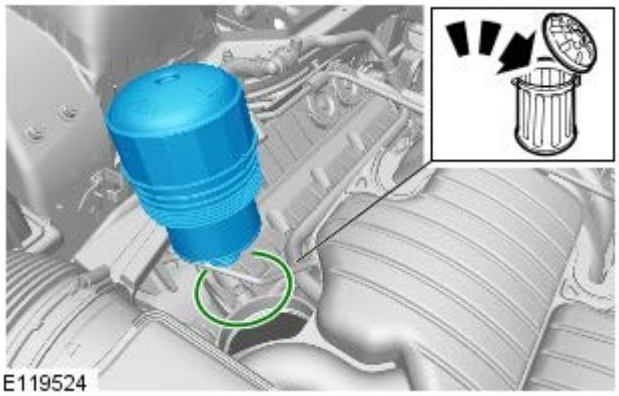
1. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

2.
   - Allow the engine oil to drain from the oil filter element housing for two minutes.



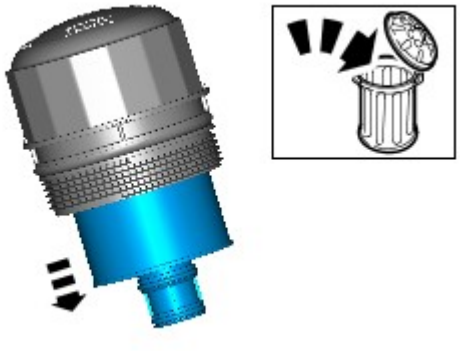
E119523

3.



E119524

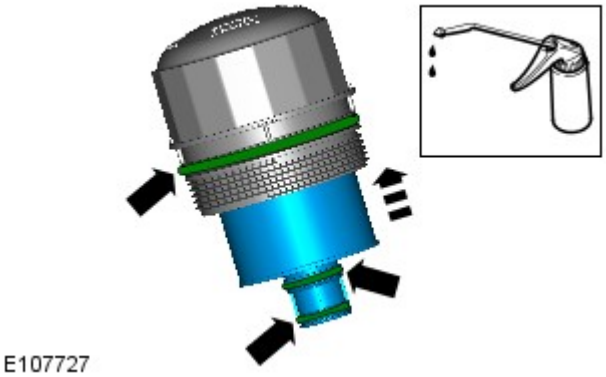
4.



E107394

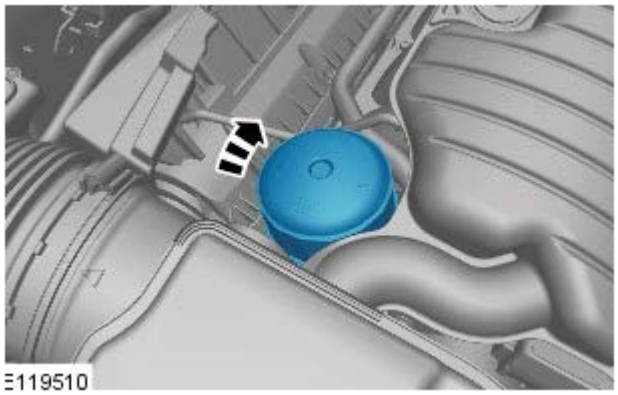
Installation

1.



E107727

2. *Torque:* 25 Nm



E119510

3. Check and top-up the engine oil.
4. Start and run the engine.
5. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

Published: 03-Dec-2011

Engine - V8 S/C 5.0L Petrol - Oil Pan Extension

Removal and Installation

Special Tool(s)

 E107676	303-1433 Lower Timing Cover Alignment tool
 E107678	303-1442 Rear Crankshaft Seal Installer
 E107679	303-1443 Rear Crankshaft Cover Alignment Tool
 E115266	303-1448 Locking Tool

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

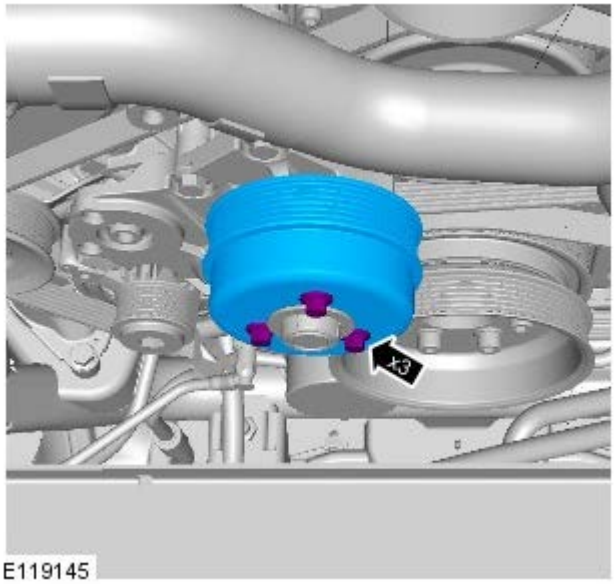
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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

   Raise and support the vehicle.

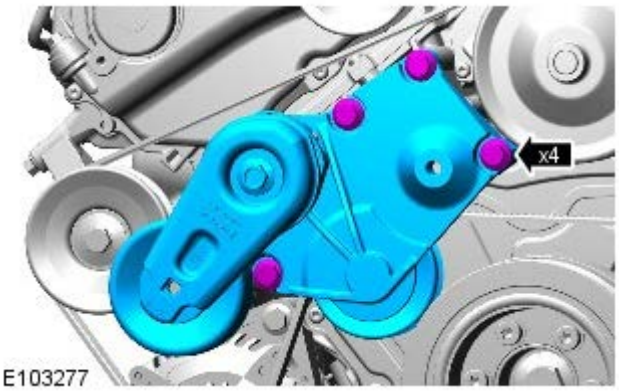
3. Refer to: Crankshaft Pulley (303-01 Engine - V8 S/C 5.0L Petrol, Removal and Installation).

4. Refer to: Engine (303-01 Engine - V8 S/C 5.0L Petrol, Removal).



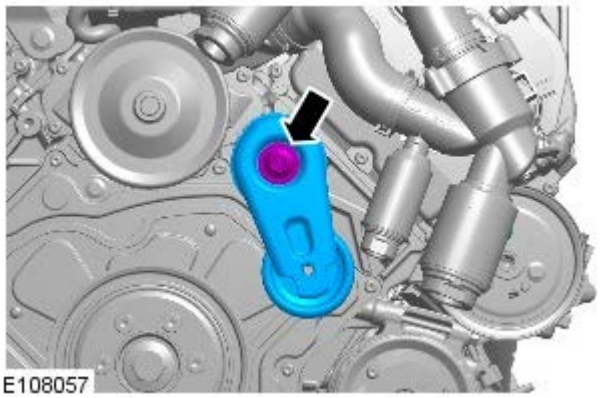
E119145

6.

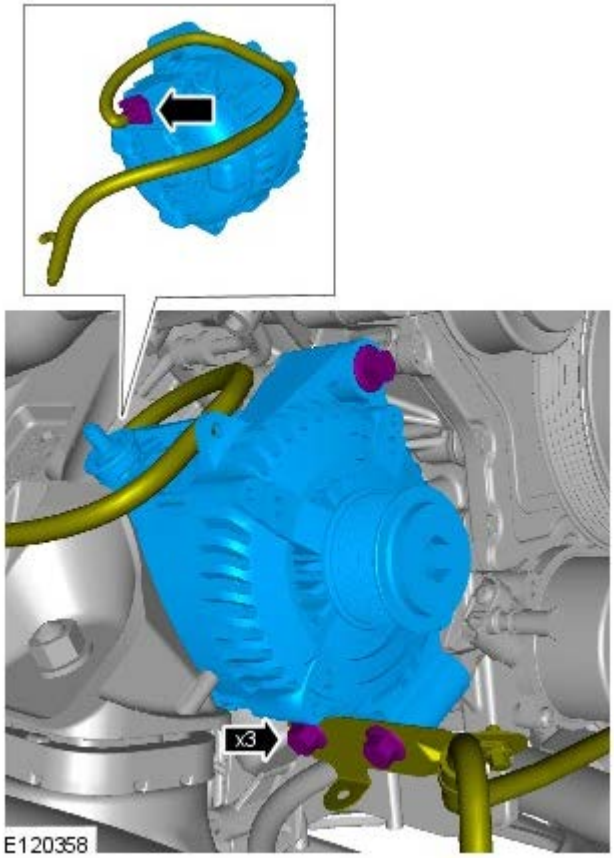


E103277

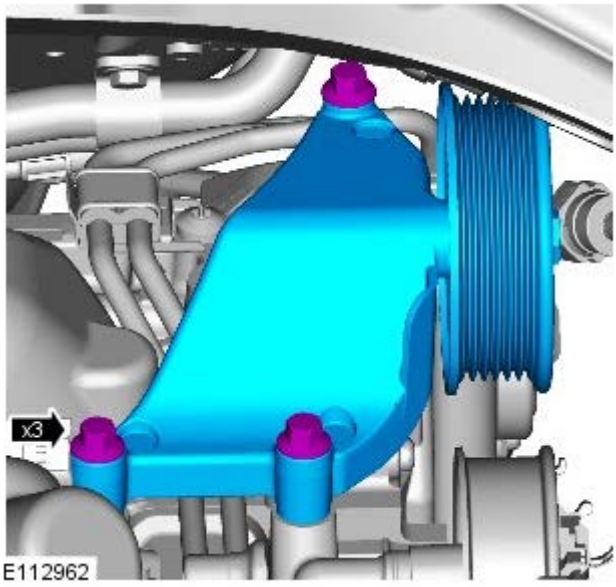
7.


E108057

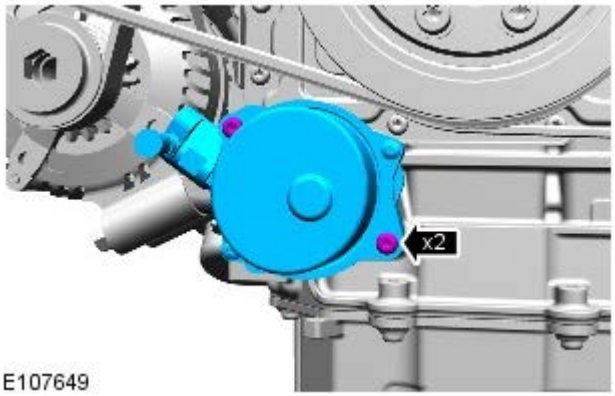
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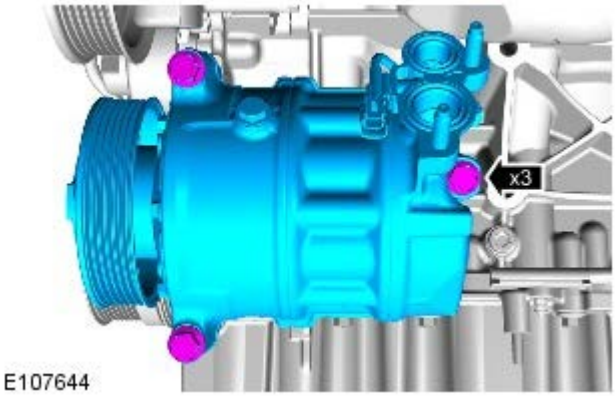
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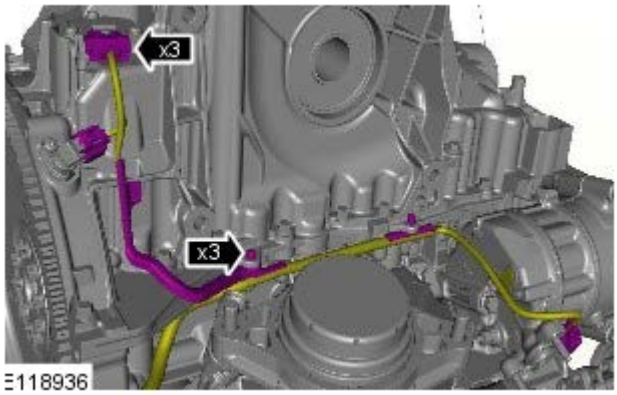
10.



11.

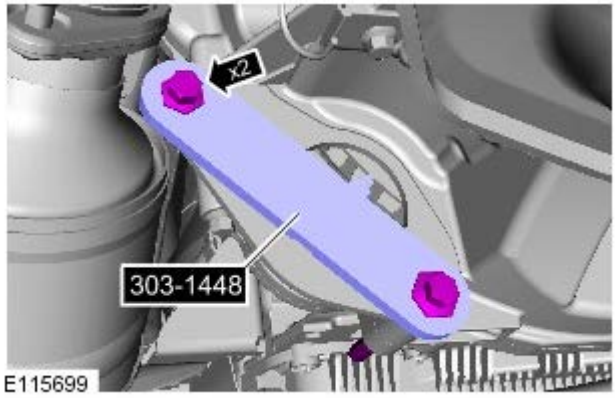


12.



13.

- Install the special tool.
- *Special Tool(s):* 303-1448



14. CAUTIONS:

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

Make sure that no components fall off during removal.

NOTES:

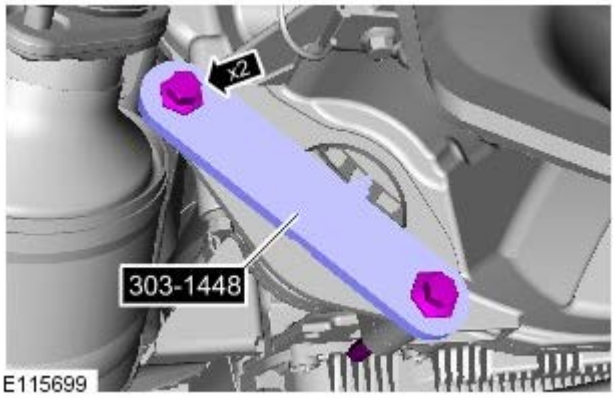
Make sure that the crankshaft is not rotated.

Make sure the crankshaft and flexplate mating faces are clean before installation.

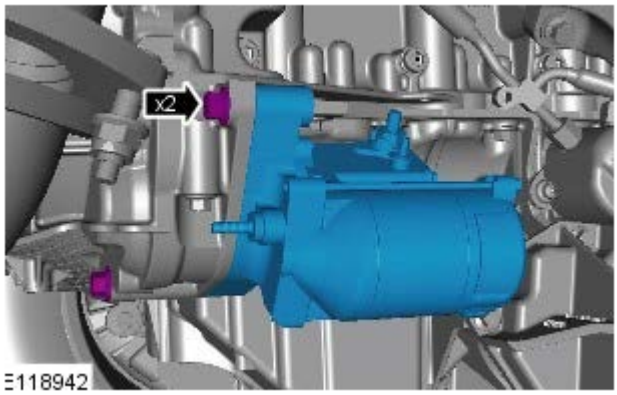


15.

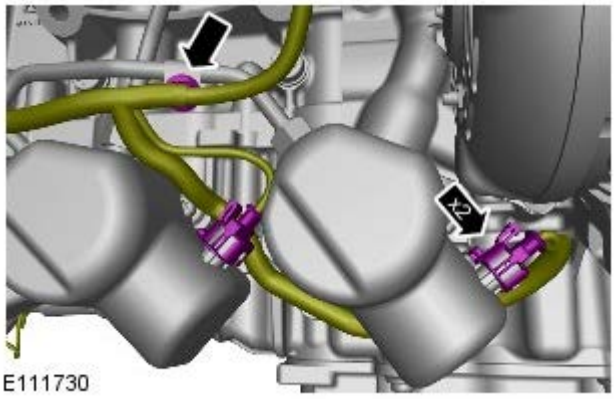
- Remove the special tool.
- *Special Tool(s):* 303-1448



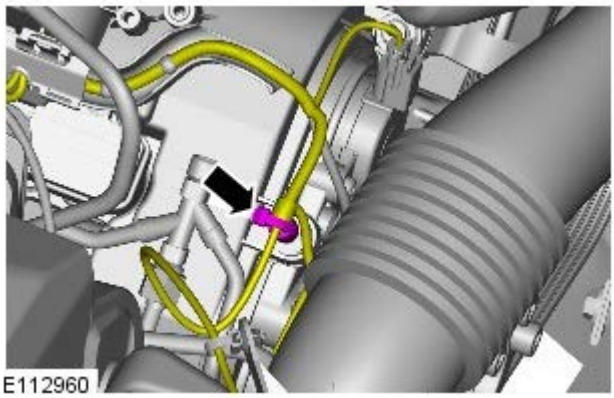
16.



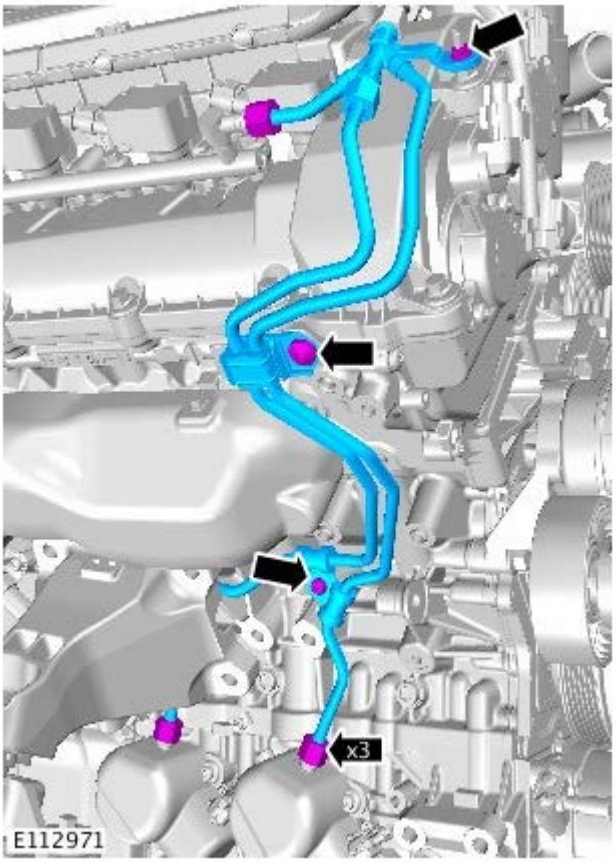
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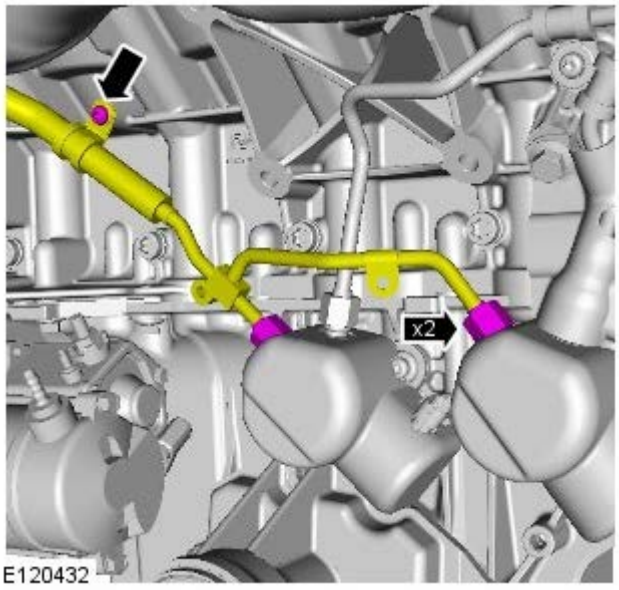
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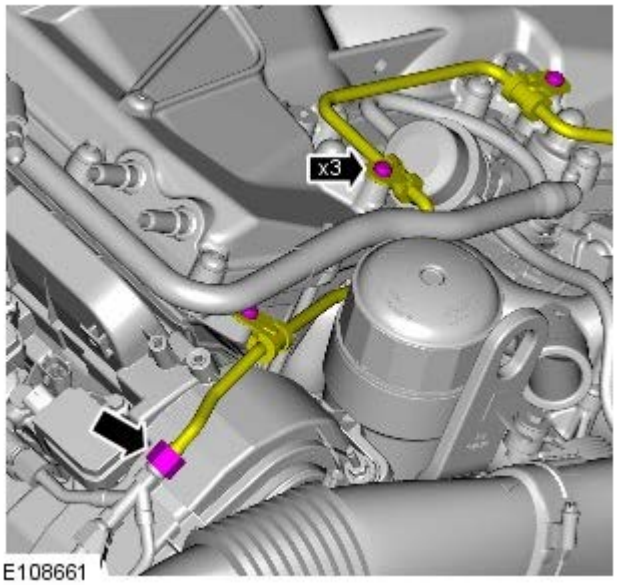
19.



20.



21.



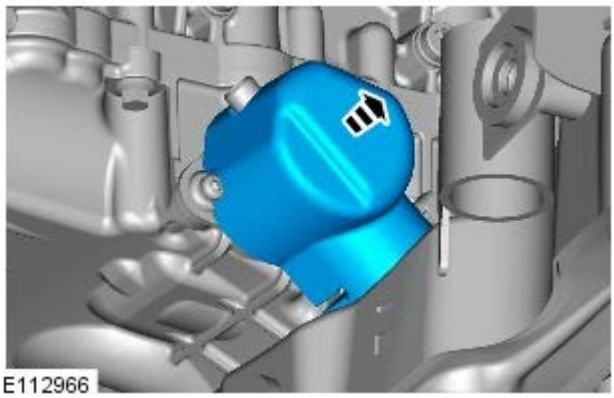
E108661



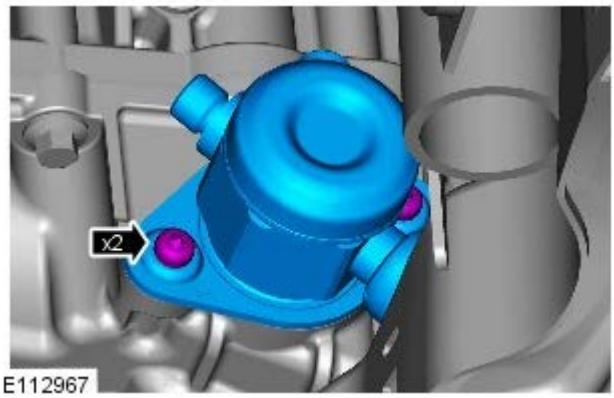
E107647

22. NOTE: The high-pressure fuel pumps are removed from the illustration for clarity.

23.

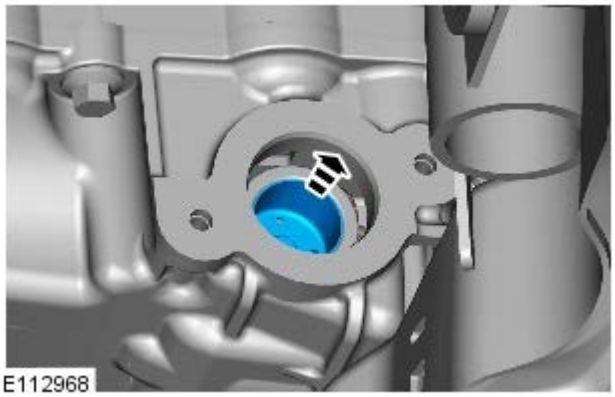

E112966

24. CAUTION: Be prepared to collect escaping fluids.

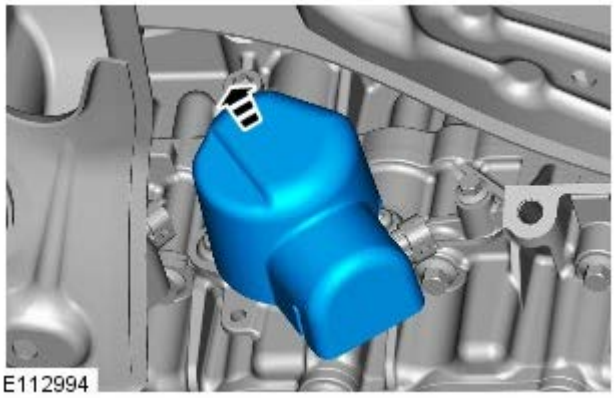


E112967

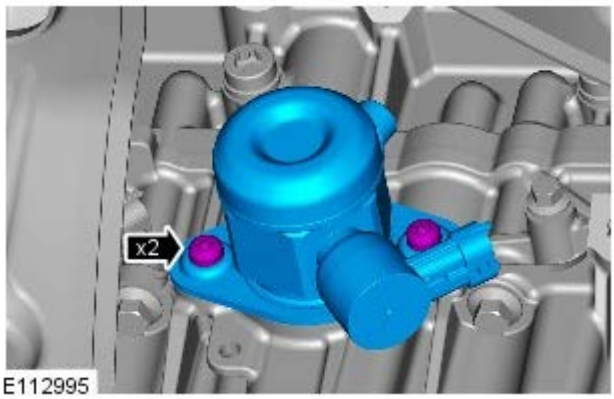
25. CAUTION: Be prepared to collect escaping fluids.



26.



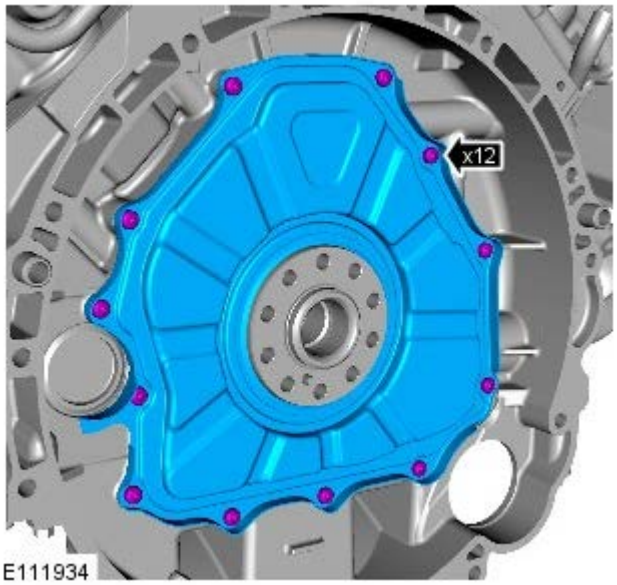
27. CAUTION: Be prepared to collect escaping fluids.



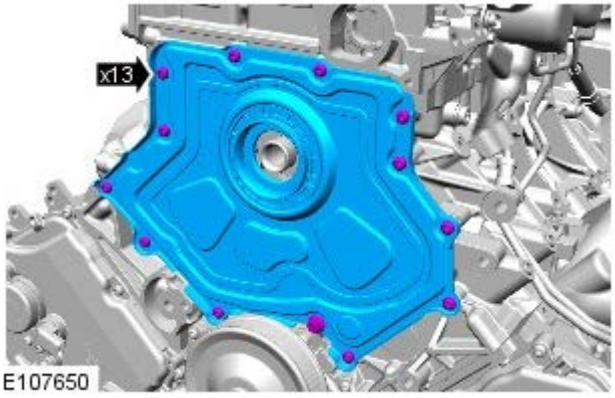
28. CAUTION: Be prepared to collect escaping fluids.



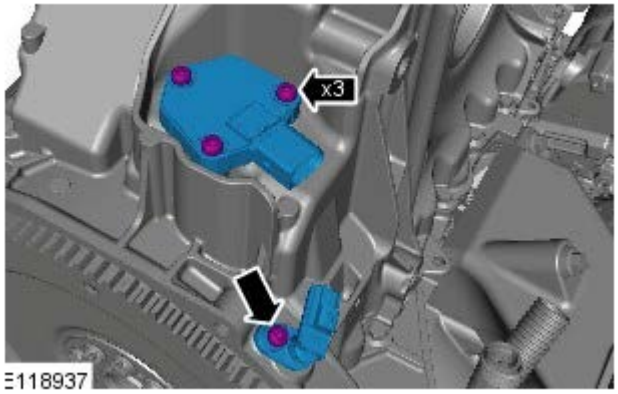
29.



30. NOTE: Discard the component.



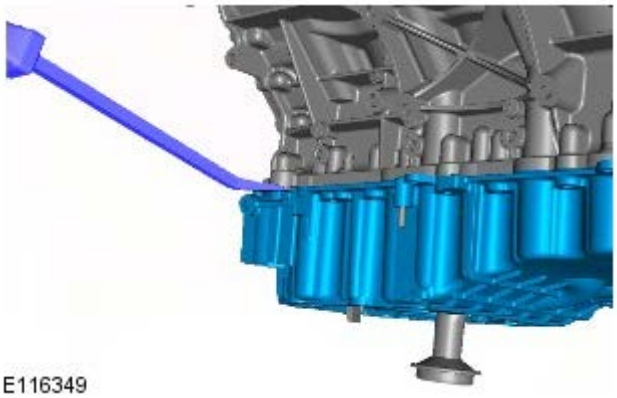
31.



32.



E118938


E116349

33. NOTE: Make sure to use the aluminium lug provided on the oil pan extension to lever against.



E118940

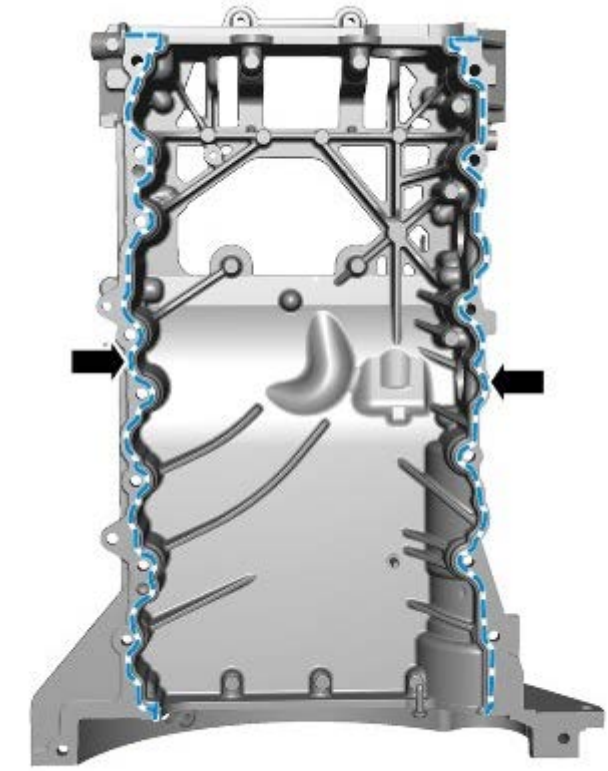
34. NOTE: Do not disassemble further if the component is removed for access only.

Installation

1. *Torque:* 10 Nm



E118940


E107654

2. CAUTIONS:

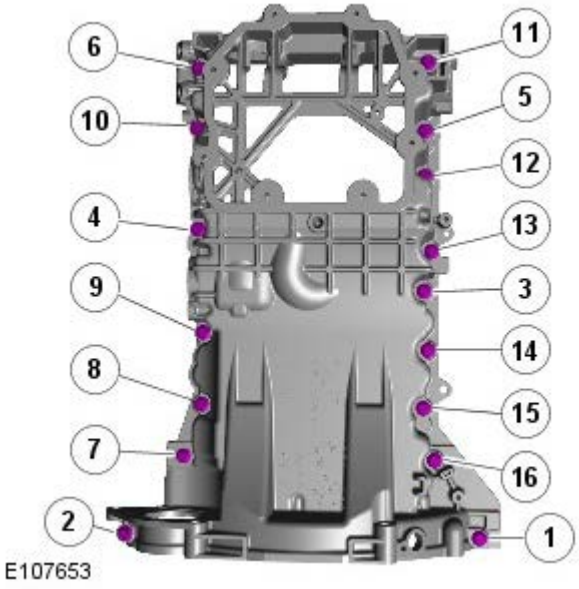
   Make sure that the mating faces are clean and free of foreign material.

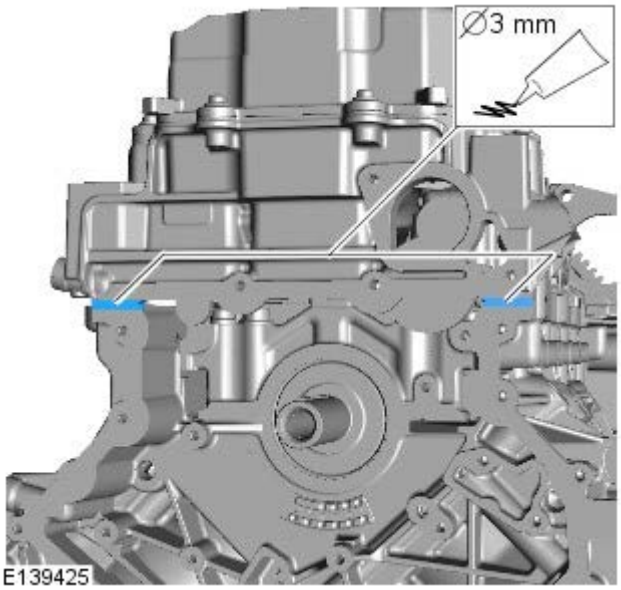
   Use only a plastic scraper when removing the sealing material.

   - Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

3. NOTE: Tighten the bolts in the indicated sequence.

   Torque: 25 Nm





4. CAUTION: Make sure that the mating faces are clean and free of foreign material.

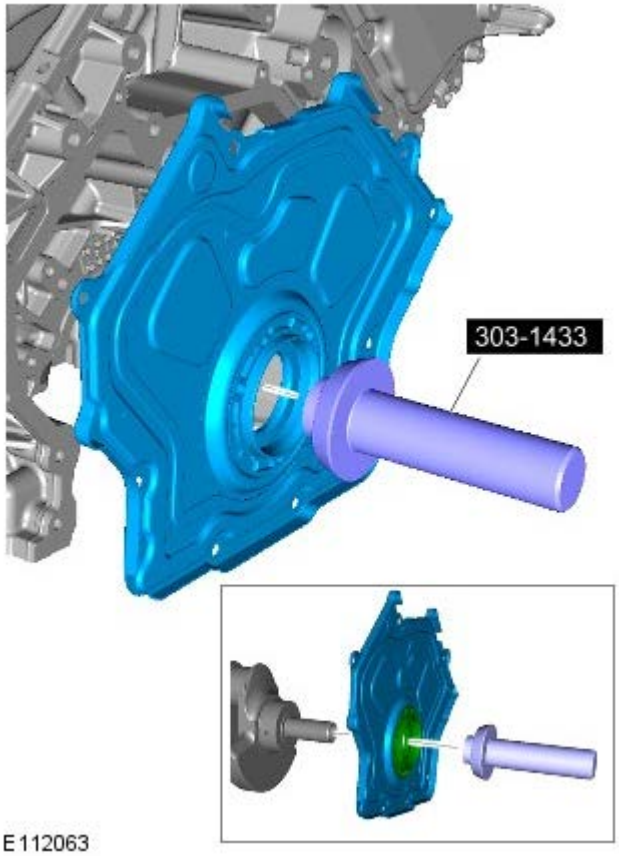
   Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

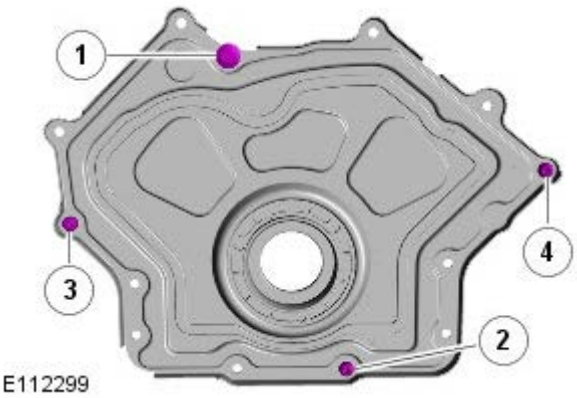
   NOTE: Install new lower timing cover.

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

   Special Tool(s): 303-1433



E112063



E112299

6. NOTE: Tighten the bolts in the indicated sequence.
   - *Torque:*
     M6 12 Nm
     M8 20 Nm

7. Remove the special tools.

8. *Torque:* 12 Nm

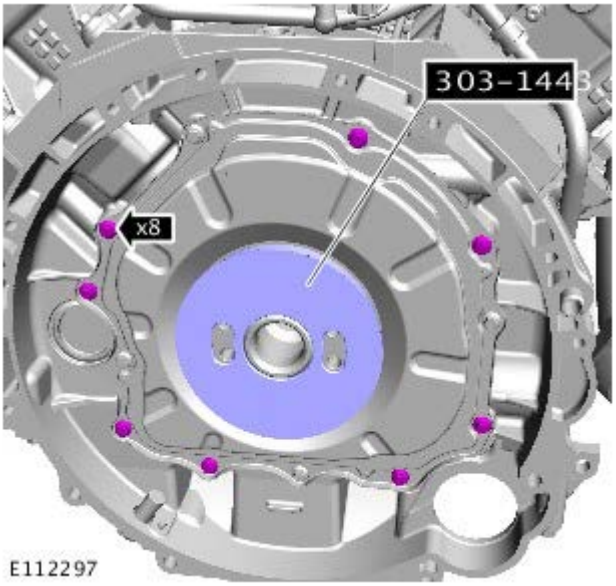


E112300

9.
   - *Special Tool(s):* 303-1442
   - *Special Tool(s):* 303-1443



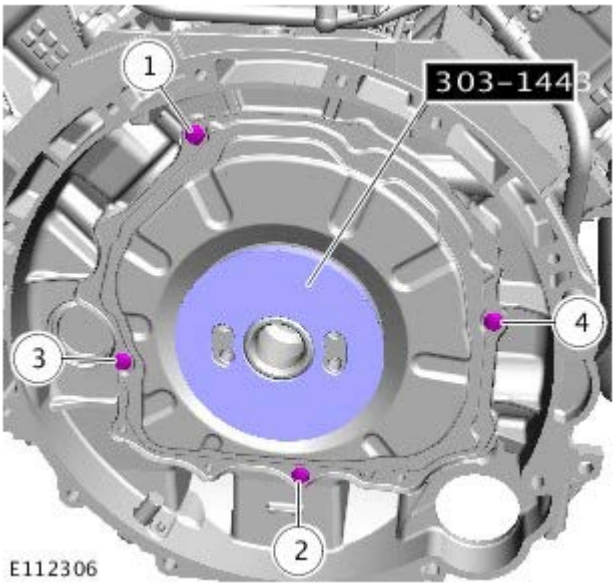
10. Remove the special tool.



11. NOTE: Tighten the bolts in the indicated sequence.

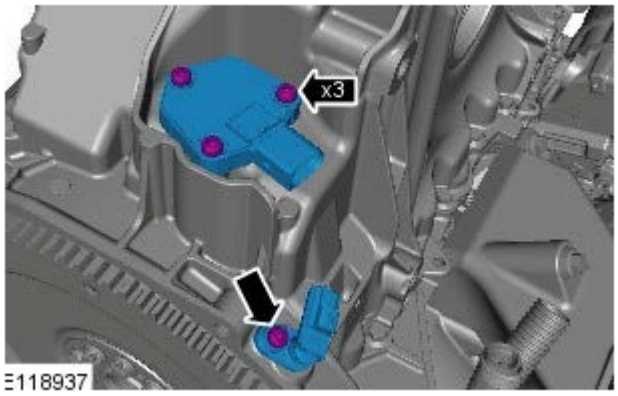
Torque: 11 Nm

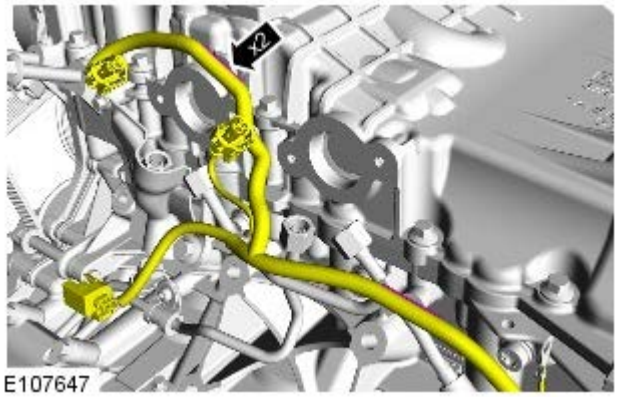
12. *Torque:* 11 Nm



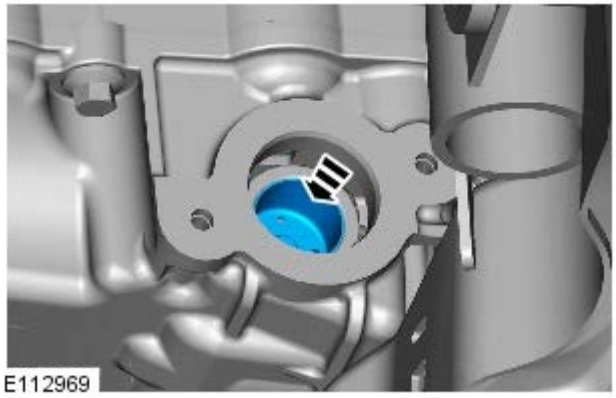
13.

- *Torque:* 11 Nm

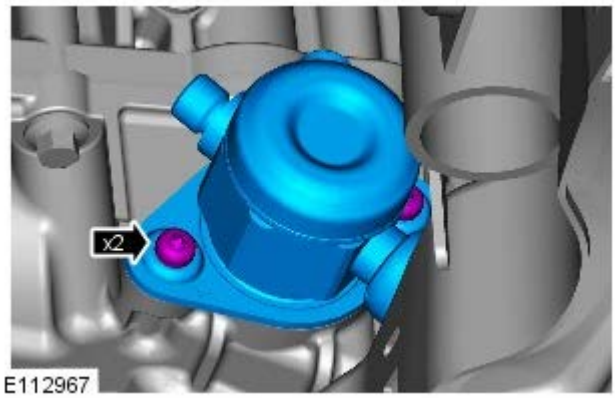




14. NOTE: The high-pressure fuel pumps are removed from the illustration for clarity.



15. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.

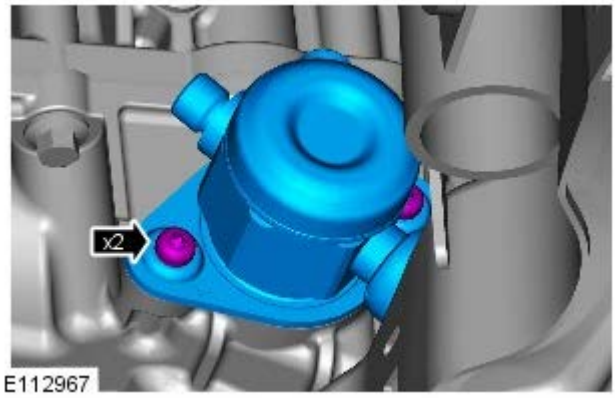


16. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

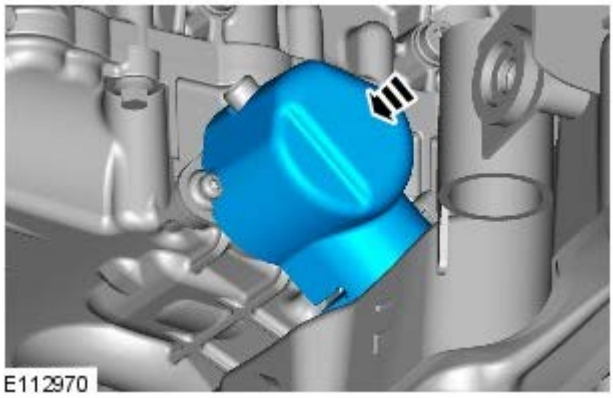
NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

- *Torque:* 11 Nm

17. Loosen the Torx screws half a turn each.



18.



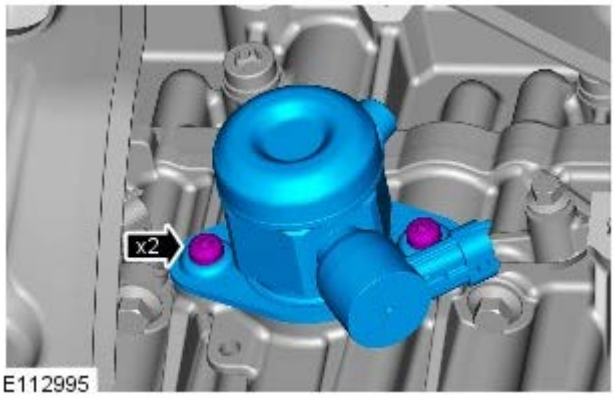
19. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.



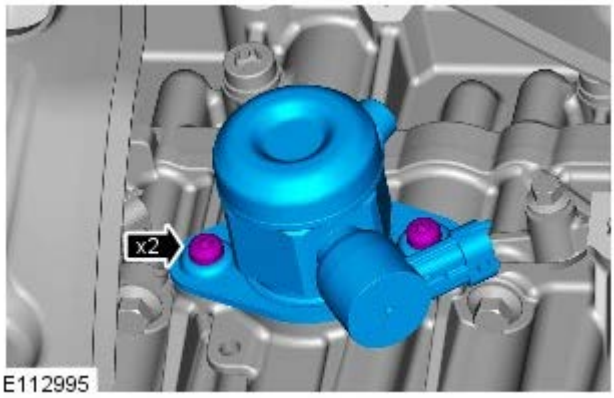
20. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

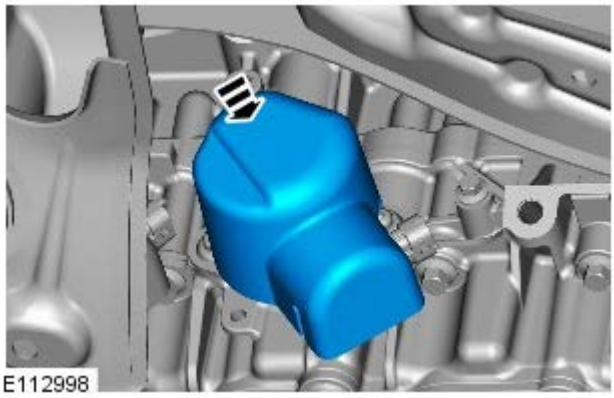
- *Torque:* 11 Nm



21. Loosen the Torx screws half a turn each.



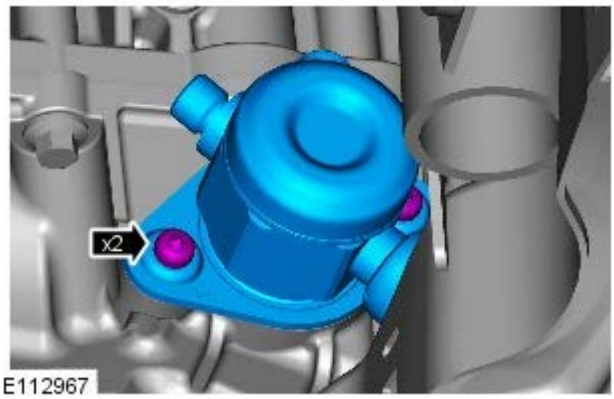
22.



23. CAUTION: Care must be taken when positioning the fuel rail high-pressure fuel pump cover to one side.

NOTE: Fuel rail high-pressure fuel pump cover shown removed for clarity.

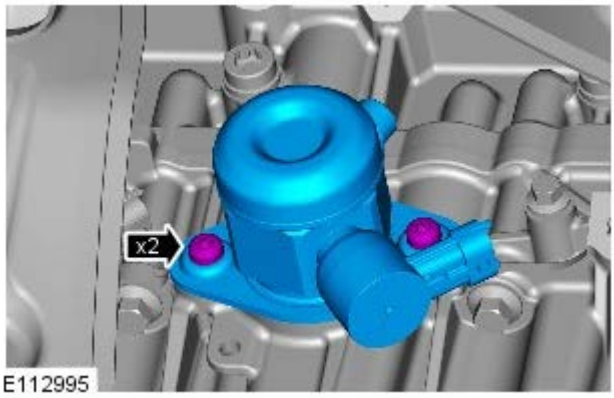
- *Torque:* 11 Nm



24. CAUTION: Care must be taken when positioning the fuel rail high-pressure fuel pump cover to one side.

NOTE: Fuel rail high-pressure fuel pump cover shown removed for clarity.

- *Torque:* 11 Nm

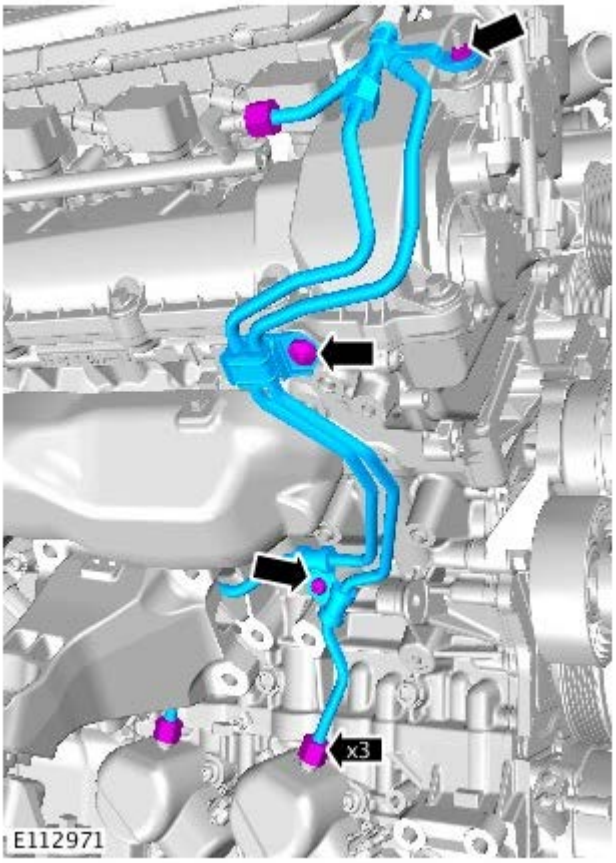


25. CAUTIONS:

Install new high-pressure fuel supply lines.

Lubricate only the union threads with clean engine oil.

NOTES:



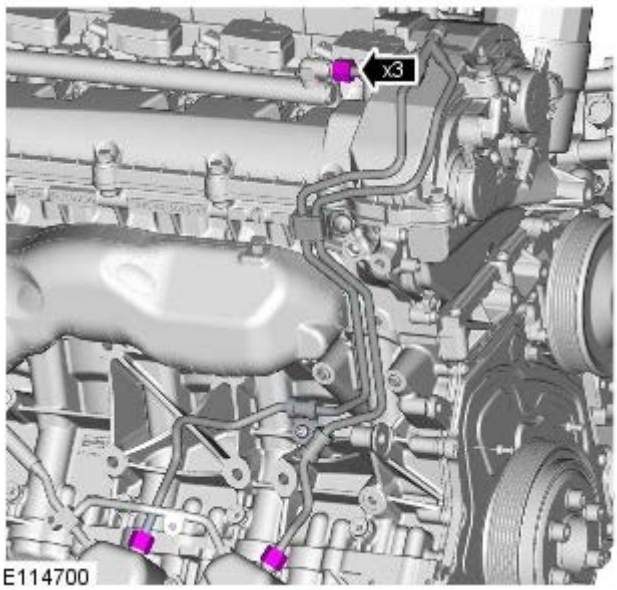
Remove and discard the blanking caps.

Install the bolt and unions fully finger tight before final tightening.

Do not fully tighten at this stage.

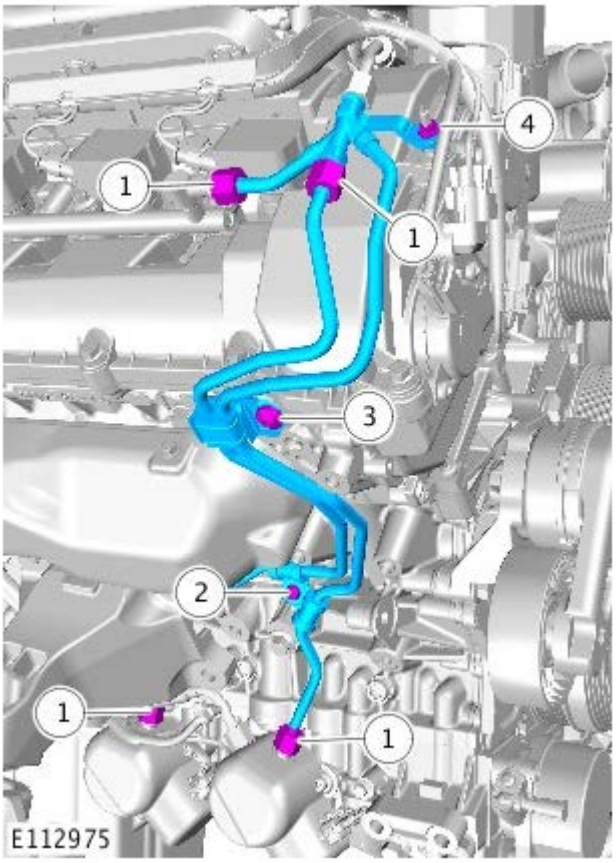
26.

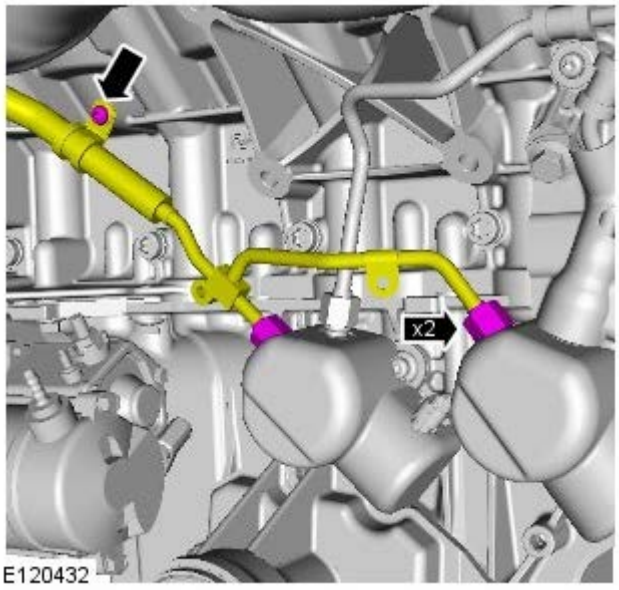
- *Torque:* 21 Nm



27.

- *Torque:*
  Unions (1) 21 Nm
  M6 (2) 11 Nm
  M8 (3) 25 Nm
  M5 nut (4) 6 Nm





28. NOTES:

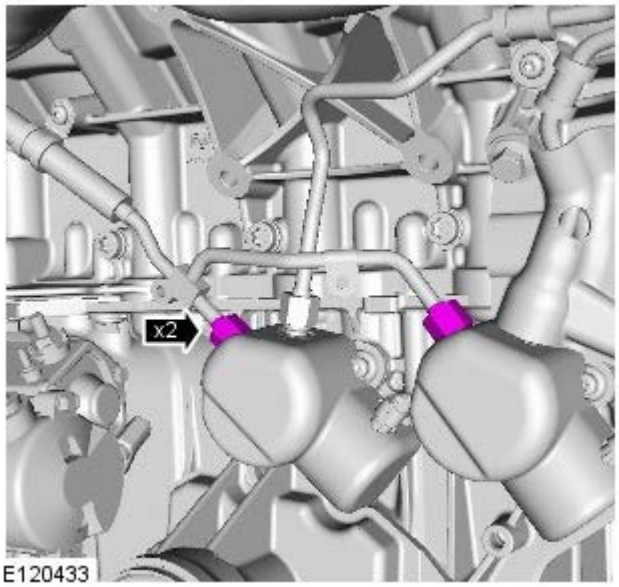
Install the bolt and unions finger tight before final tightening.

Remove and discard the blanking caps.

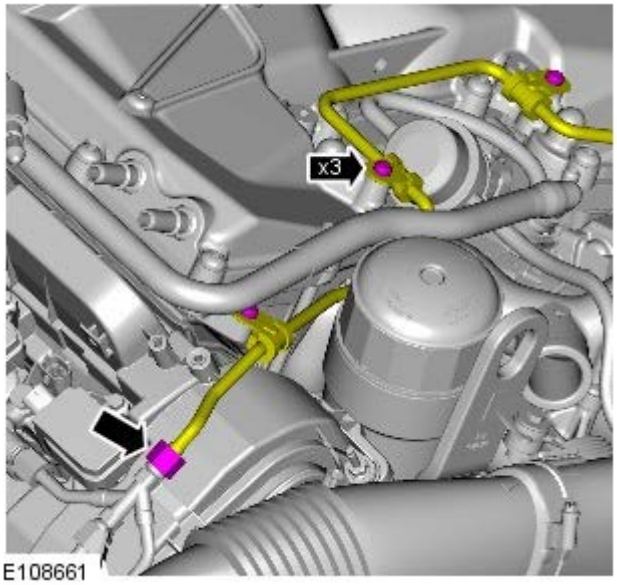
- *Torque:*
  Unions 21 Nm
  M6 11 Nm

29. CAUTION: Make sure that a new component is installed.

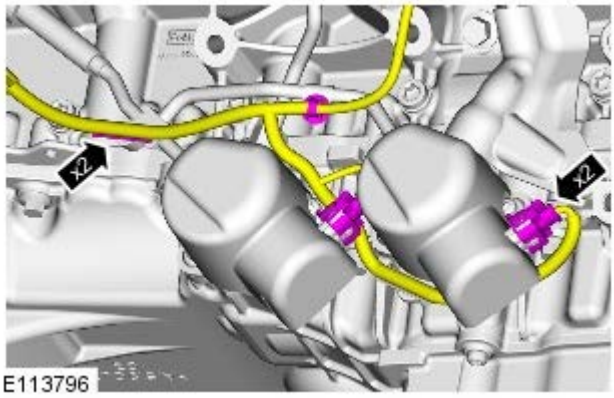
- *Torque:* 21 Nm



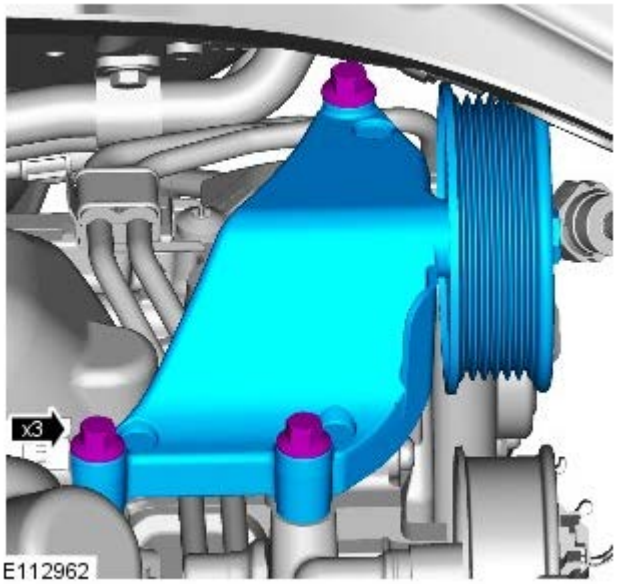
30. *Torque:*
    Unions 21 Nm
    M6 8 Nm



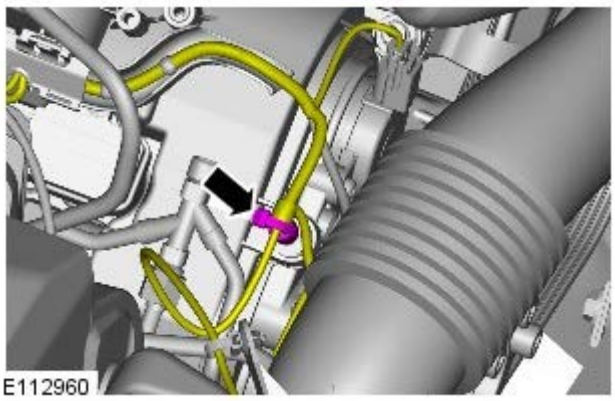
31.



32. *Torque:* 25 Nm

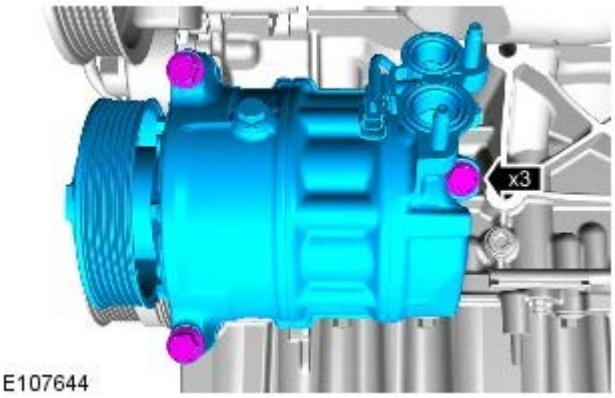


33.

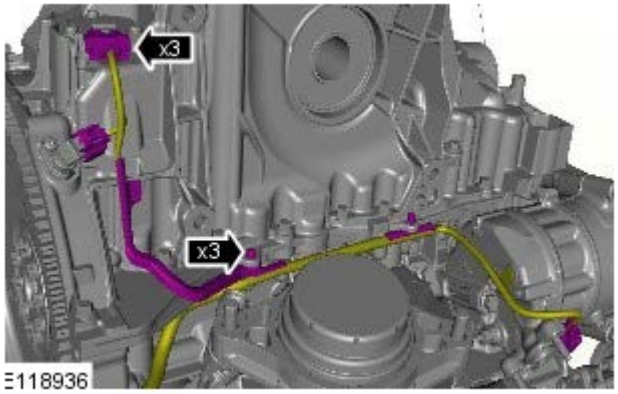


34. CAUTION: Install all the bolts finger tight before final tightening.

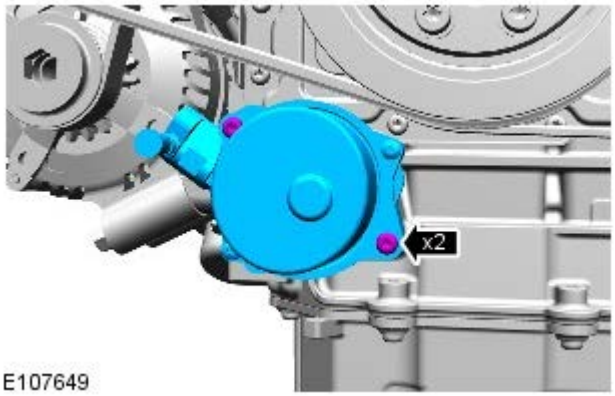
Torque: 25 Nm

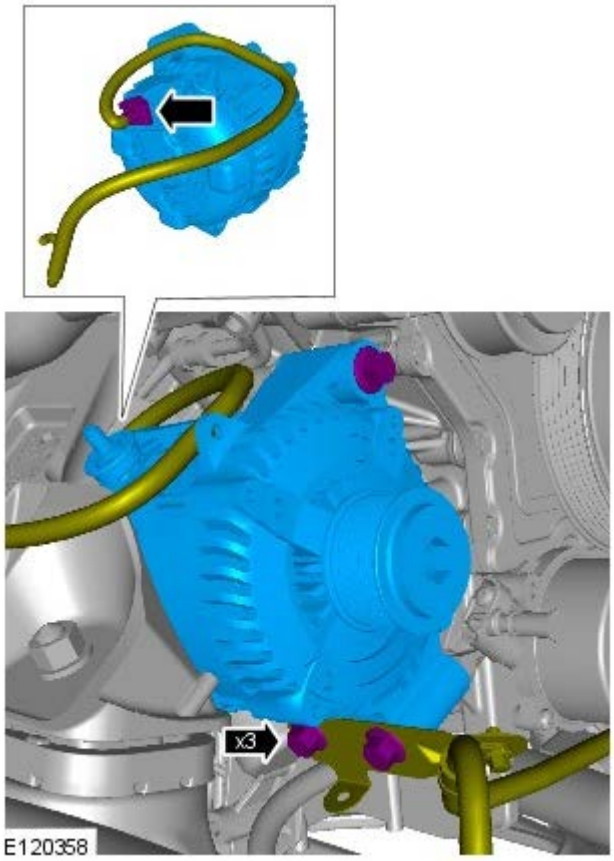


35.



36. *Torque:* 12 Nm





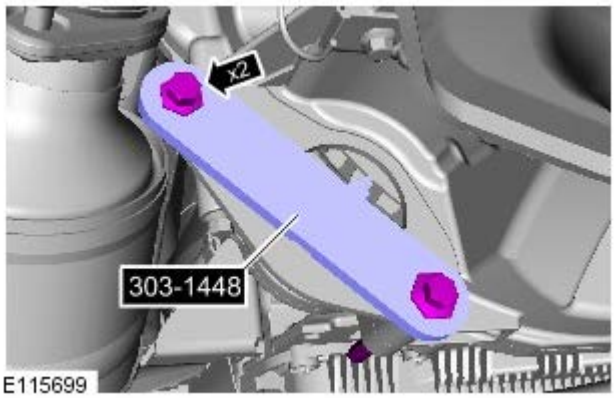
37. CAUTION: Install all the bolts finger tight before final tightening.

NOTE: Tighten the bolts in the indicated sequence.

Torque: 48 Nm

38.

- Install the special tool.
- *Special Tool(s):* 303-1448



39. CAUTIONS:

Install all the bolts finger tight before final tightening.

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



Install the bolts in the noted position.

NOTES:

Make sure that the crankshaft is not rotated.

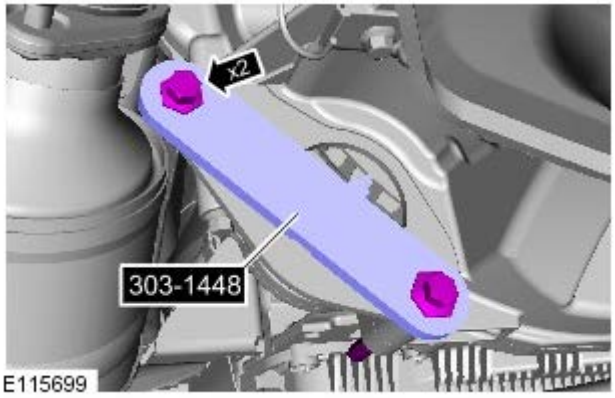
Make sure the crankshaft and flexplate mating faces are clean before installation.

Tighten the retaining bolts working diagonally.

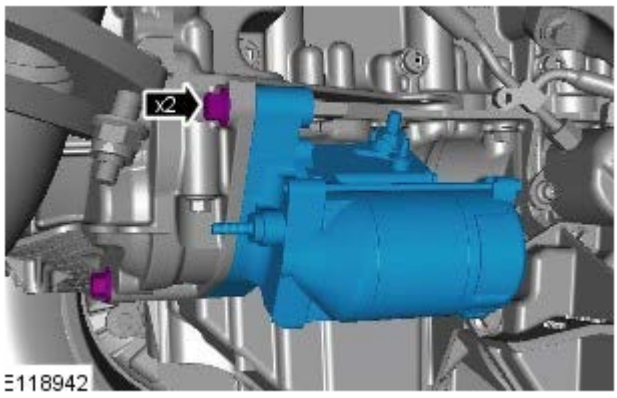
Torque:
Stage 1: 45 Nm
Stage 2: 90°

40.

- Remove the special tool.
- *Special Tool(s):* 303-1448

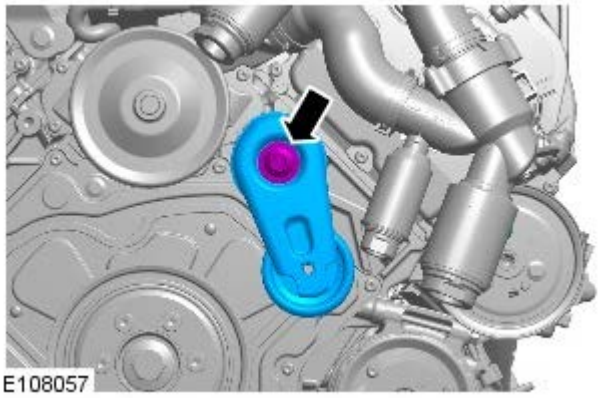


41. *Torque:* 48 Nm

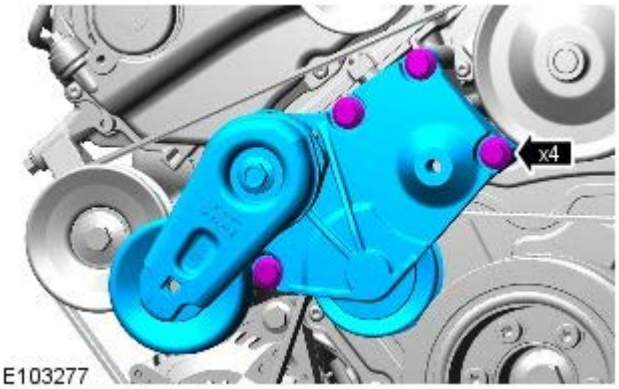


42. NOTE: Install the bolt finger tight before final tightening.

Torque: 40 Nm

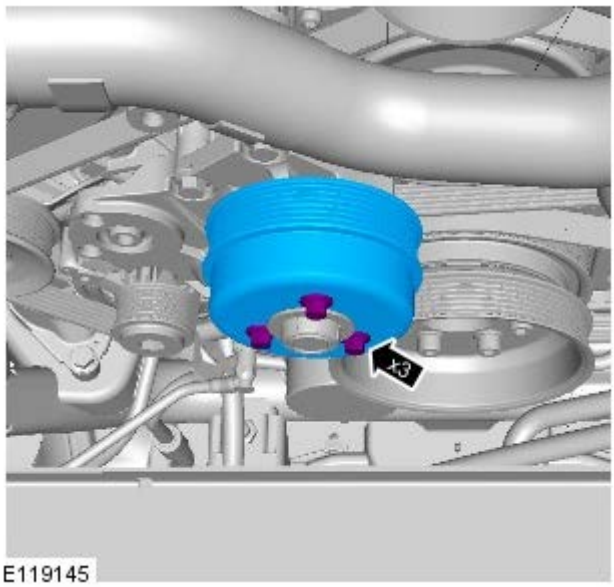

E108057

43. *Torque:* 25 Nm



E103277

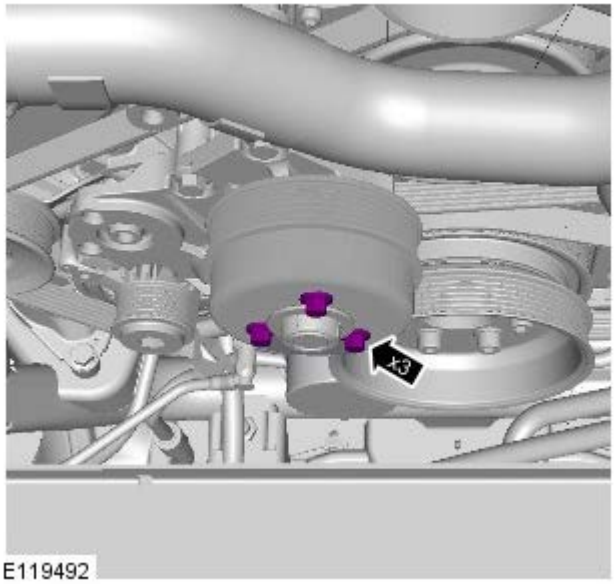
44. NOTE: Install bolts finger tight.



E119145

45. Refer to: Crankshaft Pulley (303-01 Engine - V8 S/C 5.0L Petrol, Removal and Installation).

46. *Torque:* 25 Nm



47. Refer to: Engine (303-01 Engine - V8 S/C 5.0L Petrol, Installation).

48. Lower the vehicle.

49. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 18-Oct-2011

Engine - V8 S/C 5.0L Petrol - Oil Pump

Removal and Installation

Removal

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

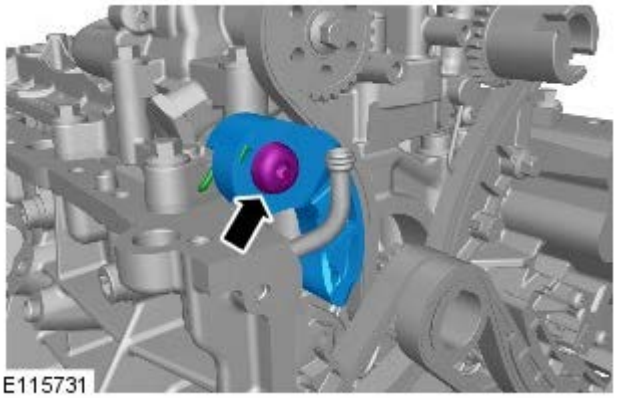
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

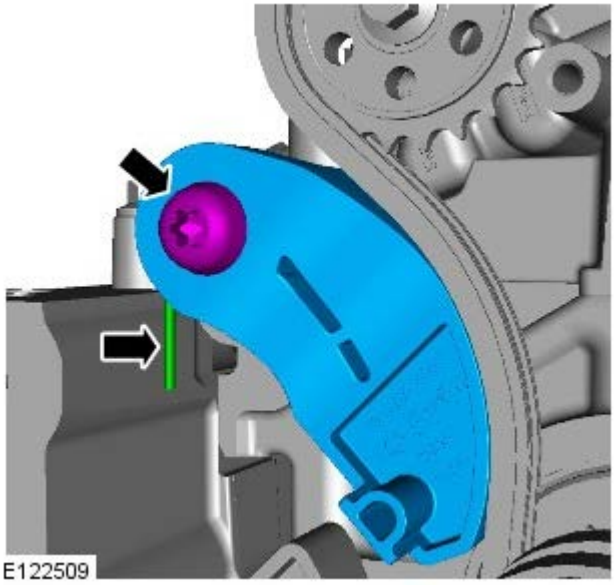
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Oil Pan Extension (303-01D, Removal and Installation).

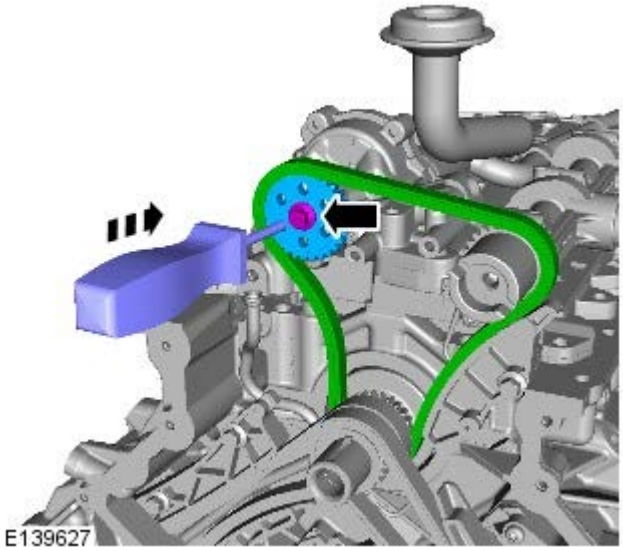


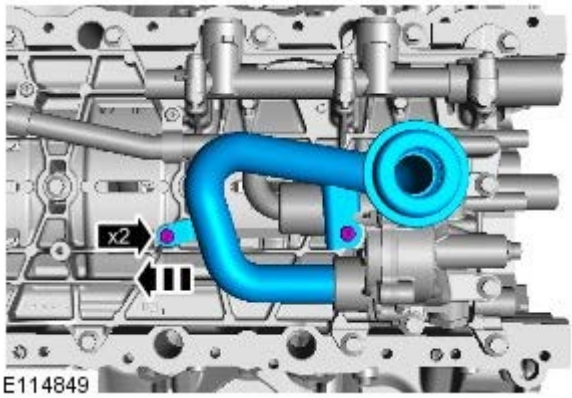
4. NOTE: Tsubaki timing drive only.



5. NOTE: INA timing drive only.

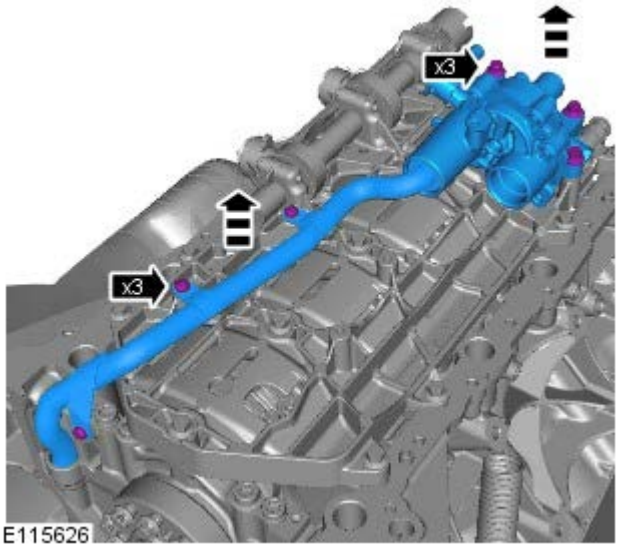
6.





7. NOTE: Remove and discard the O-ring seal.

8. CAUTION: Remove and discard the O-ring seals.



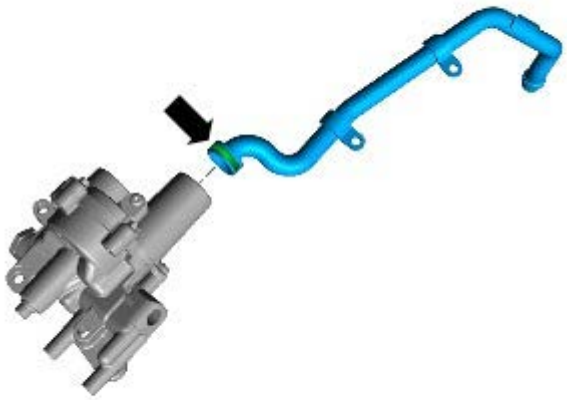
9. NOTE: Remove and discard the O-ring seal.



E139628

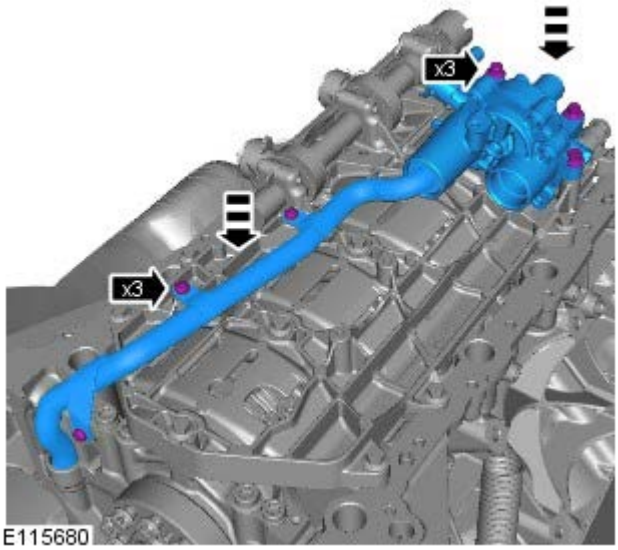
Installation

1. Lubricate and install the new O-ring seals.



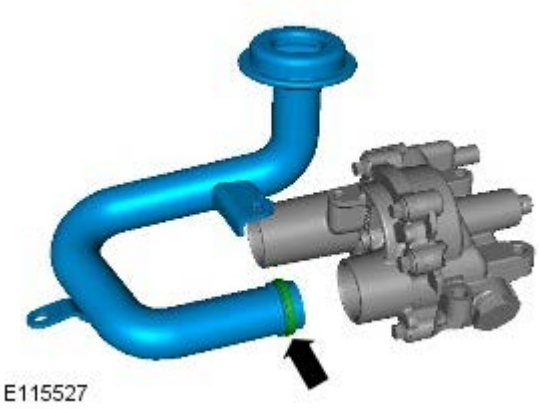
E139628

2. *Torque:*
   M8 25 Nm
   M6 12 Nm

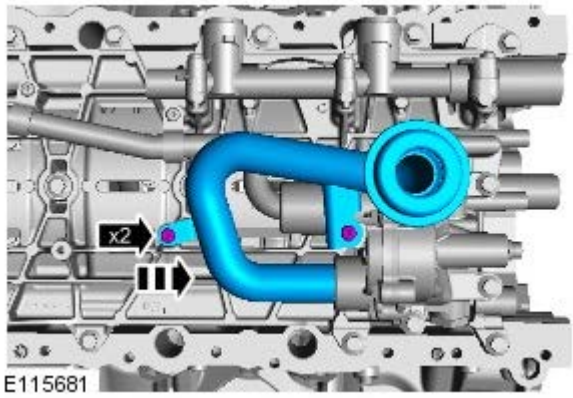


E115680

3. Lubricate and install a new O-ring seal.

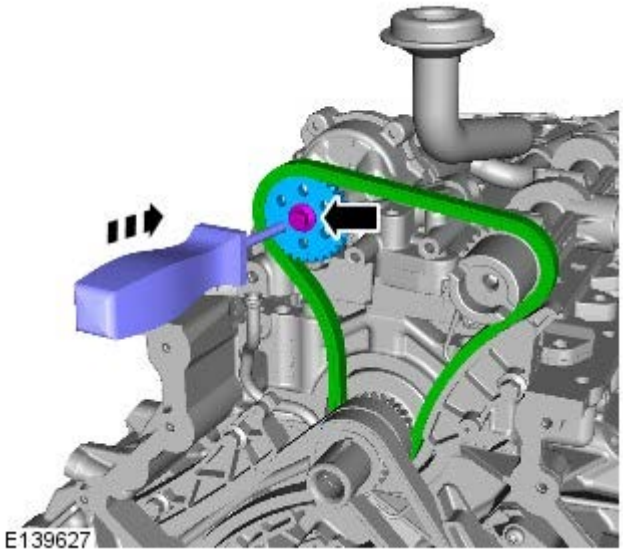

E115527

4. *Torque:* 12 Nm



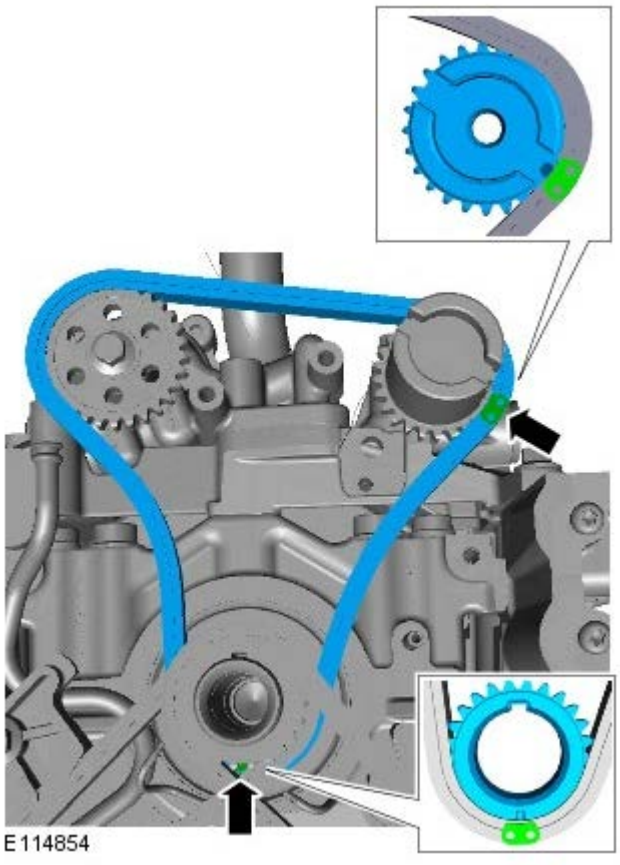
E115681

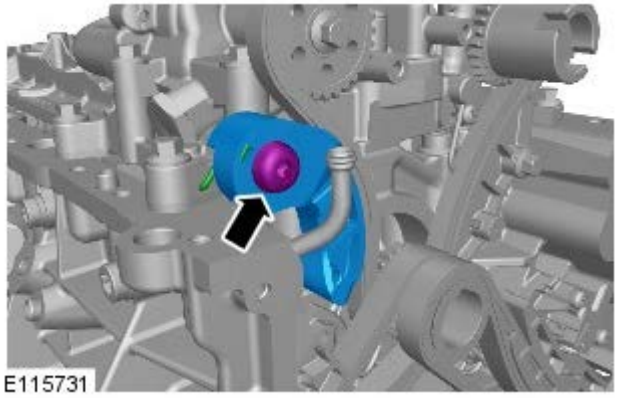
5. *Torque:* 21 Nm


E139627

6. NOTE: Tsubaki timing drive only.

   Install the lower timing chain making sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft and crankshaft sprocket markings.





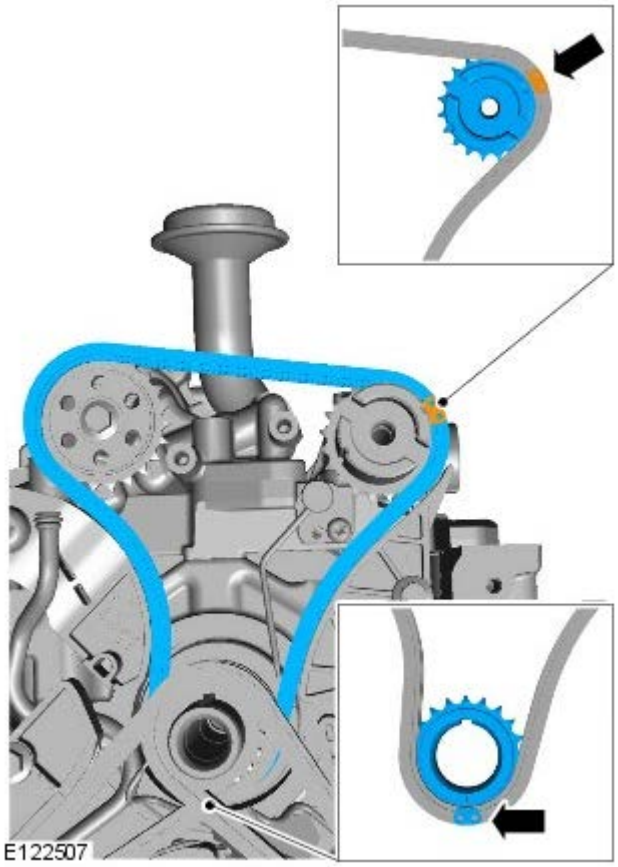
7. CAUTION: Make sure that the tensioner spring is correctly located.

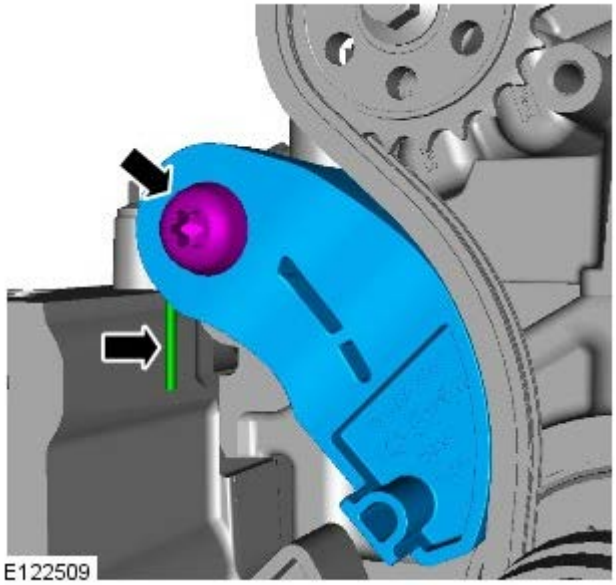
   NOTE: Tsubaki timing drive only.

   Torque: 21 Nm

8. NOTE: INA timing drive only.

   Install the lower timing chain making sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft and crankshaft sprocket markings.





9. CAUTION: Make sure that the tensioner spring is correctly located.

   NOTE: INA timing drive only.

   Torque: 21 Nm

10. Refer to: Oil Pan Extension (303-01D, Removal and Installation).

11. Connect the battery ground cable.

    Refer to: Specifications (414-00, Specifications).

Published: 19-Jun-2012

Engine - V8 S/C 5.0L Petrol - Timing Cover

Removal and Installation

Special Tool(s)

 E107676	303-1433 Lower Timing Cover Alignment tool

Removal

NOTE: Removal steps in this procedure may contain installation details.

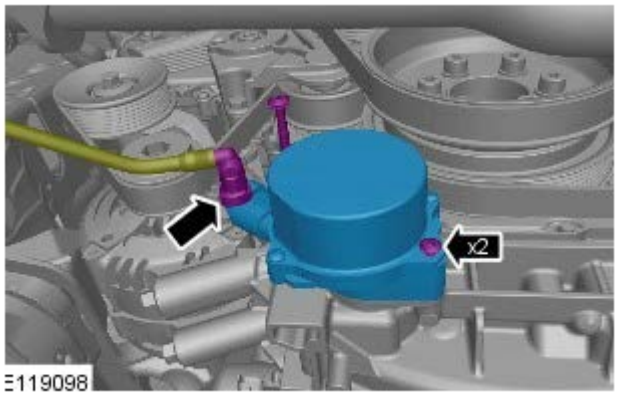
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Crankshaft Pulley (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).



4. CAUTION: Be prepared to collect escaping oil.

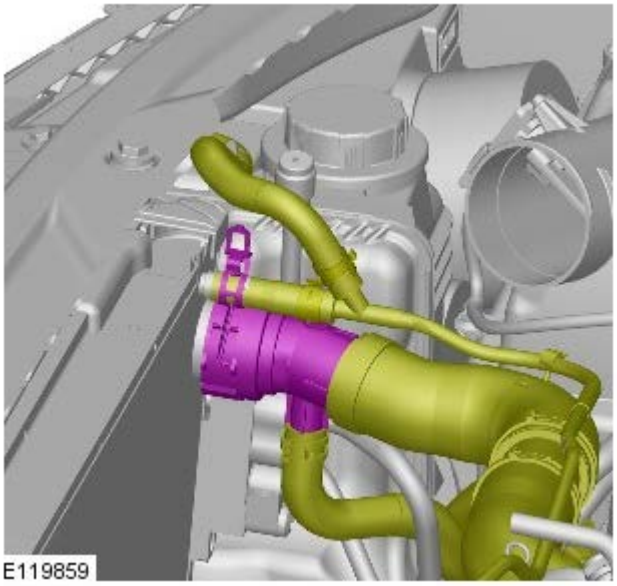
   NOTE: Discard the seal.

5. Refer to: Valve Cover LH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

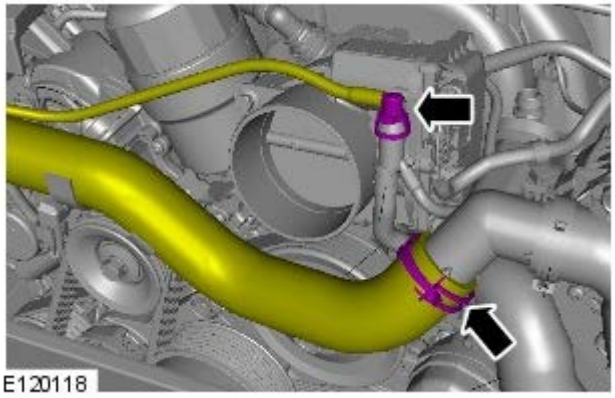
6. Refer to: Valve Cover RH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

7. Refer to: Cooling System Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

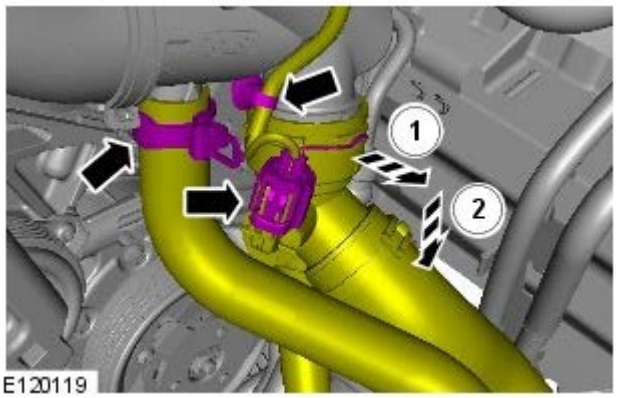
8.



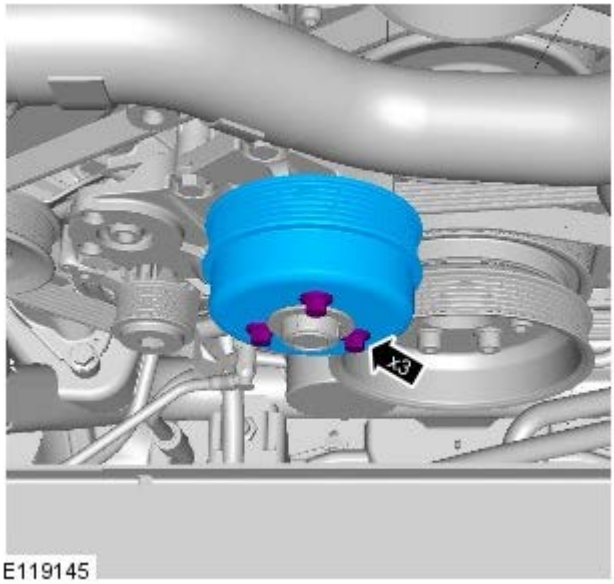
9.



10. CAUTION: Be prepared to collect escaping coolant.

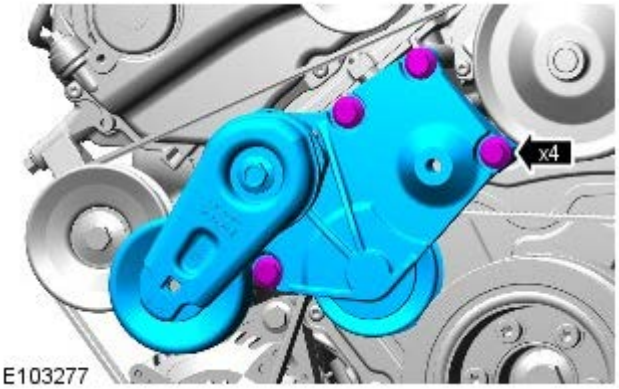


11.



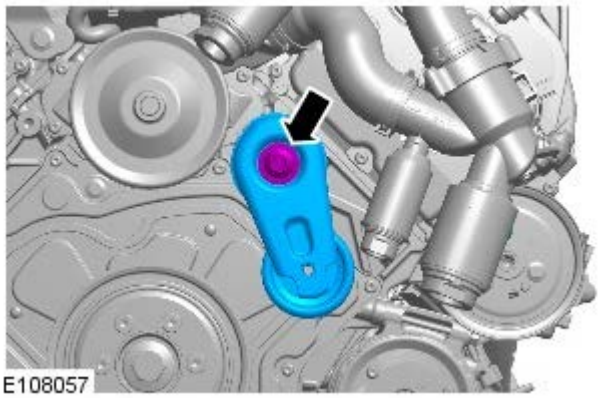
E119145

12.

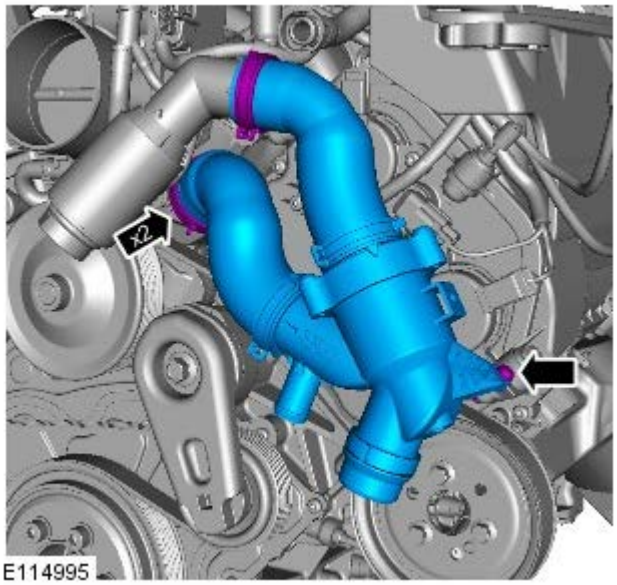


E103277

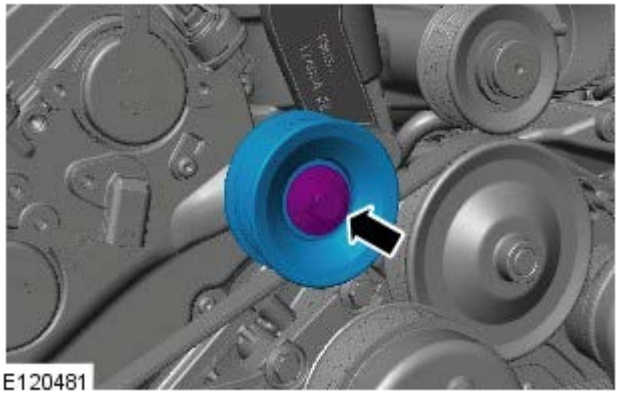
13.


E108057

14.



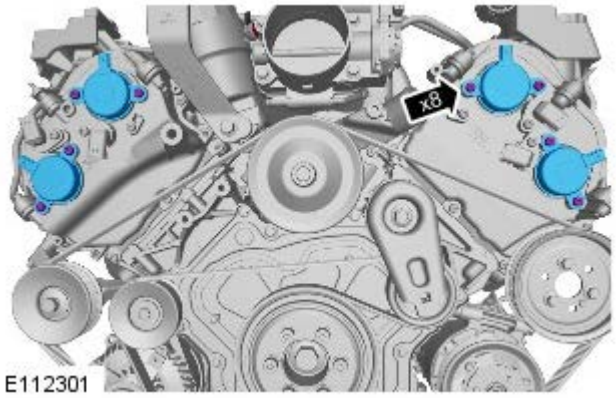
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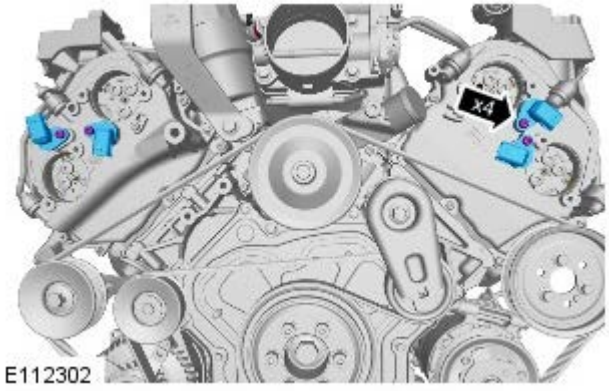
16.



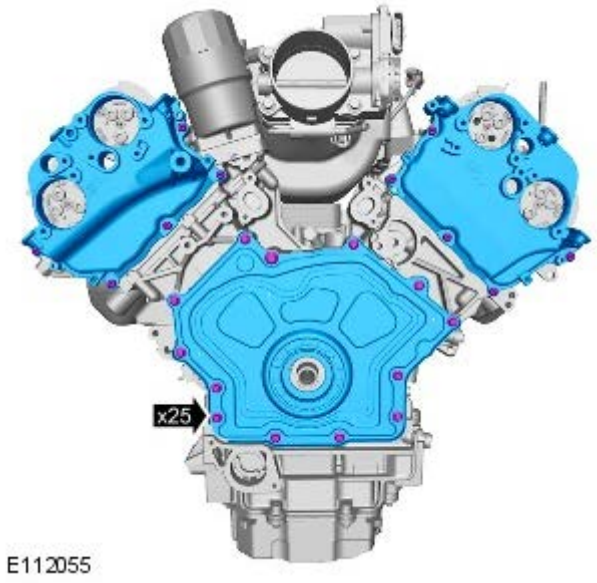
17.



18.

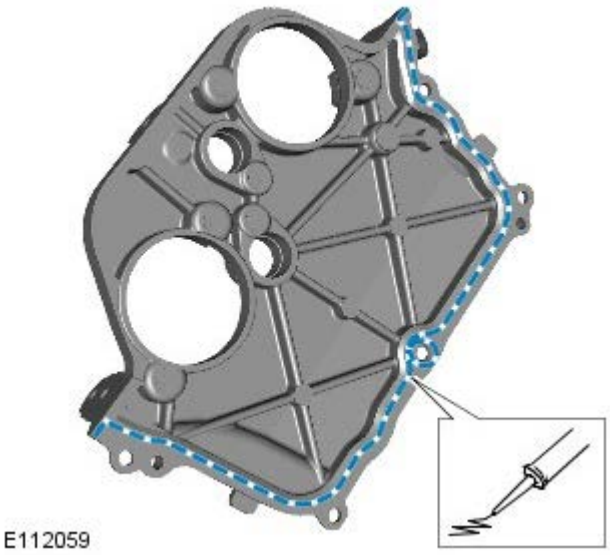


19.



Installation

1. CAUTION: Make sure that the mating faces are clean and free of foreign material.
    - Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.



E112059



E112060



E112061

2. CAUTION: Make sure that the mating faces are clean and free of foreign material.
    - Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

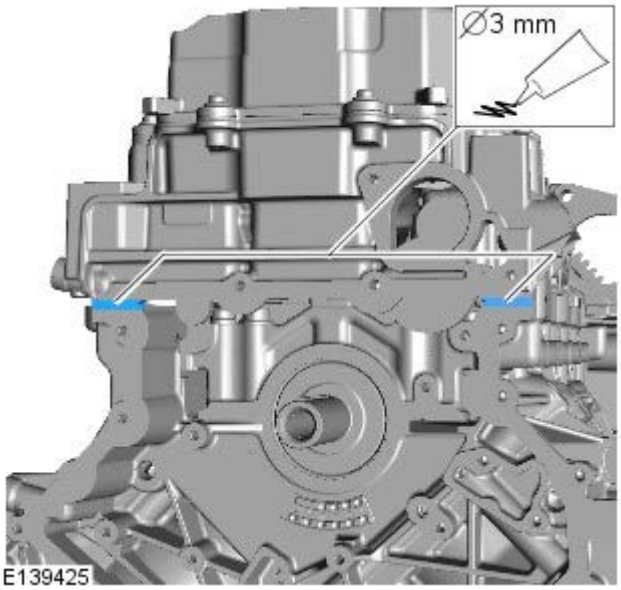
3. NOTE: Tighten the bolts in the indicated sequence.

    Torque: 12 Nm

4. NOTE: Tighten the bolts in the indicated sequence.

    Torque: 12 Nm





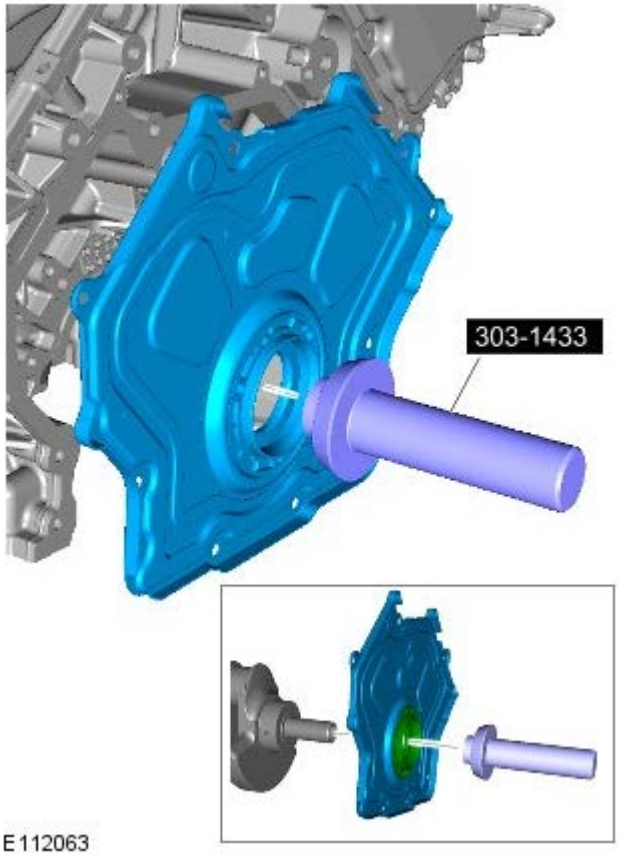
5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

6. CAUTION: Make sure that the mating faces are clean and free of foreign material.

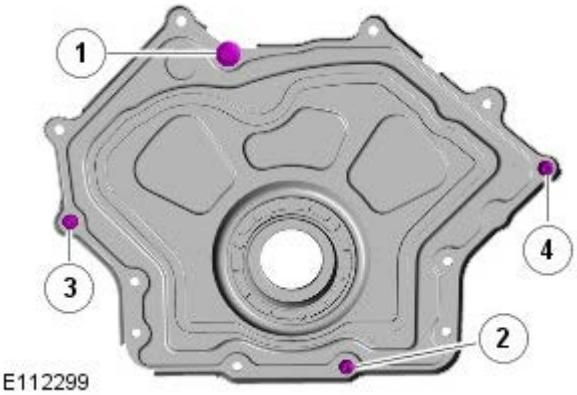
   Install the bolts, but do not tighten fully at this stage.

   Special Tool(s): 303-1433



E112063

7. *Torque:*
   M6 12 Nm
   M8 20 Nm



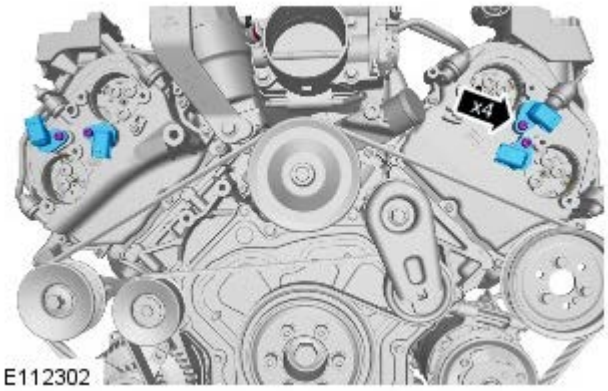
E112299

8. *Torque:* 12 Nm



E112300

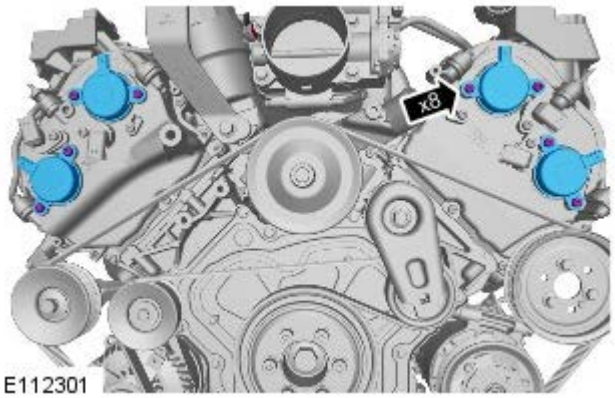
9. *Torque:* 12 Nm



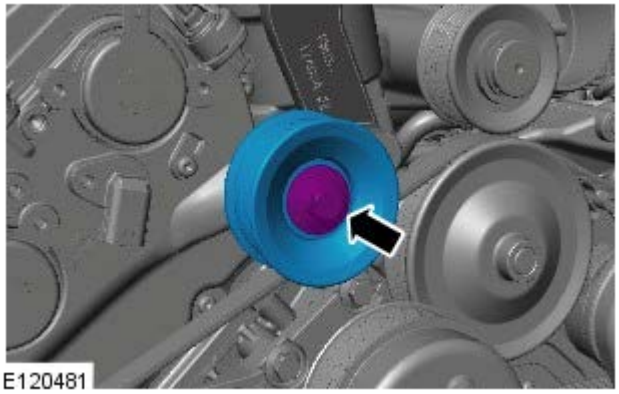
10. *Torque:* 25 Nm



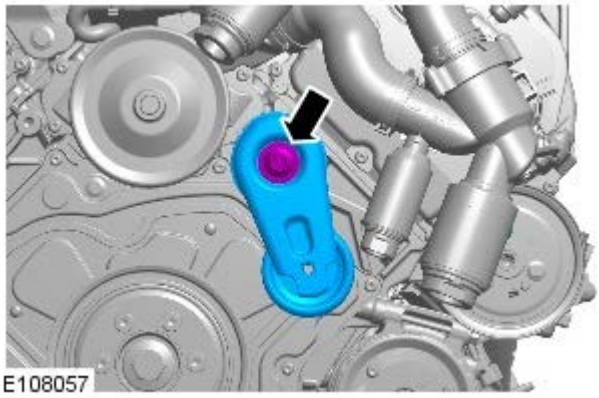
11. *Torque:* 12 Nm



12. *Torque:* 40 Nm

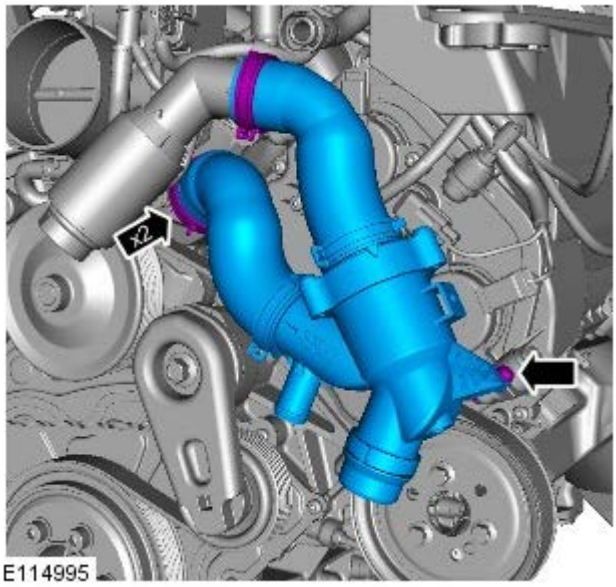


13. NOTE: Install the bolt finger tight before final tightening.

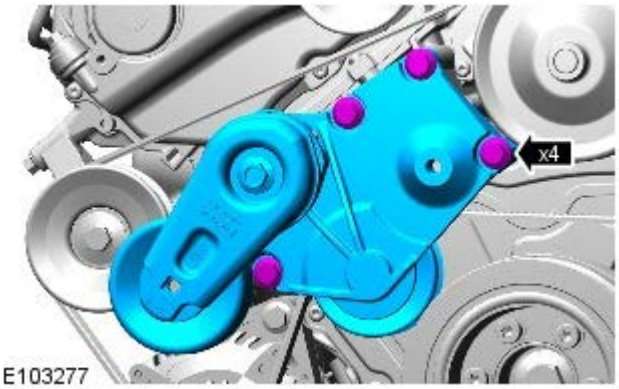


Torque: 40 Nm

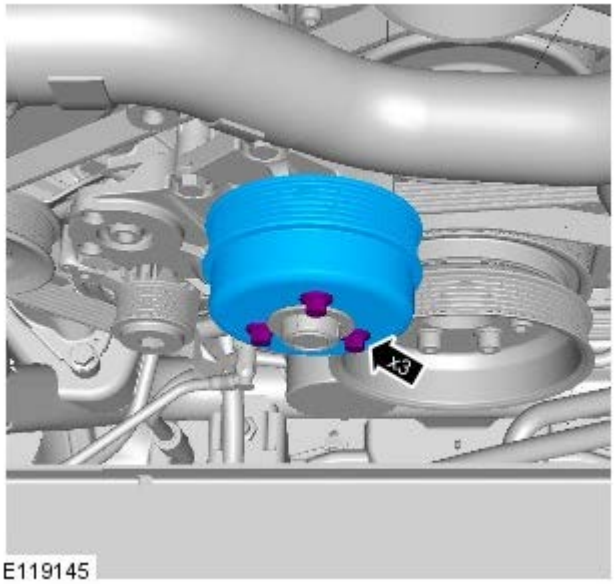
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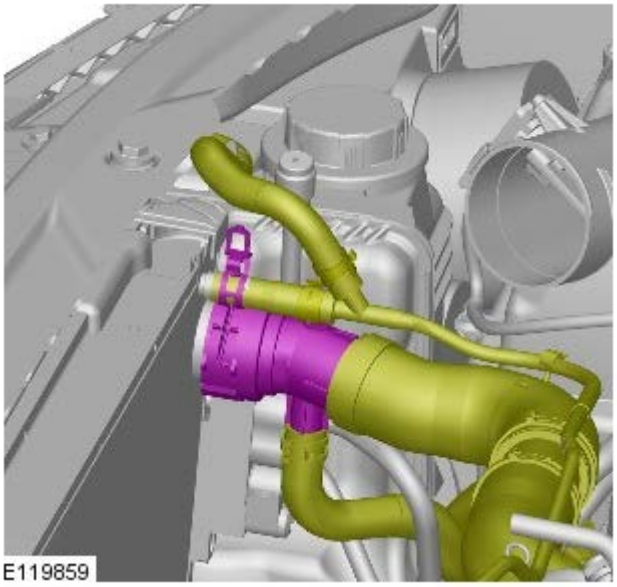
15. *Torque:* 25 Nm



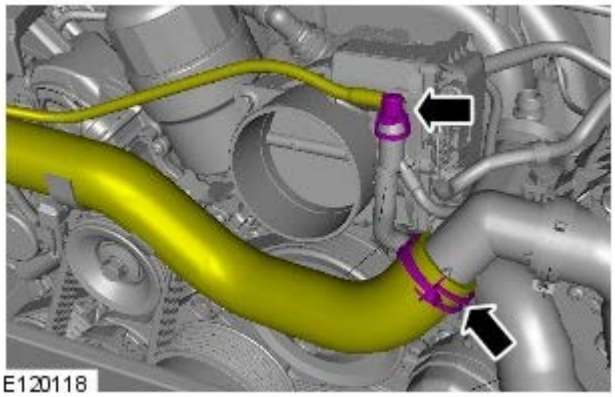
16. *Torque:* 25 Nm



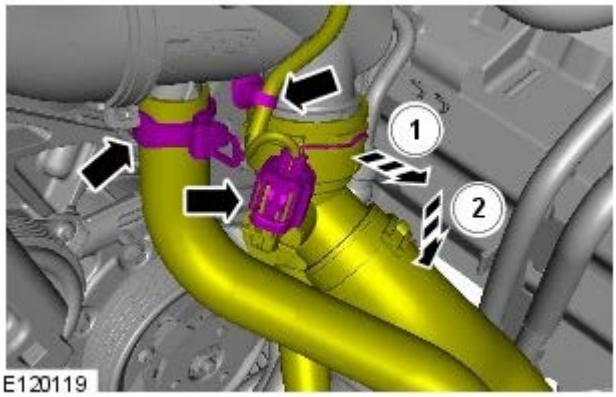
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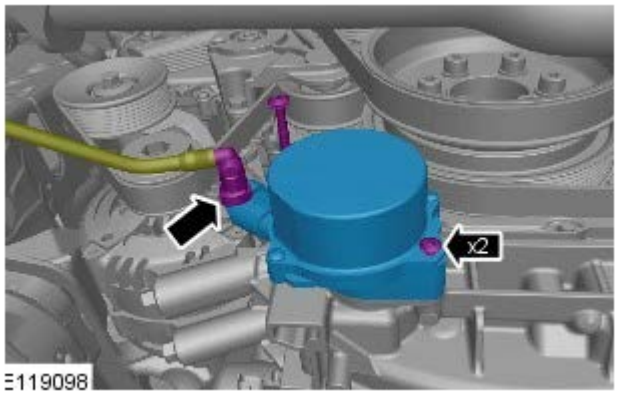


18.



19.





20. NOTE: Install a new seal.

    Torque: 12 Nm

21. Refer to: Crankshaft Pulley (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

22. Refer to: Valve Cover LH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

23. Refer to: Valve Cover RH (303-01C Engine - V8 S/C 5.0L Petrol, Removal and Installation).

24. Refer to: Cooling System Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

25. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

26. Check and top up the engine oil.

Published: 07-Jun-2012

Engine - V8 S/C 5.0L Petrol - Timing Drive Components Assembly Part Number: INA Timing Drive

Removal and Installation

Special Tool(s)

 E115263	303-1445 Timing Tool – Camshaft Alignment
 E115265	303-1447 Timing Tool
 E115266	303-1448 Locking Tool
 E115270	303-1452 Camshaft Rotating Tool
 E115271	303-1482 Tensioner Tool

Removal

CAUTION: Check all timing components for wear and install new components if required.

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

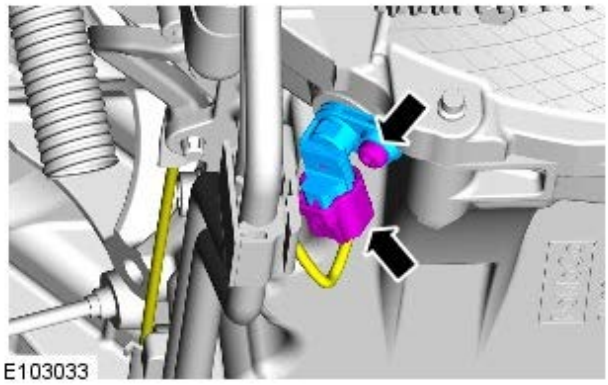
2. WARNING: Make sure to support the vehicle with axle

stands.

Raise and support the vehicle.

3. Refer to: Timing Cover (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

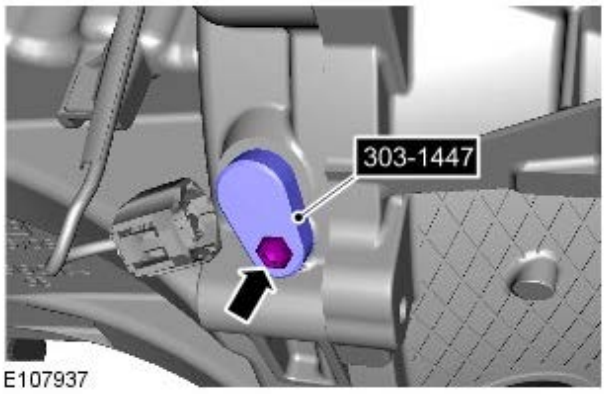
4.



5. CAUTION: Only rotate the crankshaft clockwise.

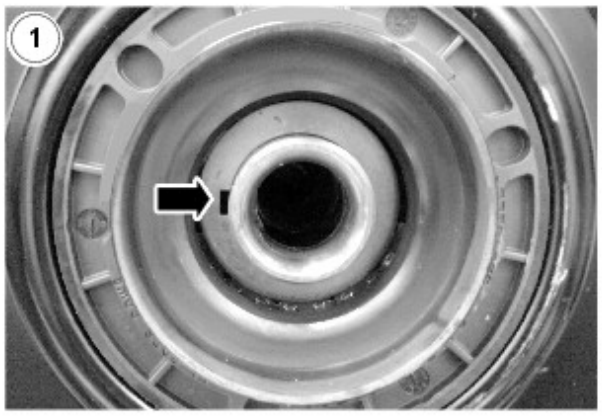
Install the special tool.

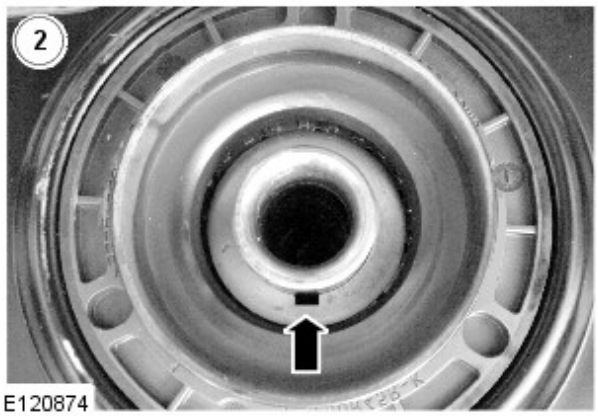
Special Tool(s): 303-1447



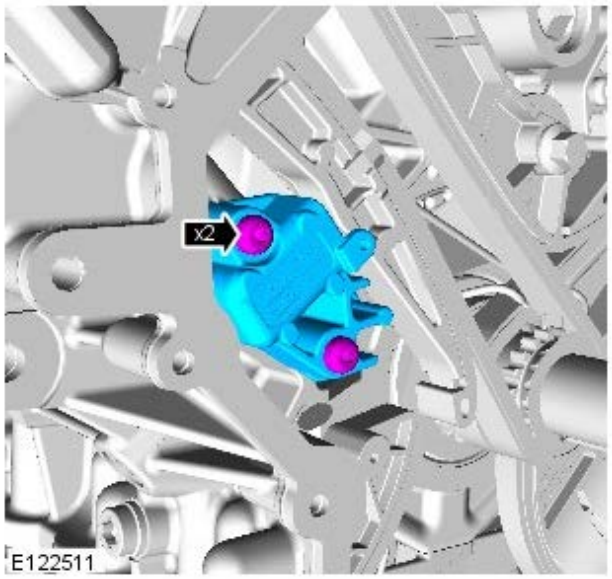
6. CAUTION: If the noted postion of the woodruff key is at the 9 o'clock position, then a new flexplate must be installed. If the woodruff key is in the 6 o'clock position then proceed with the next step.

Note the position of the crankshaft woodruff key.

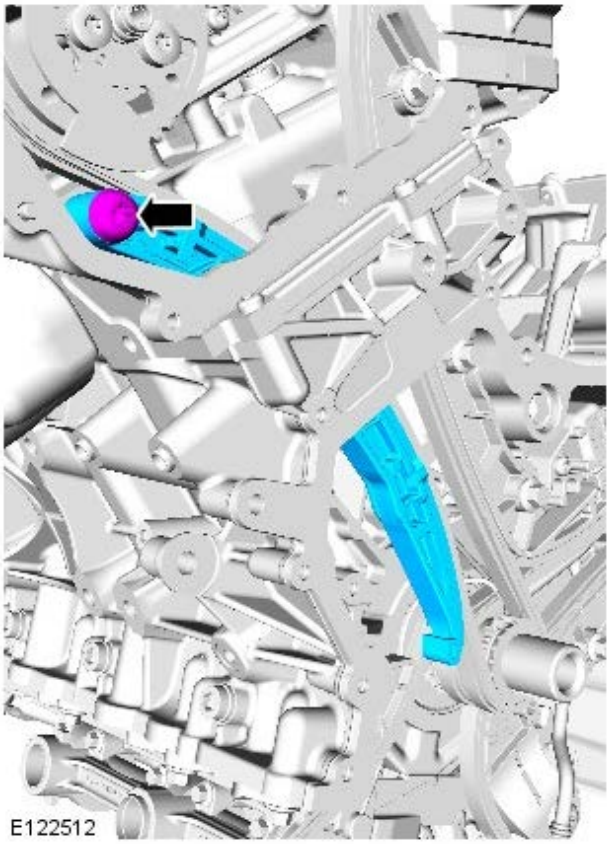




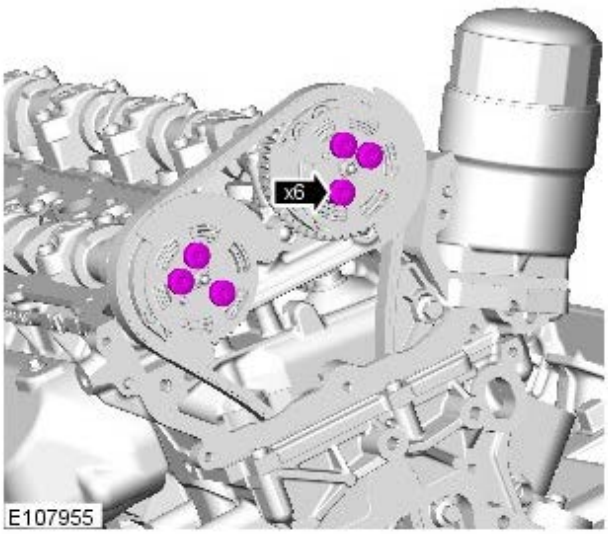
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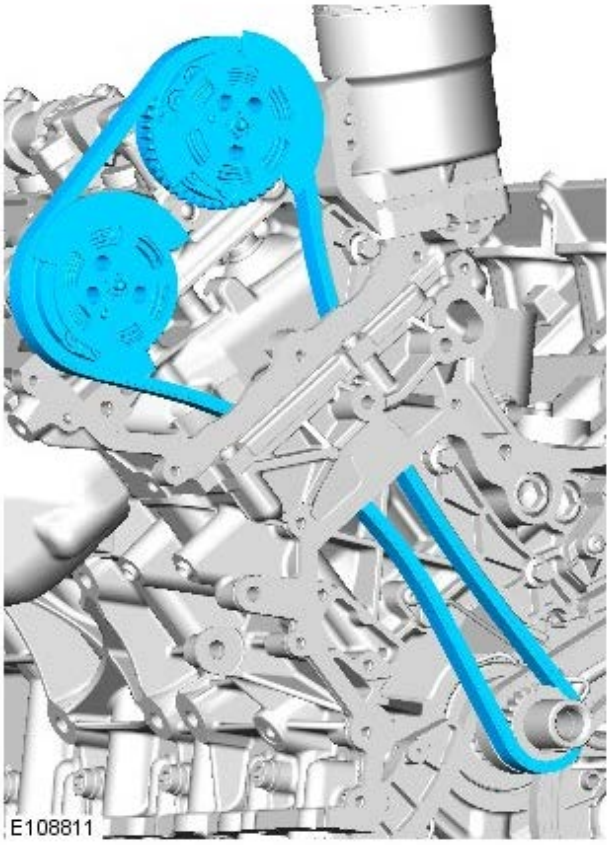


8.



9.

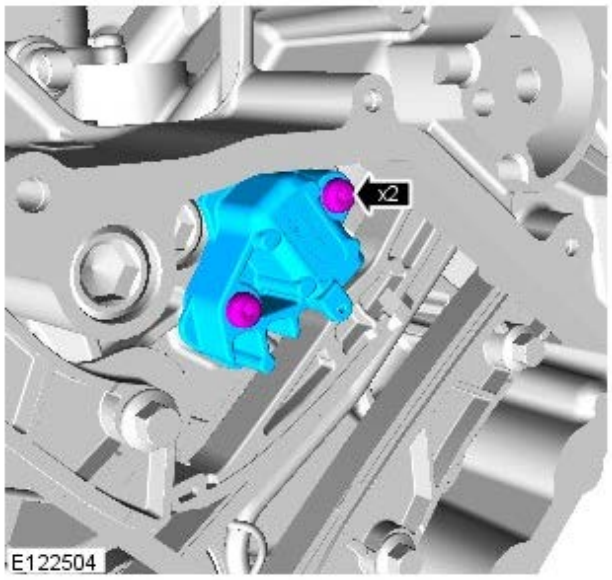




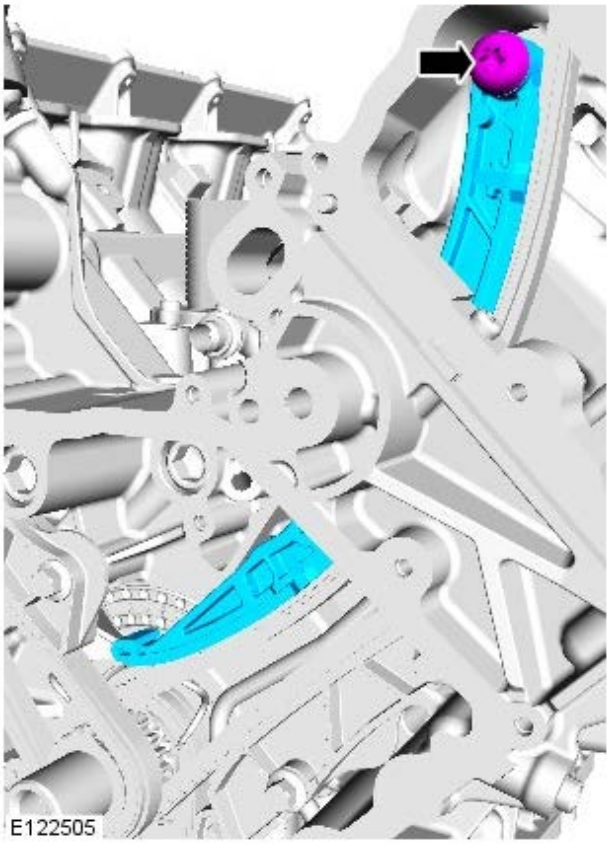
10. CAUTION: If the variable valve timing (VVT) units are knocked or dropped then the VVT must be replaced.

    Remove the timing chain with the VVT units.

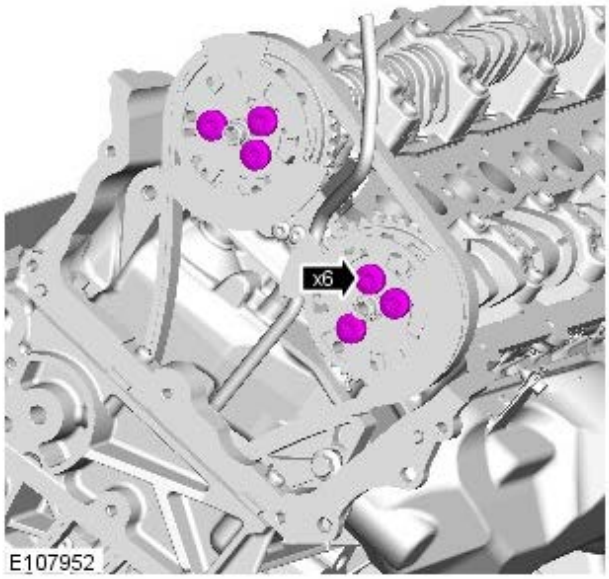
11.



12.

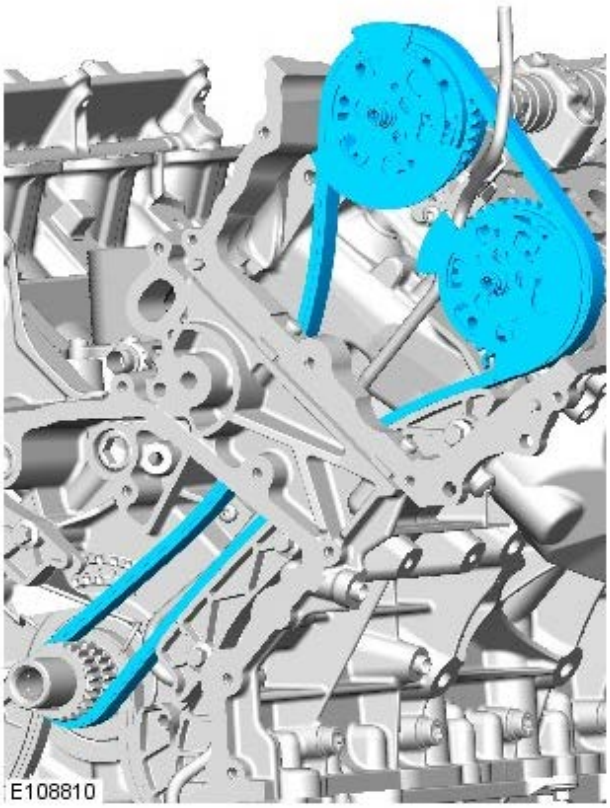


13.

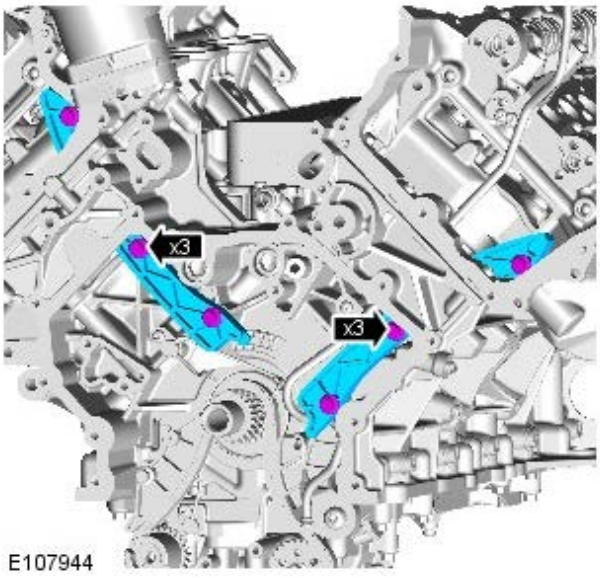


14. CAUTION: If the VVT is knocked or dropped then the VVT must be replaced.

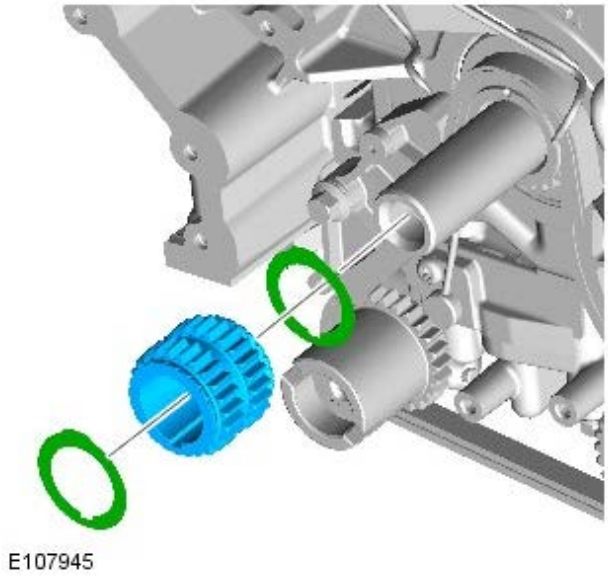
    Remove the timing chain with the VVT units.



15.

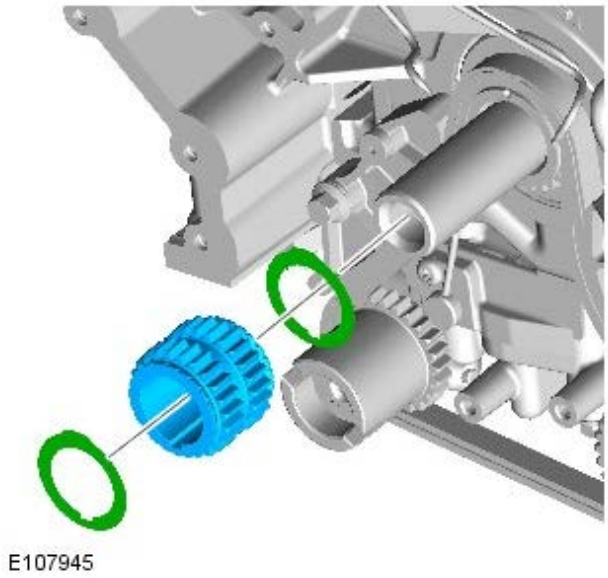


16. CAUTION: Discard the friction washer.

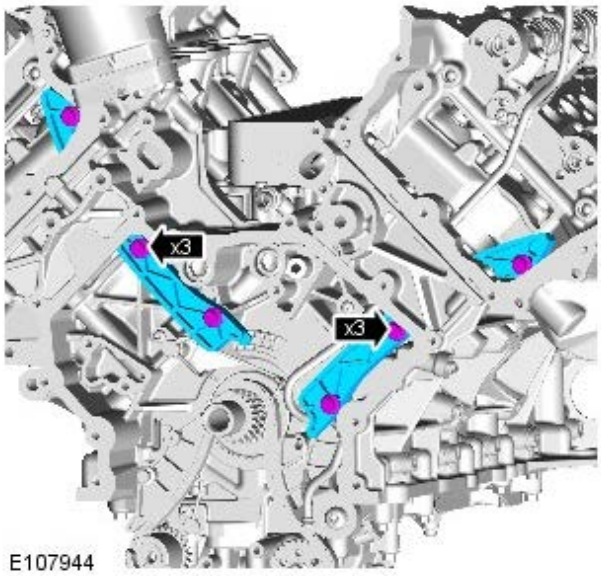


Installation

1. CAUTION: Install a new friction washer.

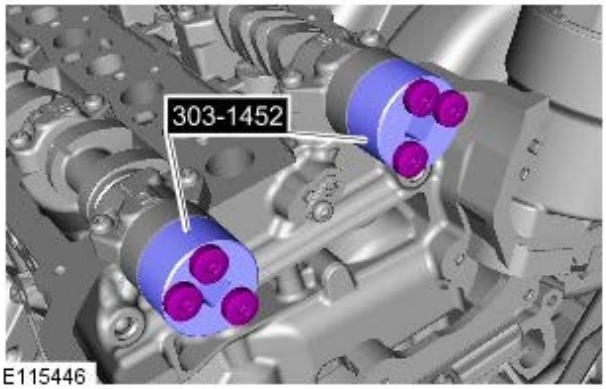


2. *Torque:* 12 Nm



3.

- Install the special tool to each Camshaft.
- *Special Tool(s):* 303-1452
- *Torque:* 10 Nm



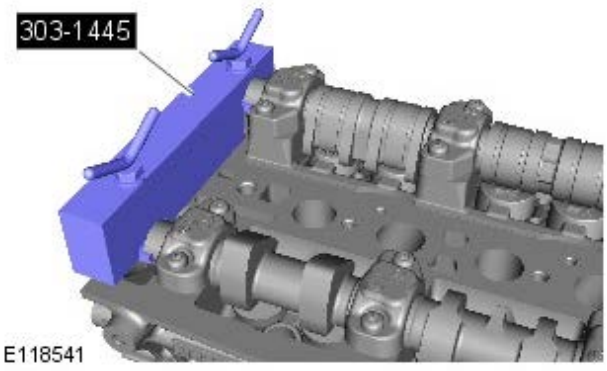
4.

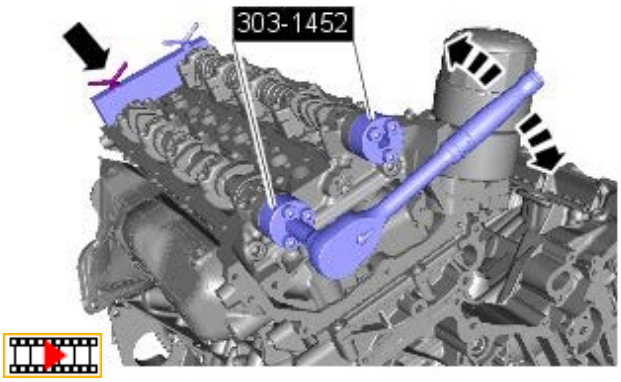
- Carefully rotate the camshafts if the position is not as shown.



5.

- Install the special tool 303-1445 to the rear of the camshafts making sure the key way's are correctly located into each slot on each of the camshafts.





6. CAUTIONS:

Do not overturn the camshafts.

Tighten the wing nuts finger tight. Failure to follow this instruction may result in damage to the components.

- Using a suitable tool, carefully rock the camshaft clockwise then anti-clockwise. Turn the special tool locking nuts until there is no movement left in camshafts.
- Repeat steps 3- 6 for the camshafts on the other cylinder head.

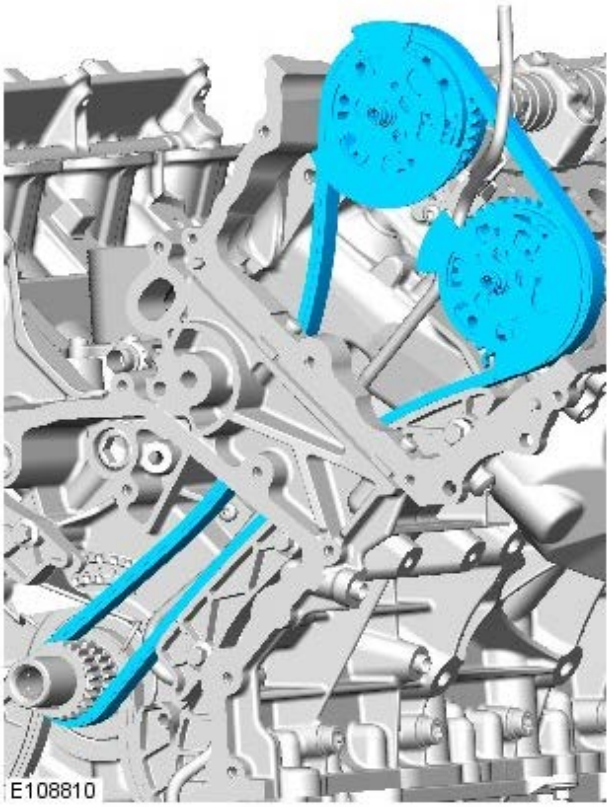
7. CAUTIONS:

Do not allow the camshaft to rotate.

If the VVT is knocked or dropped then the VVT must be replaced.

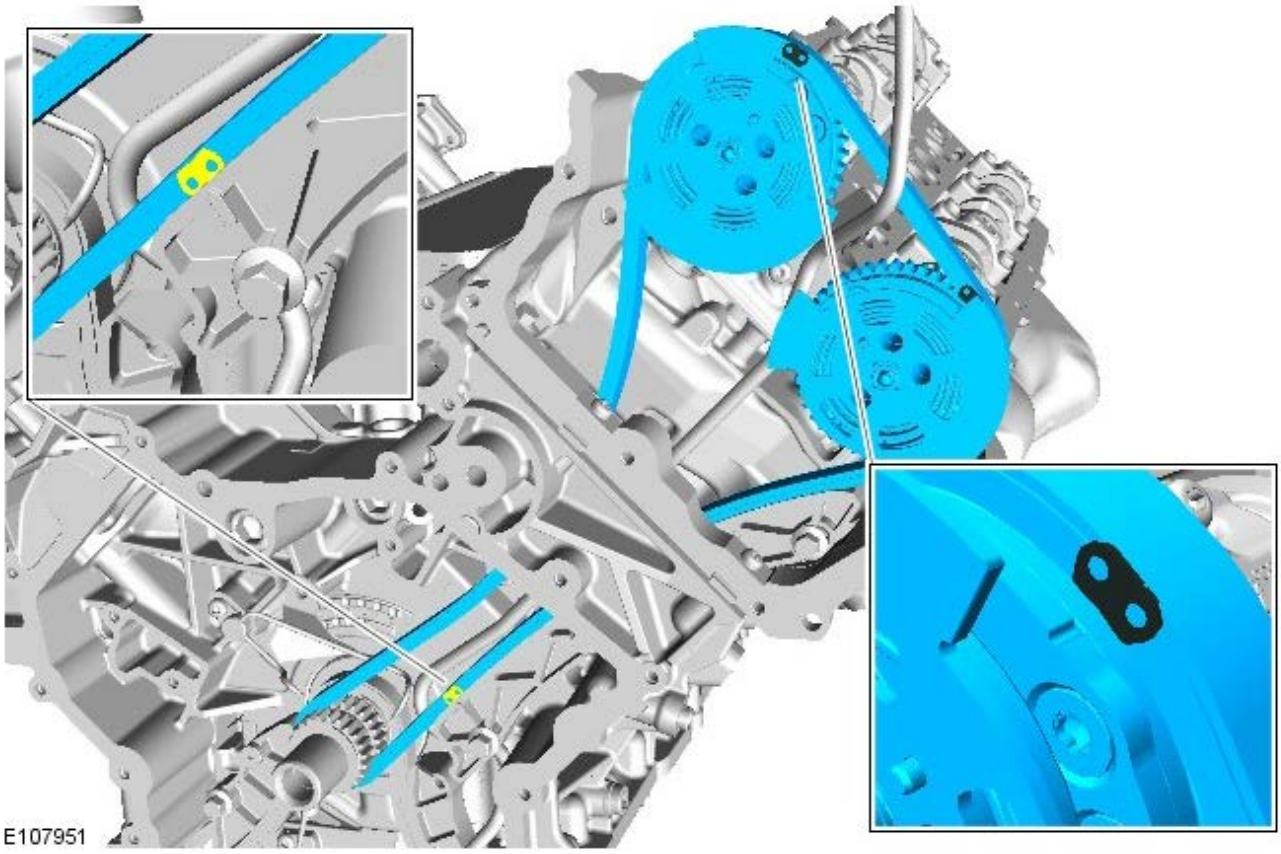
NOTE: Do not tighten at this stage.

- Install the timing chain with the variable valve timing (VVT) units.

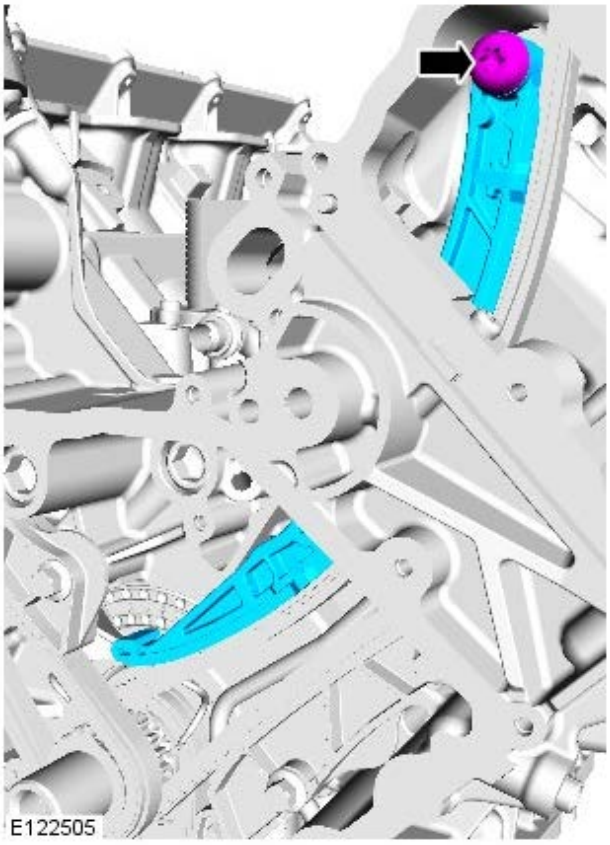


8.

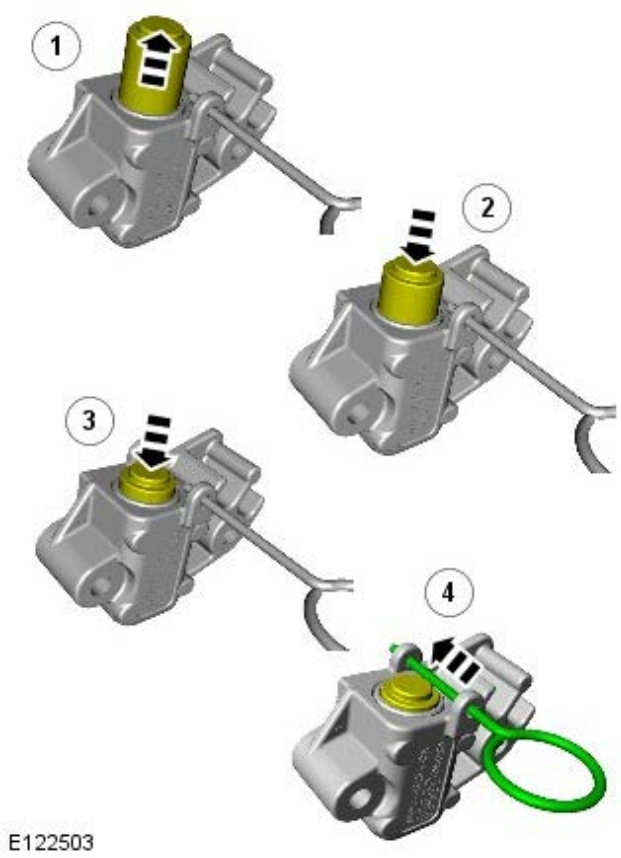
- Make sure that all the timing chain alignment marks are in the positions shown.



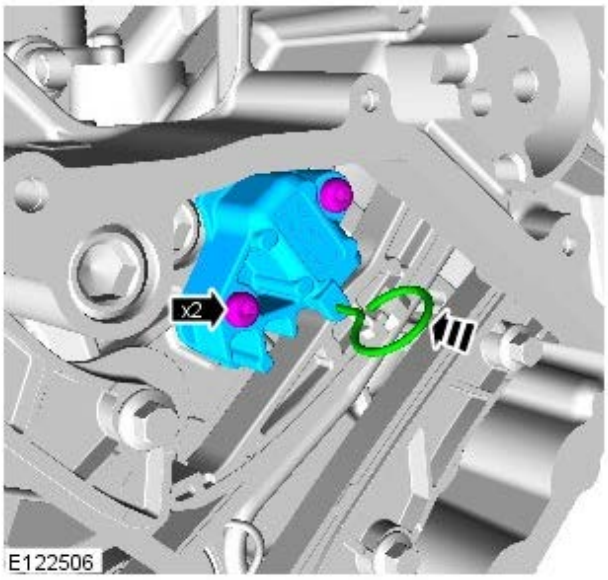
9. *Torque:* 25 Nm



10. Make sure the tensioner piston is fully extended. Then fully depress and lock the tensioner piston with the grenade pin before installation, failure to do this may result in damage to the engine.



E122503



E122506

11. CAUTION: Do not release the timing chain tensioner locking pin at this stage.

    Torque: 10 Nm

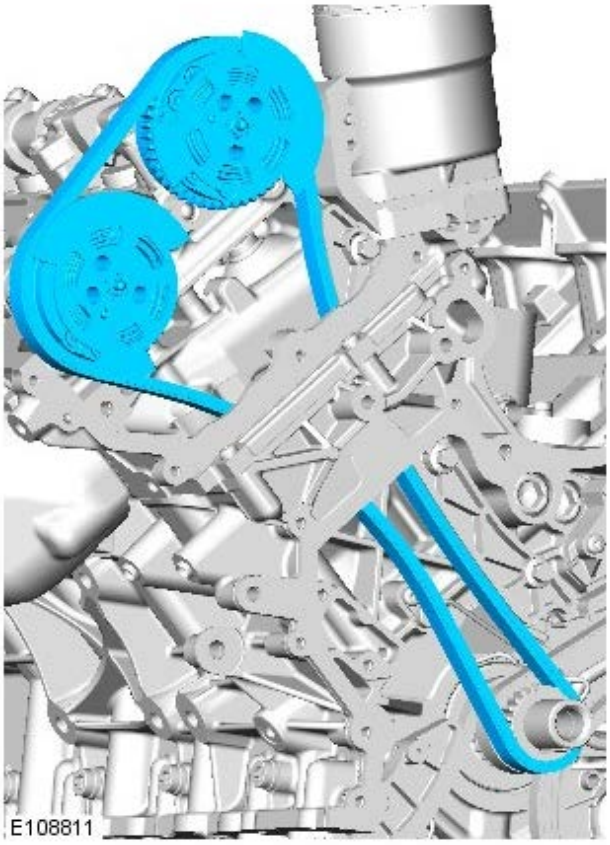
12. CAUTIONS:

    Do not allow the camshafts to rotate.

    If the VVT is knocked or dropped then the VVT must be replaced.

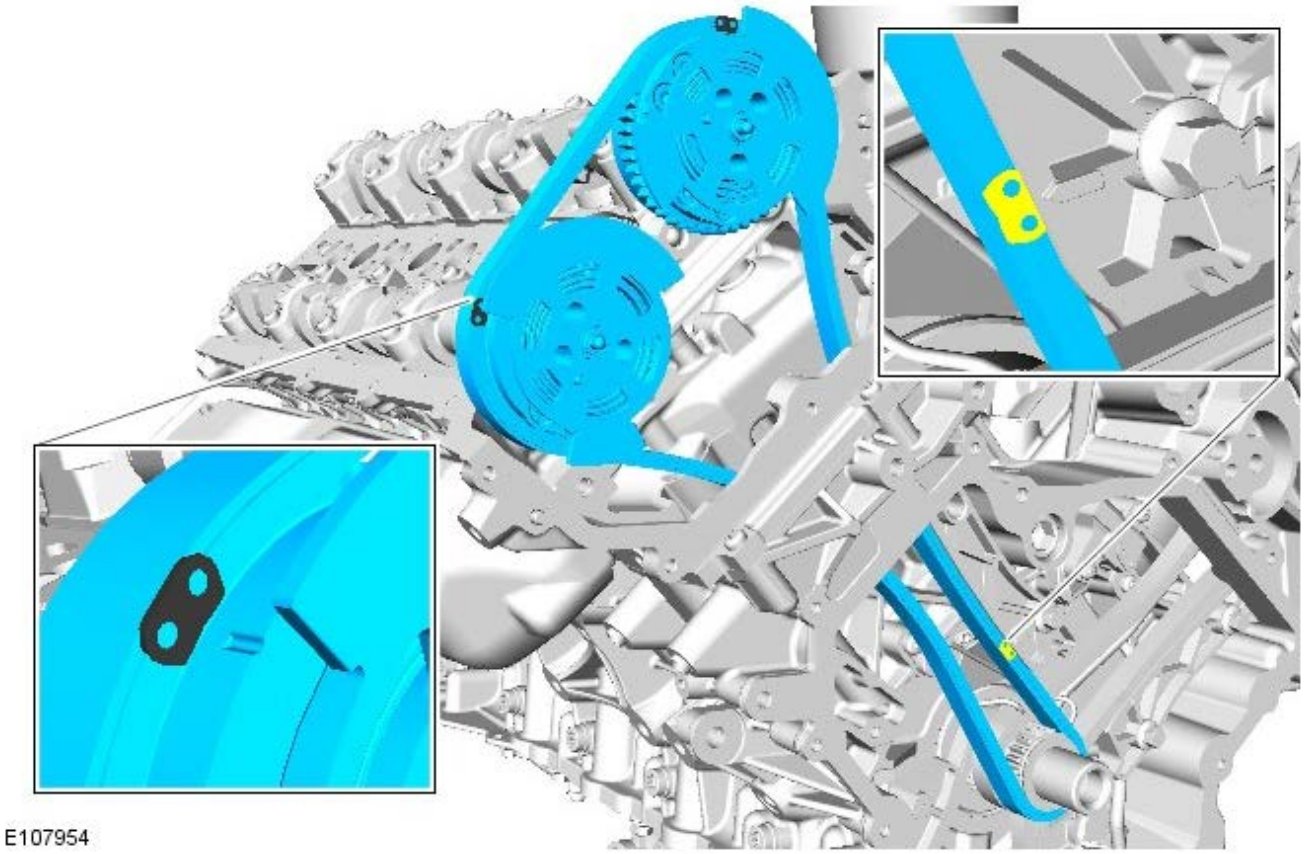
    NOTE: Do not tighten at this stage.

    - Install the timing chain with the VVT units.

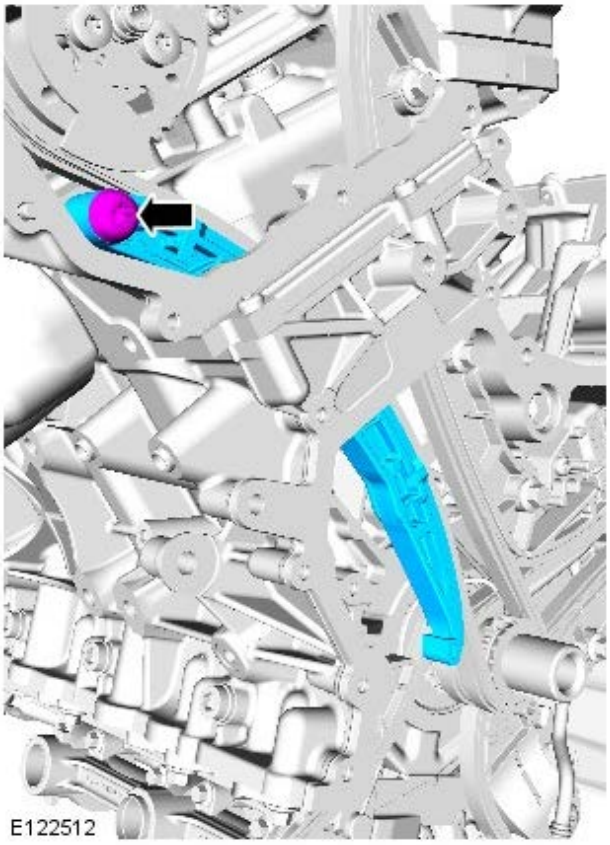


13.

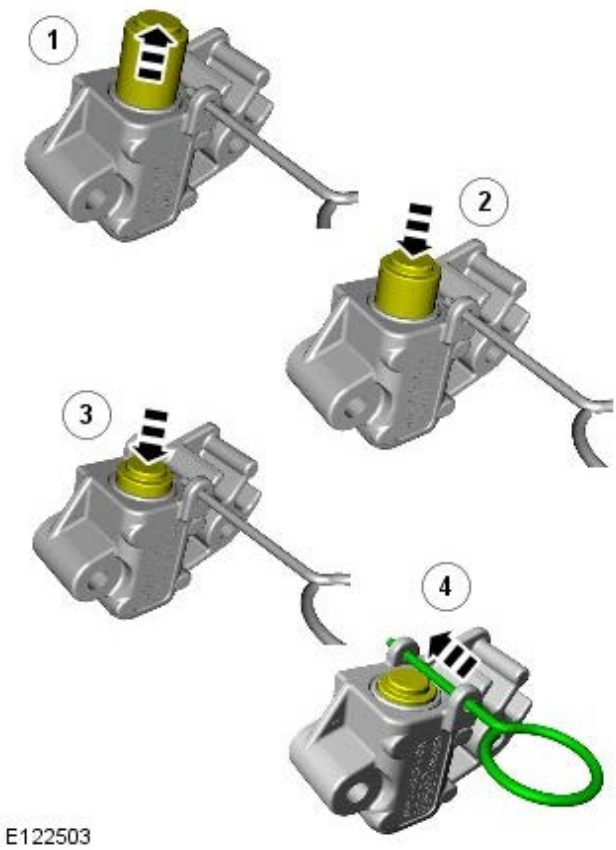
- Make sure that all the timing chain alignment marks are in the positions shown.



14. *Torque:* 25 Nm

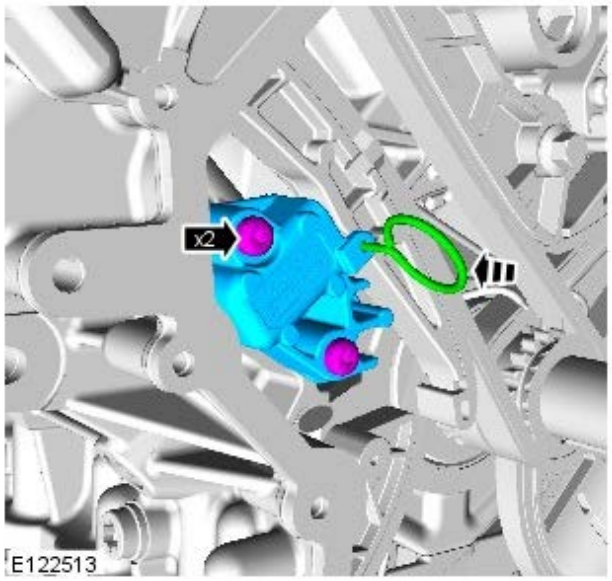


15. Make sure the tensioner piston is fully extended. Then fully depress and lock the tensioner piston with the grenade pin before installation, failure to do this may result in damage to the engine.

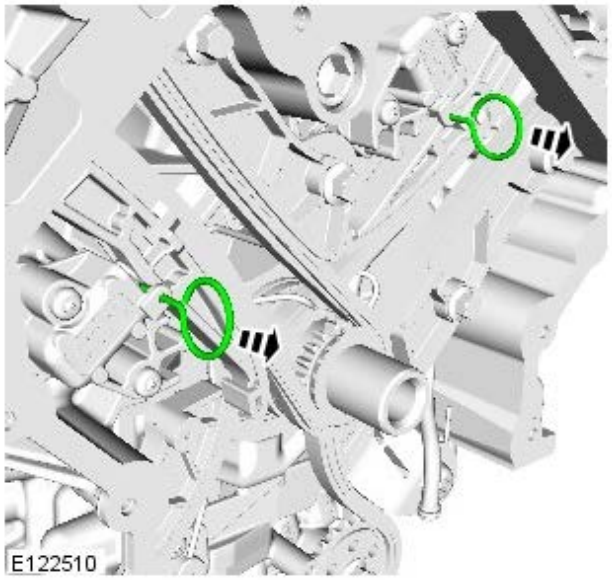


16. CAUTION: Do not release the timing chain tensioner locking pin at this stage.

Torque: 10 Nm



17.

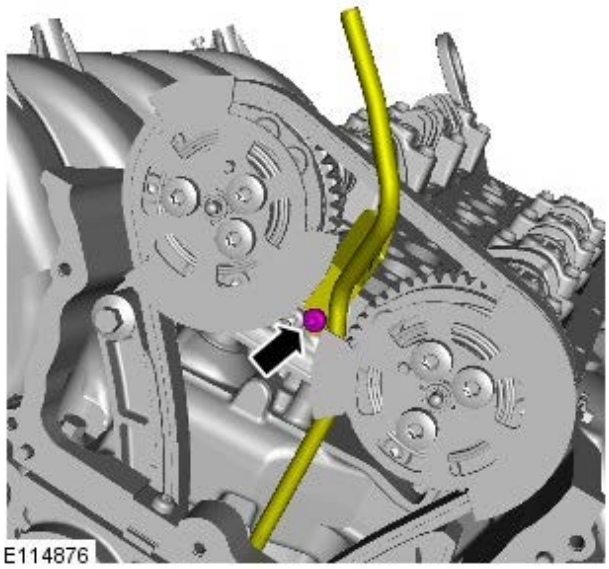


18. CAUTION: Do not use mechanical force.

Make sure that the tensioners are fully deployed.

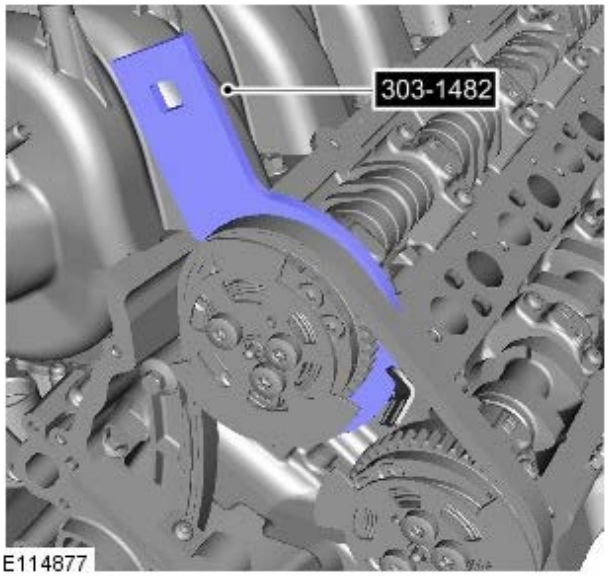
19.

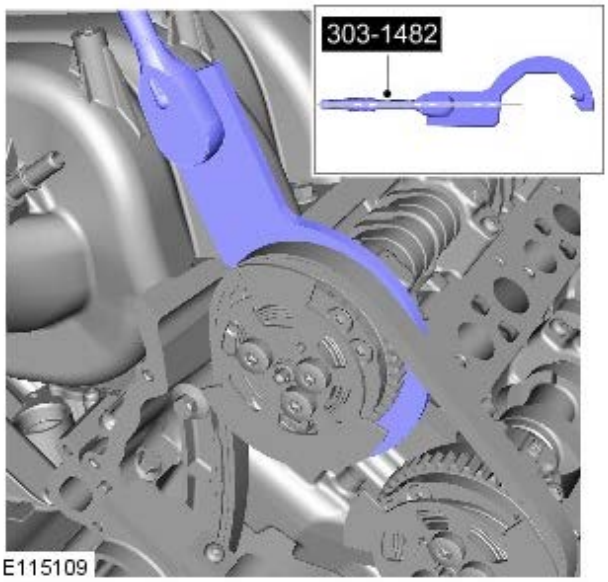
- Release and reposition the oil suction tube to one side.



20.

- Install the special tool.
- *Special Tool(s):* 303-1482



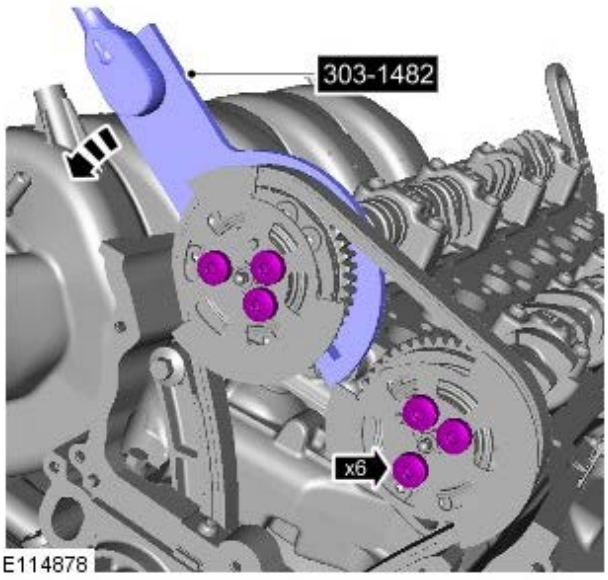


21. CAUTIONS:

Apply the torque to the end of the special tool.

Make sure that the torque wrench is aligned with the special tool as illustrated in the graphic.

- Install the torque wrench to the special tool.
- *Torque:* 35 Nm



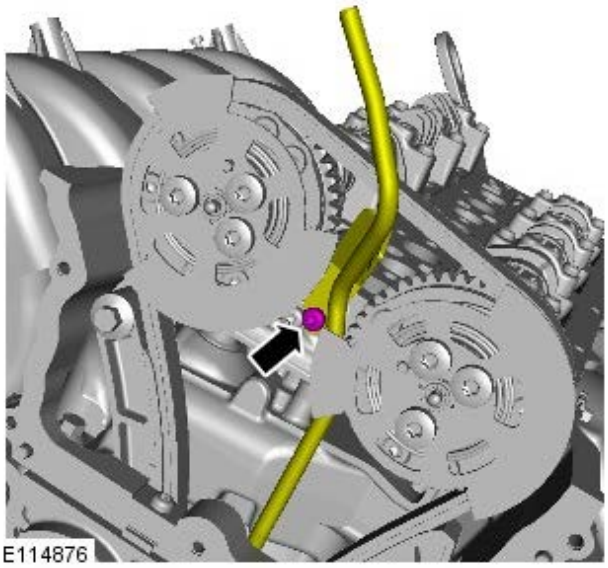
22. CAUTION: Make sure that the torque wrench does not move whilst tightening the VVT bolts.

NOTE: Make sure to tighten the exhaust VVT unit bolts first.

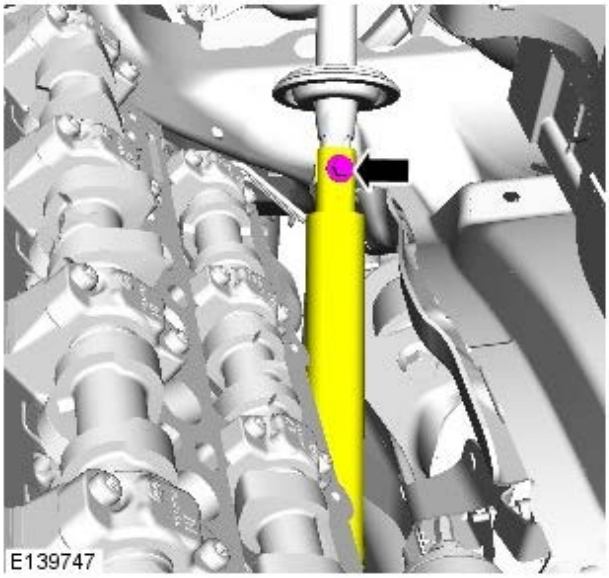
- *Torque:* 32 Nm
- *Special Tool(s):* 303-1482

23.

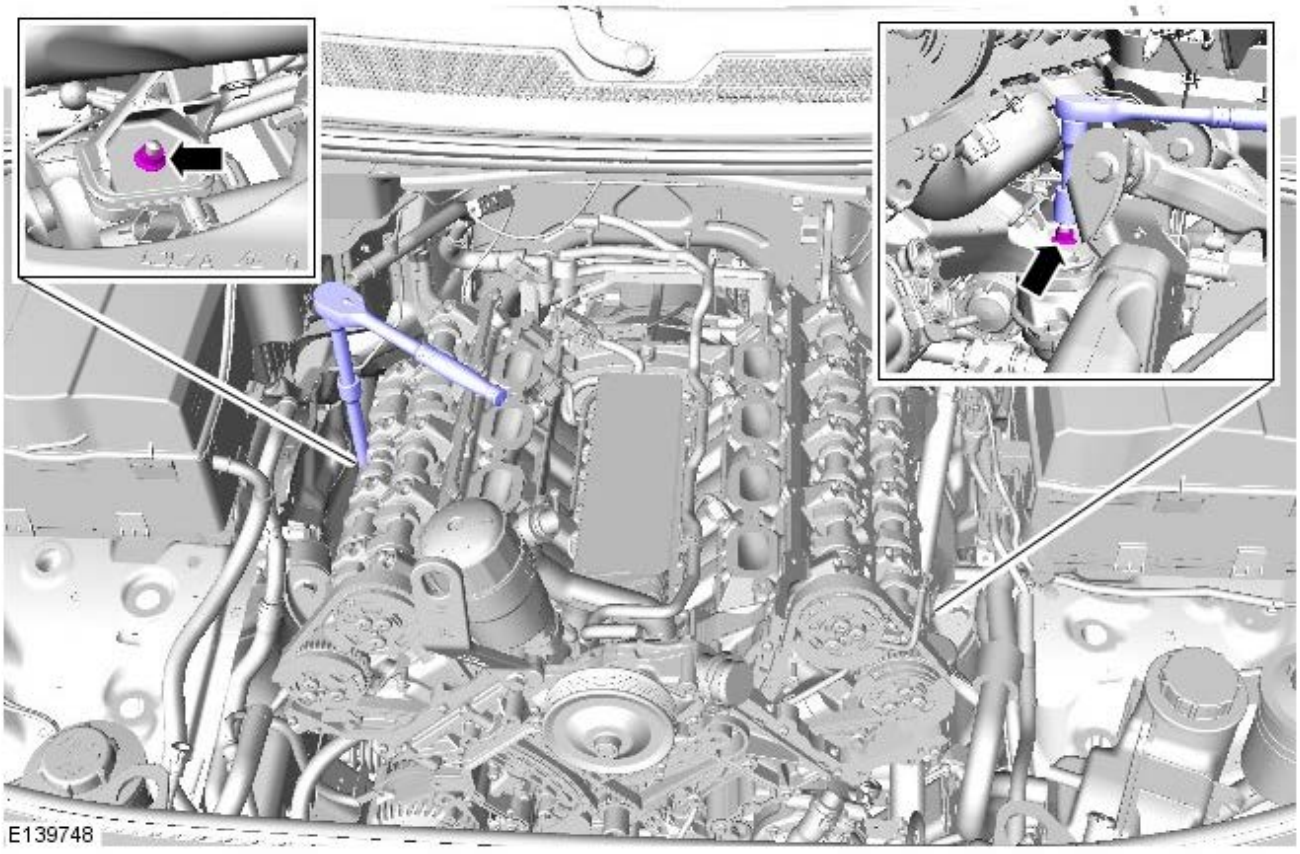
- Install the oil suction tube.
- *Torque:* 10 Nm



24.

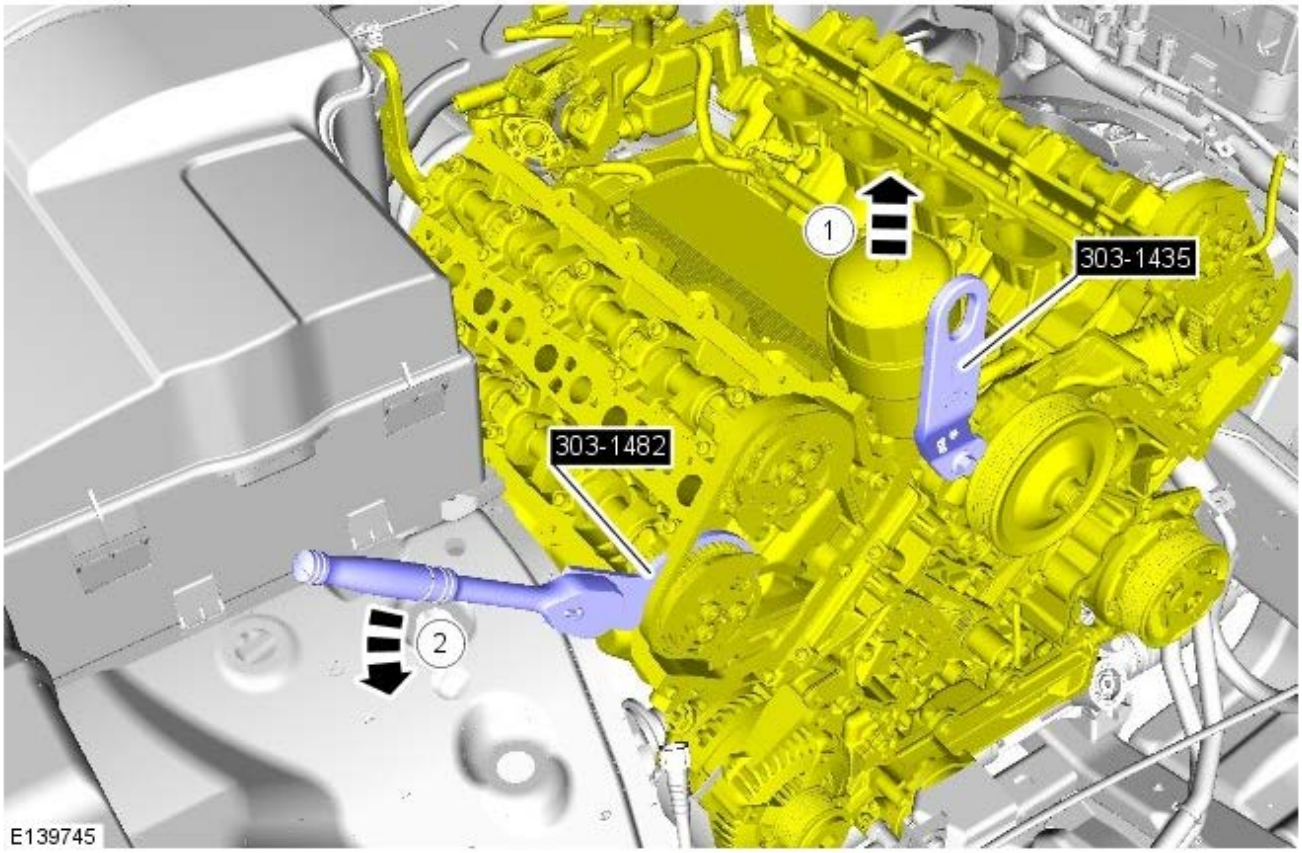


25.



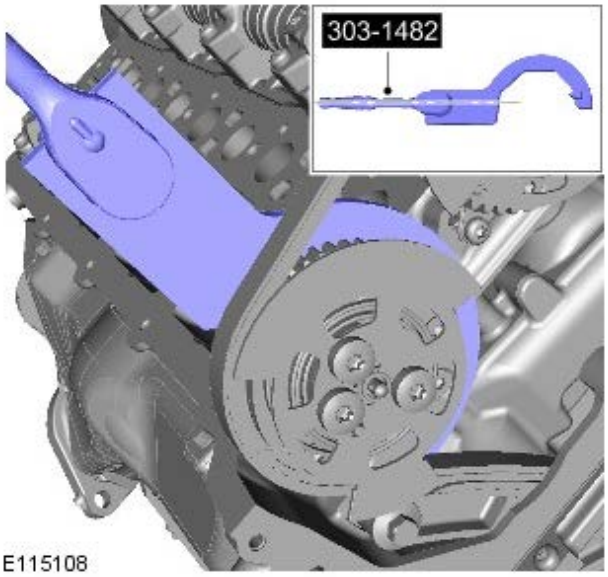
26.

- Raise and support the engine, then install the special tool.
- *Special Tool(s):* 303-1482



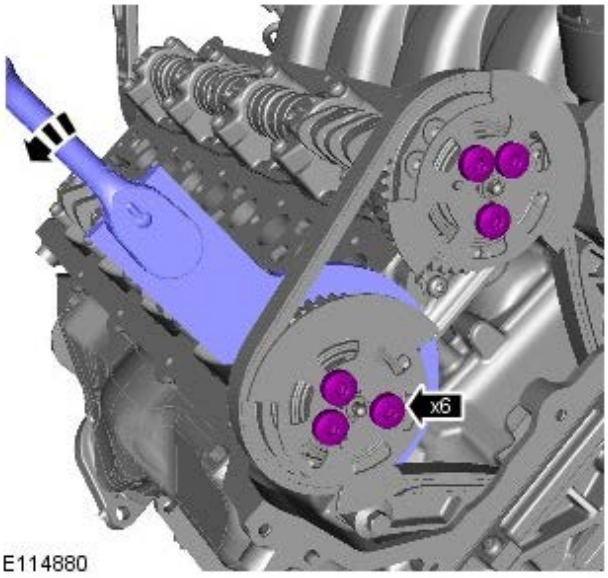
27. CAUTIONS:

Apply the torque to the end of the special tool.



Make sure that the torque wrench is aligned with the special tool as illustrated in the graphic.

- Install the torque wrench to the special tool.
- *Torque:* 35 Nm



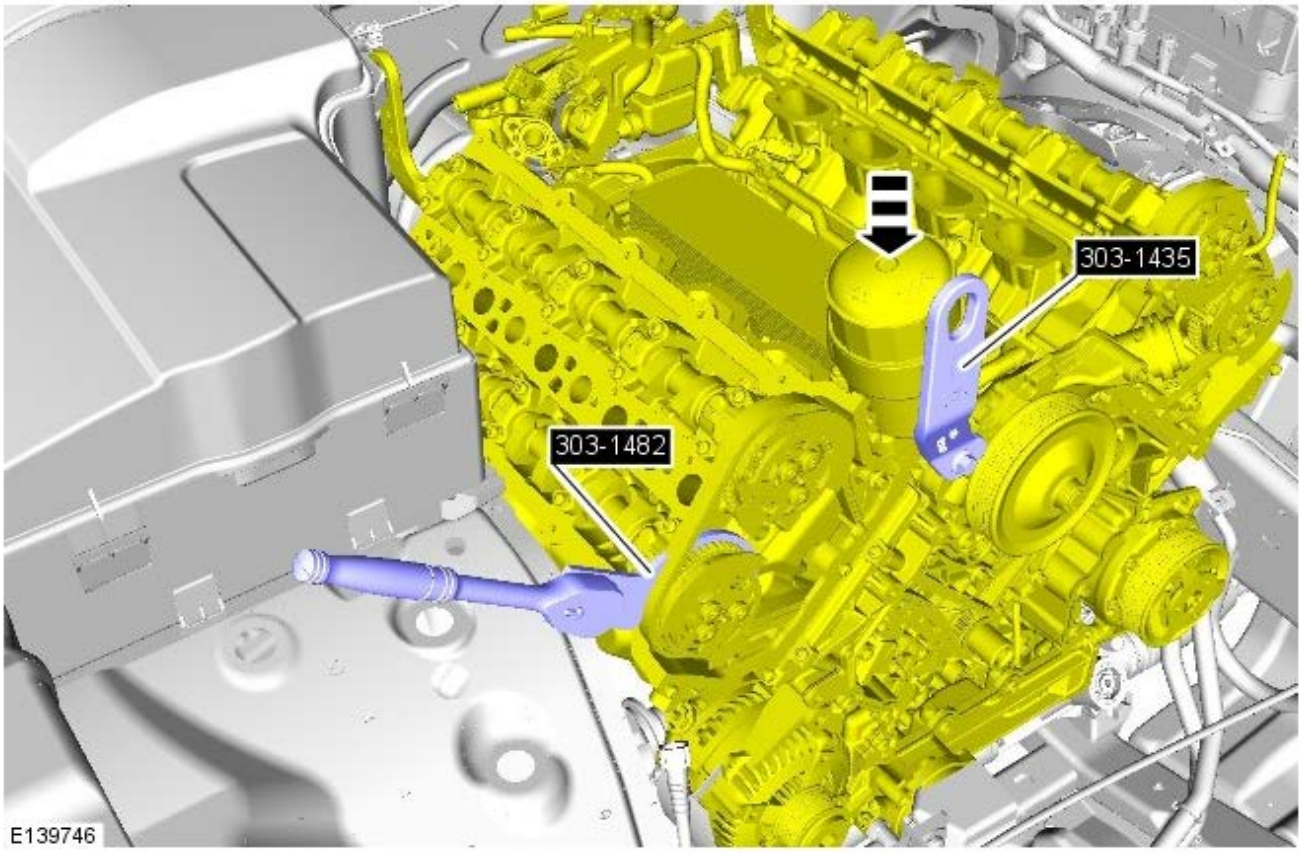
28. CAUTION: Make sure that the torque wrench does not move whilst tightening the VVT bolts.

NOTE: Make sure to tighten the inlet VVT unit bolts first.

Torque: 32 Nm

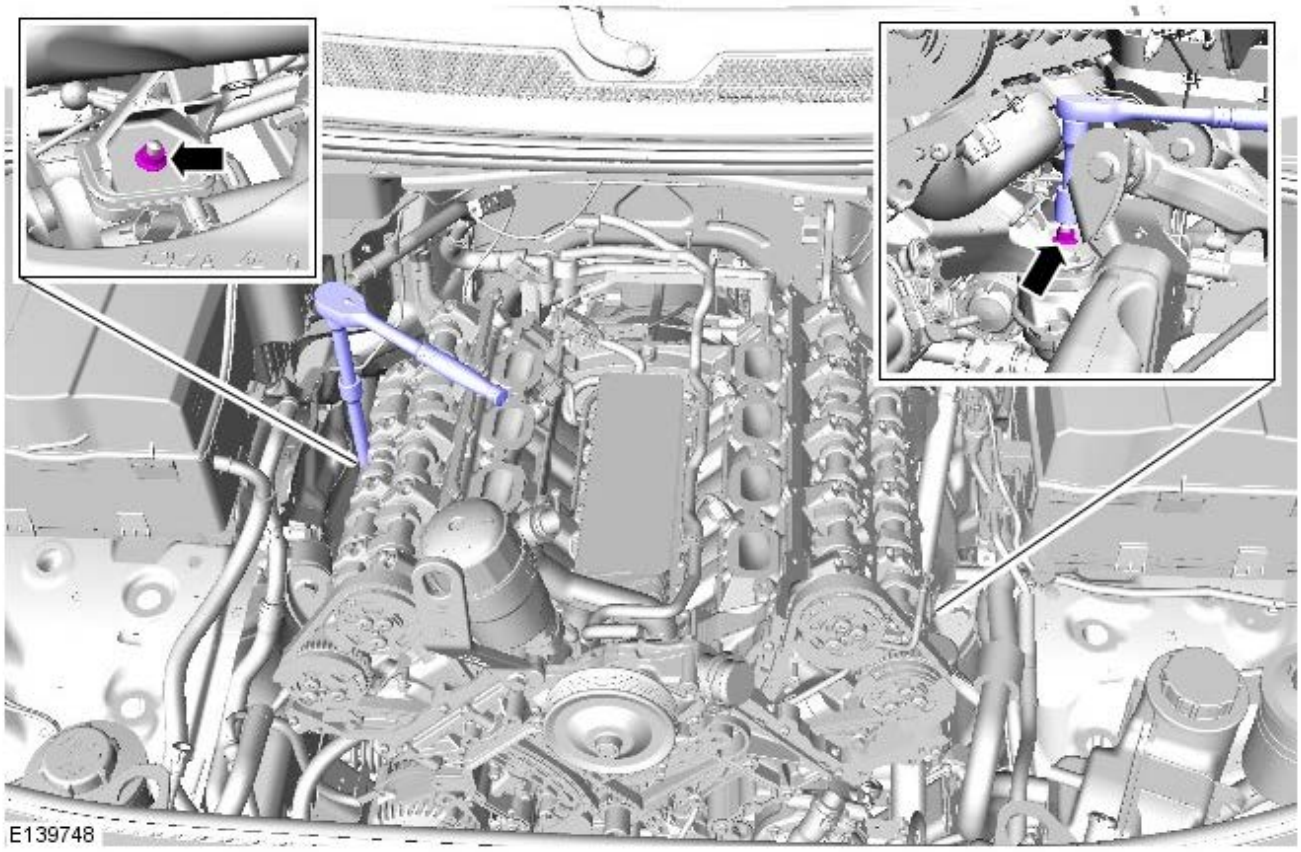
29.

- Remove the special tool and lower the engine.
- *Special Tool(s):* 303-1482



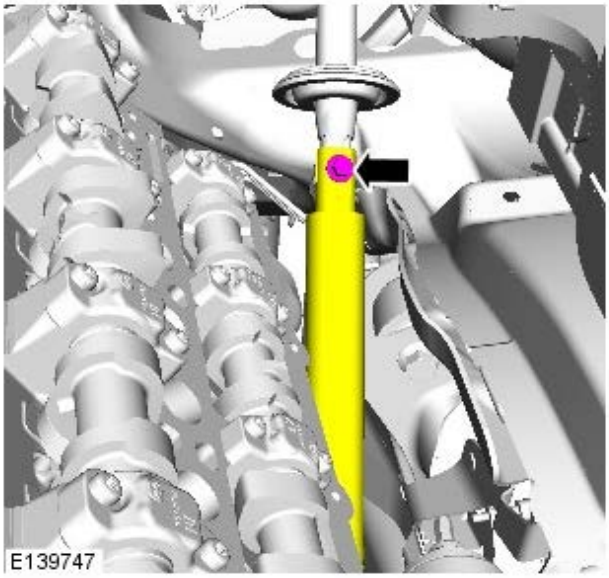
30.

- *Torque:* 100 Nm



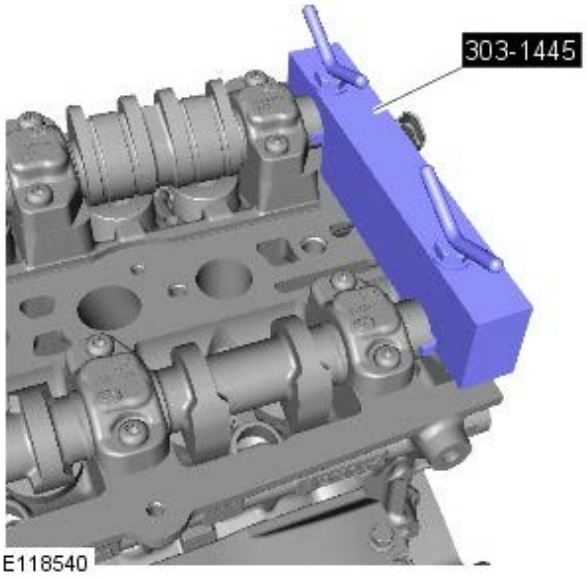
31.

- *Torque:* 20 Nm



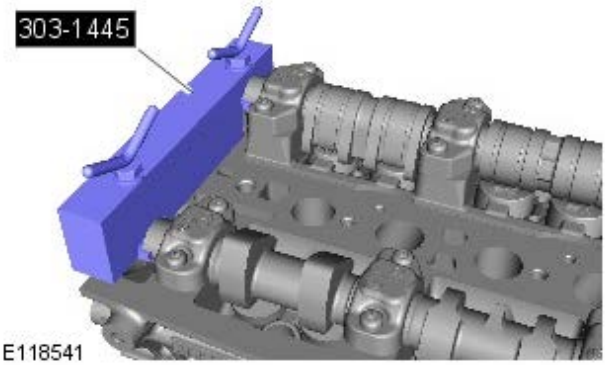
32.

- Remove the special tool.



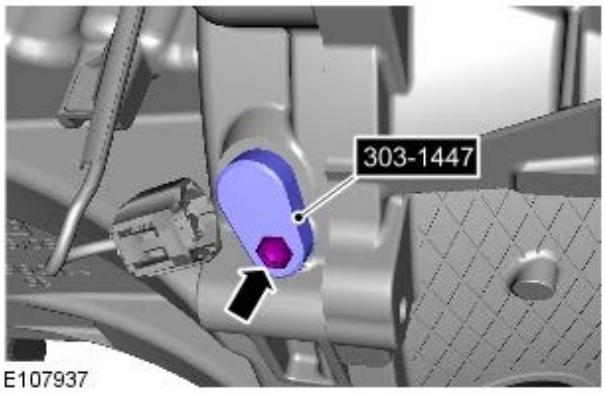
33.

- Remove the special tool.



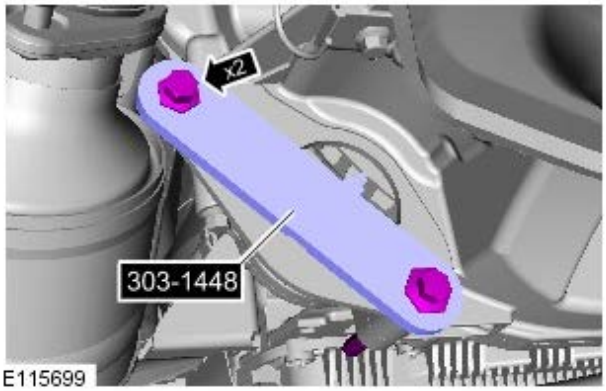
34.

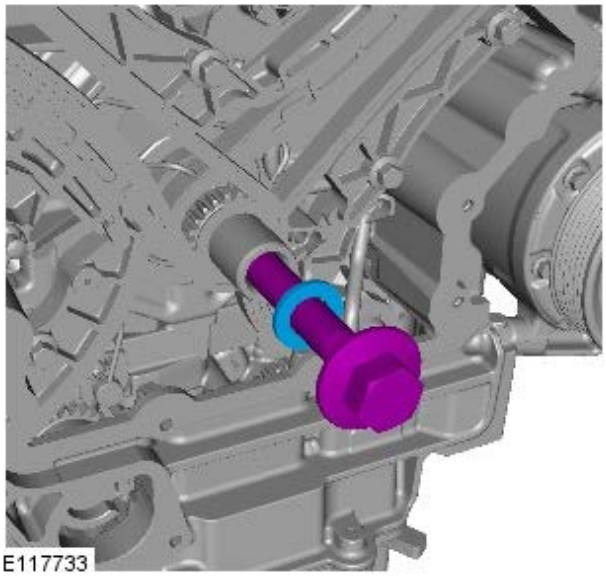
- Remove the special tool.
- *Special Tool(s):* 303-1447



35.

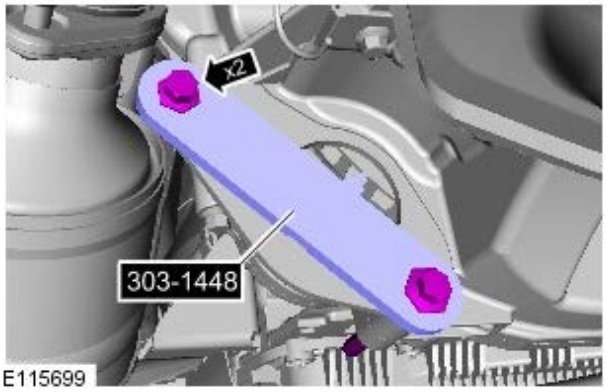
- Install the special tool.
- *Special Tool(s):* 303-1448





36. CAUTION: Install the crankshaft pulley bolt with an M16 washer to prevent damage to the crankshaft on installation.

Torque: 50 Nm

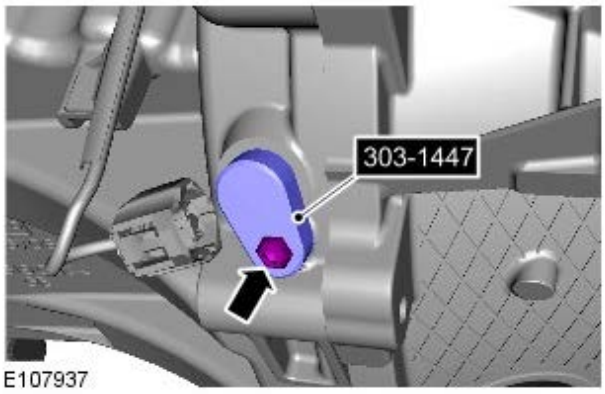


37.

- Remove the special tool.
- *Special Tool(s):* 303-1448

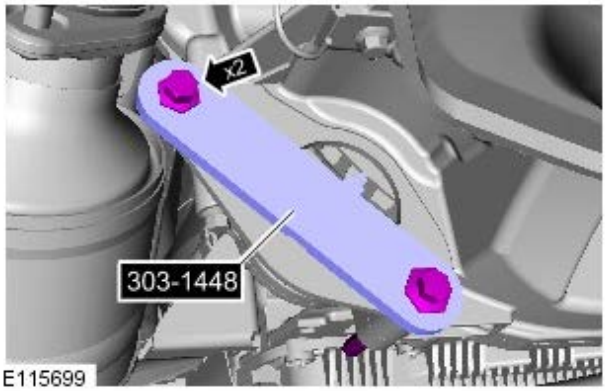
38. Rotate the engine two complete turns clockwise.

39. CAUTION: Only rotate the crankshaft clockwise.



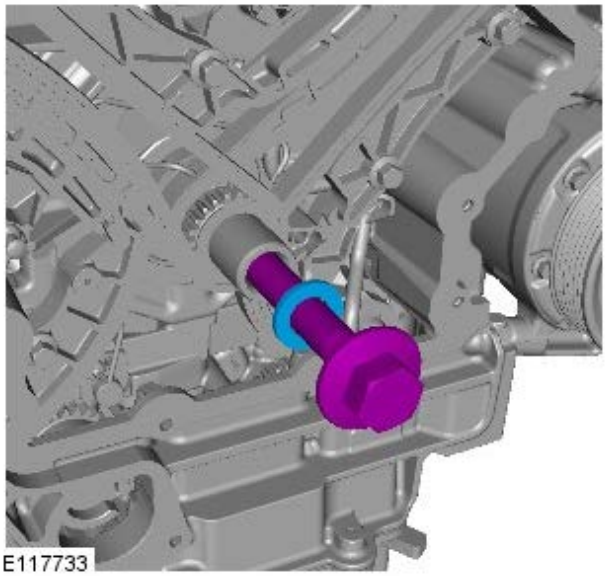
- Install the special tool.
- *Special Tool(s):* 303-1447

40.

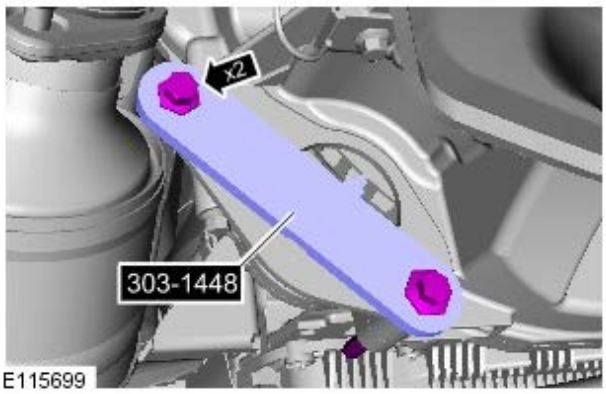


- Install the special tool.
- *Special Tool(s):* 303-1448

41.



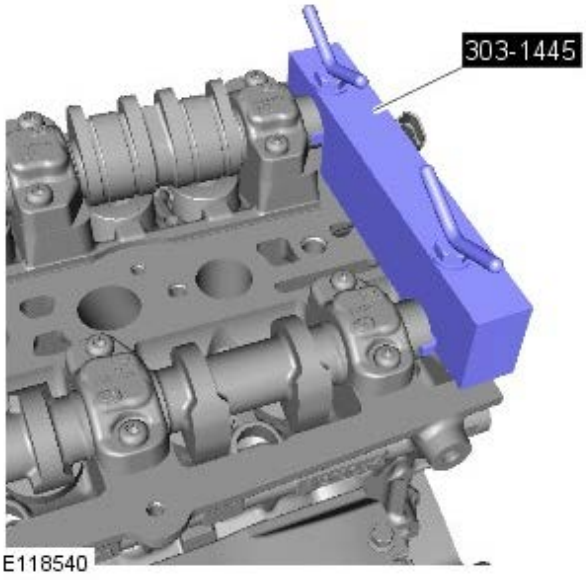
42.



- Remove the special tool.
- *Special Tool(s):* 303-1448

43. CAUTIONS:

If the special tool cannot be installed, return to

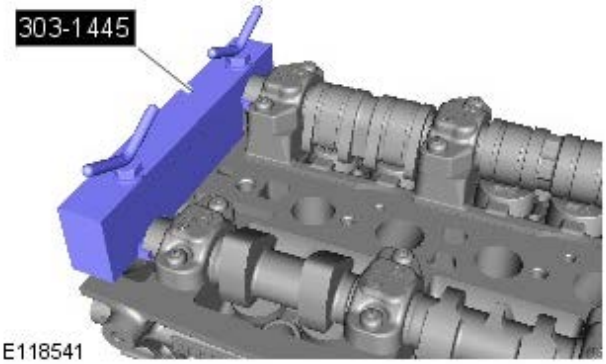


step 22 of the installation until the special tool 303-1445 is installed correctly.

If directed to step 22, make sure that the VVT unit retaining bolts are loosened prior to installing the special tool(s).

Install the special tool.

Special Tool(s): 303-1445

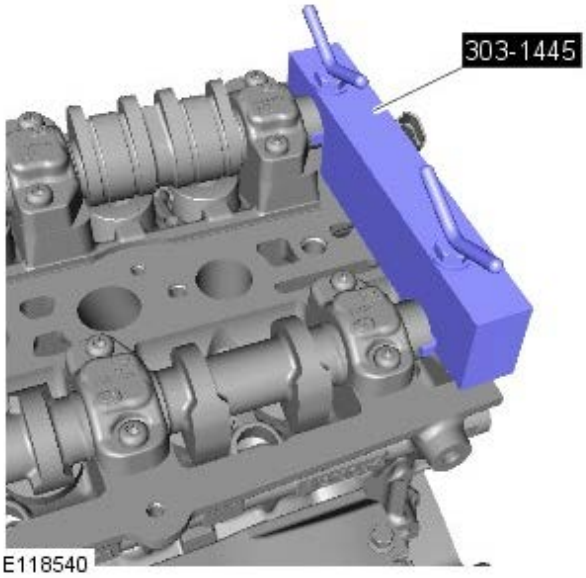


44. CAUTION: If the special tool cannot be installed, the timing chain installation steps must be repeated.

Install the special tool.

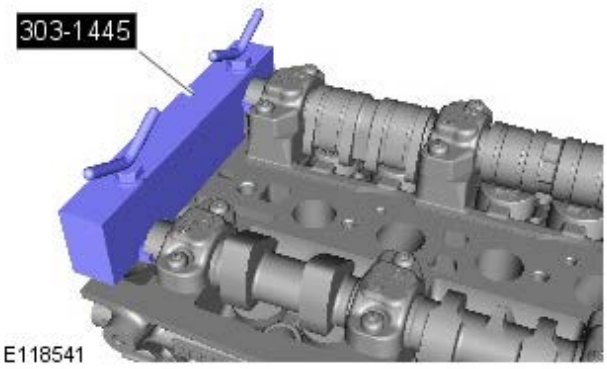
45.

- Remove the special tool.



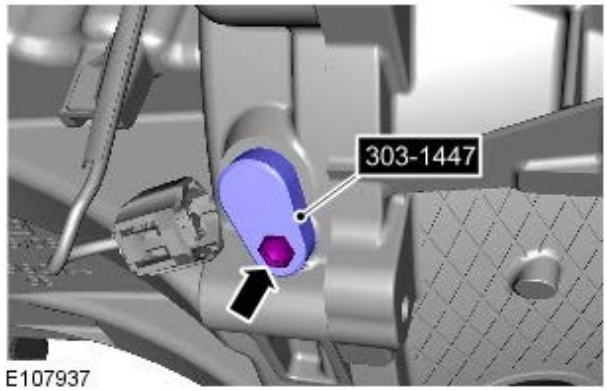
46.

- Remove the special tool.

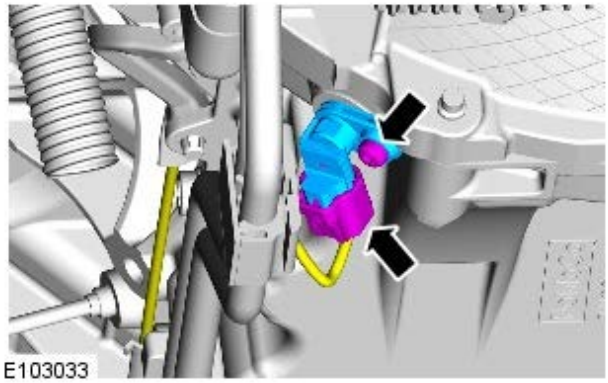


47.

- Remove the special tool.
- *Special Tool(s):* 303-1447



48. *Torque:* 10 Nm



49. Refer to: Timing Cover (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

50. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 02-Aug-2011

Engine - V8 S/C 5.0L Petrol - Timing Drive Components Assembly Part Number: Tsubaki Timing Drive

Removal and Installation

Special Tool(s)

 E115263	303-1445 Timing Tool – Camshaft Alignment
 E115265	303-1447 Timing Tool
 E115266	303-1448 Locking Tool
 E115270	303-1452 Camshaft Rotating Tool
 E115271	303-1482 Tensioner Tool

Removal

CAUTION: Check all timing components for wear and install new components if required.

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

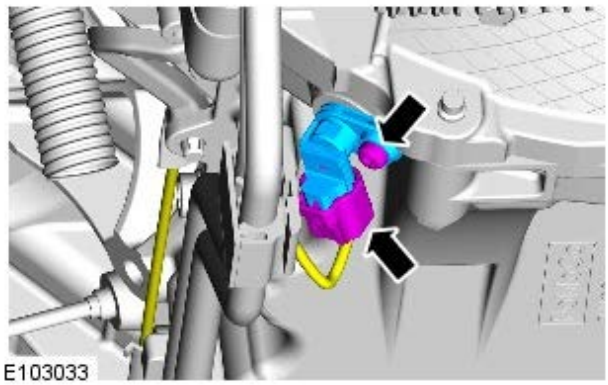
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

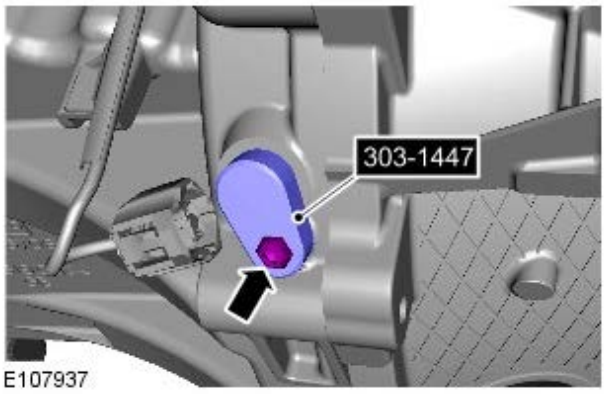
   Raise and support the vehicle.

3.



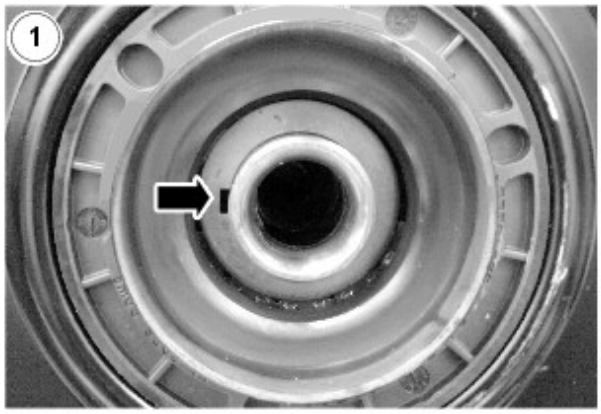
4. CAUTION: Only rotate the crankshaft clockwise.

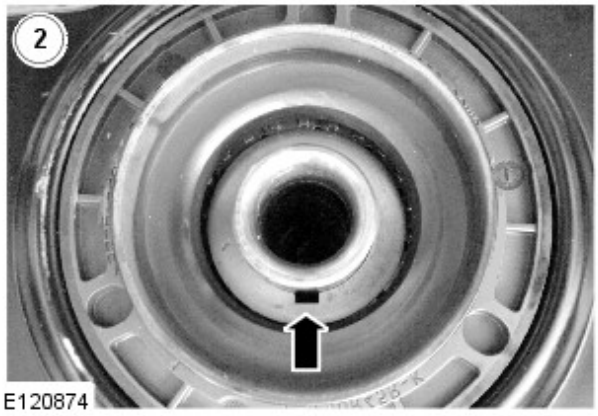
   Install the special tool.



5. CAUTION: If the noted postion of the woodruff key is at the 9 o'clock position, then a new flexplate must be installed. If the woodruff key is in the 6 o'clock position then proceed with the next step.

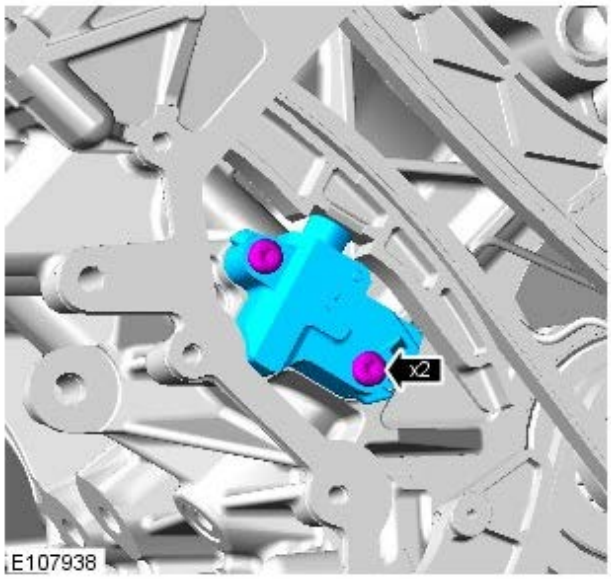
   Note the position of the crankshaft woodruff key.



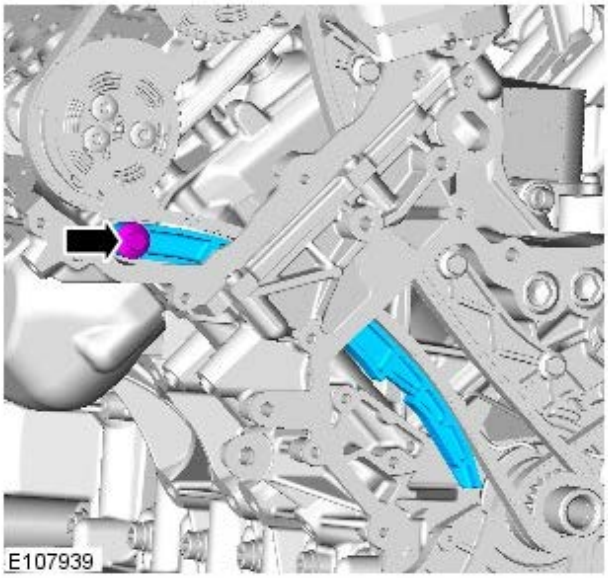


6. Refer to: Timing Cover (303-01 Engine - V8 5.0L Petrol, Removal and Installation).

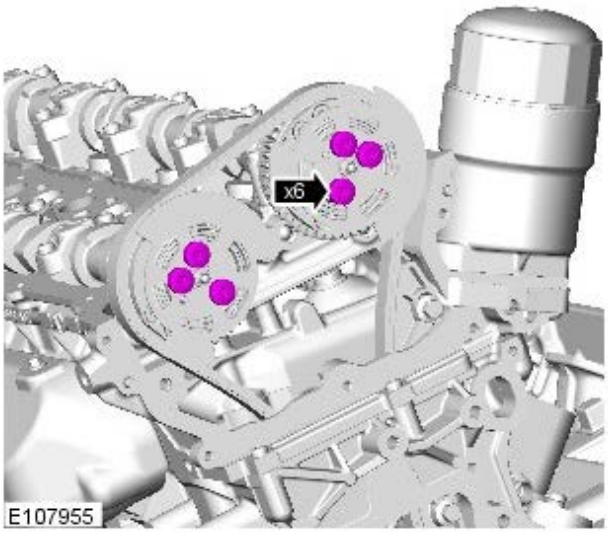
7.



8.

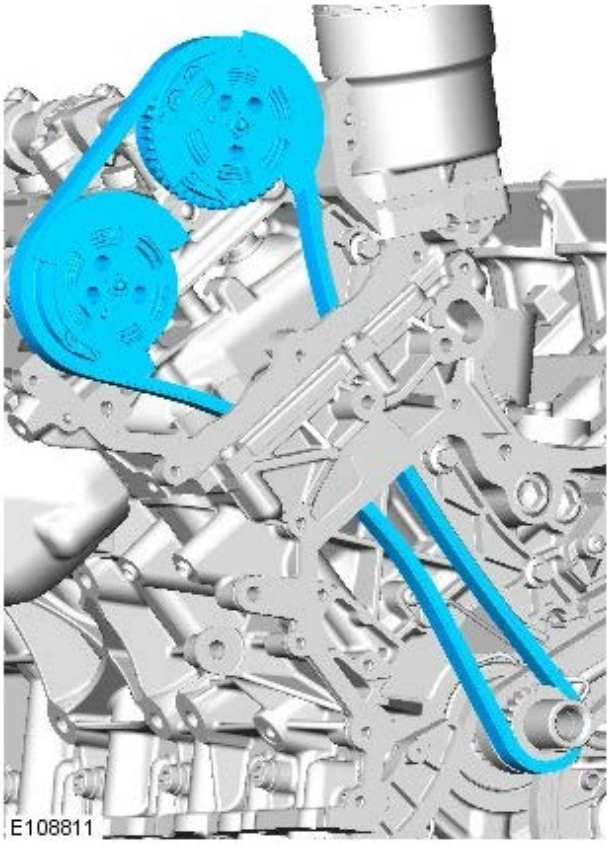


9.

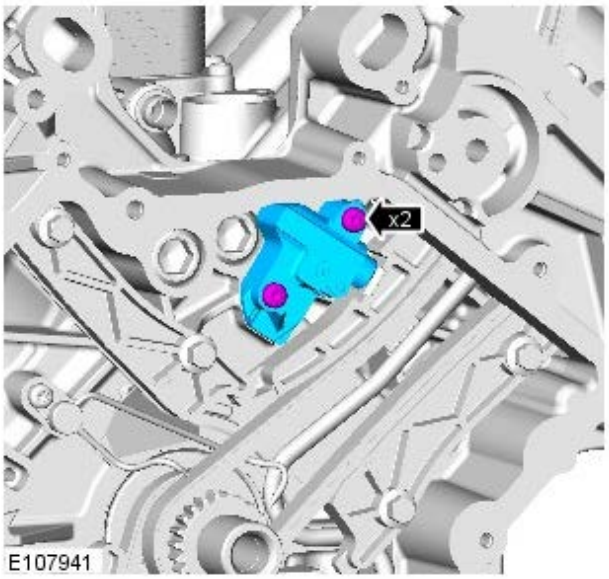


10. CAUTION: If the variable valve timing (VVT) units are knocked or dropped then the VVT must be replaced.

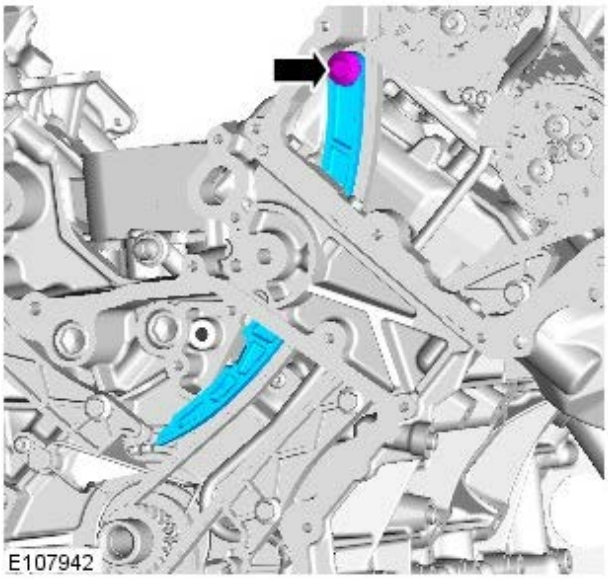
    Remove the timing chain with the VVT units.



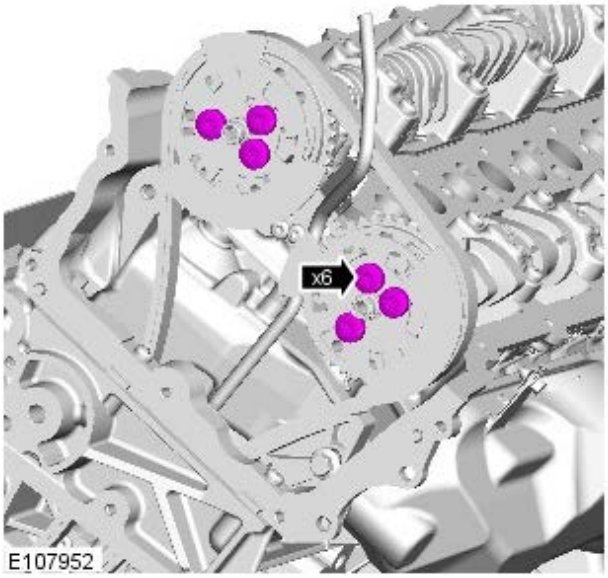
11.



12.

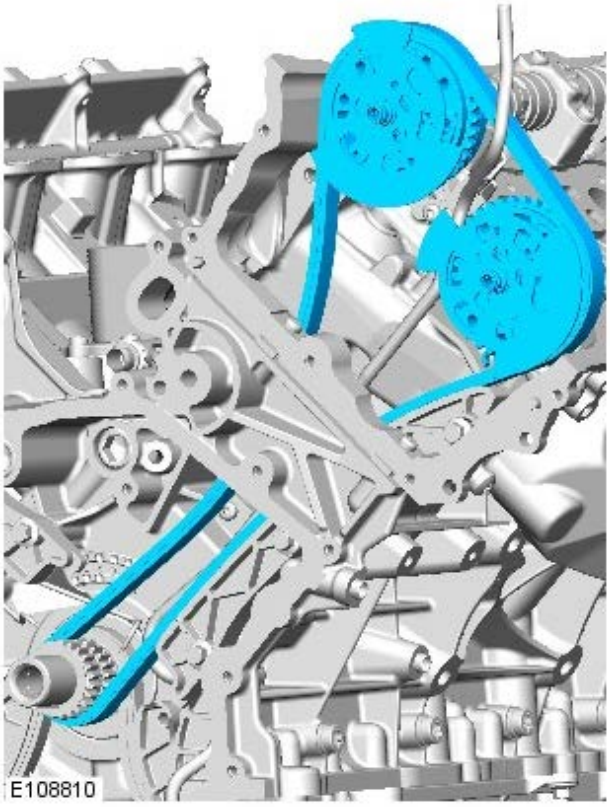


13.

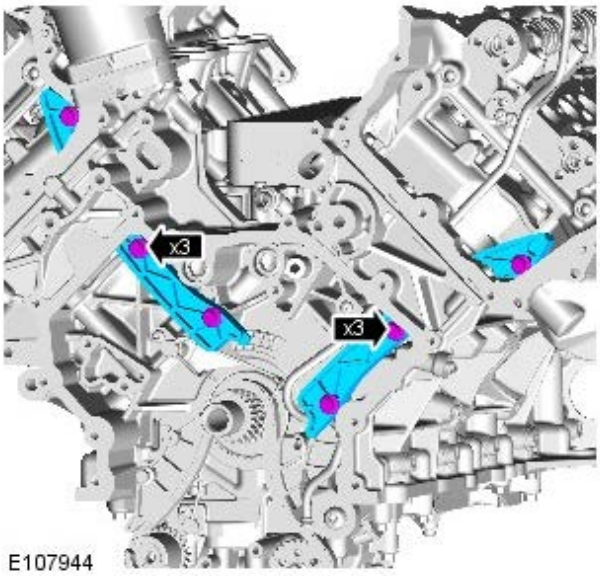


14. CAUTION: If the VVT is knocked or dropped then the VVT must be replaced.

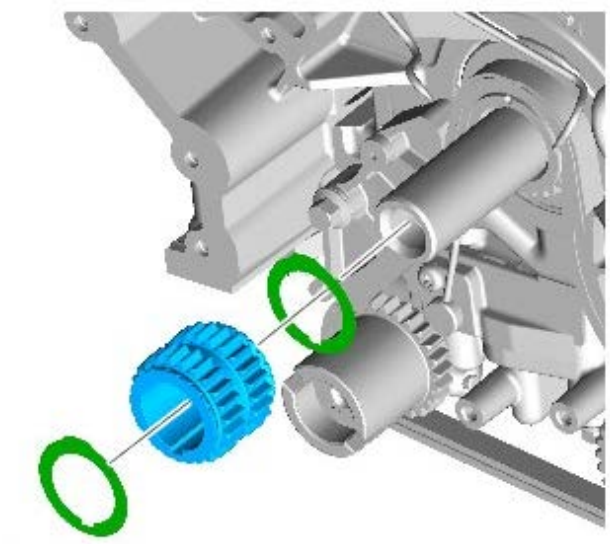
Remove the timing chain with the VVT units.



15.

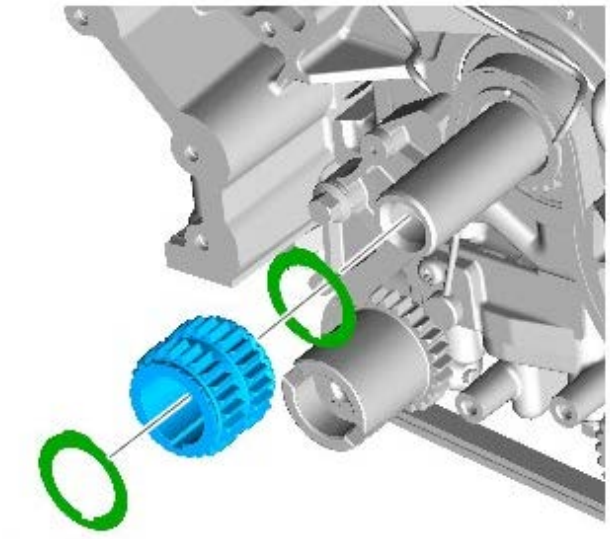


16. CAUTION: Discard the friction washers.



E107945

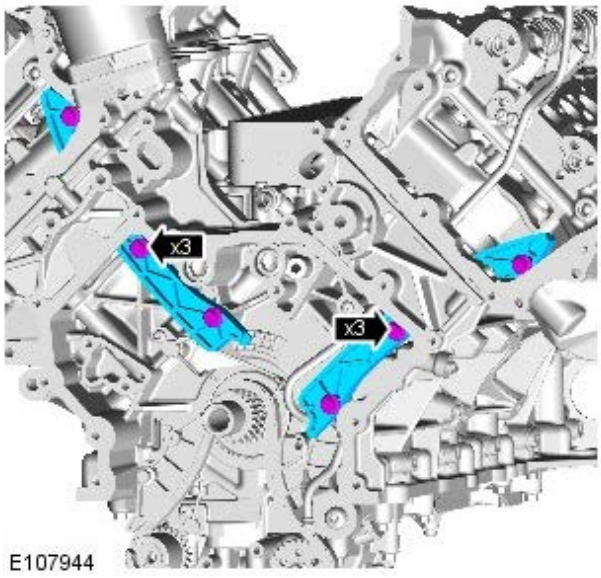
Installation



E107945

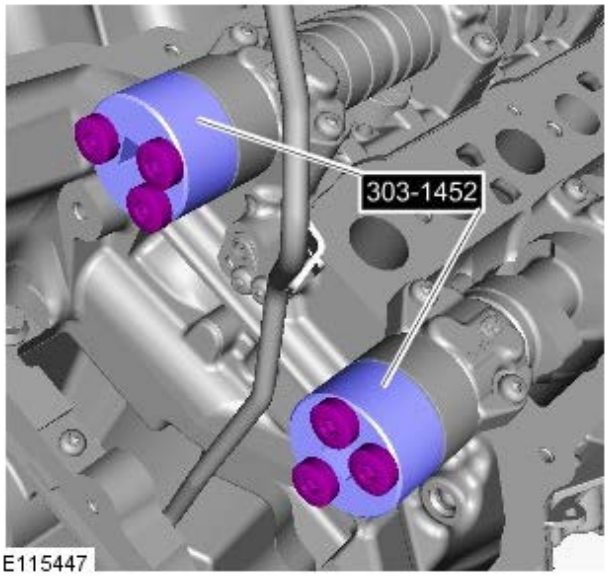
1. CAUTION: Install new friction washers.

2. *Torque:* 12 Nm



E107944

3.
   - Install the special tool to the LH bank Camshafts.
   - *Special Tool(s):* 303-1452
   - *Torque:* 10 Nm



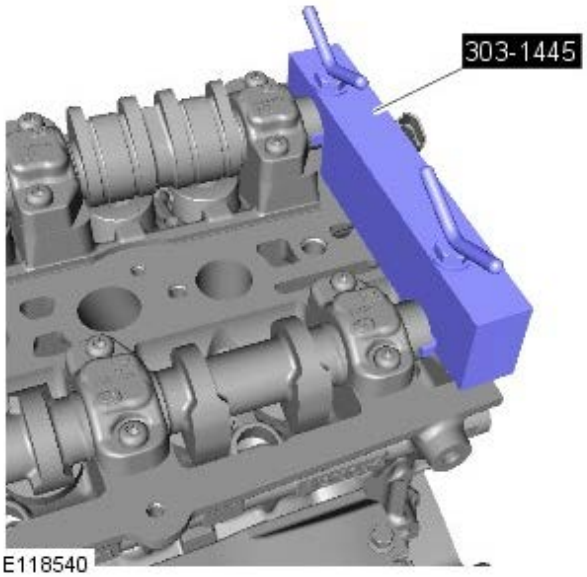
4.

- Carefully rotate the camshafts if the position is not as shown.



5.

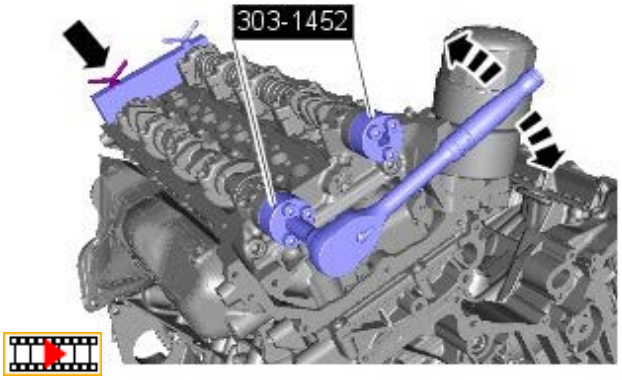
- Install the special tool 303-1445 to the rear of the camshafts making sure the key way's are correctly located into each slot on each of the camshafts.



6. CAUTIONS:

Do not overturn the camshafts.

Tighten the wing nuts finger tight. Failure to



follow this instruction may result in damage to the components.

- Using a suitable tool, carefully rock the camshaft clockwise then anti-clockwise. Turn the special tool locking nuts until there is no movement left in camshafts.
- Repeat steps 3- 6 for the camshafts on the other cylinder head.

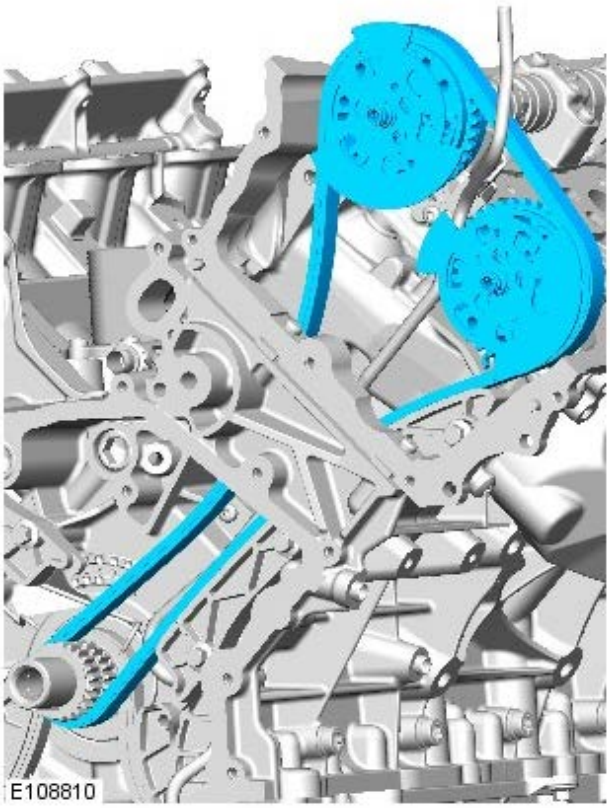
7. CAUTIONS:

Do not allow the camshaft to rotate.

If the VVT is knocked or dropped then the VVT must be replaced.

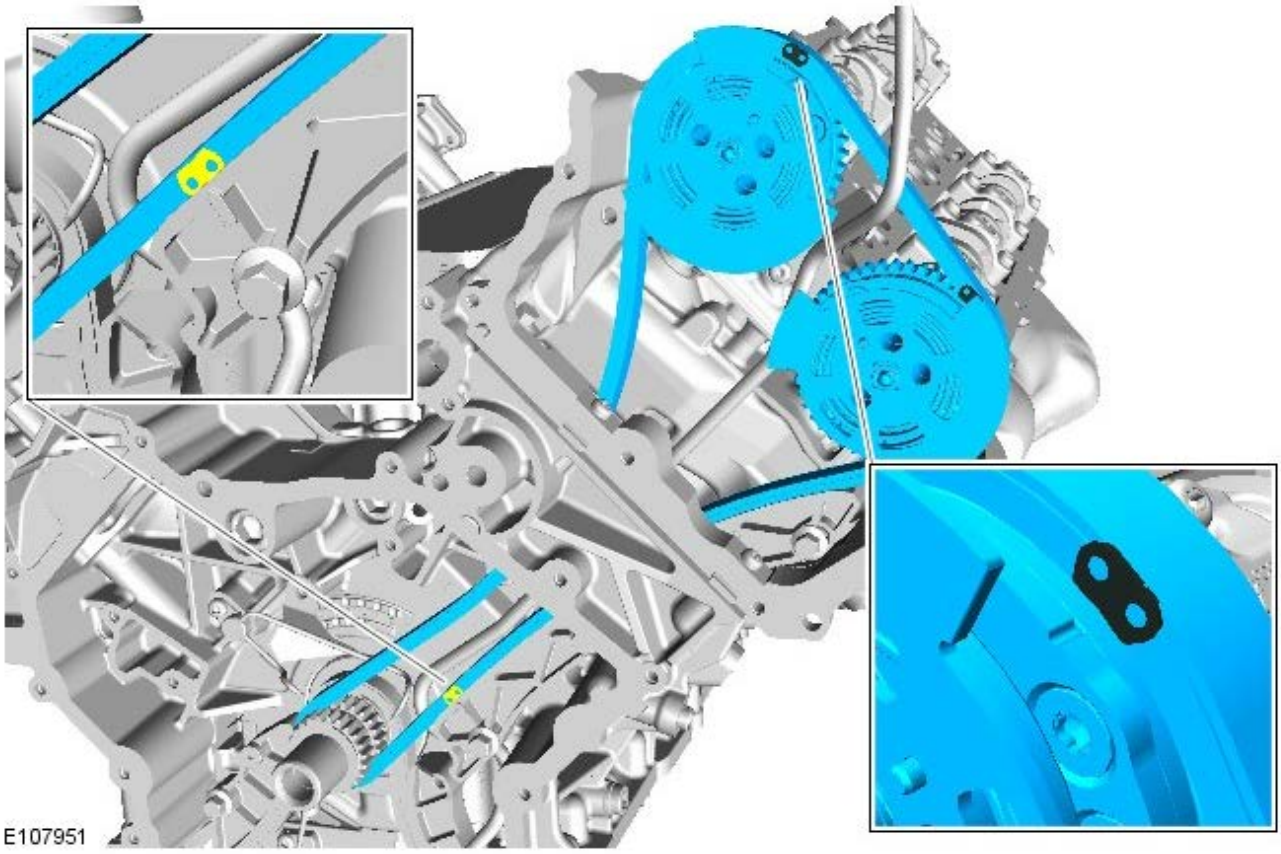
NOTE: Do not tighten at this stage.

- Install the timing chain with the variable valve timing (VVT) units.

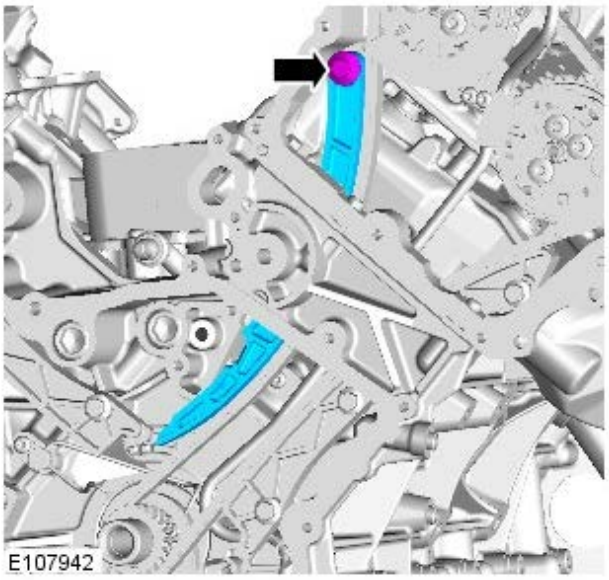


8.

- Make sure that all the timing chain alignment marks are in the positions shown.

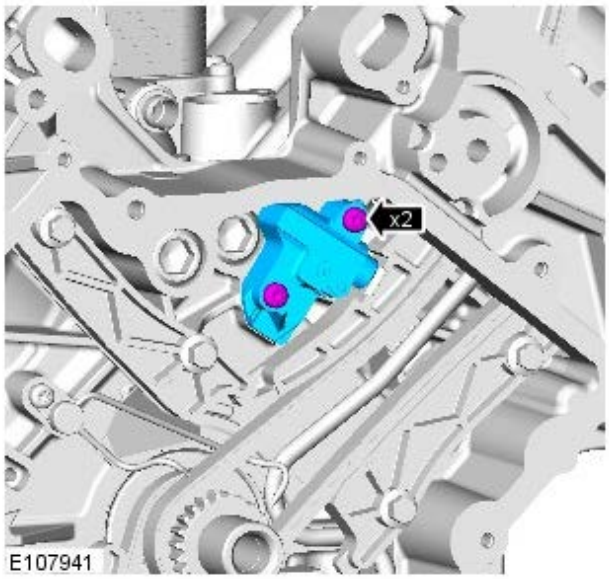


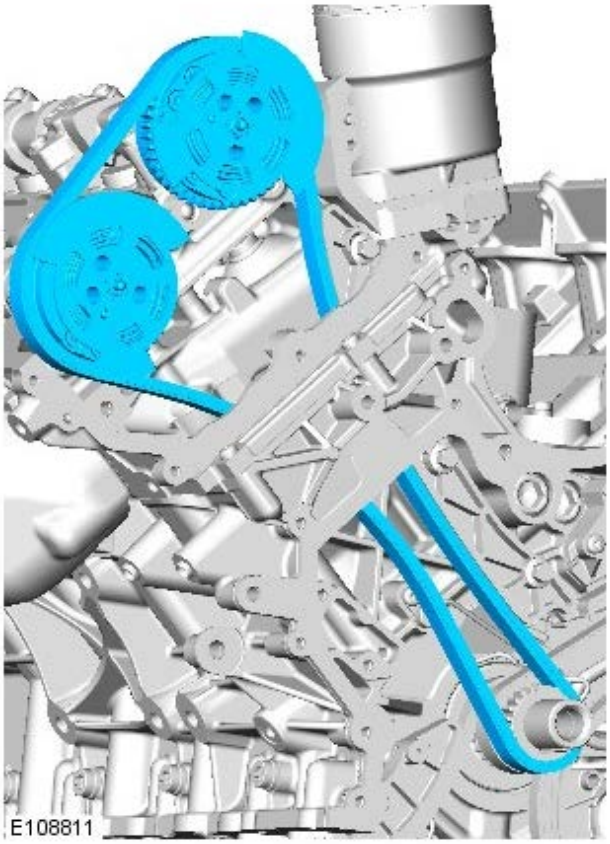
9. *Torque:* 25 Nm



10. CAUTION: Do not release the timing chain tensioner locking pin at this stage.

Torque: 10 Nm





11. CAUTIONS:

Do not allow the camshafts to rotate.

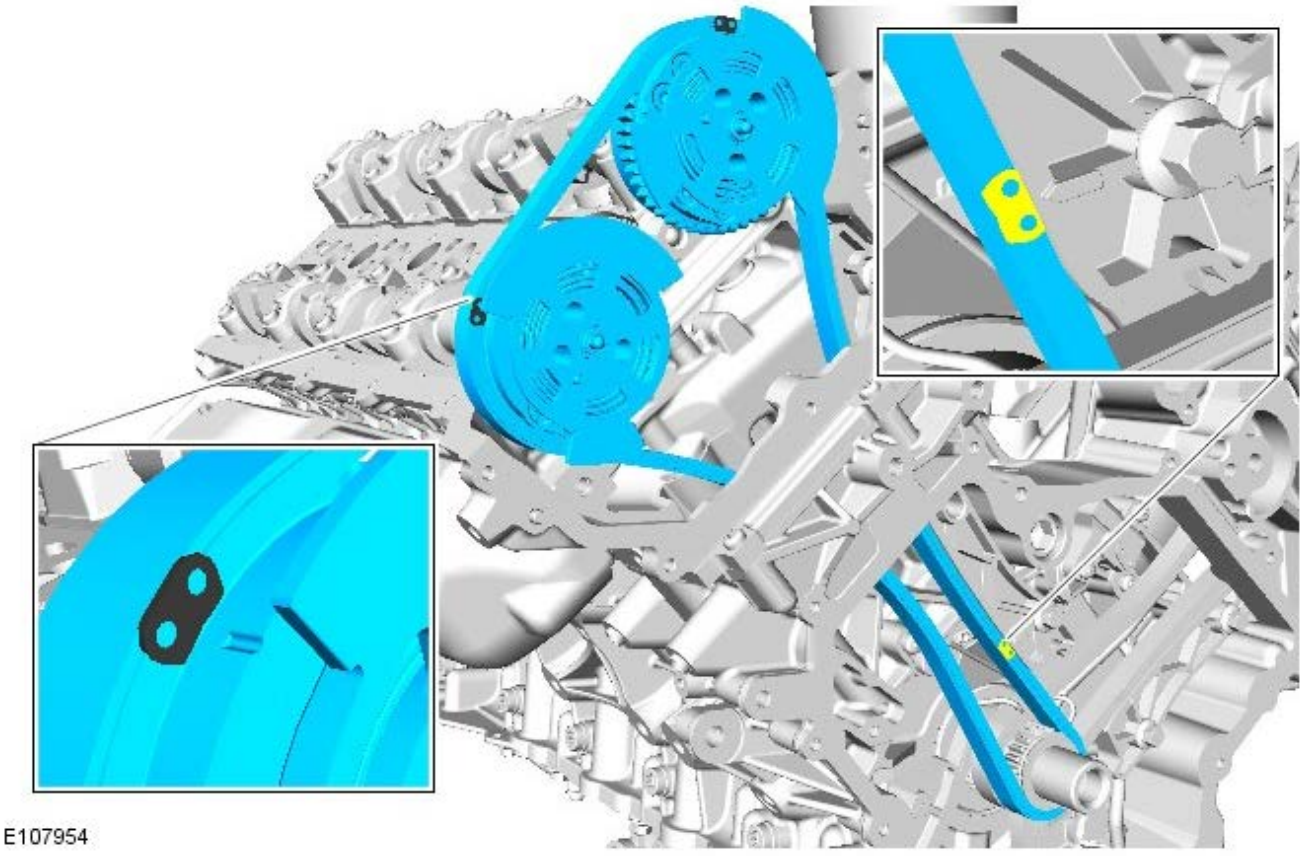
If the VVT is knocked or dropped then the VVT must be replaced.

NOTE: Do not tighten at this stage.

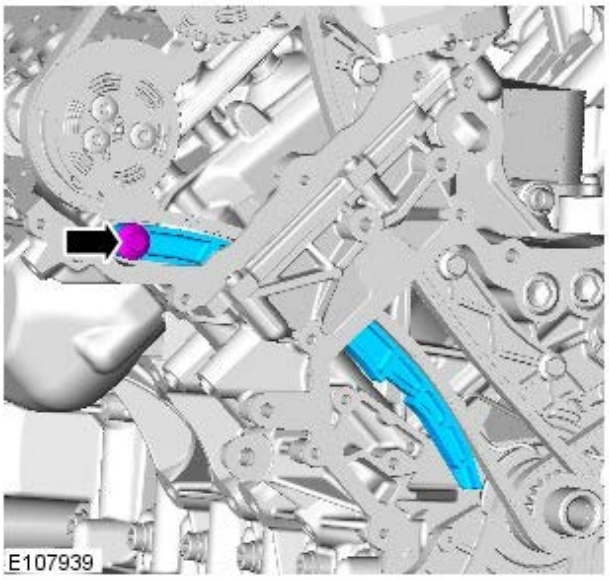
- Install the timing chain with the VVT units.

12.

- Make sure that all the timing chain alignment marks are in the positions shown.



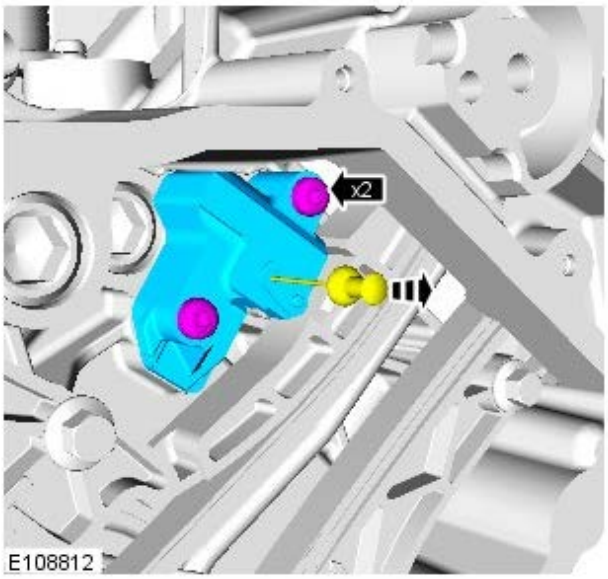
13. *Torque:* 25 Nm

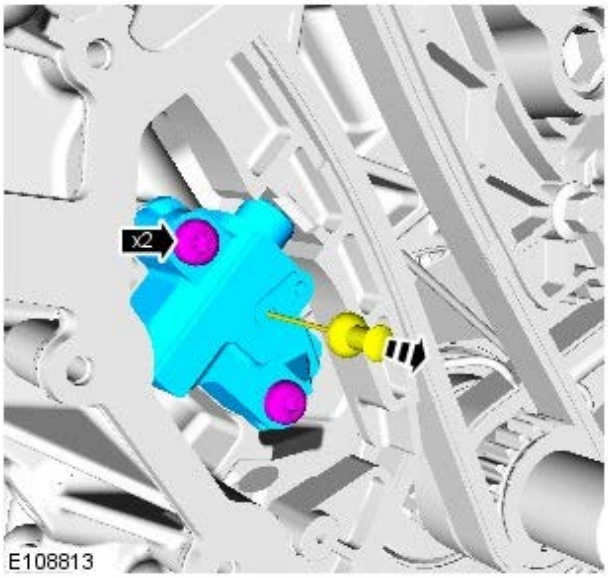


14. CAUTION: Do not use mechanical force.

Make sure that the tensioners are fully deployed.

Torque: 10 Nm

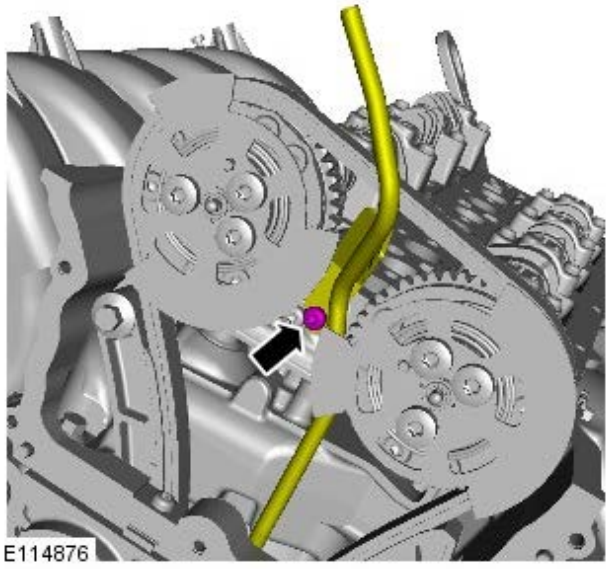




15. CAUTION: Do not use mechanical force.

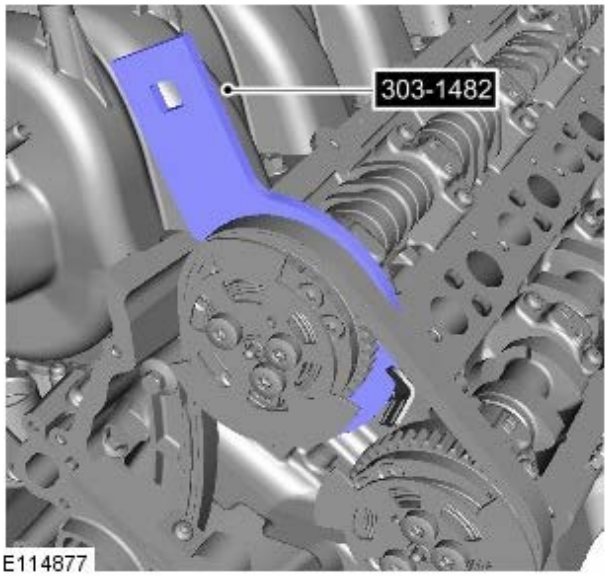
    Make sure that the tensioners are fully deployed.

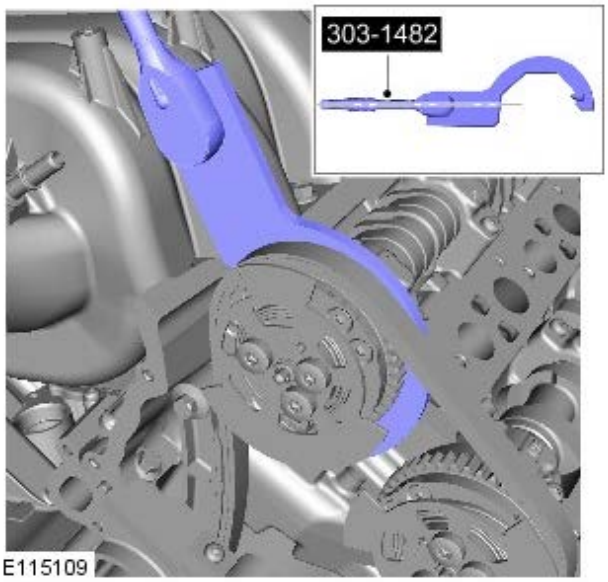
    Torque: 10 Nm



16.
- Release and reposition the oil suction tube to one side.

17.
- Install the special tool.
- *Special Tool(s):* 303-1482



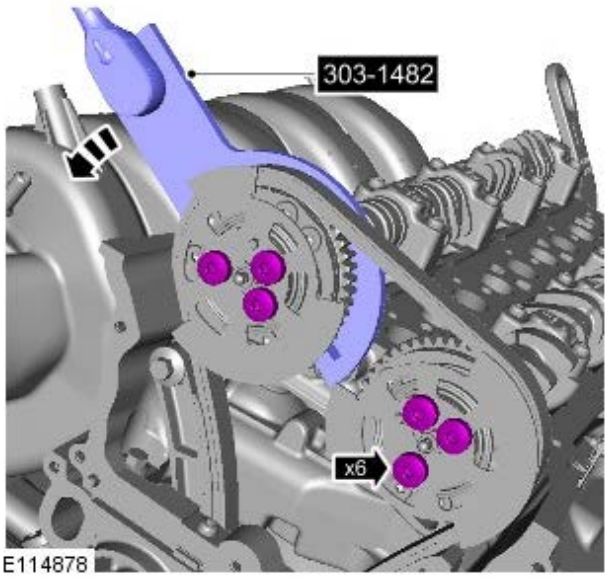


18. CAUTIONS:

Apply the torque to the end of the special tool.

Make sure that the torque wench is aligned with the special tool as illustrated in the graphic.

- Install the torque wrench to the special tool.
- *Torque:* 35 Nm



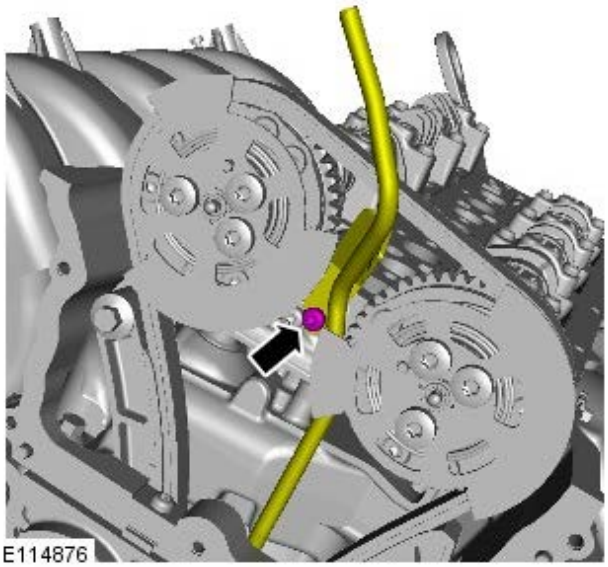
19. CAUTION: Make sure that the torque wrench does not move whilst tightening the VVT bolts.

NOTE: Make sure to tighten the exhaust VVT unit bolts first.

- *Torque:* 32 Nm
- *Special Tool(s):* 303-1482

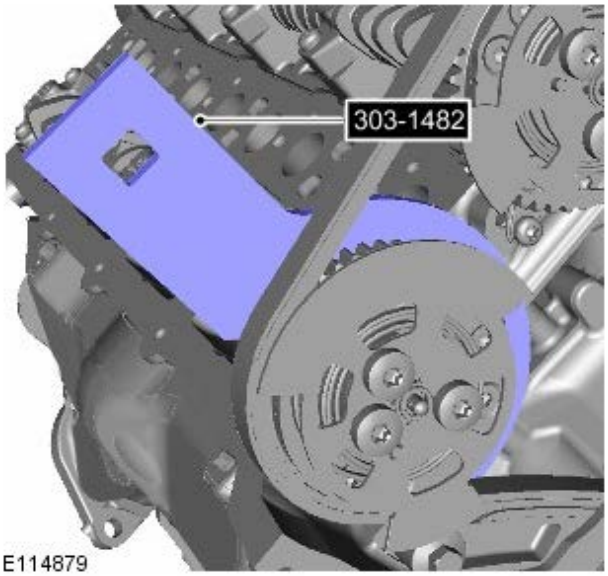
20.

- Install the oil suction tube.
- *Torque:* 10 Nm


E114876

21.

- Install the special tool.
- *Special Tool(s):* 303-1482



E114879

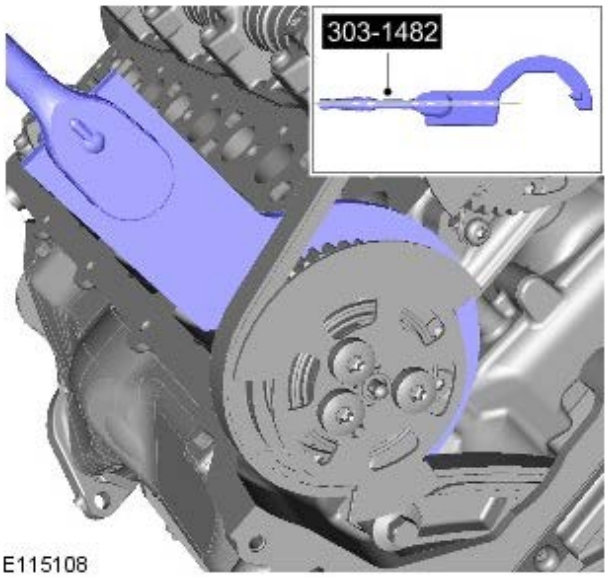
22. CAUTIONS:

Apply the torque to the end of the special tool.

Make sure that the torque wench is aligned with the special tool as illustrated in the graphic.

- Install the torque wrench to the special tool.

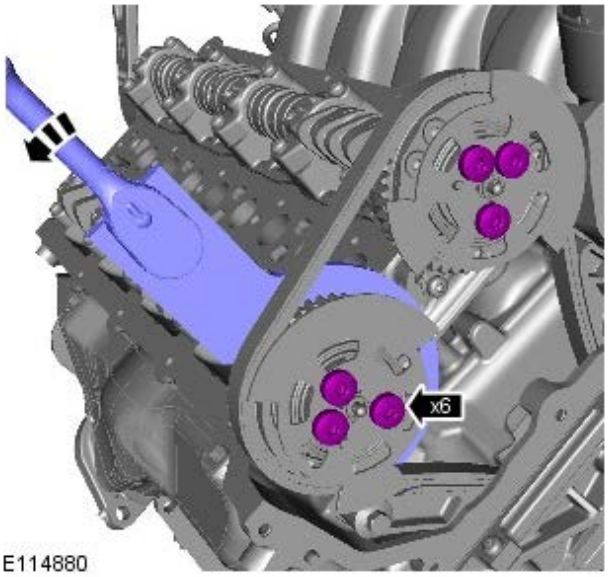
  Special Tool(s): 303-1482
- *Torque:* 35 Nm



E115108

23. CAUTION: Make sure that the torque wrench does not move whilst tightening the VVT bolts.

NOTE: Make sure to tighten the inlet VVT unit bolts first.

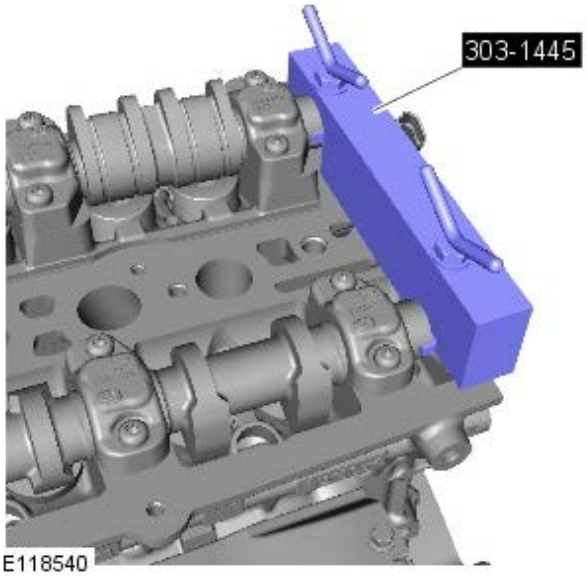


E114880

Torque: 32 Nm

24.

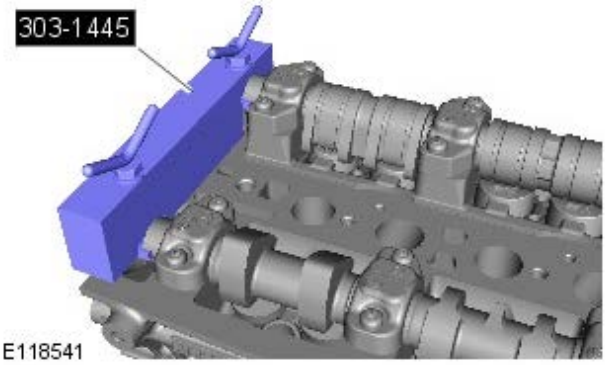
- Remove the special tool.



E118540

25.

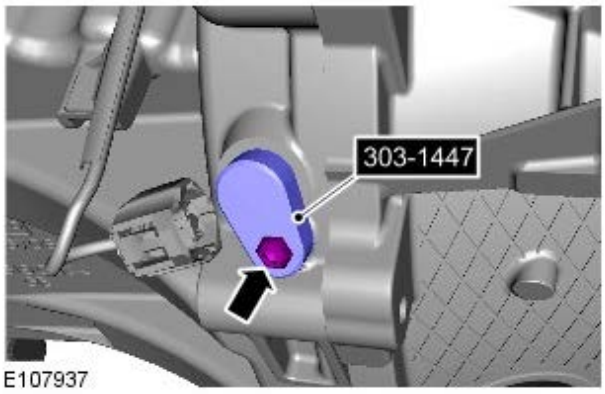
- Remove the special tool.



E118541

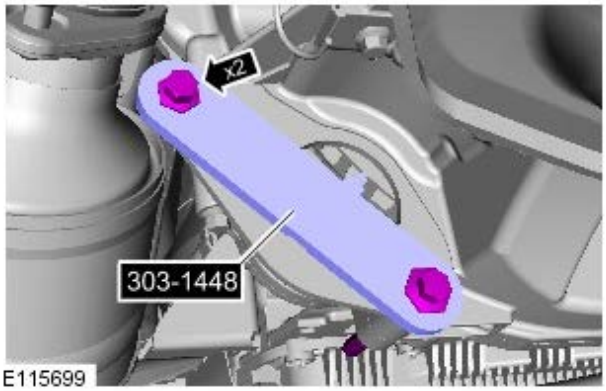
26.

- Remove the special tool.
- *Special Tool(s):* 303-1447



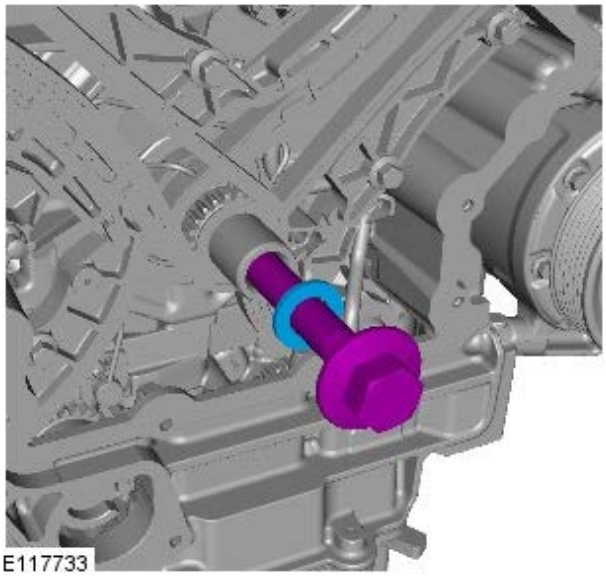
27.

- Install the special tool.
- *Special Tool(s):* 303-1448



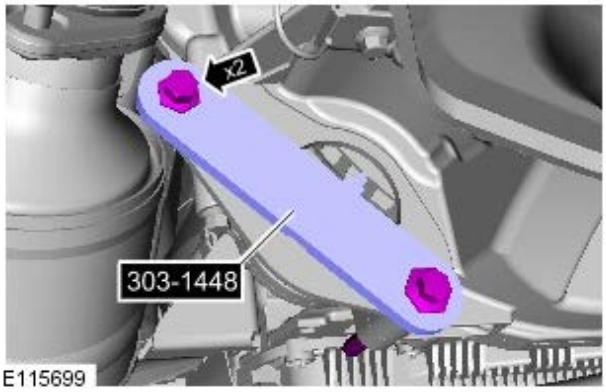
28. CAUTION: Install the crankshaft pulley bolt with an M16 washer to prevent damage to the crankshaft on installation.

Torque: 50 Nm



29.

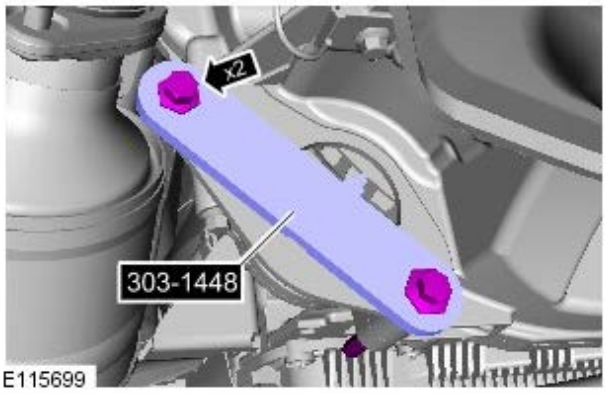
- Remove the special tool.
- *Special Tool(s):* 303-1448



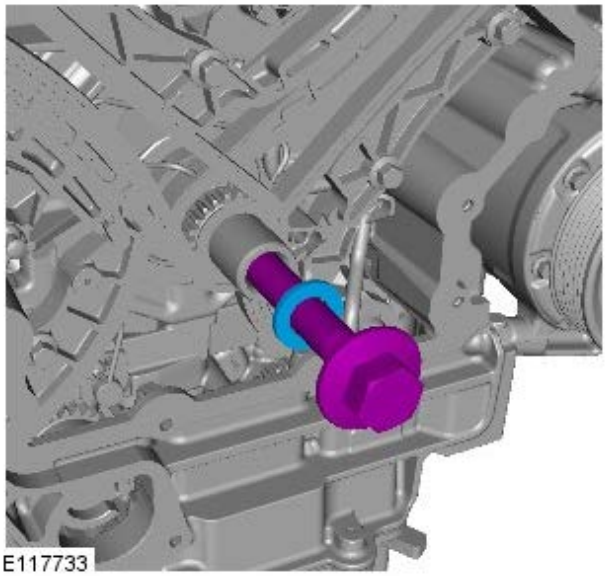
30. Rotate the engine two complete turns clockwise.

31.

- Install the special tool.
- *Special Tool(s):* 303-1448

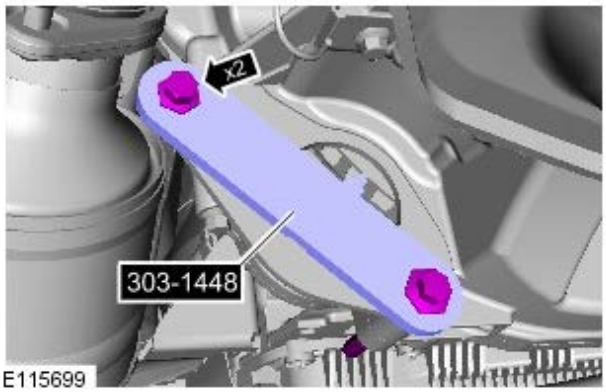


32.



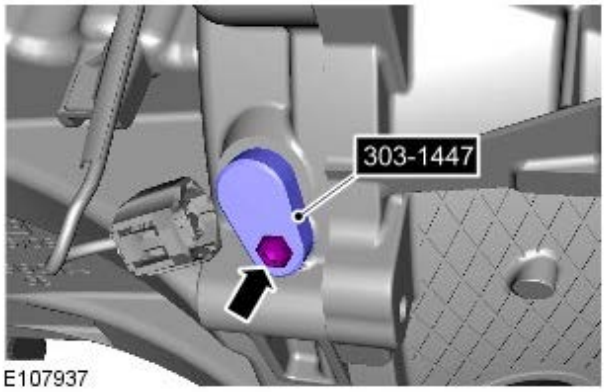
33.

- Remove the special tool.
- *Special Tool(s):* 303-1448



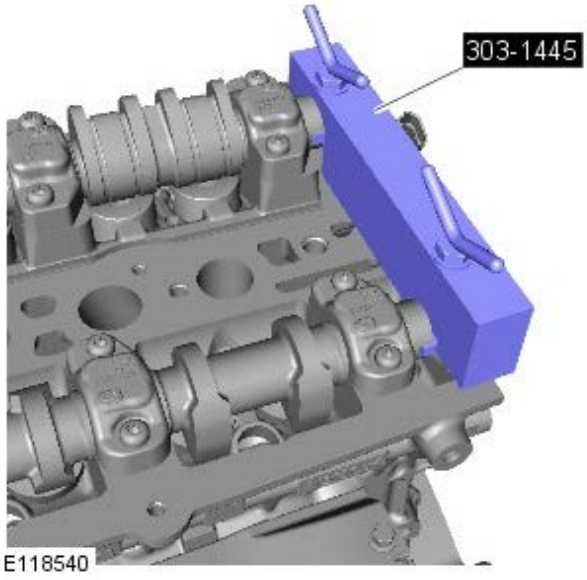
34. CAUTION: Only rotate the crankshaft clockwise.

- Install the special tool.
- *Special Tool(s):* 303-1447



35. CAUTIONS:

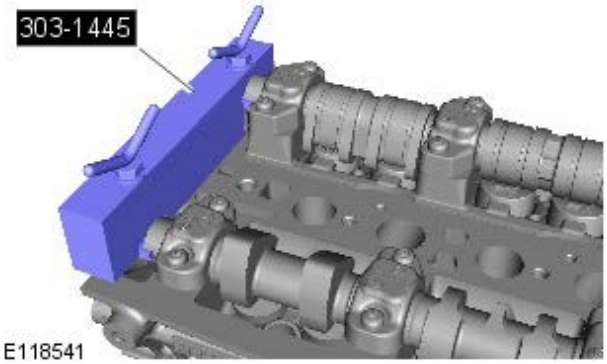
If the special tool cannot be installed, return to



step 22 of the installation until the special tool 303-1445 is installed correctly.

If directed to step 22, make sure that the VVT unit retaining bolts are loosened prior to installing the special tool(s).

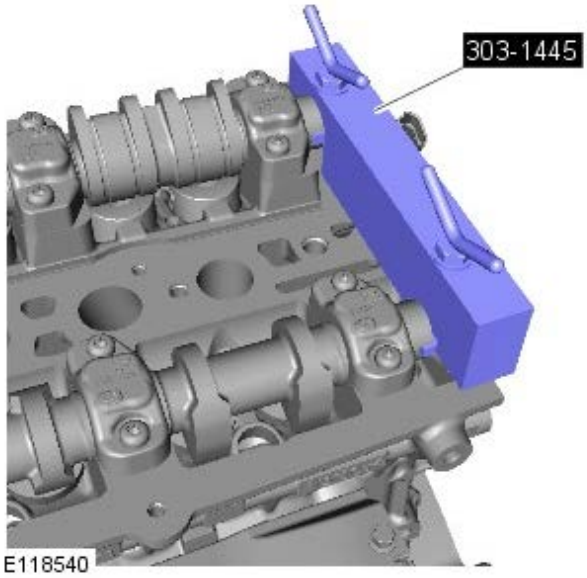
Install the special tool.



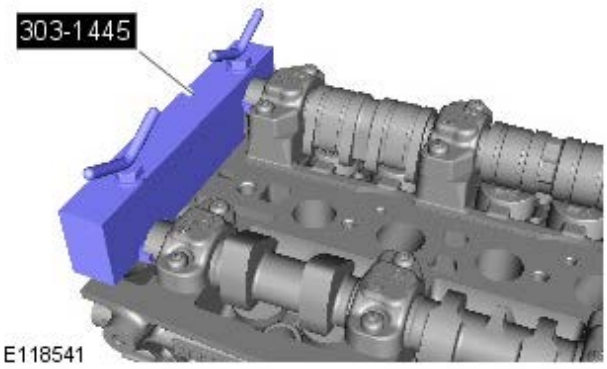
36. CAUTION: If the special tool cannot be installed, the timing chain installation steps must be repeated.

    Install the special tool.

37.
- Remove the special tool.

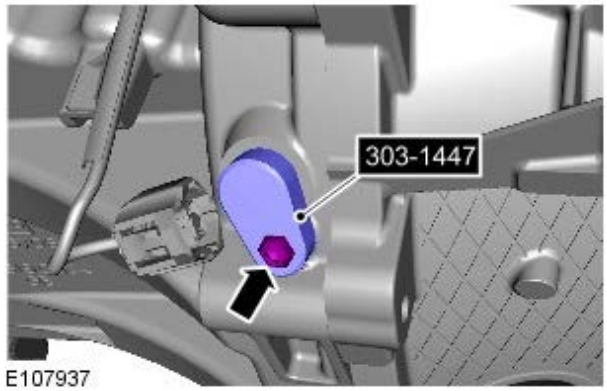


38.
- Remove the special tool.
- *Special Tool(s):* 303-1445

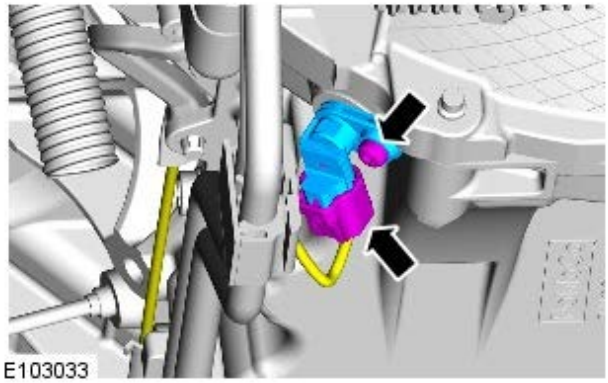


39.

- Remove the special tool.
- *Special Tool(s):* 303-1447



40. *Torque:* 10 Nm



41. Refer to: Timing Cover (303-01 Engine - V8 5.0L Petrol, Removal and Installation).

42. Connect the battery ground cable.

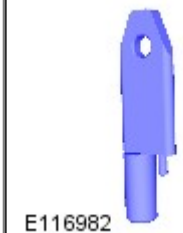
    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Valve Cover LH

Removal and Installation

Special Tool(s)

 E116982	303-1446 Valve Cover Alignment Tool

Removal

NOTES:

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

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

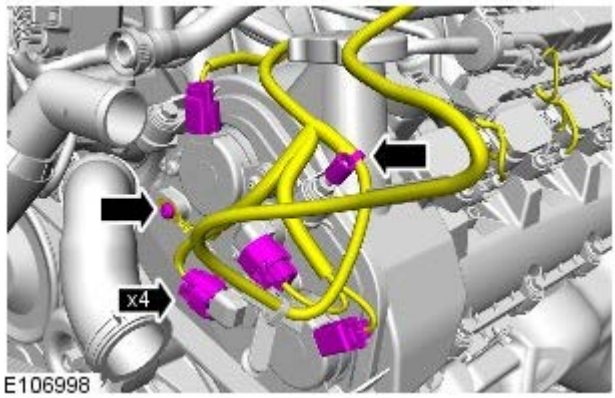
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Supercharger (303-12, Removal and Installation).

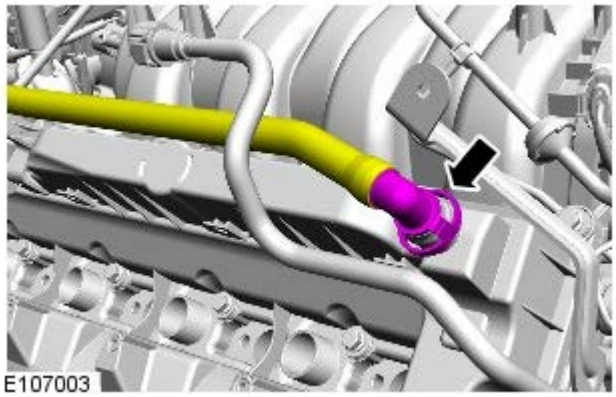
3. Refer to: Air Cleaner Outlet Pipe LH (303-12, Removal and Installation).

4. Refer to: Fuel Rail LH (303-04, Removal and Installation).

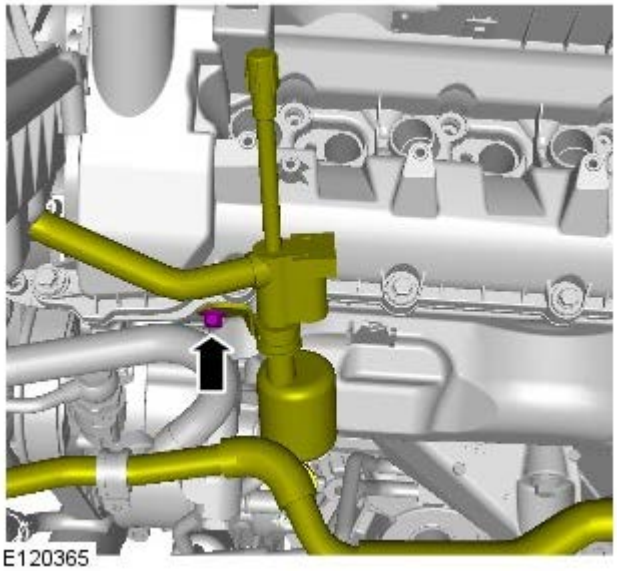
5. *Torque:* 10 Nm



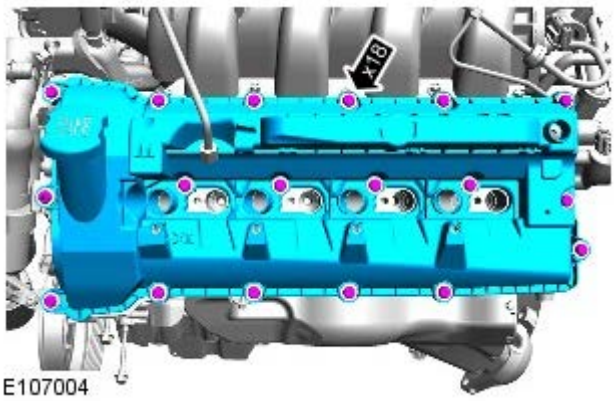
6.



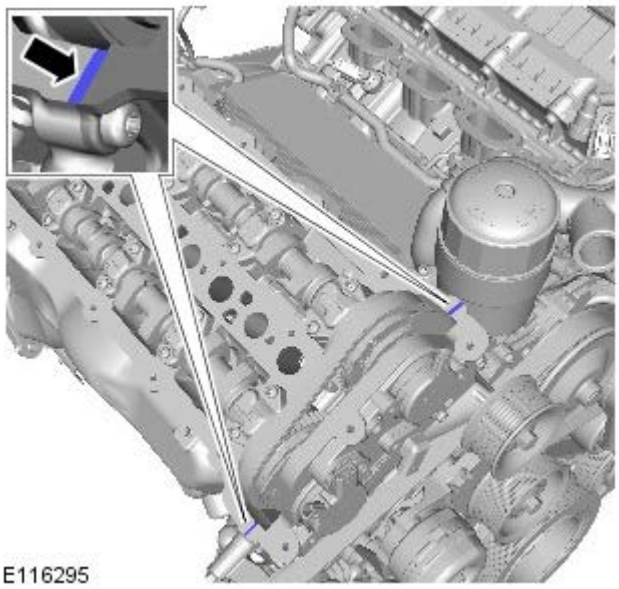
7. *Torque:* 25 Nm



8.



Installation



1. CAUTIONS:

   Use only a plastic scraper when removing the sealing material.

   Use lint free cloth.

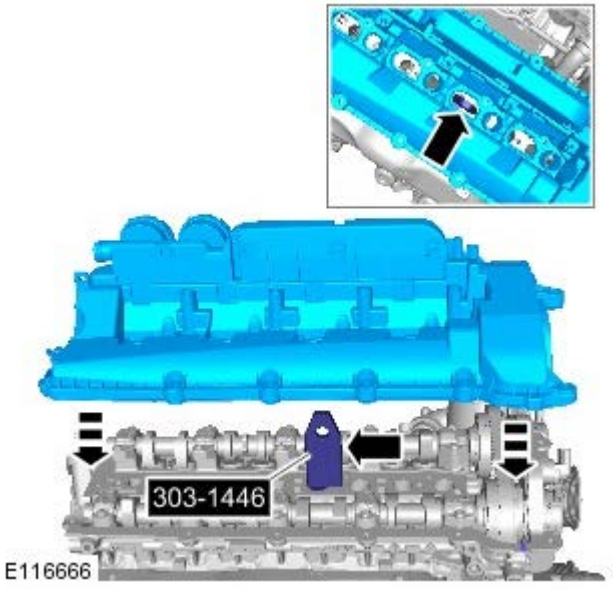
   Make sure that the mating faces are clean and free of corrosion and foreign material.

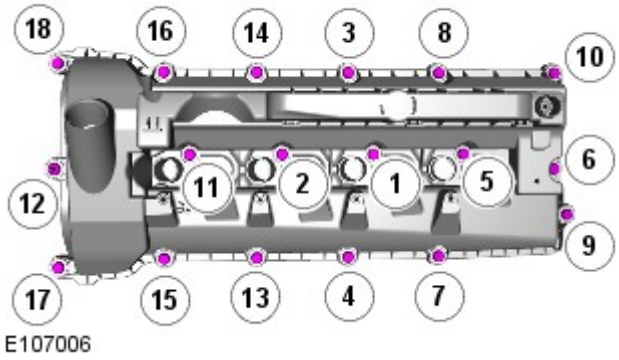
   Installation of the valve cover and tightening must be carried out within 7 minutes of applying the sealant.

   NOTE: Apply two beads of silcone gasket sealant (Loctite 5901) as shown on the illustration. The application of the sealant must be 1.5mm 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.

   To install, reverse the removal procedure.

2. *Special Tool(s):* 303-1446





3. NOTE: Tighten the bolts in the indicated sequence.

   Torque: 13 Nm

Published: 11-May-2011

Engine - V8 S/C 5.0L Petrol - Valve Cover RH

Removal and Installation

Special Tool(s)

 E116982	303-1446 Valve Cover Alignment Tool

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

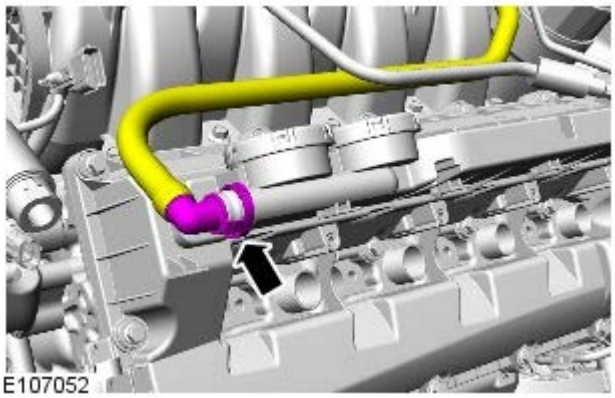
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Supercharger (303-12, Removal and Installation).

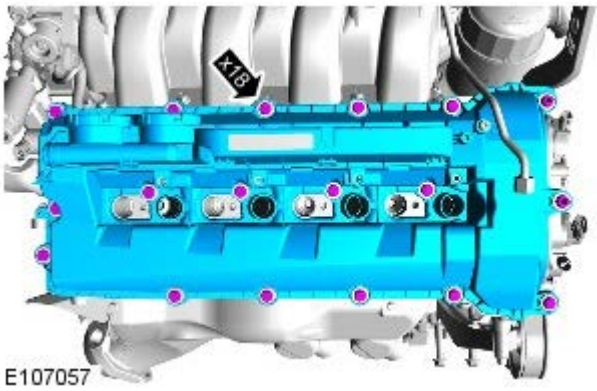
3. Refer to: Air Cleaner Outlet Pipe RH (303-12, Removal and Installation).

4. Refer to: Fuel Rail RH (303-04, Removal and Installation).

5.


E107052

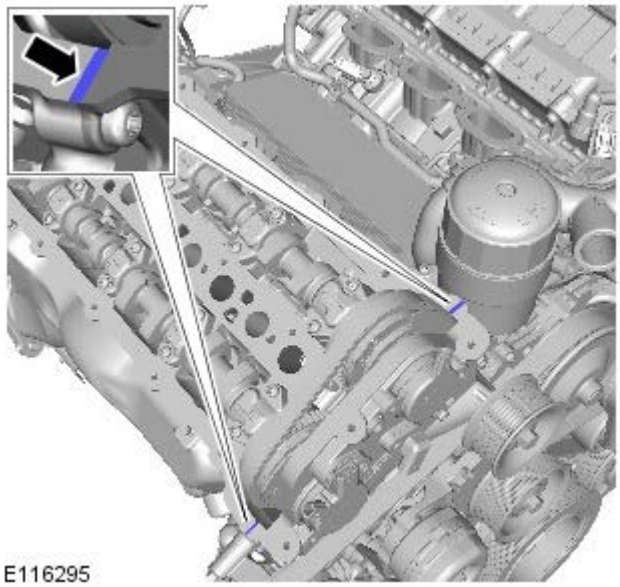
6.



E107057

Installation

1. CAUTIONS:


E116295

Use only a plastic scraper when removing the sealing material.

Use lint free cloth.

Make sure that the mating faces are clean and free of corrosion and foreign material.

Installation of the valve cover and tightening must be carried out within 7 minutes of applying the sealant.

NOTE: Apply two beads of silcone gasket sealant (Loctite 5901) as shown on the illustration. The application of the sealant must be 1.5mm 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.

To install, reverse the removal procedure.

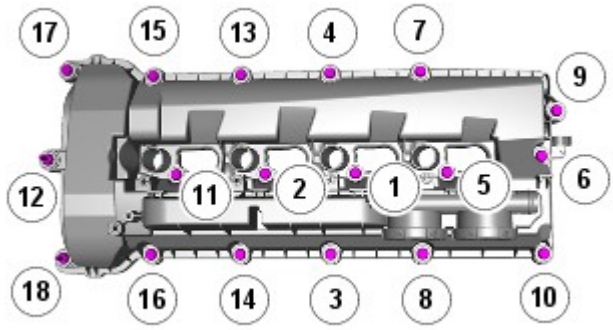
2. *Special Tool(s):* 303-1446



E116666

3. NOTE: Tighten the bolts in the indicated sequence.

Torque: 13 Nm



E107058

Published: 23-Jul-2011

Engine - V8 S/C 5.0L Petrol - Cylinder Block Oil Gallery Plug

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

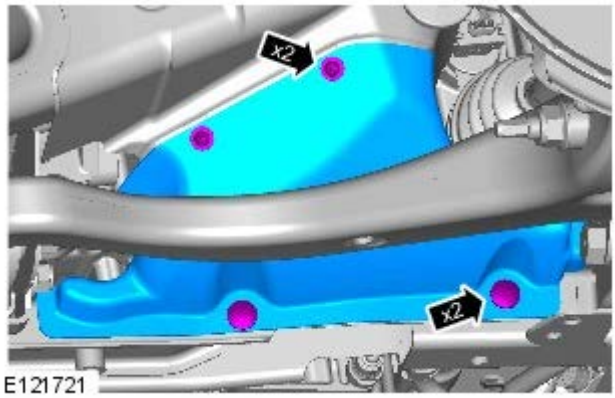
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

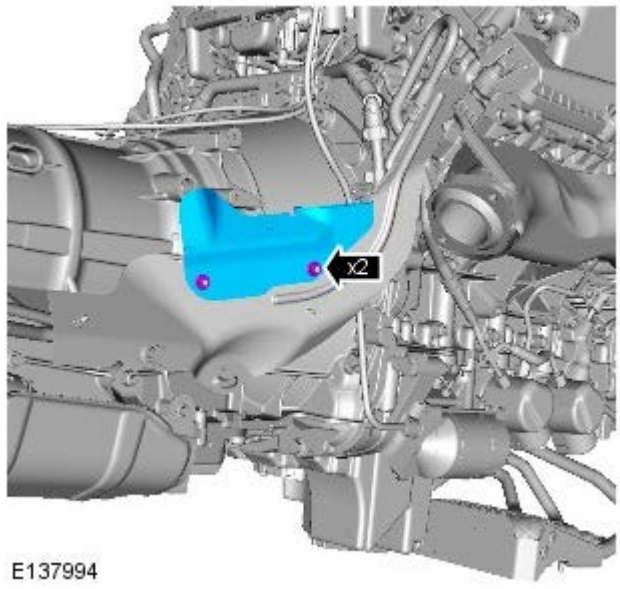
   Raise and support the vehicle.

3. Refer to: Catalytic Converter RH (309-00, Removal and Installation).

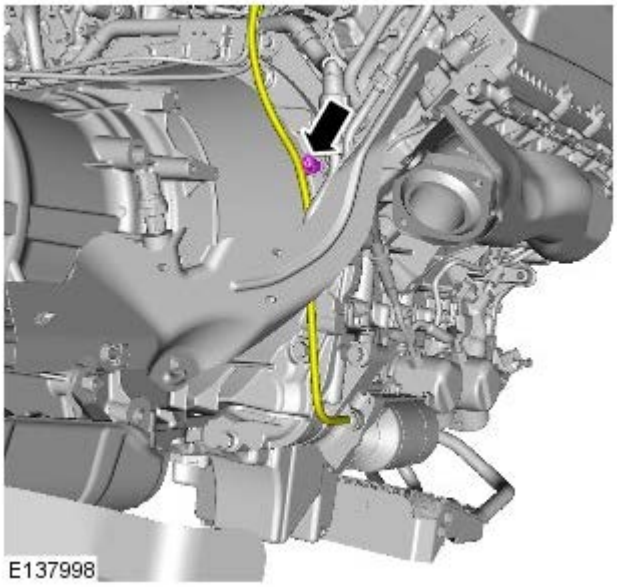
4.



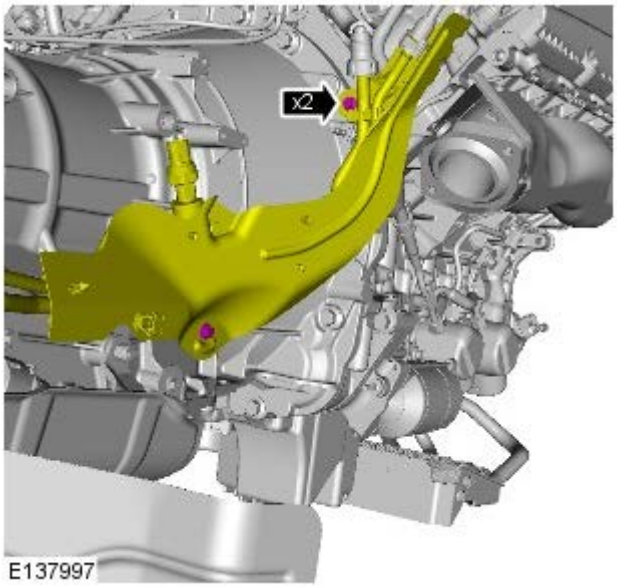
5.



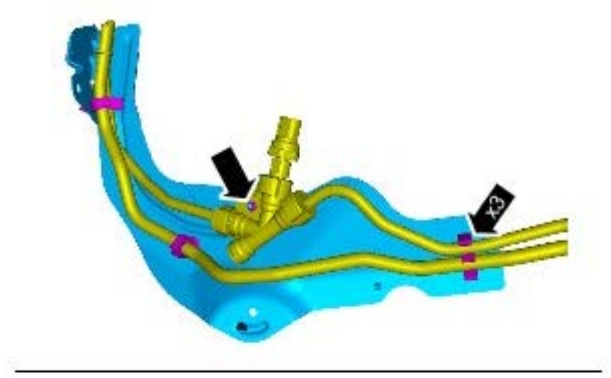
6.

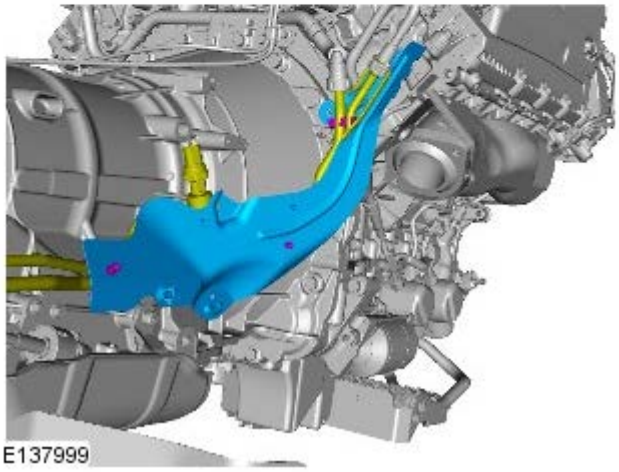


7. *Torque:* 10 Nm

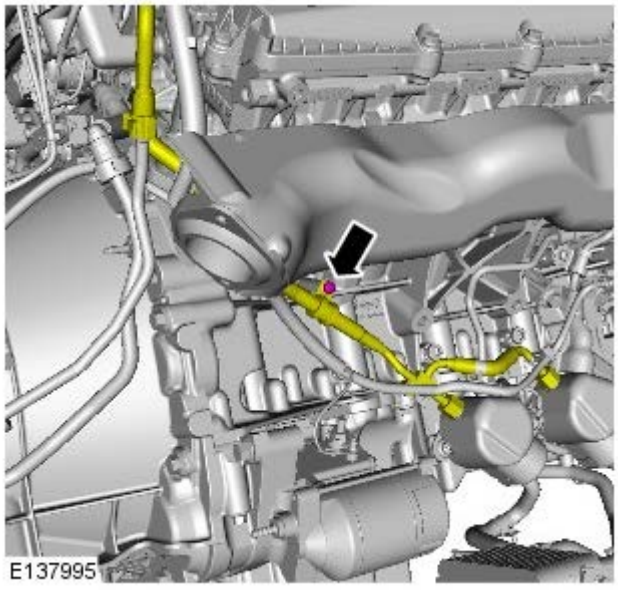


8. *Torque:* 10 Nm

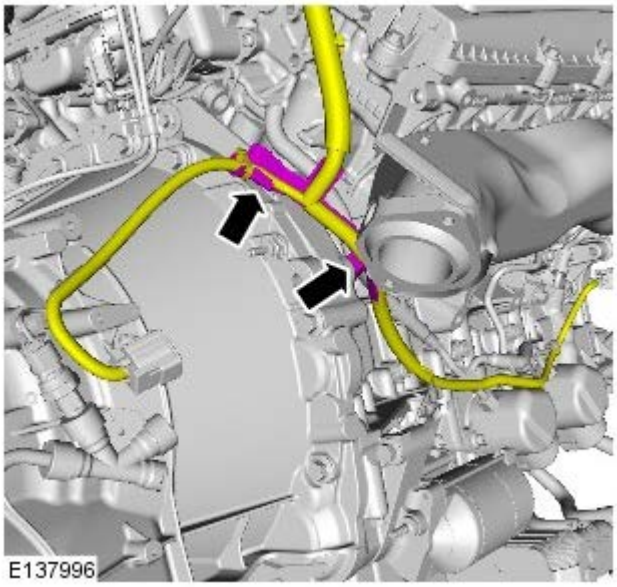


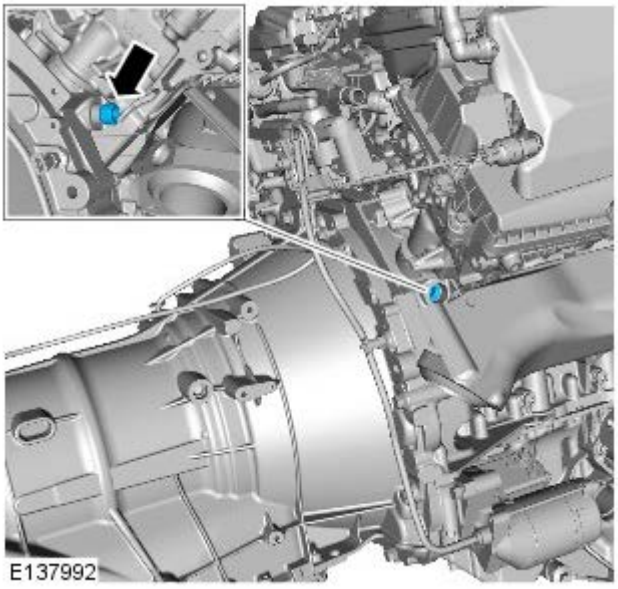


9. *Torque:* 12 Nm



10.





11. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

Torque:
Stage 1: 40 Nm
Stage 2: 180°

Installation

1. To install, reverse the removal procedure.

Published: 24-Oct-2011

Engine - V8 S/C 5.0L Petrol - Fuel Pump Camshaft Assembly Part Number: INA Timing Drive

Removal and Installation

Removal

NOTE: Some illustrations may show the engine removed for clarity.

1. Disconnect the battery groun cable.

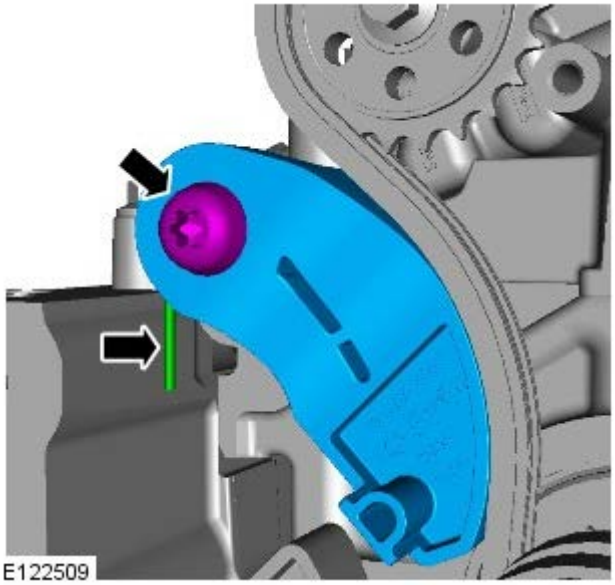
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

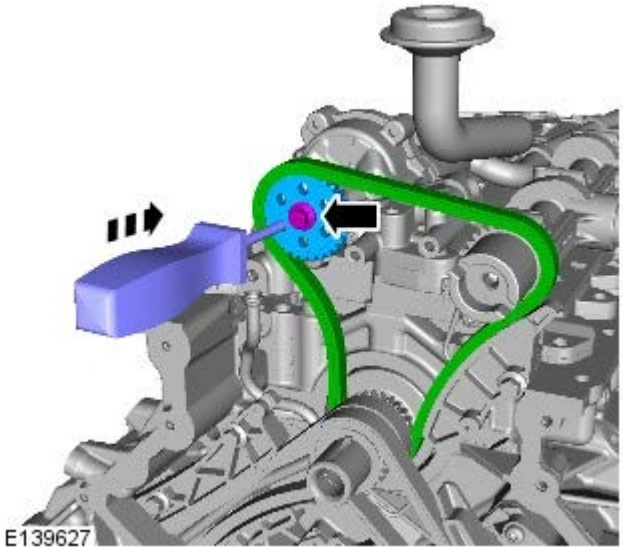
   Raise and support the vehicle.

3. Refer to: Oil Pan Extension (303-01D, Removal and Installation).

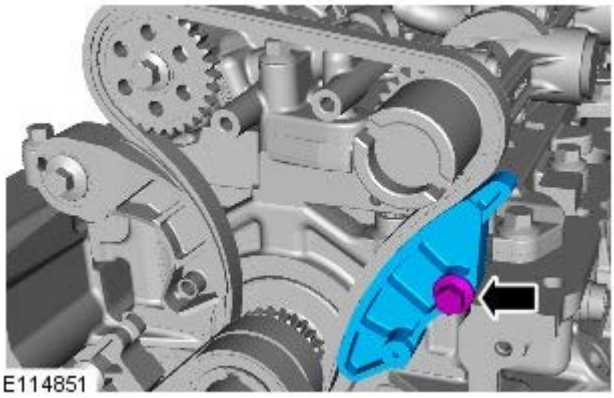
4.

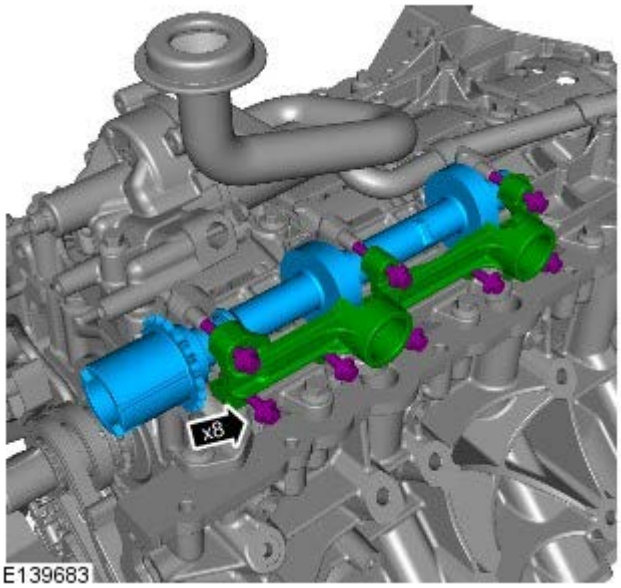


5.



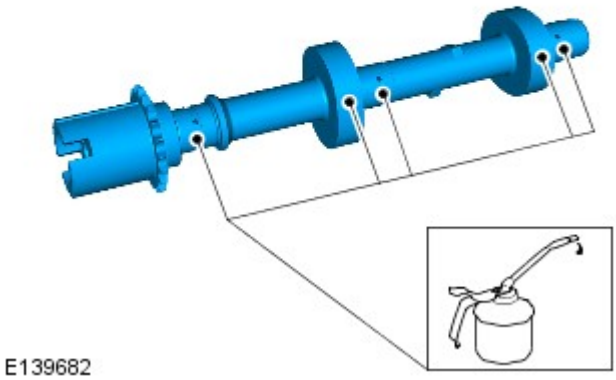
6.





7. CAUTION: Take extra care when removing the component, prevent damage to the mating faces.

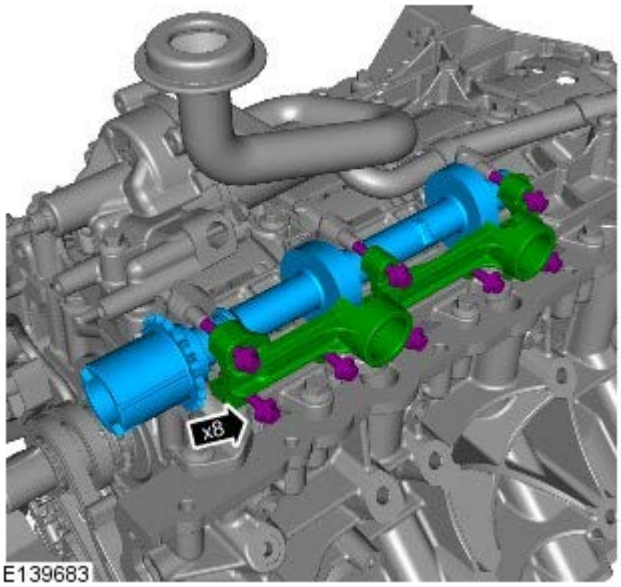
Installation



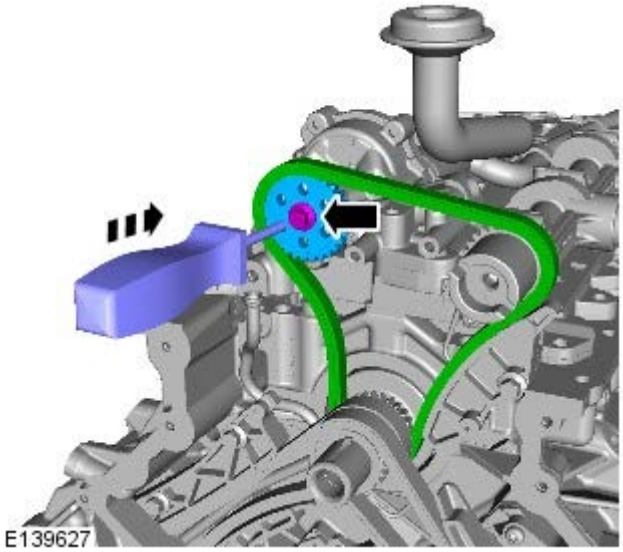
1. CAUTION: Make sure that the mating faces are clean and free of foreign material.

2. CAUTION: Take extra care not to damage the mating faces.

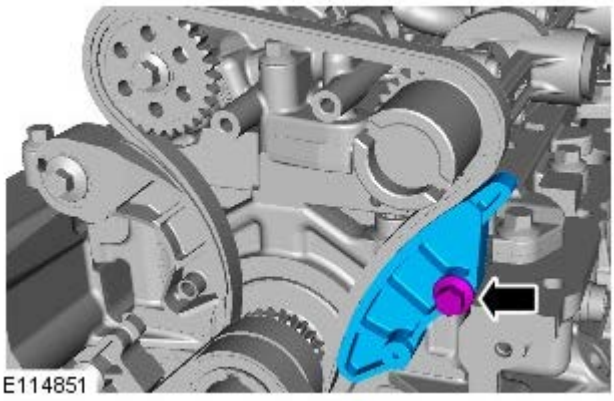
   Torque: 12 Nm



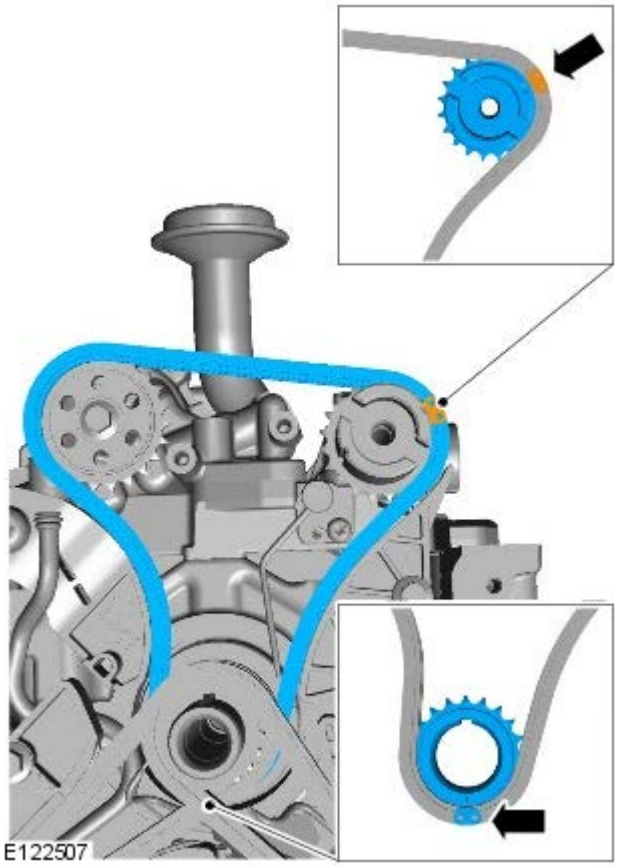
3. *Torque:* 21 Nm

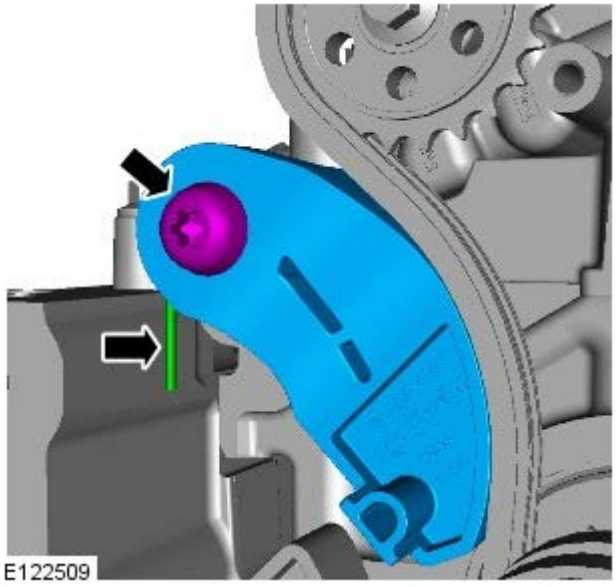


4. *Torque:* 12 Nm



5. Install the lower timing chain making sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft and crankshaft sprocket markings.





6. CAUTION: Make sure that the tensioner spring is correctly located.

   Torque: 21 Nm

7. Refer to: Oil Pan Extension (303-01D, Removal and Installation).

8. Connect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

Published: 24-Oct-2011

Engine - V8 S/C 5.0L Petrol - Fuel Pump Camshaft Assembly Part Number: Tsubaki Timing Drive

Removal and Installation

Removal

NOTE: Some illustrations may show the engine removed for clarity.

1. Disconnect the battery groun cable.

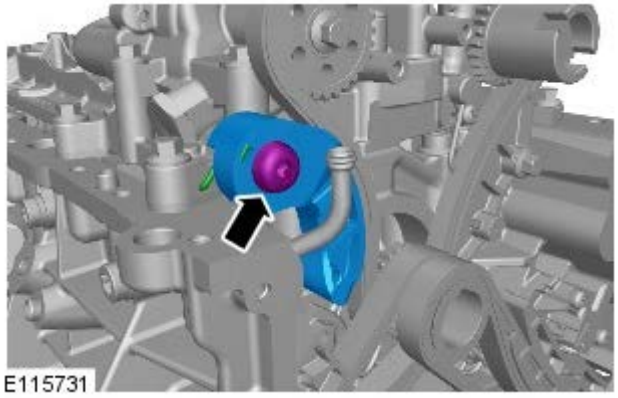
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

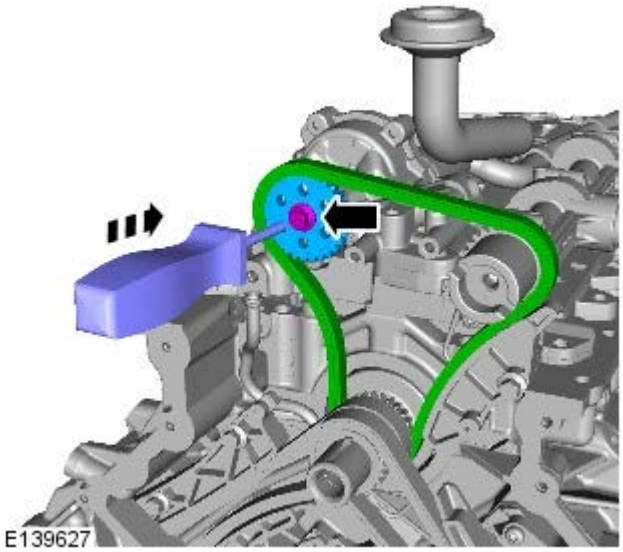
   Raise and support the vehicle.

3. Refer to: Oil Pan Extension (303-01D, Removal and Installation).

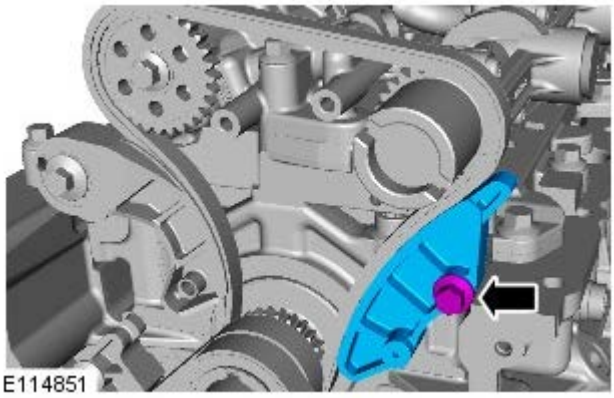
4.

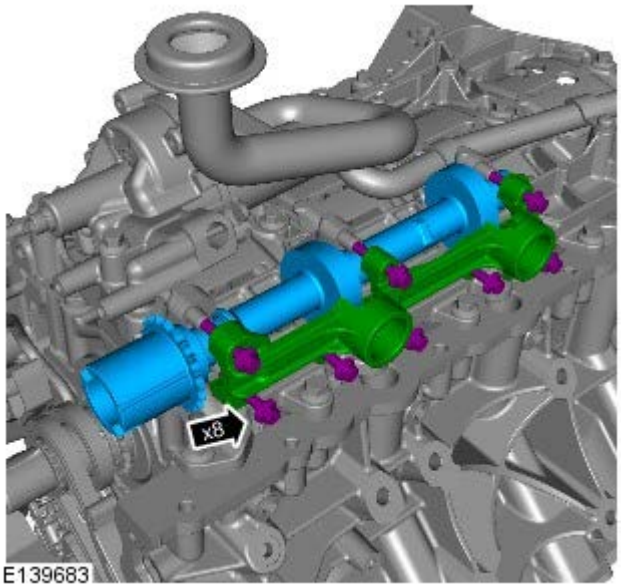


5.



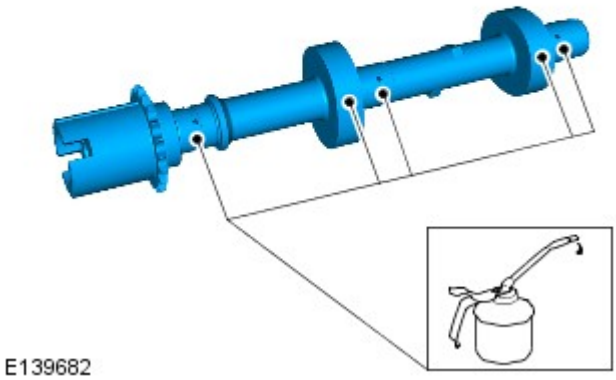
6.





7. CAUTION: Take extra care when removing the component, prevent damage to the mating faces.

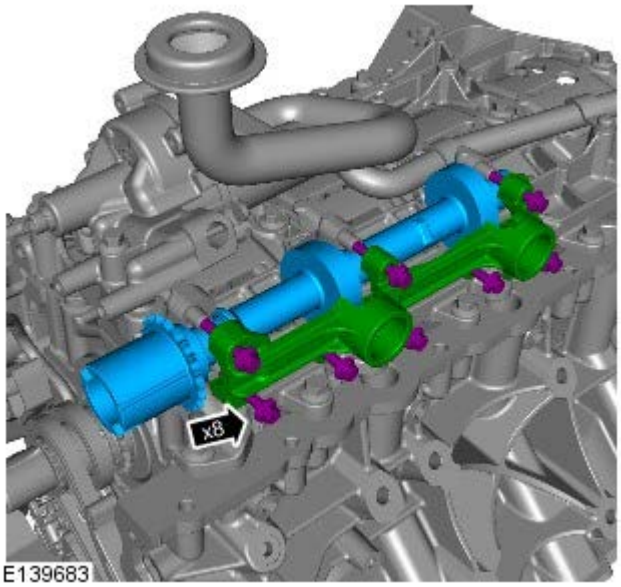
Installation



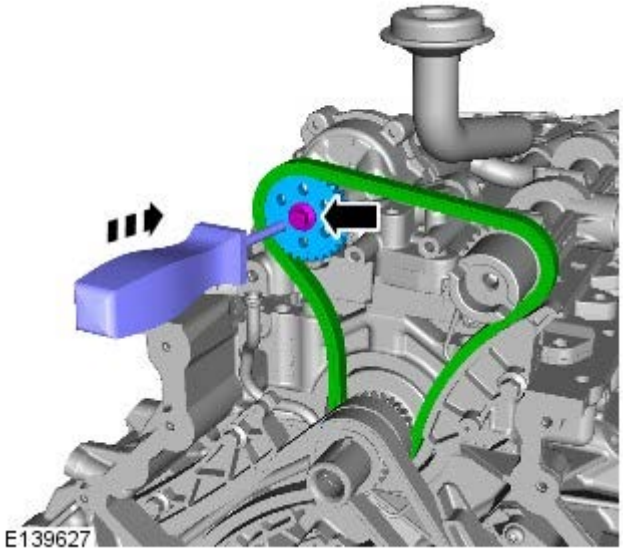
1. CAUTION: Make sure that the mating faces are clean and free of foreign material.

2. CAUTION: Take extra care not to damage the mating faces.

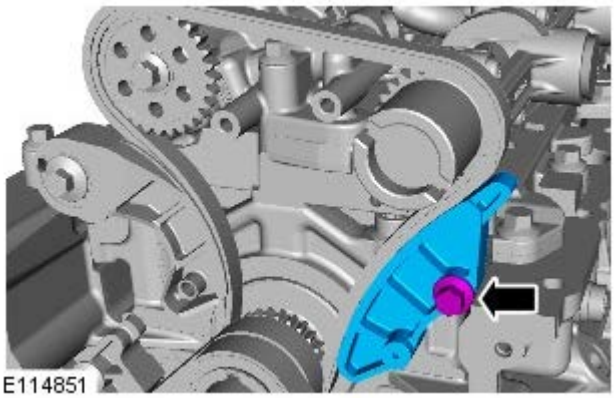
   Torque: 12 Nm



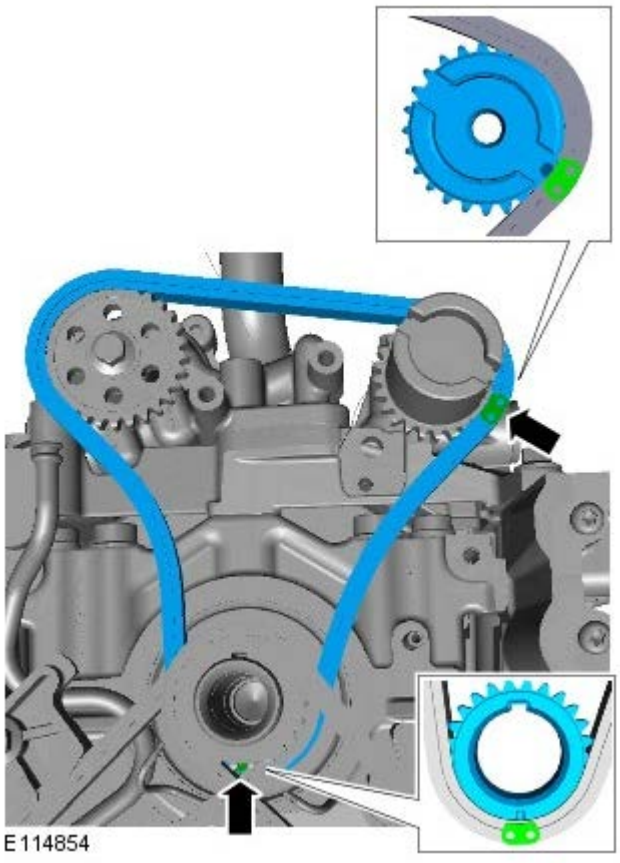
3. *Torque:* 21 Nm

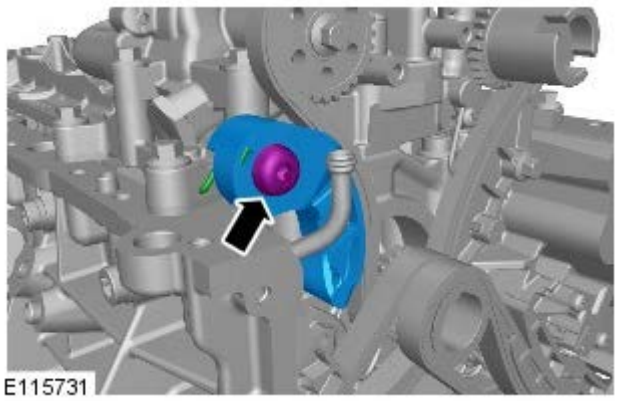


4. *Torque:* 12 Nm



5. Install the lower timing chain making sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft and crankshaft sprocket markings.





6. CAUTION: Make sure that the tensioner spring is correctly located.

   Torque: 21 Nm

7. Refer to: Oil Pan Extension (303-01D, Removal and Installation).

8. Connect the battery groun cable.

   Refer to: Specifications (414-00, Specifications).

Published: 08-Dec-2011

Engine - V8 S/C 5.0L Petrol - Lower Timing Cover

Removal and Installation

Special Tool(s)

 E107676	303-1433 Lower Timing Cover Alignment tool

Removal

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-01, Specifications).

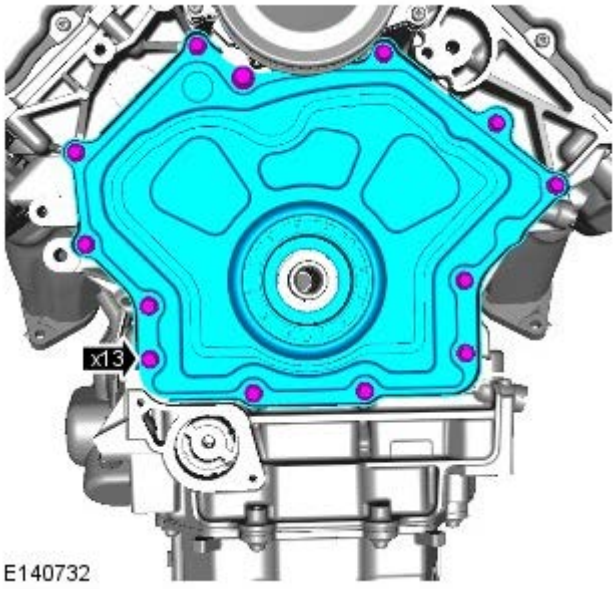
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Crankshaft Pulley (303-01D, Removal and Installation).

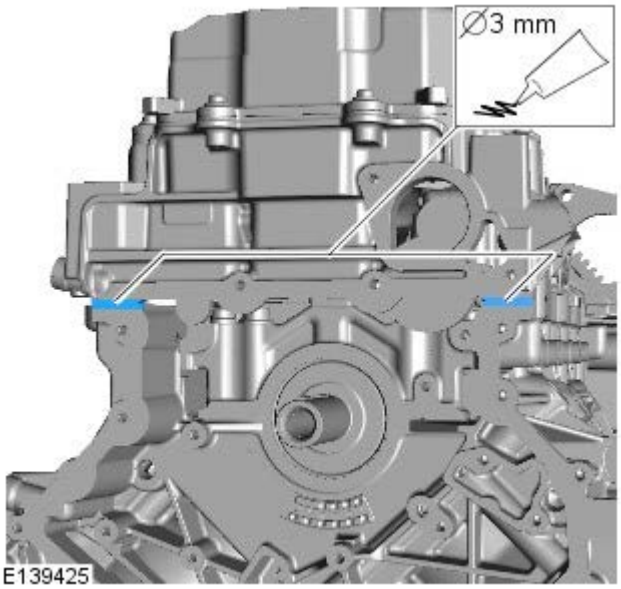
4. Refer to: Brake Vacuum Pump - V8 5.0L Petrol/V8 S/C 5.0L Petrol (206-07, Removal and Installation).

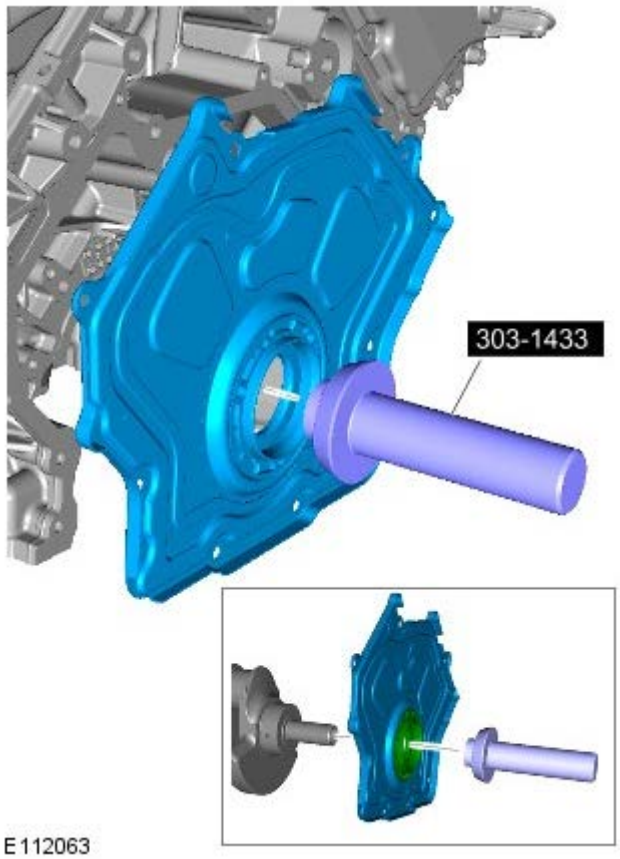
5.



Installation

1. Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

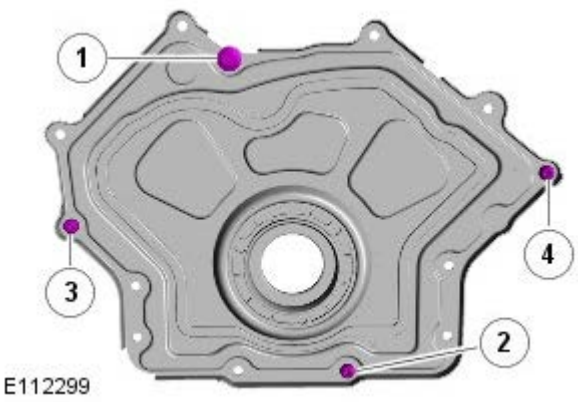




2. CAUTION: Make sure that the mating faces are clean and free of foreign material.

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

   Special Tool(s): 303-1433



3. NOTE: Tighten the bolts in the indicated sequence.

   Torque:
   M6 12 Nm
   M8 20 Nm

4. *Torque:* 12 Nm



5. Refer to: Brake Vacuum Pump - V8 5.0L Petrol/V8 S/C 5.0L Petrol (206-07, Removal and Installation).

6. Refer to: Crankshaft Pulley (303-01D, Removal and Installation).

7. Connect the battery ground cable.

   Refer to: Specifications (414-01, Specifications).

8. CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum (by following Steps 11-17), before starting the engine.

   - Fill the engine with oil - for filling values on vehicles without supercharger:

     Refer to: Specifications (303-01C, Specifications).
   - Fill the engine with oil - for filling values on vehicles with supercharger:

     Refer to: Specifications (303-01D, Specifications).
   - Clean any residual engine oil from the oil filler cap area.

9. CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.

   Follow the Steps 11-17 before starting the engine.

10.
   - Start the engine and allow to run for 10 minutes, stop the engine.
   - Check for leaks.

11. CAUTIONS:

    Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

    Make sure that the hood is open.

    - Turn the ignition on.

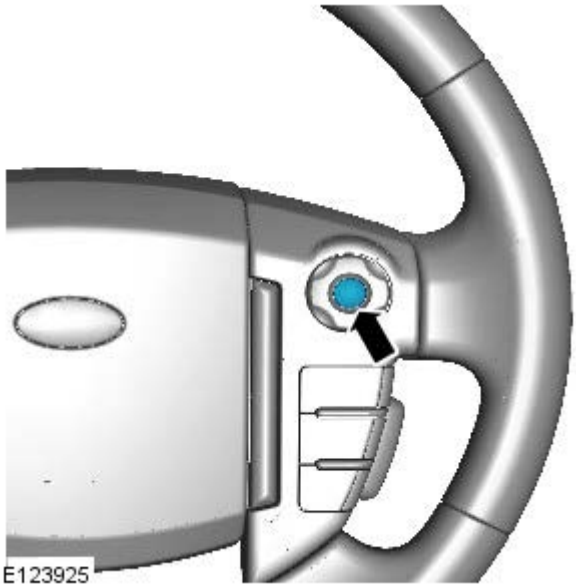
12.
    - Press the right-hand directional button to access the instrument cluster menu.



E123926

13.

- Press the right-hand OK button.



E123925

14.

- Press the right-hand directional button to access the Oil Level Display.



E123927

15.

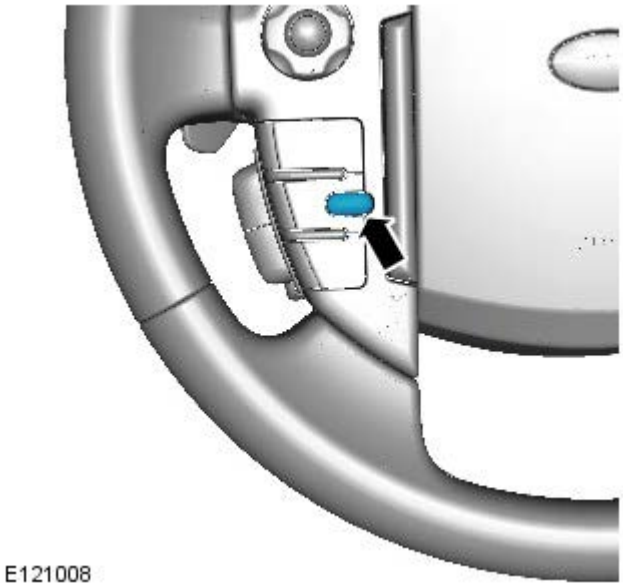
- Press the right-hand OK button and follow the instructions.



E123928

16.

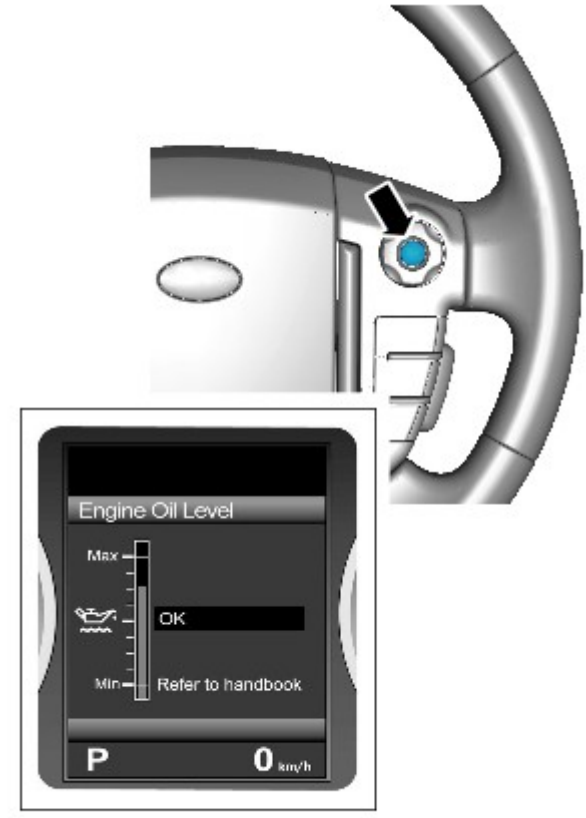
- Press the cruise control cancel button twice within 2 seconds.



E121008

17.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes (as indicated in Step 10), switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.



E123929

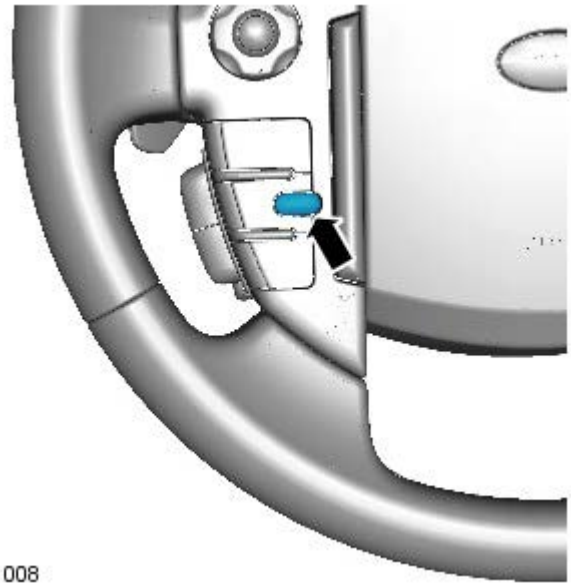
18. NOTE: If instructed to follow Steps 11-17 in a previous step, return to Step 10 and continue the procedure.

    Turn the ignition off.

19. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

20. NOTE: The following steps are to update the average oil level value.

    - Turn the ignition on.
    - Press and hold the cruise control cancel button for more than 2 seconds.



E121008

21.

- The message center display will revert to the normal display in the trip computer.

22. Turn the ignition off.

23. Turn the ignition on.

24.

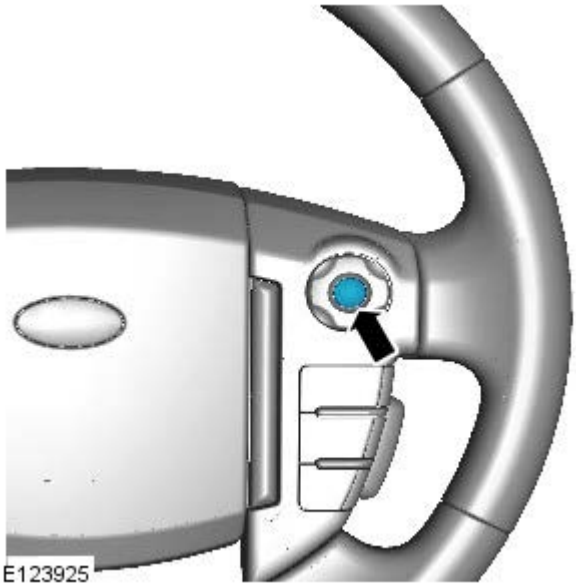
- Press the right-hand directional button to access the instrument cluster menu.



E123926

25.

- Press the right-hand OK button.



26.

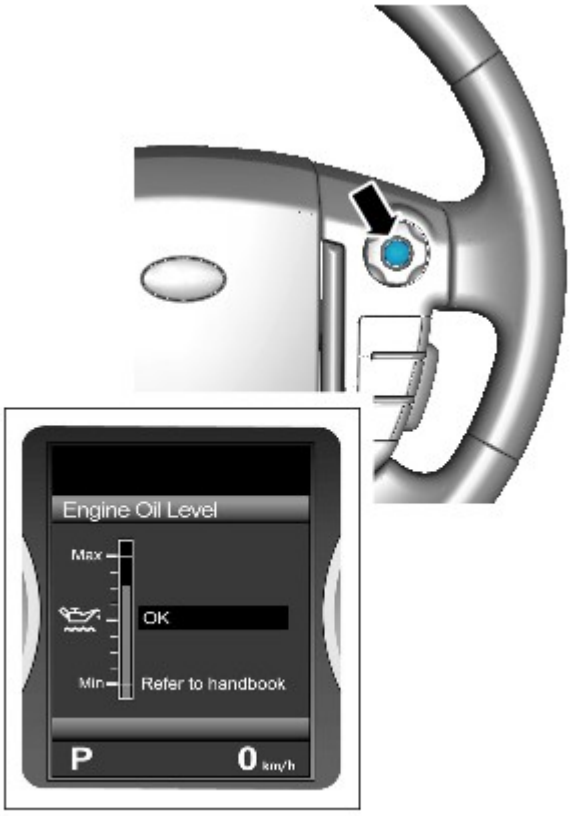
- Press the right-hand directional button to access the Oil Level Display.



E123927

27.

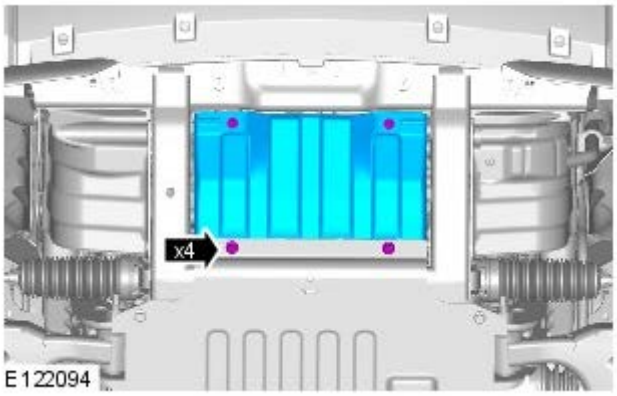
- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.



E123929

28. Refer to: Engine Undershield (501-02, Removal and Installation).

29. *Torque:* 10 Nm



E122094

Published: 31-Jul-2013

Engine - V8 S/C 5.0L Petrol - Timing Chain Tensioner Right

Removal and Installation

Removal

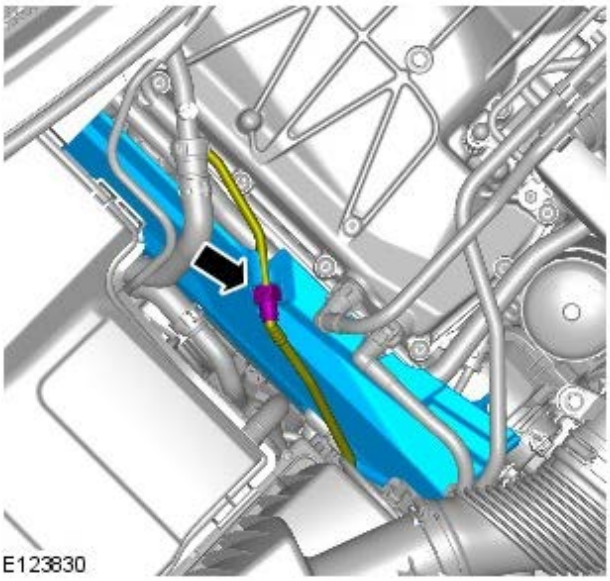
NOTES:

Removal steps in this procedure may contain installation details.

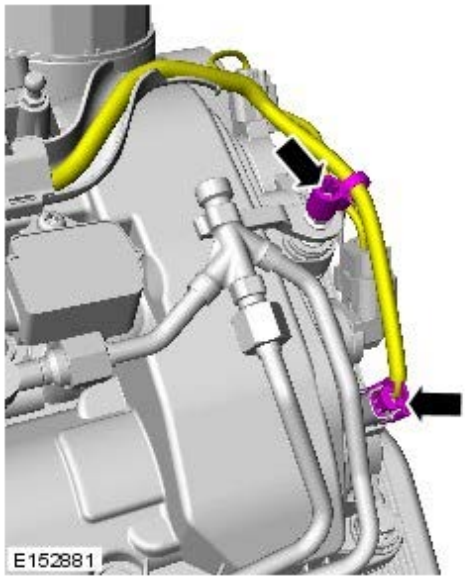
Some variation in the illustrations may occur, but the essential information is always correct.

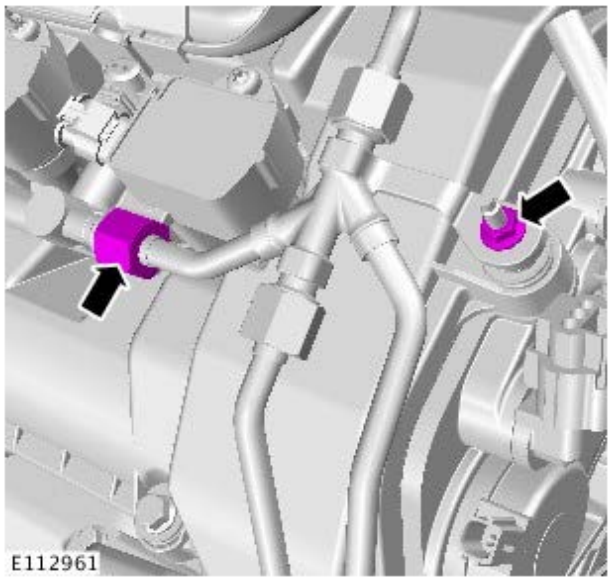
All vehicles

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Health and Safety Precautions (100-00, Description and Operation).
3. Refer to: Fuel System Pressure Release - V8 5.0L Petrol/V8 S/C 5.0L Petrol (310-00, General Procedures).
4. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05, Removal and Installation).
5.



6. Refer to: Air Cleaner Outlet Pipe RH (303-12D, Removal and Installation).
7.





8. 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 mixtures are always present and may ignite. Failure to follow these instructions may result in personal injury.

   CAUTIONS:

   Be prepared to collect escaping fuel.

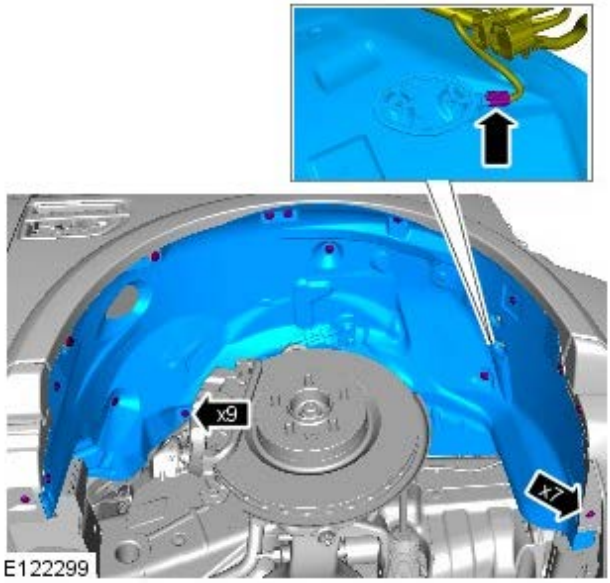
   Make sure that all openings are sealed. Use new blanking caps.

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

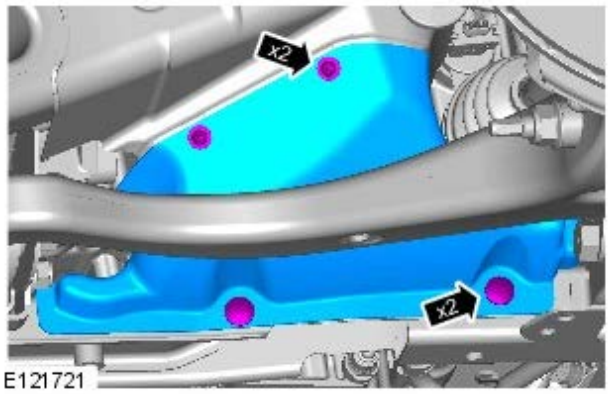
   Raise and support the vehicle.

10. Remove the front right wheel and tire.

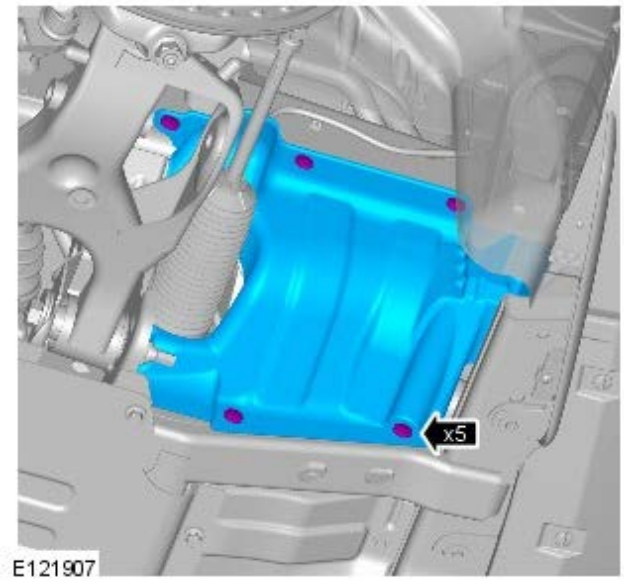
11.



12.



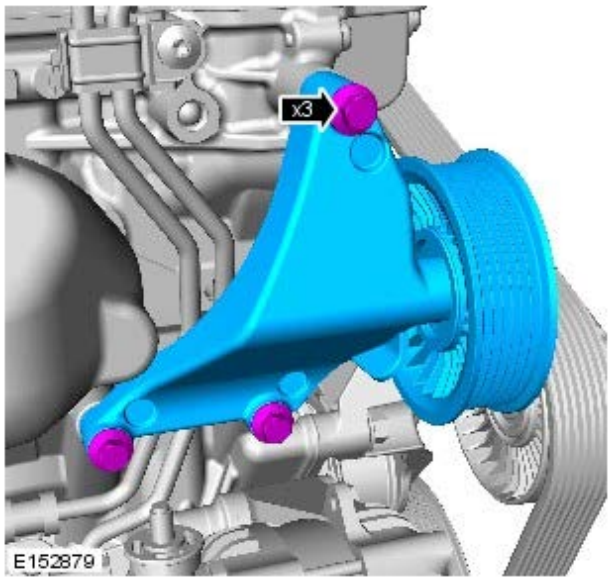
13.



14. Refer to: Generator (414-02C, Removal and Installation).

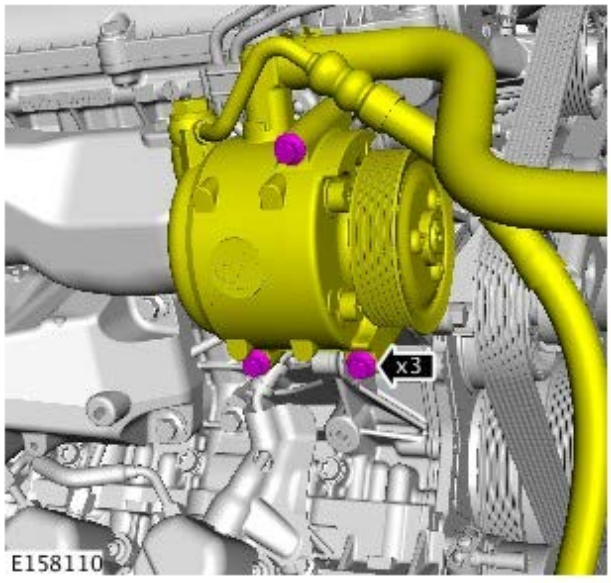
15. Refer to: Steering Column Lower Shaft (211-04, Removal and Installation).

16.

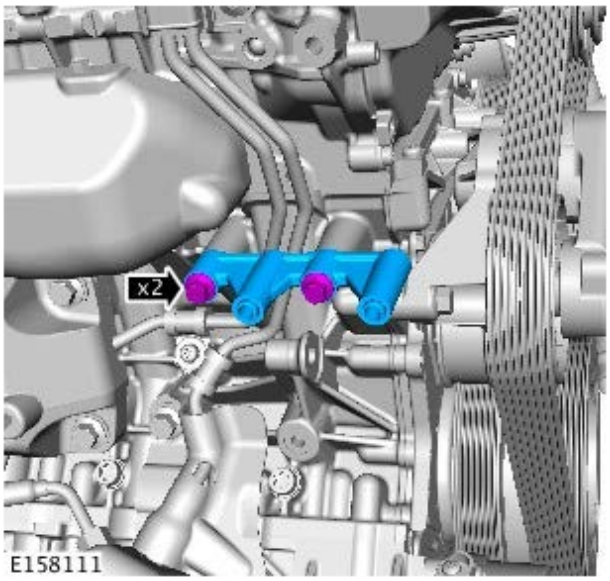


Vehicles with dynamic suspension

17.

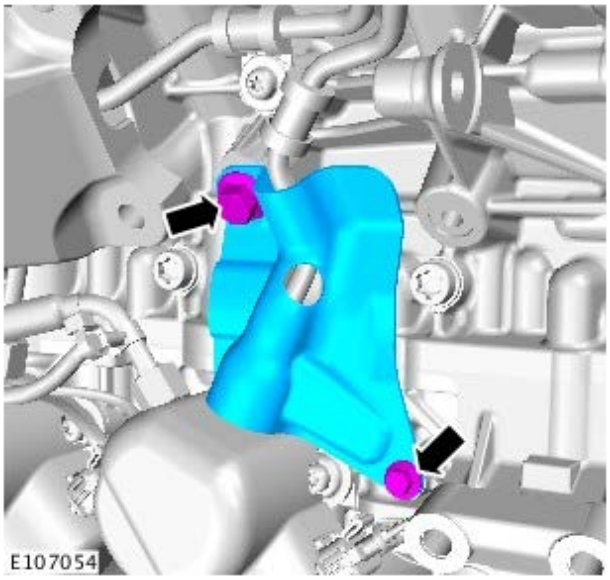


18.

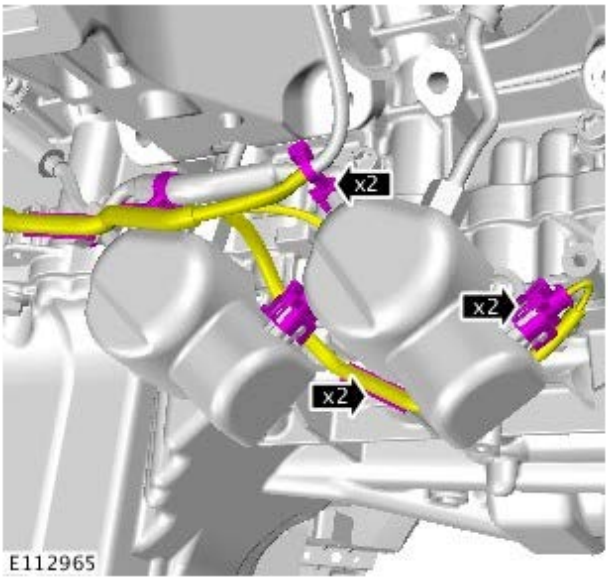


All vehicles

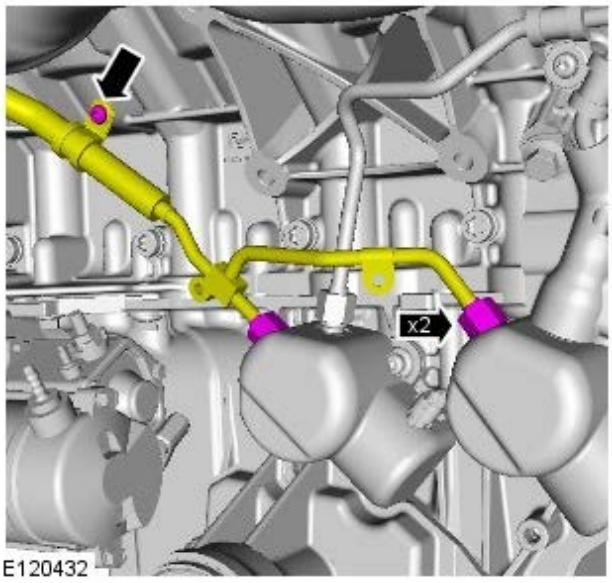
19.



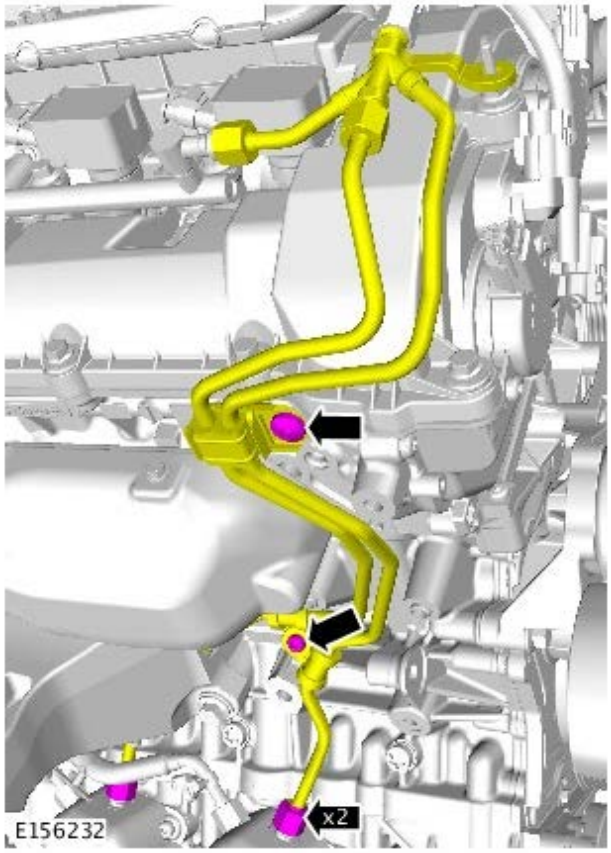
20.



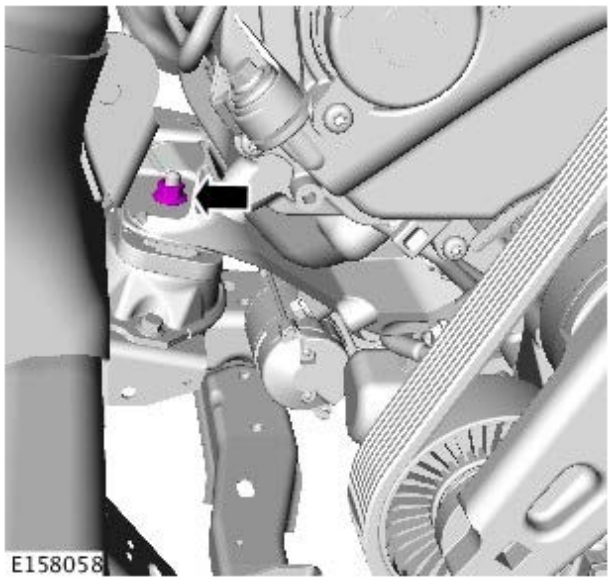
21.



22.

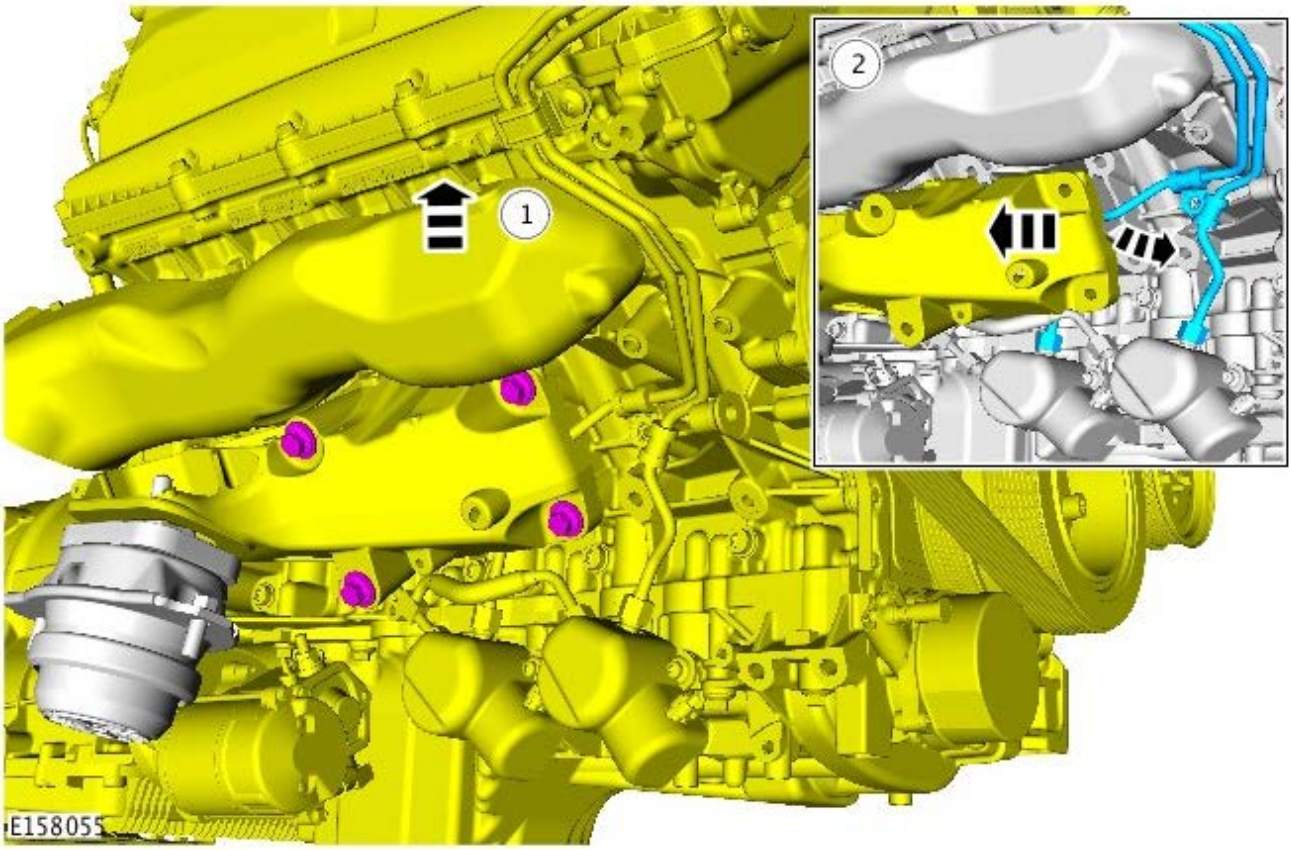


23.



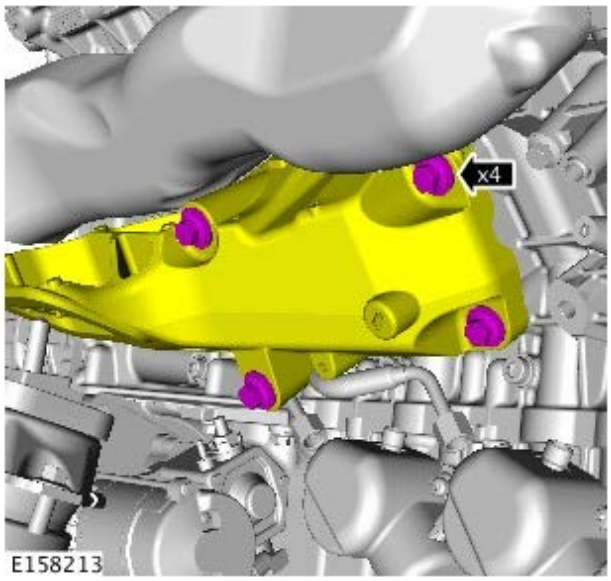
24. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

- Using a suitable hydraulic jack, raise and support the engine.
- Position the engine mount to one side for access to the fuel pipes.
- Remove the fuel pipes.

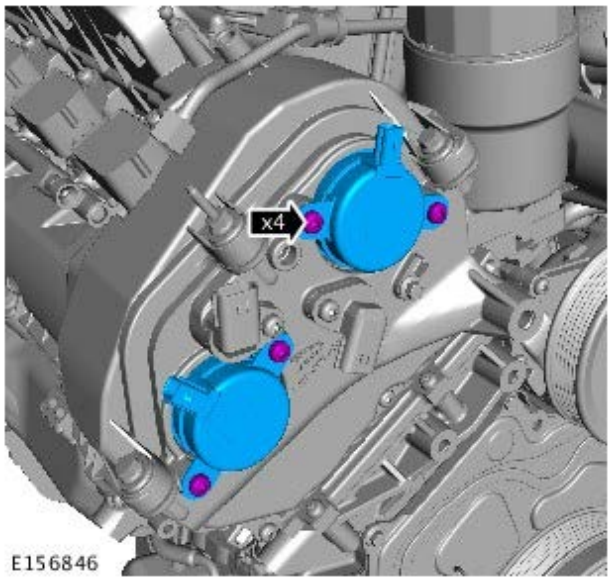


25. Carefully lower the engine onto the engine mounts.

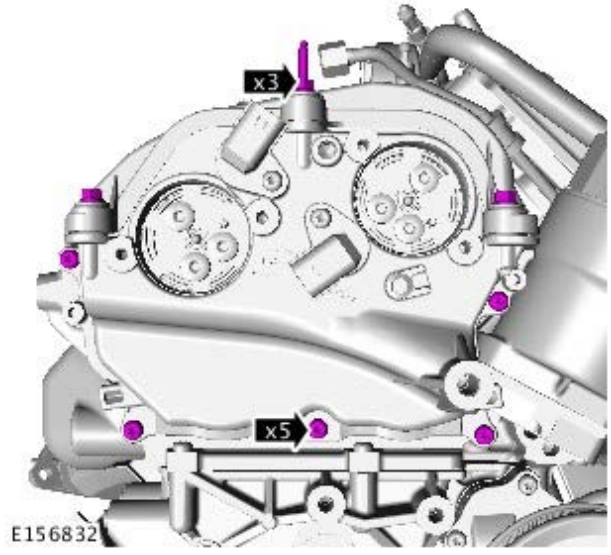
Torque: 20 Nm



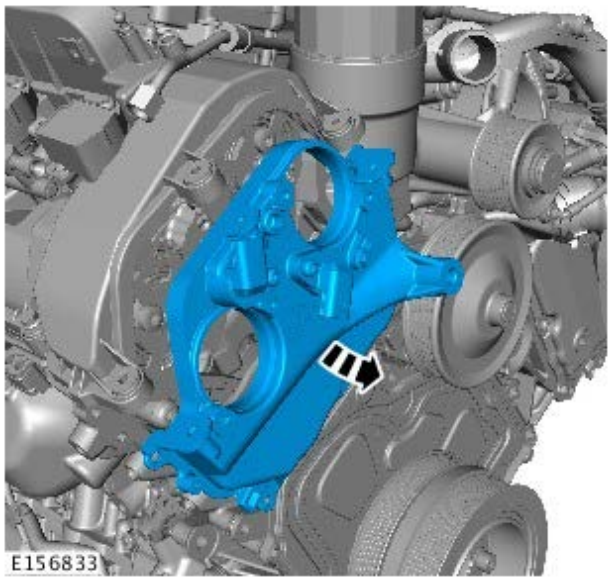
26.



27.

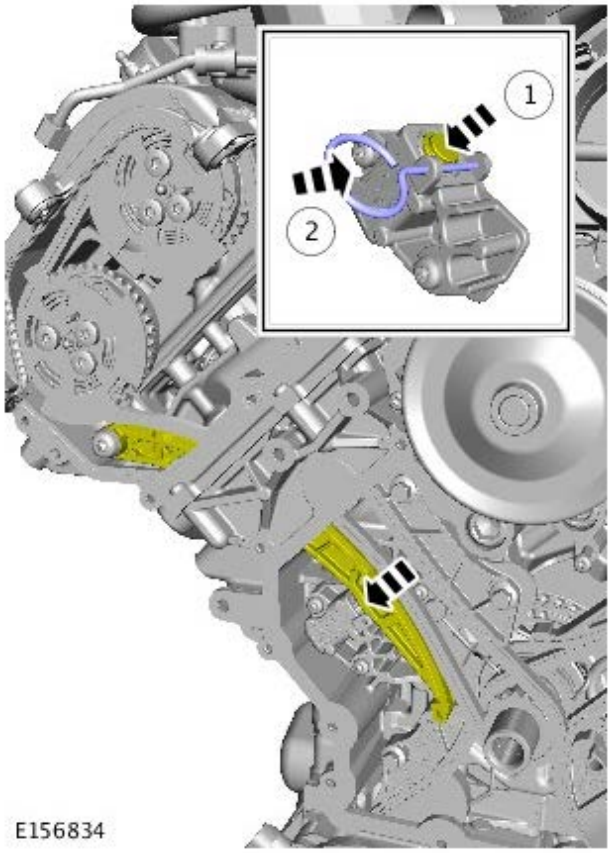


28.

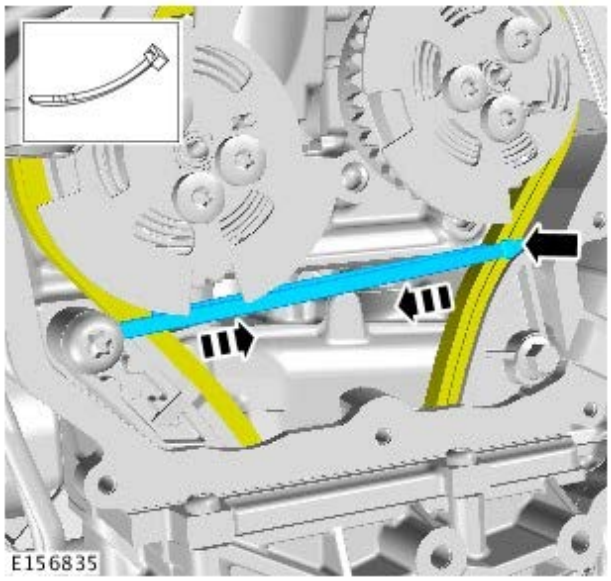


29. Refer to: Lower Timing Cover (303-01D, Removal and Installation).

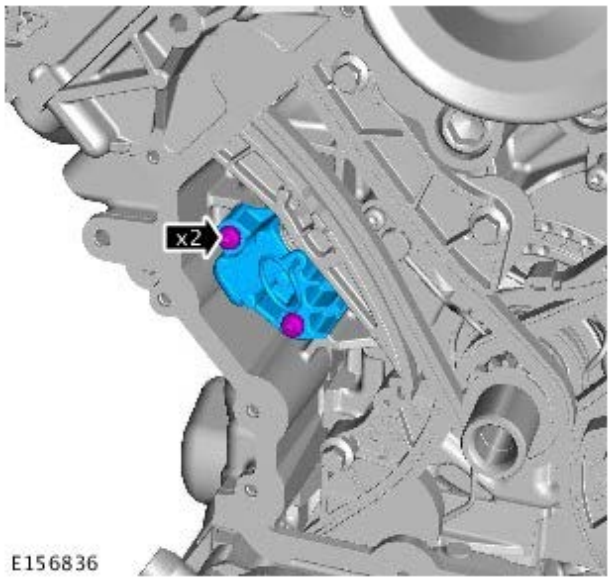
30.



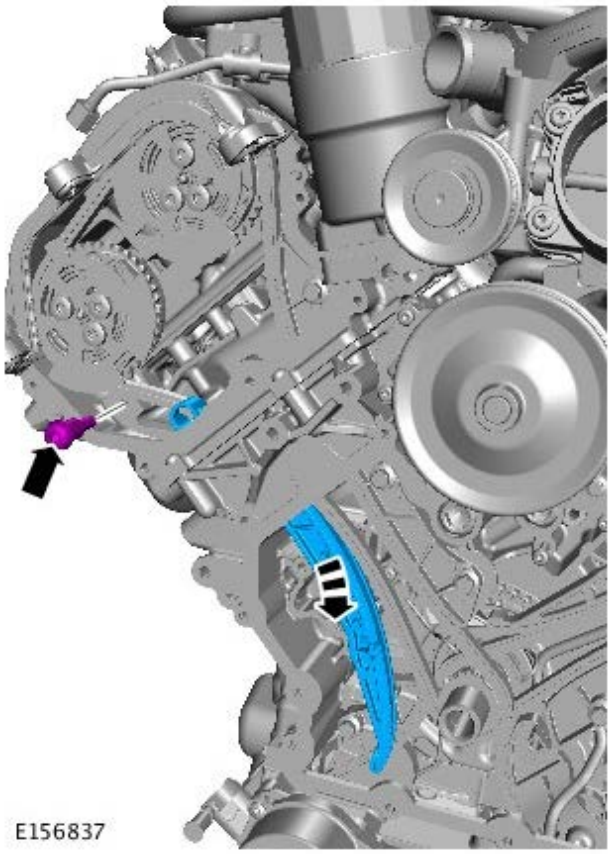
31. CAUTION: Make sure the tension is maintained on the timing chain.



32. *Torque:* 10 Nm



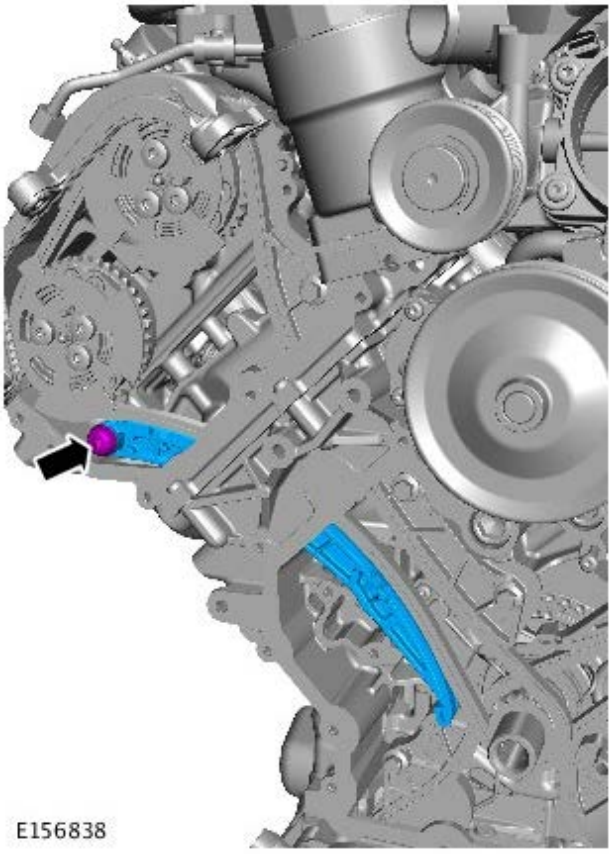
33.



Installation

All vehicles

1. *Torque:* 25 Nm

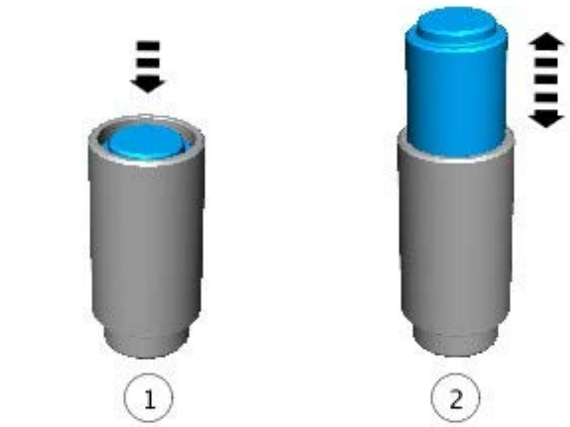


2. Remove cable tie from the timing chain.

3. NOTE: The piston is shown removed from tensioner for clarity.

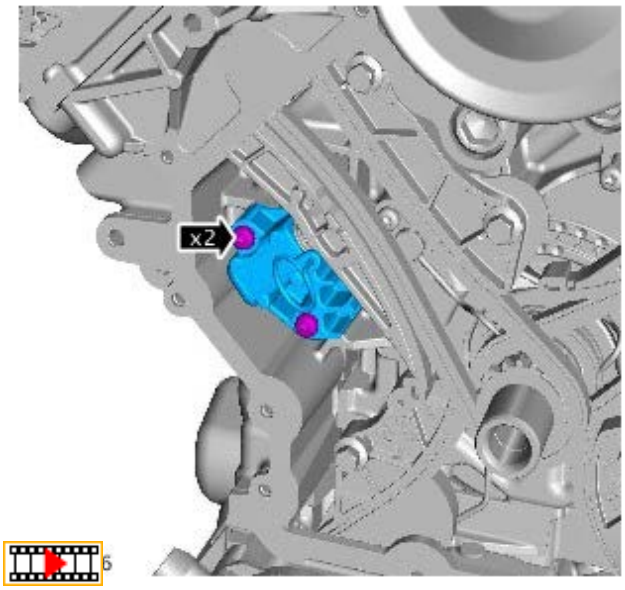
   Make sure the piston is fully compressed and free to

move before installing the grenade pin into the tensioner. Failure to do this may result in damage to the engine.

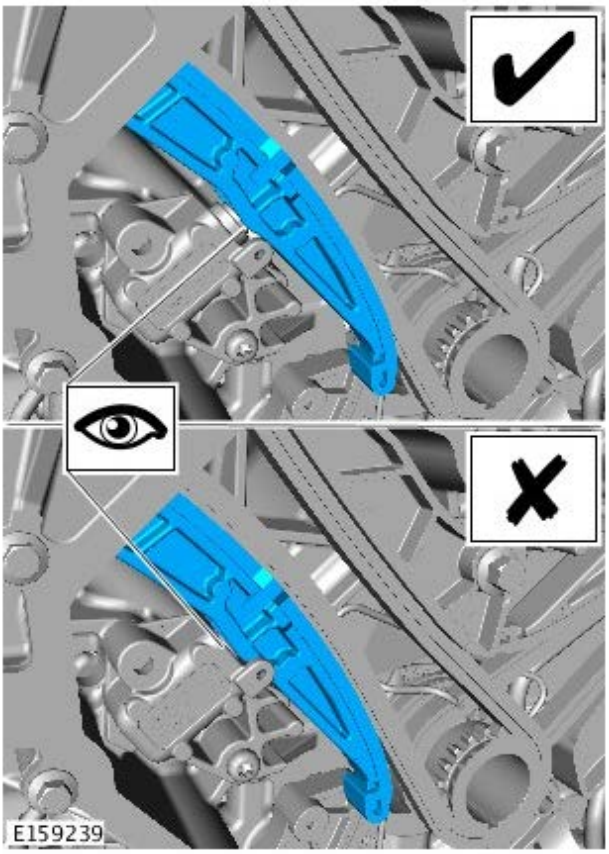


E159231

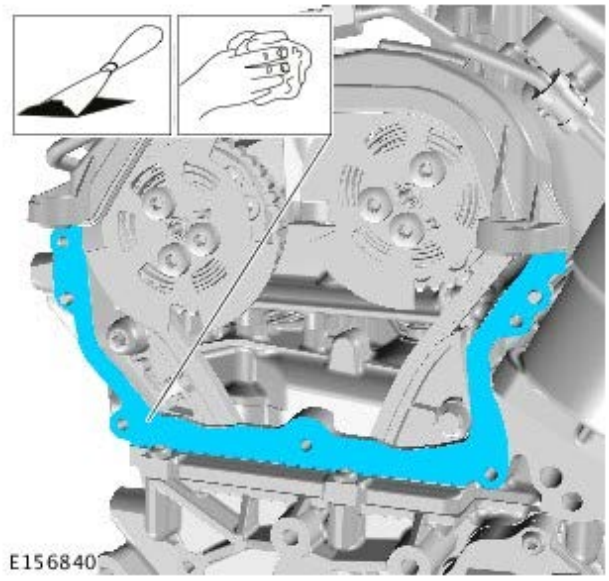
4.



5. CAUTION: Make sure when the tensioner is fully compressed the guide does not touch the tensioner body.

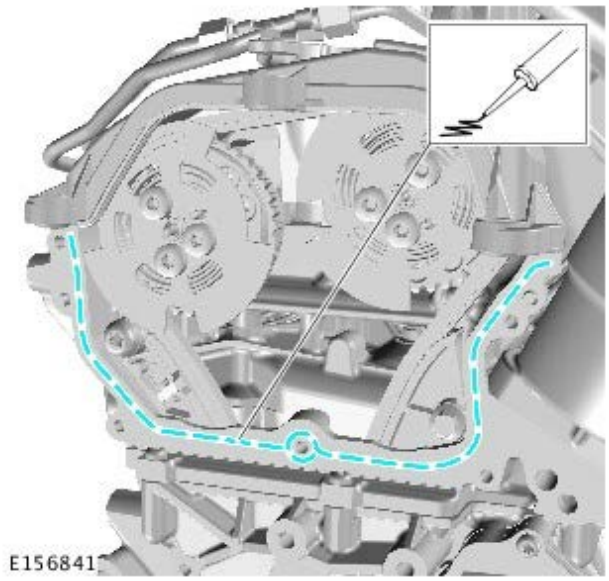


6. Refer to: Lower Timing Cover (303-01D, Removal and Installation).

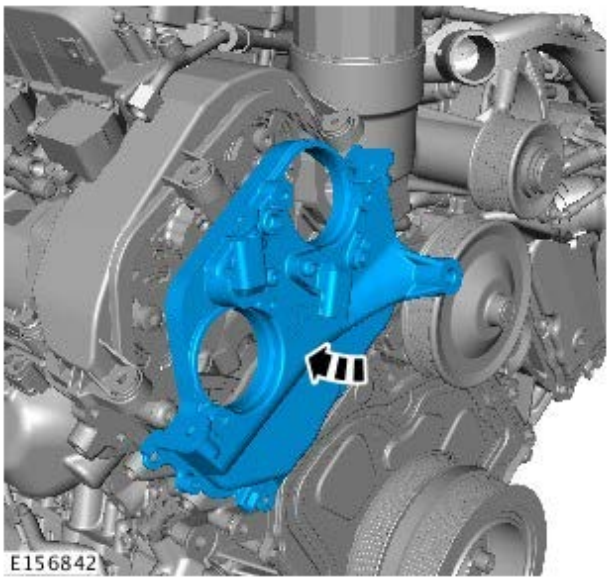


7. CAUTION: Make sure that the mating faces are clean and free of foreign material.

8. •Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.

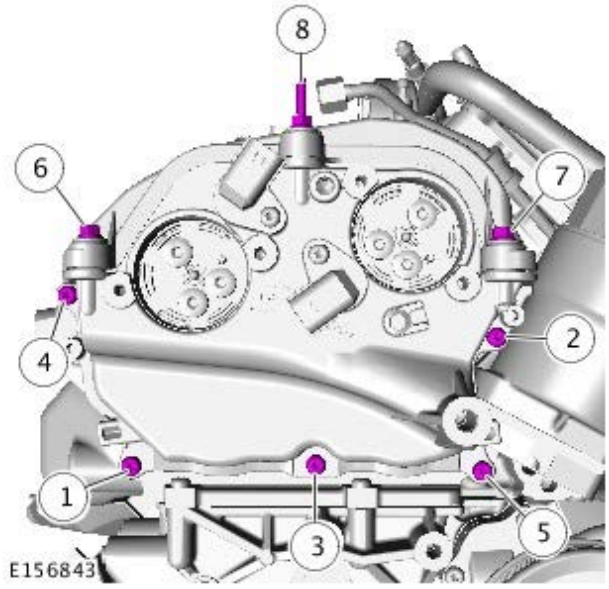


9.

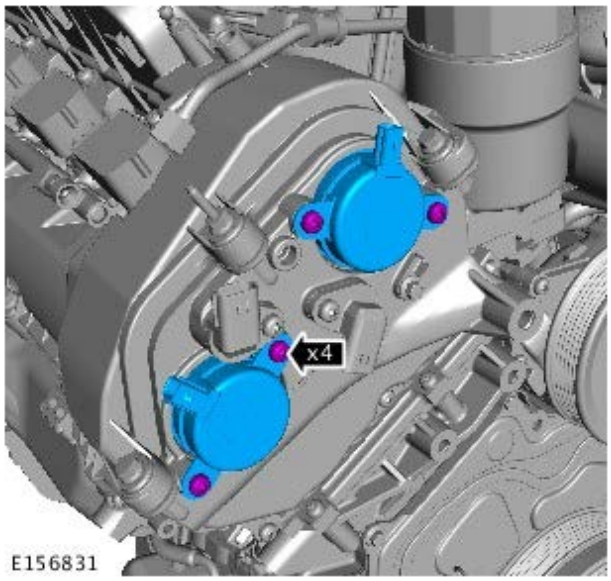


10. NOTE: Tighten bolts in the indicated sequence.

Torque: 12 Nm

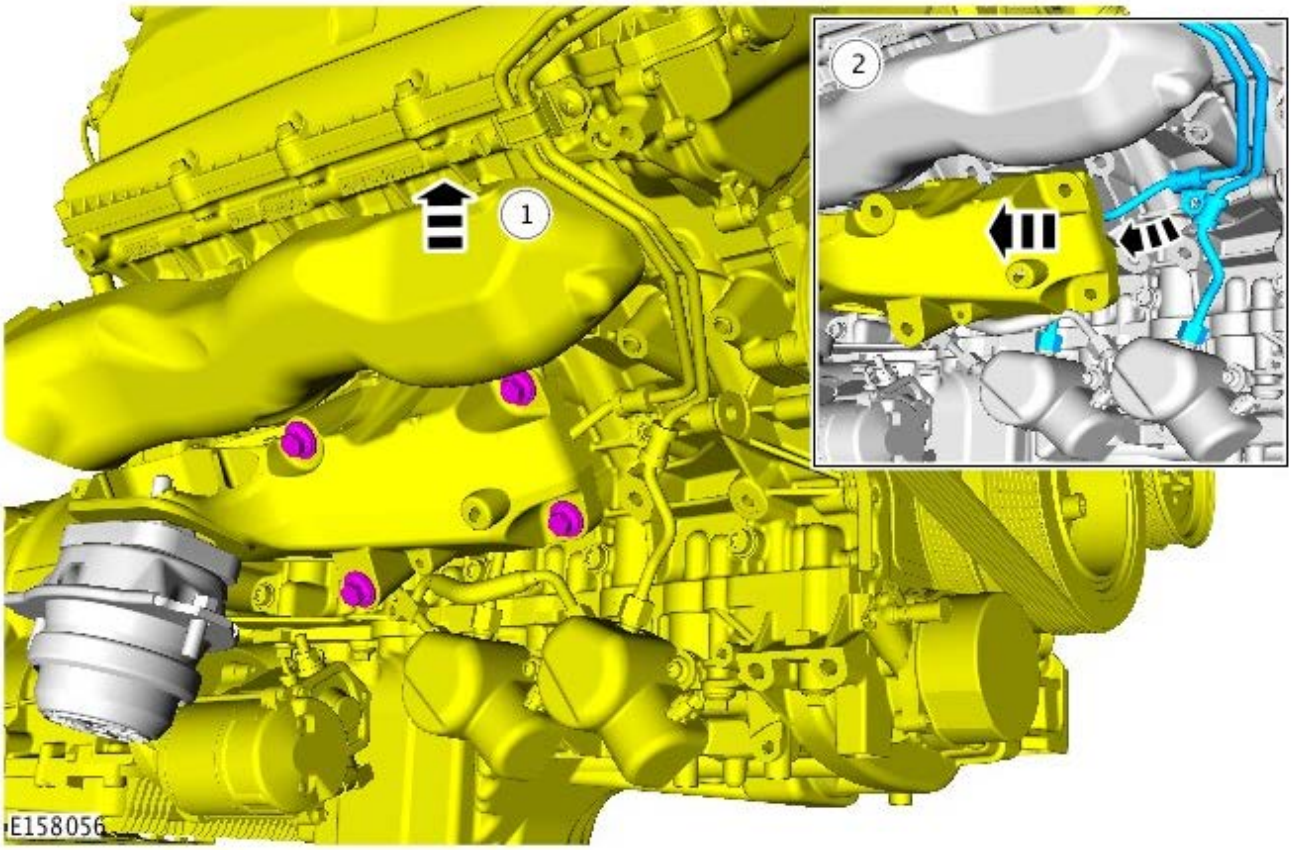


11. *Torque:* 12 Nm



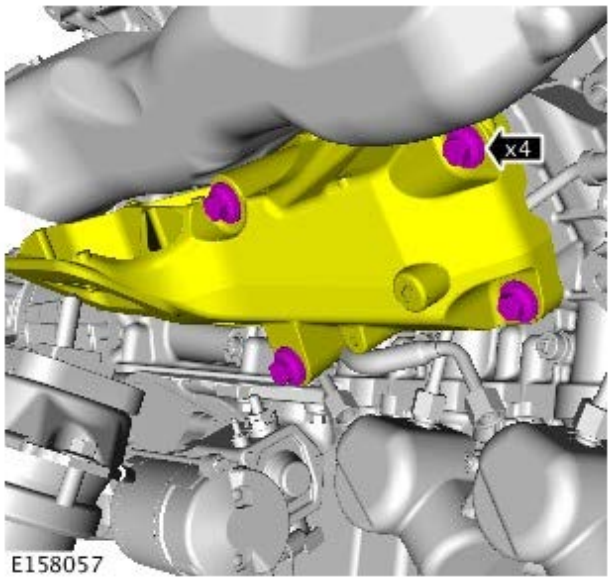
12. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

    - Using a suitable hydraulic jack, raise and support the engine.
    - Position the engine mount to one side for access to the fuel pipes.
    - Install the fuel pipes.

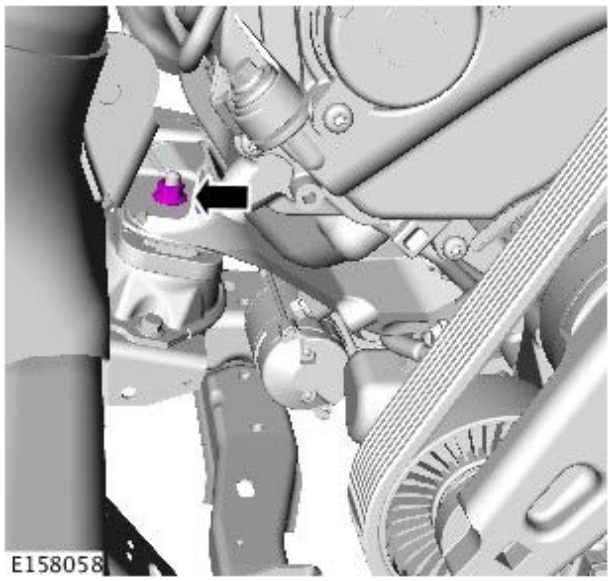


13. Carefully lower the engine onto the engine mounts.

Torque:
Stage 1: 45 Nm
Stage 2: 60°



14. *Torque:* 110 Nm



15. CAUTIONS:

Install new high-pressure fuel supply lines.

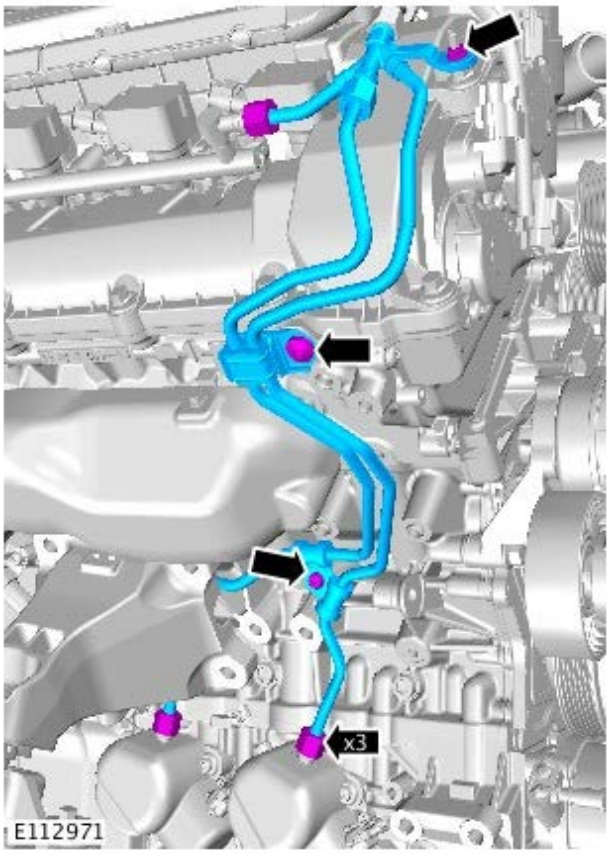
Lubricate only the union threads with clean engine oil.

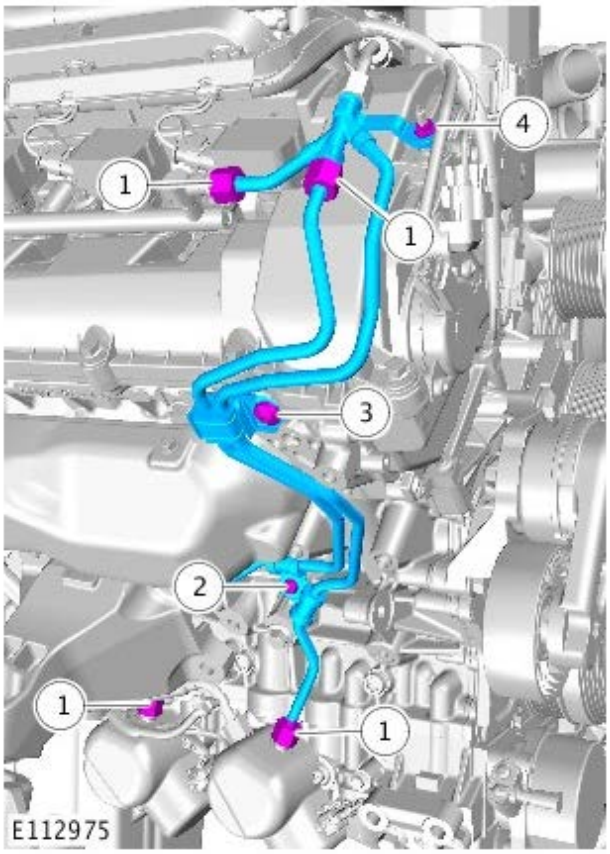
NOTES:

Remove and discard the blanking caps.

Install the bolt and unions fully finger tight before final tightening.

Do not fully tighten at this stage.





16. NOTE: Engine shown removed for clarity.

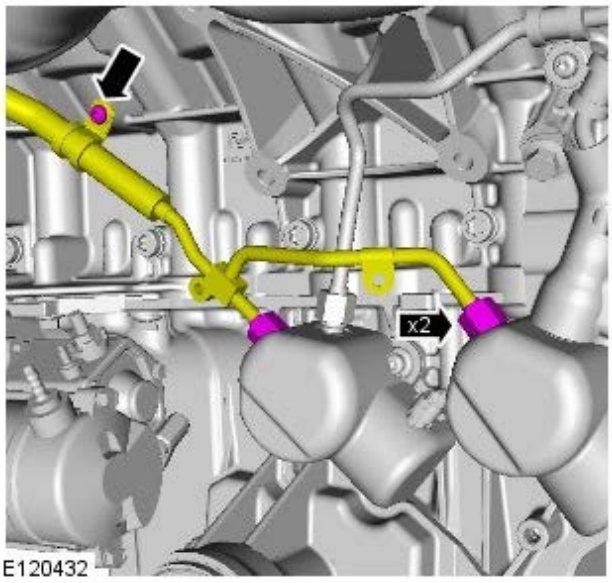
Torque:
Unions (1) 21 Nm
M6 (2) 11 Nm
M8 (3) 25 Nm
M5 nut (4) 6 Nm

17. NOTES:

Install the bolt and unions finger tight before final tightening.

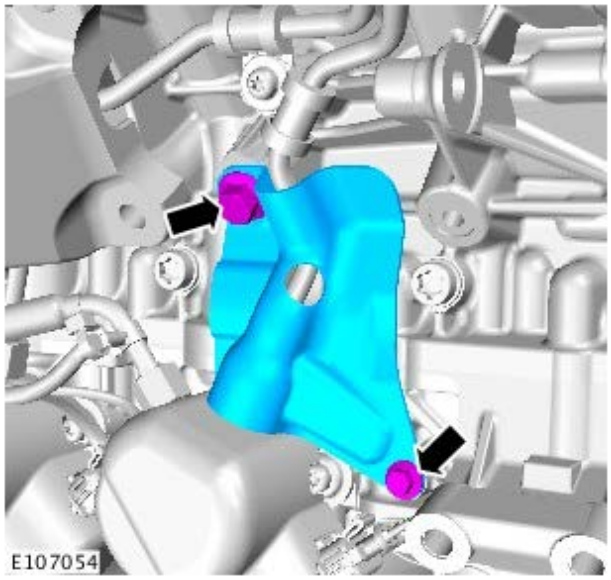
Remove and discard the blanking caps.

Torque:
Unions 21 Nm



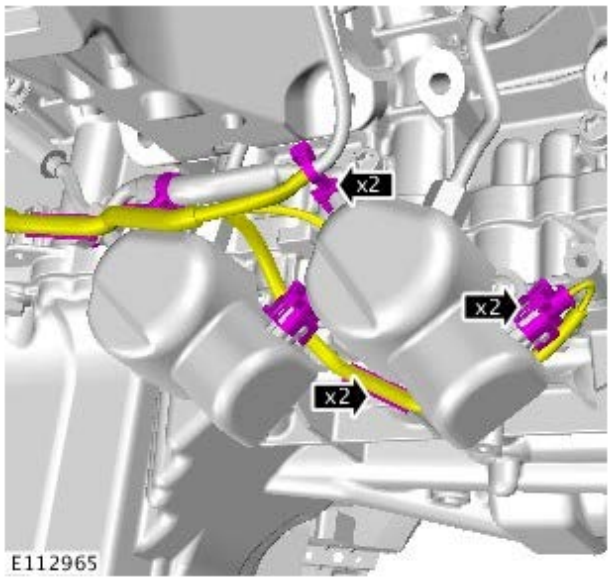
M6 11 Nm

18. The fuel pipe unions must be re-torqued after the fuel pipes have been completely installed.



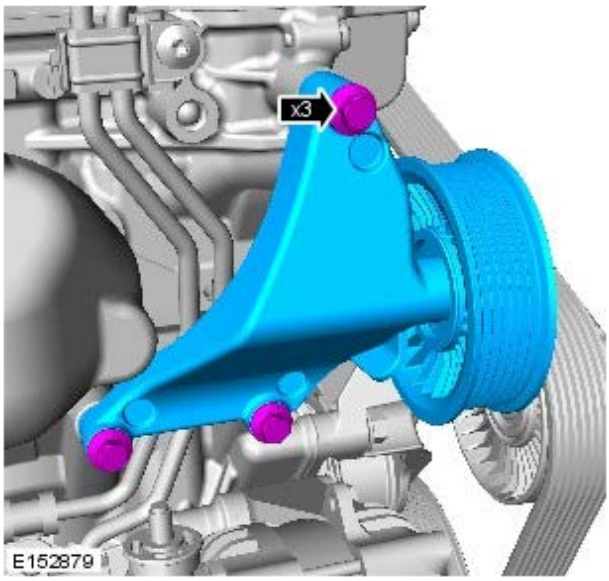
19. NOTE: Engine shown removed for clarity.

Torque:
M10 29 Nm
M6 11 Nm



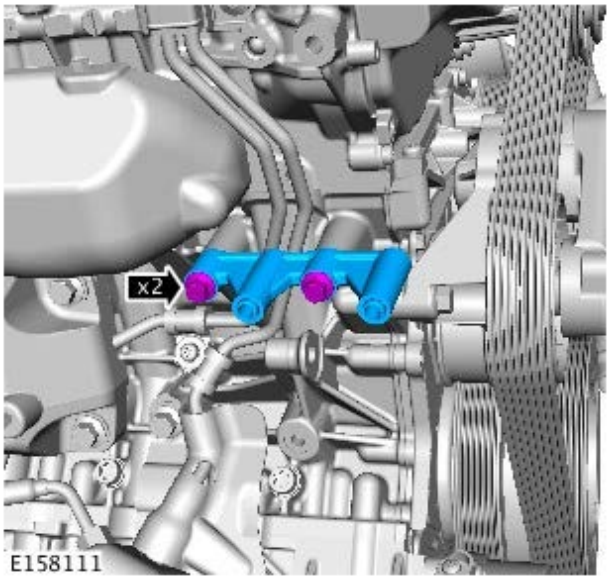
20. NOTE: Engine shown removed for clarity.

21. *Torque:* 25 Nm

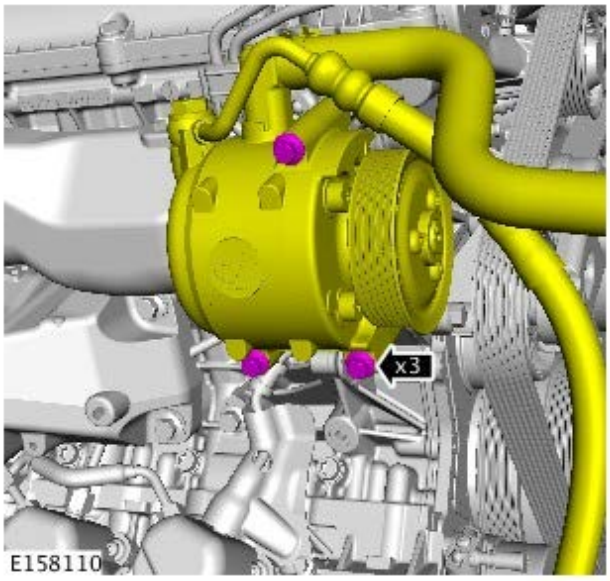


Vehicles with dynamic suspension

22. *Torque:* 25 Nm



23. *Torque:* 22 Nm



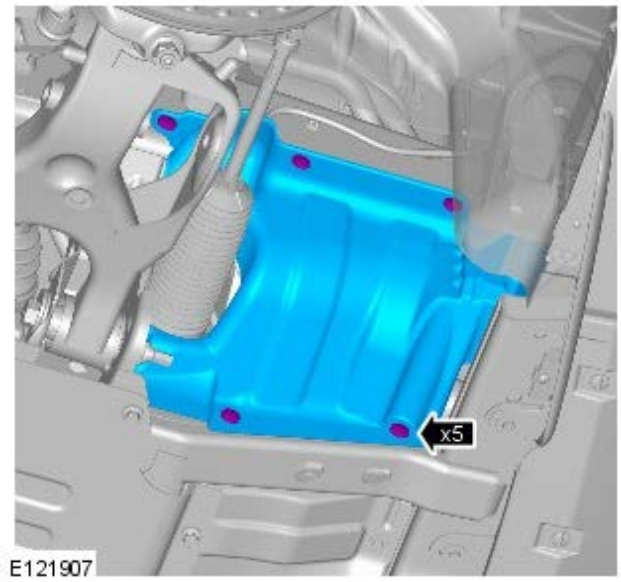
All vehicles

24. Refer to: Generator (414-02C, Removal and Installation).

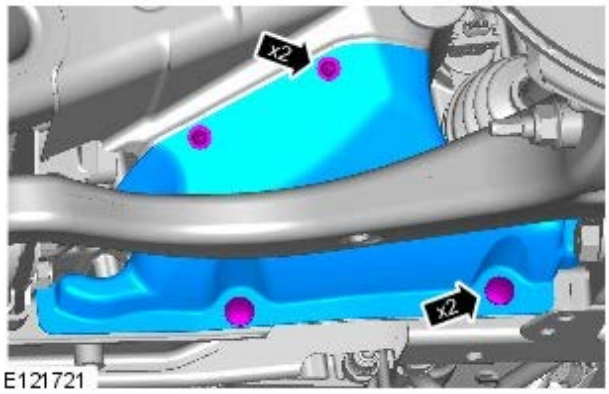
25. Refer to: Steering Column Lower Shaft (211-04, Removal and

Installation).

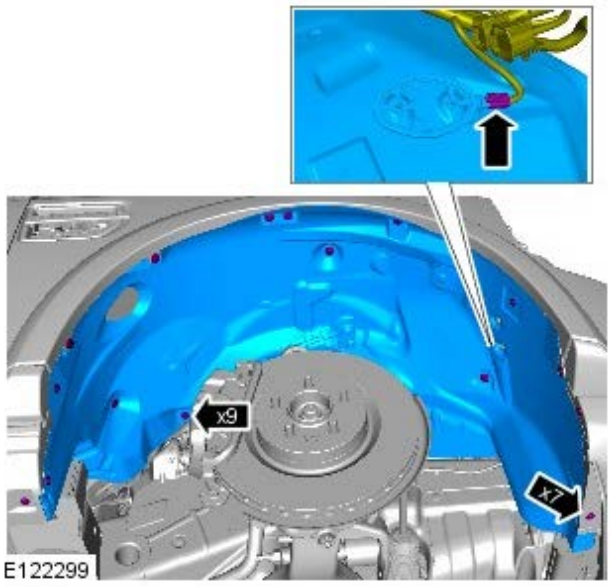
26.



27.



28.

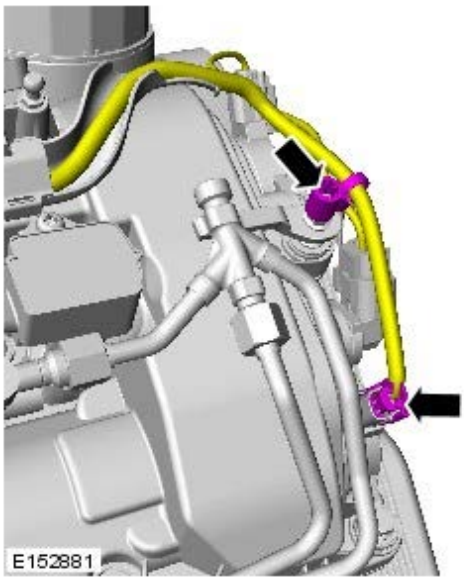


29. Lower the vehicle.

30. Install the front right wheel and tire.

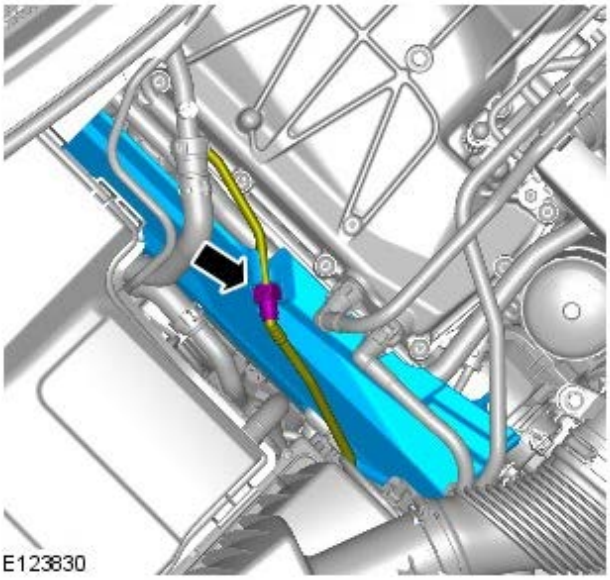
Torque: 140 Nm

31.



32. Refer to: Air Cleaner Outlet Pipe RH (303-12D, Removal and Installation).

33.



34. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05, Removal and Installation).

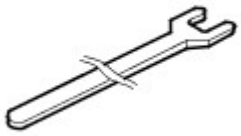
35. Refer to: Specifications (414-00, Specifications).

Published: 26-Jan-2012

Engine - V8 S/C 5.0L Petrol - Engine

Removal

Special Tool(s)

303-1142  E46076	303-1142 Viscous Coupling Wrench
303-1143  E55382	303-1143 Viscous Coupling Holding Tool

NOTES:

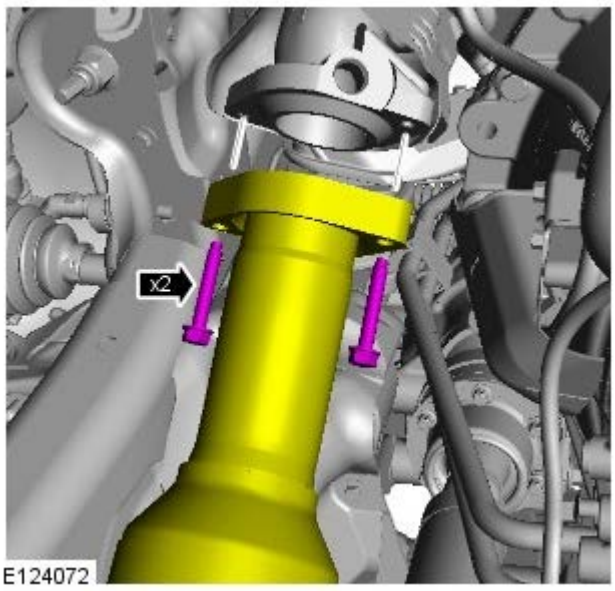
Some variation in the illustrations may occur, but the essential information is always correct.

Some illustrations may show the engine removed for clarity.

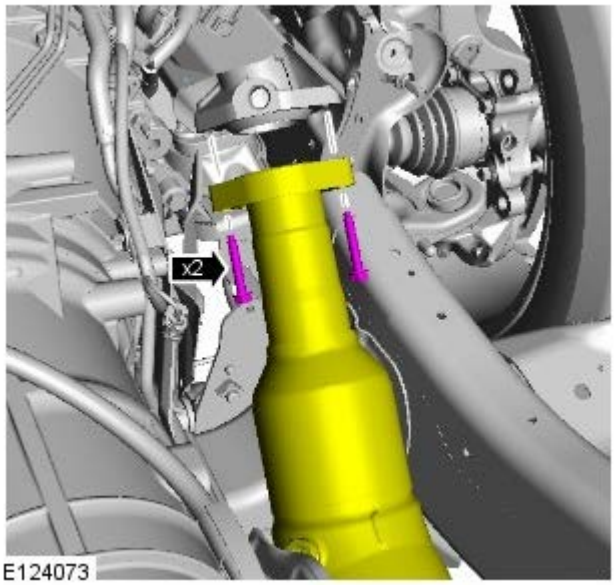
All vehicles

1. Refer to: Body - V8 S/C 5.0L Petrol (502-02 Full Frame and Body Mounting, Removal and Installation).

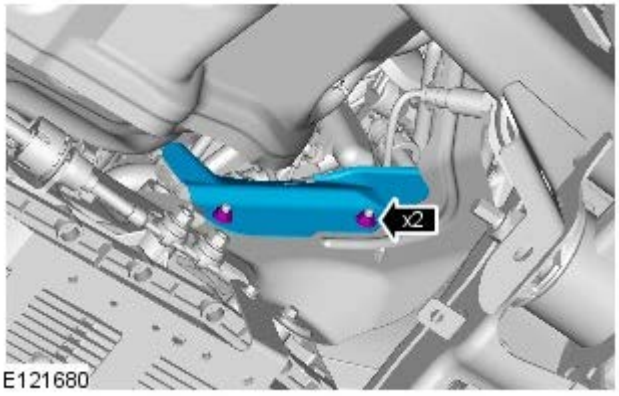
2.



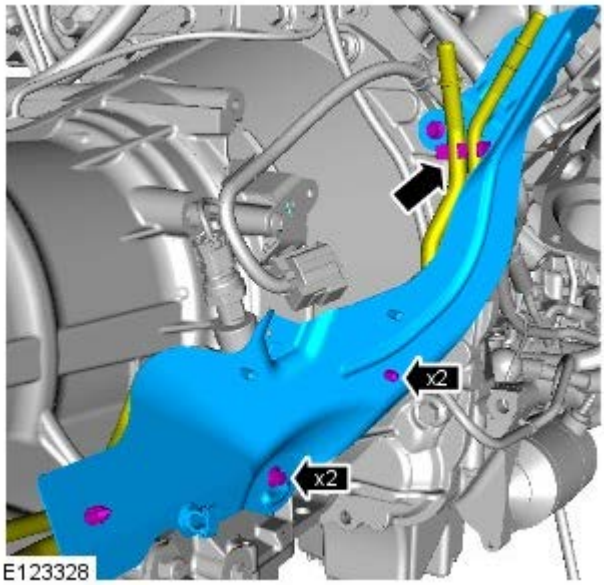
3.



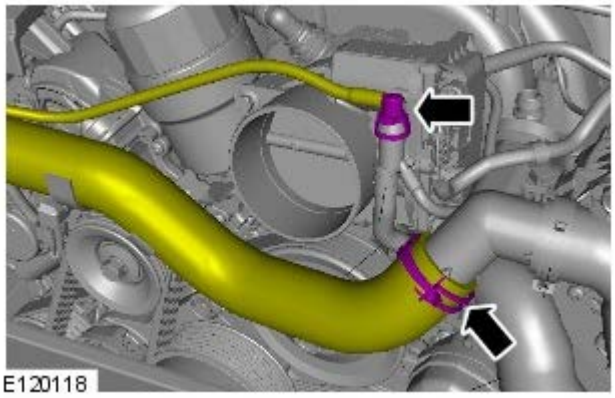
4.



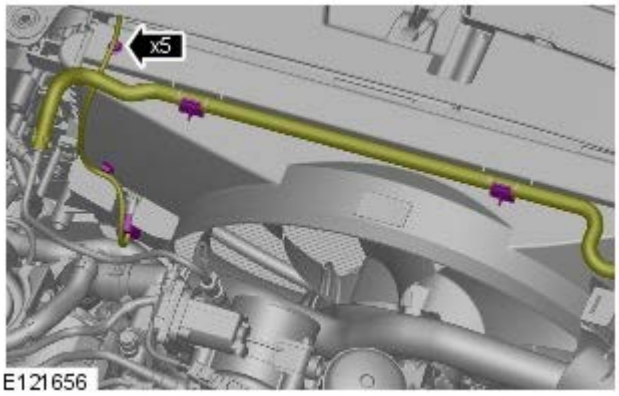
5.



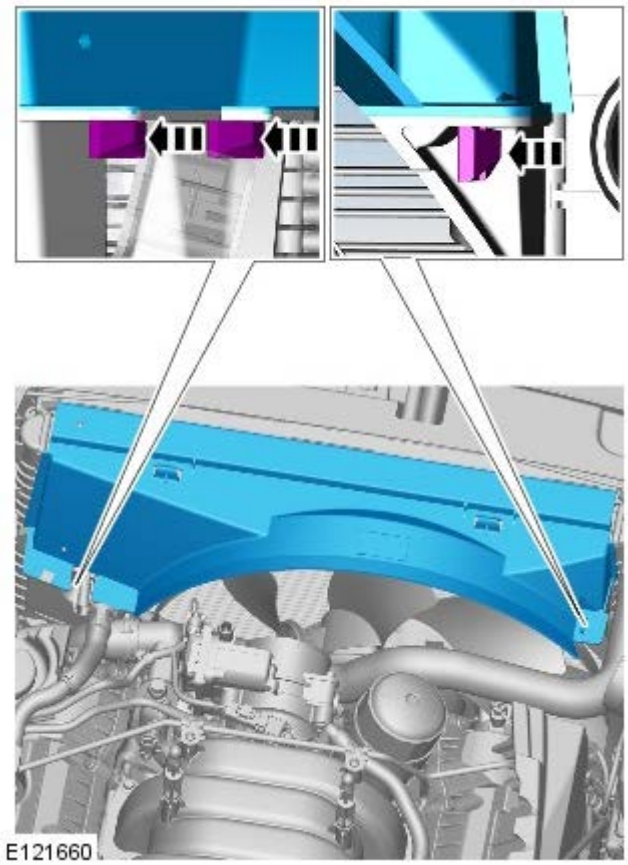
6. CAUTION: Be prepared to collect escaping coolant.



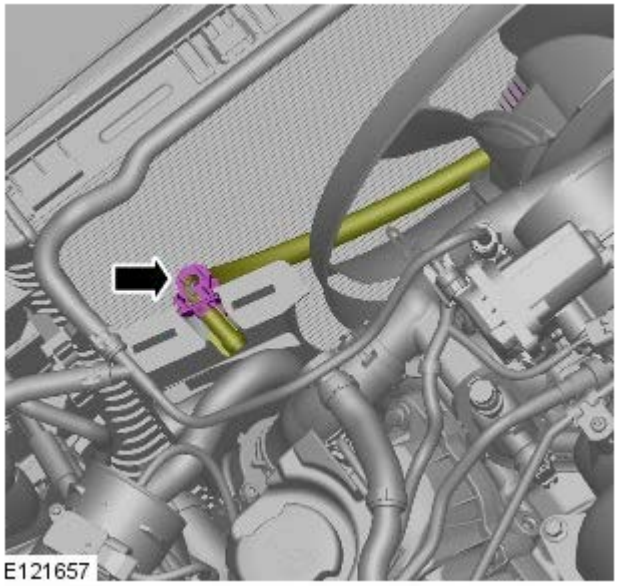
7.

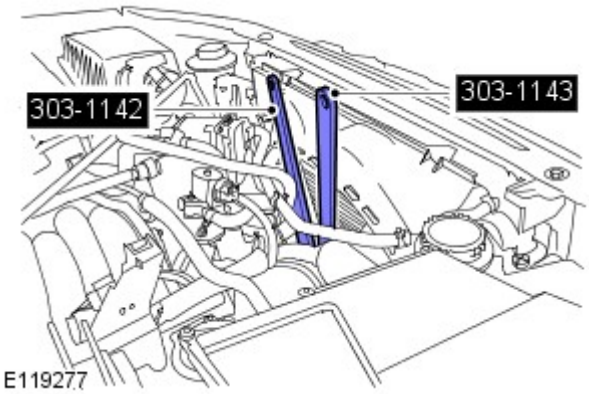


8.



9.


E121657



E119277

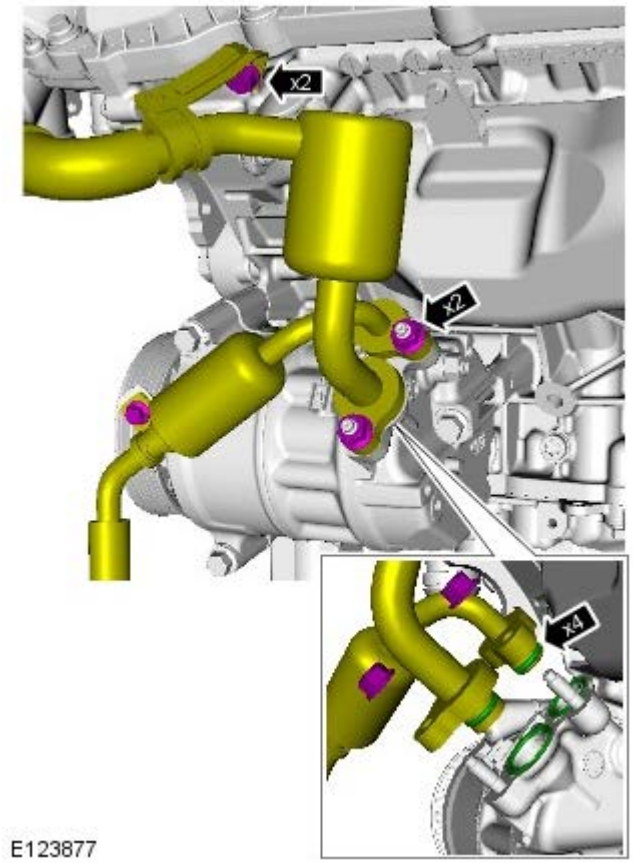
10. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

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

Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm

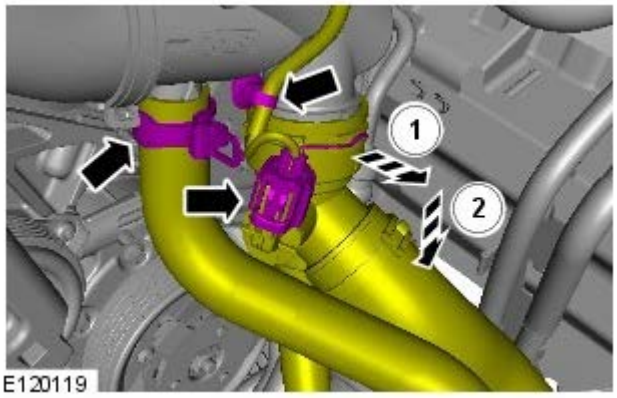
11.

- Remove and discard the 4 O-ring seals.



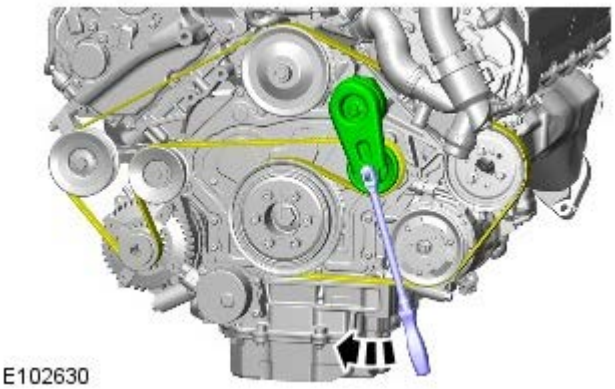
E123877

12. CAUTION: Be prepared to collect escaping coolant.



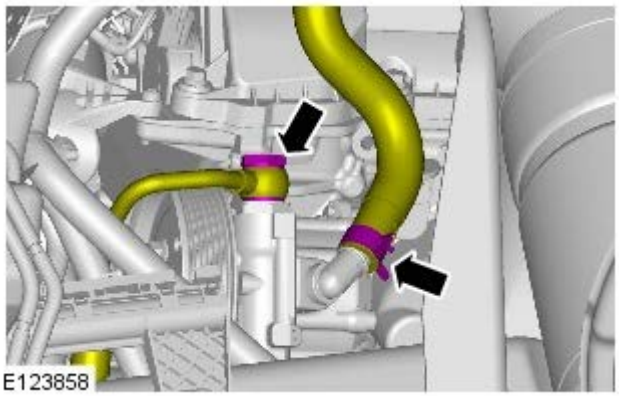
E120119

13.

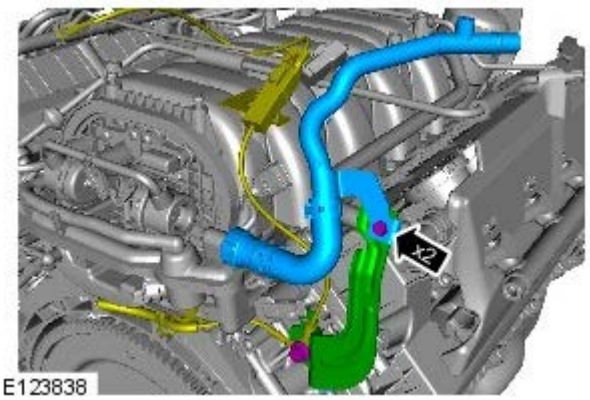

E102630

14. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

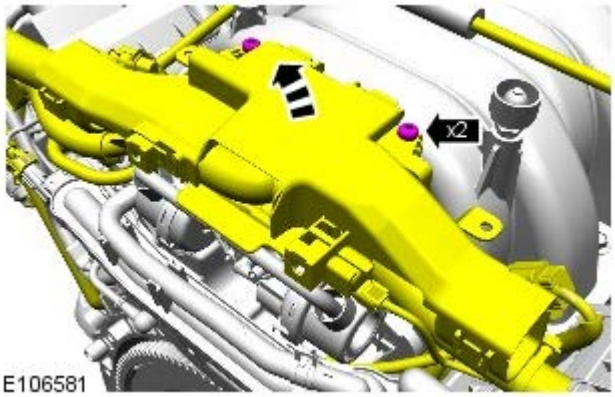

E123858

15.

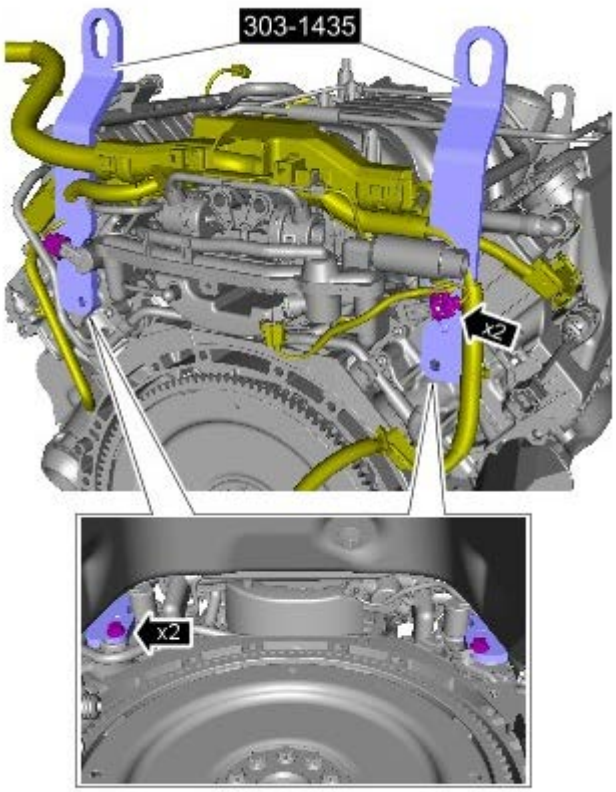


E123838

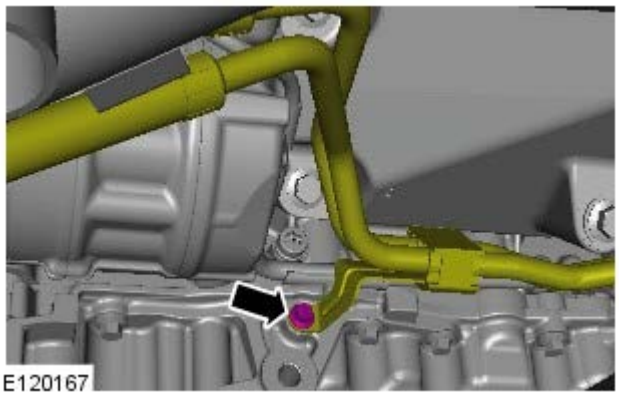
16.



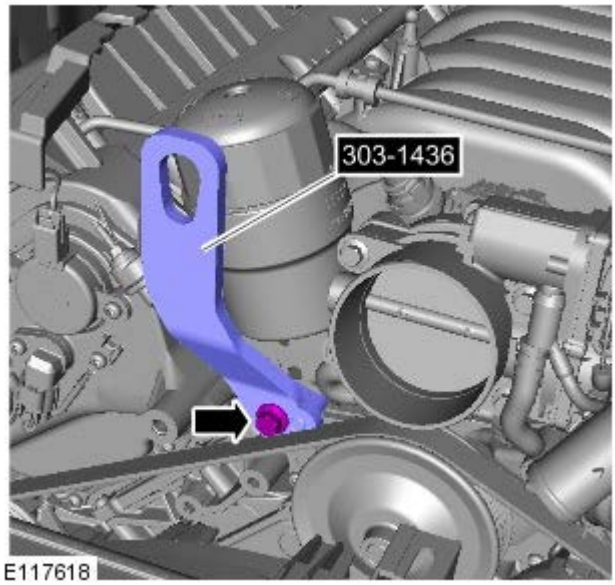
17. *Torque:* 25 Nm



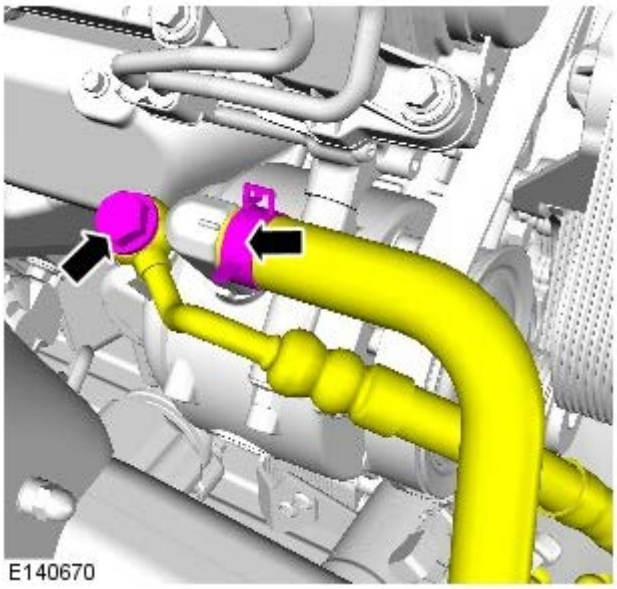
18.



19. *Torque:* 25 Nm



Vehicles with Active Stabilization



20. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

CAUTIONS:

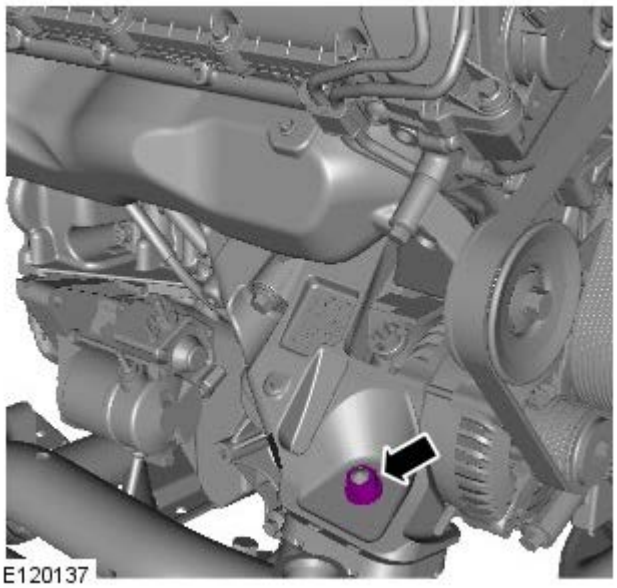
Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Make sure both O-ring seals are correctly installed on the high pressure union.

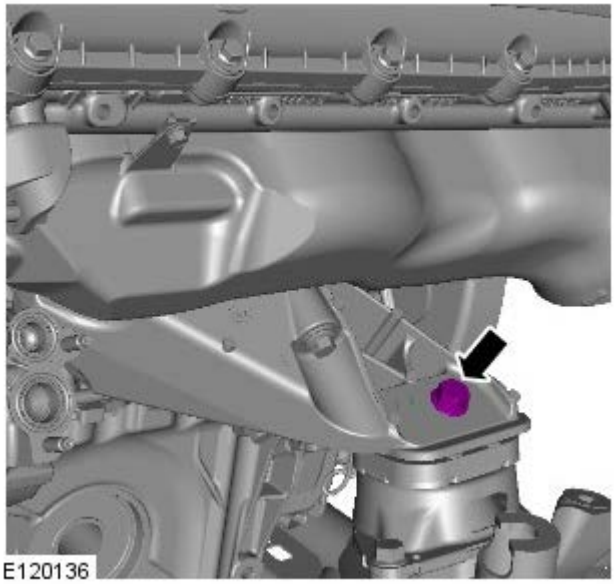
NOTE: Remove and discard the O-ring seals.

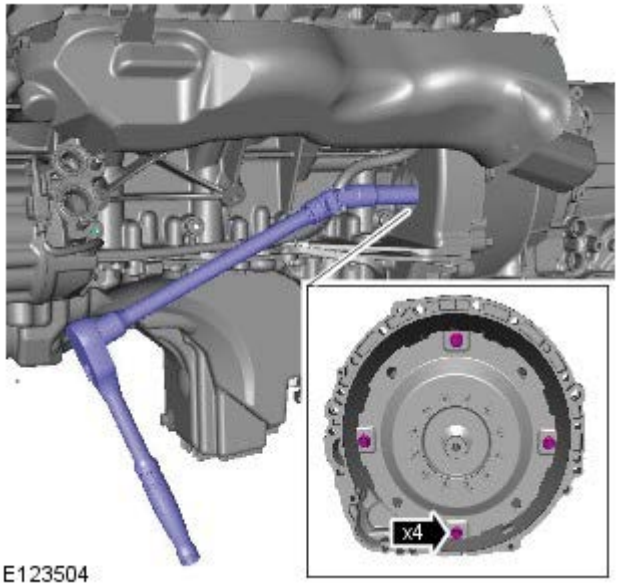
All vehicles

21.



22.

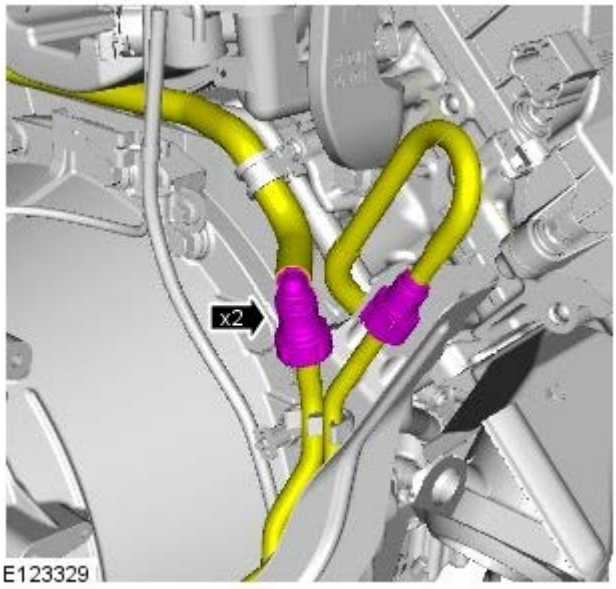

E120136



E123504

23. CAUTION: Only rotate the crankshaft clockwise.

- Mark the torque converter and flexplate when removing the last torque converter bolt. Make sure that the alignment mark is visible through the inspection hole.

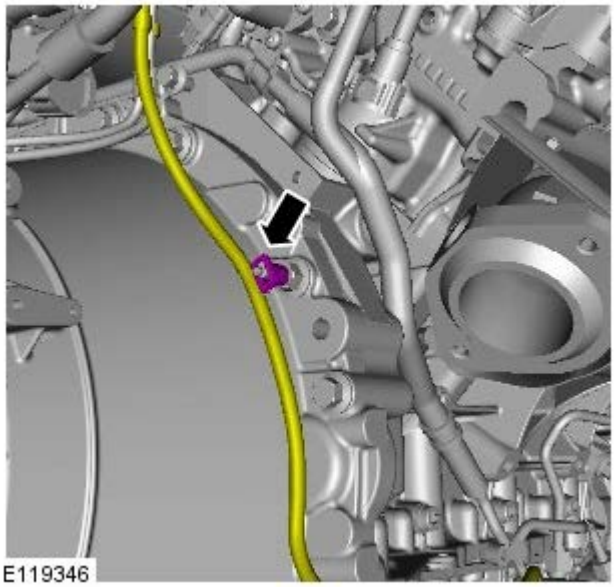


E123329

24. 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.

CAUTION: Be prepared to collect escaping fluids.

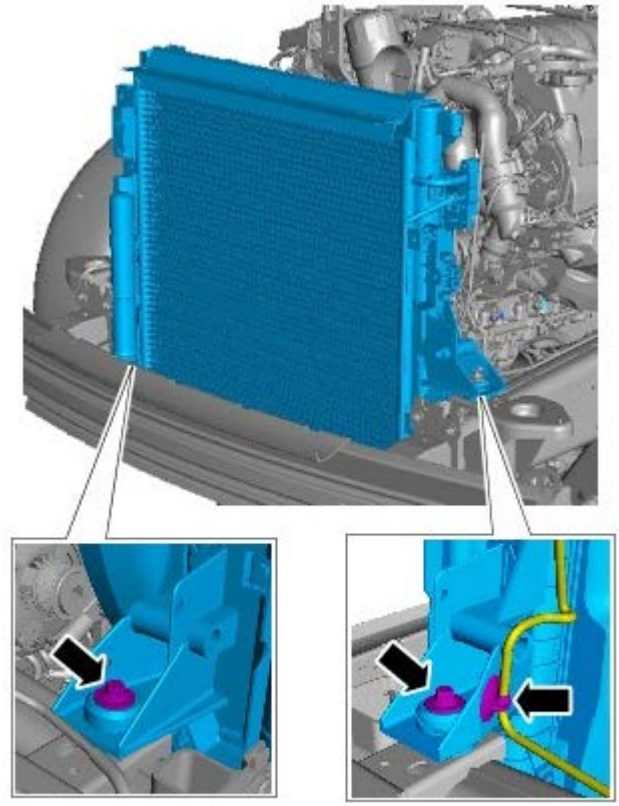
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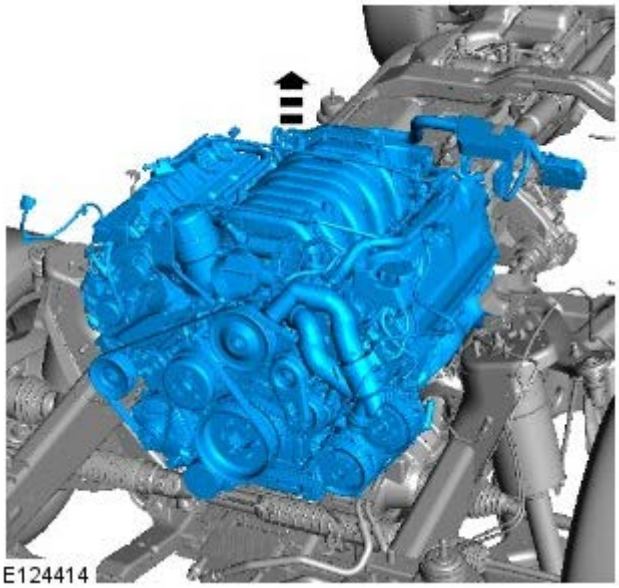
26.



27.



E124068



E124414

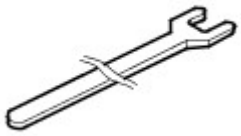
28. NOTE: This step requires the aid of another technician.

Published: 14-Nov-2011

Engine - V8 S/C 5.0L Petrol - Engine

Installation

Special Tool(s)

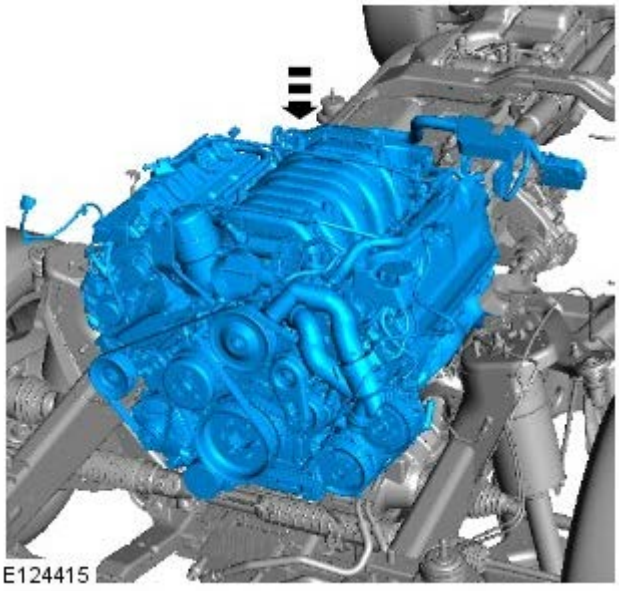
303-1142  E46076	303-1142 Viscous Coupling Wrench
303-1143  E55382	303-1143 Viscous Coupling Holding Tool

NOTES:

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

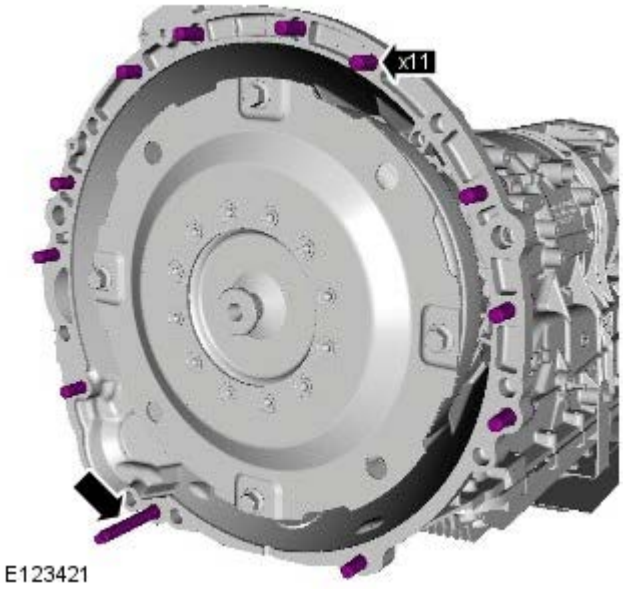
Some illustrations may show the engine removed for clarity.

All vehicles


E124415

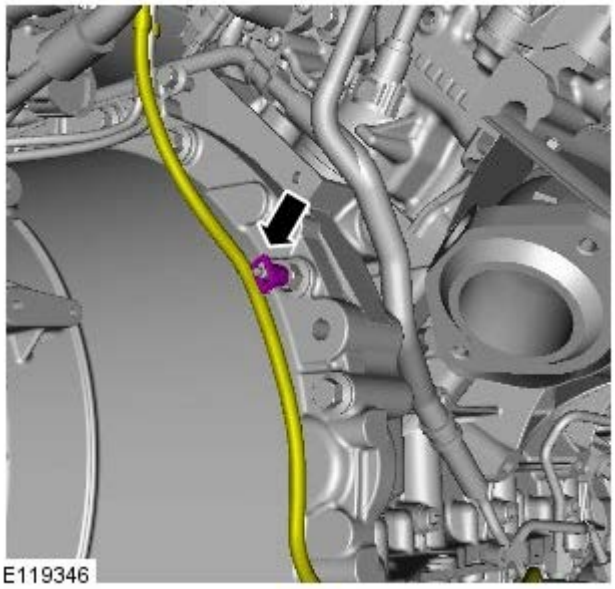
1. NOTE: This step requires the aid of another technician.

2. *Torque:* 40 Nm



E123421

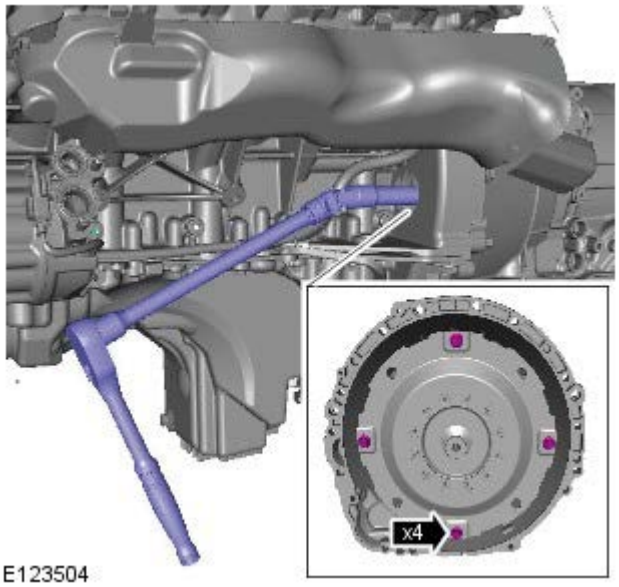
3.


E119346

4. CAUTION: Only rotate the crankshaft clockwise.

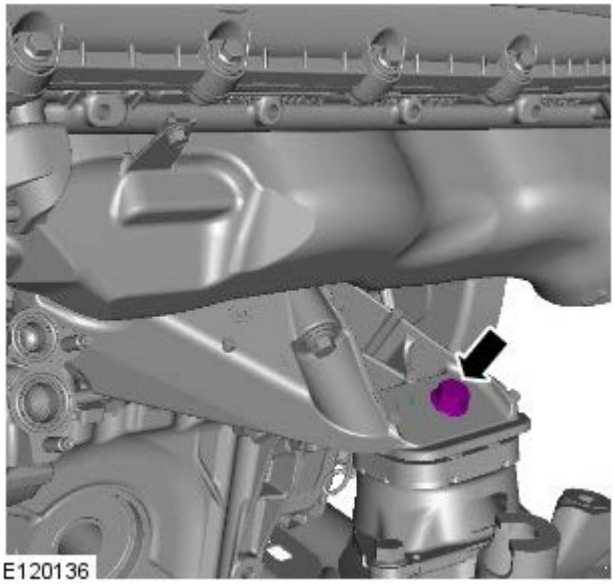
   - Make sure that the alignment mark is visible through the inspection hole on installation of the first torque converter bolt.

     Torque: 63 Nm

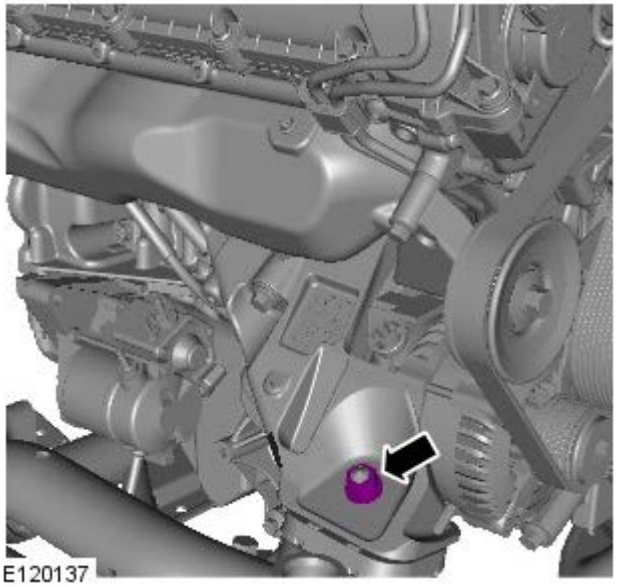


E123504

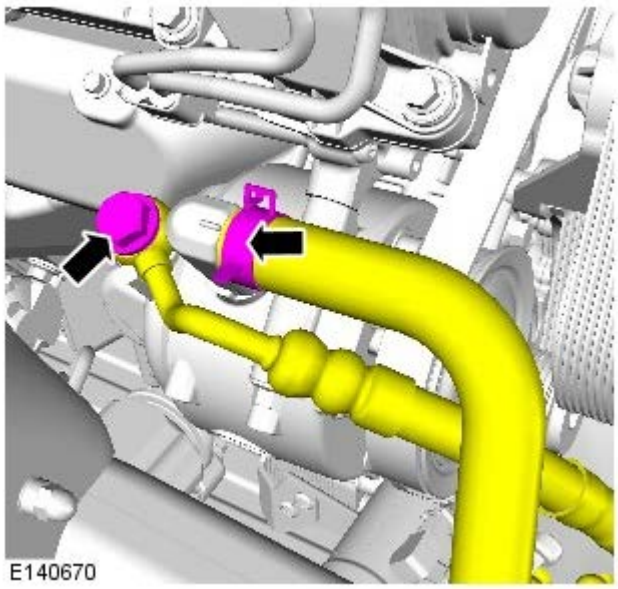
5. *Torque:* 100 Nm



6. *Torque:* 100 Nm



Vehicles with dynamic suspension



7. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

   CAUTIONS:

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

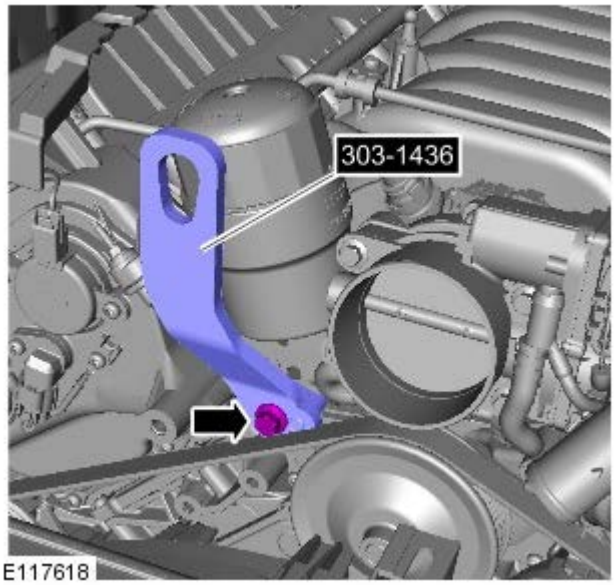
   Make sure both O-ring seals are correctly installed on the high pressure union.

   NOTE: Remove and discard the O-ring seals.

   Torque: 35 Nm

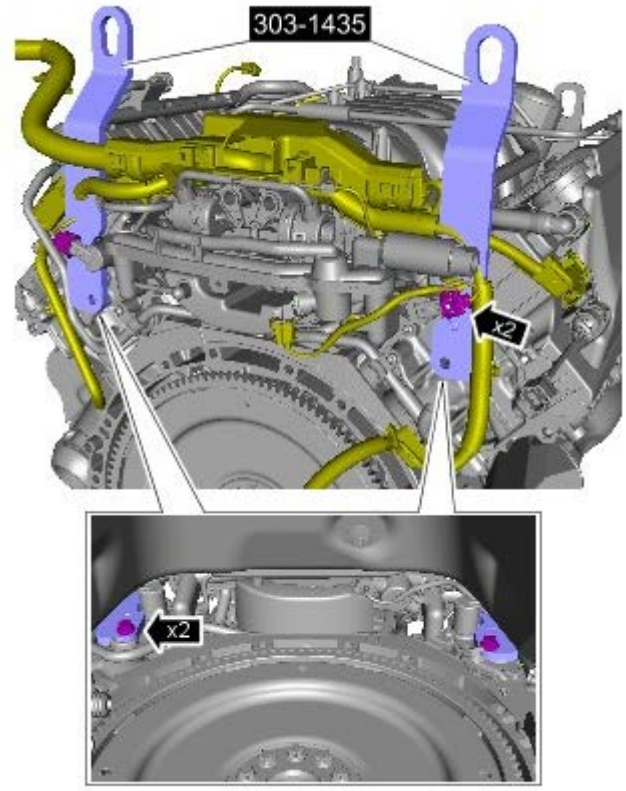
All vehicles

8. *Torque:* 25 Nm



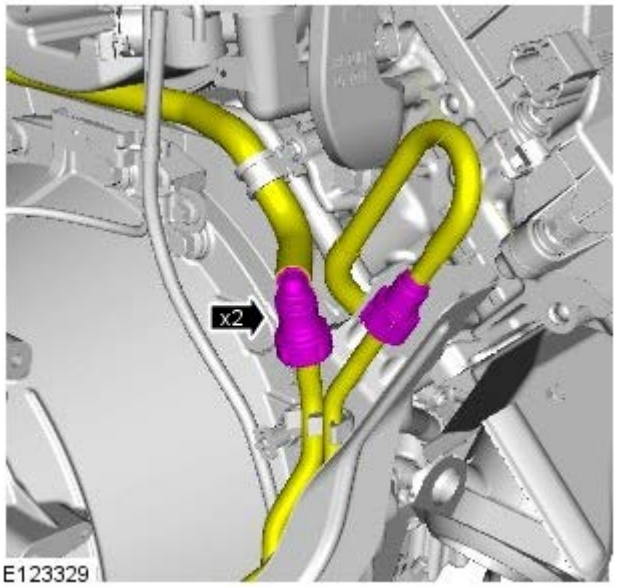
E117618

9. *Torque:* 25 Nm

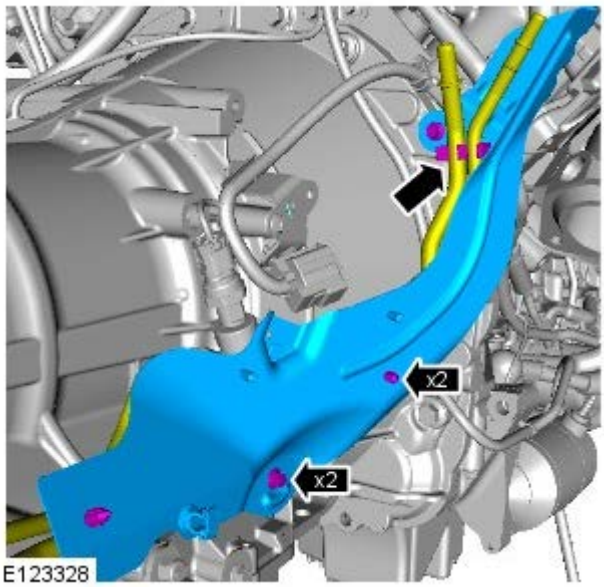


E117619

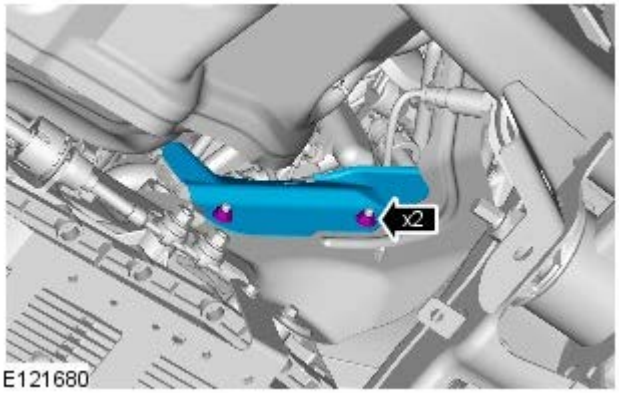
10. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



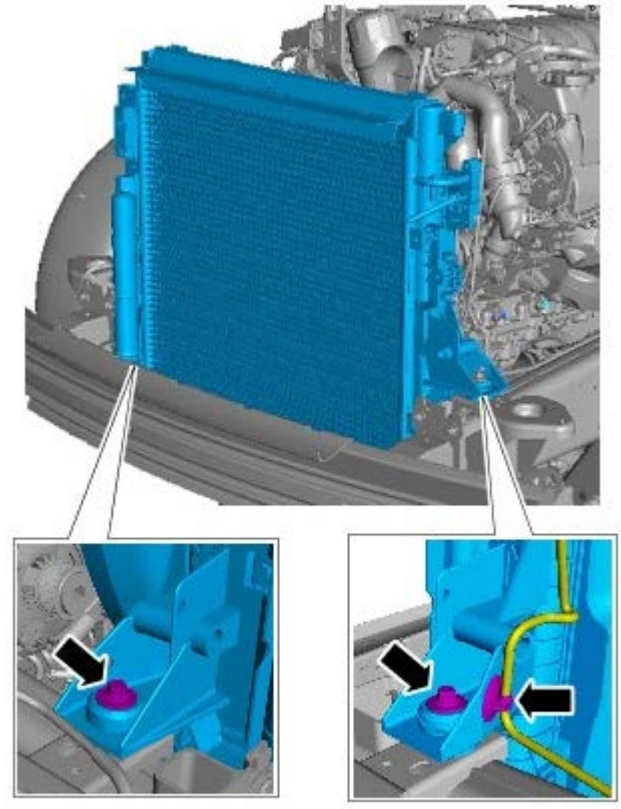
11. *Torque:* 10 Nm



12. *Torque:* 10 Nm

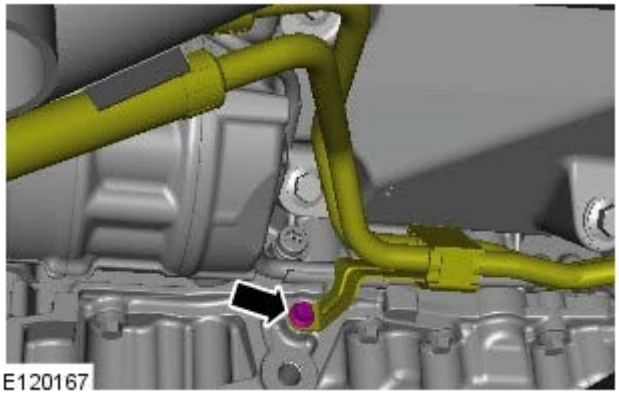


13. *Torque:* 25 Nm



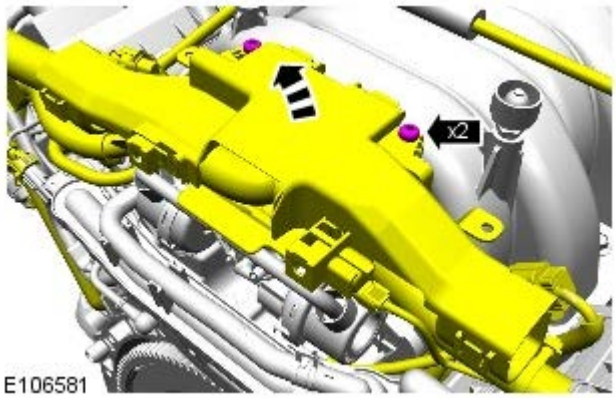
E124068

14. *Torque:* 12 Nm



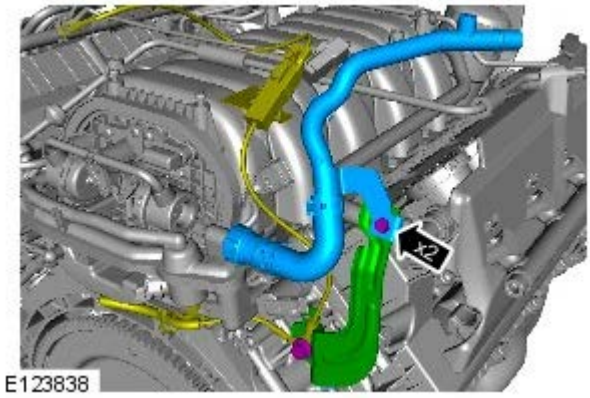
E120167

15. *Torque:* 10 Nm



E106581

16. *Torque:*
    M8 Bolt 25 Nm
    M6 Bolt 10 Nm

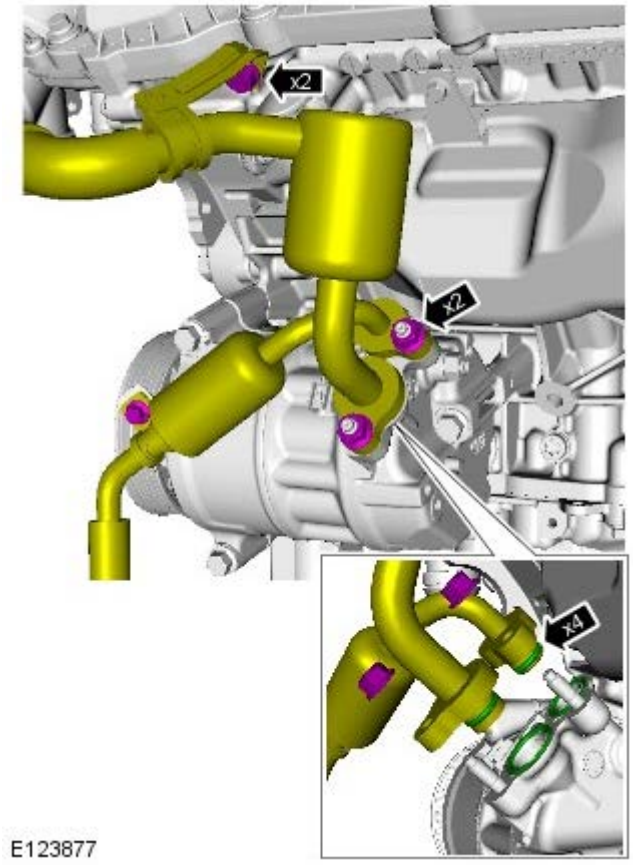


E123838

17.

- Install new 4 O-ring seals.

Torque:
M8 Nut 9 Nm
M8 Bolt 25 Nm
M6 bolt 10 Nm

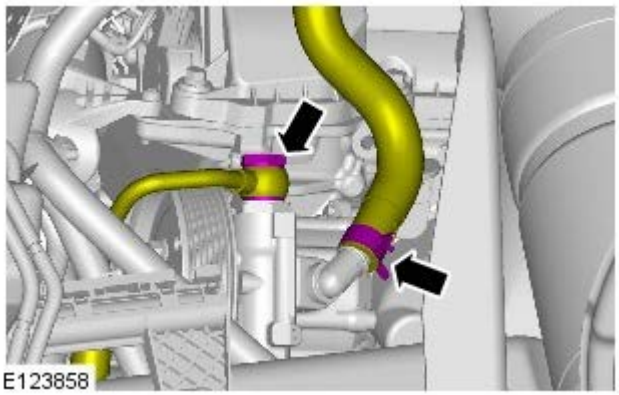


E123877

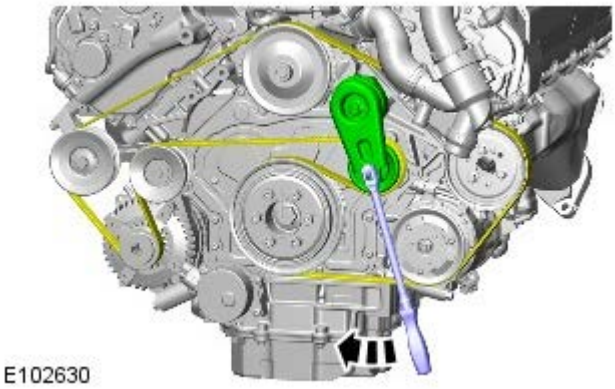
18. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

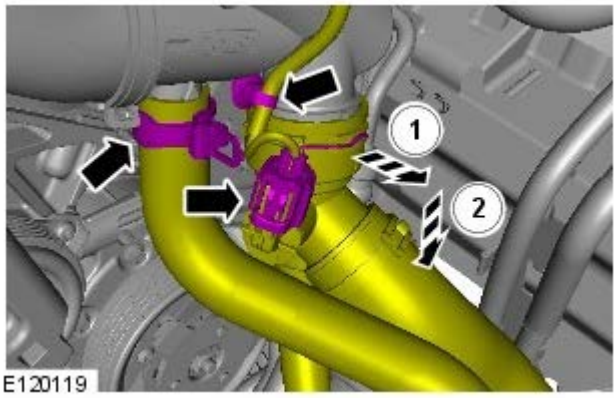
Torque: 25 Nm


E123858

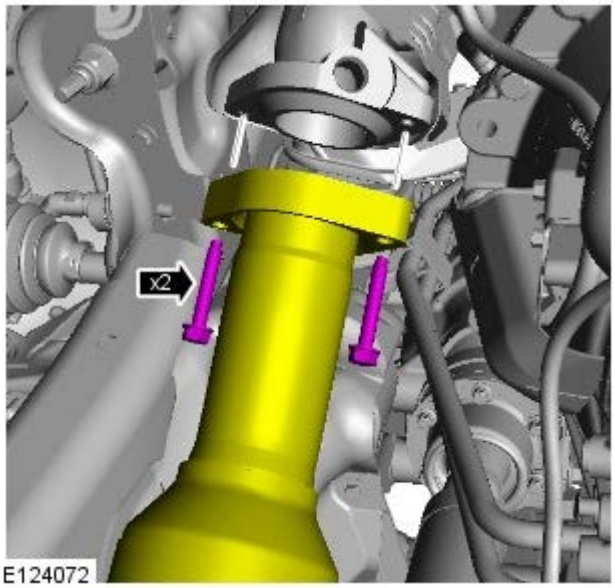
19.



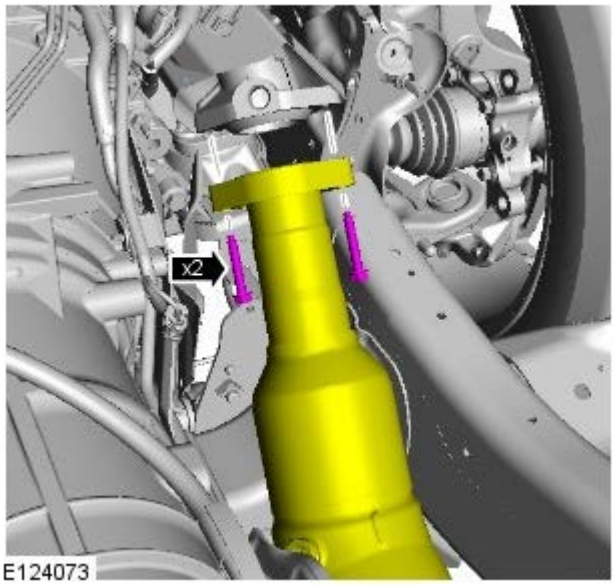
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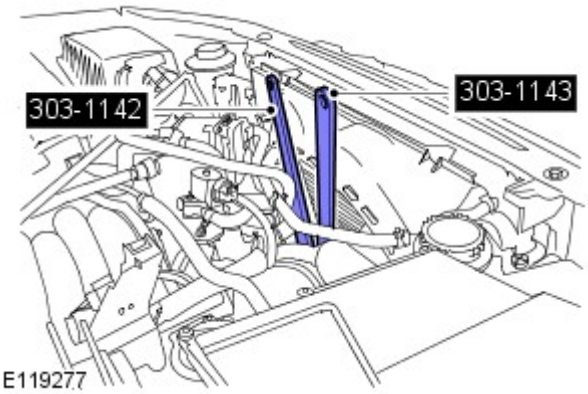


21. *Torque:* 22 Nm



22. *Torque:* 22 Nm

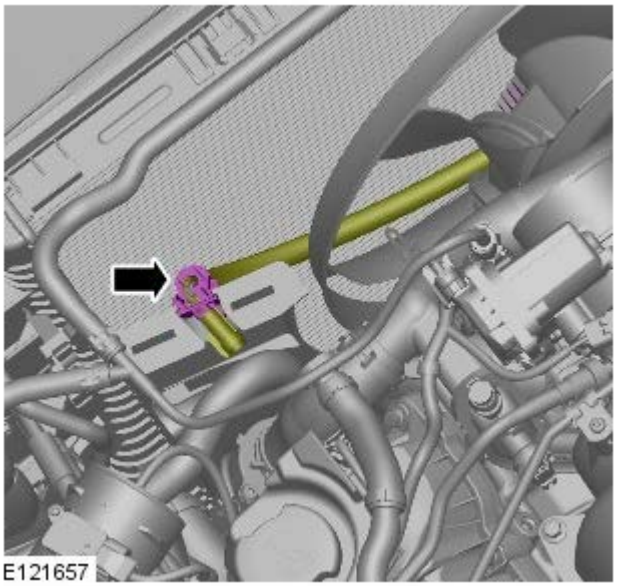




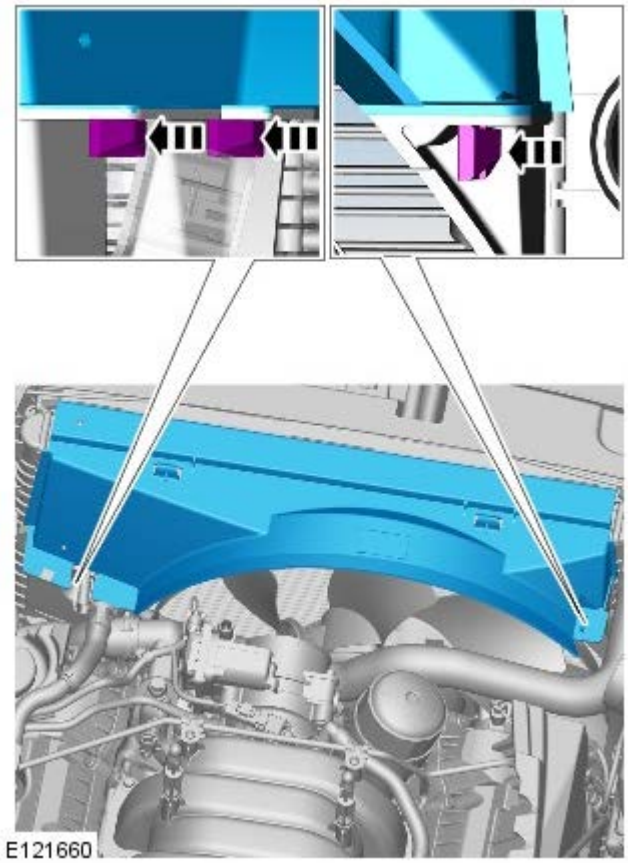
23. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm

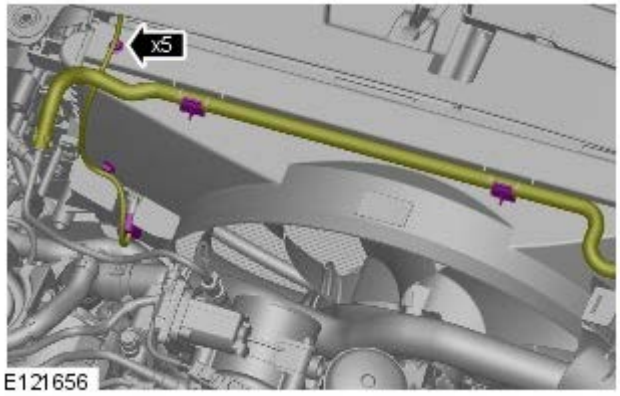
24.



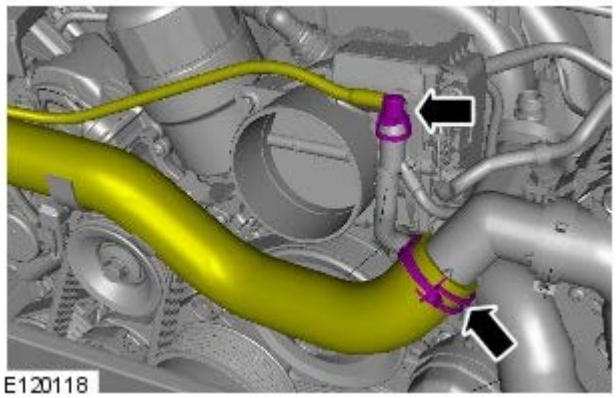
25.



26.



27. CAUTION: Be prepared to collect escaping coolant.



28. Refer to: Body - 5.0L SC V8 - AJ133 (502-02, Removal and Installation).

29. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

Published: 05-Jul-2011

Engine Cooling - TDV6 3.0L Diesel -

Description	Specification
Land Rover premium cooling system fluid	WSS M97B44-D
Land Rover premium cooling system flush	EGR-M14P7-A

Capacities

Item	Specification
Vehicles fitted with 2 zone Air Conditioning (A/C)	15.9L (dry capacity)

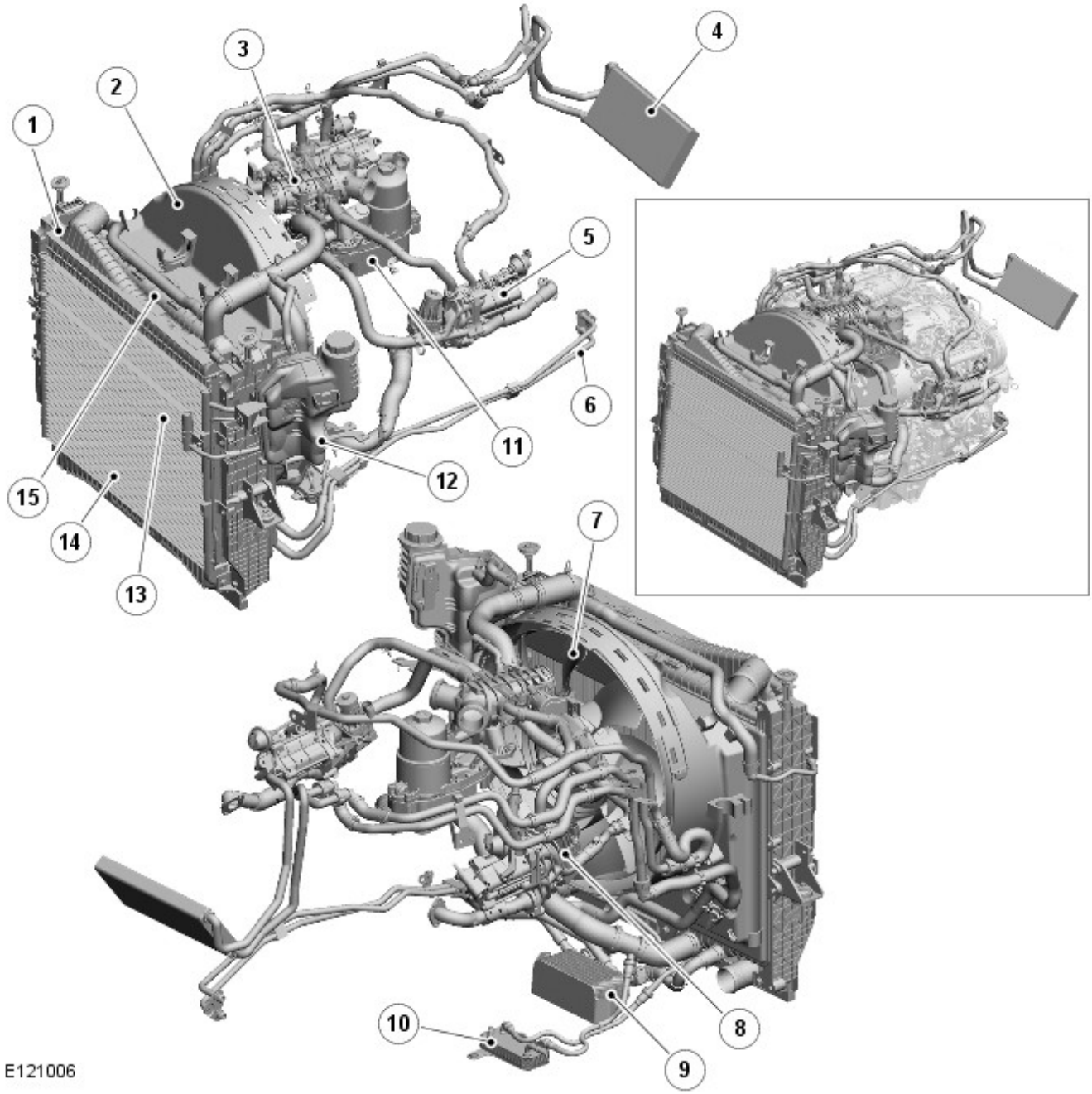
Description	Nm	lb-ft	lb-in
Coolant expansion tank bolt	10	7	-
Coolant outlet assembly bolts	10	7	-
Coolant inlet hose bolts	10	7	-
Coolant pump bolts	10	7	-
Cooling fan nut	65	48	-
Thermostat housing upper to lower bolts	4	-	35
Fuel cooler bolts	5	-	44
Air Conditioning (A/C) radiator core bolts	5	-	44
Engine cooling module bolts	15	11	-
Cooling fan shroud M6 bolts	5	-	44
Cooling fan shroud M8 bolts	15	11	-
Charge air cooler bolts	15	11	-
Coolant bleed screw(s)	3	-	27

Published: 11-May-2011

Engine Cooling - TDV6 3.0L Diesel - Engine Cooling - Component Location

Description and Operation

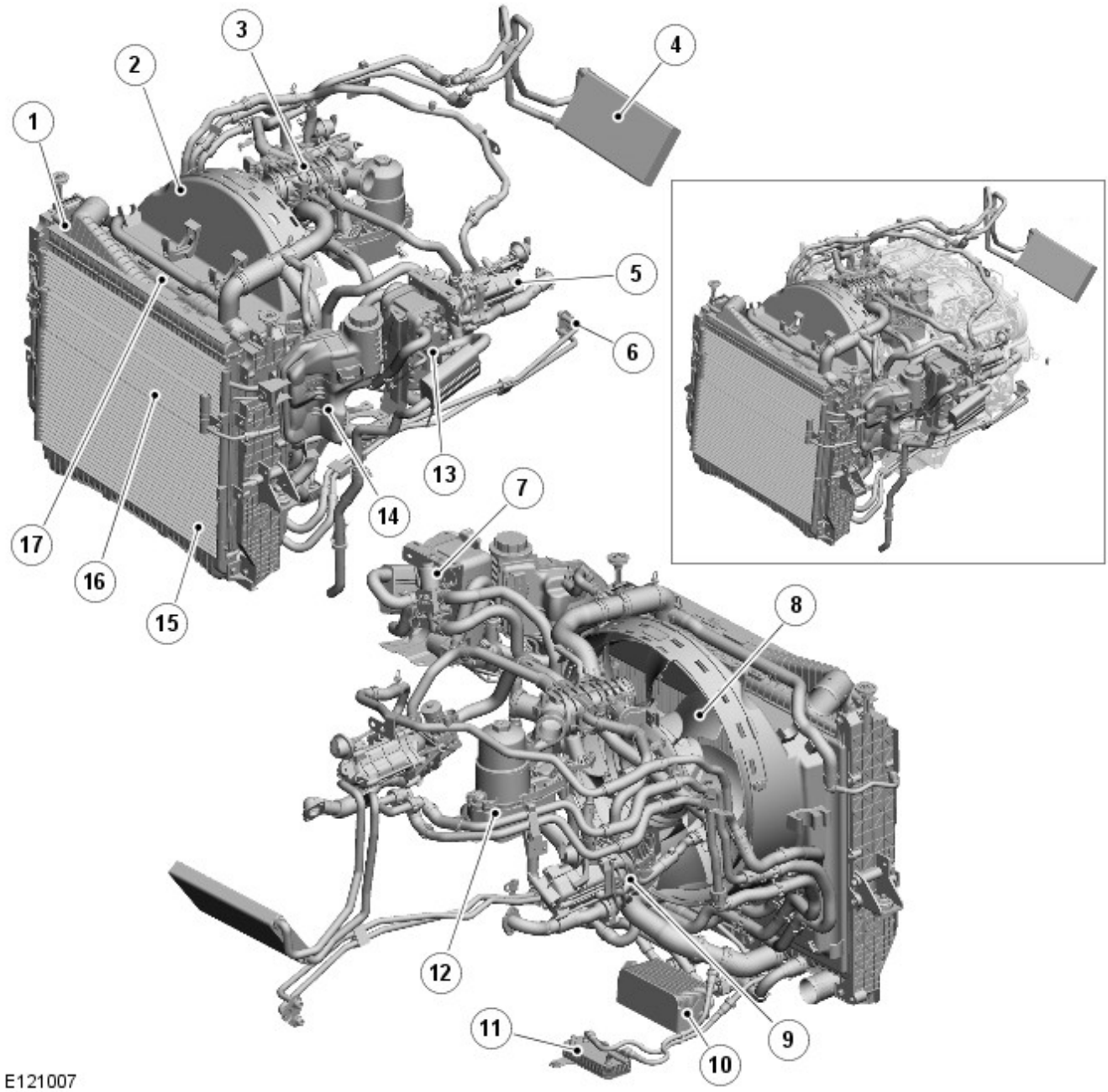
Component Location - without Fuel Fired Burning Heater



Item	Description
1	Intercooler
2	Fan cowl
3	Throttle body
4	Heater core
5	LH (left-hand)EGR (exhaust gas recirculation) cooler
6	Transmission oil cooler pipes
7	Viscous fan
8	RH (right-hand)EGR cooler
9	Transmission oil cooler
10	Fuel sub-cooler
11	Engine oil cooler
12	Expansion tank
13	Fuel cooler
14	Condenser

15 Radiator

Component Location - with Fuel Fired Burning Heater and Park Heating



E121007

Item Description

1 Intercooler
2 Fan cowl
3 Throttle body
4 Heater core
5 LHEGR cooler
6 Transmission oil cooler pipes
7 Park heating valve assembly
8 Viscous fan
9 RHEGR cooler
10 Transmission oil cooler
11 Fuel sub-cooler
12 Engine oil cooler
13 FFBH (fuel fired buring heater)
14 Expansion tank
15 Condenser
16 Fuel cooler
17 Radiator

Published: 11-May-2011

Engine Cooling - TDV6 3.0L Diesel - Engine Cooling - Overview

Description and Operation

OVERVIEW

The engine cooling system maintains the engine within an optimum temperature range under changing ambient and engine operating conditions. It also provides:

- Heating for the passenger compartment.
  Refer to: Auxiliary Heater (412-02B, Description and Operation).
- Cooling for:
  - The engine oil
  - The fuel
  - The EGR (exhaust gas recirculation) system.
    Refer to: Engine Emission Control (303-08A, Description and Operation).
  - The transmission fluid.

Published: 11-May-2011

Engine Cooling - TDV6 3.0L Diesel - Engine Cooling - System Operation and Component Description

Description and Operation

System Operation

COOLANT CIRCUIT FLOW

When the engine is running the coolant is circulated around the engine cooling system by the coolant pump. From the coolant pump, coolant flows through the cylinder block and the cylinder heads. Some of the coolant in the cylinder block is diverted through the engine oil cooler before returning to the 5-way connector via the water outlet.

From the 5-way connector, the majority of the coolant flows to the pressure relief thermostat, either directly or via the radiator, depending on the temperature of the coolant. From the outlet of the thermostat the coolant flows to the inlet of the coolant pump.

A separate hose from the radiator allows extra-cooled coolant from the radiator to flow through the transmission oil cooler. The coolant from the cooler is returned to the system via a branch in the bottom radiator hose.

Coolant from the water outlet also flows through the EGR (exhaust gas recirculation) coolers and then to the heater core. From the heater core outlet, the coolant flows to the outlet zone of the pressure relief thermostat.

The expansion tank allows expansion of coolant due to temperature increases to pass excess coolant back to the expansion tank. A small hose is connected from the water outlet to the expansion tank for this purpose. As the coolant cools, the coolant is allowed back into the system from the tank via a hose from the expansion tank into the radiator bottom hose.

PRESSURE RELIEF THERMOSTAT (PRT)

The thermostat is closed at temperatures below approximately 82°C (179°F). When the coolant temperature reaches approximately 82°C the thermostat starts to open and is fully open at approximately 96°C (204°F). In this condition the full flow of coolant is directed through the radiator. The thermostat is exposed to 90% hot coolant from the engine on one side and 10% cold coolant returning from the radiator bottom hose on the other side. Hot coolant from the engine passes from the by-pass pipe through four sensing holes in the flow valve into a tube surrounding 90% of the thermostat sensitive area. Cold coolant returning from the engine, cooled by the radiator, conducts through 10% of the sensitive area.

In cold ambient temperatures, the engine temperature is raised by approximately 10°C (50°F) to compensate for the heat loss of 10% exposure to the cold coolant returning from the bottom hose.

The by-pass flow valve is held closed by a light spring. It operates to further aid heater warm-up. When the main valve is closed and the engine speed is at idle, the coolant pump does not produce sufficient flow and pressure to open the valve. In this condition the valve prevents coolant circulating through the by-pass circuit and forces the coolant through the heater matrix only. This provides a higher flow of coolant through the heater matrix to improve passenger comfort in cold conditions. When the engine speed increases above idle, the coolant pump produces a greater flow and pressure than the heater circuit can take. The pressure acts on the by-pass flow valve and overcomes the valve spring pressure, opening the valve and limiting the pressure in the heater circuit. The valve modulates to provide maximum coolant flow through the heater core and yet allowing excess coolant to flow into the by-pass circuit to provide the engine's cooling needs at higher engine speeds.

COOLING FAN

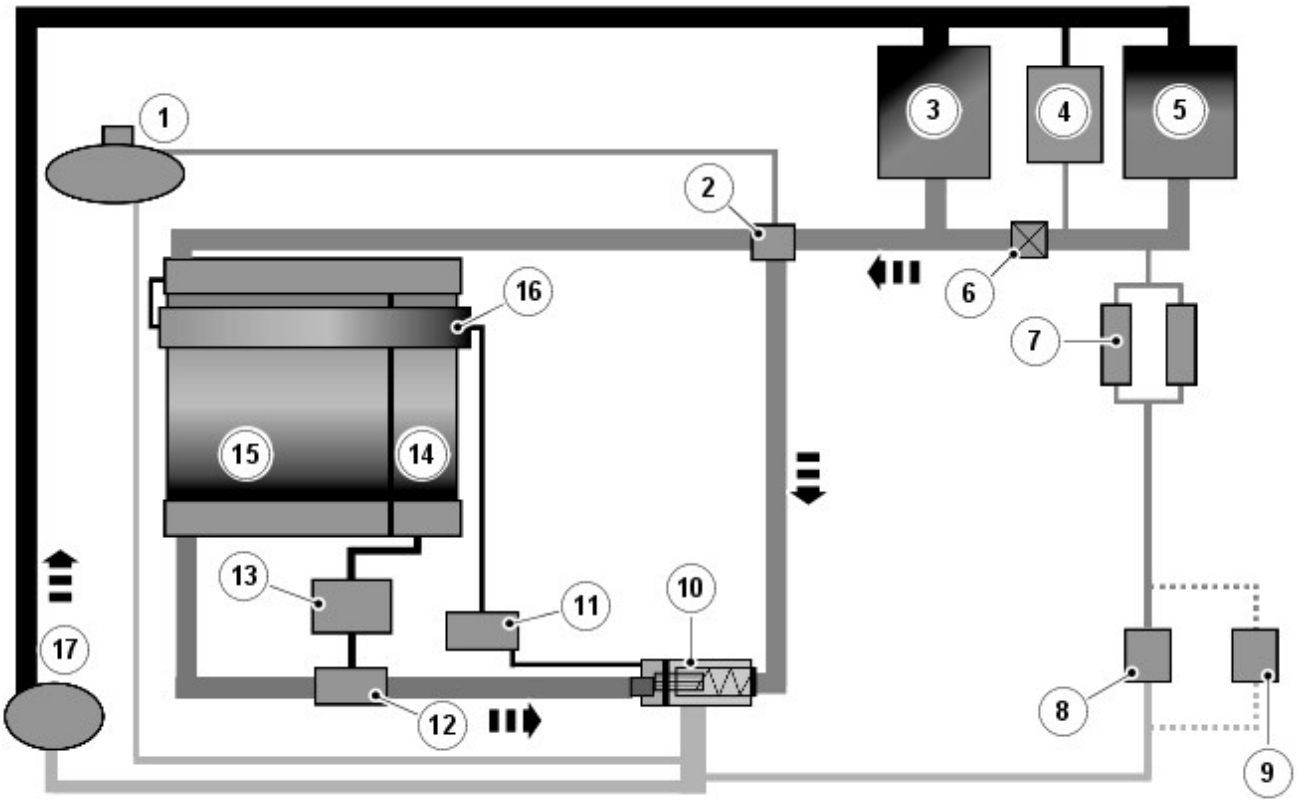
For additional airflow through the radiator matrix, particularly when the vehicle is stationary, there is an engine driven electro-viscous fan unit fitted to the rear of the radiator. The fan is used for engine cooling and for A/C (air conditioning) system cooling. This unit functions as a normal viscous fan, but with electronic control over the level engagement of the clutch. The ECM (engine control module), which determines the required fan speed, controls the level of clutch engagement. The ECM determines engagement based on the coolant, charge air, ambient and transmission oil temperatures and the A/C pressure. The fan is mounted using a left hand thread.

The viscous fan unit is electronically controlled by the ECM to optimize 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.

SCHEMATIC FLOW DIAGRAMS

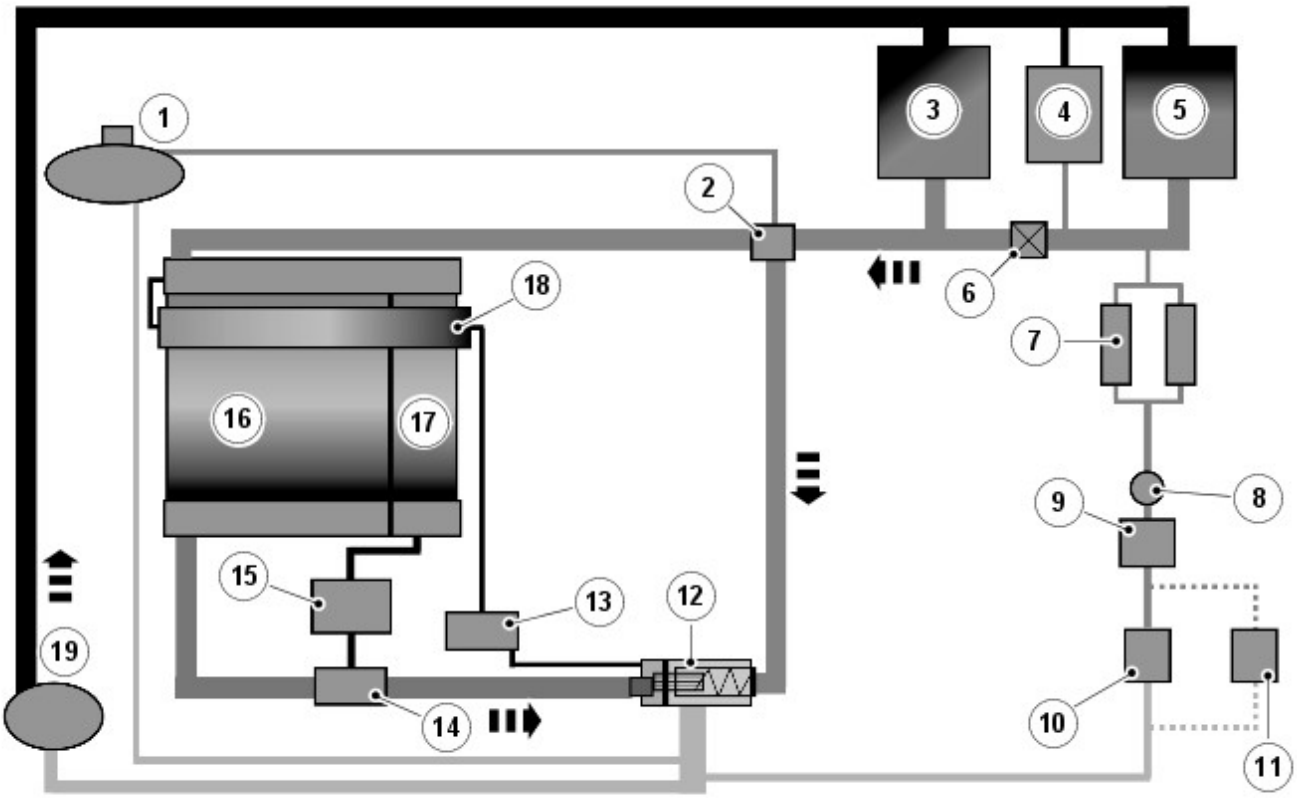
ENGINE COOLING WITHOUT FUEL FIRED BURNING HEATER



E107588

Item	Description
1	Expansion tank
2	Degas connector
3	Cylinder head
4	Engine oil cooler
5	Cylinder head
6	Static bleed point
7	EGR coolers
8	Cabin heater
9	Rear heater
10	Pressure Relief Thermostat (PRT)
11	Fuel cooler
12	Venturi connector
13	Transmission oil cooler
14	Transmission oil sub-cooler
15	Radiator
16	Fuel sub-cooler
17	Water pump

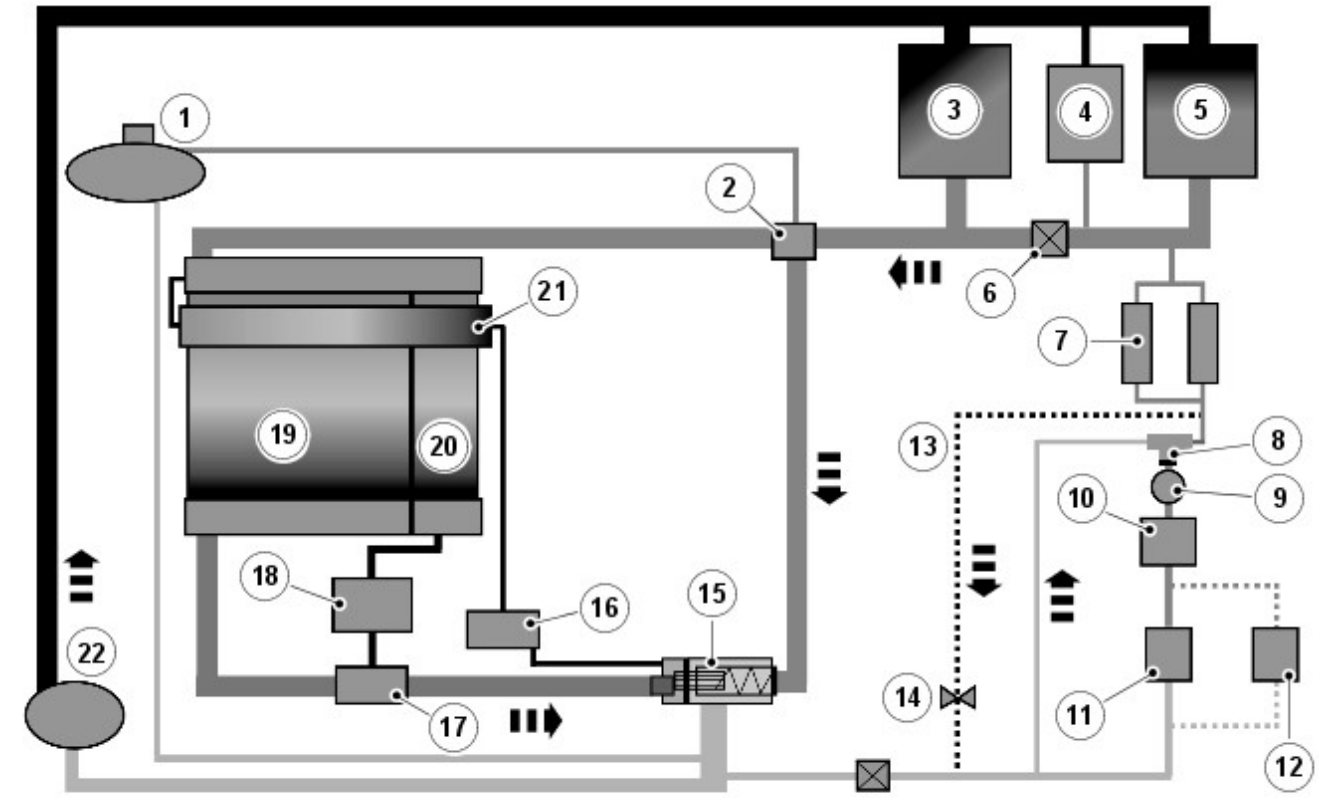
ENGINE COOLING WITH FUEL FIRED BURNING HEATER - SCHEMATIC FLOW DIAGRAM



E107589

Item	Description
1	Expansion tank
2	Degas connector
3	Cylinder head
4	Engine oil cooler
5	Cylinder head
6	Static bleed point
7	EGR coolers
8	Pump
9	FFBH (fuel fired burning heater)
10	Cabin heater
11	Rear heater
12	PRT
13	Fuel cooler
14	Venturi connector
15	Transmission oil cooler
16	Radiator
17	Transmission oil sub-cooler
18	Fuel sub-cooler
19	Water pump

ENGINE COOLING WITH FUEL FIRED BURNING HEATER AND PARK HEATING - SCHEMATIC FLOW DIAGRAM

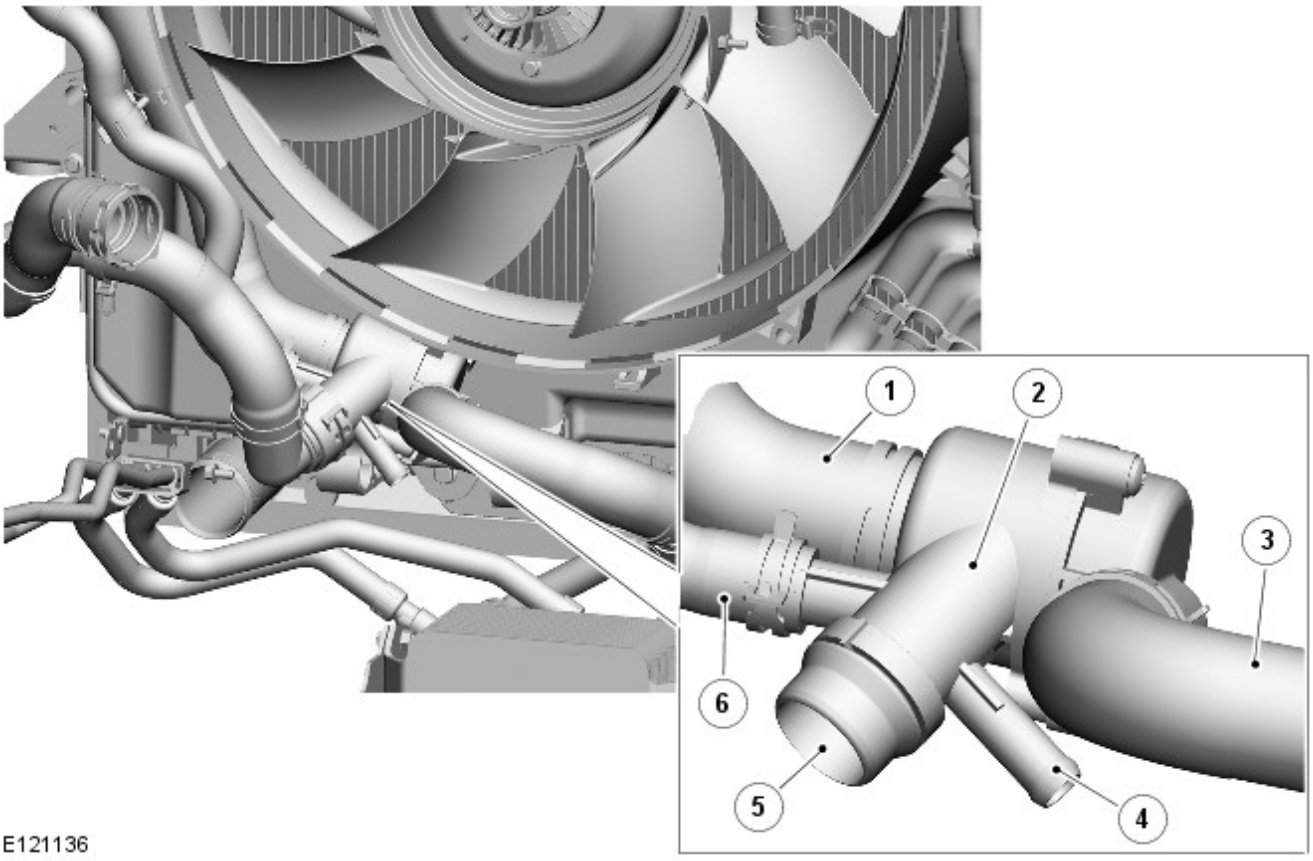


E107590

Item	Description
1	Expansion tank
2	Degas connector
3	Cylinder head
4	Engine oil cooler
5	Cylinder head
6	Static bleed point
7	EGR coolers
8	3-way valve
9	Pump
10	FFBH (fuel fired burning heater)
11	Cabin heater
12	Rear heater
13	Heater by-pass
14	Restrictor
15	PRT
16	Fuel cooler
17	Venturi connector
18	Transmission oil cooler
19	Radiator
20	Transmission oil sub-cooler
21	Fuel sub-cooler
22	Water pump

Component Description

PRESSURE RELIEF THERMOSTAT (PRT)



E121136

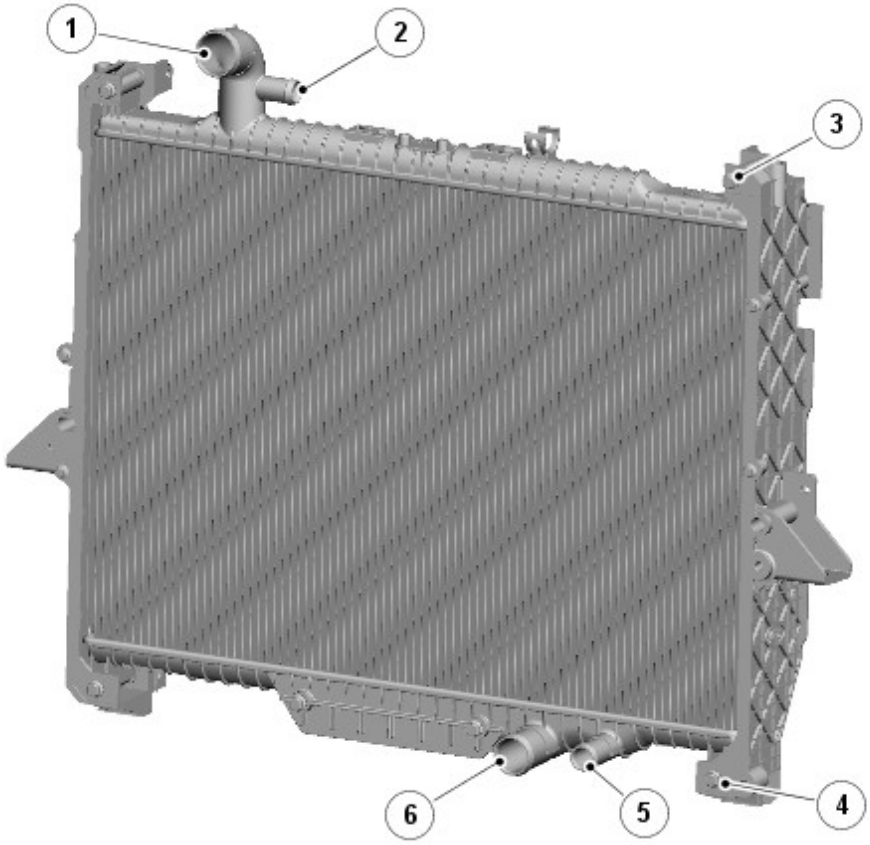
Item Description

1 Connection to radiator top hose
2 PRT body
3 Connection from radiator bottom hose
4 Heater core return connection
5 Connection to cylinder block water inlet
6 Connection to expansion tank

A plastic thermostat housing is located behind the radiator. The housing has 5 connections which locate the radiator bottom hose, top hose from the 5-way connector, coolant pump feed hose to the cylinder block and return feed from the heater core. The housing contains a wax element and a spring loaded by-pass flow valve.

The thermostat is used to maintain the coolant at the optimum temperature for efficient combustion and to aid engine warm-up.

RADIATOR



E121137

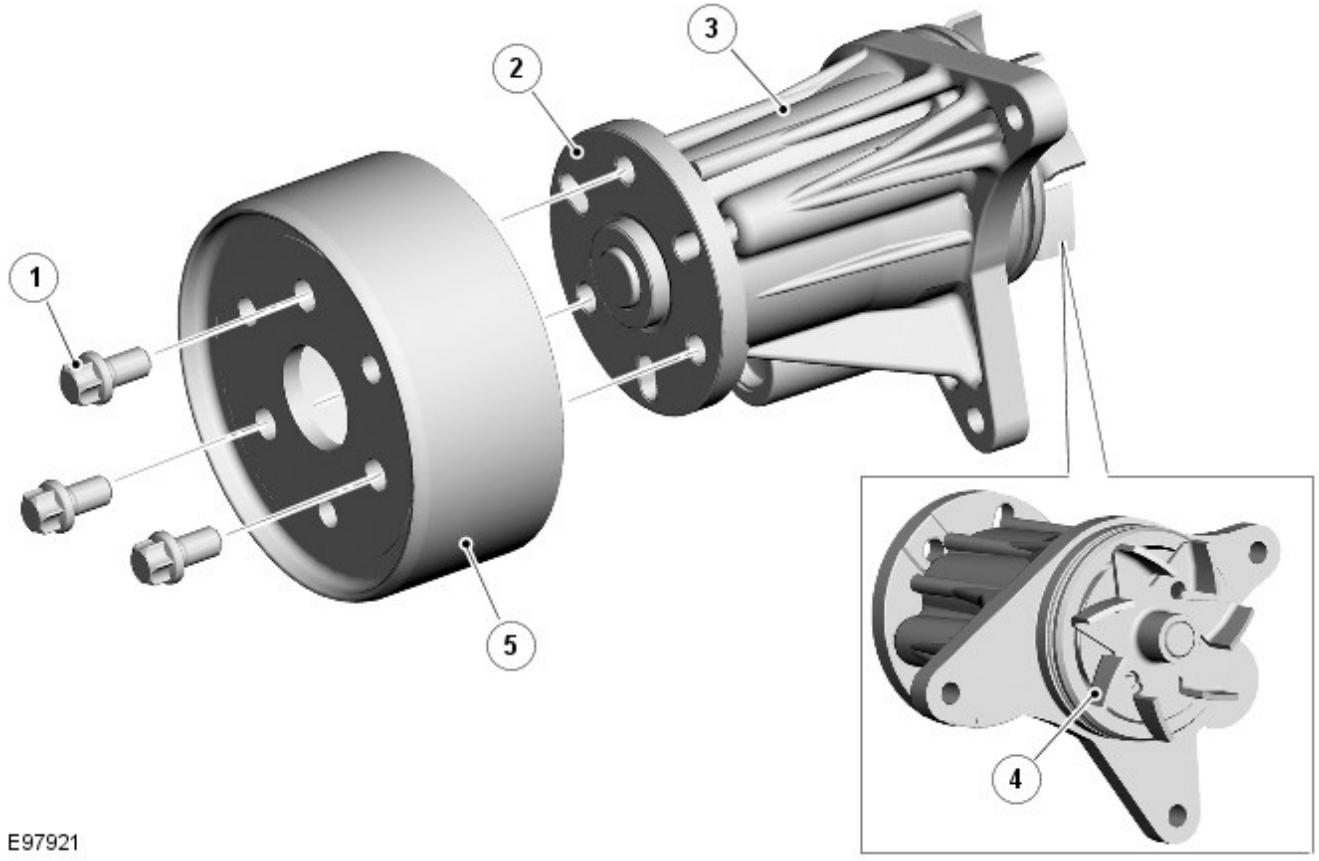
Item Description

1 Coolant inlet
2 Coolant outlet to fuel cooler
3 Support - upper (2 off)
4 Support - lower (2 off)
5 Coolant outlet to transmission oil cooler
6 Coolant outlet to pressure relief thermostat

The radiator is a vertical-flow type with an aluminum core and plastic end tanks. The radiator is located in the vehicle by locating spigots and supports integrated into the cooling pack end frames. The lower supports are installed in rubber bushes in the upper chassis rails. The lupper ocating spigots are installed in rubber bushes in the front end carrier. Coolant inlet and outlet connections are incorporated into the upper and lower end tanks respectively.

The lower end tank also has a connection for coolant outlet to the transmission fluid cooler.

COOLANT PUMP

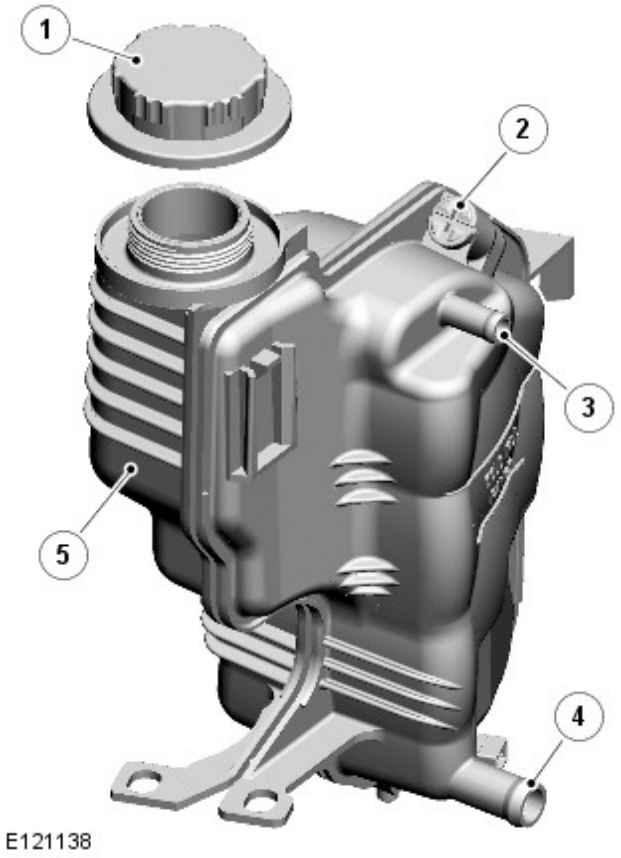


Item Description

1 Bolt (3 off)
2 Drive hub
3 Housing
4 Impeller
5 Pulley

The coolant pump has a housing that supports a shaft with an impeller attached to one end and a drive hub at the other. The housing is attached to the front of the cylinder block with the impeller located in a pumping chamber. The pump is driven by a pulley attached to the drive hub and driven by the accessory drive belt. For additional information refer to Accessory Drive 303-05B.

EXPANSION TANK



Item	Description
1	Filler cap
2	Bleed screw
3	Vent hose connection
4	Expansion hose connection
5	Expansion tank

A pressurized expansion tank system is used which continuously separates the air from the cooling system and replenishes the system through a hose connected between the expansion tank and the heater return hose. A continuous vent into the expansion tank, through a hose connected to the engine's coolant outlet connector, prevents air locks from forming in the cooling system.

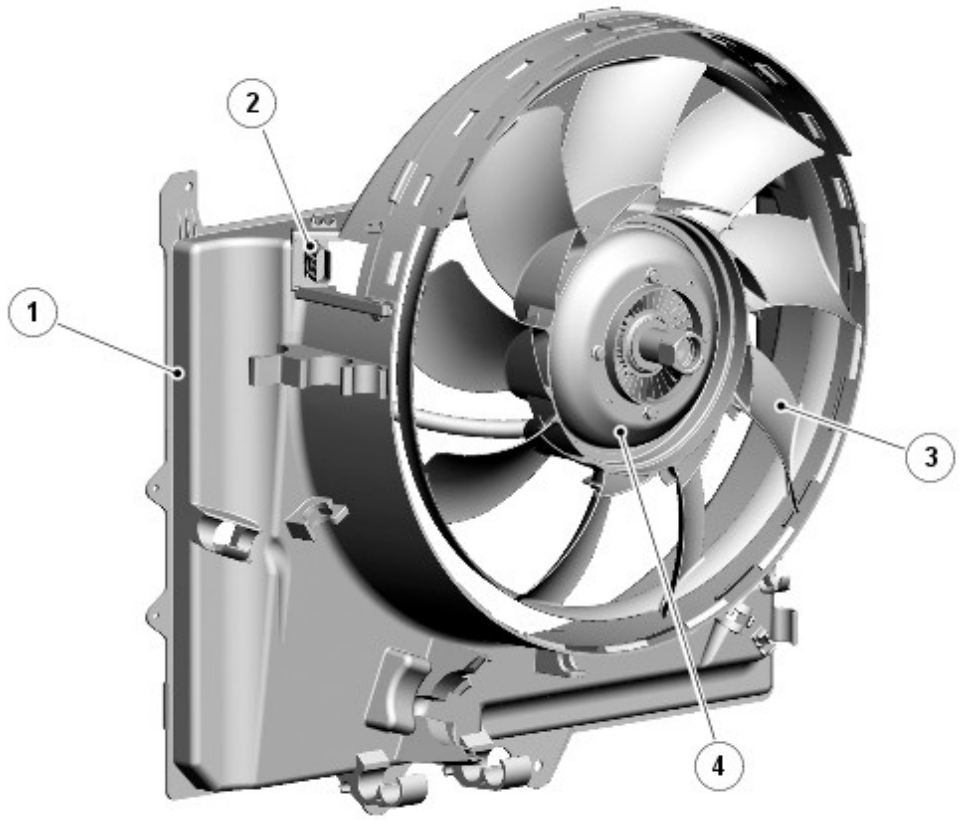
The expansion tank is installed behind the top right corner of the radiator. A filler cap, bleed screw and level sensor are incorporated into the expansion tank. MAX and MIN level markings are molded into the interior of the tank below the filler cap.

The expansion tank provides the following functions:

- Service fill
- Coolant expansion during warm-up
- Air separation during operation
- System pressurization by the filler cap

The expansion tank has an air space of approximately 0.5 to 1 liter (1.06 to 2,11 US pints), above the MAX level, to allow for coolant expansion.

COOLING FAN



E121139

Item	Description
1	Shroud
2	Electrical connector
3	Fan
4	Viscous unit

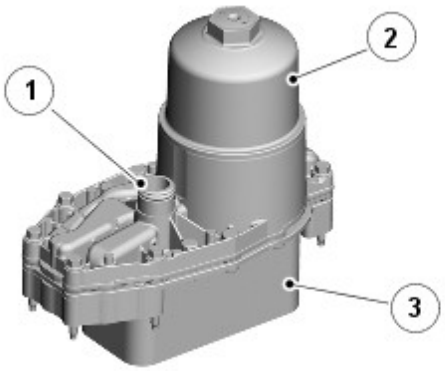
To control the cooling fan, the ECM sends a PWM (pulse width modulation) signal to the cooling fan module (integral to the ECM). The frequency of the PWM signal is used by the cooling fan module to determine the output voltage supplied to the fan motor.

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 transmission do not overheat.

The ECM operates the fan in response to inputs from the ECT (engine coolant temperature) sensor, the transmission oil temperature sensor, the charge air 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 CAN (controller area network) road speed signal received from the ABS (anti-lock brake system) module.

ENGINE OIL COOLER

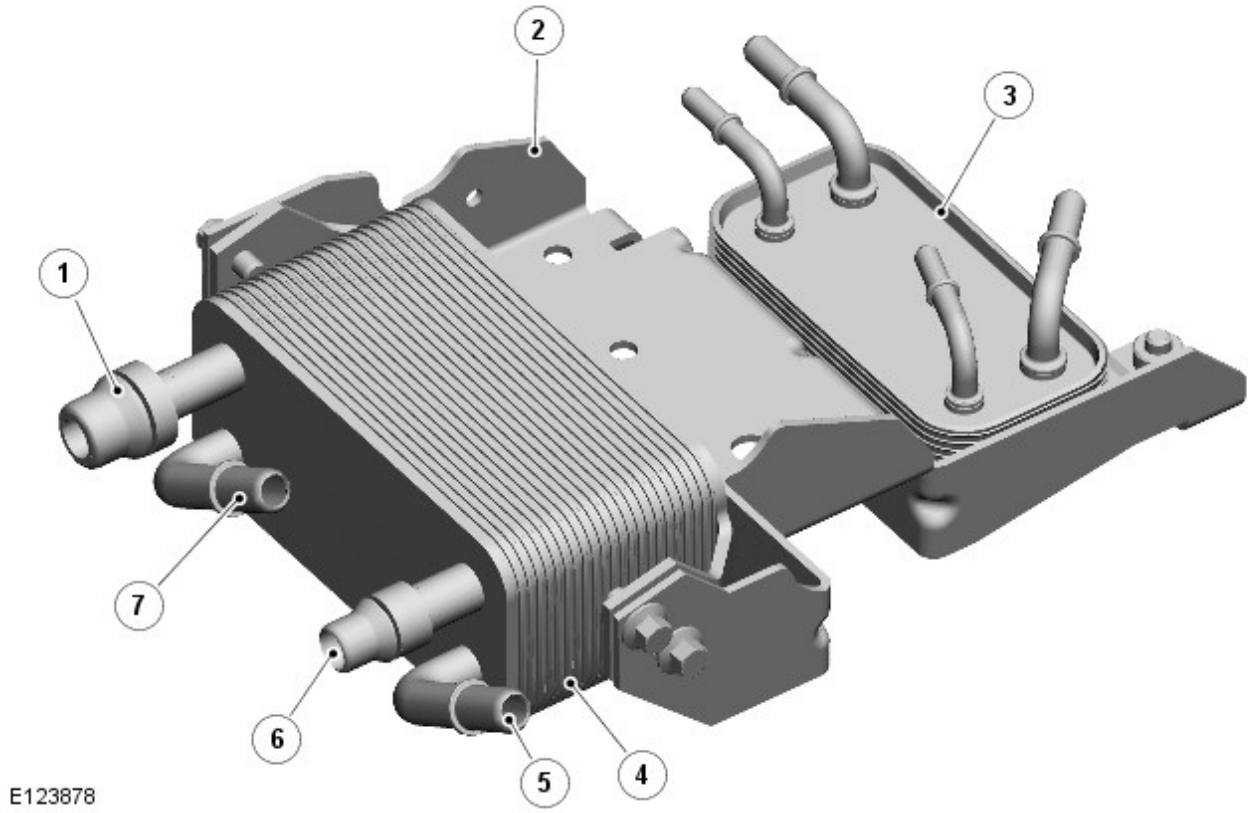


E115007

Item	Description
1	Coolant outlet
2	Engine oil filter
3	Engine oil cooler

The engine oil cooler is attached to a common adapter assembly located in the vee of the cylinder block. Inlet and outlet ports for engine oil, and an inlet port for coolant, are incorporated into the cylinder block mating face of the adapter assembly. A metal gasket seals the joint between the adapter assembly and the cylinder block. From the cylinder block, coolant flows through the adapter assembly and into the cooler. After passing through the cooler, the coolant then flows into the engine coolant water outlet.

TRANSMISSION FLUID COOLER



Item	Description
1	Coolant inlet from radiator
2	Mounting bracket
3	Fuel cooler
4	Transmission fluid cooler
5	Transmission fluid inlet
6	Coolant outlet to radiator bottom hose
7	Transmission fluid outlet

The transmission fluid cooler is located on chassis cross member behind the radiator, sharing a bracket with the fuel cooler. The cooler is connected to the cooling system with two hoses and receives cooled fluid from the lower section of the radiator, which flows through the cooler, reducing the temperature of the transmission fluid.

ENGINE COOLANT

The coolant is silicate free and must not be mixed with conventional engine coolant.

Published: 07-Aug-2012

Engine Cooling - TDV6 3.0L Diesel - Engine Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the engine cooling system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-03A Engine Cooling - TDV6 3.0L Diesel)

Engine Cooling (Description and Operation),
Engine Cooling (Description and Operation),
Engine Cooling (Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Coolant leaks • Coolant hoses • Coolant expansion tank • Radiator • Heater core • Accessory drive belt • Viscous fan	• Fuses • Harnesses • 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 the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Coolant loss	• Hoses • Hose connections • Radiator • Water pump • Heater core • Gaskets • Engine casting cracks • Engine block core plugs	• Carry out a visual inspection. If there are no obvious leaks, carry out a cooling system pressure test. Rectify any leaks as necessary
Overheating	• Low/contaminated coolant • Thermostat • Viscous fan • ECT sensor • Restricted air flow over the radiator	• Check the coolant level and condition. Carry out a cooling system pressure test. Rectify any leaks as necessary • Test the thermostat and rectify as necessary • Test the viscous fan operation, make sure the viscous fan rotates freely. Rectify as necessary • Check for obstructions to the air flow over the radiator. Rectify as necessary
Engine not reaching normal temperature	• Thermostat • Viscous fan • Thermostat • Electric fan • Fan speed module	• Test the thermostat and rectify as necessary • Test the viscous fan operation, make sure the viscous fan rotates freely

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

Engine Cooling - TDV6 3.0L Diesel - Cooling System Draining, Filling and Bleeding

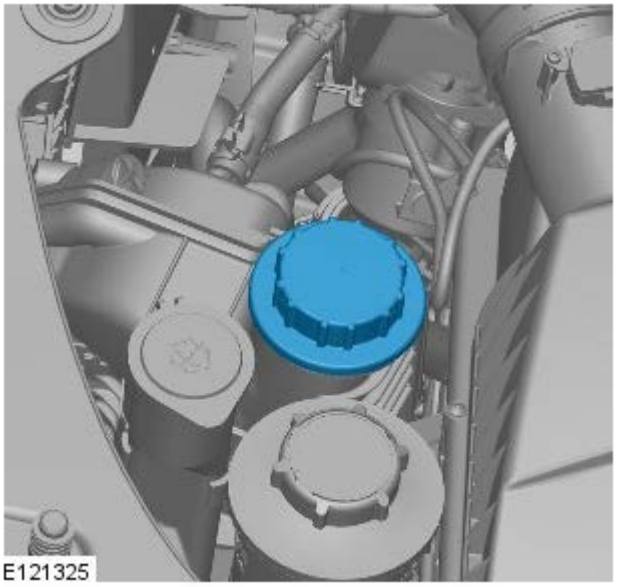
General Procedures

Draining

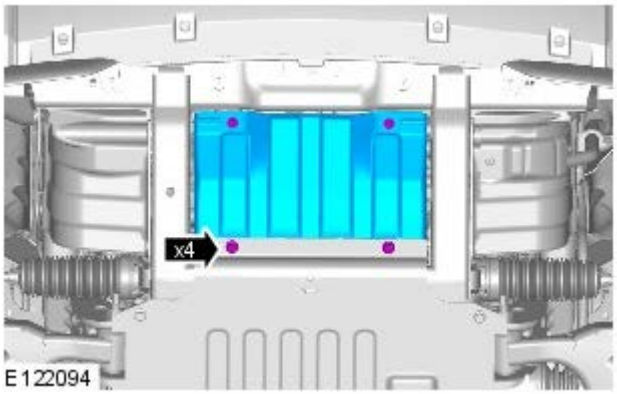
1. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

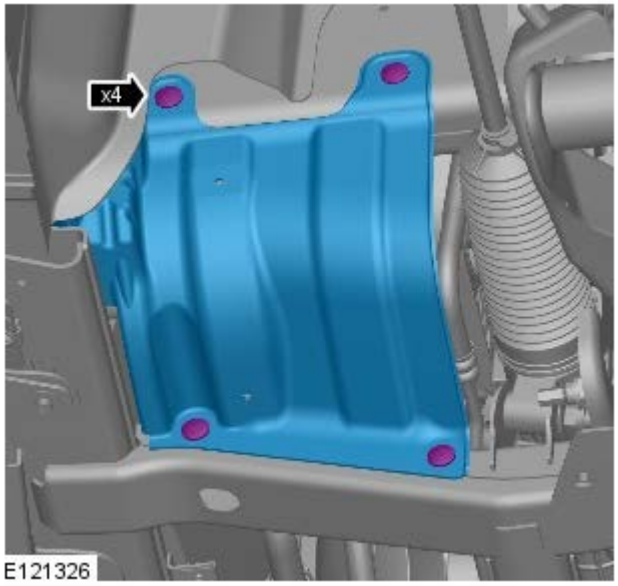


3. WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

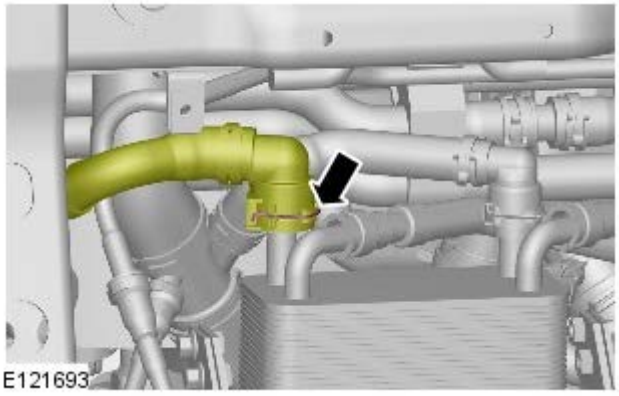


4. Remove the 4 bolts.

5.

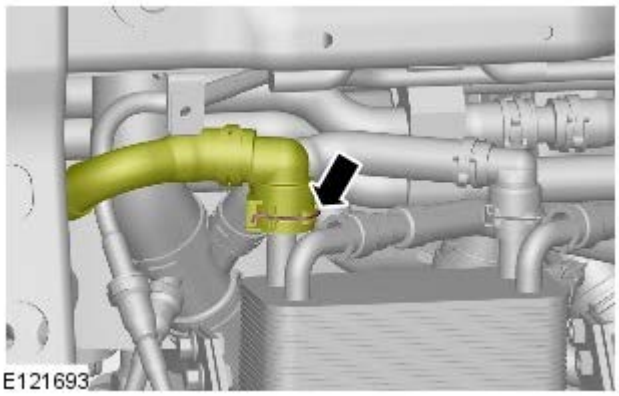


E121326

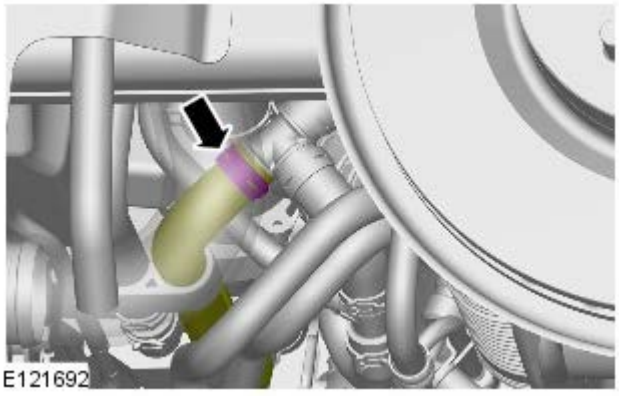

E121693

6. CAUTION: Be prepared to collect escaping coolant.

   Position a container to collect the fluid.

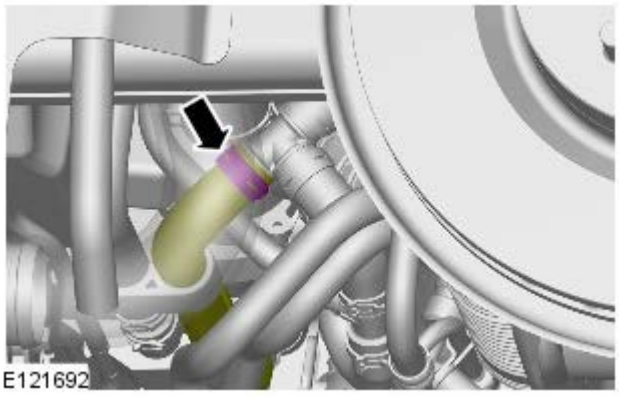

E121693

7. Connect the transmission fluid cooler coolant hose.

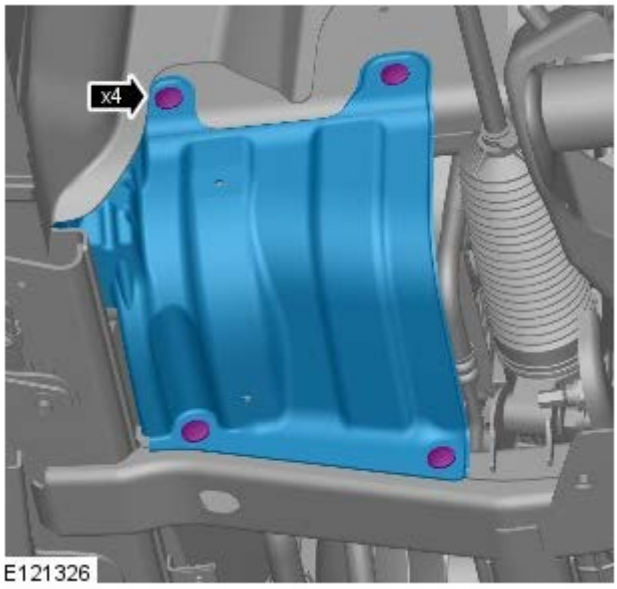

E121692

8. CAUTION: Be prepared to collect escaping coolant.

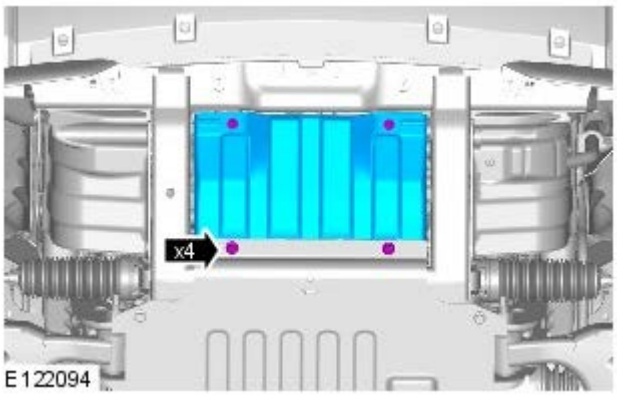
9. Install the coolant hose.



10. Install the LH splash shield.



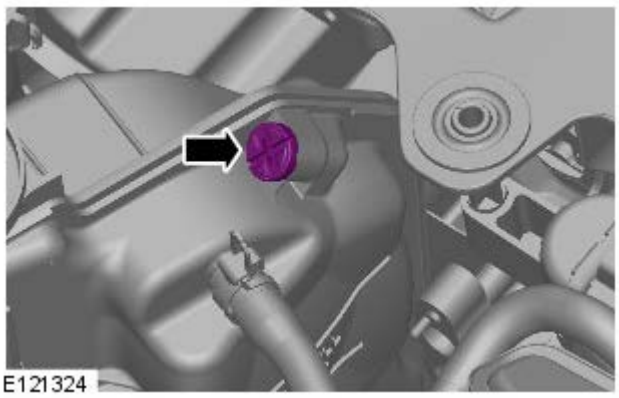
11. *Torque:* 10 Nm



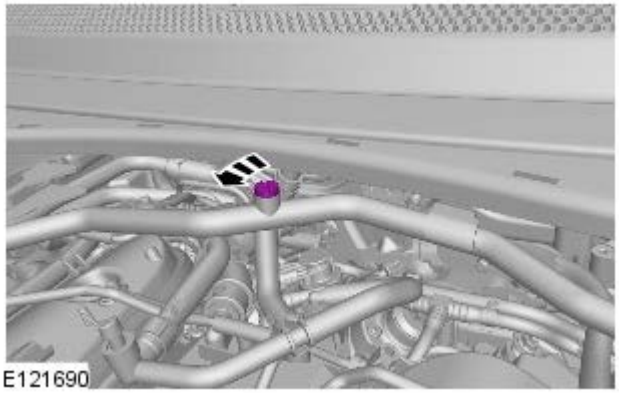
Filling

1. Lower the vehicle.

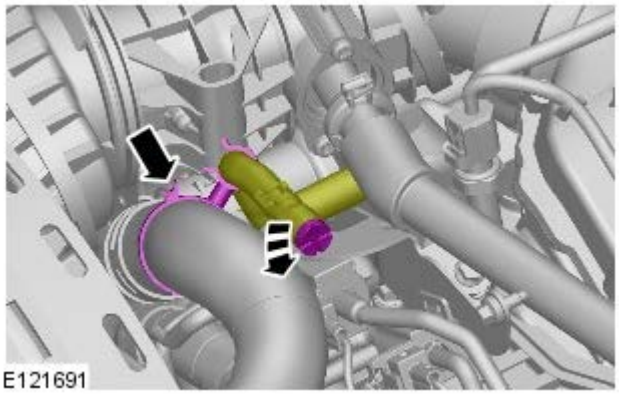
2.



3.



4.

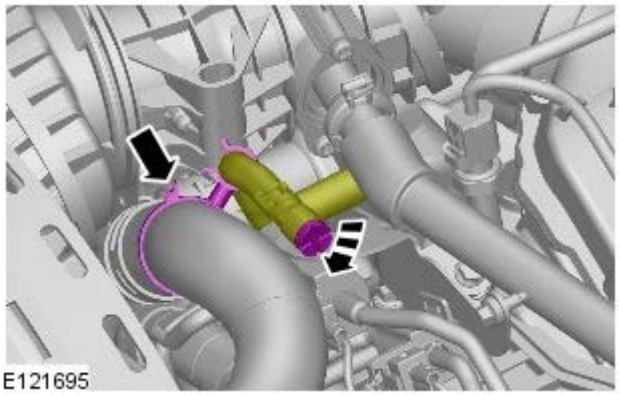


5. CAUTIONS:

   Anti-freeze concentration must be maintained at 50%.

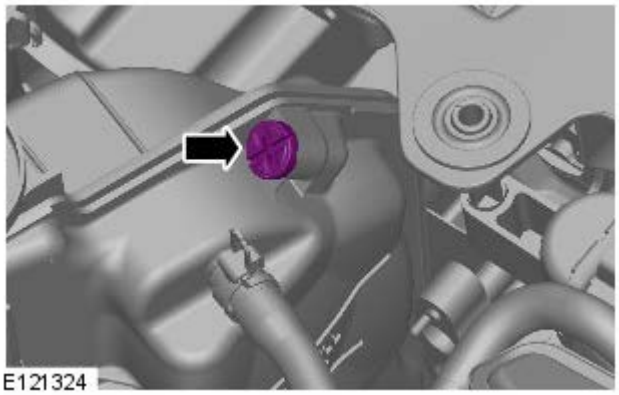
   Be prepared to collect escaping coolant.

   Fill the coolant expansion tank until coolant appears through the bleed ports.



6. CAUTION: Be prepared to collect escaping coolant.

   Fill the coolant expansion tank until coolant appears through the bleed ports.

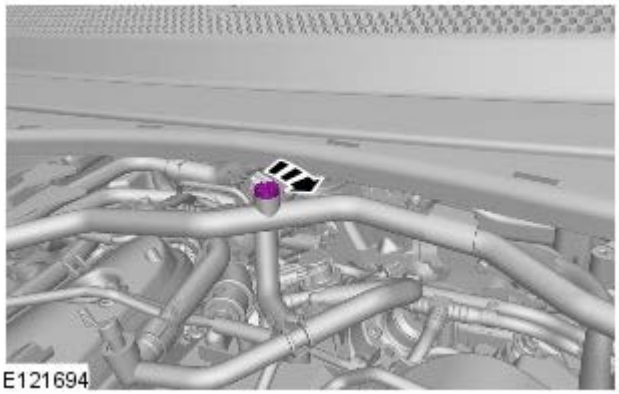


7. Set the heater controls to maximum.

8. Start the engine and continue to fill the coolant until the maximum level is reached.

9. CAUTION: Be prepared to collect escaping coolant.

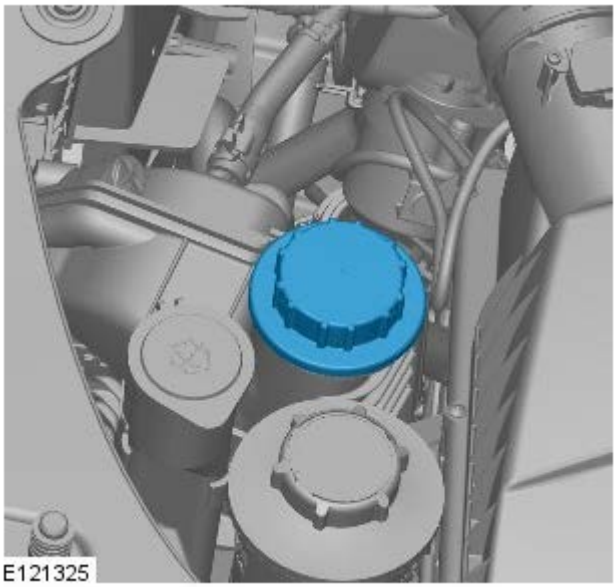
   Fill the coolant expansion tank until coolant


E121694

appears through the bleed ports.

10. Increase engine speed to 2500rpm and cycle between this and idle.

11. Continue to top-up with coolant with the engine at idle.


E121325

12. CAUTION: Correct installation of the Coolant expansion tank cap can be obtained by tightening the cap until an audible click is heard.

13. Allow the engine to idle, until hot air is emitted at the face registers.

14. CAUTION: Switch off the engine and allow the coolant temperature to go cold.

15. Visually check the engine and cooling system for signs of coolant leakage.

16. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

    CAUTIONS:

    Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure

    Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

    NOTE: When the cooling system is warm, the coolant will be approximately 10mm above the upper level mark on the expansion tank with the cap removed.

    Check and top-up the coolant if required.

17. Install the engine cover.

Published: 11-May-2011

Engine Cooling - TDV6 3.0L Diesel - Coolant Expansion Tank

Removal and Installation

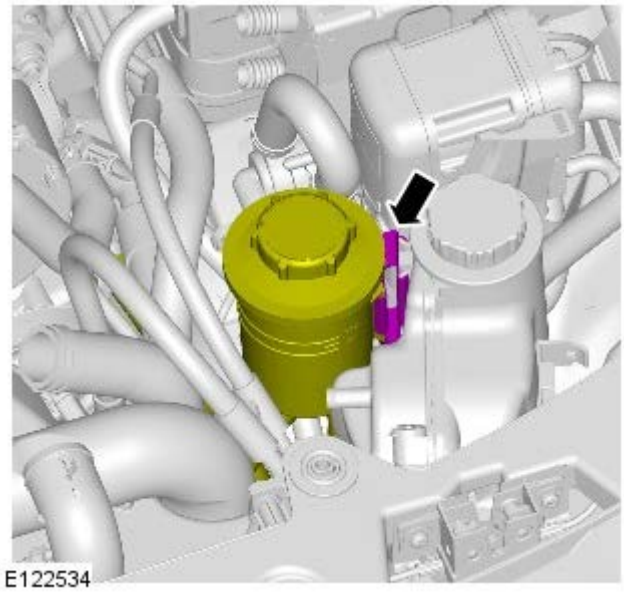
Removal

NOTE: Removal steps in this procedure may contain installation details.

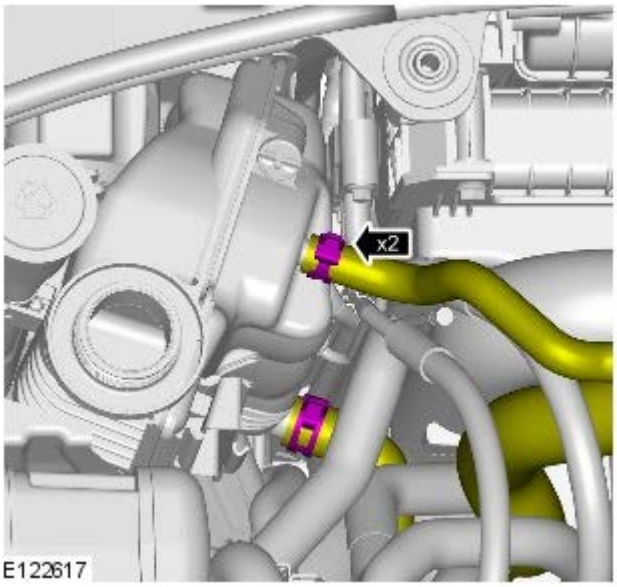
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

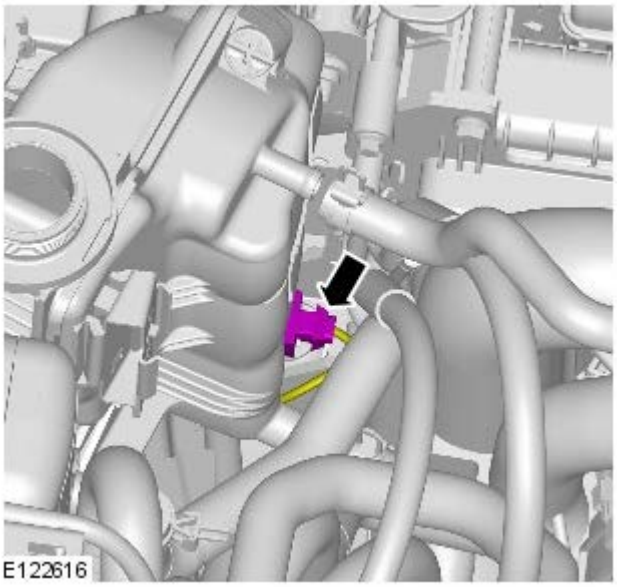
2.



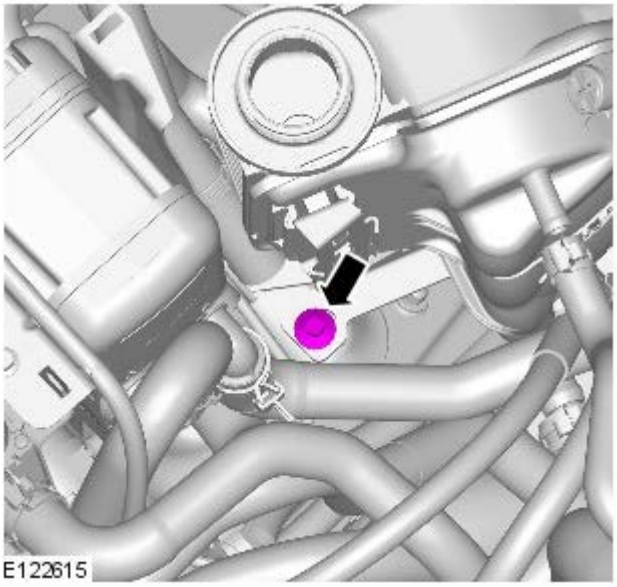
3. CAUTION: Be prepared to collect escaping coolant.



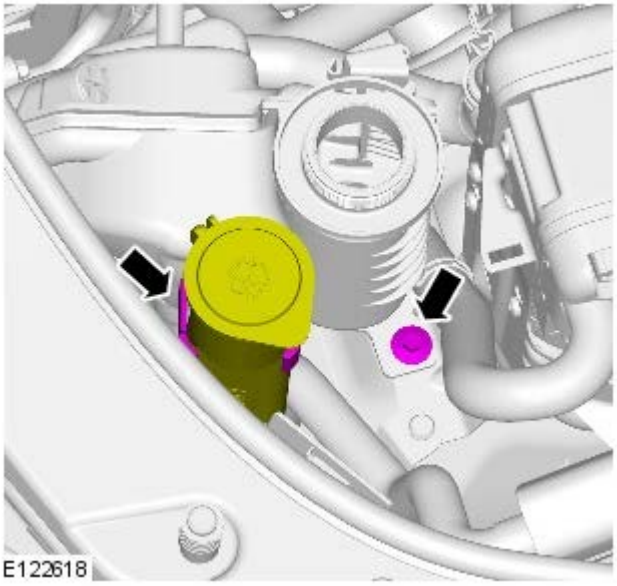
4.



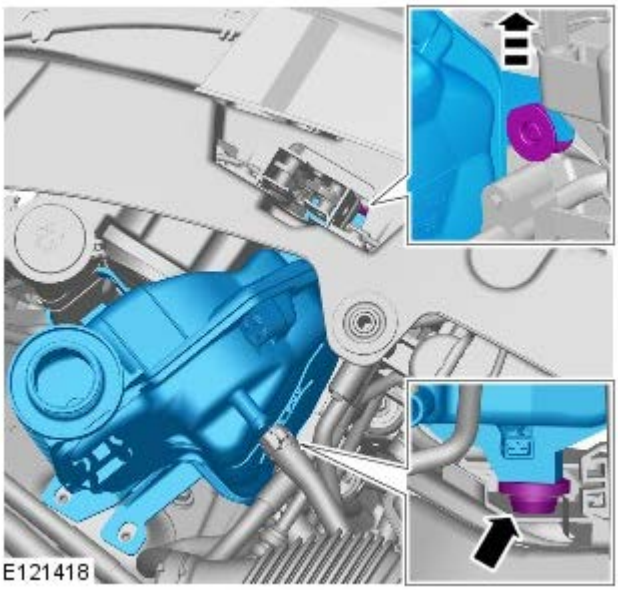
5. *Torque:* 10 Nm

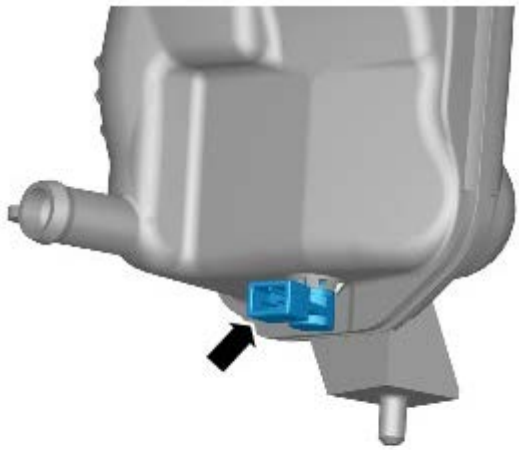


6. *Torque:* 10 Nm



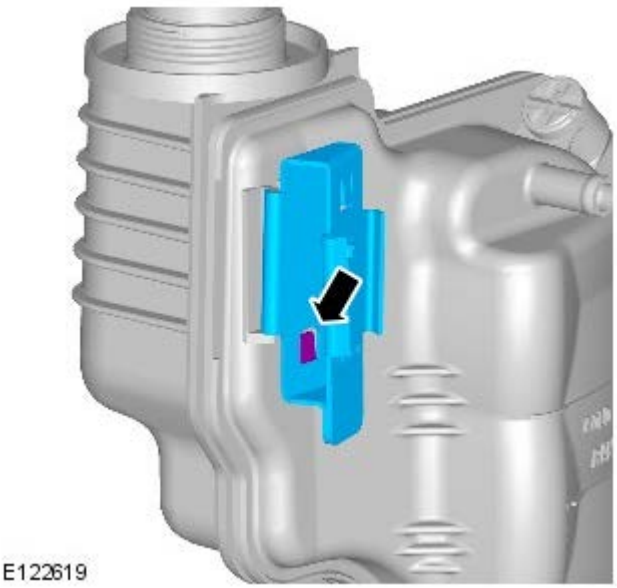
7. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.





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

9.



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine Cooling - TDV6 3.0L Diesel - Coolant Pump

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

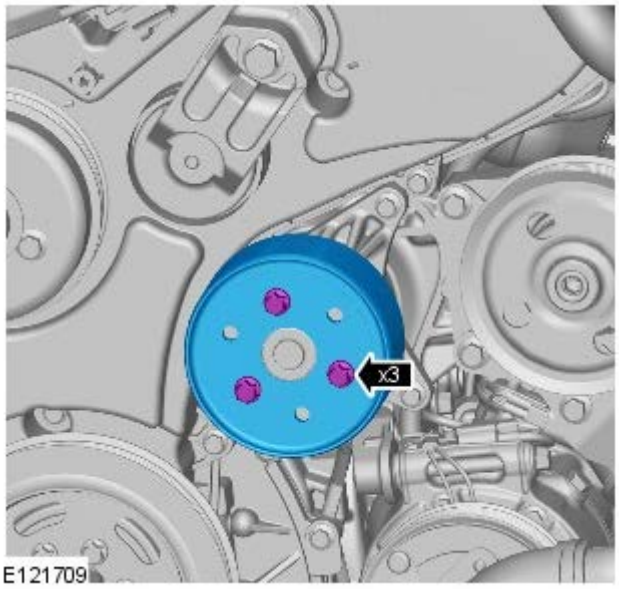
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

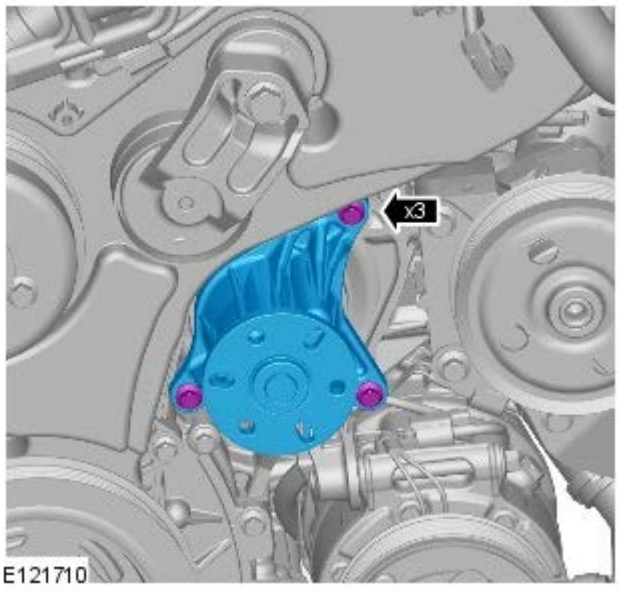
   Raise and support the vehicle.

3. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

4. Refer to: Accessory Drive Belt (303-05, Removal and Installation).



5. CAUTION: Discard the bolts.
   - Using a suitable 6mm bar, retain the coolant pump pulley.
   - *Torque:* 25 Nm



6. CAUTION: Discard the seal.
   - *Torque:* 10 Nm

Installation

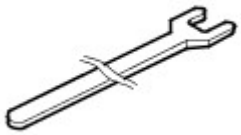
1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine Cooling - TDV6 3.0L Diesel - Cooling Fan

Removal and Installation

Special Tool(s)

303-1142  E46076	303-1142 Viscous Coupling Wrench
303-1143  E55382	303-1143 Viscous Coupling Holding Tool

Removal

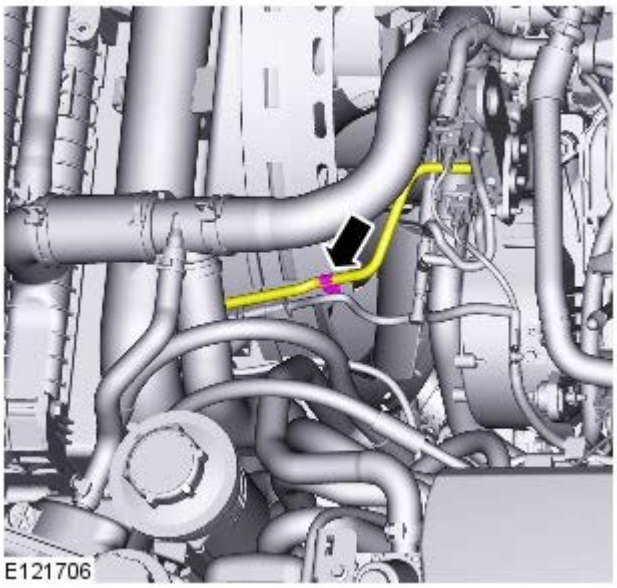
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

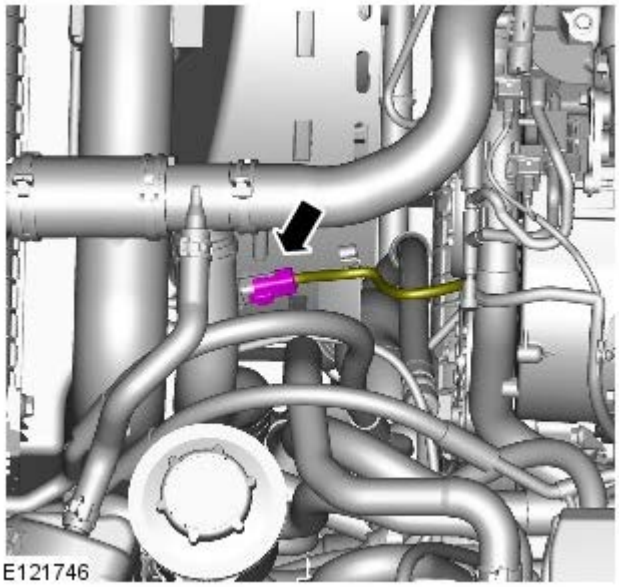
   Raise and support the vehicle.

2. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

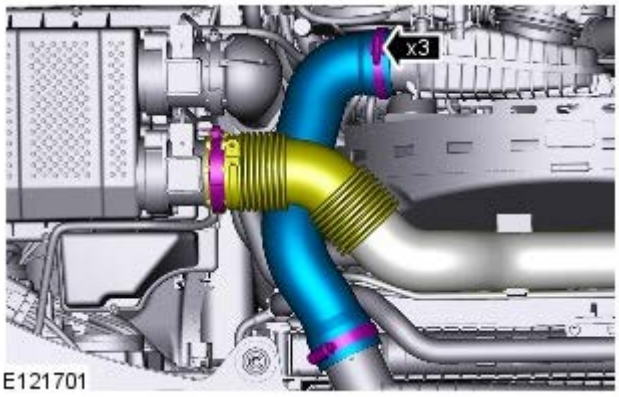
3.


E121706

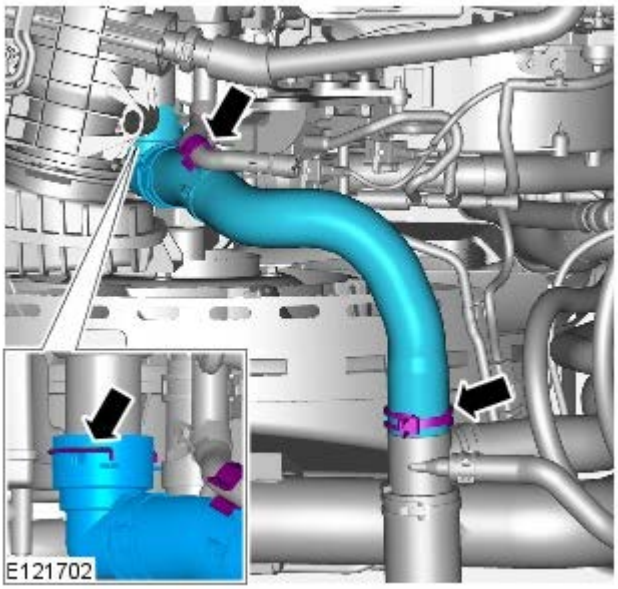
4.



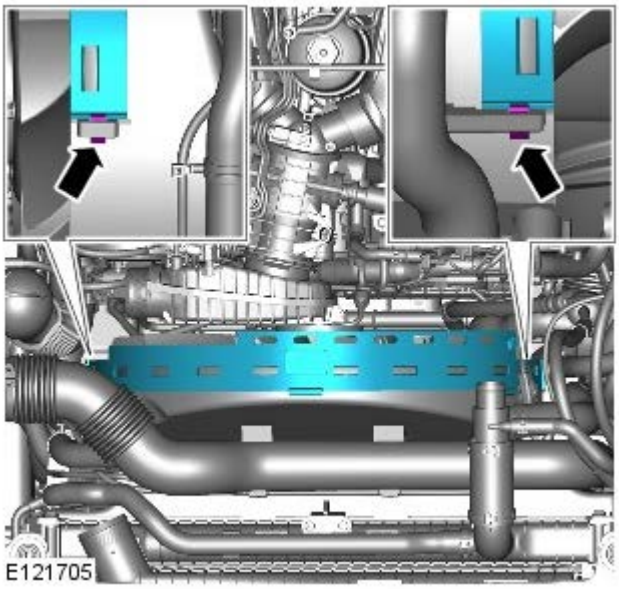
5. *Torque:* 3.5 Nm



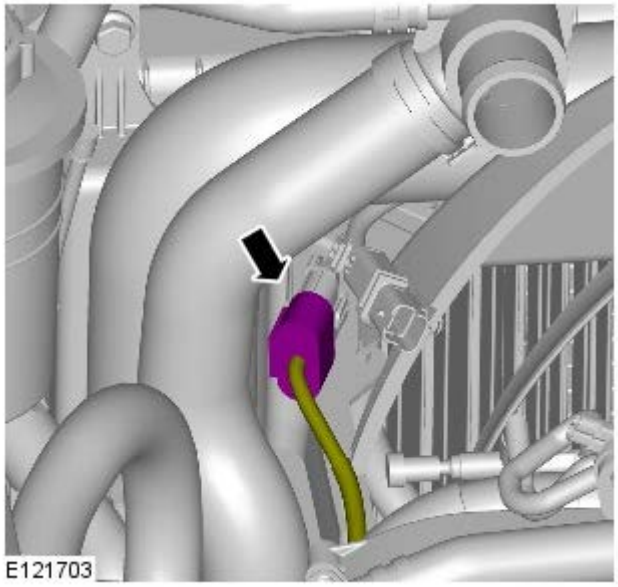
6.



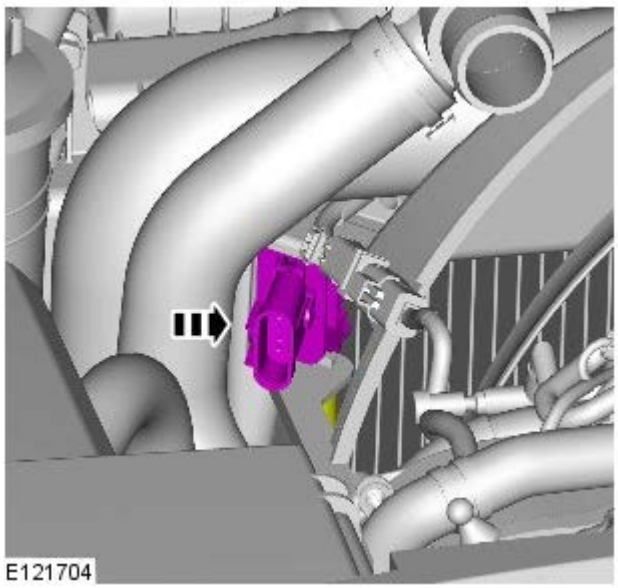
7.



8.

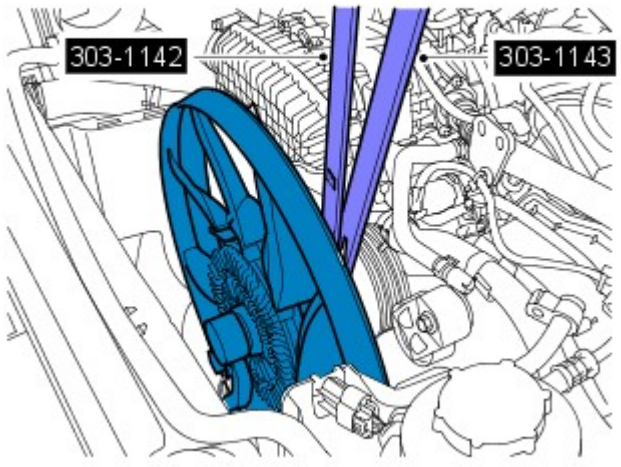


9.



10. NOTE: The thread is left handed.

Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm



E121707

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine Cooling - TDV6 3.0L Diesel - Cooling Fan Shroud

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

All vehicles

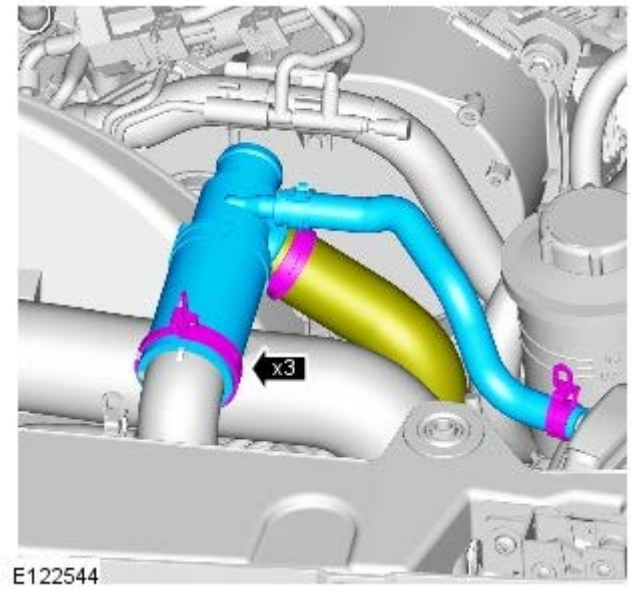
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Cooling Fan (303-03, Removal and Installation).

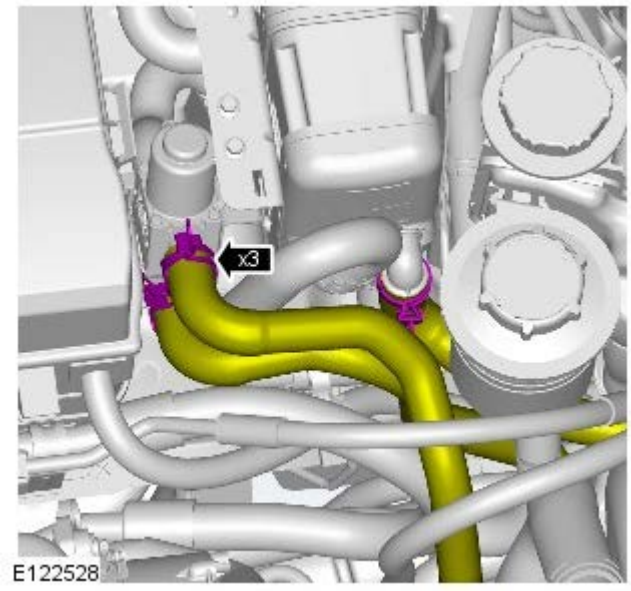
3. Refer to: Turbocharger Bypass Valve (303-04, Removal and Installation).

4. Refer to: Transmission Fluid Cooler - 3.0L Diesel (307-02, Removal and Installation).



5. CAUTION: Be prepared to collect escaping coolant.

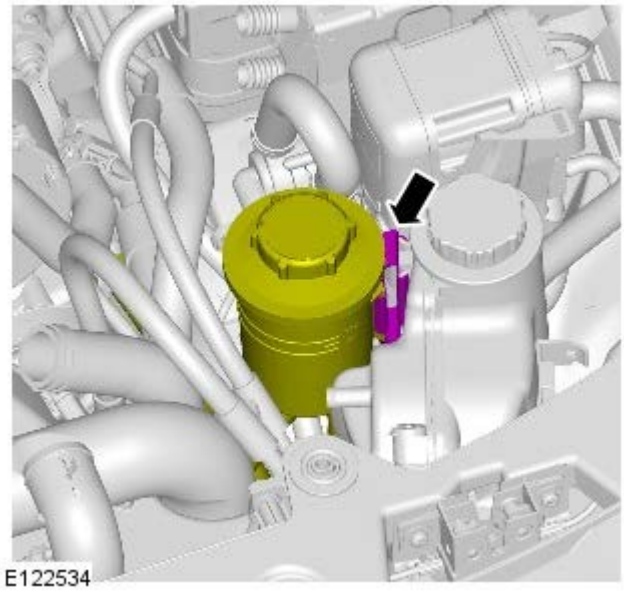
Vehicles with fuel fired booster heater



6. CAUTION: Be prepared to collect escaping coolant.

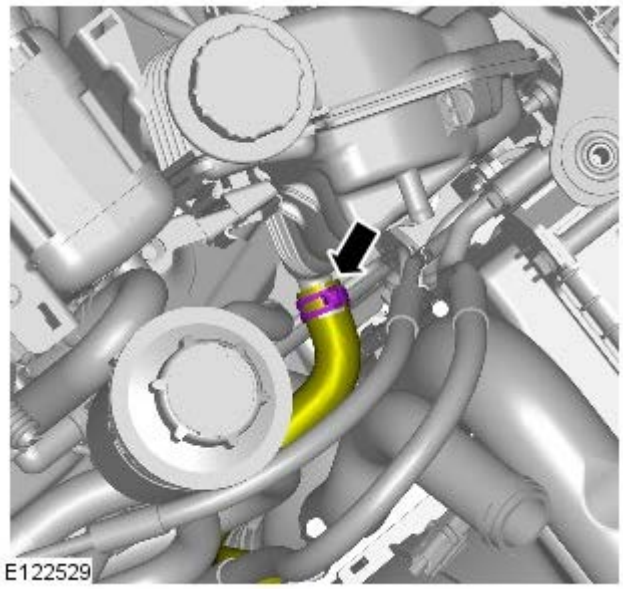
All vehicles

7.

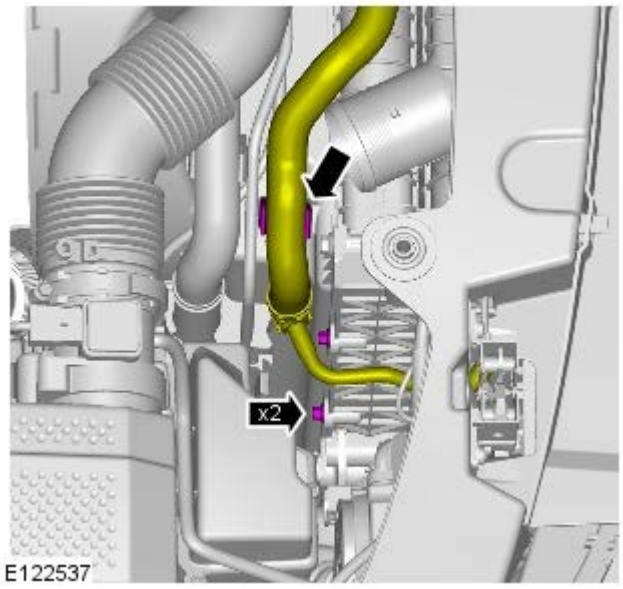


8. CAUTION: Be prepared to collect escaping coolant.

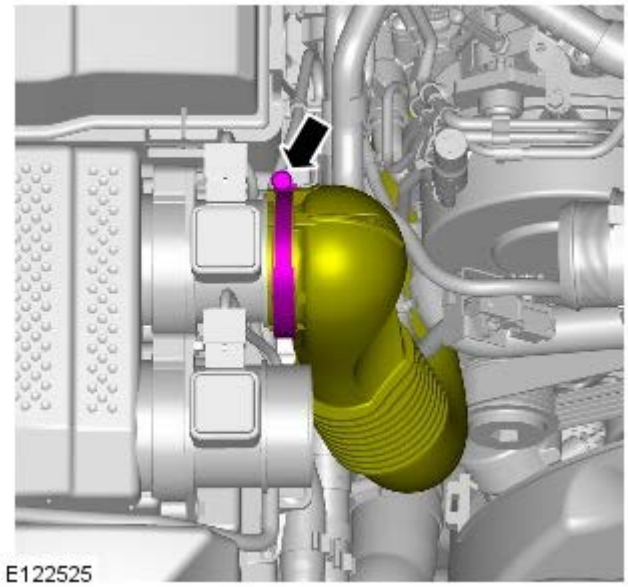
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



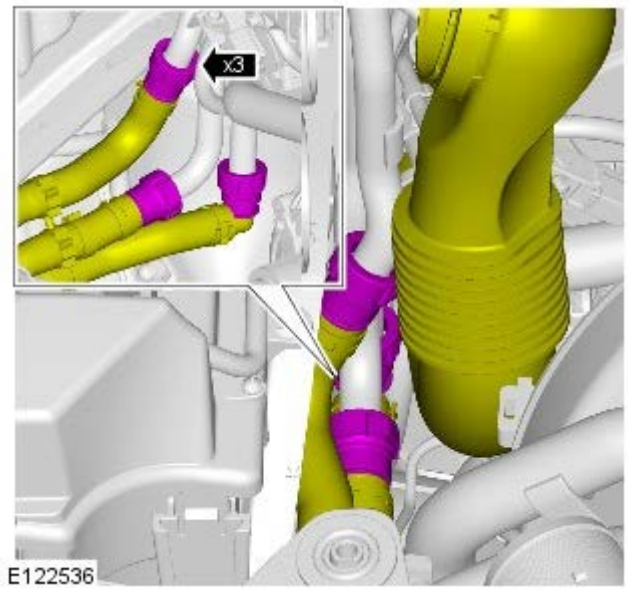
9. *Torque:* 5 Nm



10. *Torque:* 3.5 Nm

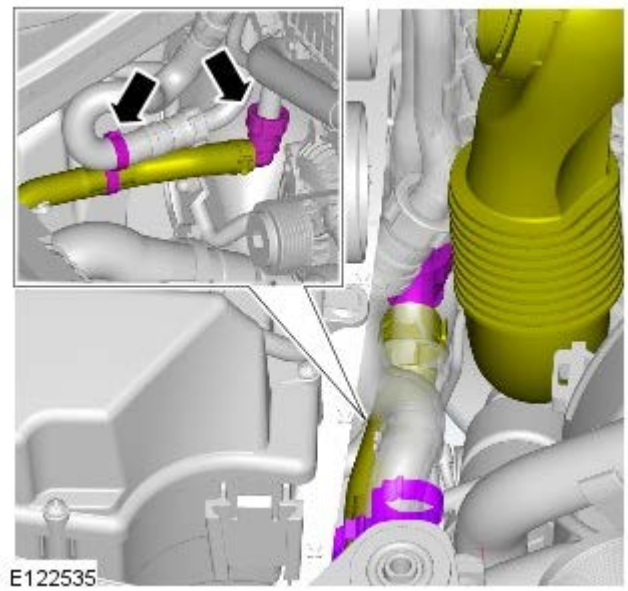


Vehicles with fuel fired booster heater



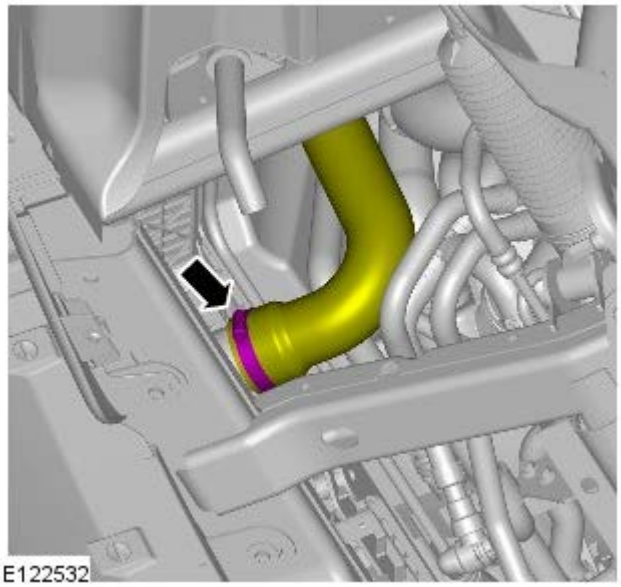
11. CAUTION: Be prepared to collect escaping coolant.

All vehicles

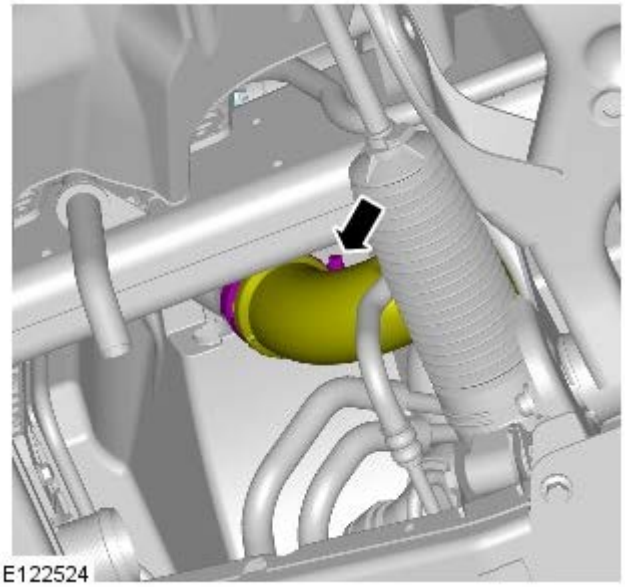


12. CAUTION: Be prepared to collect escaping coolant.

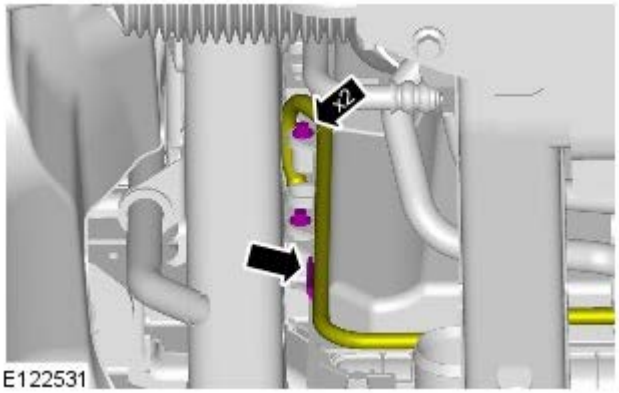
13.



14.

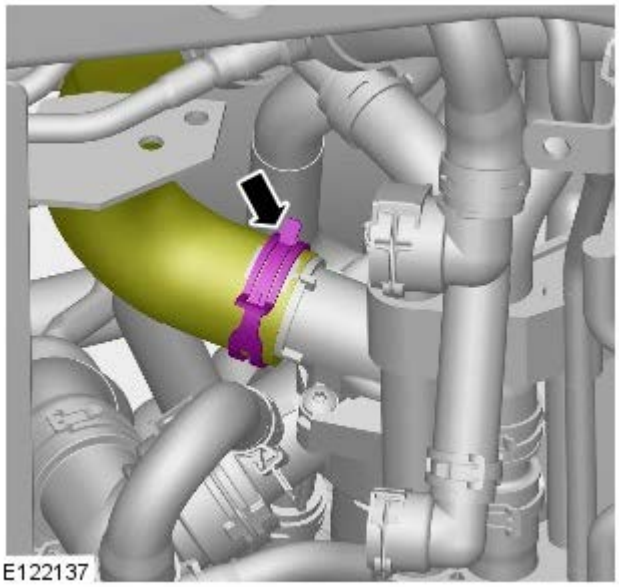


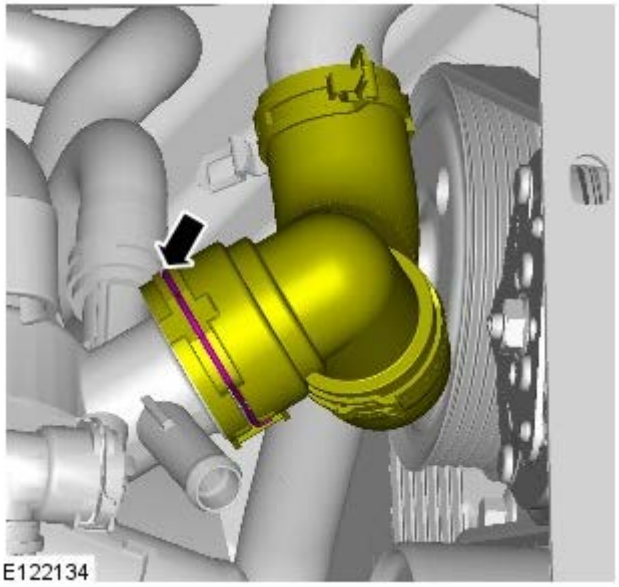
15. *Torque:* 5 Nm



16. CAUTION: Be prepared to collect escaping coolant.

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

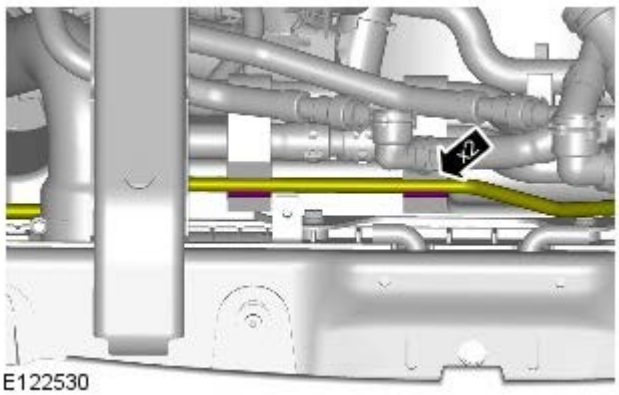




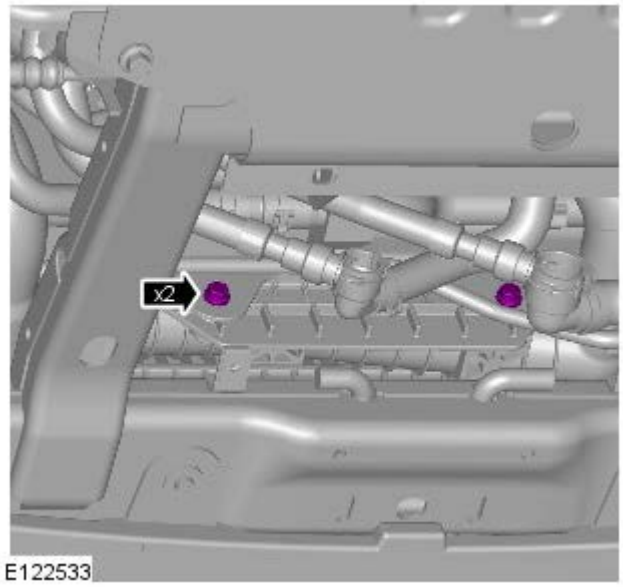
17. CAUTION: Be prepared to collect escaping coolant.

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

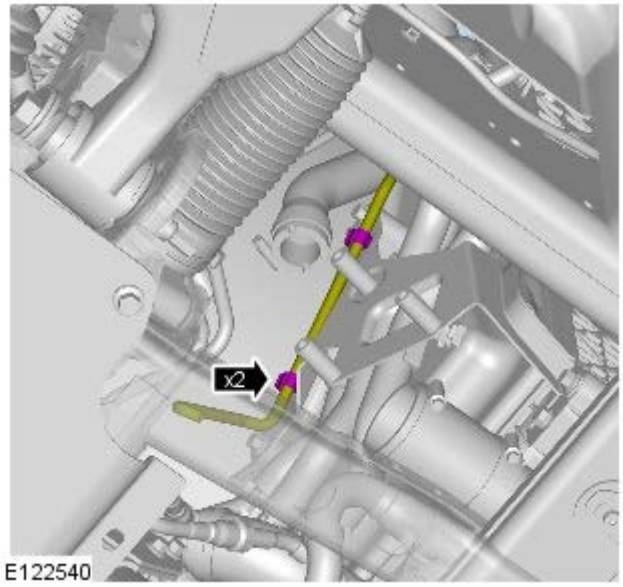
18.



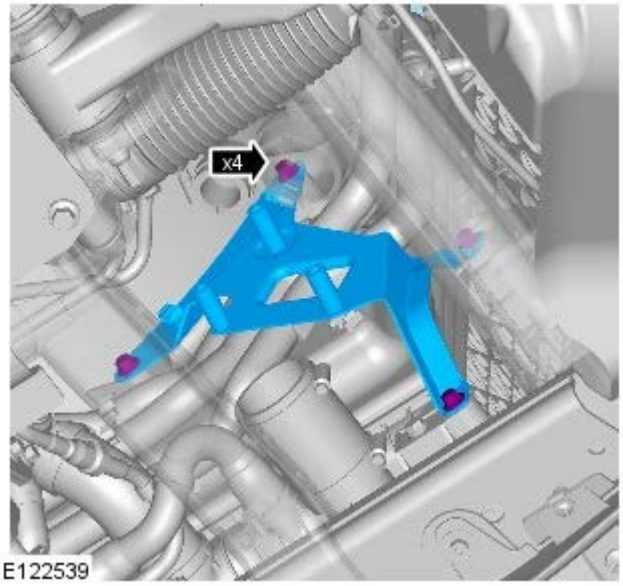
19. *Torque:* 15 Nm



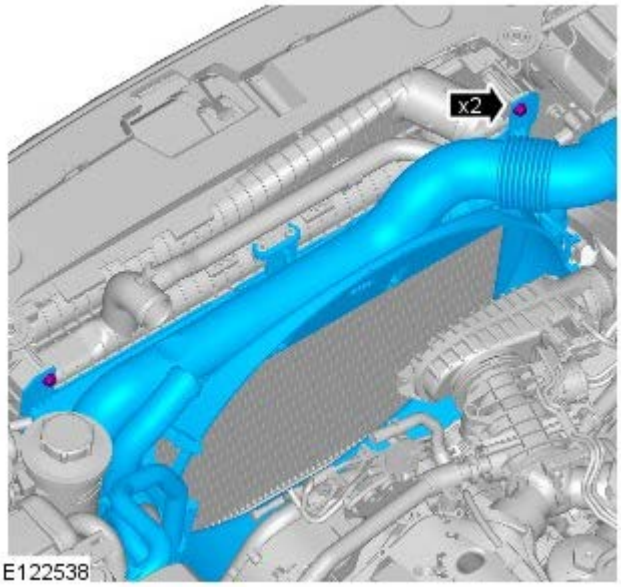
20.



21. *Torque:* 15 Nm

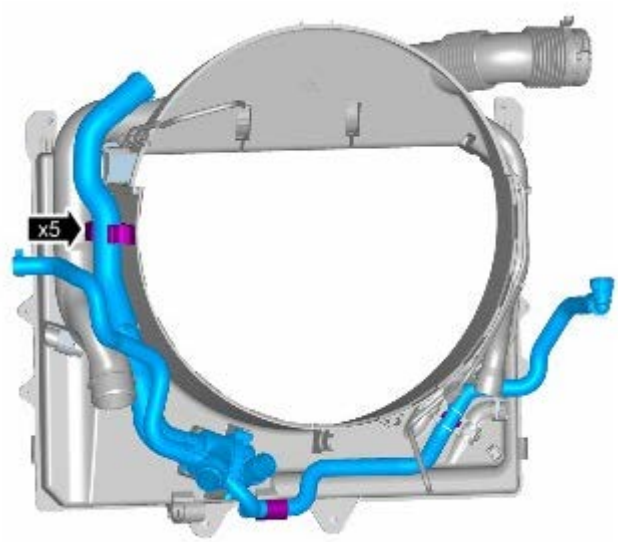


22. *Torque:* 15 Nm



E122538

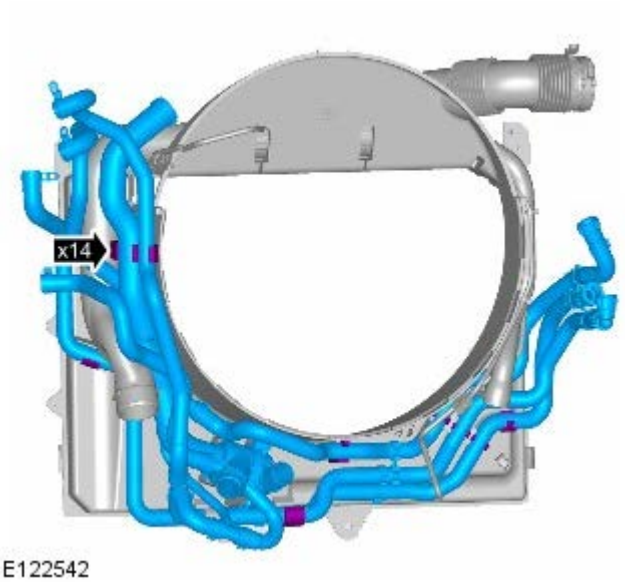
23. NOTE: Do not disassemble further if the component is removed for access only.



E122541

Vehicles with fuel fired booster heater

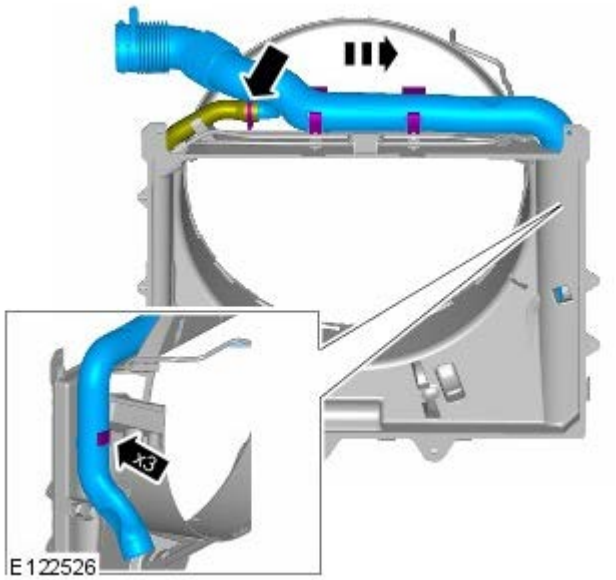
24.



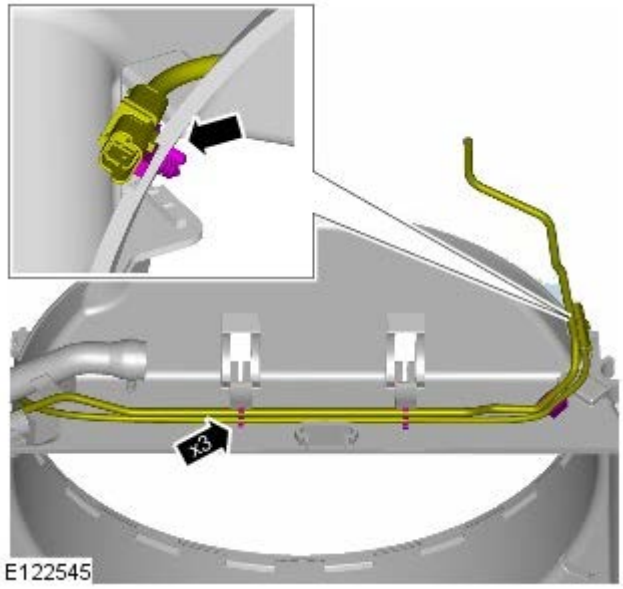
E122542

All vehicles

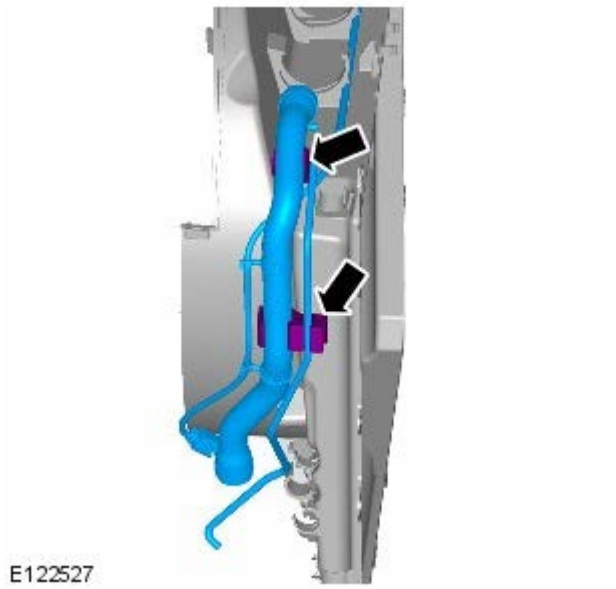
25.



26.



27.



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine Cooling - TDV6 3.0L Diesel - Radiator

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

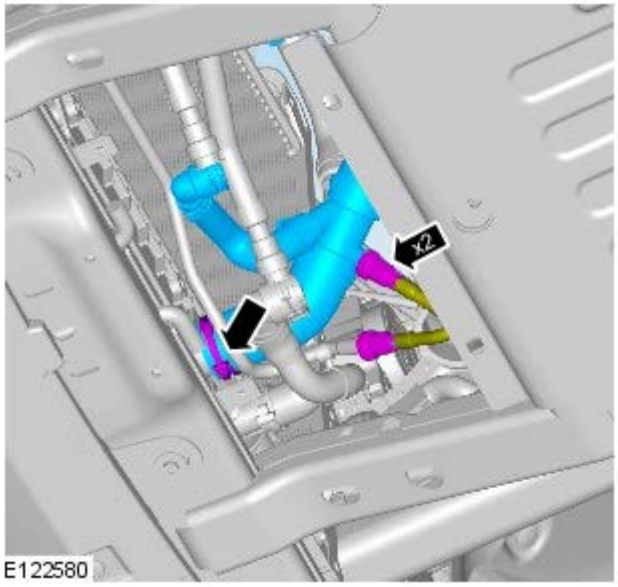
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

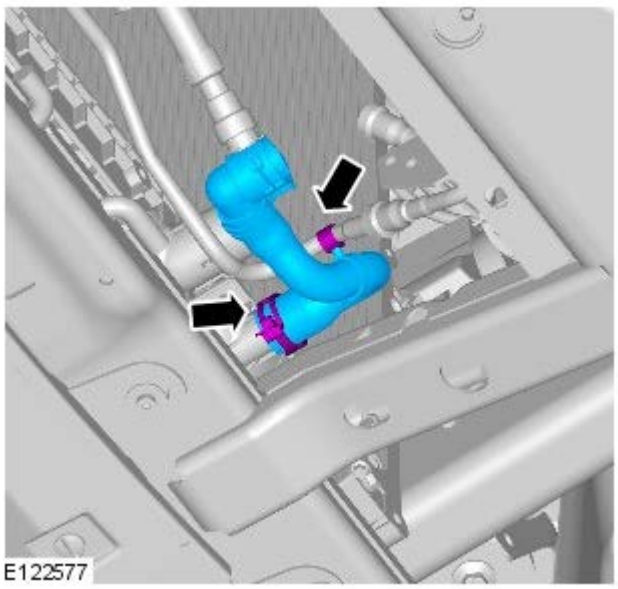
2. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).

3. Refer to: Cooling Fan Shroud (303-03, Removal and Installation).

4. Refer to: Radiator Grille (501-08, Removal and Installation).

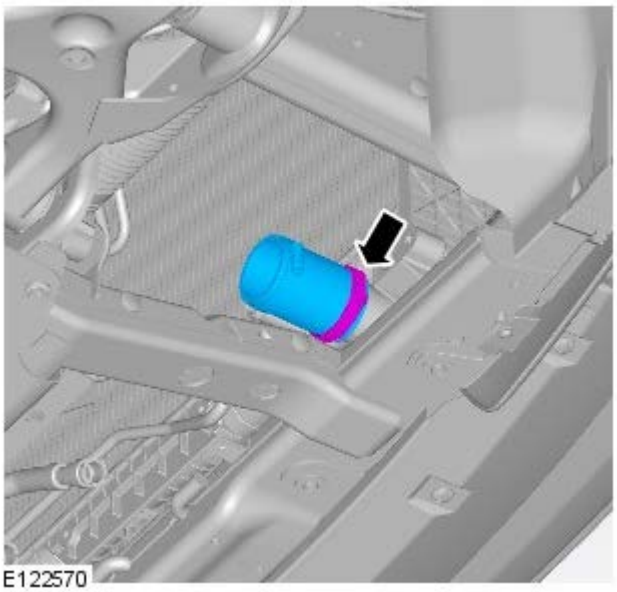


5. CAUTION: Be prepared to collect escaping coolant.

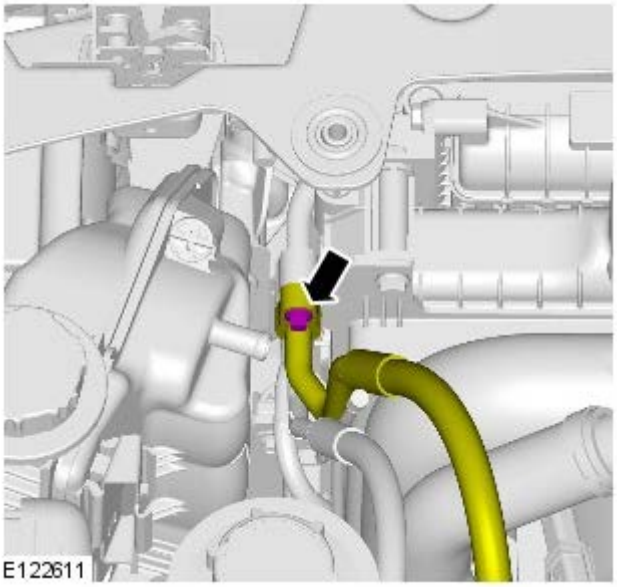


6. CAUTION: Be prepared to collect escaping coolant.

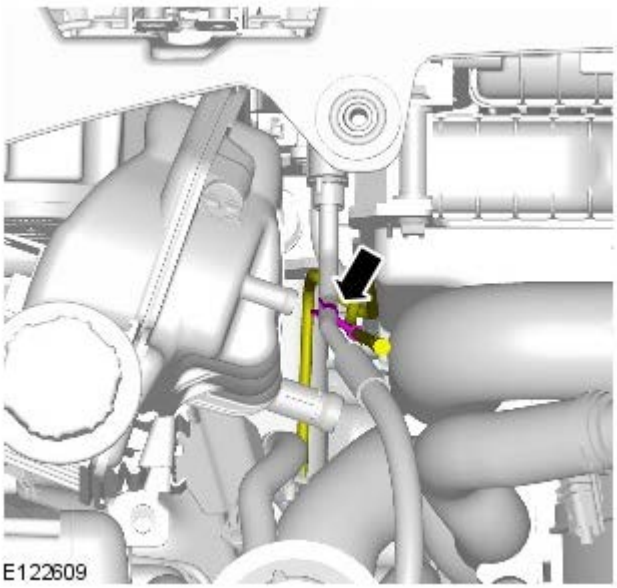
7.



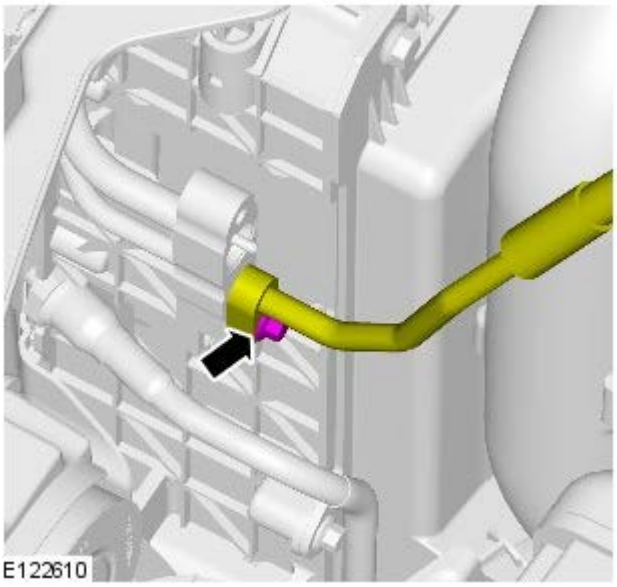
8. *Torque:* 6 Nm



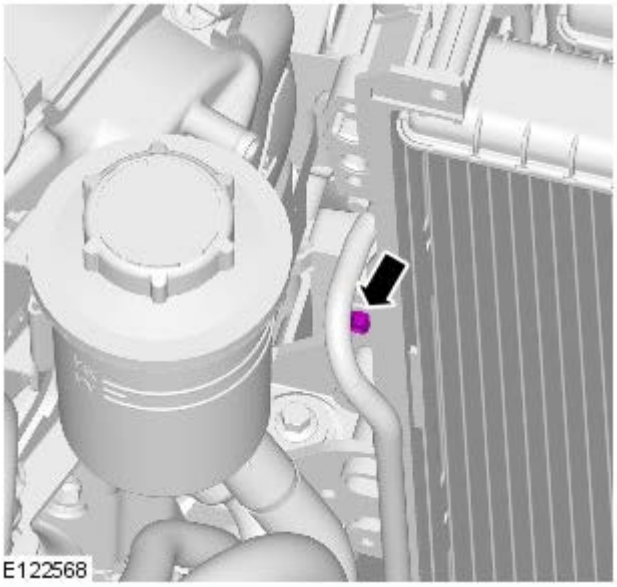
9.



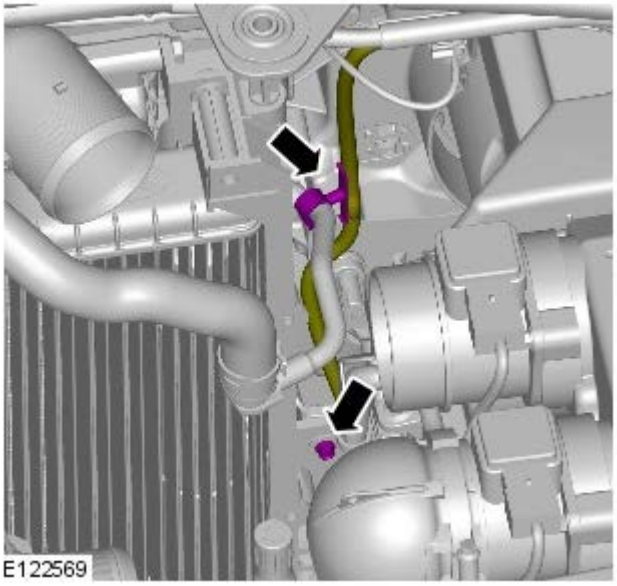
10. *Torque:* 6 Nm



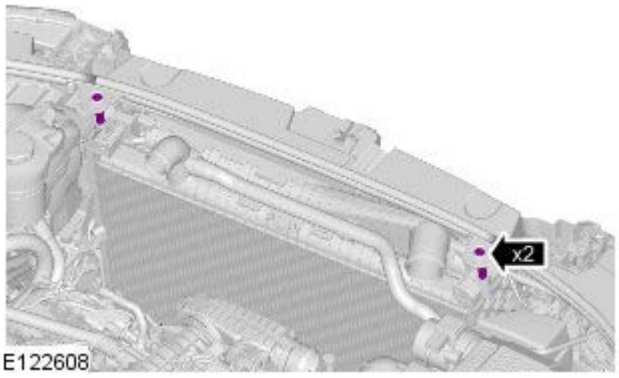
11. *Torque:* 5 Nm



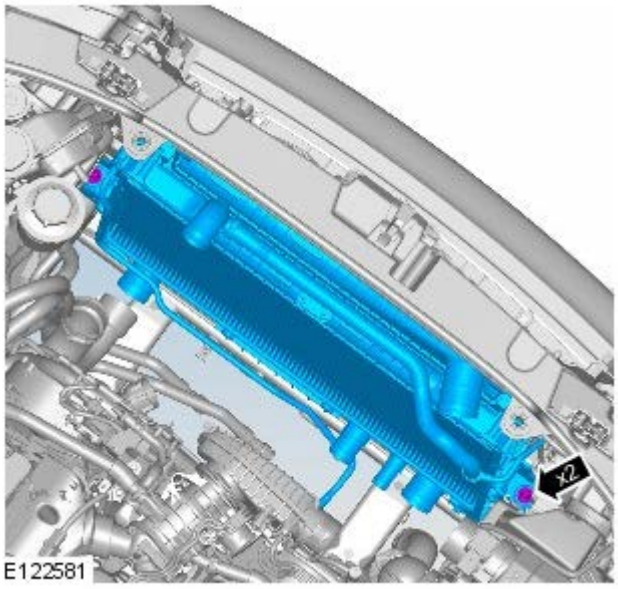
12. *Torque:* 5 Nm



13.



E122608

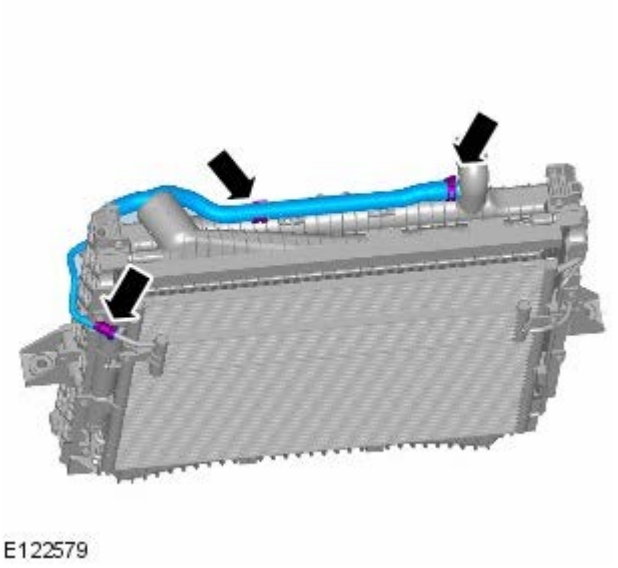


E122581

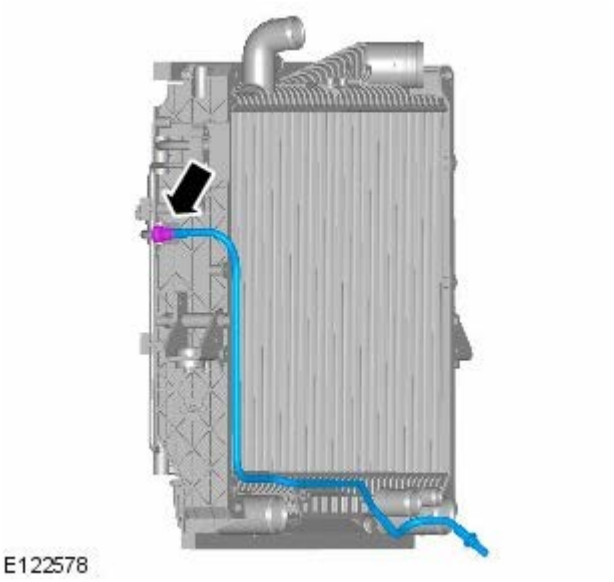
14. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

    Torque: 25 Nm

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

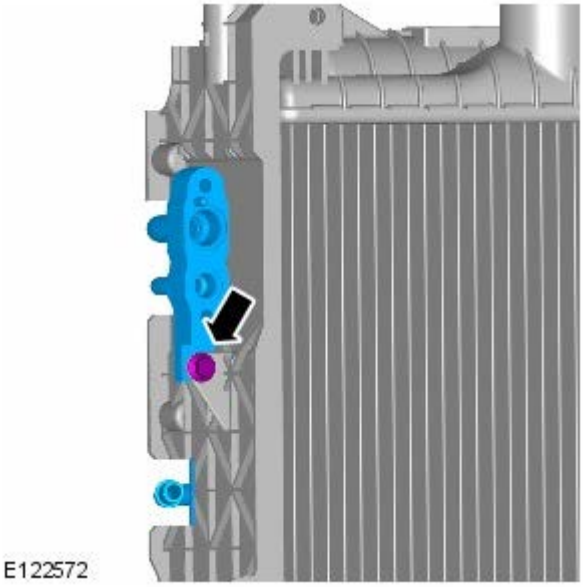

E122579

16.



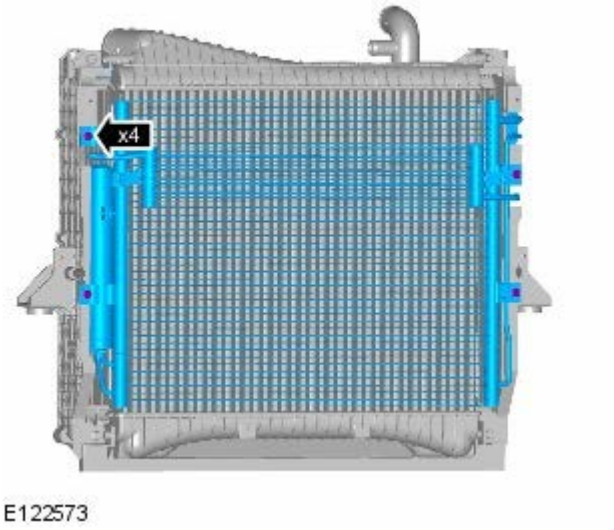
E122578

17. *Torque:* 5 Nm



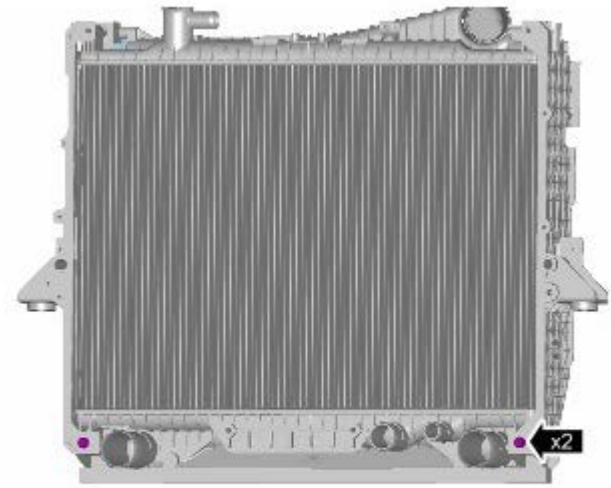
E122572

18. *Torque:* 5 Nm



E122573

19. *Torque:* 15 Nm



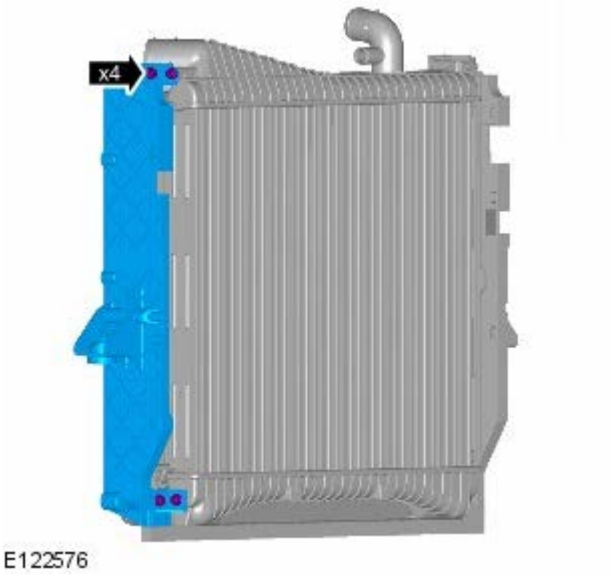
E122575

20. *Torque:* 15 Nm



E122574

21. *Torque:* 15 Nm



E122576

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine Cooling - TDV6 3.0L Diesel - Thermostat

Removal and Installation

Removal

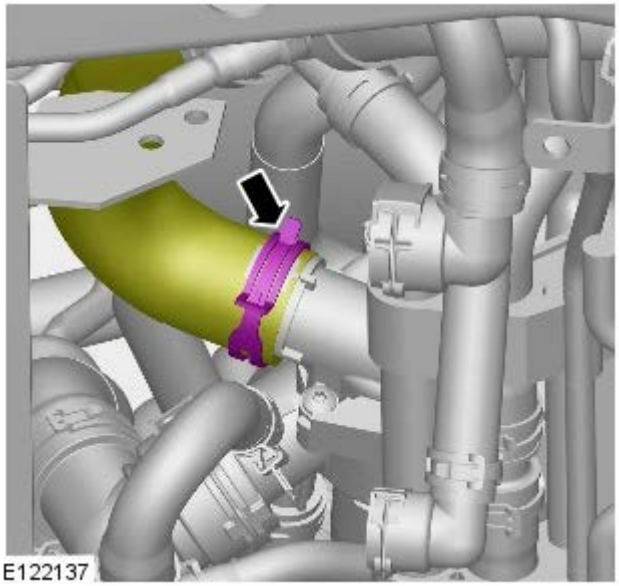
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

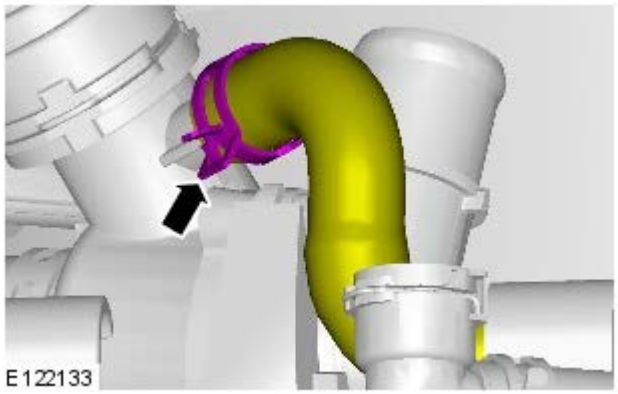
   Raise and support the vehicle.

2. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

3. Refer to: Transmission Fluid Cooler - 3.0L Diesel (307-02, Removal and Installation).

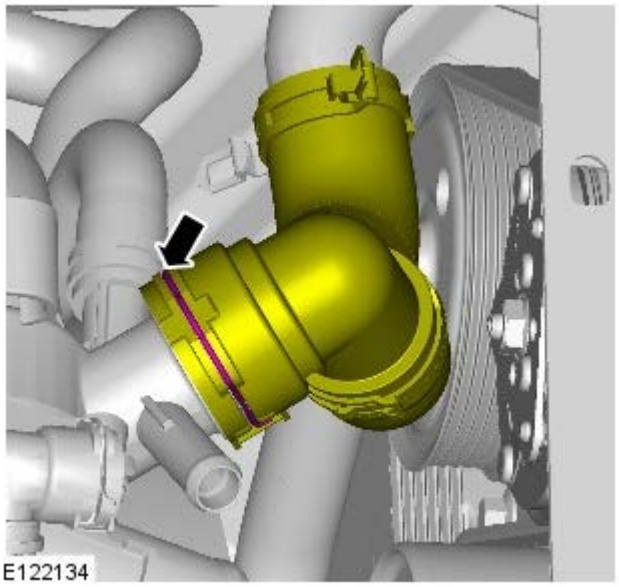


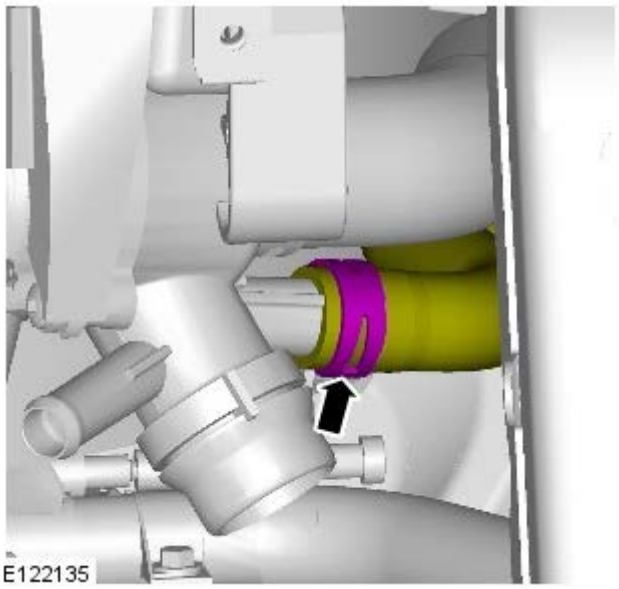
4. CAUTION: Be prepared to collect escaping coolant.



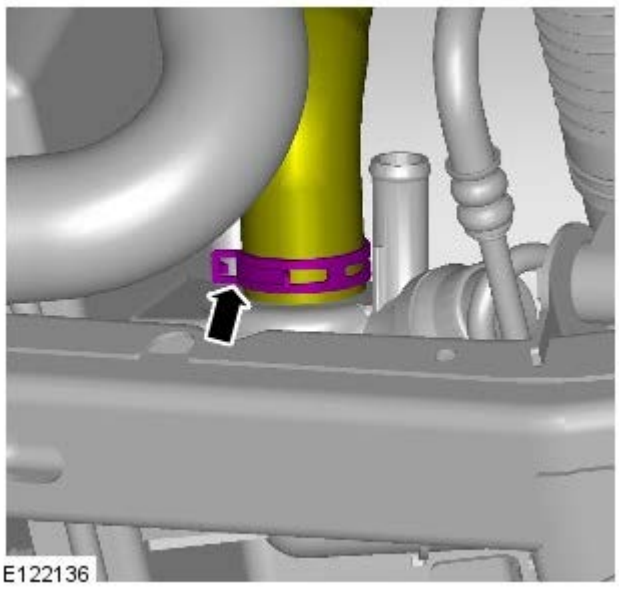
5. CAUTION: Be prepared to collect escaping coolant.

6. CAUTION: Be prepared to collect escaping coolant.



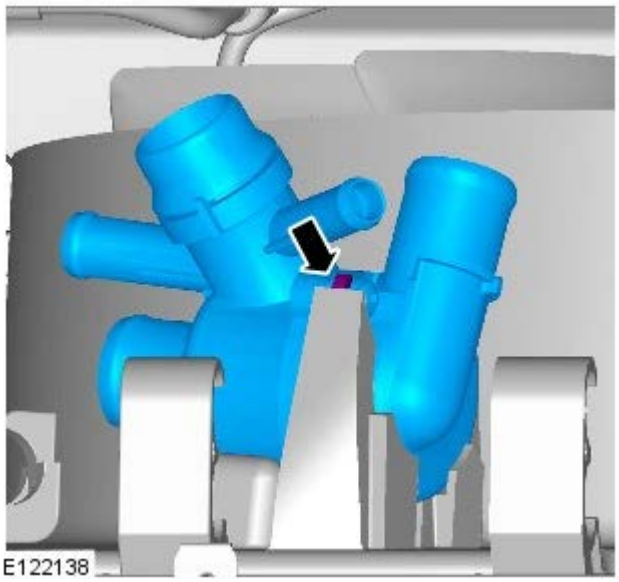


7. CAUTION: Be prepared to collect escaping coolant.

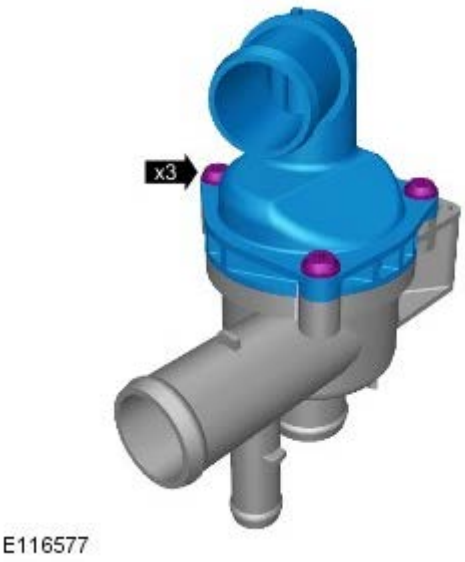


8. CAUTION: Be prepared to collect escaping coolant.

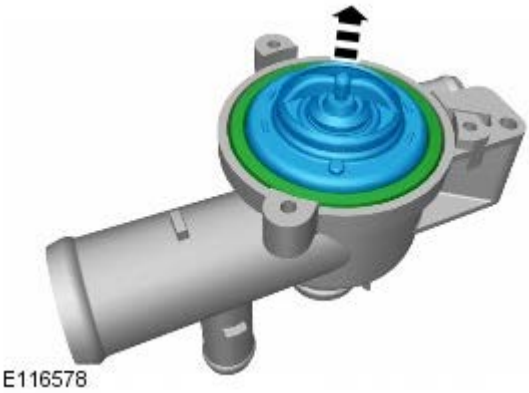
9.



10. *Torque:* 4 Nm



11. CAUTION: Discard the seal.



Installation

1. To install, reverse the removal procedure.

Published: 05-Jul-2011

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol -

Lubricants

Description	Specification
Anti-freeze	Havoline Extended Life Coolant (XLC)
Anti-freeze concentration	50%

Capacities

Item	Specification
Vehicles with supercharger	19.8L (dry capacity)
Vehicles without supercharger	15.9L (dry capacity)

Torque Specifications

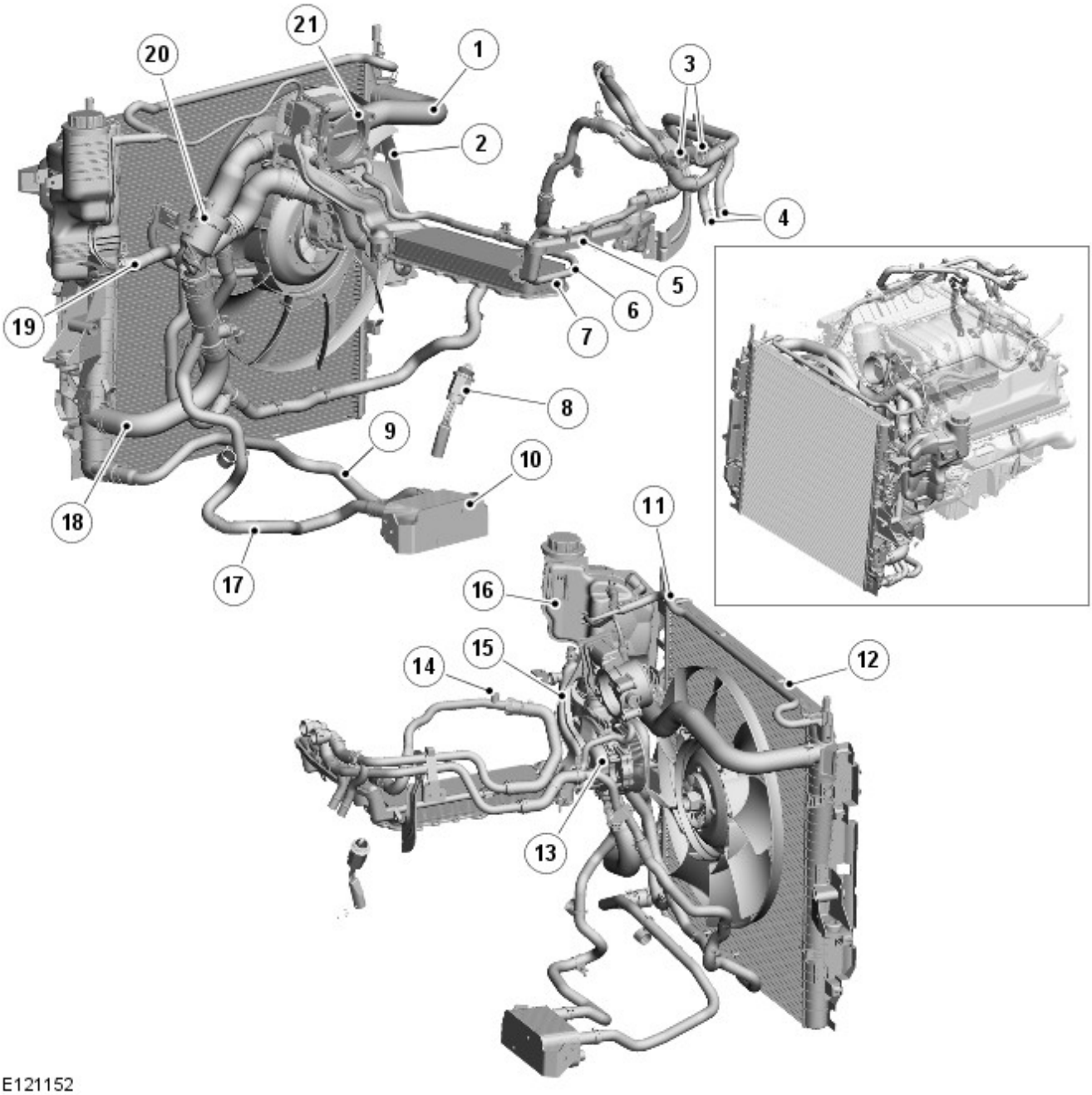
Description	Nm	lb-ft	lb-in
Coolant expansion tank retaining bolt	10	7	-
Cooling fan retaining nut	65	48	-
Thermostat housing retaining bolt	10	7	-
Coolant pump retaining bolts	12	9	-
Radiator air deflector retaining bolts	9	-	80
Refrigerant line to condenser core retaining bolts	10	7	-
Radiator retaining bolts	25	18	-
Condenser core to radiator bolts	10	7	-
Coolant bleed screw(s)	3	-	27

Published: 11-May-2011

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Engine Cooling

Description and Operation

COMPONENT LOCATION - NATURALLY ASPIRATED VEHICLES

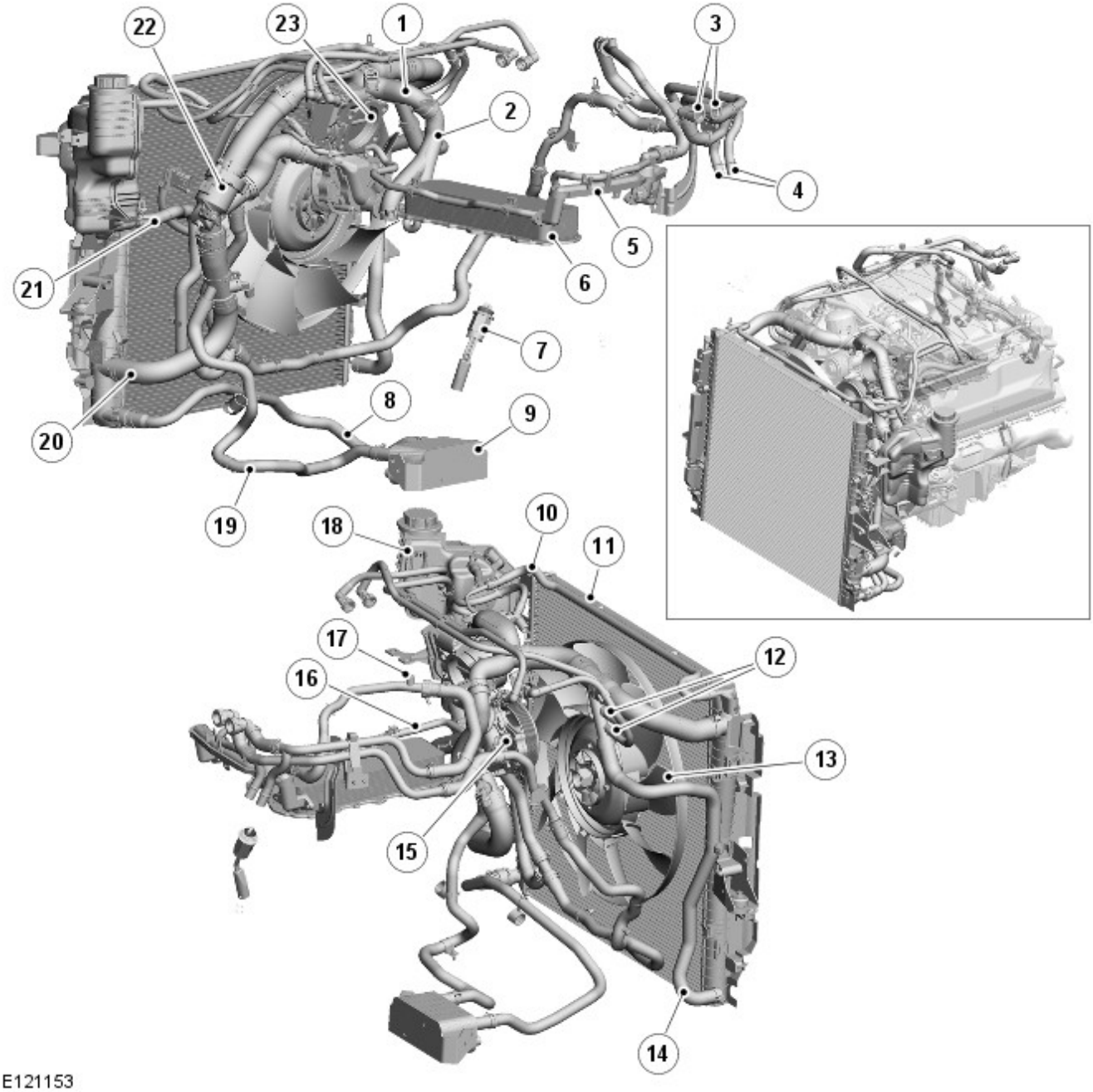


E121152

Item	Part Number	Description
1	-	Radiator upper hose
2	-	Cooling fan
3	-	Heater system supply and return hoses
4	-	FFBH (fuel fired booster heater) supply and return connections (where fitted)
5	-	Heater manifold
6	-	Throttle body heater hose
7	-	Engine oil cooler
8	-	Engine block heater (230 V version shown) or drain plug
9	-	Transmission fluid cooler supply hose
10	-	Transmission fluid cooler
11	-	Bleed hoses
12	-	Radiator
13	-	Coolant pump
14	-	Bleed screw
15	-	Outlet tube

16	-	Coolant expansion tank
17	-	Transmission fluid cooler return hose
18	-	Radiator lower hose
19	-	Coolant supply/expansion hose
20	-	Thermostat
21	-	Throttle

COMPONENT LOCATION - SUPERCHARGER VEHICLES



E121153

Item	Part Number	Description
1	-	Radiator upper hose
2	-	Outlet tube
3	-	Heater system supply and return hoses
4	-	FFBH (fuel fired booster heater) supply and return connections (where fitted)
5	-	Heater manifold
6	-	Engine oil cooler
7	-	Engine block heater (230 V version shown) or drain plug
8	-	Transmission fluid cooler supply hose
9	-	Transmission fluid cooler
10	-	Bleed hoses
11	-	Radiator
12	-	Charge air cooler return hose connections

13	-	Cooling fan
14	-	Charge air radiator supply hose
15	-	Coolant pump
16	-	Throttle body heater hose
17	-	Bleed screw
18	-	Coolant expansion tank
19	-	Transmission fluid cooler return hose
20	-	Radiator lower hose
21	-	Coolant supply/expansion hose
22	-	Thermostat
23	-	Throttle

INTRODUCTION

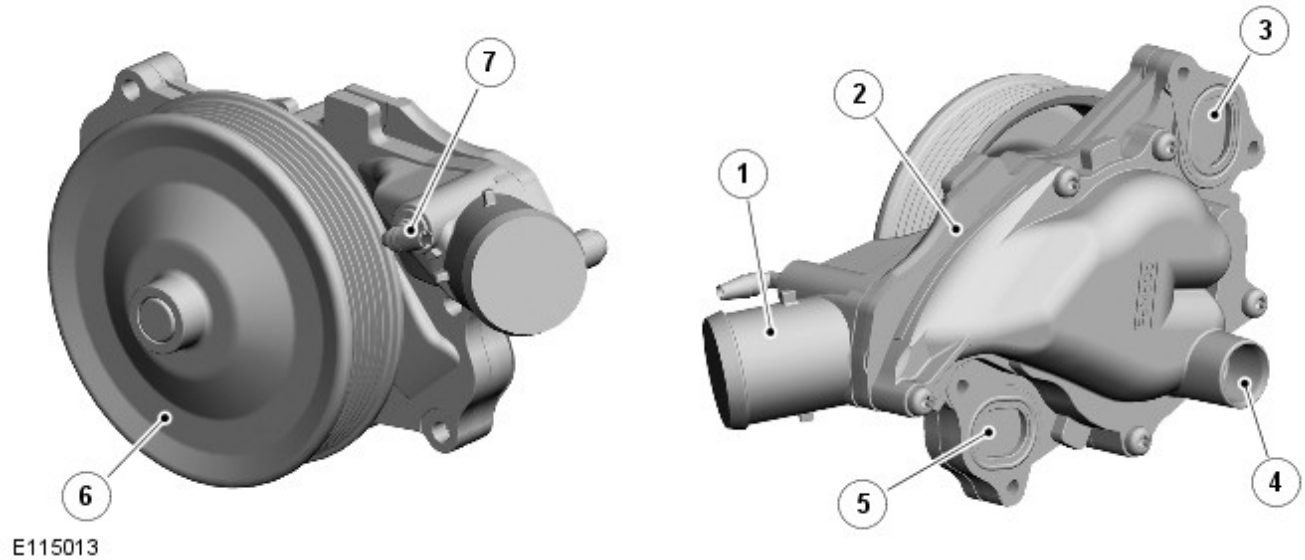
The engine cooling system maintains the engine within an optimum temperature range under changing ambient and engine operating conditions. The system is a pressurized expansion tank system with continuous bleeds to separate air from the coolant and prevent the formation of air locks. The engine cooling system also provides:

- Heating for:
  - The passenger compartment.
  - The throttle body.
- Cooling for:
  - The engine oil cooler.
  - The transmission fluid cooler.

The primary components of the engine cooling system are the:

- Coolant pump.
- Thermostat.
- Radiator.
- Cooling fan.
- Expansion tank.
- Outlet tube and heater manifold.
- Connecting hoses and pipes.

COOLANT PUMP



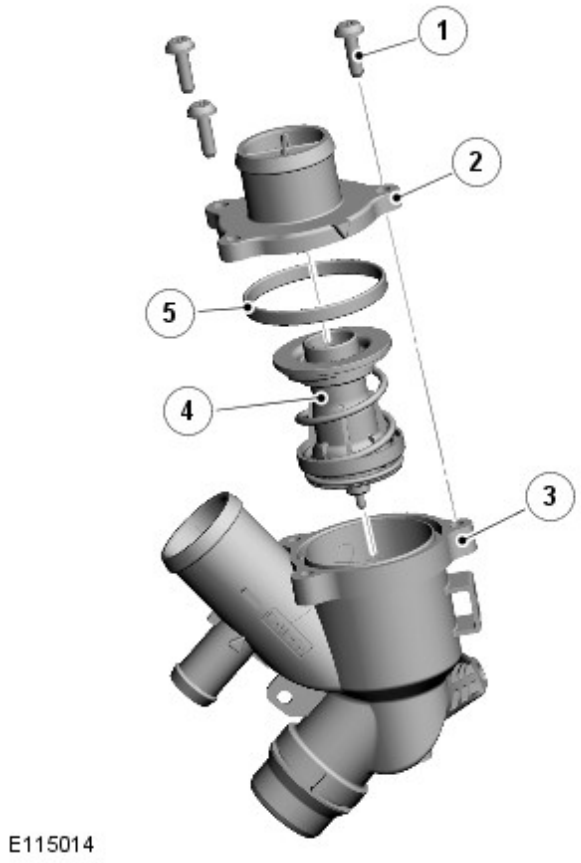
Item	Part Number	Description
1	-	Inlet connection
2	-	Pump body
3	-	Outlet flange to RH cylinder head
4	-	Outlet to engine oil cooler
5	-	Outlet flange to LH cylinder head
6	-	Pulley
7	-	Bleed pipe connection (containing check valve)

The body of the coolant pump contains an impeller attached to a shaft supported in a bearing assembly. The impeller is driven by a pulley, pressed on to the front of the shaft, which is driven by the accessory drive belt. For additional information, refer to:

Accessory Drive (303-05 Accessory Drive - 5.0L, Vehicles Without: Supercharger, Description and Operation), Accessory Drive (303-05 Accessory Drive - 5.0L, Vehicles With: Supercharger, Description and Operation).

Two coolant outlet flanges attach the coolant pump to the front of the cylinder heads. A pipe connects a further coolant outlet to a pipe from the engine oil cooler. A bleed connector is installed in the front of the coolant pump, adjacent to the coolant inlet connection from the thermostat. A check valve is incorporated into the bleed connection.

THERMOSTAT



E115014

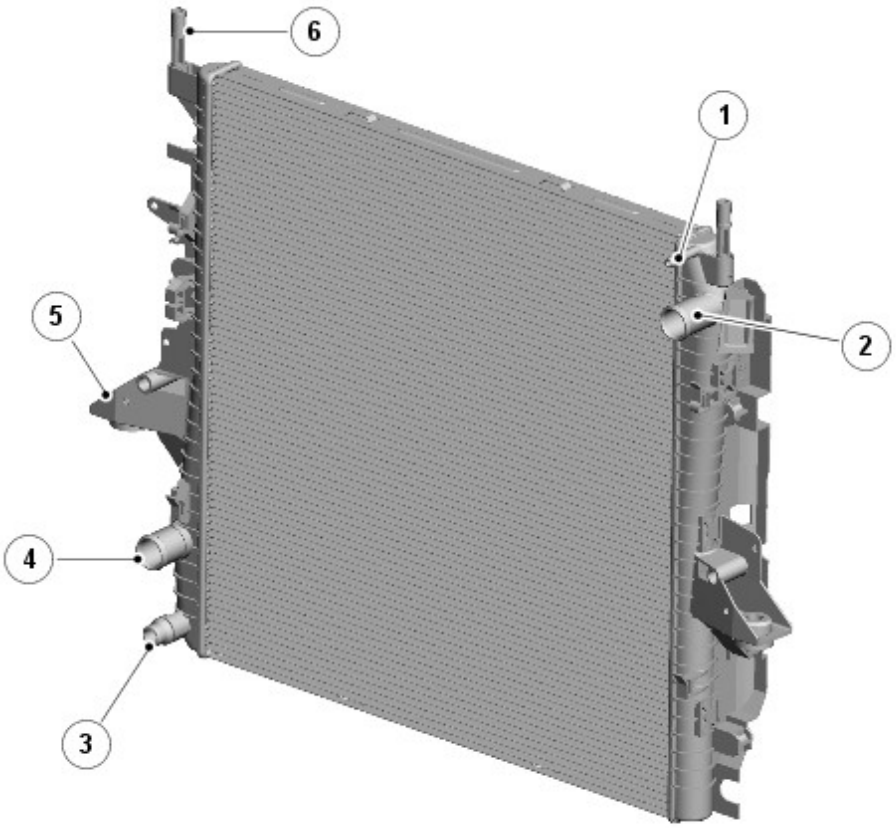
Item	Part Number	Description
1	-	Screw (3 off)
2	-	Lower body
3	-	Upper body
4	-	Thermostat
5	-	Seal

The thermostat is a multi-stage device located in the coolant pump inlet to provide fast response and control of the engine outlet temperature.

The thermostat allows rapid engine warm-up by preventing coolant flow through the radiator and by limiting coolant flow through the cylinder block when the engine is cold. During warm-up and at engines speeds above approximately 1800 rev/min, a by-pass valve opens to control the coolant flow and pressure, to protect the engine components. When the thermostat opening reaches 6 mm (0.24 in.), the by-pass flow is shut-off. When the thermostat opening exceeds 6 mm (0.24 in.), the radiator coolant flow is further controlled up to the point where the thermostat is fully open. At this point maximum radiator coolant flow is achieved to provide maximum cooling.

On both naturally aspirated and supercharger vehicles, the thermostat begins to open at 88 - 90 °C (190 - 194 °F) and is fully open at 102 °C (216 °F).

RADIATOR



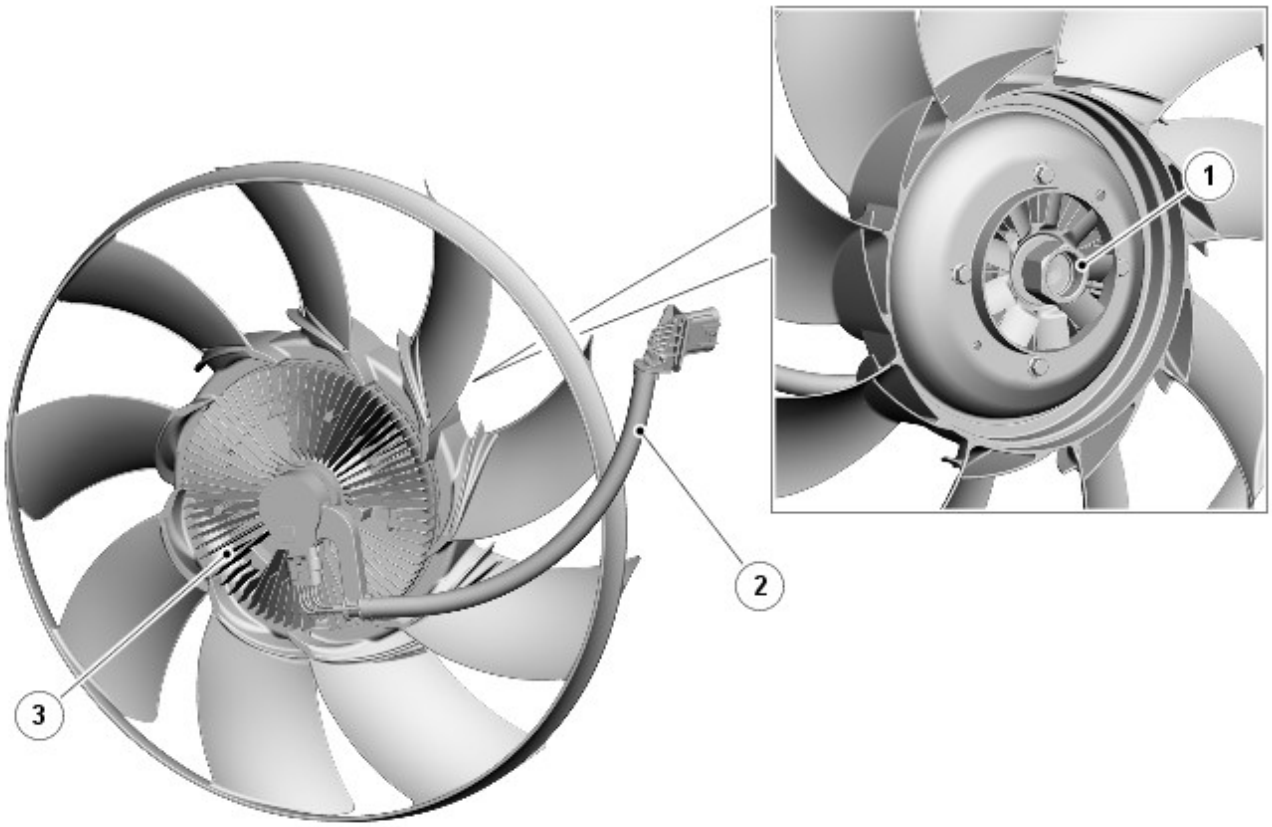
E121154

Item	Part Number	Description
1	-	Bleed hose connection
2	-	Upper hose connection
3	-	Transmission fluid cooler supply hose connection
4	-	Lower hose connection
5	-	Radiator lower support (2 off)
6	-	Radiator upper support (2 off)

The radiator is an aluminum cross flow type with plastic end tanks. Upper and lower supports locate the radiator in the radiator support assembly and the front crush siderails respectively.

Connections are incorporated into the end tanks for the upper and lower hoses, the supply hose of the transmission fluid cooler and a bleed hose.

COOLING FAN



E118879

Item	Part Number	Description
1	-	Securing nut
2	-	Harness
3	-	Electro-viscous drive unit

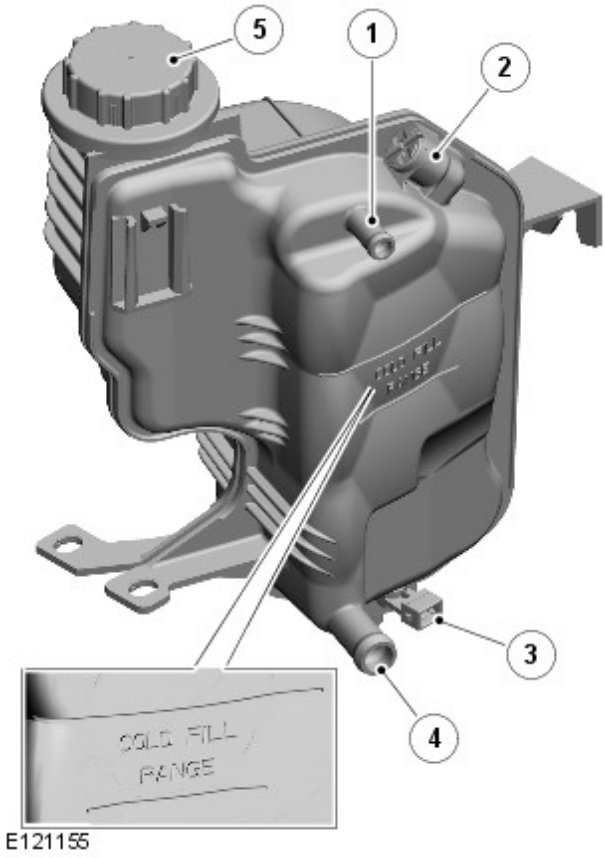
For additional airflow through the radiator, particularly when the vehicle is stationary or moving slowly, there is an engine driven electro-viscous cooling fan. The cooling fan functions as a normal viscous fan, but with electronic control over the level of engagement of the viscous clutch. The ECM (engine control module) controls the level of engagement to optimize fan speed for all operating conditions.

A securing nut attaches the cooling fan to a drive pulley, which is mounted on the front of the engine and driven by the accessory drive system.

NOTE: On naturally aspirated engines the securing nut has a LH (left-hand) thread; on SC (supercharger) engines the securing nut has a RH (right-hand) thread.

The blades of the cooling fan are located in a fan cowl attached to the rear of the radiator frame. Brushes around the circumference of the aperture in the fan cowl provide a seal with the blade shroud. An electrical connector in the top left corner of the fan cowl provides the interface between the cooling fan harness and the vehicle wiring.

EXPANSION TANK



E121155

Item	Part Number	Description
1	-	Bleed hose connection
2	-	Bleed screw
3	-	Level sensor
4	-	Coolant supply/expansion hose connection
5	-	Filler cap

The expansion tank is installed on the LH side of the cooling module, attached to the radiator support assembly and the floor sidemember. A filler cap, bleed screw and level sensor are incorporated into the expansion tank. MAX and MIN level markings are molded onto the exterior of the tank.

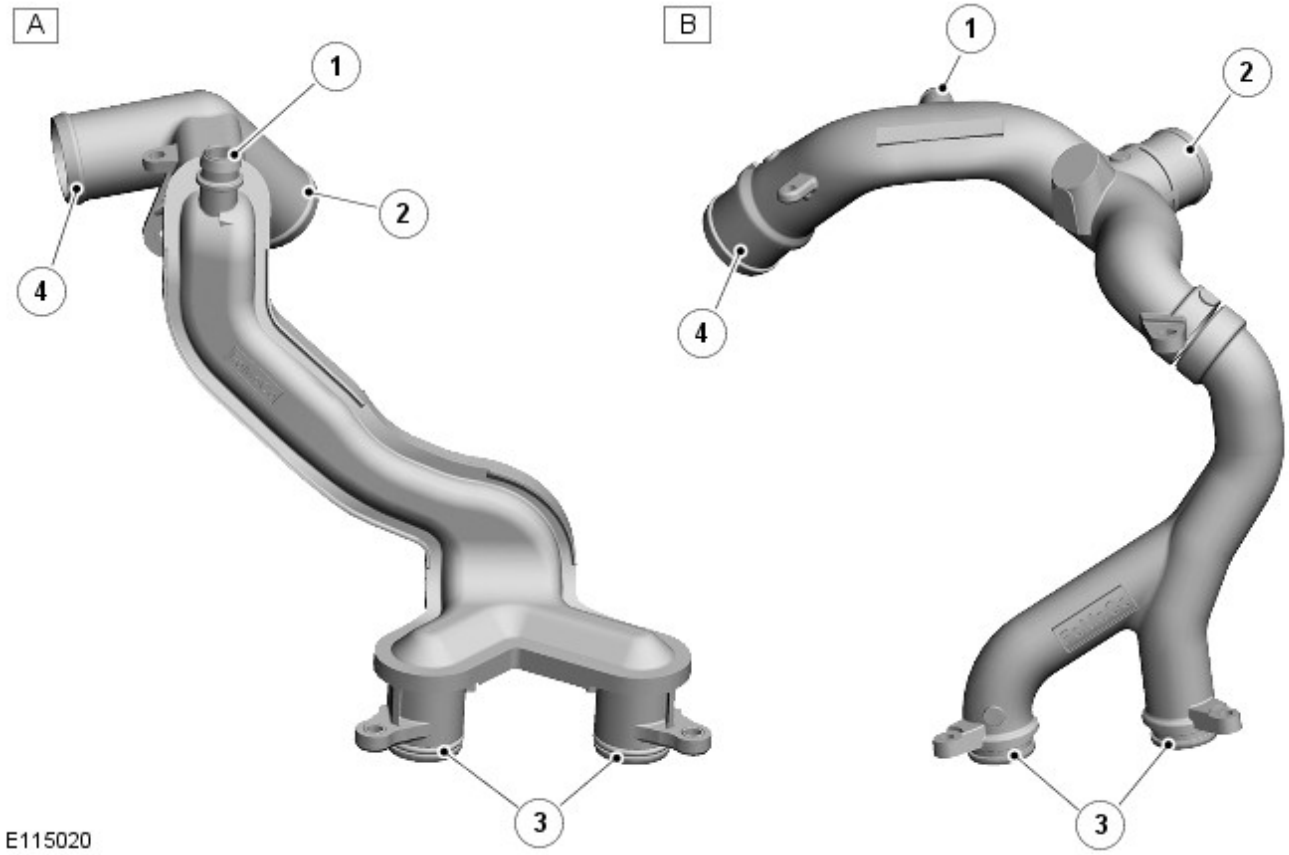
The expansion tank provides the following functions:

- Service fill.
- Coolant expansion during warm-up.
- Air separation during operation.
- System pressurization by the filler cap.

The expansion tank has an air space of approximately 1.1 liters (1.16 US quarts), above the MAX level, to allow for coolant expansion.

OUTLET TUBE AND HEATER MANIFOLD

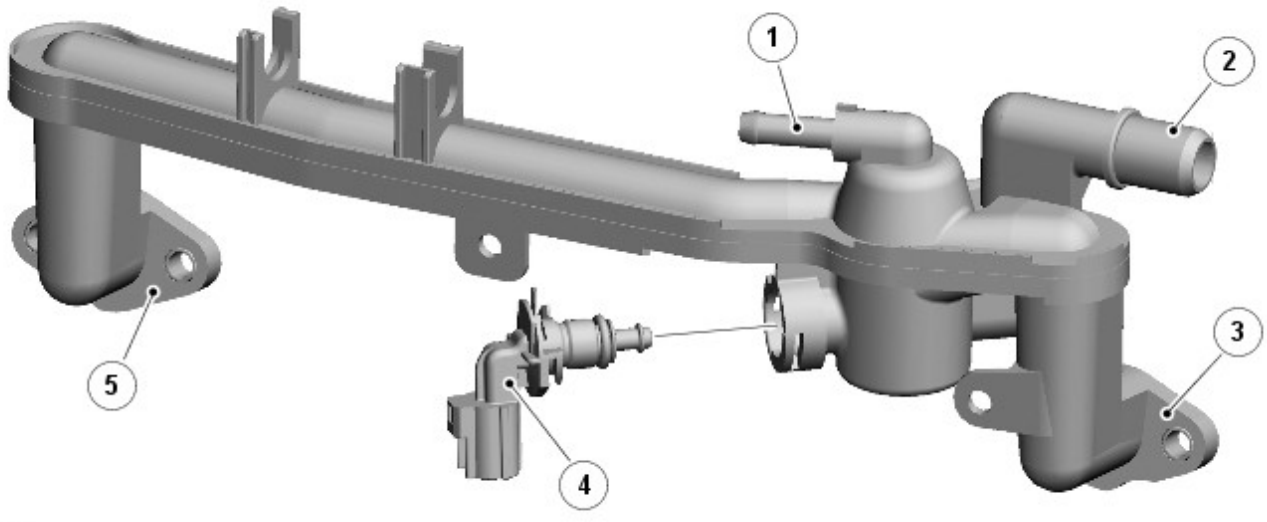
Outlet Tube



E115020

Item	Part Number	Description
A	-	Outlet tube on naturally aspirated vehicles
B	-	Outlet tube on supercharger vehicles
1	-	Bleed spigot (fitted with blanking plug)
2	-	Radiator upper hose connection
3	-	Cylinder block connections
4	-	Thermostat hose connection

Heater Manifold



E115021

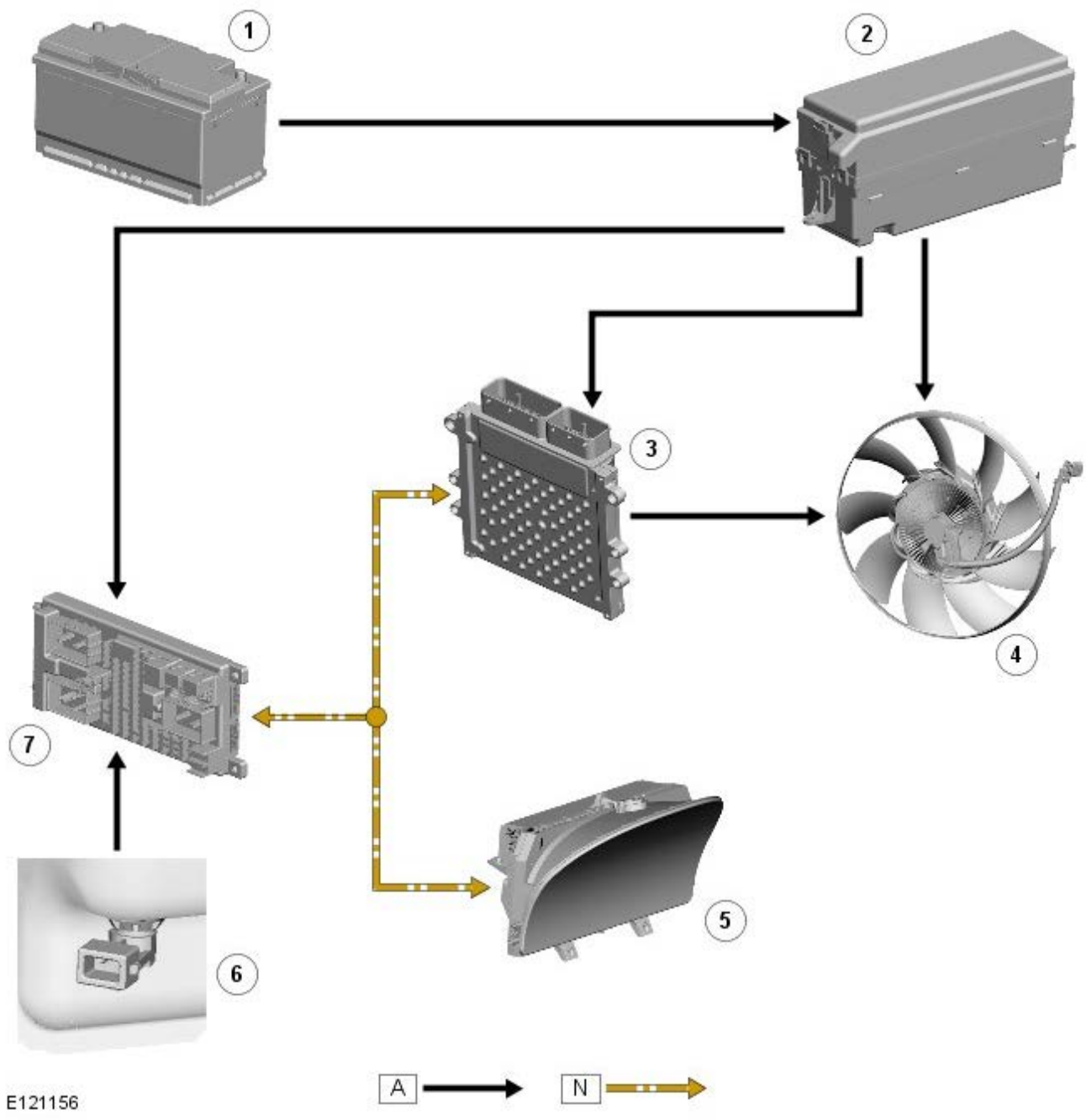
Item	Part Number	Description
1	-	Throttle body heater hose connection
2	-	Heater core supply hose connection
3	-	RH cylinder head connection
4	-	Engine coolant temperature sensor
5	-	LH cylinder head connection

ENGINE COOLANT

The engine coolant is formulated to last for ten years or 240,000 km (150,000 miles). The coolant is silicate free and must not be mixed with conventional engine coolant.

CONTROL DIAGRAM

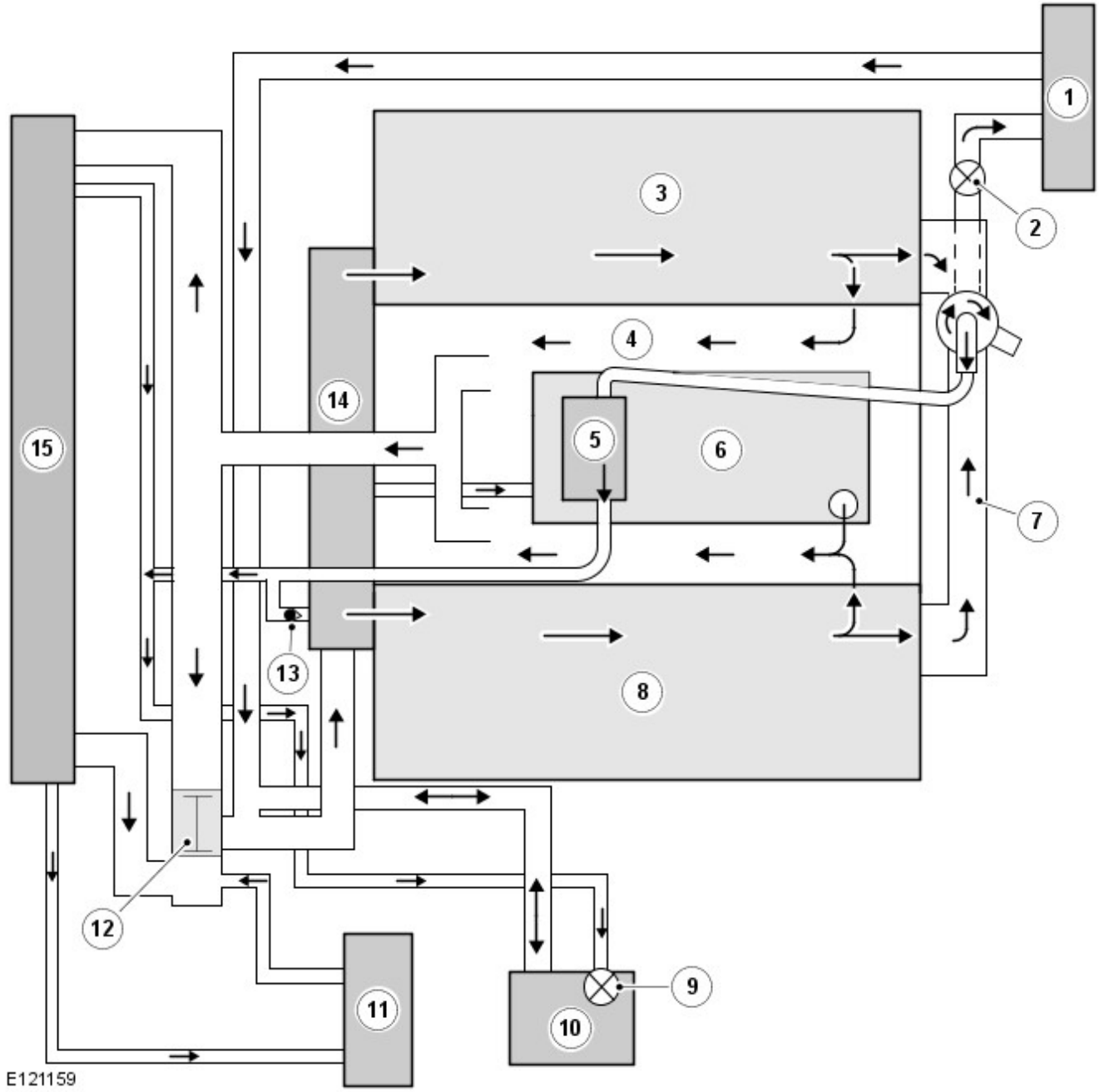
NOTE: A = Hardwired; N = Medium speed CAN (controller area network).



Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	ECM (engine control module)
4	-	Cooling fan
5	-	Instrument cluster
6	-	Coolant level sensor
7	-	CJB (central junction box)

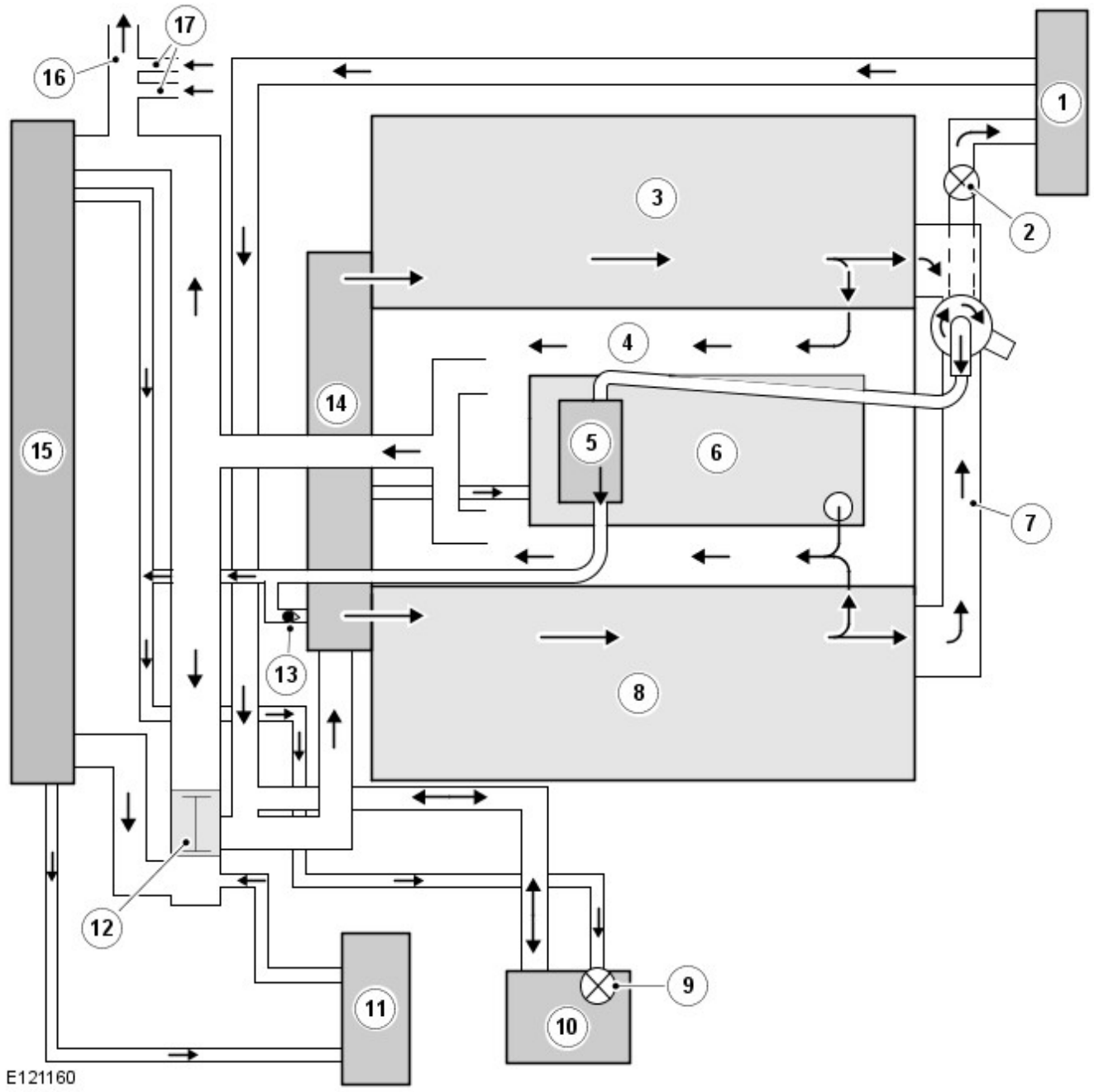
OPERATION

Engine Cooling Flow Diagram - Naturally Aspirated Vehicles



Item	Part Number	Description
1	-	Heater system
2	-	Bleed screw
3	-	RH cylinder head
4	-	Cylinder block
5	-	Throttle
6	-	Engine oil cooler
7	-	Heater manifold
8	-	LH cylinder head
9	-	Bleed screw
10	-	Expansion tank
11	-	Transmission fluid cooler
12	-	Thermostat
13	-	Check valve
14	-	Coolant pump
15	-	Radiator

Engine Cooling Flow Diagram - Supercharger Vehicles



Item	Part Number	Description
1	-	Heater system
2	-	Bleed screw
3	-	RH cylinder head
4	-	Cylinder block
5	-	Throttle
6	-	Engine oil cooler
7	-	Heater manifold
8	-	LH cylinder head
9	-	Bleed screw
10	-	Expansion tank
11	-	Transmission fluid cooler
12	-	Thermostat
13	-	Check valve
14	-	Coolant pump
15	-	Radiator
16	-	Charge air radiator supply hose connection
17	-	Charge air cooler return hose connections

When the engine is running, the coolant is circulated around the engine cooling system by the coolant pump. From the coolant pump, coolant flows through the cylinder heads and the engine oil cooler into the cylinder block and the heater manifold.

In the cylinder block, the coolant flows forwards to the outlet tube. When the coolant is cold, the thermostat is closed

and the coolant flows direct from the outlet tube back to the coolant pump. Once the coolant reaches operating temperature the thermostat begins to open, to control system temperature, and coolant flows from the outlet tube to the coolant pump via the radiator. When the thermostat is open, the coolant flow through the radiator also generates a coolant flow through the transmission fluid cooler.

From the heater manifold the coolant flows through the electronic throttle and the heater core, in parallel circuits that are unaffected by the position of the thermostat. From the electronic throttle, the coolant merges with bleed coolant from the coolant pump and flows to the expansion tank. From the heater system, the coolant flows back to the inlet of the coolant pump.

Expansion and contraction of the coolant is accommodated by an air space in the expansion tank and the compliance of the flexible hoses.

If the coolant level in the expansion tank decreases below a predetermined value, the coolant level sensor connects a ground to the CJB (central junction box), which sends a message to the instrument cluster on the medium speed CAN bus to display the message COOLANT LEVEL LOW in the message center.
For additional information, refer to: Information and Message Center (413-08 Information and Message Center, Description and Operation).

To control the cooling fan, the ECM sends a PWM (pulse width modulation) signal to the cooling fan drive unit. The ECM varies the duty cycle of the PWM signal between 0 and 100% to vary the clutch engagement and thus fan speed. The ECM determines the required fan speed from:

- Coolant, ambient air and transmission fluid temperatures
- A/C (air conditioning) system condenser cooling fan demand
- Road speed
- Terrain optimization mode.

If the electrical connections to the viscous fan are disconnected the fan will idle and the engine may overheat. If the ECM detects a cooling fan fault it stores the appropriate DTC (diagnostic trouble code) and signals the instrument cluster on the medium speed CAN bus to display the message COOLING SYSTEM FAULT MONITOR GAUGE in the message center.

Published: 07-Aug-2012

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Engine Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the engine cooling system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Engine Cooling (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Coolant leaks • Coolant hoses • Coolant expansion tank • Radiator • Heater core • Accessory drive belt • Viscous fan	• Fuses • Harnesses • 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 the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Coolant loss	• Hoses • Hose connections • Radiator • Water pump • Heater core • Gaskets • Engine casting cracks • Engine block core plugs	• Carry out a visual inspection. If there are no obvious leaks, carry out a cooling system pressure test. Rectify any leaks as necessary
Overheating	• Low/contaminated coolant • Thermostat • Viscous fan • ECT sensor • Restricted air flow over the radiator	• Check the coolant level and condition. Carry out a cooling system pressure test. Rectify any leaks as necessary • Test the thermostat and rectify as necessary • Test the viscous fan operation, make sure the viscous fan rotates freely. Rectify as necessary • Check for obstructions to the air flow over the radiator. Rectify as necessary
Engine not reaching normal temperature	• Thermostat • Viscous fan • Thermostat • Electric fan • Fan speed module	• Test the thermostat and rectify as necessary • Test the viscous fan operation, make sure the viscous fan rotates freely

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 30-Sep-2013

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Cooling System Draining and Vacuum Filling

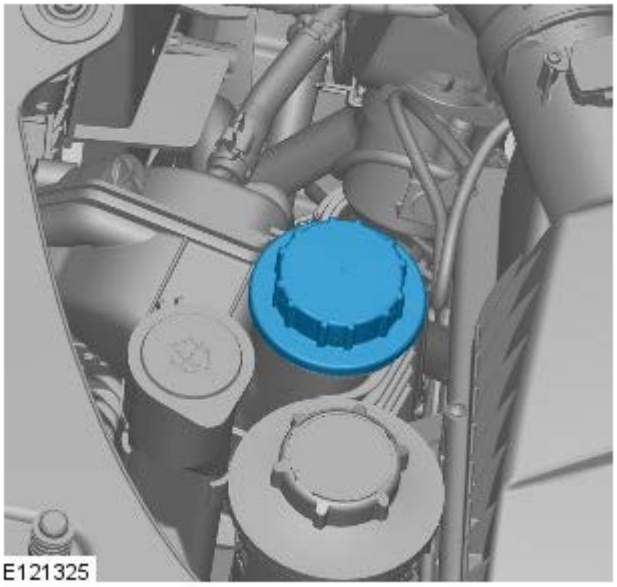
General Procedures

Draining

1. Refer to: Engine Cover - V8 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

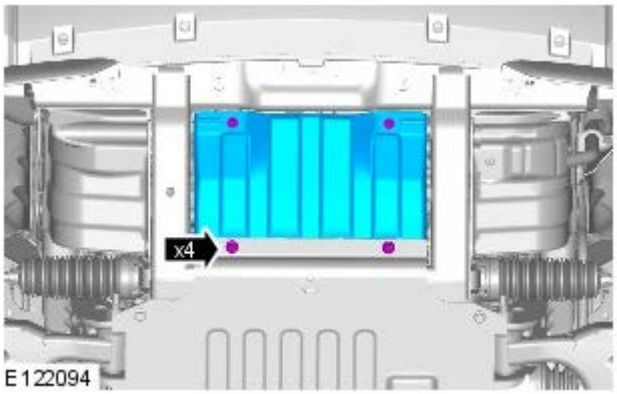


3. WARNING: Release the cooling system pressure by slowly turning the coolant expansion tank cap a quarter of a turn. Cover the expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow this instruction may result in personal injury.

   CAUTIONS:

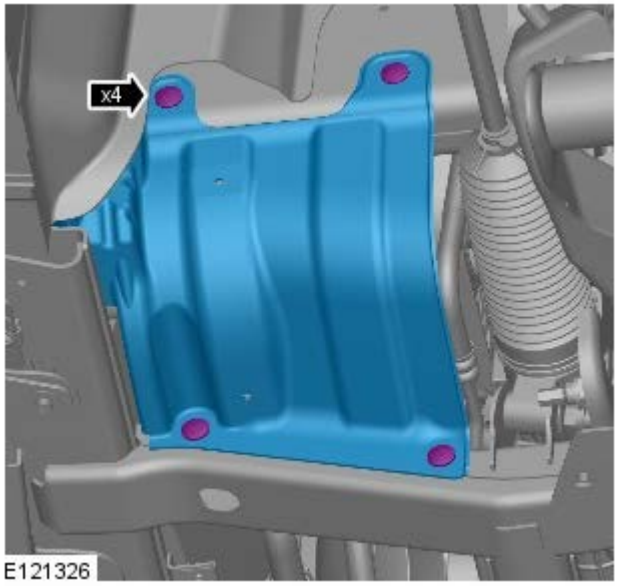
   Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure

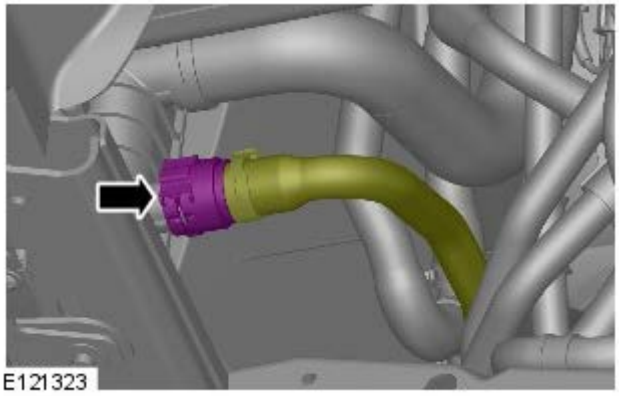
   Be prepared to collect escaping coolant.



4. Remove the 4 bolts.

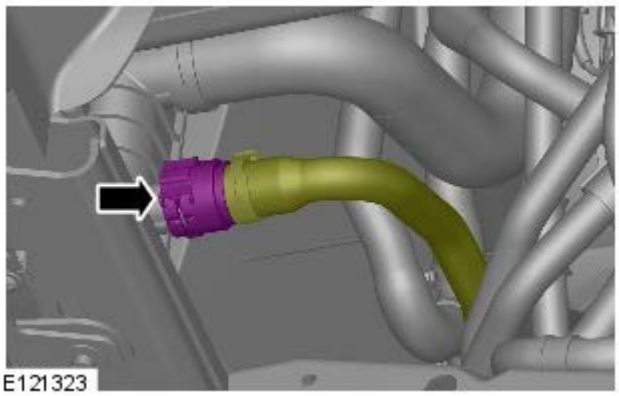
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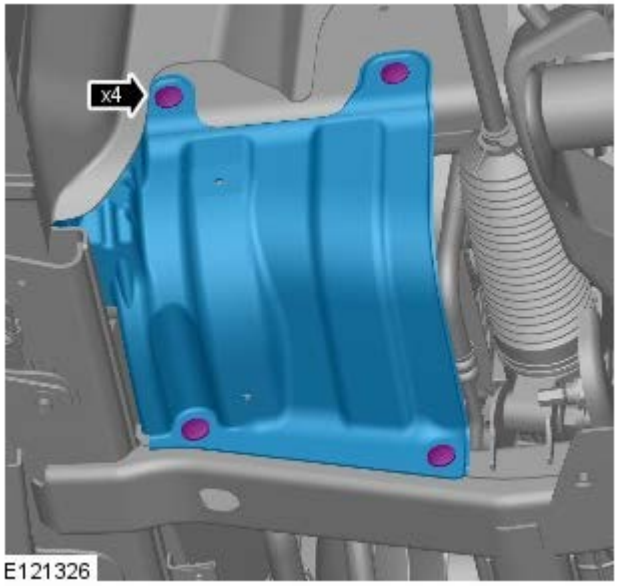
6. CAUTION: Be prepared to collect escaping coolant.

   Position a container to collect the fluid.

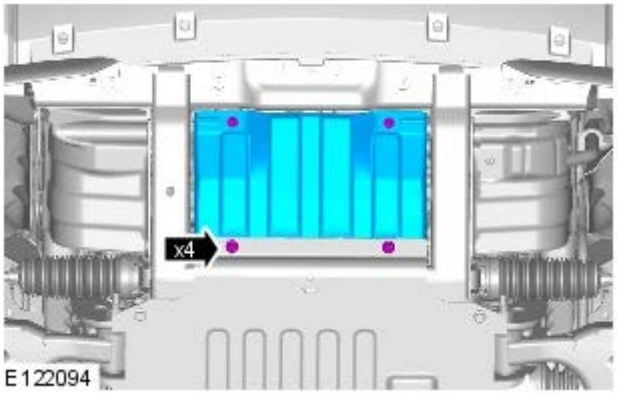


7. Install the lower coolant hose to the radiator.

8. Install the LH splash shield.



9. *Torque:* 10 Nm



Filling

1. Lower the vehicle.

2. CAUTION: Anti-freeze concentration must be maintained at 50%.

   - Install the cooling system vacuum refill adaptor to the expansion tank.
   - Install the vacuum filler gauge to the cooling system vacuum refill adaptor.
   - Install the venturi tube assembly to the vacuum filler gauge.

3. NOTES:

   Make sure the coolant supply valve is in the closed position on the vacuum filler gauge assembly.

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

   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.

4. Position the evacuated air hose into a container.

5. Open the air supply valve.

6. NOTE: Make sure the coolant supply hose is positioned into a container of fifty percent mixture of Land Rover Premium Cooling System Fluid or equivalent, meeting Land Rover specification Halvoline XLC and fifty percent water. Make sure no air can enter the supply hose.

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

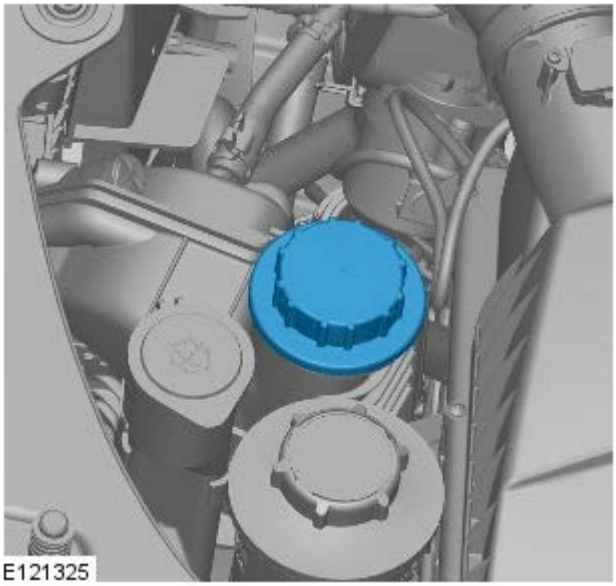
7. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.

8. Disconnect the compressed air supply line.

9. 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.

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



11. CAUTION: Correct installation of the Coolant expansion tank cap can be obtained by tightening the cap until an audible click is heard.

12. Set the heater controls to maximum.

13. 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 emited at the face registers.

14. Switch the heater off.

15. Raise the engine speed to 2000 RPM for eight minutes.

16. CAUTION: Switch off the engine and allow the coolant temperature to go cold.

    Switch the engine off.

17. Visually check the engine and cooling system for signs of coolant leakage.

18. WARNING: When releasing the cooling system pressure,

cover the coolant expansion tank cap with a thick cloth.

CAUTIONS:

 Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure

 Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

 NOTE: When the cooling system is warm, the coolant will be approximately 10mm above the upper level mark on the expansion tank with the cap removed.

Check and top-up the coolant if required.

Published: 04-Apr-2013

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Cooling System Draining, Filling and Bleeding V8 S/C 5.0L Petrol

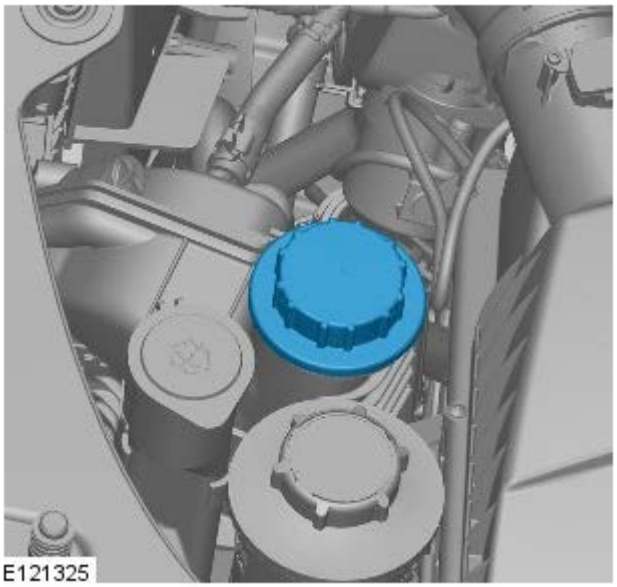
General Procedures

Draining

1. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

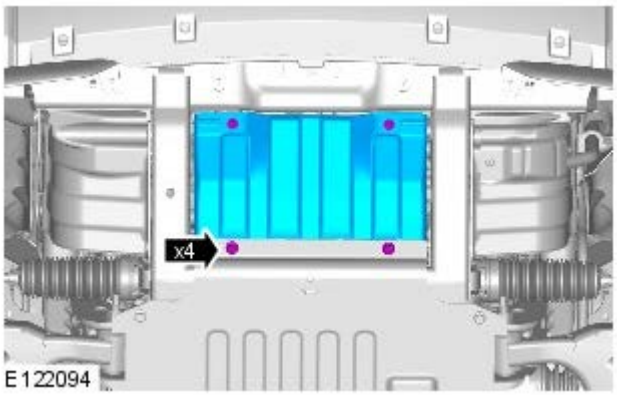


3. WARNINGS:

   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.

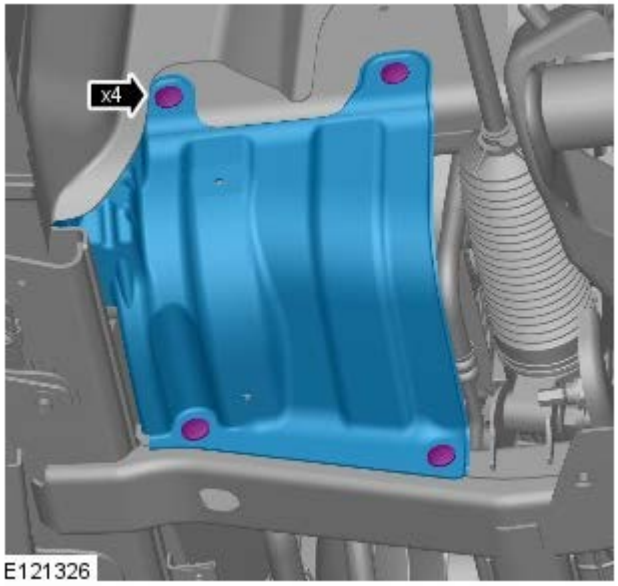
   Be prepared to collect escaping fluids.

   CAUTION: Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure.

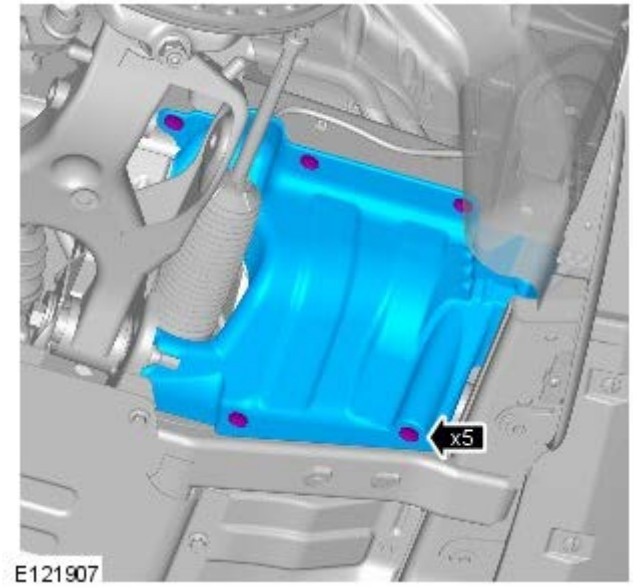


4. Remove the 4 bolts.

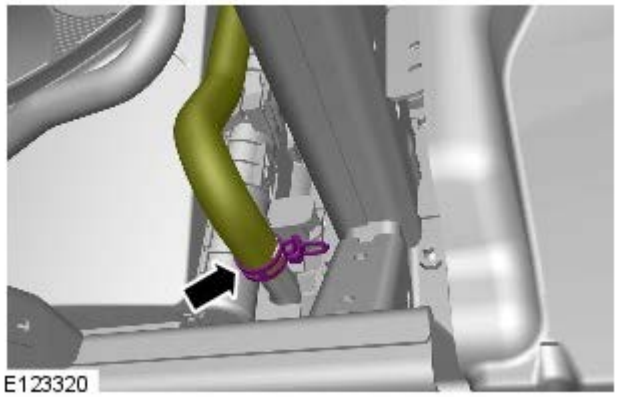
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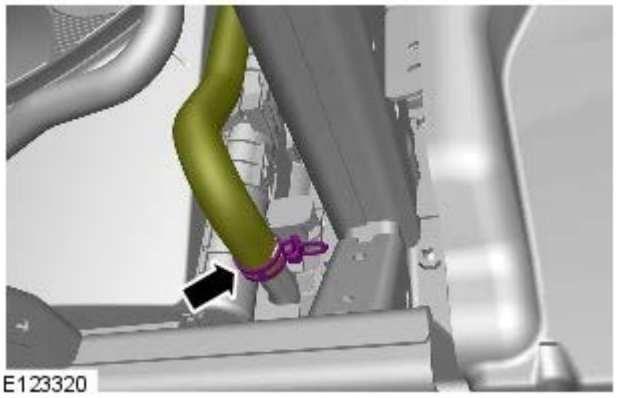
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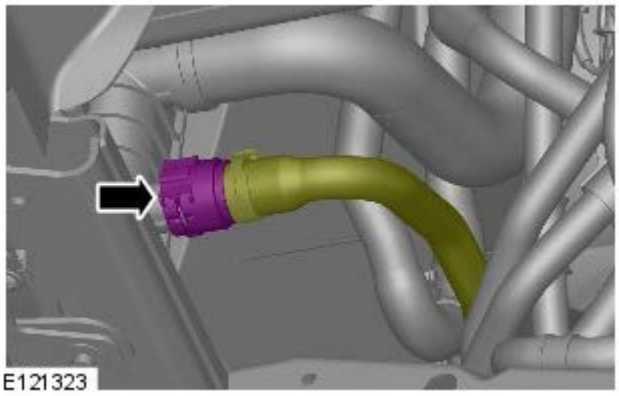


7. CAUTION: Be prepared to collect escaping fluids.



8. Install the lower coolant hose to the radiator.

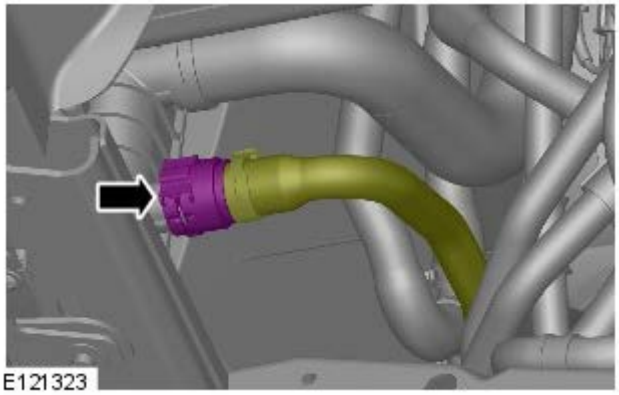

E123320


E121323

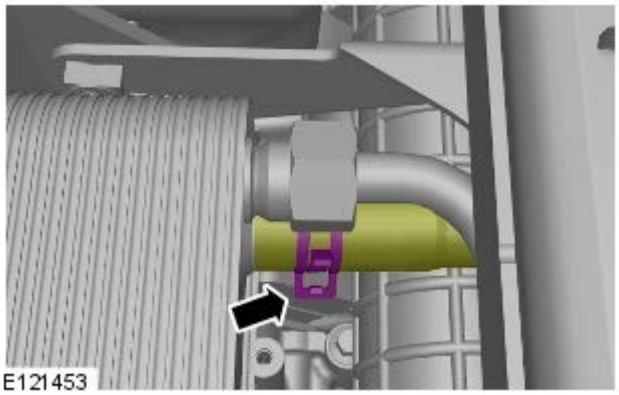
9. CAUTION: Be prepared to collect escaping fluids.

   Position a container to collect the fluid.

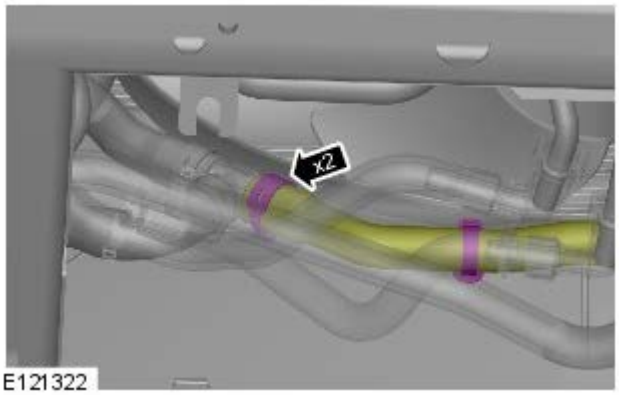
10. Install the lower coolant hose to the radiator.


E121323

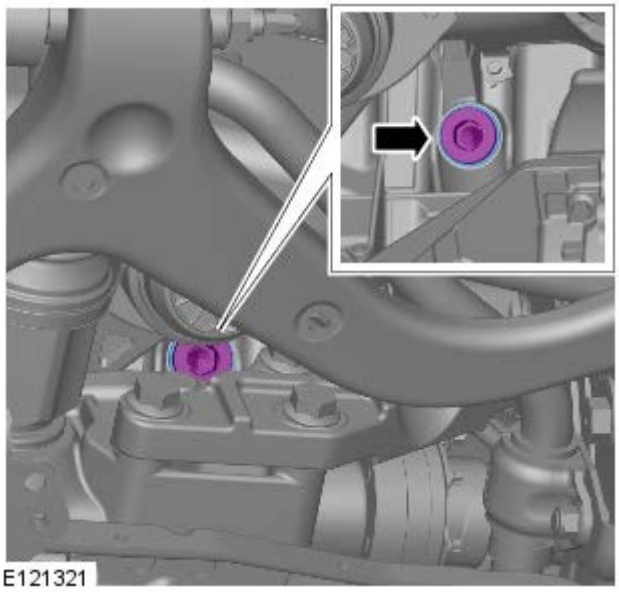
11. CAUTION: Be prepared to collect escaping fluids.


E121453

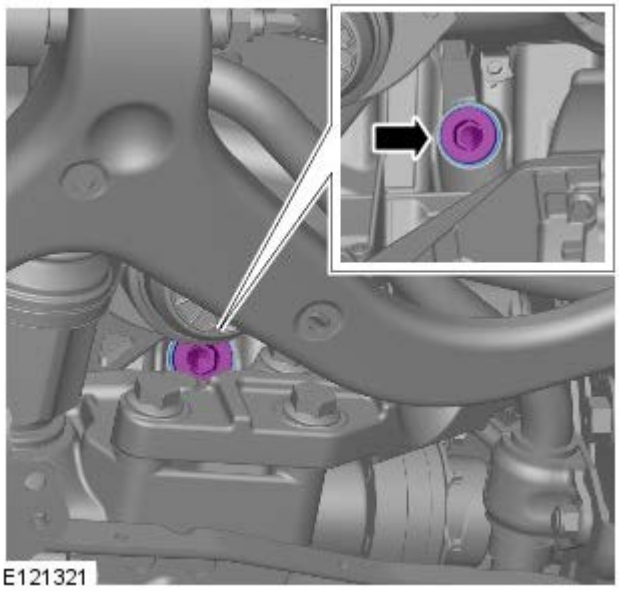
12. CAUTION: Be prepared to collect escaping fluids.



E121322


E121321

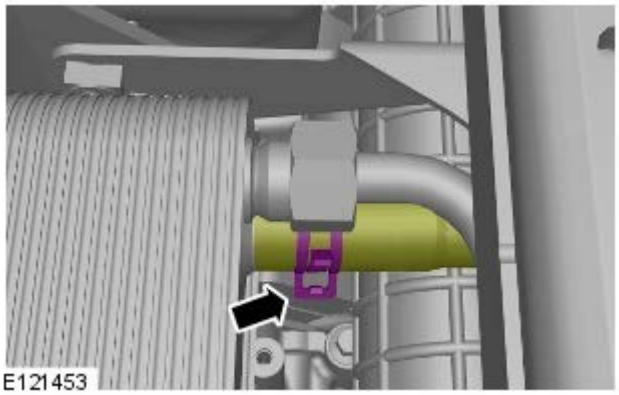
13. CAUTION: Be prepared to collect escaping fluids.


E121321

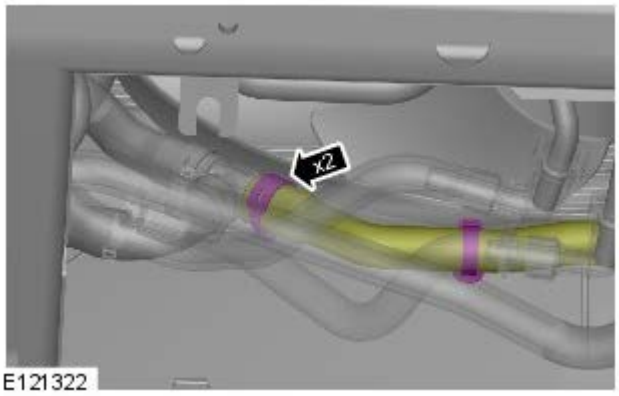
14. CAUTION: Install a new seal.

Torque: 50 Nm

15. Install the coolant hose.

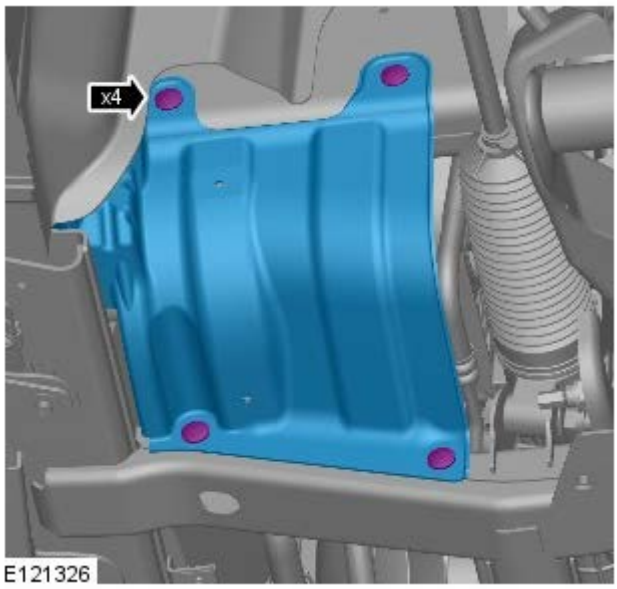

E121453

16. Install the coolant hose.



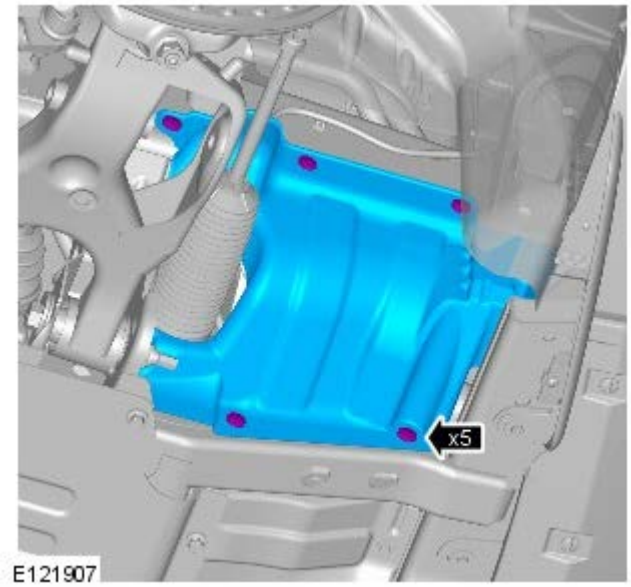
E121322

17. Install the LH splash shield.

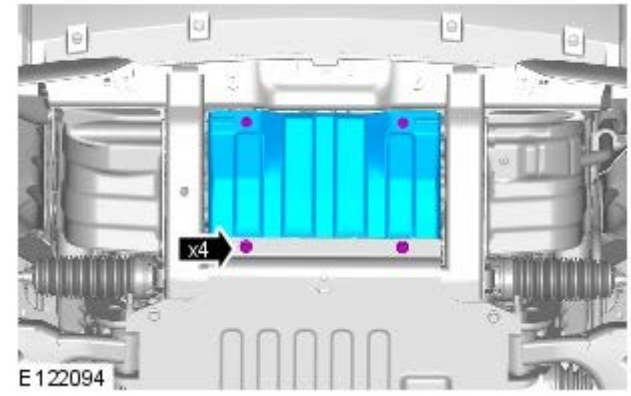


E121326

18. Install the RH splash shield.



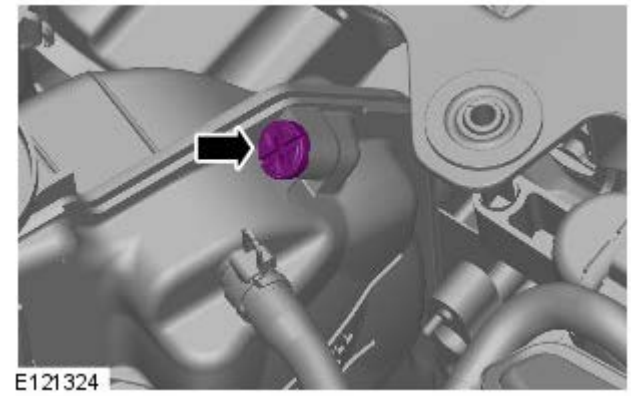
19. *Torque:* 10 Nm

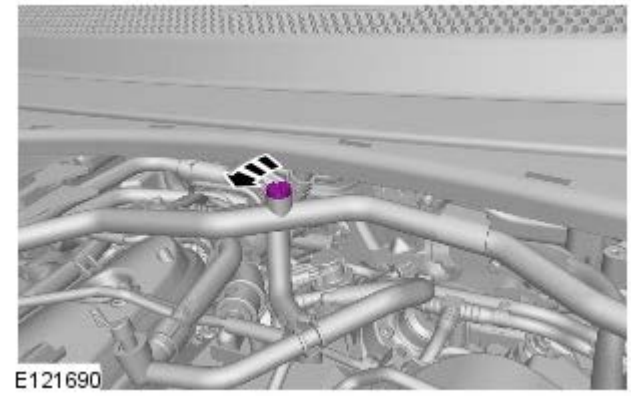


Filling

1. Lower the vehicle.

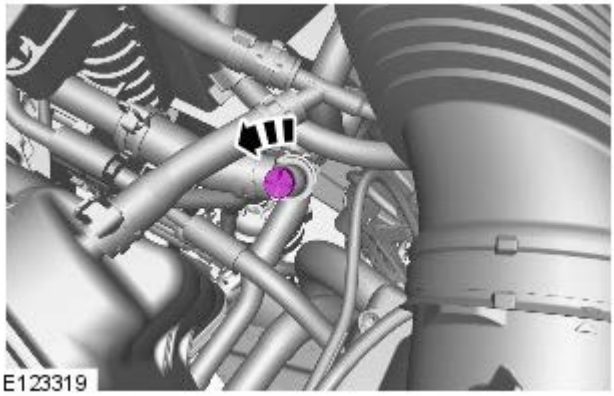
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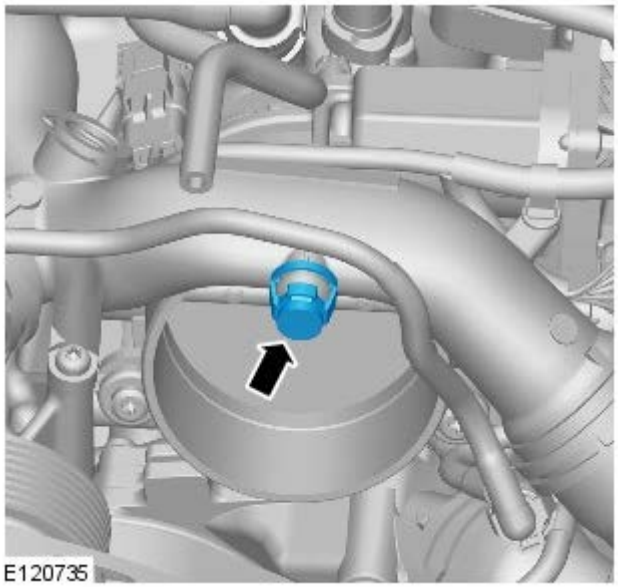


3. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

4.



5.

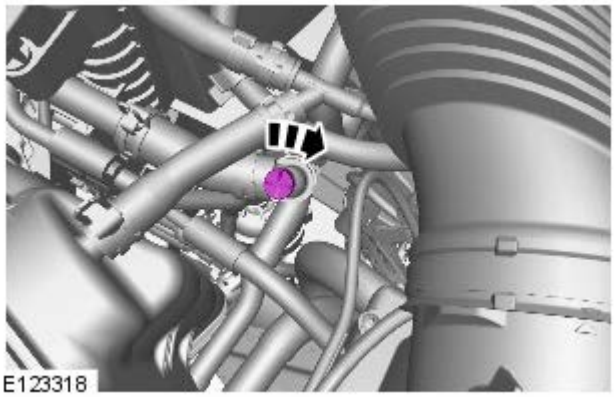


6. CAUTIONS:

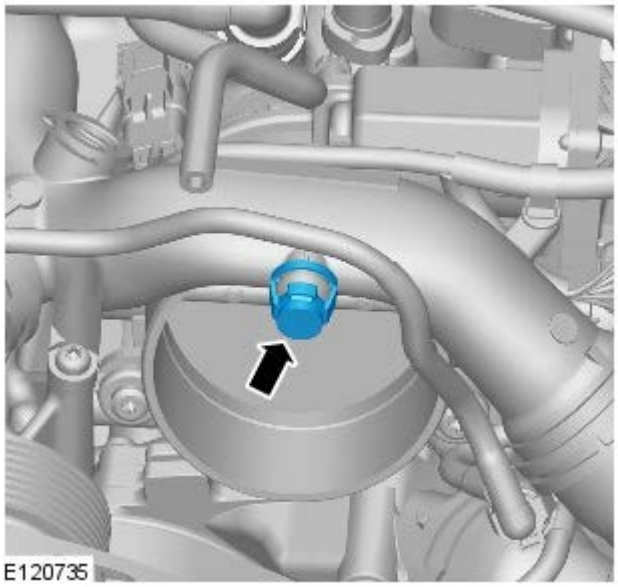
   Anti-freeze concentration must be maintained at 50%.

   Be prepared to collect escaping fluids.

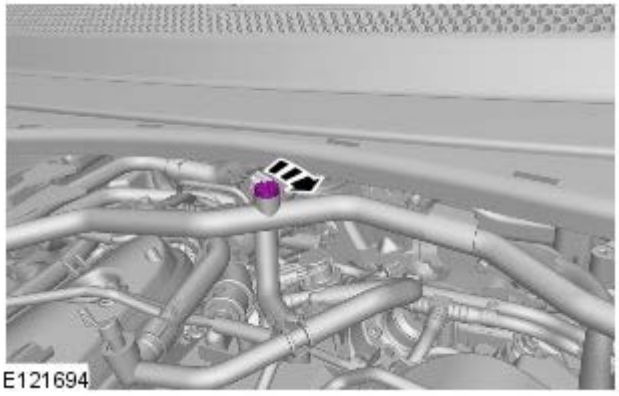
   Fill the coolant expansion tank until coolant appears through the bleed ports.



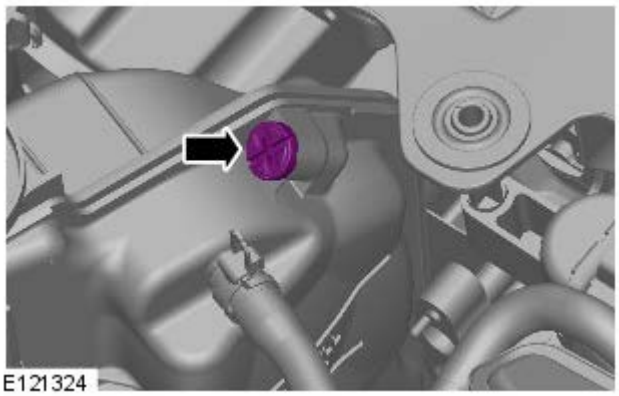
7. CAUTION: Be prepared to collect escaping fluids.


E120735

8. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).


E121694

9. CAUTION: Be prepared to collect escaping fluids.


E121324

10. CAUTION: Be prepared to collect escaping fluids.

11. Continue to fill the coolant until the maximum level is reached.

12. Set the heater controls to maximum.

13. CAUTION: Anti-freeze concentration must be maintained at 50%.

    Start the engine and continue to fill the coolant until the maximum level is reached.

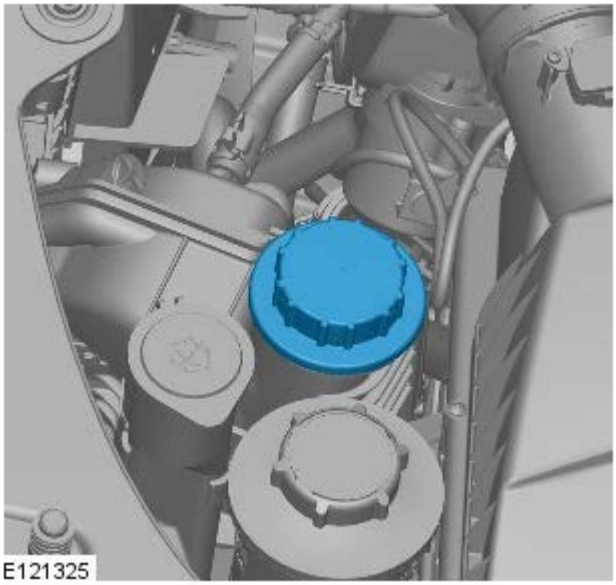
14. Increase the engine speed to 2000 rpm.

15. Check if the front heater is warm after 2 minutes, if warm proceed to step 17.

16. If not, turn the engine off for 10 seconds and then start the engine and return to step 14.

17. Once the front heater is warm, check if the rear heater is warm (if equipped).If no heat is felt, increase the engine speed to 3000 rpm for 30 seconds and return to idle.

18. Once the heat is felt at the rear heater, continue filling with coolant until the level stops dropping and top up to 65mm below the rim (to top rib on the back of the coolant expansion tank).


E121325

19. CAUTION: Correct installation of the Coolant expansion tank cap can be obtained by tightening the cap until an audible click is heard.

20. Switch the heater off.

21. Raise the engine speed to 2000 RPM for eight minutes.

22. CAUTION: Switch off the engine and allow the coolant temperature to go cold.

    Switch the engine off and allow to cool.

23. Visually check the engine and cooling system for signs of coolant leakage.

24. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

    CAUTIONS:

    Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure

    Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

    NOTE: When the cooling system is warm, the coolant will be approximately 10mm above the upper level mark on the expansion tank with the cap removed.

    Check and top-up the coolant if required.

Published: 11-May-2011

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Cooling System Draining, Filling and Bleeding V8 5.0L Petrol

General Procedures

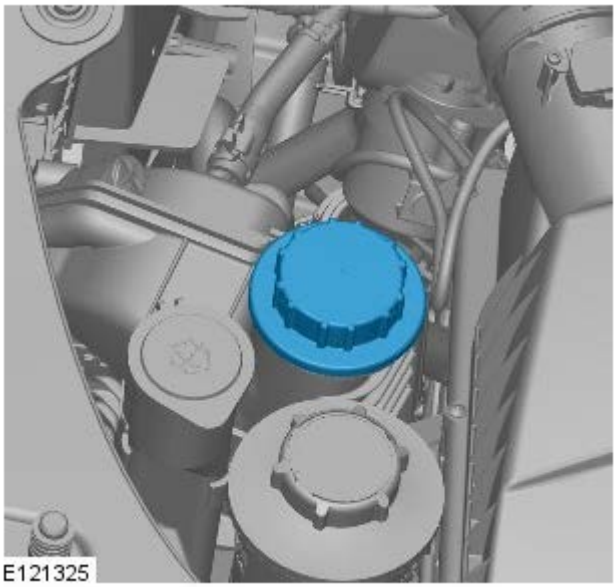
Draining

1. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12, Removal and Installation).

2. WARNING: Make sure to support the vehicle with axle stands.

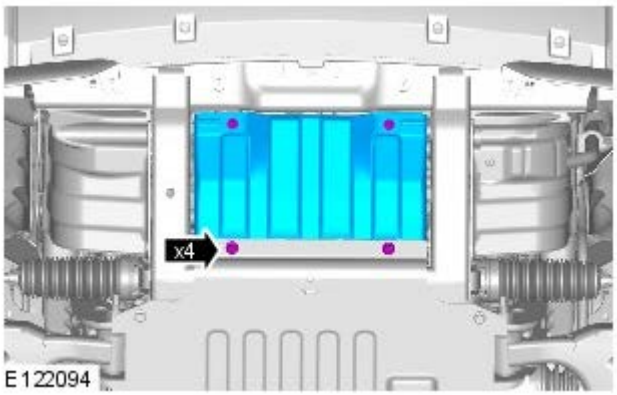
   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02, Removal and Installation).

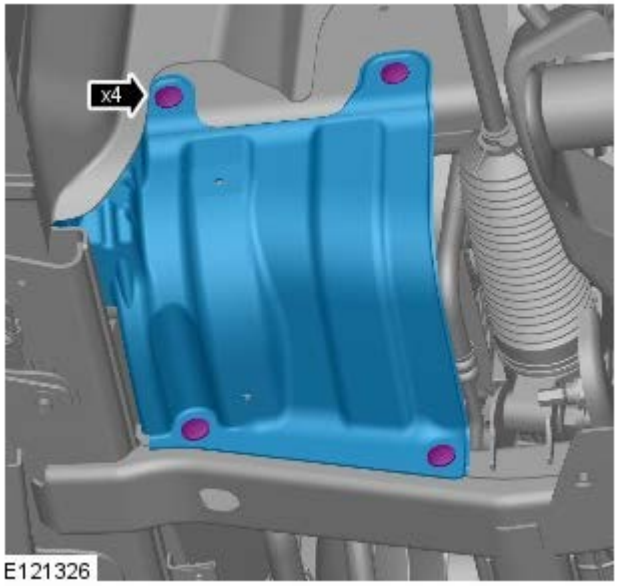


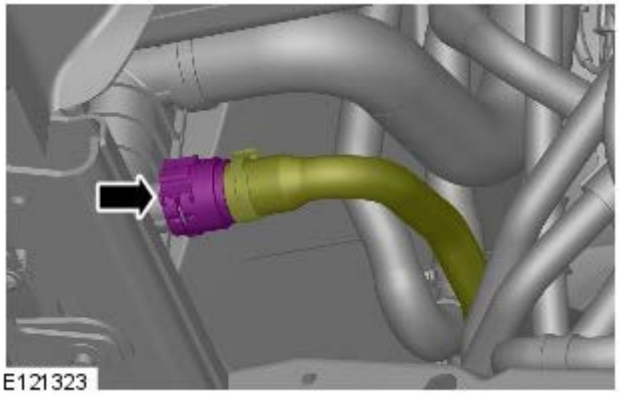
4. WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

5. Remove the 4 bolts.



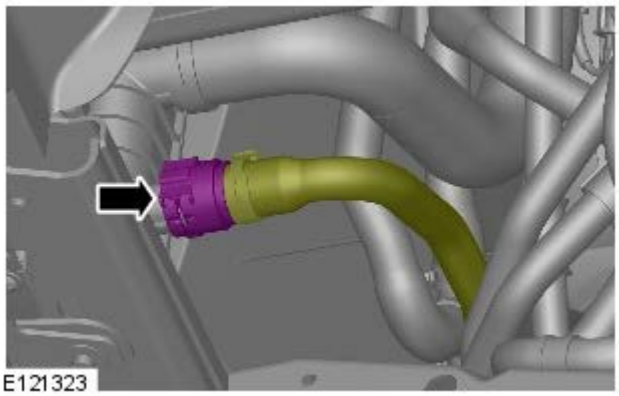
6.





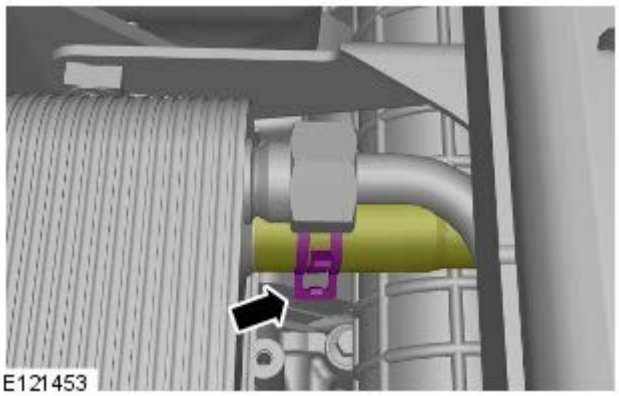
7. CAUTION: Be prepared to collect escaping coolant.

   Position a container to collect the fluid.



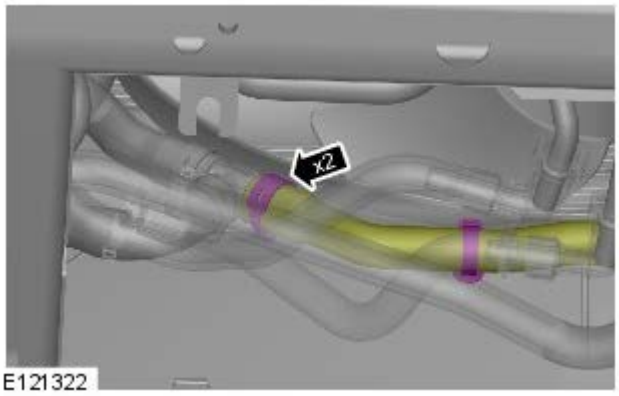
8. CAUTION: Be prepared to collect escaping coolant.

   Install the lower coolant hose to the radiator.

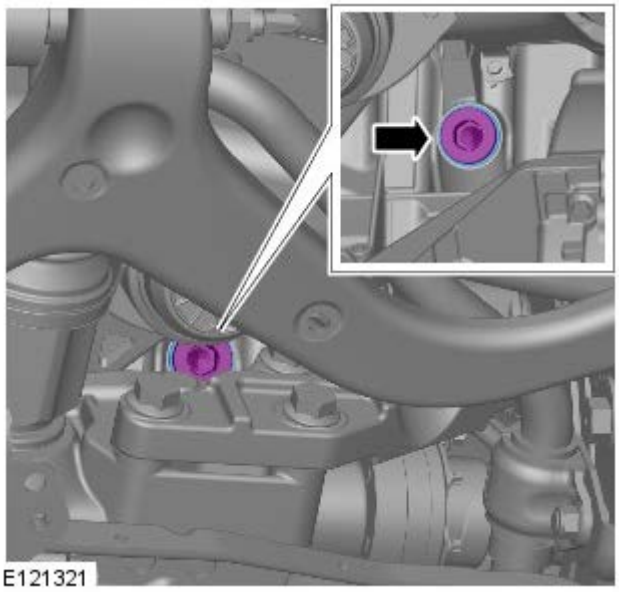


9. CAUTION: Be prepared to collect escaping coolant.

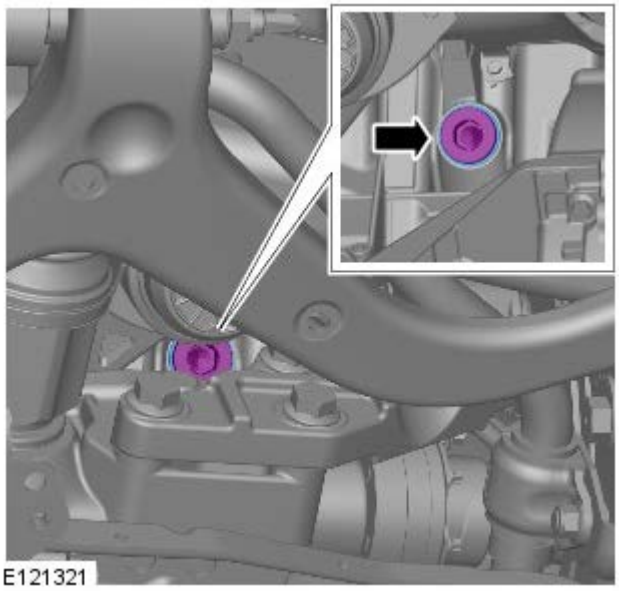
10. CAUTION: Be prepared to collect escaping coolant.



E121322


E121321

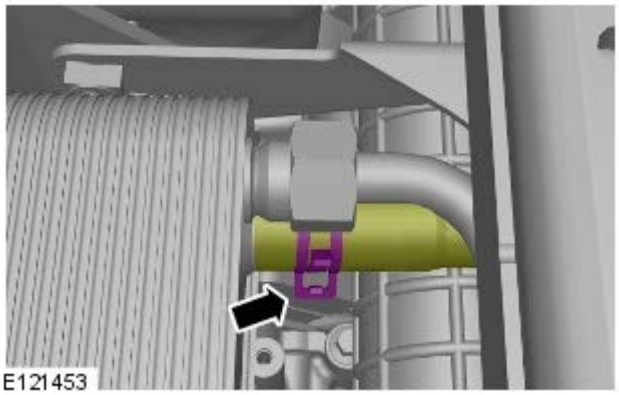
11. CAUTION: Be prepared to collect escaping coolant.


E121321

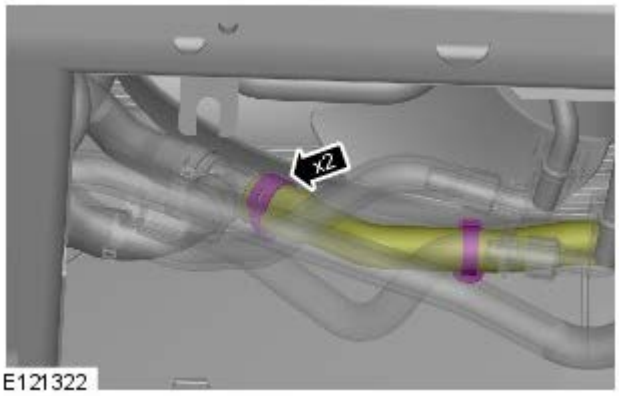
12. CAUTION: Install a new seal.

Torque: 50 Nm

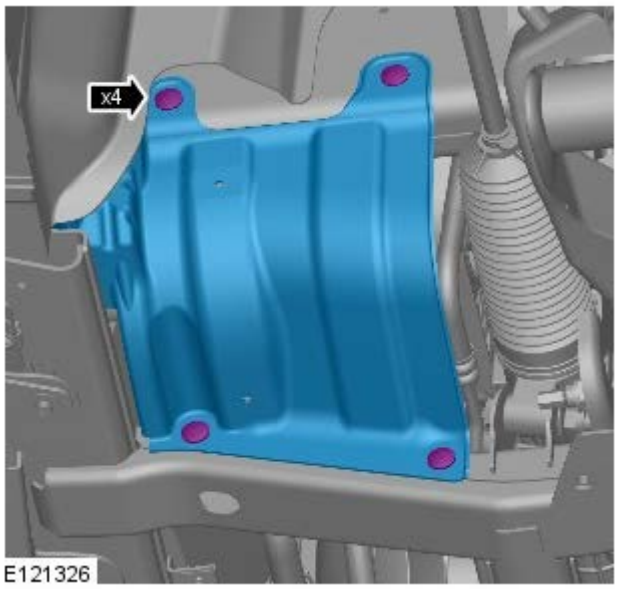
13. Install the coolant hose.



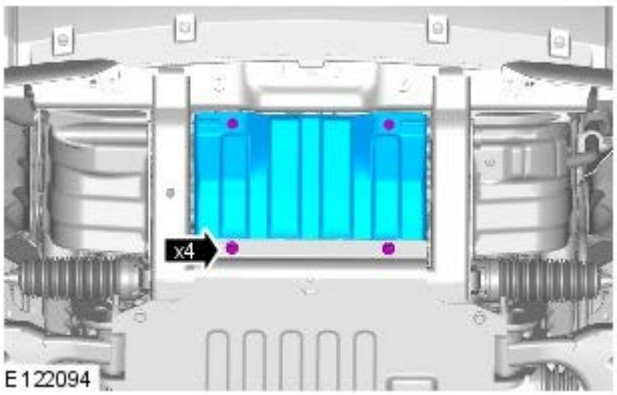
14. Install the coolant hose.



15. Install the LH splash shield.



16. *Torque:* 10 Nm



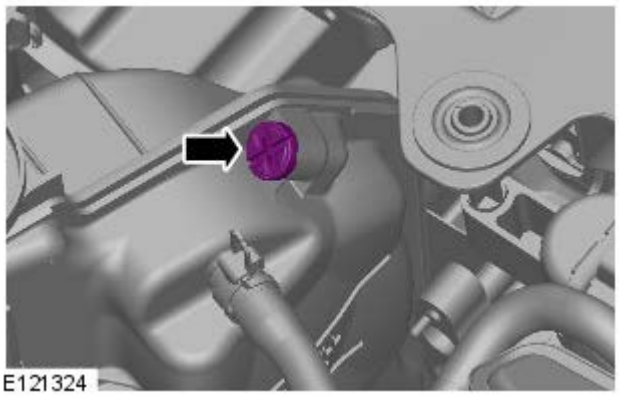
Filling

1. Refer to: Engine Undershield (501-02, Removal and Installation).

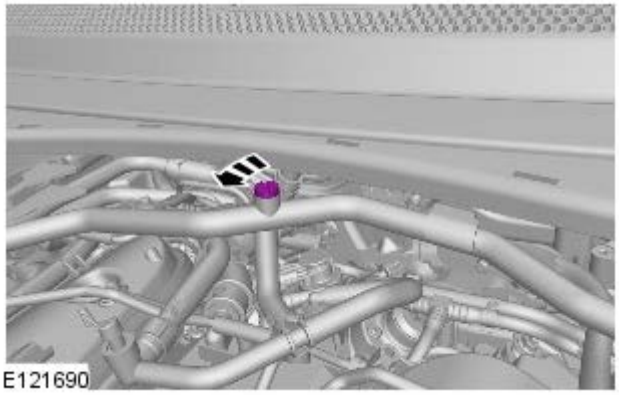
2. Lower the vehicle.

3. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12, Removal and Installation).

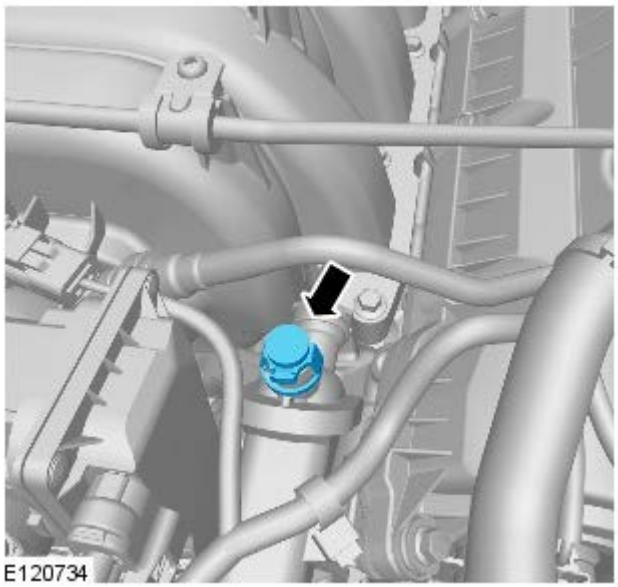
4.


E121324

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


E121690

6.

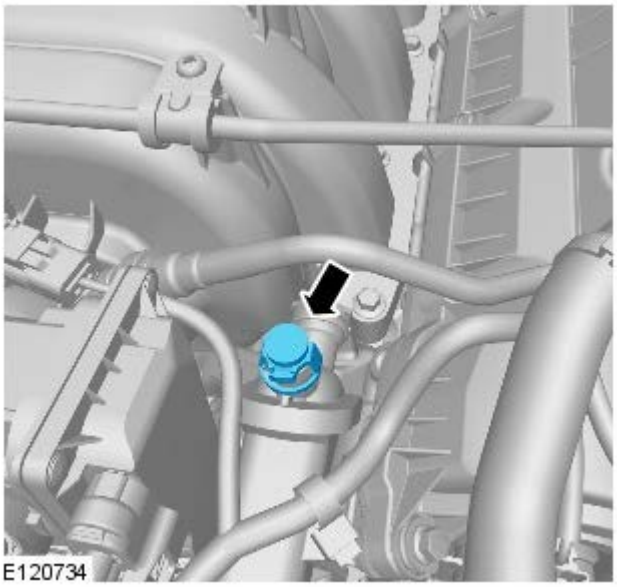

E120734

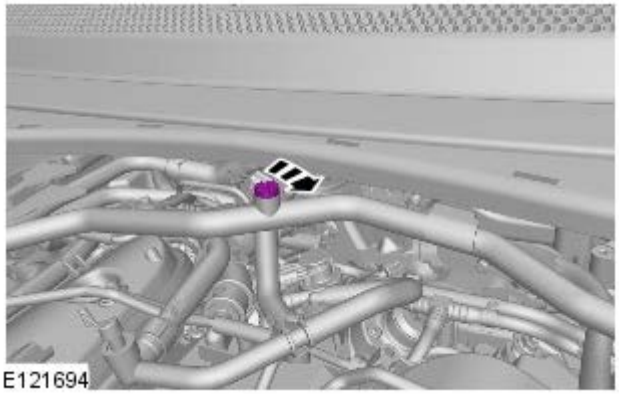
7. CAUTIONS:

Anti-freeze concentration must be maintained at 50%.

Be prepared to collect escaping coolant.

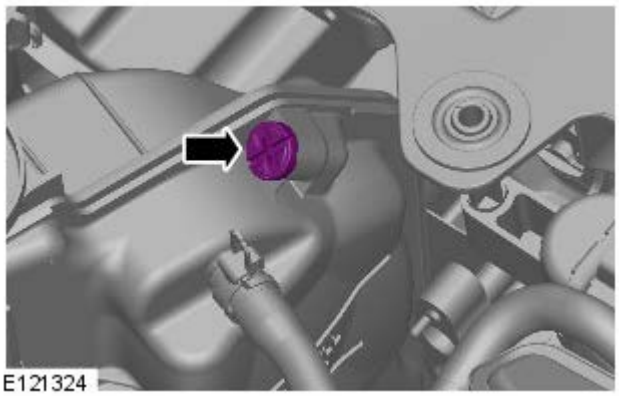
Fill the coolant expansion tank until coolant appears through the bleed ports.


E120734


E121694

8. CAUTION: Be prepared to collect escaping coolant.

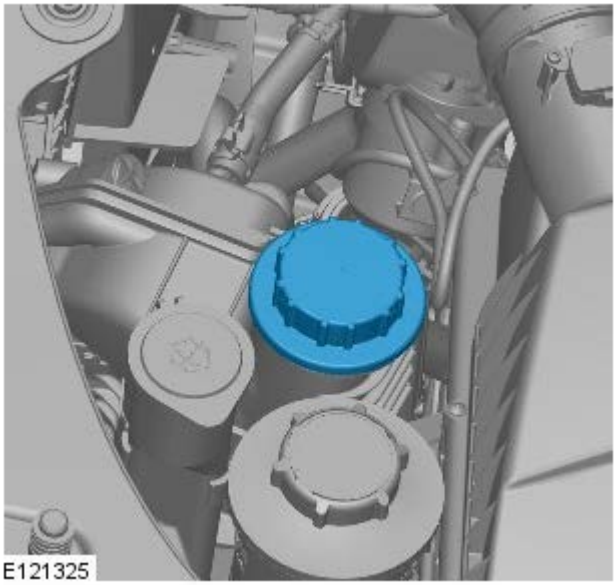
   Fill the coolant expansion tank until coolant appears through the bleed ports.


E121324

9. CAUTION: Be prepared to collect escaping coolant.

   Fill the coolant expansion tank until coolant appears through the bleed ports.

10. Set the heater controls to maximum.
11. Start the engine and continue to fill the coolant until the maximum level is reached.
12. Increase the engine speed to 1500 rpm.
13. Check if the front heater is warm after 2 minutes, if warm proceed to step 23
14. If not, turn the engine off for 10 seconds and then start the engine and return to step 20.
15. CAUTION: Correct installation of the Coolant expansion tank cap can be obtained by tightening the cap until an audible click is heard.



16. Switch the heater off.

17. Raise the engine speed to 2000 RPM for eight minutes.

18. CAUTION: Switch off the engine and allow the coolant temperature to go cold.

    Switch the engine off and allow to cool.

19. Visually check the engine and cooling system for signs of coolant leakage.

20. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

    CAUTIONS:

    Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure

    Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

    NOTE: When the cooling system is warm, the coolant will be approximately 10mm above the upper level mark on the expansion tank with the cap removed.

    Check and top-up the coolant if required.

Published: 04-Apr-2013

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Cooling System Partial Draining, Filling and Bleeding V8 5.0L Petrol

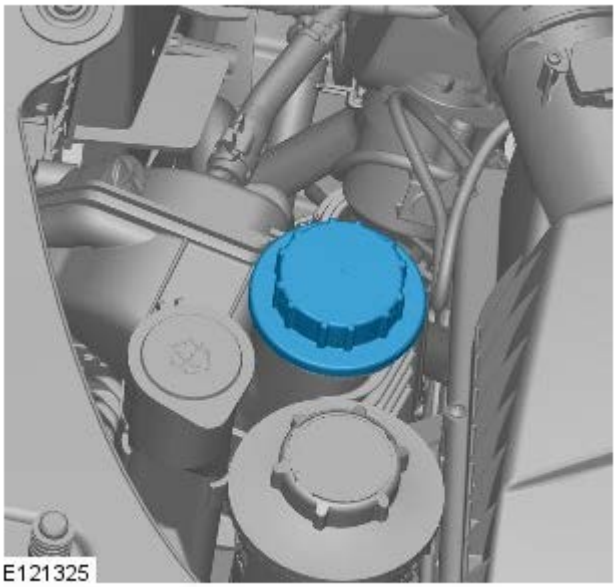
General Procedures

Draining

1. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

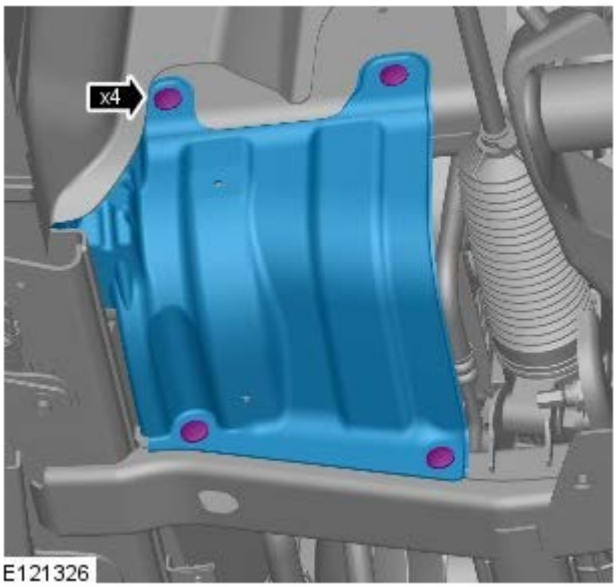


3. WARNINGS:

   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.

   Be prepared to collect escaping fluids.

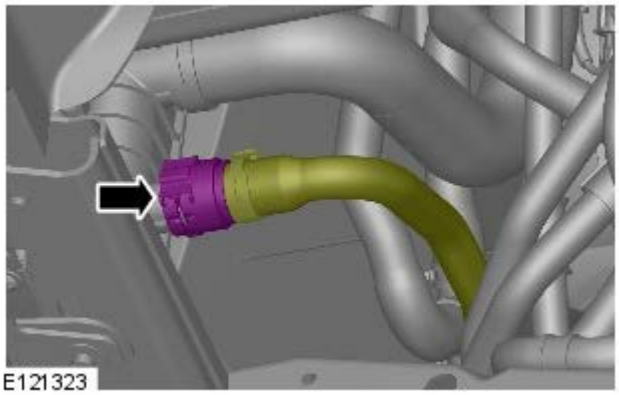
   CAUTION: Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure.



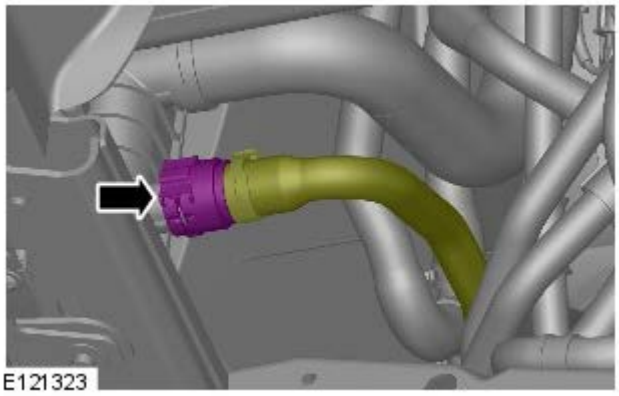
4.

5. CAUTION: Be prepared to collect escaping fluids.

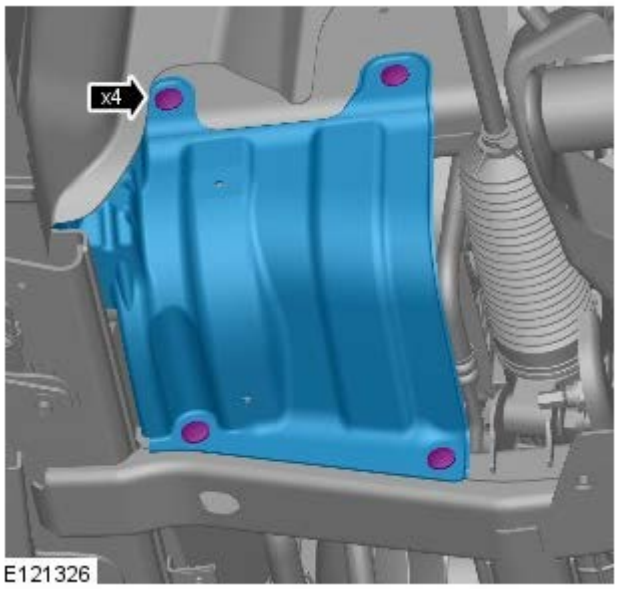
   Position a container to collect the fluid.


E121323

6. Install the lower coolant hose to the radiator.


E121323

7. Install the LH splash shield.

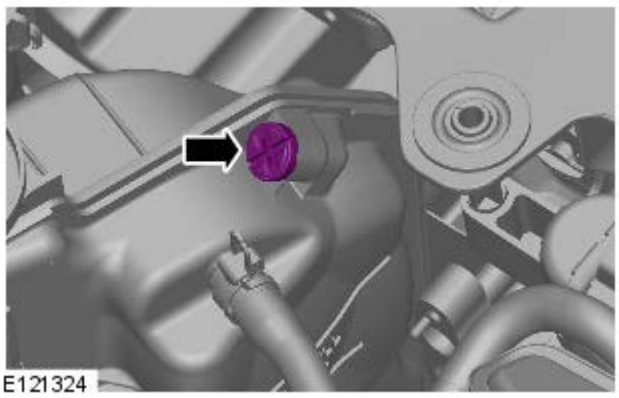


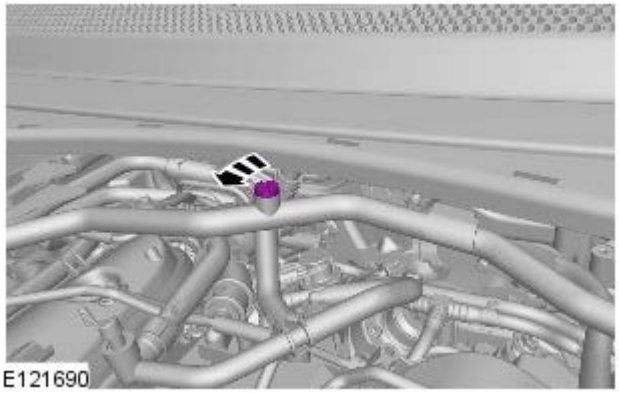
E121326

Filling

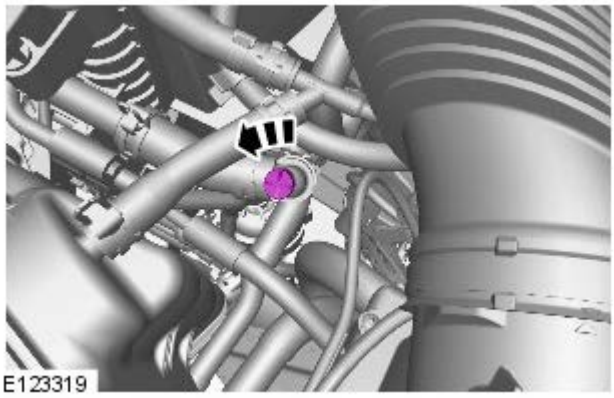
1. Lower the vehicle.

2.

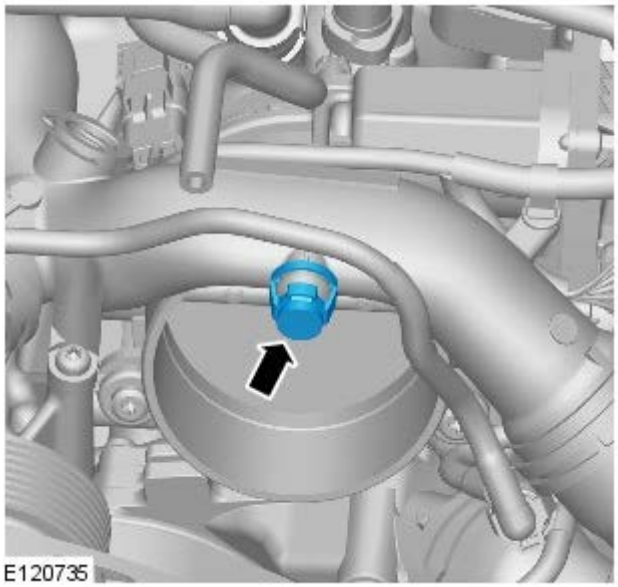

E121324


E121690

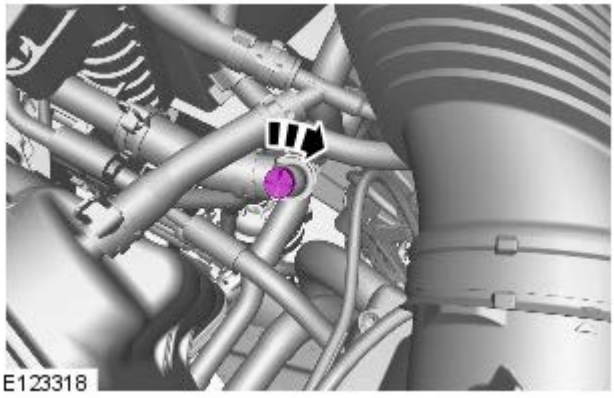
3. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.


E123319

4.


E120735

5.


E123318

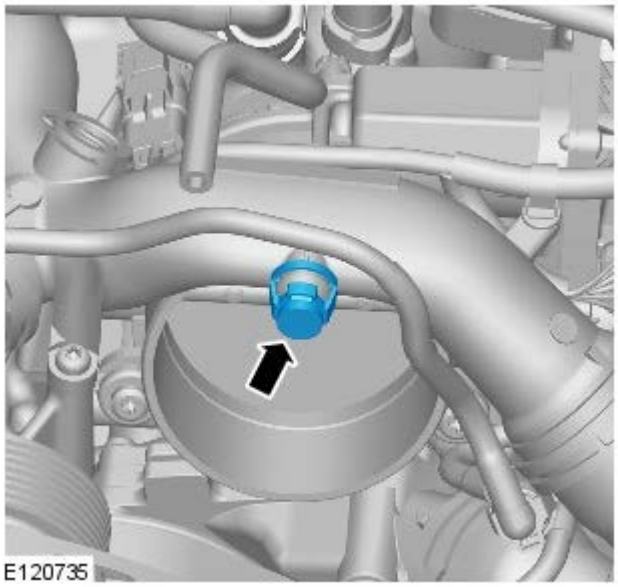
6. CAUTIONS:

Anti-freeze concentration must be maintained at 50%.

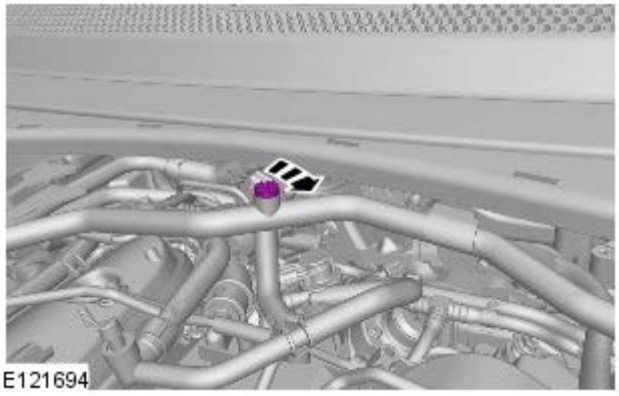
Be prepared to collect escaping fluids.

Fill the coolant expansion tank until coolant appears through the bleed ports.

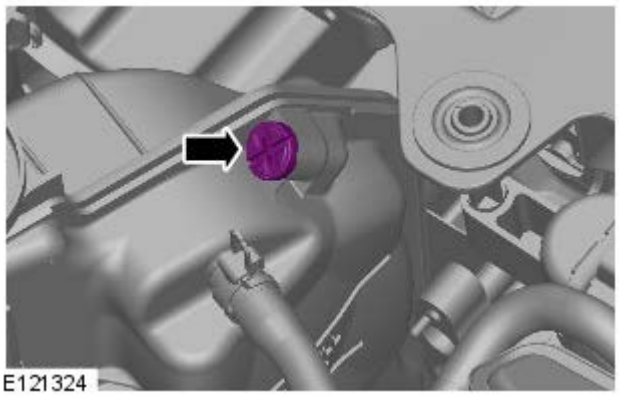
7. CAUTION: Be prepared to collect escaping fluids.



8. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).



9. CAUTION: Be prepared to collect escaping fluids.



10. CAUTION: Be prepared to collect escaping fluids.

11. Continue to fill the coolant until the maximum level is reached.

12. Set the heater controls to maximum.

13. CAUTION: Anti-freeze concentration must be maintained at 50%.

    Start the engine and continue to fill the coolant until the maximum level is reached.

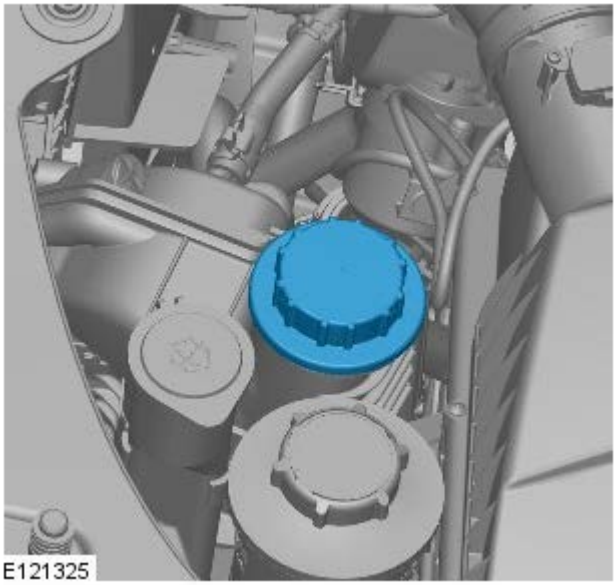
14. Increase the engine speed to 2000 rpm.

15. Check if the front heater is warm after 2 minutes, if warm proceed to step 17.

16. If not, turn the engine off for 10 seconds and then start the engine and return to step 14.

17. Once the front heater is warm, check if the rear heater is warm (if equipped).If no heat is felt, increase the engine speed to 3000 rpm for 30 seconds and return to idle.

18. Once the heat is felt at the rear heater, continue filling with coolant until the level stops dropping and top up to 65mm below the rim (to top rib on the back of the coolant expansion tank).


E121325

19. CAUTION: Correct installation of the Coolant expansion tank cap can be obtained by tightening the cap until an audible click is heard.

20. Switch the heater off.

21. Raise the engine speed to 2000 RPM for eight minutes.

22. CAUTION: Switch off the engine and allow the coolant temperature to go cold.

    Switch the engine off and allow to cool.

23. Visually check the engine and cooling system for signs of coolant leakage.

24. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

    CAUTIONS:

    Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure

    Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

    NOTE: When the cooling system is warm, the coolant will be approximately 10mm above the upper level mark on the expansion tank with the cap removed.

    Check and top-up the coolant if required.

Published: 04-Apr-2013

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Cooling System Partial Draining, Filling and Bleeding V8 S/C 5.0L Petrol

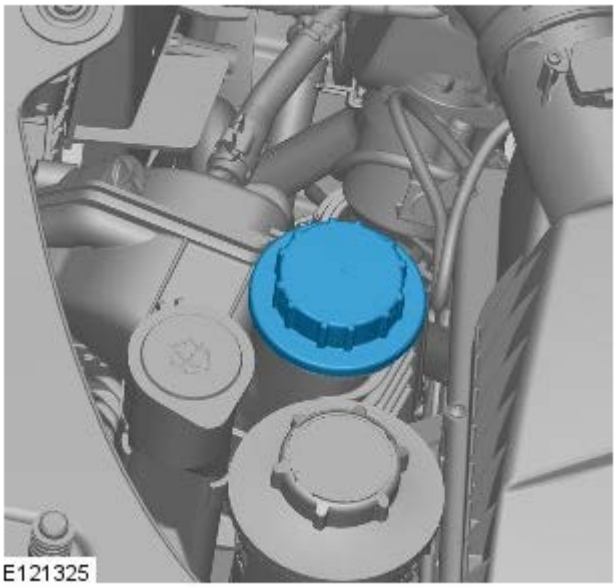
General Procedures

Draining

1. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

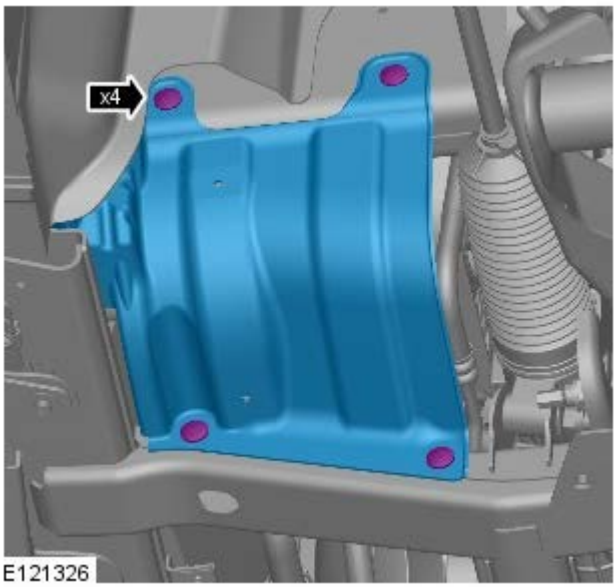


3. WARNINGS:

   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.

   Be prepared to collect escaping fluids.

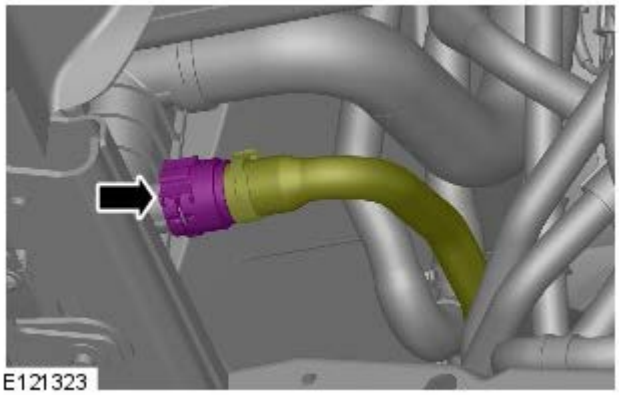
   CAUTION: Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure.



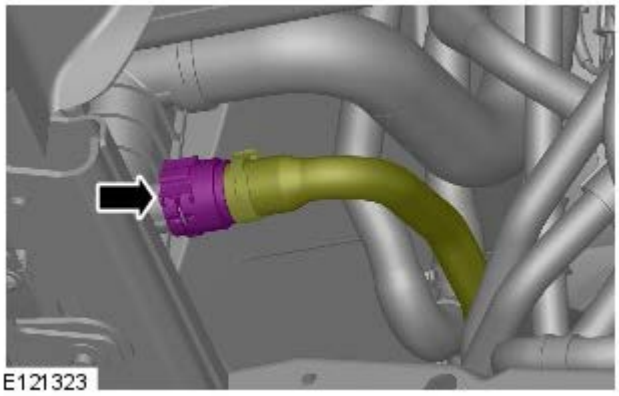
4.

5. CAUTION: Be prepared to collect escaping fluids.

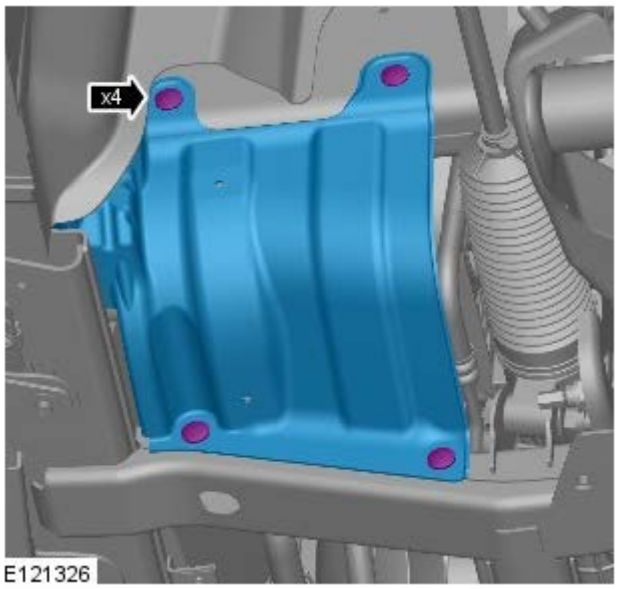
   Position a container to collect the fluid.


E121323

6. Install the lower coolant hose to the radiator.


E121323

7. Install the LH splash shield.

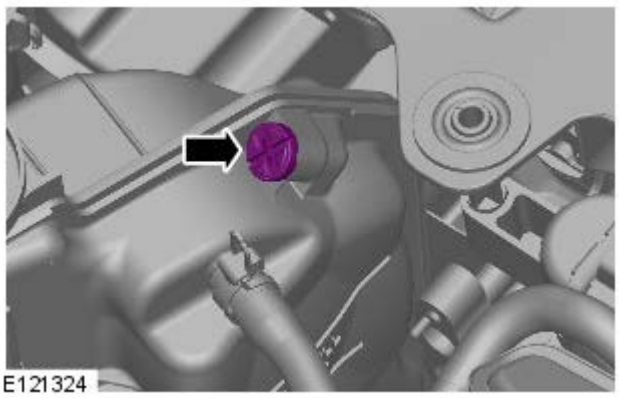


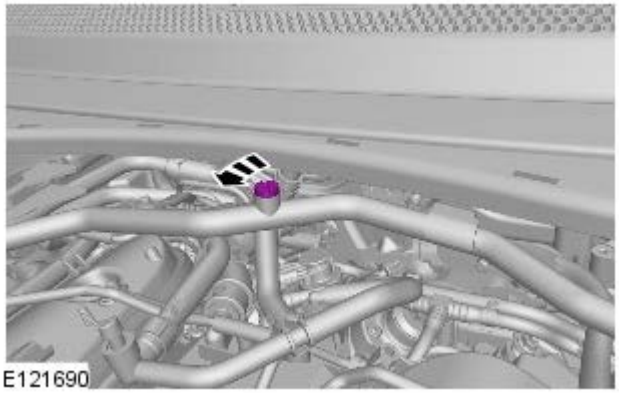
E121326

Filling

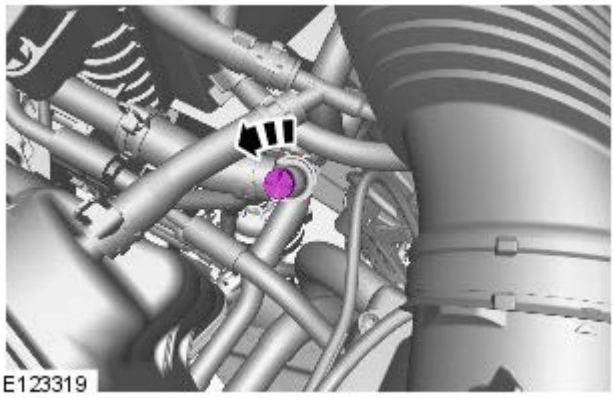
1. Lower the vehicle.

2.

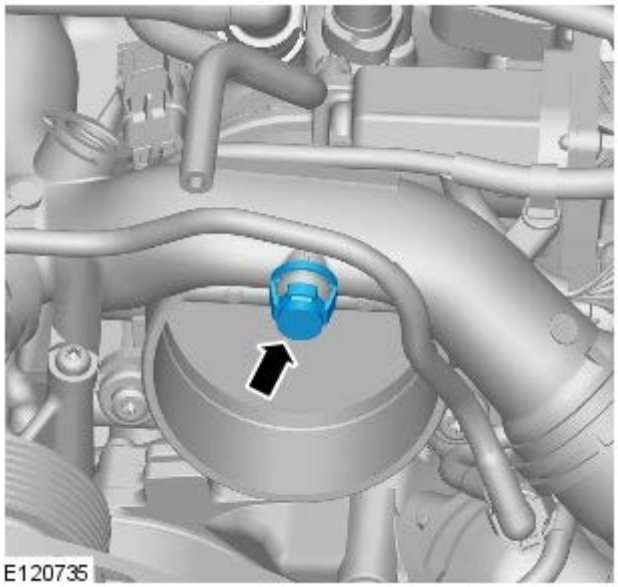

E121324


E121690

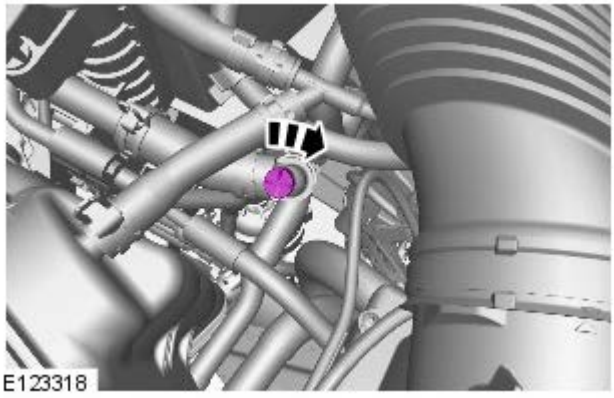
3. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.


E123319

4.


E120735

5.


E123318

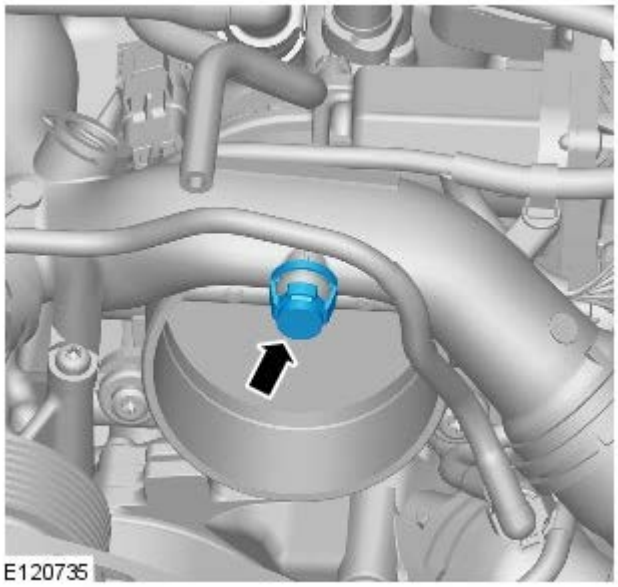
6. CAUTIONS:

Anti-freeze concentration must be maintained at 50%.

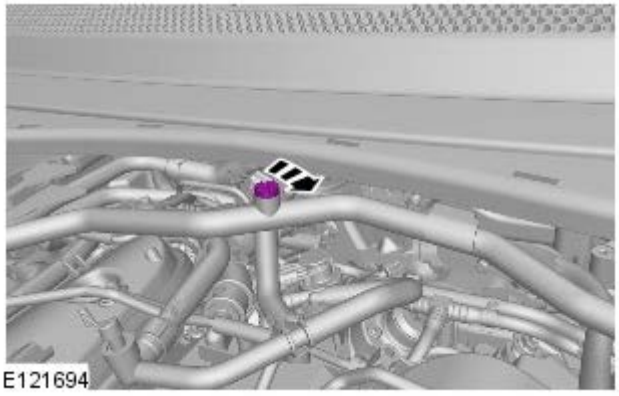
Be prepared to collect escaping fluids.

Fill the coolant expansion tank until coolant appears through the bleed ports.

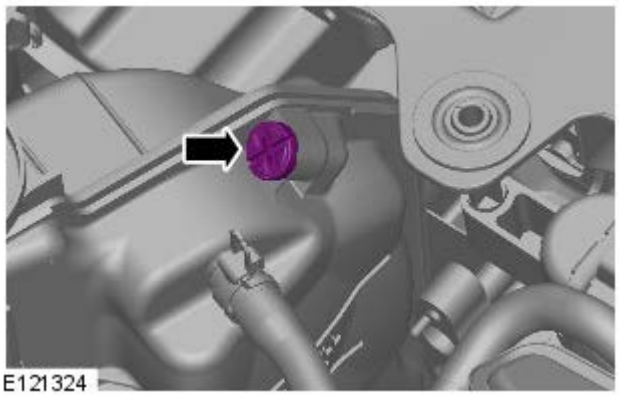
7. CAUTION: Be prepared to collect escaping fluids.


E120735

8. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).


E121694

9. CAUTION: Be prepared to collect escaping fluids.


E121324

10. CAUTION: Be prepared to collect escaping fluids.

11. Continue to fill the coolant until the maximum level is reached.

12. Set the heater controls to maximum.

13. CAUTION: Anti-freeze concentration must be maintained at 50%.

    Start the engine and continue to fill the coolant until the maximum level is reached.

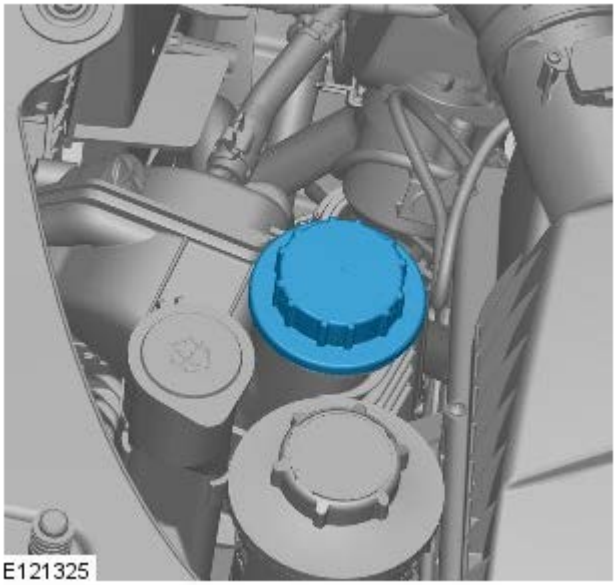
14. Increase the engine speed to 2000 rpm.

15. Check if the front heater is warm after 2 minutes, if warm proceed to step 17.

16. If not, turn the engine off for 10 seconds and then start the engine and return to step 14.

17. Once the front heater is warm, check if the rear heater is warm (if equipped).If no heat is felt, increase the engine speed to 3000 rpm for 30 seconds and return to idle.

18. Once the heat is felt at the rear heater, continue filling with coolant until the level stops dropping and top up to 65mm below the rim (to top rib on the back of the coolant expansion tank).


E121325

19. CAUTION: Correct installation of the Coolant expansion tank cap can be obtained by tightening the cap until an audible click is heard.

20. Switch the heater off.

21. Raise the engine speed to 2000 RPM for eight minutes.

22. CAUTION: Switch off the engine and allow the coolant temperature to go cold.

    Switch the engine off and allow to cool.

23. Visually check the engine and cooling system for signs of coolant leakage.

24. WARNING: When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

    CAUTIONS:

    Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure

    Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

    NOTE: When the cooling system is warm, the coolant will be approximately 10mm above the upper level mark on the expansion tank with the cap removed.

    Check and top-up the coolant if required.

Published: 21-Oct-2013

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Coolant Expansion Tank V8 S/C 5.0L Petrol, 5.0L

Removal and Installation

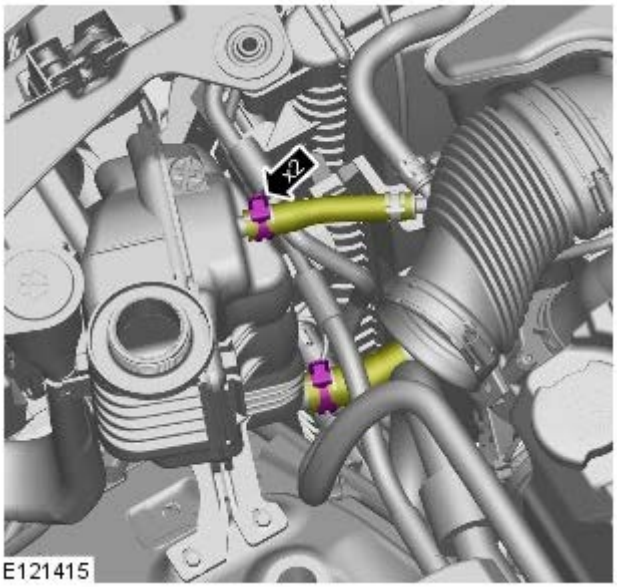
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

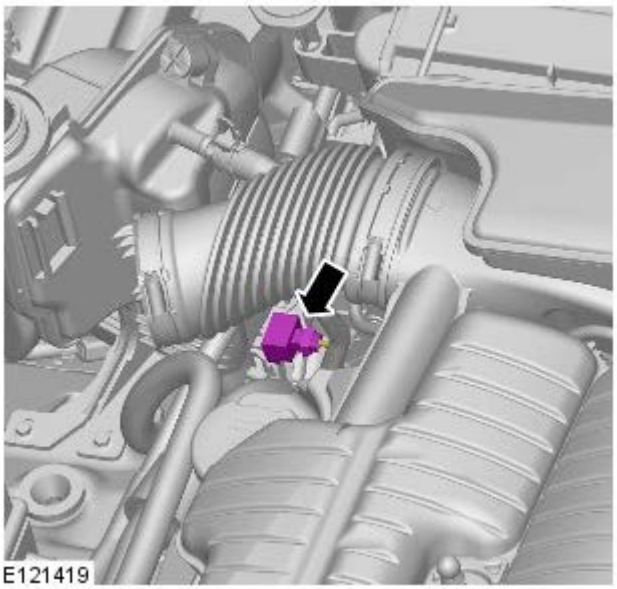
2. Refer to: Air Cleaner LH (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).



3. CAUTIONS:

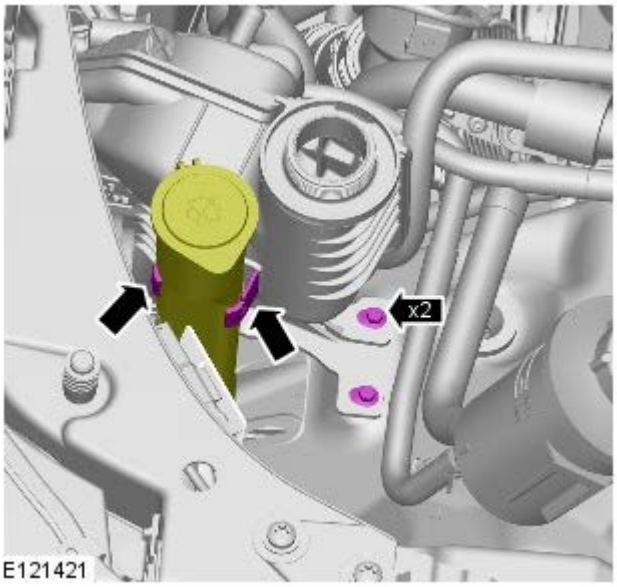
   Be prepared to collect escaping coolant.

   Clamp the hoses to minimize coolant loss.

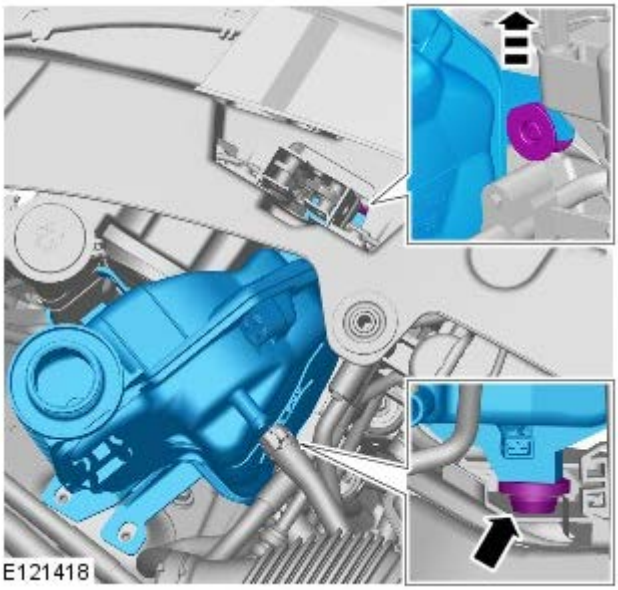


4. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

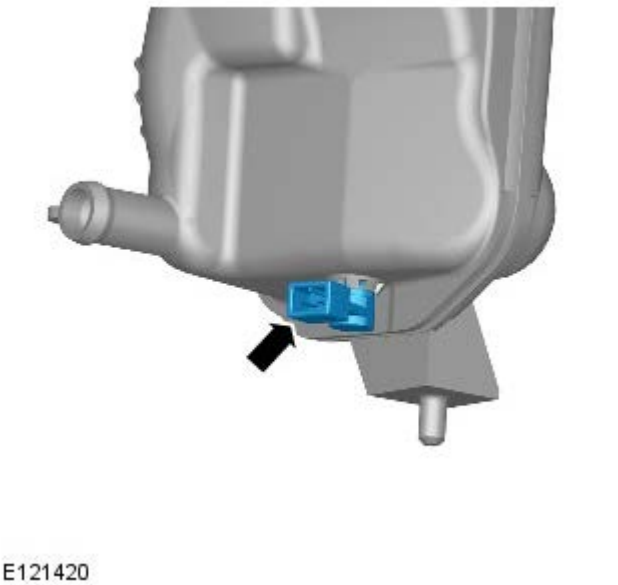
5. *Torque:* 10 Nm



6.



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



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Coolant Expansion Tank V8 5.0L Petrol, 5.0L

Removal and Installation

Removal

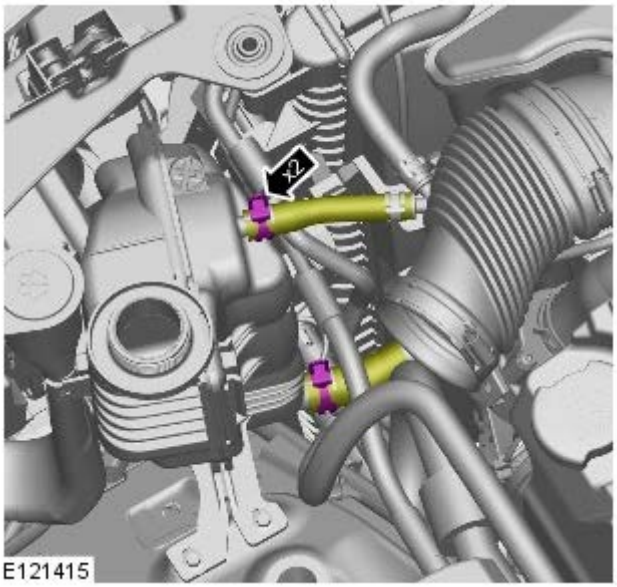
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

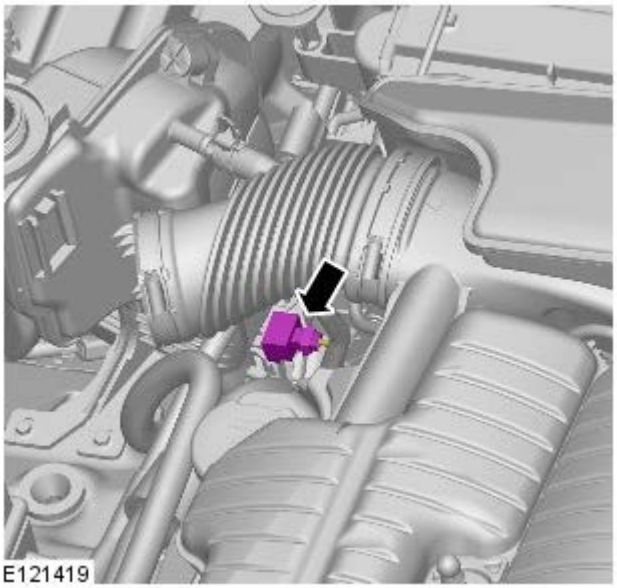
   Raise and support the vehicle.

2. Refer to: Air Cleaner LH (303-12 Intake Air Distribution and Filtering - 5.0L, Vehicles Without: Supercharger, Removal and Installation).

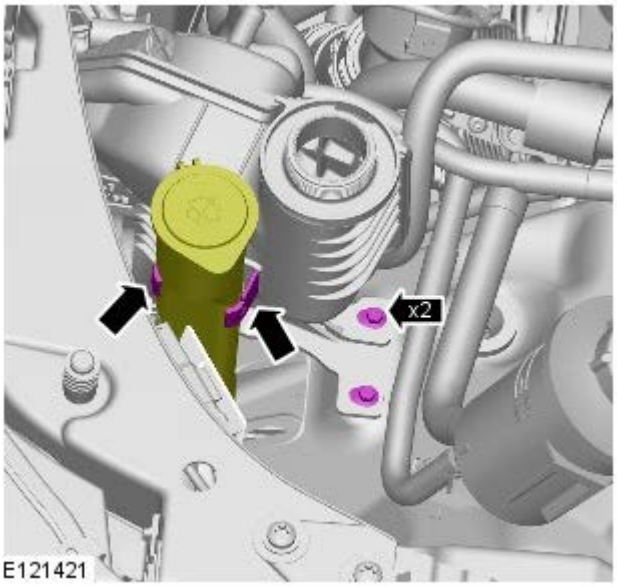
3.



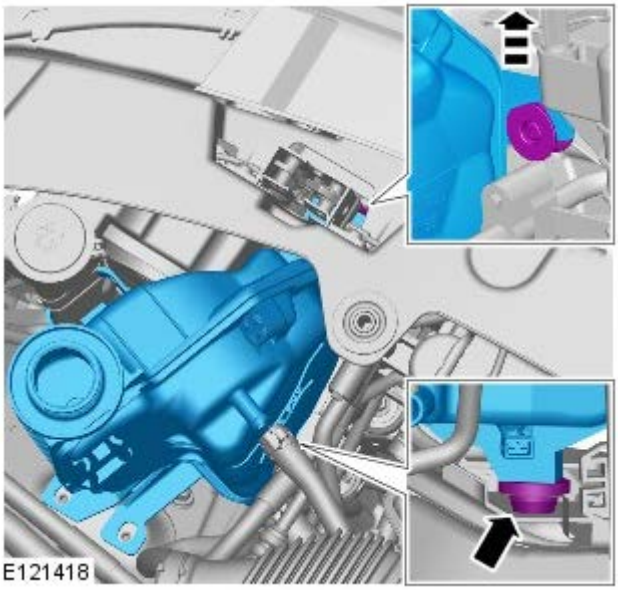
4.



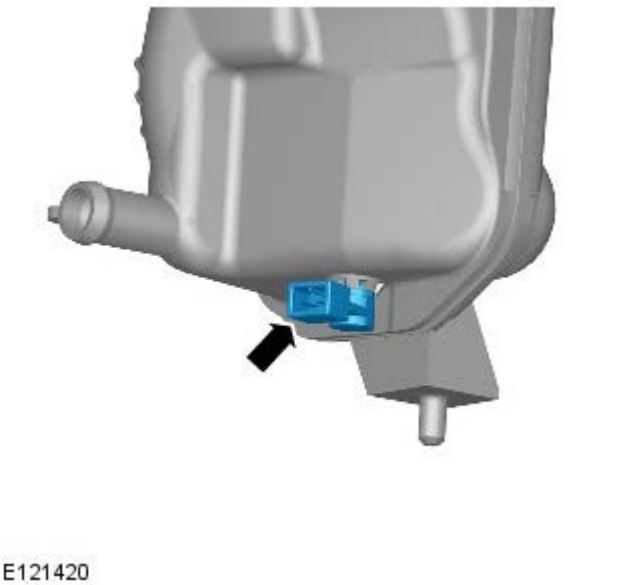
5. *Torque:* 10 Nm



6.



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



Installation

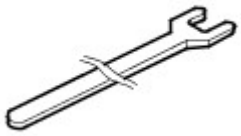
1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Cooling Fan V8 S/C 5.0L Petrol

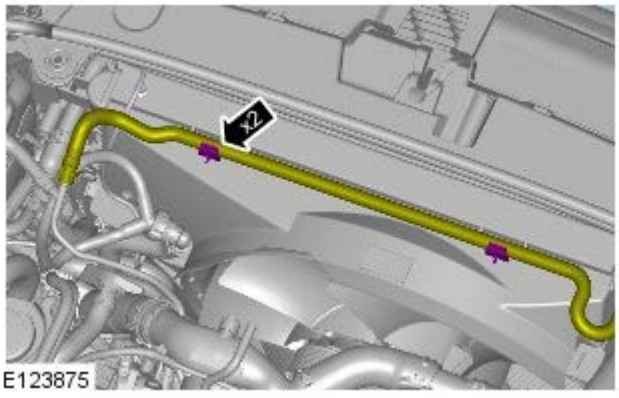
Removal and Installation

Special Tool(s)

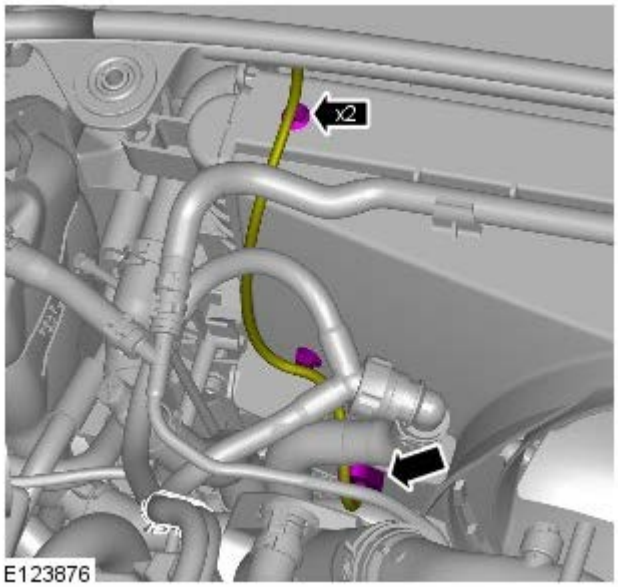
303-1142  E46076	303-1142 Viscous Coupling Wrench
303-1143  E55382	303-1143 Viscous Coupling Holding Tool

Removal

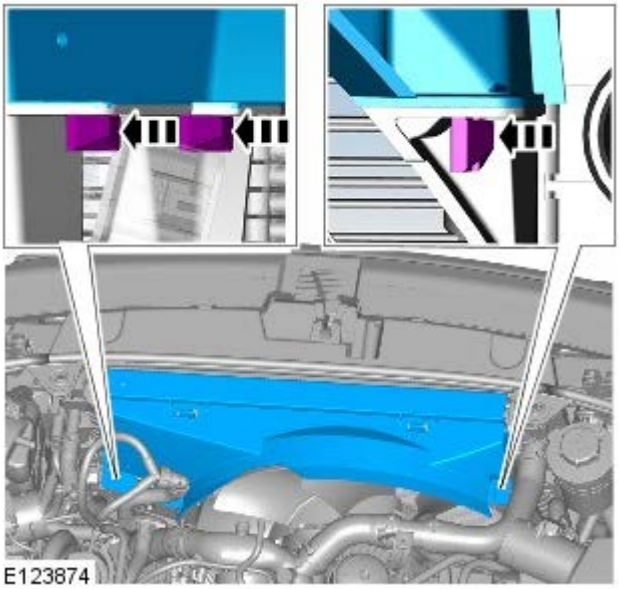
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12, Removal and Installation).
2. Refer to: Air Cleaner Outlet Pipe LH (303-12, Removal and Installation).
3. Refer to: Air Cleaner Outlet Pipe RH (303-12, Removal and Installation).
4. 

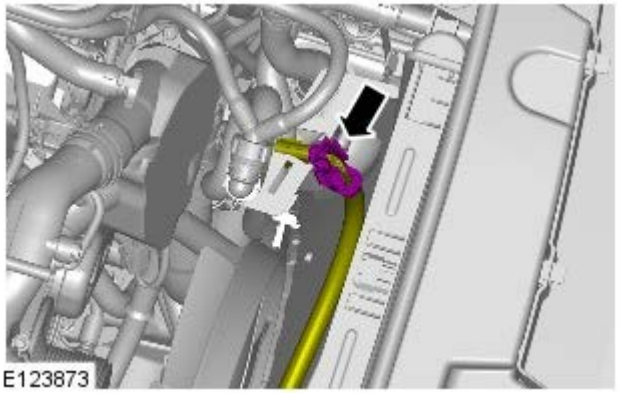
E123875
5.



6.



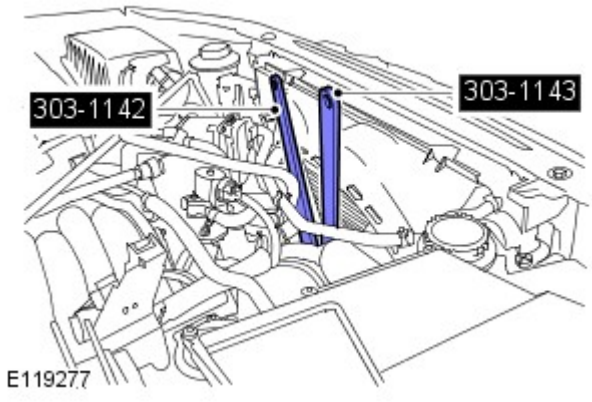
7.



8. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

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

Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm



Installation

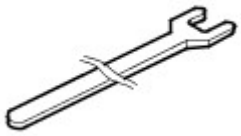
1. To install, reverse the removal procedure.

Published: 07-Nov-2011

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Cooling Fan V8 5.0L Petrol

Removal and Installation

Special Tool(s)

303-1142  E46076	303-1142 Viscous Coupling Wrench
303-1143  E55382	303-1143 Viscous Coupling Holding Tool

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

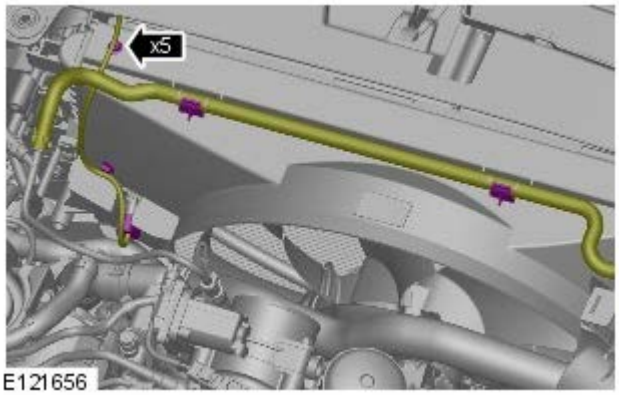
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12 Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

3. Refer to: Air Cleaner Outlet Pipe LH (303-12 Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

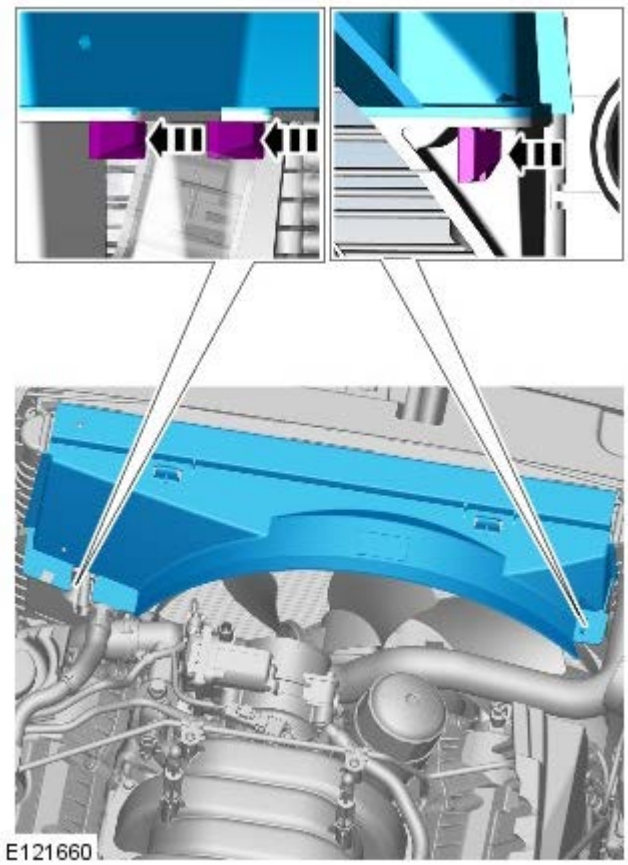
4. Refer to: Air Cleaner Outlet Pipe RH (303-12 Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

5.

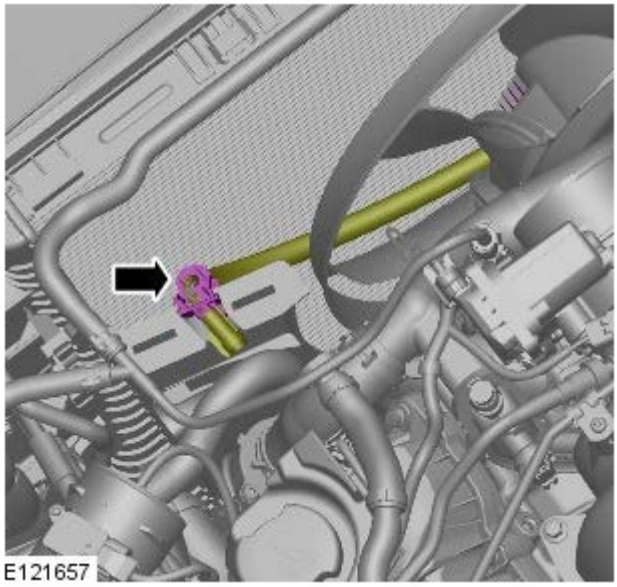


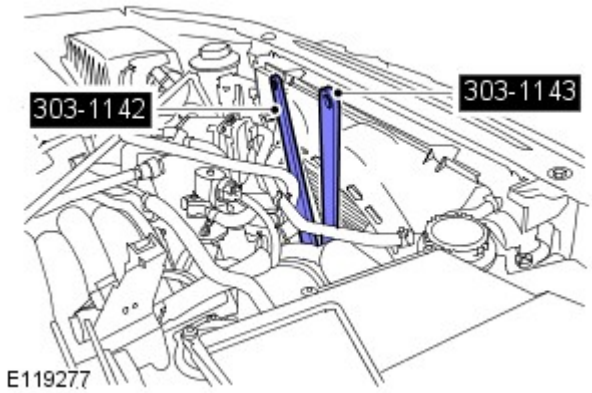
E121656

6.



7.





8. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

NOTES:

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

The thread is left handed.

Special Tool(s): 303-1142, 303-1143
Torque: 65 Nm

Installation

1. To install, reverse the removal procedure.

Published: 24-Sep-2013

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Coolant Pump V8 S/C 5.0L Petrol

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

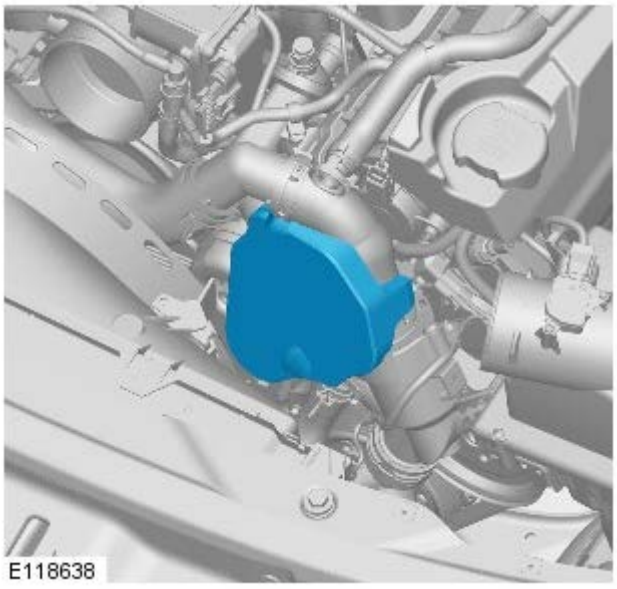
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

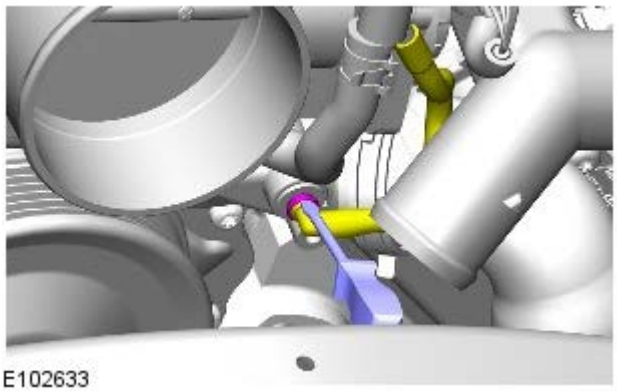
3. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

4. Refer to: Accessory Drive Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

5.

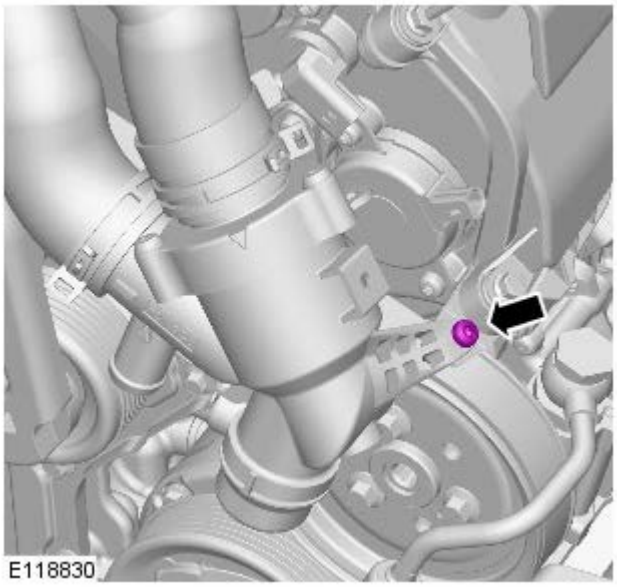


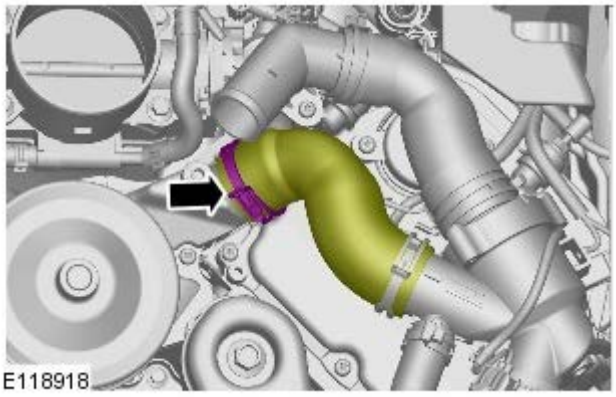
6.

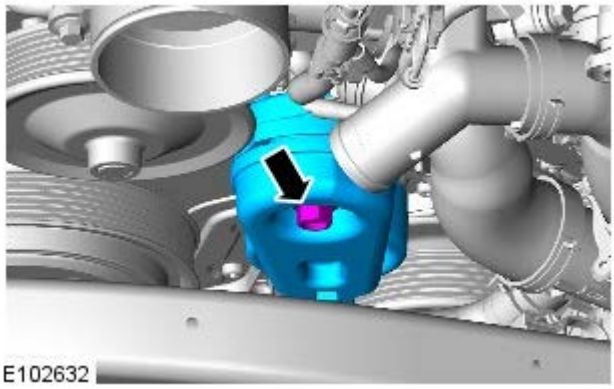


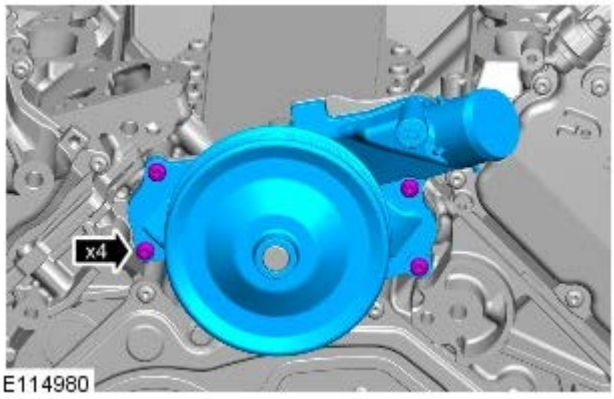
7.

- *Torque:* 10 Nm









8. NOTES:

   The retaining clips cannot be removed from the pipe.

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

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

   - *Torque:* 40 Nm

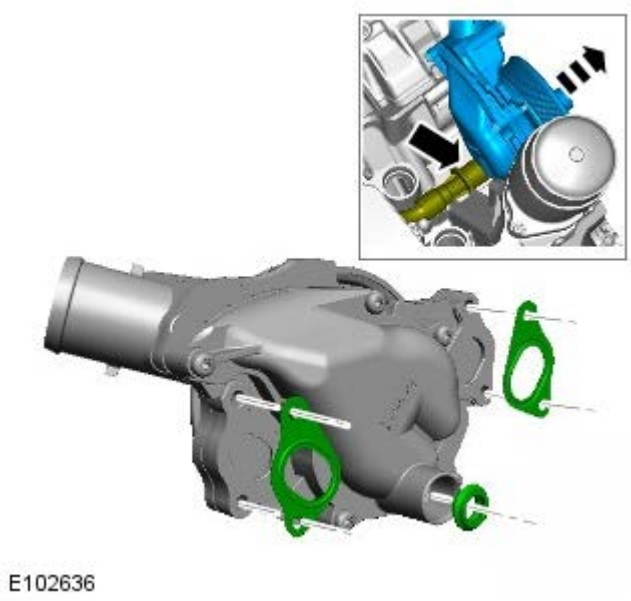
10. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

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

    NOTE: Engine shown removed for clarity.

    - *Torque:* 12 Nm

11. CAUTIONS:



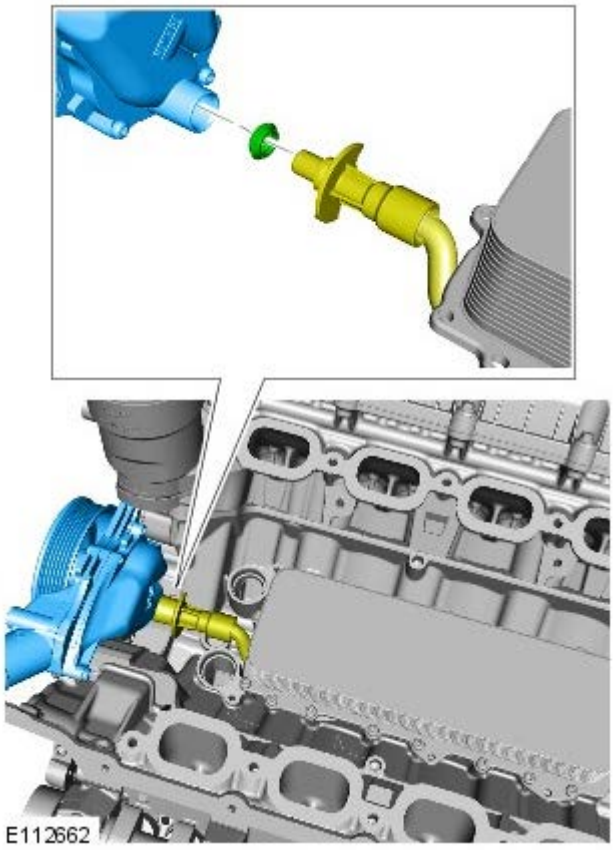
Note the fitted position of the component prior to removal.

A new O-ring seal is to be installed.

NOTE: Install new gaskets.

Installation

1. NOTE: Engine shown removed for clarity.



2. To install, reverse the removal procedure.

Published: 24-Sep-2013

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Coolant Pump V8 5.0L Petrol

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

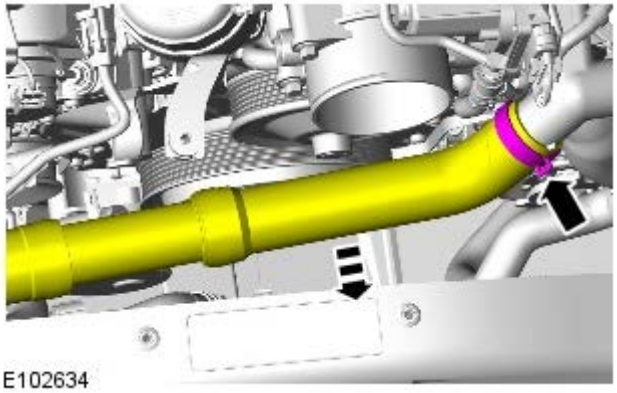
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

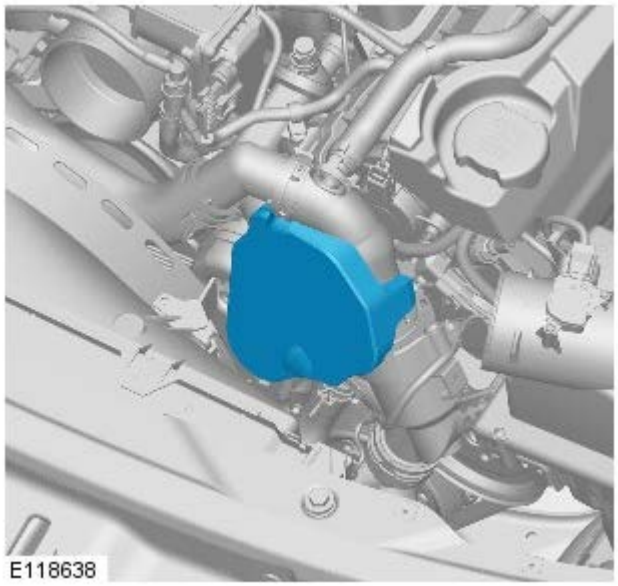
3. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).


E102634

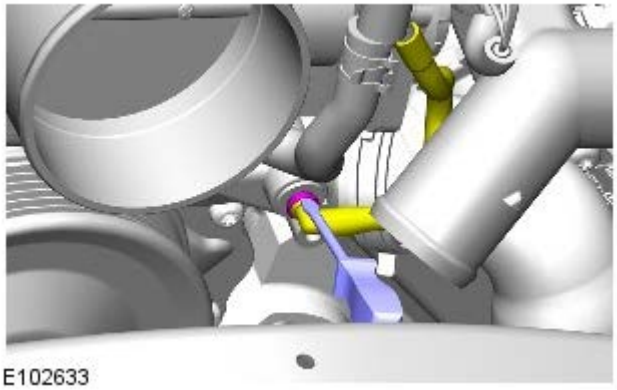
4. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

5. Refer to: Accessory Drive Belt (303-05B Accessory Drive - V8 5.0L Petrol, Removal and Installation).

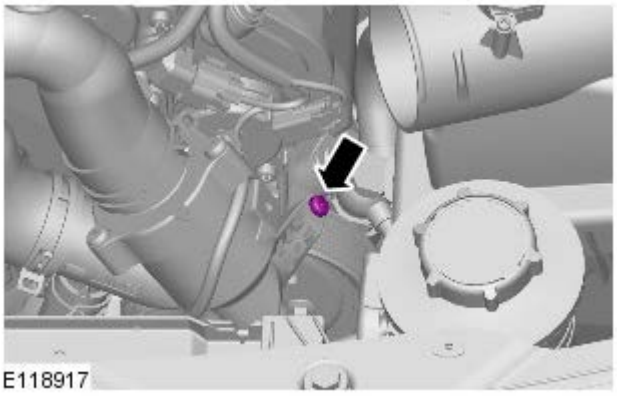
6.


E118638

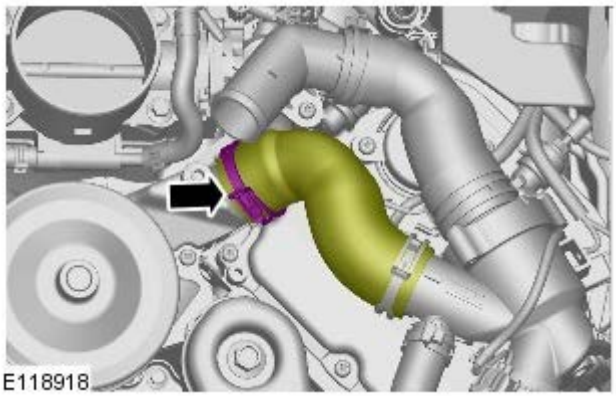
7.


E102633

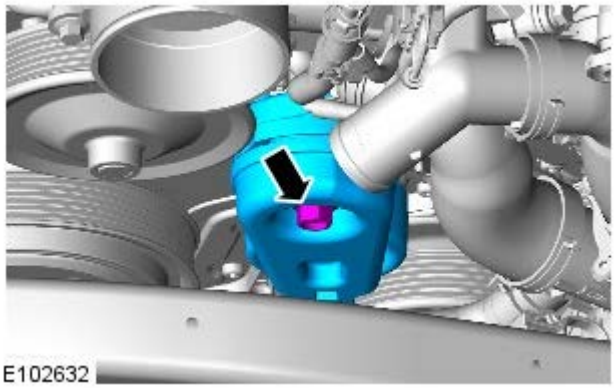
8.
- *Torque:* 10 Nm


E118917

9. NOTE: The retaining clips cannot be removed from the pipe.


E118918

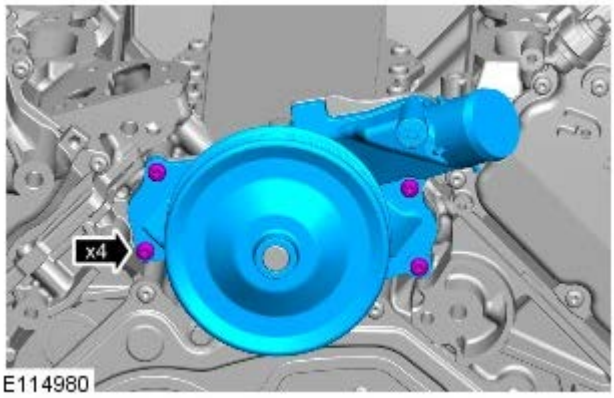
10. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.


E102632

11. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

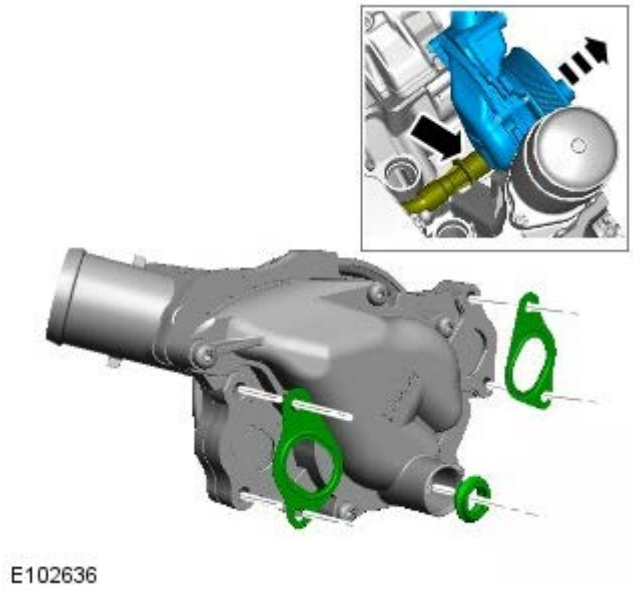
CAUTION: Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

NOTE: Engine shown removed for clarity.



E114980

- *Torque:* 12 Nm


E102636

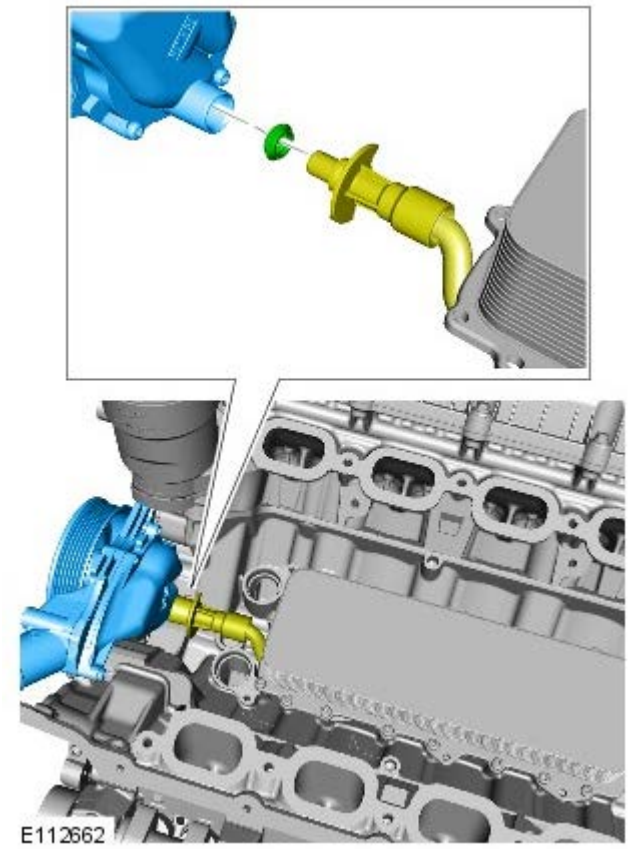
12. CAUTIONS:

Note the fitted position of the component prior to removal.

A new O-ring seal is to be installed.

NOTE: Install new gaskets.

Installation


E112662

1. NOTE: Engine shown removed for clarity.

2. To install, reverse the removal procedure.

Published: 11-May-2011

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Radiator V8 S/C 5.0L Petrol

Removal and Installation

Removal

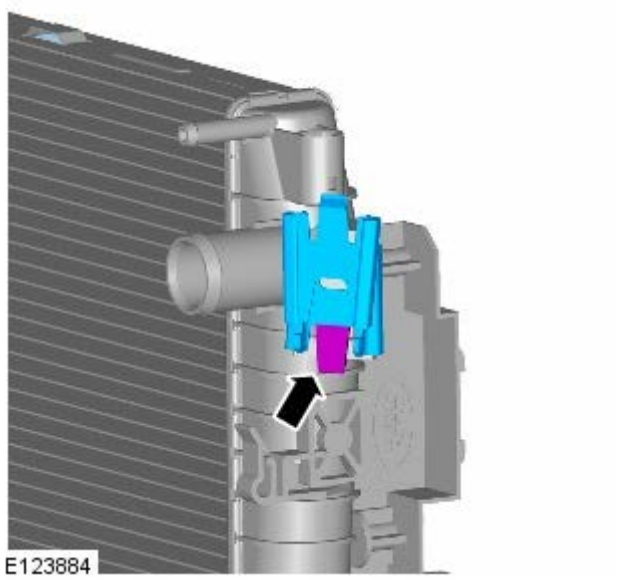
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

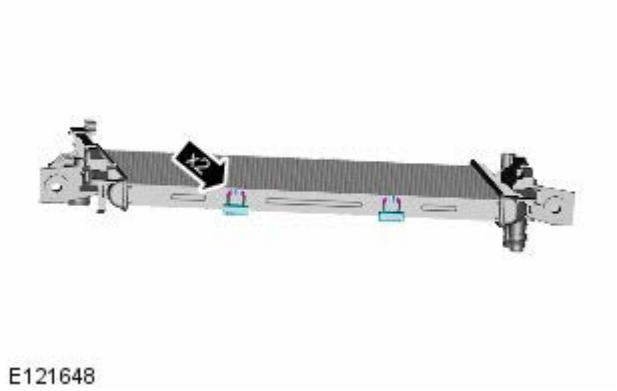
   Raise and support the vehicle.

2. Refer to: Condenser Core - Vehicles With: Supercharger (412-03, Removal and Installation).

3.



4.



Installation

1. To install, reverse the removal procedure.

Published: 25-Nov-2013

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Radiator V8 5.0L Petrol

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

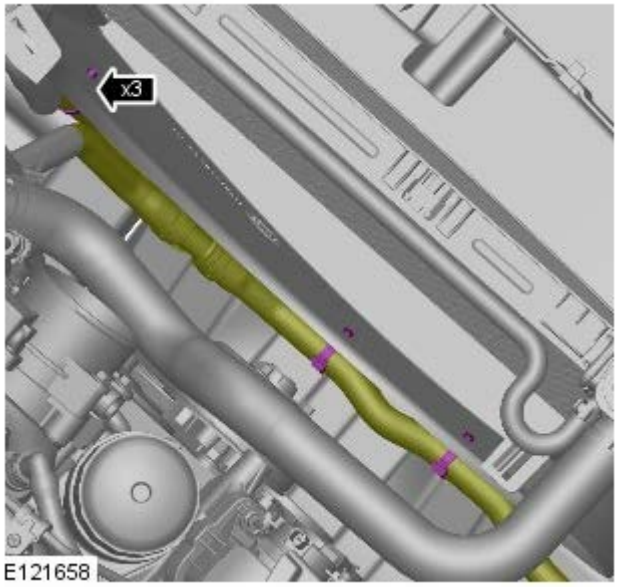
2. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

3. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

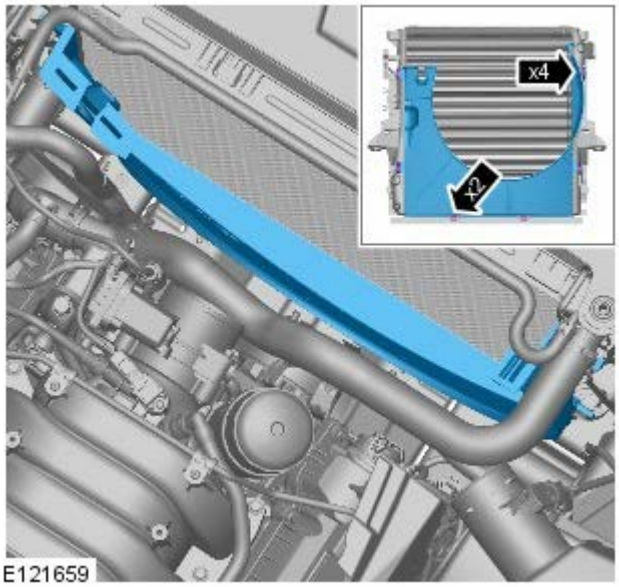
4. Refer to: Radiator Grille (501-08 Exterior Trim and Ornamentation, Removal and Installation).

5. Refer to: Cooling Fan - V8 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

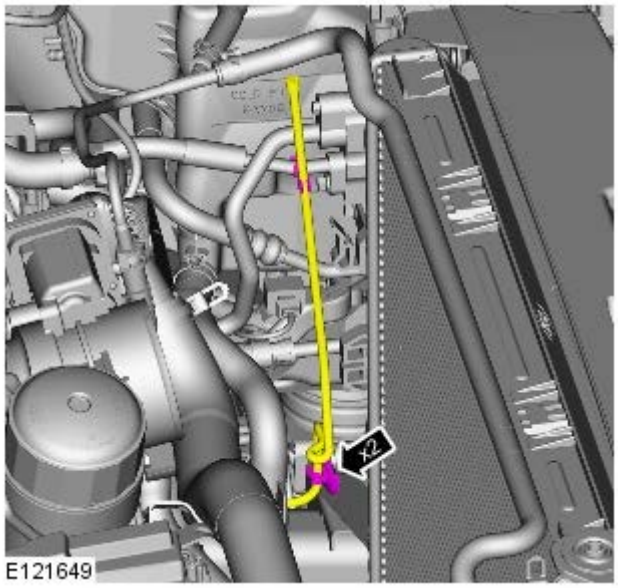
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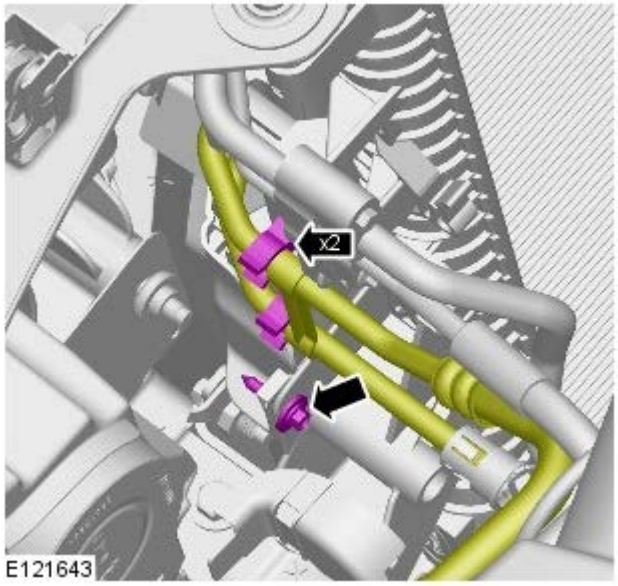
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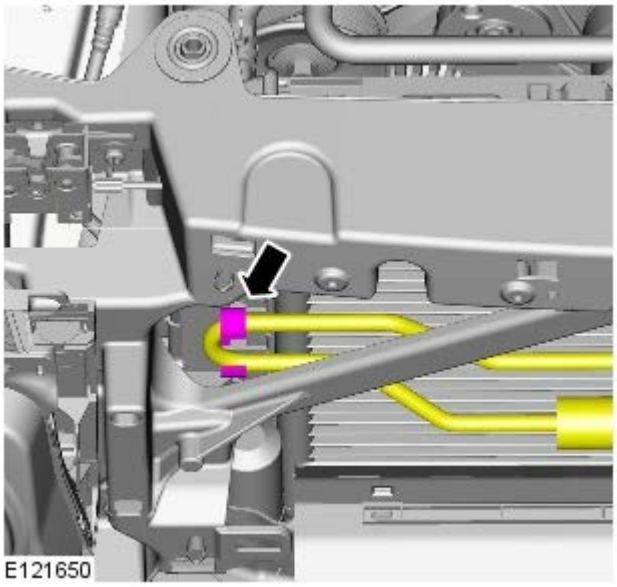
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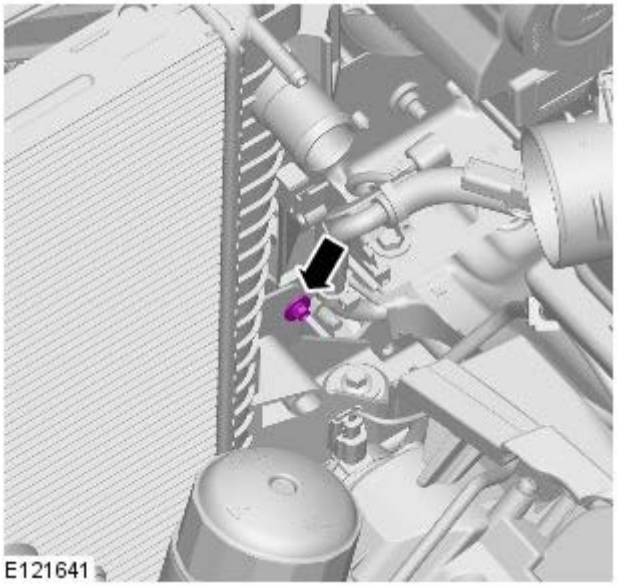
9.



10. CAUTION: Always plug any open connections to prevent contamination.

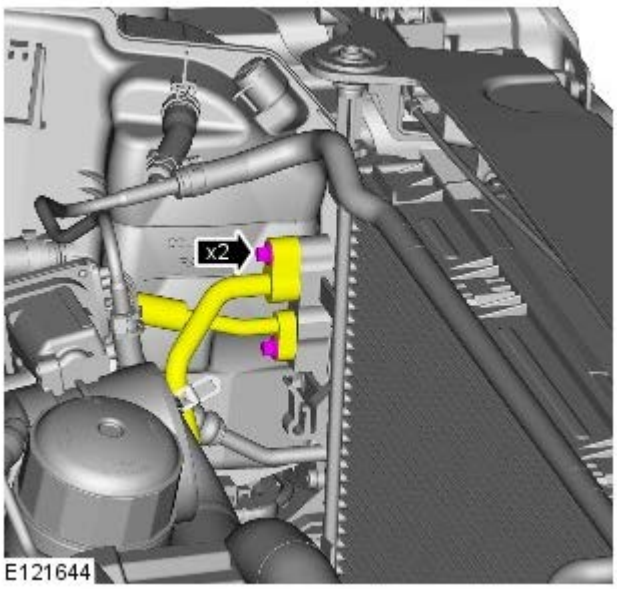


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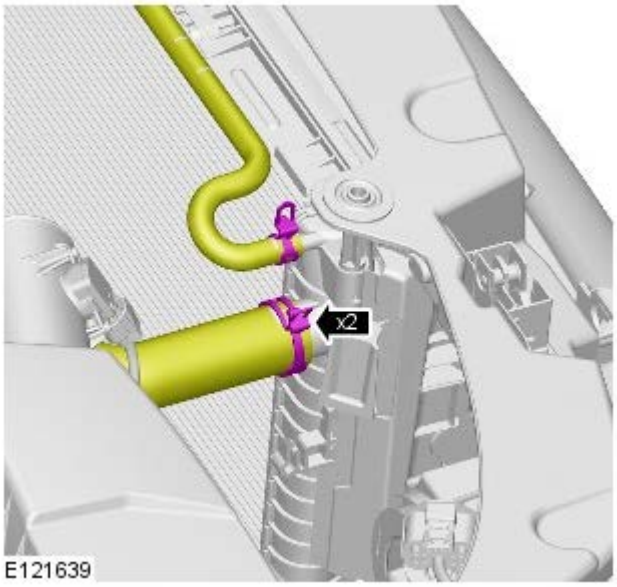


12. CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

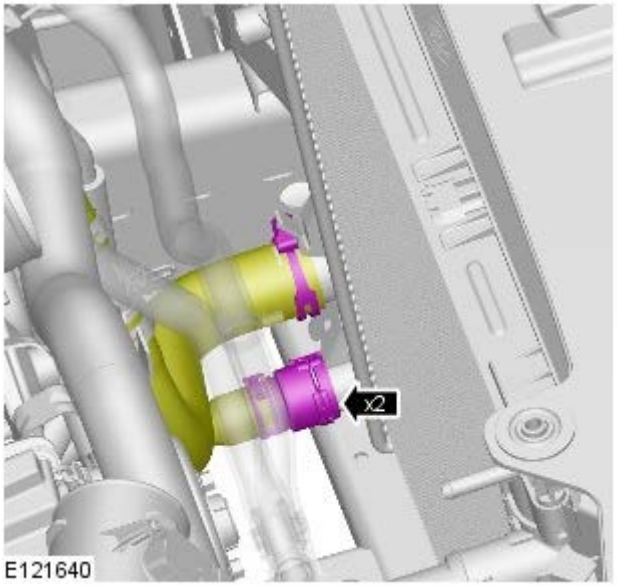
Torque: 10 Nm



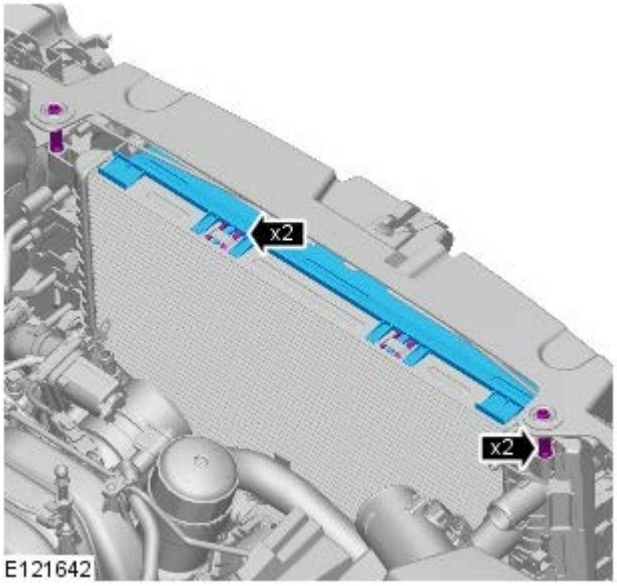
13.



14.

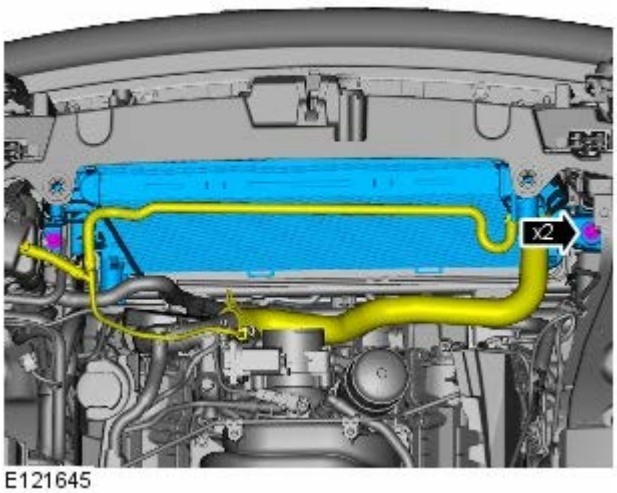


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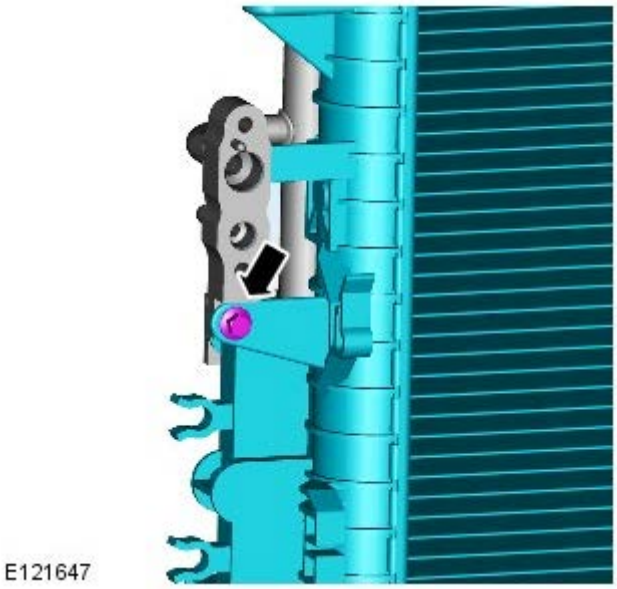


16. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

Torque: 25 Nm



E121645



E121647

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

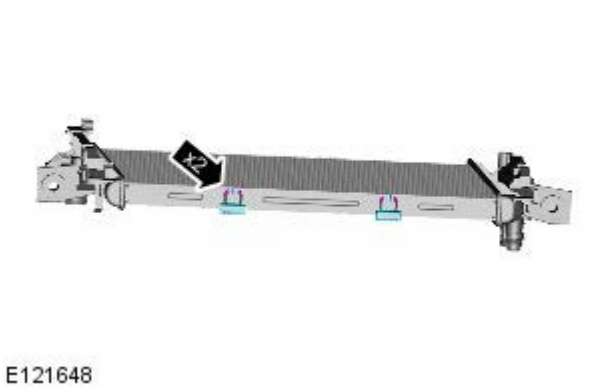
    Torque: 10 Nm

18. *Torque:* 10 Nm



E121646

19.



E121648

Installation

1. To install, reverse the removal procedure.

Published: 25-Nov-2013

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Thermostat Housing V8 S/C 5.0L Petrol

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

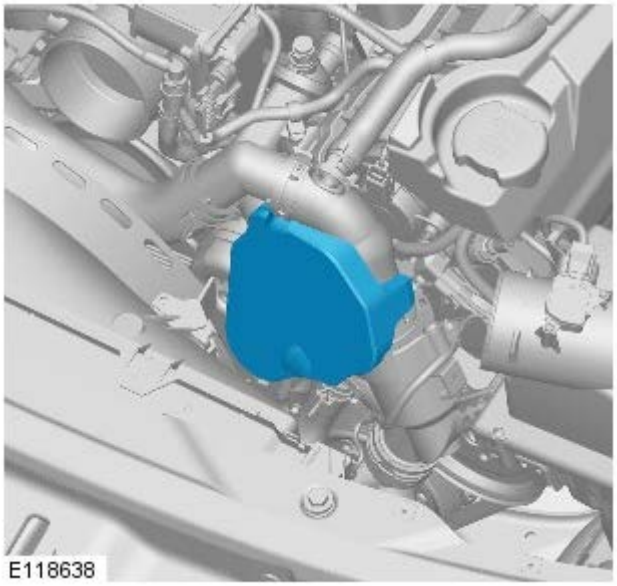
   Raise and support the vehicle.

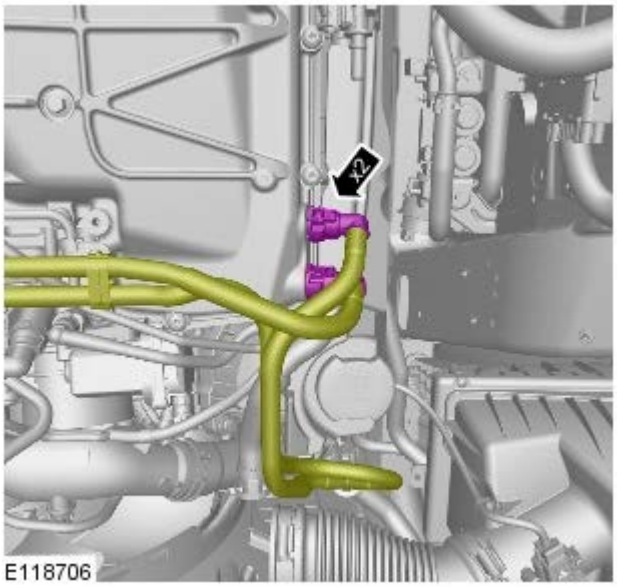
2. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

3. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

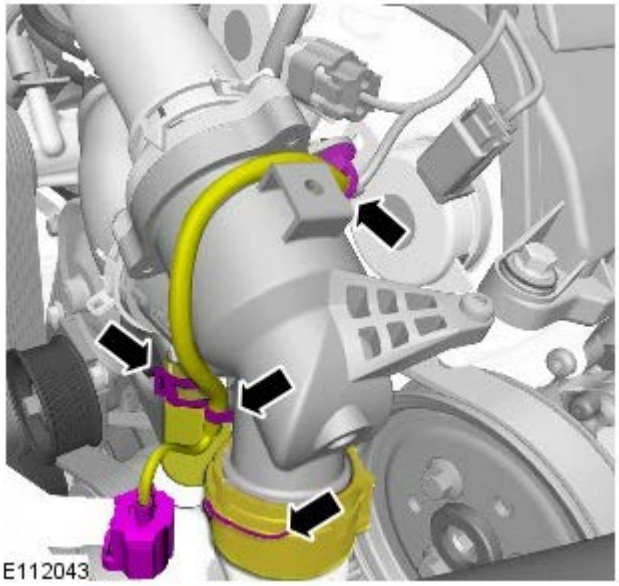
4. Refer to: Air Cleaner Outlet Pipe LH (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

5.

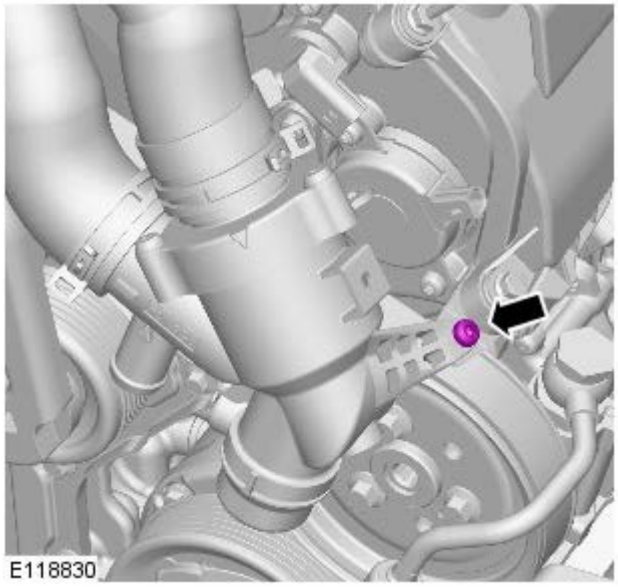




6. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

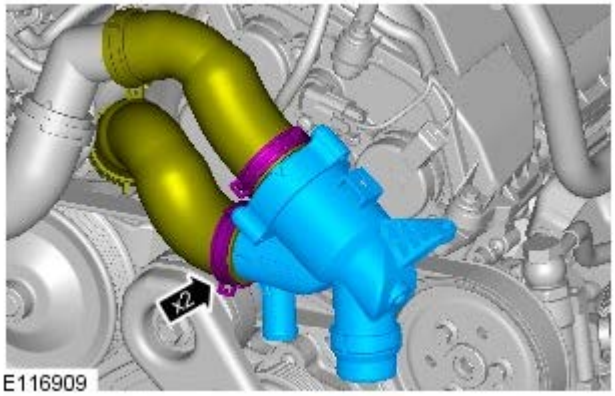


7. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



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

Torque: 10 Nm



9. NOTES:

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

The retaining clips cannot be removed from the pipe.

Installation

1. To install, reverse the removal procedure.

Published: 25-Nov-2013

Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Thermostat Housing V8 5.0L Petrol

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

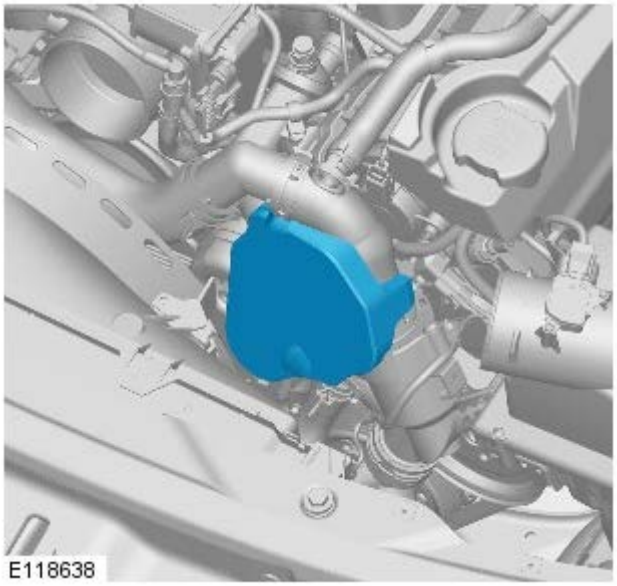
   Raise and support the vehicle.

2. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

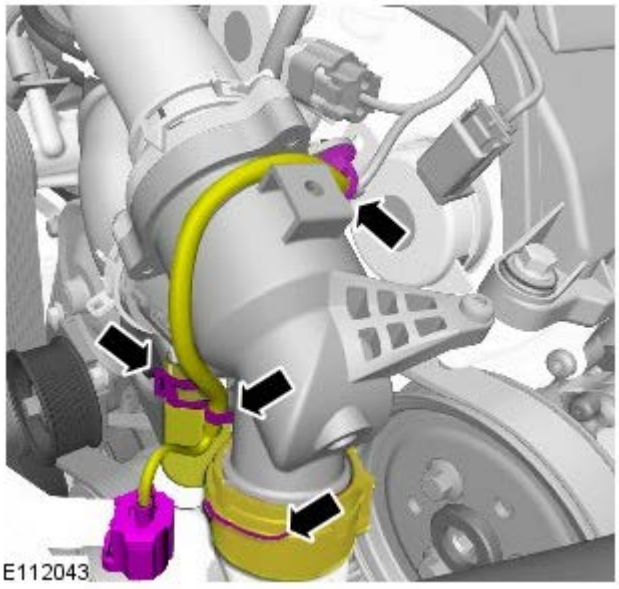
3. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

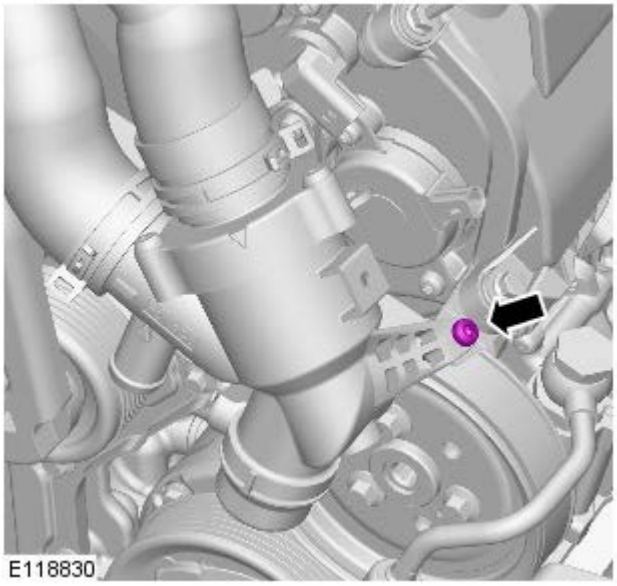
4. Refer to: Air Cleaner Outlet Pipe LH (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

5.



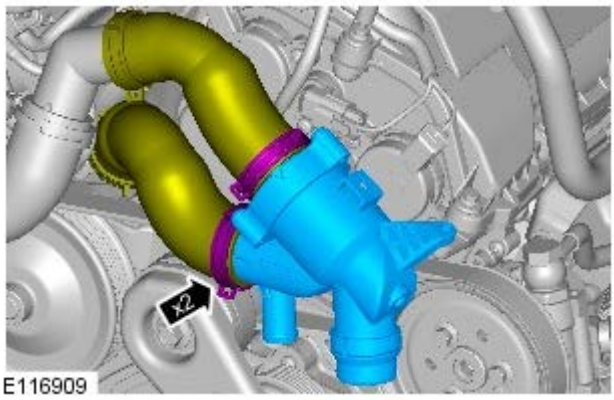
6. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.





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

   Torque: 10 Nm



8. NOTES:

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

   The retaining clips cannot be removed from the pipe.

Installation

1. To install, reverse the removal procedure.

Published: 24-Sep-2013

Supercharger Cooling - V8 S/C 5.0L Petrol -

Torque Specifications

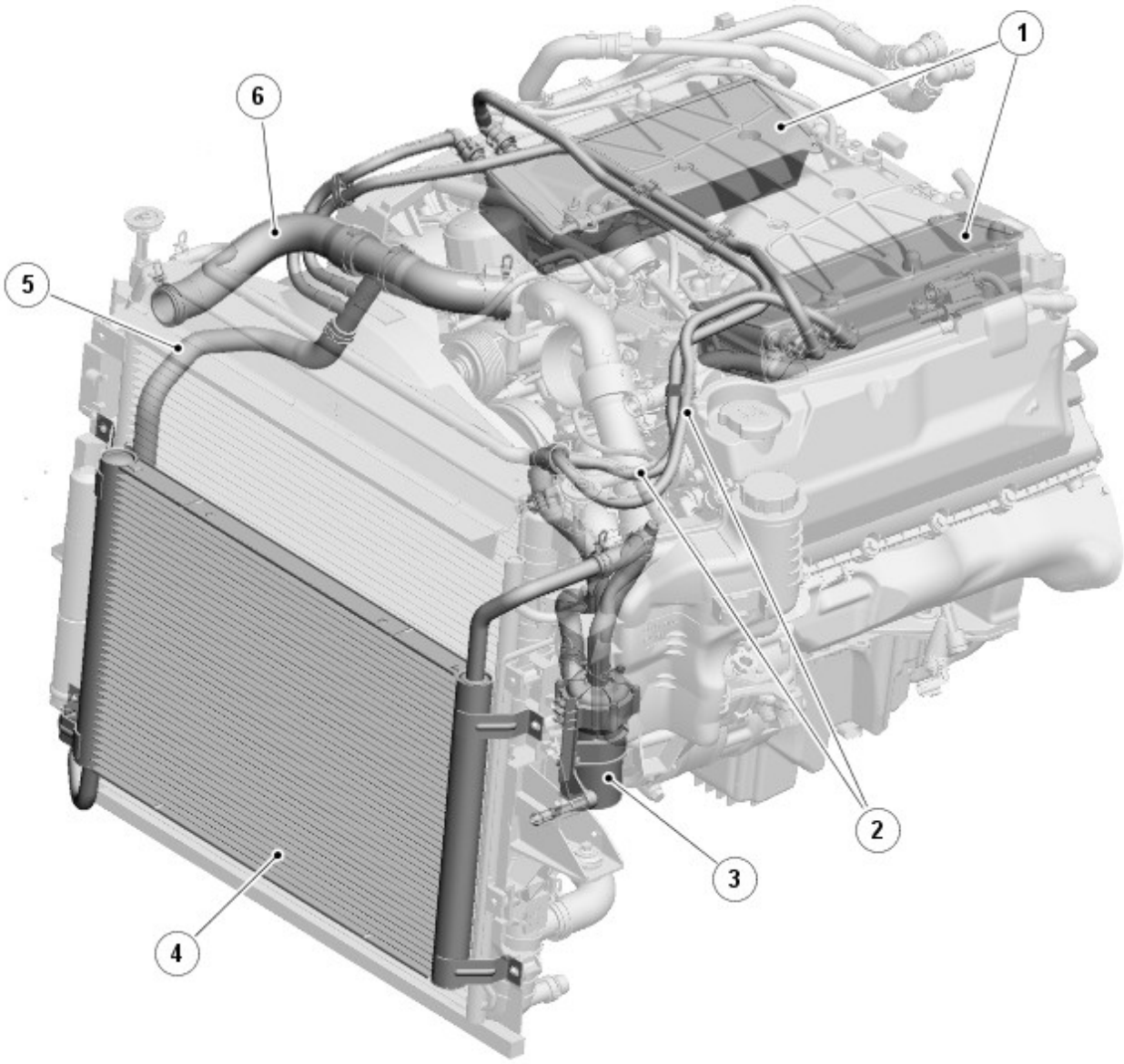
Description	Nm	lb-ft
Charge air cooler coolant pump mounting bracket bolts	6	4
Charge air cooler radiator to radiator bolts	10	7

Published: 11-May-2011

Supercharger Cooling - V8 S/C 5.0L Petrol - Supercharger Cooling

Description and Operation

COMPONENT LOCATION



E121233

Item	Part Number	Description
1	-	Charge air coolers
2	-	Supply hose to charge air coolers
3	-	Charge air coolant pump
4	-	Charge air radiator
5	-	Return hose from charge air coolers
6	-	Radiator upper hose

INTRODUCTION

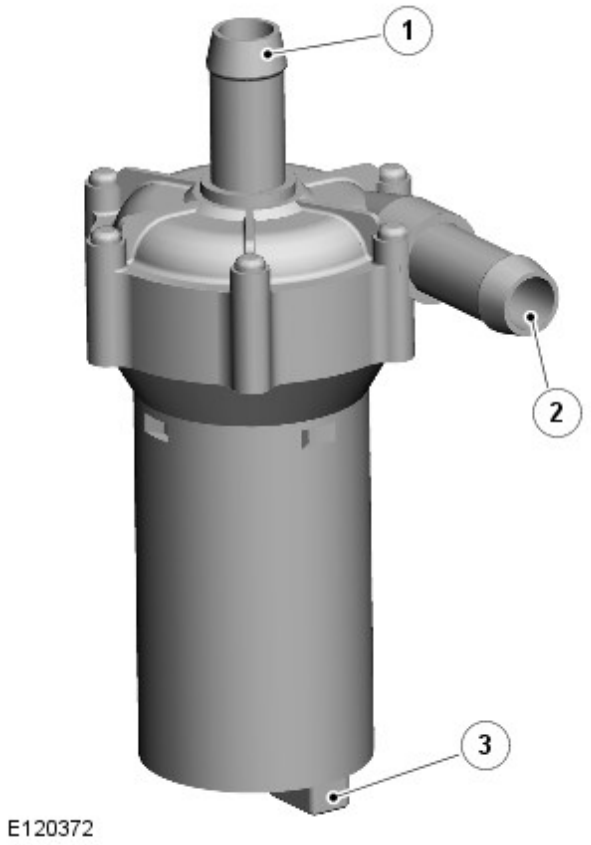
The supercharger cooling system cools the pressurized charge air from the supercharger. The supercharger cooling system consists of:

- A charge air coolant pump.
- A charge air radiator.
- Two charge air coolers.
- Connecting hoses and pipes.

The supercharger cooling system is operationally independent of the engine cooling system, but connected to it at the

radiator upper hose. The connection with the engine cooling system accommodates thermal expansion and retraction of the coolant in the supercharger cooling system, and enables filling and draining of the supercharger cooling system.

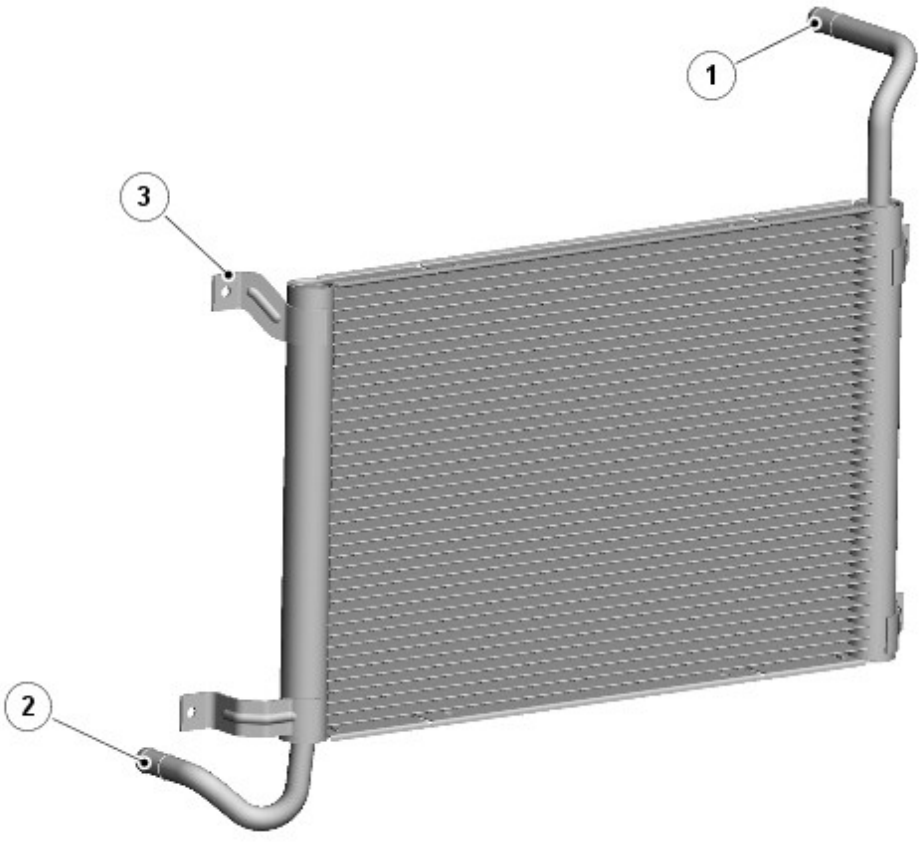
CHARGE AIR COOLANT PUMP



Item	Part Number	Description
1	-	Coolant inlet connection
2	-	Coolant outlet connection
3	-	Electrical connector

The charge air coolant pump is an electric pump installed on the LH (left-hand) side of the cooling module. Hoses connect the inlet of the charge air coolant pump to the charge air radiator, and the outlet to the charge air coolers. An electrical connector provides the interface between the motor of the charge air coolant pump and the vehicle wiring.

CHARGE AIR RADIATOR



Item	Part Number	Description
1	-	Coolant outlet connection
2	-	Coolant inlet connection
3	-	Mounting bracket (4 off)

The charge air radiator is installed at the front of the cooling module and attached to end tanks of the radiator by four mounting brackets.

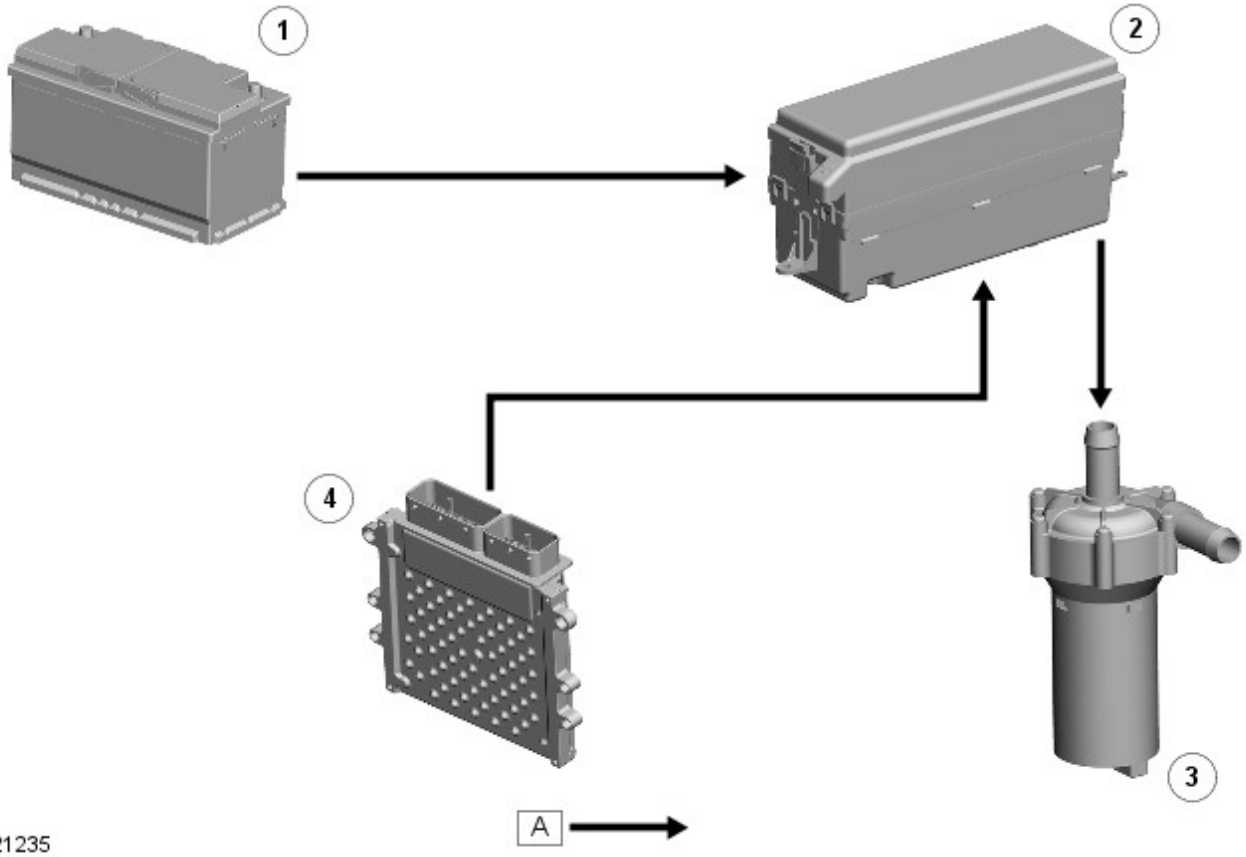
The coolant inlet and outlet connections of the charge air radiator are installed in the RH (right-hand) and LH end tanks respectively. Hoses connect the inlet of the charge air radiator to the charge air coolers, and the outlet to the charge air coolant pump.

CHARGE AIR COOLERS

A charge air cooler is installed in each intake manifold.
For additional information, refer to: Intake Air Distribution and Filtering (303-12D, Description and Operation).

CONTROL DIAGRAM

NOTE: A = Hardwired.

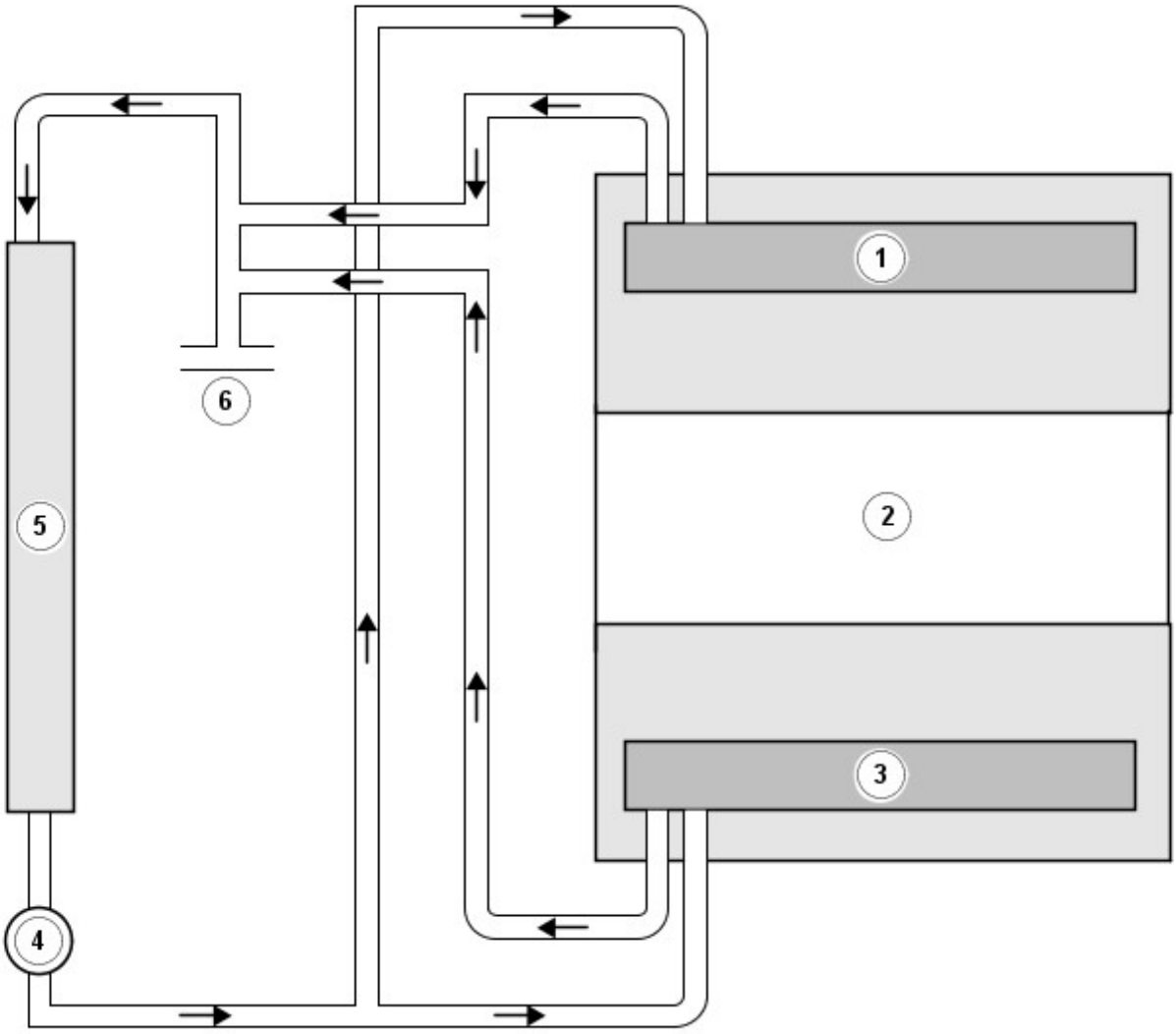


E121235

Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box) (charge air coolant pump relay)
3	-	Charge air coolant pump
4	-	ECM (engine control module)

OPERATION

Supercharger Cooling Flow Diagram



E120374

Item	Part Number	Description
1	-	RH charge air cooler
2	-	Engine
3	-	LH (left hand) charge air cooler
4	-	Charge air coolant pump
5	-	Charge air radiator
6	-	Radiator upper hose

Electrical power for the charge air coolant pump is supplied from the charge air coolant pump relay in the EJB (engine junction box). When the relay is energized, it connects power from the battery to the charge air coolant pump. Operation of the relay is controlled by the ECM (engine control module). The charge air coolant pump relay is energized continuously while the ignition is in power mode 6.

When the charge air coolant pump is running, coolant flows from the pump outlet through the charge air coolers, the charge air radiator and back to the pump inlet.

Published: 15-Aug-2012

Supercharger Cooling - V8 S/C 5.0L Petrol - Supercharger Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the engine cooling system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Supercharger Cooling (303-03C Supercharger Cooling - V8 S/C 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Coolant leaks • Coolant hoses • Coolant expansion tank • Radiator • Heater core • Accessory drive belt • Viscous fan	• Fuses • Harnesses • 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 the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Coolant loss	• Hoses • Hose connections • Radiator • Water pump • Heater core • Gaskets • Engine casting cracks • Engine block core plugs	• Carry out a visual inspection. If there are no obvious leaks, carry out a cooling system pressure test. Rectify any leaks as necessary
Overheating	• Low/contaminated coolant • Thermostat • Viscous fan • ECT sensor • Restricted air flow over the radiator	• Check the coolant level and condition. Carry out a cooling system pressure test. Rectify any leaks as necessary • Test the thermostat and rectify as necessary • Test the viscous fan operation, make sure the viscous fan rotates freely. Rectify as necessary • Check for obstructions to the air flow over the radiator. Rectify as necessary
Engine not reaching normal temperature	• Thermostat • Viscous fan • Thermostat • Electric fan • Fan speed module	• Test the thermostat and rectify as necessary • Test the viscous fan operation, make sure the viscous fan rotates freely

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 11-May-2011

Supercharger Cooling - V8 S/C 5.0L Petrol - Coolant Pump

Removal and Installation

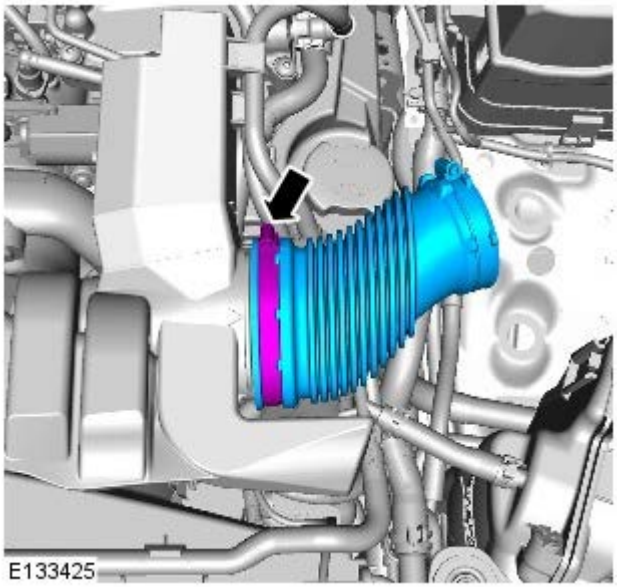
Removal

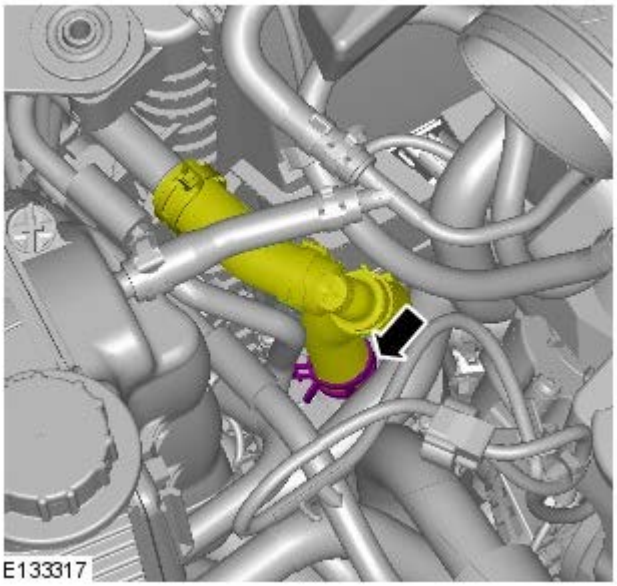
WARNING: Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure.

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

NOTE: This procedure covers the removal and installation of the supercharger auxiliary coolant pump.

1. Refer to: Specifications (414-00, Specifications).
2. Refer to: Engine Cover - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133 (501-05, Removal and Installation).
3. Refer to: Air Cleaner LH (303-12 Intake Air Distribution and Filtering - 5.0L SC V8 - AJ133, Removal and Installation).
4.





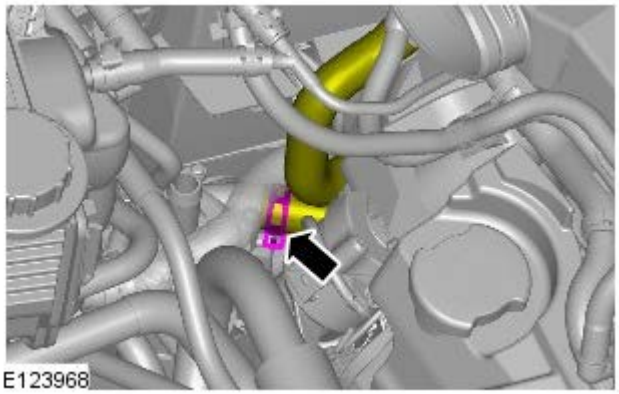
5. CAUTIONS:

   Be prepared to collect escaping coolant.

   Make sure that all openings are sealed. Use new blanking caps.

   NOTE: Clamp both auxiliary coolant pump coolant hoses to minimize coolant loss.

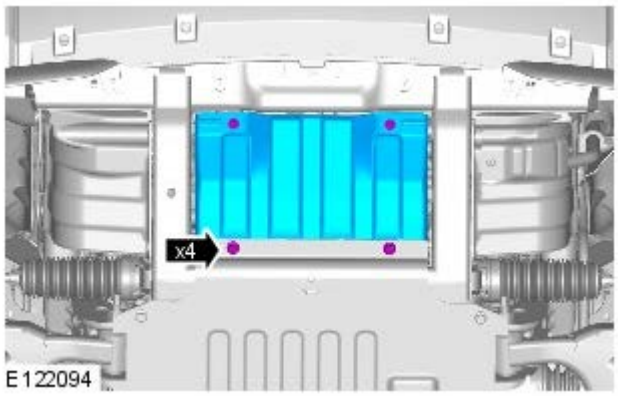
6. CAUTION: Be prepared to collect escaping coolant.



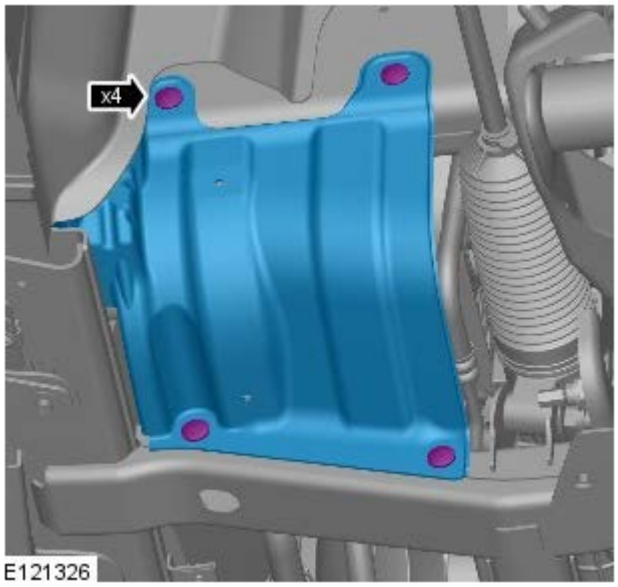
7. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

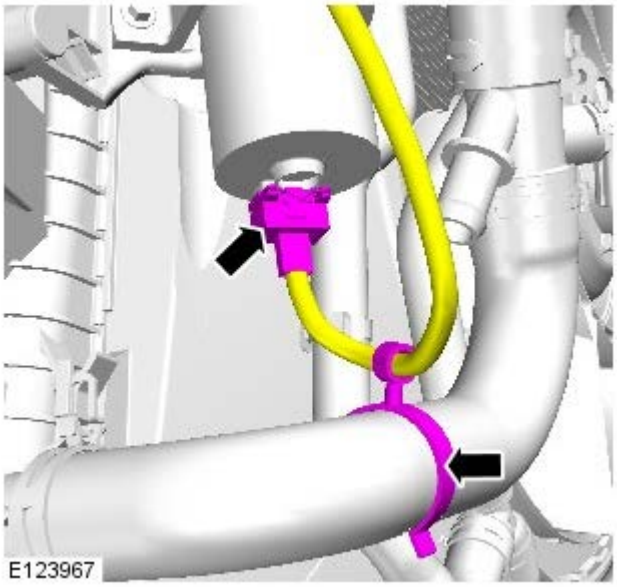
8.



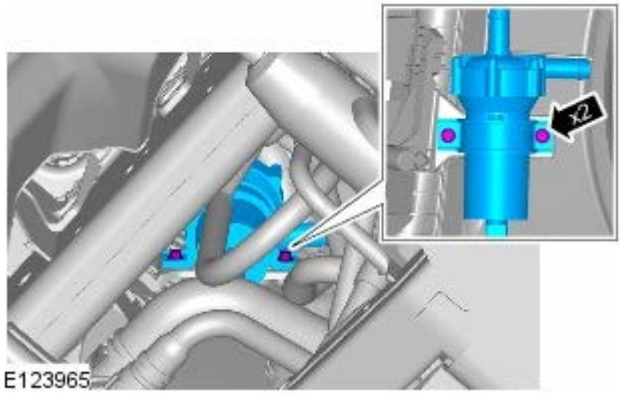
9.



10.

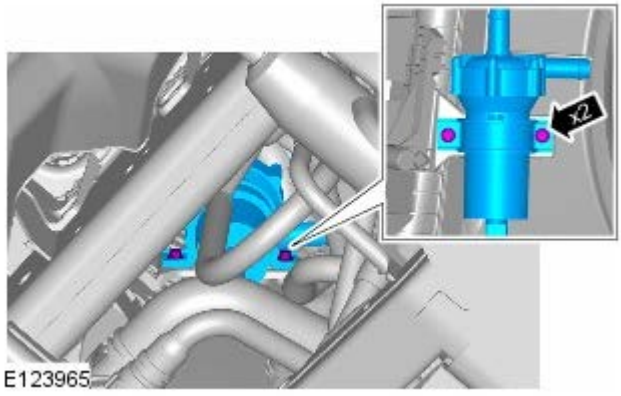


11.

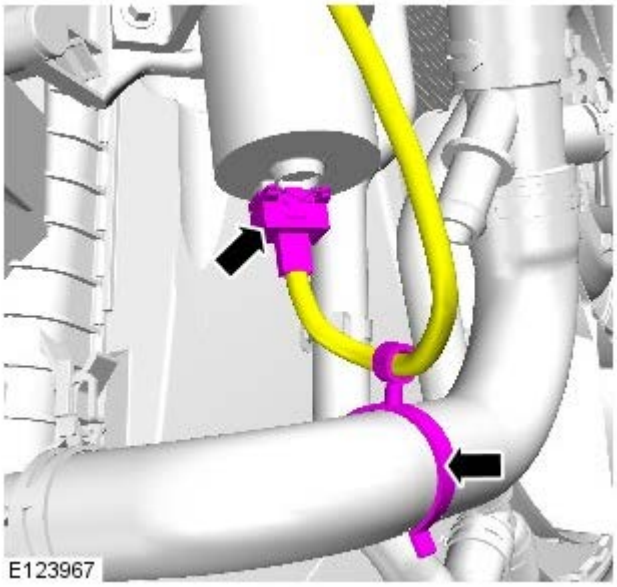


Installation

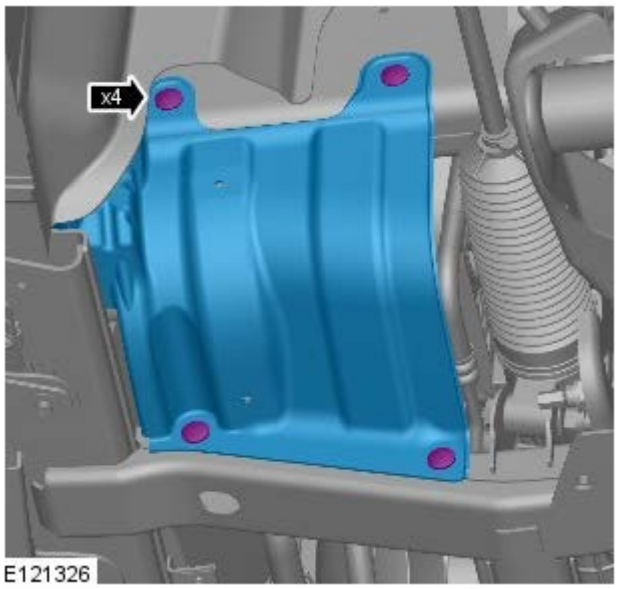
1. *Torque:* 6 Nm



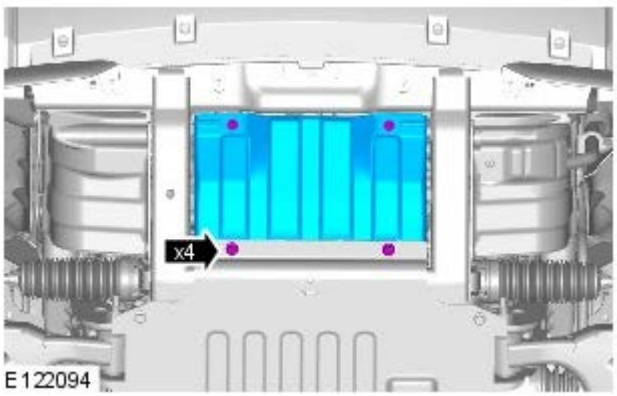
2.



3.

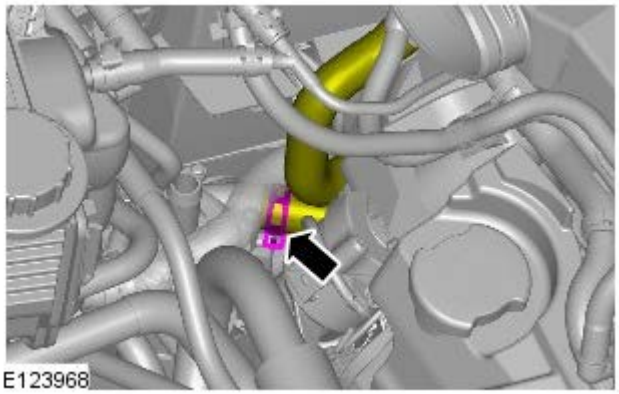


4. *Torque:*
   M6 10 Nm
   M10 62 Nm

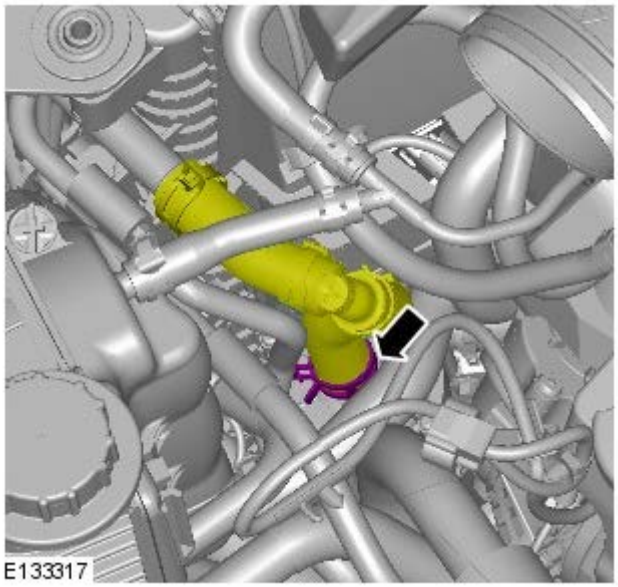


5. Lower the vehicle.

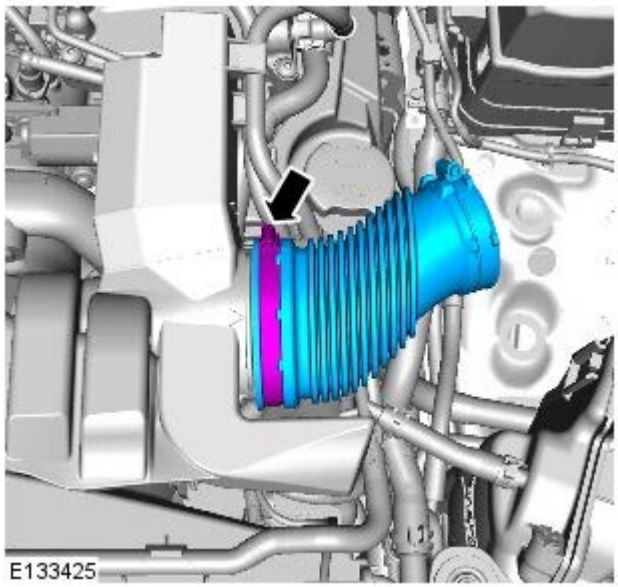
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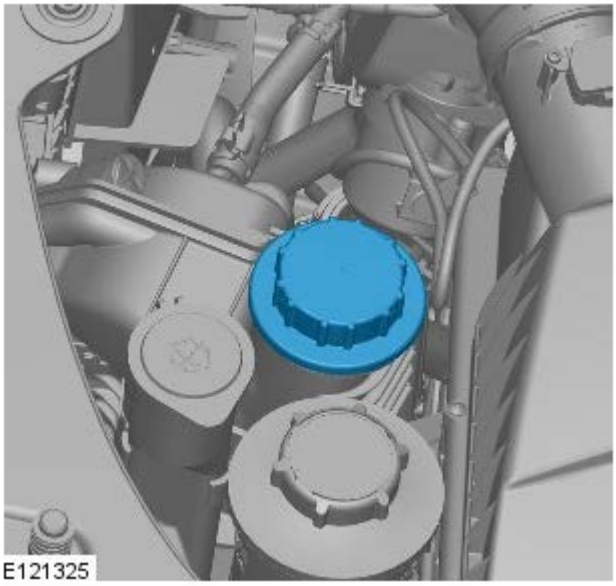


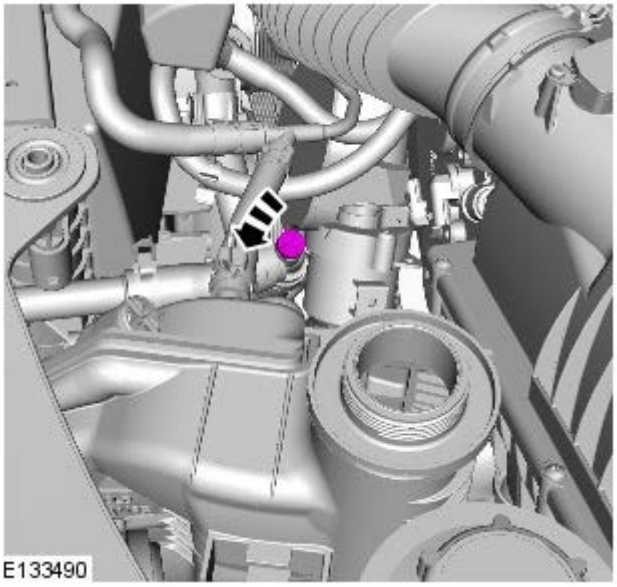
8. *Torque:* 3.5 Nm



9. Refer to: Air Cleaner LH (303-12 Intake Air Distribution and Filtering - 5.0L SC V8 - AJ133, Removal and Installation).

10.





11. When coolant runs from the bleed point bubble-free, tighten the bleed screw.

12. Check and top-up the coolant.

13. Refer to: Specifications (414-00, Specifications).

14. CAUTION: Damage to the charge air cooler coolant pump will occur if the pump is allowed to cavitate.

    NOTE: With the ignition on the charge air coolant pump will run, to aid coolant bleed. Make sure the charge air coolant pump is primed prior to running the pump.

    Start the engine and allow to run for 30 seconds, stop the engine.

15. Check and top-up the coolant.

16. Refer to: Engine Cover - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133 (501-05, Removal and Installation).

Published: 11-May-2011

Supercharger Cooling - V8 S/C 5.0L Petrol - Radiator

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

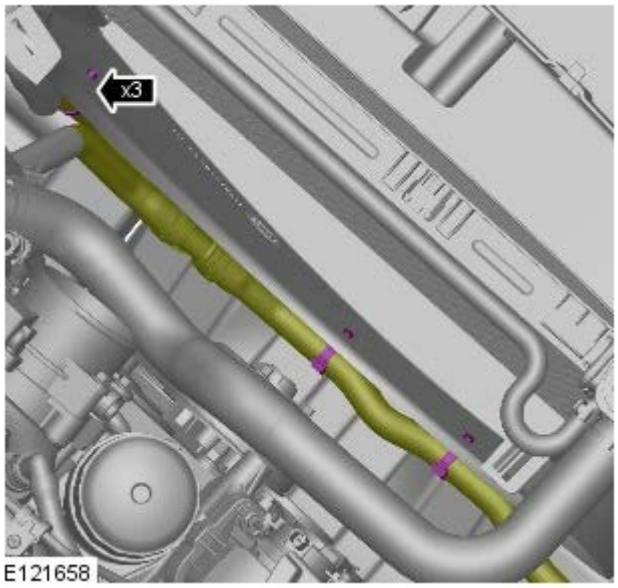
2. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).

3. Refer to: Radiator Grille (501-08, Removal and Installation).

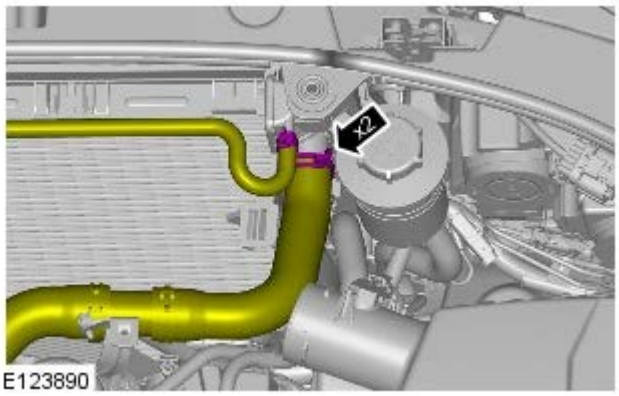
4. Refer to: Coolant Pump (303-03, Removal and Installation).

5. Refer to: Cooling Fan - Vehicles With: Supercharger (303-03, Removal and Installation).

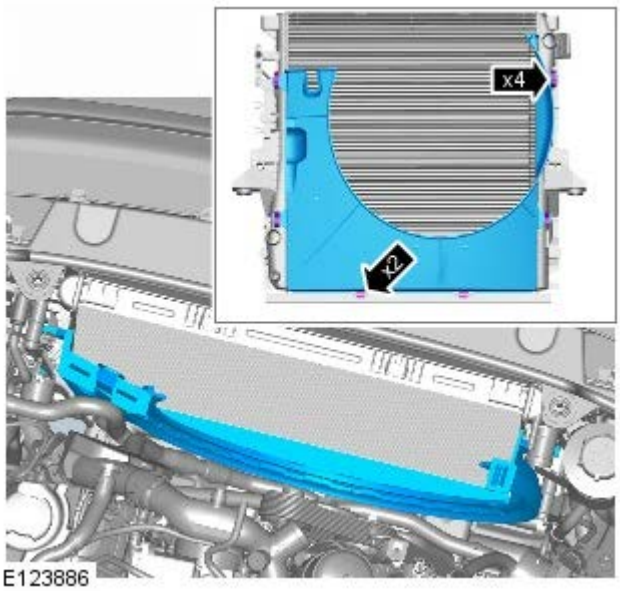
6. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



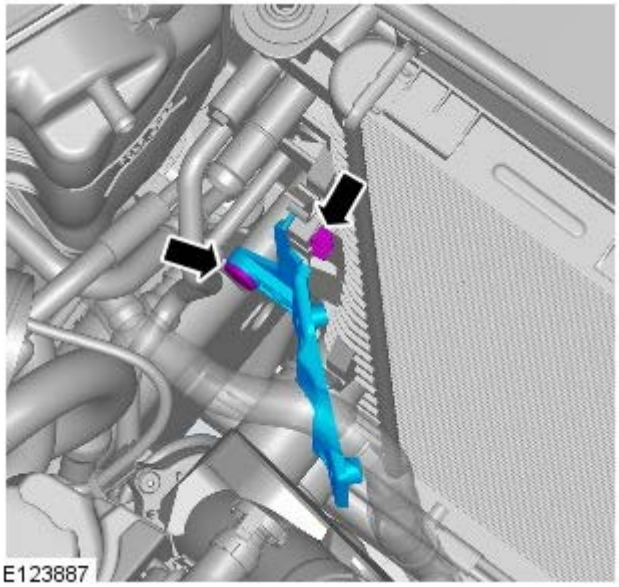
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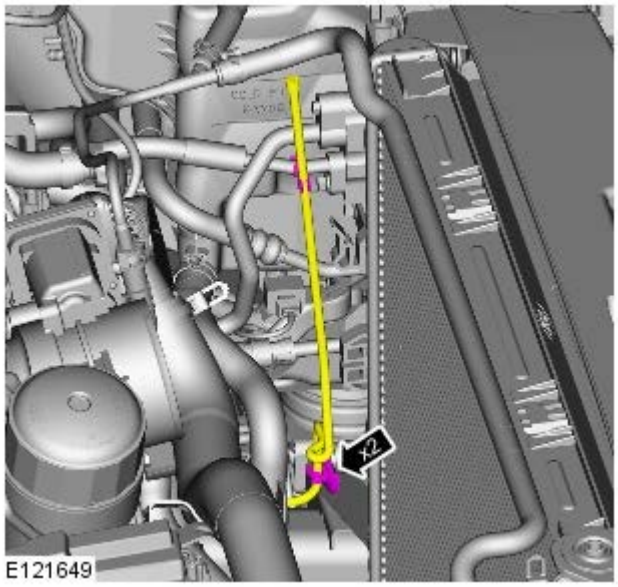
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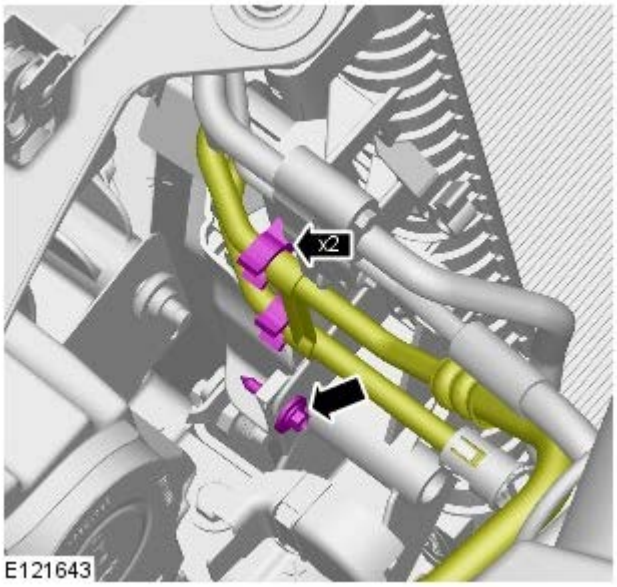
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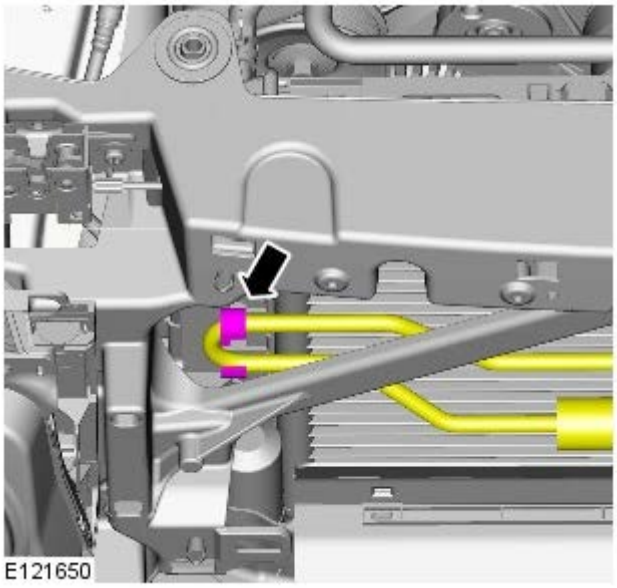


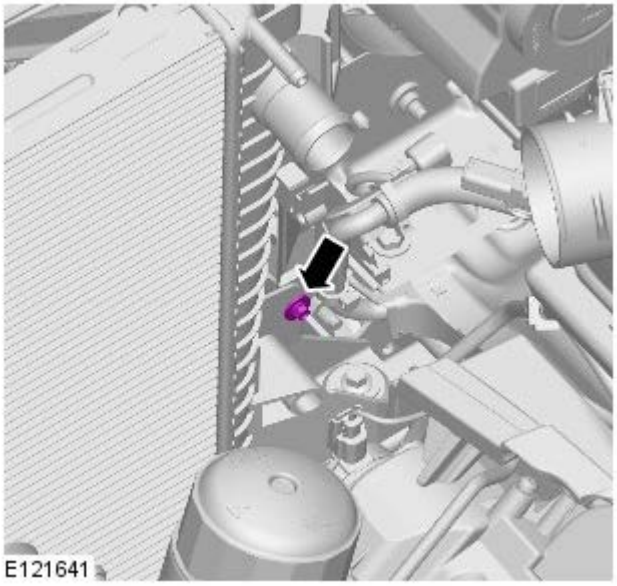
10.



11. *Torque:* 9 Nm







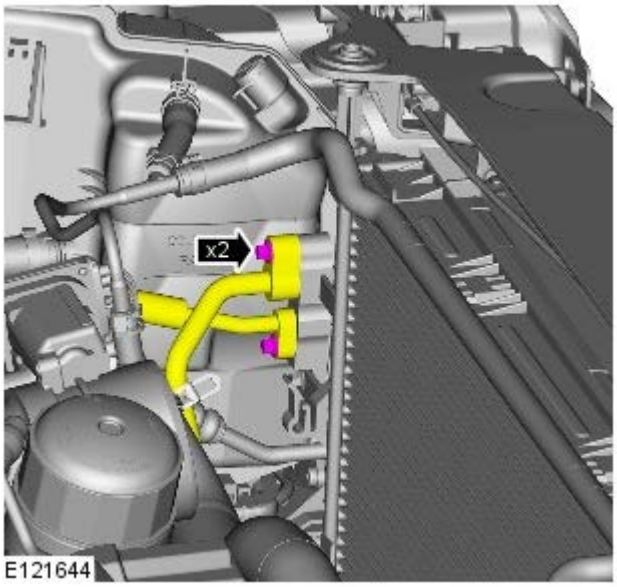
12. CAUTION: Always plug any open connections to prevent contamination.

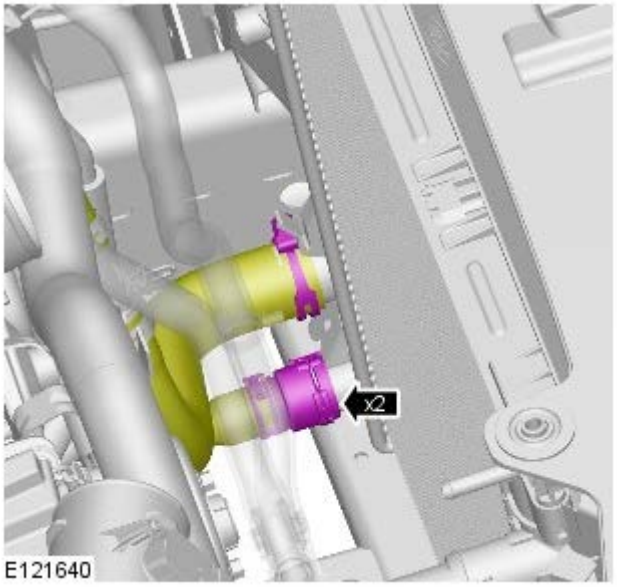
13. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 9 Nm

14. 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.

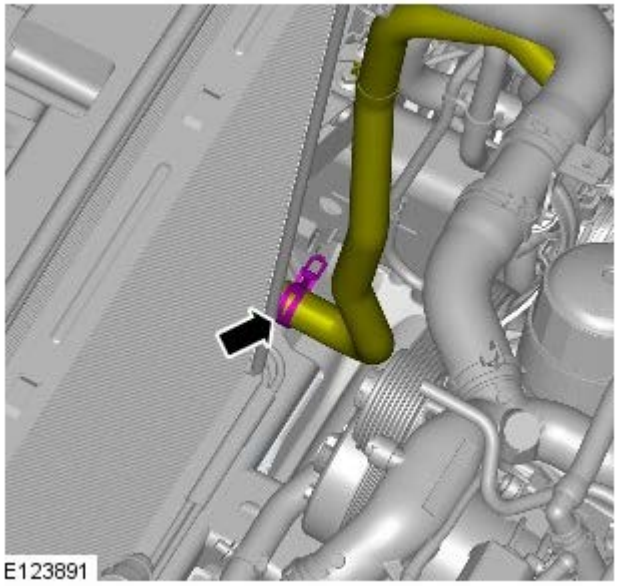
Torque: 10 Nm





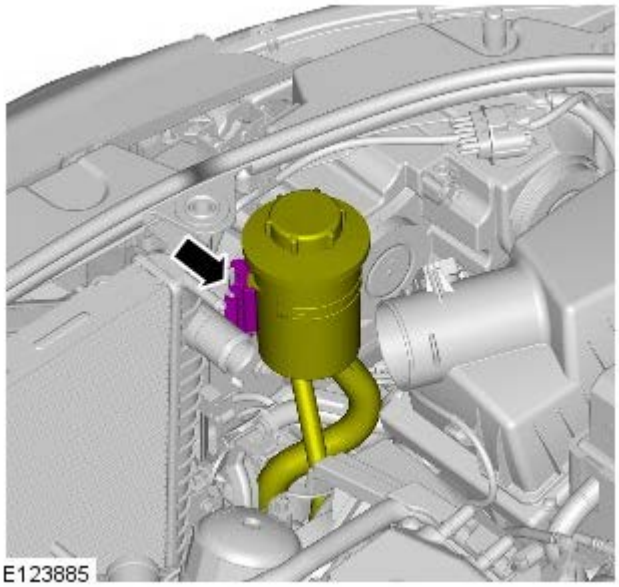
15. CAUTION: Be prepared to collect escaping coolant.

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

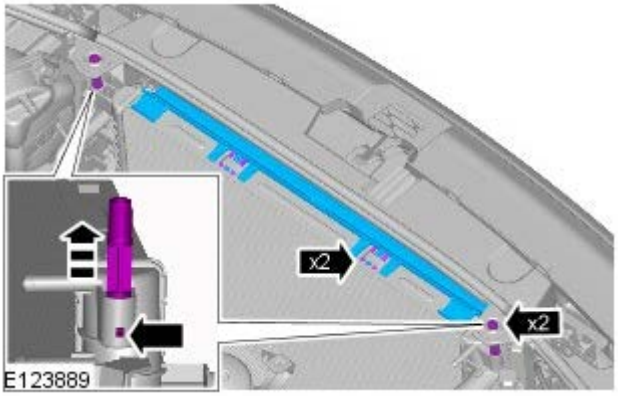


16. CAUTION: Be prepared to collect escaping coolant.

17.

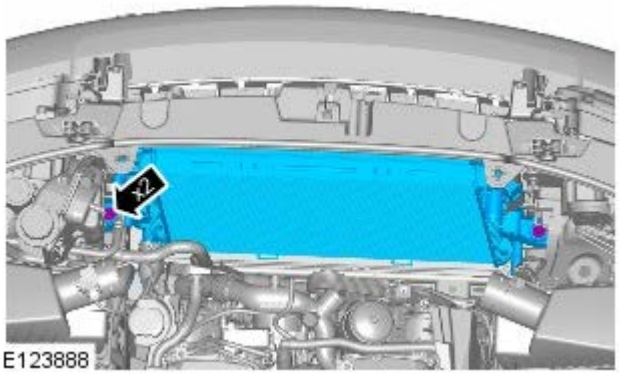


18.



19. CAUTION: Always protect the cooling pack elements to prevent accidental damage.

Torque: 25 Nm



20. *Torque:* 10 Nm



E123892

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Fuel Charging and Controls - TDV6 3.0L Diesel -

Torque Specification

NOTE: A = refer to procedure for the correct torque sequence.

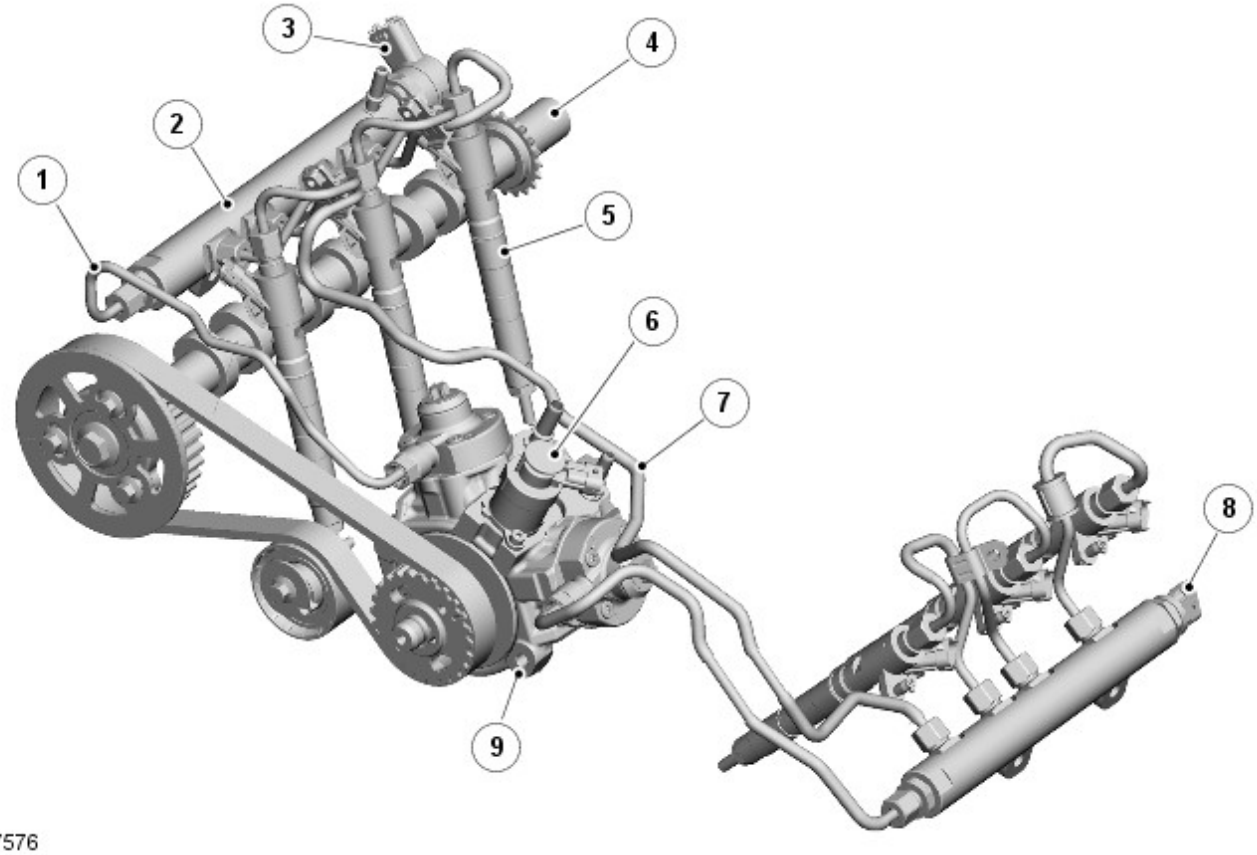
Description	Nm	lb-ft	lb-in
Fuel injection pump cradle bolts	23	16	-
Fuel injection pump retaining bolts	23	16	-
Fuel injection pump bracket	9	-	80
Fuel injection pump sprocket bolt	50	37	-
Inlet manifold retaining bolts	9	-	80
Fuel injection pump belt rear cover retaining bolts	9	-	80
Camshaft rear end accessory drive (READ) pulley hub retaining bolt	A	-	-
Fuel injection pump belt tensioner retaining bolt	23	16	-
Camshaft READ pulley retaining bolt	A	-	-
Fuel rail bracket retaining bolts	23	16	-
Fuel injector retaining bolts	10	-	-
Fuel rail retaining bolts	25	-	-
High-pressure fuel line bracket retaining bolts	9	-	80
High-pressure fuel line union nuts	A	-	-
Fuel rail supply tube union nuts	A	-	-
Fuel crossover line union nuts	A	-	-
Exhaust gas recirculation (EGR) valve retaining bolts	9	-	80

Published: 07-Nov-2013

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Charging and Controls - Component Location

Description and Operation

Component Location



E107576

Item	Description
1	High pressure fuel supply
2	Common fuel rail
3	Fuel pressure control valve
4	Exhaust camshaft
5	Injectors
6	Volume control valve
7	Fuel rail balance pipe
8	Fuel pressure sensor
9	High pressure fuel pump

Published: 07-Nov-2013

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Charging and Controls - Overview

Description and Operation

OVERVIEW

The 3.0L V6 diesel engine is equipped with a HP (high pressure) common rail fuel injection system. With this fuel injection process, a HP pump delivers a uniform level of pressure to the shared fuel lines (the common rails), which serve all 6 fuel injectors. Pressure is controlled to the optimum level for smooth operation.

The common rail system supports a pre and pilot injection depending on engine operating conditions, which reduces combustion noise levels, more commonly referred to as 'diesel knock'.

Fuel injection pressure is generated independently of engine speed and fuel injection events.

The fuel injection timing and volume are calculated by the ECM (engine control module), which then energizes the appropriate piezo actuated injector. The common rail fuel injection system has the following features:

- High fuel injection pressures of up to 2000 bar (29007 lbf/in^2) for greater atomization of fuel (increasing performance and lowering emissions).
- Variable injection to optimize combustion in all engine operating conditions
- Low tolerances and high precision throughout the life of the system.

The fuel system is divided into two sub systems:

- LP (low pressure) system
- HP system.

The LP system features the following components:

- In-tank fuel pump
- Fuel pressure regulator (integral to the fuel delivery module)
- Fuel filter
- Return pipes
- Injector return pipes
- Fuel coolers (engine and vehicle).

The LP system is regulated to 0.5 bar (7.25 lbf/in^2).

The HP system features the following components:

- HP pump
- Fuel rails and diverter rail
- HP fuel pipes
- Injectors.

Published: 31-Oct-2011

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Charging and Controls - System Operation and Component Description

Description and Operation

System Operation

ENGINE STARTING

During starting, the fuel rail pressure must be at least 150 bar (2175 lbf/in^2). Should the pressure be below this figure, the injectors will not operate, resulting in the vehicle not starting.

ENGINE STOPPING

To stop the engine the ECM (engine control module) stops energizing the actuators in the fuel injectors, therefore, no fuel is injected and the engine speed drops to zero.
Refer to: Electronic Engine Controls (303-14A Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

HP FUEL PUMP

When the HP fuel pump is rotated, pressure is created when the volume control valve is open and the pressure control valve is closed. Both valves are electronically controlled by the ECM to allow variable fuel delivery and pressure control. When the ECM actuates the piezo actuators, the fuel rail pressure drop is off-set by additional fuel being delivered to the fuel rails by the pressure control valve. The fuel pressure in the system is reduced within a few seconds after the engine has stopped as the pressure control valve no longer has the holding current it requires, and therefore opens. No residual pressure remains in the system and the fuel is returned to the LP fuel return line to the fuel filter through the open pressure control valve.

Component Description

LOW PRESSURE (LP) SYSTEM

LP Fuel Pump

The electric fuel pump is located inside the fuel tank. Fuel is pumped from the tank via the in-tank fuel pump, to the HP pump via the fuel filter.
Refer to: Fuel Tank and Lines (310-01A Fuel Tank and Lines - TDV6 3.0L Diesel, Description and Operation).

Fuel Filter

The fuel filter assembly is located in front of the fuel tank and is mounted on a bracket which is attached to the top face of the transfer box chassis cross member.

Fuel returning from the HP pump passes through the fuel cooler before returning to the filter to maintain the fuel at an optimum temperature. The returning fuel is re-circulated through the filter to help prevent waxing in cold operating conditions. Fuel pressure and fuel delivery is maintained by the in-tank pump and regulator via the tank fuel feed line.

The filter element has a capacity of 200cm3 (12.2in3). The filtration element has the capacity to filter particulate matter larger than 5 microns.

The filter has an air bleed return to the fuel tank which returns excess air and fuel to the tank.

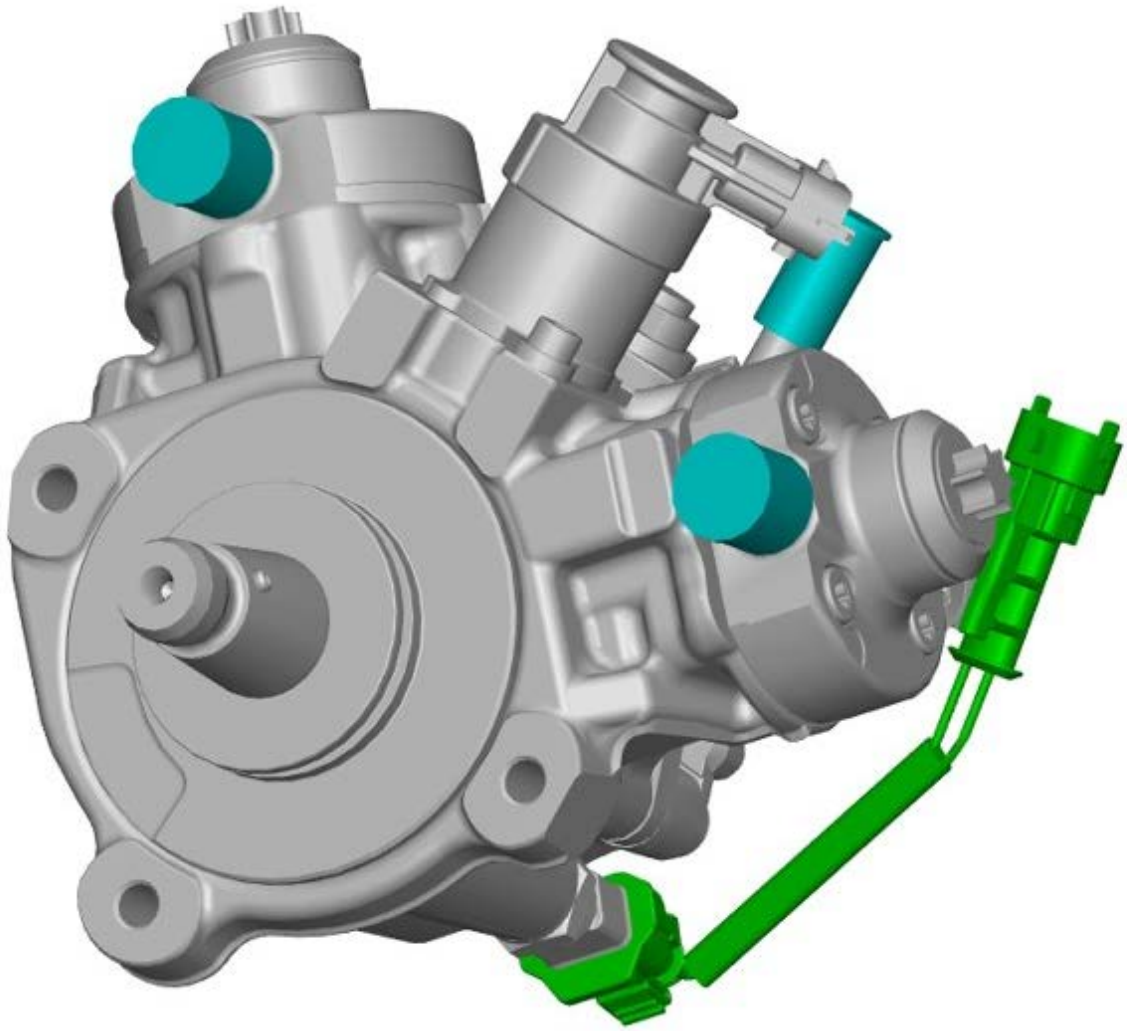
The fuel filter is also fitted with a water sensor to detect when moisture which has collected in the filter has reached an unacceptable level.
Refer to: Fuel Tank and Lines (310-01A Fuel Tank and Lines - TDV6 3.0L Diesel, Description and Operation).

Fuel Cooler

An air blast fuel cooler is located off the engine crossmember at the front of the engine oil pan. The fuel cooler has 2 connections; one is an inlet which allows heated fuel from the HP pump to be cooled, the second allows the cooled fuel to be fed from the cooler into the supply pipe from the LP fuel pump in the fuel tank, via a 'Y' connector back to the fuel filter.

HIGH PRESSURE (HP) SYSTEM

HP Fuel Pump



E108848

The HP pump is a 2 piston radial plunger pump. The pump has the ability to produce a maximum pressure of 2000 bar (29007 lbf/in²). The housing is cast from iron, the flange is cast from aluminum.

The HP pump is driven from the LH (left-hand) cylinder bank exhaust camshaft via a toothed belt. The drive from the belt rotates a cam within the pump which operates a plunger within each pumping element. A procedure and special tools are required for pump or belt replacement to time the pump.

The high-pressure pump comprises 2 high pressure pumping elements, a volume control valve, an internal transfer pump and a fuel temperature sensor.

The fuel is delivered to the internal transfer pump via the external fuel filter and an electric fuel pump which is located in the fuel tank.

The volume control valve is mounted on the high-pressure pump, and located in the feed port between the high pressure pump elements and the internal transfer pump. The volume control valve is a variable position solenoid-operated valve that is controlled by the ECM. The volume control valve determines the amount of fuel that is delivered from the internal transfer pump to the HP pumping elements. When there is no signal to the volume control valve, the valve is closed and there is no fuel delivery.

The fuel from the internal transfer pump is passed to the HP pumping elements at a constant pressure known as transfer pressure. The transfer pressure is controlled by an internal pressure relief valve. Once the fuel enters each of the HP pump elements the pressure rises rapidly, with each element providing a HP supply to one of the fuel rails. The high pressure is controlled by the high pressure regulator valve and the fuel rail pressure sensor.

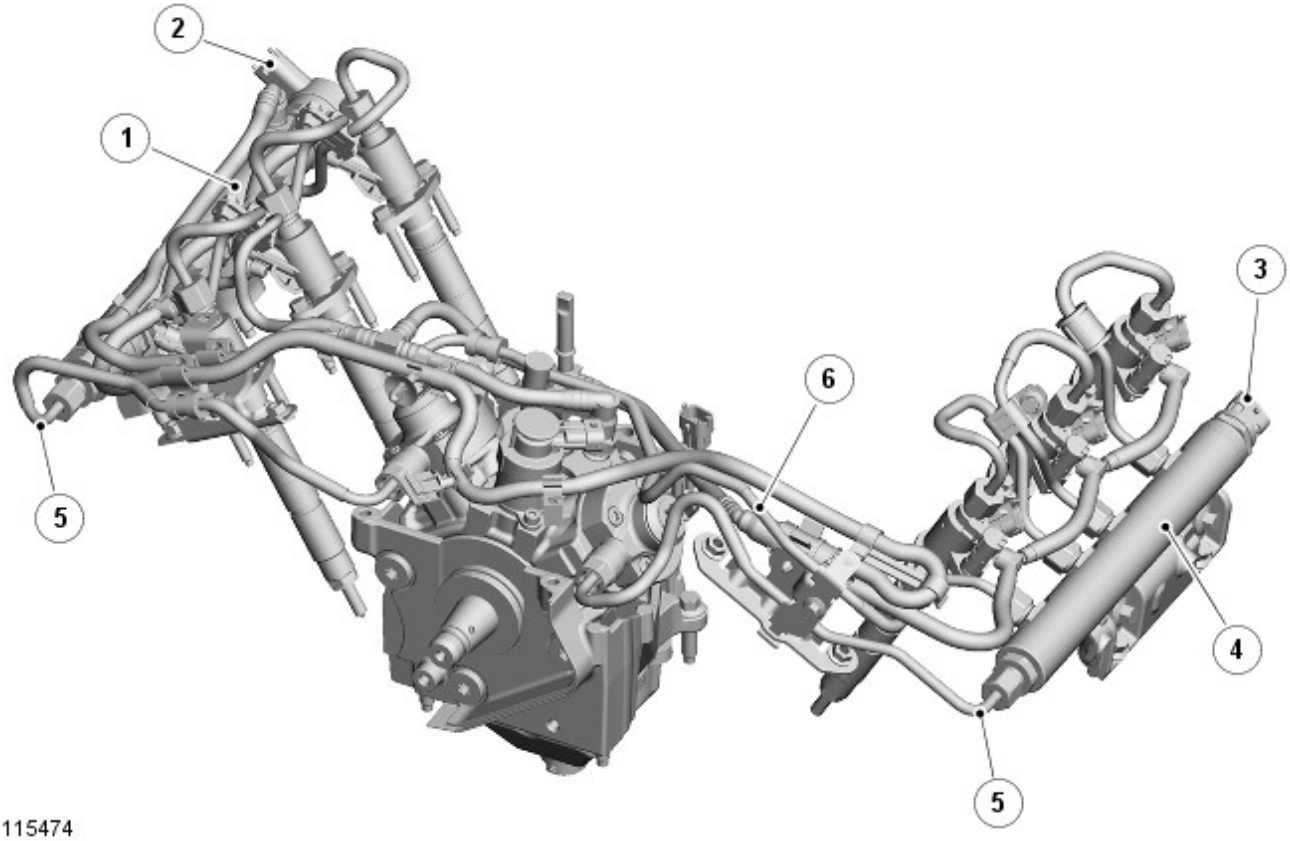
A controlled amount of fuel is allowed to leak-off from the internal transfer pump. This fuel is delivered to the pump internal components to provide cooling and lubrication and is passed back the fuel filter via the LP feed line.

The pressure control valve is located in one of the fuel rails. The fuel pressure is monitored by a pressure sensor located in the other fuel rail. The ECM controls the pressure control valve using the received signals from the pressure sensor. Reducing the pressure in the fuel rails via the pressure control valve results in fuel returning from the fuel

rails to the LP fuel return to the fuel filter.

The fuel temperature sensor is located on the rear of the HP pump. It measures the fuel temperature in the low-pressure side of the HP pump. The ECM continually monitors this signal to determine the fuel temperature to prevent overheating of the fuel system. The ECM will also make fine adjustments to fuel injection quantity to adjust for fuel temperature.

Fuel Rails



E115474

Item	Description
1	LH fuel rail
2	Fuel pressure control valve
3	Fuel pressure sensor
4	RH (right-hand) fuel rail
5	HP fuel connection from HP pump
6	Fuel rail balance pipe

The fuel rails are steel fabrications and are similar in their construction. Two fuel rails are used with each rail supplying high pressure fuel to 3 fuel injectors.

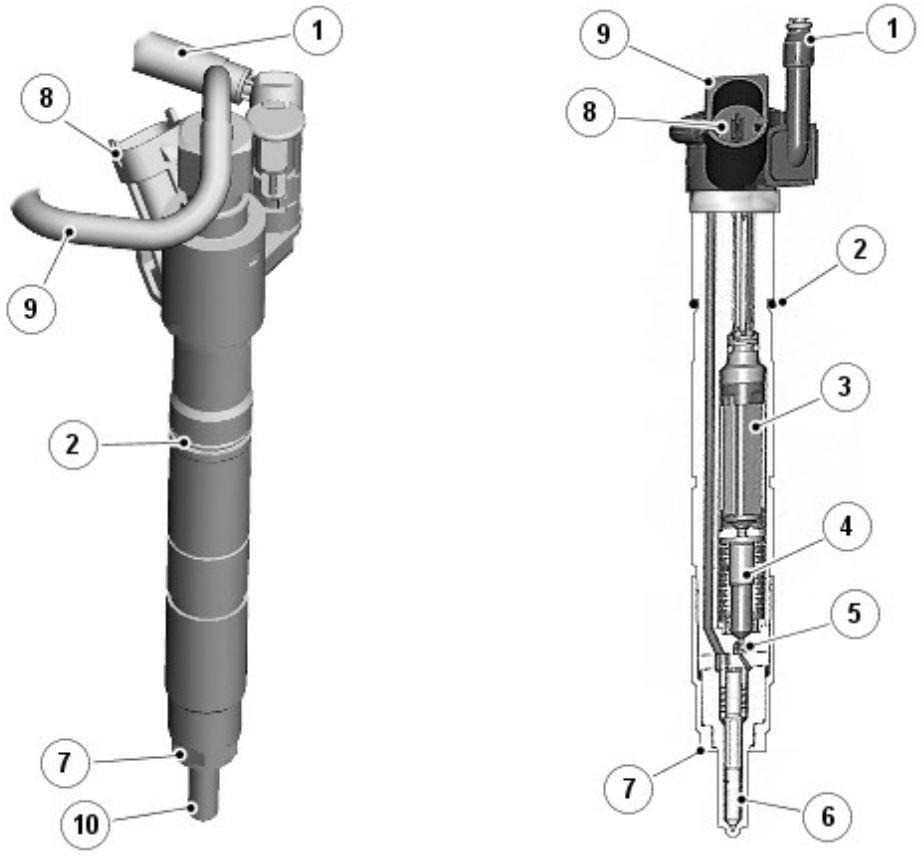
Each rail has 5 threaded connections which provide for the attachment of the high pressure fuel supply from the HP pump, the balance pipe and connections for the 3 injectors supplied with fuel from that rail.

The fuel pressure in the rails is detected by a fuel pressure sensor which is located in the end of the RH rail. The LH rail houses a pressure control valve. The ECM controls the pressure control valve using signals from the pressure sensor.

The fuel rail pressure sensor is a piezo-resistive type sensor containing an actuating diaphragm. Deflection of the diaphragm provides a proportional signal (output) voltage to the ECM, dependant on the fuel pressure within the fuel rail.

Both rails are connected together with a balance pipe which ensures the pressure in both rails is equal, even though each rail is supplied from a different pumping element in the HP pump.

Fuel Injectors



E115475

Item Description

1 Fuel return
2 O-ring seal
3 Piezo stack actuator
4 Hydraulic coupler
5 Control valve
6 Nozzle body
7 Copper sealing washer
8 Electrical connector
9 High pressure feed
10 Nozzle

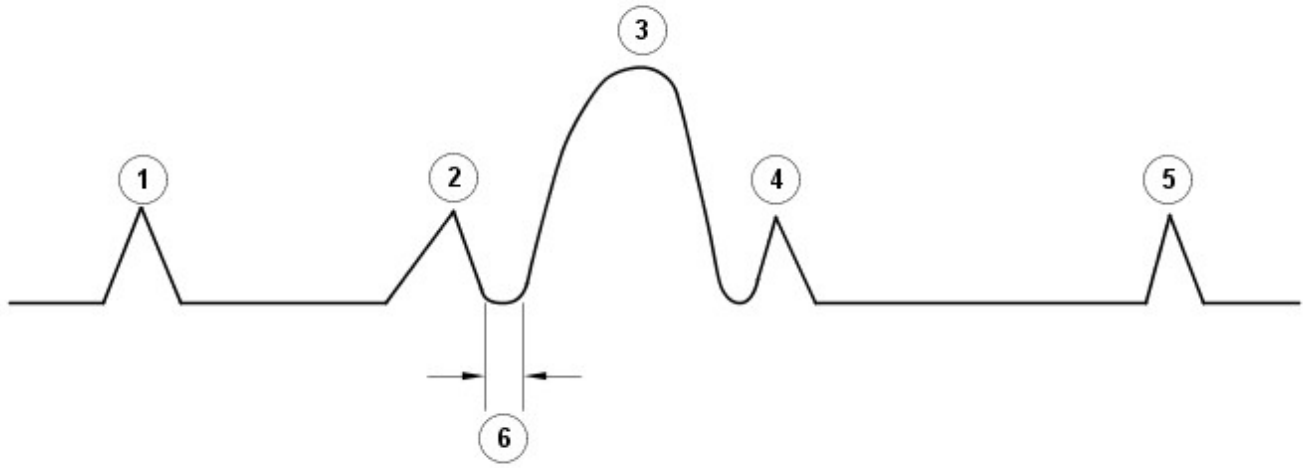
Six fuel injectors are used in the fuel system. A piezo actuator in each injector is electronically controlled by the ECM to operate the injector in response to engine speed and load conditions.

Two variants of fuel injector are installed on the 3.0 TDV6 engine, 155kW vehicles have a unique low flow fuel injector installed. Injectors should not be swapped between 155kW and 188kW engines due to the injector nozzles being different. Low flow fuel injector nozzles are not capable of sufficient fuel supply to the 188kW engine.

Each injector has an electrical connector which connects the injector to the engine harness. A fuel connection on the top of the injector provides for the high pressure fuel inlet from the HP pump. A second fuel connection allows fuel leakage within the injector to return to the HP pump.

Each injector is located in a machined hole in the cylinder head and is sealed in the cylinder head with a copper sealing washer and an O-ring seal. The injector is retained in the cylinder head with a clamp plate and 2 bolts. If an injector is removed or replaced, a new copper sealing washer and a clamp plate must be used when refitting the injector.

The injector can operate up to 5 times during one combustion cycle depending on engine speed and load. The injection sequence can occur as follows:



E107577

1. Pilot injection - occurs before the main injection and improves fuel and air mixing
2. Pre-injection - shortens the main injection's ignition delay and therefore reduces the generation of nitrous oxides
3. Main injection - delivers the required engine torque
4. After injection - occurs after the Main injection and assists the re-burn of any remaining particulate matter
5. Post injection - helps manage the temperature of the exhaust gas for more effective exhaust-gas after-treatment
6. Injection delay 0.4 ms.

Each injector is calibrated to the ECM and applicable the cylinder to which it is fitted. Therefore, if an injector is removed it must be refitted to the cylinder from which it was removed. If a new injector is fitted, a calibration routine using Land Rover approved diagnostic equipment must be performed to calibrate the injector unique code to the ECM.

The operating voltage of the injector is between 110 and 163 volts depending on engine speed and load and care must be taken when working in the vicinity of the injectors. The voltage increases linearly from 200 to 1200 bar.

Each injector has an electrical resistance value of between 150 - 250 kOhms.

CAUTION: Each injector operation is controlled by a charge and discharge cycle allowing energy to dissipate in, and recover from the injector. Never disconnect the wiring connection when the engine is running. The injector can remain open thus causing engine damage.

Published: 15-Aug-2012

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Charging and Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel)

Fuel Charging and Controls (Description and Operation),
Fuel Charging and Controls (Description and Operation),
Fuel Charging and Controls (Description and Operation).

Inspection and Verification

WARNING: Make sure that all suitable safety precautions are observed when carrying out any work on the fuel system. Failure to observe this warning may result in personal injury.

CAUTIONS:

Make sure that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in damage to the vehicle.

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

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

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

Visual Inspection

Mechanical	Electrical
• Low/contaminated fuel • Fuel supply/return line(s) • Fuel tank and filler pipe • Fuel leak(s) • Fuel filler cap • Fuel filter • Push connect fittings • Fuel rail • Fuel pump • Exhaust Gas Recirculation (EGR) system	• Fuses • Glow plug indicator • Inertia fuel shutoff switch • Fuel pump module • Sensor(s) • Engine Control Module (ECM) • Fuel volume control valve • Fuel pressure control valve • Fuel Rail Pressure (FRP) sensor • Fuel temperature sensor • Fuel injector(s) • Exhaust Gas Recirculation (EGR) system

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.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not start	• Inertia fuel shutoff switch • Low/contaminated fuel • Air leakage • Low-pressure fuel system fault • Fuel pump module (lift pump) fault • Blocked fuel filter • Fuel volume regulator blocked/contaminated • Fuel pressure control valve blocked/contaminated • Fuel pump fault	• Check that the inertia switch has not tripped - Using the manufacturer approved diagnostic system, check the Restraints Control Module (RCM) for related DTCs and refer to the relevant DTC index • Check the fuel level and condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Check the intake air system for leaks • Check the lift pump operation • Check the low-pressure fuel system for leaks/damage • Check the fuel filter • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check the fuel pump

	• Crankshaft position (CKP) sensor	• Refer to the electrical circuit diagrams and test the CKP sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance
Difficult to start	• Glow plug system fault (very cold conditions) • Low/contaminated fuel • Air leakage • Fuel pump module (lift pump) fault • Low-pressure fuel system fault • Blocked fuel filter • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Exhaust Gas Recirculation (EGR) valve(s) fault	• Refer to the electrical circuit diagrams and test the glow plug circuits for short circuit to ground, short circuit to power, open circuit, high resistance • Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Check the intake air system for leaks • Check the lift pump operation • Check the low-pressure fuel system for leaks/damage • Check the fuel filter • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check the EGR system
Rough idle	• Intake air system fault • Low/contaminated fuel • Low-pressure fuel system fault • Blocked fuel filter • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Exhaust Gas Recirculation (EGR) valve(s) fault	• Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Check the low-pressure fuel system for leaks/damage • Check the fuel filter • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check the EGR system
Lack of power when accelerating	• Intake air system fault • Restricted exhaust system • Low fuel pressure • Exhaust Gas Recirculation (EGR) valve(s) fault • Turbocharger actuator fault	• Check the intake air system for leakage or restriction • Check for a blockage/restriction in the exhaust system, install new components as necessary • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check the EGR system • Check turbocharger actuator
Engine stops/stalls	• Air leakage • Low/contaminated fuel • Low-pressure fuel system fault • High pressure fuel leak • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Exhaust Gas Recirculation (EGR) valve fault	• Check the intake air system for leaks • Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Check the fuel system for leaks/damage • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check the EGR system
Engine judders	• Low/contaminated fuel • Air ingress • Low-pressure fuel system fault • Fuel metering valve blocked/contaminated • Fuel volume control valve blocked/contaminated • Fuel pressure control	• Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Check the intake air system for leaks • Check the low-pressure fuel system for leaks/damage • Check the high pressure fuel system for leaks • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check the fuel pump

	valve blocked/contaminated • High pressure fuel leak • Fuel pump fault	
Excessive fuel consumption	• Low-pressure fuel system fault • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Fuel temperature sensor leak • High pressure fuel leak • Injector(s) fault • Exhaust Gas Recirculation (EGR) valve(s) fault	• Check the low-pressure fuel system for leaks/damage • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check the fuel temperature sensor, fuel pump, etc for leaks • Check the EGR system

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 22-Oct-2013

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Injection Component Cleaning

General Procedures

WARNINGS:

 Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1700 bar (24,656 lb-sq-in). Failure to follow this instruction may result in personal injury.

 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.

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

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

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

 Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

 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.

CAUTIONS:

 Before using the cleaning fluid, protect all electrical components and connectors with lint-free non-flocking material.

 Make sure that all parts removed from the vehicle are placed on the lint-free non-flocking material.

 Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.

 Make sure that clean non-plated tools are used. Clean tools using a new brush that will not lose its bristles and fresh cleaning fluid, prior to starting work on the vehicle.

 Use a steel topped workbench and cover it with clean, lint-free non-flocking material.

 Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

 NOTE: Pneumatic vacuum gun

1. Using a new brush that will not lose its bristles, brush cleaning fluid onto the components being removed and onto the surrounding area.
2. Using a pneumatic vacuum gun, remove all traces of cleaning fluid and foreign material.
3. Dispose of any used cleaning fluid and the brush after completing the repair.

Published: 17-Aug-2011

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Injection Pump

Removal and Installation

Special Tool(s)

 E60429	303-1145/2 Remover, Camshaft Rear Pulley Bolt
 E117205	310-138A Holding Tool, Fuel Pump Pulley
 E117206	310-139A Holding Tool, Fuel Pump Pulley
 E123916	JLR-303-1523 Remover/Installer, Camshaft Rear Pulley

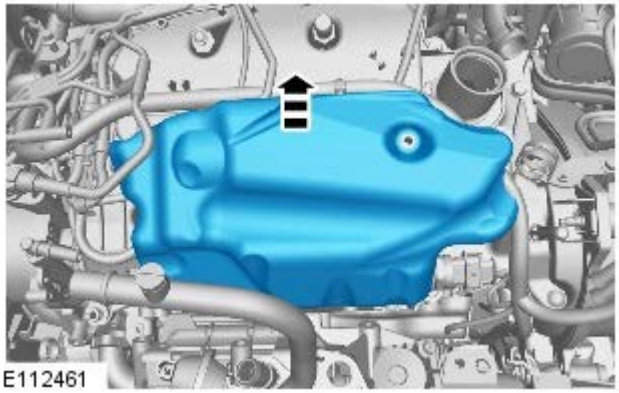
Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

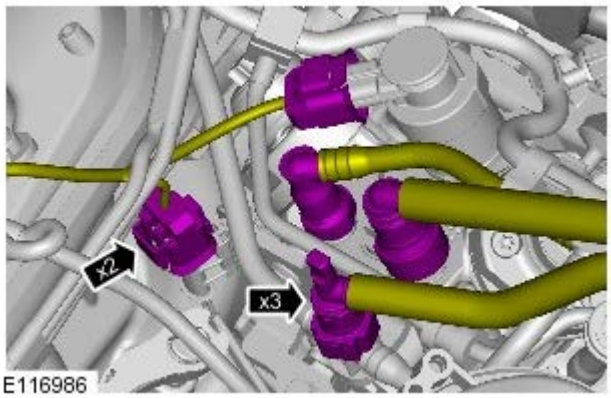
1. Refer to: Specifications (414-01 Battery, Mounting and Cables, Specifications).
2. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. NOTE: Left-hand shown, right-hand similar.


E112461

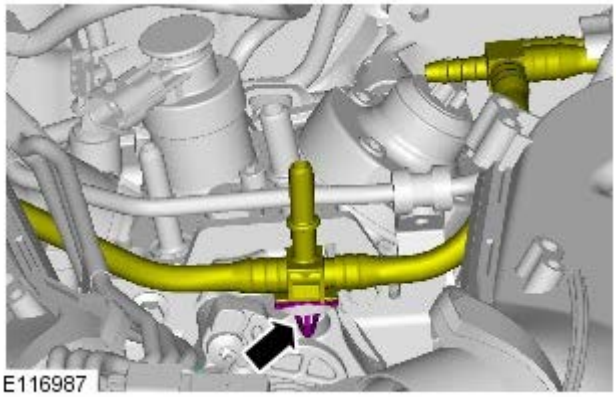
4. Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - TDV8 3.6L Diesel, General Procedures).

5. Refer to: Rear End Accessory Drive (READ) (303-05 Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

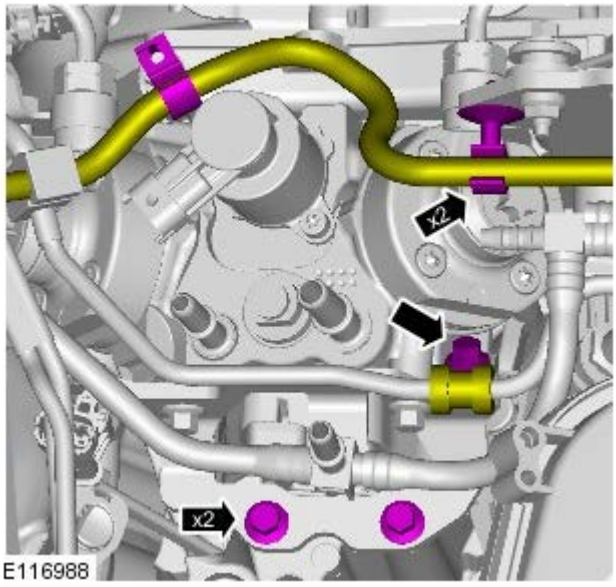
6. Refer to: Crankcase Vent Oil Separator (303-08 Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).



7. CAUTION: Be prepared to collect escaping fuel.



8. CAUTION: Be prepared to collect escaping fuel.



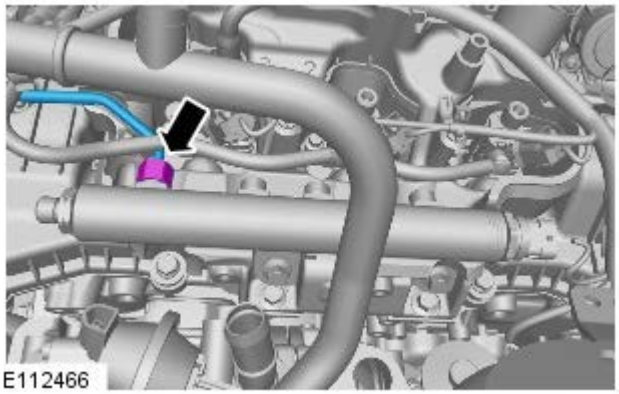
9.

10. CAUTIONS:

CAUTION: Be prepared to collect escaping fuel.

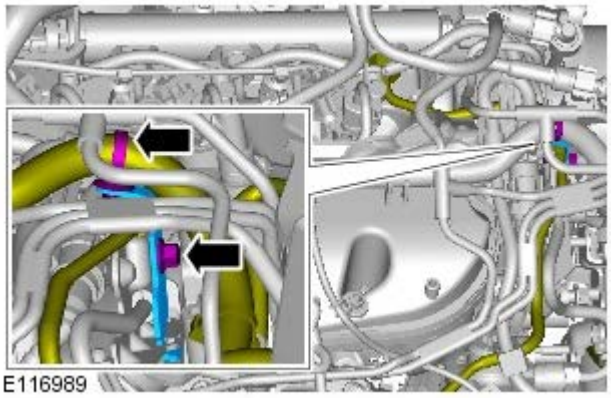
CAUTION: Discard the component.

NOTE: Some variation in the illustrations may

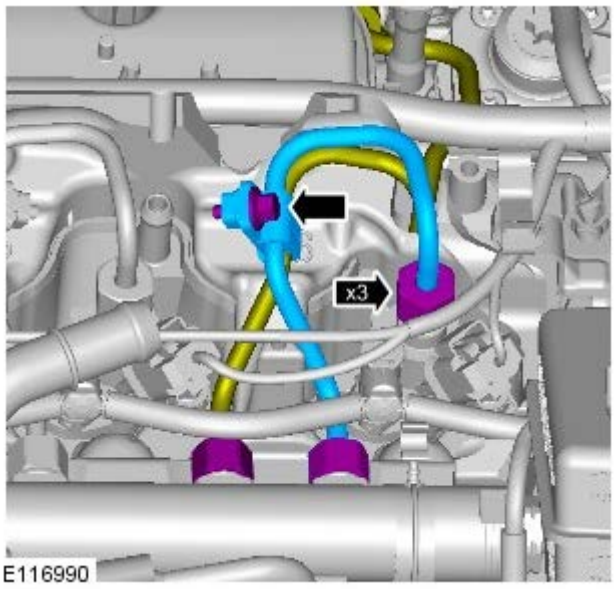

E112466

occur, but the essential information is always correct.

11.


E116989

12. CAUTIONS:

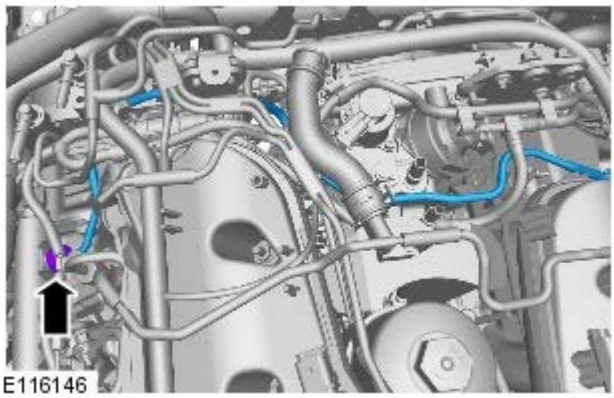


E116990

Be prepared to collect escaping fuel.

Discard the component.

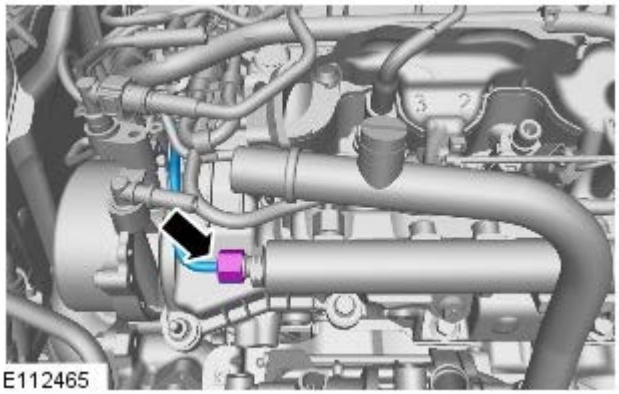
13. CAUTIONS:


E116146

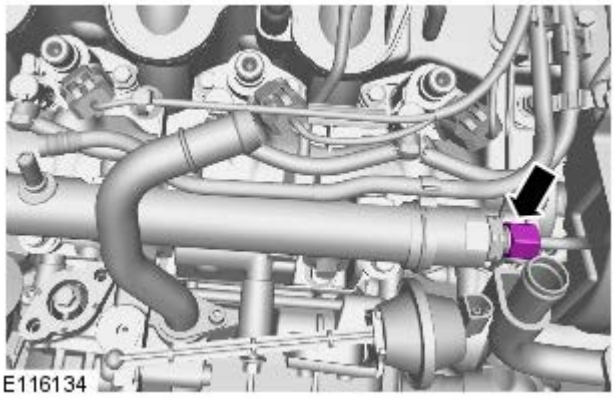
Be prepared to collect escaping fuel.

Discard the component.

14. CAUTION: Be prepared to collect escaping fuel.

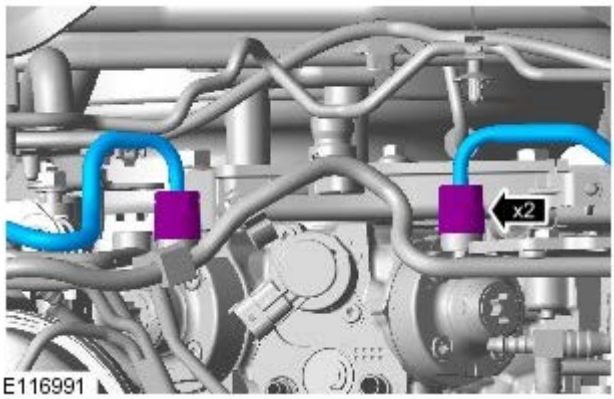


NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



15. CAUTION: Be prepared to collect escaping fuel.

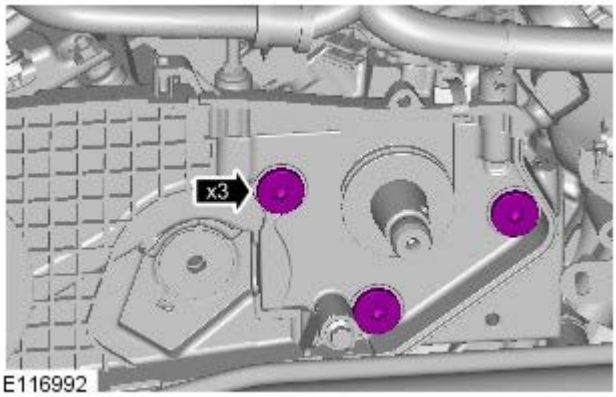
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



16. CAUTIONS:

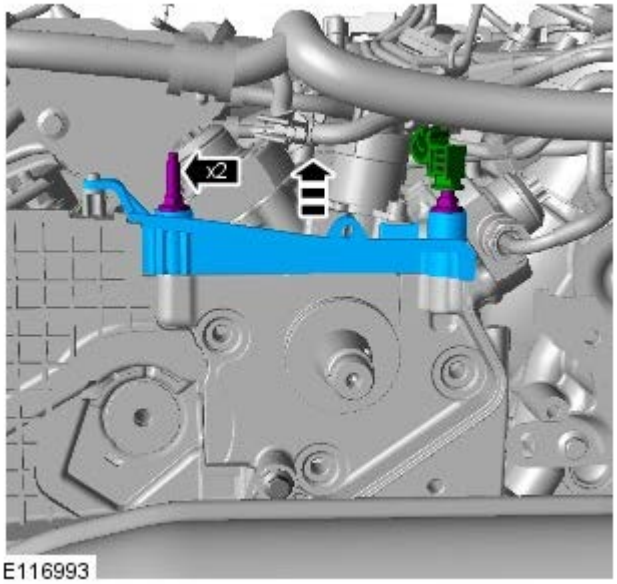
Be prepared to collect escaping fuel.

Discard the components.

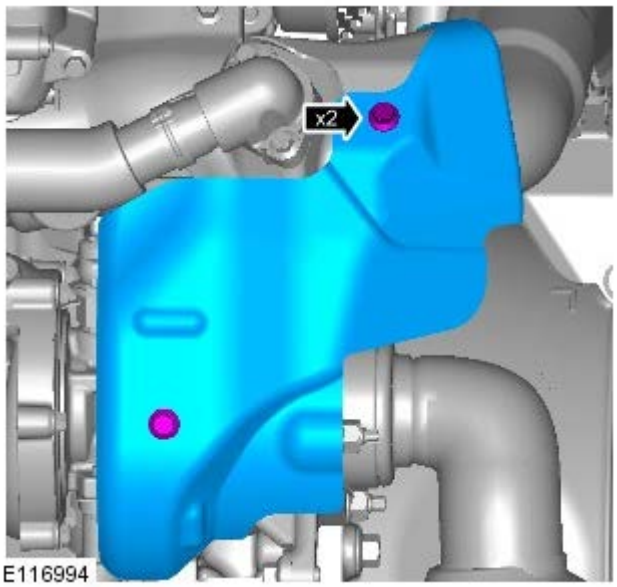


17. NOTE: Fuel injection pump pulley shown removed for clarity.

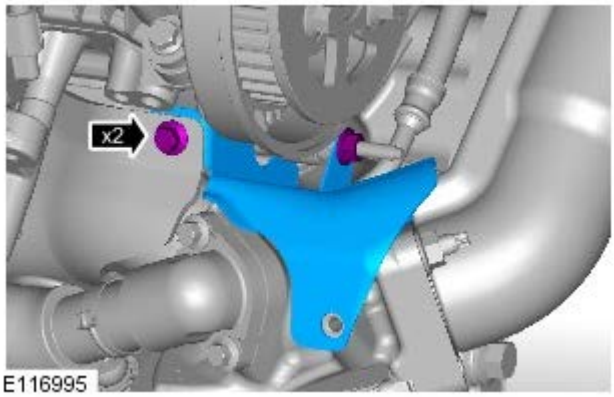
18. NOTE: Fuel injection pump pulley shown removed for clarity.



19.



20.



21. *Special Tool(s):* JLR-303-1523
Torque: 10 Nm



22. *Special Tool(s):* JLR-303-1523



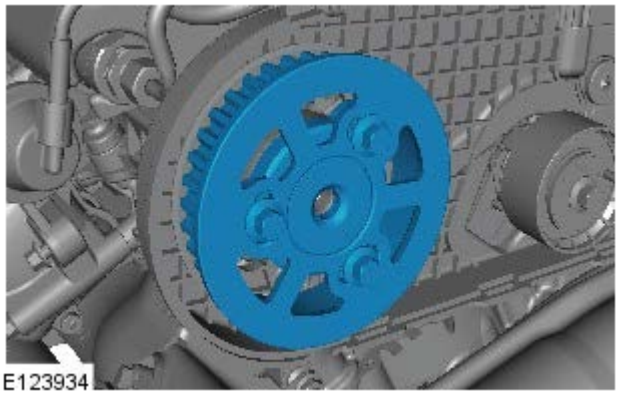
23. Remove the rear camshaft pulley retaining bolt.

    Special Tool(s): 303-1145/2

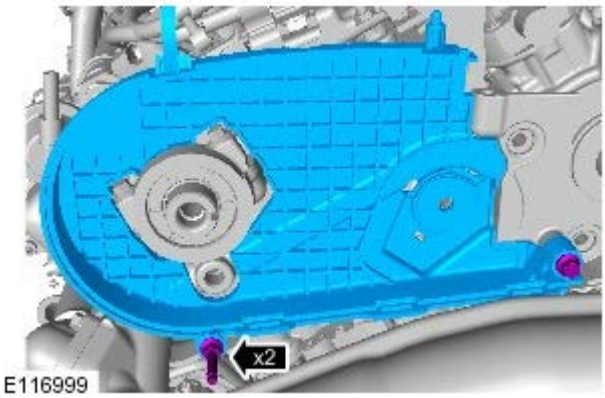


24. Remove the special tools.

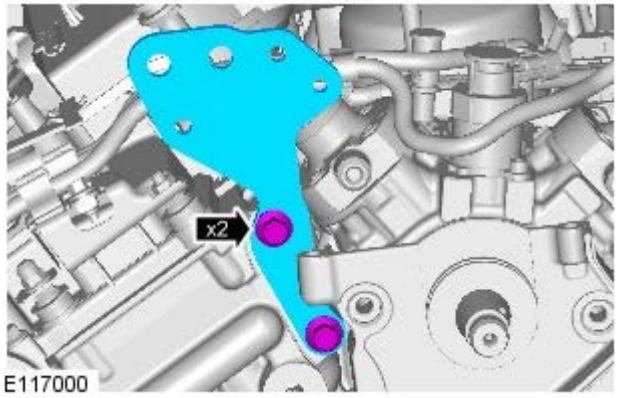
25.



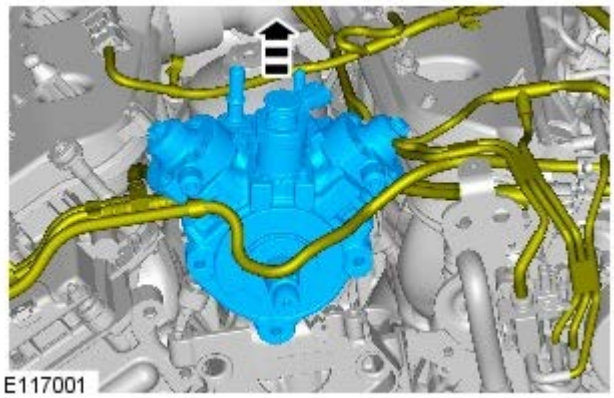
26.



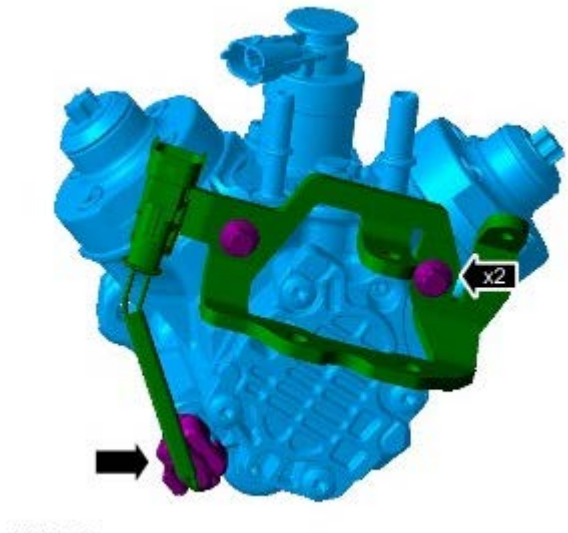
27.



28.

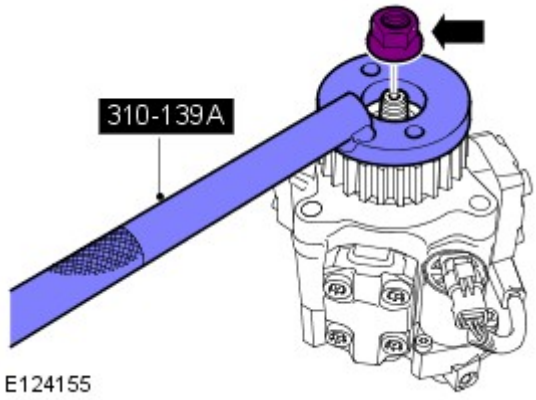


29. NOTE: Do not disassemble further if the component is removed for access only.



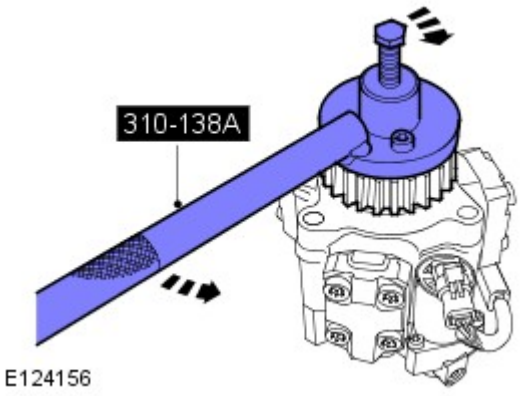
E117002

30. *Special Tool(s):* 310-139A



E124155

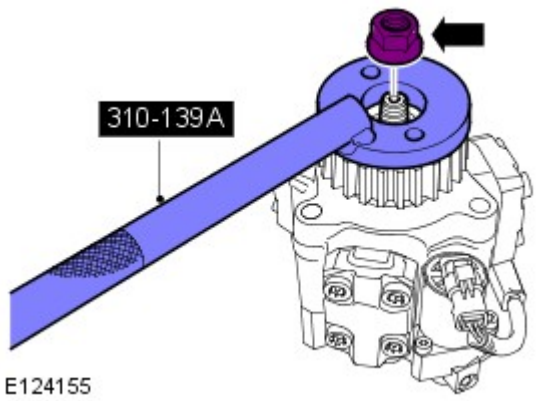
31. *Special Tool(s):* 310-138A



E124156

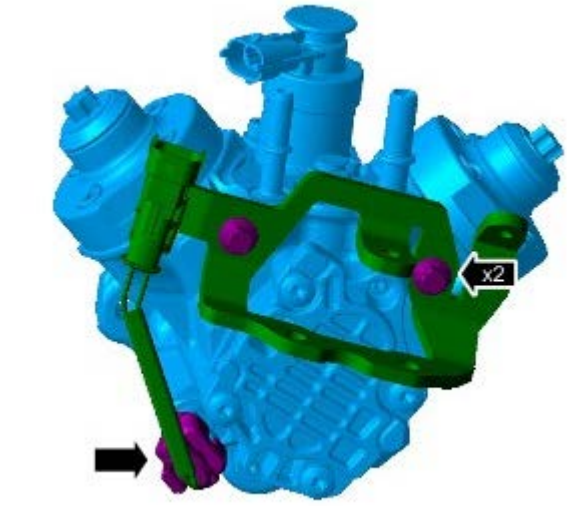
Installation

1. *Special Tool(s):* 310-139A
   Torque: 50 Nm



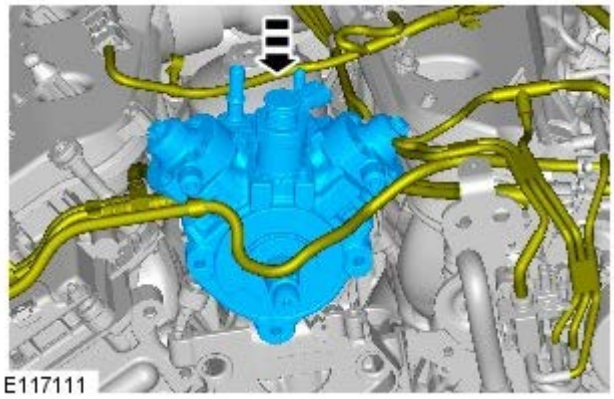
E124155

2. *Torque:* 3 Nm



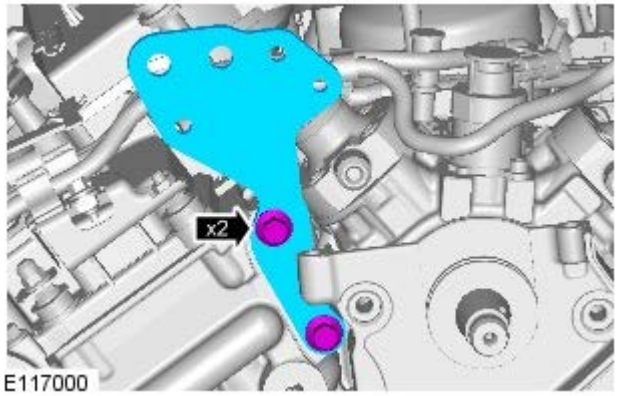
E117002

3.



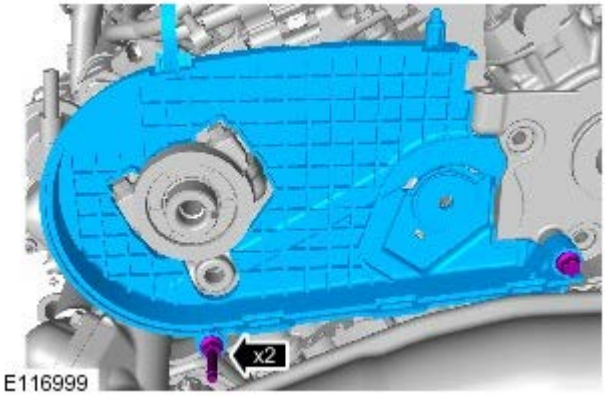
E117111

4. *Torque:* 23 Nm



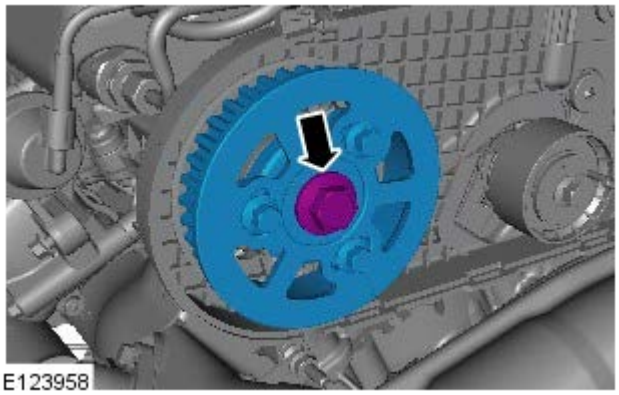
E117000

5. *Torque:* 10 Nm



E116999

6. CAUTIONS:



Apply loctite 242 (ESK-M4G247-A1) to the new camshaft pulley bolt.

Install the bolt finger tight.

7. *Torque:* 10 Nm

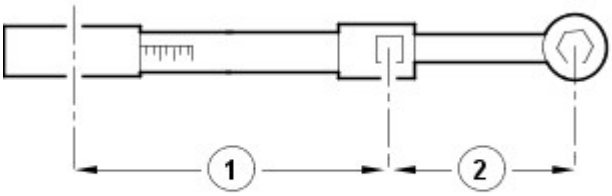


8.



9. CAUTION: Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

- Calculate the setting for the torque wrench:
- **Stage 1:** Multiply the required torque by the effective length of the torque wrench (1).
- **Stage 2:** Add the effective length of the special tool (2) to the effective length of the torque wrench.
- **Stage 3:** Divide the total of stage 1 by the total of stage 2.
- **Stage 4:** Set the torque wrench to the figure



E37107

arrived at in stage 3.



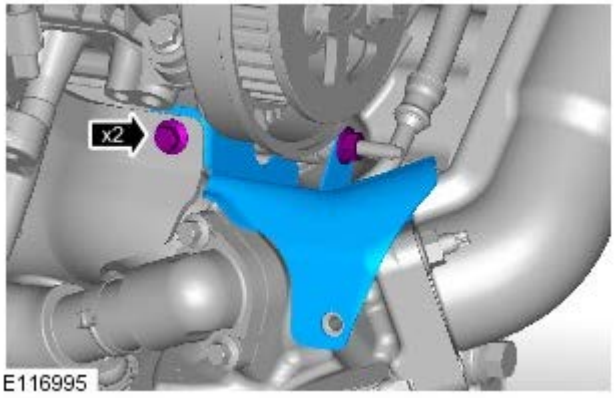
E123895

10. CAUTION: Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

Torque:
Stage 1:80 Nm
Stage 2:80°

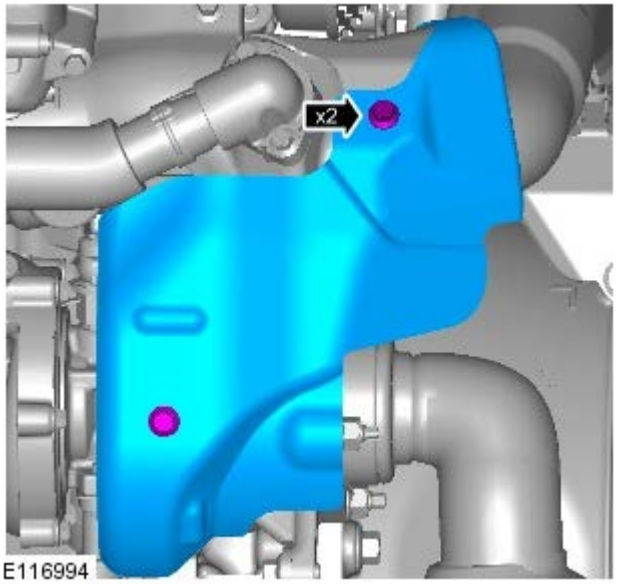
11. Remove the special tools.

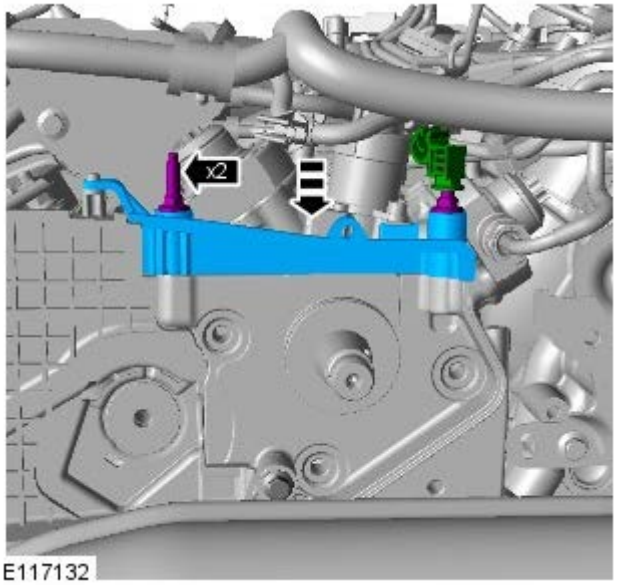
12. *Torque:* 10 Nm



E116995

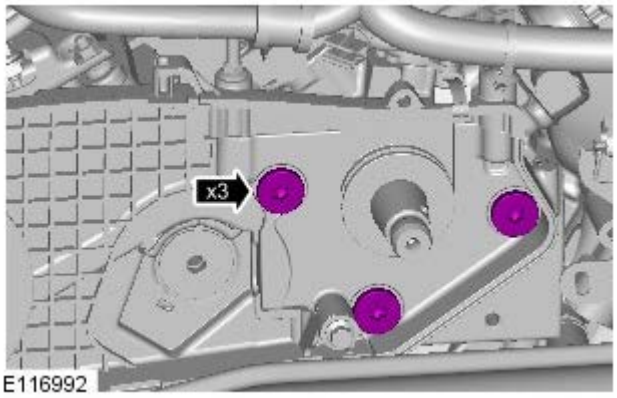
13. *Torque:* 10 Nm





14. NOTE: Fuel injection pump pulley shown removed for clarity.

    Torque: 10 Nm



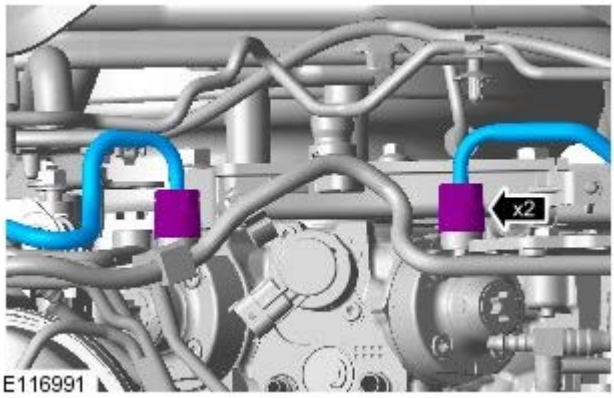
15. NOTE: Fuel injection pump pulley shown removed for clarity.

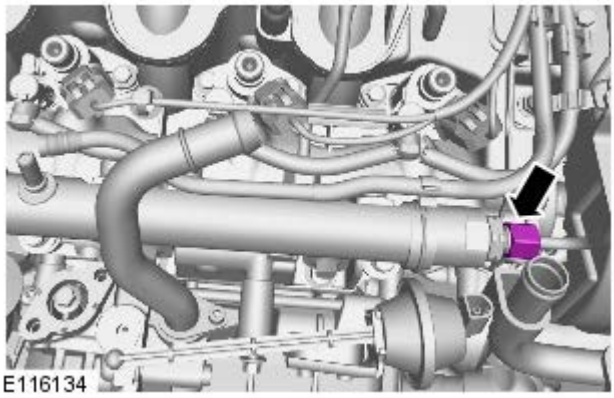
    Torque: 23 Nm

16. CAUTIONS:

    Tighten the fuel supply line unions finger tight.

    Make sure that a new component is installed.



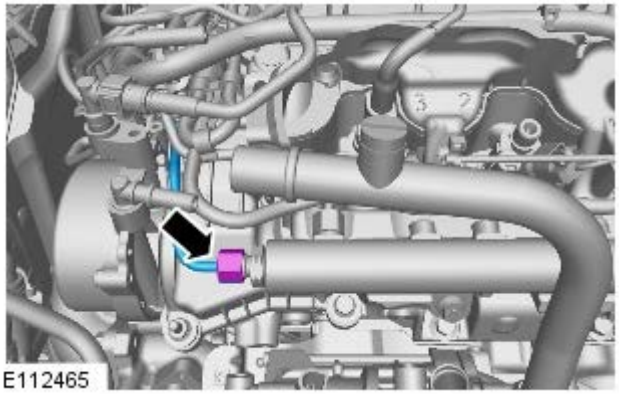


17. CAUTIONS:

Make sure that a new component is installed.

Tighten the fuel supply line unions finger tight.

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

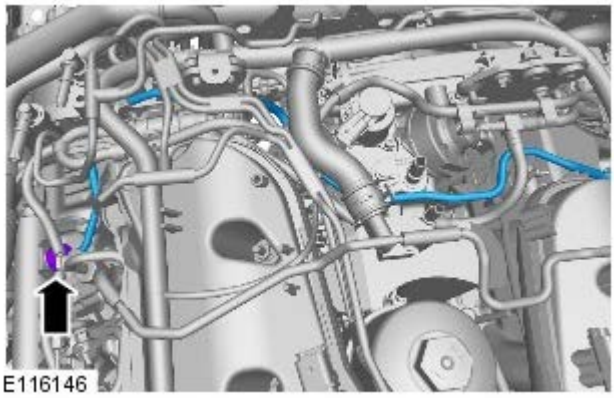


18. CAUTIONS:

Make sure that a new component is installed.

Tighten the fuel supply line unions finger tight.

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



19. CAUTIONS:

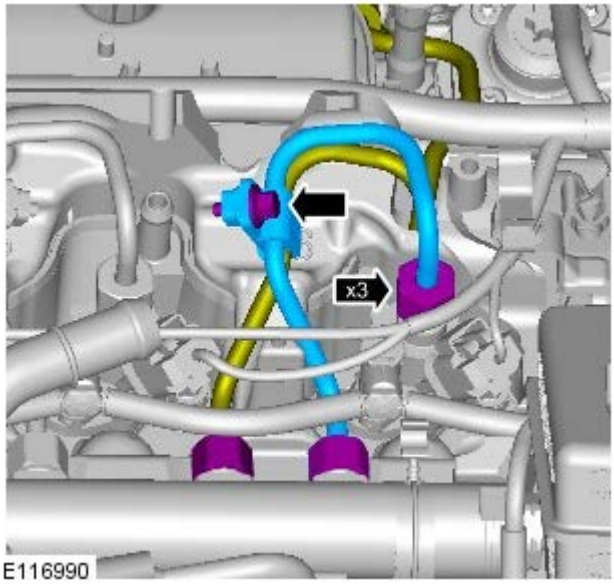
Make sure that a new component is installed.

Tighten the fuel supply line unions finger tight.

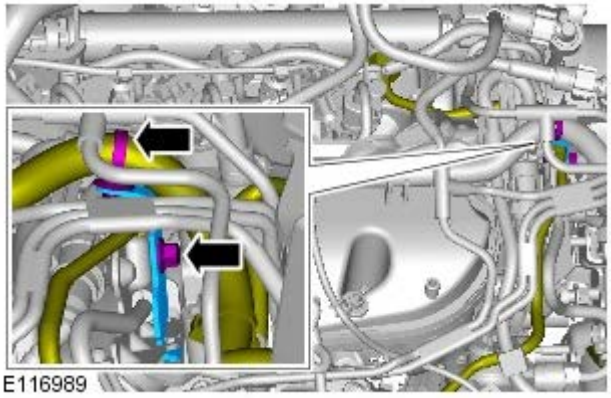
20. CAUTIONS:

Tighten the fuel supply line unions finger tight.

Make sure that new components are installed.



21. *Torque:* 10 Nm

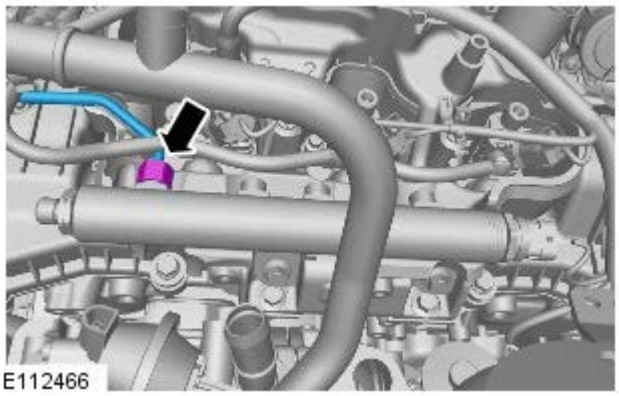


22. CAUTIONS:

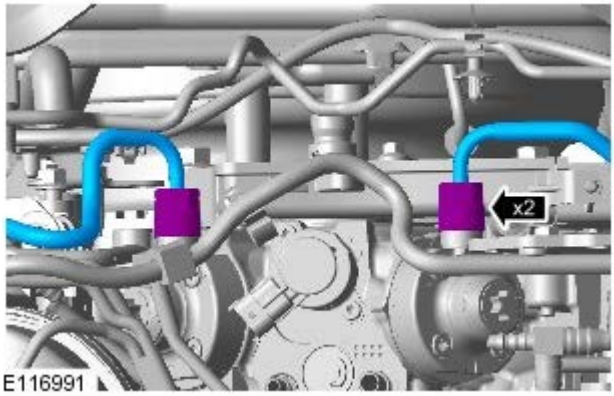
Make sure that a new component is installed.

Tighten the fuel supply line unions finger tight.

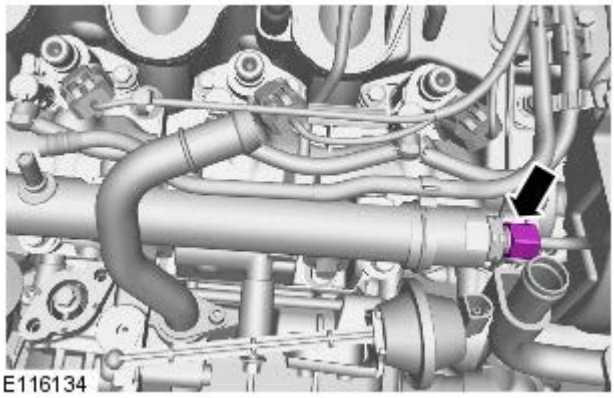
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



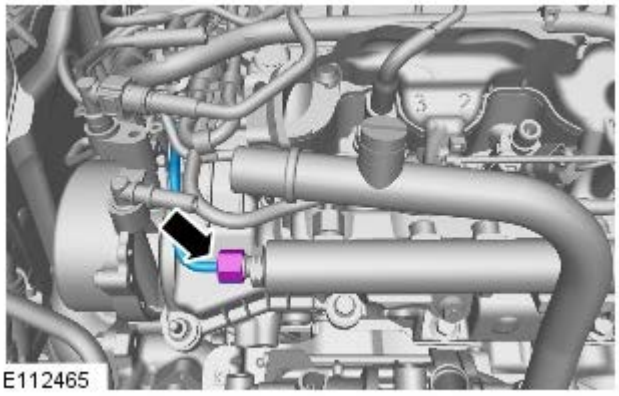
23. Tighten the high-pressure fuel lines union to 15Nm.



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

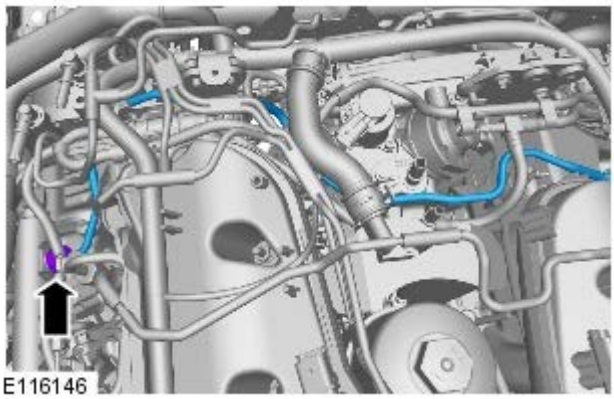

E116134

Tighten the high-pressure fuel lines union to 15Nm.

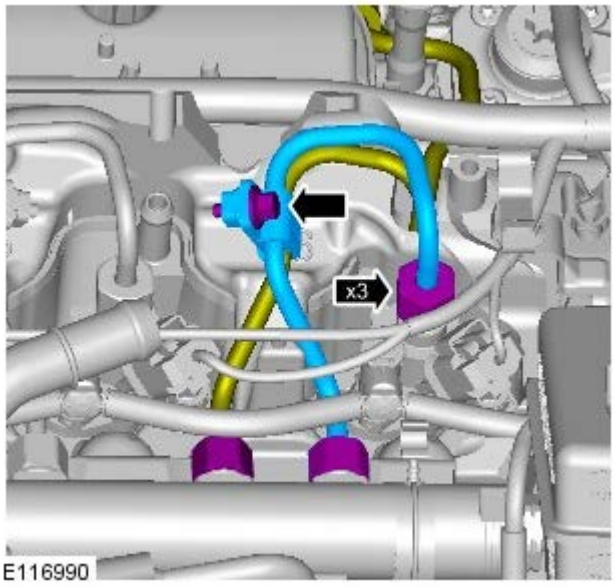

E112465

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

    Tighten the high-pressure fuel lines union to 15Nm.


E116146

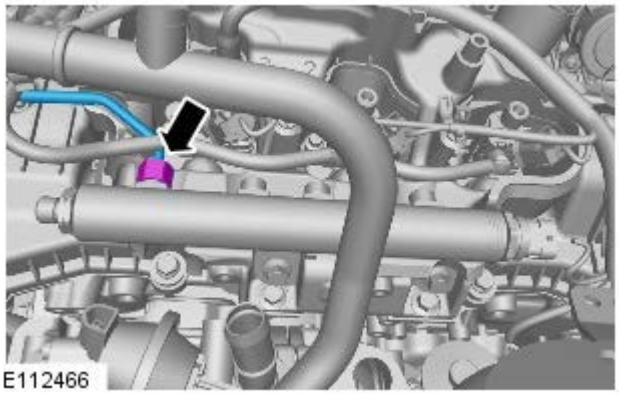
26. Tighten the high-pressure fuel lines union to 15Nm.



E116990

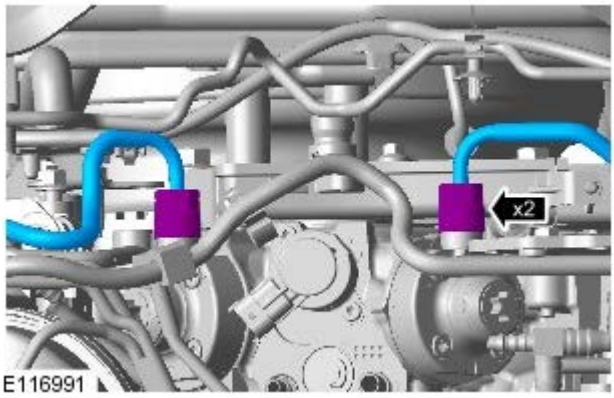
27. Tighten the high-pressure fuel lines union to 15Nm.

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



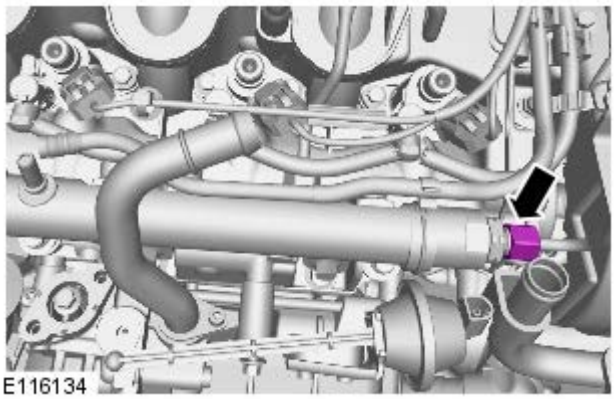
Tighten the high-pressure fuel lines union to 15Nm.

29. Tighten the high-pressure fuel line union to 35Nm.



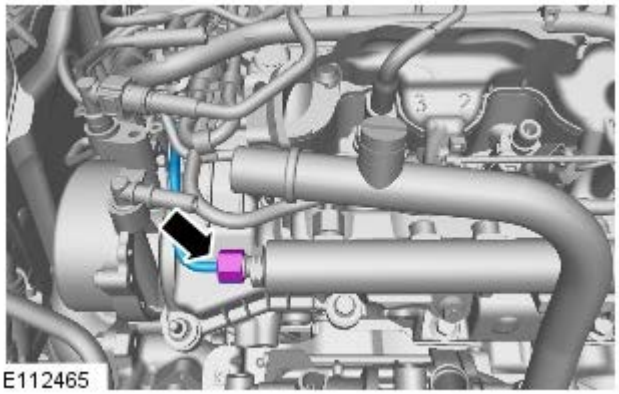
30. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Tighten the high-pressure fuel line union to 35Nm.

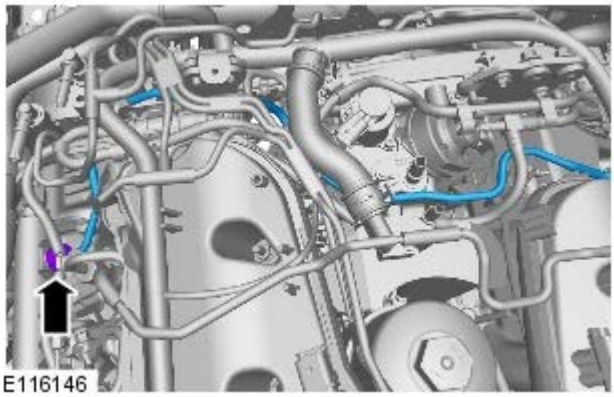


31. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

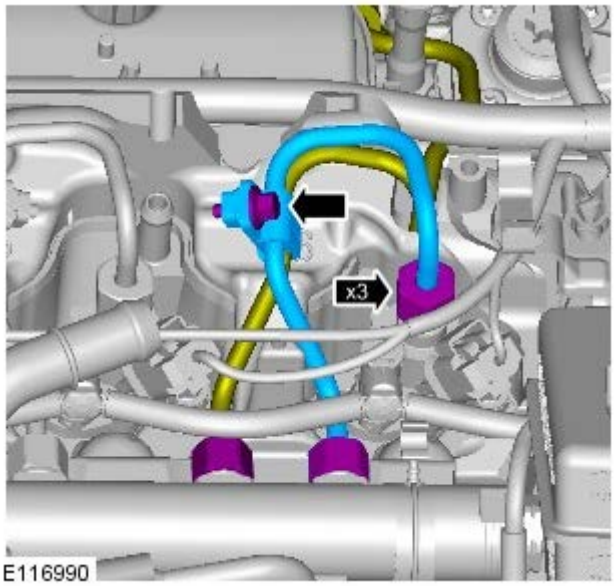
Tighten the high-pressure fuel line union to 35Nm.



32. Tighten the high-pressure fuel line union to 35Nm.


E116146

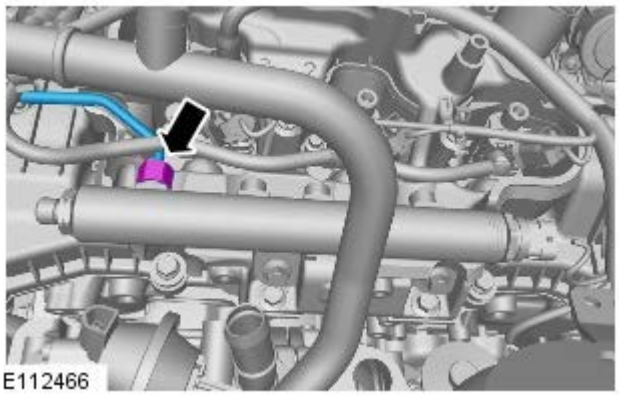
33. Tighten the high-pressure fuel line union to 35Nm.



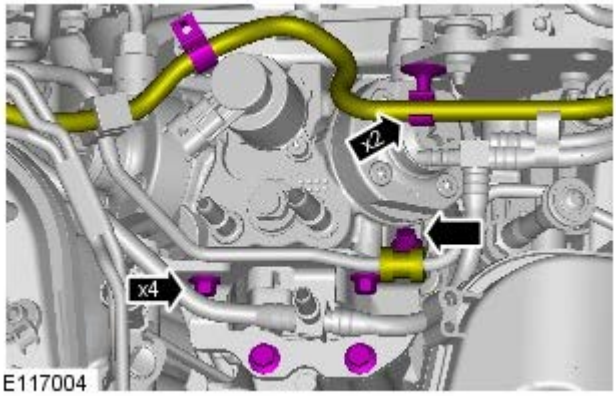
E116990

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

Tighten the high-pressure fuel line union to 35Nm.

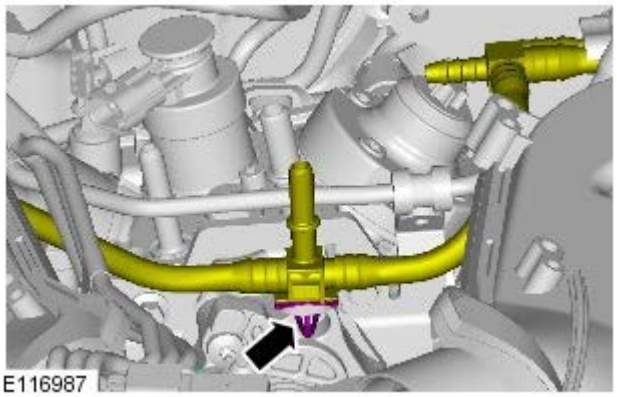

E112466

35. *Torque:* 10 Nm

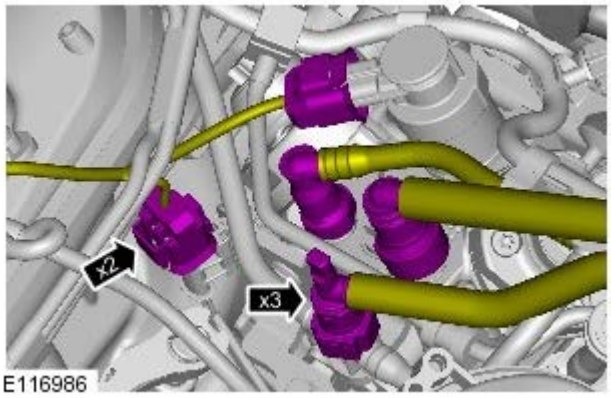


E117004

36.


E116987

37.

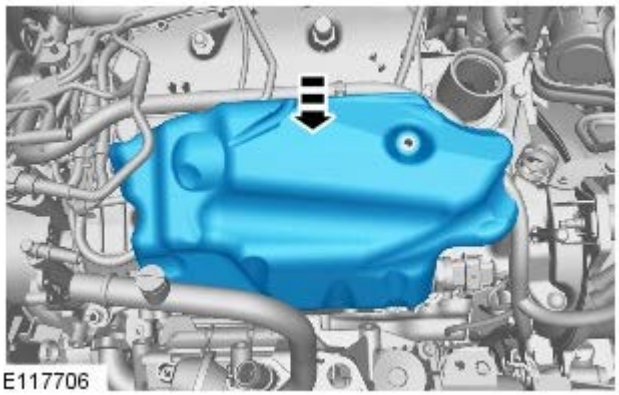


E116986

38. Refer to: Crankcase Vent Oil Separator (303-08 Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

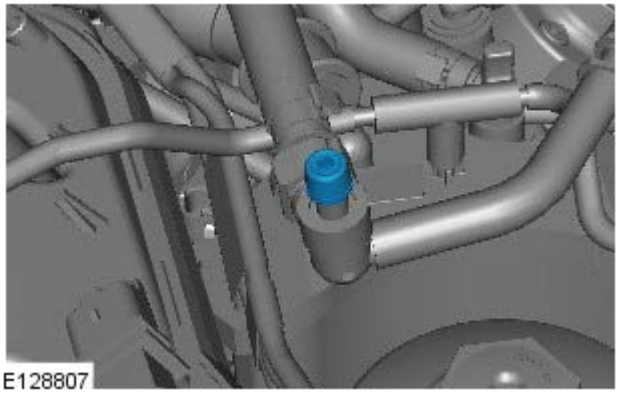
39. Refer to: Rear End Accessory Drive (READ) (303-05 Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

40. NOTE: Left-hand shown, right-hand similar.

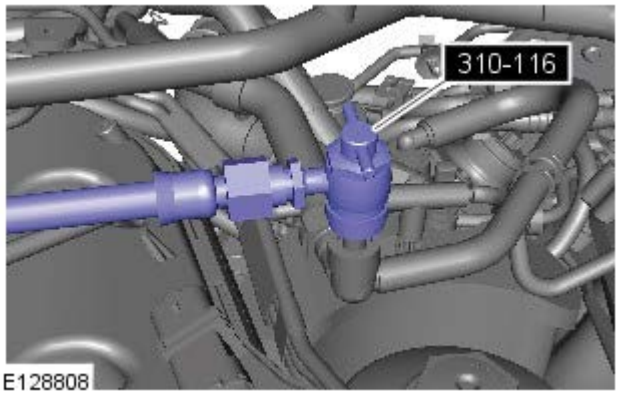

E117706

41. Refer to: Specifications (414-01 Battery, Mounting and Cables, Specifications).

42.


E128807

43. NOTES:



The gauge component of the special tool must be removed before installing to the schroder valve.

Using a suitable container, place the end of the special tool into it to collect any fluid.

Install the pipe from special tool 310-116 to the schroder valve.

44.

1. NOTE: A minimum of 12 litres of fuel in the fuel tank is required for the following Steps.

   Make sure the fuel tank has a sufficiant amount of fuel to carry out the following Steps.
2. NOTES:

   Do not start the vehicle.

   Allow 15 seconds between **each** ignition cycle (between each ignition **ON** and ignition **OFF**) to allow the fuel tank pump to pump fuel to the fuel injection pump correctly.

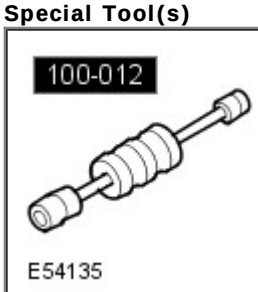
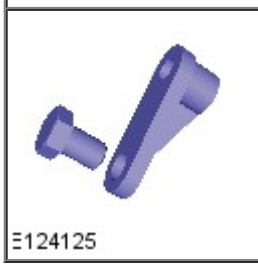
   Turn the ignition on and off four times.
3. Crank the engine until it starts.
4. Remove the special tool and suitable container.
5. Install the schroder valve cap.
6. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).
7. Road test the vehicle for at least 10 miles (16 Km).
8. Check the diagnostic trouble codes (DTC)s using the approved diagnostic tool. Clear or repair as necessary.

Published: 17-Aug-2011

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Injectors LH

Removal and Installation

Special Tool(s)

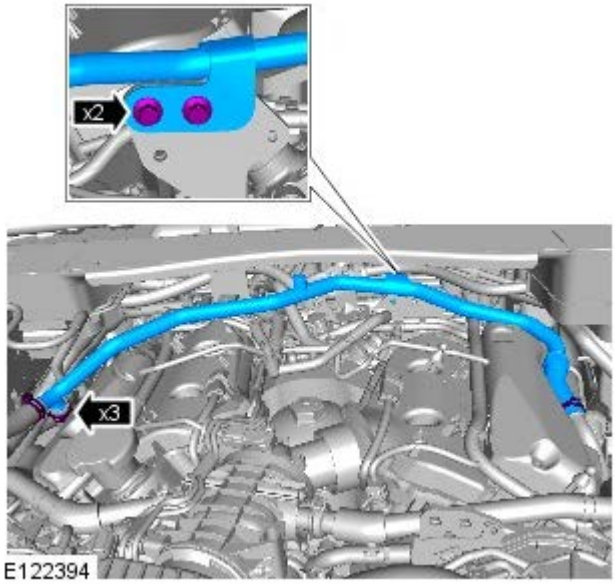
	100-012 Slide Hammer
	310-213 Fuel Injector Removal Adapter
	JLR-310-237 Remover, Fuel Injector

Removal

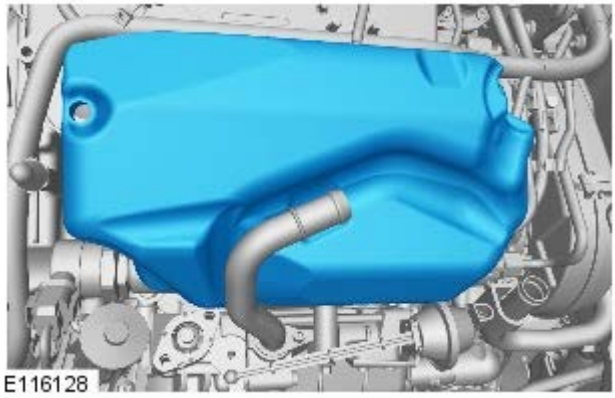
WARNING: Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install new blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

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

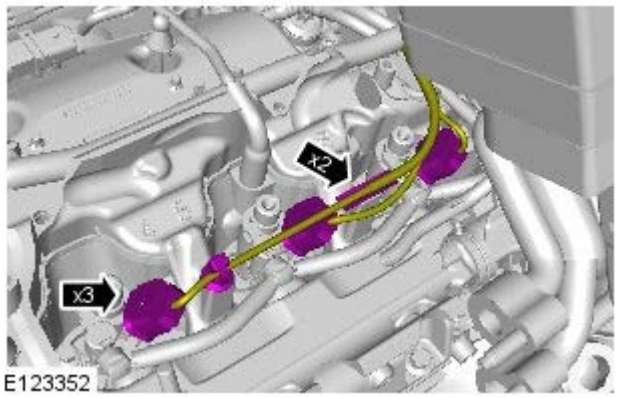
1. Refer to: Fuel Injection Component Cleaning (303-04, General Procedures).
2. Disconnect the battery earth lead.
3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).
4. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
5. CAUTION: Be prepared to collect escaping coolant.



6.



7.

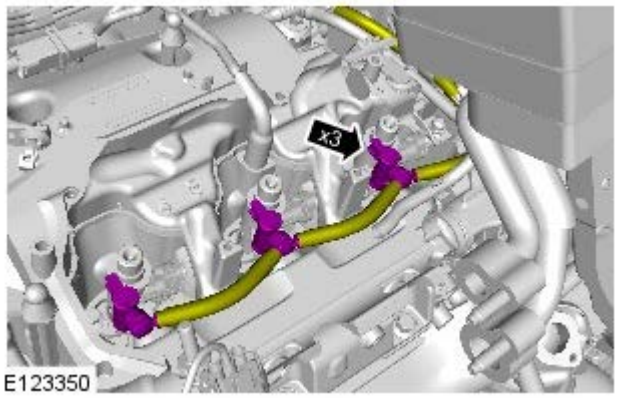


8. CAUTIONS:

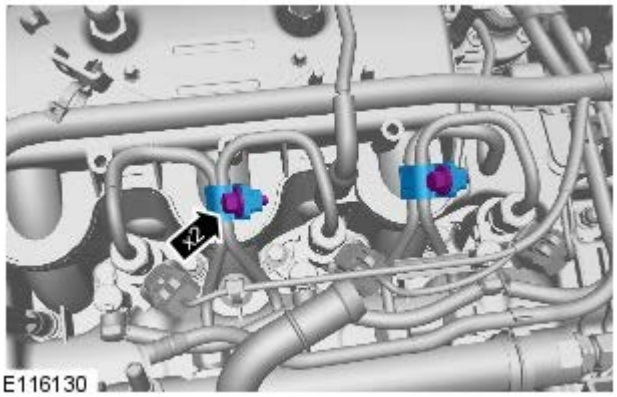
Be prepared to collect escaping fuel.

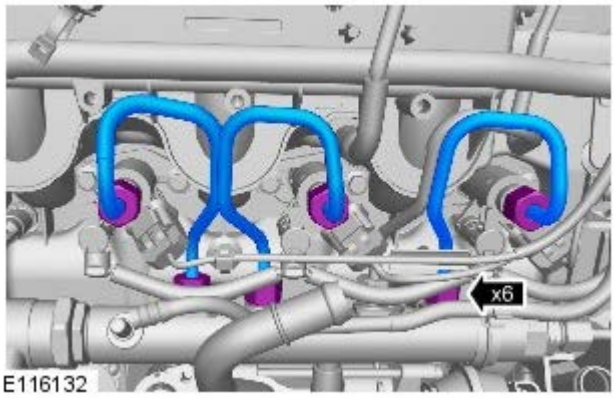
Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

NOTE: Make sure that the fuel injector return line has a maximum of 8 uses.



9.





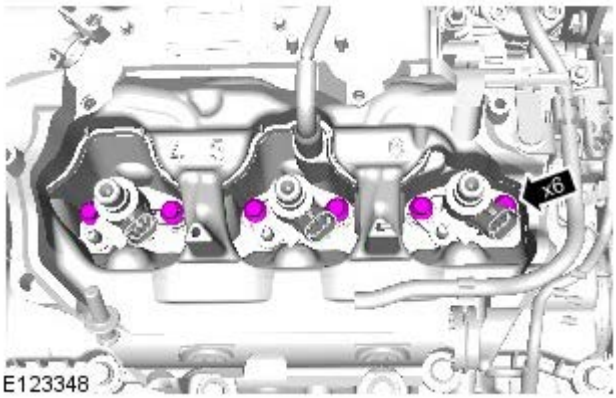
10. CAUTIONS:

Be prepared to collect escaping fuel.

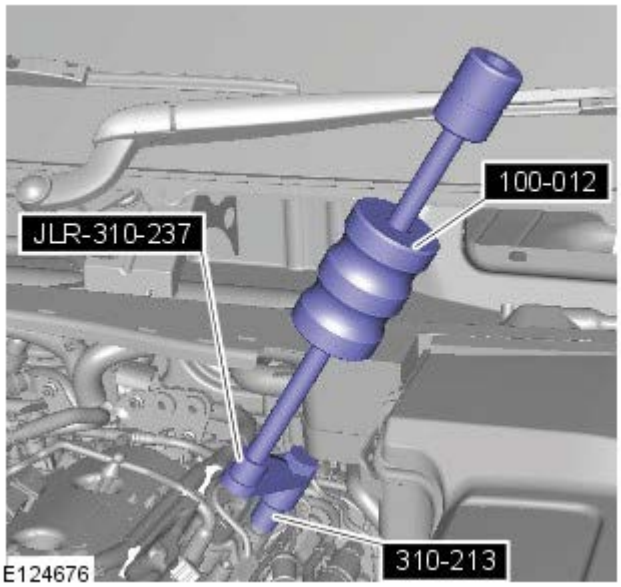
Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean.

Remove and discard the high-pressure fuel supply lines.

11.

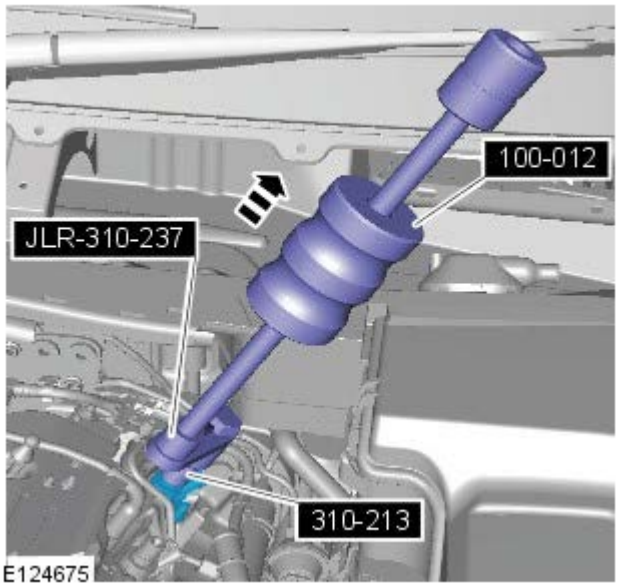


12. Install the special tool.

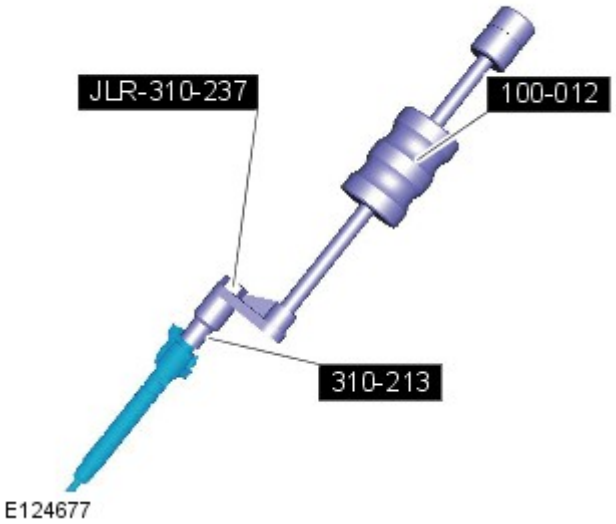


13.

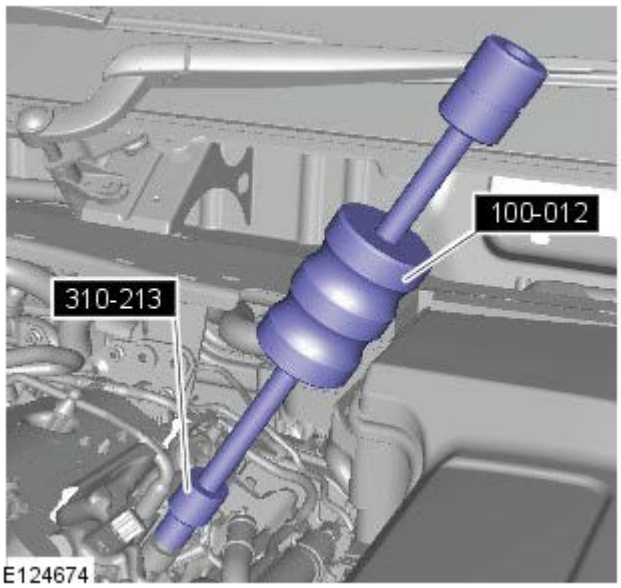
- *Special Tool(s):* JLR-310-237
- *Special Tool(s):* 310-213
- *Special Tool(s):* 100-012



14. Remove the special tool.

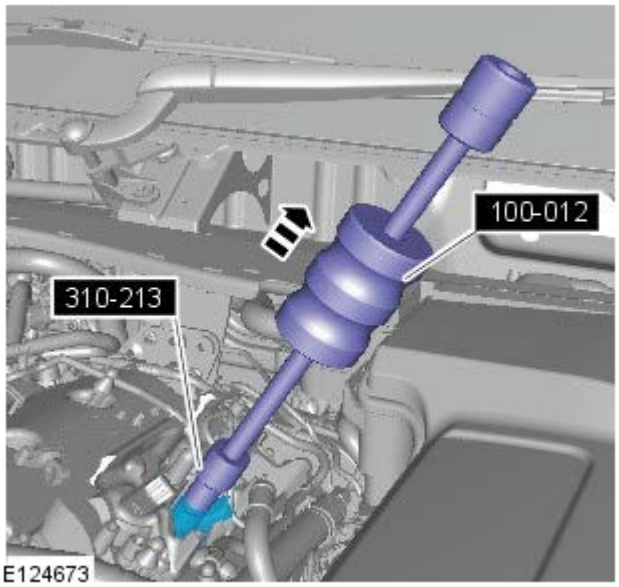


15. Install the special tool.

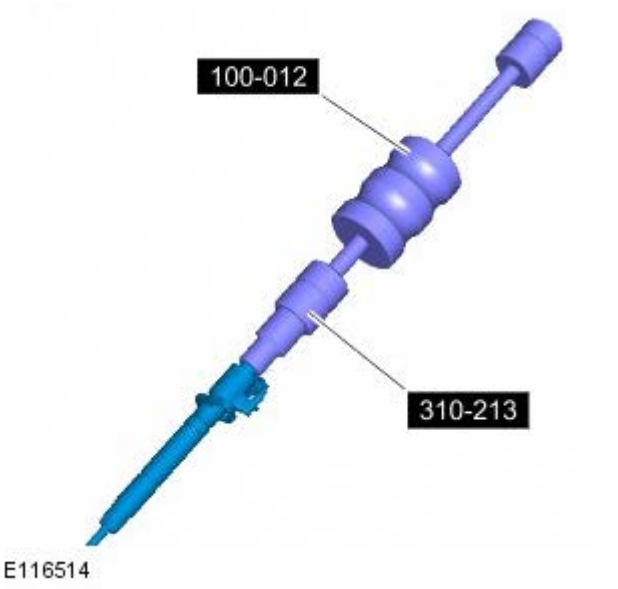


16.

- *Special Tool(s):* 310-213
- *Special Tool(s):* 100-012

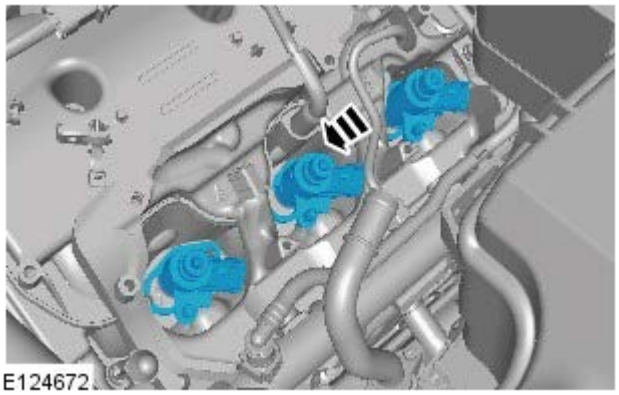


17. Remove the special tool.



18. Repeat the above procedure for the remaining injectors.

Installation

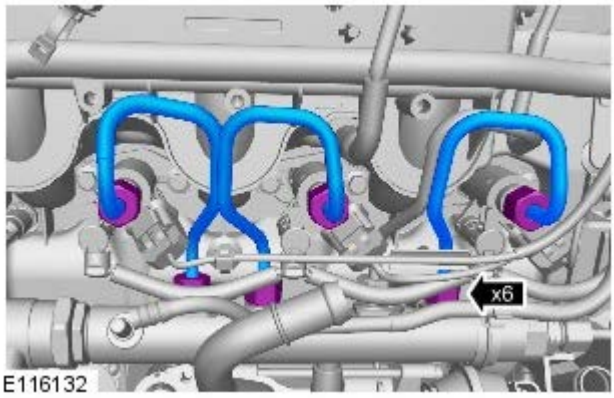


1. CAUTION: Make sure that the area around the open fuel injector ports are clean and free of foreign material and lubricant prior to installing the fuel injector.

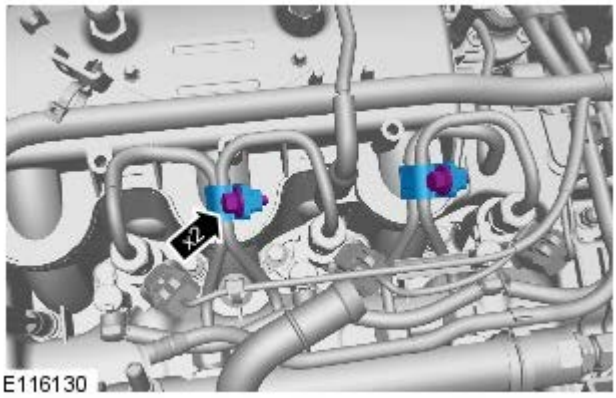
2. CAUTIONS:

   Make sure that a new component is installed.

   Only tighten the unions finger-tight at this stage.

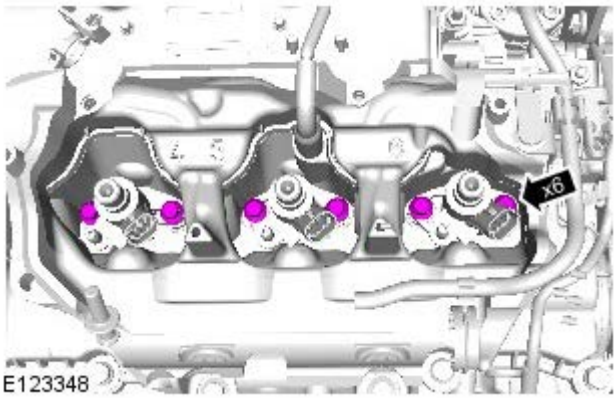


3. *Torque:* 10 Nm

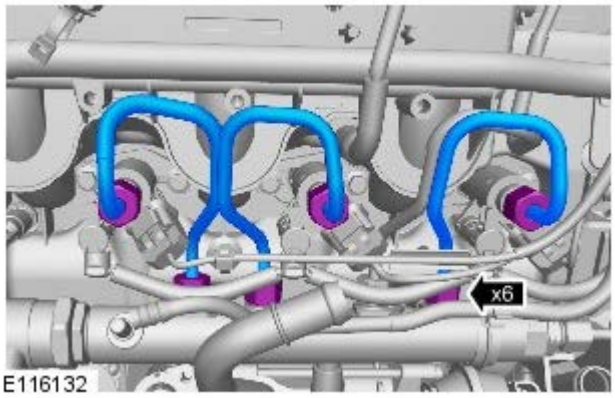


4. NOTE: Tighten the retaining bolts evenly and progressively.

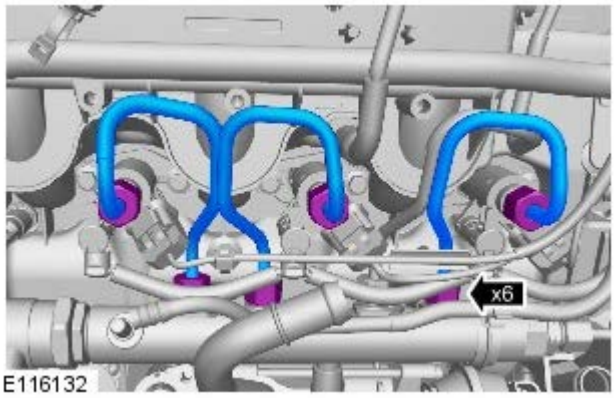
   Torque: 9 Nm



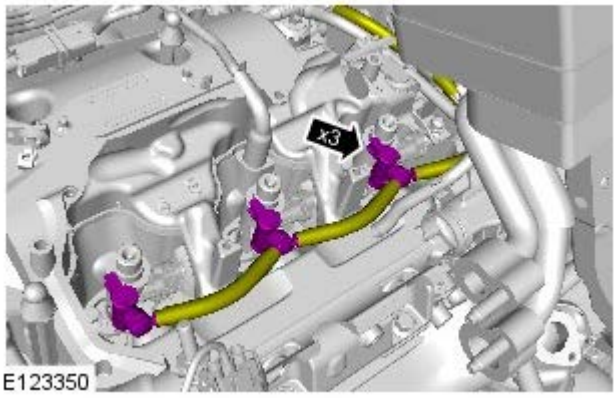
5.
   - Stage 1:Tighten the high-pressure fuel supply line unions at the fuel rail to 15Nm.
   - Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 15Nm.



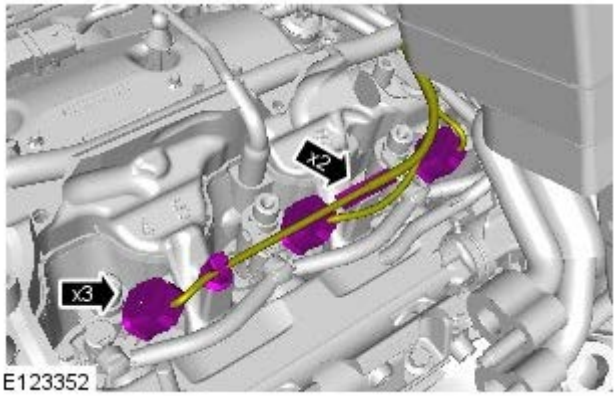
6.
   - Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 35Nm.
   - Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 35Nm.



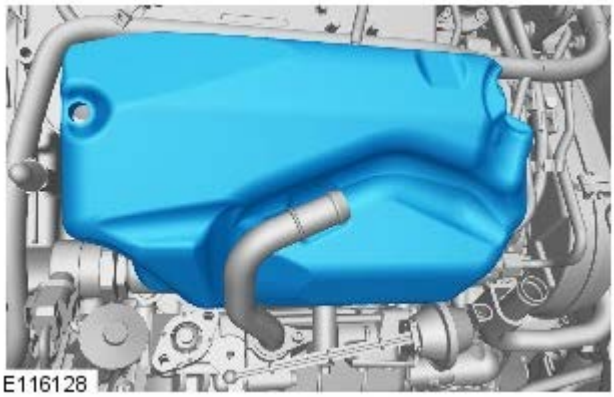
7. NOTE: Make sure that the fuel injector return line has a maximum of 8 uses.



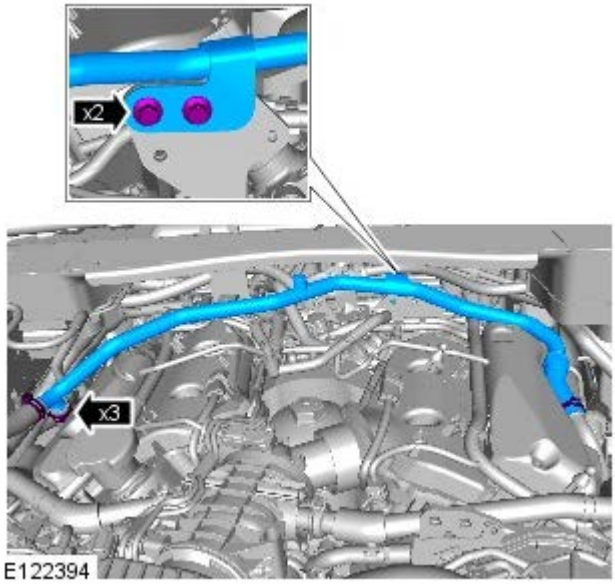
8.



9.



10. *Torque:* 10 Nm



11. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

12. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

13. Connect the battery earth lead.

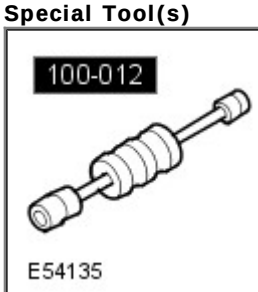
14. If a new unit is installed, configure using the approved diagnostic tool.

Published: 18-Aug-2011

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Injectors RH

Removal and Installation

Special Tool(s)

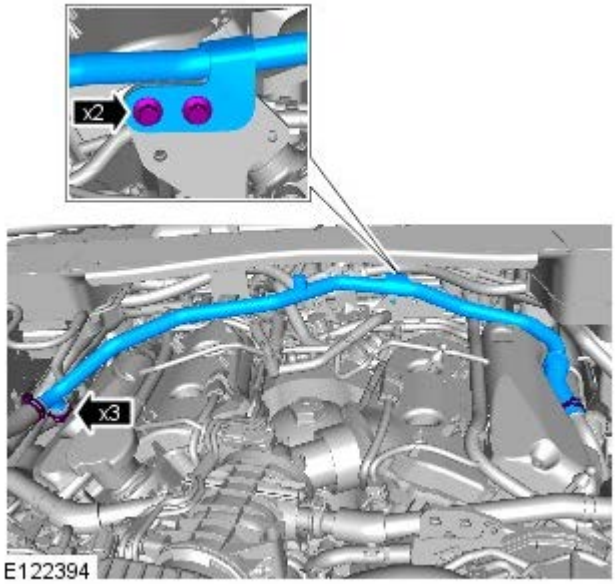
 E54135	100-012 Slide Hammer
 E116924	310-213 Fuel Injector Removal Adapter
 E124125	JLR-310-237 Remover, Fuel Injector

Removal

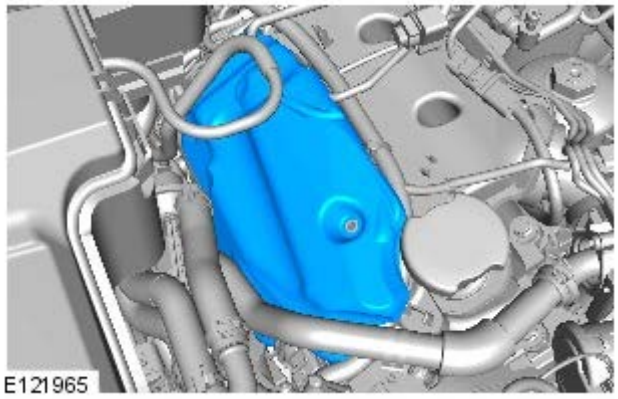
WARNING: Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install new blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

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

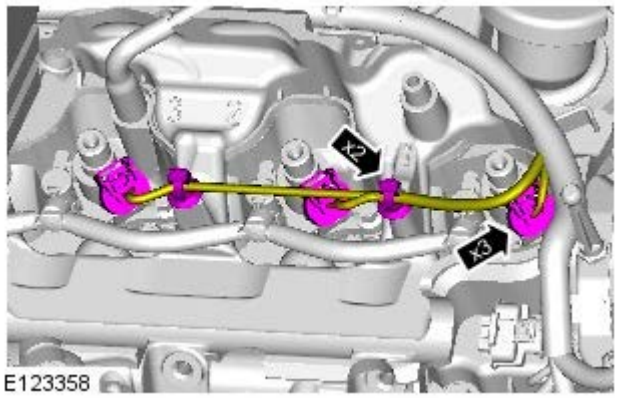
1. Refer to: Fuel Injection Component Cleaning (303-04, General Procedures).
2. Disconnect the battery earth lead.
3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).
4. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
5. CAUTION: Be prepared to collect escaping coolant.



6.



7.

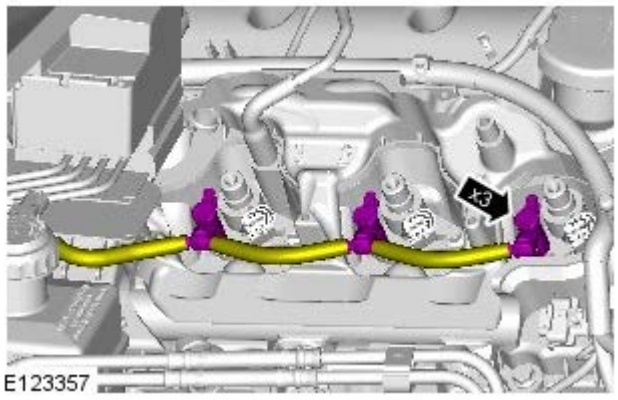


8. CAUTIONS:

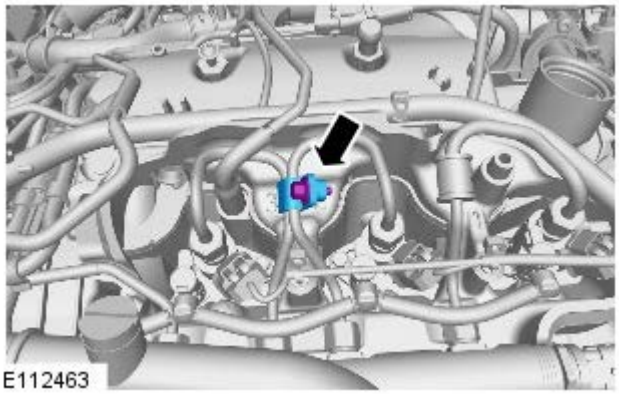
Be prepared to collect escaping fuel.

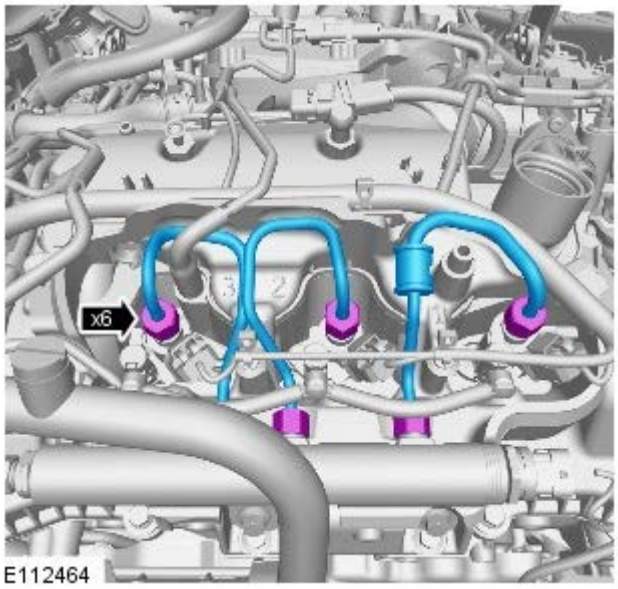
Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

NOTE: Make sure that the fuel injector return line has a maximum of 8 uses.

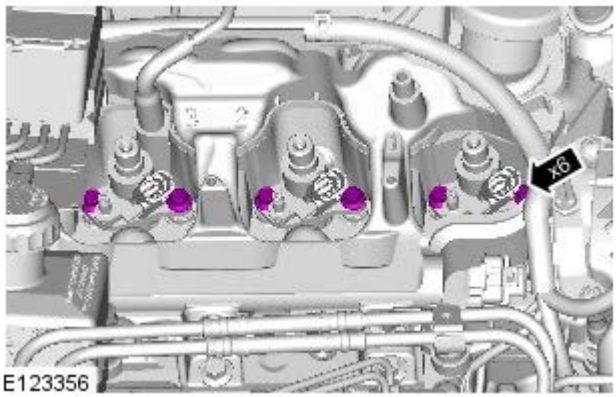


9.


E112463



E112464



E123356

10. CAUTIONS:

    Be prepared to collect escaping fuel.

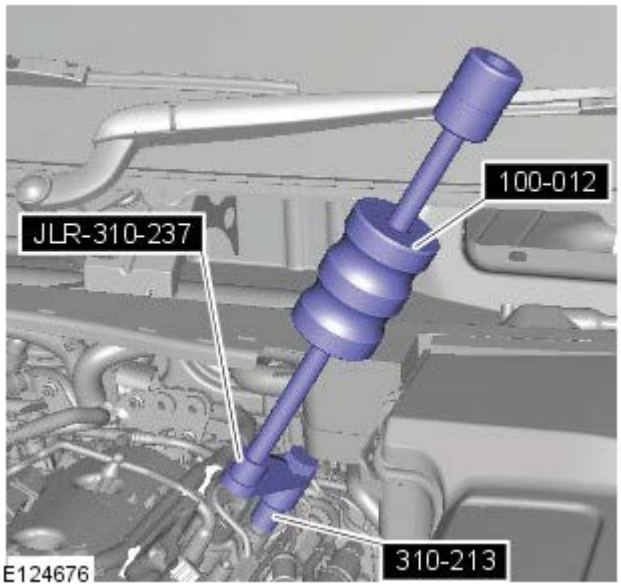
    Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean.

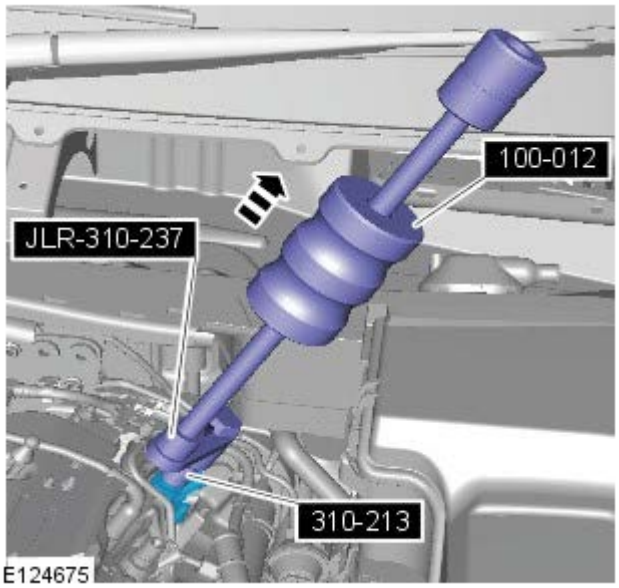
    Remove and discard the high-pressure fuel supply lines.

11.

12. CAUTION: LH illustration shown, RH is similar.

    Install the special tool.

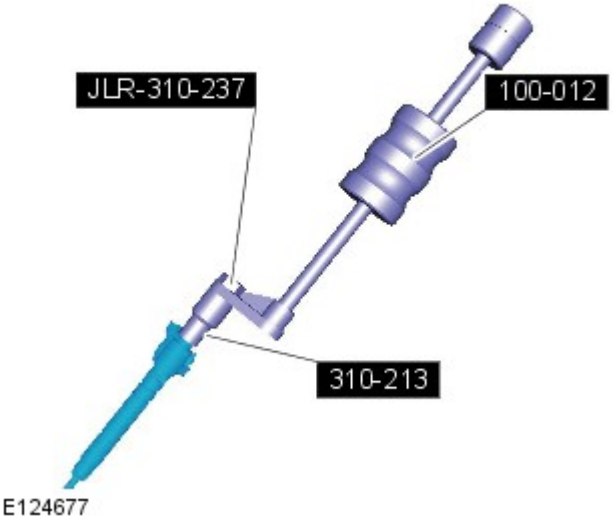




13. CAUTION: LH illustration shown, RH is similar.

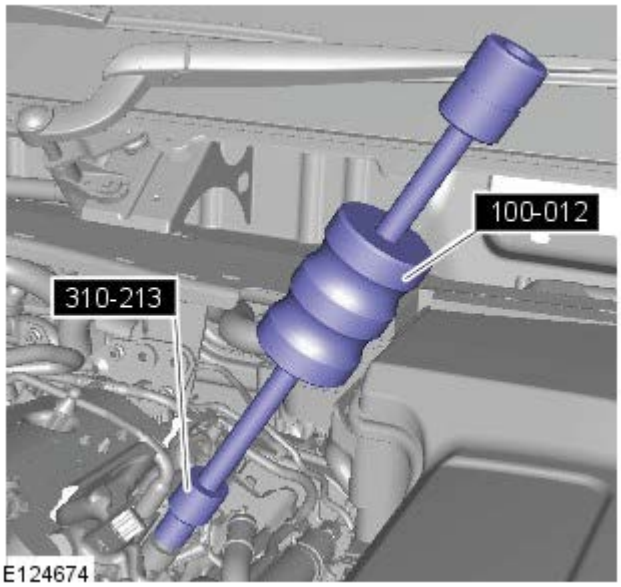
- *Special Tool(s):* 100-012
- *Special Tool(s):* JLR-310-237
- *Special Tool(s):* 310-213

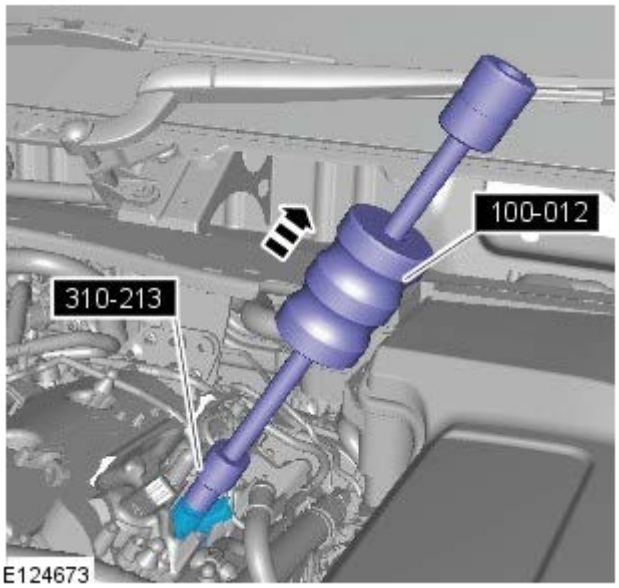
14. Remove the special tool.



15. CAUTION: LH illustration shown, RH is similar.

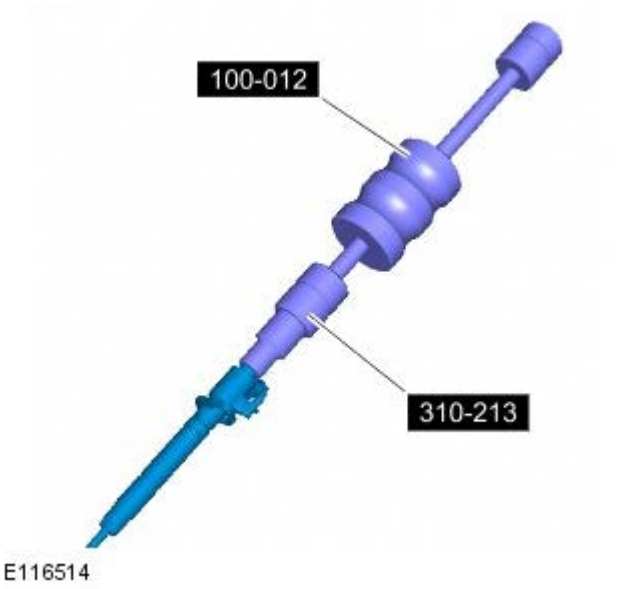
Install the special tool.





16. CAUTION: LH illustration shown, RH is similar.
    - *Special Tool(s):* 310-213
    - *Special Tool(s):* 100-012

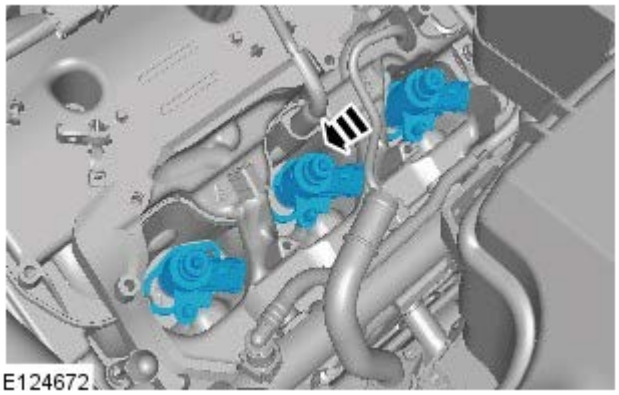
17. Remove the special tool.



18. Repeat the above procedure for the remaining injectors.

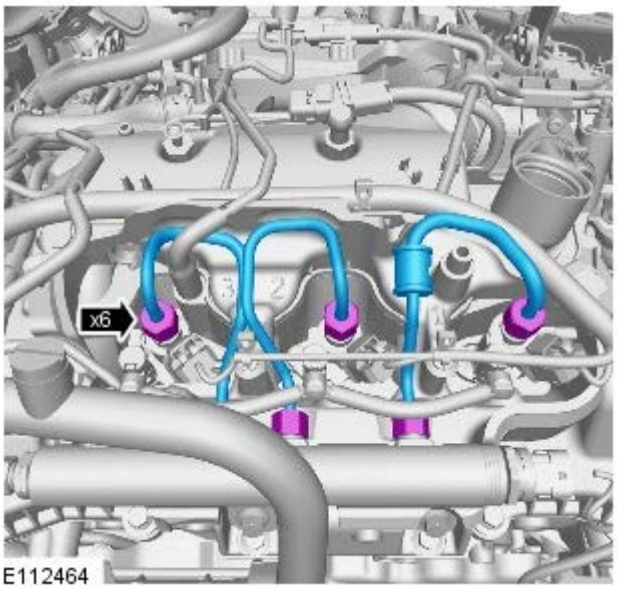
Installation

1. CAUTIONS:



Make sure that the area around the open fuel injector ports are clean and free of foreign material and lubricant prior to installing the fuel injector.

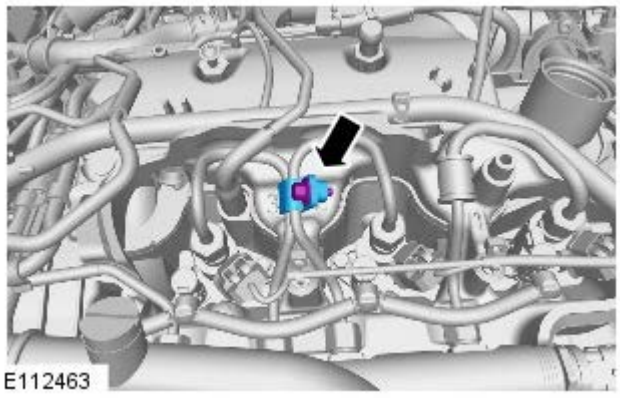
LH illustration shown, RH is similar.



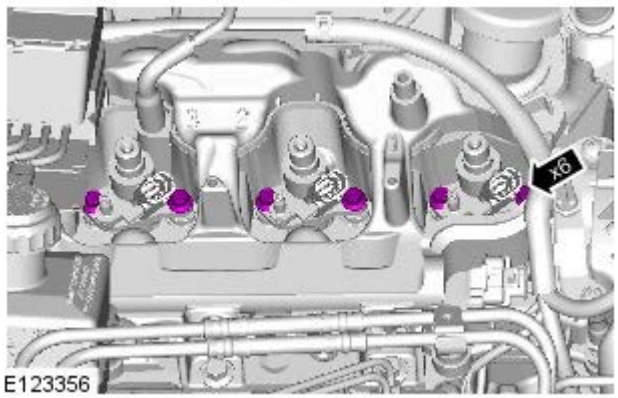
2. CAUTIONS:

   Make sure that a new component is installed.

   Only tighten the unions finger-tight at this stage.



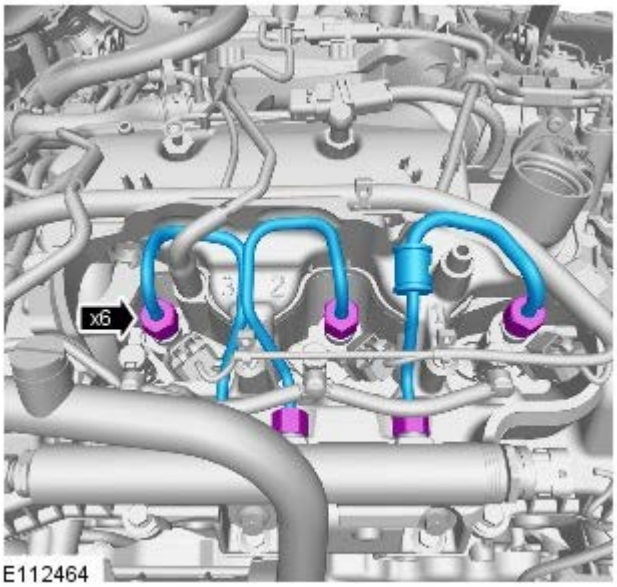
3. *Torque:* 10 Nm



4. NOTE: Tighten the retaining bolts evenly and progressively.

   Torque: 9 Nm

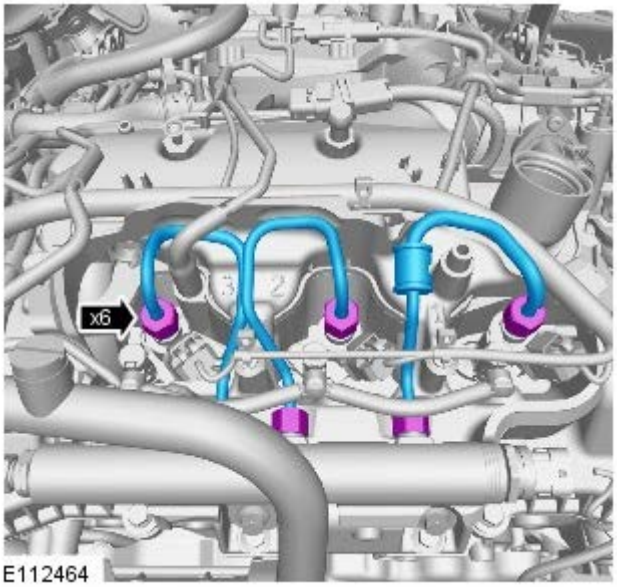
5.
   - Stage 1:Tighten the high-pressure fuel supply line unions at the fuel rail to 15Nm.
   - Stage 2: Tighten the high-pressure fuel



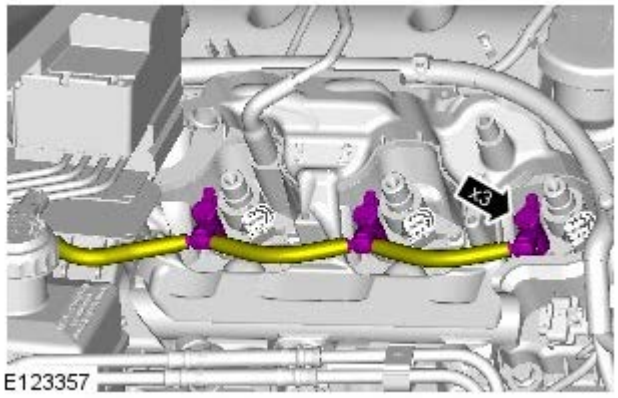
supply line unions at the injector to 15Nm.

6.

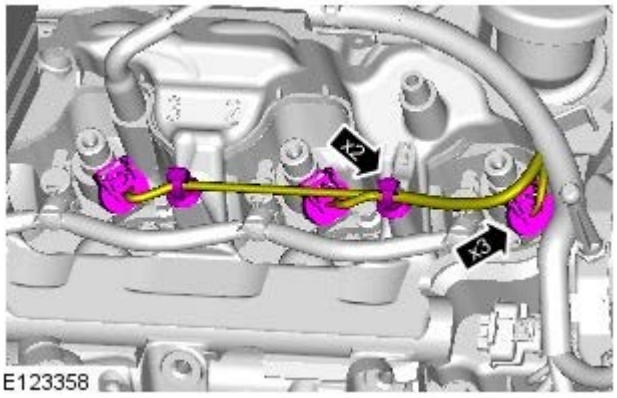
- Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 35Nm.
- Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 35Nm.



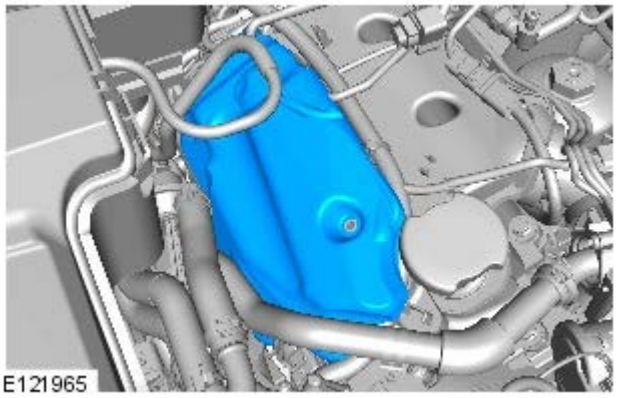
7. NOTE: Make sure that the fuel injector return line has a maximum of 8 uses.



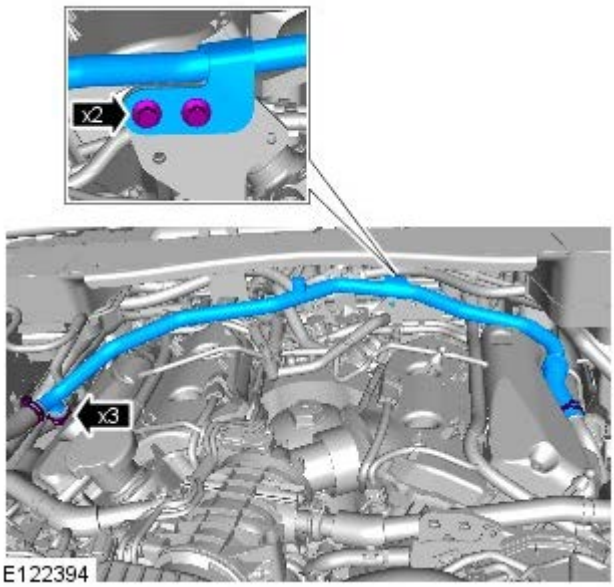
8.



9.



10. *Torque:* 10 Nm



11. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

12. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

13. Connect the battery earth lead.

14. If a new unit is installed, configure using the approved diagnostic tool.

Published: 03-Dec-2013

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Rail LH

Removal and Installation

Removal

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

1. WARNING: Make sure to support the vehicle with axle stands.

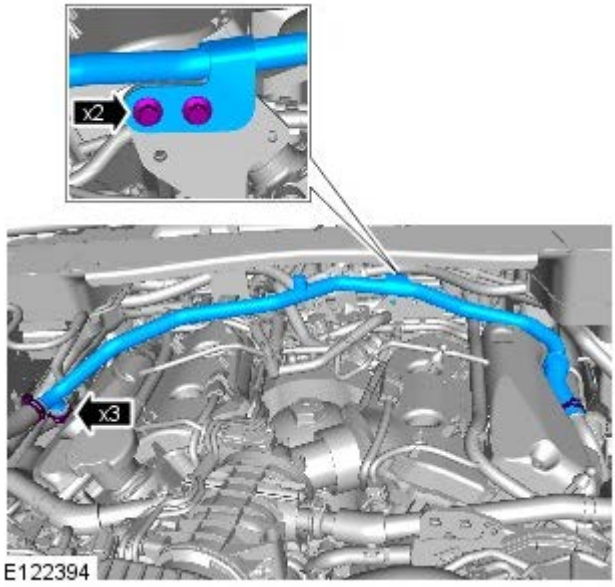
   Raise and support the vehicle.

2. Disconnect the battery ground cable.

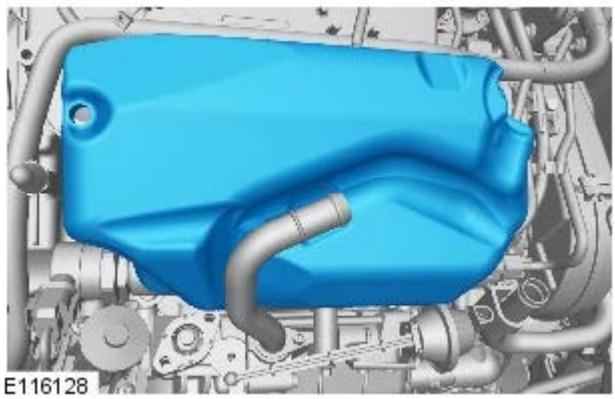
3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

4. Refer to: Fuel Injection Component Cleaning (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel, General Procedures).

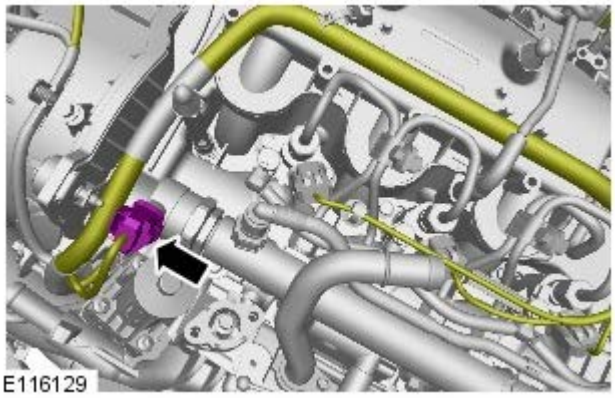
5.



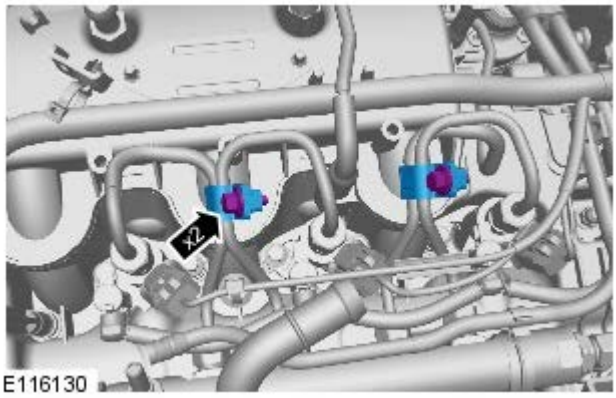
6. NOTE: Left-hand shown, right-hand similar.



7.



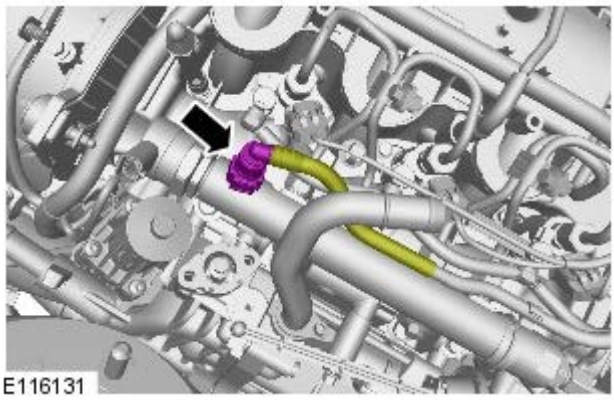
8.



9. CAUTIONS:

Be prepared to collect escaping fuel.

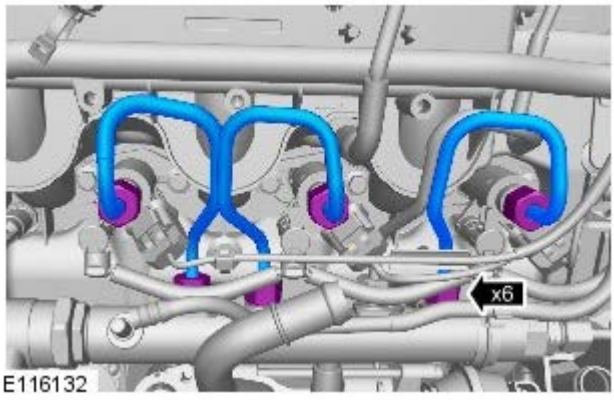
Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



10. CAUTIONS:

Be prepared to collect escaping fuel.

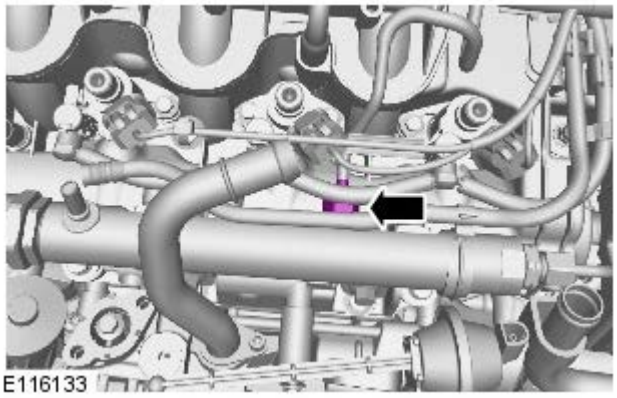
Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

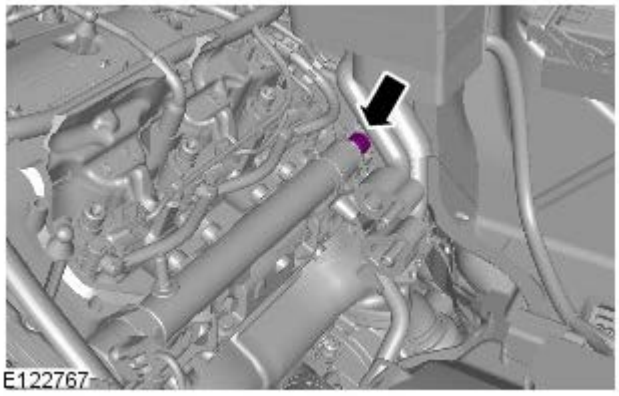


11. CAUTIONS:

Be prepared to collect escaping fuel.

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

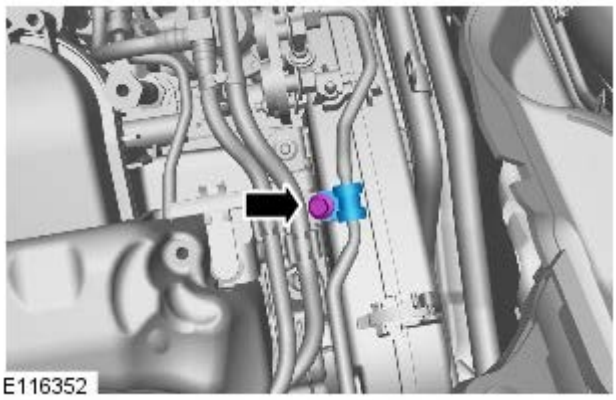




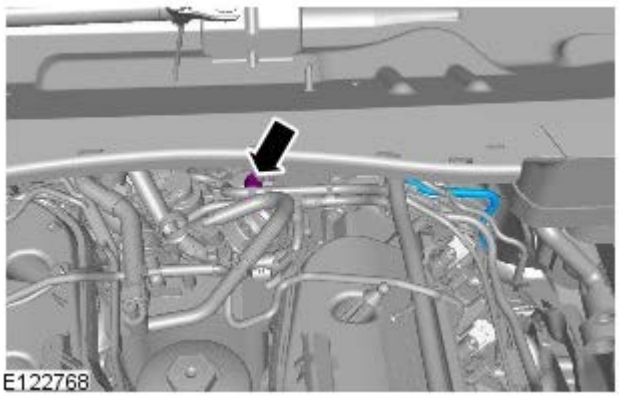
12. CAUTIONS:

    Be prepared to collect escaping fuel.

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

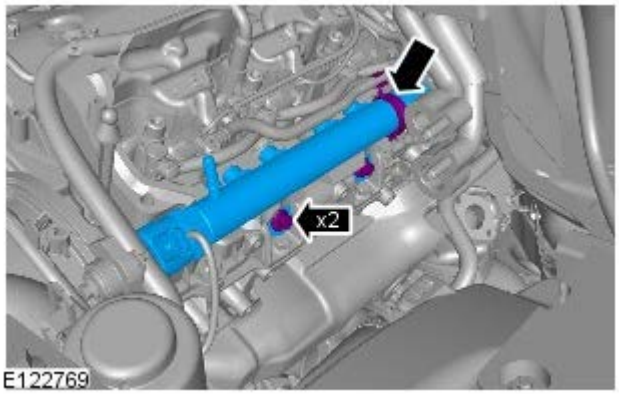


13.

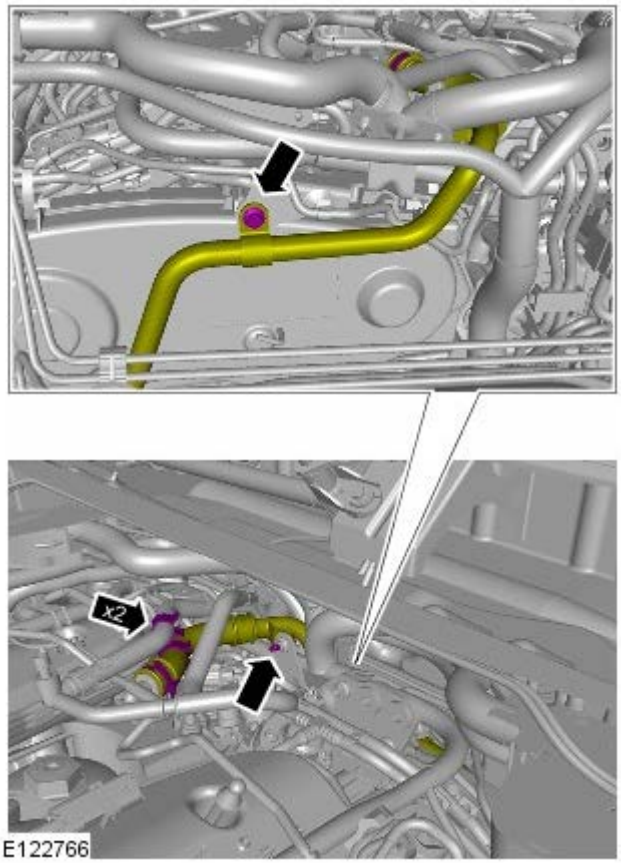


14. CAUTION: Be prepared to collect escaping fuel.

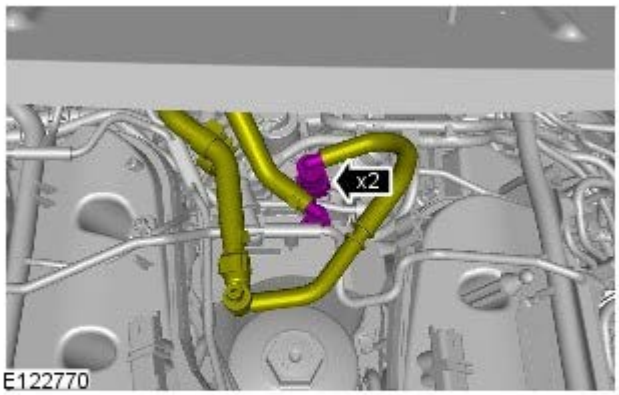
15. CAUTION: Be prepared to collect escaping fuel.



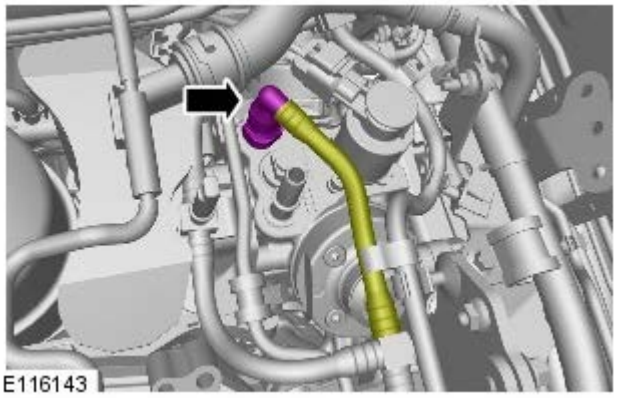
16.



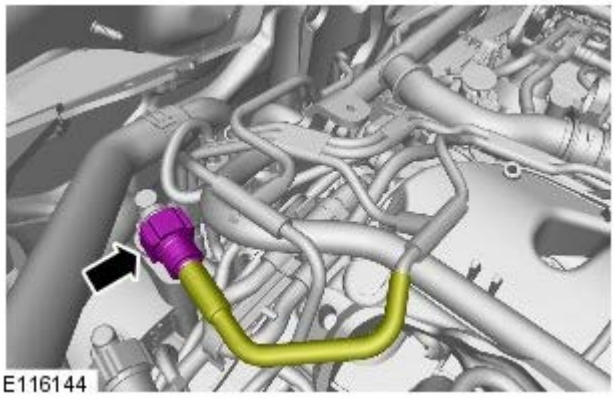
17. CAUTION: Be prepared to collect escaping fuel.



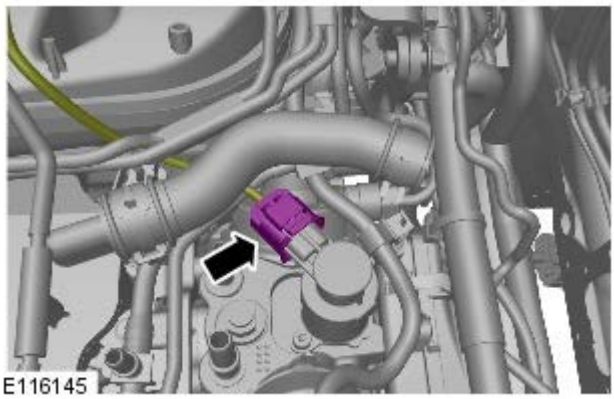
18. CAUTION: Be prepared to collect escaping fuel.


E116143

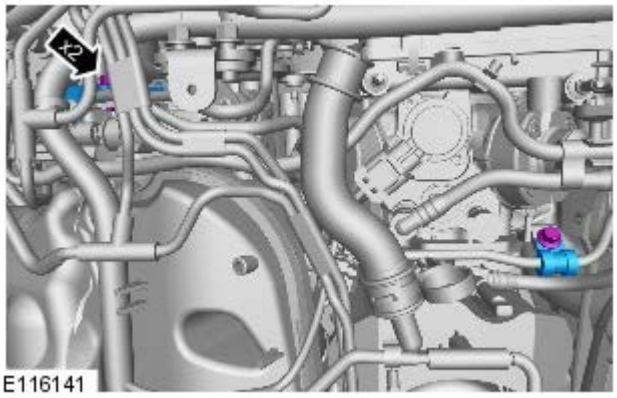
19.


E116144

20.

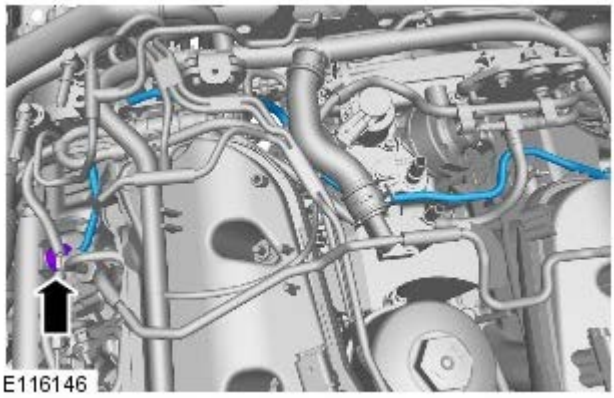

E116145

21.

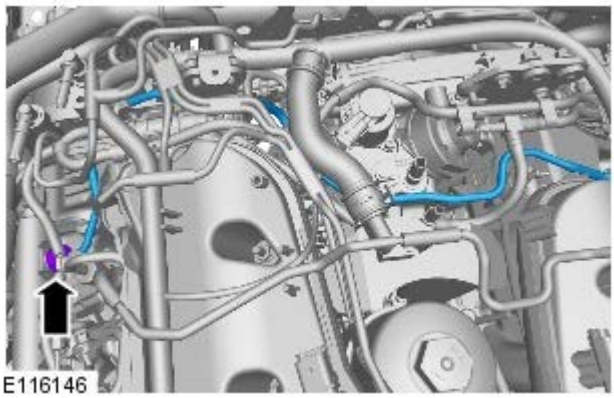


E116141

22. CAUTION: Be prepared to collect escaping fuel.



Installation

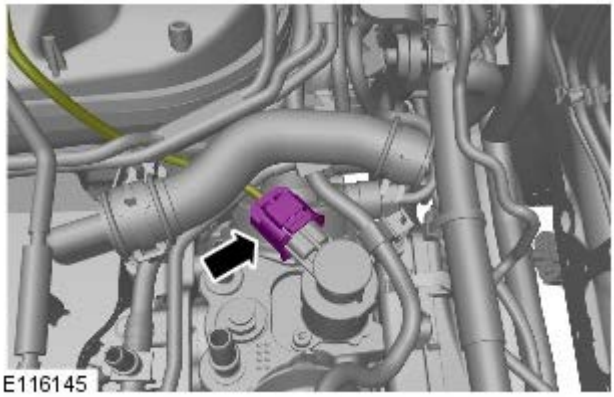


1. CAUTIONS:

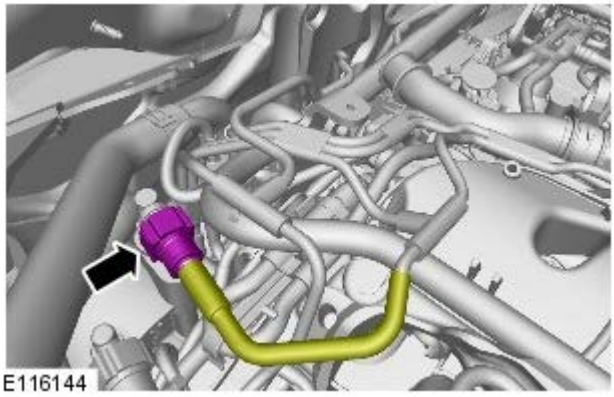
   Make sure that a new component is installed.

   Tighten the fuel supply line unions finger tight.

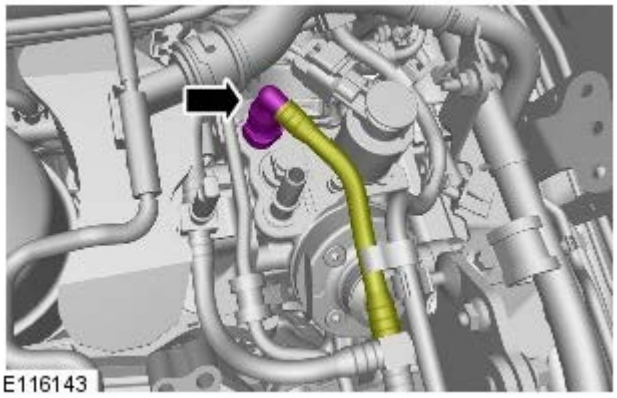
2.



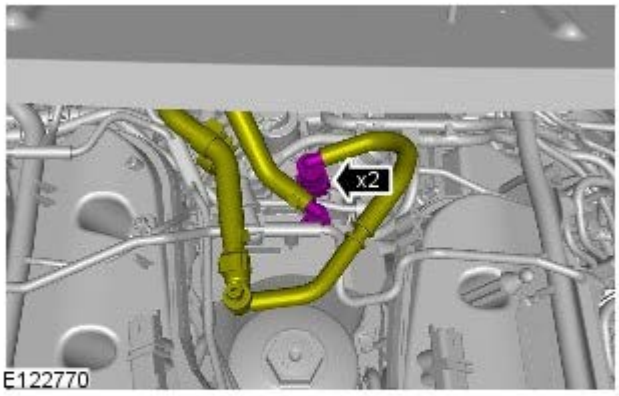
3.

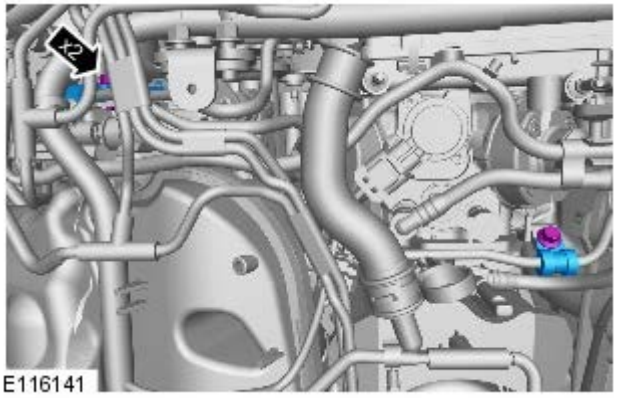


4.

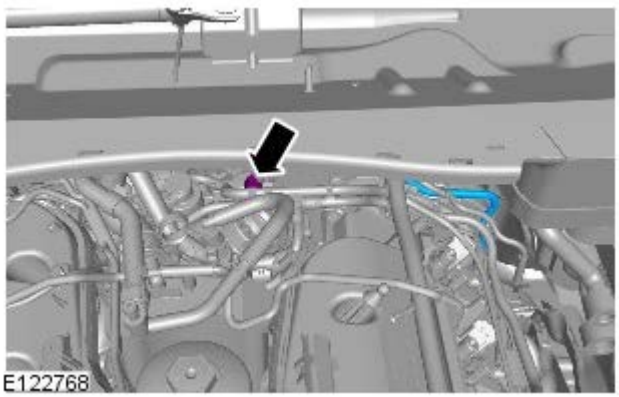


5.





6. CAUTION: Only tighten the bolts finger-tight at this stage.

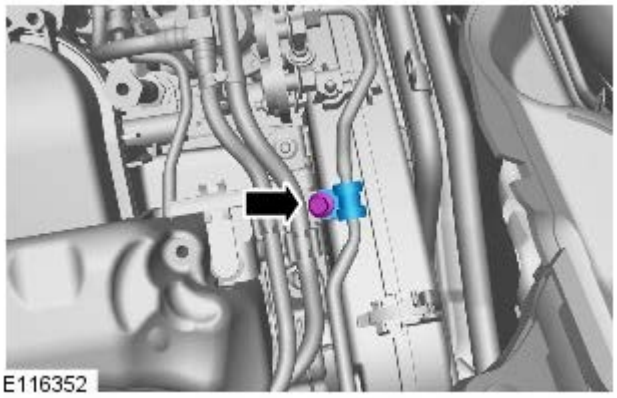


7. CAUTIONS:

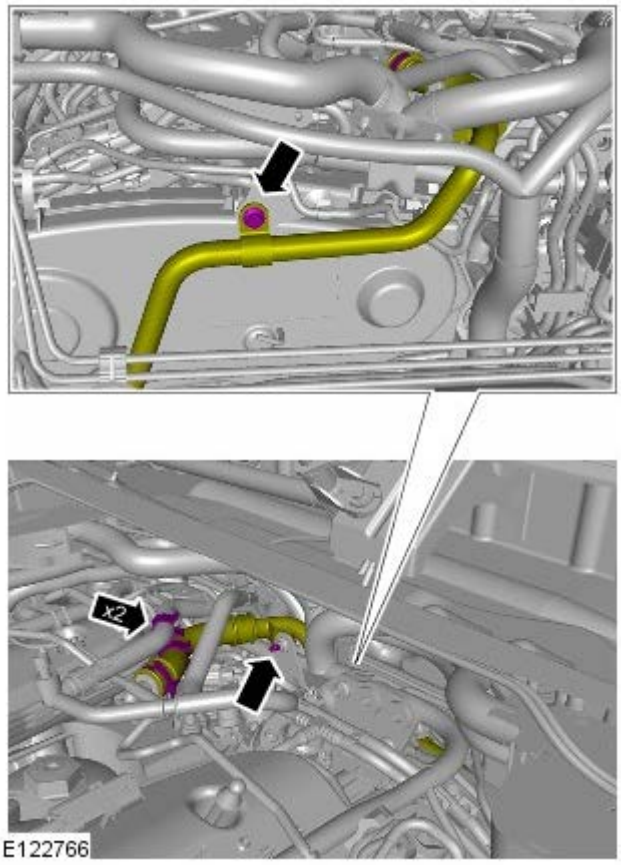
   Make sure that a new component is installed.

   Tighten the fuel supply line unions finger tight.

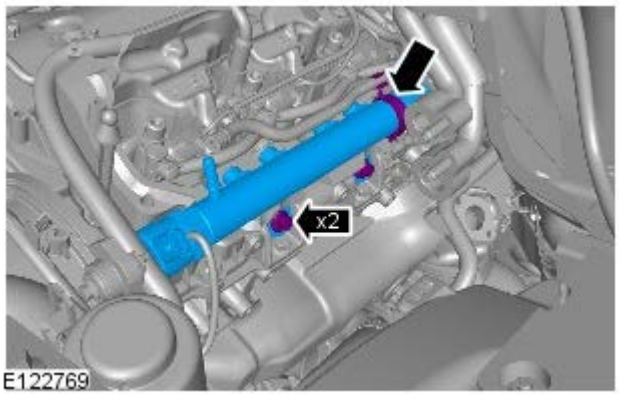
8. CAUTION: Only tighten the bolts finger-tight at this stage.



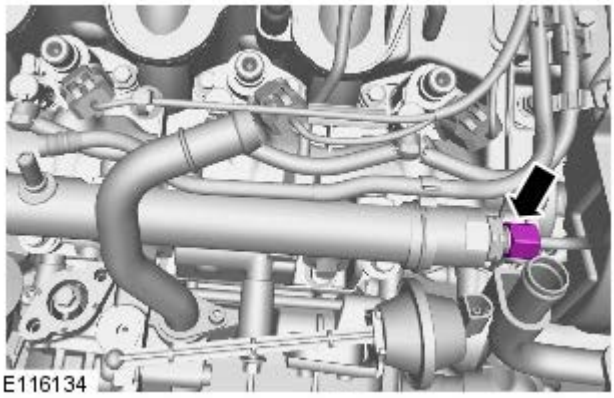
9. *Torque:* 10 Nm

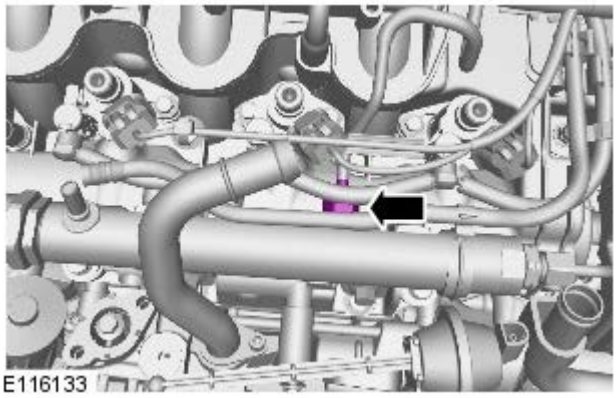


10. *Torque:* 24 Nm



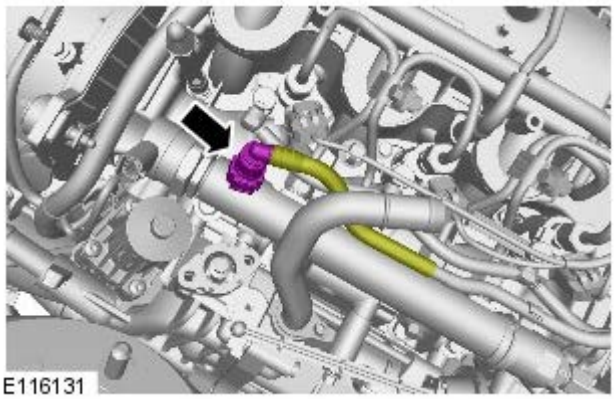
11. CAUTION: Tighten the fuel supply line unions finger tight.

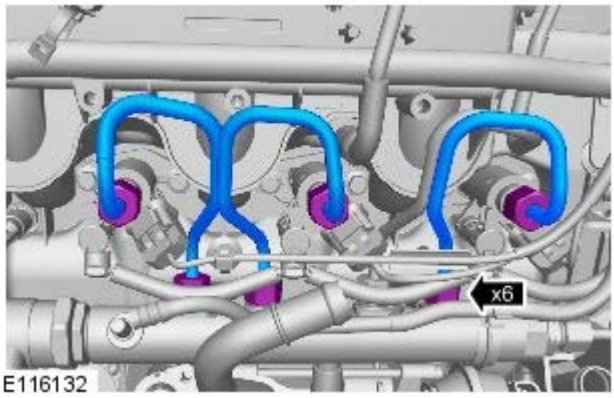




12. CAUTION: Tighten the fuel supply line unions finger tight.

13.



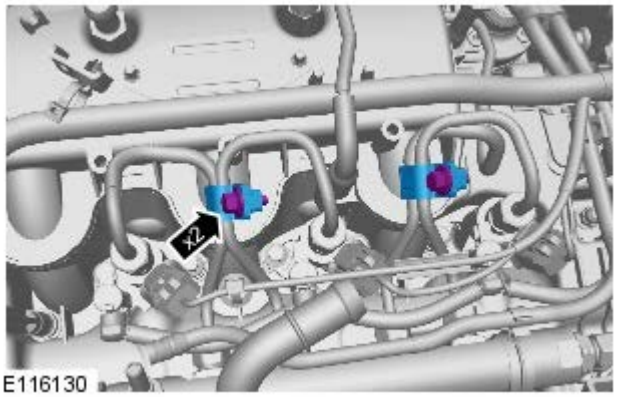


14. CAUTIONS:

Make sure that a new component is installed.

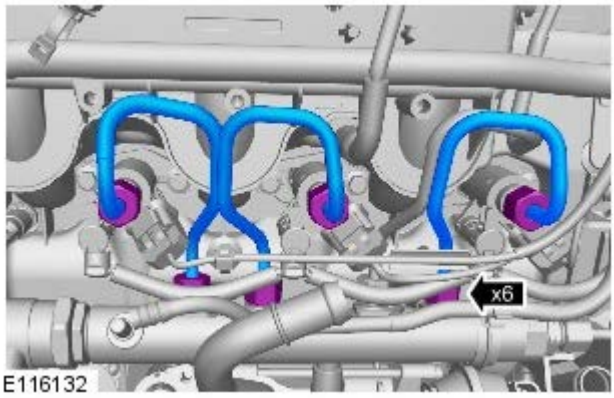
Tighten the fuel supply line unions finger tight.

15. CAUTION: Only tighten the bolt finger-tight at this stage.

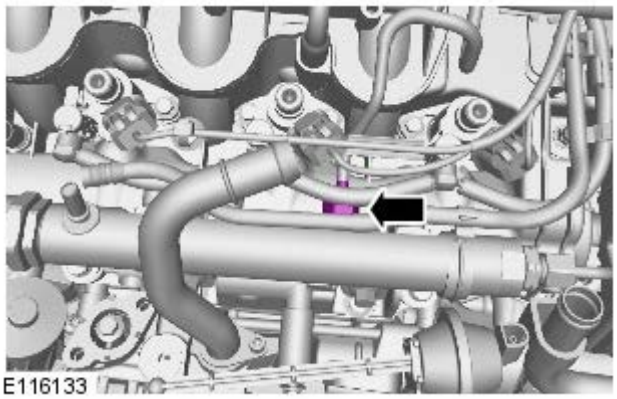


16.

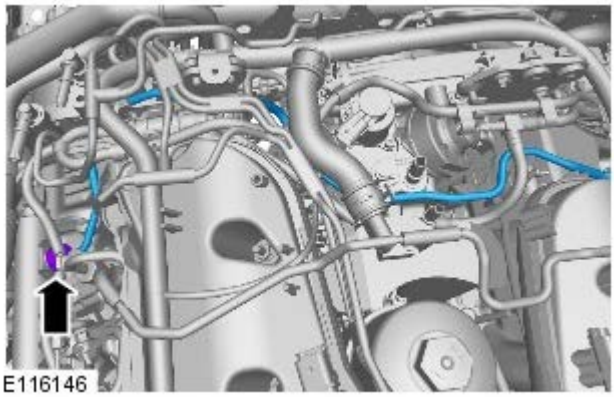
- Stage 1:Tighten the high-pressure fuel supply line unions at the fuel rail to 15Nm.
- Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 15Nm.



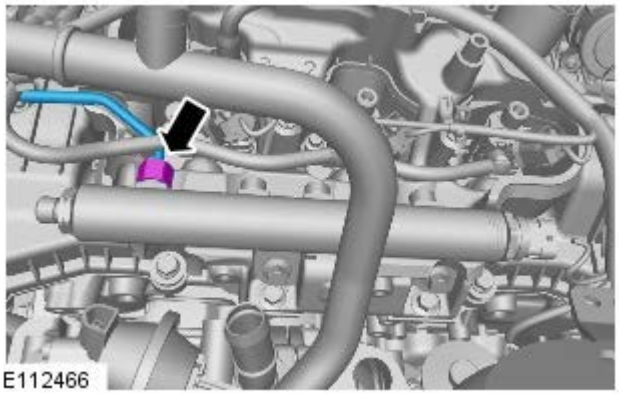
17. Tighten the high-pressure fuel lines union to 15Nm.



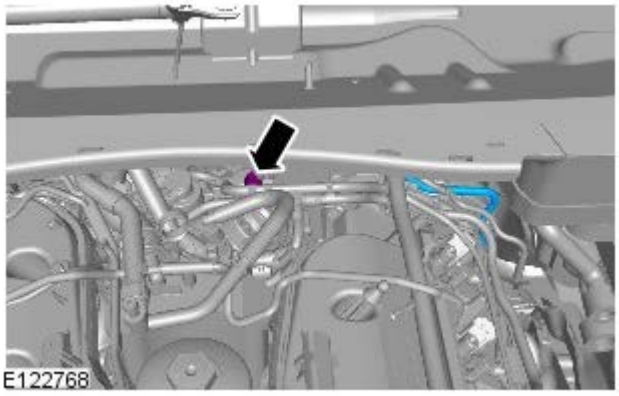
18. Tighten the high-pressure fuel lines union to 15Nm.



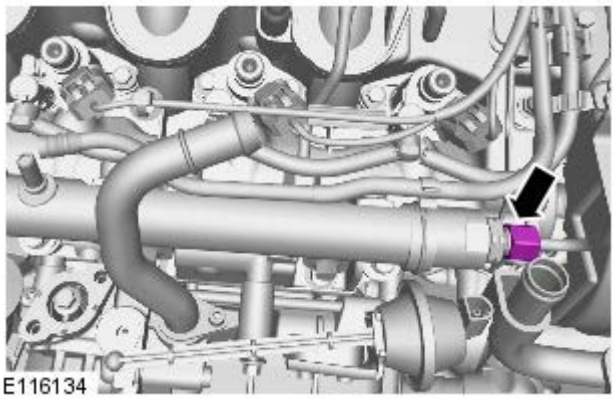
19. Tighten the high-pressure fuel lines union to 15Nm.



20. Tighten the high-pressure fuel lines union to 15Nm.

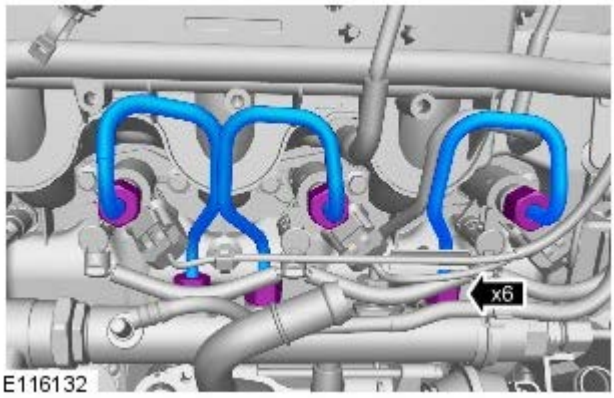


21. Tighten the high-pressure fuel lines union to 15Nm.

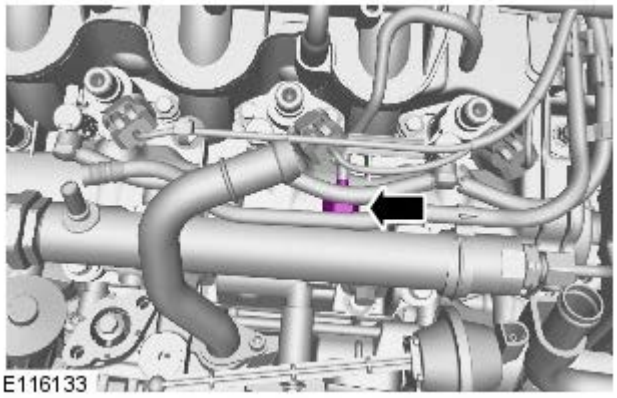


22.

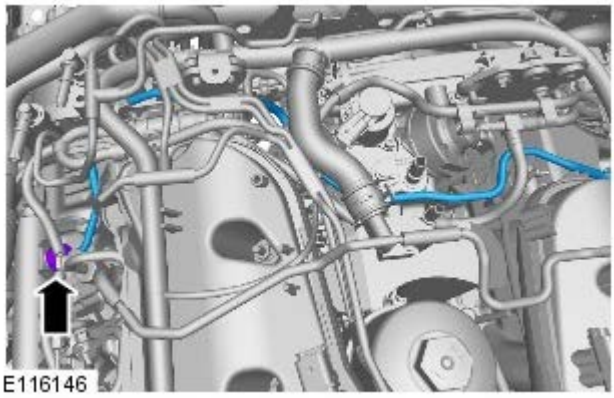
- Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 35Nm.
- Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 35Nm.



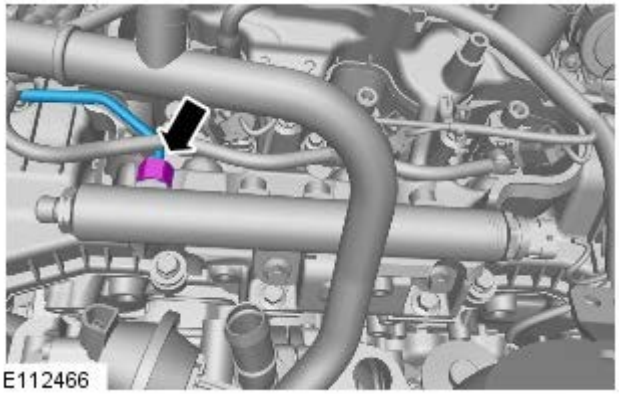
23. Tighten the high-pressure fuel line union to 30 Nm.


E116133

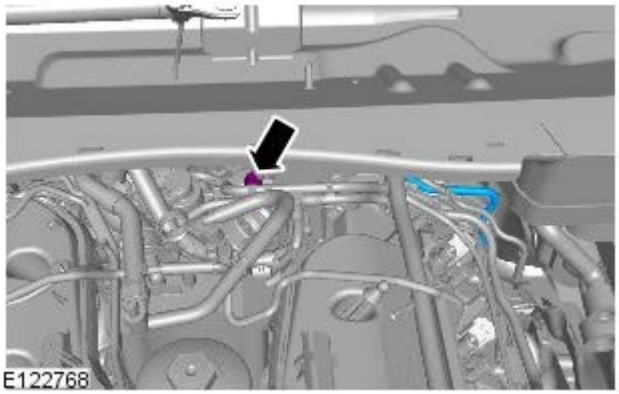
24. Tighten the high-pressure fuel line union to 30 Nm.


E116146

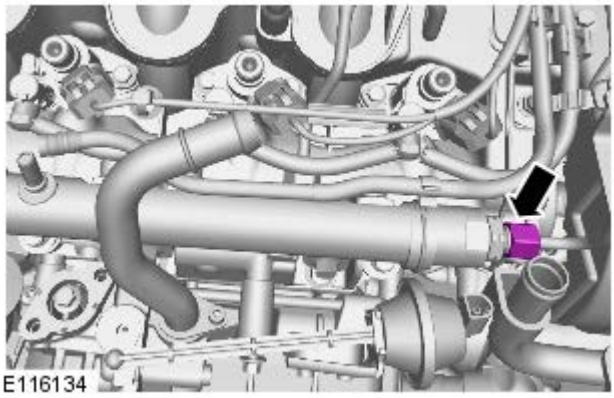
25. Tighten the high-pressure fuel line union to 30 Nm.


E112466

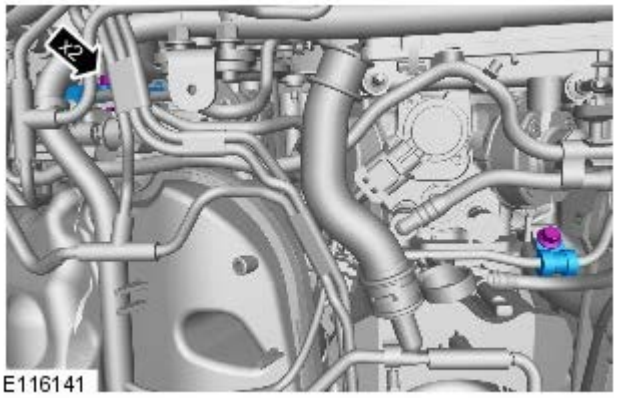
26. Tighten the high-pressure fuel line union to 30 Nm.


E122768

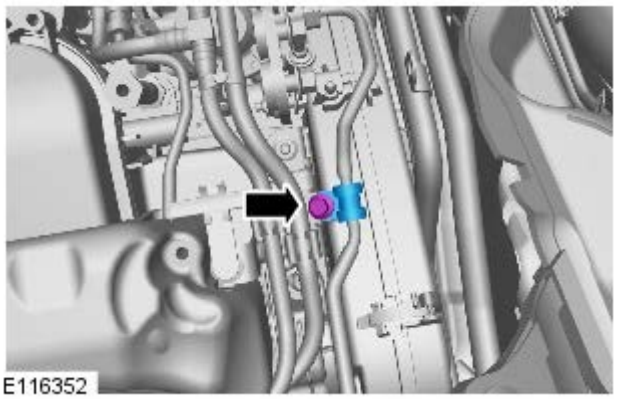
27. Tighten the high-pressure fuel line union to 30 Nm.



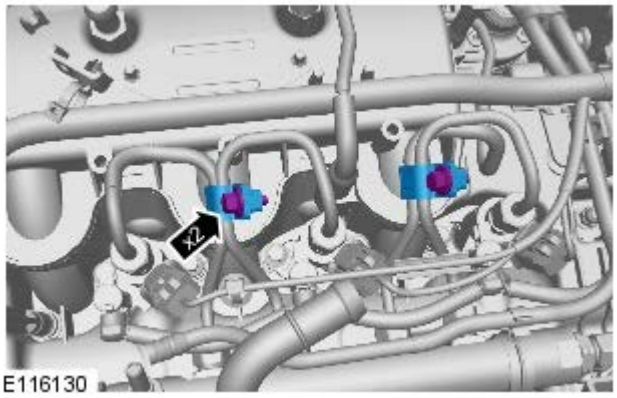
28. *Torque:* 10 Nm



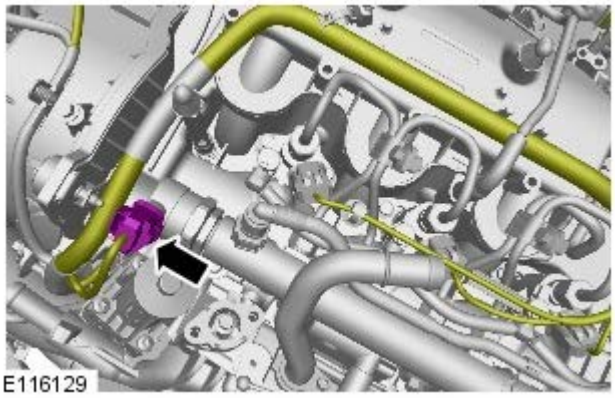
29. *Torque:* 10 Nm

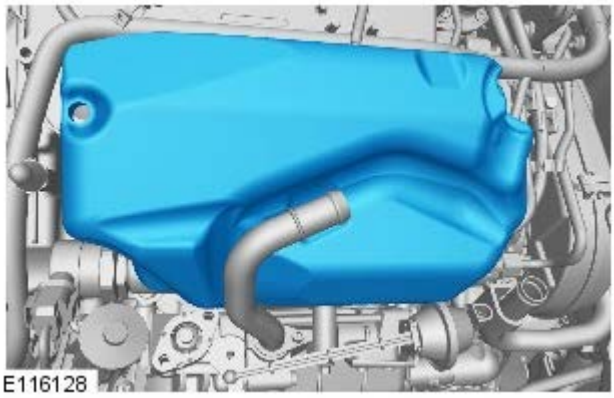


30. *Torque:* 10 Nm



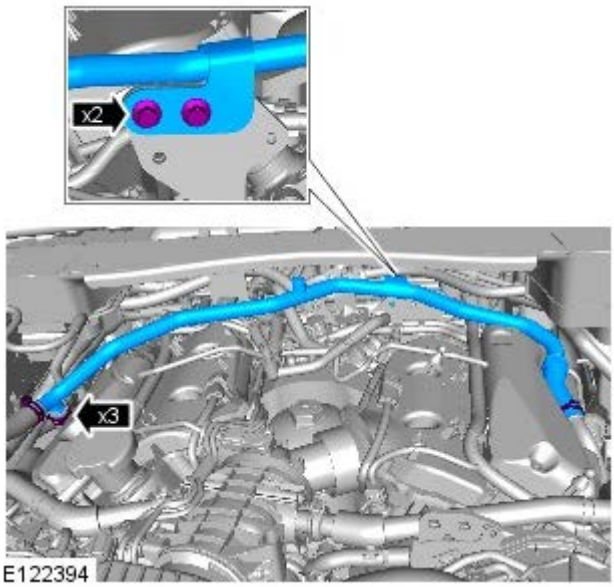
31.





32. NOTE: Left-hand shown, right-hand similar.

33.



34. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

35. Connect the battery ground cable.

Published: 17-Aug-2011

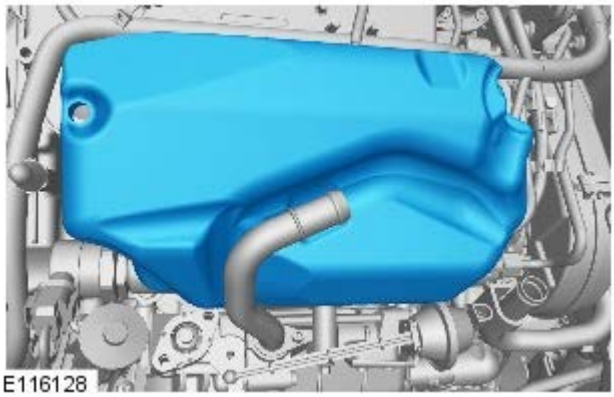
Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Rail RH

Removal and Installation

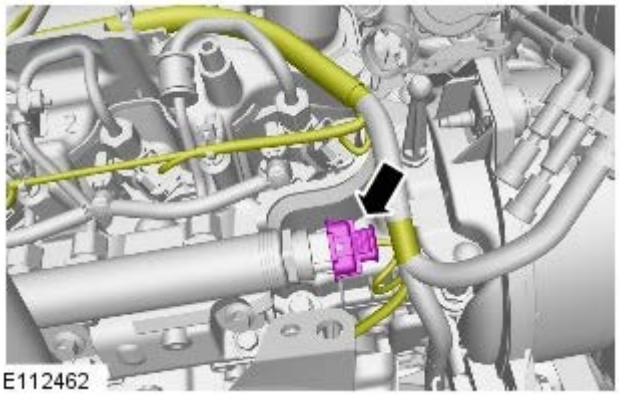
Removal

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

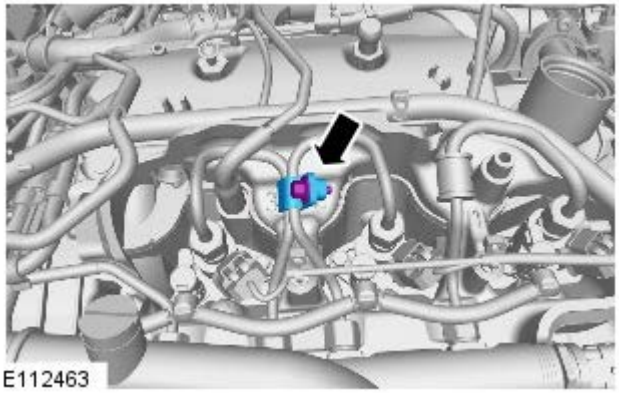
1. Disconnect the battery ground cable.
2.
3. Refer to: Fuel Injection Component Cleaning (303-04, General Procedures).


E116128

4. NOTE: Left-hand shown, right-hand similar.


E112462

5.

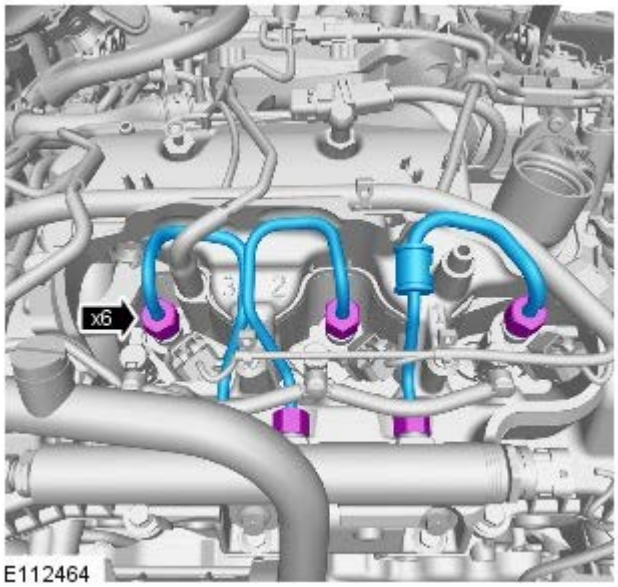

E112463

6.

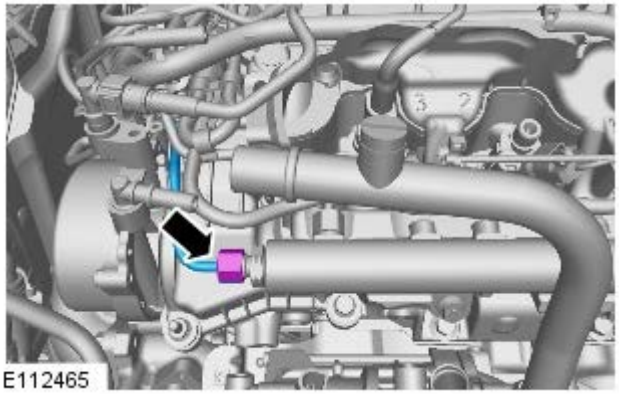
7. CAUTIONS:

Be prepared to collect escaping fuel.

Discard the component.



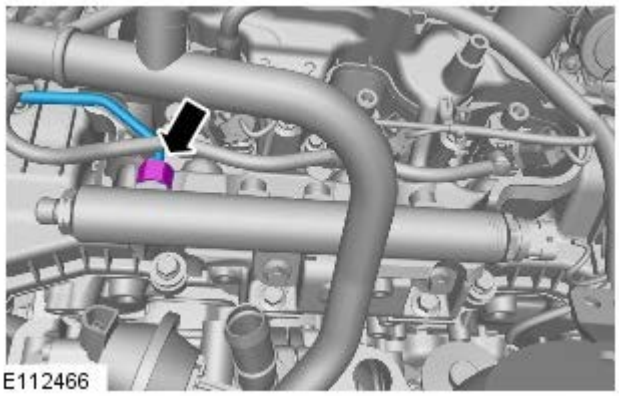
Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



8. CAUTIONS:

Be prepared to collect escaping fuel.

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

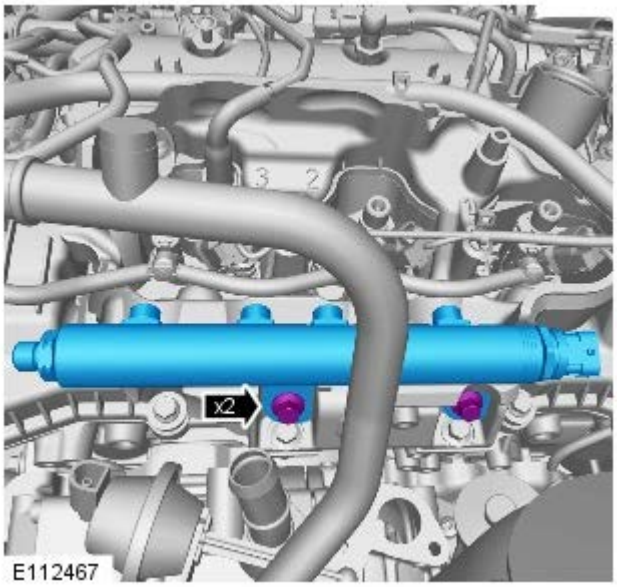


9. CAUTIONS:

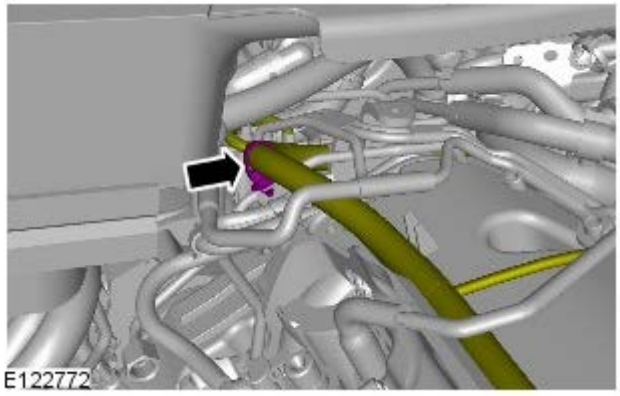
Be prepared to collect escaping fuel.

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

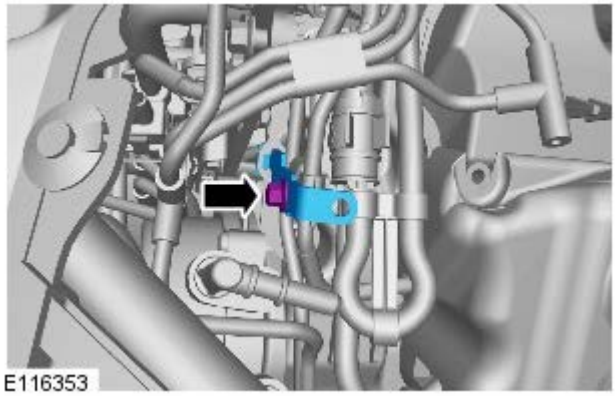
10. CAUTION: Be prepared to collect escaping fuel.



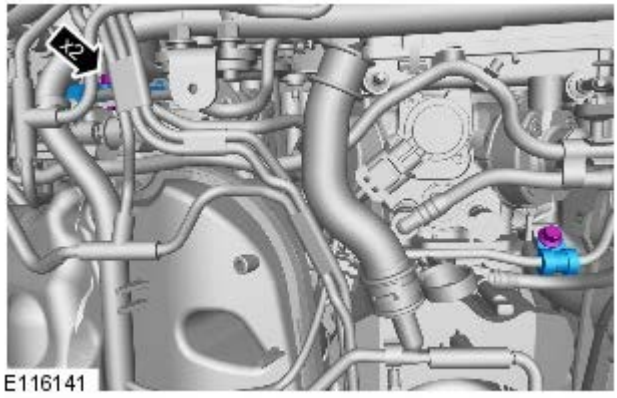
11.



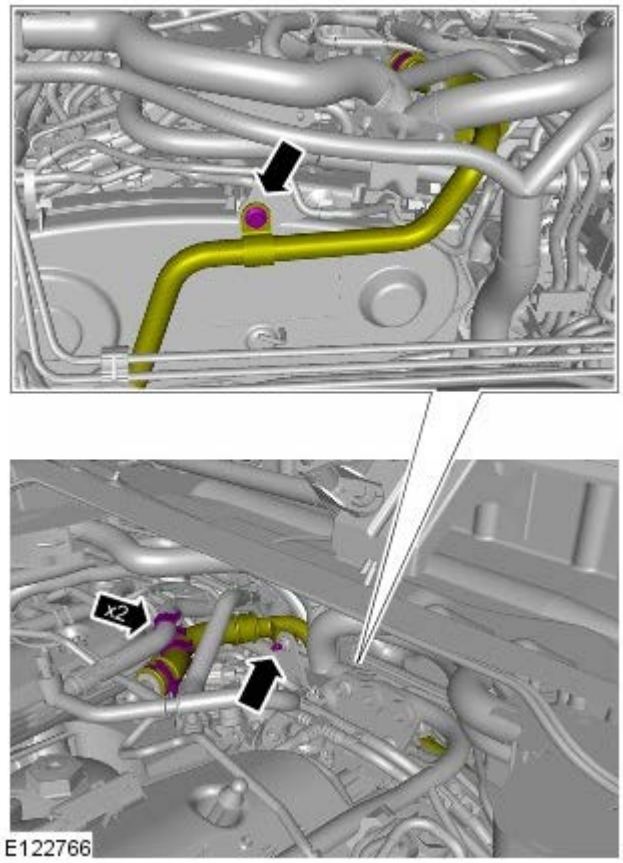
12.

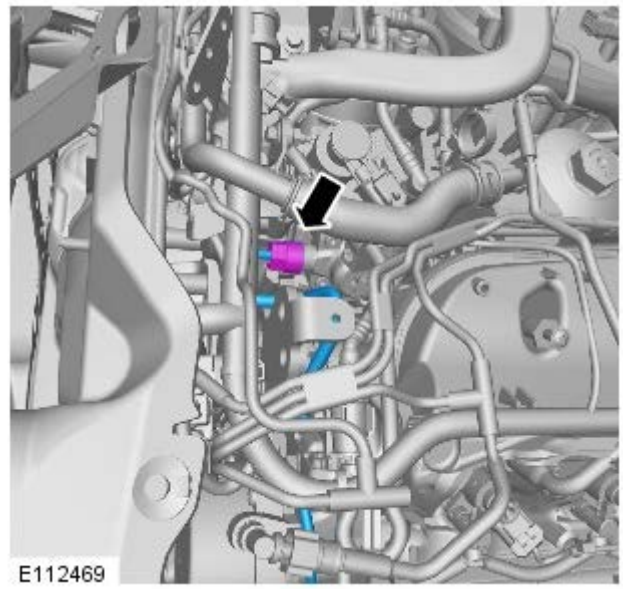


13.



14.

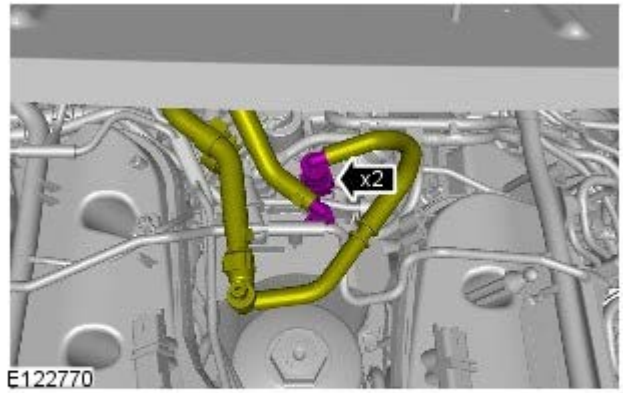




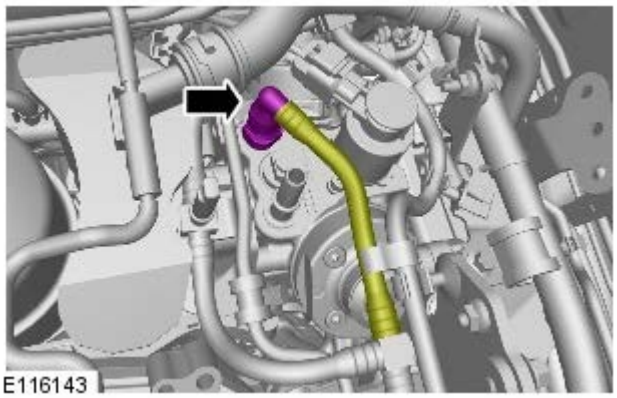
15. CAUTIONS:

    Be prepared to collect escaping fuel.

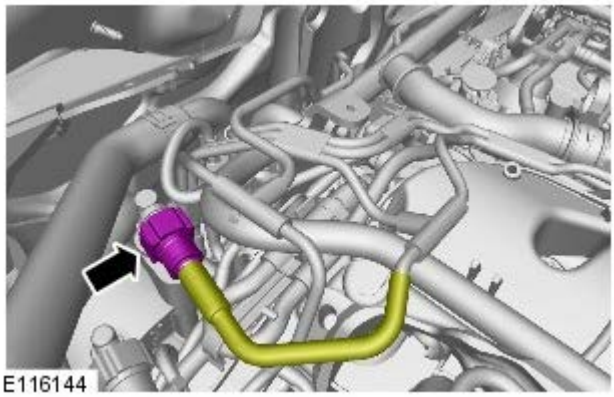
    Discard the component.



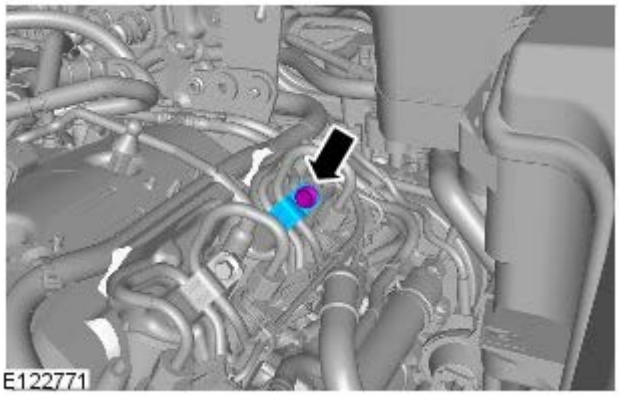
16. CAUTION: Be prepared to collect escaping fuel.



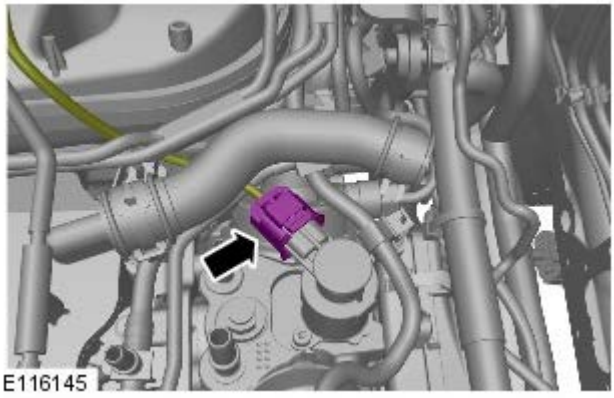
17. CAUTION: Be prepared to collect escaping fuel.



18.

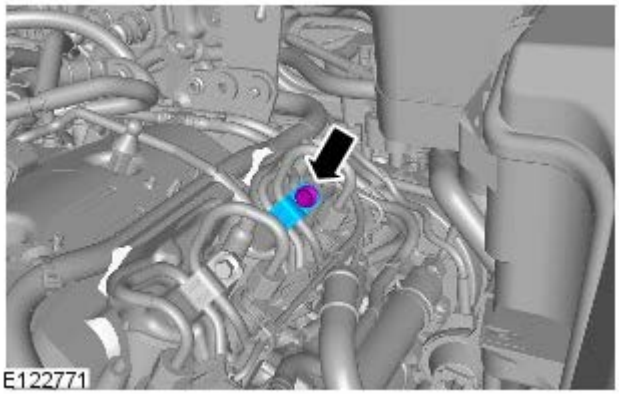


19.

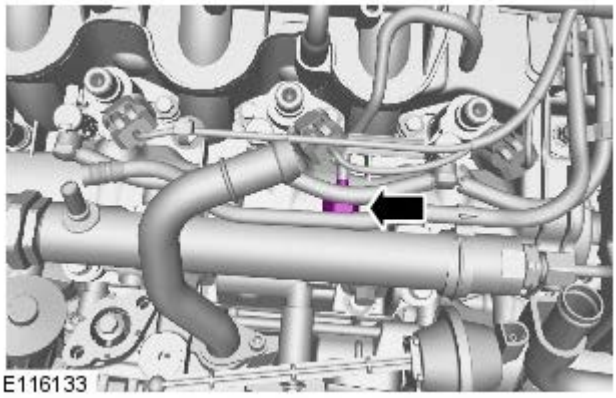


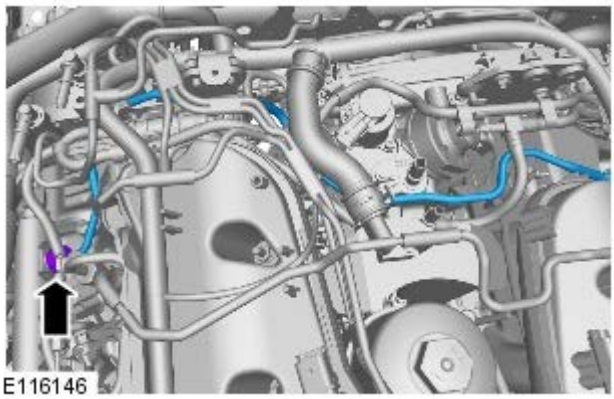
20.

21.



22.



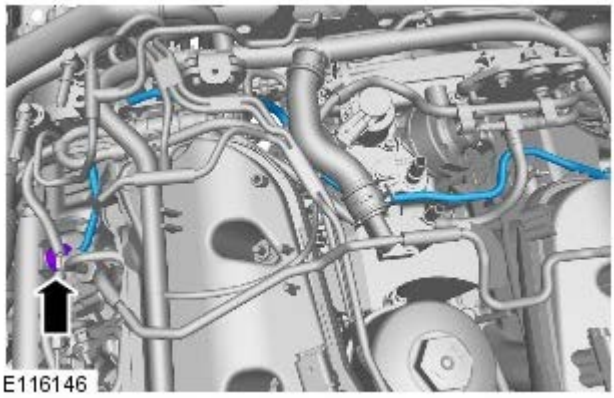


23. CAUTIONS:

⚠ Be prepared to collect escaping fuel.

⚠ Discard the component.

Installation

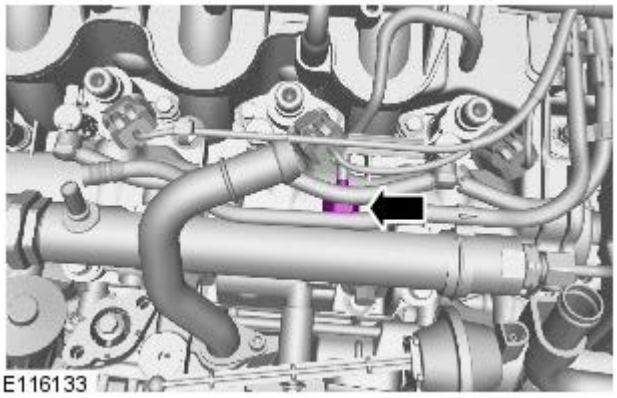


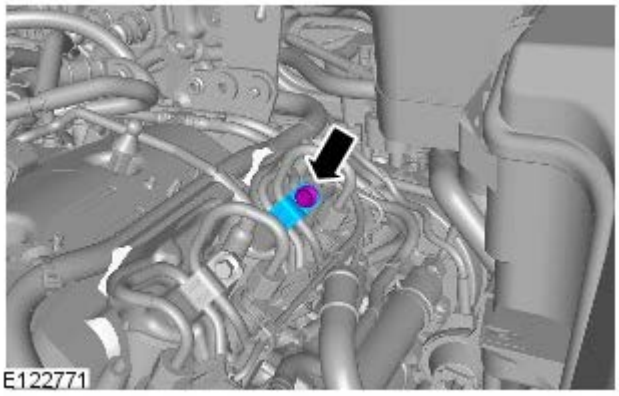
1. CAUTIONS:

⚠ Make sure that a new component is installed.

⚠ Tighten the fuel supply line unions finger tight.

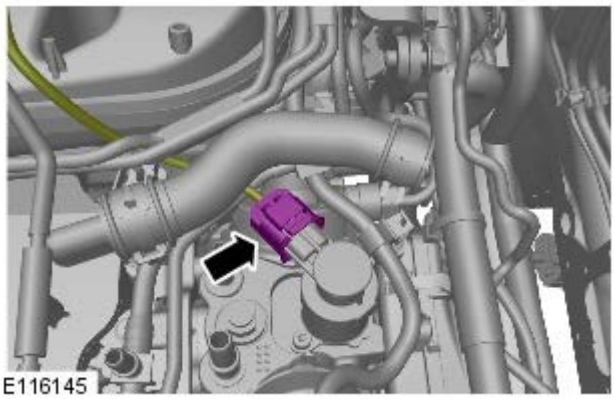
2. ⚠ CAUTION: Only tighten the unions finger-tight at this stage.



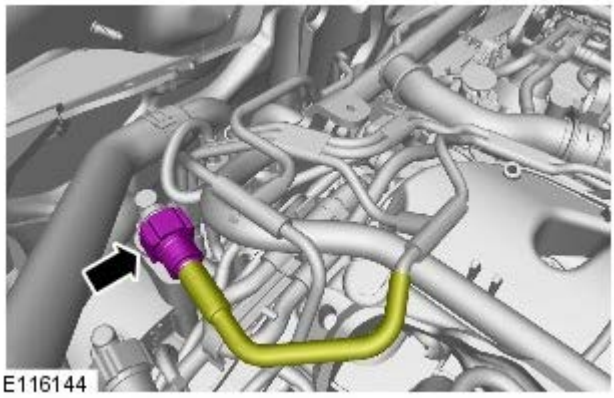


3. CAUTION: Only tighten the bolt finger-tight at this stage.

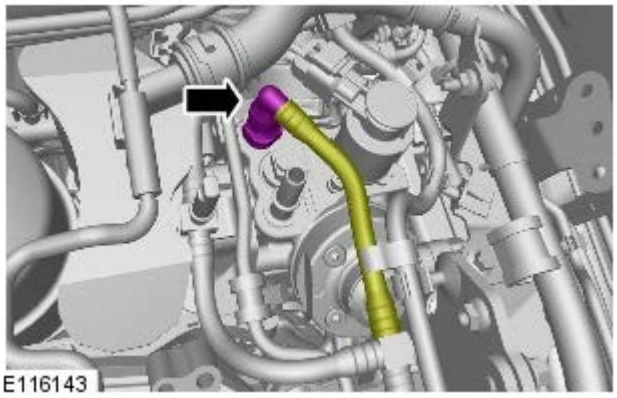
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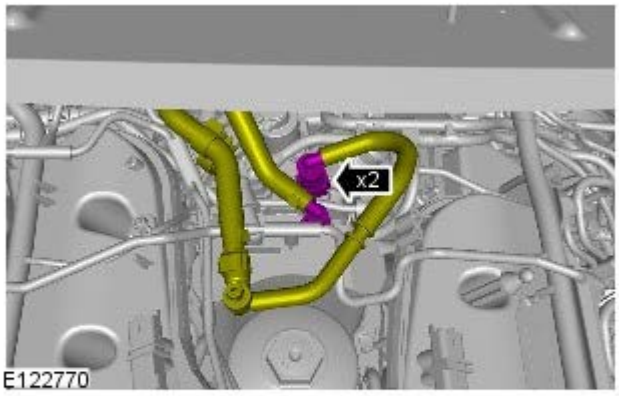
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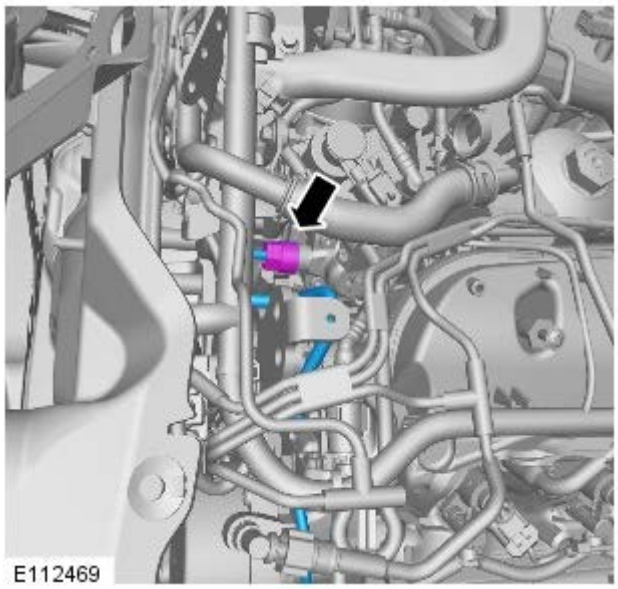


6.



7.

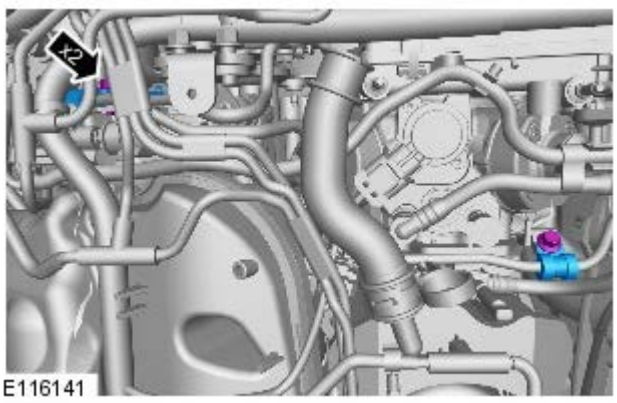




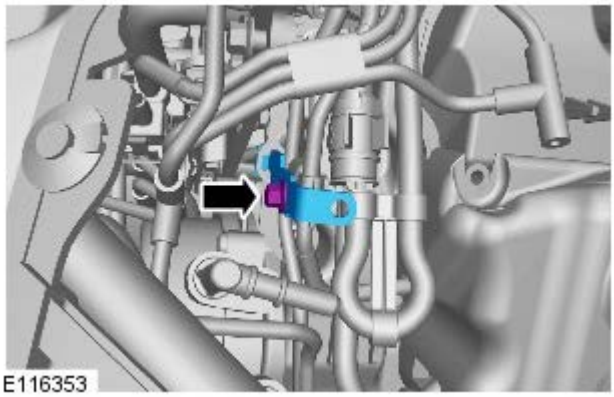
8. CAUTIONS:

Make sure that a new component is installed.

Tighten the fuel supply line unions finger tight.

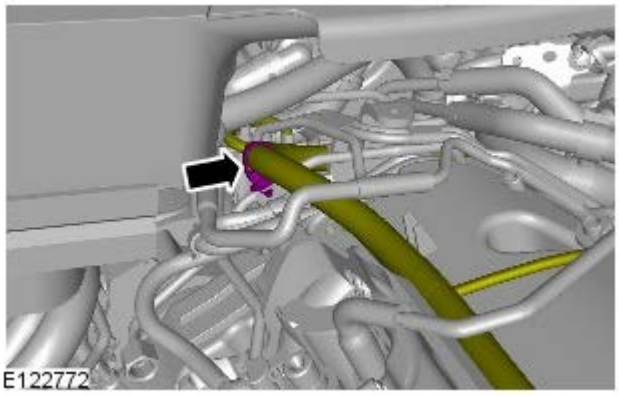


9. CAUTION: Only tighten the bolts finger-tight at this stage.

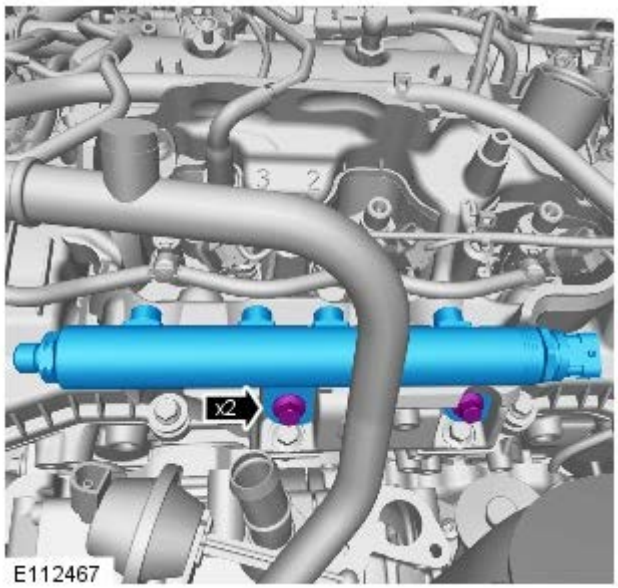


10. CAUTION: Only tighten the bolts finger-tight at this stage.

11.



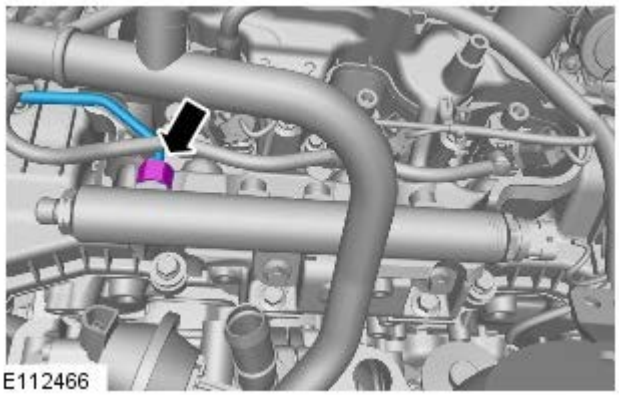
12. *Torque:* 24 Nm



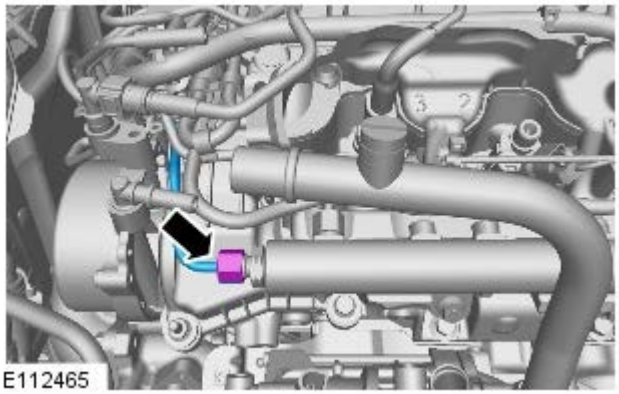
13. CAUTIONS:

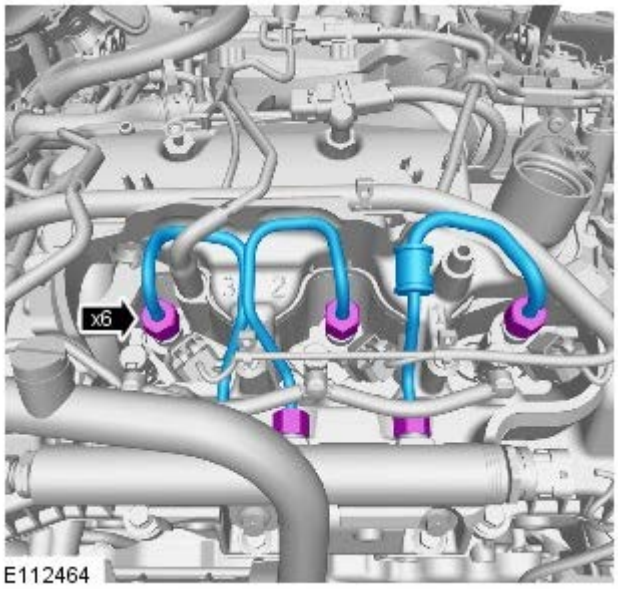
Tighten the fuel supply line unions finger tight.

Make sure that a new component is installed.

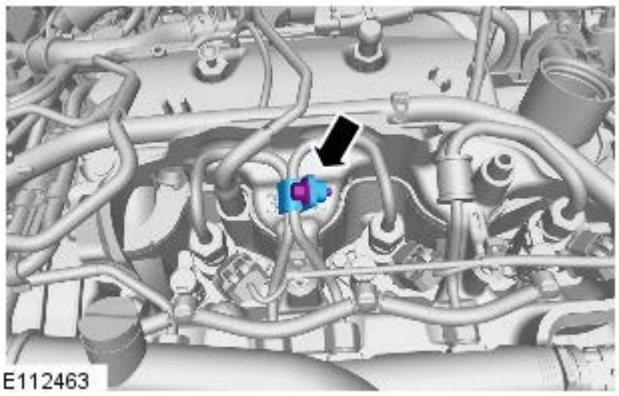


14. CAUTION: Tighten the fuel supply line unions finger tight.


E112465



E112464


E112463

15. CAUTIONS:

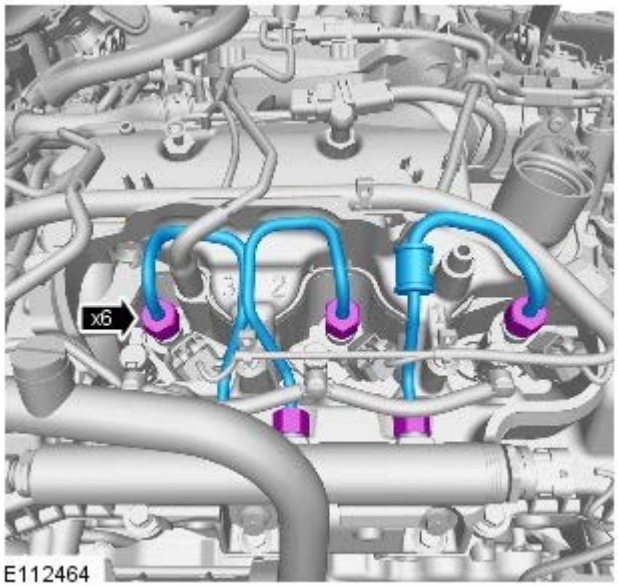
    Make sure that a new component is installed.

    Tighten the fuel supply line unions finger tight.

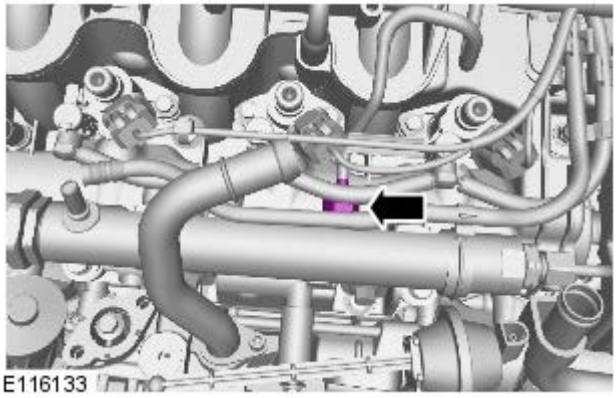
16. CAUTION: Only tighten the bolt finger-tight at this stage.

17.

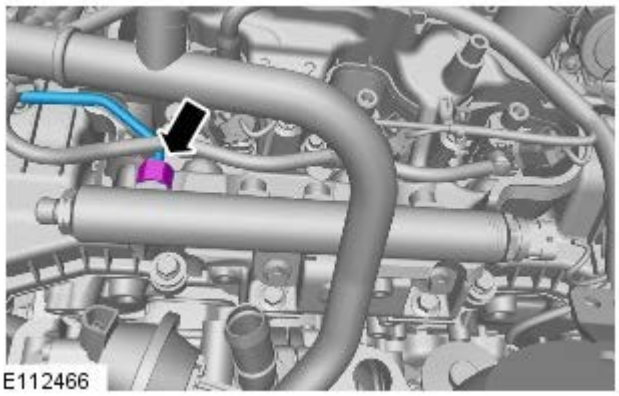
- Stage 1:Tighten the high-pressure fuel supply line unions at the fuel rail to 15Nm.
- Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 15Nm.



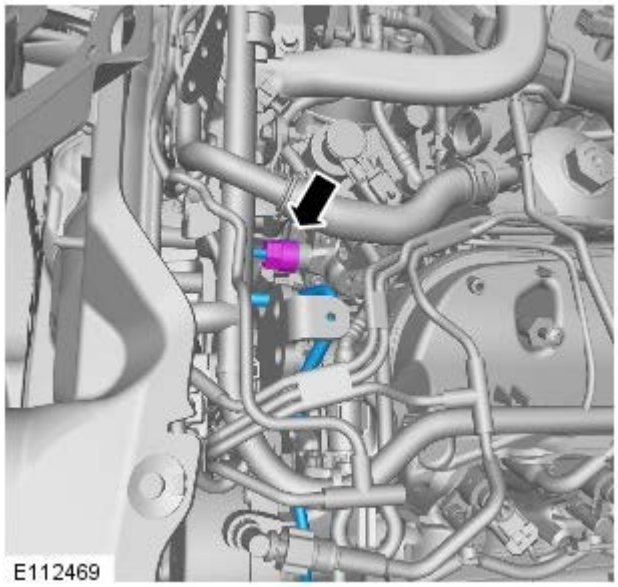
18. Tighten the high-pressure fuel lines union to 15Nm.



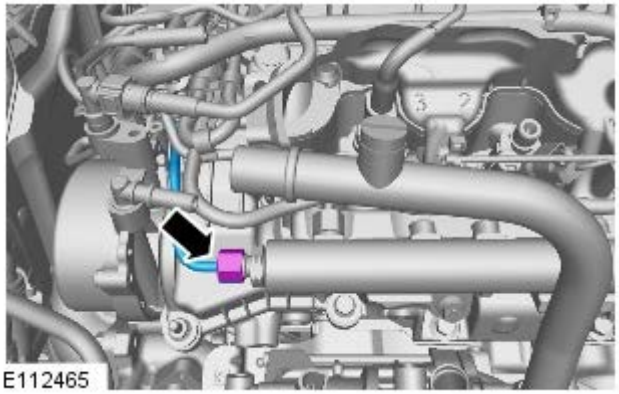
19. Tighten the high-pressure fuel lines union to 15Nm.



20. Tighten the high-pressure fuel lines union to 15Nm.

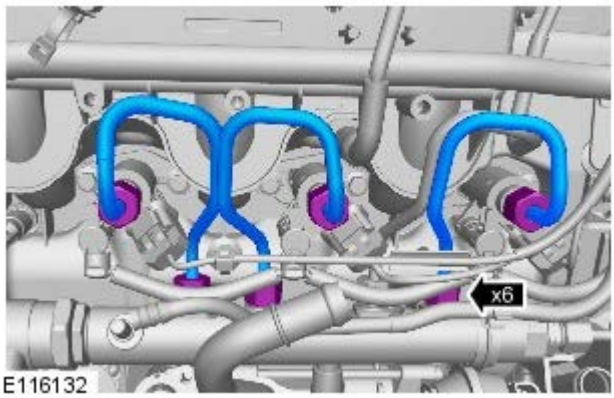


21. Tighten the high-pressure fuel lines union to 15Nm.

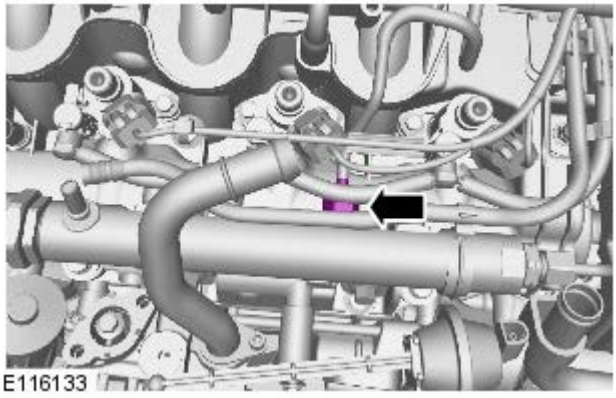


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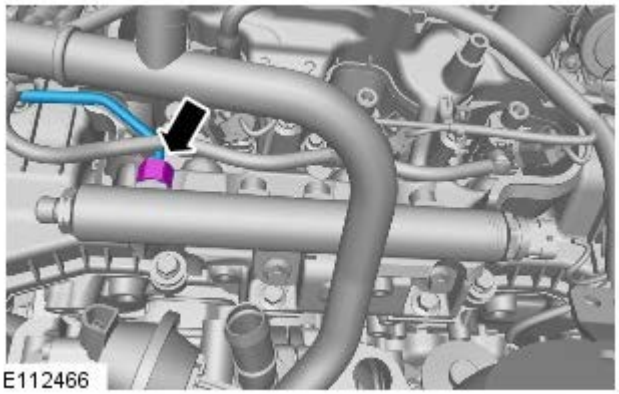
- Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 35Nm.
- Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 35Nm.



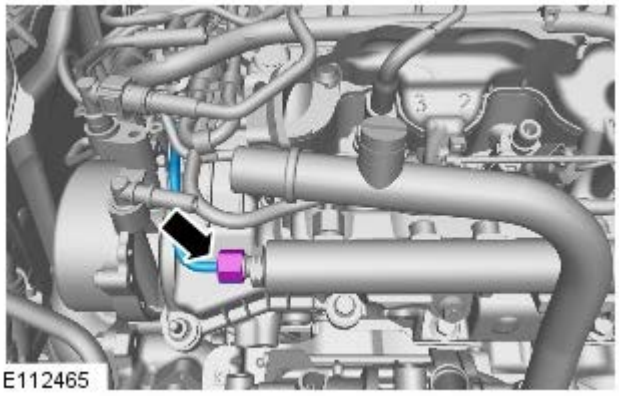
23. Tighten the high-pressure fuel line union to 30Nm.



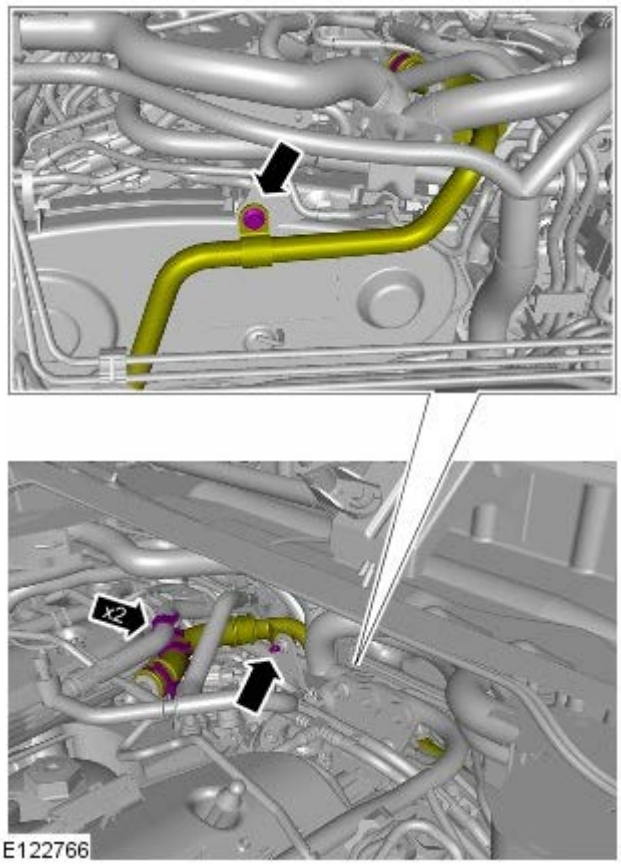
24. Tighten the high-pressure fuel line union to 30Nm.



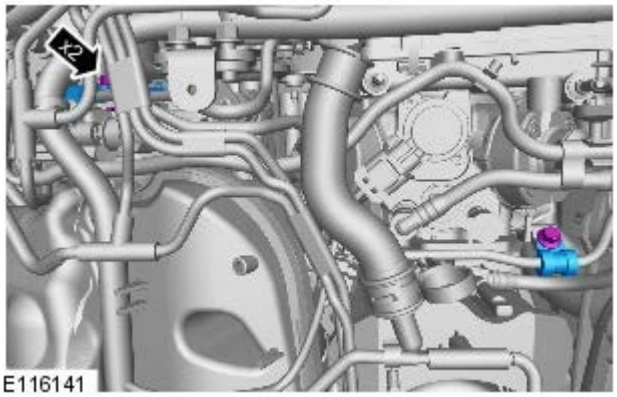
25. Tighten the high-pressure fuel line union to 30Nm.



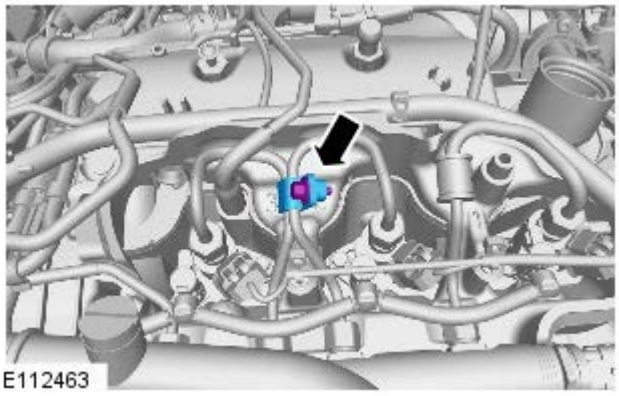
26.



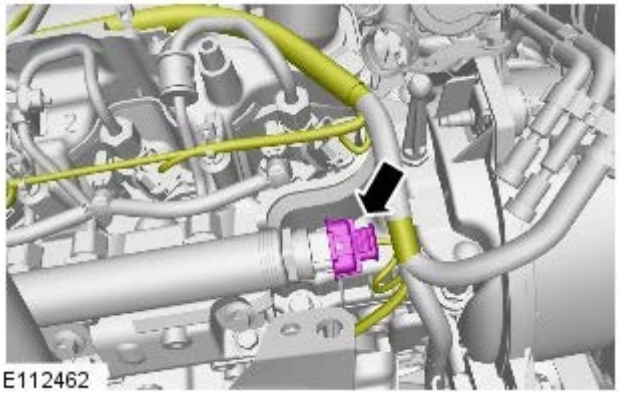
27. *Torque:* 10 Nm



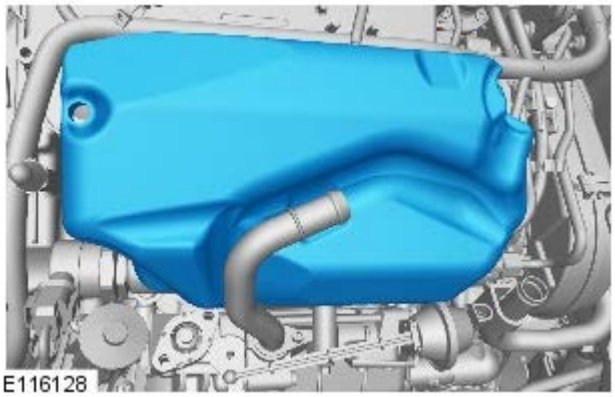
28. *Torque:* 10 Nm



29.



30. NOTE: Left-hand shown, right-hand similar.



31.

32. Connect the battery ground cable.

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Fuel Charging and Controls - TDV6 3.0L Diesel - Intake Air Shutoff Throttle

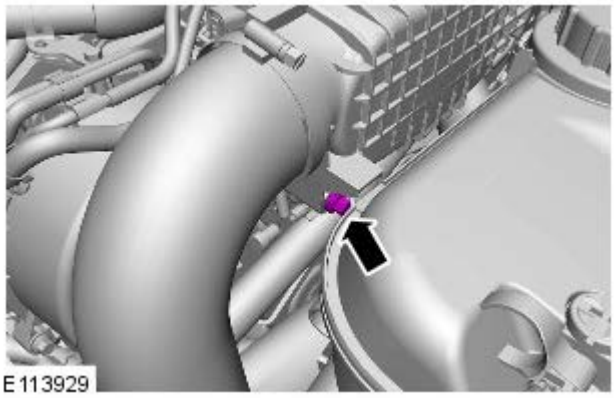
Removal and Installation

Removal

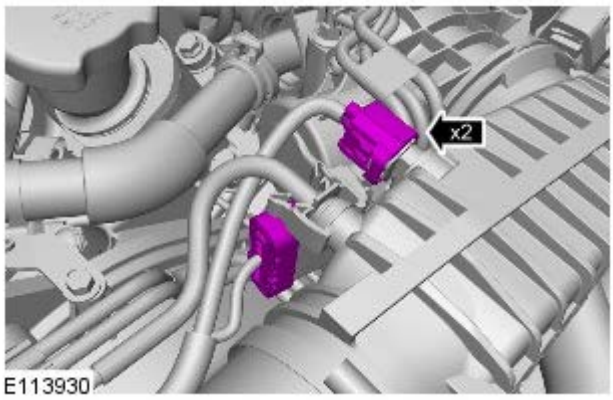
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 3.0L V6 - TdV6 (501-05 Interior Trim and Ornamentation, Removal and Installation).

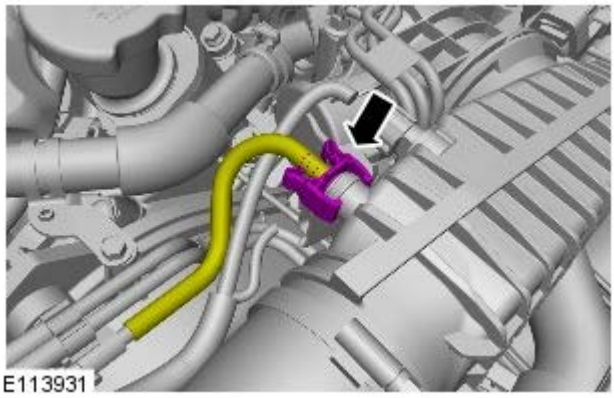
2. *Torque:* 10 Nm



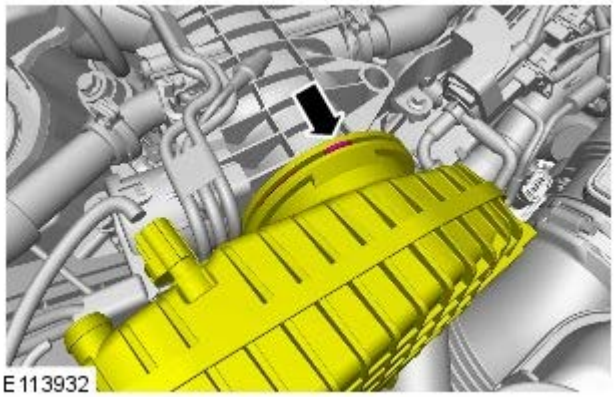
3.



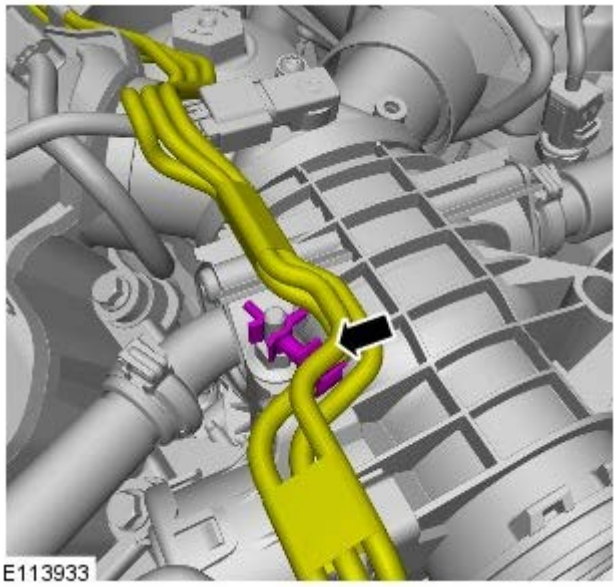
4.



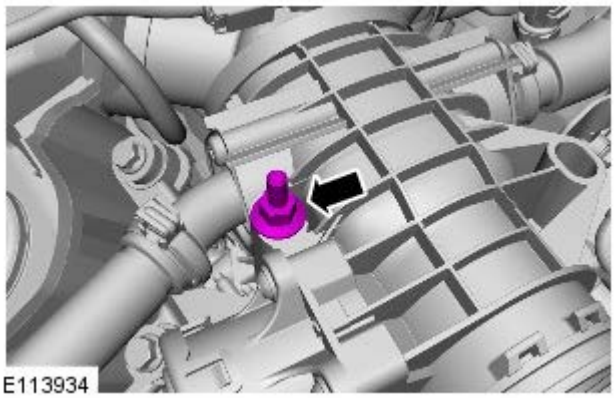
5.



6.



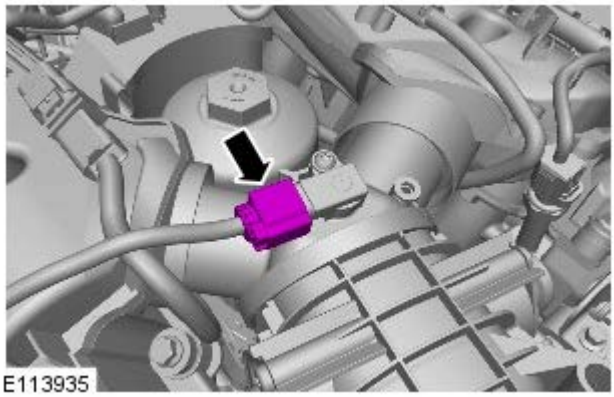
7. *Torque:* 10 Nm



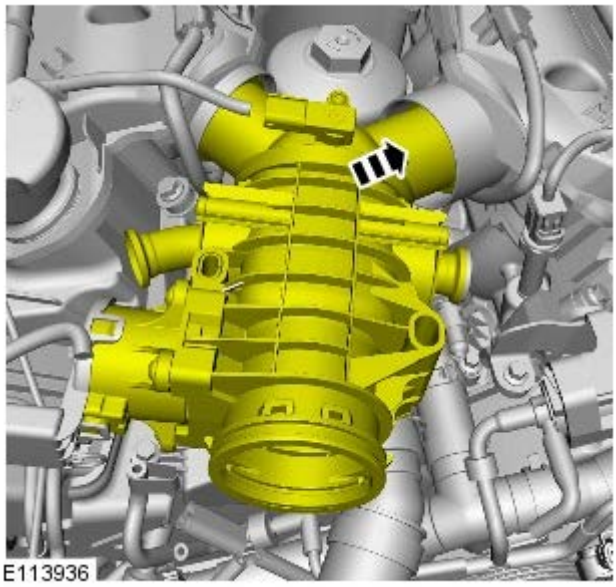
8. Refer to: Exhaust Gas Recirculation (EGR) Valve Outlet Tube LH (303-08 Engine Emission Control - 3.0L V6 - TdV6, Removal and Installation).

9. Refer to: Exhaust Gas Recirculation (EGR) Valve Outlet Tube RH (303-08 Engine Emission Control - 3.0L V6 - TdV6, Removal and Installation).

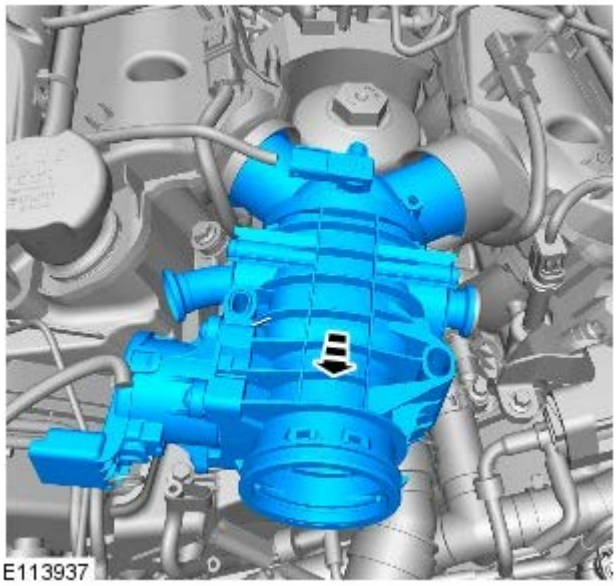
10.


E113935

11.


E113936

12.


E113937

13. CAUTION: Install the new seals.



Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

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Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel -

Torque Specification

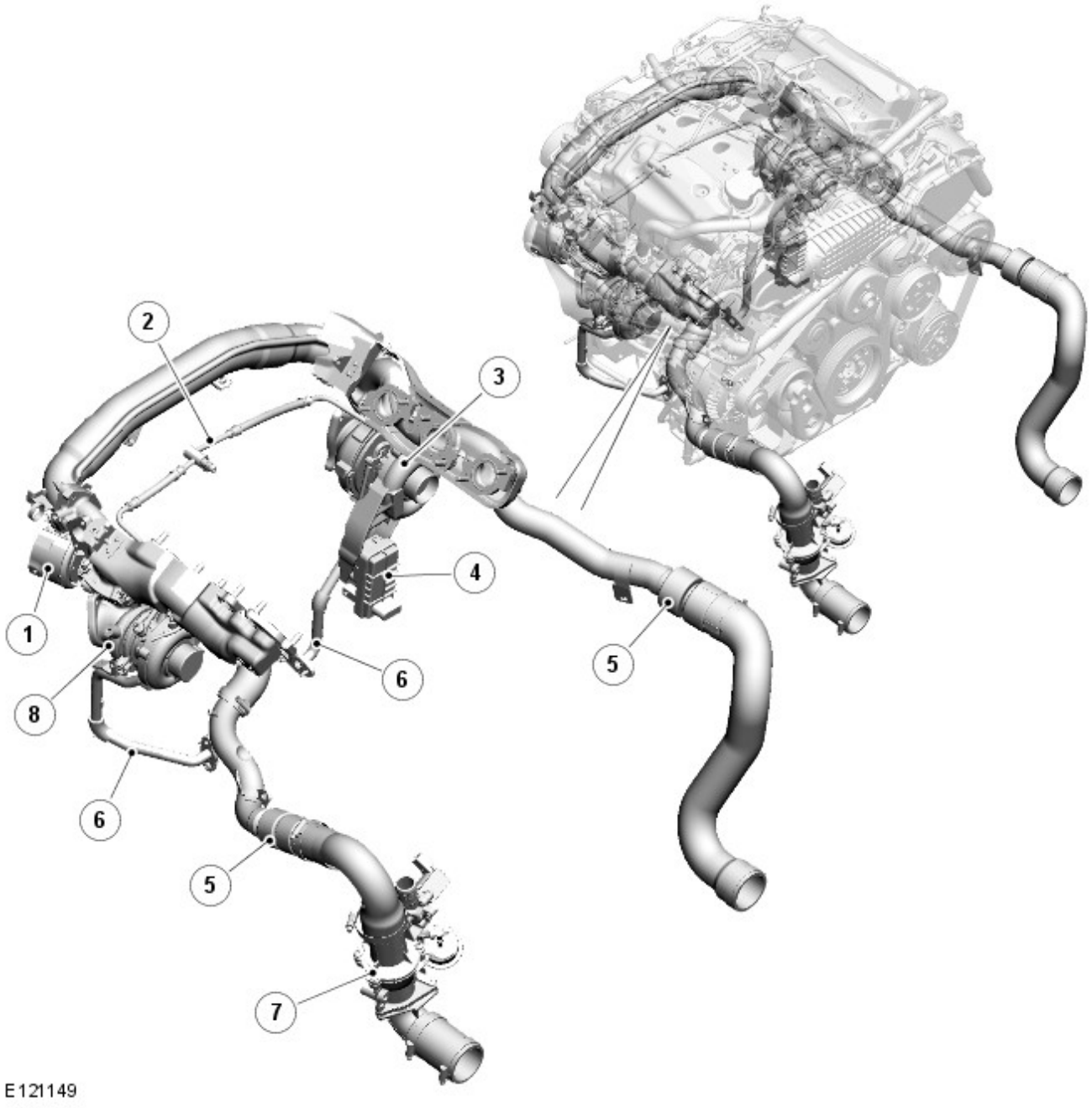
Description	Nm	lb-ft	lb-in
Exhaust manifold threaded stud	13	10	-
Exhaust manifold retaining nuts	24	18	-
Turbocharger oil return tube to turbocharger retaining bolt	9	-	80
Turbocharger oil return tube to engine retaining bolt	9	-	80
Turbocharger bracket retaining bolts	23	17	-
Turbocharger to exhaust manifold retaining nuts	24	18	-
Exhaust manifold heatshield retaining bolt	11	8	-
Exhaust heatshield retaining bolt	9	-	80
Exhaust heatshield retaining nut	10	-	7
Turbocharger oil supply tube retaining bolt	9	-	80
Turbocharger oil supply tube union bolt	30	22	-
Exhaust gas recirculation (EGR) valve retaining bolts	9	-	80
EGR valve tube to exhaust manifold retaining bolts	9	-	80

Published: 11-May-2011

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger - Component Location

Description and Operation

COMPONENT LOCATION



E121149

Item	Description
1	Secondary turbocharger turbine shut-off valve
2	Turbocharger oil supply
3	Primary turbocharger (variable vane)
4	Primary turbocharger control module (variable vane actuator)
5	Charge air tube
6	Turbocharger oil drain
7	Secondary turbocharger re-circulation valve and shut-off valve
8	Secondary turbocharger (fixed vane)

Published: 11-May-2011

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger - Overview

Description and Operation

INTRODUCTION

The 3.0L V6 diesel engine uses 2 turbochargers; a fixed vane type (secondary) and a variable vane (primary) type. The fixed vane turbocharger is fitted to the RH (right-hand) cylinder bank and the variable vane turbocharger is fitted to the LH (left-hand) cylinder bank.

Both turbochargers are used in a parallel sequential turbocharging system which enables the engine to achieve quick throttle response at low engine speeds and efficient use of exhaust gas energy at high engine speeds.

The variable vane turbocharger has an ECM (engine control module) controlled electronic rotary actuator. The rotary actuator adjusts the turbine vanes to optimize the exhaust gas flow and velocity onto the turbine wheel to maintain the required boost pressure.

The parallel sequential turbocharging system comprises the two turbochargers and the ECM. The primary variable nozzle turbine operates through the entire engine speed range but is at its most efficient at engine speeds of up to 2800 rpm. At engine speeds above 2800 rpm under load, the fixed vane secondary turbine comes into operation, with both of the turbochargers now running in a parallel bi-turbo mode.

Published: 11-May-2011

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger - System Operation and Component Description

Description and Operation

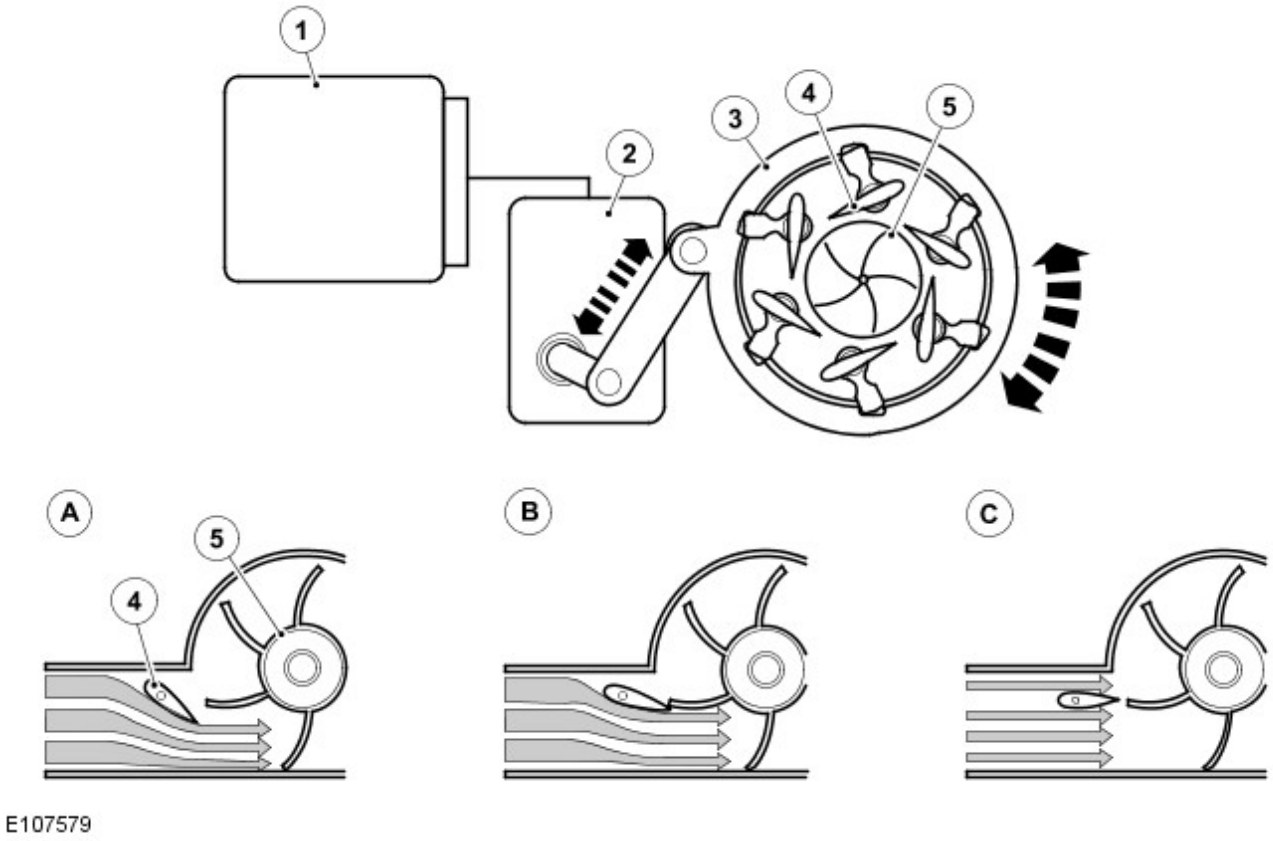
System Operation

TURBOCHARGERS

The turbine wheel of the turbocharger uses the engine's exhaust gasses to drive the compressor wheel. The compressor wheel draws in fresh air which is supplied to the engine cylinders in a compressed form.

The primary variable vane turbocharger allows the optimum inlet geometry (inlet area and flow angle) to be used over a wide range of engine operating conditions. This allows a rapid speed of response and higher boost pressures at low engine speeds. The variable vane angle determines both the inlet area as well as the flow angle, as controlled by the ECM (engine control module). The variable vanes allow efficient use of the exhaust gas energy which in turn improves turbocharger and engine efficiency.

Principles of Variable Vane Operation



E107579

Item	Description
A	Low engine speed
B	Intermediate engine speed
C	High engine speed
1	ECM
2	Electronic rotary actuator
3	Turbine housing
4	Variable vanes
5	Compressor wheel

The variable vanes in the primary turbocharger are controlled by the ECM. The ECM controls a rotary electronic actuator attached to the primary turbocharger which is used to adjust the pitch angle of the vanes by rotating the turbine housing. The electronic rotary actuator also provides the ECM with a feedback signal to determine the pitch angle of the vanes.

The variable vanes in the primary turbocharger improve the exhaust gas power transfer to the turbine wheel which in turn drives the compressor wheel. At low engine speeds this greatly assists the increase in turbocharger boost pressure.

As engine speed, and therefore the exhaust gas velocity, increases, the vanes are opened. The amount of opening is determined by the ECM to ensure that the power transfer from the turbine wheel to the compressor wheel is within the turbocharger speed and boost pressure requirements.

At high engine speed and exhaust gas flow, the ECM increases the vane opening to avoid overspeed of the turbines

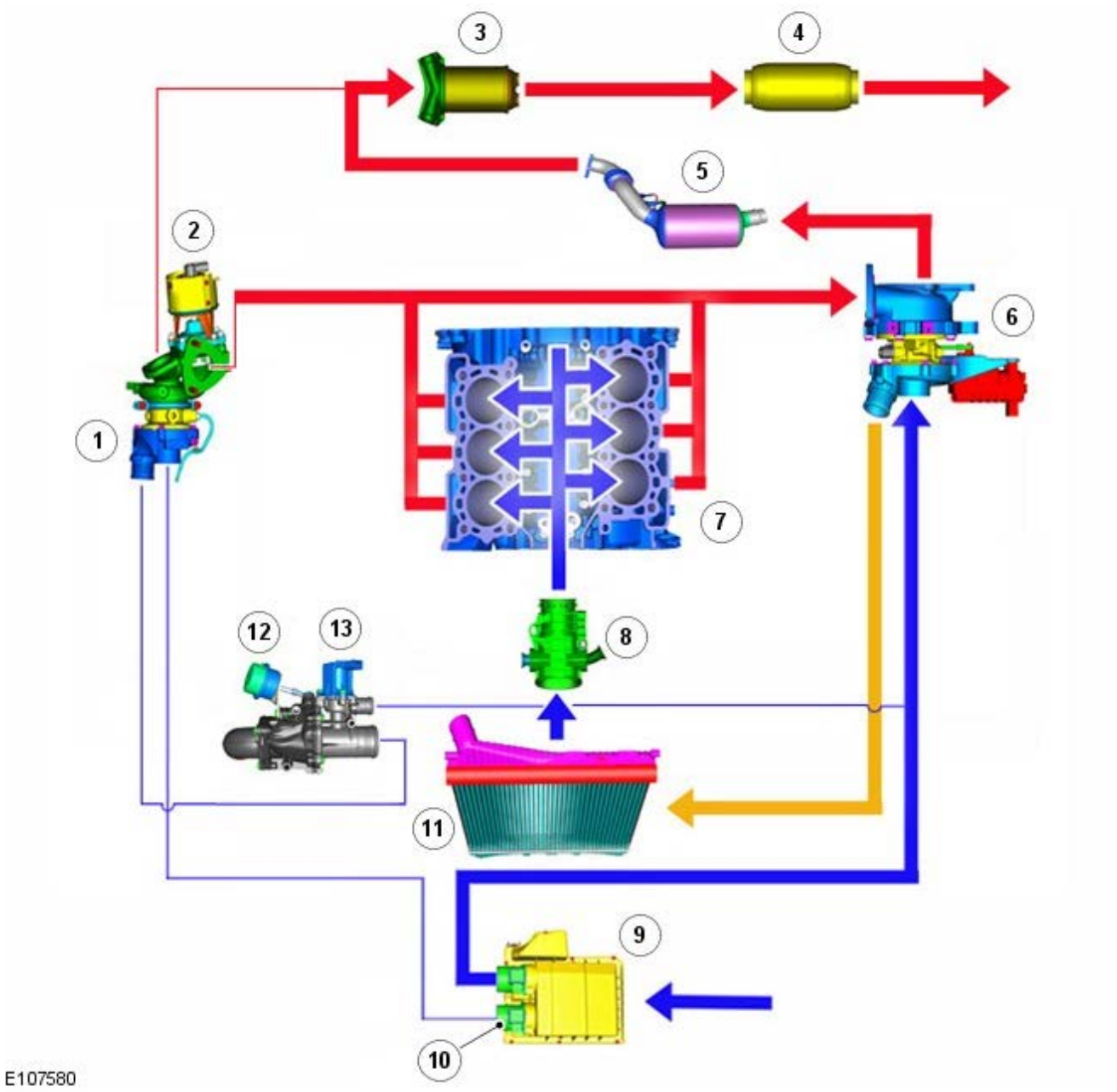
and provide a smooth high speed operation. At this point the dual mode boosting system comes into affect by utilizing the secondary (fixed vane) turbocharger.

The fixed vane turbocharger incorporates an outlet temperature senor, which is located adjacent the oxygen sensor in the close coupled catalytic converter and, an outlet pressure sensor which receives inputs from the APP (accelerator pedal position) and ECM.
Refer to: Electronic Engine Controls (303-14 Electronic Engine Controls - 3.0L Diesel, Description and Operation).

Dual Mode Boosting

The dual mode boosting system comprises two turbochargers and software within the ECM. The two turbochargers can operate in two modes; mono turbocharger operation or bi-turbocharger operation.

Mono Turbocharger Schematic Diagram



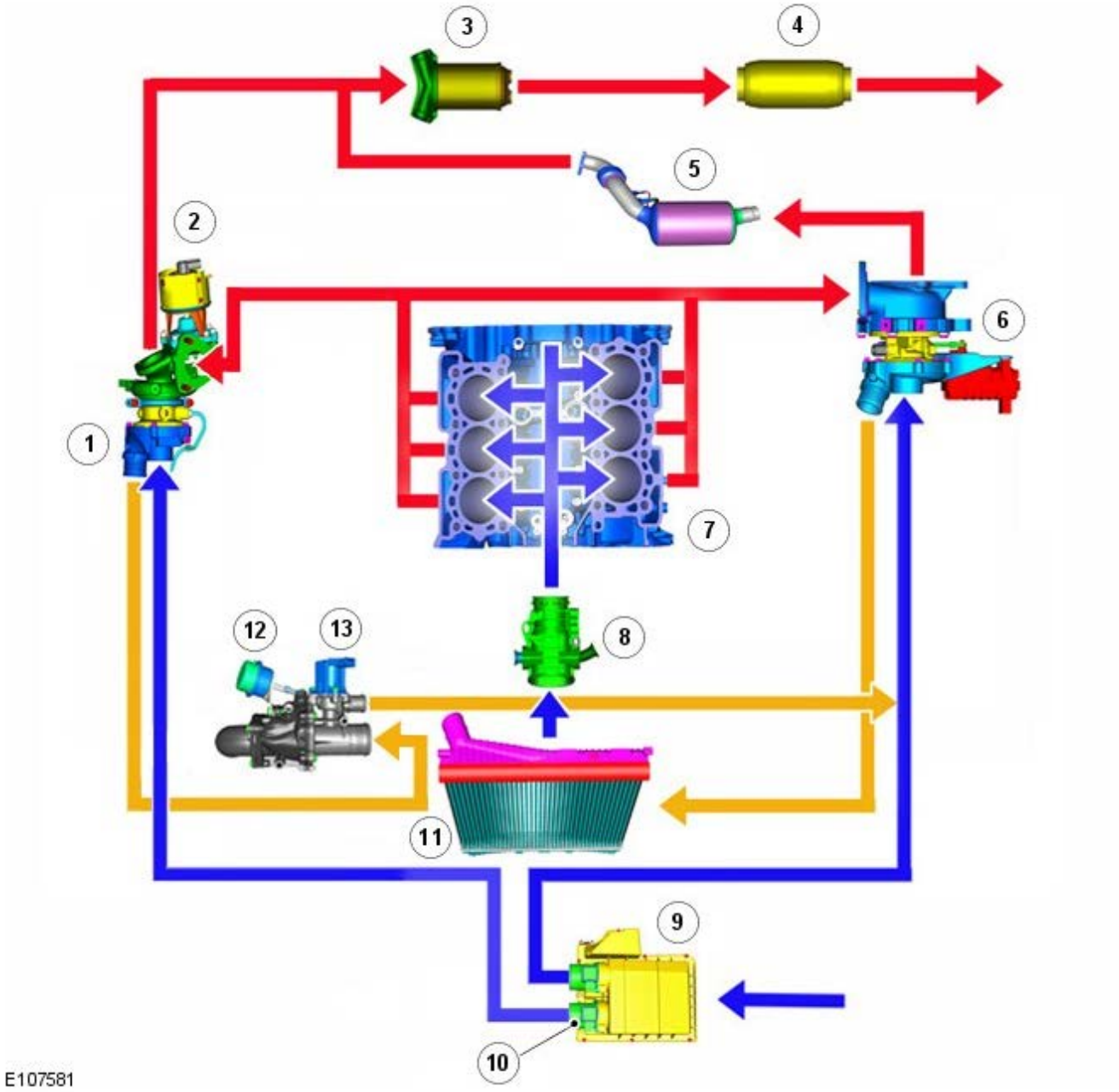
Item	Description
1	Fixed vane turbine
2	Turbine shut-off valve
3	DPF (diesel particulate filter)
4	Flexible center resonators
5	Catalytic converter
6	Variable vane turbocharger
7	Engine
8	Throttle
9	Air filter
10	MAF (mass air flow) meter

11 Charge air cooler
12 Compressor shut-off valve
13 Re-circulation valve

Fresh air is drawn through the air filter and the MAF meter to the primary turbocharger compressor. The compressed air is then passed through the charge air cooler and into the engine.

The turbine shut-off valve on the secondary turbocharger is closed and therefore exhaust gasses are unable to operate the secondary turbocharger turbine. In this condition all turbocharging boost pressure is produced by the primary turbocharger.

Bi-Turbocharger Switching Schematic Diagram



Item Description

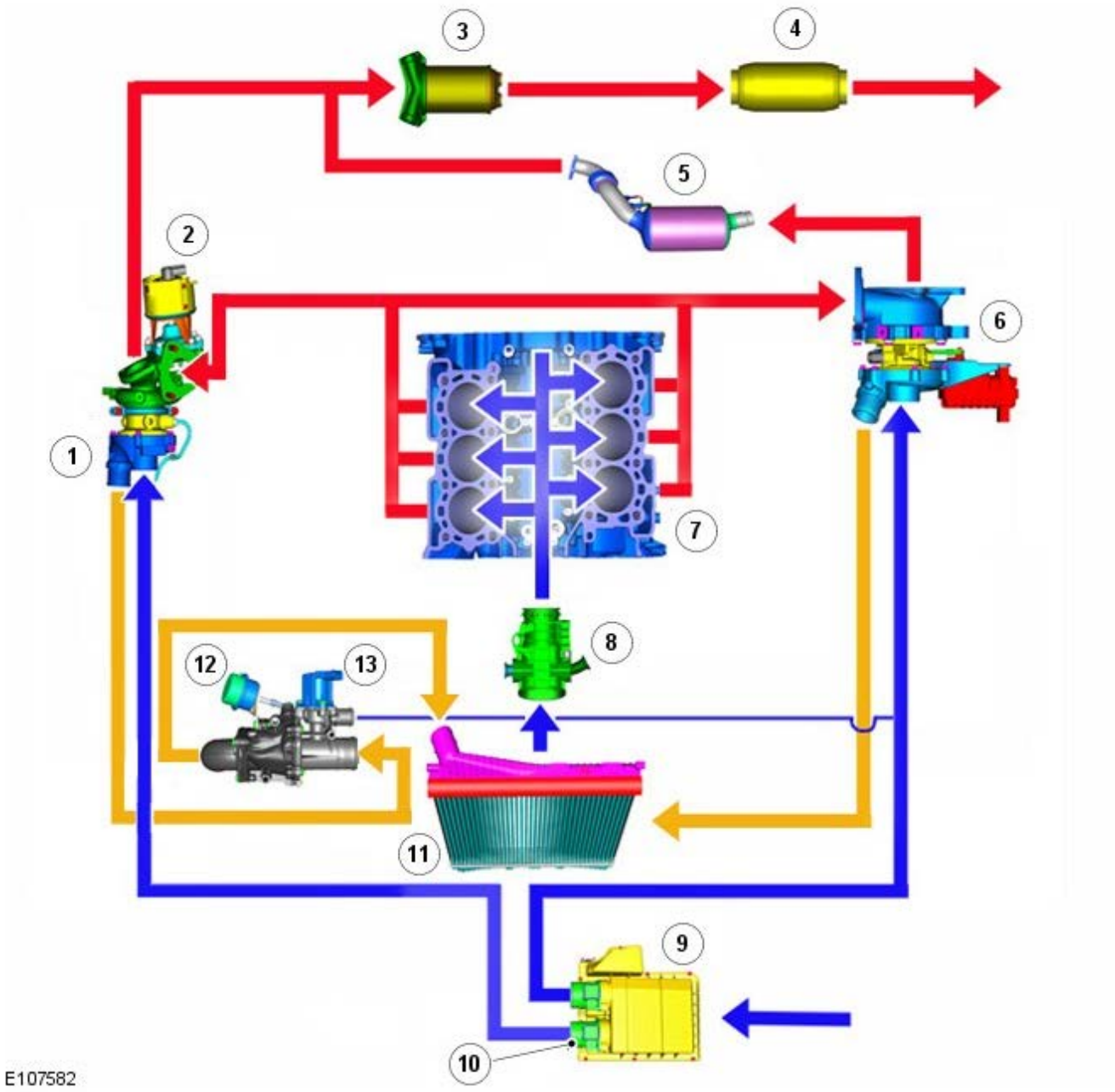
1 Fixed vane turbine
2 Turbine shut-off valve
3 DPF
4 Flexible center resonators
5 Catalytic Converter
6 Variable vane turbocharger
7 Engine
8 Throttle
9 Air filter
10 MAF meter
11 Charge air cooler

12 Compressor shut-off valve
13 Re-circulation valve

When the engine operating parameters approach the limits (approximately 2800 rpm under load) of the primary turbocharger, dual mode boosting control software within the ECM begins the switch to parallel bi-turbocharger operation. The secondary turbocharger is brought into operation by the opening of the turbine shut-off valve which allows exhaust gasses to flow through the turbine.

Initially, the secondary turbocharger does not produce a boost pressure to equal that of the primary turbocharger. Therefore, the initial boost pressure from the secondary turbocharger is fed via the re-circulation valve into the clean air inlet for the primary turbocharger. As the secondary turbocharger boost pressure output increases, the re-circulation valve is then closed and the compressor shut-off valve opened to increase the boost pressure from the secondary turbocharger which is directed into the charge air cooler.

Bi-Turbocharger Schematic Diagram



Item Description

1 Fixed vane turbine
2 Turbine shut-off valve
3 DPF
4 Flexible center resonators
5 Catalytic Converter
6 Variable vane turbocharger
7 Engine
8 Throttle
9 Air filter

10 MAF meter
11 Charge air cooler
12 Compressor shut-off valve
13 Re-circulation valve

When the secondary turbocharger has reached the required operating parameters, the re-circulation valve is closed and the compressor shut-off valve is opened. The ECM will maintain the engine operating in bi-turbocharger operation with both primary and secondary turbochargers contributing to the air charge induction. When the dual mode boosting software determines that the engine operating parameters no longer require the use of dual mode boosting, the system switches back to mono turbocharger operation.

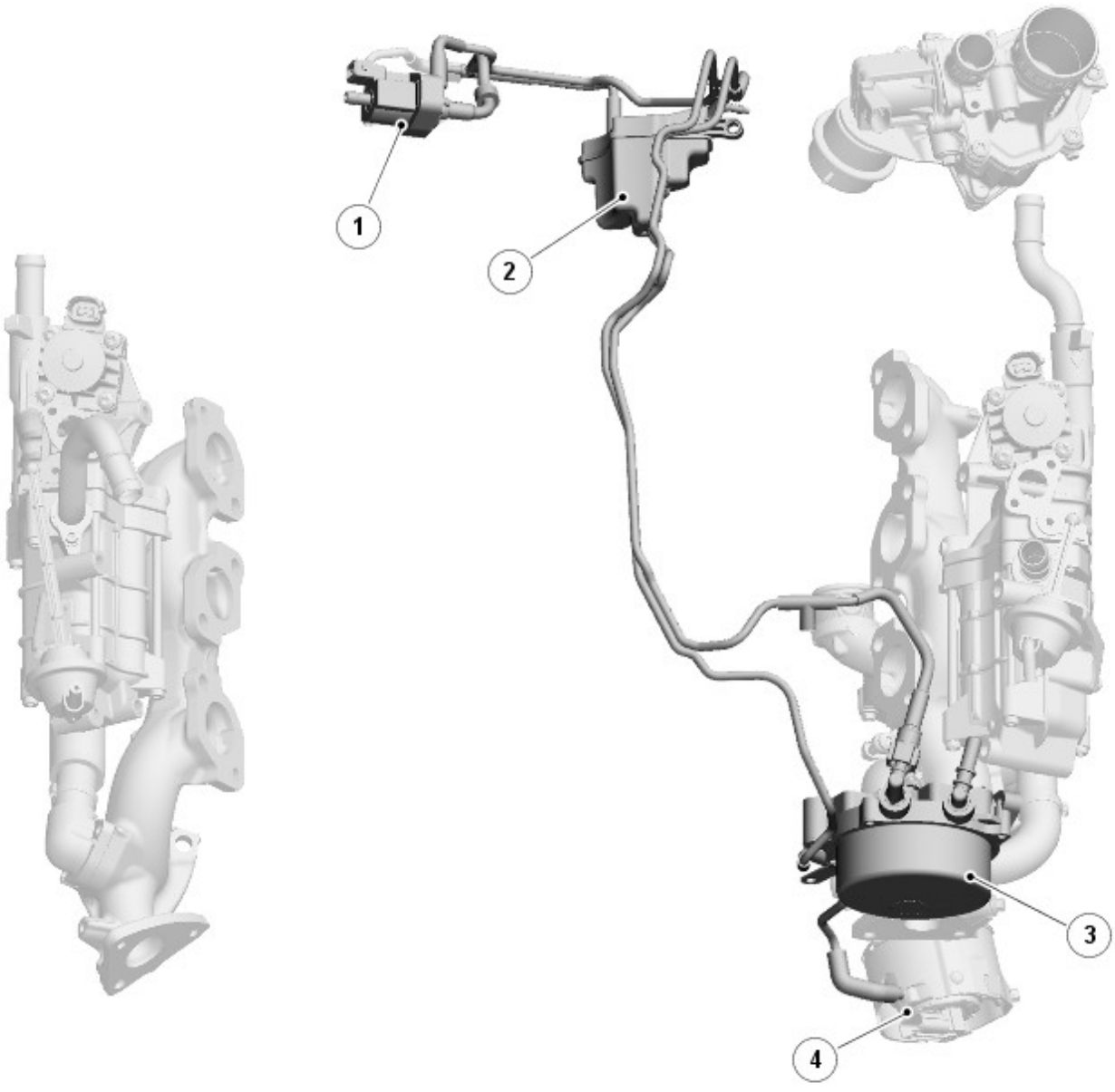
If the engine idles for more than 3 minutes, the secondary turbocharger is actuated to ensure correct lubrication. This is achieved by pressurizing the turbine shaft bearing cavities through a pipe, which is connected to the air intake system and periodically opening the turbine shut-off valve to operate the turbocharger.

CAUTION: Ensure both ends of the pipe are securely connected to the secondary turbo and the air intake system to prevent damage to the turbo components.

Turbine and Compressor Shut-off Valve Control

The secondary turbocharger turbine shut-off valve and compressor shut-off valve are controlled by the ECM through a vacuum system. The secondary turbo turbine shut-off valve also incorporates a position sensor.

Secondary Turbocharger Turbine Shut-off Valve Vacuum Control



E117413

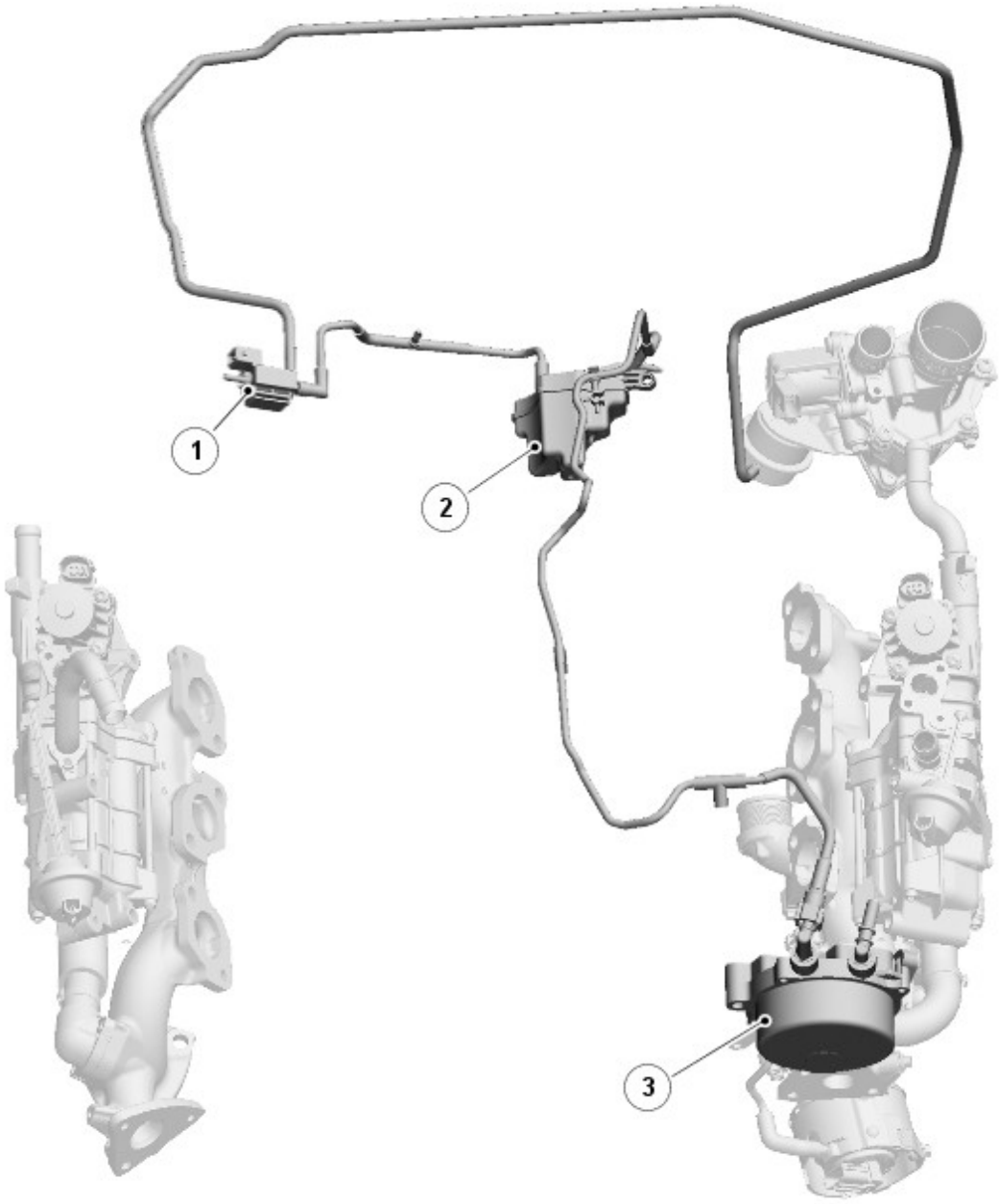
Item Description

1 Secondary turbine shut-off solenoid valve

2 Vacuum reservoir
3 Vacuum pump
4 Secondary turbine shut-off valve

If vacuum is lost to the shut-off valve it will default to the closed position. The position sensor will inform the ECM, which will initiate mono-turbo mode, restricted performance and record DTC (diagnostic trouble code).

Compressor Shut-off Valve Vacuum Control



E117414

Item Description

1 Compressor shut-off valve solenoid valve
2 Vacuum reservoir
3 Vacuum pump

If the system develops a fault, for example an air leak, the compressor shut-off valve will default to the closed position. In the default position, mono-turbo operation and restricted engine torque is initiated.

NOTE: When fault finding the vacuum system, always check for trapped/split/disconnected pipework. Any vacuum fault will cause the engine to default to limited torque mode.

Component Description

Each turbocharger consists of two turbo elements, a turbine wheel and compressor wheel, enclosed separately in cast housings and mounted on a common shaft, which rotates in two semi-floating bearings.

VARIABLE VANE TURBOCHARGER (PRIMARY)

The variable vane turbocharger is attached to the LH (left-hand) exhaust manifold and secured to 3 studs on a flange on the manifold with nuts. On production, no gasket is used to seal the joint between turbocharger and the manifold. In-service vehicles will require a service gasket to be fitted if the joint between the turbocharger and the manifold is disturbed.

A second flange on the turbocharger has 3 integral studs and provides for the attachment of the LH catalytic converter inlet pipe. Three nuts secure the inlet pipe to the flange studs and a gasket seals the joint between the components.

The compressor end of the turbocharger has two hose connections. The central connection provides a clean air supply from the air filter to the compressor. The second connection on the outside of the housing provides for a pipe connection from the turbocharger to the charge air cooler

The turbocharger is a conventional design with both the turbine wheel and the compressor wheel sharing a common shaft which is supported on bearings. The turbocharger receives an engine oil feed via a pipe from the cylinder block. The pipe supplies both turbochargers with an oil supply for lubrication purposes. An oil drain pipe from the turbocharger allows oil to drain from the turbocharger into the cylinder block.

An integral bracket houses the variable vane electronic rotary actuator. The rotary actuator is connected to an eccentric lever which moves the turbine housing to adjust the position of the vanes. When the rotary actuator operates a boss is rotated, which in turn moves the lever and changes rotary motion into linear motion. The lever is connected to the outside of the turbine housing and the linear motion is converted back to rotary motion of the housing. Operation of the electronic rotary actuator is controlled by the ECM.

FIXED VANE TURBOCHARGER (SECONDARY)

The fixed vane turbocharger is attached to the RH (right-hand) exhaust manifold and is secured to 3 studs on a flange on the manifold with nuts. On production, no gasket is used to seal the joint between turbocharger and the manifold. In-service vehicles will require a service gasket to be fitted if the joint between the turbocharger and the manifold is disturbed.

A second flange on the turbocharger has 2 integral studs and provides for the attachment of the RH exhaust system downpipe. Two nuts secure the downpipe to the flange studs and a gasket seals the joint between the downpipe and the turbocharger.

The compressor end of the turbocharger has two hose connections; the central connection provides the clean air supply from the air filter. The second connection on the outside of the turbocharger housing allows the connection from the turbocharger to the charge air cooler.

Attached to the rear of the turbocharger is a turbine shut-off valve. The valve is vacuum operated and electronically controlled by the ECM. The valve is closed when the system is operating in mono-turbocharger mode, diverting exhaust gasses from the RH exhaust manifold, via the exhaust cross-over duct to the LH exhaust manifold. When bi-turbocharger operation is required, the ECM electronically operates the valve allow vacuum to open the shut-off valve allowing exhaust gasses from the RH exhaust manifold to drive the turbine of the fixed vane turbocharger.

Published: 15-Aug-2012

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-04B Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel)

Turbocharger (Description and Operation),
Turbocharger (Description and Operation),
Turbocharger (Description and Operation).

Inspection and Verification

WARNING: The following tests may involve working in close proximity to hot components. Make sure adequate protection is used. Failure to follow this instruction may result in personal injury.

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

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

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

Visual Inspection

Mechanical	Electrical
• Intake air system • Hose(s) / hose connections • Turbochargers • General engine condition	• Circuit(s) • Engine Control Module (ECM) • Turbocharger actuators • Electrical connections and harnesses

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.

Symptom Chart

Symptom	Possible Causes	Action
Poor performance (off-boost)	• Low/contaminated fuel • Restricted intake air system • General engine condition • Engine Control Module (ECM) failure	• Check the fuel level and condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Check the intake air system for restriction • Check the engine condition, compressions, etc, if there are indications of a mechanical fault • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
No boost	• Electrical connections and harnesses • Restricted intake air system • Charge air cooler restricted/leaking • Turbocharger actuator failure(s) • Turbocharger failure(s) • Engine Control Module (ECM) failure	• Check the electrical connections and harnesses • Check the intake air system for restriction/leakage • Check the turbocharger actuators and circuits • Check the turbochargers for wear. Disconnect the turbocharger intake and outlet pipework and turn the turbochargers by hand. Any roughness indicates a fault. Check any up and down movement in the turbocharger shafts. Excessive movement indicates a fault. If in doubt, compare the suspect unit with a new turbocharger • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
No boost/excessive noise	• Turbocharger failure(s)	• Disconnect the turbocharger intake and outlet pipework and turn the turbochargers by hand. Any roughness indicates a fault. Check any up and down movement in the turbocharger shafts. Excessive

		movement indicates a fault. If in doubt, compare the suspect unit with a new turbocharger

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger LH

Removal and Installation

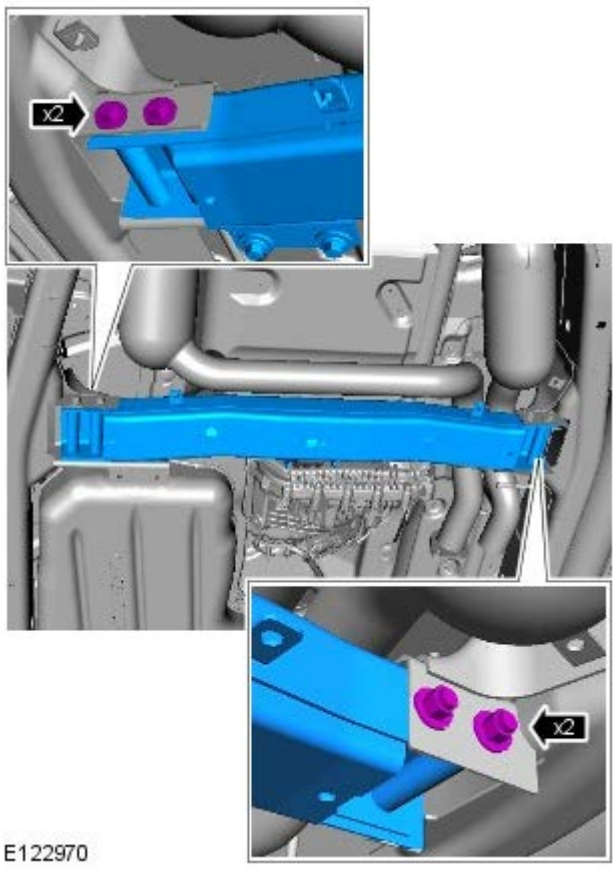
Removal

NOTES:

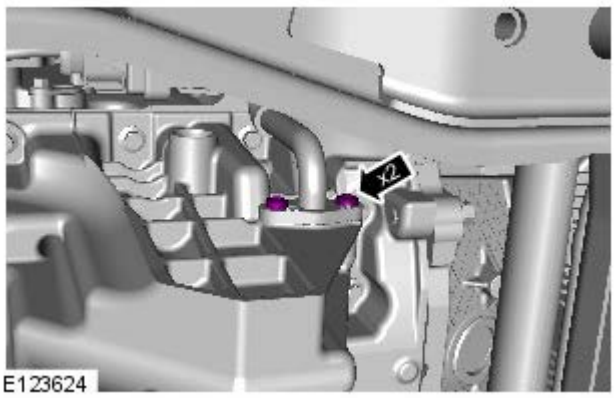
Some variation in the illustrations may occur, but the essential information is always correct.

Removal steps in this procedure may contain installation details.

1. Refer to: Exhaust System (309-00, Removal and Installation).



2. CAUTION: Only tighten the bolts finger tight at this stage.



3. CAUTIONS:

   Make sure that all openings are sealed. Use new blanking caps.

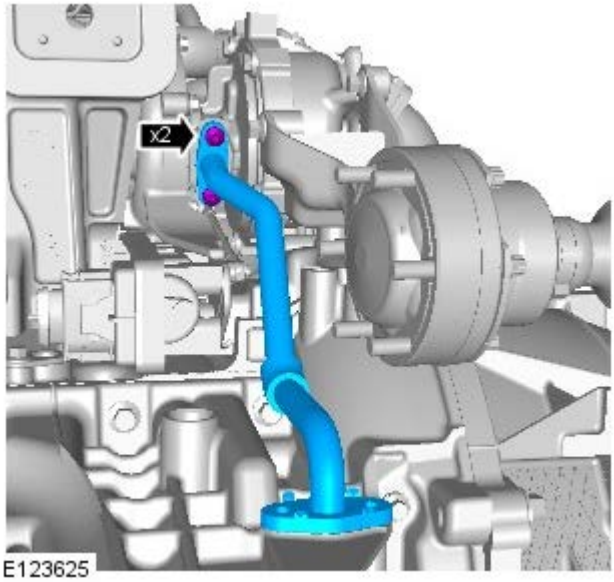
   Make sure that the area around the component is clean and free of foreign material.

   Torque: 9 Nm

4. CAUTIONS:

   Make sure that the area around the component is clean and free of foreign material.

   Make sure that all openings are sealed. Use

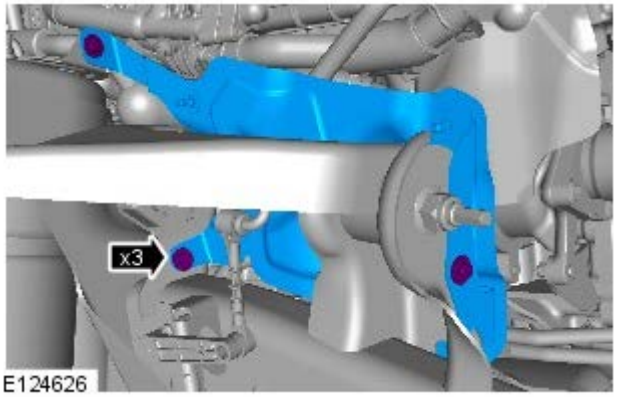


new blanking caps.

NOTE: Engine shown removed for clarity.

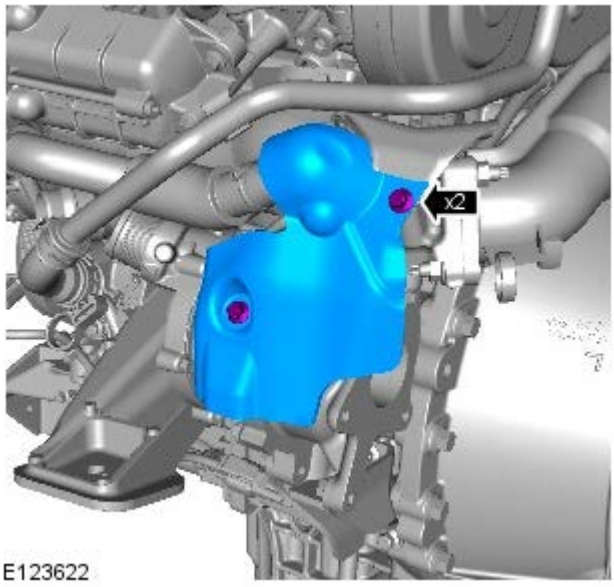
Torque: 9 Nm

5. Refer to: Body - Diesel (502-02, Removal and Installation).



6. NOTE: The heatshield consists of 3 parts.

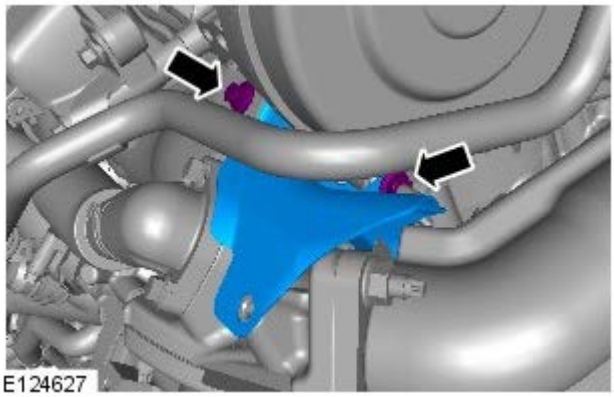
Torque: 9 Nm

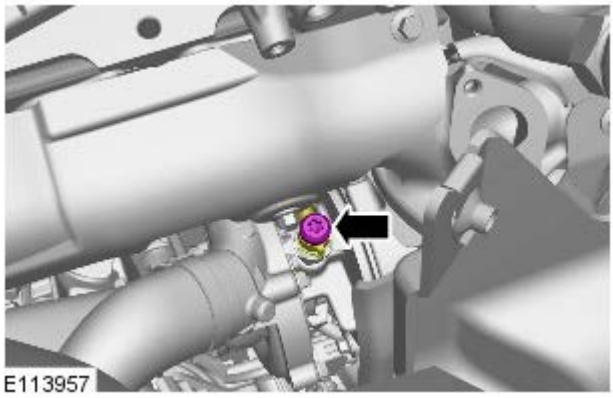


7. NOTE: Engine shown removed for clarity.

Torque: 9 Nm

8. *Torque:* 9 Nm

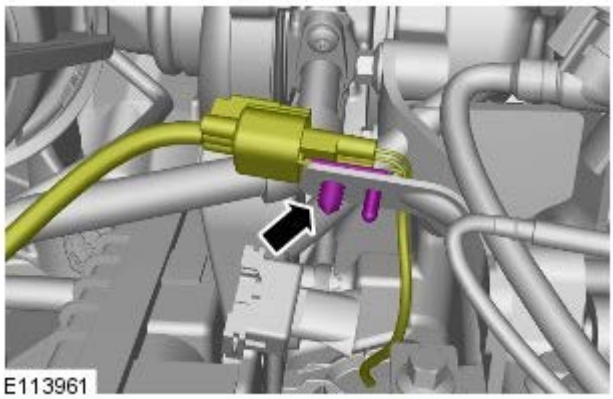




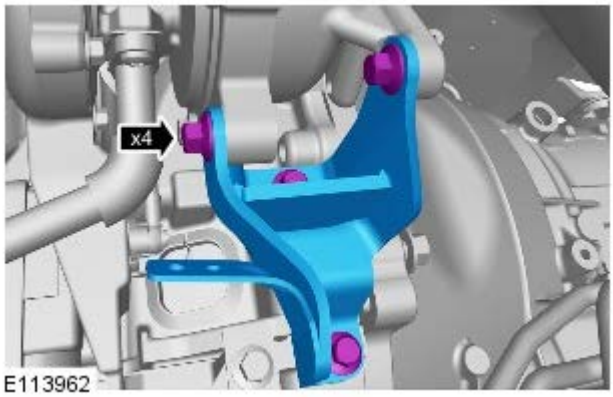
9. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

   Torque: 30 Nm

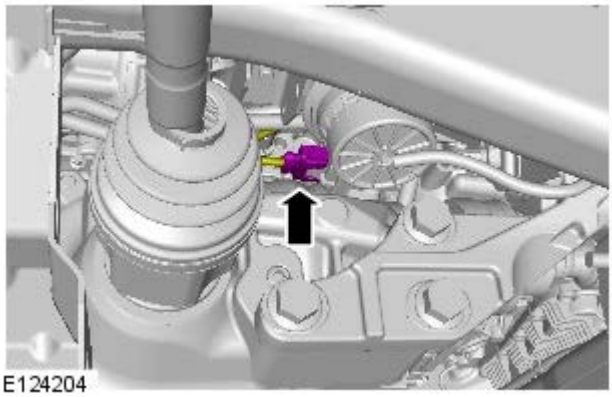
10.

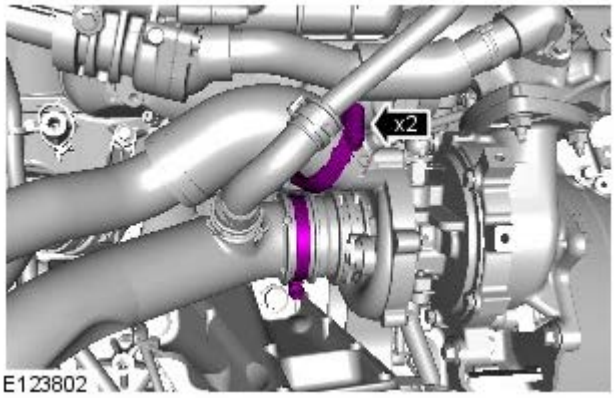


11. *Torque:* 32 Nm

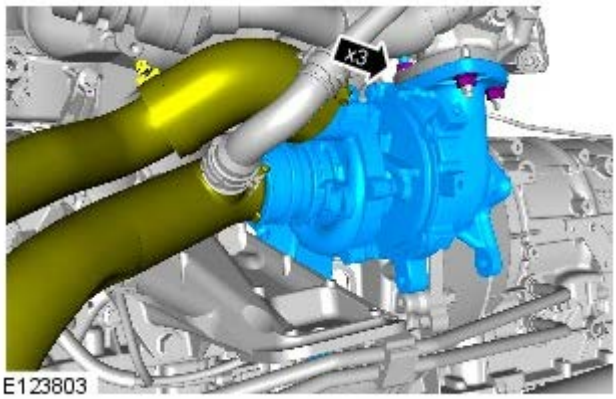


12.


E124204



E123802



E123803

13. NOTE: Engine shown removed for clarity.

14. WARNING: Make sure that new nuts are installed.

    CAUTIONS:

    Make sure that the area around the component is clean and free of foreign material.

    Discard the nuts.

    Make sure that all openings are sealed. Use new blanking caps.

    Install a new turbocharger to exhaust manifold gasket every time the turbocharger is removed.

    NOTES:

    Remove and discard the gasket.

    Engine shown removed for clarity.

    Torque: 24 Nm

Installation

1. To install reverse the removal procedure.

Published: 11-May-2011

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger RH

Removal and Installation

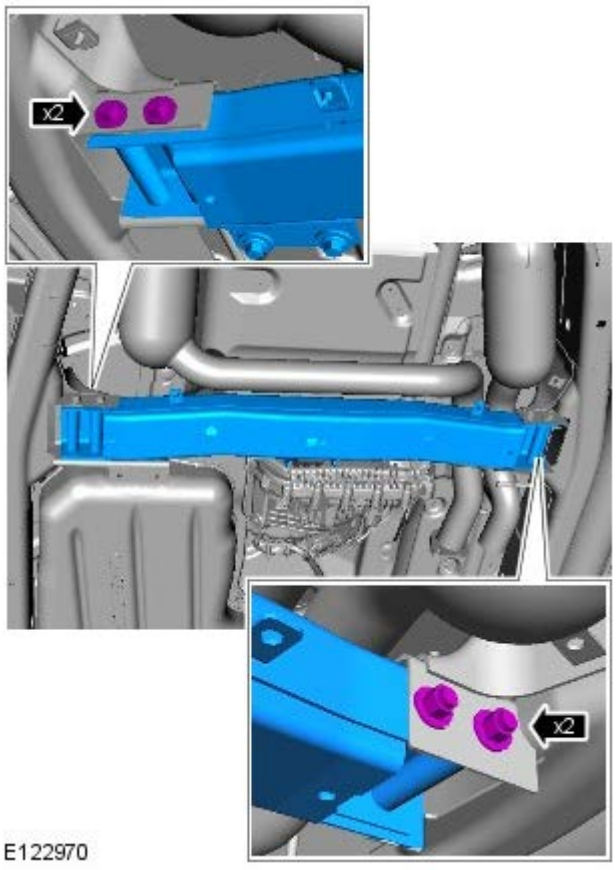
Removal

NOTES:

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

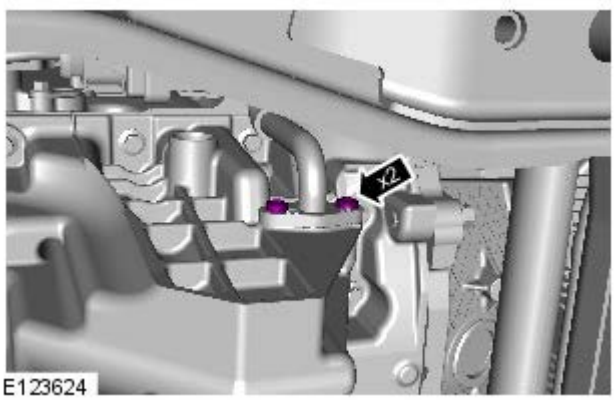
Removal steps in this procedure may contain installation details.

1. Refer to: Exhaust System (309-00 Exhaust System - 3.0L V6 - TdV6, Removal and Installation).



E122970

2. CAUTION: Only tighten the bolts finger tight at this stage.



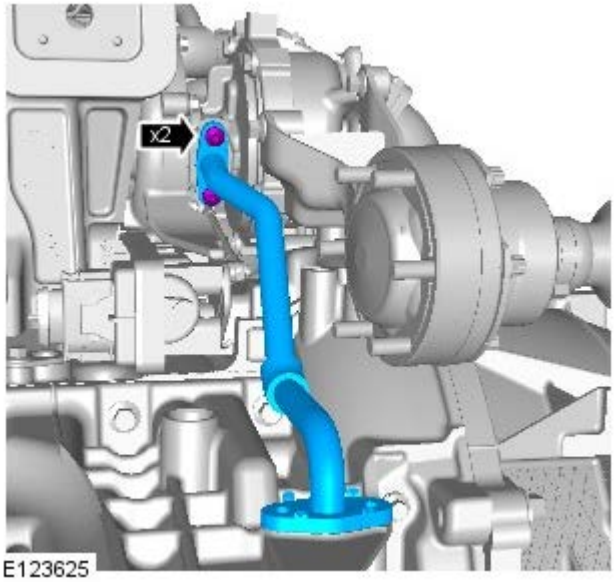
E123624

3. CAUTION: LH illustration shown, RH is similar.

   Torque: 9 Nm

4. CAUTION: LH illustration shown, RH is similar.

   NOTES:

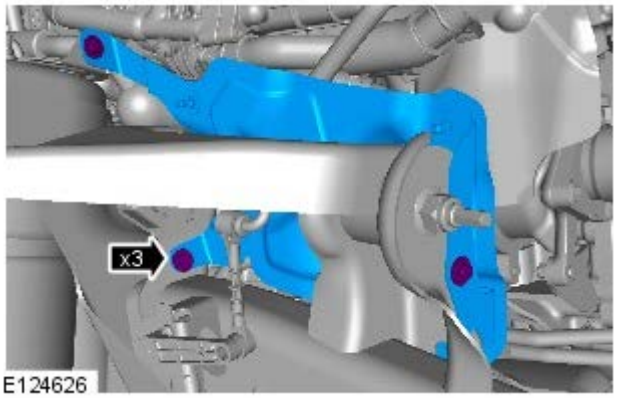


Engine shown removed for clarity.

Install new gaskets.

Torque: 9 Nm

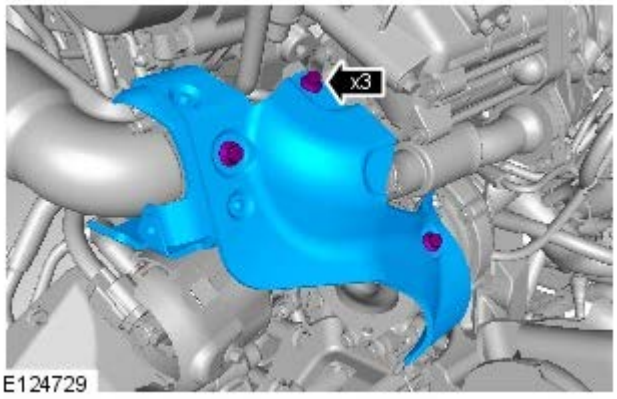
5. Refer to: Body - 2.7L V6 - TdV6/3.0L V6 - TdV6 (502-02 Full Frame and Body Mounting, Removal and Installation).



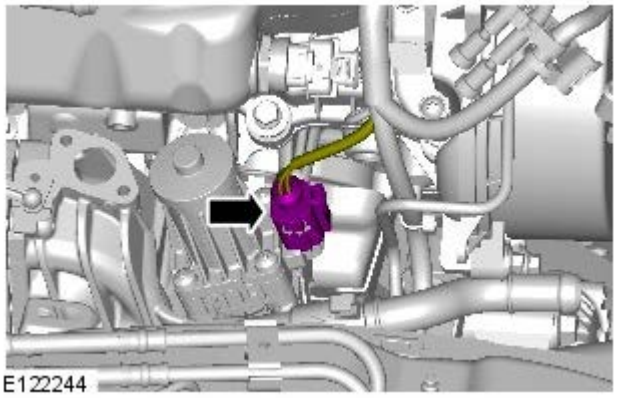
6. CAUTION: LH illustration shown, RH is similar.

NOTE: The heatshield consists of 3 parts.

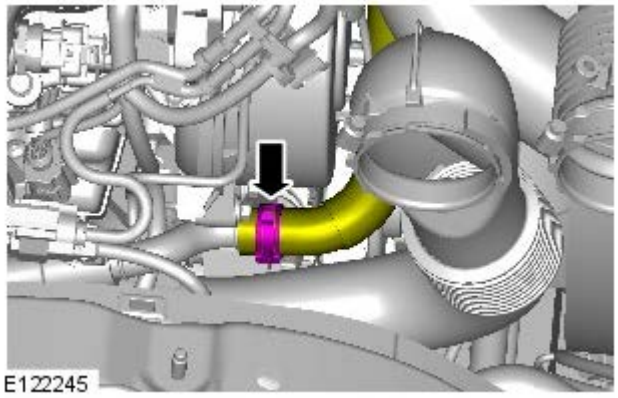
Torque: 9 Nm



7. *Torque:* 9 Nm



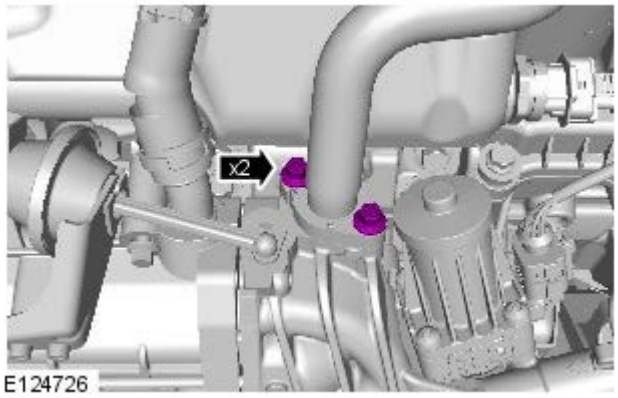
8.



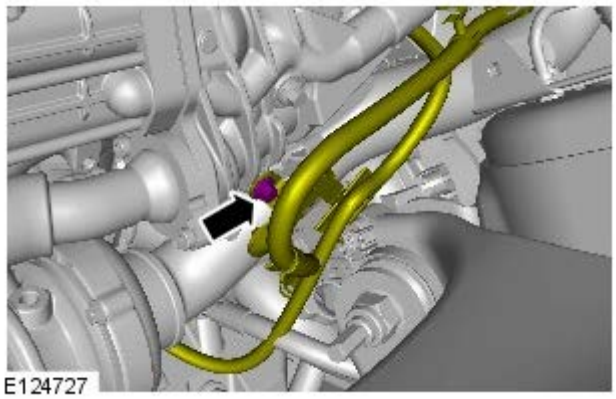
9. CAUTIONS:

   Be prepared to collect escaping coolant.

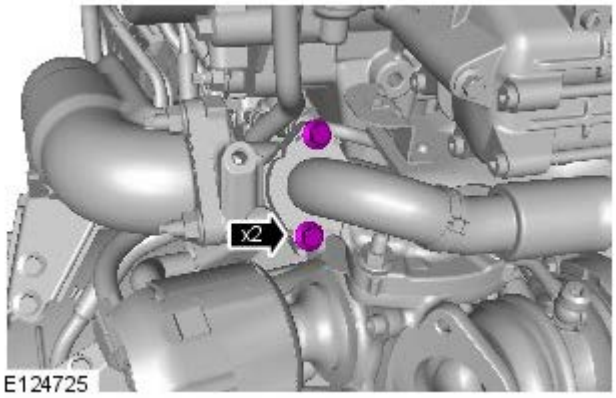
   Make sure that all openings are sealed. Use new blanking caps.



10. *Torque:* 10 Nm



11. *Torque:* 10 Nm

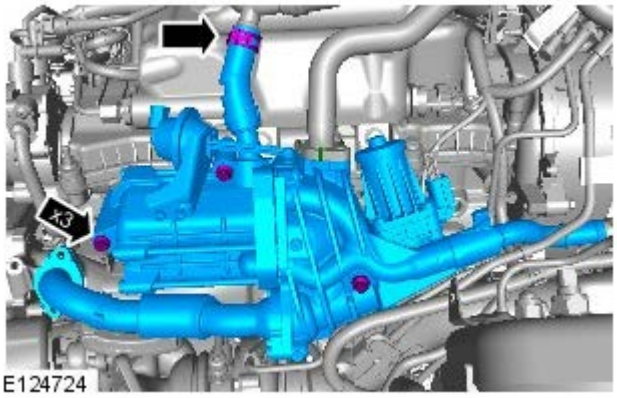


12. *Torque:* 10 Nm

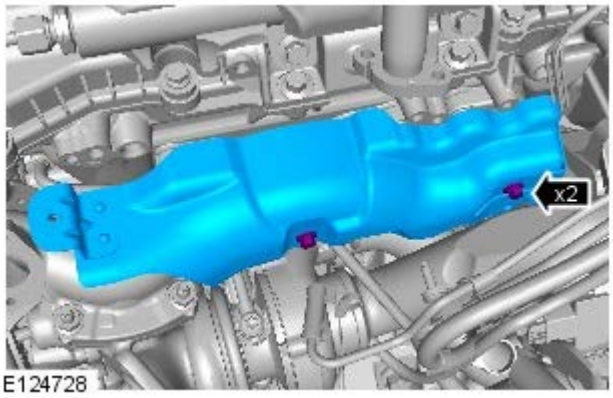
13. CAUTION: Be prepared to collect escaping coolant.

    NOTE: Install new gaskets.

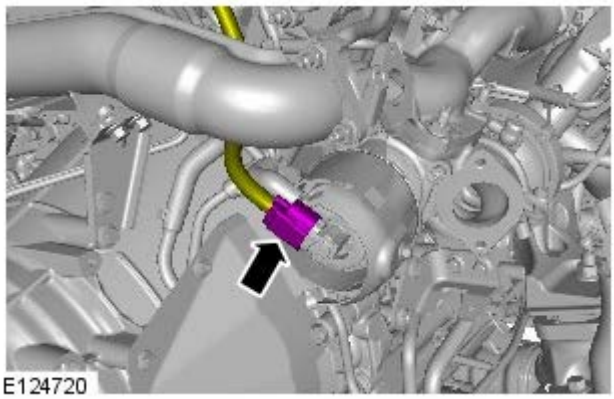
    Torque: 10 Nm



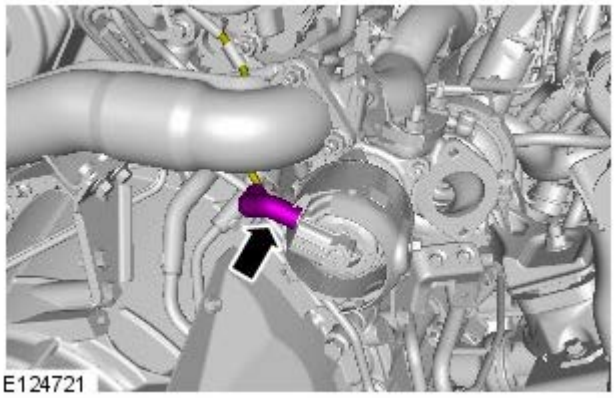
14. *Torque:* 11 Nm



15.



16.

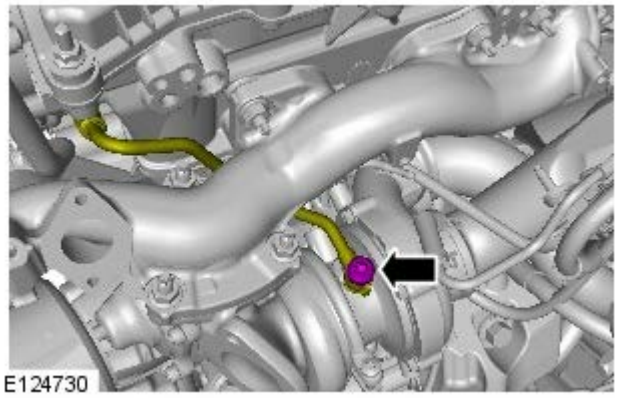


17. CAUTIONS:

Be prepared to collect escaping oil.

Make sure that all openings are sealed. Use new blanking caps.

Make sure that the area around the

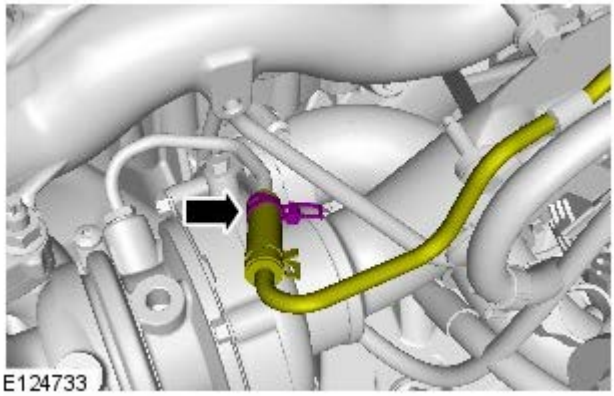


component is clean and free of foreign material.

Make sure that new sealing washers are installed.

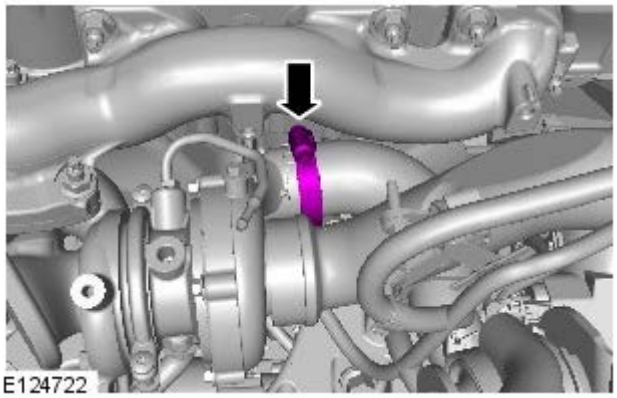
Make sure that a new bolt is installed.

Torque: 30 Nm

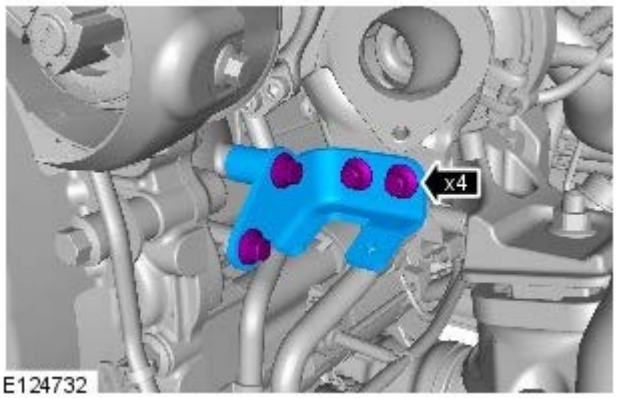


18. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

19.

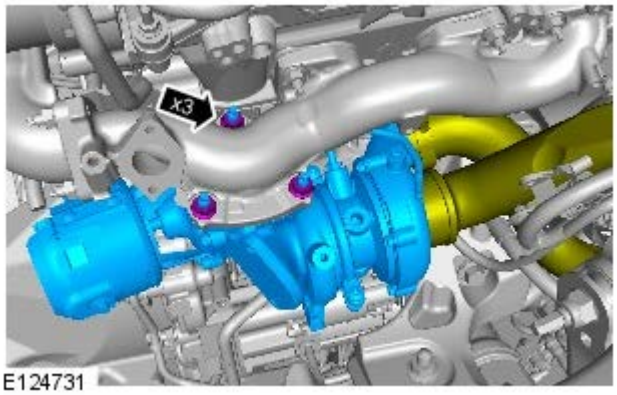


20. *Torque:* 32 Nm



21. WARNING: Make sure that new nuts are installed.

CAUTIONS:



Discard the nuts.

Make sure that all openings are sealed. Use new blanking caps.

Make sure that the area around the component is clean and free of foreign material.

Install a new turbocharger to exhaust manifold gasket every time the turbocharger is removed.

NOTE: Remove and discard the gasket.

Torque: 24 Nm

Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure the fixed vane turbocharger actuator using the approved diagnostic tool.

Published: 11-May-2011

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger Bypass Valve

Removal and Installation

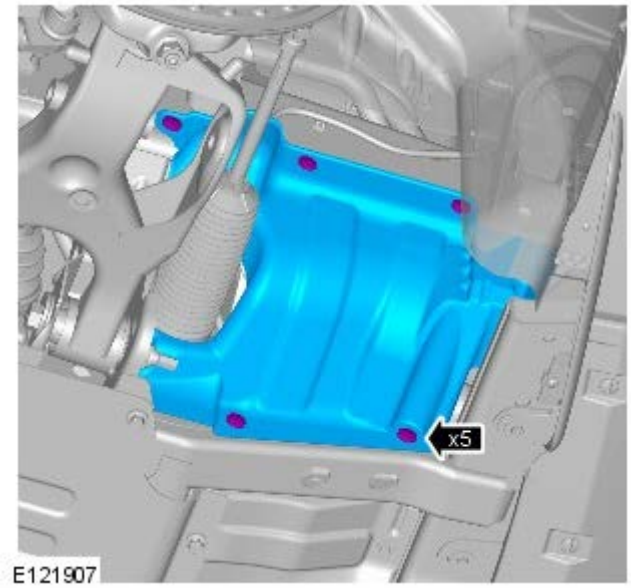
Removal

NOTE: Removal steps in this procedure may contain installation details.

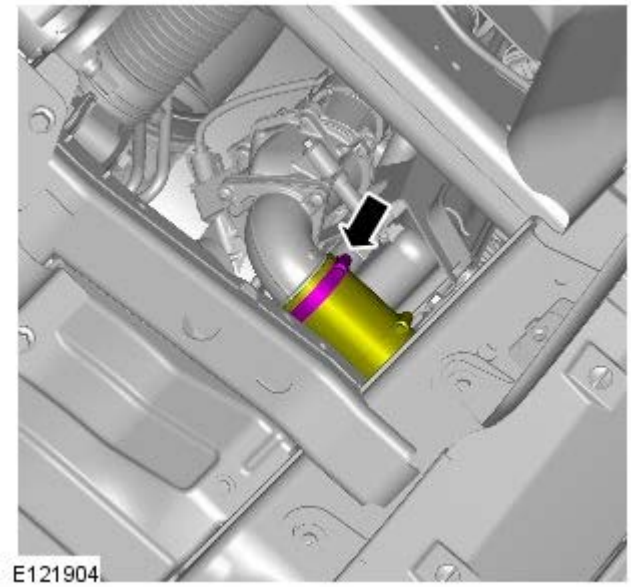
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

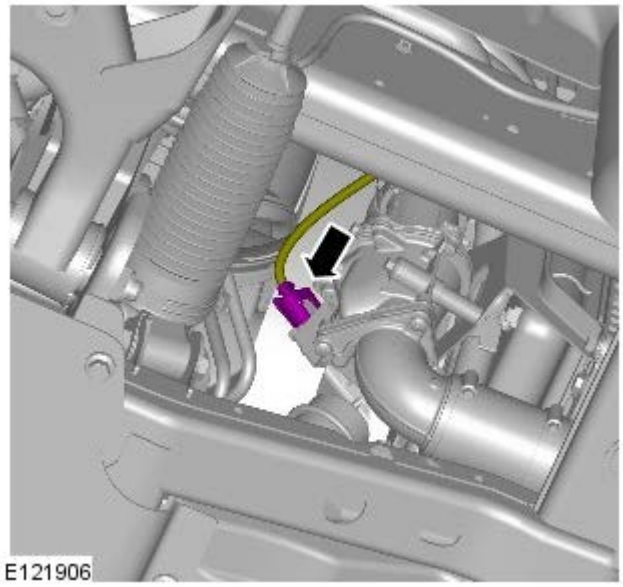
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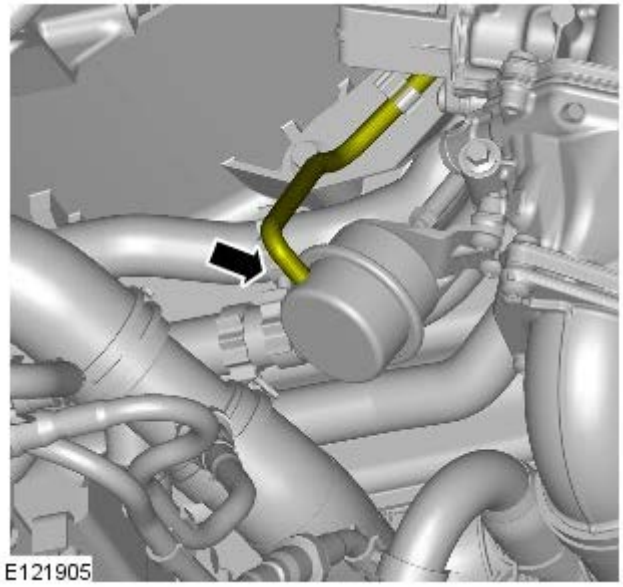
3. *Torque:* 5 Nm



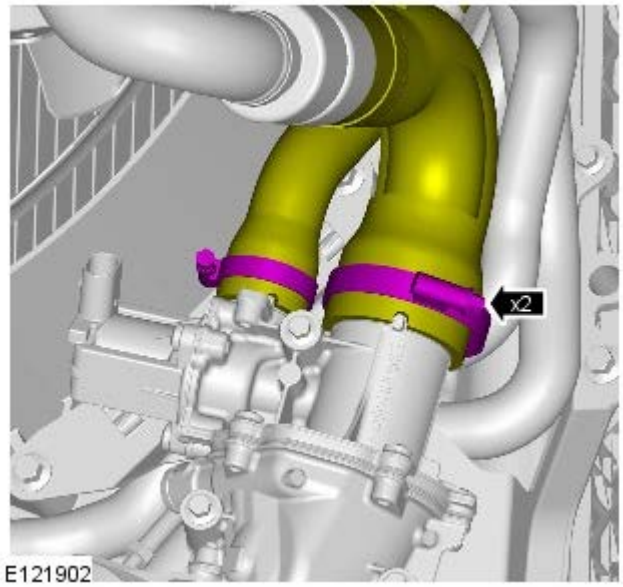
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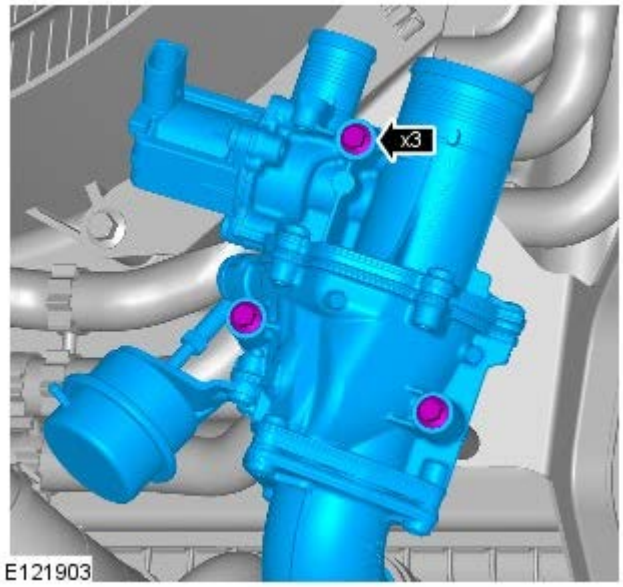
5.



6. *Torque:* 5 Nm



7. *Torque:* 10 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Fixed Vane Turbocharger Actuator

Removal and Installation

Removal

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

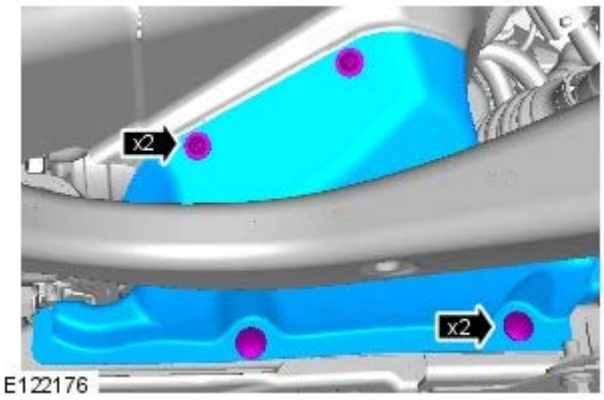
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

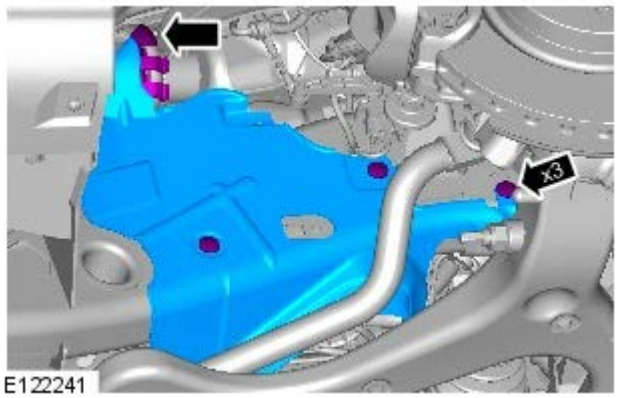
2. Refer to: Exhaust System (309-00, Removal and Installation).

3. Remove the RH front wheel and tire.

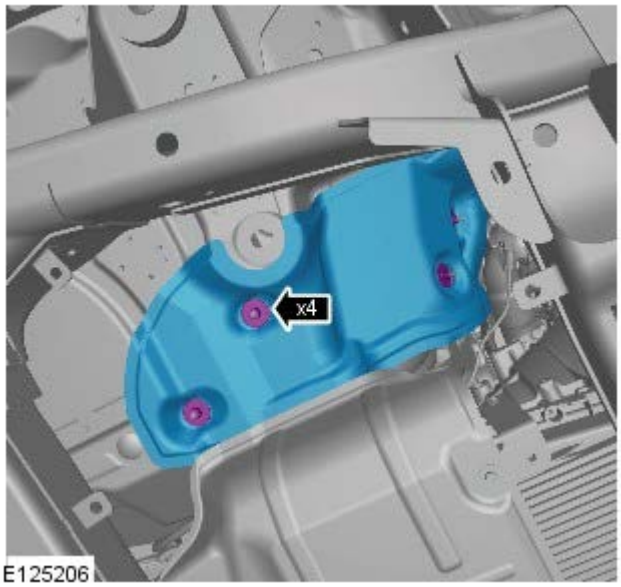
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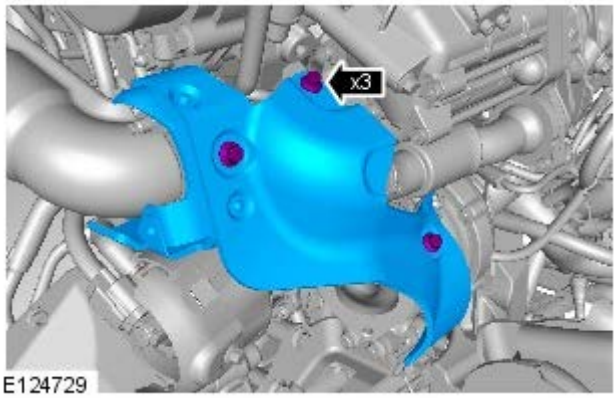
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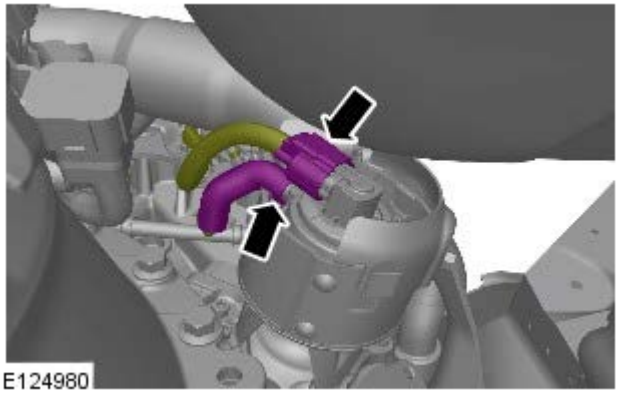
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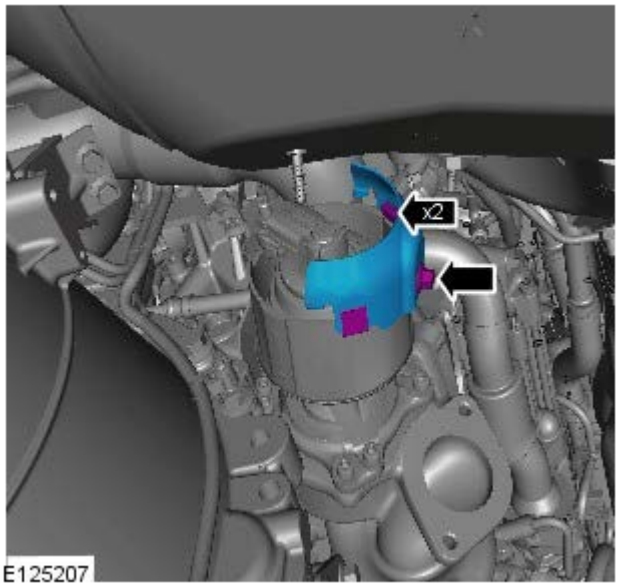
7. NOTE: Engine shown removed for clarity.



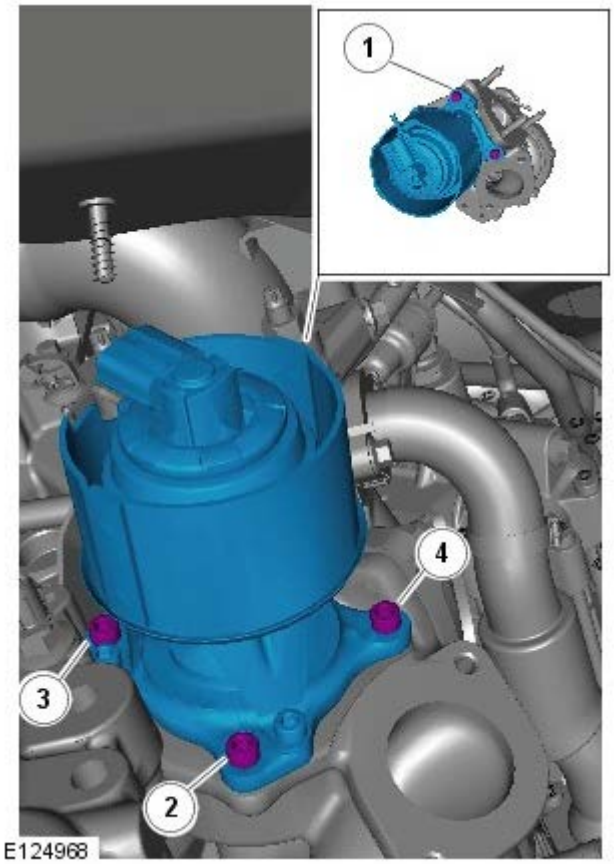
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9.



E125207



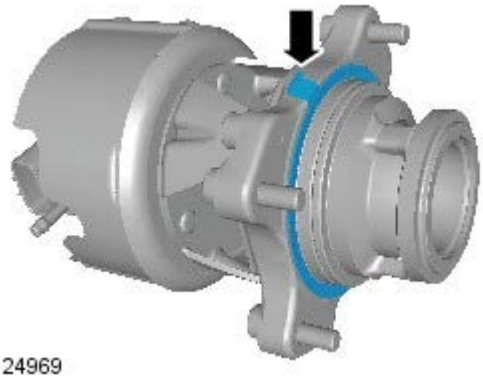
E124968

10. CAUTIONS:

Remove the Torx screws evenly and progressively.

Make sure component mating faces are not damaged during removal.

Using a suitable 130mm T30 Torx socket, remove the retaining bolts.


E124969

11. NOTES:

Make a note of the orientation of the gasket tang.

Remove and discard the gasket using the gasket tang.

12. NOTES:

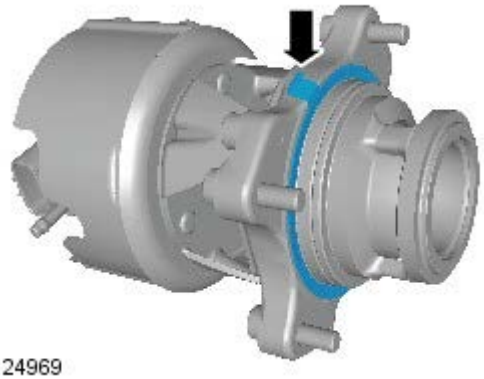


E124972

Remove and discard the gasket.

Turbocharger shown removed for clarity.

Installation



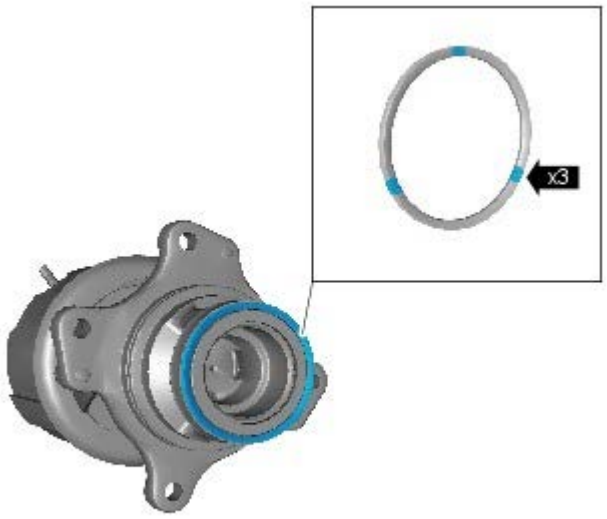
E124969

1. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

   NOTES:

   Install a new gasket.

   Make sure that the gasket tang is installed in the correct orientation as noted in the removal step.



E124970

2. CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

   NOTES:

   Install a new gasket.

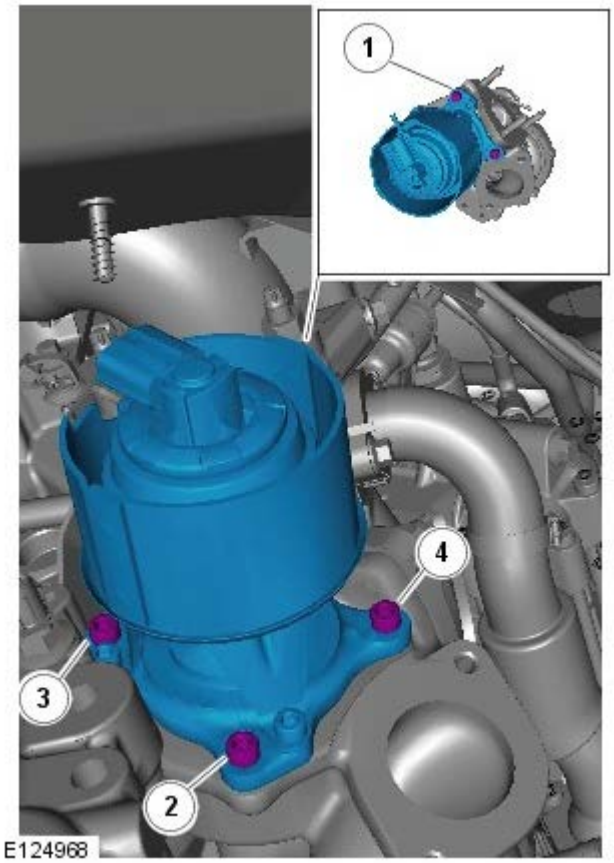
   Apply a small amount of grease in the areas indicated to allow the gasket to remain in the position for installation.

3. CAUTIONS:

   Install all the bolts finger tight before final tightening.

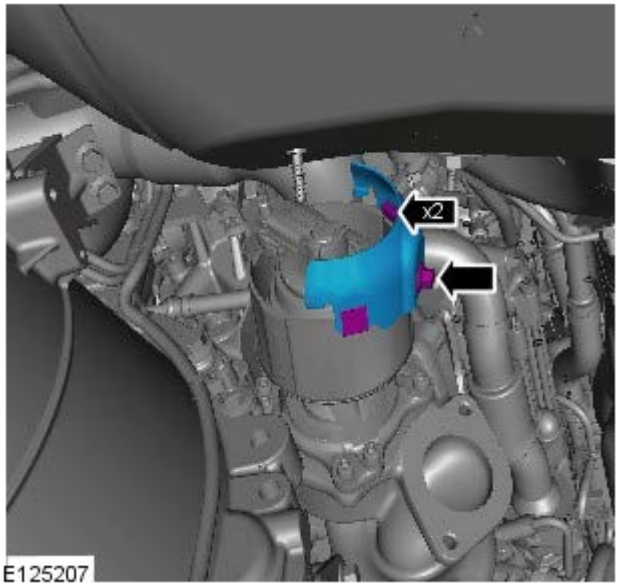
   Tighten the Torx screws evenly and progressively.

   Using a suitable 130mm T30 Torx socket, Install

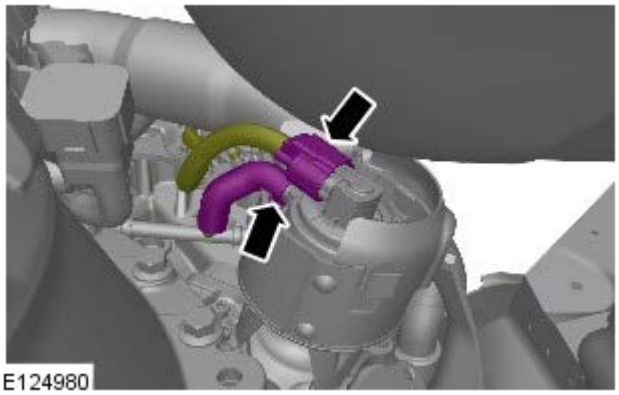


the retaining bolts.

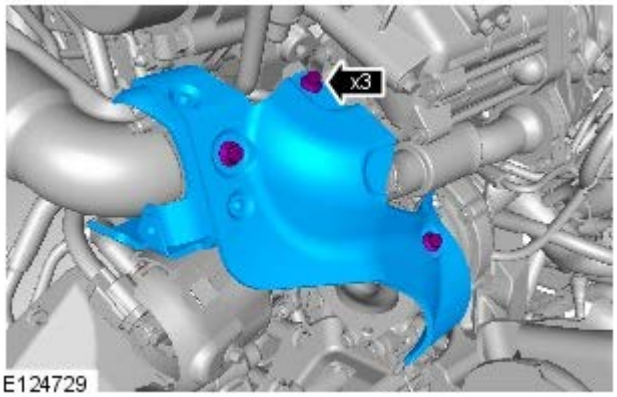
4. *Torque:* 9 Nm



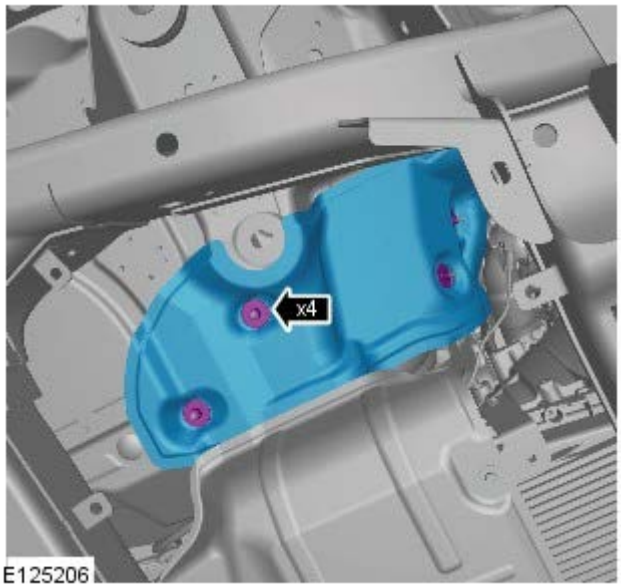
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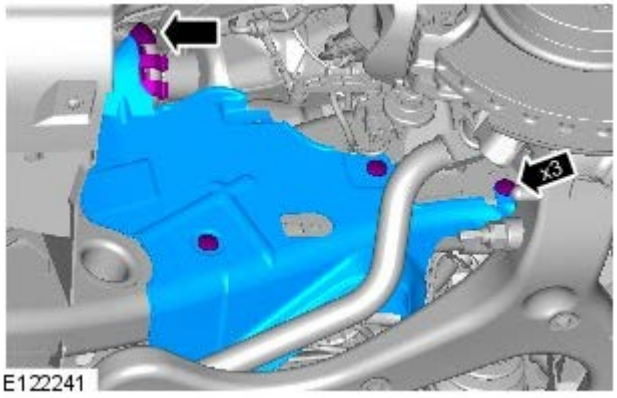
6. *Torque:* 9 Nm



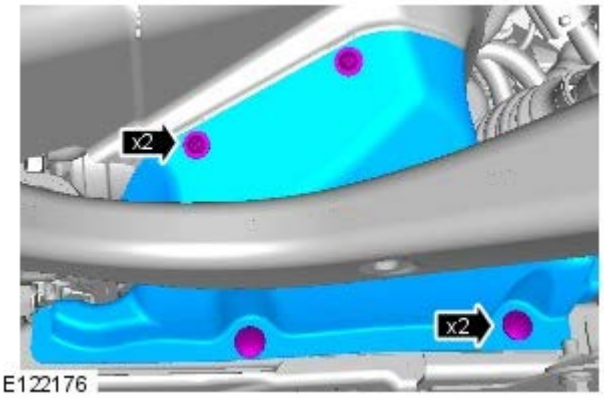
7. *Torque:* 10 Nm



8.



9.



10. Install the RH front wheel and tire.

11. Refer to: Exhaust System (309-00, Removal and Installation).

12. If a new fixed vane turbocharger actuator is installed, carry out the reset procedure for the fixed vane turbocharger actuator using approved diagnostic tool.

This section contains no data

Published: 11-May-2011

Fuel Charging and Controls - V8 5.0L Petrol -

Torque Specifications

WARNINGS:

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 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.

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

 NOTE: Tighten the fuel rail high pressure fuel pump fuel line unions and fuel rail crossover pipe unions as it is instructed in service manual.

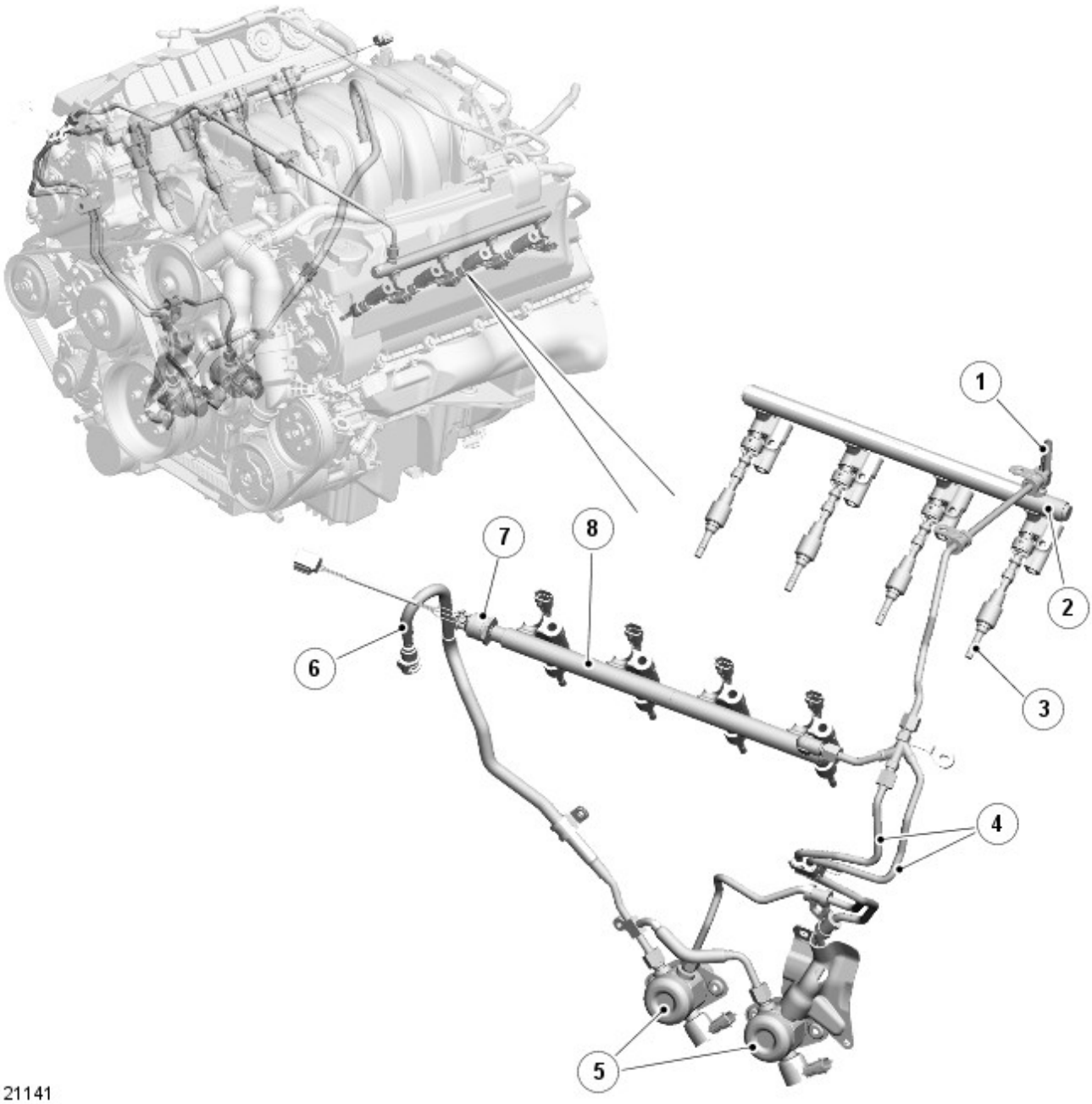
Description	Nm	lb-ft	lb-in
Ignition coil-on-plugs retaining bolts	7	-	62
Spark plugs	20	15	-
Fuel rail retaining bolt	Stage 1 - 20 Stage 2 - 30	Stage 1 - 15 Stage 2 - 22	-
Fuel rail crossover pipe unions	21	15	-
Fuel rail crossover pipe retaining bolts	8	-	71
Fuel pressure regulator	33	24	-
Fuel rail high pressure fuel pump fuel line unions	21	15	-
Fuel rail high pressure fuel pump fuel line M8 bolt	25	18	-
Fuel rail high pressure fuel pump fuel line M6 bolt	11	8	-
Fuel rail high pressure fuel pump fuel line M5 nut	6	-	53
Fuel rail high pressure fuel pump fuel line shield M10 bolt	29	21	-
Fuel rail high pressure fuel pump fuel line shield M6 bolt	11	8	-
Fuel rail high pressure fuel pump torx bolts	12	9	-
Throttle body retaining bolts	17	13	-
Accessory drive belt idler pulley retaining bolts	25	18	-
Halfshaft bearing retaining bolts	22	16	-
Right-hand engine mount to front subframe retaining bolts	56	41	-
Right-hand engine mount bracket to engine mount retaining nut	100	74	-

Published: 15-Mar-2013

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Charging and Controls

Description and Operation

COMPONENT LOCATION



E121141

Item	Part Number	Description
1	-	Crossover tube
2	-	LH (left hand) fuel rail
3	-	Fuel injector (8 off)
4	-	HP (high pressure) fuel lines
5	-	HP fuel pumps and covers
6	-	LP (low pressure) fuel lines
7	-	FRP (fuel rail pressure) sensor
8	-	RH (right hand) fuel rail

INTRODUCTION

The fuel charging and controls system is a gasoline DI (direct injection) system controlled by the ECM (engine control module).

The fuel charging and controls system consists of:

- LP and HP fuel lines.
- Two HP fuel pumps.

- Two fuel rails and a crossover tube.
- A FRP (fuel rail pressure) sensor.
- Eight fuel injectors.

LP fuel from the pump in the fuel tank is pressurized by the HP fuel pumps and supplied to the fuel injectors via the fuel rails and crossover tube. The ECM controls the fuel injectors and HP fuel pumps to inject the required volume of fuel into the combustion chambers.

LOW AND HIGH PRESSURE FUEL LINES



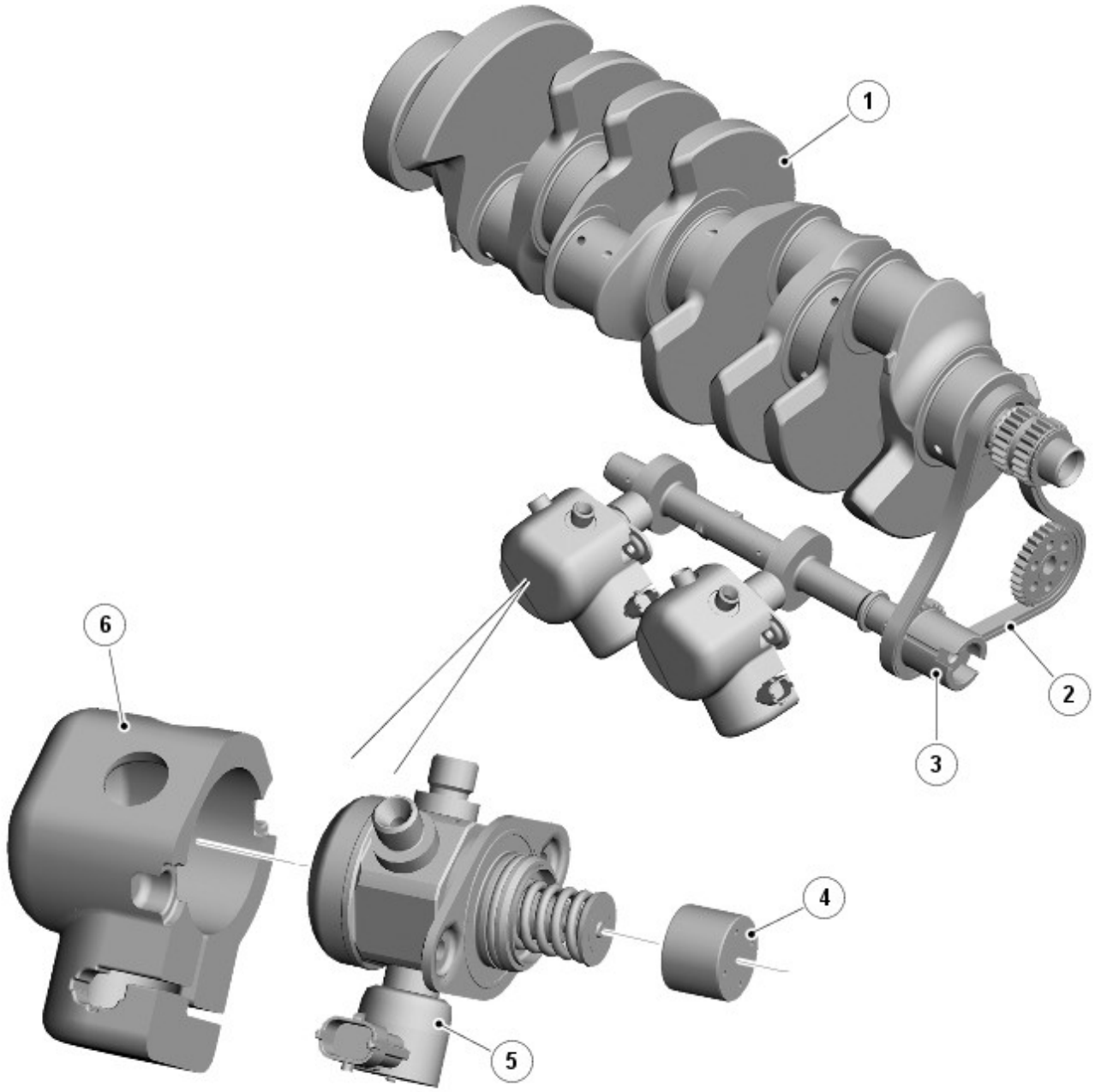
E122675

Item	Part Number	Description
A	-	LP fuel lines
B	-	HP fuel lines
1	-	Acoustic cover
2	-	Heat reflective and insulation sleeves

The LP fuel line connects the HP fuel pumps to the fuel delivery line from the fuel tank and lines system. A quick release connector at the start of the LP fuel line is held in a clip integrated into the LH (left-hand) ignition coils cover. P-clips secure the LP fuel line to the rear of each cylinder head and to the RH (right-hand) side of the cylinder block. A heat reflective and insulation sleeves are installed on the LP fuel line where it runs behind the RH exhaust manifold.

The HP fuel lines connect the HP fuel pumps to the RH fuel rail and the crossover tube. Two P-clips and a pipe clamp attach the HP fuel lines to the cylinder block and the RH cylinder head respectively. An integral bracket on the front HP fuel line is attached to a stud on the front-upper RH timing cover. An acoustic cover is installed on the bottom of the front HP fuel line.

HIGH PRESSURE FUEL PUMPS



E114701

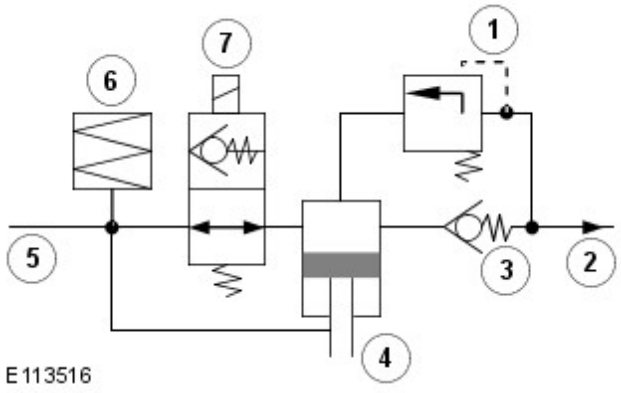
Item	Part Number	Description
1	-	Crankshaft
2	-	Auxiliary drive chain
3	-	Auxiliary camshaft
4	-	Tappet
5	-	HP fuel pump
6	-	Acoustic cover

The two HP fuel pumps are identical mechanically-driven pumps installed on the RH side of the sump body, behind the generator. An O-ring seals each of the HP fuel pumps in the sump body. The rear HP fuel pump is identified as No. 1 pump; the front HP fuel pump is identified as No. 2 pump. An acoustic cover is installed on each of the HP fuel pumps.

The HP fuel pumps are single-plunger pumps. The plunger of each pump extends through the sump body and the carrier of the auxiliary camshaft. A tappet on the end each plunger is operated by a two-lobe cam on the auxiliary camshaft. A spring installed on the outside of the plunger ensures the plunger and tappet remain in contact with the cam.

The auxiliary camshaft is driven by the crankshaft, via the auxiliary drive chain, at engine speed. The auxiliary camshaft is timed to match the pump delivery strokes with crankshaft position.

HP Fuel Pump Schematic



Item	Part Number	Description
1	-	PRV (pressure relief valve)
2	-	To HP fuel lines
3	-	Check valve
4	-	Plunger
5	-	From LP fuel lines
6	-	Damper chamber
7	-	Fuel metering valve

In addition to the plunger, each HP fuel pump contains:

- A damper chamber
- A fuel metering valve
- A check valve
- A PRV.

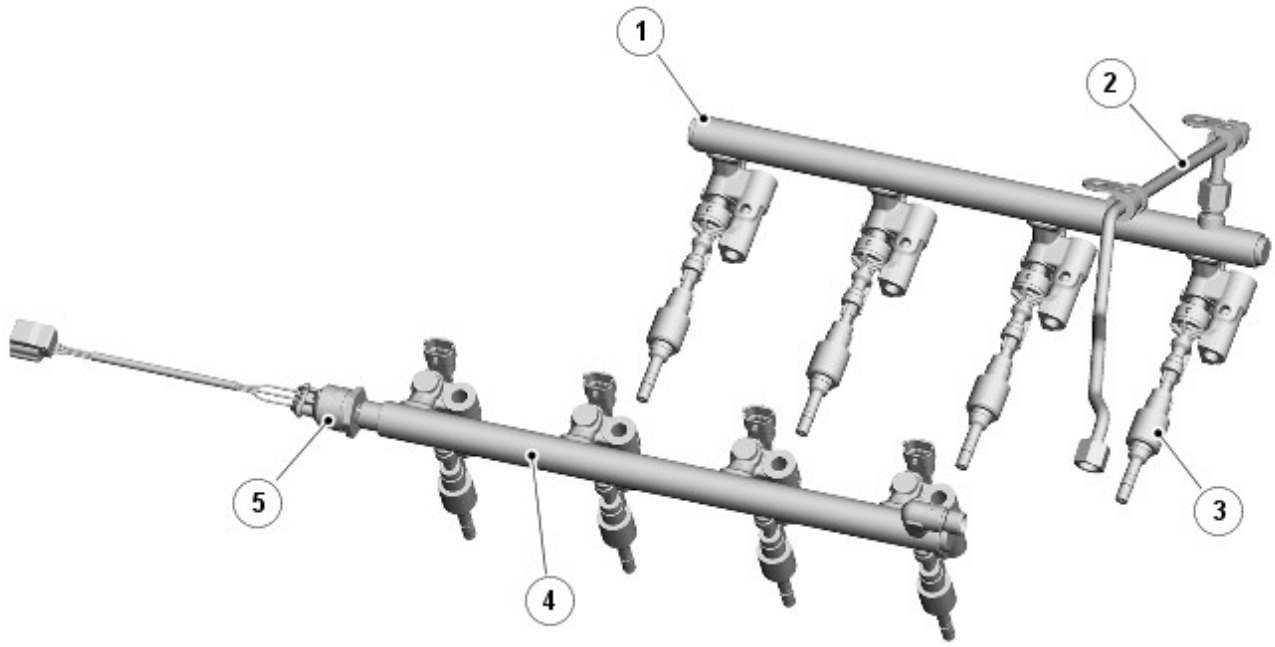
The damper absorbs pressure pulses from the plunger when the fuel metering valve is open at the start of the delivery stroke.

The fuel metering valve regulates the output pressure from the HP fuel pump. The fuel metering valve is a normally open solenoid valve controlled by the ECM. During the inlet stroke of the plunger the fuel metering valve is de-energized, which allows LP fuel into the pumping chamber. The ECM energizes the fuel metering valve closed during the delivery stroke of the plunger, which forces the fuel in the pumping chamber through the check valve into the HP lines. By changing the closing point of the fuel metering valve, the ECM can determine the volume of fuel output during the delivery stroke, and thus the pressure in the HP side of the system.

The check valve prevents the return of HP fuel to the pumping chamber during the inlet stroke of the plunger.

The PRV protects the HP side of the system from excessive pressure if there is a failure of the fuel metering valve. If the pump delivery pressure increases to 195 - 204 bar (2828 - 2959 lbf/in^2), the PRV opens and returns fuel to the inlet side of the plunger.

FUEL RAILS AND CROSSOVER TUBE



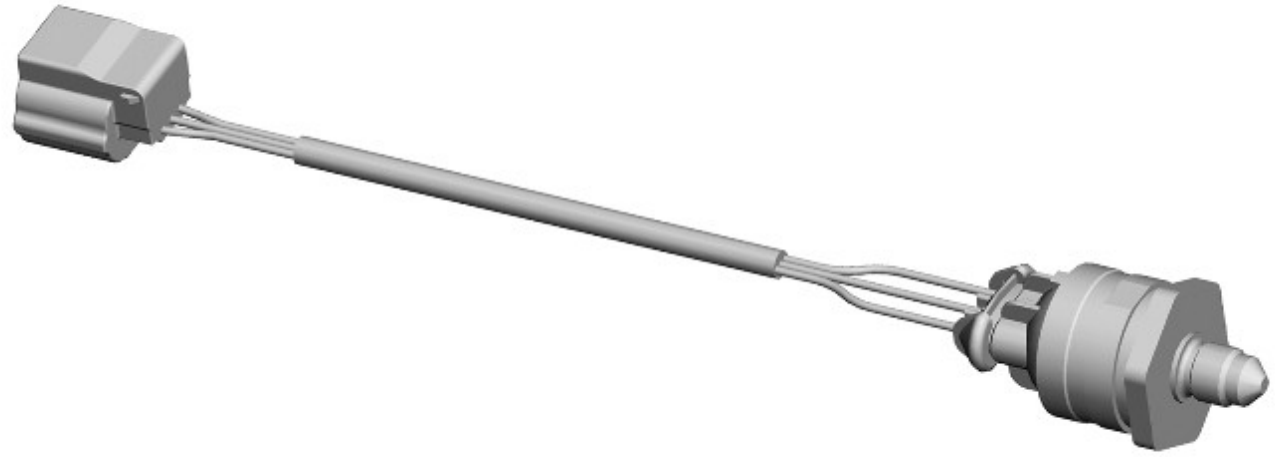
E113522

Item	Part Number	Description
1	-	LH fuel rail
2	-	Crossover tube
3	-	Fuel injector
4	-	RH fuel rail
5	-	FRP sensor

The fuel rails and crossover tube are made from stainless steel. Bolts attach each fuel rail to the related cylinder head. The crossover tube connects the front high pressure line to the LH fuel rail, which ensures there is equal pressure in the two fuel rails. Two P-clips attach the crossover tube to the intake manifold.

The rear of the RH fuel rail incorporates a threaded boss for installation of the FRP sensor.

FUEL RAIL PRESSURE SENSOR

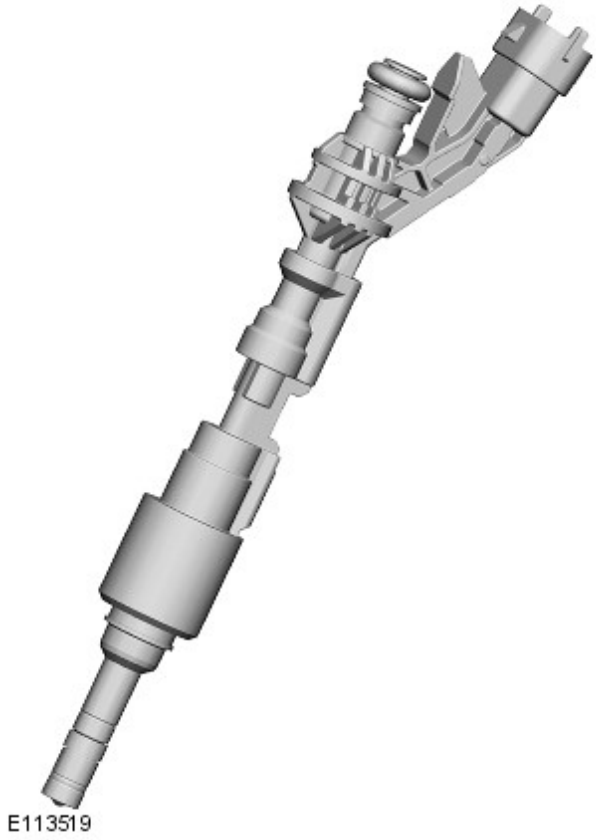


E113518

The FRP sensor provides the ECM with a continuous signal of fuel rail pressure. The FRP sensor is installed in the rear of the RH fuel rail. The FRP sensor is screwed into a threaded boss in the fuel rail. A flying lead and three pin connector provides the interface with the engine harness.

The FRP sensor contains a steel diaphragm fitted with strain gages, which are incorporated into a Wheatstone bridge. The output from the Wheatstone bridge is processed by the ECM to derive a pressure value.

FUEL INJECTORS



The fuel injectors spray fuel from the fuel rail directly into the combustion chambers. The fuel injectors are installed close to the center of the combustion chambers, between the inlet and exhaust valves and next to the spark plug.

The fuel injectors are a push fit in the fuel rails and the cylinder heads. On each fuel injector, a rubber O-ring seals the head of the fuel injector in the fuel rail. A teflon ring seals the nozzle of the fuel injector in the cylinder head. A clamp locks each fuel injector to the fuel rail.

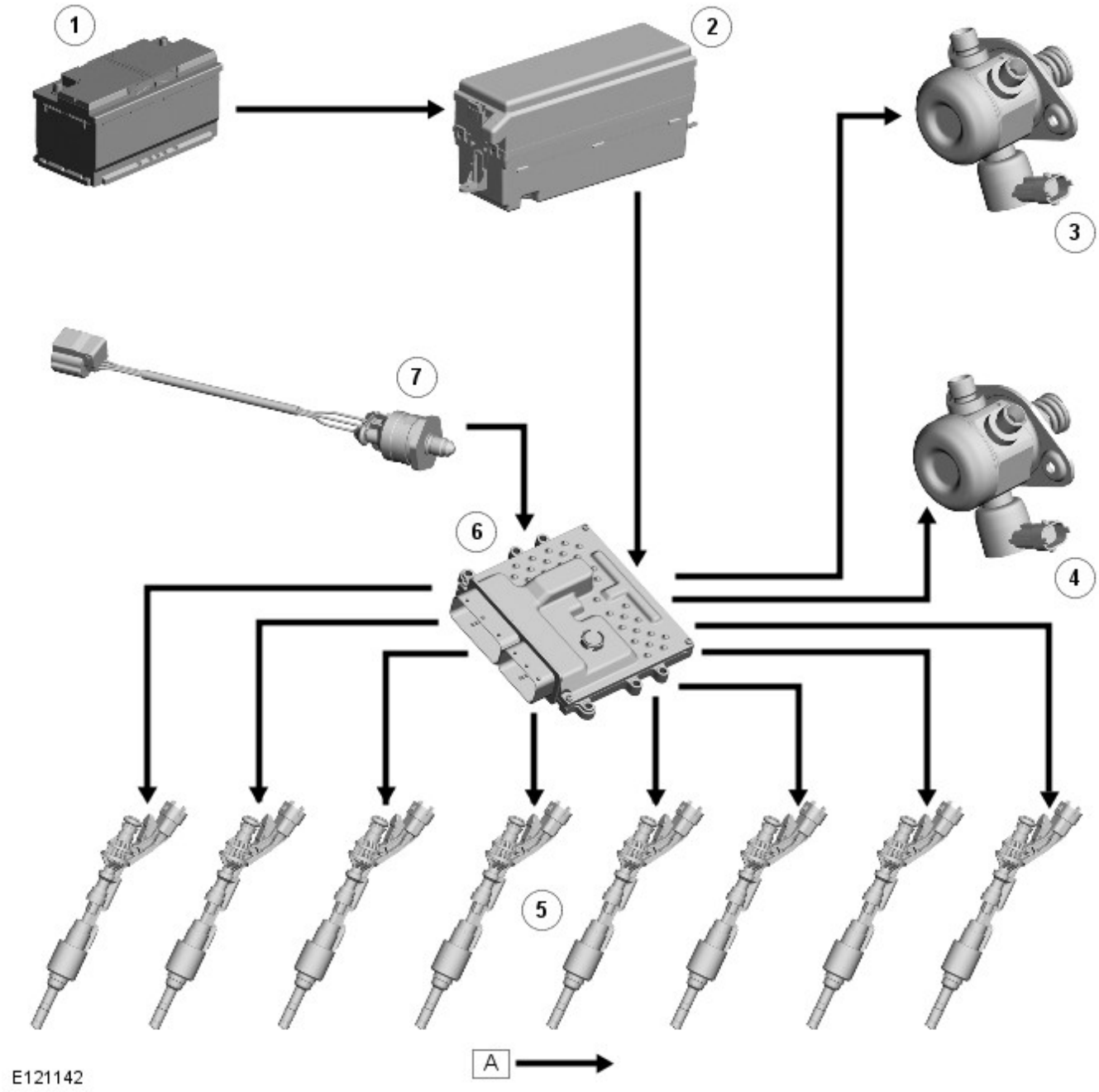
Each fuel injector contains a solenoid-operated needle valve, which opens when the solenoid winding is energized. While the needle valve is open, fuel is sprayed into the combustion chamber. The solenoid winding is connected to a power feed and a ground from the ECM, which operates the fuel injectors with a two stage power supply. Initially the ECM supplies the fuel injectors with 65 V, then once the boost current reaches 11 A the power supply is switched to battery voltage. The ECM meters the amount of fuel injected into the combustion chambers by adjusting the time that the solenoid winding is energized.

There are six holes around the tip of the nozzle through which the fuel is sprayed. Two of the holes direct fuel below the spark plug. The other four holes direct fuel evenly around the remainder of the combustion chamber.

If a fuel injector fails, the engine will suffer from unstable idle speed, poor NVH (noise, vibration and harshness) and poor emissions performance.

CONTROL DIAGRAM

NOTE: A = Hardwired



Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box) (ECM relay)
3	-	No. 1 HP fuel pump
4	-	No. 2 HP fuel pump
5	-	Fuel injectors
6	-	ECM
7	-	FRP sensor

PRINCIPLES OF OPERATION

The ECM controls the output from the HP fuel pumps to deliver the required volume of fuel at pressures up to 150 bar (2175 lbf/in^2).

The ECM also uses the signal from the FRP sensor to calculate the time the fuel injectors need to be energized to deliver the correct mass of fuel to the combustion chambers.

Published: 15-Aug-2012

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Charging and Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Fuel Charging and Controls (303-04C Fuel Charging and Controls - V8 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

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, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	• 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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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	• Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant 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 condition • Ensure the battery is in a fully charged and serviceable condition • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Difficult hot start	• Injector leak • Electronic engine control • Purge valve	• Check for injector leak, install new injector as required • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for

	• Fuel pump • Ignition system • EGR valve stuck open	related DTCs and refer to the relevant DTC index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system • EGR valve stuck open	• Check for injector leak, install new injector as required • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check for blockage in air filter element and air intake system • Check for air leakage in air intake system
Engine hesitates/poor acceleration	• Fuel pressure, fuel pump, fuel lines • Injector leak • Air leakage • Electronic engine control • Throttle motor • Restricted accelerator pedal travel (carpet, etc) • Ignition system • EGR valve stuck open • Transmission malfunction	• Check for fuel system related DTCs and refer to the relevant DTC Index • Check for injector leak, install new injector as required • Check for air leakage in air intake system • Ensure accelerator pedal is free from restriction • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Engine backfires	• Fuel pump/lines • Air leakage • Electronic engine controls • Ignition system • Sticking Variable Camshaft Timing (VCT) hub	• Check for fuel system failures • Check for air leakage in intake air system • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Engine surges	• Fuel pump/lines • Electronic engine controls • Throttle motor • Ignition system	• Check for fuel system failures • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Engine detonates/knocks	• Fuel pump/lines • Air leakage • Electronic engine controls • Sticking VCT hub	• Check for fuel system failures • Check for air leakage in intake air system • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
No throttle response	• Electronic engine controls • Throttle motor	• Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM), Transmission Control Module (TCM), and Anti-lock Brake System control module (ABS) for related DTCs and refer to the relevant DTC index. Check for air leakage in intake air system

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 11-May-2011

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Injection Component Cleaning

General Procedures

General Equipment

Pneumatic vacuum gun

Cleaning

WARNINGS:

Do not carry out any repairs to the fuel system with the engine running. Failure to follow this instruction may result in personal injury.

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.

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

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

Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

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.

CAUTIONS:

Before using the cleaning fluid, protect all electrical components and connectors with lint-free non-flocking material.

Make sure that all parts removed from the vehicle are placed on the lint-free non-flocking material.

Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.

Make sure that clean non-plated tools are used. Clean tools using a new brush that will not lose its bristles, prior to starting work on the vehicle.

Use a steel topped workbench and cover it with clean, lint-free non-flocking material.

Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

1. Using a new brush that will not lose its bristles, brush the components being removed and the surrounding area.
2. Using a pneumatic vacuum gun, remove all traces of foreign material.

General Equipment: Pneumatic vacuum gun

Published: 20-Jun-2012

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Injection Component Cleaning Using Pressure Cleaner

General Procedures

Cleaning

WARNINGS:

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

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

Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

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.

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.

CAUTIONS:

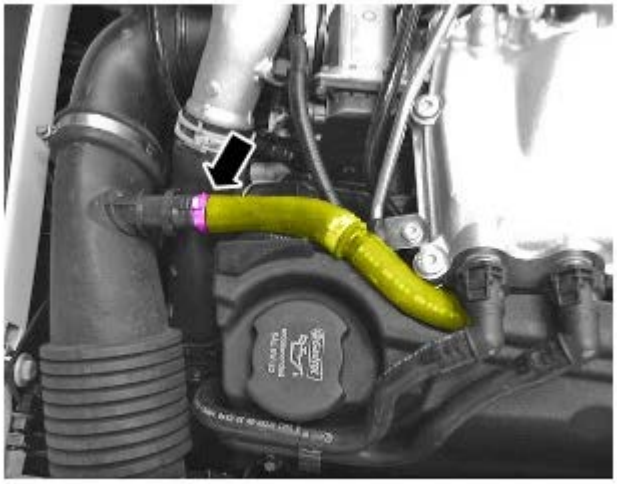
Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.

Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

Before using the cleaning fluid, protect all electrical components and connectors with lint-free non-flocking material.

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

1. CAUTION: Make sure the correct additive is used in this step. Failure to carry out this instruction may cause damage to the vehicle.
   - Open the fuel filler door and remove the cap.
   - Empty the fuel additive into the fuel filler pipe.
   - Install the fuel filler cap and close the fuel filler door.
2. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Release the breather from the air intake elbow.



E138648

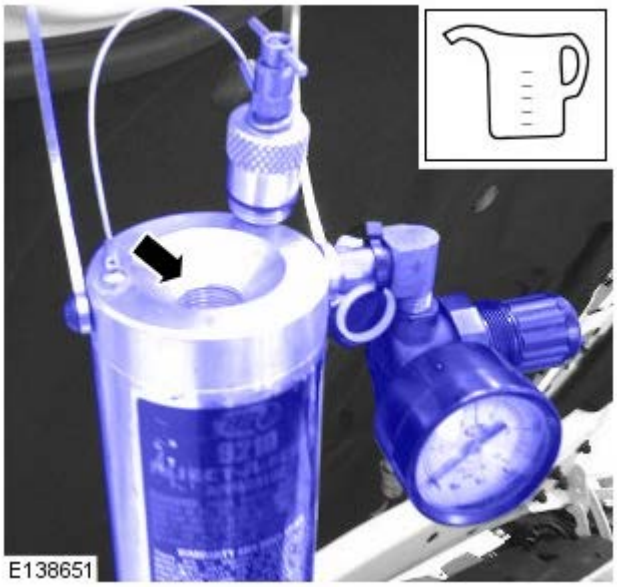


E138649

4. CAUTION: Make sure the correct additive is used in this step. Failure to carry out this instruction may cause damage to the vehicle.

   Install the cleaning equipment to a suitable location under the hood.

5.
   - Remove the cleaning equipment filler cap.
   - Empty the induction system cleaning fluid into the cleaning equipment.
   - Install the filler cap.


E138651

6. Position the intake system cleaning tool into intake elbow and secure with the clamp.


E138650

7.
- Connect a suitable compressed air line to the cleaning equipment.
- Set the pressure to 4 bar.



E138652

8. Start and run the engine.

9.
- Open the ball valve on the cleaning equipment and allow the cleaning fluid to spray into the intake elbow.

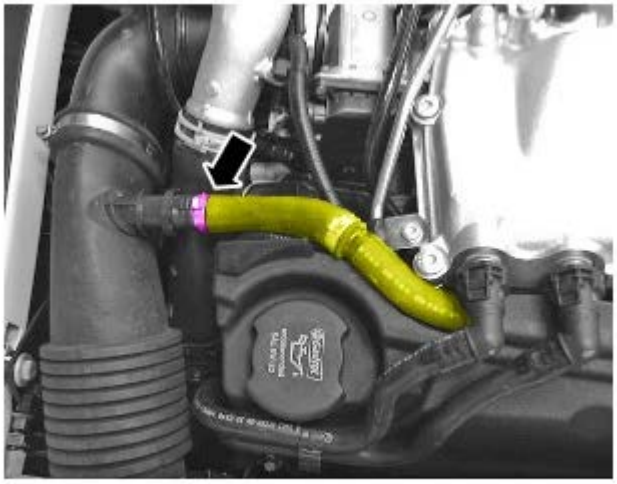


E138653

Raise the engine speed to 1200 rpm and hold until the cleaning fluid spray has stopped.

10.
- Close the ball valve.
- Release the air pressure in the cleaning equipment.
- Disconnect the air line.

11. Connect the breather to the air intake elbow.


E138648

12. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

13.
- 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 70ºC is achieved.
- Allow the engine to idle for 30 seconds.
- Switch off the engine.

14. Connect the approved diagnostic equipment to the vehicle.

15. Follow on screen prompts and check for DTC's (Diagnostic

Trouble Codes).

16. Clear the DTC's following the on screen procedure.
17. Disconnect the approved diagnostic equipment from the vehicle.

Published: 11-May-2011

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Injectors

Removal and Installation

Removal

1. Refer to: Fuel Rail LH (303-04, Removal and Installation).

Installation

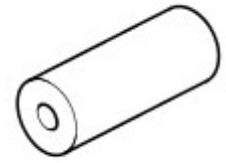
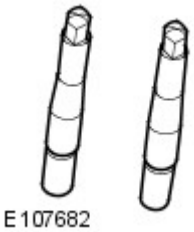
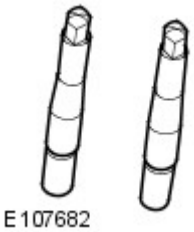
1. Refer to: Fuel Rail LH (303-04, Removal and Installation).

Published: 07-Jun-2012

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Rail LH

Removal and Installation

Special Tool(s)

 E115268	303-1450 Spark Plug Remover/Installer
 E114526	310-197 Remover, Fuel Injector
 E107680	310-198 Installer, Teflon Seal
 E107681	310-199 Re-shape Tool, Teflon Seal
 E107682	310-200-01 Fuel Rail Installation Guide Pins - Threaded
 E107682	310-200-02 Fuel Rail Installation Guide Pins - Unthreaded

Removal

CAUTIONS:

Make sure that tools and equipment are clean and free of foreign material and lubricant.

Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

NOTES:

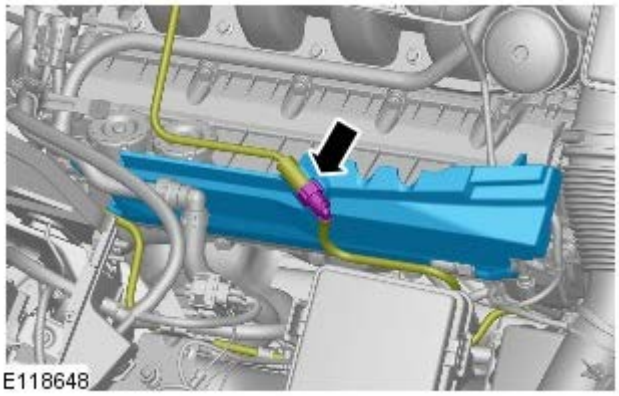
Removal steps in this procedure may contain installation details.

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

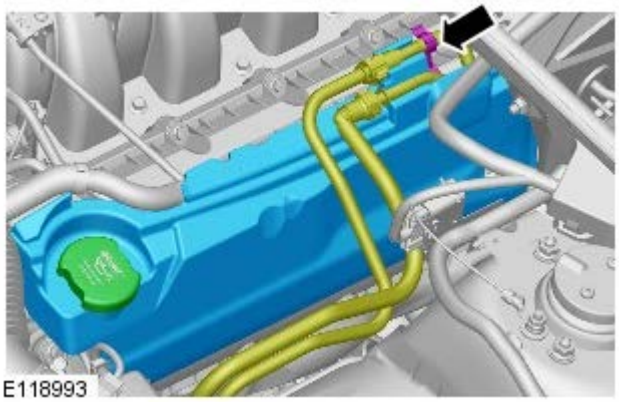
All vehicles

1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Fuel System Pressure Release - V8 5.0L Petrol/V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).
3. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).
4. Disconnect the battery ground cable.

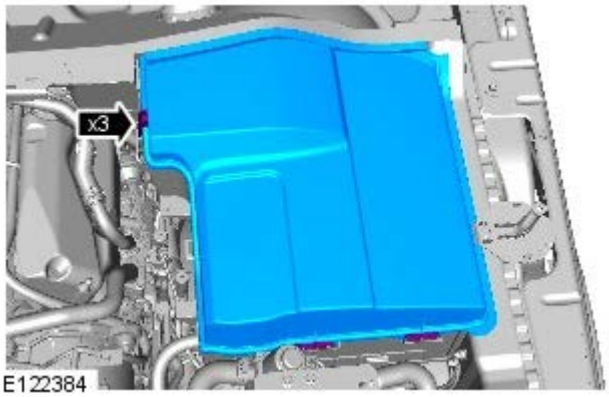
   Refer to: Specifications (414-00 Charging System - General Information, Specifications).
5. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).
6. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).


E118648

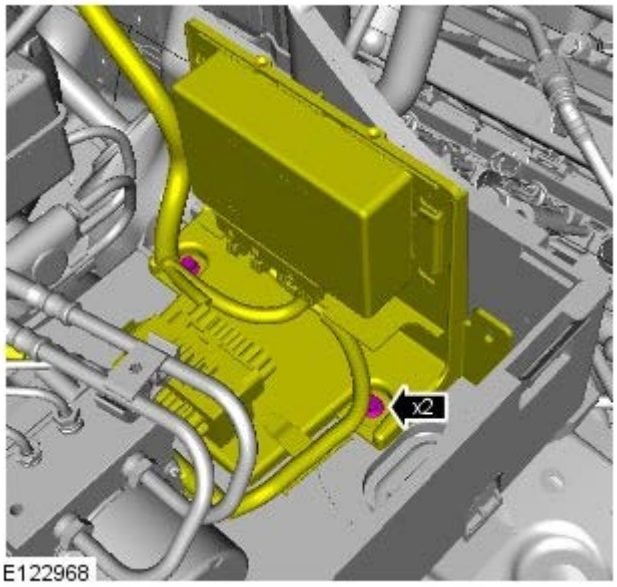
7. CAUTION: Be prepared to collect escaping fluids.


E118993

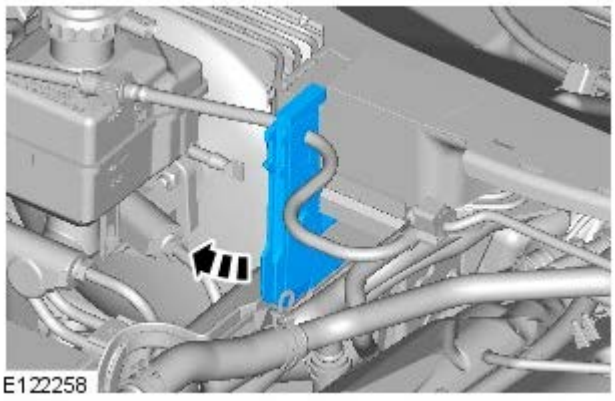
8. CAUTION: Be prepared to collect escaping fluids.
9. Refer to: Evaporative Emission Canister Purge Valve - V8 5.0L Petrol (303-13 Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).



Left-hand drive vehicles



11. NOTE: Right-hand shown, left-hand similar.



12. NOTE: Right-hand shown, left-hand similar.

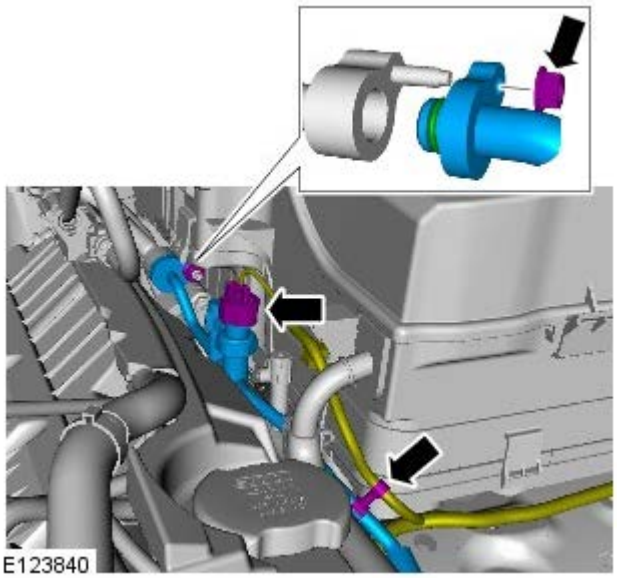
Right-hand drive vehicles

13. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

All vehicles

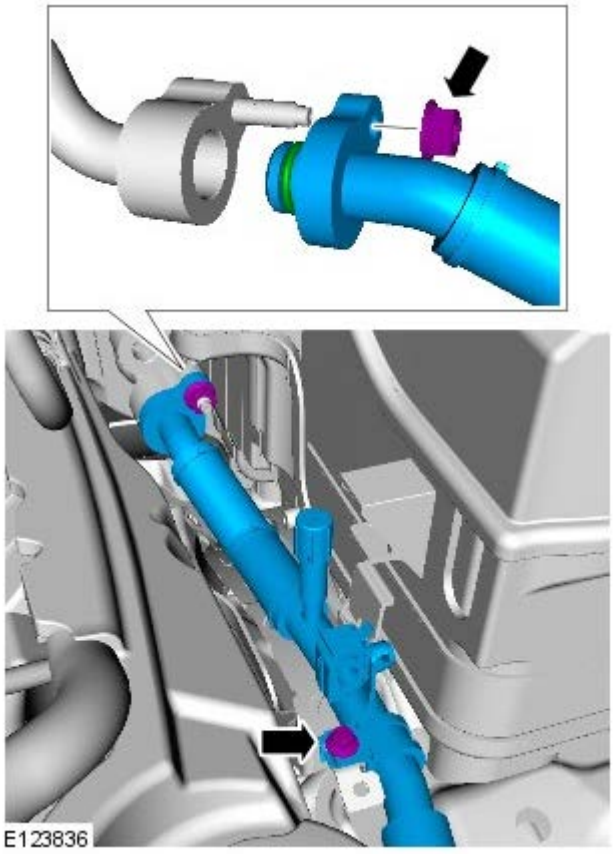
14. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

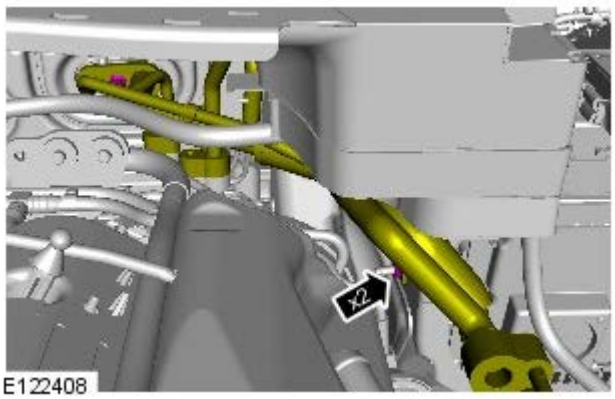
    Discard the O-ring seal.



15. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

    Discard the O-ring seal.

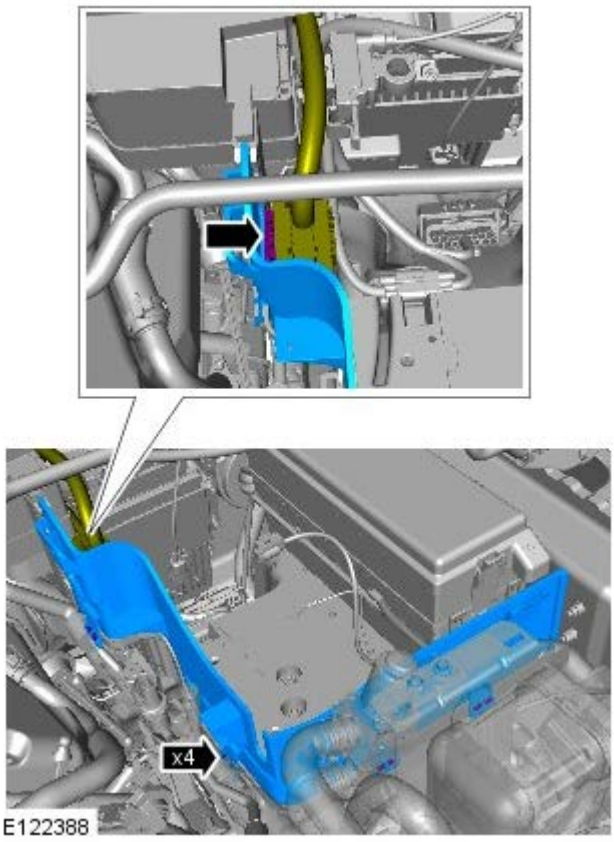




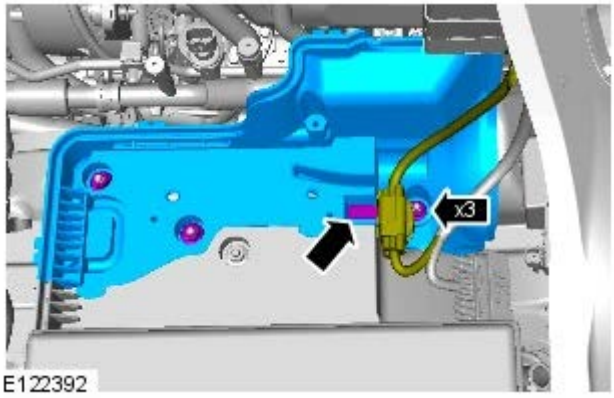
16. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

    Discard the O-ring seal.

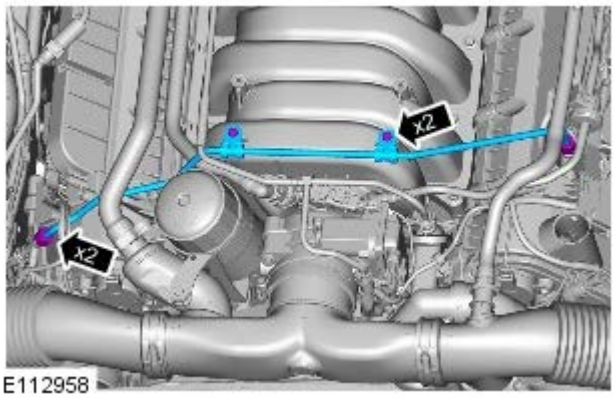
17.



18.



19. Refer to: Fuel Injection Component Cleaning (303-04D Fuel Charging and Controls - V8 S/C 5.0L Petrol, General Procedures).

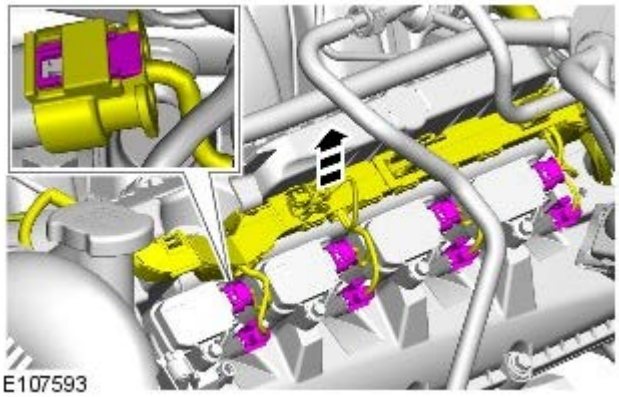


20. CAUTIONS:

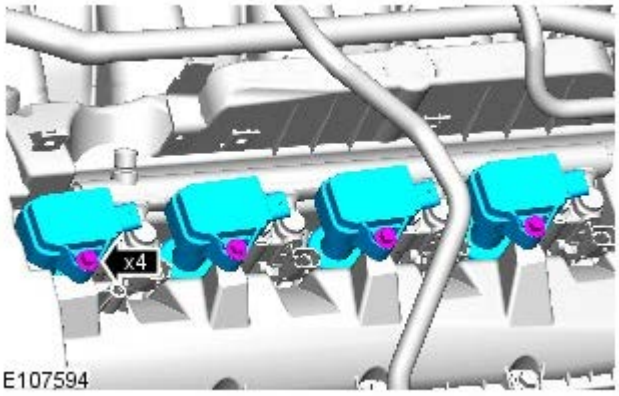
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

21.

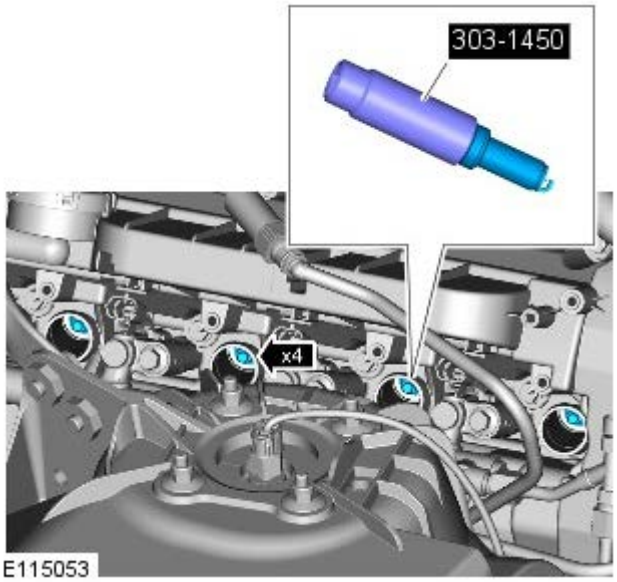


22.

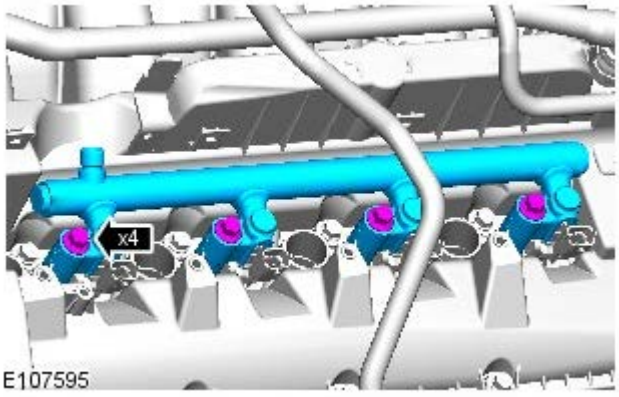


23. NOTE: RH illustration shown, LH is similar.

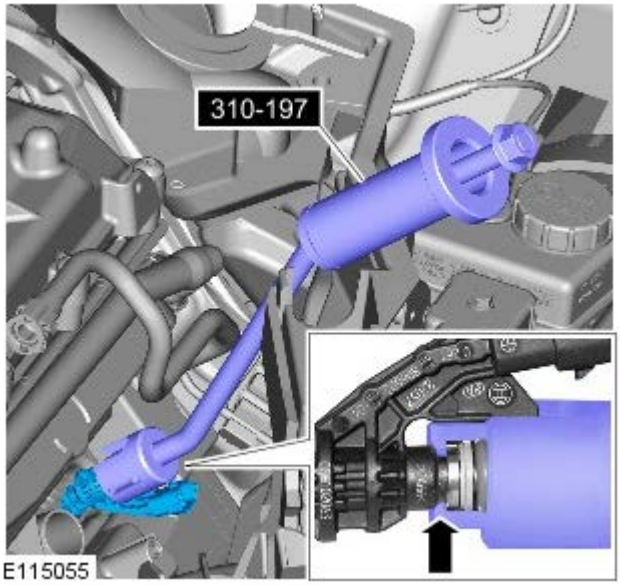
Special Tool(s): 303-1450



24. CAUTION: Make a note of the fuel injector clamp alignment to the fuel rail prior to removal.



25. CAUTIONS:



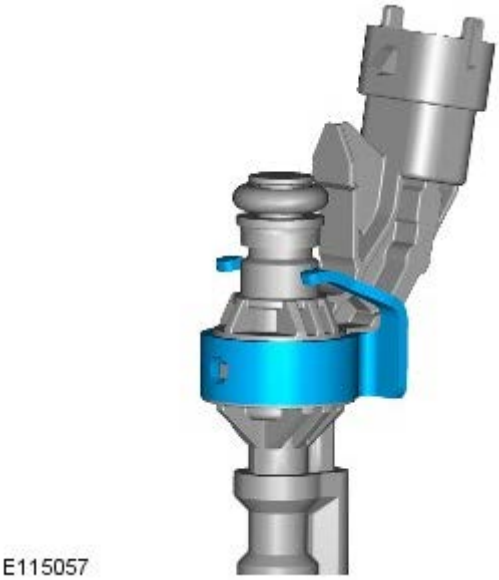
E115055

Make sure that the special tool is located correctly to the fuel injector prior to removing the fuel injector.

Make sure that the special tool is held square to the fuel injector during removal.

Make sure that all open ports are covered to prevent any foreign material ingress.

Special Tool(s): 310-197


E115057

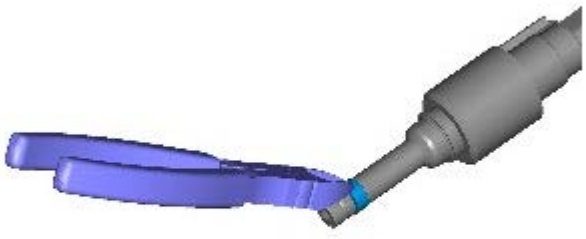
26. CAUTION: If the fuel injector is being removed without a new component being installed, the fuel injector clamp must remain with the fuel injector it is removed with.

27. CAUTIONS:

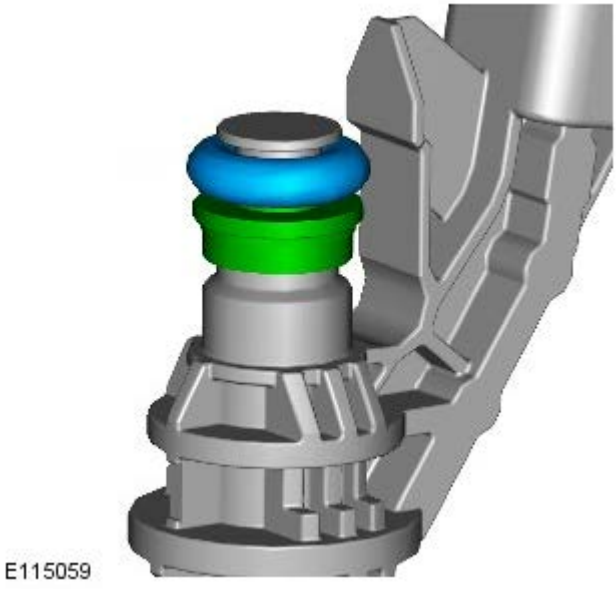
Do not use a knife to remove the Teflon seal as damage could occur to the fuel injector.

Do not cut the Teflon seal to deep as damage could occur to the fuel injector.

Pinch the Teflon seal to allow the tool to cut the Teflon seal without damaging the fuel injector.


E115058

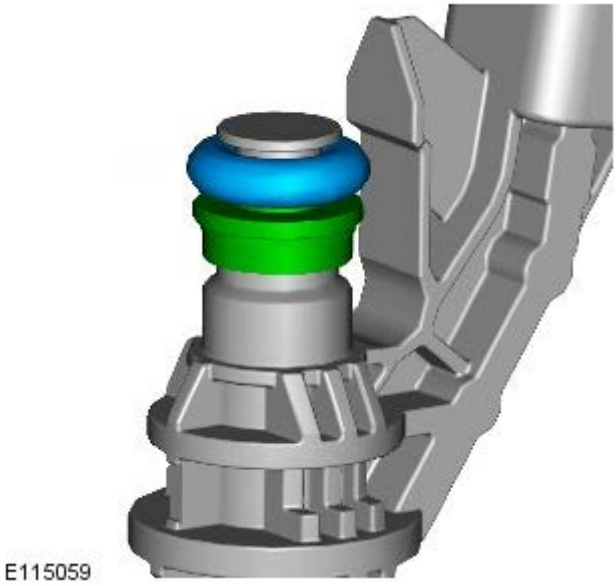
28. CAUTION: Do not use any sharp tools to remove the O-ring seal as damage could occur to the fuel injector.



Installation

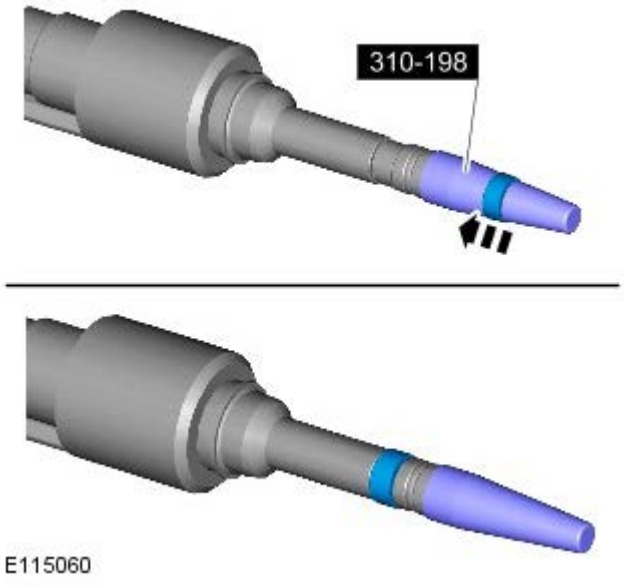
All vehicles

1. Install new O-ring seals.

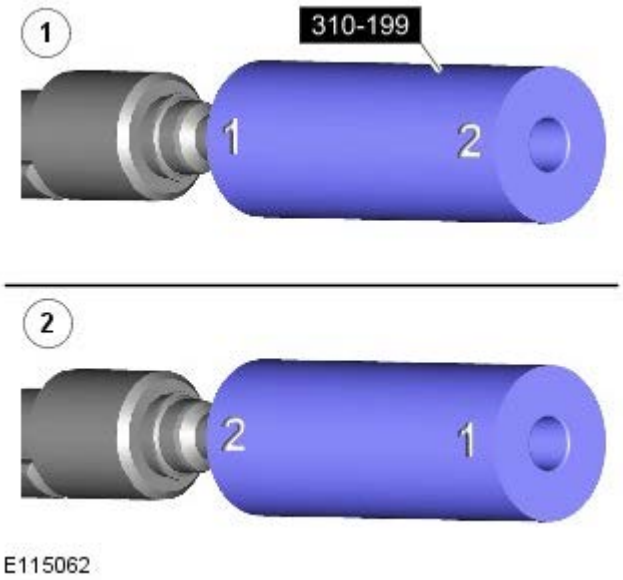


2. Install new Teflon seals.

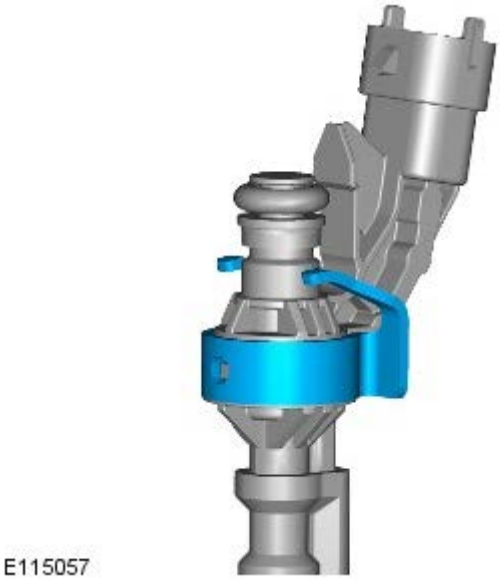
Special Tool(s): 310-198



3. *Special Tool(s):* 310-199

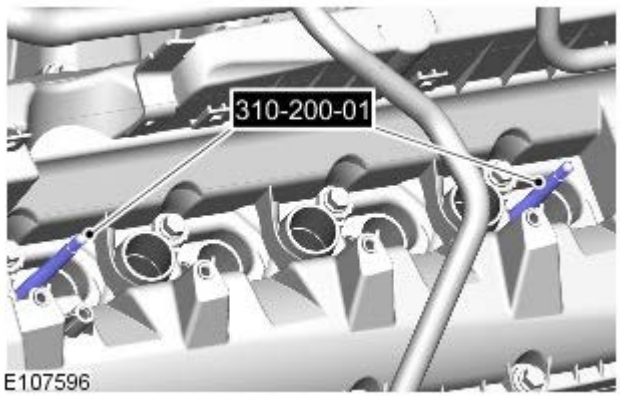


E115062



E115057

4. CAUTION: If the original fuel injector is being installed, the original fuel injector clamp must installed with the fuel injector it was removed with.



E107596

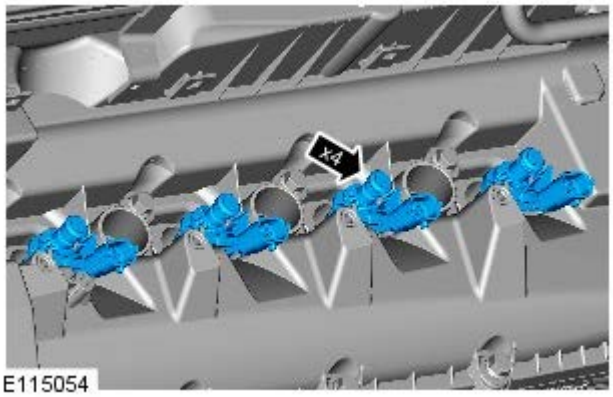
5. CAUTION: If a new cylinder head has been installed then the special tool 310-200-02 without the thread must be used to install the fuel rail.

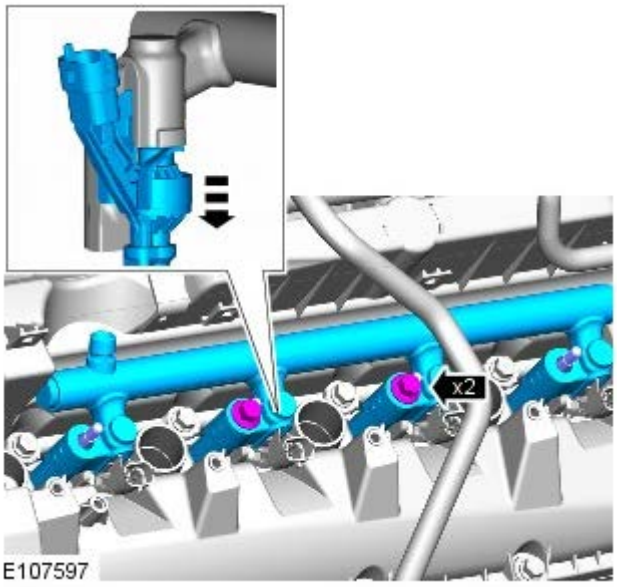
Special Tool(s): 310-200-01, 310-200-02

6. CAUTIONS:

Make sure that the area around the open fuel injector ports are clean and free of foreign material and lubricant prior to installing the fuel injector.

When installing the fuel injector(s), make sure that the Teflon seal is clean and free of foreign material and lubricant.





7. CAUTIONS:

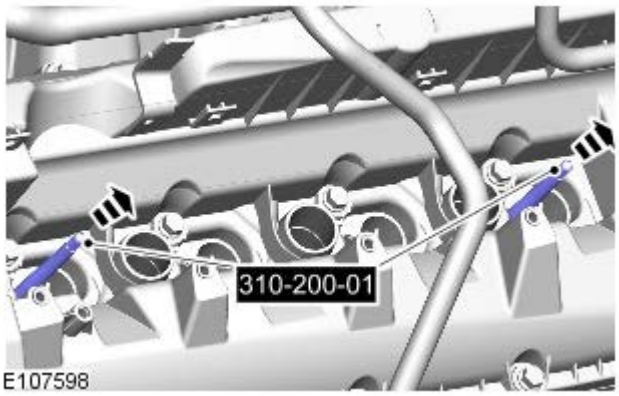
   If new fuel injectors are installed, a new injector clamp must be installed.

   Make sure that the fuel injector is aligned and installed into the fuel rail correctly, as noted in the removal step.

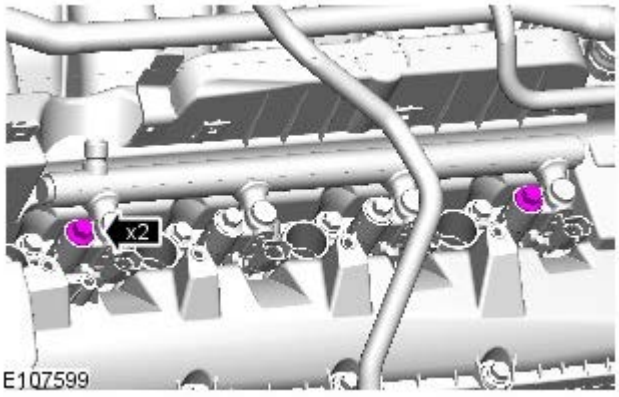
   Tighten the fuel rail retaining bolts a turn at a time until the correct torque is achieved.

   NOTE: Lubricate the fuel injector O-ring seals with clean engine oil.

   Torque: 20 Nm

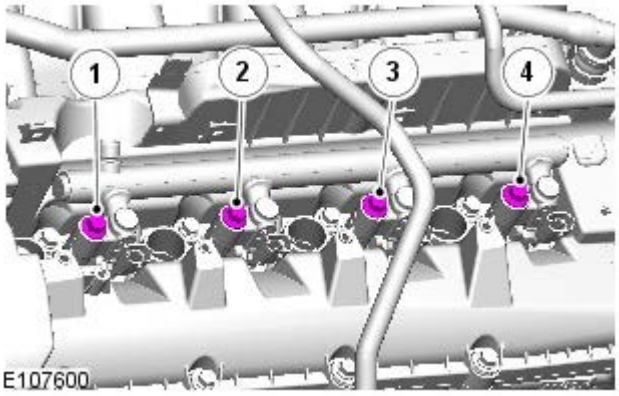


8. *Special Tool(s):* 310-200-01, 310-200-02

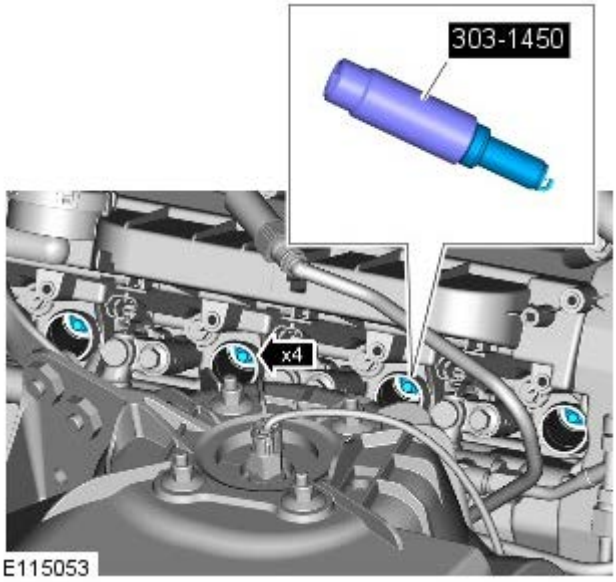


9. *Torque:* 20 Nm

10. NOTE: Tighten the bolts in the indicated sequence.

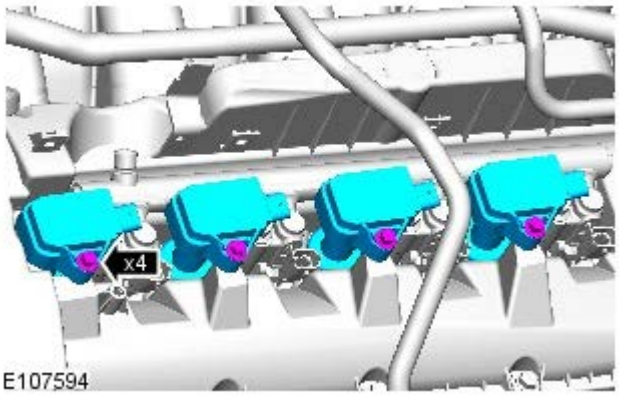


- *Torque:*
  Bolt 2 30 Nm
  Bolt 3 30 Nm
  Bolt 1 30 Nm
  Bolt 4 30 Nm

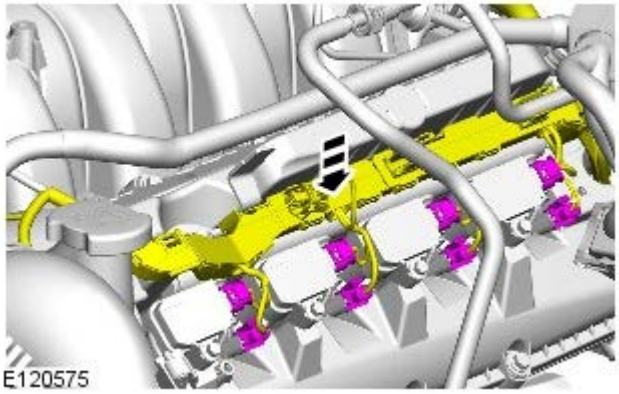


11. NOTE: RH illustration shown, LH is similar.

    Special Tool(s): 303-1450
    Torque: 20 Nm

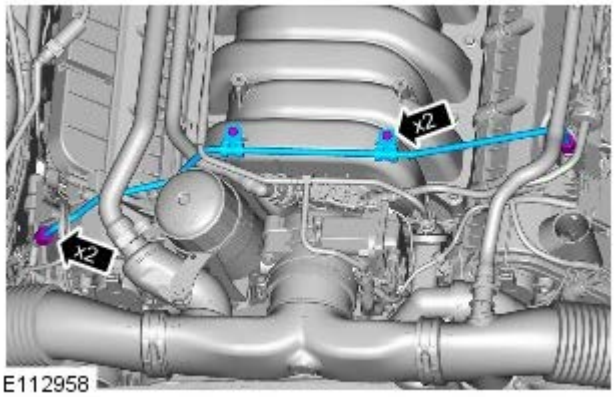


12. *Torque:* 7 Nm



13.

14. CAUTION: Lubricate only the union threads with clean engine oil.



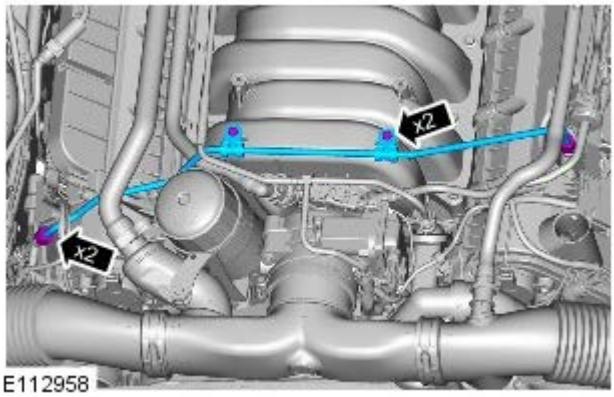
E112958

NOTES:

Do not tighten at this stage.

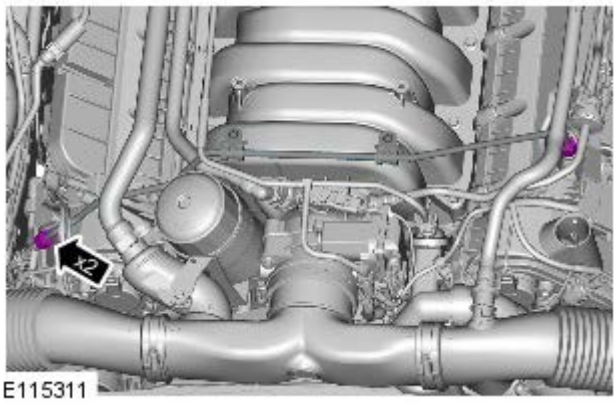
Remove and discard the blanking caps.

15. *Torque:*
    Unions 21 Nm
    Bolts 8 Nm



E112958

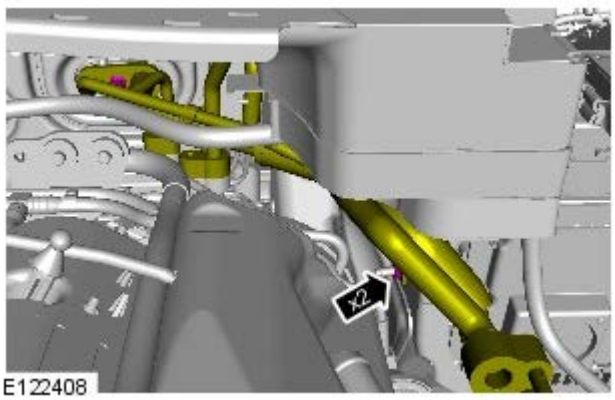
16. *Torque:* 21 Nm



E115311

17. Install new O-ring seals.

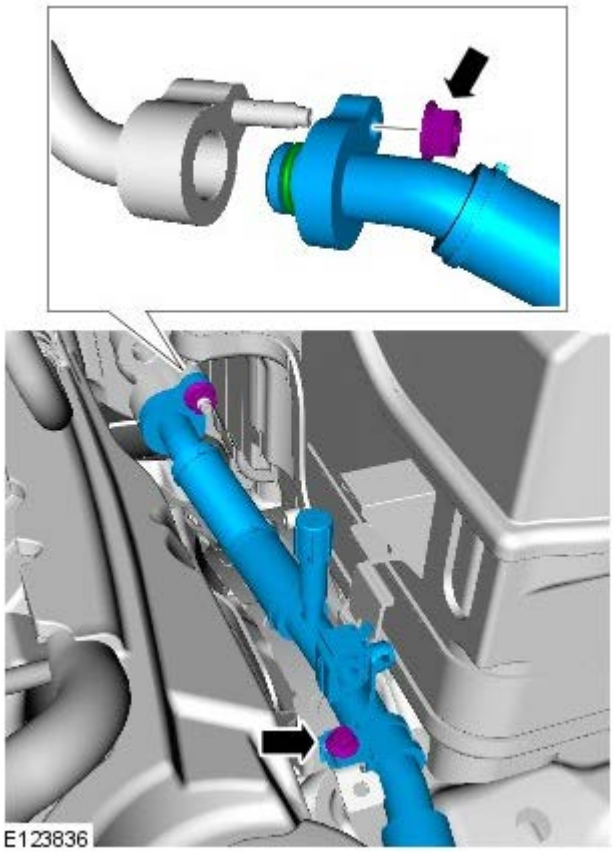
    Torque: 12 Nm



E122408

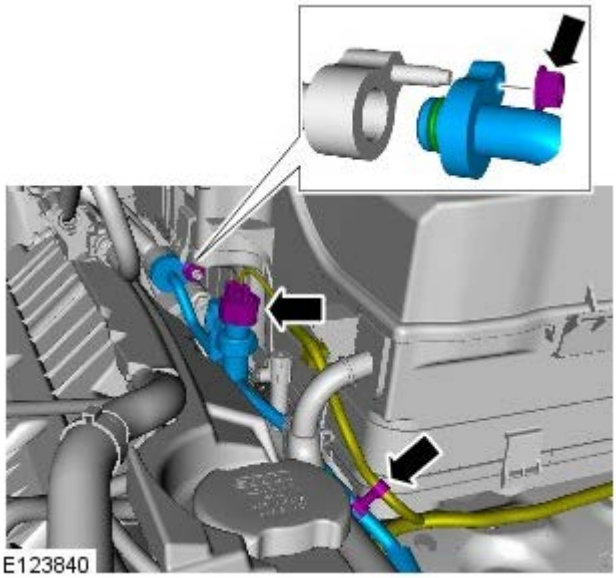
18. Install new O-ring seals.

    Torque: 12 Nm

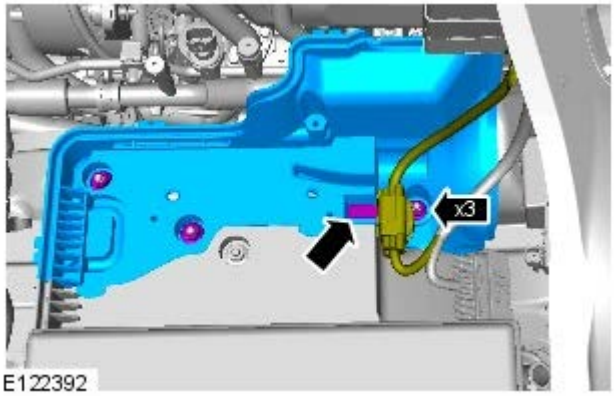


19. Install new O-ring seals.

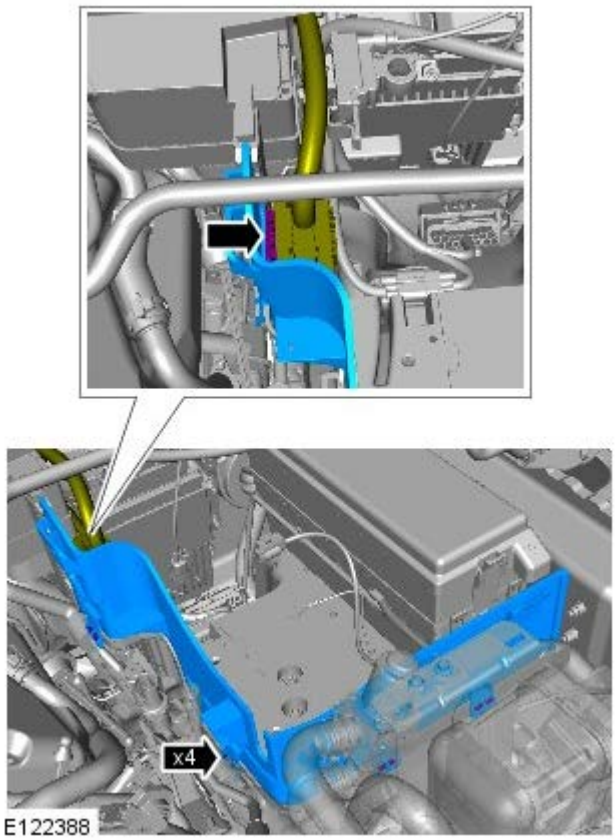
    Torque: 12 Nm



20. *Torque:* 12 Nm



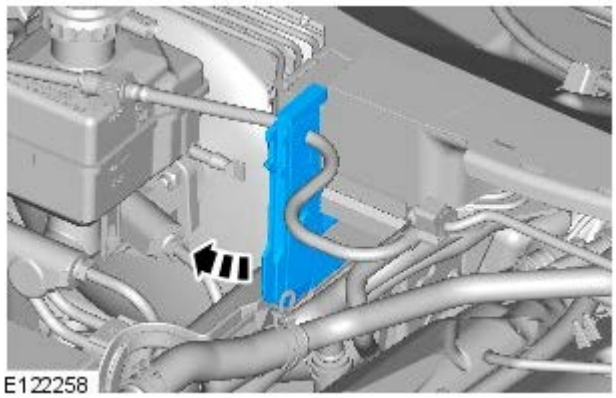
21.



Right-hand drive vehicles

22. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

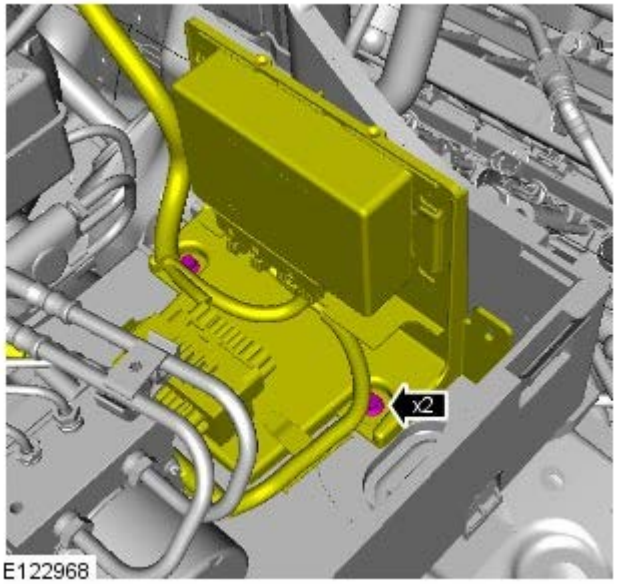
Left-hand drive vehicles



23. NOTE: Right-hand shown, left-hand similar.

24. NOTE: Right-hand shown, left-hand similar.

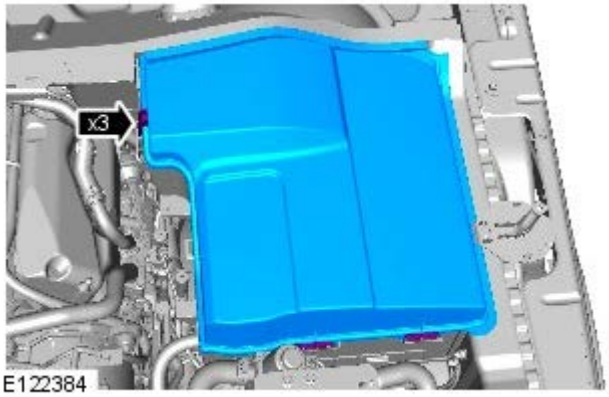
Torque: 10 Nm



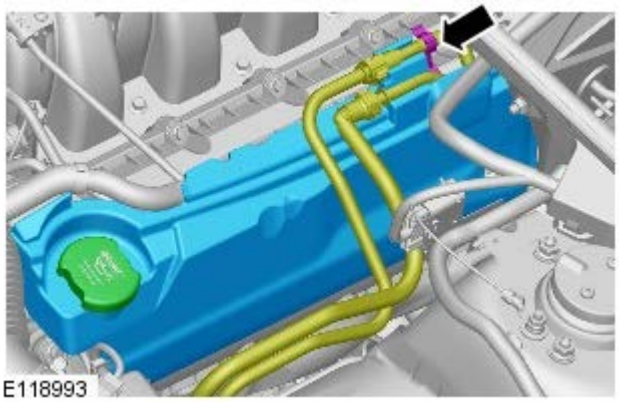
All vehicles

25. Refer to: Evaporative Emission Canister Purge Valve - V8 5.0L Petrol (303-13 Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

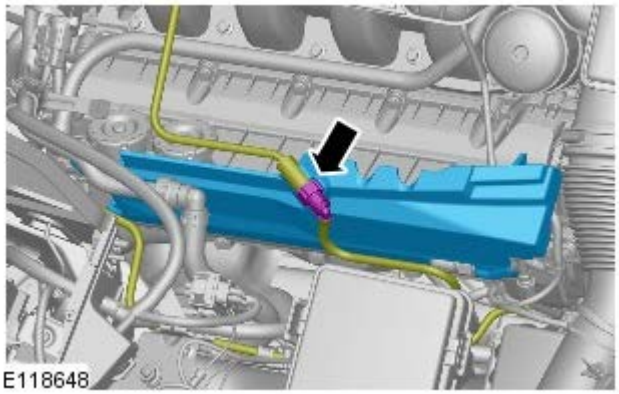
26.



27.



28. CAUTION: Be prepared to collect escaping fluids.



29. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

30. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

31. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

32. Connect the battery ground cable.

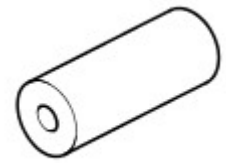
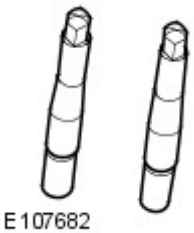
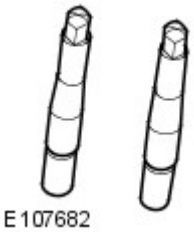
    Refer to: Specifications (414-00 Charging System - General Information, Specifications).

Published: 19-Nov-2013

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Rail RH

Removal and Installation

Special Tool(s)

 E114526	310-197 Remover, Fuel Injector
 E107680	310-198 Installer, Teflon Seal
 E107681	310-199 Re-shape Tool, Teflon Seal
 E107682	310-200-01 Fuel Rail Installation Guide Pins - Threaded
 E107682	310-200-02 Fuel Rail Installation Guide Pins - Unthreaded

Removal

CAUTIONS:

Make sure that tools and equipment are clean and free of foreign material and lubricant.

Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

NOTES:

Removal steps in this procedure may contain installation details.

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

All vehicles

1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and

Safety Precautions (100-00 General Information, Description and Operation).

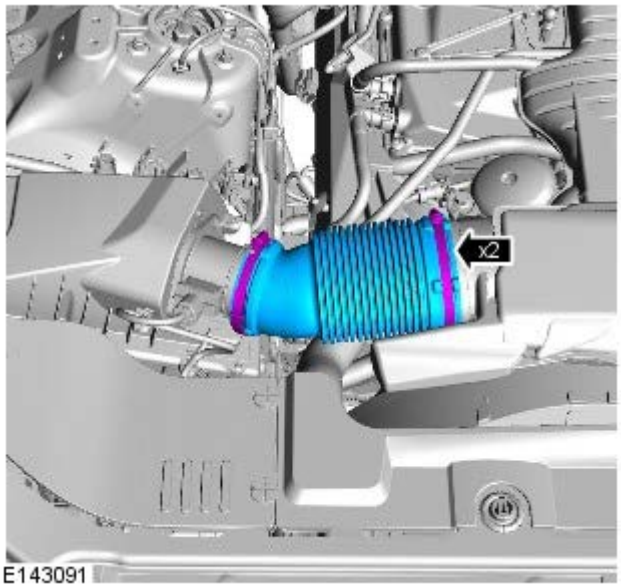
2. Refer to: Fuel System Pressure Release - V8 5.0L Petrol/V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

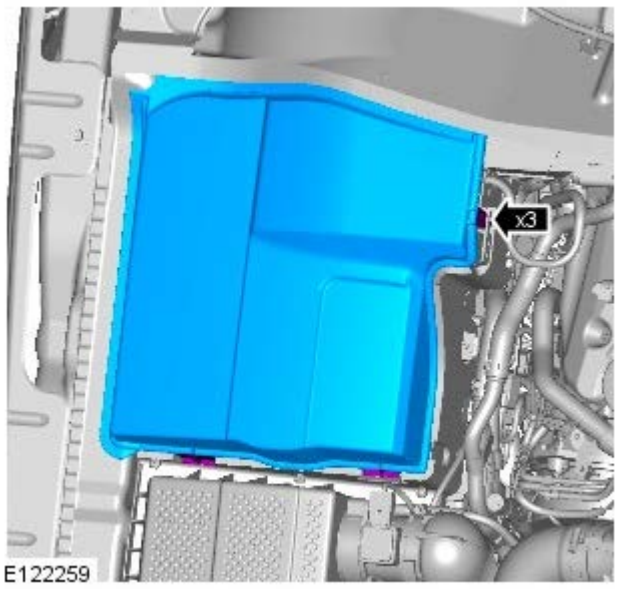
4. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

5.

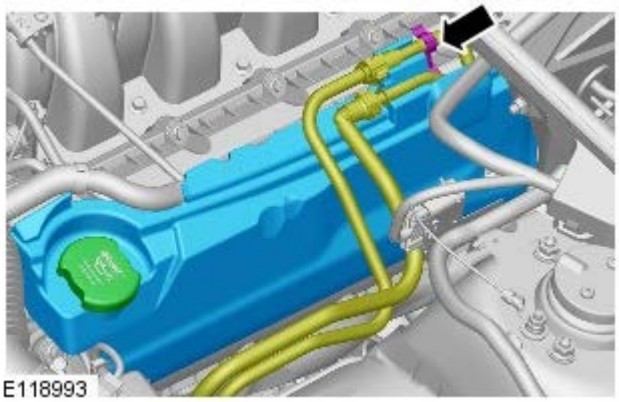


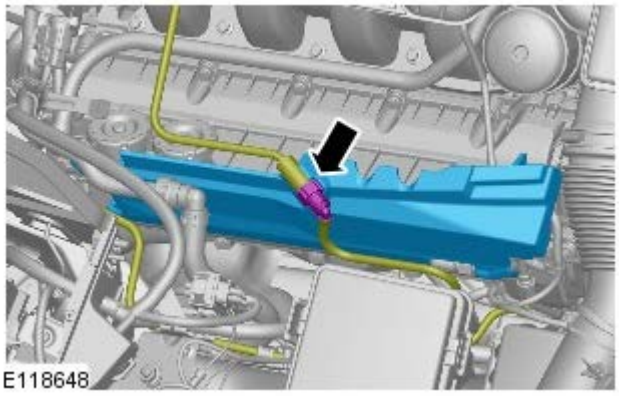
6. Refer to: Air Cleaner RH (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

7.



8. CAUTION: Be prepared to collect escaping fluids.





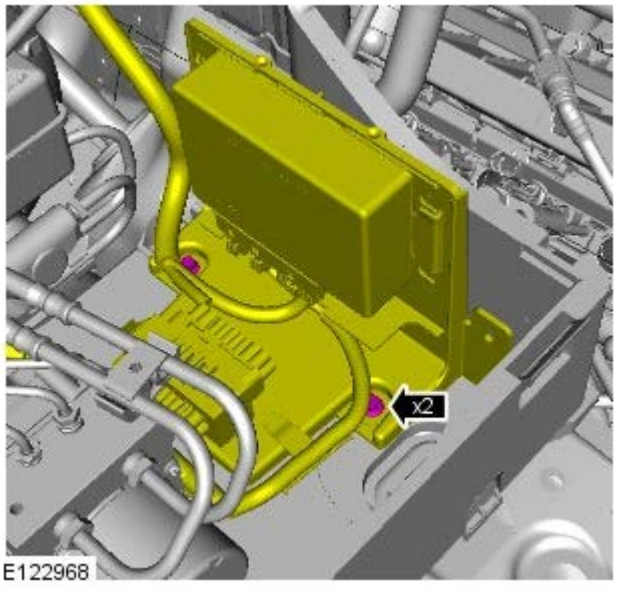
9. CAUTION: Be prepared to collect escaping fluids.

Left-hand drive vehicles

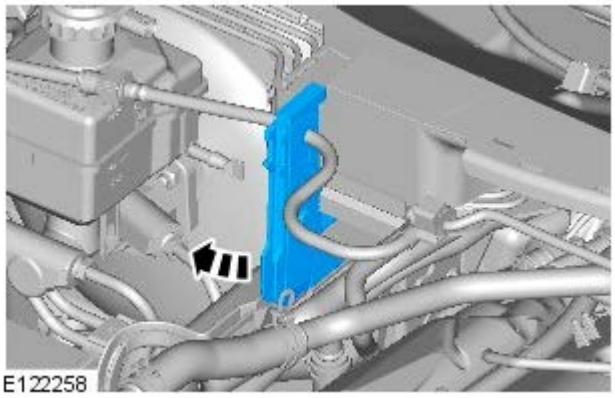
10. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

Right-hand drive vehicles

11.

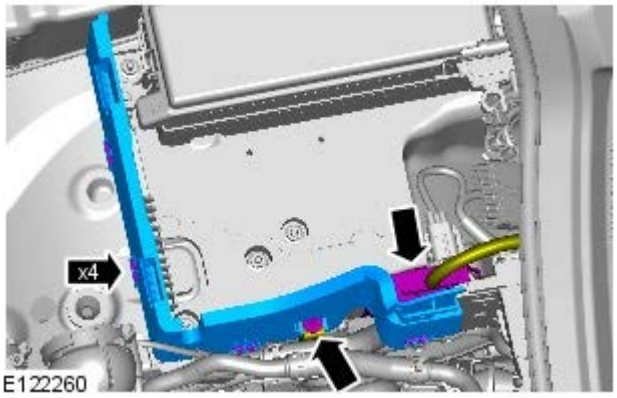


12.

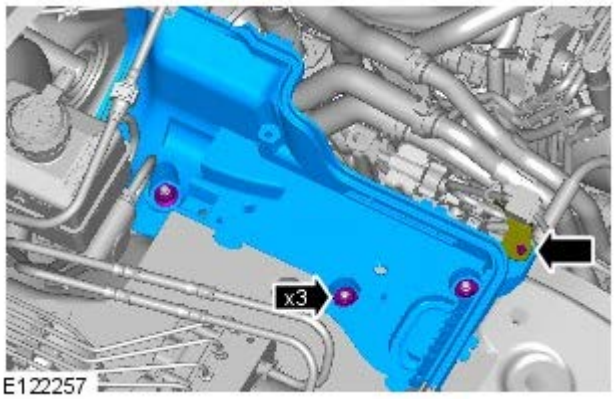


All vehicles

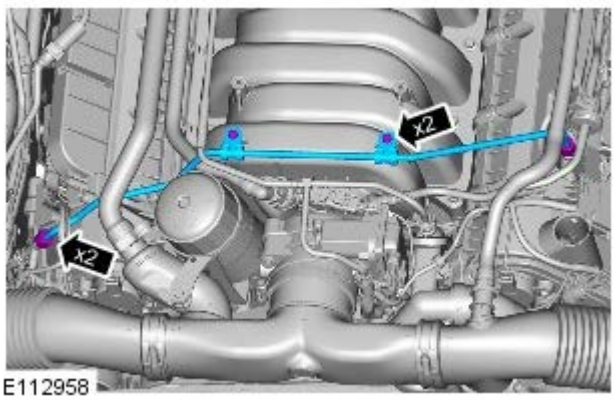
13.



14.



15. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V8 5.0L Petrol, General Procedures).

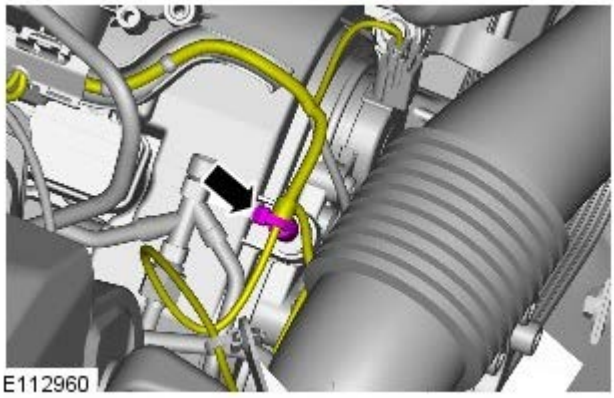


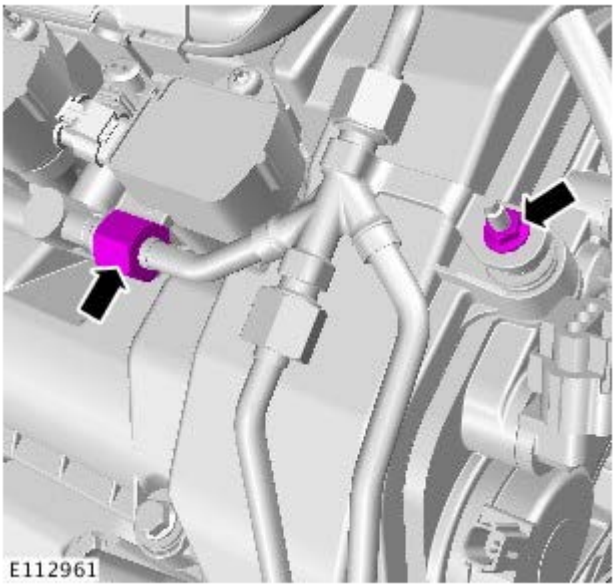
16. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

17.



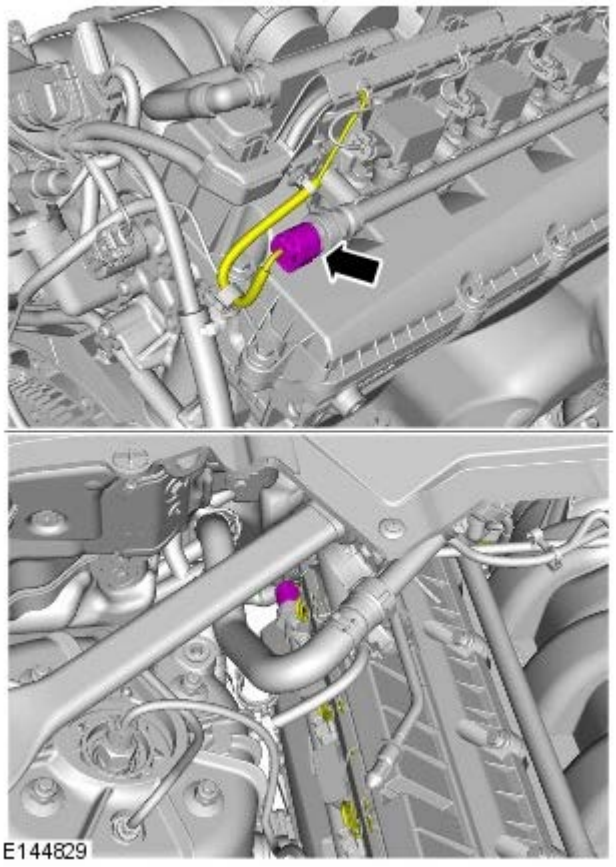


18. CAUTIONS:

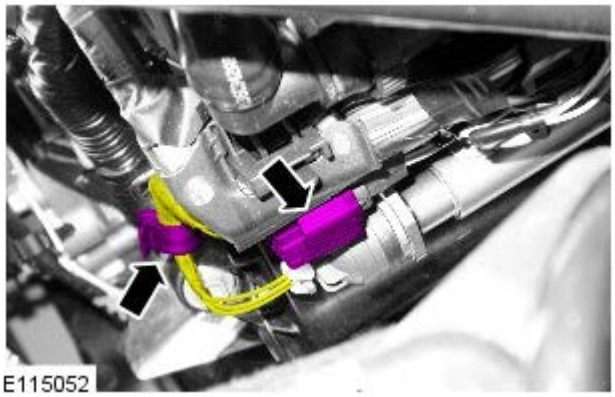
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

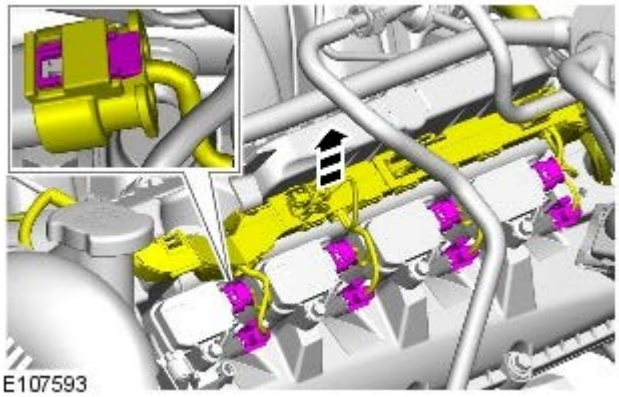
19.



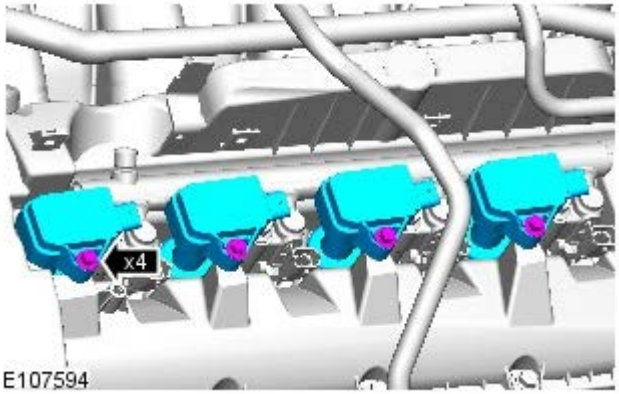
20. NOTE: If equipped.



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

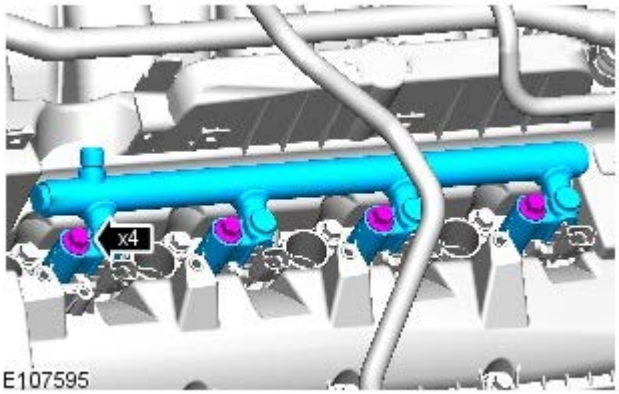


22. NOTE: LH illustration shown, RH is similar.



23. CAUTION: Make a note of the fuel injector clamp alignment to the fuel rail prior to removal.

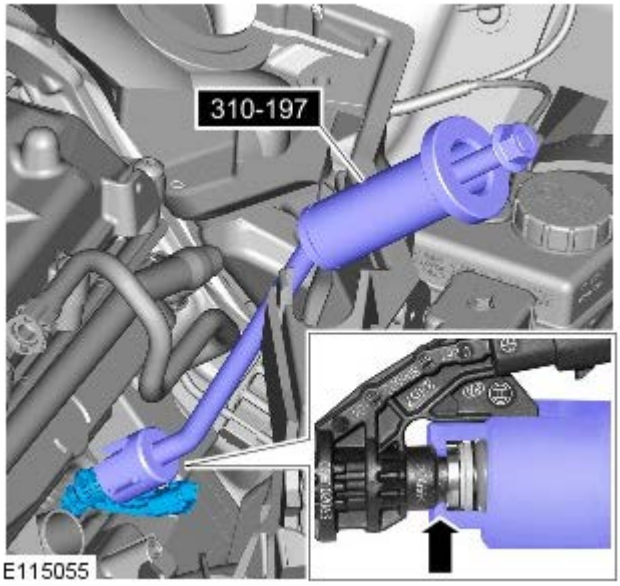
NOTE: LH illustration shown, RH is similar.



24. NOTE: This step is only required if a new fuel rail is installed.

Refer to: Fuel Rail Pressure (FRP) Sensor (303-14B Electronic Engine Controls - V8 5.0L Petrol, Removal and Installation).

25. CAUTIONS:



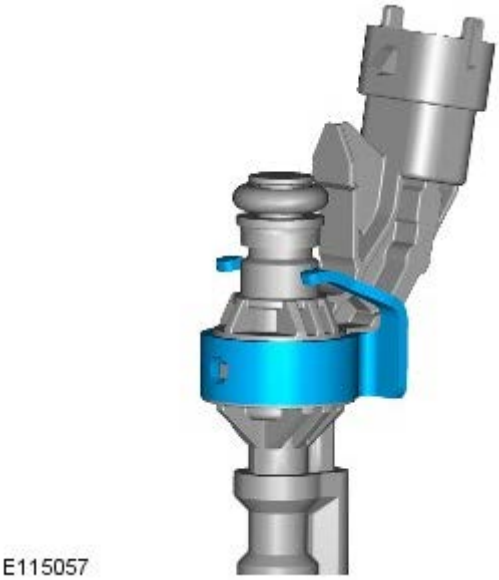
E115055

Make sure that the special tool is located correctly to the fuel injector prior to removing the fuel injector.

Make sure that the special tool is held square to the fuel injector during removal.

Make sure that all open ports are covered to prevent any foreign material ingress.

Special Tool(s): 310-197


E115057

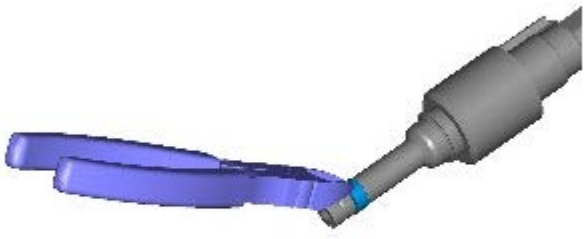
26. CAUTION: If the fuel injector is being removed without a new component being installed, the fuel injector clamp must remain with the fuel injector it is removed with.

27. CAUTIONS:

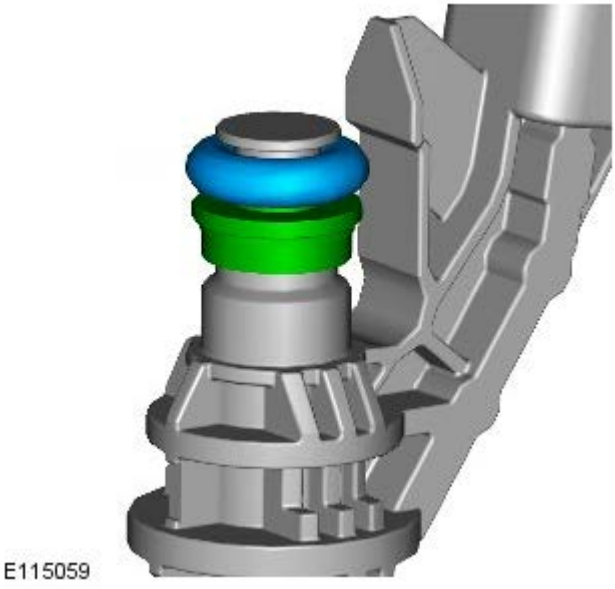
Do not use a knife to remove the Teflon seal as damage could occur to the fuel injector.

Do not cut the Teflon seal to deep as damage could occur to the fuel injector.

Pinch the Teflon seal to allow the tool to cut the Teflon seal without damaging the fuel injector.


E115058

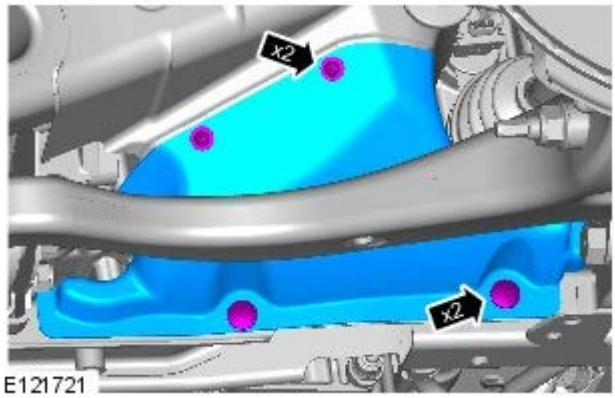
28. CAUTION: Do not use any sharp tools to remove the O-ring seal as damage could occur to the fuel injector.


E115059

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

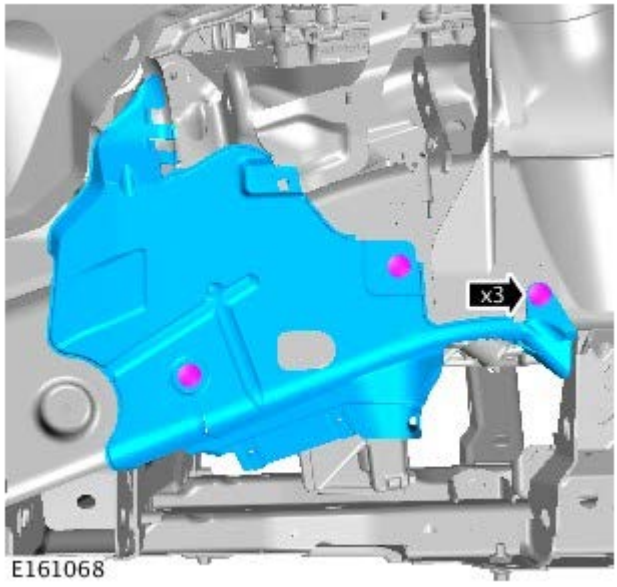
Raise and support the vehicle.

30.



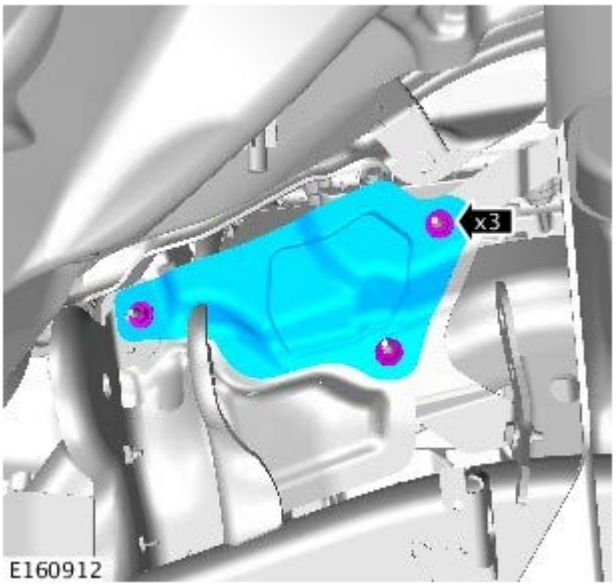
E121721

31.

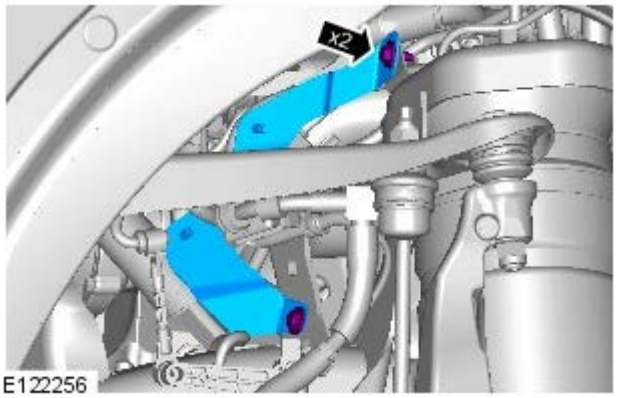


E161068

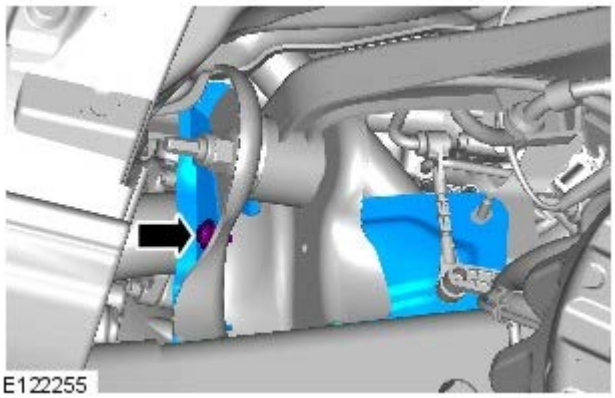
32.



33.

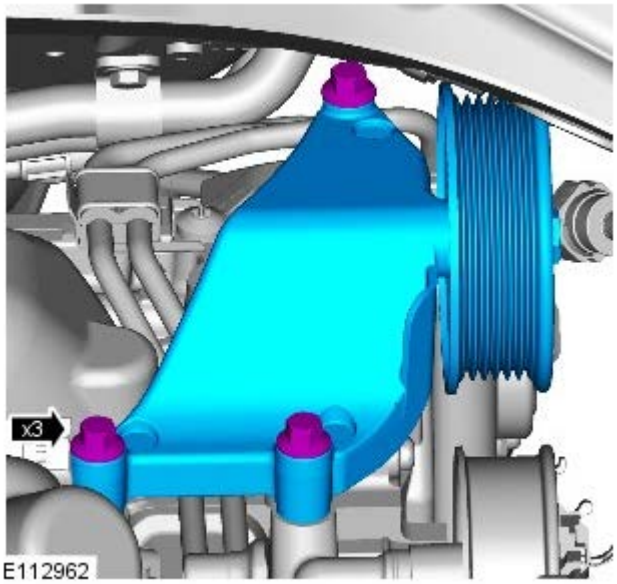


34.

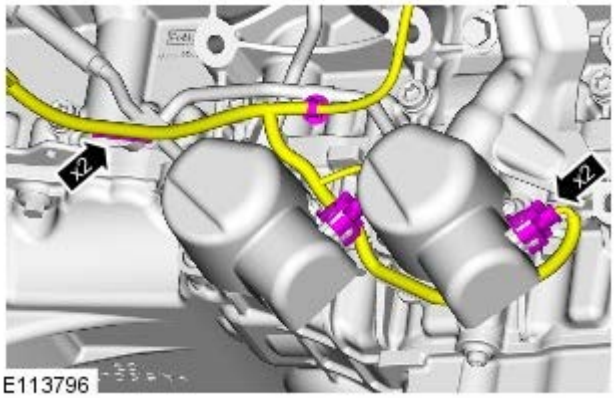


35. Refer to: Generator (414-02B Generator and Regulator - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

36.

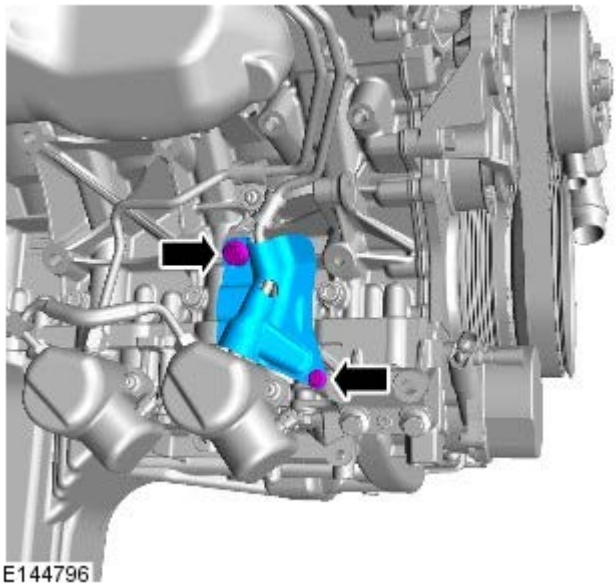


37. Refer to: Steering Gear - V8 5.0L Petrol/V8 S/C 5.0L Petrol (211-02 Power Steering, Removal and Installation).

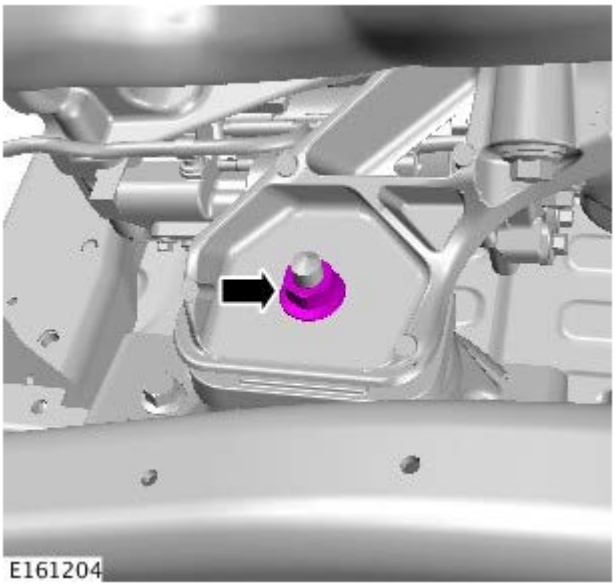


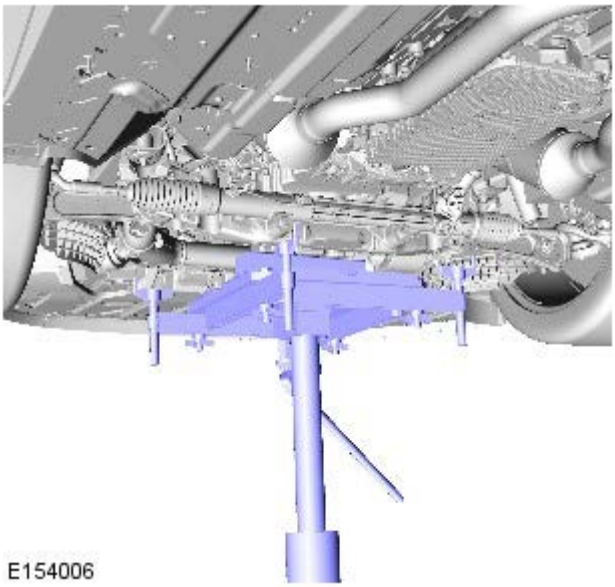
38. NOTE: Engine shown removed for clarity.

39.



40.

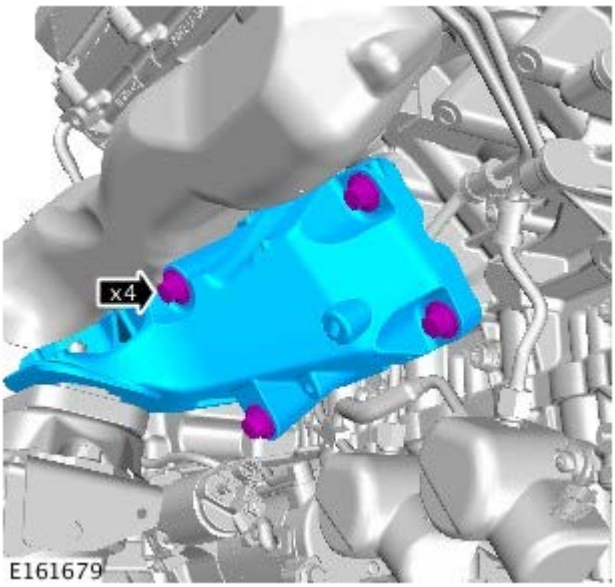




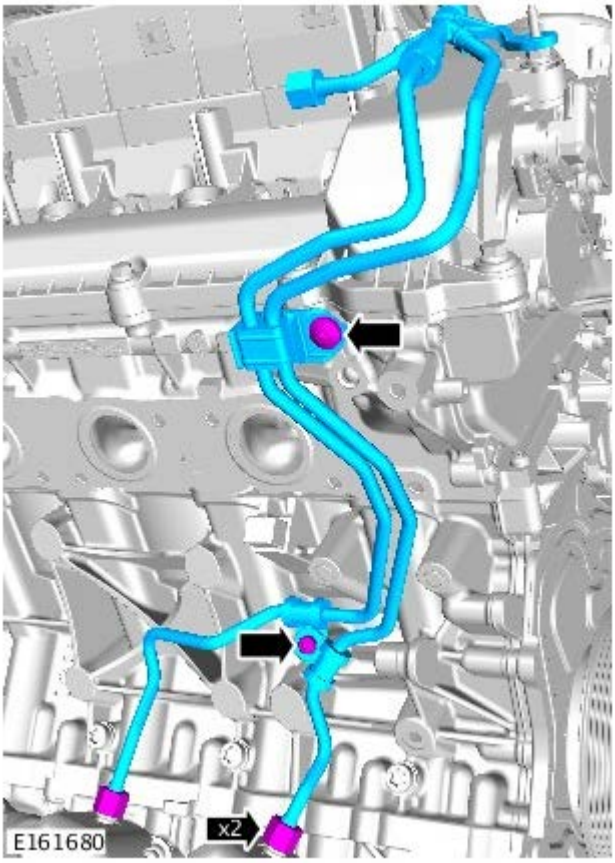
41. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

    Using a suitable hydraulic jack, support the engine.

42.



43. 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.



CAUTIONS:

Remove and discard the high-pressure fuel supply lines.

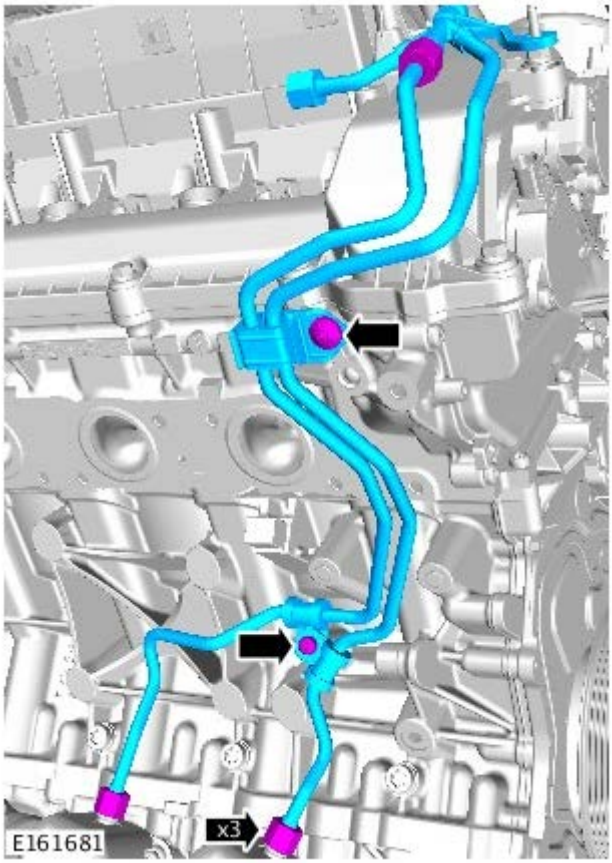
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

NOTE: Engine shown removed for clarity.

Installation

All vehicles



1. CAUTION: Lubricate only the union threads with clean engine oil.

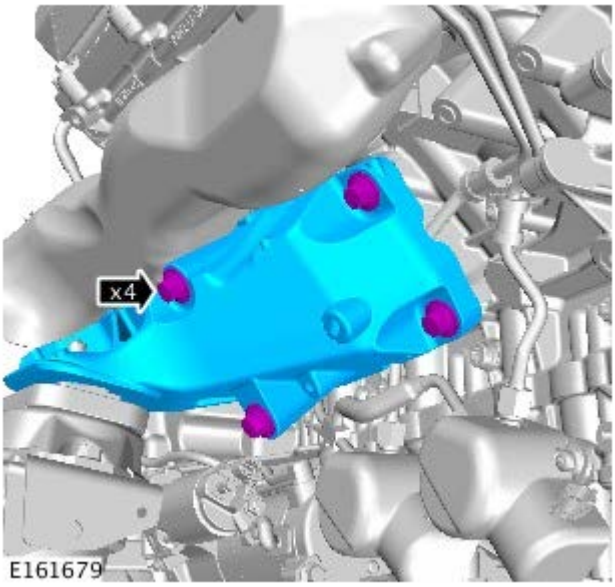
   NOTES:

   Engine shown removed for clarity.

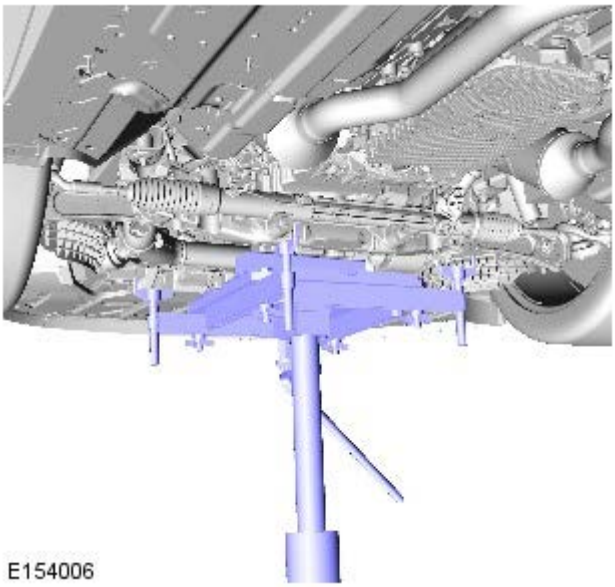
   Install the bolts and unions finger tight before final tightening.

   Remove and discard the blanking caps.

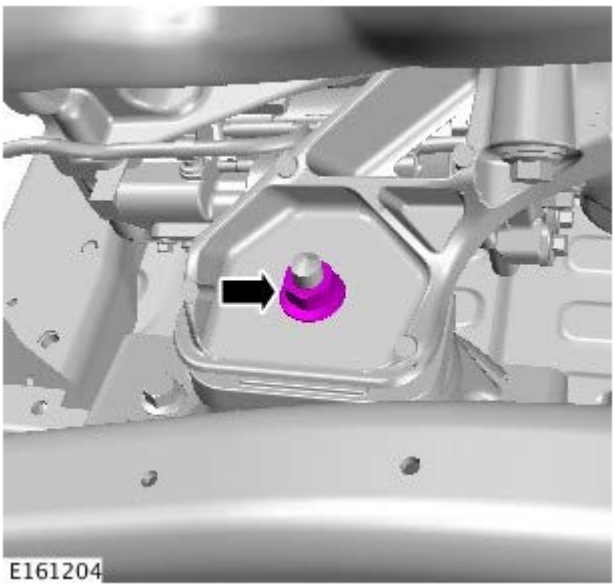
2. *Torque:*
   Stage 1: 45 Nm
   Stage 2: 60°



3. Remove the special tool.

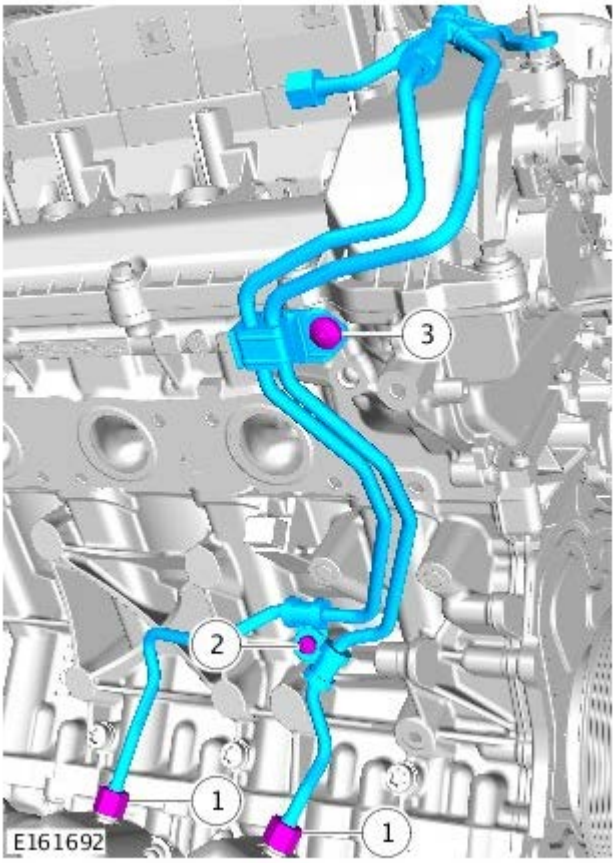


4. *Torque:* 100 Nm



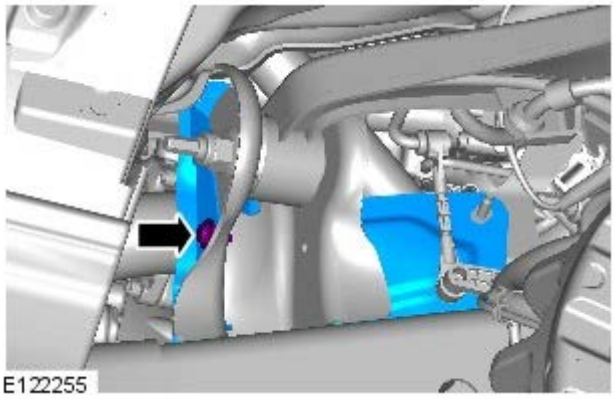
5. NOTE: Some components shown removed for clarity.

Torque:
Unions (1) 21 Nm
M6 (2) 11 Nm

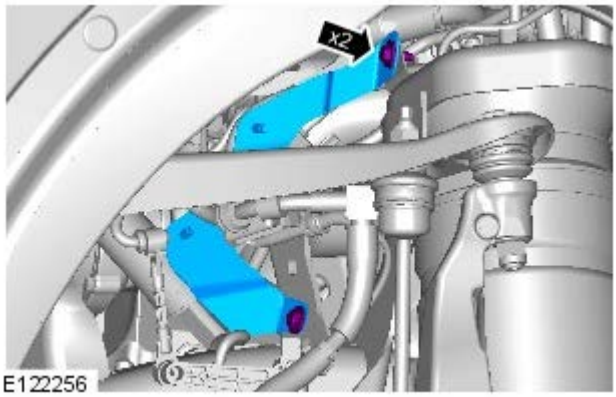


M8 (3) 25 Nm

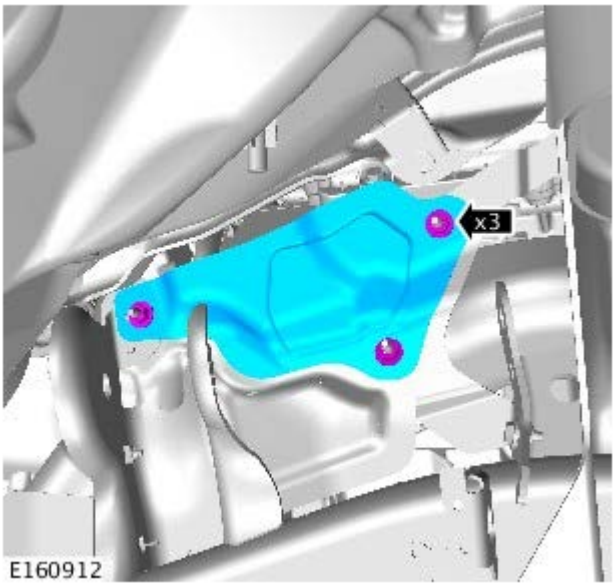
6. *Torque:* 10 Nm



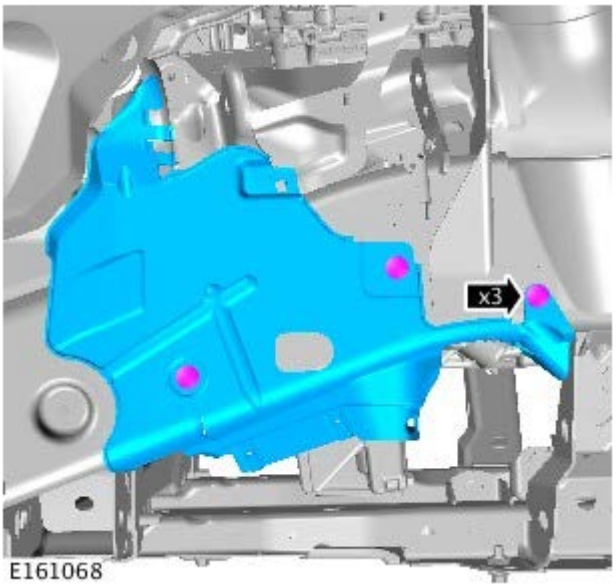
7. *Torque:* 10 Nm



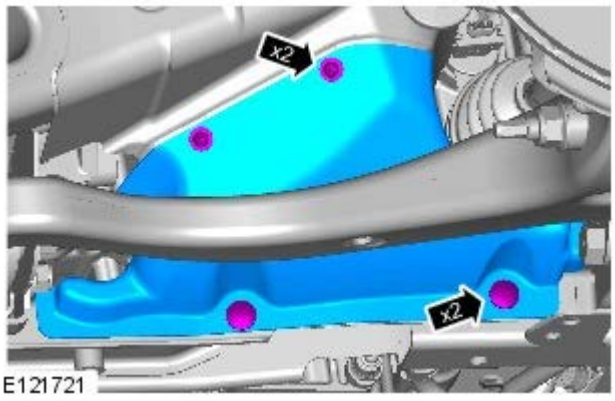
8. *Torque:* 10 Nm



9.

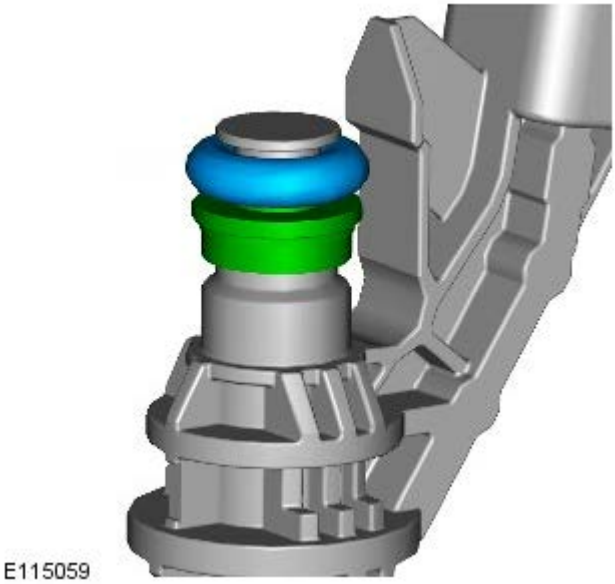


10.



11. Lower the vehicle.

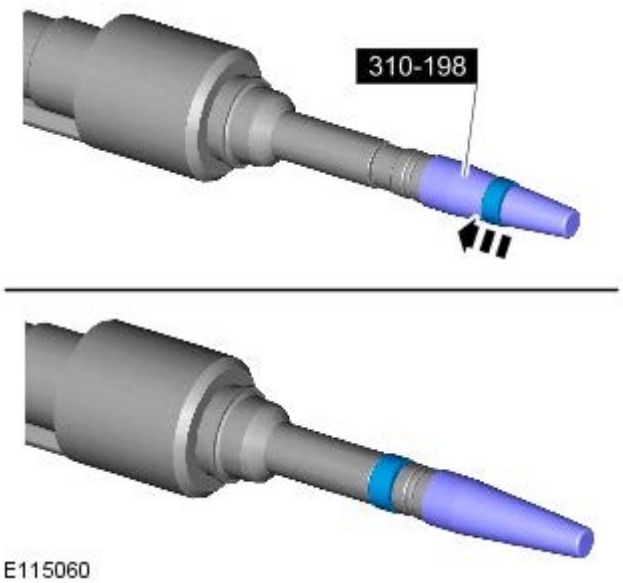
12. Install new O-ring seals.



E115059

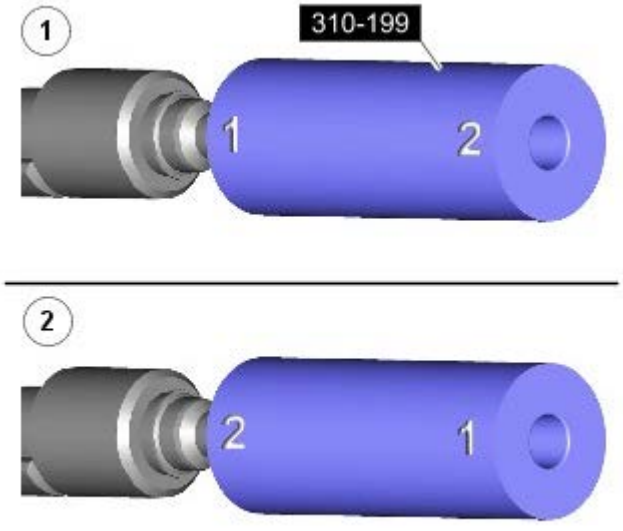
13. Install new Teflon seals.

    Special Tool(s): 310-198



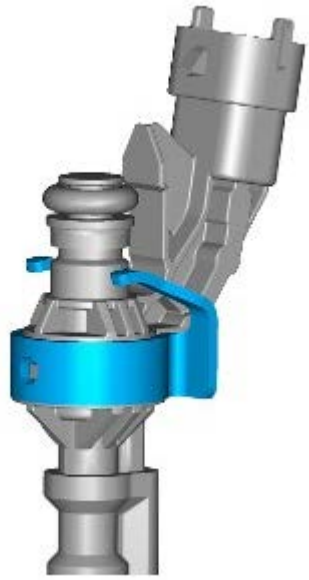
E115060

14. *Special Tool(s):* 310-199

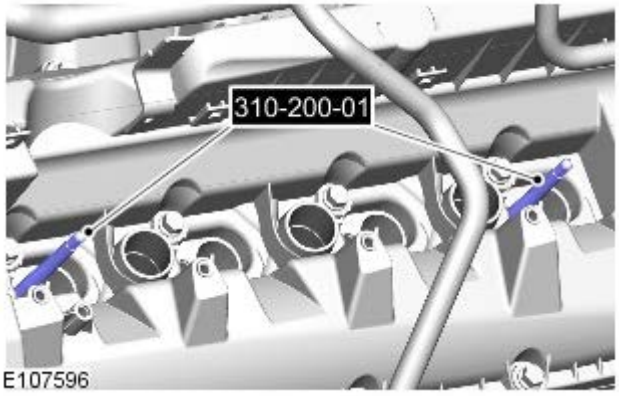


E115062

15. CAUTION: If the original fuel injector is being installed, the original fuel injector clamp must installed with the fuel injector it was removed with.



E115057

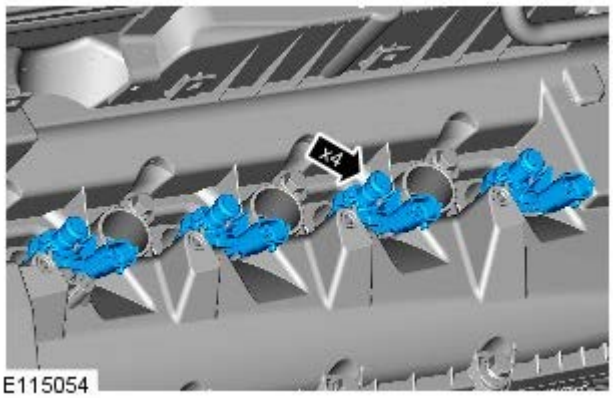


E107596

16. CAUTION: If a new cylinder head has been installed then the special tool 310-200-02 without the thread must be used to install the fuel rail.

NOTE: LH illustration shown, RH is similar.

Special Tool(s): 310-200-01, 310-200-02



E115054

17. CAUTIONS:

Make sure that the area around the open fuel injector ports are clean and free of foreign material and lubricant prior to installing the fuel injector.

When installing the fuel injector(s), make sure that the Teflon seal is clean and free of foreign material and lubricant.

NOTE: LH illustration shown, RH is similar.

18. NOTE: This step is only required if a new fuel rail is installed.

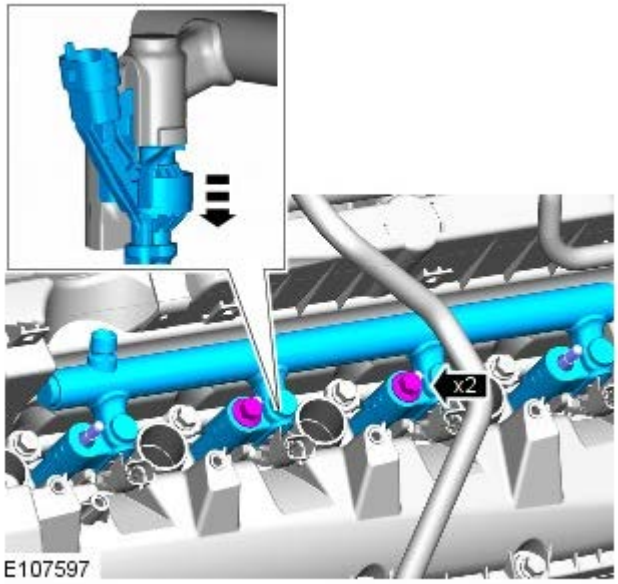
Refer to: Fuel Rail Pressure (FRP) Sensor (303-14B Electronic Engine Controls - V8 5.0L Petrol, Removal and Installation).

19. CAUTIONS:

If new fuel injectors are installed, a new injector clamp must be installed.

Make sure that the fuel injector is aligned and installed into the fuel rail correctly, as noted in the removal step.

Tighten the fuel rail retaining bolts a turn at a



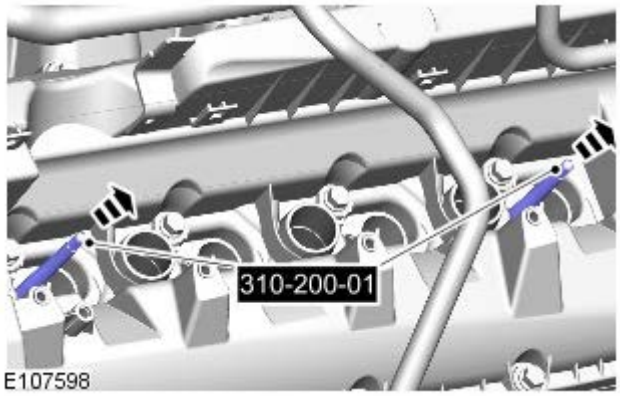
time until the correct torque is achieved.

NOTES:

Lubricate the fuel injector O-ring seals with clean engine oil.

LH illustration shown, RH is similar.

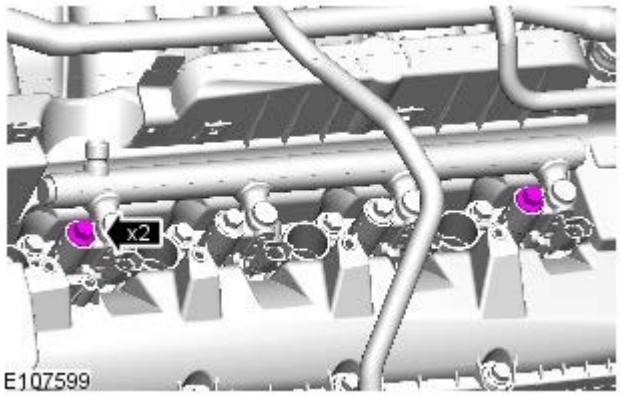
Torque: 20 Nm

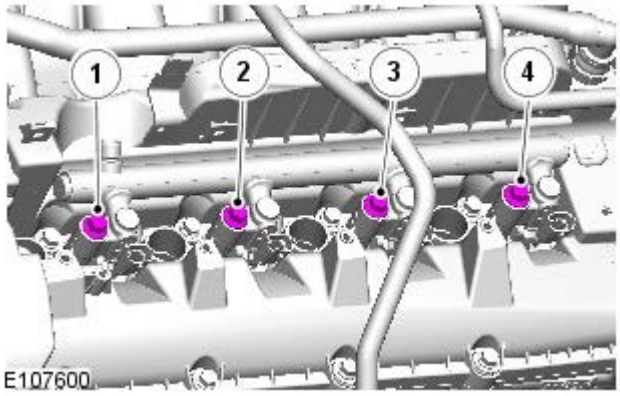


20. NOTE: LH illustration shown, RH is similar.

Special Tool(s): 310-200-01, 310-200-02

21. *Torque:* 20 Nm





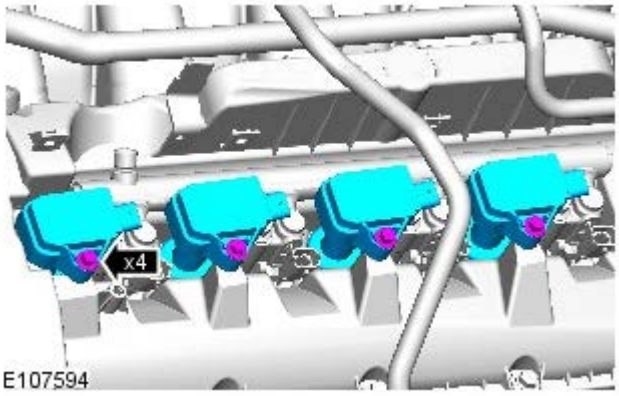
22. NOTES:

Tighten the bolts in the indicated sequence.

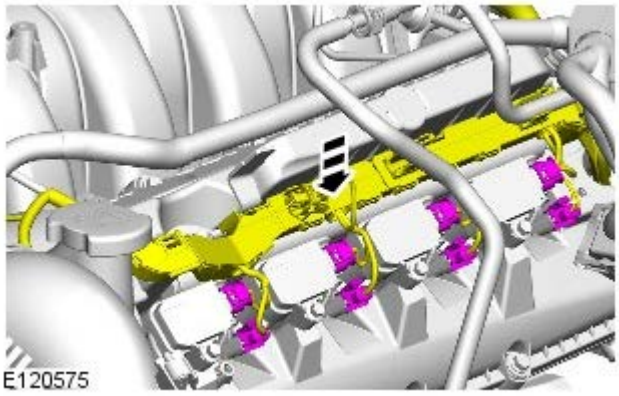
LH illustration shown, RH is similar.

- *Torque:*
  Bolt 2 30 Nm
  Bolt 3 30 Nm
  Bolt 1 30 Nm
  Bolt 4 30 Nm

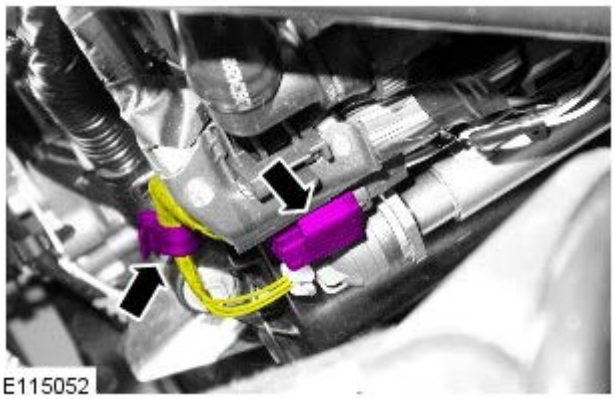
23. NOTE: LH illustration shown, RH is similar.



Torque: 7 Nm

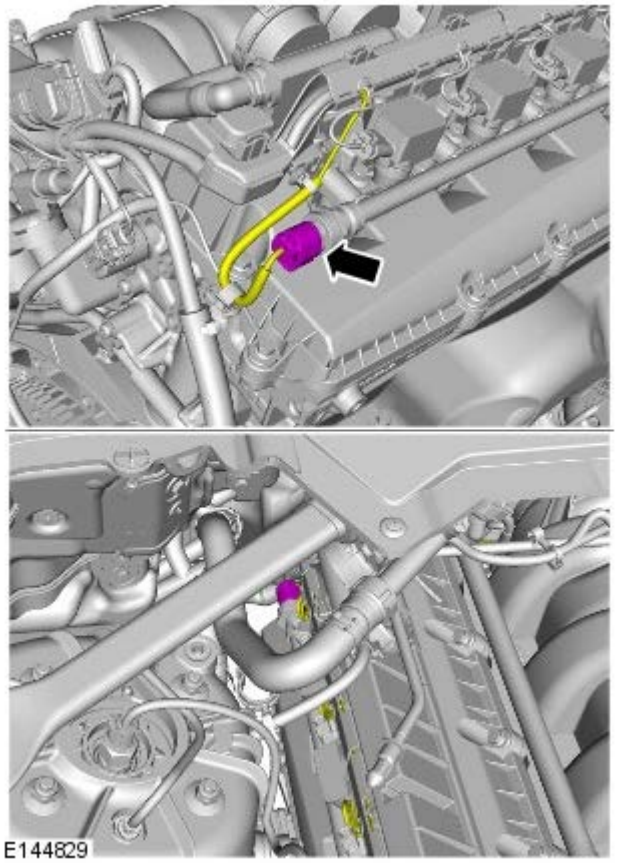


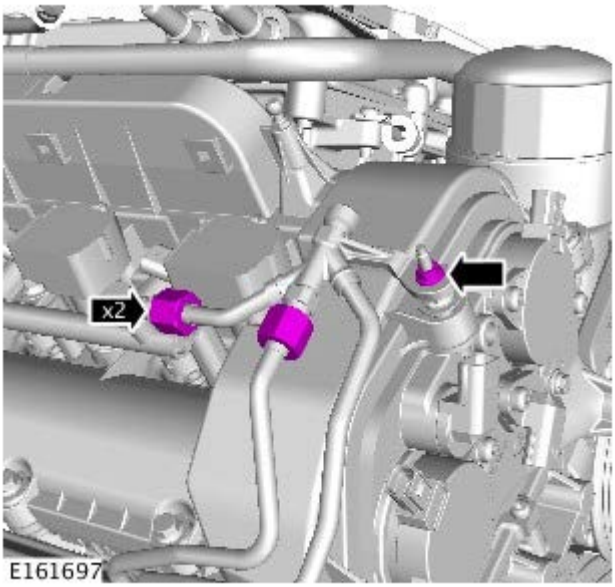
24. NOTE: LH illustration shown, RH is similar.



25. NOTE: If equipped.

26.





27. NOTE: Remove and discard the blanking caps.

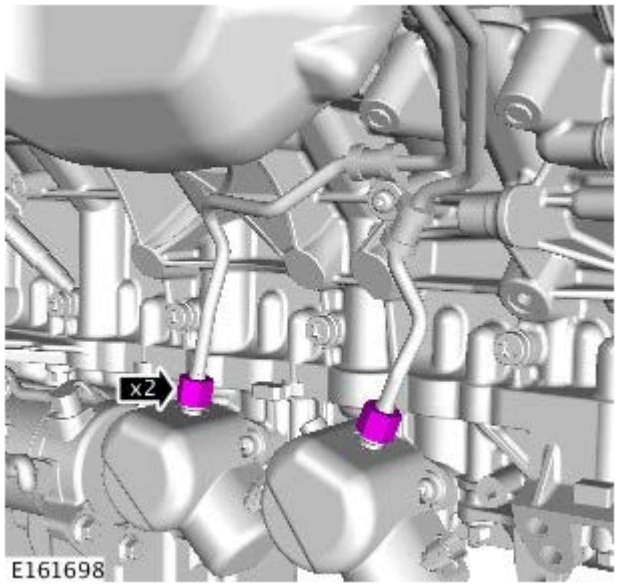
Torque:
Unions 21 Nm
Nut 6 Nm

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

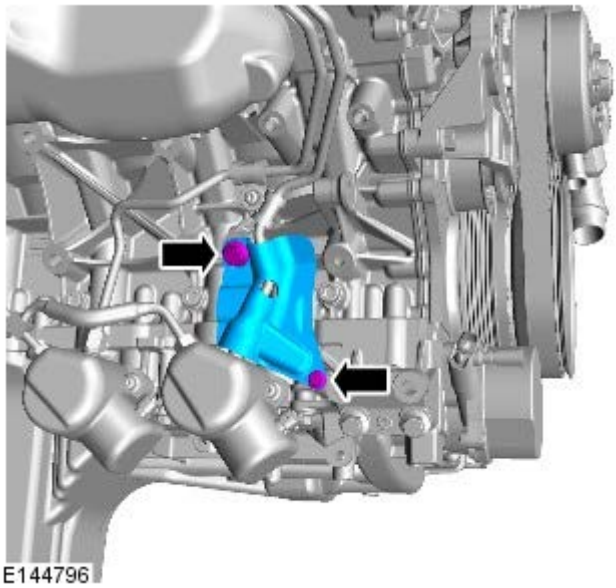
Raise and support the vehicle.

29. NOTE: Some components shown removed for clarity.

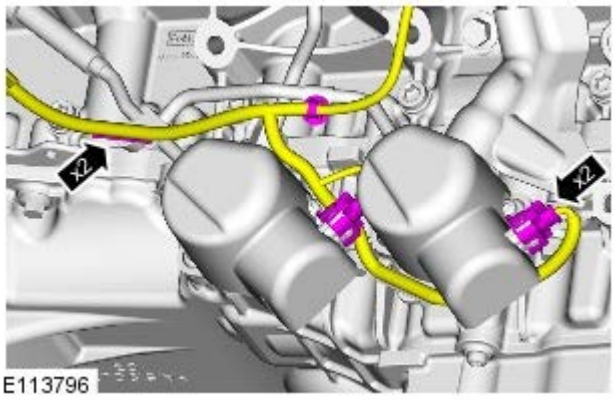
Torque: 21 Nm



30. *Torque:*
M6 12 Nm
M10 29 Nm

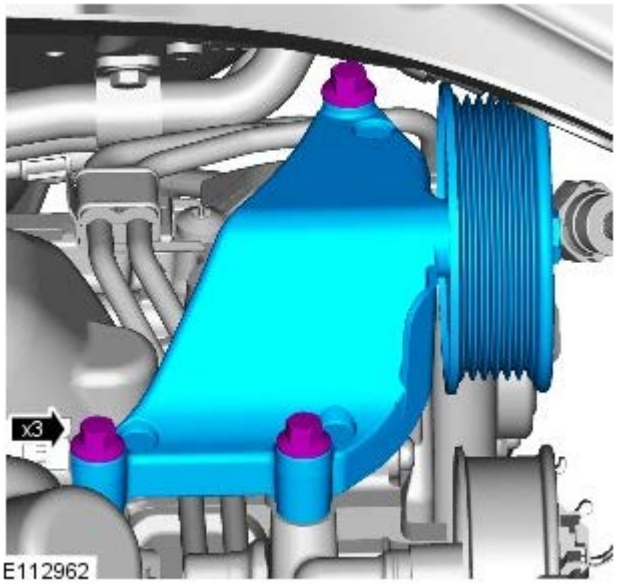


31.



32. Refer to: Steering Gear - V8 5.0L Petrol/V8 S/C 5.0L Petrol (211-02 Power Steering, Removal and Installation).

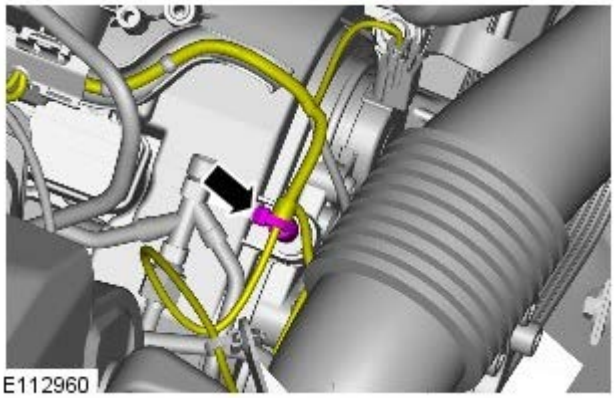
33. *Torque:* 25 Nm

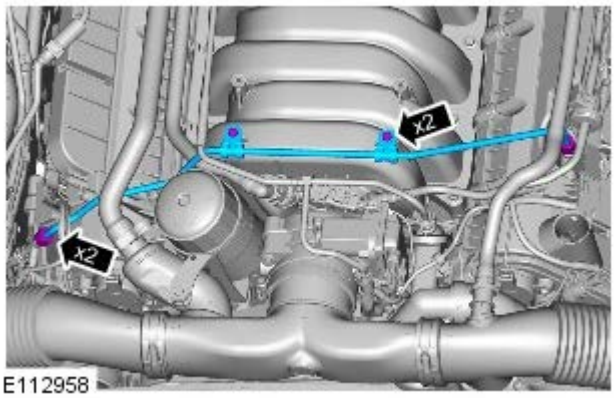


34. Refer to: Generator (414-02B Generator and Regulator - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

35. Lower the vehicle.

36.





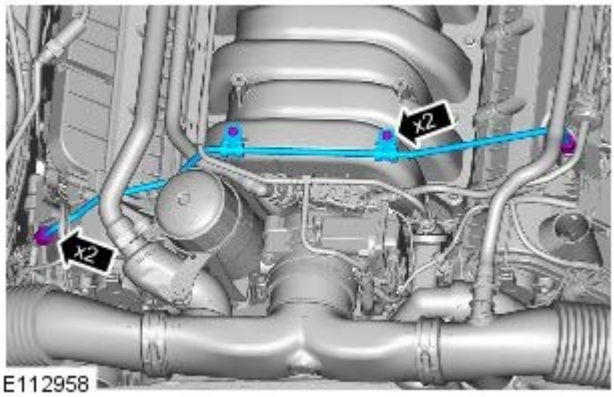
37. CAUTION: Lubricate only the union threads with clean engine oil.

NOTES:

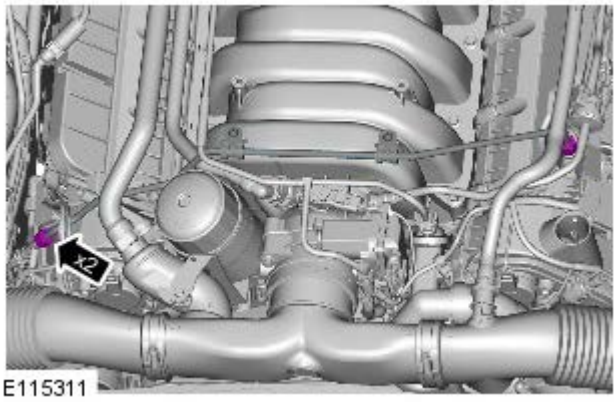
Do not tighten at this stage.

Remove and discard the blanking caps.

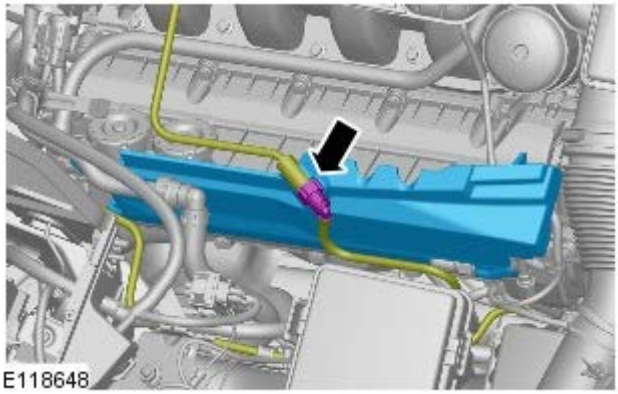
38. *Torque:*
Unions 21 Nm
Bolts 8 Nm



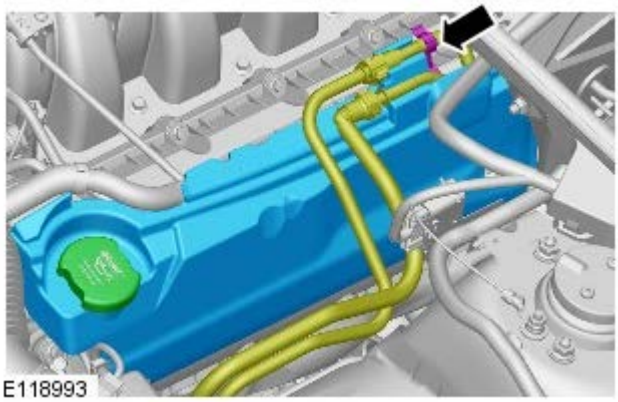
39. *Torque:* 21 Nm



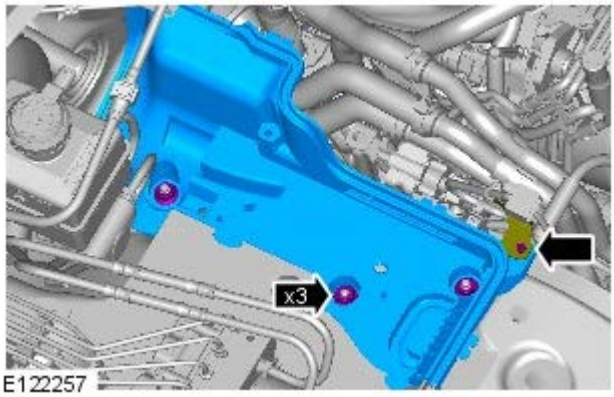
40.



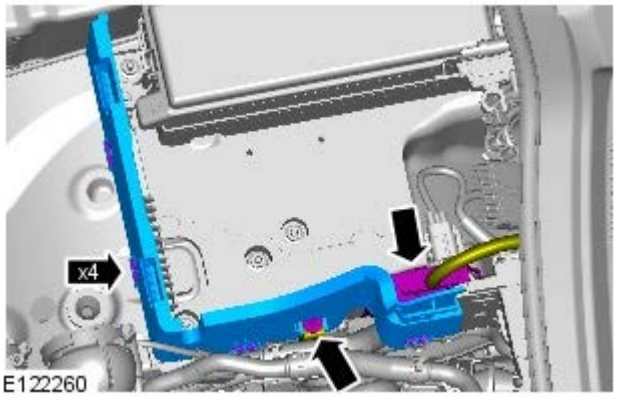
41.



42. *Torque:* 12 Nm

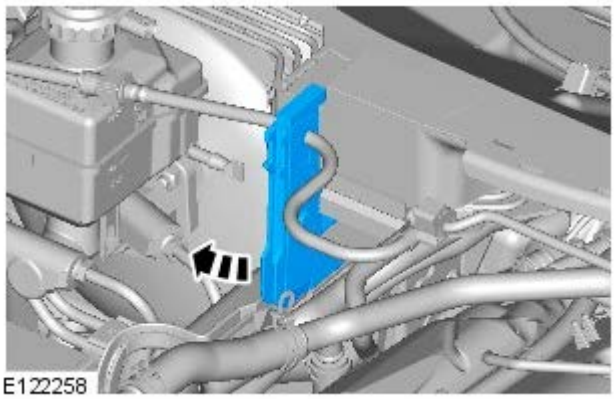


43.

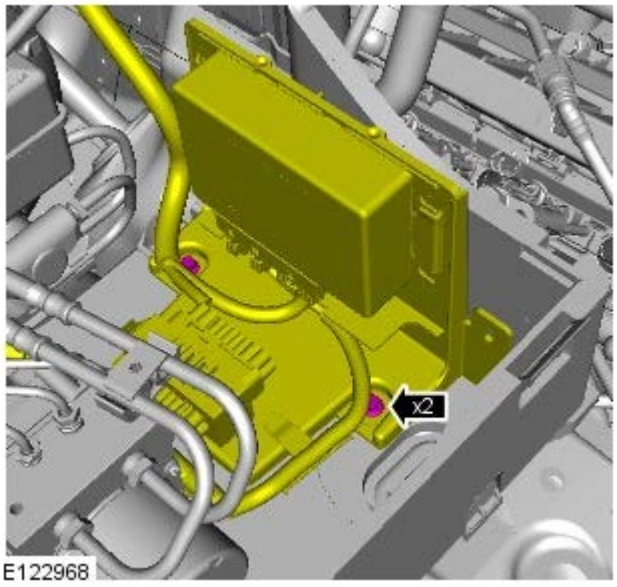


Right-hand drive vehicles

44.



45. *Torque:* 10 Nm

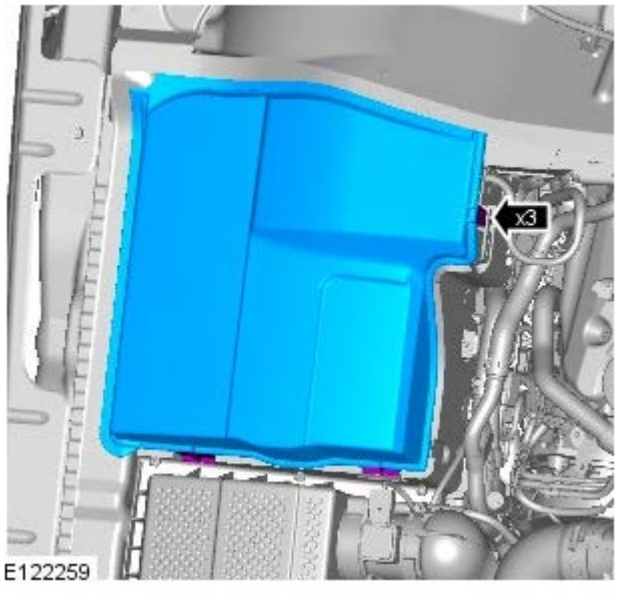


Left-hand drive vehicles

46. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

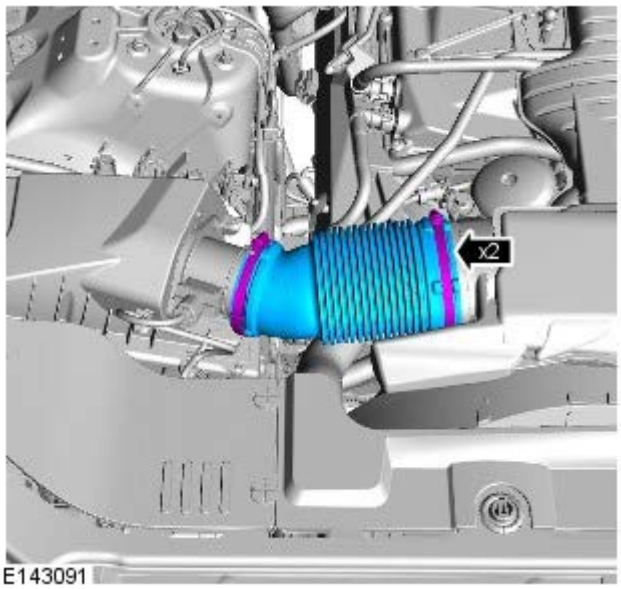
All vehicles

47.



48. Refer to: Air Cleaner RH (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

49. *Torque:* 3.5 Nm



50. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

51. Connect the battery ground cable.

Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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Fuel Charging and Controls - V8 5.0L Petrol - High Pressure Fuel Pump 1

Removal and Installation

Removal

CAUTIONS:

Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

Make sure that tools and equipment are clean, free of foreign material and lubricant.

NOTES:

Removal steps in this procedure may contain installation details.

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

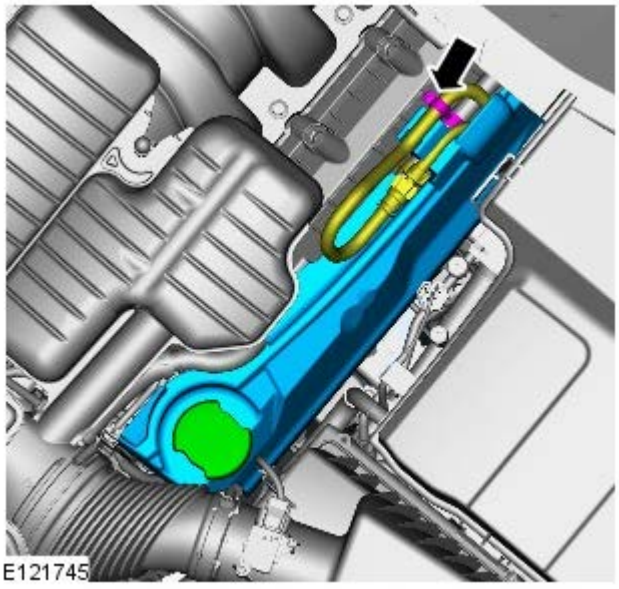
1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Refer to: Fuel System Pressure Release - V8 5.0L Petrol/V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

3. Disconnect the battery ground cable.

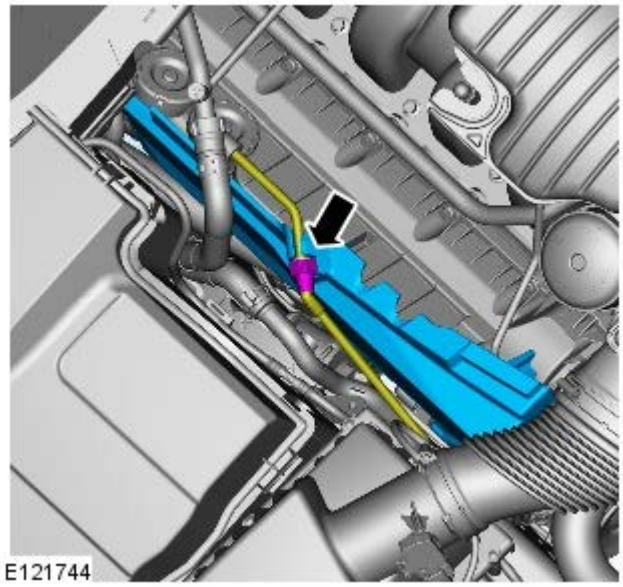
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

4. Refer to: Engine Oil Draining and Filling (303-01B Engine - V8 5.0L Petrol, General Procedures).



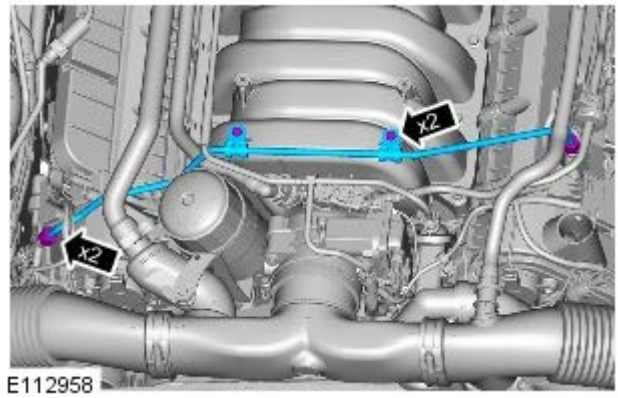
5. CAUTION: Be prepared to collect escaping fluids.

6.



7. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

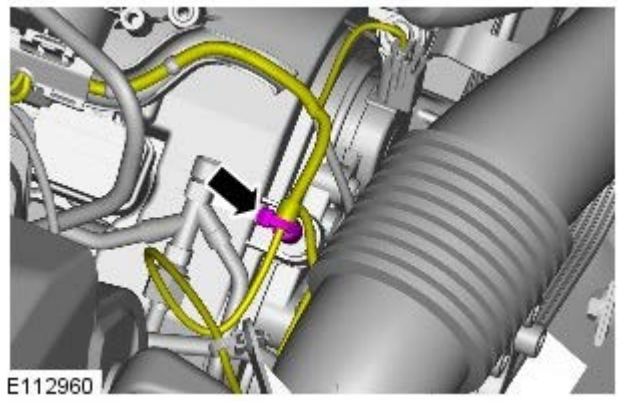
8. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V8 5.0L Petrol, General Procedures).



9. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

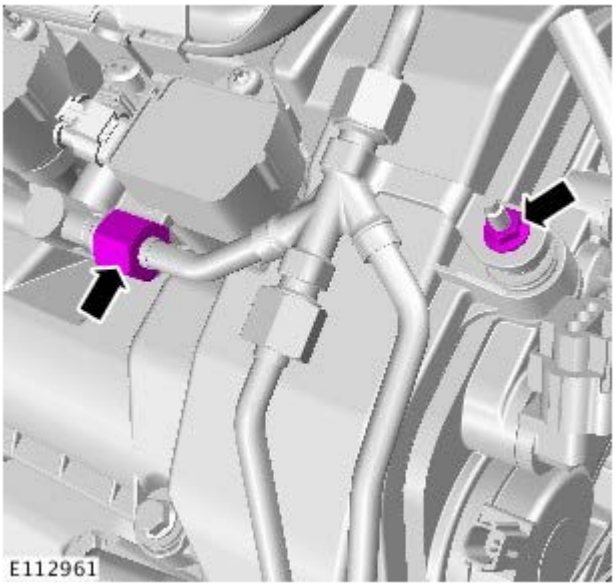


10.

11. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.



12. 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.

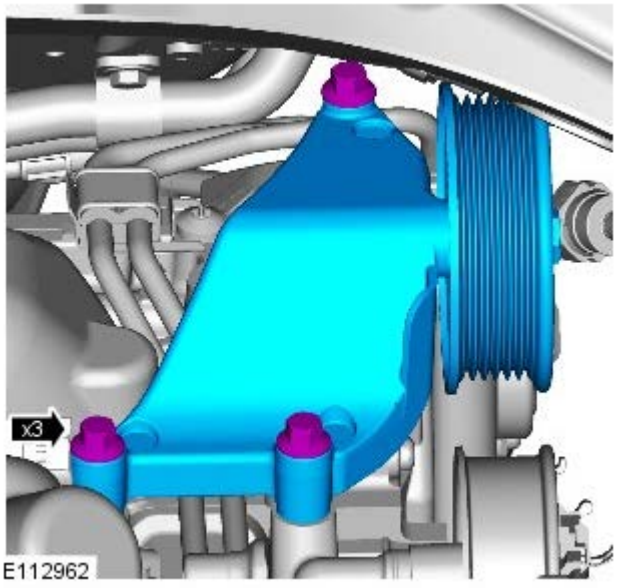
13. NOTE: RH Drive vehicles only.

    Refer to: Steering Gear - V8 5.0L Petrol/V8 S/C 5.0L Petrol (211-02 Power Steering, Removal and Installation).

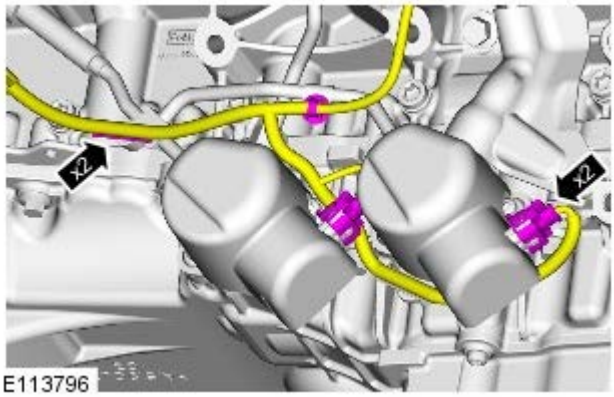
14. Refer to: Engine Mount RH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

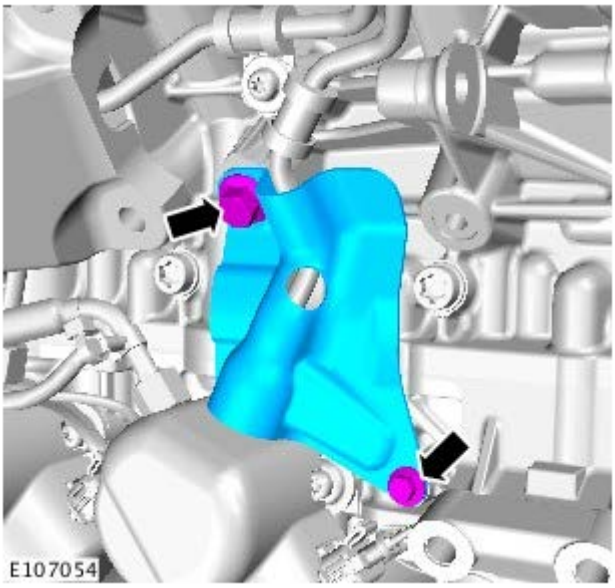
15. Refer to: Generator (414-02B Generator and Regulator - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

16.

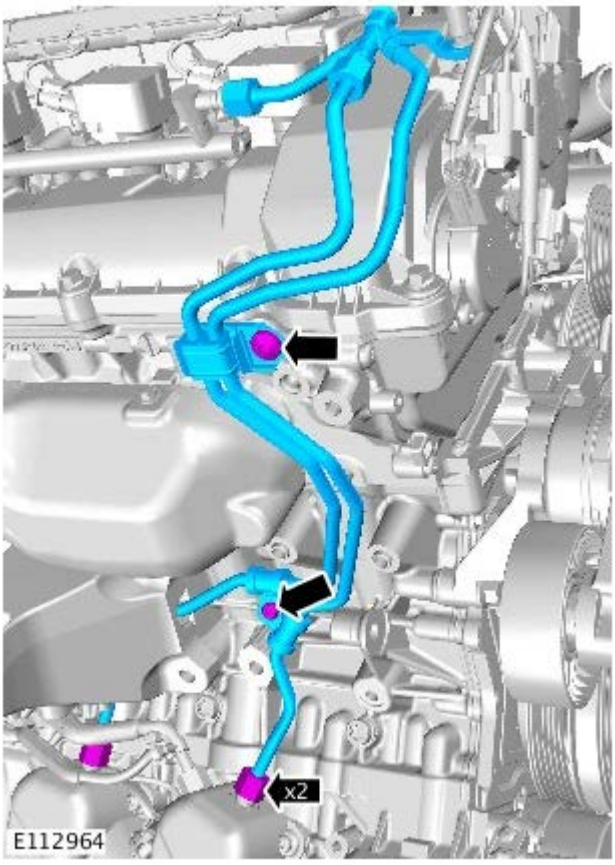


17. NOTE: Engine shown removed for clarity.





18. NOTE: Engine shown removed for clarity.



19. CAUTIONS:

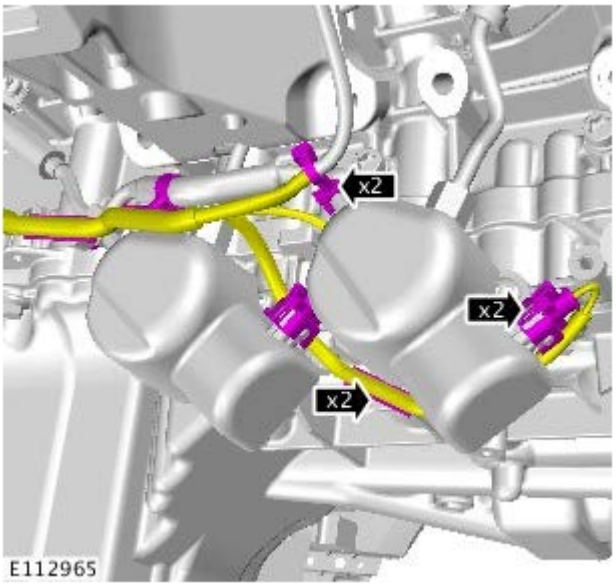
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

Remove and discard the high-pressure fuel supply lines.

NOTE: Engine shown removed for clarity.

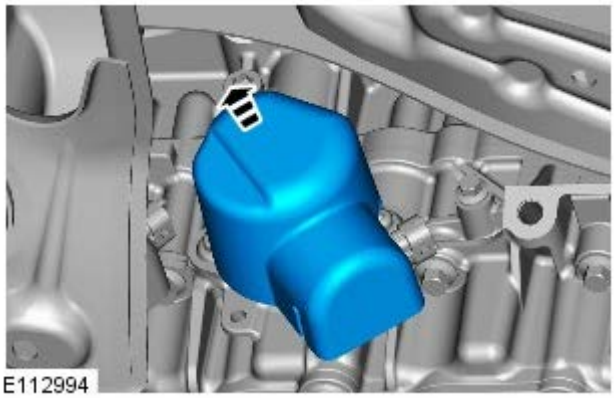
20. CAUTIONS:



Be prepared to collect escaping fluids.

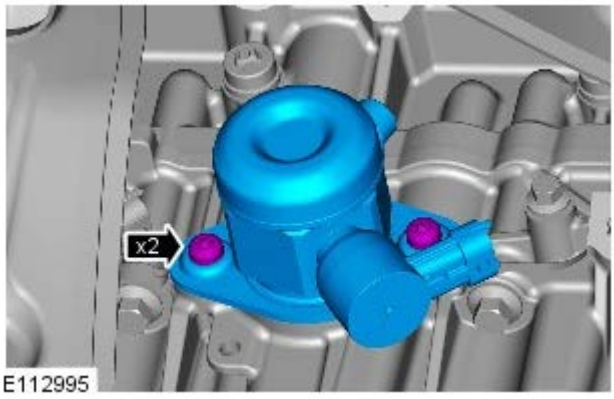
Make sure that all openings are sealed. Use new blanking caps.

21.



22. CAUTION: Be prepared to collect escaping fluids.

Loosen the Torx screws a turn each at a time.



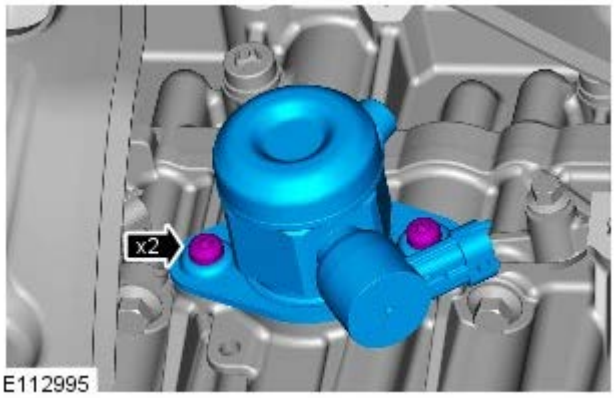
23. CAUTION: Be prepared to collect escaping fluids.



Installation



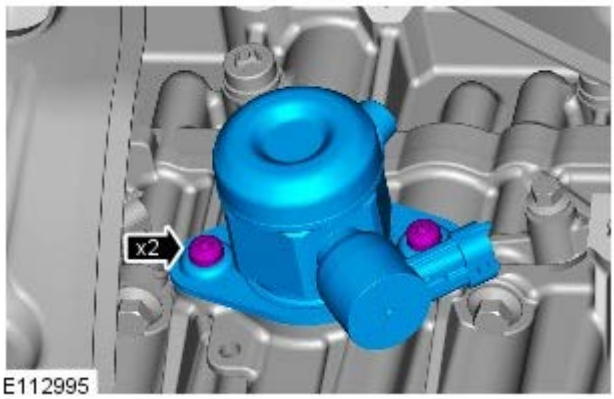
1. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.



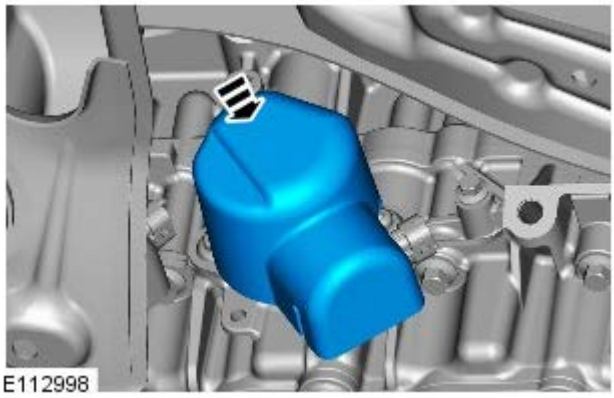
2. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

   NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

   Torque: 11 Nm



3. Loosen the Torx screws half a turn each.



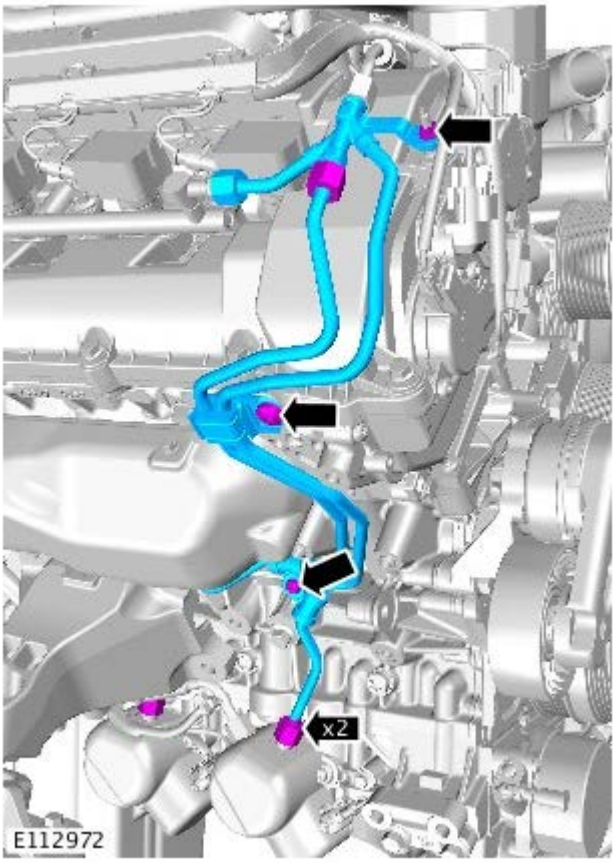
4.

5. CAUTIONS:

   Install new high-pressure fuel supply lines.

   Lubricate only the union threads with clean engine oil.

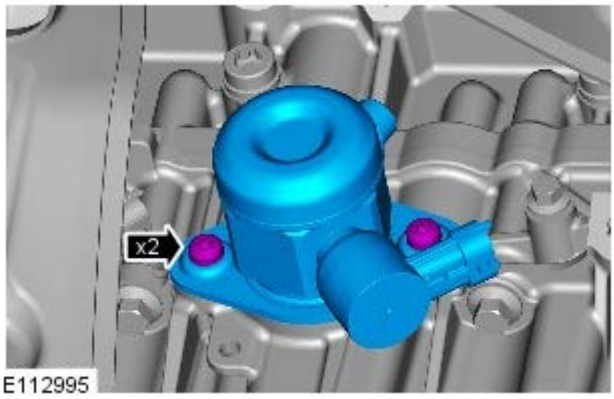
   NOTES:



Remove and discard the blanking caps.

Engine shown removed for clarity.

Install the bolt and unions fully finger tight before final tightening.

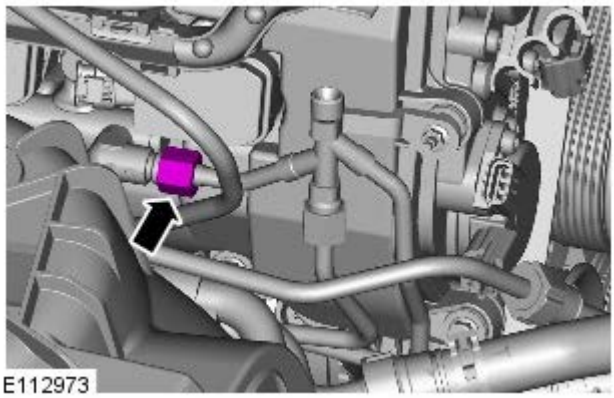


6. CAUTION: Care must be taken when positioning the fuel rail high-pressure fuel pump cover to one side.

NOTE: Fuel rail high-pressure fuel pump cover shown removed for clarity.

Torque: 11 Nm

7. Lower the vehicle.



8. NOTES:

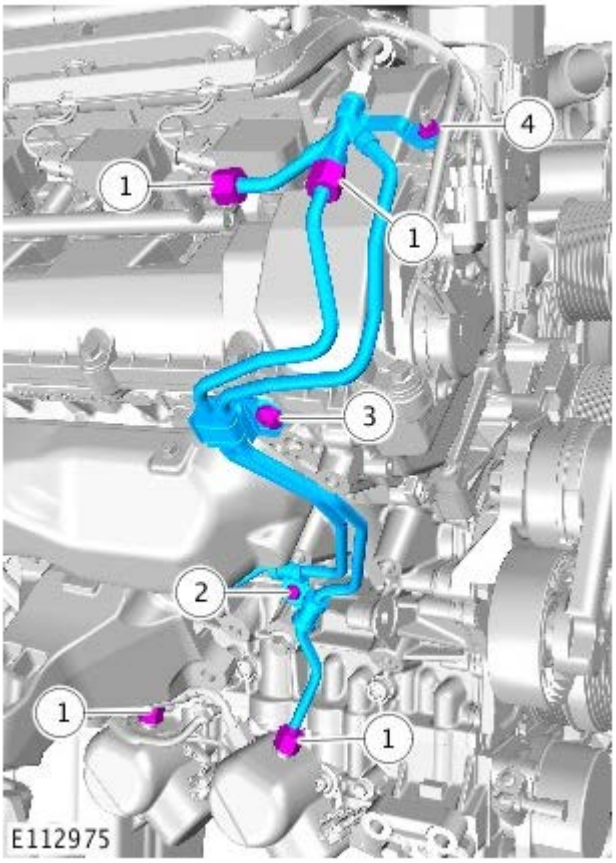
Do not tighten at this stage.

Remove and discard the blanking caps.

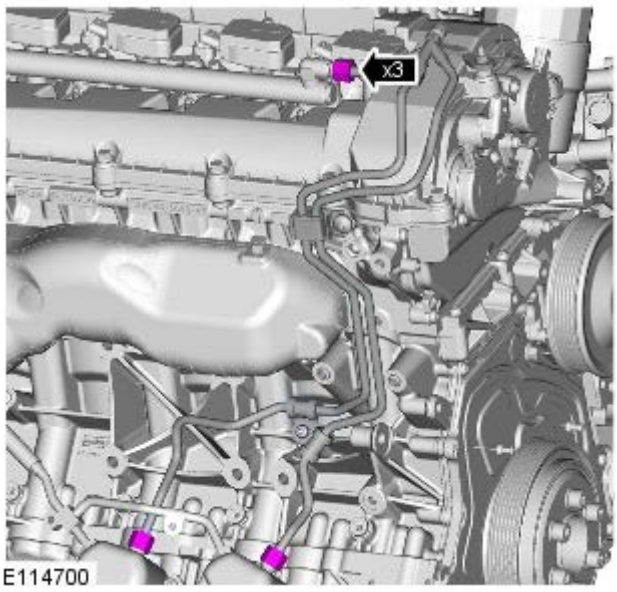
9. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

10. NOTE: Engine shown removed for clarity.



Torque:
Unions (1) 21 Nm
M6 (2) 11 Nm
M8 (3) 25 Nm
M5 nut (4) 6 Nm



11. NOTE: Engine shown removed for clarity.

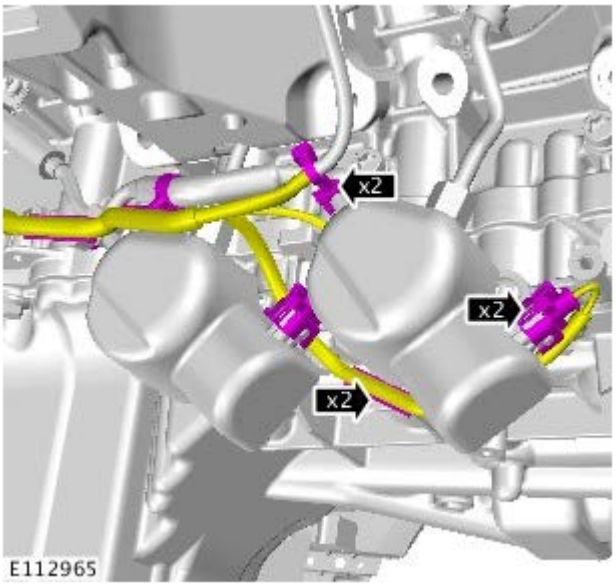
Torque: 21 Nm

12. NOTES:

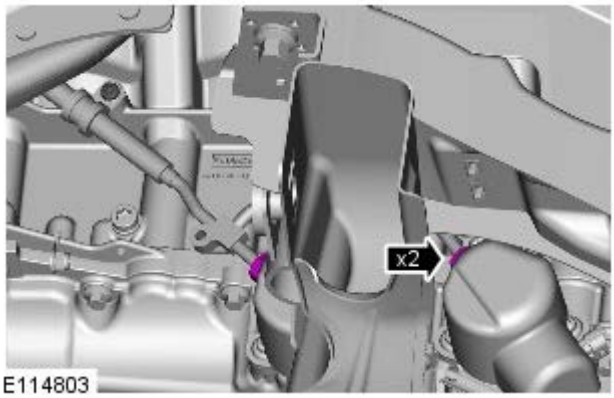
Install the bolt and unions finger tight before final tightening.

Remove and discard the blanking caps.

Torque:
Unions 21 Nm
M6 11 Nm

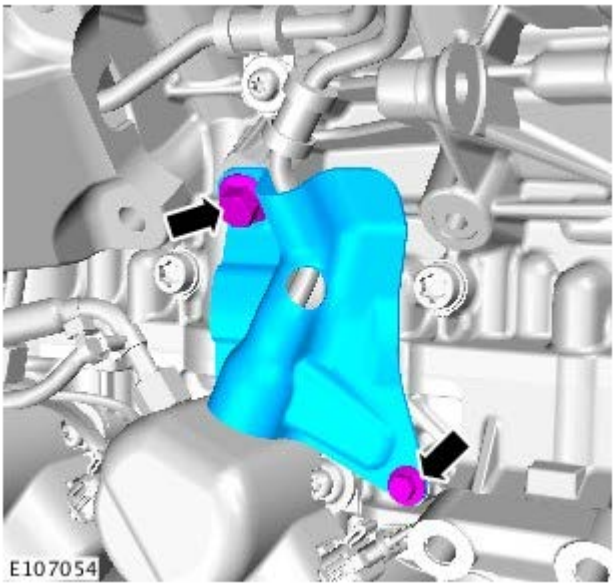


13. *Torque:* 21 Nm

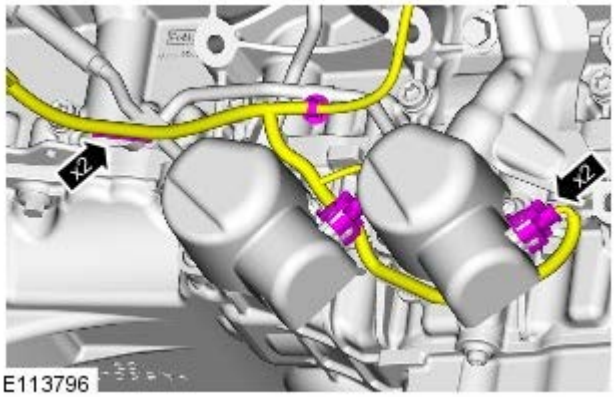


14. NOTE: Engine shown removed for clarity.

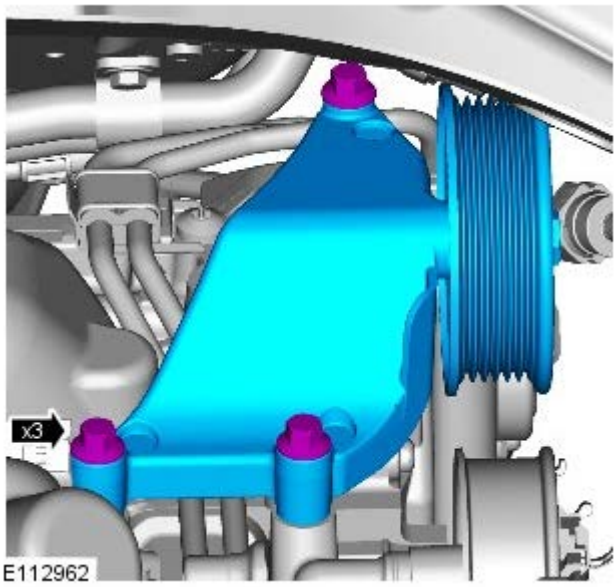
Torque:
M10 29 Nm
M6 11 Nm



15. NOTE: Engine shown removed for clarity.



16. *Torque:* 25 Nm



17. Refer to: Generator (414-02B Generator and Regulator - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

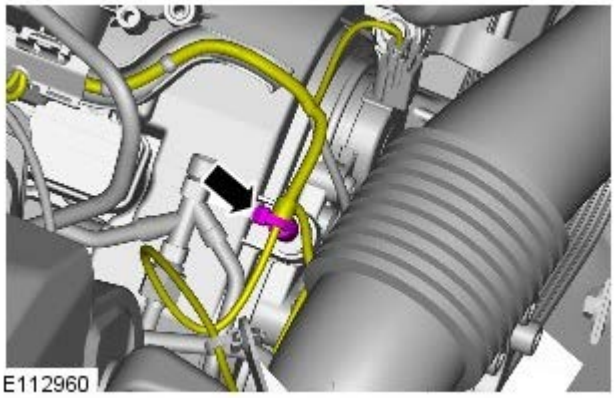
18. Refer to: Engine Mount RH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

19. NOTE: RH Drive vehicles only.

    Refer to: Steering Gear - V8 5.0L Petrol/V8 S/C 5.0L Petrol (211-02 Power Steering, Removal and Installation).

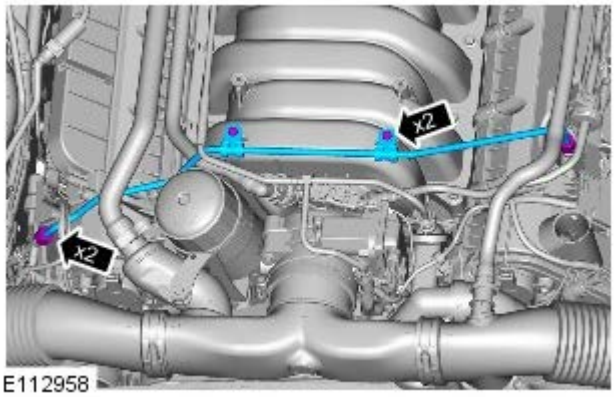
20. Lower the vehicle.

21.



22. NOTES:

    Lubricate the union threads with clean engine oil.

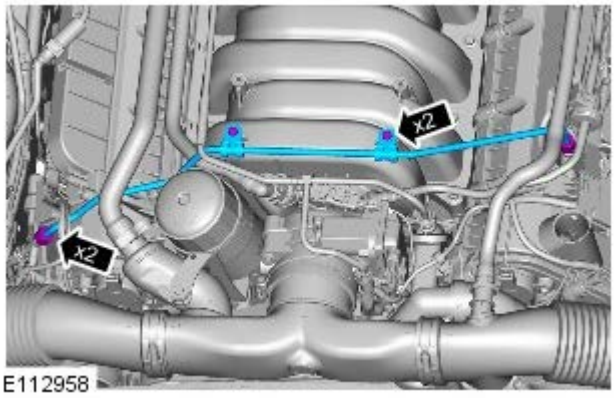


E112958

Do not tighten at this stage.

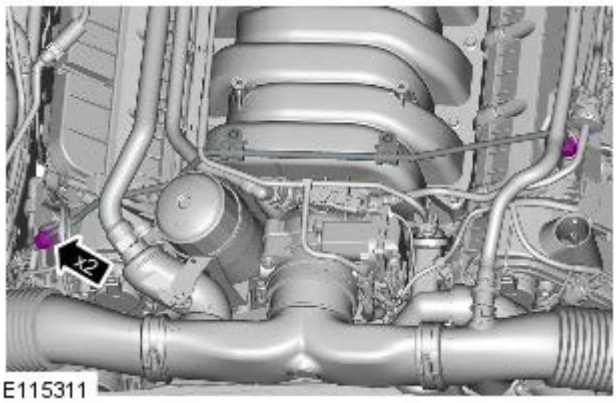
Remove and discard the blanking caps.

23. *Torque:*
    Unions 21 Nm
    Bolts 8 Nm



E112958

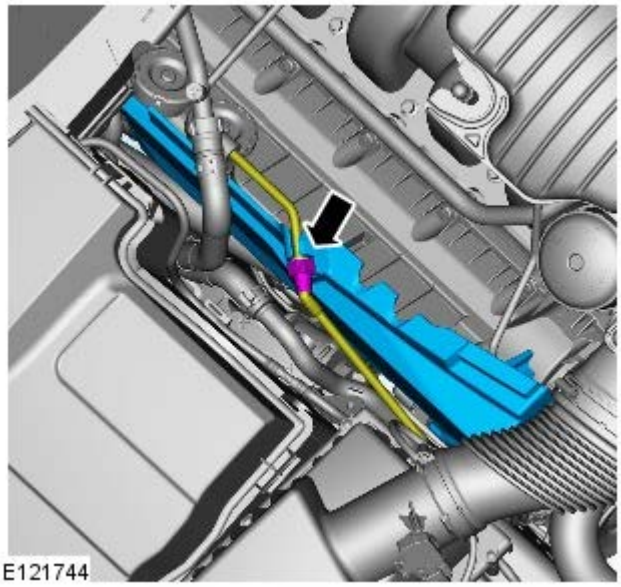
24. *Torque:* 21 Nm



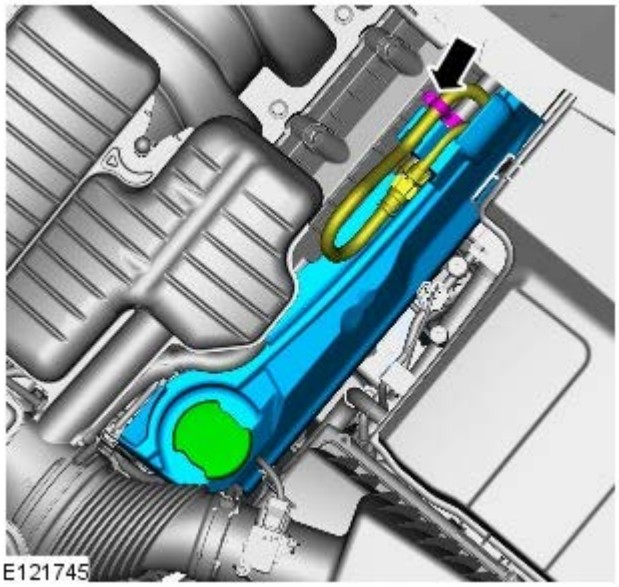
E115311

25. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

26.


E121744

27.



28. Refer to: Engine Oil Draining and Filling (303-01B Engine - V8 5.0L Petrol, General Procedures).

29. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

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Fuel Charging and Controls - V8 5.0L Petrol - High Pressure Fuel Pump 2

Removal and Installation

Removal

CAUTIONS:

Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

Make sure that tools and equipment are clean, free of foreign material and lubricant.

NOTES:

Removal steps in this procedure may contain installation details.

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

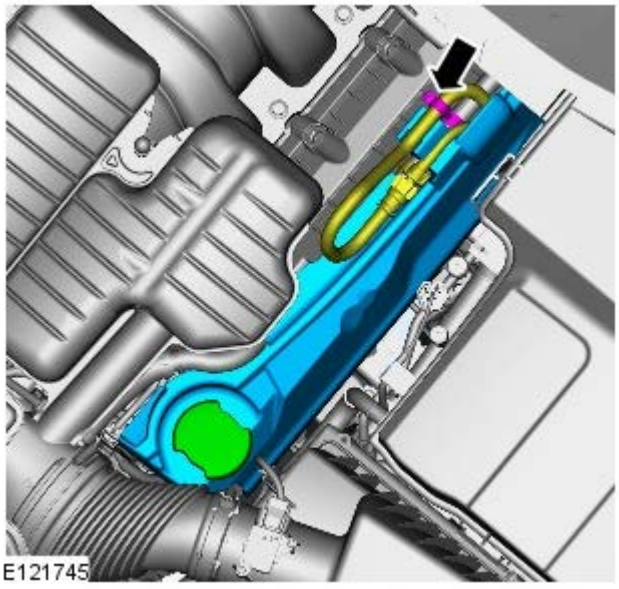
1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Refer to: Fuel System Pressure Release - V8 5.0L Petrol/V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

3. Disconnect the battery ground cable.

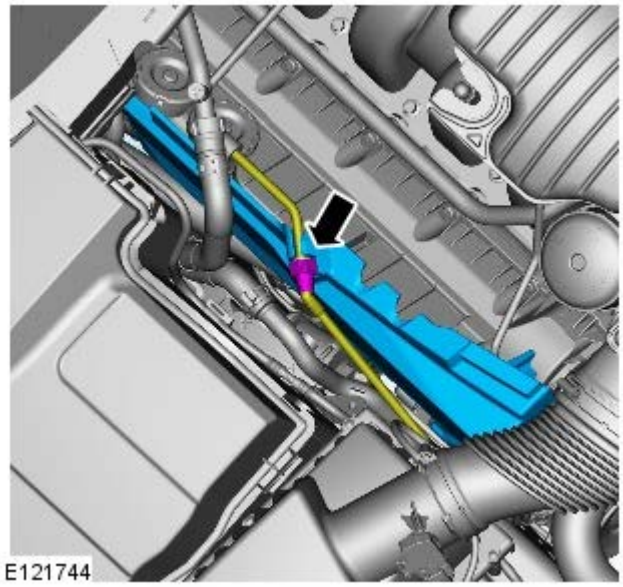
   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

4. Refer to: Engine Oil Draining and Filling (303-01B Engine - V8 5.0L Petrol, General Procedures).



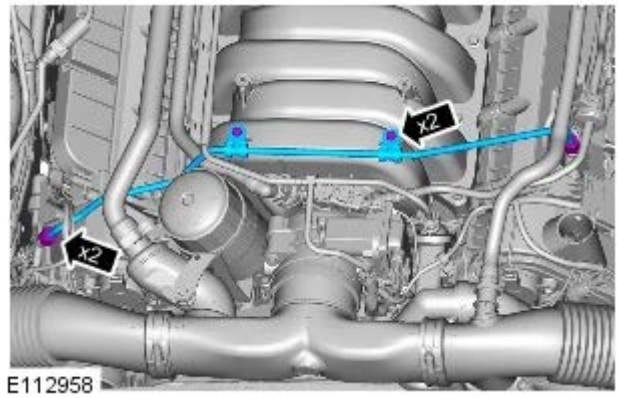
5. CAUTION: Be prepared to collect escaping fluids.

6.



7. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

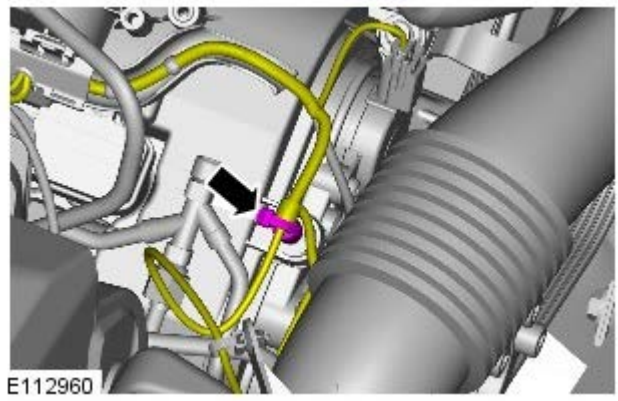
8. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V8 5.0L Petrol, General Procedures).



9. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

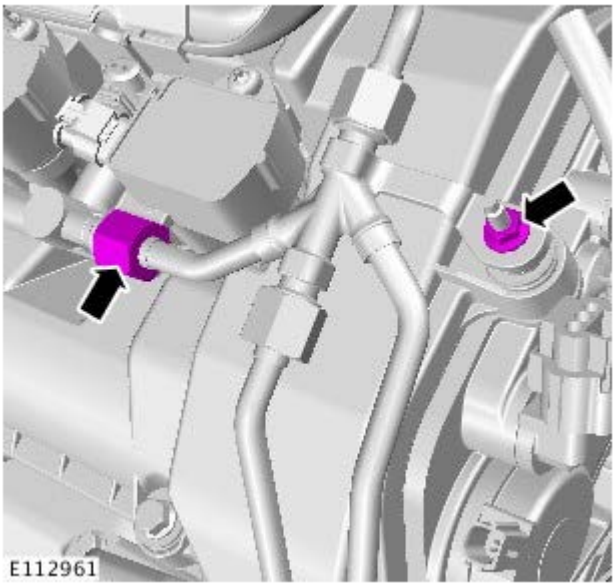


10.

11. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.



12. 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.

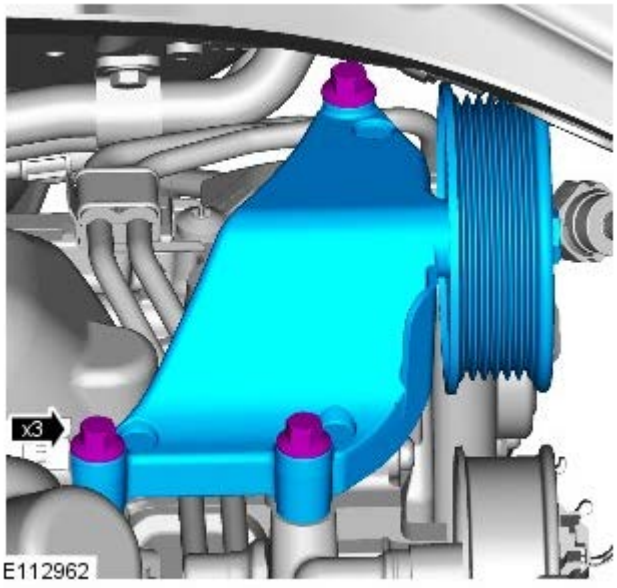
13. NOTE: RH Drive vehicles only.

    Refer to: Steering Gear - V8 5.0L Petrol/V8 S/C 5.0L Petrol (211-02 Power Steering, Removal and Installation).

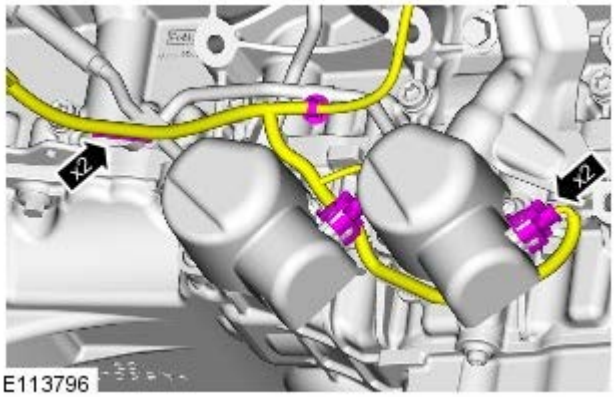
14. Refer to: Engine Mount RH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

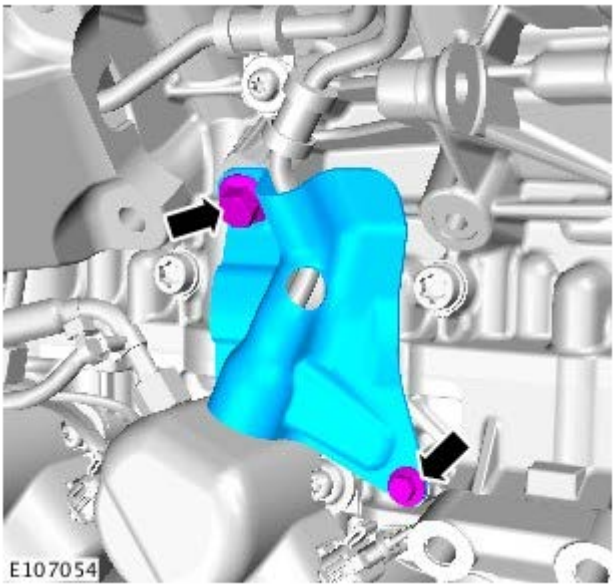
15. Refer to: Generator (414-02B Generator and Regulator - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

16.

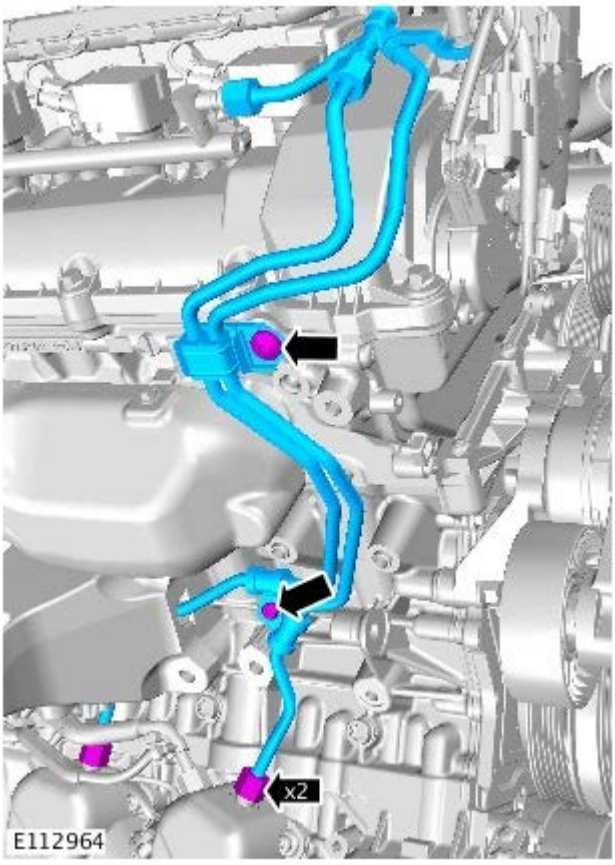


17. NOTE: Engine shown removed for clarity.





18. NOTE: Engine shown removed for clarity.



19. CAUTIONS:

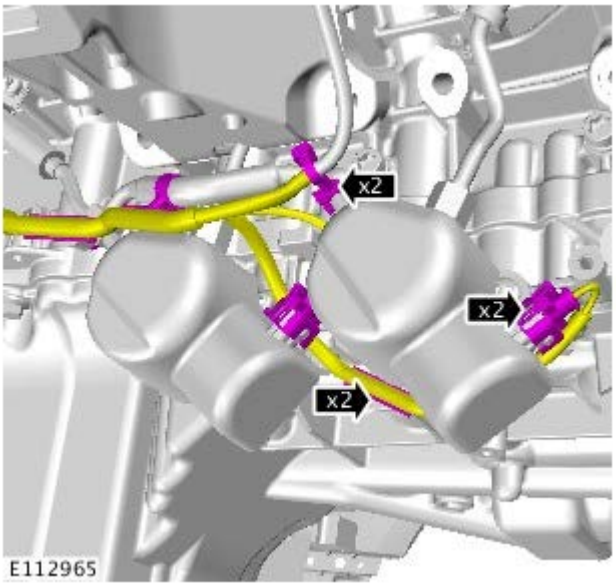
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

Remove and discard the high-pressure fuel supply lines.

NOTE: Engine shown removed for clarity.

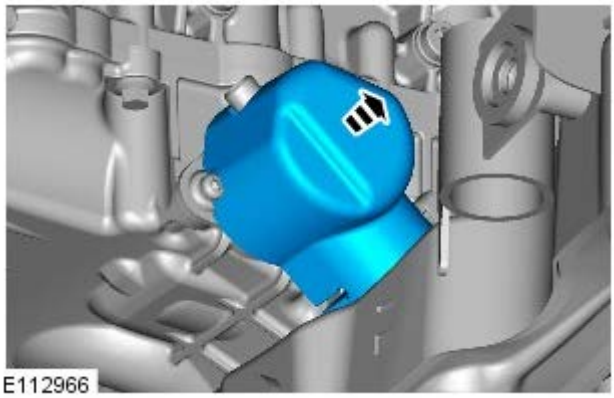
20. CAUTIONS:



Be prepared to collect escaping fluids.

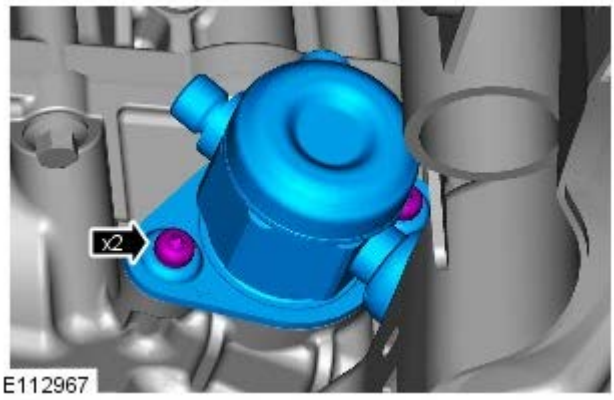
Make sure that all openings are sealed. Use new blanking caps.

21.

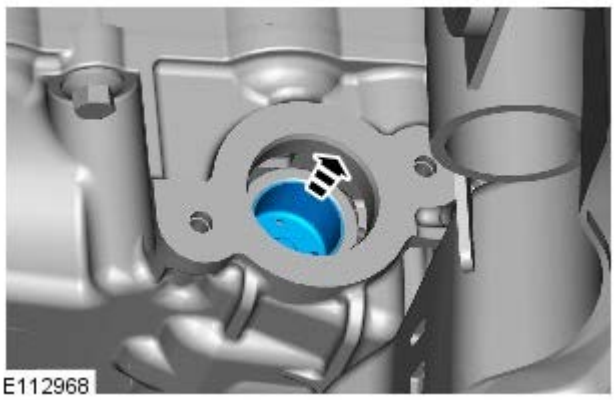


22. CAUTION: Be prepared to collect escaping fluids.

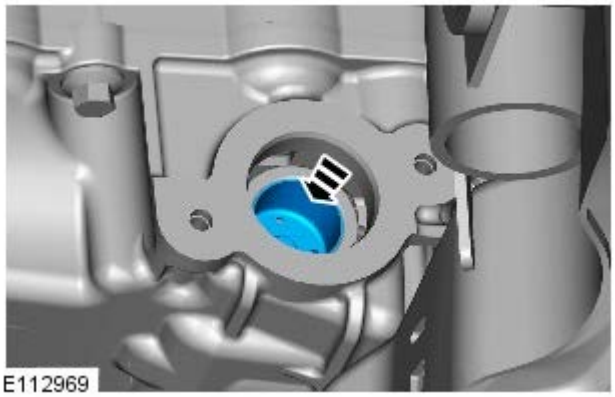
Loosen the Torx screws a turn each at a time.



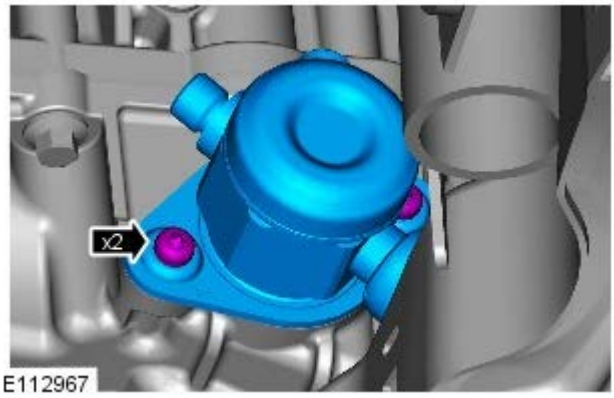
23. CAUTION: Be prepared to collect escaping fluids.



Installation



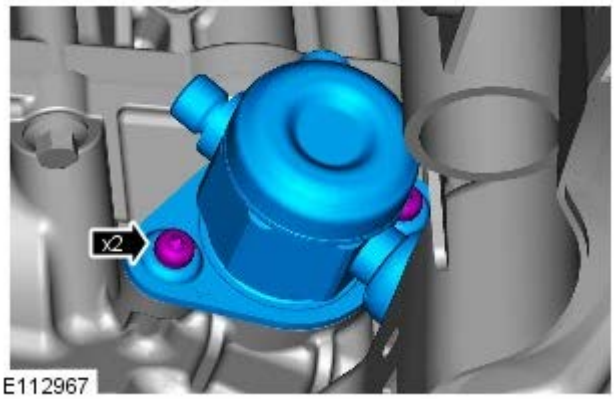
1. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.



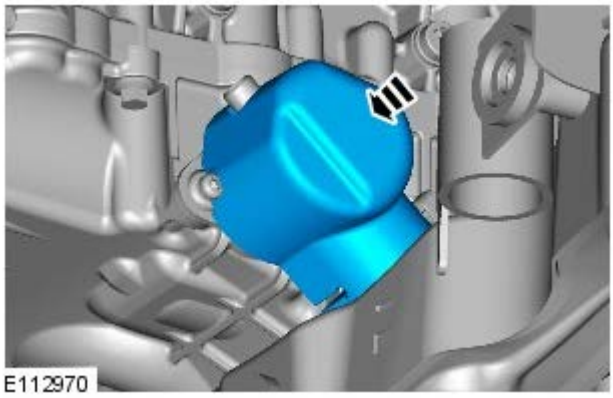
2. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

   NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

   Torque: 11 Nm



3. Loosen the Torx screws half a turn each.



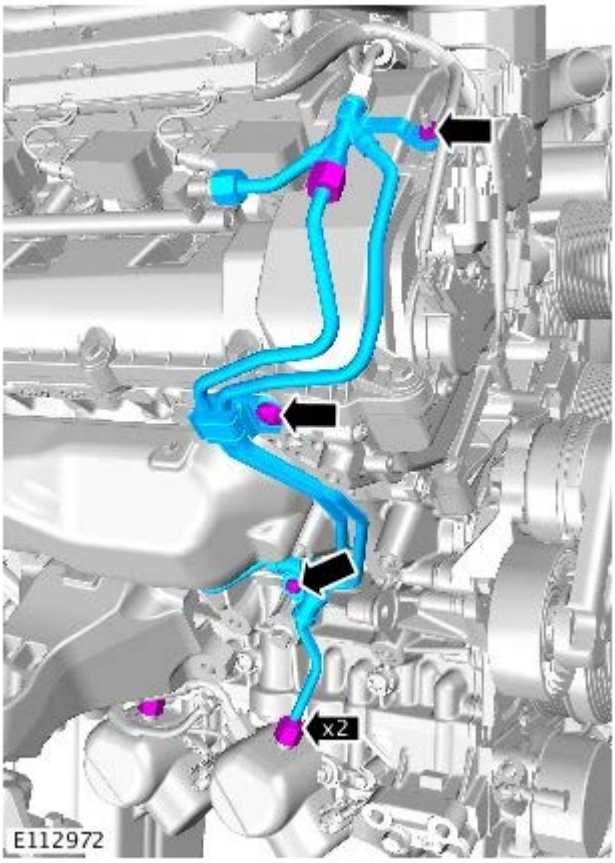
4.

5. CAUTIONS:

   Install new high-pressure fuel supply lines.

   Lubricate only the union threads with clean engine oil.

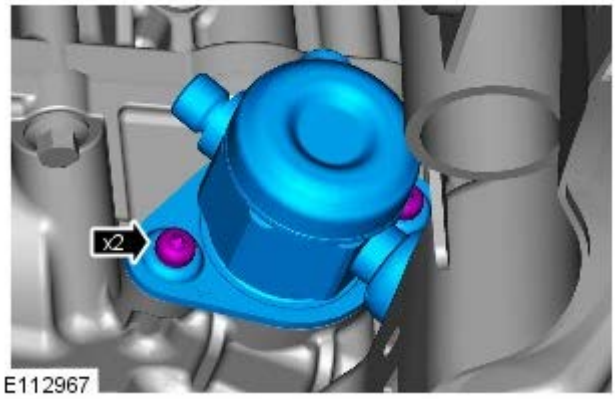
   NOTES:



Remove and discard the blanking caps.

Engine shown removed for clarity.

Install the bolt and unions fully finger tight before final tightening.

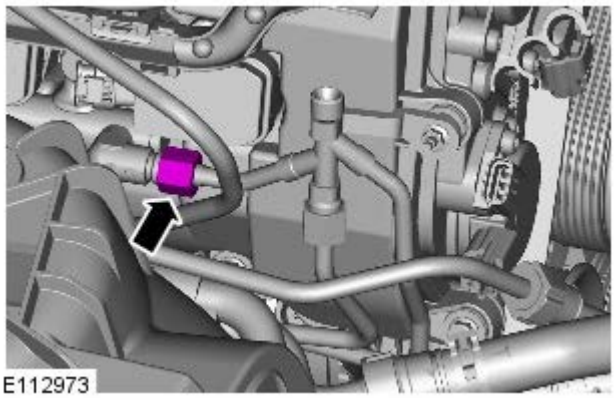


6. CAUTION: Care must be taken when positioning the fuel rail high-pressure fuel pump cover to one side.

NOTE: Fuel rail high-pressure fuel pump cover shown removed for clarity.

Torque: 11 Nm

7. Lower the vehicle.



8. NOTES:

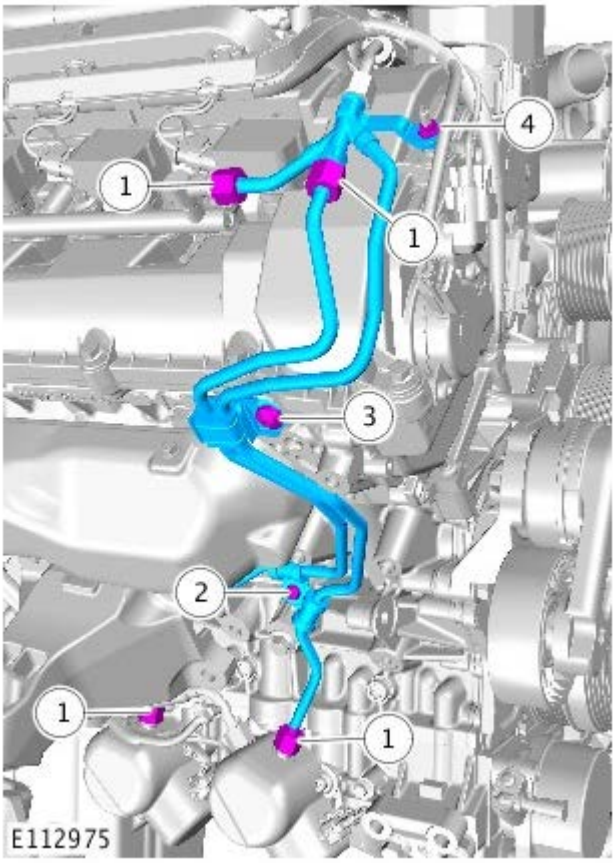
Do not tighten at this stage.

Remove and discard the blanking caps.

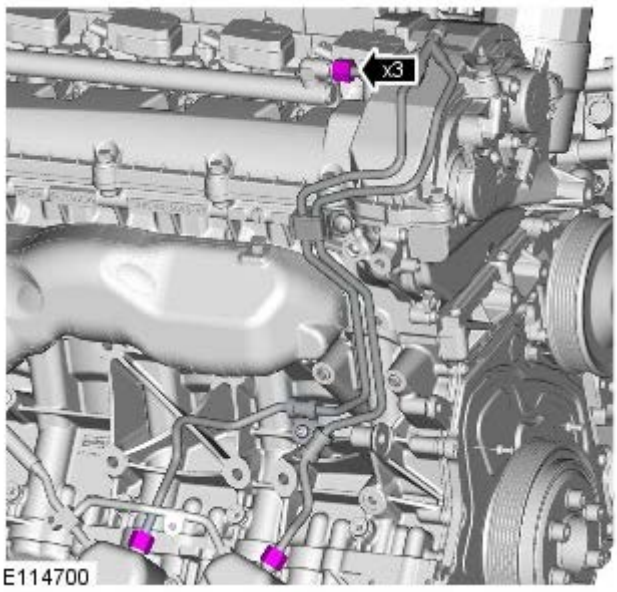
9. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

10. NOTE: Engine shown removed for clarity.



Torque:
Unions (1) 21 Nm
M6 (2) 11 Nm
M8 (3) 25 Nm
M5 nut (4) 6 Nm



11. NOTE: Engine shown removed for clarity.

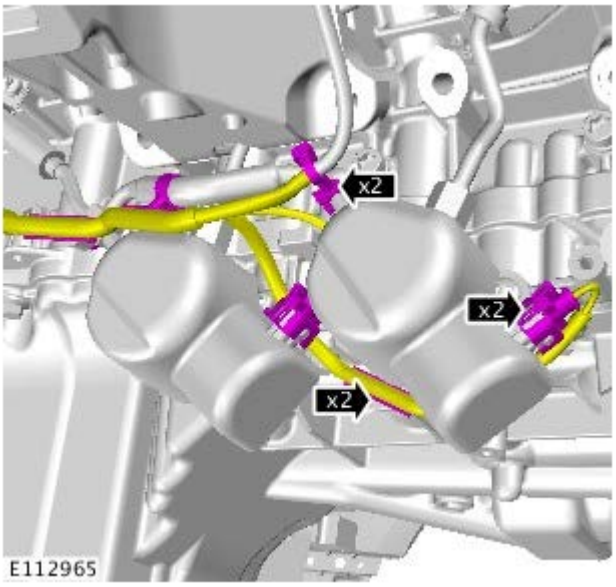
Torque: 21 Nm

12. NOTES:

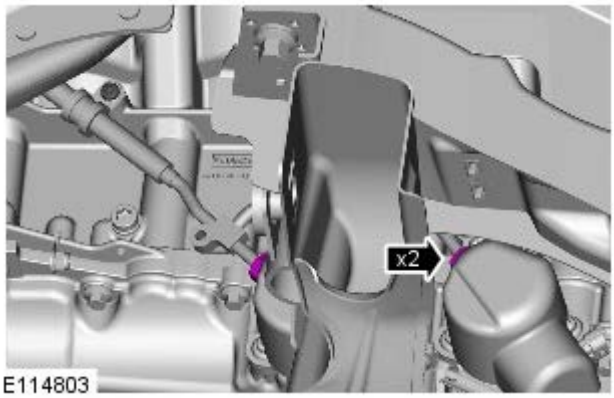
Install the bolt and unions finger tight before final tightening.

Remove and discard the blanking caps.

Torque:
Unions 21 Nm
M6 11 Nm

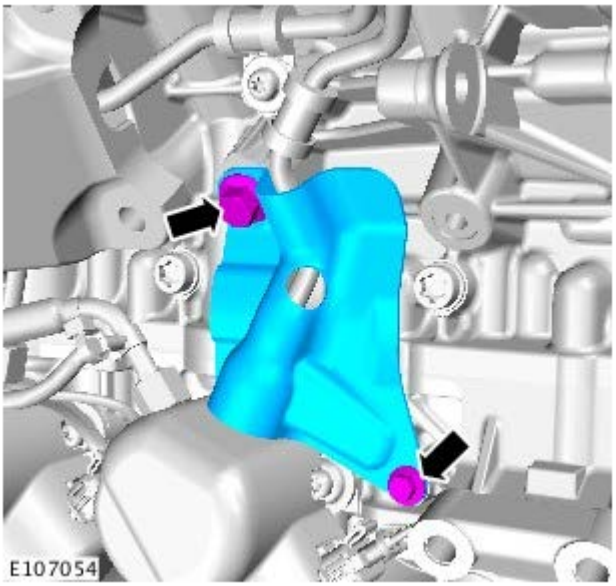


13. *Torque:* 21 Nm

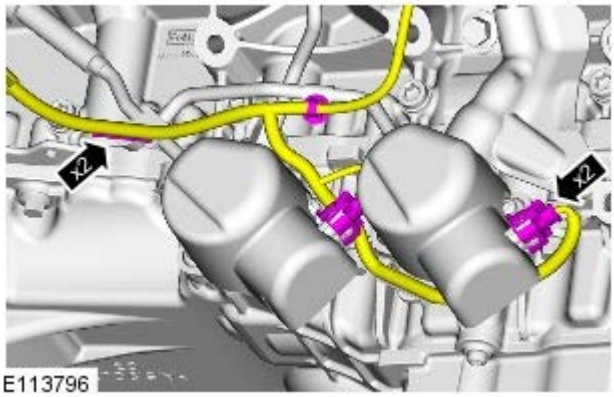


14. NOTE: Engine shown removed for clarity.

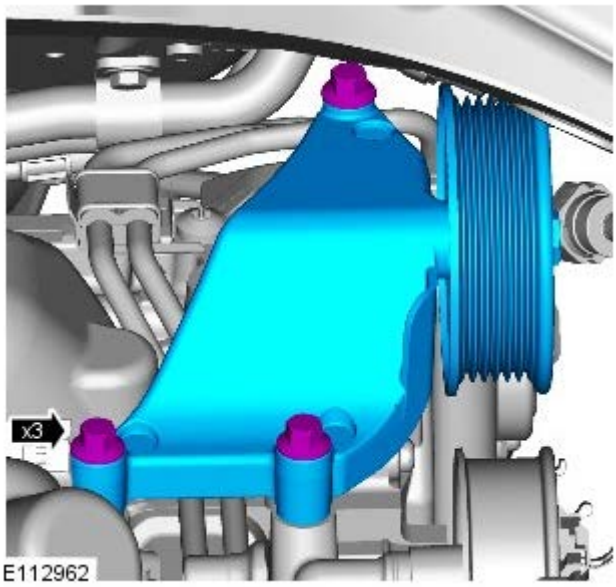
Torque:
M10 29 Nm
M6 11 Nm



15. NOTE: Engine shown removed for clarity.



16. *Torque:* 25 Nm



17. Refer to: Generator (414-02B Generator and Regulator - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

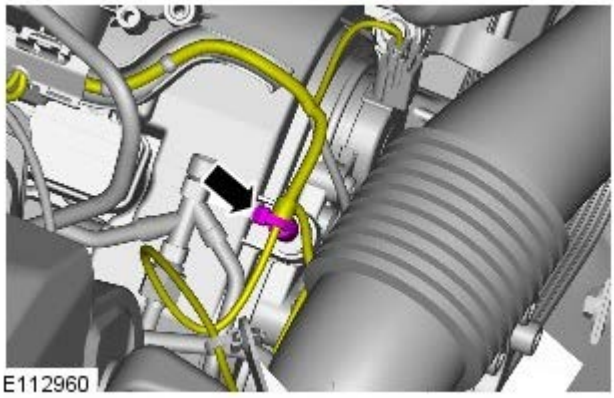
18. Refer to: Engine Mount RH (303-01B Engine - V8 5.0L Petrol, Removal and Installation).

19. NOTE: RH Drive vehicles only.

    Refer to: Steering Gear - V8 5.0L Petrol/V8 S/C 5.0L Petrol (211-02 Power Steering, Removal and Installation).

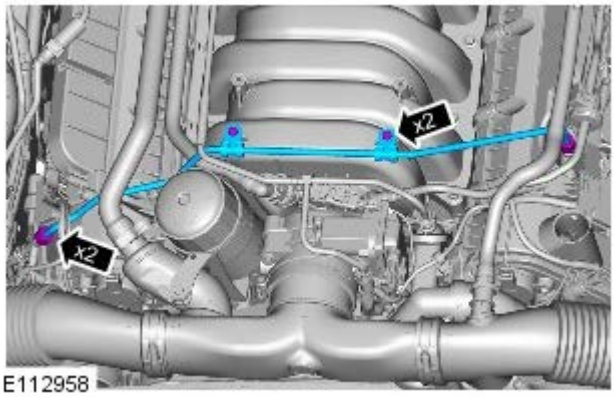
20. Lower the vehicle.

21.



22. NOTES:

    Lubricate the union threads with clean engine oil.

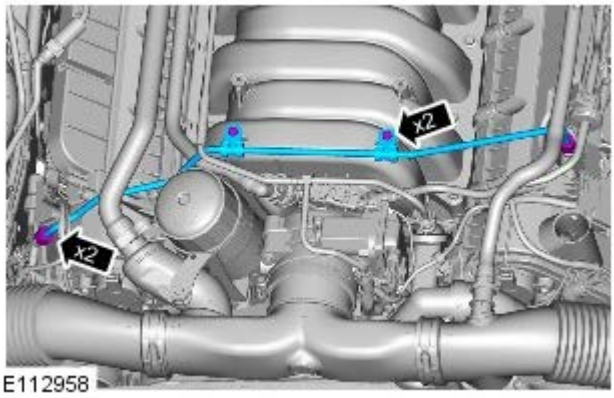


E112958

Do not tighten at this stage.

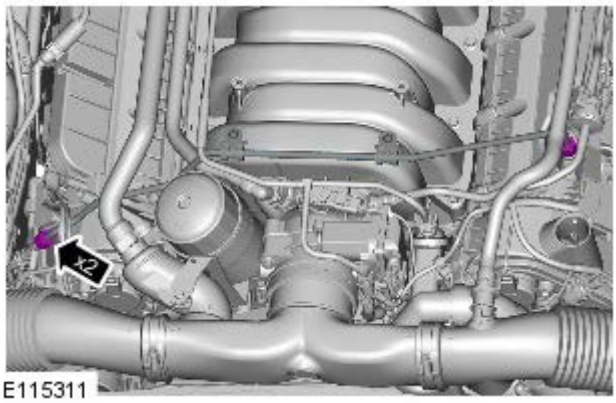
Remove and discard the blanking caps.

23. *Torque:*
    Unions 21 Nm
    Bolts 8 Nm



E112958

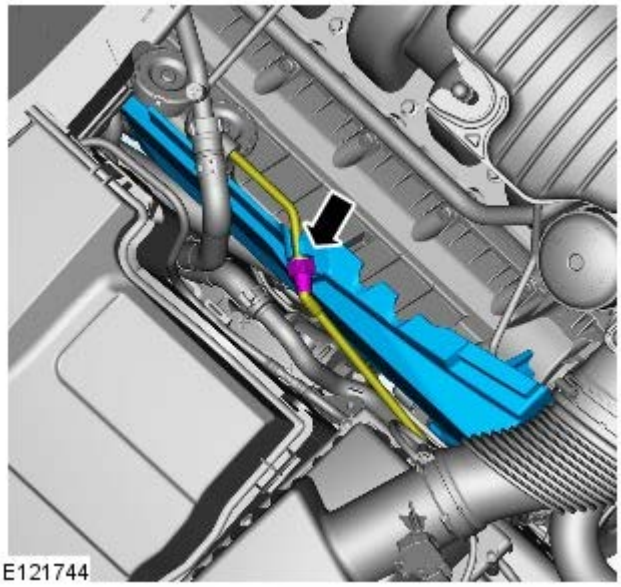
24. *Torque:* 21 Nm



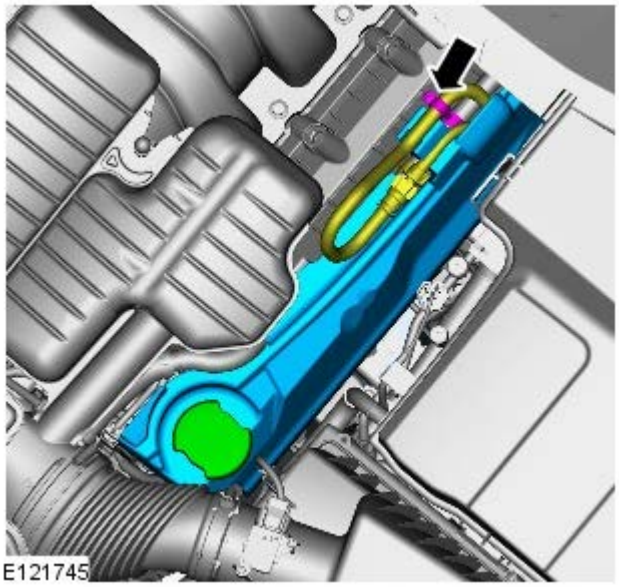
E115311

25. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

26.


E121744

27.



28. Refer to: Engine Oil Draining and Filling (303-01B Engine - V8 5.0L Petrol, General Procedures).

29. Connect the battery ground cable.

    Refer to: Specifications (414-00 Charging System - General Information, Specifications).

Published: 11-May-2011

Fuel Charging and Controls - V8 5.0L Petrol - Throttle Body

Removal and Installation

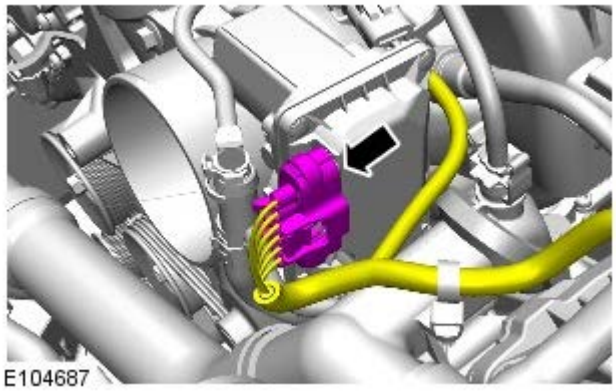
Removal

NOTES:

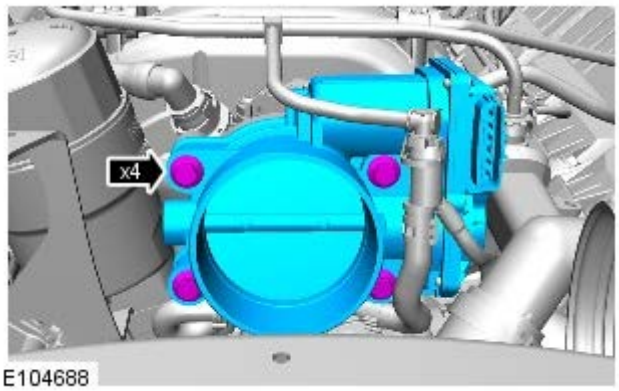
Removal steps in this procedure may contain installation details.

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

1. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12, Removal and Installation).

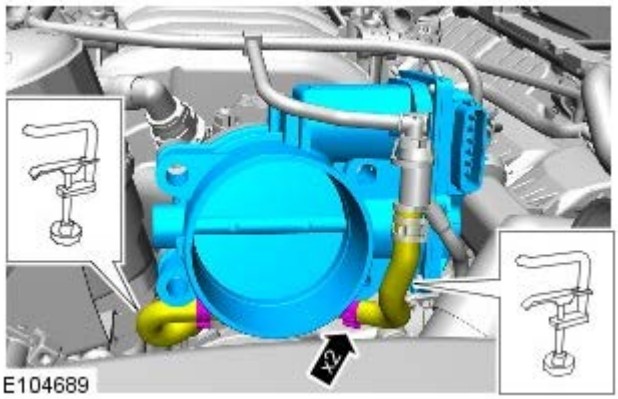


2. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



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

   Torque: 17 Nm



4. CAUTIONS:

   Do not attempt to clean the throttle body bore, build up of deposits reduces air leakage past the throttle plate at the fully closed position.

   Be prepared to collect escaping fluids.

   NOTES:

   Clamp the hose to minimize coolant loss.

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

Installation

1. To install, reverse the removal procedure.
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

Published: 11-May-2011

Fuel Charging and Controls - V8 S/C 5.0L Petrol -

Torque Specifications

WARNINGS:

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 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.

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

 NOTE: Tighten the fuel rail high pressure fuel pump fuel line unions and fuel rail crossover pipe unions as it is instructed in service manual.

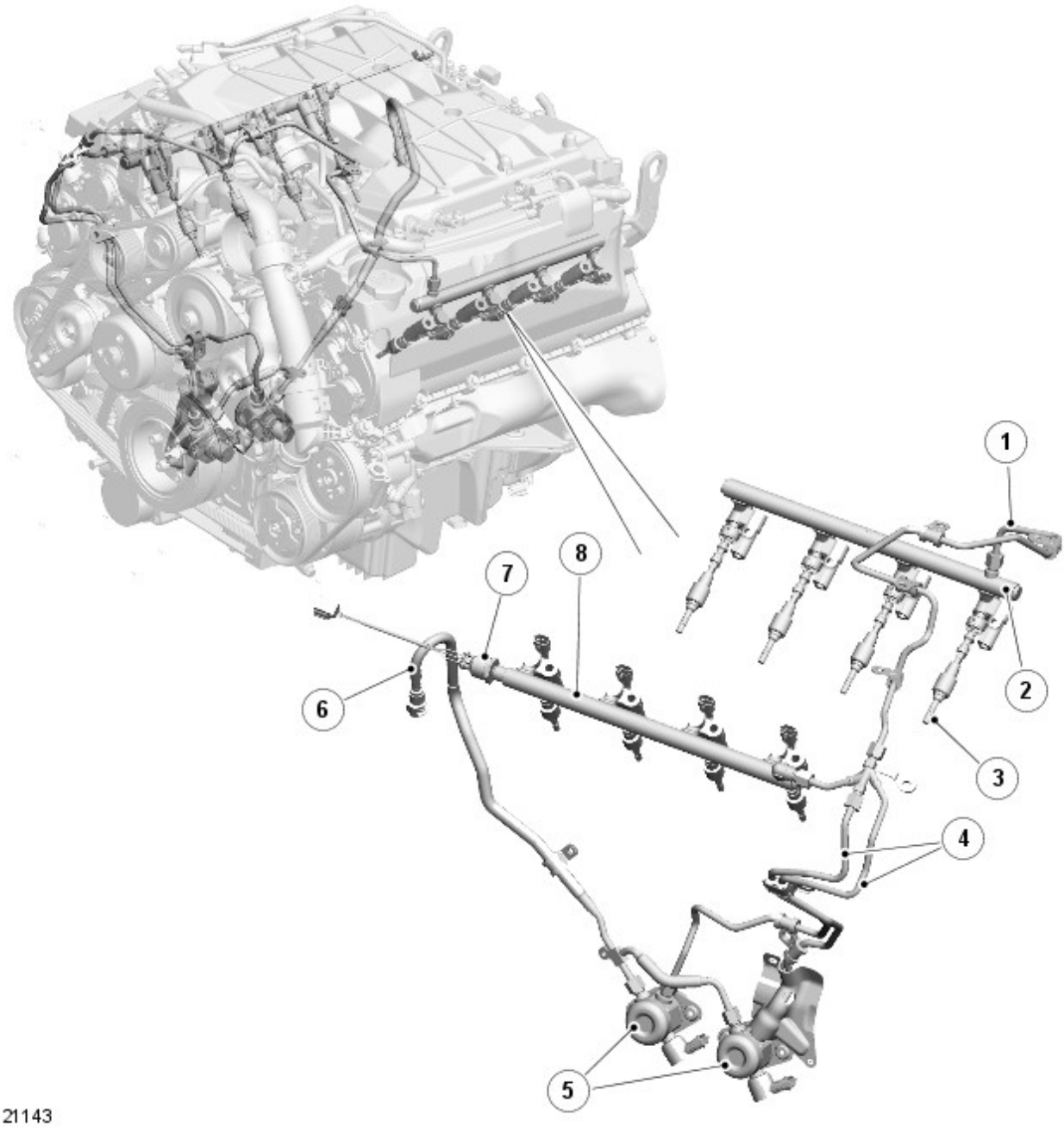
Description	Nm	lb-ft	lb-in
Ignition coil-on-plugs retaining bolts	7	-	62
Spark plugs	20	15	-
Fuel rail retaining bolt	Stage 1 - 20 Stage 2 - 30	Stage 1 - 15 Stage 2 - 22	-
Fuel rail crossover pipe unions	21	15	-
Fuel rail crossover pipe retaining bolts	12	9	-
Fuel pressure regulator	33	24	-
Fuel rail high pressure fuel pump fuel line unions	21	15	-
Fuel rail high pressure fuel pump fuel line M8 bolt	25	18	-
Fuel rail high pressure fuel pump fuel line M6 bolt	11	8	-
Fuel rail high pressure fuel pump fuel line M5 nut	6	-	53
Fuel rail high pressure fuel pump fuel line shield M10 bolt	29	21	-
Fuel rail high-pressure fuel pump fuel line shield M6 bolt	11	8	-
Fuel rail high pressure fuel pump torx bolts	12	9	-
Throttle body retaining bolts	10	7	-
Accessory drive belt idler pulley retaining bolts	25	18	-
Halfshaft bearing retaining bolts	22	16	-
Right-hand engine mount to front subframe retaining bolts	56	41	-
Right-hand engine mount bracket to engine mount retaining nut	100	74	-

Published: 15-Mar-2013

Fuel Charging and Controls - V8 S/C 5.0L Petrol - Fuel Charging and Controls

Description and Operation

COMPONENT LOCATION



E121143

Item	Part Number	Description
1	-	Crossover tube
2	-	LH (left hand) fuel rail
3	-	Fuel injector
4	-	HP (high pressure) fuel lines
5	-	HP fuel pumps and covers
6	-	LP (low pressure) fuel lines
7	-	FRP (fuel rail pressure) sensor
8	-	RH (right hand) fuel rail

INTRODUCTION

The fuel charging and controls system is a gasoline DI (direct injection) system controlled by the ECM (engine control module).

The fuel charging and controls system consists of:

- LP and HP fuel lines.
- Two HP fuel pumps.
- Two fuel rails and a crossover tube.
- A FRP (fuel rail pressure) sensor.
- Eight fuel injectors.

LP fuel from the pump in the fuel tank is pressurized by the HP fuel pumps and supplied to the fuel injectors via the fuel rails and crossover tube. The ECM controls the fuel injectors and HP fuel pumps to inject the required volume of fuel into the combustion chambers.

LOW AND HIGH PRESSURE FUEL LINES



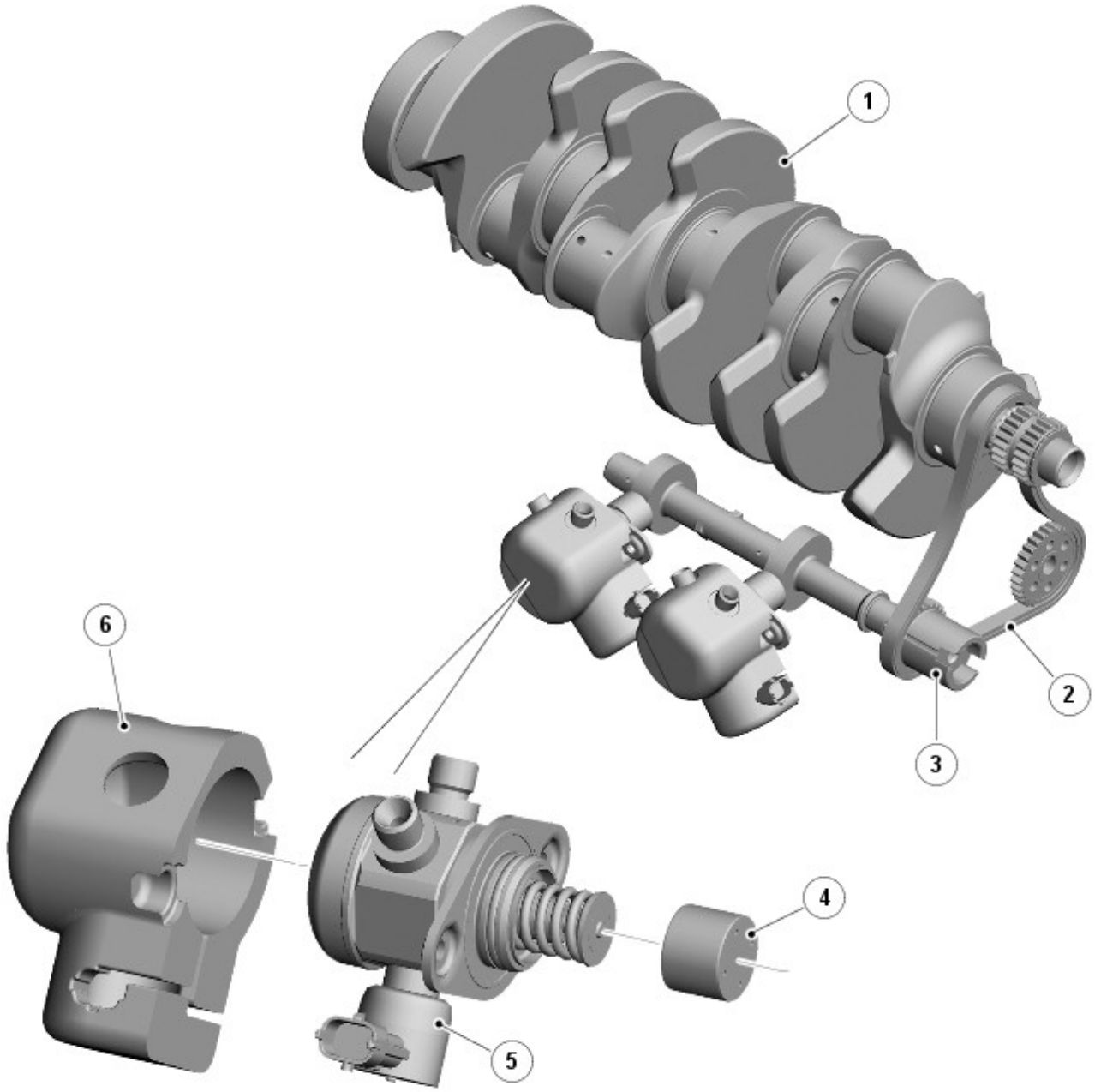
E122675

Item	Part Number	Description
A	-	LP fuel lines
B	-	HP fuel lines
1	-	Acoustic cover
2	-	Heat reflective and insulation sleeves

The LP fuel line connects the HP fuel pumps to the fuel delivery line from the fuel tank and lines system. A quick release connector at the start of the LP fuel line is held in a clip integrated into the LH (left-hand) ignition coils cover. P-clips secure the LP fuel line to the rear of each cylinder head and to the RH (right-hand) side of the cylinder block. A heat reflective and insulation sleeves are installed on the LP fuel line where it runs behind the RH exhaust manifold.

The HP fuel lines connect the HP fuel pumps to the RH fuel rail and the crossover tube. Two P-clips and a pipe clamp attach the HP fuel lines to the cylinder block and the RH cylinder head respectively. An integral bracket on the front HP fuel line is attached to a stud on the front-upper RH timing cover. An acoustic cover is installed on the bottom of the front HP fuel line.

HIGH PRESSURE FUEL PUMPS



E114701

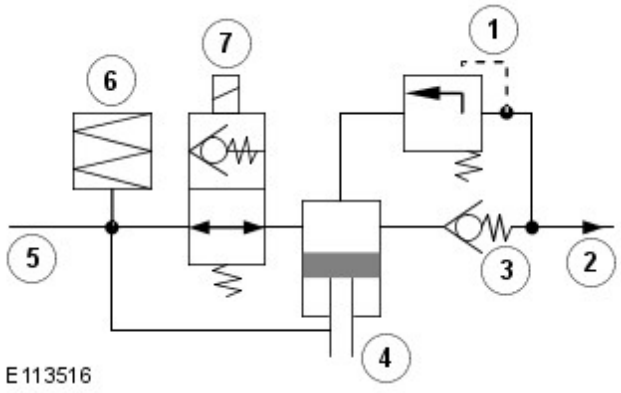
Item	Part Number	Description
1	-	Crankshaft
2	-	Auxiliary drive chain
3	-	Auxiliary camshaft
4	-	Tappet
5	-	HP fuel pump
6	-	Acoustic cover

The two HP fuel pumps are identical mechanically-driven pumps installed on the RH side of the sump body, behind the generator. An O-ring seals each of the HP fuel pumps in the sump body. The rear HP fuel pump is identified as No. 1 pump; the front HP fuel pump is identified as No. 2 pump. An acoustic cover is installed on each of the HP fuel pumps.

The HP fuel pumps are single-plunger pumps. The plunger of each pump extends through the sump body and the carrier of the auxiliary camshaft. A tappet on the end each plunger is operated by a two-lobe cam on the auxiliary camshaft. A spring installed on the outside of the plunger ensures the plunger and tappet remain in contact with the cam.

The auxiliary camshaft is driven by the crankshaft, via the auxiliary drive chain, at engine speed. The auxiliary camshaft is timed to match the pump delivery strokes with crankshaft position.

HP Fuel Pump Schematic



Item	Part Number	Description
1	-	PRV (pressure relief valve)
2	-	To HP fuel lines
3	-	Check valve
4	-	Plunger
5	-	From LP fuel lines
6	-	Damper chamber
7	-	Fuel metering valve

In addition to the plunger, each HP fuel pump contains:

- A damper chamber.
- A fuel metering valve.
- A check valve.
- A PRV.

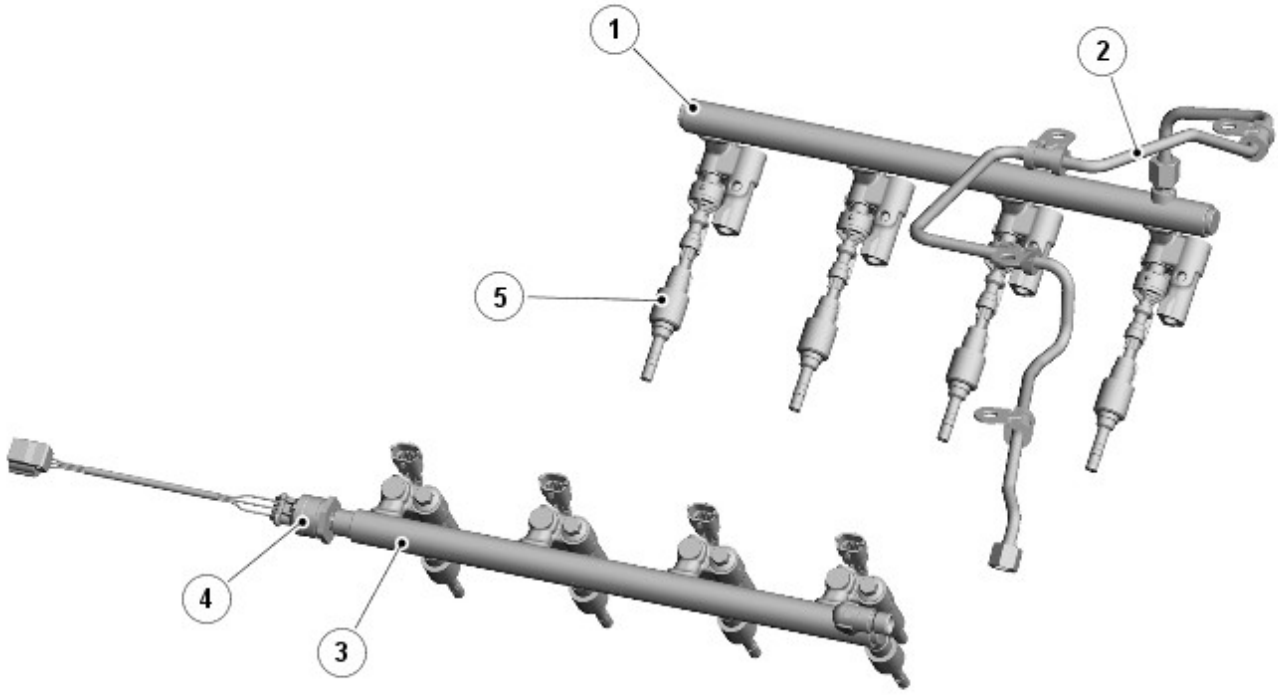
The damper absorbs pressure pulses from the plunger when the fuel metering valve is open at the start of the delivery stroke.

The fuel metering valve regulates the output pressure from the HP fuel pump. The fuel metering valve is a normally open solenoid valve controlled by the ECM. During the inlet stroke of the plunger the fuel metering valve is de-energized, which allows LP fuel into the pumping chamber. The ECM energizes the fuel metering valve closed during the delivery stroke of the plunger, which forces the fuel in the pumping chamber through the check valve into the HP lines. By changing the closing point of the fuel metering valve, the ECM can determine the volume of fuel output during the delivery stroke, and thus the pressure in the HP side of the system.

The check valve prevents the return of HP fuel to the pumping chamber during the inlet stroke of the plunger.

The PRV protects the HP side of the system from excessive pressure if there is a failure of the fuel metering valve. If the pump delivery pressure increases to 195 - 204 bar (2828 - 2959 lbf/in^2), the PRV opens and returns fuel to the inlet side of the plunger.

FUEL RAILS AND CROSSOVER TUBE



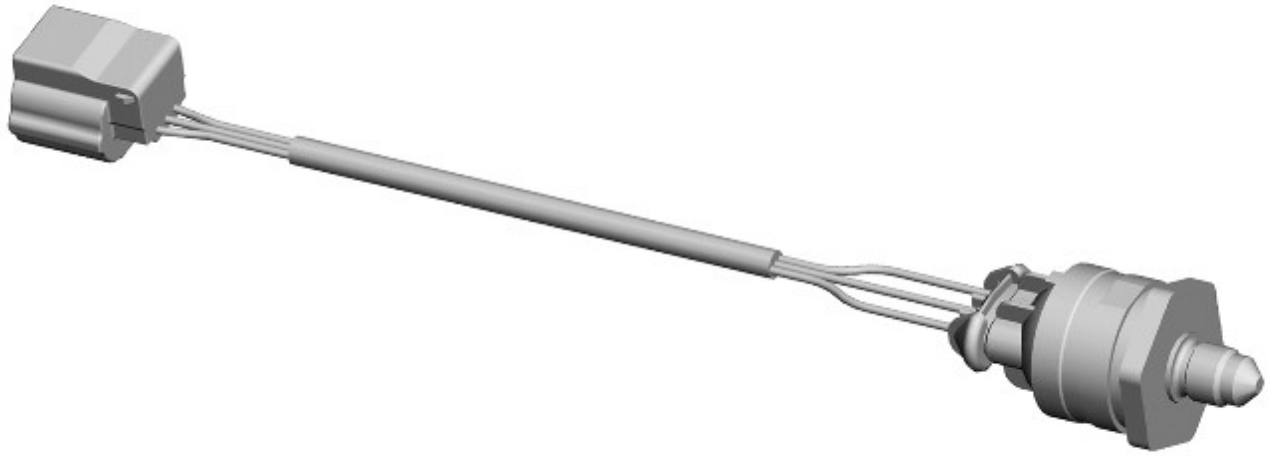
E113517

Item	Part Number	Description
1	-	LH fuel rail
2	-	Crossover tube
3	-	RH fuel rail
4	-	FRP sensor
5	-	Fuel injector

The fuel rails and crossover tube are made from stainless steel. Bolts attach each fuel rail to the related cylinder head. The crossover tube connects the front high pressure line to the LH fuel rail, which ensures there is equal pressure in the two fuel rails. Four P-clips attach the crossover tube to the intercooler-tank top.

The rear of the RH fuel rail incorporates a threaded boss for installation of the FRP sensor.

FUEL RAIL PRESSURE SENSOR

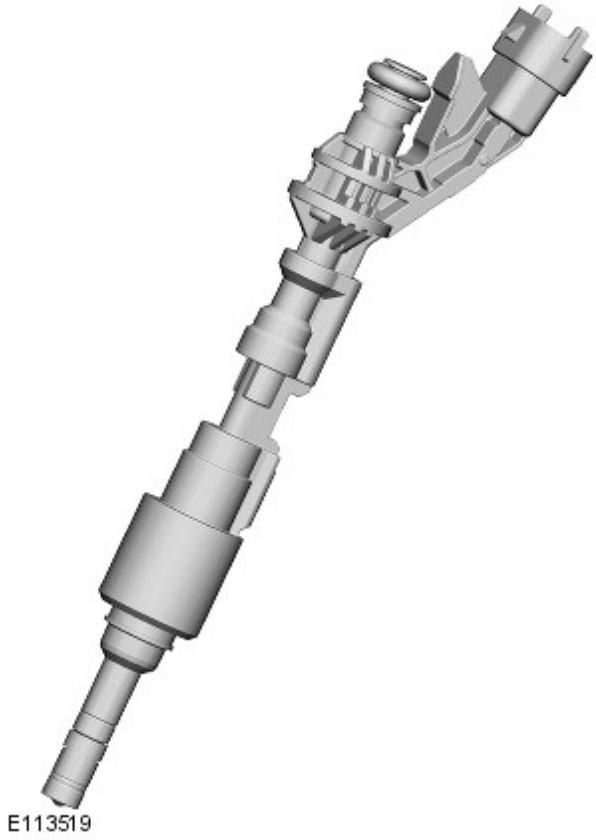


E113518

The FRP sensor provides the ECM with a continuous signal of fuel rail pressure. The FRP sensor is installed in the rear of the RH fuel rail. The FRP sensor is screwed into a threaded boss in the fuel rail. A flying lead and three pin connector provides the interface with the engine harness.

The FRP sensor contains a steel diaphragm fitted with strain gages, which are incorporated into a Wheatstone bridge. The output from the Wheatstone bridge is processed by the ECM to derive a pressure value.

FUEL INJECTORS



The fuel injectors spray fuel from the fuel rail directly into the combustion chambers. The fuel injectors are installed close to the center of the combustion chambers, between the inlet and exhaust valves and next to the spark plug.

The fuel injectors are a push fit in the fuel rails and the cylinder heads. On each fuel injector, a rubber O-ring seals the head of the fuel injector in the fuel rail. A teflon ring seals the nozzle of the fuel injector in the cylinder head. A clamp locks each fuel injector to the fuel rail.

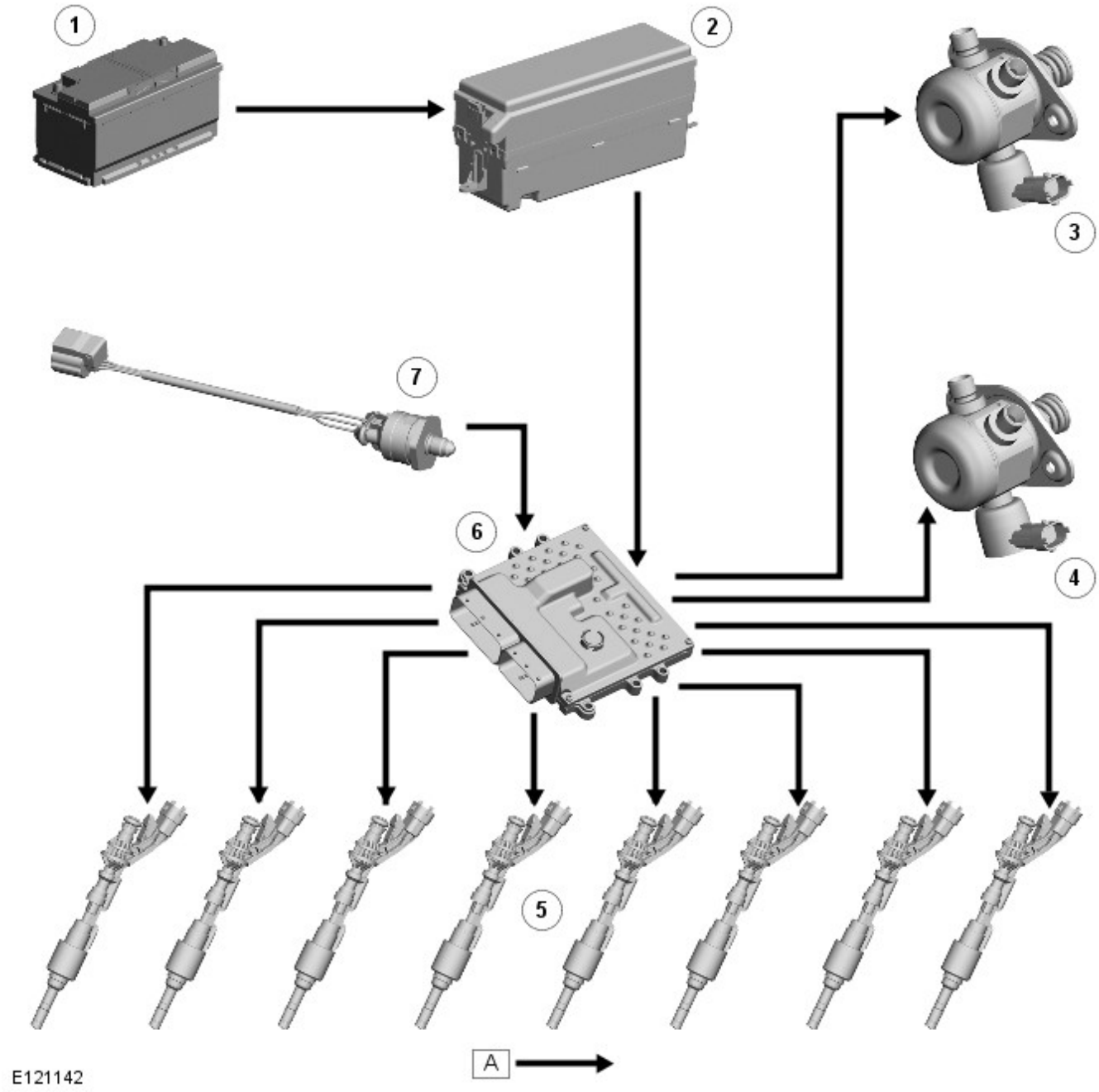
Each fuel injector contains a solenoid-operated needle valve, which opens when the solenoid winding is energized. While the needle valve is open, fuel is sprayed into the combustion chamber. The solenoid winding is connected to a power feed and a ground from the ECM, which operates the fuel injectors with a two stage power supply. Initially the ECM supplies the fuel injectors with 65 V, then once the boost current reaches 11 A the power supply is switched to battery voltage. The ECM meters the amount of fuel injected into the combustion chambers by adjusting the time that the solenoid winding is energized.

There are six holes around the tip of the nozzle through which the fuel is sprayed. Two of the holes direct fuel below the spark plug. The other four holes direct fuel evenly around the remainder of the combustion chamber.

If a fuel injector fails, the engine will suffer from unstable idle speed, poor NVH (noise, vibration and harshness) and poor emissions performance.

CONTROL DIAGRAM

NOTE: A = Hardwired



Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box) (ECM relay)
3	-	No. 1 HP fuel pump
4	-	No. 2 HP fuel pump
5	-	Fuel injectors
6	-	ECM
7	-	FRP sensor

PRINCIPLES OF OPERATION

The ECM controls the output from the HP fuel pumps to deliver the required volume of fuel at pressures up to 150 bar (2175 lbf/in^2).

The ECM uses the signal from the FRP sensor to calculate the time the fuel injectors need to be energized to deliver the correct mass of fuel to the combustion chambers.

Published: 15-Aug-2012

Fuel Charging and Controls - V8 S/C 5.0L Petrol - Fuel Charging and Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Fuel Charging and Controls (303-04D Fuel Charging and Controls - V8 S/C 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

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, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	• 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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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	• Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant 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 condition • Ensure the battery is in a fully charged and serviceable condition • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Difficult hot start	• Injector leak • Electronic engine control	• Check for injector leak, install new injector as required • Using the manufacturer approved diagnostic

	• Purge valve • Fuel pump • Ignition system • EGR valve stuck open	system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system • EGR valve stuck open	• Check for injector leak, install new injector as required • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check for blockage in air filter element and air intake system • Check for air leakage in air intake system
Engine hesitates/poor acceleration	• Fuel pressure, fuel pump, fuel lines • Injector leak • Air leakage • Electronic engine control • Throttle motor • Restricted accelerator pedal travel (carpet, etc) • Ignition system • EGR valve stuck open • Transmission malfunction	• Check for fuel system related DTCs and refer to the relevant DTC Index • Check for injector leak, install new injector as required • Check for air leakage in air intake system • Ensure accelerator pedal is free from restriction • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Engine backfires	• Fuel pump/lines • Air leakage • Electronic engine controls • Ignition system • Sticking Variable Camshaft Timing (VCT) hub	• Check for fuel system failures • Check for air leakage in intake air system • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Engine surges	• Fuel pump/lines • Electronic engine controls • Throttle motor • Ignition system	• Check for fuel system failures • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Engine detonates/knocks	• Fuel pump/lines • Air leakage • Electronic engine controls • Sticking VCT hub	• Check for fuel system failures • Check for air leakage in intake air system • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
No throttle response	• Electronic engine controls • Throttle motor	• Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM), Transmission Control Module (TCM), and Anti-lock Brake System control module (ABS) for related DTCs and refer to the relevant DTC index. Check for air leakage in intake air system • Check for air leakage in intake air system

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 11-May-2011

Fuel Charging and Controls - V8 S/C 5.0L Petrol - Fuel Injection Component Cleaning

General Procedures

General Equipment

Pneumatic vacuum gun

Cleaning

WARNINGS:

 Do not carry out any repairs to the fuel system with the engine running. Failure to follow this instruction may result in personal injury.

 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.

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

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

 Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

 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.

CAUTIONS:

 Before using the cleaning fluid, protect all electrical components and connectors with lint-free non-flocking material.

 Make sure that all parts removed from the vehicle are placed on the lint-free non-flocking material.

 Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.

 Make sure that clean non-plated tools are used. Clean tools using a new brush that will not lose its bristles, prior to starting work on the vehicle.

 Use a steel topped workbench and cover it with clean, lint-free non-flocking material.

 Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

1. Using a new brush that will not lose its bristles, brush the components being removed and the surrounding area.
2. Using a pneumatic vacuum gun, remove all traces of foreign material.

General Equipment: Pneumatic vacuum gun

Published: 20-Jun-2012

Fuel Charging and Controls - V8 S/C 5.0L Petrol - Fuel Injection Component Cleaning Using Pressure Cleaner

General Procedures

Cleaning

WARNINGS:

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

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

Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

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.

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.

CAUTIONS:

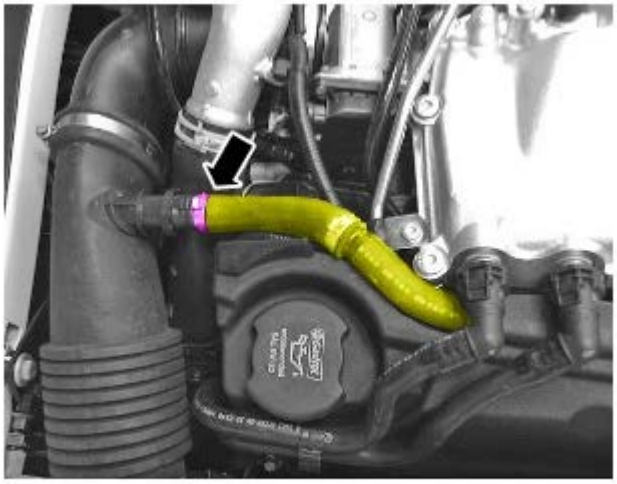
Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.

Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

Before using the cleaning fluid, protect all electrical components and connectors with lint-free non-flocking material.

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

1. CAUTION: Make sure the correct additive is used in this step. Failure to carry out this instruction may cause damage to the vehicle.
   - Open the fuel filler door and remove the cap.
   - Empty the fuel additive into the fuel filler pipe.
   - Install the fuel filler cap and close the fuel filler door.
2. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Release the breather from the air intake elbow.



E138648

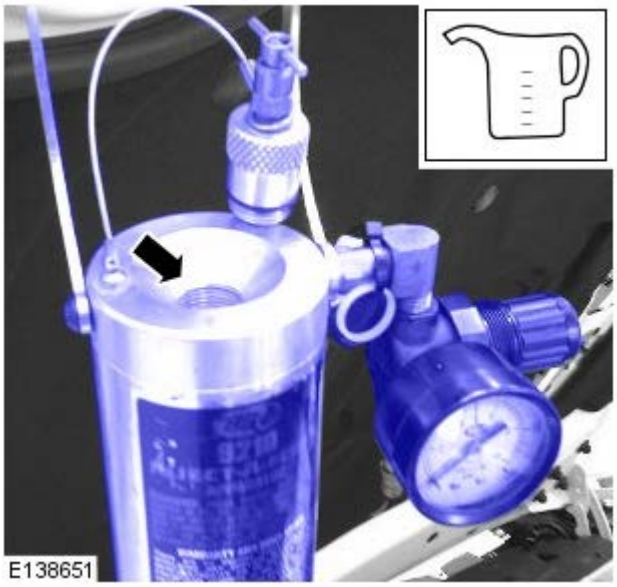


E138649

4. CAUTION: Make sure the correct additive is used in this step. Failure to carry out this instruction may cause damage to the vehicle.

   Install the cleaning equipment to a suitable location under the hood.

5.
   - Remove the cleaning equipment filler cap.
   - Empty the induction system cleaning fluid into the cleaning equipment.
   - Install the filler cap.


E138651

6. Position the intake system cleaning tool into intake elbow and secure with the clamp.


E138650

7.
- Connect a suitable compressed air line to the cleaning equipment.
- Set the pressure to 4 bar.



E138652

8. Start and run the engine.

9.
- Open the ball valve on the cleaning equipment and allow the cleaning fluid to spray into the intake elbow.

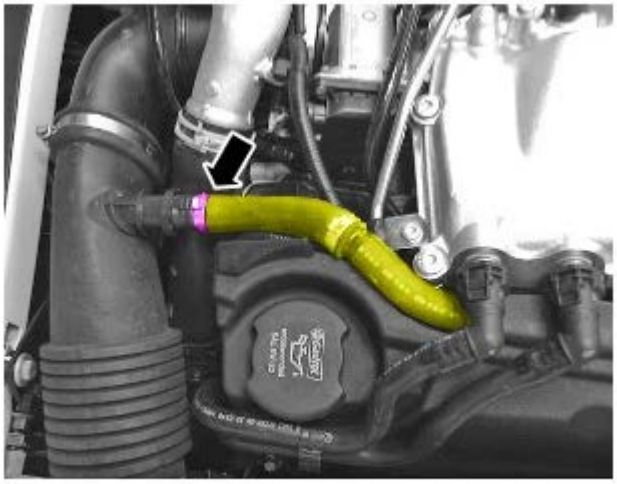


E138653

Raise the engine speed to 1200 rpm and hold until the cleaning fluid spray has stopped.

10.
- Close the ball valve.
- Release the air pressure in the cleaning equipment.
- Disconnect the air line.

11. Connect the breather to the air intake elbow.


E138648

12. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

13.
- 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 70ºC is achieved.
- Allow the engine to idle for 30 seconds.
- Switch off the engine.

14. Connect the approved diagnostic equipment to the vehicle.

15. Follow on screen prompts and check for DTC's (Diagnostic

Trouble Codes).

16. Clear the DTC's following the on screen procedure.
17. Disconnect the approved diagnostic equipment from the vehicle.

Published: 11-May-2011

Fuel Charging and Controls - V8 S/C 5.0L Petrol - Fuel Injectors

Removal and Installation

Removal

1. Refer to: Fuel Rail LH (303-04, Removal and Installation).

Installation

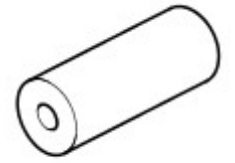
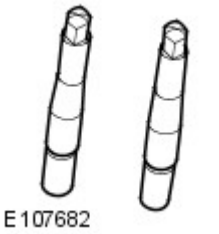
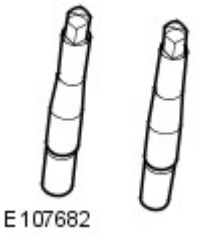
1. Refer to: Fuel Rail LH (303-04, Removal and Installation).

Published: 07-Jun-2012

Fuel Charging and Controls - V8 S/C 5.0L Petrol - Fuel Rail LH

Removal and Installation

Special Tool(s)

 E115268	303-1450 Spark Plug Remover/Installer
 E114526	310-197 Remover, Fuel Injector
 E107680	310-198 Installer, Teflon Seal
 E107681	310-199 Re-shape Tool, Teflon Seal
 E107682	310-200-01 Fuel Rail Installation Guide Pins - Threaded
 E107682	310-200-02 Fuel Rail Installation Guide Pins - Unthreaded

Removal

CAUTIONS:

Make sure that tools and equipment are clean and free of foreign material and lubricant.

Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

NOTES:

Removal steps in this procedure may contain installation details.

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

All vehicles

1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

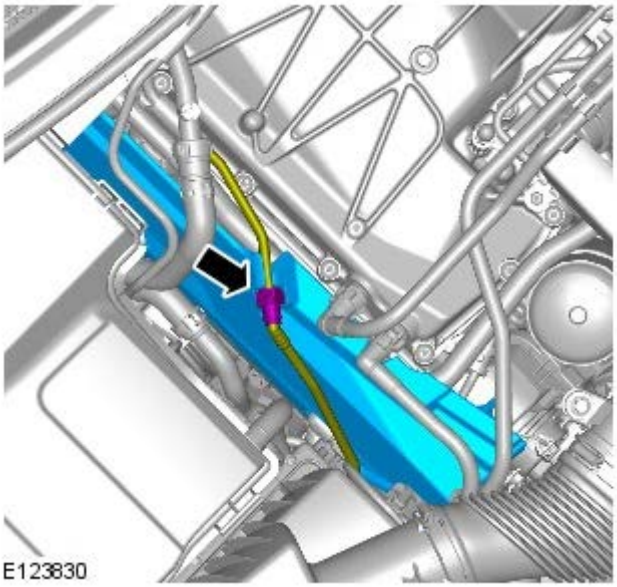
2. Refer to: Fuel System Pressure Release - V8 5.0L Petrol/V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

3. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

4. Disconnect the battery ground cable.

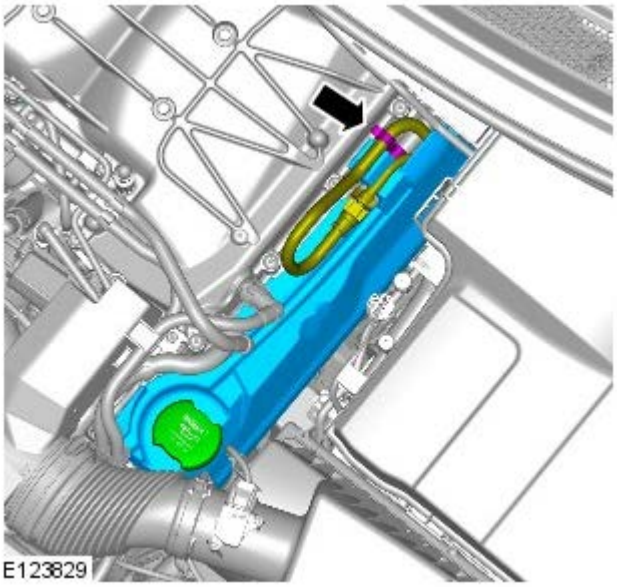
   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

5. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).



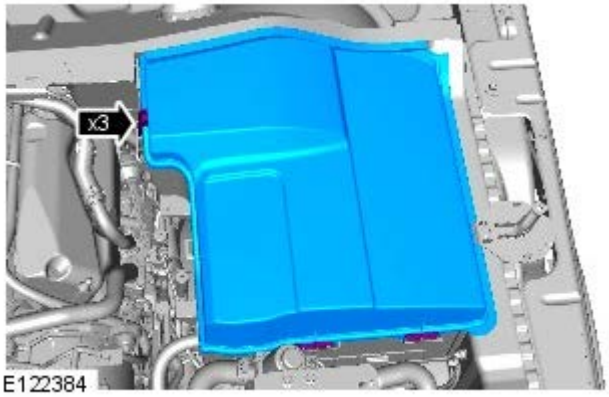
6. CAUTION: Be prepared to collect escaping fluids.

7.



8. Refer to: Evaporative Emission Canister Purge Valve - V8 S/C 5.0L Petrol (303-13 Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

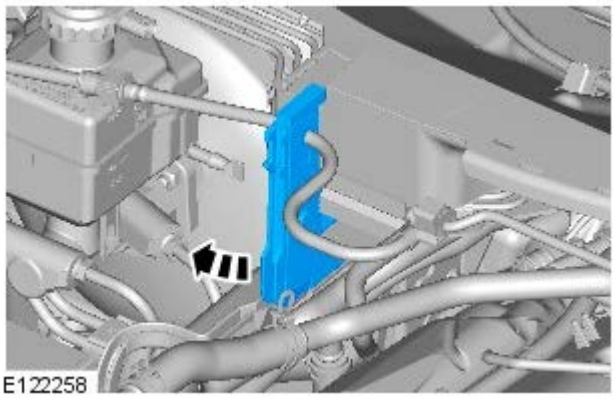
9.



Right-hand drive vehicles

10. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

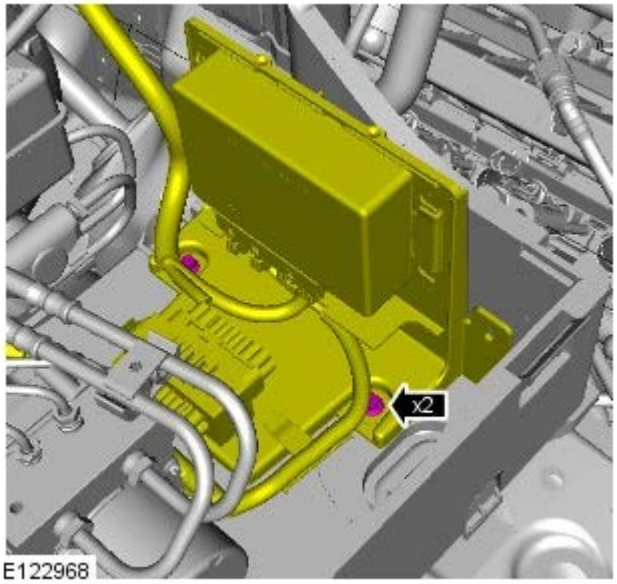
Left-hand drive vehicles



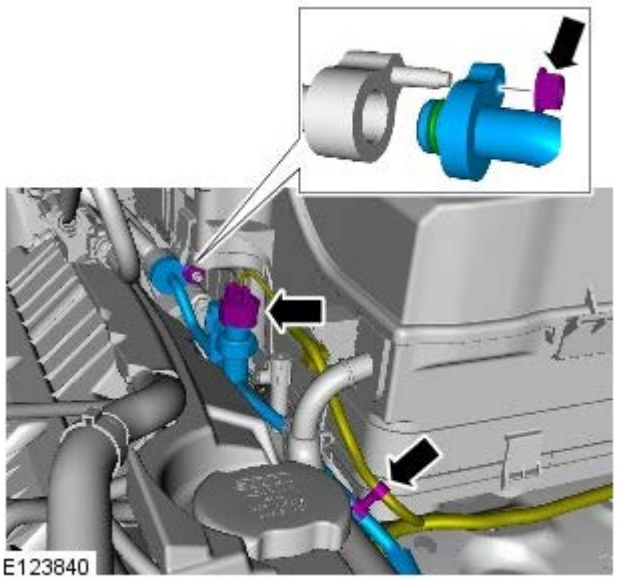
11. NOTE: Right-hand shown, left-hand similar.

12. NOTE: Right-hand shown, left-hand similar.

Torque: 10 Nm



All vehicles

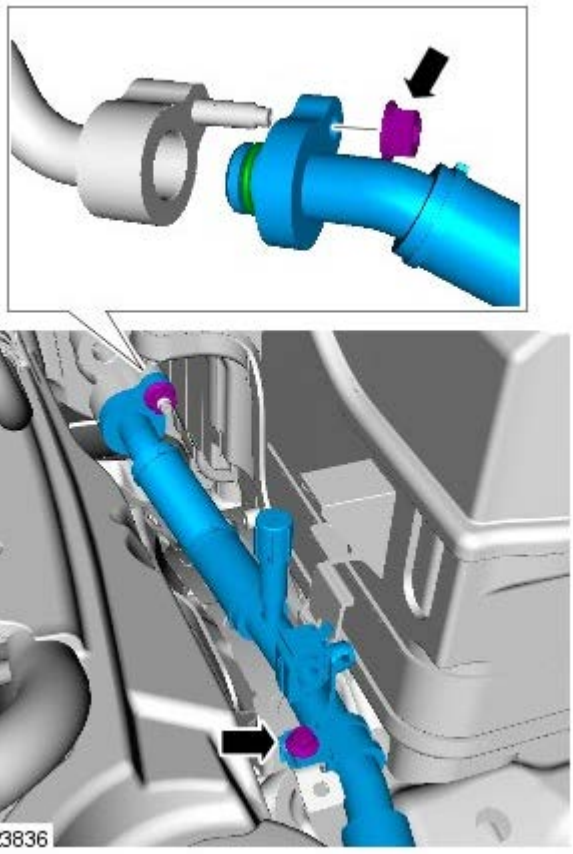


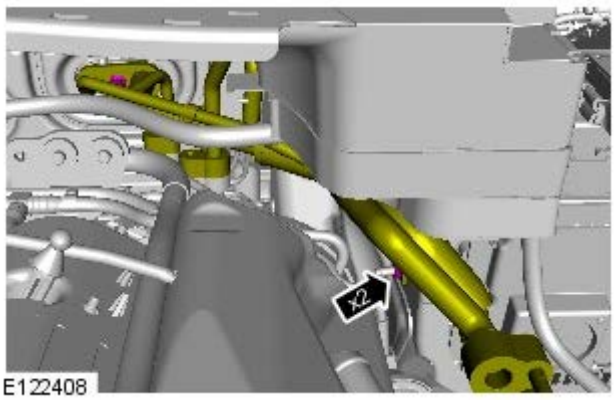
13. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

    Discard the O-ring seal.

14. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

    Discard the O-ring seal.

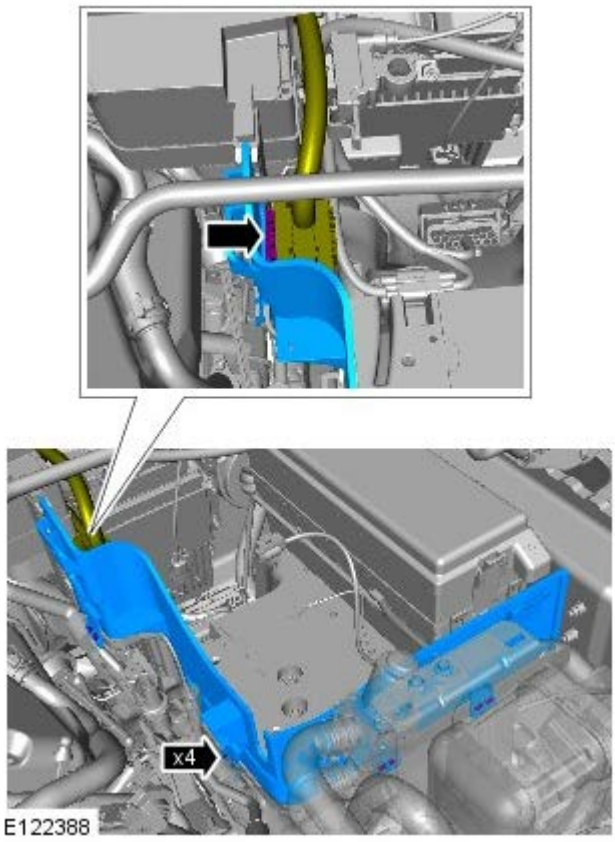




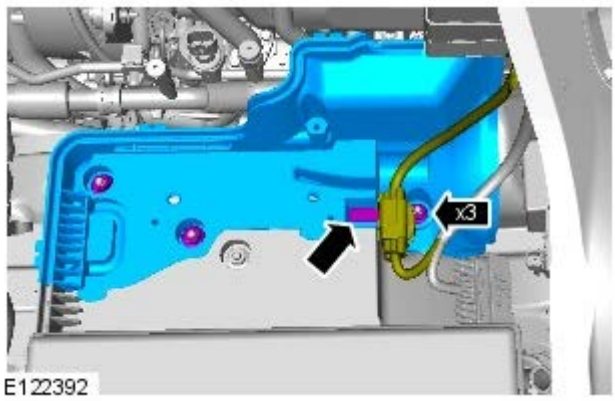
15. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

    Discard the O-ring seal.

16.

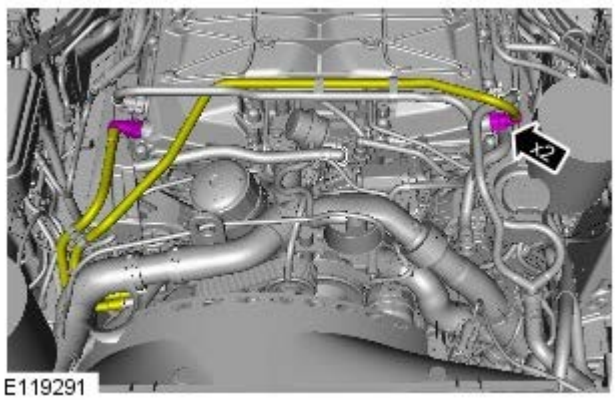


17.

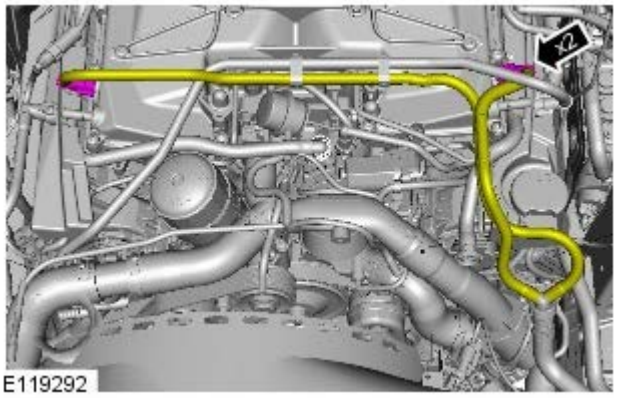


18. Refer to: Fuel Injection Component Cleaning (303-04D Fuel Charging and Controls - V8 S/C 5.0L Petrol, General Procedures).

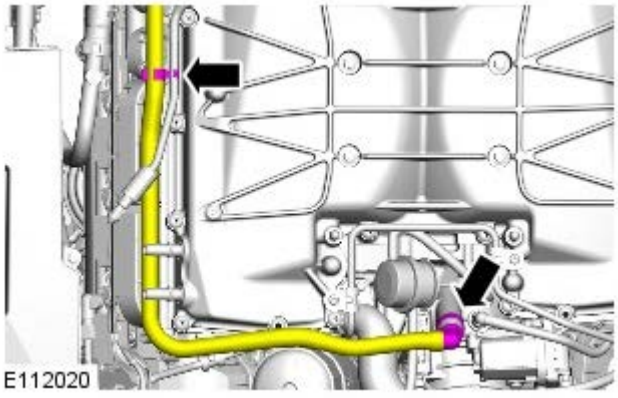
19.



20.



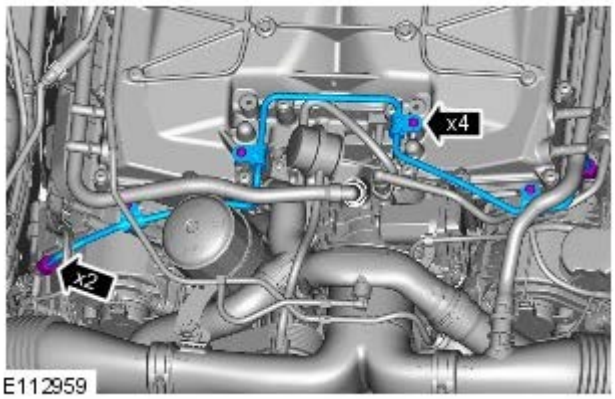
21.



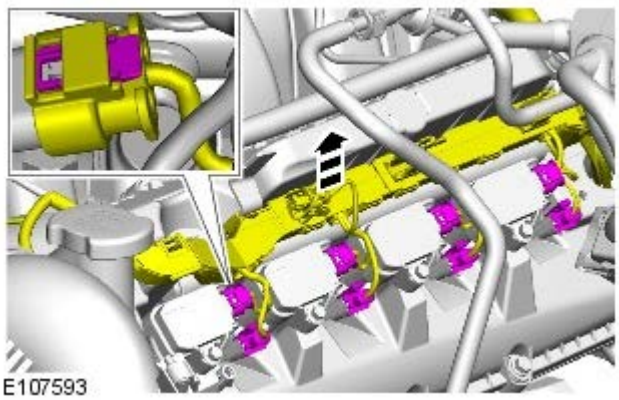
22. CAUTIONS:

Make sure that all openings are sealed. Use new blanking caps.

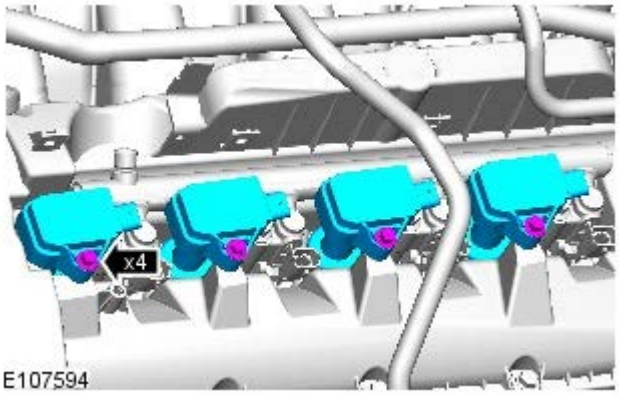
Be prepared to collect escaping fluids.



23.

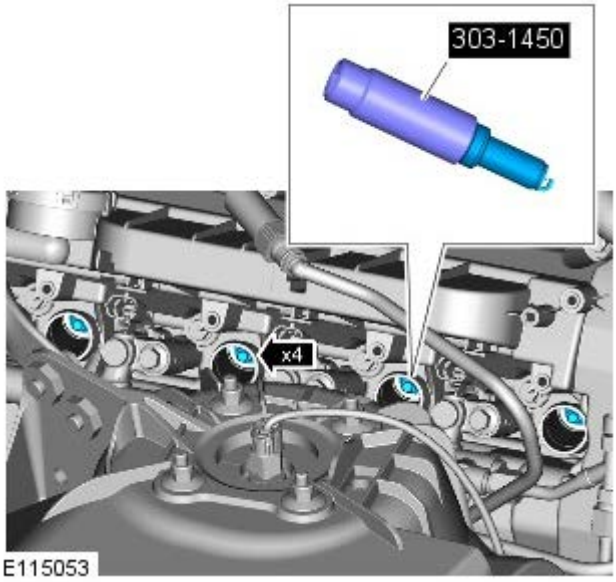


24.

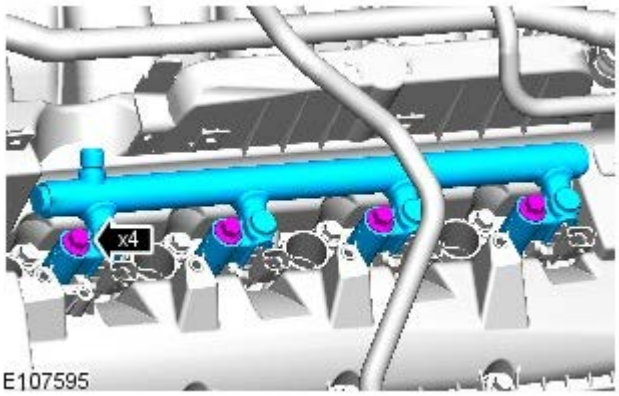


25. NOTE: RH illustration shown, LH is similar.

Special Tool(s): 303-1450



26. CAUTION: Make a note of the fuel injector clamp alignment to the fuel rail prior to removal.



27. CAUTIONS:

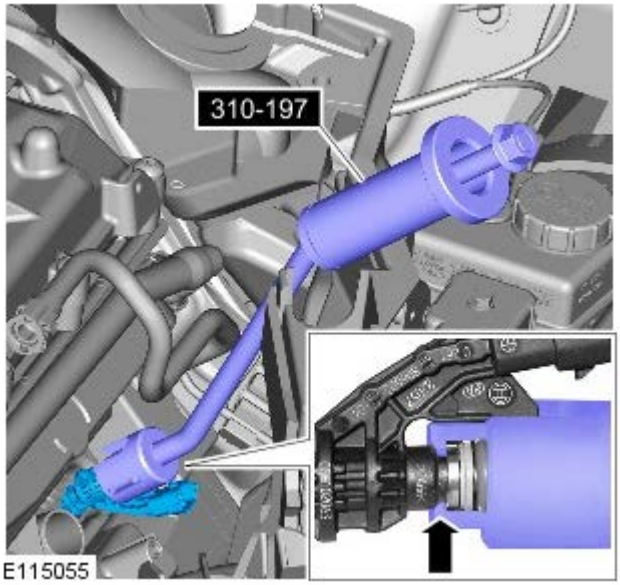
Make sure that the special tool is located correctly to the fuel injector prior to removing the fuel injector.

Make sure that the special tool is held square to the fuel injector during removal.

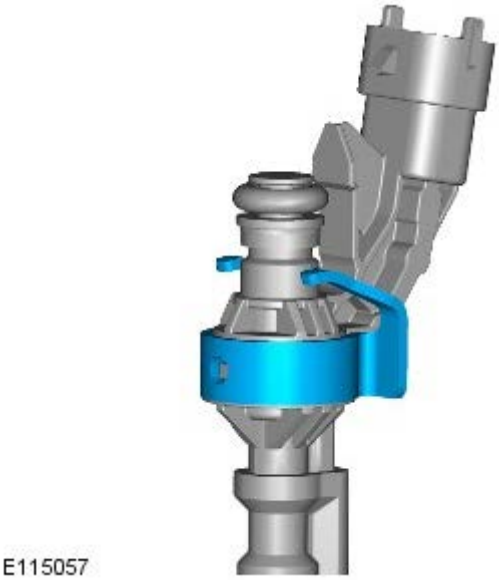
Make sure that all open ports are covered to prevent any foreign material ingress.

NOTE: RH illustration shown, LH is similar.

Special Tool(s): 310-197



E115055


E115057

28. CAUTIONS:

    If new fuel injectors are installed, a new injector clamp must be installed.

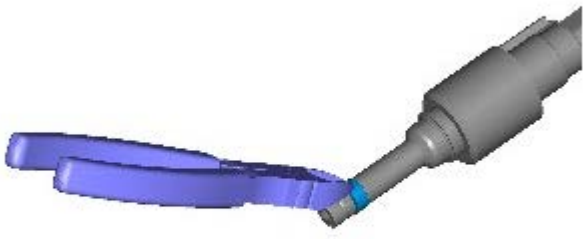
    If the fuel injector is being removed without a new component being installed, the fuel injector clamp must remain with the fuel injector it is removed with.

29. CAUTIONS:

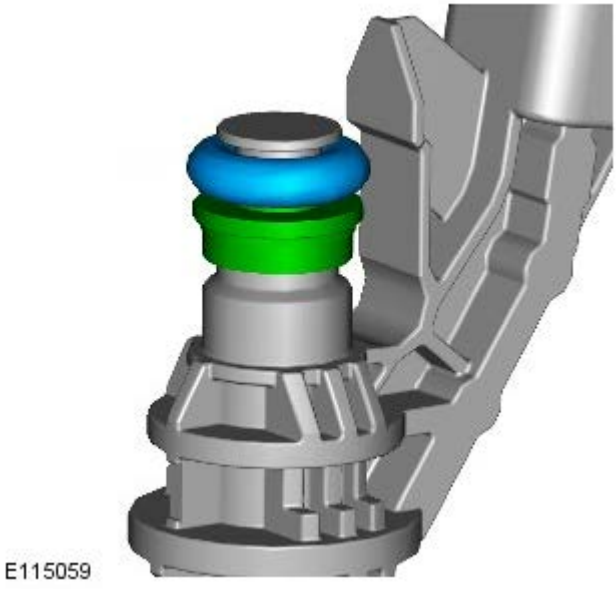
    Do not use a knife to remove the Teflon seal as damage could occur to the fuel injector.

    Do not cut the Teflon seal to deep as damage could occur to the fuel injector.

    Pinch the Teflon seal to allow the tool to cut the Teflon seal without damaging the fuel injector.


E115058

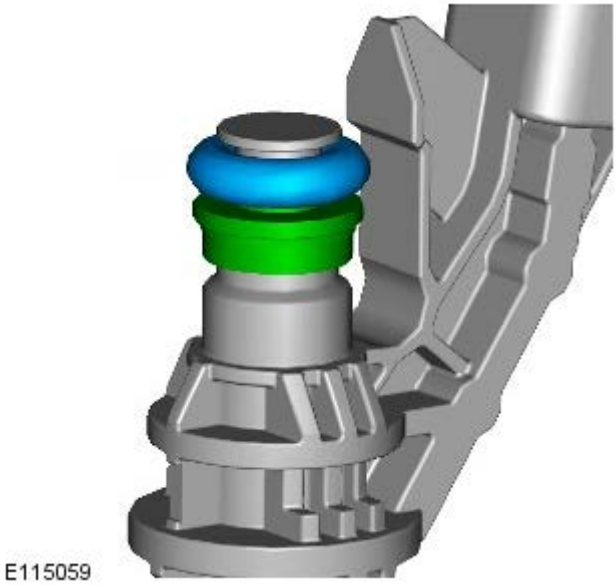
30. CAUTION: Do not use any sharp tools to remove the O-ring seal as damage could occur to the fuel injector.



Installation

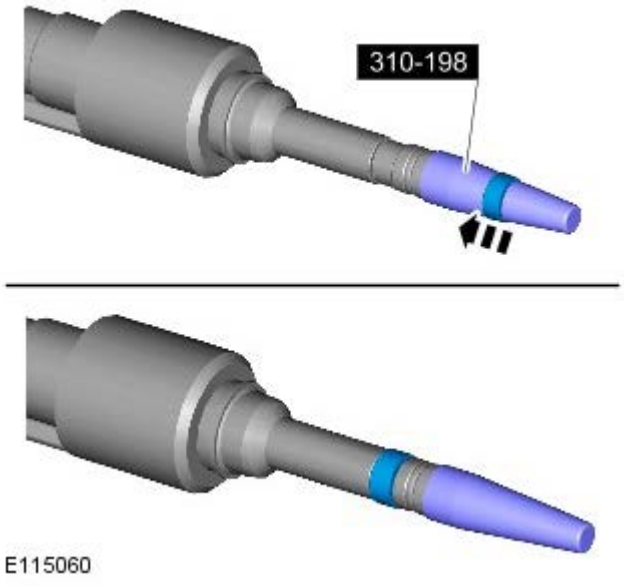
All vehicles

1. Install new O-ring seals.

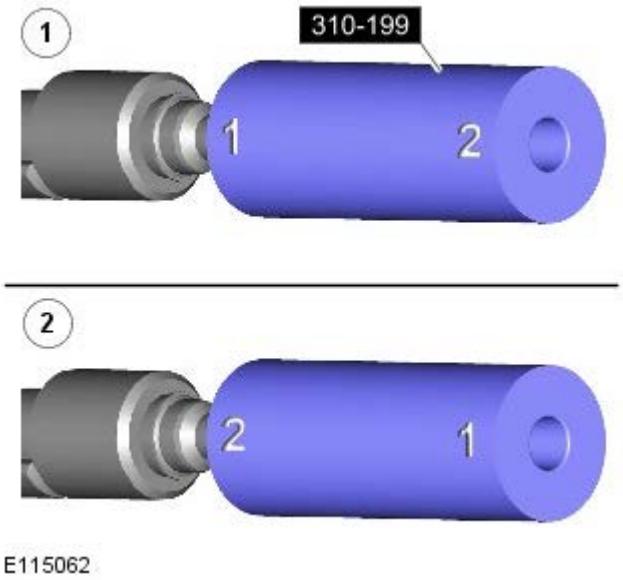


2. Install new Teflon seals.

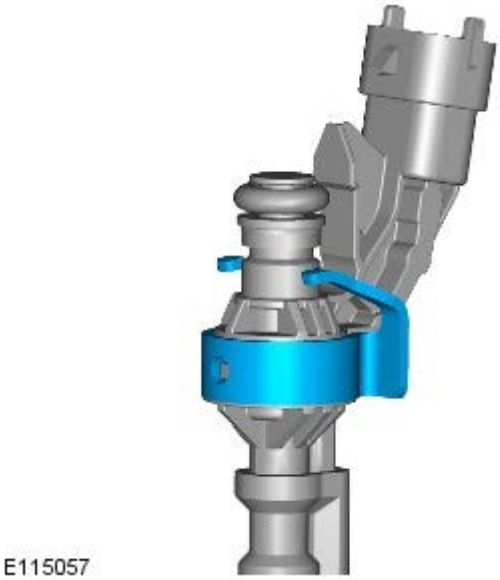
Special Tool(s): 310-198



3. *Special Tool(s):* 310-199

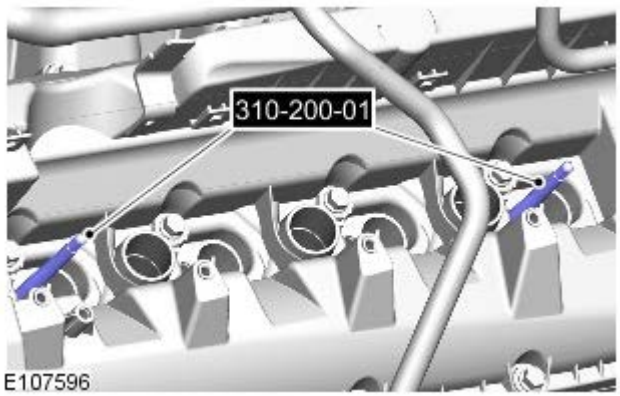


E115062



E115057

4. CAUTION: If the original fuel injector is being installed, the original fuel injector clamp must installed with the fuel injector it was removed with.



E107596

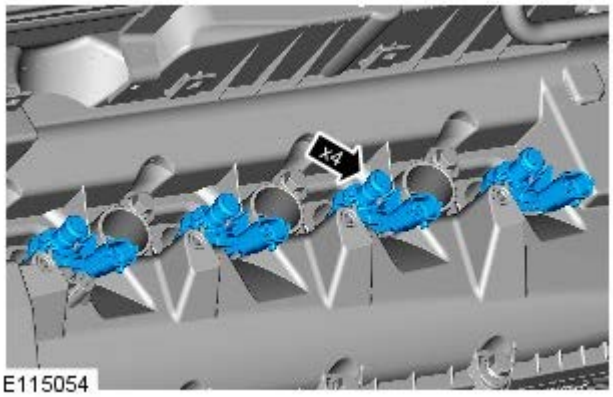
5. CAUTION: If a new cylinder head has been installed then the special tool 310-200-02 without the thread must be used to install the fuel rail.

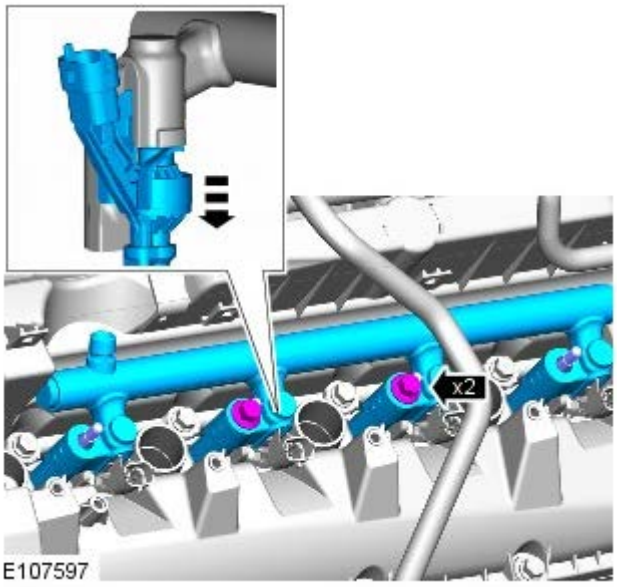
Special Tool(s): 310-200-01, 310-200-02

6. CAUTIONS:

Make sure that the area around the open fuel injector ports are clean and free of foreign material and lubricant prior to installing the fuel injector.

When installing the fuel injector(s), make sure that the Teflon seal is clean and free of foreign material and lubricant.





7. CAUTIONS:

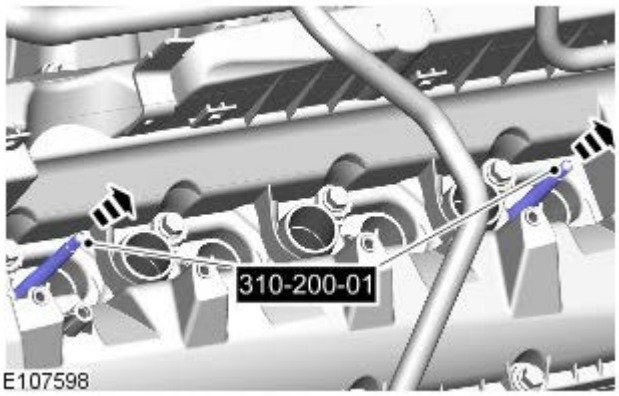
   If new fuel injectors are installed, a new injector clamp must be installed.

   Make sure that the fuel injector is aligned and installed into the fuel rail correctly, as noted in the removal step.

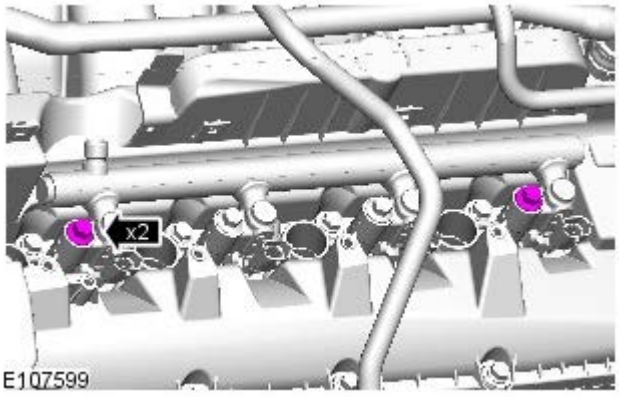
   Tighten the fuel rail retaining bolts a turn at a time until the correct torque is achieved.

   NOTE: Lubricate the fuel injector O-ring seals with clean engine oil.

   Torque: 20 Nm

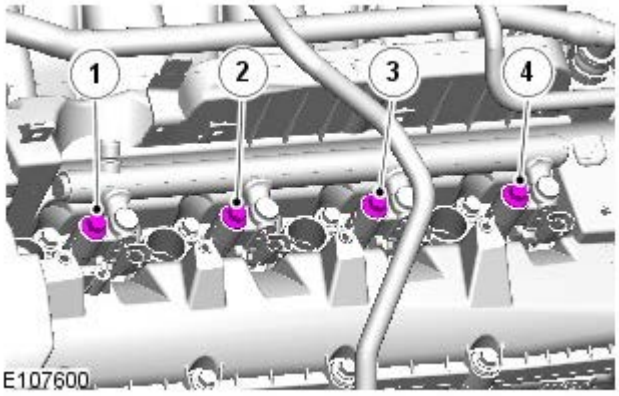


8. *Special Tool(s):* 310-200-01, 310-200-02



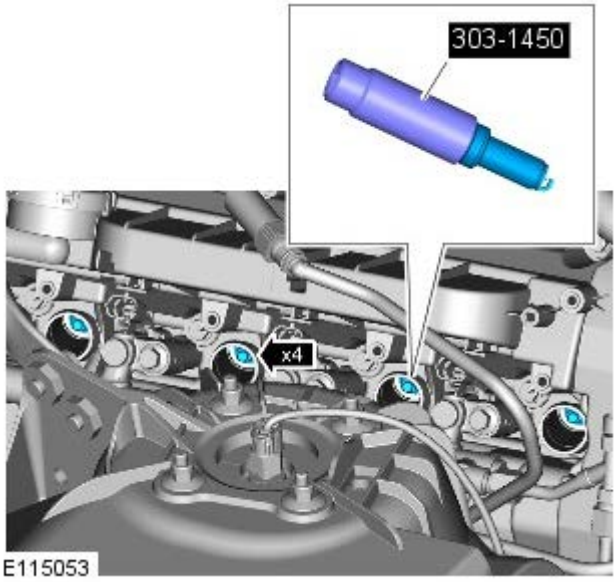
9. *Torque:* 20 Nm

10. NOTE: Tighten the bolts in the indicated sequence.



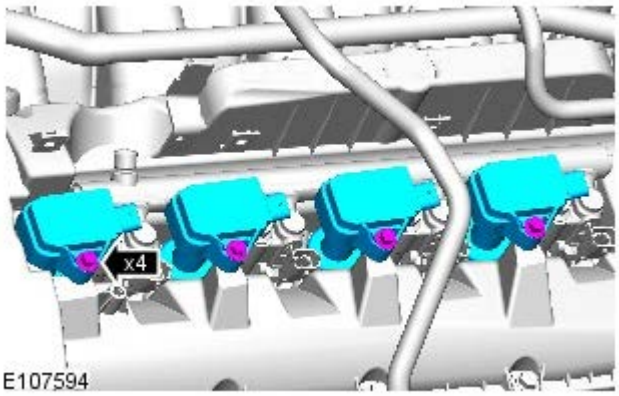
Torque:
Bolt 2 30 Nm
Bolt 3 30 Nm
Bolt 1 30 Nm
Bolt 4 30 Nm

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

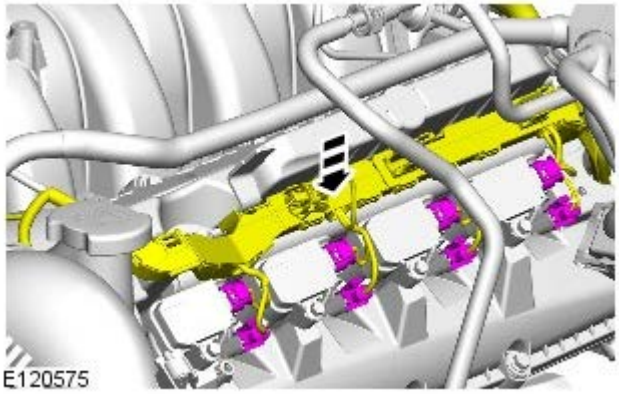


Special Tool(s): 303-1450
Torque: 20 Nm

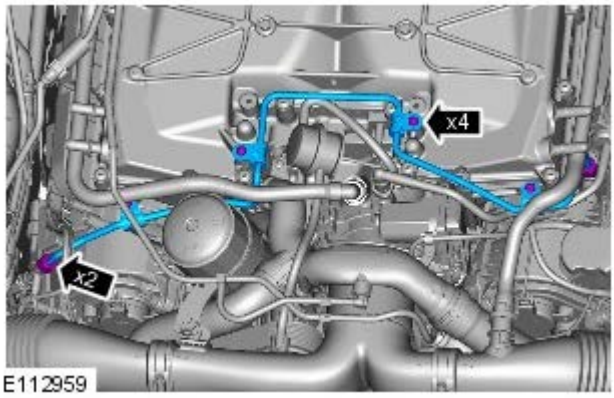
12. *Torque:* 7 Nm



13.



14. CAUTION: Lubricate only the union threads with clean engine oil.

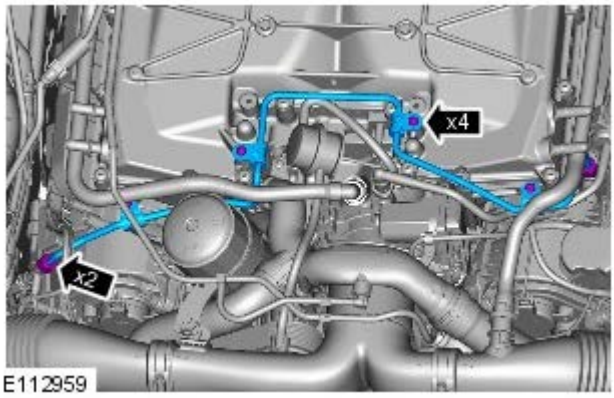


NOTES:

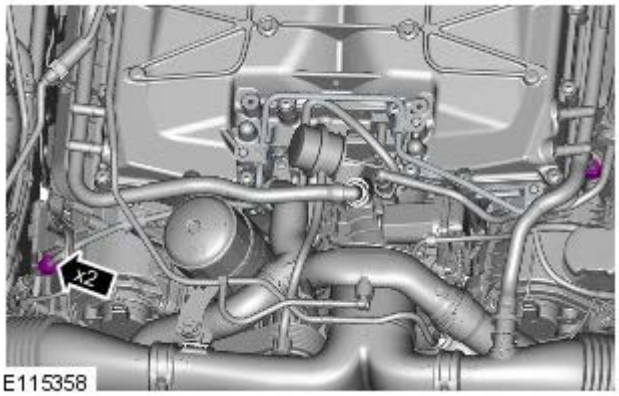
△ Do not tighten at this stage.

△ Remove and discard the blanking caps.

15. *Torque:*
    Unions 21 Nm
    Bolts 8 Nm

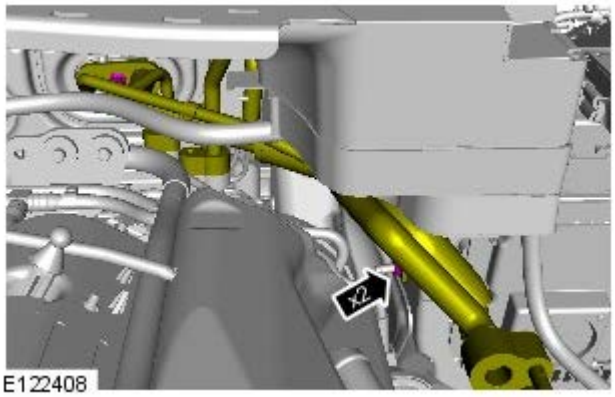


16. *Torque:* 21 Nm



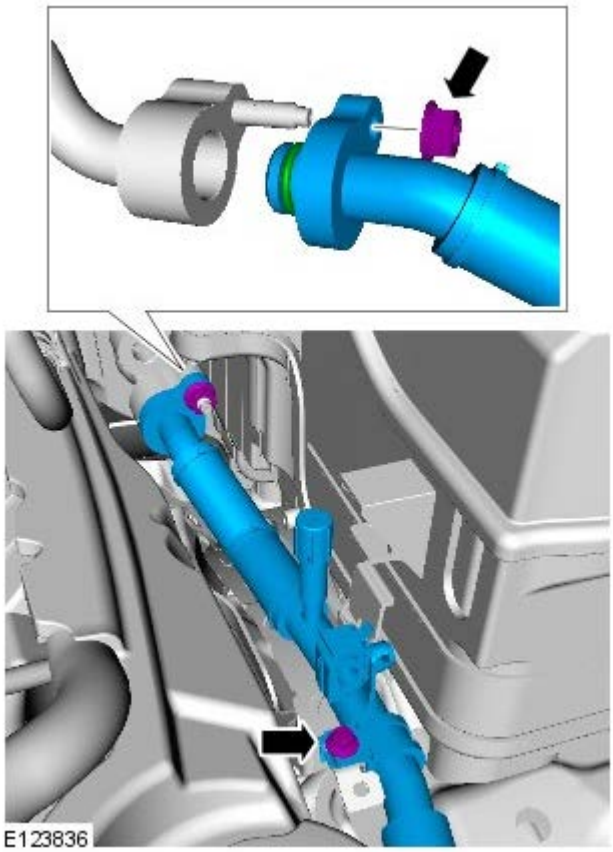
17. Install new O-ring seals.

    Torque: 12 Nm



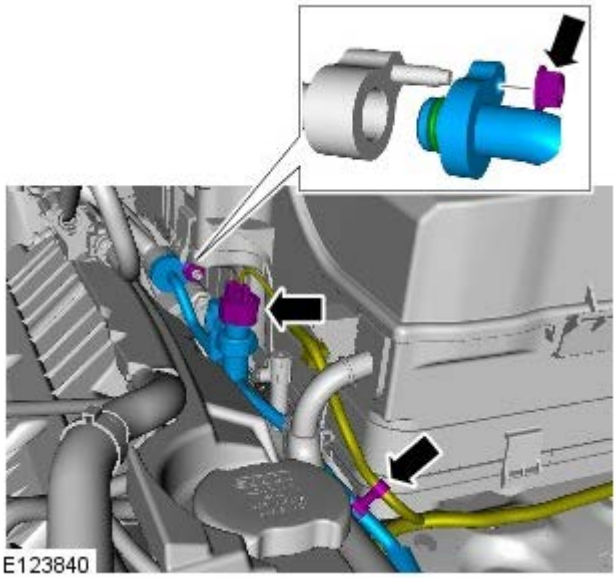
18. Install new O-ring seals.

    Torque: 12 Nm

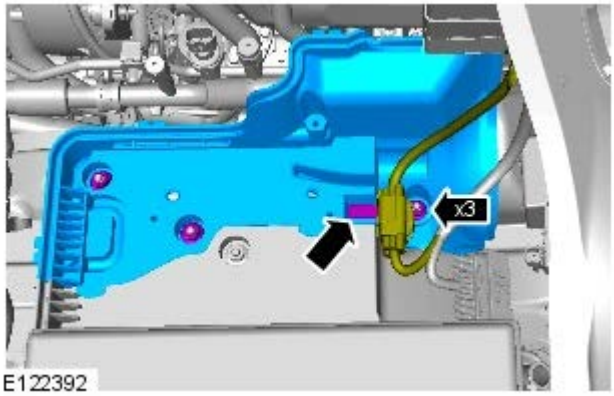


19. Install new O-ring seals.

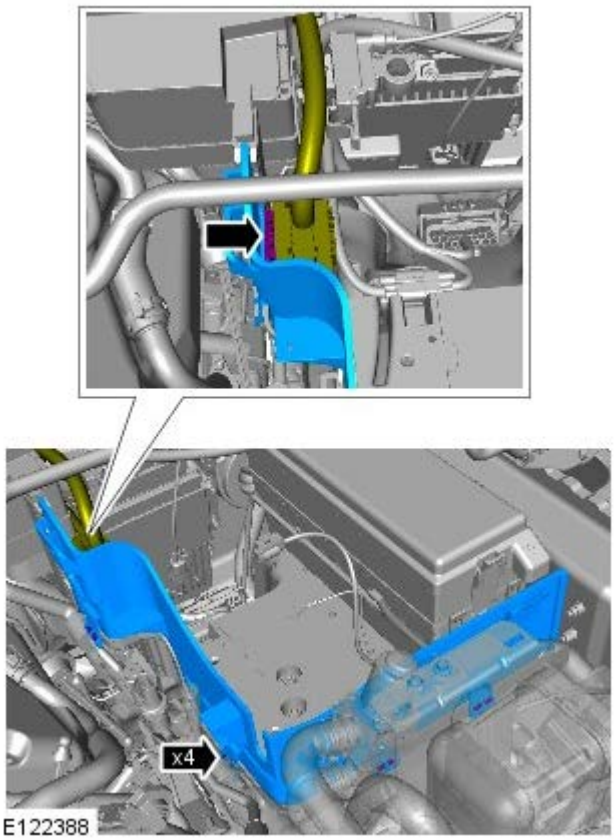
    Torque: 12 Nm



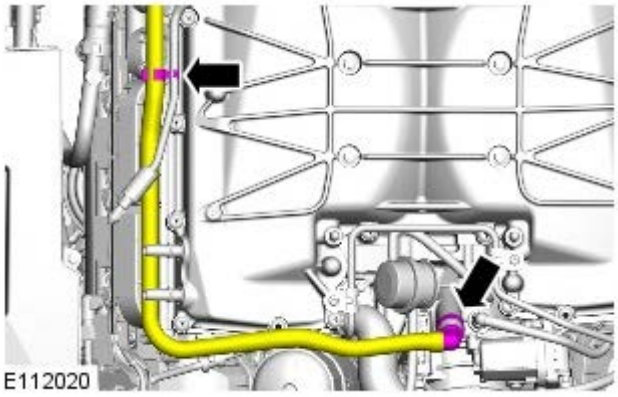
20. *Torque:* 12 Nm



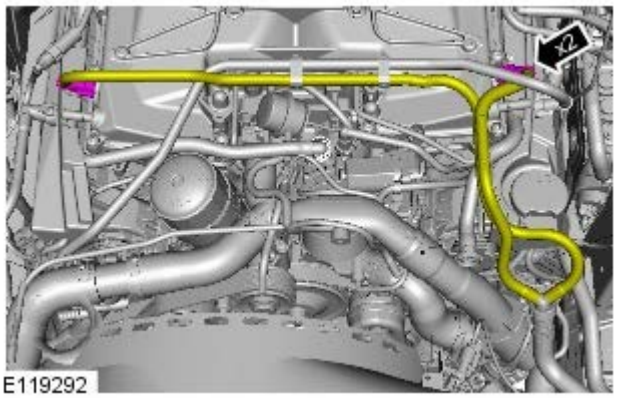
21.



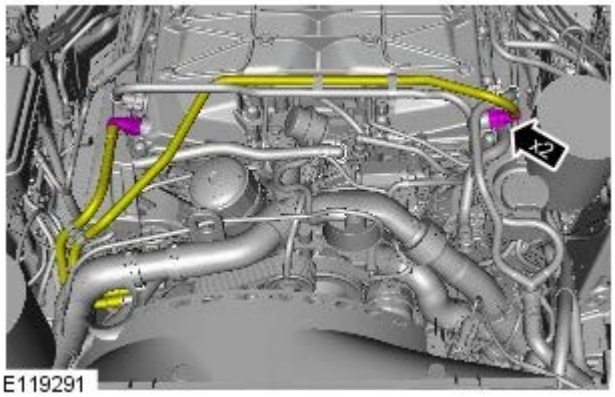
22.



23.



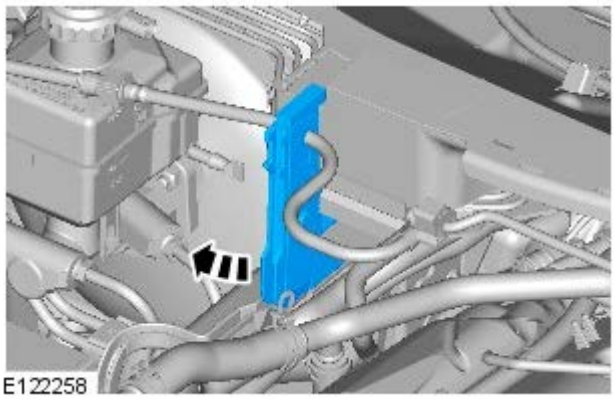
24.



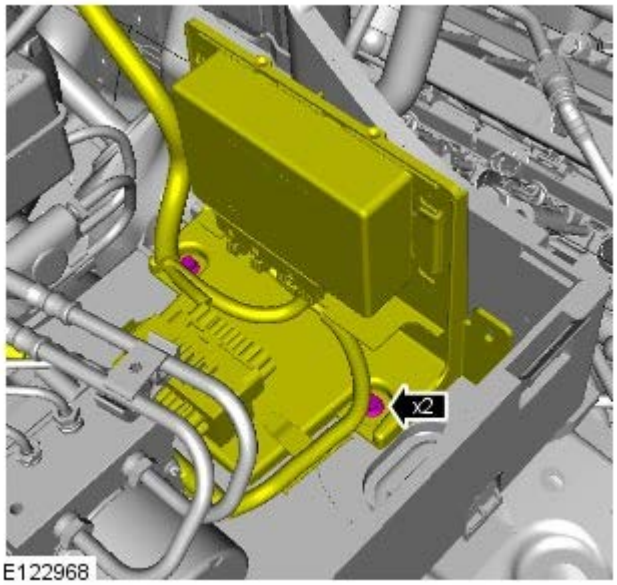
Right-hand drive vehicles

25. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

Left-hand drive vehicles



26. NOTE: Right-hand shown, left-hand similar.



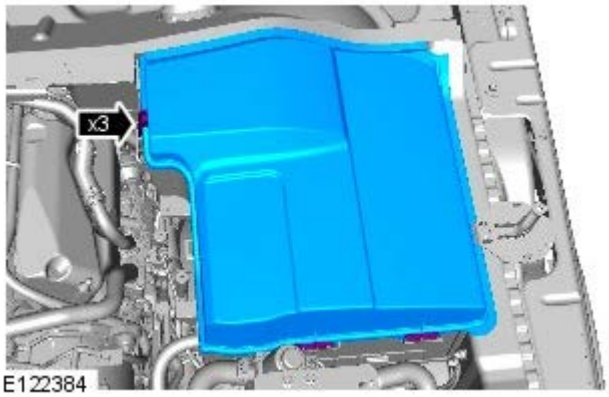
27. NOTE: Right-hand shown, left-hand similar.

Torque: 10 Nm

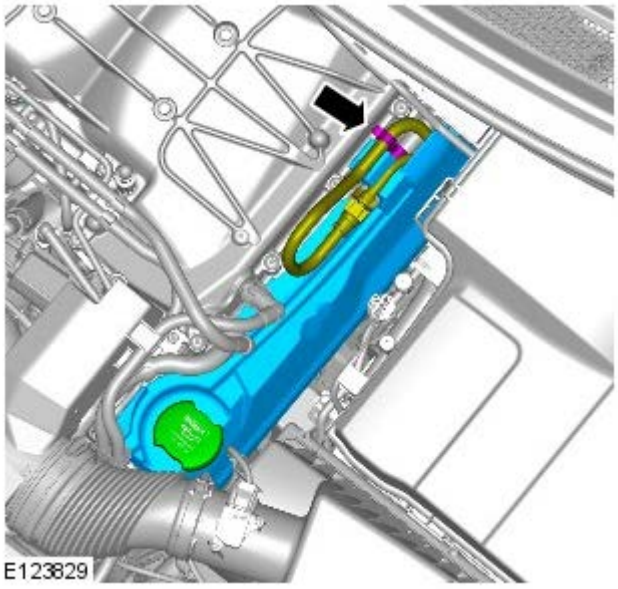
All vehicles

28. Refer to: Evaporative Emission Canister Purge Valve - V8 S/C 5.0L Petrol (303-13 Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

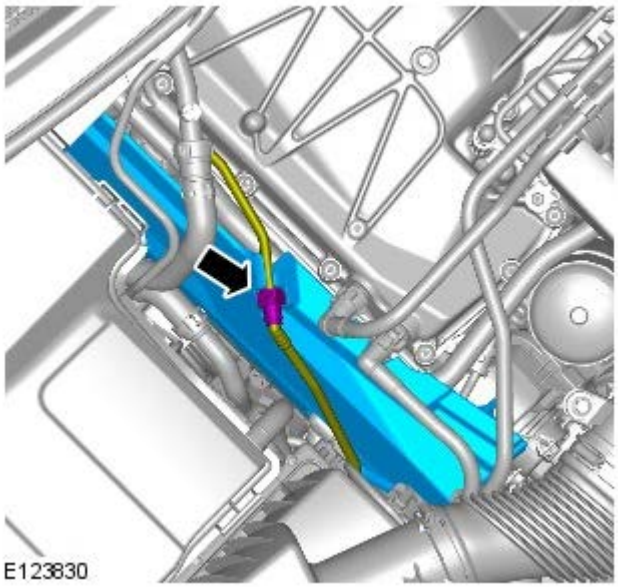
29.



30.



31. CAUTION: Be prepared to collect escaping fluids.



32. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

33. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

34. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

35. Connect the battery ground cable.

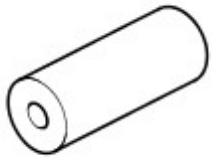
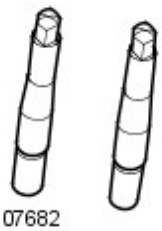
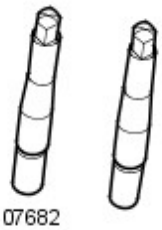
Refer to: Specifications (414-00 Charging System - General Information, Specifications).

Published: 15-Nov-2013

Fuel Charging and Controls - V8 S/C 5.0L Petrol - Fuel Rail RH

Removal and Installation

Special Tool(s)

 E115268	303-1450 Spark Plug Remover/Installer
 E114526	310-197 Remover, Fuel Injector
 E107680	310-198 Installer, Teflon Seal
 E107681	310-199 Re-shape Tool, Teflon Seal
 E107682	310-200-01 Fuel Rail Installation Guide Pins - Threaded
 E107682	310-200-02 Fuel Rail Installation Guide Pins - Unthreaded

Removal

CAUTIONS:

Make sure that tools and equipment are clean and free of foreign material and lubricant.

Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

NOTES:

Removal steps in this procedure may contain installation details.

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

All vehicles

1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Refer to: Fuel System Pressure Release - V8 5.0L Petrol/V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

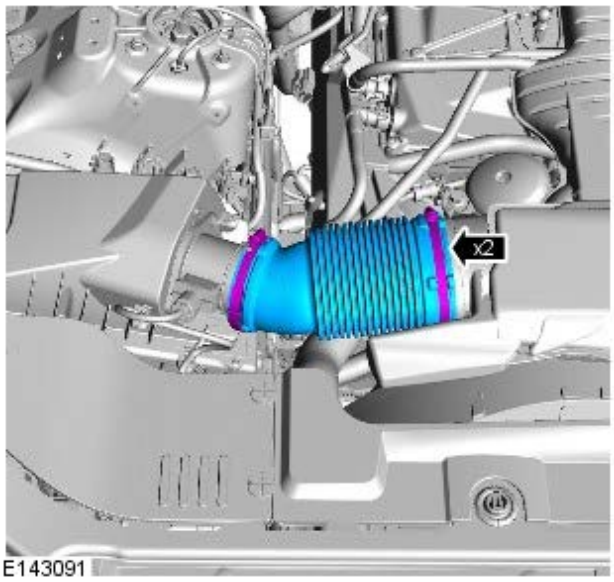
3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

4. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

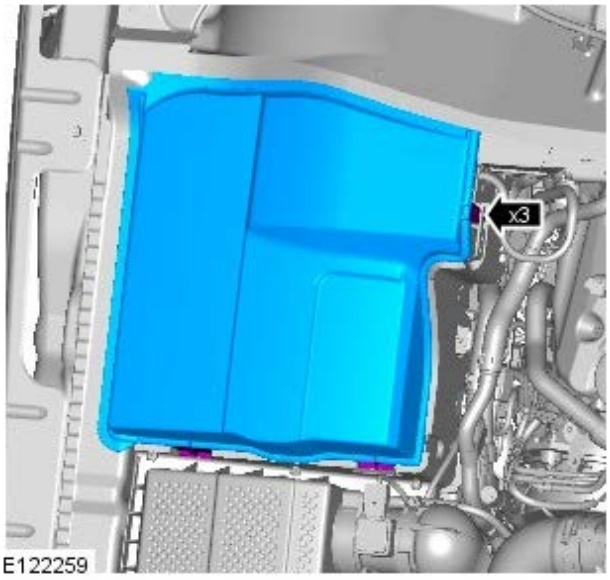
5. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

6.



7. Refer to: Air Cleaner RH (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

8.

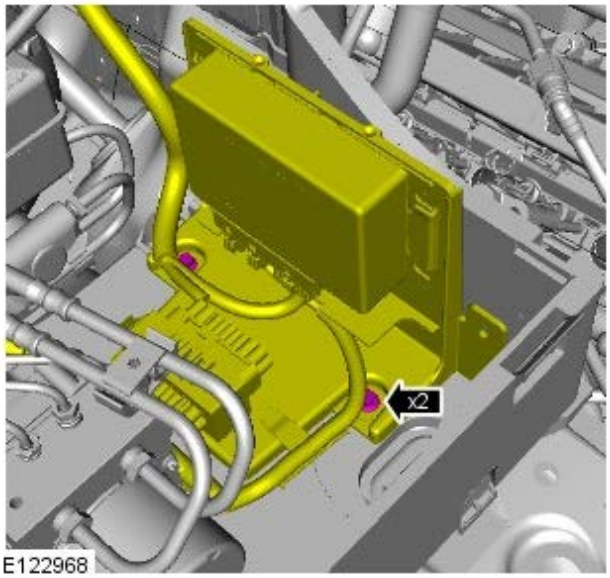


Left-hand drive vehicles

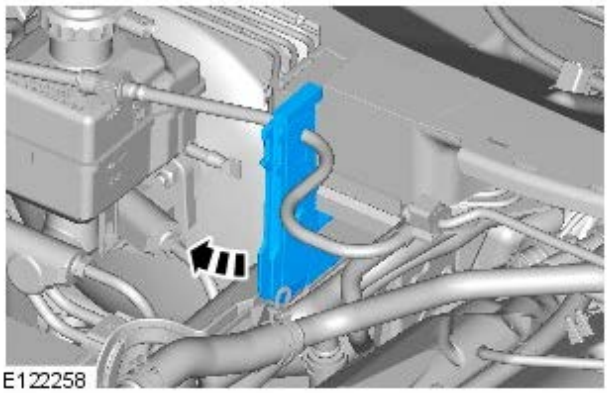
9. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

Right-hand drive vehicles

10.

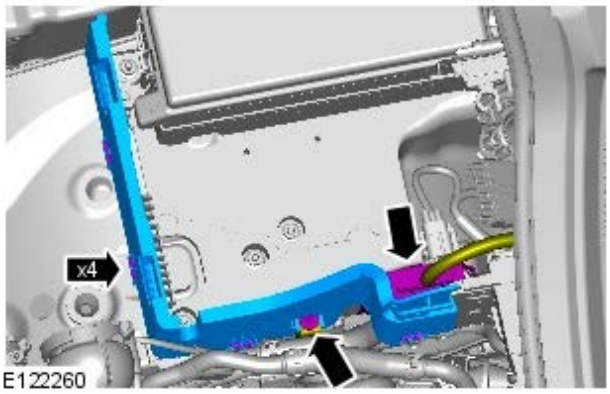


11.

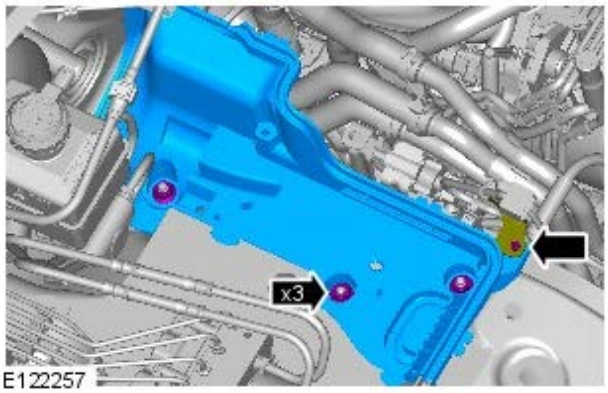


All vehicles

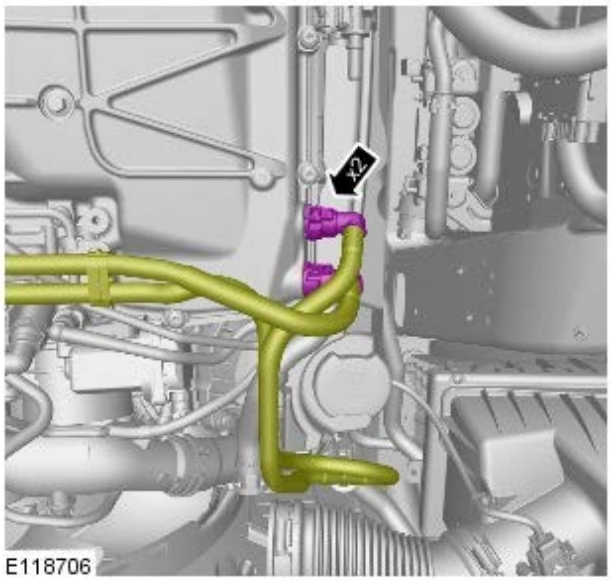
12.



13.

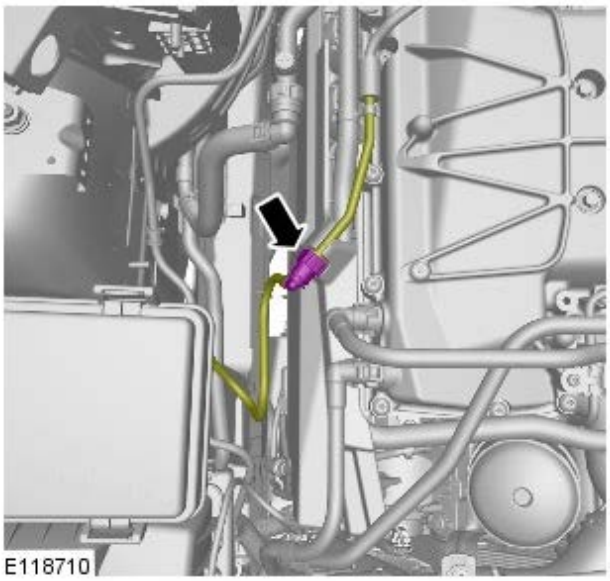


14. Refer to: Fuel Injection Component Cleaning (303-04C Fuel Charging and Controls - V8 5.0L Petrol, General Procedures).

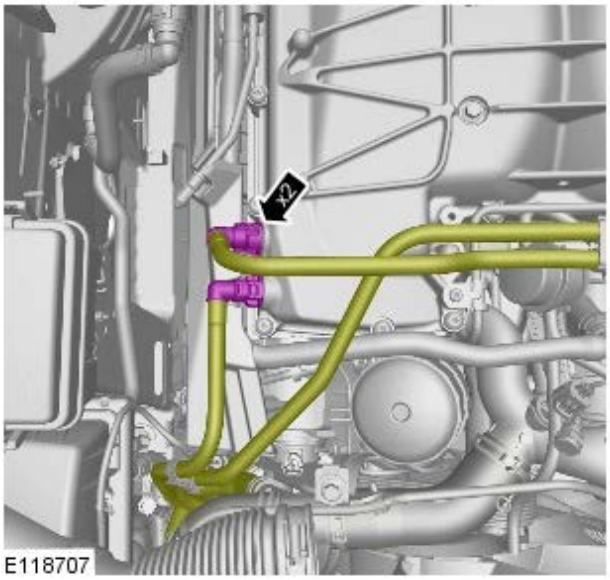


15. CAUTION: Be prepared to collect escaping coolant.

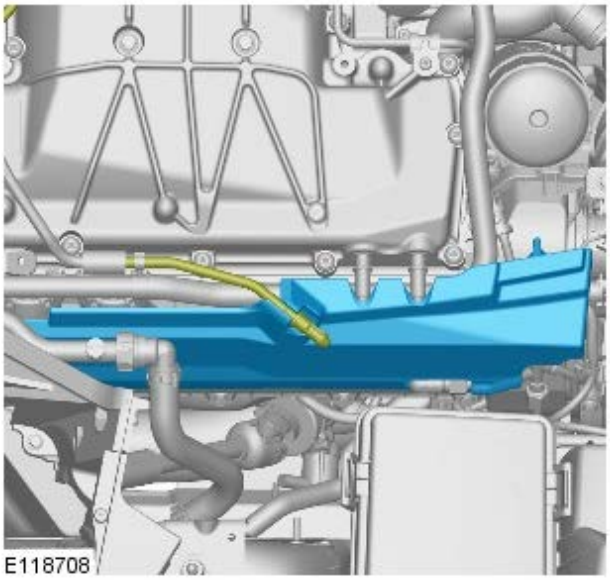
16.



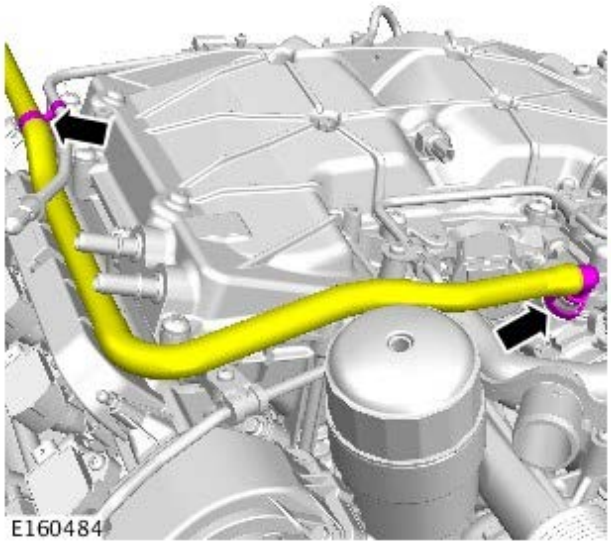
17. CAUTION: Be prepared to collect escaping coolant.



18.



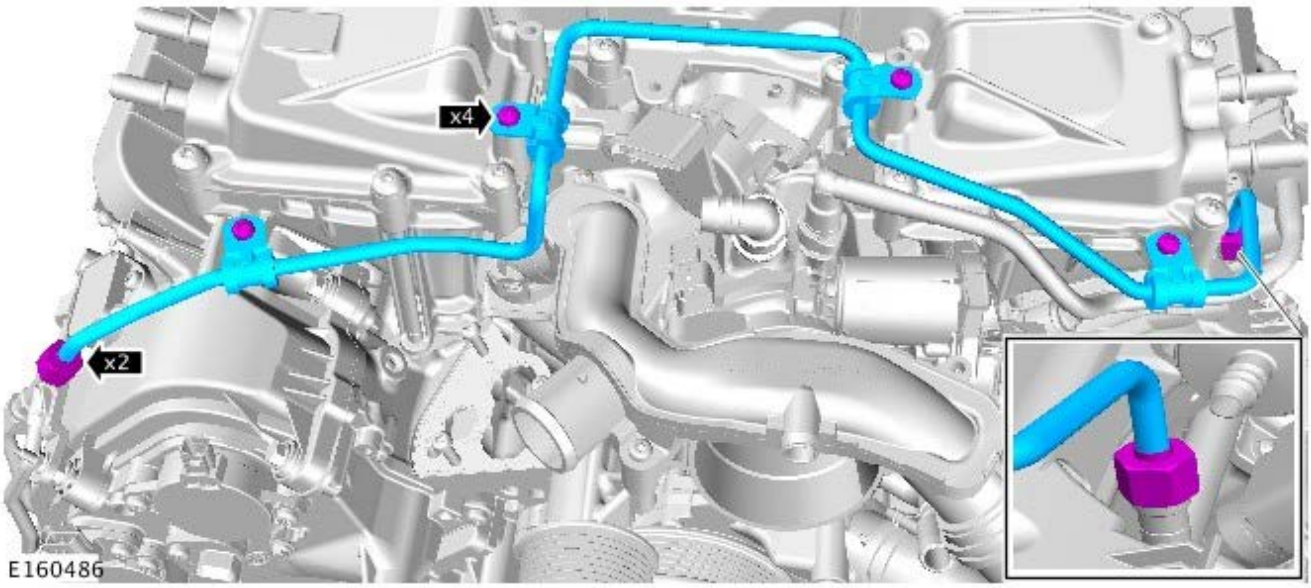
19. CAUTION: Be prepared to collect escaping fluids.



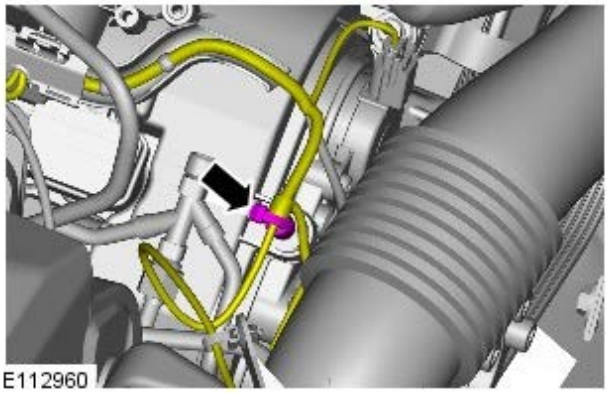
20. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

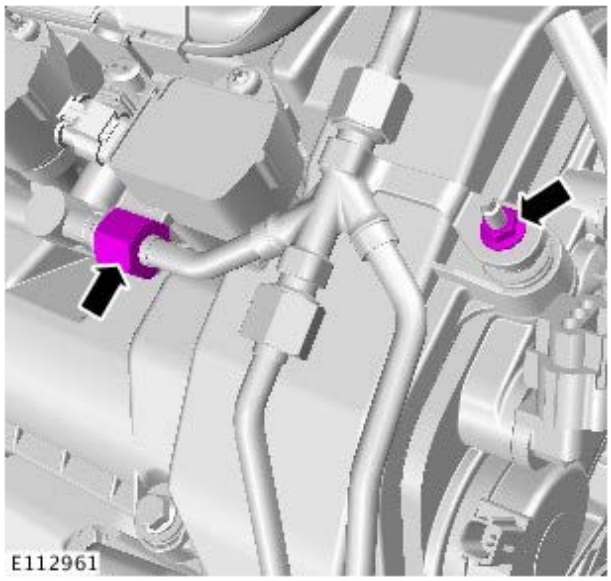


21.



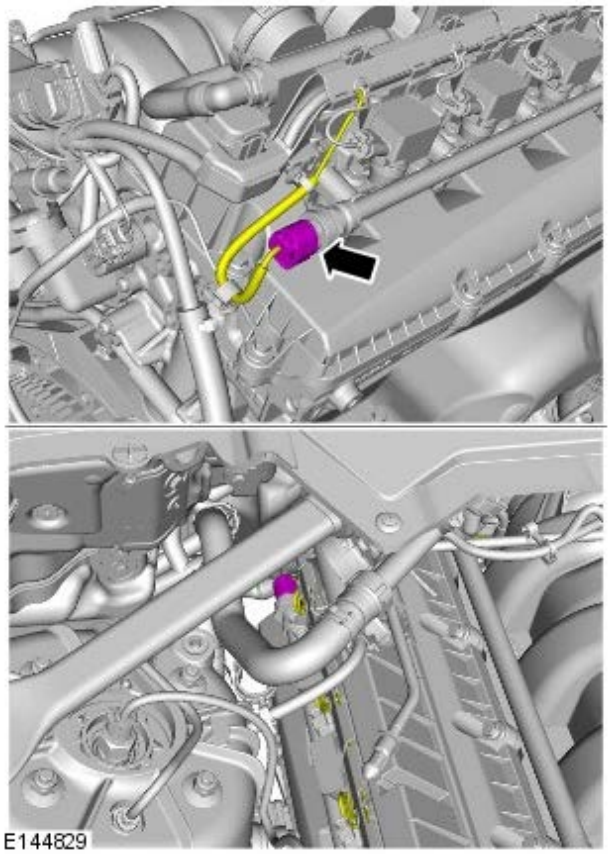
22. CAUTIONS:

Be prepared to collect escaping fluids.

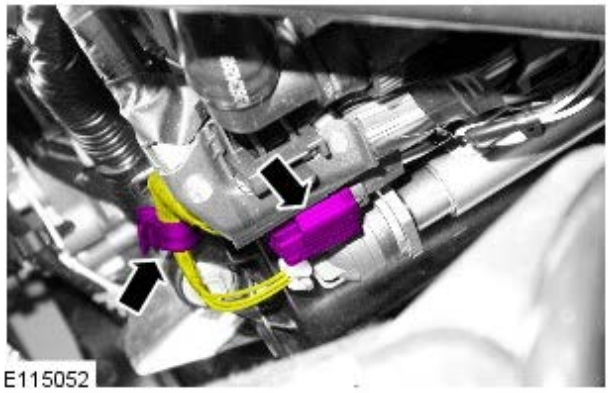


Make sure that all openings are sealed. Use new blanking caps.

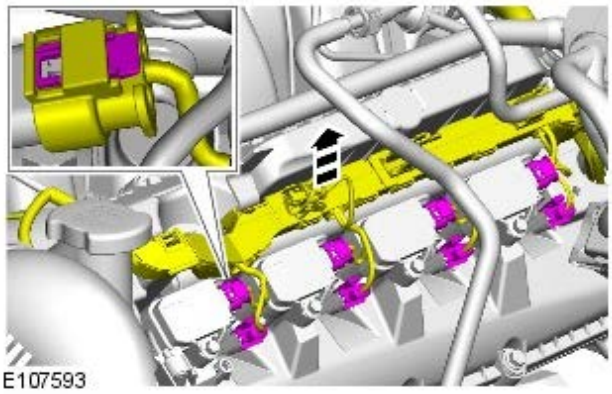
23.



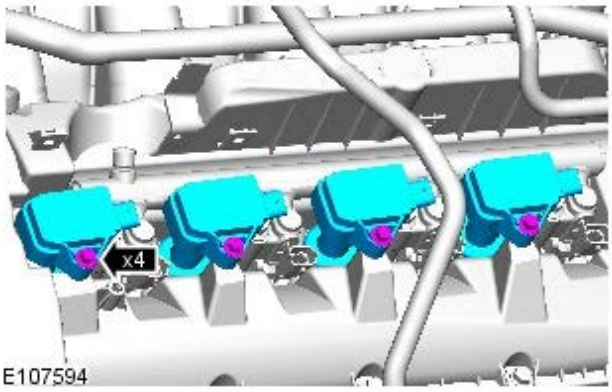
24. NOTE: If equipped.



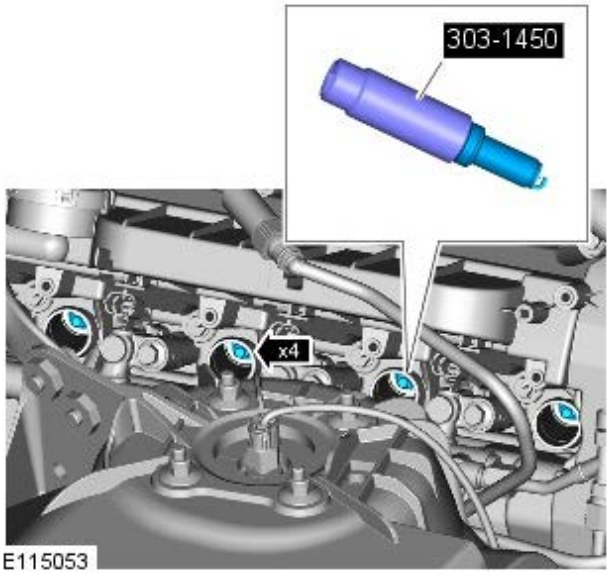
25. NOTE: LH illustration shown, RH is similar.



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

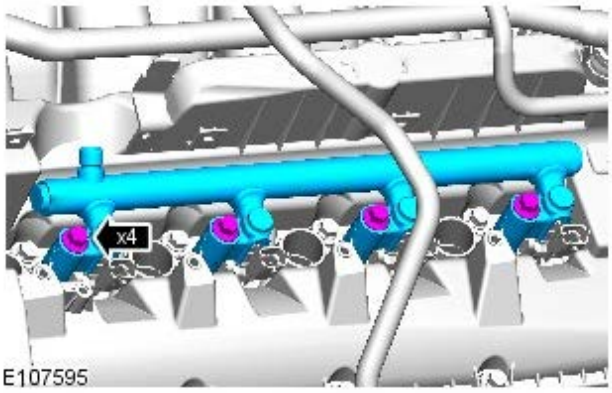


27. *Special Tool(s):* 303-1450



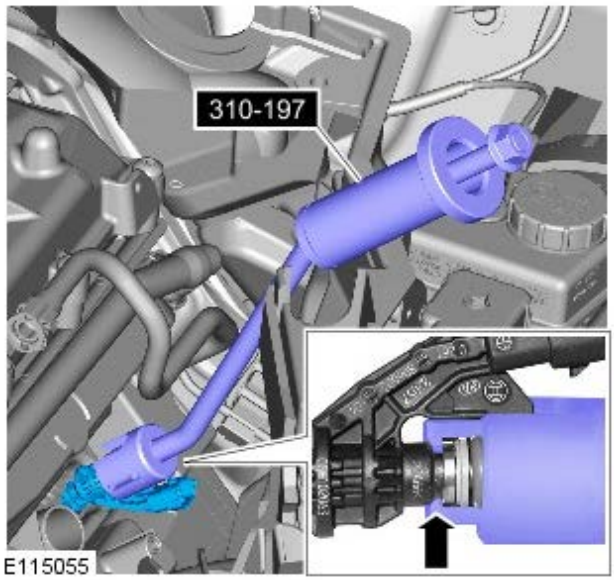
28. CAUTION: Make a note of the fuel injector clamp alignment to the fuel rail prior to removal.

NOTE: LH illustration shown, RH is similar.



29. NOTE: This step is only required if a new fuel rail is installed.

Refer to: Fuel Rail Pressure (FRP) Sensor (303-14B Electronic



E115055

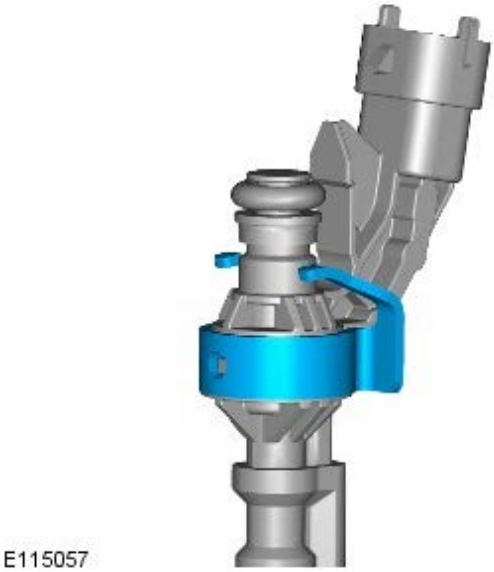
30. CAUTIONS:

Make sure that the special tool is located correctly to the fuel injector prior to removing the fuel injector.

Make sure that the special tool is held square to the fuel injector during removal.

Make sure that all open ports are covered to prevent any foreign material ingress.

Special Tool(s): 310-197


E115057

31. CAUTION: If the fuel injector is being removed without a new component being installed, the fuel injector clamp must remain with the fuel injector it is removed with.


E115058

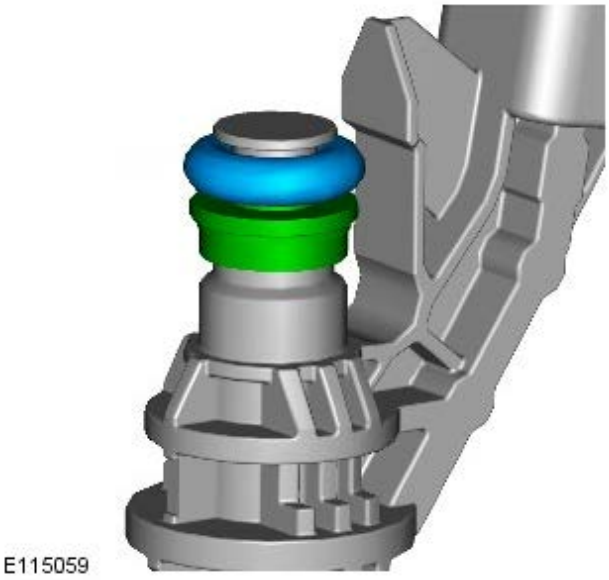
32. CAUTIONS:

Do not use a knife to remove the Teflon seal as damage could occur to the fuel injector.

Do not cut the Teflon seal to deep as damage could occur to the fuel injector.

Pinch the Teflon seal to allow the tool to cut the Teflon seal without damaging the fuel injector.

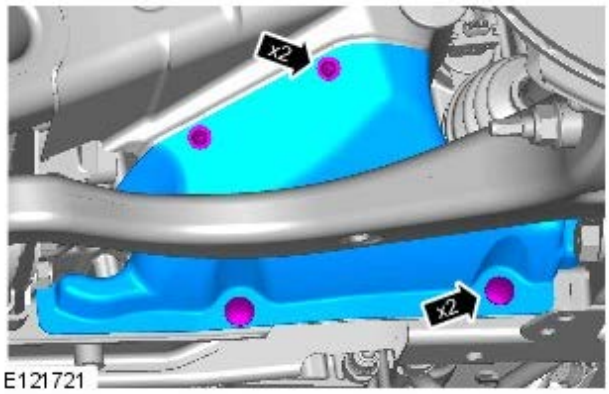
33. CAUTION: Do not use any sharp tools to remove the O-ring seal as damage could occur to the fuel injector.


E115059

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

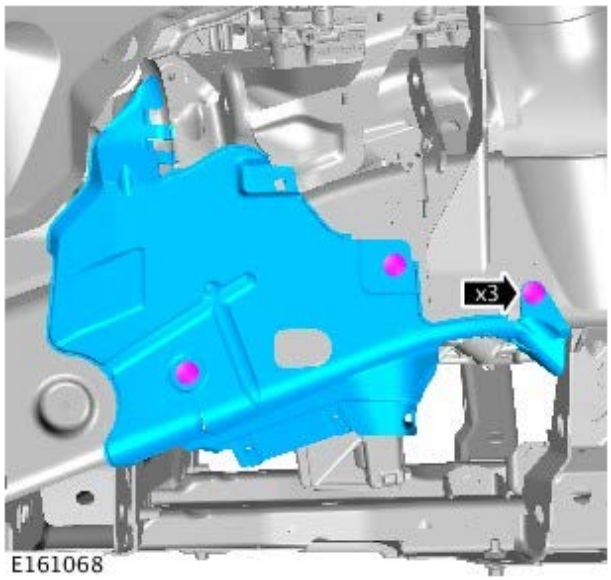
Raise and support the vehicle.

35.



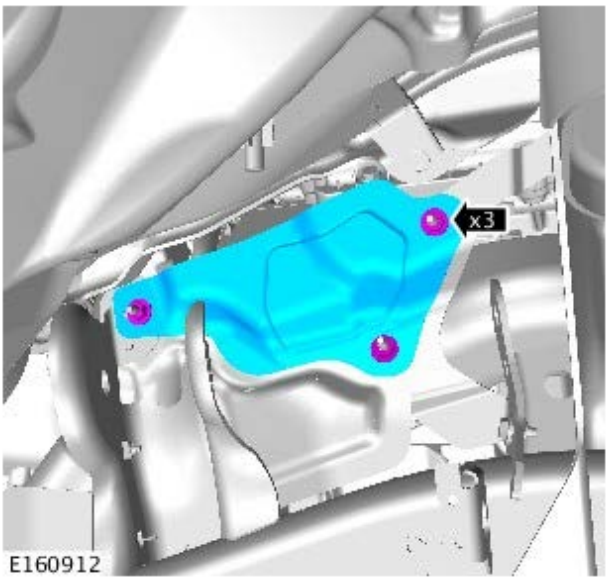
E121721

36.

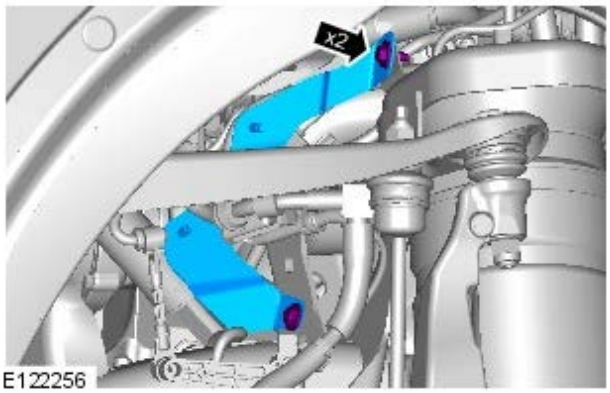


E161068

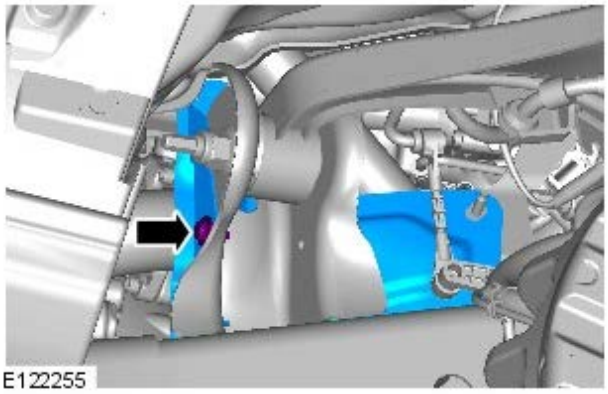
37.



38.

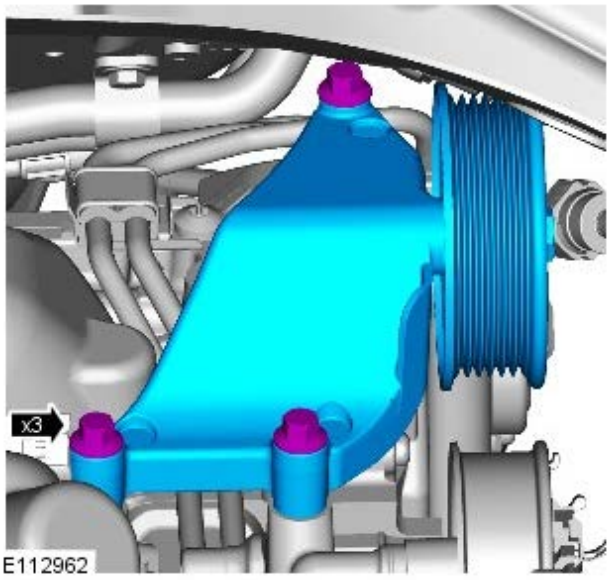


39.

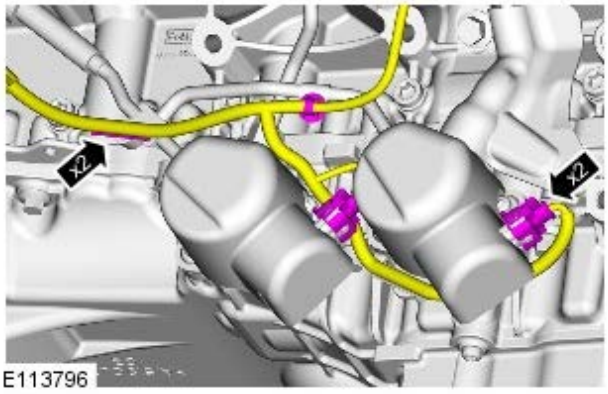


40. Refer to: Generator (414-02B Generator and Regulator - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

41.

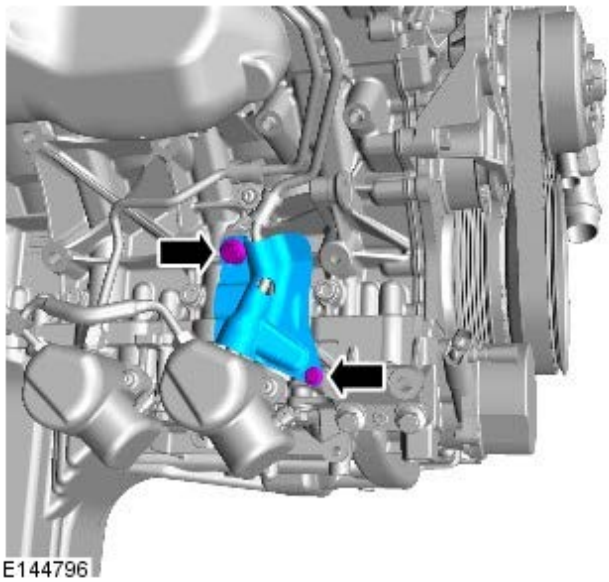


42. Refer to: Steering Gear - V8 5.0L Petrol/V8 S/C 5.0L Petrol (211-02 Power Steering, Removal and Installation).

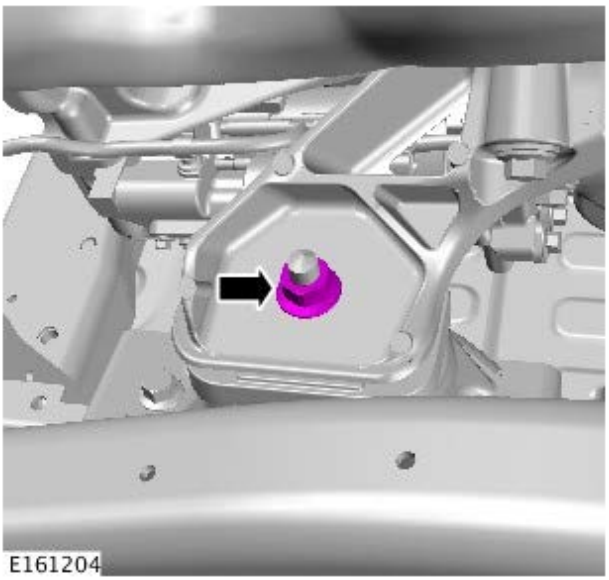


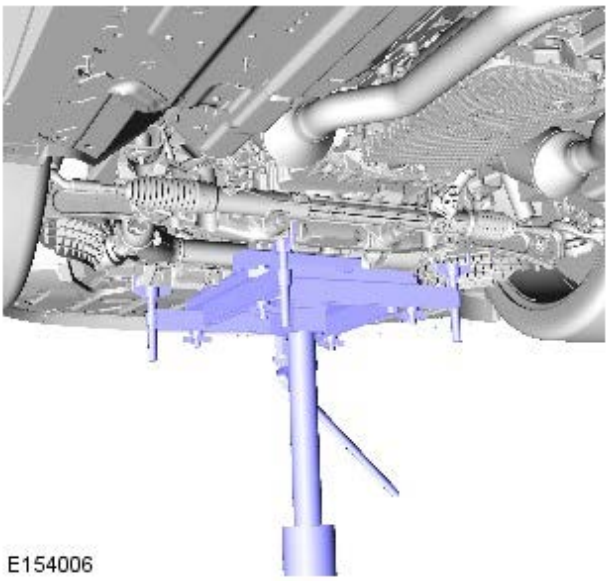
43. NOTE: Engine shown removed for clarity.

44.



45.

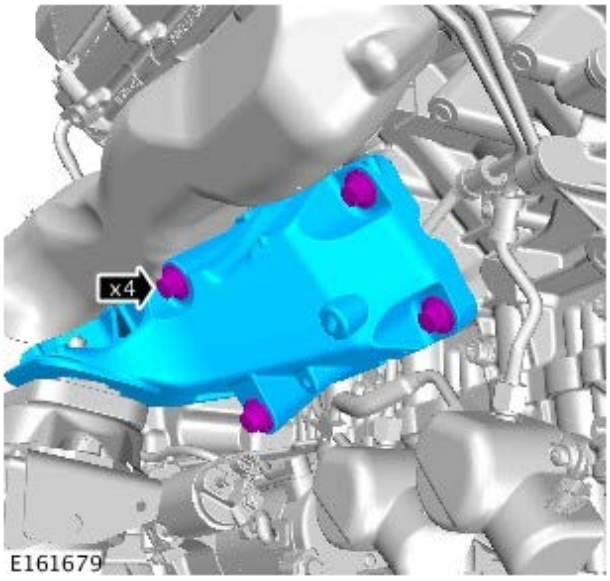




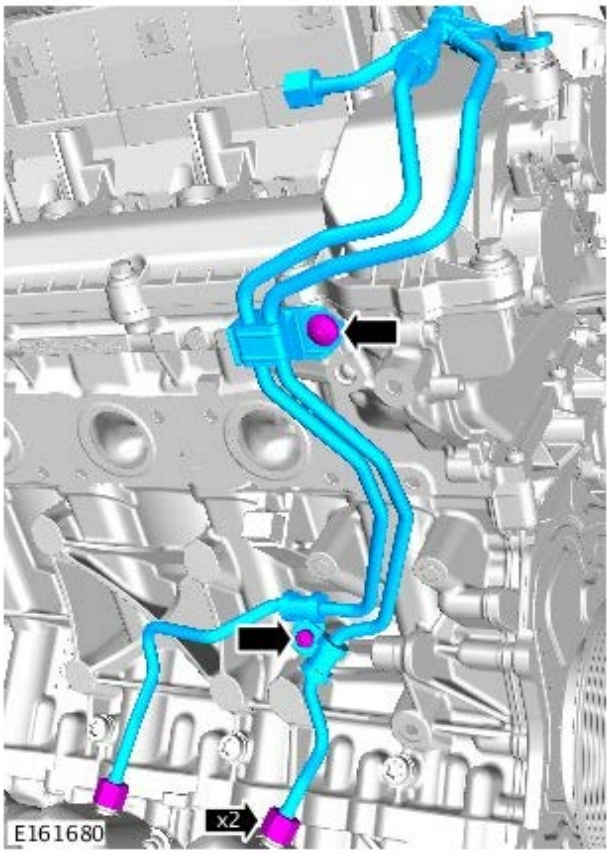
46. CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

    Using a suitable hydraulic jack, support the engine.

47.



48. 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.



CAUTIONS:

Remove and discard the high-pressure fuel supply lines.

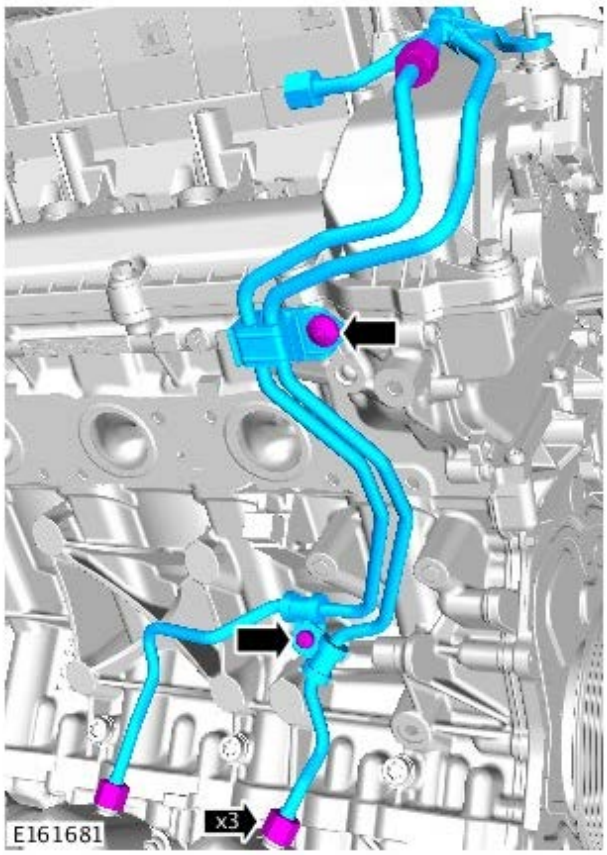
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

NOTE: Engine shown removed for clarity.

Installation

All vehicles



1. CAUTION: Lubricate only the union threads with clean engine oil.

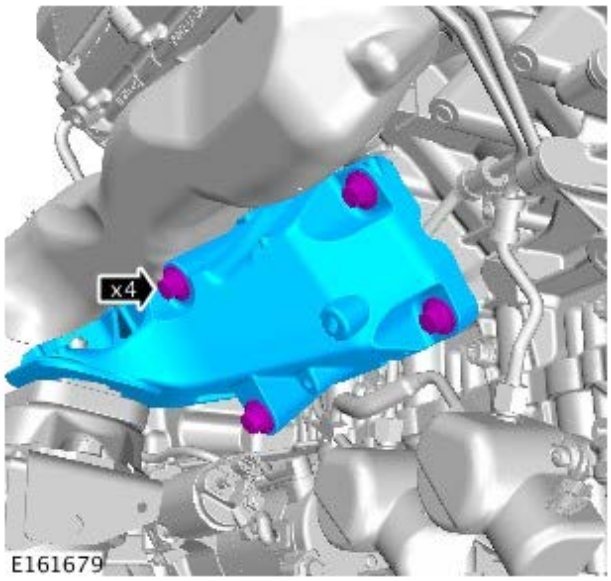
   NOTES:

   Engine shown removed for clarity.

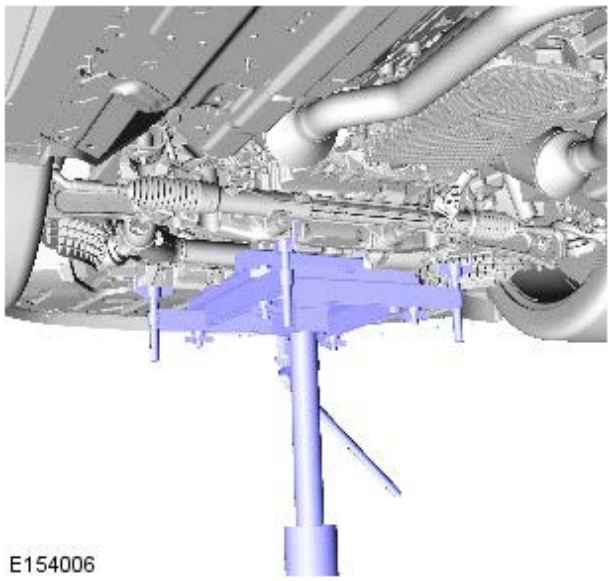
   Install the bolts and unions finger tight before final tightening.

   Remove and discard the blanking caps.

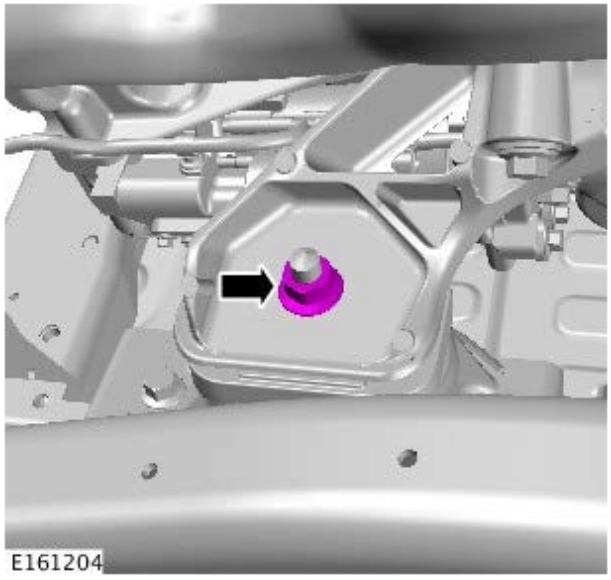
2. *Torque:*
   Stage 1:45 Nm
   Stage 2:60°



3. Remove the special tool.

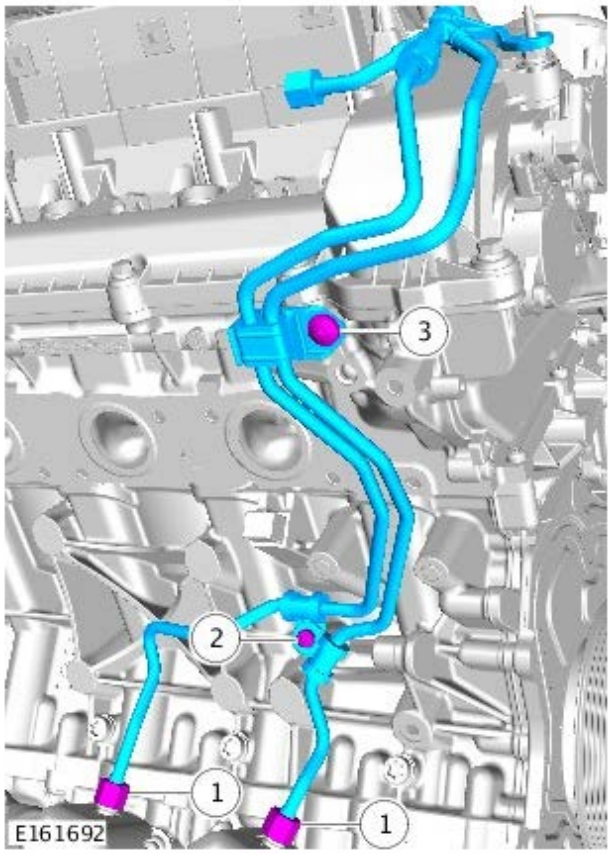


4. *Torque:* 100 Nm

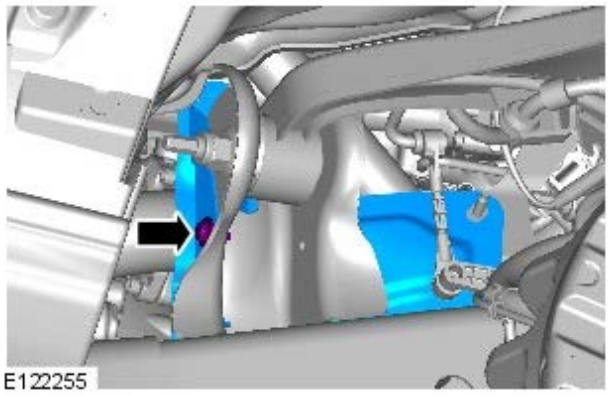


5. NOTE: Some components shown removed for clarity.

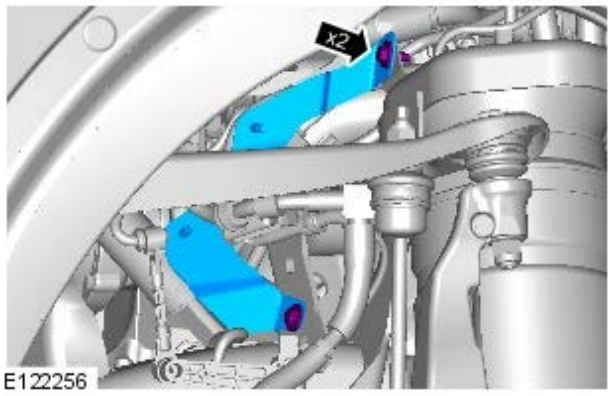
   Torque:
   Unions (1) 21 Nm
   M6 (2) 11 Nm
   M8 (3) 25 Nm



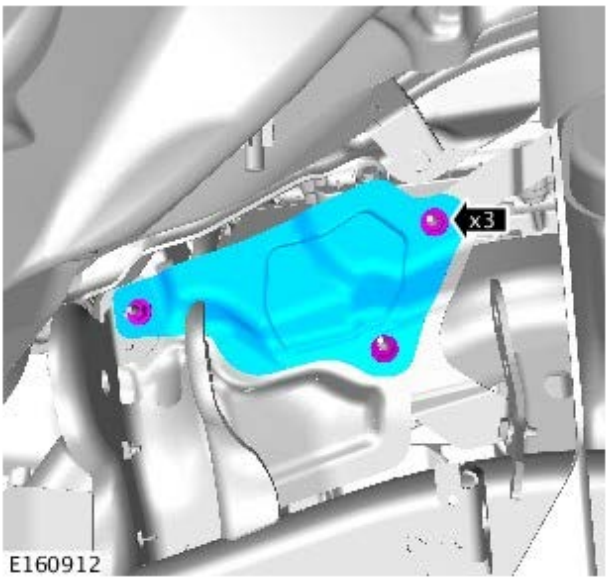
6. *Torque:* 10 Nm



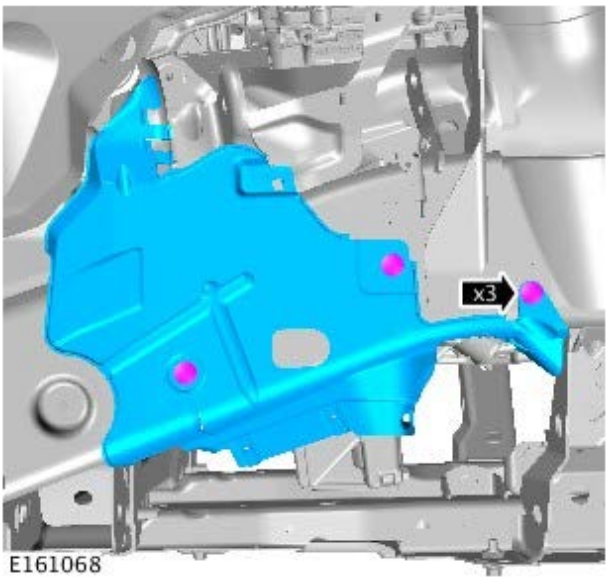
7. *Torque:* 10 Nm



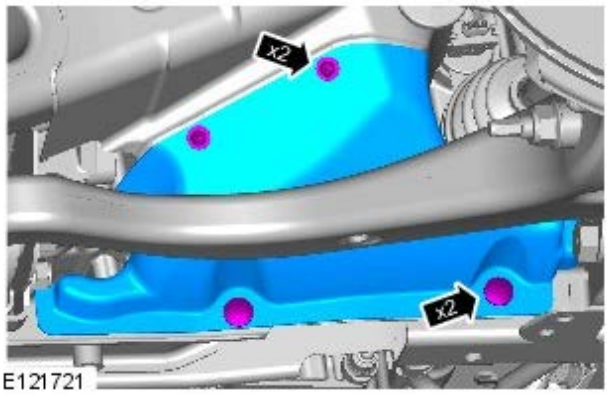
8. *Torque:* 10 Nm



9.

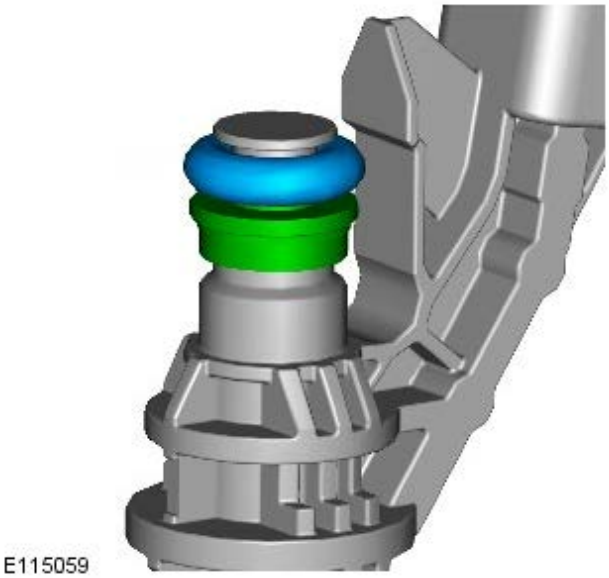


10.



11. Lower the vehicle.

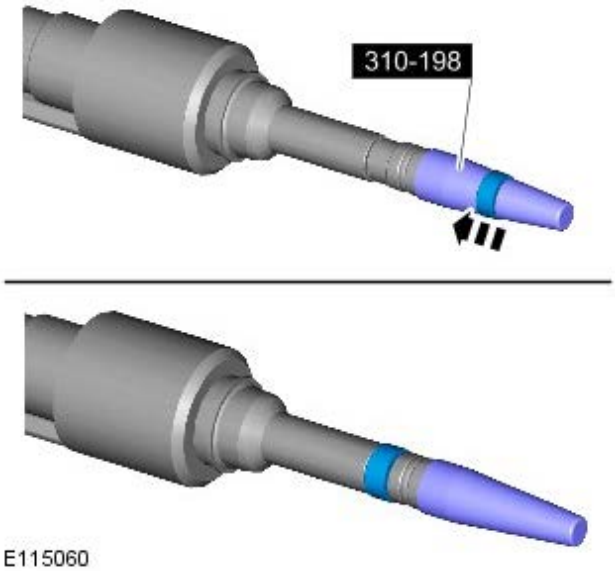
12. Install new O-ring seals.



E115059

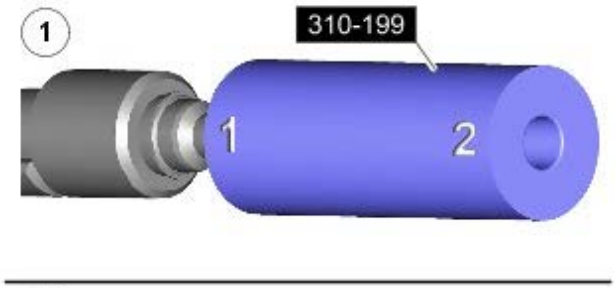
13. Install new Teflon seals.

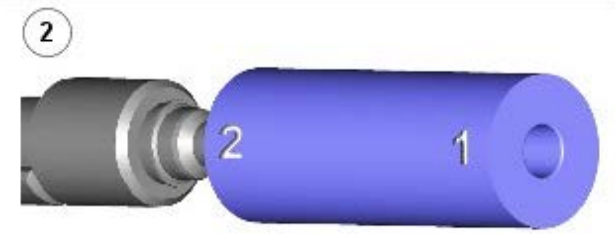
    Special Tool(s): 310-198



E115060

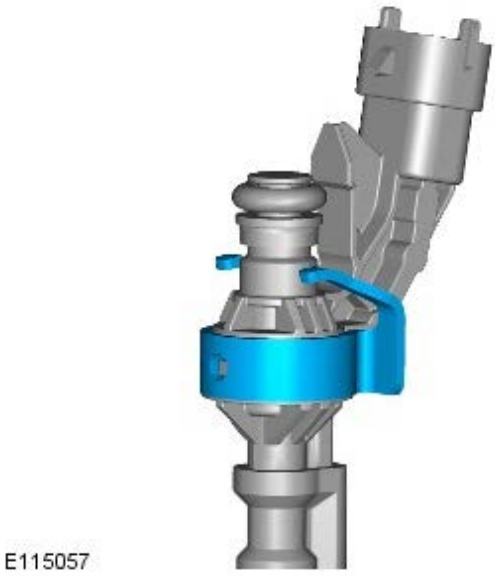
14. *Special Tool(s):* 310-199

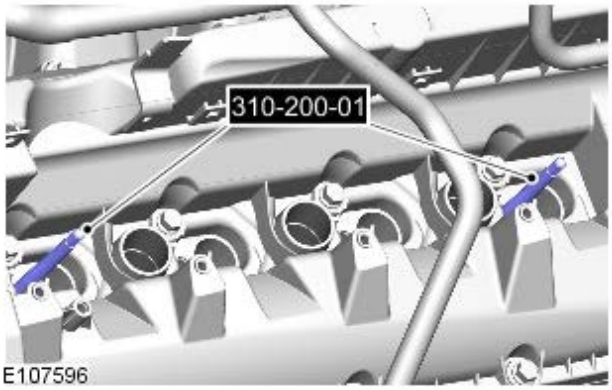




E115062

15. CAUTION: If the original fuel injector is being installed, the original fuel injector clamp must installed with the fuel injector it was removed with.


E115057

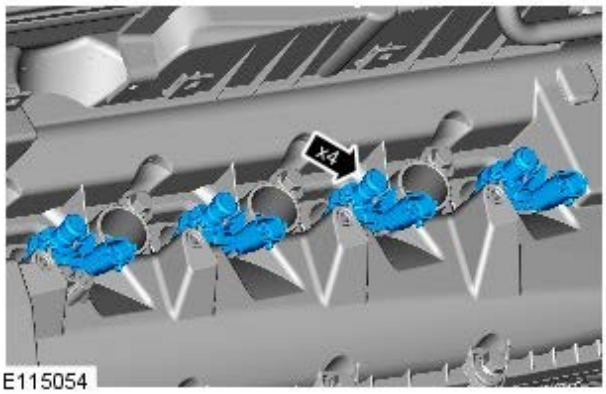


E107596

16. CAUTION: If a new cylinder head has been installed then the special tool 310-200-02 without the thread must be used to install the fuel rail.

NOTE: LH illustration shown, RH is similar.

Special Tool(s): 310-200-01, 310-200-02



E115054

17. CAUTIONS:

Make sure that the area around the open fuel injector ports are clean and free of foreign material and lubricant prior to installing the fuel injector.

When installing the fuel injector(s), make sure that the Teflon seal is clean and free of foreign material and lubricant.

NOTE: LH illustration shown, RH is similar.

18. NOTE: This step is only required if a new fuel rail is installed.

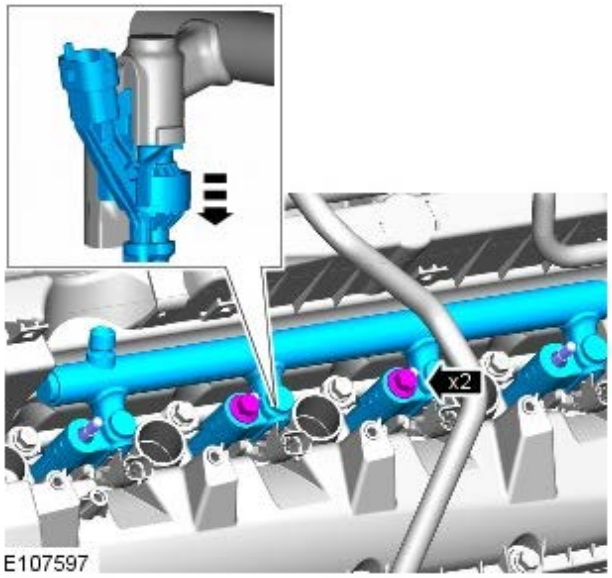
Refer to: Fuel Rail Pressure (FRP) Sensor (303-14B Electronic Engine Controls - V8 5.0L Petrol, Removal and Installation).

19. CAUTIONS:

If new fuel injectors are installed, a new injector clamp must be installed.

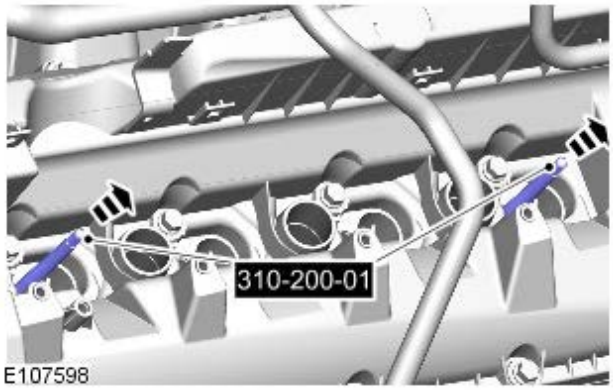
Make sure that the fuel injector is aligned and installed into the fuel rail correctly, as noted in the removal step.

Tighten the fuel rail retaining bolts a turn at a time until the correct torque is achieved.



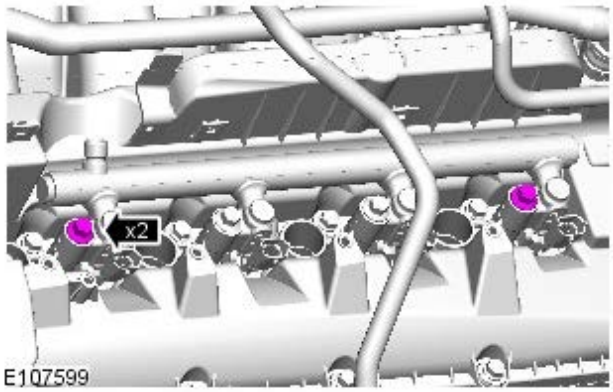
NOTE: Lubricate the fuel injector O-ring seals with clean engine oil.

Torque: 20 Nm



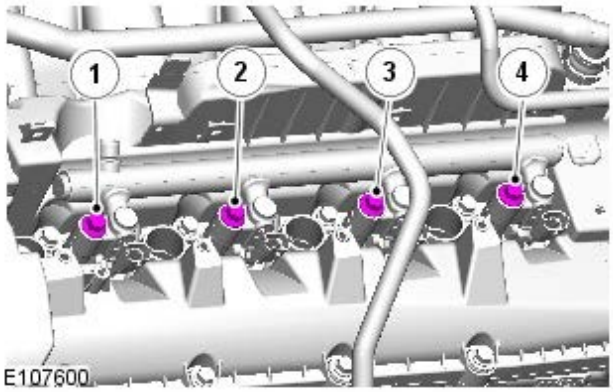
20. NOTE: LH illustration shown, RH is similar.

Special Tool(s): 310-200-01, 310-200-02



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

Torque: 20 Nm



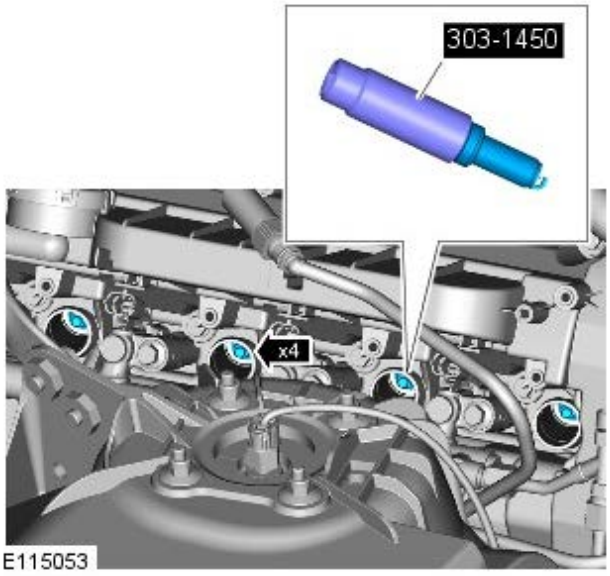
22. NOTES:

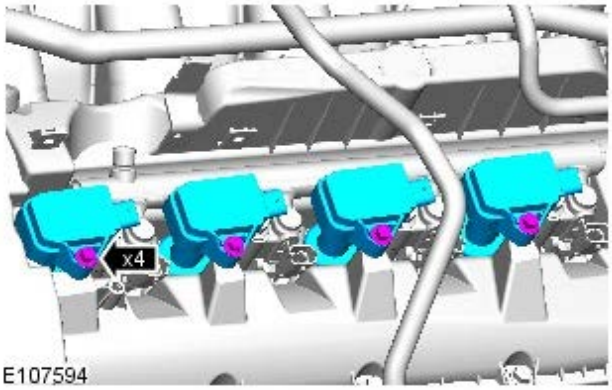
Tighten the bolts in the indicated sequence.

LH illustration shown, RH is similar.

Torque:
Bolt 2 30 Nm
Bolt 3 30 Nm
Bolt 1 30 Nm
Bolt 4 30 Nm

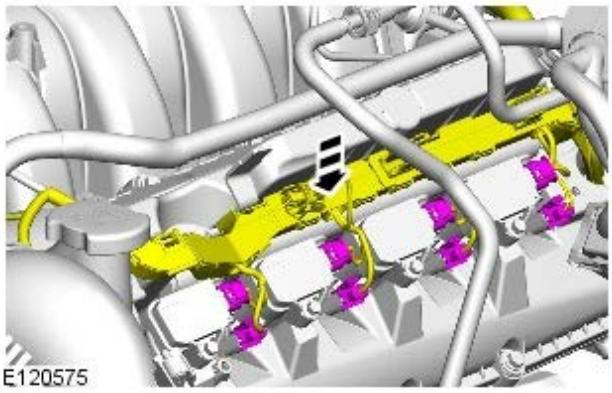
23. *Special Tool(s):* 303-1450
Torque: 20 Nm



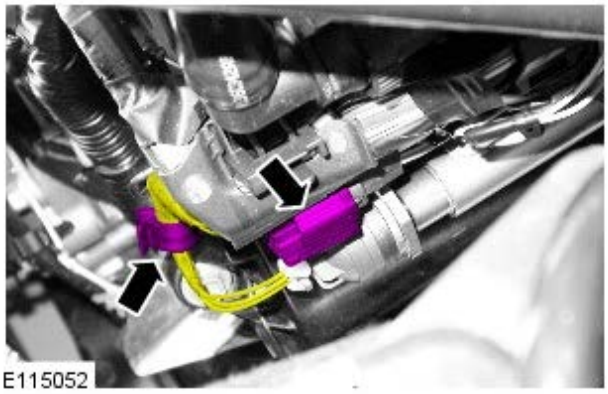


24. NOTE: LH illustration shown, RH is similar.

Torque: 7 Nm

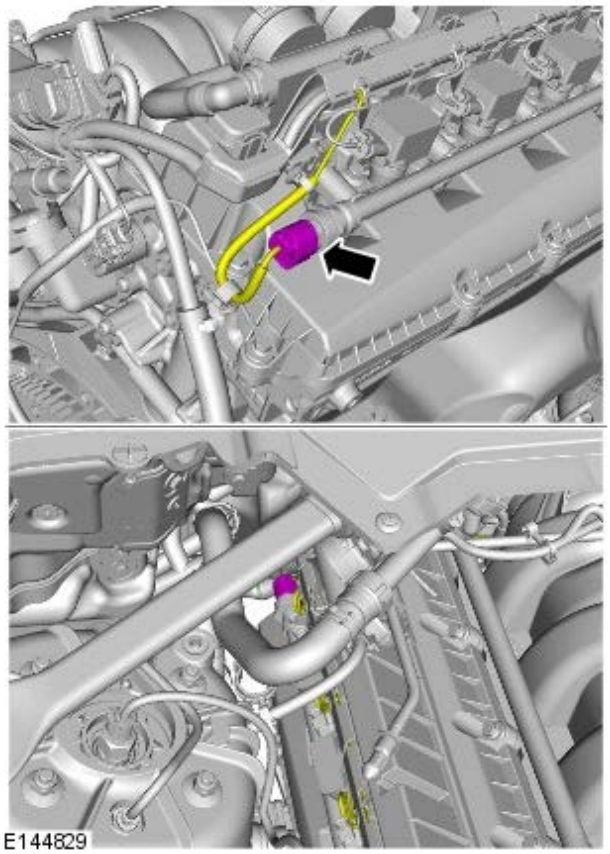


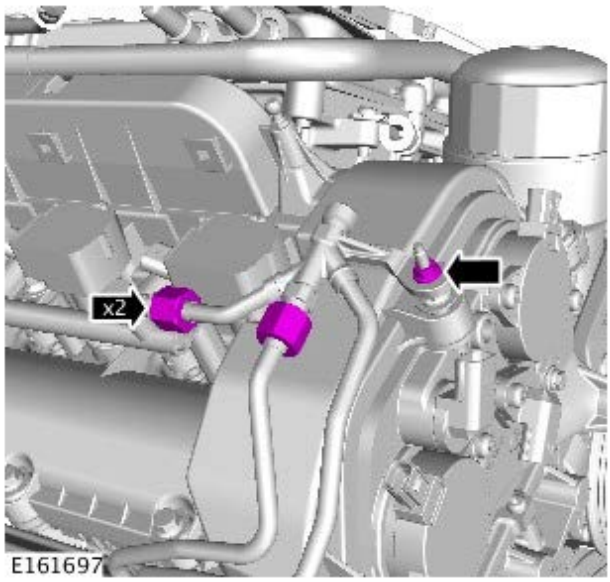
25. NOTE: LH illustration shown, RH is similar.



26. NOTE: If equipped.

27.





28. NOTE: Remove and discard the blanking caps.

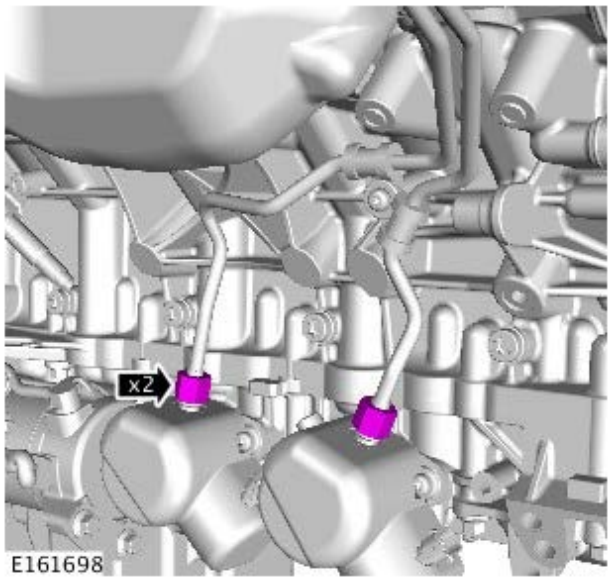
Torque:
Unions 21 Nm
Nut 6 Nm

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

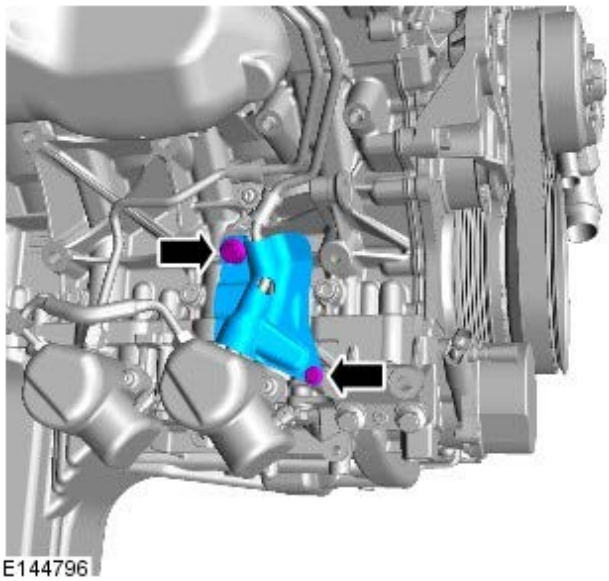
Raise and support the vehicle.

30. NOTE: Some components shown removed for clarity.

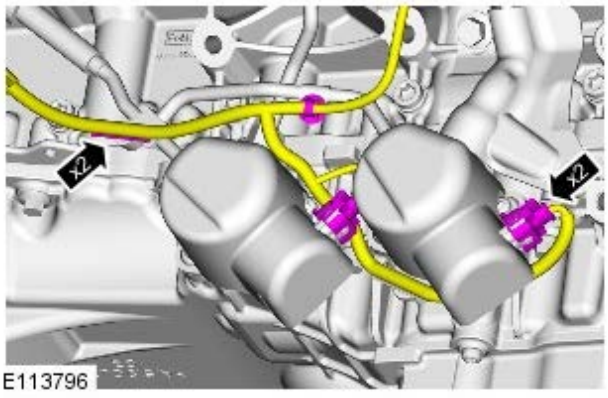
Torque: 21 Nm



31. *Torque:*
    M6 12 Nm
    M10 29 Nm

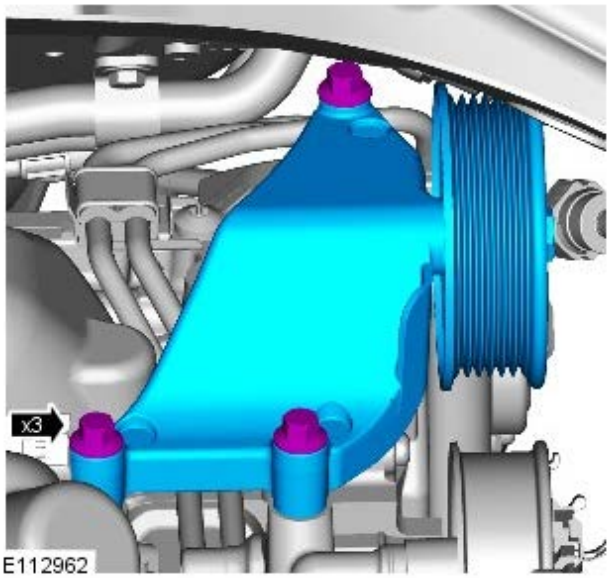


32.



33. Refer to: Steering Gear - V8 5.0L Petrol/V8 S/C 5.0L Petrol (211-02 Power Steering, Removal and Installation).

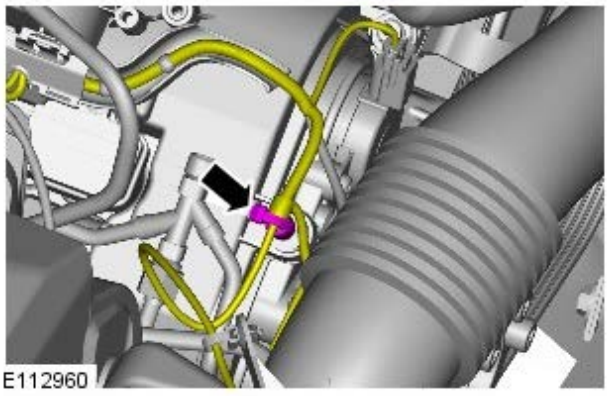
34. *Torque:* 25 Nm



35. Refer to: Generator (414-02B Generator and Regulator - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

36. Lower the vehicle.

37.

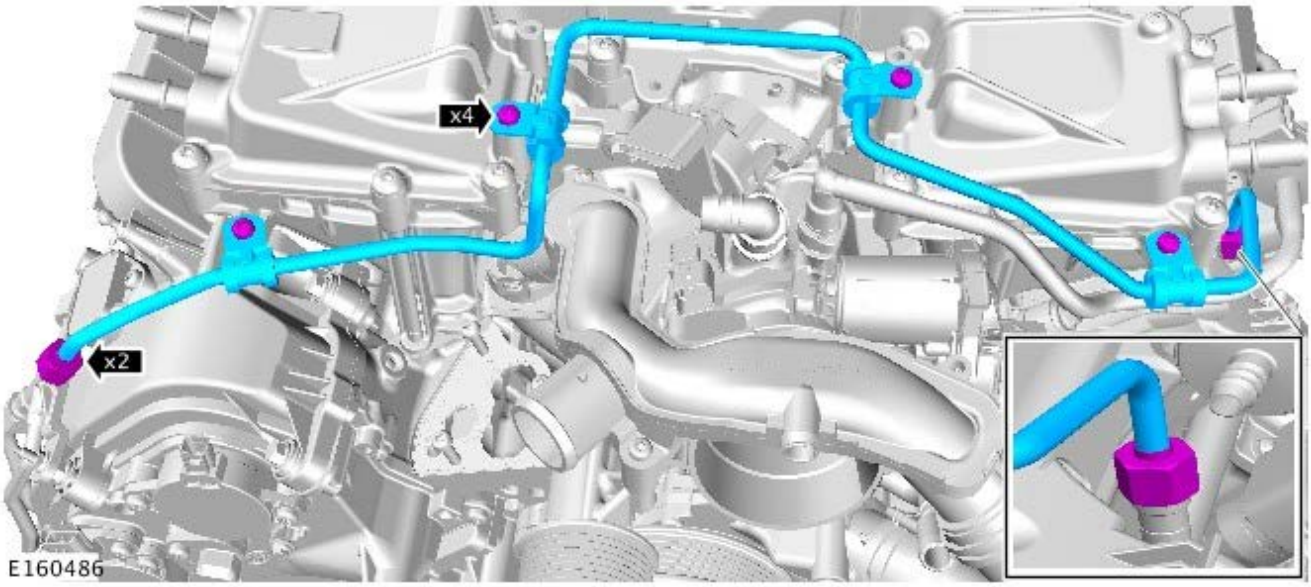


38. CAUTION: Lubricate only the union threads with clean engine oil.

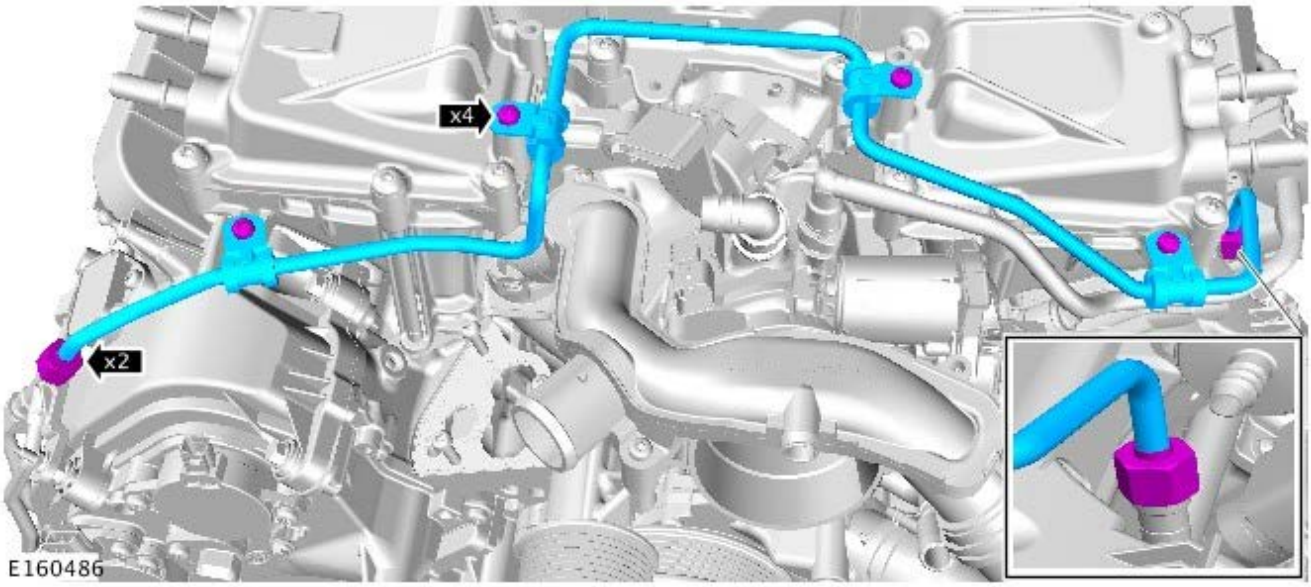
NOTES:

Install the bolts and unions finger tight before final tightening.

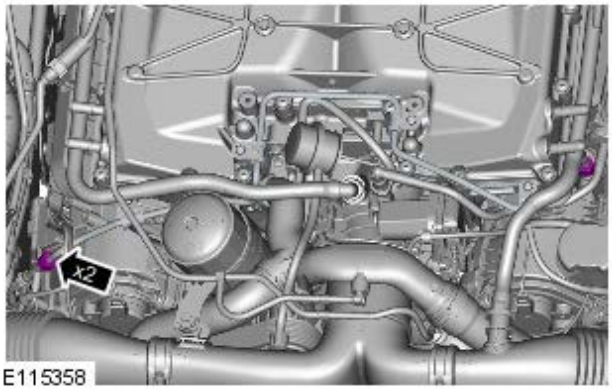
Remove and discard the blanking caps.



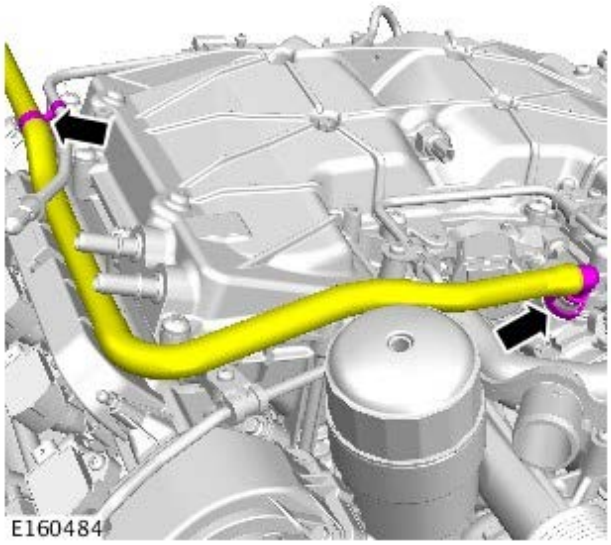
39. *Torque:*
    Unions 21 Nm
    Bolts 12 Nm



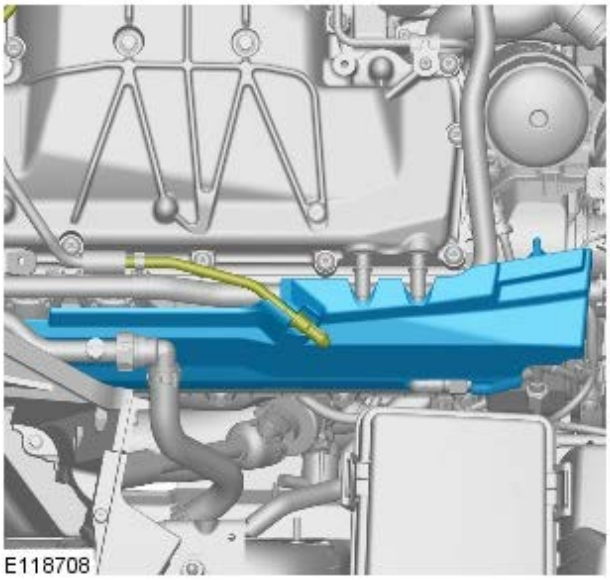
40. *Torque:* 21 Nm



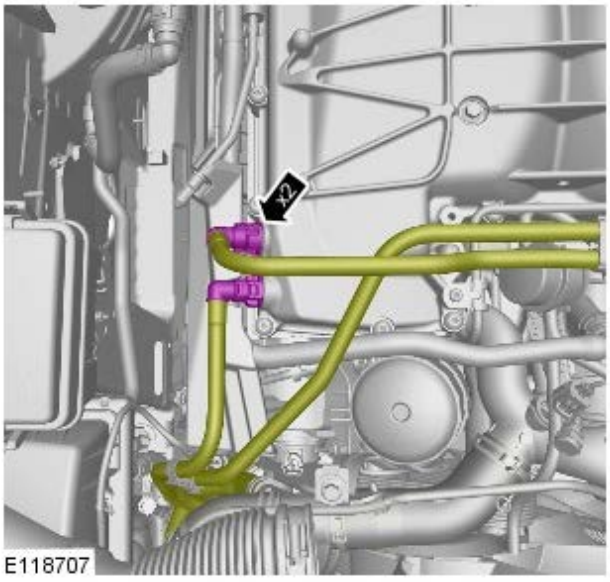
41.



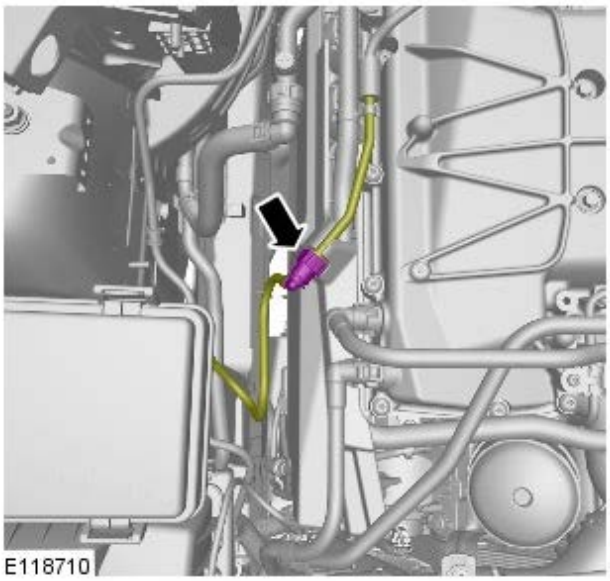
42.



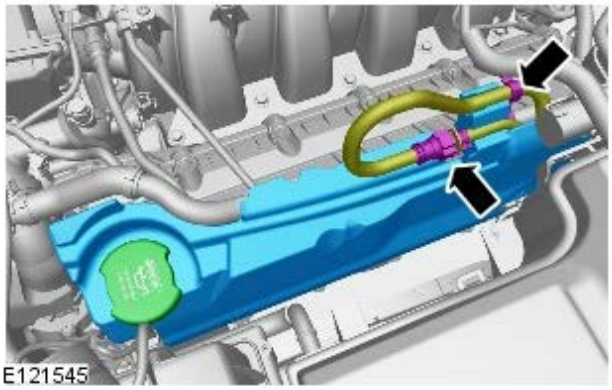
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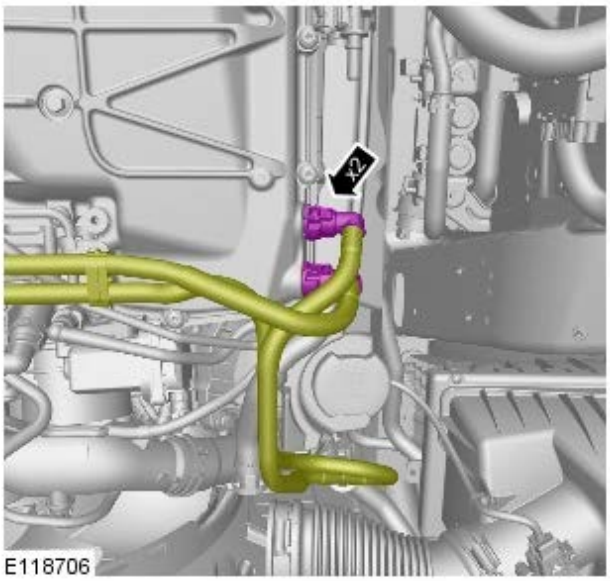
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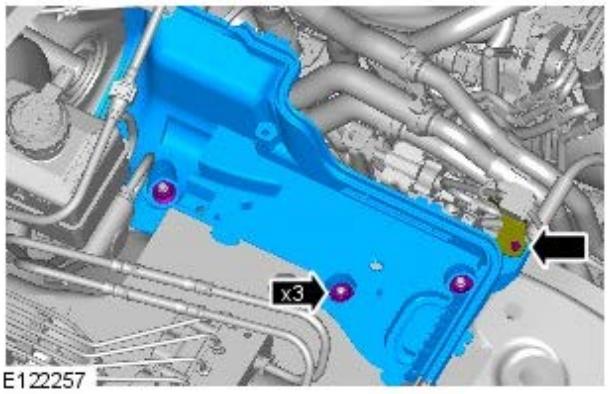
45.



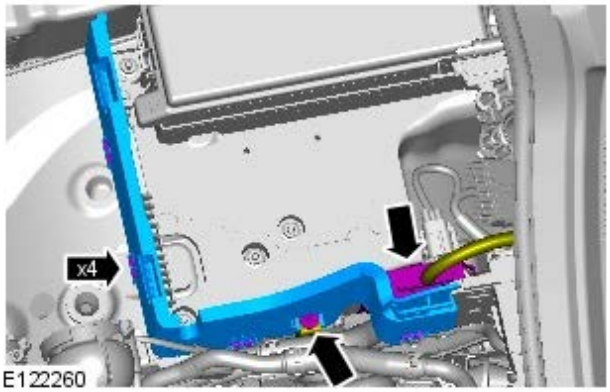
46.



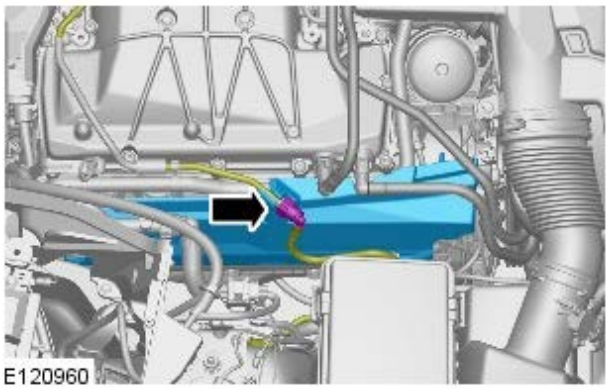
47. *Torque:* 12 Nm



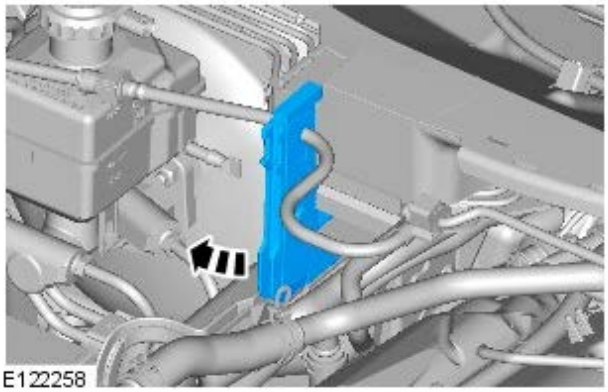
48.



49.



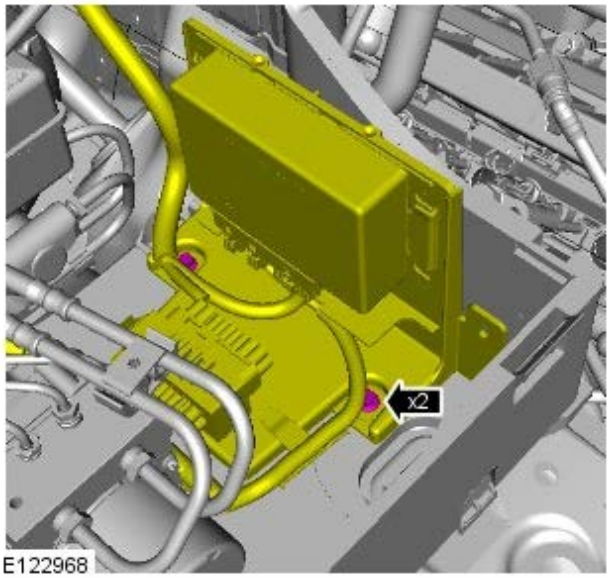
Right-hand drive vehicles



50. NOTE: Right-hand shown, left-hand similar.

51. NOTE: Right-hand shown, left-hand similar.

Torque: 10 Nm

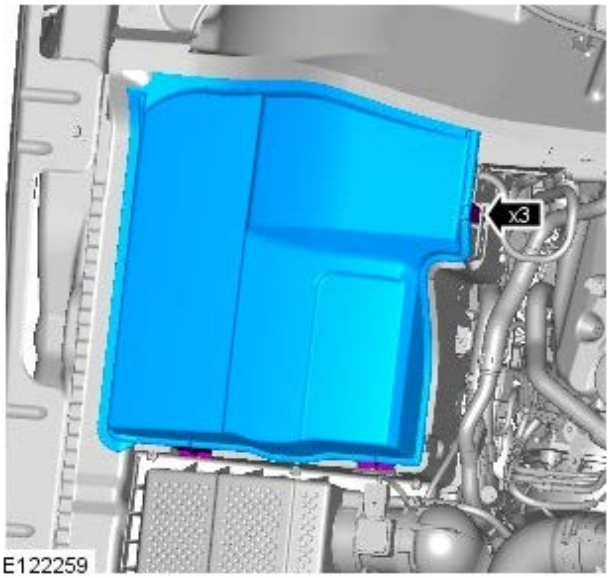


Left-hand drive vehicles

52. Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

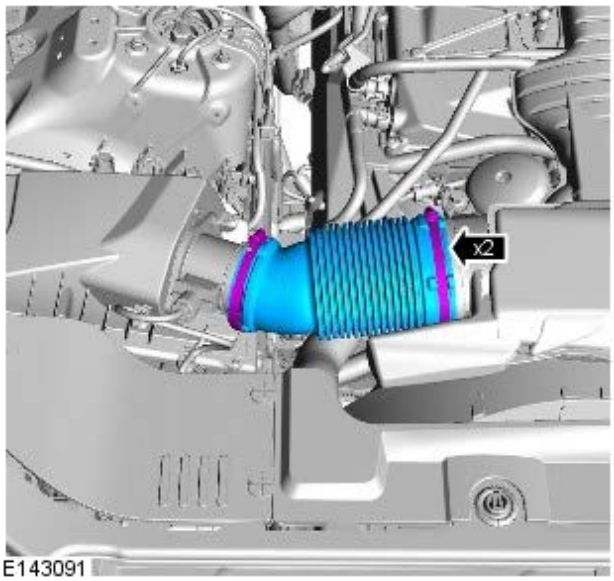
All vehicles

53.



54. Refer to: Air Cleaner RH (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

55.



56. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

57. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

58. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 11-May-2011

Fuel Charging and Controls - V8 S/C 5.0L Petrol - High Pressure Fuel Pump 1

Removal and Installation

Removal

CAUTIONS:

Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

Make sure that tools and equipment are clean, free of foreign material and lubricant.

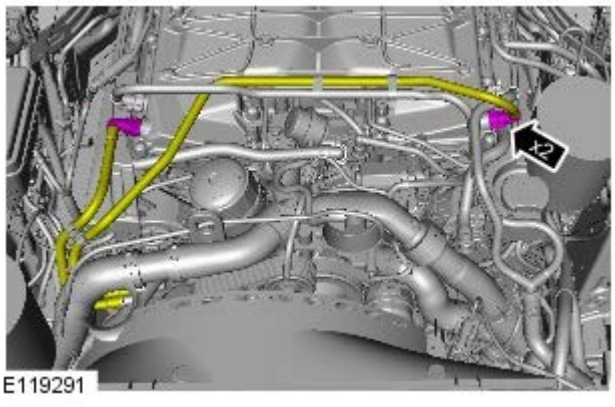
NOTES:

Removal steps in this procedure may contain installation details.

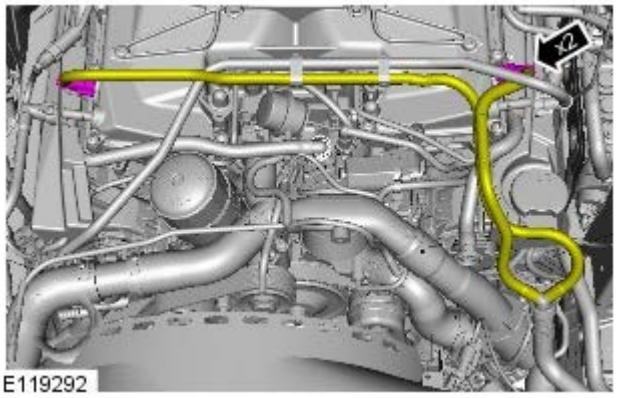
Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Fuel System Pressure Release - 5.0L (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

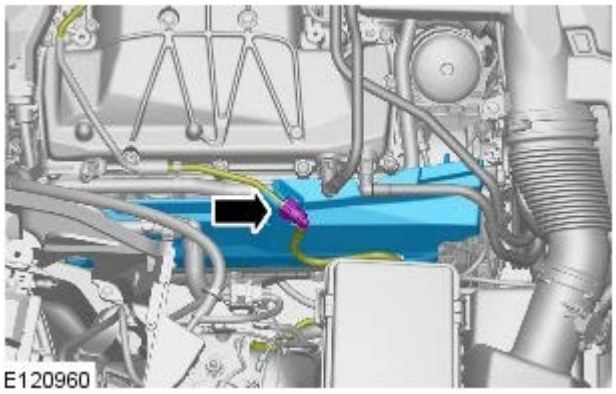
   Refer to: Specifications (414-00 Charging System - General Information, Specifications).
4. Refer to: Engine Oil Draining and Filling (303-01 Engine - 5.0L, Vehicles Without: Supercharger, General Procedures).
5. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12 Intake Air Distribution and Filtering - 5.0L, Vehicles With: Supercharger, Removal and Installation).
6. Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 5.0L, Vehicles Without: Supercharger, General Procedures).



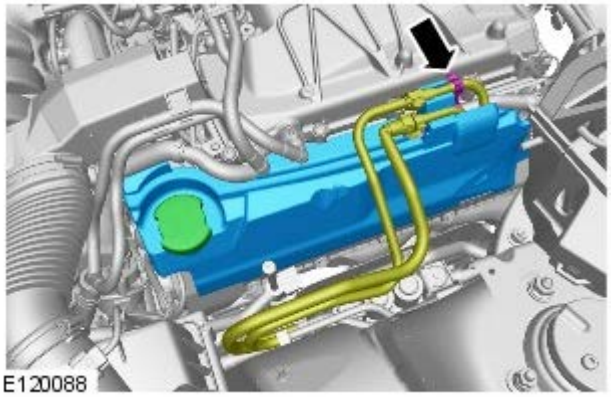
7. CAUTION: Be prepared to collect escaping coolant.
8. WARNING: Be prepared to collect escaping fluids.



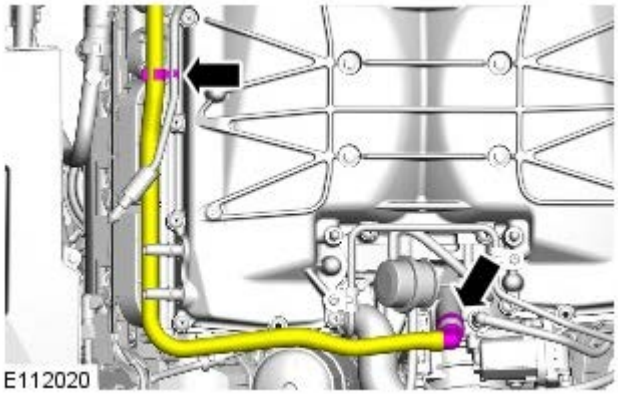
9.



10.



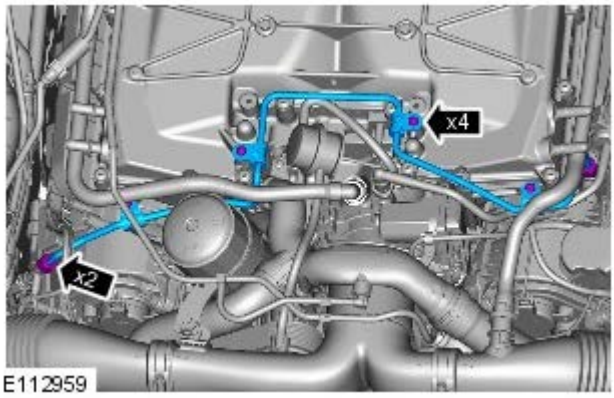
11.



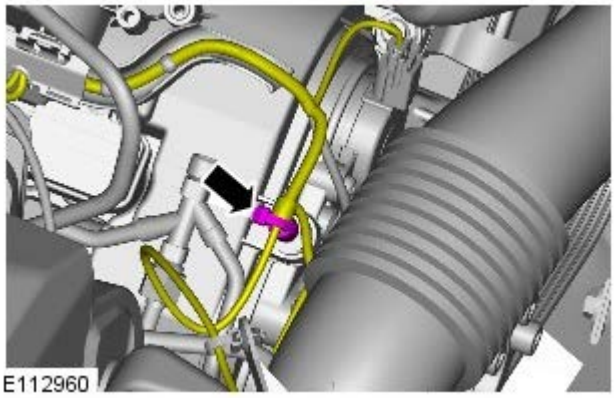
12. CAUTIONS:

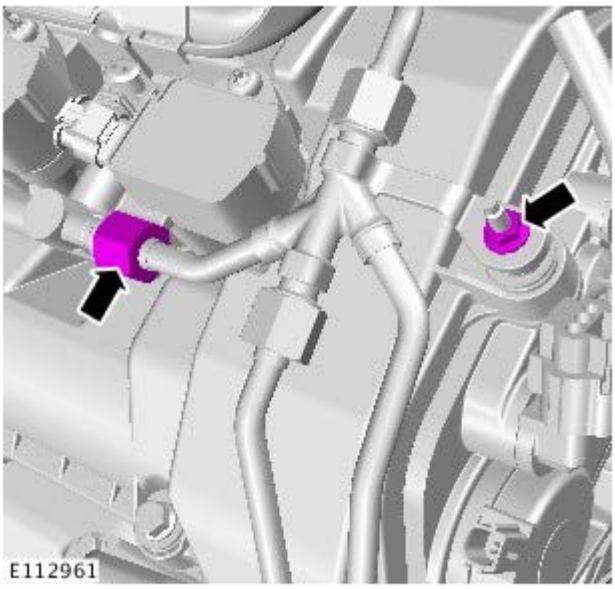
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.



13.





14. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

15. Refer to: Dynamic Response Module (204-06 Ride and Handling Optimization, Removal and Installation).

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

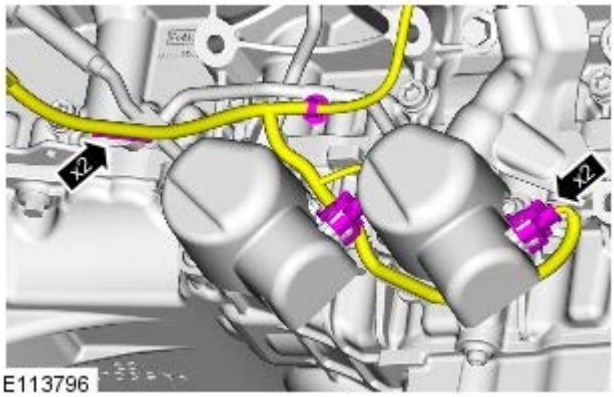
Raise and support the vehicle.

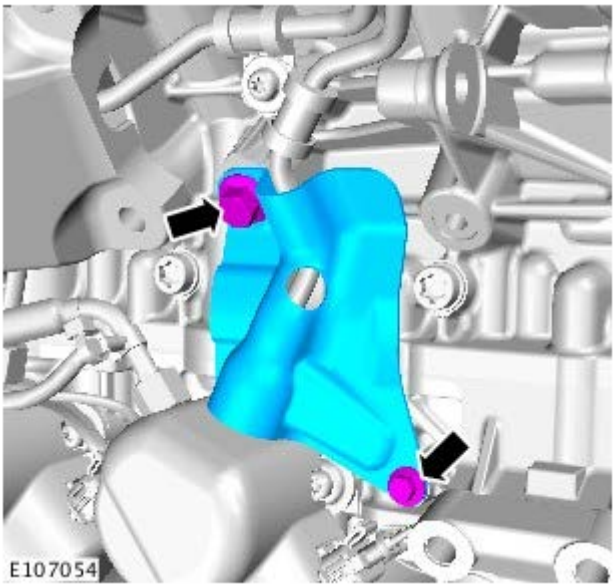
17. Refer to: Steering Gear - 5.0L, Petrol (211-02, Removal and Installation).

18. Refer to: Engine Mount RH (303-01 Engine - 5.0L, Vehicles Without: Supercharger, Removal and Installation).

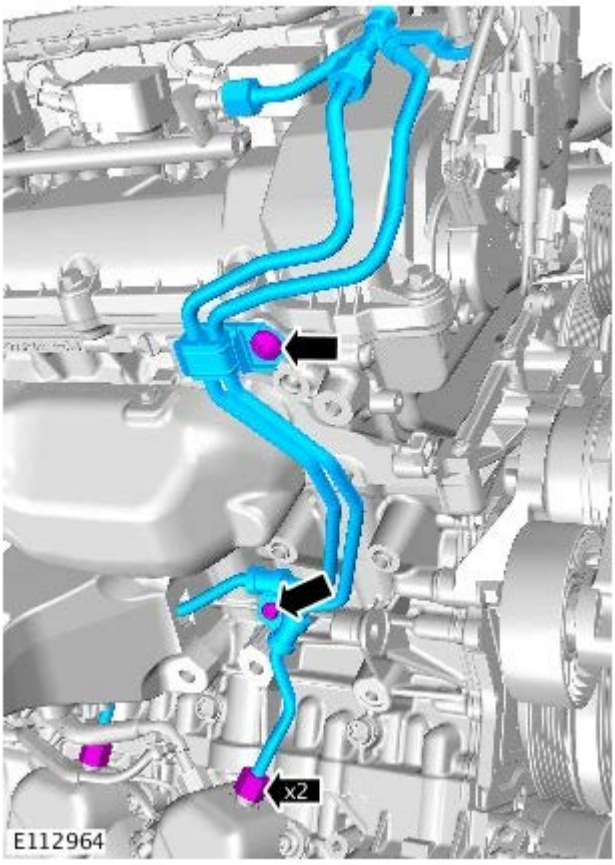
19. Refer to: Generator (414-02 Generator and Regulator - 5.0L, Removal and Installation).

20. NOTE: Engine shown removed for clarity.





21. NOTE: Engine shown removed for clarity.



22. CAUTIONS:

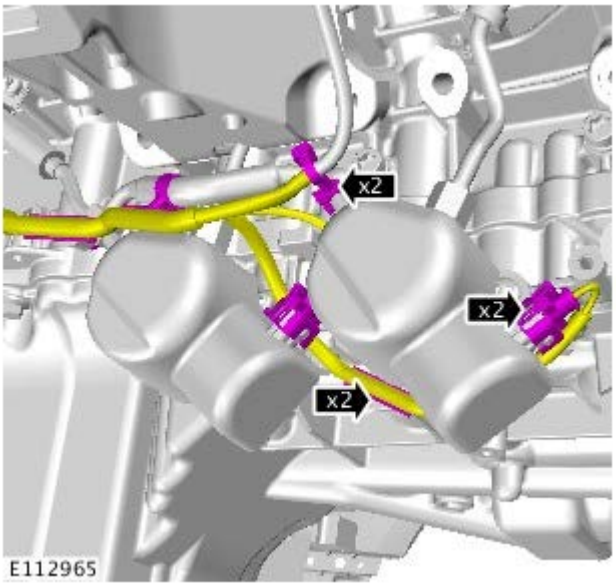
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

Remove and discard the high-pressure fuel supply lines.

NOTE: Engine shown removed for clarity.

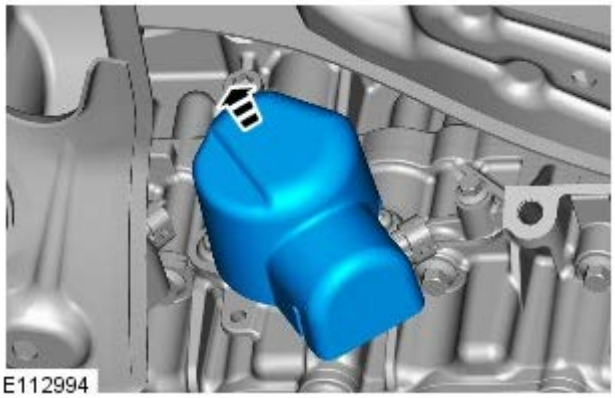
23. CAUTIONS:



Be prepared to collect escaping fluids.

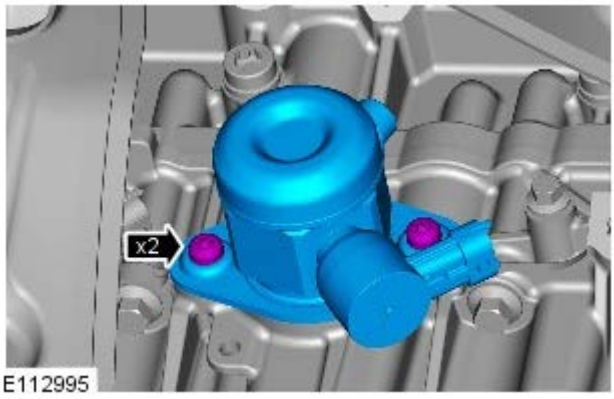
Make sure that all openings are sealed. Use new blanking caps.

24.



25. CAUTION: Be prepared to collect escaping fluids.

Loosen the Torx screws a turn each at a time.



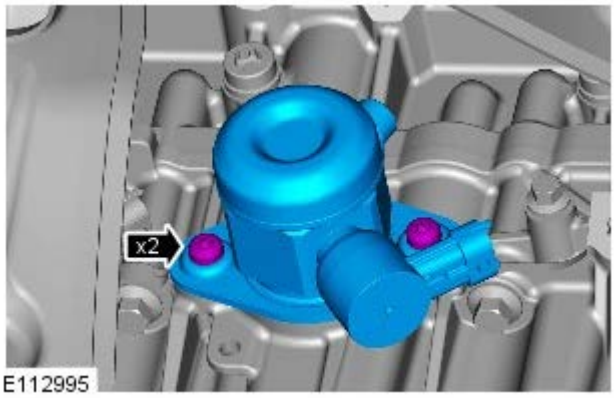
26. CAUTION: Be prepared to collect escaping fluids.



Installation



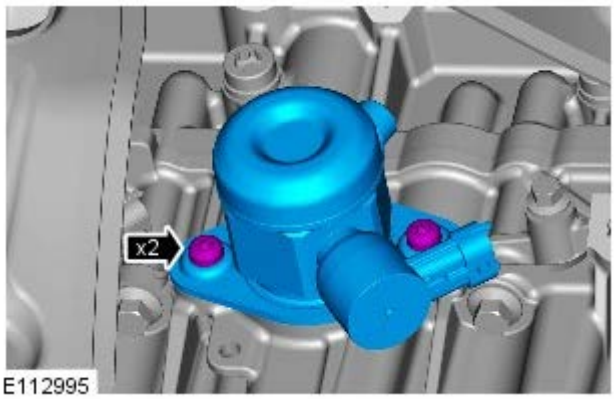
1. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.



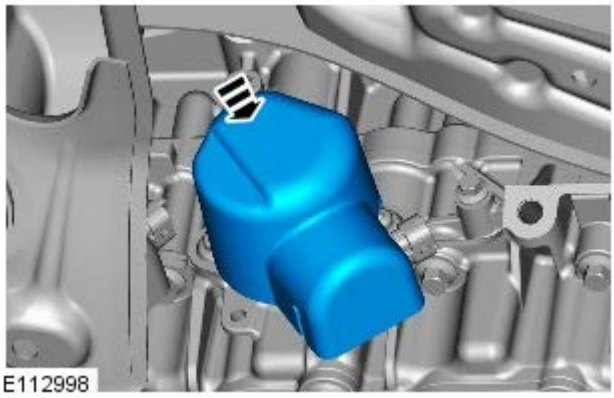
2. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

   NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

   Torque: 11 Nm



3. Loosen the Torx screws half a turn each.

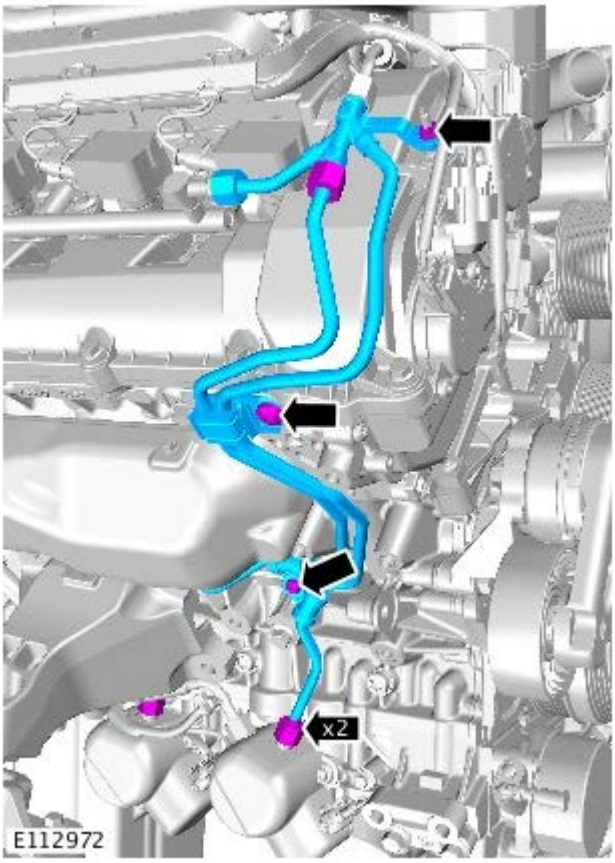


4.

5. CAUTION: Install new high-pressure fuel supply lines.

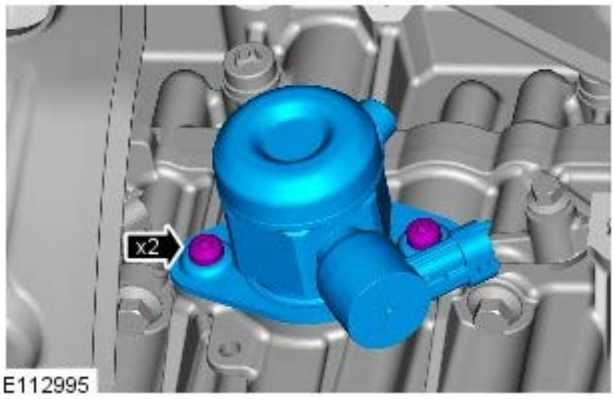
   NOTES:

   Remove and discard the blanking caps.



Engine shown removed for clarity.

Install the bolt and unions fully finger tight before final tightening.

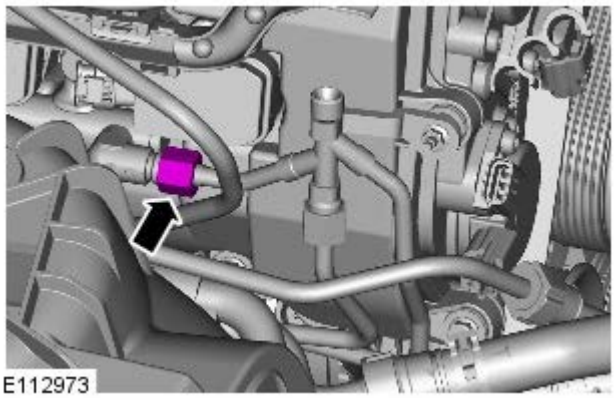


6. CAUTION: Care must be taken when positioning the fuel rail high-pressure fuel pump cover to one side.

NOTE: Fuel rail high-pressure fuel pump cover shown removed for clarity.

Torque: 11 Nm

7. Lower the vehicle.



8. NOTES:

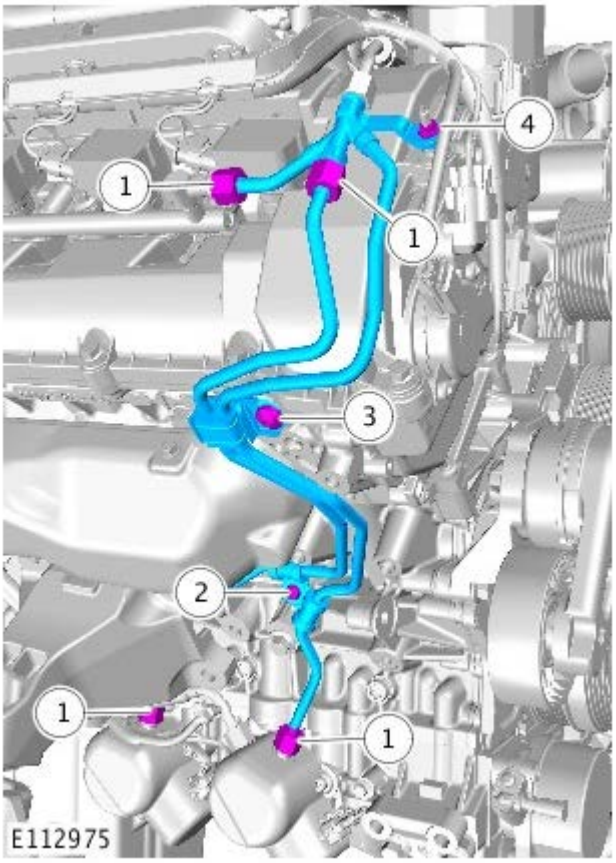
Do not tighten at this stage.

Remove and discard the blanking caps.

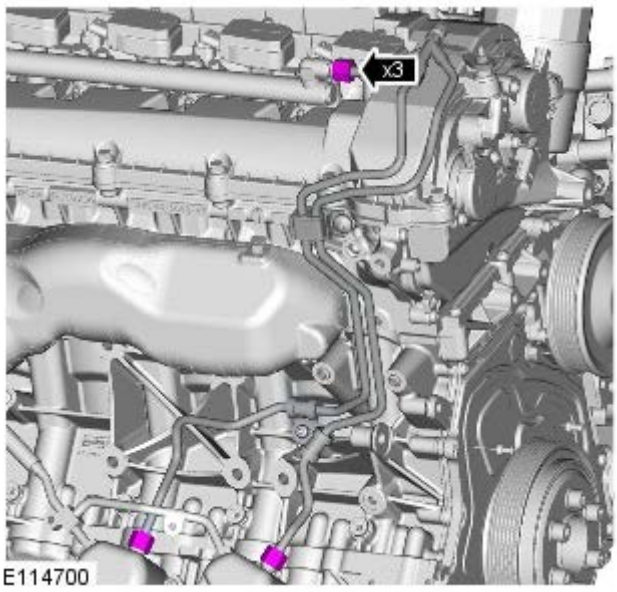
9. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

10. NOTE: Engine shown removed for clarity.



Torque:
Unions (1) 21 Nm
M6 (2) 11 Nm
M8 (3) 25 Nm
M5 nut (4) 6 Nm



11. NOTE: Engine shown removed for clarity.

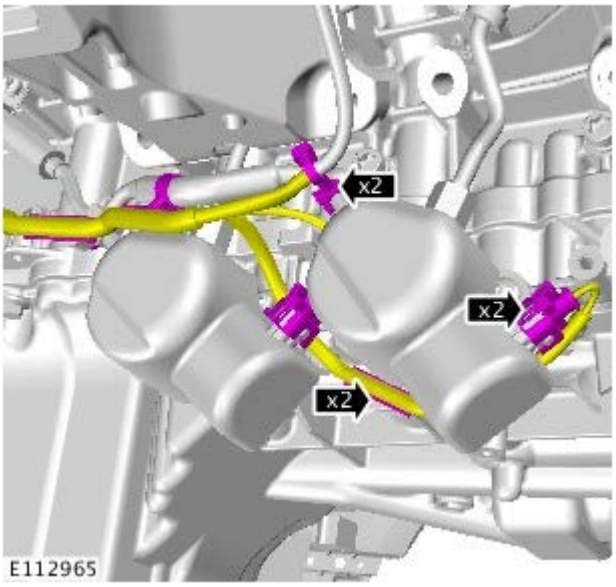
Torque: 21 Nm

12. NOTES:

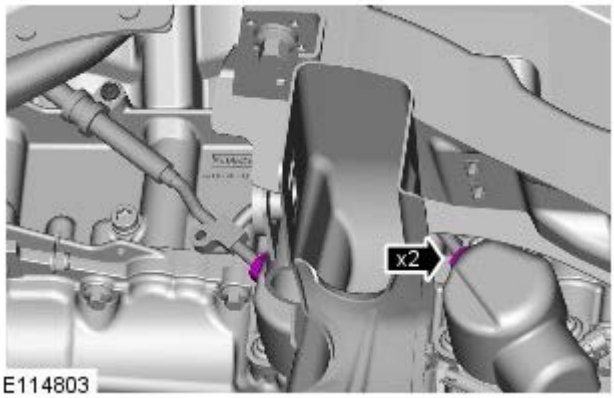
Install the bolt and unions finger tight before final tightening.

Remove and discard the blanking caps.

Torque:
Unions 21 Nm
M6 11 Nm

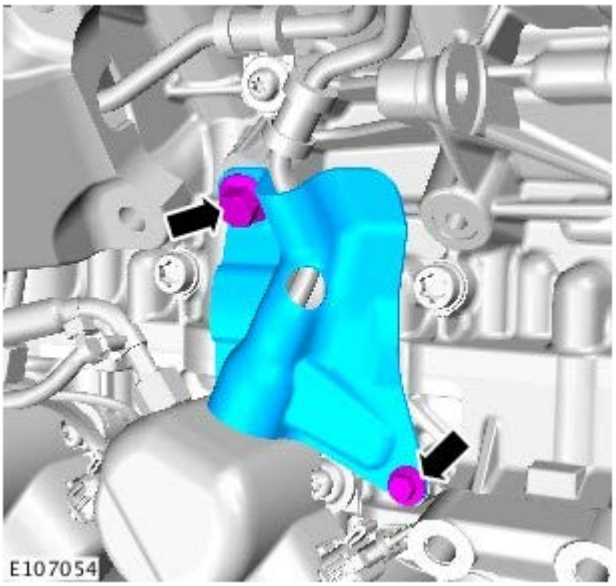


13. *Torque:* 21 Nm

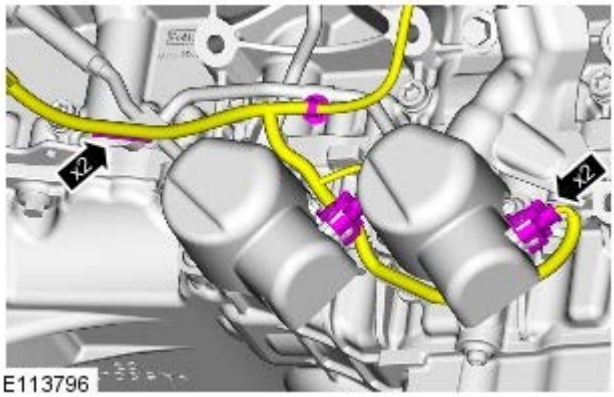


14. NOTE: Engine shown removed for clarity.

Torque:
M10 29 Nm
M6 11 Nm



15. NOTE: Engine shown removed for clarity.



16. Refer to: Generator (414-02 Generator and Regulator - 5.0L, Removal and Installation).

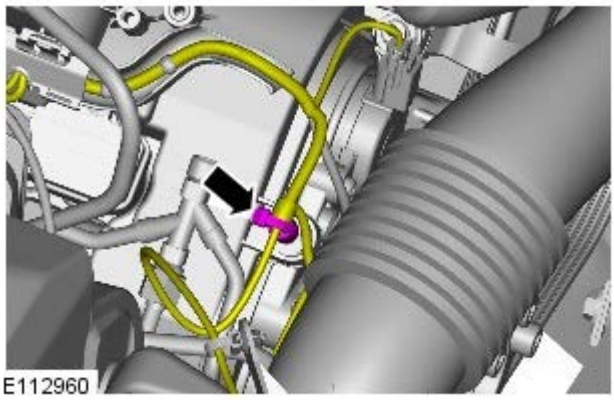
17. Refer to: Engine Mount RH (303-01 Engine - 5.0L, Vehicles Without: Supercharger, Removal and Installation).

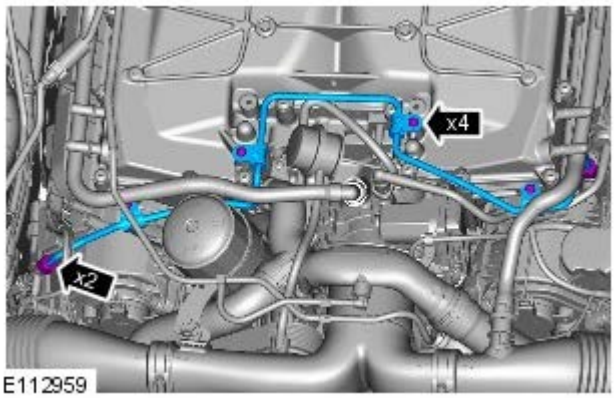
18. Refer to: Steering Gear - 5.0L, Petrol (211-02, Removal and Installation).

19. Lower the vehicle.

20. Refer to: Dynamic Response Module (204-06 Ride and Handling Optimization, Removal and Installation).

21.



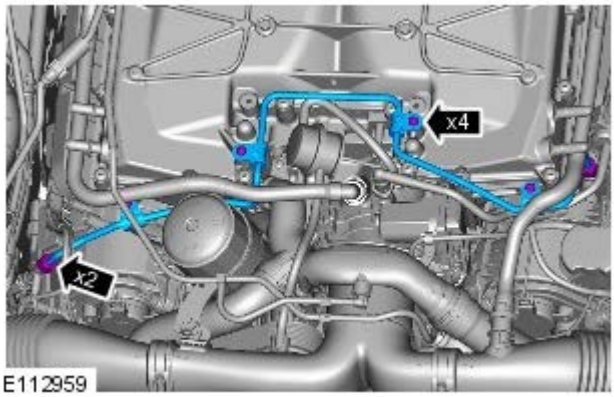


22. NOTES:

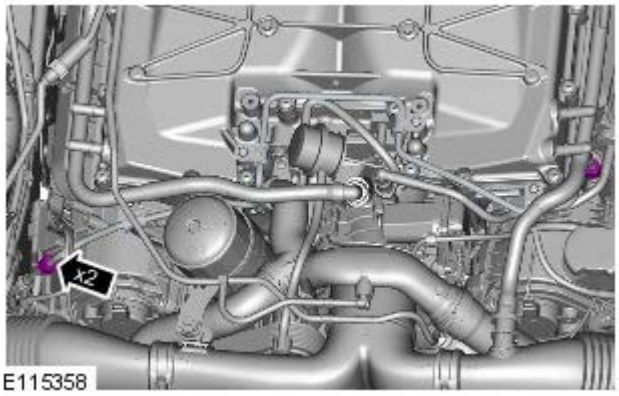
Do not tighten at this stage.

Remove and discard the blanking caps.

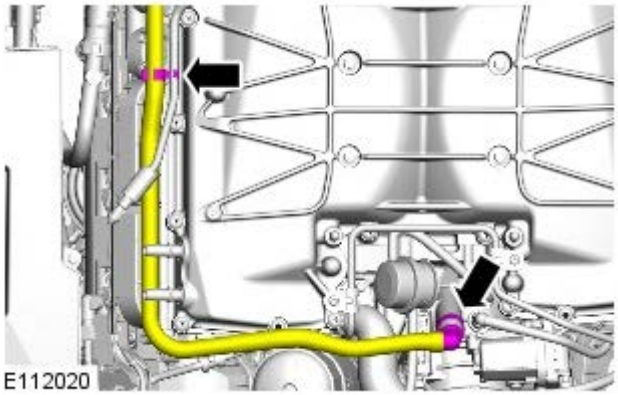
23. *Torque:*
Unions 21 Nm
Bolts 8 Nm



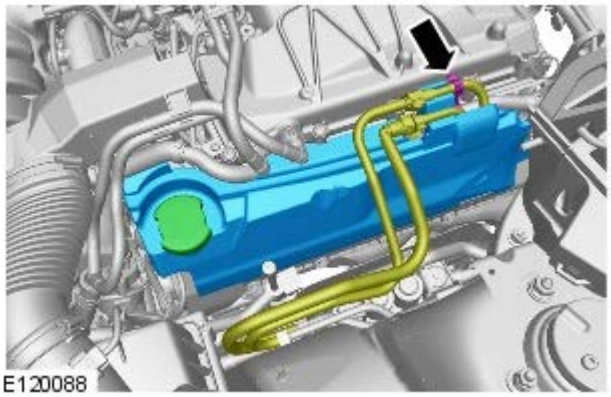
24. *Torque:* 21 Nm



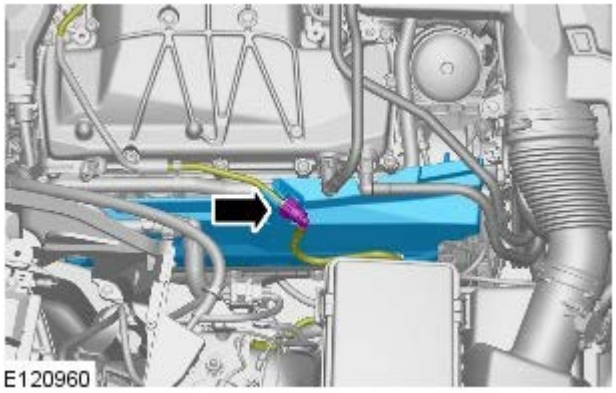
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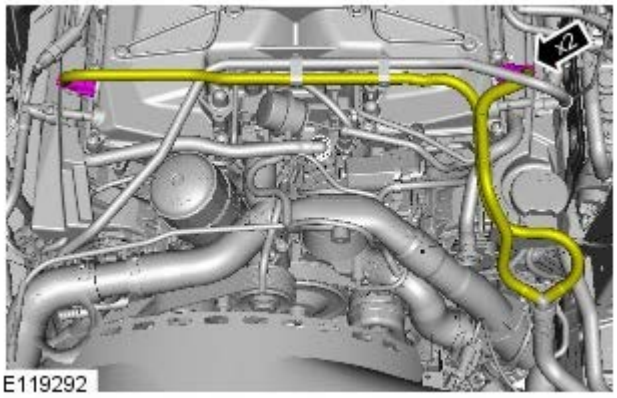


26.

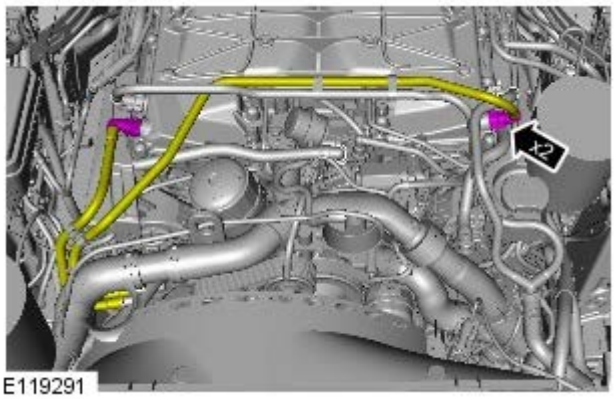


27.





28. WARNING: Be prepared to collect escaping fluids.



29. CAUTION: Be prepared to collect escaping coolant.

30. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12 Intake Air Distribution and Filtering - 5.0L, Vehicles With: Supercharger, Removal and Installation).

31. Refer to: Engine Oil Draining and Filling (303-01 Engine - 3.0L Diesel, General Procedures).

32. Connect the battery ground cable.

    Refer to: Specifications (414-00 Charging System - General Information, Specifications).

Published: 11-May-2011

Fuel Charging and Controls - V8 S/C 5.0L Petrol - High Pressure Fuel Pump 2

Removal and Installation

Removal

CAUTIONS:

Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

Make sure that tools and equipment are clean, free of foreign material and lubricant.

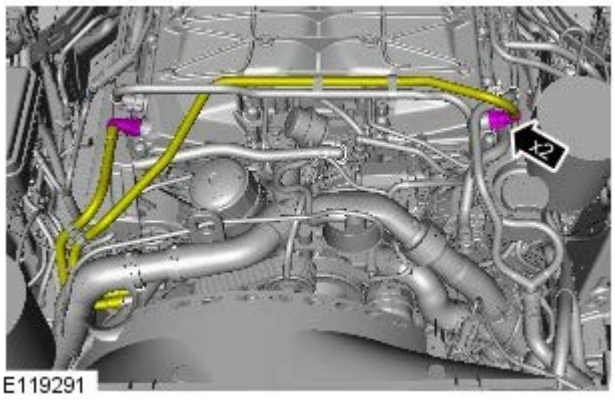
NOTES:

Removal steps in this procedure may contain installation details.

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

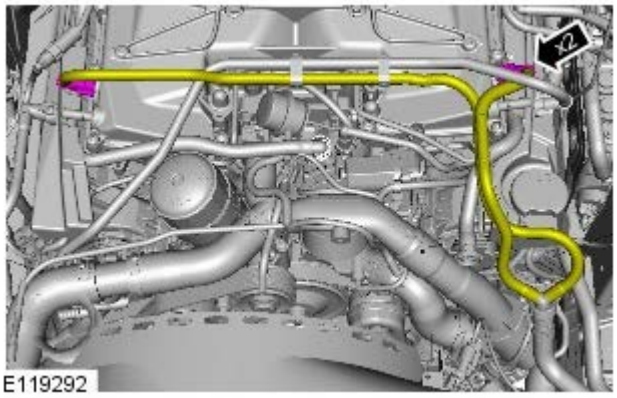
1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).
2. Refer to: Fuel System Pressure Release - 5.0L (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Charging System - General Information, Specifications).
4. Refer to: Engine Oil Draining and Filling (303-01 Engine - 5.0L, Vehicles Without: Supercharger, General Procedures).
5. Refer to: Fuel Injection Component Cleaning (303-04 Fuel Charging and Controls - 5.0L, Vehicles Without: Supercharger, General Procedures).
6. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12 Intake Air Distribution and Filtering - 5.0L, Vehicles With: Supercharger, Removal and Installation).

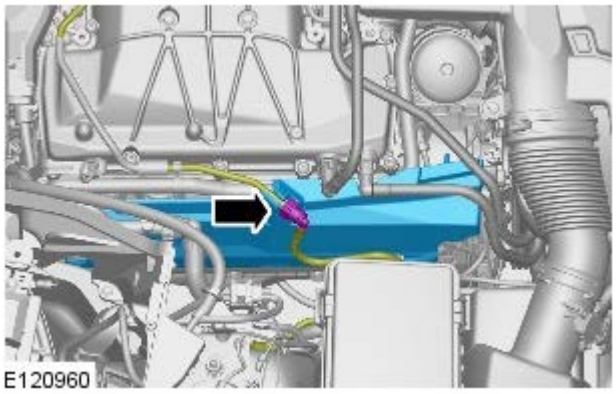


7. CAUTION: Be prepared to collect escaping coolant.

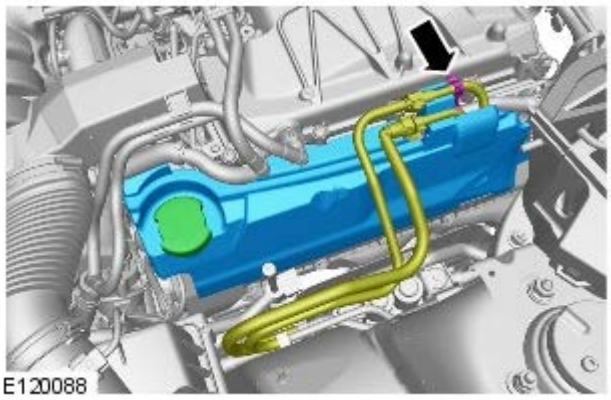
8. WARNING: Be prepared to collect escaping fluids.



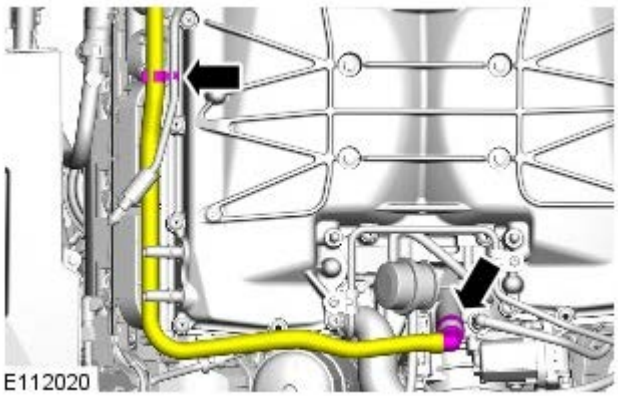
9.



10. CAUTION: Be prepared to collect escaping fluids.



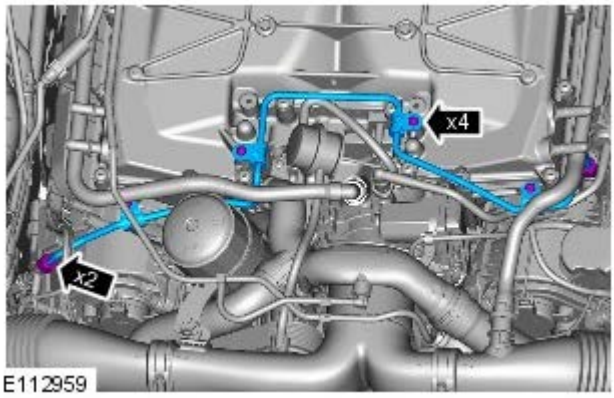
11. CAUTION: Be prepared to collect escaping fluids.



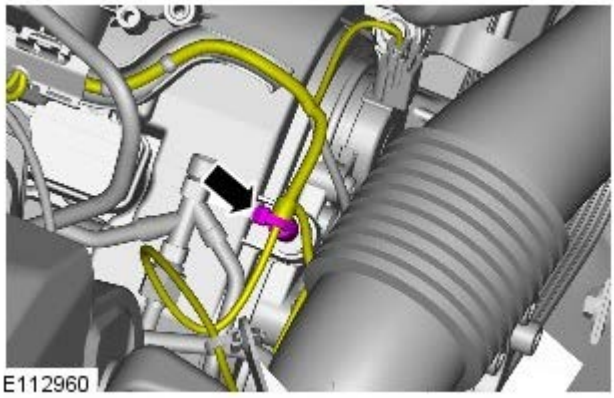
12. CAUTIONS:

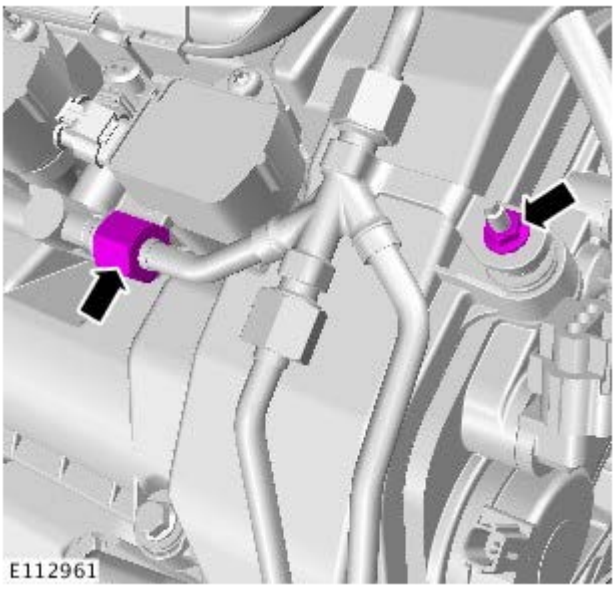
CAUTION: Be prepared to collect escaping fluids.

CAUTION: Make sure that all openings are sealed. Use new blanking caps.



13.





14. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

15. Refer to: Dynamic Response Module (204-06 Ride and Handling Optimization, Removal and Installation).

16. WARNING: Make sure to support the vehicle with axle stands.

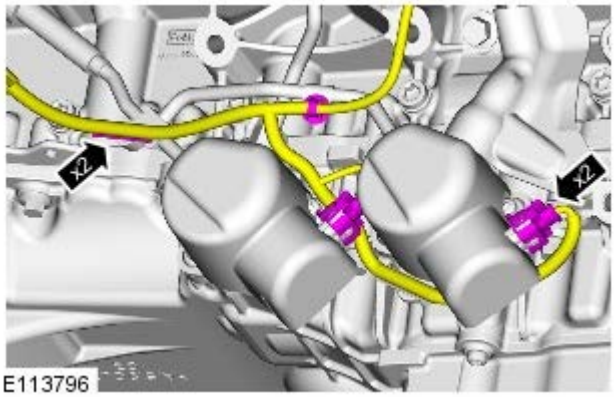
Raise and support the vehicle.

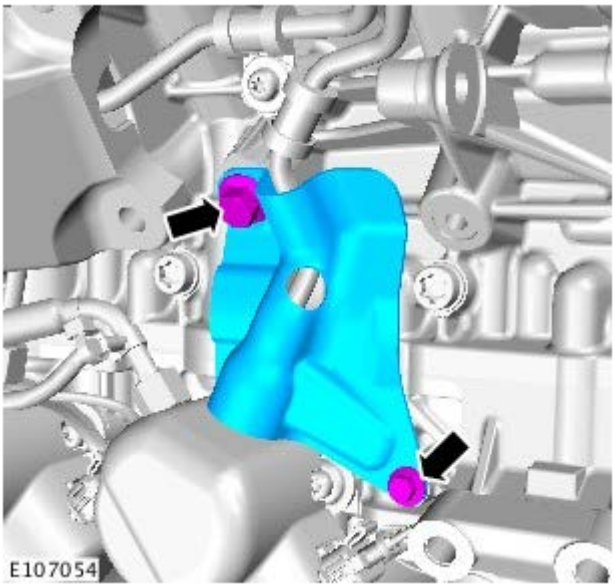
17. Refer to: Steering Gear - 5.0L, Petrol (211-02, Removal and Installation).

18. Refer to: Engine Mount RH (303-01 Engine - 5.0L, Vehicles Without: Supercharger, Removal and Installation).

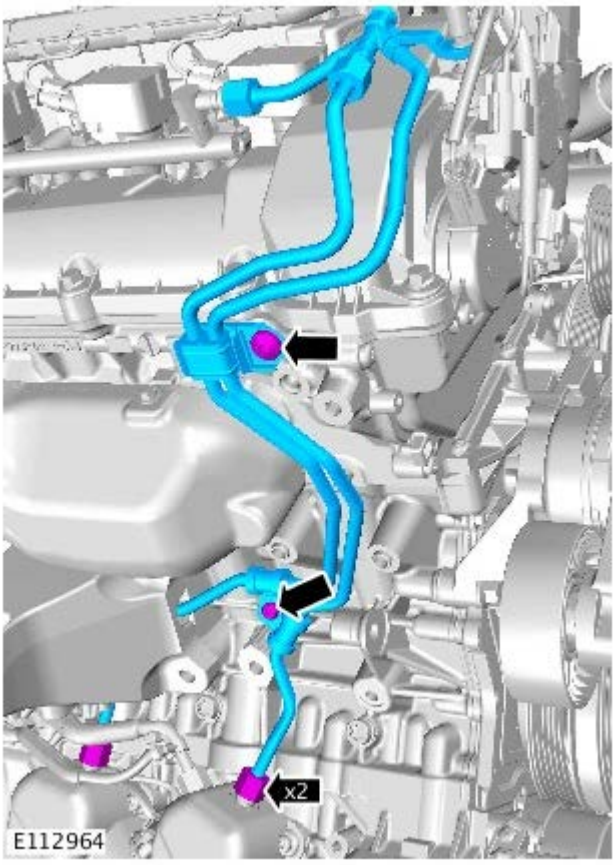
19. Refer to: Generator (414-02 Generator and Regulator - 5.0L, Removal and Installation).

20. NOTE: Engine shown removed for clarity.





21. NOTE: Engine shown removed for clarity.



22. CAUTIONS:

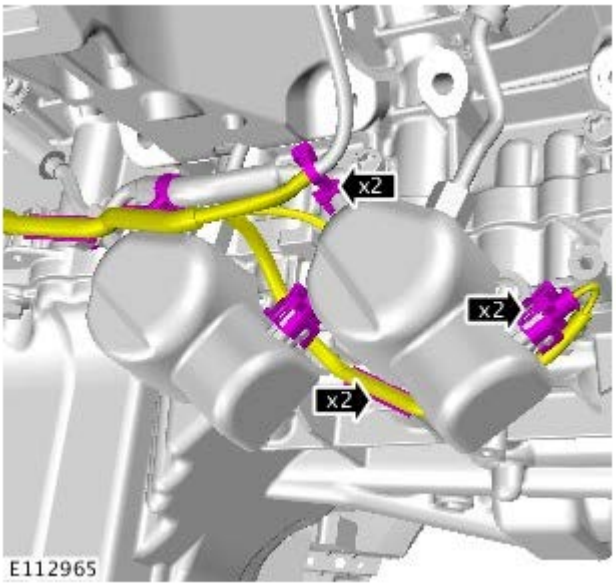
Be prepared to collect escaping fluids.

Make sure that all openings are sealed. Use new blanking caps.

Remove and discard the high-pressure fuel supply lines.

NOTE: Engine shown removed for clarity.

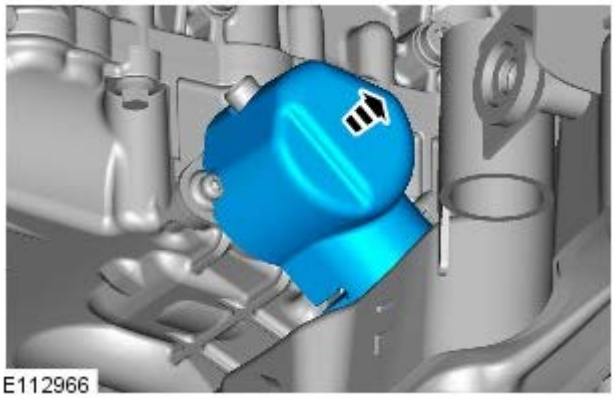
23. CAUTIONS:



Be prepared to collect escaping fluids.

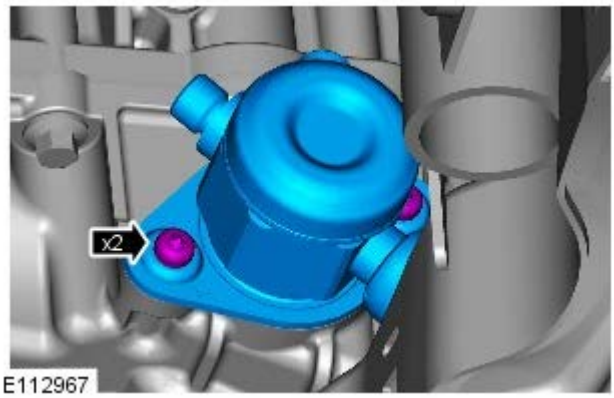
Make sure that all openings are sealed. Use new blanking caps.

24.

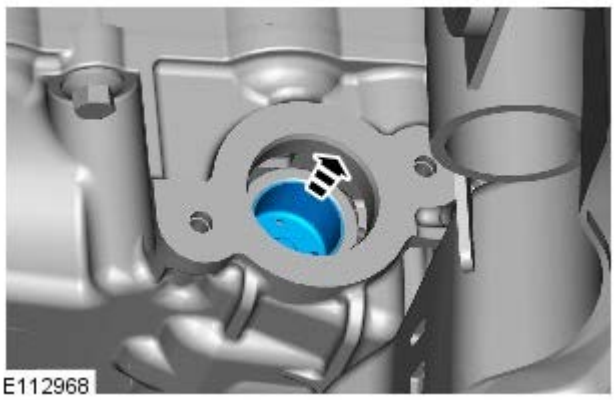


25. CAUTION: Be prepared to collect escaping fluids.

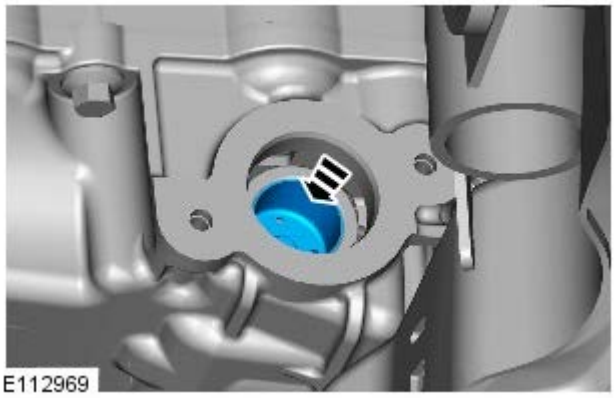
Loosen the Torx screws a turn each at a time.



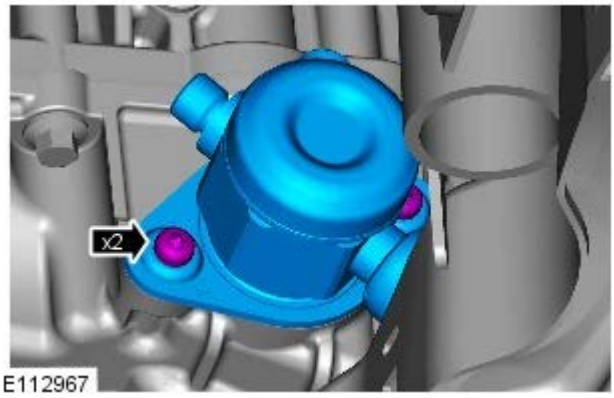
26. CAUTION: Be prepared to collect escaping fluids.



Installation



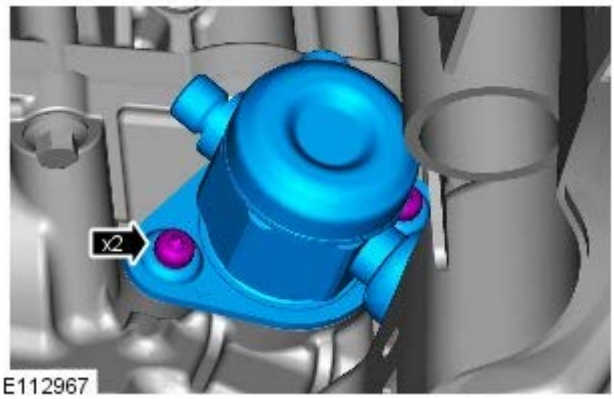
1. NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.



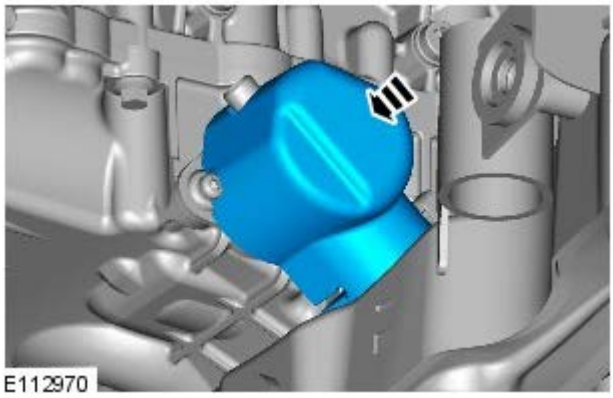
2. CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

   NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

   Torque: 11 Nm



3. Loosen the Torx screws half a turn each.

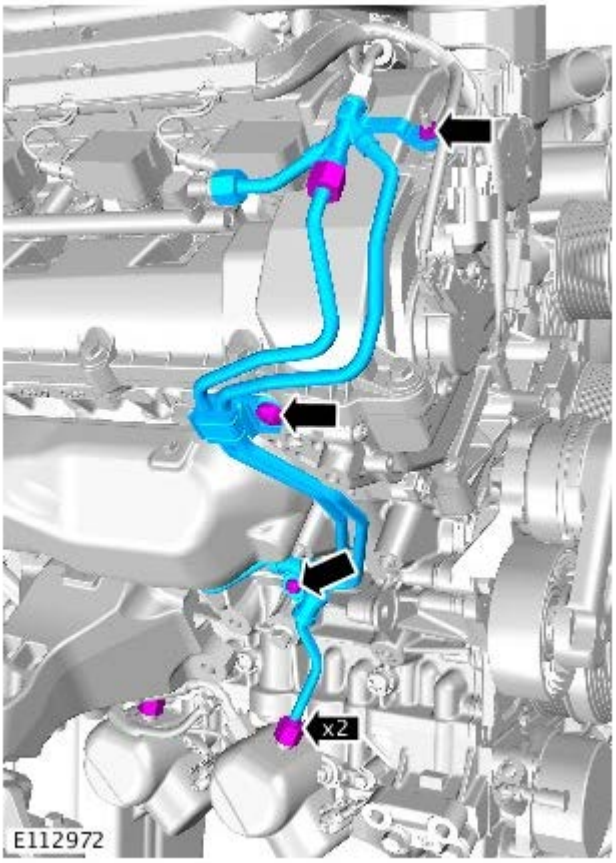


4.

5. CAUTION: Install new high-pressure fuel supply lines.

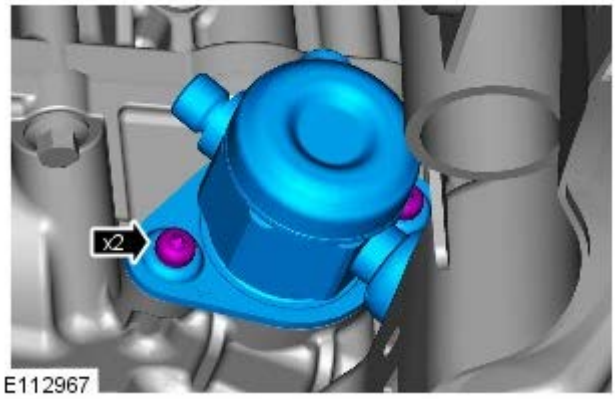
   NOTES:

   Remove and discard the blanking caps.



Engine shown removed for clarity.

Install the bolt and unions fully finger tight before final tightening.

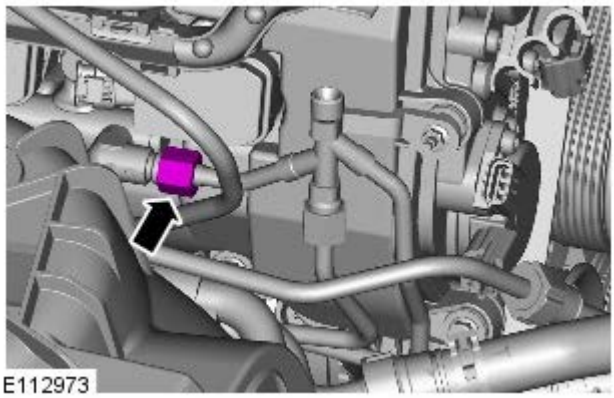


6. CAUTION: Care must be taken when positioning the fuel rail high-pressure fuel pump cover to one side.

NOTE: Fuel rail high-pressure fuel pump cover shown removed for clarity.

Torque: 11 Nm

7. Lower the vehicle.



8. NOTES:

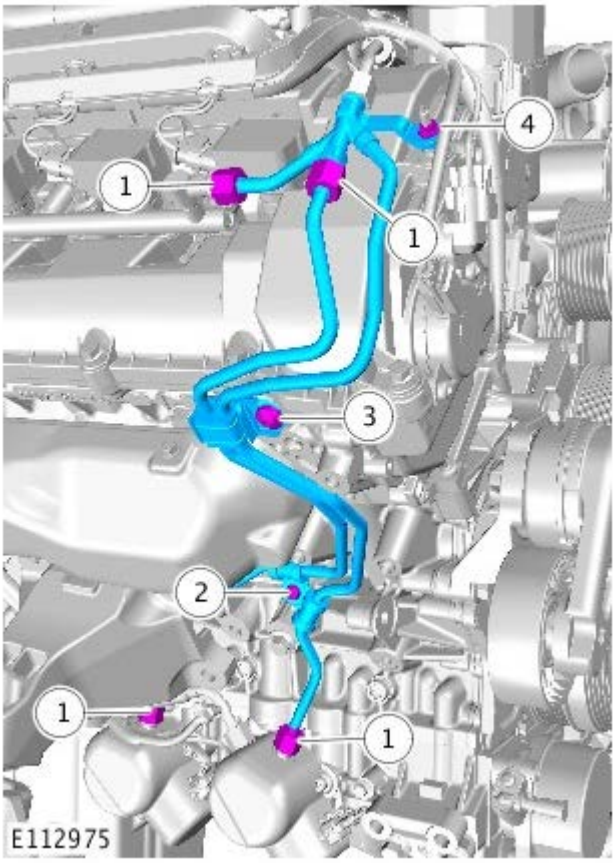
Do not tighten at this stage.

Remove and discard the blanking caps.

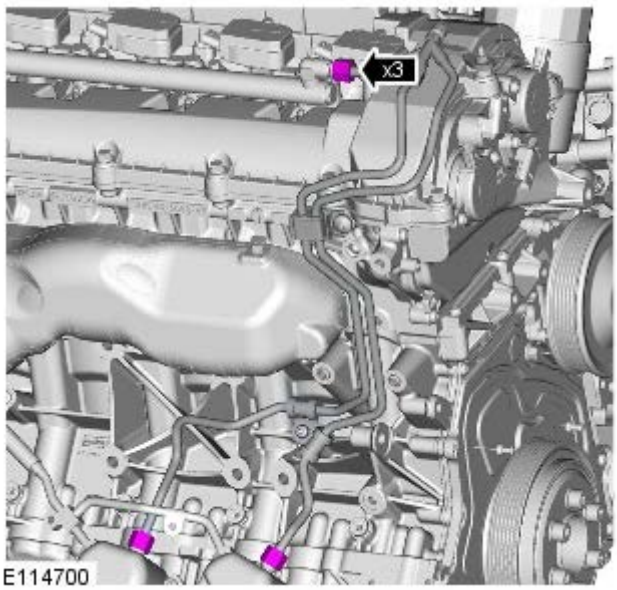
9. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

10. NOTE: Engine shown removed for clarity.



- *Torque:*
  Unions (1) 21 Nm
  M6 (2) 11 Nm
  M8 (3) 25 Nm
  M5 nut (4) 6 Nm



11. NOTE: Engine shown removed for clarity.

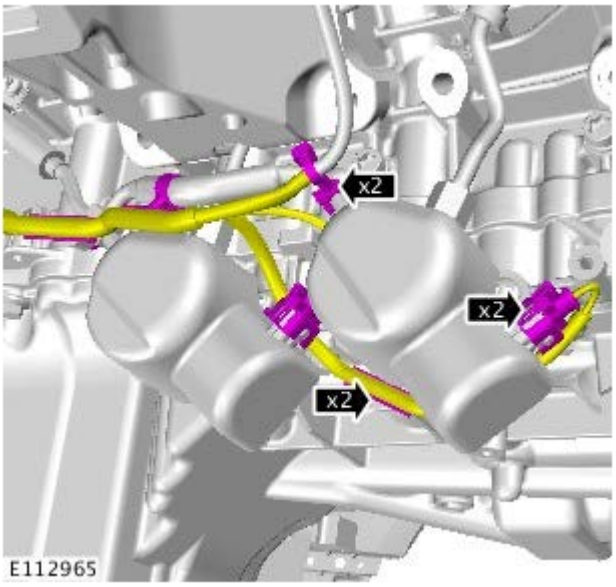
    Torque: 21 Nm

12. NOTES:

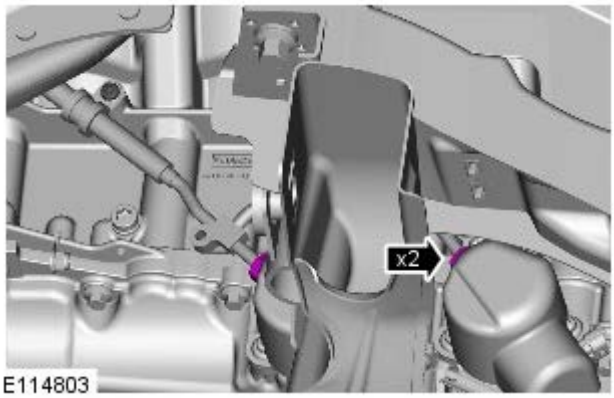
    Install the bolt and unions finger tight before final tightening.

    Remove and discard the blanking caps.

- *Torque:*
  Unions 21 Nm
  M6 11 Nm

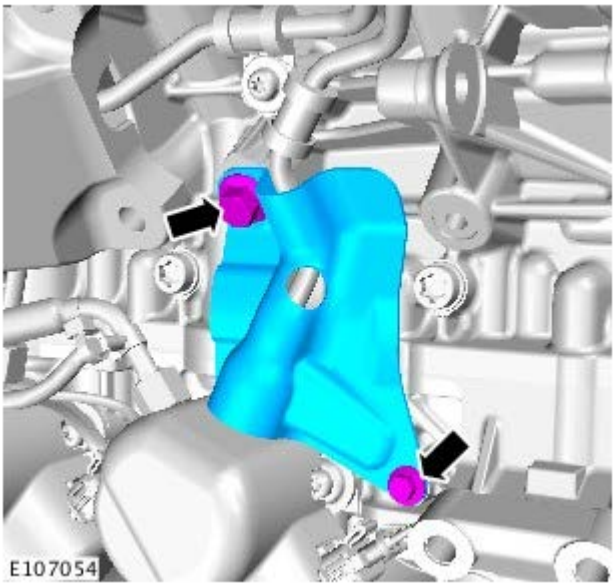


13. *Torque:* 21 Nm

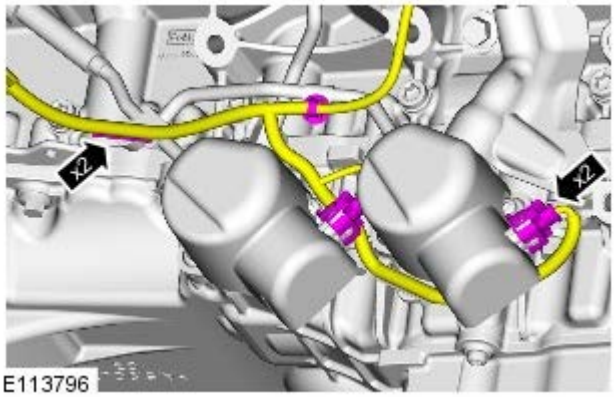


14. NOTE: Engine shown removed for clarity.

Torque:
M10 29 Nm
M6 11 Nm



15. NOTE: Engine shown removed for clarity.



16. Refer to: Generator (414-02 Generator and Regulator - 5.0L, Removal and Installation).

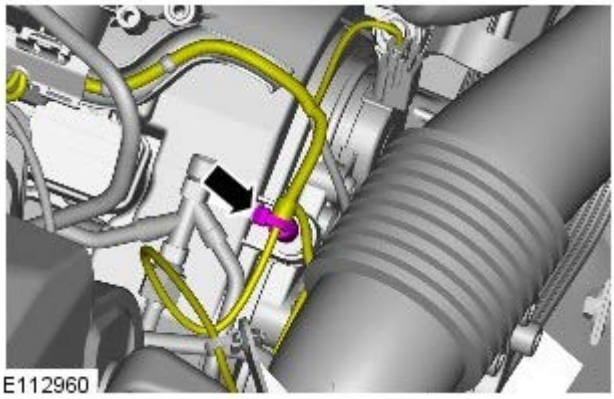
17. Refer to: Engine Mount RH (303-01 Engine - 5.0L, Vehicles Without: Supercharger, Removal and Installation).

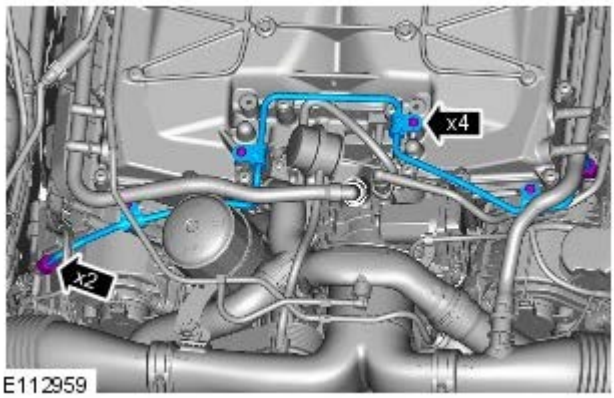
18. Refer to: Steering Gear - 5.0L, Petrol (211-02, Removal and Installation).

19. Lower the vehicle.

20. Refer to: Dynamic Response Module (204-06 Ride and Handling Optimization, Removal and Installation).

21.





22. CAUTION: Lubricate only the union threads with clean engine oil.

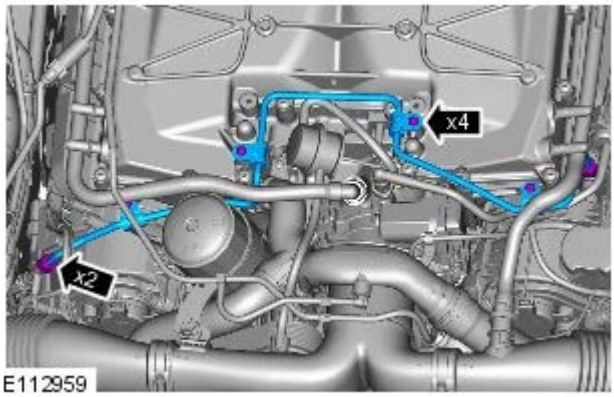
NOTES:

Do not tighten at this stage.

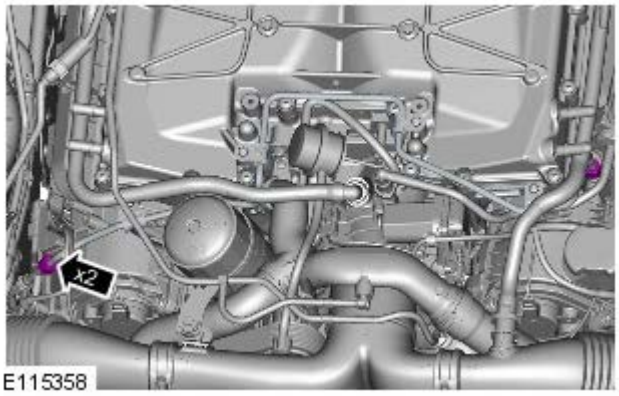
Remove and discard the blanking caps.

23.

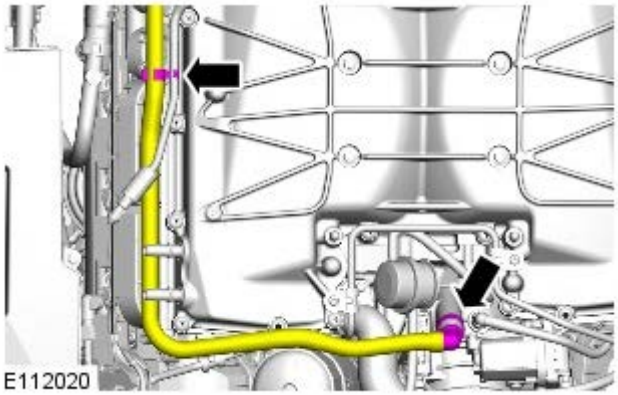
- *Torque:*
  Unions 21 Nm
  Bolts 8 Nm



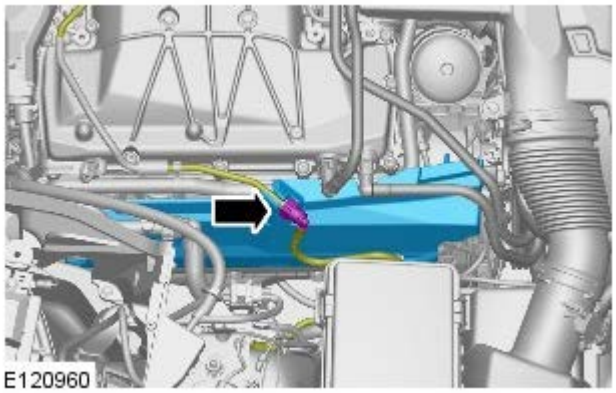
24. *Torque:* 21 Nm



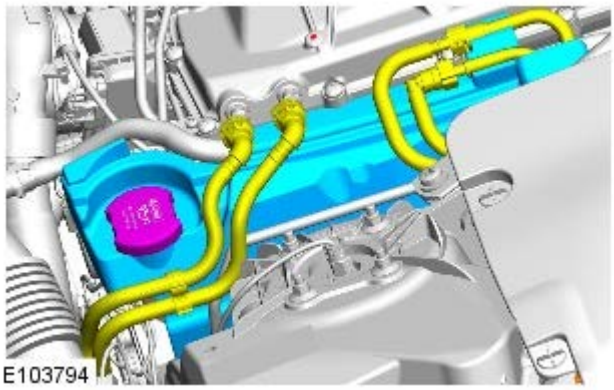
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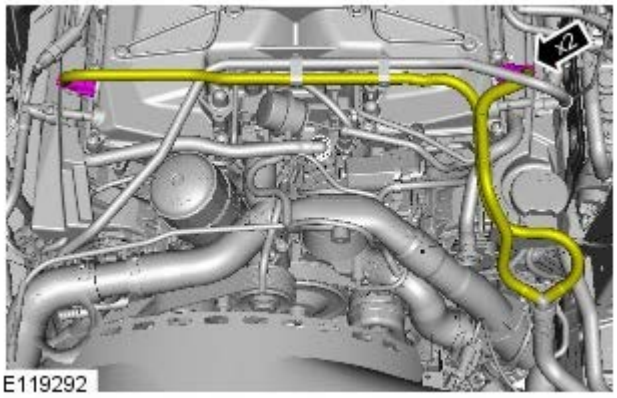


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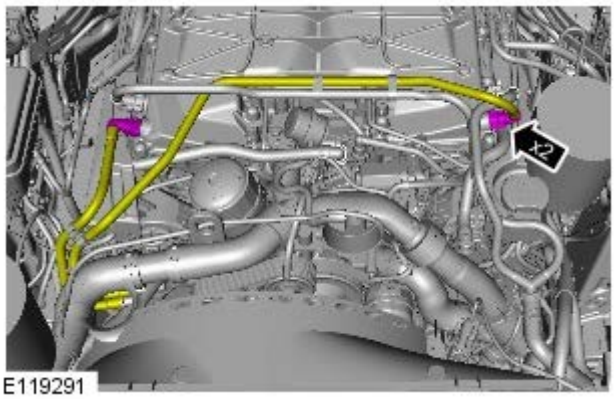
27.


E103794



E119292

28. WARNING: Be prepared to collect escaping fluids.



E119291

29. CAUTION: Be prepared to collect escaping coolant.

30. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12 Intake Air Distribution and Filtering - 5.0L, Vehicles With: Supercharger, Removal and Installation).

31. Refer to: Engine Oil Draining and Filling (303-01 Engine - 5.0L, Vehicles Without: Supercharger, General Procedures).

32. Connect the battery ground cable.

    Refer to: Specifications (414-00 Charging System - General Information, Specifications).

Published: 25-Apr-2013

Fuel Charging and Controls - V8 S/C 5.0L Petrol - Throttle Body

Removal and Installation

Removal

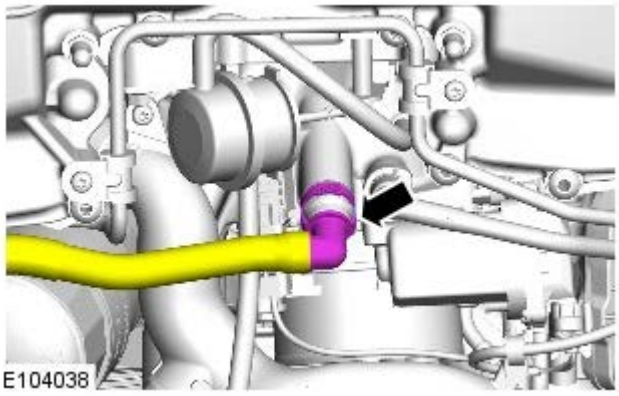
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

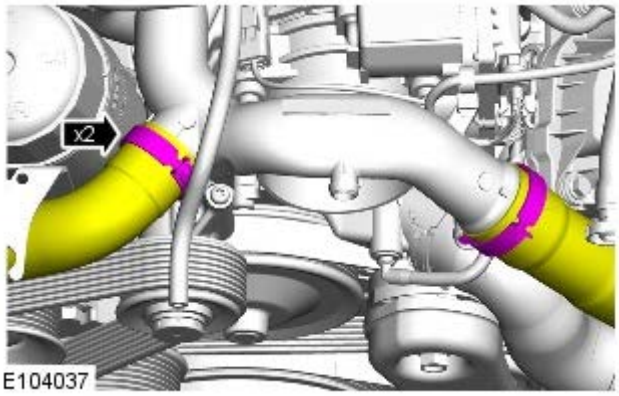
   Raise and support the vehicle.

2. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

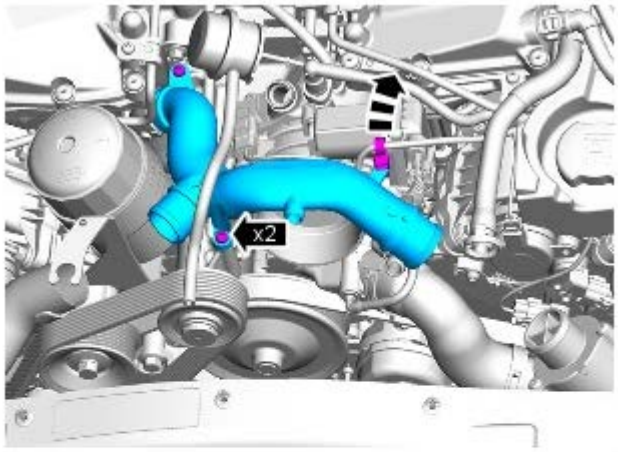
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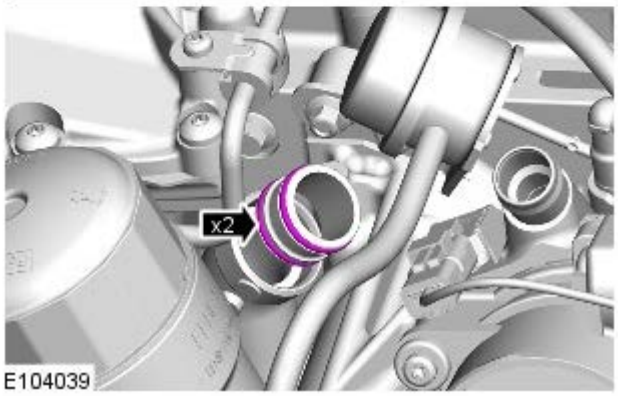


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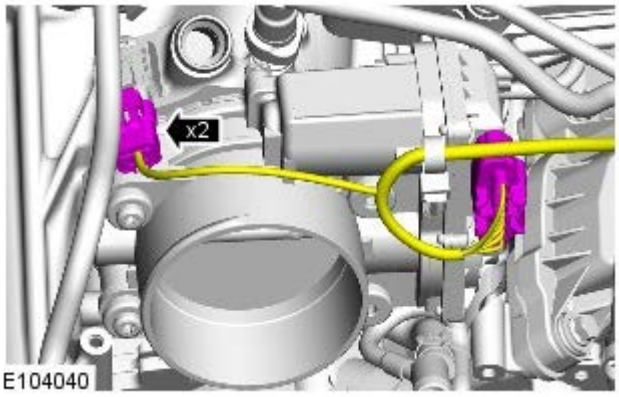


5. *Torque:* 10 Nm

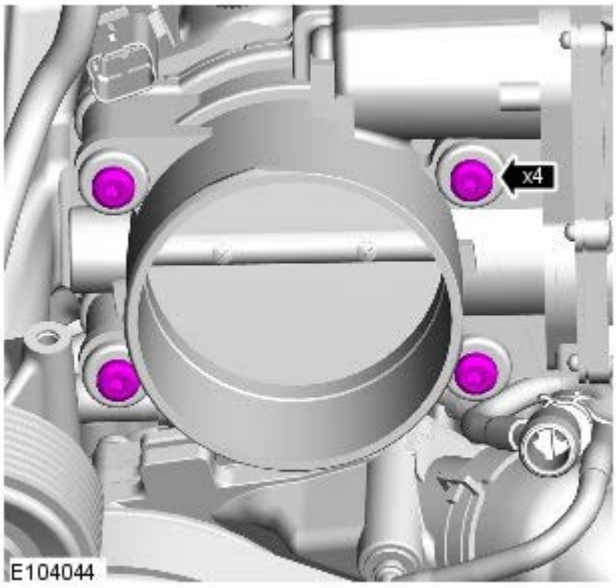




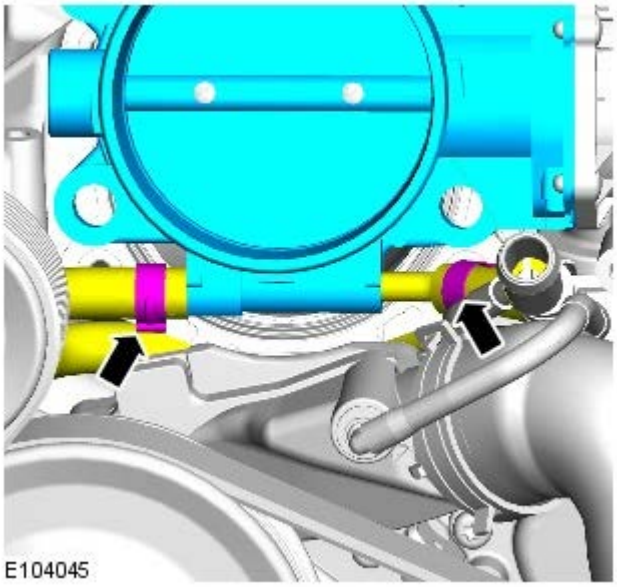
6.



7. *Torque:* 10 Nm



8. CAUTIONS:



Do not attempt to clean the throttle body bore, build up of deposits reduces air leakage past the throttle plate at the fully closed position.

Take extra care when removing the throttle body, failure to follow this instruction may result in damage to the manifold absolute pressure (MAP) sensor.

- Remove and discard the gasket.
- Install a new gasket.
- Clean the components mating faces.

Installation

1. To install, reverse the removal procedure.
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

Published: 11-May-2011

Accessory Drive - TDV6 3.0L Diesel -

Torque Specification

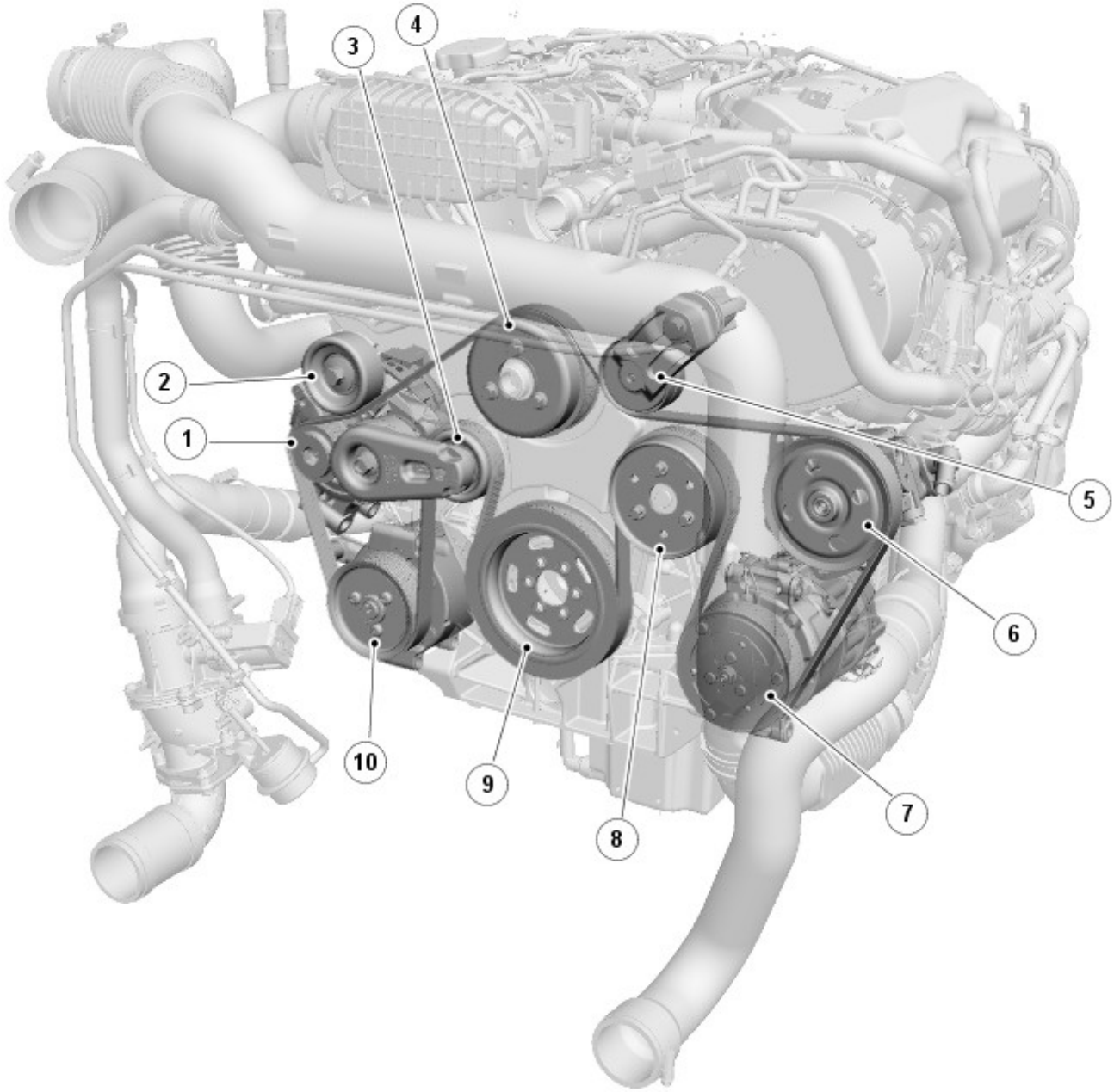
NOTE: **A = refer to procedure for correct torque sequence**

Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner retaining bolt	47	35	-
Accessory drive belt idler pulley retaining bolt	50	37	-
Fuel injection pump sprocket retaining nut	**A**	-	-
Camshaft rear hub bolt	Stage 1 - 80 Stage 2 - 80 degrees	Stage 1 - 59 Stage 2 - 80 degrees	-
Camshaft rear pulley retaining bolts	23	17	-
Rear end accessory drive belt (READ) belt tensioner retaining bolt	23	17	-

Published: 11-May-2011

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive - Component Location

Description and Operation



E122132

Item	Description
1	Generator
2	Idler
3	Belt tensioner
4	Viscous fan pulley
5	Idler
6	Power steering pump
7	A/C (air conditioning) compressor
8	Coolant pump
9	Crankshaft pulley
10	Dynamic response pump

Published: 11-May-2011

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive - Overview

Description and Operation

OVERVIEW

The crankshaft pulley drives a six ribbed poly V belt which in turn drives all of the engine mounted accessories.

Published: 11-May-2011

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive - System Operation and Component Description

Description and Operation

System Operation

OPERATION

The crankshaft pulley is attached to and rotates with the crankshaft. The pulley provides the drive for the accessory drive vee belt which in turn provides rotational power for the front mounted accessories such as the generator, power steering pump, coolant pump, Dynamic Response pump and the A/C (air conditioning) compressor.

The crankshaft pulley is a combined pulley and torsional vibration damper.

Component Description

DESCRIPTION

The accessory drive belt, which is a maintenance free poly-V type belt, is automatically pre-loaded by the belt tensioner and routed over idlers in order to maintain sufficient friction around the drive wheels. This ensures slip-free drive of the accessory components.

The torsional vibration damper incorporates compressed rubber between its inner and outer diameters to reduce peak levels of torsional vibration within the crankshaft.

The belt tensioner is calibrated to provide the correct amount of tension to the belt for a given drive system. Unless a spring within the tensioner assembly breaks, or some other mechanical part of the tensioner fails, there is no need to check the tensioner for correct tension.

The accessory drive belt should be inspected at every routine service for excessive wear and damage.

The belt tensioner consists of an idler pulley, which is free to rotate on a bearing located at the end of a spring-loaded pivot arm.

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Accessory Drive - TDV6 3.0L Diesel - Accessory Drive

Diagnosis and Testing

Principles of Operation

For a detailed description of the accessory drive system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-05A Accessory Drive - TDV6 3.0L Diesel)

Accessory Drive (Description and Operation),
Accessory Drive (Description and Operation),
Accessory Drive (Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical
• Auxiliary drive belt condition (cracking/damage/contamination) • Idler assembly • Generator • Engine cooling fan • Tensioner assembly • Engine coolant pump • Power steering pump • Air Conditioning (A/C) compressor • Torsional vibration damper • Dynamic response pump • Tensioner assembly • Auxiliary drive belt • Security/correct installation of the fuel injection pump cover • Fuel injection pump belt condition (cracking/damage/contamination) • Fuel injection pump belt tensioner assembly • Fuel injection pump • Fuel injection pump belt

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

CAUTION: If the engine is run without the auxiliary drive belts connected to eliminate driven components, diagnostic trouble codes, (DTCs) may be set which must be cleared before the vehicle is returned to the owner. The engine should not be run for more than 2-3 minutes with the belts disconnected. Failure to follow this instruction may result in damage to the vehicle.

4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart (accessory drive belt)

Symptom	Possible Causes	Action
Noise	• Auxiliary drive belt condition • Auxiliary drive belt tension • Pulleys misaligned • Driven components (including tensioners)	• Check the auxiliary drive belt condition (see visual inspection) • Check the auxiliary drive belt tensioner function • Check the pulley alignment • Check the driven components for excessive resistance to rotation
Auxiliary drive belt does not hold tension	• Belt condition • Tensioner fault	• Check the auxiliary drive belt condition (see visual inspection) • Check the auxiliary drive belt tensioner function

Symptom Chart (fuel injection pump belt)

Symptom	Possible Causes	Action
Noise	• Fuel injection pump belt condition • Fuel injection pump belt fouling cover • Fuel injection pump belt tensioner bearing failure • Fuel injection pump failure	• Check the fuel injection pump belt condition (see visual inspection) • Check the fuel injection pump belt cover for indications of fouling (this may indicate a pump misalignment), refer to the relevant workshop manual section • The fuel injection pump belt tensioner must be renewed if the belt is removed, making a check of the bearing impractical • Remove the fuel injection pump belt, check the fuel injection pump pulley for security. Check the fuel injection pump for excessive resistance to rotation (excessive resistance in the pump will cause the pulley securing nut to loosen as a design feature). Check for diagnostic trouble codes (DTCs) indicating a pump malfunction
Fuel injection pump belt does not hold tension	• Fuel injection pump belt condition • Tensioner fault	• Check the fuel injection pump belt condition (see visual inspection) • Check the tensioner function
Loss of drive (with no drive to the fuel injection pump, the engine will not run)	• Fuel injection pump belt broken / stripped teeth • Drive pulleys loose	• Investigate the cause of the fuel injection pump belt breakage/damage (a belt broken at a 45 degree angle normally indicates a shear, a break straight across the belt normally indicates that the belt has been crimped). • Check the fuel injection pump for excessive resistance to rotation (excessive resistance in the pump will cause the pulley securing nut to loosen as a design feature). Check for DTCs indicating a pump malfunction

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive Belt

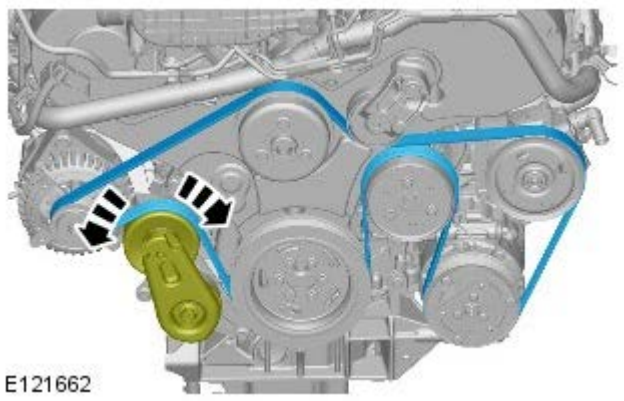
Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

All vehicles

1. Refer to: Cooling Fan (303-03, Removal and Installation).

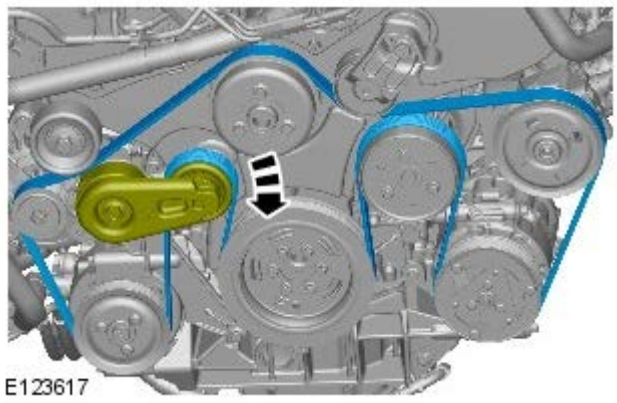


2. NOTES:

   Note the fitted position of the accessory drive belt.

   Engine shown removed for clarity.

Vehicles with Active Stabilization



3. NOTES:

   Note the fitted position of the accessory drive belt.

   Engine shown removed for clarity.

Installation

1. CAUTIONS:

   Make sure that the accessory drive belt is correctly located on each pulley.

   Clean and inspect the accessory drive belt pulleys for damage.

   To install, reverse the removal procedure.

Published: 11-May-2011

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive Belt Idler Pulley

Removal and Installation

Removal

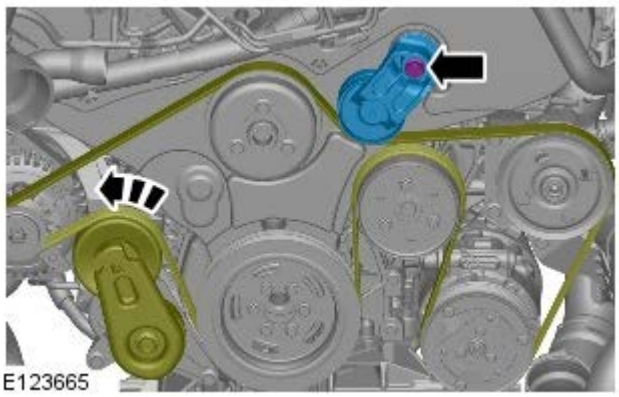
NOTES:

Removal steps in this procedure may contain installation details.

Engine shown removed for clarity.

All vehicles

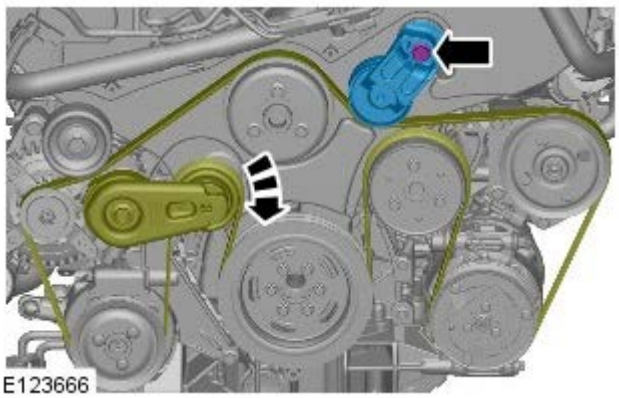
1. Refer to: Cooling Fan (303-03, Removal and Installation).



2. NOTE: Note the fitted position of the accessory drive belt.

   Torque: 50 Nm

Vehicles with Active Stabilization



3. NOTE: Note the fitted position of the accessory drive belt.

   Torque: 50 Nm

Installation

1. CAUTIONS:

   Make sure that the accessory drive belt is correctly located on each pulley.

   Clean and inspect the accessory drive belt pulleys for damage.

   To install, reverse the removal procedure.

Published: 11-May-2011

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive Belt Tensioner

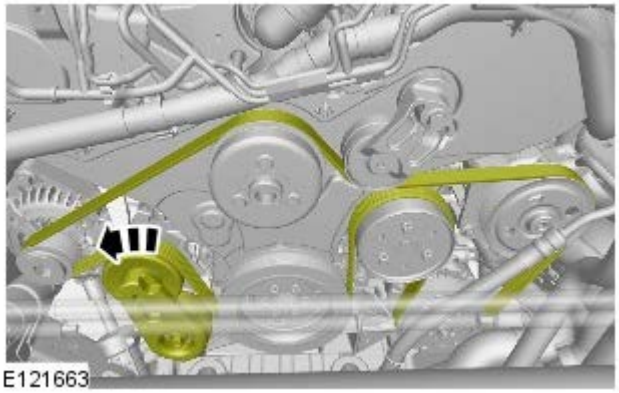
Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

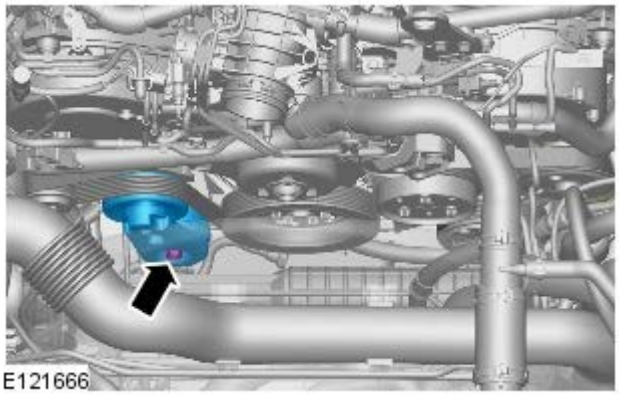
All vehicles

1. Refer to: Cooling Fan (303-03A, Removal and Installation).

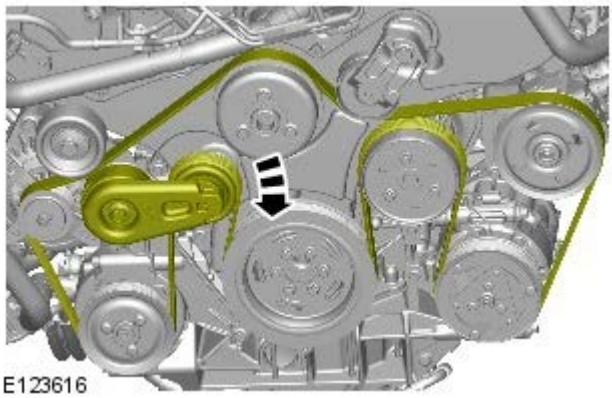


2. NOTE: Note the fitted position of the accessory drive belt.

3. *Torque:* 47 Nm

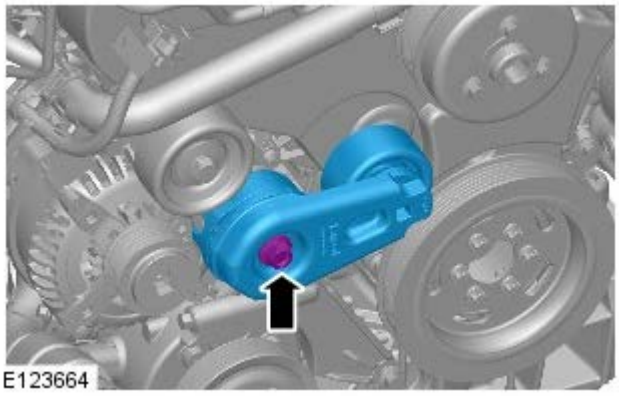


Vehicles with Active Stabilization



4. NOTE: Note the fitted position of the accessory drive belt.

5. *Torque:* 47 Nm



Installation

1. CAUTIONS:

   Make sure that the accessory drive belt is correctly located on each pulley.

   Clean and inspect the accessory drive belt pulleys for damage.

   To install, reverse the removal procedure.

Published: 11-May-2011

Accessory Drive - TDV6 3.0L Diesel - Fuel Injection Pump Pulley

Removal and Installation

Removal

1. Refer to: Fuel Injection Pump (303-04C, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Accessory Drive - TDV6 3.0L Diesel - Rear End Accessory Drive (READ)

Removal and Installation

Special Tool(s)

 E54540	303-1117 Timing Peg, Automatic Transmission
 E116926	310-212 Rear End Accessory Drive (READ) belt Timing Tool

Removal

WARNINGS:

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.

Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.

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.

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.

CAUTIONS:

Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

Do not disassemble or clean inside the fuel pump, even with an ultrasonic cleaner. Always install a new fuel pump when required.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. Refer to: Engine Cover - 3.0L V6 - TdV6 (501-05, Removal and Installation).

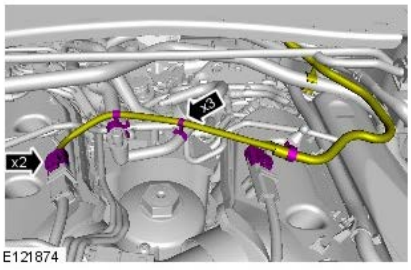
3. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

4. Refer to: Starter Motor (303-06, Removal and Installation).

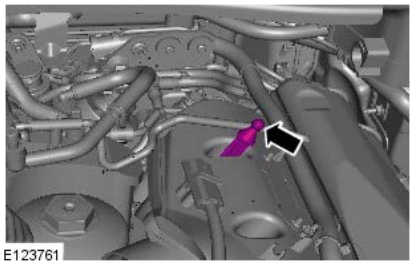
5. Lower the vehicle.

6.

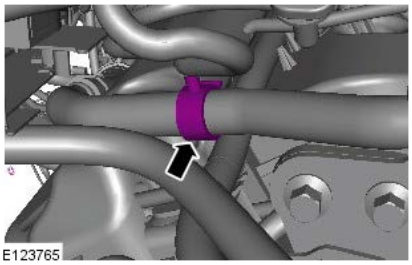


E121874

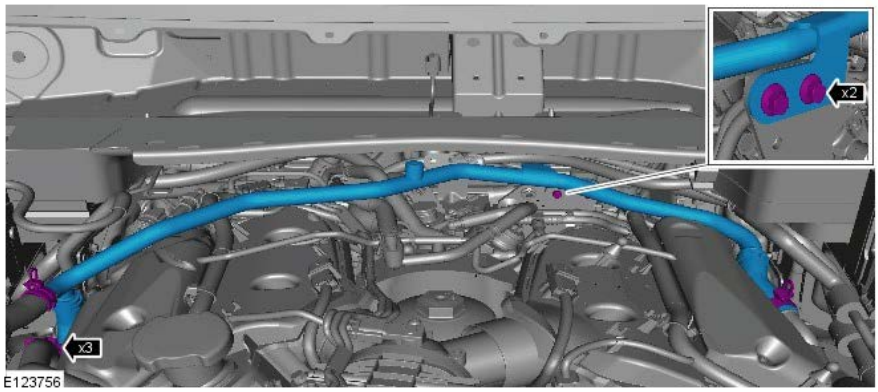
7.


E123761

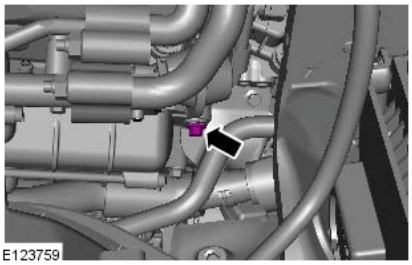
8. NOTE: Engine shown removed for clarity.



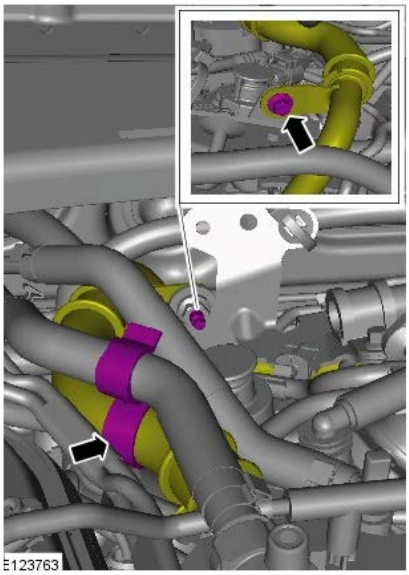
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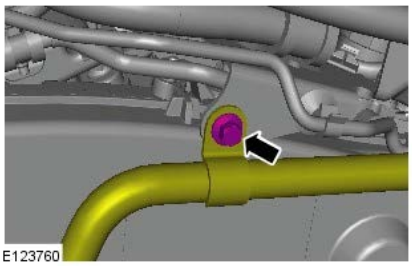
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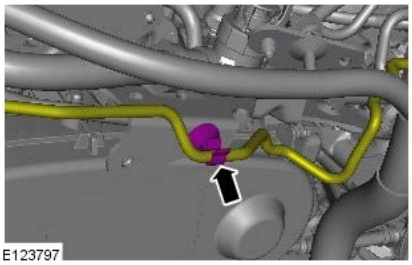
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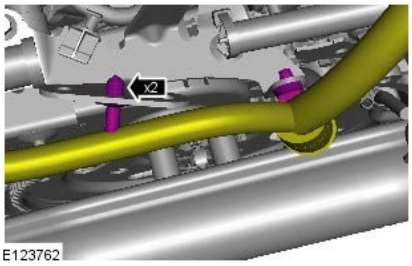
12. NOTE: Engine shown removed for clarity.



13. NOTE: Engine shown removed for clarity.

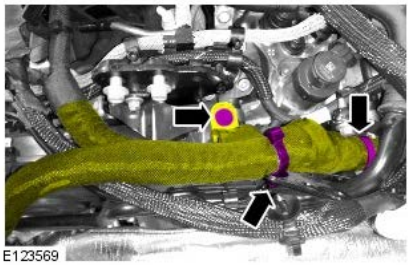

E123797

14. NOTE: Engine shown removed for clarity.

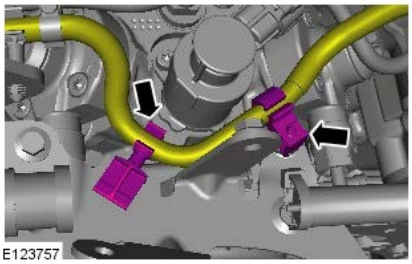


E123762

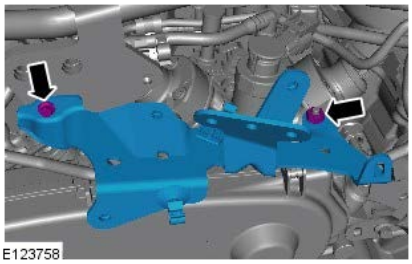
15. NOTE: Engine shown removed for clarity.


E123569

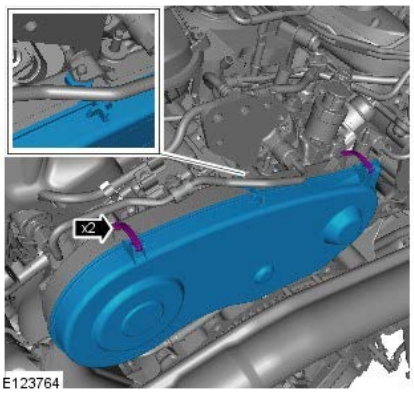
16. NOTE: Engine shown removed for clarity.


E123757

17. NOTE: Engine shown removed for clarity.


E123758

18.



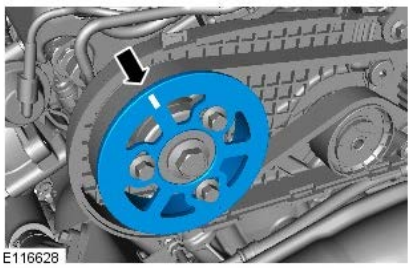
E123764

19. CAUTION: Only rotate the crankshaft clockwise.

NOTES:

This step requires the aid of another technician.

Engine shown removed for clarity.

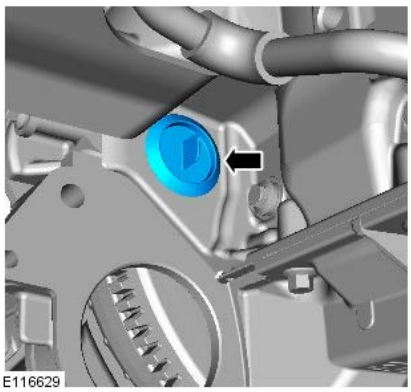


Rotate the crankshaft until the mark on the rear camshaft pulley is in the illustrated position.

20. WARNING: Make sure to support the vehicle with axle stands.

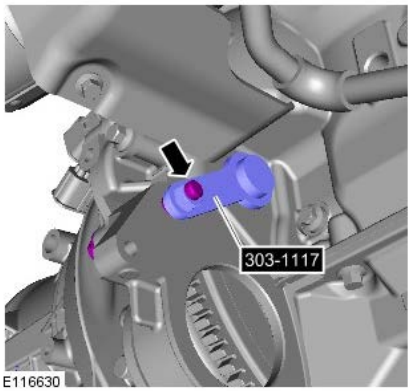
Raise and support the vehicle.

21.

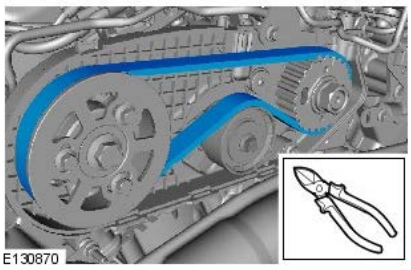


22.

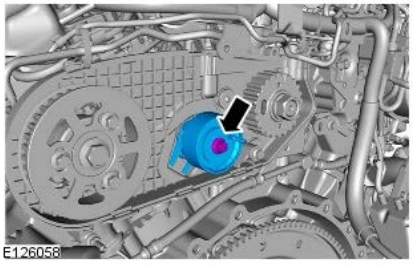
- Install the special tool.
- *Special Tool(s):* 303-1117



23. Lower the vehicle.



24. NOTE: Engine shown removed for clarity.



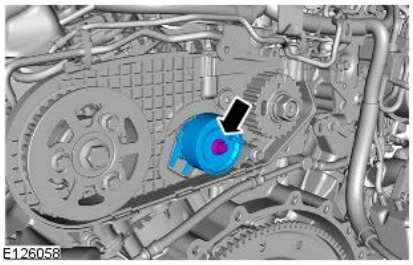
25. NOTE: Engine shown removed for clarity.

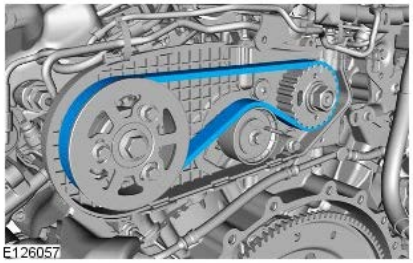
Installation

1. CAUTION: Make sure that the READ belt tensioner tang is correctly located to the READ belt rear cover. Failure to follow this instruction may result in damage to the engine.

   NOTE: Make sure that the rear end accessory drive (READ) belt tensioner locking pin is not removed until the READ belt tensioner is fully installed.

   - *Torque:* 23 Nm



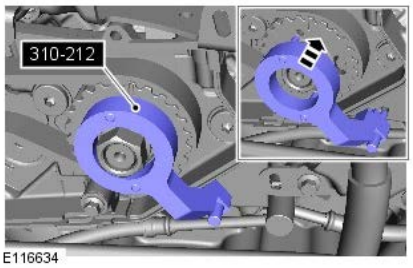


2. CAUTION: Do not install the new READ belt to the pulleys with the READ belt tensioner installed. Failure to follow this instruction may result in damage to the READ belt.

   NOTES:

   The READ rotates in a counter-clockwise direction when viewed from the rear of the engine.

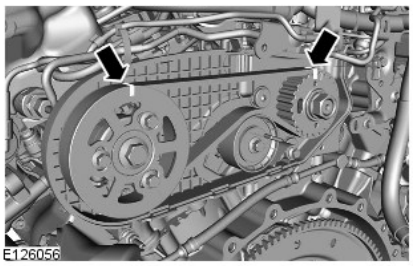
   Make sure the new READ belt is correctly seated onto the camshaft and fuel pump pulleys.



3. NOTE: Engine shown removed for clarity.

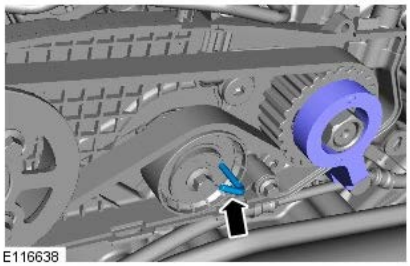
   Install the special tool.

   Special Tool(s): 310-212

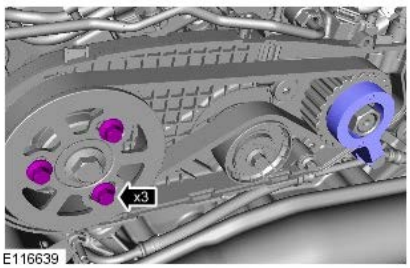


4. NOTE: Make sure that the READ belt tensioner locking pin is not removed until the READ belt tensioner is fully installed.

   Make sure that the READ belt is aligned with the marks on the rear camshaft pulley and READ pulley as illustrated.

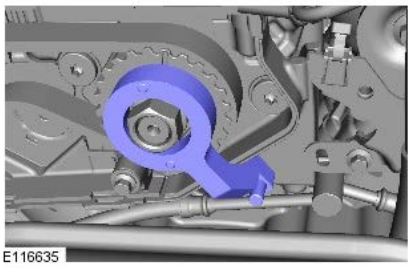


5. NOTE: Engine shown removed for clarity.



6. NOTE: Engine shown removed for clarity.

   Torque: 23 Nm

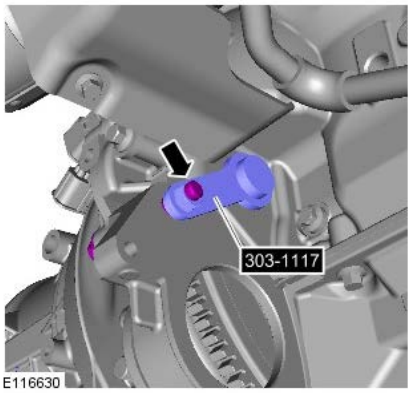


7. NOTE: Engine shown removed for clarity.
   - Remove the special tool.

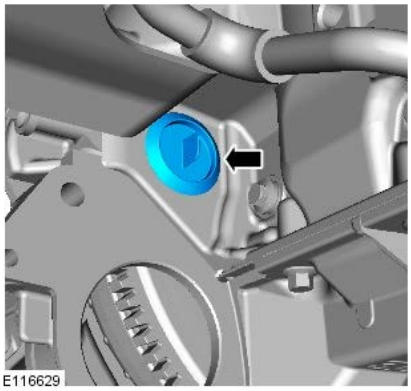
8. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

9. Remove the special tool.

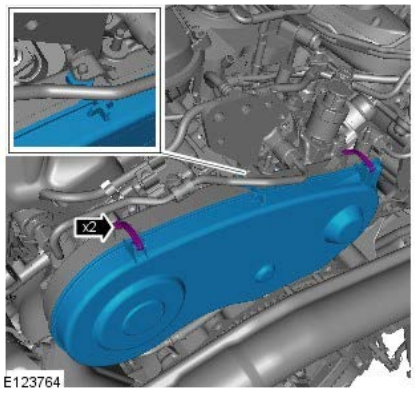


10.

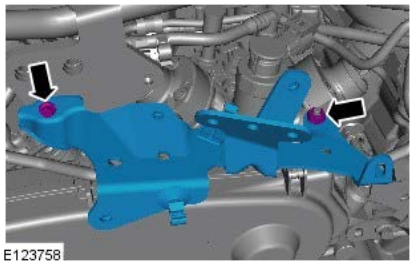


11. Lower the vehicle.

12.

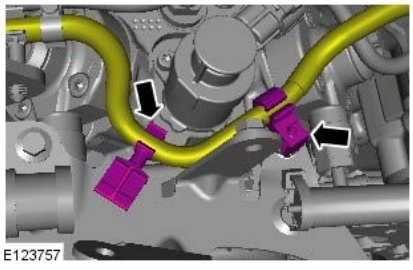


13. NOTE: Engine shown removed for clarity.

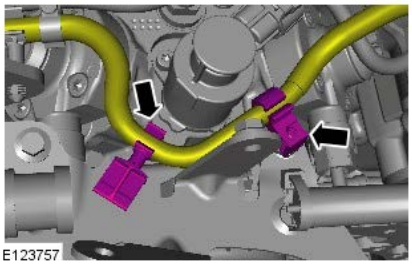


- *Torque:* 10 Nm

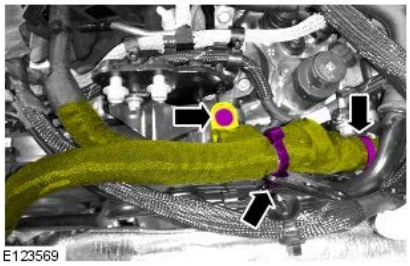
14. NOTE: Engine shown removed for clarity.

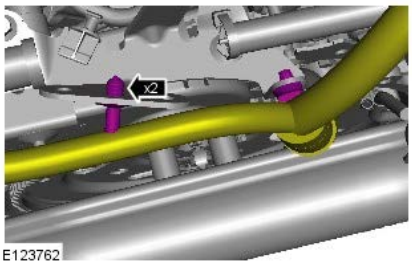


15. NOTE: Engine shown removed for clarity.

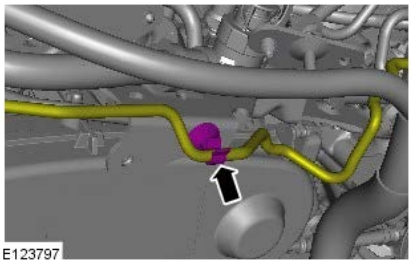


16. NOTE: Engine shown removed for clarity.
    - *Torque:* 5 Nm

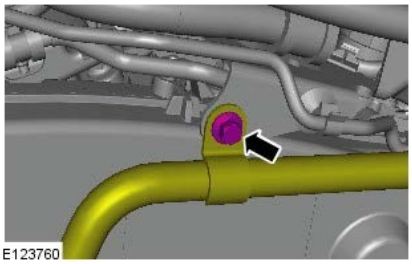




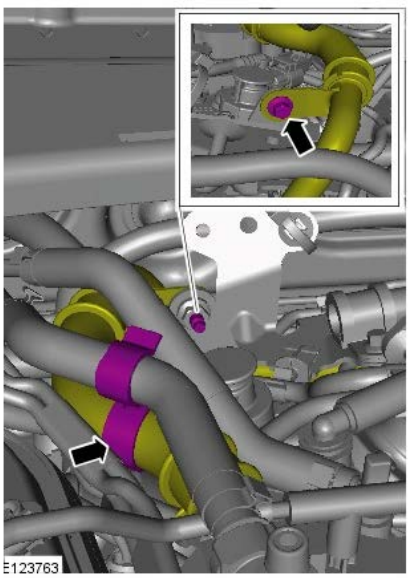
17. NOTE: Engine shown removed for clarity.



18. NOTE: Engine shown removed for clarity.



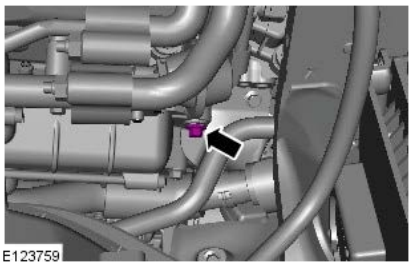
19. NOTE: Engine shown removed for clarity.
    - *Torque:* 10 Nm



20.
    - *Torque:* 10 Nm

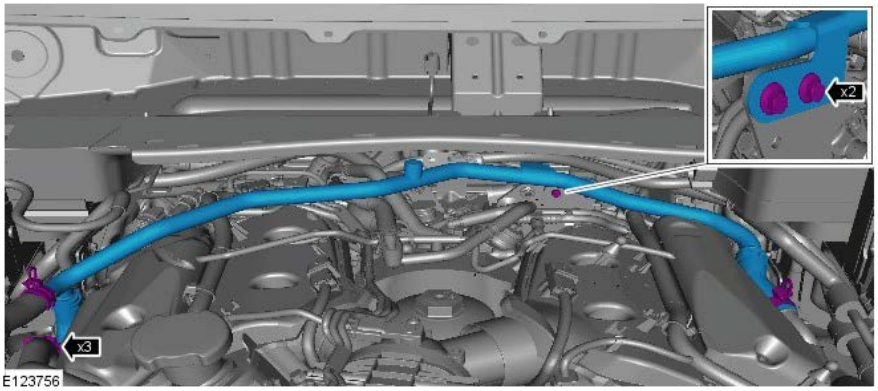
21.

- *Torque:* 10 Nm

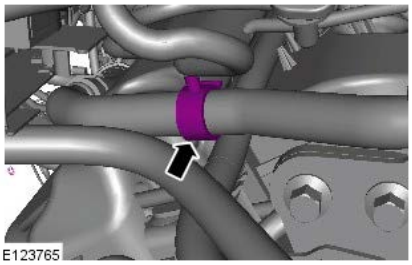


22.

- *Torque:* 10 Nm

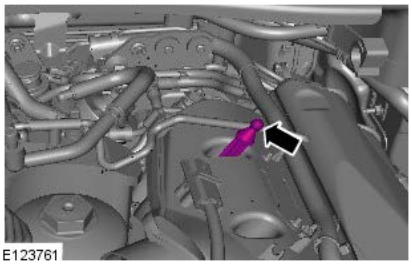


23. NOTE: Engine shown removed for clarity.

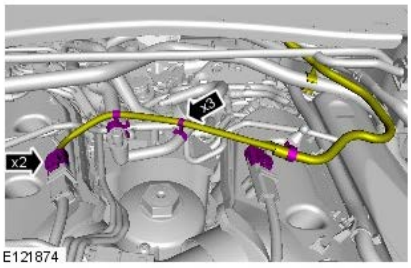


24.

- *Torque:* 5 Nm



25.



26. WARNING: Make sure to support the vehicle with axle stands.
Raise and support the vehicle.

27. Refer to: Starter Motor (303-06, Removal and Installation).

28. Lower the vehicle.

29. Refer to: Engine Cover - 3.0L V6 - TdV6 (501-05, Removal and Installation).

30. Connect the battery ground cable.
Refer to: Specifications (414-00, Specifications).

31. Check and top-up the coolant.

Published: 11-May-2011

Accessory Drive - V8 5.0L Petrol -

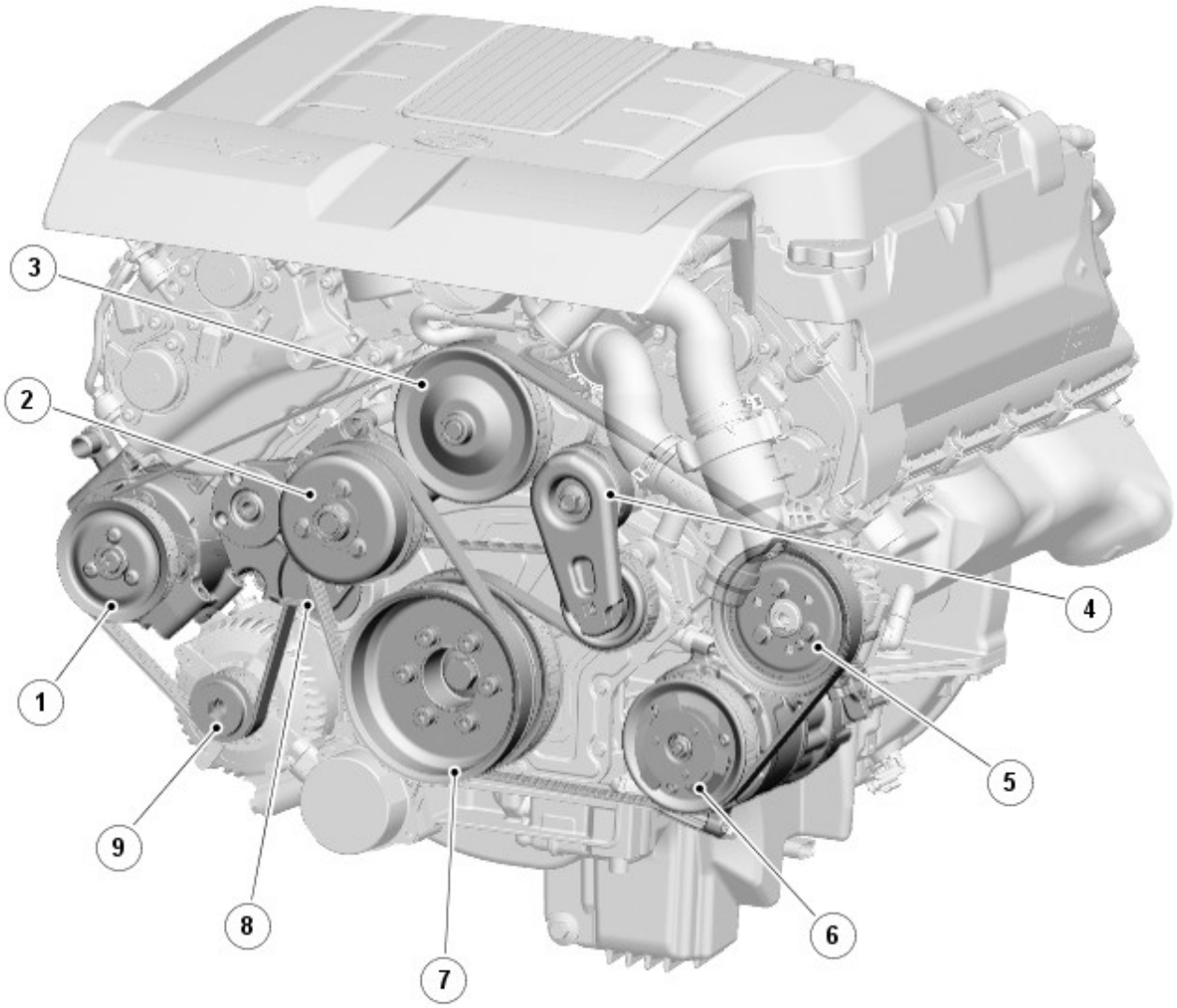
Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner retaining bolt	48	35	-
Accessory drive belt idler pulley retaining bolt - all vehicles	48	35	-
Accessory drive belt center idler pulley retaining bolt - vehicles without supercharger	25	19	-
Accessory drive belt idler pulley retaining bolt to tensioner bracket - vehicles with supercharger	48	35	-
Supercharger belt tensioner bracket retaining bolt	25	19	-
Supercharger belt tensioner retaining bolt	48	35	-
Supercharger belt idler pulley retaining bolt	48	35	-
Cooling fan pulley retaining bolts	25	19	
Cooling fan retaining nut	65	48	

Published: 11-May-2011

Accessory Drive - V8 5.0L Petrol - Accessory Drive

Description and Operation

COMPONENT LOCATION



E121543

Item	Part Number	Description
1	-	Dynamic response pump
2	-	Viscous cooling fan pulley
3	-	Coolant pump
4	-	Belt tensioner
5	-	Power steering pump
6	-	A/C (air conditioning) compressor
7	-	Crankshaft pulley/torsional vibration damper
8	-	Idler pulley
9	-	Generator

INTRODUCTION

The accessory drive is a belt system powered by a pulley attached to the front of the crankshaft. The crankshaft pulley, which incorporates a torsional vibration damper, drives primary and secondary drive belts. An automatic belt tensioner in the primary belt run maintains the drive belt at the correct tension. Together with idler pulleys, the belt tensioner also guides the primary drive belt clear of obstructions and sets the correct 'wrap-around' of the accessory component drive pulleys to ensure a slip-free drive.

Primary Drive Belt

The primary drive belt is a six-ribbed poly-V belt that drives the:

- Dynamic response pump
- Coolant pump
- Power steering pump
- A/C (air conditioning) compressor
- Generator.

Secondary Drive Belt

The secondary drive belt is a six-ribbed poly-V belt that drives the pulley of the viscous cooling fan.

Belt Tensioner

The belt tensioner consists of an idler pulley on the end of a spring loaded pivot arm. The pivot arm can be turned for removal and installation of the belt.

The belt tensioner is calibrated to automatically maintain the correct tension in the drive belt.

Published: 15-Aug-2012

Accessory Drive - V8 5.0L Petrol - Accessory Drive

Diagnosis and Testing

Principles of Operation

For a detailed description of the accessory drive system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Accessory Drive (303-05B Accessory Drive - V8 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical
• Auxiliary drive belt condition (cracking/damage/contamination) • Auxiliary drive belt tension • Pulley alignment • Coolant pump • Auxiliary drive belt tensioner assembly • Air conditioning compressor • Power steering pump • Crankshaft pulley • Generator • Deflection pulley • Cooling fan pulley

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

CAUTION: If the engine is run without the auxiliary drive belts connected to eliminate driven components, diagnostic trouble codes, (DTCs) may be set which must be cleared before the vehicle is returned to the owner. The engine should not be run for more than 2-3 minutes with the belts disconnected. Failure to follow this instruction may result in damage to the vehicle.

4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Noise	• Auxiliary drive belt condition • Auxiliary drive belt tension • Pulleys misaligned • Driven components (including tensioners)	• Check the auxiliary drive belt condition • Check the auxiliary drive belt tensioner function • Check the pulley alignment • Check the driven components for excessive resistance to rotation
Auxiliary drive belt does not hold tension	• Auxiliary drive belt condition • Auxiliary drive belt tensioner fault	• Check the auxiliary drive belt condition • Check the auxiliary drive belt tensioner function

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 11-May-2011

Accessory Drive - V8 5.0L Petrol - Accessory Drive Belt

Removal and Installation

Removal

NOTES:

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

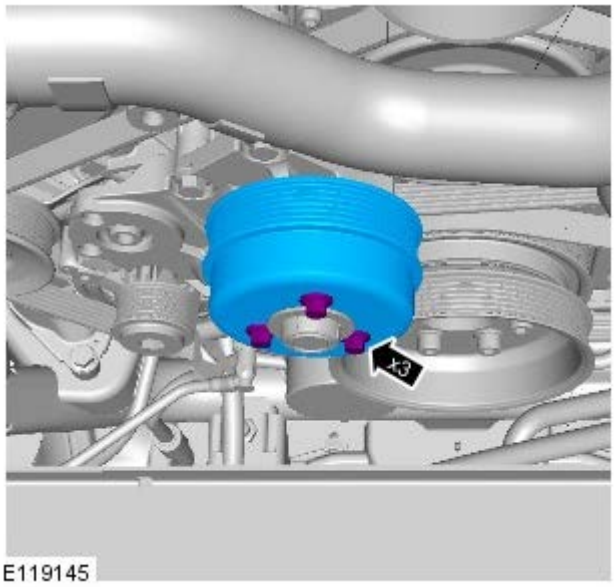
Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

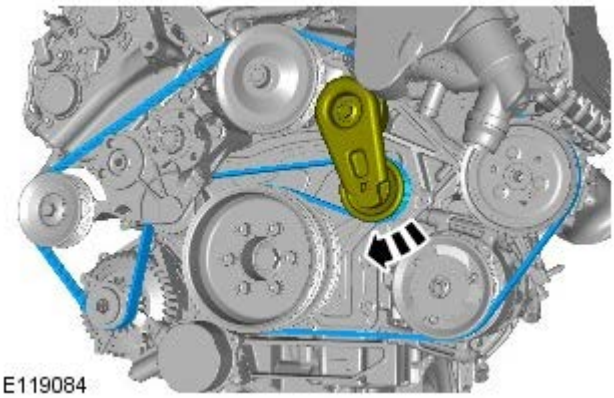
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Cooling Fan Belt (303-05, Removal and Installation).

3.



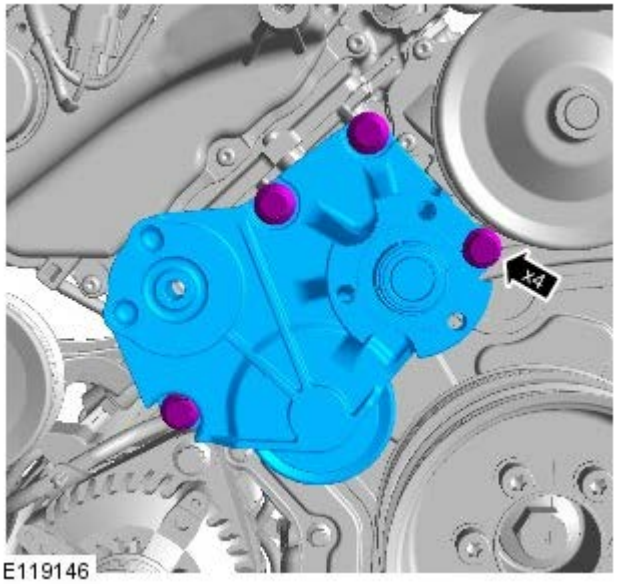
E119145



E119084

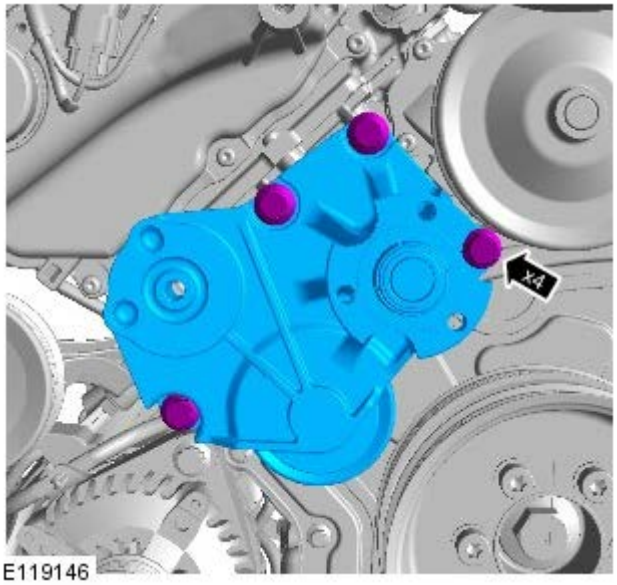
4. NOTE: Note the fitted position.

5.

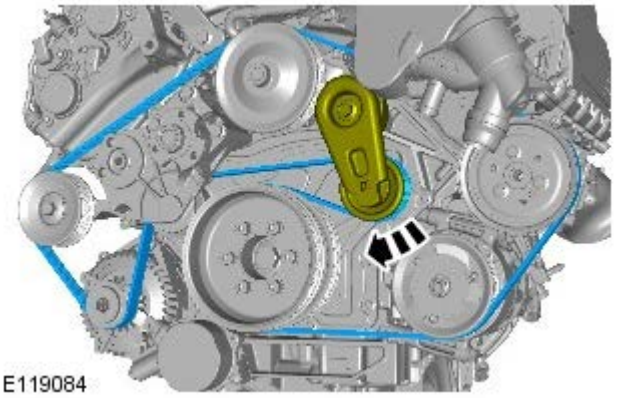


Installation

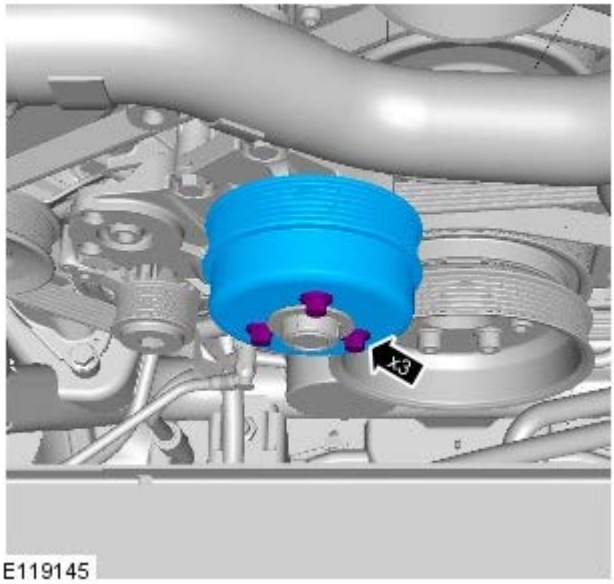
1. *Torque:* 25 Nm



2. NOTE: Note the fitted position.

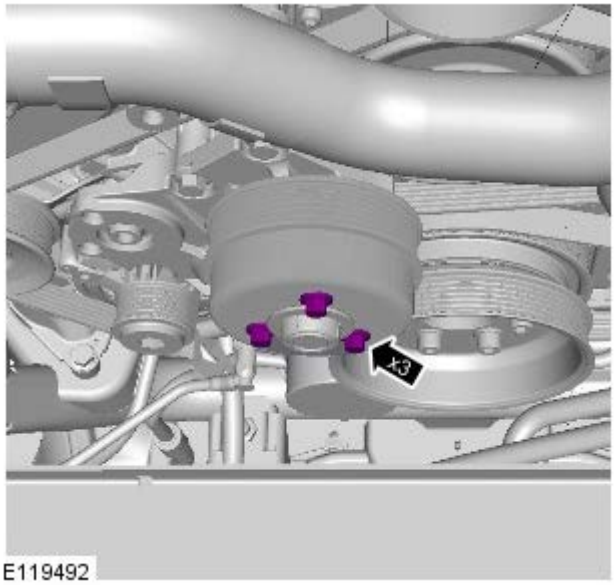


3. *Torque:* 25 Nm



E119145

4. *Torque:* 25 Nm



E119492

5. Refer to: Cooling Fan Belt (303-05, Removal and Installation).
6. Connect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Accessory Drive - V8 5.0L Petrol - Accessory Drive Belt Idler Pulley

Removal and Installation

Removal

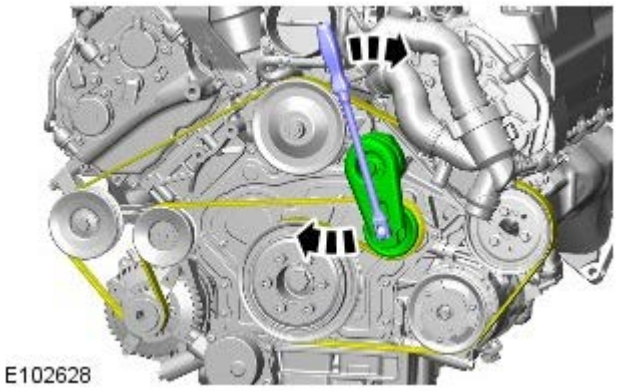
NOTES:

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

Removal steps in this procedure may contain installation details.

1. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12 Intake Air Distribution and Filtering - 5.0L NA V8 - AJ133, Removal and Installation).

2.



3. *Torque:* 48 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Accessory Drive - V8 5.0L Petrol - Accessory Drive Belt Tensioner

Removal and Installation

Removal

NOTES:

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

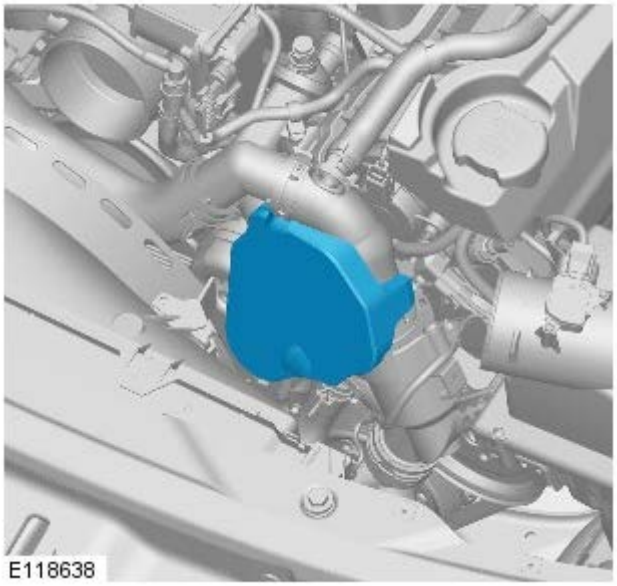
Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

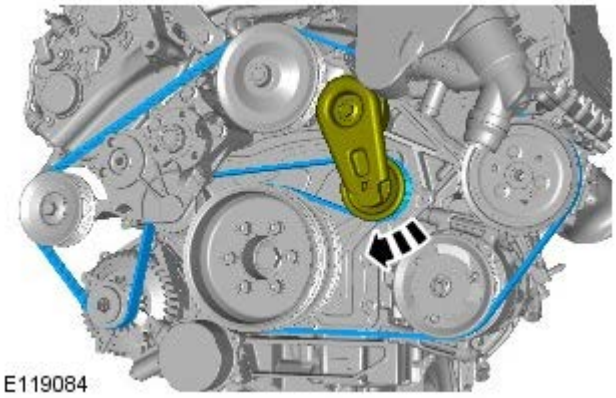
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12, Removal and Installation).

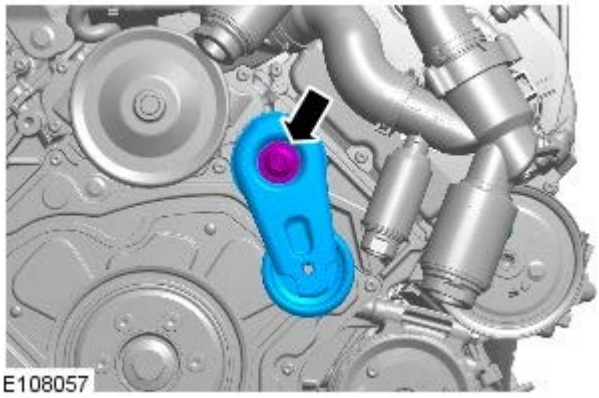
3.



4. NOTE: Note the fitted position.



5. *Torque:* 40 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Accessory Drive - V8 5.0L Petrol - Cooling Fan Belt

Removal and Installation

Special Tool(s)

 E119168	303-1500 Installer, Stretchy Belt

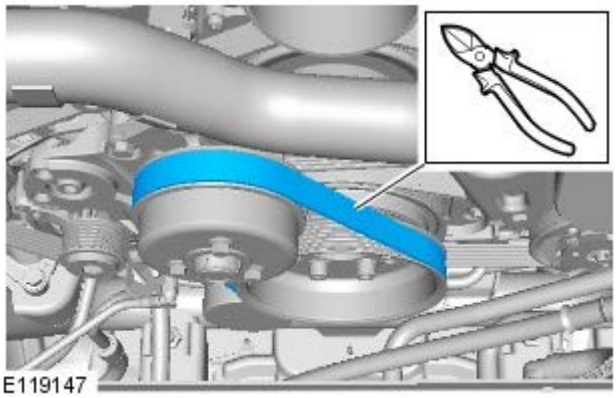
Removal

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

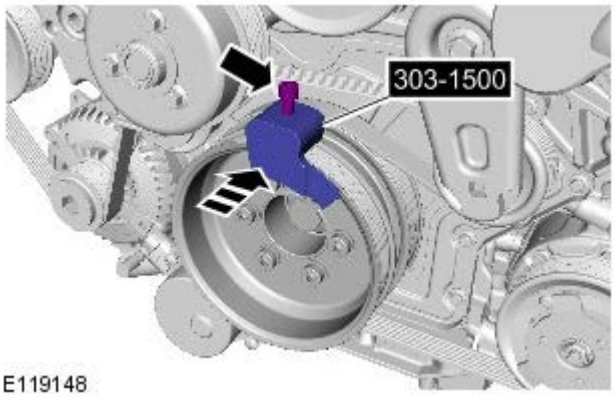
2. Refer to: Cooling Fan (303-03, Removal and Installation).

3.

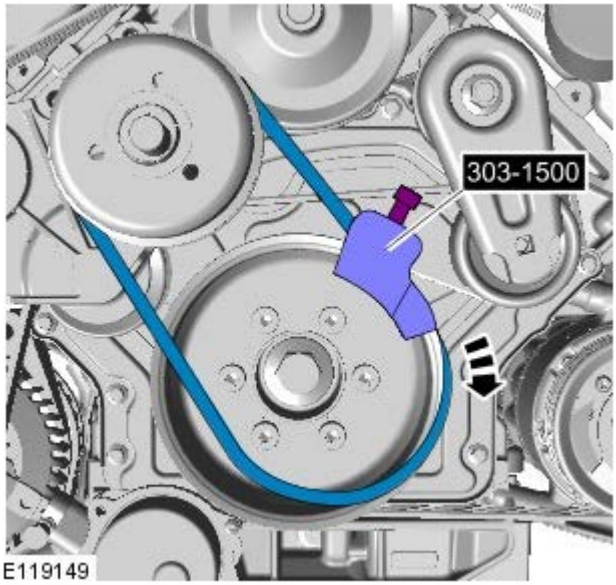


Installation

1. *Special Tool(s):* 303-1500



2. Install the cooling fan belt.



3.
   - Whilst rotating the engine, make sure that pressure is applied to the left hand side of the cooling fan belt to aid installation.
   - Rotate the engine until the special tool has reached the 9 o clock position.

4. Remove the special tool.

5. Rotate the engine clockwise twice, making sure that the belt is seated on both pulleys correctly.

6. Refer to: Cooling Fan (303-03, Removal and Installation).

7. Connect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Accessory Drive - V8 S/C 5.0L Petrol -

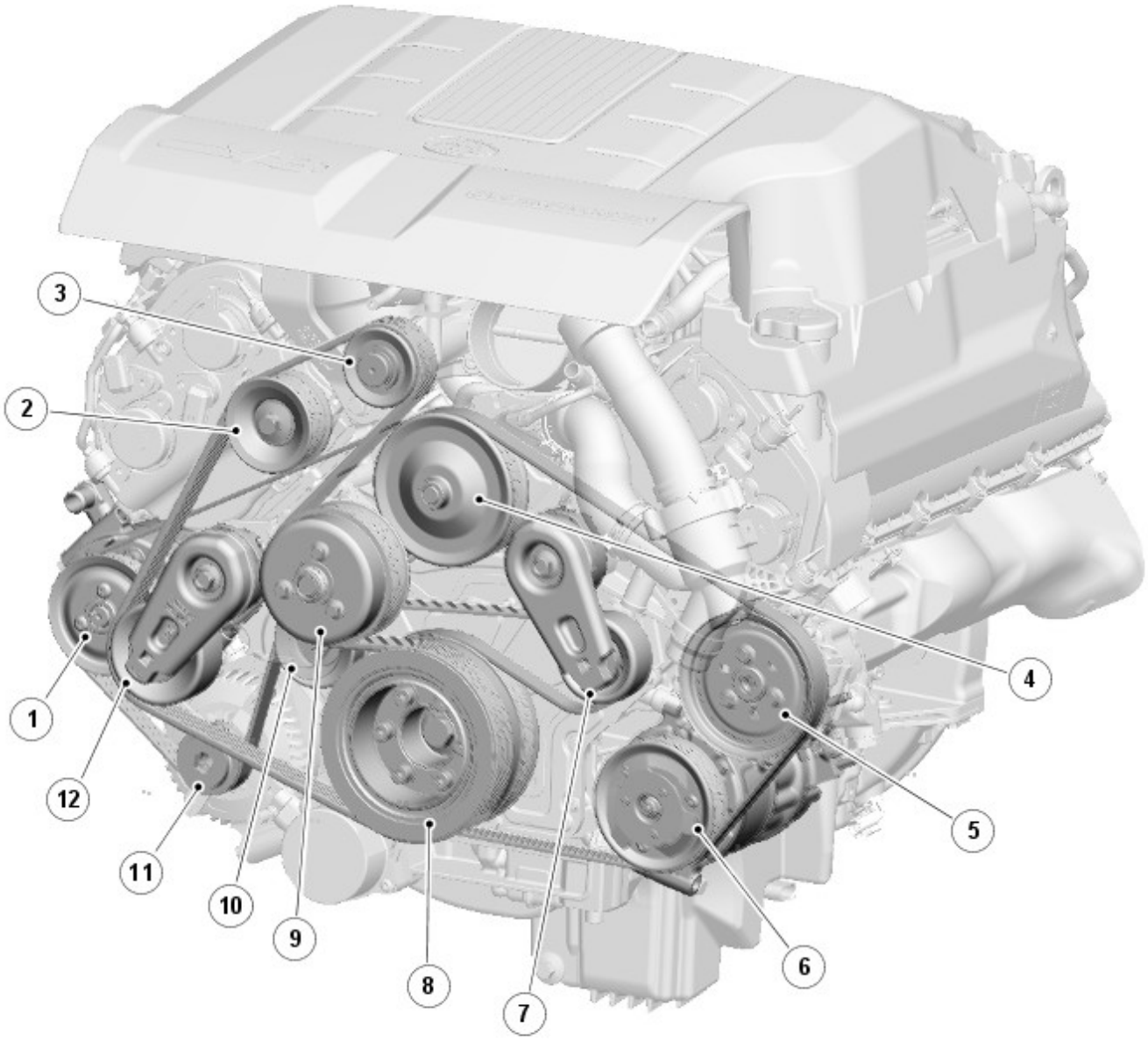
Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner retaining bolt	48	35	-
Accessory drive belt idler pulley retaining bolt - all vehicles	48	35	-
Accessory drive belt center idler pulley retaining bolt - vehicles without supercharger	25	19	-
Accessory drive belt idler pulley retaining bolt to tensioner bracket - vehicles with supercharger	48	35	-
Supercharger belt tensioner bracket retaining bolt	25	19	-
Supercharger belt tensioner retaining bolt	48	35	-
Supercharger belt idler pulley retaining bolt	48	35	-
Cooling fan pulley retaining bolts	25	19	
Cooling fan retaining nut	65	48	

Published: 11-May-2011

Accessory Drive - V8 S/C 5.0L Petrol - Accessory Drive

Description and Operation

COMPONENT LOCATION



E121126

Item	Part Number	Description
1	-	Secondary belt tensioner
2	-	Idler pulley
3	-	Supercharger
4	-	Coolant pump
5	-	Power steering pump
6	-	A/C compressor
7	-	Primary belt tensioner
8	-	Crankshaft pulley/torsional vibration damper
9	-	Viscous cooling fan pulley
10	-	Idler pulley
11	-	Generator
12	-	Dynamic response pump

INTRODUCTION

The accessory drive is a belt system powered by a pulley attached to the front of the crankshaft. The crankshaft

pulley, which incorporates a torsional vibration damper, drives primary and secondary drive belts. An automatic belt tensioner in each belt run maintains the drive belts at the correct tension. Together with idler pulleys, the belt tensioners also guide the drive belts clear of obstructions and set the correct 'wrap-around' of the accessory component drive pulleys to ensure a slip-free drive.

Primary Drive Belt

The primary drive belt is a six-ribbed poly-V belt that drives the:

- Dynamic response pump.
- Coolant pump
- Power steering pump
- A/C (air conditioning) compressor
- Generator

Secondary Drive Belt

The secondary drive belt is an eight-ribbed poly-V belt that drives the SC (supercharger) and the pulley of the viscous cooling fan.

Belt Tensioners

Each belt tensioner consists of an idler pulley on the end of a spring loaded pivot arm. The pivot arm can be turned for removal and installation of the belt.

Each belt tensioner is calibrated to automatically maintain the correct tension in the related drive belt.

Published: 15-Aug-2012

Accessory Drive - V8 S/C 5.0L Petrol - Accessory Drive

Diagnosis and Testing

Principles of Operation

For a detailed description of the accessory drive system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Accessory Drive (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical
• Auxiliary drive belt condition (cracking/damage/contamination) • Auxiliary drive belt tension • Pulley alignment • Coolant pump • Auxiliary drive belt tensioner assembly • Air conditioning compressor • Power steering pump • Crankshaft pulley • Generator • Deflection pulley • Cooling fan pulley

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

CAUTION: If the engine is run without the auxiliary drive belts connected to eliminate driven components, diagnostic trouble codes, (DTCs) may be set which must be cleared before the vehicle is returned to the owner. The engine should not be run for more than 2-3 minutes with the belts disconnected. Failure to follow this instruction may result in damage to the vehicle.

4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Noise	• Auxiliary drive belt condition • Auxiliary drive belt tension • Pulleys misaligned • Driven components (including tensioners)	• Check the auxiliary drive belt condition • Check the auxiliary drive belt tensioner function • Check the pulley alignment • Check the driven components for excessive resistance to rotation
Auxiliary drive belt does not hold tension	• Auxiliary drive belt condition • Auxiliary drive belt tensioner fault	• Check the auxiliary drive belt condition • Check the auxiliary drive belt tensioner function

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 11-May-2011

Accessory Drive - V8 S/C 5.0L Petrol - Accessory Drive Belt

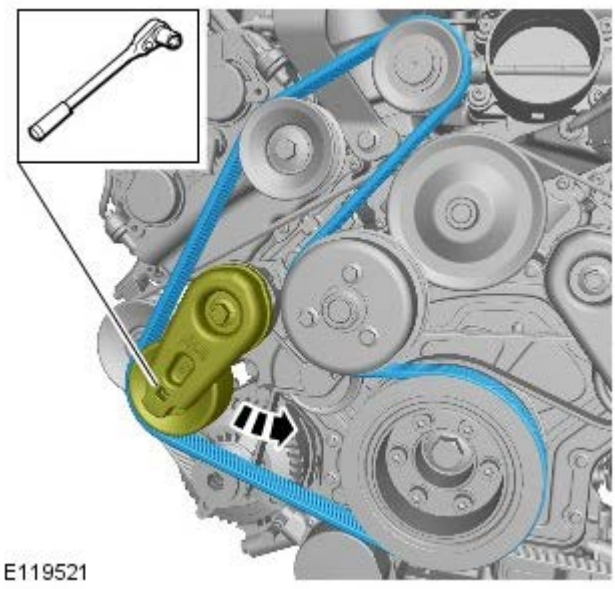
Removal and Installation

Removal

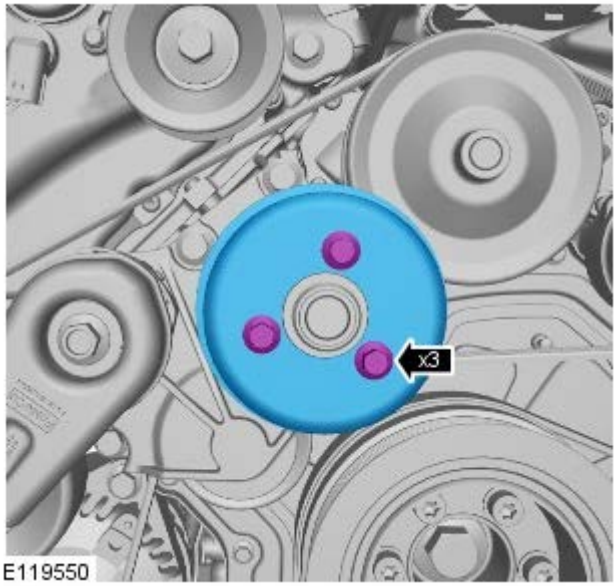
NOTE: Removal steps in this procedure may contain installation details.

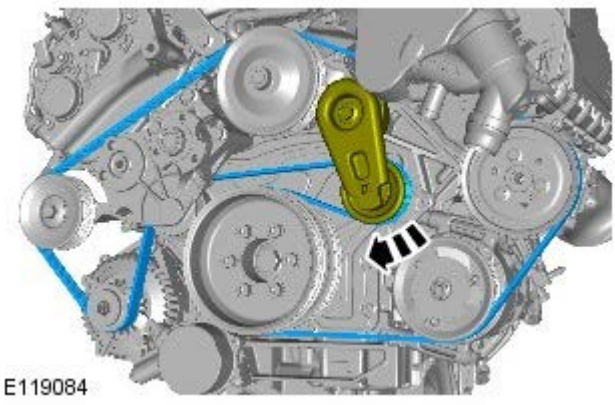
1. Refer to: Cooling Fan - Vehicles With: Supercharger (303-03C, Removal and Installation).

2.



3.





4. NOTES:

Note the fitted position.

Engine shown removed for clarity.

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

5.



Installation

1. *Torque:* 25 Nm

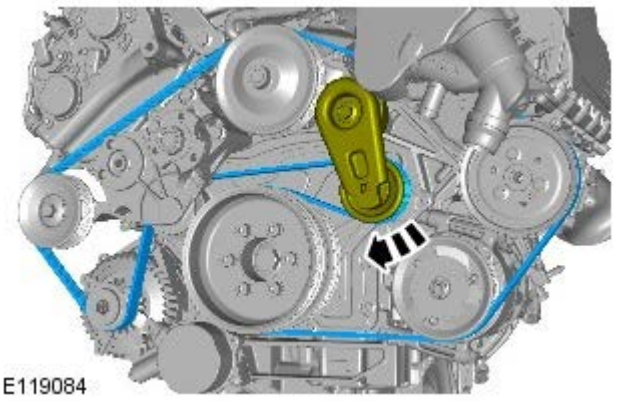


2. CAUTION: Make sure that the accessory drive belt is correctly located on each pulley.

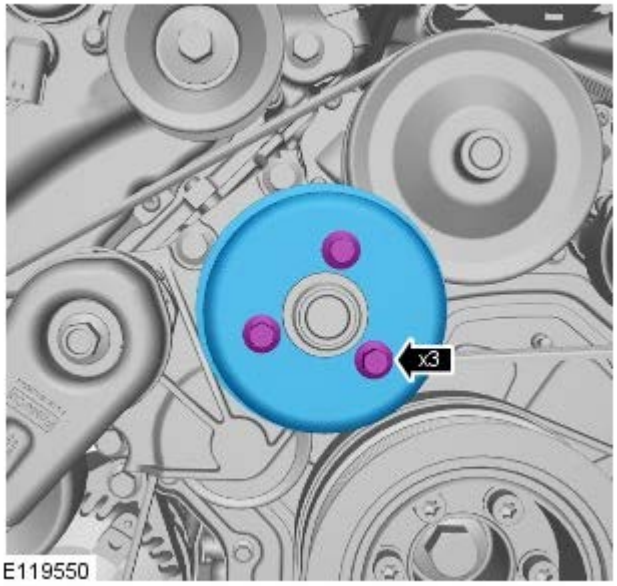
   NOTES:

   Engine shown removed for clarity.

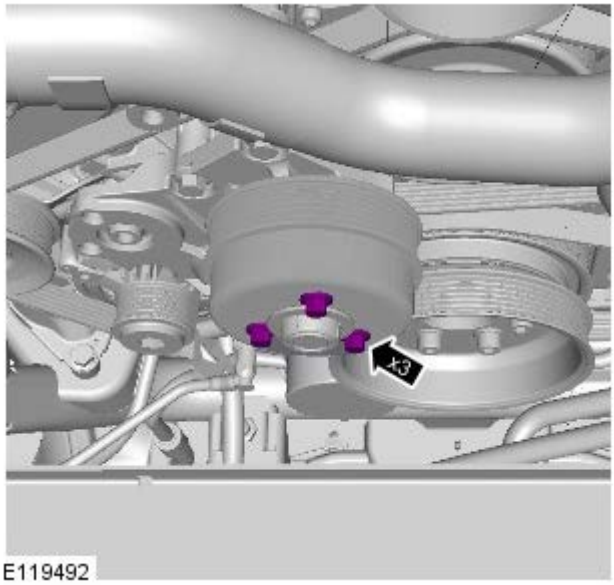
   Some variation in the illustrations may occur, but the essential information is always correct.



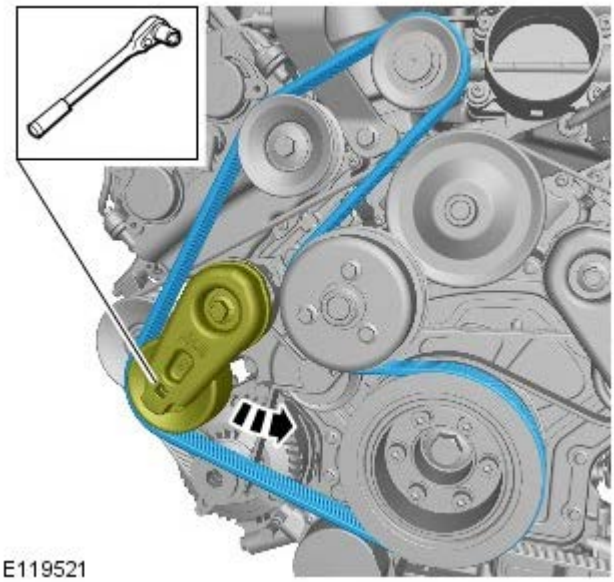
3. *Torque:* 25 Nm



4. *Torque:* 25 Nm



5. CAUTION: Make sure the supercharger belt is correctly aligned to the pulleys. Failure to follow this instruction may result in damage to the vehicle.



6. Refer to: Cooling Fan - Vehicles With: Supercharger (303-03C, Removal and Installation).

Published: 11-May-2011

Accessory Drive - V8 S/C 5.0L Petrol - Accessory Drive Belt Tensioner

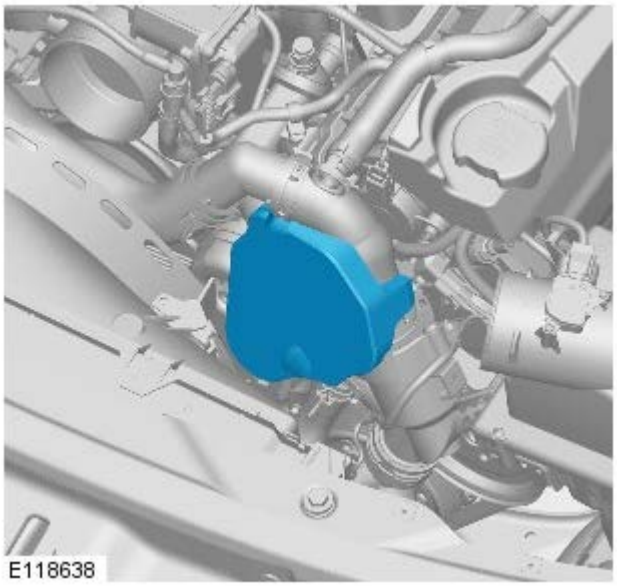
Removal and Installation

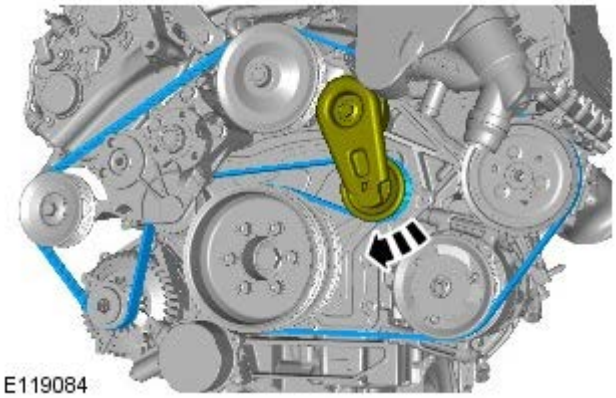
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12, Removal and Installation).

2.



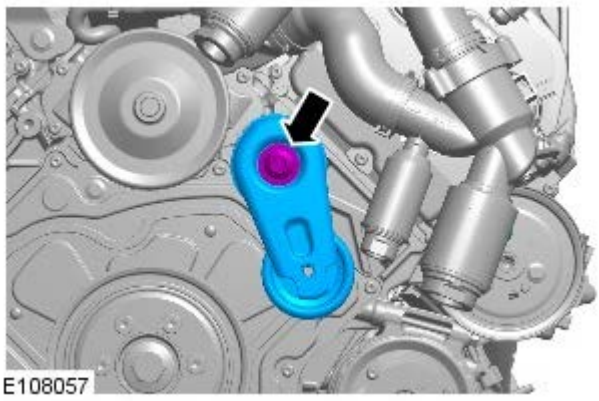


3. NOTES:

   Note the fitted position.

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

   Engine shown removed for clarity.



4. NOTE: Engine shown removed for clarity.

   Torque: 40 Nm

Installation

1. CAUTION: Make sure that the accessory drive belt is correctly located on each pulley.

To install, reverse the removal procedure.

Published: 11-May-2011

Accessory Drive - V8 S/C 5.0L Petrol - Supercharger Belt

Removal and Installation

Removal

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

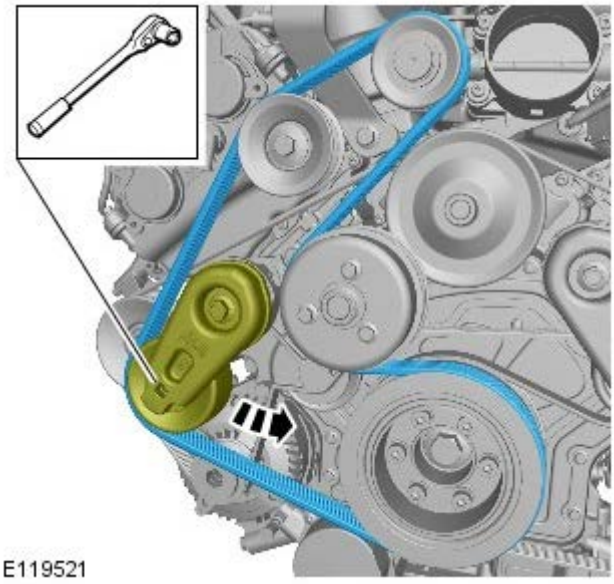
2. Refer to: Engine Undershield (501-02, Removal and Installation).

3. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12, Removal and Installation).

4. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

5.



Installation

1. CAUTION: Make sure that the accessory drive belt is correctly aligned to the pulleys. Failure to follow this instruction may result in damage to the vehicle.

   To install reverse the removal procedure.

Published: 11-May-2011

Accessory Drive - V8 S/C 5.0L Petrol - Supercharger Belt Idler Pulley

Removal and Installation

Removal

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. Refer to: Engine Undershield (501-02, Removal and Installation).

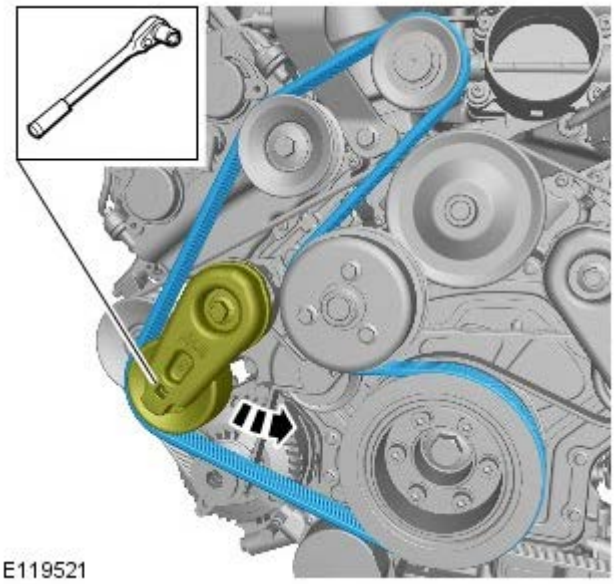
3. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

4. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12, Removal and Installation).

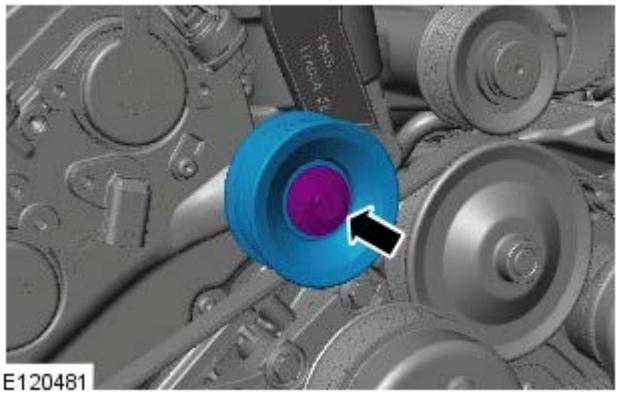
5. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

6.



7. *Torque:* 40 Nm



Installation

1. CAUTION: Make sure the supercharger belt is correctly aligned to the pulleys. Failure to follow this instruction may result in damage to the vehicle.

   To install, reverse the removal procedure.

Published: 11-May-2011

Accessory Drive - V8 S/C 5.0L Petrol - Supercharger Belt Tensioner

Removal and Installation

Removal

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. Refer to: Engine Undershield (501-02, Removal and Installation).

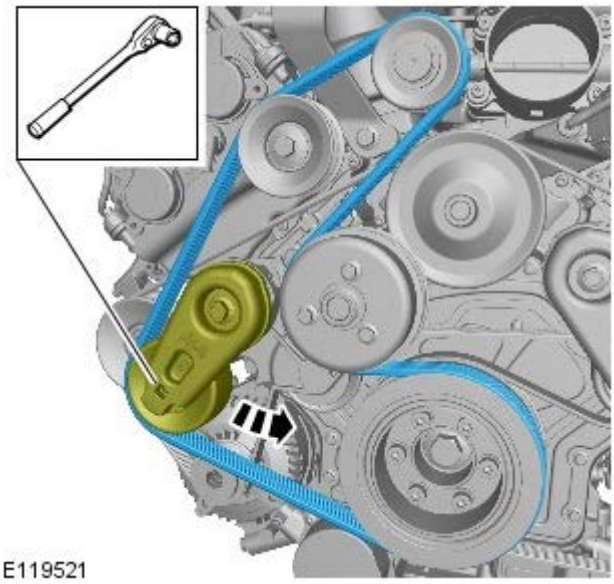
3. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

4. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12, Removal and Installation).

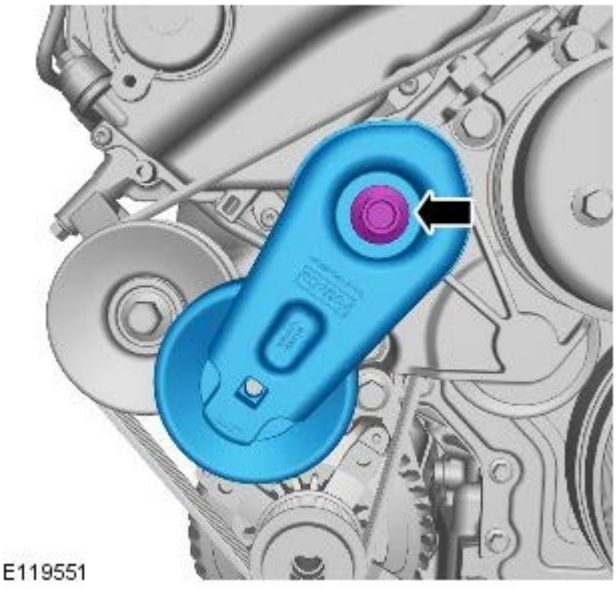
5. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

6.



7. *Torque:* 40 Nm



Installation

1. CAUTIONS:

    Make sure the supercharger belt is correctly aligned to the pulleys. Failure to follow this instruction may result in damage to the vehicle.

    Clean and inspect the accessory drive belt pulleys for damage.

   To install, reverse the removal procedure.

Published: 11-May-2011

Starting System - TDV6 3.0L Diesel -

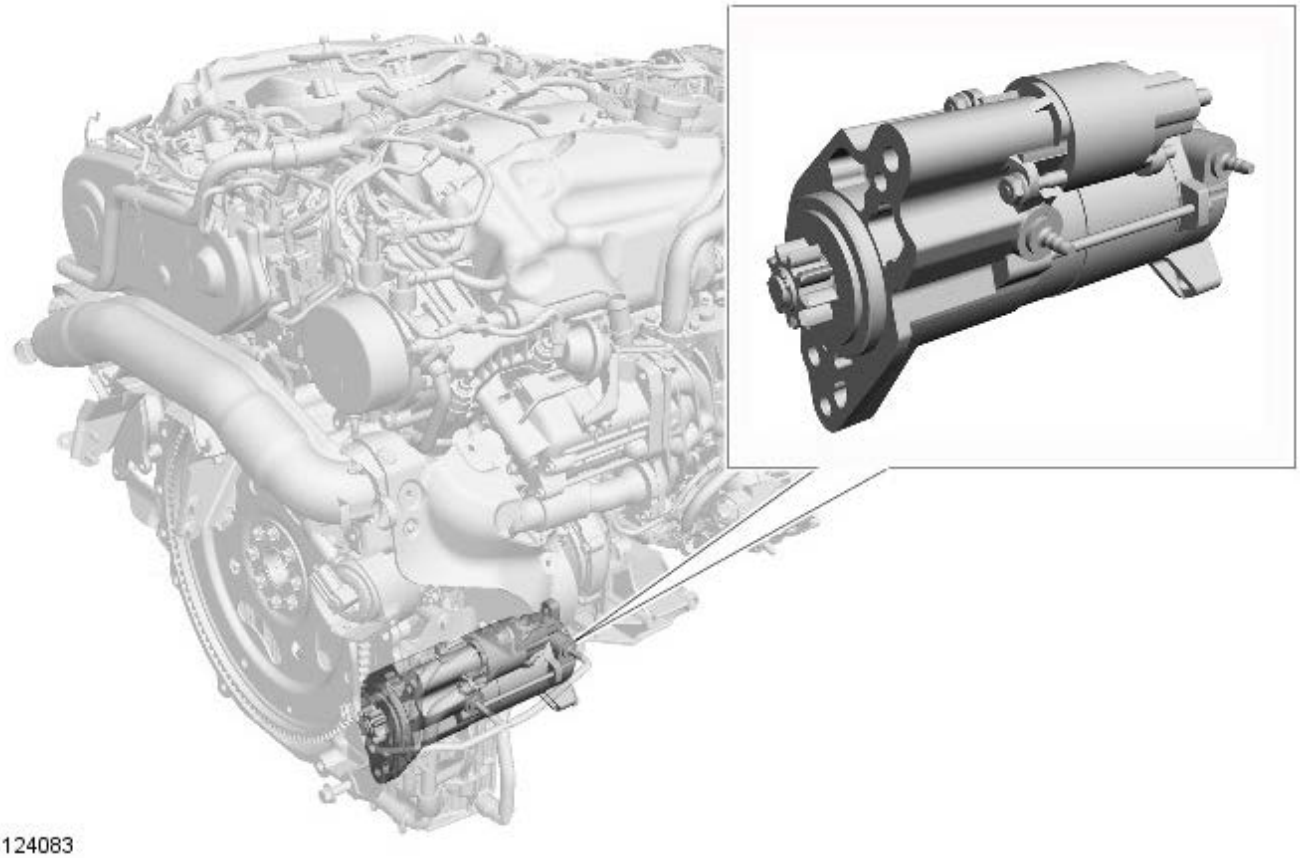
Description	Nm	lb-ft	lb-in
Starter motor to oil pan bolts	47	35	-
Battery positive terminal integral connector retaining nut	10	7	-
Solenoid terminal integral connector nut	7	-	62

Published: 11-May-2011

Starting System - TDV6 3.0L Diesel - Starting System - Component Location

Description and Operation

Component Location



E124083

Published: 11-May-2011

Starting System - TDV6 3.0L Diesel - Starting System - Overview

Description and Operation

OVERVIEW

The starter motor is located on the rear RH (right-hand) side of the oil pan and protrudes through an aperture to drive the flywheel via a ring gear. The motor is secured to the oil pan by 2 bolts. The rear of the starter motor is attached to a support bracket which in turn is bolted to the oil pan. The bracket provides crucial support for the starter motor and must not be omitted when installing or reinstalling the unit.

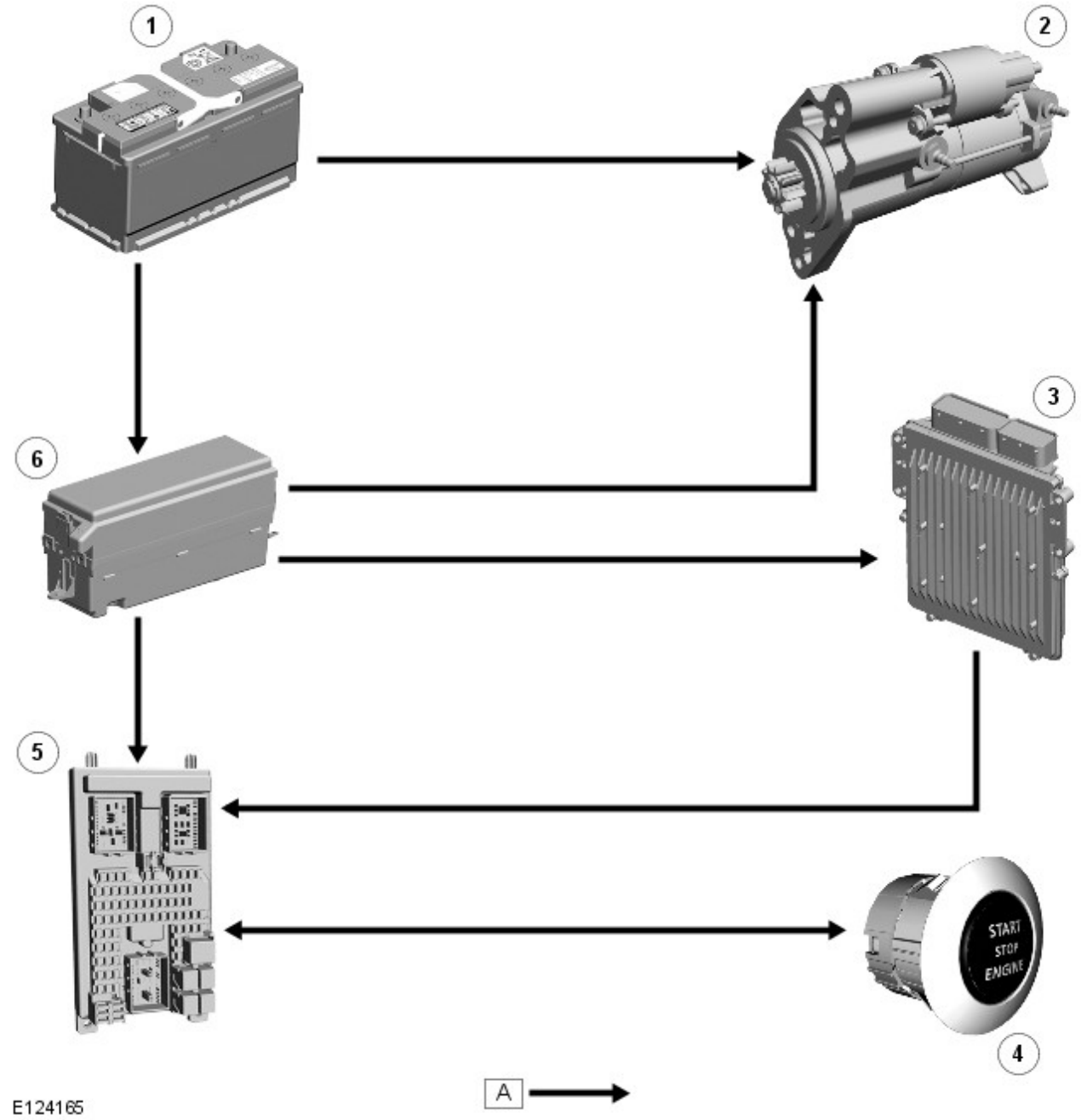
Published: 11-May-2011

Starting System - TDV6 3.0L Diesel - Starting System - System Operation and Component Description

Description and Operation

Control Diagram

NOTE: **A** = Hardwired



Item	Description
1	Battery
2	Starter motor
3	ECM (engine control module)
4	Stop/start switch
5	CJB (central junction box)
6	EJB (engine junction box)

System Operation

OPERATION

The starter solenoid is energised by a signal from the ECM when the stop/start switch is pressed and the driver has depressed the brake pedal. When engine cranking is requested, the ECM checks that a valid key code has been received before granting the crank request.

Once engine cranking has been granted, the ECM energizes the starter motor relay located in the engine compartment fusebox. The closing of the starter motor relay contacts causes battery voltage to be applied to the starter motor solenoid. The solenoid is energised and the pinion gear is pushed to engage with the flywheel ring gear. Simultaneously, the starter solenoid contacts close, causing current to flow into the motor brushes and armature which operates the motor. The armature rotational force is transferred to the engine's ring gear through the pinion gear, rotates the flywheel and starts the engine.

Component Description

DESCRIPTION

The Denso starter motor is rated as 2.2 kW. It is a conventional design with the motor and pinion in line and the solenoid mounted above.

The starter motor is of the pre-engaged type and comprises a series wound motor, an overrunning clutch and an integral solenoid. This starter incorporates labyrinth-breathing tubes to help with sealing and drainage.

The power for starter operation is supplied on a substantial single cable connected direct from the battery positive terminal, via a megafuse. The cable is connected to the solenoid via a copper threaded stud and secured with a nut.

Published: 15-Jul-2013

Starting System - TDV6 3.0L Diesel - Starting System

Diagnosis and Testing

Principles of Operation

For a detailed description of the starting system and operation, refer to the relevant description and operation section of the workshop manual. REFER to: (303-06A Starting System - TDV6 3.0L Diesel)

Starting System (Description and Operation),
Starting System (Description and Operation),
Starting System (Description and Operation).

Inspection and Verification

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

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

Visual Inspection

Mechanical	Electrical
• Starter motor • Engine (turns freely)	• Battery • Fuses • Starter relay • Wiring harness • Damaged, loose or corroded connectors • Ignition switch • Generator • Transmission control module • Engine control module

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
5. Check DDW for open campaigns. Refer to the corresponding bulletins and SSM's which may be valid for the specific customer complaint and carry out the recommendations as needed.

Symptom Chart

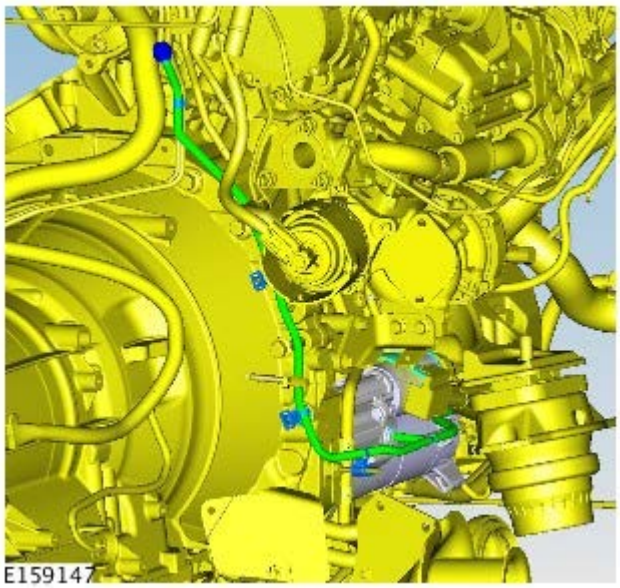
Symptom	Possible Causes	Action
The engine does not crank (starter motor does **not** turn)	• Gear selector not in **P** or **N** position (vehicles with automatic transmission) • Battery • Starter relay • Invalid key code received by central junction box • Brake pedal switch failure • Harness/connectors • Starter motor • Ignition switch • Generator • Transmission control module • Engine control module • Engine seized	Make sure the gear selector is in the **P** or **N** position and correctly adjusted. Check the battery condition and state of charge. Check for DTCs indicating an immobilizer or brake pedal switch failure. Check the starter motor relay, ignition switch and generator circuits. Refer to the electrical guides. Check for TCM and ECM DTCs. Check that the engine turns freely
The engine does not crank (starter motor **does** turn)	• Starter motor installation • Starter motor • Flywheel/drive plate ring gear	Check the starter motor installation (fasteners tight, starter motor square to engine, etc). Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc
Engine cranks too	• Battery • Harness/connectors	Check the battery condition and state of charge. Check the starter motor circuits. Refer to the electrical guides. Check the engine oil grade and

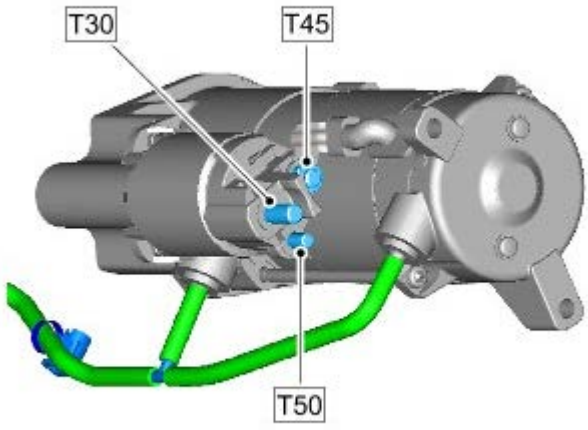
slowly	Starter motor • Oil grade	condition
Engine cranks too fast	• Low engine compression	Check the engine compressions
Excessive starter motor noise	• Starter motor • Flywheel/drive plate ring gear • Starter motor installation/casing	Check the starter motor installation (fasteners tight, motor square to engine, etc). Check the starter motor casing condition. Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc
The engine does not crank (starter motor **'clicks'**	• Low battery voltage • Battery failure • Water ingress starter motor breather tube • High resistance through connectors, terminals, megafuses, cables, and installation to the starter motor • Failure of starter motor ring gear • Failure of flywheel ring gear	GO to Pinpoint Test A.

DTC index

For a list of diagnostic trouble codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

PINPOINT TEST A : STARTER MOTOR PRIOR APPROVAL TEST PROCEDURE	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**
A1: PRE CHECKS (MANUFACTURER APPROVED BATTERY TESTER)	
	1 Please refer to workshop manual section 414-01 and carry out the diagnosis and testing using the manufacturer approved test equipment. Record the information using the battery care report sheet
	Have the battery care routines using the manufacturer approved test equipment been carried out and has the information using the battery care report sheet been recorded? **Yes** Proceed to next step **No** Carry out the battery care routines using the manufacturer approved test equipment. Record the information using the battery care report sheet Proceed to next step
A2: PRE CHECKS (GENERAL WEATHER CONDITIONS)	
	NOTE: The results of this test step may be required by dealer technical support **1** Confirm with the customer and record the weather conditions and ambient temperature (as accurately as possible) at the time of failure
	2 Confirm and record the weather conditions and ambient temperature (as accurately as possible) at the time of test
	Have the weather conditions and ambient temperature been recorded **Yes** Proceed to next step **No** Record the weather conditions and ambient temperature Proceed to next step
A3: CHECK FOR RELATED STARTER MOTOR, IMMOBILIZER DIAGNOSTIC TROUBLE CODES	
	1 Using the manufacturer approved diagnostic system, check for starter motor or immobilizer, related DTCs and refer to the relevant DTC index

	Are starter motor or immobilizer, related DTCs logged? **Yes** Carry out any repair action as requiredClear the DTC and retest **No** Proceed to next step
A4: CHECK INSTALLATION OF STARTER MOTOR BREATHER TUBE	
 E159147	**1** Please refer to workshop manual and check the starter motor breather tube is installed and routed correctly. The shepherds crook needs to be positioned correctly to prevent water ingress to the starter motor
	Is the starter motor breather tube installed and routed correctly? **Yes** Proceed to next step **No** Install the breather tube and route it correctlyAttempt 10 starts to the vehicle. If the vehicle does **NOT** start during any of the 10 attempts. Install new starter motorIf the vehicle **DOES** start during all of the 10 attemptsProceed to next step
A5: STARTER MOTOR CHECKS	
NOTE: This test will require the technician to listen for audible result, high surrounding noise may hinder the outcome	
	1 Set the ignition ON
	2 Depress the brake pedal
	3 Depress the start button
	Was there an audible click when the start button was pressed and did the vehicle start? (Audible click will not be heard if the vehicle starts) **Yes** Proceed to next step **No** Set the ignition OFF. Repeat this starter motor check a further 10 times. Record the result for number of none click testsIf there was an audible click when the start button was pressed during the 10 test cycle. Proceed to next step
A6: CHECK CONNECTIONS ON THE STARTER MOTOR	
	1 Please refer to workshop manual section 303-06 specification section

 E158114	
	2 Gain access to the starter motor
	3 Refer to the electrical circuit diagrams and check the battery power supply and terminal to the starter motor (battery positive cable nut T30 permanent feed B1)
	4 Refer to the electrical circuit diagrams and check the operating supply and terminal to the starter motor (switch lead to the starter motor solenoid nut T50)
	5 Refer to the electrical circuit diagrams and check the power feed stud on the starter motor (T45 terminal)
	6 Refer to the electrical circuit diagrams and inspect connections for signs of becoming loose, water ingress, and terminals/stud for damage and/or corrosion
	Are terminal/stud connections to starter motor, loose, damaged or corroded? **Yes** Rectify as requiredRe-check the system is operating correctlyReturn vehicle to the customer **No** Proceed to next step
A7: VOLTAGE DROP GROUND CIRCUIT	
WARNING: During this test be aware of hot or moving parts. Failure to follow this instruction may result in personal injury	
NOTES: You will require assistance during this test	
You may require extended test leads for the multimeter	
	1 Connect the multimeter between the battery negative terminal and the starter motor ground (where bolted to the bell housing)
	2 Set the multimeter to read DC voltage. Set the ignition ON. Depress the brake pedal. Depress the start button and record the reading
	Is reading equal to or below 0.6 volts? **Yes** Proceed to next step **No** Refer to the electrical circuit diagrams and check ground circuit between battery negative terminal and starter motor for corrosion and high resistanceRectify as requiredRe-check the system is operating correctlyReturn vehicle to the customer
A8: VOLTAGE DROP POWER CIRCUIT	
WARNING: During this test be aware of hot or moving parts. Failure to follow this instruction may result in personal injury	
NOTES:	

 You will require assistance during this test	
 You may require extended test leads for the multimeter	
	1 Connect the multimeter between the battery positive terminal and the power feed stud on the starter motor (T45 terminal)
	2 Set the multimeter to read DC voltage. Set the ignition ON. Depress the brake pedal. Depress the start button and record the reading
	Is reading equal to or below 0.8 volts? **Yes** Proceed to next step **No** Refer to the electrical circuit diagrams and check power circuit between battery positive terminal and the power feed stud on the starter motor (T45 terminal) including mega fuses, for corrosion and high resistanceRectify as requiredRe-check the system is operating correctlyReturn vehicle to the customer
A9: VOLTAGE AT STARTER MOTOR (T50)	
 WARNING: During this test be aware of hot or moving parts. Failure to follow this instruction may result in personal injury	
NOTES:  You will require assistance during this test	
 You may require extended test leads for the multimeter	
	1 Check the operating supply voltage to the starter motor (T50)
	2 Connect the multimeter between the starter motor (T50) terminal and ground
	3 Set the multimeter to read DC voltage. Set the ignition ON. Depress the brake pedal. Depress the start button and record the reading
	Is the reading between 9 & 12 volts during cranking? **Yes** Proceed to next step **No** Refer to the electrical circuit diagrams and check starter relay circuit for open circuit, high resistanceRectify as requiredRe-check the system is operating correctlyReturn vehicle to the customer
A10: VOLTAGE AT STARTER MOTOR SOLENOID (T45)	
 WARNING: During this test be aware of hot or moving parts. Failure to follow this instruction may result in personal injury	
 NOTE: You will require assistance during this test	
	1 Check the operating supply voltage to the starter motor (T45)
	2 Connect the multimeter between the starter motor (T45) terminal and ground
	3 Set the multimeter to read DC voltage. Set the ignition ON. Depress the brake pedal. Depress the start button and record the reading
	Is the reading between 6 & 9 volts during cranking? **Yes** Proceed to next step **No** Check and install new starter motor and breather tube
A11: STARTER MOTOR VISUAL INSPECTION	
 WARNING: During this test isolate the vehicle battery. Failure to follow this instruction may result in personal injury	
	1 Remove the starter motor
	2 Visually inspect the starter motor ring gear for failure
	3 Visually inspect the flywheel ring gear for failure
	Was there evidence of failure to the starter motor of flywheel ring gear **Yes** Check and install new parts as requiredRe-check the

		system is operating correctlyReturn vehicle to the customer
	No	Contact dealer technical support with all of the recorded values from the above tests

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

Starting System - TDV6 3.0L Diesel - Starter Motor

Removal and Installation

Removal

1. Disconnect the battery ground cable.

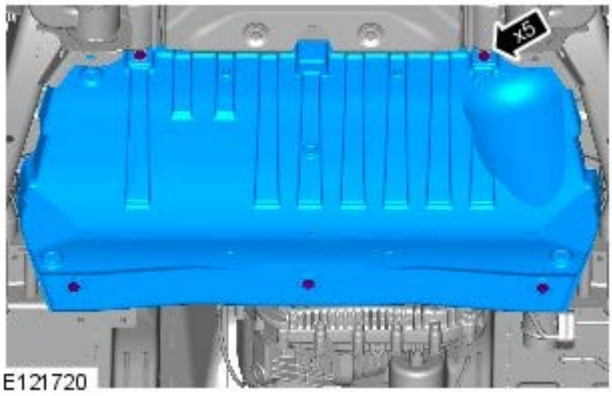
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

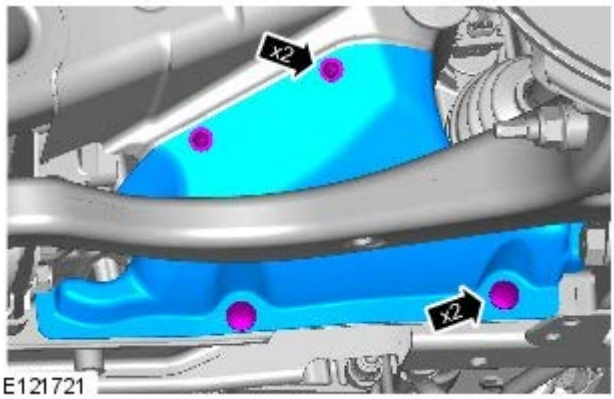
   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02, Removal and Installation).

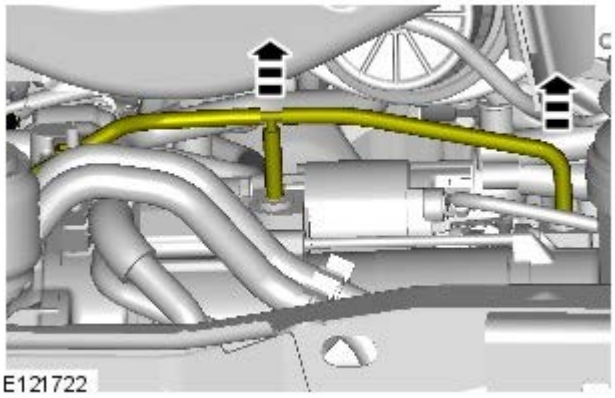
4. *Torque:* 62 Nm



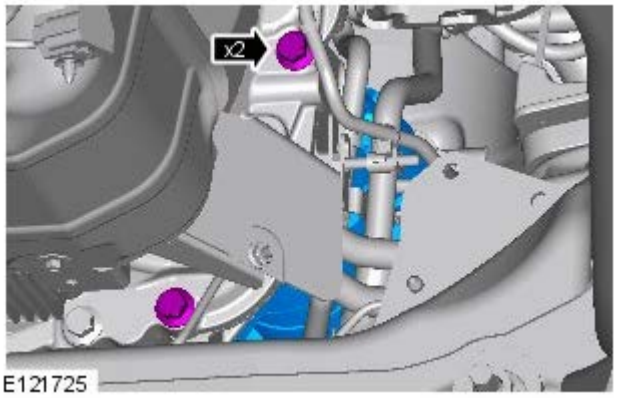
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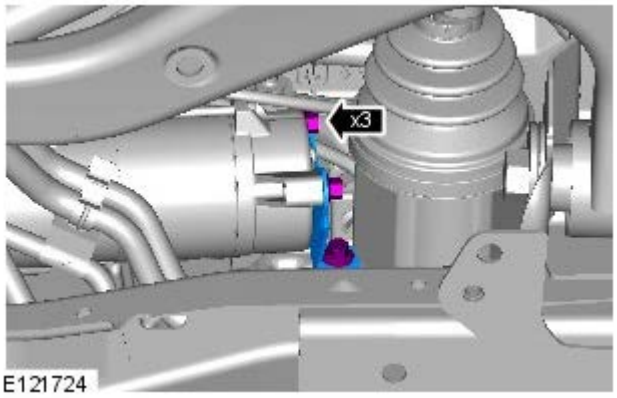
6.



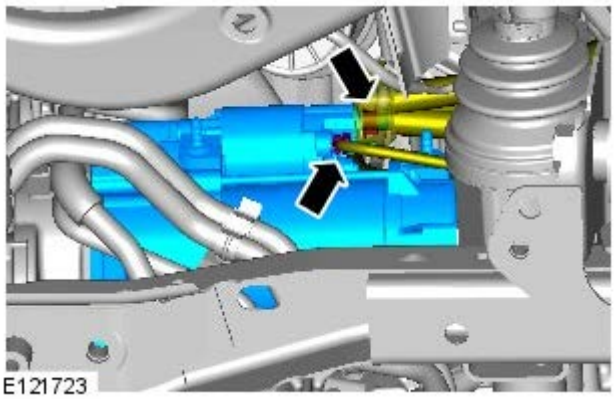
7. *Torque:* 47 Nm



8. *Torque:* 47 Nm



9. *Torque:*
   M8 10 Nm
   M6 7 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Starting System - V8 5.0L Petrol/V8 S/C 5.0L Petrol -

Description	Nm	lb-ft	lb-in
Starter motor retaining bolts	48	36	-
Battery positive terminal connector retaining nut	10	7	-
Solenoid terminal connector retaining nut	4	-	35

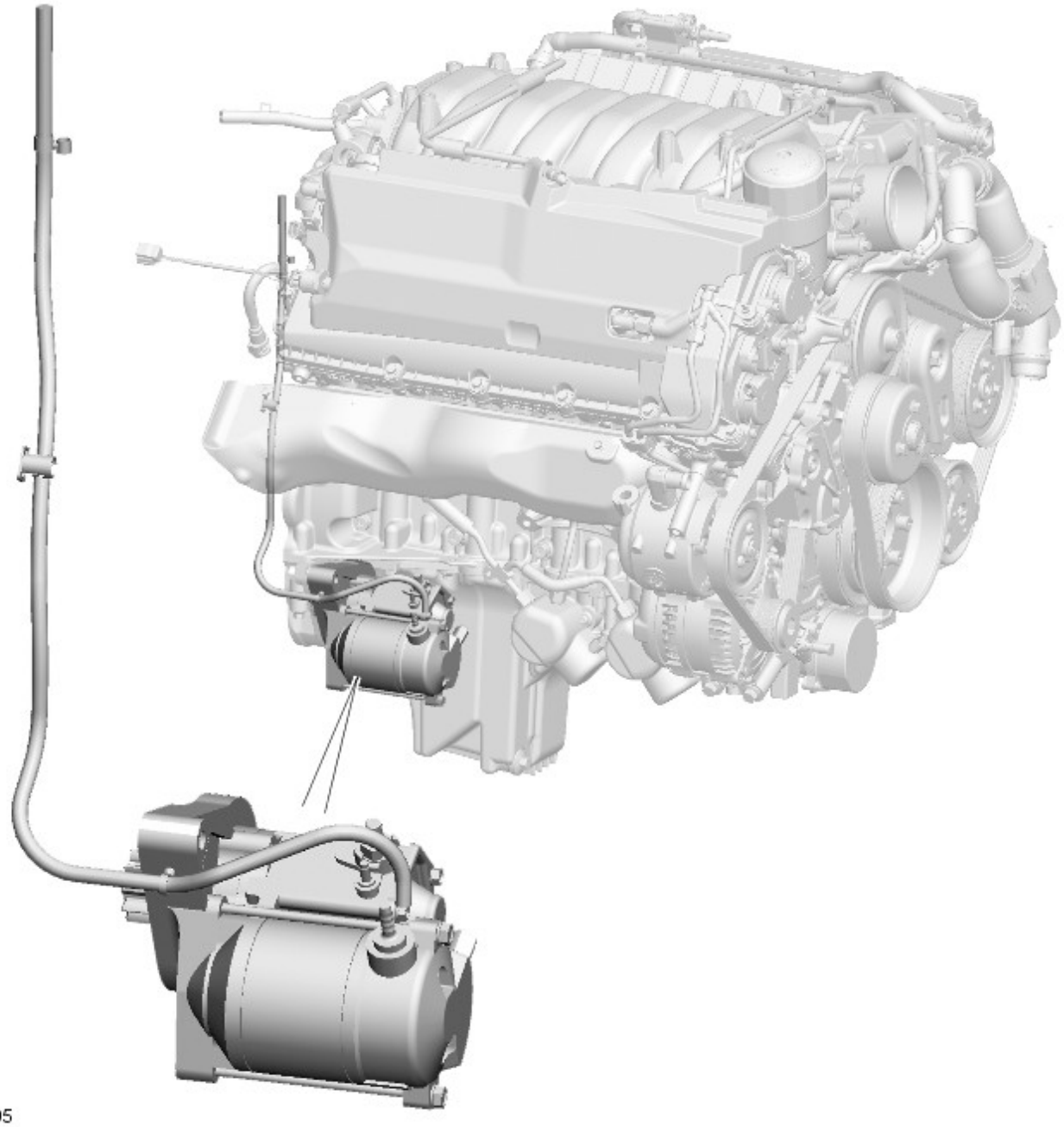
Published: 11-May-2011

Starting System - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Starting System

Description and Operation

COMPONENT LOCATION

NOTE: Installation on naturally aspirated engine shown, installation on supercharger engine similar.



E121595

INTRODUCTION

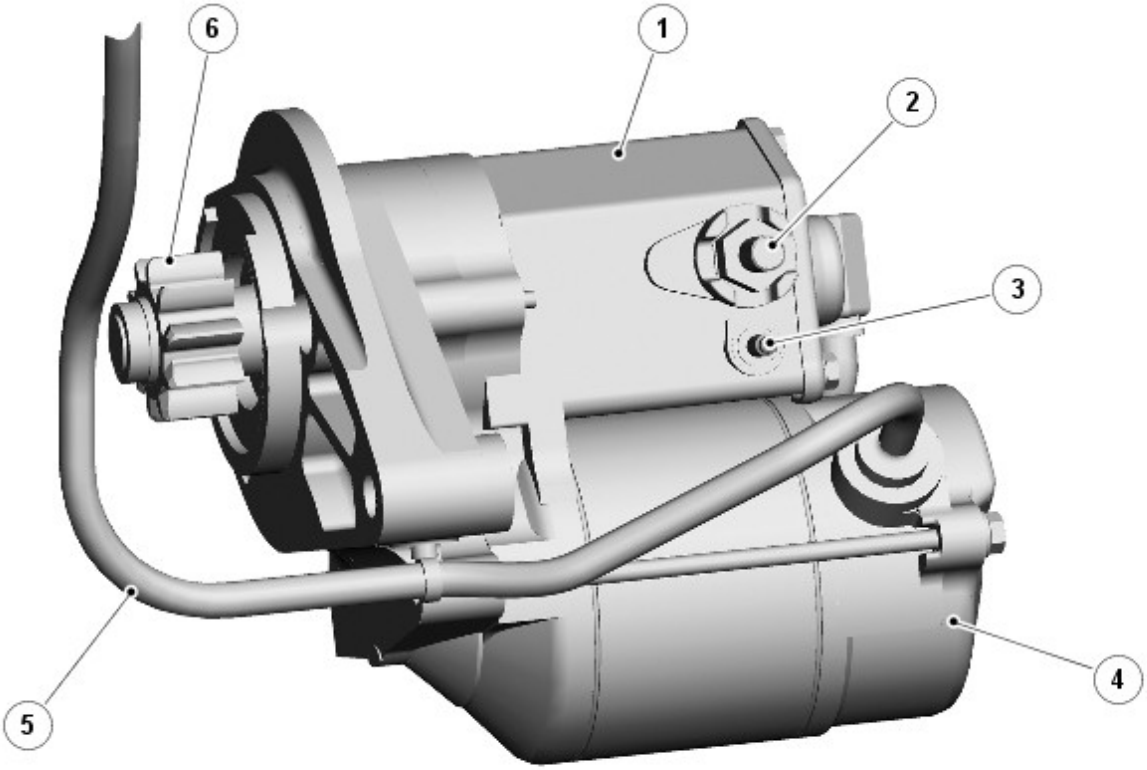
The starter motor is manufactured by Denso and is rated at 1.4 kW. The motor is geared directly to the pinion. The motor is a series wound motor with an overrunning clutch. The interior of the motor is ventilated through a breather tube attached to the rear of the engine.

The starter motor is located on the rear right side of the engine sump. The motor is installed in an aperture in the sump and the pinion is engaged with the ring gear of the crankshaft drive plate.

A heavy duty cable, which supplies the electrical power to turn the starter motor, is connected to the battery positive terminal via 500 A megafuse.

At the starter motor, the cable is connected to a terminal stud on the solenoid. The power feed from the starter relay, to energize the solenoid, is connected to a second terminal stud on the solenoid.

Starer Motor Assembly

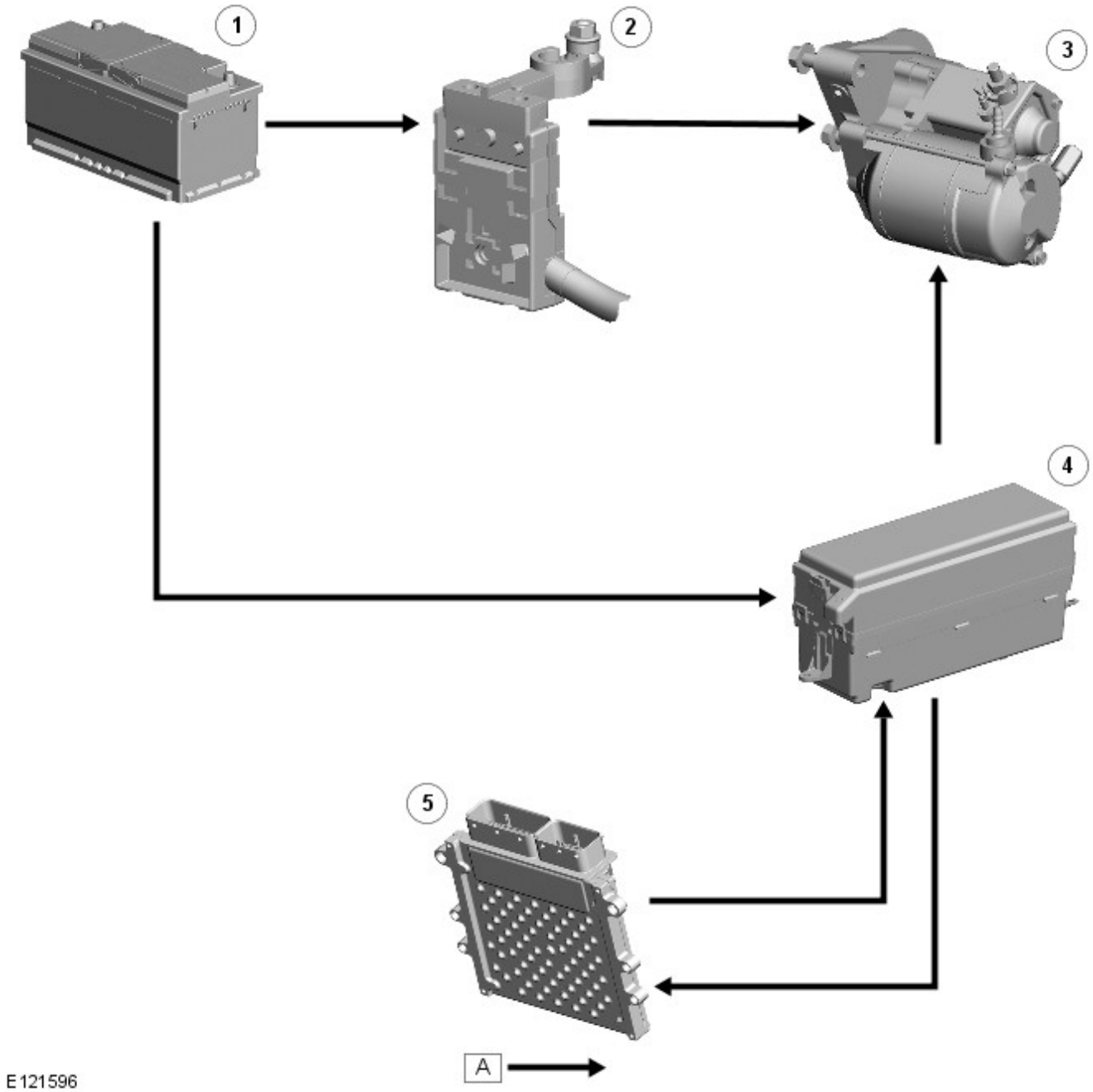


E120142

Item	Part Number	Description
1	-	Starter solenoid
2	-	Starter power terminal
3	-	Solenoid power terminal
4	-	Electric motor
5	-	Breather tube
6	-	Pinion gear

CONTROL DIAGRAM

NOTE: A = Hardwired.



Item	Part Number	Description
1	-	Battery
2	-	Terminal post megafuse (500 A)
3	-	Starter motor
4	-	EJB (engine junction box) (starter relay)
5	-	ECM (engine control module)

OPERATION

Engine crank requests are monitored by the passive anti-theft system and, if valid, passed on to the ECM (engine control module).
For additional information, refer to: Anti-Theft - Passive (419-01B, Description and Operation).

When the ECM receives a crank request, it energizes the starter relay in the EJB (engine junction box). The energized starter relay supplies 12 V power to energize the pull-in coil of the starter solenoid. Once activated, the pull-in coil engages the solenoid plunger, which engages the pinion gear with the ring gear. The plunger then closes the solenoid circuit, feeding power from the 500 A megafuse on the battery positive terminal to the starter motor.

Published: 06-Apr-2013

Starting System - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Starting System

Diagnosis and Testing

Principles of Operation

For a detailed description of the starting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Starting System (303-06B Starting System - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Gear selector lever cable adjustment (vehicles with automatic transmission) • Starter motor • Engine (turns freely)	• Battery • Fuses • Starter relay • Wiring harness(es) • Damaged, loose or corroded connectors • Ignition switch • Generator • Transmission Control Module (TCM) • 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.
5. Check DDW for open campaigns. Refer to the corresponding bulletins and SSM's which may be valid for the specific customer complaint and carry out the recommendations as needed.

Symptom Chart

Symptom	Possible Causes	Action
The engine does not crank (starter motor **does not** turn)	• Gear selector not in **P** or **N** position (vehicles with automatic transmission) • Battery • Starter relay • Invalid key code received by Central Junction Box (CJB) • Harness/connectors • Starter motor • Ignition switch • Generator • Transmission Control Module (TCM) • Engine Control Module (ECM) • Engine seized	• Make sure the gear selector is in the **P** or **N** position and correctly adjusted • Check the battery condition and state of charge • Using the manufacturer approved diagnostic system, check the Central Junction Box (CJB) for related DTCs and refer to the relevant DTC index • Check the starter motor relay, ignition switch and generator circuits • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) and Transmission Control Module (TCM) for related DTCs and refer to the relevant DTC index • Check that the engine turns freely
The engine does not crank (starter motor **does** turn)	• Starter motor installation • Starter motor • Flywheel / drive plate ring gear	• Check the starter motor installation (fasteners tight, starter motor square to engine, etc) • Check the flywheel / drive plate ring gear teeth for damage, foreign objects, etc
Engine cranks too slowly	• Battery • Harness/connectors	• Check the battery condition and state of charge • Check the starter motor circuits

	Starter motor • Oil grade	Check the engine oil grade and condition
Engine cranks too fast	• Low engine compression	• Check the engine compressions
Excessive starter motor noise	• Starter motor • Flywheel / drive plate ring gear • Starter motor installation/casing	• Check the starter motor installation (fasteners tight, motor square to engine, etc) • Check the starter motor casing condition • Check the flywheel / drive plate ring gear teeth for damage, foreign objects, etc

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 11-May-2011

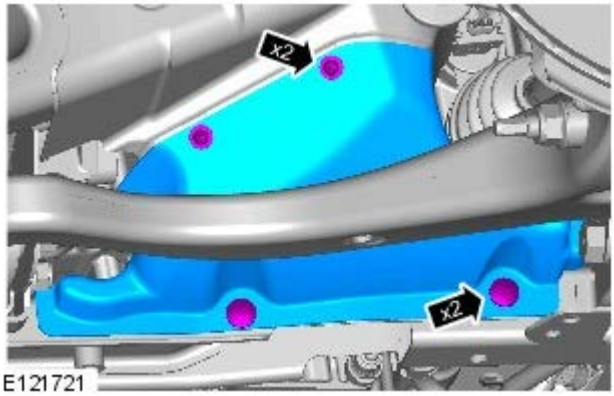
Starting System - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Starter Motor

Removal and Installation

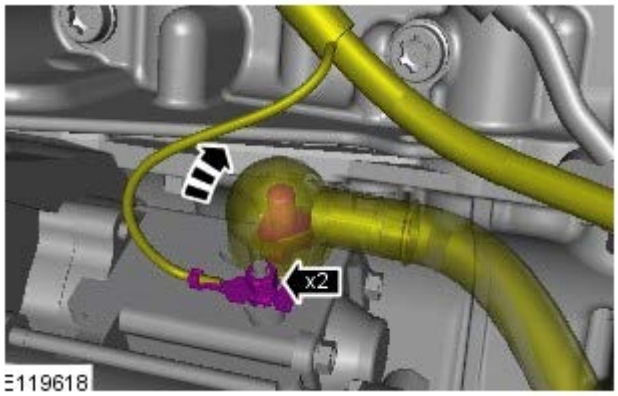
Removal

1. Refer to: Specifications (414-00, Specifications).
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

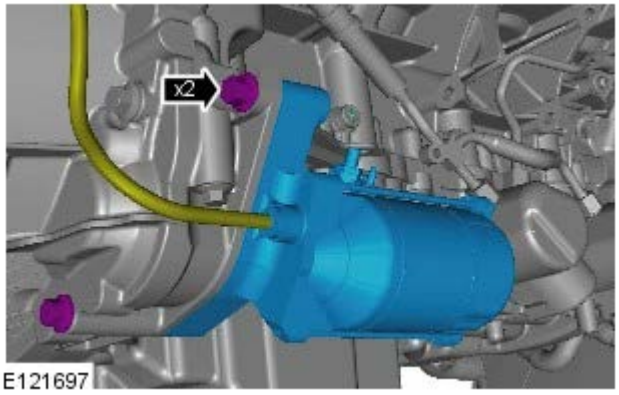
   Raise and support the vehicle.
3. Refer to: Engine Undershield (501-02, Removal and Installation).
4.



5. *Torque:*
   M8 10 Nm
   M6 4 Nm



6. *Torque:* 48 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

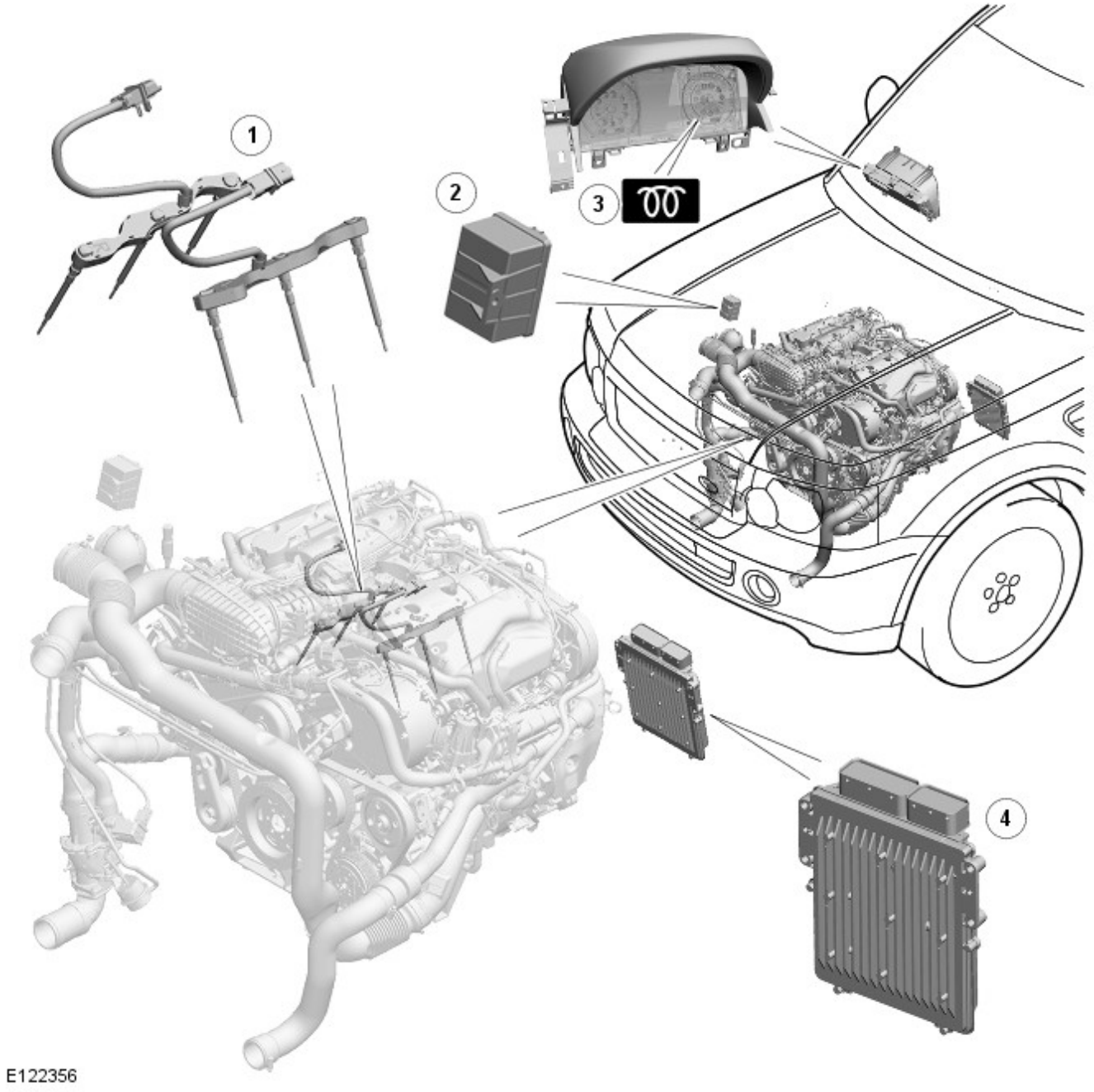
Glow Plug System - TDV6 3.0L Diesel -

Description	Nm	lb-ft	lb-in
Glow plug	10	-	89

Published: 11-May-2011

Glow Plug System - TDV6 3.0L Diesel - Glow Plug System - Component Location

Description and Operation



Item	Description
1	Glow plugs
2	Glow plug module
3	Glow plug warning lamp
4	ECM (engine control module)

Published: 11-May-2011

Glow Plug System - TDV6 3.0L Diesel - Glow Plug System - Overview

Description and Operation

OVERVIEW

The glow plug system includes a glow plug installed in the inlet side of each cylinder and a glow plug module. The glow plugs heat the combustion chambers before and during cranking, to aid cold starting, and after the engine starts to reduce emissions and engine noise when idling with a cold engine.

The glow plugs are connected for each bank by a common harness which is connected into the main engine harness. The harness for each bank connects into a connector block which attaches to each of the glow plugs for that bank. The glow plugs are connected directly to the glow plug module which is controlled by glow plug software contained within the ECM (engine control module).

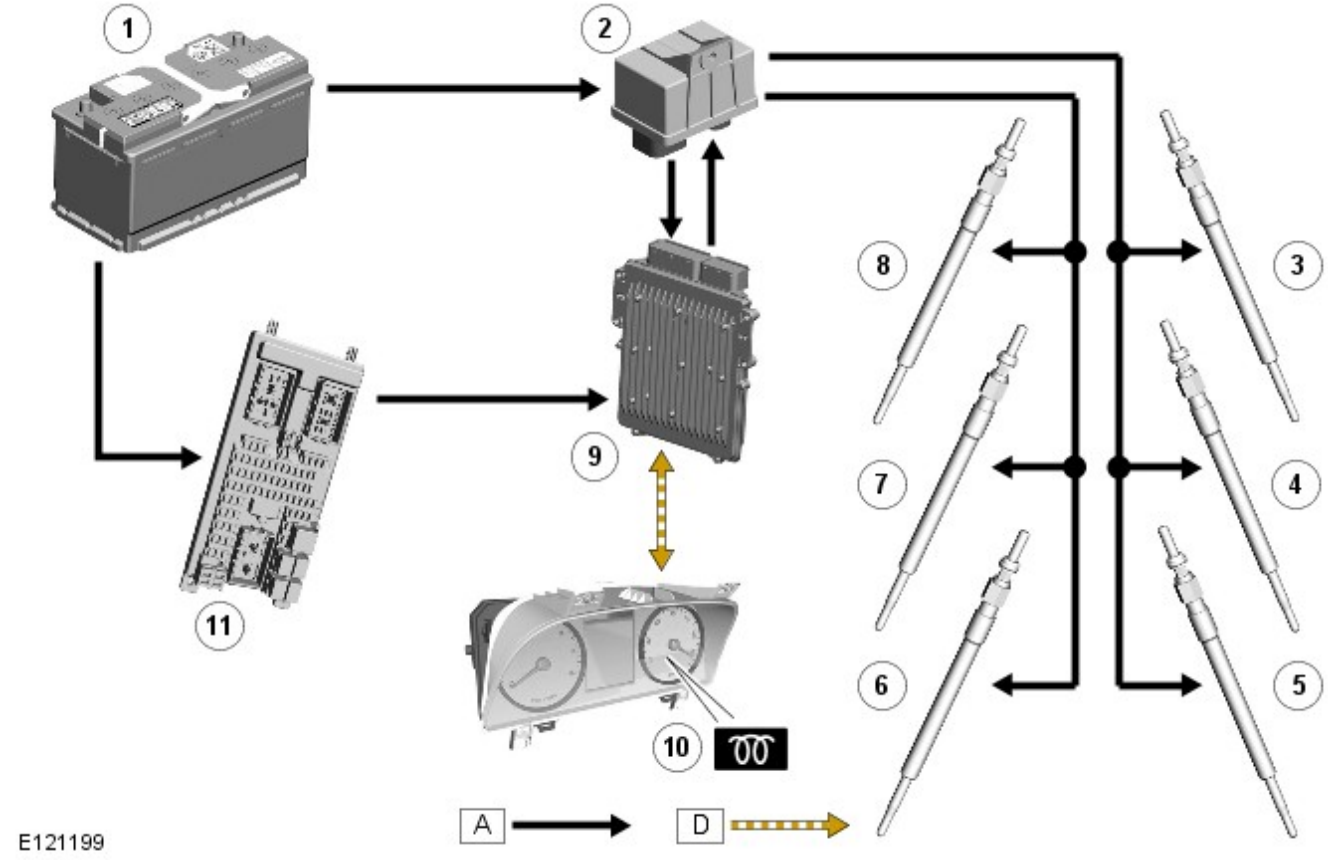
Published: 11-May-2011

Glow Plug System - TDV6 3.0L Diesel - Glow Plug System - System Operation and Component Description

Description and Operation

Control Diagram

NOTE: **A** = Hardwired; **D** = High Speed CAN (controller area network)



Item	Description
1	Battery
2	Glow plug module
3	Glow plug
4	Glow plug
5	Glow plug
6	Glow plug
7	Glow plug
8	Glow plug
9	ECM (engine control module)
10	Instrument cluster (glow plug warning indicator)
11	CJB (central junction box)

System Operation

System Operation

There are three phases of glow plug heating:

- Pre heating
- Crank heating
- Post heating

The ECM determines the heating times from the ECT (engine coolant temperature). The lower the engine coolant temperature, the longer the heating times.

When the ignition is switched to power mode 9, the ECM calculates any required heating times and, if heating is required, energizes the glow plug relays in the CJB. When pre heating is required, the ECM also sends a message to the instrument cluster, on the high speed CAN, to request illumination of the glow plug indicator. The glow plug indicator remains illuminated for the duration of the pre heating phase, or until the ignition is switched to crank, whichever occurs first. If required, the ECM keeps the glow plug relays energized during cranking and for the duration of any post heating phase.

The ECM monitors the drive circuit of the glow plug relay for plausibility of operation, continuity, and short and open circuits. If a fault is detected, the ECM stores a related fault code.

Pre Heating

Pre-heat is the length of time the glow plugs operate prior to engine cranking. The ECM controls the pre-heat time based on ECT sensor output and barometric pressure. If the ECT sensor fails, the ECM will use a predefined temperature as a default value The pre-heat duration is extended if the coolant temperature is low.

The ECM receives the corresponding temperature signal from the ECT sensor.

The preheating period is dependent on the temperature signal (low temperature = longer preheating period).

The driver is informed that preheating is in operation by the glow plug indicator light in the instrument cluster coming on. The preheating times become longer as the coolant temperature falls.

The BARO (barometric pressure) also has an influence on activation and deactivation of the glow plugs in the event of large altitude differences.

Crank Heating

Crank heating is carried out at every start where the coolant temperature is below the predefined threshold of 20°C. Crank heating begins if the engine speed exceeds 80 rpm for longer than 50ms, or the starter is active for longer than 4 sec. If the coolant temperature sensor is defective, a default temperature of 0°C is used.

Post Heating

Post heat is the length of time the glow plugs operate after the engine starts. The ECM controls the post heating time based on ECT sensor output. The post heat phase reduces engine noise, improves idle quality and reduces hydrocarbon emissions.

Preheating is followed by the post heating phase once the engine has started. The post heating phase depends upon how the vehicle is driven.

In addition to ECT, BARO and engine speed, the injected fuel quantity is significant in this context. For example, if the injected fuel quantity is less than 70 mg per piston stroke and the coolant temperature is below -20°C, post heating is performed.

Component Description

Glow Plug

The ceramic sheathed element glow plugs are made from a heat-resistant, electrically conductive ceramic material. The ceramic sheathed-element glow plugs outer layer is heated directly and is self regulating. The self regulation allows the resistance of the sheathed element to automatically increase as the heat increases preventing the glow plug from overheating. In addition, during the heating process and under the control of the glow plug relay, the glow plugs can be operated above their nominal voltages. This permits heat-up speeds of 1000°C per second. The sheathed-element glow plugs reach a maximum glow temperature of 1300°C and can hold a temperature of 1150°C for several minutes after the first-start glow or at intervening times.

Each cylinder bank has a separate harness connecting the three glow plugs. The harness connects into the engine wiring harness and each harness has a connector block which attaches to each of the glow plugs for that bank.

The glow plug module receives a battery voltage feed via a 250A fusible and a 60A fuse in the engine compartment fusebox. Operation of the glow plug module is controlled by the ECM, which also controls the illumination of the glow plug indicator in the instrument cluster.

The system has been designed as a low-voltage glow system. At 7 volts, the nominal voltage of the sheathed-element glow plugs is significantly lower than the 12 volts of the main electrical circuit. The electronic glow plug module matches the voltage to the sheathed-element glow plugs and controls their glow temperature precisely to the specific requirements of the engine. This produces the optimum glow temperature even when the main circuit voltage is interrupted during engine starting. The lower power consumption of the ceramic glow plugs and their time-staggered activation reduce to a minimum the peak load on the main circuit during the cold start and immediate post-start periods.

In the event of glow plug failure, the engine may be difficult to start and excessive smoke emissions may be observed after starting.

Published: 16-Aug-2012

Glow Plug System - TDV6 3.0L Diesel - Glow Plug System

Diagnosis and Testing

Principles of Operation

For a detailed description of the glow plug system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-07A Glow Plug System - TDV6 3.0L Diesel)

Glow Plug System (Description and Operation),
Glow Plug System (Description and Operation),
Glow Plug System (Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Electrical
• Glow plug warning indicator • Fuses • Glow plug relays • Engine management control relay • Wiring harness(es) • Electrical connector(s) • Glow plug(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, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Poor starting (extreme weather conditions)	• Glow plugs inoperative/inefficient • Fuel temperature too low	• Refer to the electrical circuit diagrams and test the glow plugs circuit for short circuit to ground, short circuit to power, open circuit, high resistance • Check for glow plug DTCs
High cold-engine emissions	• After-glow phase inoperative	NOTE: After-glow is designed to function at engine temperatures below 50°C (122°F), and below 2,500rpm • Refer to the electrical circuit diagrams and test the glow plugs circuit for short circuit to ground, short circuit to power, open circuit, high resistance • Check for glow plug DTCs
High cold-engine noise, vibration or harshness	• After-glow phase inoperative	NOTE: After-glow is designed to function at engine temperatures below 50°C (122°F), and below 2,500rpm • Refer to the electrical circuit diagrams and test the glow plugs circuit for short circuit to ground, short circuit to power, open circuit, high resistance • Check for glow plug DTCs

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

Glow Plug System - TDV6 3.0L Diesel - Glow Plugs

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

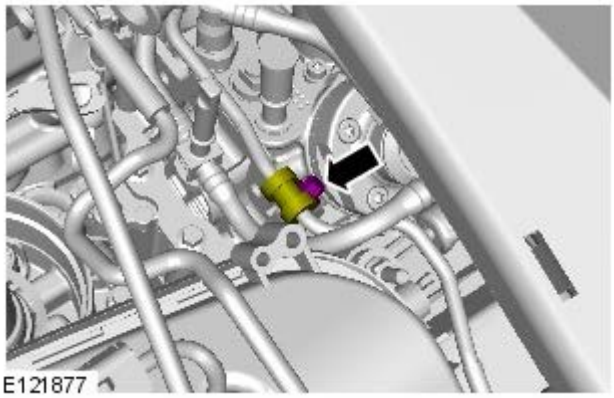
   Refer to: Specifications (414-01, Specifications).

2. Refer to: Intake Air Shutoff Throttle (303-04, Removal and Installation).

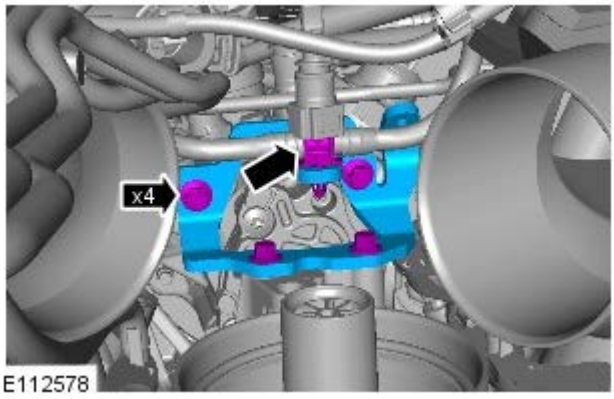
3. Refer to: Crankcase Vent Oil Separator (303-08, Removal and Installation).

4. Refer to: Oil Filter Element (303-01, Removal and Installation).

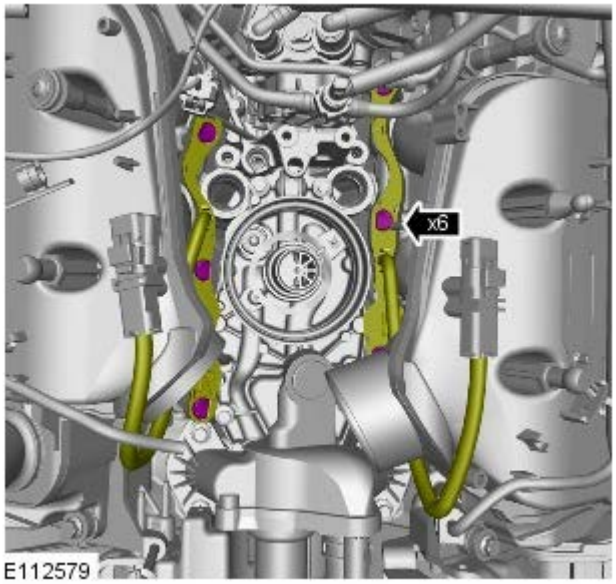
5.



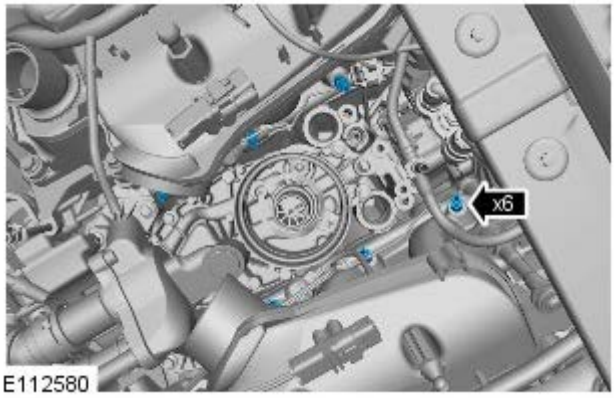
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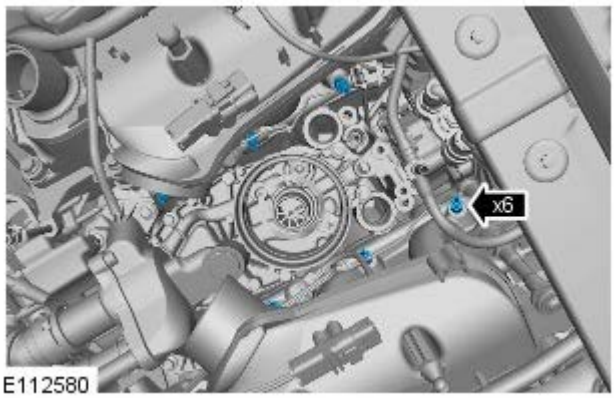
7. CAUTION: Take extra care not to damage the component.



8.



Installation



1. CAUTIONS:

   Take extra care when handling the component.

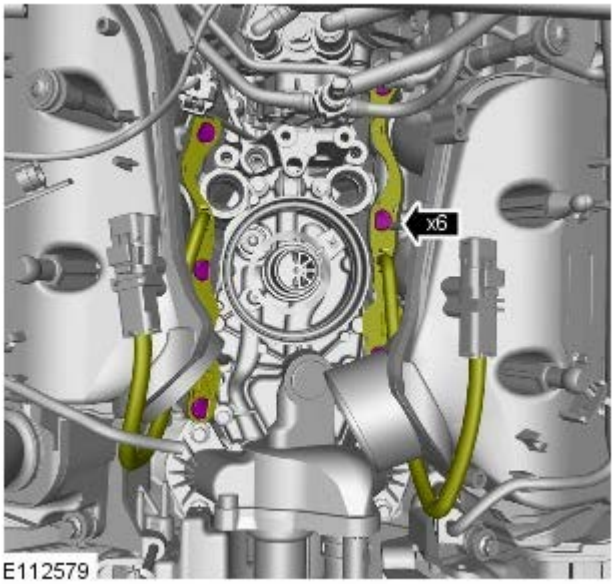
   Fixings must be started by hand to avoid damaging threads.

   If accidentally dropped or knocked install a new module.

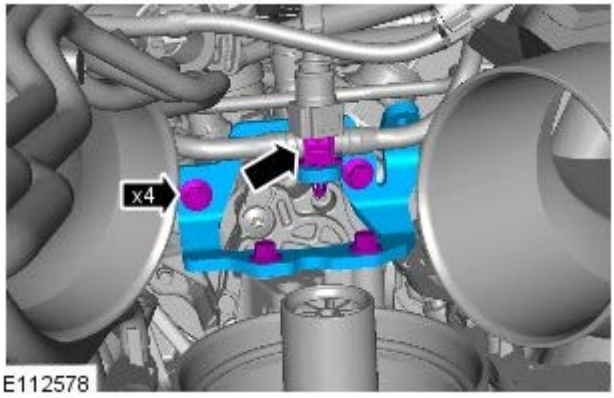
   Make sure the engine is cold before this procedure is carried out. Failure to follow this instruction may result in damage to the vehicle.

   Torque: 10 Nm

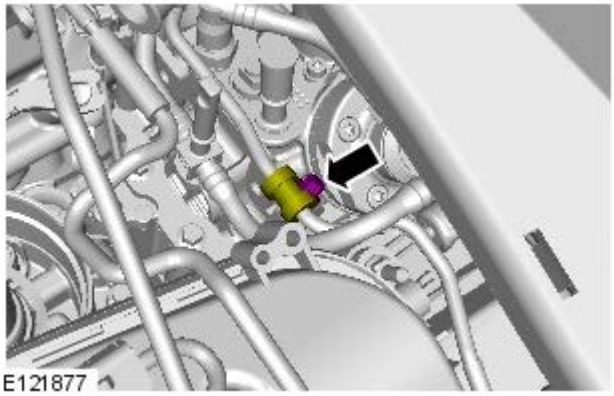
2. CAUTION: Take extra care not to damage the component.



3. *Torque:* 10 Nm



4. *Torque:* 10 Nm



5. Refer to: Oil Filter Element (303-01, Removal and Installation).
6. Refer to: Crankcase Vent Oil Separator (303-08, Removal and Installation).
7. Refer to: Intake Air Shutoff Throttle (303-04, Removal and Installation).
8. Connect the battery ground cable.

   Refer to: Specifications (414-01, Specifications).

Published: 11-May-2011

Engine Ignition - V8 5.0L Petrol/V8 S/C 5.0L Petrol -

Item	Specification
Firing order	1:2:7:3:4:5:6:8
Spark plug type - Vehicles with supercharger	ILKAR6C-10
Spark plug type - Vehicles without supercharger	ILKAR6C-10

Description	Nm	lb-ft	lb-in
Spark plugs	20	15	-
Ignition coil-on-plug retaining bolts	7	5	-

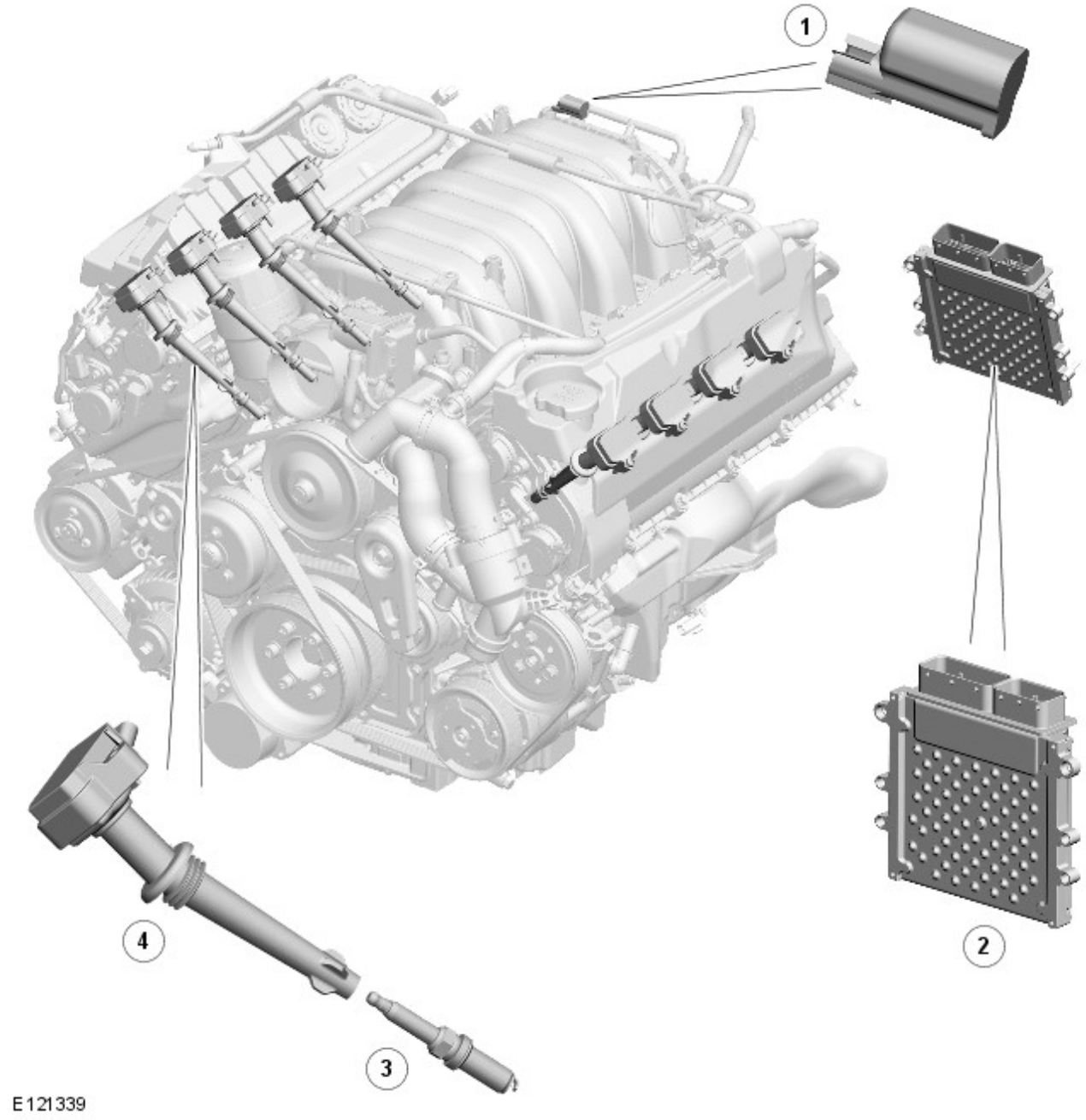
Published: 11-May-2011

Engine Ignition - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Engine Ignition

Description and Operation

COMPONENT LOCATION

NOTE: Installation on RHD (right-hand drive) naturally aspirated vehicle shown, other installations similar.

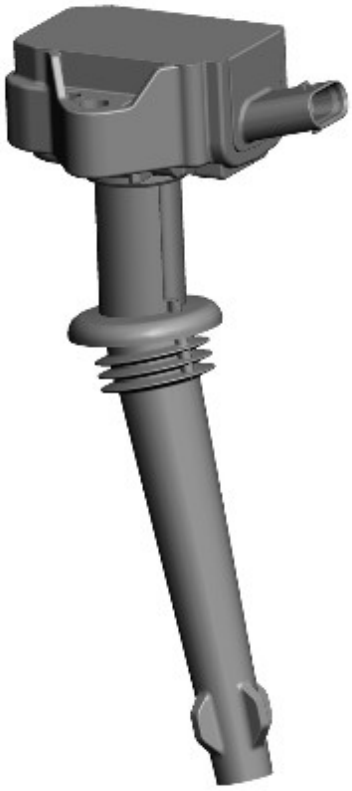


Item	Part Number	Description
1	-	RFI (radio frequency interference) suppressor
2	-	ECM (engine control module)
3	-	Spark plug (8 off)
4	-	Ignition coil (8 off)

INTRODUCTION

The engine ignition system is a coil-on-plug, single spark system controlled by the ECM (engine control module). An iridium tipped spark plug is installed in each combustion chamber, between the inlet and exhaust valves, and an ignition coil is installed on each spark plug. A RFI (radio frequency interference) suppressor is connected to the power feed to the ignition coils.

IGNITION COILS

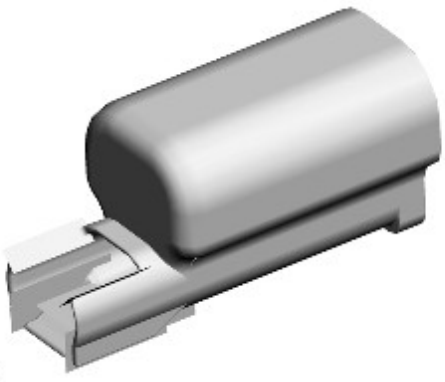


E116147

The ignition coils are installed in the cylinder head covers, under the NVH (noise, vibration and harshness) covers. Each ignition coil locates on a spark plug and is secured to the related cylinder head cover with a single screw. Each ignition coil incorporates a three pin electrical connector for connection to the engine harness.

Each ignition coil contains a primary and a secondary winding. The primary winding receives electrical power from the ignition relay in the power distribution box. A power stage in the primary winding allows the ECM to interrupt the power supply, to induce a voltage in the secondary winding and thus the spark plug. A diode in the ground side of the secondary winding reduces any undesirable switch-on voltage, to prevent misfiring into the intake manifold. The power stage limits the maximum voltage and current in the primary winding, to protect the power stage and limit the voltage in the secondary winding.

RFI SUPPRESSOR

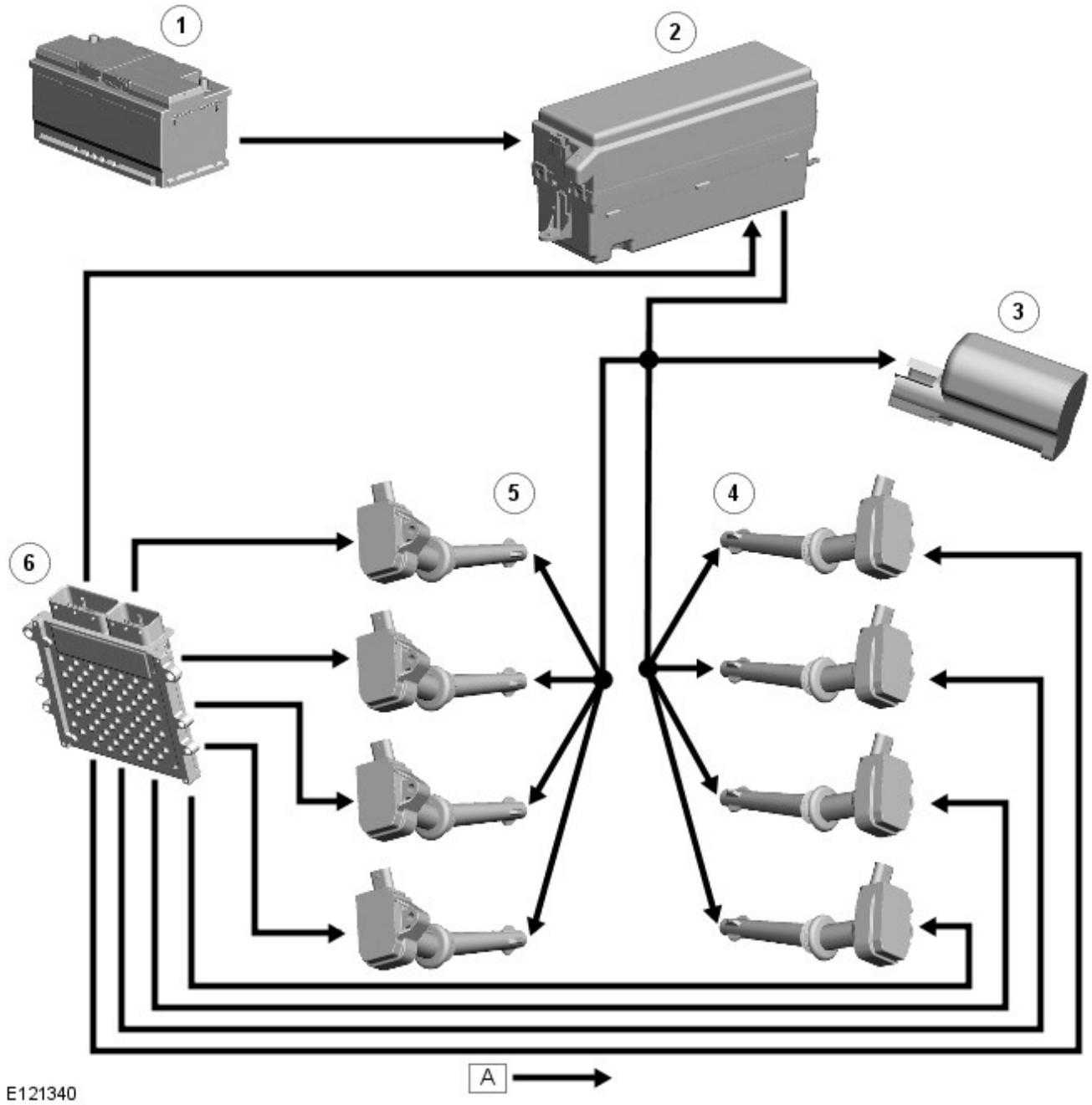


E108416

The RFI (radio frequency interference) suppressor is installed on the engine harness carrier at the rear of the engine.

CONTROL DIAGRAM

NOTE: A = Hardwired



Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box) (ECM relay)
3	-	RFI suppressor
4	-	LH (left hand) cylinder bank ignition coil (4 off)
5	-	RH (right hand) cylinder bank ignition coil (4 off)
6	-	ECM

OPERATION

The ignition coils are supplied with electrical power from the battery via the ECM relay in the EJB (engine junction box). The ECM controls the operation of the ECM relay.

The ECM sends a separate signal to each ignition coil to trigger the power stage switching. The ECM calculates the dwell time from the 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 sufficient spark energy is available without excessive primary current flow, which avoids overheating and 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.

Published: 16-Aug-2012

Engine Ignition - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Engine Ignition

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine ignition system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Engine Ignition (303-07B Engine Ignition - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Engine oil level • Cooling system coolant level • Fuel level • Fuel contamination/grade/quality • Exhaust Gas Recirculation (EGR) valves	• Fuses • Wiring harness • Loose or corroded electrical connectors • Ignition coils • 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 symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	• 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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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	• Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant 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 condition • Ensure the battery is in a fully charged and serviceable condition • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Difficult hot start	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system	• Check for injector leak, install new injector as required • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index

	• EGR valve stuck open	
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 required • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check for blockage in air filter and air intake system • Check for air leakage in air intake system
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	• Check for fuel system related DTCs and refer to the relevant DTC Index • Check for injector leak, install new injector as required • Check for air leakage in air intake system • Ensure accelerator pedal is free from restriction • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) and Transmission Control Module (TCM) for related DTCs and refer to the relevant DTC index
Engine backfires	• Fuel pump/lines • Air leakage • Electronic engine controls • Ignition system • Sticking Variable Camshaft Timing (VCT) hub	• Check for fuel system failures • Check for air leakage in intake air system • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Engine surges	• Fuel pump/lines • Electronic engine controls • Throttle motor • Ignition system	• Check for fuel system failures • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Engine detonates/knocks	• Fuel pump/lines • Air leakage • Electronic engine controls • Sticking VCT hub	• Check for fuel system failures • Check for air leakage in intake air system • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
No throttle response	• Electronic engine controls • Throttle motor	• Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM), Transmission Control Module (TCM), and Anti-lock Brake System control module (ABS) for related DTCs and refer to the relevant DTC index • Check for air leakage in intake air system

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

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Engine Ignition - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Ignition Coil-On-Plug

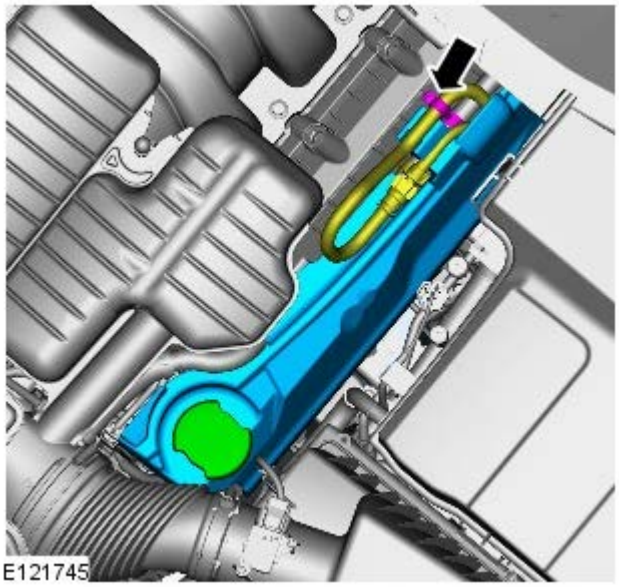
Removal and Installation

Removal

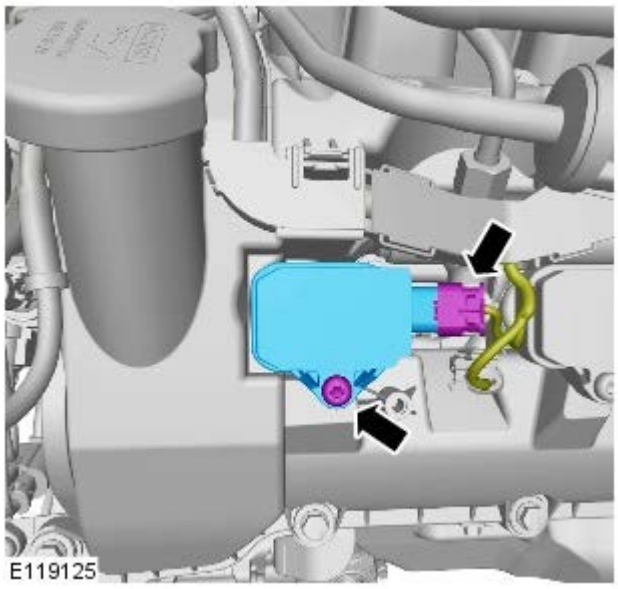
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

2.



3. *Torque:* 7 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine Ignition - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Spark Plugs V8 5.0L Petrol

Removal and Installation

Special Tool(s)

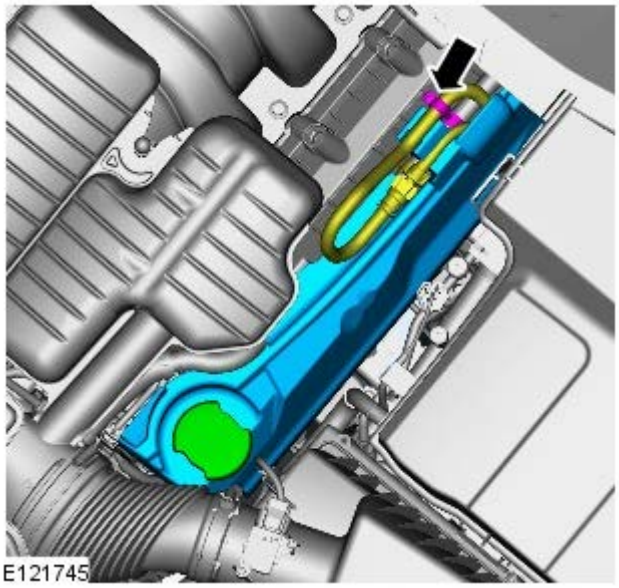
 E115268	303-1450 Spark Plug Remover/Installer

Removal

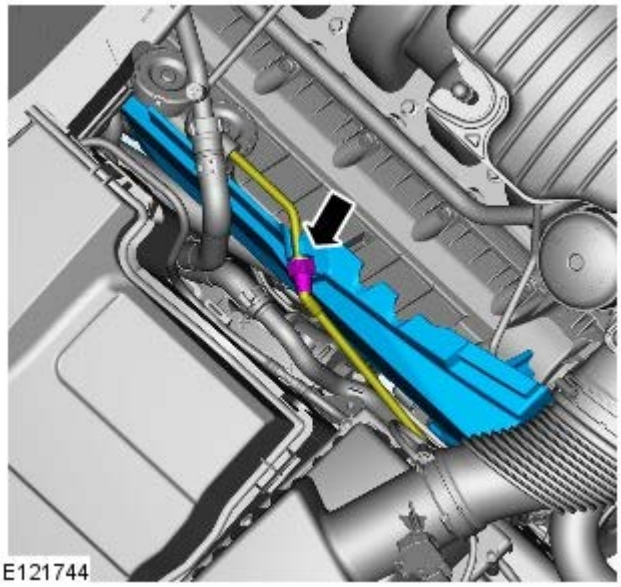
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 5.0L NA V8 - AJ133 (501-05, Removal and Installation).

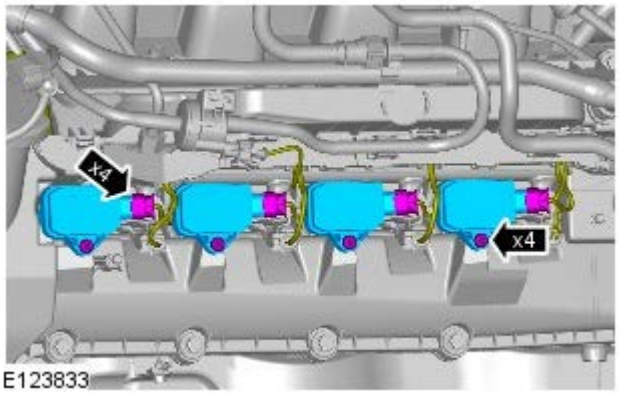
2.


E121745

3.

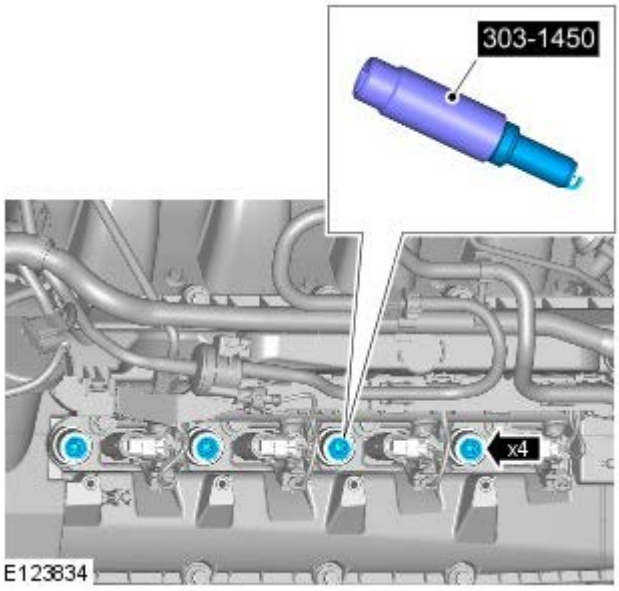

E121744

4. NOTE: Left-hand shown, right-hand similar.



Torque: 7 Nm

5. *Special Tool(s):* 303-1450
   Torque: 20 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine Ignition - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Spark Plugs V8 S/C 5.0L Petrol

Removal and Installation

Special Tool(s)

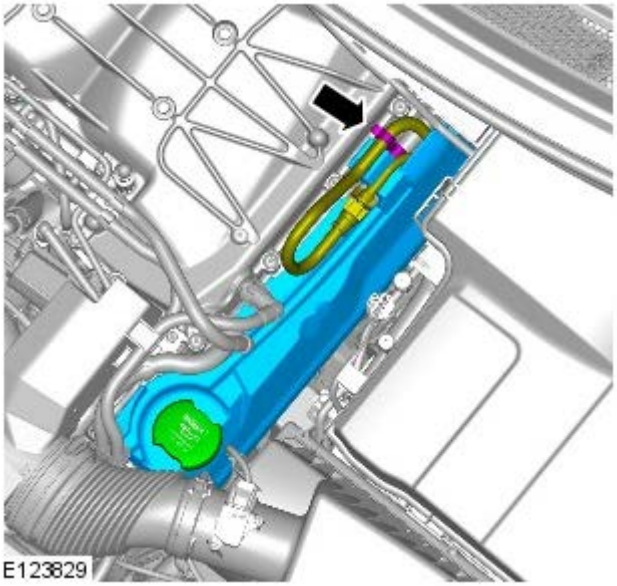
 E115268	303-1450 Spark Plug Remover/Installer

Removal

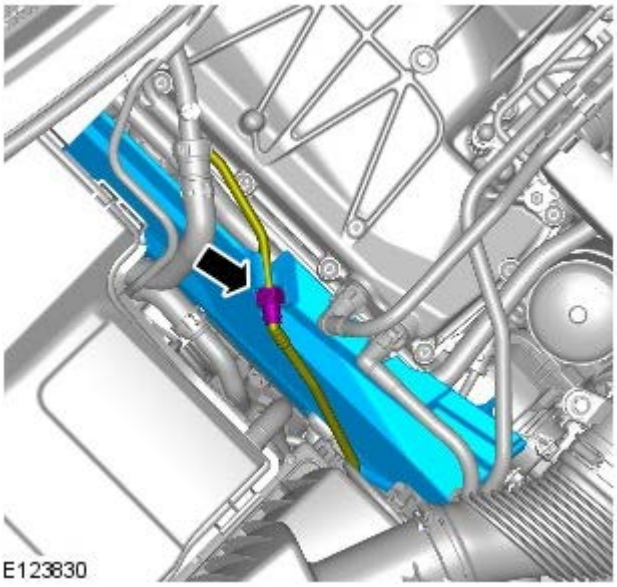
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

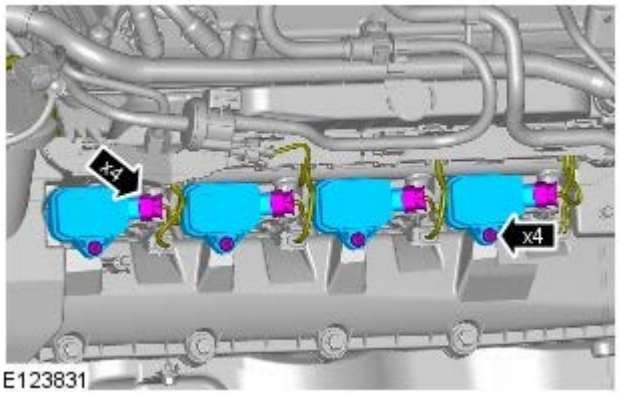
2.


E123829

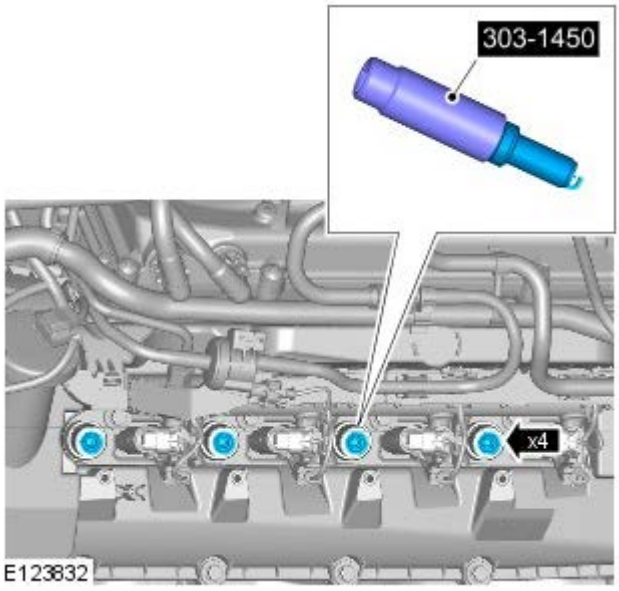
3.


E123830

4. NOTE: Left-hand shown, right-hand similar.



Torque: 7 Nm



5. NOTE: Left-hand shown, right-hand similar.

Special Tool(s): 303-1450
Torque: 20 Nm

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine Emission Control - TDV6 3.0L Diesel -

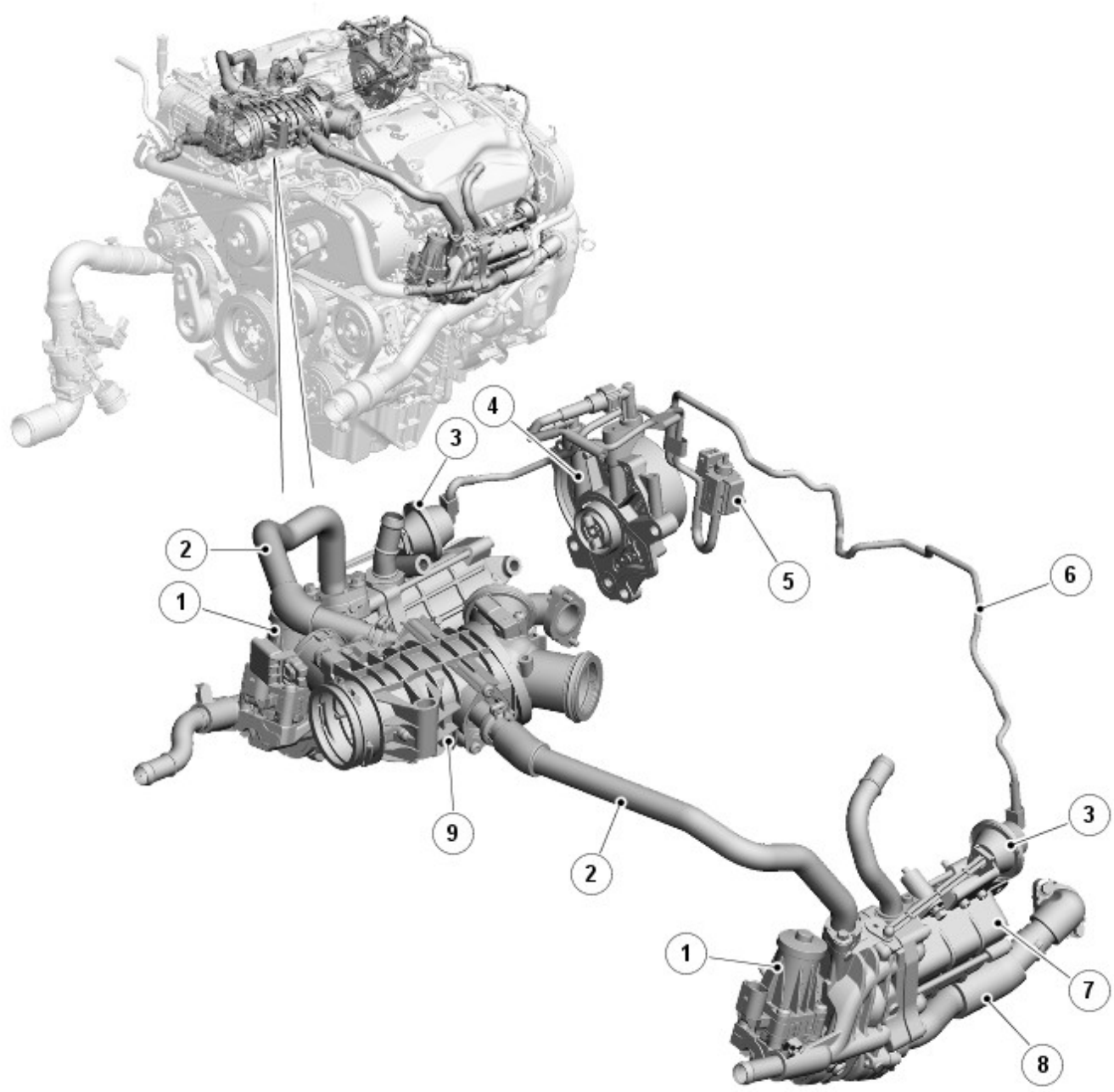
Description	Nm	lb-ft	lb-in
Exhaust gas recirculation (EGR) valve to cylinder head retaining bolts	10	7	89
EGR valve to EGR cooler retaining bolts	10	7	89
EGR valve tube to exhaust manifold retaining bolts	10	7	89
EGR valve cooler mounting bracket retaining bolt	10	7	89
EGR valve outlet tube to EGR valve retaining bolts	10	7	89
EGR valve outlet tube to timing cover retaining bolt	5	4	35

Published: 11-May-2011

Engine Emission Control - TDV6 3.0L Diesel - Engine Emission Control - Component Location

Description and Operation

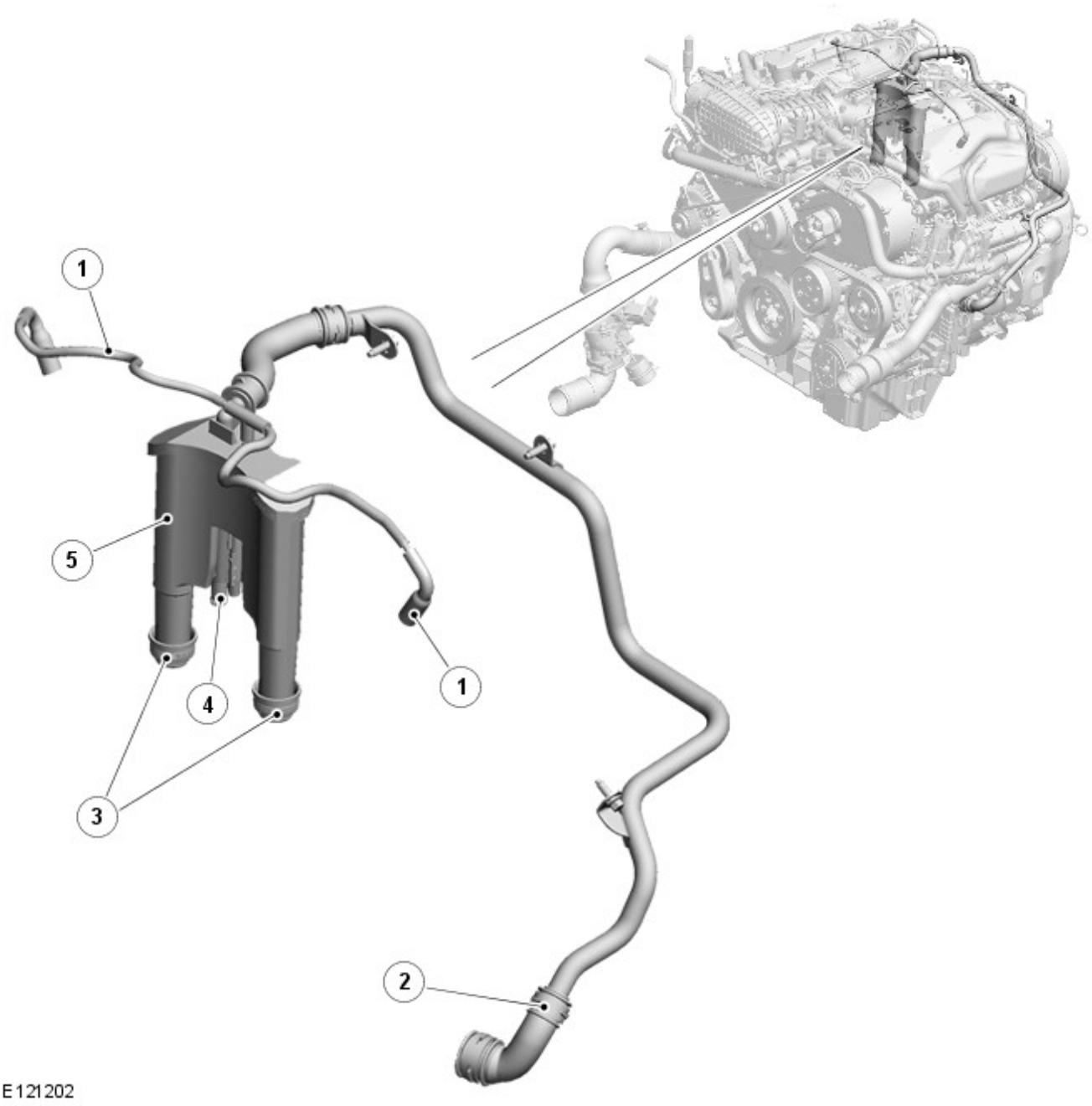
EGR (exhaust gas recirculation) Component Location



E121201

Item	Description
1	EGR valve motor
2	EGR outlet pipe
3	By-pass valve vacuum actuator
4	Vacuum pump
5	Solenoid valve
6	Vacuum pipe (2 off)
7	EGR cooler
8	EGR inlet pipe from exhaust manifold
9	Throttle intake manifold

Crankcase Ventilation Component Location



E121202

Item Description

1 Cylinder ventilation scavenger hose - 2 off
2 Crankcase gas to air intake hose
3 Crankcase breather cylinder block connections
4 Oil drain to oil filter housing
5 Crankcase breather and oil separator

Published: 11-May-2011

Engine Emission Control - TDV6 3.0L Diesel - Engine Emission Control - Overview

Description and Operation

OVERVIEW

Exhaust Gas Recirculation (EGR) System

The EGR (exhaust gas recirculation) system is used to control the amount of exhaust gas being re-circulated in order to reduce exhaust emissions and combustion noise. EGR is enabled when the engine is at normal operating temperature and under cruising conditions.

Crankcase Ventilation System

The crankcase ventilation system ensures that all gasses emitted from the crankcase during engine running are separated from any oil particles and re-circulated via the clean air induction system.

Published: 11-May-2011

Engine Emission Control - TDV6 3.0L Diesel - Engine Emission Control - System Operation and Component Description

Description and Operation

System Operation

EXHAUST GAS RE-CIRCULATION (EGR) SYSTEM OPERATION

If small volumes of fuel are injected into a combustion chamber full of pure air, the effect is to create a very lean mixture. This burns at a high temperature, which in turn causes the excess oxygen in the mixture to combine with the naturally occurring nitrogen in the air to create nitrogen oxides (NOx), a noxious class of pollutants associated with acid rain. This is a particular problem for diesel engines at low to medium loads (as the engine has no throttle, the cylinder is replenished with a full charge of 'air' at every induction stroke). Exhaust gas is blended into the intake air charge to create the cylinder charge. As the exhaust gas effectively contains no oxygen, it prevents the formation of a very lean mixture, so lowering combustion temperatures and minimizing the formation of NOx.

At low engine speeds and loads, over 50 percent of the cylinder charge can be made up of recycled exhaust gas. This is routed directly from the exhaust manifold and passes through a gas-water heat exchanger before being supplied to the inlet manifold. The volume of exhaust gas added to the intake charge is regulated by an electronically controlled EGR (exhaust gas recirculation) valve, actuated according to precise engine speed and load by the engine management system.

CRANKCASE VENTILATION SYSTEM OPERATION

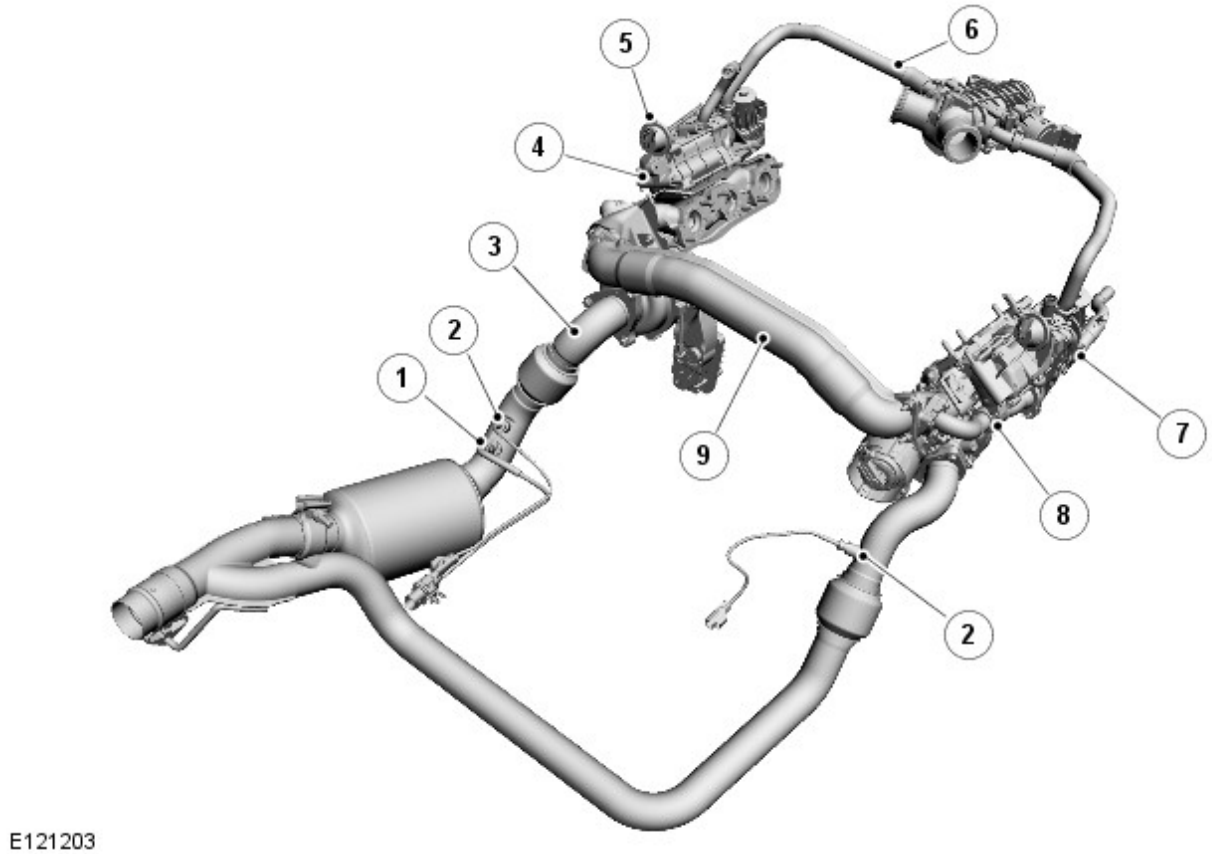
Crankcase gasses are drawn into the oil separator unit from the crankcase and the cylinder head covers (both banks) by a vacuum created by a connection into the air induction system.

The crankcase gasses are circulated around the oil separator where the gas and oil are separated. The gas is returned to the inlet side of the air induction system prior to the primary turbocharger. The collected oil is drained down to the sump via the oil cooler and filter housing on the cylinder block.

Component Description

EXHAUST GAS RE-CIRCULATION (EGR) SYSTEM

EGR System Control Components



E121203

Item	Description
1	Oxygen sensor
2	Exhaust gas temperature sensorLH (left-hand)
3	Exhaust pipe
4	EGR cooler

5 By-pass valve vacuum actuatorEGR valve motor
6 EGR outlet pipe
7 EGR cooler and valve housing
8 EGR inlet pipe
9 Exhaust system cross-over pipe

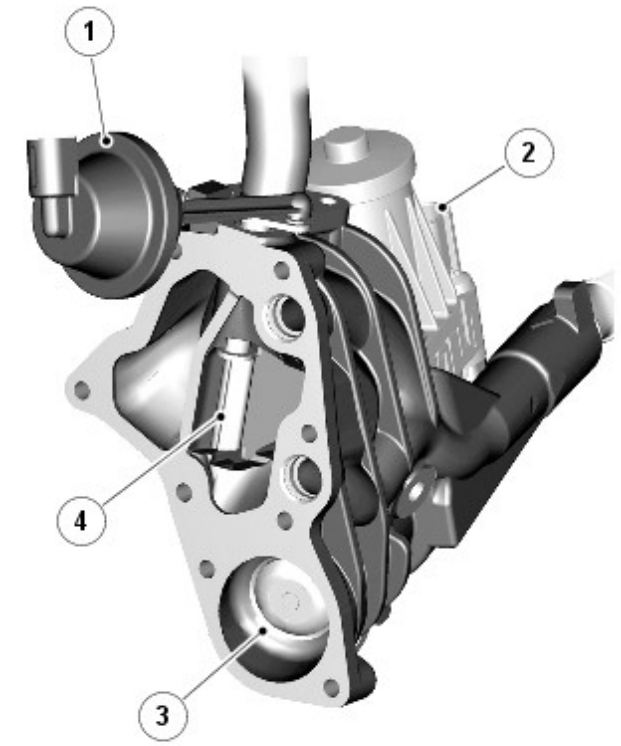
The EGR system comprises an EGR cooler and housing assembly which is bolted to the cylinder head, above the exhaust manifold. Each EGR assembly comprises an EGR cooler, a by-pass housing, a by-pass valve motor and a by-pass valve vacuum actuator.

A pipe is connected to the exhaust manifold and directs exhaust gasses into the by-pass housing. A second pipe from the by-pass housing connects to the throttle intake manifold and passes the cooled exhaust gasses into the intake manifold to mix with the clean air entering the engine from the air filter.

The EGR cooler is attached to the by-pass housing with a gasket and 5 screws. The by-pass housing has an engine coolant connection which allows coolant to flow from the engine oil cooler into the by-pass housing. Engine coolant flows from the by-pass housing into a water jacket within the cooler which in cools the exhaust gasses by heat transfer within the cooler. The engine coolant flows from the cooler through an outlet pipe and is passed back into the cooling system via the heater core.

The by-pass housing contains the EGR valve motor, the EGR valve and the by-pass valve.

By-pass Housing Components



E107585

Item Description

1 By-pass valve vacuum actuator
2 EGR valve motor
3 EGR valve
4 By-pass valve

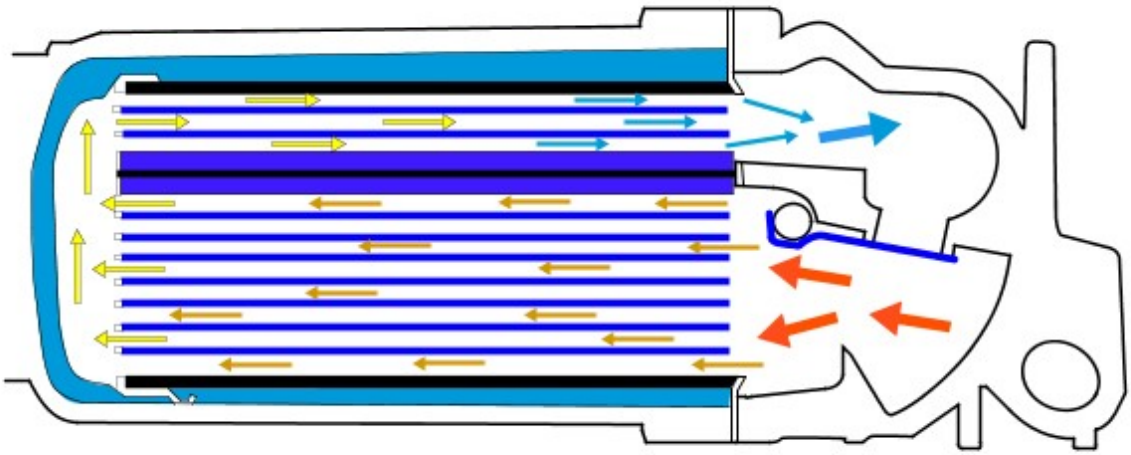
By-Pass Valve

The by-pass valve is a vacuum operated valve which directs the flow of exhaust gasses either through the EGR cooler or by-passes the cooler and directs the gasses directly to the intake manifold.

A vacuum actuator is located on a bracket attached to each EGR cooler. The actuator receives a vacuum which is produced by the vacuum pump located at the rear of the engine. The vacuum actuator is connected to the by-pass valve within the by-pass housing by a connecting rod.

The vacuum supply to the actuator is controlled by the ECM (engine control module). When by-pass control is required, the ECM energizes a vacuum solenoid valve which applies vacuum to the vacuum actuators. The vacuum causes the actuators to move the connecting rods in a linear direction. The linear movement of the rod is transferred to rotary movement of the by-pass valve within the by-pass housing.

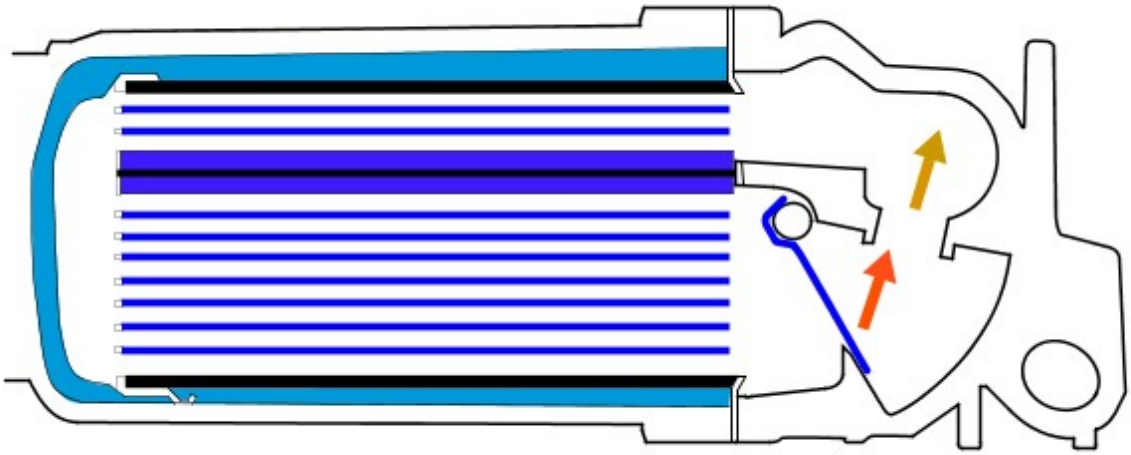
By-Pass Valve Closed



E112407

When the by-pass valve is closed, exhaust gasses are directed through the cooler before being passed to the intake manifold.

By-Pass Valve Open



E112408

When the by-pass valve is open, exhaust gasses are passed directly through the by-pass housing into the intake manifold with no cooling applied to the gasses.

EGR Valve

The EGR valve motor is located on the by-pass housing. A 5 pin connector provides the power, ground and ECM signal and feedback connections for the motor.

The motor is secured to the by-pass housing with 4 torx screws. A pinion gear on the motor spindle drives a geared rack which is connected to the EGR valve in the by-pass housing.

The motor is controlled by the ECM which provides power supply to operate the motor as required. A 5 Volt feedback signal is passed to the ECM which is used to establish motor position for precise control.

CRANKCASE VENTILATION

The crankcase ventilation system comprises an oil breather and separator. The breather receives crankcase directly from the crankcase and also from the cylinder heads.

The breather is connected to the top of the cylinder block with two seals. Two scavenge pipes located on the top of the breather are connected to the cylinder head covers. A breather pipe is connected from the top of the breather to the clean air intake hose at a point prior to the primary turbocharger.

Clean air being drawn into the engine when it is running creates a vacuum in the breather pipe. This vacuum in turn creates a vacuum in the oil breather and separator which draws gasses from the crankcase and cylinder heads into the breather. These gasses are circulated around the breather, allowing oil particles to be separated from the gas. The gasses are drawn into the breather pipe and are mixed with the clean air being drawn into the turbocharger.

The oil particles separated from the gasses accumulate in the oil separator and drain through a third connection at the bottom of the oil breather and separator, through a connection on the oil cooler housing to the oil pan.

Published: 16-Aug-2012

Engine Emission Control - TDV6 3.0L Diesel - Engine Emission Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine emission control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-08A Engine Emission Control - TDV6 3.0L Diesel)

Engine Emission Control (Description and Operation),
Engine Emission Control (Description and Operation),
Engine Emission Control (Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Engine breather system • Oil separator • Exhaust Gas Recirculation (EGR) pipes/hoses (check for cracks) • Exhaust Gas Recirculation (EGR) valve(s) • Exhaust Gas Recirculation (EGR) cooler(s) • Vacuum system	• Fuse(s) • Wiring harness • Loose or corroded electrical connector(s) • Intake air shut off throttle • Exhaust Gas Recirculation (EGR) valve(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, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Difficult to start Poor/erratic idle Lack of power when accelerating	• Exhaust Gas Recirculation (EGR) valve stuck open	• Check the Exhaust Gas Recirculation (EGR) valve
Engine stops/stalls	• Exhaust Gas Recirculation (EGR) valve stuck open • Breather system disconnected/restricted/blocked	• Check the Exhaust Gas Recirculation (EGR) valve • Check the engine breather system • Check the oil separator • Check for Exhaust Gas Recirculation (EGR) DTCs
Excessive fuel consumption Excessive black smoke Excessive emissions	• Exhaust Gas Recirculation (EGR) valve stuck open • Exhaust Gas Recirculation (EGR) not operating • Breather system restricted/blocked	
Excessive blow-by	• Breather system restricted/blocked	• Check the engine breather hoses • Check the oil separator
Engine oil leaks	• Breather system restricted/blocked	• Check the engine breather hoses • Check the oil separator

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

Engine Emission Control - TDV6 3.0L Diesel - Crankcase Vent Oil Separator

Removal and Installation

Removal

NOTES:

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

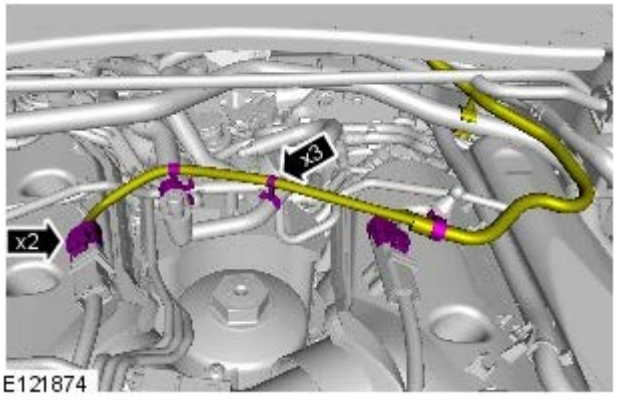
Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

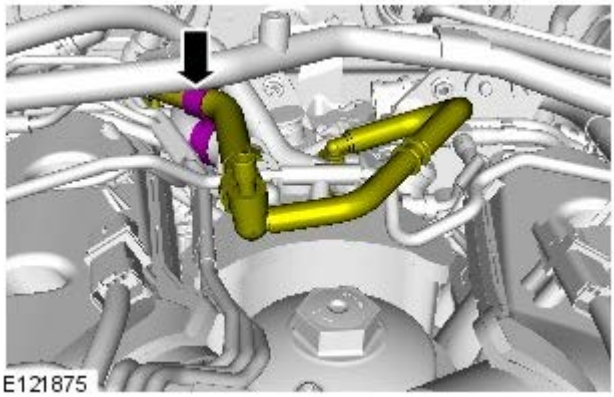
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).

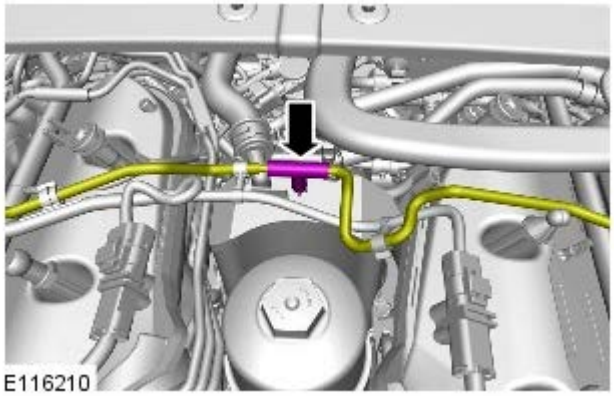
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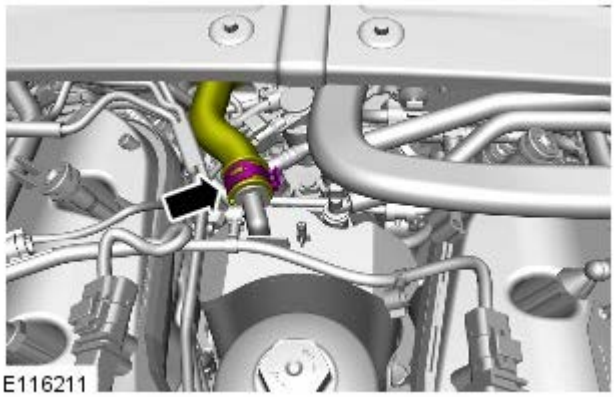
4.

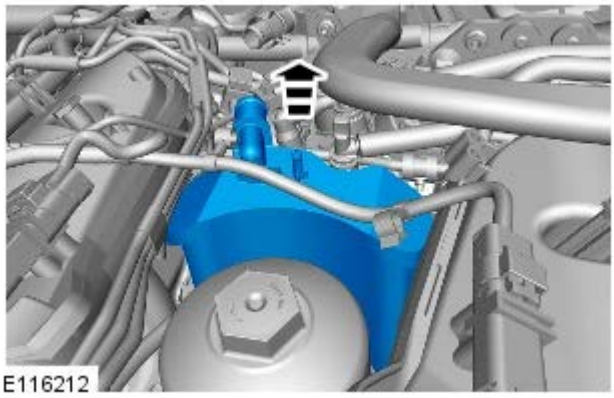


5.



6.





7. CAUTIONS:

   Make sure that all openings are sealed.

   Lubricate the O-ring seals with clean engine oil.

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Engine Emission Control - TDV6 3.0L Diesel - Exhaust Gas Recirculation (EGR) Valve LH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

All vehicles

1. Disconnect the battery ground cable.

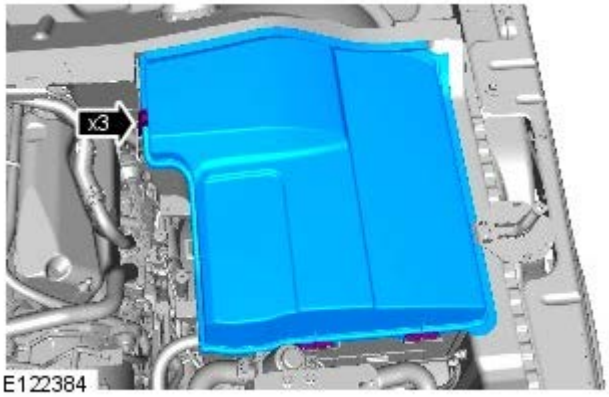
   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

2. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

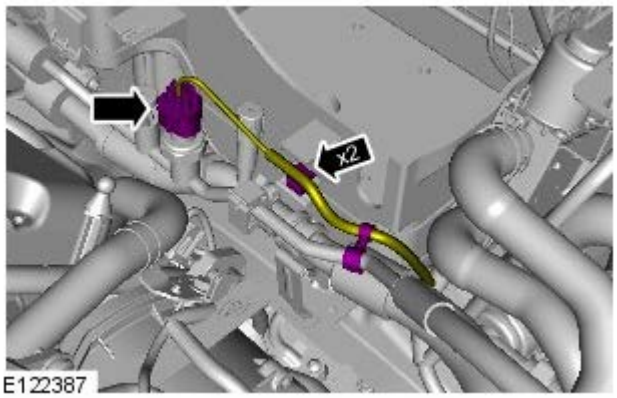
3. Refer to: Cooling System Draining, Filling and Bleeding (303-03 Engine Cooling - 3.0L V6 - TdV6, General Procedures).

4. Refer to: Engine Cover - 3.0L V6 - TdV6 (501-05 Interior Trim and Ornamentation, Removal and Installation).

5.

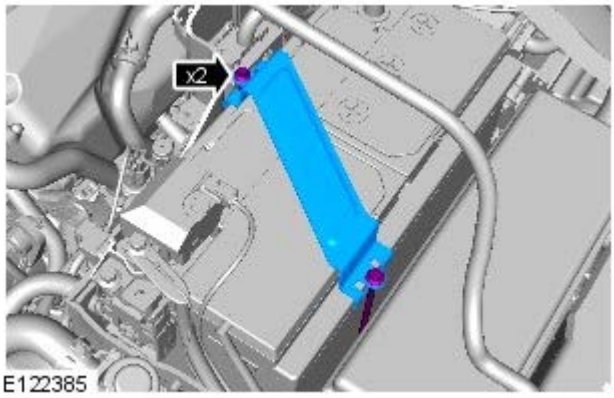


6.

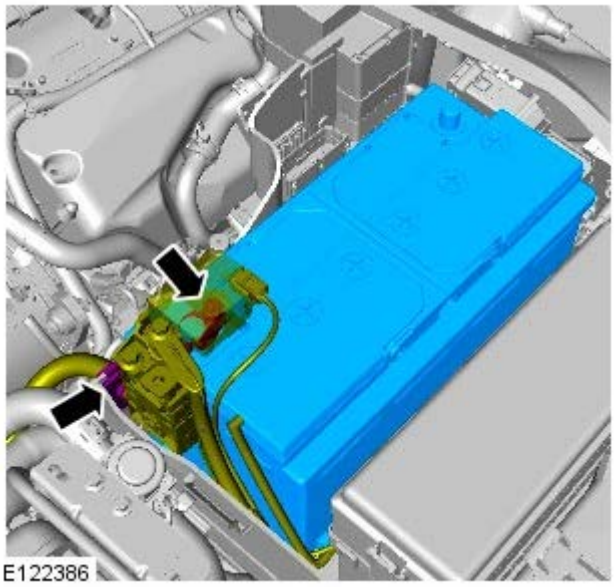


Right-hand drive vehicles

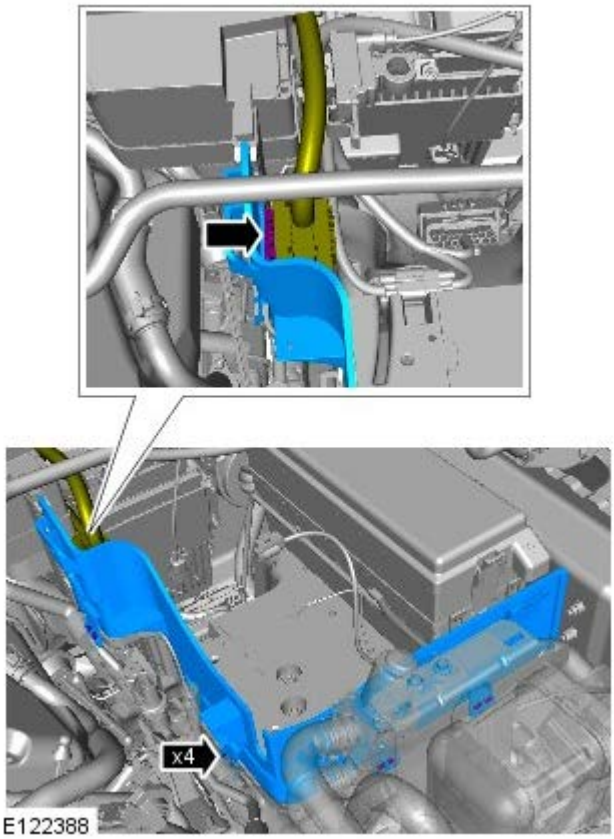
7. *Torque:* 10 Nm



8. *Torque:* 10 Nm

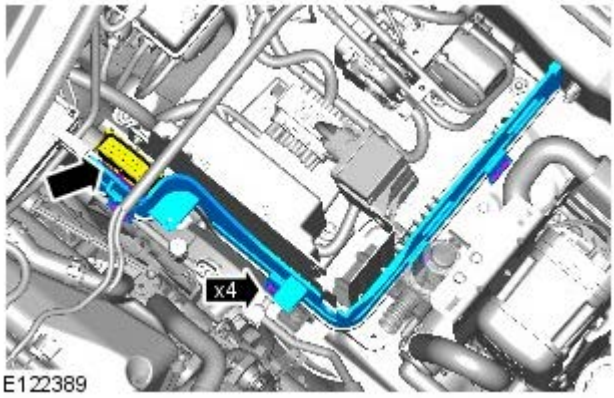


9.

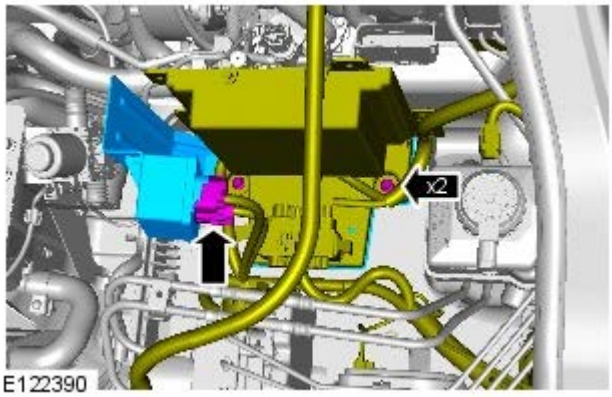


Left-hand drive vehicles

10.

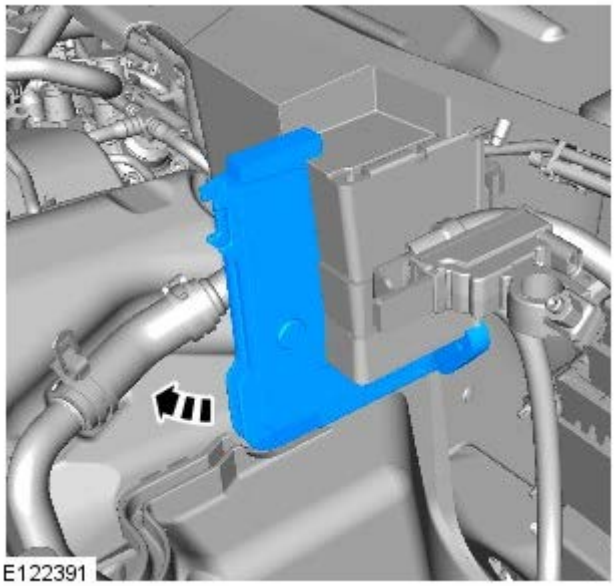


11.

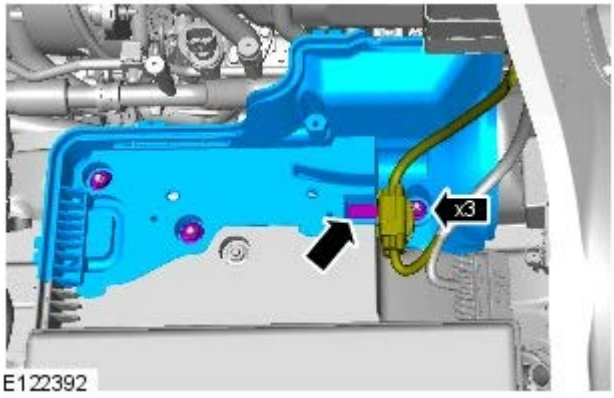


All vehicles

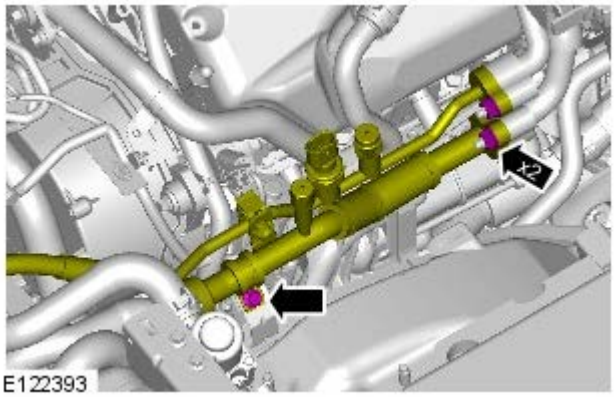
12.



13. *Torque:* 12 Nm



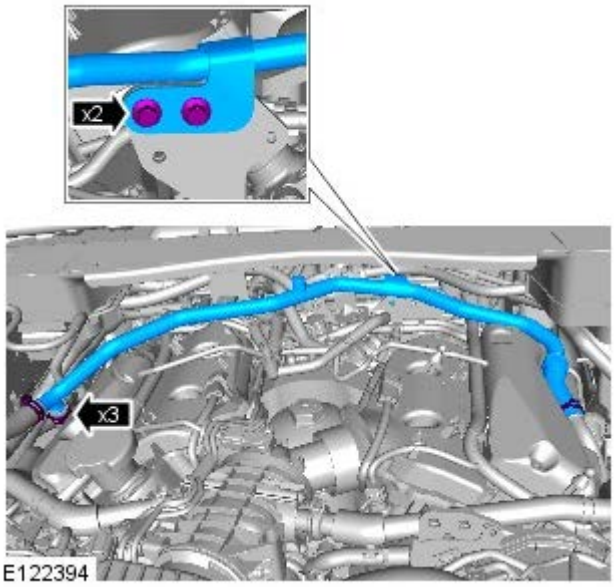
14. CAUTION: Make sure that all openings are



sealed. Use new blanking caps.

NOTE: Install new O-ring seals.

Torque: 10 Nm

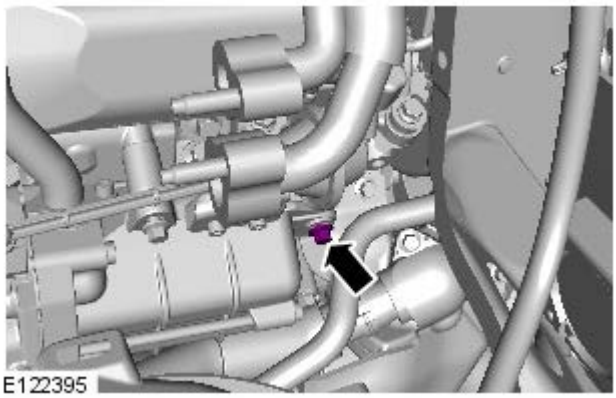


15. CAUTION: Make sure that all openings are sealed.

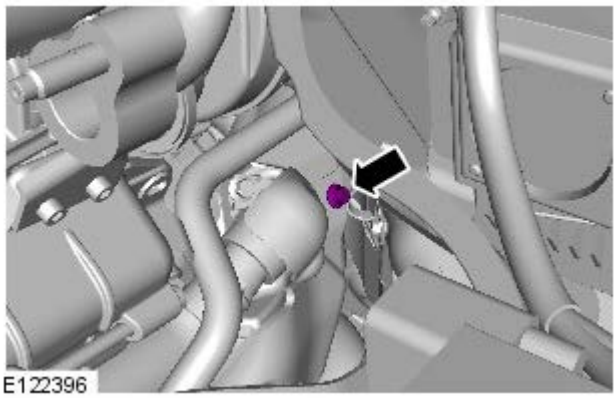
    Torque: 10 Nm

16. Refer to: Exhaust Gas Recirculation (EGR) Valve Outlet Tube LH (303-08 Engine Emission Control - 3.0L V6 - TdV6, Removal and Installation).

17. *Torque:* 10 Nm



18. *Torque:* 9 Nm

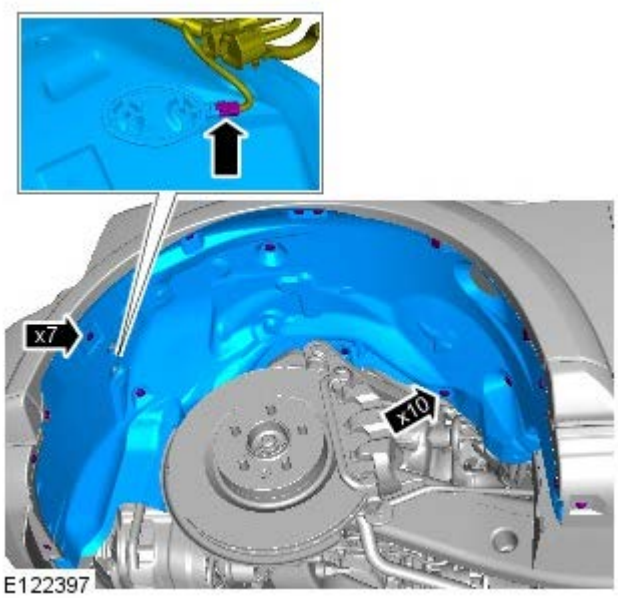


19. WARNING: Make sure to support the vehicle with axle stands.

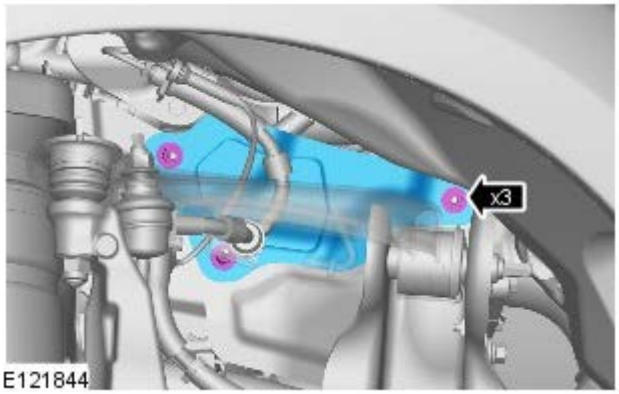
    Raise and support the vehicle.

20. Remove the LH front wheel and tire.

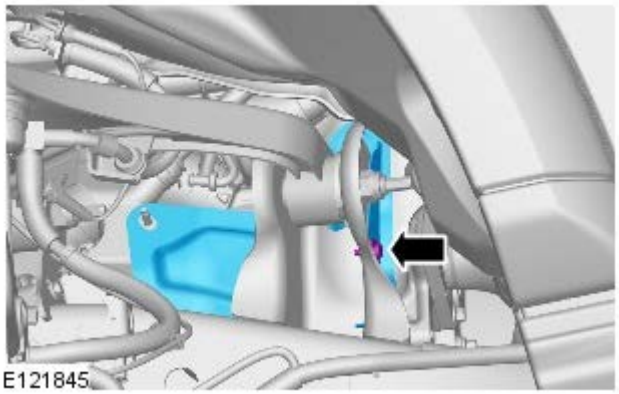
21.



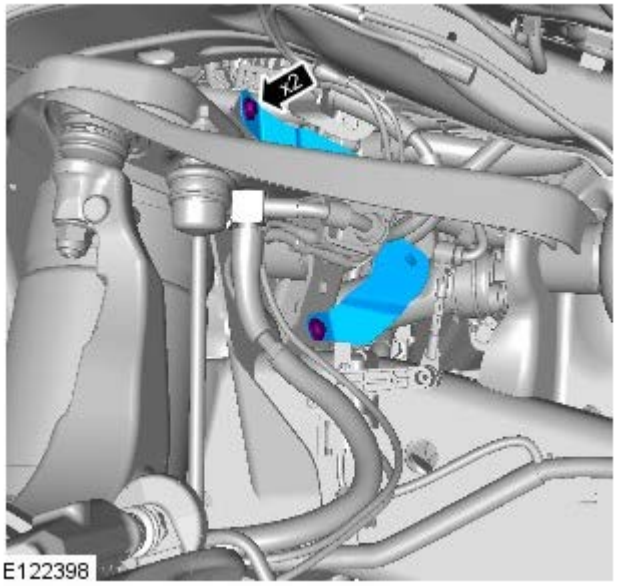
22. *Torque:* 9 Nm



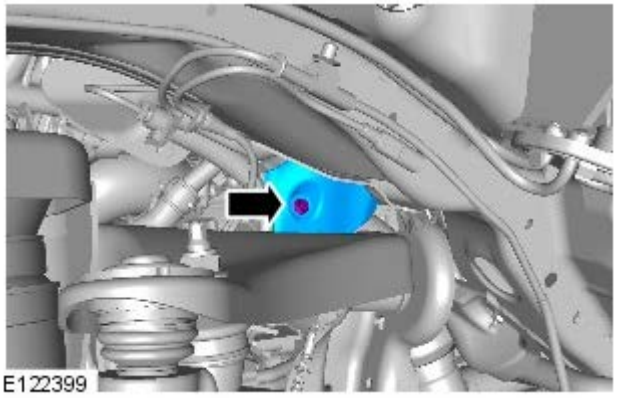
23. *Torque:* 9 Nm



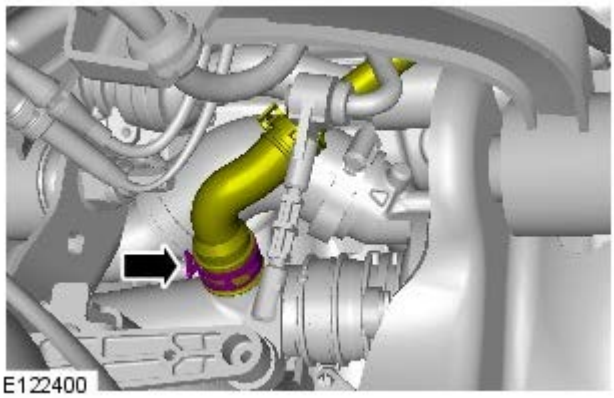
24. *Torque:* 9 Nm



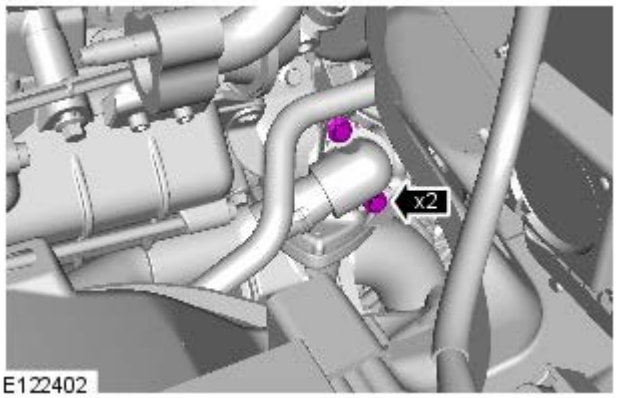
25. *Torque:* 9 Nm



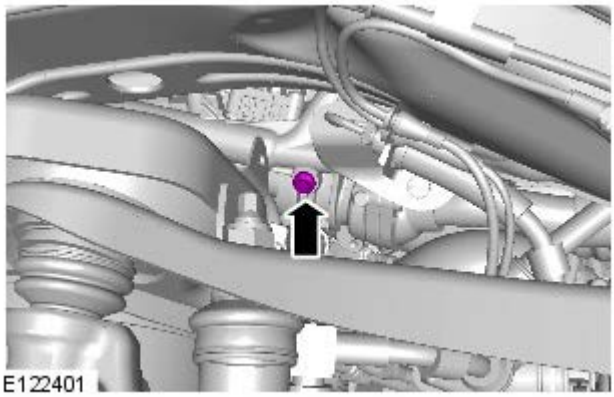
26. CAUTION: Make sure that all openings are sealed.

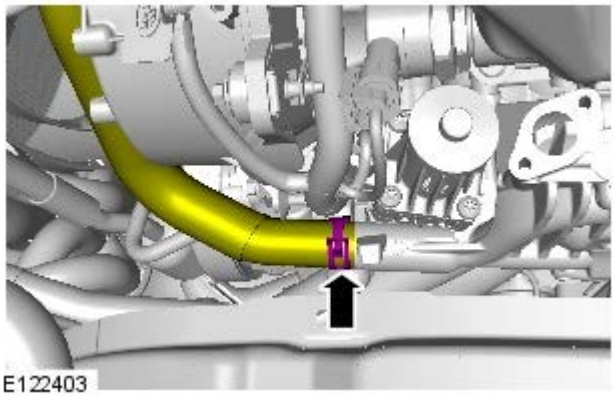


27. *Torque:* 10 Nm



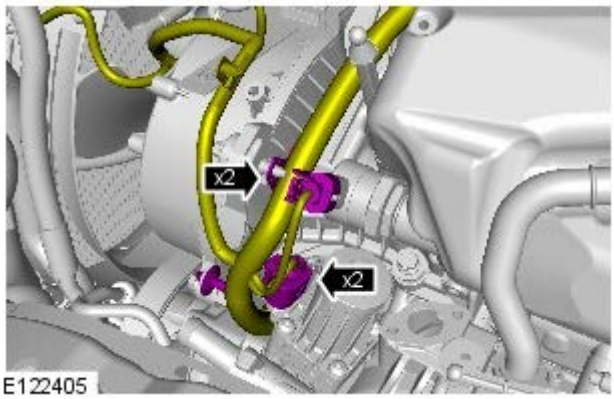
28. *Torque:* 10 Nm

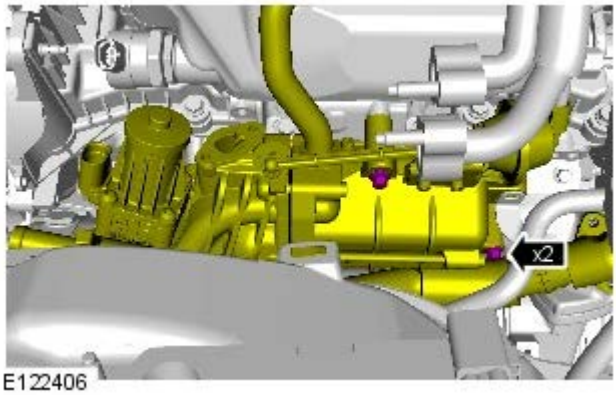




29. CAUTION: Make sure that all openings are sealed.

30.





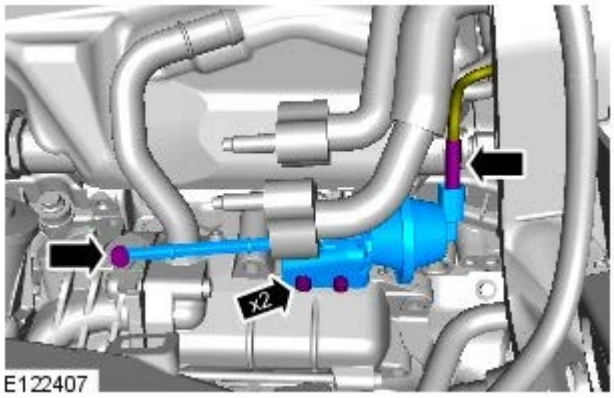
31. CAUTION: Make sure that all openings are sealed.

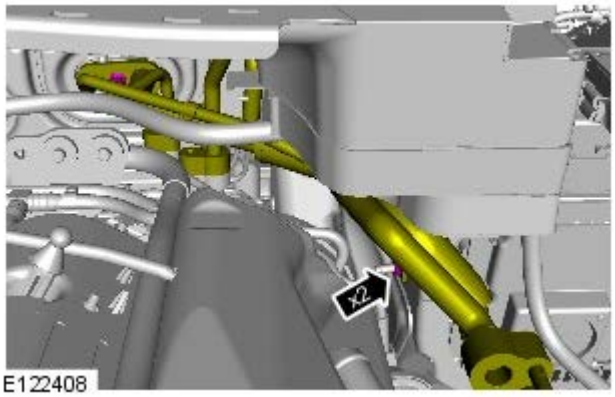
Torque: 10 Nm

32. CAUTION: Take extra care not to damage the component.

NOTE: An audible click is heard when the ball joint is fully latched.

Torque: 8 Nm





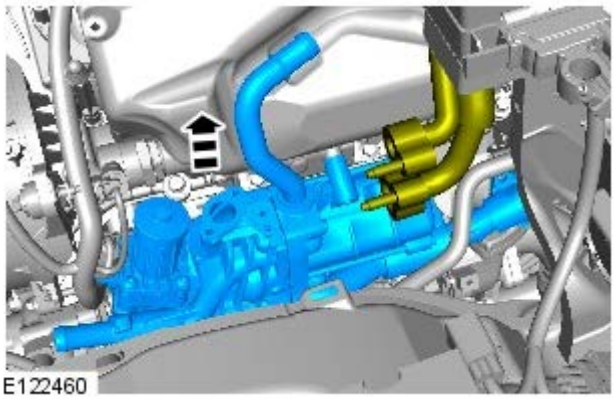
33. CAUTIONS:

    Install new o-ring seals

    Make sure that all openings are sealed. Use new blanking caps.

    Torque: 6 Nm

34.



Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 11-May-2011

Engine Emission Control - TDV6 3.0L Diesel - Exhaust Gas Recirculation (EGR) Valve RH

Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

All vehicles

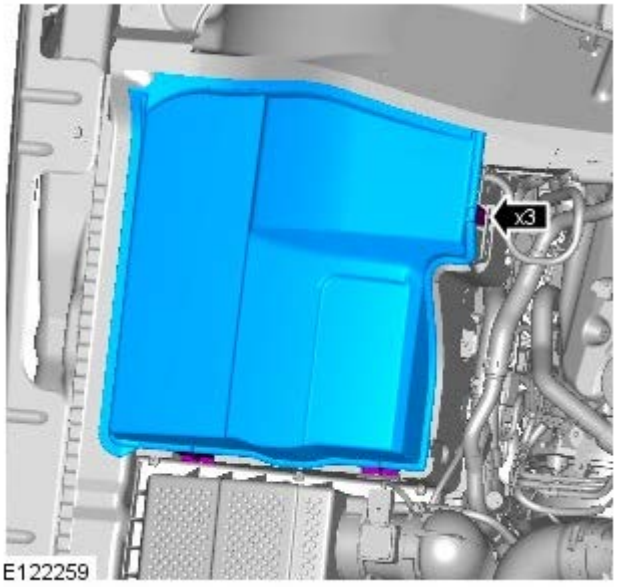
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

2. Refer to: Cooling System Draining, Filling and Bleeding (303-03 Engine Cooling - 3.0L V6 - TdV6, General Procedures).

3. Refer to: Engine Cover - 3.0L V6 - TdV6 (501-05 Interior Trim and Ornamentation, Removal and Installation).

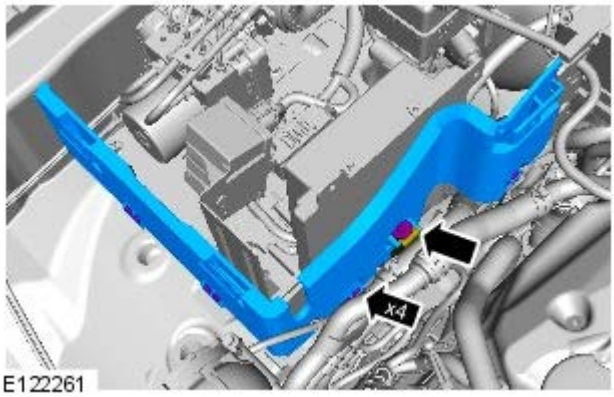
4.



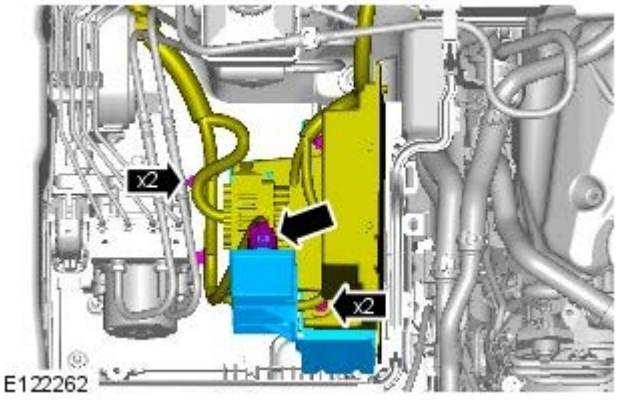
5. Refer to: Air Cleaner (303-12 Intake Air Distribution and Filtering - 3.0L V6 - TdV6, Removal and Installation).

Right-hand drive vehicles

6.

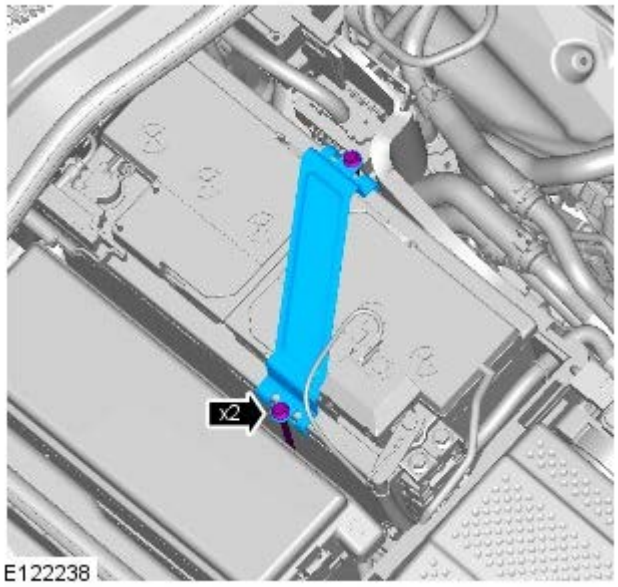


7. *Torque:* 10 Nm

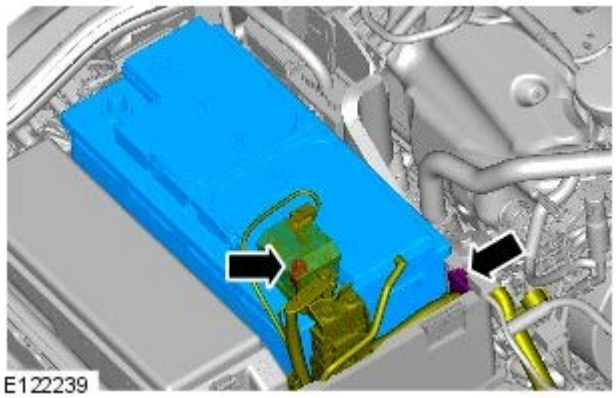


Left-hand drive vehicles

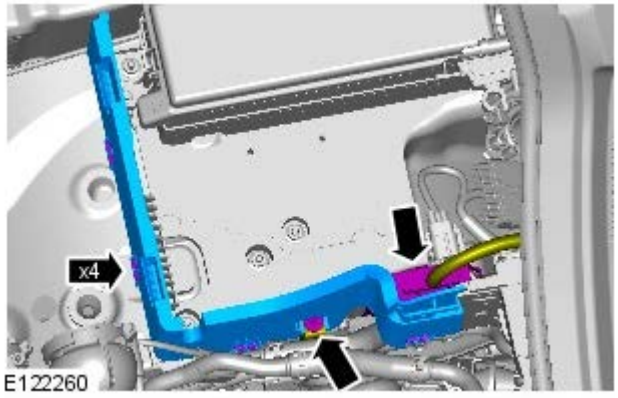
8. *Torque:* 10 Nm



9. *Torque:* 10 Nm

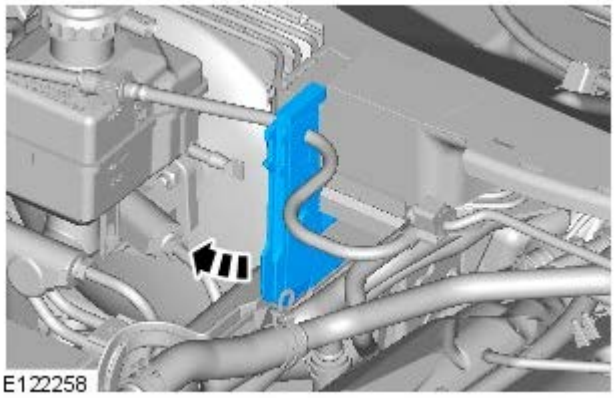


10.

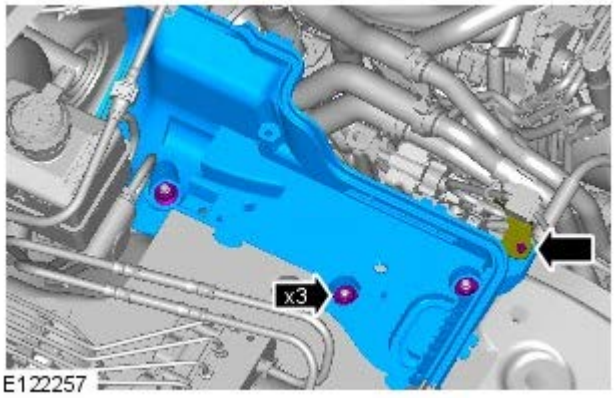


All vehicles

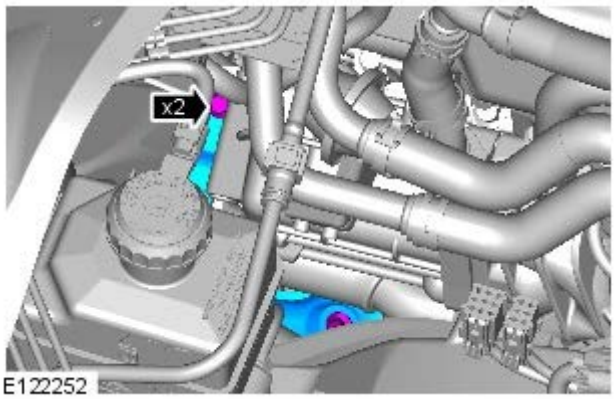
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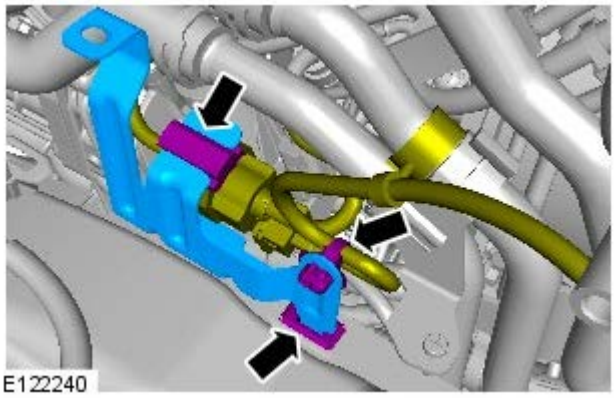
12. *Torque:* 12 Nm



13. *Torque:* 9 Nm



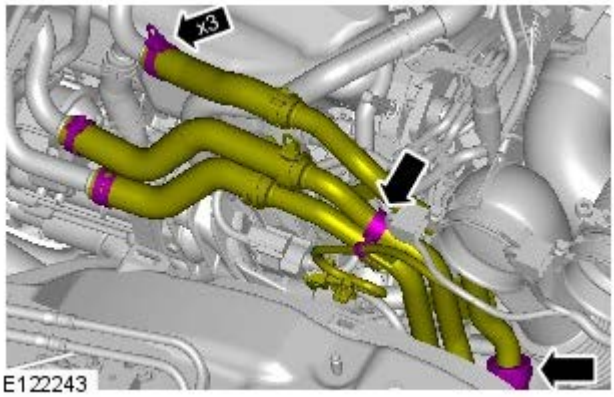
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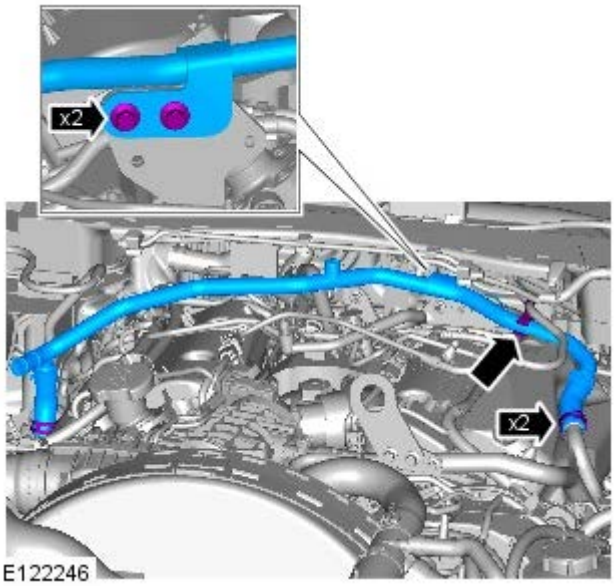


15. CAUTIONS:

Be prepared to collect escaping fluids.

Make sure that all openings are sealed.





16. CAUTION: Make sure that all openings are sealed.

    Torque: 10 Nm

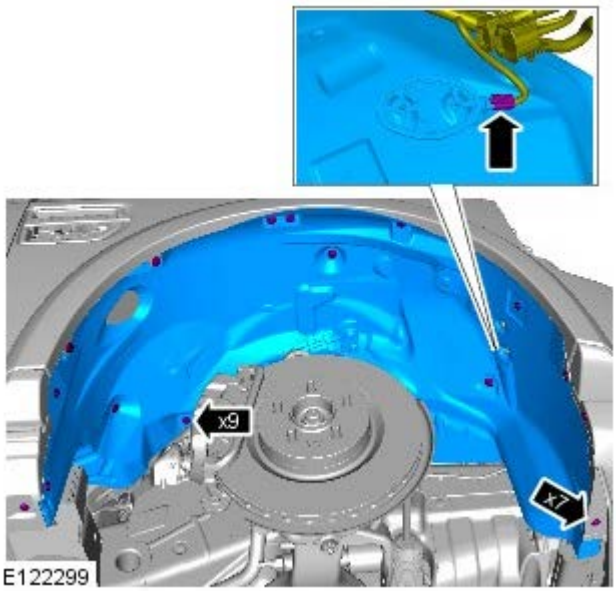
17. Refer to: Exhaust Gas Recirculation (EGR) Valve Outlet Tube RH (303-08 Engine Emission Control - 3.0L V6 - TdV6, Removal and Installation).

18. WARNING: Make sure to support the vehicle with axle stands.

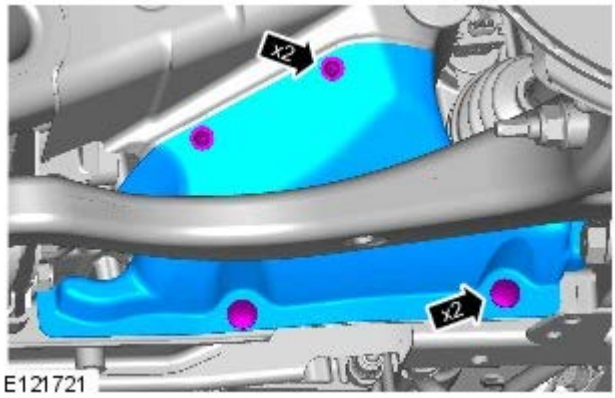
    Raise and support the vehicle.

19. Remove the RH front wheel and tire.

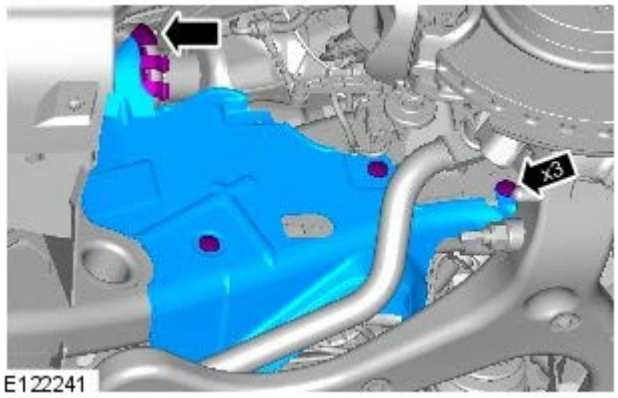
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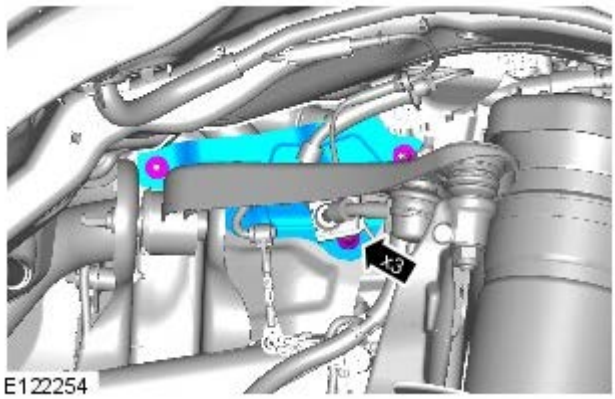
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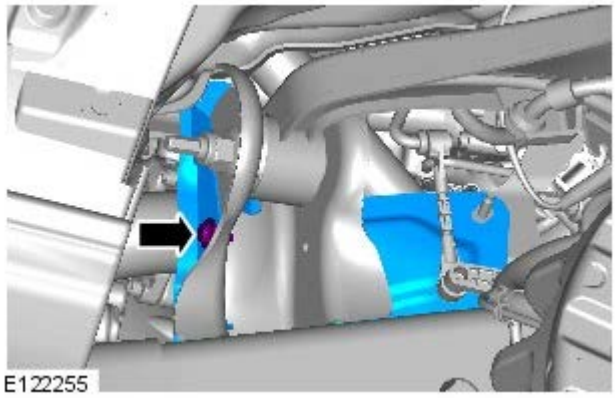
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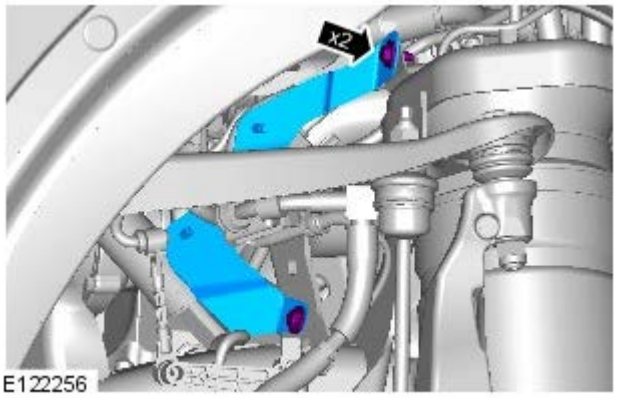
23. *Torque:* 9 Nm



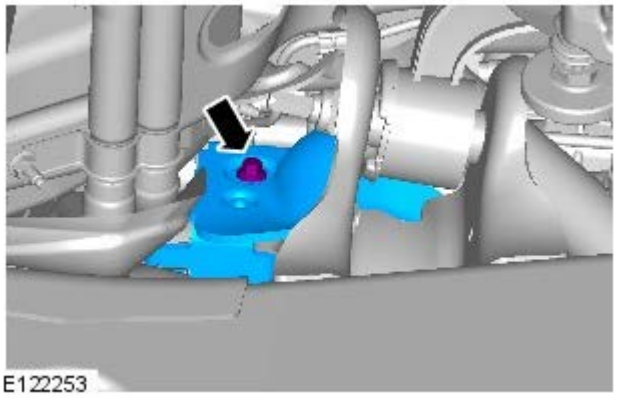
24. *Torque:* 9 Nm



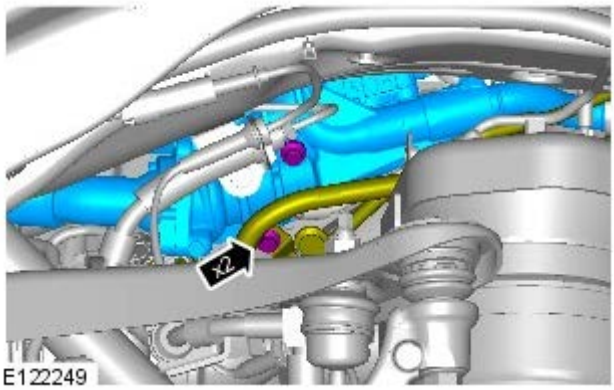
25. *Torque:* 9 Nm



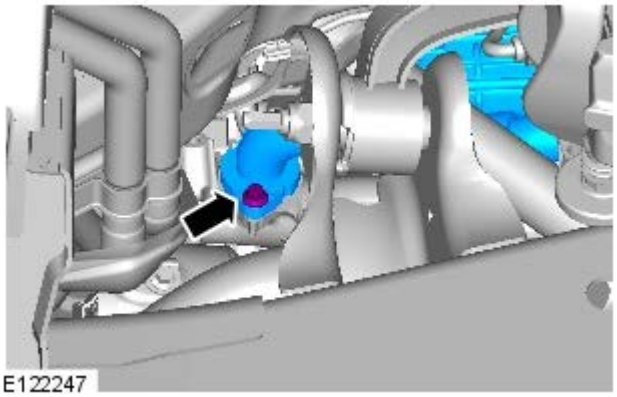
26. *Torque:* 9 Nm



27. *Torque:* 10 Nm



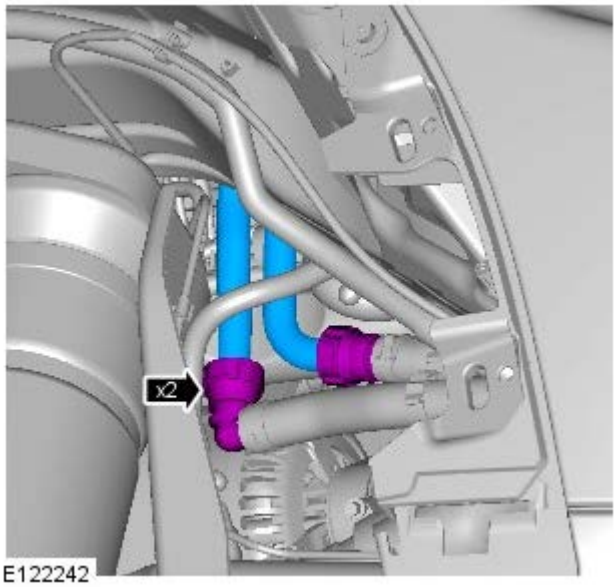
28. *Torque:* 10 Nm



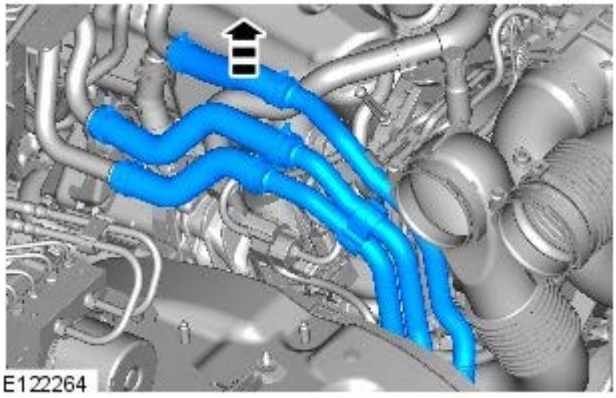
29. CAUTIONS:

Be prepared to collect escaping fluids.

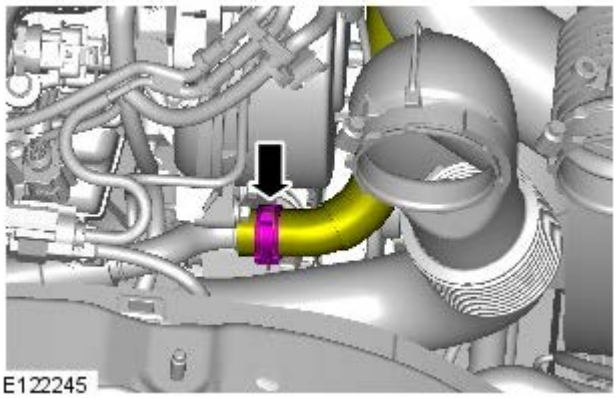
Make sure that all openings are sealed.



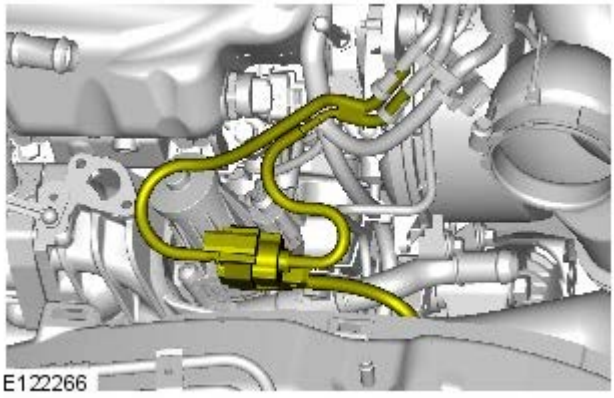
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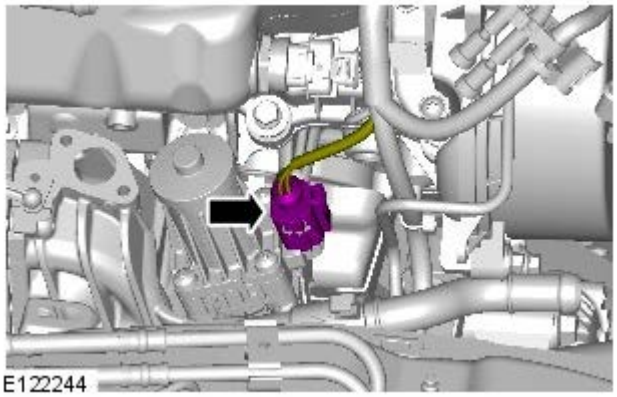
31. CAUTION: Make sure that all openings are sealed.



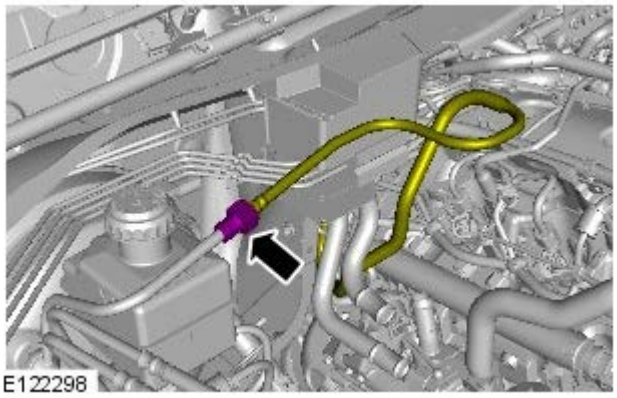
32.



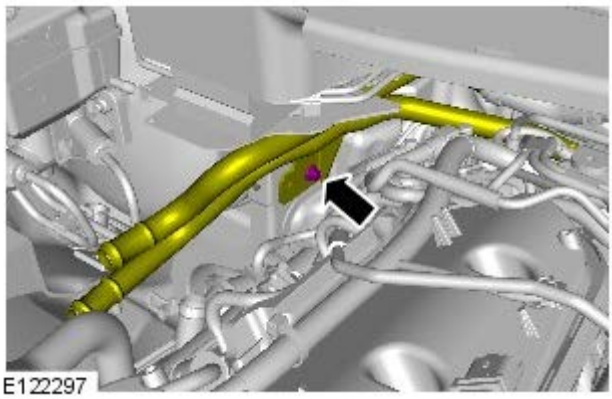
33.


E122244

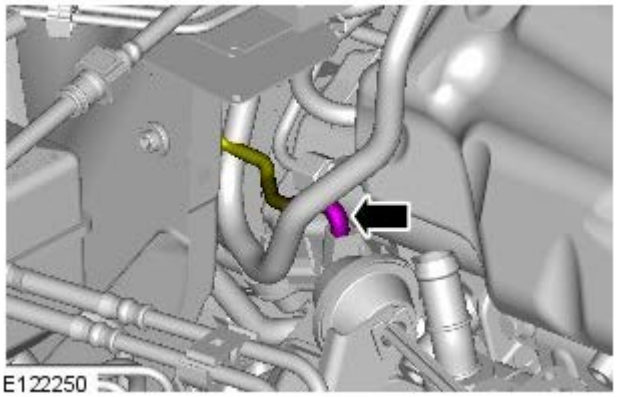
34. CAUTION: Make sure that all openings are sealed.


E122298

35. *Torque:* 10 Nm


E122297

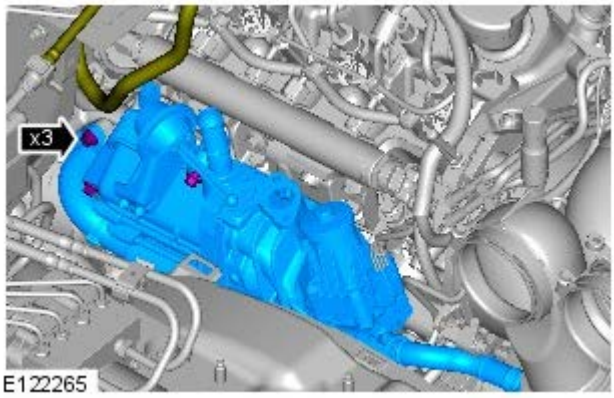
36.


E122250

37. CAUTION: Make sure that all openings are sealed.

NOTE: Install a new gasket.

Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 11-May-2011

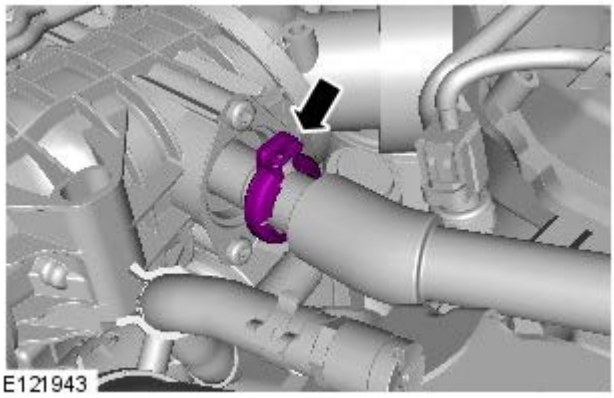
Engine Emission Control - TDV6 3.0L Diesel - Exhaust Gas Recirculation (EGR) Valve Outlet Tube LH

Removal and Installation

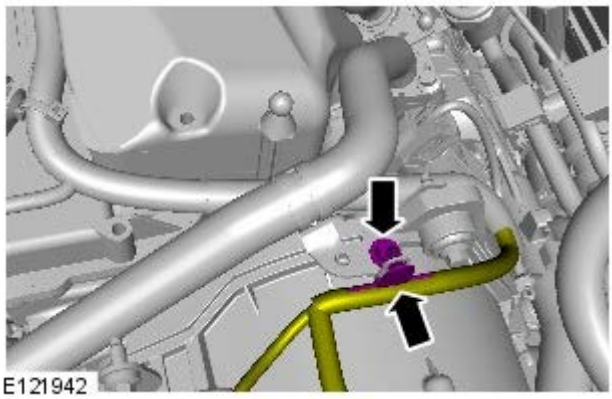
Removal

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

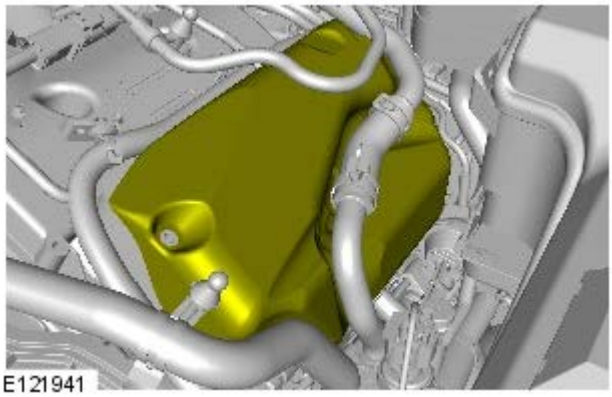
1. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).


E121943

2. NOTE: Discard the retaining clips.


E121942

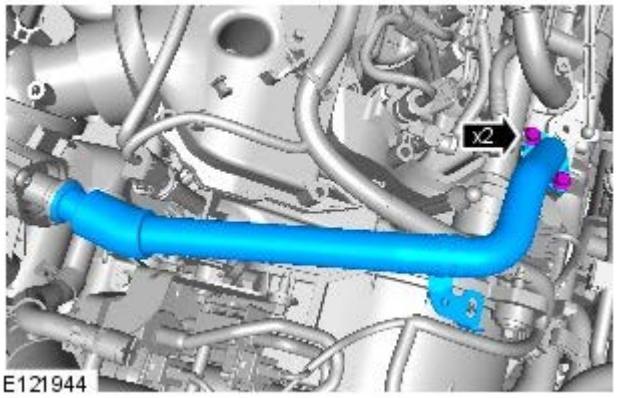
3.


E121941

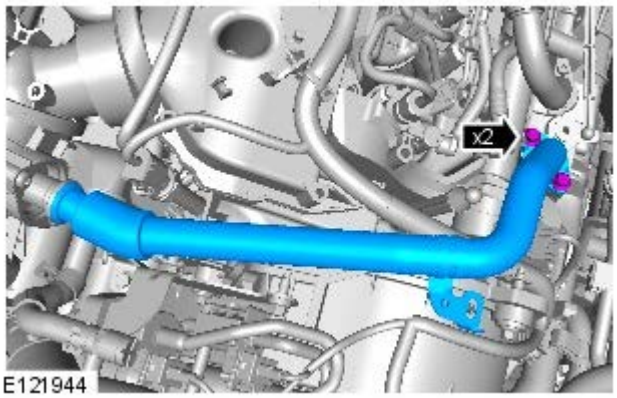
4.

5. CAUTION: Make sure that all openings are sealed.

NOTE: Discard the gasket.

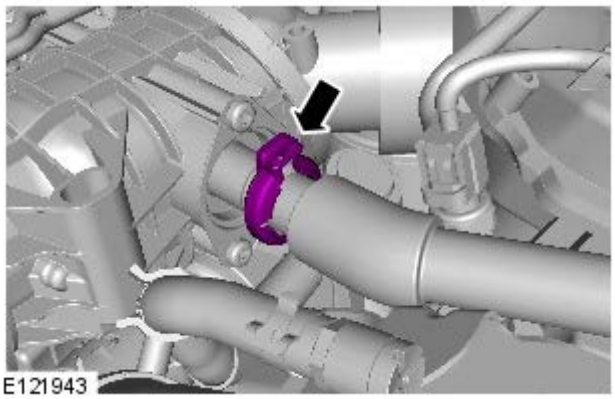


Installation



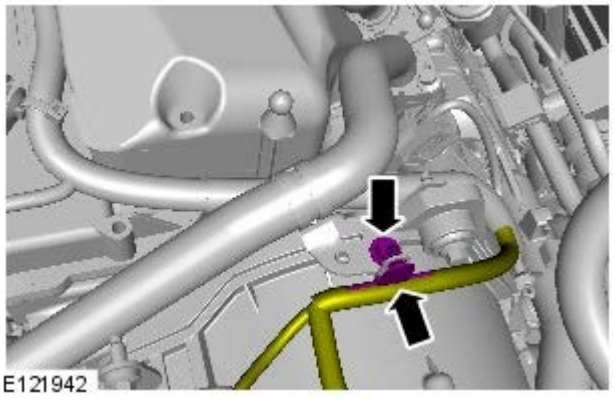
1. CAUTION: Only tighten the bolts finger-tight at this stage.

   NOTE: Install a new gasket.

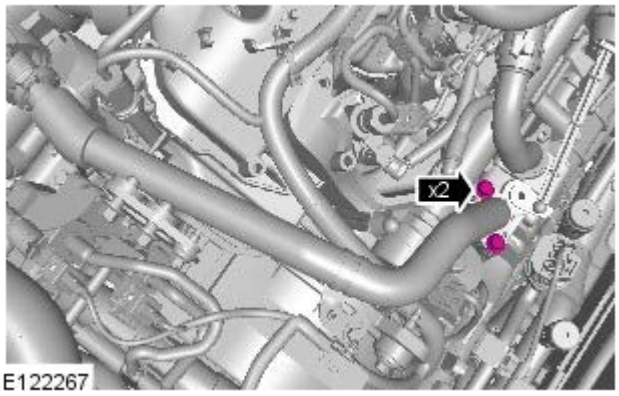


2. CAUTION: Install a new clamp. Close the clamp to the first audible click by hand. Making sure that the clamp is in a central position to the joint, close to the second audible click using a suitable tool.

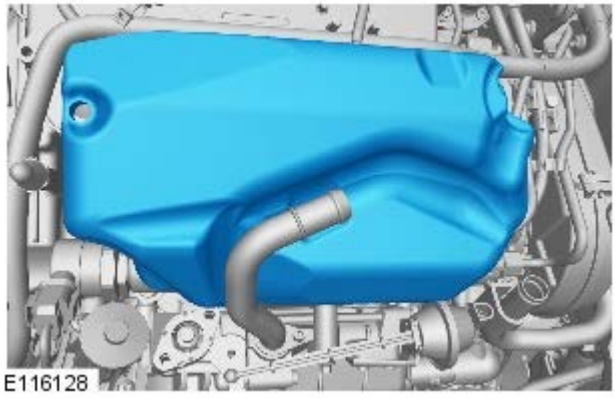
3. *Torque:* 5 Nm



4. *Torque:* 10 Nm



5.



6. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).

Published: 11-May-2011

Engine Emission Control - TDV6 3.0L Diesel - Exhaust Gas Recirculation (EGR) Valve Outlet Tube RH

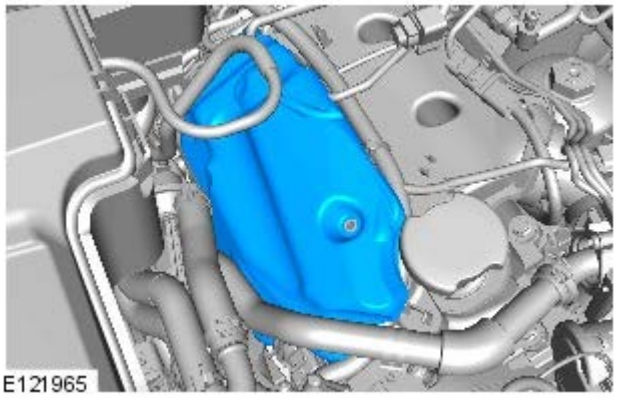
Removal and Installation

Removal

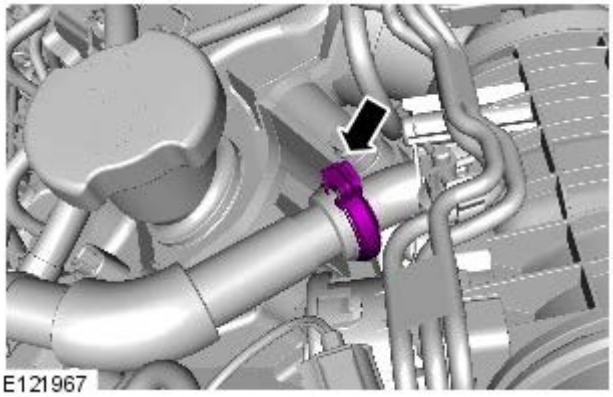
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).

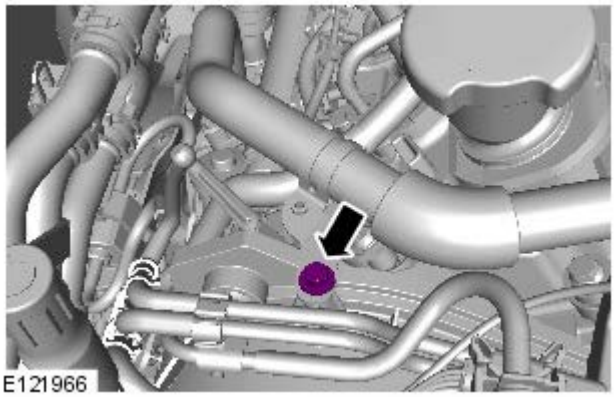
2.



3. NOTE: Discard the retaining clips.

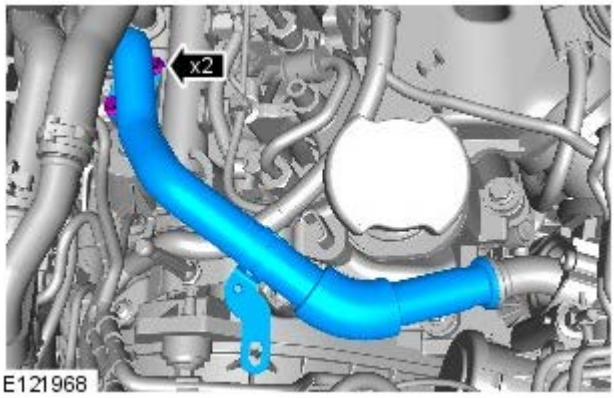


4.

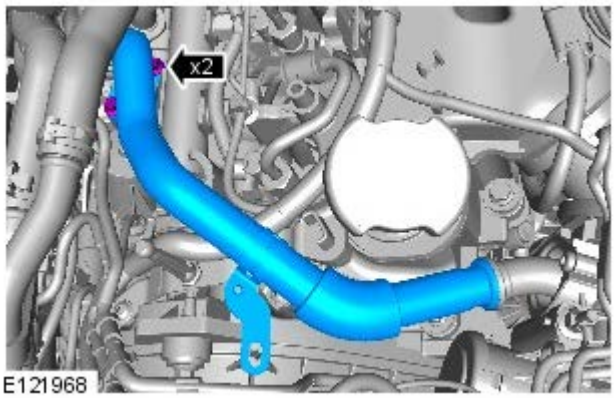


5. CAUTION: Make sure that all openings are sealed.

NOTE: Discard the gasket.

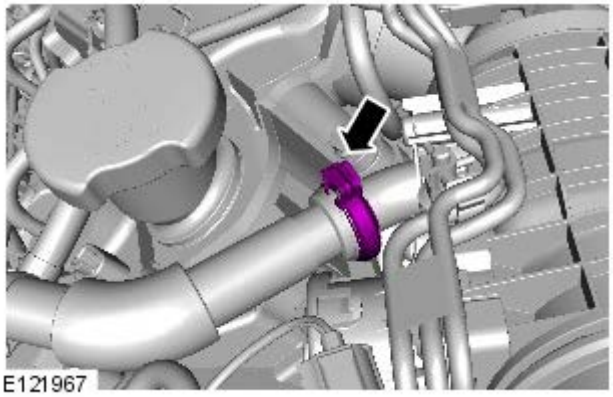


Installation



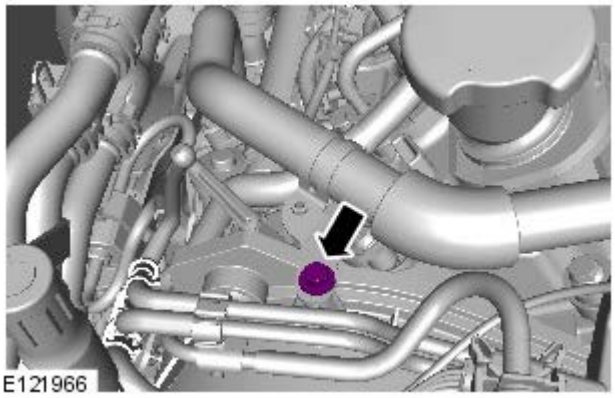
1. CAUTION: Only tighten the bolts finger-tight at this stage.

   NOTE: Install a new gasket.

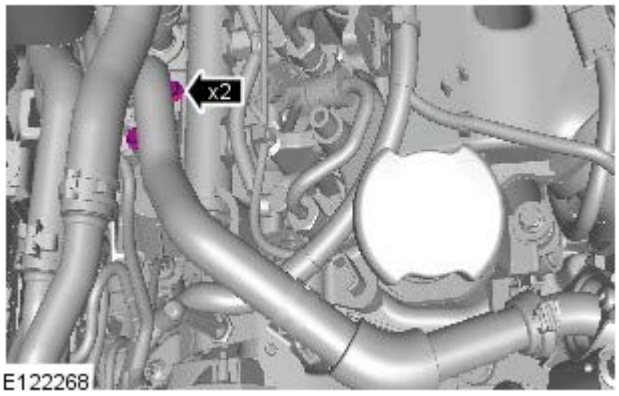


2. CAUTION: Install a new clamp. Close the clamp to the first audible click by hand. Making sure that the clamp is in a central position to the joint, close to the second audible click using a suitable tool.

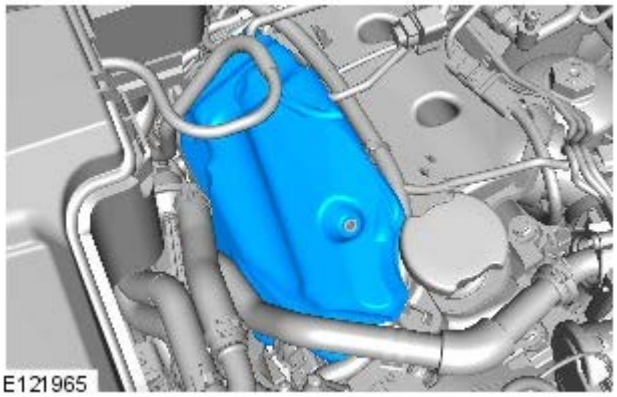
3. *Torque:* 5 Nm



4. *Torque:* 10 Nm



5.



6. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).

Published: 11-May-2011

Engine Emission Control - V8 5.0L Petrol - Engine Emission Control

Description and Operation

COMPONENT LOCATION



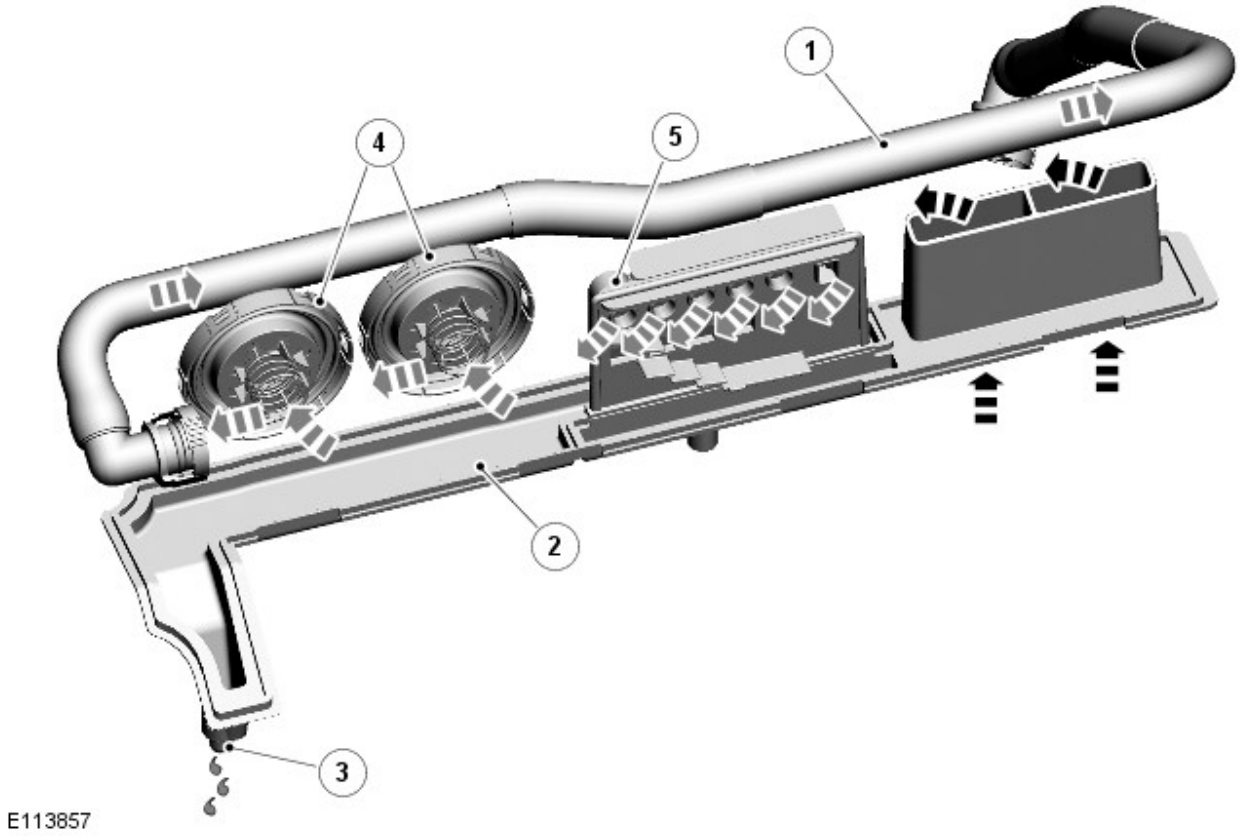
E121609

Item	Part Number	Description
1	-	Part load breather
2	-	Full load breather

INTRODUCTION

The engine emission control system reduces the level of hydrocarbon emissions released to atmosphere from the engine. The engine emission control system consists of a PCV (positive crankcase ventilation) system with part and full load breathers. Piston blow-by gases are drawn through the breathers into the engine air intake and added to the air charge. The resultant depression in the engine sump, front covers and cylinder head covers reduces the load on the joint seals in those areas.

PART LOAD BREATHER

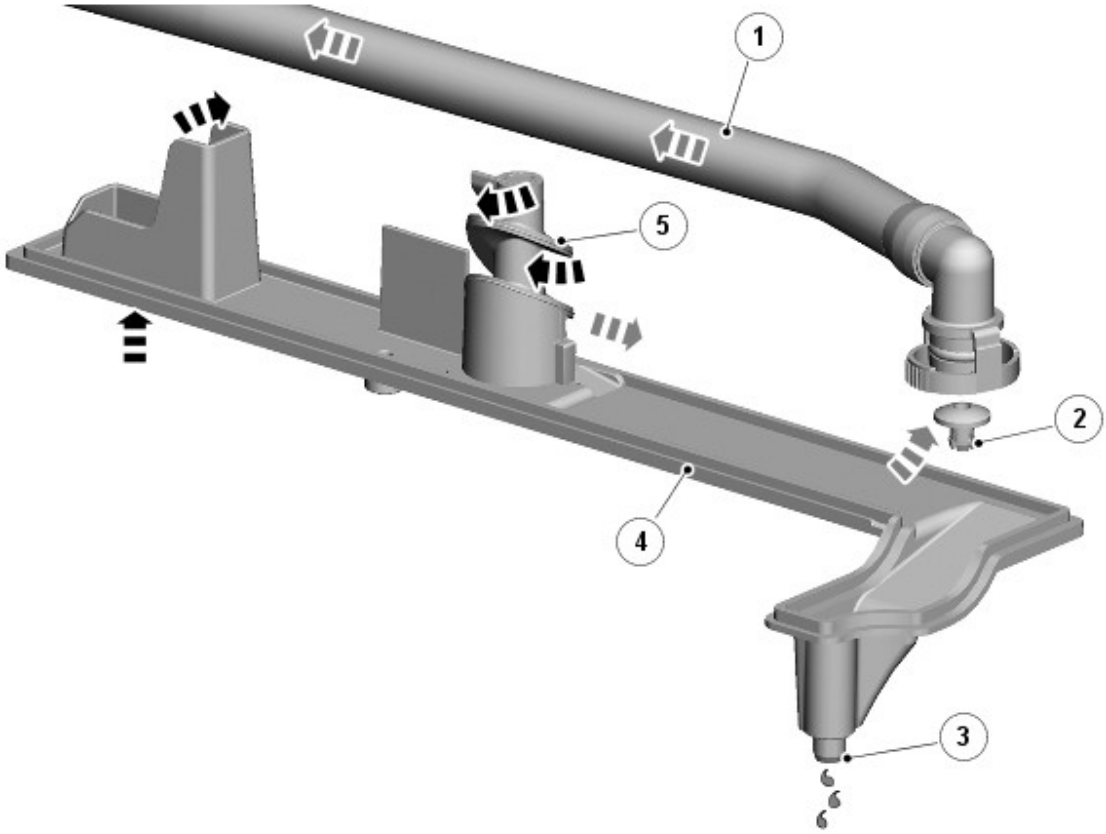


Item	Part Number	Description
1	-	Flexible hose
2	-	Baffle plate
3	-	Oil drain
4	-	PCV (positive crankcase ventilation) valve
5	-	Oil separator

The part load breather consists of an oil separator, two PCV valves and a flexible hose. The oil separator and the PCV valves are installed in the top of the RH (right-hand) cylinder head cover. The flexible hose connects the RH cylinder head cover to the inlet of the intake manifold.

The oil separator is installed in a channel in the top of the cylinder head cover. A baffle plate, which incorporates a gas inlet and an oil drain, is installed over the channel. The two PCV valves are installed on the outside of the cylinder head cover and connected in parallel in the gas outlet from the channel to the flexible hose. The PCV valves prevent reverse flow into the cylinder head cover when there is minimal depression in the intake manifold.

FULL LOAD BREATHER



E113867

Item	Part Number	Description
1	-	Flexible hose
2	-	Two-way valve
3	-	Oil drain
4	-	Baffle plate
5	-	Oil separator

The full load breather consists of an oil separator, a two-way valve and a flexible hose. The oil separator and the two-way valve are installed in the top of the LH (left-hand) cylinder head cover. The flexible hose connects the LH cylinder head cover to the LH air duct of the intake air distribution and filtering system.

The oil separator is installed in a channel in the top of the cylinder head cover. A baffle plate, which incorporates a gas inlet and an oil drain, is installed over the channel. The two-way valve is installed in the gas outlet from the channel. The two-way valve prevents reverse flow into the cylinder head cover when there is minimal depression in the air duct.

Published: 16-Aug-2012

Engine Emission Control - V8 5.0L Petrol - Engine Emission Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine emission control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Engine Emission Control (303-08B Engine Emission Control - V8 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Exhaust Gas Recirculation (EGR) system • Breather hoses • Positive Crankcase Ventilation (PCV) valve • Fuel level • Fuel contamination/grade/quality • Throttle body	• Fuses • Loose or corroded electrical connectors • Exhaust Gas Recirculation (EGR) 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 symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Difficult to start cold	• Battery • Crankshaft Position (CKP) sensor • Exhaust Gas Recirculation (EGR) valve stuck open • Fuel system • Evaporative emissions purge valve	• For battery information, CKP sensor, fuel system and purge valve tests, refer to relevant workshop manual section • Check the EGR valve
Engine stalls soon after start	• Breather system disconnected/restricted • Engine Control Module (ECM) relay • Mass Airflow (MAF) sensor • Ignition system • Air filter restricted • Air leakage • Fuel lines	• Check the engine breather hoses, PCV, etc • Check the ECM relay operation • For MAF sensor, ignition system tests, air intake and fuel line information, refer to relevant workshop manual section
Poor throttle response	• Accelerator Pedal Position (APP) sensor malfunction • Throttle Position (TP) sensors • Engine Coolant Temperature (ECT) sensor • Mass Airflow (MAF) sensor • Transmission malfunction • Traction control event • Air leakage • Breather system	• For APP, TP, ECT, MAF sensor tests, intake system checks and transmission information, refer to relevant workshop manual section • Check the breather system hoses, PCV, etc.

	disconnected/restricted	

DTC Index

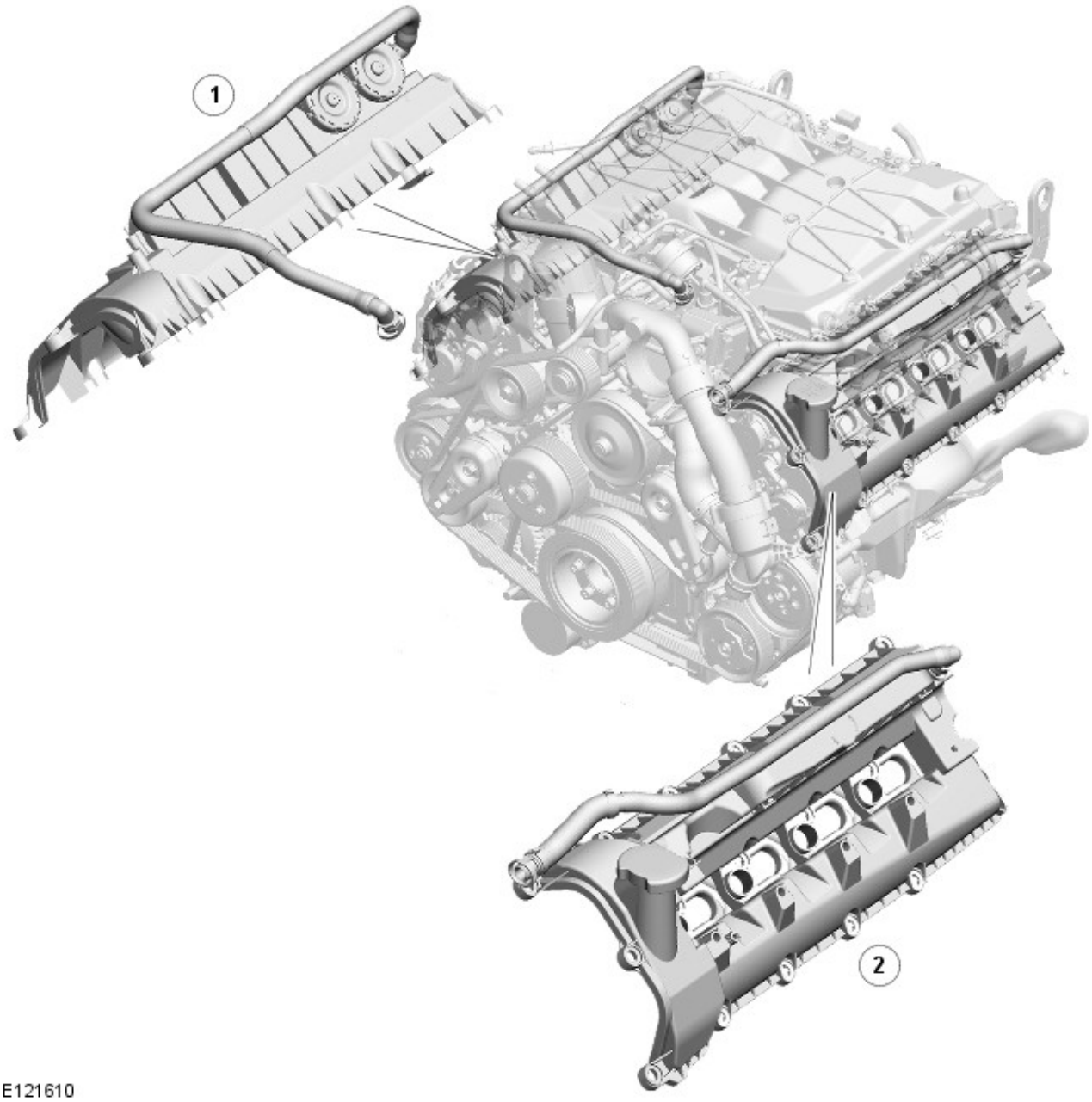
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 11-May-2011

Engine Emission Control - V8 S/C 5.0L Petrol - Engine Emission Control

Description and Operation

COMPONENT LOCATION



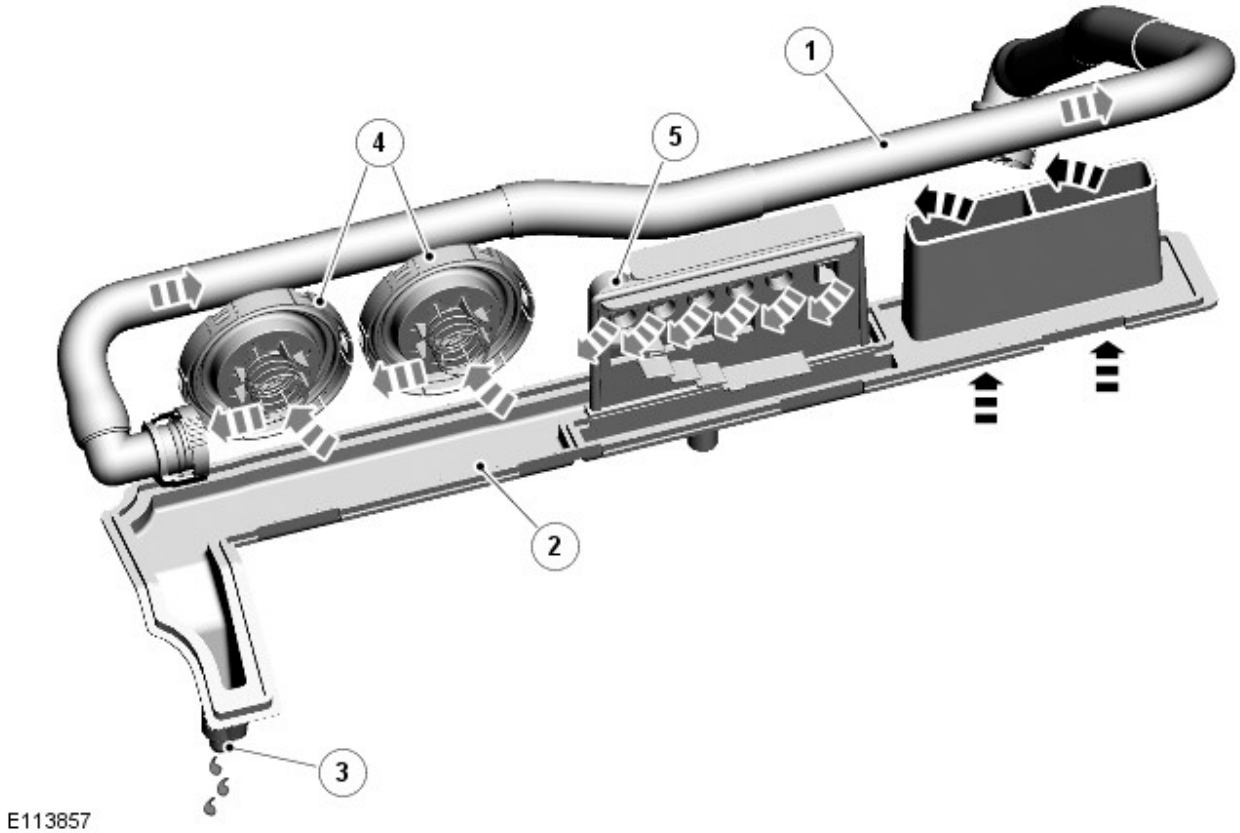
E121610

Item	Part Number	Description
1	-	Part load breather
2	-	Full load breather

INTRODUCTION

The engine emission control system reduces the level of hydrocarbon emissions released to atmosphere from the engine. The engine emission control system consists of a PCV (positive crankcase ventilation) system with part and full load breathers. Piston blow-by gases are drawn through the breathers into the engine air intake and added to the air charge. The resultant depression in the engine sump, front covers and cylinder head covers reduces the load on the joint seals in those areas.

PART LOAD BREATHER

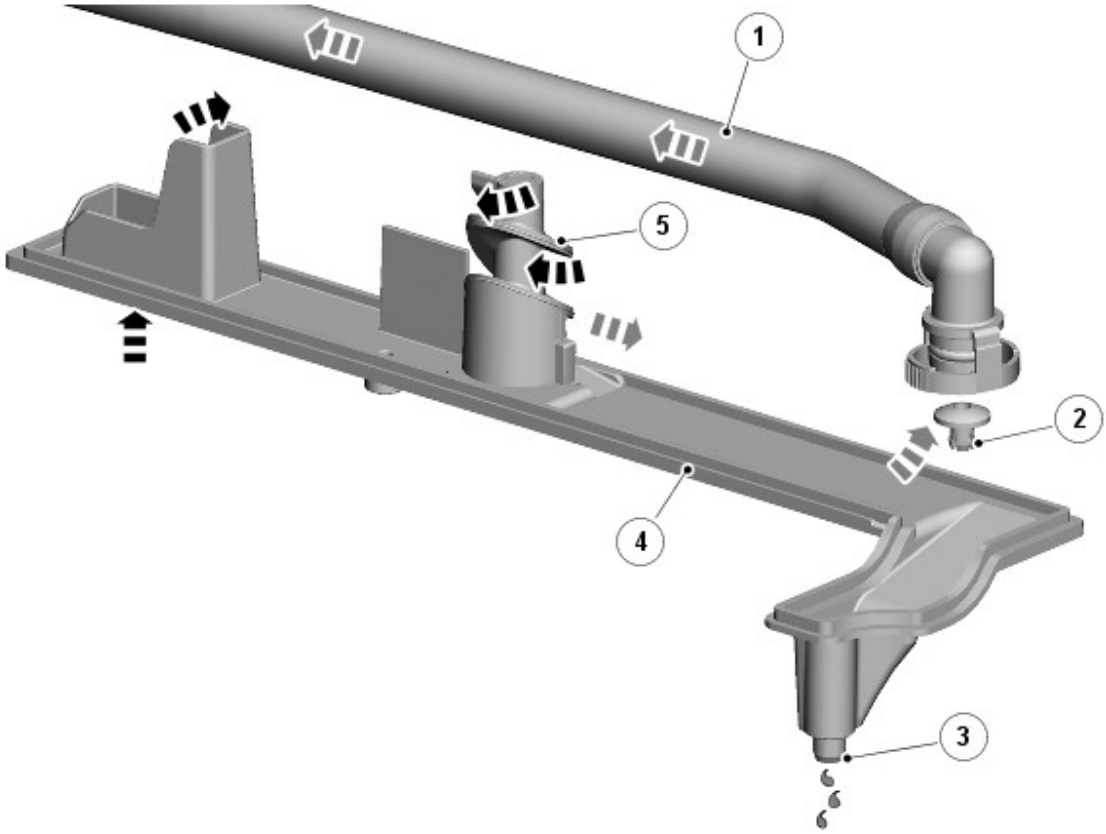


Item	Part Number	Description
1	-	Flexible hose
2	-	Baffle plate
3	-	Oil drain
4	-	PCV (positive crankcase ventilation) valves
5	-	Oil separator

The part load breather consists of an oil separator, two PCV valves and a flexible hose. The oil separator and the PCV valves are installed in the top of the RH (right-hand) cylinder head cover. The flexible hose connects the RH cylinder head cover to the inlet of the SC (supercharger).

The oil separator is installed in a channel in the top of the cylinder head cover. A baffle plate, which incorporates a gas inlet and an oil drain, is installed over the channel. The two PCV valves are installed on the outside of the cylinder head cover and connected in parallel in the gas outlet from the channel to the flexible hose. The PCV valves prevent reverse flow into the cylinder head cover when there is minimal depression in the inlet of the SC.

FULL LOAD BREATHER



E113867

Item	Part Number	Description
1	-	Flexible hose
2	-	Two-way valve
3	-	Oil drain
4	-	Baffle plate
5	-	Oil separator

The full load breather consists of an oil separator, a two-way valve and a flexible hose. The oil separator and the two-way valve are installed in the top of the LH (left-hand) cylinder head cover. The flexible hose connects the LH cylinder head cover to the LH air duct of the intake air distribution and filtering system.

The oil separator is installed in a channel in the top of the cylinder head cover. A baffle plate, which incorporates a gas inlet and an oil drain, is installed over the channel. The two-way valve is installed in the gas outlet from the channel. The two-way valve prevents reverse flow into the cylinder head cover when there is minimal depression in the air duct.

Published: 16-Aug-2012

Engine Emission Control - V8 S/C 5.0L Petrol - Engine Emission Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine emission control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Engine Emission Control (303-08C Engine Emission Control - V8 S/C 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Exhaust Gas Recirculation (EGR) system • Breather hoses • Positive Crankcase Ventilation (PCV) valve • Fuel level • Fuel contamination/grade/quality • Throttle body	• Fuses • Loose or corroded electrical connectors • Exhaust Gas Recirculation (EGR) 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 symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Difficult to start cold	• Battery • Crankshaft Position (CKP) sensor • Exhaust Gas Recirculation (EGR) valve stuck open • Fuel system • Evaporative emissions purge valve	• For battery information, CKP sensor, fuel system and purge valve tests, refer to relevant workshop manual section • Check the EGR valve
Engine stalls soon after start	• Breather system disconnected/restricted • Engine Control Module (ECM) relay • Mass Airflow (MAF) sensor • Ignition system • Air filter restricted • Air leakage • Fuel lines	• Check the engine breather hoses, PCV, etc • Check the ECM relay operation • For MAF sensor, ignition system tests, air intake and fuel line information, refer to relevant workshop manual section
Poor throttle response	• Accelerator Pedal Position (APP) sensor malfunction • Throttle Position (TP) sensors • Engine Coolant Temperature (ECT) sensor • Mass Airflow (MAF) sensor • Transmission malfunction • Traction control event • Air leakage • Breather system	• For APP, TP, ECT, MAF sensor tests, intake system checks and transmission information, refer to relevant workshop manual section • Check the breather system hoses, PCV, etc.

	disconnected/restricted	

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 11-May-2011

Intake Air Distribution and Filtering - TDV6 3.0L Diesel -

Torque Specification

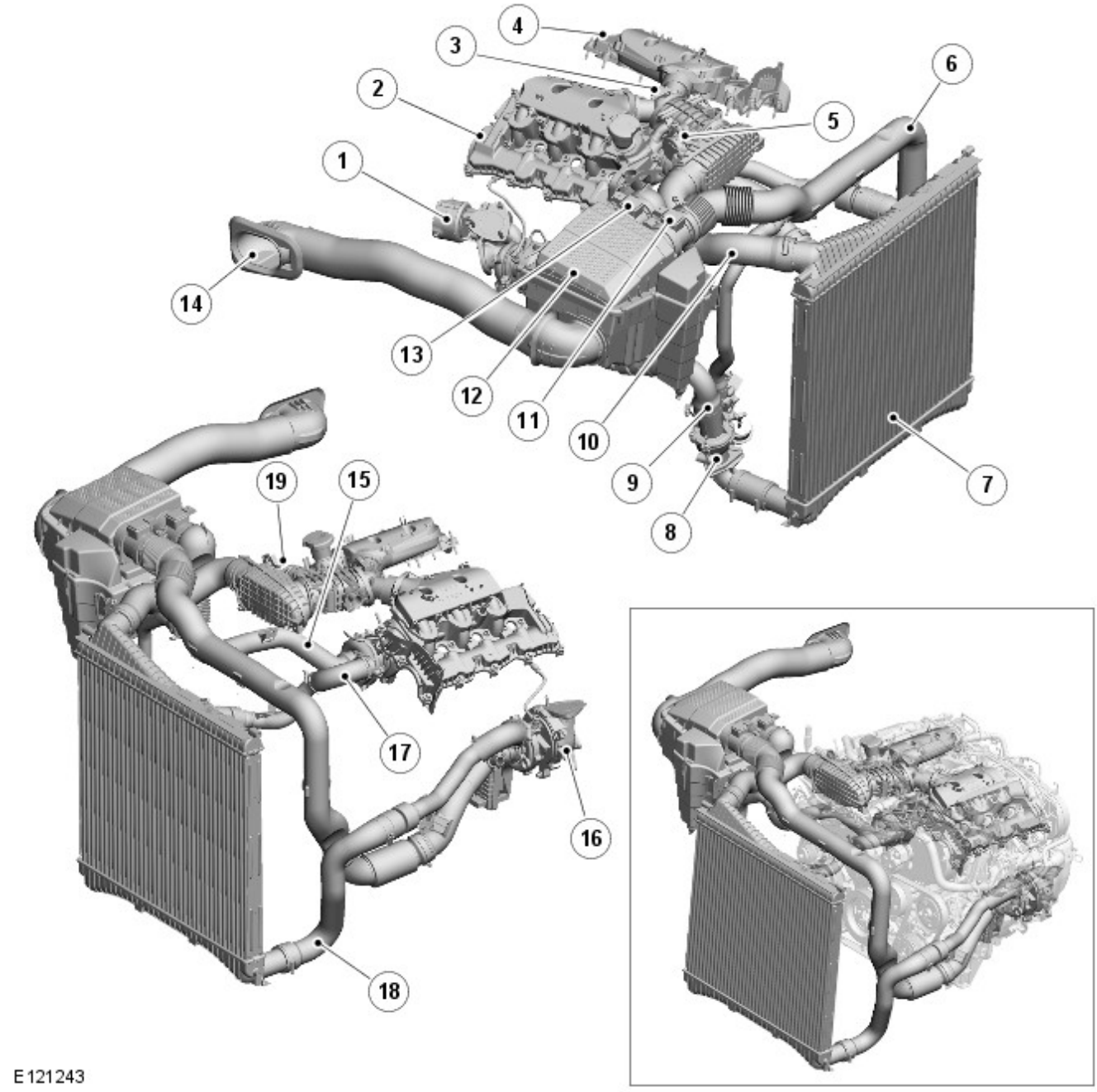
Description	Nm	lb-ft	lb-in
Air cleaner outlet pipe circlip	3.5	-	31
Charge air cooler to radiator bollts	15	11	-

Published: 11-May-2011

Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Intake Air Distribution and Filtering - Component Location

Description and Operation

Component Location



Item	Description
1	Secondary turbocharger
2	RH (right-hand) intake manifold
3	Charge air MAPT (manifold absolute pressure and temperature) sensor
4	LH (left-hand) intake manifold
5	Intake manifold throttle actuator
6	Intake air to primary turbocharger pipe
7	Charge air cooler
8	Compressor shut-off and recirculation valve assembly
9	Pipe - Compressed air from secondary turbocharger to charge air cooler
10	Charge air cooler to throttle intake manifold pipe
11	MAF (mass air flow) / IAT (intake air temperature) sensor (primary turbocharger)
12	Air cleaner housing
13	MAF sensor (secondary turbocharger)
14	Air intake

15 Intake air to secondary turbocharger pipe
16 Primary turbocharger
17 Pipe - Compressed air from secondary turbocharger to charge air cooler
18 Pipe - Compressed air from primary turbocharger to charge air cooler
19 Charge air temperature sensor

Published: 11-May-2011

Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Intake Air Distribution and Filtering - Overview

Description and Operation

Authoring Template

OVERVIEW

The intake air distribution and filtering system comprises:

- Two MAF (mass air flow) / IAT (intake air temperature) sensor
- Charge air temperature sensors
- Air cleaner and housing
- Charge air cooler
- Primary and secondary turbochargers.

The system cleans, cools and compresses the intake air. The turbochargers compress the air which is then cooled in the charge air cooler before being mixed with the injected fuel in the cylinder producing a high energy combustion increasing engine performance.

Published: 11-May-2011

Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Intake Air Distribution and Filtering - System Operation and Component Description

Description and Operation

System Operation

OPERATION

Air is drawn into the air intake system via the air intake vent located on the front RH (right-hand) fender of the vehicle. The air passes into the air cleaner housing and passes through the air cleaner. The air cleaner is a pleated, paper type filter which removes dust, pollen etc. from the intake air.

The filtered clean air passes from the air cleaner housing to the turbocharger inlet valve assembly. Depending on engine load and operating conditions, the intake air can be passed to only the primary turbocharger or to both the primary and secondary turbochargers.

Exhaust gasses leaving the exhaust manifolds are used to drive a turbine in the turbocharger which is turn drives a compressor. The rotational speed of the compressor is directly related to the speed of the exhaust gasses leaving the engine. Increased exhaust gas emission drives the turbine, and subsequently the compressor, faster, further compressing the intake air delivered to the engine.

The compression of the air by the turbocharger increases the air pressure. The intake air is passed into the charge air cooler which reduces the air temperature as it passes through the cooler. This in turn increases the volumetric efficiency by increasing intake air charge density. The cooled and compressed air is mixed with the injected fuel in the cylinder producing a high energy combustion increasing engine performance.

Component Description

DESCRIPTION

Air Cleaner and Housing

The air cleaner housing is located in the front RH side of the engine compartment. The housing has a water drain. Two NVH (noise, vibration and harshness) mounting grommets secure the air cleaner housing.

The air cleaner element is a pleated paper type element with a rubber seal around its perimeter. The seal locates in a groove in the housing and prevents air by-passing the element. The housing upper lid can be removed by removing 4 screws to release the lid.

Charge Air Cooler

The charge air cooler is located at the front of the engine compartment, between the A/C (air conditioning) condenser and the engine cooling radiator.

Turbochargers are designed to force more air mass into the engine intake manifold and combustion chambers. This compression process by the turbocharger produces heat which can reduce the performance gains of turbocharging due to reduced density of the intake air and an increase the cylinder combustion temperature. To counteract this, the charge air cooler is used to reduce the intake air temperature which increases the density of the air allowing more air molecules to be delivered to the combustion chamber.

The cooler is a cross flow type cooler and has inlet and outlet connections. The bottom LH (left-hand) and RHconnections are the inlets for the compressed air delivered from the turbocharger compressors. The top RH connection is the outlet for the cooled compressed air to be delivered to the throttle intake manifold.

The charge air cooler is an air-to-air type cooler. Heated air from the turbochargers is passed through tubes in the cooler. Ambient air passing over the tubes cools the intake air as it passes through the cooler.

Air Intake Components

The air intake components comprise 3 main components; airbox, intake ducting and a throttle intake manifold.

Airbox

The airbox allows for the connection of the cooled intake air from the charge air cooler to the throttle intake manifold. The air cleaner housing houses a MAF (mass air flow) sensor incorporating a temperature sensor which measures the air entering the turbochargers and passes this information to the ECM (engine control module).
Refer to: Electronic Engine Controls (303-14B, Description and Operation).

There are two ducts from the airbox, one ducts air to the primary turbocharger and the other to the secondary turbocharger. Boost pressure is applied via the secondary ducting to the secondary turbocharger to maintain the correct lubrication during driving conditions where the secondary turbocharger is inactive.
Refer to: Turbocharger (303-04D, Description and Operation).

Throttle Intake Manifold

The throttle intake manifold is located between the 2 intake manifolds and the airbox. The manifold splits the air entering the engine between the 2 intake manifolds.

The throttle intake manifold houses a DC (direct current) electric throttle actuator which controls a flap in the body of the manifold. The flap is controlled by the ECM and is constantly adjusted in response to driver inputs via the throttle

pedal to precisely control the amount of air allowed into the intake manifolds.
Refer to: Electronic Engine Controls (303-14B, Description and Operation).

Pipe connections on either side of the throttle intake manifold allow for the attachment of the exhaust gas outlet pipes from the EGR (exhaust gas recirculation) valves. The ends of the EGR pipes are specially designed to mix the recirculated exhaust gas with the intake air and provide an even distribution to each side of the engine.
Refer to: Engine Emission Control (303-08B, Description and Operation).

A boost pressure sensor is located on the top of the manifold where the air flow splits for the 2 intake manifolds. The pressure sensor measures the pressure of the intake air as delivered from the one or both of the turbochargers and passes this information to the ECM for turbocharger control.
Refer to: Electronic Engine Controls (303-14B, Description and Operation).

Intake Manifolds

The intake manifolds are an integral part of the cylinder head covers. Each intake manifold is connected to the throttle intake manifold via a push fit, sealed connection. The intake manifolds direct intake air to the inlet valves for each combustion chamber.

Published: 16-Aug-2012

Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Intake Air Distribution and Filtering

Diagnosis and Testing

Principles of Operation

For a detailed description of the intake air distribution and filtering system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-12A Intake Air Distribution and Filtering - TDV6 3.0L Diesel)

Intake Air Distribution and Filtering (Description and Operation),
Intake Air Distribution and Filtering (Description and Operation),
Intake Air Distribution and Filtering (Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Hoses and ducts condition and installation • Air filter condition and installation • Restricted air intake • Vacuum hoses condition and installation • Pipework to turbocharger condition and installation • Turbocharger condition and installation • Charge air coolers	• Fuse(s) • Wiring harness • Loose or corroded electrical connector(s) • Mass Air Flow (MAF) sensor • Air Charge Temperature (ACT) sensor • Manifold absolute pressure (MAP) sensor • Intake Air Temperature (IAT) sensor • Intake air shut-off throttle solenoid

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.

Symptom Chart

Symptom	Possible Causes	Action
Vehicle does not start/hard starting	• Restricted/blocked air intake • Restricted/blocked air filter	• Clear the restriction • Install a new air filter as necessary
Poor performance	• Turbocharger fault • Throttle body fault • Charge air cooler hoses	• Inspect the turbochargers • Test the intake air shutoff throttle function (make sure the throttle body returns to the open position) • Inspect the charge air cooler hoses
Excessive intake noise	• Intake air leak after the turbocharger • Intake pipe disconnected/damaged after the air cleaner • Air cleaner assembly incorrectly assembled/damaged	• Inspect the joint between the air intake elbow and the intake air shutoff throttle. Inspect the joints between the throttle body outlets and the intake manifolds. Inspect the charge air cooler seals • Check the intake system and hoses for correct installation/damage • Check the air cleaner assembly for correct installation/damage

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

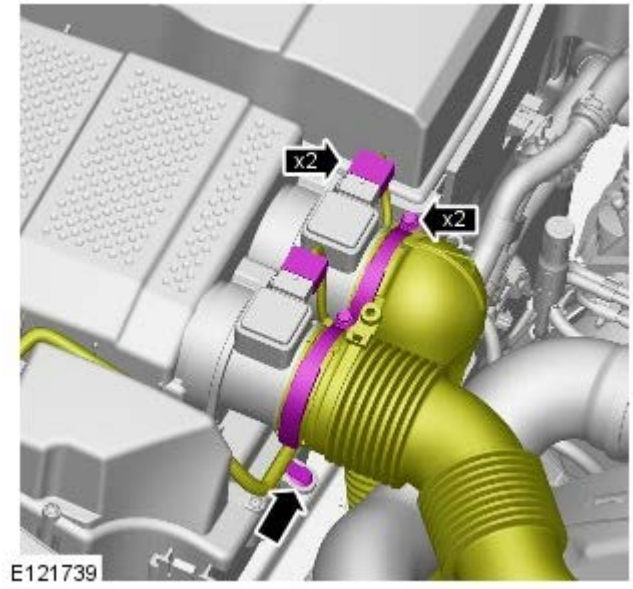
Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Air Cleaner

Removal and Installation

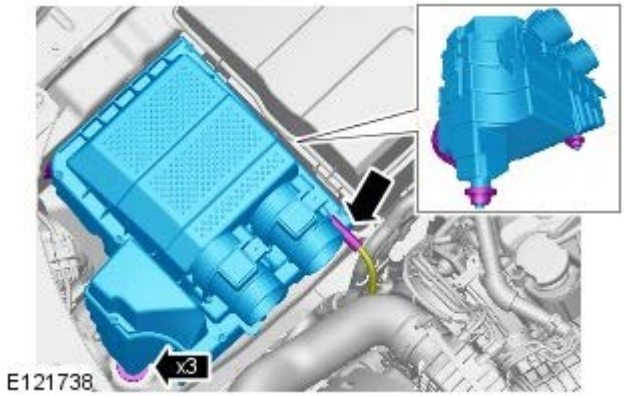
Removal

NOTE: Removal steps in this procedure may contain installation details.

1.



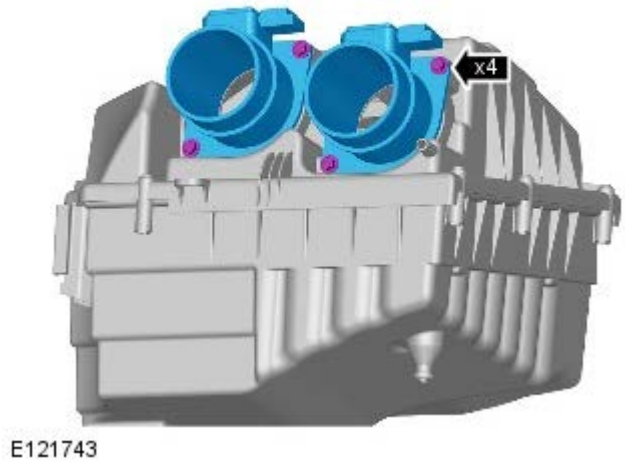
2.



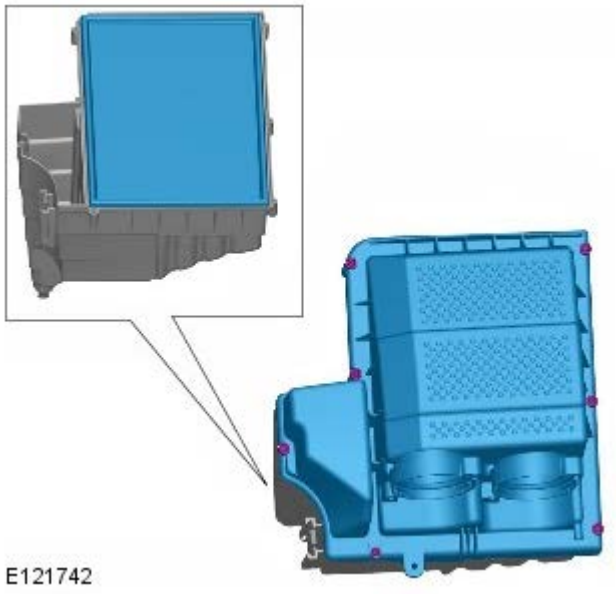
3. NOTES:

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

Remove and discard the O-ring seals.



4.



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

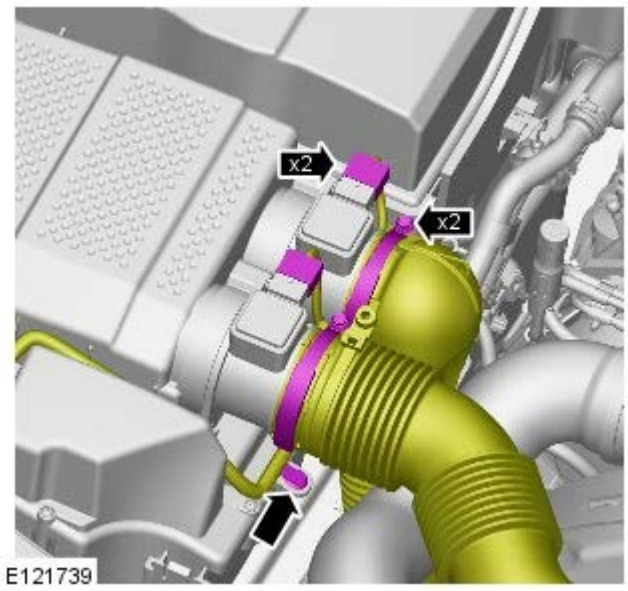
Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Air Cleaner Element

Removal and Installation

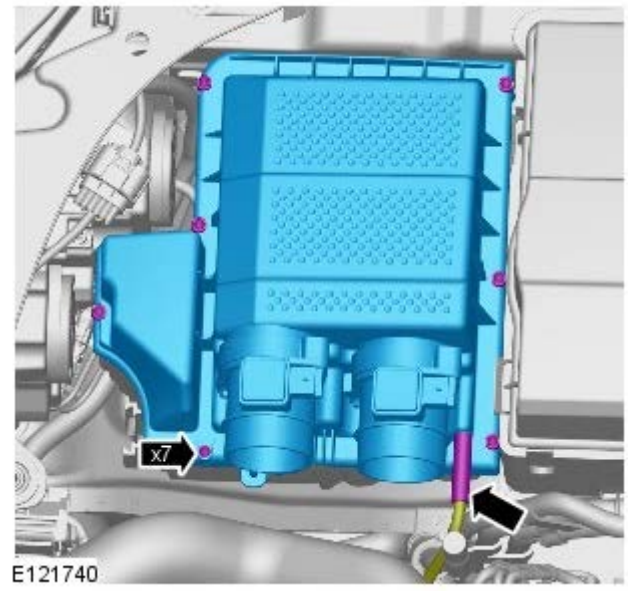
Removal

NOTE: Removal steps in this procedure may contain installation details.

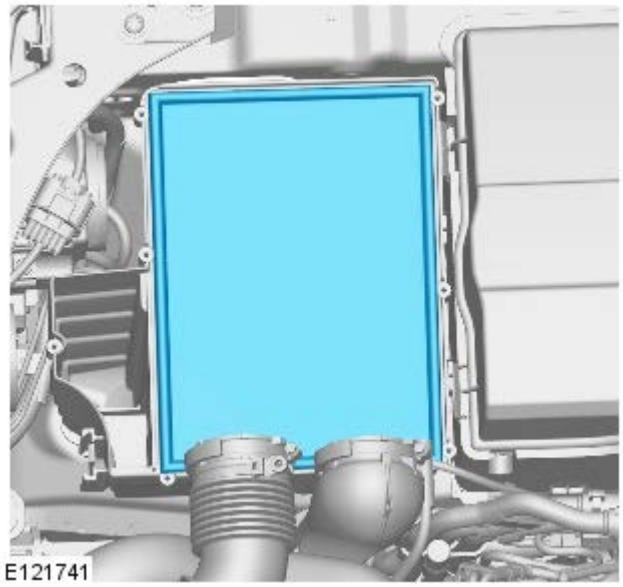
1.



2.



3.



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Charge Air Cooler

Removal and Installation

Removal

 NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Radiator (303-03, Removal and Installation).

Installation

1. Refer to: Radiator (303-03, Removal and Installation).

Published: 11-May-2011

Intake Air Distribution and Filtering - V8 5.0L Petrol -

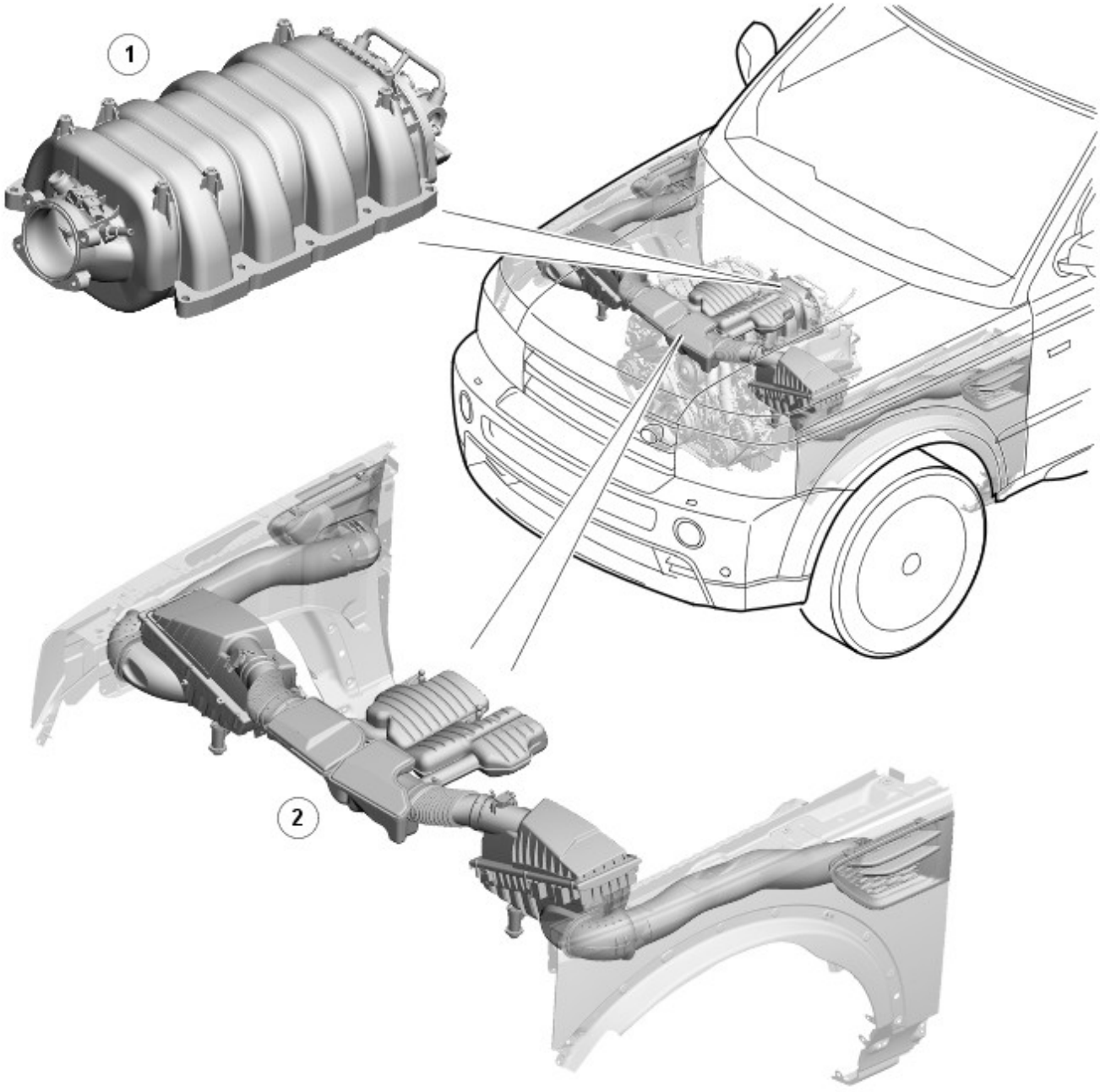
Description	Nm	lb-ft	lb-in
Air Cleaner Outlet Pipe T-Connector clip	3.5	-	31
Air Cleaner Outlet clips	3.5	-	31
Throttle body retaining studs	17	13	-
Intake manifold retaining bolts	25	18	-
Manifold absolute pressure (MAP) sensor	5	-	44

Published: 11-May-2011

Intake Air Distribution and Filtering - V8 5.0L Petrol - Intake Air Distribution and Filtering

Description and Operation

COMPONENT LOCATION



E121096

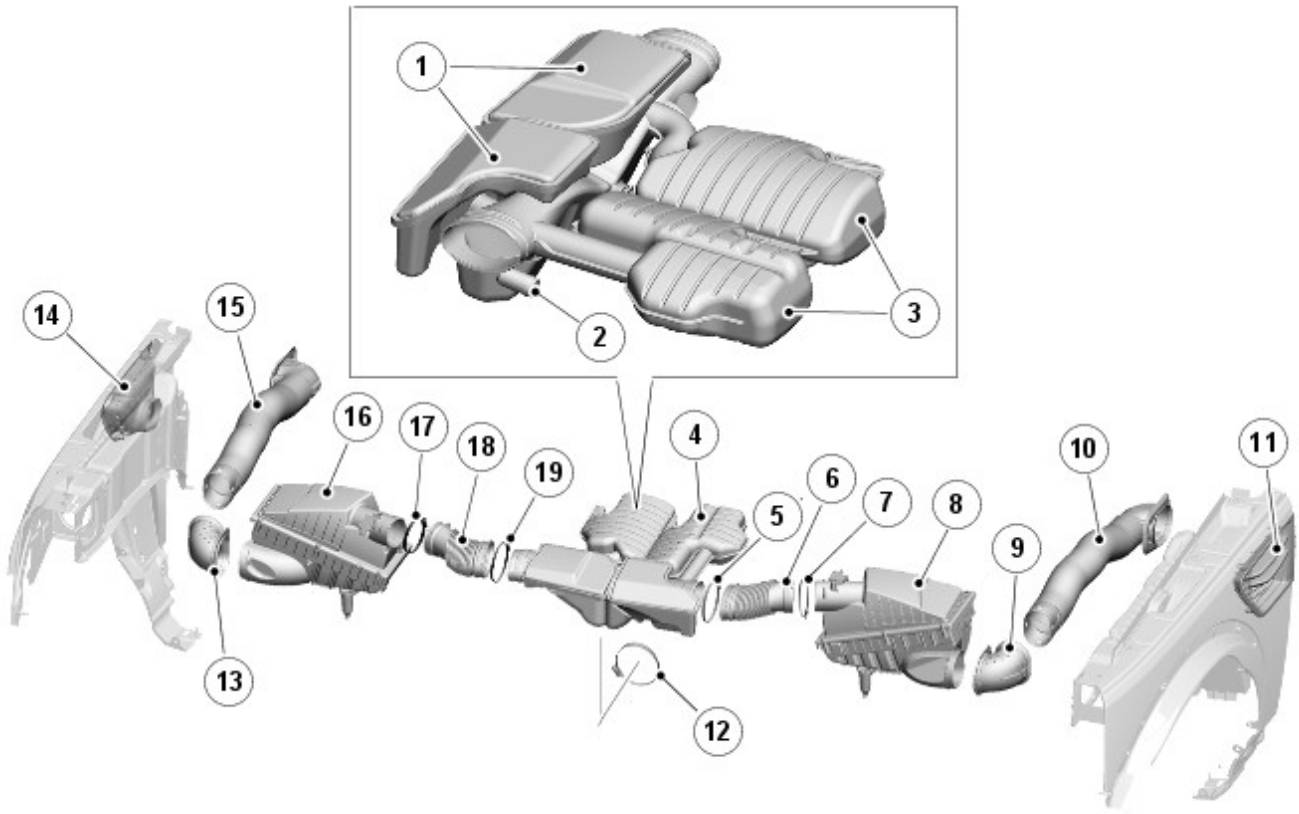
Item	Part Number	Description
1	-	Intake manifold
2	-	Air intakes, air cleaners and air ducts

INTRODUCTION

The intake air distribution and cleaning system comprises:

- Dual air intakes, air cleaners and air ducts.
- An intake manifold.

AIR INTAKES, AIR CLEANERS AND AIR DUCTS



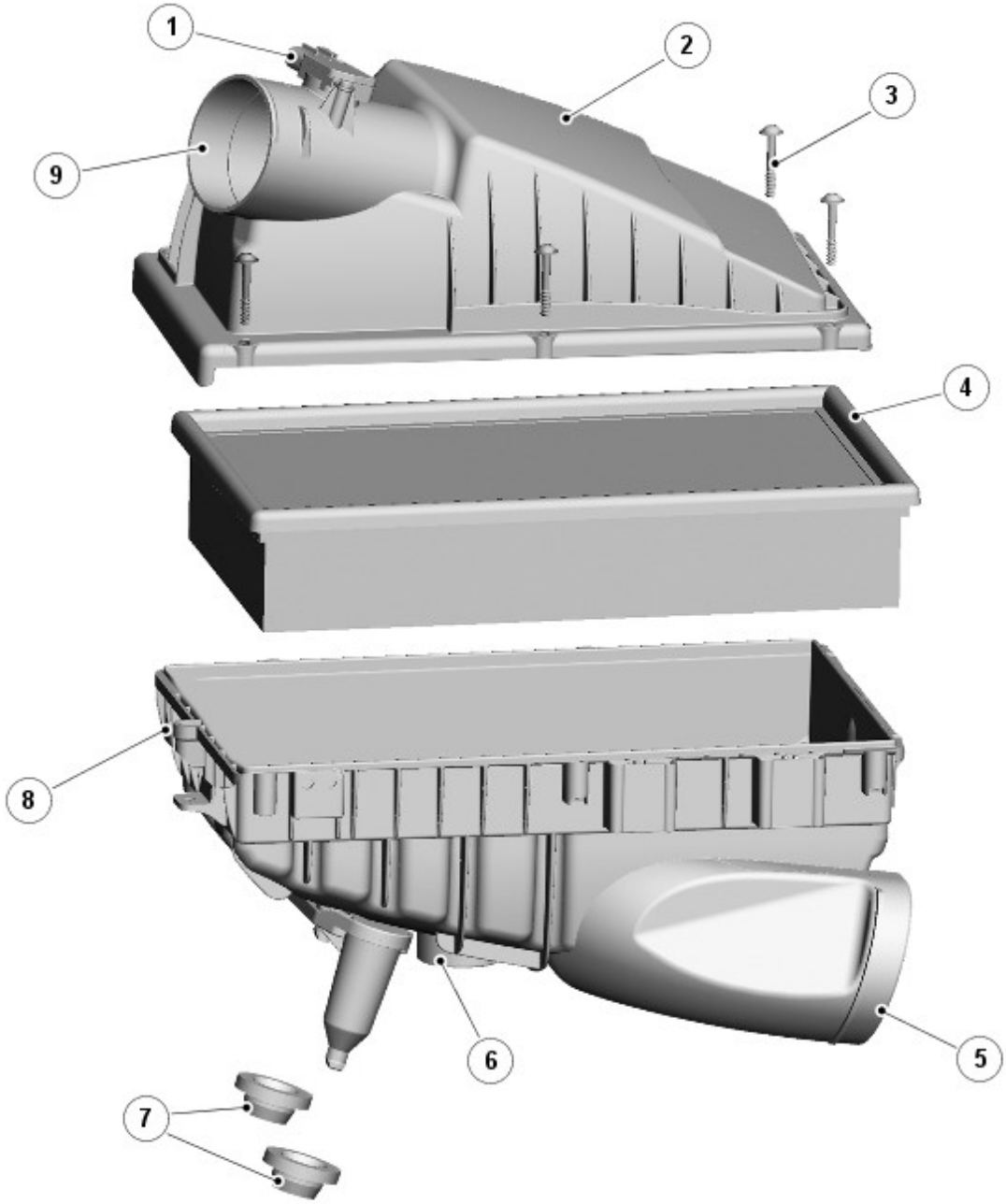
E121097

Item	Part Number	Description
1	-	Resonators
2	-	Full load breather connector stub
3	-	Resonators
4	-	Clean air duct
5	-	Hose clamp
6	-	LH (left hand) clean air convolute
7	-	Hose clamp
8	-	LH air cleaner
9	-	LH dirty air duct
10	-	LH air intake hose
11	-	LH air intake
12	-	Hose clamp
13	-	RH (right hand) dirty air duct
14	-	RH air intake
15	-	RH air intake hose
16	-	RH air cleaner
17	-	Hose clamp
18	-	RH clean air convolute
19	-	Hose clamp

Air is supplied to the air cleaners through the air intakes, air intake hoses and dirty air ducts in the fenders.

The air cleaners are located in the engine compartment, forward of the suspension housings. Two isolators locate each air cleaner on the related front side member. Each air cleaner consists of an air cleaner element installed in a tray and enclosed with a cover secured by six screws. Air inlet and outlet connections are incorporated into the tray and cover respectively. The bottom of the tray incorporates a drain valve to prevent the accumulation of water in the air cleaner. The air outlet connection incorporates a MAFT (mass air flow and temperature) sensor.

Air Cleaner



E121098

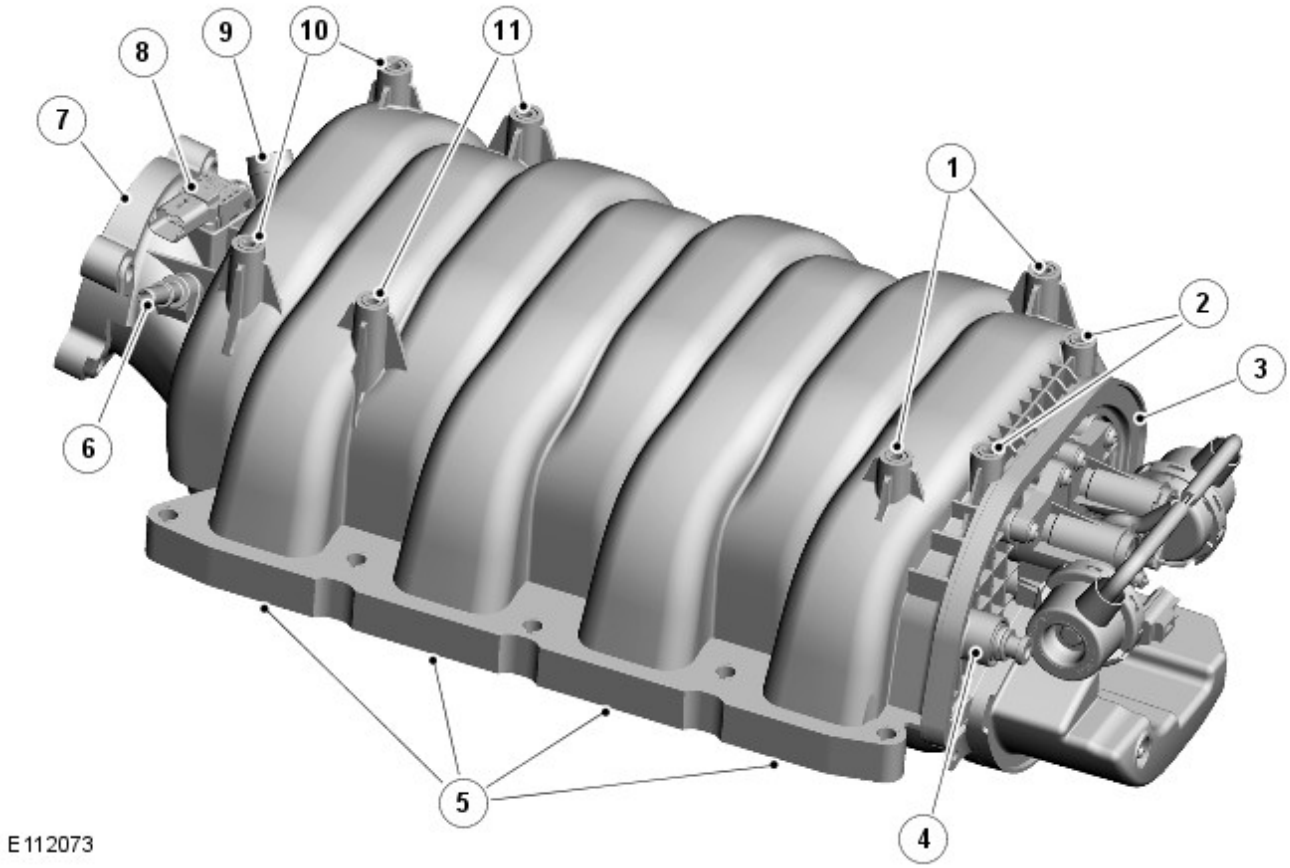
Item	Part Number	Description
1	-	MAFT sensor
2	-	Cover
3	-	Screw (6 off)
4	-	Air cleaner element
5	-	Inlet connection
6	-	Drain valve
7	-	Isolators
8	-	Tray
9	-	Outlet connection

The clean air convolutes and the clean air duct direct the air from the air cleaners into the electric throttle. Hose clamps connect the clean air convolutes and the clean air duct together, and to the air cleaners and the electric throttle.

The clean air duct also incorporates the following:

- Resonators, to reduce air induction noise.
- A connector stub for the engine full load breather pipe.

INTAKE MANIFOLD



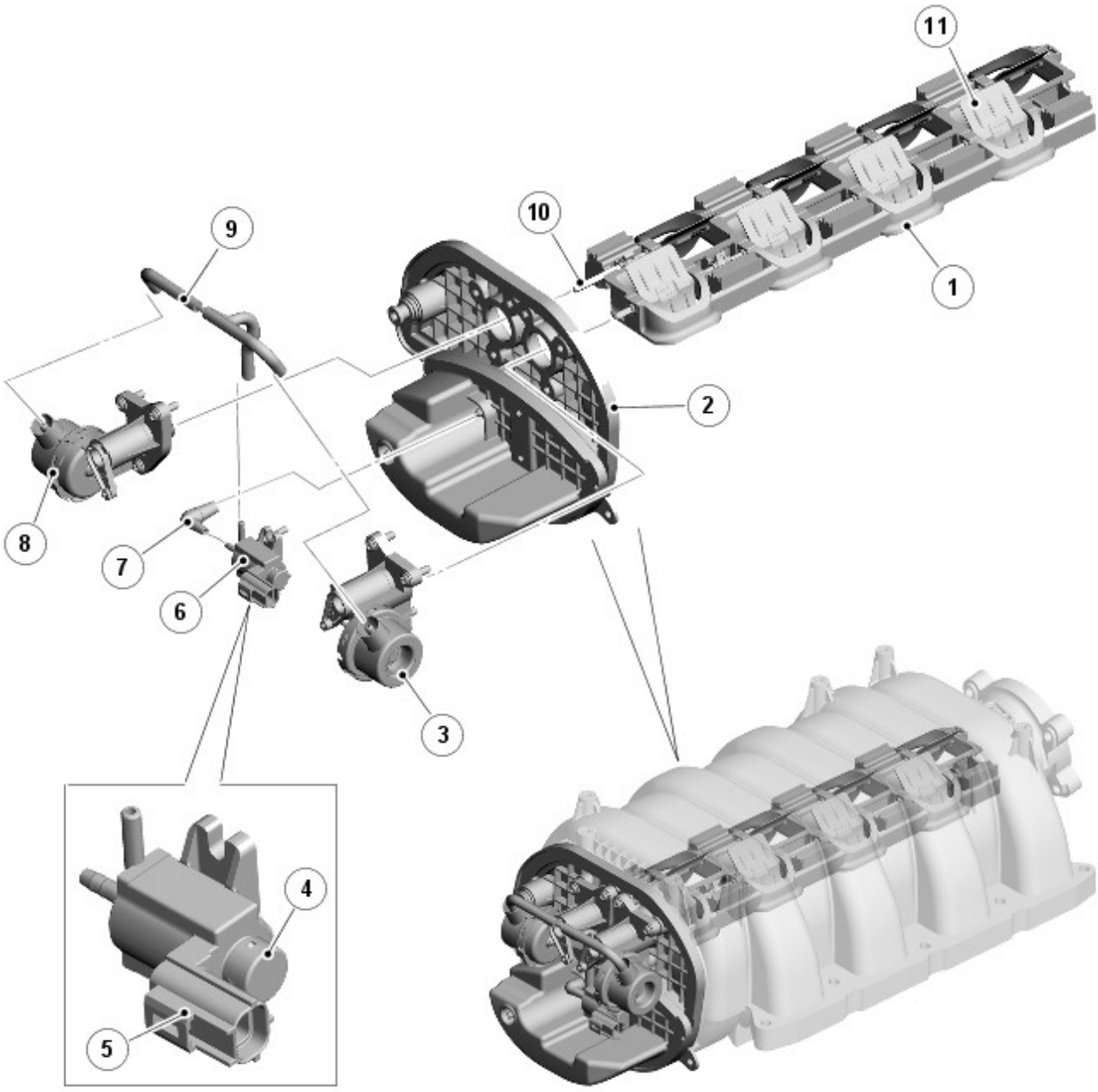
Item	Part Number	Description
1	-	Engine cover rear attachment points
2	-	Engine harness shield attachment points
3	-	Cover plate
4	-	Brake booster vacuum connection
5	-	Outlet ports
6	-	Evaporative emissions connection
7	-	Inlet port
8	-	MAP (manifold absolute pressure) sensor
9	-	Part load breather connection
10	-	Fuel crossover tube attachment points
11	-	Engine cover front attachment points

The intake manifold is installed between the cylinder heads and directs air from the electric throttle to the individual cylinders. The inlet port connects to a central chamber in the intake manifold. Eight separate tracts connect the central chamber to the outlet ports. A cover plate seals the rear of the intake manifold.

The intake manifold incorporates:

- A stub pipe for connection of the part load breather.
- A stub pipe for connection of the evaporative emissions system.
- A MAP (manifold absolute pressure) sensor.
- A vacuum connection for the brake booster.
- Threaded inserts to provide attachment points for the electric throttle, fuel crossover tube, engine cover and an engine harness shield.
- Compression limiters in the cylinder head attachment points.
- Seals in the inlet and outlet ports.
- A VIS (variable intake system).

Variable Intake System



E112074

Item	Part Number	Description
1	-	Cassette
2	-	Cover plate
3	-	RH pneumatic actuator
4	-	Vent cap
5	-	Electrical connector
6	-	Tuning valve
7	-	Vacuum connector
8	-	LH pneumatic actuator
9	-	Vacuum hoses
10	-	Drive shaft
11	-	Flap valve

The VIS changes the length of the tracts in the intake manifold to improve the air flow to the cylinders, which improves the engine power and torque.

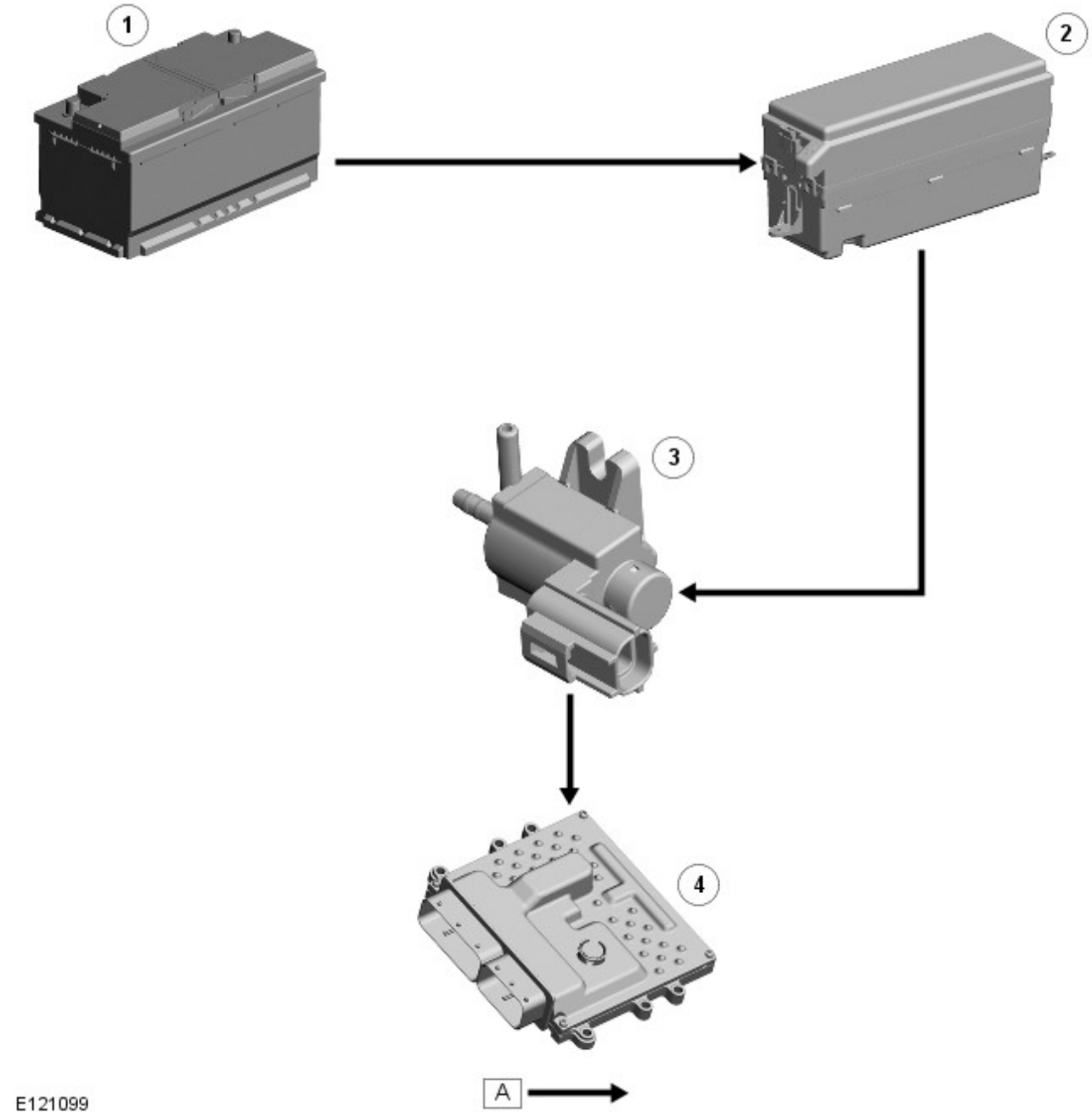
A cassette in the intake manifold contains eight flap valves, each located in an opening part-way along one of the tracts. Two drive shafts connect the flap valves together in two groups of four. Each drive shaft is connected to a pneumatic actuator installed on the cover plate of the intake manifold.

A tuning valve, also installed on the cover plate, controls the application of vacuum pressure to the pneumatic actuators. The tuning valve is a normally-closed solenoid-operated valve installed in the vacuum line between the cover plate and the pneumatic actuators. A vent cap on the tuning valve allows atmospheric pressure into the vacuum line to the pneumatic actuators when the tuning valve is closed.

The ECM (engine control module) controls the operation of the tuning valve.

CONTROL DIAGRAM (VARIABLE INTAKE SYSTEM)

NOTE: A = Hardwired



Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box) (ECM relay)
3	-	Tuning valve
4	-	ECM

OPERATION

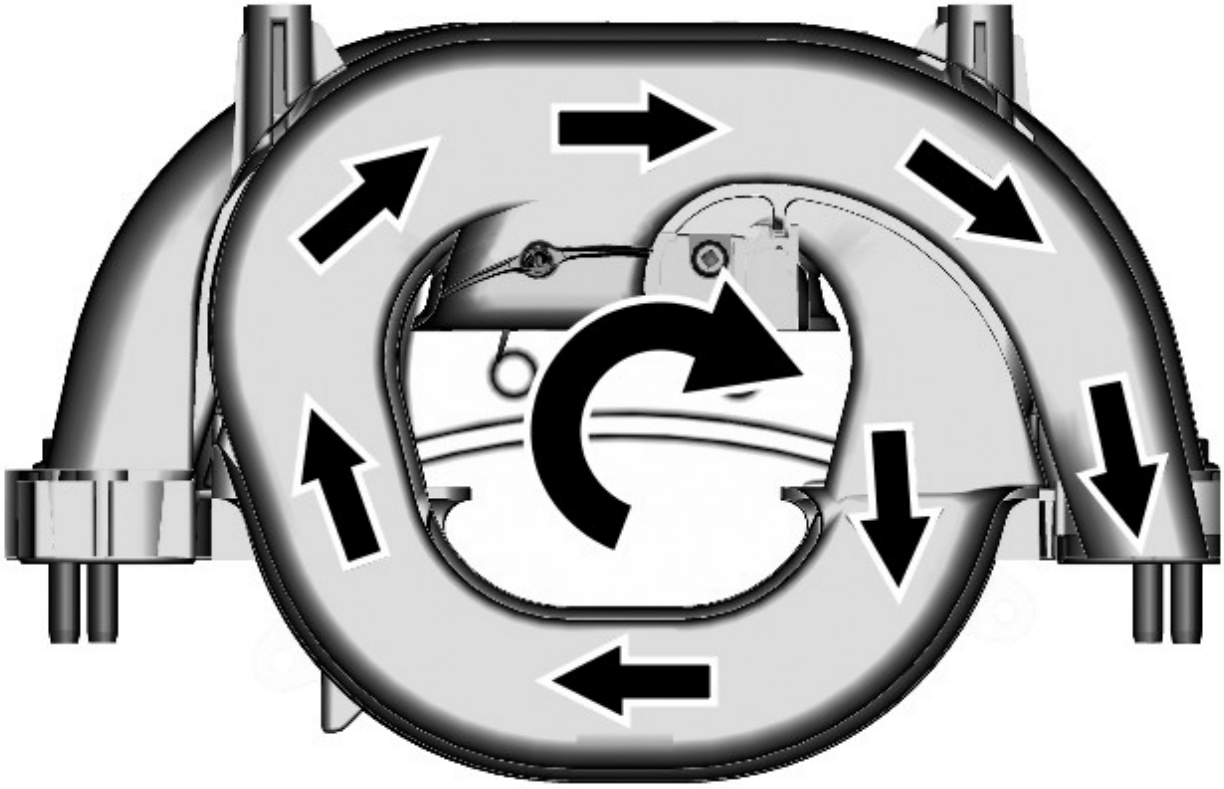
Variable Intake System

The flap valves can be set to one of two positions, to produce short or long intake tracts in the intake manifold. Long intake tracts are produced with the flap valves closed. Short intake tracts are produced with the flap valves open. The flap valves are closed at engine speeds up to 4700 rev/min and open at engine speeds of 4700 rev/min and above, with a hysteresis of 50 rev/min.

The tuning valve receives a power feed from the EMS relay in the EJB (engine junction box), and is connected to ground through the ECM. To close the flap valves, the ECM connects the tuning valve to ground. The energized tuning valve blanks off the atmospheric vent and opens the vacuum line between the cover plate and the pneumatic actuators. The depression in the intake manifold is sensed at the pneumatic actuators, which turn the drive shafts and move the flap valves to the closed position.

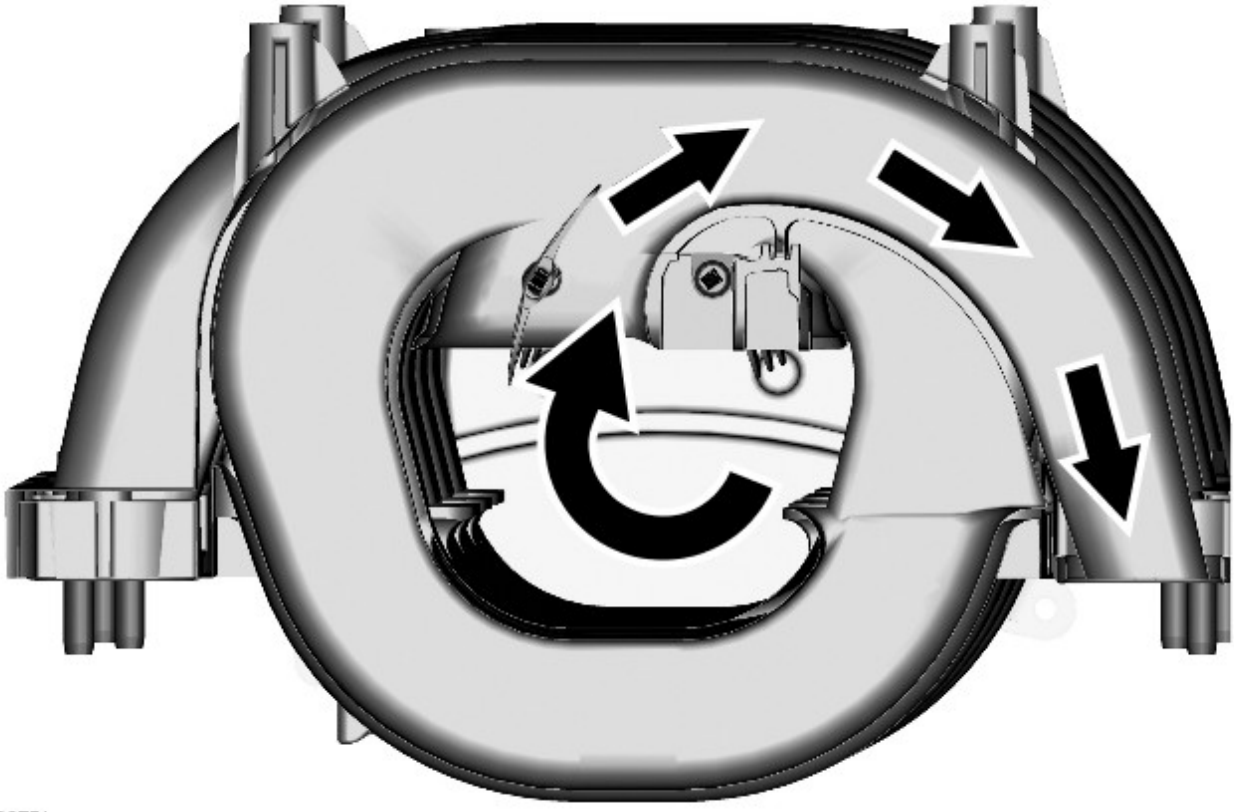
To open the flap valves, the ECM disconnects the ground connection and the tuning valve is de-energized closed. Atmospheric pressure is sensed at the pneumatic actuators through the vent cap on the intake manifold tuning valve and the flap valves move to the open position.

Flap Valves Closed



E106750

Flap Valves Open



E106751

Published: 16-Aug-2012

Intake Air Distribution and Filtering - V8 5.0L Petrol - Intake Air Distribution and Filtering

Diagnosis and Testing

Principles of Operation

For a detailed description of the intake air distribution and filtering system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Intake Air Distribution and Filtering (303-12B Intake Air Distribution and Filtering - V8 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Hoses and ducts (damage/connections) • Air filter (contaminated/blocked) • Restricted air intake	• Mass Air Flow (MAF) sensor • Manifold Absolute Pressure (MAP) sensor • Manifold Absolute Pressure/Temperature (MAPT) sensor • Throttle body • Harness (security/damage) • Connections (security/damage)

3. 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.

Symptom Chart

Symptom	Possible Causes	Action
Vehicle does not start/hard starting/poor performance	• Restricted/blocked air intake • Restricted/blocked air filter	• Clear the restriction • Install a new air filter as necessary
Excessive intake noise	• Intake pipe disconnected/damaged after the air cleaner • Air cleaner assembly incorrectly assembled/damaged	• Check the intake system and hoses for correct installation/damage • Check the air cleaner assembly for correct installation/damage

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 11-May-2011

Intake Air Distribution and Filtering - V8 5.0L Petrol - Air Cleaner Element

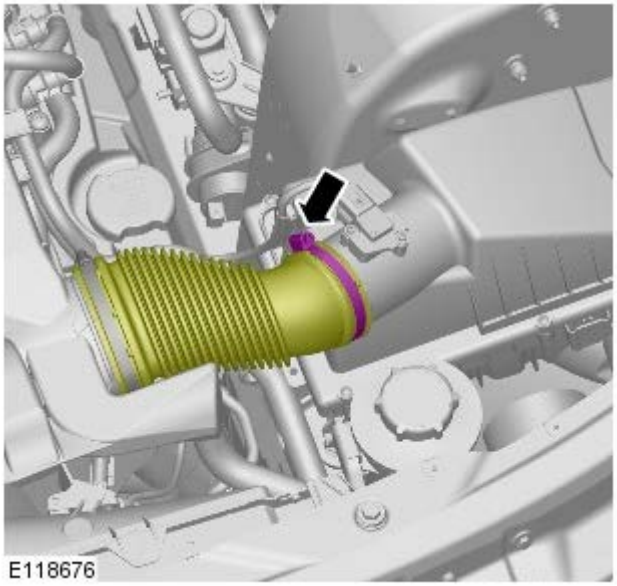
Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

Air cleaner elements must be renewed in pairs.

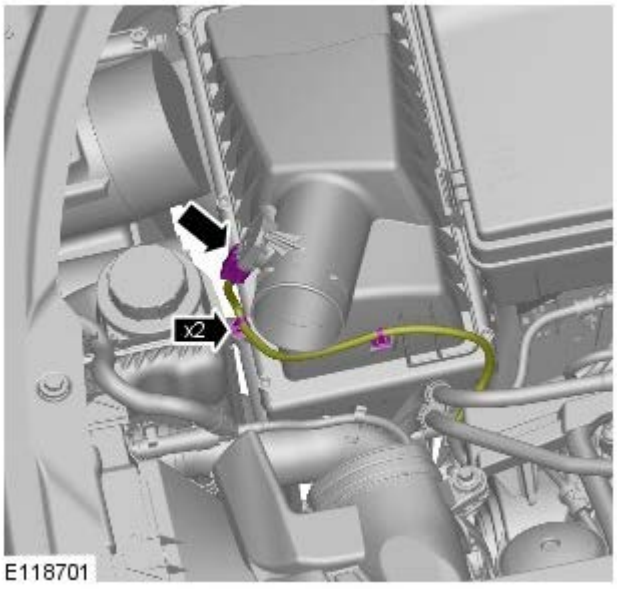


1. NOTES:

   Left-hand shown, right-hand similar.

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

   Torque: 3.5 Nm



2. NOTES:

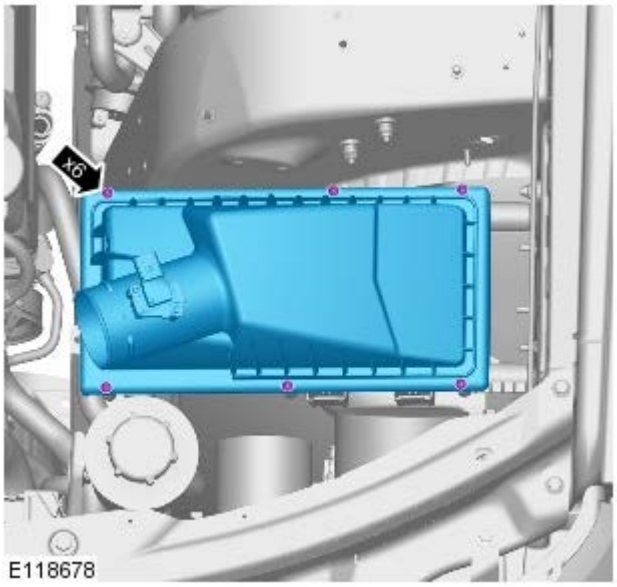
   Left-hand shown, right-hand similar.

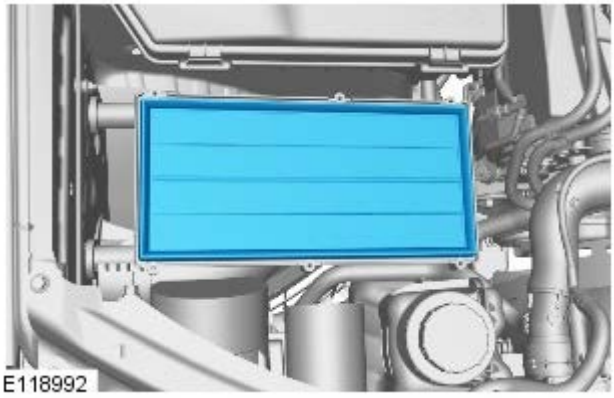
   Some variation in the illustrations may occur, but the essential information is always correct.

3. NOTES:

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

   Left-hand shown, right-hand similar.





4. NOTES:

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

   Right-hand shown, left-hand similar.

   - Repeat the above procedure for the other side.

Installation

1. To install reverse the removal procedure.

Published: 11-May-2011

Intake Air Distribution and Filtering - V8 5.0L Petrol - Air Cleaner LH

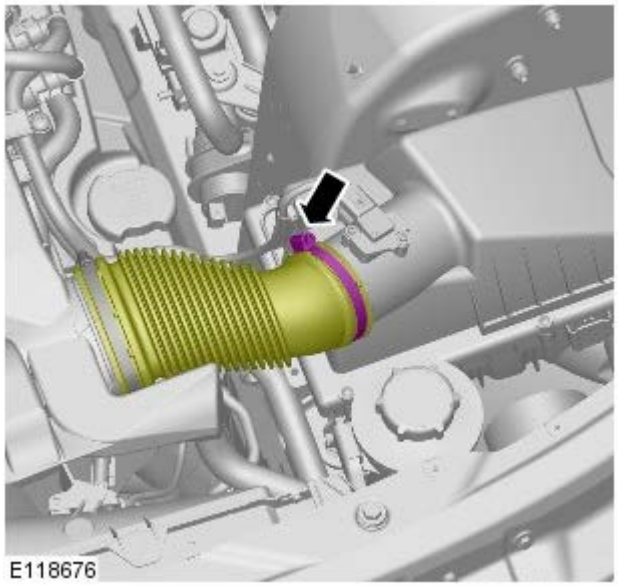
Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

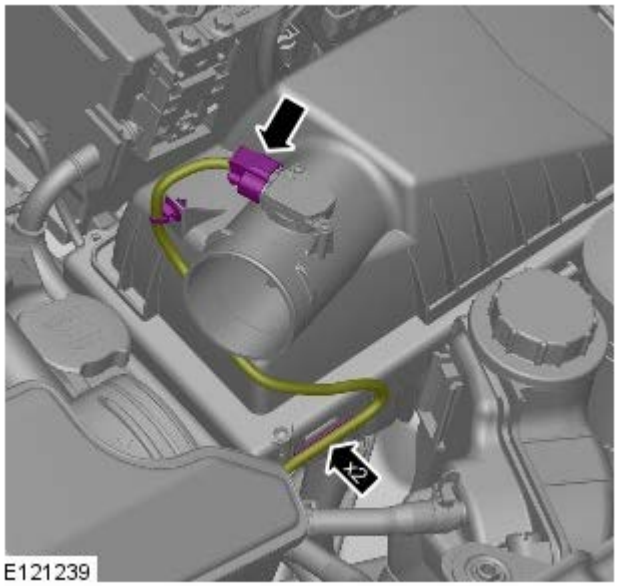
The ignition must be switched off.



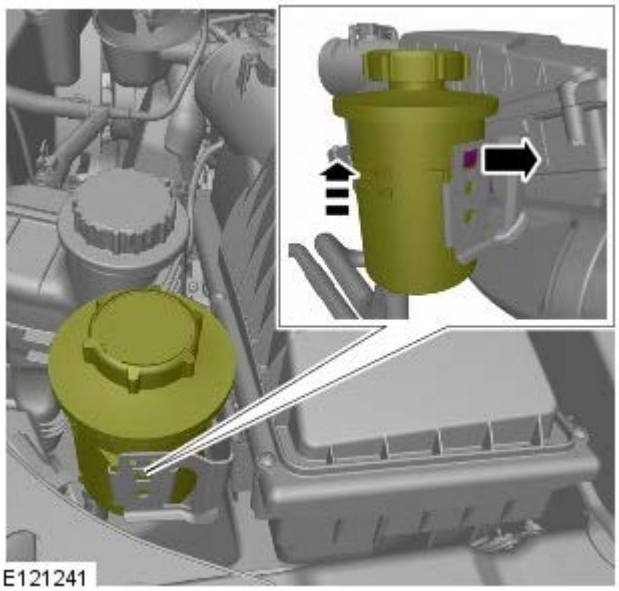
1. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

   Torque: 3.5 Nm

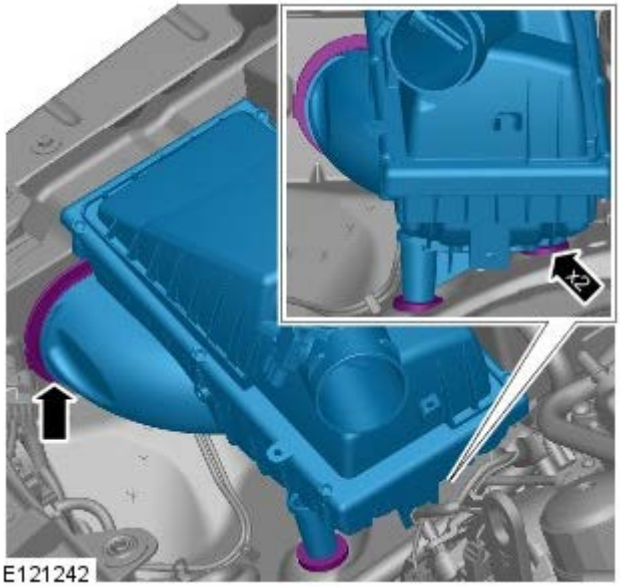
2.



3.


E121241

4. NOTE: Right-hand shown, left-hand similar.

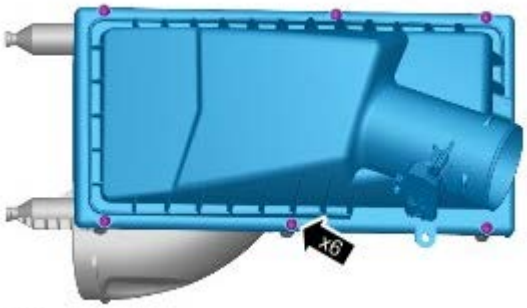


E121242

5. NOTES:

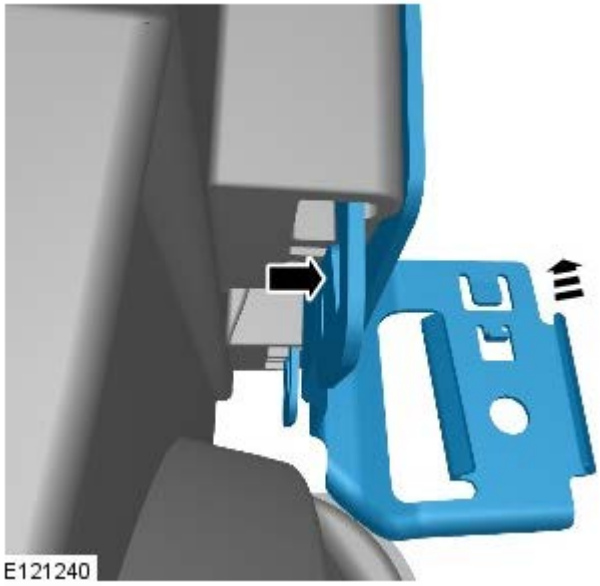
   Do not disassemble further if the component is removed for access only.

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



E118991

6.



7.



Installation

1. To install reverse the removal procedure.

Published: 11-May-2011

Intake Air Distribution and Filtering - V8 5.0L Petrol - Air Cleaner RH

Removal and Installation

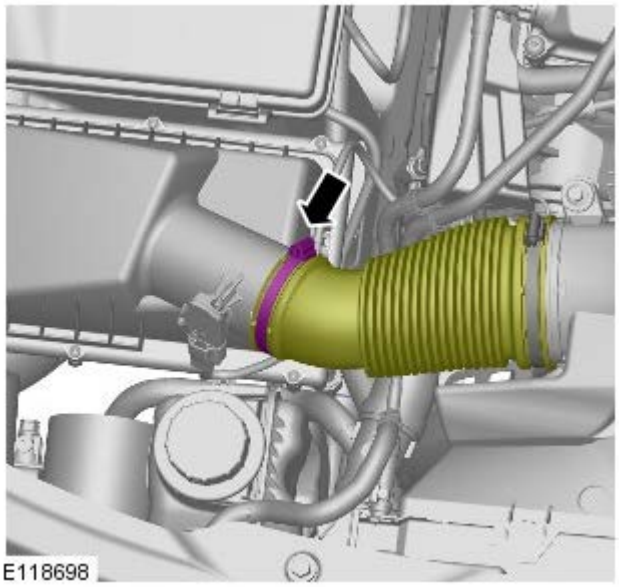
Removal

NOTES:

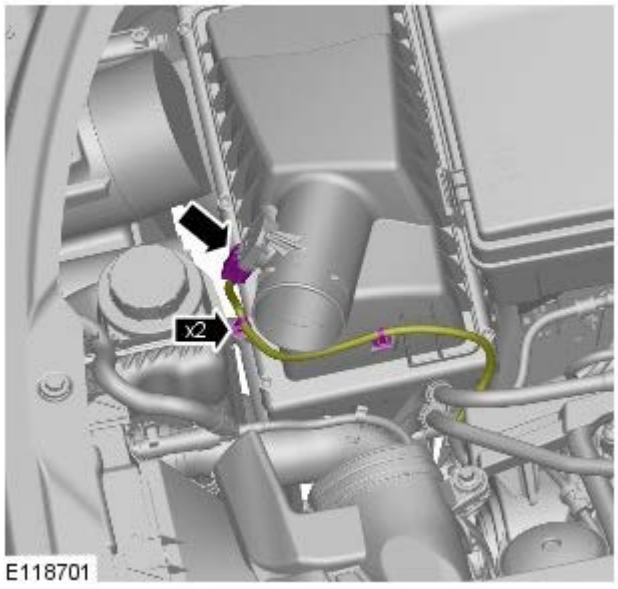
Removal steps in this procedure may contain installation details.

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

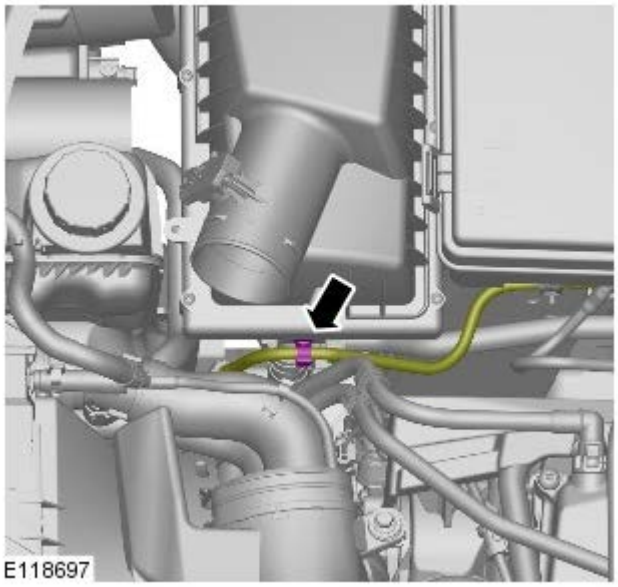
1. *Torque:* 3.5 Nm



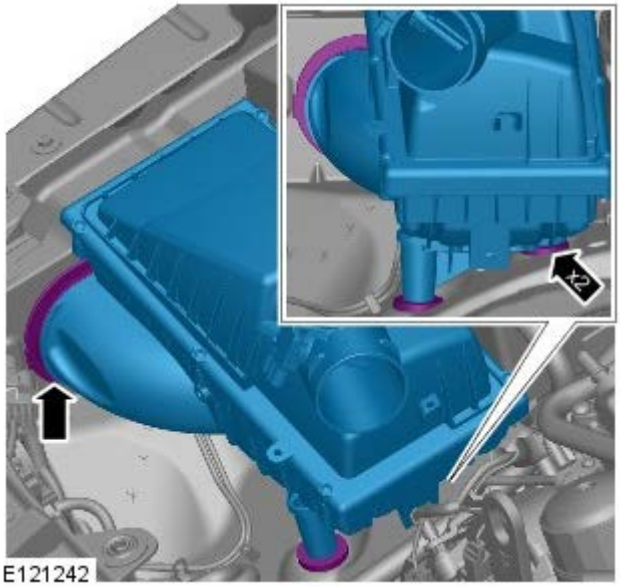
2.



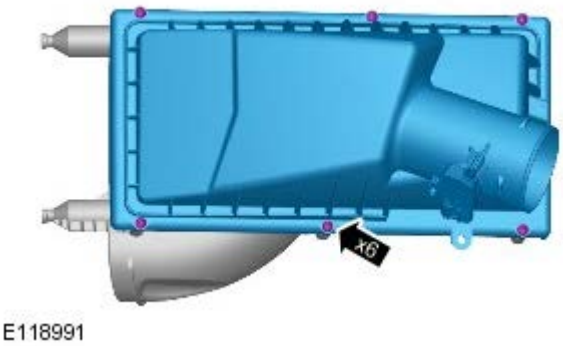
3.



4.



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



6.



E121597

Installation

1. To install reverse the removal procedure.

Published: 11-May-2011

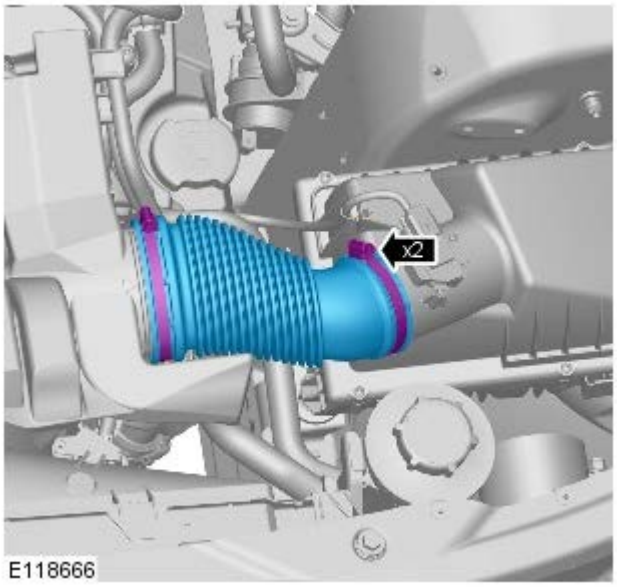
Intake Air Distribution and Filtering - V8 5.0L Petrol - Air Cleaner Outlet Pipe LH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).



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

   Torque: 3.5 Nm

Installation

1. To install reverse the removal procedure.

Published: 11-May-2011

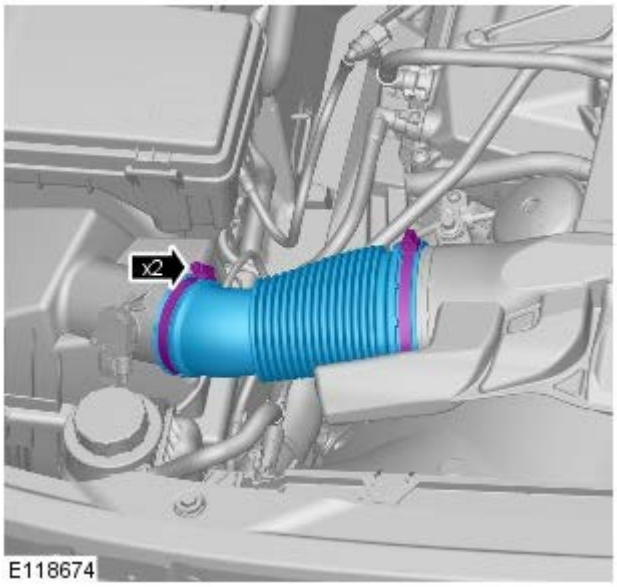
Intake Air Distribution and Filtering - V8 5.0L Petrol - Air Cleaner Outlet Pipe RH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).



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

   Torque: 3.5 Nm

Installation

1. To install reverse the removal procedure.

Published: 11-May-2011

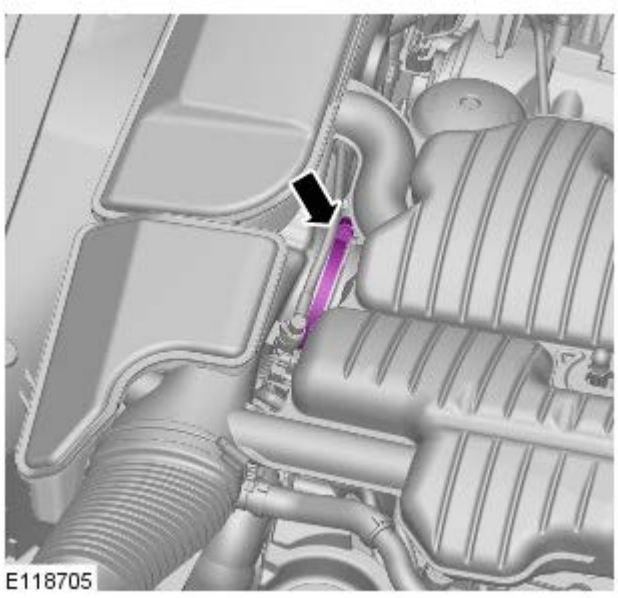
Intake Air Distribution and Filtering - V8 5.0L Petrol - Air Cleaner Outlet Pipe T-Connector

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

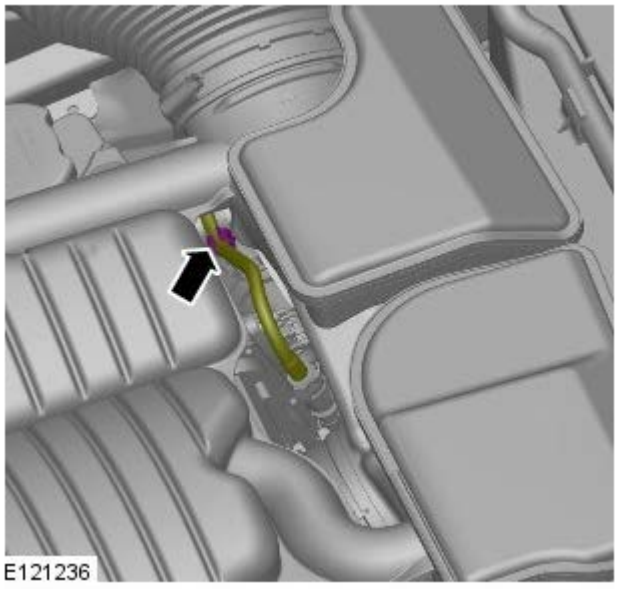
1. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).



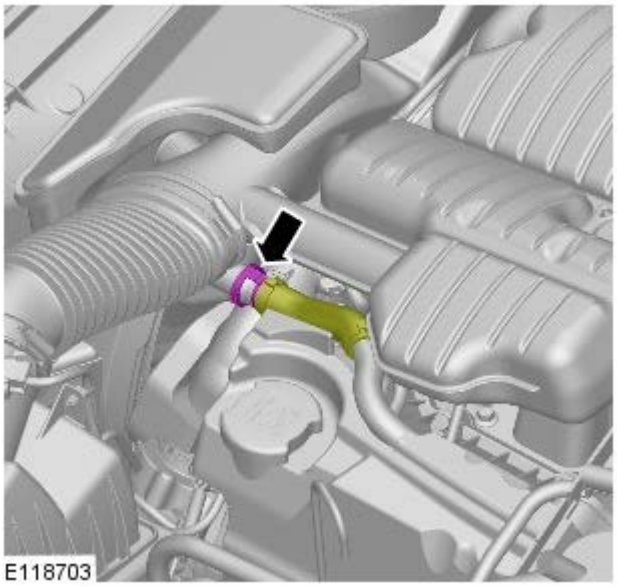
2. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

   Torque: 3.5 Nm

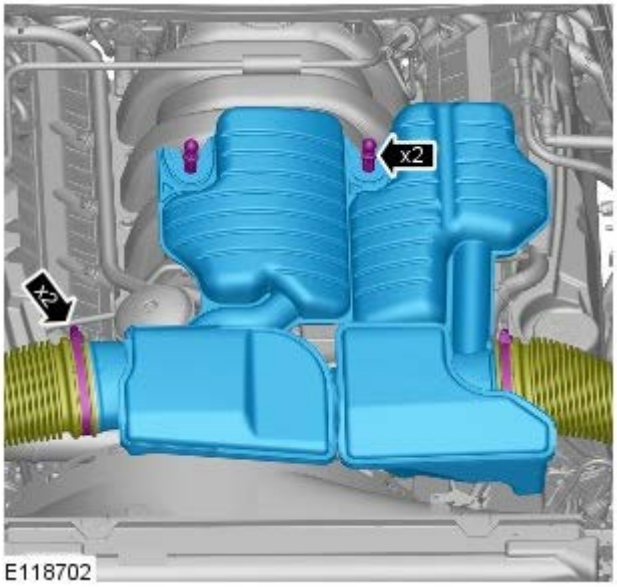
3.



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



5. *Torque:* 3.5 Nm



Installation

1. To install reverse the removal procedure.

Published: 11-May-2011

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol -

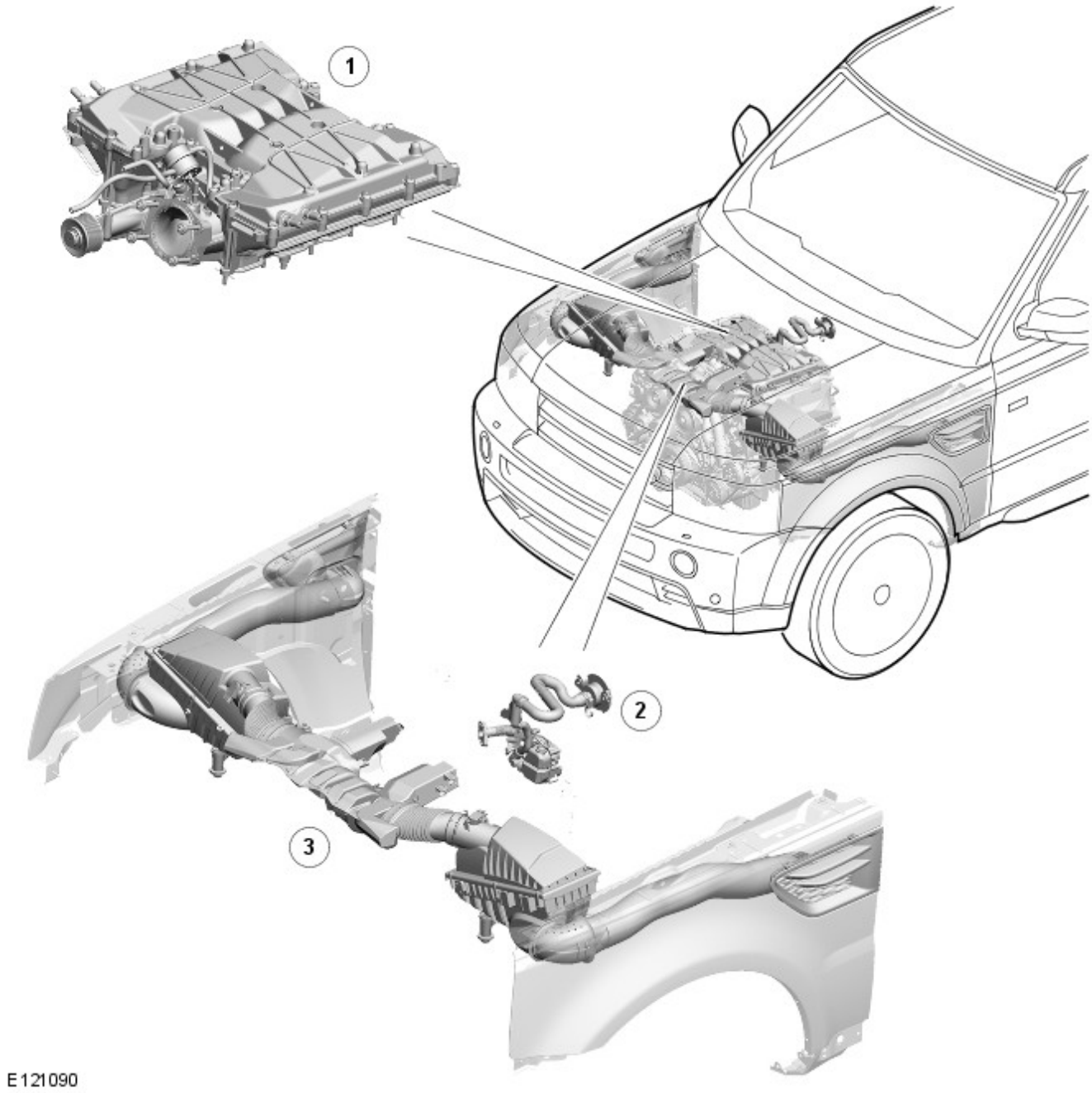
Description	Nm	lb-ft	lb-in
Air Cleaner Outlet Pipe T-Connector bolt	10	7	-
Air Cleaner Outlet Pipe T-Connector clip	3.5	-	31
Air Cleaner Outlet clips	3.5	-	31
Supercharger retaining bolts	25	18	-
Charge air cooler lower assembly retaining bolts	25	18	-
Throttle body retaining studs	10	7	-
Charge air cooler top assembly retaining bolts	25	18	-
Manifold absolute pressure and temperature (MAPT) sensor	5	-	44
Coolant outlet pipe	11	8	-

Published: 11-May-2011

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Intake Air Distribution and Filtering

Description and Operation

COMPONENT LOCATION



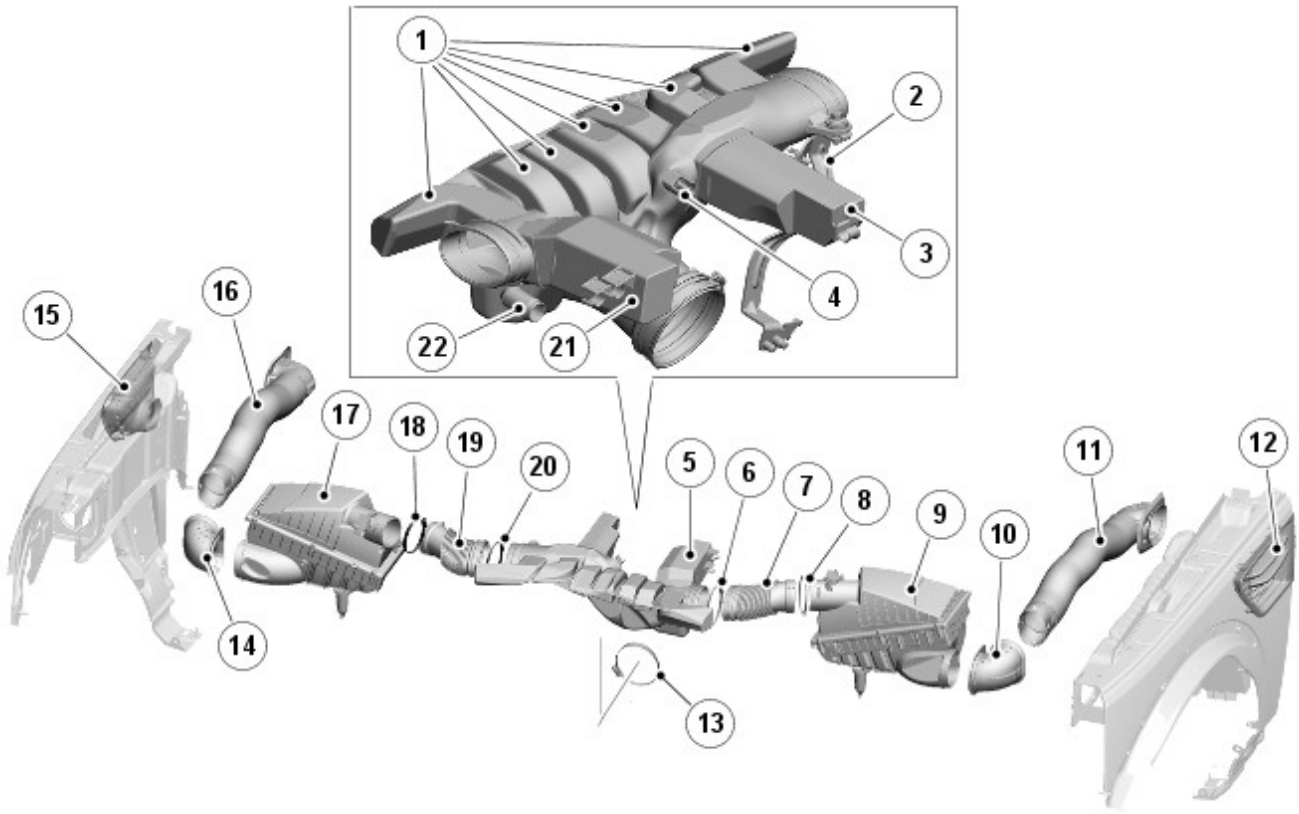
Item	Part Number	Description
1	-	Supercharger and intake manifolds
2	-	Noise feedback system
3	-	Air intakes, air cleaners and air ducts

INTRODUCTION

The intake air distribution and filtering system comprises:

- Dual air intakes, air cleaners and air ducts.
- A supercharger and intake manifolds.
- A noise feedback system.

AIR INTAKES, AIR CLEANERS AND AIR DUCTS



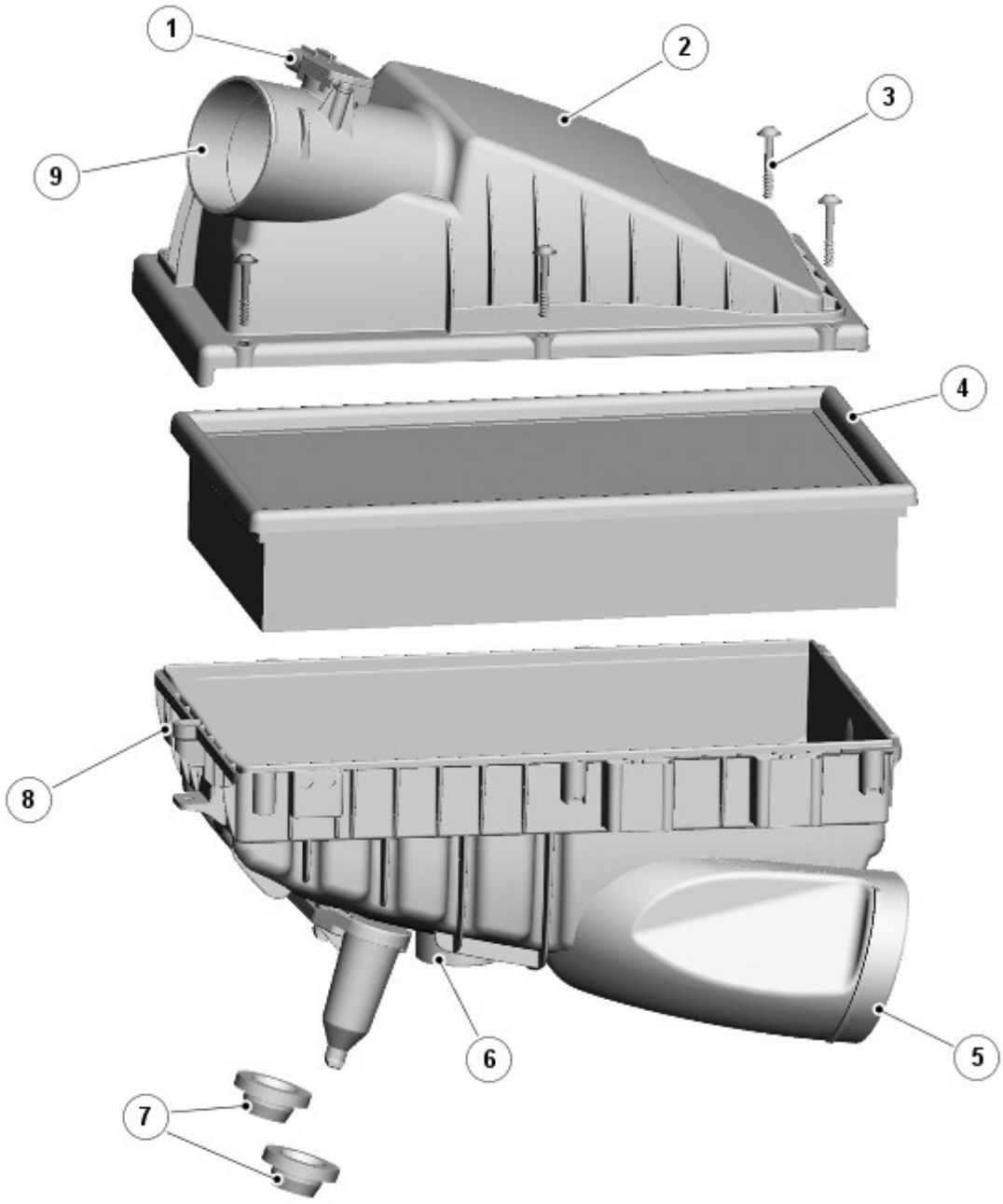
E121091

Item	Part Number	Description
1	-	Resonators
2	-	Mounting grommet and bracket
3	-	Resonator
4	-	Connector stub for vacuum tube of SC (supercharger) bypass valve actuator
5	-	Clean air duct
6	-	Hose clamp
7	-	LH (left hand) clean air convolute
8	-	Hose clamp
9	-	LH air cleaner
10	-	LH dirty air duct
11	-	LH air intake hose
12	-	LH air intake
13	-	Hose clamp
14	-	RH (right hand) dirty air duct
15	-	RH air intake
16	-	RH air intake hose
17	-	RH air cleaner
18	-	Hose clamp
19	-	RH clean air convolute
20	-	Hose clamp
21	-	Resonator
22	-	Full load breather connector stub

Air is supplied to the air cleaners through the air intakes, air intake hoses and dirty air ducts in the fenders.

The air cleaners are located in the engine compartment, forward of the suspension housings. Two isolators locate each air cleaner on the related front side member. Each air cleaner consists of an air cleaner element installed in a tray and enclosed with a cover secured by six screws. Air inlet and outlet connections are incorporated into the tray and cover respectively. The bottom of the tray incorporates a drain valve to prevent the accumulation of water in the air cleaner. The air outlet connection incorporates a MAFT (mass air flow and temperature) sensor.

Air Cleaner



E121098

Item	Part Number	Description
1	-	MAFT sensor
2	-	Cover
3	-	Screw (6 off)
4	-	Air cleaner element
5	-	Inlet connection
6	-	Drain valve
7	-	Isolators
8	-	Tray
9	-	Outlet connection

The clean air convolutes and the clean air duct direct the air from the air cleaners into the electric throttle. Hose clamps connect the clean air convolutes and the clean air duct together, and to the air cleaners and the electric throttle.

The clean air duct also incorporates the following:

- Resonators, to reduce air induction noise.
- A connector stub for the engine full load breather pipe.

The clean air duct is supported by a bracket attached to the RH (right-hand) cylinder head.

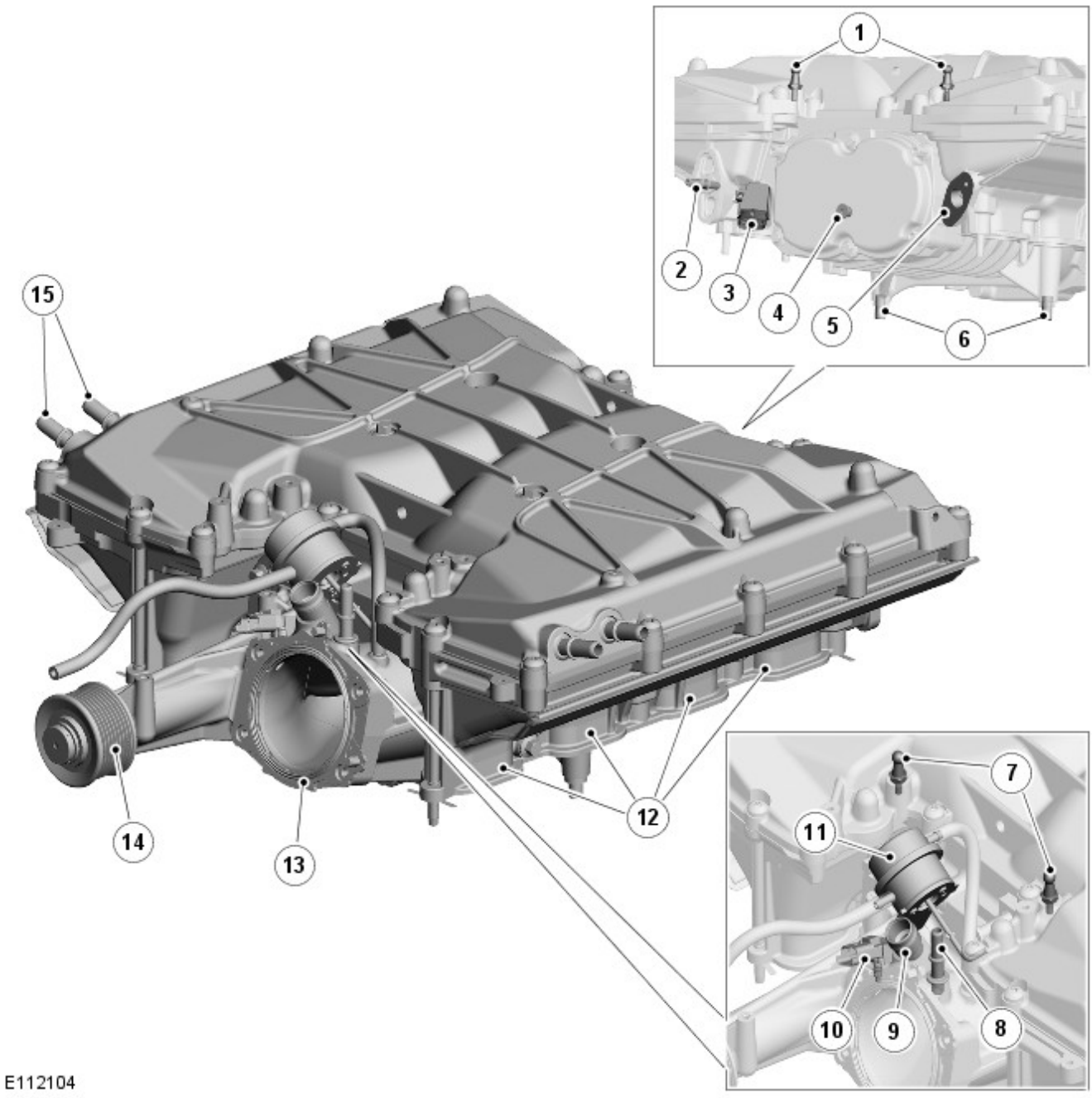
SUPERCHARGER AND INTAKE MANIFOLDS

The SC (supercharger) increases the pressure, and thus mass, of the air supplied to the engine, to increase the engine's power output. Two separate intake manifolds direct air from the SC to the cylinder inlet ports.

The intake manifolds are attached to their related cylinder heads and the sides of the SC. Two dowels locate the SC in position on the cylinder block. A charge air cooler tank top is installed on top of the SC and intake manifolds to form the air duct from the SC outlet to the intake manifolds. A charge air cooler is installed in each intake manifold.

The charge air cooler tank top incorporates four studs for the attachment of the engine cover. A NVH (noise, vibration and harshness) pad is attached to the side of each intake manifold.

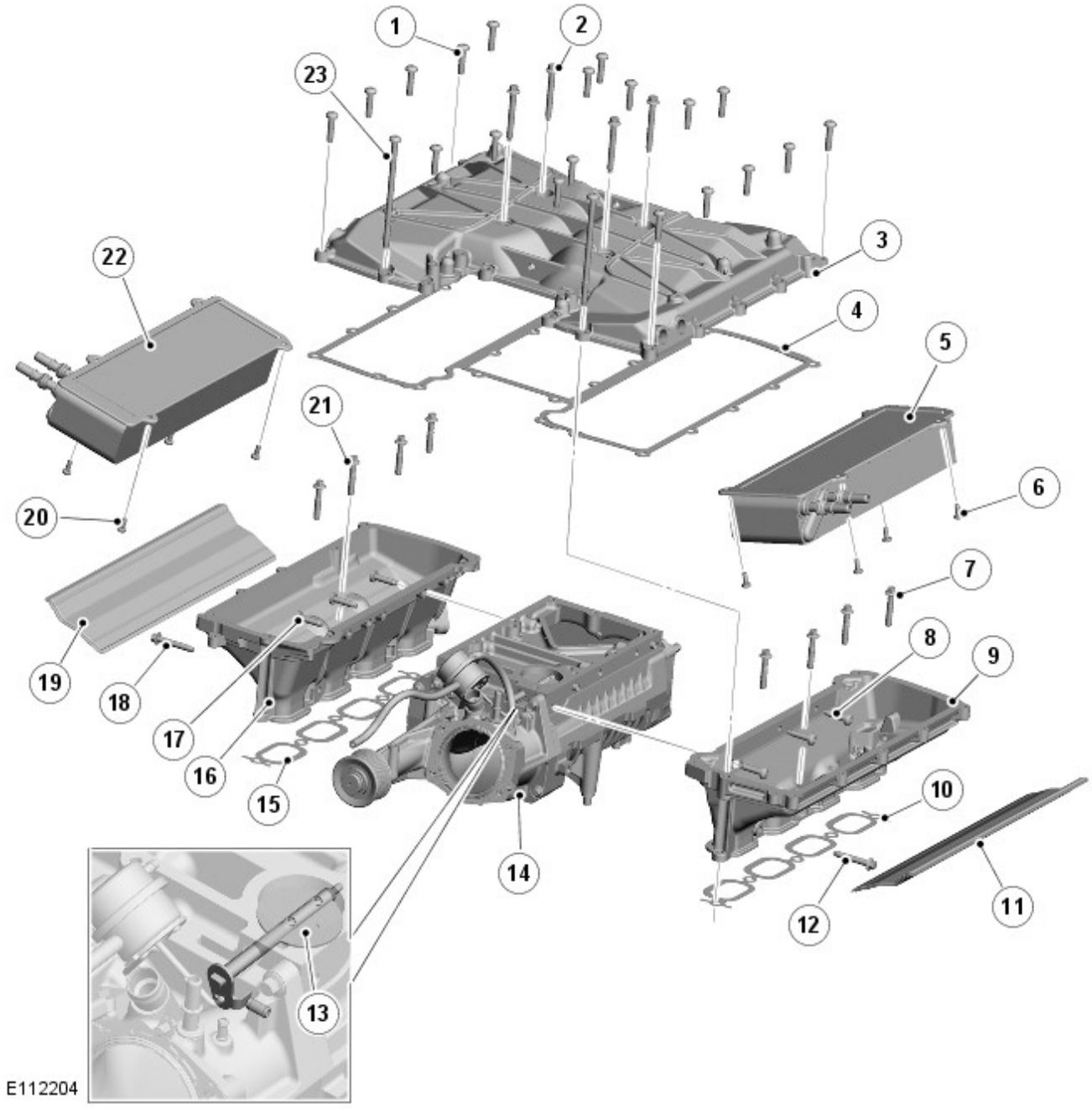
Supercharger and Intake Manifolds - Assembled



Item	Part Number	Description
1	-	Engine cover rear attachment points
2	-	Vacuum connector stub
3	-	MAPT (manifold absolute pressure and temperature) sensor
4	-	SC filler/level plug
5	-	Symposer inlet pipe connection
6	-	Dowels
7	-	Engine cover front attachment points
8	-	EVAP (evaporative emissions) connector stub
9	-	Part load breather connector stub
10	-	MAP (manifold absolute pressure) sensor
11	-	Bypass valve pneumatic actuator
12	-	Outlet ports
13	-	Inlet port
14	-	Pulley

15	-	Coolant inlet and outlet connections

Supercharger and Intake Manifolds - Exploded



Item	Part Number	Description
1	-	M08 x 35 mm screw (19 off)
2	-	M08 x 65 mm screw (4 off)
3	-	Charge air cooler tank top
4	-	Gasket
5	-	LH charge air cooler
6	-	M6 x 15 mm screw (4 off)
7	-	M08 x 45 mm screw (4 off)
8	-	M08 x 30 mm crew (3 off)
9	-	LH intake manifold
10	-	Gasket
11	-	NVH pad
12	-	M08 x 50 mm screw
13	-	Bypass valve
14	-	SC
15	-	Gasket
16	-	RH intake manifold
17	-	M08 x 30 mm crew (3 off)
18	-	M08 x 50 mm screw

19	-	NVH pad
20	-	M6 x 15 mm screw (4 off)
21	-	M08 x 45 mm screw (4 off)
22	-	RH charge air cooler
23	-	M08 x 150 mm screw

Supercharger

The SC is a Roots blower with high angle helix rotors driven at 2.1 x engine speed by the secondary belt of the accessory drive.

The two rotors of the SC are contained in a housing. The ends of the rotors are supported in bearings in the front cover and the bearing plate. A rear cover seals the bearing plate and incorporates a filler/level plug for lubricant. A pulley transfers power from the accessory drive to the shaft of one of the rotors.

A pneumatic actuator on the front cover is attached to a by-pass valve in the housing. The bypass valve regulates a flow of air from the outlet of the SC back to the inlet side of the rotors, to control the outlet pressure of the SC. Hoses connect the pneumatic actuator to the throttle T-piece of the air ducts, upstream of the electric throttle, and to the front cover, downstream of the electric throttle. A lever connects the actuating rod of the pneumatic actuator to the shaft of the bypass valve. A screw in the front cover limits movement of the lever in the closed direction to allow calibration of the SC output.

The front cover also incorporates:

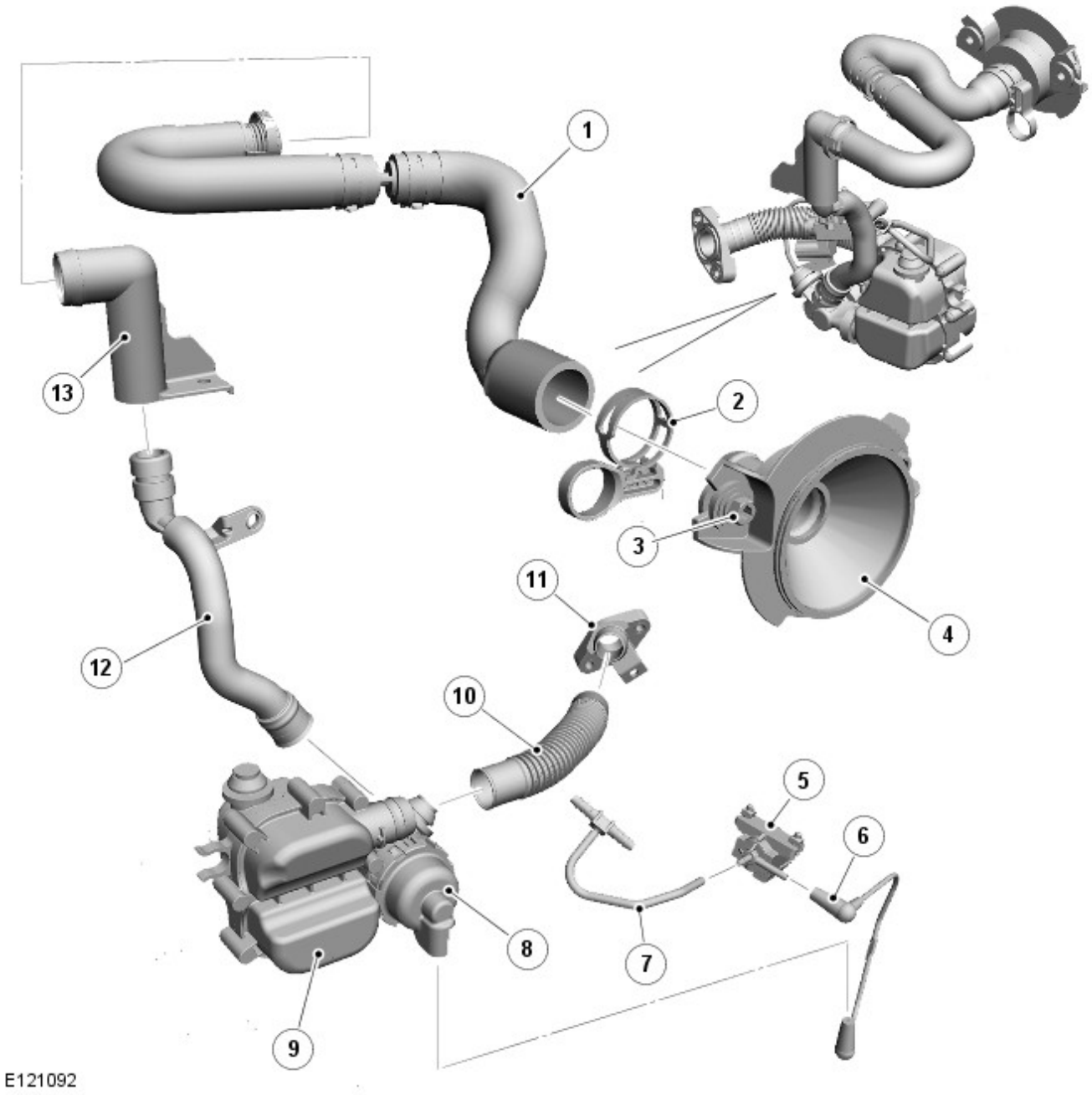
- The SC air inlet and mounting face for the electric throttle.
- A connector stub for the part load breather.
- A MAP (manifold absolute pressure) sensor.
- A connector stub for a hose from the EVAP (evaporative emission) canister purge valve.

Intake Manifolds

Each intake manifold is attached to the SC with three screws and a bolt. Two dowels ensure correct alignment of each intake manifold. The RHD (right-hand drive) intake manifold incorporates a connection port for the symposer, which, although fitted, is inactive on this vehicle. The LH (left-hand) intake manifold incorporates:

- A connector stub for the brake vacuum system.
- A MAPT (manifold absolute pressure and temperature) sensor.

NOISE FEEDBACK SYSTEM



Item	Part Number	Description
1	-	Feedback tube
2	-	Clip
3	-	Grommet assembly
4	-	Resonator
5	-	Tuning valve
6	-	Vacuum hose - tuning valve to pneumatic actuator
7	-	Vacuum hose - tuning valve to brake vacuum system
8	-	Pneumatic valve
9	-	Symposer
10	-	Inlet pipe
11	-	Flange
12	-	Outlet pipe
13	-	Outlet adapter

The noise feedback system generates a sporty, powerful engine sound in the passenger compartment, at high engine load and speed settings, to enhance the driving experience. The noise feedback system consists of a symposer system, a feedback tube and a resonator. Activation of the noise feedback system is controlled by the ECM (engine control module).

Symposer System

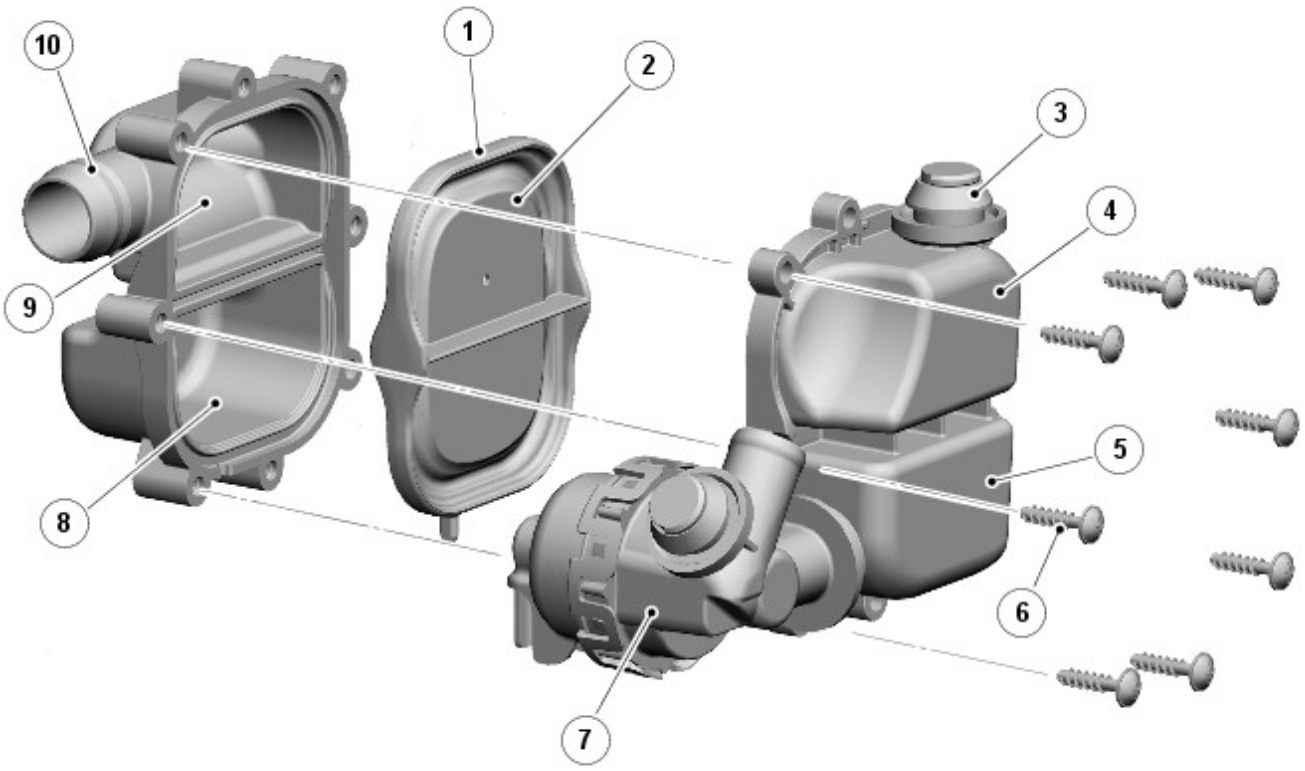
The symposer system modifies induction sound waves of a specific frequency range, at given engine settings, to produce the required engine sound. The symposer system consists of:

- An inlet pipe and flange.
- A symposer and pneumatic valve assembly.
- A tuning valve and associated vacuum tubes.
- An outlet pipe.
- An outlet adapter.

The inlet pipe and flange transfer induction noise from the RH intake manifold to the symposer. The pipe is a push fit on the symposer and the flange, which is attached to the rear face of the RH intake manifold.

The symposer contains two pairs of chambers, one pair on the inlet side and one pair on the outlet side. The inlet pipe connects to one of the chambers on the inlet side of the symposer, and the pneumatic valve connects to one of the chambers on the outlet side of the symposer. A calibrated orifice in the inlet pipe connection on the symposer limits the range of sound waves that pass through it. A 'paddle' installed in a diaphragm forms the separating wall in each pair of chambers. The paddle is able to pivot about its lateral axis where it passes through the wall that separates the two pairs of chambers.

Symposer



E112106

Item	Part Number	Description
1	-	Diaphragm
2	-	Paddle
3	-	Isolator
4	-	Inlet chamber (sealed)
5	-	Outlet chamber (open to pneumatic valve)
6	-	Screw (8 off)
7	-	Pneumatic valve
8	-	Outlet chamber
9	-	Inlet chamber (open to inlet pipe)
10	-	Inlet pipe connection

The pneumatic valve controls the flow of sound from the symposer outlet. It is a normally-closed valve connected directly to the outlet of the symposer and operated by vacuum pressure. Two isolators, one on the pneumatic valve and one on the symposer, locate the assembly on a bracket attached to the SC rear cover.

The tuning valve controls the application of vacuum pressure to the pneumatic valve. Two screws attach the tuning valve to the same bracket as the symposer and pneumatic valve. The tuning valve is a normally-closed solenoid-operated valve installed in the vacuum line between a T-connection in the brake vacuum system and the pneumatic valve. A vent cap on the tuning valve allows atmospheric pressure into the vacuum line to the pneumatic valve when the tuning valve is closed.

The outlet pipe carries sound from the pneumatic valve to the feedback tube via the outlet adapter. The outlet pipe is a push fit on the pneumatic valve and in the outlet adapter. A screw attaches the outlet adapter to an engine harness bracket installed between the two intake manifolds.

Feedback Tube

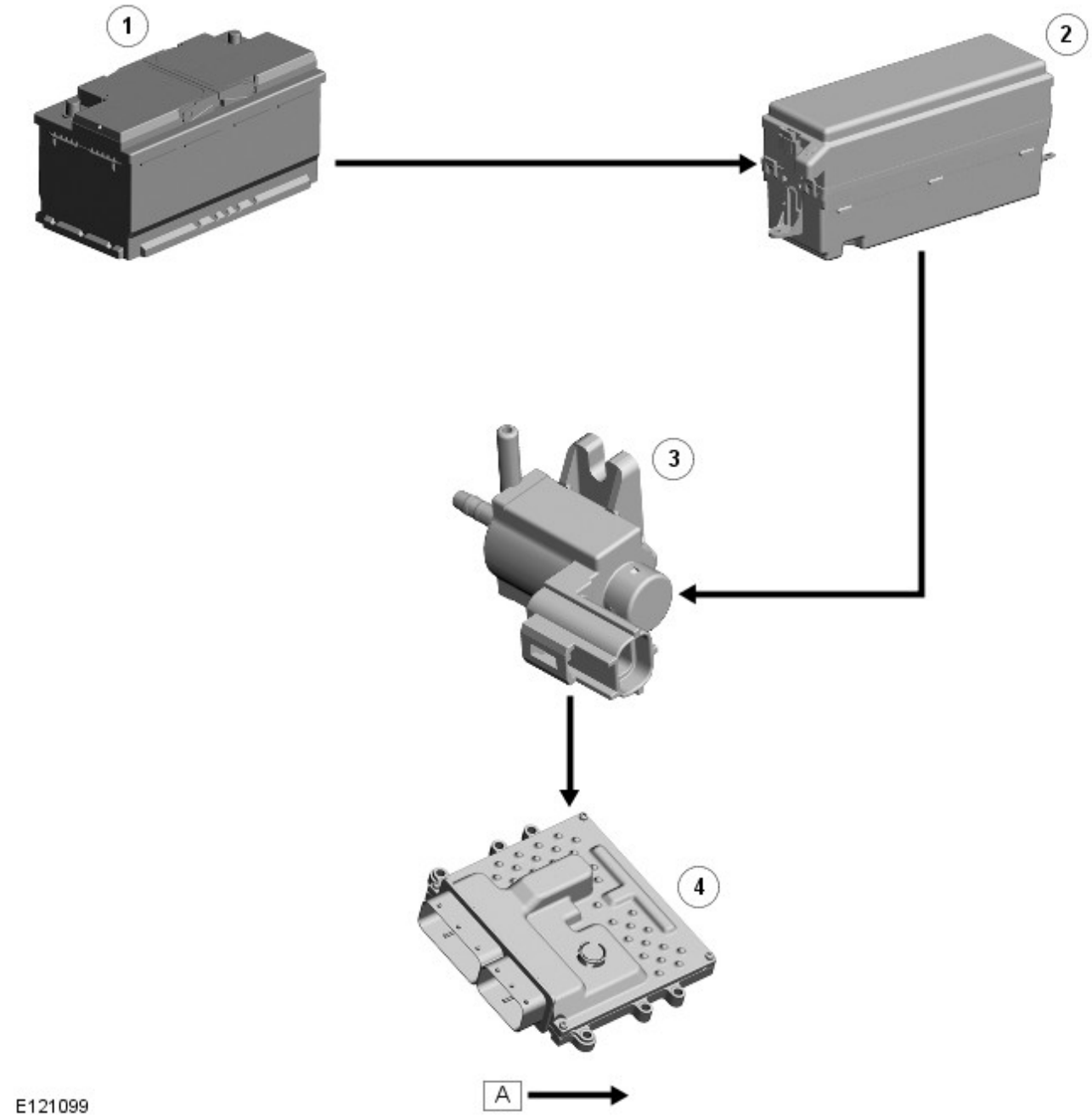
The feedback tube transfers the sound from the symposer system to the resonator. Clips secure the feedback tube to the outlet adapter of the symposer system and to the resonator.

Resonator

The resonator directs the sound from the feedback tube into the passenger compartment. The resonator is installed in the passenger compartment side of the engine bulkhead, on two mounting grommets each consisting of an isolator and a compression limiter.

CONTROL DIAGRAM (NOISE FEEDBACK SYSTEM)

NOTE: A = Hardwired



Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box) (ECM relay)
3	-	Tuning valve
4	-	ECM

OPERATION

Supercharger

At closed or partially open throttle positions, the bypass valve is fully open, allowing a flow of air from the SC outlet back to the inlet side. This results in little or no pressure increase across the SC. Progressive opening of the throttle

reduces the depression downstream of the electric throttle. This is sensed by the pneumatic actuator, which moves to close the bypass valve. As the bypass valve closes there is a corresponding increase in the outlet pressure from the SC, which increases engine power output.

Noise Feedback System

Sound waves from the RH intake manifold are filtered by the calibrated orifice in the inlet pipe connection on the symposer. The sound waves make the paddle oscillate and generate pulsations in the outlet chambers. When the pneumatic valve is open, the pulsations are transmitted through the outlet pipe and feedback tube to the resonator in the passenger compartment.

The tuning valve of the noise feedback system receives a power feed from the ECM relay in the EJB (engine junction box) and is connected to ground through the ECM. At lower engine loads and speeds the ECM keeps the ground open circuit and the tuning valve is de-energized closed. Atmospheric pressure is sensed at the pneumatic valve through the vent cap on the tuning valve, which keeps the pneumatic valve closed and prevents sound from the symposer entering the feedback system.

At higher engine loads and speeds the ECM connects the tuning valve to ground. The tuning valve energizes, blanks off the atmospheric vent and opens the vacuum line between the brake vacuum system and the pneumatic valve. The depression in the brake vacuum system is sensed at the pneumatic valve, which opens and allows sound from the symposer into the feedback system.

The status of the pneumatic valve at various engine loads and speeds is given below:

Pneumatic Valve Status

NOTE: Values are for valve opening with increasing engine load and speed. Deduct 0.05 g/rev and 50 rev/min for valve closing with decreasing engine load and speed.

Engine Load: g/rev	Engine Speed: rev/min							
	0	500	1000	2500	3000	4000	5800	6500
1.30	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
1.35	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
1.40	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Open
1.60	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Open
1.80	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Open
2.50	Closed	Closed	Closed	Closed	Closed	Open	Open	Open
3.00	Closed	Closed	Closed	Closed	Closed	Open	Open	Open
3.50	Closed	Closed	Closed	Open	Open	Open	Open	Open

Published: 16-Aug-2012

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Intake Air Distribution and Filtering

Diagnosis and Testing

Principles of Operation

For a detailed description of the intake air distribution and filtering system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Intake Air Distribution and Filtering (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Hoses and ducts (damage/connections) • Air filter (contaminated/blocked) • Restricted air intake • Supercharger • Supercharger drive belt • Supercharger seals and gaskets • Charge air coolers (damage/connection)	• Mass Air Flow (MAF) sensor • Manifold Absolute Pressure (MAP) sensor • Manifold Absolute Pressure/Temperature (MAPT) sensor • Throttle body • Harness (security/damage) • Connections (security/damage)

3. 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.

Symptom Chart

Symptom	Possible Causes	Action
Vehicle does not start/hard starting/poor performance	• Restricted/blocked air intake • Restricted/blocked air filter	• Clear the restriction • Install a new air filter as necessary
Excessive intake noise	• Intake pipe disconnected/damaged after the air cleaner • Air cleaner assembly incorrectly assembled/damaged	• Check the intake system and hoses for correct installation/damage • Check the air cleaner assembly for correct installation/damage
Lack of boost	• Supercharger drive belt broken/slipping • Supercharger fault • Supercharger air intake fault • Major air leakage (after the supercharger)	• Check the supercharger and drive belt • Check the charge air coolers
Noise	• Supercharger drive belt slipping • Supercharger fault • Major air leakage (after the supercharger)	• Check the supercharger and drive belt • Remove the supercharger drive belt and recheck for noise. Turn the supercharger by hand and check for excessive resistance. Check for excessive play at the supercharger pulley • Check the charge air coolers

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 11-May-2011

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Air Cleaner Outlet Pipe T-Connector

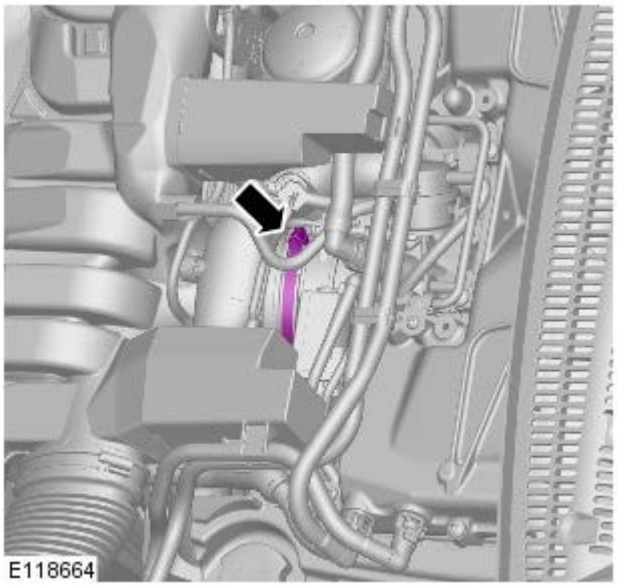
Removal and Installation

Removal

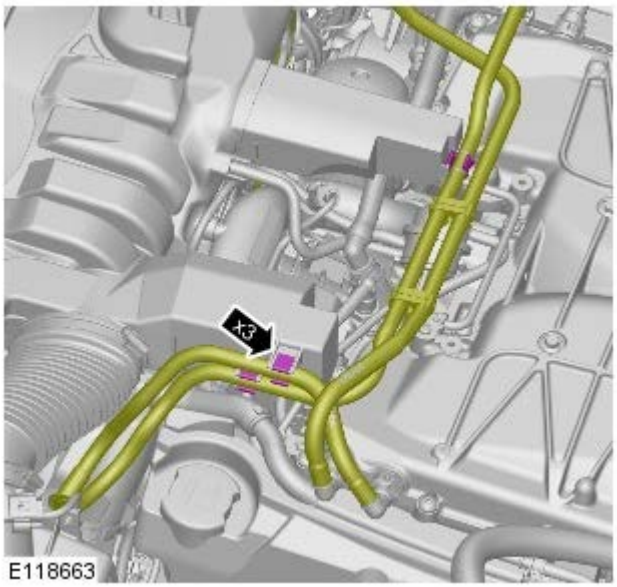
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

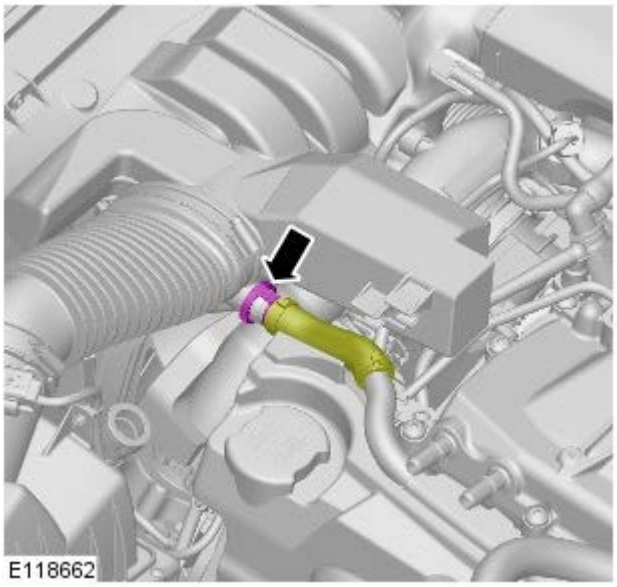
2. *Torque:* 3.5 Nm



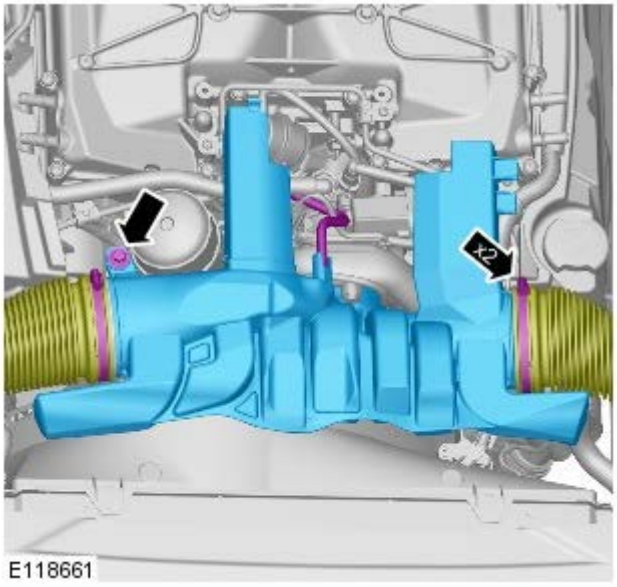
3.



4.



5. *Torque:* 10 Nm



Installation

1. To install, reverse the removal procedure.

Published: 25-Apr-2013

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Charge Air Cooler

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

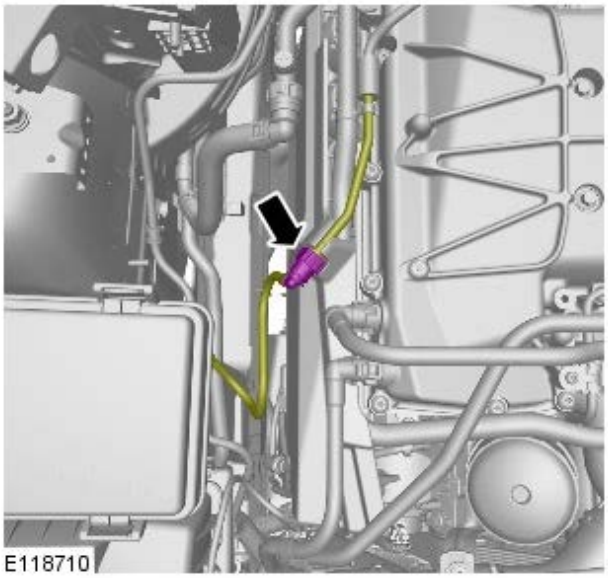
   Raise and support the vehicle.

2. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

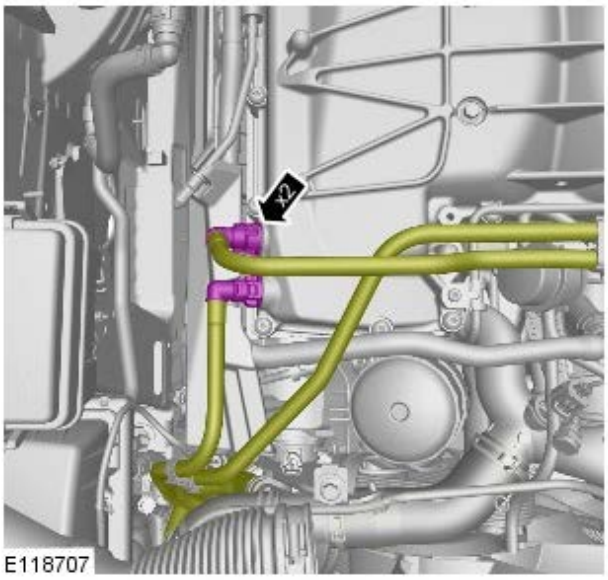
3. Refer to: Fuel Injection Component Cleaning (303-04D Fuel Charging and Controls - V8 S/C 5.0L Petrol, General Procedures).

4. Refer to: Fuel System Pressure Release - V8 5.0L Petrol/V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

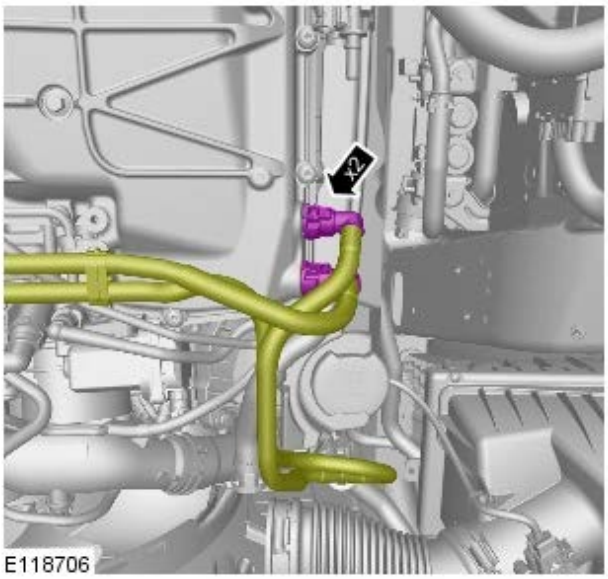
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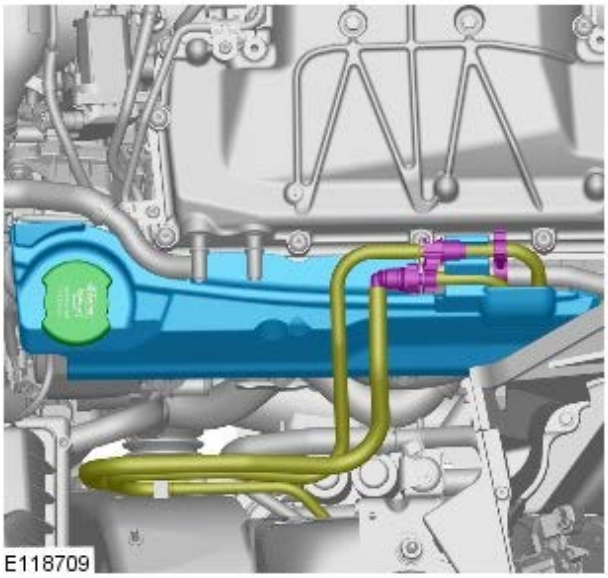
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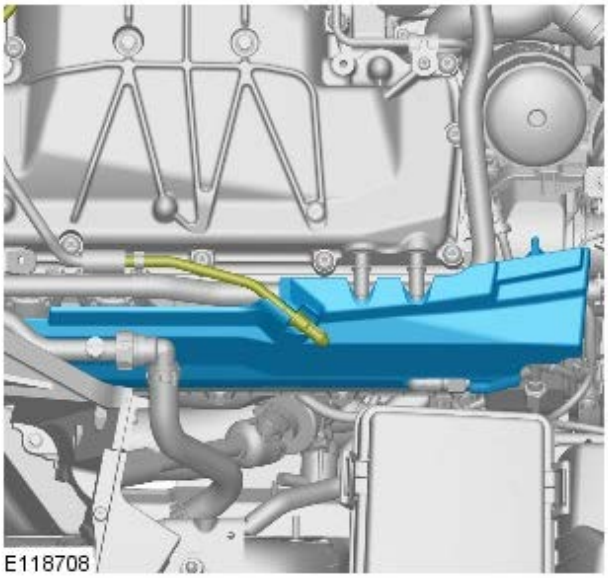
7.



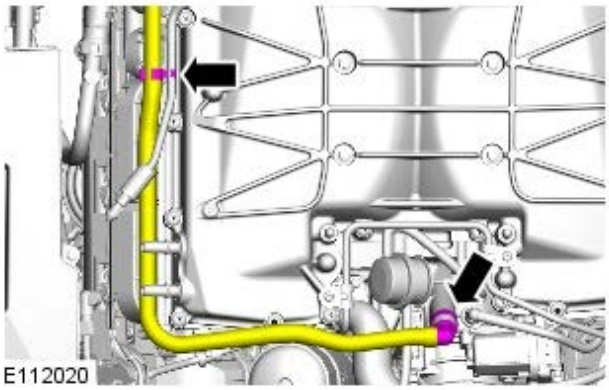
8. CAUTION: Be prepared to collect escaping fluids.

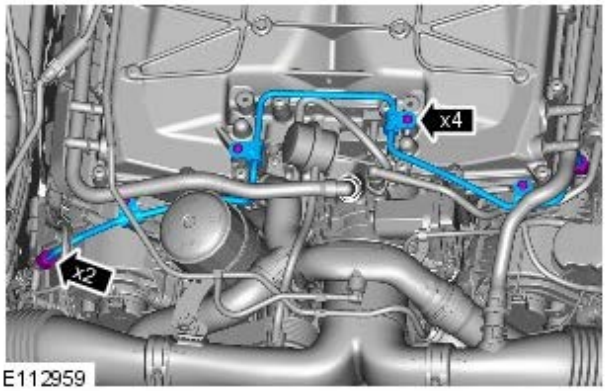


9.



10.





11. 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.

    CAUTIONS:

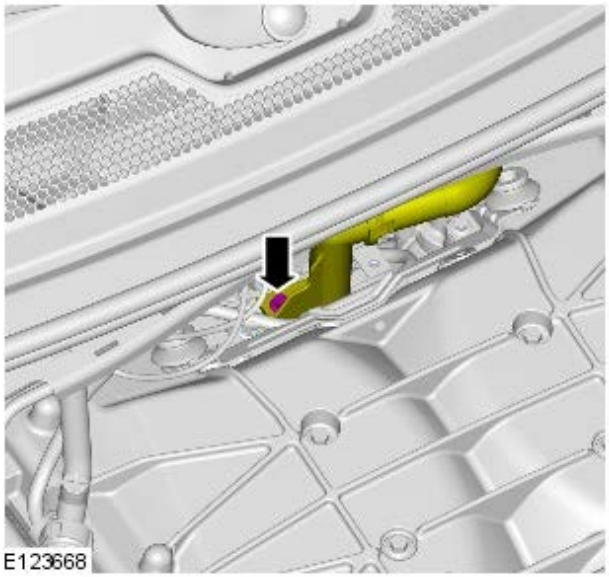
    Make sure that the fuel line union does not rotate.

    Be prepared to collect escaping fluids.

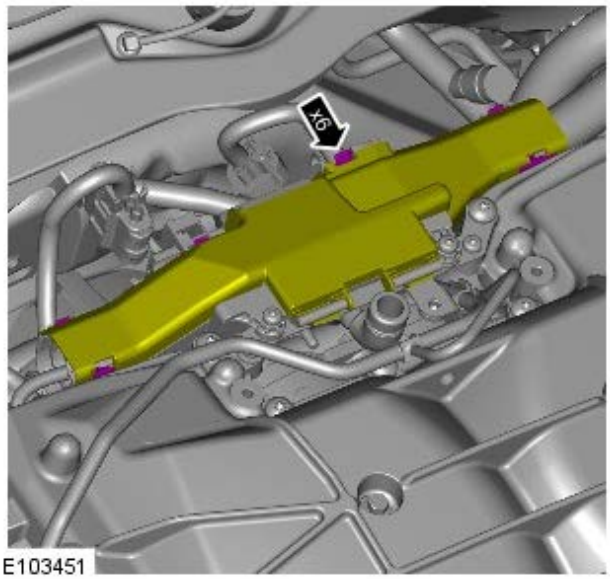
    Make sure that all openings are sealed. Use new blanking caps.

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

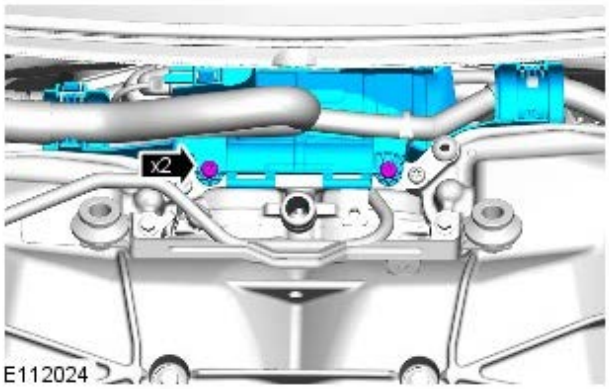
12. *Torque:* 10 Nm



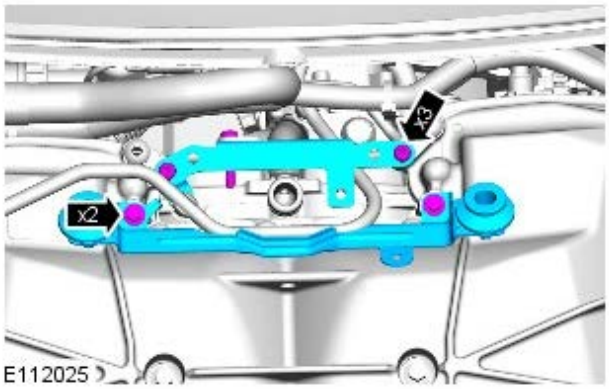
13. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



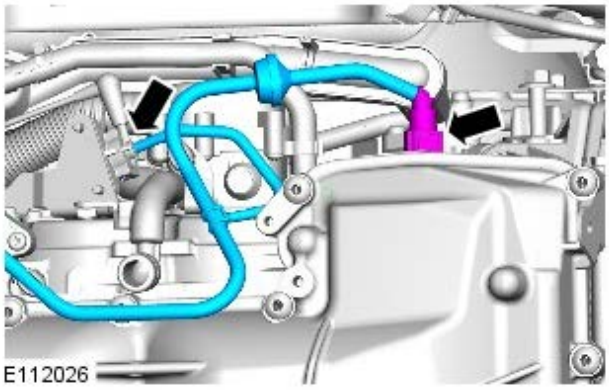
14. *Torque:* 10 Nm



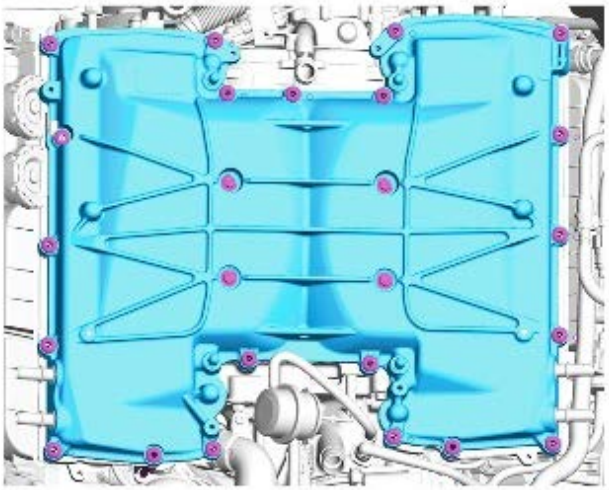
15. *Torque:* 10 Nm



16.



17. NOTE: Remove and discard the gasket.



E120312

Installation

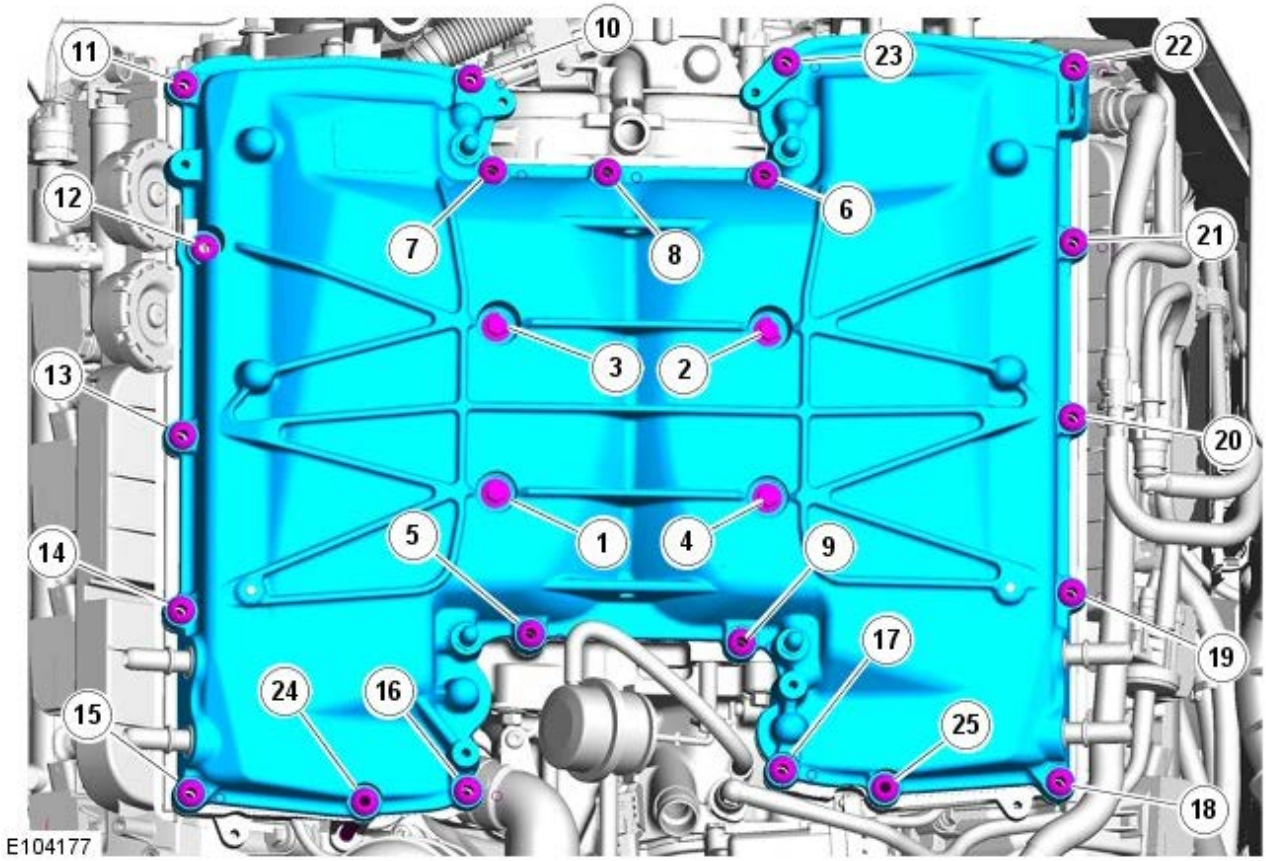
1. To install, reverse the removal procedure.
2. NOTES:

   Install and finger tighten bolts in sequence illustrated.

   Tighten the bolts in the indicated sequence.

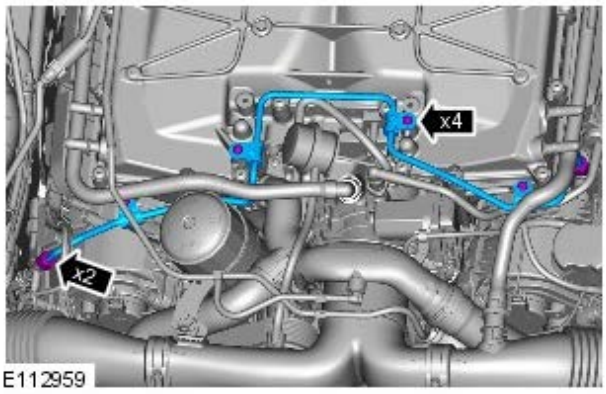
   Install a new gasket.

   Torque: 25 Nm



E104177

3. 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.

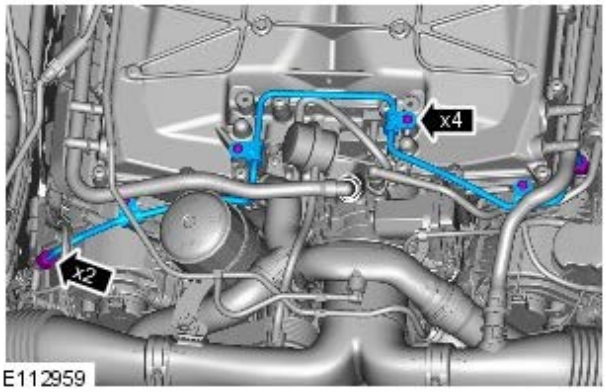
CAUTION: Lubricate only the union threads with clean engine oil.

NOTES:

Do not tighten at this stage.

Remove and discard the blanking caps.

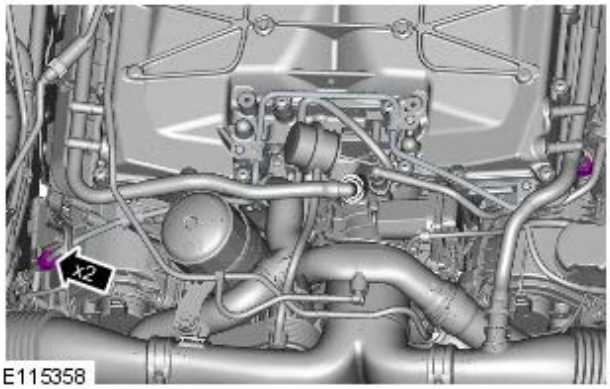
Some variation in the illustrations may occur, but the essential information is always correct.



4. 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.

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

Torque:
Union 21 Nm
M6 12 Nm



5. WARNINGS:

Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow these instructions may result in personal injury.

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

Torque: 21 Nm

Published: 04-Apr-2013

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Supercharger

Removal and Installation

Special Tool(s)

 E115267	303-1449-01 Supercharger Installation Guide Pins - Threaded
 E115267	303-1449-02 Supercharger Installation Guide Pins - Unthreaded

Removal

CAUTION: If a new cylinder head has been installed, then new taptite bolts must be used to install the supercharger.

NOTES:

New taptite bolts when used cut their own threads on the first application.

Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

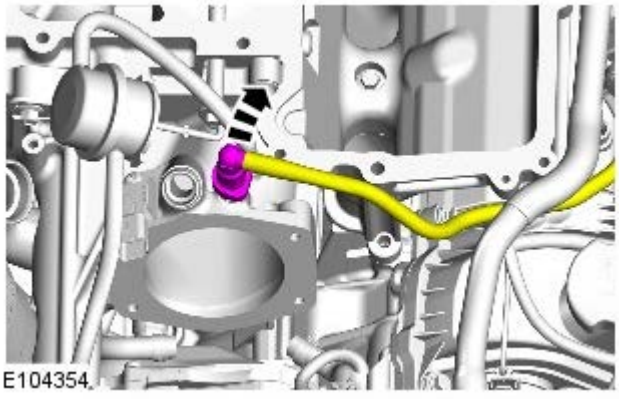
   Raise and support the vehicle.

2. Refer to: Supercharger Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

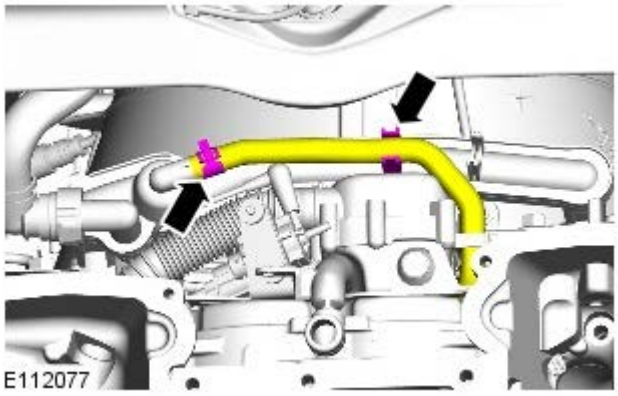
3. Refer to: Throttle Body (303-04D Fuel Charging and Controls - V8 S/C 5.0L Petrol, Removal and Installation).

4. Refer to: Charge Air Cooler (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

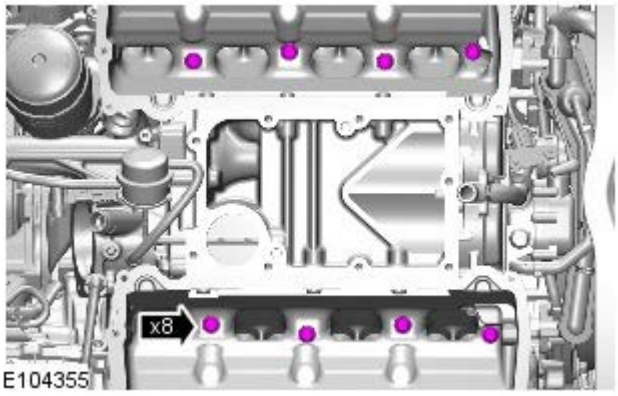
5.


E104354

6.

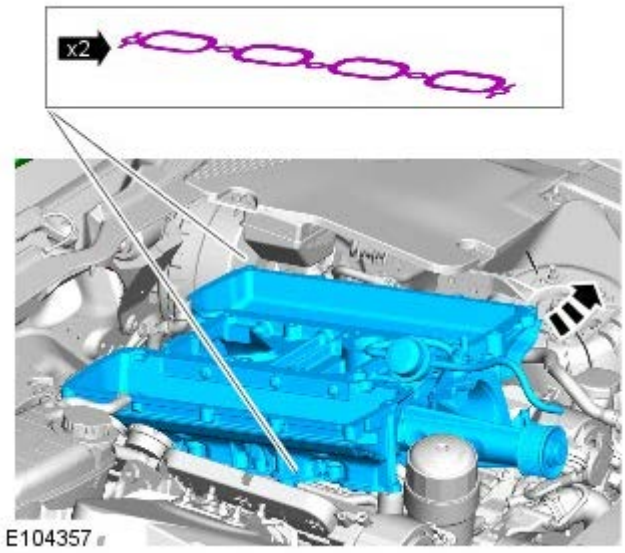


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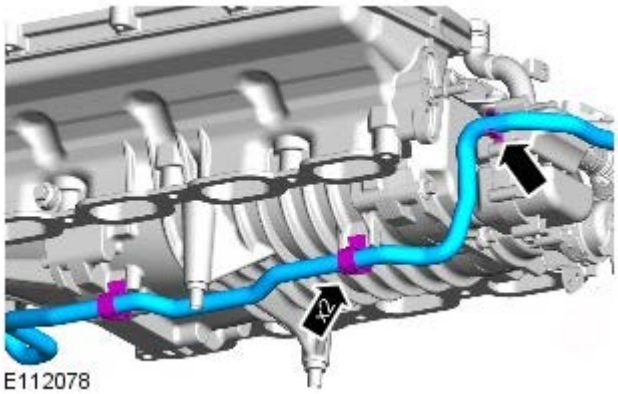


8. NOTE: Detatch component but do not remove at this stage.

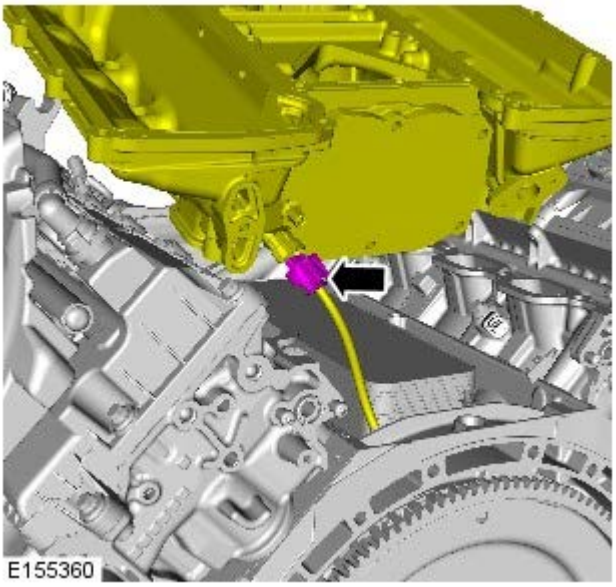
Discard the gaskets.



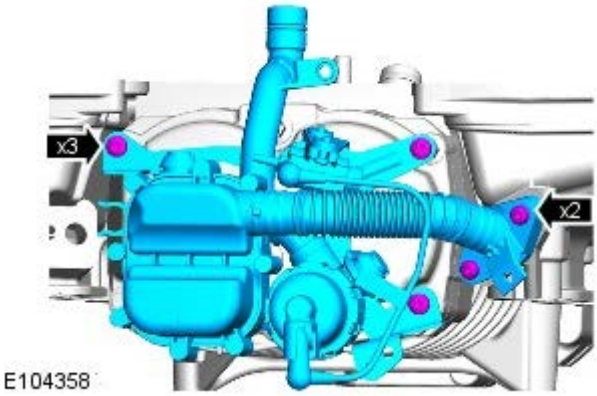
9.



10. CAUTION: Make sure the wiring harness and electrical connectors are not damaged during this operation.

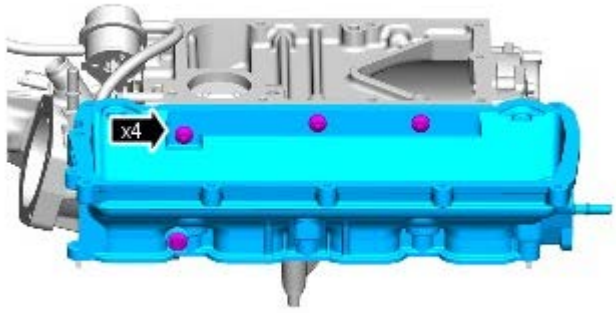

E155360

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



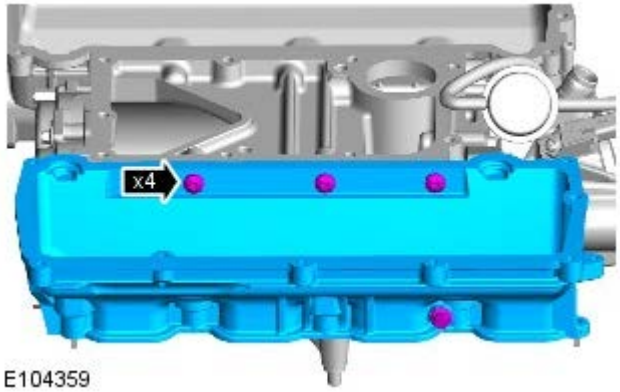
E104358

12. *Torque:* 25 Nm



E104360

13.



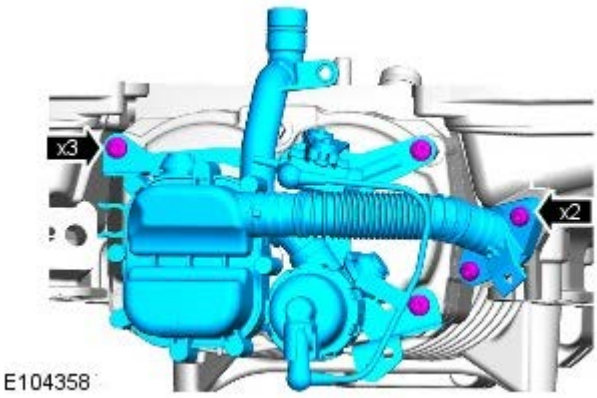
E104359

Installation

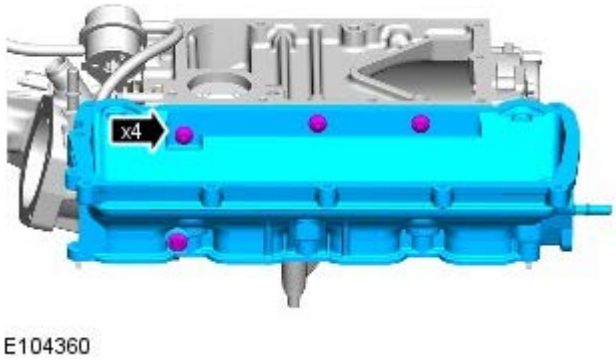
CAUTION: If a new cylinder head has been installed, then new taptite bolts must be used to install the supercharger.

NOTE: New taptite bolts when used cut their own threads on the first application.

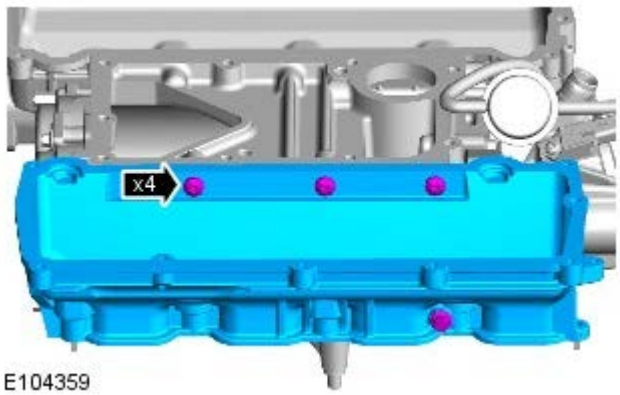
1. *Torque:* 10 Nm



2. *Torque:* 25 Nm



3. *Torque:* 25 Nm



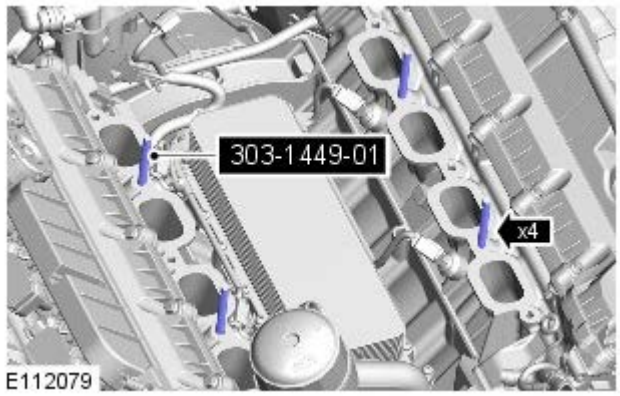
4. CAUTIONS:

   If a new cylinder head has been installed then the special tool 303-1449-02 without the thread must be used to install the supercharger.

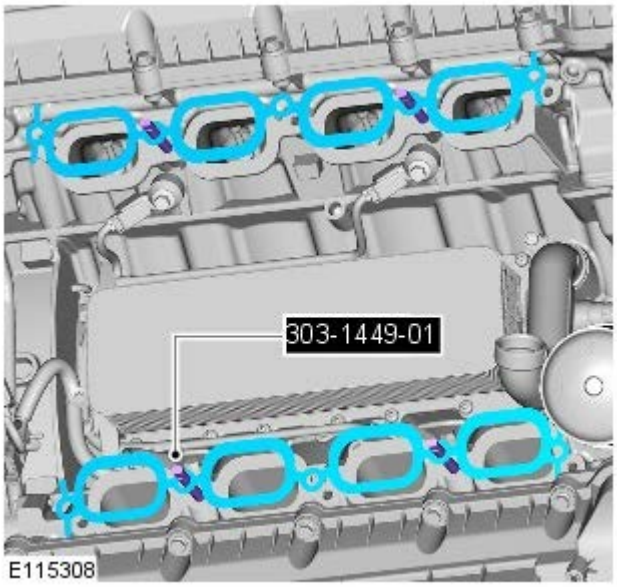
   If a new cylinder head has been installed, then new taptite bolts must be used to install the supercharger.

   NOTE: New taptite bolts when used cut their own threads on the first application.

   - *Special Tool(s):* 303-1449-01
   - *Special Tool(s):* 303-1449-02



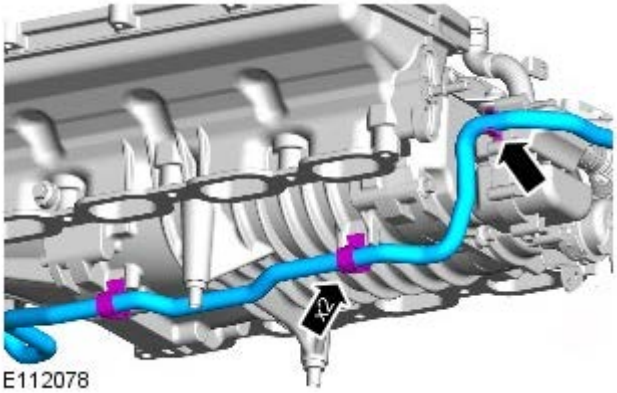
5. CAUTION: Make sure that the mating faces



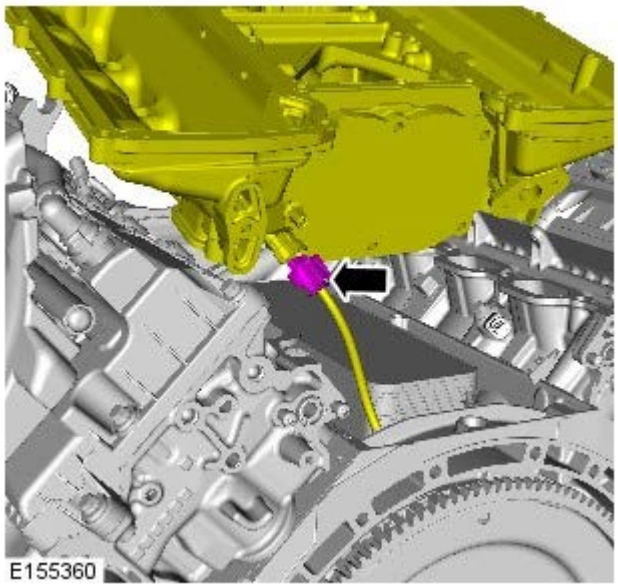
are clean and free of foreign material.

- Install new gaskets.

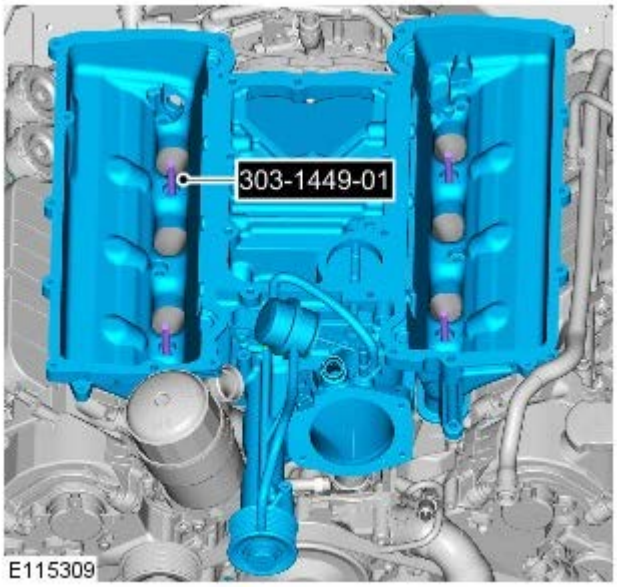
6.

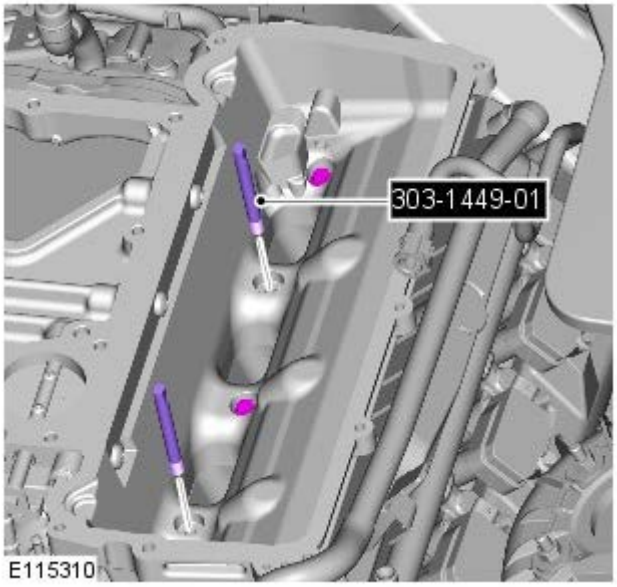


7.



8. CAUTION: Make sure that the mating faces are clean and free of foreign material.

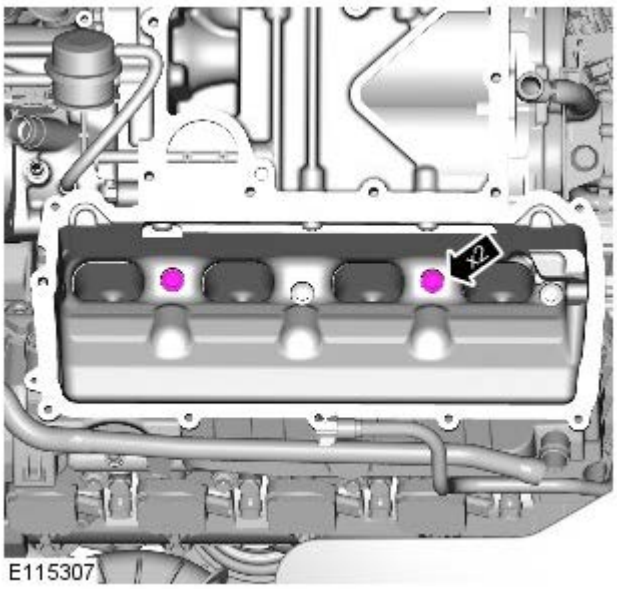




9. CAUTION: If a new cylinder head has been installed then the special tool 303-1449-02 without the thread must be used to install the supercharger.

   NOTE: Left-hand shown, right-hand similar.

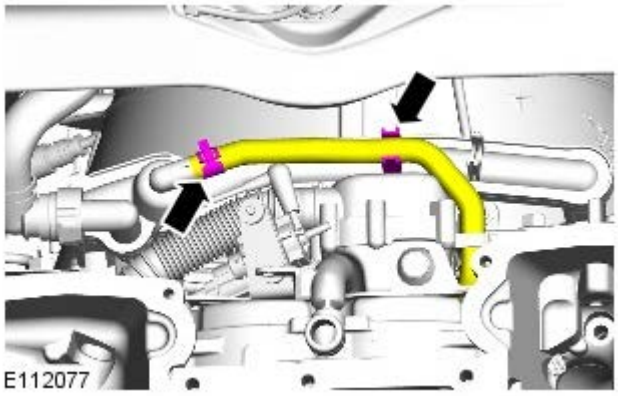
   Torque: 25 Nm



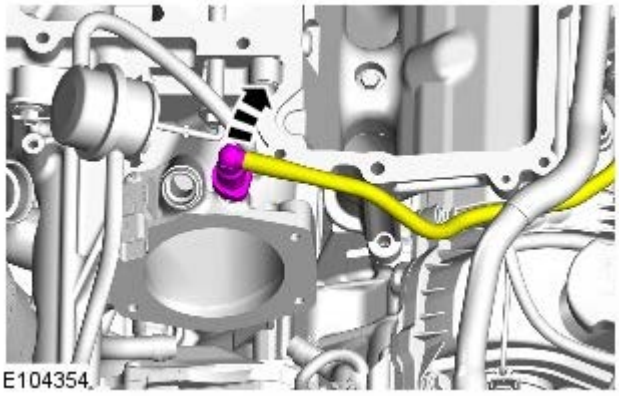
10. NOTE: Left-hand shown, right-hand similar.

    Torque: 25 Nm

11.



12.



13. Refer to: Charge Air Cooler (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

14. Refer to: Throttle Body (303-04D Fuel Charging and Controls - V8 S/C 5.0L Petrol, Removal and Installation).

15. Refer to: Supercharger Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

Published: 11-May-2011

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Air Cleaner Element

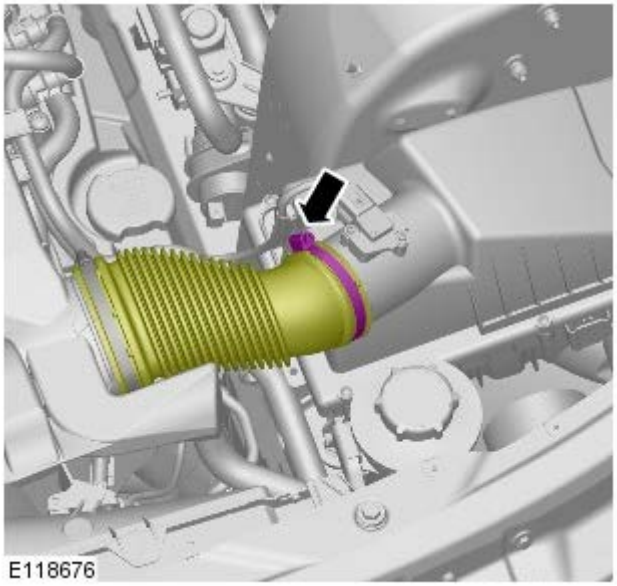
Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

Air cleaner elements must be renewed in pairs.

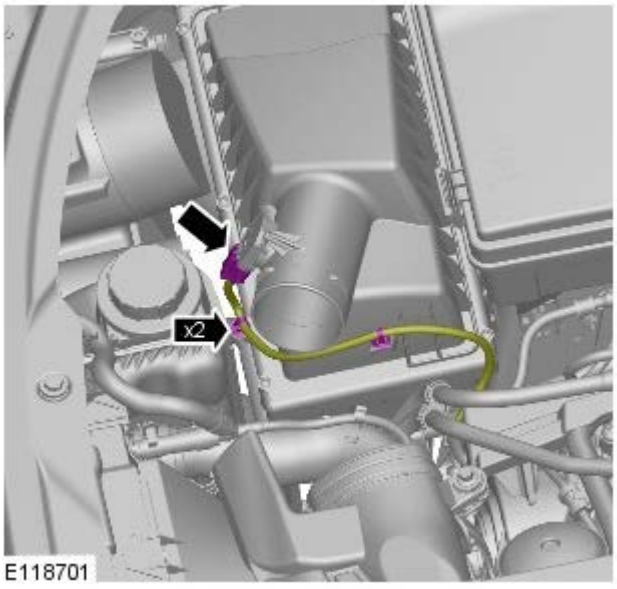


1. NOTES:

   Left-hand shown, right-hand similar.

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

   Torque: 3.5 Nm



2. NOTES:

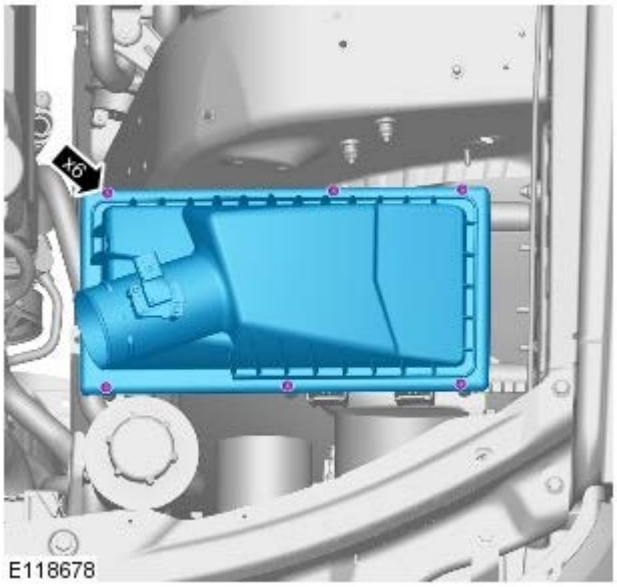
   Left-hand shown, right-hand similar.

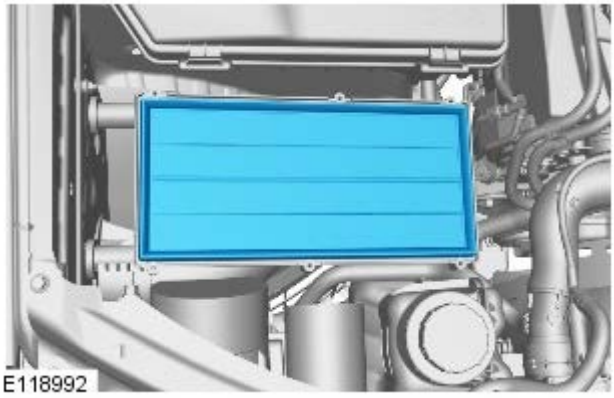
   Some variation in the illustrations may occur, but the essential information is always correct.

3. NOTES:

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

   Left-hand shown, right-hand similar.





4. NOTES:

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

   Right-hand shown, left-hand similar.

   - Repeat the above procedure for the other side.

Installation

1. To install reverse the removal procedure.

Published: 11-May-2011

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Air Cleaner LH

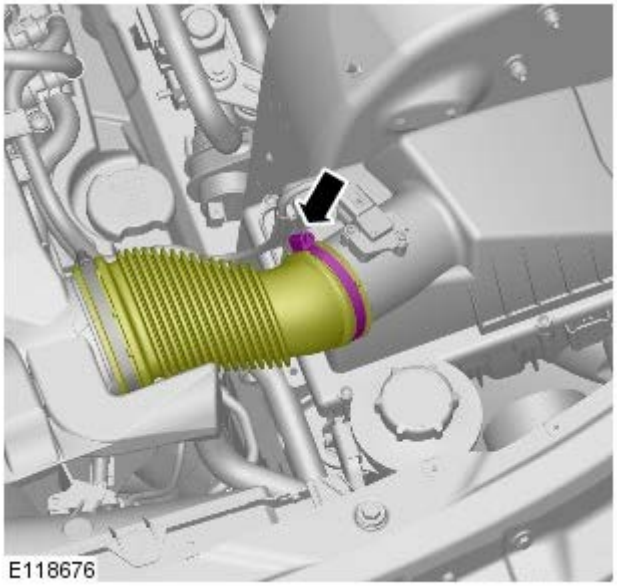
Removal and Installation

Removal

NOTES:

Removal steps in this procedure may contain installation details.

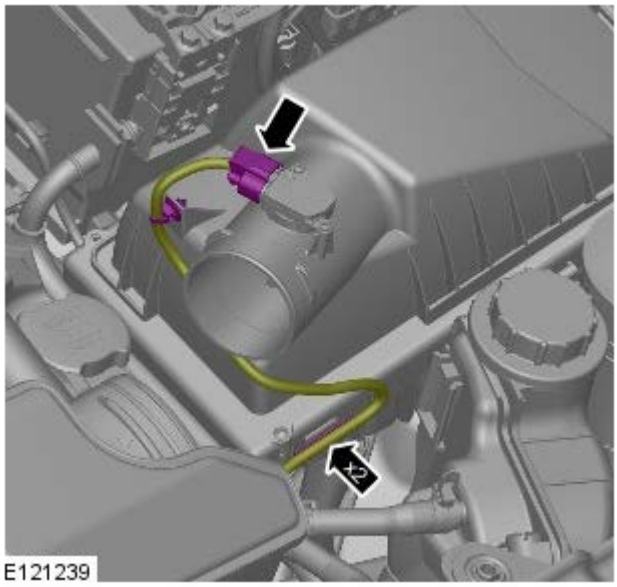
The ignition must be switched off.



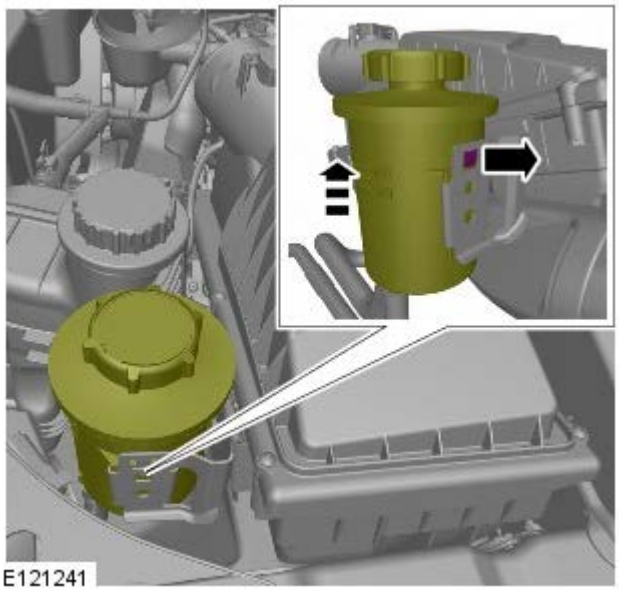
1. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

   Torque: 3.5 Nm

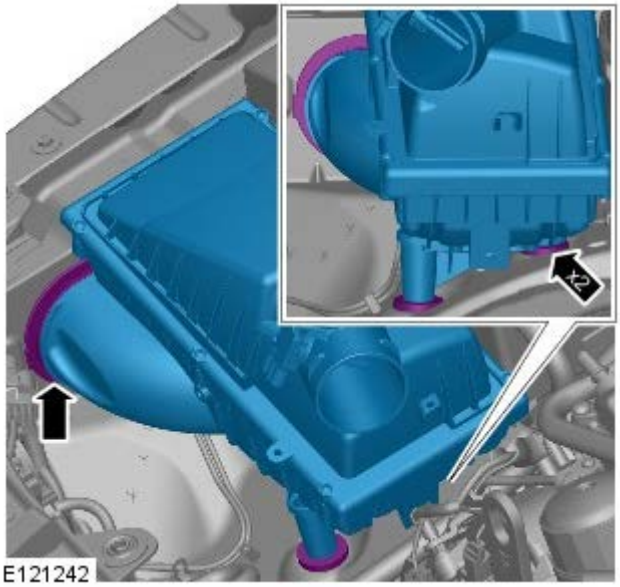
2.



3.


E121241

4. NOTE: Right-hand shown, left-hand similar.

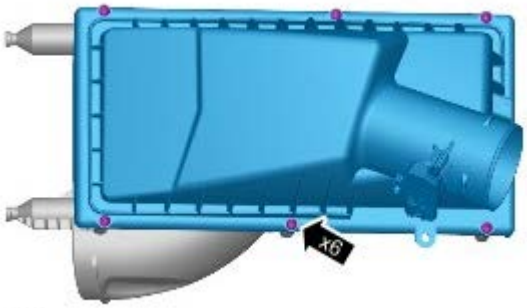


E121242

5. NOTES:

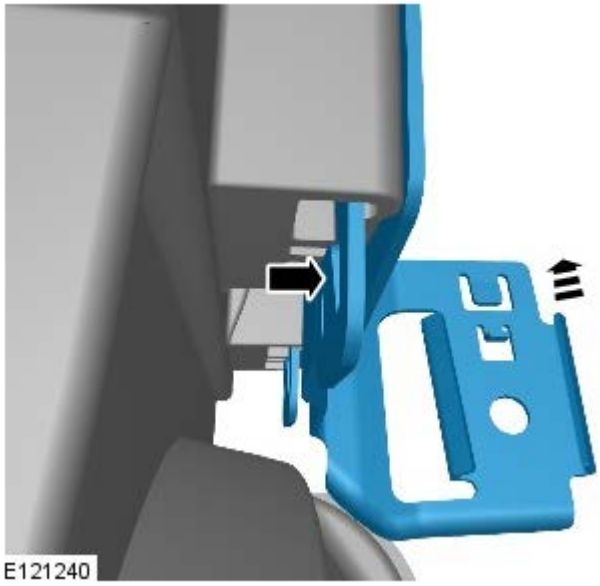
   Do not disassemble further if the component is removed for access only.

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



E118991

6.



7.



Installation

1. To install reverse the removal procedure.

Published: 11-May-2011

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Air Cleaner RH

Removal and Installation

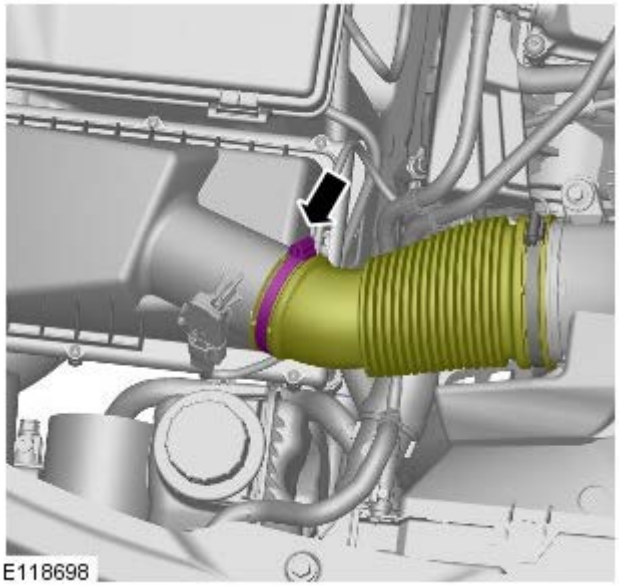
Removal

NOTES:

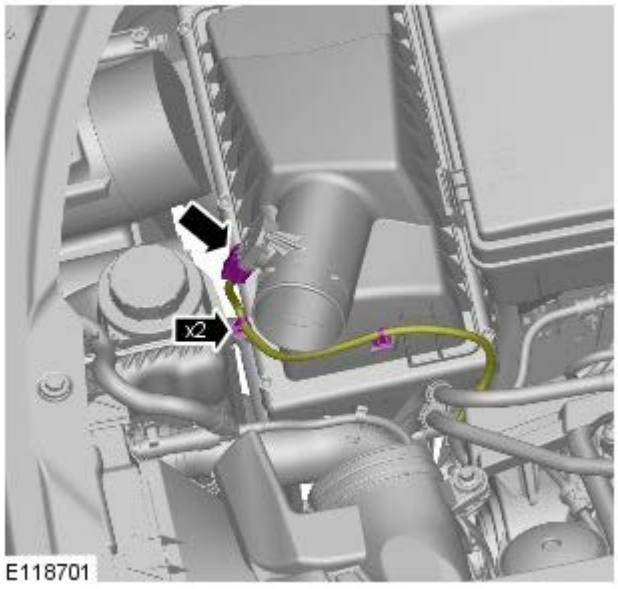
Removal steps in this procedure may contain installation details.

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

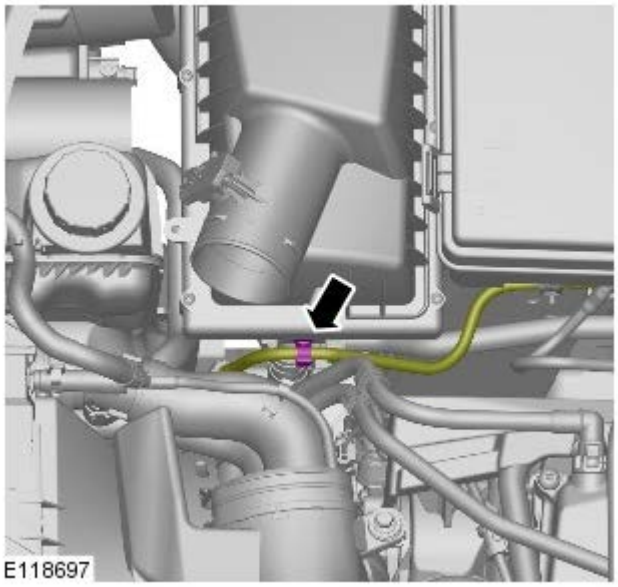
1. *Torque:* 3.5 Nm



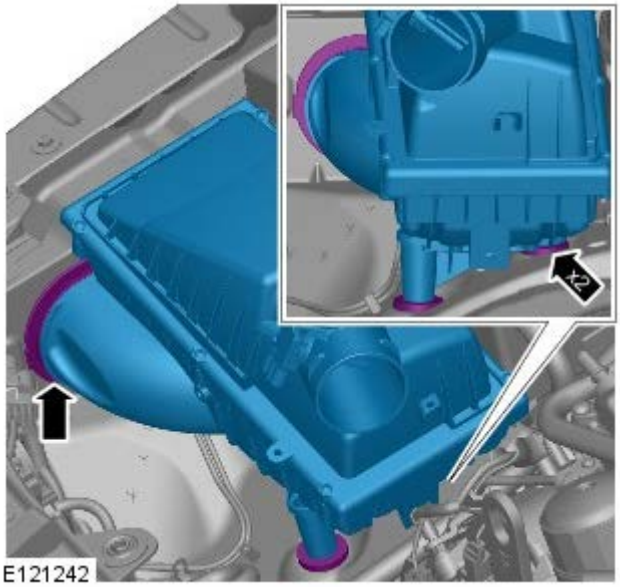
2.



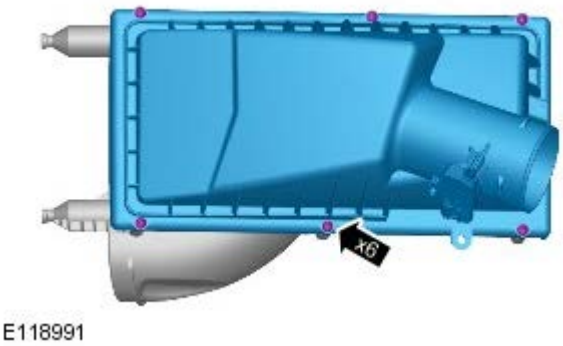
3.



4.



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



6.



E121597

Installation

1. To install reverse the removal procedure.

Published: 11-May-2011

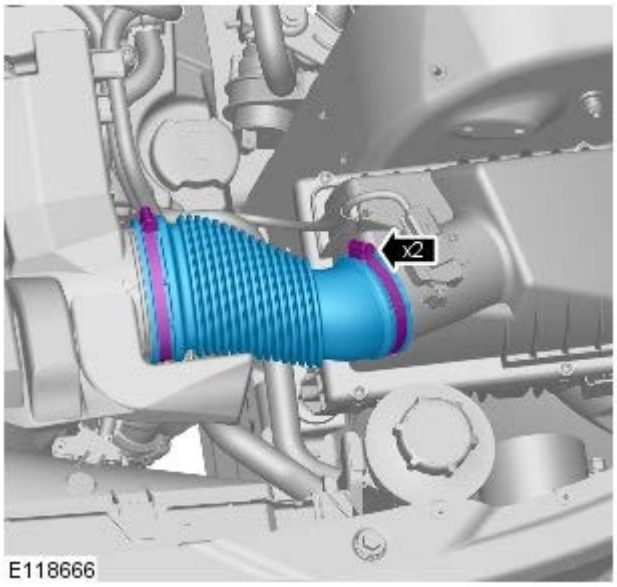
Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Air Cleaner Outlet Pipe LH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).



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

   Torque: 3.5 Nm

Installation

1. To install reverse the removal procedure.

Published: 11-May-2011

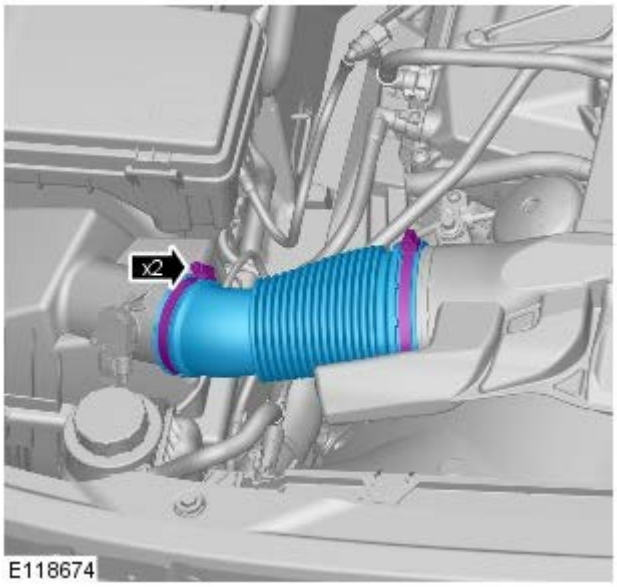
Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Air Cleaner Outlet Pipe RH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).



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

   Torque: 3.5 Nm

Installation

1. To install reverse the removal procedure.

Published: 18-Nov-2013

Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol - Supercharger Spring Isolator

Removal and Installation

Removal

CAUTION: Make sure that all open ports are covered to prevent any foreign material ingress.

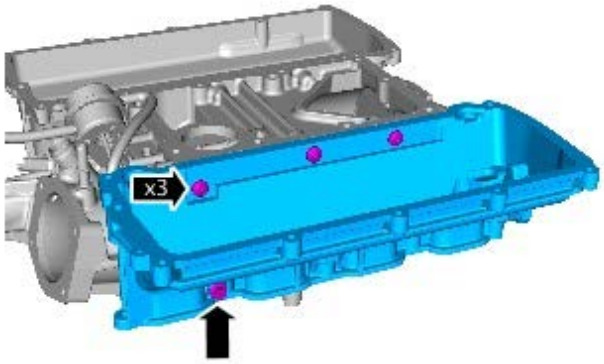
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

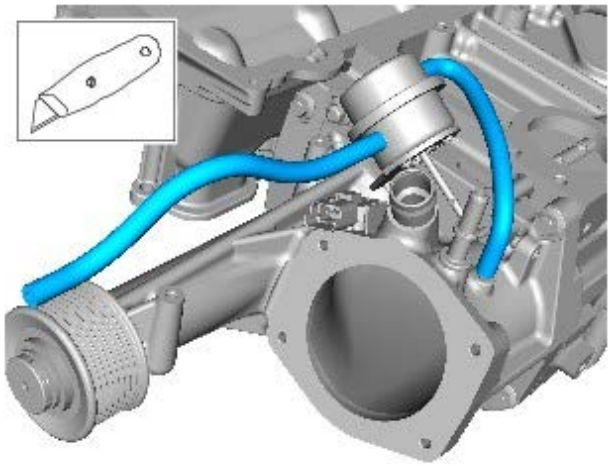
   Raise and support the vehicle.

2. Refer to: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

3.



E160352



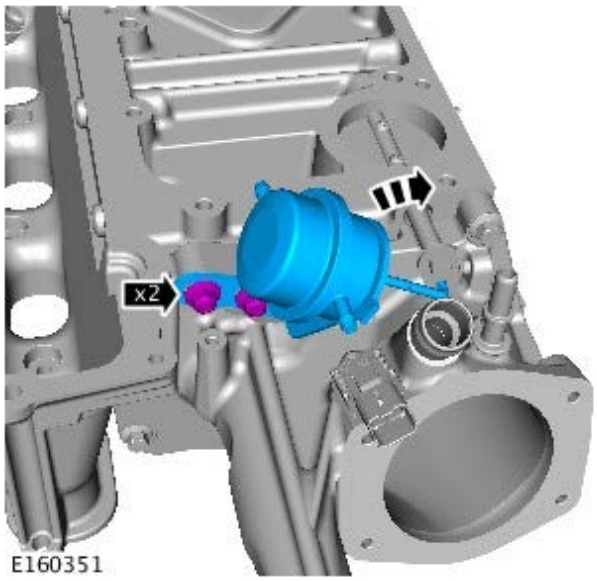
E160350

4. NOTES:

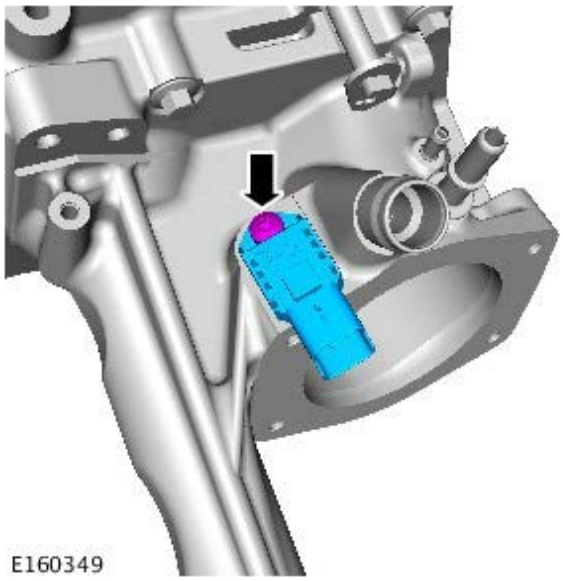
   Note the orientation prior to removal.

   Hoses must be cut off to prevent damage to the actuator.

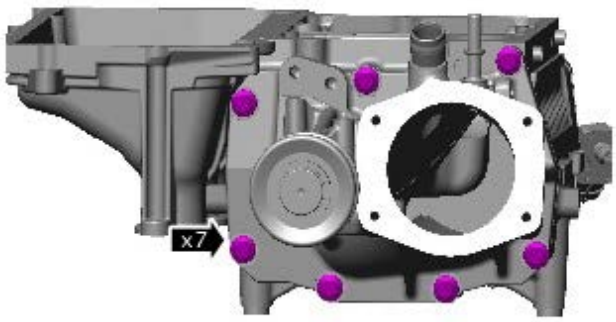
5.



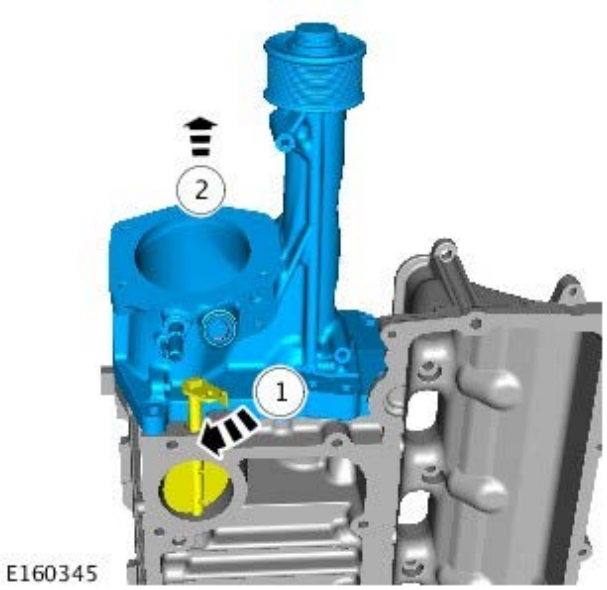
6.



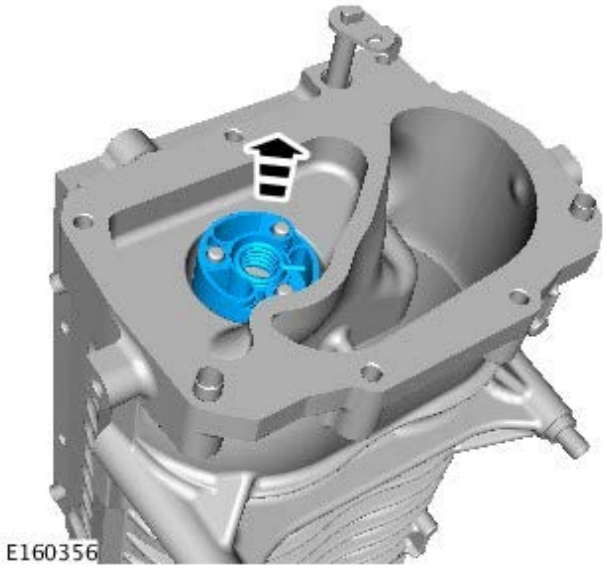
7.



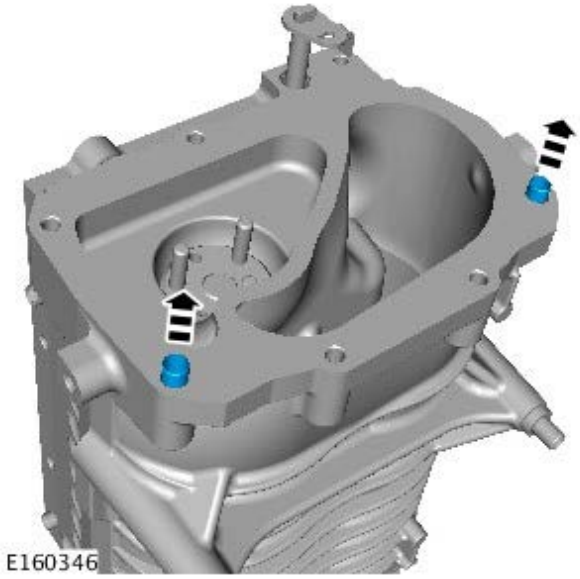
8. CAUTION: Make sure the actuator arm is rotated to allow the front cover to be removed. Failure to follow this instruction may result in damage to the component.



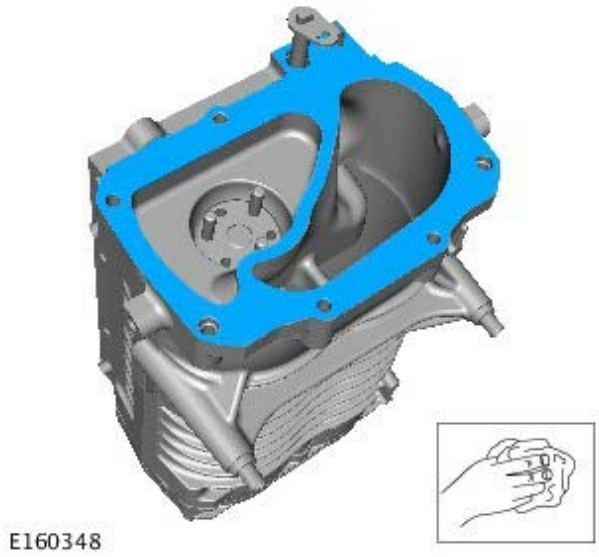
9. CAUTION: Make sure that all open ports are covered to prevent any foreign material ingress.



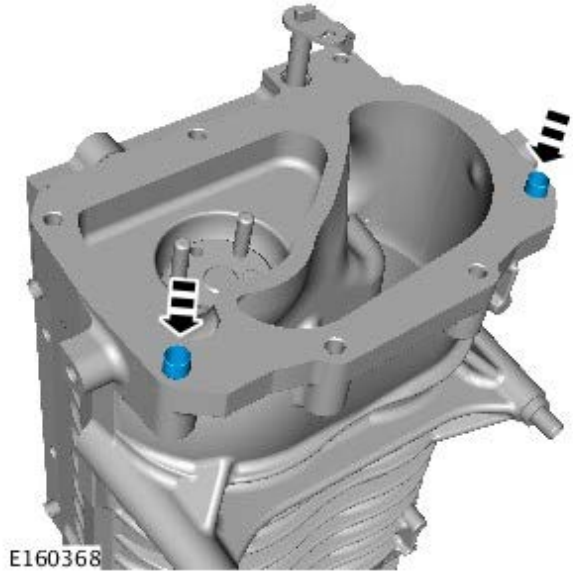
10.



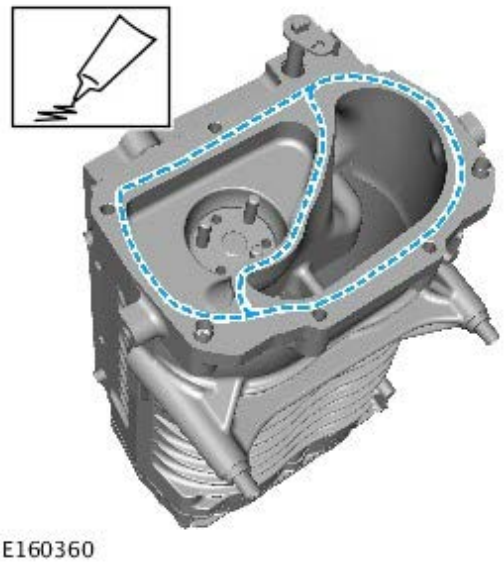
11. CAUTION: Make sure that all open ports are covered to prevent any foreign material ingress.


E160348

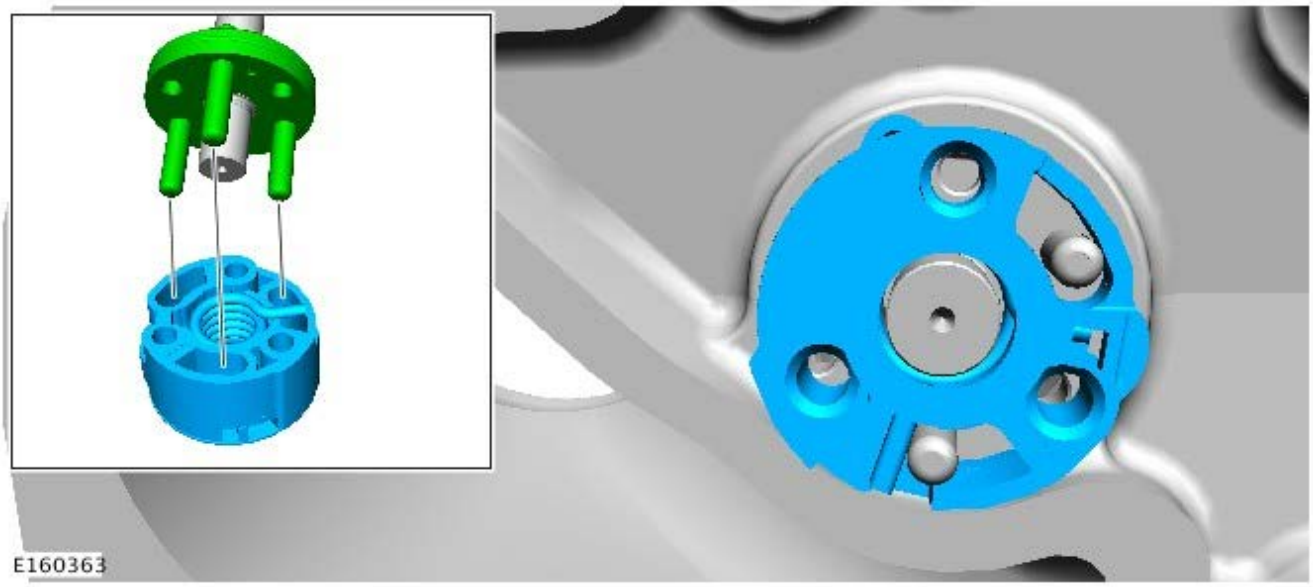
Installation


E160368

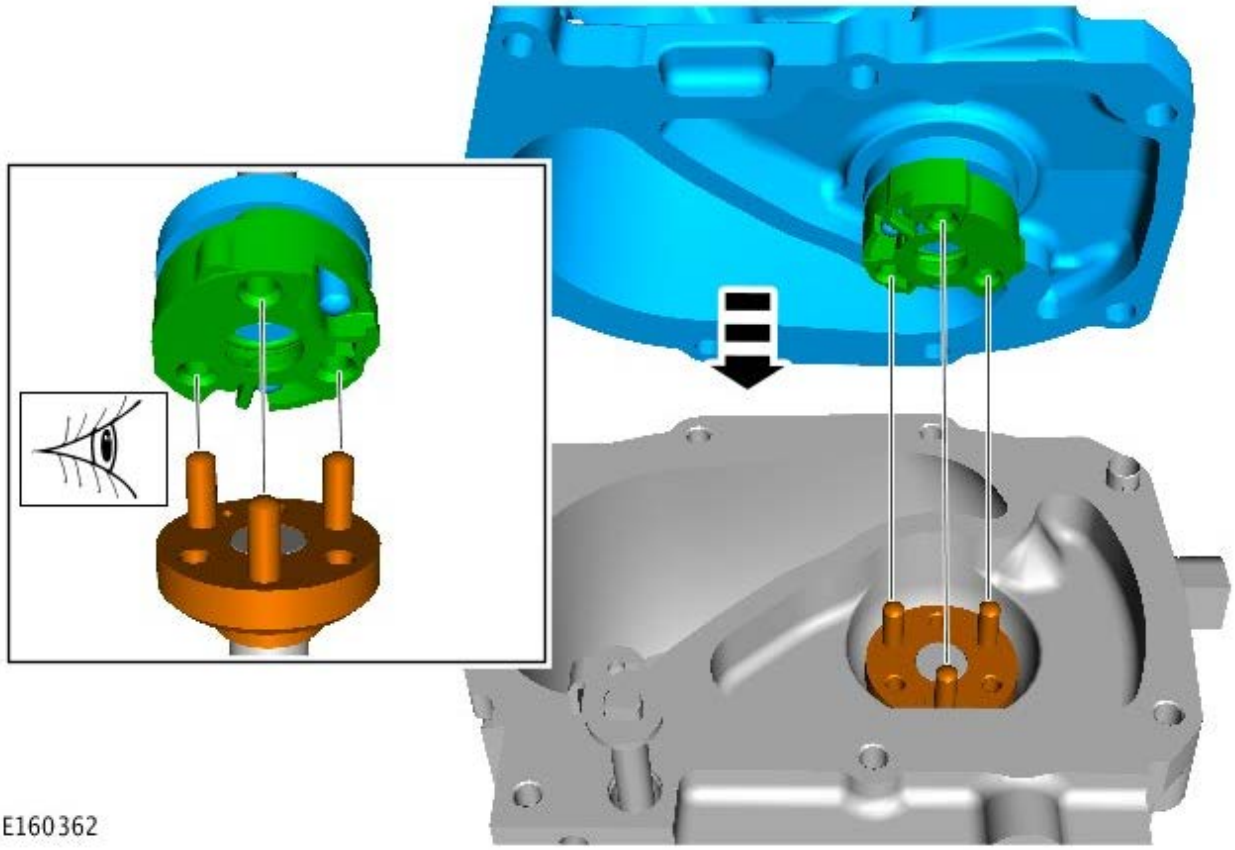
1. CAUTION: Make sure that all open ports are covered to prevent any foreign material ingress.


E160360

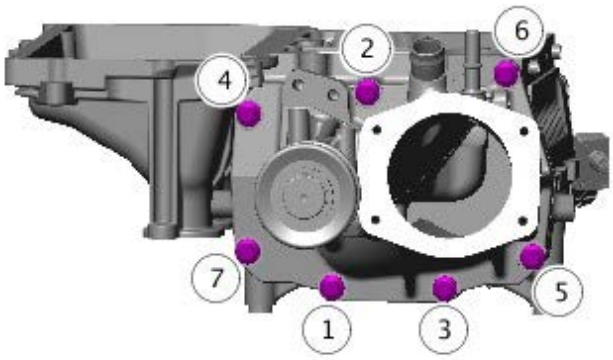
2. CAUTION: Apply a continuous bead of gasket sealant as shown on the illustration. The application of the sealant must be 1mm diameter. Install the component immediately after applying the sealant without smearing the sealant.



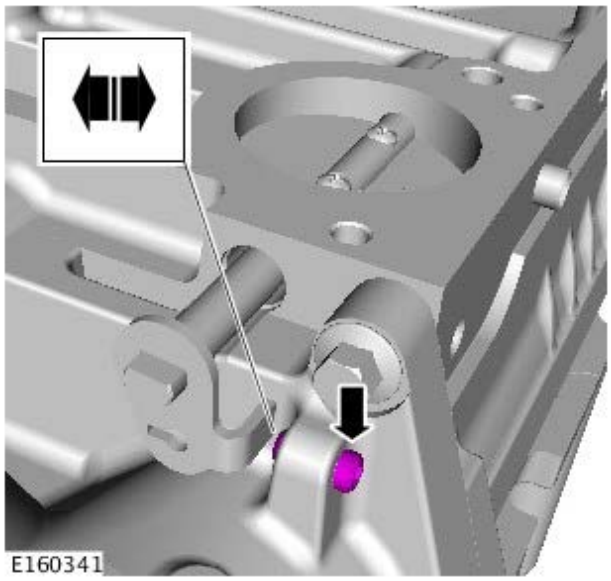
4.



5. *Torque:* 27 Nm



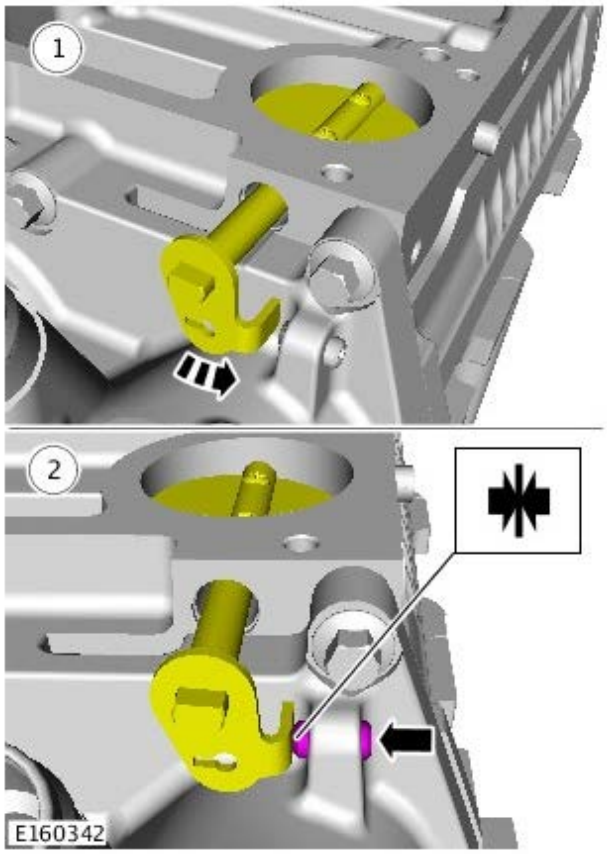
E160365



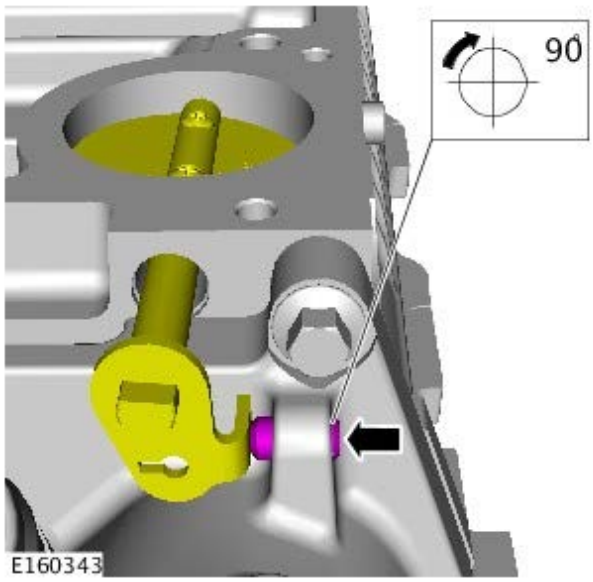
E160341

6. NOTE: Loosen the adjustment screw.

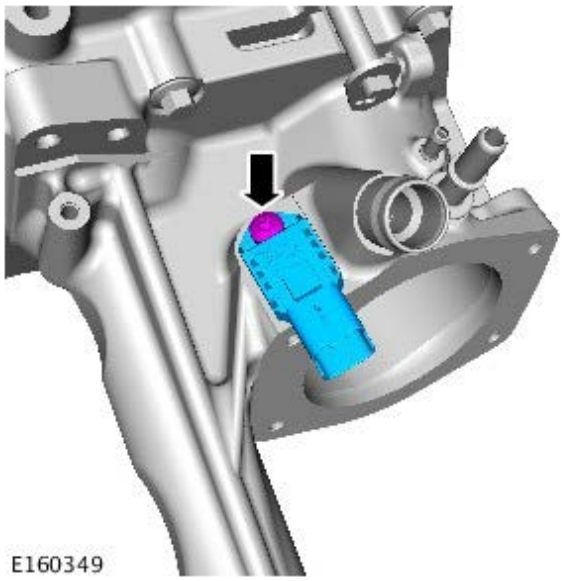
7.
   1. Using light pressure rotate the arm clockwise and hold.
   2. Tighten the adjustment screw until no gap is visible.



8.

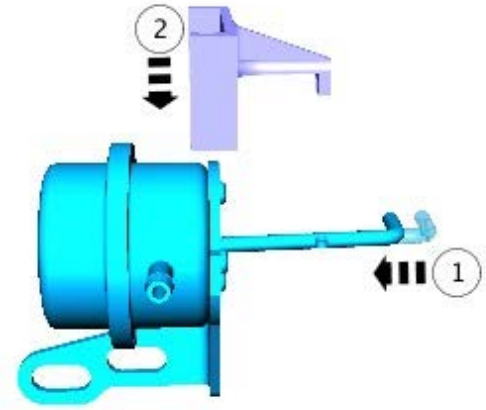


9. *Torque:* 5 Nm



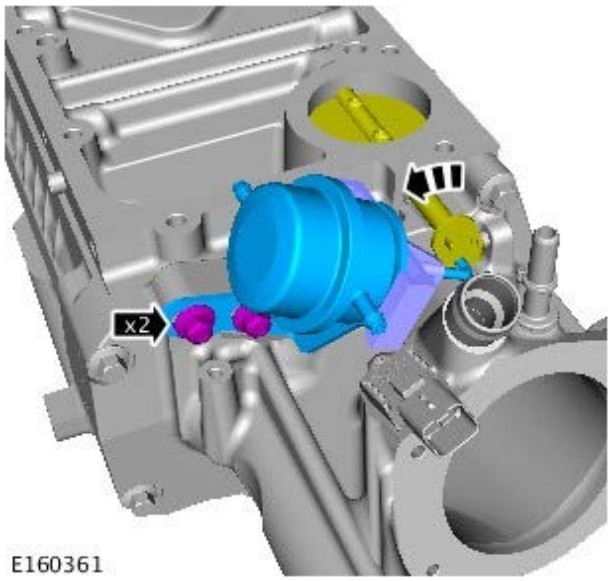
E160349

10. Assemble the installation tool, supplied, to the actuator.



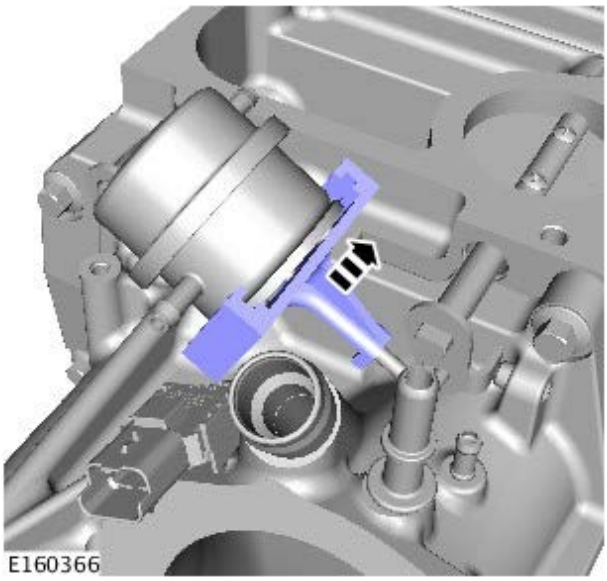
E160364

11. *Torque:* 20 Nm



E160361

12. Remove the installation tool.

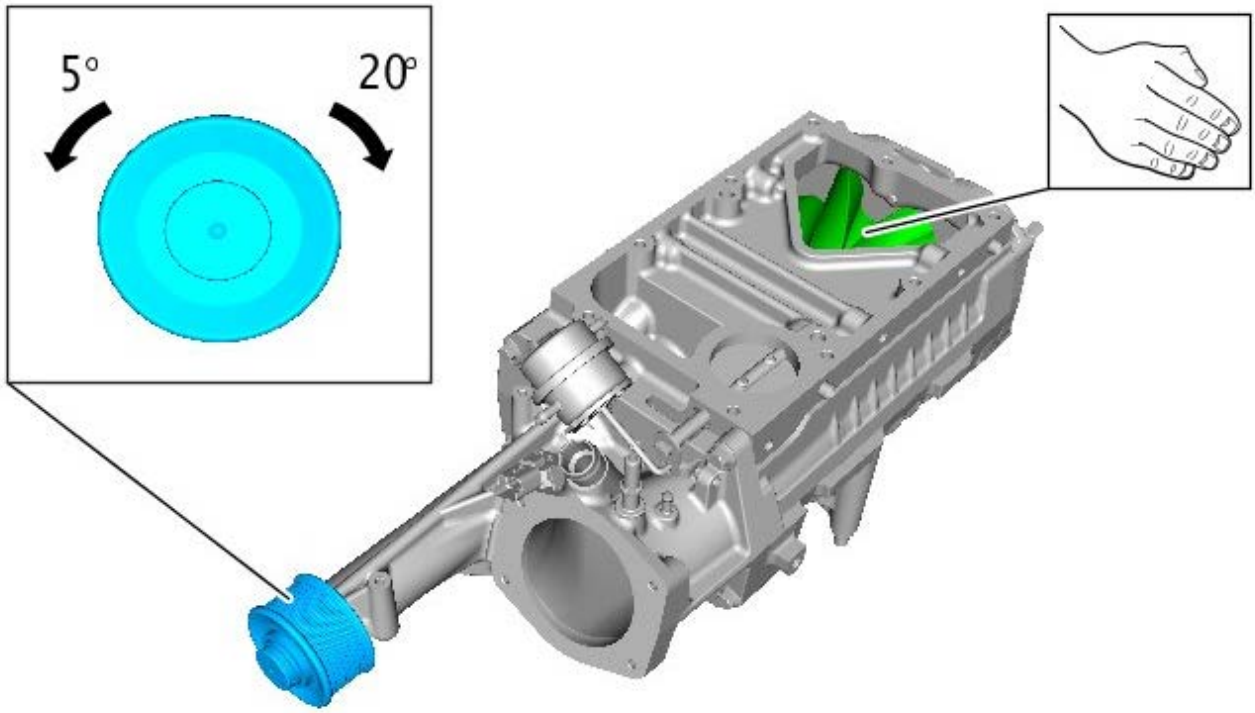


13. CAUTIONS:

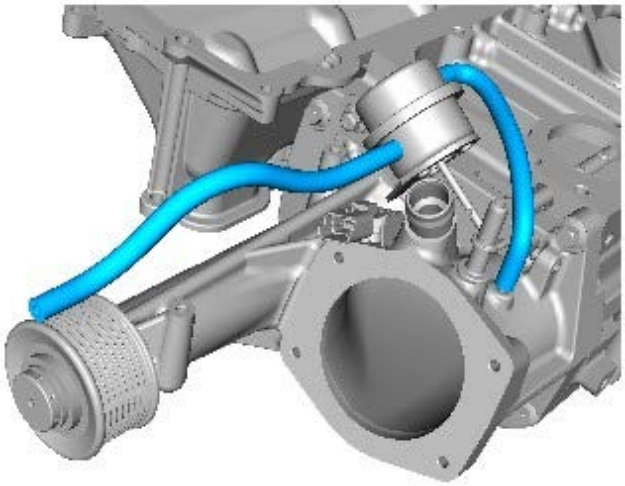
⚠ Make sure that spring resistance is felt in both directions of the pulley as shown.

⚠ Make sure that all open ports are covered to prevent any foreign material ingress.

NOTE: Supercharger rotors will appear polished, this is normal.

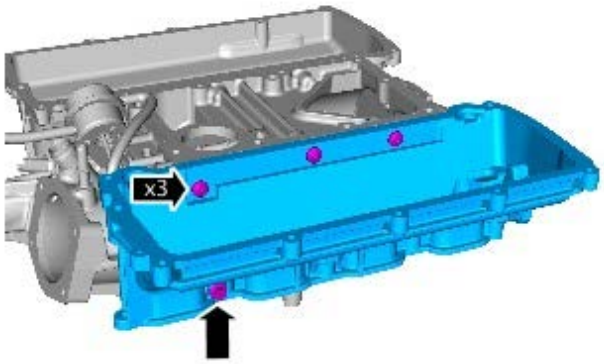


14. ⚠ CAUTION: Make sure the components are installed as noted on removal. Failure to follow this instruction may result in damage to the component.



E160367

15. *Torque:* 25 Nm



E160352

16. Refer to: Supercharger (303-12C Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

Published: 11-May-2011

Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol -

Torque Specifications

Description	Nm	lb-ft	lb-in
Evaporative emission canister retaining bolts	19	14	-

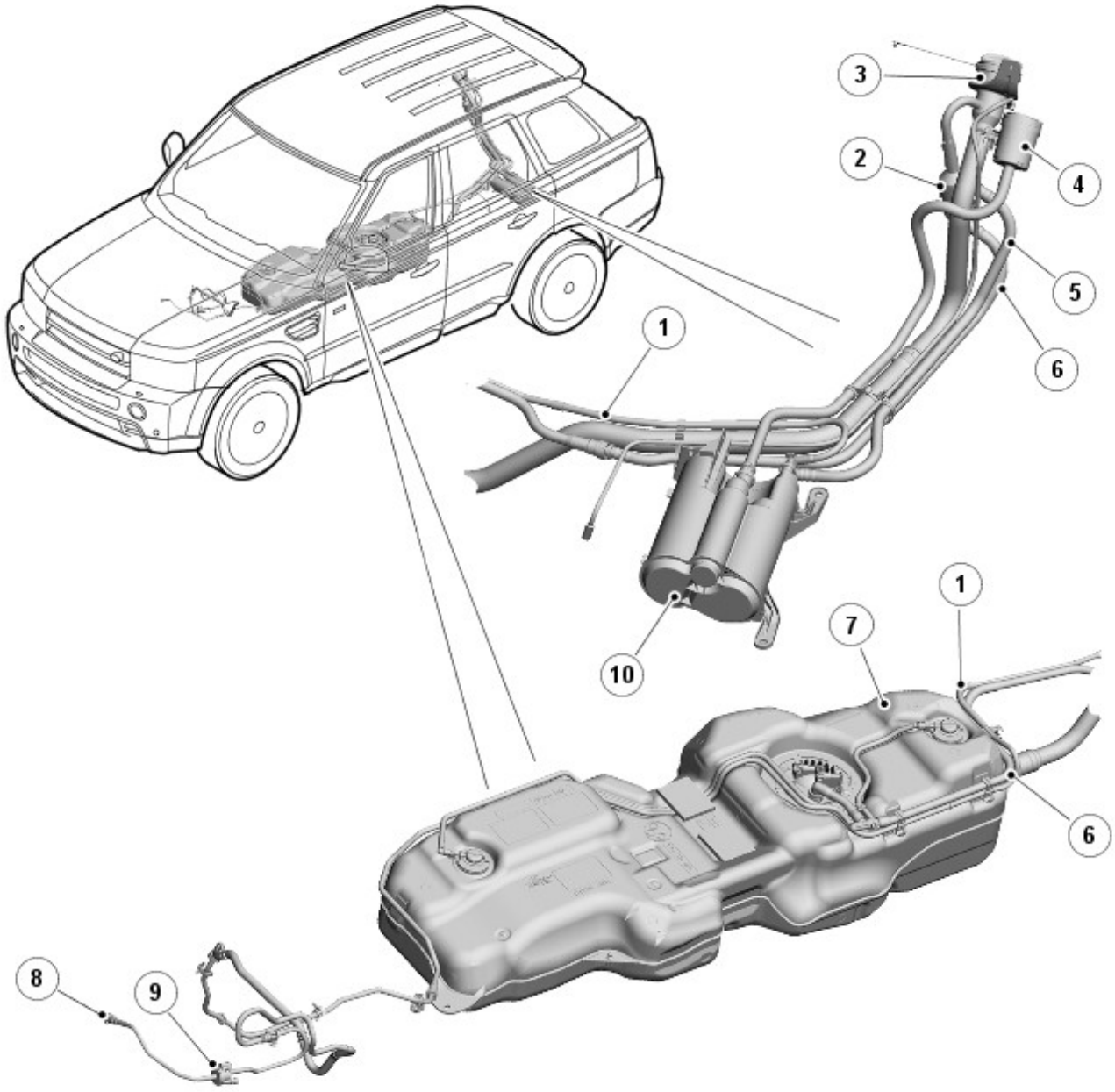
Published: 03-Jul-2013

Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Evaporative Emissions

Description and Operation

COMPONENT LOCATION - ALL EXCEPT NAS

NOTE: Installation on naturally aspirated vehicle shown, installation on SC (supercharger) vehicle similar.

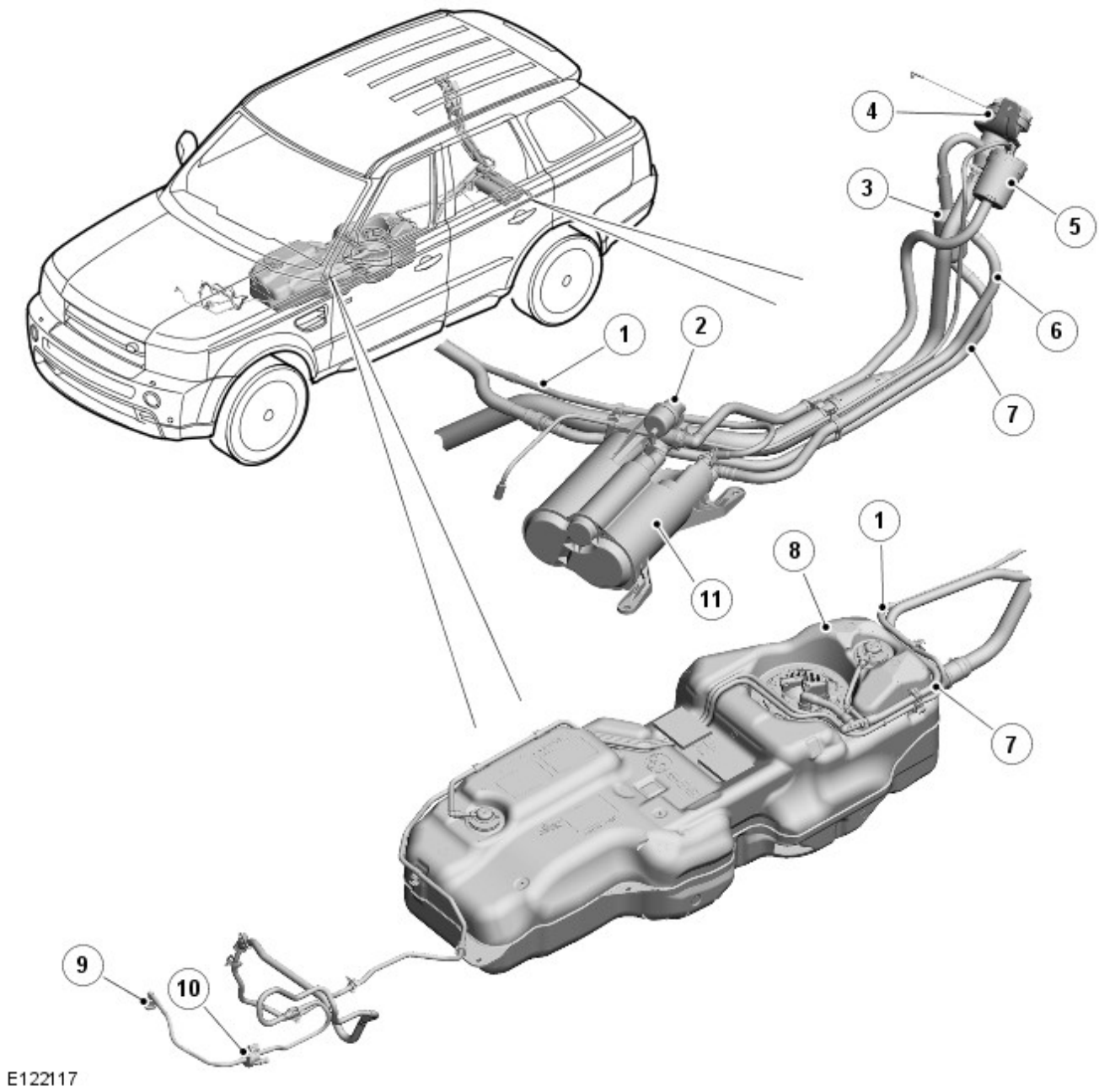


E122116

Item	Part Number	Description
1	-	Charcoal canister to purge valve pipe
2	-	Vapor separator
3	-	Fuel filler pipe and cap
4	-	Atmospheric vent filter
5	-	Vapor separator to charcoal canister pipe
6	-	Fuel tank to vapor separator pipe
7	-	Fuel tank
8	-	Purge line connector to inlet manifold
9	-	Purge valve
10	-	Charcoal canister

COMPONENT LOCATION - NAS

NOTE: Installation on SC vehicle shown, installation on naturally aspirated vehicle similar.



Item	Part Number	Description
1	-	Charcoal canister to purge valve pipe
2	-	DMTL (diagnostic module tank leakage) pump
3	-	Vapor separator
4	-	Fuel filler pipe and cap
5	-	Atmospheric vent filter
6	-	Vapor separator to charcoal canister pipe
7	-	Fuel tank to vapor separator pipe
8	-	Fuel tank
9	-	Purge line connector to supercharger
10	-	Purge valve
11	-	Charcoal canister

INTRODUCTION

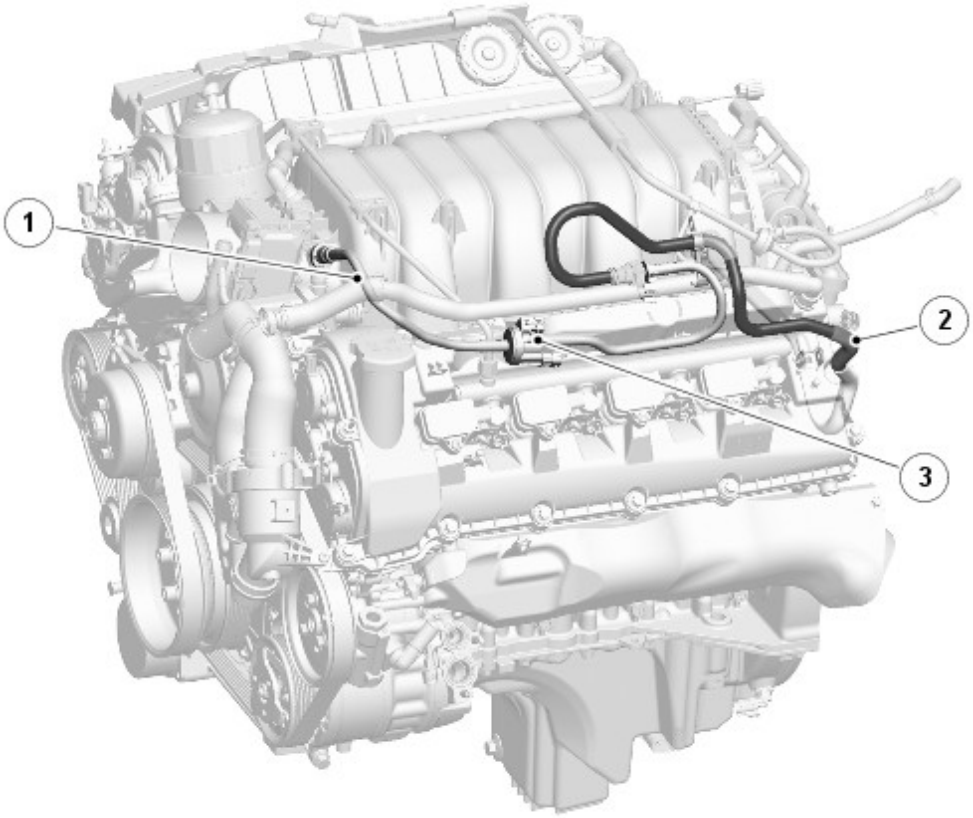
The EVAP (evaporative emission) control system reduces the level of hydrocarbons released into the atmosphere by fuel vapor venting from the fuel tank. The system comprises a charcoal canister, purge valve and interconnecting vent pipes. The vent pipes are connected to the system components using quick 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 flows to the charcoal canister through the tank vent pipes, via a liquid/vapor separator.

The vapor from the liquid/vapor separator is absorbed and stored by the charcoal canister. 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 during the combustion cycle.

PURGE VALVE AND PIPES

NOTE: Installation on naturally aspirated vehicle shown, installation on SC vehicle similar.



E122118

Item	Part Number	Description
1	-	Pipe to engine
2	-	Pipe from charcoal canister
3	-	Purge valve

The purge valve is installed on a bracket attached to the LH (left-hand) cylinder head cover. The pipe to the engine from the purge valve is connected to the intake manifold (naturally aspirated vehicles), or SC front cover (SC vehicles), with a quick release connecter. The pipe to the charcoal canister from the purge valve is installed between the LH cylinder head cover and ignition coil cover. From the rear of the LH cylinder head, the pipe then goes across the back of the engine, along the RH (right-hand) side of the transmission, along the fuel tank and rearwards of the tank to the charcoal canister.

The purge valve is a solenoid operated valve, which is closed when de-energized. The valve is controlled by the ECM (engine control module) and is operated when engine operating conditions are suitable for purging of the charcoal canister.

The purge valve is controlled by a PWM (pulse width modulation) signal at 10 Hz from the ECM. At this frequency, the pulses of purge gas flow into the engine in an almost continuous flow. The valve operates between 0% and 99% duty or mark space ratio (% open time).

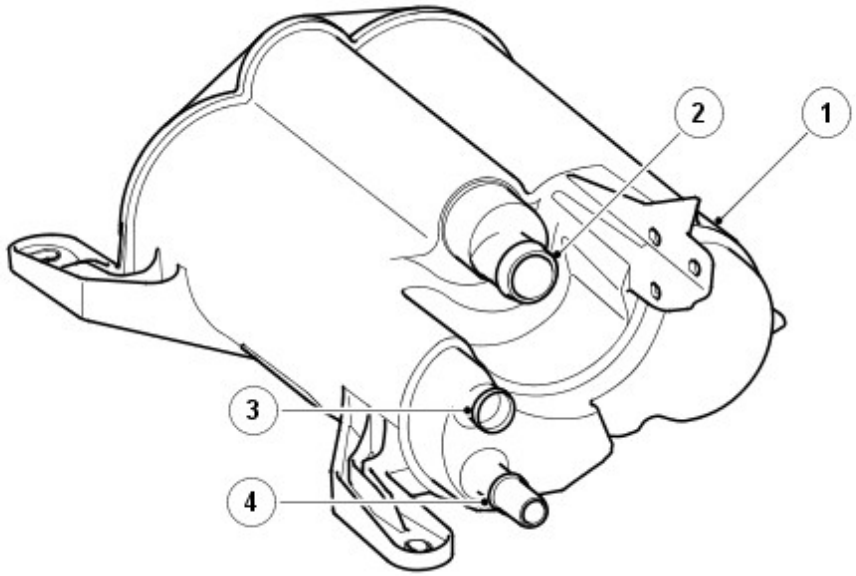
The atmospheric pressure at the air intake vent of the system is higher than the inlet manifold pressure under all throttled engine running conditions. It is this pressure differential across the system that causes the air to flow through the air intake of the purge system and in to the engine. The operation of the supercharger does not affect the purging process.

The ECM waits until the engine is running with a coolant temperature of 55 °C (131 °F) or above and 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 the engine to stall or loss of AFR (air fuel ratio) control to occur). The concentration is then determined from the amount of adjustment that the closed loop fueling is required to make to achieve the target AFR. Once the concentration has been determined, the purge flow can be increased 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 atmospheric vent filter and, on NAS vehicles, the DMTL pump.

CHARCOAL CANISTER

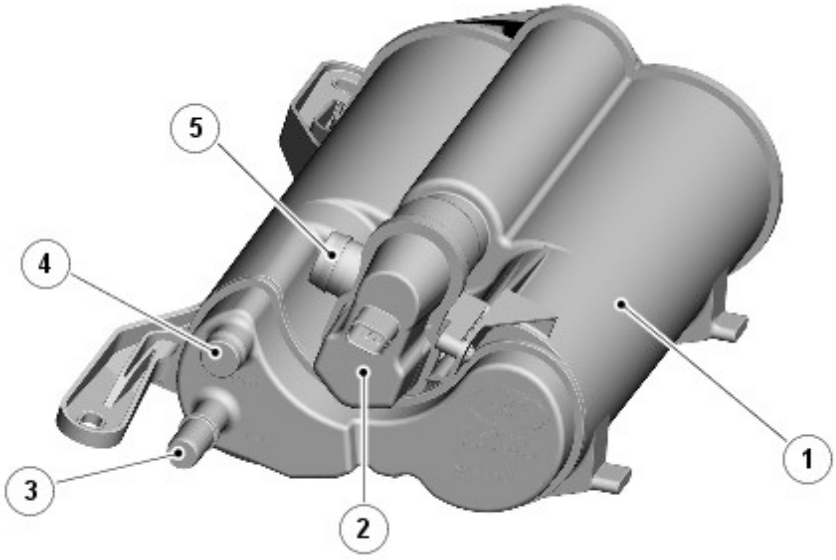
Charcoal Canister - All Except NAS



E44560

Item	Part Number	Description
1	-	Charcoal canister
2	-	Atmospheric vent pipe connection
3	-	Purge valve pipe connection
4	-	Fuel tank vent pipe connection

Charcoal Canister - NAS



E122119

Item	Part Number	Description
1	-	Charcoal canister
2	-	DMTL pump
3	-	Fuel tank vent pipe connection
4	-	Purge valve pipe connection
5	-	Atmospheric vent pipe connection

The charcoal canister is located in a central position, forward of the spare wheel. It is attached at the rear with two bolts which screw into the spare wheel carrier. At the front, the canister has two lugs which locate in the EPB (electronic parking brake) module support bracket.

The canister on all except NAS vehicles has a capacity of 1400 cc (85.4 in^3).

The canister on NAS vehicles has a capacity of 3000 cc (183 in^3).

The canister has three connections for attachment of the pipes from the atmospheric vent, the purge valve and the tank vent. On NAS vehicles, the DMTL pump is installed between the atmospheric vent connection and the atmospheric vent pipe.

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 stricter emissions regulations.

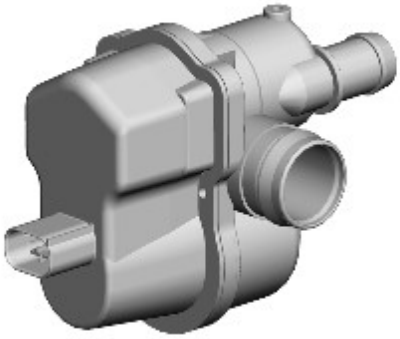
A filter on the atmospheric vent prevents dust being drawn into the system. The filter is located by the fuel filler cap.

DIAGNOSTIC MODULE TANK LEAKAGE - NAS ONLY

The DMTL system is a legislative requirement for NAS vehicles. The DMTL system periodically checks the EVAP system and the fuel tank for leaks when the ignition is switched off.

The DMTL system comprises the previously described components of the EVAP system and a DMTL pump.

DMTL Pump



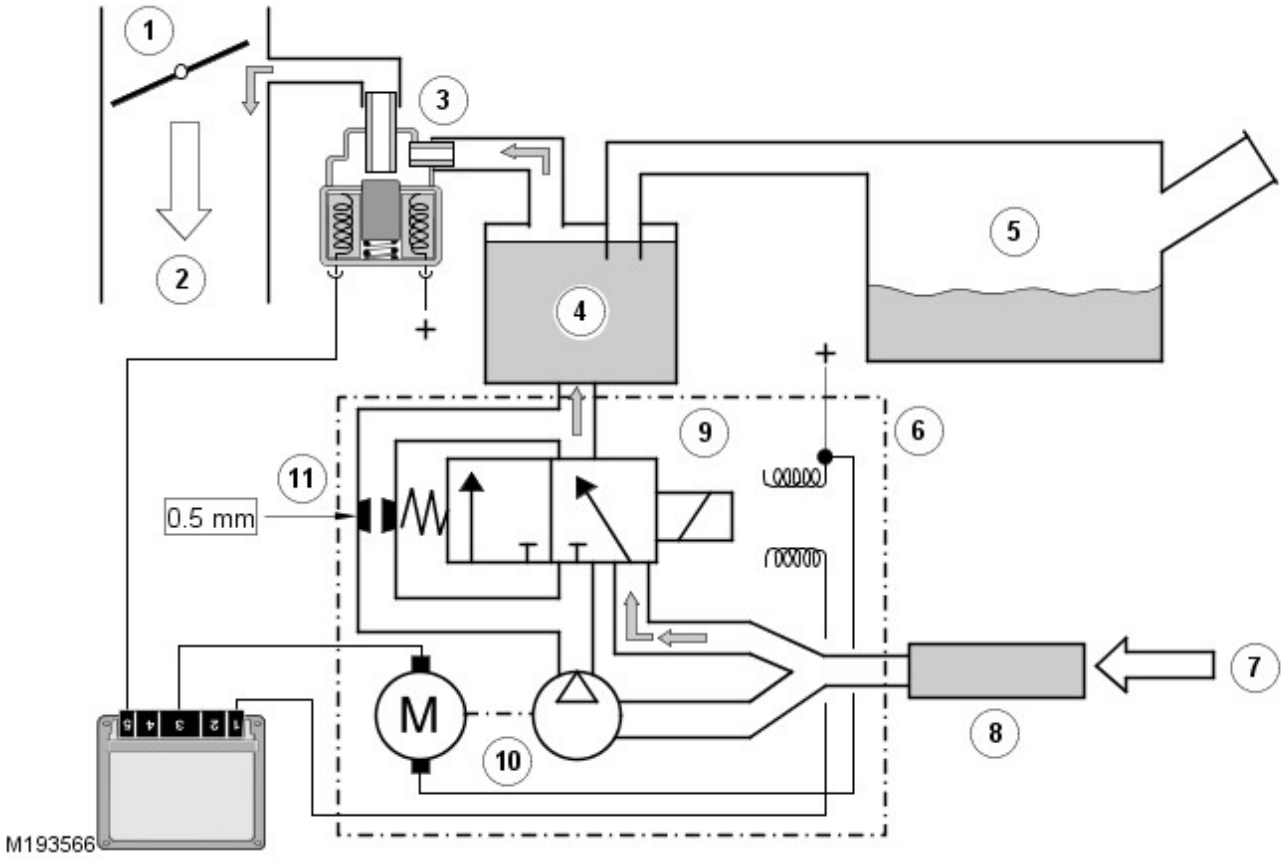
E122120

The DMTL pump is connected to the atmospheric vent of the charcoal canister and incorporates an electric air pump, a PTC (positive temperature coefficient) heating element, a normally open change-over valve and a reference orifice. The DMTL pump is only operated when the ignition is off and is controlled by the ECM. The ECM also monitors the electric air pump operation and the change-over valve for faults.

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 change-over 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.

DMTL System Inactive

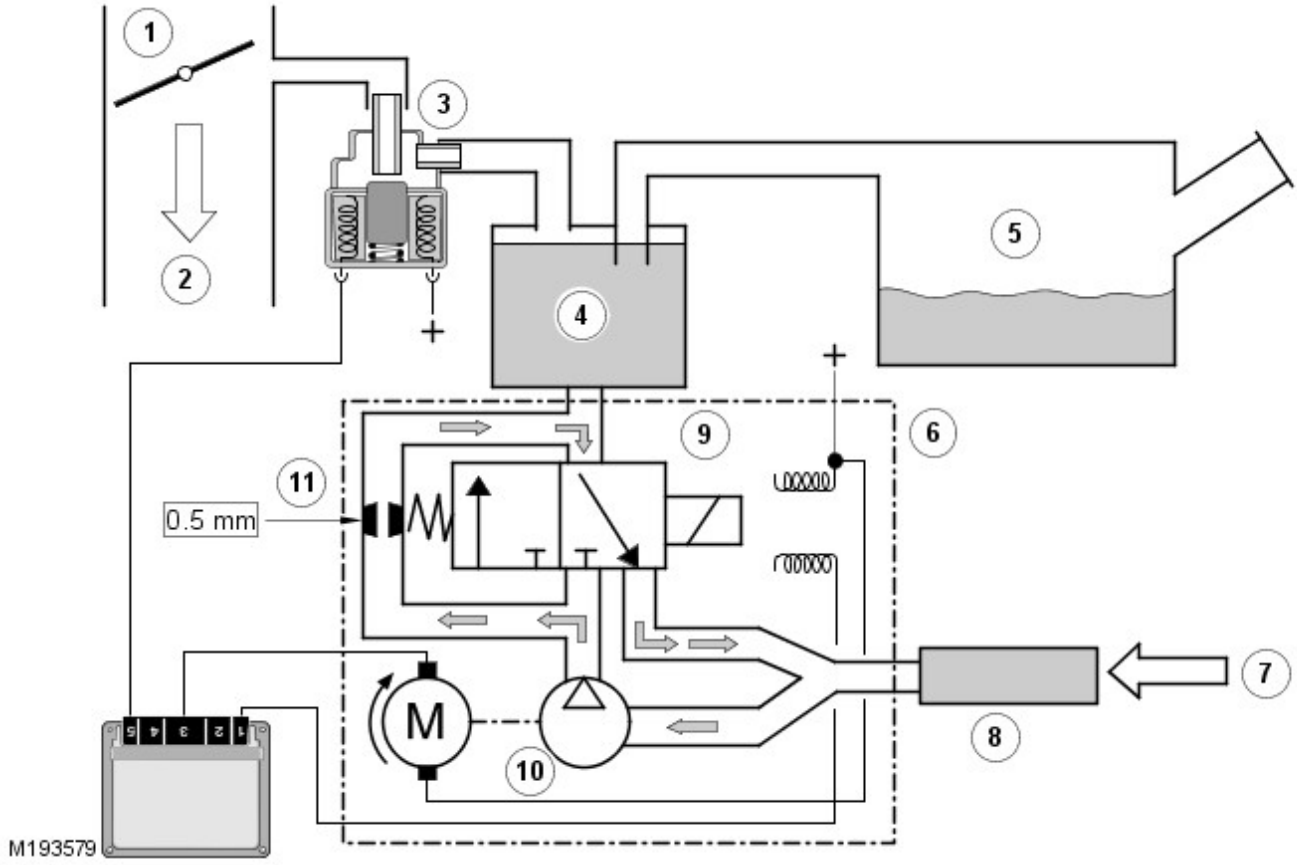


Item	Part Number	Description
1	-	Throttle plate
2	-	Air flow to engine
3	-	Purge valve
4	-	Charcoal canister
5	-	Fuel tank
6	-	DMTL pump assembly
7	-	Air intake
8	-	Air filter
9	-	Change-over valve
10	-	Pump
11	-	Reference orifice

In its inactive state, the DMTL pump motor and the change-over valve solenoid are not energized. When the ECM energizes the purge valve, filtered fresh air enters the evaporative system through the open change-over valve of the DMTL pump. The filtered air enters the system compensating for engine vacuum drawing on the hydrocarbon vapors stored in the charcoal canister.

DMTL System Active

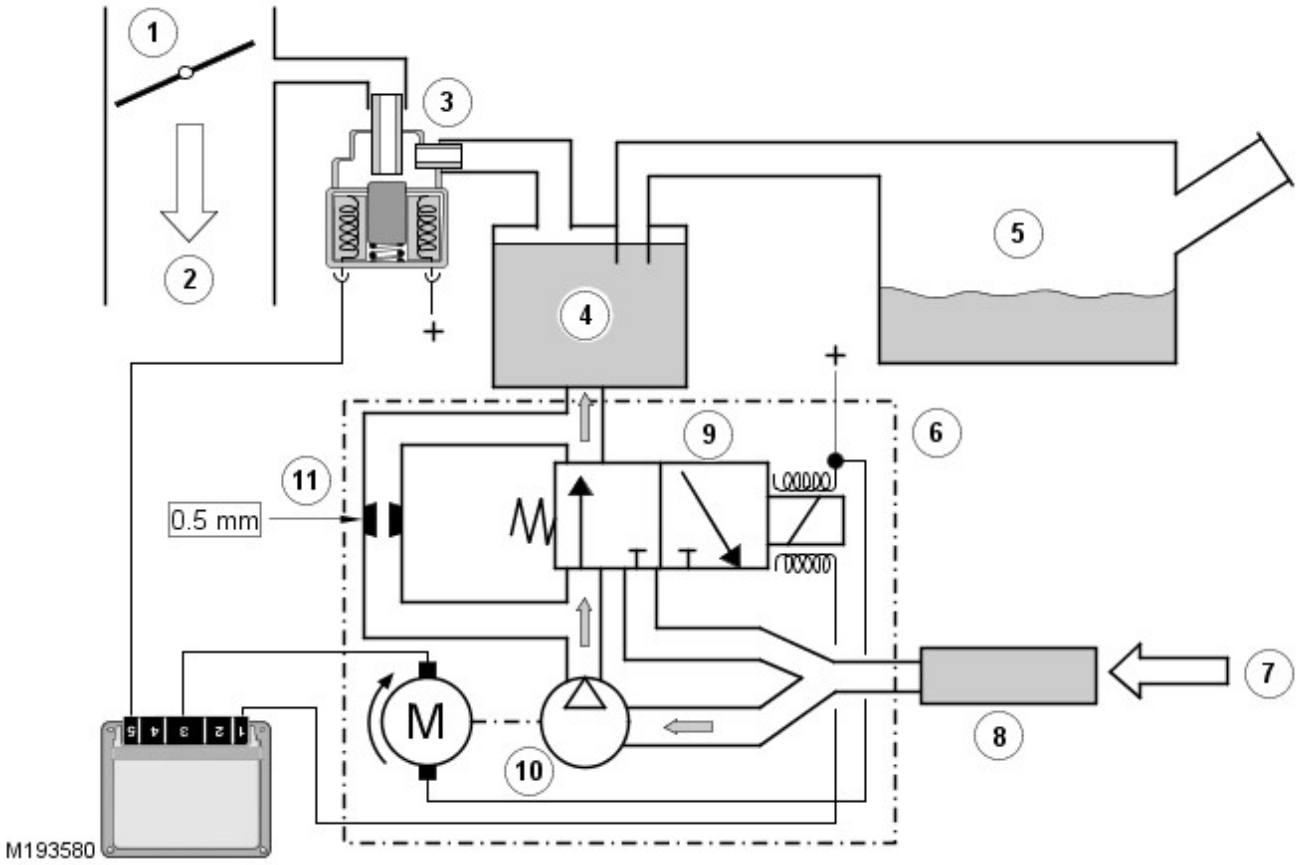
Phase 1 - Reference Measurement



Item	Part Number	Description
1	-	Throttle plate
2	-	Air flow to engine
3	-	Purge valve
4	-	Charcoal canister
5	-	Fuel tank
6	-	DMTL pump assembly
7	-	Air intake
8	-	Air filter
9	-	Change-over valve
10	-	Pump
11	-	Reference orifice

When the ECM activates the DMTL system, it first activates only the DMTL pump motor. This pumps air through a 0.5 mm (0.02 in) reference orifice, which causes the electric motor to draw a specific amperage value. This value equates to the size of the reference orifice.

Phase 2 - Leak Detection



Item	Part Number	Description
1	-	Throttle plate
2	-	Air flow to engine
3	-	Purge valve
4	-	Charcoal canister
5	-	Fuel tank
6	-	DMTL pump assembly
7	-	Air intake
8	-	Air filter
9	-	Change-over valve
10	-	Pump
11	-	Reference orifice

When the change-over valve solenoid is energized, the valve closes, sealing the EVAP system from atmosphere. Providing there are no leaks, the air pump will begin to pressurize the EVAP system and the load and current draw on the pump increases. By monitoring the rate and level of the current increase, the ECM can determine if there is a leak in the EVAP system.

During normal vehicle operation, the ECM energizes the heating element in the pump to prevent condensation formation and possible incorrect current readings.

Leaks are classified as:

- Minor - equivalent to a hole diameter of 0.5 to 1.0 mm (0.02 to 0.04 in)
- Major - equivalent to hole diameter of 1.0 mm (0.04 in) or greater.

The ECM performs a check for major leaks each time the ignition is switched off, providing the following conditions are met:

- The vehicle speed is zero
- The engine speed is zero
- The atmospheric pressure is above 70 kPa (10.15 lbf/in^2), i.e. the altitude is less than approximately 3047 m (10000 feet).
- The ambient temperature is between 0 and 40 °C (32 and 104 °F)
- The charcoal canister vapor concentration factor is 5 or less (where 0 is no fuel vapor, 1 is stoichiometric fuel vapor and greater than 1 is rich fuel vapor).
- The fuel tank level is valid and between 15 and 85% of nominal capacity
- The engine running time during the previous cycle was more than 10 minutes
- The battery voltage is between 10 and 15 volts
- The last engine off time was more than 180 minutes
- No errors are detected with the EVAP components, the ambient air temperature and the fuel level
- High range is selected on the transfer box.

NOTE: A leak test can be performed using the Land Rover approved diagnostic equipment. 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.

When the leak check is complete, the ECM stops the DMTL pump and opens (de-energizes) the change-over valve.

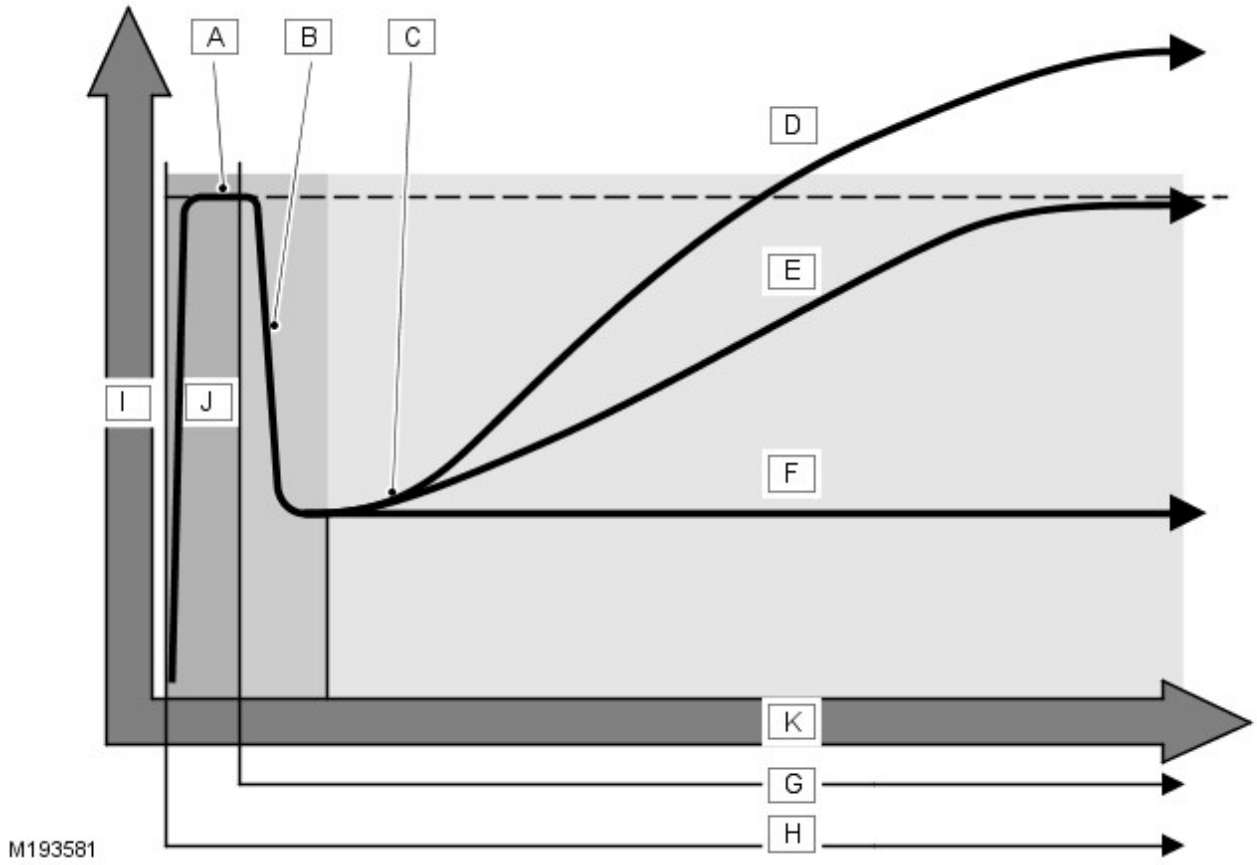
If the fuel filler cap is opened or refueling is detected during the leak check, by a sudden drop in the current draw or a rise in the fuel level, the ECM aborts the leak check.

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 MIL (malfunction indicator lamp) in the instrument cluster on the next drive cycle.

The duration of a leak check can be between 60 and 900 seconds depending on the test results (developed tank pressure amperage within a specific time period) and fuel tank level.

The following chart depicts the logic used to determine fuel system leaks:

Test Results



Item	Part Number	Description
A	-	Current stabilizes
B	-	Current drops
C	-	Current rises
D	-	No leak detected
E	-	0.5 mm leak
F	-	Leak >1.0 mm
G	-	Change-over valve energized
H	-	Pump motor energized
I	-	Motor current pressure
J	-	Reference measurement 0.5 mm
K	-	Time duration

Published: 11-Jul-2012

Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Evaporative Emissions

Diagnosis and Testing

Principles of Operation

For a detailed description of the evaporative emission system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to:

Evaporative Emissions (303-13 Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation),
Evaporative Emissions (303-13A, Description and Operation),
Evaporative Emissions (303-13A, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Fuel filler cap and seal • Fuel filler neck • DMTL fresh air filter (restriction, etc) • Fuel tank (leaks, damage, etc) • Fuel lines and joints, etc • Carbon canister • Purge valve • Diagnostic module fuel tank leak (DMTL) pump module	• Fuses • Connectors • Harness • Purge valve • Diagnostic module fuel tank leak (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, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.
5. Where K-Line, Vacutec or other proprietary smoke test equipment is available, it should be utilized to assist with Evaporative Emissions System leak diagnosis.

Symptom Chart

Symptom	Possible Causes	Action
Difficulty in filling fuel tank	• Restriction in the vapour line between the fuel tank and the carbon canister outlet/atmospheric port	Check for restrictions/damage, etc (see visual inspection)
Fuel smell	• System leak • Purge valve inoperative	Check for leaks, check the purge valve operation
'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

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Evaporative Leak OBD Fault Rectification Guide

Determine Which DTC Has Been Stored

Using the manufacturer approved diagnostic system, choose **diagnostic session**, then choose the following symptom paths : **Powertrain/engine system/fuel vapour and odor, Powertrain/engine system/fuel tank, Electrical/instruments/warning lamps/engine malfunction lamp/lamp illuminated, Powertrain/engine system/engine performance/fuel consumption high**

NOTE: This guide covers DTCs that relate to evaporative leak monitoring, as listed in the table below

DTC	Description
P0442-00	DMTL small leak
P0447-00	DMTL COV electrical low (open)
P0448-00	DMTL COV electrical high
P0455-00	DMTL rough leak
P2401-00	DMTL pump electrical low (open)
P2402-00	DMTL pump electrical high
P2404-2F	DMTL noise fault
P2404-29	DMTL reference leak
P2405-00	DMTL reference current low
P2406-00	DMTL reference current high
P2450-00	DMTL COV stuck open
P2451-00	DMTL COV stuck closed
P240B-00	DMTL heater electrical low (open)
P240C-00	DMTL heater electrical high

Attempt To Replicate The Fault Using The "Fuel Leak Check" Forced Test

1. Record any DTCs that has been logged
2. Using the manufacturer approved diagnostic system, in the **Recommendations** tab run the **Fuel Leak Check** forced test
3. For the test to run the fuel level must be between 15% and 85%
4. During this procedure the engine must be off
5. The possible responses from the test and the associated DTCs are listed below
6. If again no fault is found it could suggest that the failure mode is a borderline condition (refer to section 3) or that it was caused by incorrect fitment of the fuel cap or the fuel filler neck is at fault therefore it is important not disturb the fuel cap
7. Disconnect purge pipe from the purge valve, observe the condition of connection (the seating and condition of the "O" ring) and then reconnect. Using the manufacturer approved diagnostic system, run **Purge Valve Self Test** (to clean the purge valve) then run the **Fuel Leak Check**
8. If the test failed, a smoke test is required to determine the cause of the leak

NOTE: P240B & P240C are not included in the **Fuel Leak Check** forced test (these monitors run at every ignition on and complete within 30 seconds)

Response Description	ID	Equivalent DTC
Function running: Reference leak measurement	1	
Function running: Rough leak measurement	2	
Function running: Small leak measurement	3	
Function running: 2nd ref leak measurement	4	
Function running: COV Cleaning	5	
Function aborted due to conditions: Vbatt conditions not correct (too high/ low)	11	
Function aborted due to conditions: Variation Ref. I (reference current) too high	12	P2404-29
Function aborted due to conditions: DMTL electrical fault	13	P0447, P0448
Function aborted due to conditions: Maximum diagnostic time exceeded	14	
Function aborted due to conditions: Crash detected	15	
Function aborted due to conditions: Refuel detected	20	
Function aborted due to conditions: Filler cap opened	21	
Function aborted due to conditions: Engine start	23	
Function aborted due to conditions: Noisy current measurement	24	P2404-2F
Function aborted due to conditions: Ambient temp outside range	26	
Function aborted due to conditions: Ambient pressure outside range	27	
Function aborted due to conditions: Other conditions	29	
Function complete - Tight system, fault free	30	
Function complete - Fine leak detected	31	P0442
Function complete - Rough leak detected	32	P0455
Function complete - Module error	33	P2401, P2402, P2450, P2451, P2405, P2406, P2404-29
Function complete - Medium leak detected	34	P0442, P0455

Read The "Ranking values" To Determine How Far Away The Result Is From The Failure Threshold

9. When the **Fuel Leak Check** forced test has completed the test results (known as ranking values) will be displayed

10. These should be compared against the limits shown in the table below
11. If the test result is borderline then there is a risk that a failure will occur at a later date (during customer usage of the vehicle)
12. To avoid this the vehicle should be carefully checked for any small leaks

Ranking Value	Normal Result For Tight System	Leak Failure Condition
Rough Leak (40 thou+)	0 > = 50	>= 128
Small Leak (20 thou+)	0 > = 60	>= 128

TRACE THE ROOT CAUSE OF THE FAULT

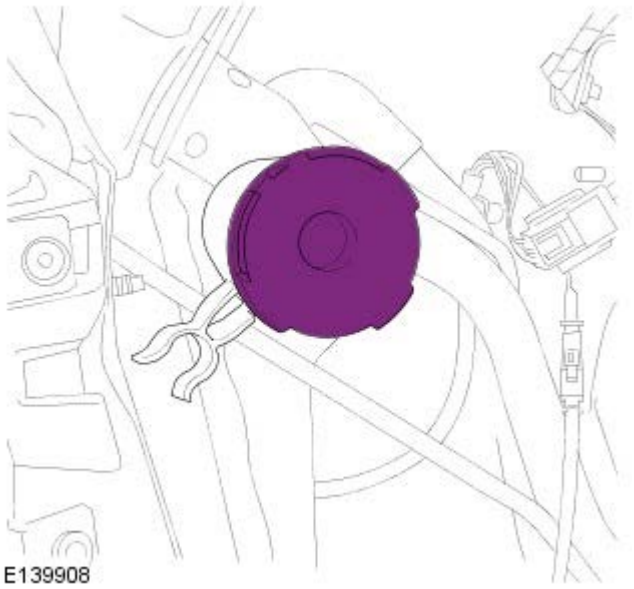
The list below provides some suggested actions to help trace the root cause of the fault

Each action should be followed up with a **Fuel Leak Check** forced test (and ranking value check) in order to determine if any improvement has been made

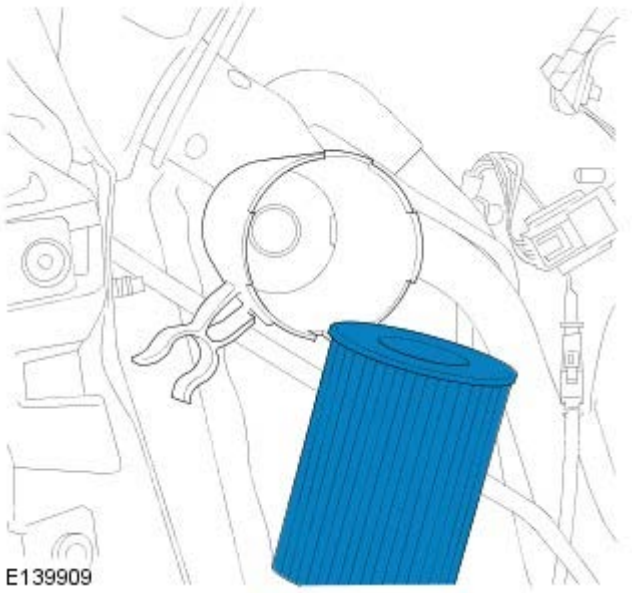
DTC	Fault Description	Fault Rectification Actions after smoke test
P0442-00	DMTL small leak	• 1. Inspect / refit filler cap after smoke test (inspect filler neck for correct fitment to pocket so that filer neck protrudes) • 2. Run engine at idle; Using the manufacturer approved diagnostic system, run **Purge Valve Self Test** (to clean the purge valve) • 3. Check that the DMTL module wiring connector has been installed correctly and that the seals around the connector body and individual wires are in good condition • 4. Check all fuel system connections are correctly installed and secure • 5. Visually inspect purge canister, purge pipes, fuel tank and filler neck for any obvious damage • 6. Try isolating the purge valve by fitting a blanking plug to the purge pipe • 7. Carry out a smoke test • 8. Replace the DMTL module
P0447-00	DMTL COV electrical low (open)	• 1. Check fuse • 2. Check that fuse fits tightly into the fuse holder • 3. Check that the DMTL module wiring connector has been fitted correctly • 4. Check wiring harness continuity between DMTL module and ECU connectors • 5. Replace DMTL module
P0448-00	DMTL COV electrical high	• 1. Check wiring • 2. Replace DMTL module
P0455-00	DMTL rough leak	• 1. Inspect / refit filler cap after smoke test (inspect filler neck for correct fitment to pocket so that filer neck protrudes) • 2. Run engine at idle; Using the manufacturer approved diagnostic system, run "Purge Valve Self Test" (to help clean the purge valve) • 3. Check that the DMTL module wiring connector has been installed correctly and that the seals around the connector body and individual wires are in good condition (surprisingly, this is a potential leakage path!) • 4. Check all fuel system connections are correctly installed and secure • 5. Visually inspect purge canister, purge pipes, fuel tank and filler neck for any obvious damage • 6. Try isolating the purge valve by fitting a blanking plug to the purge pipe • 7. Carry out a smoke test • 8. Replace DMTL module
P2401-00	DMTL pump electrical low (open)	• 1. Check fuse • 2. Check that fuse fits correctly into the fuse holder • 3. Check that the DMTL module wiring connector has been fitted correctly • 4. Check wiring harness continuity between DMTL module and ECU connectors • 5. Replace DMTL module
P2402-00	DMTL pump electrical high	• 1. Check wiring • 2. Replace DMTL module
P2404-2F	DMTL noise fault	• Replace DMTL module
P2404-29	DMTL reference leak	• Replace DMTL module
P2405-00	DMTL reference current low	• Replace DMTL module
P2406-00	DMTL reference current high	• 1. Check for any blockages in the DMTL ventilation pipe & filter • 2. Replace DMTL module
P2450-00	DMTL COV stuck open	• Replace DMTL module
P2451-00	DMTL COV stuck close	• Replace DMTL module
P240B-	DMTL heater	• 1. Check fuse

00	electrical low (open)	• 2. Check that fuse fits tightly into the fuse holder • 3. Check that the DMTL module wiring connector has been fitted correctly • 4. Check wiring harness continuity between DMTL module and ECU connectors • 5. Replace DMTL module
P240C-00	DMTL heater electrical high	• 1. Check wiring • 2. Replace DMTL module

Pre and 10MY Denso/Bosch PCM Systems



E139908

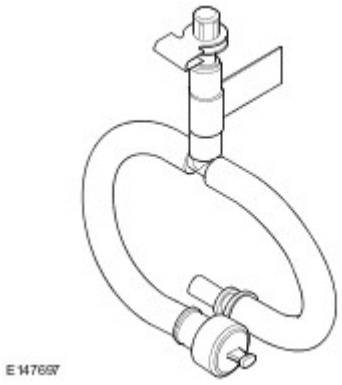


E139909

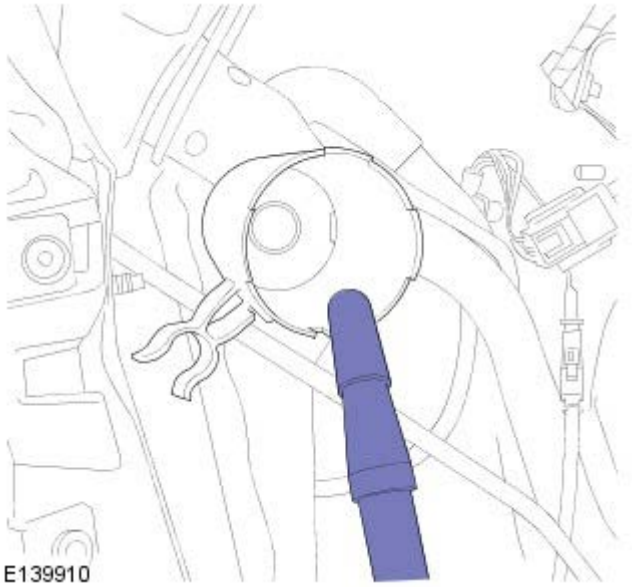
CAUTION: The Maximum pressure of the EVAP system is 0.07 bar **do not exceed**

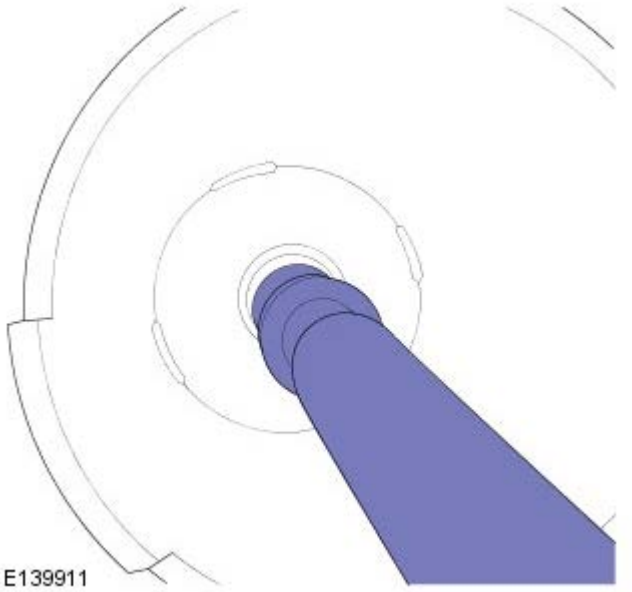
NOTE: Apart from the purge valve connection, it is recommended to smoke test the EVAP system without disturbing any joints associated with the system, this will determine the leak more accurately and quickly

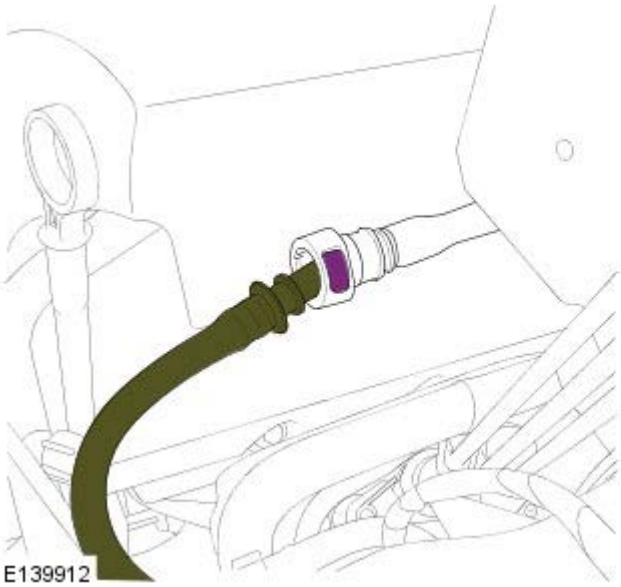
- 1. Remove rear wheel arch liner to access fuel filler neck
- 2. On the fuel filler neck the DMTL filter will be visible as shown in picture. Unclip filter housing from fuel filler neck to gain better access to DMTL filter
- 3. Remove carefully the top of filter to expose filter and remove
- 4. Attach rubber adapter to tip of smoke machine nozzle to ensure tight seal to filter housing. Disconnect the purge pipe from purge valve; this will be an escape point for the smoke to exit
- 5. Allow tester to complete self-test and green READY light to turn ON 2. For best Tester performance; completely unwind Tester's supply hose
- 6. Press **Smoke** on control panel to fill EVAP system with smoke vapour. The control panel **Smoke** light will light indicating smoke production. The smoke setting is on a 15 minute timer. Pressing the **Smoke** button again turns Tester off. It is normal for the flow meter ball, while in the smoke mode, not to be as steady as when it is in the **Test** mode. Note: The pressure gauge is active only after smoke cycle is complete
- 7. Continue introducing smoke into the EVAP System until the flow meter's ball stops descending and this assures the system test pressure is met and smoke will appear from the purge pipe, then close off purge pipe with special tool (Test Adapter Hose/EVAP Port 310-142)



NOTE: Special tool (Test Adapter Hose/EVAP Port 310-142)



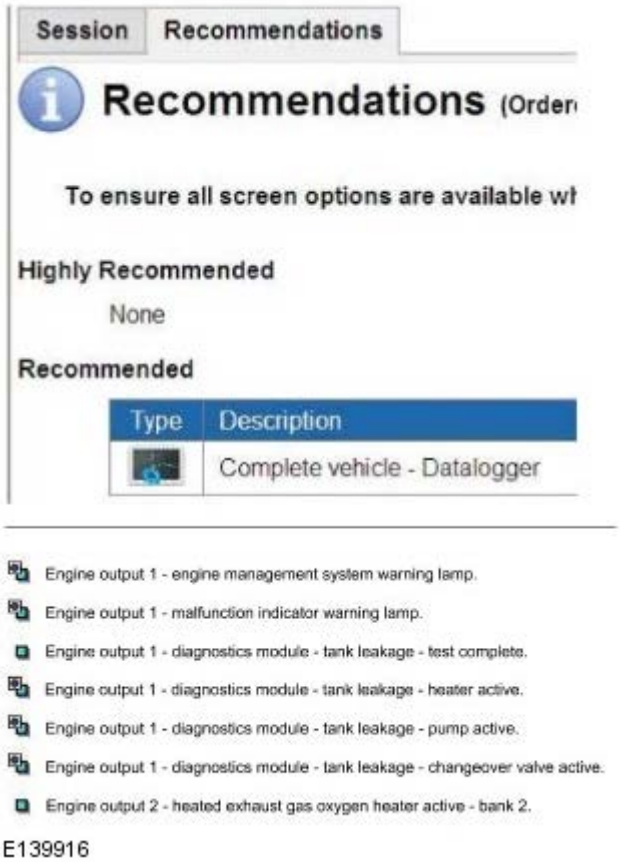




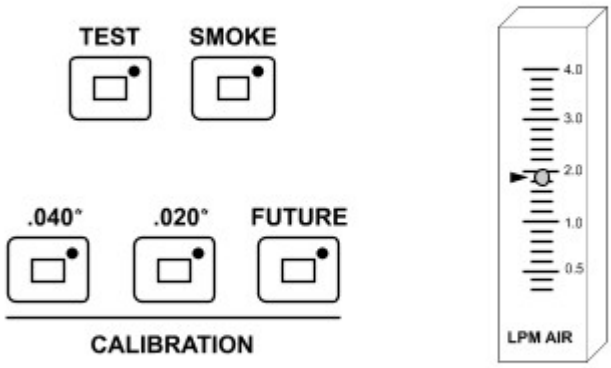
CAUTION: On some vehicles, the DMTL filter can not be removed, in these instances fill the system through the purge valve and smoke will appear from the filter

Pre 10MY Vehicles

On pre 10MY DMTL systems, Using the manufacturer approved diagnostic system, select **Measurement application** session then select the **Recommendations** tab which will give you access to **Datalogger**. Then select **Engine systems** then select the **Output state control** data-logger signal **Engine output 1 – diagnostic module – tank leakage -change over valve active** which will close the system. Then select **Engine output 1 – diagnostic module – tank leakage – pump active** this will pressurize the EVAP system



E139916



E139913

10MY vehicles

On 10MY vehicles a smoke test application is available so therefore only smoke fill the system and then run the application

- 8. Follow the EVAP system path with the halogen light provided and looks for the smoke exiting the leak(s) or use the UV light provided and look for the dye deposited at the exact location of the leak(s)
- 9. Repair the leak(s) and perform the **Fuel Leak Check** application again or smoke test to verify repair, as well as to make sure there are no additional leaks in the EVAP system

The UltraTraceUV® smoke solution's dye feature is especially helpful when the leak is in an area that is not readily visible, as on the top of the fuel tank or behind a panel. Once you gain access to the area of the leak, wear the yellow UV glasses and shine the UV light provided to identify the exact location of the leak(s). Smoke exiting a very small leak is even easier to see with lower pressure. If you encounter smoke leaking out of an area but find it difficult to pinpoint exactly where the source of the leak is; try reducing the pressure in the system being tested by turning the Tester OFF and allow the pressure to dissipate. The longer a particular leak is allowed to leak, the more fluorescent dye material will be deposited at that leak. With some vapour system leaks, the leak may only present itself under vacuum and not under pressure. If equipment permits, test the system in both states. Purge valve faults [P0441, P0444, P0458 and P0459] should all inhibit DMTL leak test and therefore need to be resolved prior to any DMTL issues. For this reason, when smoke testing the vapour system, it should be sufficient to enter the system at the connection up stream of the purge valve. If no leak is found then testing the remainder of the system up to the purge valve is recommended

NOTE: It may be possible to search for small leaks using a gas analyzer and looking for HC (hydro carbon) spikes. This should enable leaks to be detected in areas of the vapor system that our out of sight of the technician. The solenoid should be deactivated after five minutes to prevent potential damage. Check that connector and individual terminals are sealed correctly

Phase-One – (quantifying the leak)



E139914

- 1. Connect the tester supply hose to vehicle EVAP system. > Refer to appropriate vehicle application
- 2. Determine if the vehicle's EVAP system you are testing is governed by a .020" (0.5 mm) or .040" (1 mm)

acceptable leak standard. Press the appropriate calibration standard on the tester's control panel and observe the position of the flow meter ball. > This function automatically turns off in 10 seconds

- 3. Position the flow meter's pointer flag so that it aligns with the measurement observed in step 2 above. > This sets PASS / FAIL mark
- 4. Close vehicle's EVAP Vent Solenoid. > Refer to appropriate vehicle application
- 5. Press TEST on control panel and fill EVAP system. > This introduces 5-minutes of nitrogen gas
- 6. Look for flow meter ball to stop descending indicating that the vehicle system is full. > Fill time 1-4 minutes depending on system volume
- 7. Compare flow meter ball reading to pointer flag. > ABOVE flag = FAIL (go to Phase-Two). > BELOW flag = PASS (test complete)

Testing With Pressure and Vacuum Decay

In addition to quantifying the leak with the Phase-One flow test, the Tester allows you the flexibility of testing the vehicle's EVAP system by using either **Pressure Decay** or **Vacuum Decay** methods. Below are instructions for performing both decay tests

Pressure-Decay Test

NOTE: The Pressure Decay test is best performed immediately after the Phase-one flow test, since the system has already built up pressure

At the completion of the Phase-one flow test, the EVAP system is fully pressurized, since the Phase-one test uses pressure to perform its flow test. Testing pressure decay with the Vacutec® 522B-J/LR is very simple. All you need to do is the following:

- 1. Allow tester to complete self-test and green **READY** light to turn ON
- 2. Connect Tester supply hose to vehicle EVAP system
- 3. Close vehicle's EVAP Vent solenoid > Refer to appropriate vehicle application
- 4. Press **VACUUM** switch on the tester control panel
  - NOTE: The vacuum switch is on a 30-second timer, which should be sufficient time to draw the appropriate vacuum from the EVAP system. Press VACUUM switch again if additional time is required
- 5. After vacuum timer turns off, observe the vacuum gauge for any decay (loss of vacuum) indicating a leak in the EVAP system



E139915

NOTE: Disconnect the Tester from the vehicle after the Vacuum Decay Test. The fuel pressure in the vehicle's fuel tank is constantly changing due to the vehicle's fuel volatility and that could cause the Tester's pressure gauge to exceed its maximum reading limits

Published: 11-May-2011

Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Evaporative Emission Canister Purge Valve V8 5.0L Petrol

Removal and Installation

Removal

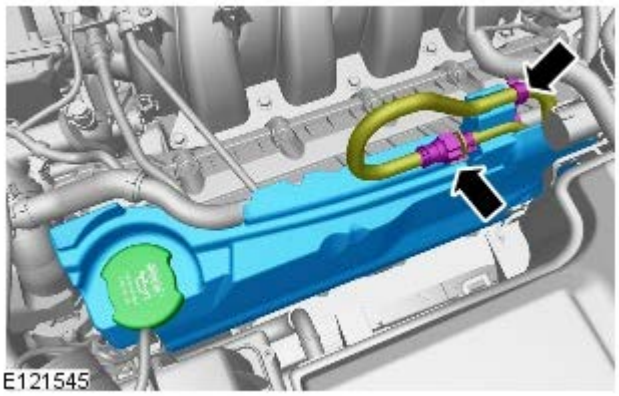
NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

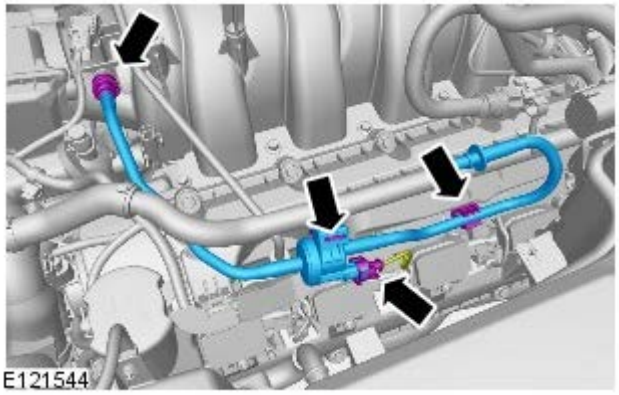
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12, Removal and Installation).

3.



4.



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Evaporative Emission Canister Purge Valve V8 S/C 5.0L Petrol

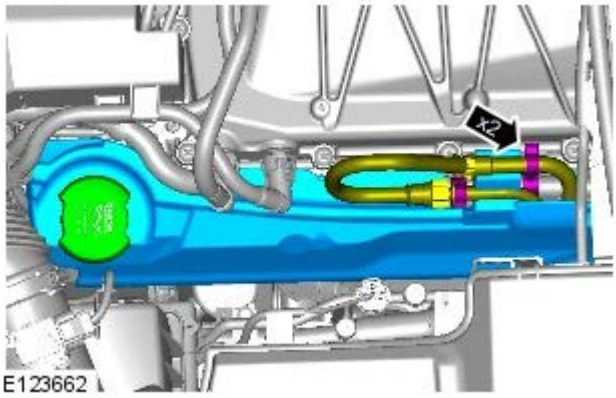
Removal and Installation

Removal

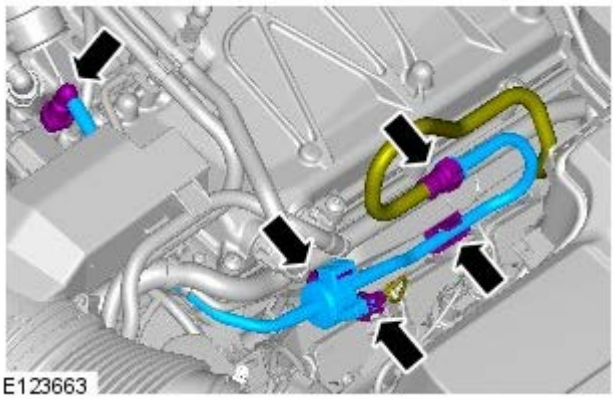
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

2.



3.



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel -

Torque Specification

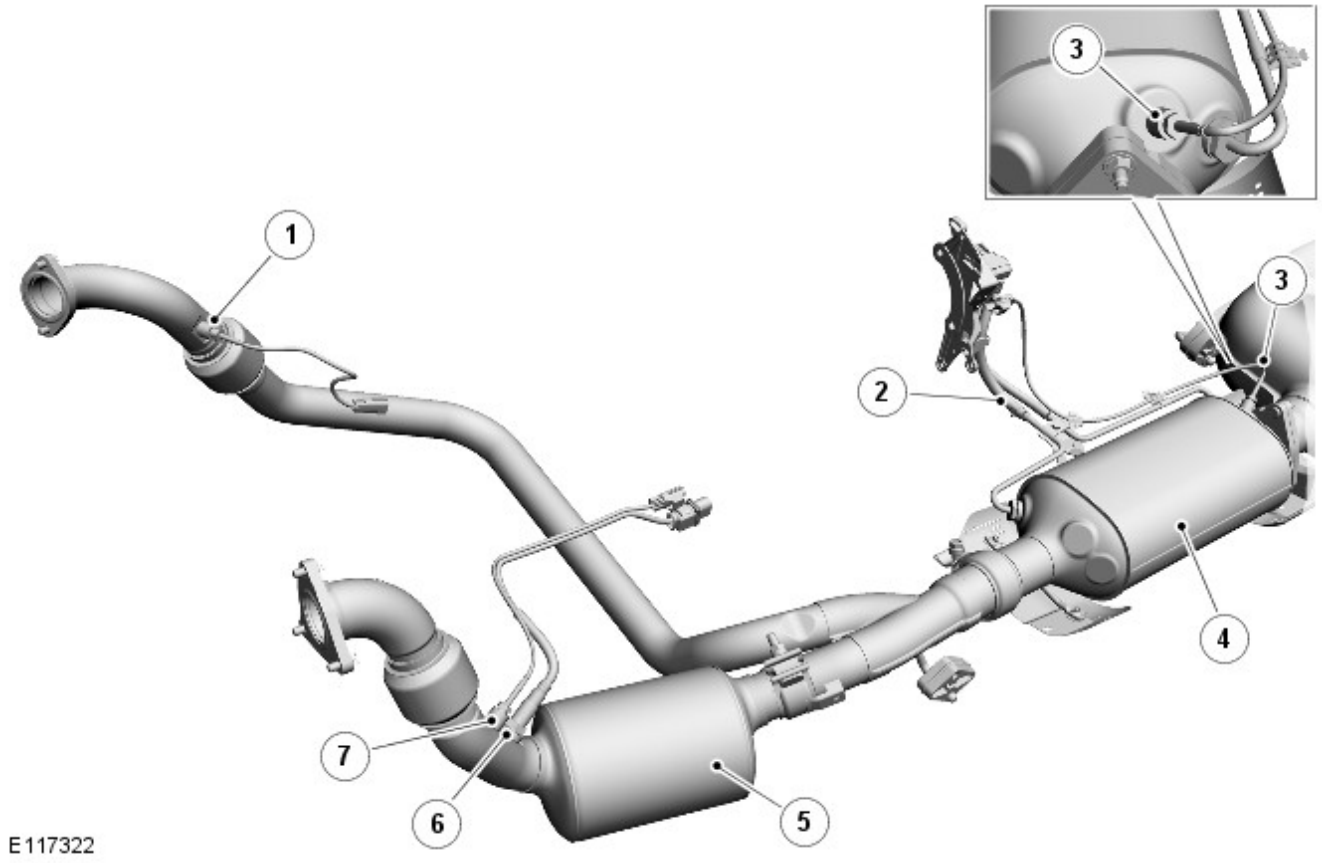
Description	Nm	lb-ft	lb-in
Camshaft position (CMP) sensor retaining bolt	10	7	-
Crankshaft position (CKP) sensor retaining bolt	5	-	44
Engine control module (ECM) retaining bolts	7	-	62
Engine control module (ECM) retaining nuts	7	-	62
Engine oil pressure (EOP) sensor	14	11	-
Engine oil level sensor retaining bolts	10	7	-
Mass air flow (MAF) sensor	2	-	18
Manifold absolute pressure (MAP) sensor	3	-	27
Exhaust gas temperature sensor RH	35	26	-
Pre catalytic converter temperature sensor	35	26	-
Post catalytic converter temperature sensor	35	26	-
Pre diesel particulate filter (DPF) exhaust gas temperature sensor	35	26	-
Post DPF exhaust gas temperature sensor	35	26	-
Heated oxygen sensor (HO2S)	48	35	-

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Electronic Engine Controls - Component Location

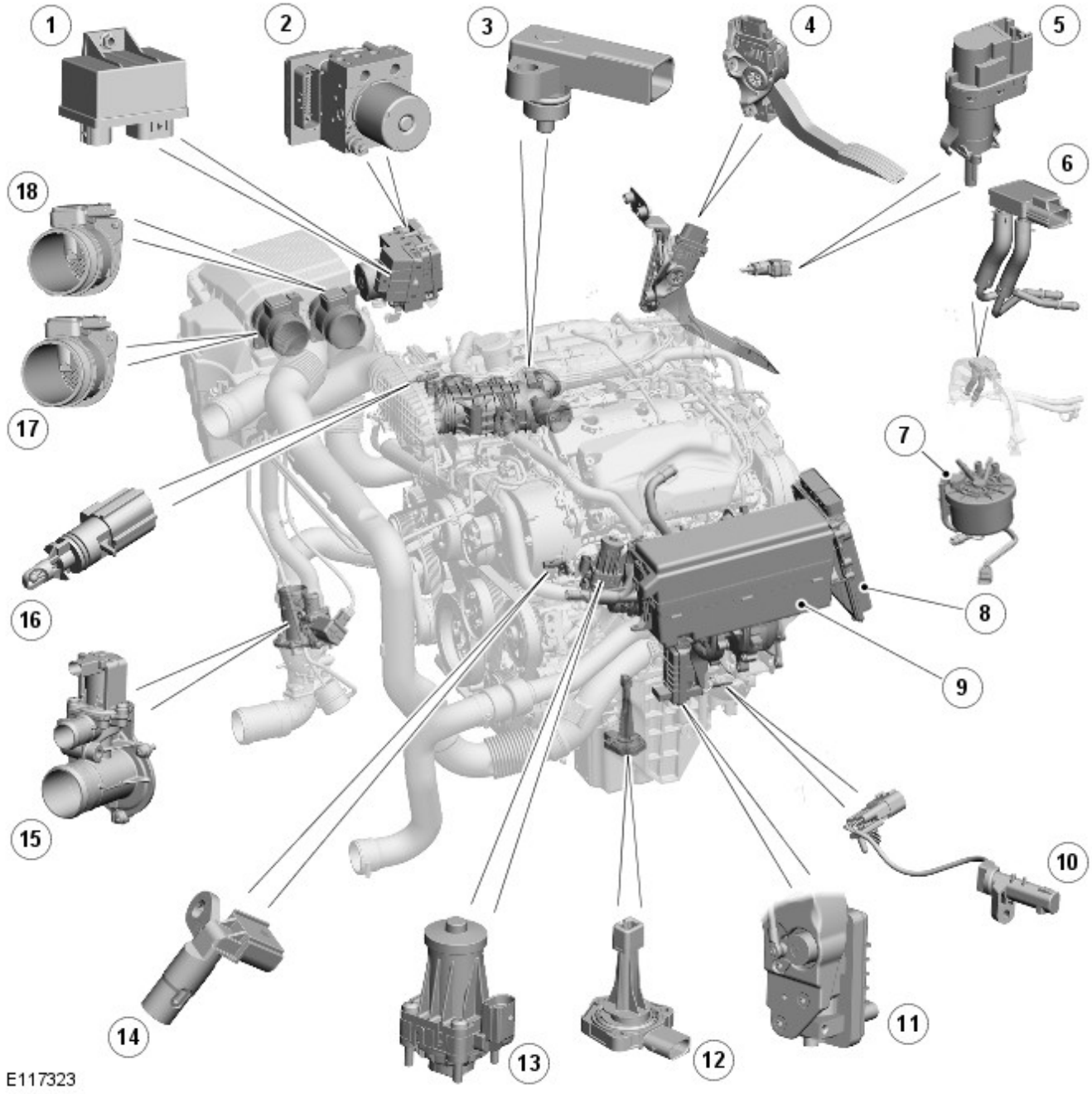
Description and Operation

Component Location - Sheet 1 of 3

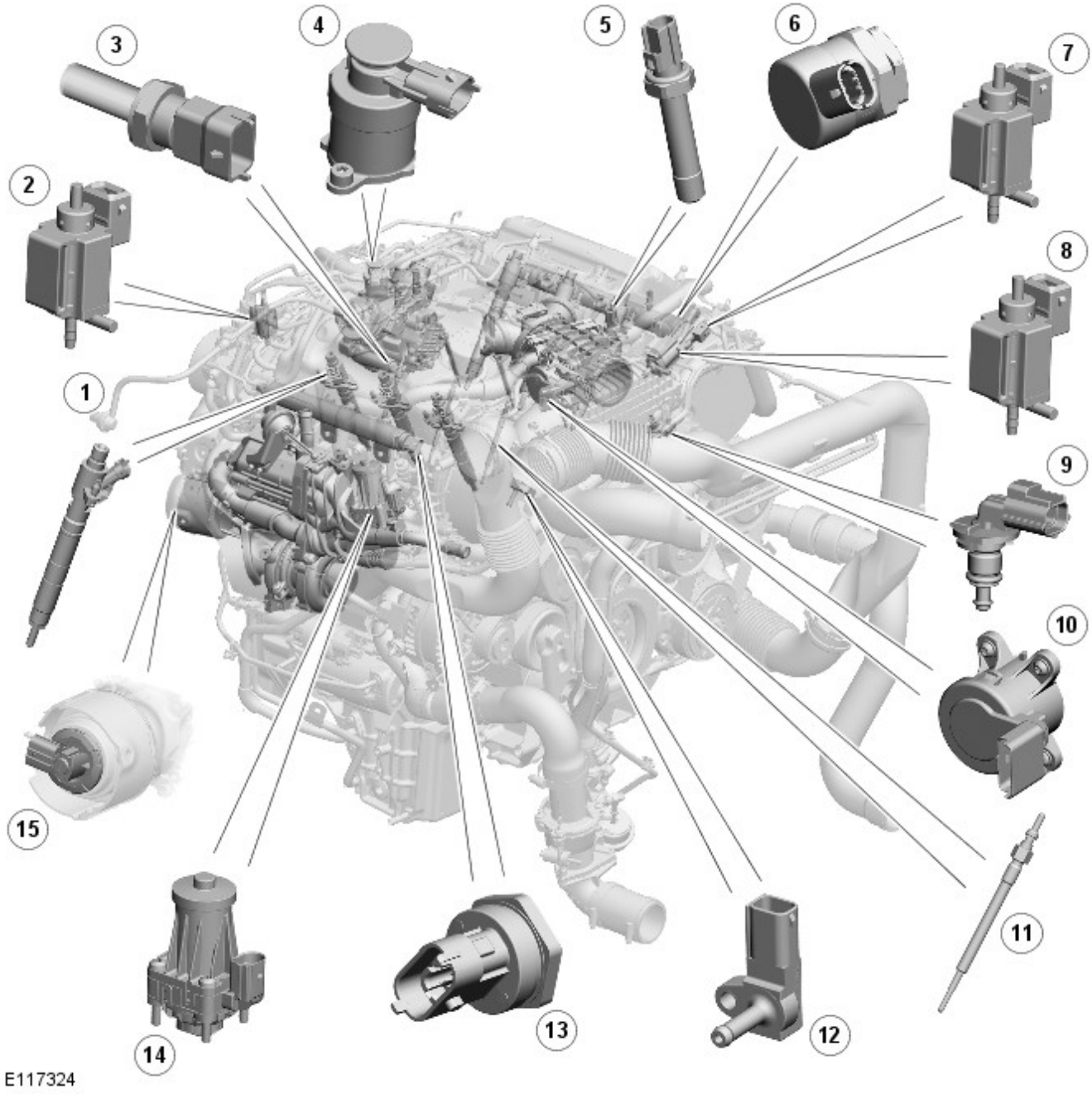


Item	Description
1	Exhaust gas temperature sensor
2	DPF (diesel particulate filter) pressure pipes (connected to differential pressure sensor located on top of transmission)
3	DPF temperature sensors
4	DPF
5	Catalyst (RH (right-hand) bank)
6	HO2S (heated oxygen sensor)
7	Pre-catalyst temperature sensor

Component Location - Sheet 2 of 3



Item	Description
1	Glow plug module
2	ABS (anti-lock brake system) module
3	MAP (manifold absolute pressure) sensor
4	APP (accelerator pedal position) sensor
5	Brake lamp/brake test switch
6	Differential pressure sensor
7	Water-in-fuel sensor
8	ECM (engine control module)
9	EJB (engine junction box)
10	CKP (crankshaft position) sensor
11	Primary turbocharger control module
12	Engine oil level/temperature sensor
13	LH (left-hand)EGR (exhaust gas recirculation) valve
14	CMP (camshaft position) sensor
15	Secondary turbocharger compressor recirculation valve
16	Charge air temperature sensor
17	MAF (mass air flow) / IAT (intake air temperature) sensor (primary turbocharger)
18	MAF sensor (secondary turbocharger)



Item	Description
1	Fuel injector (6 off)
2	EGR cooler bypass vacuum solenoid valve
3	High pressure fuel pump inlet temperature sensor
4	High pressure fuel pump volume control valve
5	Engine oil pressure sensor
6	Fuel pressure control valve
7	Secondary turbocharger compressor shut-off solenoid valve
8	Secondary turbocharger turbine shut-off solenoid valve
9	ECT (engine coolant temperature) sensor
10	Throttle actuator
11	Glow plug (6 off)
12	Secondary turbocharger boost pressure sensor
13	Fuel pressure sensor
14	RHEGR valve
15	Secondary turbocharger turbine shut-off valve and position sensor

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Electronic Engine Controls - Overview

Description and Operation

OVERVIEW

The 3.0L V6 diesel engine has an ECM (engine control module) controlled engine management system. Multiple sensor inputs and precision control of actuators are used by the ECM to achieve optimum performance during all driving conditions.

The ECM receives and processes information from the following input sources:

- Oil level sensor
- Secondary turbocharger shut-off sensor
- Secondary turbocharger boost pressure sensor
- Generator
- Differential pressure sensor
- CMP (camshaft position) sensor
- CKP (crankshaft position) sensor
- Fuel rail pressure sensor
- Fuel temperature sensor
- Air charge temperature sensor
- ECT (engine coolant temperature) sensor
- TP (throttle position) sensor
- MAF (mass air flow) sensor
- MAF/IAT (intake air temperature) sensor
- MAP (manifold absolute pressure) sensor
- EGR (exhaust gas recirculation) sensors
- HO2S (heated oxygen sensor)
- Catalyst and Diesel Particulate Filter (DPF) temperature sensors
- Brake lamp switch

The ECM outputs controlling signals to the following sensors and actuators:

- A/C (air conditioning) compressor clutch solenoid
- A/C compressor clutch
- Fuel injectors
- Glow plug relay
- Fuel pressure control valve
- Fuel volume control valve
- Fan control module
- Vacuum control valves (EGR cooler by-pass, secondary turbocharger compressor shut-off, secondary turbocharger turbine shut-off)
- ABS (anti-lock brake system) module
- TCM (transmission control module)
- Instrument cluster
- RCM (restraints control module)
- Primary turbocharger control module
- EGR recirculation valves
- Alternator
- Throttle actuator
- Secondary turbocharger compressor recirculation valve

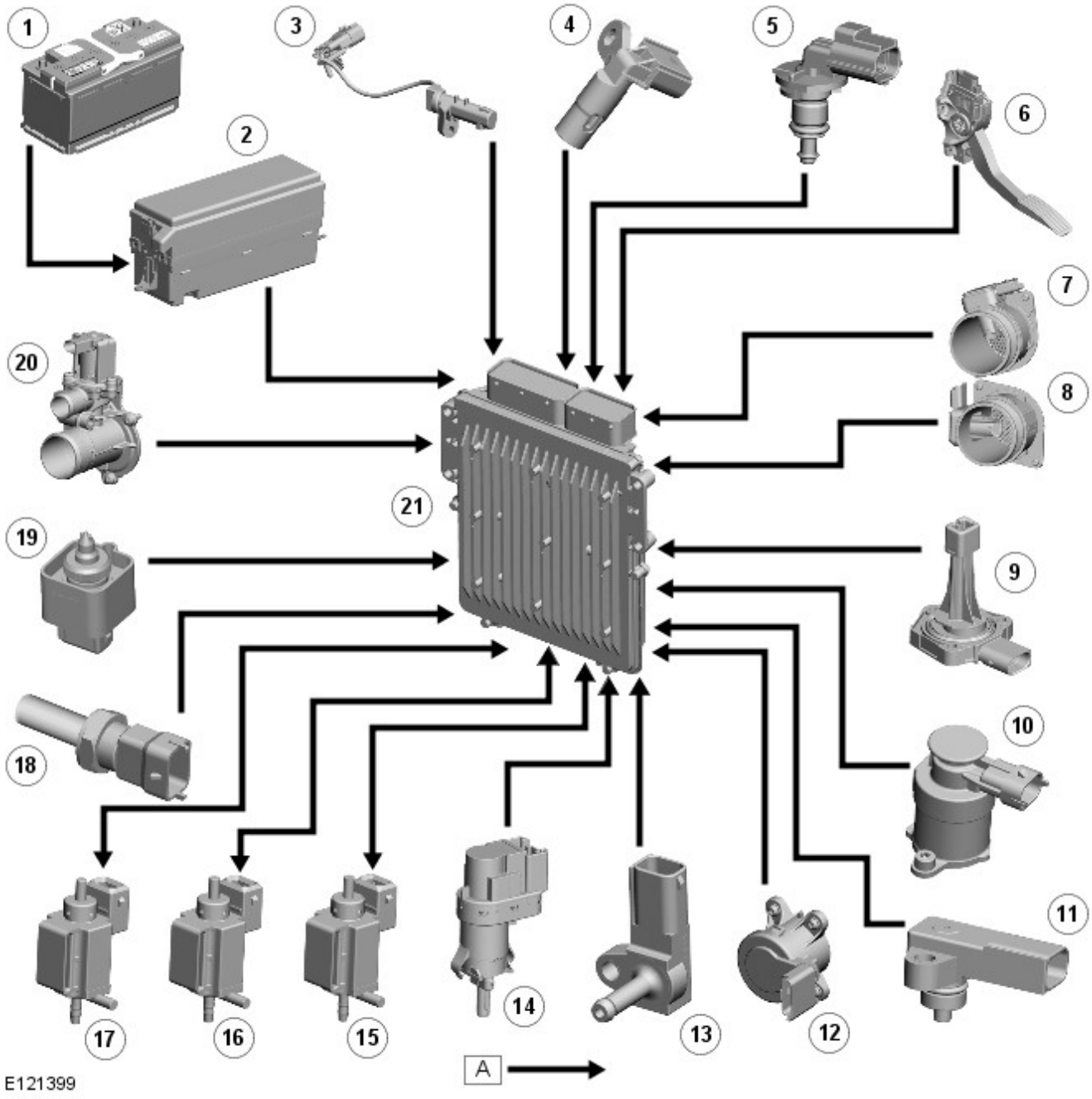
Published: 22-Jan-2014

Electronic Engine Controls - TDV6 3.0L Diesel - Electronic Engine Controls - System Operation and Component Description

Description and Operation

Control Diagram

3.0L V6 Diesel Control Diagram - Sheet 1 of 2



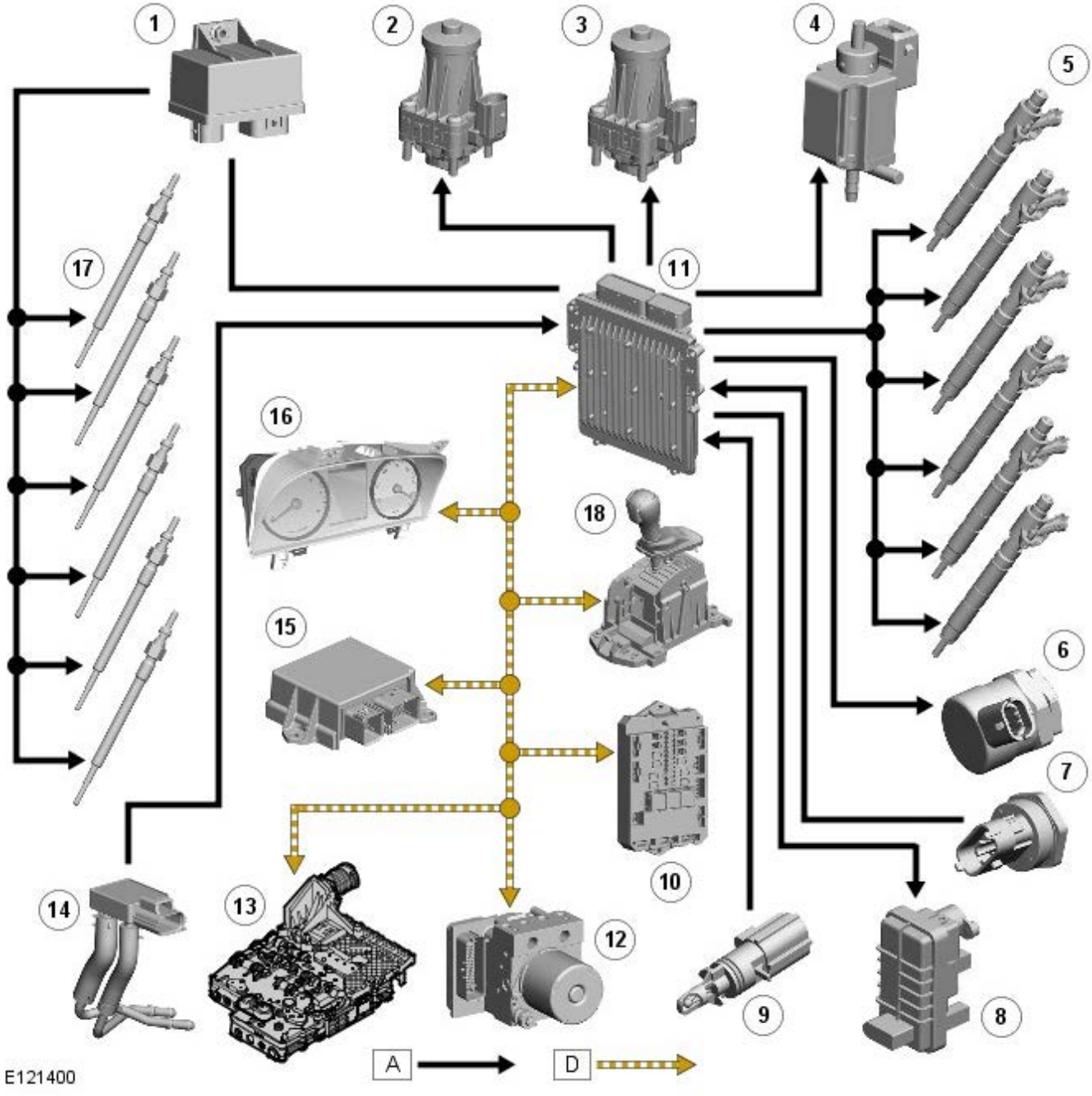
Item Description

NOTE: **A** = Hardwired

1 Battery
2 EJB (engine junction box)
3 CKP (crankshaft position) sensor
4 CMP (camshaft position) sensor
5 ECT (engine coolant temperature) sensor
6 APP (accelerator pedal position) sensor
7 MAF (mass air flow)/IAT (intake air temperature) sensor
8 MAF sensor
9 Engine oil level/temperature sensor
10 High pressure fuel pump volume control valve
11 MAP (manifold absolute pressure) sensor
12 Throttle actuator

13 Secondary turbocharger boost pressure sensor
14 Brake lamp/brake test switch
15 EGR (exhaust gas recirculation) solenoid valve
16 Secondary turbocharger turbine shut-off solenoid valve
17 Secondary turbine compressor shut-off solenoid valve
18 High pressure fuel pump inlet temperature sensor
19 Water in fuel sensor
20 Secondary turbocharger recirculation valve
21 ECM (engine control module)

3.0L V6 Diesel Control Diagram - Sheet 2 of 2



Item Description

NOTE: **A** = Hardwired; **D** = High Speed CAN (controller area network)

1 Glow plug relay
2 LH (left-hand)EGR recirculation valve
3 RH (right-hand)EGR recirculation valve
4 EGR cooler bypass vacuum solenoid valve
5 Fuel injector (6 off)
6 Fuel pressure control valve
7 Fuel pressure sensor
8 Primary turbocharger control module
9 Charge air temperature sensor

10 CJB (central junction box)
11 ECM
12 ABS (anti-lock brake system) module
13 TCM (transmission control module)
14 Differential pressure sensor
15 RCM (restraints control module)
16 Instrument cluster
17 Glow plug (6 off)
18 Transmission selector

System Operation

OPERATION

The 3.0L V6 diesel engine management system is controlled by an ECM and is able to monitor, adapt and precisely control the fuel injection. The ECM uses multiple sensor inputs and precision control of actuators to achieve optimum performance during all driving conditions.

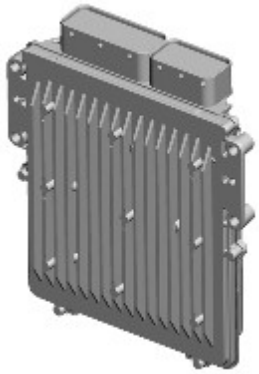
The ECM controls fuel delivery to all six cylinders via a common rail injection system. The common rail system uses a fuel rail to accumulate highly pressurized fuel and feed the six, electronically controlled injectors. The fuel rail is located in close proximity to the injectors, which assists in maintaining full system pressure at each injector at all times.

The ECM uses the drive by wire principle for acceleration control. There are no control cables or physical connections between the accelerator pedal and the engine. Accelerator pedal demand is communicated to the ECM by two potentiometers located in an APP sensor. The ECM uses the two signals to determine the position, rate of movement and direction of movement of the pedal. The ECM then uses this data, along with other engine information from other sensors, to achieve the optimum engine response.

Component Description

DESCRIPTION

Engine Control Module (ECM)



E123673

The ECM is located on a bracket on the passenger side of the engine compartment bulkhead.

The ECM connected to the vehicle harnesses via 2 connectors. The ECM contains data processors and memory microchips. The output signals to the actuators are in the form of ground paths provided by driver circuits within the ECM. The ECM driver circuits produce heat during normal operation and dissipate this heat via the casing. Some sensors receive a regulated voltage supplied by the ECM. This avoids incorrect signals caused by voltage drop during cranking.

The ECM performs self diagnostic routines and stores fault codes in its memory. These fault codes and diagnostics can be accessed using Land Rover approved diagnostic equipment. If the ECM is to be replaced, the new ECM is supplied 'blank' and must be configured to the vehicle using Land Rover approved diagnostic equipment. A 'flash' EEPROM (electrically erasable programmable read only memory) allows the ECM to be externally configured, using Land Rover approved diagnostic equipment, with market specific or new tune information. The current engine tune data can be accessed and read using Land Rover approved diagnostic equipment.

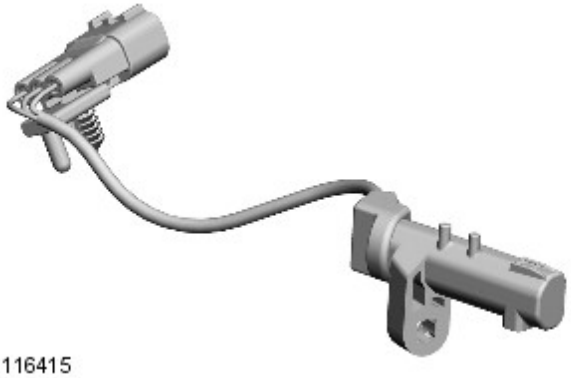
When a new ECM is fitted, it must also be synchronized to other system control modules using Land Rover approved diagnostic equipment. ECM's cannot be 'swapped' between vehicles as they must be 'matched' with security information to other system modules.

The ECM is connected to the engine sensors which allow it to monitor the engine operating conditions. The ECM processes these signals and decides the actions necessary to maintain optimum engine performance in terms of drive ability, fuel efficiency and exhaust emissions. The memory of the ECM is programmed with instructions for how to control the engine. The memory also contains data in the form of maps which the ECM uses as a basis for fueling and emission control. By comparing the information from the sensors to the data in the maps, the ECM is able to calculate the various output requirements. The ECM contains an adaptive strategy which updates the system when components vary due to production tolerances or ageing.

The ECM is connected to other system control modules and receives data from these modules on the high speed CAN

bus to enable precise engine control under all vehicle operating conditions.

Crankshaft Position (CKP) Sensor



E116415

The CKP sensor is located at the rear of the engine block on the LH side. The sensor lead passes through a cover in an aperture on the side of the engine block. The sensor is secured to a bracket on a plate which locates the rear crankshaft oil seal. The sensor tip is aligned with a magnetic trigger reluctor wheel which is attached to the end of the crankshaft. The trigger wheel is a press fit on the end of the crankshaft. The trigger wheel must be carefully aligned to the crankshaft to ensure correct timing. The sensor produces a square wave signal, the frequency of which is proportional to engine speed.

The ECM monitors the CKP sensor signal and can detect engine over-speed. The ECM counteracts engine over-speed by gradually fading out speed synchronized functions. The CKP is a Hall effect sensor. The sensor measures the magnetic field variation induced by the magnetized trigger wheel.

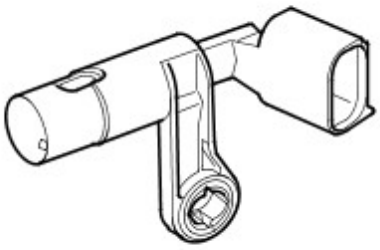
The trigger wheel has a 60 minus 2 tooth pattern. The missing teeth represent 12 degrees of crankshaft rotation and provide a reference point for the angular position of the crankshaft at 21 degrees BTDC (before top dead center) on cylinder 1.

When the space with the two missing teeth pass the sensor tip, a gap in the signal is produced which the ECM uses to determine the crankshaft position. The air gap between the sensor tip and the ring is important to ensure correct signals are output to the ECM. The recommended air gap between the CKP and the trigger wheel is 0.4 mm- 1.5 mm.

The ECM uses the signal from the CKP sensor for the following functions:

- Synchronization
- Determine fuel injection timing
- Produce an engine speed signal which is broadcast on the high speed CAN bus for use by other systems.

Camshaft Position (CMP) Sensor



E46902

The CMP is located on the front face of the LH cylinder head. The sensor tip protrudes through an aperture in the front face of the cylinder head to pick up on a reluctor behind the camshaft pulley. The CMP sensor is a Hall effect type sensor.

The ECM uses the CMP sensor signal to determine if the piston in No. 1 cylinder is at injection TDC (top dead center) or exhaust TDC. Once this has been established, the ECM can then operate the correct injector to inject fuel into the cylinder when the piston is at injection TDC.

The CMP sensor is a Hall effect sensor which used by the ECM at engine start-up to synchronize the ECM with the CKP sensor signal. The ECM does this by using the CMP sensor signal to identify number one cylinder to ensure the correct injector timing. Once the ECM has established the injector timing, the CMP sensor signal is no longer used.

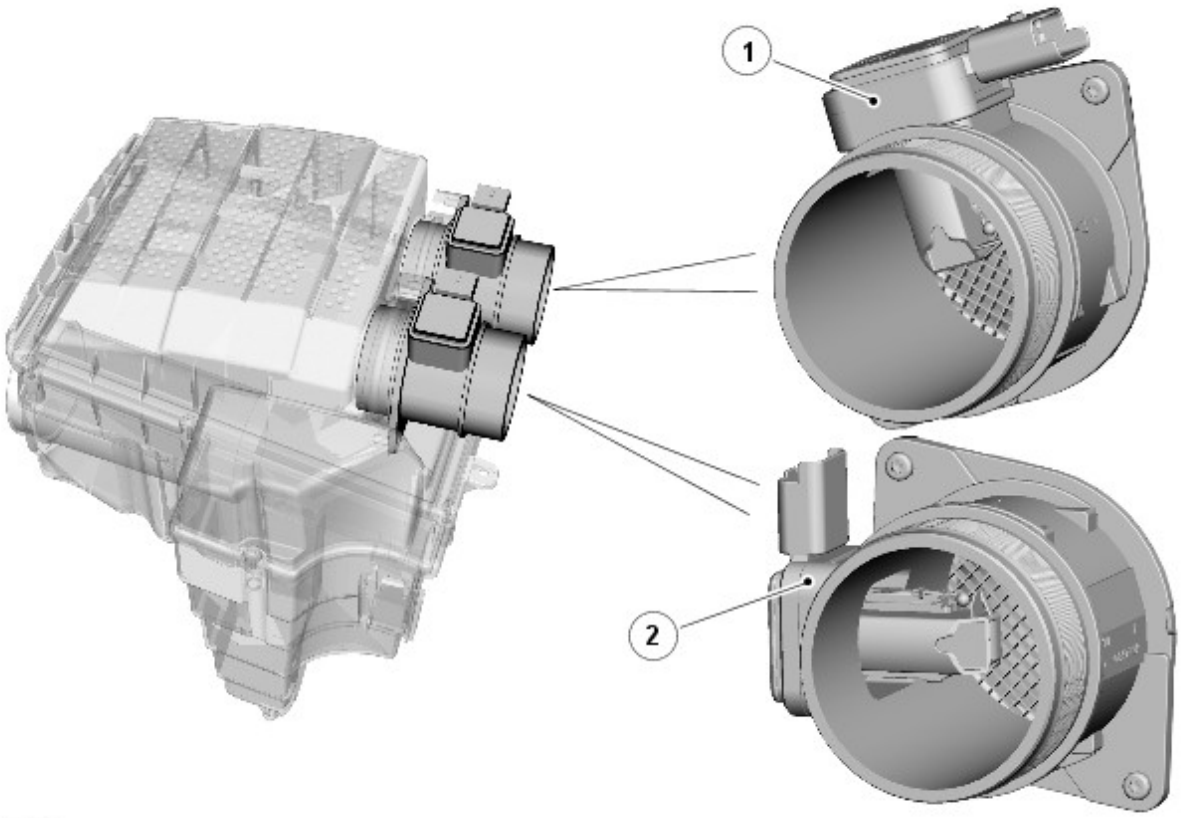
The CMP sensor receives a 5V supply from the ECM. Two further connections to the ECM provide ground and signal output.

If a fault occurs, an error is registered in the ECM. Two types of failure can occur; no CMP sensor signal or a synchronization error of the CMP and CKP sensors. The error recorded by the ECM can also relate to a total failure of

the crankshaft signal or crankshaft signal dynamically implausible. Both components should be checked to determine the cause of the fault.

If a fault occurs with the CMP sensor when the engine is running, the engine will continue to run but the ECM will deactivate boost pressure control. Once the engine is switched off, the engine will crank but will not restart while the fault is present.

Mass Air Flow (MAF) and Inlet Air Temperature (IAT) Sensors



E123727

Item	Description
1	MAF sensor
2	MAF/IAT sensor

The MAF/IAT sensors are located on the inlet air duct directly after the air filter box. Two sensors are fitted; the front sensor, located prior to the intake air to primary turbocharger pipe, is a combined MAF/IAT sensor (4-wire). The rear sensor, located prior to the intake air to secondary turbocharger pipe, is a MAF sensor (3-wire) only.

The MAF sensors work on the hot film principle. Each sensor has 2 sensing elements which are contained within a film. One element is maintained at ambient (air intake) temperature, e.g. 25°Celsius (77°F). The other element is heated to 200°Celsius (392°F) above the ambient temperature, e.g. 225°Celsius (437°F). Intake air entering the engine passes through the MAF sensors and has a cooling effect on the film. The ECM monitors the current required to maintain the 200°Celsius (392°F) differential between the two elements and uses the differential to provide a precise, non-linear, signal which equates to the volume of air being drawn into the engine.

The MAF sensor output is a digital signal proportional to the mass of the incoming air. The ECM uses this data, in conjunction with signals from other sensors and information from stored fueling maps, to determine the precise fuel quantity to be injected into the cylinders. The signal is also used as a feedback signal for the EGR system.

The IAT sensor in the front sensor incorporates a NTC (negative temperature coefficient) thermistor in a voltage divider circuit. The NTC thermistor works on the principle of decreasing resistance in the sensor as the temperature of the intake air increases. As the thermistor allows more current to pass to ground, the voltage sensed by the ECM decreases. The change in voltage is proportional to the temperature change of the intake air. Using the voltage output from the IAT sensor, the ECM can correct the fueling map for intake air temperature. The correction is an important requirement because hot air contains less oxygen than cold air for any given volume.

The MAF sensor receives a 12V supply from the BJB (battery junction box) and a ground connection via the ECM. Two further connections to the ECM provide a MAF signal and IAT signal.

The IAT sensor receives a 3.3V reference voltage from the ECM and shares a ground with the MAF sensor. The signal output from the IAT sensor is calculated by the ECM by monitoring changes in the supplied reference voltage to the IAT sensor voltage divider circuit.

The ECM checks the calculated air mass against the engine speed. If the calculated air mass is not plausible, the ECM uses a default air mass figure which is derived from the average engine speed compared to a stored characteristic map. The air mass value will be corrected using values for boost pressure, atmospheric pressure and air temperature.

If one of the MAF sensors fails the ECM implements the default strategy based on engine speed. In the event of a

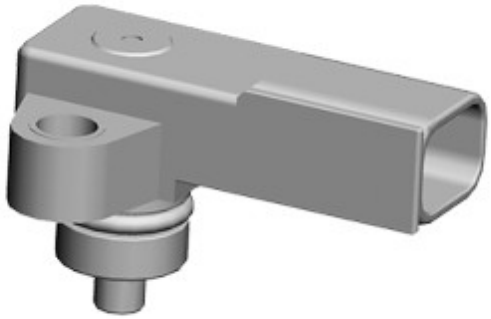
MAF sensor signal failure, the following symptoms may be observed:

- EGR system off
- Delayed engine response
- Reduced engine performance.

If the IAT sensor fails the ECM uses a default intake air temperature of 40°Celsius (104°F). In the event of an IAT sensor failure, the following symptom may be observed:

- Under fueling, resulting in reduced engine performance.

Manifold Absolute Pressure (MAP) Sensor



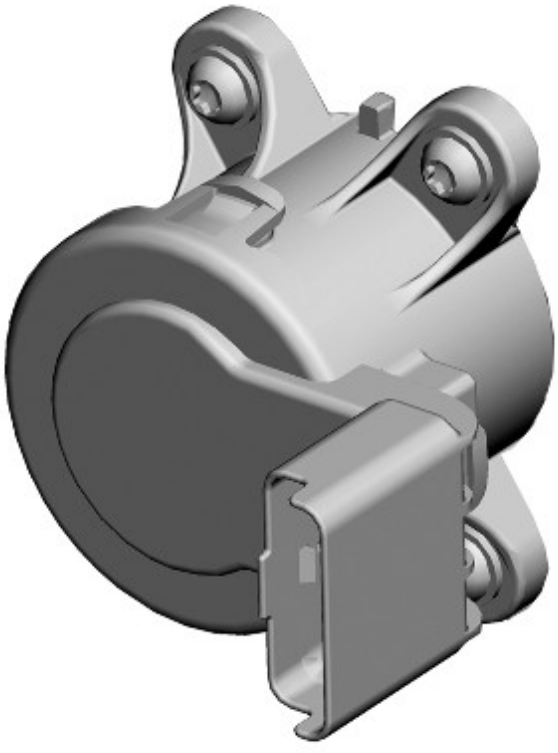
E123688

The MAP sensor is located on top of the throttle intake manifold. The MAP sensor measures the absolute pressure in the intake manifold. The sensor is a semi-conductor type sensor which responds to pressure acting on a membrane within the sensor, altering the output voltage. The sensor receives a 5V reference voltage and a ground from the ECM and returns a signal of between 0.5 - 4.5V to the ECM. A low pressure returns a low voltage signal to the ECM and a high pressure returns a high voltage.

The MAP sensor detects quick pressure changes in the intake manifold after the electric throttle. The signal is used in conjunction with the MAF sensor signal to calculate the injection period.

The ECM monitors the engine MAP sensor for faults and can store fault related codes. These can be retrieved using Land Rover approved diagnostic equipment. If the sensor fails, the ECM uses the MAF/IAT sensor signal value as a substitute.

Electronic Throttle Actuator



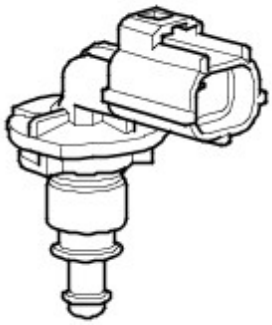
E116417

The electronic throttle actuator is located on the side of the throttle intake manifold.

The electronic throttle actuator controls the volume of air allowed into the inlet manifolds by means of a DC (direct

current) motor which controls a flap in the body of the throttle. The actuator is controlled by the ECM which operates the actuator in response to driver inputs from the APP sensor and other engine related sensors to provide the correct air flow to the intake manifolds.

Engine Coolant Temperature (ECT) Sensor



E46905

The ECT sensor is located in the LHEGR cooler coolant inlet pipe, at the front of the engine. The ECT sensor provides the ECM and the instrument cluster with engine coolant temperature status.

The ECM uses the temperature information for the following functions:

- Fueling calculations
- Limit engine operation if engine coolant temperature becomes too high
- Cooling fan operation
- Glow plug activation time.

The instrument cluster uses the temperature information for generation of engine temperature messages. The engine coolant temperature signal is also transmitted on the medium speed CAN bus by the instrument cluster for use by other systems.

The ECT sensor circuit consists of an internal voltage divider circuit which incorporates an NTC thermistor. As the coolant temperature rises the resistance through the sensor decreases and vice versa. The output from the sensor is the change in voltage as the thermistor allows more current to pass to ground relative to the temperature of the coolant.

The ECM compares the signal voltage to stored values and adjusts fuel delivery to ensure optimum drive ability at all times. The engine will require more fuel when it is cold to overcome fuel condensing on the cold metal surfaces inside the combustion chamber. To achieve a richer air/fuel ratio, the ECM extends the injector opening time. As the engine warms up the air/fuel ratio is leaned off.

The input to the sensor is a 3.3V reference voltage supplied from the voltage divider circuit within the ECM. The ground from the sensor is also connected to the ECM which measures the returned current and calculates a resistance figure for the sensor which relates to the coolant temperature.

If the ECT sensor fails, the following symptoms may be observed:

- Difficult cold start
- Difficult hot start
- Engine performance compromised
- Temperature gauge inoperative or inaccurate reading.

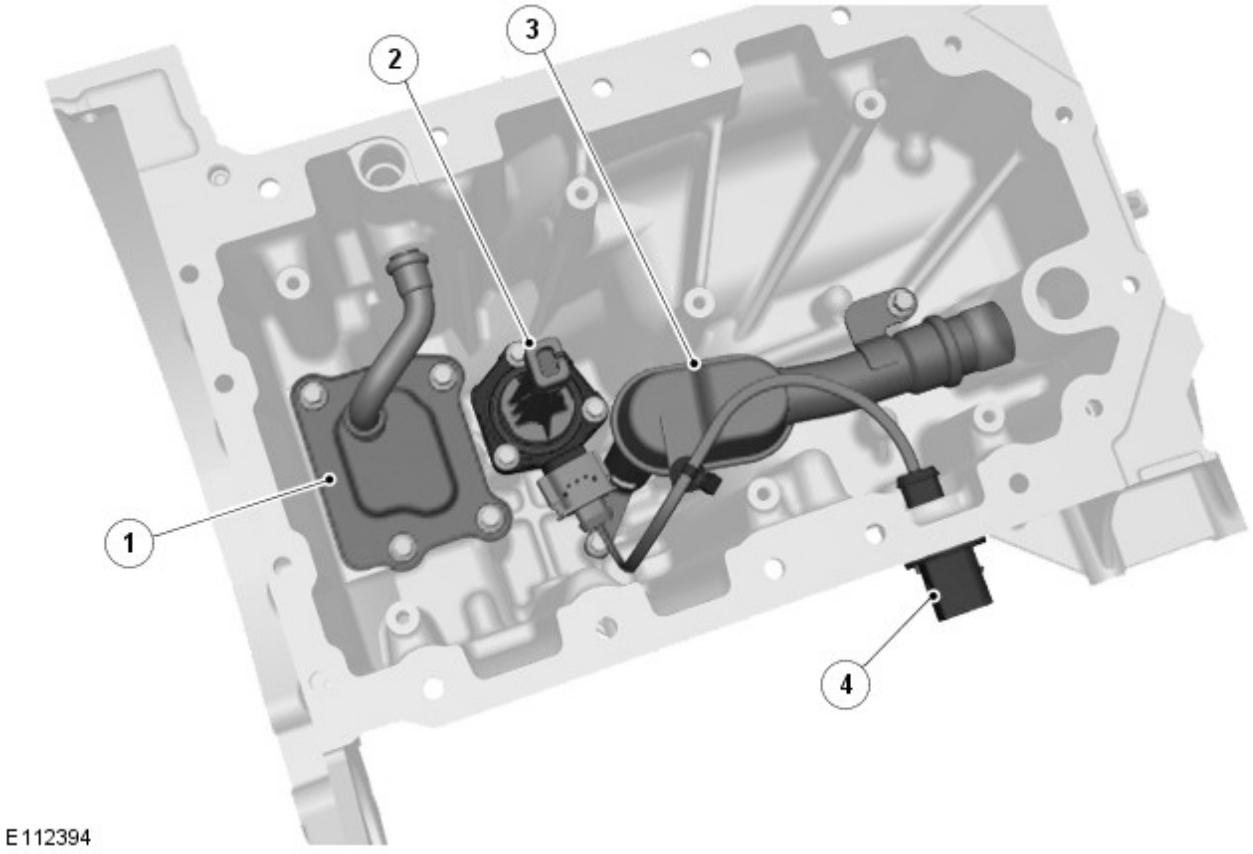
In the event of ECT sensor signal failure, the ECM applies a default value of 80°Celsius (176°F) coolant temperature for fueling purposes. The ECM will also permanently operate the cooling fan at all times when the ignition is switched on, to protect the engine from overheating.

The table that follows shows ECT sensor values and the corresponding sensor resistance and voltage values.

Temperature (Degrees Celsius)	Resistance (KOhms)	Voltage (Volts)
- 40	925	3.23
- 30	496	3.16
- 20	277	3.06
- 10	160	2.91
-0	96	2.70
10	59	2.42
20	37	2.09
30	24	1.75
40	16	1.41
50	11	1.11
60	7.55	0.86
70	5.34	0.66
80	3.84	0.50
90	2.80	0.38
100	2.08	0.29

110	1.56	0.22
120	1.19	0.17
130	0.918	0.14
140	0.715	0.11
150	0.563	0.08

Engine Oil Level and Oil Temperature Sensor



Item Description

1 Oil scavenge reservoir
2 Engine oil level and temperature sensor
3 Oil pick-up pipe
4 Engine oil level and temperature sensor electrical connector

The 3.0L V6 diesel engine is not fitted with a conventional dipstick. The dipstick is replaced with an ultrasonic oil level and temperature sensor which is located with 3 bolts on the inside of the oil pan.

The sensor uses ultrasonic pulses to determine the oil level in the oil pan. The level sensor sends an ultrasonic pulse vertically upward and measures the time taken for the pulse to be reflected back to the sensor from the upper surface of the oil. A second reference pulse is also transmitted across a reference distance. The time periods of the first and second pulses are compared and the sensor calculates the oil height in the oil pan. The sensor then converts the results into a PWM (pulse width modulation) signal to the ECM which converts the frequency of the signal into an oil level height.

The sensor uses an NTC type sensor to determine the oil temperature. The sensor measures the oil temperature and converts the sensor signal into a PWM signal to the ECM which converts the frequency of the signal into an oil temperature.

If the oil level is incorrect or a system fault occurs, a warning message is displayed in the instrument cluster message center. The messages that follow can be displayed in the message center:

Warning	System Status
ENGINE OIL LOW (Amber warning triangle displayed)	The oil is at the minimum level for safe operation. Top-up with 2 liters (3.5 pints) of oil.
ENGINE OIL HIGH (Amber warning triangle displayed)	This warning is displayed when the engine is started, if the oil is above the maximum level for safe operation. Stop the vehicle as soon as safety permits and seek qualified assistance to have the engine oil drained, before driving the vehicle.
ENGINE OIL CRITICALLY LOW (Red warning triangle displayed)	The oil is below the minimum level for safe operation. Stop the vehicle as soon as safety permits and top-up with 2.5 liters (4.4 pints) of oil. Wait for 10 minutes, re-check the oil level reading and top-up again if necessary.
ENGINE OIL LEVEL MONITOR SYSTEM FAULT (Amber warning triangle displayed)	A fault with the oil level monitoring system is indicated. Seek qualified assistance as soon as possible.

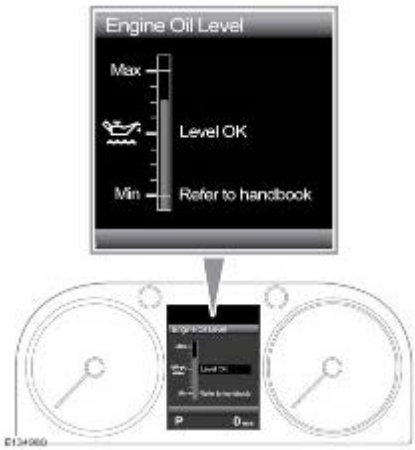
Oil Level Check

Check the oil level weekly, when the engine is hot and with the vehicle resting on level ground.

NOTE: Switch off the engine and let the vehicle stand for ten minutes to allow the oil drain back to the oil pan. Do not start the engine.

The oil level can be viewed in the message centre when the ignition is on (power mode 6), the engine stopped and the transmission in Park (P).

NOTE: The system will not give a reading until the oil level has stabilized.



An indication of the oil level is displayed on the gauge. Messages to the right of the gauge give advice of any action that may need to be taken.

If the oil level is within the required operating range, the message **'Level OK'** will be displayed. Do not add any additional oil to the engine.

If the oil level is below the required operating range, a message advising how much oil to add will be displayed. Add the recommended quantity of oil then re-check the level.

If **'Overfilled'** is displayed, seek qualified assistance immediately. Do not drive the vehicle as this will cause serious damage to the engine.

Engine Oil Top-Up

CAUTIONS:

Failure to use oil that meets the required specification, could cause excessive engine wear, a build-up of sludge and deposits and increase pollution. It could also lead to engine failure and invalidation of vehicle warranty.

Overfilling with oil could result in severe engine damage.

Use the procedure that follows to replenish the engine oil level:

- With the ignition on, but the engine not running, unscrew the oil filler cap.
- Add the appropriate quantity of oil (as indicated by the message center oil level display). Wait 10 minutes to allow the oil level stabilize and re-check the level. Clean up any oil spilled during topping up
- Once the correct level is achieved, refit the filler cap and hand-tighten securely until one click is heard.

NOTES:

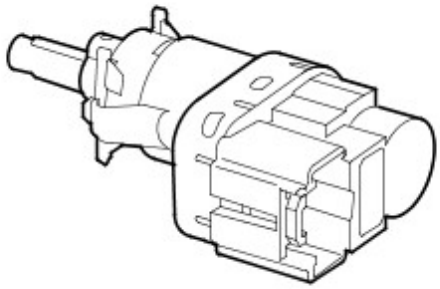
The approximate quantity of oil required to raise the level from the minimum level of safe operation to the maximum, is 2.0 liters (3.5 pints).

The ignition must be left on during the top-up, so that the electronic dipstick can register and display the new oil level. This enables an accurate level re-check.

Live Reading/Average Reset

A procedure is available to allow the technician to access the actual engine oil level, rather than the average engine oil level which is available to the driver. An additional procedure is also available to reset the average engine oil level. Refer to Engine - 3.0L Diesel - General Procedures - Engine Oil Draining and Filling 303-01B.

Brake Lamp/Brake Test Switch



E46910

The brake lamp/brake test switch is located on the pedal box and is operated by the brake pedal. The 2 pole switch has a normally open circuit switch connected to battery voltage which closes the circuit when the driver has depressed the brake pedal and a normally closed circuit which is connected to ground when the driver depresses the brake pedal. The switch contacts are connected directly to the ECM and the ECM also receives a brake pressure signal on the high speed CAN bus from the ABS module.

The ECM uses the brake signal for the following:

- To limit fueling during braking
- To inhibit/cancel Speed control if the brakes are applied.

In the event of a brake switch failure, the following symptoms may be observed:

- Speed control inactive
- Increased fuel consumption.

Fuel Pressure Control Valve



E116419

The fuel pressure control valve is incorporated into the forward end of the common fuel rail for the LH cylinder bank. The control valve regulates the fuel pressure within the fuel rails and is controlled by the ECM. The control valve is a PWM controlled solenoid valve.

When the solenoid is de-energized, an internal spring holds an internal valve closed. At fuel pressure of 100 bar (1450 lbf/in^2) or higher, the force of the spring is overcome, opening the valve and allowing fuel pressure to decay into the fuel return pipe. When the pressure in the fuel rail decays to approximately 100 bar (1450 lbf/in^2) or less, the spring force overcomes the fuel pressure and closes the valve. When the ECM energizes the solenoid, the valve is closed allowing the fuel pressure to build. The pressure in the fuel rail in this condition can reach approximately 2000 bar (29000 lbf/in^2).

The ECM constantly monitors the fuel pressure and activates the fuel pressure control valve accordingly to control the fuel rail pressure within the require parameters. Relieved fuel from the fuel rails is directed through the fuel rail leak-off pipe to the fuel filter return circuit.

The ECM controls the fuel rail pressure by operating the control valve solenoid using a PWM signal. By varying the duty cycle of the PWM signal, the ECM can accurately control the fuel rail pressure and hence the pressure delivered to the injectors according to engine load. This is achieved by the control valve allowing a greater or lesser volume of fuel to pass from the high pressure side of the pump to the un-pressurized fuel return line, regulating the pressure on the high pressure side.

The fuel pressure control valve receives a PWM signal from the ECM of between 0 and 12V. The ECM controls the operation of the control valve using the following information to determine the required fuel pressure:

- Fuel rail pressure
- Engine load
- APP sensor position
- Engine coolant temperature
- Engine speed.

In the event of a total failure of the fuel pressure control valve, the engine will not start. In the event of a partial

failure of the fuel pressure control valve, the ECM will activate the solenoid with the minimum duty cycle which results in the injection quantity being limited.

Fuel Pressure Sensor



E116418

The fuel pressure sensor is located in the forward end of the common fuel rail for the RH cylinder bank. The sensor is screwed into a threaded port in the end of the fuel rail.

The fuel pressure sensor is a piezo-resistive type sensor containing an actuating diaphragm. Deflection of the diaphragm provides a proportional signal (output) voltage to the ECM, dependant on the fuel pressure within the fuel rails.

Accelerator Pedal Position (APP) Sensor



E116420

The APP sensor allows the ECM to determine the driver requests for vehicle speed, acceleration and deceleration. The ECM uses this information to determine the torque demand from the engine via injection control.

The APP sensor is installed on the pedal box and secured to a bracket with 3 screws.

The APP sensor is incorporated into the pedal box assembly. The APP sensor is a twin track rotary potentiometer type sensor which is integral with the throttle pedal housing.

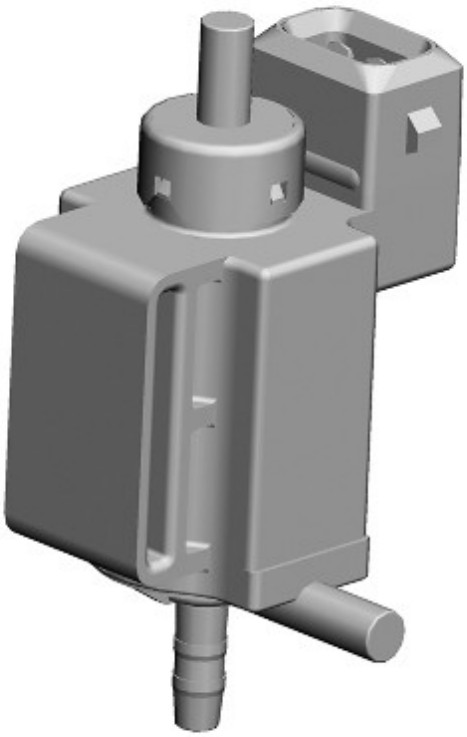
A six pin electrical connector provides the interface with the vehicle harness. The accelerator pedal is connected to a spindle on the RH side of the APP sensor. The APP sensor receives two separate electrical supplies and generates two different outputs.

Both tracks are analogue output signals connected to the ECM. Both signals contain the same positional information, but the secondary track has half the voltage output of the primary track.

If there is a fault with the primary track, the secondary track is used and the vehicle/engine response to pedal demand will be sluggish. If both analogue signals have a fault, the engine adopts a constant high speed of 1300 rpm to allow the vehicle to move. Torque application and reduction of engine speed back to normal idle speed can be subsequently controlled via brake lamp/brake test switch operation.

The ECM constantly checks the range and plausibility of the two signals and stored a fault code if it detects a fault.

EGR Cooler Bypass Vacuum Solenoid Valve



E116421

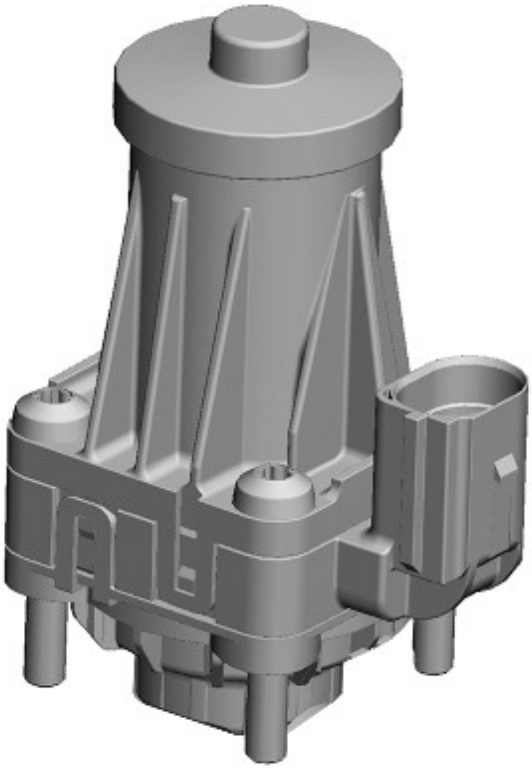
The EGR cooler bypass solenoid valve is located on a bracket at the rear of the engine, adjacent to the vacuum pump.

The solenoid valve has a vacuum pipe connection to the vacuum pump which provides the vacuum when the engine is running. Two outlets from the solenoid valve each connect to an EGR bypass vacuum actuator.

When the EGR cooler bypass solenoid valve is energized, vacuum created by the vacuum pump is applied to each EGR bypass vacuum actuator and exhaust gasses by-pass the EGR cooler. The default position is for exhaust gas cooling. The actuators move under the influence of the vacuum and move a valve within the EGR cooler to divert the exhaust gasses straight through the cooler. This system is used when the engine management system determines that exhaust gas cooling is not required.

The EGR cooler bypass solenoid valve receives a 12 volt supply from the EJB. The ECM controls the operation of the solenoid valve by controlling the ground path for the solenoid.

Exhaust Gas Recirculation (EGR) Valve Motor



E116422

The EGR valve motors each receive a 12 volt supply and ground from the ECM.

The 12 volt power supply from the ECM operates the EGR valve motor. Three further wires connect the EGR valve to the ECM a 5 volt reference voltage, a ground and a position signal feedback.

The valve is used to direct a calculated proportion of exhaust gas back into the combustion chamber.

Engine Oil Pressure Sensor

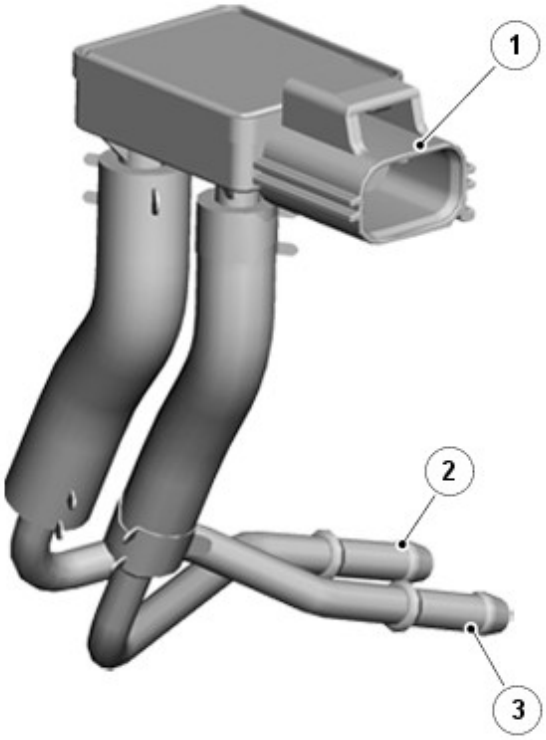


E116423

The engine oil pressure sensor is located in a threaded port in the LH cylinder head. The sensor is connected directly to the instrument cluster.

The sensor is not connected to the ECM but is supplied with a reference voltage from the instrument cluster. The sensor ground is through the sensor body and the engine. When the oil pressure falls to below a predetermined threshold, the sensor internal switch contacts close, completing a circuit from the instrument cluster. This circuit is sensed by the instrument cluster which displays and appropriate warning message and warning lamp to alert the driver.

Differential Pressure Sensor



E123690

Item	Description
1	Electrical connector
2	Low pressure connection
3	High pressure connection

The differential pressure sensor is located on the rear of the transfer box, adjacent to the DPF (diesel particulate filter).

The differential pressure sensor is used by the DPF software to monitor the condition of the DPF. Two pipe connections on the sensor are connected by pipes to the inlet and outlet ends of the DPF. The pipes allow the sensor to measure the inlet and outlet pressures of the DPF.

As the amount of particulates trapped by the DPF increases, the pressure at the inlet side of the DPF increases in comparison to the DPF outlet. The DPF software uses this comparison, in conduction with other data, to calculate the accumulated amount of trapped particulates.

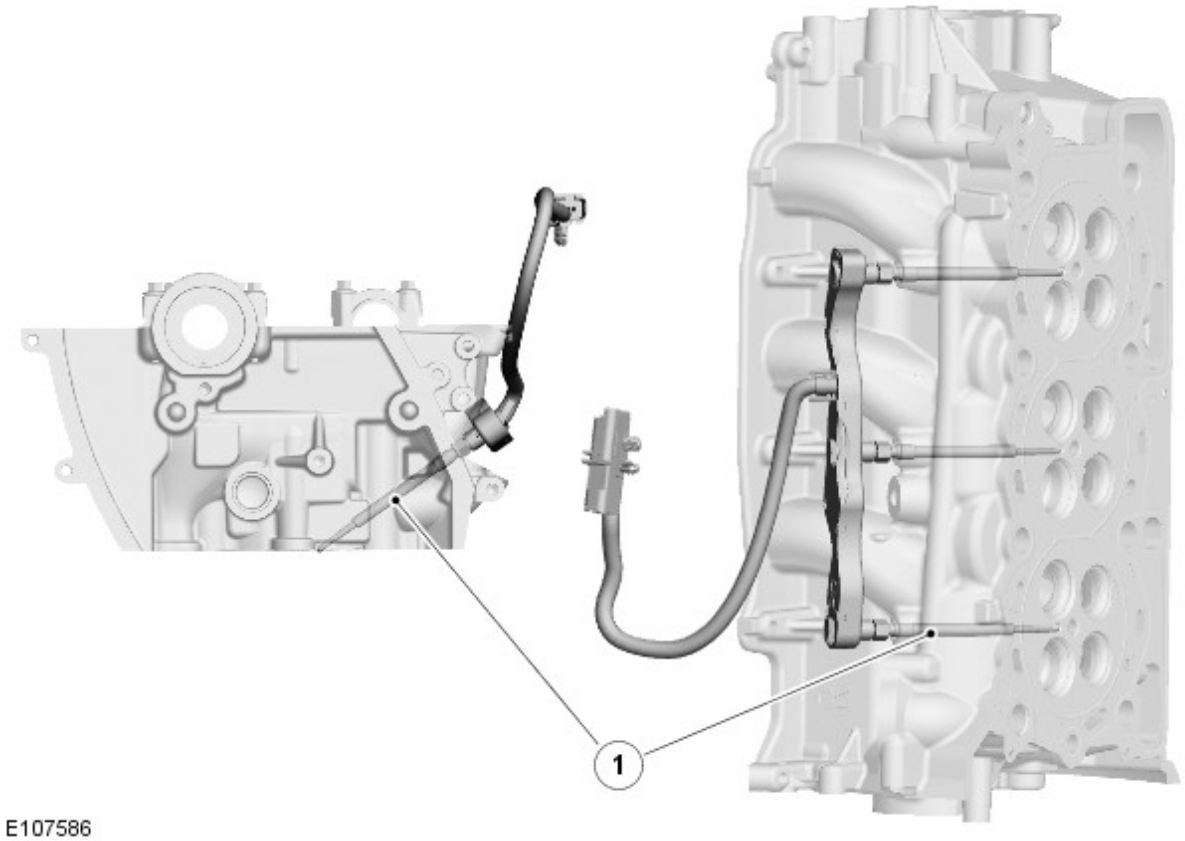
By measuring the pressure difference between the DPF inlet and outlet air flow the DPF software can determine if the DPF is becoming blocked and requires regeneration.

A DPF is recognized as overloaded if the differential pressure under certain operating conditions exceeds the overload limit calculated by the ECM. The DPF software may start regeneration attempts but be unable to complete them. These attempts are counted by the ECM and, if the maximum number of regeneration attempts is reached, a fault entry is recorded in the ECM at the next ignition on cycle.

The DPF software performs the following checks using the DPF differential pressure sensor:

- Sensor plausibility check
- DPF efficiency
- DPF overloaded
- DPF clogged
- Circuit range checks (max. and min.)
- DPF hose lines (dropped, crossed and blocked)
- DPF dislodged/damaged
- Monitoring of the maximum regeneration attempts in the lower load range

Glow Plugs



E107586

Item Description

1 Glow plug

Three glow plugs are located in each of the cylinder heads, on the inlet side. The glow plugs and the glow plug module are a vital part of the engine starting strategy. The glow plugs heat the air inside the cylinder during cold starts to assist combustion. The use of glow plugs helps reduce the amount of additional fuel required on start-up, and consequently reduces the emission of black smoke. The use of glow plugs also reduces the amount of injection advance required, which reduces engine noise, particularly when idling with a cold engine.

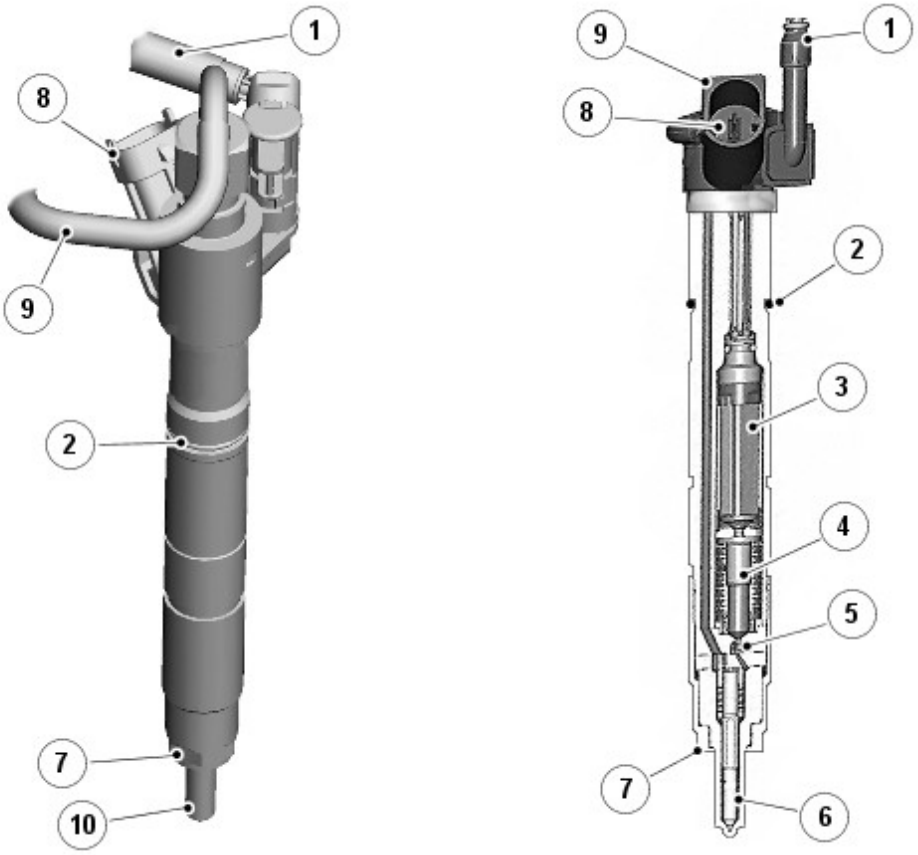
There are three phases of glow plug activity:

- Pre-heat
- During crank
- Post heat.

The ceramic sheathed element glow plugs are made from a heat-resistant, electrically conductive ceramic material. The ceramic sheathed-element glow plugs outer layer is heated directly and is self regulating. The self regulation allows the resistance of the sheathed element to automatically increase as the heat increases preventing the glow plug from overheating. In addition, during the heating process and under the control of the glow plug module, the glow plugs can be operated above their nominal voltages. This permits heat-up speeds of 1000°C per second. The sheathed-element glow plugs reach a maximum glow temperature of 1300°C and can hold a temperature of 1150°C for several minutes after the first-start glow or at intervening times.

The glow plugs are controlled by the ECM using the glow plug module and external sensor values to control the glow plug operation via internal software.

Fuel Injectors



E115475

Item Description

1 Fuel return
2 O-ring seal
3 Piezo stack actuator
4 Hydraulic coupler
5 Control valve
6 Nozzle body
7 Copper sealing washer
8 Electrical connector
9 High pressure feed
10 Nozzle

Six fuel injectors are used in the fuel system. A piezo actuator in each injector is electronically controlled by the ECM to operate the injector in response to engine speed and load conditions.

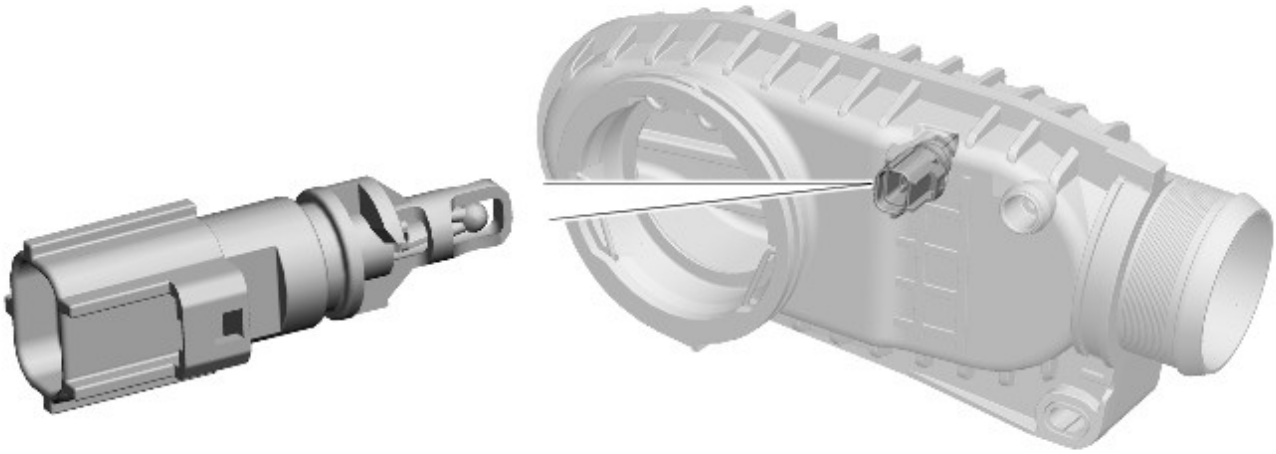
Each injector is calibrated to the ECM and applicable the cylinder to which it is fitted. Therefore, if an injector is removed it must be refitted to the cylinder from which it was removed. If a new injector is fitted, a calibration routine using Land Rover approved diagnostic equipment must be performed to calibrate the injector unique code to the ECM.

The operating voltage of the injector is between 110 and 163 volts depending on engine speed and load and care must be taken when working in the vicinity of the injectors. The voltage increases linearly with the injector operating pressure from 200 to 1200 bar.

Each injector has an electrical resistance value of between 150 - 250 kOhms.

CAUTION: Each injector operation is controlled by a charge and discharge cycle allowing energy to dissipate in, and recover from the injector. Never disconnect the wiring connection when the engine is running. The injector can remain open causing engine damage.

Charge Air Temperature Sensor



E116759

The is charge air temperature sensor is located in the rear of the intake chamber immediately preceding the throttle intake manifold. The sensor is used to measure the intake air temperature from the turbochargers in order to calculate the required amount of fueling.

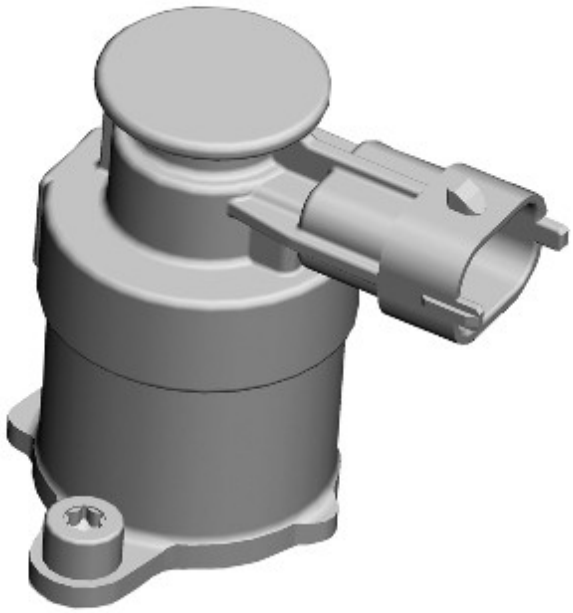
The charge air temperature sensor incorporates a NTC thermistor in a voltage divider circuit. The NTC thermistor works on the principle of decreasing resistance in the sensor as the temperature of the charge air increases. As the thermistor allows more current to pass to ground, the voltage sensed by the ECM decreases. The change in voltage is proportional to the temperature change of the charge air. Using the voltage output from the charge air temperature sensor, the ECM can correct the fueling map for charge air temperature. The correction is an important requirement because hot air contains less oxygen than cold air for any given volume.

The charge air temperature sensor receives a 3.3V reference voltage from the ECM. The signal output from the charge air temperature sensor is calculated by the ECM by monitoring changes in the supplied reference voltage to the charge air temperature sensor voltage divider circuit.

If the charge air temperature sensor fails the ECM uses a default charge air temperature of -5°C (23°F). In the event of a charge air temperature sensor failure, any of the following symptoms may be observed:

- Over fueling, resulting black smoke emitting from the exhaust
- Idle speed control inoperative.

High Pressure Fuel Pump Volume Control Valve



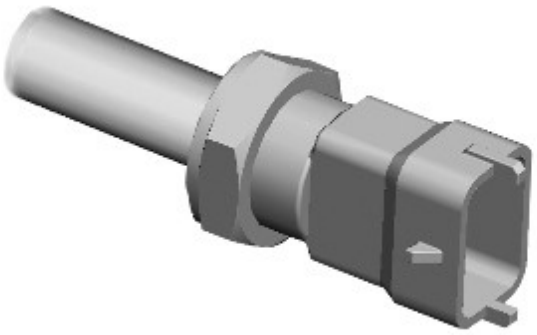
E116761

The high pressure fuel pump volume control valve is mounted on the high pressure pump, and located in the feed port between the high-pressure pump elements and the internal transfer pump. The high pressure fuel pump volume control valve is a variable position solenoid-operated valve that is controlled by the ECM.

The high pressure fuel pump volume control valve is controlled by a PWM signal from the ECM to allow a defined amount of 'leak off' from the high pressure fuel pump. The leak off fuel provides cooling and lubrication for the high-pressure pump internal components. The fuel is returned through a leak off pipe to the fuel filter, where it cools and is returned into the fuel filter via the low pressure return line.

The high pressure fuel pump volume control valve determines the amount of fuel that is delivered from the internal transfer pump to the high pressure pumping elements. When there is no signal to the high pressure fuel pump volume control valve, the valve is closed and there is no fuel delivery. The ECM applies a varying PWM signal of between 0 to 100% to control the required fuel volume.

High Pressure Fuel Pump Inlet Temperature Sensor



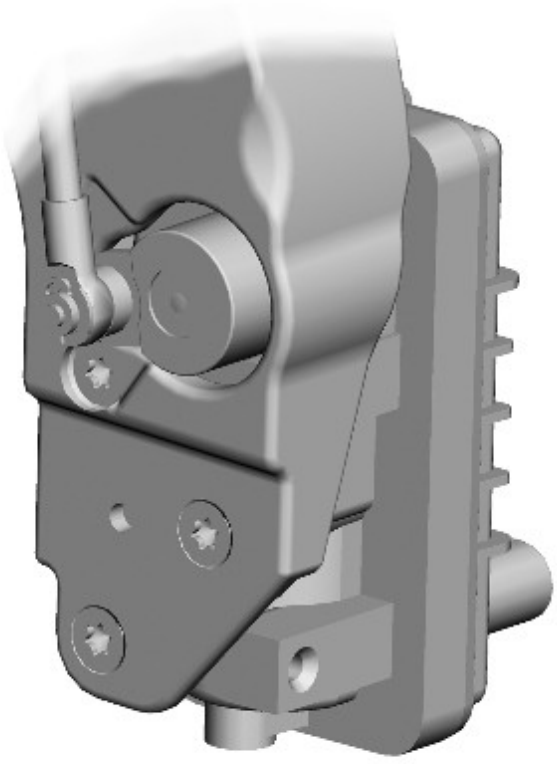
E116762

The high pressure fuel pump inlet temperature sensor is located on the rear of the high pressure fuel pump. It measures the fuel temperature in the low-pressure side of the high pressure fuel pump.

The ECM continually monitors this signal to determine the fuel temperature to prevent overheating of the fuel system. The ECM will also make fine adjustments to fuel injection quantity to adjust for fuel temperature.

The inlet temperature sensor is an NTC thermistor. As the fuel temperature rises the resistance through the sensor decreases and visa versa. The ECM measures the change in voltage as the thermistor allows more current to pass to ground relative to the fuel temperature.

Primary Turbocharger Control Module



E116424

The primary turbocharger control module is attached to a bracket which is an extension of the turbocharger body.

The primary turbocharger control module comprises a stepper motor which electronically controls the primary

turbocharger variable vanes by moving an actuating lever. When the stepper motor drive shaft turns, a position signal is created. The ECM receives the position signal to determine the angular position of the vanes.

The stepper motor is connected to an output shaft. The output shaft has a connecting rod attached eccentrically which converts the rotary motion of the shaft into linear motion of the connecting rod. The opposite end of the connecting rod is attached to an actuating lever. The actuating lever moves with the connecting rod and adjusts the variable vanes mechanically.

The ECM provides the stepper motor with a power and ground for stepper motor operation and also a reference voltage, ground and position signal connections for variable vane position control.

Secondary Turbocharger Boost Pressure Sensor



E116425

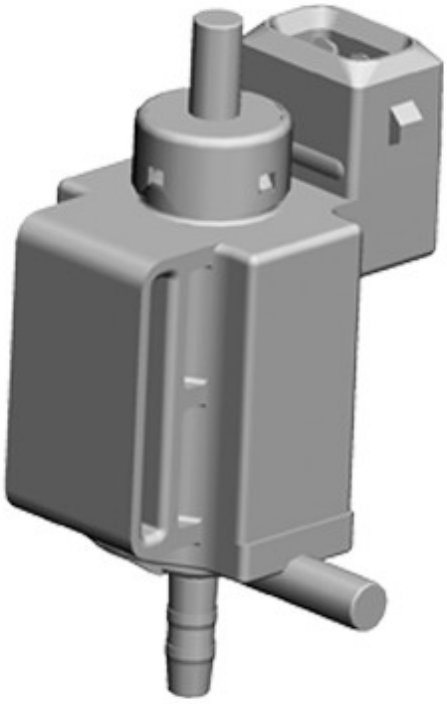
The secondary turbocharger boost pressure sensor is located on the steering pump mounting bracket on the RH side of the engine. The sensor is connected via a hose to the charge air outlet pipe from the secondary turbocharger compressor.

The sensor provides a voltage signal to the ECM relative to the output charge air pressure from the secondary turbocharger. The boost pressure sensor has a 3 pin connector which is connected to the ECM and provides a 5V reference supply from the ECM, a signal input to the ECM and a ground for the sensor.

The boost pressure sensor uses a diaphragm transducer to measure pressure. The ECM uses the boost pressure sensor signal for the following functions:

- Maintain manifold boost pressure
- Reduce exhaust smoke emissions when driving at high altitude
- Control of the EGR system
- To help smooth control of the mono to bi and bi to mono turbo transitions
- To aid the air path diagnostics.

Secondary Turbocharger Turbine Shut-off Solenoid Valve



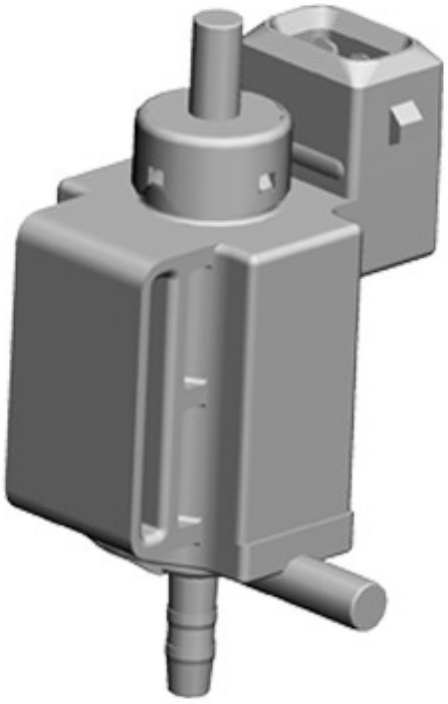
E123687

The secondary turbocharger turbine shut-off solenoid valve is located on a bracket at the front of the engine, above the LH front cylinder cover assembly. The bracket is shared with the secondary turbocharger compressor shut-off solenoid valve. The secondary turbocharger turbine shut-off solenoid valve is the innermost of the two solenoid valves.

The secondary turbocharger turbine shut-off solenoid valve receives a vacuum supply from the vacuum pump. The valve is connected by a pipe to the turbine shut-off valve vacuum actuator which is located on the rear of the secondary turbocharger. A position sensor is attached to the turbine shut-off valve vacuum actuator to inform the ECM of the turbine shut-off position.

Operation of the valve vacuum actuator is controlled by a PWM signal from the ECM and the secondary turbocharger turbine shut-off solenoid valve. When the shut-off solenoid is energized by the ECM a 4.5V PWM current is applied to operate the solenoid, vacuum is then applied to the shut-off valve vacuum actuator. The valve is opened allowing the secondary turbocharger turbine to be driven by the exhaust gasses for as long as the valve is open. When the valve is to be closed the ECM applies a 0.5V PWM current to the solenoid.

Secondary Turbocharger Compressor Shut-off Solenoid Valve



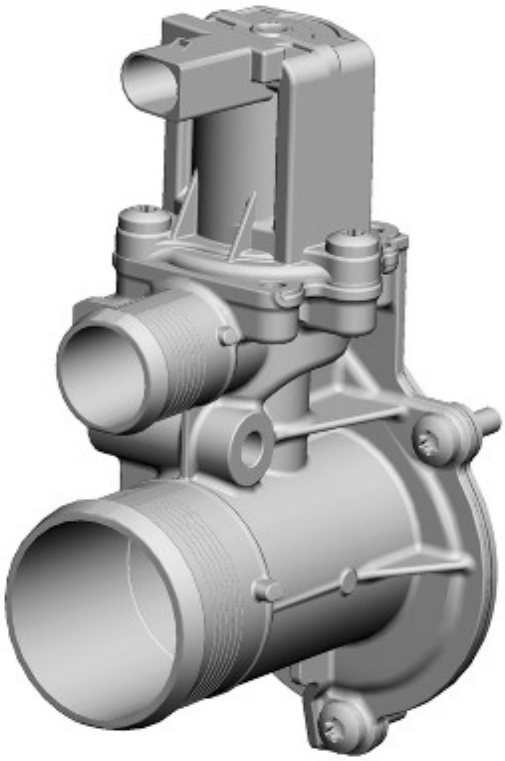
E123687

The secondary turbocharger compressor shut-off solenoid valve is located on a bracket at the front of the engine, above the LH front cylinder cover assembly. The bracket is shared with the secondary turbocharger turbine shut-off solenoid valve. The secondary turbocharger compressor shut-off solenoid valve is the outermost of the two solenoid valves.

The secondary turbocharger compressor shut-off solenoid valve receives a vacuum supply from the vacuum pump. The valve is connected by a pipe to the compressor shut-off vacuum actuator located on the charge air intake manifold tube. When the vacuum is applied to the vacuum actuator, the actuator operates to open the shut-off valve allowing charge air to flow into the air intake pipe.

Operation of the secondary turbocharger compressor shut-off solenoid valve is controlled by a PWM signal from the ECM; 0% is off and 100% is on (solenoid activated). The solenoid valve is opened when bi-turbocharger operation is required allowing compressed charge air from the secondary turbocharger compressor to enter the air intake system.

Secondary Turbocharger Compressor Recirculation Valve



E116426

The secondary turbocharger compressor recirculation valve motor is located on the compressor recirculation valve housing, adjacent to the compressor shut-off valve. The solenoid valve is attached to the compressor recirculation valve with 3 screws.

The secondary turbocharger compressor recirculation valve motor is controlled by the ECM. The valve is used during operation of the secondary turbocharger. When the ECM is switching to bi-turbocharger operation, the valve motor is operated which opens the recirculation path to the primary turbocharger. This allows the secondary turbocharger to increase its speed. When the secondary turbocharger has reached its optimum operating speed the recirculation valve motor is operated, closing the recirculation path to the primary turbocharger.

Secondary Turbocharger Turbine Shut-off Valve and Position Sensor



E116760

The secondary turbocharger turbine shut-off valve and position sensor is located on the turbine vacuum shut-off valve. The sensor has three connections to the ECM; a 5V reference voltage, a ground and a signal return.

The sensor is connected to the turbine shut-off vacuum actuator and senses when the actuator has operated. The sensor returns a 0 - 5V analogue position signal to the ECM to confirm that the vacuum actuator has operated.

Water-in-fuel Sensor



E123689

The fuel filter element has a water sensor located in its base. The sensor is screwed into a threaded hole in the base of the element. When the filter is replaced at service, the sensor can be unscrewed from the element and installed in the new element. The sensor has an electrical connector located at the side of the element which can be disconnected to assist element removal.

The water-in-fuel sensor is connected to the ECM. When the water in the element reaches 64 cm3 (3.9 in3) the ECM issues a high speed CAN bus message to the instrument cluster to display a 'WATER IN FUEL' message in the message center.

Published: 16-Aug-2012

Electronic Engine Controls - TDV6 3.0L Diesel - Electronic Engine Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the electronic engine control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-14A Electronic Engine Controls - TDV6 3.0L Diesel)

Electronic Engine Controls (Description and Operation),
Electronic Engine Controls (Description and Operation),
Electronic Engine Controls (Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Engine oil level • Cooling system coolant level • Fuel level • Fuel contamination/grade/quality • Fuel leaks • Auxiliary drive belt • Sensor installation/condition • Viscous fan and solenoid	• Fuses • Wiring harness • Electrical connector(s) • 5V sensor supply • 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 symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not start	• Inertia fuel shutoff switch • Low/contaminated fuel • Air leakage • Low-pressure fuel system fault • Fuel pump module (lift pump) fault • Blocked fuel filter • Fuel volume regulator blocked/contaminated • Fuel pressure control valve blocked/contaminated • Fuel pump fault • Crankshaft position (CKP) sensor	• Check that the inertia switch has not tripped - Using the manufacturer approved diagnostic system, check the Restraints Control Module (RCM) for related DTCs and refer to the relevant DTC index • Check the fuel level and condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Inspect the intake air system for leaks • Inspect the low-pressure fuel system for leaks/damage • Test the lift pump operation • Check the fuel filter • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check the fuel pump • Refer to the electrical circuit diagrams and test the CKP sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance
Difficult to start	• Glow plug system fault (very cold conditions) • Low/contaminated fuel • Air leakage • Fuel pump module (lift pump) fault • Low-pressure fuel system fault	• Refer to the electrical circuit diagrams and test the glow plug circuits for short circuit to ground, short circuit to power, open circuit, high resistance • Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Inspect the intake air system for leaks • Test the lift pump operation • Inspect the low-pressure fuel system for leaks/damage

	• Blocked fuel filter • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Exhaust Gas Recirculation (EGR) valve(s) fault	• Check the fuel filter • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check the EGR system
Rough idle	• Intake air system fault • Low/contaminated fuel • Low-pressure fuel system fault • Blocked fuel filter • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Exhaust Gas Recirculation (EGR) valve(s) fault	• Inspect the intake air system for leaks • Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Inspect the low-pressure fuel system for leaks/damage • Check the fuel filter • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check the EGR system
Lack of power when accelerating	• Intake air system fault • Restricted exhaust system • Low fuel pressure • Exhaust Gas Recirculation (EGR) valve(s) fault • Turbocharger actuator fault	• Inspect the intake air system for leakage or restriction • Check for a blockage/restriction in the exhaust system, install new components as necessary • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check the EGR system • Check turbocharger actuator
Engine stops/stalls	• Air leakage • Low/contaminated fuel • Low-pressure fuel system fault • High pressure fuel leak • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • Exhaust Gas Recirculation (EGR) valve fault	• Inspect the intake air system for leaks • Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Inspect the fuel system for leaks/damage • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check the EGR system
Engine judders	• Low/contaminated fuel • Air ingress • Low-pressure fuel system fault • Fuel metering valve blocked/contaminated • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated • High pressure fuel leak • Fuel pump fault	• Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Inspect the intake air system for leaks • Inspect the low-pressure fuel system for leaks/damage • Inspect the high pressure fuel system for leaks • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Test the lift pump operation
Excessive fuel consumption	• Low-pressure fuel system fault • Fuel volume control valve blocked/contaminated • Fuel pressure control valve blocked/contaminated	• Inspect the low-pressure fuel system for leaks/damage • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Inspect the fuel temperature sensor, fuel pump, etc for leaks • Check the EGR system

	• Fuel temperature sensor leak • High pressure fuel leak • Injector(s) fault • Exhaust Gas Recirculation (EGR) valve(s) fault	

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel , DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Camshaft Position (CMP) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

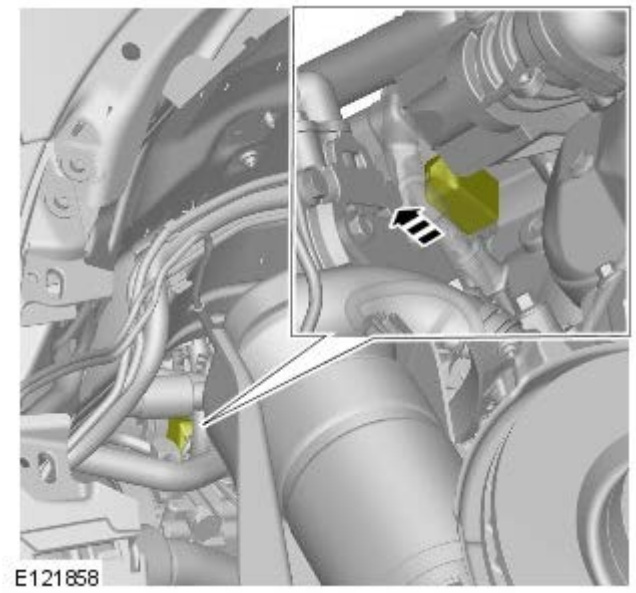
2. Refer to: Cooling Fan (303-03, Removal and Installation).

3. Refer to: Fender Splash Shield (501-02, Removal and Installation).

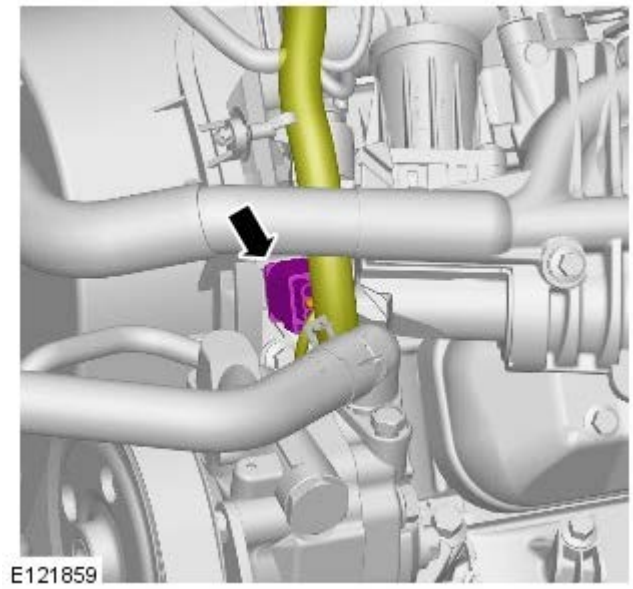
4. Remove the LH front wheel and tire.

   Torque: 140 Nm

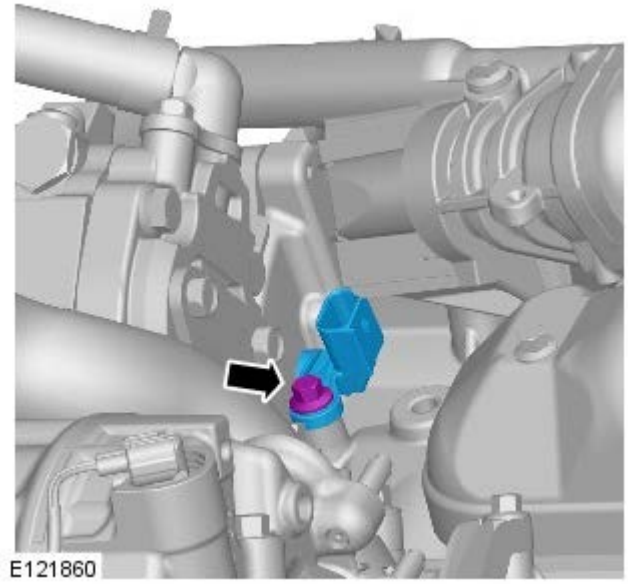
5.



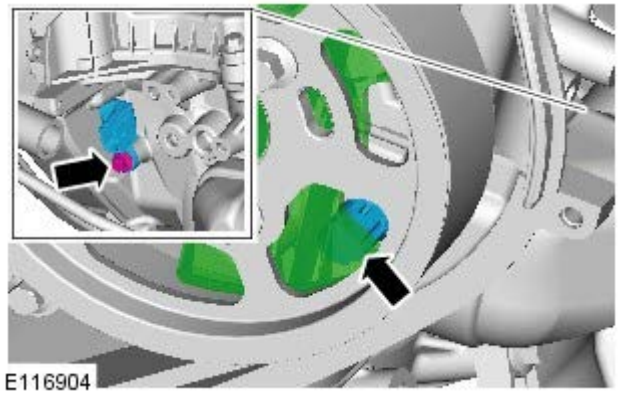
6.



7. *Torque:* 10 Nm



Installation



1. CAUTIONS:

   Make sure that the mating faces are clean and free of foreign material.

   The Camshaft position (CMP) sensor tip must rest on one of the three webs on the back of the camshaft pulley. Incorrect installation may result in the CMP sensor being damaged.

   NOTES:

   Only turn the engine in the normal direction of rotation.

   Timing belt left hand cover shown removed for clarity.

   Turn the engine until one of the three webs on the back of the camshaft pulley is visible through the CMP sensor housing.

2. To install, reverse the removal procedure.

Published: 17-Oct-2013

Electronic Engine Controls - TDV6 3.0L Diesel - Crankshaft Position (CKP) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

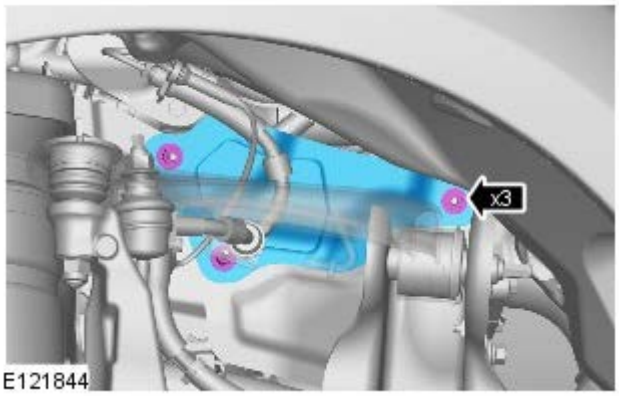
2. Refer to: Suspension Height Sensor (204-05 Vehicle Dynamic Suspension, Removal and Installation).

3. Refer to: Engine Oil Vacuum Draining and Filling (303-01A Engine - TDV6 3.0L Diesel, General Procedures).

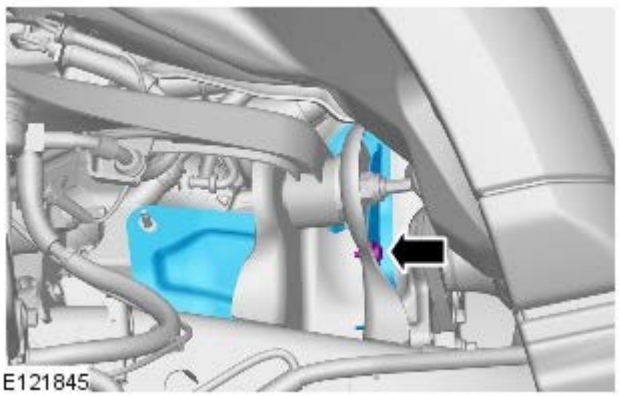
4. Remove the left-hand front wheel and tire.

   Torque: 140 Nm

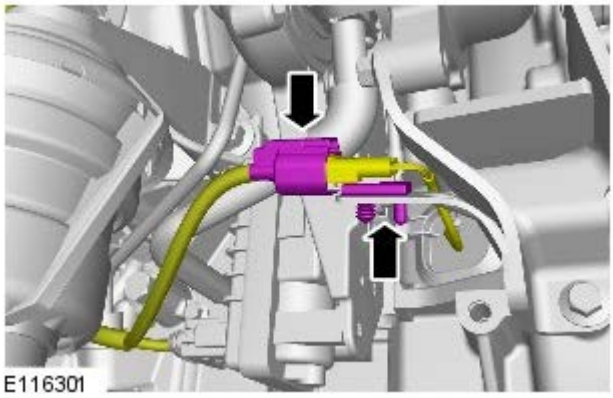
5.



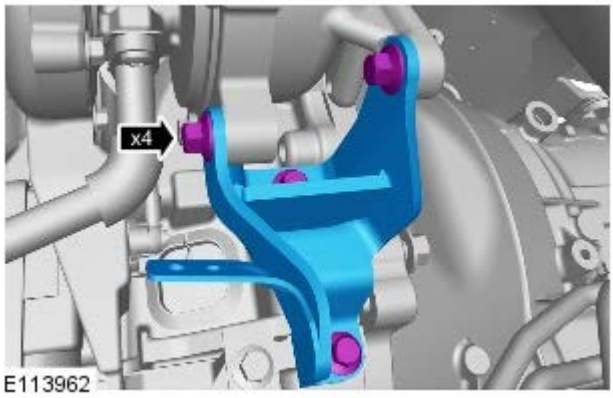
6.



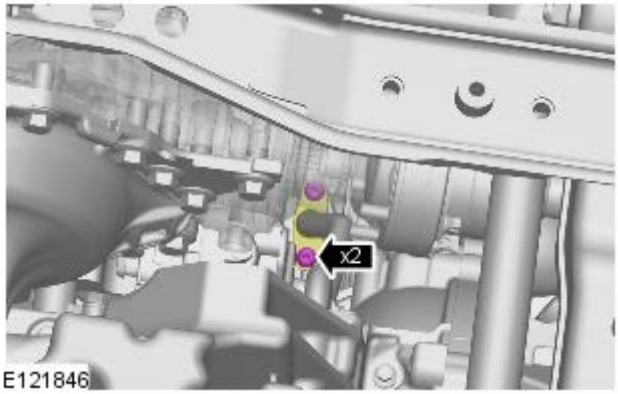
7. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



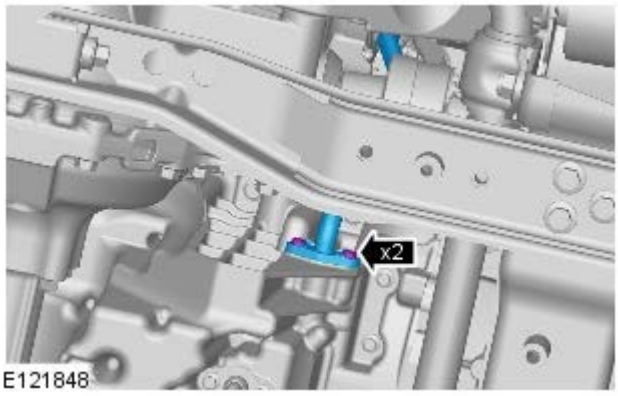
8. *Torque:* 32 Nm



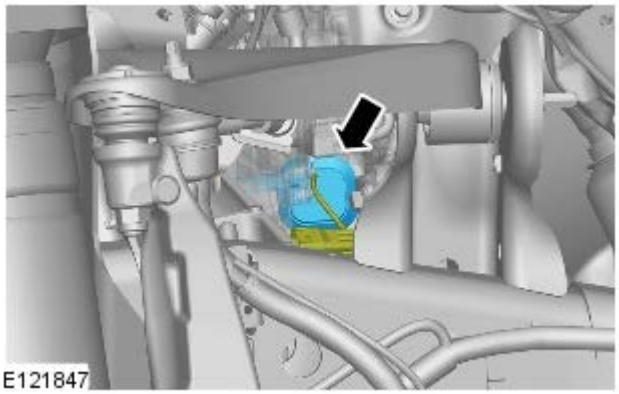
9. NOTE: Remove and discard the gasket.
   - *Torque:* 10 Nm

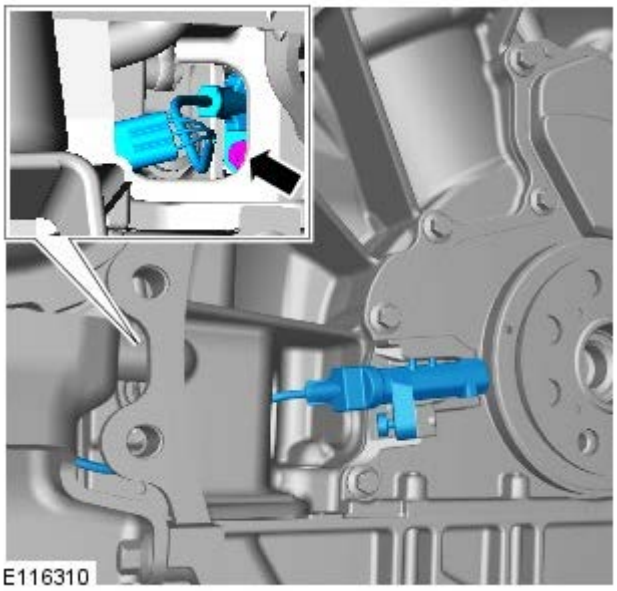


10.
   - *Torque:* 10 Nm



11.





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

    NOTES:

    Engine shown removed for clarity.

    The CKP sensor retaining bolt should not be removed from the CKP sensor.

    - Rotate the crankshaft sensor 180 degrees in order to remove from engine.

      Torque: 5 Nm

Installation

1. CAUTION: Install the CKP sensor correctly into the housing. Failure to follow this instruction may result in damage to the CKP sensor.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Crankshaft Position (CKP) Sensor Ring

Removal and Installation

Special Tool(s)

	303-1130 Installer - Crankshaft Position (CKP) Sensor Ring

Removal

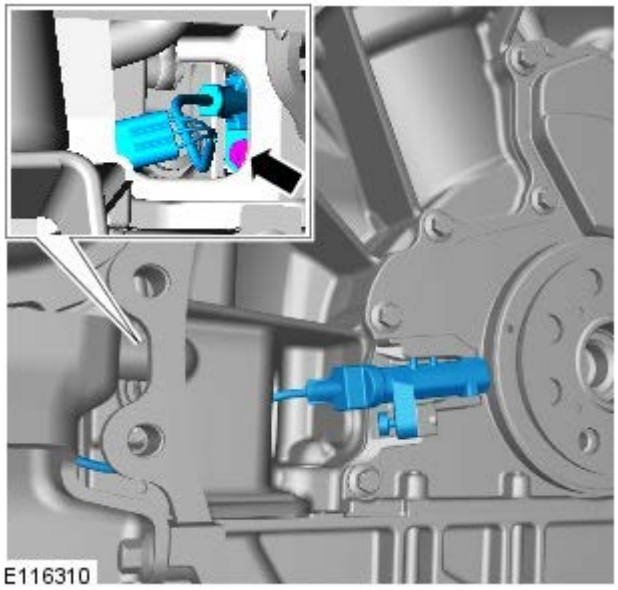
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

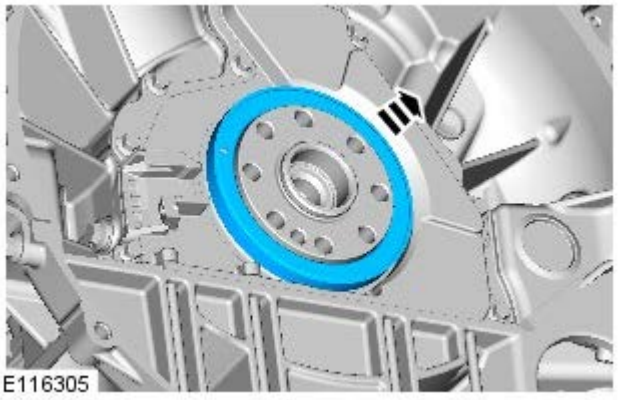
   Raise and support the vehicle.

3. Refer to: Flexplate (303-01A, Removal and Installation).



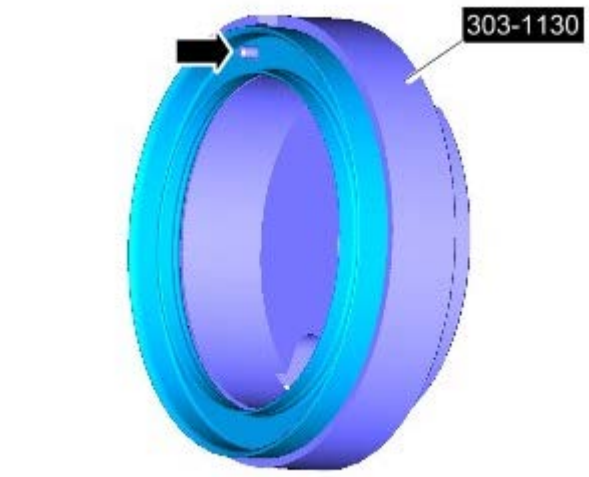
4. CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

   NOTE: The CKP sensor retaining bolt should not be removed from the CKP sensor.



5.

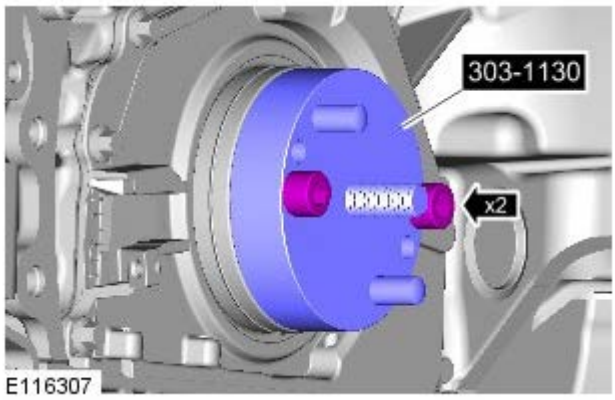
Installation



E116306

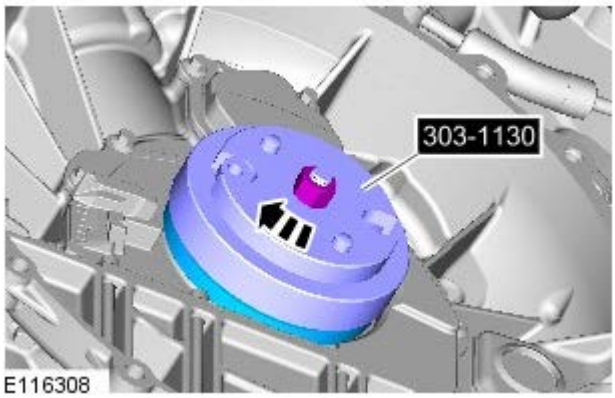
1. CAUTION: Make sure that the CKP sensor ring is aligned correctly with the special tool pip and that both mating surfaces are fully seated.
   - *Special Tool(s):* 303-1130

2. Install the special tool.



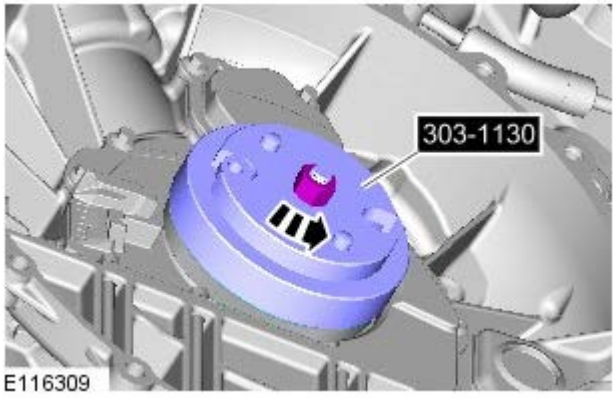
E116307

3.



E116308

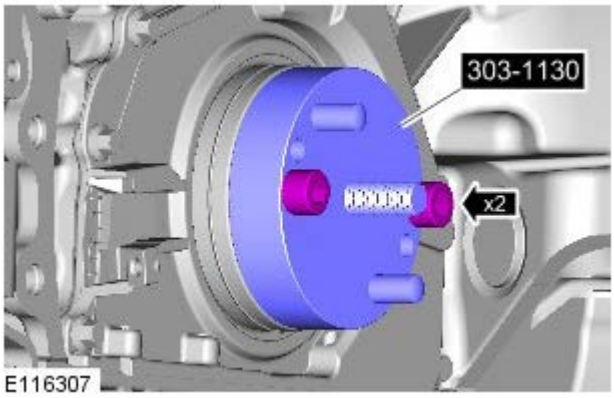
4.

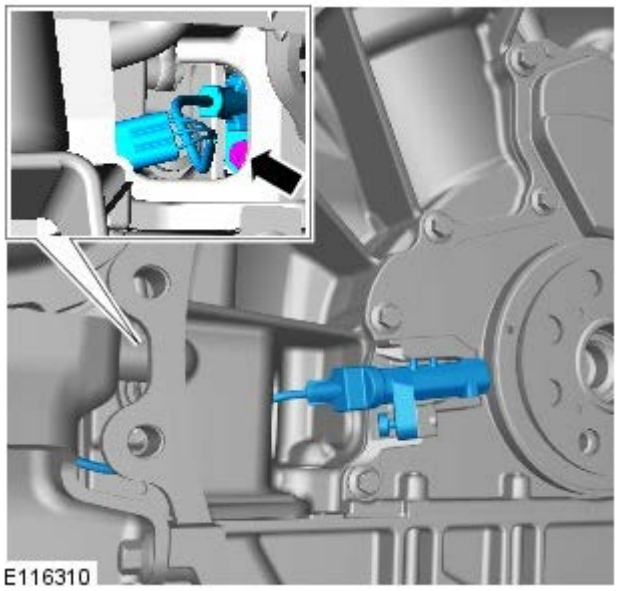


E116309

5. Remove the special tool.

   Special Tool(s): 303-1130





6. CAUTIONS:

   Install the CKP sensor correctly into the housing. Failure to follow this instruction may result in damage to the CKP sensor.

   Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

   - *Torque:* 5 Nm

7. Refer to: Flexplate (303-01A, Removal and Installation).

8. Connect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Diesel Particulate Filter (DPF) Differential Pressure Sensor

Removal and Installation

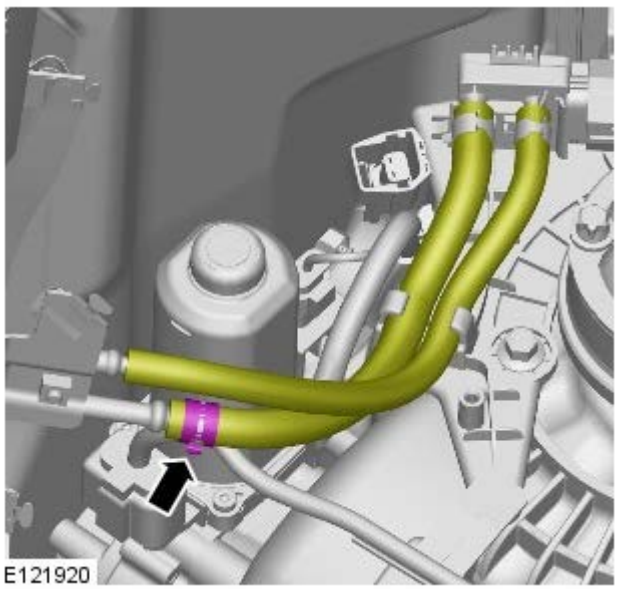
Removal

NOTE: Removal steps in this procedure may contain installation details.

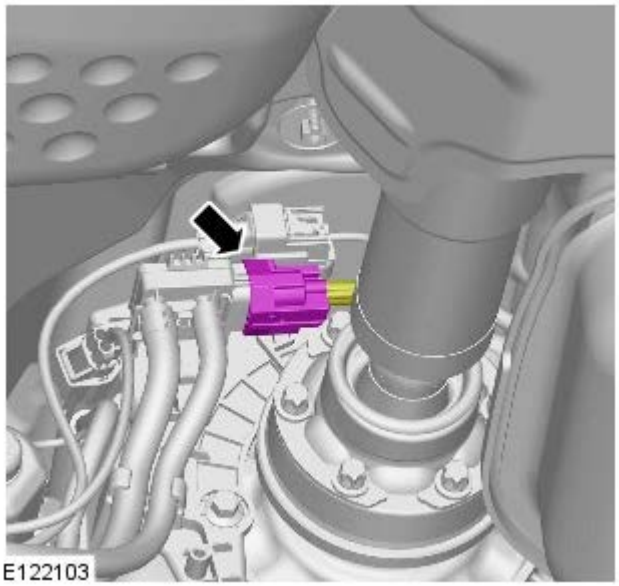
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

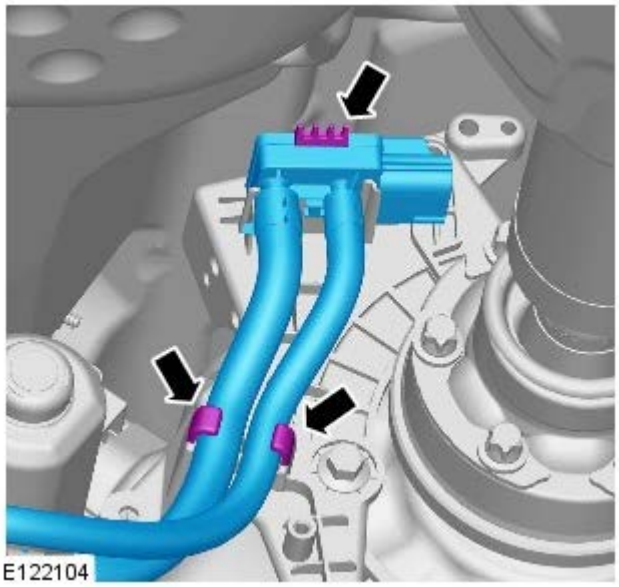
2.



3.



4.



5.



Installation

1. To install, reverse the removal procedure.
2. NOTE: This step is only necessary when installing a new component.
    1. Using the diagnostic tool, clear diagnostic trouble codes (DTCs) from the engine control module (ECM).
    2. Using the data logger, check the engine oil temperature.
    3. Make sure the selector lever is in the 'P' position.
    4. Start and run the engine.
    5. Make sure that the engine oil is at a minimum temperature of 50 degrees C.
    6. Allow the engine to idle for 2 minutes and 30 seconds.
    7. Make sure that the engine cooling fan is not running.
    8. Turn off the ignition.
    9. Wait for 30 seconds.
    10. Repeat steps 4 to 9, a further 5 times.
    11. Disconnect the Jaguar approved diagnostic system.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Engine Coolant Temperature (ECT) Sensor

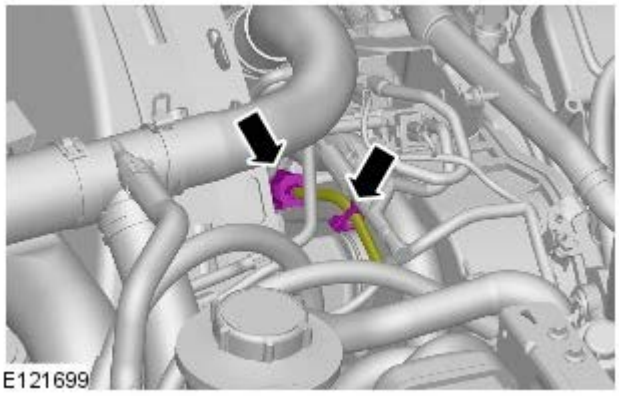
Removal and Installation

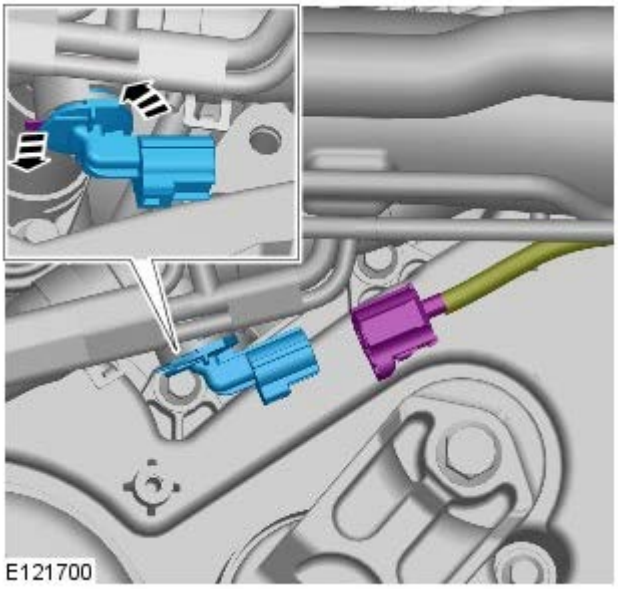
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).

2.





3. CAUTIONS:

   Be prepared to collect escaping fluids.

   The seal is to be reused unless damaged.

   Make sure that the mating faces are clean and free of foreign material.

   NOTE: Release the locking tang to remove the ECT sensor.

Installation

1. NOTE: Make sure that all the component mating faces are clean.

   To install, reverse the removal procedure.

2. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Engine Control Module (ECM)

Removal and Installation

Removal

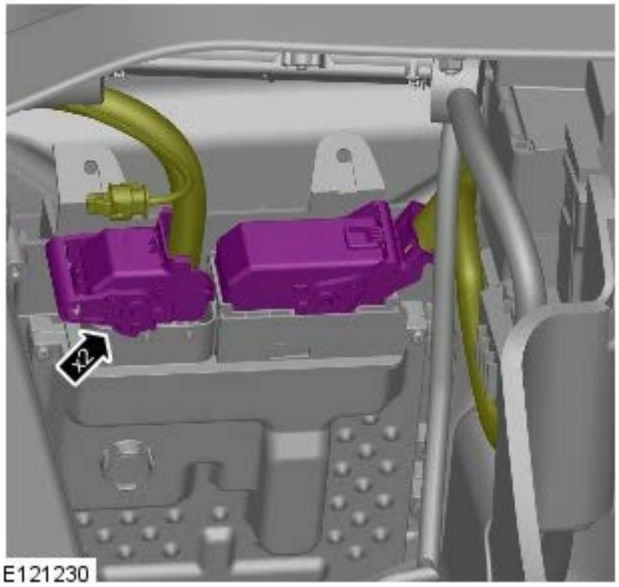
NOTE: Removal steps in this procedure may contain installation details.

All vehicles

1. Remove the battery.

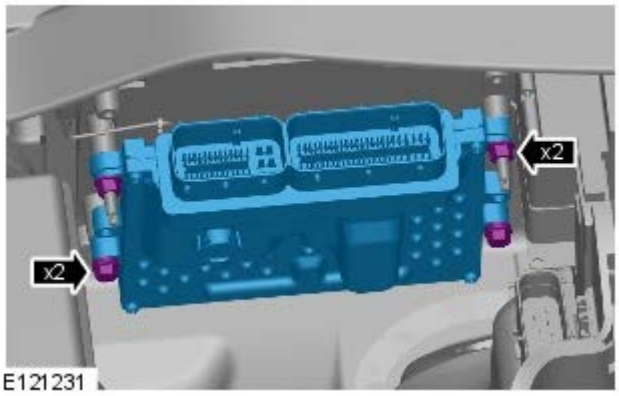
   Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

Left-hand drive vehicles



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

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

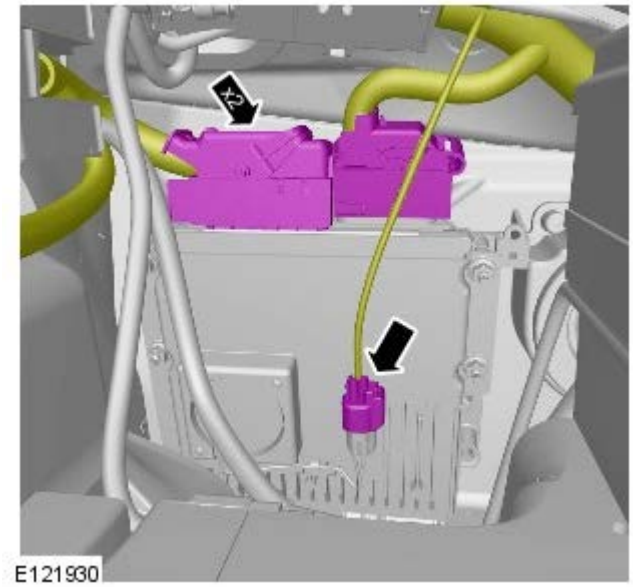


3. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

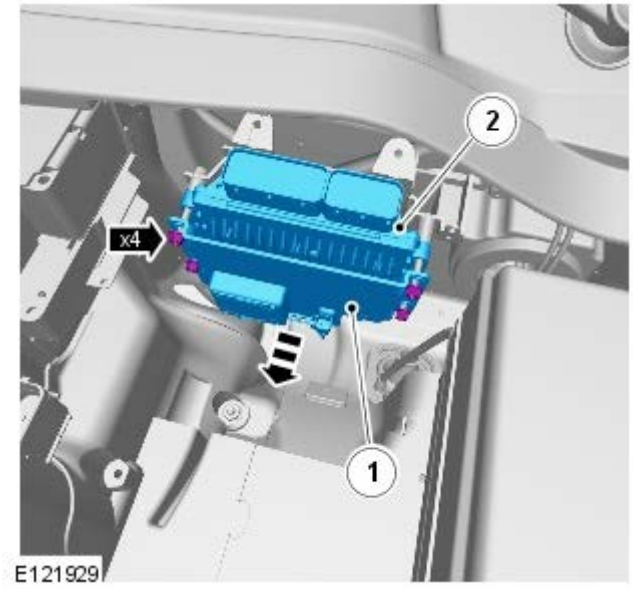
   Torque: 7 Nm

Right-hand drive vehicles

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



5. *Torque:* 7 Nm



Installation

1. To install, reverse the removal procedure.
2. New units must be configured using the Programmable Module Routine in the diagnostic tool.

Published: 25-Feb-2013

Electronic Engine Controls - TDV6 3.0L Diesel - Engine Oil Level Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

All vehicles

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

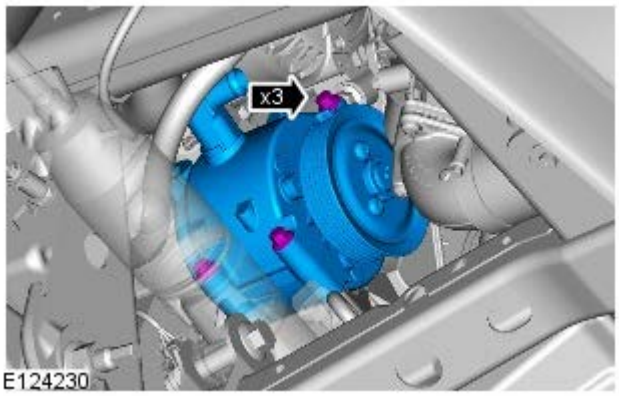
3. Refer to: Engine Oil Draining and Filling (303-01A Engine - TDV6 3.0L Diesel, General Procedures).

4. Refer to: Axle Assembly (205-03 Front Drive Axle/Differential, Removal and Installation).

5. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

Vehicles with dynamic suspension

6. Refer to: Front Stabilizer Bar - V8 5.0L Petrol/V8 S/C 5.0L Petrol (204-06 Ride and Handling Optimization, Removal and Installation).



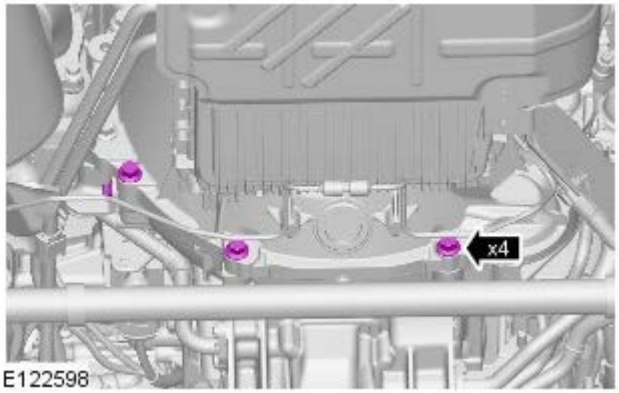
7. NOTES:

   Detach the component, do not remove.

   If equipped.

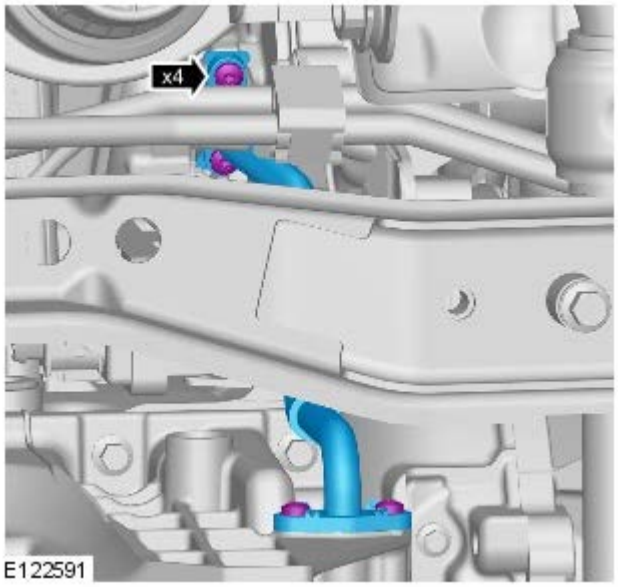
   Torque: 22 Nm

All vehicles



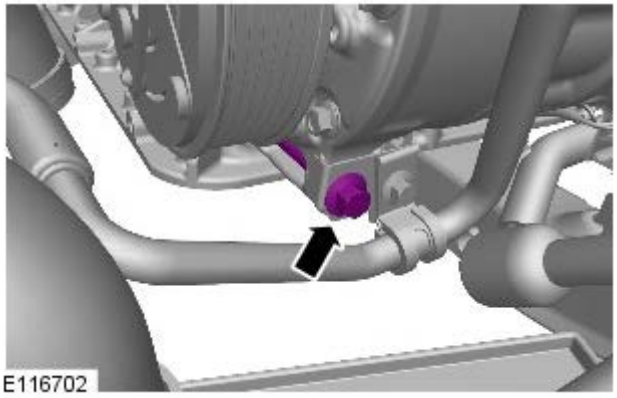
8. *Torque:*
   M10 40 Nm
   M8 24 Nm

9. CAUTION: Make sure that the gaskets are correctly located.

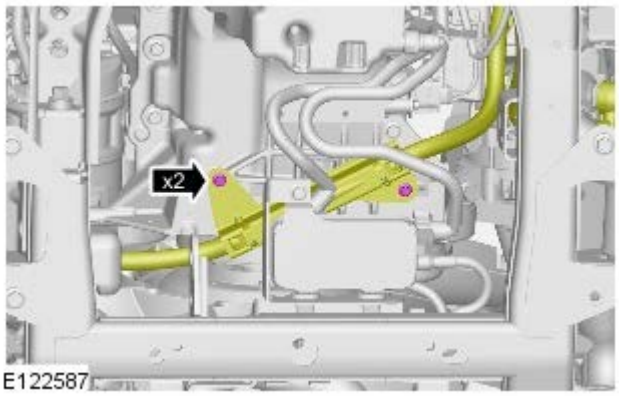


Torque: 10 Nm

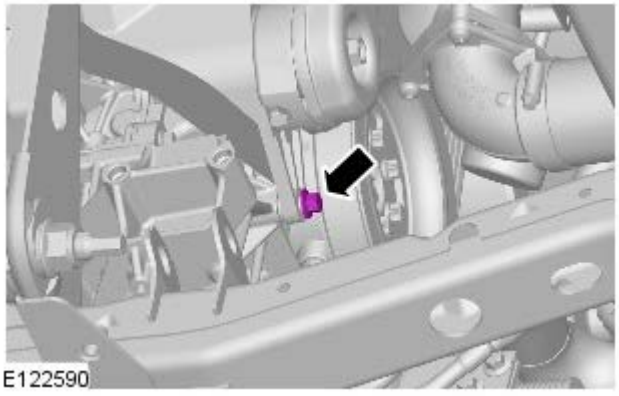
10. *Torque:* 25 Nm



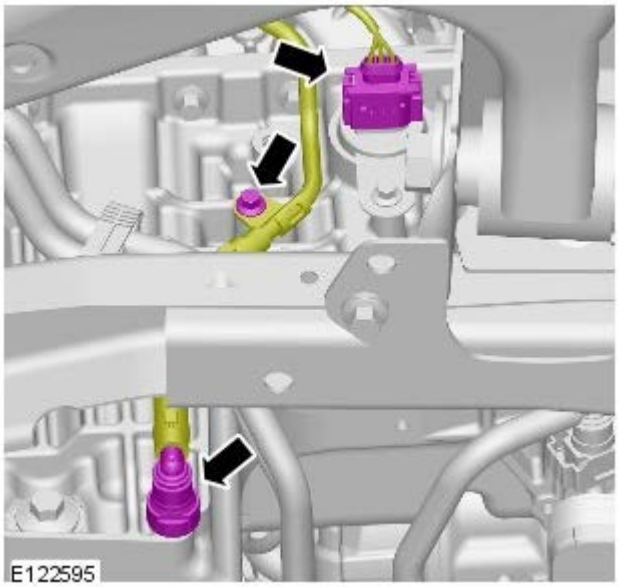
11. *Torque:* 10 Nm



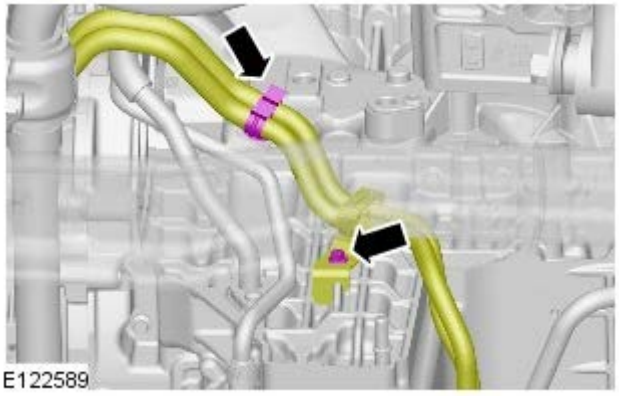
12. *Torque:* 24 Nm



13. *Torque:* 10 Nm

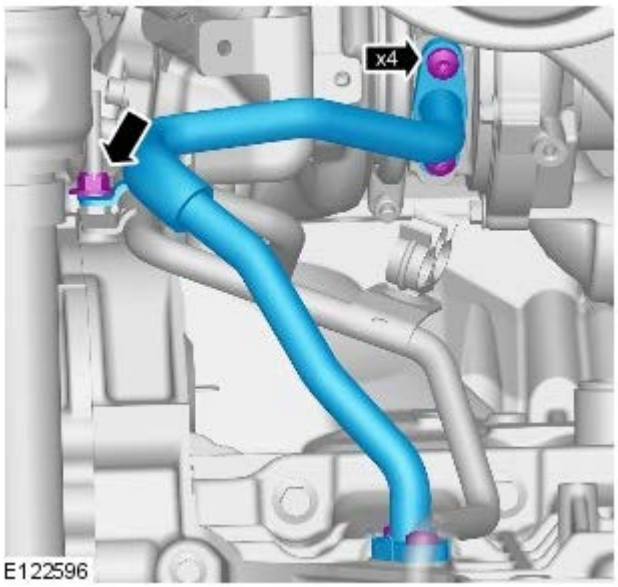


14. *Torque:* 10 Nm



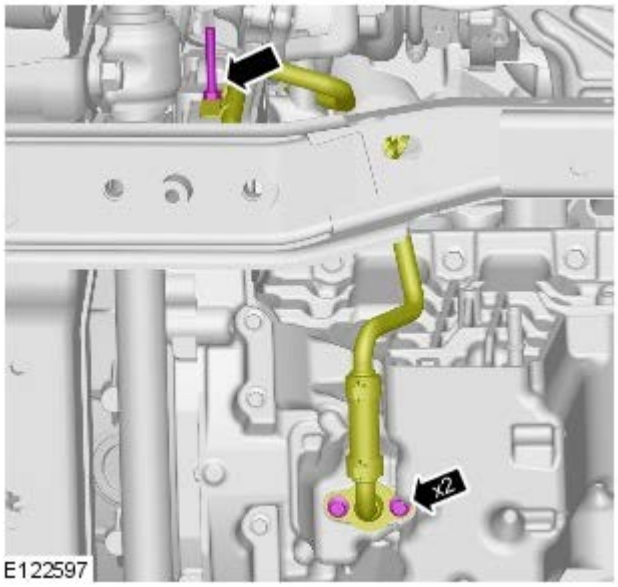
15. CAUTION: Make sure that the gaskets are correctly located.

    Torque: 10 Nm



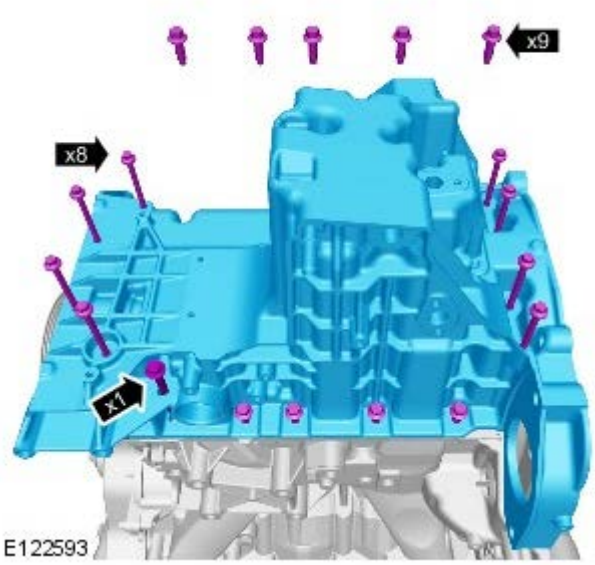
16. NOTE: Remove and discard the gasket.

    Torque: 10 Nm

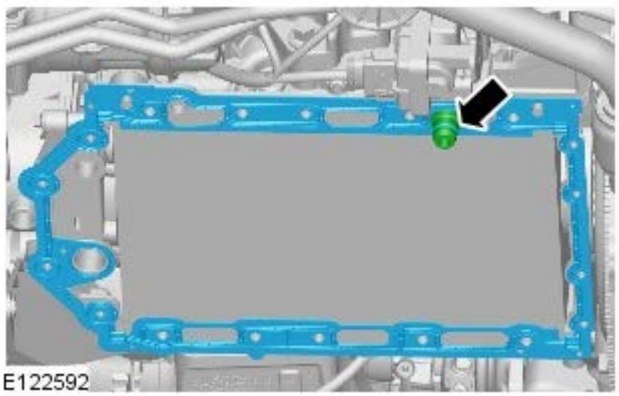


17. CAUTION: Note the position of the bolts, prior to removal.

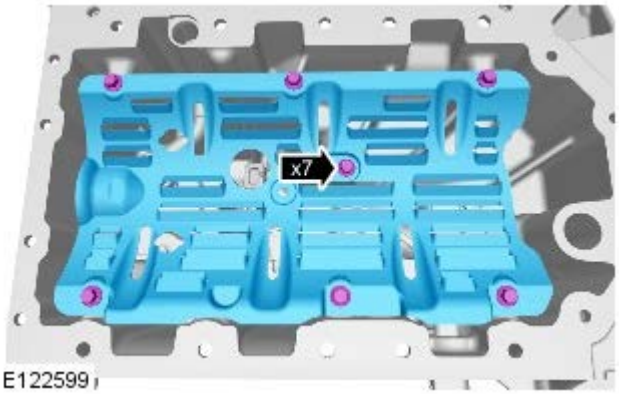
Torque:
M8 23 Nm
M6 10 Nm



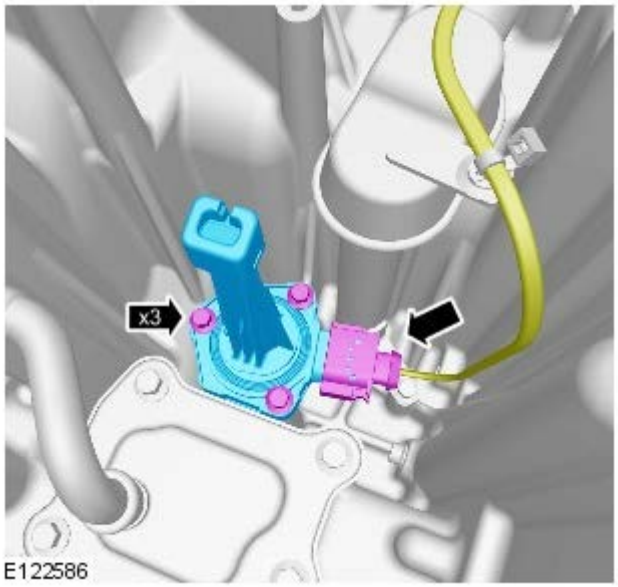
18. NOTE: Remove and discard the O-ring seal.



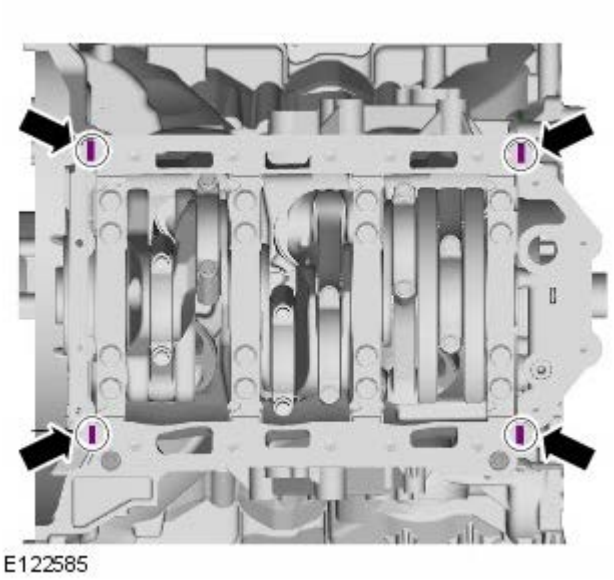
19. *Torque:* 10 Nm



20. *Torque:* 10 Nm



Installation



1. CAUTIONS:

   Make sure that the mating faces are clean and free of corrosion and foreign material.

   Installation of the oil pan and tightening must be carried out within 7 minutes of applying the sealant.

   Apply an 8 mm bead of sealant to the cylinder block in the areas shown.

2. To install, reverse the removal procedure.

Published: 11-May-2011

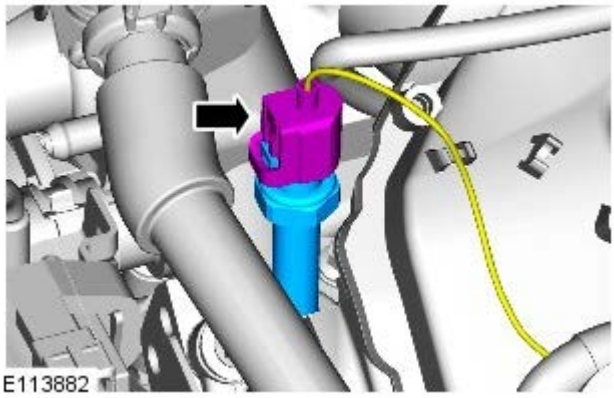
Electronic Engine Controls - TDV6 3.0L Diesel - Engine Oil Pressure (EOP) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).



2. CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.
   - *Torque:* 14 Nm

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Exhaust Gas Temperature Sensor RH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

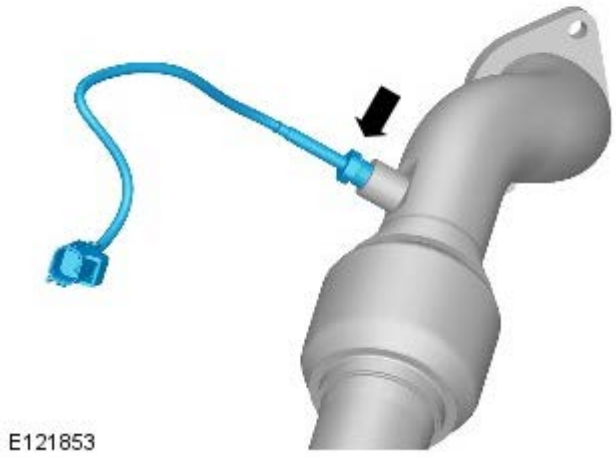
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Exhaust System (309-00, Removal and Installation).

3. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Torque: 35 Nm



Installation

1. CAUTION: If accidentally dropped or knocked install a new sensor.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Heated Oxygen Sensor (HO2S)

Removal and Installation

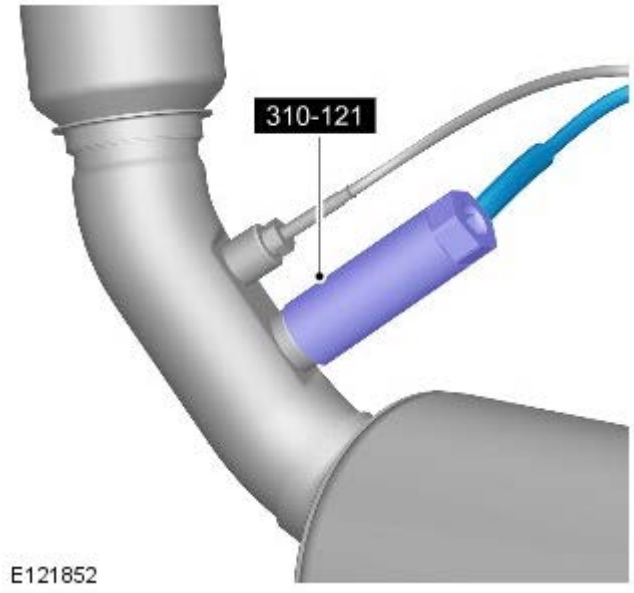
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Catalytic Converter (309-00 Exhaust System - 3.0L V6 - TdV6, Removal and Installation).



3. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Torque: 48 Nm

Installation

1. CAUTIONS:

   If accidentally dropped or knocked install a new sensor.

   Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

   NOTES:

   If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   Make sure the anti-seize compound does not contact the HO2S tip.

   To install, reverse the removal procedure.

2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Intake Air Temperature (IAT) Sensor

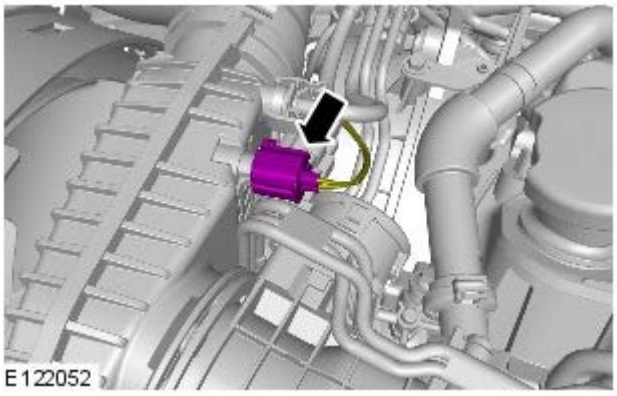
Removal and Installation

Removal

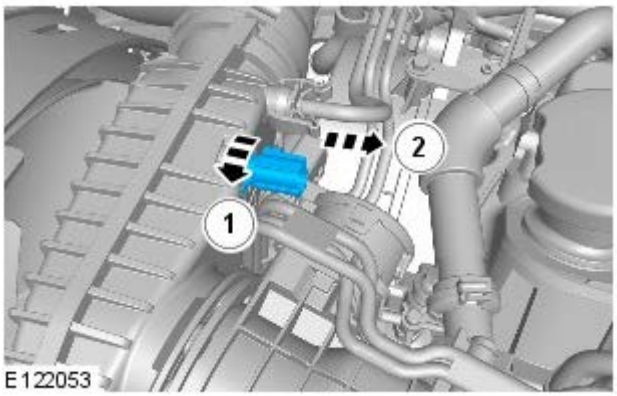
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).

2.



3.



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Manifold Absolute Pressure (MAP) Sensor

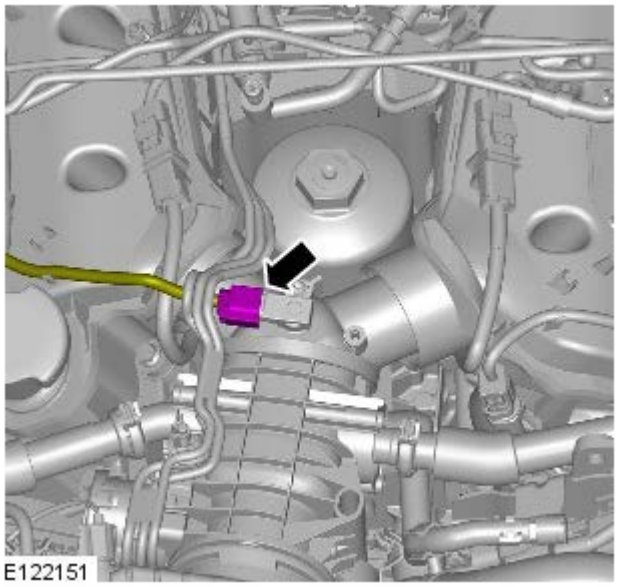
Removal and Installation

Removal

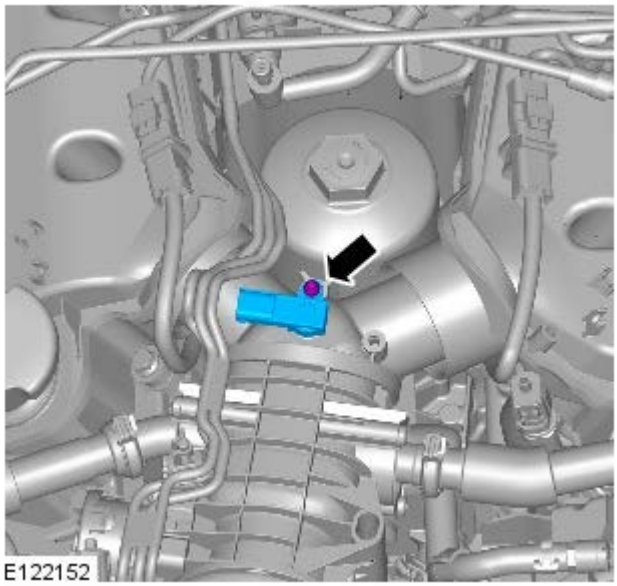
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Engine Cover - 3.0L Diesel (501-05, Removal and Installation).

2.



3. *Torque:* 3 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

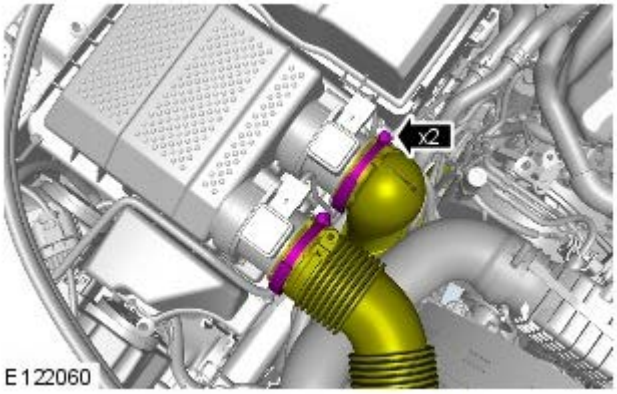
Electronic Engine Controls - TDV6 3.0L Diesel - Mass Air Flow (MAF) Sensor

Removal and Installation

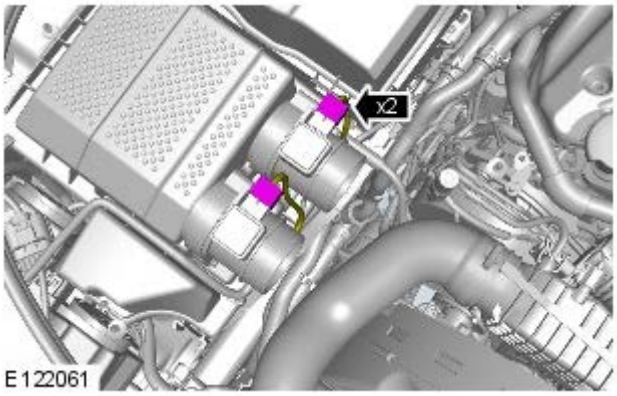
Removal

NOTE: Removal steps in this procedure may contain installation details.

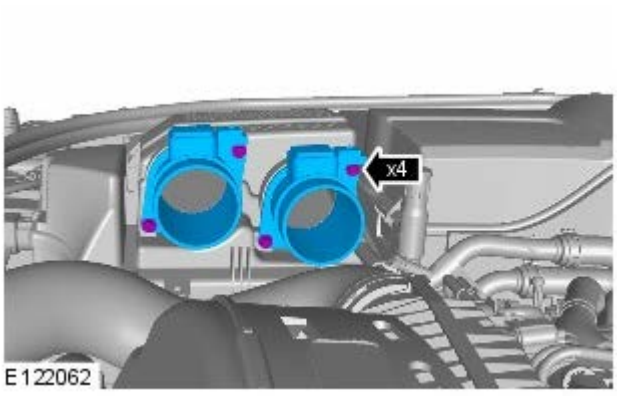
1. *Torque:* 3.5 Nm



2.



3. *Torque:* 2 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Oil Temperature Sensor

Removal and Installation

Removal

 NOTE: Removal steps in this procedure may contain installation details.

1. The oil temperature sensor is an integrated part of the engine oil level sensor.

   Refer to: Engine Oil Level Sensor (303-14, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Post Catalytic Converter Temperature Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

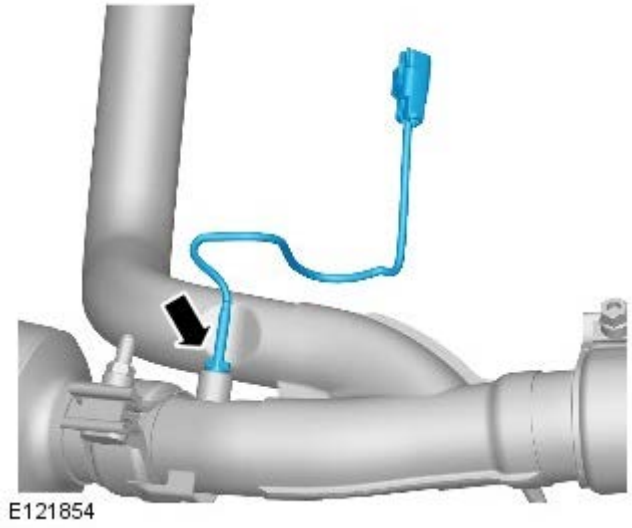
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Exhaust System (309-00, Removal and Installation).

3. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Torque: 35 Nm



Installation

1. CAUTION: If accidentally dropped or knocked install a new sensor.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Post DPF Exhaust Gas Temperature Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

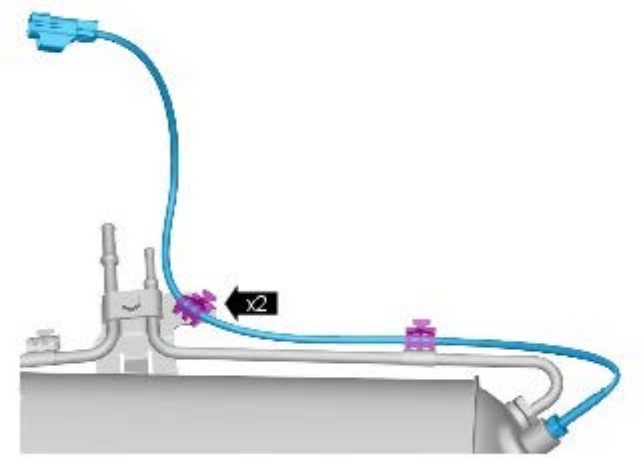
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Diesel Particulate Filter (DPF) (309-00, Removal and Installation).

3. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Torque: 35 Nm



E121856

Installation

1. CAUTION: If accidentally dropped or knocked install a new sensor.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Pre Catalytic Converter Temperature Sensor

Removal and Installation

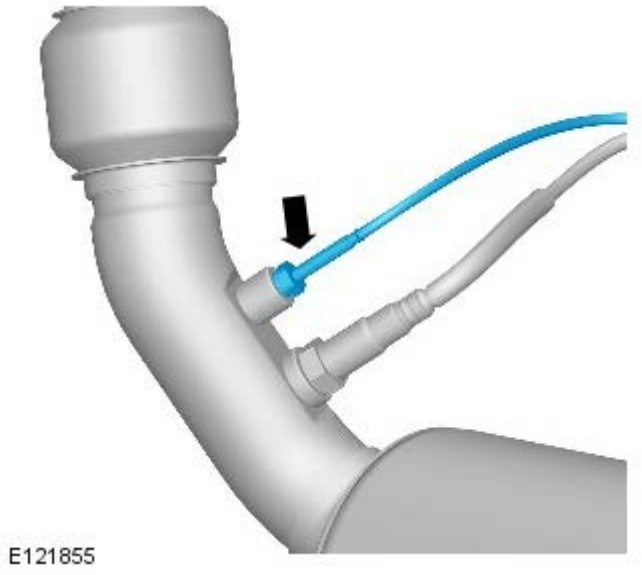
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Exhaust System (309-00, Removal and Installation).



3. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Torque: 35 Nm

Installation

1. CAUTION: If accidentally dropped or knocked install a new sensor.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - TDV6 3.0L Diesel - Pre DPF Exhaust Gas Temperature Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

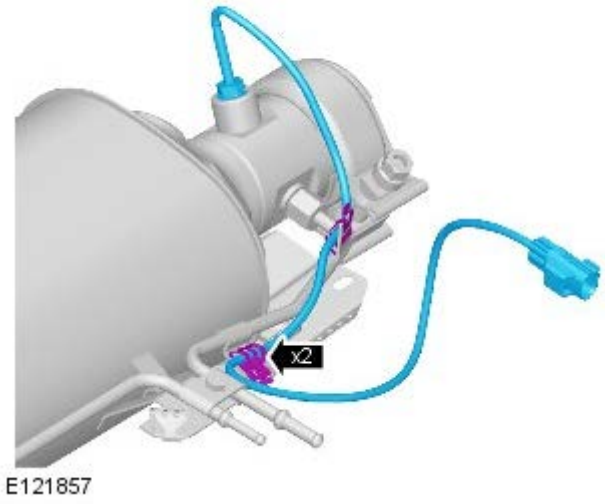
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Diesel Particulate Filter (DPF) (309-00, Removal and Installation).

3. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Torque: 35 Nm



E121857

Installation

1. CAUTION: If accidentally dropped or knocked install a new sensor.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol -

Torque Specifications

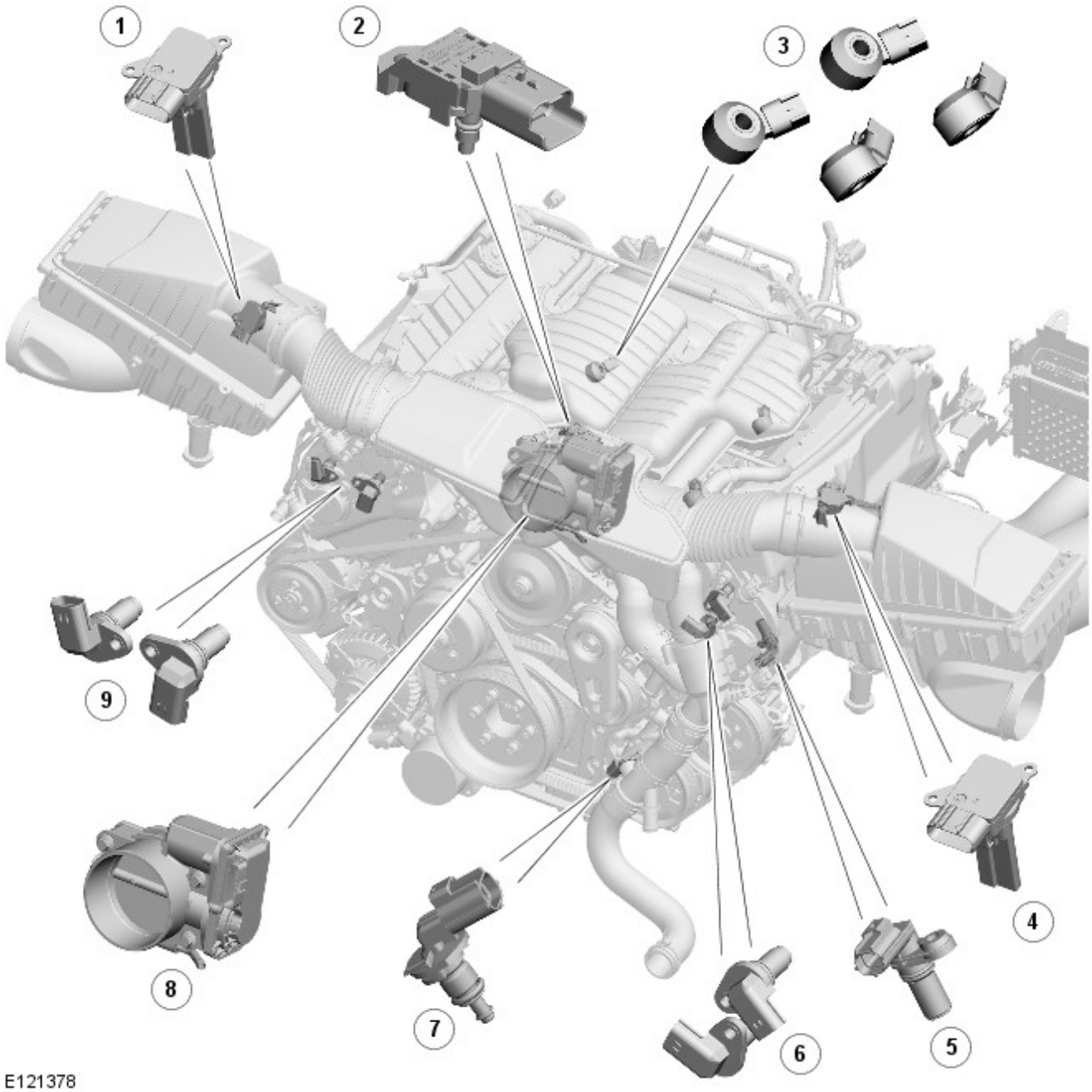
Description	Nm	lb-ft	lb-in
Camshaft position (CMP) sensor(s) retaining bolt	10	7	-
Crankshaft position (CKP) sensor retaining bolt	10	7	-
Heated oxygen sensor(s) (HO2S)	48	35	-
Catalyst monitor sensor(s)	48	35	-
Knock sensor(s) (KS) retaining bolt	20	15	-
Fuel rail pressure (FRP) sensor	32	24	-
Manifold absolute pressure and temperature (MAPT) sensor	5	-	44
Engine oil level sensor retaining bolts	12	8	-
Variable valve timing (VVT) oil control solenoid(s) retaining bolts	10	7	-
Engine control module (ECM) retaining bolts	7	-	62
Engine control module (ECM) retaining nuts	7	-	62
Mass air flow (MAF) sensor retaining bolts	1.2	-	10.6

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Electronic Engine Controls

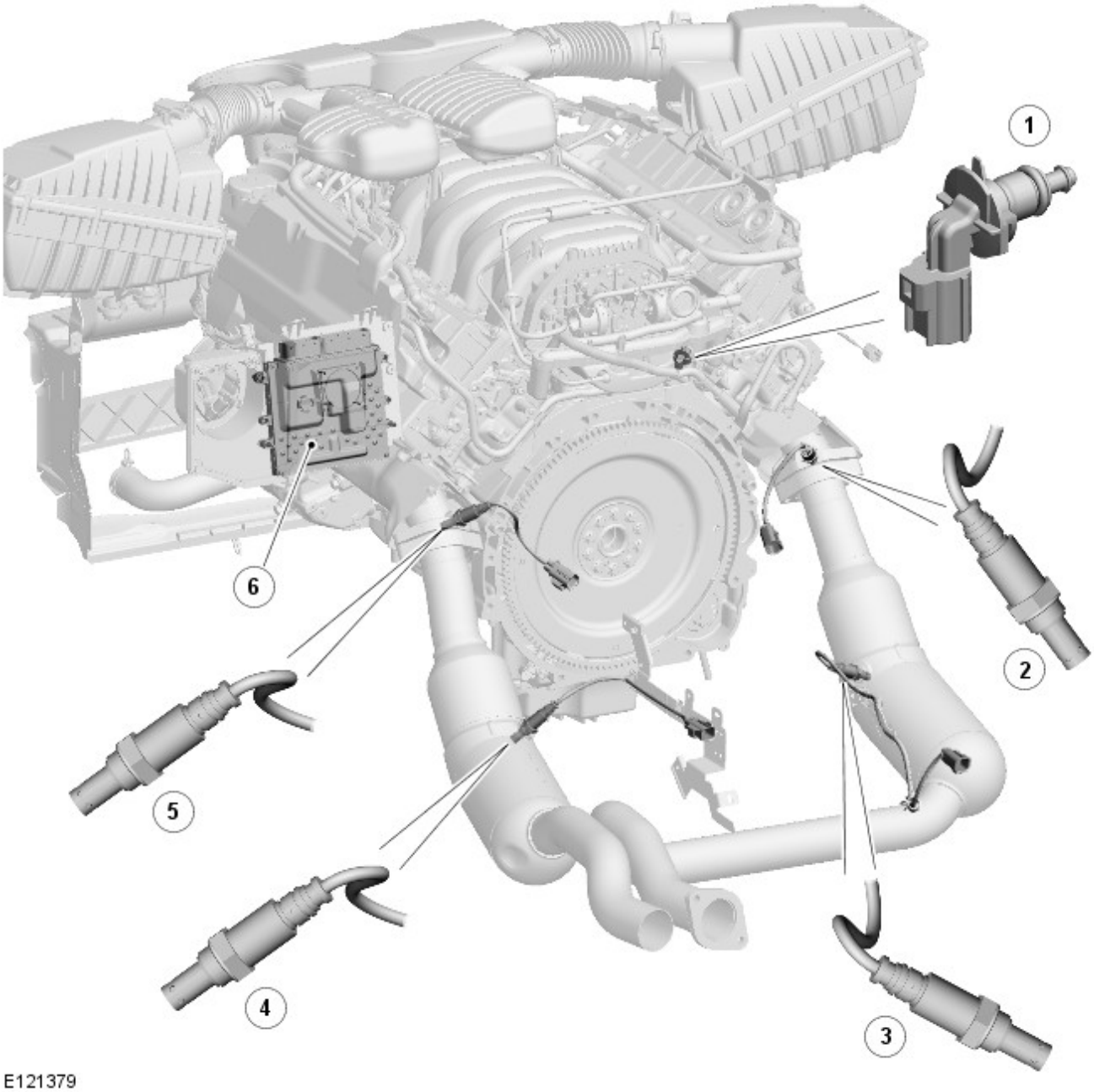
Description and Operation

COMPONENT LOCATION - SHEET 1 OF 3



Item	Part Number	Description
1	-	MAFT (mass air flow and temperature) sensor
2	-	MAP (manifold absolute pressure) sensor
3	-	Knock sensors
4	-	MAFT sensor
5	-	CKP (crankshaft position) sensor
6	-	CMP (camshaft position) sensors
7	-	ECT (engine coolant temperature) sensor (ECT 2)
8	-	Electronic throttle
9	-	CMP sensors

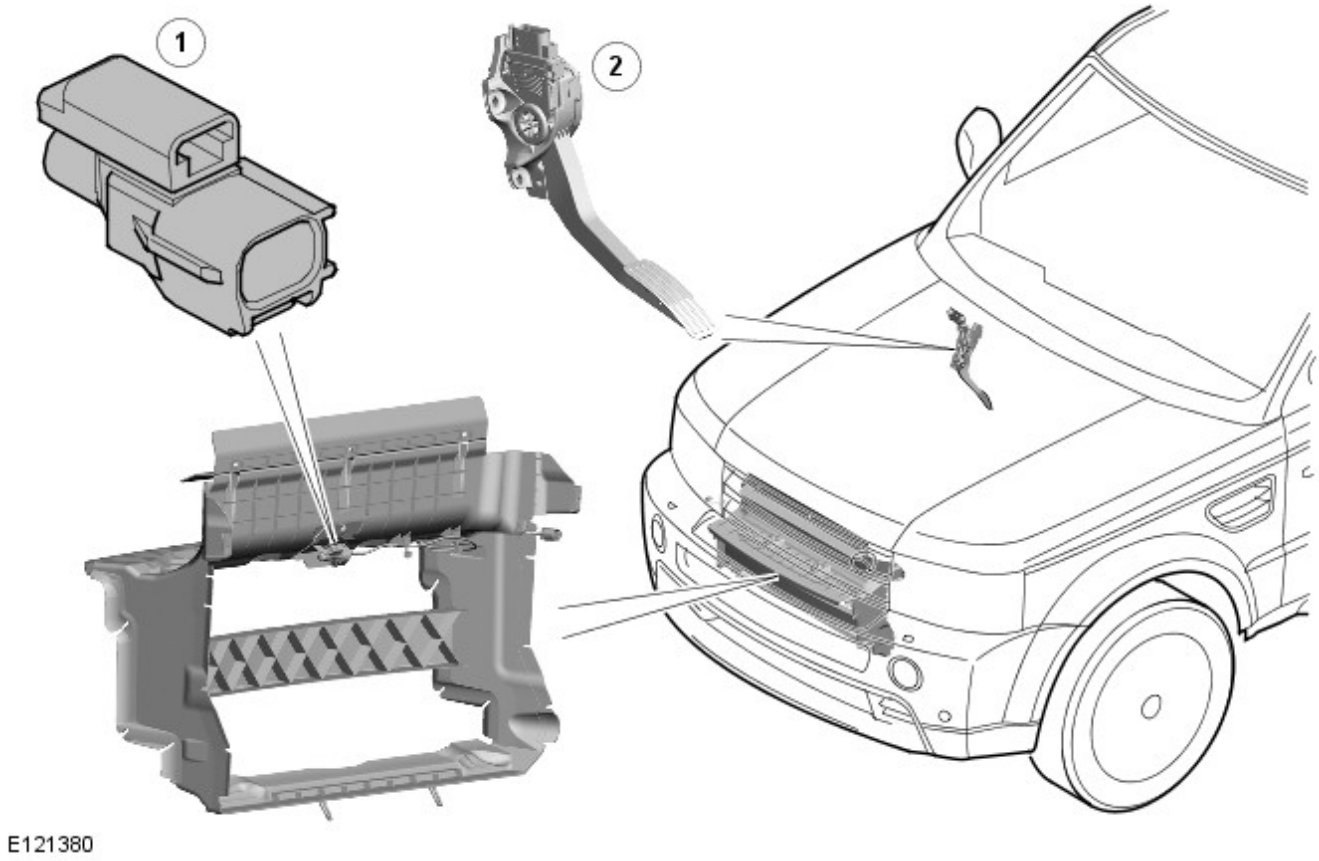
COMPONENT LOCATION - SHEET 2 OF 3



E121379

Item	Part Number	Description
1	-	ECT sensor (ECT 1)
2	-	Upstream HO2S (heated oxygen sensor)
3	-	Downstream HO2S
4	-	Downstream HO2S
5	-	Upstream HO2S
6	-	ECM (engine control module)

COMPONENT LOCATION - SHEET 3 OF 3



Item	Part Number	Description
1	-	AAT (ambient air temperature) sensor
2	-	APP (accelerator pedal position) sensor

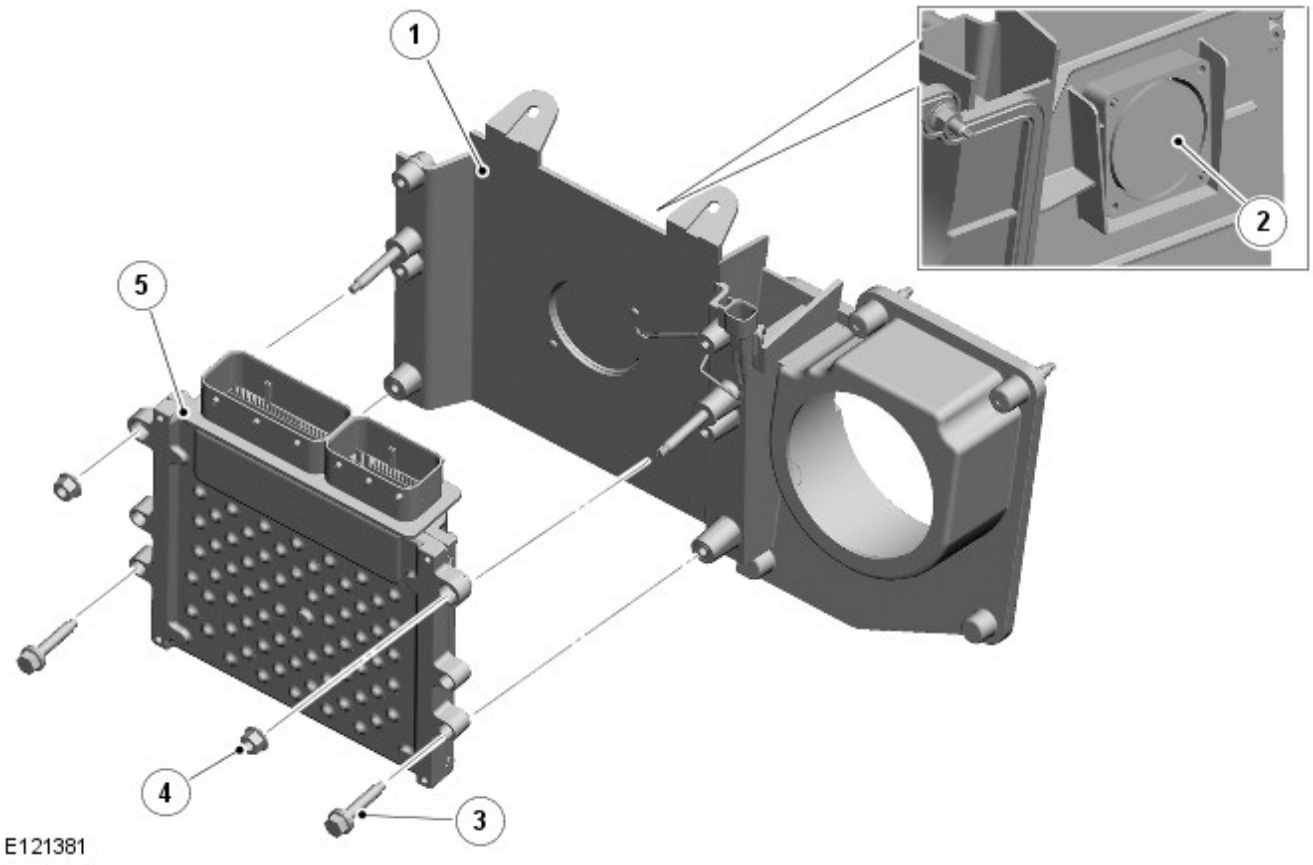
INTRODUCTION

The EEC (electronic engine control) system operates the engine to generate the output demanded by the accelerator pedal and loads imposed by other systems. The EEC system has an ECM (engine control module) that uses a torque-based strategy to evaluate inputs from sensors and other systems, then produces outputs to engine actuators to produce the required torque.

The EEC system controls the following:

- Charge air
- Fueling
- Ignition timing
- Valve timing
- Cylinder knock
- Idle speed
- Engine cooling fan
- Evaporative emissions
- On-board diagnostics
- Immobilization system interface
- Speed control.

ENGINE CONTROL MODULE



Item	Part Number	Description
1	-	ECM and cooling fan mounting bracket
2	-	Cooling fan
3	-	Screw (2 off)
4	-	Nut (2 off)
5	-	ECM

The ECM is installed in the passenger side protective box in the engine compartment, on a bracket attached to the engine bulkhead. The bracket also contains an electric cooling fan. The ECM, which has an internal temperature sensor, controls the operation of the cooling fan. While the ignition is on, the cooling fan receives a power supply from the ECM relay in the EJB (engine junction box). When cooling is required, the ECM connects the cooling fan to ground.

The ECM has the capability of adapting its fuel and ignition control outputs in response to several sensor inputs.

The ECM receives inputs from the following:

- CKP (crankshaft position) sensor.
- CMP (camshaft position) sensors (4 off).
- ECT (engine coolant temperature) sensors (2 off).
- Knock sensors (4 off).
- MAP (manifold absolute pressure) sensor.
- MAFT (mass air flow and temperature) sensors (2 off).
- Throttle position sensor.
- Heated oxygen sensors (4 off).
- APP (accelerator pedal position) sensor.
- Ambient air temperature sensor.
- FRP (fuel rail pressure) sensor.
  For additional information, refer to: Fuel Charging and Controls (303-04E, Description and Operation).
- Engine cooling fan.
  For additional information, refer to: Engine Cooling (303-03C, Description and Operation).
- Stoplamp switch.
  For additional information, refer to: Anti-Lock Control - Traction Control (206-09A, Description and Operation).
- Speed control cancel/suspend switch.
  For additional information, refer to: Speed Control (310-03C, Description and Operation).
- Oil level and temperature sensor.
  For additional information, refer to: Engine (303-01C, Description and Operation).
- Fuel LP (low pressure) sensor. For additional information, refer to: Fuel Tank and Lines (310-01C, Description and Operation).
- Fuel pump driver module. For additional information, refer to: Fuel Tank and Lines (310-01C, Description and Operation).

The ECM provides outputs to the following:

- Electronic throttle.
- Main relay.

- Heaters elements of the heated oxygen sensors (4 off).
- Fuel injectors (8 off).
  For additional information, refer to: Fuel Charging and Controls (303-04E, Description and Operation).
- Ignition coils (8 off).
  For additional information, refer to: Engine Ignition (303-07C, Description and Operation).
- VCT (variable camshaft timing) solenoids (4 off).
  For additional information, refer to: Engine (303-01C, Description and Operation).
- Camshaft profile switching solenoids (2 off).
  For additional information, refer to: Engine (303-01C, Description and Operation).
- Variable intake system tuning valve.
  For additional information, refer to: Intake Air Distribution and Filtering (303-12C, Description and Operation).
- EVAP (evaporative emission) canister purge valve.
  For additional information, refer to: Evaporative Emissions (303-13, Description and Operation).
- Engine starter relay.
  For additional information, refer to: Starting System (303-06C, Description and Operation).
- Engine cooling fan.
  For additional information, refer to: Engine Cooling (303-03C, Description and Operation).
- Generator.
  For additional information, refer to: Generator (414-02C, Description and Operation).
- HP fuel pumps. For additional information, refer to: Fuel Tank and Lines (310-01C, Description and Operation).
- Fuel pump driver module. For additional information, refer to: Fuel Tank and Lines (310-01C, Description and Operation).
- DMTL (diagnostic module - tank leakage) (NAS only).
  For additional information, refer to: Evaporative Emissions (303-13, Description and Operation).

CRANKSHAFT POSITION SENSOR



E116086

The CKP sensor is an inductive sensor that allows the ECM to determine the angular position of the crankshaft and the engine speed.

The CKP sensor is installed in the rear left side of the sump body, in line with the engine drive plate. The sensor is secured with a single screw and sealed with an O-ring. A two pin electrical connector provides the interface with the engine harness.

The head of the CKP sensor faces a reluctor ring pressed into the outer circumference of the engine drive plate. The reluctor ring has a 60 minus 2 tooth pattern. There are 58 teeth at 6° intervals, with two teeth removed to provide a reference point with a centerline that is 21° BTDC (before top dead center) on cylinder 1 of bank A.

If the CKP sensor fails, the ECM:

- Uses signals from the CMP sensors to determine the angular position of the crankshaft and the engine speed
- Adopts a limp home mode where engine speed is limited to a maximum of 3000 rev/min.

With a failed CKP sensor, engine starts will require a long crank time while the ECM determines the angular position of the crankshaft.

CAMSHAFT POSITION SENSORS



E116087

The CMP sensors are MRE (magneto resistive element) sensors that allow the ECM to determine the angular position of the camshafts. MRE sensors produce a digital output which allows the ECM to detect speeds down to zero.

The four CMP sensors are installed in the front upper timing covers, one for each camshaft.

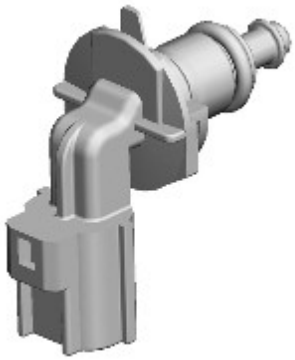
Each CMP sensor is secured with a single screw and sealed with an O-ring. On each CMP sensor, a three pin electrical connector provides the interface with the engine harness.

The head of each CMP sensor faces a sensor wheel attached to the front of the related VCT unit.

If an exhaust CMP sensor fails, the ECM disables the VCT of both exhaust camshafts.

If an intake CMP sensor fails, the ECM disables the VCT of both intake camshafts. This can result in the engine being slow, or failing, to start.

ENGINE COOLANT TEMPERATURE SENSORS



E108397

The ECT sensors are NTC (negative temperature coefficient) thermistors that allow the ECM to monitor the engine coolant temperature.

There are two identical ECT sensors installed, which are identified as ECT 1 and ECT 2. Each sensor is secured with a twist-lock and latch mechanism, and is sealed with an O-ring. A two pin electrical connector provides the interface between the sensor and the engine harness.

ECT 1

ECT 1 is installed in the heater manifold, at the rear of the RH (right-hand) cylinder head. The input from this sensor is used in calibration tables and by other systems.

If there is an ECT 1 fault, the ECM adopts an estimated coolant temperature. On the second consecutive trip with an ECT 1 fault, the ECM illuminates the MIL (malfunction indicator lamp).

ECT 2

ECT 2 is installed in the lower hose connector which attaches to the bottom of the thermostat. The input from this sensor is used for OBD (on-board diagnostic) 2 diagnostics and, in conjunction with the input from ECT 1, to confirm that the thermostat is functional.

If there is an ECT 2 fault, the ECM illuminates the MIL on the second consecutive trip.

KNOCK SENSORS



E108400

The knock sensors are piezo-ceramic sensors that allow the ECM to employ active knock control and prevent engine damage from pre-ignition or detonation.

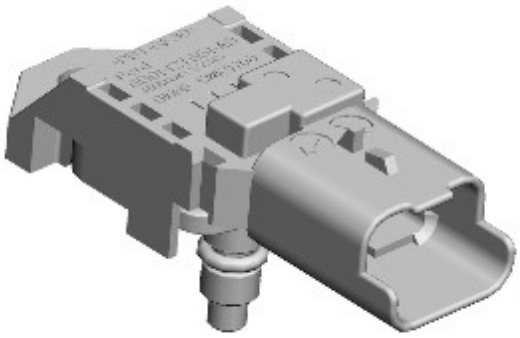
Two knock sensors are installed on the inboard side of each cylinder head, one mid-way between cylinders 1 and 2, and one mid-way between cylinders 3 and 4. Each knock sensor is secured with a single screw. On each knock sensor, a two pin electrical connector provides the interface with the engine harness.

The ECM compares the signals from the knock sensors with mapped values stored in memory to 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.

The ECM cancels closed loop control of the ignition system if the signal received from a knock sensor becomes implausible. In these circumstances the ECM defaults to base mapping for the ignition timing. This 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.

The ECM calculates the default value if one sensor fails on each bank of cylinders.

MANIFOLD ABSOLUTE PRESSURE SENSOR



E108402

The MAP sensor allows the ECM to calculate the load on the engine, which is used in the calculation of fuel injection time.

The MAP sensor is installed in the air inlet of the intake manifold. The sensor is secured with a single screw and sealed with an O-ring. A three pin electrical connector provides the interface with the engine harness.

If the MAP sensor fails, the ECM adopts a default value of 1 bar (14.5 lbf/in.^{2}).

With a failed MAP sensor, the engine will suffer from poor starting, rough running and poor driveability.

MASS AIR FLOW AND TEMPERATURE SENSORS



E116091

The MAFT sensors allow the ECM to measure the mass flow and the temperature of the air flow into the engine. The mass air flow is measured with a hot film element in the sensor. The temperature of the air flow is measured with a NTC thermistor in the sensor. The mass air flow is used to determine the fuel quantity to be injected in order to maintain the target air/fuel mixture required for correct operation of the engine and the catalytic converters.

There are two MAFT sensors installed, one in each air cleaner outlet duct. Each MAFT sensor is secured with two screws and sealed with an O-ring. On each MAFT sensor, a five pin electrical connector provides the interface with the engine harness.

If the hot film element signal fails the ECM invokes a software backup strategy to calculate the mass air flow from other inputs. Closed loop fuel control, closed loop idle speed control and evaporative emissions control are discontinued. The engine will suffer from poor starting, poor throttle response and, if the failure occurs while driving, the engine speed may dip and surging may occur before recovering.

If the NTC thermistor signal fails the ECM adopts a default value of 25 °C (77 °F) for the intake air temperature.

THROTTLE POSITION SENSORS

The TP (throttle position) sensors allow the ECM to determine the position and angular rate of change of the throttle blade.

There are two TP sensors located in the electronic throttle. See below for details of the electronic throttle.

If a TP sensor fails, the ECM:

- Adopts a limp home mode where engine speed is limited to a maximum of approximately 2000 rev/min
- Discontinues evaporative emissions control
- Discontinues closed loop control of engine idle speed.

With a failed TP sensor, the engine will suffer from poor running and throttle response.

HEATED OXYGEN SENSORS



E119261

The heated oxygen sensors allow the ECM to measure the oxygen content of the exhaust gases, for closed loop control of the fuel:air mixture and for catalytic converter monitoring.

An upstream heated oxygen sensor is installed in the outlet of each exhaust manifold, which enables independent control of the fuel:air mixture for each cylinder bank. A downstream heated oxygen sensor is installed in each catalytic converter, which enables the performance of the catalytic converters to be optimized and monitored.

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 (pulse width modulation) signal from the ECM. The heater elements are operated after each engine start, once it has been calculated that there is no moisture in the exhaust (between 0 and 2 minutes delay), and also during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperature. The PWM duty cycle is carefully controlled to prevent thermal shock to cold sensors. A non-functioning heater delays the sensor's readiness for closed loop control and increases emissions.

The upstream heated oxygen sensors produce a constant voltage, with a variable current that is proportional to the lambda ratio. The downstream heated oxygen sensors produce an output voltage dependant on the ratio of the exhaust gas oxygen to the ambient oxygen.

The heated oxygen 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.

If a heated oxygen sensor fails:

- The ECM defaults to open loop fueling for the related cylinder bank
- The CO (carbon monoxide) and emissions content of the exhaust gases may increase
- The exhaust may smell of rotten eggs (hydrogen sulphide).

With a failed heated oxygen sensor, the engine will suffer from reduced refinement and performance.

ACCELERATOR PEDAL POSITION SENSOR



E118973

The APP sensor allows the ECM to determine the driver requests for vehicle speed, acceleration and deceleration. The ECM uses this information, together with information from the ABS (anti-lock brake system) module and the TCM (transmission control module), to determine the setting of the electronic throttle.

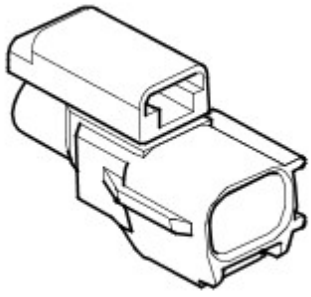
Three screws attach the APP sensor and integrated accelerator pedal to a bracket on the lower dash panel. A six pin electrical connector provides the interface with the vehicle harness.

The APP sensor is a twin track potentiometer. Each track receives an independent power supply from the ECM and returns an independent analog signal to the ECM. Both signals contain the same positional information, but the signal from track 2 is half the voltage of the signal from track 1 at all positions.

If both signals have a fault, the ECM adopts a limp home mode, which limits the engine speed to 2000 rev/min maximum.

The ECM constantly checks the range and plausibility of the two signals and stores a fault code if it detects a fault.

AMBIENT AIR TEMPERATURE SENSOR



E43580

The AAT (ambient air temperature) sensor is a NTC thermistor that allows the ECM to monitor the temperature of the air around the vehicle. The ECM uses the AAT input for a number of functions, including engine cooling fan control. The ECM also transmits the ambient temperature on the high speed CAN (controller area network) bus for use by other control modules.

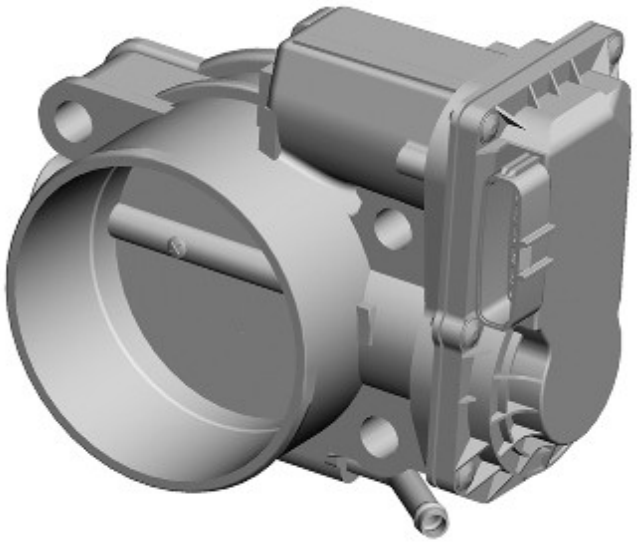
The AAT sensor is installed on a bracket in the front bumper ducting, on the vehicle centerline.

The ECM supplies the sensor with a 5 V reference voltage and a ground, and translates the return signal voltage into a temperature.

If there is a fault with the AAT sensor, the ECM calculates the AAT from the temperature inputs of the MAFT sensors. If the AAT sensor and the temperature inputs of the MAFT sensors are all faulty, the ECM adopts a default ambient

temperature of 25 °C (77 °F).

ELECTRONIC THROTTLE



E116090

The ECM uses the electronic throttle to help regulate engine torque.

The electronic throttle is attached to the intake manifold.
For additional information, refer to: Intake Air Distribution and Filtering (303-12C, Description and Operation).

The throttle plate is operated by an electric DC (direct current) motor integrated into the throttle body. The ECM uses a PWM signal to control the DC motor. The ECM compares the APP sensor inputs against an electronic request or value to determine the required position of the throttle plate. The ECM and electronic throttle are also required to:

- Monitor requests for cruise control operation
- Automatically operate the electronic throttle for accurate cruise control
- Perform all dynamic stability control engine interventions
- Monitor and carry out maximum engine speed and road speed cut outs
- Provide different engine maps for the ride and handling optimization system.

A software strategy within the ECM calibrates the position of the throttle plate at the beginning of each ignition cycle. When the ignition is turned on, the ECM performs a self test and calibration routine by fully closing the throttle plate and then opening it again. This tests the default position springs and allows the ECM to learn the fully closed position.

ECM RELAY

The ECM relay is used to initiate the power up and power down routines within the ECM. The ECM relay is installed in the EJB.

When the ignition is turned on, battery voltage is applied to the ignition sense input. The ECM then starts its power up routines and energizes the ECM relay.

When the ignition is turned off, the ECM maintains its powered up state while it conducts the power down routines. This can be for:

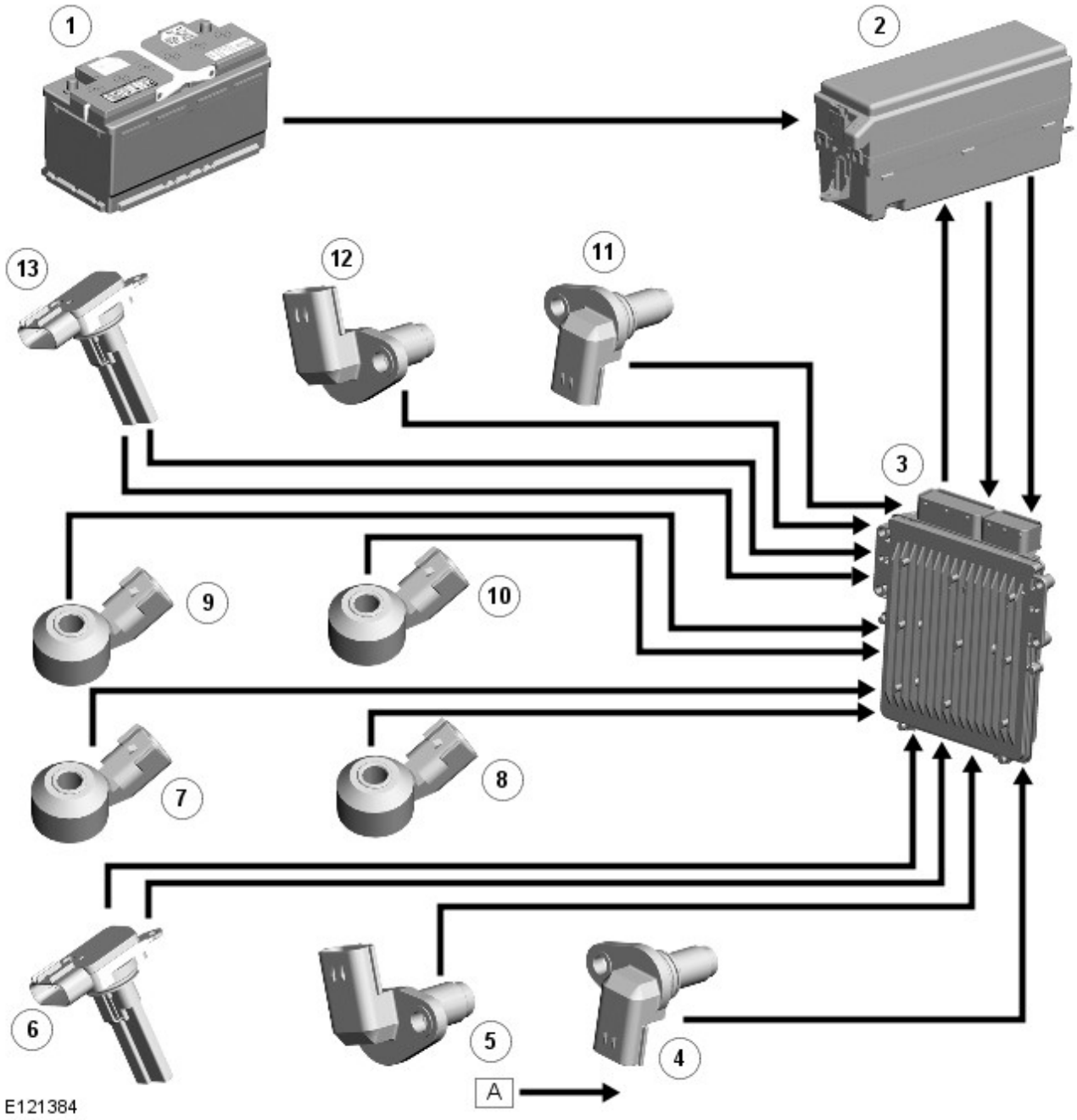
- Up to 20 minutes in extreme cases, when the DMTL system is running (NAS markets) or the TCM is 'kept awake' because of a 'not in park' condition
- Up to 5 minutes when cooling fans are required.

On completion of the power down routines the ECM de-energizes the ECM relay.

CONTROL DIAGRAM

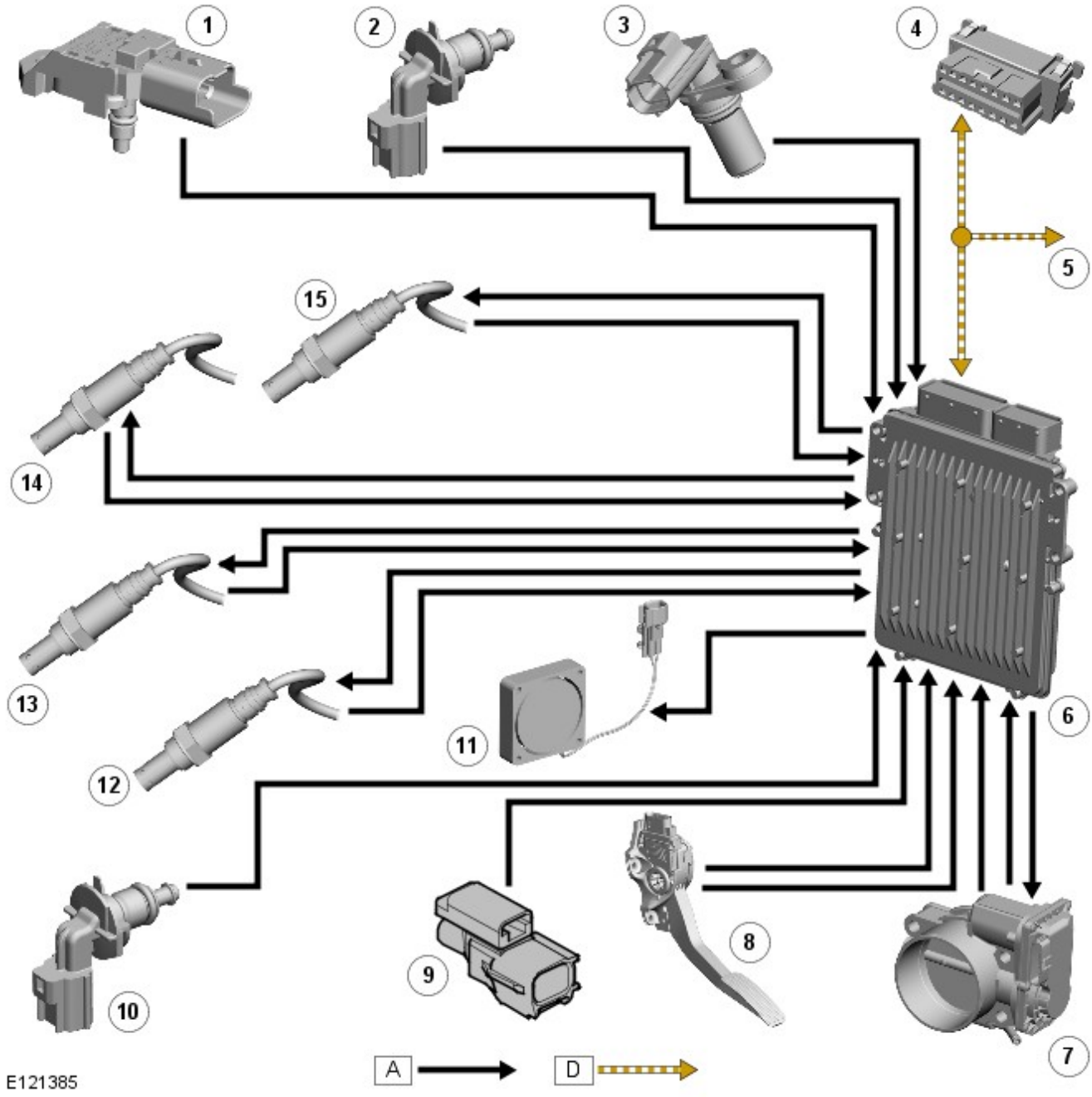
Sheet 1 of 2

NOTE: A = Hardwired.



Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	ECM
4	-	LH (left hand) intake CMP sensor
5	-	LH exhaust CMP sensor
6	-	LH MAFT sensor
7	-	LH front knock sensor
8	-	LH rear knock sensor
9	-	RH (right hand) front knock sensor
10	-	RH rear knock sensor
11	-	RH intake CMP sensor
12	-	RH exhaust CMP sensor
13	-	RH MAFT sensor

NOTE: A = Hardwired; D = High speed CAN bus.



Item	Part Number	Description
1	-	MAP sensor
2	-	ECT sensor (ECT 2)
3	-	CKP sensor
4	-	Diagnostic socket
5	-	To other system control modules
6	-	ECM
7	-	Electronic throttle
8	-	APP sensor
9	-	AAT sensor
10	-	ECT sensor (ECT 1)
11	-	ECM cooling fan
12	-	LH upstream HO2S
13	-	LH downstream HO2S
14	-	RH downstream HO2S
15	-	RH upstream HO2S

OPERATION

ECM Adaptions

The ECM has the ability to adapt the input values it uses to control certain outputs. This capability maintains engine refinement and ensures the engine emissions remain within the legislated limits. The components which have

adaptions associated with them are:

- The APP sensor
- The heated oxygen sensors
- The MAFT sensors
- The CKP sensor
- Electronic throttle
- Knock sensors.

Oxygen and MAFT Sensors

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 heated 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 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 drive plates 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 drive plate adaption if the ECM is renewed or replaced. The ECM supports four drive plate adaptions for the CKP sensor. Each adaption relates to a specific engine speed range. The engine speed ranges are detailed in the table below:

Adaption	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 an amount of misfire that could lead to the legislated emissions limit being exceeded by a given amount. The second level is a misfire rate that causes degradation in catalytic converter efficiency.

The ECM monitors the number of misfire occurrences within two engine revolution ranges. If the ECM determines a misfire failure within either of these two ranges, over two consecutive journeys, it will record a fault code and details of the engine speed, engine load and engine coolant temperature. In addition, if the second level of misfire occurs, on any trip, the ECM flashes the MIL while the fault is occurring.

The signal from the CKP sensor indicates how fast the poles on the drive plate are passing the sensor tip. A sine wave is generated each time a pole passes the sensor tip. The ECM can detect variations in drive plate 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. TheECM will evaluate the signal against a number of factors and will decide whether to record the occurrence or ignore it. The ECM can assign a misfire judgement to an individual cylinder, which can be viewed on Land Rover approved diagnostic equipment.

Diagnostics

The ECM stores each fault as a DTC (diagnostic trouble code). The DTC and associated environmental and freeze frame data can be read using Land Rover approved diagnostic equipment, which can also read real time data from each sensor, the adaption values currently being employed and the current fueling, ignition and idle speed settings.

Published: 16-Aug-2012

Electronic Engine Controls - V8 5.0L Petrol - Electronic Engine Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the electronic engine control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Electronic Engine Controls (303-14B Electronic Engine Controls - V8 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Engine oil level • Cooling system coolant level • Fuel level • Fuel contamination/grade/quality • Fuel leaks • Auxiliary drive belt • Sensor installation/condition • Viscous fan and solenoid • Air filter condition	• Fuses • Wiring harness • Electrical connector(s) • 5V sensor supply • 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 symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	• 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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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	• Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant 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	• Refer to the relevant section of the workshop manual and test the engine coolant level and condition • Refer to the relevant section of the workshop manual and test the battery • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Difficult hot start	• Injector leak • Electronic engine control	• Check for injector leak, install new injector as required • Using the manufacturer approved diagnostic

	• Purge valve • Fuel pump • Ignition system • Exhaust Gas Recirculation (EGR) valve stuck open	system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system • Exhaust Gas Recirculation (EGR) valve stuck open	• Check for injector leak, install new injector as required • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check for blockage in air filter and air intake system • Check for air leakage in air intake system
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 • Exhaust Gas Recirculation (EGR) valve stuck open • Transmission malfunction	• Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check for injector leak, install new injector as necessary • Check for air leakage in air intake system • Ensure accelerator pedal is free from restriction • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) and Transmission Control Module (TCM) for related DTCs and refer to the relevant DTC index
Engine backfires	• Fuel pump/lines • Air leakage • Electronic engine controls • Ignition system • Sticking Variable Camshaft Timing (VCT) hub	• Check for fuel system failures • Check for air leakage in intake air system • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Engine surges	• Fuel pump/lines • Electronic engine controls • Throttle motor • Ignition system	• Check for fuel system failures • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Engine detonates/knocks	• Fuel pump/lines • Air leakage • Electronic engine controls • Sticking Variable Camshaft Timing (VCT) hub	• Check for fuel system failures • Check for air leakage in intake air system • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
No throttle response	• Electronic engine controls • Throttle motor	• Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM), Transmission Control Module (TCM), and Anti-lock Brake System control module (ABS) for related DTCs and refer to the relevant DTC index • Check for air leakage in intake air system

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Powertrain Control Module (PCM) Long Drive Cycle Self-Test

General Procedures

 WARNING: Where possible, all road tests should be on well surfaced and dry roads. Always comply with speed limits and local traffic regulations.

NOTES:

 This procedure is an overcheck only. If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

 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.

   Make sure the engine temperature is above 60 ºC (140 ºF).

   Carry out a road test and perform the following operations.
   1. Accelerate to 55 mph (88 km/h) in 5th gear and cruise for 2 minutes with the engine speed at or above 1800rpm.
   2. Lift off the throttle and allow the vehicle to decelerate until the engine speed is less than 1000 rpm.
   3. Stop the vehicle.
   4. Release brake, allow the vehicle to move with no throttle for 1 minute.
   5. 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.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Powertrain Control Module (PCM) Short Drive Cycle Self-Test

General Procedures

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 70ºC (158 ºF) 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.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Camshaft Position (CMP) Sensor LH

Removal and Installation

Removal

1. Disconnect the battery ground cable.

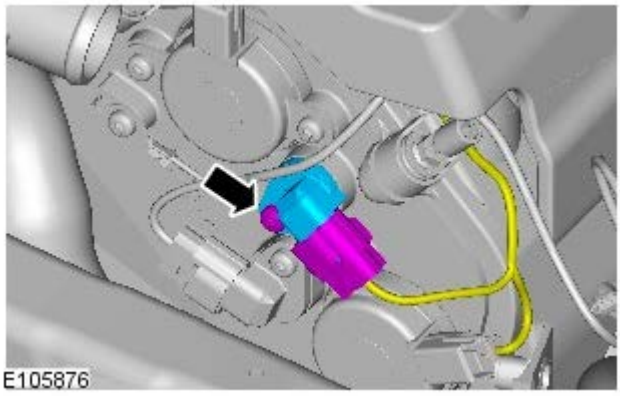
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Thermostat Housing - Vehicles Without: Supercharger (303-03, Removal and Installation).

4. *Torque:* 10 Nm



Installation

1. CAUTIONS:

   Make sure that the mating faces are clean and free of foreign material.

   Make sure that the sensor tip is clean and free of foreign material.

   NOTE: Lubricate the O-ring seals with clean engine oil.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Camshaft Position (CMP) Sensor RH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

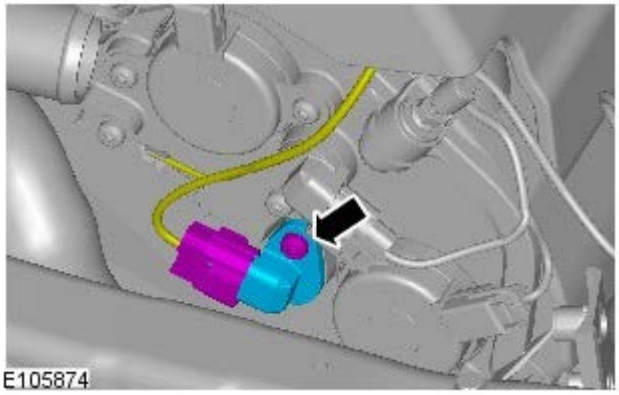
   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Thermostat Housing - 5.0L NA V8 - AJ133 (303-03 Engine Cooling - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133, Removal and Installation).

4. *Torque:* 10 Nm



Installation

1. CAUTIONS:

   Make sure that the mating faces are clean and free of foreign material.

   Make sure that the sensor tip is clean and free of foreign material.

   NOTE: Lubricate the O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Catalyst Monitor Sensor LH

Removal and Installation

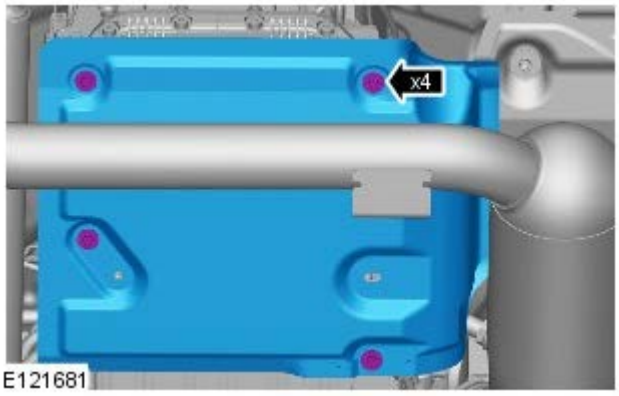
Removal

NOTE: Removal steps in this procedure may contain installation details.

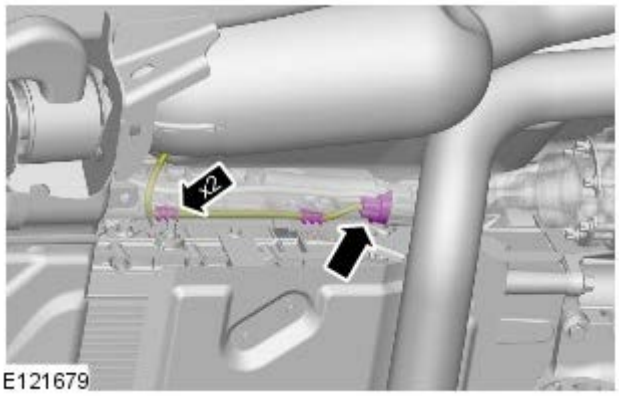
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. *Torque:* 10 Nm

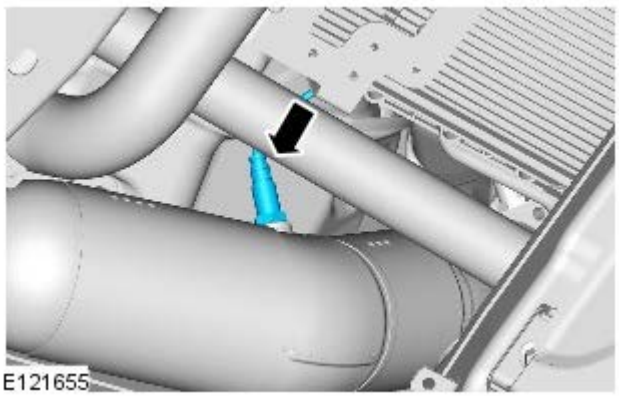


3.



4. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Torque: 48 Nm



Installation

1. CAUTIONS:

   If accidentally dropped or knocked install a new sensor.

   Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust

or driveshaft.

NOTES:

 If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

 Make sure the anti-seize compound does not contact the HO2S tip.

To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Catalyst Monitor Sensor RH

Removal and Installation

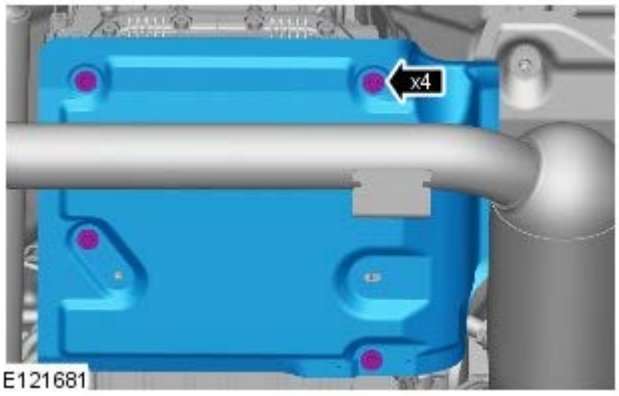
Removal

NOTE: Removal steps in this procedure may contain installation details.

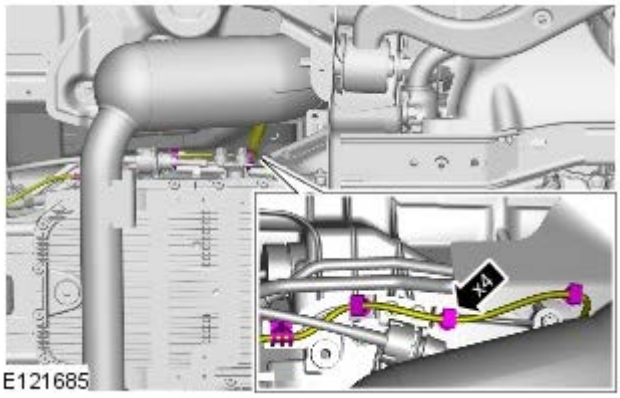
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

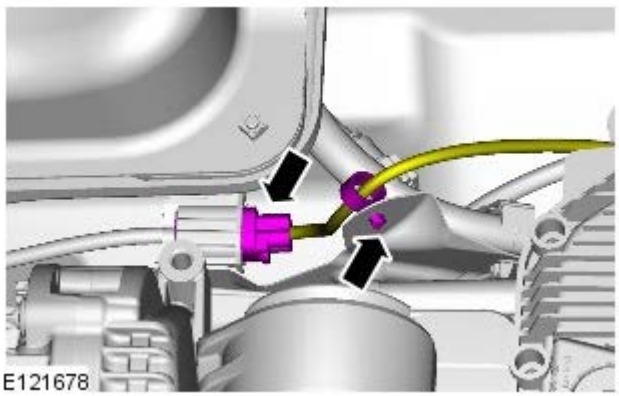
2. *Torque:* 10 Nm



3.

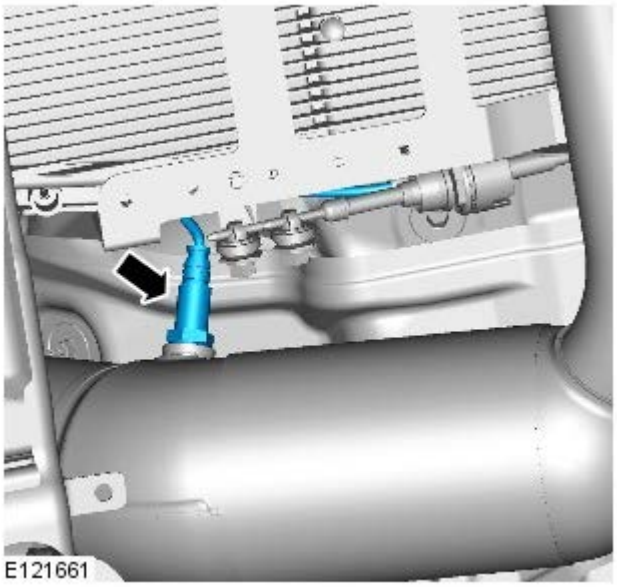


4.



5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Torque: 48 Nm



Installation

1. CAUTIONS:

   Make sure the anti-seize compound does not contact the HO2S tip.

   If accidentally dropped or knocked install a new sensor.

   Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Crankshaft Position (CKP) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

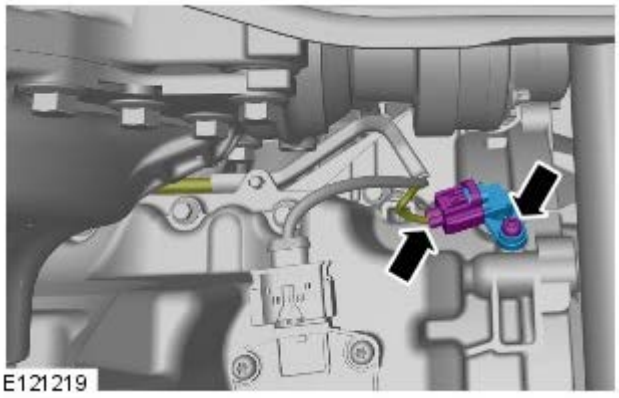
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).



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

   Torque: 10 Nm

Installation

1. CAUTIONS:

   Make sure that the mating faces are clean and free of foreign material.

   Make sure that the component is clean, free of foreign material and lubricant.

   To install, reverse the removal procedure.

2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

Published: 20-Sep-2013

Electronic Engine Controls - V8 5.0L Petrol - Engine Control Module (ECM)

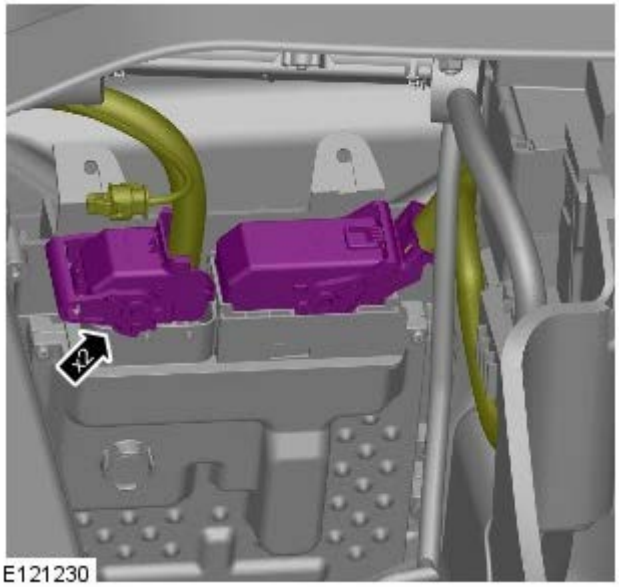
Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

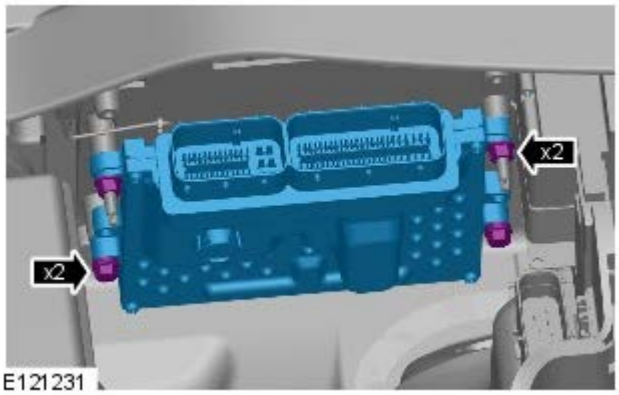
1. Remove the battery.

   Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).



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

3. *Torque:* 7 Nm



Installation

1. To install, reverse the removal procedure.

Published: 25-Nov-2013

Electronic Engine Controls - V8 5.0L Petrol - Engine Coolant Temperature (ECT) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

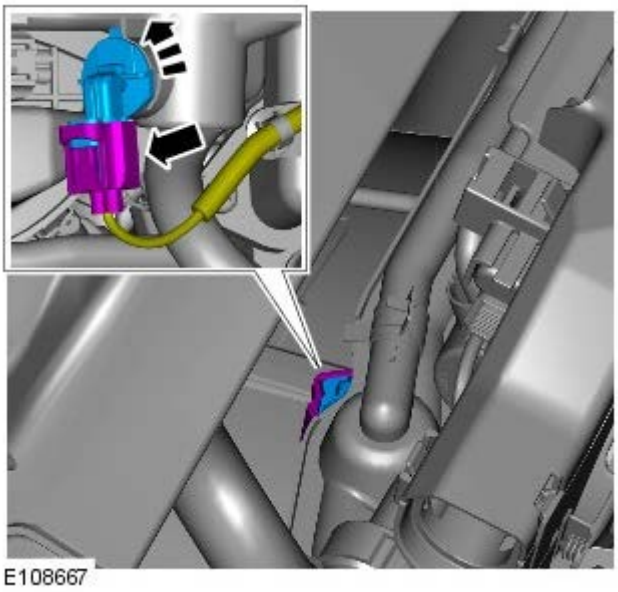
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

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


E108667

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Engine Oil Level Sensor

Removal and Installation

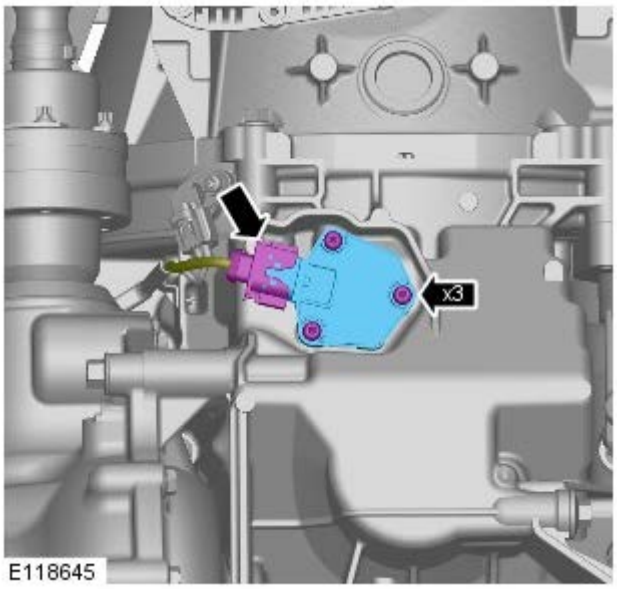
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Engine Oil Draining and Filling (303-01, General Procedures).



3. CAUTIONS:

   Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

   Remove and discard the O-ring seal.

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

   Torque: 12 Nm

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Front Knock Sensor (KS) LH

Removal and Installation

Removal

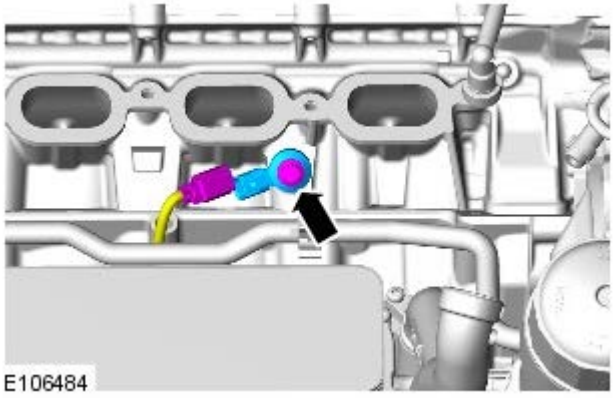
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Intake Manifold (303-01, Removal and Installation).

3. *Torque:* 20 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Front Knock Sensor (KS) RH

Removal and Installation

Removal

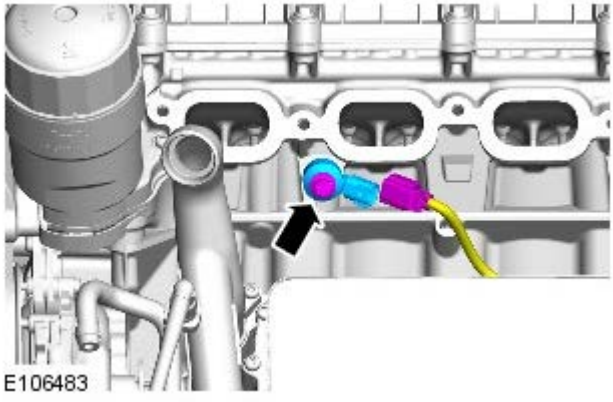
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Intake Manifold (303-01, Removal and Installation).

3. *Torque:* 20 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Fuel Rail Pressure (FRP) Sensor

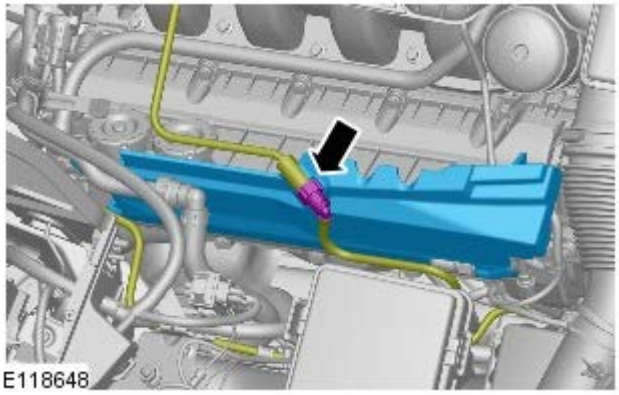
Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00, Description and Operation).
2. Refer to: Fuel System Pressure Release - 5.0L (310-00, General Procedures).
3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).
4. Refer to: Fuel Injection Component Cleaning (303-04, General Procedures).
5. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).



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



7. CAUTIONS:

   Be prepared to collect escaping fluids.

   Make sure that all openings are sealed. Use new blanking caps.

   - *Torque:* 32 Nm

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Heated Oxygen Sensor (HO2S) LH

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

Removal

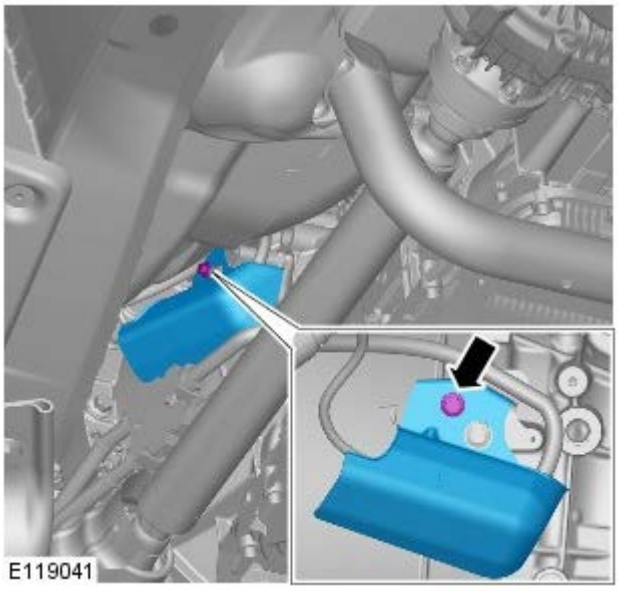
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

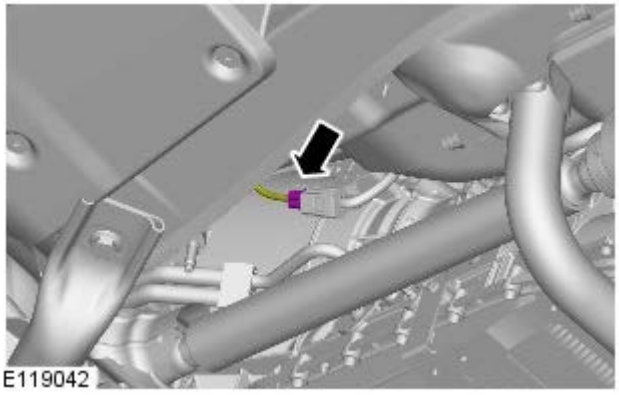
   Raise and support the vehicle.

2. Refer to: Exhaust System (309-00 Exhaust System - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133, Removal and Installation).

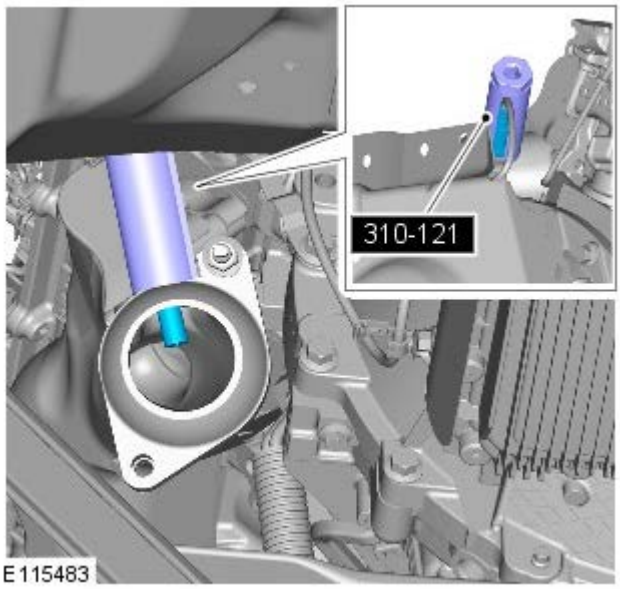
3. *Torque:* 11 Nm



4.



5. CAUTION: Make sure that the mating faces are clean and free of foreign material.



Special Tool(s): 310-121
Torque: 48 Nm

Installation

1. CAUTIONS:

   Make sure the anti-seize compound does not contact the HO2S tip.

   If accidentally dropped or knocked install a new sensor.

   Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Heated Oxygen Sensor (HO2S) RH

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

Removal

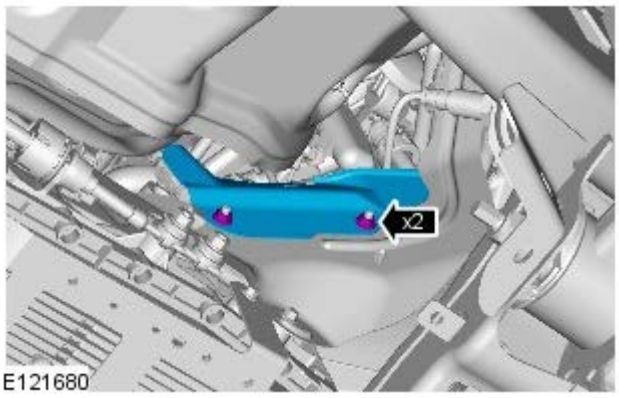
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

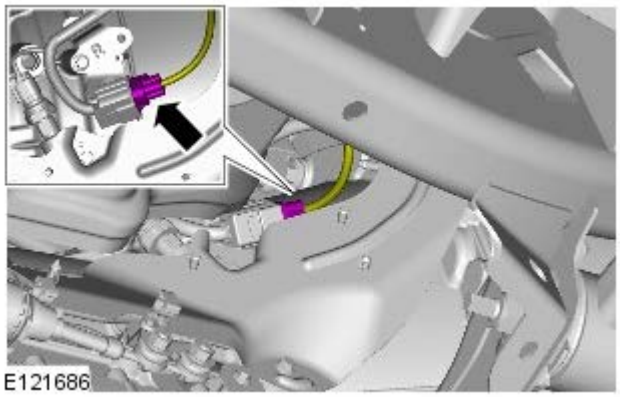
   Raise and support the vehicle.

2. Refer to: Exhaust System (309-00, Removal and Installation).

3. *Torque:* 9 Nm

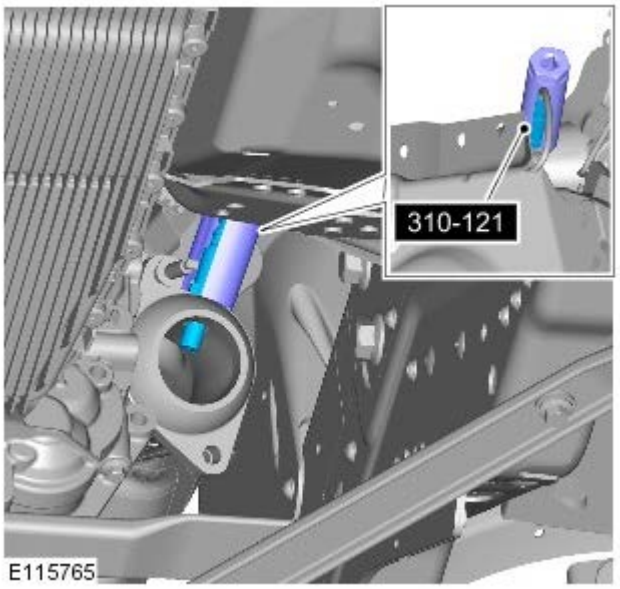


4.



5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Special Tool(s): 310-121
   Torque: 48 Nm



Installation

1. CAUTIONS:

   Make sure the anti-seize compound does not contact the HO2S tip.

   If accidentally dropped or knocked install a new sensor.

   Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

Published: 11-May-2011

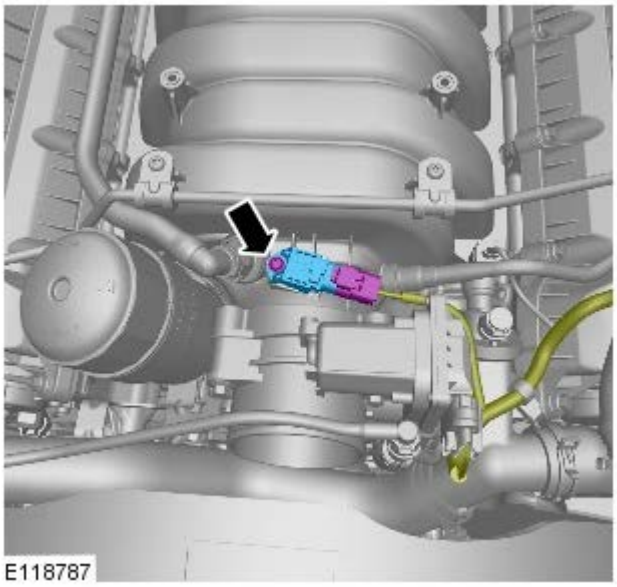
Electronic Engine Controls - V8 5.0L Petrol - Manifold Absolute Pressure (MAP) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Air Cleaner Outlet Pipe T-Connector (303-12, Removal and Installation).



2. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
   - *Torque:* 5 Nm

Installation

1. To install, reverse the removal procedure.

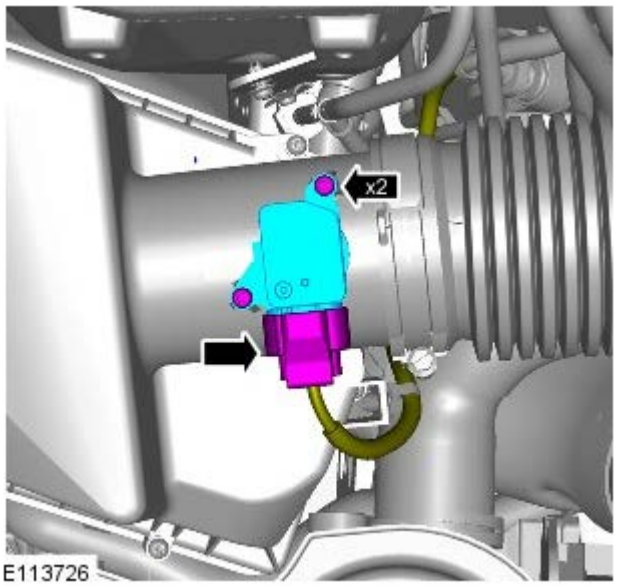
Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Mass Air Flow (MAF) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.



1. NOTES:

   Right-hand shown, left-hand similar.

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

   Torque: 1.2 Nm

Installation

1. To install reverse the removal procedure.
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Rear Knock Sensor (KS) LH

Removal and Installation

Removal

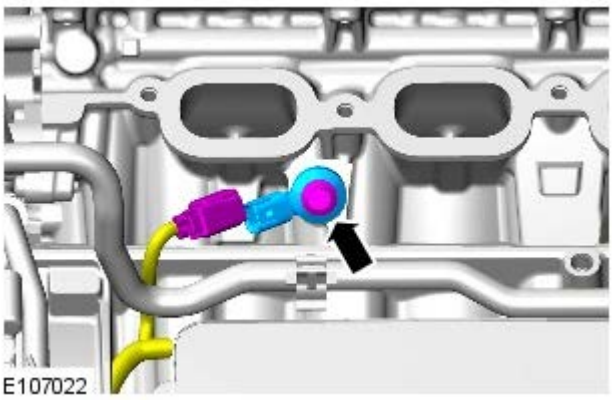
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Intake Manifold (303-01, Removal and Installation).

3. *Torque:* 20 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Rear Knock Sensor (KS) RH

Removal and Installation

Removal

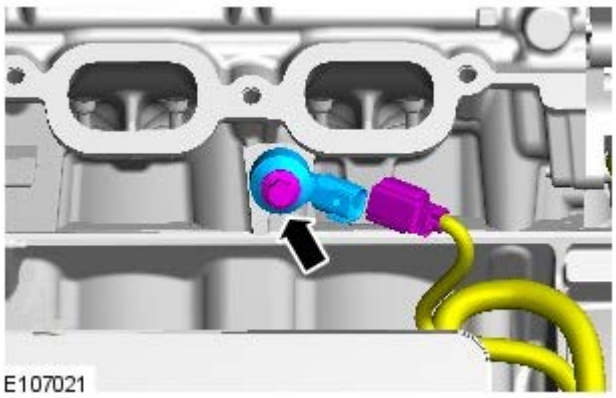
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Intake Manifold (303-01, Removal and Installation).

3. *Torque:* 20 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Variable Valve Timing (VVT) Oil Control Solenoid LH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

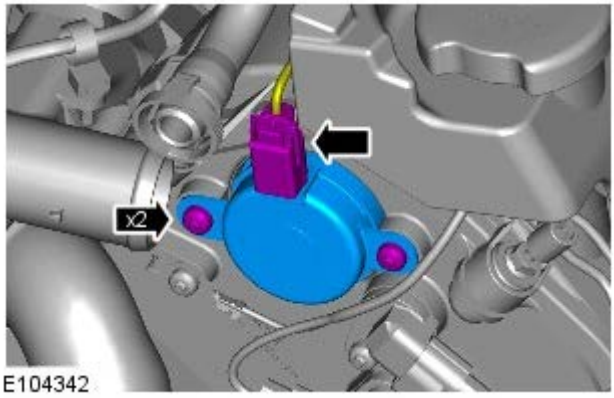
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

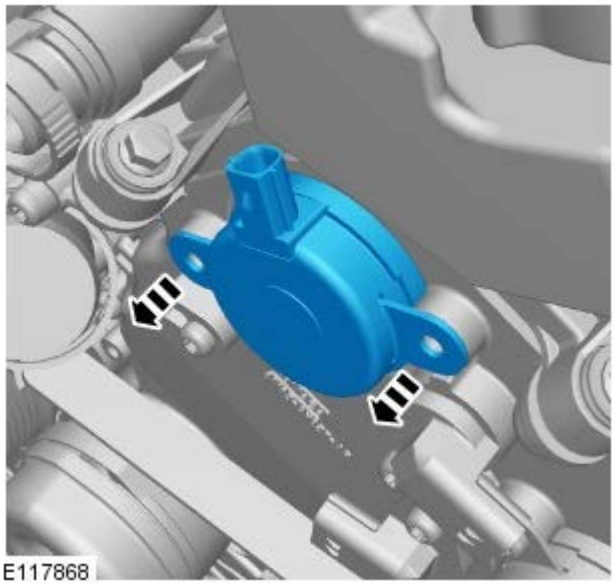
   Raise and support the vehicle.

3. Refer to: Thermostat Housing - Vehicles Without: Supercharger (303-03, Removal and Installation).



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

   Torque: 10 Nm



5. CAUTION: Evenly and progressively, remove the VVT units from each side.

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

Installation

1. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   NOTE: Lubricate the O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 5.0L Petrol - Variable Valve Timing (VVT) Oil Control Solenoid RH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

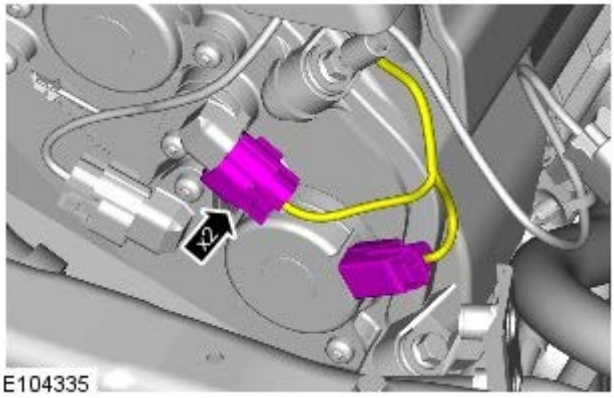
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

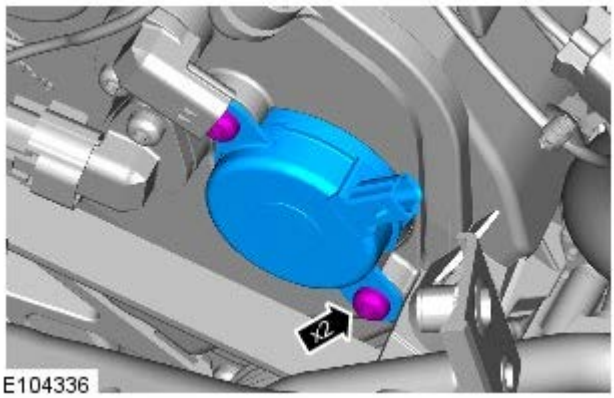
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Thermostat Housing - Vehicles Without: Supercharger (303-03, Removal and Installation).



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

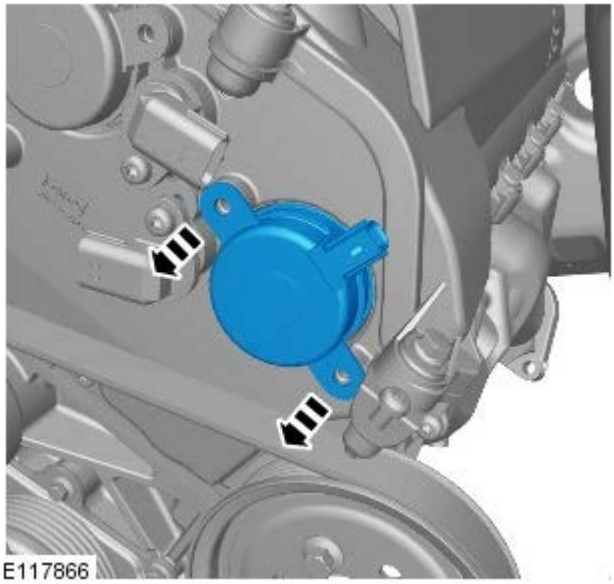


5. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

   Torque: 10 Nm

6. CAUTION: Evenly and progressively, remove the VVT units from each side.

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



Installation

1. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   NOTE: Lubricate the O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol -

Torque Specifications

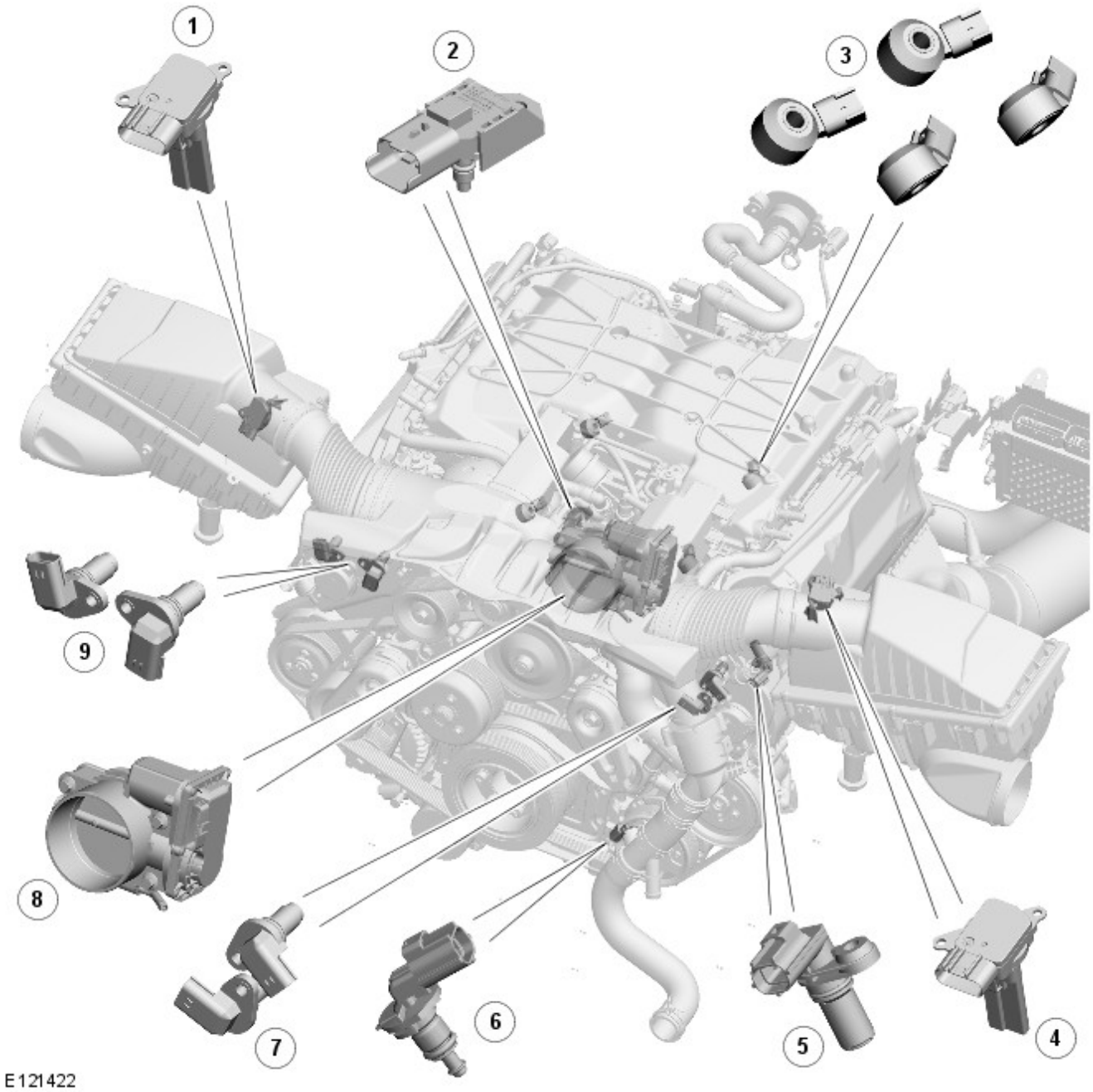
Description	Nm	lb-ft	lb-in
Camshaft position (CMP) sensor(s) retaining bolt	10	7	-
Crankshaft position (CKP) sensor retaining bolt	10	7	-
Heated oxygen sensor(s) (HO2S)	48	35	-
Catalyst monitor sensor(s)	48	35	-
Knock sensor(s) (KS) retaining bolt	20	15	-
Fuel rail pressure (FRP) sensor	32	24	-
Manifold absolute pressure and temperature (MAPT) sensor	5	-	44
Engine oil level sensor retaining bolts	12	8	-
Variable valve timing (VVT) oil control solenoid(s) retaining bolts	10	7	-
Engine control module (ECM) retaining bolts	7	-	62
Engine control module (ECM) retaining nuts	7	-	62
Mass air flow (MAF) sensor retaining bolts	1.2	-	10.6

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Electronic Engine Controls

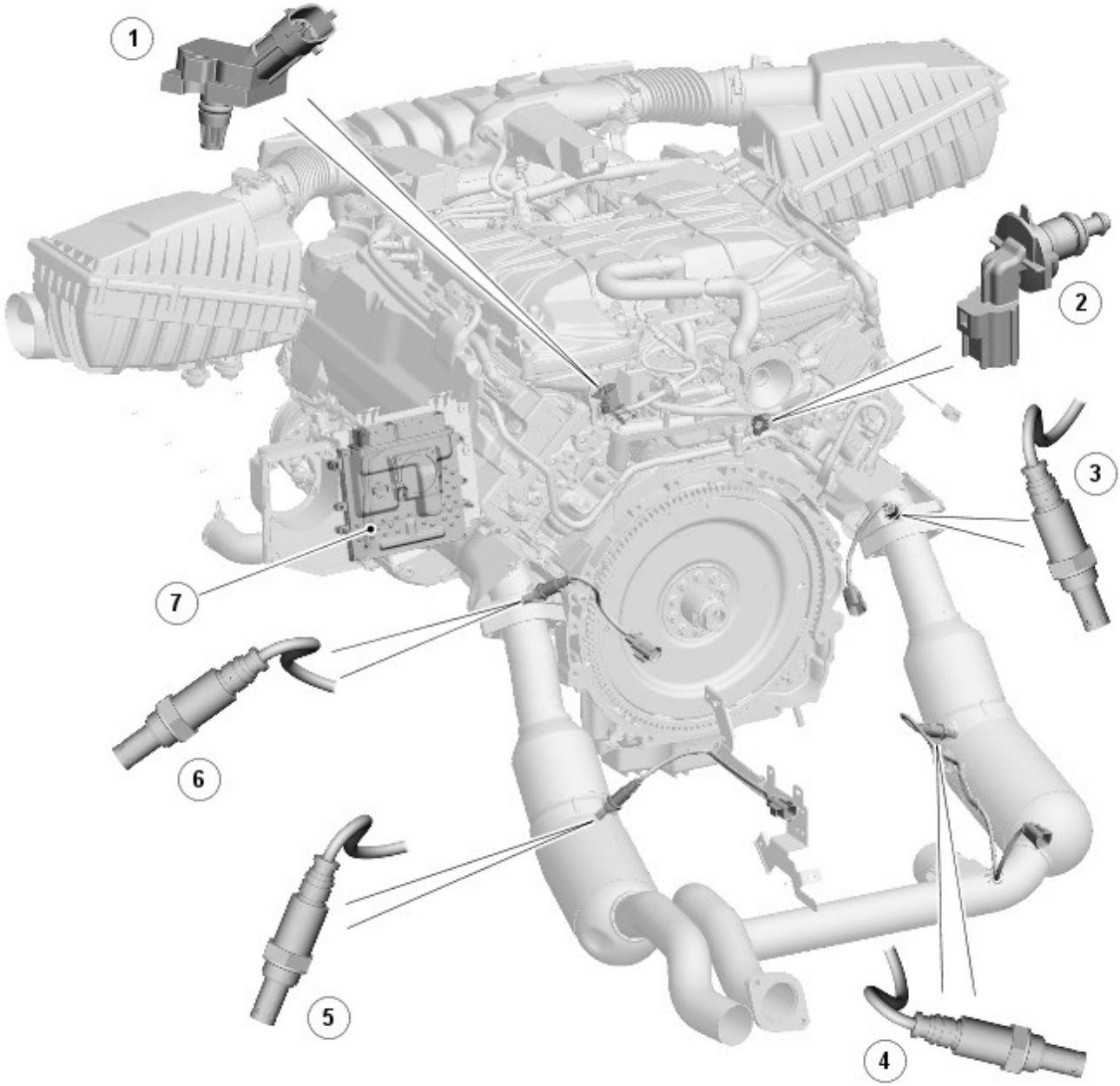
Description and Operation

COMPONENT LOCATION - SHEET 1 OF 3



Item	Part Number	Description
1	-	MAFT (mass air flow and temperature) sensor
2	-	MAP (manifold absolute pressure) sensor
3	-	Knock sensors
4	-	MAFT sensor
5	-	CKP (crankshaft position) sensor
6	-	ECT (engine coolant temperature) sensor (ECT 2)
7	-	CMP (camshaft position) sensors
8	-	Electronic throttle
9	-	CMP sensors

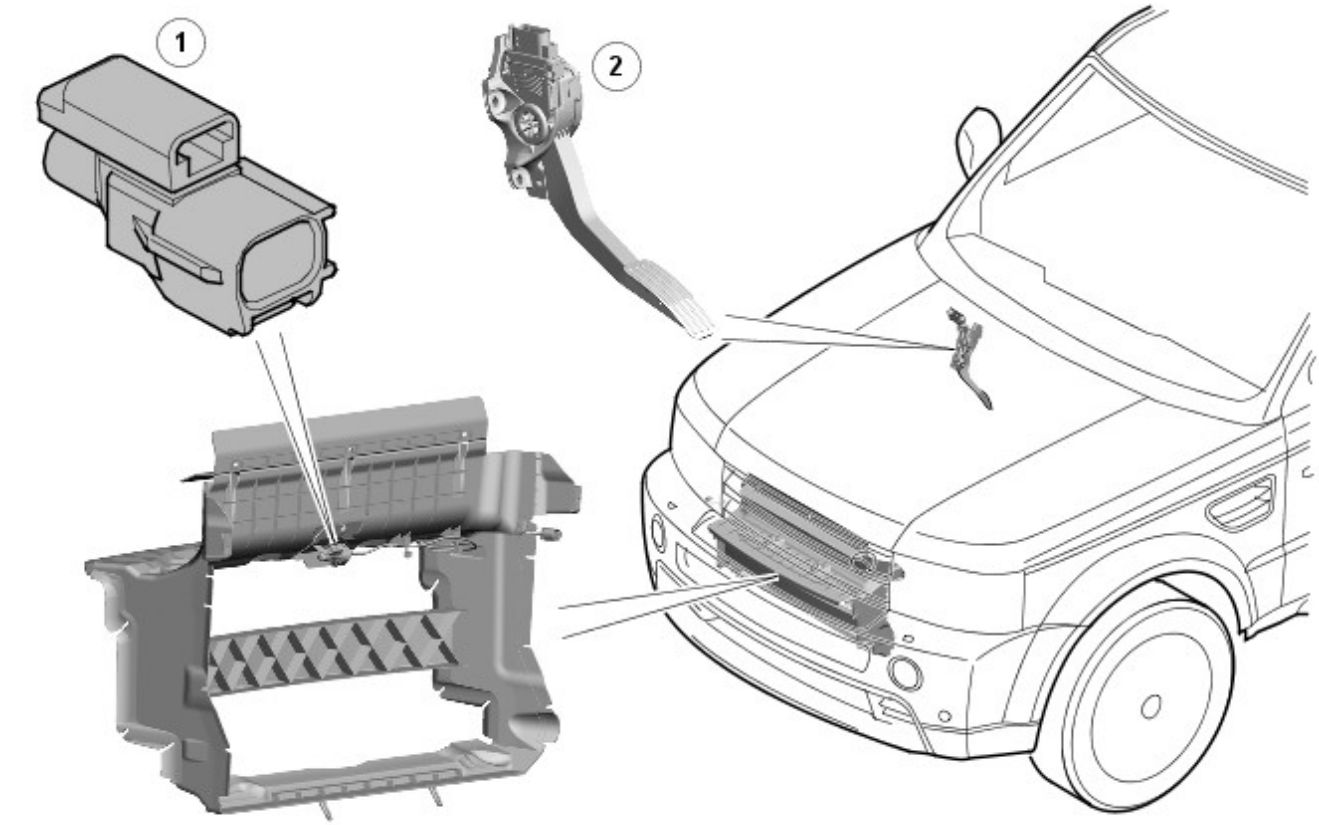
COMPONENT LOCATION - SHEET 2 OF 3



E121423

Item	Part Number	Description
1	-	MAPT (manifold absolute pressure and temperature) sensor
2	-	ECT sensor (ECT 1)
3	-	Upstream HO2S (heated oxygen sensor)
4	-	Downstream HO2S
5	-	Downstream HO2S
6	-	Upstream HO2S
7	-	ECM (engine control module)

COMPONENT LOCATION - SHEET 3 OF 3



Item	Part Number	Description
1	-	AAT (ambient air temperature) sensor
2	-	APP (accelerator pedal position) sensor

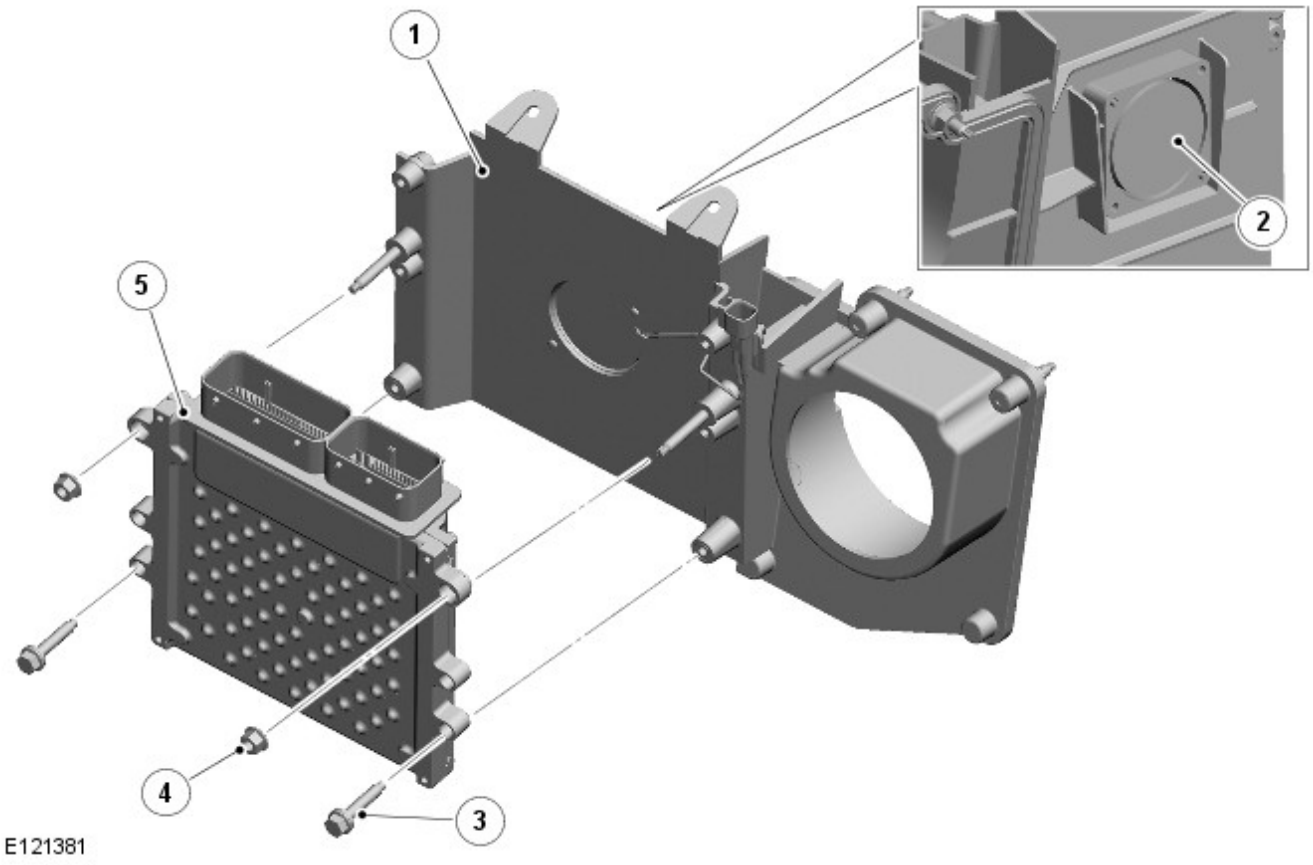
INTRODUCTION

The EEC (electronic engine control) system operates the engine to generate the output demanded by the accelerator pedal and loads imposed by other systems. The EEC system has an ECM (engine control module) that uses a torque-based strategy to evaluate inputs from sensors and other systems, then produces outputs to engine actuators to produce the required torque.

The EEC system controls the following:

- Charge air
- Fueling
- Ignition timing
- Valve timing
- Cylinder knock
- Noise feedback system
- Idle speed
- Engine cooling fan
- Evaporative emissions
- On-board diagnostics
- Immobilization system interface
- Speed control.

ENGINE CONTROL MODULE



Item	Part Number	Description
1	-	ECM and cooling fan mounting bracket
2	-	Cooling fan
3	-	Screw (2 off)
4	-	Nut (2 off)
5	-	ECM

The ECM is installed in the passenger side protective box in the engine compartment, on a bracket attached to the engine bulkhead. The bracket also contains an electric cooling fan. The ECM, which has an internal temperature sensor, controls the operation of the cooling fan. While the ignition is on, the cooling fan receives a power supply from the ECM relay in the EJB (engine junction box). When cooling is required, the ECM connects the cooling fan to ground.

The ECM has the capability of adapting its fuel and ignition control outputs in response to several sensor inputs.

The ECM receives inputs from the following:

- CKP (crankshaft position) sensor.
- CMP (camshaft position) sensors (4 off).
- ECT (engine coolant temperature) sensors (2 off).
- Knock sensors (4 off).
- MAP (manifold absolute pressure) sensor.
- MAFT (mass air flow and temperature) sensors (2 off).
- MAPT (manifold absolute pressure and temperature) sensor.
- Throttle position sensor.
- Heated oxygen sensors (4 off).
- APP (accelerator pedal position) sensor.
- Ambient air temperature sensor.
- FRP (fuel rail pressure) sensor.
  For additional information, refer to: Fuel Charging and Controls (303-04F, Description and Operation).
- Engine cooling fan.
  For additional information, refer to: Engine Cooling (303-03C, Description and Operation).
- Stoplamp switch.
  For additional information, refer to: Anti-Lock Control - Traction Control (206-09A, Description and Operation).
- Speed control cancel/suspend switch.
  For additional information, refer to: Speed Control (310-03C, Description and Operation).
- Oil level and temperature sensor.
  For additional information, refer to: Engine (303-01D, Description and Operation).
- Fuel LP (low pressure) sensor. For additional information, refer to: Fuel Tank and Lines (310-01C, Description and Operation).
- Fuel pump driver module. For additional information, refer to: Fuel Tank and Lines (310-01C, Description and Operation).

The ECM provides outputs to the following:

- Electronic throttle.

- Main relay.
- Heaters elements of the heated oxygen sensors (4 off).
- Fuel injectors (8 off).
  For additional information, refer to: Fuel Charging and Controls (303-04F, Description and Operation).
- Ignition coils (8 off).
  For additional information, refer to: Engine Ignition (303-07C, Description and Operation).
- VCT (variable camshaft timing) solenoids (4 off).
  For additional information, refer to: Engine (303-01D, Description and Operation).
- Noise feedback system tuning valve.
  For additional information, refer to: Intake Air Distribution and Filtering (303-12D, Description and Operation).
- EVAP (evaporative emission) canister purge valve.
  For additional information, refer to: Evaporative Emissions (303-13, Description and Operation).
- Engine starter relay.
  For additional information, refer to: Starting System (303-06C, Description and Operation).
- Engine cooling fan.
  For additional information, refer to: Engine Cooling (303-03C, Description and Operation).
- Intercooler water pump relay.
  For additional information, refer to: Supercharger Cooling (303-03D, Description and Operation).
- Generator.
  For additional information, refer to: Generator (414-02C, Description and Operation).
- HP fuel pumps. For additional information, refer to: Fuel Tank and Lines (310-01C, Description and Operation).
- Fuel pump driver module. For additional information, refer to: Fuel Tank and Lines (310-01C, Description and Operation).
- DMTL (diagnostic module - tank leakage).
  For additional information, refer to: Evaporative Emissions (303-13, Description and Operation).

CRANKSHAFT POSITION SENSOR



E116086

The CKP sensor is an inductive sensor that allows the ECM to determine the angular position of the crankshaft and the engine speed.

The CKP sensor is installed in the rear left side of the sump body, in line with the engine drive plate. The sensor is secured with a single screw and sealed with an O-ring. A two pin electrical connector provides the interface with the engine harness.

The head of the CKP sensor faces a reluctor ring pressed into the outer circumference of the engine drive plate. The reluctor ring has a 60 minus 2 tooth pattern. There are 58 teeth at 6° intervals, with two teeth removed to provide a reference point with a centerline that is 21° BTDC (before top dead center) on cylinder 1 of bank A.

If the CKP sensor fails, the ECM:

- Uses signals from the CMP sensors to determine the angular position of the crankshaft and the engine speed
- Adopts a limp home mode where engine speed is limited to a maximum of 3000 rev/min.

With a failed CKP sensor, engine starts will require a long crank time while the ECM determines the angular position of the crankshaft.

CAMSHAFT POSITION SENSORS



E116087

The CMP sensors are MRE (magneto resistive element) sensors that allow the ECM to determine the angular position of the camshafts. MRE sensors produce a digital output which allows the ECM to detect speeds down to zero.

The four CMP sensors are installed in the front upper timing covers, one for each camshaft.

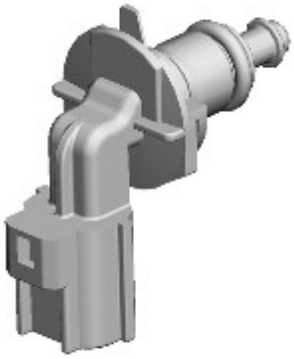
Each CMP sensor is secured with a single screw and sealed with an O-ring. On each CMP sensor, a three pin electrical connector provides the interface with the engine harness.

The head of each CMP sensor faces a sensor wheel attached to the front of the related VCT unit.

If an exhaust CMP sensor fails, the ECM disables the VCT of both exhaust camshafts.

If an intake CMP sensor fails, the ECM disables the VCT of both intake camshafts. This can result in the engine being slow, or failing, to start.

ENGINE COOLANT TEMPERATURE SENSORS



E108397

The ECT sensors are NTC (negative temperature coefficient) thermistors that allow the ECM to monitor the engine coolant temperature.

There are two identical ECT sensors installed, which are identified as ECT 1 and ECT 2. Each sensor is secured with a twist-lock and latch mechanism, and is sealed with an O-ring. A two pin electrical connector provides the interface between the sensor and the engine harness.

ECT 1

ECT 1 is installed in the heater manifold, at the rear of the RH (right-hand) cylinder head. The input from this sensor is used in calibration tables and by other systems.

If there is an ECT 1 fault, the ECM adopts an estimated coolant temperature. On the second consecutive trip with an ECT 1 fault, the ECM illuminates the MIL (malfunction indicator lamp).

ECT 2

ECT 2 is installed in the lower hose connector which attaches to the bottom of the thermostat. The input from this sensor is used for OBD (on-board diagnostic) 2 diagnostics and, in conjunction with the input from ECT 1, to confirm that the thermostat is functional.

If there is an ECT 2 fault, the ECM illuminates the MIL on the second consecutive trip.

KNOCK SENSORS



E108400

The knock sensors are piezo-ceramic sensors that allow the ECM to employ active knock control and prevent engine damage from pre-ignition or detonation.

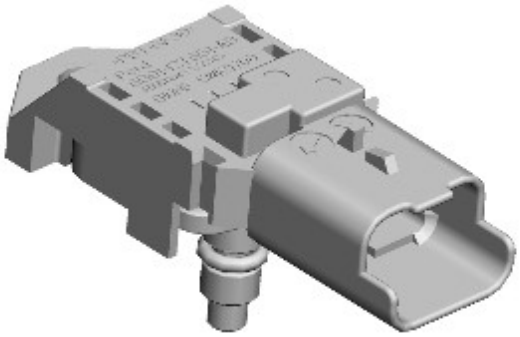
Two knock sensors are installed on the inboard side of each cylinder head, one mid-way between cylinders 1 and 2, and one mid-way between cylinders 3 and 4. Each knock sensor is secured with a single screw. On each knock sensor, a two pin electrical connector provides the interface with the engine harness.

The ECM compares the signals from the knock sensors with mapped values stored in memory to 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.

The ECM cancels closed loop control of the ignition system if the signal received from a knock sensor becomes implausible. In these circumstances the ECM defaults to base mapping for the ignition timing. This 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.

The ECM calculates the default value if one sensor fails on each bank of cylinders.

MANIFOLD ABSOLUTE PRESSURE SENSOR



E108402

The MAP sensor allows the ECM to calculate the load on the engine, which is used in the calculation of fuel injection time.

The MAP sensor is installed in the air inlet of the SC (supercharger). The sensor is secured with a single screw and sealed with an O-ring. A three pin electrical connector provides the interface with the engine harness.

If the MAP sensor fails, the ECM adopts a default value of 1 bar (14.5 lbf/in.^{2}).

With a failed MAP sensor, the engine will suffer from poor starting, rough running and poor driveability.

MASS AIR FLOW AND TEMPERATURE SENSORS



E116091

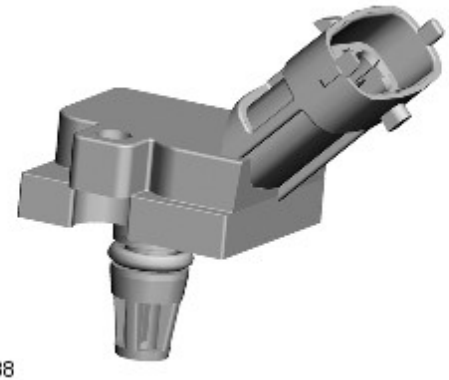
The MAFT sensors allow the ECM to measure the mass flow and the temperature of the air flow into the engine. The mass air flow is measured with a hot film element in the sensor. The temperature of the air flow is measured with a NTC thermistor in the sensor. The mass air flow is used to determine the fuel quantity to be injected in order to maintain the target air/fuel mixture required for correct operation of the engine and the catalytic converters.

There are two MAFT sensors installed, one in each air cleaner outlet duct. Each MAFT sensor is secured with two screws and sealed with an O-ring. On each MAFT sensor, a five pin electrical connector provides the interface with the engine harness.

If the hot film element signal fails the ECM invokes a software backup strategy to calculate the mass air flow from other inputs. Closed loop fuel control, closed loop idle speed control and evaporative emissions control are discontinued. The engine will suffer from poor starting, poor throttle response and, if the failure occurs while driving, the engine speed may dip and surging may occur before recovering.

If the NTC thermistor signal fails the ECM adopts a default value of 25 °C (77 °F) for the intake air temperature.

MANIFOLD ABSOLUTE PRESSURE AND TEMPERATURE SENSOR



E116088

The MAPT sensor allows the ECM to calculate the air charge density immediately before it enters the cylinders. This is used to adjust the ignition timing relative to the boost pressure, and to monitor the performance of the charge air coolers.

The MAPT sensor is installed in the LH (left-hand) charge air cooler outlet. The sensor is secured with a single screw and sealed with an O-ring. A four pin electrical connector provides the interface with the engine harness.

THROTTLE POSITION SENSORS

The TP (throttle position) sensors allow the ECM to determine the position and angular rate of change of the throttle blade.

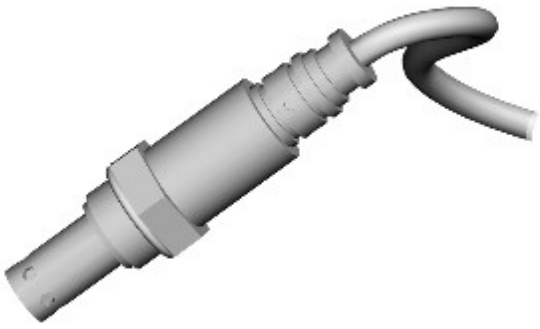
There are two TP sensors located in the electronic throttle. See below for details of the electronic throttle.

If a TP sensor fails, the ECM:

- Adopts a limp home mode where engine speed is limited to a maximum of approximately 2000 rev/min
- Discontinues evaporative emissions control
- Discontinues closed loop control of engine idle speed.

With a failed TP sensor, the engine will suffer from poor running and throttle response.

HEATED OXYGEN SENSORS



E119261

The heated oxygen sensors allow the ECM to measure the oxygen content of the exhaust gases, for closed loop control of the fuel:air mixture and for catalytic converter monitoring.

An upstream heated oxygen sensor is installed in the outlet of each exhaust manifold, which enables independent control of the fuel:air mixture for each cylinder bank. A downstream heated oxygen sensor is installed in each catalytic converter, which enables the performance of the catalytic converters to be optimized and monitored.

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 (pulse width modulation) signal from the ECM. The heater elements are operated after each engine start, once it has been calculated that there is no moisture in the exhaust (between 0 and 2 minutes delay), and also during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperature. The PWM duty cycle is carefully controlled to prevent thermal shock to cold sensors. A non-functioning heater delays the sensor's readiness for closed loop control and increases emissions.

The upstream heated oxygen sensors produce a constant voltage, with a variable current that is proportional to the lambda ratio. The downstream heated oxygen sensors produce an output voltage dependant on the ratio of the exhaust gas oxygen to the ambient oxygen.

The heated oxygen 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.

If a heated oxygen sensor fails:

- The ECM defaults to open loop fueling for the related cylinder bank
- The CO (carbon monoxide) and emissions content of the exhaust gases may increase
- The exhaust may smell of rotten eggs (hydrogen sulphide).

With a failed heated oxygen sensor, the engine will suffer from reduced refinement and performance.

ACCELERATOR PEDAL POSITION SENSOR



E118973

The APP sensor allows the ECM to determine the driver requests for vehicle speed, acceleration and deceleration. The ECM uses this information, together with information from the ABS (anti-lock brake system) module and the TCM (transmission control module), to determine the setting of the electronic throttle.

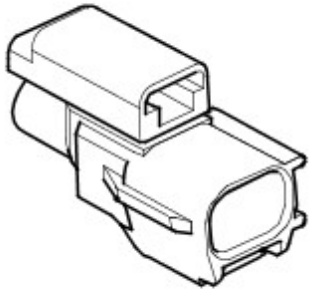
Three screws attach the APP sensor and integrated accelerator pedal to a bracket on the lower dash panel. A six pin electrical connector provides the interface with the vehicle harness.

The APP sensor is a twin track potentiometer. Each track receives an independent power supply from the ECM and returns an independent analog signal to the ECM. Both signals contain the same positional information, but the signal from track 2 is half the voltage of the signal from track 1 at all positions.

If both signals have a fault, the ECM adopts a limp home mode, which limits the engine speed to 2000 rev/min maximum.

The ECM constantly checks the range and plausibility of the two signals and stores a fault code if it detects a fault.

AMBIENT AIR TEMPERATURE SENSOR



E43580

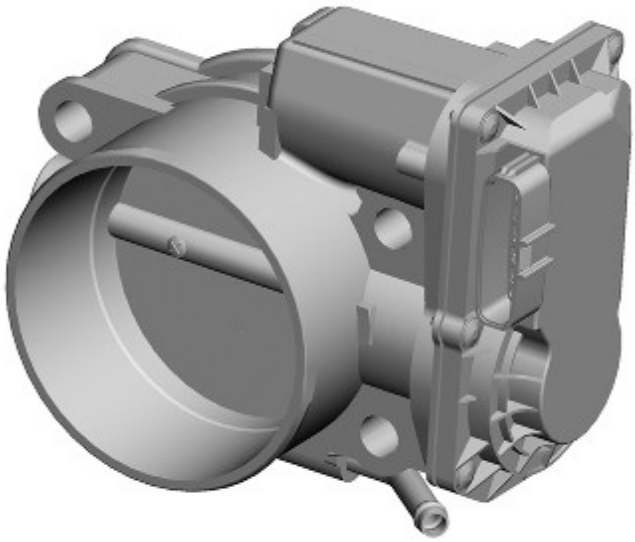
The AAT (ambient air temperature) sensor is a NTC thermistor that allows the ECM to monitor the temperature of the air around the vehicle. The ECM uses the AAT input for a number of functions, including engine cooling fan control. The ECM also transmits the ambient temperature on the high speed CAN (controller area network) bus for use by other control modules.

The AAT sensor is installed on a bracket in the front bumper ducting, on the vehicle centerline.

The ECM supplies the sensor with a 5 V reference voltage and a ground, and translates the return signal voltage into a temperature.

If there is a fault with the AAT sensor, the ECM calculates the AAT from the temperature inputs of the MAFT sensors. If the AAT sensor and the temperature inputs of the MAFT sensors are all faulty, the ECM adopts a default ambient temperature of 25 °C (77 °F).

ELECTRONIC THROTTLE



E116090

The ECM uses the electronic throttle to help regulate engine torque.

The electronic throttle is installed between the T piece duct, of the intake air distribution and filtering system, and the inlet of the SC.
For additional information, refer to: Intake Air Distribution and Filtering (303-12D, Description and Operation).

The throttle plate is operated by an electric DC (direct current) motor integrated into the throttle body. The ECM uses a PWM signal to control the DC motor. The ECM compares the APP sensor inputs against an electronic request or value to determine the required position of the throttle plate. The ECM and electronic throttle are also required to:

- Monitor requests for cruise control operation
- Automatically operate the electronic throttle for accurate cruise control
- Perform all dynamic stability control engine interventions
- Monitor and carry out maximum engine speed and road speed cut outs
- Provide different engine maps for the ride and handling optimization system.

A software strategy within the ECM calibrates the position of the throttle plate at the beginning of each ignition cycle. When the ignition is turned on, the ECM performs a self test and calibration routine by fully closing the throttle plate and then opening it again. This tests the default position springs and allows the ECM to learn the fully closed position.

ECM RELAY

The ECM relay is used to initiate the power up and power down routines within the ECM. The ECM relay is installed in the EJB.

When the ignition is turned on, battery voltage is applied to the ignition sense input. The ECM then starts its power up routines and energizes the ECM relay.

When the ignition is turned off, the ECM maintains its powered up state while it conducts the power down routines. This can be for:

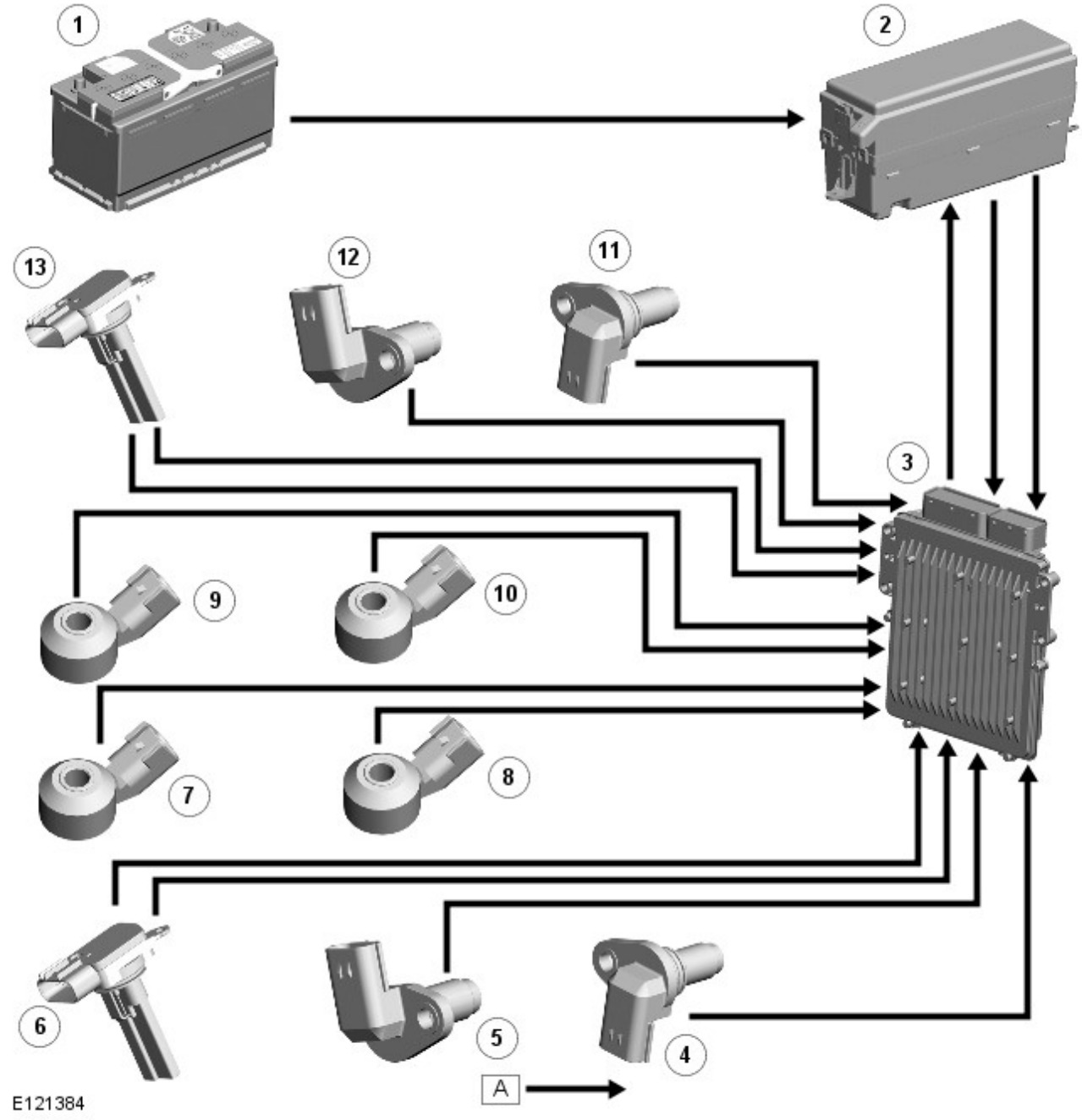
- Up to 20 minutes in extreme cases, when the DMTL system is running (NAS markets) or the TCM is 'kept awake' because of a 'not in park' condition
- Up to 5 minutes when cooling fans are required.

On completion of the power down routines the ECM de-energizes the ECM relay.

CONTROL DIAGRAM

Sheet 1 of 2

NOTE: A = Hardwired.

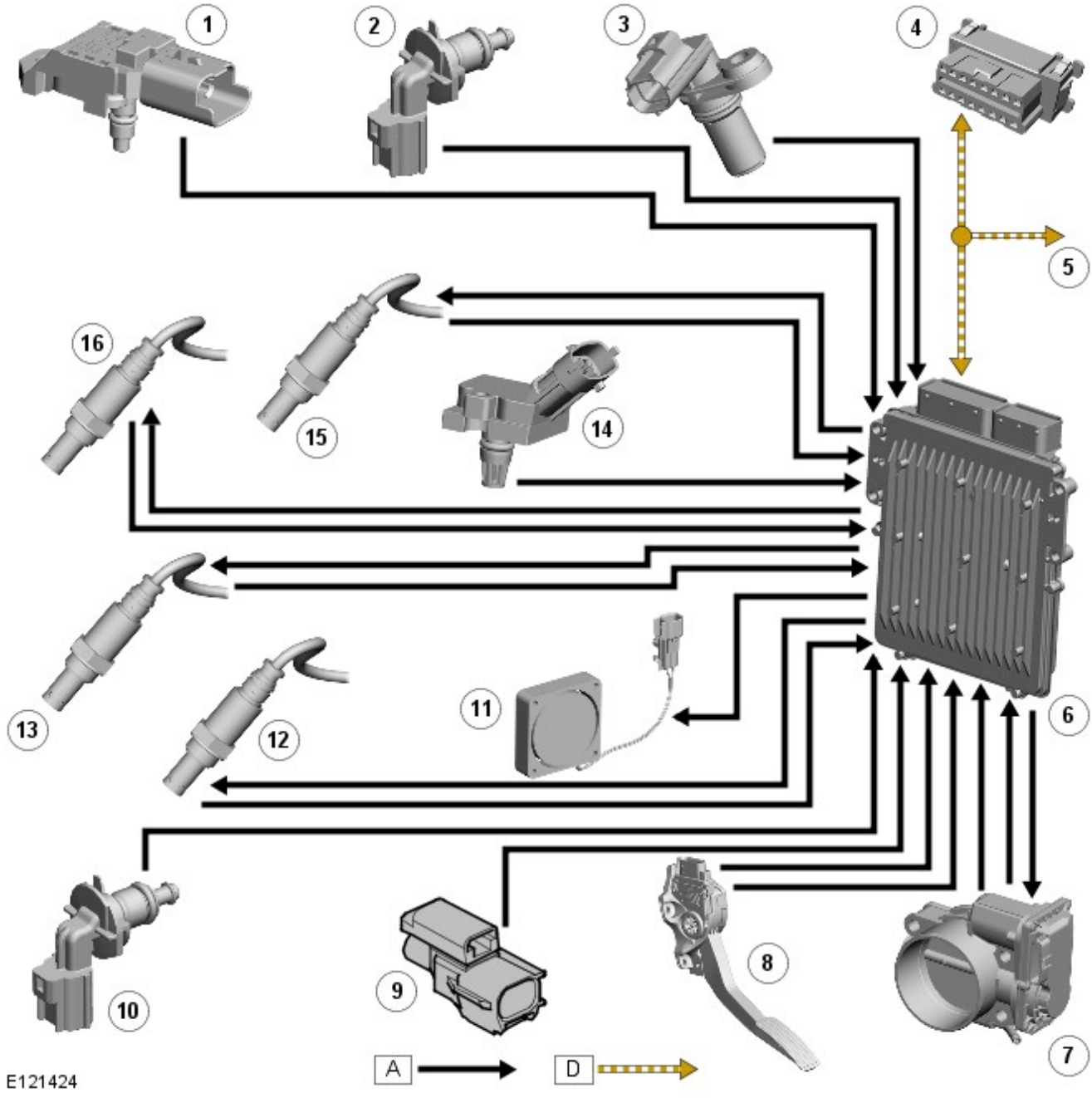


Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	ECM
4	-	LH (left hand) intake CMP sensor
5	-	LH exhaust CMP sensor
6	-	LH MAFT sensor

7	-	LH front knock sensor
8	-	LH rear knock sensor
9	-	RH (right hand) front knock sensor
10	-	RH rear knock sensor
11	-	RH intake CMP sensor
12	-	RH exhaust CMP sensor
13	-	RH MAFT sensor

Sheet 2 of 2

NOTE: A = Hardwired; D = High speed CAN bus.



Item	Part Number	Description
1	-	MAP sensor
2	-	ECT sensor (ECT 2)
3	-	CKP sensor
4	-	Diagnostic socket
5	-	To other system control modules
6	-	ECM
7	-	Electronic throttle
8	-	APP sensor
9	-	AAT sensor
10	-	ECT sensor (ECT 1)

11	-	ECM cooling fan
12	-	LH downstream HO2S
13	-	LH upstream HO2S
14	-	MAPT sensor
15	-	RH downstream HO2S
16	-	RH upstream HO2S

OPERATION

ECM Adaptions

The ECM has the ability to adapt the input values it uses to control certain outputs. This capability maintains engine refinement and ensures the engine emissions remain within the legislated limits. The components which have adaptions associated with them are:

- The APP sensor
- The heated oxygen sensors
- The MAFT sensors
- The CKP sensor
- Electronic throttle.
- Knock sensors.

Oxygen and MAFT Sensors

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 heated 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 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 drive plates 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 drive plate adaption if the ECM is renewed or replaced. The ECM supports four drive plate adaptions for the CKP sensor. Each adaption relates to a specific engine speed range. The engine speed ranges are detailed in the table below:

Adaption	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 an amount of misfire that could lead to the legislated emissions limit being exceeded by a given amount. The second level is a misfire rate that causes degradation in catalytic converter efficiency.

The ECM monitors the number of misfire occurrences within two engine revolution ranges. If the ECM determines a misfire failure within either of these two ranges, over two consecutive journeys, it will record a fault code and details of the engine speed, engine load and engine coolant temperature. In addition, if the second level of misfire occurs, on any trip, the ECM flashes the MIL while the fault is occurring.

The signal from the CKP sensor indicates how fast the poles on the drive plate are passing the sensor tip. A sine wave is generated each time a pole passes the sensor tip. The ECM can detect variations in drive plate 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. TheECM will evaluate the signal against a number of factors and will decide whether to record the occurrence or ignore it. The ECM can assign a misfire judgement to an individual cylinder, which can be viewed on Land Rover approved diagnostic equipment.

Diagnostics

The ECM stores each fault as a DTC (diagnostic trouble code). The DTC and associated environmental and freeze frame data can be read using Land Rover approved diagnostic equipment, which can also read real time data from each sensor, the adaption values currently being employed and the current fueling, ignition and idle speed settings.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Electronic Engine Controls

Diagnosis and Testing

For additional information.
REFER to: Electronic Engine Controls (303-14C, Diagnosis and Testing).

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Powertrain Control Module (PCM) Long Drive Cycle Self-Test

General Procedures

WARNING: Where possible, all road tests should be on well surfaced and dry roads. Always comply with speed limits and local traffic regulations.

NOTES:

This procedure is an overcheck only. If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

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.

   Make sure the engine temperature is above 60 ºC (140 ºF).

   Carry out a road test and perform the following operations.
   1. Accelerate to 55 mph (88 km/h) in 5th gear and cruise for 2 minutes with the engine speed at or above 1800rpm.
   2. Lift off the throttle and allow the vehicle to decelerate until the engine speed is less than 1000 rpm.
   3. Stop the vehicle.
   4. Release brake, allow the vehicle to move with no throttle for 1 minute.
   5. 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.

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Electronic Engine Controls - V8 S/C 5.0L Petrol - Powertrain Control Module (PCM) Short Drive Cycle Self-Test

General Procedures

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 70ºC (158 ºF) 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.

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Electronic Engine Controls - V8 S/C 5.0L Petrol - Camshaft Position (CMP) Sensor LH

Removal and Installation

Removal

1. Disconnect the battery ground cable.

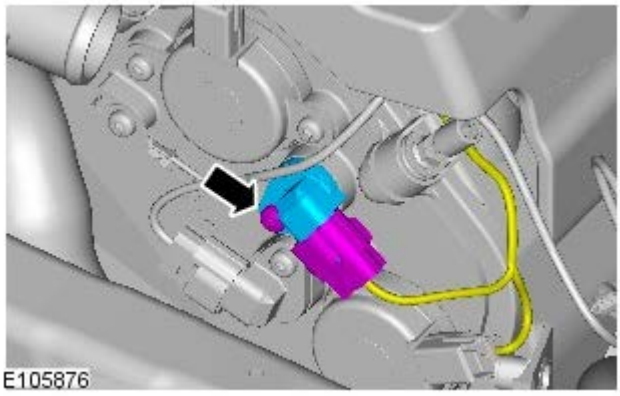
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Thermostat Housing - Vehicles With: Supercharger (303-03, Removal and Installation).

4. *Torque:* 10 Nm



Installation

1. CAUTIONS:

   Make sure that the mating faces are clean and free of foreign material.

   Make sure that the sensor tip is clean and free of foreign material.

   NOTE: Lubricate the O-ring seals with clean engine oil.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Camshaft Position (CMP) Sensor RH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

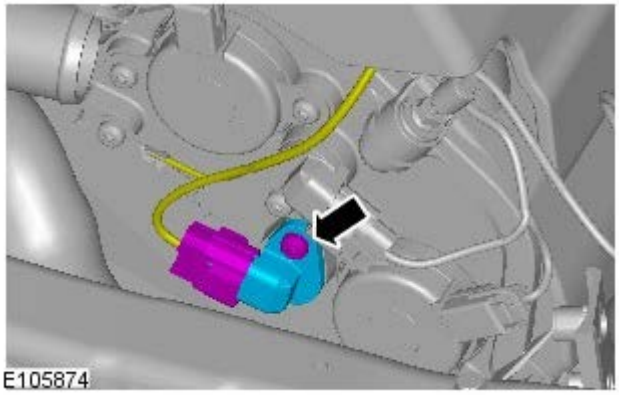
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Thermostat Housing - 5.0L SC V8 - AJ133 (303-03 Engine Cooling - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133, Removal and Installation).



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

   Torque: 10 Nm

Installation

1. CAUTIONS:

   Make sure that the mating faces are clean and free of foreign material.

   Make sure that the sensor tip is clean and free of foreign material.

   NOTE: Lubricate the O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

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Electronic Engine Controls - V8 S/C 5.0L Petrol - Catalyst Monitor Sensor LH

Removal and Installation

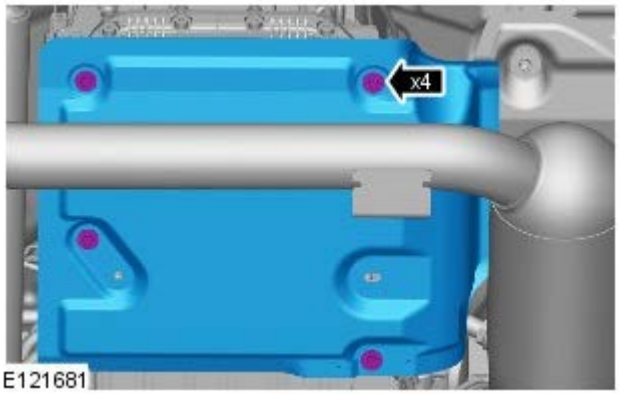
Removal

NOTE: Removal steps in this procedure may contain installation details.

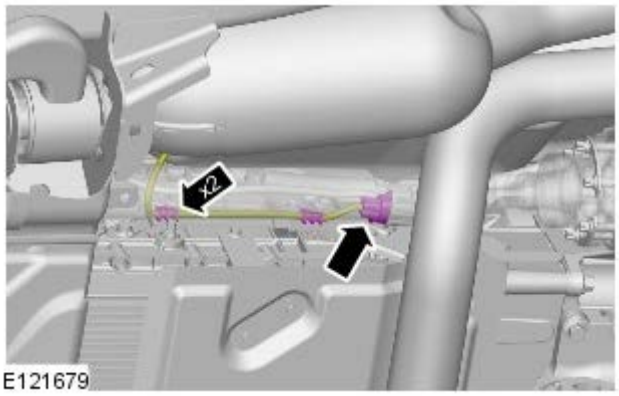
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. *Torque:* 10 Nm

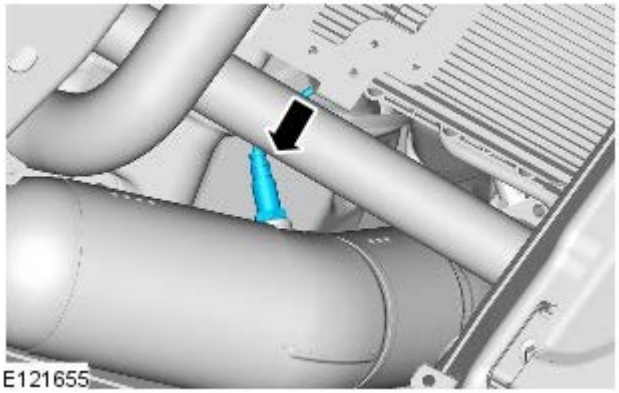


3.



4. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Torque: 48 Nm



Installation

1. CAUTIONS:

   If accidentally dropped or knocked install a new sensor.

 Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

NOTES:

 If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

 Make sure the anti-seize compound does not contact the HO2S tip.

To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Catalyst Monitor Sensor RH

Removal and Installation

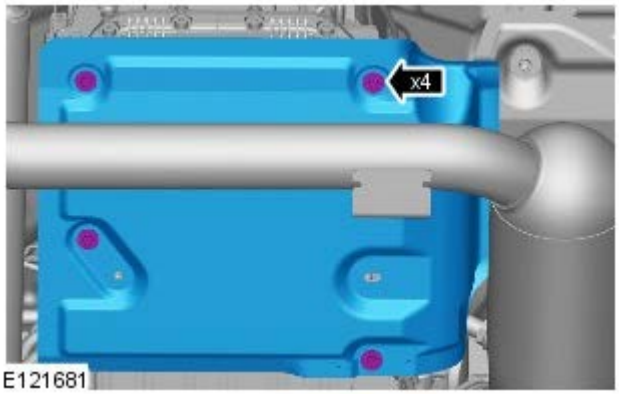
Removal

NOTE: Removal steps in this procedure may contain installation details.

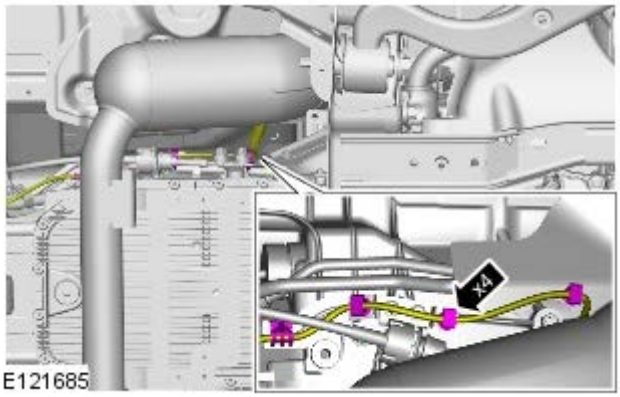
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

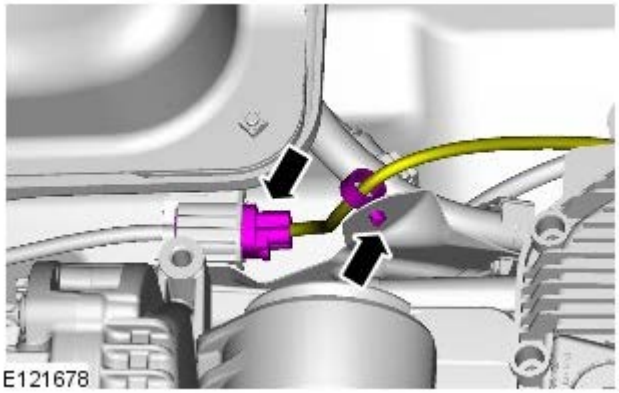
2. *Torque:* 10 Nm



3.

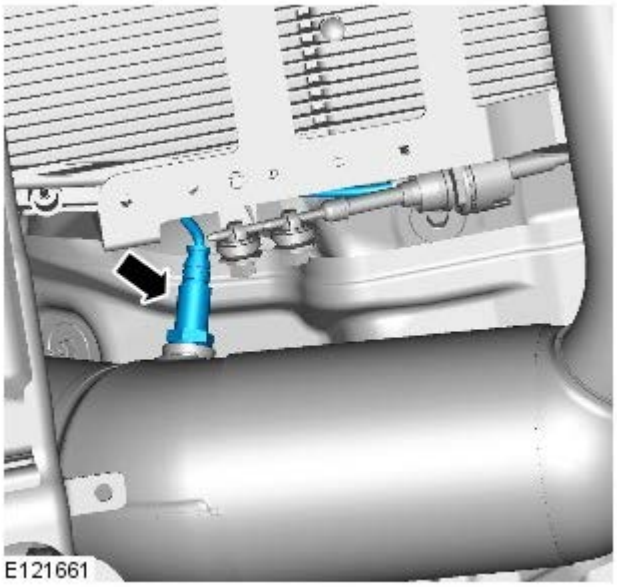


4.



5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Torque: 48 Nm



Installation

1. CAUTIONS:

   Make sure the anti-seize compound does not contact the HO2S tip.

   If accidentally dropped or knocked install a new sensor.

   Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Crankshaft Position (CKP) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

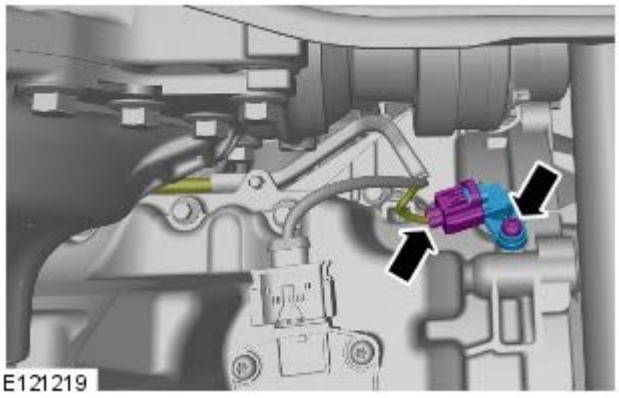
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).



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

   Torque: 10 Nm

Installation

1. CAUTIONS:

   Make sure that the mating faces are clean and free of foreign material.

   Make sure that the component is clean, free of foreign material and lubricant.

   To install, reverse the removal procedure.

2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

Published: 20-Sep-2013

Electronic Engine Controls - V8 S/C 5.0L Petrol - Engine Control Module (ECM)

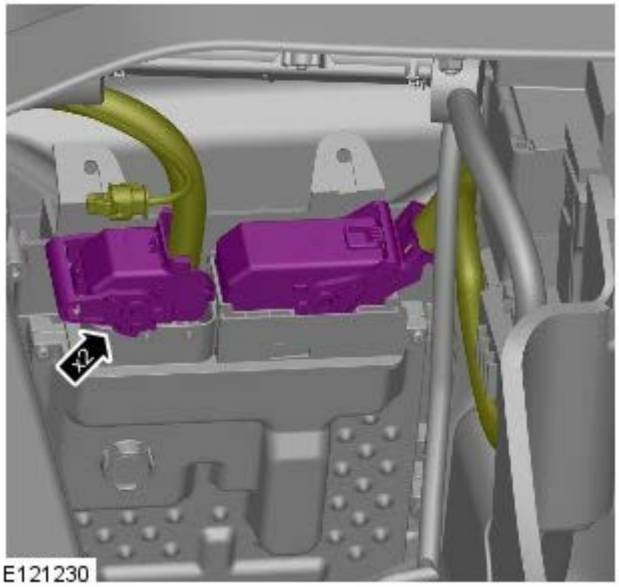
Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

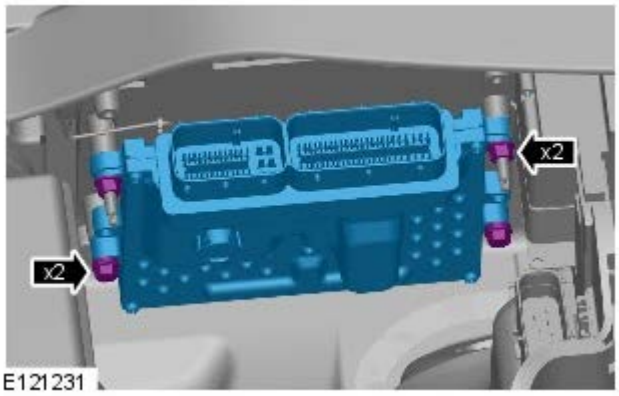
1. Remove the battery.

   Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).



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

3. *Torque:* 7 Nm



Installation

1. To install, reverse the removal procedure.

Published: 25-Nov-2013

Electronic Engine Controls - V8 S/C 5.0L Petrol - Engine Coolant Temperature (ECT) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

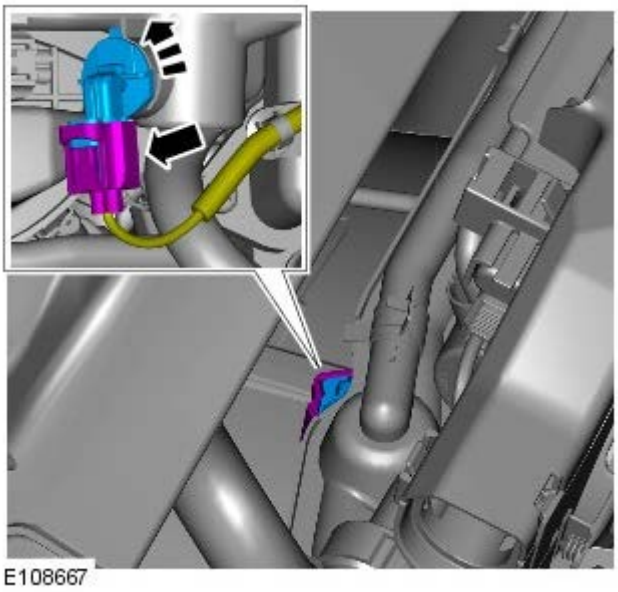
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

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



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Engine Oil Level Sensor

Removal and Installation

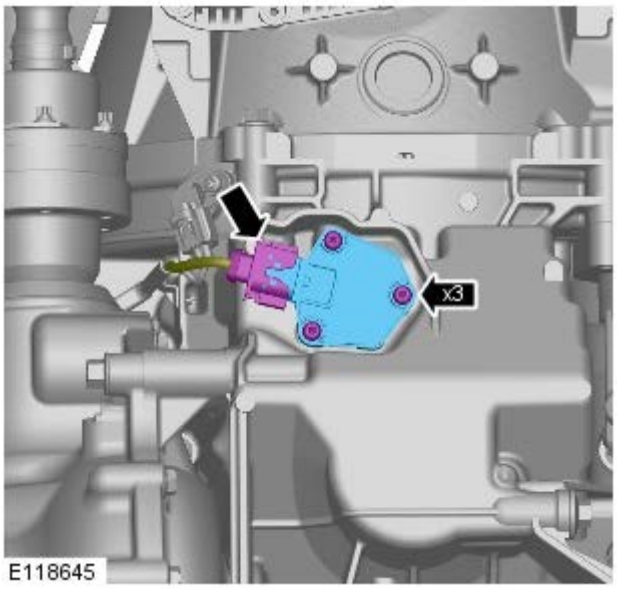
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Engine Oil Draining and Filling (303-01, General Procedures).



3. CAUTIONS:

   Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

   Remove and discard the O-ring seal.

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

   Torque: 12 Nm

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Front Knock Sensor (KS) LH

Removal and Installation

Removal

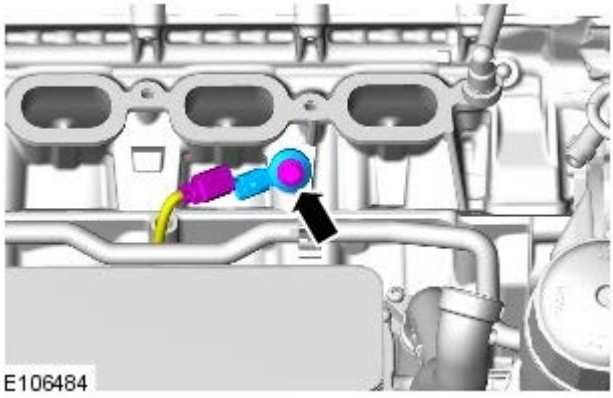
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Supercharger (303-12, Removal and Installation).

3. *Torque:* 20 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Front Knock Sensor (KS) RH

Removal and Installation

Removal

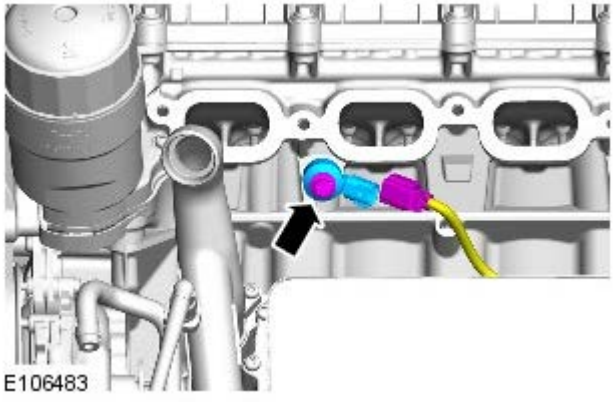
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Supercharger (303-12, Removal and Installation).

3. *Torque:* 20 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Fuel Rail Pressure (FRP) Sensor

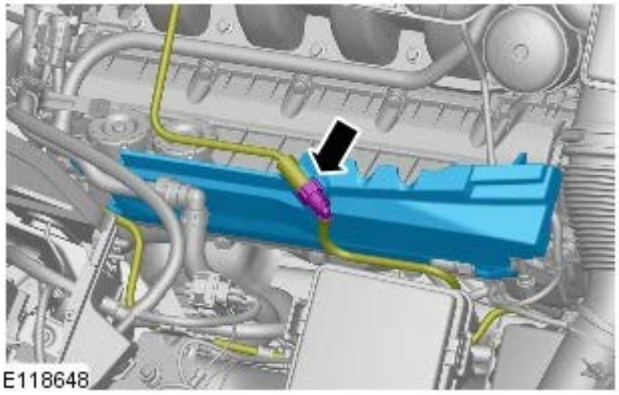
Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00, Description and Operation).
2. Refer to: Fuel System Pressure Release - 5.0L (310-00, General Procedures).
3. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).
4. Refer to: Fuel Injection Component Cleaning (303-04, General Procedures).
5. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).



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



7. CAUTIONS:

   Be prepared to collect escaping fluids.

   Make sure that all openings are sealed. Use new blanking caps.

   - *Torque:* 32 Nm

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Heated Oxygen Sensor (HO2S) LH

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

Removal

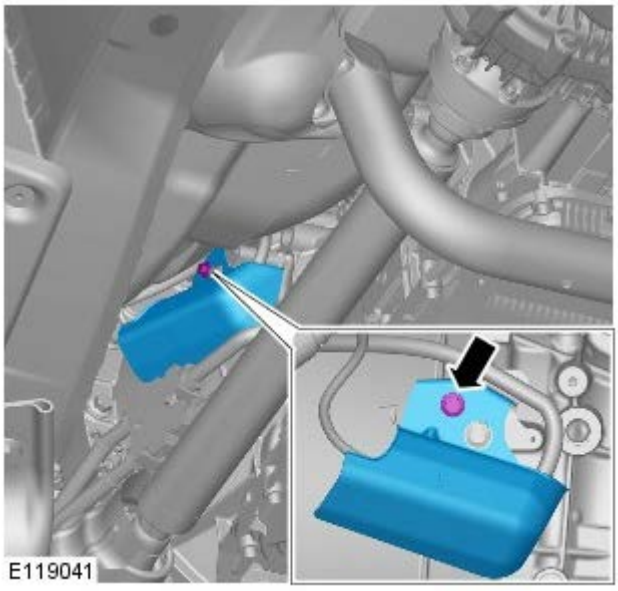
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

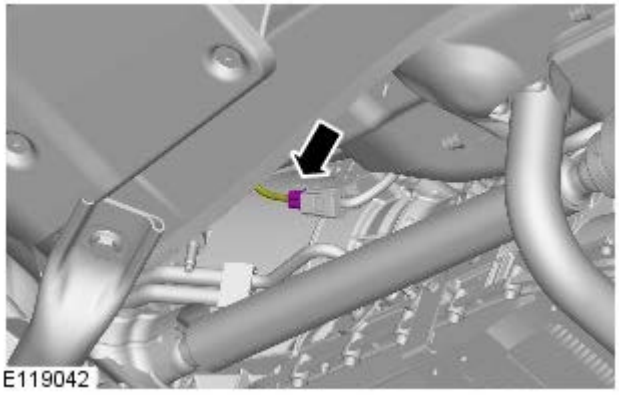
   Raise and support the vehicle.

2. Refer to: Exhaust System (309-00 Exhaust System - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133, Removal and Installation).

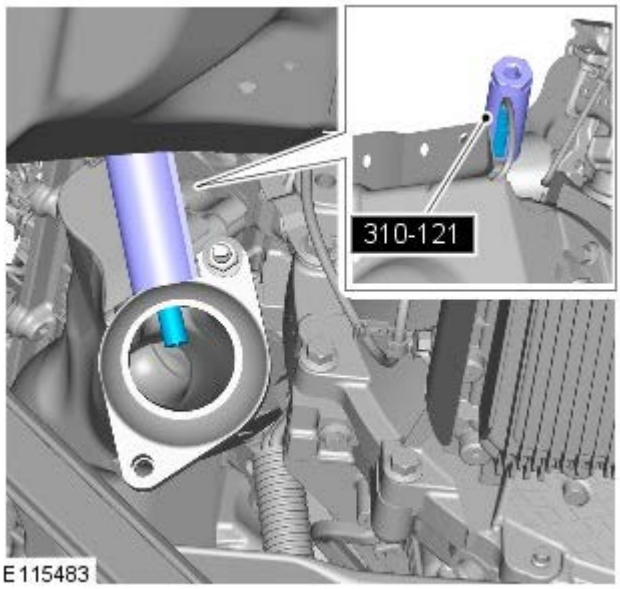
3. *Torque:* 11 Nm



4.



5. CAUTION: Make sure that the mating faces are clean and free of foreign material.



Special Tool(s): 310-121
Torque: 48 Nm

Installation

1. CAUTIONS:

   Make sure the anti-seize compound does not contact the HO2S tip.

   If accidentally dropped or knocked install a new sensor.

   Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

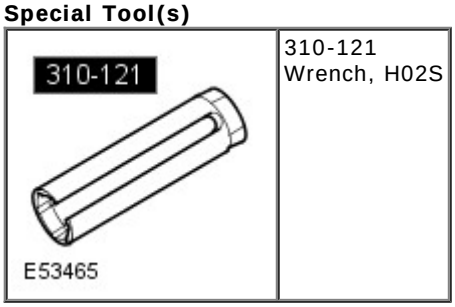
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Heated Oxygen Sensor (HO2S) RH

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

Removal

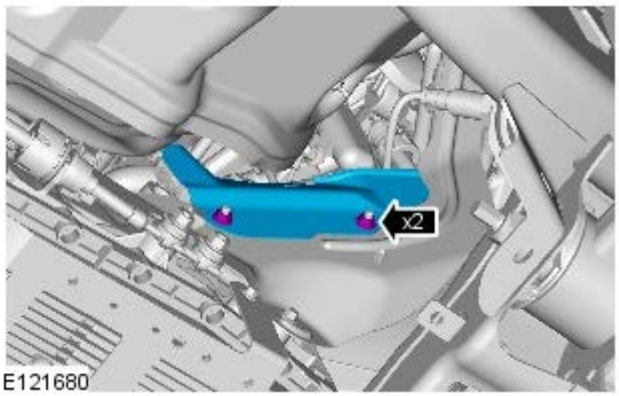
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

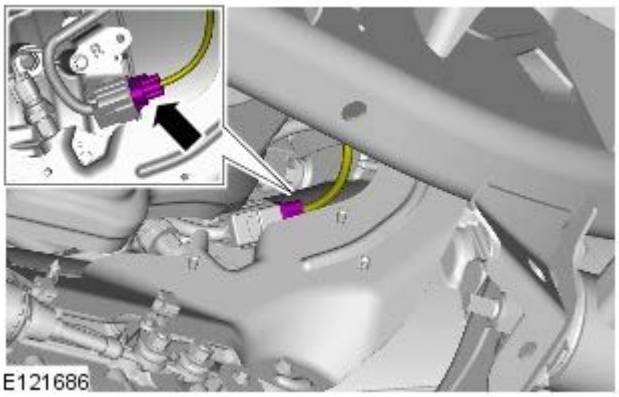
   Raise and support the vehicle.

2. Refer to: Exhaust System (309-00, Removal and Installation).

3. *Torque:* 9 Nm

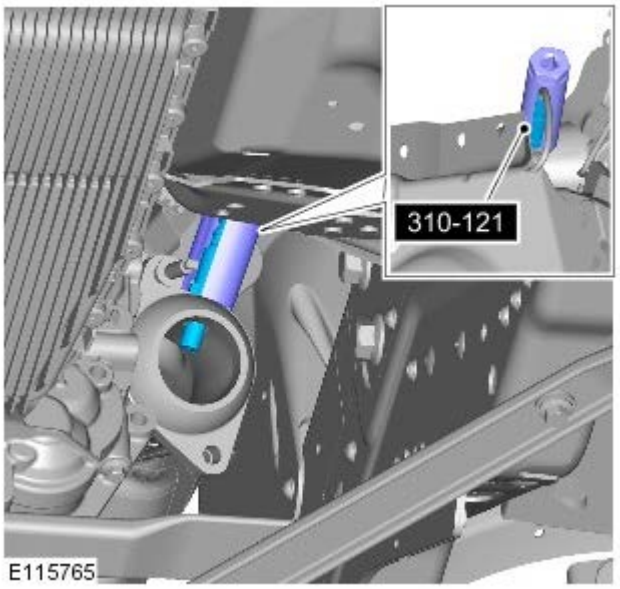


4.



5. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   Special Tool(s): 310-121
   Torque: 48 Nm



Installation

1. CAUTIONS:

   Make sure the anti-seize compound does not contact the HO2S tip.

   If accidentally dropped or knocked install a new sensor.

   Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

Published: 25-Nov-2013

Electronic Engine Controls - V8 S/C 5.0L Petrol - Manifold Absolute Pressure (MAP) Sensor

Removal and Installation

Removal

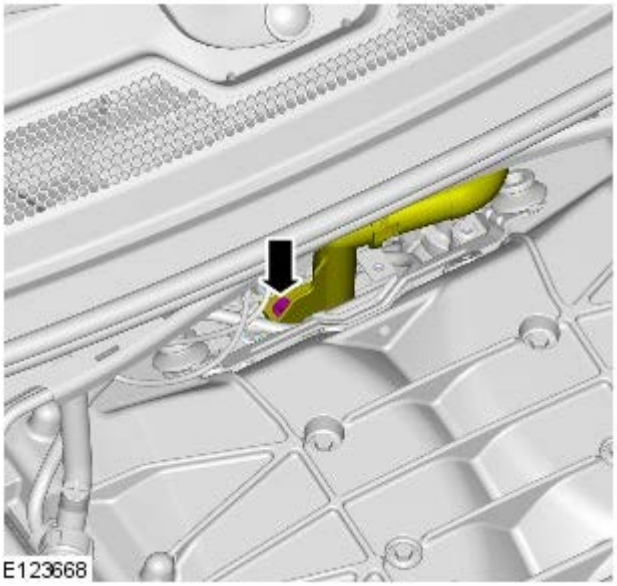
NOTE: Removal steps in this procedure may contain installation details.

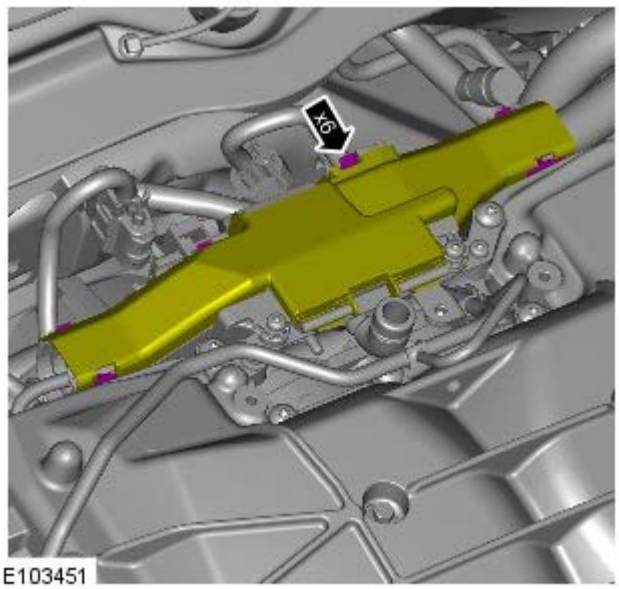
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Cooling System Partial Draining, Filling and Bleeding - V8 S/C 5.0L Petrol (303-03B Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, General Procedures).

3. *Torque:* 10 Nm

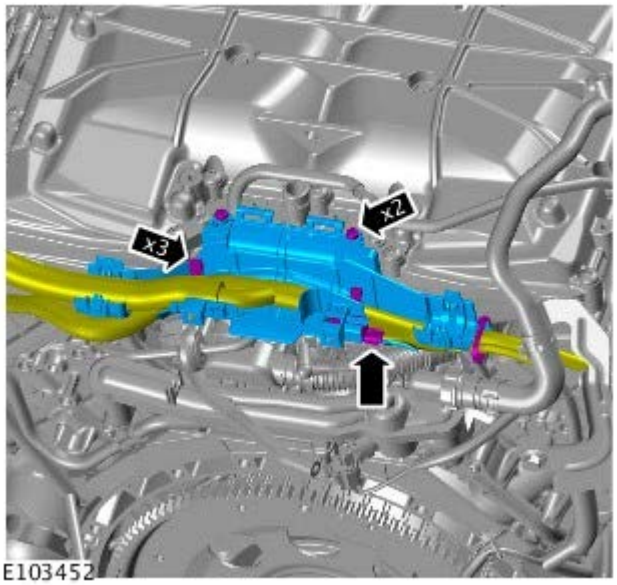


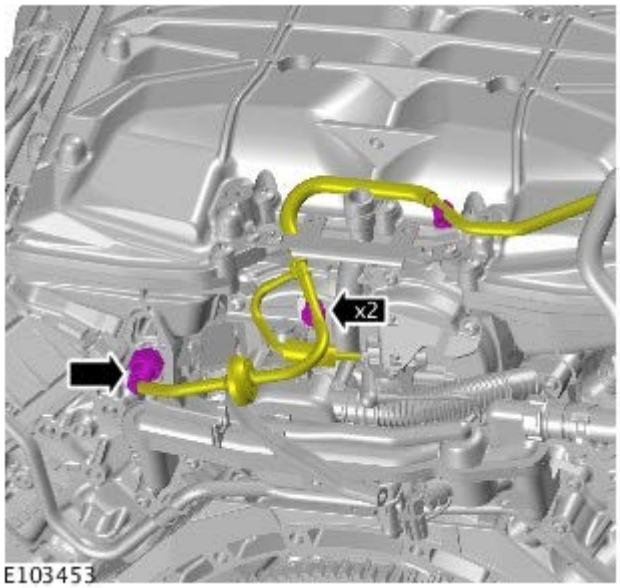


4. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

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

   - *Torque:* 10 Nm

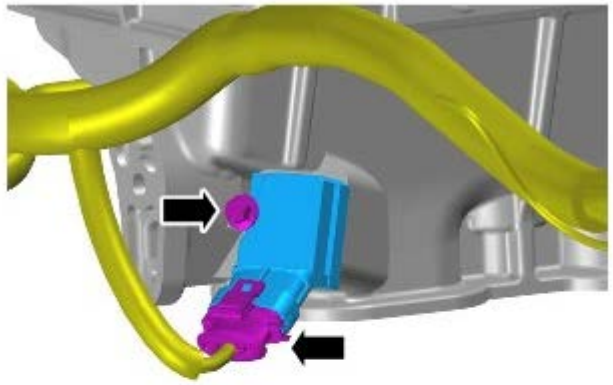


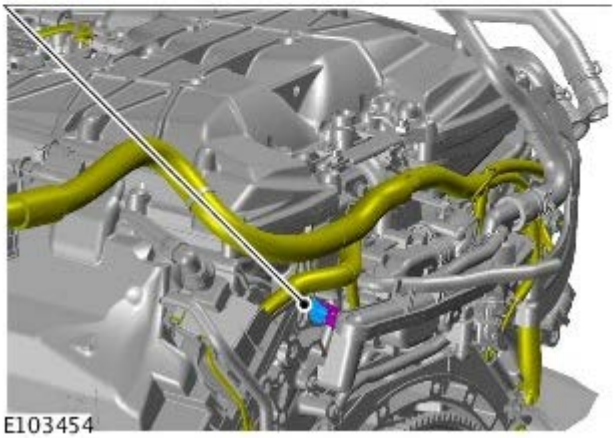


6. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

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

   - *Torque:* 5 Nm





Installation

1. To install, reverse the removal procedure.

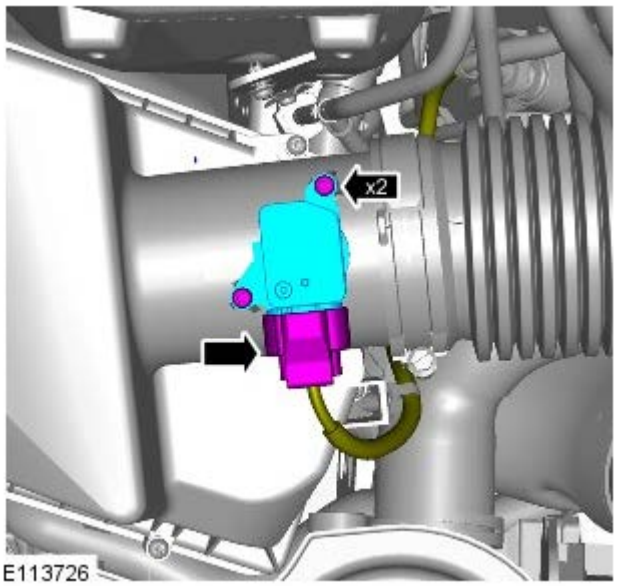
Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Mass Air Flow (MAF) Sensor

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.



1. NOTES:

   Right-hand shown, left-hand similar.

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

   Torque: 1.2 Nm

Installation

1. To install reverse the removal procedure.
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Rear Knock Sensor (KS) LH

Removal and Installation

Removal

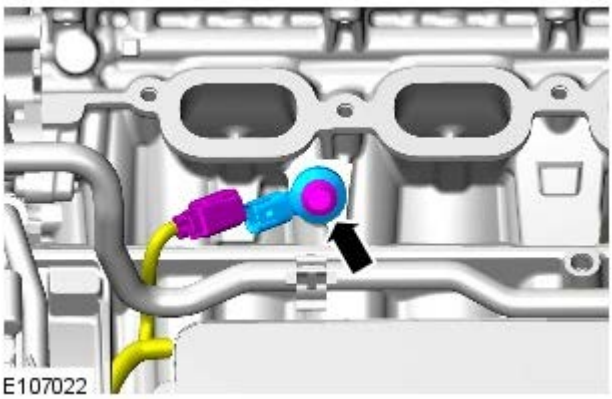
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Supercharger (303-12, Removal and Installation).

3. *Torque:* 20 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Rear Knock Sensor (KS) RH

Removal and Installation

Removal

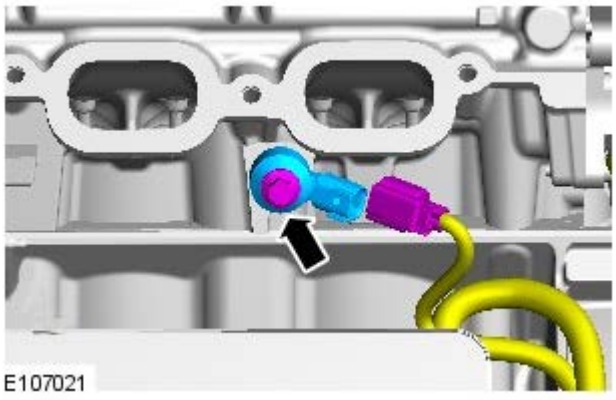
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Supercharger (303-12, Removal and Installation).

3. *Torque:* 20 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Variable Valve Timing (VVT) Oil Control Solenoid LH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

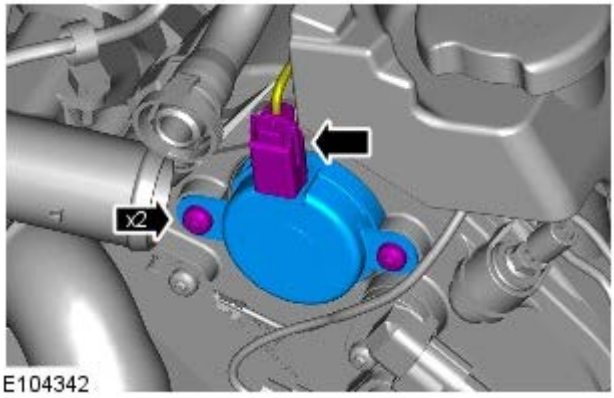
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

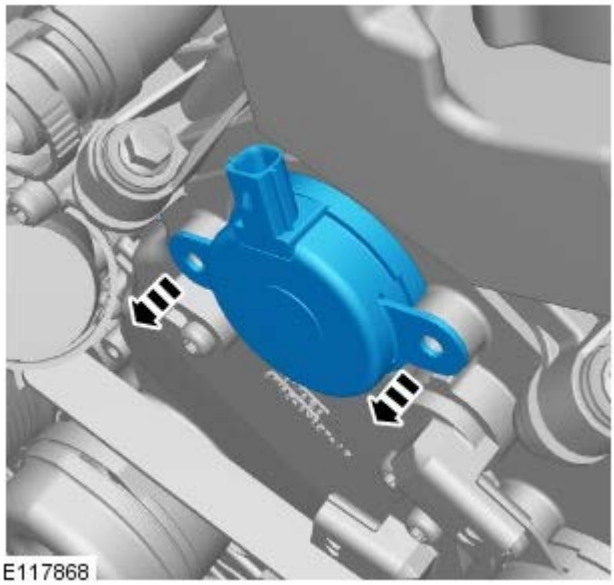
   Raise and support the vehicle.

3. Refer to: Thermostat Housing - Vehicles With: Supercharger (303-03, Removal and Installation).



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

   Torque: 10 Nm



5. CAUTION: Evenly and progressively, remove the VVT units from each side.

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

Installation

1. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   NOTE: Lubricate the O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

Published: 11-May-2011

Electronic Engine Controls - V8 S/C 5.0L Petrol - Variable Valve Timing (VVT) Oil Control Solenoid RH

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

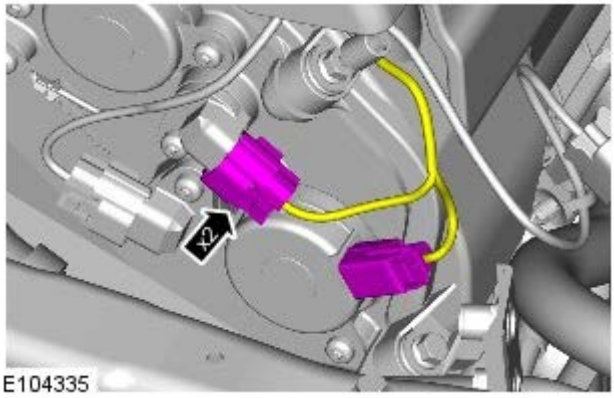
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

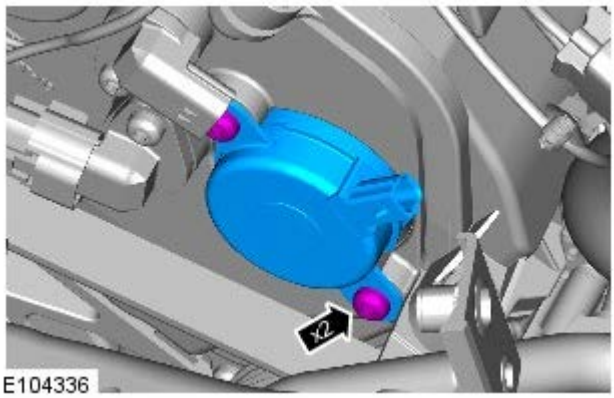
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Thermostat Housing - Vehicles With: Supercharger (303-03, Removal and Installation).



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

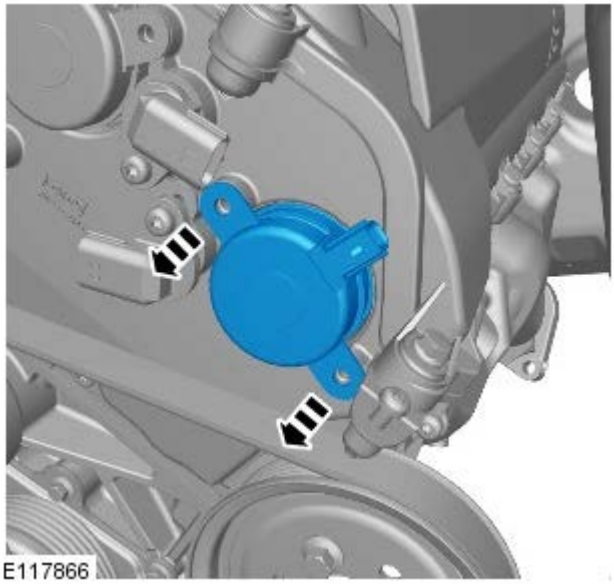


5. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

   Torque: 10 Nm

6. CAUTION: Evenly and progressively, remove the VVT units from each side.

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



Installation

1. CAUTION: Make sure that the mating faces are clean and free of foreign material.

   NOTE: Lubricate the O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

Published: 11-May-2011

Automatic Transmission / Transaxle - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission -

Maintenance

CAUTION: Use only Shell M1375.4 Automatic transmission fluid. Use of any other fluids may result in a transmission malfunction or failure.

Description	Intervals
Normal maintenance	Filled for life.
Severe duty maintenance	Change the fluid at 48,000 km (30,000 miles) intervals.

Capacities

	Liters
Transmission	9.9

Lubricants, Fluids, Sealers and Adhesives

Description	Specification
Transmission fluid	Shell M1375.4
Sealant	WSS-M4G323-A6
Metal surface cleaner	WSW-M5B392-A
High temperature grease	Molecote FB180

Torque Specifications

NOTE: A = refer to the procedure for correct torque sequence

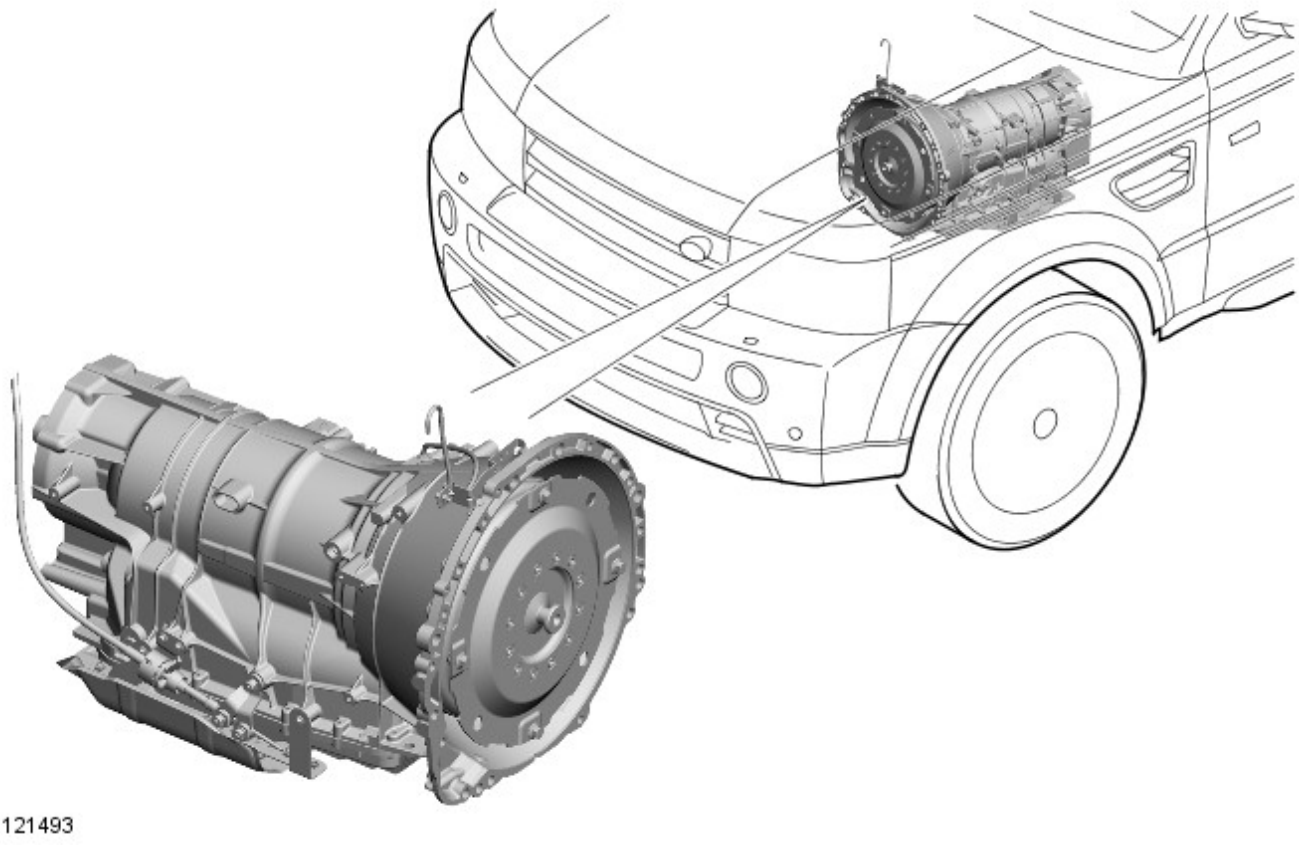
Description	Nm	lb-ft	lb-in
Transmission retaining bolts	48	35	-
Transmission mount retaining bolts	60	44	-
Transmission fluid fill plug	A	A	A
Transmission control module (TCM) and main control valve body retaining bolts	8	-	53
Torque converter retaining bolts	62	46	-
Transmission fluid cooler tube retaining bolt	22	16	-
Transmission fluid drain plug	8	-	53
Transmission fluid pan, gasket and filter retaining bolts	8	-	53

Published: 11-May-2011

Automatic Transmission / Transaxle - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission Description

Description and Operation

COMPONENT LOCATION



E121493

INTRODUCTION

The ZF 6HP28 transmission is an electronically controlled, hydraulically operated, six speed automatic unit. The hydraulic and electronic control elements of the transmission, including the TCM (transmission control module), are incorporated in a single unit located inside the transmission and is known as 'Mechatronic'.

5.0L SC (supercharger) and 3.0L diesel models use an uprated derivative of the ZF 6HP28 transmission used in the 5.0L naturally aspirated models.

The ZF 6HP28 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
- ASIS (adaptive shift strategy), to provide continuous adaptation of shift changes to suit the driving style of the driver, which can vary from sporting to economical
- Connected to the ECM (engine control module) via the high speed CAN (controller area network) bus for communications
- Default mode if major faults occur
- Diagnostics available from the TCM via the high speed CAN bus.

The transmission selections are made using the selector lever in the floor console and two paddle switches on the steering wheel.
For additional information, refer to: External Controls (307-05B, Description and Operation).

TRANSMISSION

The transmission comprises the main casing which houses all of the transmission components. The main casing also incorporates an integral bell housing.

A fluid pan is attached to the lower face of the main casing and is secured with bolts. The fluid pan is sealed to the main casing 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,

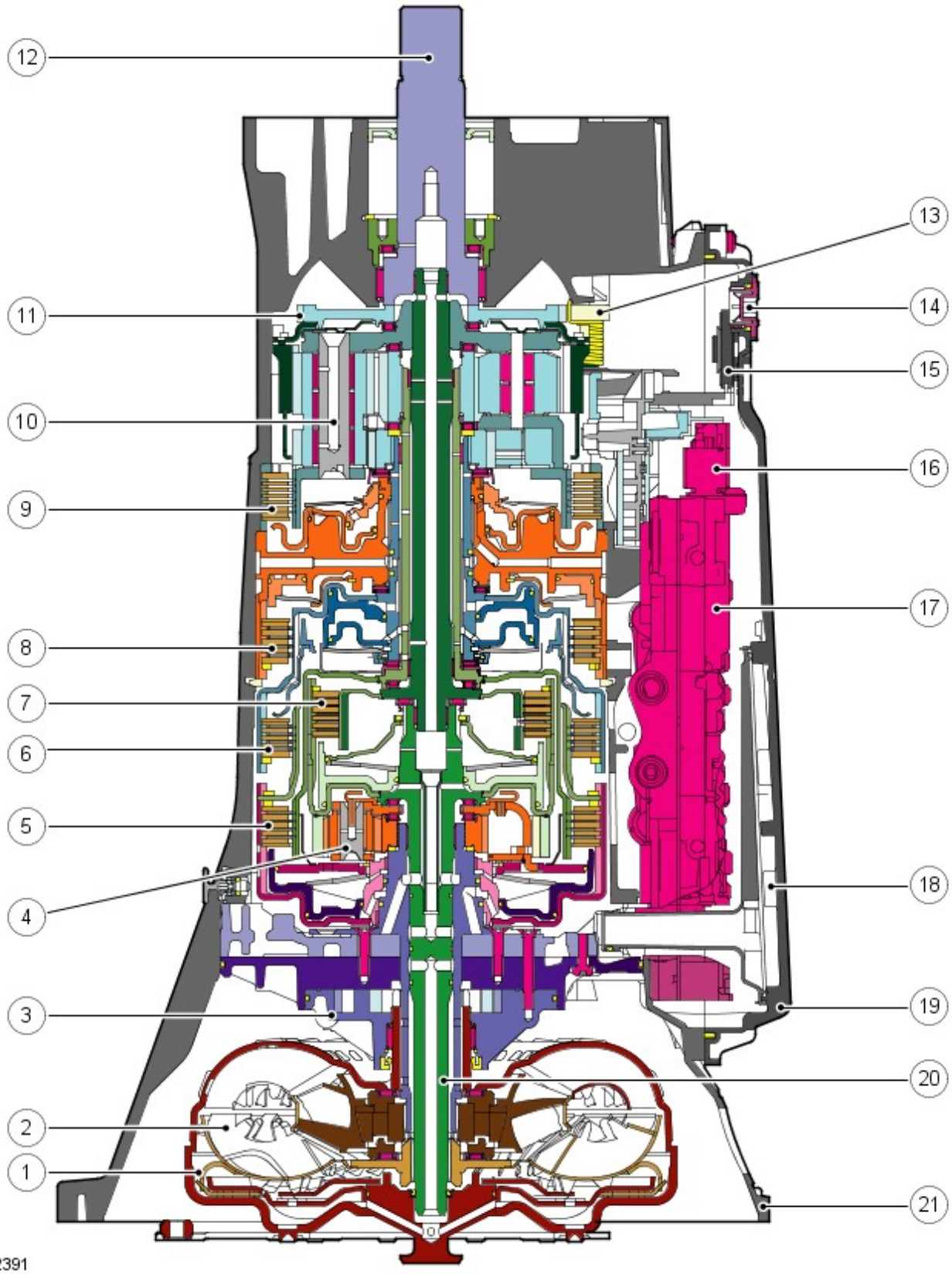
the fluid pan with integral filter must be replaced.

On the RH (right-hand) side of the transmission, a gear change lever is installed on the end of a selector shaft. The selector shaft operates a selector spool valve and a selector switch in the transmission. A selector cable, connected between the gear change lever and the selector lever in the floor console, controls the position of the selector shaft.

The integral bell housing provides protection for the torque converter assembly and also provides the attachment for the gearbox to the engine. 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 casing, behind the torque converter.

The main casing contains the following major components:

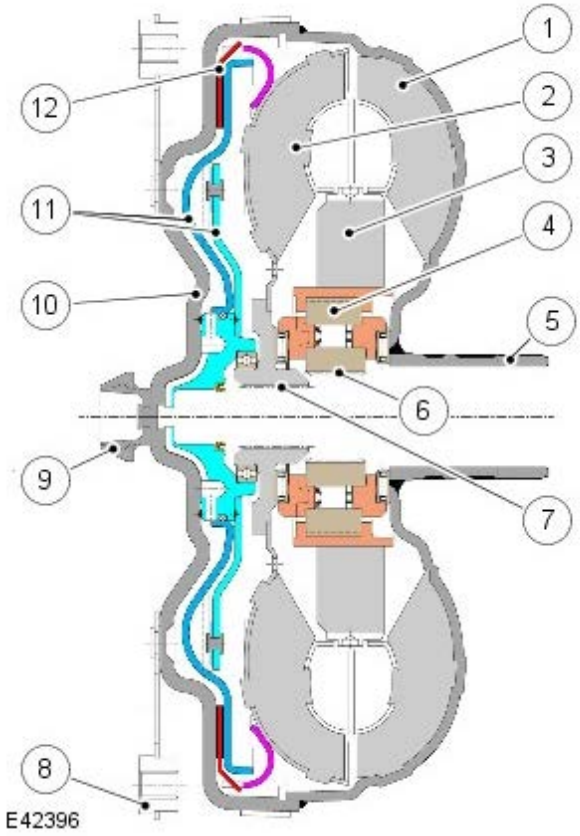
- Input shaft
- Output shaft
- Mechatronic valve block which contains the solenoids, speed sensors and the TCM
- Three rotating multiplate drive clutches
- Two fixed multiplate brake clutches
- A single planetary gear train and a double planetary gear train.



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	-	Transmission casing

TORQUE CONVERTER



Item	Part Number	Description
1	-	Impeller
2	-	Turbine
3	-	Stator
4	-	Freewheel clutch
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 attached to the rear of the crankshaft.

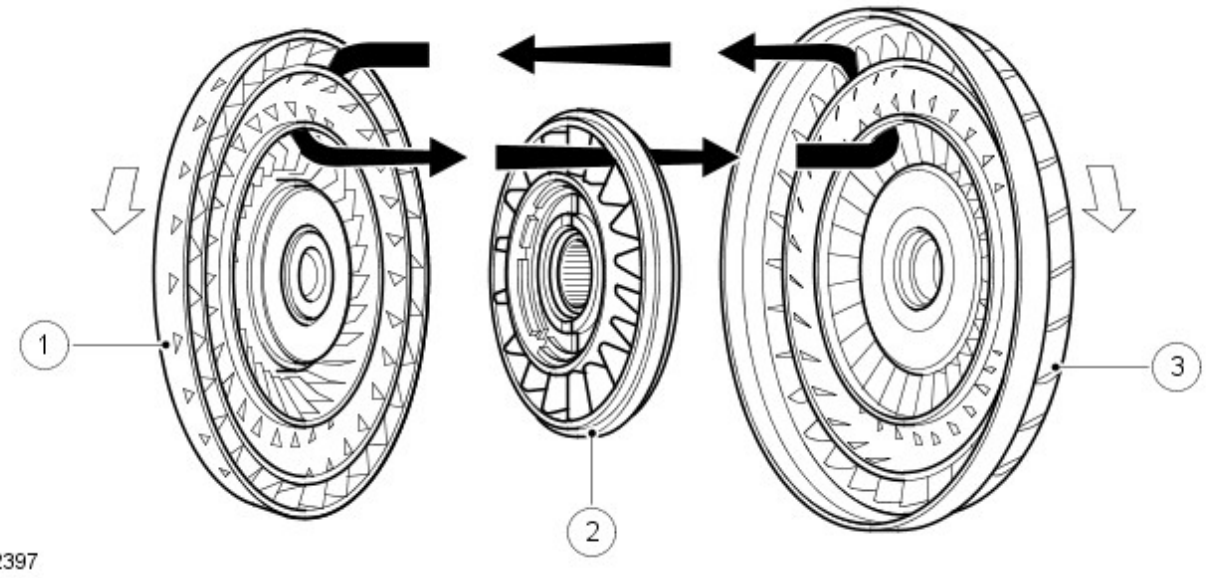
The torque converter comprises an impeller, a stator and a turbine. The torque converter is a sealed unit with all components located between the converter housing cover and the impeller. The two components are welded together to form a sealed, fluid filled housing. With the impeller welded to the converter housing cover, the impeller is therefore driven at engine crankshaft speed.

The converter housing cover has four threaded bosses, which provide for attachment of the engine drive plate. 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



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 center 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 a counter-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.

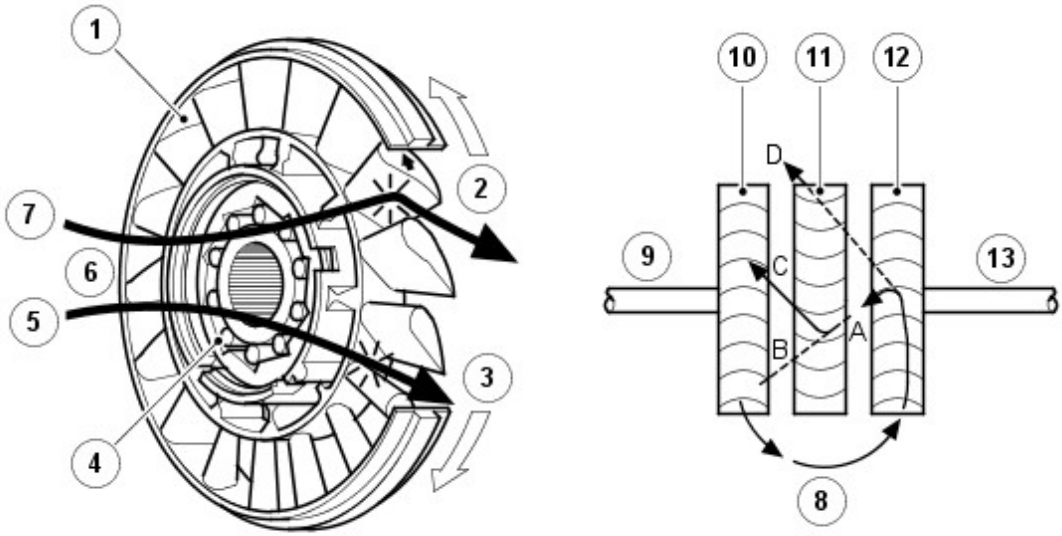
Stator

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: The following illustration shows a typical stator



E 42398

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

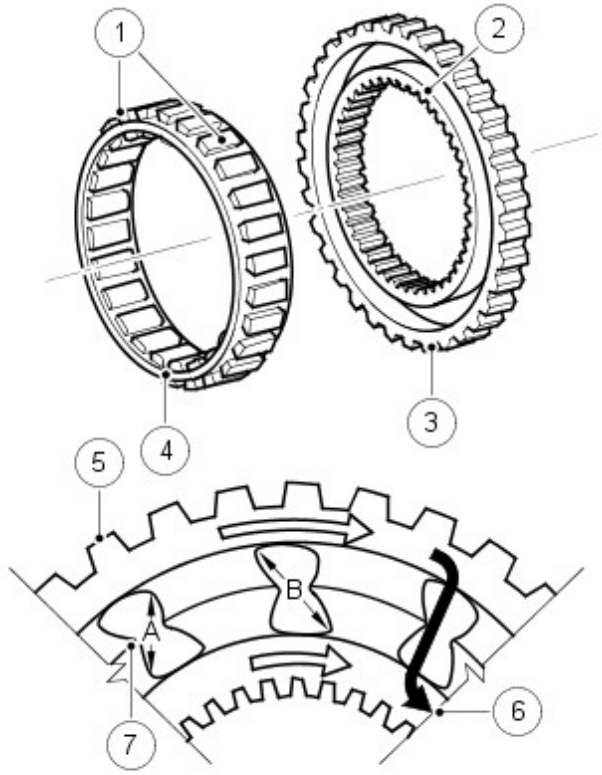
Fluid emitted from the impeller acts on the turbine. If the turbine is rotating at a slower speed than the fluid from the impeller, the fluid will be deflected by the turbine blades in the path **'A'**. The fluid is directed at and deflected by the stator blades from path **'B'** to path **'C'**. This 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 ZF 6HP28 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.

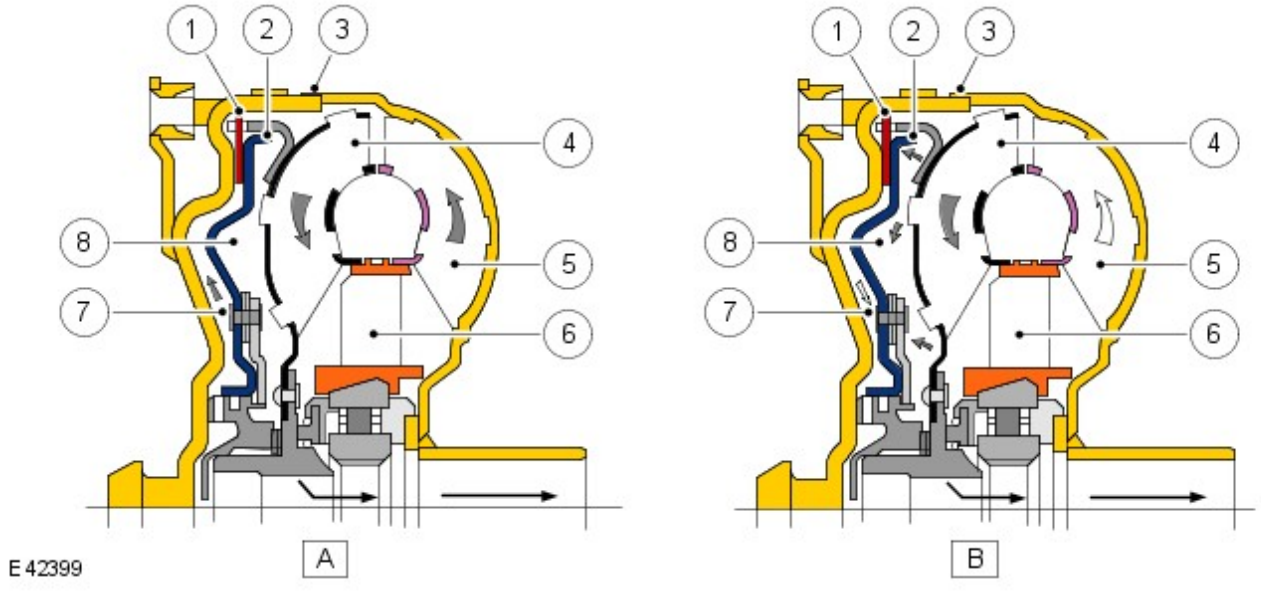
On the illustration shown, when the outer race is rotated in a clockwise direction, the sprags twist and are 'wedged' between the inner and outer races. The sprags then transfer the rotation of the outer race to the inner race, which rotates at the same speed.

Lock-Up Clutch Mechanism

The TCC (torque converter clutch) is hydraulically controlled by an EPRS (electronic pressure regulating solenoid), which is controlled by the TCM. This allows the torque converter to have three 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 (pulse width modulation) 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.

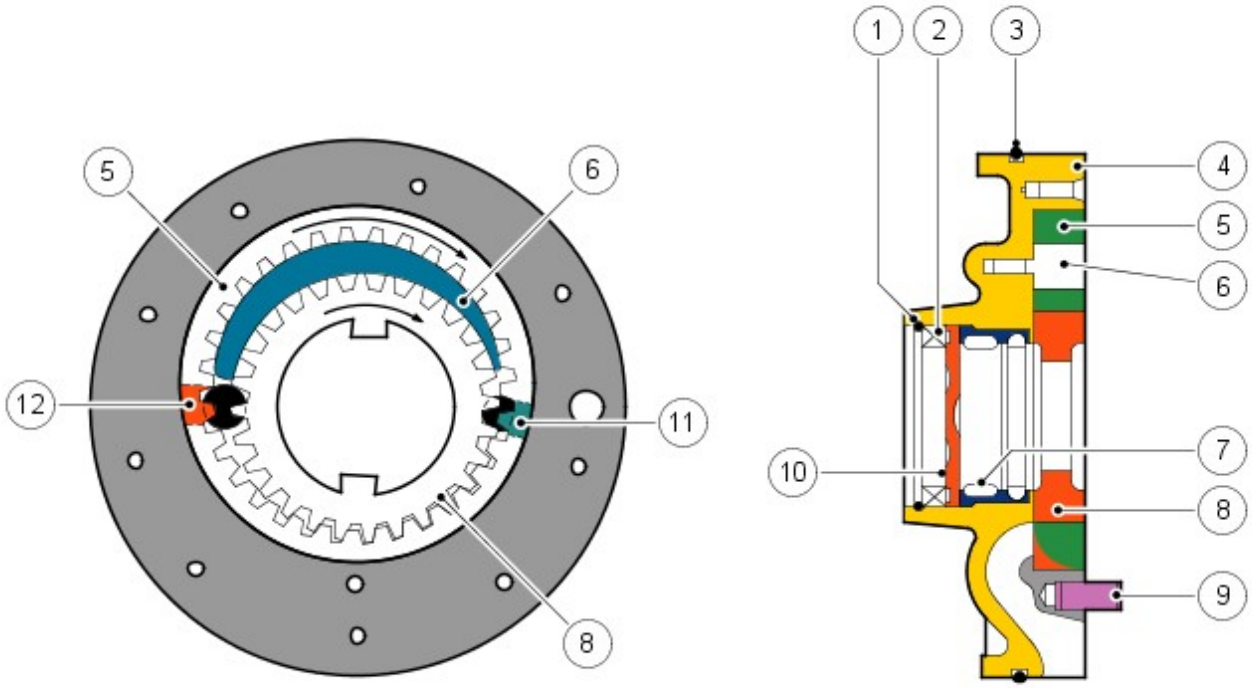
In the unlocked condition, the oil pressure supplied to the piston chamber and the turbine chamber is equal. Pressurized fluid flows through a drilling in the turbine shaft and through the piston chamber to the turbine chamber. In this condition the clutch plate is held away from the torque converter body and torque converter slip is permitted.

In the locked condition, the TCC spool valves are actuated by the EPRS. 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 ZF 6HP28 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 cm^3 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	-	Centering 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 centering 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.

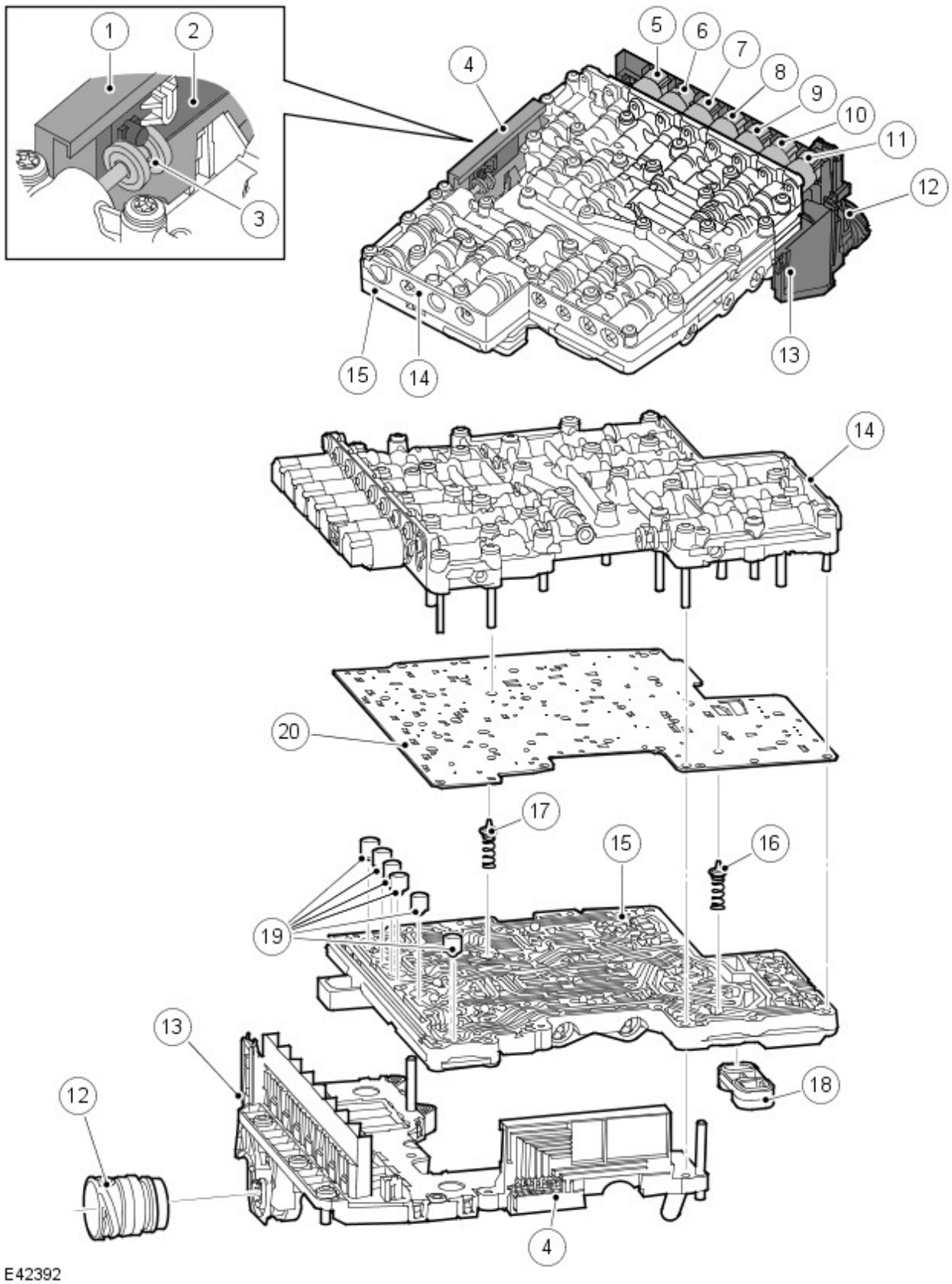
MECHATRONIC VALVE BLOCK

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
- Six pressure regulator solenoids
- One shift control solenoid

- One damper
- Twenty one hydraulic spool valves
- Manually operated selector valve
- Temperature sensor
- Turbine speed sensor
- Output shaft speed sensor.

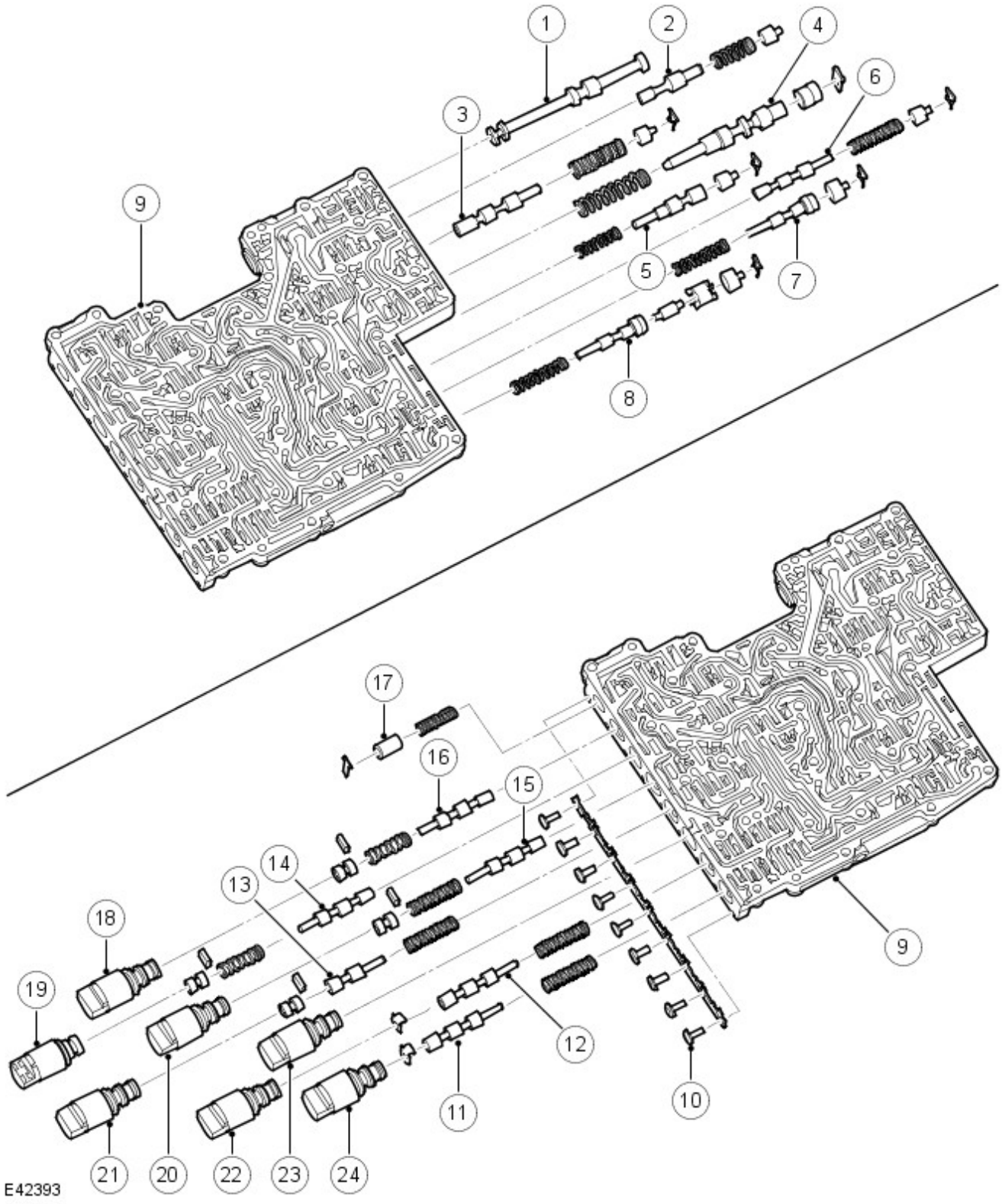
Mechatronic Valve Block



Item	Part Number	Description
1	-	Position switch
2	-	Sliding block
3	-	Selector spool valve
4	-	Position switch assembly

5	-	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	-	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

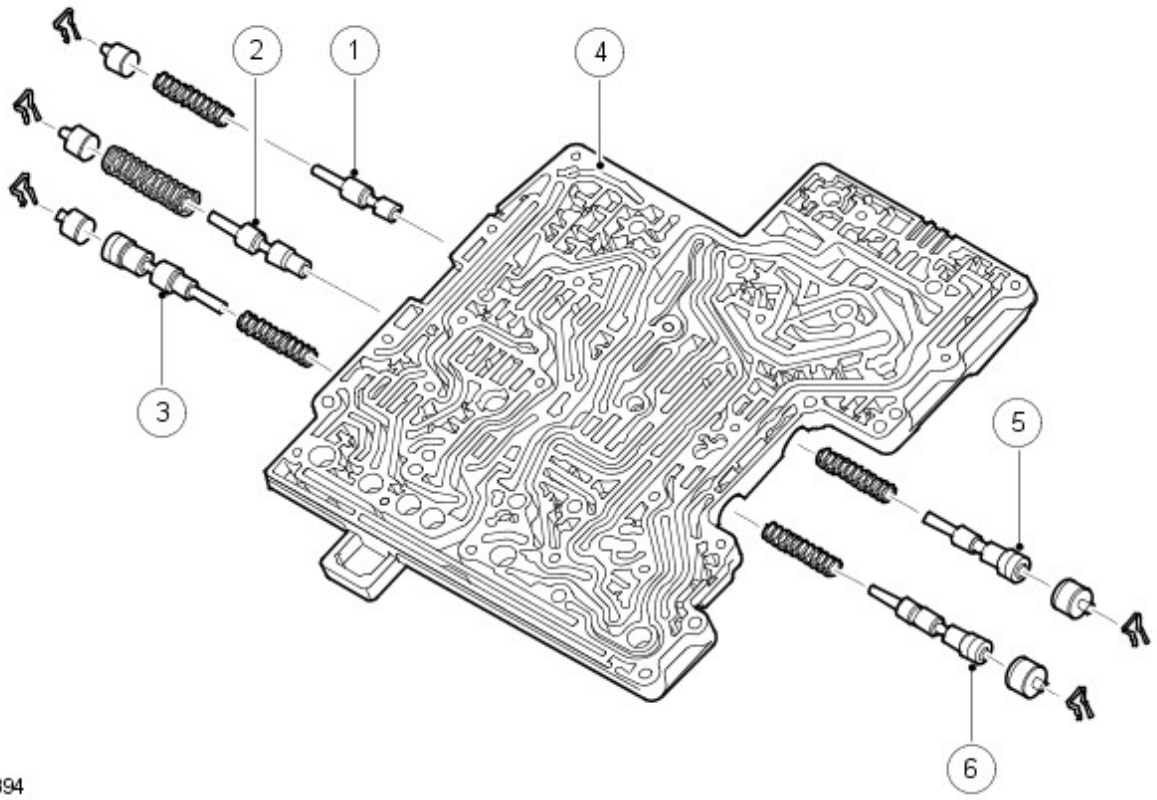
Valve Housing Components



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	-	EPRS 6
19	-	Solenoid valve 1
20	-	EPRS 4
21	-	EPRS 5
22	-	EPRS 2
23	-	EPRS 3
24	-	EPRS 1

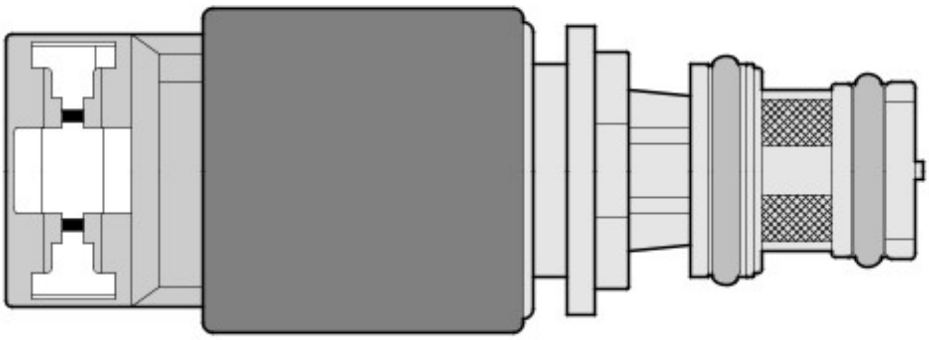
Valve Plate Components



E42394

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



E42713

Six EPRS are located in the valve block. The solenoids are controlled by 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:

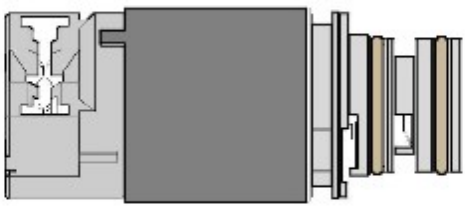
EPRS	Function
1	Clutch A
2	Clutch B
3	Clutch C
4	Brake clutches D and E
5	System pressure control
6	Torque converter lock-up control

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 $lbf.in^2$).

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 operates the solenoids using a PWM earth 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 $lbf.in^2$).

The resistance of the solenoid coil winding for solenoid is between 26 to 30.4 ohms at 20 °C (68 °F).

Control Solenoid



E42714

A shift control SV (solenoid valve) 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 for 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 theTCM 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 1 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

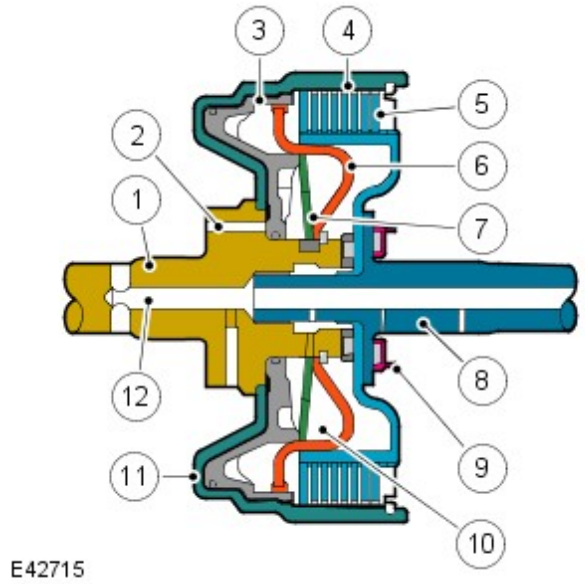
The valve block contains 21 spool valves which control various functions of the transmission. The spool valves are of conventional design and are operated by fluid pressure.

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, 1 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 equalization chamber
11	-	Piston chamber
12	-	Lubrication channel

There are three drive clutches and two brake clutches used in the ZF 6HP28 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 5.0L SC and 3.0L diesel models, the uprated transmission includes additional clutch plates to enable the transmission to manage the additional power output from these engines.

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 equalization 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 equalization 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.

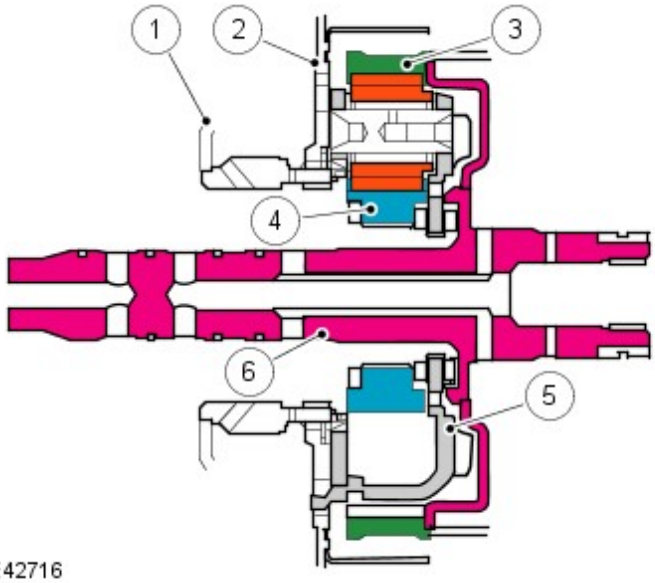
PLANETARY GEAR TRAINS

The planetary gear trains used on the ZF 6HP28 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 six forward gears and the one reverse gear.

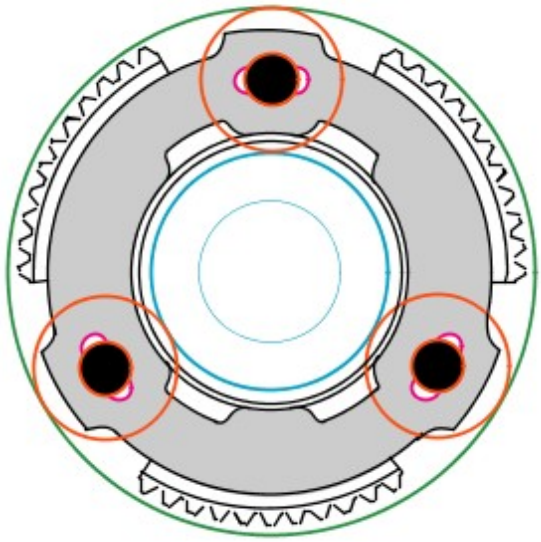
Single Web Planetary Gear Train

The single web planetary gear train comprises:

- Sunwheel
- Four planetary gears
- Planetary gear carrier (spider)
- Ring gear or annulus.

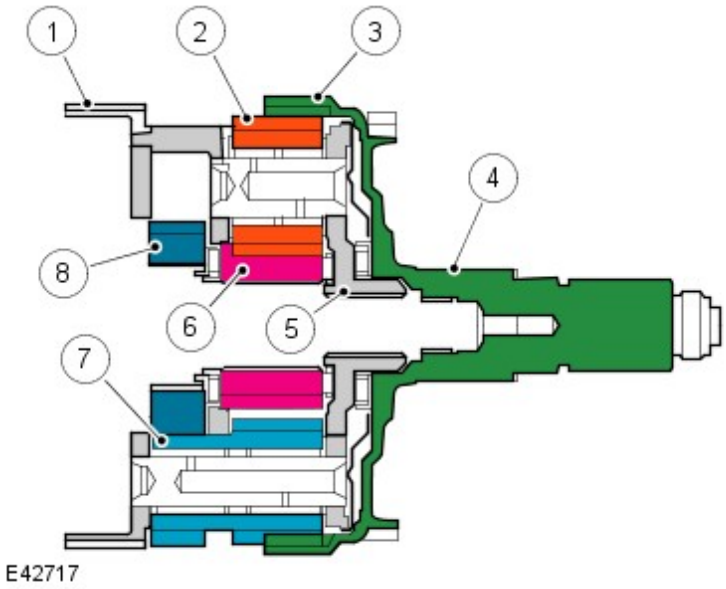


E42716



Item	Part Number	Description
1	-	Cylinder
2	-	Baffle plate
3	-	Ring gear
4	-	Sun gear
5	-	Planetary gear spider
6	-	Torque converter input shaft

Torque Converter Input Shaft





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:

- Two sunwheels
- Three short planetary gears
- Three long planetary gears
- Planetary gear carrier
- Ring gear or annulus

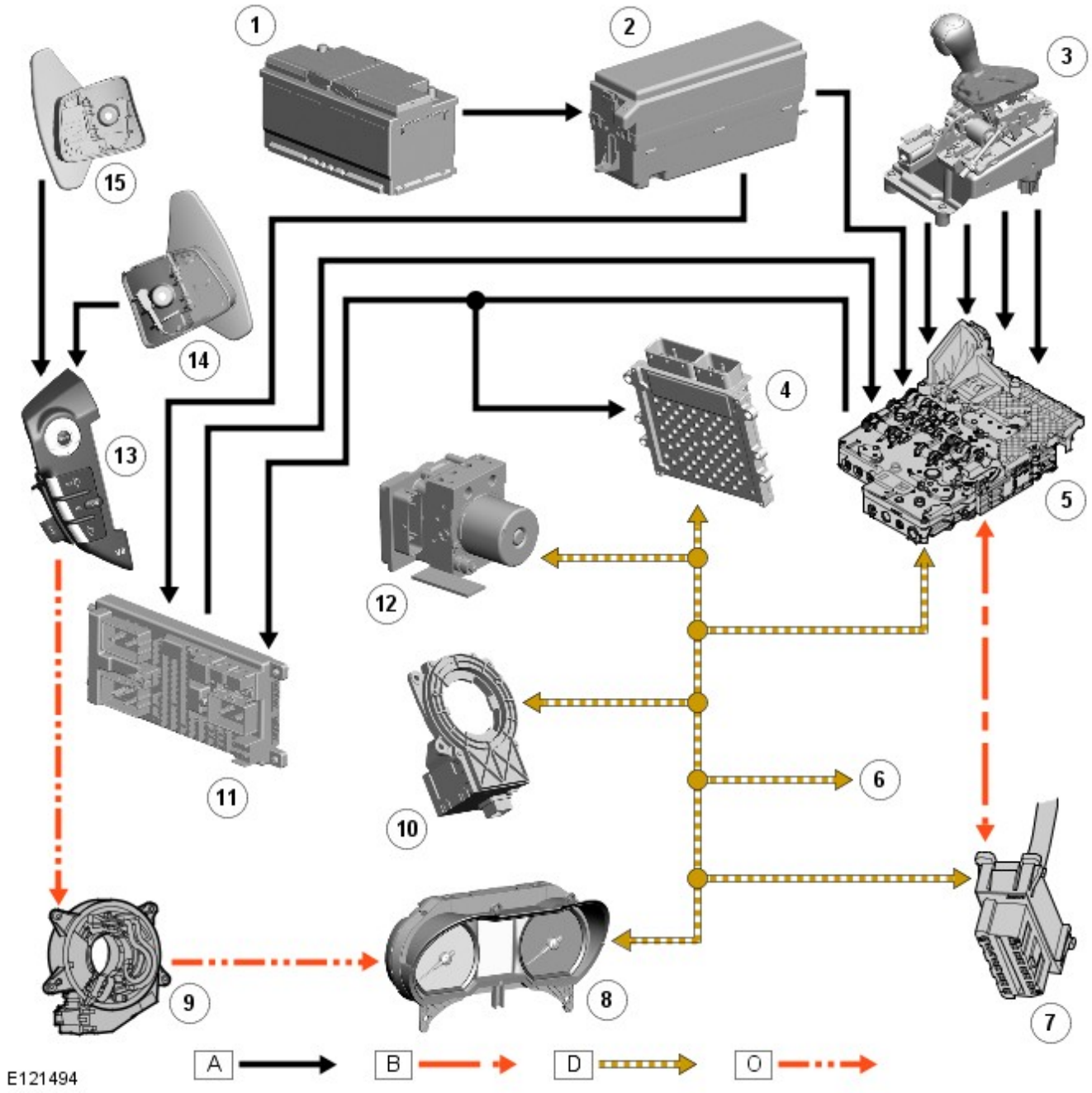
TRANSMISSION CONTROL MODULE

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.

CONTROL DIAGRAM

NOTE: A = Hardwired; B = K bus; D = High speed CAN bus O = LIN (local interconnect network) bus.



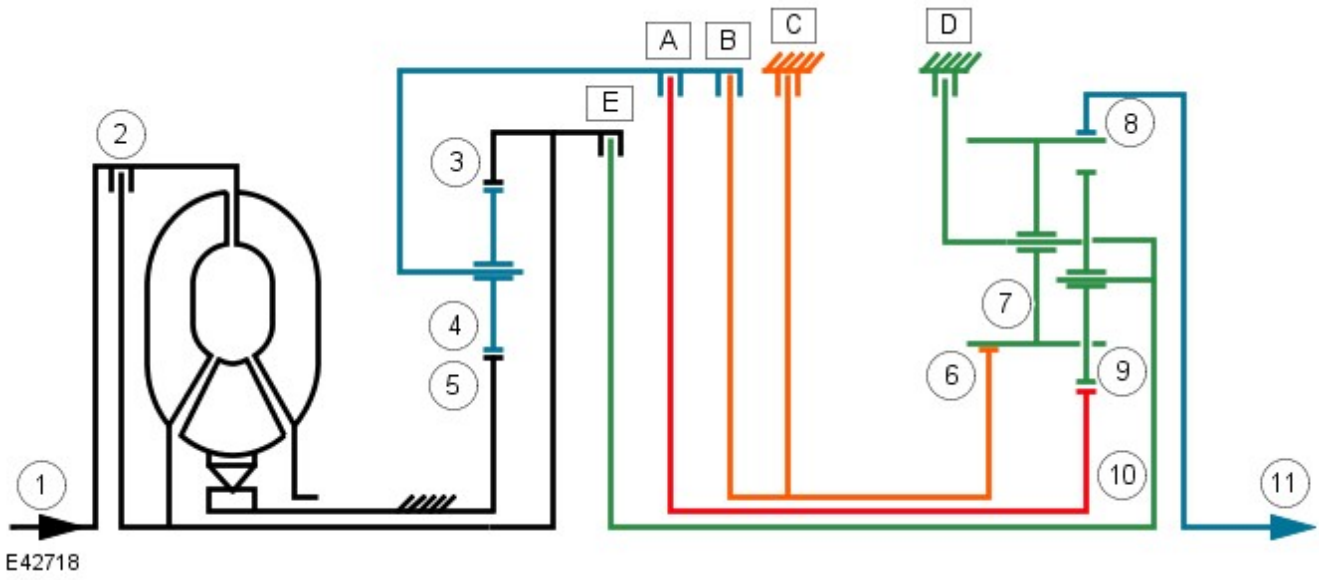
Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	Selector lever
4	-	ECM (engine control module)
5	-	TCM
6	-	To other systems
7	-	Diagnostic socket
8	-	Instrument cluster
9	-	Clockspring
10	-	Steering angle sensor
11	-	CJB (central junction box)
12	-	ABS module
13	-	Steering wheel LH switchpack
14	-	Upshift paddle switch
15	-	Downshift paddle switch

OPERATION

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 TCM

memory and physical transmission operating conditions such as vehicle speed, throttle position, engine load and selector lever position.

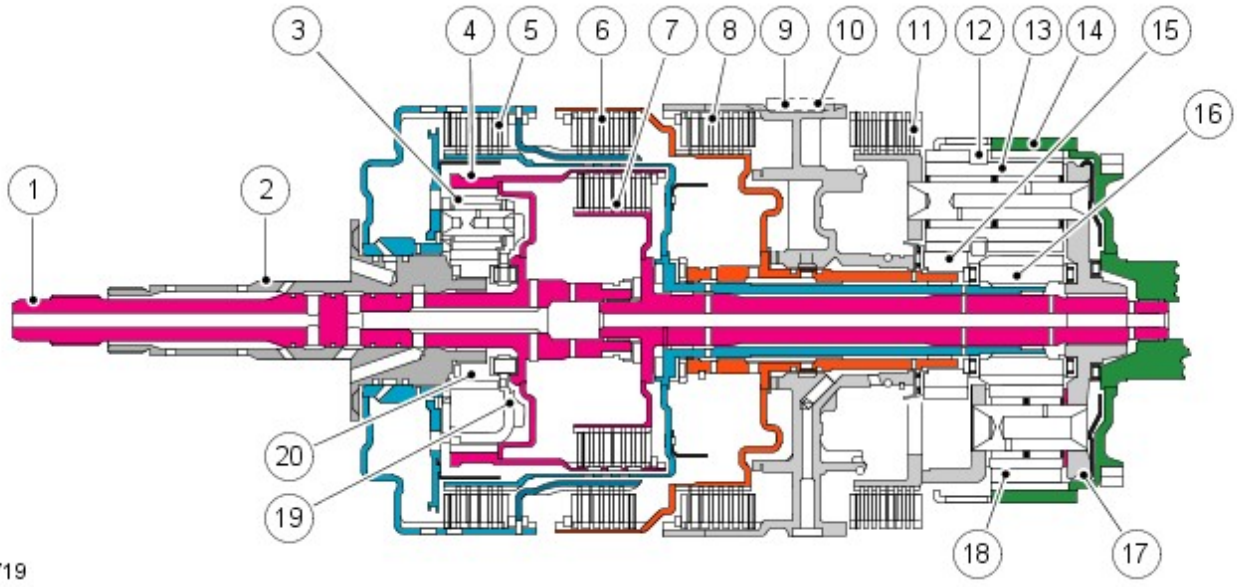


Item	Part Number	Description
1	-	Torque input from engine
2	-	Torque converter lock-up clutch
3	-	Single web planetary gear carrier
4	-	Single web planetary gears
5	-	Single web sunwheel 1
6	-	Double web sunwheel 2
7	-	Double web planetary gears - long
8	-	Double web planetary gear carrier
9	-	Double 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

Shift Elements

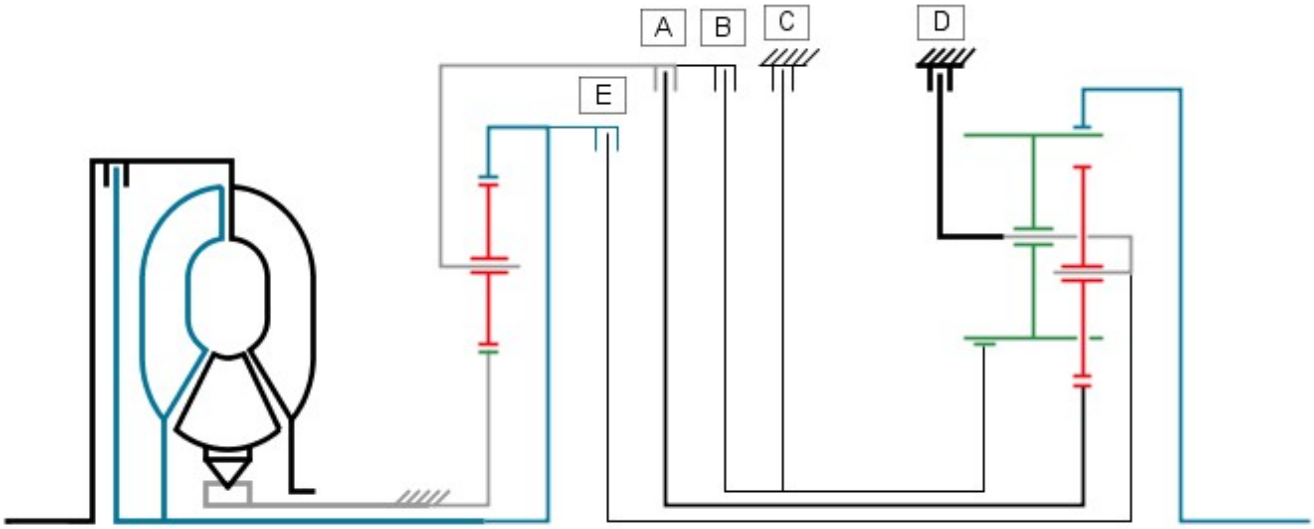


Item	Part Number	Description
1	-	Turbine shaft
2	-	Stator shaft
3	-	Single web planetary gear train
4	-	Ring gear 1
5	-	Clutch A
6	-	Clutch B
7	-	Clutch E
8	-	Brake clutch C
9	-	Fixed connection to transmission housing
10	-	Shaft key
11	-	Brake clutch D
12	-	Double web planetary gear train
13	-	Planetary 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 three rotating multiplate clutches (A, B and E) and two 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



E42720

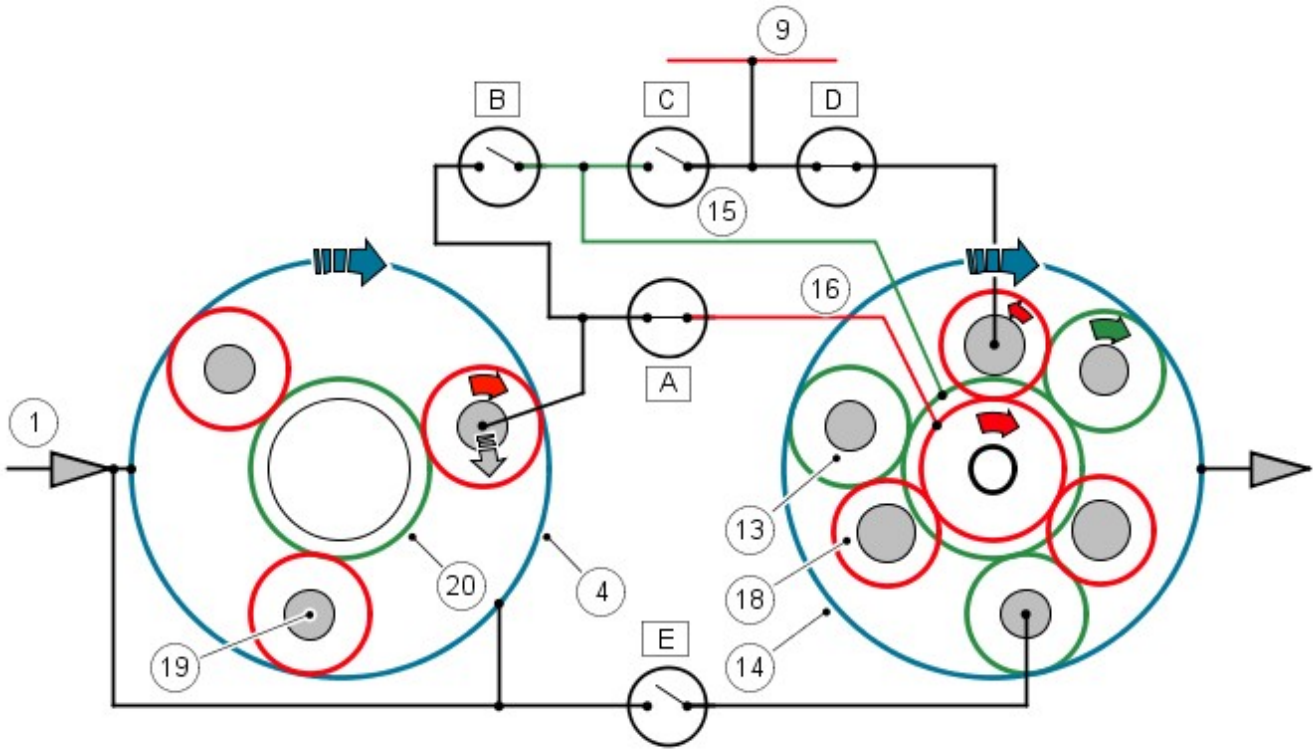
The selector lever and the selector valve spool are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to the ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

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.

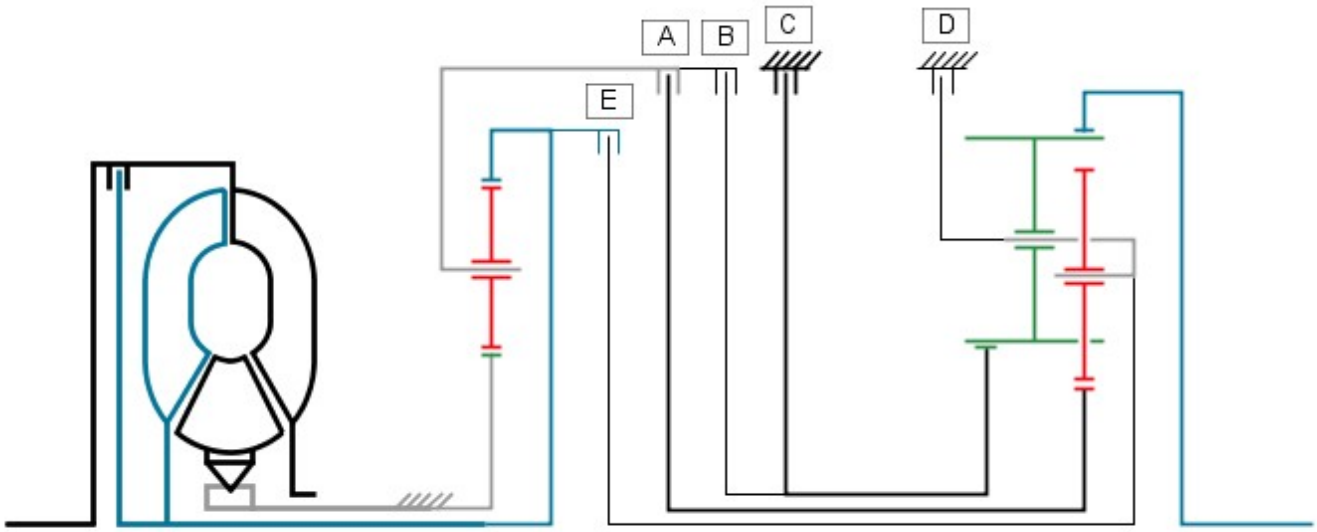
The double web planetary gear train is locked against the transmission housing by brake 'D'. This allows ring gear 2 (output shaft) to be driven in the same direction as the engine via the long planetary gears.

NOTE: Refer to 'Shift Elements' illustration for key



E42721

Power Flow 2nd Gear



E42722

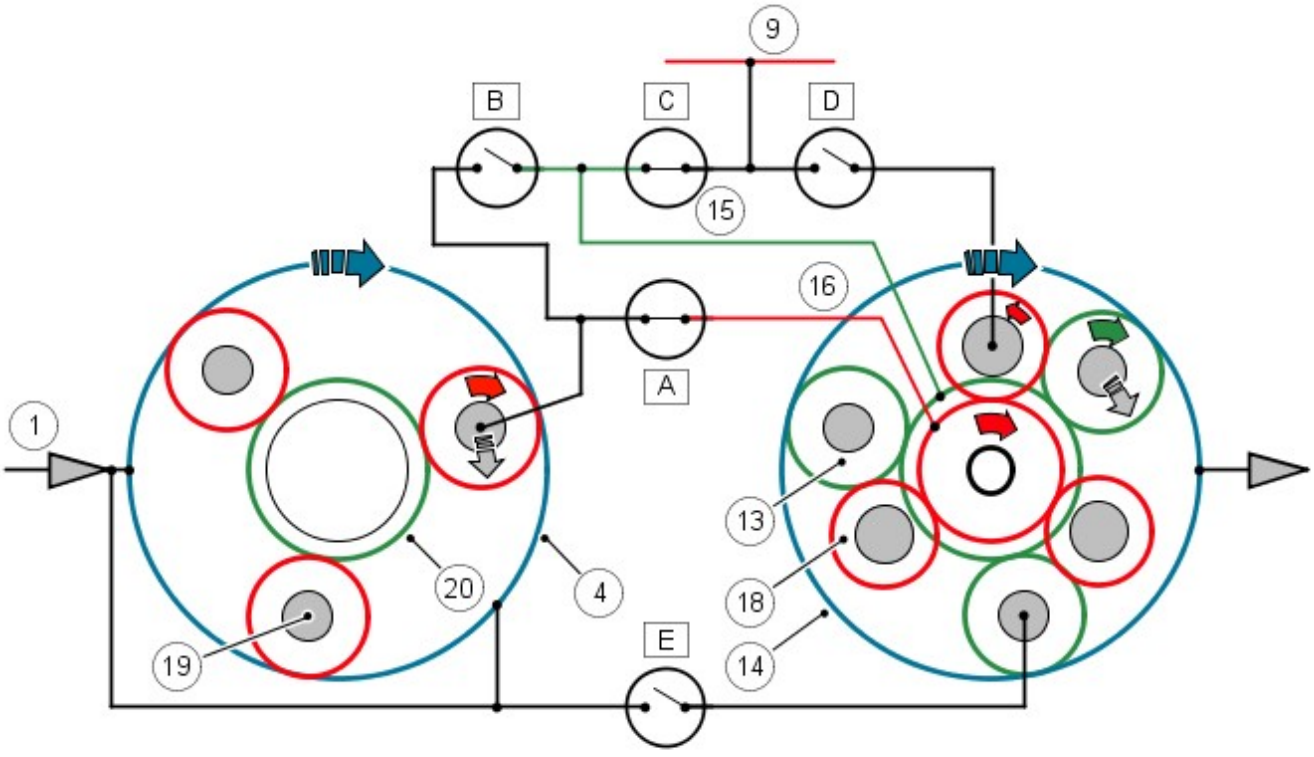
The selector lever and the selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to the ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

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.

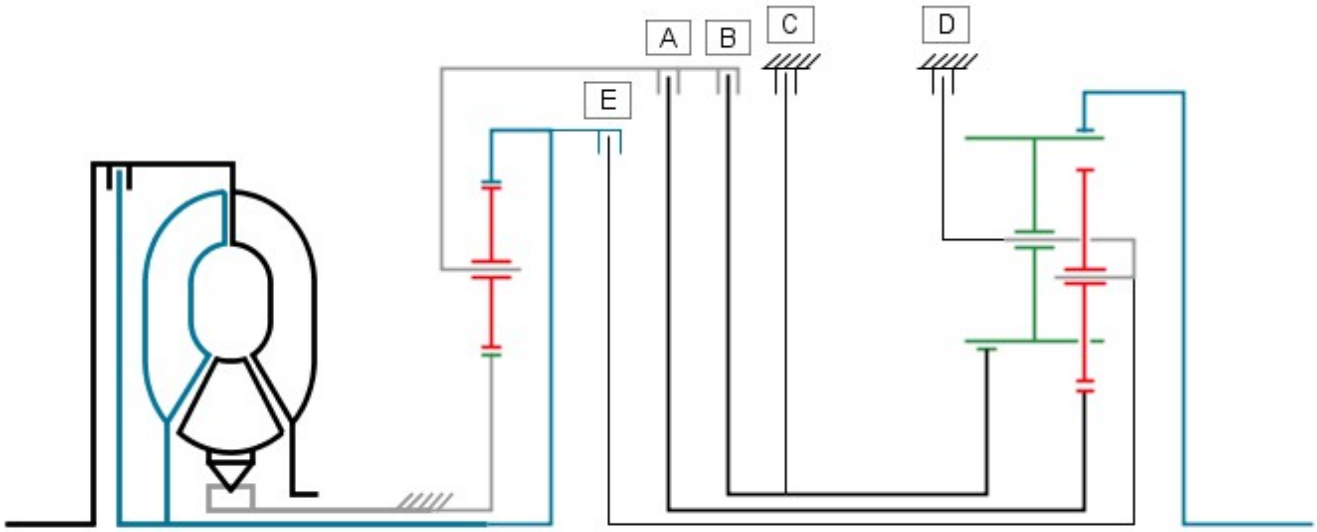
Sunwheel 2 is locked to the transmission housing by brake clutch 'C'. The long planetary gears, which are also meshed with the short planetary gears, roll around the fixed sunwheel 2 and transmit drive to the double web planetary gear train carrier and ring gear 2 in the direction of engine rotation.

NOTE: Refer to 'Shift Elements' illustration for key



E42723

Power Flow 3rd Gear



E 42724

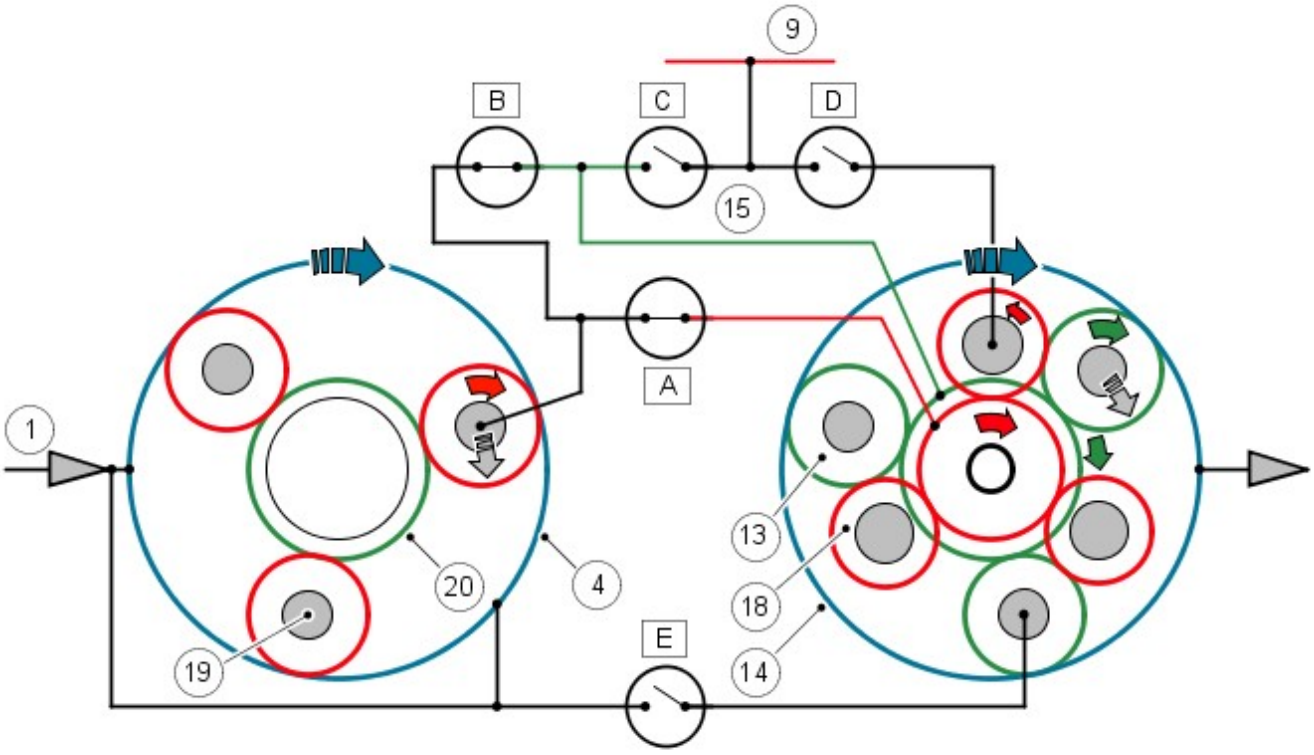
The selector lever and the selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to the ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

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.

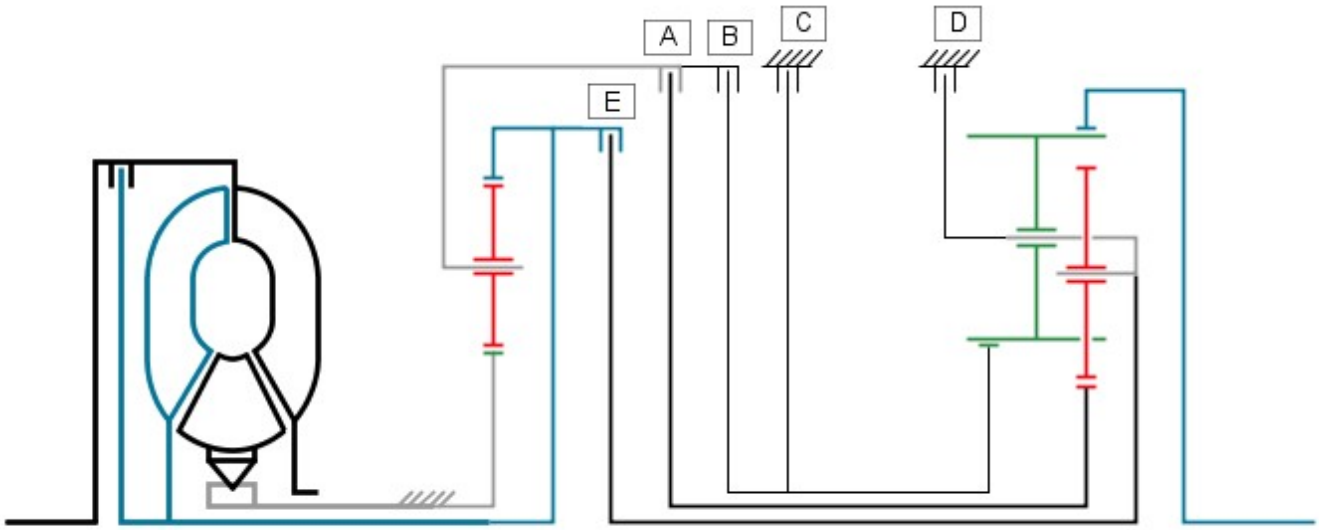
Sunwheel 2 is driven via clutch 'B' which is engaged. The long planetary gears, which are also meshed with the short planetary gears, cannot roll around the fixed sunwheel 2 and therefore transmit drive to the locked double web planetary gear train carrier in the direction of engine rotation.

NOTE: Refer to 'Shift Elements' illustration for key



E42725

Power Flow 4th Gear



E42726

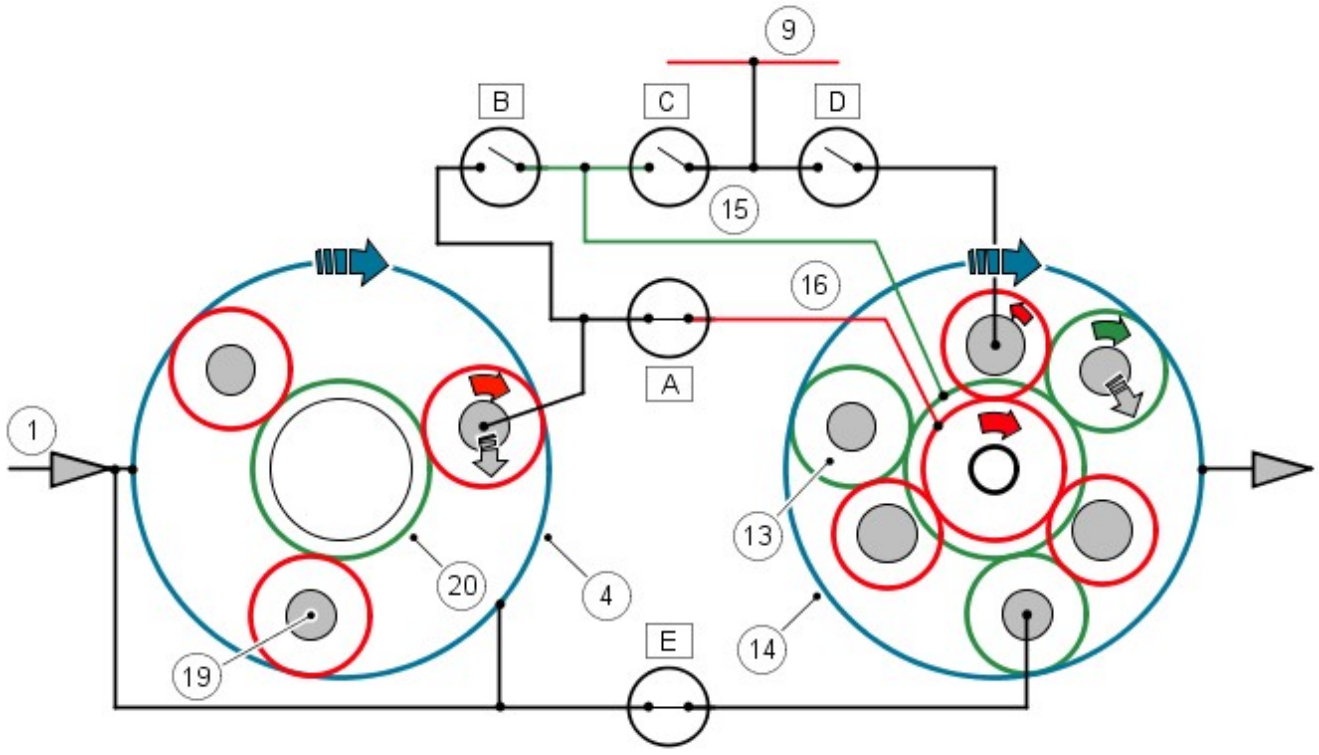
The selector lever and the selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

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.

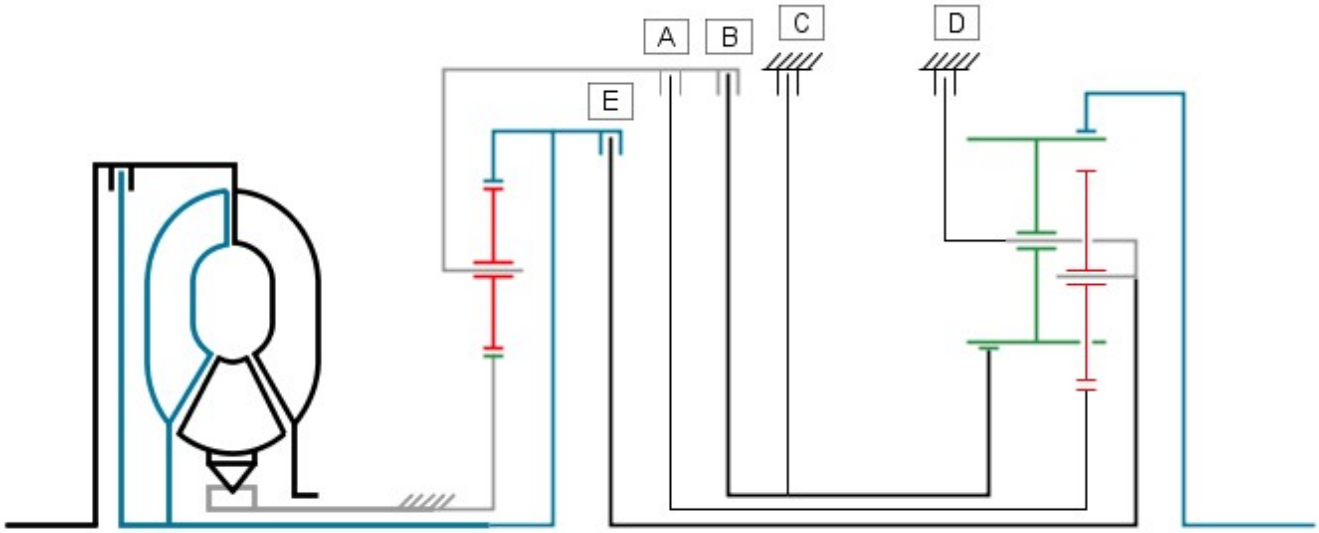
The double web planetary gear carrier is driven via clutch 'E' which is engaged. The long planetary gears, which are also meshed with the short planetary gears and the double web planetary gear carrier, drive ring gear 2 in the direction of engine rotation.

NOTE: Refer to 'Shift Elements' illustration for key



E42727

Power Flow 5th Gear



E42728

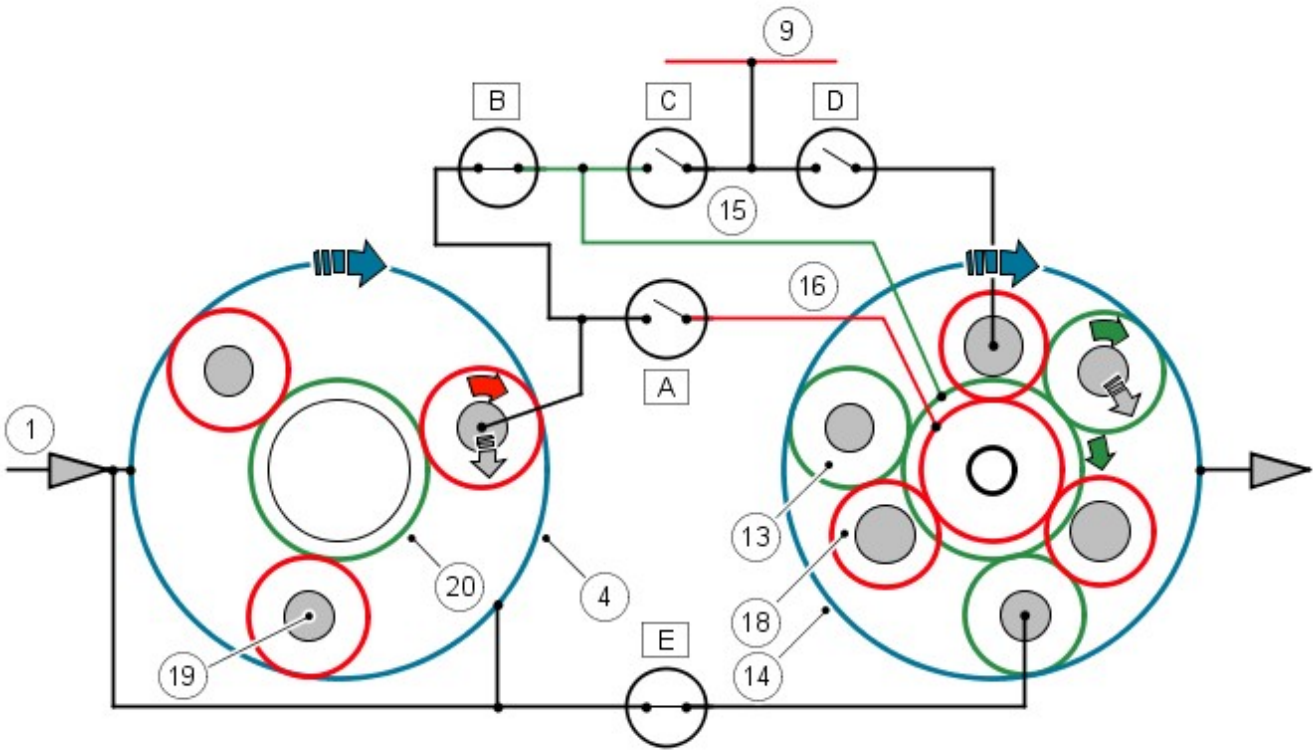
The selector lever and the selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

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.

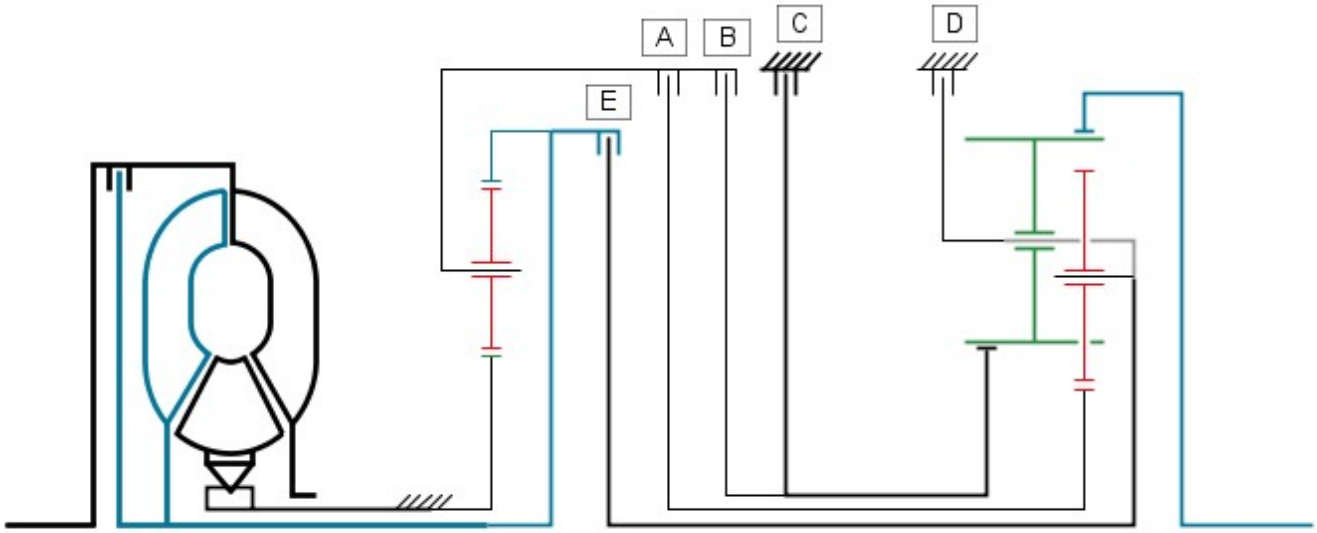
The long planetary gears, which are also meshed with the short planetary gears and the double web planetary gear carrier, drive ring gear 2 in the direction of engine rotation.

NOTE: Refer to 'Shift Elements' illustration for key



E42729

Power Flow 6th Gear



E42730

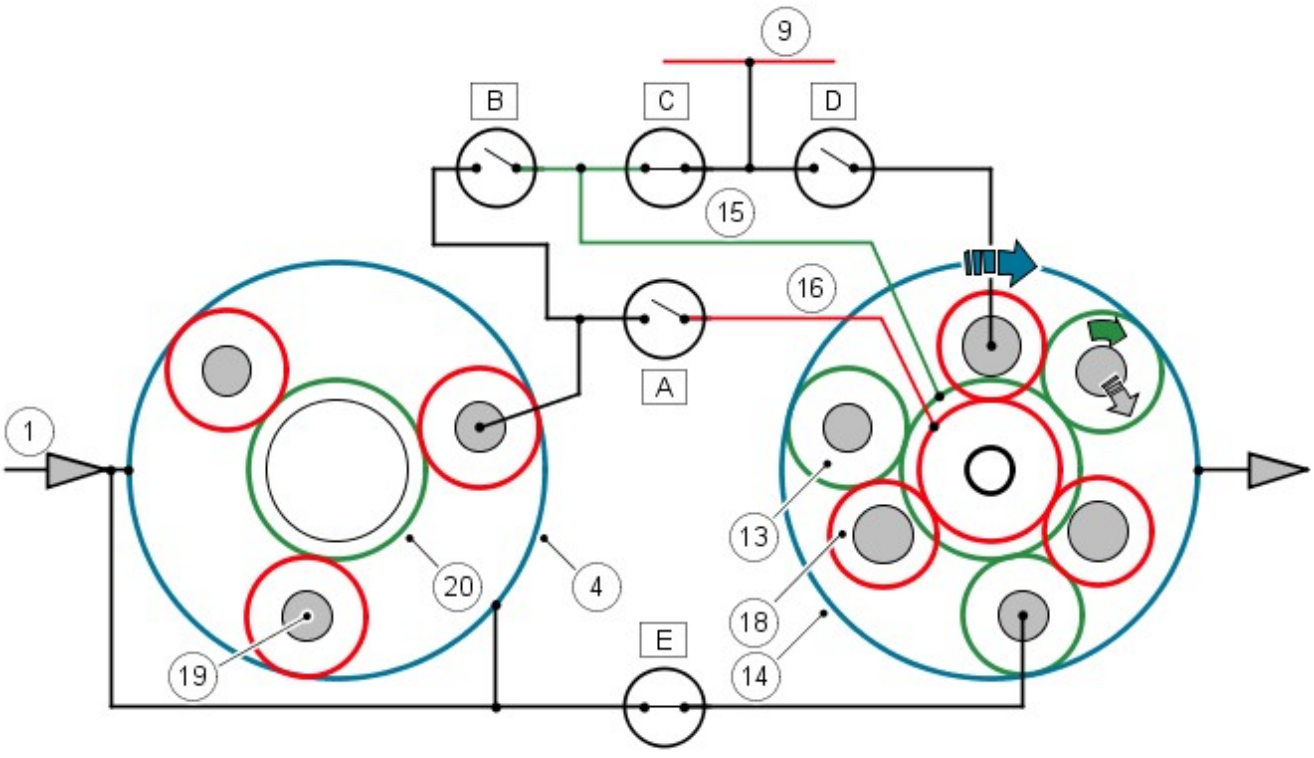
The selector lever and the selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

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.

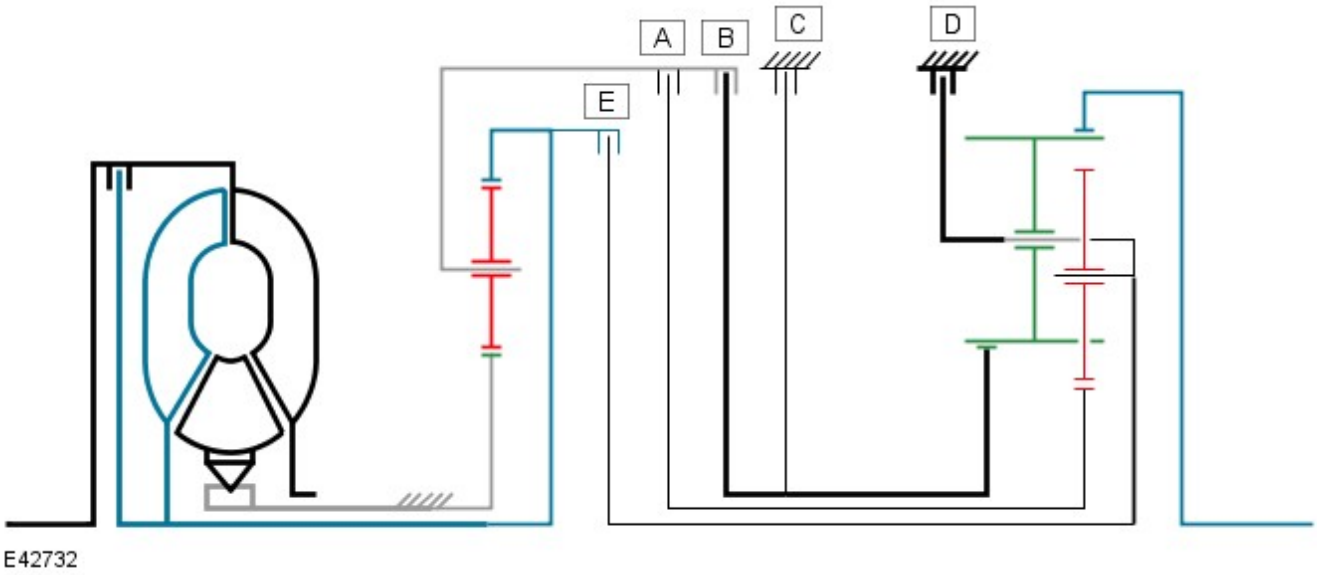
Clutch 'E' is engaged and drives the double web planetary gear carrier. This causes the long planetary gears to rotate around the fixed sunwheel 2 and transmit drive to ring gear 2 which is driven in the direction of engine rotation.

NOTE: Refer to 'Shift Elements' illustration for key



E42731

Power Flow Reverse Gear



E42732

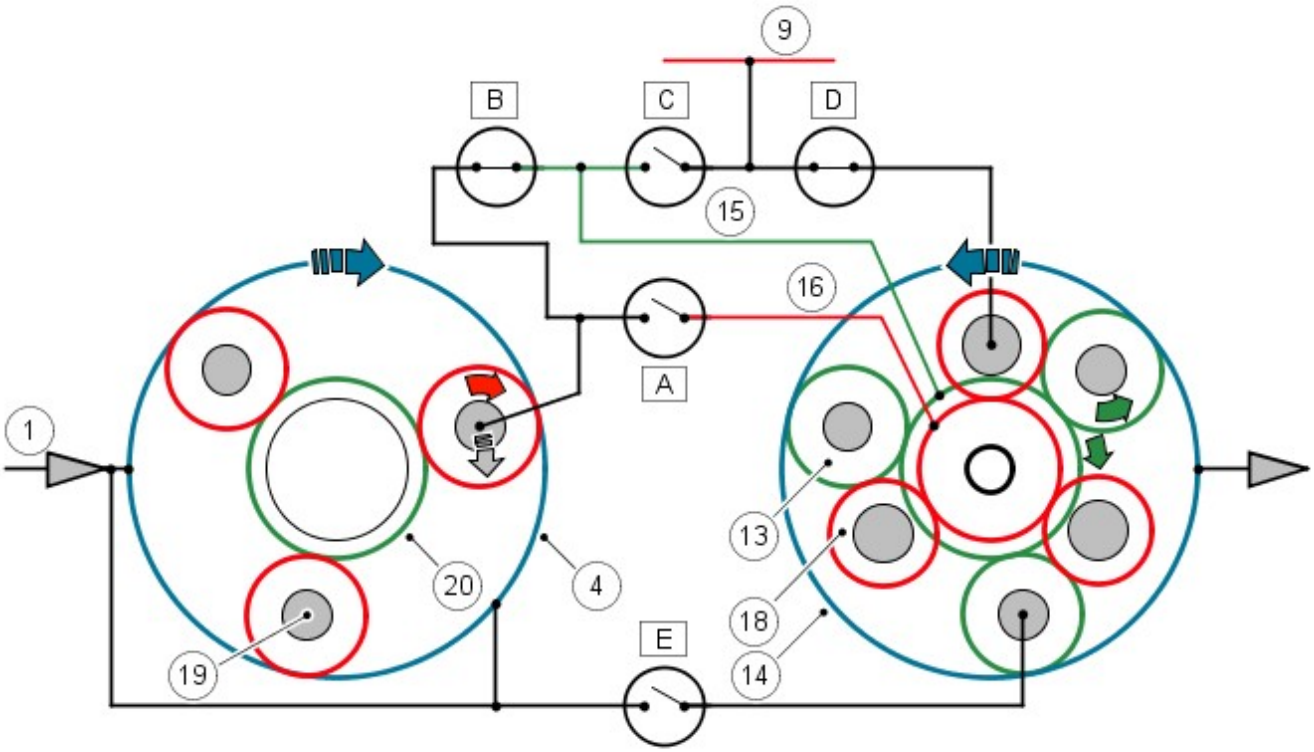
The selector lever and the selector spool valve are in the 'R' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

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.

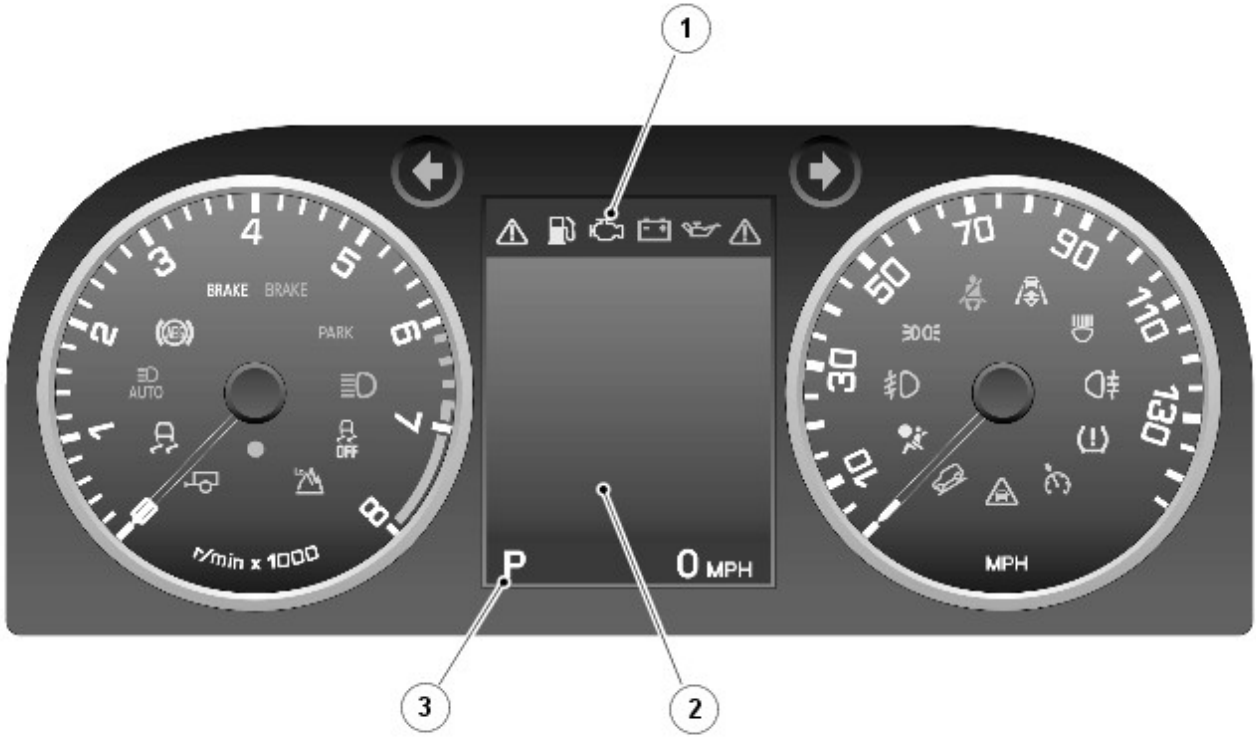
The double web planetary gear carrier is locked to the transmission housing by brake clutch 'D'. This allows ring gear 2 to be driven in the opposite direction to engine rotation by the long planetary gears.

NOTE: Refer to 'Shift Elements' illustration for key



E42733

Instrument Cluster



E121495

Item	Part Number	Description
1	-	MIL (malfunction indicator lamp)
2	-	Message center
3	-	Transmission status display

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 two displays in the instrument cluster.
For additional information, refer to: Instrument Cluster (413-01, Description and Operation).

Malfunction Indicator Lamp

The MIL (malfunction indicator lamp) is located in the tachometer of the instrument cluster. Transmission related faults which may affect the vehicle emissions 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 Land Rover approved diagnostic equipment which reads the fault codes stored in the TCM memory.

Transmission Status Display

The transmission status display is located in the tachometer of the instrument cluster. The display shows the selector lever position or the selected gear when in manual and sport modes.

The following table shows the displays and their descriptions.

Symbol	Description
P	Park selected
R	Reverse selected
N	Neutral selected
D	Drive selected
s*	Sport mode selected (* = current gear)
1	1st gear selected (manual CommandShift mode)
2	2nd gear selected (manual CommandShift mode)
3	3rd gear selected (manual CommandShift mode)
4	4th gear selected (manual CommandShift mode)
5	5th gear selected (manual CommandShift mode)
6	6th gear selected (manual CommandShift mode)

Message Center

The message center is located in the center of the instrument cluster. The message center is a LCD (liquid crystal display) that relays vehicle status and operating information to the driver and can display messages relating to a number of vehicle systems. If a transmission fault occurs, the message GEARBOX FAULT is displayed in the message center.
For additional information, refer to: Information and Message Center (413-08, Description and Operation).

Transmission Control Module

The TCM outputs signals to control the shift control solenoid valve and the EPRS to control the hydraulic operation of the transmission.

The TCM processes signals from the transmission speed and temperature sensors, the selector lever, the ECM and other vehicle systems. From the received signal inputs and pre-programmed data, the TCM calculates the correct gear, torque converter clutch setting and optimum pressure settings for gear shift and lock-up clutch control.

The ECM supplies the engine management data over the high speed CAN bus. The TCM requires engine data to efficiently control the transmission operation, for example; flywheel torque, engine speed, accelerator pedal angle, engine temperature. The steering angle sensor and the ABS (anti-lock brake system) module also supply data to the TCM on the high speed CAN bus. 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.

Using the signal inputs and the memorized data, the TCM control program computes the correct gear and torque converter lock-up clutch setting and the optimum pressure settings for gear shift and lock-up clutch control. Special output-side modules (power output stages, current regulator circuits), allow the TCM to control the solenoid valves and pressure regulators and consequently precisely control the hydraulics of the automatic transmission. In addition, the amount and duration of engine interventions are supplied to the engine management by way of the CAN bus.

The TCM determines the position of the selector lever using signals from:

- The selector switch in the transmission.
- The park lock and M/S (manual/sport) 'CommandShift' switches on the selector lever.

When the driver operates the steering wheel paddle switches the selections are sensed by the TCM, which then operates in the manual CommandShift mode. If the selector lever is in D, the CommandShift mode is temporary and will cancel after a time period or can be cancelled by pressing and holding the + paddle for approximately 2 seconds. If the selector lever is in the M/S position, the CommandShift mode is permanent and can only be cancelled by pressing and holding the + paddle for approximately 2 seconds or by moving the selector lever to the D position.

The TCM transmits the position of the selector lever and the selected gear on the high speed CAN bus. This information is shown in the gear selector display in the instrument cluster.

Engine Stall

If the vehicle stalls it will coast down in gear, with the transmission providing drive to the engine. A restart can be attempted at this point and the engine may start and the driver can continue.

If the coast down speed reduces such that the speed of the engine is less than 600 rev/min, the transmission will go to neutral, D illumination will flash in the instrument cluster. The driver needs to select neutral or park and then press the brake pedal to restart the engine.

If the start/stop button is pressed when driving, the message ENGINE STOP BUTTON PRESSED is displayed in the message center but there will be no change to the ignition state. If the driver requires to switch off the engine, the start/stop button must be pressed for a second time. The engine will be stopped and will be back driven by the transmission as the vehicle coasts down.

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Automatic Transmission/Transaxle - TDV6 3.0L Diesel /V8 5.0L Petrol/V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Diagnostics

Diagnosis and Testing

Principle of Operation

For a detailed description of the automatic transmission/transaxle system and operation, refer to the relevant Description and Operation sections in the workshop manual. REFER to: Transmission Description (307-01 Automatic Transmission/Transaxle - 5.0L/3.0L Diesel, Description and Operation).

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. Refer to the relevant section in the workshop manual.

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.

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 Specification section in the workshop manual.

Fluid Condition Check

1. Check the fluid level.
2. Observe the color and the odor of the fluid. The color under normal circumstances should be like honey, not dark 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

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

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

Visual Inspection

Mechanical	Electrical	Hydraulic
• Damaged/stuck shift mechanism • Damaged automatic transmission casing	• 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

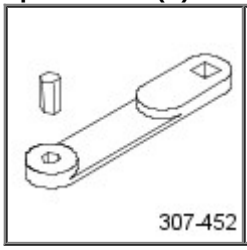
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Transmission Control Module (TCM) - Siemens (100-00 General Information, Description and Operation).

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Automatic Transmission / Transaxle - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission Fluid Level Check

General Procedures

Special Tool(s)

	307-452 Wrench, Transmission Filler Plug

Check

WARNINGS:

Observe due care when draining, as the fluid can be very hot.

Observe due care when working near a hot exhaust system.

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

1.
   - The following steps must be observed before starting the transmission fluid level check.
   - The vehicle must be on a horizontal ramp.
   - The parking brake must be applied.
   - The engine must be running for 2 minutes with the transmission control switch (TCS) in the "P" position.

2. CAUTION: Make sure that the transmission fluid temperature is below 30 degrees before starting the fluid level check.

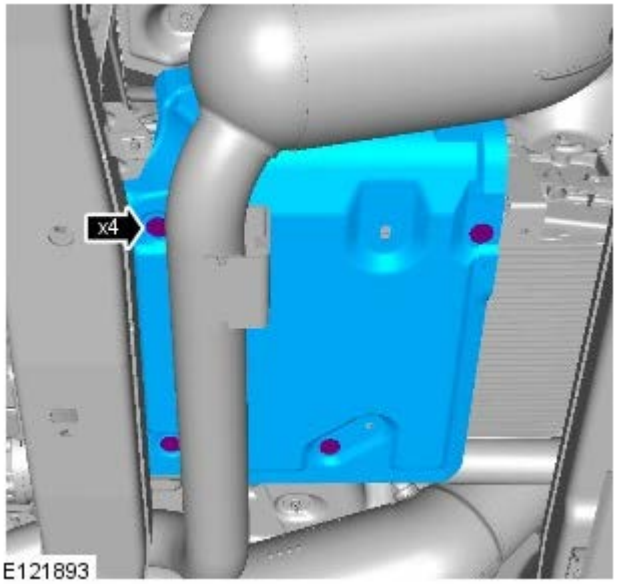
   Connect the diagnostic tool to the vehicle.

3.
   - Start the engine.
   - Apply, and hold, the footbrake.
   - 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.

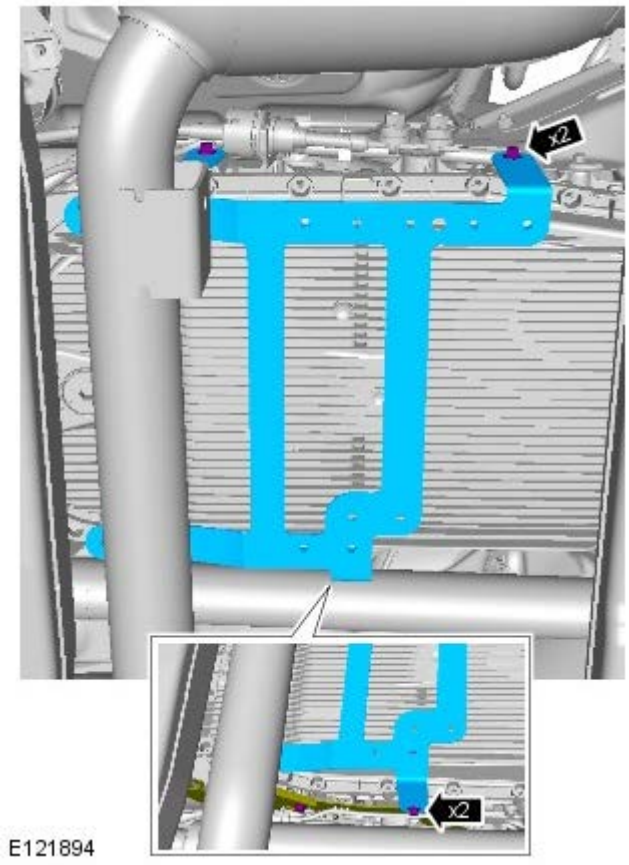
4. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

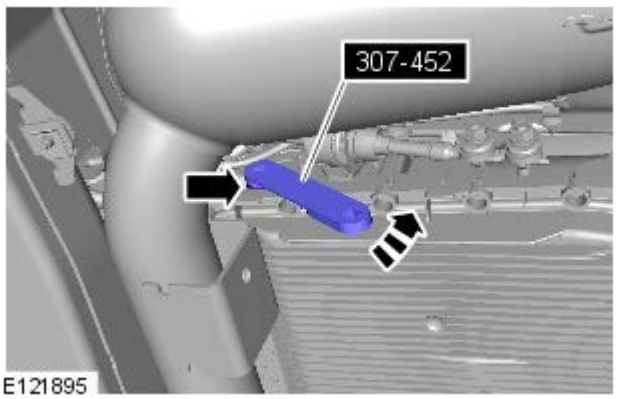
5. *Torque:* 9 Nm



6. *Torque:* 9 Nm



7. Place a suitable container under the transmission fluid fill plug.



8. WARNINGS:

Observe due care when draining, as the fluid can be very hot.

Observe due care when working near a hot exhaust system.

CAUTIONS:

The transmission 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.

Discard the seal.

- *Special Tool(s):* 307-452
- Clean the area around the transmission fluid level plug.

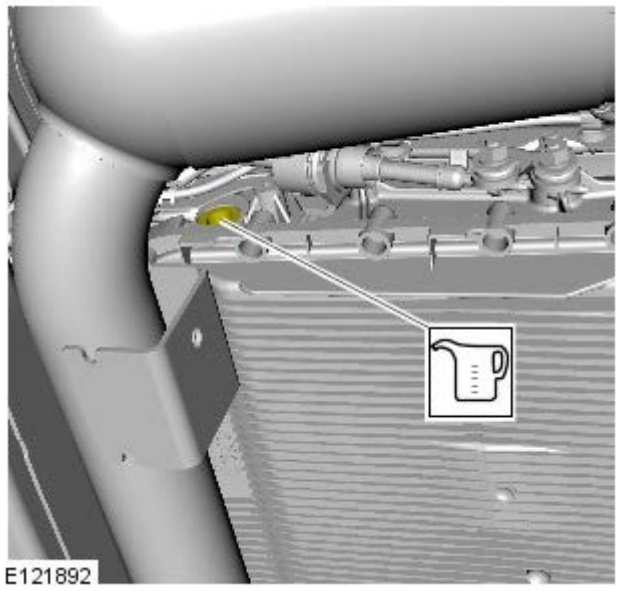
Adjustment

WARNINGS:

Observe due care when draining, as the fluid can be very hot.

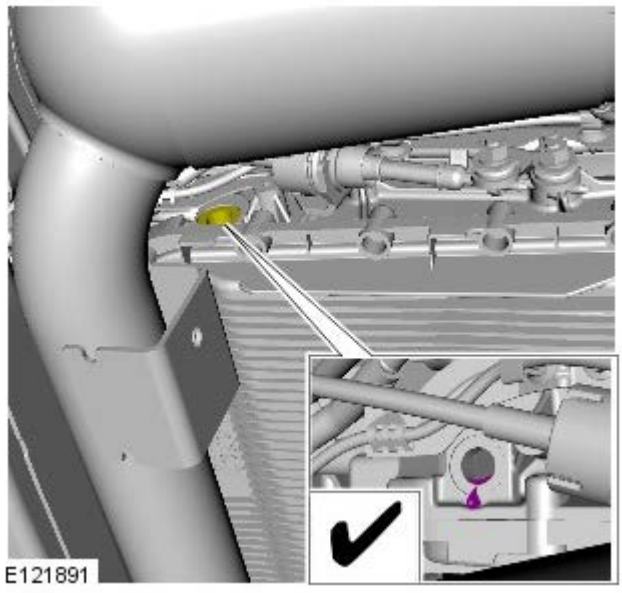
Observe due care when working near a hot exhaust system.

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



1. NOTE: Use transmission fluid meeting Land Rover specification.

   If the transmission fluid does not come out of the transmission fluid fill plug hole the transmission fluid level is insufficient. If this is the case add the transmission fluid in 0.5 liter units into the transmission fluid fill plug hole until fluid comes out.

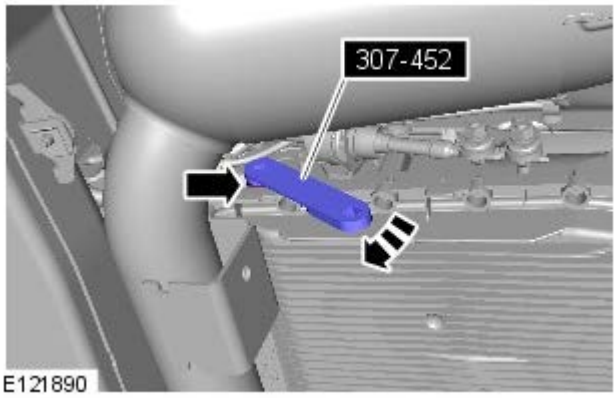


2. NOTE: Make sure the transmission fluid temperature does not exceed 50 °C (122 °F). If the transmission fluid temperature does exceed 50 °C (122 °F) stop the transmission fluid level check and allow the transmission fluid to cool until the temperature is below 30 °C (86 °F).

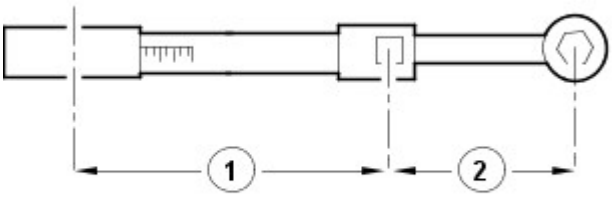
   Allow the transmission fluid to drain from the transmission fluid filler plug hole until the flow almost stops.

3. NOTE: Install a new sealing washer.

   Using the special tool, install the new transmission fluid fill plug.

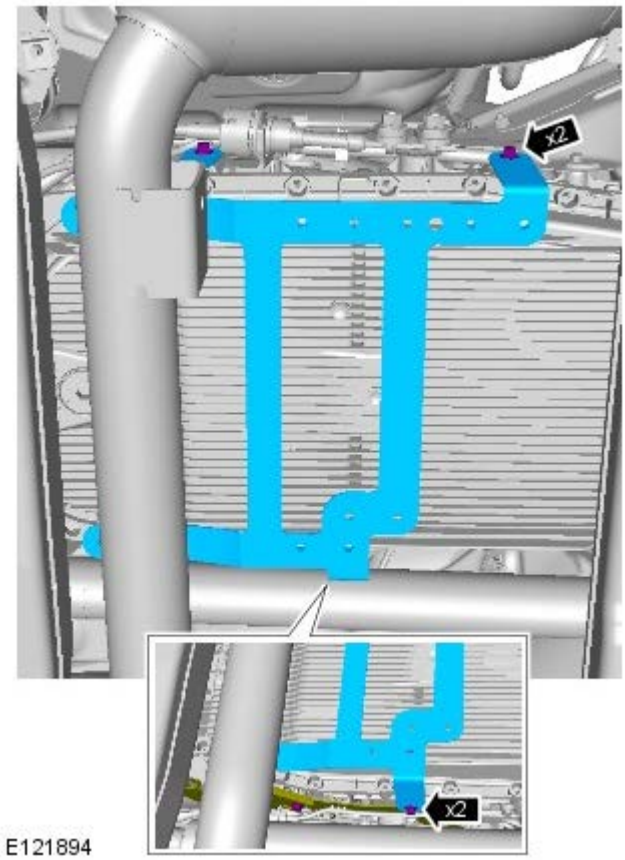


E121890



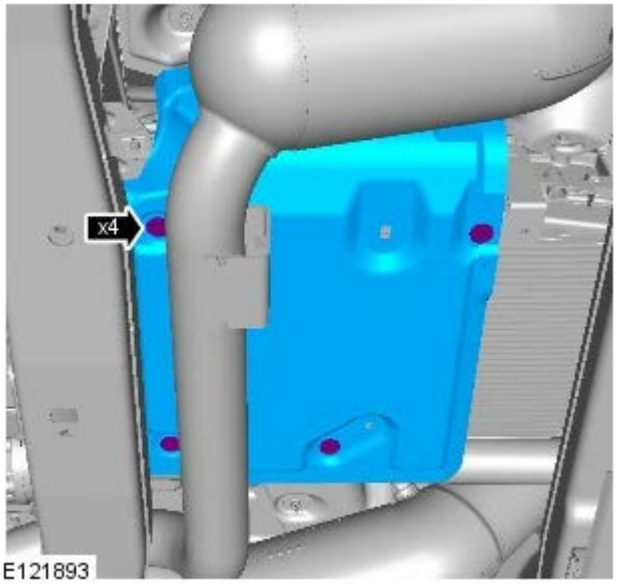
E37107

4. CAUTION: Make sure the transmission fluid fill plug is tightened to the correct specification. Failure to follow this instruction may result in damage to the vehicle.
   - To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
   - 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 (1).
   - 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.
   - Tighten the transmission fluid fill plug to the torque given by the calculation.
5. Remove the special tool.
6. Remove the container.
7. *Torque:* 9 Nm



E121894

8. *Torque:* 9 Nm



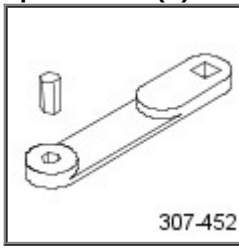
9. Lower the vehicle.
10. Disconnect the diagnostic tool to the vehicle.

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Automatic Transmission / Transaxle - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission Fluid Drain and Refill

General Procedures

Special Tool(s)

	307-452 Wrench, Transmission Filler Plug

Drain

WARNINGS:

Observe due care when draining, as the fluid can be very hot.

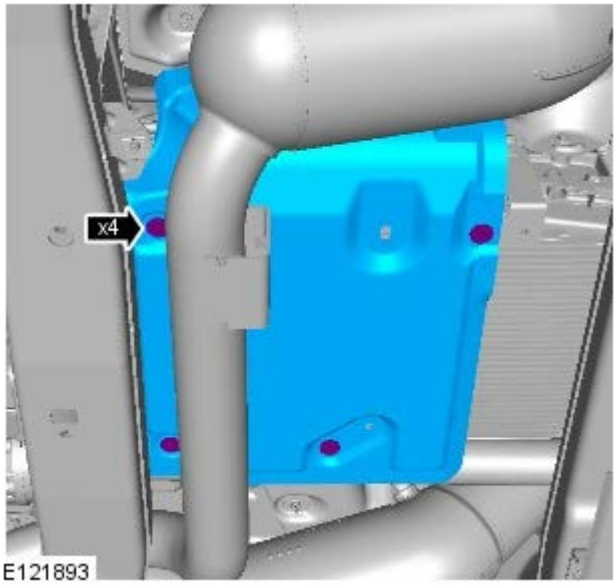
Observe due care when working near a hot exhaust system.

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

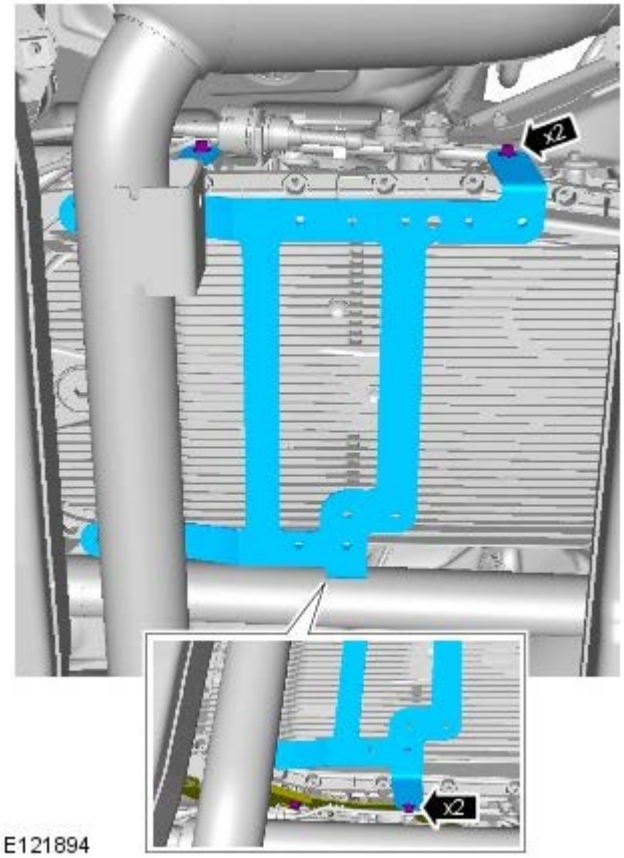
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. *Torque:* 9 Nm

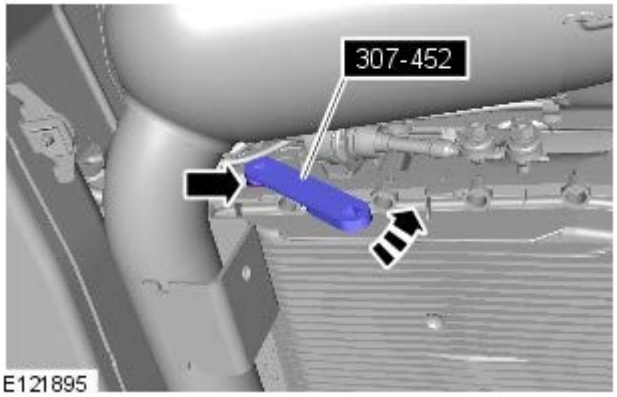


3. *Torque:* 9 Nm

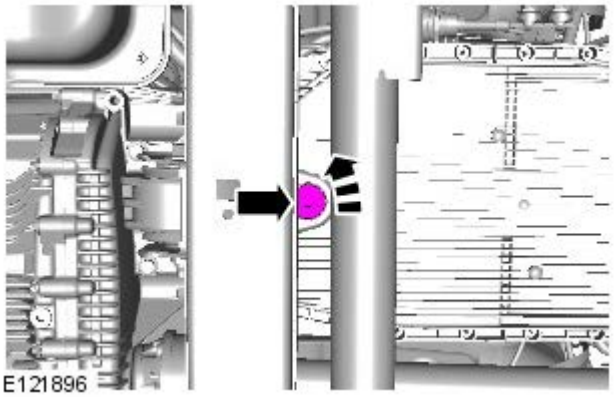


4. Place a container under the transmission.

5. *Special Tool(s):* 307-452

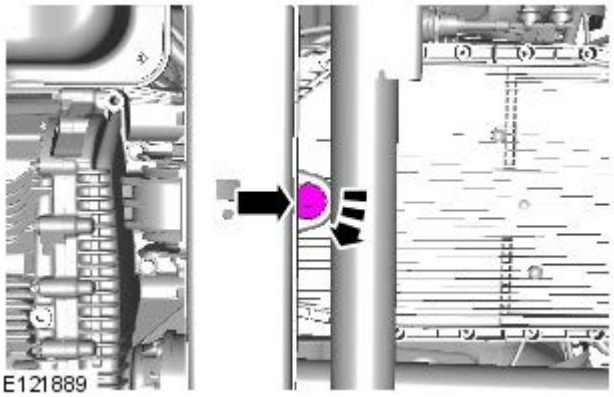


6.
- Allow the fluid to drain.
- Discard the component.



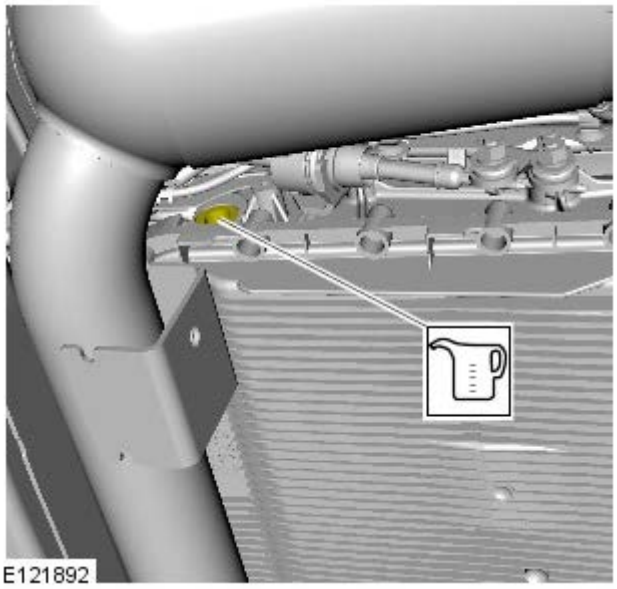
Filling

1. *Torque:* 8 Nm

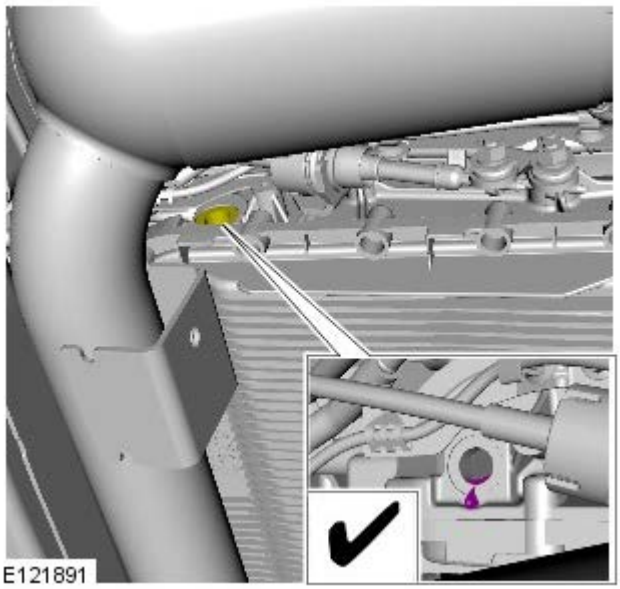


2.

- Refill the transmission with fluid.
- Use transmission fluid meeting Land Rover specification.

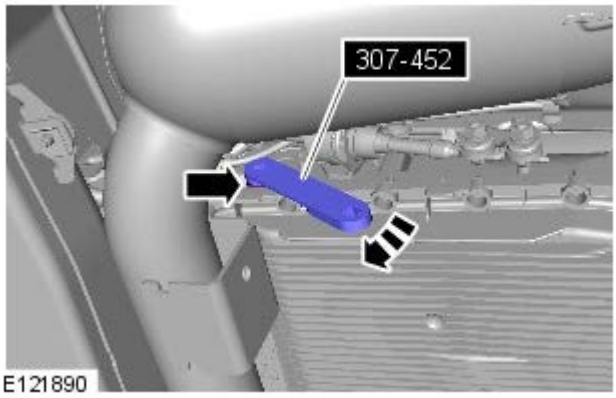


3. Allow the transmission fluid to drain from the transmission fluid filler plug hole until the flow almost stops.

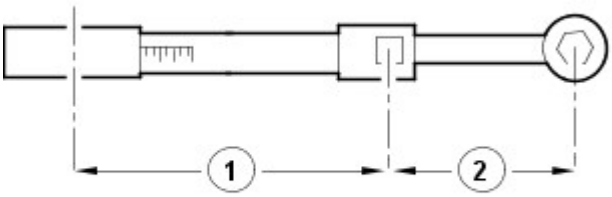


4. NOTE: Install a new sealing washer.

- Loosely install the transmission fluid fill plug.



E121890

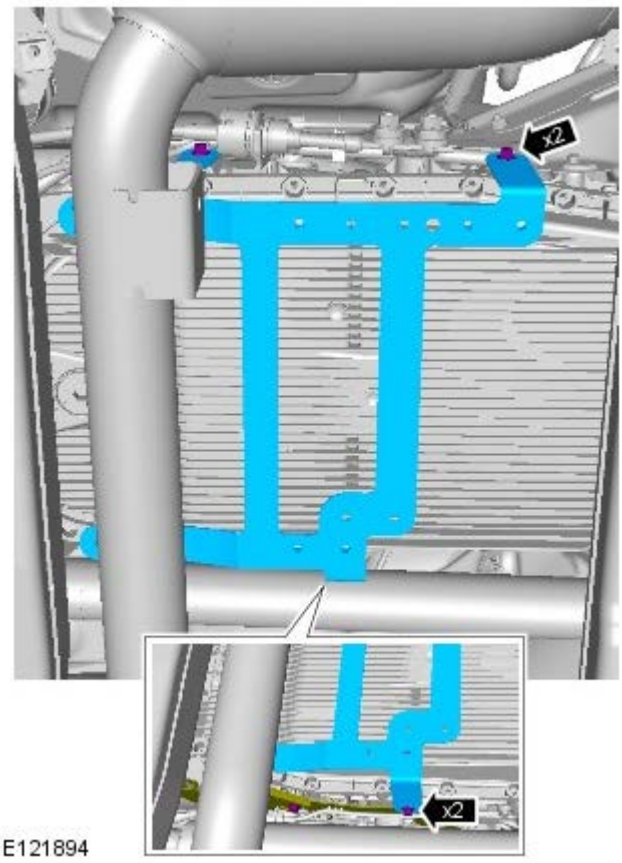


E37107

5. CAUTION: Make sure the transmission fluid fill plug is tightened to the correct specification. Failure to follow this instruction may result in damage to the vehicle.
   - To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
   - 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 (1).
   - 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.
   - Tighten the transmission fluid fill plug to the torque given by the calculation.
6. Carry out a transmission fluid level check.

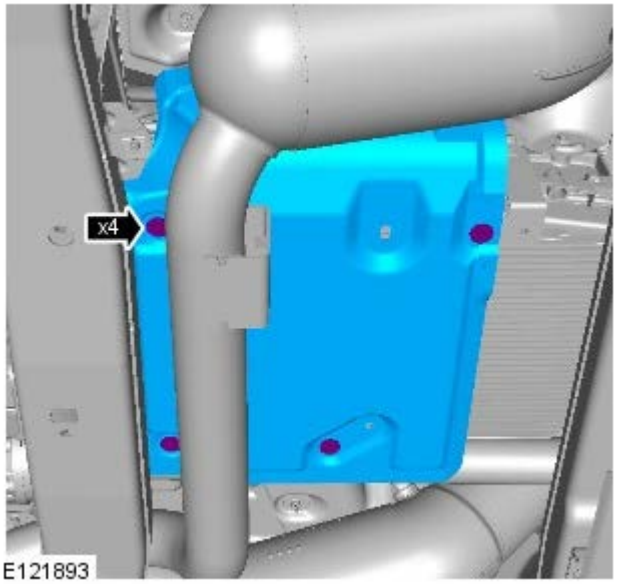
   Refer to: Transmission Fluid Level Check (307-01, General Procedures).

7. *Torque:* 9 Nm



E121894

8. *Torque:* 9 Nm



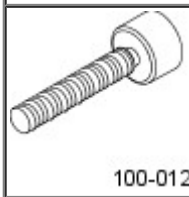
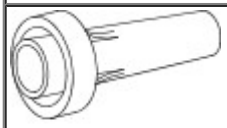
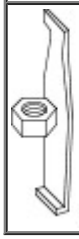
9. Lower the vehicle.

Published: 11-May-2011

Automatic Transmission/Transaxle - TDV6 3.0L Diesel /V8 5.0L Petrol/V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Input Shaft Seal

Removal and Installation

Special Tool(s)

 E54135	100-012 Slide Hammer
 100-012-01	100-012-01 Slide Hammer Adapter
 E84067	307-613 Holding Pins, Torque Converter
 308246	308-246 Installer, Front Seal
 308-375	308-375 Remover, Input and Output Seal

Removal

1. WARNING: Make sure to support the vehicle with axle stands.

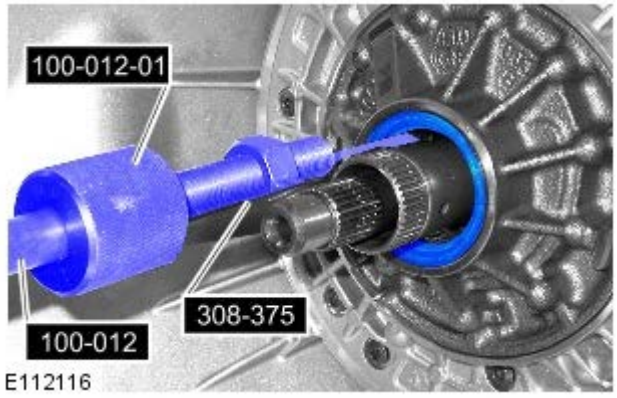
   Raise and support the vehicle.

2. Refer to: Transmission - 3.0L Diesel (307-01B, Removal). Refer to: Transmission - 5.0L (307-01 Automatic Transmission/Transaxle - 3.0L Diesel, 5.0L, Removal).

3. *Special Tool(s):* 307-613



E112115



E112116

4. CAUTIONS:

   Take extra care not to damage the edges of the component.

   Discard the seal.

   Special Tool(s): 100-012, 100-012-01, 308-375

Installation



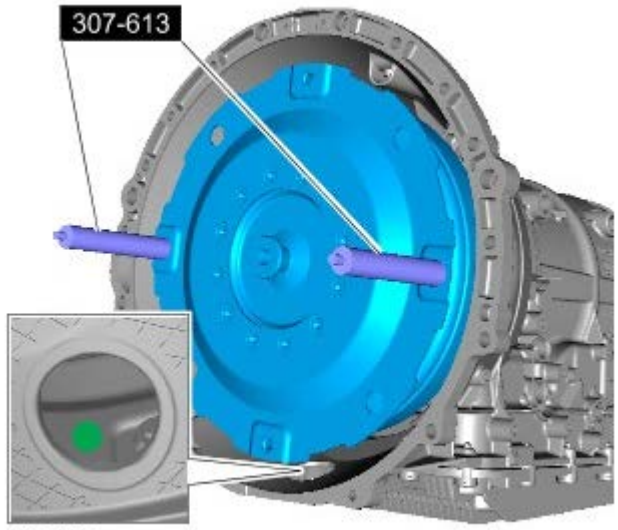
E112117

1. CAUTION: Install a new seal.

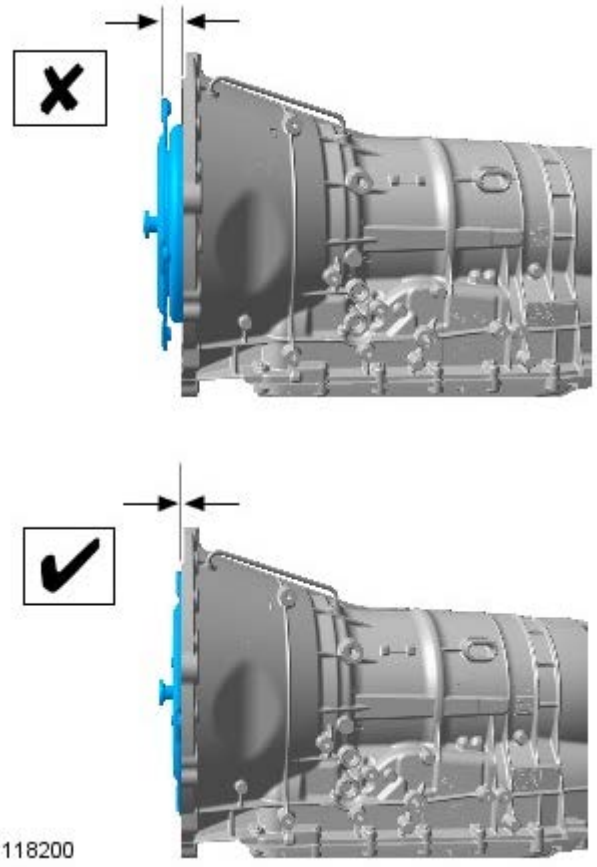
   Special Tool(s): 308-246

2. NOTE: Make sure that the alignment mark is visable through the inspection hole as illustrated.

   Special Tool(s): 307-613



E112118


E118200

3. CAUTION: Make sure the torque converter is fully located into the oil pump drive.

4. Refer to: Transmission - 5.0L (307-01 Automatic Transmission/Transaxle - 3.0L Diesel, 5.0L, Installation).
Refer to: Transmission - 3.0L Diesel (307-01B, Installation).

Published: 11-May-2011

Automatic Transmission / Transaxle - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Extension Housing Seal

Removal and Installation

Special Tool(s)

	303-903 Remover, Input Shaft Seal
	307-520 Installer, Output Shaft Seal

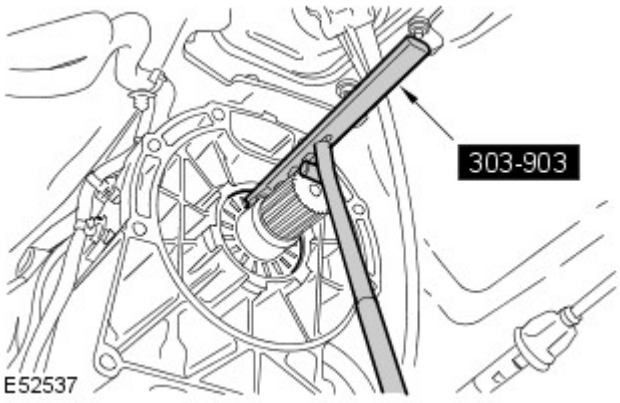
Removal

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the transfer case.

   Refer to: Transfer Case - 5.0L (308-07, Removal).
   Refer to: Transfer Case - 3.0L Diesel (308-07B, Removal).



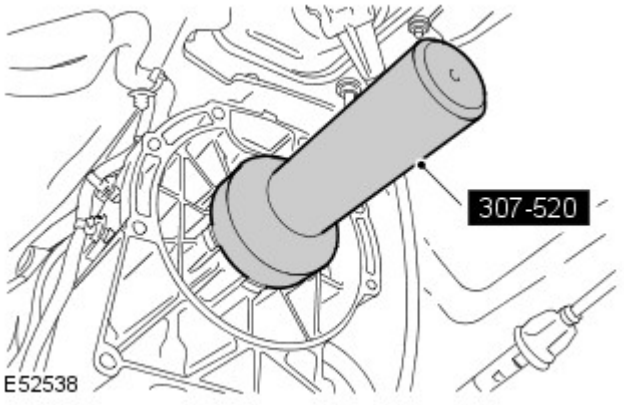
3. CAUTION: Care must be taken to avoid damage to the seal register and running surface.
   - Remove the transmission output shaft oil seal.
   - Use the special tool.
   - *Special Tool(s):* 303-903

Installation

1. CAUTIONS:

   Oil seals must be fitted dry.

   Make sure that the mating faces are clean and free of foreign material.
   - Install a new transmission output shaft oil seal.
   - Clean the seal register.
   - Use the special tool.
   - *Special Tool(s):* 307-520



2. Install the transfer case.

   Refer to: Transfer Case - 5.0L (308-07, Removal).
   Refer to: Transfer Case - 3.0L Diesel (308-07B, Removal).

3. Check and top-up the transmission fluid level.

   Refer to: Transmission Fluid Level Check (307-01, General Procedures).

Published: 11-May-2011

Automatic Transmission / Transaxle - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission Control Module (TCM) and Main Control Valve Body

Removal and Installation

Removal

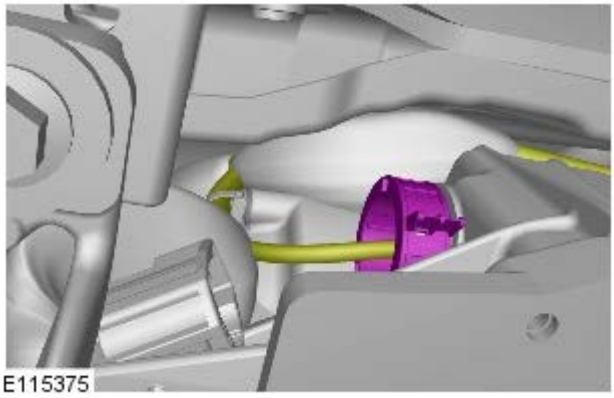
NOTE: The transmission control module (TCM) is part of the main control valve body and cannot be serviced separately.

1. WARNING: Make sure to support the vehicle with axle stands.

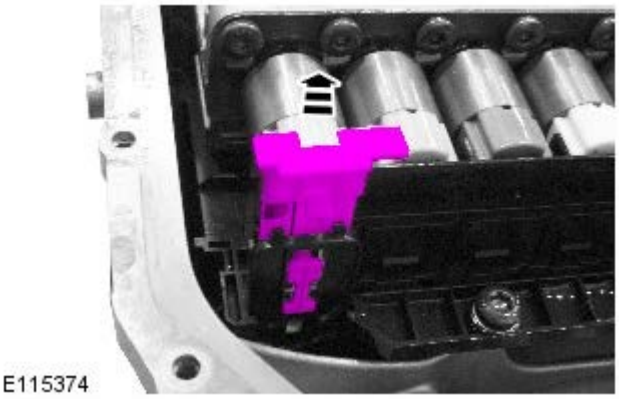
   Raise and support the vehicle.

2. Refer to: Transmission Fluid Pan, Gasket and Filter (307-01, Removal and Installation).

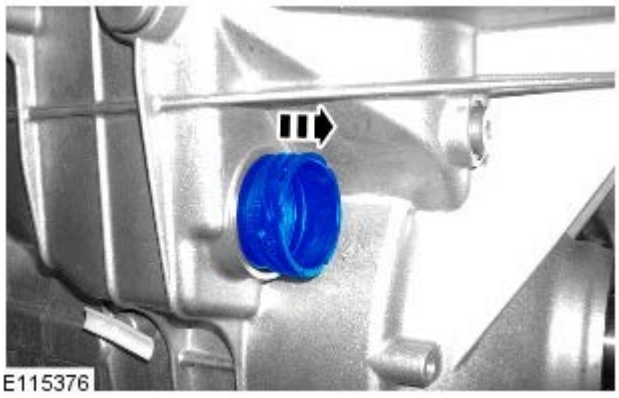
3.



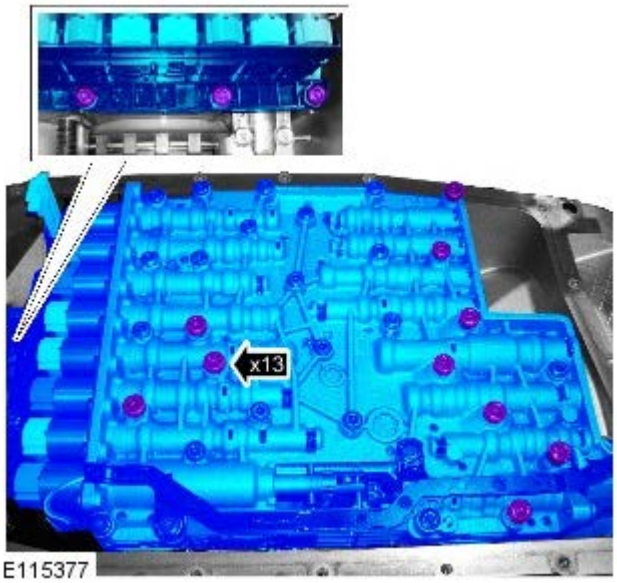
4.



5. CAUTION: Discard the component.



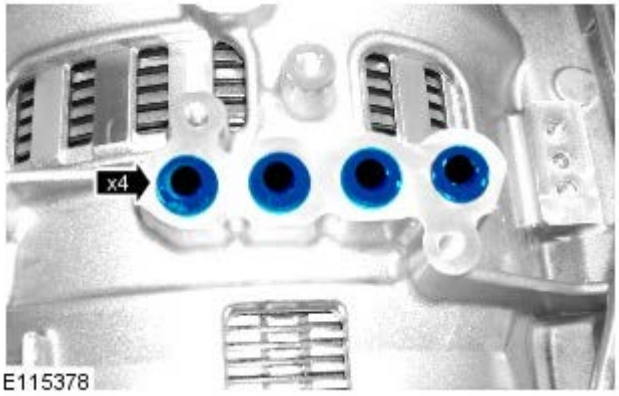
6. CAUTION: Be prepared to collect escaping



fluids.

NOTE: Note the position of the manual park brake release.

7.



8.



Installation

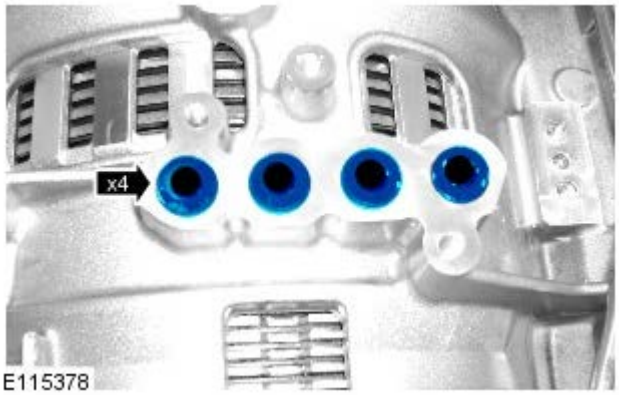


1. CAUTIONS:

   Make sure that when fully fitted, all seals protrude by the same amount.

   Install the new seals.

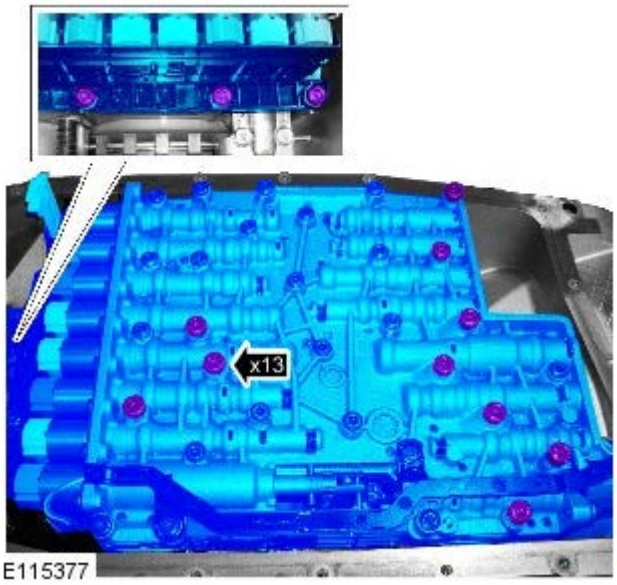
   - Install a new seal block.



2. CAUTIONS:

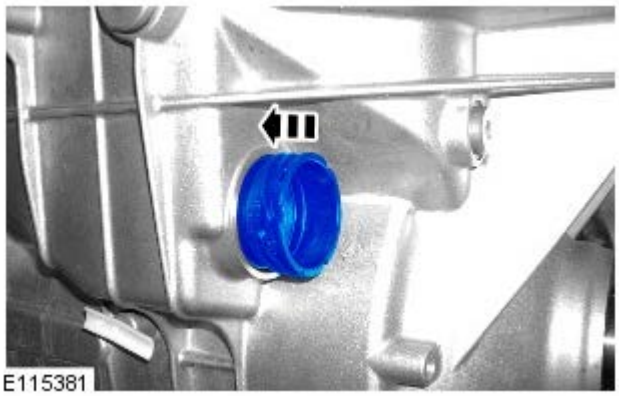
   Install the new seals.

   Make sure that when fully fitted, all seals protrude by the same amount.



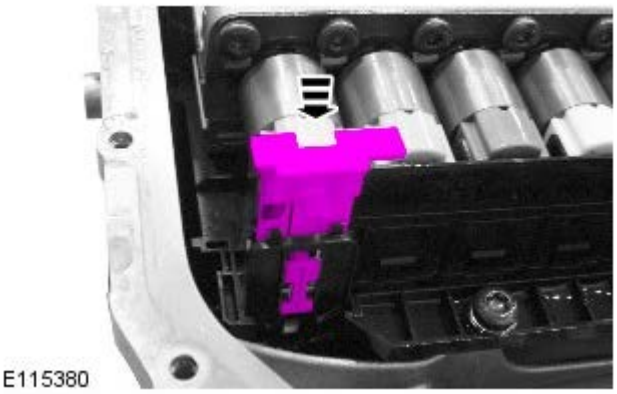
3. CAUTION: Make sure the manual park release is correctly engaged.

   Torque: 8 Nm

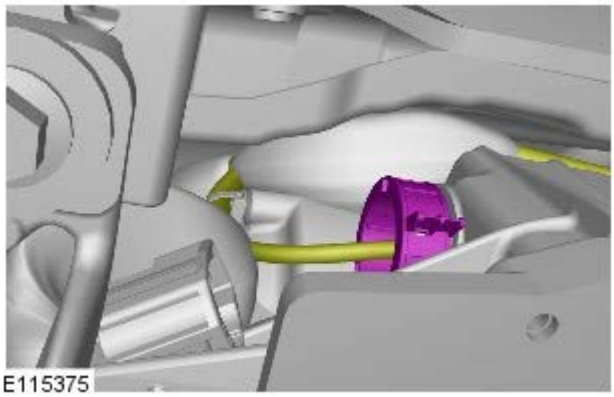


4. CAUTION: Make sure that a new component is installed.

5.



6.


E115375

7. Refer to: Transmission Fluid Pan, Gasket and Filter (307-01, Removal and Installation).

8. If a new component has been installed, configure using Jaguar approved diagnostic equipment.

Published: 06-Dec-2011

Automatic Transmission / Transaxle - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission Fluid Pan, Gasket and Filter

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

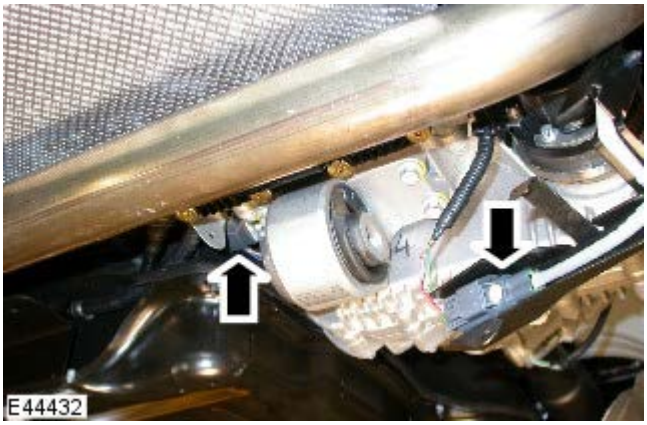
2. Refer to: Transmission Fluid Drain and Refill (307-01, General Procedures).

3. Refer to: Transmission Support Crossmember - 5.0L (502-02, Removal and Installation).

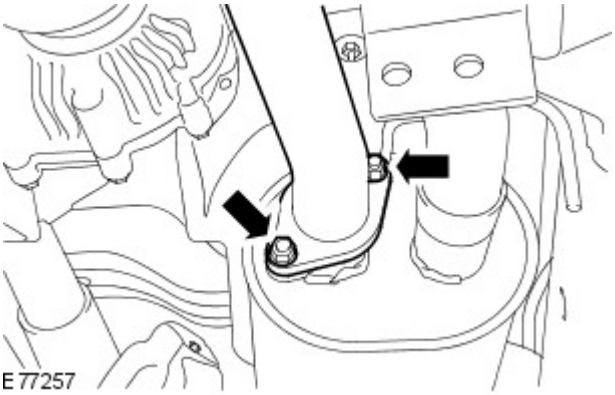
4.



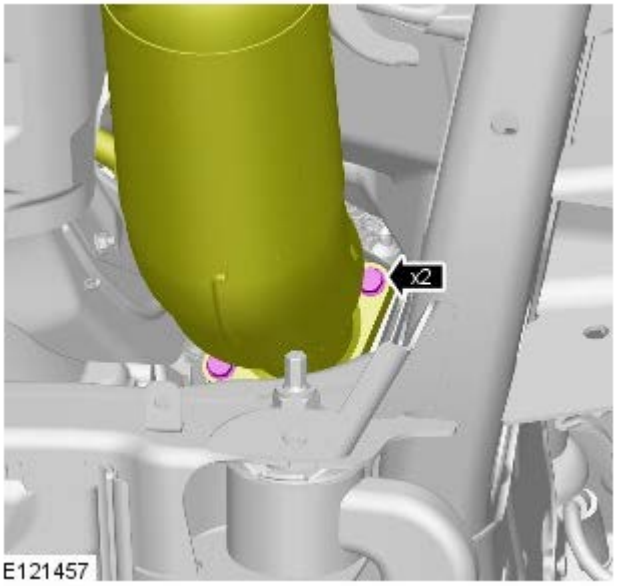
5.



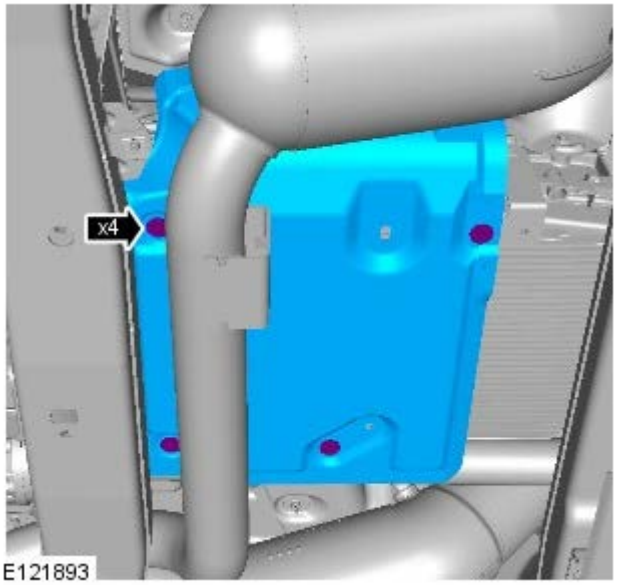
6.



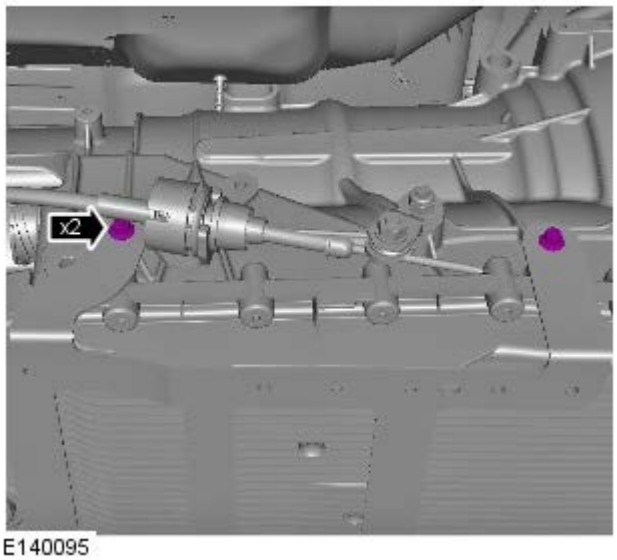
7. NOTE: Install a new gasket.



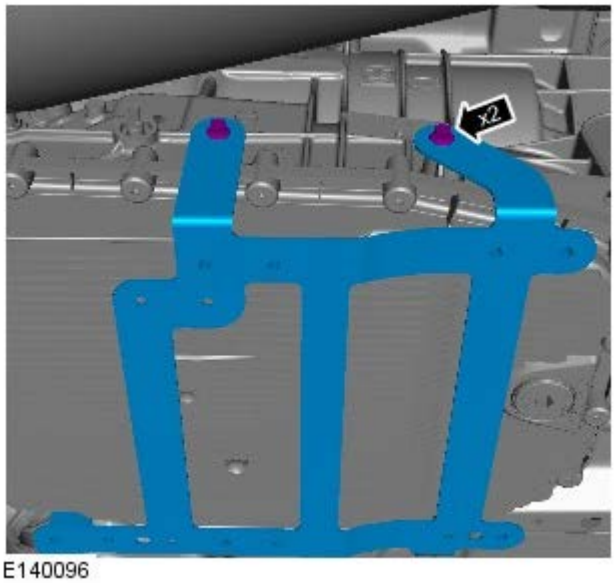
8.



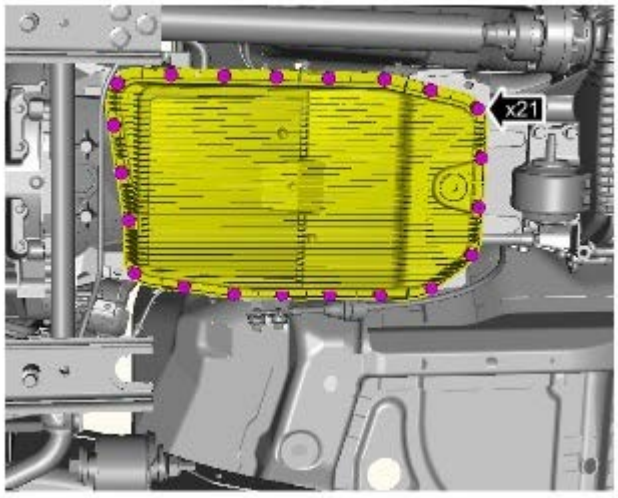
9.

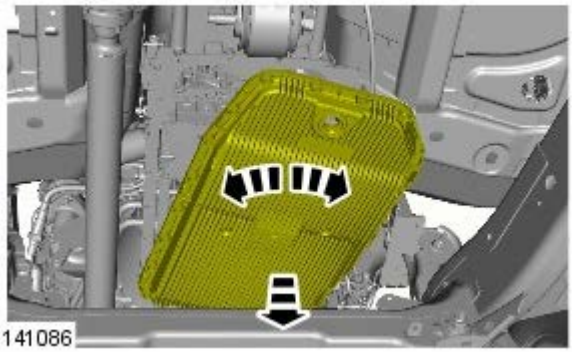


10.



E140096



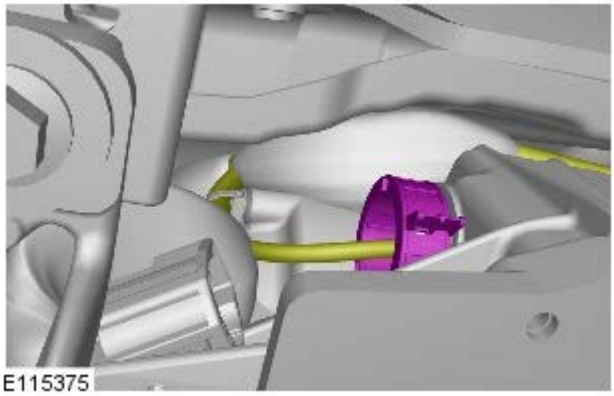

E141086

11. CAUTION: Be prepared to collect escaping fluids.

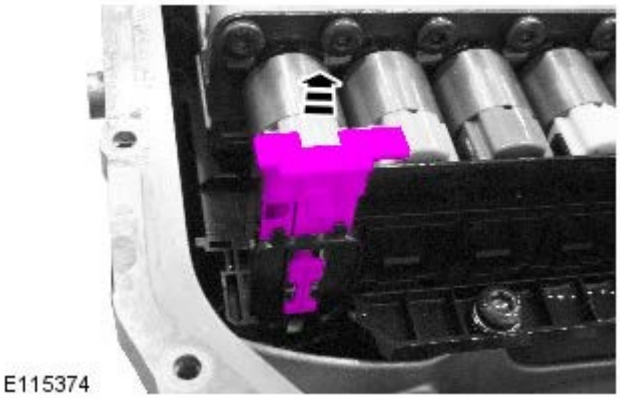
NOTE: The component cannot be removed at this stage.

Detach the transmission fluid pan from the transmission.

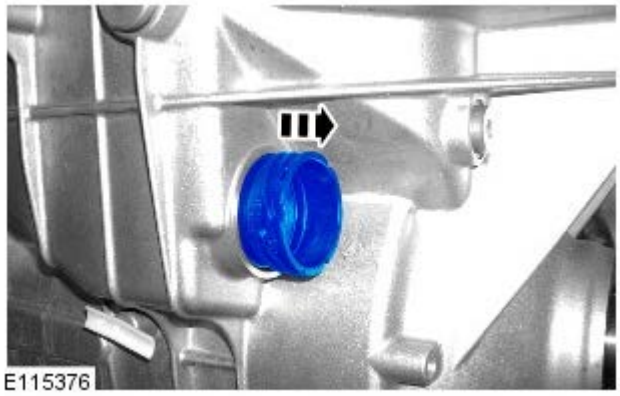
12.


E115375

13.


E115374

14. CAUTION: Discard the component.


E115376

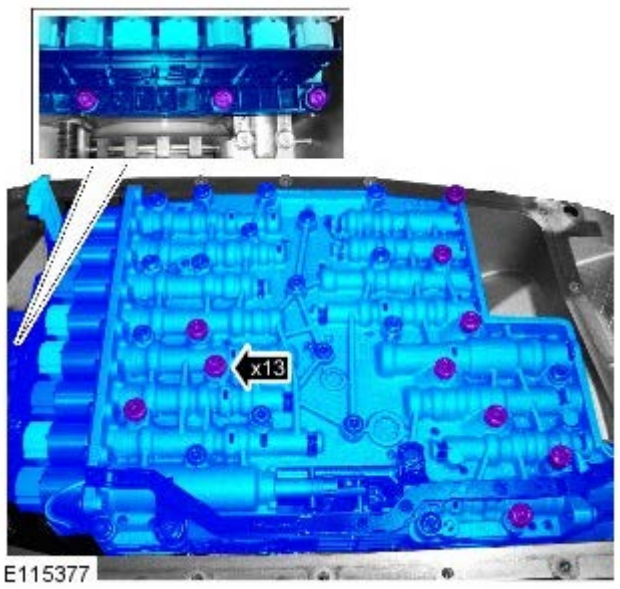
15. CAUTION: Be prepared to collect escaping fluids.

NOTES:

Note the position of the manual park brake release.

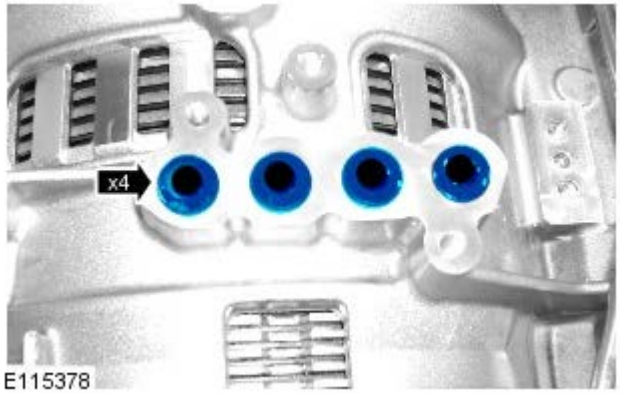
Transmission fluid pan shown removed for clarity.

Remove the transmission control module and the transmission fluid pan.



E115377

16.



E115378

17.



18. Remove the transmission fluid pan and the transmission control module.
19. Remove and discard the gasket.

Installation

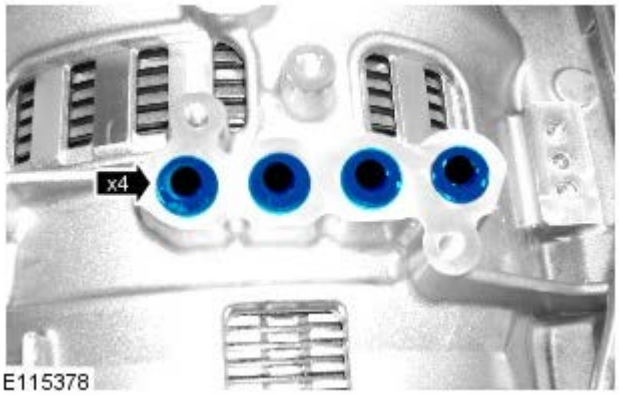


1. CAUTIONS:

   Make sure that when fully fitted, all seals protrude by the same amount.

   Install the new seals.

   - Install a new seal block.



2. CAUTIONS:

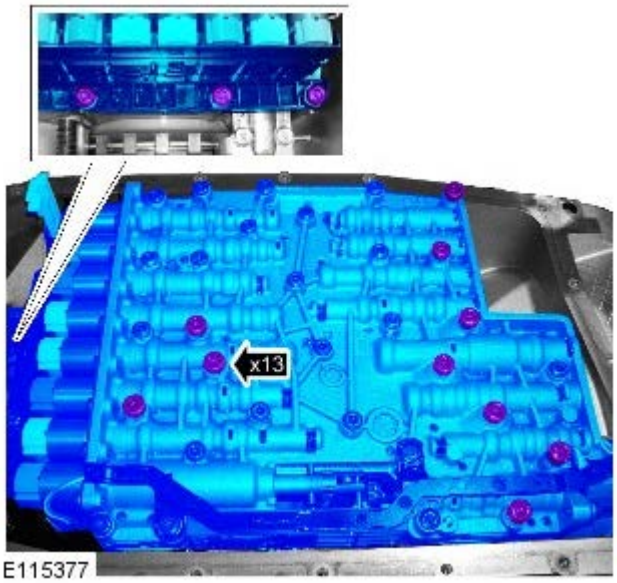
   Install the new seals.

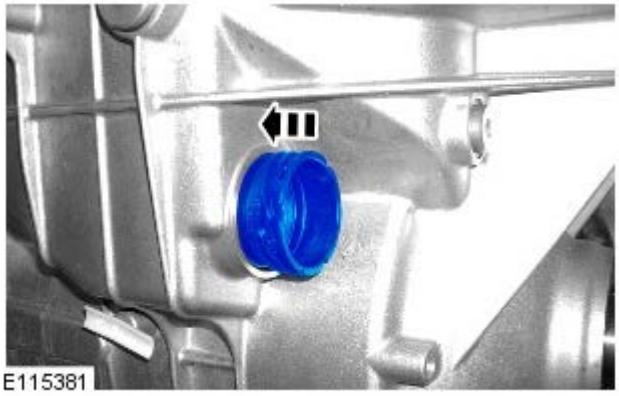
   Make sure that when fully fitted, all seals protrude by the same amount.

3. Install the new gasket.
4. Install the transmission fluid pan and the transmission control module.
5. CAUTION: Make sure the manual park release is correctly engaged.

   NOTE: Transmission fluid pan shown removed for clarity.

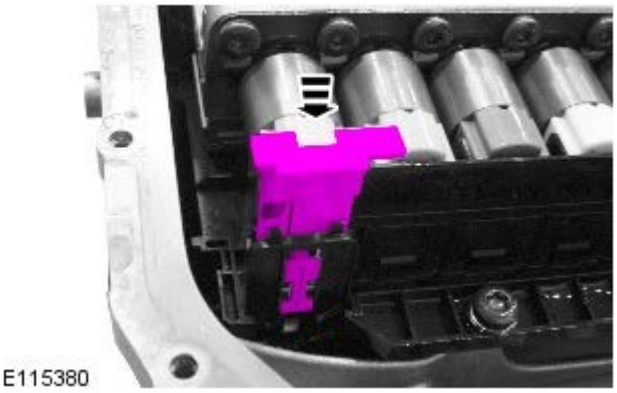
   Tighten to 8 Nm.



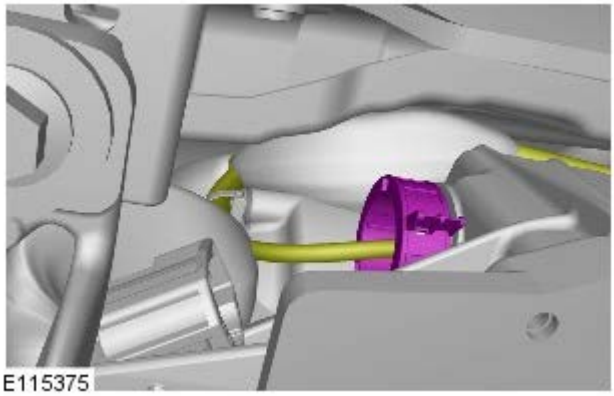


6. CAUTION: Make sure that a new component is installed.

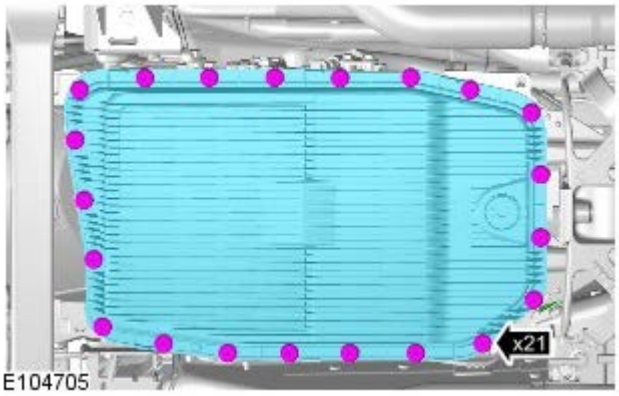
7.



8.

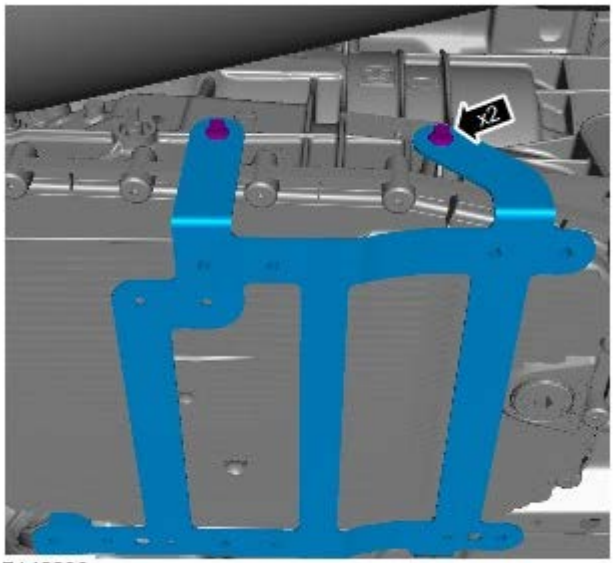


9. Tighten to 8 Nm.



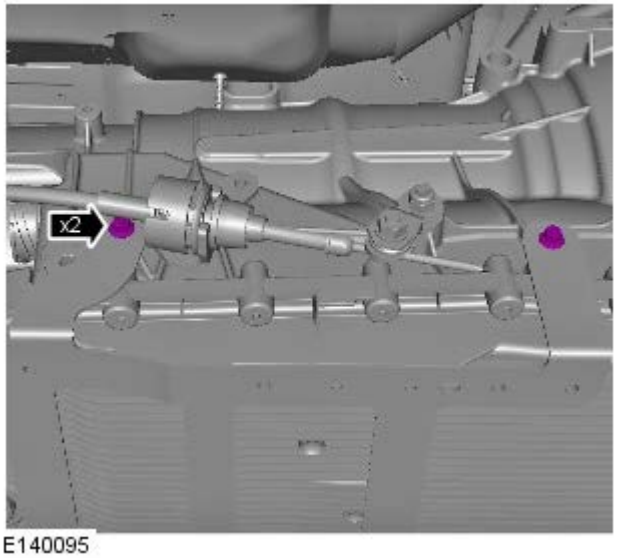
E104705

10.



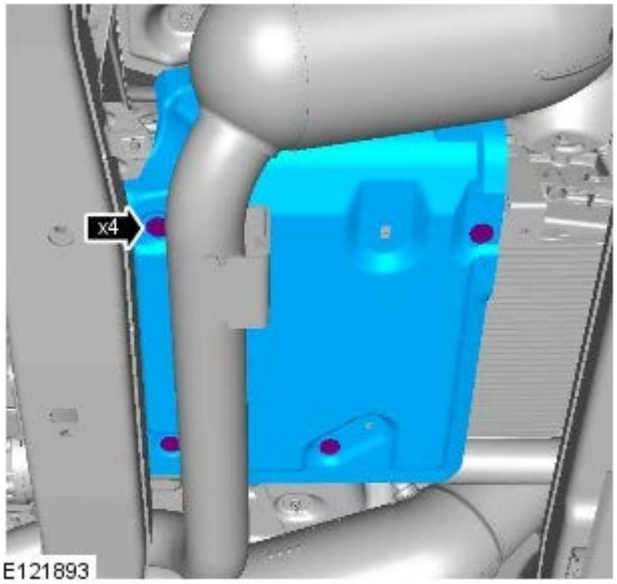
E140096

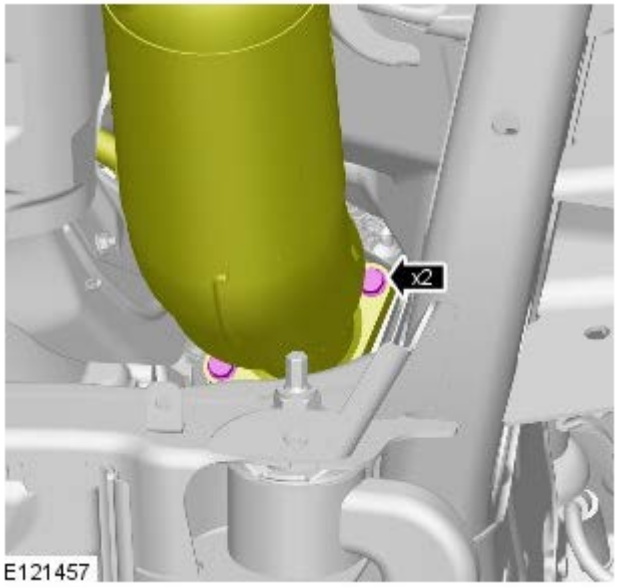
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E140095

12.

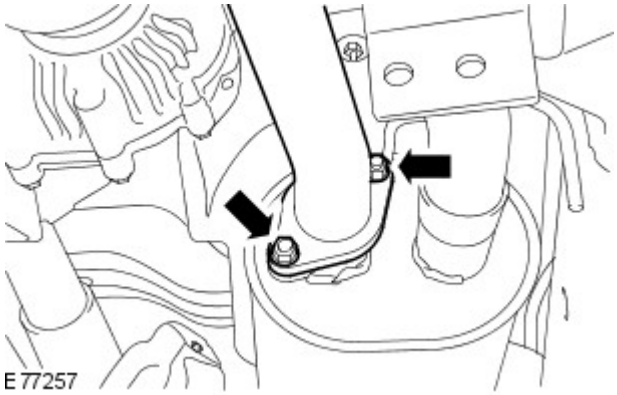




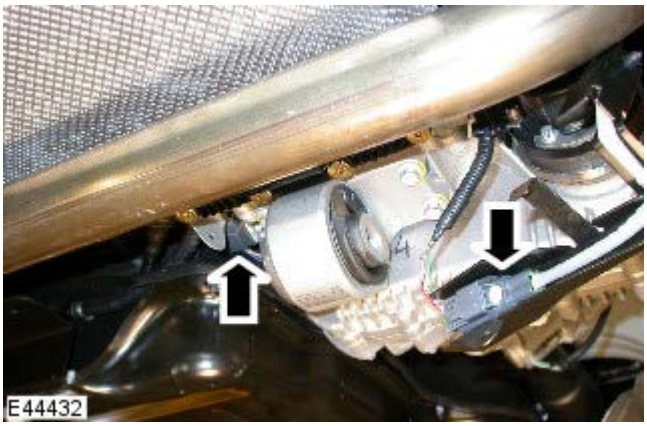
13. NOTE: Install a new gasket.

    Tighten to 22 Nm.

14. Tighten to 22 Nm.



15.



16.



17. Refer to: Transmission Support Crossmember - 5.0L (502-02, Removal and Installation).

18. Refer to: Transmission Fluid Drain and Refill (307-01, General Procedures).

19. Lower the vehicle.

Published: 11-May-2011

Automatic Transmission / Transaxle - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission Support Insulator

Removal and Installation

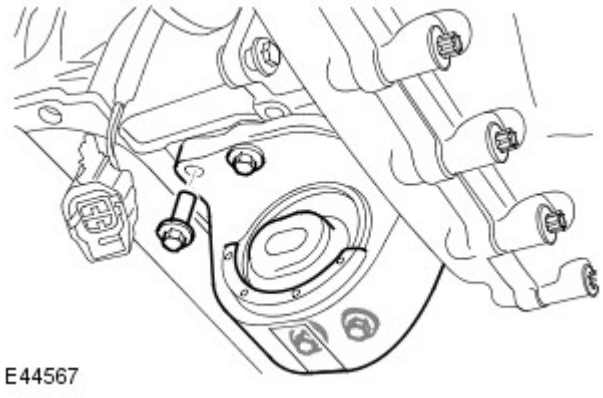
Removal

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the transmission crossmember.
   For additional information, refer to: Transmission Support Crossmember - 5.0L (502-02, Removal and Installation) / Transmission Support Crossmember - 3.0L Diesel (502-02, Removal and Installation).

3. Remove the transmission support insulator.
   - Remove the 4 bolts.



Installation

1. To install, reverse the removal procedure.
   - Clean the component mating faces.
   - Tighten the bolts to 60 Nm (44 lb.ft).

Published: 11-May-2011

Automatic Transmission/Transaxle - TDV6 3.0L Diesel /V8 5.0L Petrol/V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission V8 5.0L Petrol/V8 S/C 5.0L Petrol

Removal

NOTES:

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

Some illustrations may show the transmission removed for clarity.

Some illustrations may show the engine removed for clarity.

1. Remove the battery.

   Refer to: Battery (414-01, Removal and Installation).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

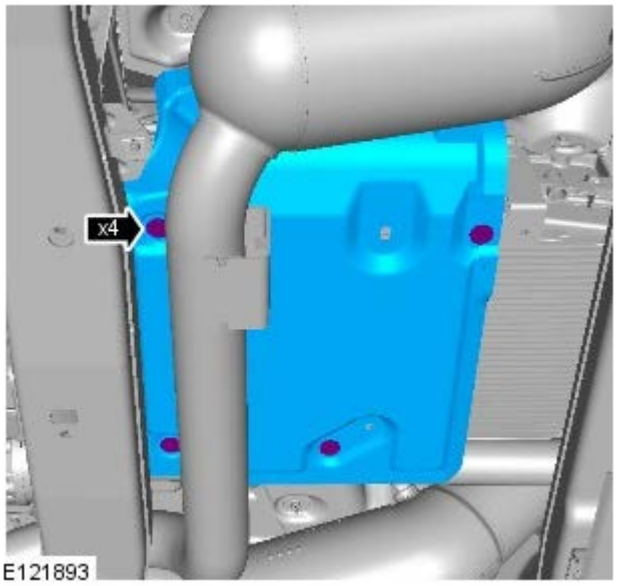
3. Refer to: Rear Driveshaft (205-01, Removal and Installation).

4. Refer to: Exhaust System (309-00, Removal and Installation).

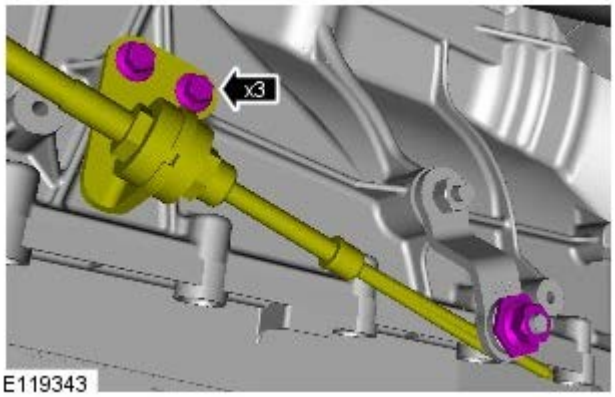
5. Refer to: Front Driveshaft - 5.0L (205-01, Removal and Installation).

6. Refer to: Axle Assembly (205-03, Removal and Installation).

7.

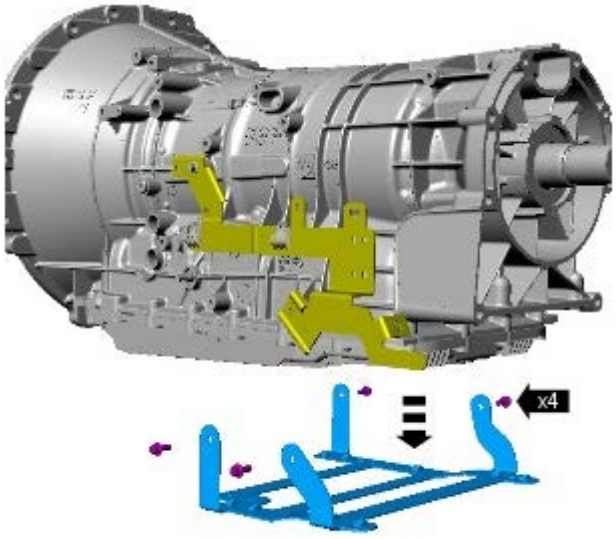


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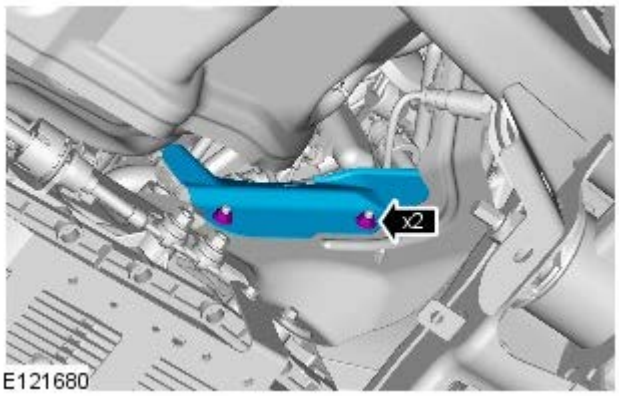
E119343

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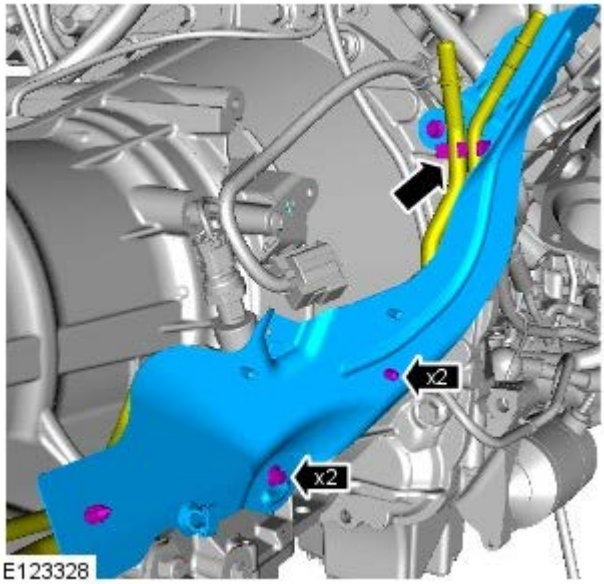
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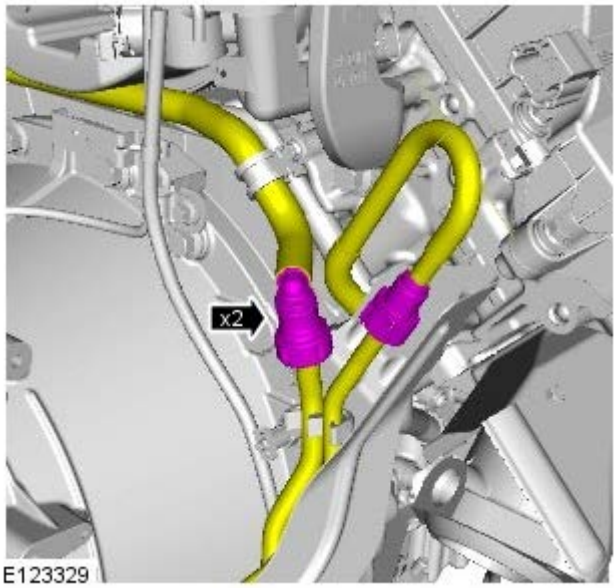
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E121680

11.

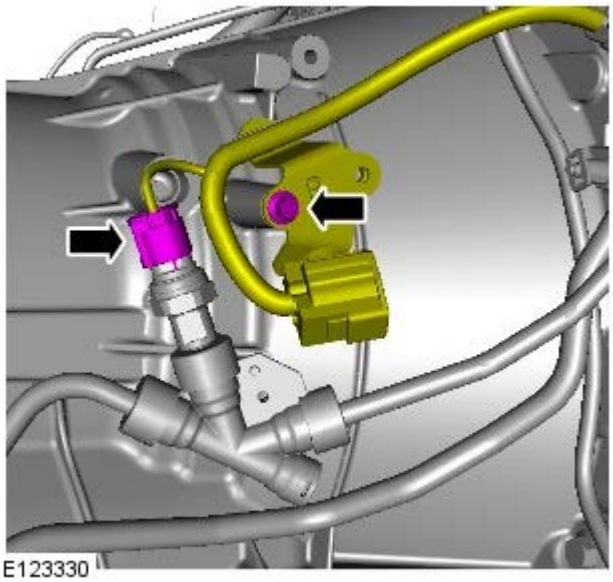




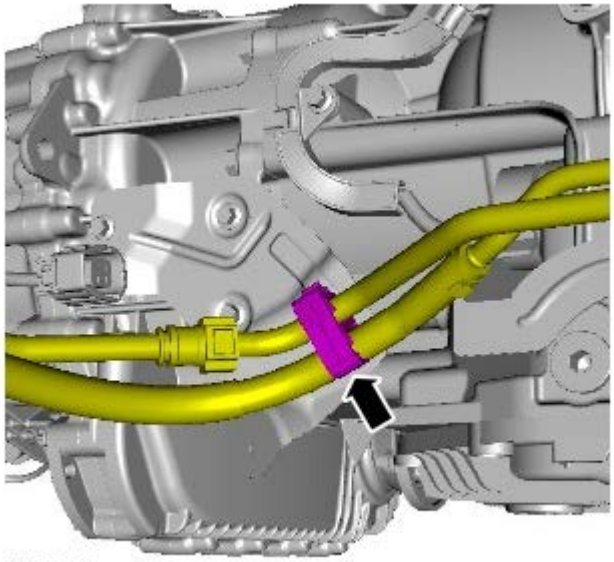
12. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

    CAUTION: Be prepared to collect escaping fluids.

13.

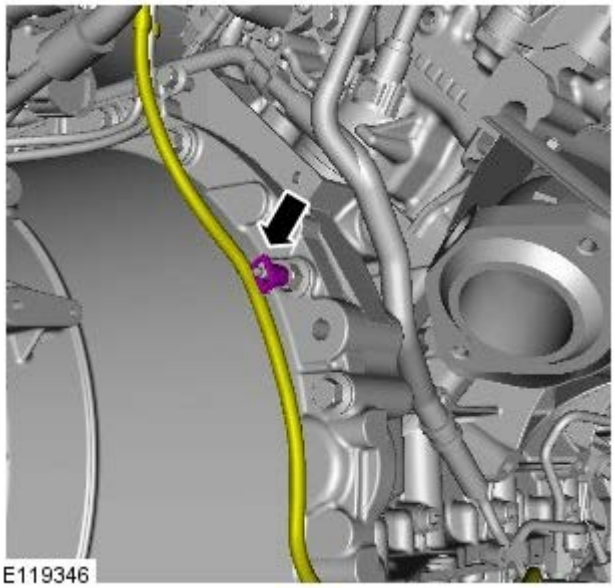


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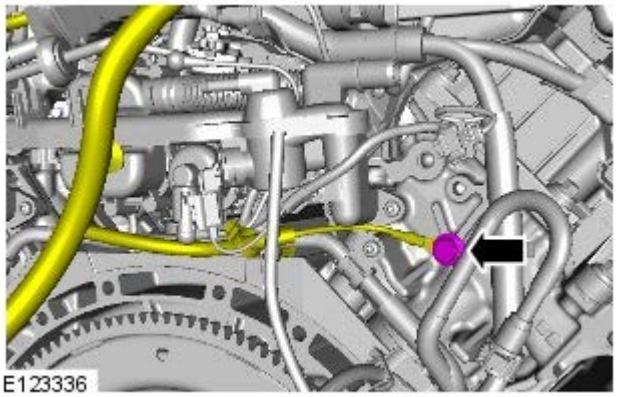
E123332

15.



E119346

16.

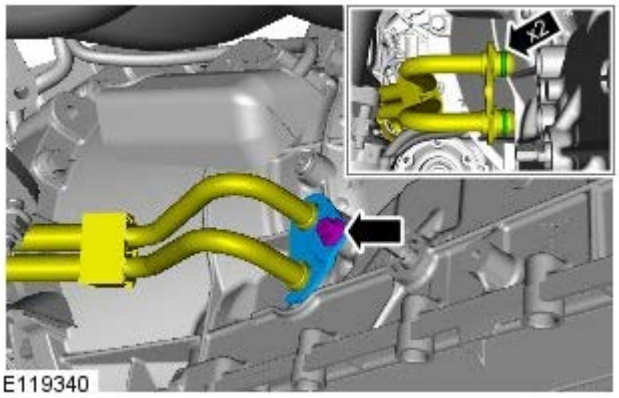


E123336

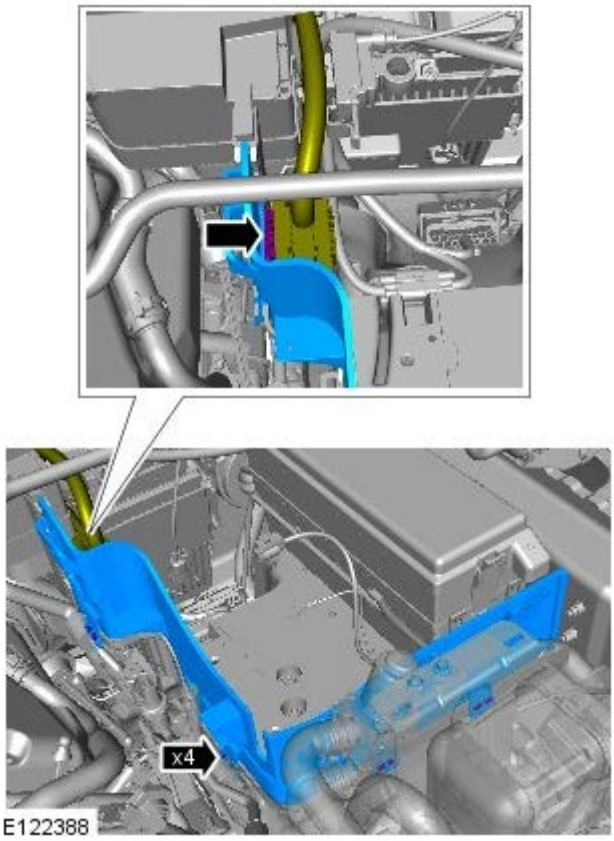
17. WARNING: Be prepared to collect escaping fluids.

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

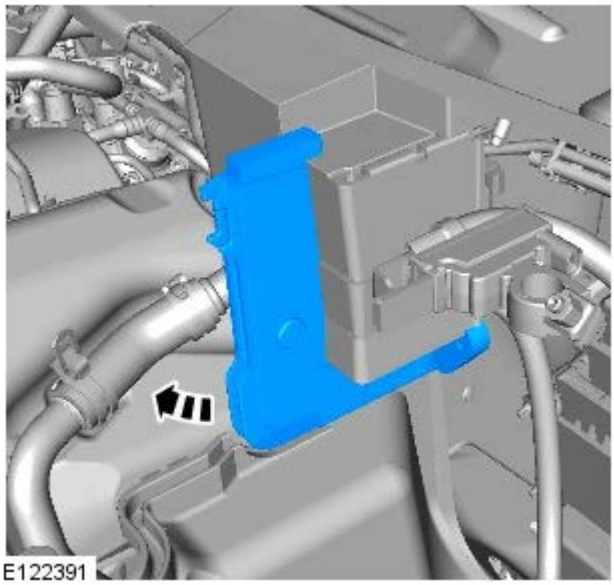
- Remove and discard the 2 O-ring seals.



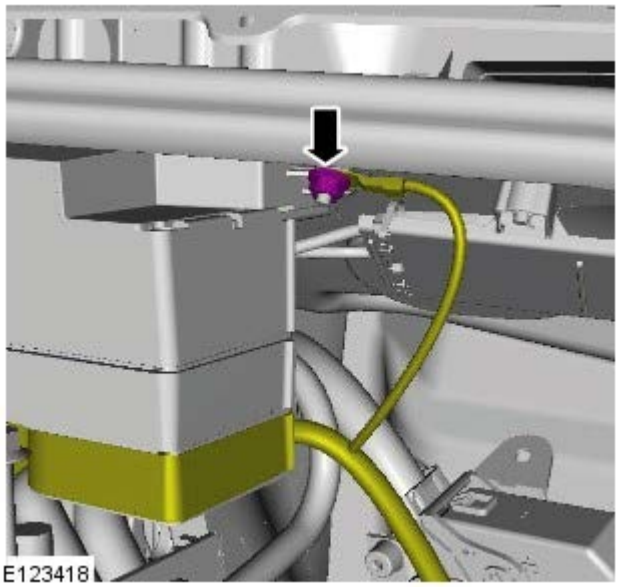
18. NOTE: RHD illustration shown, LHD is similar.



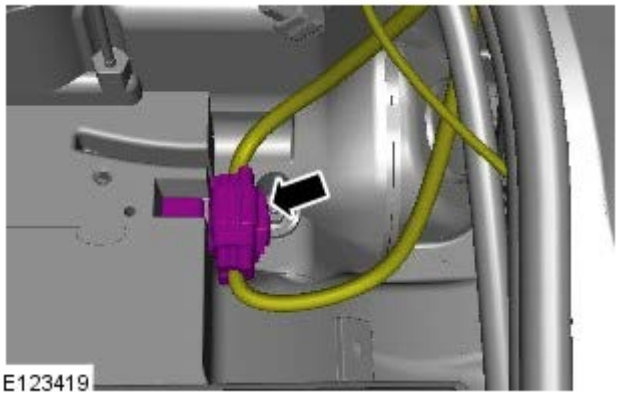
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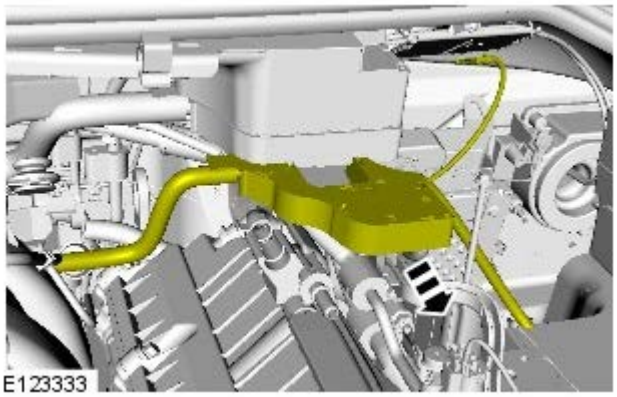
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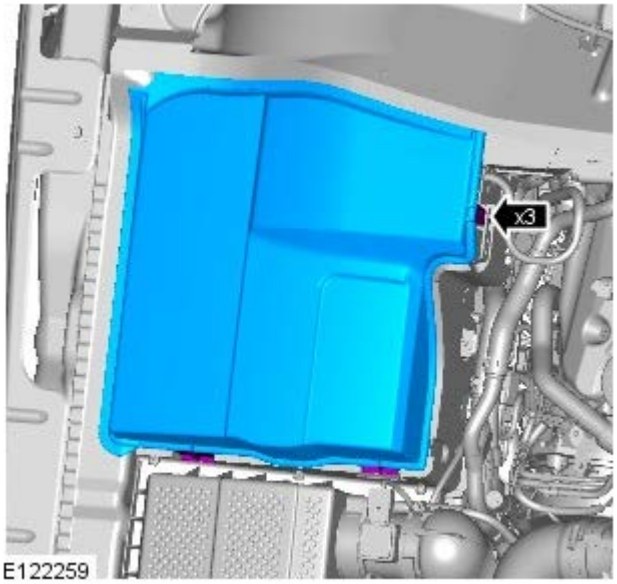
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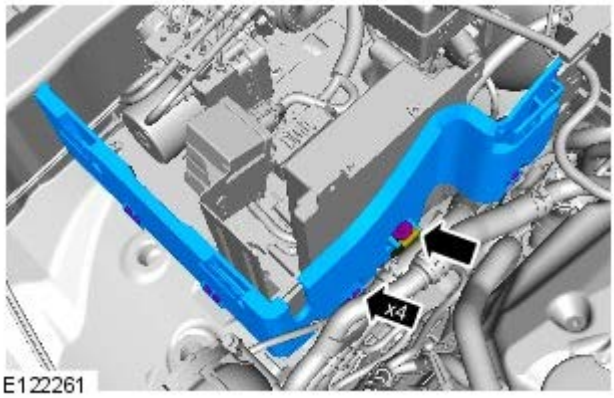
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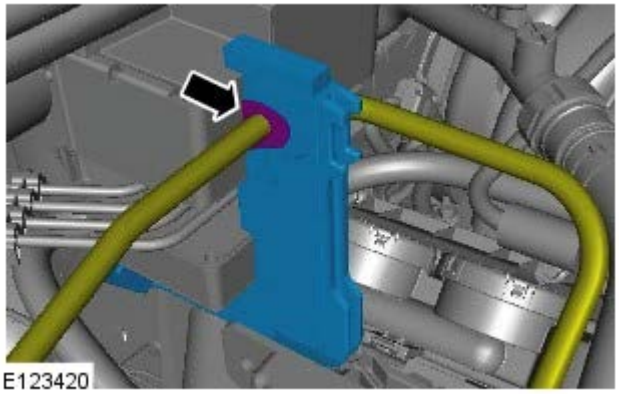
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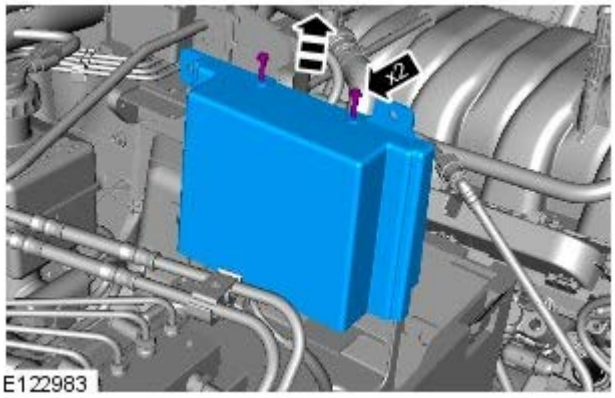
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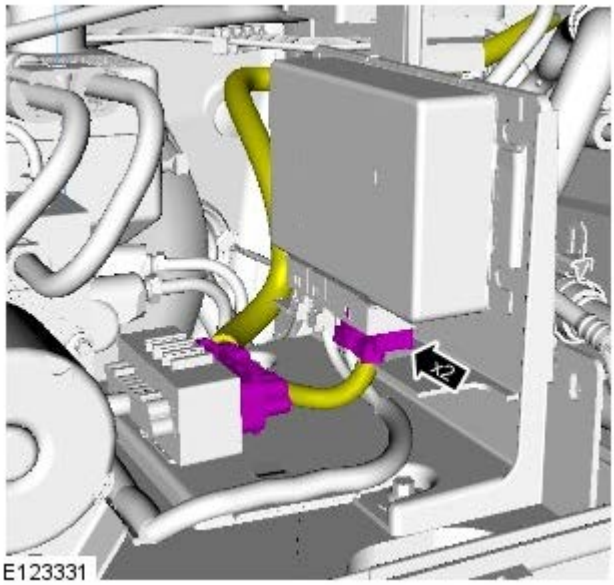
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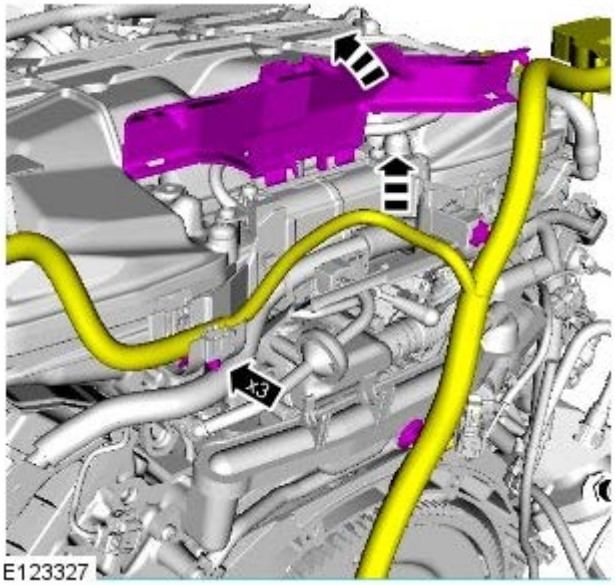
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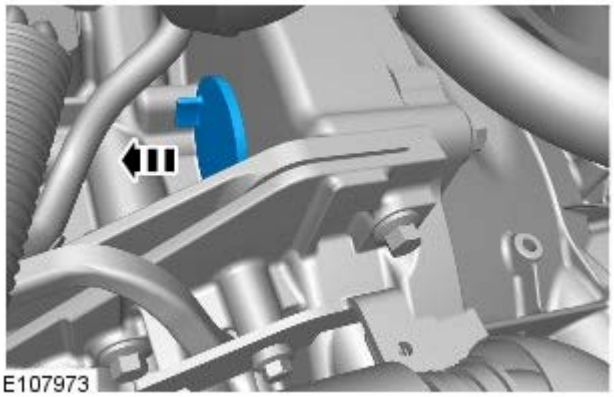
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28.

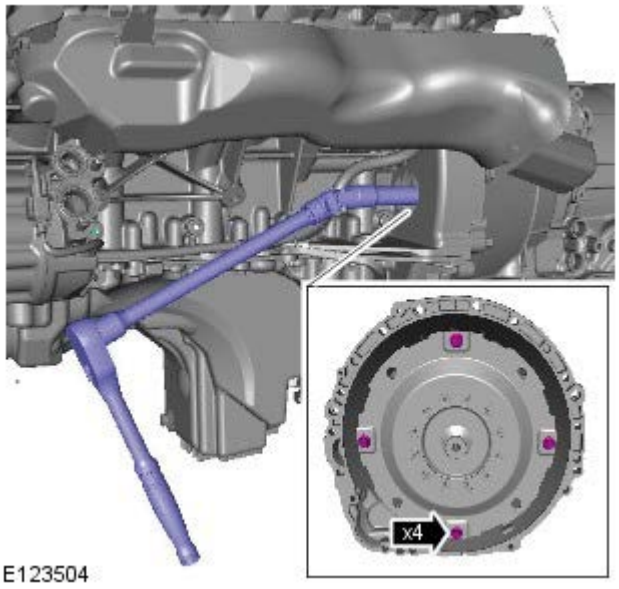


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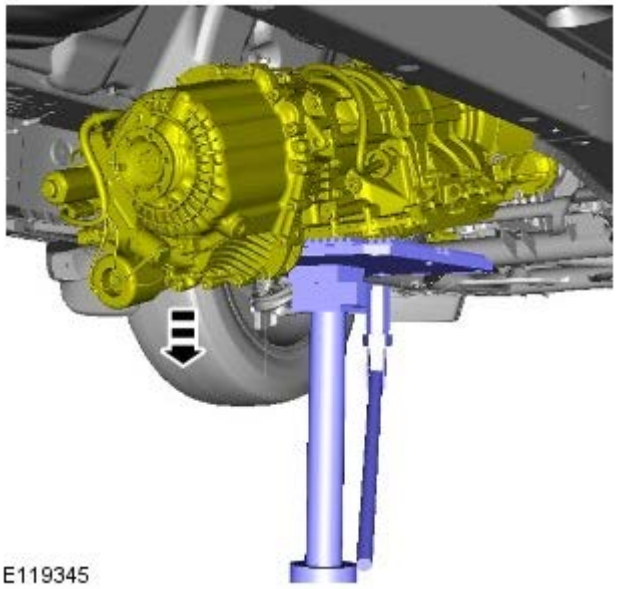


30. CAUTION: Only rotate the crankshaft clockwise.

- Make sure that the alignment mark is visable through the inspection hole on removal of the last torque converter bolt.



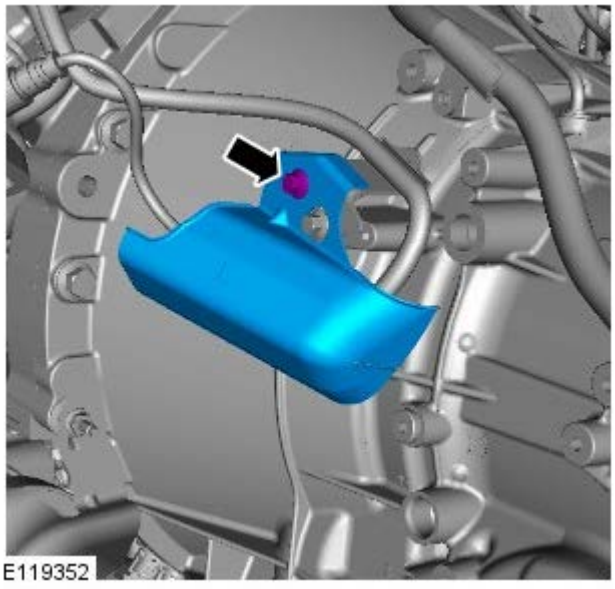
E123504


E119345

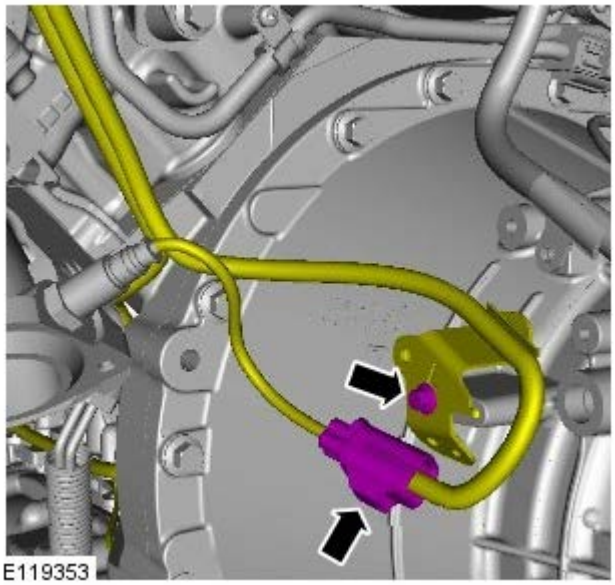
31. WARNING: Make sure that the transmission is secured with suitable retaining straps.

Lower the rear of the transmission for access.

32.

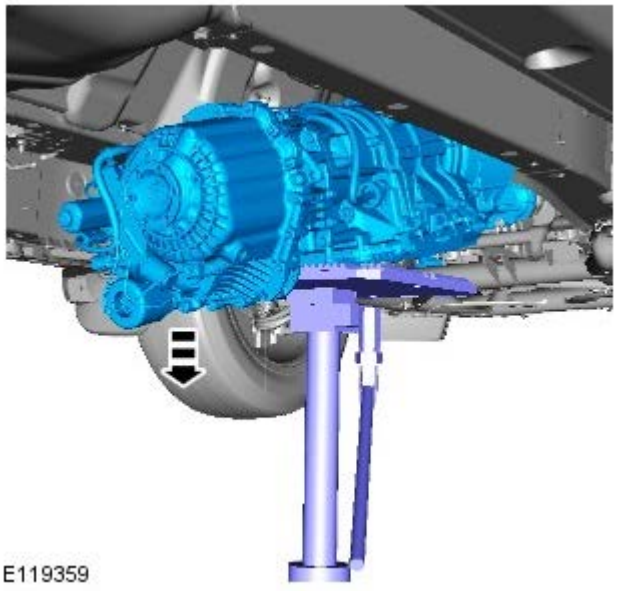

E119352

33.



34.





35. CAUTION: Make sure that the torque converter remains in the transmission.

NOTE: This step requires the aid of another technician.

- Using a suitable hydraulic jack, support the transmission.
- Do not disassemble further if removed for access only
- Install the torque converter retainer.

Published: 29-Apr-2013

Automatic Transmission / Transaxle - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission TDV6 3.0L Diesel

Removal

NOTES:

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

Some illustrations may show the transmission removed for clarity.

Some illustrations may show the engine removed for clarity.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

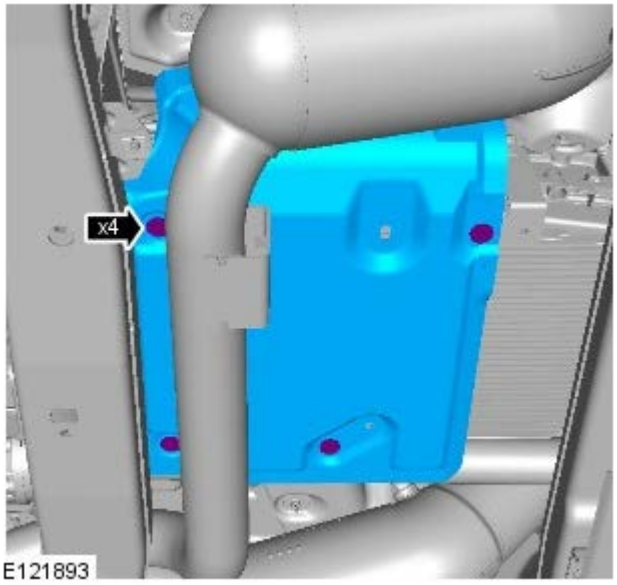
   Raise and support the vehicle.

3. Refer to: Rear Driveshaft (205-01 Driveshaft, Removal and Installation).

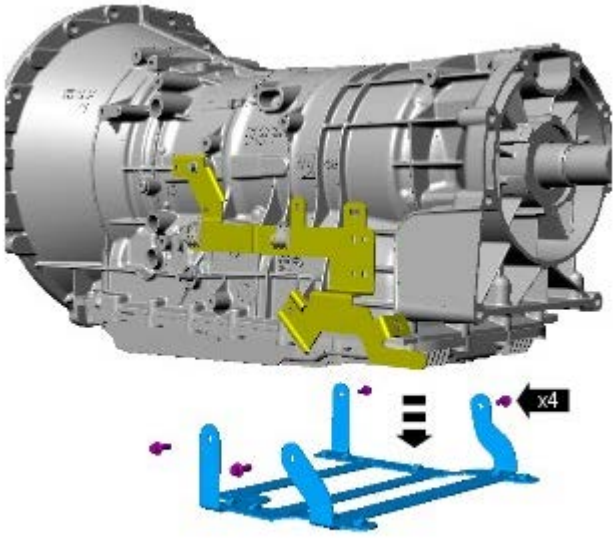
4. Refer to: Exhaust System (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

5. Refer to: Front Driveshaft - TDV6 3.0L Diesel (205-01 Driveshaft, Removal and Installation).

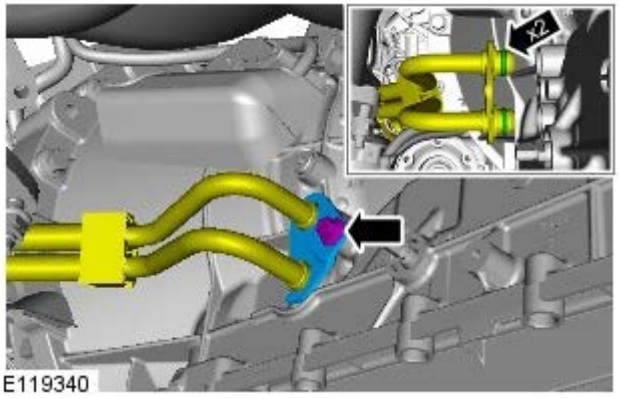
6.



7.



E123334



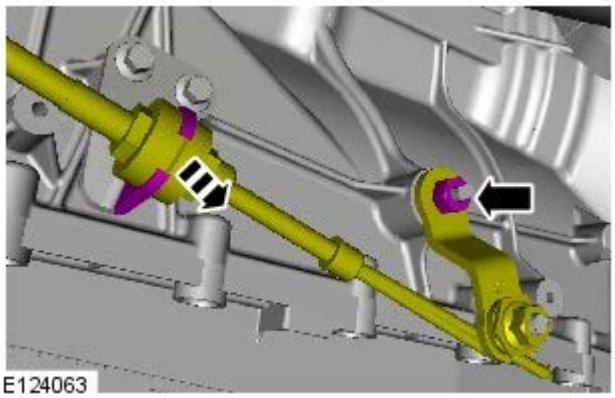
E119340

8. WARNING: Be prepared to collect escaping fluids.

NOTE: Make sure that all openings are sealed. Use new blanking caps.

- Remove and discard the 2 O-ring seals.

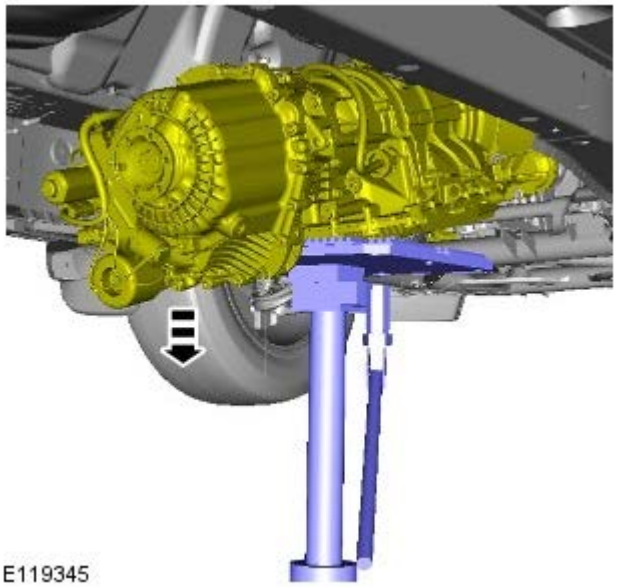
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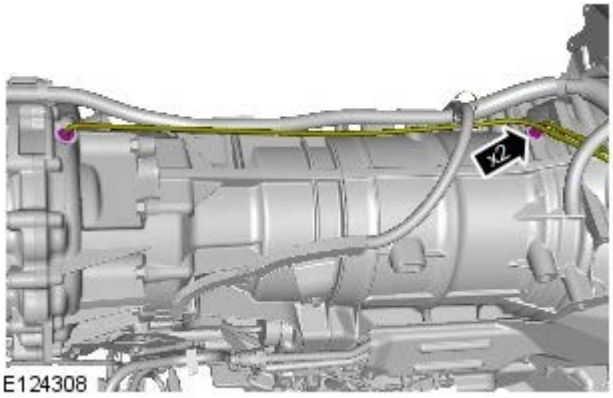
E124063

10. WARNING: Make sure that the transmission is secured with suitable retaining straps.

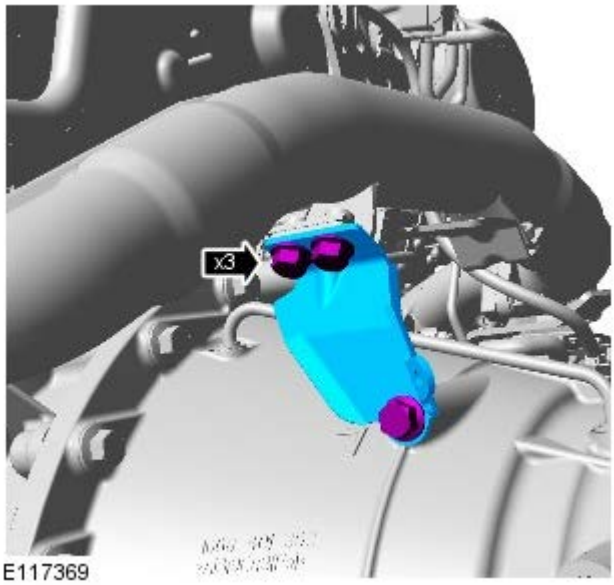
Lower the rear of the transmission for access.



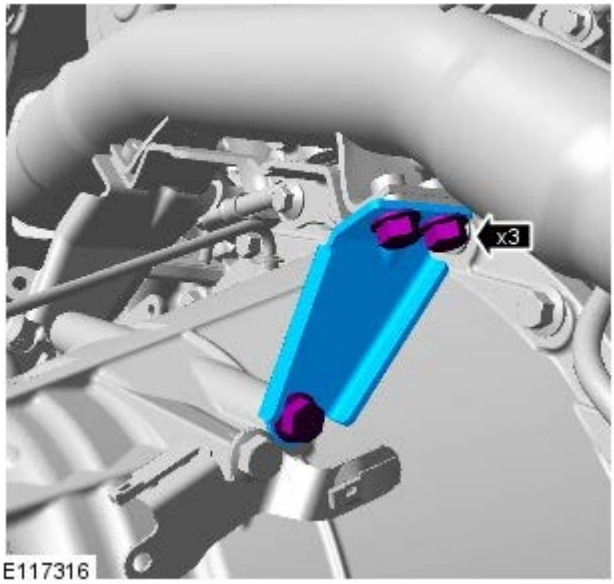
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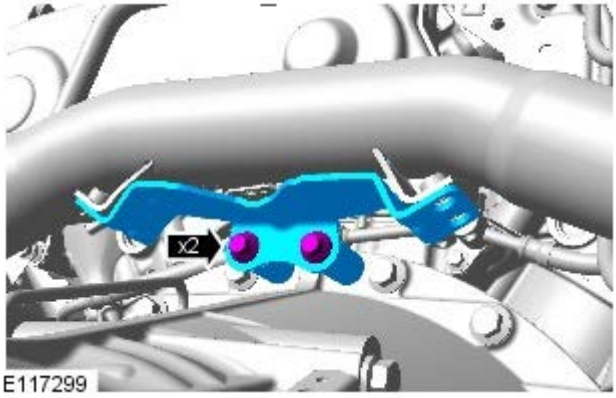
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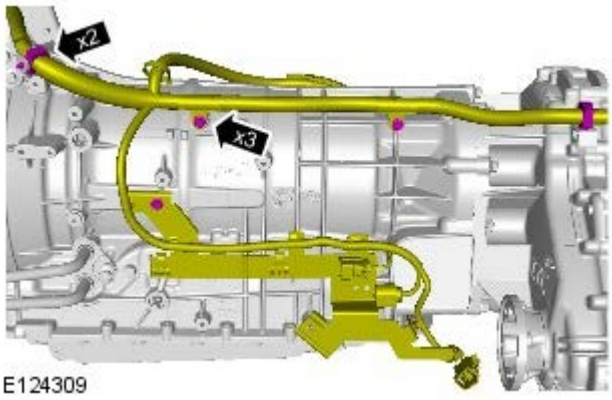
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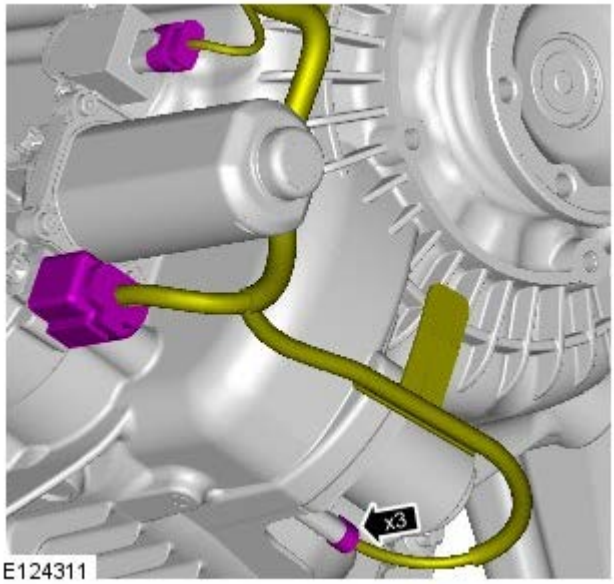
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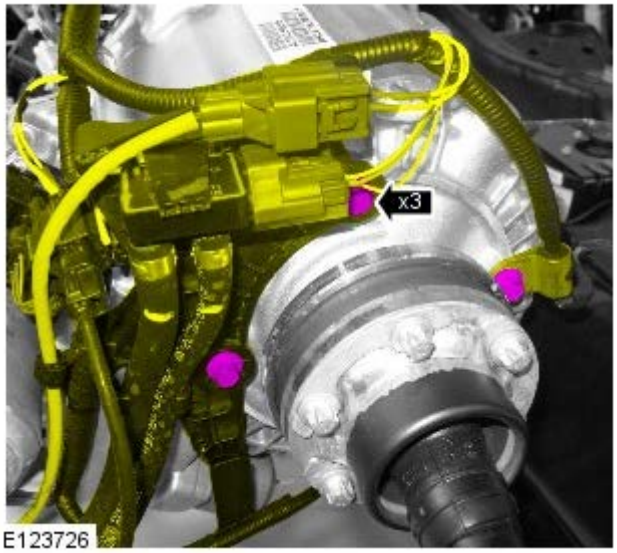
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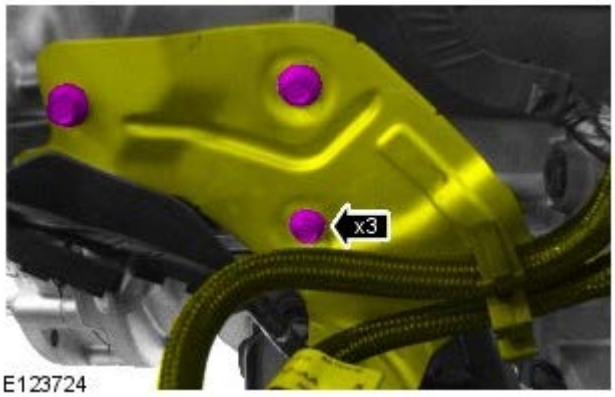
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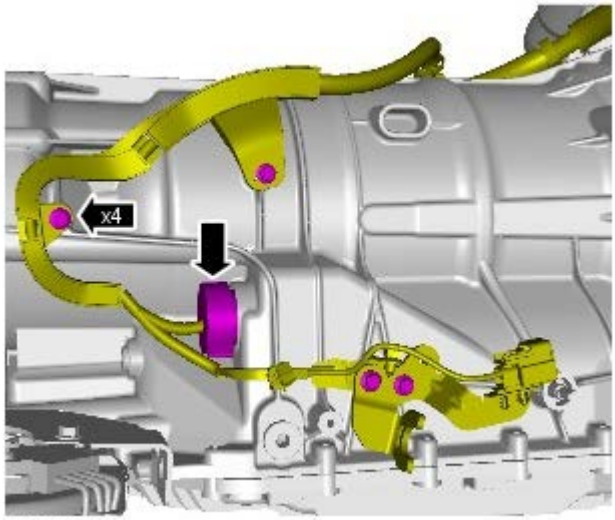
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18.

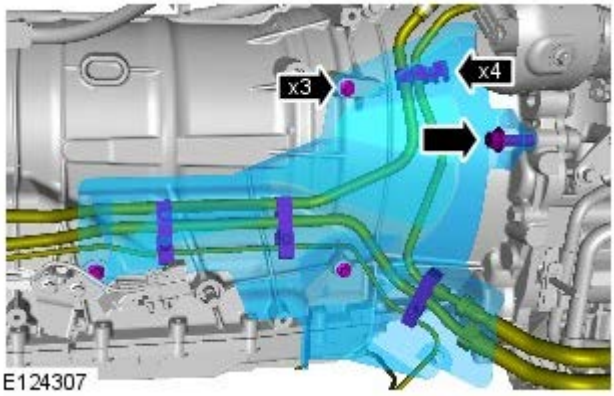


19.



E124310

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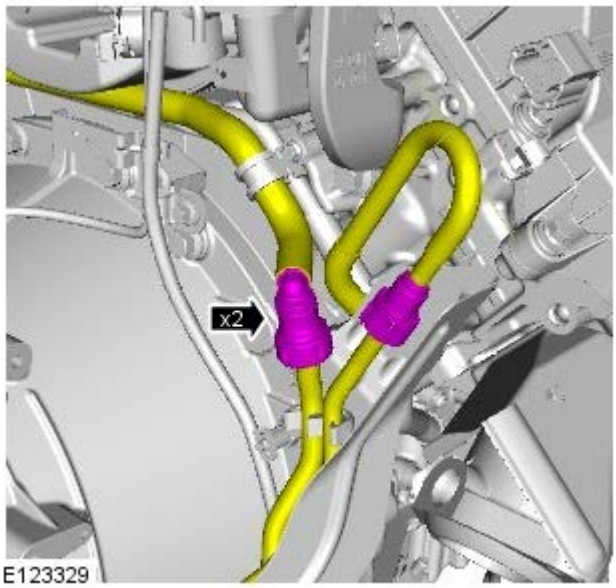


E124307

21. 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.

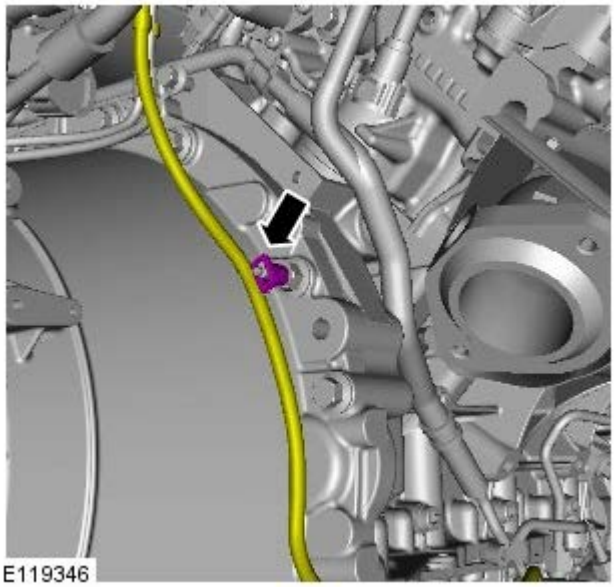
CAUTION: Be prepared to collect escaping fluids.

NOTE: Make sure that all openings are sealed. Use new blanking caps.

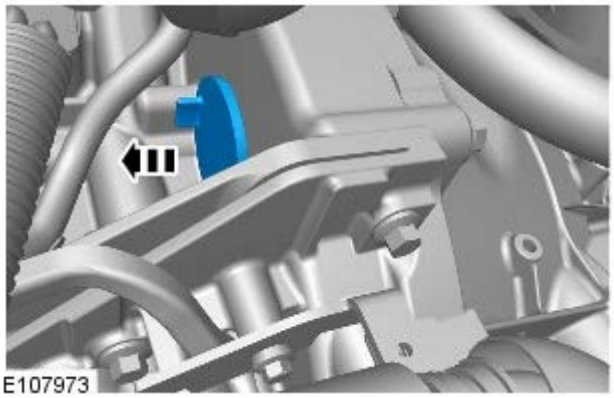


E123329

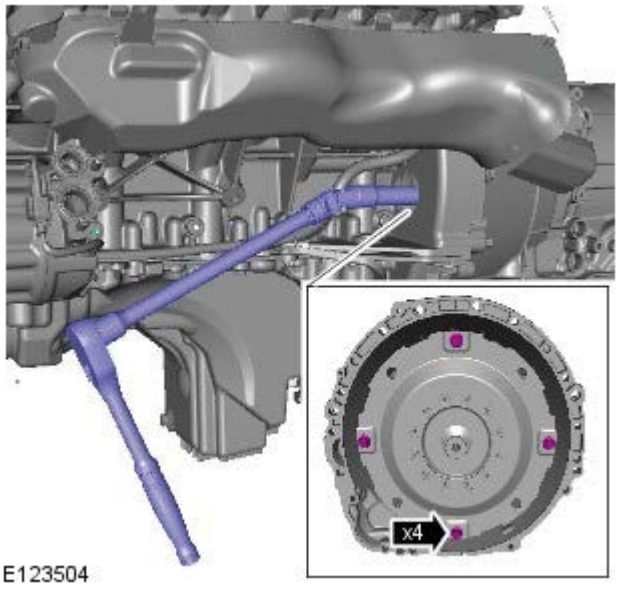
22.



23. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

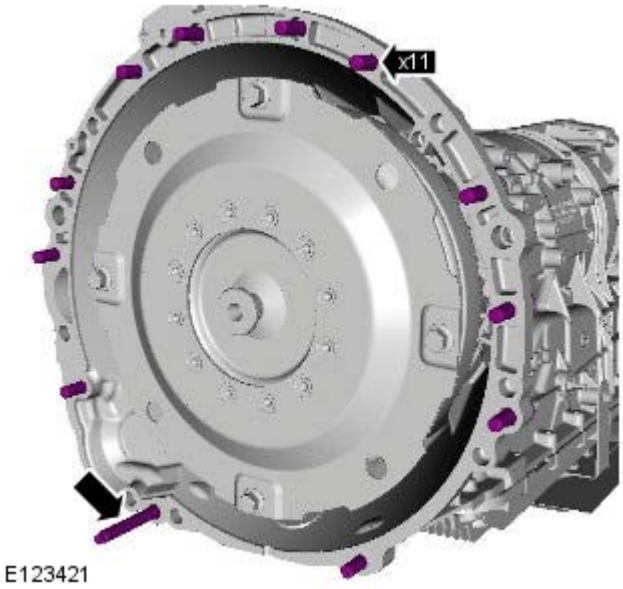


24. NOTE: Left-hand shown, right-hand similar.

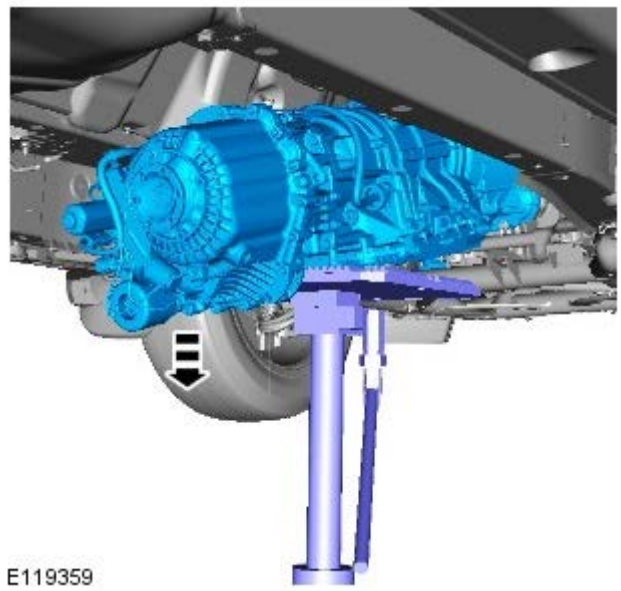


25. NOTE: Left-hand shown, right-hand similar.

26.



E123421


E119359

27. CAUTION: Make sure that the torque converter remains in the transmission.

NOTE: This step requires the aid of another technician.

- Using a suitable hydraulic jack, support the transmission.
- Do not disassemble further if removed for access only
- Install the torque converter retainer.

Published: 16-May-2013

Automatic Transmission/Transaxle - TDV6 3.0L Diesel /V8 5.0L Petrol/V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission V8 5.0L Petrol/V8 S/C 5.0L Petrol

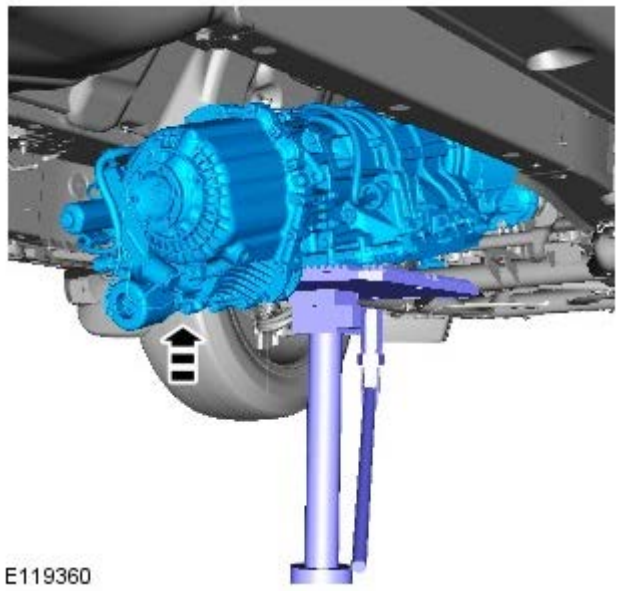
Installation

NOTES:

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

Some illustrations may show the transmission removed for clarity.

Some illustrations may show the engine removed for clarity.

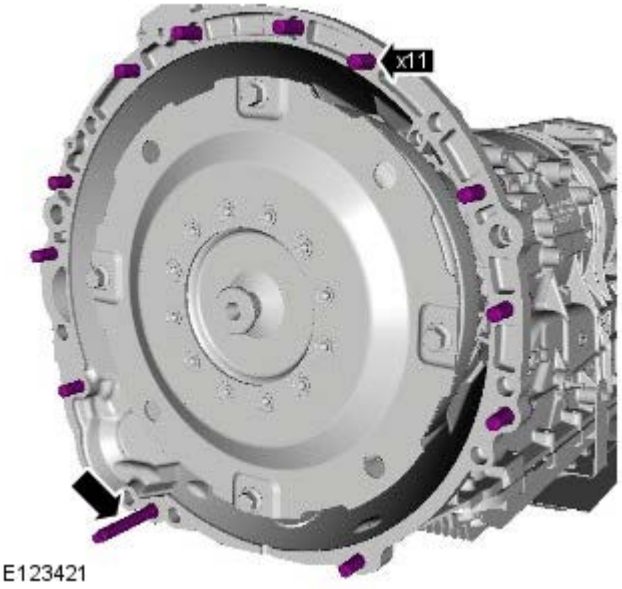


1. CAUTIONS:

   Apply grease of the correct specification to the torque converter spigot.

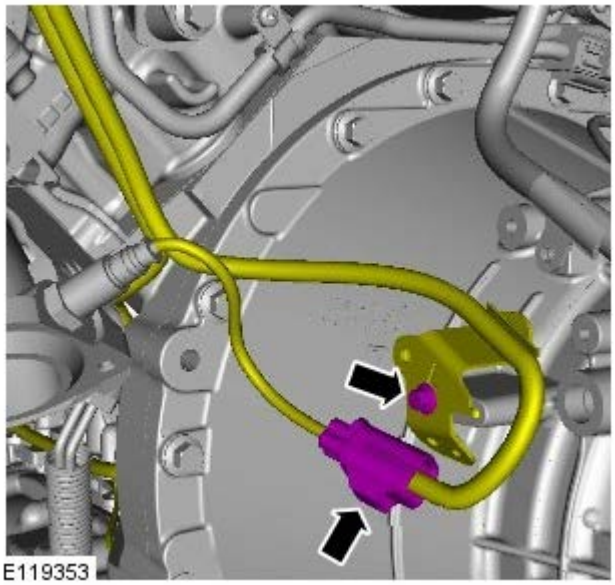
   Make sure the torque converter remains connected to the transmission.

   With assistance, install the transmission.

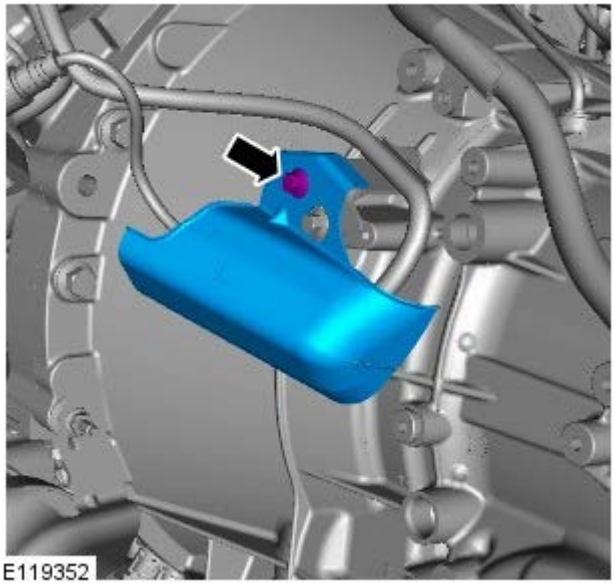


2. *Torque:* 40 Nm

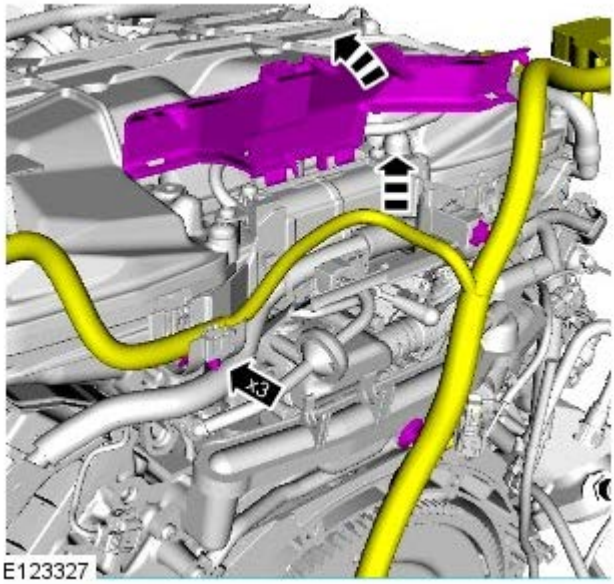
3. *Torque:* 10 Nm



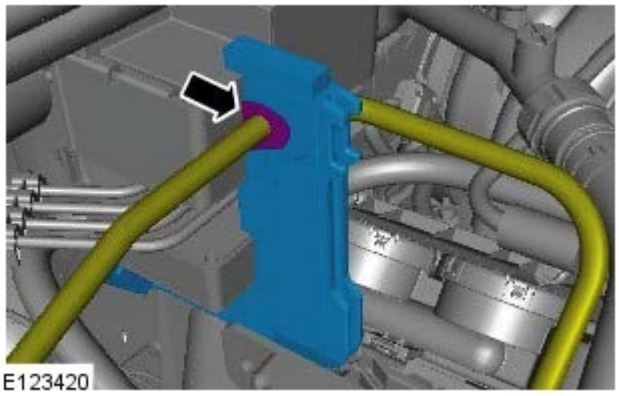
4. *Torque:* 10 Nm



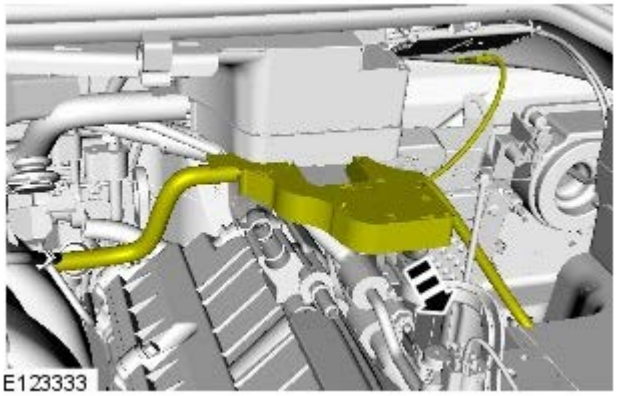
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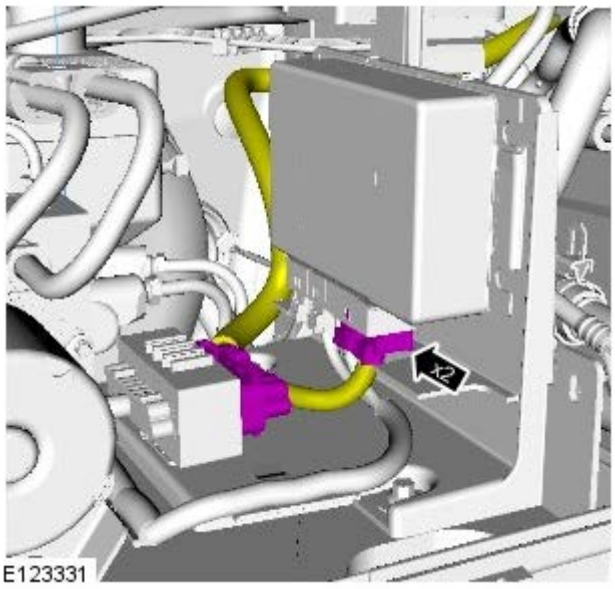
6.



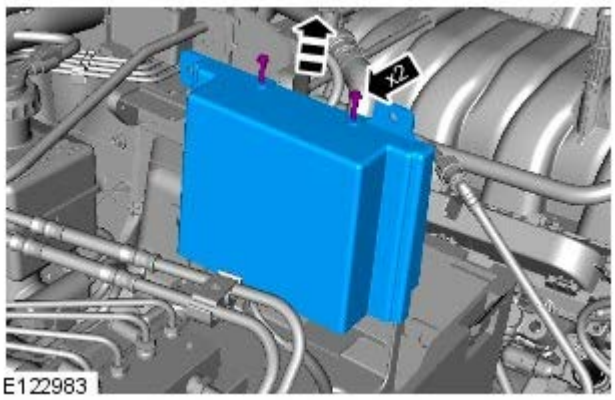
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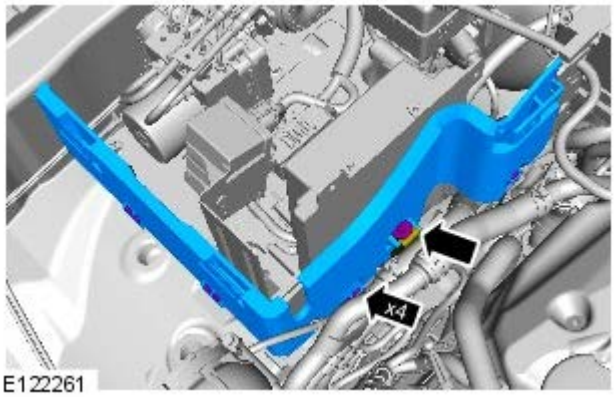
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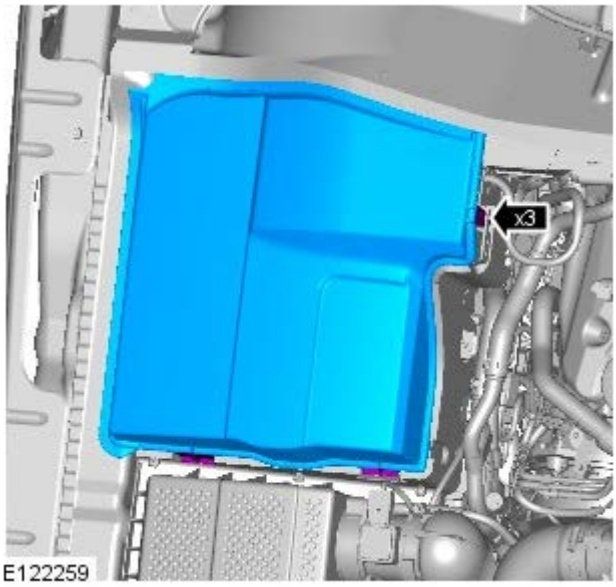
9. *Torque:* 3 Nm



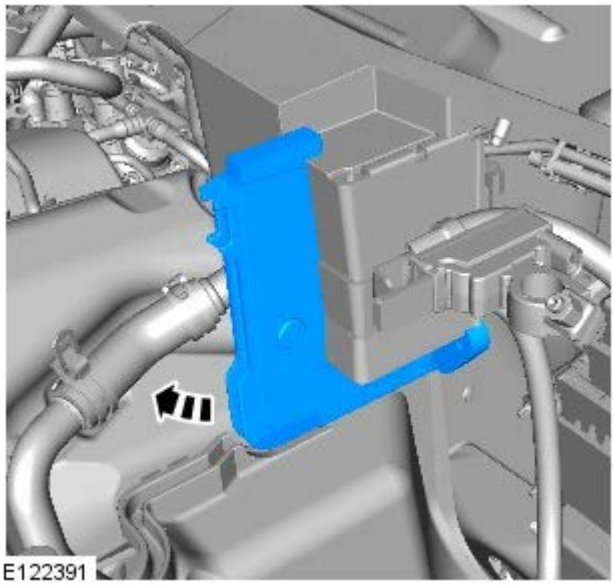
10. *Torque:* 9 Nm



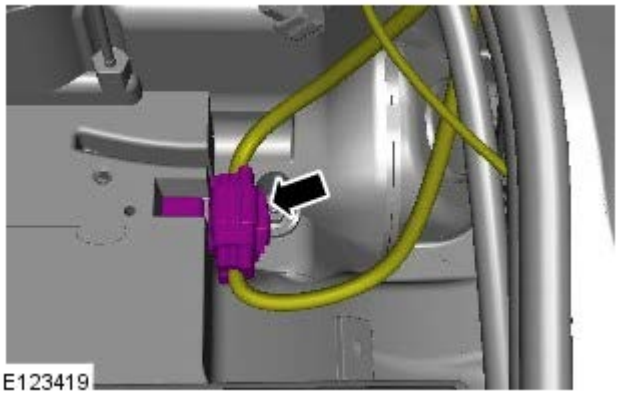
11. NOTE: RHD illustration shown, LHD is similar.



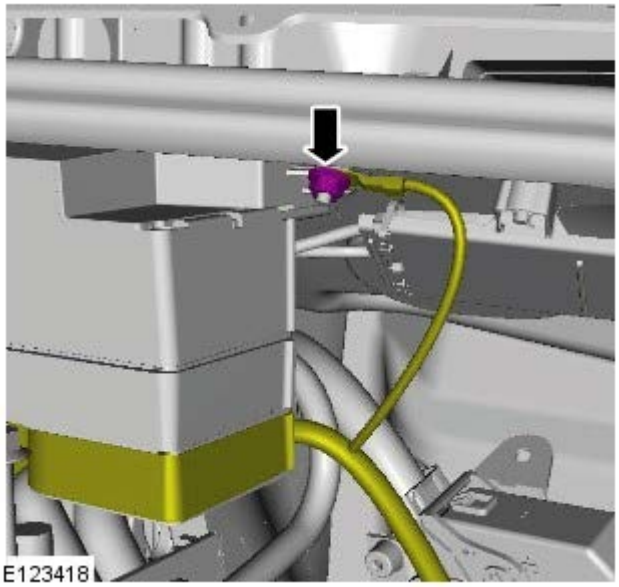
12.



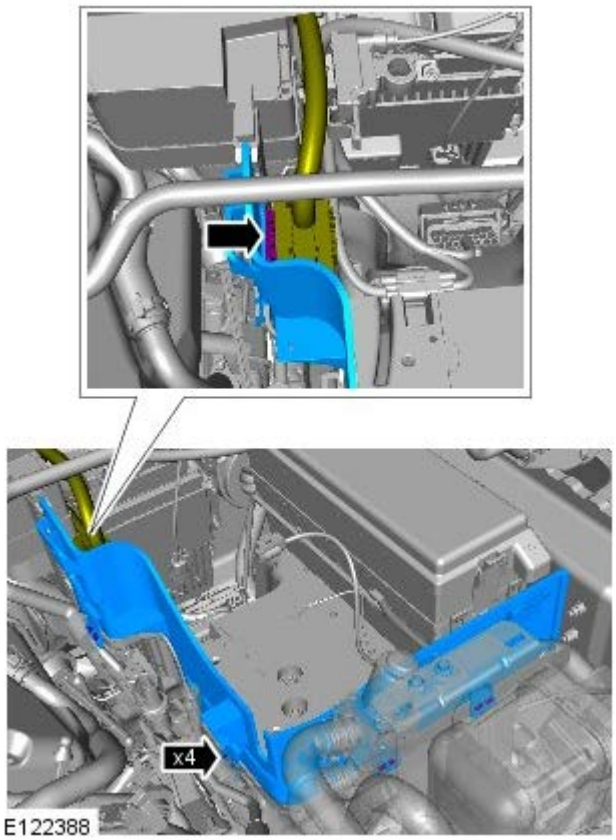
13.



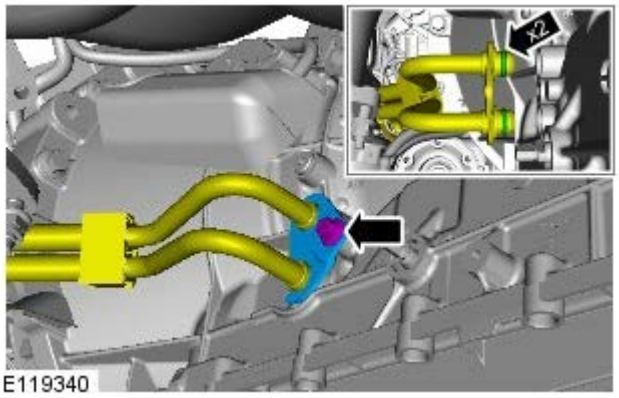
14. *Torque:* 9 Nm



15. NOTE: RHD illustration shown, LHD is similar.

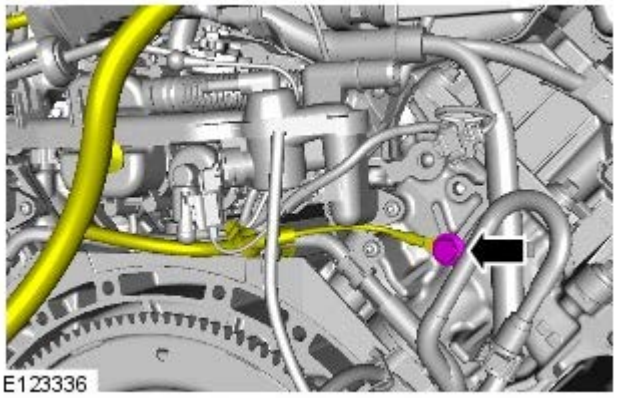


16. WARNING: Be prepared to collect escaping fluids.

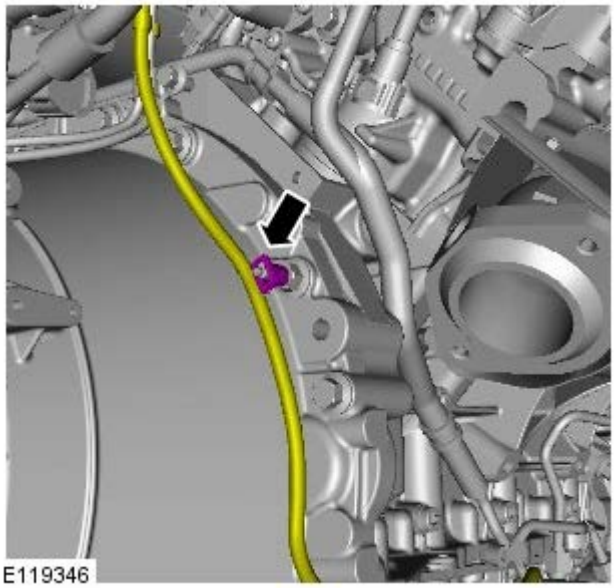


- Install new O-ring seals.
- *Torque:* 12 Nm

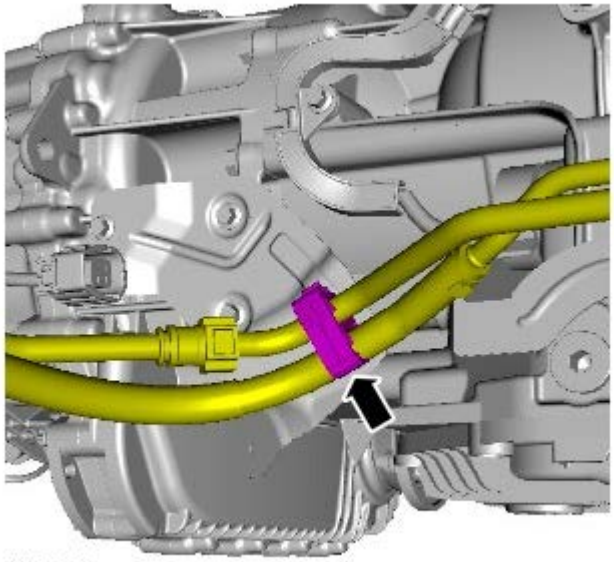
17.



18.

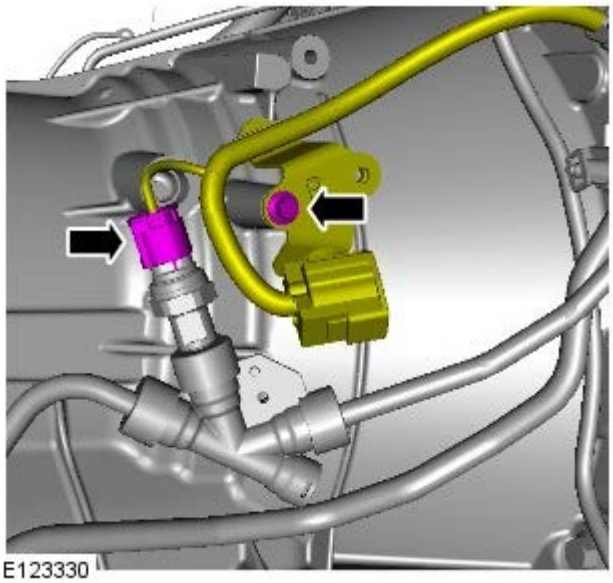


19.



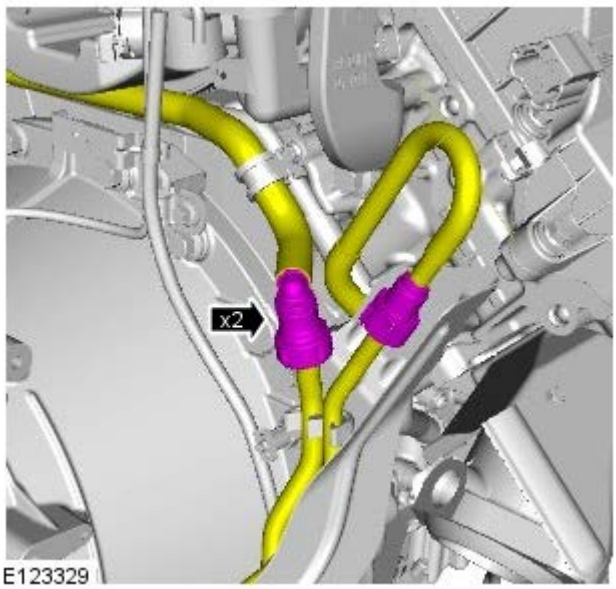
E123332

20. *Torque:* 10 Nm



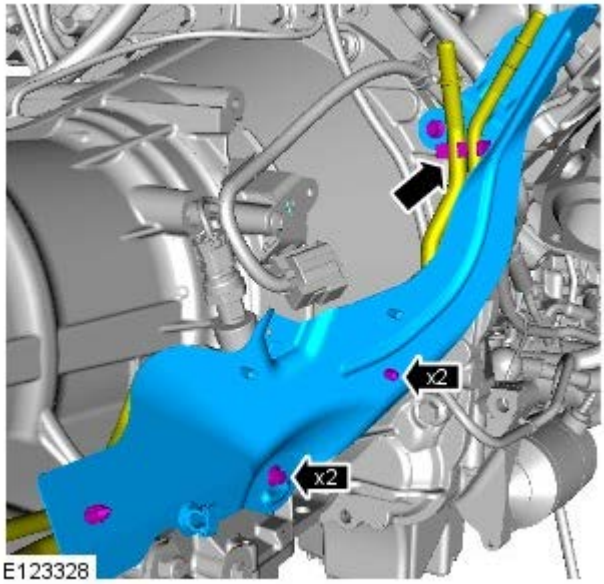
E123330

21. 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.

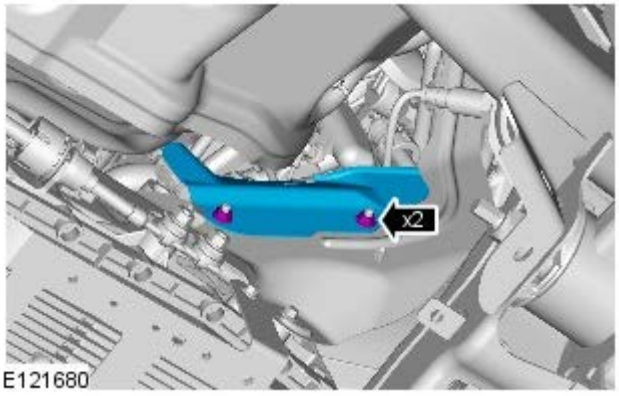


E123329

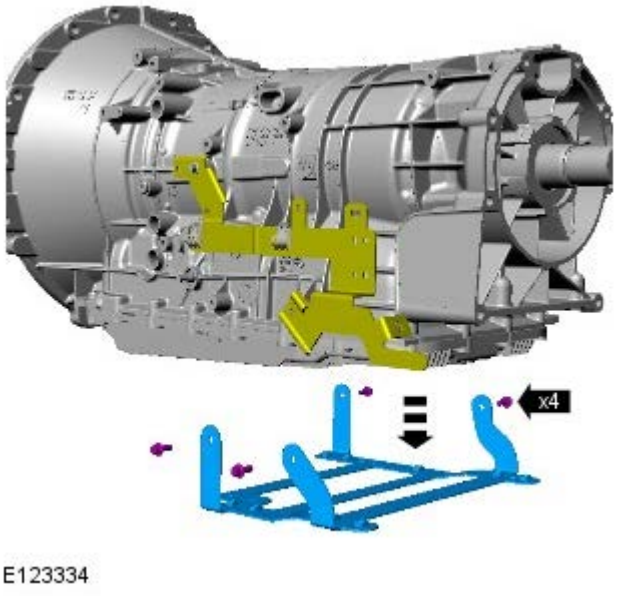
22. *Torque:* 10 Nm



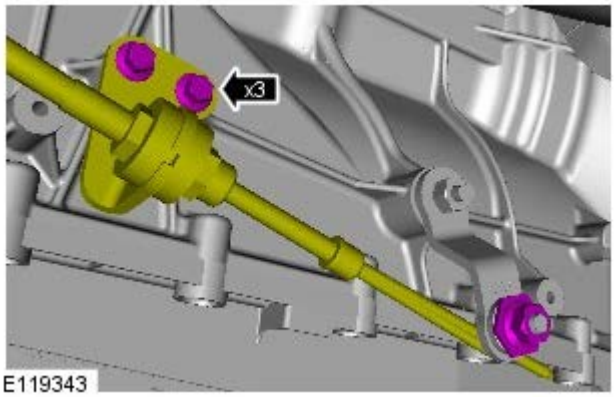
23. *Torque:* 10 Nm



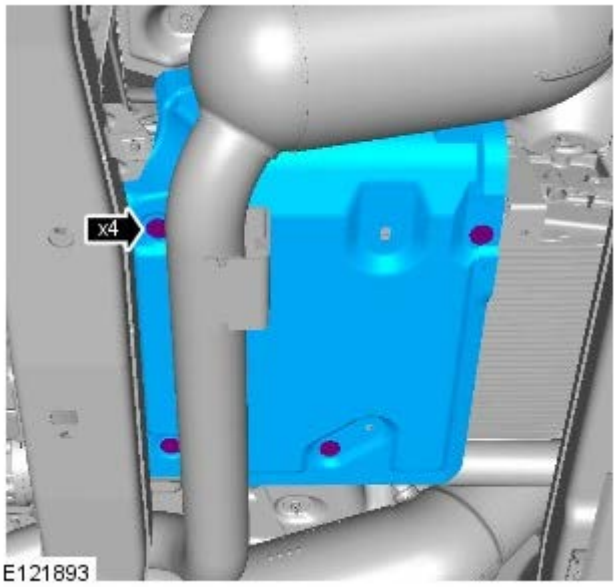
24. *Torque:* 9 Nm



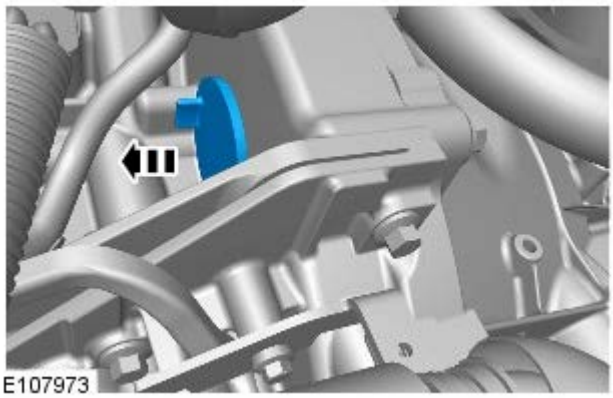
25. *Torque:*
    M6 Bolt 10 Nm
    M6 Nut 12 Nm



26. *Torque:* 8 Nm



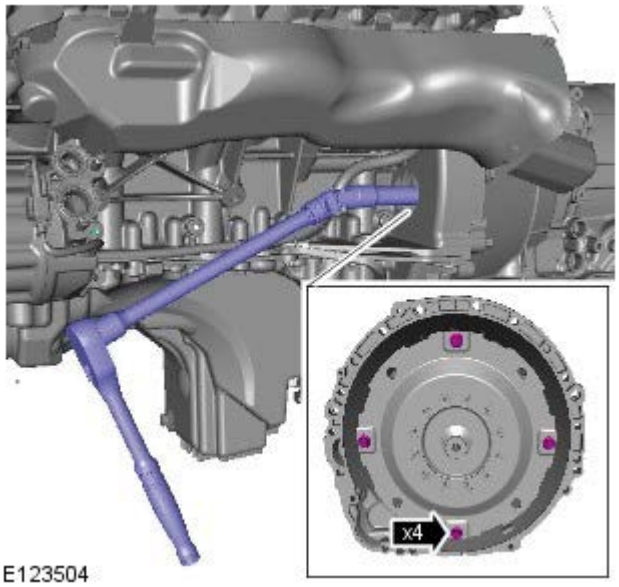
27.



28. CAUTION: Only rotate the crankshaft clockwise.

Make sure that the alignment mark is visable through the inspection hole on install of the first torque converter bolt.

Torque: 63 Nm



29. Refer to: Front Driveshaft - V8 5.0L Petrol/V8 S/C 5.0L Petrol (205-01 Driveshaft, Removal and Installation).

30. Refer to: Exhaust System (309-00B Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

31. Refer to: Rear Driveshaft (205-01 Driveshaft, Removal and Installation).

32. Refer to: Axle Assembly (205-03 Front Drive Axle/Differential, Removal and Installation).

33. WARNING: Make sure to support the vehicle with axle stands.

    Lower the vehicle.

34. Install the battery.

    Refer to: Battery (414-01 Battery, Mounting and Cables, Removal and Installation).

35. If a new component has been installed, configure using Land rover approved diagnostic equipment.

Published: 14-May-2013

Automatic Transmission/Transaxle - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission TDV6 3.0L Diesel

Installation

Special Tool(s)

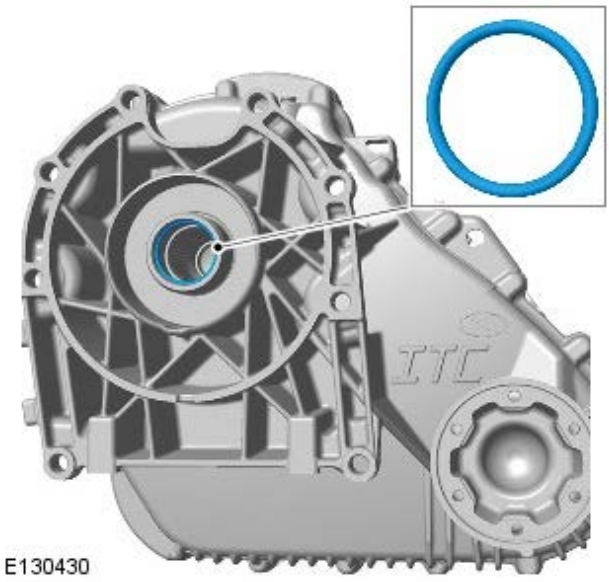
	303-1069 Adapter, Wrench

NOTES:

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

Some illustrations may show the transmission removed for clarity.

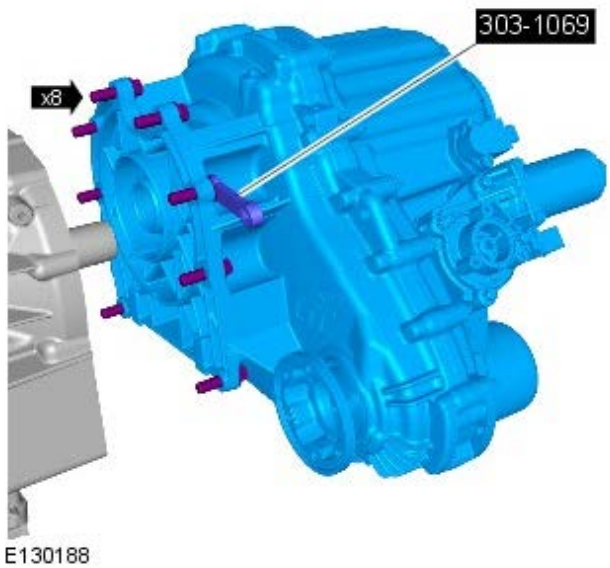
Some illustrations may show the engine removed for clarity.



1. NOTES:

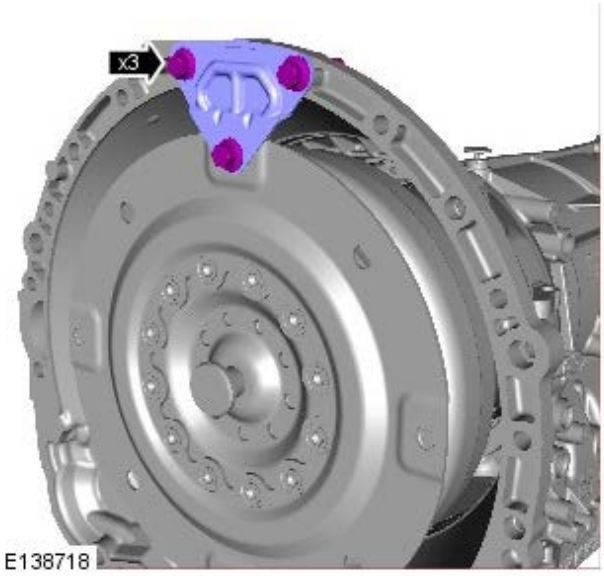
   This step is only required if previously removed.

   Install a new O-ring seal.

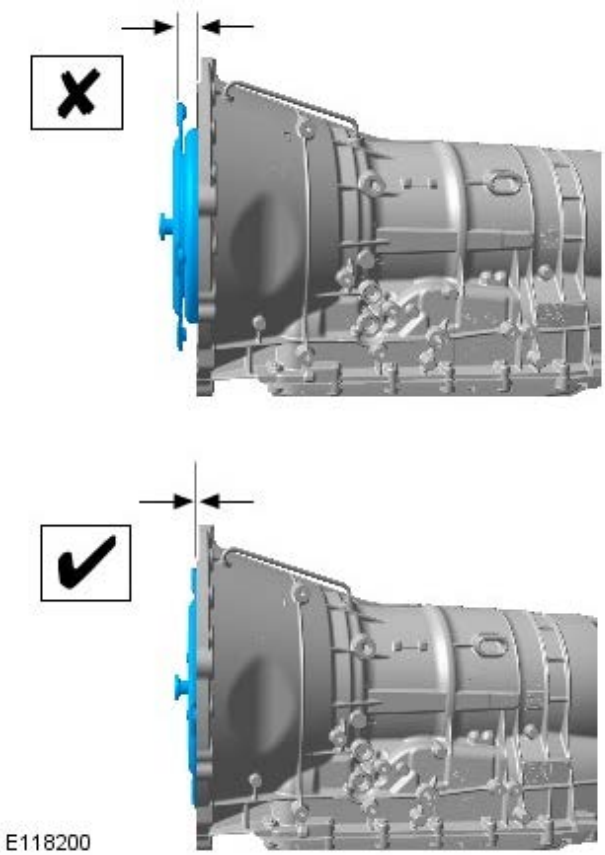


2. NOTE: This step is only required if previously removed.

   - Clean the component mating faces.
   - Lubricate input shaft splines with 'Weicon TL7391' grease.
   - *Special Tool(s):* 303-1069
   - *Torque:* 45 Nm



3. CAUTION: Make sure that the torque converter remains in the transmission.

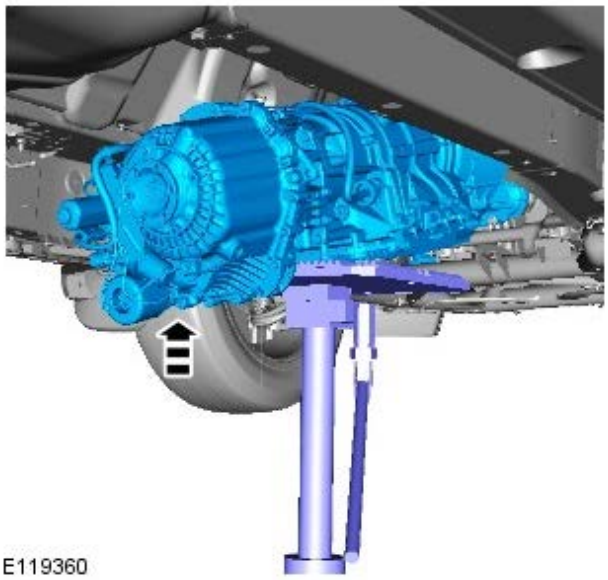


4. CAUTION: Make sure the torque converter is fully located into the oil pump drive.

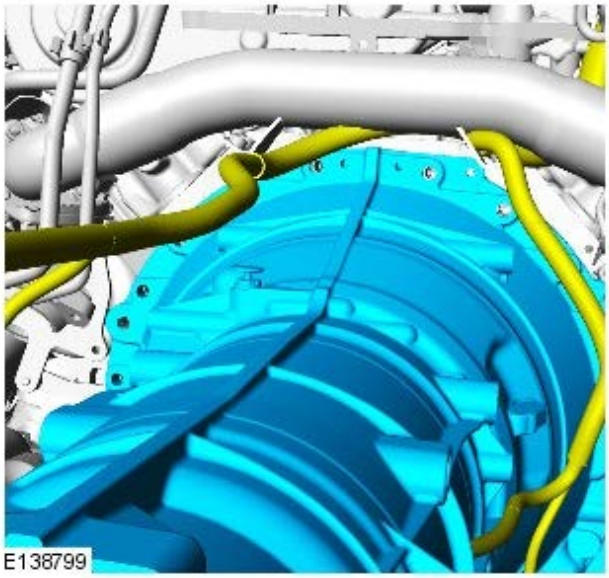
5. CAUTIONS:

   Apply grease of the correct specification to the torque converter spigot.

   Make sure that the torque converter remains in the transmission.



E119360

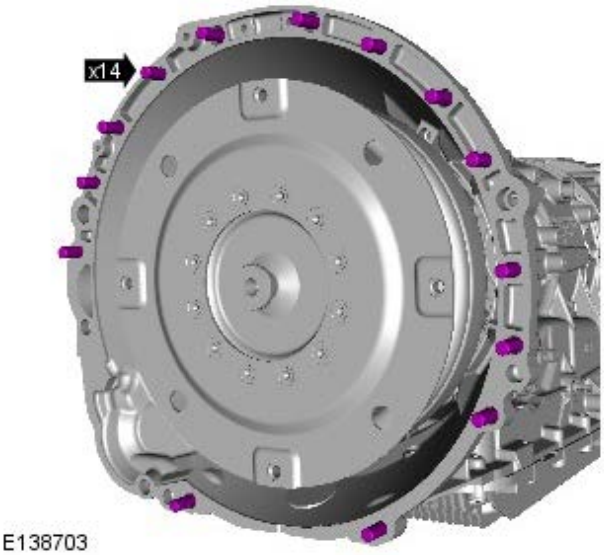


E138799

6. CAUTION: Care must be taken to avoid damaging the transmission wiring harness.

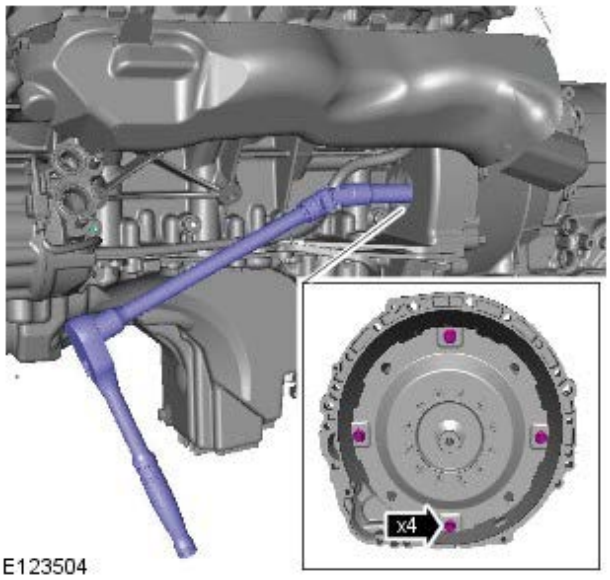
   Cut the cable ties securing the harness.

7. *Torque:* 40 Nm

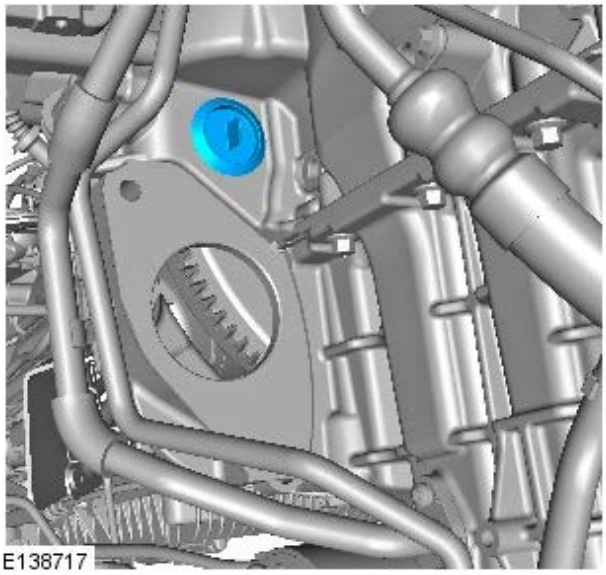


E138703

8. *Torque:* 63 Nm

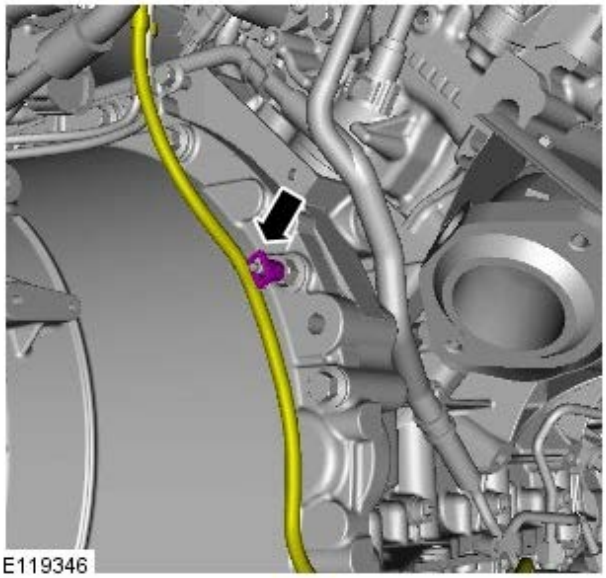


9.

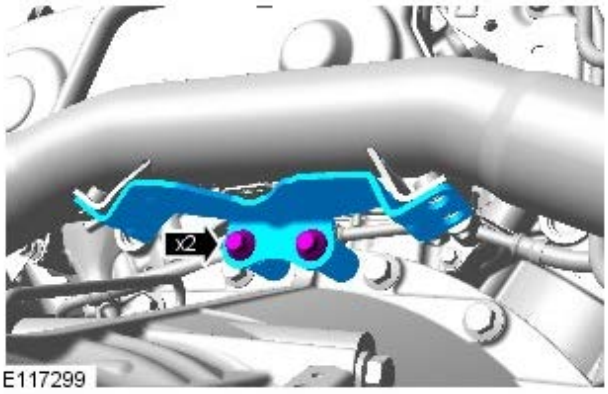


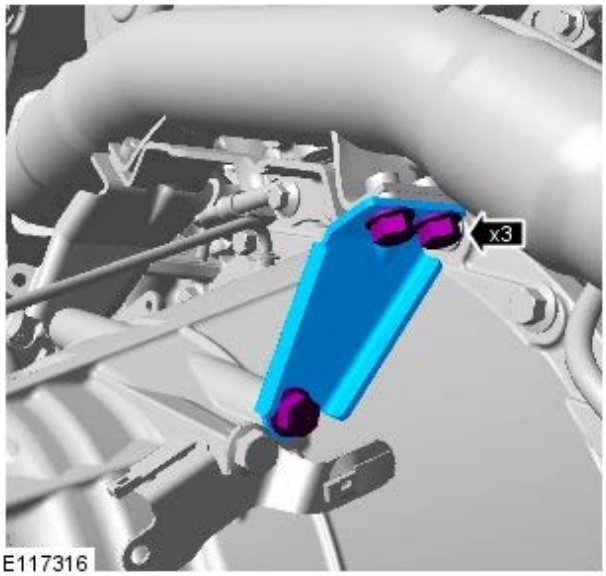
10. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

11.

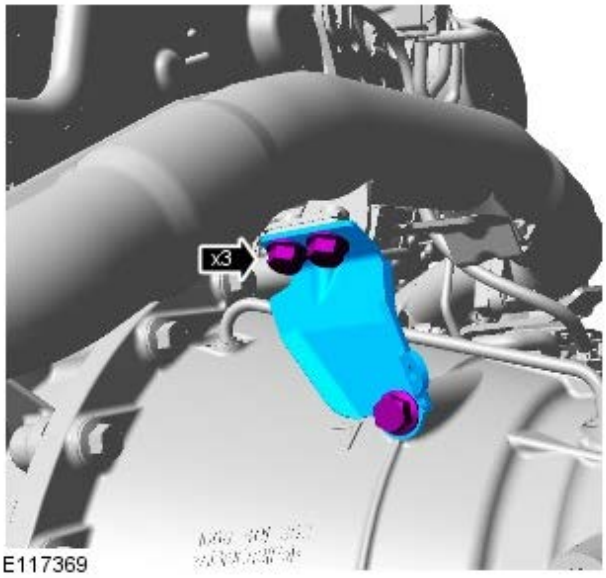


12. *Torque:* 23 Nm



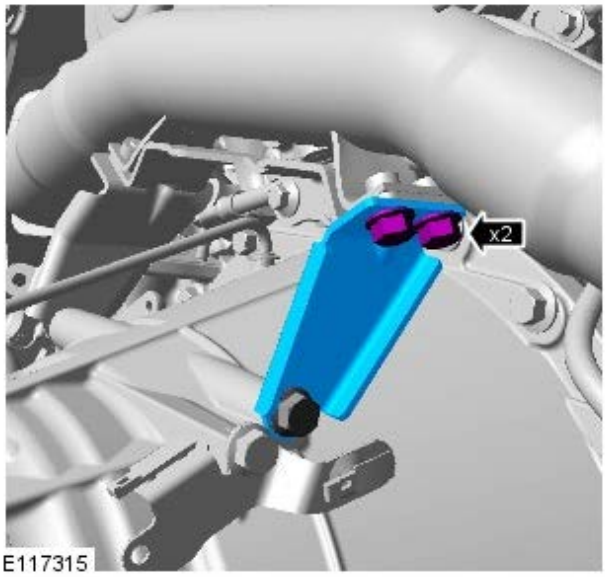


13. CAUTION: Only tighten the bolts finger-tight at this stage.

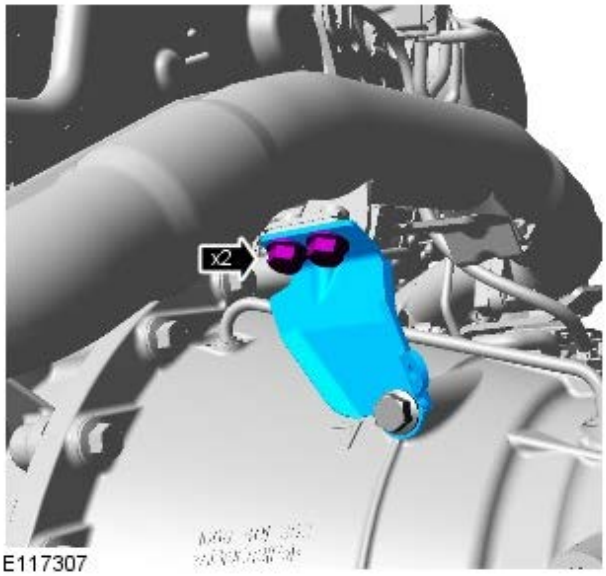


14. CAUTION: Only tighten the bolts finger-tight at this stage.

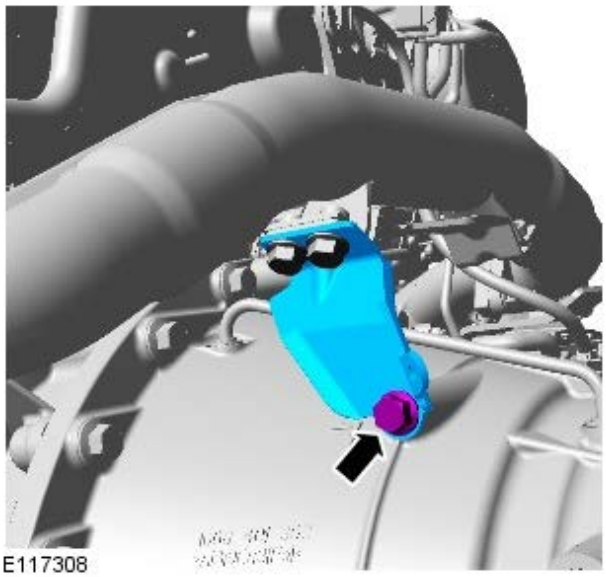
15. *Torque:* 23 Nm



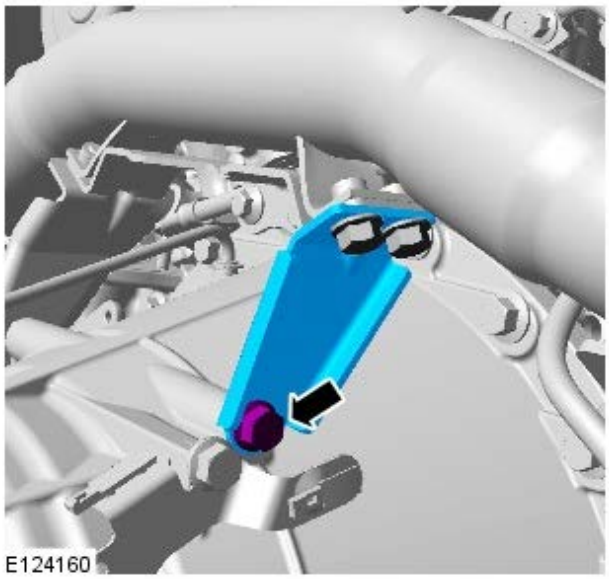
16. *Torque:* 23 Nm



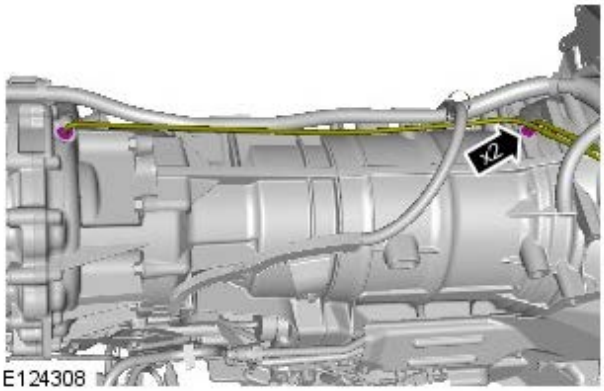
17. *Torque:* 23 Nm



18. *Torque:* 23 Nm

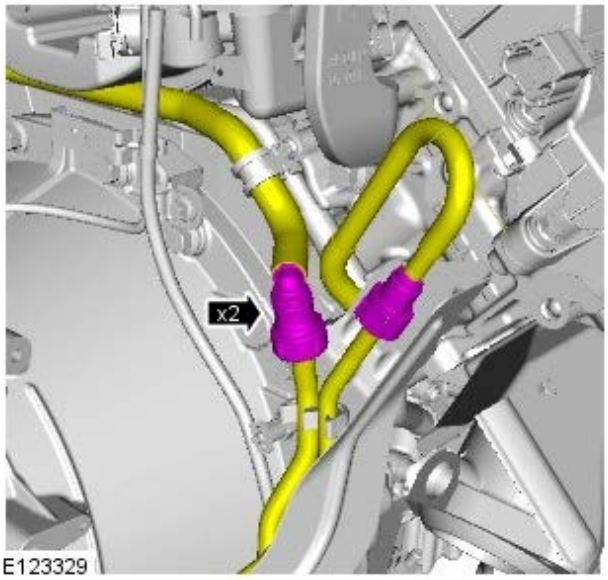


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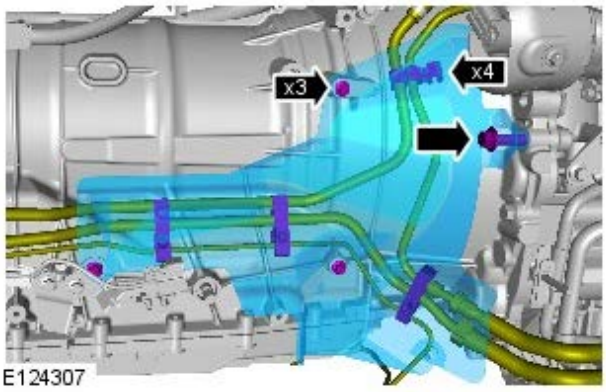


20. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

CAUTION: Be prepared to collect escaping fluids.

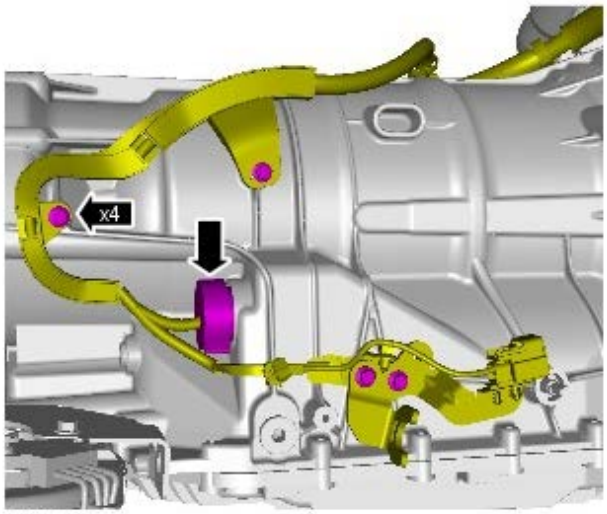


21. *Torque:*
M6 9 Nm
M10 40 Nm



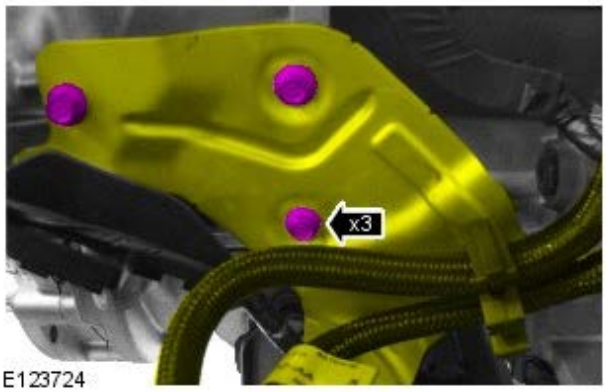
E124307

22. *Torque:* 9 Nm



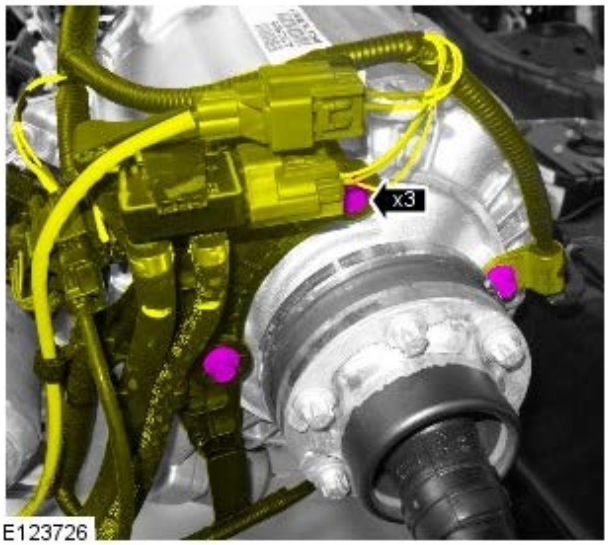
E124310

23. *Torque:* 9 Nm



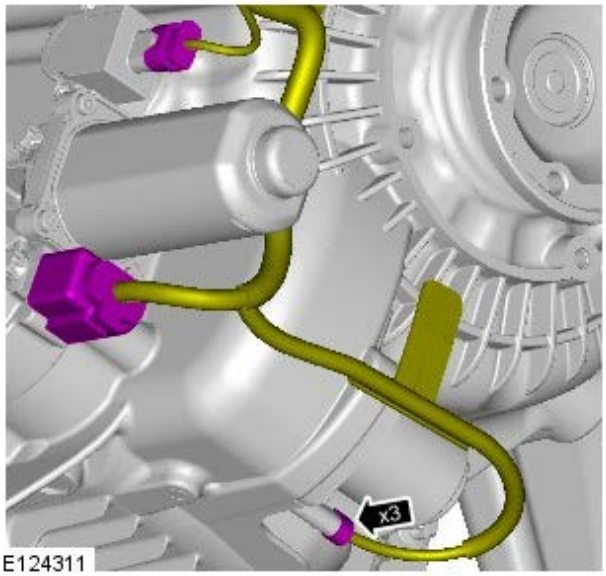
E123724

24. *Torque:* 9 Nm



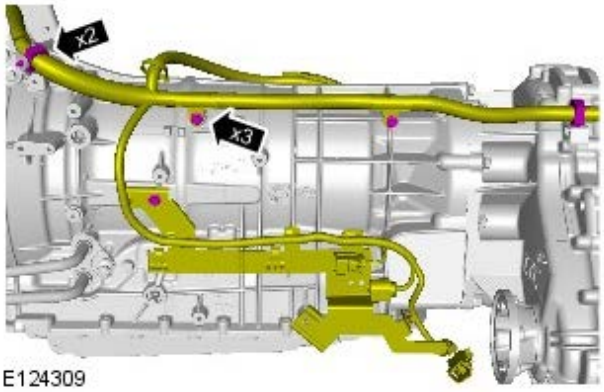
E123726

25.



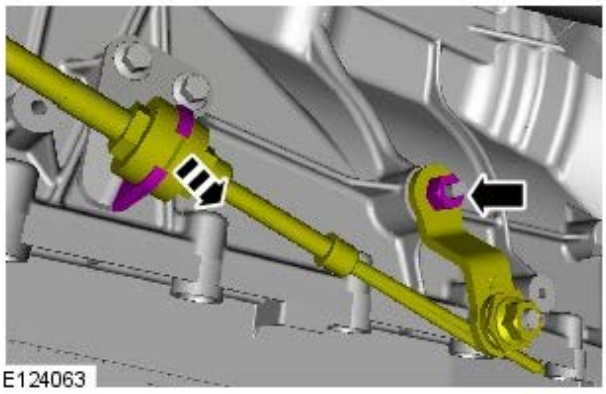
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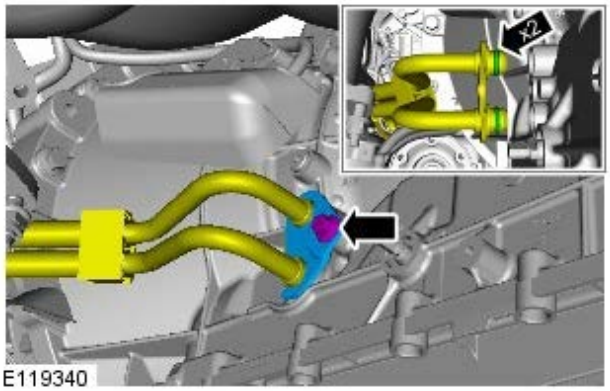
26. *Torque:* 9 Nm



E124309

27. *Torque:* 12 Nm

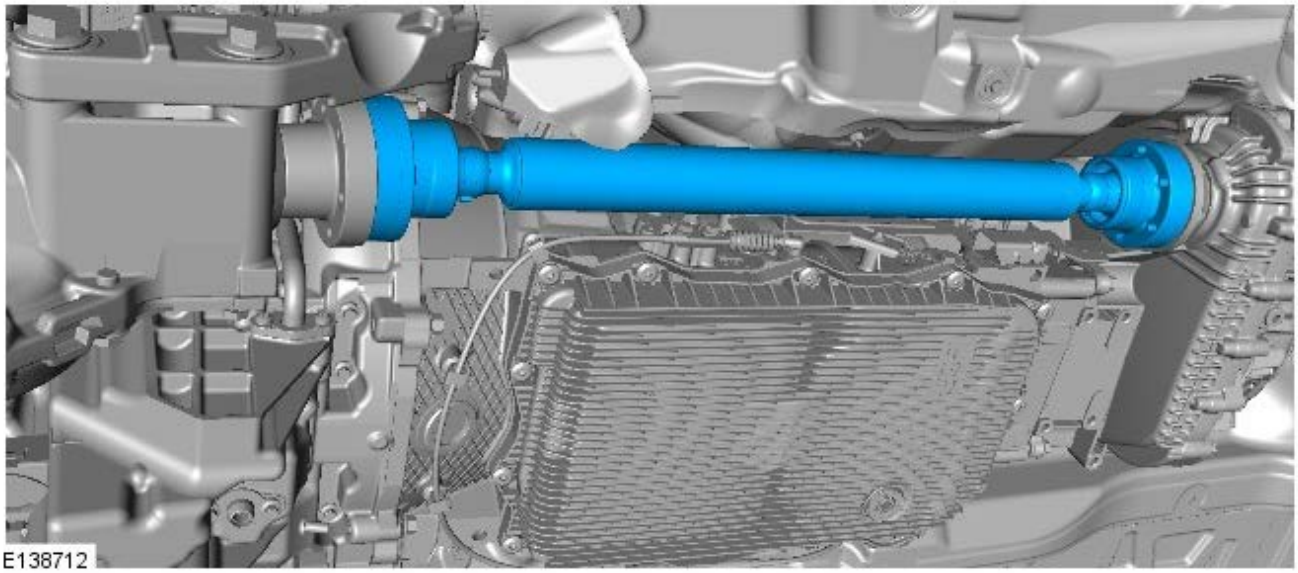




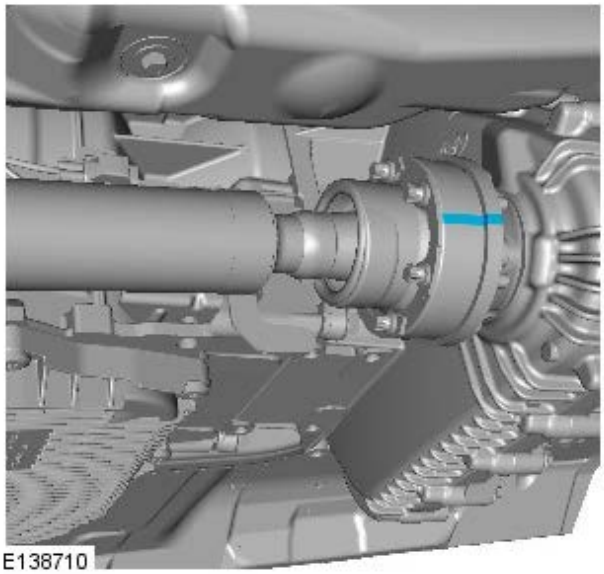
28. NOTE: Install new O-ring seals.

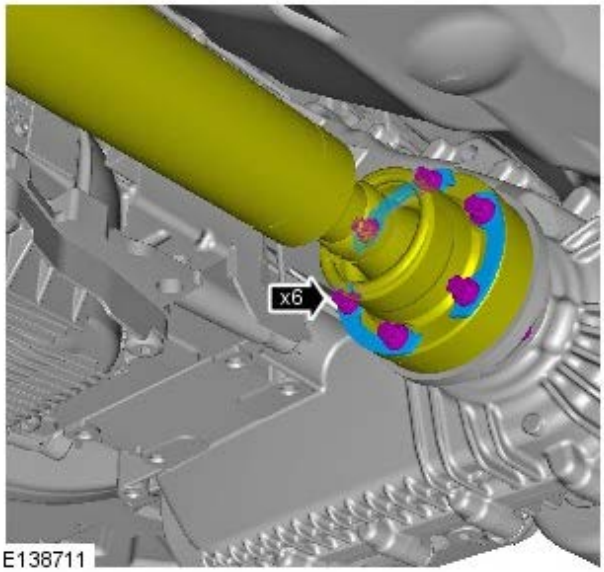
Torque: 12 Nm

29. Using a suitable tie strap, secure the driveshaft.

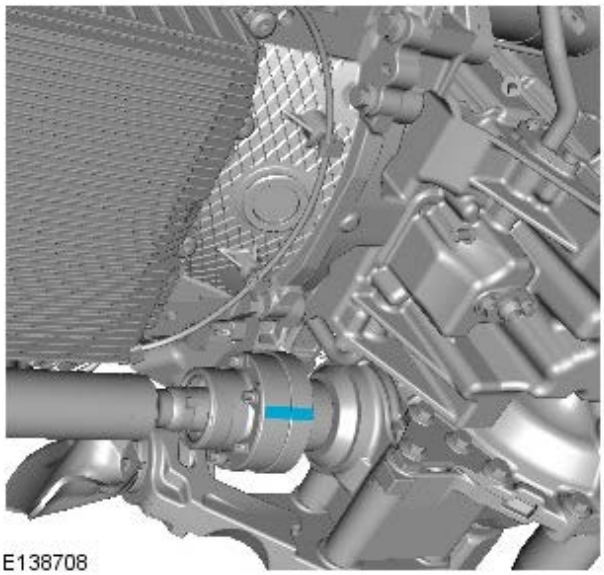


30. NOTE: Make sure that the component aligns with the installation mark noted in the removal step.


E138710



E138711


E138708

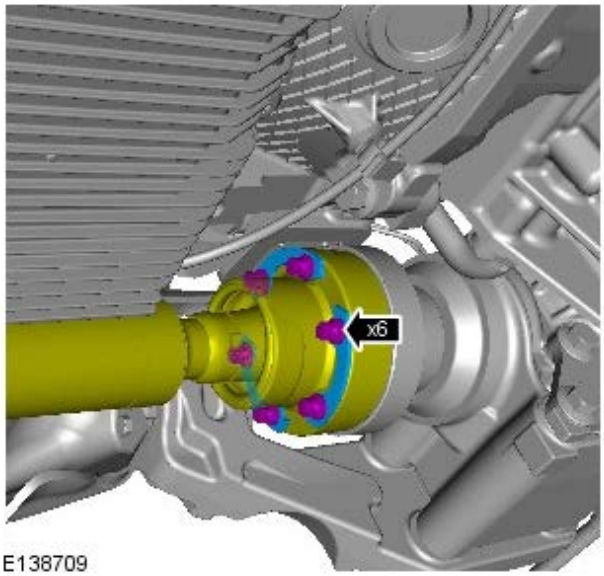
31. CAUTION: Make sure that new bolts are installed.

Torque:
Stage 1:45 Nm
Stage 2:90°

32. NOTE: Make sure that the component aligns with the installation mark noted in the removal step.

33. CAUTION: Make sure that new bolts are installed.

Torque:
Stage 1:45 Nm
Stage 2:90°



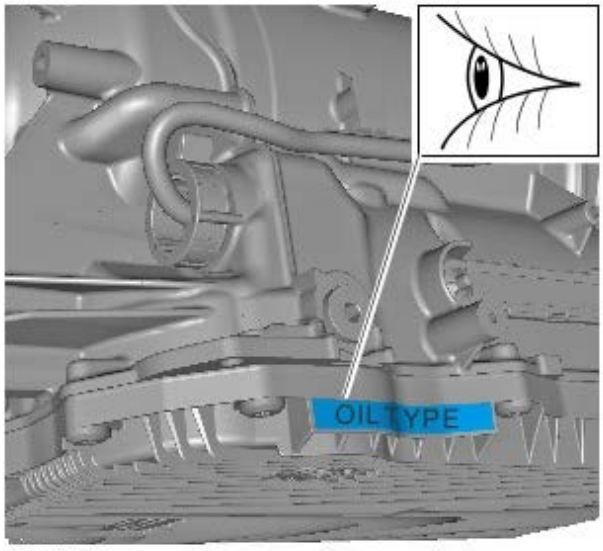
E138709

34. Refer to: Exhaust System (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

35.
- Remove the securing straps.
- Remove the jack supporting the transmission.

36. Refer to: Rear Driveshaft (205-01 Driveshaft, Removal and Installation).

37.
- Connect the battery ground cable.
- Refer to: Specifications (414-00, Specifications).



E138154

38. CAUTIONS:

Make sure the correct specification of oil is used.

Make sure the transmission fluid fill plug is tightened to the correct specification. Failure to follow this instruction may result in damage to the vehicle.

NOTE: Install a new fluid level filler plug.

- Carry out a transmission fluid level check.
- To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
- 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 (1).
- 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.
- Tighten the transmission fluid fill plug to the torque given by the calculation.

39. If a new component has been installed, configure using Land rover approved diagnostic equipment.

Published: 26-Sep-2011

Automatic Transmission / Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD -

Maintenance

CAUTION: Use only Shell L12108 (ZF Lifeguard 8) Automatic transmission fluid. Use of any other fluids may result in a transmission malfunction or failure.

Description	Intervals
Normal maintenance	Filled for life.
Severe duty maintenance	Change the fluid at 48,000 km (30,000 miles) intervals.

Capacities

	Liters
Transmission	8.5

Lubricants, Fluids, Sealers and Adhesives

Description	Specification
Transmission fluid	Shell L12108 (ZF Lifeguard 8)
Sealant	WSS-M4G323-A6
Metal surface cleaner	WSW-M5B392-A
High temperature grease	Molecote FB180

Torque Specifications

NOTE: * = refer to the procedure for correct torque sequence

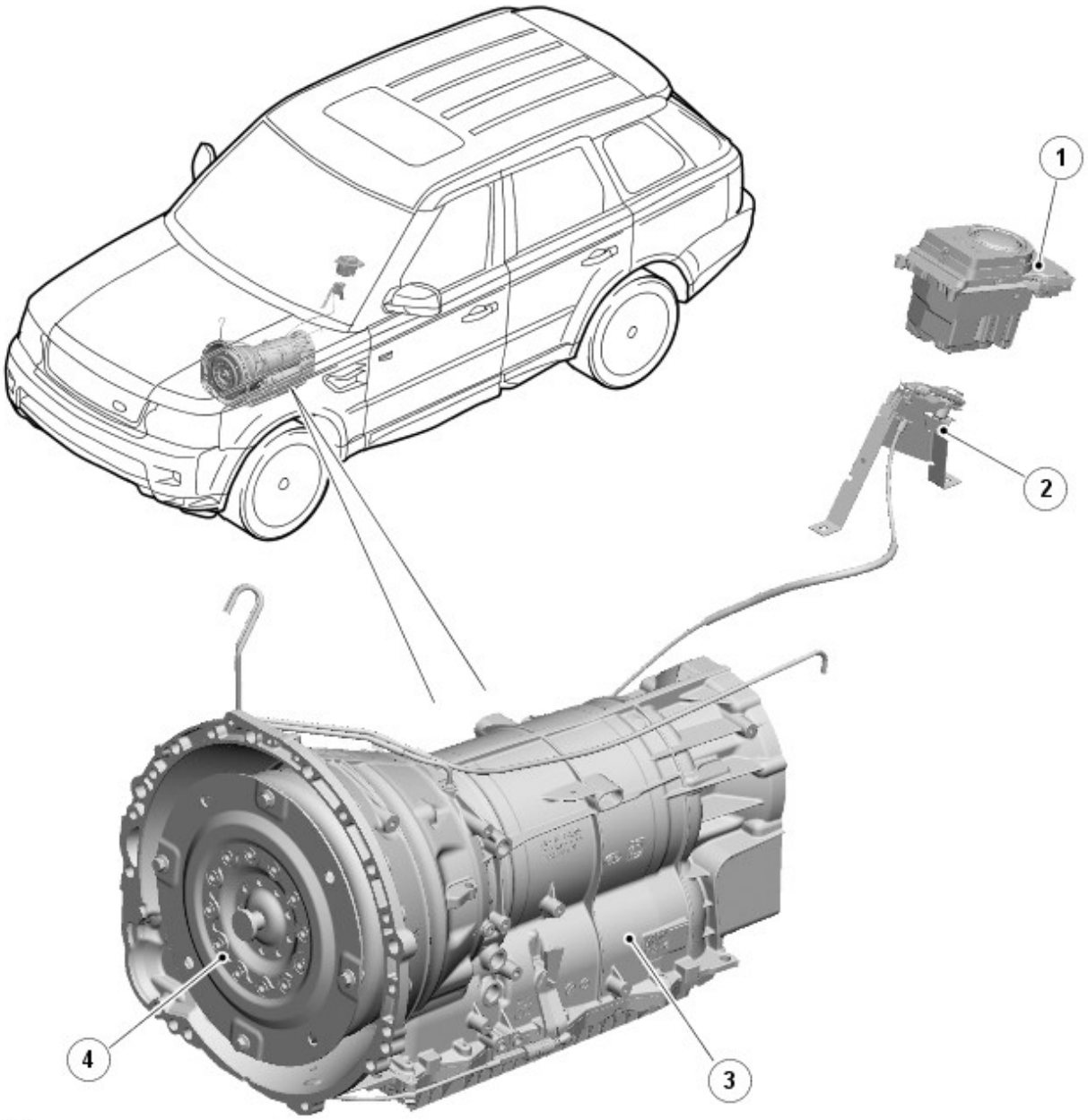
Description	Nm	lb-ft	lb-in
Transmission retaining bolts	40	30	-
Transmission mount retaining bolts	60	44	-
* Transmission fluid fill plug	35	26	-
* Transmission control module (TCM) and main control valve body retaining bolts	8	6	-
Torque converter retaining bolts	63	46	-
Transmission fluid cooler tube retaining bolt	12	9	-
Transmission fluid drain plug	8	6	-
* Transmission fluid pan, gasket and filter retaining bolts	10	7	-

Published: 04-Oct-2011

Automatic Transmission / Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Description

Description and Operation

COMPONENT LOCATION



E137696

Item	Part Number	Description
1	-	Electronic Transmission Selector (ETS)
2	-	Emergency park release lever
3	-	Automatic transmission
4	-	Torque converter

INTRODUCTION

The ZF 8HP70 transmission is an electronically controlled, hydraulically operated, eight speed automatic unit. The hydraulic and electronic control elements of the transmission, including the TCM (transmission control module), are incorporated in a single unit located inside the transmission and is known as 'Mechatronic'.

The ZF 8HP70 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

ASIS (adaptive shift strategy), to provide continuous adaptation of shift changes to suit the driving style of the driver, which can vary from sporting to economical
- Connected to the ECM (engine control module) via the high speed CAN (controller area network) bus for communications
- Default mode if major faults occur
- Diagnostics available from the TCM via the high speed CAN bus.

The higher fuel efficiency of the ZF 8HP70 automatic transmission is mainly due to the following modifications:

- a wider ratio spread and more gears for better adaptation to ideal engine operating points
- significantly reduced drag torque in the shift elements (only two open shift elements per gear)
- use of a more efficient ATF (automatic transmission fluid) pump (double-stroke vane pump)
- Decoupling of the transmission when the vehicle is at standstill
- improved torsion damping in the converter.

The transmission selections are made using the Electronic Transmission Selector (ETS) in the floor console.
For additional information, refer to: External Controls (307-05B, Description and Operation).

TRANSMISSION

The transmission comprises the main casing which houses all of the transmission components. The main casing also incorporates an integral torque converter housing.

A fluid pan is attached to the lower face of the main casing and is secured with bolts. The fluid pan is sealed to the main casing with a gasket. Removal of the fluid pan allows access to the Mechatronic valve block. The fluid pan has magnets located at the rear which collects any ferrous 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 transmission does not have a Bowden cable for park lock operation. This is initiated electronically when the ETS is moved to the 'P' park position. An emergency park interlock release mechanism is provided to release the park interlock if a failure occurs.

A new feature of the 8 speed transmission is decoupling of the transmission when the vehicle is at a standstill. Normally the transmission remains in gear with the torque converter slipping and the vehicle is prevented from moving by applying the brake. The new system disengages one of the transmission clutches and only a minimum rotating load remains. This has the effect of further reducing fuel consumption.

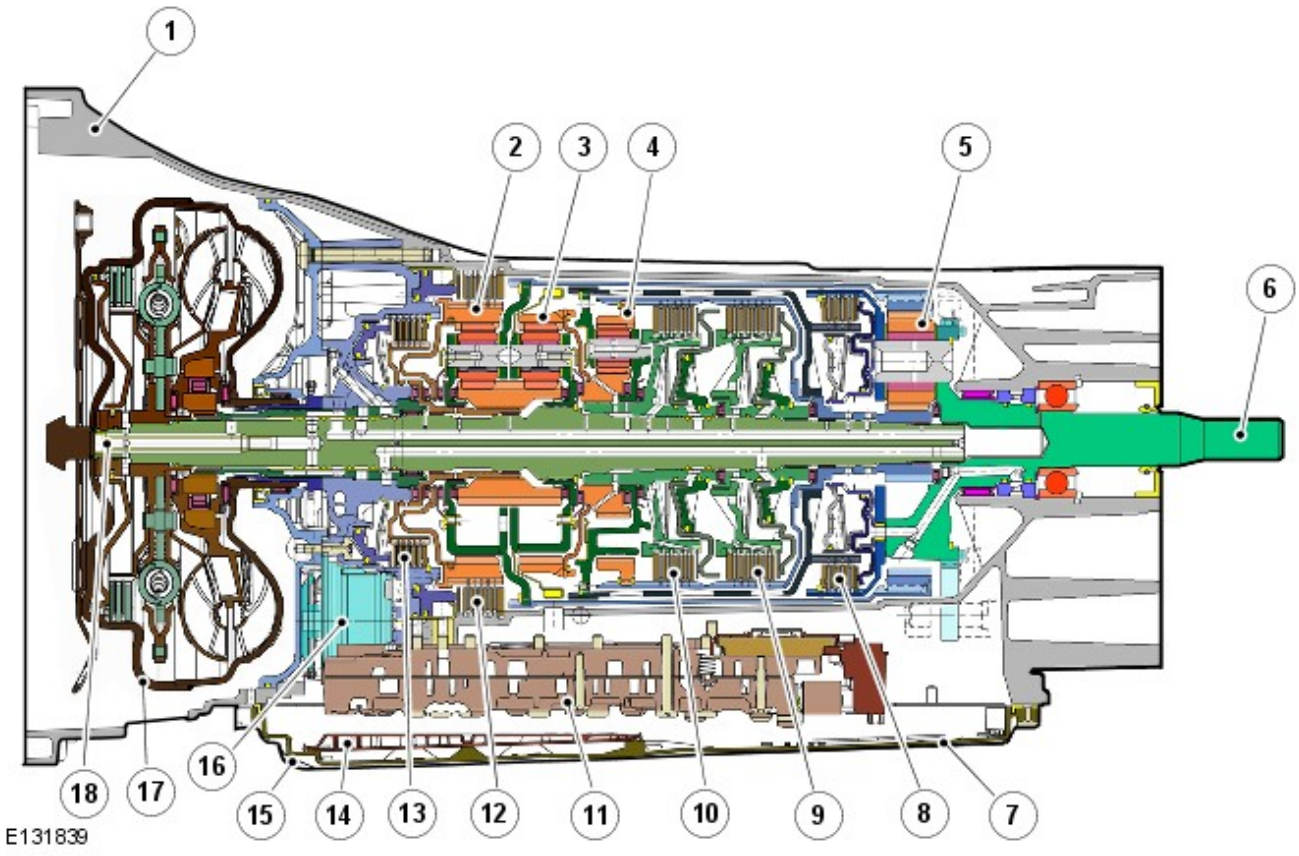
The internal oil pump is driven by a simplex chain and 2 drive gears from the input shaft. The oil pump is a double stroke vane cell pump which delivers 50 cm^2 of transmission fluid per revolution.

The integral torque converter housing provides protection for the torque converter assembly and also provides the attachment for the gearbox to the engine. The torque converter is a non-serviceable assembly which also contains the lock-up clutch mechanism.

The main casing contains the following major components:

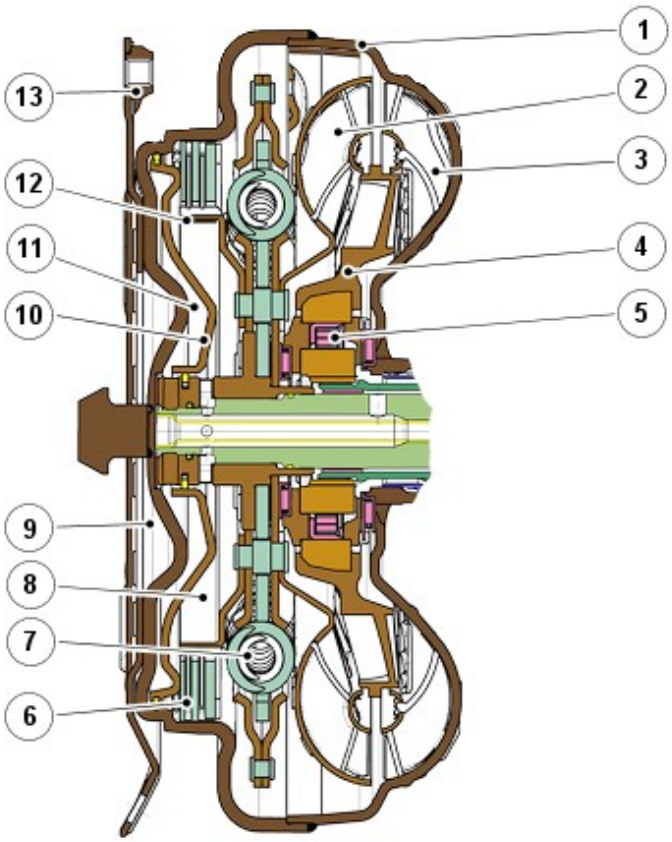
- Input shaft
- Output shaft
- Mechatronic valve block which contains the solenoids, speed sensors and the TCM
- Three rotating multiplate drive clutches
- Two fixed multiplate brake clutches
- Four planetary gear trains.

Transmission Sectional View



Item	Part Number	Description
1	-	Transmission casing
2	-	Gear set 1
3	-	Gear set 2
4	-	Gear set 3
5	-	Gear set 4
6	-	Output shaft
7	-	Drain plug
8	-	Clutch D
9	-	Clutch C
10	-	Clutch E
11	-	Mechatronic valve block
12	-	Brake B
13	-	Brake A
14	-	Fluid filter
15	-	Fluid pan
16	-	Fluid pump
17	-	Torque converter
18	-	Input shaft

TORQUE CONVERTER



E131838

Item	Part Number	Description
1	-	Converter cover
2	-	Turbine
3	-	Impeller
4	-	Stator
5	-	Stator freewheel
6	-	Lined plate of lock-up clutch
7	-	Torsional vibration damper
8	-	Pipe 1 and 2
9	-	Pipe 3
10	-	Lock-up clutch piston
11	-	Space behind lock-up clutch
12	-	Disc carrier
13	-	Drive plate/disc carrier

The torque converter is the coupling element between the engine and the transmission and is located in the torque converter 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 flex plate attached to the rear of the crankshaft.

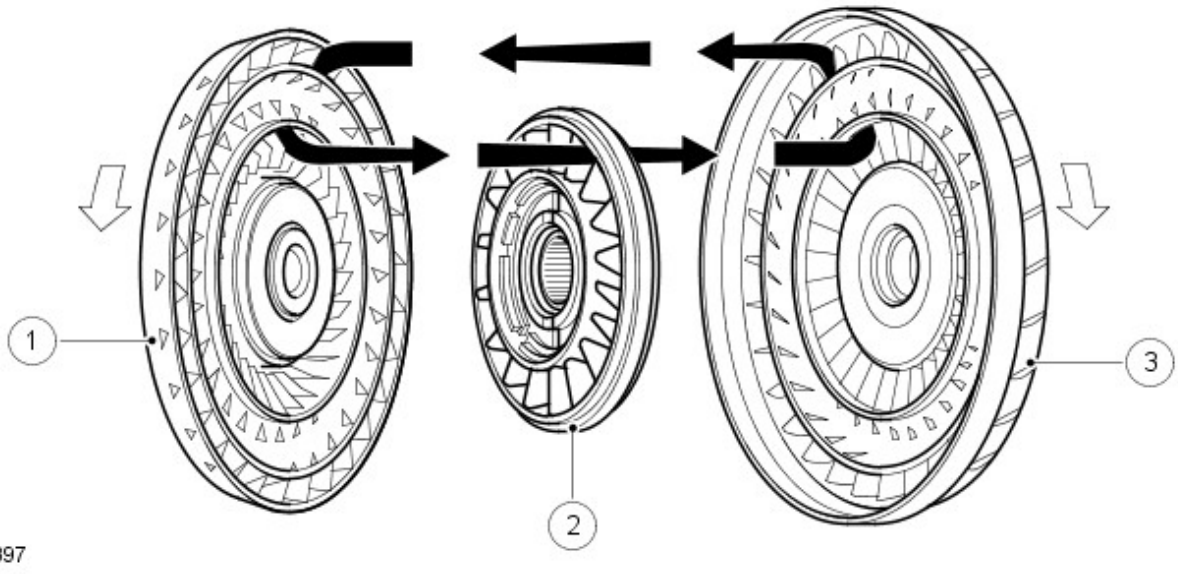
The torque converter comprises an impeller, a stator and a turbine. The torque converter is a sealed unit with all components located between the converter housing cover and the impeller. The two components are welded together to form a sealed, fluid filled housing. With the impeller brazed to the converter housing cover, the impeller is therefore driven at engine crankshaft speed.

The converter housing drive plate has four threaded bosses, which provide for attachment of the engine flex plate. The threaded bosses also provide for location of special tools which are required to remove the torque converter from the torque converter housing.

Impeller

Fluid Flow

NOTE: The following illustration shows a typical turbine, stator and impeller.



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 center 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, applying a turning force to the turbine from the impeller.

The fluid leaving the inner row of the turbine blades is rotated in a counter-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. To prevent this, the stator is located between the impeller and the turbine.

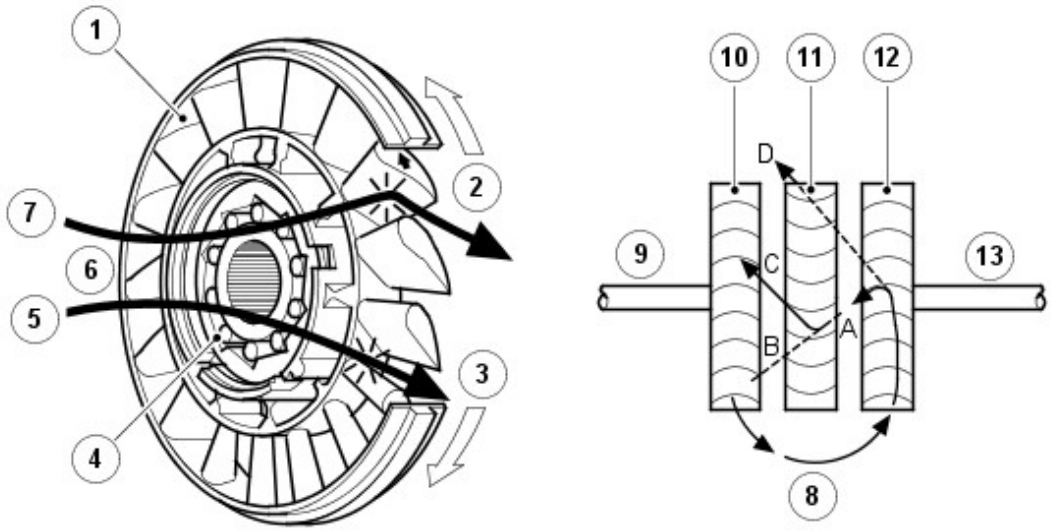
Stator

The stator is located on the splined transmission stator 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 produces the torque multiplication effect of the torque converter.

Stator Functions

NOTE: The following illustration shows a typical stator



E42398

Item	Part Number	Description
1	-	Blades
2	-	Stator held – fluid flow redirected
3	-	Stator rotates freely
4	-	Roller freewheel
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

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 roller 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 transmission 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 freewheel 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.

One Way Free Wheel Clutch

The free wheel clutch can perform two functions; hold the stator stationary and free wheel allowing the stator to rotate without a drive output. The free wheel clutch used is of the roller type and comprises an inner and outer race and a roller and cage assembly. The inner and outer races are pressed into their related components with which they rotate. The roller and cage assembly is located between the inner and outer races.

The rollers are located in a cage which is a spring which holds the rollers in the 'wedge' direction and maintains them in contact with the inner and outer races. The outer race has a series of ramps which allow the rollers to lock the inner and outer races together.

When the outer race is rotated in a clockwise direction, the rollers are 'wedged' between the inner and outer races. The rollers then prevent the rotation of the outer race by holding it to the inner race, which is held stationary.

Lock-Up Clutch Mechanism

The TCC (torque converter clutch) is hydraulically controlled by an Electronic Pressure Regulating Solenoid (EPRS) , which is controlled by the TCM. This allows the torque converter to have three states of operation as follows:

- Fully engaged
- Controlled slip variable engagement
- Fully disengaged.

The torque converter pressure valve reduces system pressure and guarantees the pressure needed for the torque converter. It also limits the maximum torque converter pressure, to prevent the torque converter from expanding.

The solenoid valve is operated by PWM (pulse width modulation) signals from the TCM to give full, partial or no lock-up of the torque converter.

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 is reduced and the pressure in the turbine chamber is allowed to push the piston back. In this condition the clutch plate are released and torque converter slip is permitted.

In the locked condition, the TCC spool valves are actuated by the EPRS. Pressurized fluid is directed into the lock-up clutch piston. The piston moves with the pressure and pushes the clutch plates together. As the pressure increases, the friction between the clutch plates increases, finally resulting in full lock-up of the clutch plates. In this condition there is direct mechanical drive from the engine crankshaft to the transmission planetary gear train.

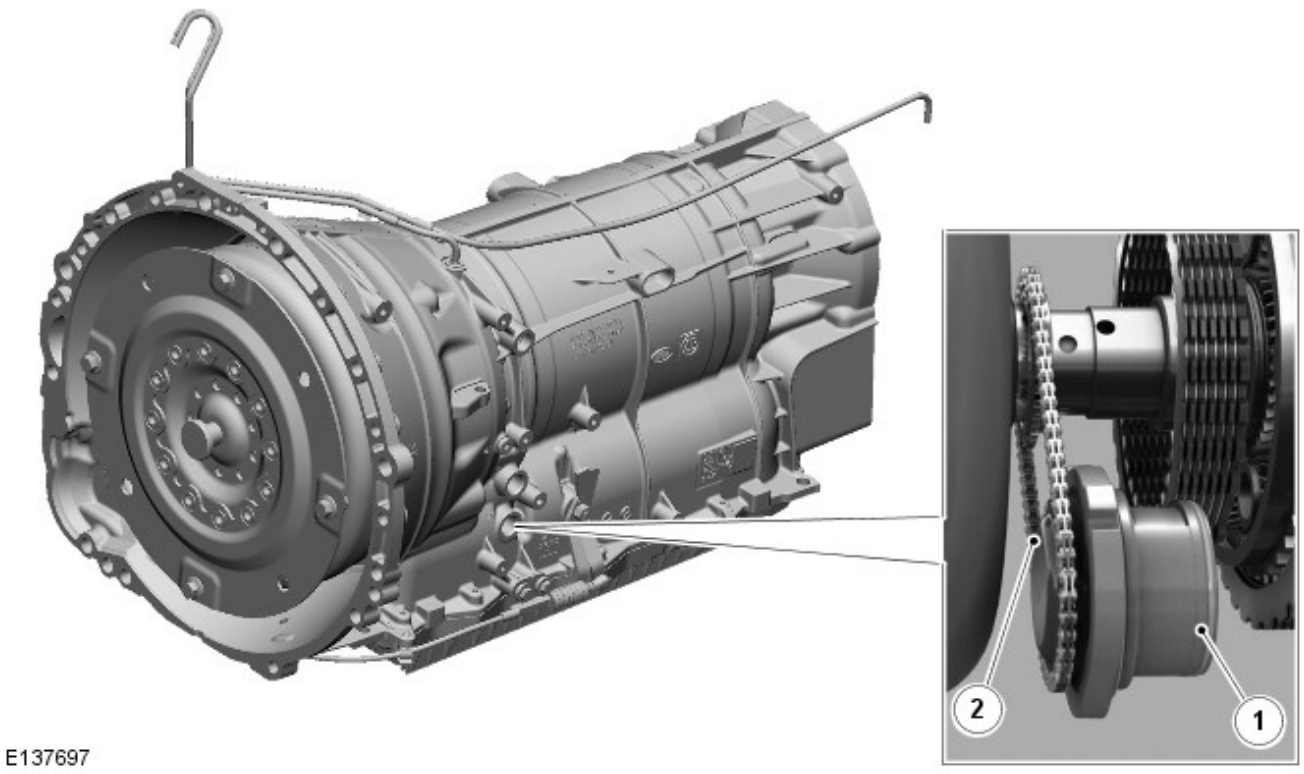
The standstill decoupling feature is new for the 8 speed transmission. When the vehicle comes to a standstill (with the brakes applied), the converter is disconnected from the driveline so that only a slight residual load remains. This further reduces fuel consumption. Decoupling is by actuating clutch B in the transmission, and is dependent on load and output speed.

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 ZF 8HP70 fluid pump is a double stroke, vane type pump and is located below the transmission input shaft. The pump is driven by a chain drive from a sprocket located on the input shaft. The pump has a delivery rate of 50 cm^3 per revolution. The drive sprocket is driven at engine speed through a splined connection in the torque converter shell.

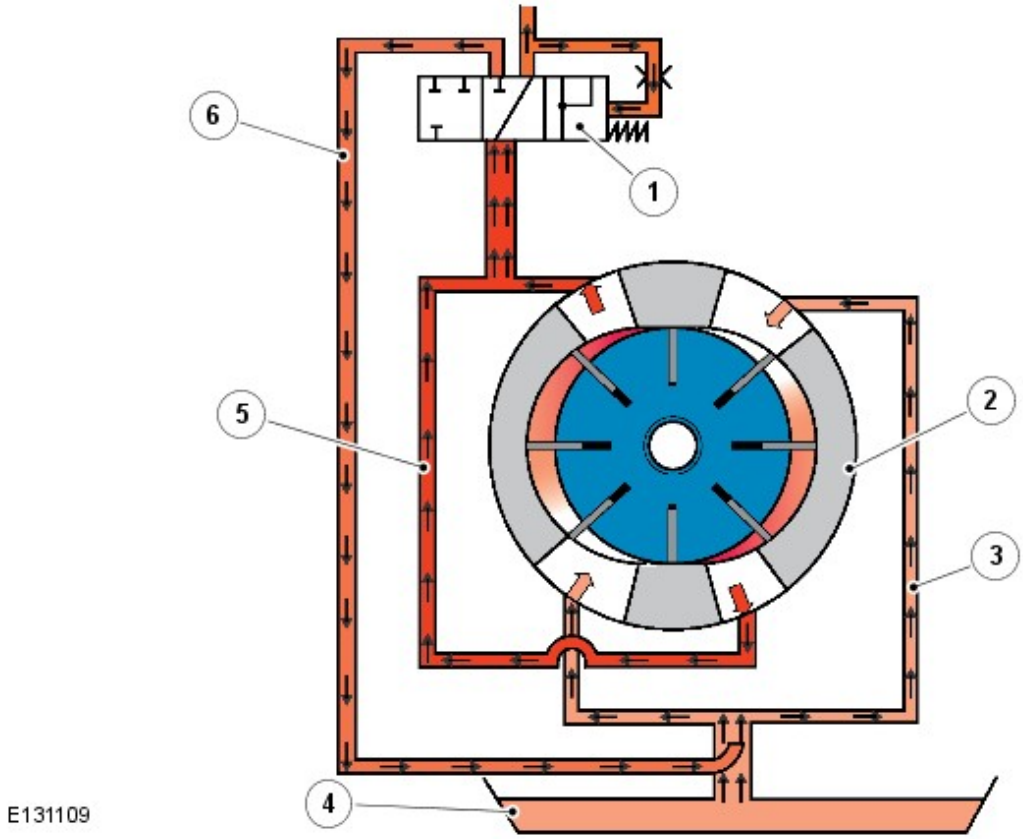
Double Vane Fluid Pump Location



E137697

Item	Part Number	Description
1	-	Vane pump
2	-	Chain drive from torque converter cover

Double Vane Fluid Pump Schematic Diagram



Item	Part Number	Description
1	-	System pressure valve
2	-	Vane pump
3	-	Intake pipe
4	-	Oil pan
5	-	Pressure pipe
6	-	Recycling of redundant fluid

The pump comprises a sprocket, a rear cover with bearing, a front cover with bearing, a cylinder, a rotor shaft and a rotor with vanes. A pressure relief valve is fitted in the pressure outlet gallery from the pump but is not an integral part of the pump itself.

A sprocket is located around the transmission input shaft. Splines on the torque converter nose and the sprocket ensure a positive drive. A simplex chain transmits the rotation of the torque converter cover into rotation of the pump rotor shaft via a second sprocket fitted to the rotor shaft. The gearing of the two sprockets rotates the pump rotor shaft at a speed slightly higher than the Revolutions Per minute (RPM) of the torque converter cover which is directly connected to the engine crank.

The pump contains 7 vanes which are attached to the rotor and rotate within the cam shaped cylinder. As the vanes rotate, the eccentricity of the central hole in the cylinder causes the space between the vanes to increase. This causes a depression between the vanes and fluid is drawn into the space between the vanes via a suction port connected to the fluid pan. The fluid passes through the fluid pan filter before it is drawn into the pump.

As the rotor shaft rotates further, the inlet port is closed by the vanes which have drawn in fluid, trapping the fluid in the space between the vanes. The eccentric hole in the cylinder causes the space between the vanes to decrease and consequentially compresses and pressurizes the fluid trapped between them.

Further rotation of the rotor shaft moves the vanes towards the outlet port. As the vanes pass the outlet port the pressurized fluid passes from the space between the vanes into the pressure gallery to the pressure relief valve.

As the pump is a double stroke vane pump, this sequence is repeated twice per revolution of the rotor shaft.

The pressure relief valve controls the pressure and flow of fluid delivered to the transmission valve block, torque converter and other components. Pressure is controlled by a relief valve which limits the maximum system pressure to 32 bar (464 lbf/in²). The pressure control maintains a constant pressure of fluid irrespective of torque converter input shaft rotational speed. A metering orifice is subject to the pump output pressure. If the pressure in the orifice reaches a predetermined level, a spring loaded ball in the flow control valve is lifted from its seat and pressurized fluid is allowed to recirculate through the pump.

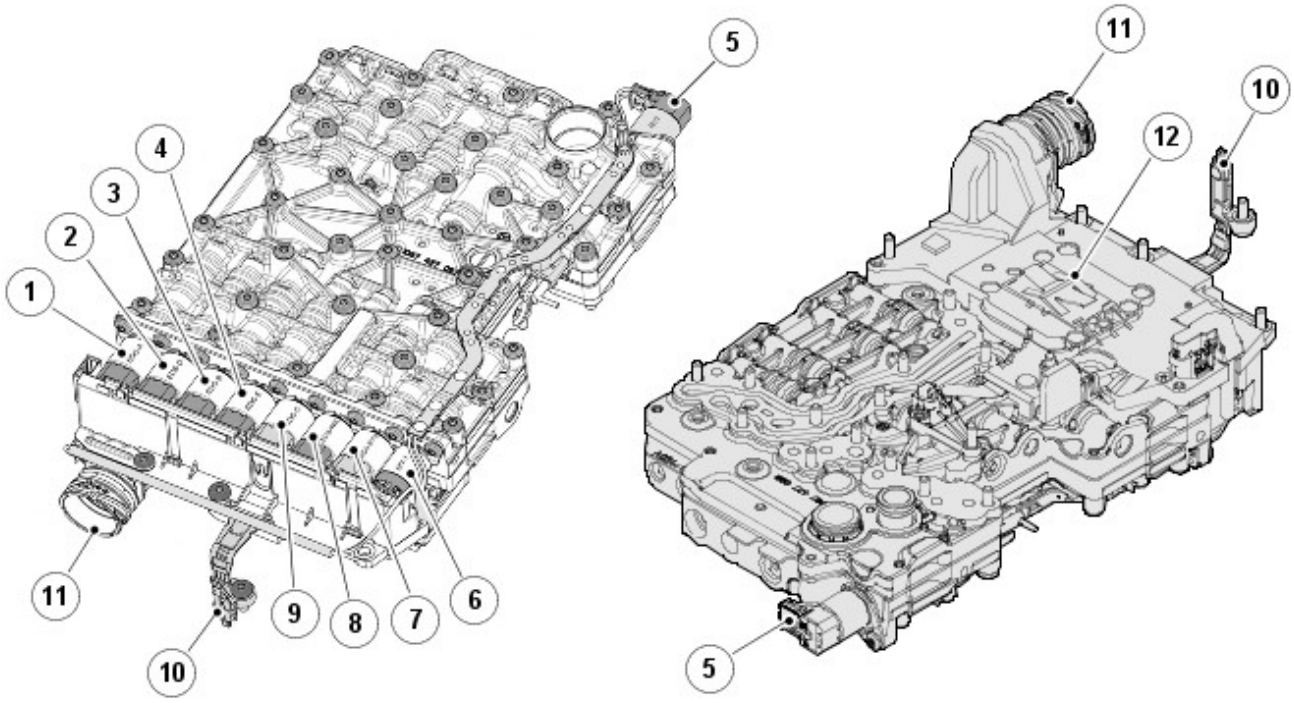
MECHATRONIC VALVE BLOCK

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
- Seven pressure regulator solenoids

- Two park lock solenoids
- Twenty one hydraulic spool valves
- Temperature sensor
- Turbine speed sensor
- Output shaft speed sensor.

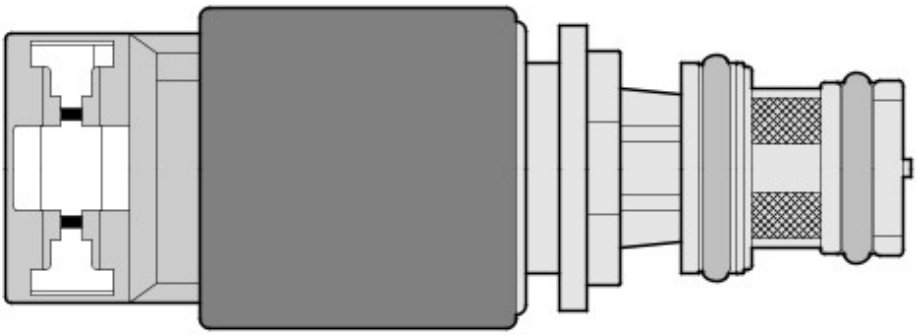
Mechatronic Valve Block



E131253

Item	Part Number	Description
1	-	EPRS A - A brake valve
2	-	EPRS D - D clutch valve
3	-	EPRS B - B brake valve
4	-	EPRS E - E clutch valve
5	-	MV 2 - magnet-valve 2 for electrical park interlock (hold out of park)
6	-	MV 1 - pressure reducing valve
7	-	EPRS SYS - system pressure valve
8	-	EPRS WK - Torque converter lock-up clutch valve
9	-	EPRS C - C clutch valve
10	-	Transmission input shaft speed sensor
11	-	Electrical connector
12	-	Transmission Control Module (TCM) - hidden

Electronic Pressure Regulator Solenoids (EPRS)



E42713

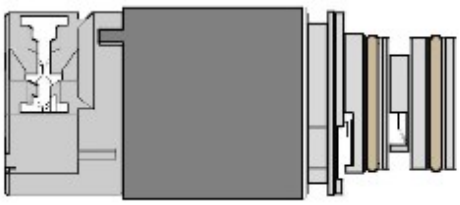
Seven EPRS are located in the valve block. The solenoids are controlled by PWM signals from the TCM. The solenoids convert the electrical signals into hydraulic control pressure proportional to the signal to actuate the spool valves for precise transmission operation.

Solenoids EPRS A, B, D, E and WK supply a higher control pressure as the signal amperage increases and can be identified by an orange 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 - 4.7 bar (0 - 68 lbf.in^2).

Solenoids EPRS C and SYS supply a lower control pressure as the signal amperage increases and can be identified by a gray connector cap. 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 4.7 - 0 bar (68 - 0 lbf.in^2).

The resistance of the solenoid coil winding for EPRS solenoids is 5.05 Ohms at 20 °C (68 °F).

Control Solenoid (MV 1)



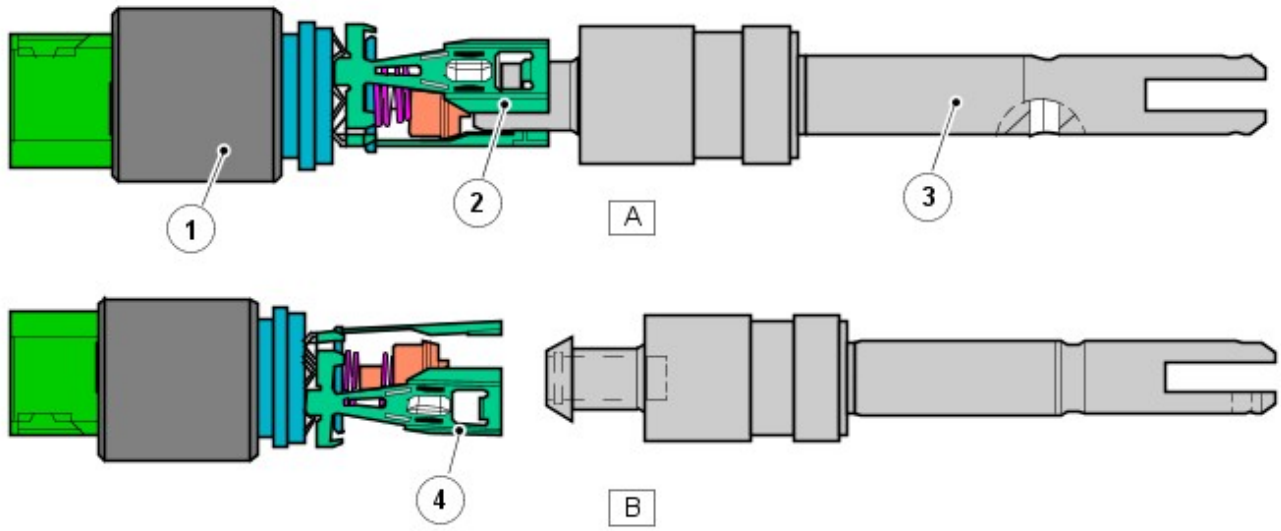
E42714

A shift control solenoid MV1 (Magnetic Valve 1) 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 energizes the solenoid in a programmed sequence for clutch application for gear ratio changes and shift control.

The resistance of the solenoid coil winding for solenoid is between 10 to 11 Ohms at 20 °C (68 °F).

Control Solenoid (MV 2)



E131254

Item	Part Number	Description
A	-	Solenoid in locked (energized) condition - park lock released
B	-	Solenoid in unlocked (de-energized) condition - park lock engaged
1	-	Solenoid
2	-	Claw - locked
3	-	Piston
4	-	Claw - unlocked

A control solenoid MV 2 (Magnetic Valve 2) is located in the valve block. The solenoid is controlled by the TCM and converts electrical signals into hydraulic control signals to control the electronic park lock function

The control solenoid is an on/off solenoid which is controlled by the TCM by switching the solenoid to earth.

When the park position is deselected, control solenoid MV2 resets the parking lock valve in the Mechatronic valve block. This is achieved by the TCM providing the ground for the solenoid which is energized, releasing the claws from retaining the park lock piston. Main fluid pressure acting on the parking lock piston, pushes the piston back to release the lock.

When the park position is selected, control solenoid MV2 is de-energized. The fluid pressure at the parking lock cylinder piston is vented and the mechanical interlock of the piston is opened. A pre-tensioned torsion spring at the park lock disc pulls the piston into the "park" position where the piston engages with the control solenoid claws and is locked in the park position. An emergency release wire cable can be used to release the parking lock manually if an electrical failure occurs.

The resistance of the solenoid coil winding for solenoid is 25 Ohms at 20 °C (68 °F).

When the neutral "N" position is selected and the engine is turned off, the fluid pressure at the park lock cylinder piston is released. The current supply to the control solenoid MV2 remains. The park lock cylinder piston is still held in the unlocked position by the spring force acting on the park lock disc, preventing the park lock plate from engaging the parking lock. This allows the vehicle to be moved when the engine is not running for a short time. Should the battery voltage fall below the level required to maintain the solenoid in the energized condition, the park lock will be engaged.

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 theTCM 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.

Spool Valves

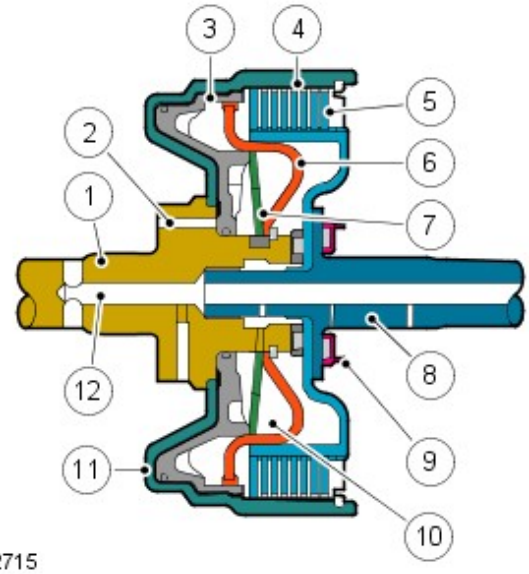
The valve block contains spool valves which control various functions of the transmission. The spool valves are of conventional design and are operated by fluid pressure.

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, 1 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 Clutch or Brake – Typical



E42715

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 (for clutch, not brake)
7	-	Diaphragm spring
8	-	Output shaft
9	-	Bearing
10	-	Dynamic pressure equalization chamber
11	-	Piston chamber
12	-	Lubrication channel

There are three drive clutches and two brakes used in the transmission. Each clutch comprises a number of friction plates dependent on the output controlled. A typical clutch consists of a number of alternating steel plates and plates with friction material bonded to each face.

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 and clutch cooling. The fluid is passed via a drilling in the input 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 equalization chamber overcomes any centrifugal 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 equalization 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 8 forward gears and the reverse gear are produced by a combination of four simple planetary gear sets, 3 clutches and 2 brakes. The front two gear sets share a common sun gear. Power is output always through the planetary carrier of the fourth gearset.

Five shift elements comprising 3 clutches and 2 brakes, are responsible for all 8 forward and reverse gears. High efficiency is achieved by the use of only 2 shift elements disengaged in each gear which reduces drag and so increases the efficiency.

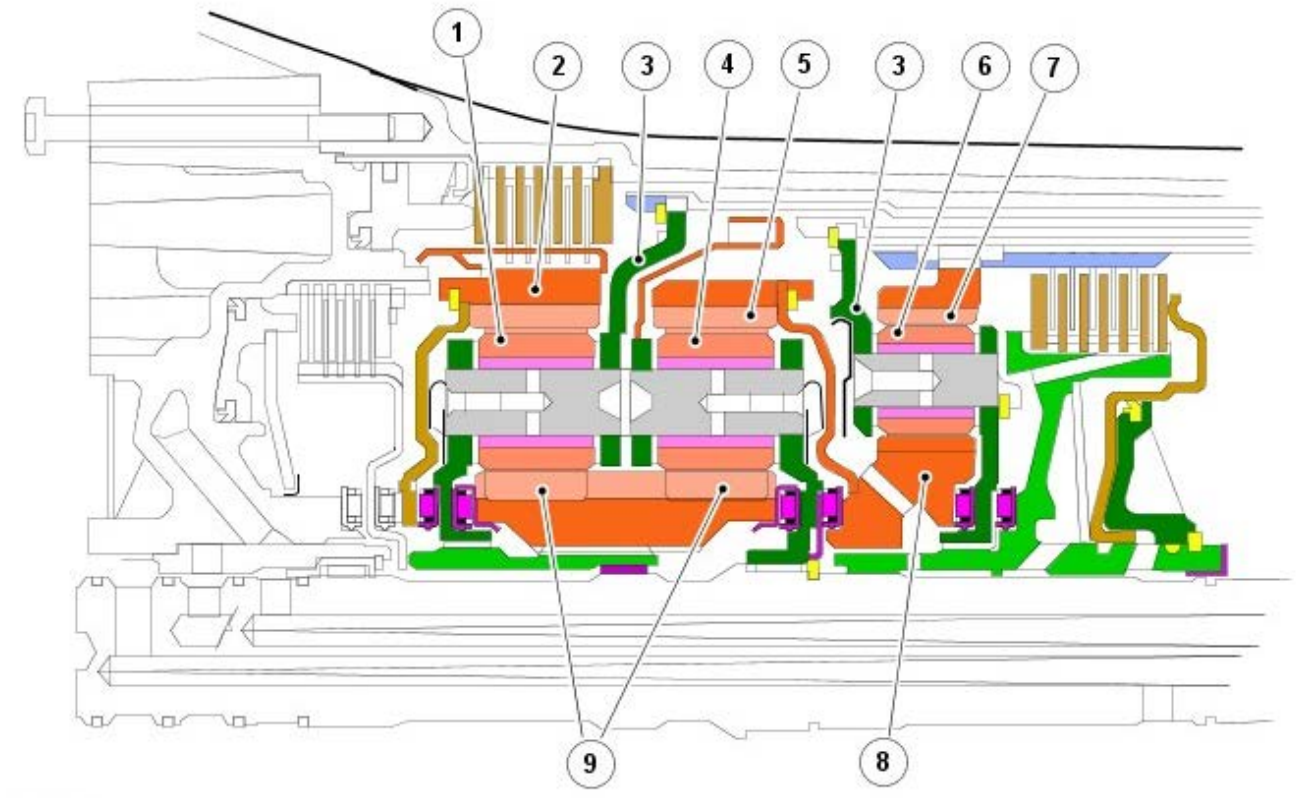
Planetary Gear Sets 1, 2 and 3

The planetary gear sets 1 and 2 comprise:

- Sunwheel - shared by both gear sets
- 4 planetary gears per gear set
- Planetary gear carrier (spider) per gear set
- Ring gear per gear set.

The planetary gear set 3 comprises:

- Sunwheel
- 3 planetary gears
- Planetary gear carrier (spider)
- Ring gear.



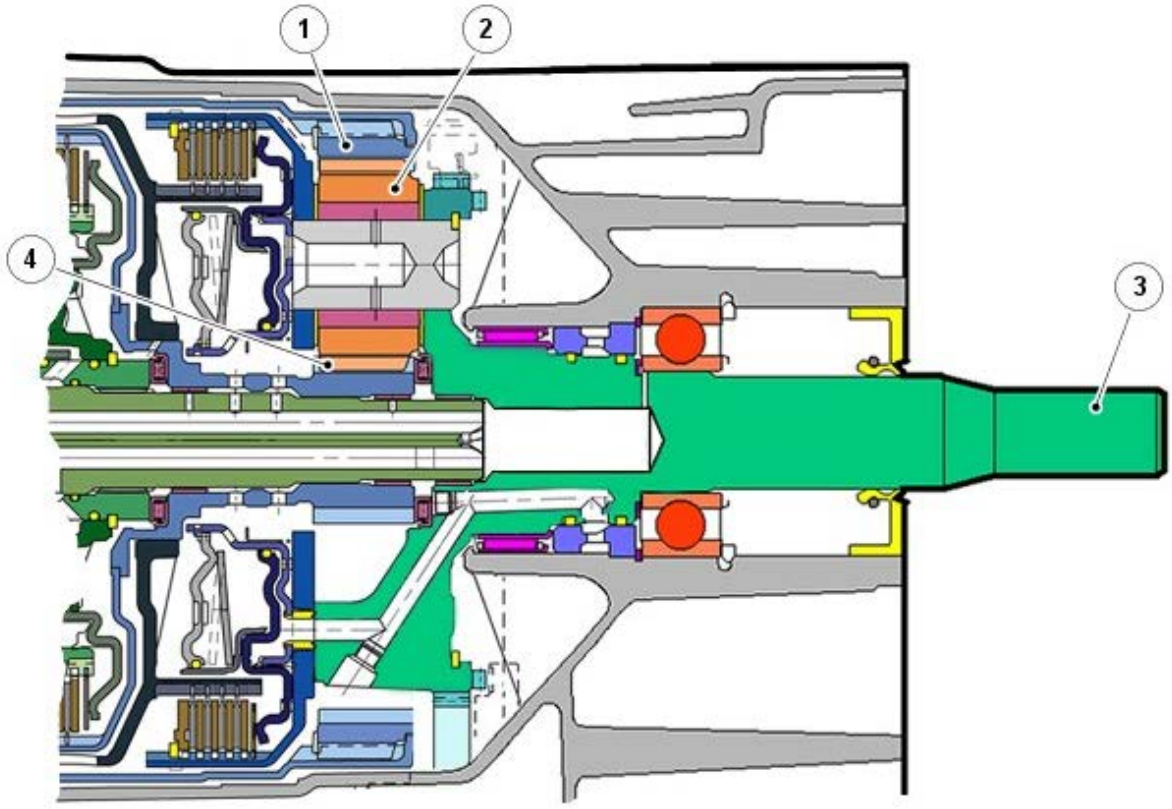
E131255

Item	Part Number	Description
1	-	Planetary gears - gear set 1
2	-	Ring gear - gear set 1
3	-	Planetary gear carrier (spider)
4	-	Planetary gears - gear set 2
5	-	Ring gear - gear set 2
6	-	Planetary gears - gear set 3
7	-	Ring gear - gear set 3
8	-	Sun wheel - gear set 3
9	-	Sun wheel - joint gear sets 1 and 2

Planetary Gear Set 4

The planetary gear set 4 comprises:

- Sunwheel
- 4 planetary gears
- Planetary gear carrier (spider) - output shaft
- Ring gear.



E131256

Item	Part Number	Description
1	-	Ring gear
2	-	Planetary gears
3	-	Output shaft / gear carrier
4	-	Sun wheel

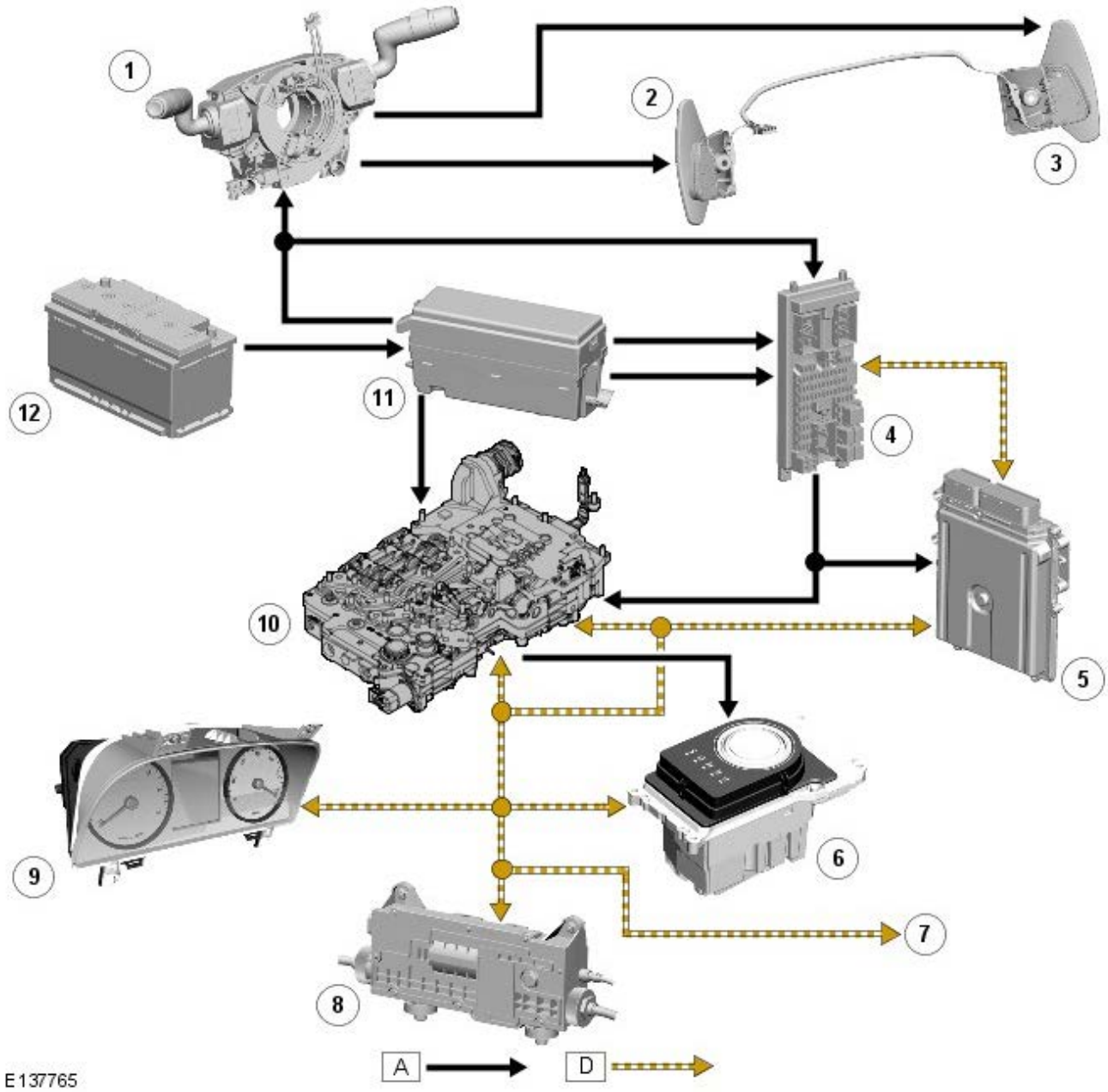
TRANSMISSION CONTROL MODULE

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.

CONTROL DIAGRAM

NOTE: **A** = Hardwired; **B** = K bus; **D** = High speed CAN bus; **O** = Local Interconnect Network (LIN) bus



Item	Part Number	Description
1	-	Clockspring / Steering wheel module
2	-	Downshift paddle switch
3	-	Upshift paddle switch
4	-	CJB (central junction box)
5	-	ECM (engine control module)
6	-	ETS (electronic transmission selector)
7	-	High-speed Controller Area Network (CAN) to other systems and components
8	-	Parking brake module
9	-	Instrument cluster
10	-	TCM (Transmission Control Module)
11	-	Steering wheel paddle switches
12	-	BJB (Battery Junction Box)
13	-	Battery

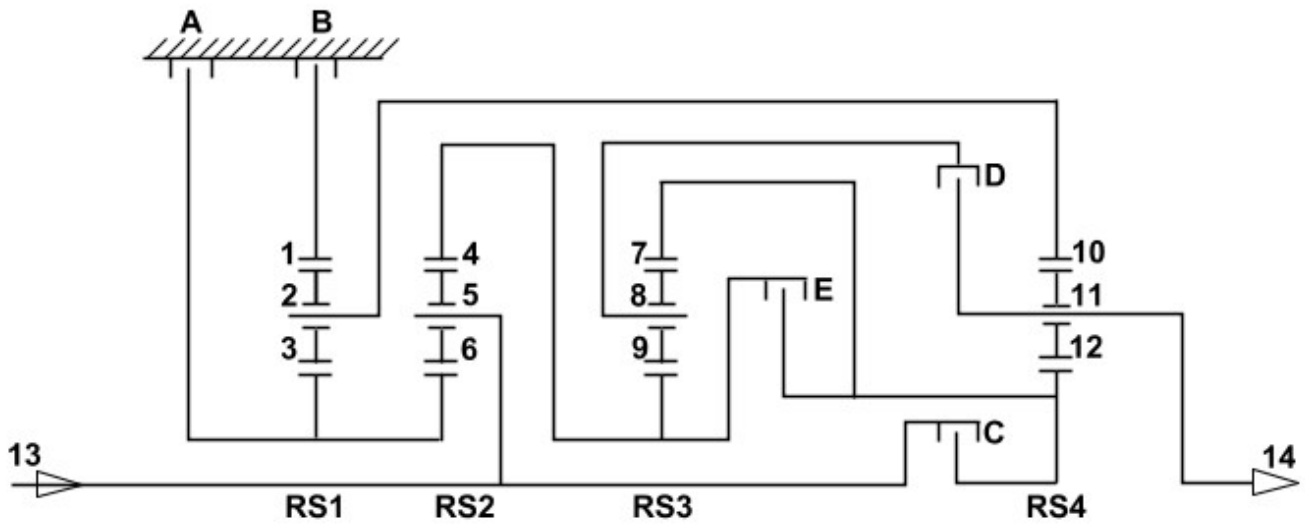
OPERATION

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 TCM memory and physical transmission operating conditions such as vehicle speed, throttle position, engine load and selector lever position.

All gear shifts from 1st to 8th and 8th to 1st are known as 'overlap' shifts. Overlap shifts are during a gear shift one

clutch must remain capable of transmitting torque at a reduced main pressure until the other clutch is ready to accept the torque.



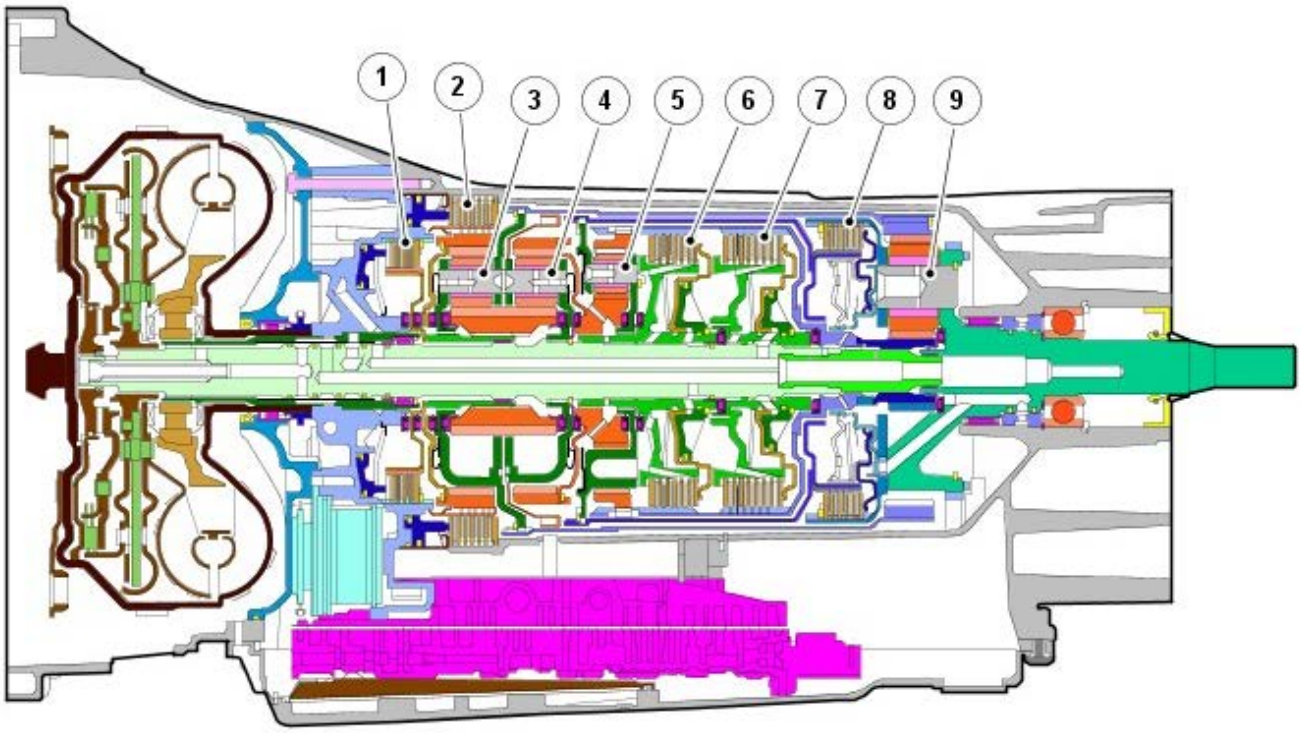
E131258

Item	Part Number	Description
A	-	Multiplate brake
B	-	Multiplate brake
C	-	Multiplate clutch
D	-	Multiplate clutch
E	-	Multiplate clutch
1	-	Ring gear of planetary gear set 1
2	-	Planetary gears of planetary gear set 1
3	-	Sun gear of planetary gear set 1
4	-	Ring gear of planetary gear set 2
5	-	Planetary gears of planetary gear set 2
6	-	Sun gear of planetary gear set 2
7	-	Ring gear of planetary gear set 3
8	-	Planetary gears of planetary gear set 3
9	-	Sun gear of planetary gear set 3
10	-	Ring gear of planetary gear set 4
11	-	Planetary gears of planetary gear set 4
12	-	Sun gear of planetary gear set 4
13	-	Power input from torque converter
14	-	Power output to output shaft

Engine torque is transferred, via operation of single or combinations of clutches to the 4 planetary gear trains. All gear trains are controlled by reactionary inputs from brake clutches to produce the 8 forward gears and 1 reverse gear. The ratios are as follows:

Gear	1st	2nd	3rd	4th	5th	6th	7th	8th	Reverse
Ratio	4.714	3.143	2.106	1.667	1.285	1.000	0.839	0.667	3.317

Shift Elements



E131259

Item	Part Number	Description
1	-	Brake A
2	-	Brake B
3	-	Gear set 1
4	-	Gear set 2
5	-	Gear set 3
6	-	Clutch E
7	-	Clutch C
8	-	Clutch D
9	-	Gear set 4

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.

Instrument Cluster



E137706

Item	Part Number	Description
1	-	MIL (malfunction indicator lamp)
2	-	Message center
3	-	Transmission status display

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 two displays in the instrument cluster.
For additional information, refer to: Instrument Cluster (413-01, Description and Operation).

Malfunction Indicator Lamp

The MIL (malfunction indicator lamp) is located in the tachometer of the instrument cluster. Transmission related faults which may affect the vehicle emissions 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 Land Rover approved diagnostic equipment which reads the fault codes stored in the TCM memory.

Transmission Status Display

The transmission status display is located in the tachometer of the instrument cluster. The display shows the selector lever position or the selected gear when in manual and sport modes.

The following table shows the displays and their descriptions.

Symbol	Description
P	Park selected
R	Reverse selected
N	Neutral selected
D*	Drive and temporary manual mode selected (* = current gear)
S*	Sport mode selected (* = current gear)
1	1st gear selected (manual CommandShift mode)
2	2nd gear selected (manual CommandShift mode)
3	3rd gear selected (manual CommandShift mode)
4	4th gear selected (manual CommandShift mode)
5	5th gear selected (manual CommandShift mode)
6	6th gear selected (manual CommandShift mode)
7	7th gear selected (manual CommandShift mode)
8	8th gear selected (manual CommandShift mode)

Message Center

The message center is located in the instrument cluster. The message center is a Thin Film Transistor (TFT) display that relays vehicle status and operating information to the driver and can display messages relating to a number of vehicle systems. If a transmission fault occurs, the message GEARBOX FAULT is displayed in the message center.
For additional information, refer to: Information and Message Center (413-08, Description and Operation).

Transmission Control Module

The TCM outputs signals to control the shift control solenoid valves and the EPRS's to control the hydraulic operation of the transmission.

The TCM processes signals from the transmission speed and temperature sensors, the Electronic Transmission Selector (ETS), the ECM and other vehicle systems. From the received signal inputs and pre-programmed data, the TCM calculates the correct gear, torque converter clutch setting and optimum pressure settings for gear shift and lock-up clutch control.

The ECM supplies the engine management data over the high speed CAN bus. The TCM requires engine data to efficiently control the transmission operation, for example; flywheel torque, engine speed, accelerator pedal angle, engine temperature. The steering angle sensor and the ABS (anti-lock brake system) module also supply data to the TCM on the high speed CAN bus. 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 CJB (central junction box) supplies steering wheel paddle data over the high speed CAN bus. The TCM uses this to schedule driver requested upshifts and downshifts.

Using the signal inputs and the memorized data, the TCM control program computes the correct gear and torque converter lock-up clutch setting and the optimum pressure settings for gear shift and lock-up clutch control. Special output-side modules (power output stages, current regulator circuits), allow the TCM to control the solenoid valves and pressure regulators and consequently precisely control the hydraulics of the automatic transmission. In addition, the amount and duration of engine interventions are supplied to the engine management by way of the CAN bus.

The TCM determines the position of the selector lever using signals from the electronic transmission selector on the high speed CAN bus and Local LIN (local interconnect network) bus

The TCM transmits the position of the electronic transmission selector and any manual gear selected on the high speed CAN bus. This information is shown in the gear selector display in the instrument cluster.

Engine Stall

If the vehicle stalls it will coast down in gear, with the transmission providing drive to the engine. A restart can be attempted at this point and the engine may start and the driver can continue.

If the coast down speed reduces such that the speed of the engine is less than 400 rev/min, the transmission will go to neutral, D illumination will flash in the instrument cluster. The driver needs to select neutral or park and then press the brake pedal to restart the engine.

If the start/stop button is pressed when driving, the message ENGINE STOP BUTTON PRESSED is displayed in the message center but there will be no change to the ignition state. If the driver requires to switch off the engine, the start/stop button must be pressed for a second time. The engine will be stopped and will be back driven by the transmission as the vehicle coasts down.

Published: 04-Nov-2011

Automatic Transmission/Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Diagnostics TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD

Diagnosis and Testing

Principle of Operation

For a detailed description of the automatic transmission/transaxle system and operation, refer to the relevant Description and Operation sections in the workshop manual. REFER to: Transmission Description (307-01B, Description and Operation).

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
REFER to: Transmission Fluid Level Check (307-01B, General Procedures).

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
REFER to: Transmission Fluid Level Check (307-01B, General Procedures).

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
REFER to: Specifications (307-01B, Specifications).

Fluid Condition Check

1. Check the fluid level
2. Observe the color and the odor of the fluid. The color under normal circumstances should be like honey, not dark 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

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

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

Visual Inspection

Mechanical	Electrical	Hydraulic
• Damaged/stuck shift mechanism • Damaged automatic transmission casing	• Blown fuse(s) • Damaged, loose or corroded connectors	• Fluid level too high/low • Poor condition of

	• Wiring harness	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

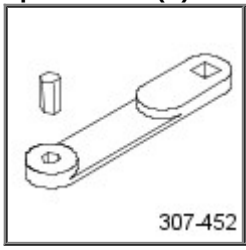
For a list of DTCs that could be logged on this vehicle, please refer to Section 100-00.
REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Transmission Control Module (TCM) - Bosch (100-00, Description and Operation).

Published: 27-Sep-2011

Automatic Transmission / Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Level Check

General Procedures

Special Tool(s)

	307-452 Wrench, Transmission Filler Plug

Check

WARNINGS:

Observe due care when draining, as the fluid can be very hot.

Observe due care when working near a hot exhaust system.

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

1.
   - The following steps must be observed before starting the transmission fluid level check.
   - The vehicle must be on a horizontal ramp.
   - The parking brake must be applied.
   - Place the transmission control switch (TCS) knob in the N position.

2.
   - Start the engine.
   - Apply, and hold, the footbrake.
   - Move the TCS to the 'R' position and wait for 5 seconds.
   - Move the TCS to the 'D' position and wait for 5 seconds.
   - Engage second gear and wait for 5 seconds.
   - Move the TCS back to the 'N' position.

3. Make sure that the torque converter is full of oil by holding the engine speed at 2,000 rpm for a minimum of 30 seconds. Move the TCS to the park position and allow the engine to idle between 600rpm and 750 rpm.

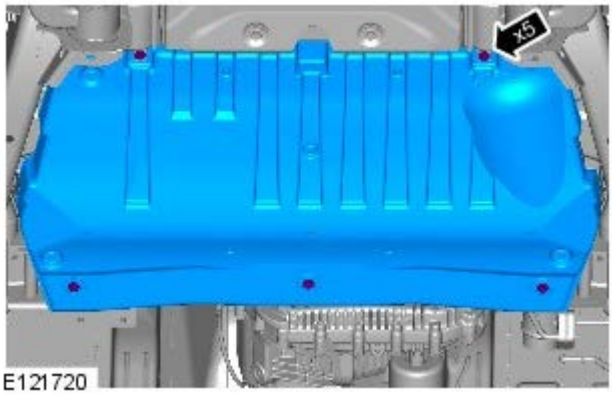
4. Connect the diagnostic tool to the vehicle.

5. Make sure that the transmission oil has exceeded a temperature of 69 degrees celsius so that the thermostat has fully opened allowing full circulation of the transmission fluid. Allow the temperature to drop below 30 degrees celsius before checking the transmission oil level.

6. WARNING: Make sure to support the vehicle with axle stands.

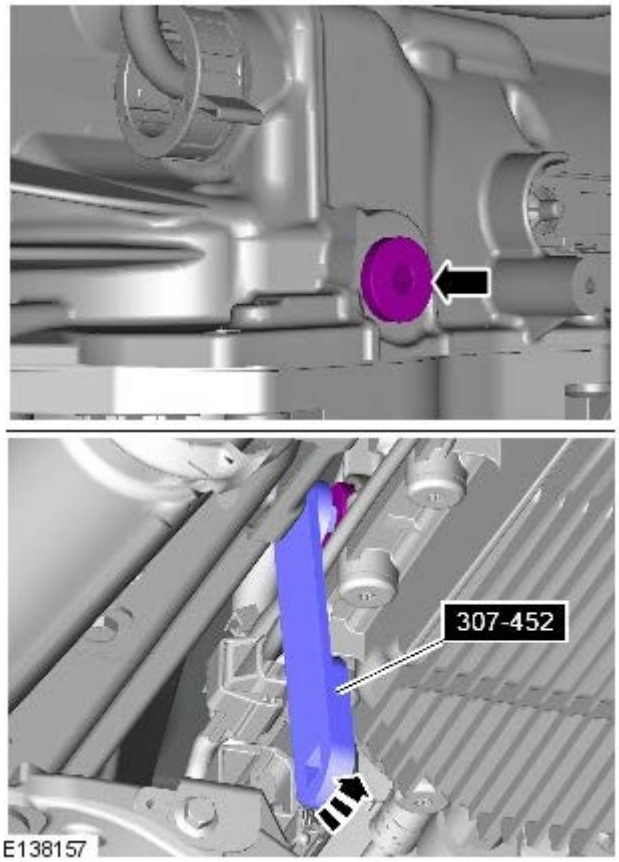
   Raise and support the vehicle.

7.



8. CAUTION: Make sure that the transmission fluid temperature is below 30 degrees before starting the fluid level check.

   Place a suitable container under the transmission fluid fill plug.



9. CAUTIONS:

   The transmission 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.

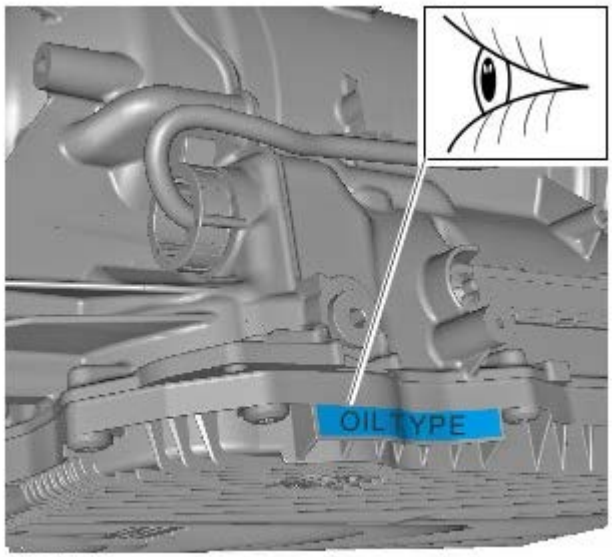
   Discard the component.

   - *Special Tool(s):* 307-452
   - Clean the area around the transmission fluid level plug.

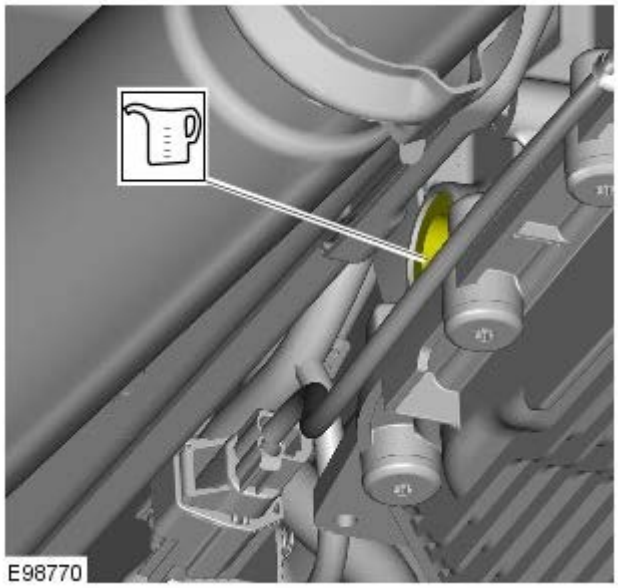
Adjustment

1. CAUTION: Make sure the correct specification of oil is used.

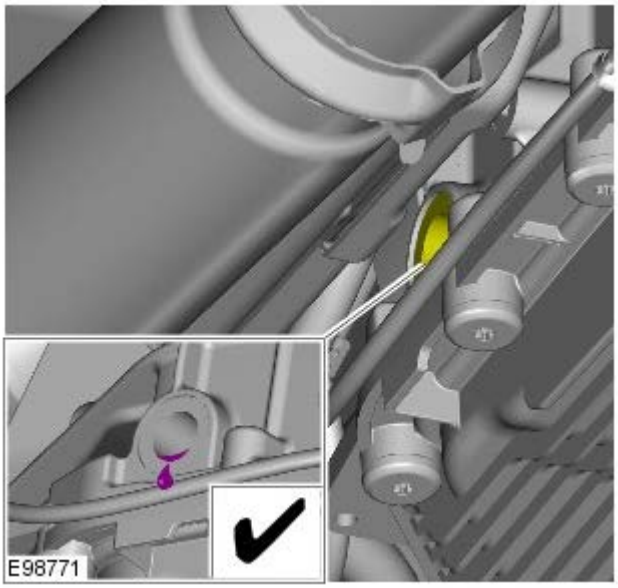
   Refer to: Specifications (307-01B, Specifications).



E138154


E98770

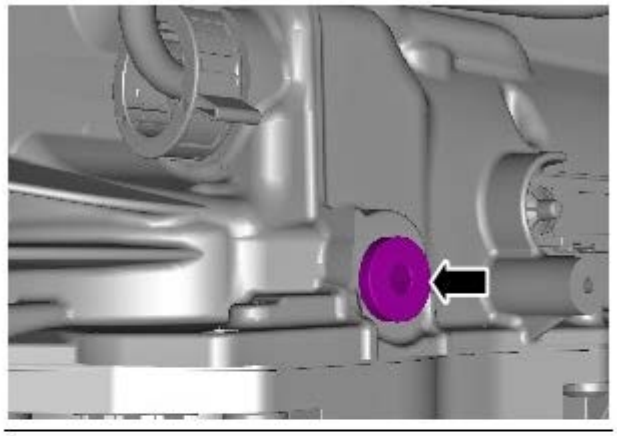
2. If the transmission fluid does not come out of the transmission fluid fill plug hole the transmission fluid level is insufficient. If this is the case add the transmission fluid in 0.5 liter units into the transmission fluid fill plug hole until fluid comes out.


E98771

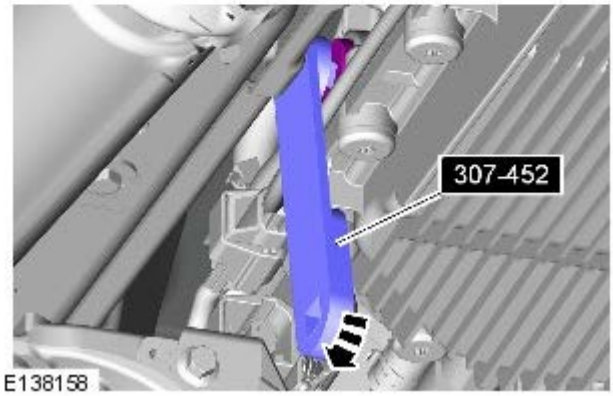
3. Allow the transmission fluid to drain from the transmission fluid filler plug hole until the flow almost stops.

4. WARNING: Make sure to support the vehicle with axle stands.

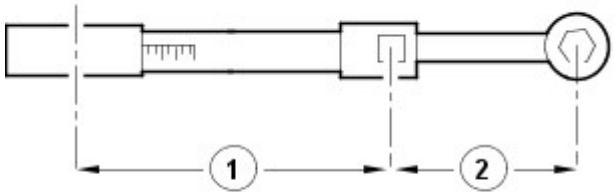
NOTE: Install a new fluid level filler plug.



- Using the special tool, install the new transmission fluid fill plug.
- Lower the vehicle on the lift.
- Switch off the engine.
- Raise and support the vehicle.

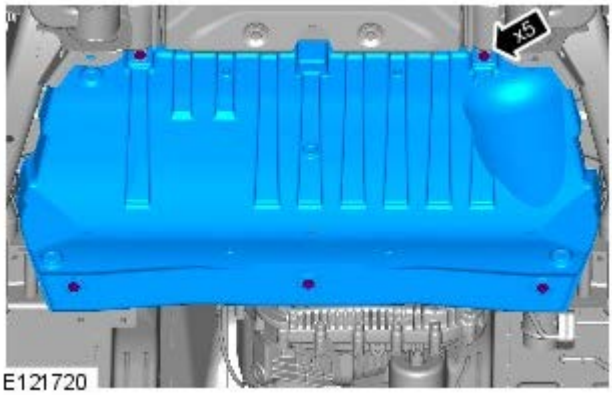


E138158



E37107

5. CAUTION: Make sure the transmission fluid fill plug is tightened to the correct specification. Failure to follow this instruction may result in damage to the vehicle.
   - To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
   - 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 (1).
   - 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.
   - Tighten the transmission fluid fill plug to the torque given by the calculation.
6. Remove the special tool.
7. Remove the container.
8. *Torque:* 10 Nm



E121720

9. Lower the vehicle.

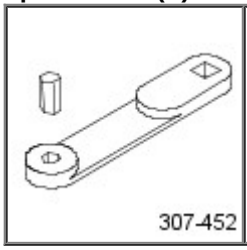
10. Disconnect the diagnostic tool.

Published: 27-Sep-2011

Automatic Transmission / Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Drain and Refill

General Procedures

Special Tool(s)

	307-452 Wrench, Transmission Filler Plug

WARNINGS:

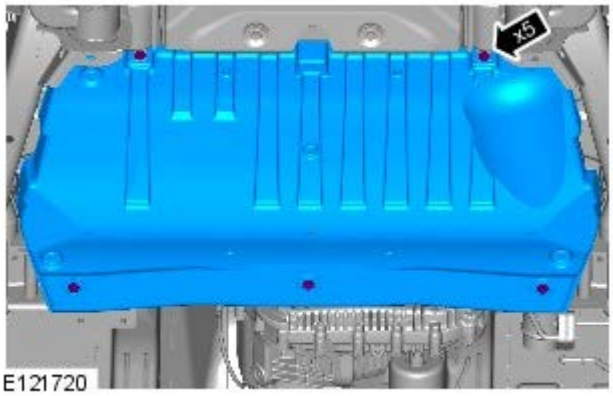
Observe due care when draining, as the fluid can be very hot.

Observe due care when working near a hot exhaust system.

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

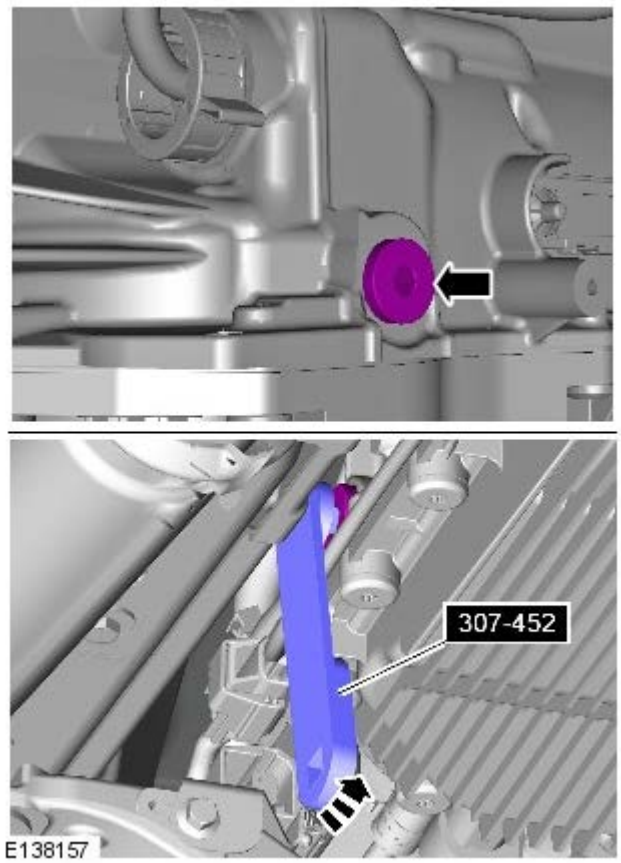
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. 

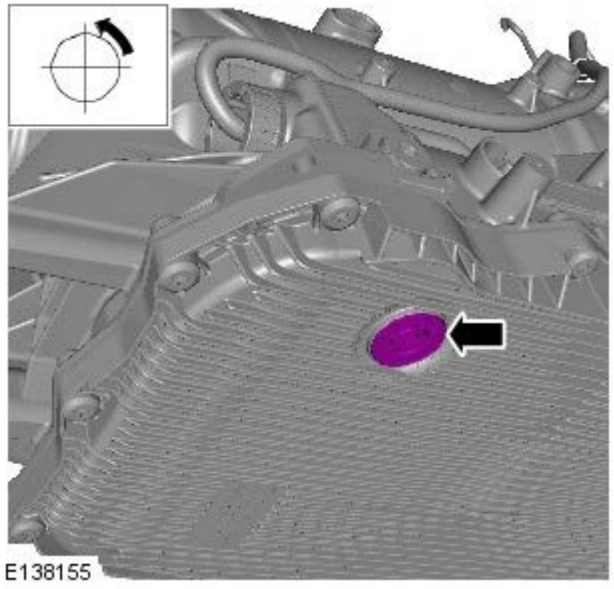
3. Place a container under the transmission.

4. - *Special Tool(s):* 307-452
   - Discard the component.



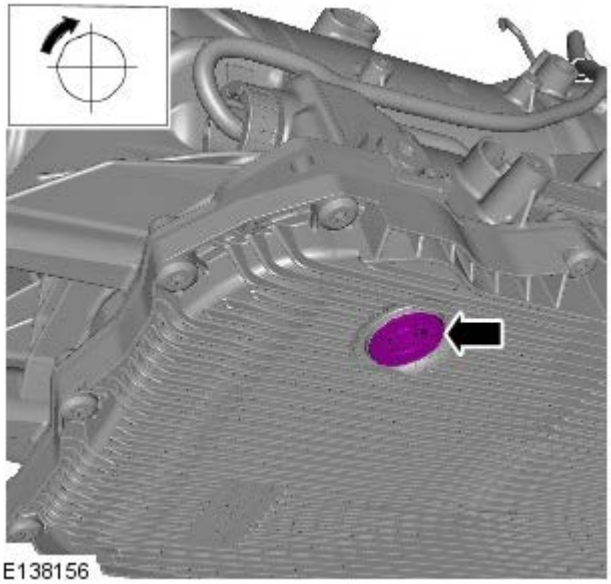
5.

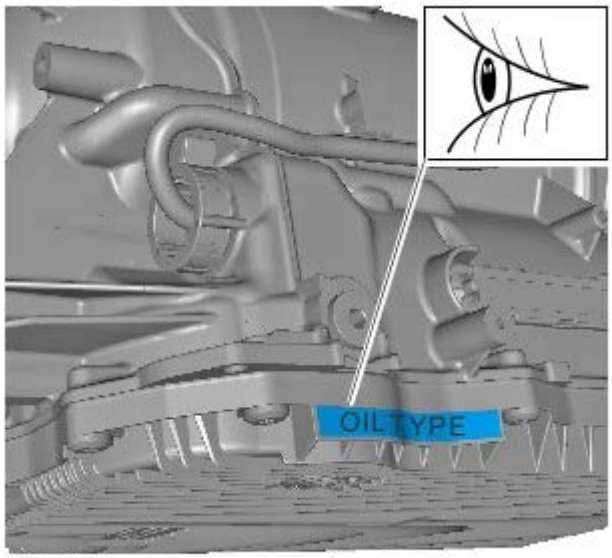
- Allow the fluid to drain.
- Discard the component.



6.

- Install a new component.
- *Torque:* 8 Nm


E138156

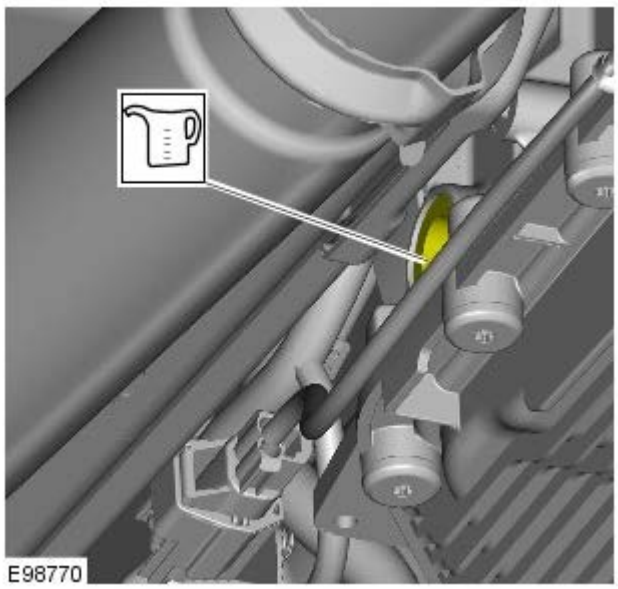


E138154

7. CAUTION: Make sure the correct specification of oil is used.

   Refer to: Specifications (307-01B, Specifications).

8.
   - Refill the transmission with fluid.
   - For fluid quantity, refer to the specification's section.


E98770

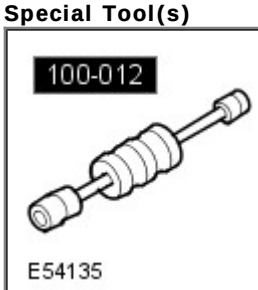
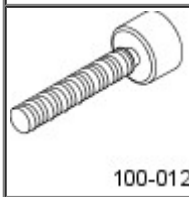
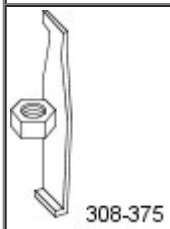
9. Refer to: Transmission Fluid Level Check (307-01, General Procedures).

Published: 27-Sep-2011

Automatic Transmission/Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Input Shaft Seal

Removal and Installation

Special Tool(s)

	100-012 Slide Hammer
	100-012-01 Slide Hammer Adapter
	307-613 Holding Pins, Torque Converter
	308-375 Remover, Input and Output Seal
	JLR-308-845 Installer, Input Shaft Seal

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

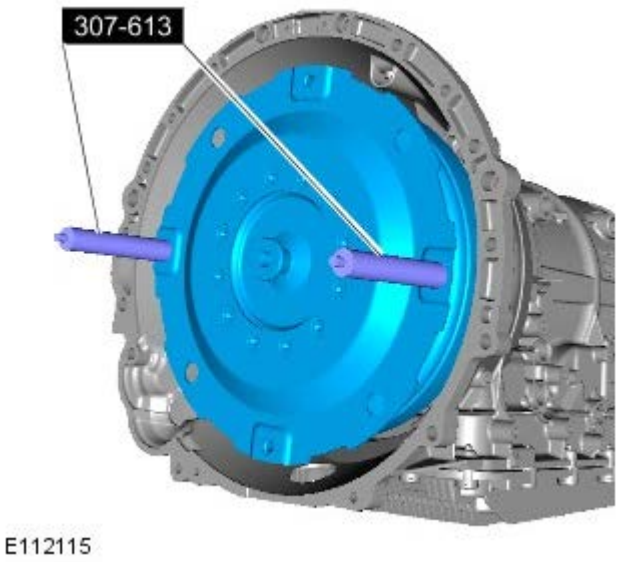
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

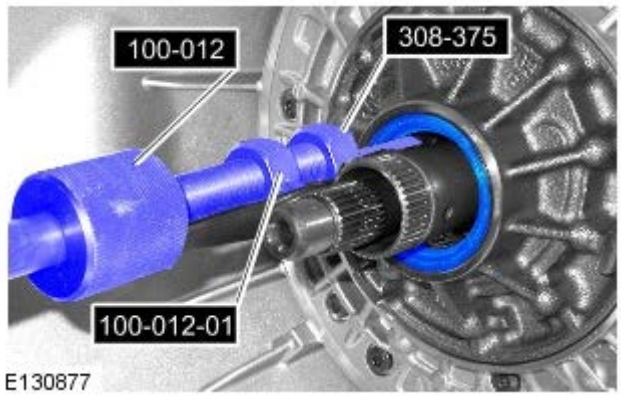
   Raise and support the vehicle.

3. Refer to: Transmission (307-01B Automatic Transmission/Transaxle - TDV6 3.0L Diesel , Vehicles With:



4. CAUTION: Be prepared to collect escaping fluids.

   Special Tool(s): 307-613



5. CAUTIONS:

   Discard the seal.

   Care must be taken to avoid damage to the seal register and running surface.

   Special Tool(s): 100-012, 100-012-01, 308-375

Installation

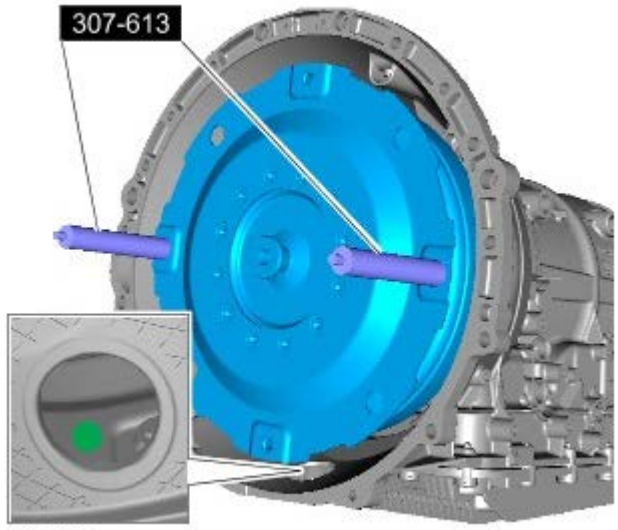


1. CAUTION: Install a new seal.

   Special Tool(s): JLR-308-845

2. CAUTION: Be prepared to collect escaping fluids.

   NOTE: Make sure that the painted mark is at the lowest possible point when the first retaining bolt is installed, as illustrated.



E112118

3. NOTE: Make sure that the torque converter is fully engaged to the transmission.



E138283

4. Refer to: Transmission (307-01B Automatic Transmission/Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Installation).

5. Connect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

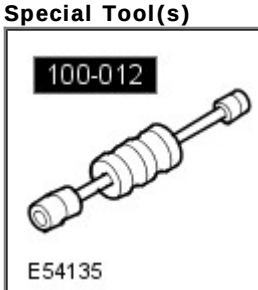
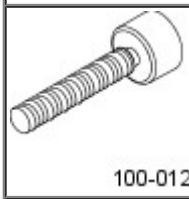
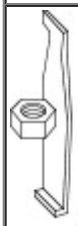
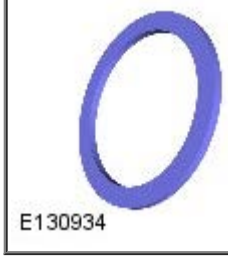
6. Refer to: Transmission Fluid Level Check (307-01B Automatic Transmission/Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

Published: 26-Sep-2011

Automatic Transmission / Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Extension Housing Seal

Removal and Installation

Special Tool(s)

	100-012 Slide Hammer
	100-012-01 Slide Hammer Adapter
	307-520 Installer, Output Shaft Seal
	308-375 Remover, Input and Output Seal
	JLR-307-520-01 Adapter, Output Shaft Seal

Removal

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

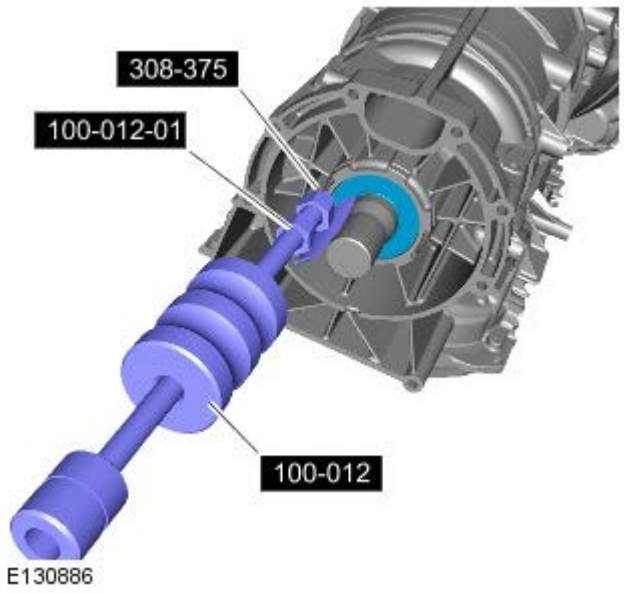
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

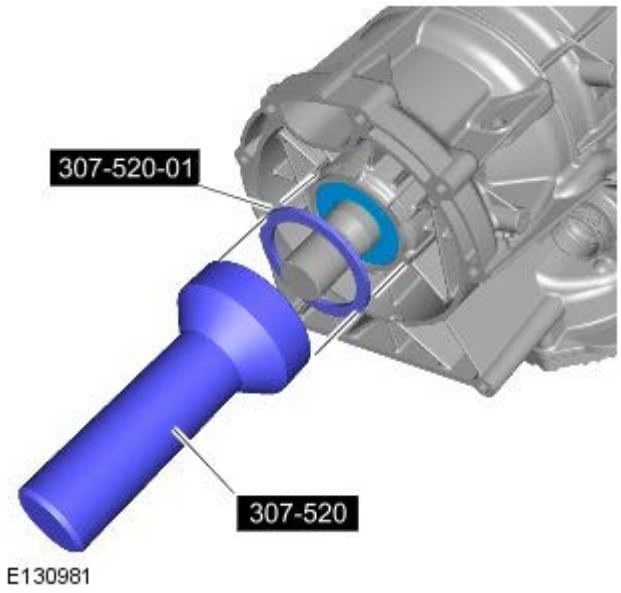
3. Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B, Removal).

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

   Special Tool(s): 100-012, 100-012-01, 308-375



Installation



1. CAUTIONS:

   Oil seals must be fitted dry.

   Make sure that the mating faces are clean and free of foreign material.

   Special Tool(s): 307-520, JLR-307-520-01

2. Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B, Installation).

3. Connect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

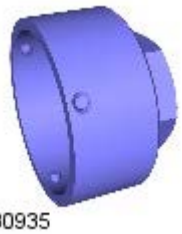
4. Refer to: Transmission Fluid Level Check (307-01B, General Procedures).

Published: 26-Sep-2011

Automatic Transmission / Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Control Module (TCM) and Main Control Valve Body

Removal and Installation

Special Tool(s)

 E130935	JLR-308-844 Remover/Installer, Transmission Control Module Electrical Connector

Removal

WARNING: Be prepared to collect escaping fluid.

CAUTION: Make sure all suitable safety precautions are taken to protect the TCM and main control valve body electrical connector pins against electrostatic discharge.

NOTE: Removal steps in this procedure may contain installation details.

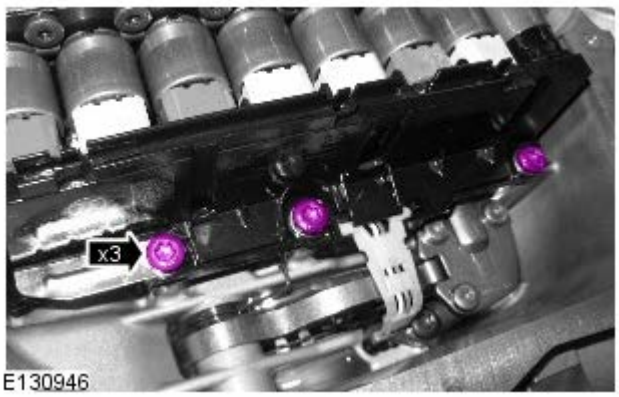
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Transmission Fluid Pan, Gasket and Filter (307-01, Removal and Installation).

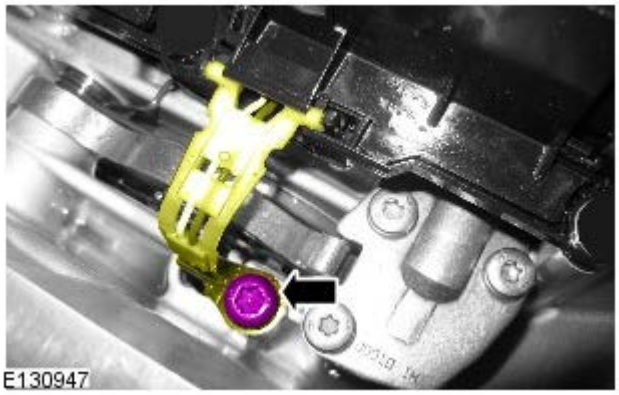


E130946

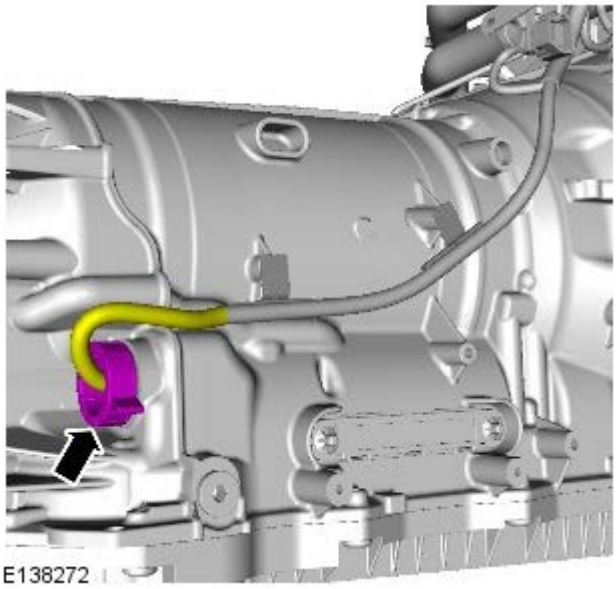
4. CAUTION: Discard the bolts.

   Take precautions to avoid any electrostatic charging, which could damage this comopnent.

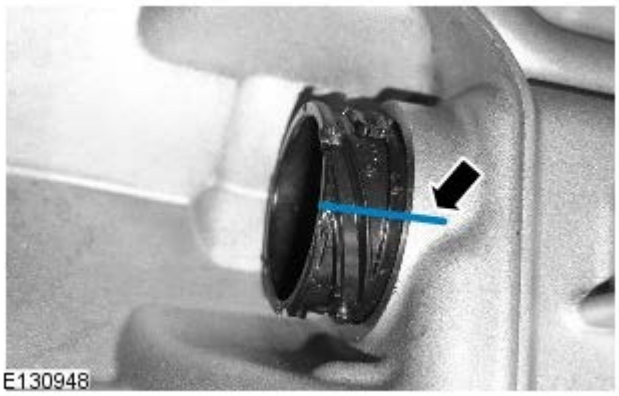
5. CAUTION: Discard the bolt.



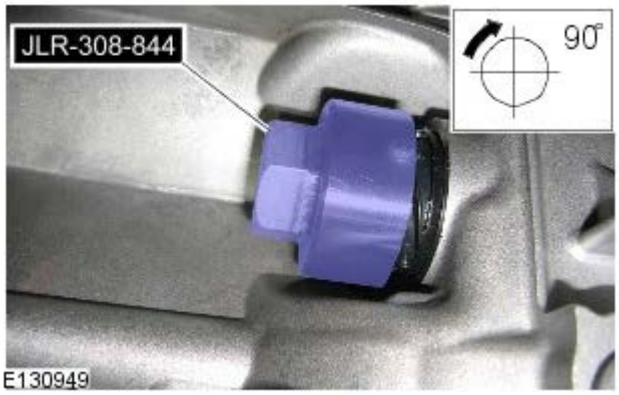
6.



7. CAUTION: Note the fitted position of the component prior to removal.



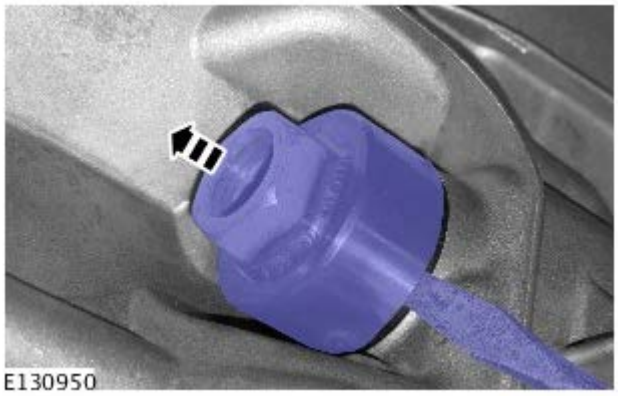
8. *Special Tool(s):* JLR-308-844

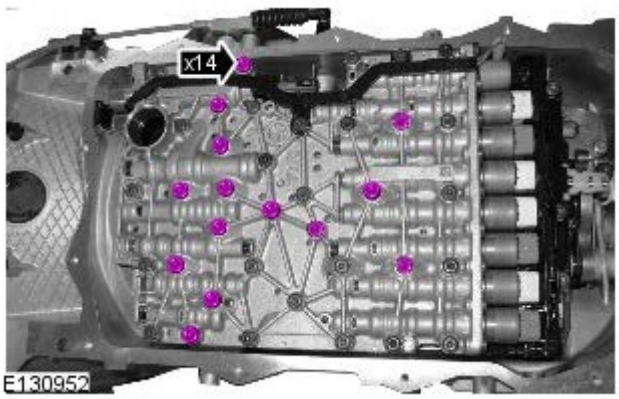


9.



10.

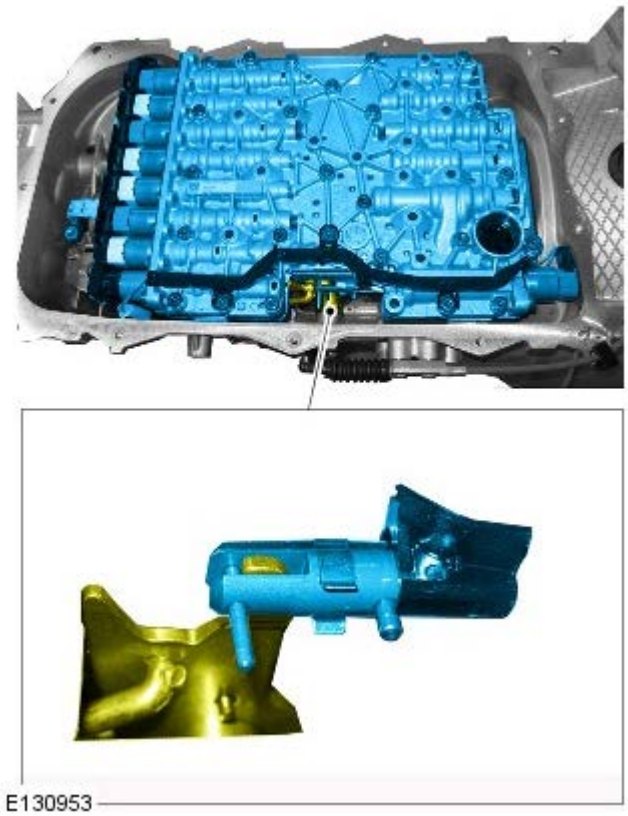




11. CAUTION: Discard the bolts.

12. WARNING: Be prepared to collect escaping fluid.

NOTE: Note the position of the manual park brake release.



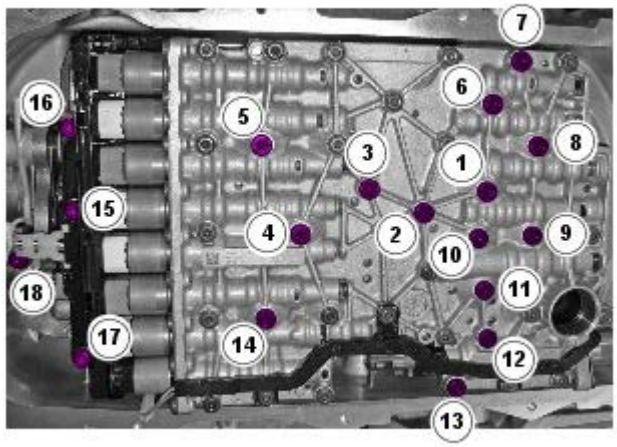
E130953

Installation

1. To install, reverse the removal procedure.
2. CAUTION: Make sure that new bolts are installed.

   NOTE: Tighten the retaining bolts evenly and progressively.

   Torque: 8 Nm



E130933

3. Using the diagnostic tool, calibrate the main control valve body and the transmission control module (TCM).

Published: 06-Aug-2013

Automatic Transmission / Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Pan, Gasket and Filter

Removal and Installation

General Equipment

Transmission jack

Removal

NOTES:

Removal steps in this procedure may contain installation details.

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

1. Disconnect the battery ground cable.

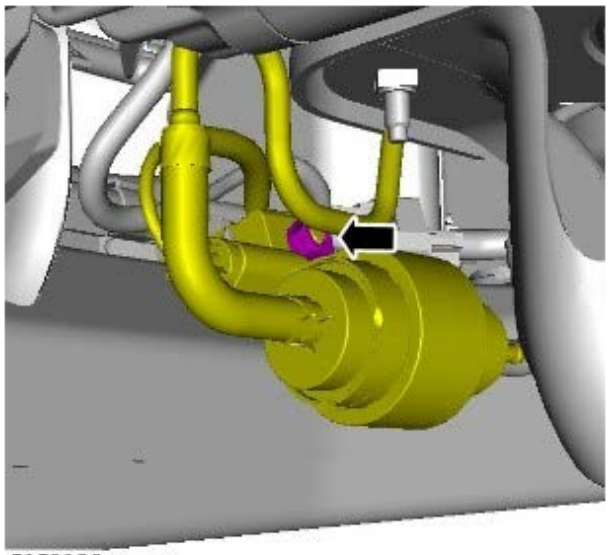
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Transmission Fluid Drain and Refill (307-01B Automatic Transmission/Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

4. *Torque:* 10 Nm

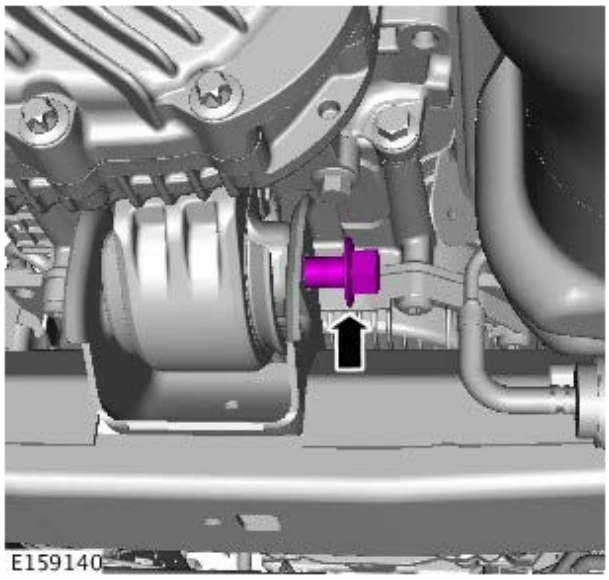


E159139

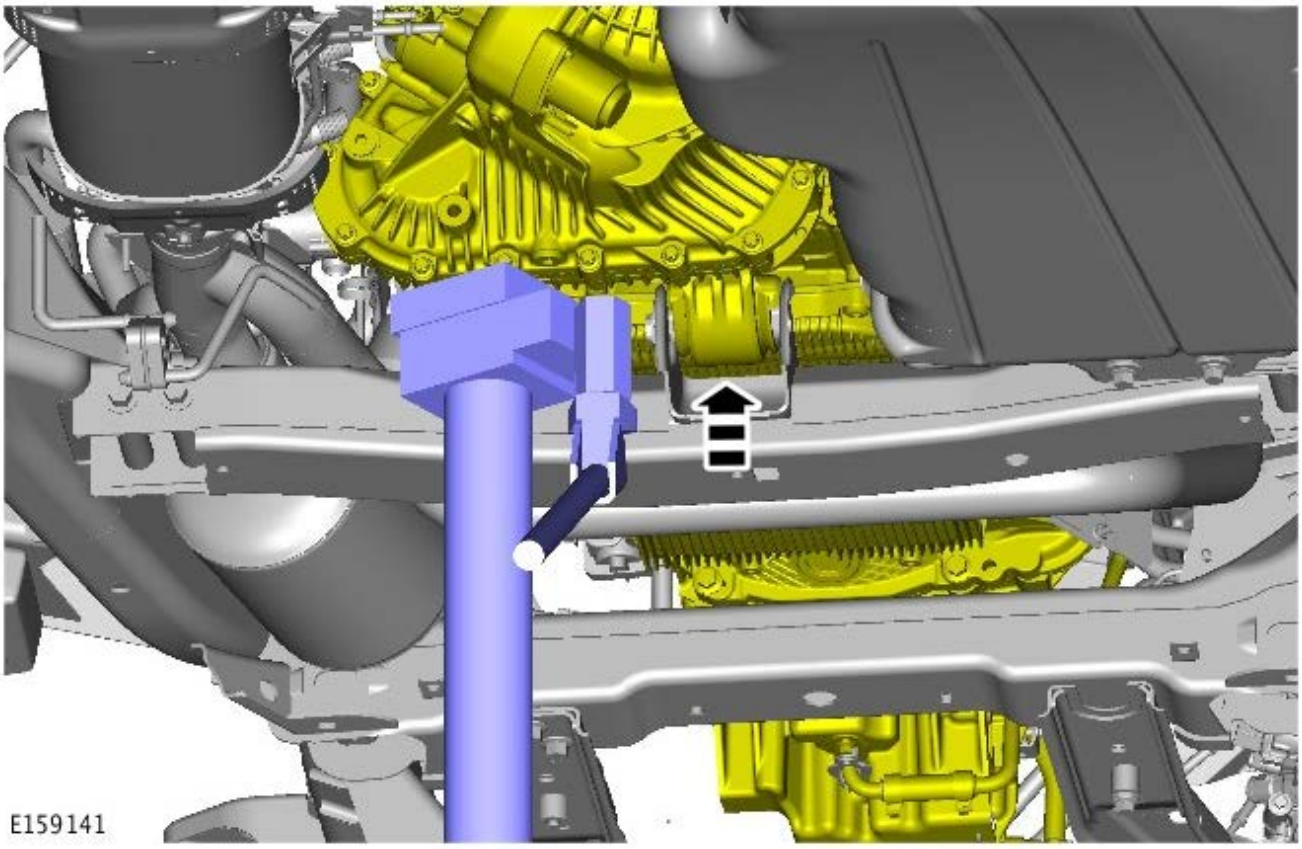
5. Using the transmission jack, support the transmission.

   General Equipment: Transmission jack

6. *Torque:* 175 Nm



7.



8. CAUTIONS:

Take extra care when removing the component, prevent damage to the mating faces.

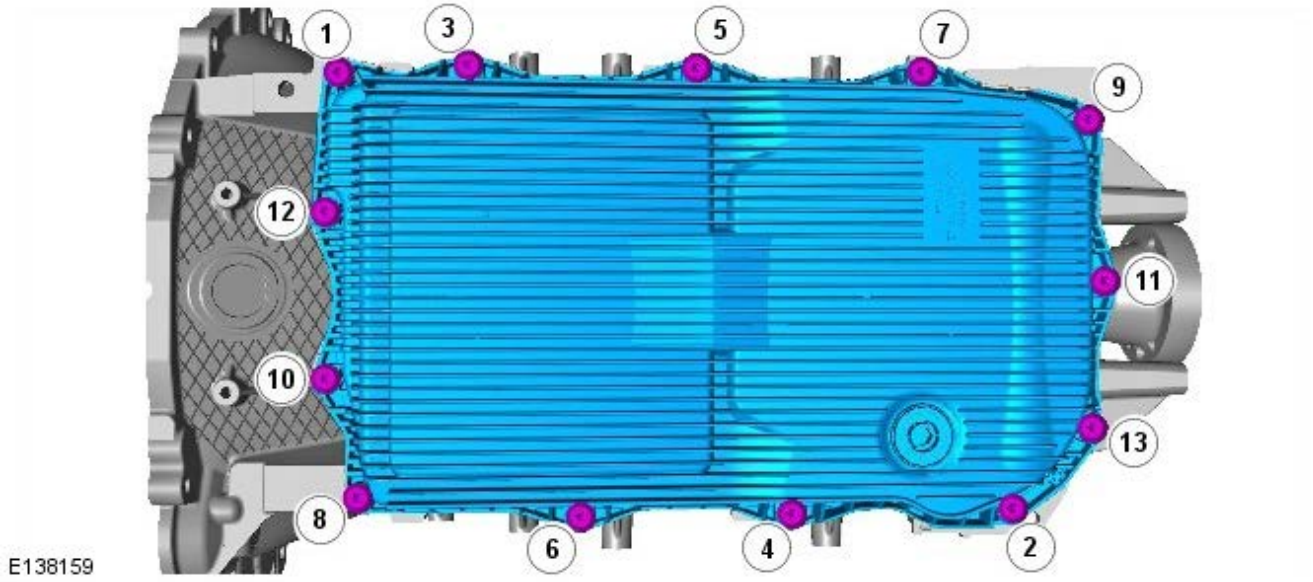
Make sure that the area around the component is clean and free of foreign material.

Be prepared to collect escaping fluids.

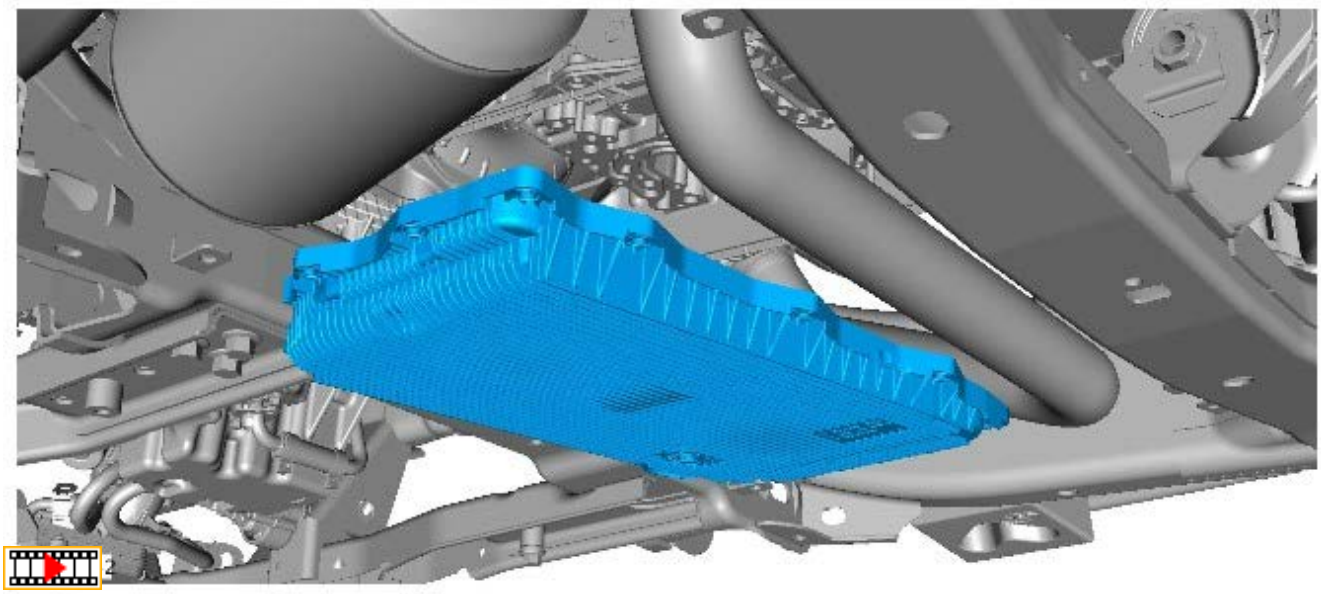
Discard all components including pan and bolts.

Remove and install pan bolts in order sequence 1 to 13.

Torque: 10 Nm



9. NOTE: Turn pan through 90 degrees to allow removal.



Installation

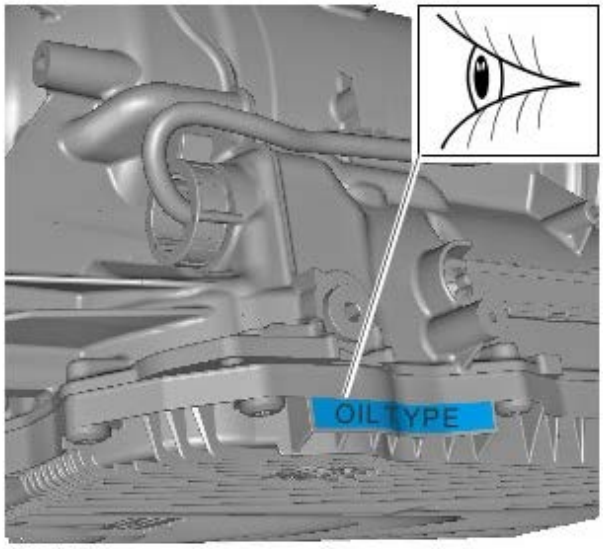
1. CAUTIONS:

   Make sure the correct specification of oil is used.

   Make sure that new components are installed.

   Make sure that the mating faces are clean and free of foreign material.

   To install, reverse the removal procedure.



E138154

Published: 24-Oct-2012

Automatic Transmission / Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Support Insulator

Removal and Installation

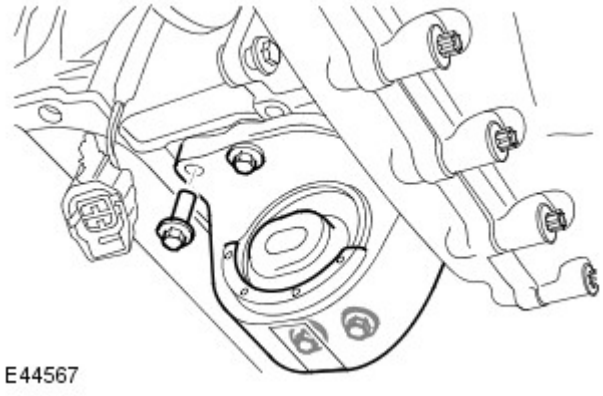
Removal

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the transmission crossmember.
   For additional information, refer to: Transmission Support Crossmember - V8 5.0L Petrol/V8 S/C 5.0L Petrol (502-02 Full Frame and Body Mounting, Removal and Installation) / Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

3. Remove the transmission support insulator.
   - Remove the 4 bolts.



Installation

1. To install, reverse the removal procedure.
   - Clean the component mating faces.
   - Tighten the bolts to 60 Nm (44 lb.ft).

Published: 02-May-2013

Automatic Transmission / Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission

Removal

Special Tool(s)

303-1069  E53727	303-1069 Adapter, Wrench

General Equipment
Transmission jack

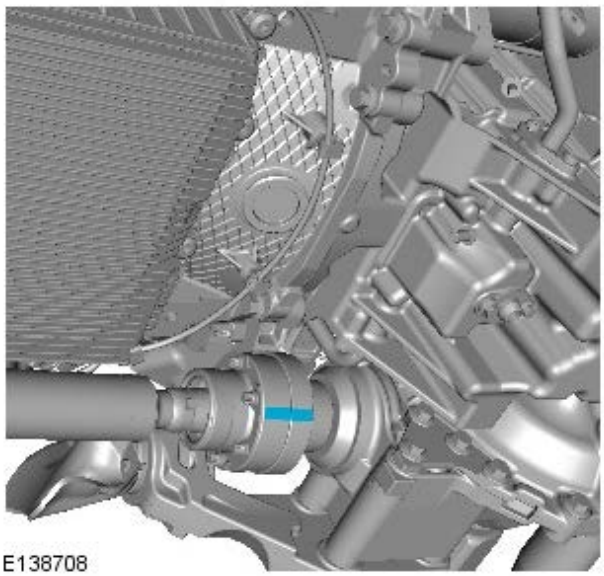
NOTES:

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

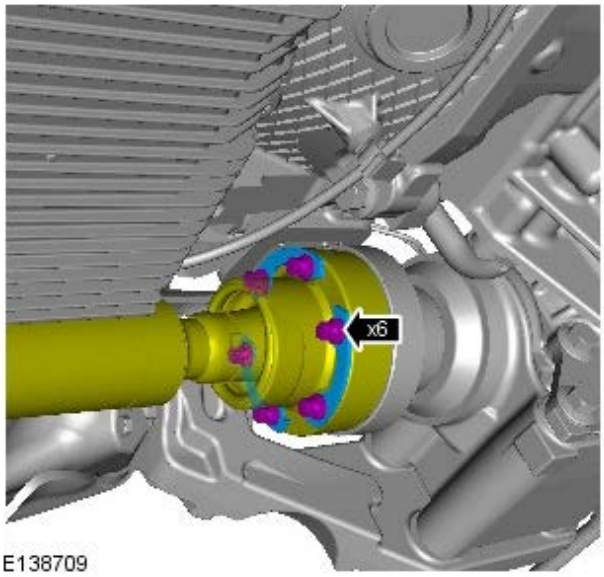
Some illustrations may show the transmission removed for clarity.

Some illustrations may show the engine removed for clarity.

1. Disconnect the battery ground cable.
2. WARNING: Make sure to support the vehicle with axle stands.

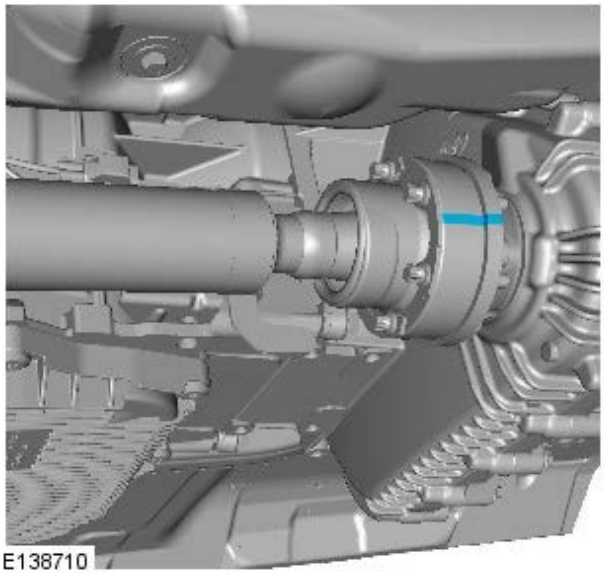
   Raise and support the vehicle.
3. Refer to: Exhaust System (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
4. Refer to: Rear Driveshaft (205-01 Driveshaft, Removal and Installation).
5. 
   E138708
6. CAUTION: Discard the bolts.

   Using a suitable tie strap, secure the driveshaft.

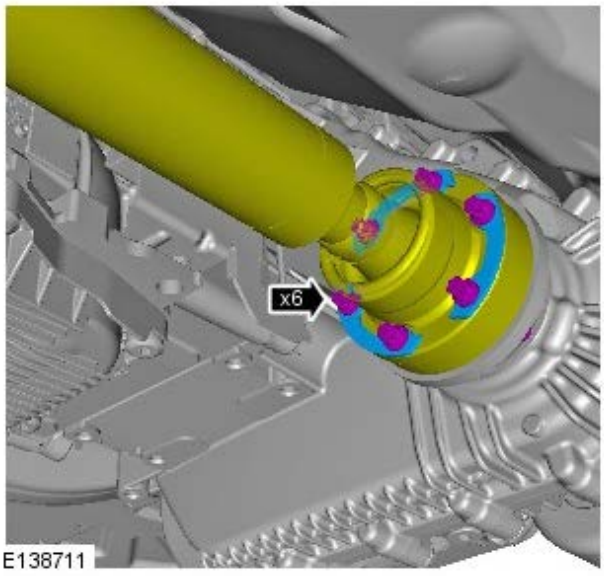


E138709

7.

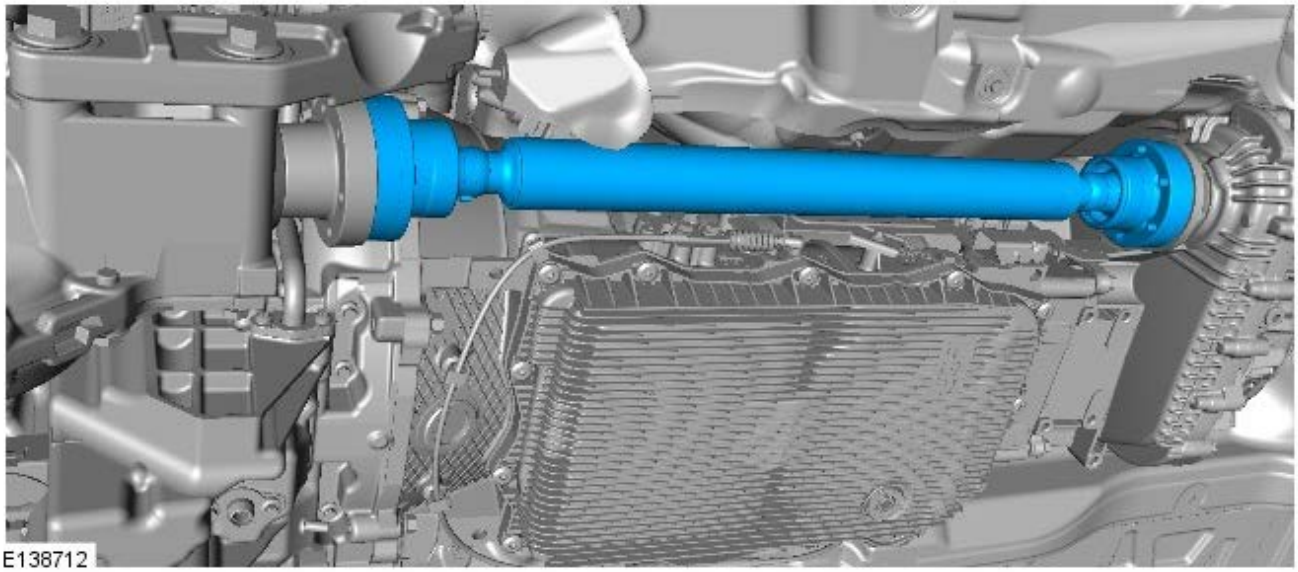

E138710

8. CAUTION: Discard the bolts.



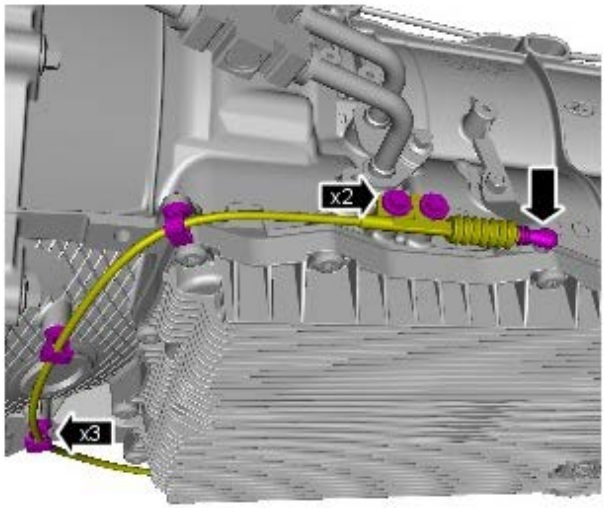
E138711

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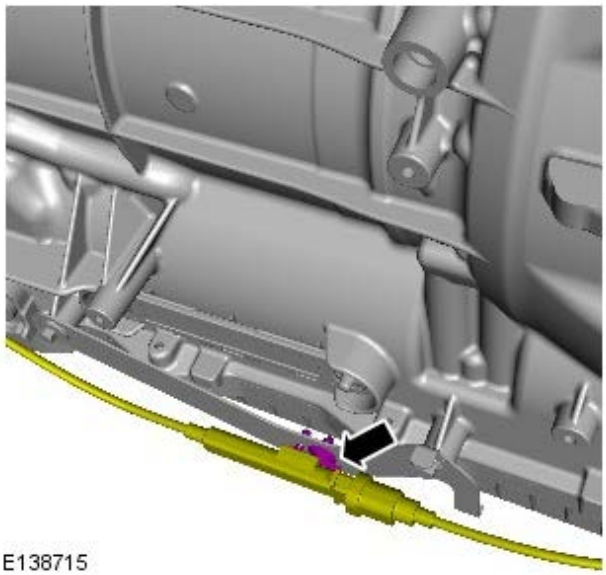
E138712

10.



E138714

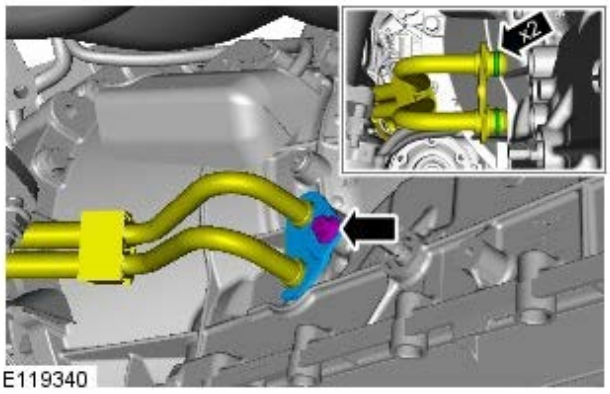
11. NOTE: Discard the retaining clip.



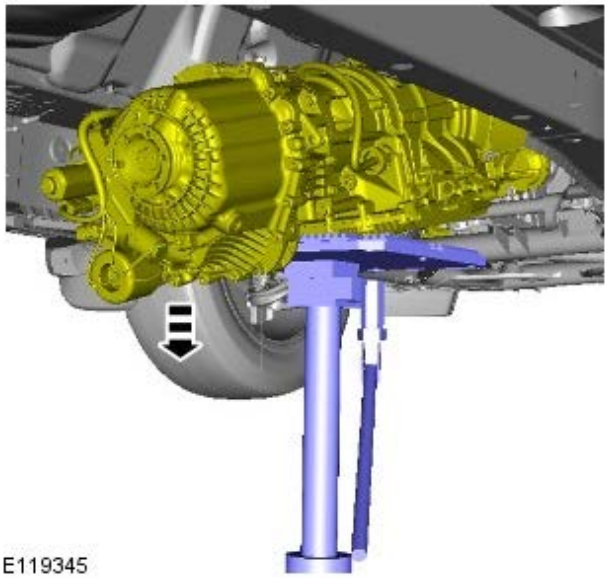
E138715

12. WARNING: Be prepared to collect escaping fluids.

NOTE: Make sure that all openings are sealed. Use new blanking caps.



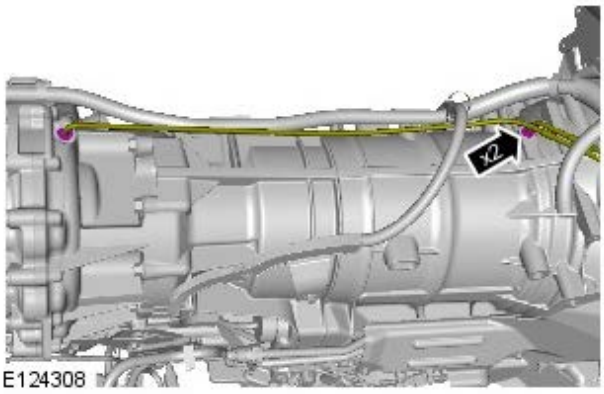
Remove and discard the 2 O-ring seals.



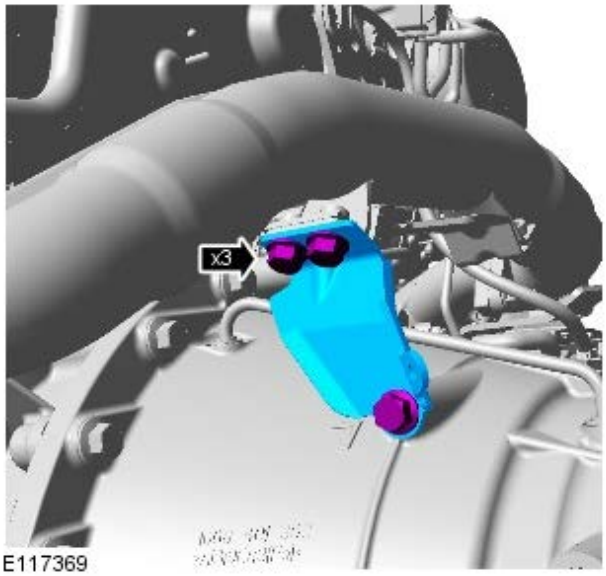
13. WARNING: Make sure that the transmission is secured with suitable retaining straps.

- *General Equipment:* Transmission jack
- Lower the rear of the transmission for access.

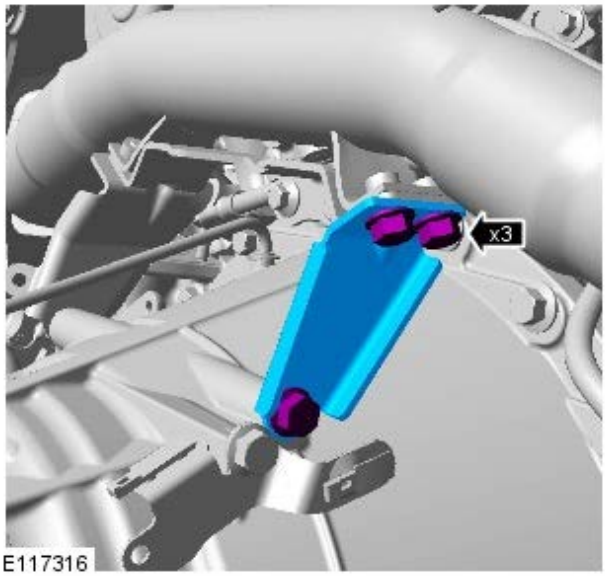
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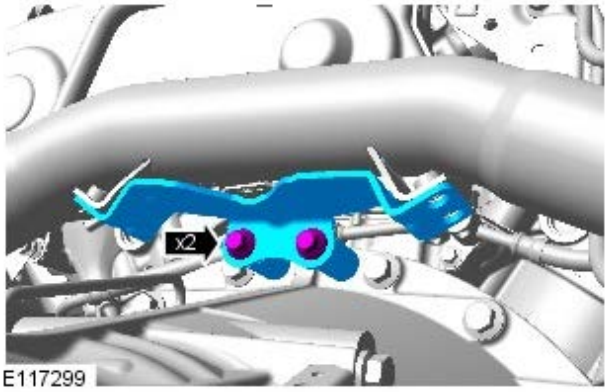
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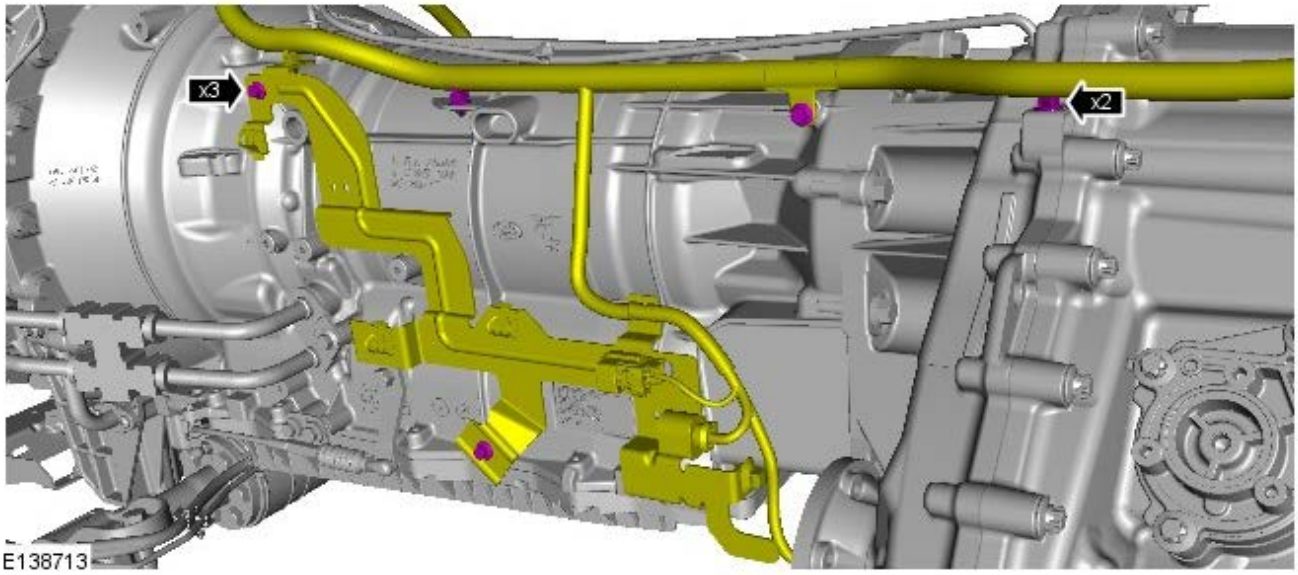
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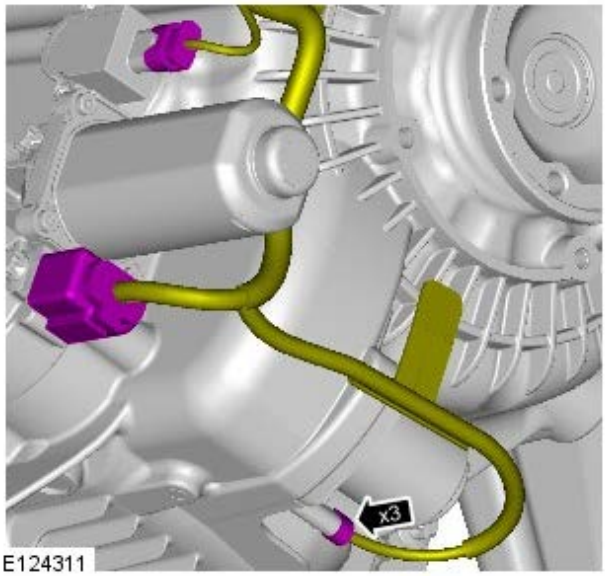
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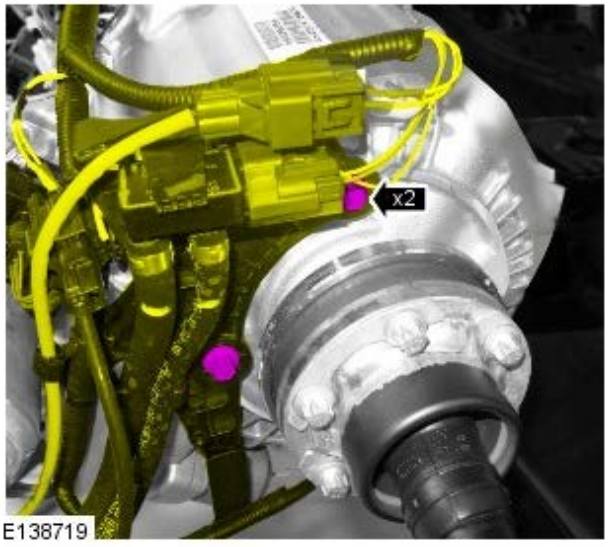
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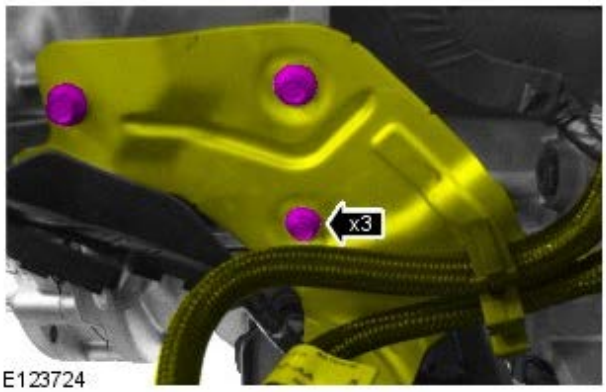
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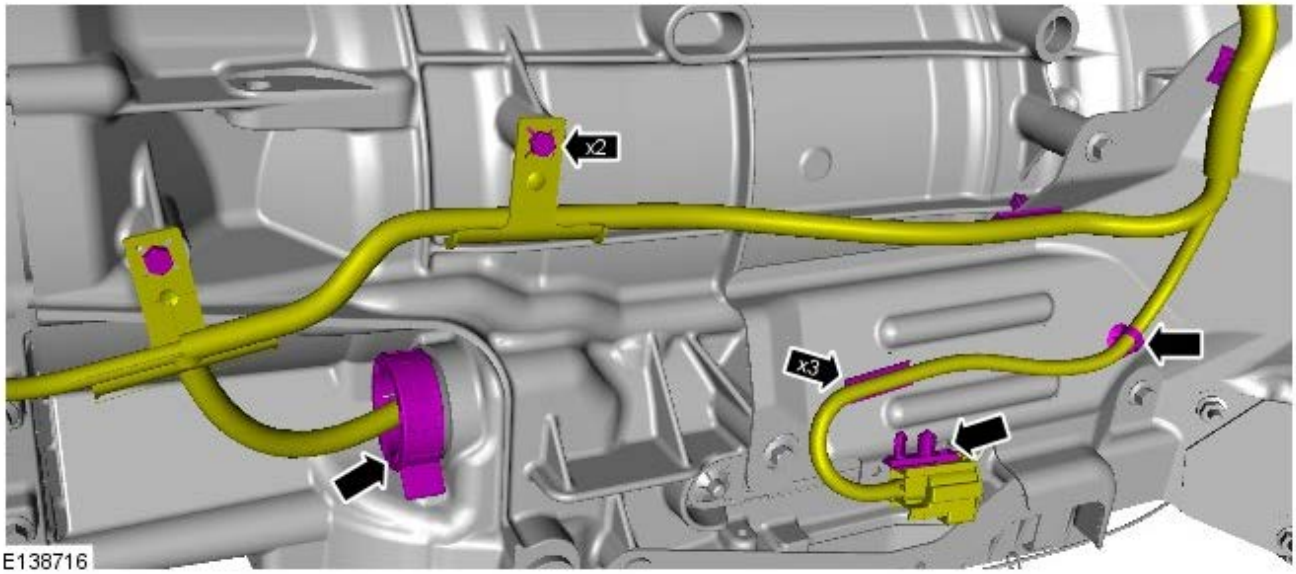
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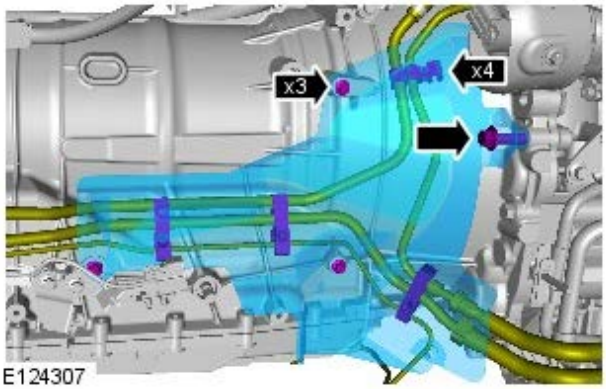
21.



22.



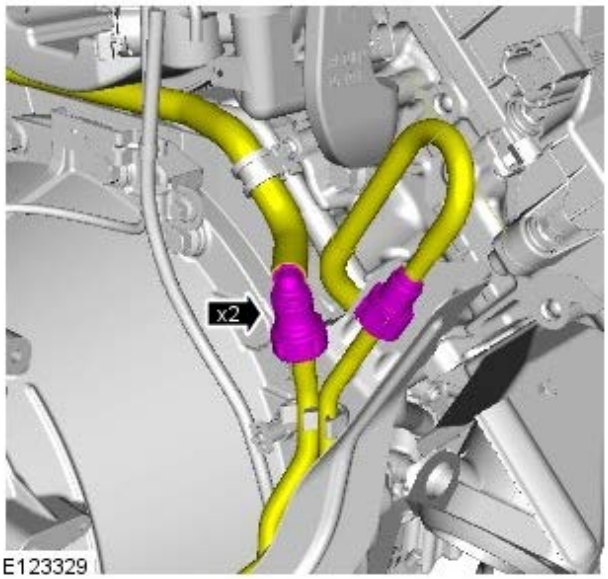
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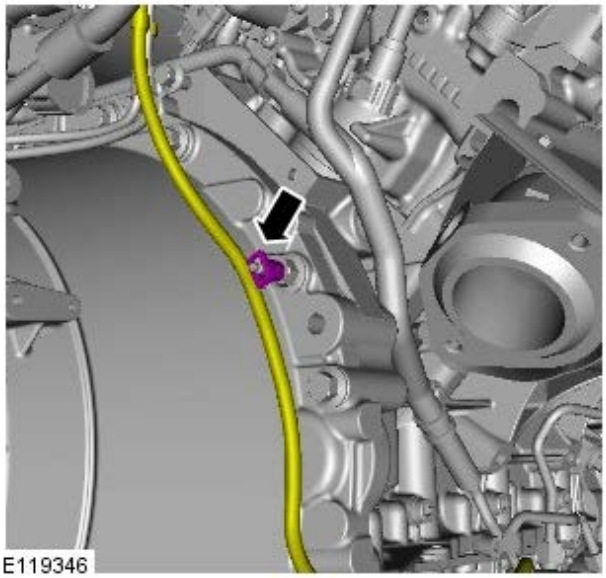
24. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

CAUTION: Be prepared to collect escaping fluids.

NOTE: Make sure that all openings are sealed. Use new blanking caps.

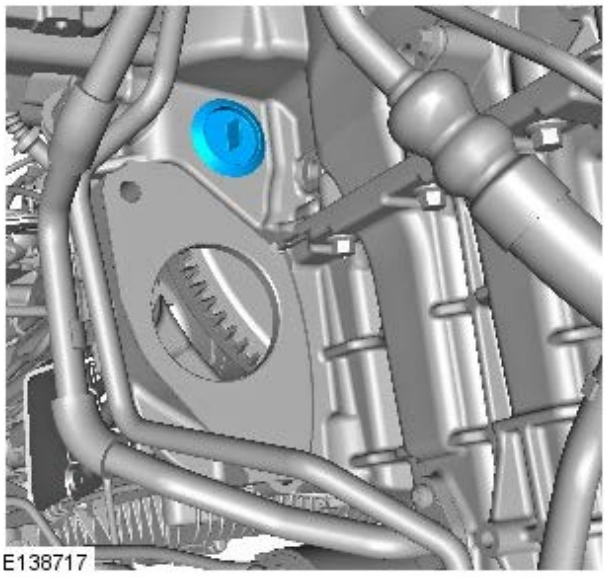


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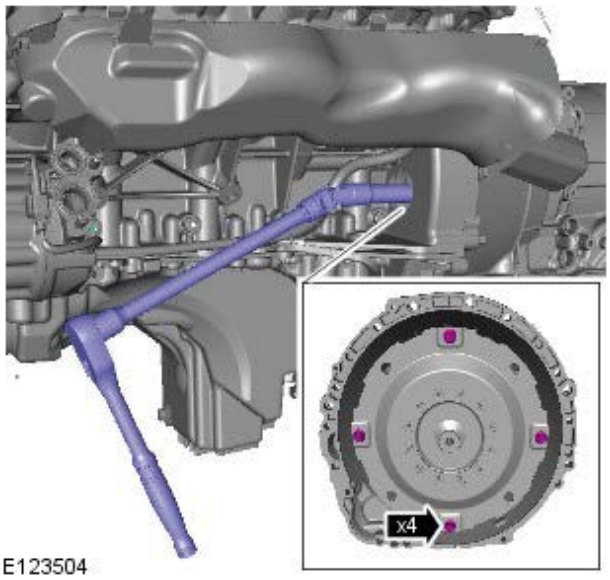


26. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

27.

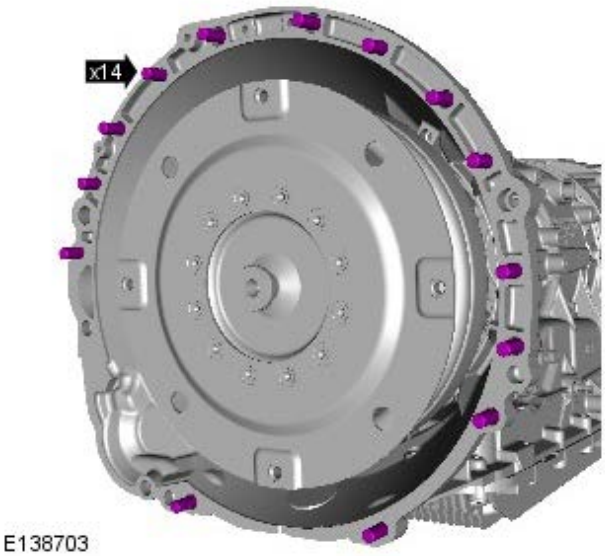


28.



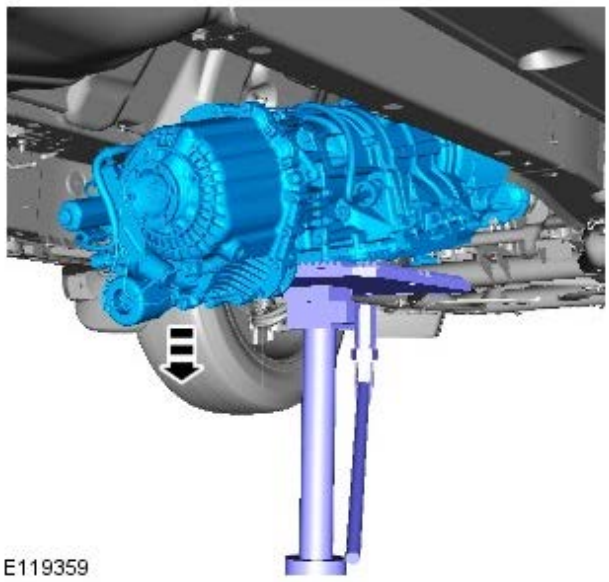
E123504

29.

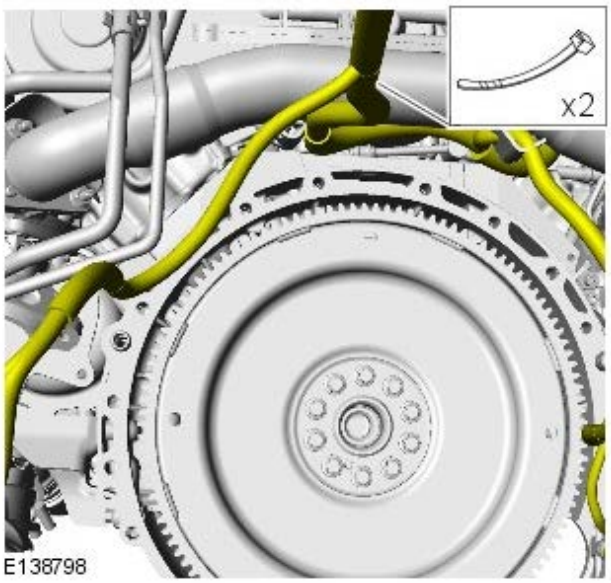


E138703

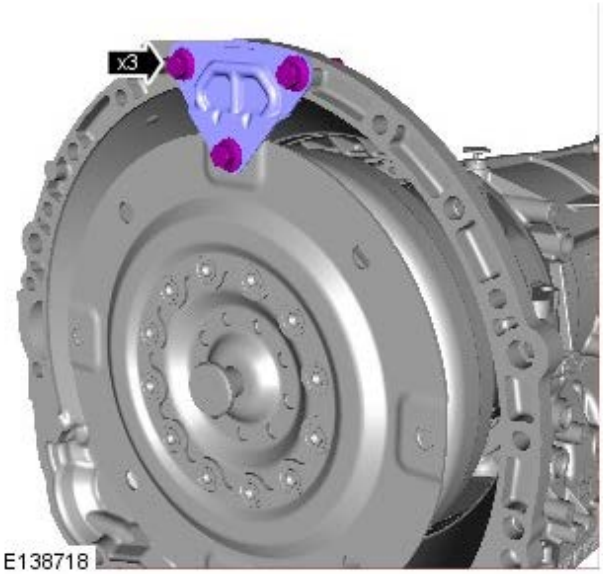
30. WARNING: Make sure that the transmission is secured with suitable retaining straps.


E119359

31. Carefully tie the harness aside.

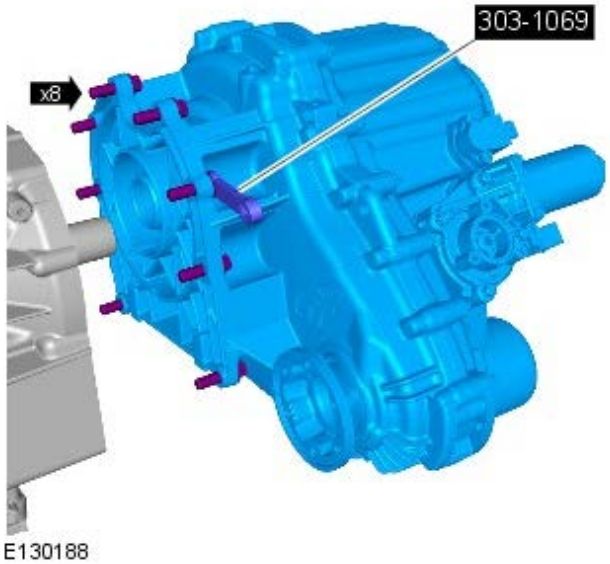


32. CAUTION: Make sure that the torque converter remains in the transmission.



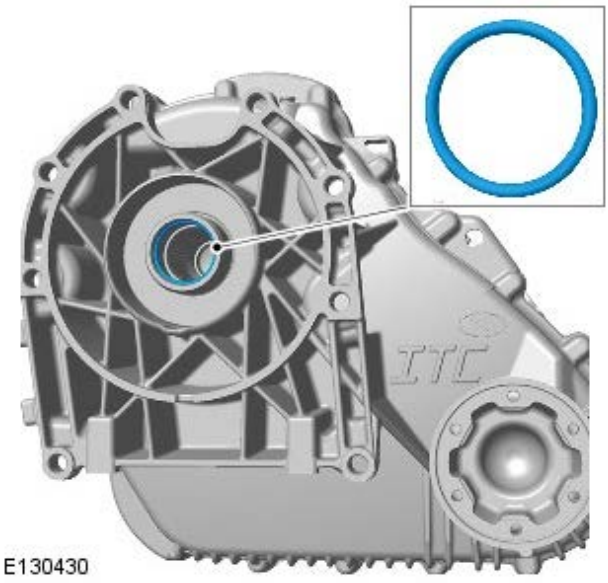
33. NOTE: Do not disassemble further if the component is removed for access only.

Special Tool(s): 303-1069



34. CAUTION: Inspect the seal, replace if damaged

NOTE: Remove and discard the O-ring seal.



E130430

Published: 02-May-2013

Automatic Transmission / Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission

Installation

Special Tool(s)

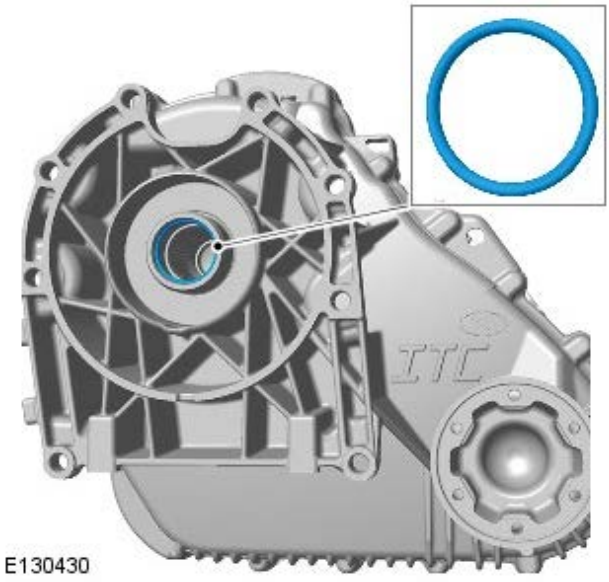
303-1069  E53727	303-1069 Adapter, Wrench

NOTES:

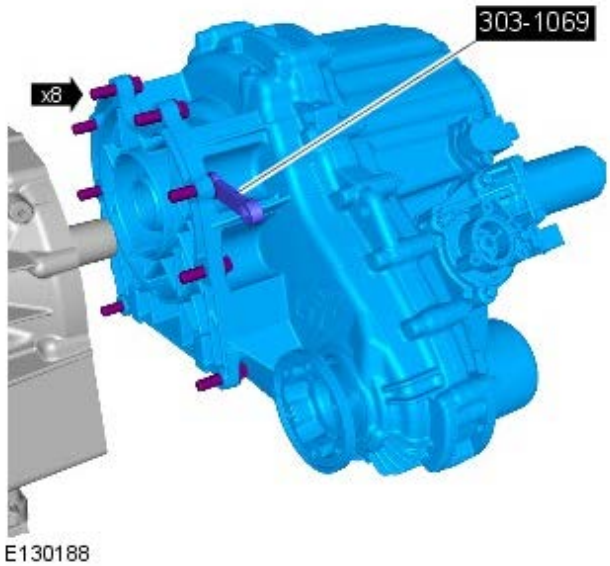
Some variation in the illustrations may occur, but the essential information is always correct.

Some illustrations may show the transmission removed for clarity.

Some illustrations may show the engine removed for clarity.

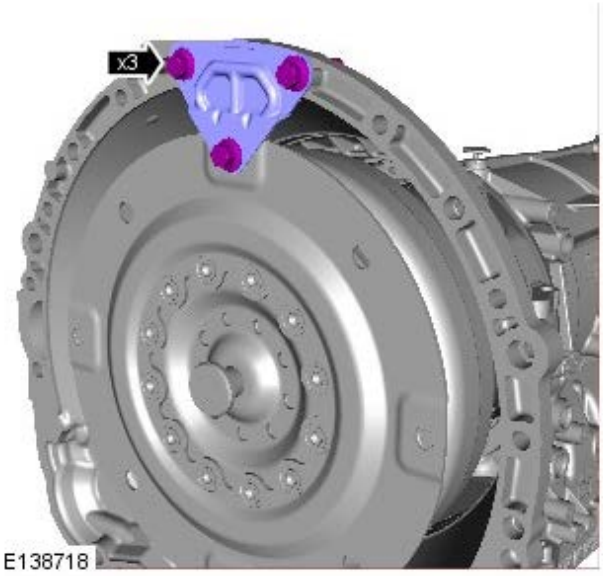

E130430

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



E130188

2. NOTE: This step is only required if previously removed.
   - Clean the component mating faces.
   - Lubricate input shaft splines with 'Weicon TL7391' grease.
   - *Special Tool(s):* 303-1069
   - *Torque:* 45 Nm



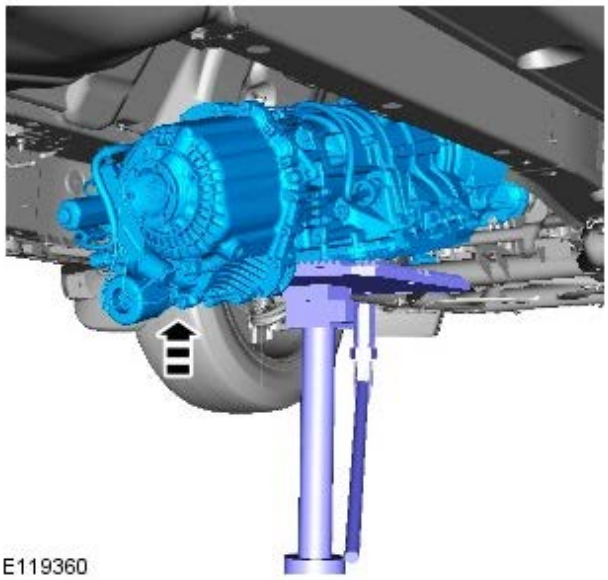
3. CAUTION: Make sure that the torque converter remains in the transmission.



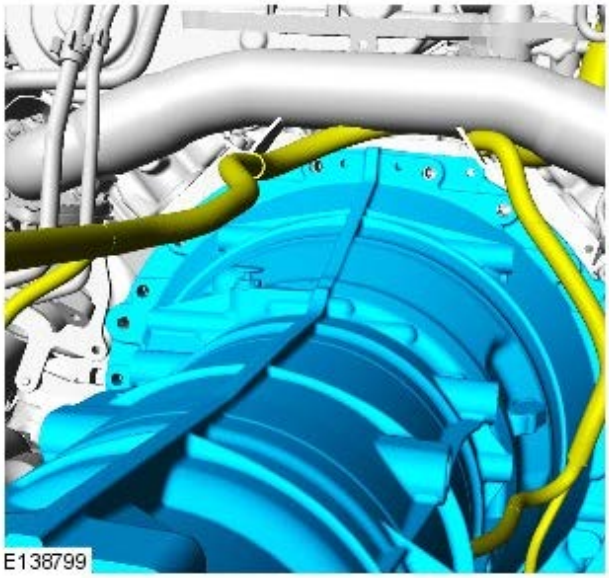
4. NOTE: Make sure that the torque converter is fully engaged to the transmission.

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

   Clean the component mating faces.



E119360

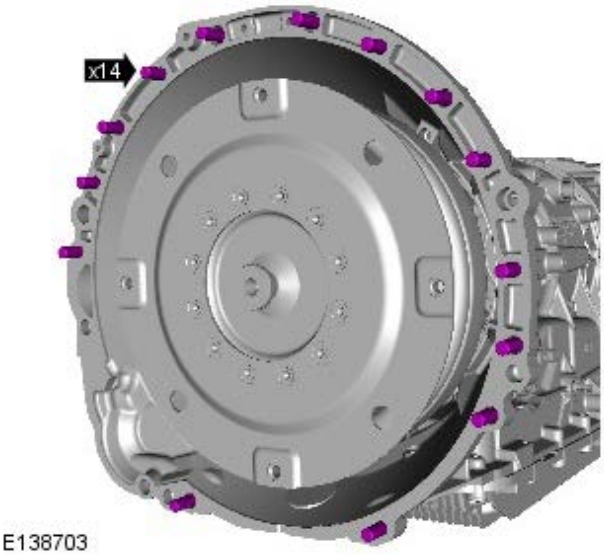


E138799

6. CAUTION: Care must be taken to avoid damaging the engine bay wiring harnesses.

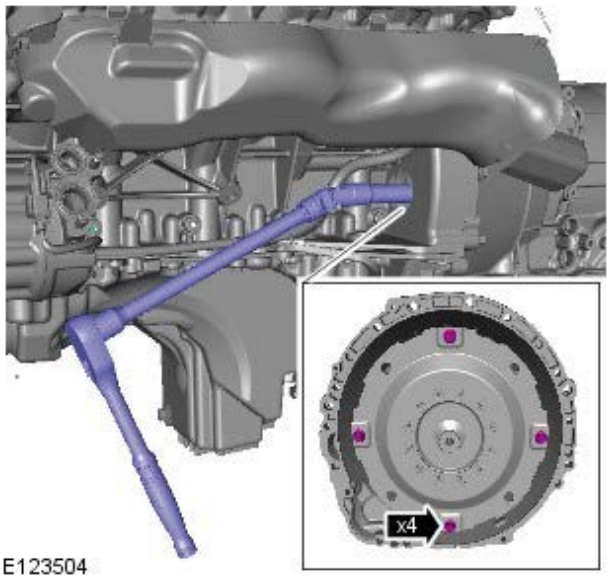
   Cut the cable ties that are holding the harnesses aside.

7. *Torque:* 40 Nm

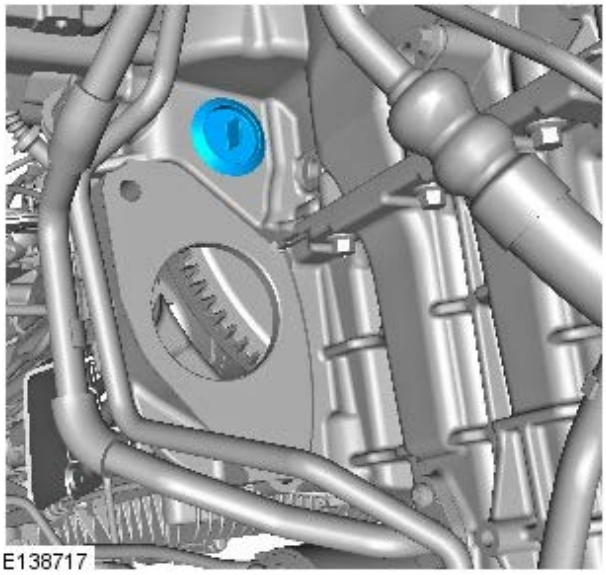


E138703

8. *Torque:* 63 Nm

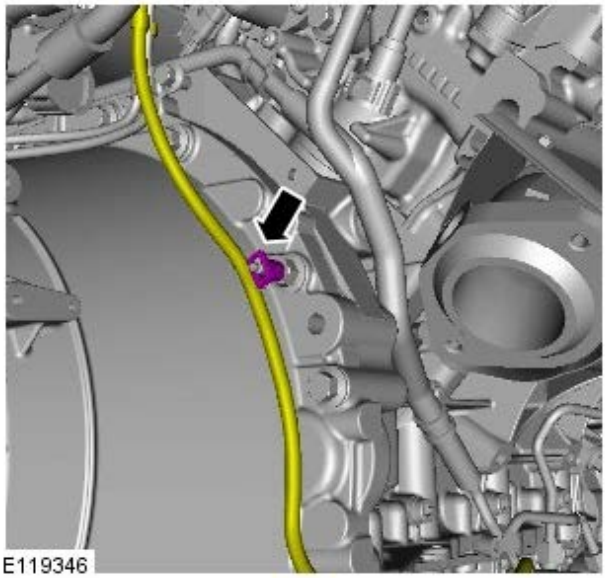


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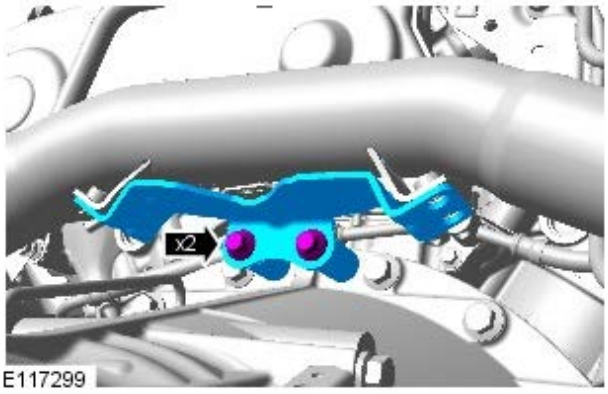


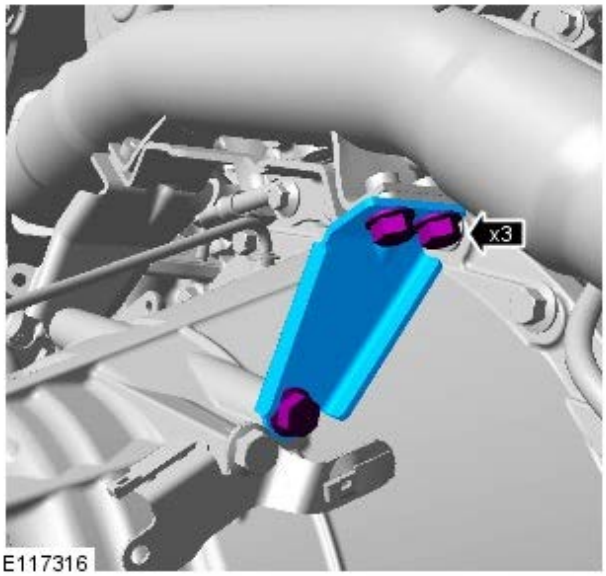
10. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

11.

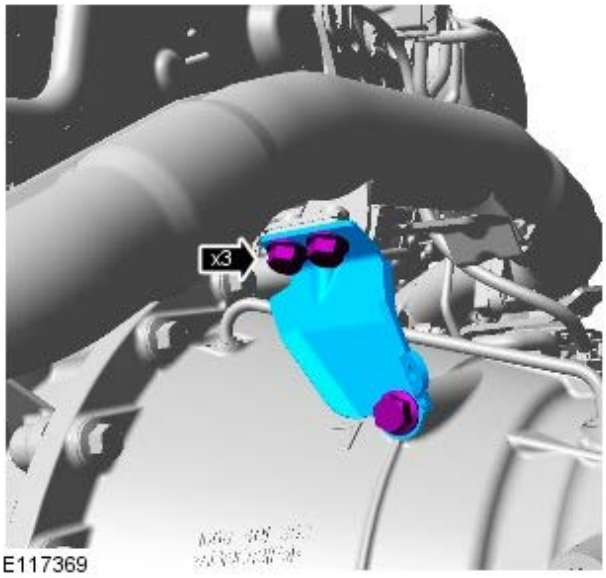


12. *Torque:* 23 Nm



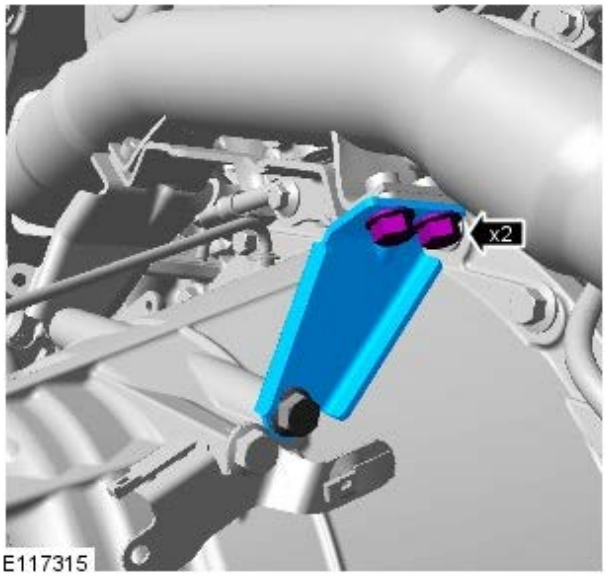


13. CAUTION: Only tighten the bolts finger-tight at this stage.

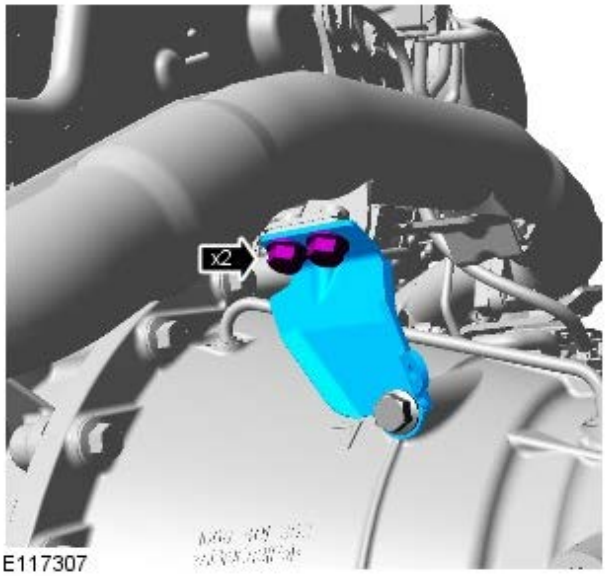


14. CAUTION: Only tighten the bolts finger-tight at this stage.

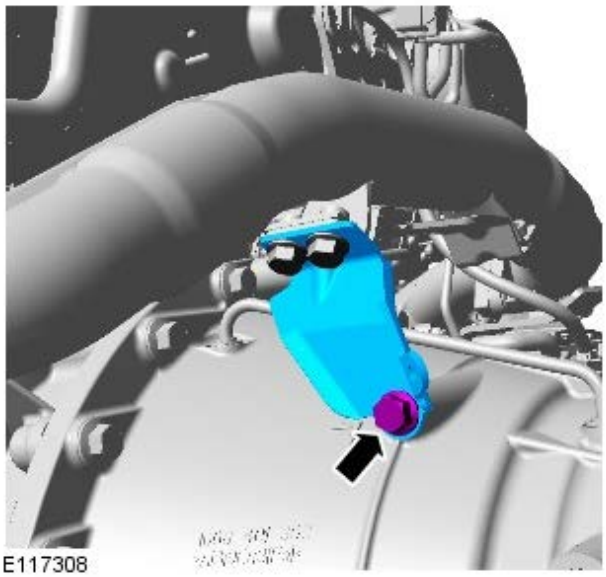
15. *Torque:* 23 Nm



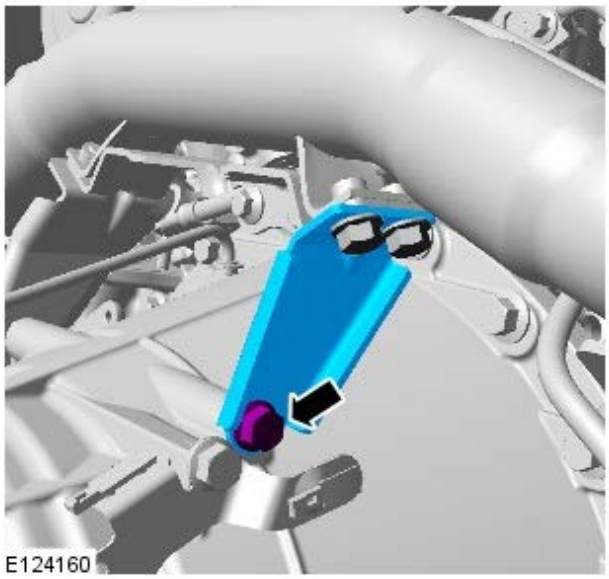
16. *Torque:* 23 Nm



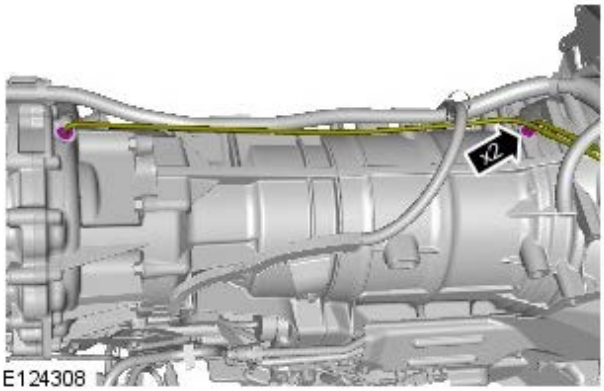
17. *Torque:* 23 Nm



18. *Torque:* 23 Nm

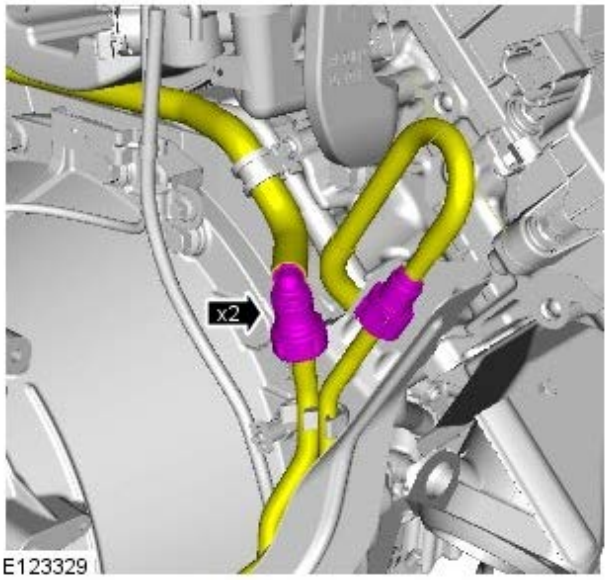


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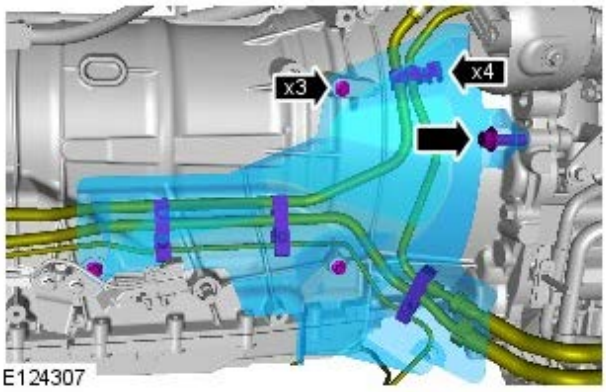


20. WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

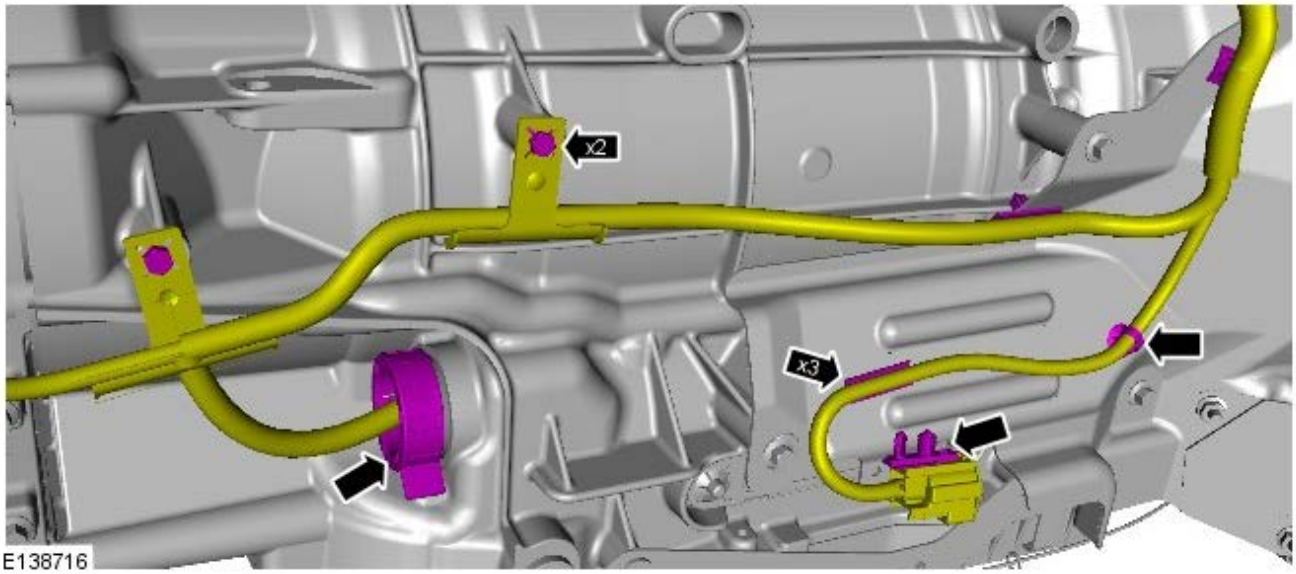
CAUTION: Be prepared to collect escaping fluids.



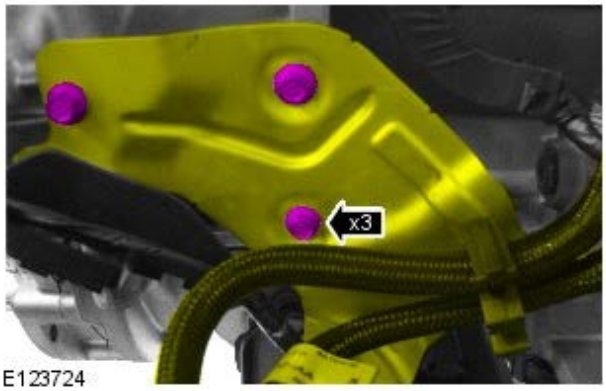
21. *Torque:*
M6 9 Nm
M10 40 Nm



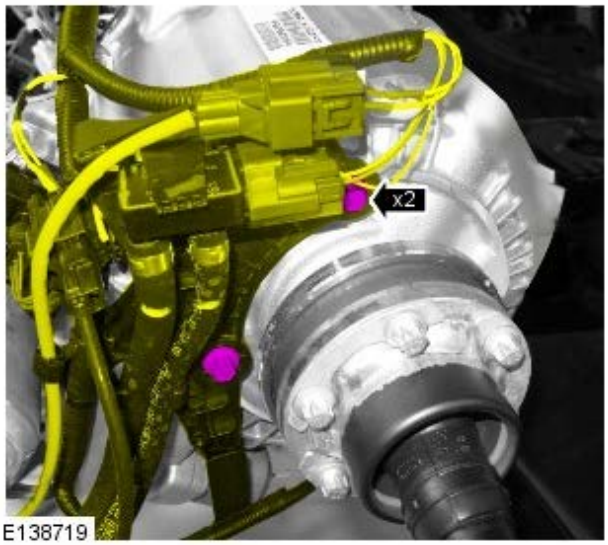
22. *Torque:* 9 Nm



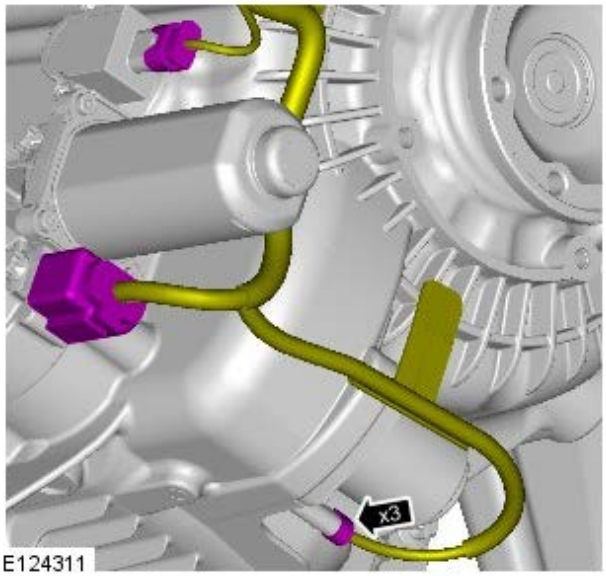
23. *Torque:* 9 Nm



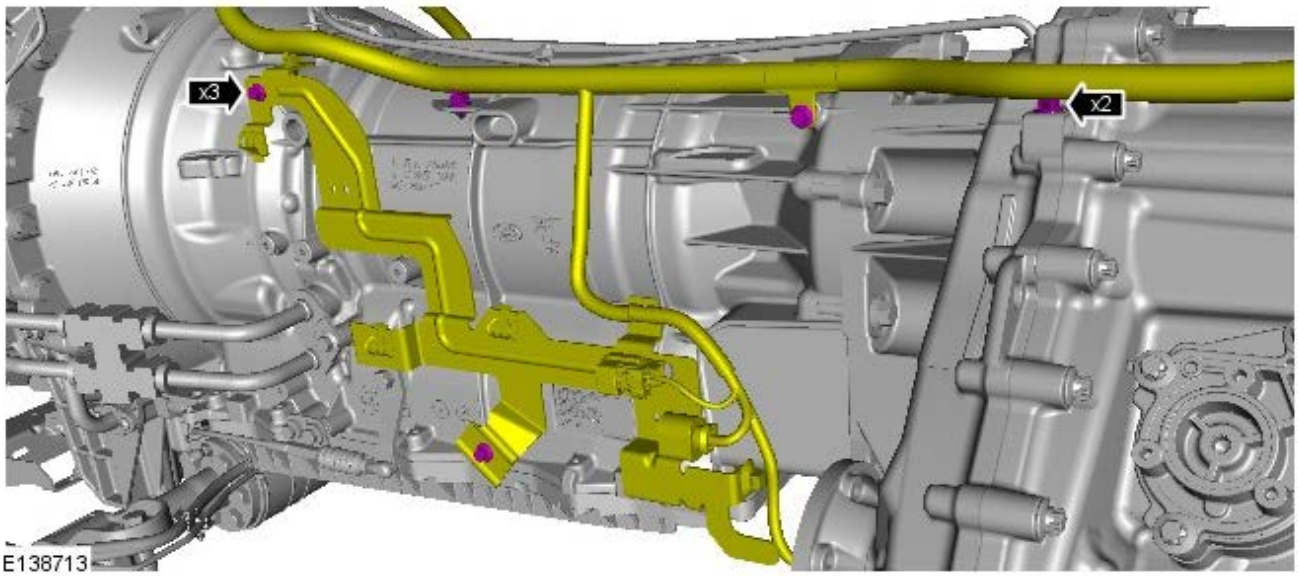
24. *Torque:* 9 Nm



25.

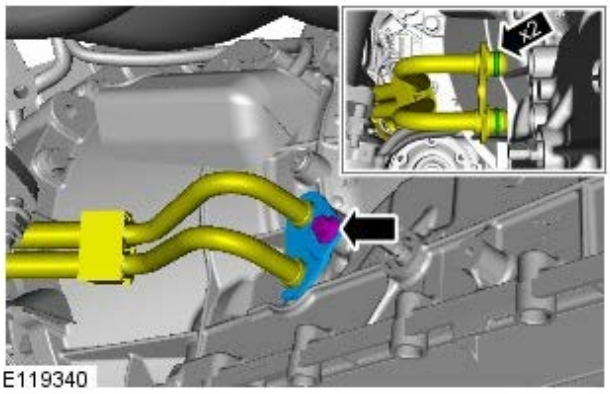


26. *Torque:* 9 Nm



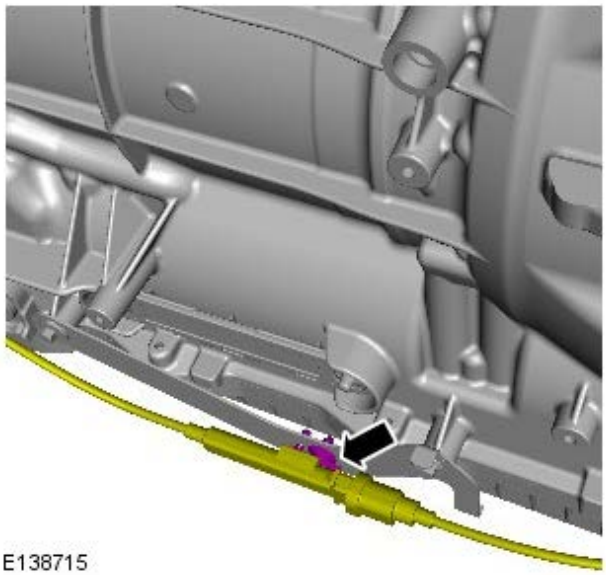
27. NOTE: Install new O-ring seals.

Torque: 12 Nm

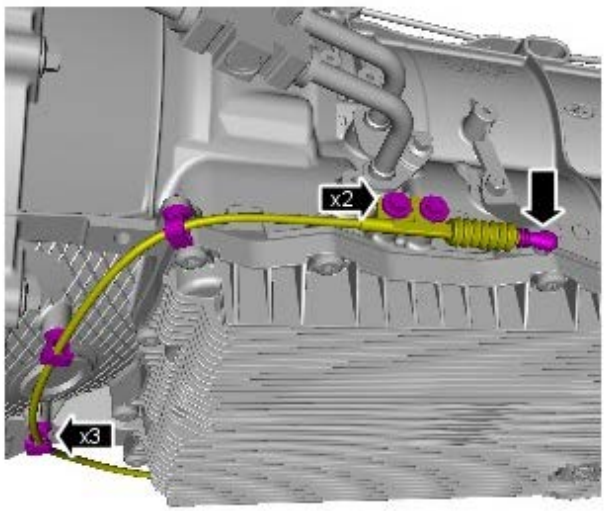


E119340

28. NOTE: Install a new retaining clip.

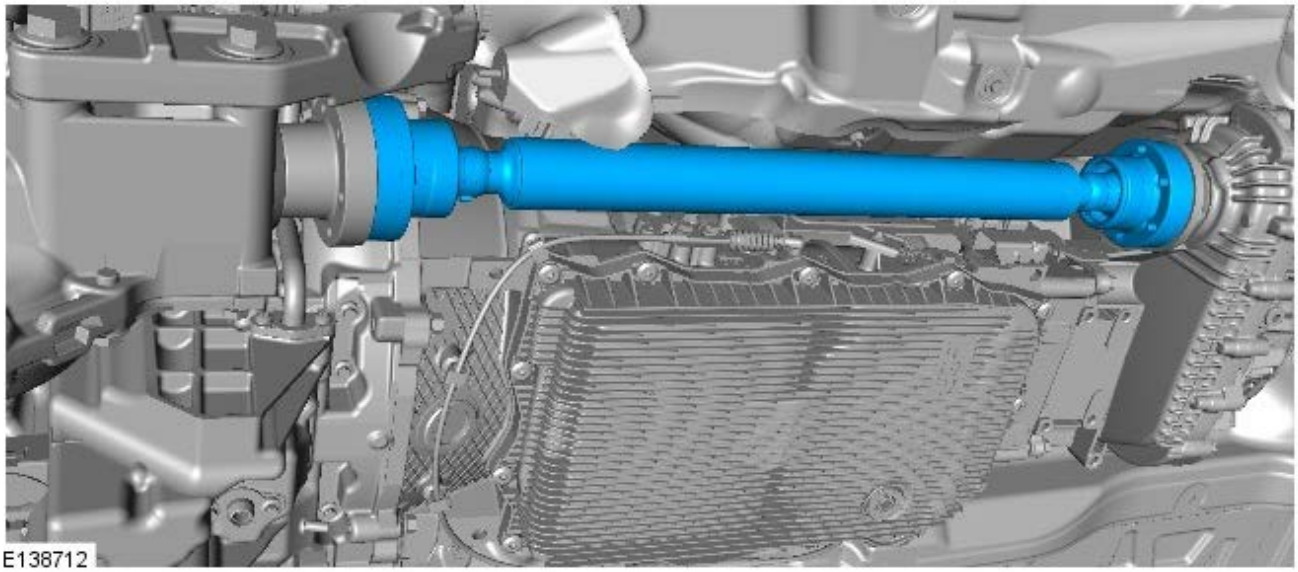

E138715

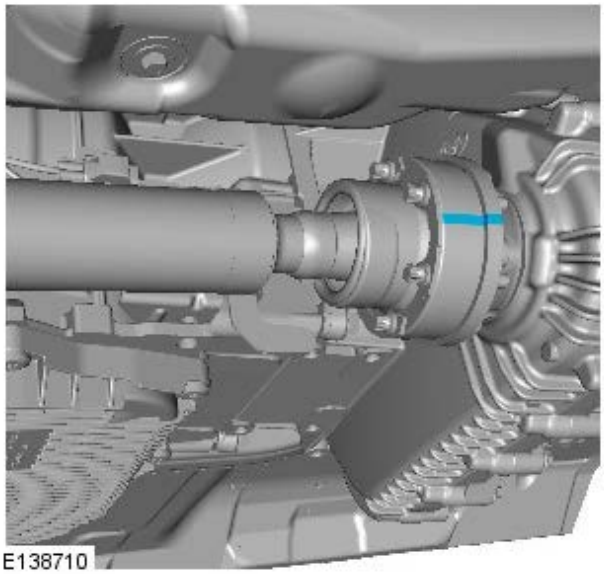
29. *Torque:* 10 Nm



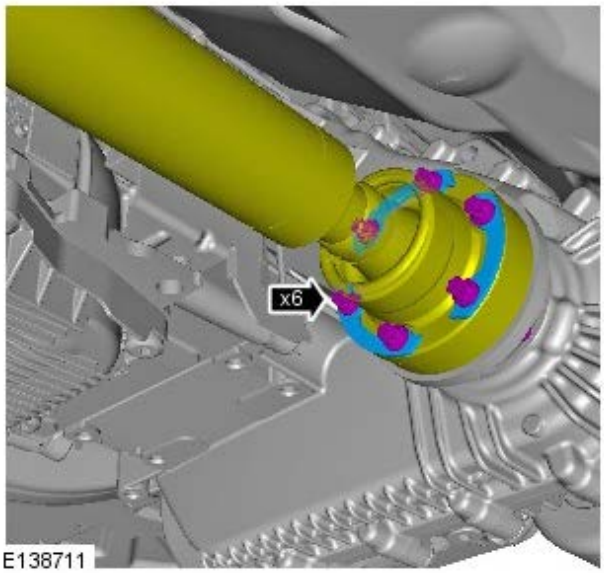
E138714

30.


E138712


E138710

31. NOTE: Make sure that the component aligns with the installation mark noted in the removal step.

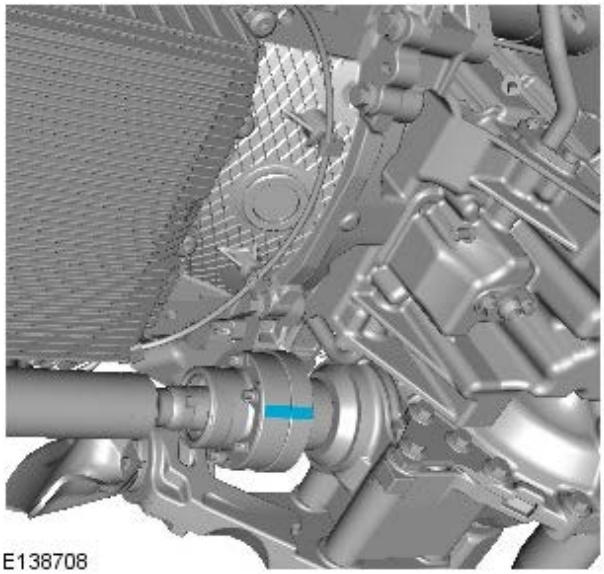


E138711

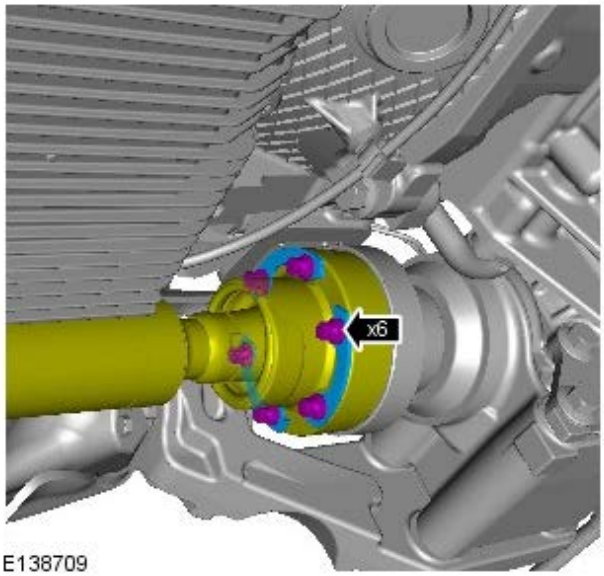
32. CAUTION: Make sure that new bolts are installed.

Torque:
Stage 1: 45 Nm
Stage 2: 90°

33. NOTE: Make sure that the component aligns with the installation mark noted in the removal step.



E138708



E138709

34. CAUTION: Make sure that new bolts are installed.

    Torque:
    Stage 1: 45 Nm
    Stage 2: 90°

35. Refer to: Rear Driveshaft (205-01 Driveshaft, Removal and Installation).

36. Refer to: Exhaust System (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

37.
    - Remove the securing straps.
    - Remove the jack supporting the transmission.
    - Lower the vehicle.

38. Connect the battery ground cable.

    Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

39. Refer to: Transmission Fluid Level Check (307-01B Automatic Transmission/Transaxle - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, General Procedures).

Published: 11-May-2011

Transmission / Transaxle Cooling - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission -

Lubricants

CAUTIONS:

 Do not use any lubricant other than that specified.

 Do not over lubricate.

Item	Specification
Transmission fluid	ATF Shell M 1375.4 Land Rover Part No. TYK500050

Capacity

Item	Capacity
Initial dry fill	9.5 Litres (16.7 pints) (10.0 US quarts)

Torque Specification

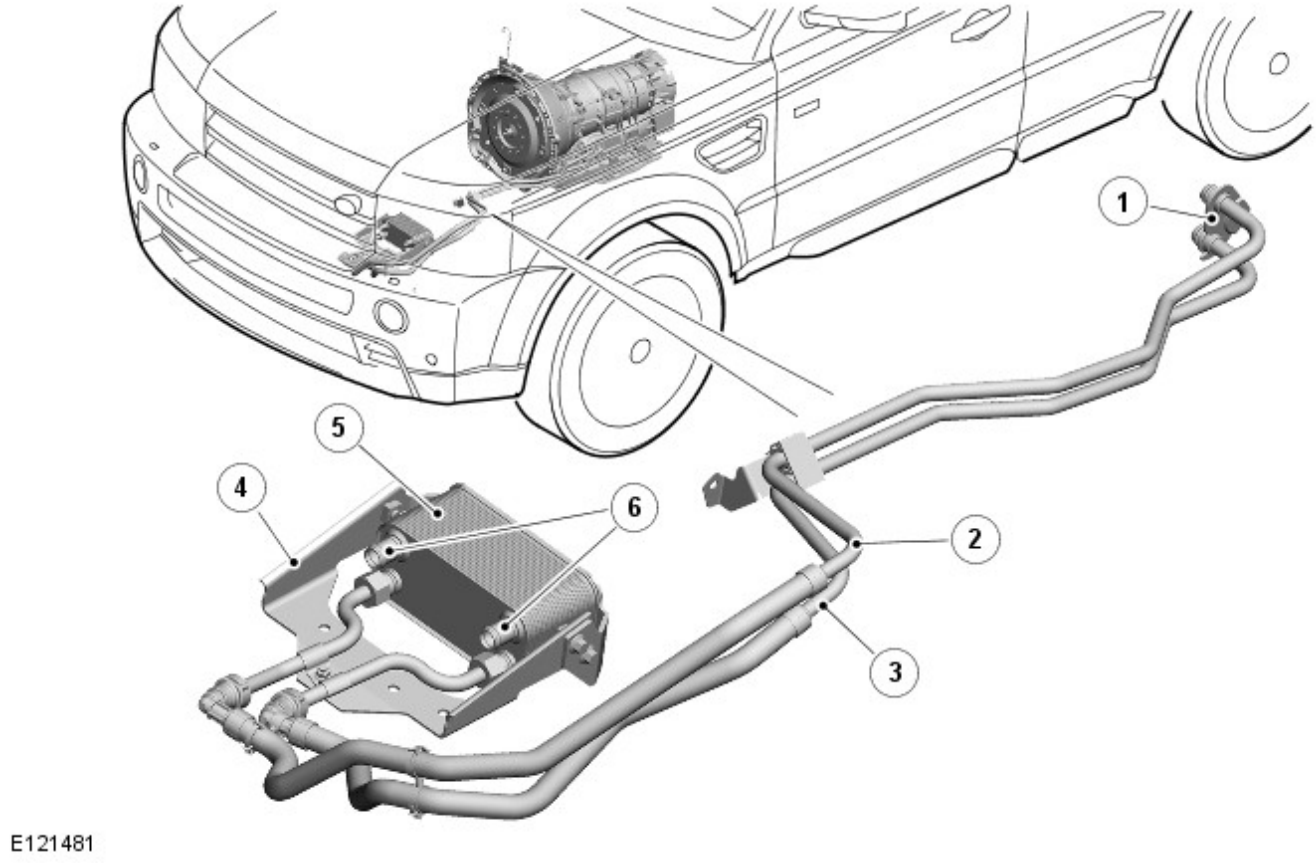
Description	Nm	lb-ft	lb-in
Transmission fluid cooler tube to transmission housing bolt	23	17	-
Transmission fluid cooler tube bracket retaining bolt - vehicles with Engine 5.0L	10	7	-
Transmission fluid cooler tube bracket retaining nut - vehicles with Engine 3.0D	11	8	-
Transmission fluid cooler retaining bolts	25	18	-
Transmission fluid cooler tube line union to cooler	16	12	-

Published: 11-May-2011

Transmission / Transaxle Cooling - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission Cooling

Description and Operation

COMPONENT LOCATION



E121481

Item	Part Number	Description
1	-	Latch-plate
2	-	Return hose and pipe (to transmission)
3	-	Feed hose and pipe (from transmission)
4	-	Mounting bracket
5	-	Transmission fluid cooler
6	-	Engine coolant hose connections

INTRODUCTION

Transmission cooling is provided by a transmission fluid cooler, which transfers heat from the transmission to the engine cooling system. The transmission fluid cooler is installed in the engine compartment, on a mounting bracket attached to the crossmember of the secondary loadpath frame.

Two hose and pipe assemblies connect the transmission fluid cooler to the automatic transmission. Two engine coolant hose connections are incorporated into the transmission fluid cooler for the supply and return of coolant from the engine cooling system.
For additional information, refer to: Engine Cooling (303-03C, Description and Operation).

Fluid from the pump in the automatic transmission flows through the feed hose and pipe to the transmission fluid cooler. The fluid then flows through the transmission fluid cooler, and the return hose and pipe, to the sump of the automatic transmission.

Published: 20-Aug-2012

Transmission/Transaxle Cooling - TDV6 3.0L Diesel /V8 5.0L Petrol/V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the automatic transmission cooling system, refer to the relevant Description and Operation sections in the workshop manual. REFER to: Transmission Cooling (307-02B Transmission/Transaxle Cooling - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).

Inspection and Verification

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

Visual Inspection

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 cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Condition	Possible Causes	Action
Overheating 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 transmission fluid cooler
Overheating of the automatic transmission	• Obstruction in the automatic transmission fluid pipes	• Flush out the automatic transmission fluid cooler tubes with new automatic transmission fluid. If the flushing is unsuccessful, install new automatic transmission fluid cooler pipes
Loss of automatic transmission fluid	• Connections to the automatic transmission and the automatic transmission fluid cooler	• Check the integrity of the automatic transmission fluid cooler pipes, connections and seals. Check the torque of the pipe fixings
Loss of automatic transmission fluid	• Leak at oil cooler	• Check the integrity of the automatic transmission fluid cooler pipes, connections and seals. Check the torque of the pipe fixings

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Transmission Control Module (TCM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

Transmission / Transaxle Cooling - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission Fluid Cooler V8 5.0L Petrol / V8 S/C 5.0L Petrol

Removal and Installation

Removal

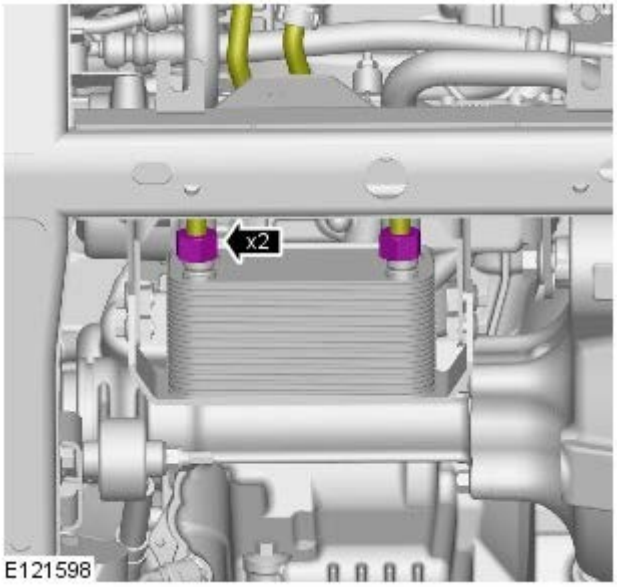
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Cooling System Draining and Vacuum Filling (303-03, General Procedures).

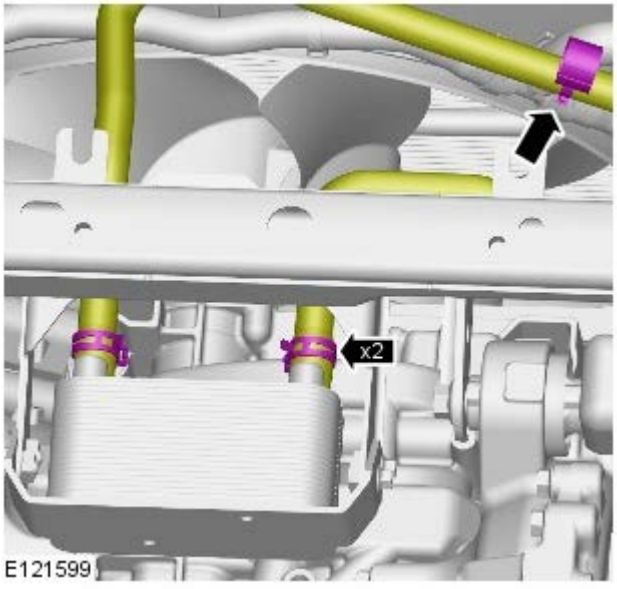
3. Refer to: Transmission Fluid Level Check (307-01, General Procedures).



4. WARNING: Be prepared to collect escaping fluids.

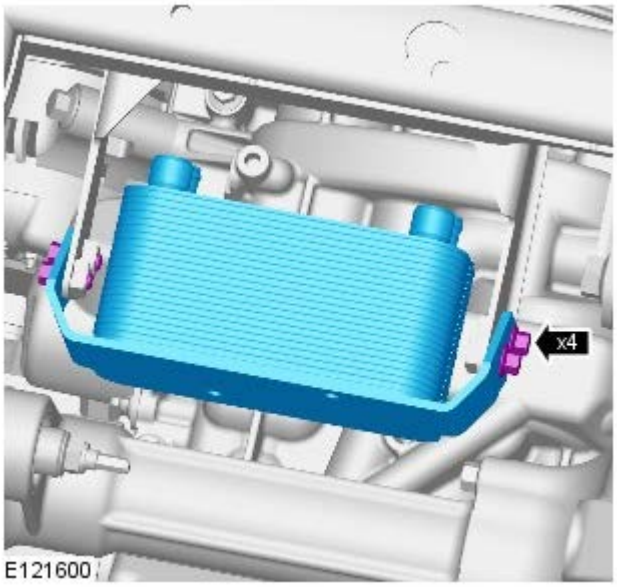
   CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.

   Torque: 16 Nm



5. WARNING: Be prepared to collect escaping fluids.

6. *Torque:* 25 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Transmission / Transaxle Cooling - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission Fluid Cooler TDV6 3.0L Diesel

Removal and Installation

Removal

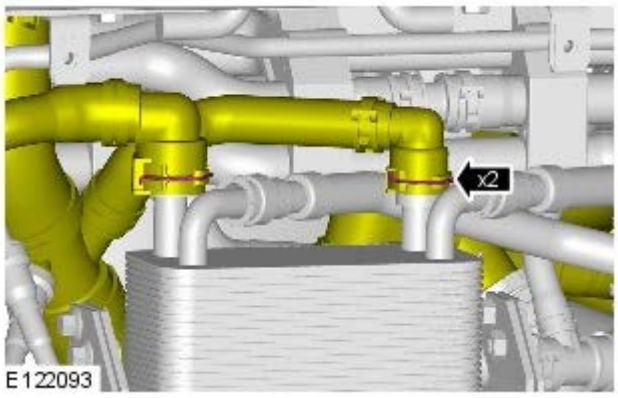
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

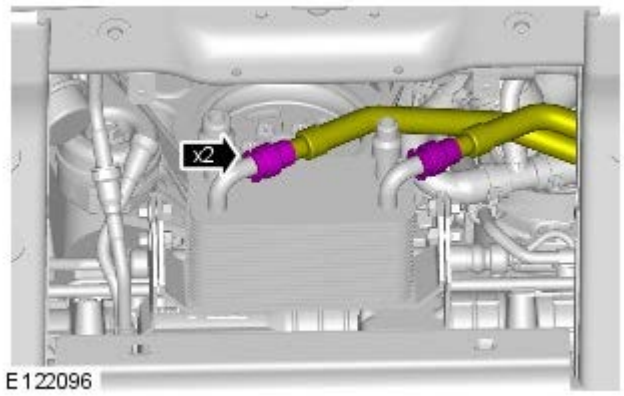
   Raise and support the vehicle.

2. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

3. Refer to: Transmission Fluid Level Check (307-01, General Procedures).

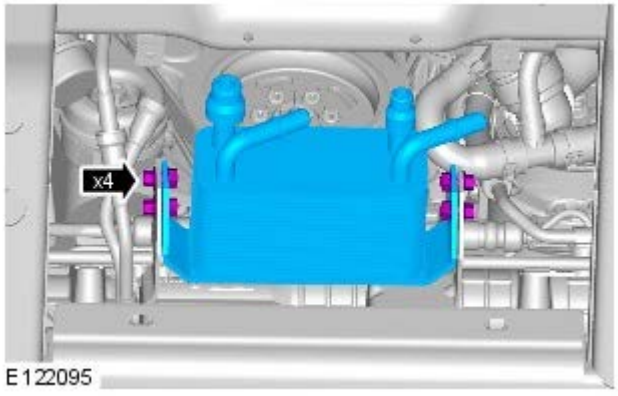


4. WARNING: Be prepared to collect escaping fluids.



5. WARNING: Be prepared to collect escaping fluids.

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



6. *Torque:* 23 Nm

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Transmission / Transaxle Cooling - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission Fluid Cooler Tubes V8 5.0L Petrol / V8 S/C 5.0L Petrol

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

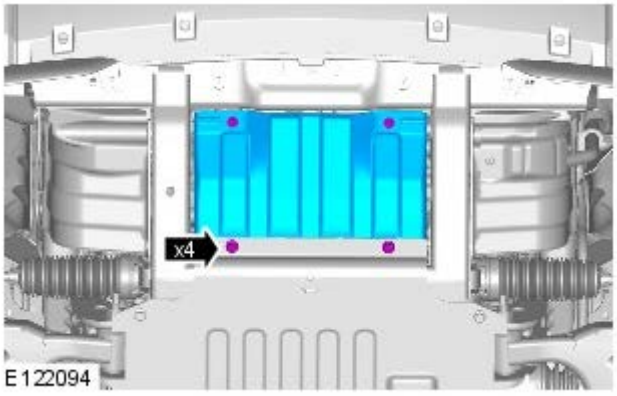
   Raise and support the vehicle.

2. Refer to: Engine Undershield (501-02, Removal and Installation).

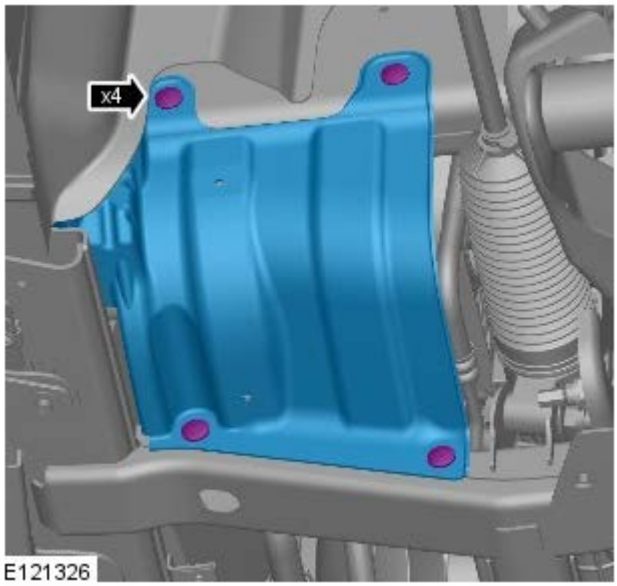
3. Remove the LH front road wheel.

   Torque: 140 Nm

4. *Torque:* 10 Nm



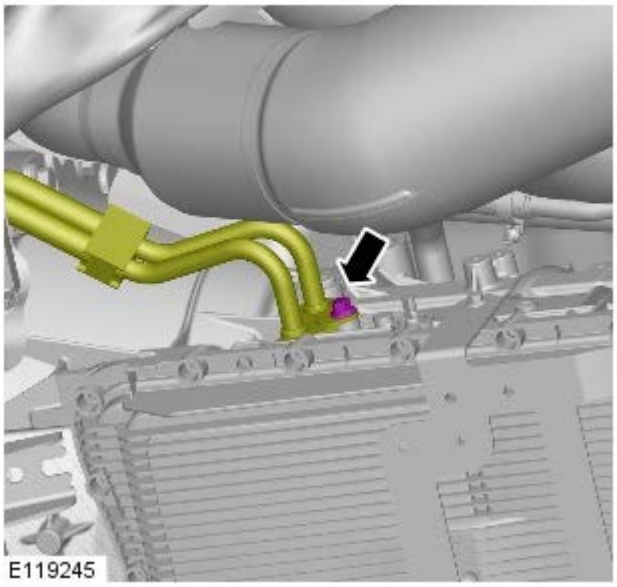
5.



6. WARNING: Be prepared to collect escaping fluids.

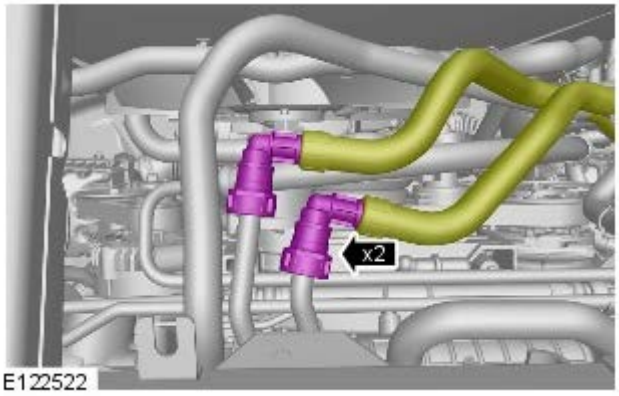
   CAUTION: Always plug any open connections to prevent contamination.

   NOTE: Some variation in the illustrations may



occur, but the essential information is always correct.

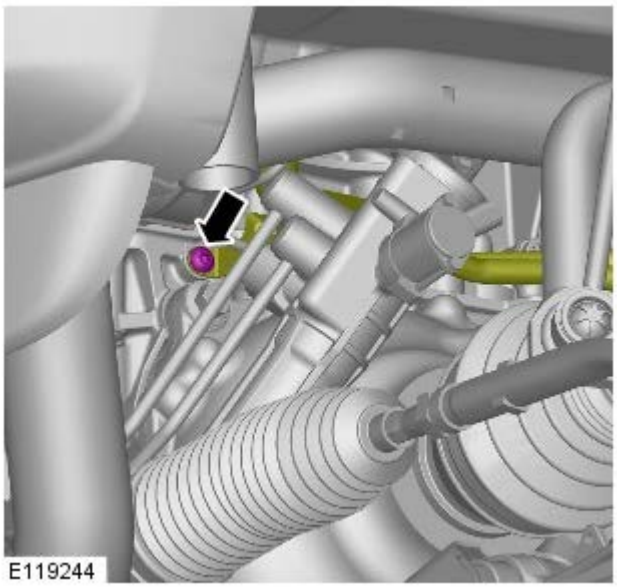
Torque: 23 Nm



7. WARNING: Be prepared to collect escaping fluids.

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

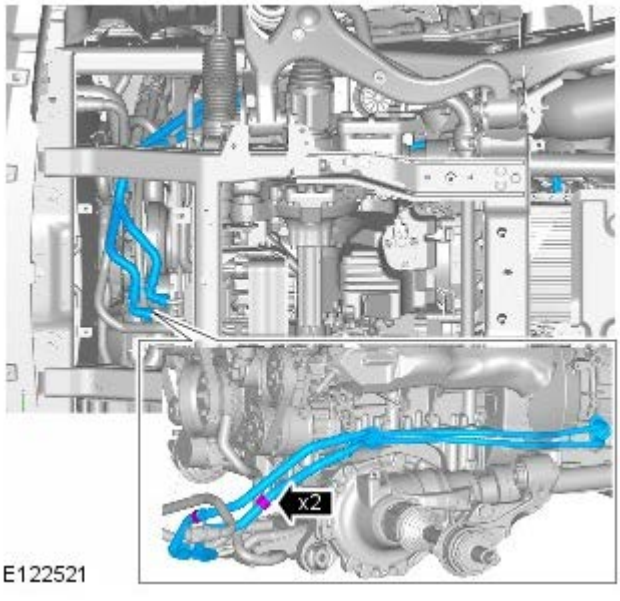
Torque: 16 Nm



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

Torque: 10 Nm

9.



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Transmission / Transaxle Cooling - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Transmission Fluid Cooler Tubes TDV6 3.0L Diesel

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

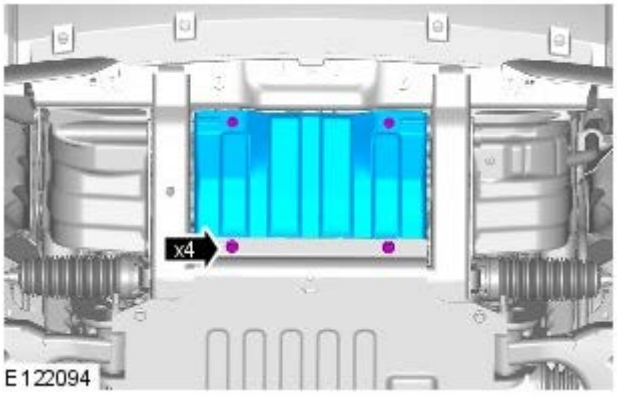
   Raise and support the vehicle.

2. Refer to: Engine Undershield (501-02, Removal and Installation).

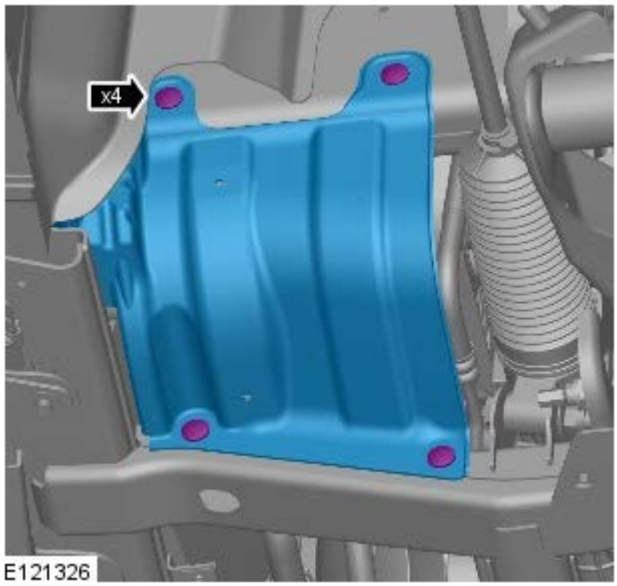
3. Remove the LH front road wheel.

   Torque: 140 Nm

4. *Torque:* 10 Nm



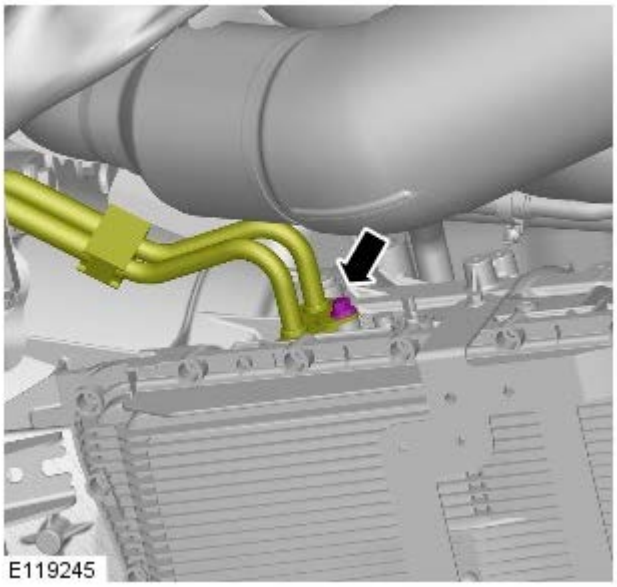
5.



6. WARNING: Be prepared to collect escaping fluids.

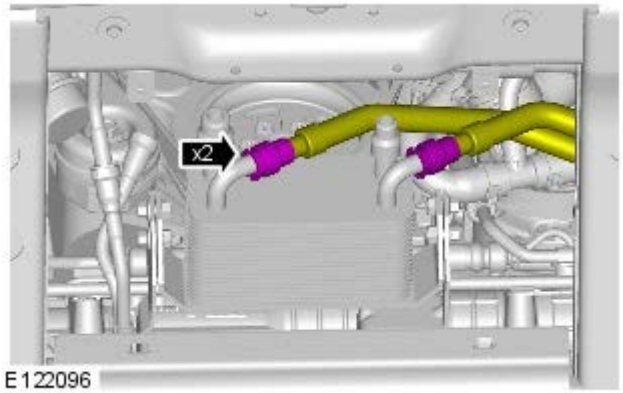
   CAUTION: Always plug any open connections to prevent contamination.

   NOTE: Some variation in the illustrations may



occur, but the essential information is always correct.

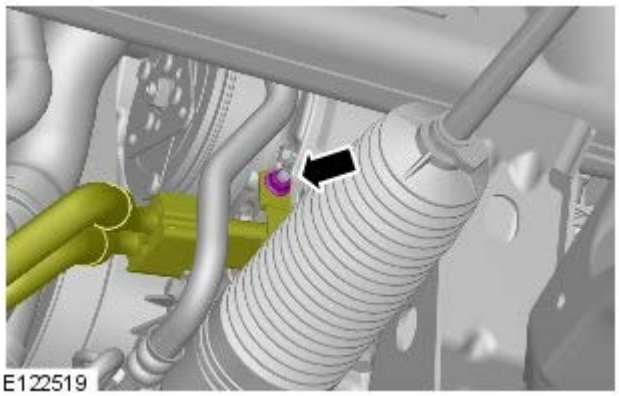
Torque: 23 Nm



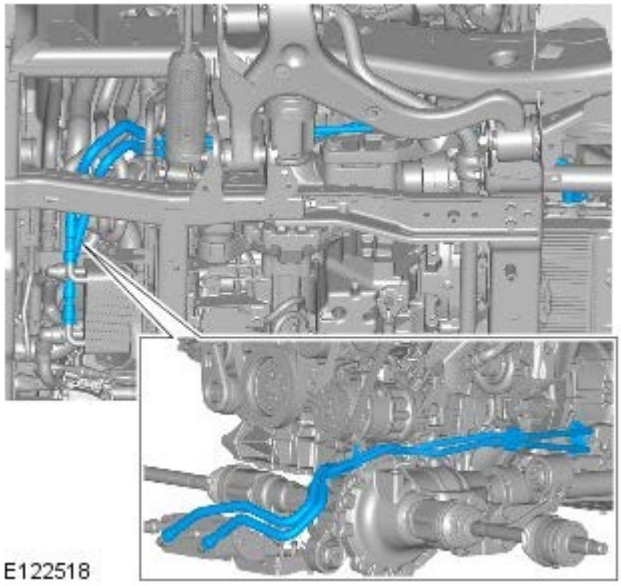
7. WARNING: Be prepared to collect escaping fluids.

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

8. *Torque:* 11 Nm



9. WARNING: Be prepared to collect escaping fluids.



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Transmission / Transaxle Cooling - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD -

Lubricants

CAUTIONS:

 Do not use any lubricant other than that specified.

 Do not over lubricate.

Item	Specification
Transmission fluid	ATF Shell M 1375.4 Land Rover Part No. TYK500050

Capacity

Item	Capacity
Initial dry fill	9.5 Litres (16.7 pints) (10.0 US quarts)

Torque Specification

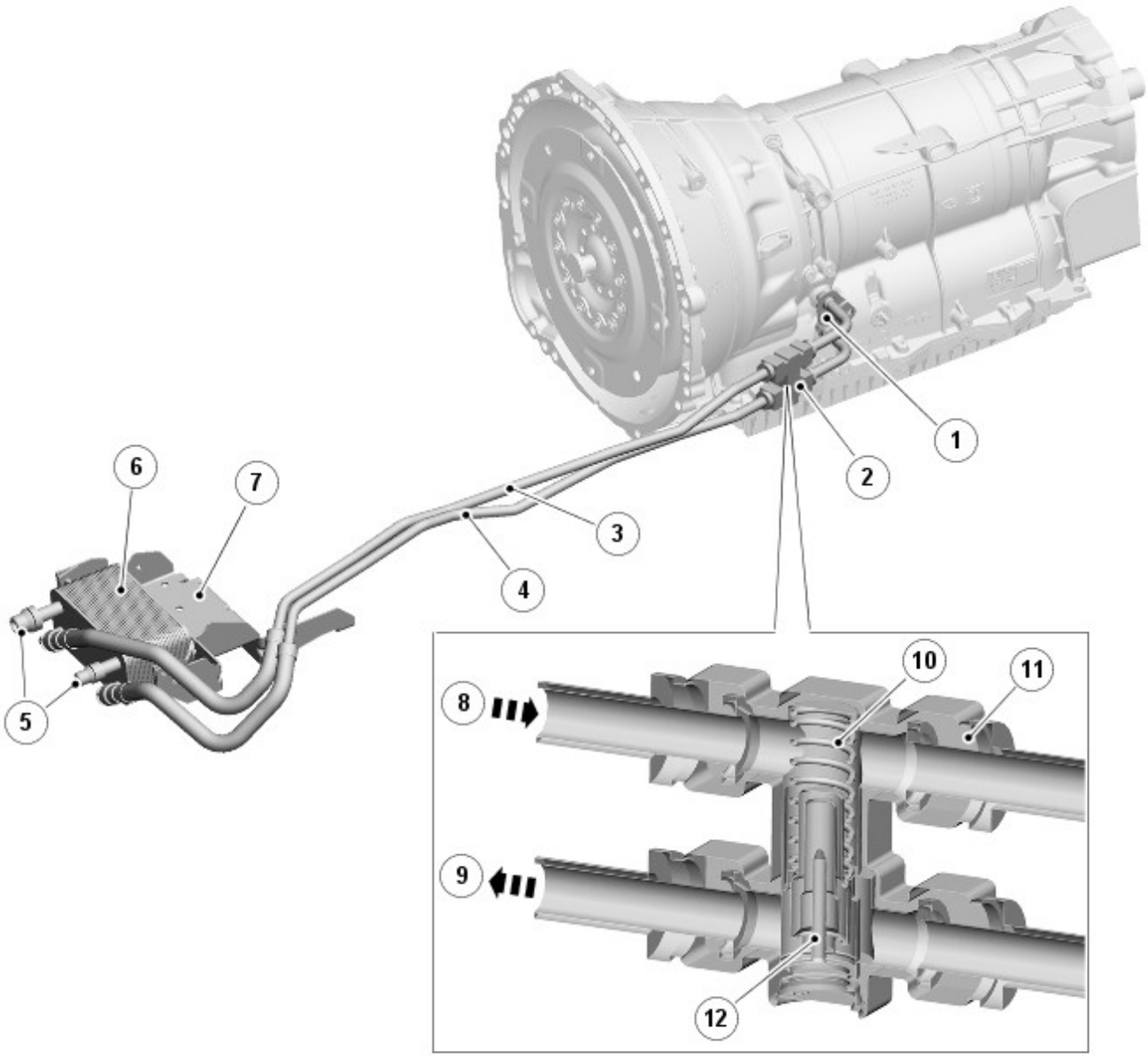
Description	Nm	lb-ft	lb-in
Transmission fluid cooler tube to transmission housing bolt	23	17	-
Transmission fluid cooler tube bracket retaining bolt - vehicles with Engine 5.0L	10	7	-
Transmission fluid cooler tube bracket retaining nut - vehicles with Engine 3.0D	11	8	-
Transmission fluid cooler retaining bolts	25	18	-
Transmission fluid cooler tube line union to cooler	16	12	-

Published: 11-Oct-2011

Transmission / Transaxle Cooling - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Cooling

Description and Operation

TRANSMISSION COOLING COMPONENTS



E138647

Item	Part Number	Description
1	-	Latch-plate, transmission cooling pipe connection
2	-	Thermostatic valve
3	-	Fluid return pipe (to transmission)
4	-	Fluid supply pipe (from transmission)
5	-	Engine coolant hose connections
6	-	Transmission fluid cooler
7	-	Support bracket
8	-	Fluid return flow
9	-	Fluid supply flow
10	-	Spring
11	-	Thermostatic valve body
12	-	Valve

DESCRIPTION

The transmission fluid cooler is a separate cooling unit located behind the engine cooling radiator. The unit is attached, via a bracket, to the cooling pack protection subframe. The transmission is connected to the fluid cooler via flexible hoses and metal pipes.

The transmission fluid cooler is a dedicated cooler which is connected into the engine cooling system circuit. The transmission fluid is cooled by the temperature differential between the transmission fluid and the engine coolant flowing through the cooler.

Fluid is supplied from the transmission fluid pump, through the thermostatic valve (if open) into the cooler. After passing through the cooler, the fluid passes out of the cooler and is returned to the transmission fluid pan.

The thermostatic valve is located in the transmission cooler fluid supply and return lines. The valve contains a bi-metallic spring and valve which is closed when the transmission fluid temperature is below 69 ºC (156.2 ºF). At a temperature of 69 ºC (156.2 ºF) and above, the valve begins to open allowing the fluid to flow around the cooler. The valve is fully open at 79 ºC (174.2 ºF) .

Published: 20-Aug-2012

Transmission / Transaxle Cooling - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the automatic transmission cooling system, refer to the relevant Description and Operation sections in the workshop manual. REFER to: Transmission Cooling (307-02B Transmission/Transaxle Cooling - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD, Description and Operation).

Inspection and Verification

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

Visual Inspection

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 cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Condition	Possible Causes	Action
Overheating 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 transmission fluid cooler
Overheating of the automatic transmission	• Obstruction in the automatic transmission fluid pipes	• Flush out the automatic transmission fluid cooler tubes with new automatic transmission fluid. If the flushing is unsuccessful, install new automatic transmission fluid cooler pipes
Loss of automatic transmission fluid	• Connections to the automatic transmission and the automatic transmission fluid cooler	• Check the integrity of the automatic transmission fluid cooler pipes, connections and seals. Check the torque of the pipe fixings
Loss of automatic transmission fluid	• Leak at oil cooler	• Check the integrity of the automatic transmission fluid cooler pipes, connections and seals. Check the torque of the pipe fixings

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Transmission Control Module (TCM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

Transmission / Transaxle Cooling - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Cooler V8 5.0L Petrol / V8 S/C 5.0L Petrol

Removal and Installation

Removal

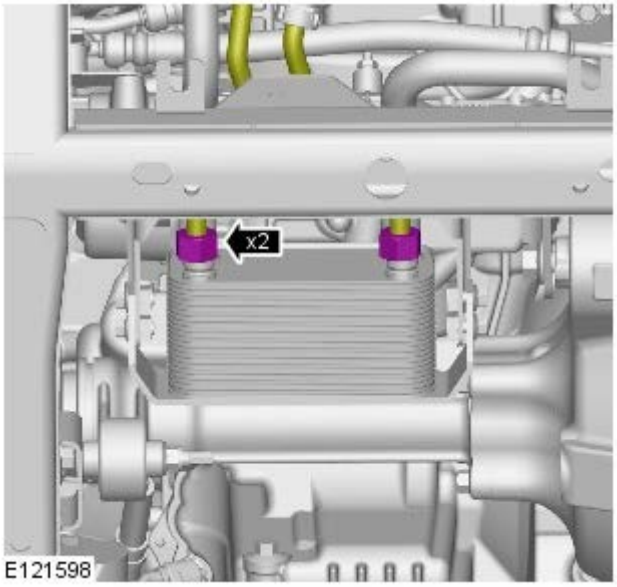
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Cooling System Draining and Vacuum Filling (303-03, General Procedures).

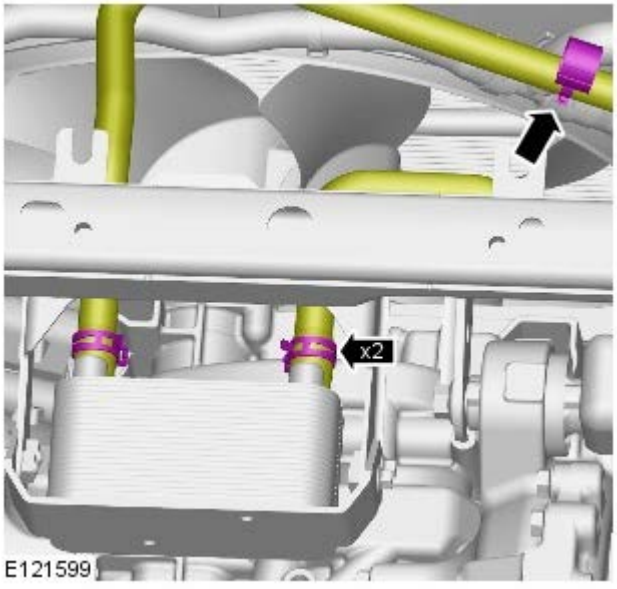
3. Refer to: Transmission Fluid Level Check (307-01, General Procedures).



4. WARNING: Be prepared to collect escaping fluids.

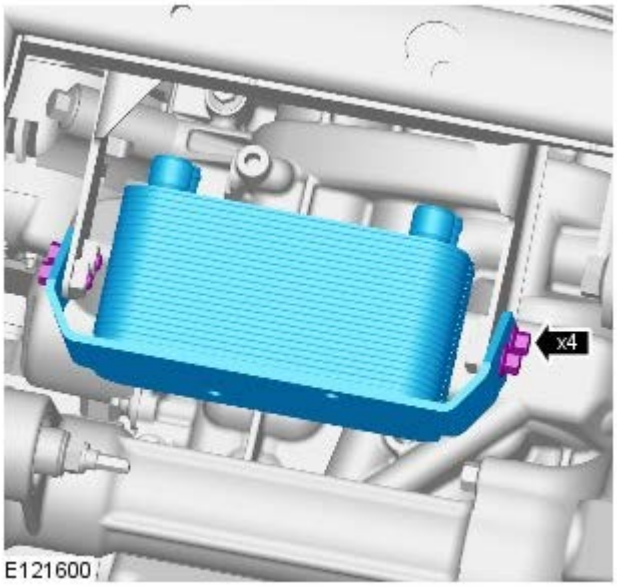
   CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.

   Torque: 16 Nm



5. WARNING: Be prepared to collect escaping fluids.

6. *Torque:* 25 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Transmission / Transaxle Cooling - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Cooler TDV6 3.0L Diesel

Removal and Installation

Removal

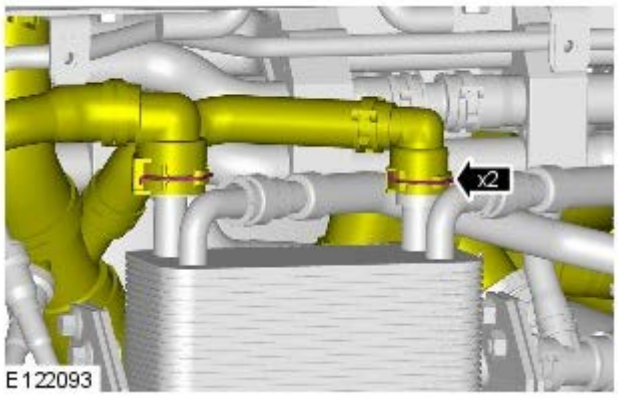
NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

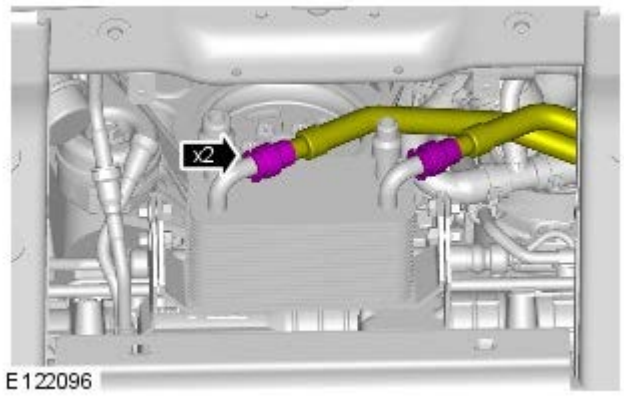
   Raise and support the vehicle.

2. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

3. Refer to: Transmission Fluid Level Check (307-01, General Procedures).

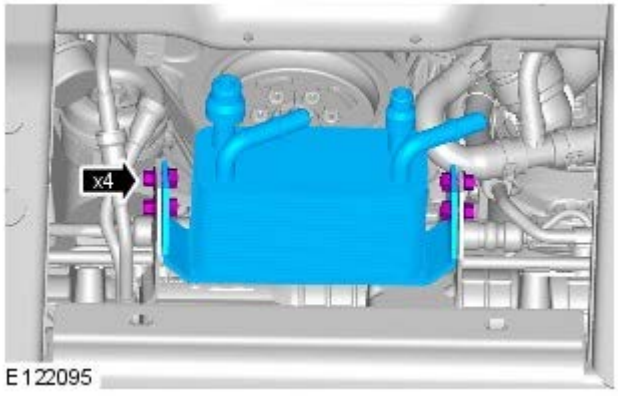


4. WARNING: Be prepared to collect escaping fluids.



5. WARNING: Be prepared to collect escaping fluids.

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



6. *Torque:* 23 Nm

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Transmission / Transaxle Cooling - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Cooler Tubes V8 5.0L Petrol / V8 S/C 5.0L Petrol

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

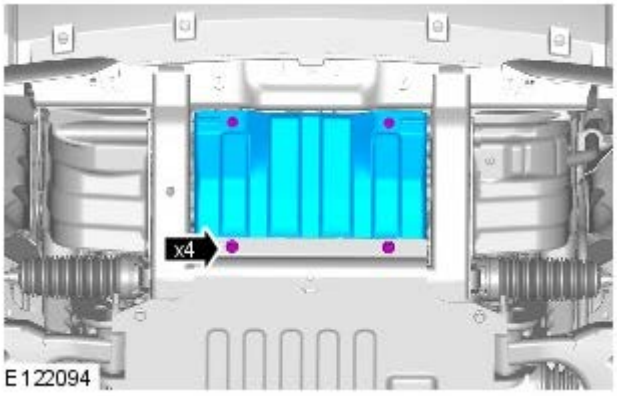
   Raise and support the vehicle.

2. Refer to: Engine Undershield (501-02, Removal and Installation).

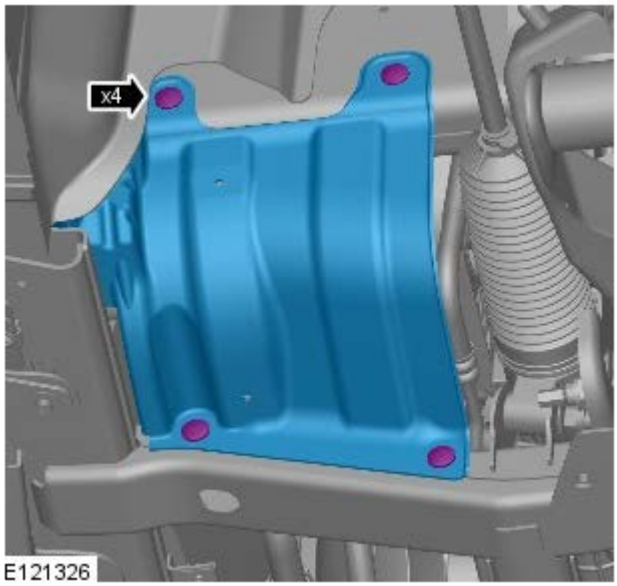
3. Remove the LH front road wheel.

   Torque: 140 Nm

4. *Torque:* 10 Nm



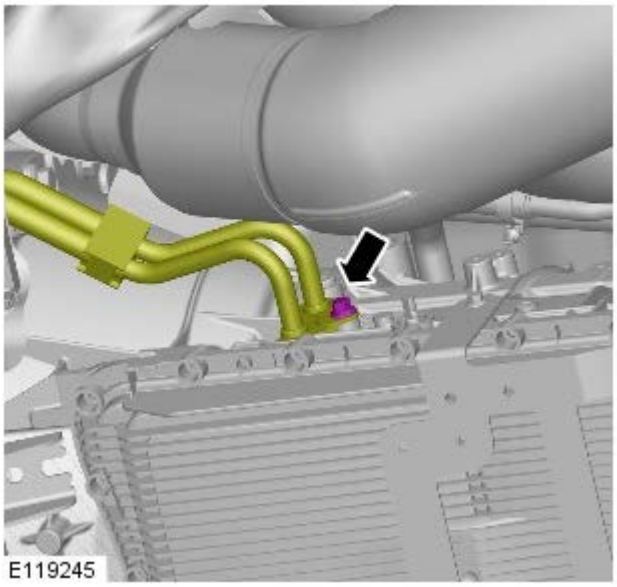
5.



6. WARNING: Be prepared to collect escaping fluids.

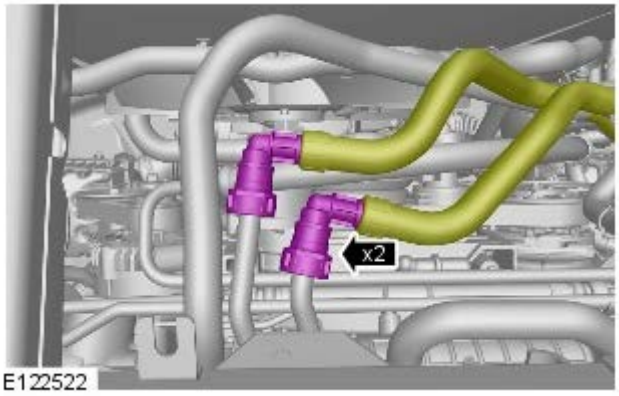
   CAUTION: Always plug any open connections to prevent contamination.

   NOTE: Some variation in the illustrations may



occur, but the essential information is always correct.

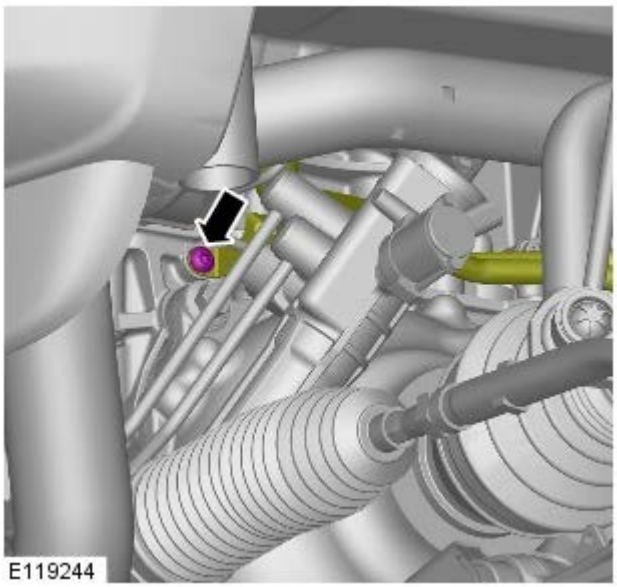
Torque: 23 Nm



7. WARNING: Be prepared to collect escaping fluids.

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

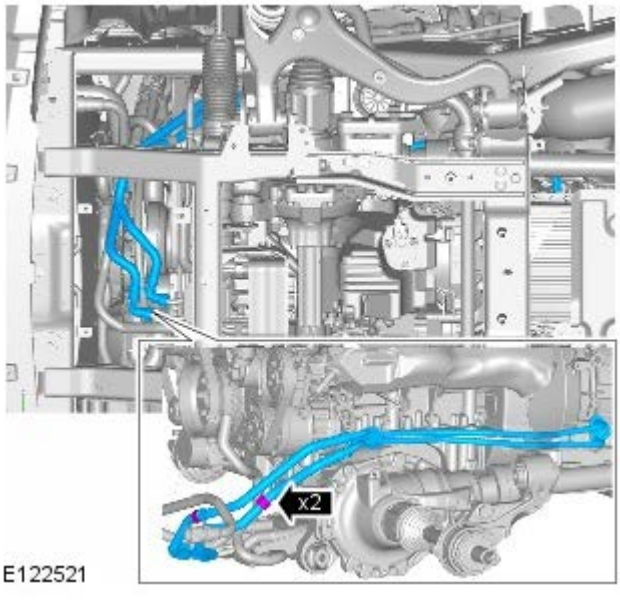
Torque: 16 Nm



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

Torque: 10 Nm

9.



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Transmission / Transaxle Cooling - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Fluid Cooler Tubes TDV6 3.0L Diesel

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. WARNING: Make sure to support the vehicle with axle stands.

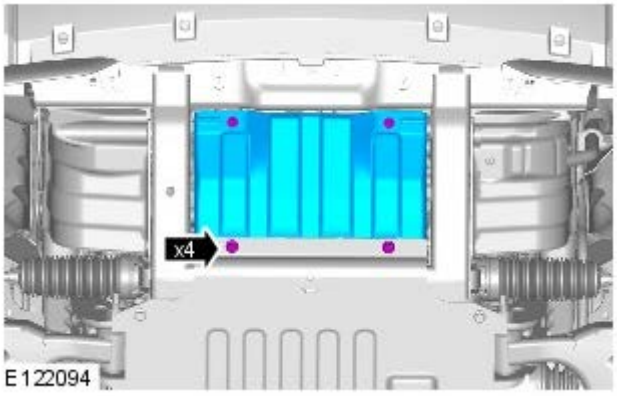
   Raise and support the vehicle.

2. Refer to: Engine Undershield (501-02, Removal and Installation).

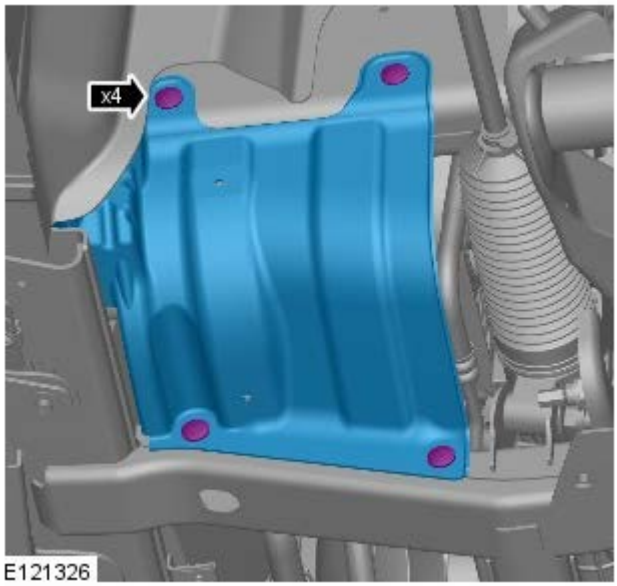
3. Remove the LH front road wheel.

   Torque: 140 Nm

4. *Torque:* 10 Nm



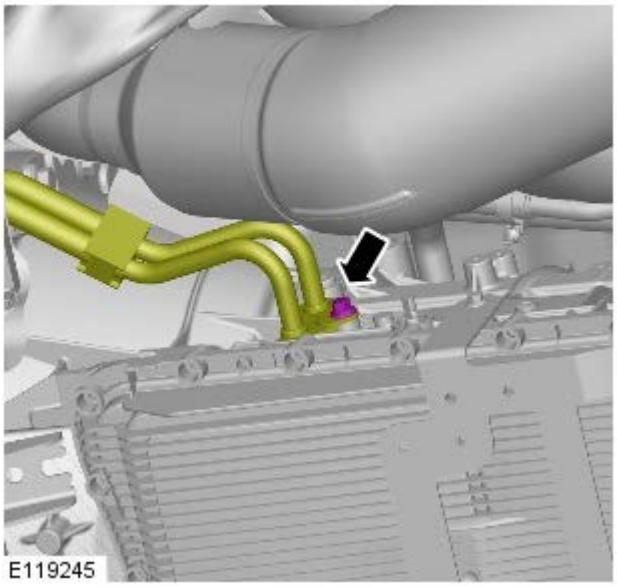
5.



6. WARNING: Be prepared to collect escaping fluids.

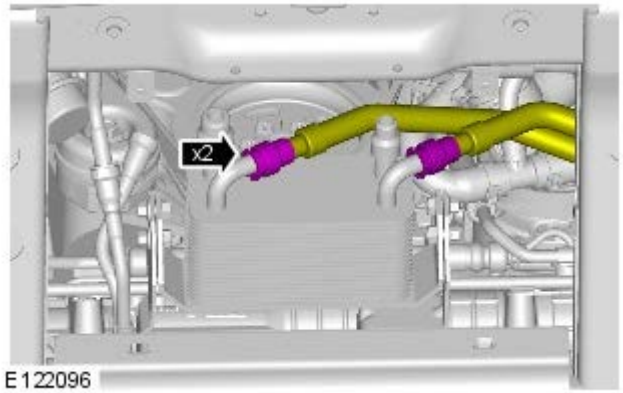
   CAUTION: Always plug any open connections to prevent contamination.

   NOTE: Some variation in the illustrations may



occur, but the essential information is always correct.

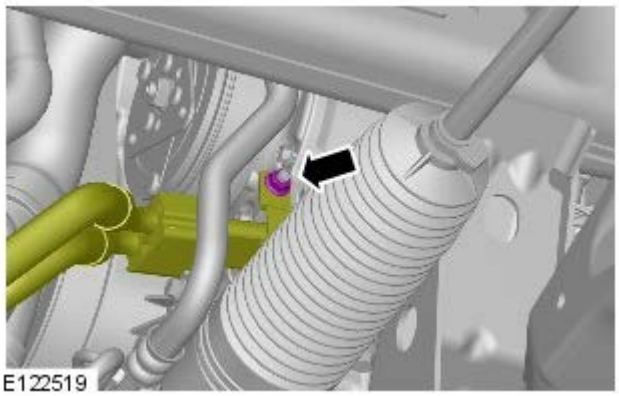
Torque: 23 Nm



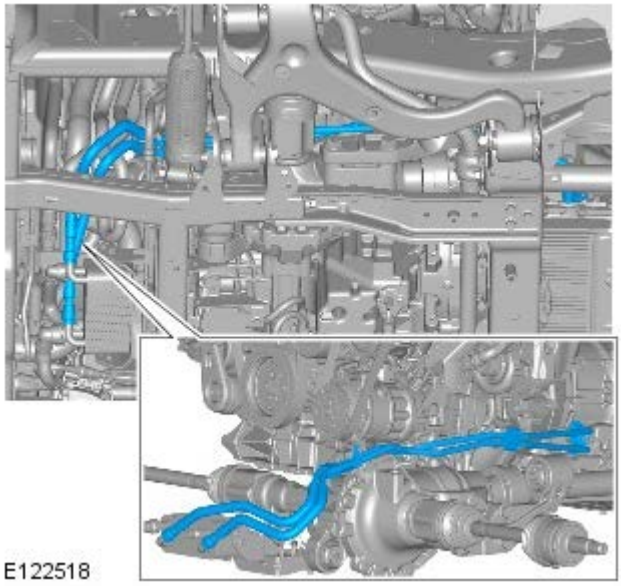
7. WARNING: Be prepared to collect escaping fluids.

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

8. *Torque:* 11 Nm



9. WARNING: Be prepared to collect escaping fluids.



Installation

1. To install, reverse the removal procedure.

Published: 30-Sep-2011

Automatic Transmission/Transaxle External Controls - TDV6 3.0L Diesel /V8 5.0L Petrol/V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission -

Torque Specifications

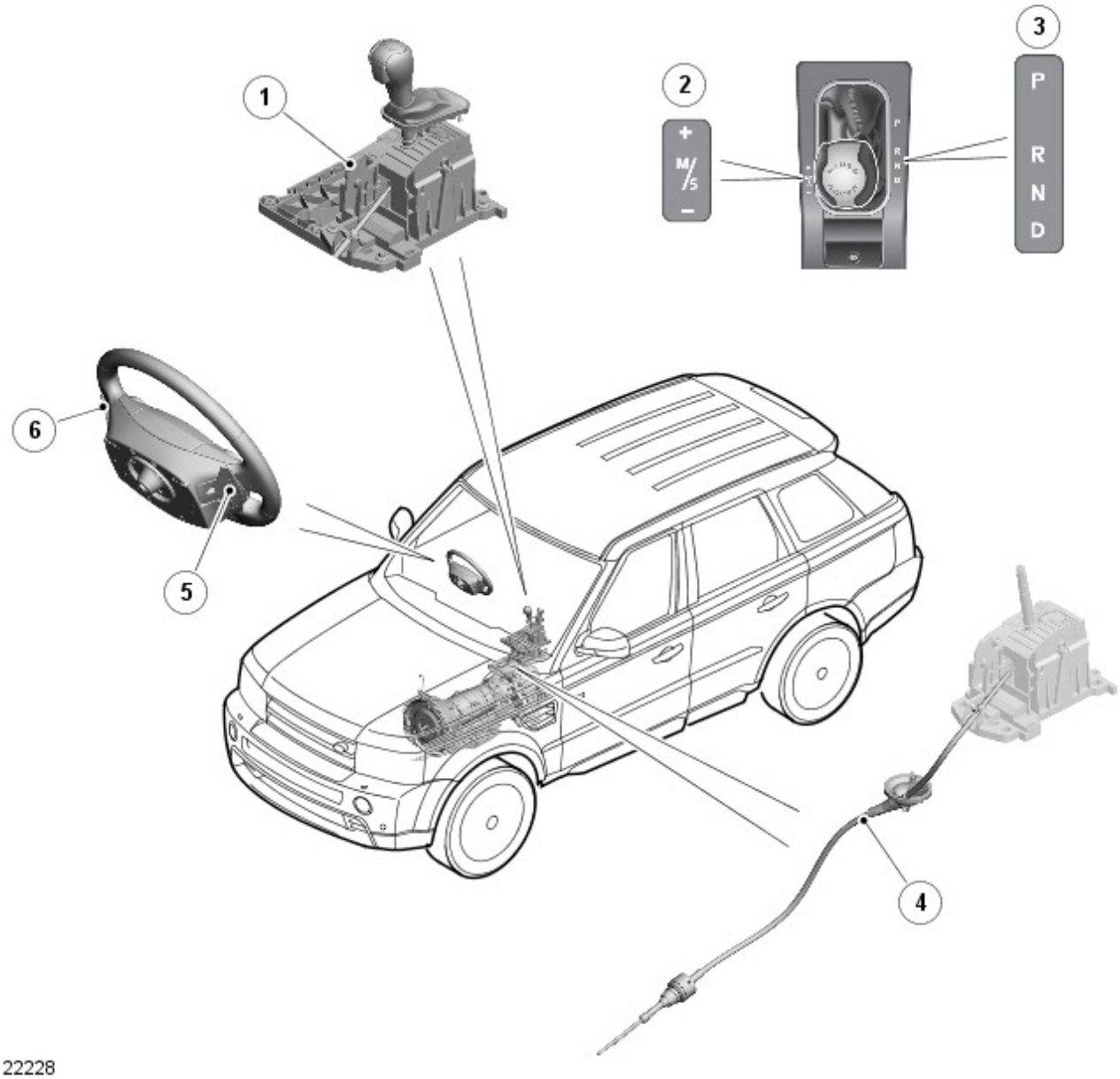
Description	Nm	lb-ft
Transmission undershield bolts	10	7
Emergency park position release cable bracket to transmission bolts	10	7
Emergency park position release lever cable bracket to floor console bolt	3	2

Published: 11-May-2011

Automatic Transmission / Transaxle External Controls - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - External Controls

Description and Operation

COMPONENT LOCATION



E122228

Item	Part Number	Description
1	-	Selector lever assembly
2	-	M/S (manual/sport) display
3	-	Selector lever position display
4	-	Selector cable
5	-	Downshift paddle switch (where fitted)
6	-	Upshift paddle switch (where fitted)

INTRODUCTION

The external controls for the transmission consist of a selector lever assembly, a selector cable and two paddle switches (standard fit on SC (supercharger) vehicles, optional fit on all other vehicles).

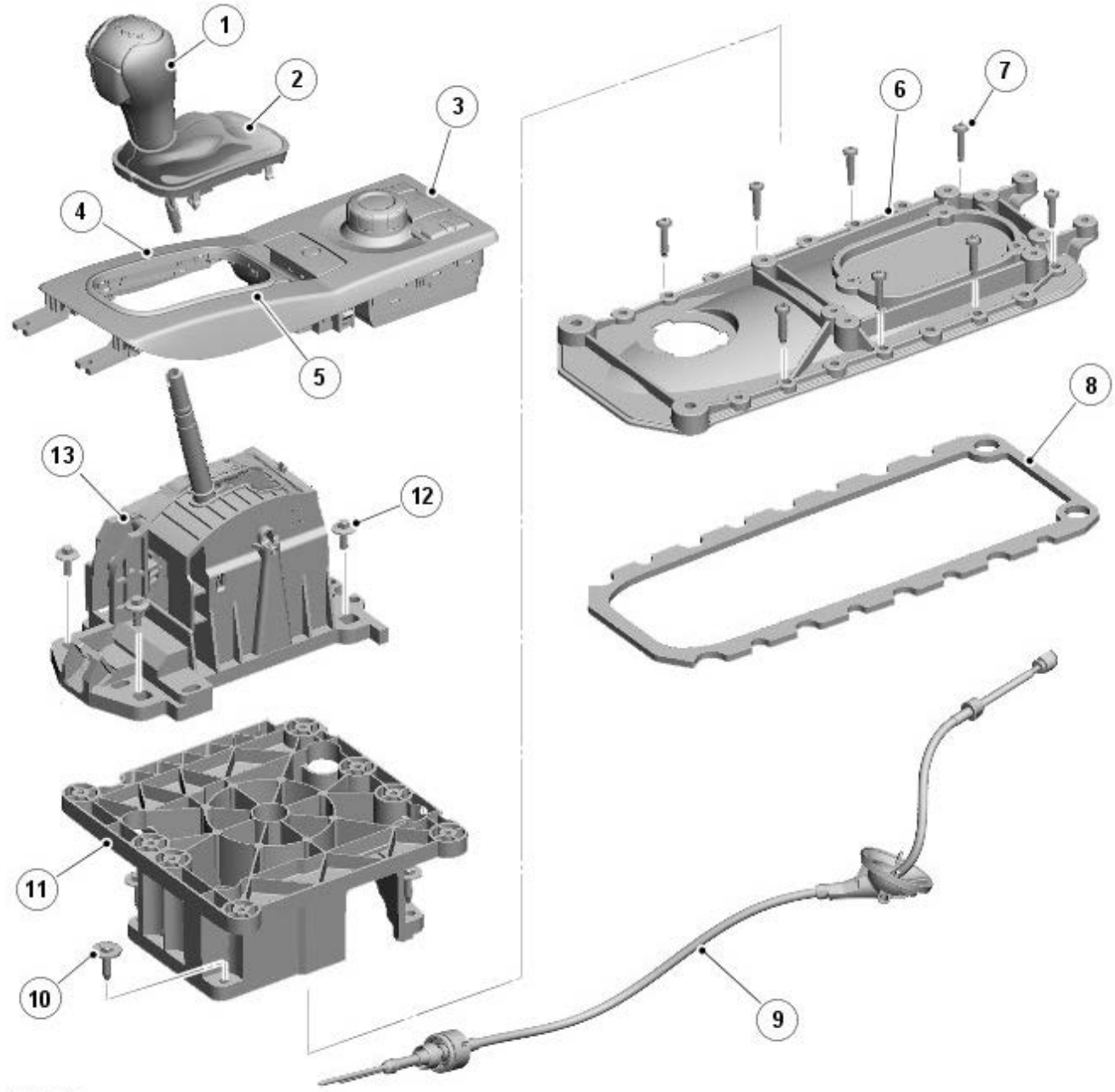
The selector cable transmits the position of the selector lever to the transmission.

Where fitted, the paddle switches can be used to inititiate gear changes, with the selector lever in either the D or

M/S position, causing a change of operating mode from automatic gear selection to manual gear selection.

The selector lever position is displayed on the selector lever position display and the M/S (manual/sport) display. The selector lever position and current forward gear are also displayed in the instrument cluster.
For additional information, refer to: Transmission Description (307-01B, Description and Operation).

SELECTOR LEVER ASSEMBLY



E123910

Item	Part Number	Description
1	-	Selector lever
2	-	Gaiter
3	-	Switch pack and finisher
4	-	Selector lever position display
5	-	M/S display
6	-	Mounting plate
7	-	Screw (8 off)
8	-	Seal
9	-	Selector cable
10	-	Screw and washer (4 off)
11	-	Plinth
12	-	Bolt and washer (4 off)
13	-	Interlock emergency release lever and selector assembly

The selector lever assembly is located in the floor console and is secured to the transmission tunnel closure plate.
The selector lever assembly comprises a moulded plastic housing which provides for the location of the selector

components.

The lever is connected to a crosspiece which allows for the selection of P, R, N, D in a forward and backward direction and selection between D and M/S in a left/right direction.

When M/S (sport) mode is selected the lever can be moved in a forward or backward direction to select + or - for manual (CommandShift®) operation. If left in sport mode, all gear changes are performed automatically.

If manual (CommandShift®) mode is selected, all gear changes are based on inputs received by the TCM (transmission control module) from manual +/- Hall effect sensors located in the selector lever assembly.

The selector lever assembly houses the following components:

- PCB (printed circuit board)
- Shift Interlock solenoid
- Park and Neutral locking levers.

The selector lever positions are as follows:

- P (park) : no torque transmitted to the drive wheels and prevents the vehicle from moving by locking the transmission
- R (reverse) : selects reverse gear - only to be selected when the vehicle is stationary and the engine is at idle
- N (neutral) : no torque transmitted to the drive wheels - allows the vehicle to roll, so ensure the EPB (electronic parking brake) is applied before leaving the vehicle in this state
- D (drive) : this position uses all six forward gears in automatic operation
- M/S : this position engages the sport mode, which uses all six forward gears as in D, but will upshift at higher engine speeds improving acceleration
- + and - : initiates upshifts and downshifts respectively, allowing the transmission to be used as a sequential manual transmission (CommandShift® mode) with six forward gears

The selector lever position is displayed to the driver on the selector lever position display, M/S display and in the instrument cluster.

Manual/Sport and +/- CommandShift® Sensors

The PCB in the selector lever assembly contains Hall effect sensors to activate the M/S mode and provide the +/- signals.

When the selector lever is moved to the M/S position, the lower magnet located in the selector lever is moved close to the M/S Hall effect sensor on the PCB. This provides a signal for the TCM, which initiates sport mode.

When the selector lever is moved to the + or - position, the magnet is moved close to one of the Hall effect sensors positioned either side of the M/S Hall effect sensor. When an input from either the + or - sensor is received, manual CommandShift® mode is initiated by the TCM. A spring moves the selector lever back to the center position when released. When the selector lever is moved back to the D position, the TCM returns to normal automatic operation.

Selector Lever Position and Manual/Sport Displays

The displays are incorporated into the switch pack and finisher on the selector lever assembly. The selector lever position display is located on the RH (right-hand) side of the selector lever and the M/S display is located on the LH (left-hand) side of the selector lever. The two displays are connected to the PCB of the selector lever assembly. An LED (light emitting diode) is installed under the P, R, N and D of the selector lever position display and the M/S of the M/S display. The position of the selector lever is sensed by the PCB, which illuminates the related LED in the displays.

P, R, N, D Position Switch

The P, R, N, D position switch is located within the Mechatronic valve block in the transmission. The switch is operated by movement of the selector lever to the P, R, N or D positions via the selector cable, which is connected between the selector lever and the transmission selector shaft.

The switch is electrically connected to the TCM, which outputs a common power supply to each of the four switch contacts. This power supply is also used by the two speed sensors and the fluid temperature sensor in the transmission. Each of the four switch contacts have a separate output to the TCM, which enables the TCM to detect the position of the selector lever.

Shift Interlock Solenoid

The shift interlock solenoid is located on the side of the selector lever assembly. The solenoid is connected to two locking levers, which engage with the base of the selector lever and lock it in the P and N positions when the solenoid is de-energized. Operation of the solenoid is controlled by the TCM.

When the ignition is on and the brake pedal is pressed, the TCM energizes the solenoid and the selector lever can be moved from the P or N position. This prevents the selector lever from being moved to the D or R position unintentionally, and the application of the brakes prevents the vehicle 'creeping' when the transmission engages gear.

Movement of the selector lever from the P or N positions is prevented if the TCM senses the engine speed is above 2500 rev/min, even if the brake pedal is pressed.

The selector lever is locked in the N position during the transfer box changing range from high to low or vice versa.

If there is a vehicle electrical failure, or failure of the interlock solenoid or associated wiring, it is possible to move the selector lever from the P position by removing the selector lever, and the switch pack and finisher, and lifting the white tab on the rear of the selector lever assembly. While holding the tab in this position, the selector lever can be

moved from the P position.

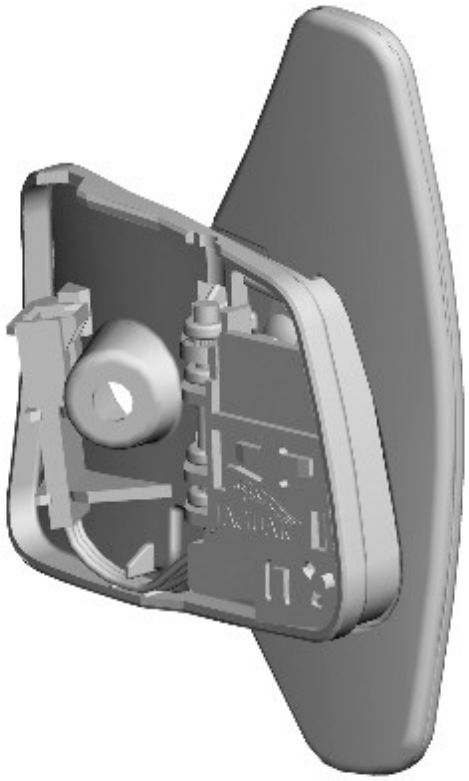
SELECTOR CABLE

The selector cable is used as a mechanical connection between the selector lever and the transmission. Movement of the selector lever between the P, R, N and D positions moves the cable. Movement of the cable is prevented when the selector lever is in the M/S position.

A seal is installed on the cable where it passes through the mounting plate. The outer cable is attached to a bracket on the transmission. The inner cable is connected to a lever attached to the transmission selector shaft.

Movement of the selector lever between the P, R, N and D positions moves the inner cable, which moves the lever. The lever transforms the linear movement of the cable into rotary movement of the selector shaft, which operates the P, R, N, D position switch and a spool valve in the Mechatronic valve block.

PADDLE SWITCHES (WHERE FITTED)



E115235

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 CommandShift® feature.

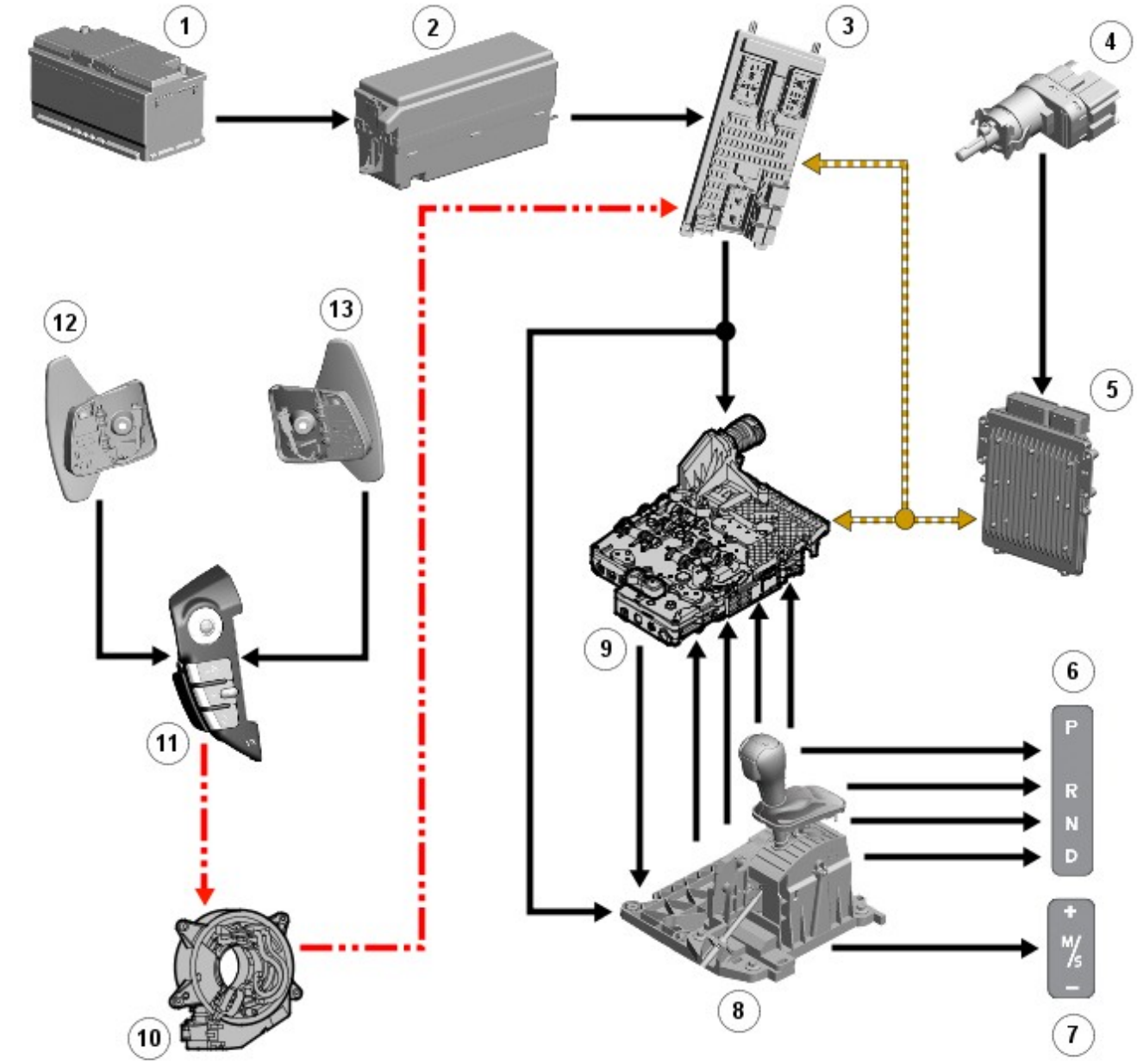
Each paddle switch has three connections; ground, illumination PWM (pulse width modulation) supply and ground switch signal. The paddle switches are hardwired to the steering wheel audio switches. Operation of the paddle switch completes a ground path to the audio switch assembly. The audio switch assembly converts the completed ground signal into a LIN (local interconnect network) bus signal, which is passed via the clockspring to the CJB (central junction box). The CJB converts the signal into a high speed CAN (controller area network) bus signal to the TCM.

Pulling the LH (-) paddle provides down changes and pulling the RH (+) paddle provides up changes. The first operation of either paddle, after sport mode is selected, puts the transmission into permanent manual CommandShift® mode. Moving the selector lever back to the D position returns the transmission to conventional automatic operation.

Temporary operation of manual CommandShift® mode can be activated with the selector lever in the D position. Operation of either the upshift or downshift paddle activates the manual mode operation. If the selector lever is in D, CommandShift® mode will cancel after a time period or can be cancelled by pressing and holding the + paddle for approximately 1.2 seconds.

CONTROL DIAGRAM

NOTE: A = Hardwired; D = High speed CAN bus; O = LIN bus.



Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box) (50 A megafuse)
3	-	CJB (central junction box) (ignition relay)
4	-	Stoplamp switch
5	-	ECM (engine control module)
6	-	Selector lever position display
7	-	M/S display
8	-	Selector lever assembly
9	-	TCM/Mechatronic valve block
10	-	Clockspring
11	-	Steering wheel audio switchpack
12	-	Downshift paddle switch (where fitted)
13	-	Upshift paddle switch (where fitted)

Published: 28-Oct-2011

Automatic Transmission/Transaxle External Controls - TDV6 3.0L Diesel /V8 5.0L Petrol/V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - External Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the automatic transmission/transaxle external controls system and operation, refer to the relevant Description and Operation section of the workshop manual.

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Check for stuck/jammed switches and buttons • Visibly worn or damaged components • Loose or missing fastners	• Fuses • Loose or corroded electrical connectors

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

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Gear Shift Module (GSM) (100-00, Description and Operation).

Published: 11-May-2011

Automatic Transmission / Transaxle External Controls - TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol, Vehicles With: 6HP28 6-Speed Automatic Transmission - Selector Lever Assembly

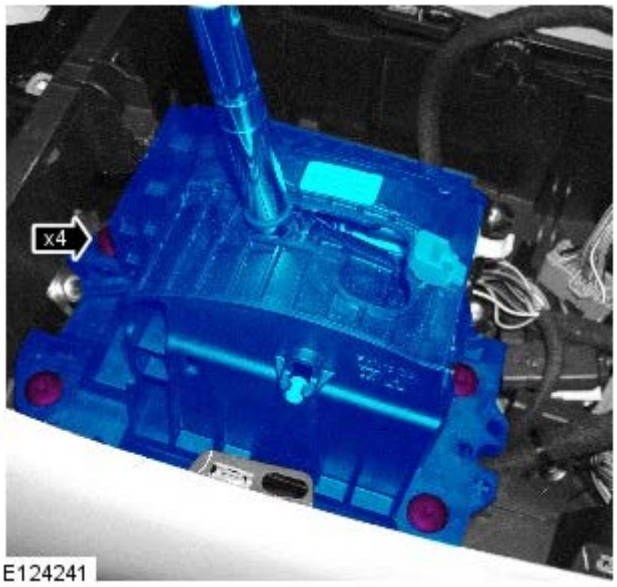
Removal and Installation

Removal

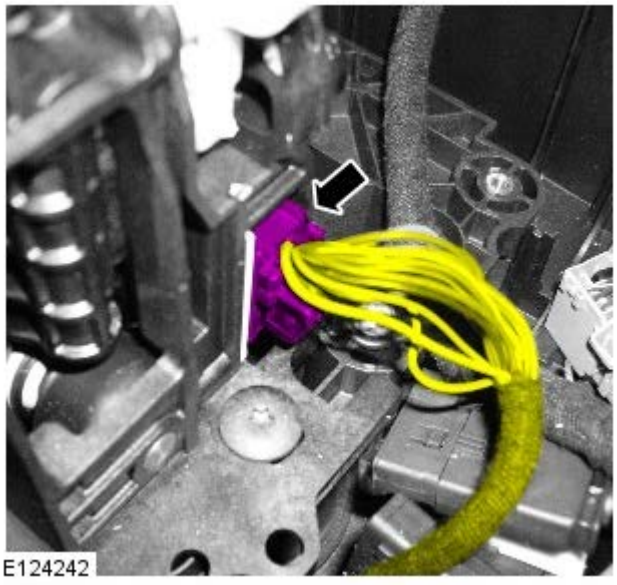
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Floor Console Upper Section (501-12, Removal and Installation).

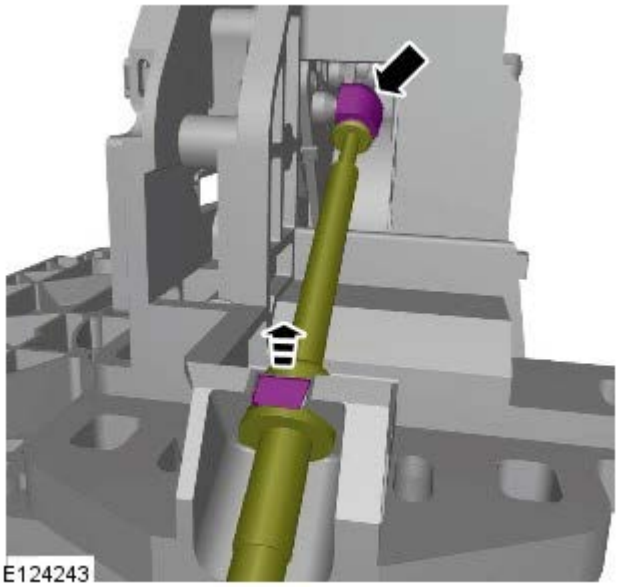
2. *Torque:* 10 Nm



3.



4.



Installation

1. To install, reverse the removal procedure.

Published: 30-Sep-2011

Automatic Transmission / Transaxle External Controls - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD -

Torque Specifications

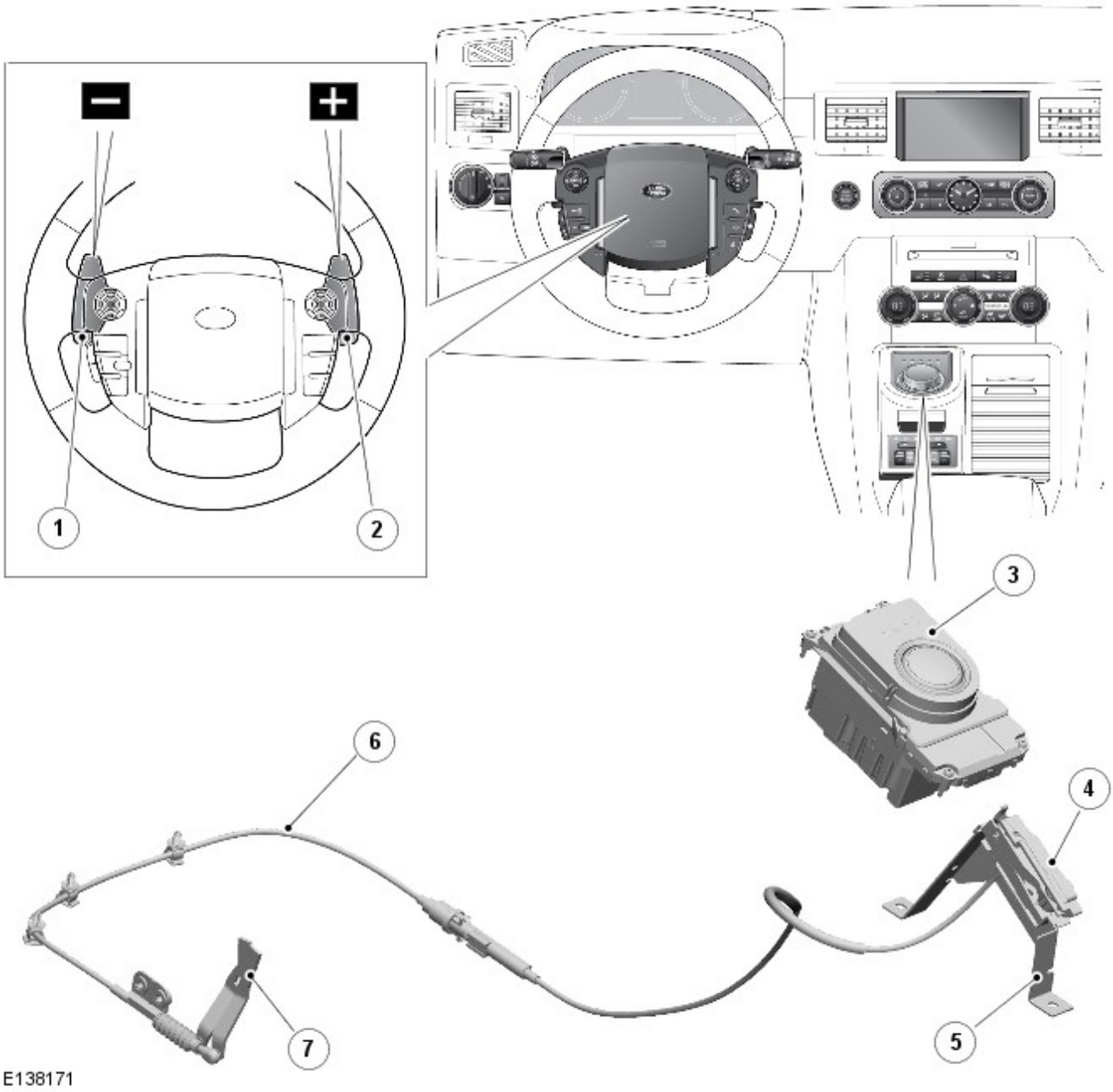
Description	Nm	lb-ft
Transmission undershield bolts	10	7
Emergency park position release cable bracket to transmission bolts	10	7
Emergency park position release lever cable bracket to floor console bolt	3	2

Published: 04-Oct-2011

Automatic Transmission / Transaxle External Controls - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - External Controls

Description and Operation

TRANSMISSION EXTERNAL CONTROLS - COMPONENT LOCATION



Item	Part Number	Description
1	-	Downshift paddle switch
2	-	Upshift paddle switch
3	-	Electronic Transmission Selector (ETS)
4	-	Emergency park lock lever
5	-	Mounting bracket
6	-	Cable
7	-	Emergency park lock transmission lever

OVERVIEW

The external controls for the transmission consist of an ETS (Electronic Transmission Selector), two steering wheel mounted paddle switches and an emergency park lock release-lever and cable. The ETS transmits driver transmission selections to the TCM (transmission control module). The paddle switches allow the driver to initiate gear shifts in all transmission modes; 'D' (Drive), 'S' (Sport) and 'S' (Sport) manual CommandShift.

The emergency park release allows the transmission park-lock to be disengaged during vehicle recovery operations.

DESCRIPTION

The ETS (Electronic Transmission Selector) is a rotary selector installed in the floor console and controls the driver transmission selections.

The TCM allows the transmission to be operated as a conventional automatic unit by selecting: 'P' (Park), 'R' (Reverse), 'N' (Neutral), 'D' (Drive) on the ETS. Rotation of the ETS allows the selection of P, R, N and D. By depressing the ETS and rotating clockwise from the D position, S mode can be selected. The ETS is a fully electronic rotary transmission-selector with no mechanical connection to the transmission.

The ETS rises once the engine is running. When the engine is stopped with the ETS in any position other than 'N', it retracts into the console again. If the ETS is in position 'N' when the engine is stopped, it remains in the raised position for up to 10 minutes; for use in a drive-through car wash for example. After 10 minutes the ETS automatically retracts. The ETS also retracts if 'P' is selected within the 10 minute period of 'N' selection. If the ETS does not rise from the console when the engine is started, but electrical power is supplied to the ETS, the retracted ETS can still be rotated to make selections.

If electrical power to the ETS is lost, the ETS will not rise from the console when the engine is started and the retracted selector will not rotate. The ETS contains an internal interlock solenoid to prevent the selector from being rotated when the engine is not running.

The engine can be stopped with the ETS in any position. Once the engine is stopped the selector will automatically reset to the 'P' position and the transmission park-lock will be engaged, except if the selector is in the 'N' position when the engine is stopped.

PADDLE SWITCHES

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 'Commandshift' feature. Each paddle switch has three connections; ground, illumination PWM (pulse width modulation) supply and ground switch signal.

EMERGENCY PARK RELEASE

 WARNING: The vehicle must be suitably restrained either by use of the EPB (electronic parking brake) or wheel chocks before operation of the emergency park-release mechanism in order to prevent vehicle roll-away.

If the vehicle requires recovery/transportation, the emergency park-release mechanism is used to manually disengage the park-lock and position the transmission in neutral. The emergency park release mechanism consists of an operating lever that is connected to a park interlock lever on the transmission by a cable assembly. The operating lever is installed in the floor console, under the drinks holder. To access lever remove the drinks holder. The park interlock lever is attached to the transmission selector shaft via a Bowden cable.

OPERATION

Rotation of the ETS (Electronic Transmission Selector) selector to any of the five positions is sensed by the TCM via the high-speed CAN (controller area network). The TCM then reacts according to the selected position.

PARK INTERLOCK AND NEUTRAL LOCK

Neutral lock is a requirement for the ETS. The selector is always locked at ignition 'on' when the engine is not running, except after an engine stall when the selector is not in 'P' or 'N'. If, when driving with the ETS in 'S', 'D' or 'R' at a speed of more than 5 km/h (3 mph), and the driver selects 'P' or 'N'; without the brake pedal pressed, the ETS will be immediately locked once the vehicle speed falls to below 5 km/h (3 mph).

With the brake pedal pressed, the ETS will remain unlocked for as long as the brake pedal remains pressed, regardless of vehicle speed. The transmission will only engage park once the vehicle speed is less than 2 km/h (1 mph). If the driver selects 'N' and releases the brake pedal with a vehicle speed of less than 5 km/h (3 mph), the ETS will be locked 2 seconds after 'N' is selected. The selector will remain locked until the driver presses the brake pedal again.

To ensure that a driver request to change from a non-driving range ('N' for example) to a driving range ('D' for example), the park interlock and neutral lock features are used in conjunction with the intermediate position. If the transmission receives a range change request without the brake pedal pressed, the TCM initiates a soft lock function. The transmission will remain in park or neutral, depending on the starting position.

The ETS is a magnetic system using Hall effect sensors to determine the position of the selector. The 'S' (sport) position selection allows the TCM to operate the transmission using the semi-automatic 'Commandshift' system. Gear selections are sensed by the TCM when the driver operates the steering wheel paddle-switches. Once the ETS position is confirmed, the TCM outputs appropriate information on the high-speed CAN bus which is received by the instrument cluster to display the gear selection information in the message center. The paddles can also be used on a temporary basis when the ETS is in the 'D' position to override the automatic gear selection if required.

If a transmission position letter is flashing in the message center and the vehicle has no drive, the driver must:

- Press the brake pedal
- Reselect 'N' or 'P' on the ETS
- Select the required driving range, ensuring that the brake pedal is pressed.

Rocking Function

The rocking function compliments the neutral lock function. For all changes from a non-driving range to a driving range, it is necessary to press the brake pedal (to release either the park interlock or neutral lock). In situations where the driver will require to change the gear selection from 'R' to 'D', or from 'D' to 'R', without brake pedal input (car park maneuvering, 3 point turns or 'rocking' the vehicle from a slippery surface for example), the rocking function gives a 2 second lock delay when 'N' is selected on the ETS and the brake pedal is not pressed.

Intermediate Position

If the ETS is rotated slowly from 'P' to 'S' and back to position 'P' with the brake pedal pressed, the 'R' or 'D' position display letter in the message center will flash and the transmission will remain in park or neutral depending on the previous starting position of the selector. If the brake pedal is released when 'R' or 'D' is flashing in the message center and the ETS is rotated to the 'R' or 'D' position, the required range will not be selected and the transmission will remain in park or neutral, depending on the previous starting position. This feature is known as soft lock. If the driving range letter in the message center is flashing and the vehicle has no drive, the driver should depress the brake pedal to reselect 'N' or 'P', and then select the required driving range while the brake pedal remains pressed.

PADDLE SWITCHES

The paddle switches are hardwired to the steering wheel audio and via the clockspring to the instrument cluster. The instrument cluster converts the signal into a high-speed CAN bus signal to the TCM.

Pulling the LH (left-hand) downshift (-) paddle provides down changes and pulling the RH (right-hand) upshift (+) paddle provides up changes. The first operation of either paddle, after sport mode is selected, puts the transmission into permanent manual Commandshift. Rotation of the ETS back to the 'D' position, returns the transmission to conventional automatic operation. Temporary operation of Commandshift mode can also be operated with the ETS in the 'D' position. Operation of either the upshift or downshift paddles activates the manual mode operation. If the ETS is in 'D', Commandshift will cancel after a time period or can be cancelled by pressing and holding the (+) paddle for approximately 2 seconds.

EMERGENCY PARK RELEASE

One end of the operating lever is attached to a base by a hinge pin. A locking cylinder is installed in the other end of the operating lever, to secure the operating lever to the base. The operating lever is raised by pulling on a strap. When operated, the emergency park release mechanism turns the transmission selector shaft.

 WARNING: Before disengaging the park lock, apply the EPB if electrical power is available or apply restraints to the vehicle, for example wheel chocks, to prevent vehicle roll-away. Ensure that the ignition is turned off.

To disengage the park lock: Remove the drinks holders. Rotate the locking mechanism of the emergency park release lever 90 degrees counterclockwise. Apply the footbrake, pull the operating lever upwards and ensure it locks in the vertical position. Raising the operating lever causes the emergency park release cable to rotate the park interlock lever on the transmission, which disengages the parking pawl and engages neutral. This allows the vehicle to freewheel.

To re-engage the park lock: Hold the strap on the operating lever, release the latch and lower the operating lever to the horizontal position. Lock the operating lever by turning the locking mechanism 90 degrees clockwise. Install the drink holders..

Published: 29-Nov-2011

Automatic Transmission / Transaxle External Controls - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Control Switch (TCS)

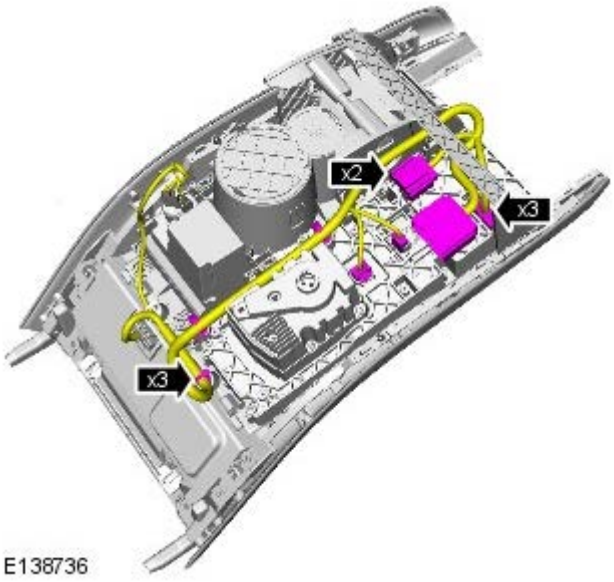
Removal and Installation

Removal

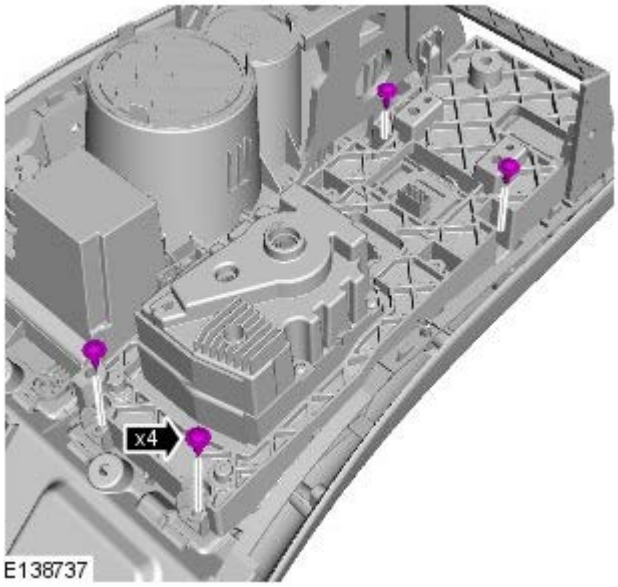
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Floor Console Upper Section (501-12, Removal and Installation).

2.



3.



4.



E138743

5.



E138746

Installation

1. To install, reverse the removal procedure.

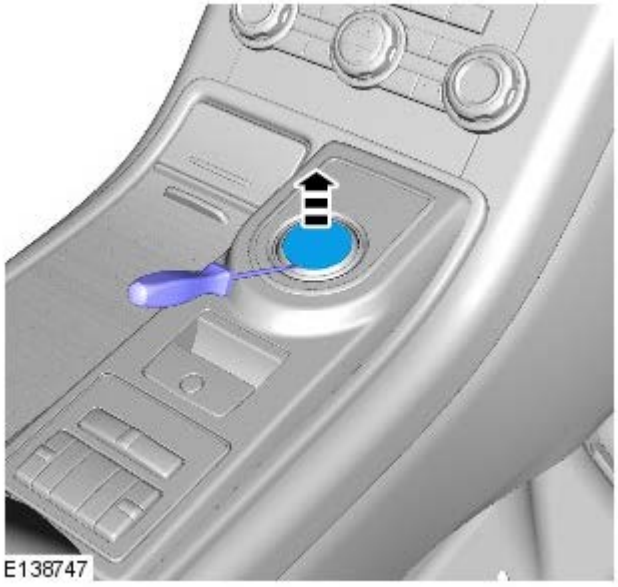
Published: 29-Nov-2011

Automatic Transmission / Transaxle External Controls - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Transmission Control Switch (TCS) Knob

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

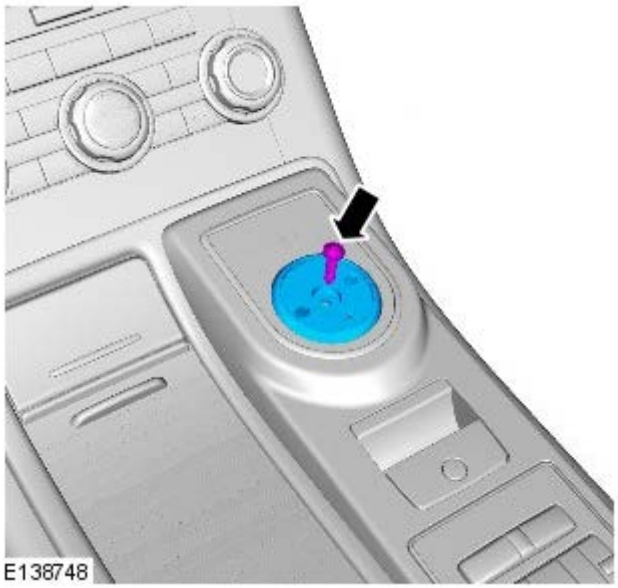


1. WARNING: The cap will be released suddenly. Keep hands clear during removal. Failure to follow this instruction may result in personal injury.

   CAUTIONS:

   Do not start the engine.

   Care must be taken to avoid damaging the surrounding components.



2. *Torque:* 2 Nm

Installation

1. CAUTION: Make sure that a new component is installed.

   NOTE: Make sure to install the TCS plastic carrier to the TCS knob.

   To install, reverse the removal procedure.

Published: 30-Sep-2011

Automatic Transmission / Transaxle External Controls - TDV6 3.0L Diesel , Vehicles With: 8HP70 8-Speed Automatic Transmission AWD - Emergency Park Position Release Lever

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

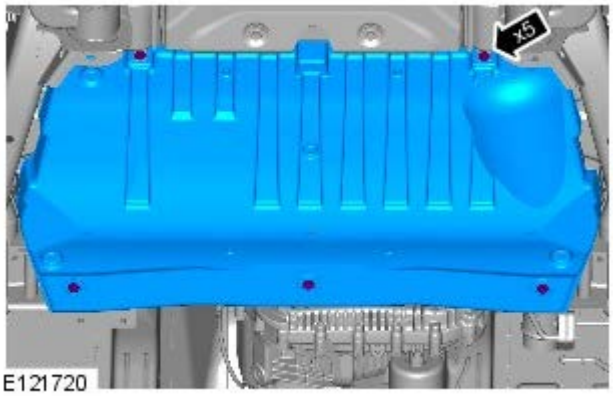
1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

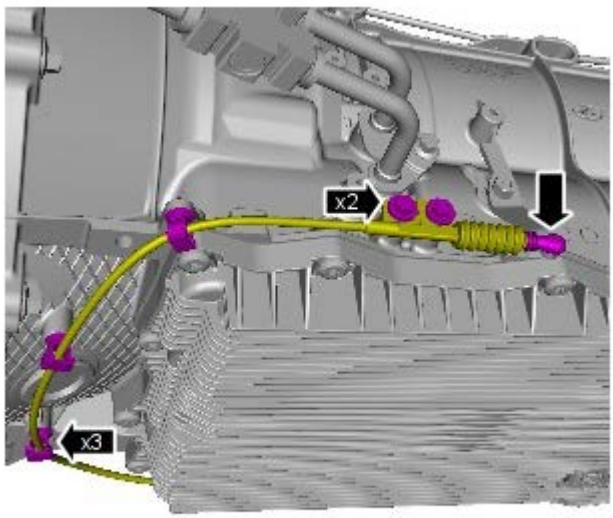
   Raise and support the vehicle.

3. *Torque:* 10 Nm



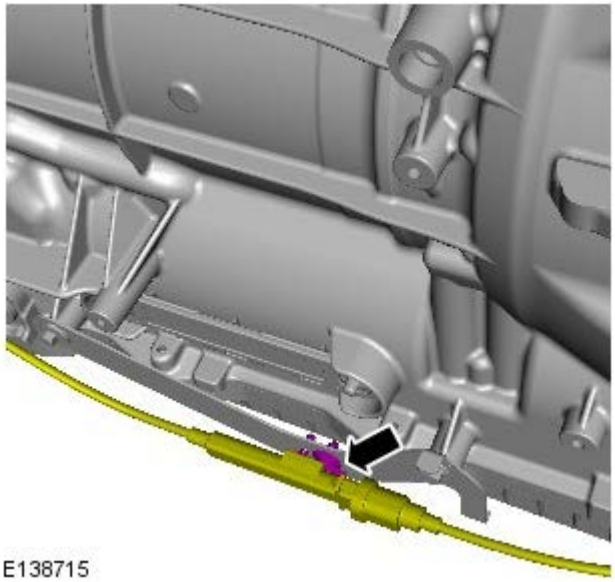
E121720

4. *Torque:* 10 Nm



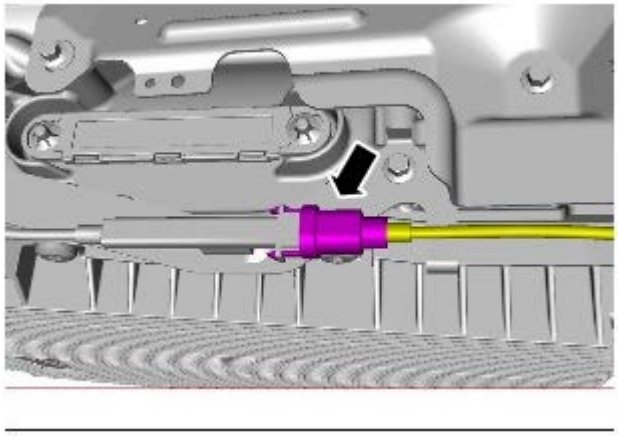
E138714

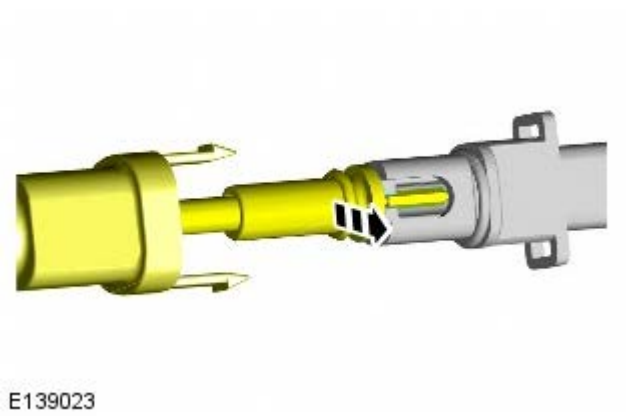
5.



E138715

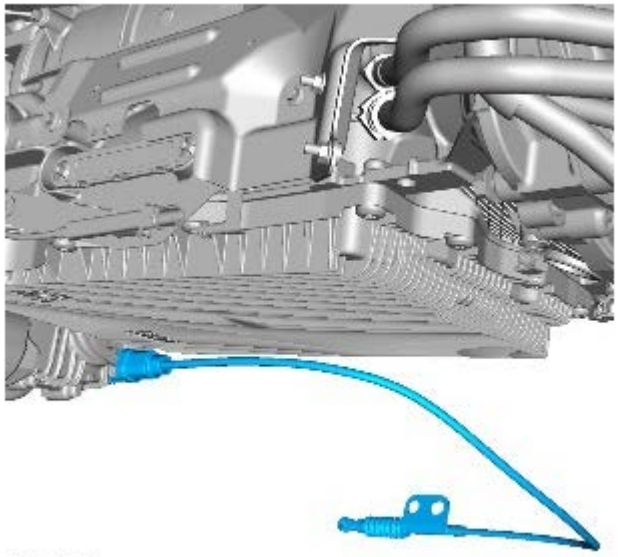
6.





E139023

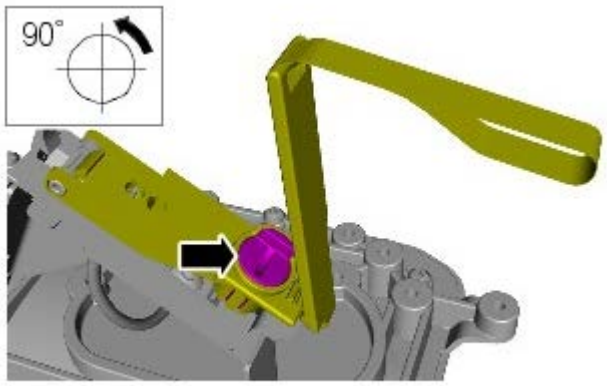
7.



E139024

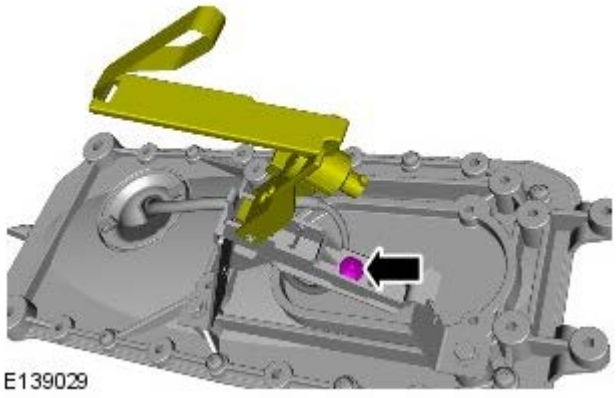
8. Lower the vehicle.

9. Refer to: Floor Console Upper Section (501-12, Removal and Installation).



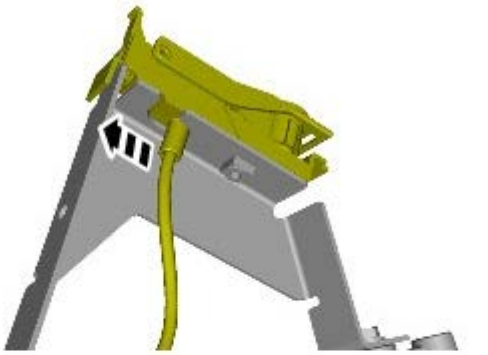
10. CAUTION: Make sure the parking brake is applied or chock the wheels and ensure that all personnel are clear of the vehicle before carrying out the following procedure.

Torque: 3 Nm



E139029

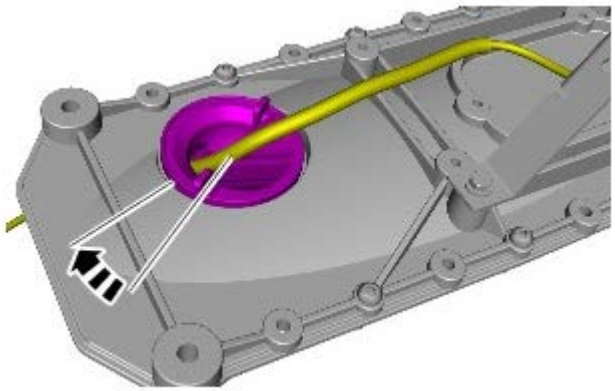
11.

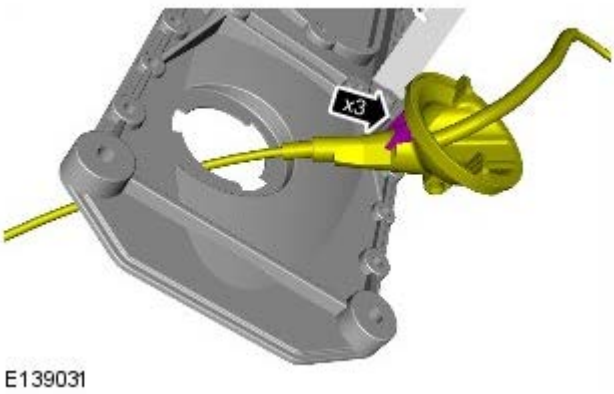




E139030

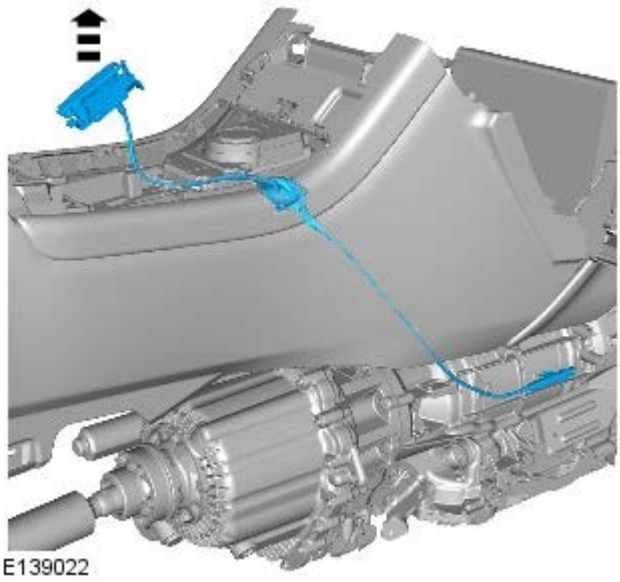
12.





E139031

13.


E139022

Installation

1. To install, reverse the removal procedure.

Published: 09-Oct-2013

Four-Wheel Drive Systems -

Torque Specifications

NOTE: *** New bolts must be used when a new component is installed.**

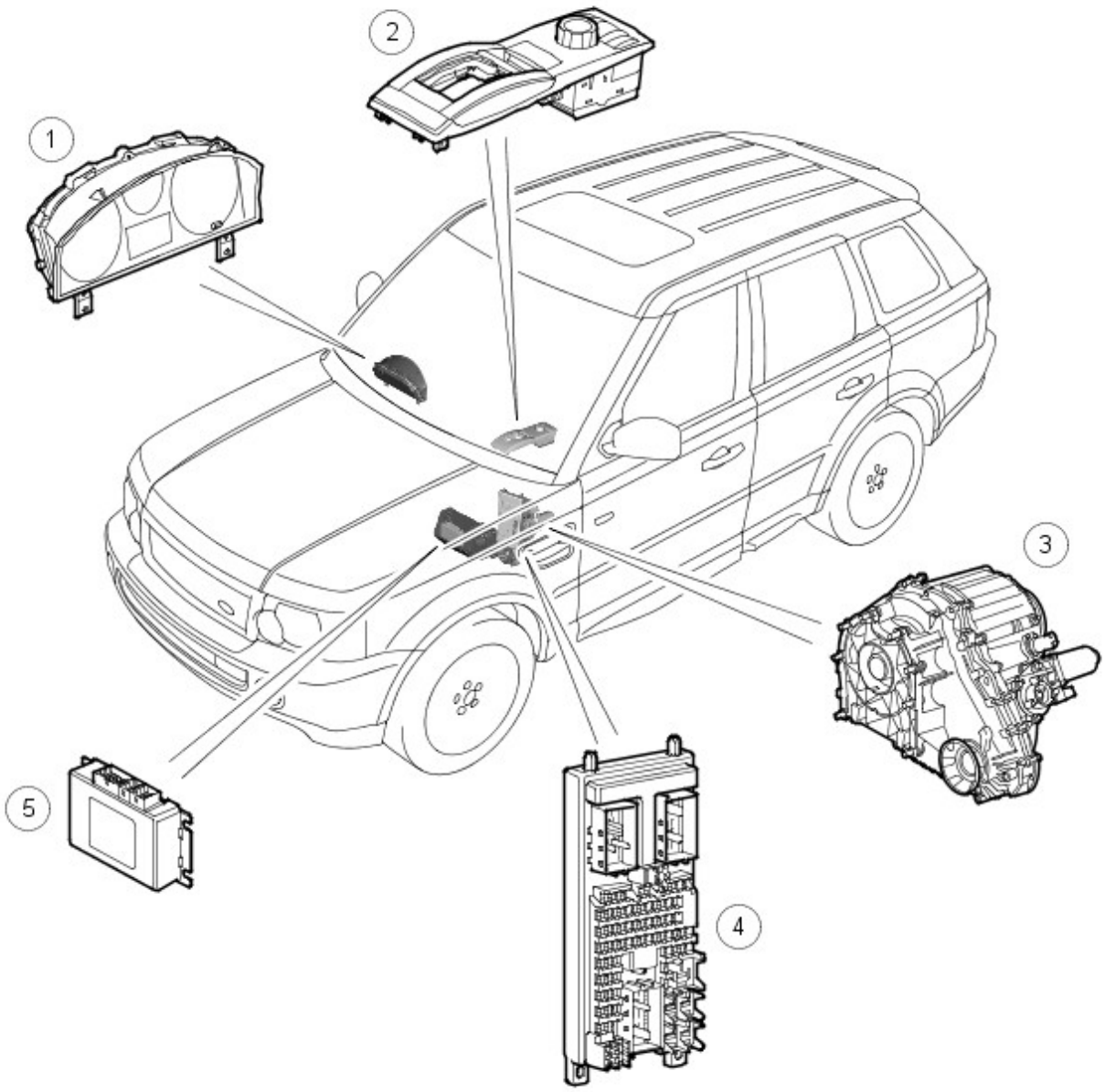
Description	Nm	lb-ft
* Transfer case shift motor Torx bolts	35	26
* Transfer case clutch control solenoid Torx bolts	5	4
* High/Low range sensor Torx bolts	5	4

Published: 11-May-2011

Four-Wheel Drive Systems - Four-Wheel Drive Systems

Description and Operation

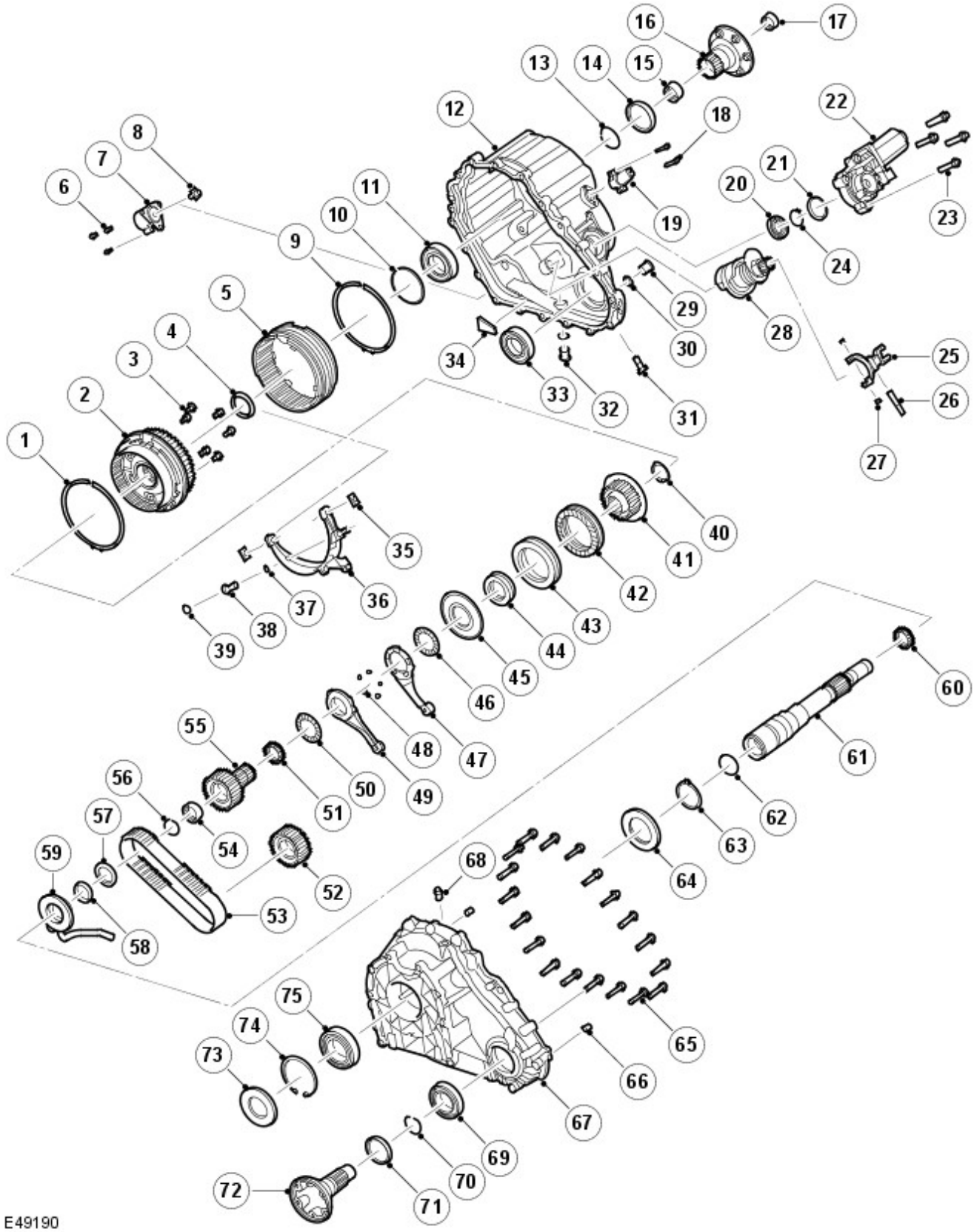
Transfer Box Component Location



E56593

Item	Part Number	Description
1	-	Instrument cluster
2	-	Range change selection switch
3	-	Transfer box
4	-	Central junction box (CJB)
5	-	Transfer box control module

Transfer Box Exploded View



Item	Part Number	Description
1	-	Synchronisation spring
2	-	Differential assembly
3	-	Bolt, 6 off
4	-	Spacer ring
5	-	Shifting sleeve
6	-	Bolt, 3 off
7	-	Solenoid
8	-	Shifting element
9	-	Synchronisation spring
10	-	Circlip

11	-	Ball bearing
12	-	Rear housing
13	-	Circlip
14	-	Seal ring
15	-	Needle roller bearing
16	-	Rear output flange
17	-	Needle roller bearing
18	-	Bolt, 2 off
19	-	Selector fork position sensor
20	-	Bearing
21	-	Circlip
22	-	Transfer box motor assembly
23	-	Bolt, 4 off
24	-	Circlip
25	-	Shifting fork
26	-	Fork pin
27	-	Sliding block
28	-	Actuator assembly
29	-	Fill plug
30	-	Seal ring
31	-	Ball retention
32	-	Drain plug
33	-	Seal ring
34	-	Particle collector magnet
35	-	Sliding blocks, 2 of
36	-	High/low shifting fork
37	-	O-ring
38	-	High/low fork pin
39	-	Circlip
40	-	Circlip
41	-	Clutch hub
42	-	Clutch friction plate, 10 off
43	-	Clutch steel plate, 10 off
44	-	Disc spring, 6 off
45	-	Clutch piston
46	-	Axial needle roller bearing
47	-	Transfer box motor lever assembly
48	-	Ball, 5 off
49	-	Transfer box motor lever assembly
50	-	Axial needle roller bearing
51	-	Needle roller bearing
52	-	Front output sprocket
53	-	Chain
54	-	Needle roller bearing
55	-	Sprocket
56	-	Circlip
57	-	Thrust washer
58	-	Spacer ring
59	-	Oil pump assembly
60	-	Needle roller bearing
61	-	Input shaft
62	-	O-ring
63	-	Circlip
64	-	Disc spring, 2 off
65	-	Bolt, 19 off
66	-	Dowel pin (2 off)
67	-	Front housing
68	-	Breather cartridge
69	-	Bearing
70	-	Circlip
71	-	Seal ring
72	-	Front output flange

73	-	Seal ring
74	-	Circlip
75	-	Bearing

GENERAL

The DD295 transfer box is full time, permanent four-wheel-drive unit, with 50/50 torque distribution to the front and rear driveshafts. Magna Steyr Powertrain manufactures the unit, which is identical for all engine derivatives and supports the following features:

- Permanent four-wheel-drive with a bevel gear centre differential, providing a 50:50 torque split
- Selectable high and low range for optimum on-road and off-road performance
- Two-speed, fully synchronized 'shift-on-the-move' system allows the driver to change the range without having to stop the vehicle
- Electronically controlled multi-plate clutch providing a centre differential lock and torque biasing function to give improved traction performance and vehicle dynamic stability.

A strategy, to electronically control the centre differential multi plate clutch assembly, has been developed to provide;

- a pre-loading function, increasing locking torque with increased driving torque
- a slip controller to increase locking torque under off-road conditions and decrease locking torque for optimum comfort, e.g. parking.

The unit is located under the vehicle and is mounted on the cross-member, behind the transmission.

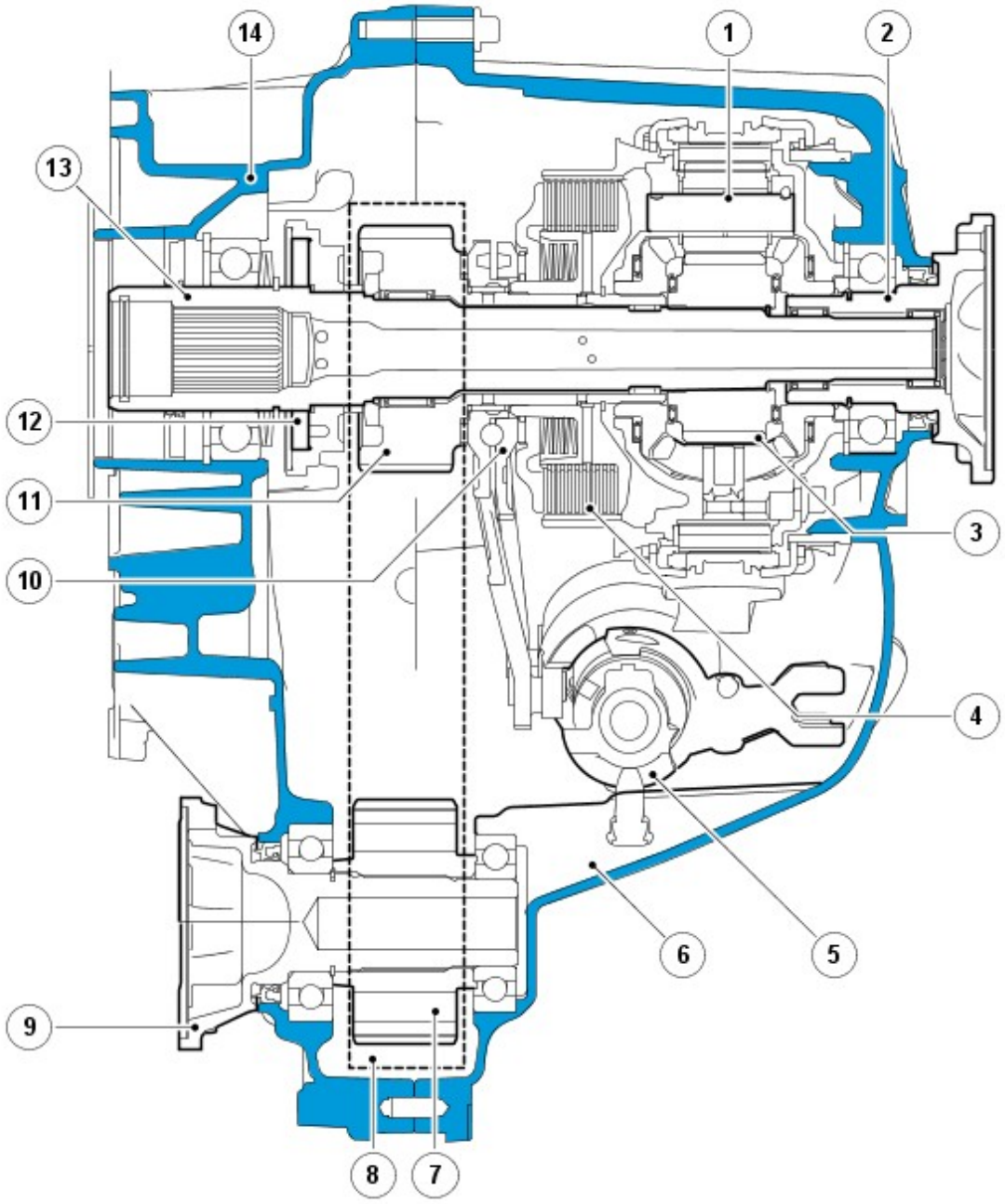
The transfer box receives a torque input from the transmission output shaft, which is passed through the unit to two outputs for the front and rear drive shafts.

The input torque is equally distributed via a bevel gear type differential. In order to provide an optimal torque distribution to each wheel in all driving conditions, the unit is equipped with an electronically controlled locking and torque-biasing device. This device detects wheel slip via various vehicle system inputs to the transfer box control module and locks the differential accordingly. The locking torque is applied through a multi-plate clutch assembly.

A planetary gear set, located in the differential assembly, allows the driver to select high or low range whilst driving, this is known as 'shift on the move'. When in low range, the planetary gear set provides a ratio of 2.93:1, which gives the vehicle an extremely low crawl speed for off road driving and trailer towing. High range is a direct drive from the transmission output shaft and provides a 1:1 ratio.

Both the centre differential locking and biasing and the 'shift on the move' features are actuated via a DC transfer box motor, which is controlled by the transfer box control module, via a Pulse Width Modulation (PWM) signal.

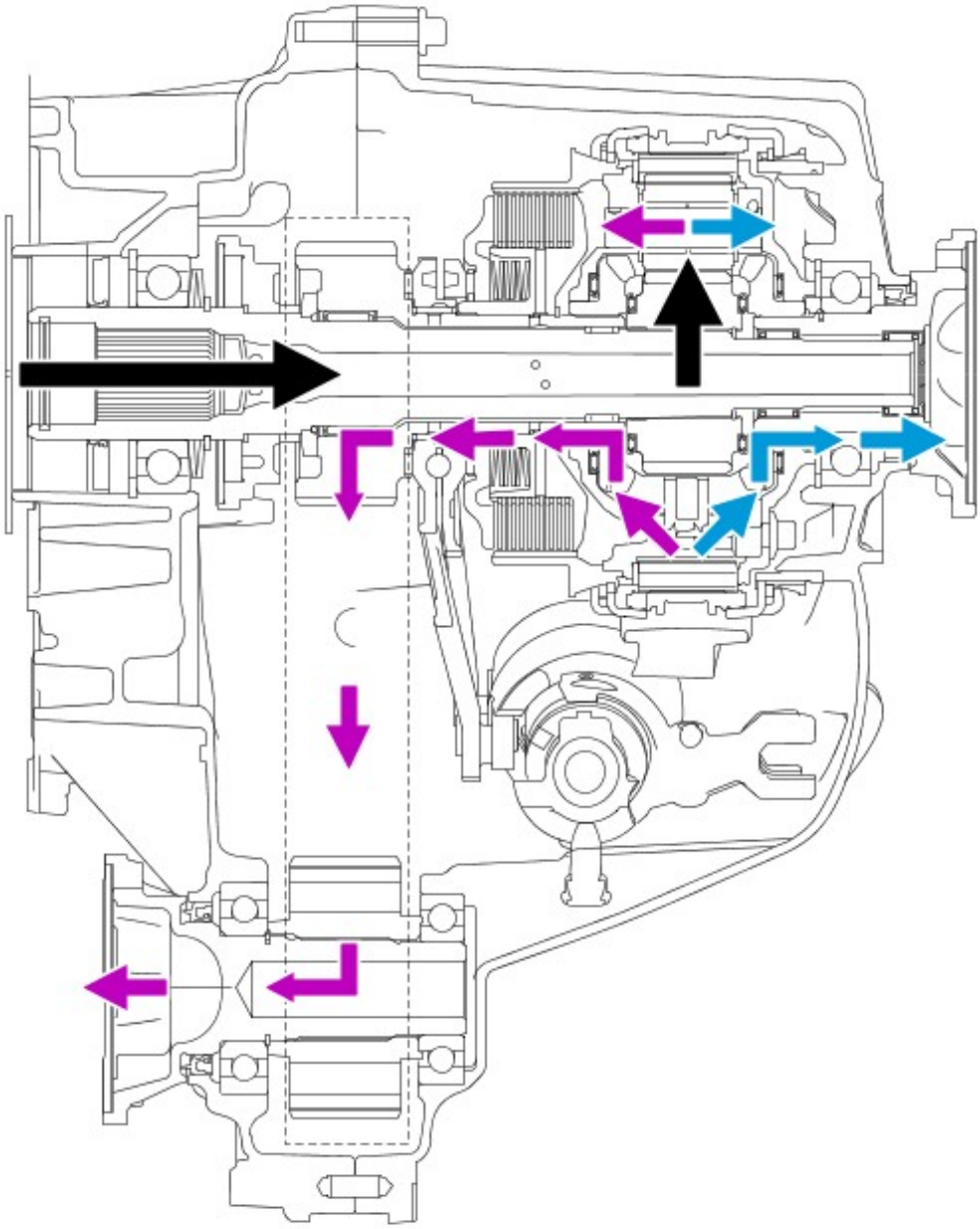
Transfer Box - Sectional View



E49191

Item	Part Number	Description
1	-	Planetary gear set
2	-	Rear output flange
3	-	Centre differential assembly
4	-	Multi-plate clutch
5	-	Transfer box motor module
6	-	Rear housing assembly
7	-	Front output sprocket
8	-	Chain drive
9	-	Front output flange
10	-	Transfer box motor levers
11	-	Sprocket
12	-	Oil pump assembly
13	-	Input shaft
14	-	Front housing assembly

Transfer Box Power Flow



E49192

Input torque from the transmission is transferred to the input shaft of the transfer box and then onto the planetary sun gear and planetary pinion gears. The planetary pinion gears are held in place by the planet pinion shafts, which are connected to the differential carrier, and drive the differential pinion gears. The torque is then distributed to both the front and rear carriers, which are connected to the outputs of the transfer box. The rear carrier is connected directly to the rear output flange; the front carrier is connected to the sprocket and therefore to the chain drive, which provides front output flange rotation.

TRANSFER BOX CASINGS

The front and rear casing assemblies are manufactured from cast aluminium.

Front Casing Assembly

The front casing assembly provides the location for the input shaft bearing, the front output flange bearing and the oil pump. It is also equipped with threaded holes to mount the chassis mounting bush, two lifting eyes and a breather cartridge for the transfer box breather pipe. The breather pipe allows an equalisation between atmospheric and internal transfer box pressure.

Rear Casing Assembly

The rear casing assembly provides the location for the rear output flange bearing, the transfer box motor and the oil fill and drain plug. Fins are cast into the rear casing assembly to improve heat dissipation. The unit number is also stamped into the rear housing.

OIL PUMP

An oil pump assembly is located in the front casing to provide lubrication for the bearings and rotary components through cross-drillings in the input shaft. A flat-sectioned coupling on the input shaft drives the rotor of the pump;

the stator is fixed to the front housing assembly. A tube is attached to the pump, which leads into a calm suction area at the bottom of the two casing assemblies. The collector magnet in the suction area of the pump collects any metallic debris.

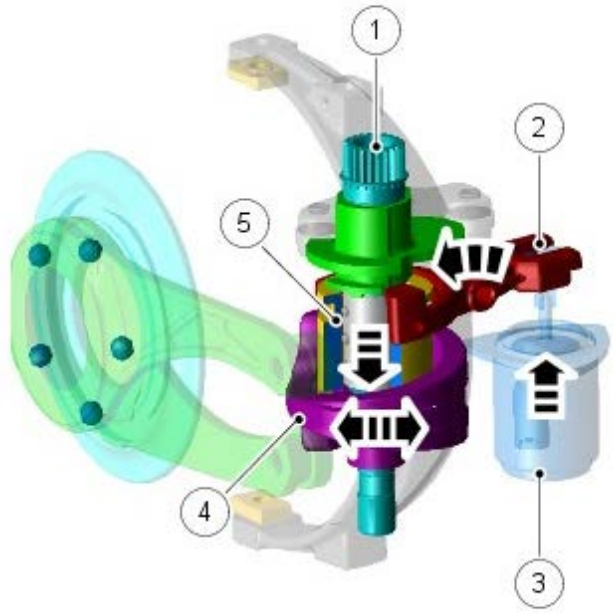
CHAIN DRIVE

The chain-drive transfers drive from the centre differential to the front output flange. A 3/8" pitch chain connects the sprocket on the transfer box input shaft with the sprocket on the front output flange. As both sprockets have the same number of teeth, the rotational speed of both sprockets is identical.

TRANSFER BOX MOTOR

One motor operates both the high/low range change and the differential locking and torque-biasing device (multi-plate clutch). The motor solenoid switches between the two functions, while the motor provides the rotational movement for both operations.

Transfer Box Motor Position For Clutch Control Mode



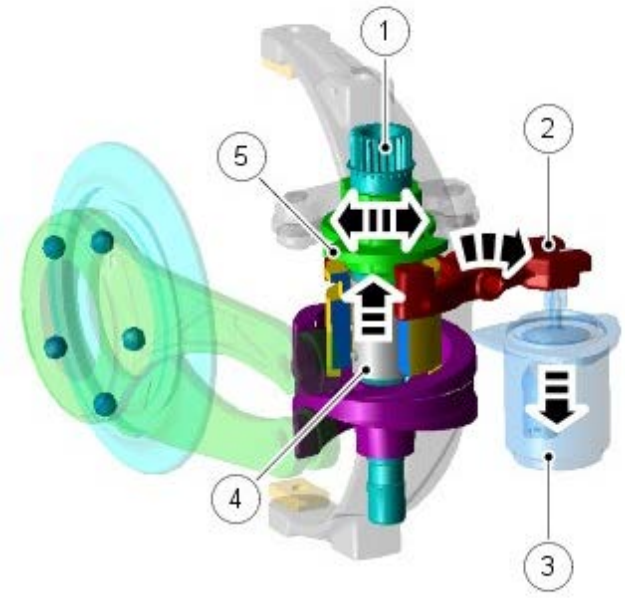
E49193

Item	Part Number	Description
1	-	Motor shaft
2	-	Solenoid shift fork
3	-	Solenoid
4	-	Clutch control disc
5	-	Shifting sleeve

To actuate the multi-plate clutch, the transfer box control module energizes the solenoid (3). The solenoid pin pivots the solenoid shift fork (2), which engages the shifting sleeve (5) into the dogteeth on the clutch control disc (4). The rotational movement of the motor shaft (1) is then linked to the clutch control disc via the shifting sleeve.

This is the normal operating mode of the transfer box. In this position, the range change function is disengaged and mechanically locked.

Transfer Box Motor Position For High/Low Range Mode



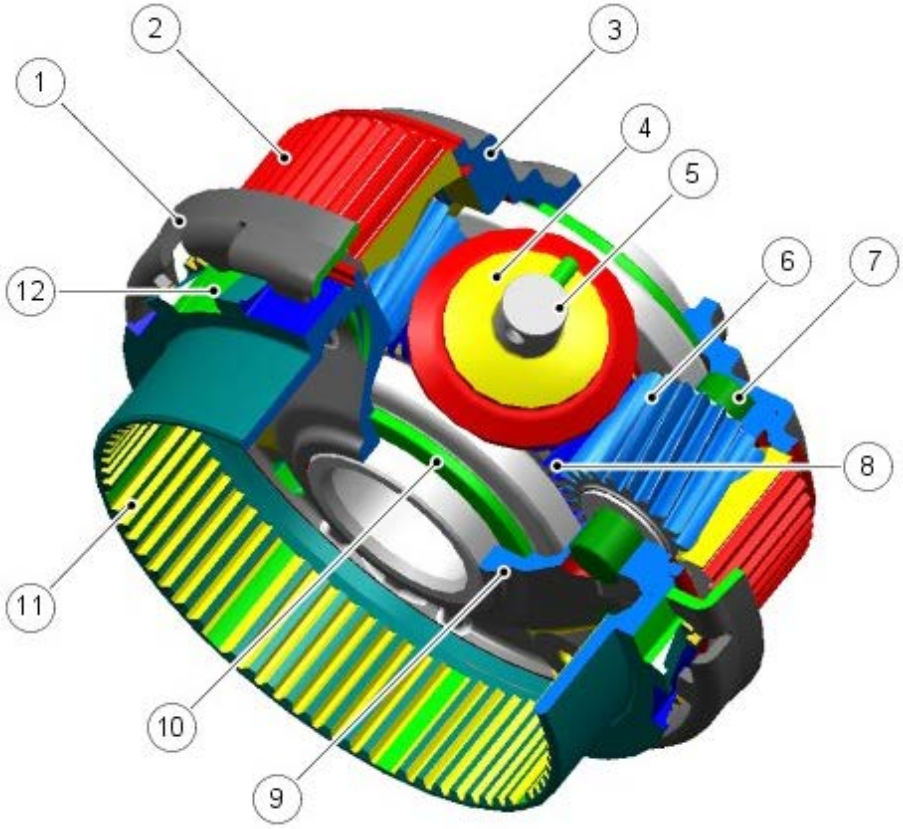
E49194

Item	Part Number	Description
1	-	Motor shaft
2	-	Solenoid shift fork
3	-	Solenoid
4	-	Shifting sleeve
5	-	Actuation cam

To actuate the high/low range change, the transfer box control module de-energizes the solenoid (3). A spring in the solenoid retracts the solenoid pin and rotates the solenoid shift fork (2). This engages the shifting sleeve (4) to the dogteeth on the high/low actuation cam (5). The rotational movement of the motor shaft (1) is then linked to the cam.

In this position, the multi-plate clutch is open, the differential cannot be locked and torque cannot be biased. Once the range change is complete the system returns to clutch control mode. In the event of an electrical failure, the motor will default to this position.

CENTER DIFFERENTIAL ASSEMBLY



E49195

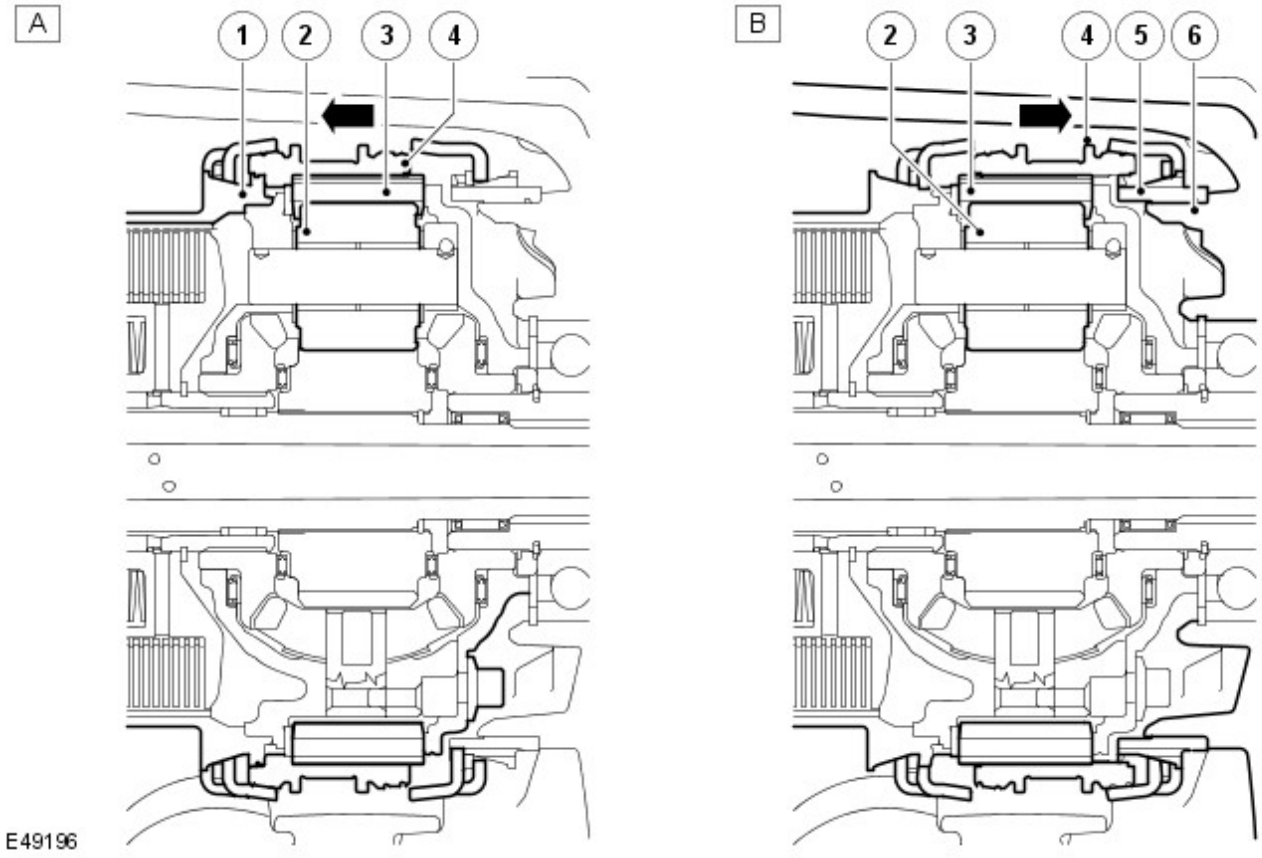
Item	Part Number	Description
1	-	Synchronisation cup and spring
2	-	Planetary ring gear
3	-	Differential carrier
4	-	Pinion gears
5	-	Pinion gear shafts
6	-	Planetary pinion gears
7	-	Planetary pinion gear shafts
8	-	Planetary sun gear
9	-	Differential cover
10	-	Differential side gears
11	-	Multi-plate clutch basket
12	-	Dogteeth

The center differential assembly is the primary feature of the transfer box. Torque is transmitted through the center differential carrier and distributed to the differential gears and the front and rear output flanges. The planetary gear set, for the high/low range change function, is also an integral part of the centre differential assembly.

The assembly comprises 3 differential pinion gears (4) and shafts (5), which are equally spaced within the centre differential carrier (3). The differential shafts have a rigid connection to the differential carrier. Located between the pinion gears are 3 planetary pinion gears (6) and shafts (7). The planetary sun gear (8) and two differential side gears (10) are located in the centre line of the carrier.

The planetary ring gear (2) is supported in both directions by the differential casing and the differential cover (9). The planetary ring gear is connected to a shifting sleeve, which is engaged in either high or low range.

The multi-plate clutch basket (11), which is welded to the differential casing, supports the friction plates, the dogteeth (12) for high range engagement and the synchronisation cup and spring (1) for the 'shift-on-the-move' function.

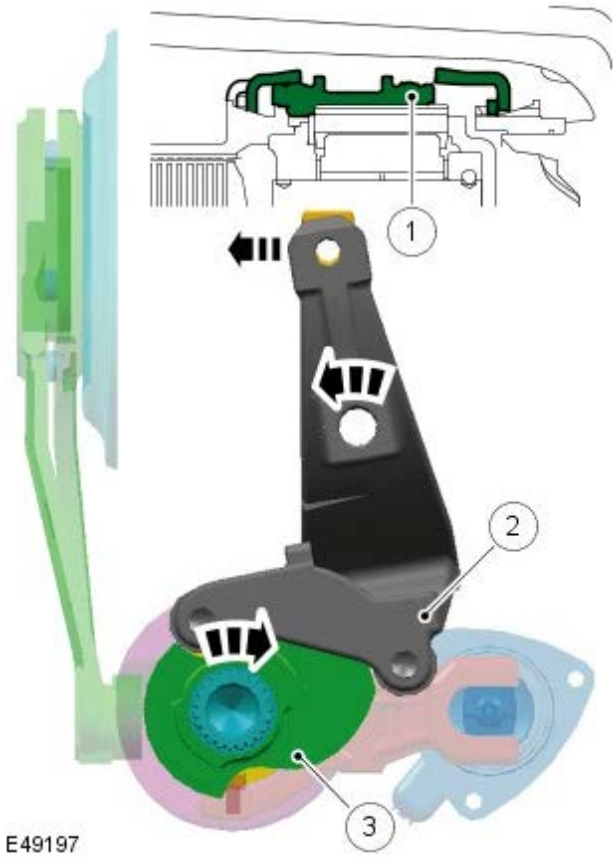


Item	Part Number	Description
A	-	High range position
B	-	Low range position
1	-	Dogteeth
2	-	Planetary pinion gears
3	-	Planetary ring gear
4	-	Shifting sleeve
5	-	Low range dogteeth
6	-	Rear carrier assembly

When high range is engaged, the shifting sleeve (4) connects to the differential carrier via dogteeth (1). The planetary ring gear (3), via the shifting sleeve, and the planetary pinion gears (5), via the planetary shafts, which are also attached to the differential carrier. The planetary gear set rotates as one unit and therefore turns the differential side gear with a 1:1 ratio.

In low range the motor moves the shifting sleeve (4) in the direction of the low range dogteeth (5). The low range dogteeth, with the synchronisation cup and spring, are fixed to the rear carrier assembly (6). When the shifting sleeve is engaged with the low range dogteeth, the planetary ring gear (3), via the shifting sleeve, is stationary and the planetary pinion gears (2), via the planetary bolts, turn the differential side gears with 2.93: 1 ratio.

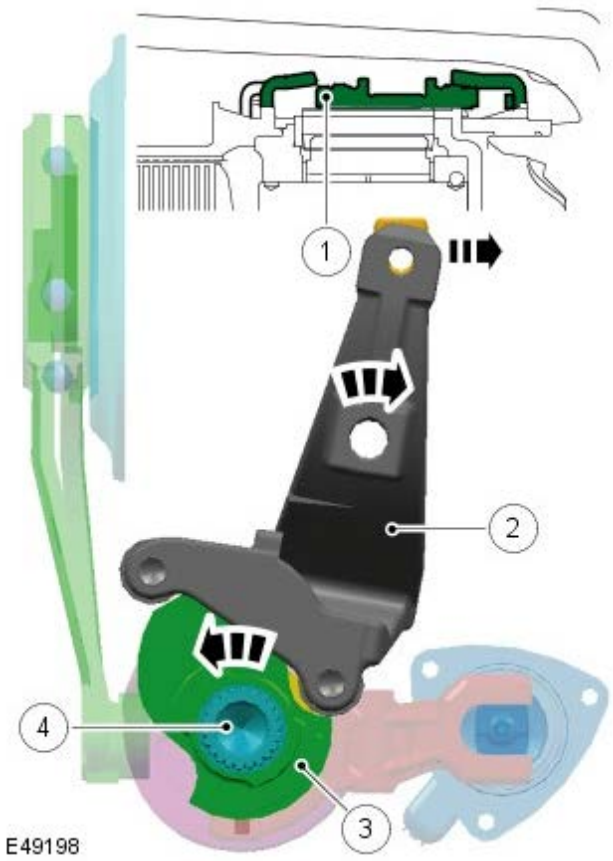
High range actuation sequence



Item	Part Number	Description
1	-	Shifting sleeve
2	-	High/low shifting fork
3	-	Shifting cam

The rotational movement of the motor shaft turns the shifting cam (3) to high range position. The shifting cam then moves the shifting sleeve (1), via the high/low shifting fork (2), into the high range position. After the synchronisation sequence, the planetary ring gear is connected to the high range dogteeth, via the shifting sleeve, on the differential carrier. In this position, the input speed equals the output speed, which equates to a high range ratio of 1:1.

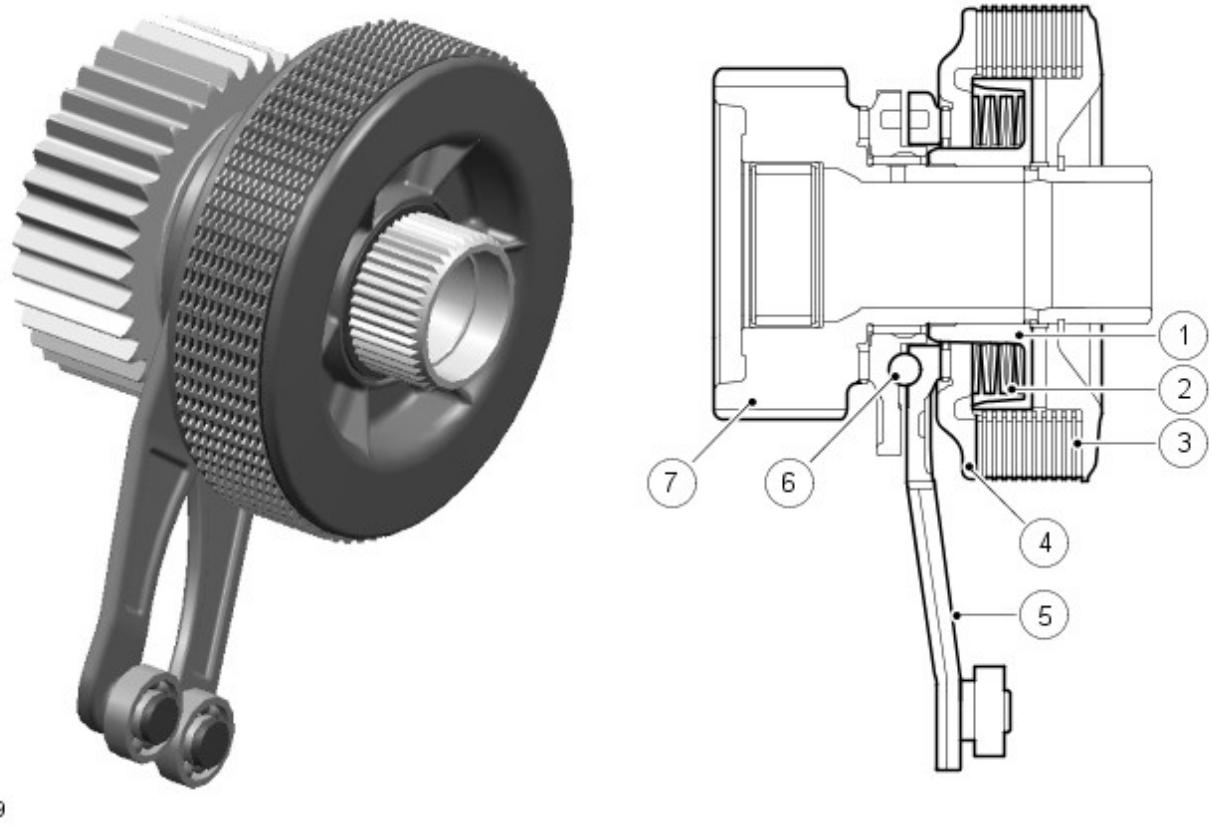
Low range actuation sequence



Item	Part Number	Description
1	-	Shifting sleeve
2	-	High/low shifting fork
3	-	Shifting cam
4	-	Motor shaft

The rotational movement of the motor shaft (4) turns the shifting cam (3) into low range position. The shifting cam then moves the shifting sleeve (1) of the centre differential assembly via the high/low shifting fork (2) into low range position. After the synchronisation sequence, the planetary ring gear is connected to the low range dogteeth, via the shifting sleeve, on the rear carrier assembly. The output speed is then reduced to a ratio of 2.93:1.

MULTI-PLATE CLUTCH ASSEMBLY



E49199

Item	Part Number	Description
1	-	Clutch hub
2	-	Cup springs
3	-	Clutch plates
4	-	Clutch piston
5	-	Motor levers
6	-	Ball ramp mechanism
7	-	Sprocket

The multi-plate clutch assembly for both centre and rear differentials act in a similar way. The aim of the multi-plate clutch assembly is to prevent excessive differential slip and therefore maximise the traction performance of the vehicle. This is fundamentally different from the 'braked' traction control, which can only counteract differential slip when it occurs.

A certain amount of differential slip is required to allow the vehicle to turn corners and to remain stable under control of the Anti-lock Braking System (ABS). The transfer box control module monitors the driver's demands through primary vehicle controls and automatically sets the slip torque at the differentials. The system is completely automatic and does not require any special driver input.

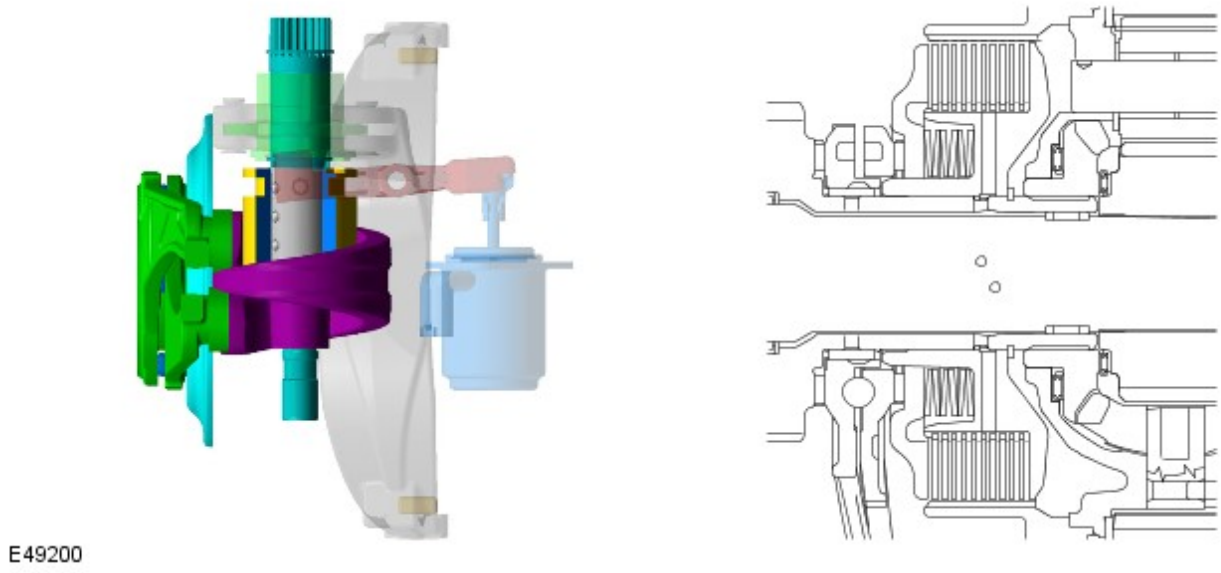
The multi-plate clutch assembly actively controls the torque flow through the centre differential and optimises the torque distribution in the driveline. The clutch assembly biases the torque from the transmission to the axle and wheels with the higher grip and prevents the wheels with the lower grip from spinning.

The multi-plate clutch assembly comprises the sprocket (7), which is connected to the front differential side gear, the motor levers (5) with the ball ramp mechanism (6), the clutch hub (1) as support for the clutch plates (3), the clutch piston (4) to generate friction between the clutch plates, and a pack of cup springs (2) to return the clutch piston into its original position.

One set of friction plates are connected to the clutch hub; the other set of friction plates are connected to the multi-plate clutch basket, which is welded to the centre differential housing.

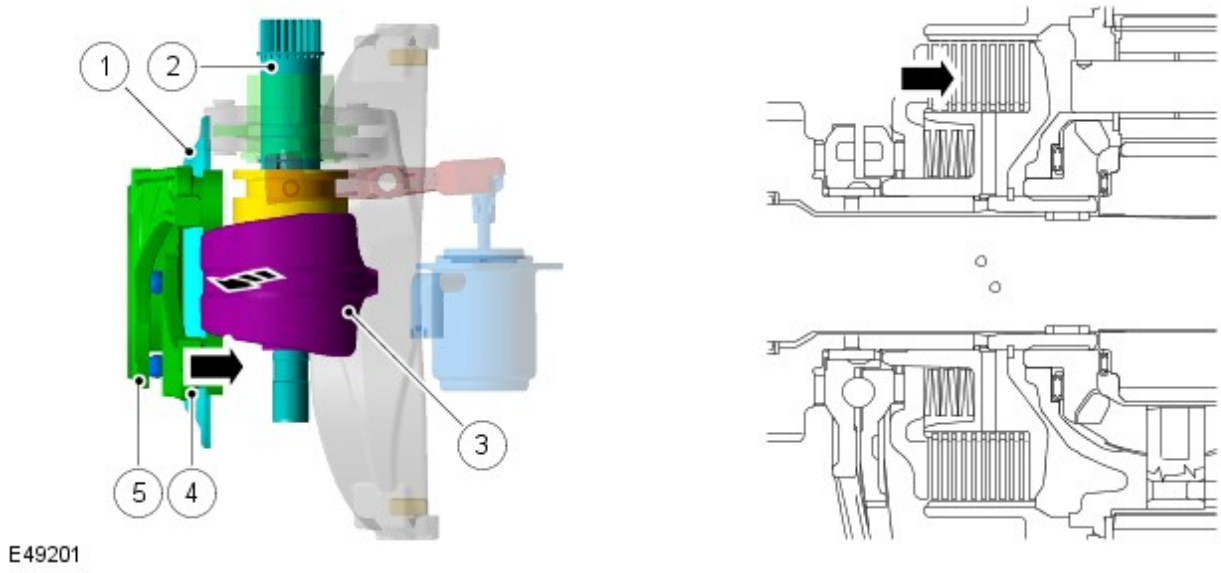
Multi-plate Clutch Actuation

Transfer box motor levers in initial position, multi-plate clutch open condition



E49200

Transfer box motor in end position, multi-plate clutch closed condition



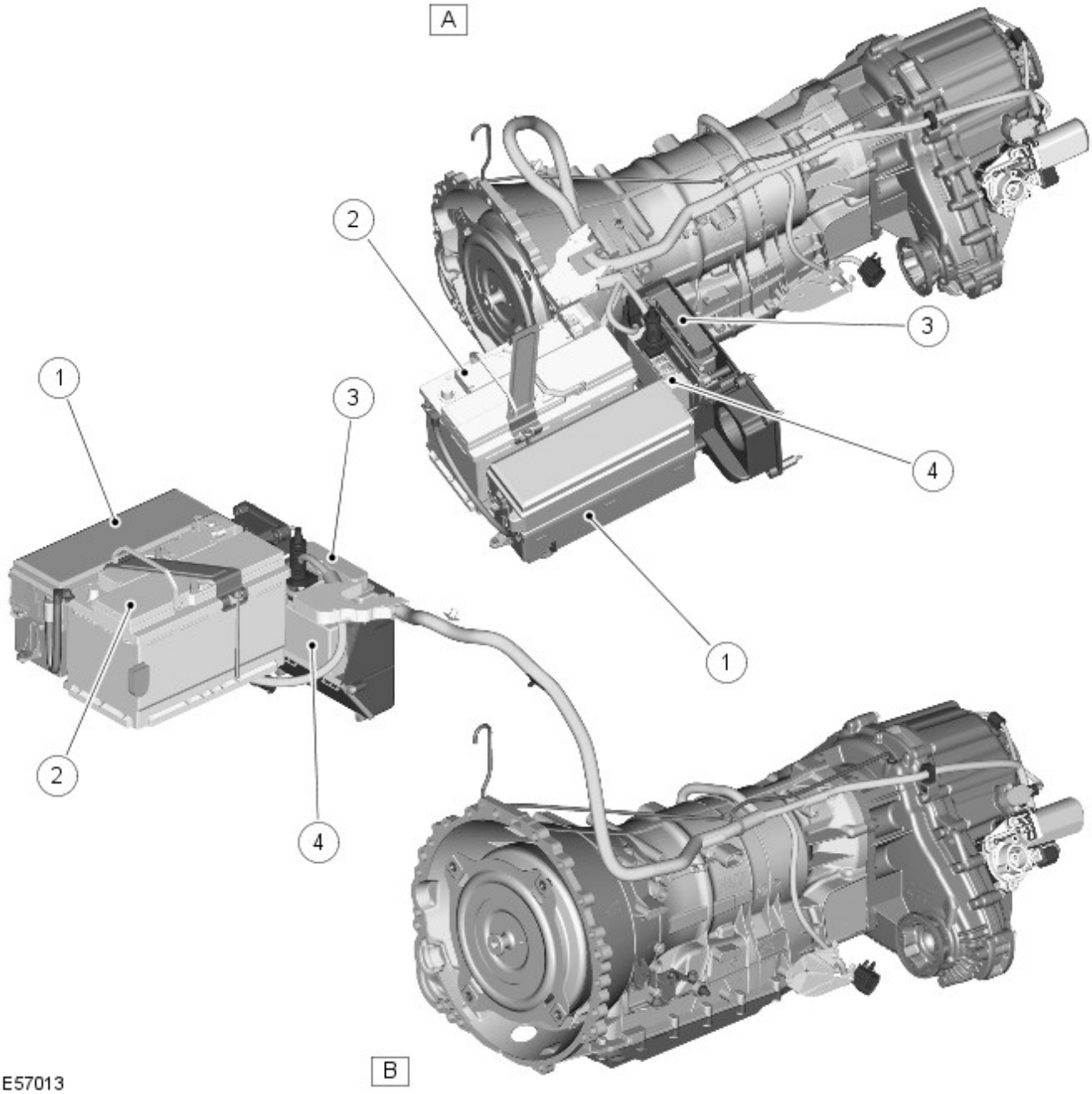
E49201

Item	Part Number	Description
1	-	Clutch piston
2	-	Motor shaft
3	-	Clutch control disc
4	-	Motor levers
5	-	Ramp mechanism balls

By turning the clutch control disc (3), via the motor shaft (2), the motor levers (4) are rotated relative to each other. This relative movement acts on 5 balls (5) in a ramp mechanism between the two levers and give a defined axial movement. The movement forces the clutch piston (1) to induce friction between the plates supported by the clutch hub and the plates supported by the clutch basket on the differential carrier. This frictional force inhibits the differential rotation; the differential carrier and front differential side gear are locked together.

TRANSFER BOX CONTROL MODULE

The transfer box control module controls the high/low 'shift-on-the-move' actuation and the multi-plate clutch actuation. The control module is located in the E-box, next to the Engine Control Module (ECM), behind the battery in the engine compartment. The position of the control module changes with LH and RH drive vehicles.



Item	Part Number	Description
A	-	RH drive
B	-	LH drive
1	-	Battery Junction Box (BJB)
2	-	Battery
3	-	Engine Control Module (ECM)
4	-	Transfer box control module

The control module is connected to the Controller Area Network (CAN) bus and controls transfer box operation using CAN messages from other control modules on the network.

The control module memorises the position of the transfer box motor when the ignition is switched off.

The transfer box control module uses the same actuator to control both range change function and application of centre differential locking torque. The module uses position feed back from the actuator to provide smooth range changing capability and graduated application of locking torque appropriate for the current driving conditions. Range change can be carried out while moving providing the transmission is in neutral and the vehicle is below the speed necessary for the requested range change.

The control module uses three connectors for all inputs and outputs. It receives a permanent power supply via a 30A fusible link located in the Battery Junction Box (BJB), and an ignition supply via fuse 24 in the Central Junction Box (CJB).

The control module uses a series of programmed shift maps to control the synchronisation speed and ensure that a maximum shift time of approximately one second is achieved.

If the control module is replaced, T4 must be connected to the vehicle and the transfer box control module self-calibration procedure must be performed. This procedure must also be performed if the transfer box motor assembly

is replaced.

Default/Limp-home Strategy

If a fault occurs with the transfer box, the transfer box control module or one of the required input signals i.e. road speed signal, the control module records an error code and will respond appropriately to provide the highest level of system capability under the specific fault conditions. The following fault states are possible:

Fault state	System response	Driver warning
No reduction in capability	Diagnostic Trouble Code (DTC) will be recorded but no effect on performance	None
Clutch control not possible. Temporary over temperature condition	The tractive capability of the vehicle, off road, is reduced	Driveline over temperature warning lamp or "TRANSMISSION OVERHEAT SLOW DOWN" on message centre
Clutch control not possible. Permanent fault	The tractive capability of the vehicle, off road, is reduced	Driveline fault warning lamp or "TRANSMISSION FAULT TRACTION REDUCED" on message centre
Range change not possible	The system inhibits the driver from making a range change	Driveline fault warning lamp or "TRANSMISSION RANGE CHANGE INOPERATIVE" on message centre
Stuck in Transfer box neutral	The transfer box is stuck between high and low range resulting in no drive to wheels	Flash low range indicator plus "PARK LOCK FAILURE APPLY HAND/PARKBRAKE" message on message centre

If a driveline over temperature condition has occurred, after the driveline has been allowed to cool, clutch control will be re-enabled and the warnings will disappear. There is no need to seek service assistance following an over temperature event.

If clutch control or range change is not possible due to a permanent fault the driver must seek service assistance at the earliest opportunity.

If the system suffers a fault, which causes the transfer box to fail in neutral, the control module is designed to continue attempting to engage the requested range or return to its original range for a fixed number of attempts. If this has not been successful and the low range lamp is still flashing the driver should bring the vehicle to a halt and attempt the range change again while stationary. If this does not work after a number of attempts, key off for 30 seconds, restart engine and request range change again while stationary. The driver must seek service assistance at the earliest opportunity.

Transfer Box Control Module Pin Out Details

Connector C1319

Pin No.	Description	Input/output
1	Not used	-
2	Not used	-
3	CAN bus low	Data (input and output)
4	Range change selection switch - High	Input
5	Range change selection switch - Low	Input
6	CAN bus high	Data (input and output)
7	Key interlock solenoid	Output
8	LED-high	Output
9	LED-low	Output

Connector C1854

Pin No.	Description	Input/output
1	CAN bus low	Data (input and output)
2	Not used	-
3	Ignition power supply	Input
4	CAN bus high	Data (input and output)
5	Ground	-
6	Permanent battery power supply	Input

Connector C1855

Pin No.	Description	Input/output
1	Hall sensor signal-A	Input
2	Ground	-
3	Hall sensors supply	Output
4	Not used	-
5	Temperature sensor	Input
6	Hall sensor signal-B	Input
7	Selector position ground	-
8	5V position sensor supply	Output
9	Selector mode solenoid ground	-
10	Selector position sensor signal	Input
11	Not Used	-
12	Selector mode solenoid power supply	Output
13	Not Used	-
14	Not Used	-

15	Motor supply/ground	Input/output
16	Not Used	-
17	Not Used	-
18	Motor supply/ground	Input/output

TRANSFER BOX CONTROL MODULE INPUTS

The transfer box control module receives the following inputs:

- Range change selection switch
- High/low position sensor
- Transfer box actuator motor temperature
- Transfer box actuator motor position sensor
- CAN bus messages.

CAN Bus Messages

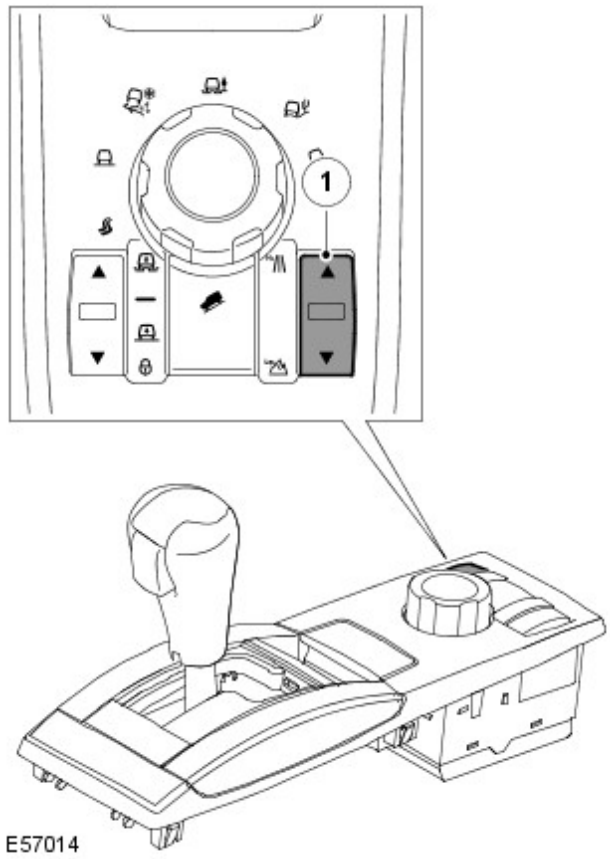
The CAN bus is a high speed broadcast network connected between various vehicle control modules. The CAN network carries an extensive list of messages between the different control modules enabling more sophisticated control with reduced complexity. Data on the network is packaged for efficient communication and prioritised according the urgency and importance of the messages. The bus comprises two wires, which are twisted together to minimise electromagnetic interference (noise) produced by the CAN messages.
For additional information, refer to: Communications Network (418-00, Description and Operation).

The transfer box control module is connected on the CAN bus and controls transfer box operation using CAN messages from other control units on the network. Wheel speed, vehicle acceleration, engine torque and speed, gear information, from the transmission, temperature information, car configuration, axle ratios and Terrain Response mode inputs, are some of the main signals received by the control module.

In the event of a CAN bus failure the following symptoms may be observed:

- Shift from high to low or low to high inoperative
- Instrument cluster low range warning lamp inoperative
- Warning messages or lamps displayed in instrument cluster.

Range Change Selection Switch



Item	Part Number	Description
1	-	Range change selection switch

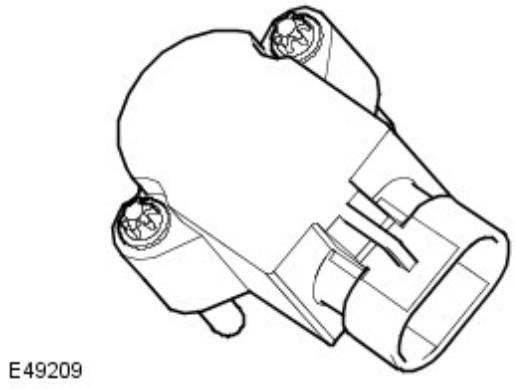
The range change selection switch is located behind the main transmission selection lever, in the centre console. The switch is a 3-position momentary action centre sprung device. The driver pushes the lever forward to select high range and back to select low range.

The switch comprises a housing, which provides the location for a sliding contact. When the switch is moved to the high or low position, it completes a momentary connection to 12V with one of two micro-switches located at each end of the range change selection switch. These micro-switches correspond to the high or low range positions.

The transfer box control module receives this momentary signal and selects the requested range.

In this position, a spring will move the selector lever to the centre position when released.

High/Low Position Sensor



The high/low position sensor converts the pivotal movement of the high/low fork into a PWM signal on the input. The PWM signal of the position sensor differs between high range and low range. The control module checks this signal and informs the driver, via the instrument cluster and the range change selection switch LED's, if a range change is in progress or has been completed.

The high/low position sensor is connected to the transfer box control module via a three-pin connector.

TRANSFER BOX CONTROL MODULE OUTPUTS

The transfer box control module sends the following outputs:

- CAN bus messages
- Key interlock solenoid
- High/low range change LED
- Transfer box motor
- Solenoid.

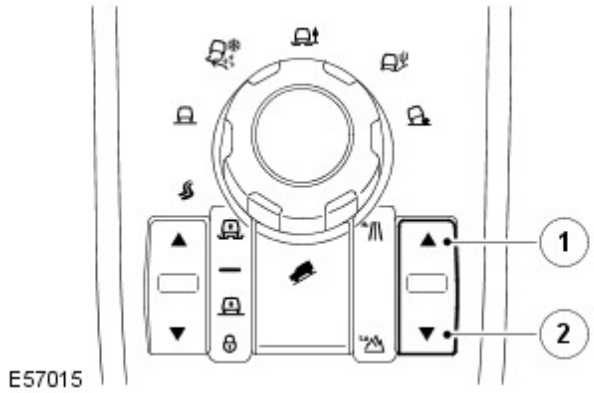
CAN Bus Messages

The control module also sends messages via the CAN bus to tell other control modules on the network, the status of the transfer box. The high/low status, clutch torque and default mode status are some of the main signals sent out by the transfer box control module.

Key Interlock Solenoid

The transfer box control module is able to send a signal to the key interlock solenoid. This signal locks the key in the ignition barrel to prevent it from being removed if the transmission is not in the 'Park' position.

High/Low Range Change LED



Item	Part Number	Description
1	-	High range LED
2	-	Low range LED

The control module is responsible for illuminating the 2 'high/low' range change LED's adjacent to the range change lever. One LED indicates high range and the other indicates low range.

One LED will be on continuously when in the corresponding range.

When changing range, the current range LED will remain on until the new range status has been achieved.

The new range LED will start flashing only when the range change has commenced (i.e. speed and neutral conditions have been met). The new range LED will be illuminated continuously at the same instant that the current range (now

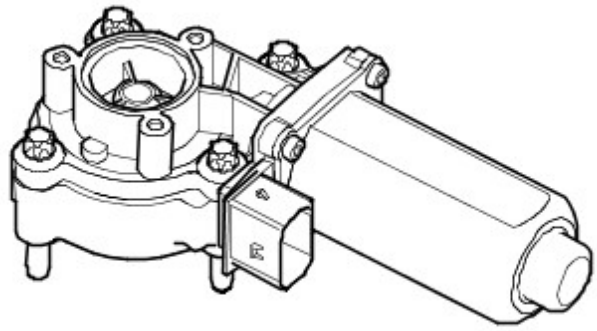
the old range) LED turns off.

The flash rate is 2 Hz with a 50% duty cycle.

The LED's have 2 levels of intensity, high when the vehicle lights are switch off and low when they are switched on.

If both lights are flashing at 0.5 Hz, this would indicate a transfer box fault or that the transfer box is in undefined range and may require calibration.

Transfer Box Motor



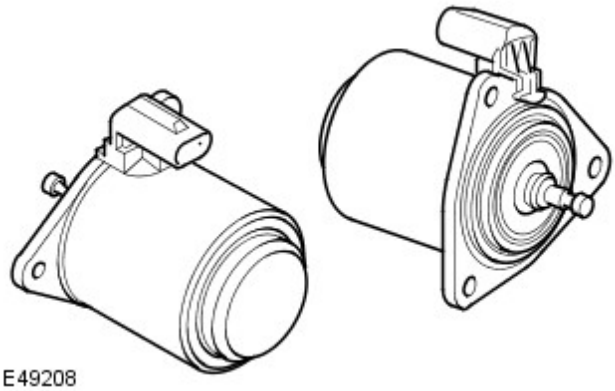
E49207

The transfer box motor provides the necessary movement to perform the high/low range change and the multi-plate clutch actuation. The motor is located on the rear casing assembly and secured with four bolts.

The motor is a PWM controlled, DC motor with an integrated worm gear reduction drive. It is connected to the transfer box control module with an eight-pin connector; the power supply of the motor is maintained through two large diameter cables on the motor connector. An internal position sensor checks the rotational movement of the motor.

There is a temperature sensor located within the motor housing.

Solenoid



E49208

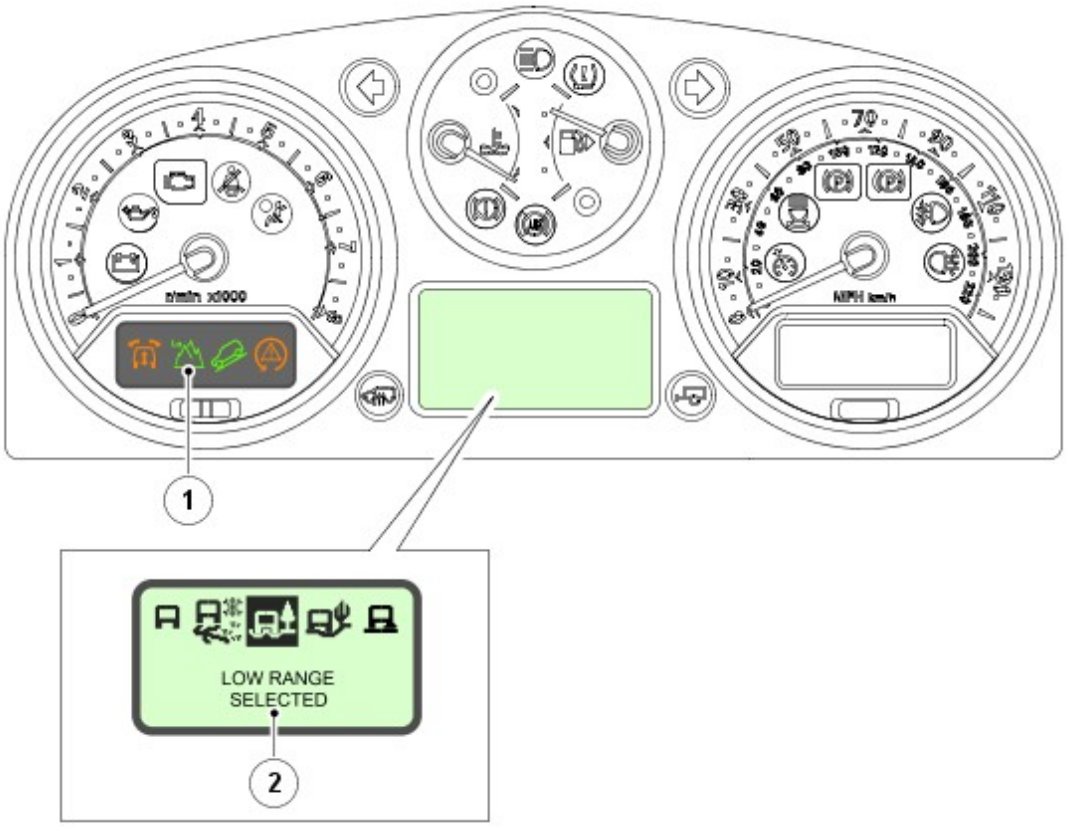
The solenoid switches the power flow on the actuation system between high/low range change mode and clutch control mode. When the solenoid is energized, the solenoid pin deploys and activates the clutch control mode. When the solenoid is de-energized, the internal spring rejects the solenoid pin and activates the high/low range change mode.

NOTE: In order to replace the solenoid in service, the solenoid must be energized using T4.

The solenoid is connected to the transfer box control module with a two-pin connector.

Status Indication

Instrument Cluster



Item	Part Number	Description
1	-	Low-range status indicator
2	-	Message centre text

The low range status indicator will take the form of a mountain symbol and has the following logic:

- Lamp on = low range
- Lamp off = high range
- Lamp flashing = range change in progress/range undefined/range fault.

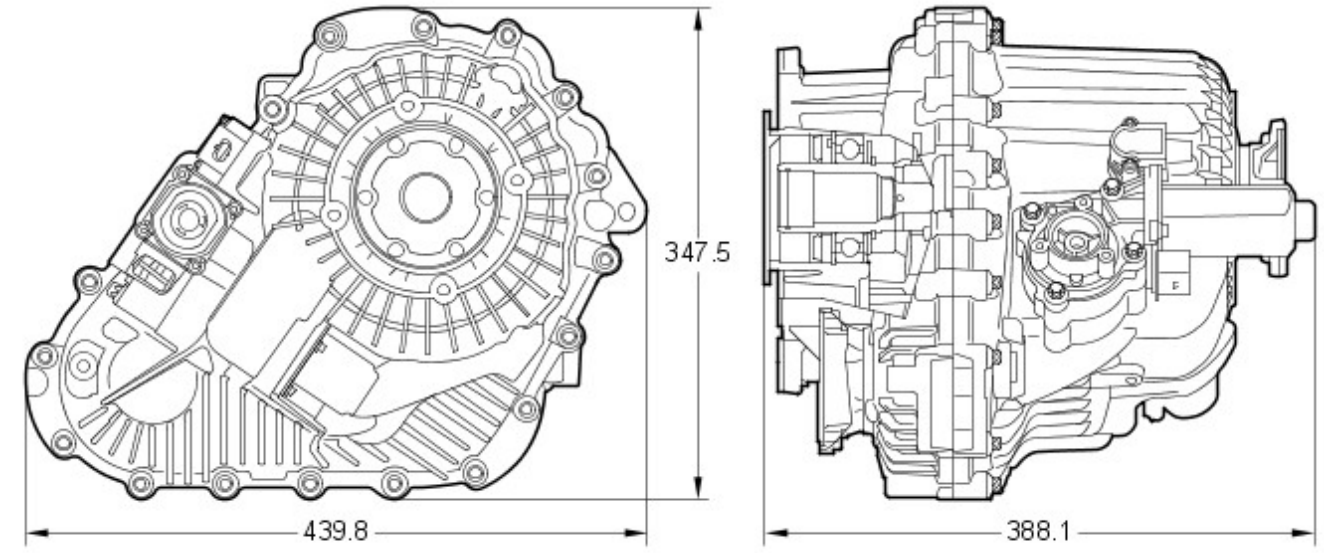
There will also be a message displayed in the message centre, which will inform the driver of any faults with the transfer box.

The following table shows the messages that can be displayed in the message centre relating to the transfer box:

Message	Description	Chime
'LOW RANGE ENGAGED'	Transfer case has engaged low range after a range change request	Single
'HIGH RANGE ENGAGED'	Transfer case has engaged high range after a range change request	Single
'SPEED TOO HIGH FOR RANGE CHANGE'	Range change request when vehicle speed too high	Single
'SELECT NEUTRAL FOR RANGE CHANGE'	Range change request when lever not in neutral	Single
'PARK LOCK FAILURE APPLY HANDBRAKE' (PARKBRAKE US/CAN)	This alerts the driver that the transmission park lock function is inoperative due to transfer box out of high or low range. Transfer box control module has stopped transmitting on the CAN bus during a range change or while in neutral mode and as a result the transmission park lock function is inoperative	One per second for three seconds
'TRANSMISSION RANGE CHANGE INOPERATIVE'	Transfer box has detected a fault inhibiting a new range change. Control unit has shut down due to thermal overload	Single
'TRANSMISSION OVER HEAT SLOW DOWN'	Centre differential temperature is approaching the over heated threshold	Single
'TRANSMISSION FAULT – TRACTION REDUCED'	Centre differential has failed - operating as an open differential	Single
'TRANSMISSION FAULT – TRACTION REDUCED'	Transfer box control module has stopped transmitting on the CAN bus and defaults to open centre differential	Single

SERVICE

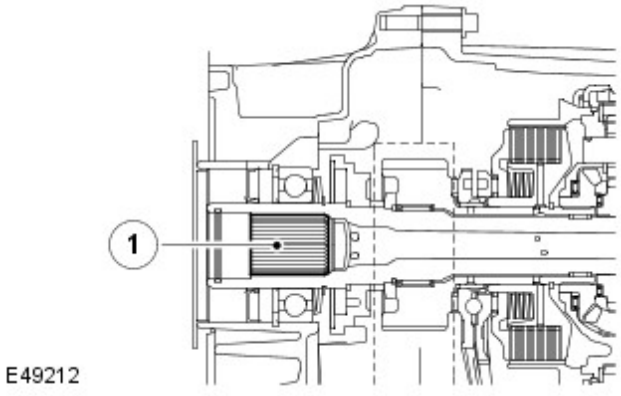
Basic Dimensions (Millimetres)



The transfer box weighs 40.30 kg without oil and 41.55 kg with oil. The unit requires 1500 ml ± 2% of oil from empty (dry).

The oil used in the transfer box is Shell TF 0753, which has been specially developed by Magna Steyr and Shell. The oil contains unique additives, which enhance the transfer box operation. No other oil must be used in the transfer box.

There is a unique type of grease, Weicon anti-seize montagepaste grau TL 7391, that needs to be applied to the units input shaft spline when installing or reinstalling the transfer box.



Item	Part Number	Description
1	-	Input shaft spline

DIAGNOSTICS

The transfer box control module can store fault codes, which can be retrieved using T4 or a diagnostic tool using KW2000* protocol.

The information is communicated via a diagnostic socket.

The diagnostic socket allows the exchange of information between the various control modules on the bus systems and T4 or another suitable diagnostic tool. The information is communicated to the socket via the CAN bus. This allows the retrieval of diagnostic information and programming of certain functions using T4 or another suitable diagnostic tool.

The transfer box control module uses Diagnostic Trouble Codes (DTC), which relate to transfer box electrical faults.

Clutch and Range Change Mechanism Calibration

In order for the range change mechanism to function correctly, the transfer box control module must be calibrated to the mechanical dimensions of the transfer box that it is connected to.

This procedure will need to be followed if one of the following occurs:

- The vehicle is first assembled
- The switch is changed
- The transfer box control module is changed
- The transfer box or range position sensor is changed
- Vehicle or transfer box control module fault has caused the transfer box to revert to an undefined range.

Calibration can be carried out using the service tool or by following this procedure:

1. Switch ignition to position II without the engine running
2. Select neutral
3. Depress the throttle pedal fully
4. Press and hold the range change switch for 5 or more seconds to allow calibration to start
5. When the calibration is heard to start, the switch and throttle pedal can be released
6. Upon adopting high range, start the engine and wait 30 seconds while the first calibration of the clutch in high range is done. While this calibration process is in progress, no shifting is accepted
7. Switch ignition off and wait 15 seconds
8. Start engine
9. Perform a range change to low range. Wait 30 seconds while the first calibration of the clutch in low range is done. While this calibration process is in progress, no shifting is accepted
10. Switch ignition off and wait 15 seconds
11. Range and clutch calibration is now complete.

SYSTEM OPERATION

The selection of high/low range is achieved by using a switch located behind the main transmission selection lever in the centre console. A range change can only be performed when the transmission selector lever is in neutral (position 'N'). The accelerator pedal must not be depressed when a range change is in progress.

If high or low range is requested and the transmission selector lever is in a position other than 'N' or 'P', the instrument cluster message center will display 'SELECT NEUTRAL'.

NOTE: If the transmission selector lever is in the 'P' position, the range change will not take place and the 'SELECT NEUTRAL' message will not be displayed in the message centre.

When low range is selected, the low range 'mountain' symbol will flash when the range change is taking place and then remain illuminated when the range change is complete. The instrument cluster message centre will display 'LOW RANGE' for approximately 3 seconds followed by a chime from the instrument cluster to confirm that the range change has been completed. Only 'D' and 'Manual mode' are available, the 'Sport mode' selection is not available.

When high range is selected, the low range 'mountain' symbol will flash when the range change is taking place and then extinguish when the range change is complete. The instrument cluster message centre will display 'HIGH RANGE' for approximately 3 seconds followed by a chime from the instrument cluster to confirm that the range change has been completed.

The design of the transfer box allows range changes when the vehicle is moving, within set limitations as follows:

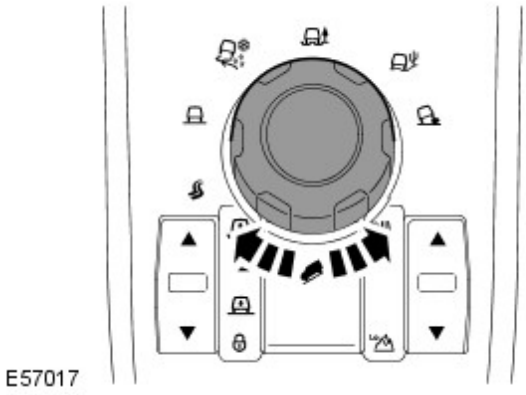
- High to Low – at speeds not exceeding 25 mph (40 km/h)
- Low to High – at speeds not exceeding 37 mph (60 km/h).

If the vehicle speed is higher than the parameters given, the instrument cluster message centre will display 'SLOW DOWN'. When the correct speed range is reached, the message will be deleted and the range change will commence.

The transfer box control module interprets a road speed of less than 2 mph (3 km/h) as a static shift (vehicle not moving). In this instance, the driver must use the shift lock procedure of operating the brake pedal to allow the selector lever to be moved from 'N' to 'D' after the range change has been performed.

High range should be used for all normal road driving and also for off-road driving across dry, level terrain. Low range should only be required where low speed manoeuvring is necessary, such as reversing a trailer, negotiating steep slippery surfaces or boulder-strewn terrain. Low range should also be used for extreme off-road conditions where progress in high range cannot be maintained. Low range should never be used for normal road driving.

Terrain Response



The Terrain Response system allows the driver to select a program, which will provide the optimum settings for traction and performance for the prevailing terrain conditions.

The system is controlled by a rotary control located on the centre console. The rotary control allows the selection of one of the following five programs:

- Special programs off (general driving conditions)
- Grass/Gravel/Snow
- Mud/Ruts
- Sand

- Rock crawl.

The Terrain Response system uses a combination of vehicle subsystems to achieve the required vehicle characteristics for the terrain selected. The following subsystems form the Terrain Response system:

- Engine management system
- Transmission
- Transfer box
- Rear locking differential (if fitted)
- Brake system
- Air suspension.

Each subsystem control module provides a feedback for the selected program so that the Terrain Response control module can check that all systems are controlling the system correctly.
For additional information, refer to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Description and Operation).

HIGH RANGE OPERATION

In high range, the torque input from the transmission is passed to the transfer box input shaft. The position of the synchronizer sleeve couples the shaft directly to the differential housing. The differential splits the torque between the two side gears. One side gear is connected by splines and passes the torque to the rear output flange. The second side gear is connected to the chain drive sprocket and passes the torque, via the chain, to the front output flange.

LOW RANGE OPERATION

In low range, the torque input from the transmission is passed to the transfer box input shaft. The synchroniser sleeve is moved and connects the planetary carrier to the differential housing. The torque from the transmission is now directed through the sun gear of the epicyclic gearset and, via the pinion gears and pinion gear shafts, into the planetary carrier. The annulus gear of the epicyclic gearset is secured inside the casing and generates the low range ratio of 2.93:1. The torque is then passed, via the synchroniser sleeve, to the differential housing where it is split between the two side gears. One side gear is connected by splines and passes the torque to the rear output flange. The second side gear is connected to the chain drive sprocket and passes the torque, via the chain, to the front output flange.

HIGH/LOW RANGE GEARS WITH SHIFT-ON-THE-MOVE

The driver is able to change between high and low range gears while the vehicle is moving, or if the vehicle is stationary.

Pushing the range change lever makes a range change requests. This lever is located on the centre console behind and to one side of the main transmission lever.

The driver requests a high to low range change by pushing the range change lever towards the rear of the vehicle and, conversely, a low to high request by pushing the lever towards the front of the vehicle. The range change lever is centre sprung and therefore does not latch in the forward or rear positions.

The driver is informed of the range status via a green lamp (mountain symbol) in the instrument cluster and LED's next to the range change lever. The lamp will not be illuminated in high range, illuminated in low range and flashes during a range change. There are two LED's on the range change lever one for high and one for low. During a range change the new range LED will flash.

The vehicle will remain in the selected range unless the driver requests a change, i.e. it will not automatically revert to high range following a key off/key on sequence.

RANGE CHANGE PROCEDURE

Neutral must be selected on the main transmission before requesting a range change and then select the appropriate gear following completion of the range change. During the range change the main transmission will be locked in neutral.

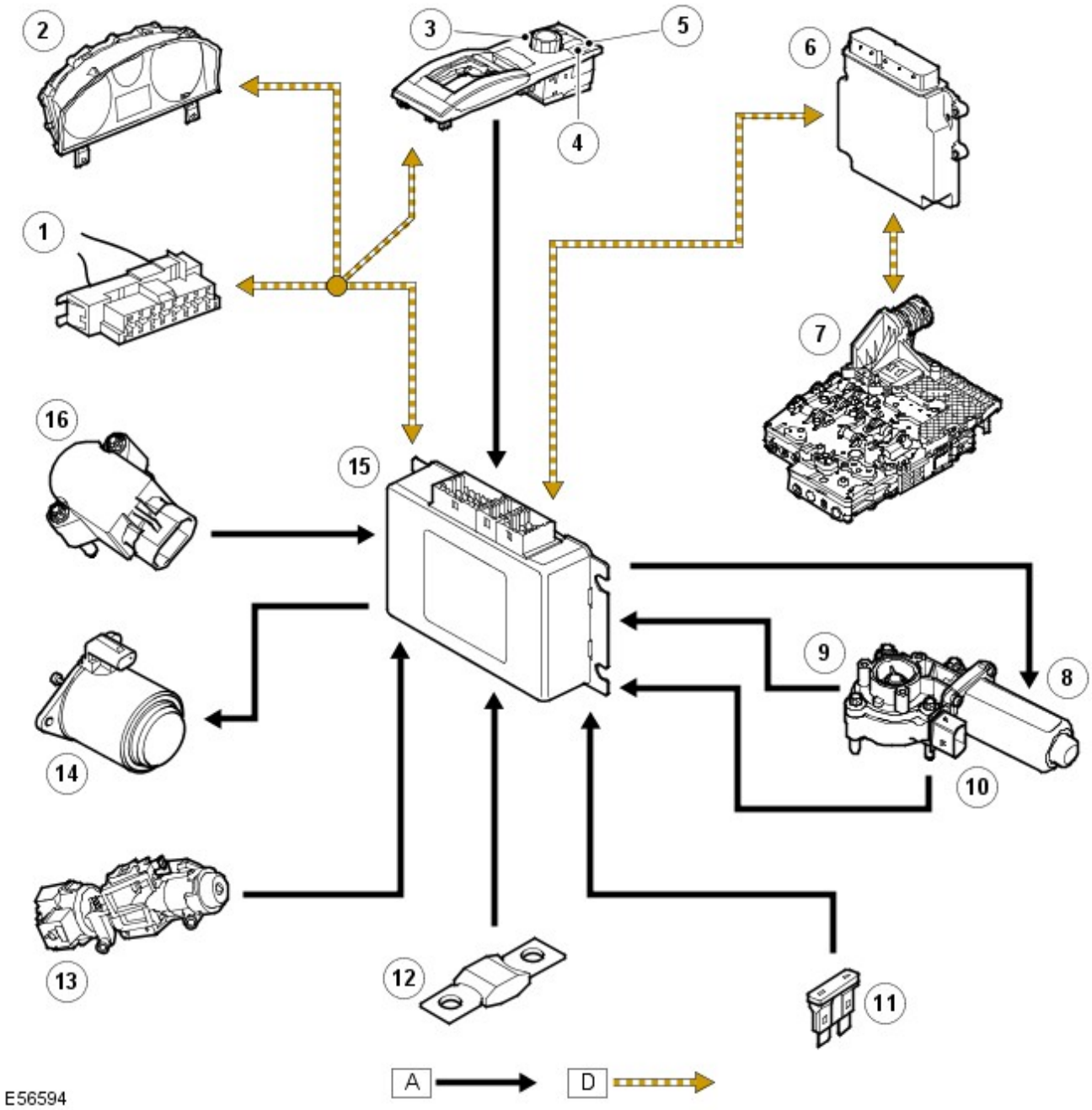
If neutral is not selected when a range change is requested then the request is denied and the driver will be advised to select neutral via the instrument cluster message centre.

The range change process can take up to one second to complete following a request being accepted.

There is a limit set on the maximum speed at which a range change can be achieved. The maximum speed for a high to low range change is 25 mph (40 km/h). The maximum speed for a low to high range change is 37 mph (60 km/h). If the vehicle speed is over the limit when a range change is selected then the request is denied and the instrument cluster message centre will display a 'SLOW DOWN' message.

TRANSFER BOX CONTROL DIAGRAM

 NOTE: A = Hardwired; D = CAN bus



Item	Part Number	Description
1	-	Diagnostic socket
2	-	Instrument cluster
3	-	Terrain Response rotary control
4	-	High/Low range selection switch
5	-	High/Low range LED
6	-	Engine Control Module (ECM)
7	-	Transmission Control Module (TCM)
8	-	Transfer box motor
9	-	Temperature sensor
10	-	Hall sensors (speed and direction)
11	-	Fuse 24 ignition feed
12	-	Fusible link permanent battery feed
13	-	Ignition switch
14	-	Solenoid
15	-	Transfer box control module
16	-	High/low position sensor

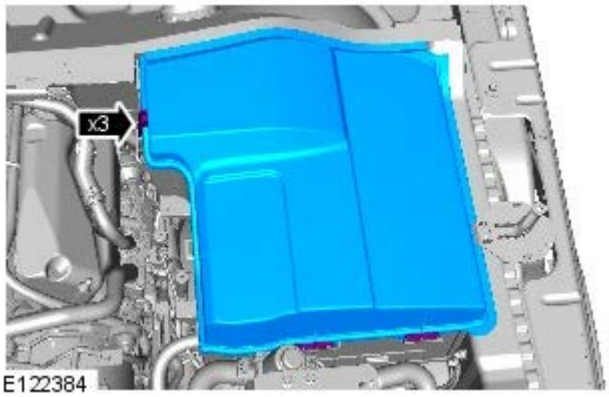
Published: 08-Nov-2013

Four-Wheel Drive Systems - Four-Wheel Drive (4WD) Control Module

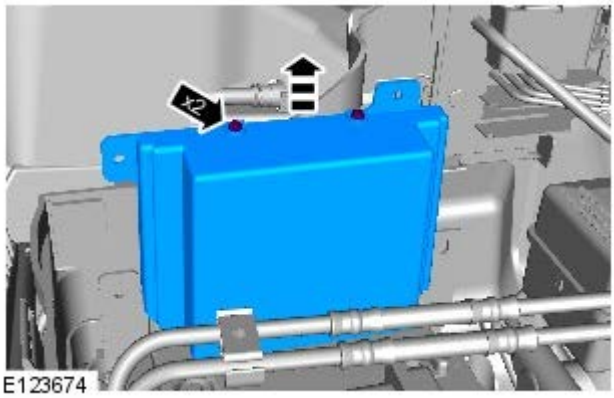
Removal and Installation

Removal

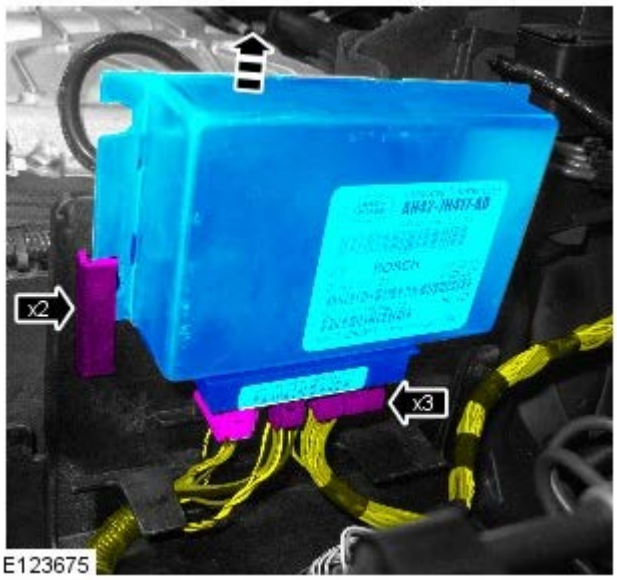
NOTE: LHD illustration shown, RHD is similar.



1. Remove drivers side plenum box lid.



2. Remove the four-wheel drive control module cover.
   - Remove the 2 bolts.



3. Release and remove the four-wheel drive control module.
   - Disconnect the 3 electrical connectors.

Installation

1. To install, reverse the removal procedure.
2.
   1. Connect the Land Rover approved diagnostic equipment.
   2. Clear any Diagnostic Trouble Codes (DTCs).
   3. Start the diagnostic service function **transfer case-transfer case replacement.**
   4. Clear any DTCs after calibration and check for correct

operation.

Published: 08-Nov-2013

Four-Wheel Drive Systems - Transfer Case Shift Motor

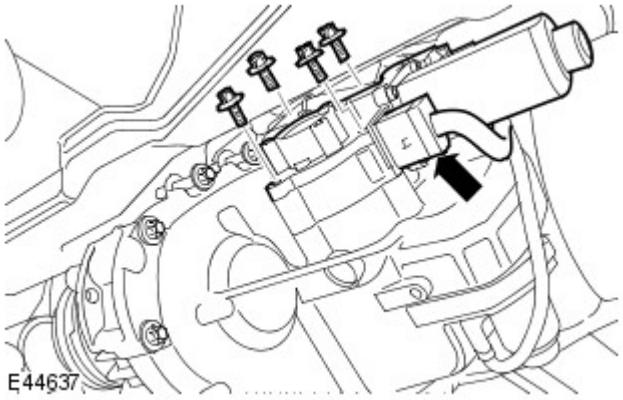
Removal and Installation

Removal

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the transmission crossmember.
   For additional information, refer to: Transmission Support Crossmember - V8 5.0L Petrol/V8 S/C 5.0L Petrol (502-02 Full Frame and Body Mounting, Removal and Installation) / Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).



3. CAUTIONS:

   To avoid damage to the joints or gaiters, do not allow the transmission to hang on the driveshafts.

   Discard the bolts.

   Remove the shift motor.
   - Lower the rear of the transmission for access.
   - Disconnect the electrical connector.
   - Remove the 4 Torx bolts.

Installation

1. CAUTION: Make sure that new bolts are installed.

   Install the shift motor.
   - Clean the components.
   - Tighten the Torx bolts to 35 Nm (26 lb.ft).
   - Connect the electrical connector.

2. Install the transmission crossmember.
   For additional information, refer to: Transmission Support Crossmember - V8 5.0L Petrol/V8 S/C 5.0L Petrol (502-02 Full Frame and Body Mounting, Removal and Installation) / Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

3. Connect the Land Rover approved diagnostic equipment.
   1. Start the diagnostic service function **transfer case-transfer case replacement.**
   2. Clear any Diagnostic Trouble Codes (DTCs) after calibration and check for correct operation.

Published: 26-Sep-2013

Four-Wheel Drive Systems - Transfer Case Clutch Solenoid

Removal and Installation

Removal

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Drain the transfer case.

   Refer to: Transfer Case Draining and Filling (308-07B Transfer Case, General Procedures).



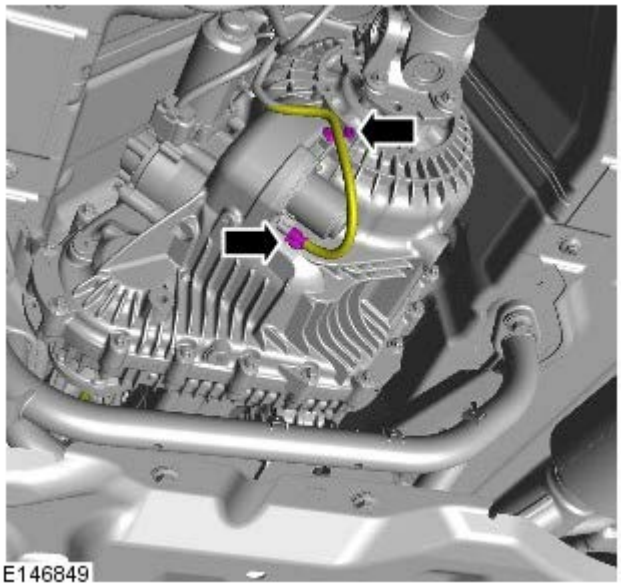
3. CAUTION: Connect the diagnostic tool, prior to removal of the solenoid. Carry out the diagnostic service function **transfer case – solenoid replacement**.

   NOTES:

   Some fluid spillage is inevitable during this operation.

   Note the orientation of the electrical connector prior to removal.

4.



Installation



1. CAUTIONS:

   Failure to energise the solenoid to aid installation of the arm, may result in damage to the shift fork once the component is installed and the system is operated.

   Make sure the seal is installed correctly.

   Make sure that new bolts are installed.

   Make sure that the electrical connector is installed in the correct orientation as noted in the removal step.

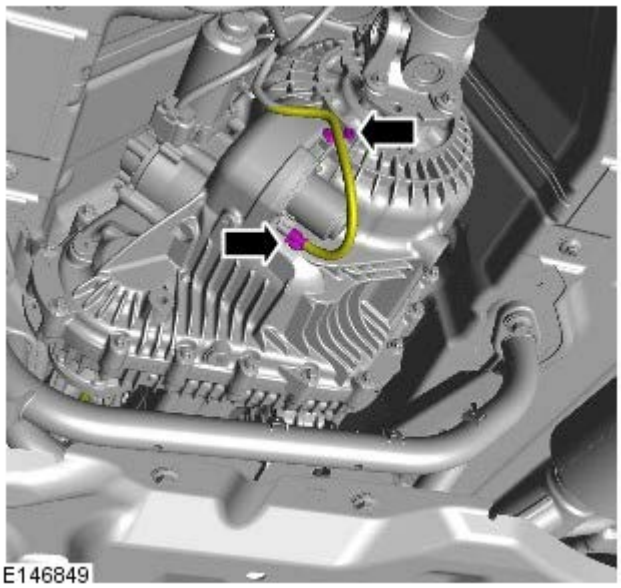
   Make sure that the component sits flush to the transfer case.

   NOTE: **Tighten the retaining bolts evenly and progressively.**

   Connect the electrical connector and energise the solenoid (use the service function **transfer case – solenoid replacement** to assist with energising the solenoid) to allow the arm to extend and correctly locate into the shift fork.

   Torque: 5 Nm

2.



3. Fill the transfer case.

   Refer to: Transfer Case Draining and Filling (308-07B Transfer Case, General Procedures).

4. Using the approved diagnostic equipment, clear all diagnostic trouble code(s) (DTCs) and check for correct operation.

Published: 08-Nov-2013

Four-Wheel Drive Systems - High/Low Range Sensor

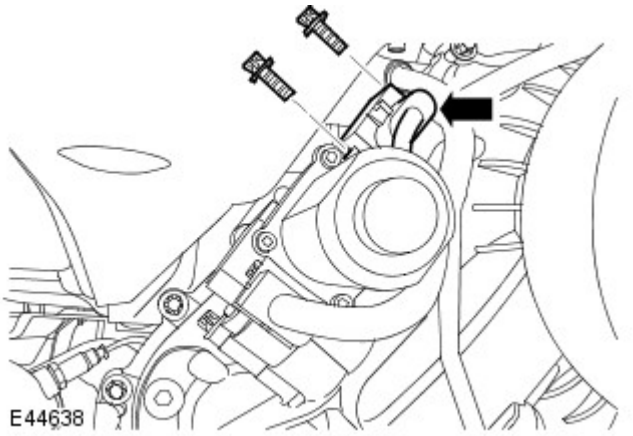
Removal and Installation

Removal

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the crossmember.
   For additional information, refer to: Transmission Support Crossmember - V8 5.0L Petrol/V8 S/C 5.0L Petrol (502-02 Full Frame and Body Mounting, Removal and Installation) / Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).



3. CAUTIONS:

   To avoid damage to the joints or gaiters, do not allow the transmission to hang on the driveshafts.

   Discard the bolts.

   Remove the high/low range sensor.
   - Lower the rear of the transmission for access.
   - Disconnect the electrical connector.
   - Remove the 2 Torx bolts.

Installation

1. CAUTION: Make sure that new bolts are installed.

   To install, reverse the removal procedure.
   - Clean the components.
   - Install the high/low range sensor.
   - Tighten the Torx bolts to 5 Nm (4 lb.ft).

2. Install the crossmember.
   For additional information, refer to: Transmission Support Crossmember - V8 5.0L Petrol/V8 S/C 5.0L Petrol (502-02 Full Frame and Body Mounting, Removal and Installation) / Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

3. Connect the Land Rover approved diagnostic equipment.
   1. Start the service function **transfer case-absolute position sensor replacement.**
   2. Clear any Diagnostic Trouble codes (DTCs) after calibration and check for correct operation.

Published: 06-Nov-2013

Transfer Case -

Sealers and Lubricants

Item	Specification
* Recommended oil	Shell TF 0753
Capacity - Wet and dry fill	1.5 litres, (2.6 pints) (1.5 US quarts)
Input shaft splines grease	Weicon TL7391
Sealant	STC 50550 or Loctite 5900

*** CAUTION:** Do not use any lubricant other than that specified

General Specification

Item	Specification
Model	DD295
Type	Two speed, permanent four wheel drive transfer case having synchronised shift on the move facility with an actively controlled wet clutch and 50/50 torque split across the centre differential
Clutch type	Wet, multi-plate
Maximum torque capacity	2500 Nm (1842.5 lb-ft)
Ratios:	
High	1:1
Low	2.93:1
Maximum shift speeds:	
High to low ratio	0 km/h (0 mph)
Low to high ratio	60 km/h (37.2 mph)

Torque Specifications

Description	Nm	lb-ft
Transfer case fluid drain plug M16	22	16
Transfer case fluid level/filler plug M16	22	16
Transfer case fluid drain plug M18	28	21
Transfer case fluid level/filler plug M18	28	21
Fuel tank heat shield nuts/bolts	10	7
Drive shaft Torx screws	55	40
Drive shaft centre bearing bolts	30	22
Transmission support insulator	60	44
Wiring harness securing bolts	10	7
Fuel line support bracket bolts	10	7
Transfer case retaining bolts	45	33
* Transfer case shift motor bolts	35	26
* Transfer case clutch control solenoid bolts	5	4
* Transfer case high / low range sensor bolts	5	4

*** New bolts must be used when a new component is installed.**

Published: 11-May-2011

Transfer Case - Transfer Case

Description and Operation

For additional information, refer to: Four-Wheel Drive Systems (308-07A, Description and Operation).

Published: 31-Oct-2013

Transfer Case - Transfer Case

Diagnosis and Testing

Principle of Operation

For a detailed description of the transfer case system and operation, refer to the relevant Description and Operation section of the workshop manual.
REFER to: Transfer Case (308-07B Transfer Case, Description and Operation).

Inspection and Verification

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

NOTES:

If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

When performing voltage or resistance tests, always use a digital multimeter accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance always take the resistance of the digital multimeter leads into account.

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

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

Visual Inspection

Mechanical	Electrical
• Transfer case • Driveshafts • Differentials • Halfshafts • Fluid leaks	• Fuse(s) • Wiring harnesses and connectors • Controller Area Network (CAN) circuits • Instrument Cluster (IC) • High/low range switch • Transfer Case Control Module (TCCM)

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
5. Check DDW for open campaigns. Refer to the corresponding bulletins and SSMs which may be valid for the specific customer complaint and carry out the recommendations as required

Symptom Chart

Symptom	Message	Possible Causes	Action
Loss of drive due to transfer case being stuck in neutral Automatic transmission park lock function inoperative due to transfer case stuck in neutral	PARK LOCK FAILURE APPLY HANDBRAKE	• High speed CAN bus circuit short circuit to ground, short circuit to power, open circuit, high resistance • Transfer case range change mechanism obstruction	• Using the manufacturer approved diagnostic system, perform a CAN network integrity test. Refer to the electrical circuit diagrams and test the high speed CAN bus circuit for short circuit to ground, short circuit to power, open circuit, high resistance • Using the manufacturer approved diagnostic system, check the transfer case control module for related DTCs and refer to the relevant DTC index
Loss of drive	-	• Front/rear driveshaft failure • Front/center/rear differential failure • Front/rear left/right halfshaft failure	• Check the integrity of the front and rear driveshafts • Check the integrity of the front, center and rear differentials • Check the integrity of the halfshafts • Using the manufacturer approved diagnostic system, check the transfer case control module for related DTCs and refer to the relevant DTC index

		• Transfer case system failure	
Range change inhibited	TRANSMISSION RANGE CHANGE INOPERATIVE	• Transfer case control module has shut down due to thermal overload • Transfer case range change mechanism obstruction • Transfer case control module internal failure	• Using the manufacturer approved diagnostic system, check the transfer case control module for related DTCs and refer to the relevant DTC index
Off road traction reduced	TRANSMISSION OVERHEAT SLOW DOWN	• Center differential temperature is approaching the overheat threshold	• Using the manufacturer approved diagnostic system, check the transfer case control module for related DTCs and refer to the relevant DTC index
	TRANSMISSION FAULT – TRACTION REDUCED	• Center differential clutch has failed - Operating as an open differential • Transfer case control module has stopped transmitting on the CAN bus and defaults to open center differential	• Using the manufacturer approved diagnostic system, check the transfer case control module for related DTCs and refer to the relevant DTC index • Using the manufacturer approved diagnostic system, perform a CAN network integrity test. Refer to the electrical circuit diagrams and check the high speed CAN bus circuit for short circuit to ground, short circuit to power, open circuit, high resistance
Judder during low speed manoeuvring with high steering inputs (front and rear driveshafts rotating at different speeds)	-	• Transfer case clutch not disengaged fully due to water contamination of the transfer case fluid	• Refer to the relevant section of the workshop manual and check the transfer case fluid level/condition. If water is present in the fluid (white coloration/emulsification), check the integrity of the transfer case breather and drain and refill the transfer case fluid. Using the manufacturer approved diagnostic system, perform routine - Transfer Case Replacement. Clear the DTCs and re-test. If the fault persists, install a new transfer case and perform routine - Transfer Case Replacement
Clunk during transfer case range change Clunk when ignition is set to off (transfer case cycles to rest position)	-	• Transfer case clutch not calibrated correctly • Transfer case fluid contaminated due to water ingress	• Using the manufacturer approved diagnostic system, perform routine - Transfer Case Replacement. Check the transfer case control module for related DTCs and refer to the relevant DTC index • Refer to the relevant section of the workshop manual and check the transfer case fluid level/condition. If water is present in the fluid (white coloration/emulsification), check the integrity of the transfer case breather and drain and refill the transfer case fluid. Using the manufacturer approved diagnostic system, perform routine - Transfer Case Replacement. If the fault persists, install a new transfer case and perform routine - Transfer Case Replacement
Whine from the transfer case	-	• Transfer case chain wear	NOTE: VIN LS288059 to LS784343 • For vehicles within the VIN range listed above, refer to the relevant section of the workshop manual and install a new transfer case chain • For vehicles outside of the VIN range listed above, install a new transfer case and perform routine - Transfer Case Replacement
	-	• Transfer case bearing wear	NOTE: VIN pre-LS288059 • For vehicles within the VIN range listed above, install a new transfer case front/rear output shaft bearing and seal • For vehicles outside of the VIN range listed above, install a new transfer case and perform routine - Transfer Case Replacement

Transfer case fluid burnt (darker color than normal)	-	Excessive off-road driving • Transfer case clutch worn/burnt	Refer to the relevant section of the workshop manual and drain and refill the transfer case fluid. Using the manufacturer approved diagnostic system, perform routine - Transfer Case Replacement. Check the transfer case control module for related DTCs and refer to the relevant DTC index • Check the integrity of the driveshafts, differentials and halfshafts. Rectify as necessary. Check the vehicle history for driveline failures. If no driveline failures have occurred, refer to the relevant section of the workshop manual and drain and refill the transfer case fluid, and using the manufacturer approved diagnostic system, perform routine - Transfer Case Replacement. Clear the DTCs and re-test. If a driveline failure has occurred, drain and refill the transfer case fluid, and perform routine - Transfer Case Replacement. Clear the DTCs and re-test. If the fault persists, install a new transfer case and perform routine - Transfer Case Replacement
Vibration through the steering wheel, front seat or floor at 2400rpm to 2800rpm during medium to heavy acceleration	-	• Transfer case is torsioning/twisting on the rear of the transmission	NOTE: This Action applies to 5.0L petrol vehicles only. • Install a mass damper (part number IAI500100) to the vacant threaded hole in the transfer case. Torque the fixing (part number IYP500080) to 75Nm

Repairs

Transfer Case Adaptions

When new transfer case components are installed, the relevant routine must be performed using the manufacturer approved diagnostic system:

- Transfer case control module - Transfer Case Replacement routine
- Transfer case motor - Transfer Case Replacement routine
- Transfer case - Transfer Case Replacement routine
- Transfer case mode selector solenoid - Solenoid Replacement routine
- Transfer case mode selector position sensor - Absolute Position Sensor Replacement routine

Drive Cycle

To validate a transfer case repair, the following drive cycle must be completed:

1. Drive the vehicle a short distance and halt and drive away at least twice
2. Select low range and then select high range (vehicle not moving)
3. Select low range and then select high range (vehicle moving at appropriate speed)
4. Halt the vehicle and select Park
5. Set the ignition to off
6. Wait until the transmission control switch Park LED has extinguished
7. Drive the vehicle until the engine, transmission and transfer case are at normal operating temperature
8. Repeat steps 1 to 6

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Transfer Case Control Module (TCCM) (100-00 General Information, Description and Operation).

Published: 07-Nov-2013

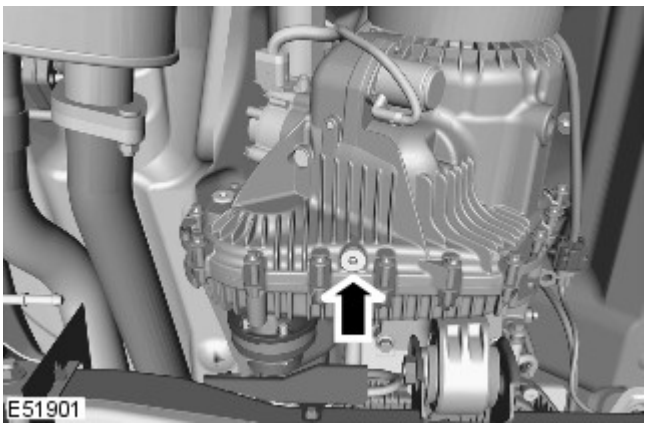
Transfer Case - Transfer Case Draining and Filling

General Procedures

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.

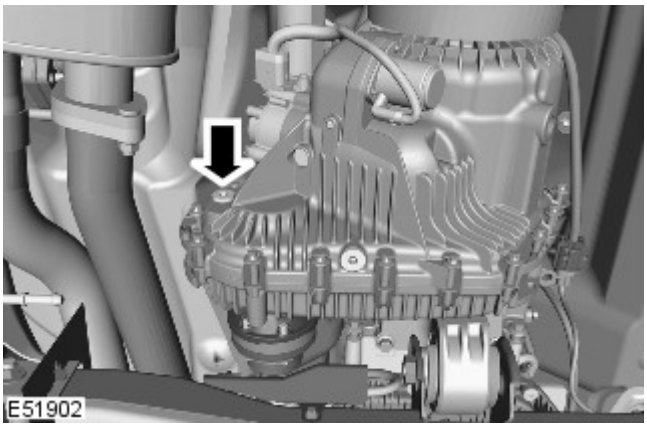
2. Position a container to collect the fluid.



3. Remove the fluid drain plug.
   - Clean the immediate area.
   - Remove and discard the sealing washer.

4. Allow the fluid to drain.

5. Install the drain plug and tighten it to; M16 plug: 22 Nm (16 lb.ft), M18 plug: 28 Nm (21 lb ft).
   - Clean the component mating faces.
   - Install a new sealing washer.



6. Remove the fluid filler/level plug.
   - Clean the immediate area.
   - Remove and discard the sealing washer.

7. Refill transfer case with the recommended fluid, until the fluid is level with bottom of filler/level plug hole.
   For additional information, refer to: Specifications (308-07B Transfer Case, Specifications).

8. Install the fluid filler/level plug and tighten to; M16 plug: 22 Nm (16 lb.ft), M18 plug: 28 Nm (21 lb ft).
   - Clean the component mating faces.
   - Install a new sealing washer.

Published: 11-May-2011

Transfer Case - Transfer Case Input Shaft Seal V8 5.0L Petrol/V8 S/C 5.0L Petrol

In-vehicle Repair

Special Tool(s)

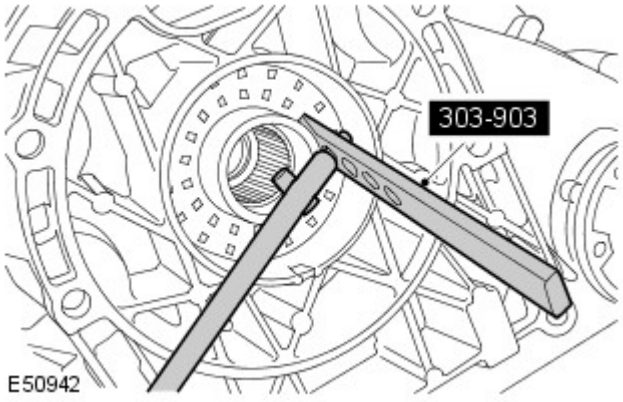
 E50940	Oil seal remover 303-903(LRT-12-092)
 E50941	Oil seal installer 308-598

Removal

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the transfer case.
   For additional information, refer to: Transfer Case - 5.0L (308-07, Removal).



E50942

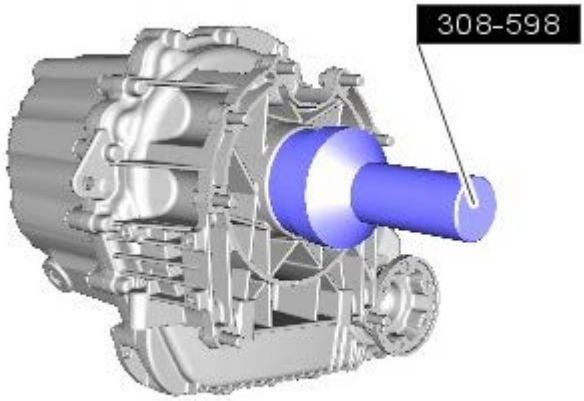
3. CAUTION: Care must be taken to avoid damage to the seal register and running surface.

   Carefully remove and discard the oil seal.
   - Use the special tool.

Installation

1. CAUTION: Oil seals must be fitted dry.

   Install a new seal.
   - Clean the seal register.
   - Use the special tool.



E50943

2. Install the transfer case.
   For additional information, refer to: Transfer Case - 5.0L (308-07, Removal).

Published: 11-May-2011

Transfer Case - Transfer Case Input Shaft Seal TDV6 3.0L Diesel

In-vehicle Repair

Special Tool(s)

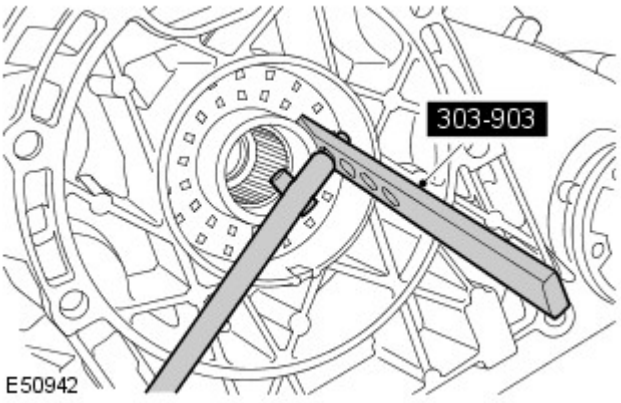
	Oil seal remover 303-903(LRT-12-092)
	Oil seal installer 308-598

Removal

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the transfer case.
   For additional information, refer to: Transfer Case - 3.0L Diesel (308-07, Removal).



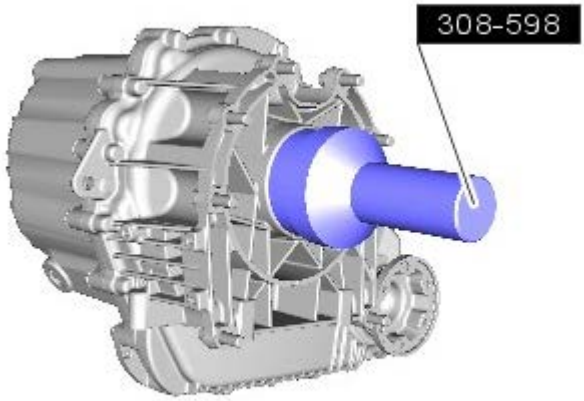
3. CAUTION: Care must be taken to avoid damage to the seal register and running surface.

   Carefully remove and discard the oil seal.
   - Use the special tool.

Installation

1. CAUTION: Oil seals must be fitted dry.

   Install a new seal.
   - Clean the seal register.
   - Use the special tool.



E50943

2. Install the transfer case.
   For additional information, refer to: Transfer Case - 3.0L Diesel (308-07, Removal).

Published: 11-May-2011

Transfer Case - Transfer Case Input Shaft Seal TDV8 3.6L Diesel

In-vehicle Repair

Special Tool(s)

308-598  E50941	Oil seal installer 308-598
303-903  E50940	Oil seal remover 303-903(LRT-12-092)

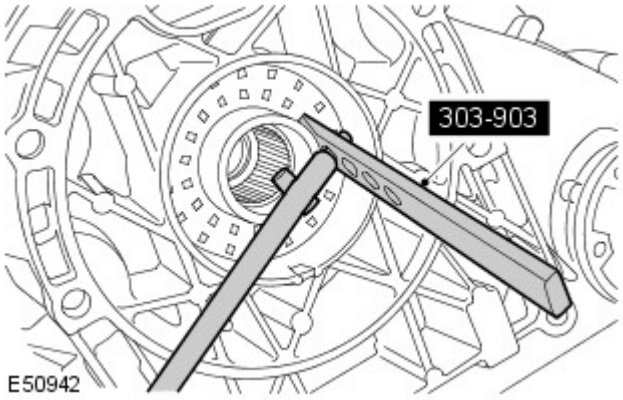
Removal

1. Disconnect the battery ground cable.
   For additional information, refer to: Specifications (414-00, 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 transfer case.
   For additional information, refer to: Transfer Case - 3.6L (TdV8) Diesel (308-07, Removal).



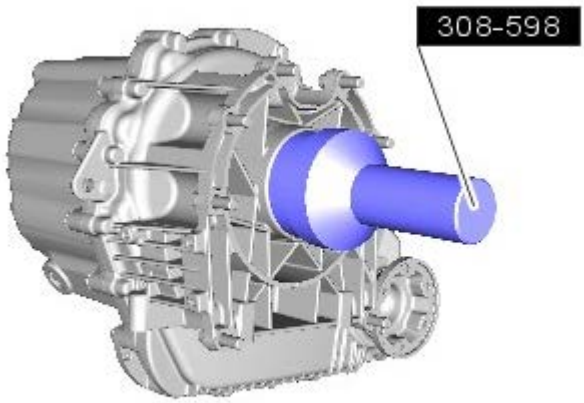
4. CAUTION: Care must be taken to avoid damage to the seal register and running surface.

   Carefully remove and discard the oil seal.
   - Use the special tool.

Installation

1. CAUTION: Oil seals must be fitted dry.

   Install a new seal.
   - Clean the seal register.
   - Use the special tool.



E50943

2. Install the transfer case.
   For additional information, refer to: Transfer Case - 3.6L (TdV8) Diesel (308-07, Removal).

3. Connect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).

Published: 06-Nov-2013

Transfer Case - Transfer Case Chain

Removal and Installation

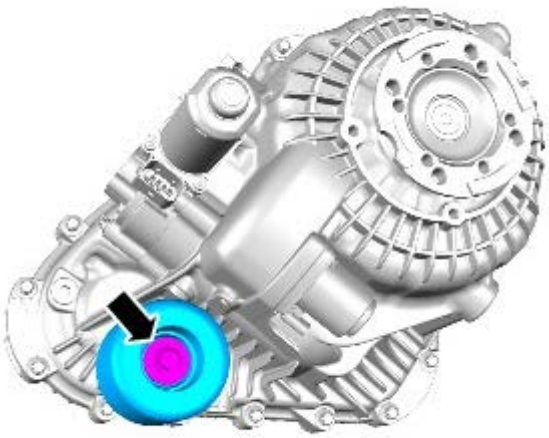
Removal

1. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: Transfer Case - V8 5.0L Petrol/V8 S/C 5.0L Petrol (308-07B Transfer Case, Removal).
   Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case, Removal).
   Refer to: Transfer Case - TDV8 3.6L Diesel (308-07B Transfer Case, Removal).

3. With assistance, secure the transfer case with it's transmission mating face down on a flat surface.

4.



E159189

5. WARNING: Eye protection must be worn.

   CAUTION: Make sure the bolt holes are clean and free from swarf.



E159190

6. WARNING: Eye protection must be worn.

   CAUTION: Make sure the bolt holes are clean and free from swarf.



E159191

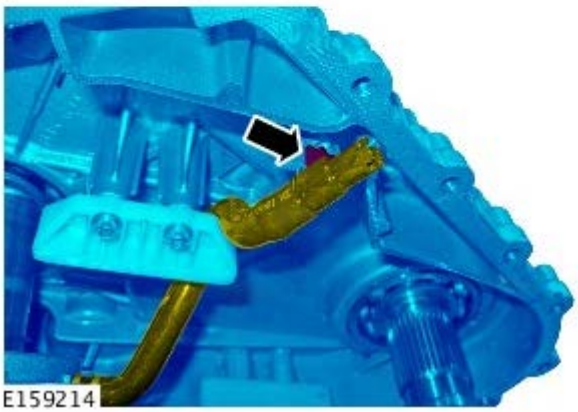
7. CAUTION: Care must be taken when turning the transfer case over. The transfer case halves must not be allowed to separate.

   With assistance, release the transfer case and secure with the rear face of the transfer case facing down on a flat surface.



8. CAUTION: Care must be taken to avoid damaging the mating surfaces.

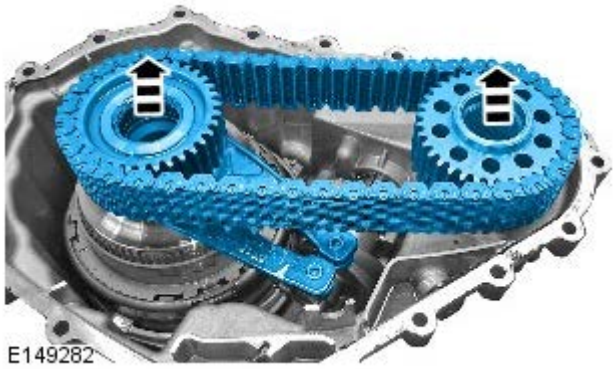
   Using a soft faced mallet, release the front casing.



E159214

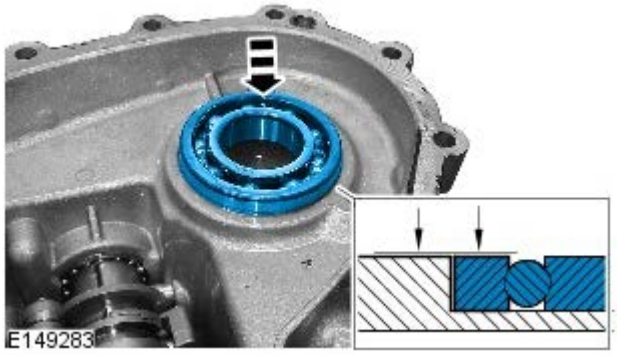
9.





10. CAUTION: The shaft may be tight on the bearing. Care must be taken when removing the component.

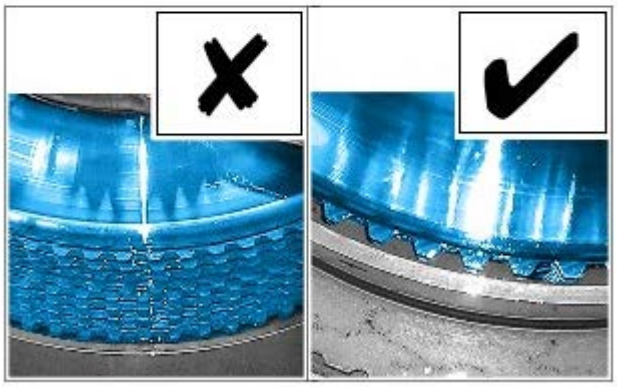
Installation



1. CAUTION: Make sure that the front driveshaft gear bearing is fully seated before installing the new chain and gear.

2. CAUTION: Make sure that the clutch assembly is correctly located as illustrated.



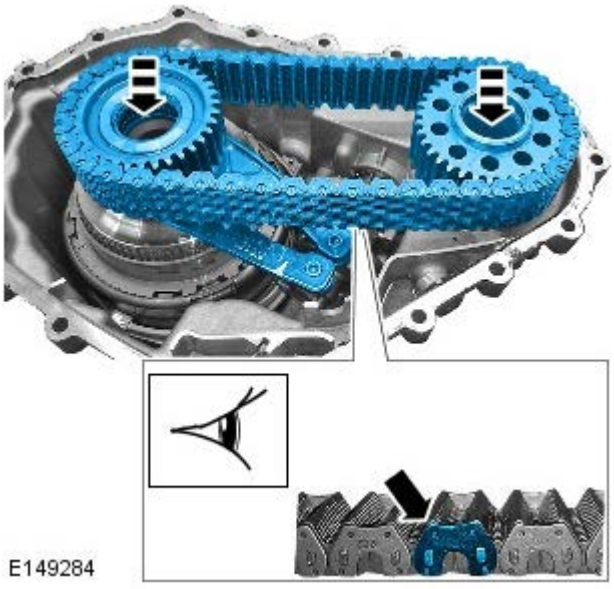


E149289



E149286

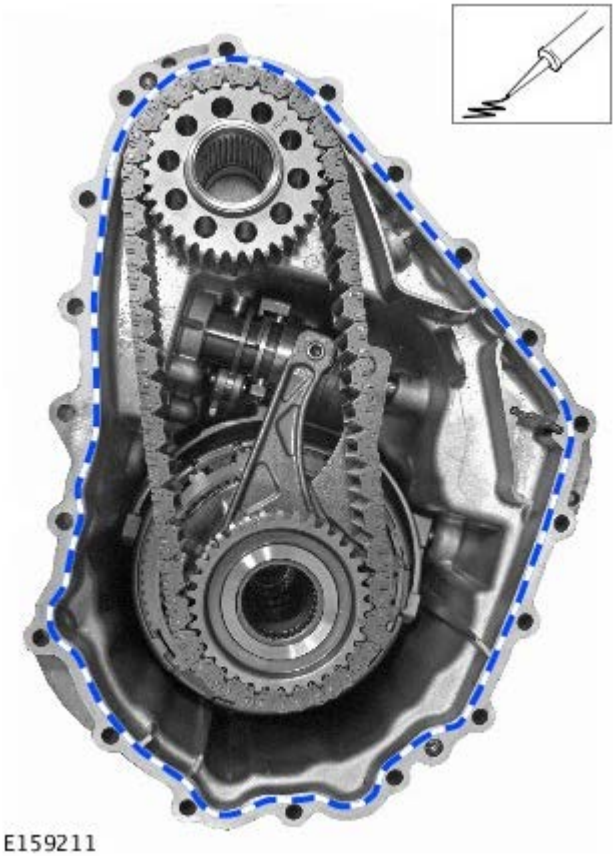
3. CAUTION: Make sure that the clutch assembly is correctly located as illustrated.



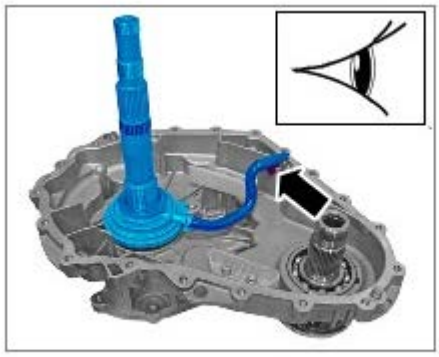
E149284

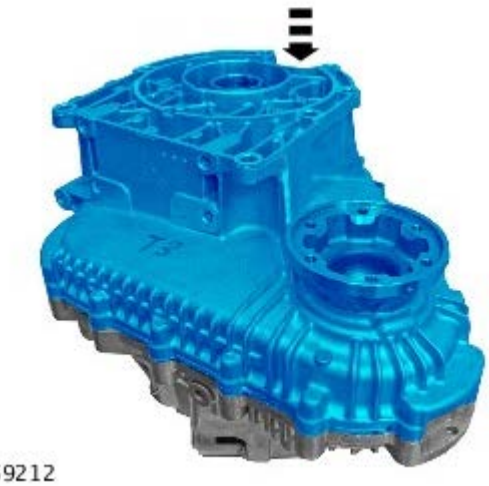
4. CAUTION: Make sure that the chain is installed with the chain link facing down.

5. Apply a 2mm bead of sealant to one surface of the transfer case mating faces, as shown.



E159211





E159212

6. CAUTIONS:

   Make sure that the input shaft spacer is correctly located.

   The input shaft and fluid pump assembly must be supported and held in place by hand, until it is located securely into the clutch assembly.

   Install the front half of the case.

7. CAUTION: Care must be taken when turning the transfer case over. The transfer case halves must not be allowed to separate.

   With assistance, release the transfer case and secure with it's transmission mating face down on a flat surface.

8. CAUTION: Only tighten the bolts finger-tight

at this stage.



E159191

9. *Torque:* 10 Nm



E159409

10. *Torque:* 35 Nm



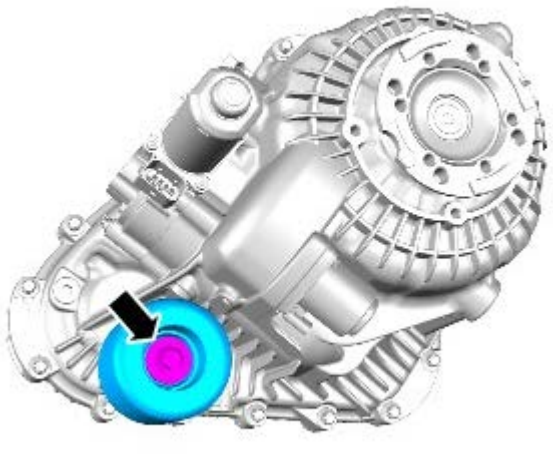
E159191

11. *Torque:* 35 Nm



E159190

12. *Torque:* 75 Nm



E159189

13. Refer to: Transfer Case - V8 5.0L Petrol/V8 S/C 5.0L Petrol (308-07B Transfer Case, Installation).
    Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case, Installation).
    Refer to: Transfer Case - TDV8 3.6L Diesel (308-07B Transfer Case, Installation).

14. Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

Published: 08-Nov-2013

Transfer Case - Transfer Case Front Output Seal

Removal and Installation

Special Tool(s)

	205-818 Installer, Seal
	308-620 Installer, Seal
	308-636 Installer
	JLR-308-926 Support Tool, Transfer Case
	JLR-308-933 Remover, Transfer Case Flange

Removal

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

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

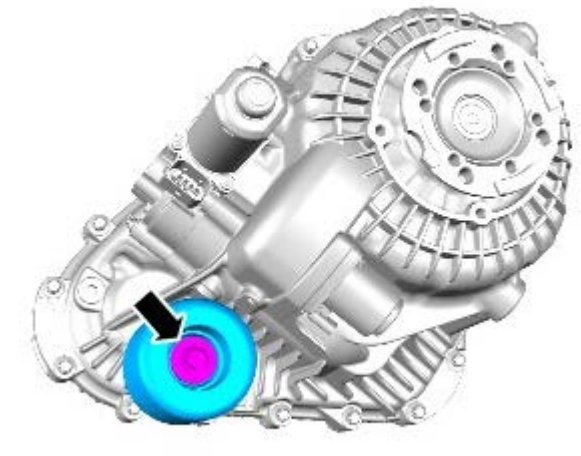
   Raise and support the vehicle.

2. Refer to: Transfer Case Draining and Filling (308-07B Transfer Case, General Procedures).

3. Refer to: Transfer Case - V8 5.0L Petrol/V8 S/C 5.0L Petrol (308-07B Transfer Case, Removal).
   Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case, Removal).
   Refer to: Transfer Case - TDV8 3.6L Diesel (308-07B Transfer Case, Removal).

4. With assistance, secure the transfer case with it's transmission mating face down on a flat surface.

5.



E159189

6. WARNING: Eye protection must be worn.

CAUTION: Make sure the bolt holes are clean and free of swarf.



E159190

7. WARNING: Eye protection must be worn.

CAUTION: Make sure the bolt holes are clean and free of swarf.



E159191

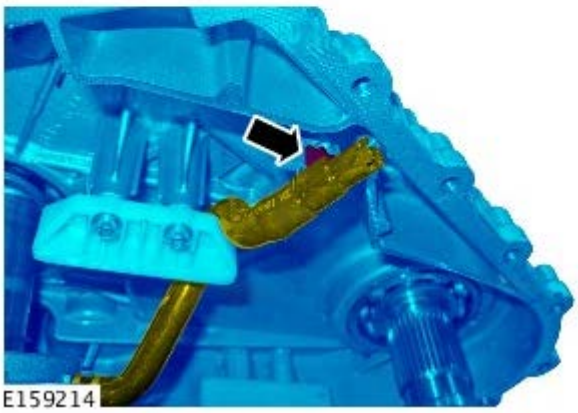
8. CAUTION: Care must be taken when turning the transfer case over. The transfer case halves must not be allowed to separate.

   With assistance, release the transfer case and secure with the rear face of the transfer case facing down on a flat surface.



9. CAUTION: Care must be taken to avoid damage to the mating surfaces.

   Using a soft faced mallet, release the front casing.



E159214

10. Remove the sealant from the transfer case mating faces.

11.


E159216

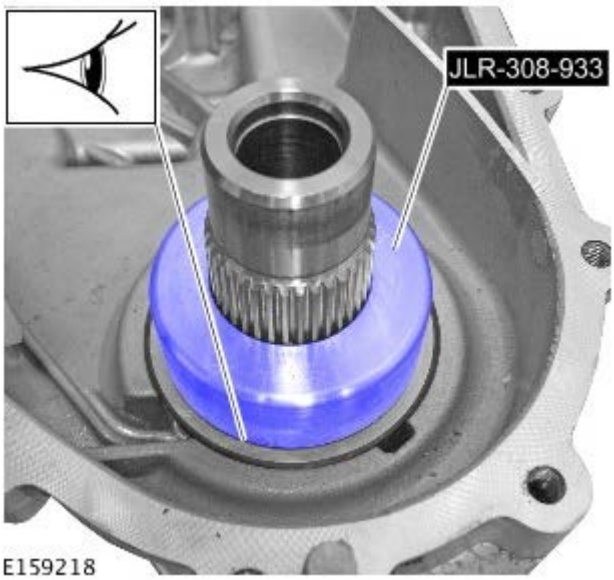
12. *Special Tool(s):* JLR-308-926



E159217

13. CAUTION: Make sure that the special tool is correctly located. This will make sure that the snap ring is fully compressed during the next step.

Special Tool(s): JLR-308-933



E159218

14. CAUTIONS:

Do not use excessive force whilst removing the flange assembly.



Discard the snap ring.

Special Tool(s): JLR-308-933

15.



16.



Installation

CAUTION: During the installation, make sure that all components are clean and free from foreign material.

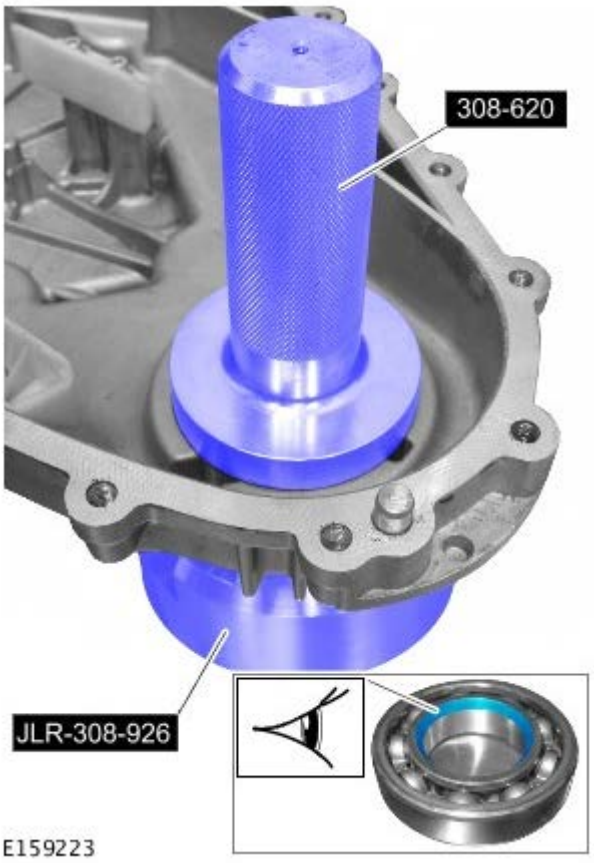
1. Position the special tool as shown, to support the



E159222

transfer case during the next step.

Special Tool(s): JLR-308-926



E159223

2. CAUTIONS:

   The chamfer on the bearing inner track must face the seal.

   The transfer case must be supported by the special tool on a flat surface during this step.

   Install the bearing.

   Special Tool(s): 308-620, JLR-308-926

3. Install the seal.

   Special Tool(s): 308-636



E159224



E159225

4. CAUTIONS:

   Centralise the snap ring in the snap ring groove before installing the output flange.

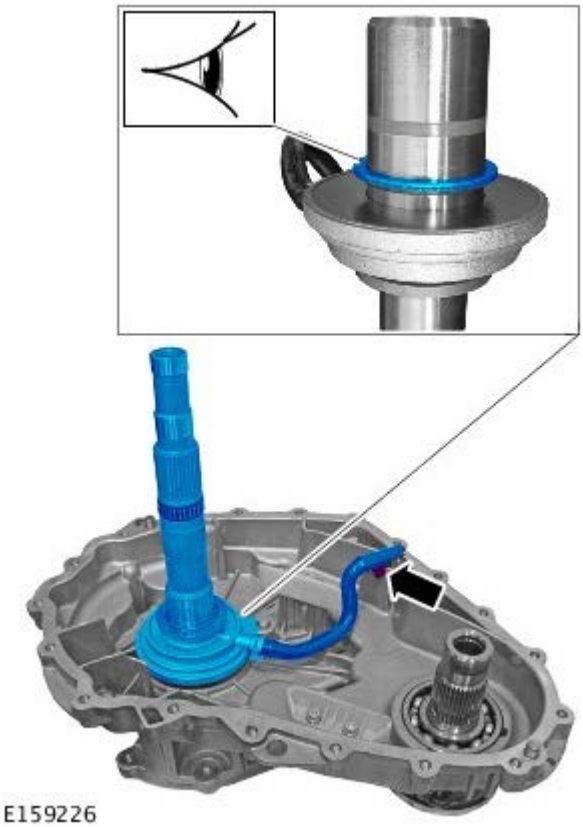
   Extreme care is necessary to make sure the snap ring enters the bearing squarely.

   Install a new snap ring.

   Using the special tool and with assistance, install the drive flange.

   Special Tool(s): 205-818

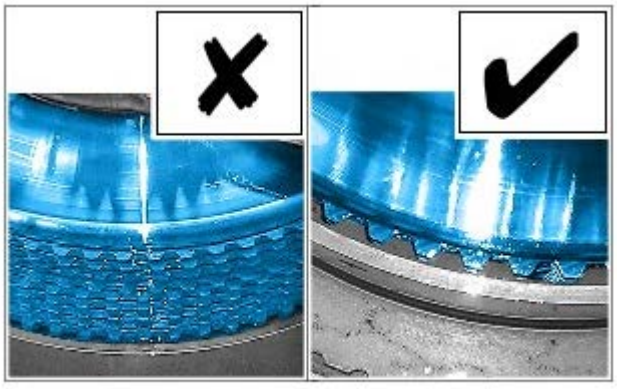
5. CAUTION: Make sure that the oil pump is installed over its location peg.



E159226

6. Clean the magnetic filter.





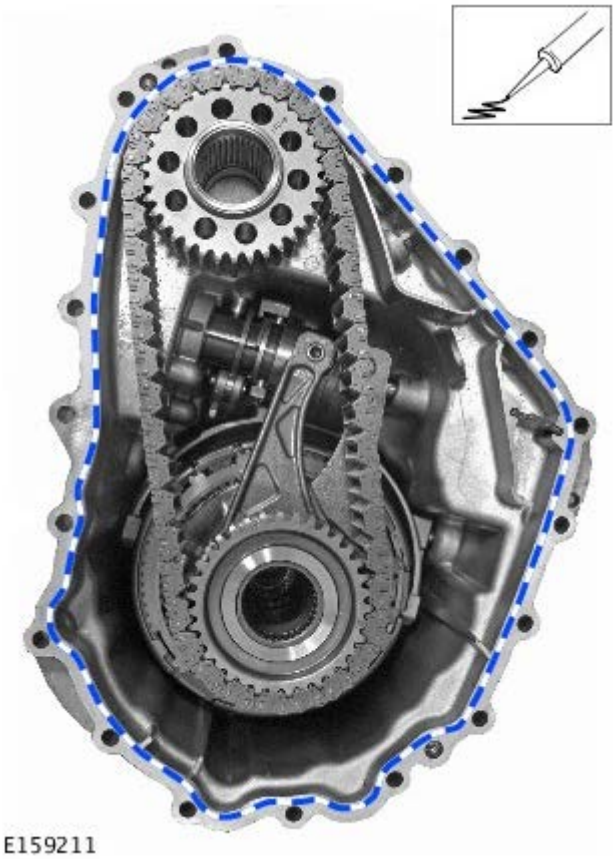
E149289

7. CAUTION: Make sure that the clutch assembly is correctly located as illustrated.

8. CAUTION: Make sure that the clutch assembly is correctly located as illustrated.



9. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.

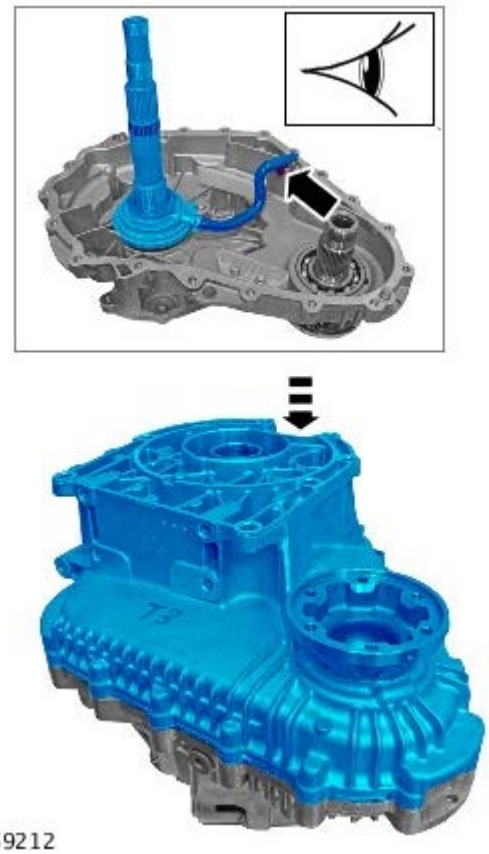


10. CAUTIONS:

    Make sure that the input shaft spacer is correctly located.

    The input shaft and fluid pump assembly must be supported and held in place by hand, until it is located securely into the clutch assembly.

    Install the front half of the transfer case.



E159212

11. CAUTION: Care must be taken when turning the transfer case over. The transfer case halves must not be allowed to separate.

    With assistance, release the transfer case and secure with it's transmission mating face down on a flat surface.

12. CAUTION: Only tighten the bolts finger-tight at this stage.



E159191

13. *Torque:* 10 Nm



E159409

14. *Torque:* 35 Nm



E159191

15. *Torque:* 35 Nm



E159190

16. *Torque:* 75 Nm



E159189

17. With assistance, release the transfer case from the flat surface.

18. Refer to: Transfer Case - V8 5.0L Petrol/V8 S/C 5.0L Petrol (308-07B Transfer Case, Installation).
    Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case, Installation).
    Refer to: Transfer Case - TDV8 3.6L Diesel (308-07B Transfer Case, Installation).

19. Refer to: Transfer Case Draining and Filling (308-07B Transfer Case, General Procedures).

Published: 08-Nov-2013

Transfer Case - Transfer Case Front Output Shaft Bearing

Removal and Installation

Removal

1. The transfer case front output shaft bearing must be serviced with the seal as a pair.

   Refer to: Transfer Case Front Output Seal (308-07B Transfer Case, Removal and Installation).

Installation

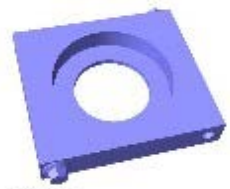
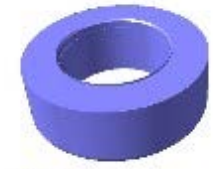
1. To install, reverse the removal procedure.

Published: 08-Nov-2013

Transfer Case - Transfer Case Rear Output Seal

Removal and Installation

Special Tool(s)

 E159758	204-525-1 Replacer, Drive Flange
 205-726 E87692	205-726 Remover/Installer, Wheel Hub Bearing
 308-637 E55697	308-637 Installer
 E158795	JLR-308-927 Support Tool, Transfer Case
 E158797	JLR-308-931 Remover, Transfer Case Flange

Removal

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

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.

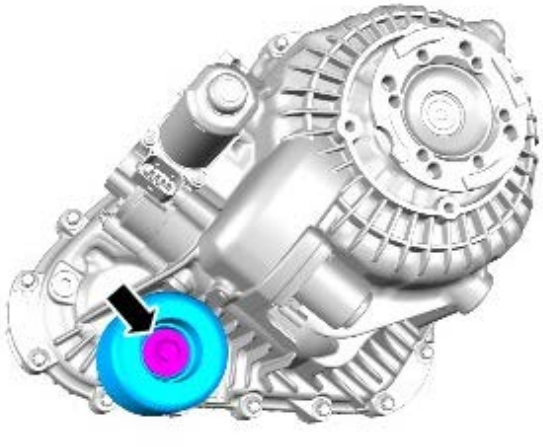
2. Refer to: Transfer Case Draining and Filling (308-07B Transfer Case, General Procedures).

3. Refer to: Transfer Case - V8 5.0L Petrol/V8 S/C 5.0L Petrol (308-07B Transfer Case, Removal).
   Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case, Removal).
   Refer to: Transfer Case - TDV8 3.6L Diesel (308-07B Transfer Case, Removal).

4. With assistance, secure the transfer case with it's transmission

mating face down a flat surface.

5.



E159189

6. WARNING: Eye protection must be worn.

CAUTION: Make sure the bolt holes are clean and free of swarf.



E159190

7. WARNING: Eye protection must be worn.

CAUTION: Make sure the bolt holes are clean and free of swarf.



E159191



E159192

8. CAUTION: Care must be taken to avoid damage to the mating surfaces.

   Using a soft faced mallet, release the rear casing.

9.



E159215

10. Locate the magnetic filter. The filter may have dropped into the front housing in the previous step.



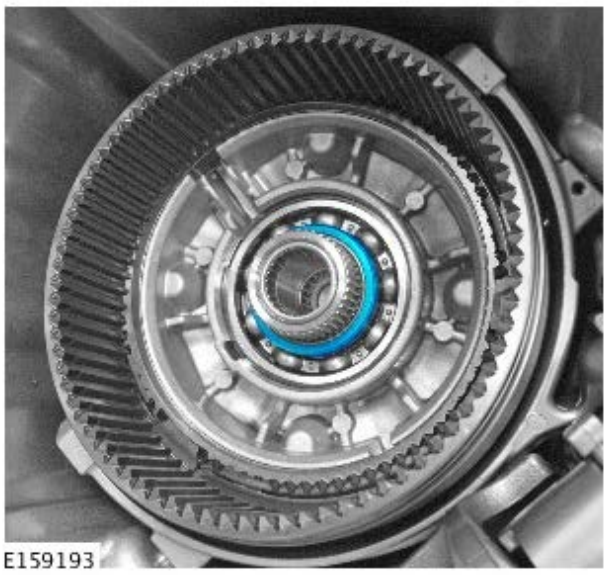


E159213

11. CAUTION: Make sure that the mating faces are clean and free of foreign material.

    Remove the sealant from the transfer case mating faces.

12. Remove the spacer.



E159193

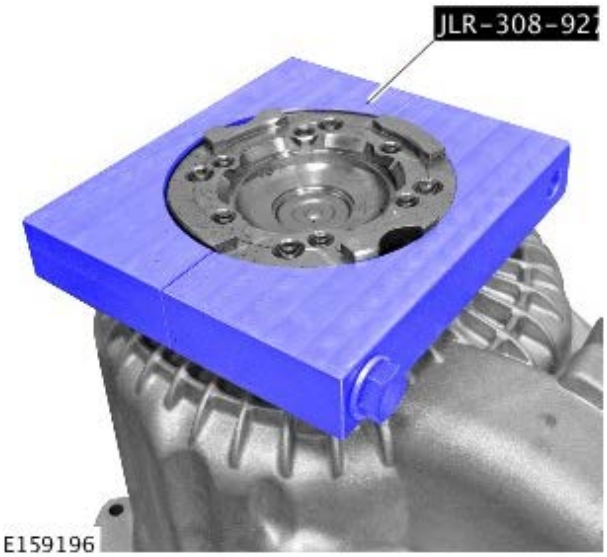
13.



14. NOTE: Remove as an assembly.

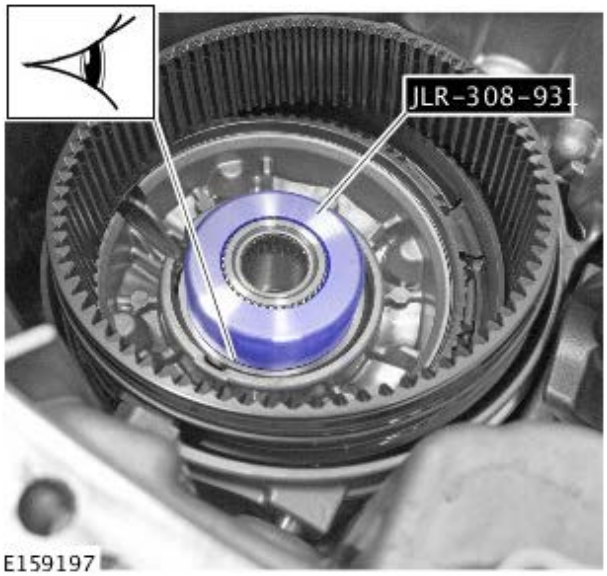


15. *Special Tool(s):* JLR-308-927



16. CAUTION: Make sure that the special tool is correctly located. This will make sure that the snap ring is fully compressed during the next step.

Special Tool(s): JLR-308-931



17. CAUTIONS:

    Do not use excessive force whilst removing the flange assembly.

    Discard the snap ring.

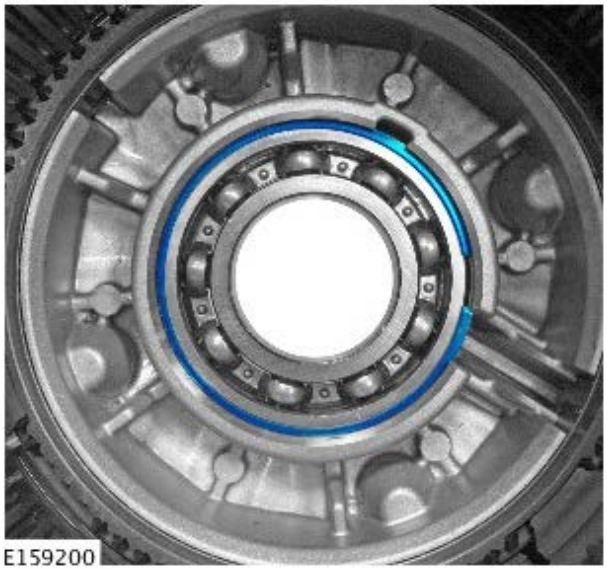
    Special Tool(s): JLR-308-931



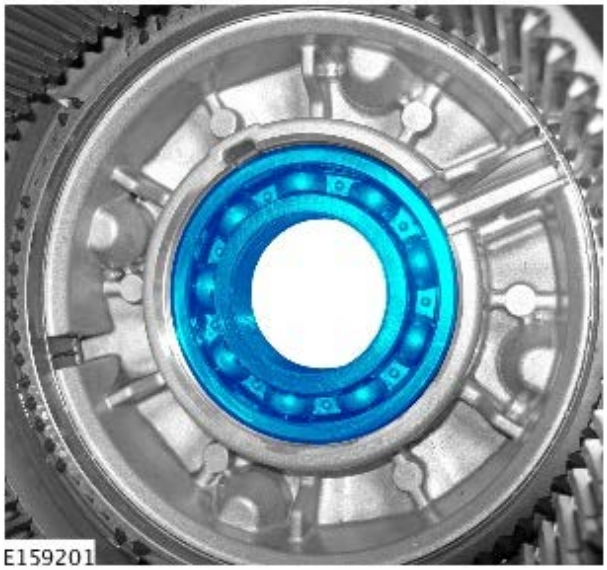
18.



19.



20.



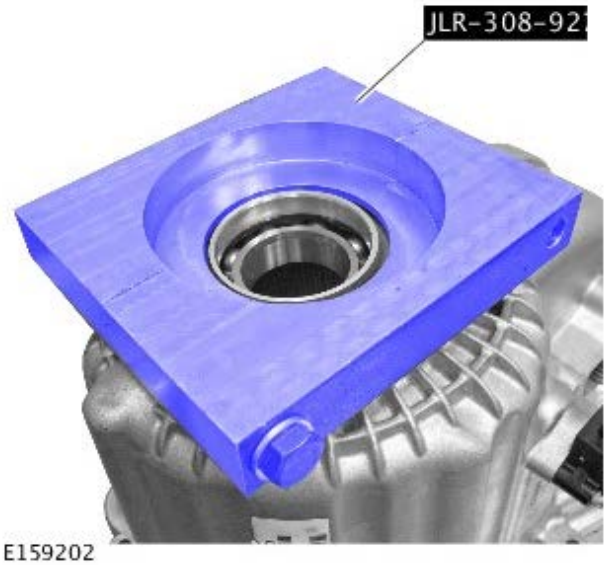
21. With assistance, release the transfer case from the flat surface.

Installation

CAUTION: During the installation, make sure that all components are clean and free from foreign material.

1. Position the special tool as shown, to support the transfer case during the next step.

   Special Tool(s): JLR-308-927







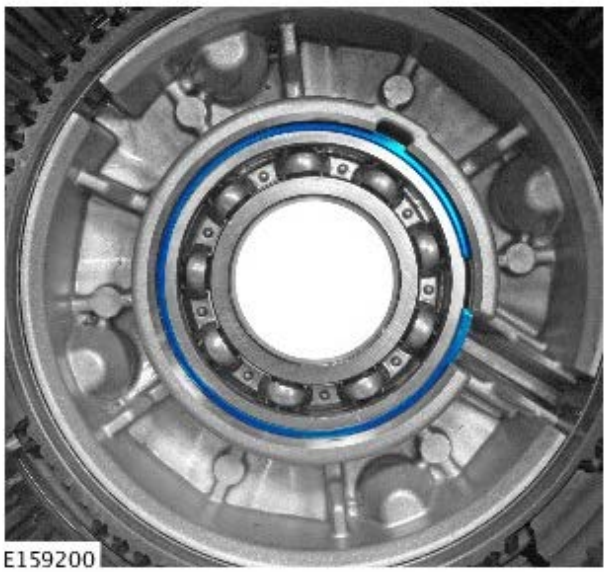
E159203

2. CAUTION: The chamfer on the bearing inner track must face the seal.

   Install the bearing.

   Special Tool(s): 205-726

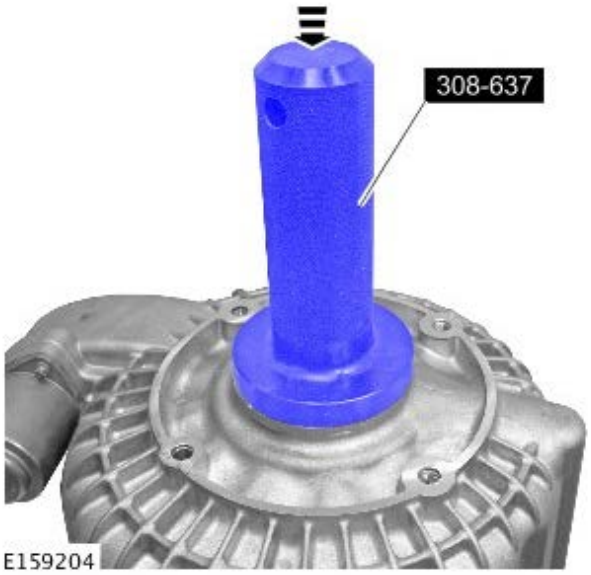
3.

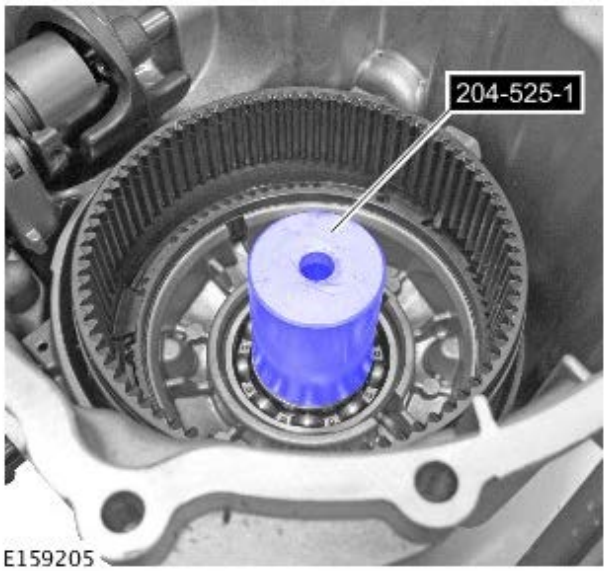


E159200

4. Install the seal.

   Special Tool(s): 308-637





5. CAUTIONS:

   Centralise the snap ring in the snap ring groove before installing the output flange.

   Extreme care is necessary to make sure the snap ring enters the bearing squarely.

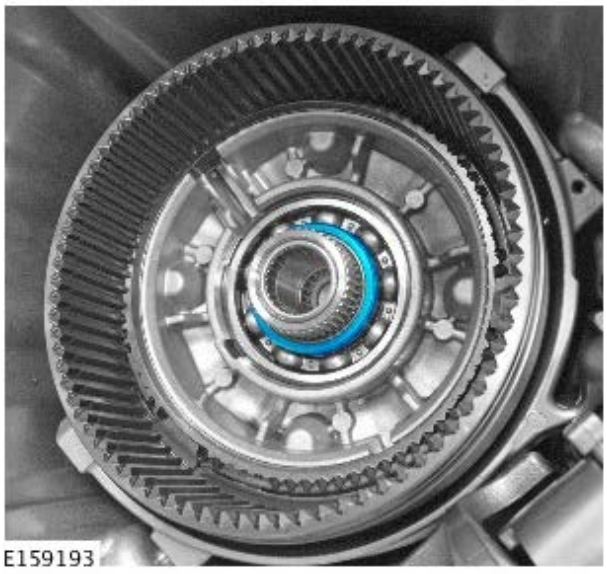
   Install a new snap ring.

   Using the special tool and with assistance, install the drive flange.

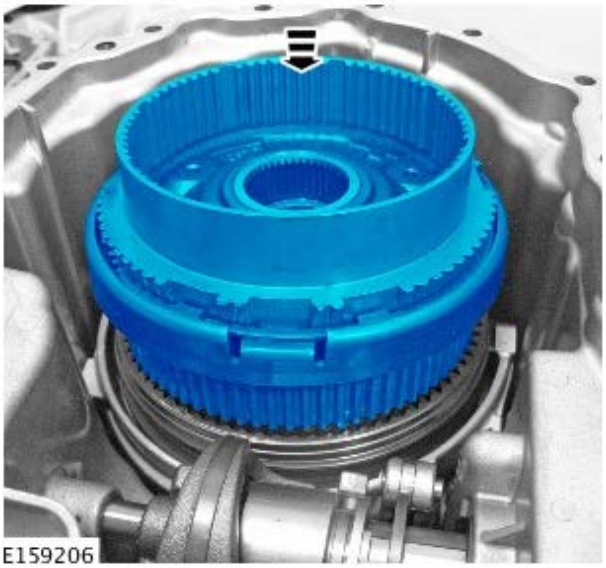
   Special Tool(s): 204-525-1

6. With assistance, secure the rear half of the transfer case with it's rear face down on a flat surface.

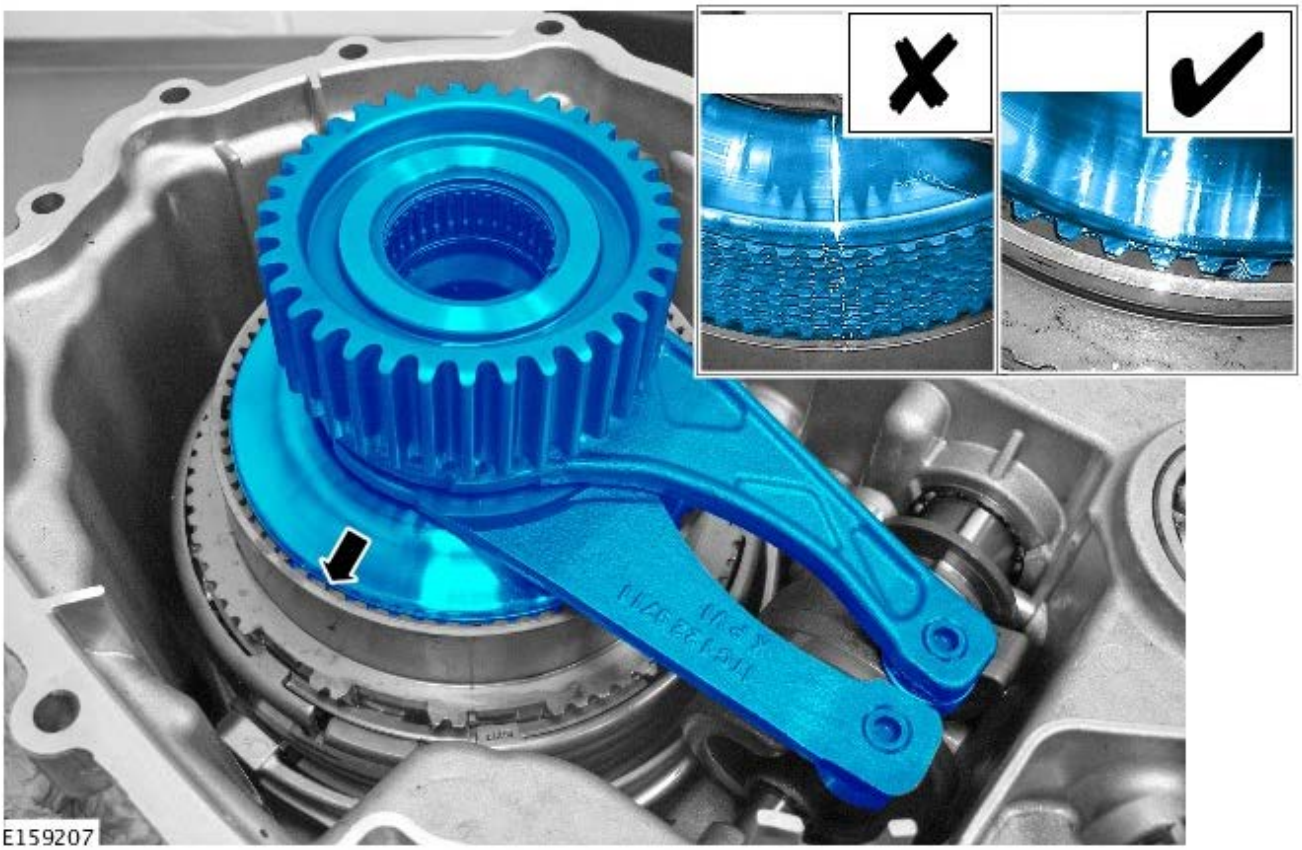
7. Install the spacer.



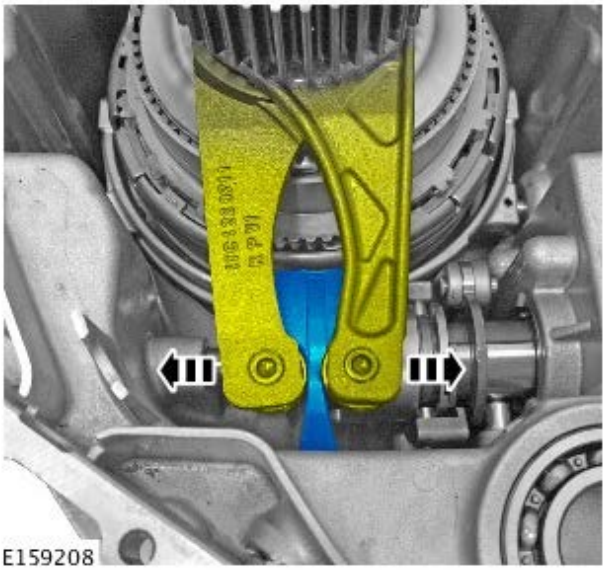
8. NOTE: Rotate the differential to engage the splines.



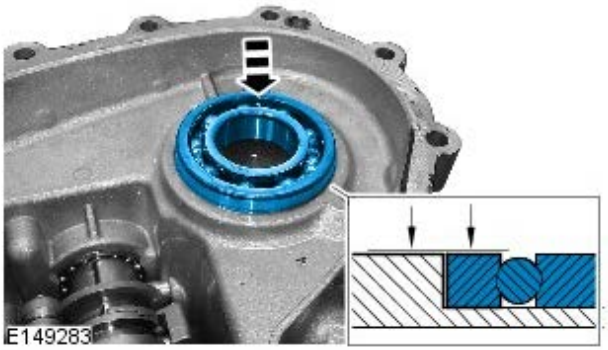
9. NOTE: Rotate the assembly to engage the clutch plates.



10.

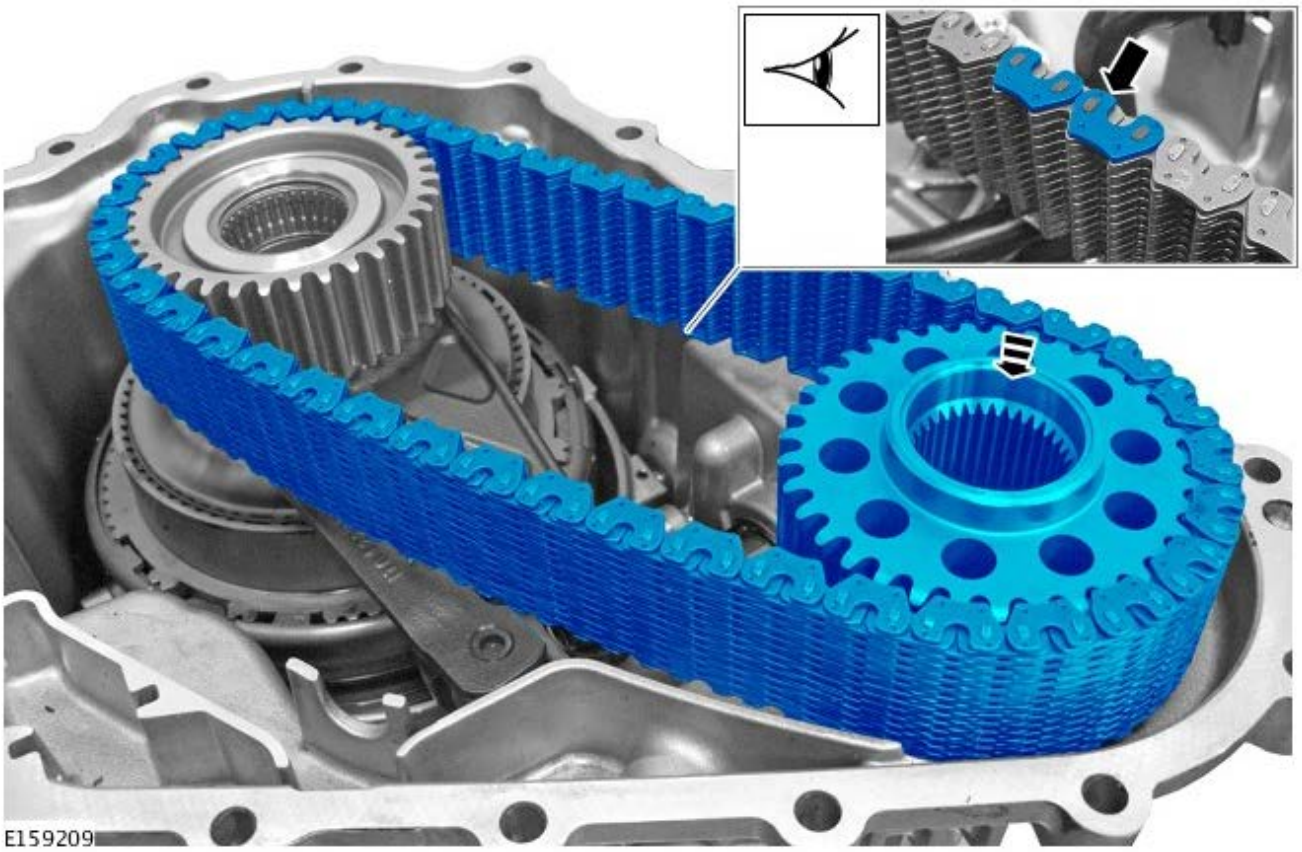


11. CAUTION: Make sure that the front driveshaft gear bearing is fully seated before installing the chain and gear.

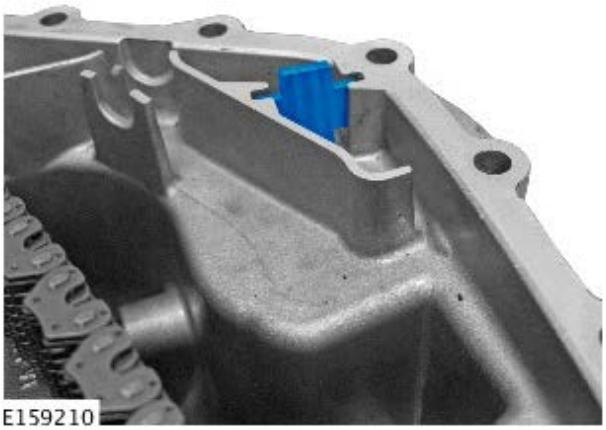


12. CAUTION: Make sure that the chain is installed with the dark links facing down.

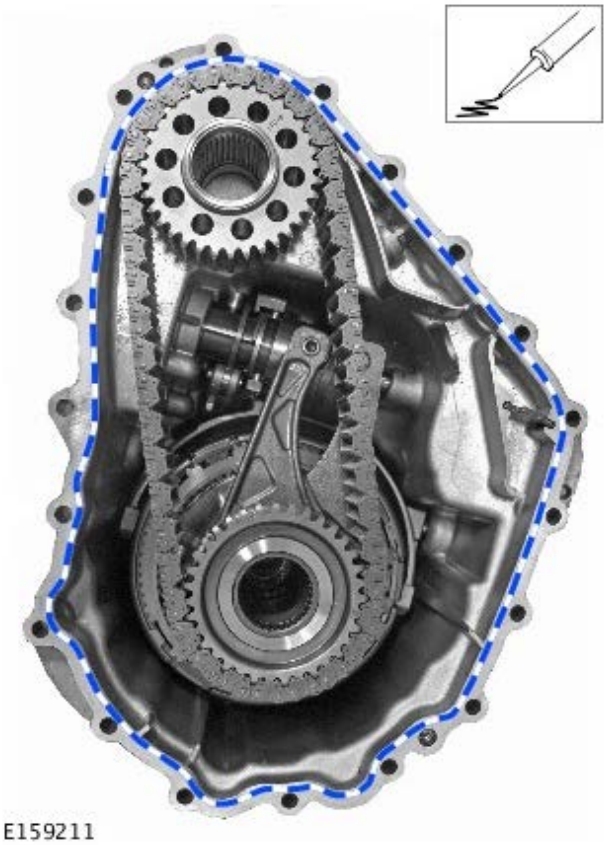
NOTE: The relieved splined inner diameter of the sprocket must face up as shown.



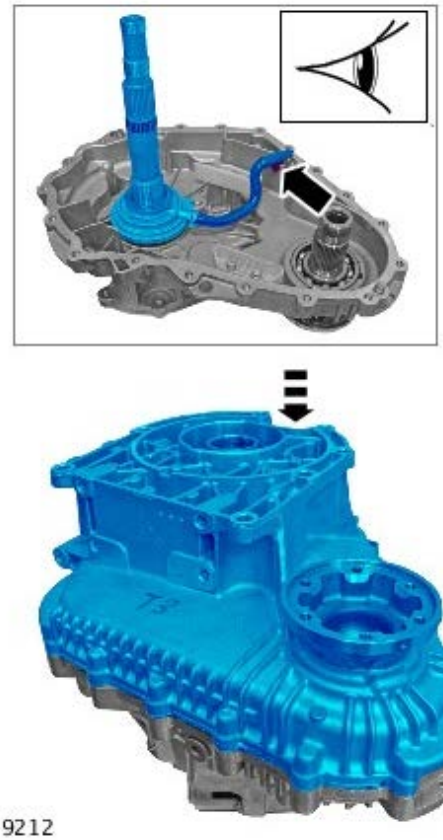
13. CAUTION: Make sure that the component is clean and free of foreign material .



14. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.



E159211



E159212

15. CAUTIONS:

    Make sure that the input shaft spacer is located correctly.

    The input shaft and fluid pump assembly must be supported and held in place by hand, until it is located securely into the clutch assembly.

    Install the front half of the transfer case.

16. CAUTION: Care must be taken when turning the transfer case over. The transfer case halves must not be allowed to separate.

    With assistance, release the transfer case and secure with it's transmission mating face down on a flat surface.

17. CAUTION: Only tighten the bolts finger-tight at this stage.



E159191

18. *Torque:* 10 Nm



E159409

19. *Torque:* 35 Nm



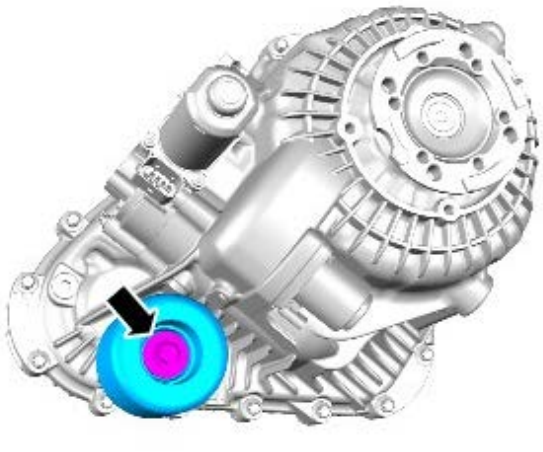
E159191

20. *Torque:* 35 Nm



E159190

21. *Torque:* 75 Nm



E159189

22. With assistance, release the transfer case from the flat surface.

23. Refer to: Transfer Case - V8 5.0L Petrol/V8 S/C 5.0L Petrol (308-07B Transfer Case, Installation).
Refer to: Transfer Case - TDV6 3.0L Diesel (308-07B Transfer Case, Installation).
Refer to: Transfer Case - TDV8 3.6L Diesel (308-07B Transfer Case, Installation).

24. Refer to: Transfer Case Draining and Filling (308-07B Transfer Case, General Procedures).

Published: 08-Nov-2013

Transfer Case - Transfer Case Rear Output Shaft Bearing

Removal and Installation

Removal

1. The transfer case rear output shaft bearing must be serviced with the seal as a pair.

   Refer to: Transfer Case Rear Output Seal (308-07B Transfer Case, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

Published: 11-Nov-2013

Transfer Case - Transfer Case V8 5.0L Petrol/V8 S/C 5.0L Petrol

Removal

Special Tool(s)

303-1069  E53727	Wrench adaptor 303-1069

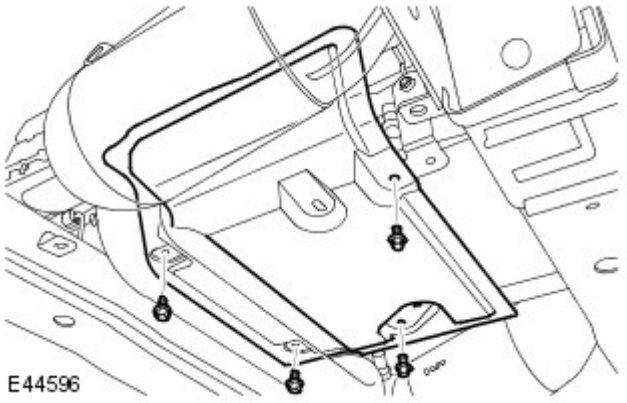
Removal

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

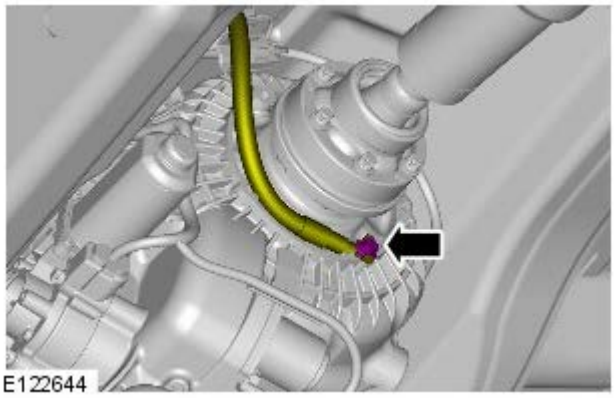
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

3. Remove the transmission heat shield.
   - Remove the 4 bolts.


E44596

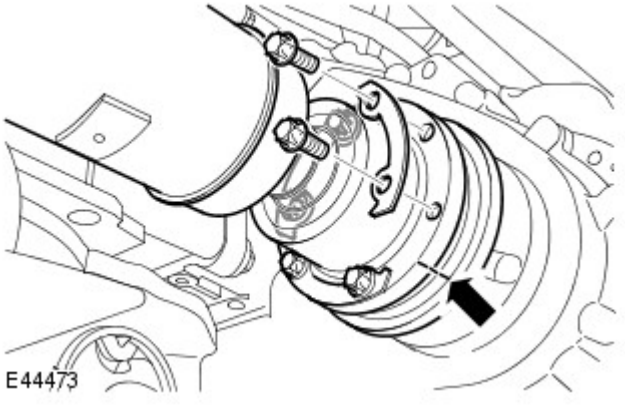
4. Remove the ground cable from the transfer box.
   - Remove the bolt.


E122644

5. NOTE: Do not carry out this step if the component removed for access only.

   Drain the transfer case fluid.
   For additional information, refer to: Transfer Case Draining and Filling (308-07B Transfer Case, General Procedures).

6. Remove the transmission crossmember.
   For additional information, refer to: Transmission Support Crossmember - V8 5.0L Petrol/V8 S/C 5.0L Petrol (502-02 Full Frame and Body Mounting, Removal and Installation).

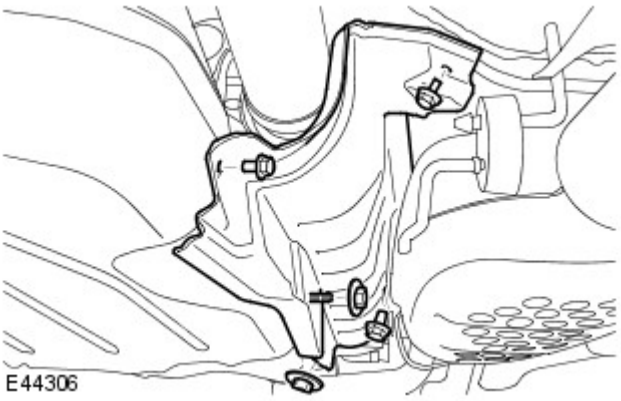


7. CAUTIONS:

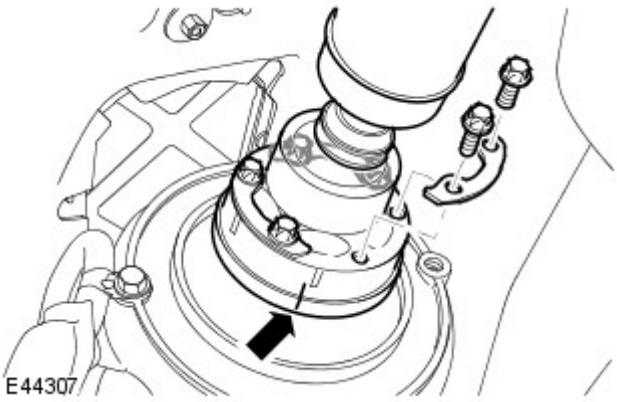
   Mark the position of the driveshaft flange in relation to the drive pinion flange.

   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Release the front driveshaft from the transfer case drive flange.
   - Remove the 6 Torx bolts and washers, discard the bolts.
   - Using a suitable tie strap, reposition and secure the driveshaft to the exhaust system.



8. Remove the fuel tank heat shield.
   - Remove the 3 bolts and 2 nuts.

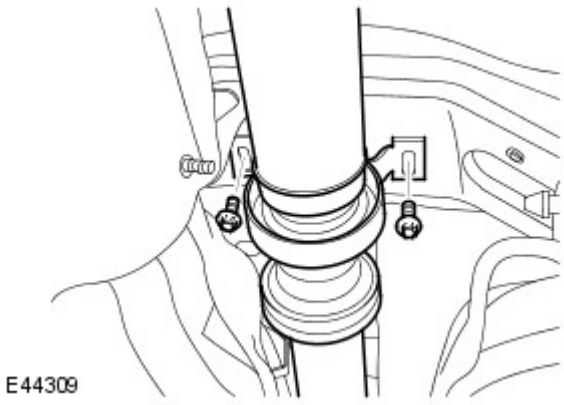


9. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

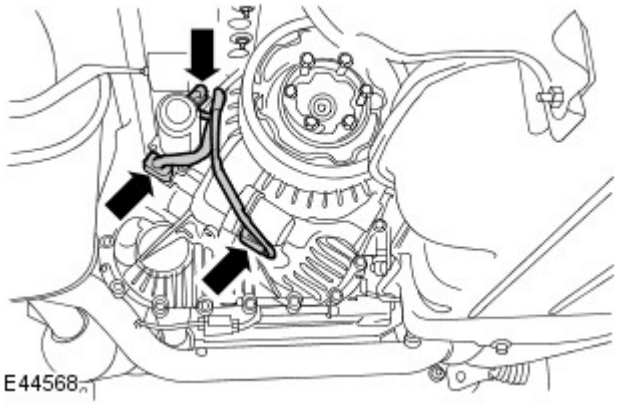
   Release the rear driveshaft from the transfer case drive flange.
   - Remove the 6 Torx bolts and washers.



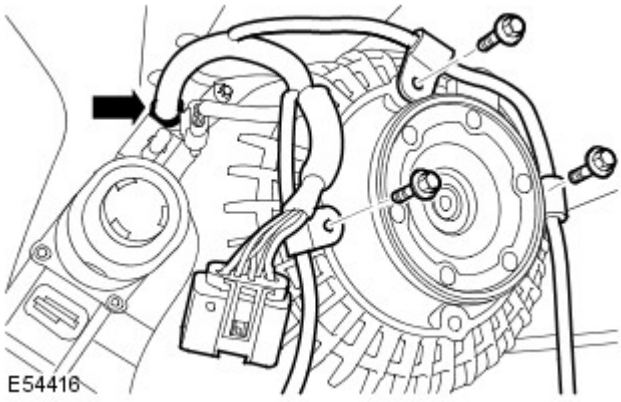
10. CAUTION: To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

    Release the driveshaft center bearing mount.
    - Remove the 2 driveshaft center bearing mount bolts.
    - Using suitable securing strap, reposition and support the driveshaft.

11. Disconnect the transfer case 3 electrical connectors.

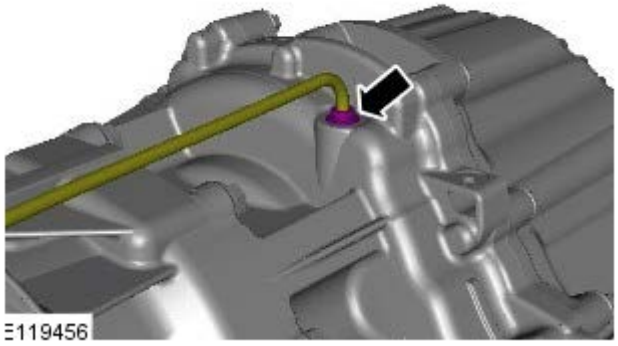


12. Release the wiring harness from the transfer case.
    - Remove the 3 bolts.
    - Release the clip.

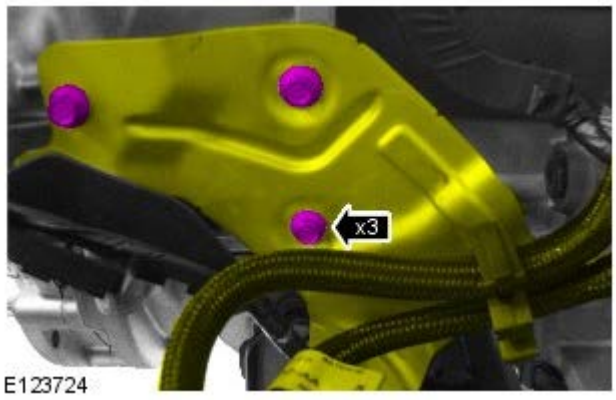


13. CAUTION: Always plug any open connections to prevent contamination.

    Disconnect the breather line.
    - Depress the locking ring.



14. Release the fuel line support bracket.
    - Remove the 3 bolts.

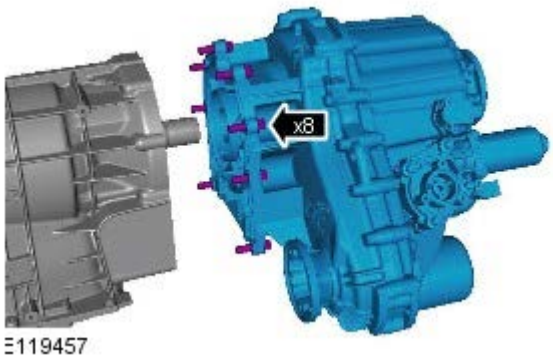


15. Support the transmission on a jack.

16. WARNING: Secure the component to the transmission jack.

    Using a transmission jack, support the transfer case.

17. With assistance, remove the transfer case.
    - Remove the 8 bolts.
    - Move the fuel hose support bracket aside.



E119457

- Remove the O-ring seal.

Published: 11-Nov-2013

Transfer Case - Transfer Case TDV6 3.0L Diesel

Removal

Special Tool(s)

	Wrench adaptor 303-1069

Removal

All vehicles

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

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

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

   Raise and support the vehicle.

Vehicles with diesel particulate filter (DPF)

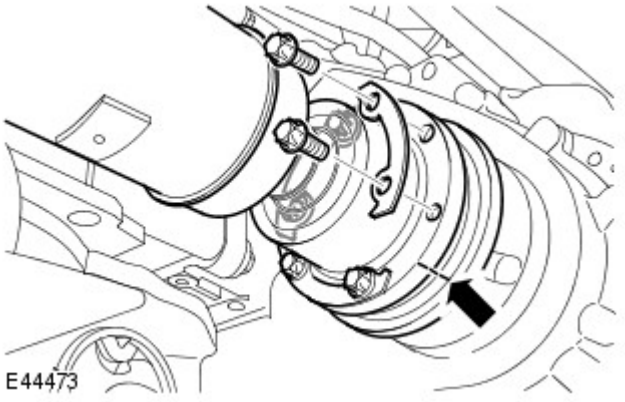
3. Remove the diesel particulate filter (DPF).
   For additional information, refer to: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

All vehicles

4. NOTE: Do not carry out this step if the component removed for access only.

   Drain the transfer case fluid.
   For additional information, refer to: Transfer Case Draining and Filling (308-07B Transfer Case, General Procedures).

5. Remove the transmission crossmember.
   For additional information, refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

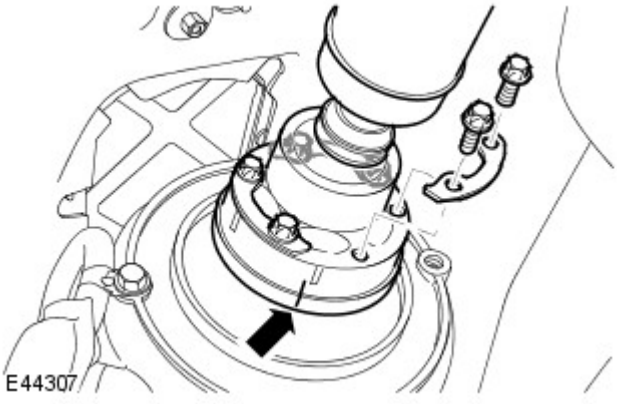


6. CAUTION: To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   NOTE: Mark the position of the driveshaft on the transmission flange.

   Release the front driveshaft from the transfer case drive flange.
   - Remove the 6 Torx bolts and washers, discard the bolts.
   - Using a suitable tie strap, secure the driveshaft.

7. CAUTION: To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

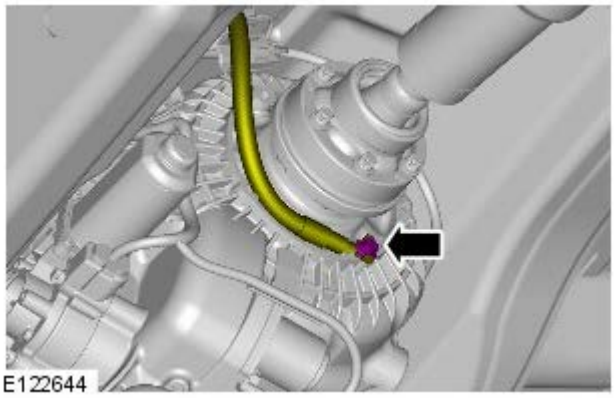


NOTE: Mark the position of the driveshaft on the transmission flange.

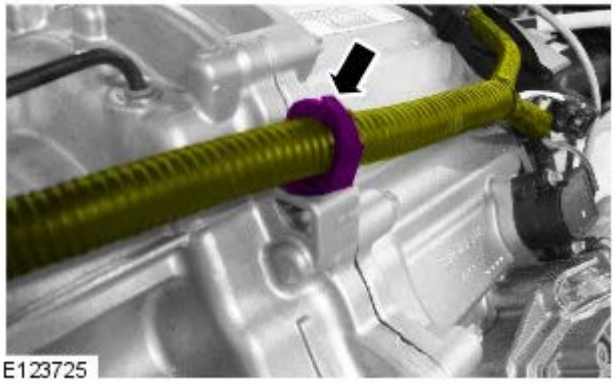
Release the rear driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers.
- Using a suitable tie strap, secure the driveshaft.

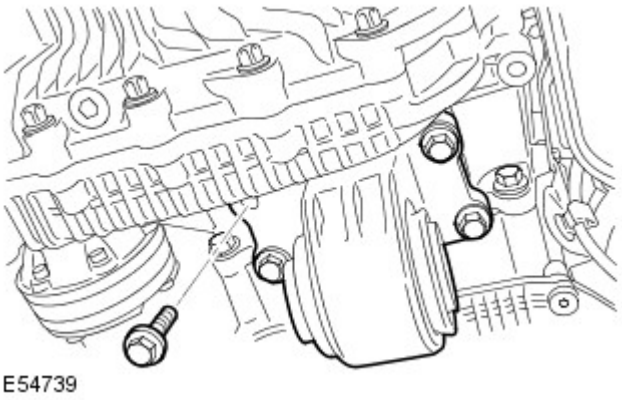
8. Remove the ground cable from the transfer box.
   - Remove the bolt.



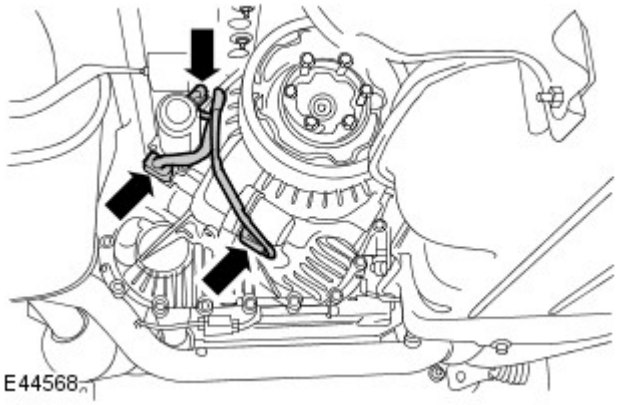
9. Release the transmission wiring harness retaining clip.



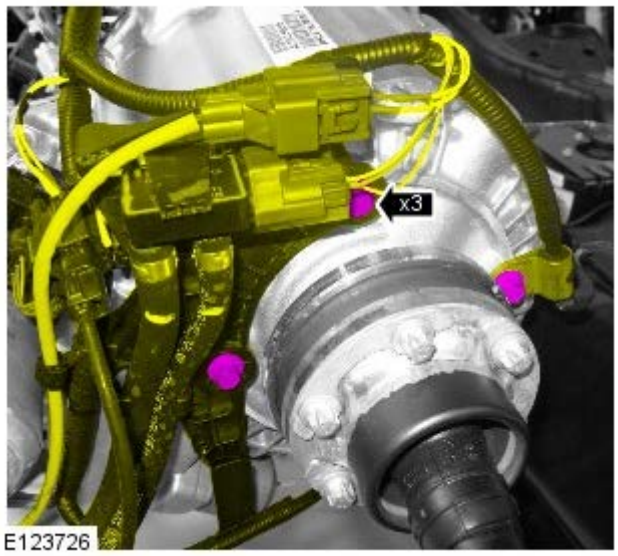
10. Remove the transmission support insulator.
    - Remove the 4 bolts.



11. Disconnect the transfer case 3 electrical connectors.

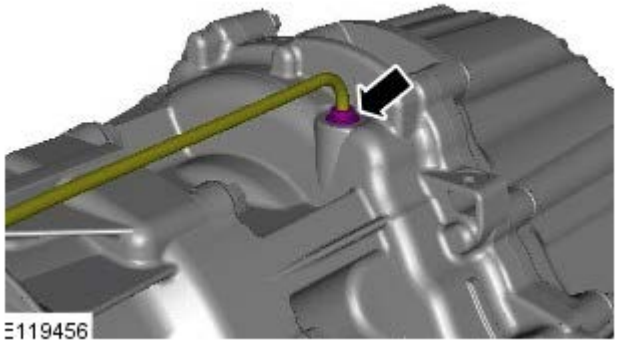


12. Release the wiring harness from the transfer case.
    - Remove the 3 bolts.

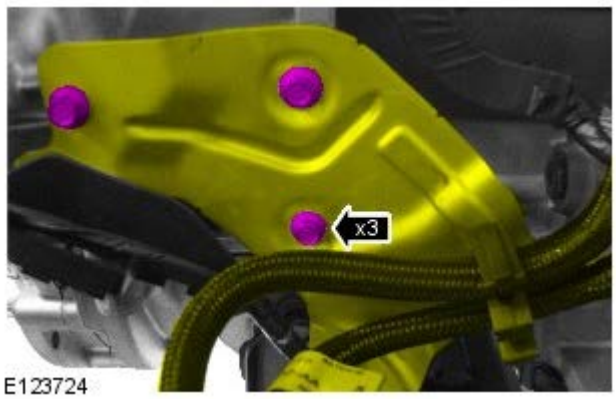


13. CAUTION: Always plug any open connections to prevent contamination.

    Disconnect the breather line.
    - Depress the locking ring.



14. Release the fuel line support bracket.
    - Remove the 3 bolts.



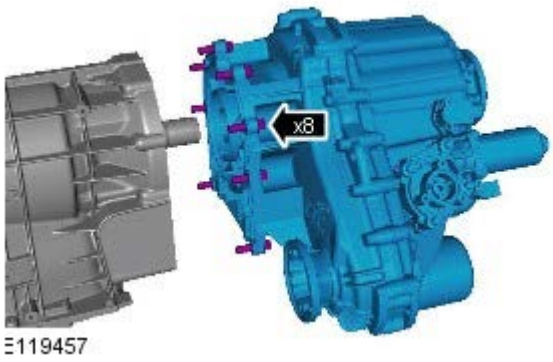
15. Support the transmission on a jack.

16. WARNING: Secure the component to the transmission

jack.

Using a transmission jack, support the transfer case.

17. With assistance, remove the transfer case.
    - Remove the 8 bolts.
    - Move the fuel hose support bracket aside.
    - Remove the O-ring seal.



E119457

Published: 11-Nov-2013

Transfer Case - Transfer Case TDV8 3.6L Diesel

Removal

Special Tool(s)

	Wrench adaptor 303-1069

Removal

All vehicles

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.

Vehicles with diesel particulate filter (DPF)

2. Remove the diesel particulate filter (DPF). For additional information, refer to: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

Vehicles without diesel particulate filter (DPF)

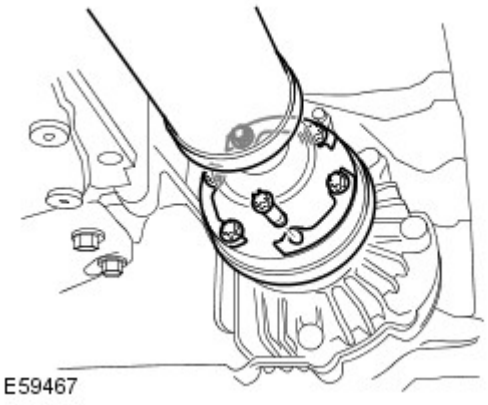
3. Remove the front muffler.
   For additional information, refer to: Front Muffler (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

All vehicles

4. NOTE: Do not carry out this step if the component removed for access only.

   Drain the transfer case fluid.
   For additional information, refer to: Transfer Case Draining and Filling (308-07B Transfer Case, General Procedures).

5. Remove the transmission crossmember. For additional information, refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).



6. CAUTIONS:

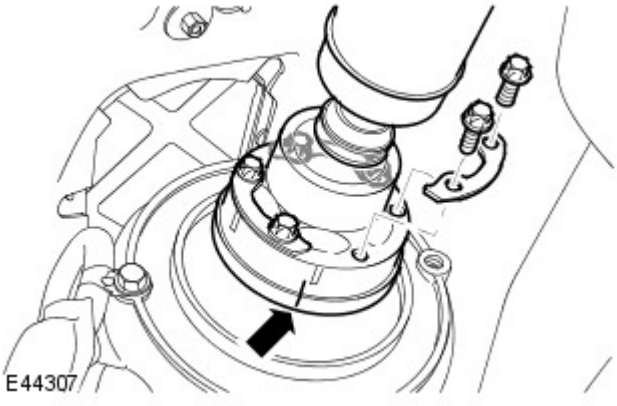
   Mark the position of the driveshaft flange in relation to the drive pinion flange.

   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Release the front driveshaft from the transfer case drive flange.
   - Remove and discard the 6 bolts.
   - Remove the 3 washers.
   - Using a suitable tie strap, secure the driveshaft.

7. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

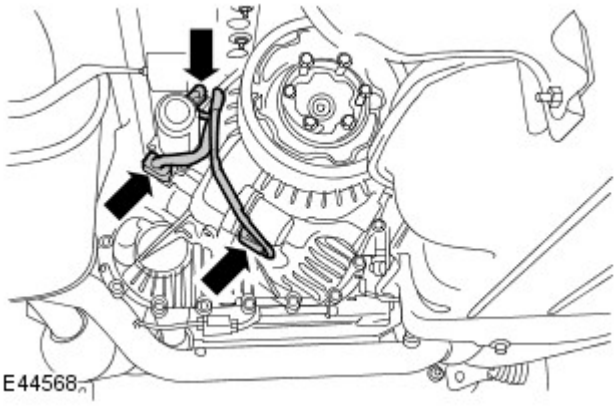


To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

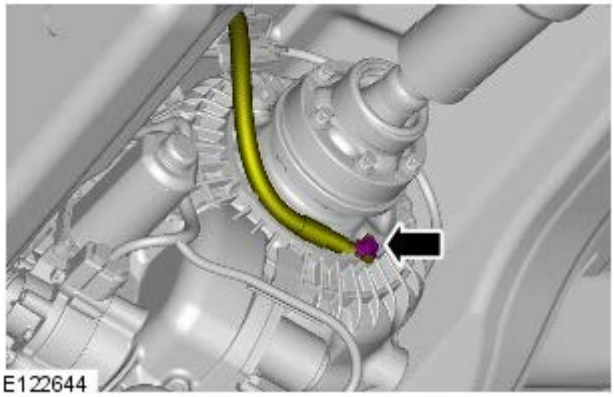
Release the rear driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers.
- Using a suitable tie strap, secure the driveshaft.

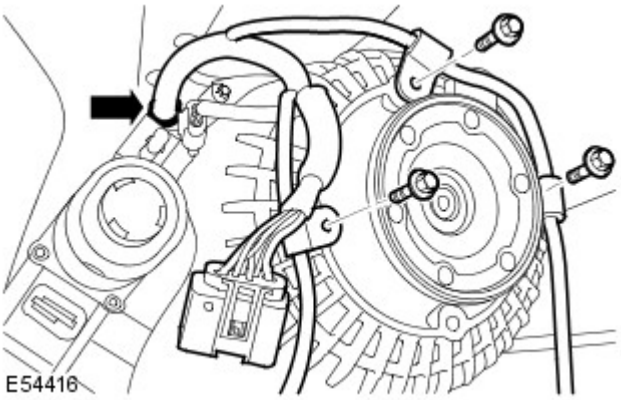
8. Disconnect the 3 electrical connectors from the transfer case.



9. Remove the ground cable from the transfer box.
   - Remove the bolt.

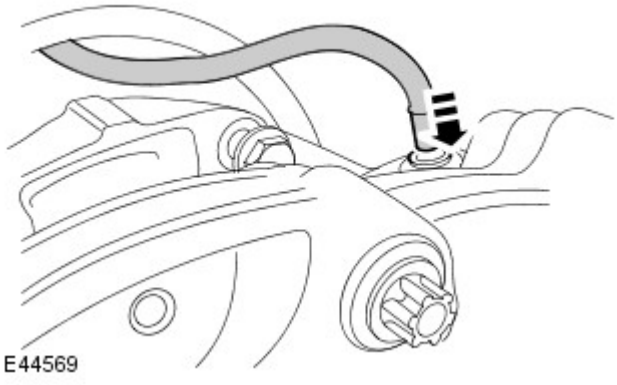


10. Release the wiring harness from the transfer case.
    - Remove the 3 bolts.
    - Release the clip.

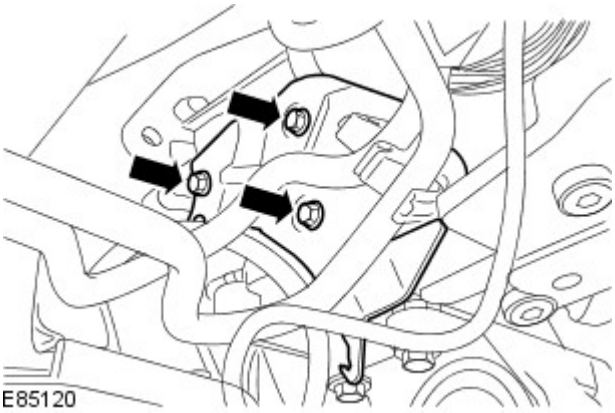


11. CAUTION: Always plug any open connections to prevent contamination.

    Disconnect the breather line.
    - Release the locking ring.



12. Release the fuel line support bracket.
    - Remove the 3 bolts.

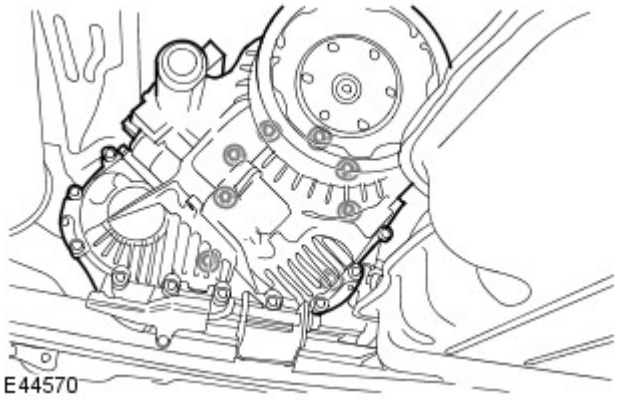


13. Support the transmission.

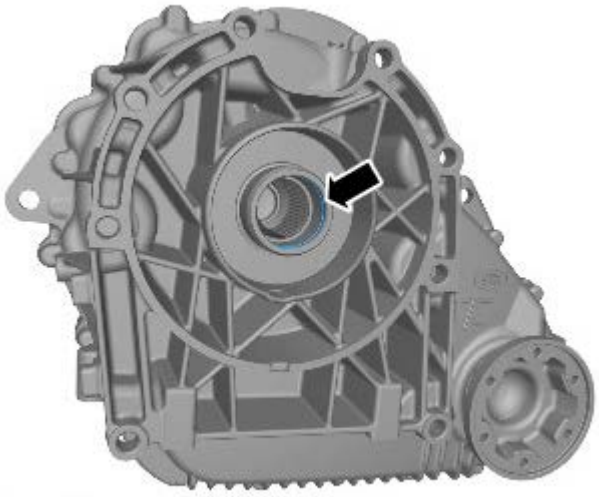
14. WARNING: Secure the component to the transmission jack.

    Using a transmission jack, support the transfer case.

15. With assistance, remove the transfer case.
    - Remove the 8 bolts.
    - Move the fuel hose support bracket aside.



16. Remove and discard the O-ring seal.



E127507

Published: 11-Nov-2013

Transfer Case - Transfer Case V8 5.0L Petrol/V8 S/C 5.0L Petrol

Installation

Special Tool(s)

	Wrench adaptor 303-1069

Installation

1. With assistance, install the transfer case.
   - Clean the component mating faces.
   - Lubricate input shaft splines with 'Weicon TL7391' grease.
   - Install the O-ring seal.
   - Using the special tool, tighten the bolts to 45 Nm (33 lb.ft).
2. Connect the breather line.
3. Position the fuel line support bracket.
   - Tighten the bolts to 10 Nm (7 lb.ft).
   - Secure the fuel lines.
4. Connect the electrical connectors.
5. Secure the wiring harness to the transfer case.
   - Secure with the clip.
   - Tighten the bolts to 25 Nm (18 lb.ft).
6. Secure the front driveshaft to the transfer case drive flange.
   - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
   - Stage 2: Tighten the bolts a further 90 degrees.
7. Secure the rear driveshaft to the transfer case drive flange.
   - Clean the component mating faces.
   - Tighten the Torx bolts to 55 Nm (40 lb.ft).
8. CAUTIONS:

   Align the driveshaft center bearing mount by moving the floating front section of the shaft backward or forwards until the bolt holes in the mount align with the holes in the chassis.

   Make sure the center bearing mount is not under tension.

   Install the driveshaft center bearing mount bolts.
   - Align the center bearing mount.
   - Tighten the driveshaft center bearing retaining bolts to 30 Nm (22 lb.ft).
9. Install the fuel tank heat shield.
   - Tighten the bolts to 6 Nm (4 lb.ft).
   - Tighten the nuts to 3 Nm (2 lb.ft).
10. Install the ground cable to the transfer box.
    - Tighten the bolt to 15Nm (11 lb.ft).
11. Install the transmission heat shield.
    - Tighten the bolts to 10 Nm (7 lb.ft).
12. Install the transmission crossmember.
    For additional information, refer to: Transmission Support Crossmember - V8 5.0L Petrol/V8 S/C 5.0L Petrol (502-02 Full Frame and Body Mounting, Removal and Installation).

13.  NOTE: Do not carry out this step if the component removed for access only.

    Fill the transfer case with the recommended fluid.
    For additional information, refer to: Transfer Case Draining and Filling (308-07B Transfer Case, General Procedures).

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

15.  NOTE: Do not carry out this step if the component removed for access only.

    1. Connect the Land Rover approved diagnostic equipment.
    2. Start the diagnostic service function **transfer case-transfer case replacement.**
    3. Clear any Diagnostic Trouble Codes (DTCs) after calibration and check for correct operation.

Published: 11-Nov-2013

Transfer Case - Transfer Case TDV6 3.0L Diesel

Installation

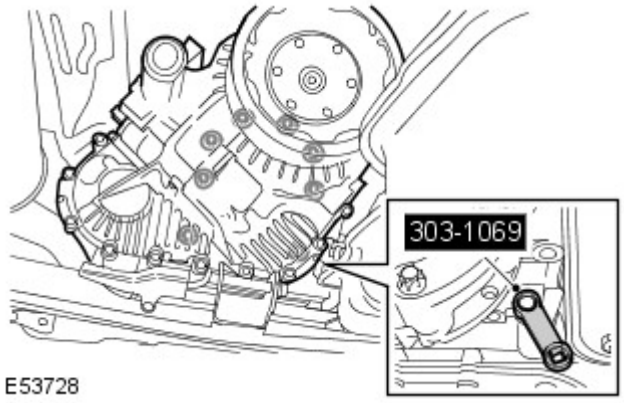
Special Tool(s)

 E53727	Wrench adaptor 303-1069

Installation

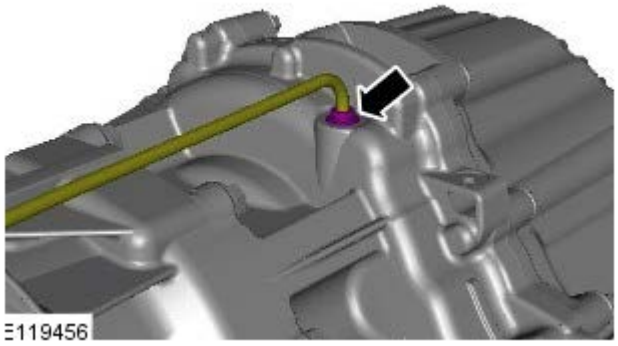
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

All vehicles

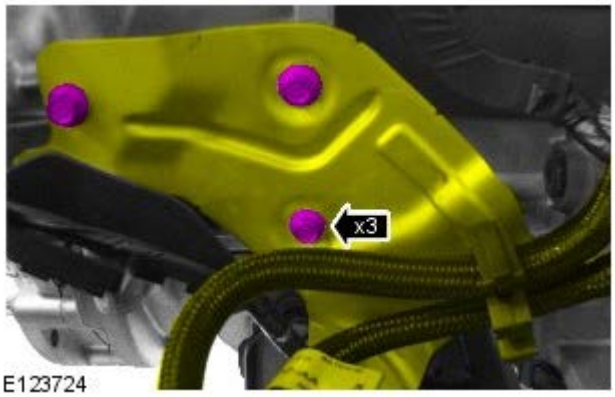


E53728

1. With assistance, install the transfer case.
   - Clean the component mating faces.
   - Lubricate input shaft splines with 'Weicon TL7391' grease.
   - Install the O-ring seal.
   - Align the fuel hose support bracket.
   - Using the special tool, tighten the bolts to 45 Nm (33 lb.ft).


E119456

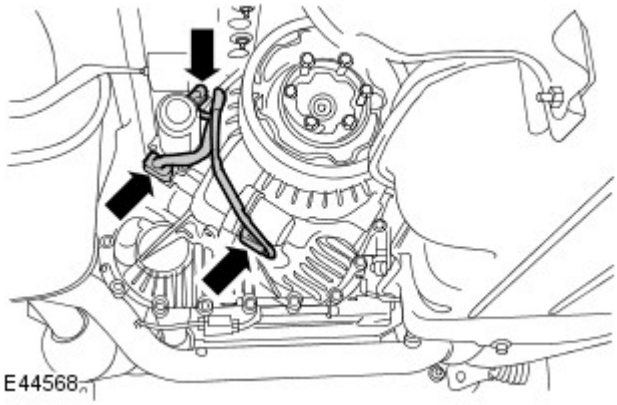
2. Connect the breather line.



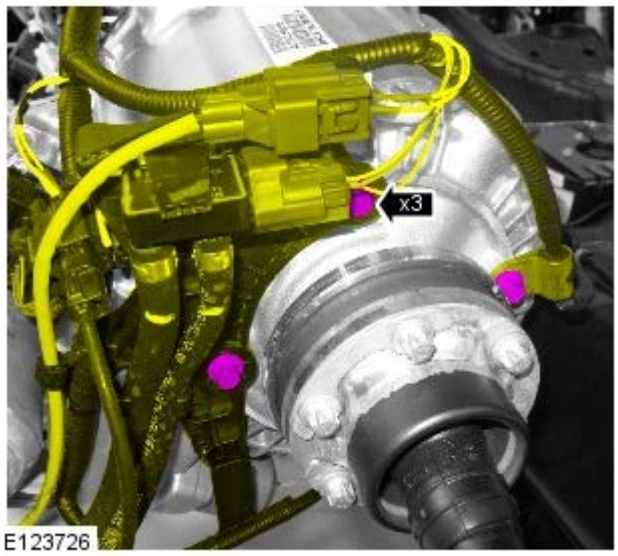
E123724

3. Secure the fuel line support bracket.
   - Tighten the bolts to 10 Nm (7 lb.ft).

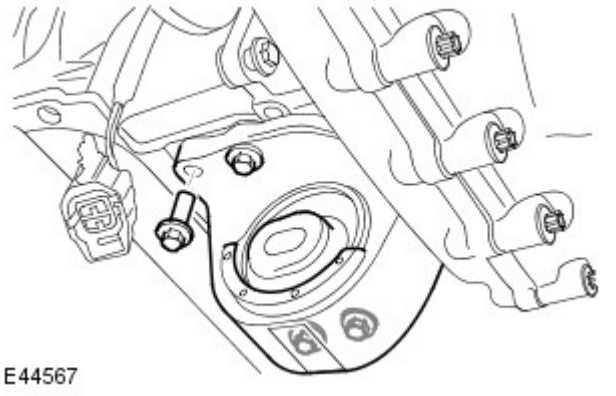
4. Connect the electrical connectors.



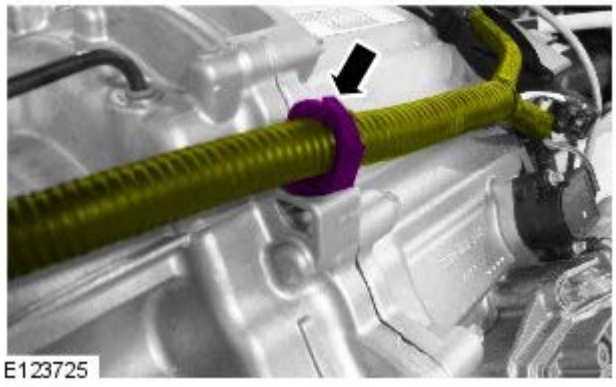
5. Secure the wiring harness to the transfer case.
    - Tighten the bolts to 25 Nm (18 lb.ft).



6. Install the transmission support insulator.
    - Clean the component mating faces.
    - Tighten the bolts to 60 Nm (44 lb.ft).



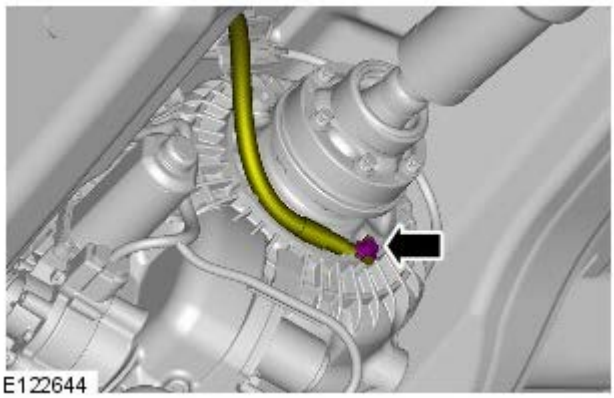
7. Secure the transmission wiring harness.



8. Secure the rear driveshaft to the transfer case drive flange.
    - Install the washers.
    - Tighten the Torx bolts to 55 Nm (40 lb.ft).

9. Secure the front driveshaft to the transfer case drive flange.
    - Install the washers.
    - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
    - Stage 2: Tighten the bolts a further 90 degrees.

10. Install the ground cable to the transfer box.
    - Tighten the bolt to 15Nm (11 lb.ft).



11. Install the transmission crossmember.
    For additional information, refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

Vehicles with diesel particulate filter (DPF)

12. Install the DPF.
    For additional information, refer to: Diesel Particulate Filter (DPF) (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

All vehicles

13. NOTE: Do not carry out this step if the component removed for access only.

    Fill the transfer case with the recommended fluid.
    For additional information, refer to: Transfer Case Draining and Filling (308-07B Transfer Case, General Procedures).

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

15. NOTE: Do not carry out this step if the component removed for access only.

    1. Connect the Land Rover approved diagnostic equipment.
    2. Start the diagnostic service function **transfer case-transfer case replacement.**
    3. Clear any Diagnostic Trouble Codes (DTCs) after calibration and check for correct operation.

Published: 11-Nov-2013

Transfer Case - Transfer Case TDV8 3.6L Diesel

Installation

Special Tool(s)

	Wrench adaptor 303-1069

Installation

All vehicles

1. With assistance, install the transfer case.
   - Clean the components mating faces.
   - Lubricate the input shaft splines with the recomended grease.
   - Install a new O-ring seal.
   - Tighten the bolts to 45 Nm (33 lb.ft).
2. Secure the fuel line support bracket.
   - Tighten the bolts to 10 Nm (7 lb.ft).
3. Connect the breather line.
4. Install the ground cable to the transfer box.
   - Tighten the bolt to 15Nm (11 lb.ft).
5. Secure the wiring harness to the transfer case.
   - Secure with the clip.
   - Tighten the bolts to 25 Nm (18 lb.ft).
6. Connect the electrical connectors.
7. NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

   Secure the rear driveshaft to the transfer case drive flange.
   - Tighten the Torx bolts to 55 Nm (40 lb.ft).
8. Secure the front driveshaft to the transfer case drive flange.
   - Install the washers.
   - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
   - Stage 2: Tighten the bolts a further 90 degrees.
9. Install the transmission crossmember.
   For additional information, refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

Vehicles with diesel particulate filter (DPF)

10. Install the DPF. For additional information, refer to: Front Muffler (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

Vehicles without diesel particulate filter (DPF)

11. Install the front muffler.For additional information, refer to: Front Muffler (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

All vehicles

12. NOTE: Do not carry out this step if the component removed for access only.

Fill the transfer case with the recommended fluid.
For additional information, refer to: Transfer Case Draining and Filling (308-07B Transfer Case, General Procedures).

13.

 NOTE: Do not carry out this step if the component removed for access only.

1. Connect the Land Rover approved diagnostic equipment.
2. Start the diagnostic service function **transfer case-transfer case replacement.**
3. Clear any Diagnostic Trouble Codes (DTCs) after calibration and check for correct operation.

Published: 11-May-2011

Exhaust System - TDV6 3.0L Diesel -

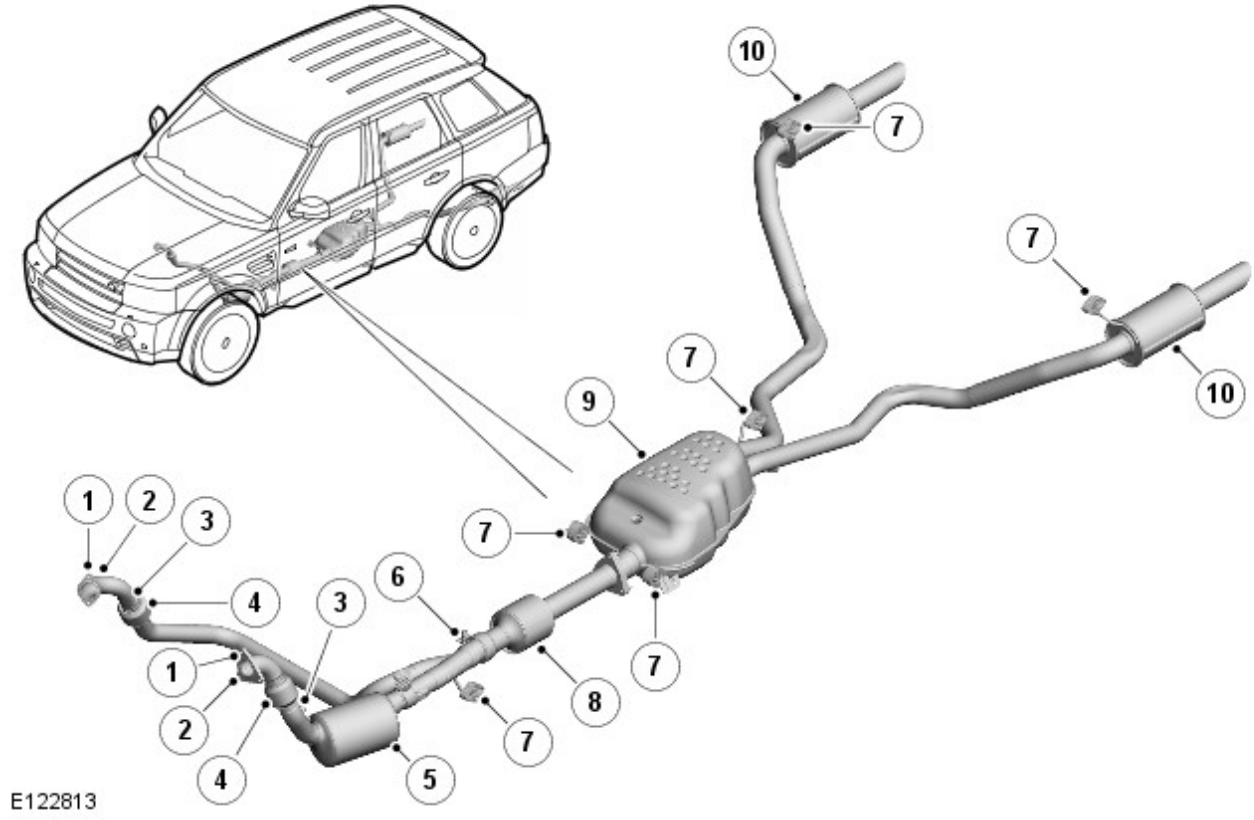
Description	Nm	lb-ft	lb -in
Turbocharger to catalytic converter retaining bolts	28	21	-
Catalytic converter clamp without diesel particulate filter (DPF)	48	35	-
Catalytic converter clamp with DPF	48	35	-
DPF to front muffler securing strap nuts	23	17	-
Catalytic converter temperature sensors	35	26	-
DPF temperature sensor	35	26	-
Heated oxygen sensor (HO2S)	48	35	-
DPF heat shield retaining bolts	10	7	-
Service clamp	48	35	-

Published: 02-Feb-2012

Exhaust System - TDV6 3.0L Diesel - Exhaust System

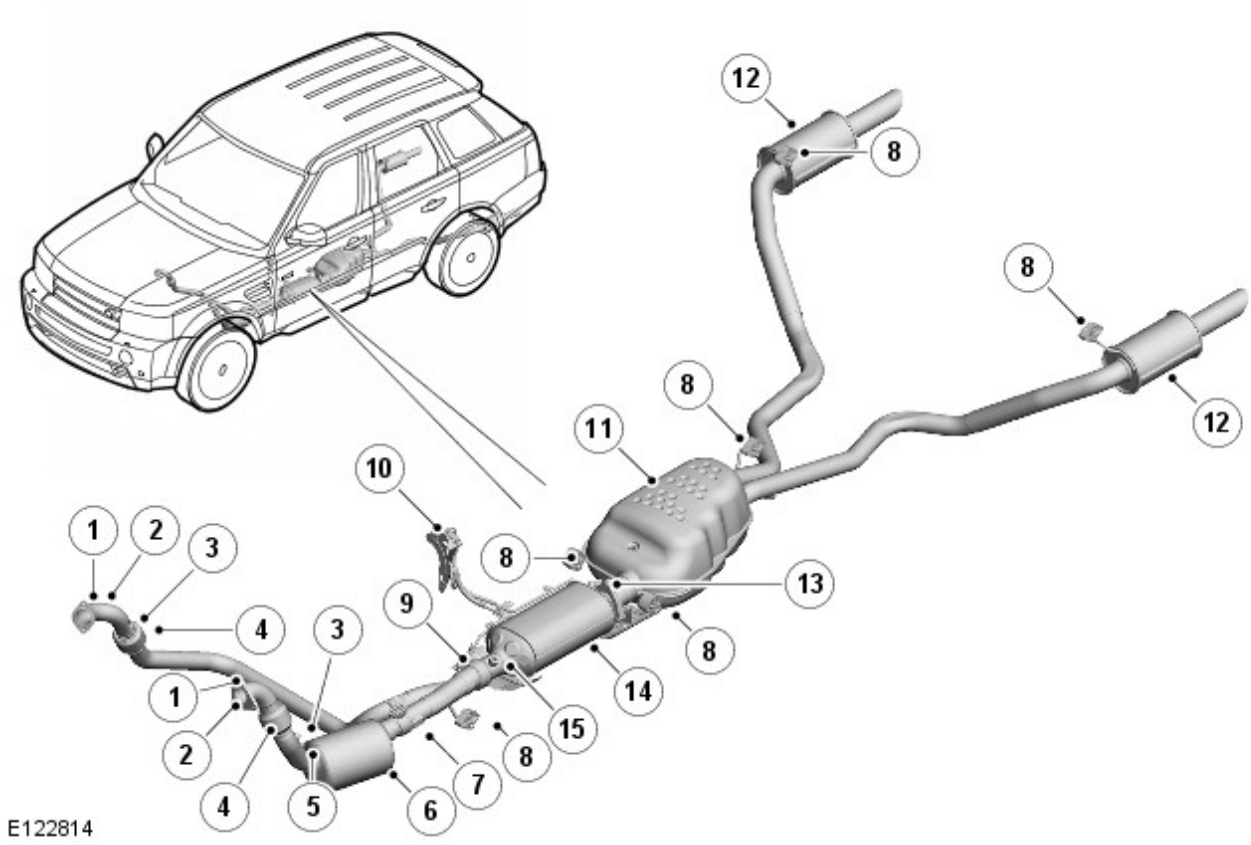
Description and Operation

3.0L TdV6 EXHAUST SYSTEM COMPONENT LOCATION - WITHOUT DIESEL PARTICULATE FILTER



Item	Part Number	Description
1	-	Bolt (5 off)
2	-	Gasket
3	-	Heated Oxygen Sensor (HO2S) mounting boss
4	-	Flexible coupling
5	-	Catalytic converter
6	-	Clamp
7	-	Mounting rubber (6 off)
8	-	Catalytic converter
9	-	Silencer - Center
10	-	Silencer - Rear

3.0L TdV6 EXHAUST SYSTEM COMPONENT LOCATION - WITH DIESEL PARTICULATE FILTER (IF FITTED)



Item	Part Number	Description
1	-	Bolt (5 off)
2	-	Gasket
3	-	Temperature sensor mounting boss
4	-	Flexible coupling
5	-	HO2S mounting boss
6	-	Catalytic converter
7	-	Clamp
8	-	Mounting rubber (6 off)
9	-	Clamp
10	-	Differential pressure sensor
11	-	Silencer - Center
12	-	Silencer - Rear
13	-	Temperature sensor mounting boss
14	-	Diesel Particulate Filter (DPF)
15	-	Temperature sensor mounting boss

OVERVIEW

The 3.0L V6 TdV6 exhaust system is fabricated from stainless steel and is supplied as four separate assemblies; 2 front sections, one incorporating a catalytic converter, a connecting section or Diesel Particulate Filter (DPF) and a rear section incorporating a centre silencer and two rear silencers.

The system is attached to the underside of the body with 6 mounting rubbers which are located on mild steel hanger bars that are welded to the system. The mounting rubbers locate on corresponding hangers which are welded to the underside of the vehicle body.

The system has service repair items available. Indentations in the rear section between the center and the rear silencers show the cut points for the service replacement rear silencers or front section. When a service repair section is used, the joint is connected using a sleeve and two clamps to connect the pipes at the cut points.

Two variants of the exhaust system are available; a non DPF system and a system incorporating a DPF. The DPF is required to comply with EU5 emission regulations

CAUTION: The use of bio-fuels can seriously contaminate and destroy the coatings used on the catalytic converter. The DPF and the catalytic converter can become irreversibly contaminated if non-specified oils or fuels are used. This will result in the vehicle being unable to regenerate the DPF, becoming non-compliant with tailpipe emission regulations and replacement of the catalytic converter and DPF will be required.

If the vehicle is waded in deep water and the engine is stopped with the tailpipes submerged, the water, which can enter the system, can also contaminate both the DPF and the catalytic converter. This again can result in catalytic

converter damage and damaging the ability for the DPF to regenerate therefore requiring both components to be replaced.

DESCRIPTION

FRONT SECTION

The front section comprises 1 catalytic converter for the LH (left-hand) bank of cylinders. The catalytic converter has a welded inlet pipe which is curved through 90 degrees. The RH (right-hand) bank also has a curved inlet pipe which connects to a pipe to the DPF (if fitted) or catalytic converter assembly (vehicles without DPF).

The outer end of each inlet pipe is fitted with a flange which mates with the turbocharger for each bank of cylinders. Three bolts in the LH flange and two bolts in the RH flange locate in threaded holes in the mating flange on the turbocharger. Each flange is sealed with a gasket. The inlet pipes are 55 mm (2.16 in) diameter and are fitted with a flexible coupling.

The base of the catalytic converter has a connection with the LH bank outlet pipe and is secured with a clamp. The outlet connection from the LH bank catalytic converter and the outlet connection from the RH bank, merge into one single pipe which then connects to the DPF (if fitted) or catalytic converter assembly (vehicles without DPF).

The DPF (if fitted) or catalytic converter assembly (vehicles without DPF) is connected at its rearward end to the center silencer with a flange connection with the rear exhaust section. Three studs in the DPF (if fitted) or catalytic converter assembly (vehicles without DPF) mate with the center silencer rear section flange and are secured with 3 nuts and sealed with a gasket.

REAR SECTION

The centre silencer comprises two pressed stainless steel shells which are welded together to give a capacity of 25.2 liters (1537 in^3). The silencer contains baffles and perforated tubes which reduce noise as the exhaust gases pass through the silencer.

Hanger bars are welded to the front right hand side and left hand side of the silencer and provide for the location of mounting rubbers. The silencer has two 60 mm (2.3 in) diameter outlet pipes, with a 1.5 mm (0.06 in) wall thickness, which are curved to pass around the rear suspension components. Each outlet pipe terminates in a welded joint with the rear silencers. The outlet pipes have a hanger bar which provides for the location of a mounting rubber. A hanger bar is welded to the front face of each rear silencer and provides for the location of a mounting rubber.

The silencer is a circular fabrication with a baffle tube which is surrounded with glass fiber to provide further noise suppression. Each silencer has a capacity of 2.7 liters (165 in^3). The silencers each have an outlet pipe which is 65 mm (2.55 in) diameter, with a wall thickness of 1.2 mm (0.05 in). On vehicles without a DPF fitted, each outlet pipe is curved downwards, on vehicles with a DPF fitted the outlet pipes are straight.

CATALYTIC CONVERTER

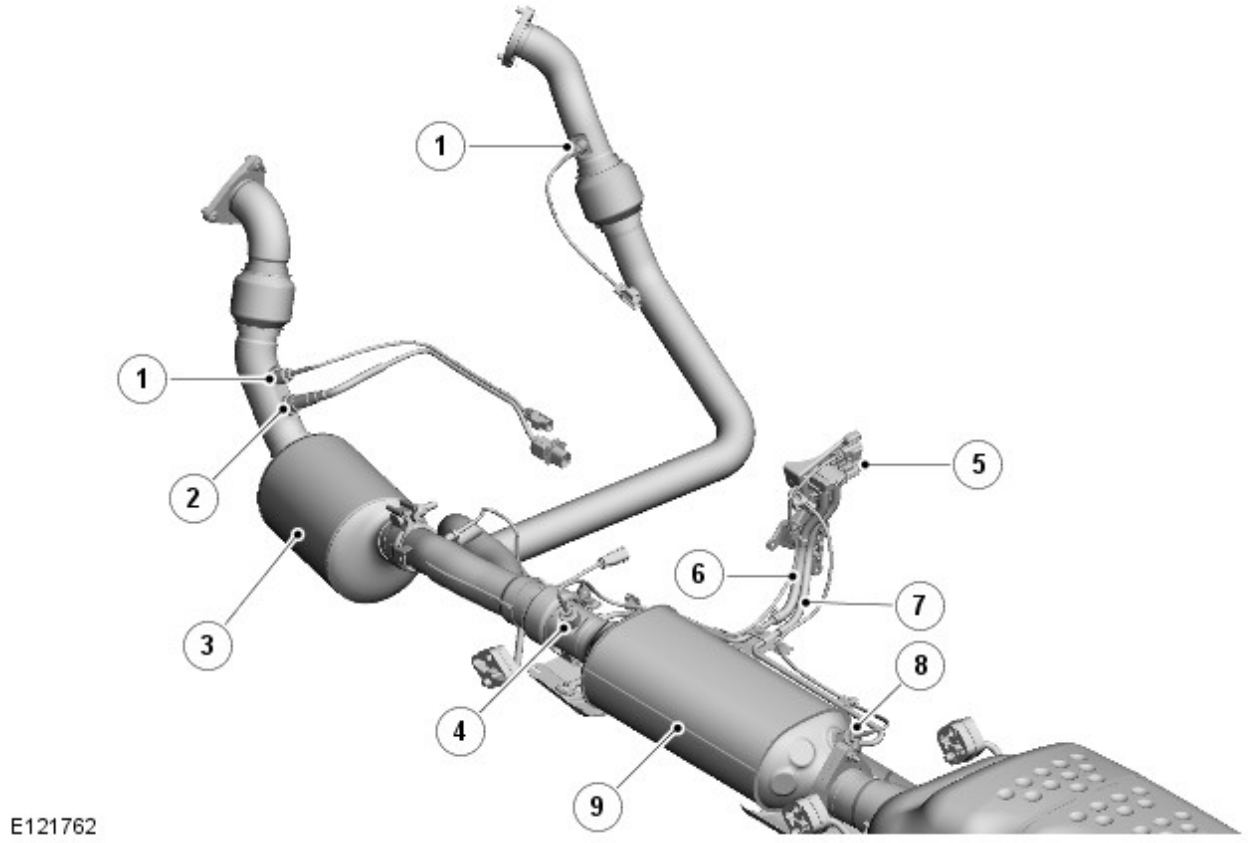
The oxidizing catalytic converter is fitted in the front section of the LH bank outlet pipe from the turbocharger, after the pre-catalyst exhaust gas temperature sensor (vehicles with DPF only) and the Heated Oxygen Sensor (HO2S).

NOTE: On vehicles fitted with a DPF: The pre and post catalyst exhaust gas temperature sensors are used by the engine management system to monitor the DPF for regeneration purposes.

On vehicles without a DPF, a second smaller catalytic converter is fitted in place of the DPF to further improve emissions.

The engine management system provides accurately metered quantities of fuel to the combustion chambers to ensure the most efficient use of fuel and to minimise the exhaust emissions. To further reduce the carbon monoxide and hydrocarbons content of the exhaust gases, a catalytic converter is integrated into the LH bank front pipe of the exhaust system. In the catalytic converter the exhaust gases are passed through honeycombed ceramic elements coated with a special surface treatment called 'washcoat'. The washcoat increases the surface area of the ceramic elements by a factor of approximately 7000. On top of the washcoat is a coating containing platinum and palladium, which are the active constituents for converting harmful emissions into inert by-products. The platinum and palladium add oxygen to the carbon monoxide and the hydrocarbons in the exhaust gases, to convert them into carbon dioxide and water respectively.

DIESEL PARTICULATE FILTER (DPF)



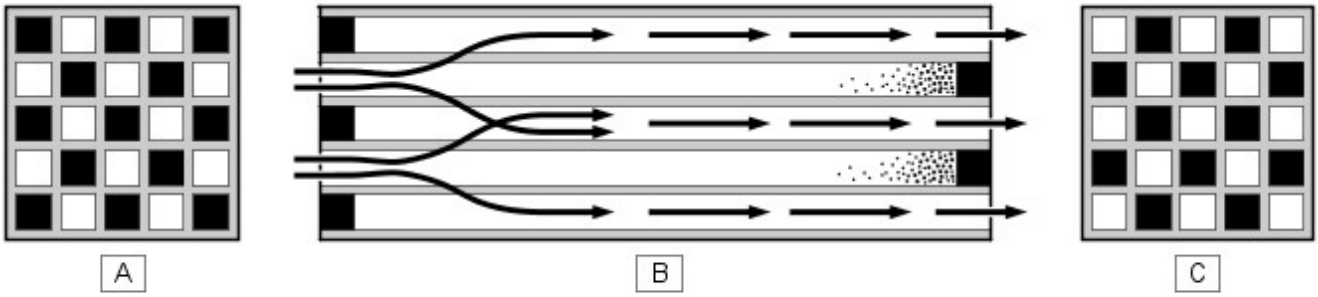
Item	Part Number	Description
1	-	Exhaust gas temperature sensor (2 off)
2	-	HO2S
3	-	Catalytic converter
4	-	Pre DPF temperature sensor
5	-	Differential pressure sensor
6	-	High pressure pipe
7	-	Low pressure pipe
8	-	Post DPF temperature sensor
9	-	DPF

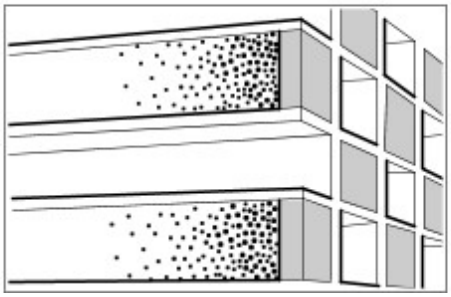
The DPF system reduces diesel particulate emissions to negligible levels to meet European Stage 5 emission standards. The particulate emissions are the black fumes emitted from the diesel engine under certain load conditions. The emissions are a complex mixture of solid and liquid components with the majority of the particulates being carbon microspheres on which hydrocarbons from the engine's fuel and lubricant condense.

The DPF is located in the exhaust system, downstream of the catalytic converters. A major feature of the DPF is its ability for to trap carbon particles before they are emitted to the atmosphere and then to oxidize the carbon at an opportune time. Regeneration is the oxidation of particulates trapped by the filter. The regeneration process takes place at calculated intervals and is not noticeable by the driver of the vehicle. Regeneration is most important, since an overfilled filter can damage the engine through excessive exhaust back pressure and can itself be damaged. The material trapped in the filter is in the most part carbon particles with some absorbed hydrocarbons.

The DPF system comprises the following components:

- • Diesel particulate filter (silicone carbide ceramic)
- • DPF control software incorporated into the Engine Control Module (ECM)
- • Exhaust gas temperature sensors
- • Differential pressure sensor.





E68716

Item	Part Number	Description
A	-	A. Front face showing alternate closed cells
B	-	B. Side view showing exhaust gas flow through the filter and particulate build up
C	-	C. Rear face showing alternate closed cells

The DPF uses a technology based on a filter with a catalytic coating. The DPF is made from silicon carbide housed in a steel container and has excellent thermal shock resistance and thermal conductivity properties. The DPF is designed for the engine's operating requirements to maintain the optimum back pressure requirements.

The porous surface of the filter consists of a number of small parallel channels positioned in the longitudinal direction of the exhaust system. Adjacent channels in the filter are alternately plugged at the end. This design forces the exhaust gasses to flow through the porous walls, which act as the filter medium. Particulate matter which are too big to pass through the porous surface are collected and stored in the channels.

The collected particulate matter, if not removed, can create an obstruction to exhaust gas flow. The particles are removed by a regeneration process which oxidizes the particles.

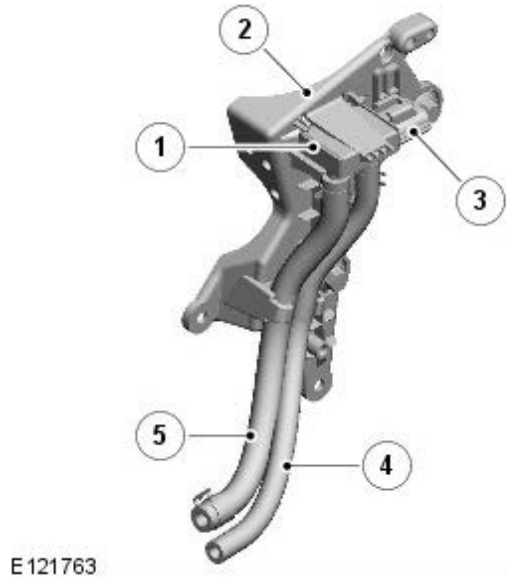
DPF regeneration is controlled by the temperature of the exhaust gasses and the DPF. The DPF includes a wash coat to the filter surface which comprises platinum and other active components and is similar to the catalytic converter. At certain exhaust gas and DPF temperatures the assembly promotes oxidation of the particles in addition to oxidizing carbon monoxide and hydrocarbon emissions.

The exhaust gas and DPF temperatures are controlled by the DPF software located in the ECM. The DPF software monitors the load status of the DPF based on driving style, distance travelled and signals from the differential pressure sensor and temperature sensors. When the particulate loading of the DPF reaches predetermined levels, the DPF is actively regenerated by adjusting, in conjunction with the ECM, various engine control functions such as:

- • fuel injection
- • intake air throttle
- • exhaust gas recirculation
- • turbocharger boost pressure control.

The regeneration process is possible because of the flexibility of the common-rail fuel injection engine which provides precise control of fuel flow, fuel pressure and injection timing which are essential requirements to promote the efficient regeneration process.

Differential Pressure Sensor



Item	Part Number	Description
1	-	Differential pressure sensor
2	-	Bracket (attached to transfer box)
3	-	Electrical connector
4	-	Low pressure pipe
5	-	High pressure pipe

The differential pressure sensor is located on a bracket which is attached to the transfer case.

The differential pressure sensor is used by the DPF software to monitor the condition of the DPF. Two pipe connections on the sensor are connected by pipes to the inlet and outlet ends of the DPF. The pipes allow the sensor to measure the inlet (high) and outlet (low) pressures of the DPF

As the amount of particulates trapped by the DPF increases, the pressure at the inlet side of the DPF increases in comparison to the DPF outlet. The DPF software uses this comparison, in conjunction with other data, to calculate the accumulated amount of trapped particulates.

By measuring the pressure difference between the DPF inlet and outlet and the DPF temperature, the DPF software can determine if the DPF is becoming blocked and requires regeneration.

Diesel Particulate Filter Temperature Sensors

Four temperature sensors are used in the DPF system. Two temperature sensors are located in the inlet pipes from each cylinder bank, just before the flexible couplings. A third is located in the inlet pipe to the DPF and the fourth sensor is located in the DPF outlet pipe to the center silencer.

The sensors measure the temperature of exhaust gas leaving the turbochargers, the temperature of the exhaust gas before it passes through the DPF and the temperature of the exhaust gas exiting the DPF. The 4 sensors provide the information needed to calculate the DPF temperature.

The information is used, in conjunction with other data, to estimate the amount of accumulated particulates and to control the DPF temperature.

Instrument Cluster Indications

For drivers who make regular short journeys at low speeds, it may not be possible to efficiently regenerate the DPF. This condition will be detected by the DPF software and will alert the driver as follows:

When the DPF becomes full the driver will be alerted to this condition by a message 'DPF FULL' accompanied by a handbook symbol. As detailed in the Owners Handbook, the driver should drive the vehicle until the engine is at its normal operating temperature and then drive for a further 20 minutes at speeds of between 45 and 70 mph (72 and 112 km/h). Successful regeneration of the DPF is indicated to the driver by the 'DPF FULL' message no longer being displayed. It should be noted that this condition is not a fault in the hardware. The message is intended to provide feedback to the driver that the current driving style may not be optimal for DPF regeneration and that high oil dilution may occur (refer to the following section 'Engine Oil Dilution').

A further DPF loading state may occur in which the DPF software detects that the DPF is still blocked, the message will change to 'DPF FULL VISIT DEALER', the driver should take the vehicle to an authorized dealer to have the DPF force regenerated. This message may imply that the DPF requires replacement - refer to service documentation for service regeneration options before replacing the DPF.

DIESEL PARTICULATE FILTER - SIDE EFFECTS

The following section details some side effects caused by the active regeneration process.

Engine Oil Dilution

Engine oil dilution can occur due to small amounts of fuel entering the engine crankcase during the post-injection

phases. This has made it necessary to introduce a calculation based on driving style to reduce oil service intervals if necessary. The driver is alerted to the oil service by a message in the instrument cluster.

The DPF software monitors the driving style, the frequency of the active regeneration and duration. Using this information a calculation can be made on the engine oil dilution. When the DPF software calculates the engine oil dilution has reached a predetermined threshold (fuel being 7% of engine oil volume) a service message is displayed in the instrument cluster.

Depending on driving style, some vehicles may require an oil service before the designated interval. If an service message is displayed, the vehicle will be required to have a full service and the service interval counter will need to be reset.

Fuel Consumption

During the active regeneration process of the DPF, there will be an increase in fuel consumption. However, because active regeneration occurs infrequently and for limited periods of time, the overall effect on fuel consumption is less than 1%. The additional fuel used during the active regeneration process is accounted for in the instantaneous (where applicable) and average fuel consumption displays in the instrument cluster.

OPERATION

Passive Regeneration

Passive regeneration requires no special engine management intervention and occurs during normal engine operation. The passive regeneration involves a slow conversion of the particulate matter deposited in the DPF into carbon dioxide. This process is active when the DPF temperature reaches 250°C (482°F) and is a continuous process when the vehicle is being driven at higher engine loads and speeds.

During passive regeneration, the oxidation rate is low. This is due to the chemical reaction process and is only effective within the normal operating temperature range of 250°C to 500°C (482°F to 932°F).

Above this temperature range the conversion efficiency of the particulates into carbon dioxide increases as the DPF temperature is raised. These temperatures can normally be achieved using the active regeneration process.

Active Regeneration

Active regeneration starts when the particulate loading of the DPF reaches a threshold as monitored or determined by the DPF control software. The threshold calculation is based on driving style, distance travelled and back pressure signals from the differential pressure sensor.

Active regeneration generally occurs every 450 miles (725 km) although this is highly dependant on how the vehicle is driven. For example, if the vehicle is driven at low loads in urban traffic regularly, active regeneration will occur more often. This is due to the rapid build-up of particulates in the DPF than if the vehicle is driven at high speeds when passive regeneration will have occurred.

The DPF software incorporates a mileage trigger which is used as back-up for active regeneration. If active regeneration has not been initiated by a back pressure signal from the differential pressure sensor, regeneration is requested based on distance traveled.

Active regeneration of the DPF is commenced when the temperature of the DPF is increased to the oxidation temperature of the particles. The DPF temperature is raised by increasing the exhaust gas temperature. This is achieved by introducing post-injection of fuel after the pilot and main fuel injections have occurred.

This is determined by the DPF software monitoring the signals from the two DPF temperature sensors to establish the temperature of the DPF. Depending on the DPF temperature, the DPF software requests the ECM to perform either one or two post-injections of fuel:

- • The first post-injection of fuel retards combustion inside the cylinder which increases the temperature of the exhaust gas
- • The second post-injection of fuel is injected late in the power stroke cycle. The fuel partly combusts in the cylinder, but some unburnt fuel also passes into the exhaust where it creates an exothermic event within the catalytic converter, further increasing the temperature of the DPF.

The active regeneration process takes approximately 20 minutes to complete. The first phase increases the DPF temperature to 500°C (932°F). The second phase further increases the DPF temperature to 600°C (1112°F) which is the optimum temperature for particle combustion. This temperature is then maintained for 15-20 minutes to ensure complete oxidation of the particles within the DPF. The process converts the carbon particles to carbon dioxide and water.

The active regeneration temperature of the DPF is closely monitored by the DPF software to maintain a target temperature of 600°C (1112°F) at the DPF inlet. The temperature control ensures that the temperatures do not exceed the operational limits of the turbocharger and the catalytic converter. The turbocharger inlet temperature must not exceed 830°C (1526°F) and the catalytic converter brick temperature must not exceed 800°C (1472°F) and the exit temperature must remain below 750°C (1382°F).

During the active regeneration process the following ECM controlled events occur:

- • The turbocharger is adjusted to reduce boost pressure. This minimizes heat transmission from the exhaust gas to the turbocharger and reduces the rate of exhaust gas flow allowing optimum heating of the DPF. If the driver demands an increase in engine torque, the turbocharger will respond by closing the vanes as necessary
- • The intake throttle is adjusted as this assists in increasing the exhaust gas temperature and reduces the rate of exhaust gas flow which has the effect of reducing the time for the DPF to reach the optimum temperature
- • The Exhaust Gas Recirculation (EGR) valve is closed. The use of EGR decreases the exhaust gas temperature and therefore prevents the optimum DPF temperature being achieved.

If, due to vehicle usage and/or driving style, the active regeneration process cannot take place or is unable to regenerate the DPF, the dealer can force regenerate the DPF. This is achieved by either driving the vehicle until the engine is at its normal operating temperature and then driving for a further 20 minutes at speeds of between 45 and 70 mph (72 and 112 km/h) or by connecting a Jaguar approved diagnostic system to the vehicle which will guide the technician through an automated regeneration procedure to clean the DPF.

Diesel Particulate Filter Control

The DPF requires constant monitoring to ensure that it is operating at its optimum efficiency and does not become blocked. The ECM contains DPF software which controls the monitoring and operation of the DPF system and also monitors other vehicle data to determine regeneration periods and service intervals.

The DPF software can be divided into three separate control software modules; a DPF supervisor module, a DPF fuel management module and a DPF air management module.

These three modules are controlled by a fourth software module known as the DPF co-ordinator module. The co-ordinator module manages the operation of the other modules when an active regeneration is requested. The DPF supervisor module is a sub-system of the DPF co-ordinator module.

DPF Fuel Management Module

The DPF fuel management module controls the following functions:

- • Timing and quantity of the four split injections per stroke (pilot, main and two post injections)
- • Injection pressure and the transition between the three different calibration levels of injection.

The above functions are dependant on the condition of the catalytic converter and the DPF.

The controlled injection determines the required injection level in addition to measuring the activity of the catalytic converter and the DPF. The fuel management calculates the quantity and timing for the four split injections, for each of the three calibration levels for injection pressure, and also manages the transition between the levels.

The two post injections are required to separate the functionality of increasing in-cylinder gas temperatures and the production of hydrocarbons. The first post injection is used to generate the higher in-cylinder gas temperature while simultaneously retaining the same engine torque output produced during normal (non-regeneration) engine operation. The second post injection is used to generate hydrocarbons by allowing unburnt fuel into the catalytic converter without producing increased engine torque.

DPF Air Management Module

The DPF air management module controls the following functions:

- • EGR control
- • Turbocharger boost pressure control
- • Intake air temperature and pressure control.

During active regeneration, the EGR operation is disabled and the closed-loop activation of the turbocharger boost controller is calculated. The air management module controls the air in the intake manifold to a predetermined level of pressure and temperature. This control is required to achieve the correct in-cylinder conditions for stable and robust combustion of the post injected fuel.

The module controls the intake air temperature by actuating the EGR throttle and by adjustment of the turbocharger boost pressure control.

DPF Co-ordinator Module

The DPF co-ordinator module reacts to a regeneration request from the supervisor module by initiating and co-ordinating the following DPF regeneration requests:

- EGR cut-off
- Turbocharger boost pressure control
- Engine load increase
- Control of air pressure and temperature in the intake manifold
- Fuel injection control.

When the supervisor module issues a regeneration request, the co-ordinator module requests EGR cut-off and a regeneration specific turbocharger boost pressure control. It then waits for a feedback signal from the EGR system confirming that the EGR valve is closed.

When the EGR valve is closed, the co-ordinator module initiates requests to increase engine load by controlling the intake air temperature and pressure.

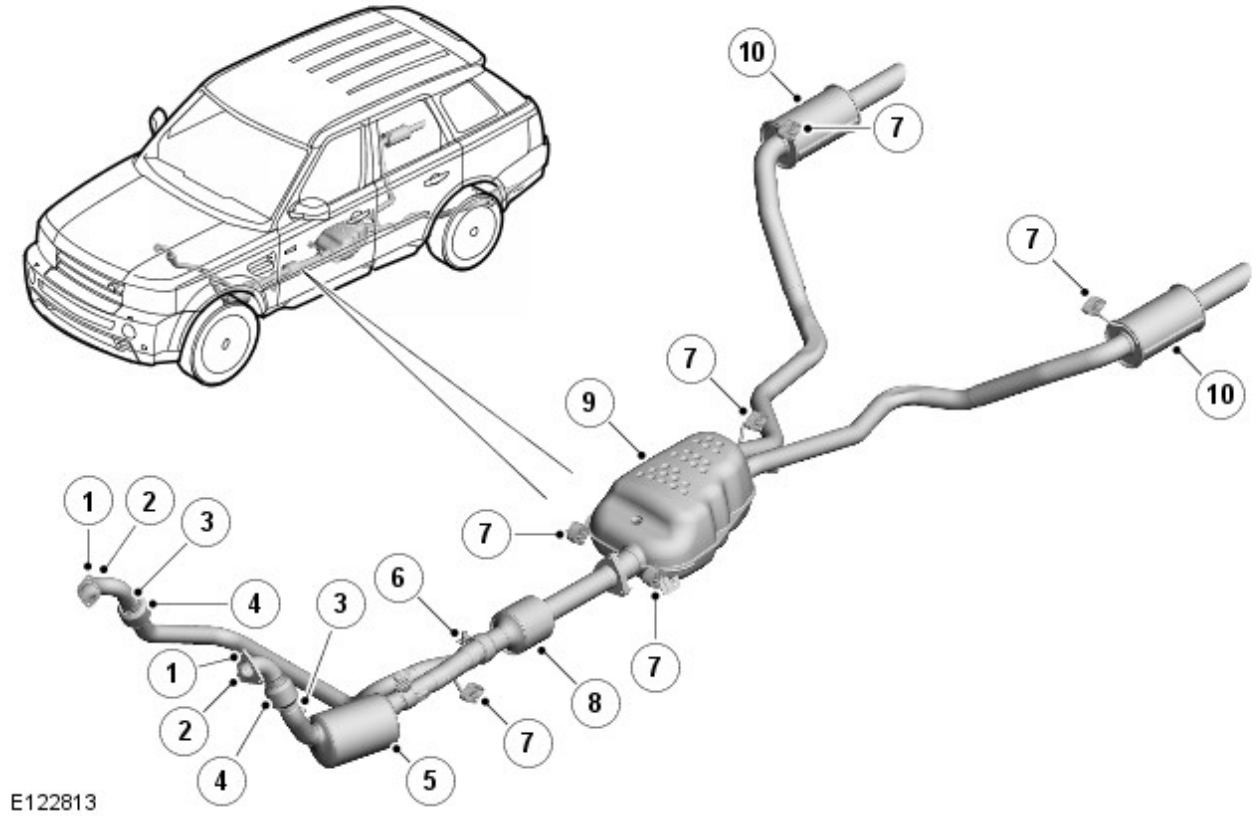
Once confirmation is received that intake conditions are controlled or a calibration time has expired, the co-ordinator module then changes to a state awaiting an accelerator pedal release manoeuvre from the driver. If this occurs or a calibration time has expired, the co-ordinator module generates a request to control fuel injections to increase exhaust gas temperature.

Published: 03-Feb-2012

Exhaust System - TDV6 3.0L Diesel - Diesel Particulate Filter - Component Location

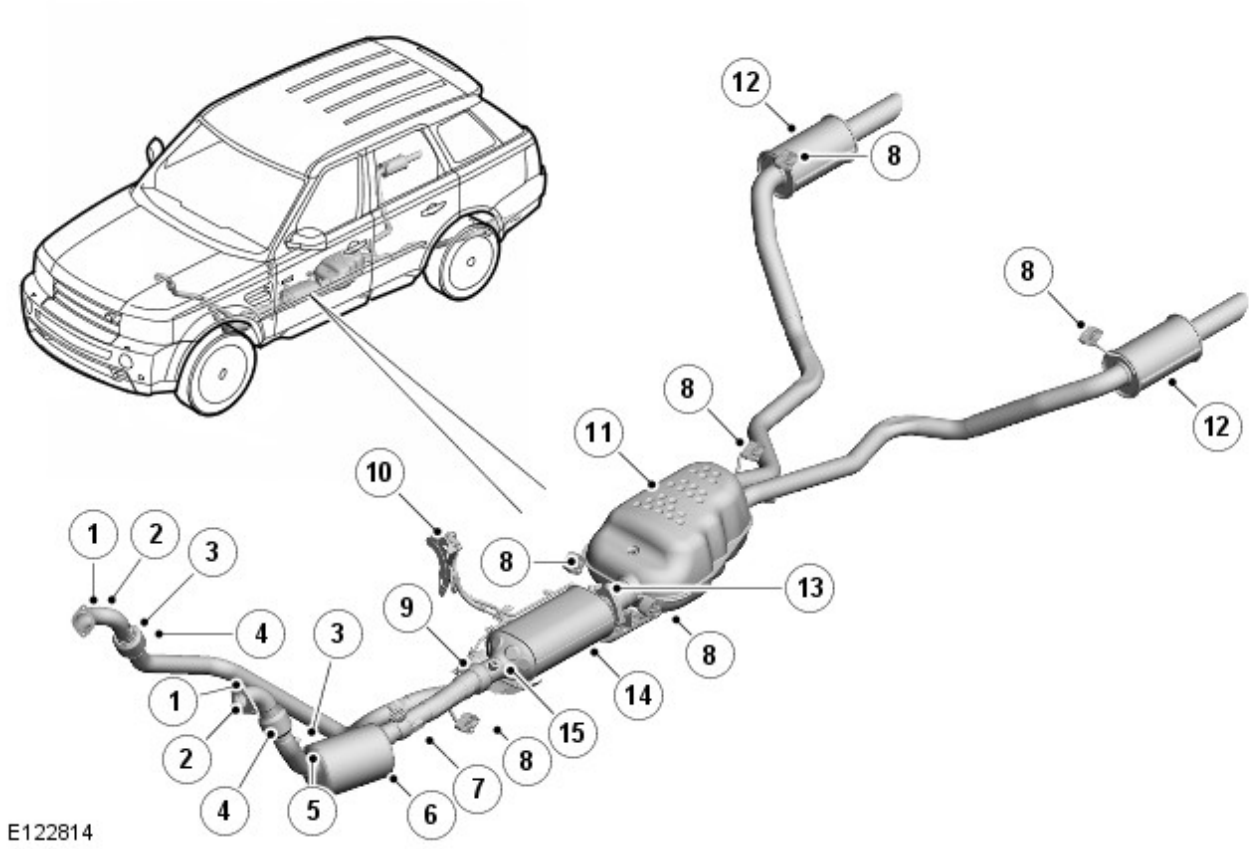
Description and Operation

3.0L TdV6 EXHAUST SYSTEM COMPONENT LOCATION - WITHOUT DIESEL PARTICULATE FILTER



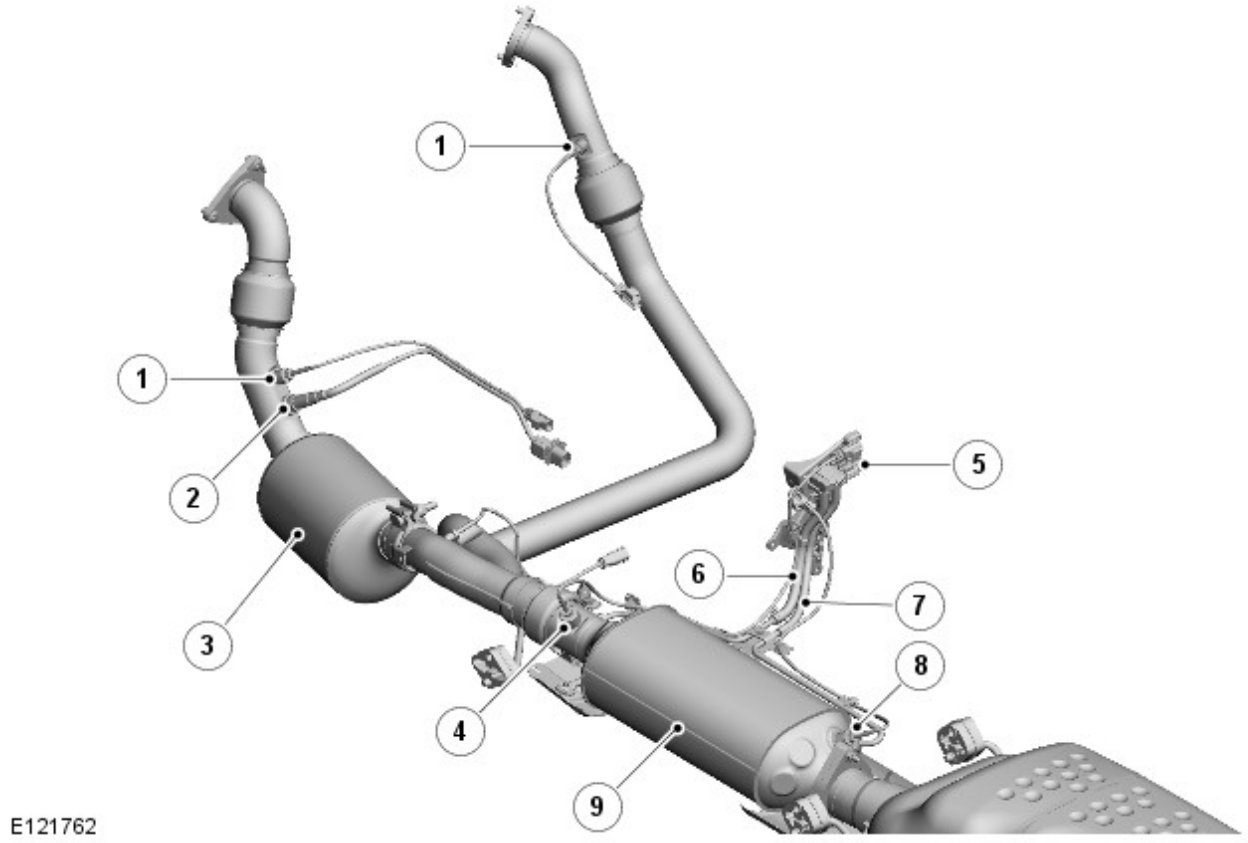
Item	Description
1	Bolt (5 off)
2	Gasket
3	Heated Oxygen Sensor (HO2S) mounting boss
4	Flexible coupling
5	Catalytic converter
6	Clamp
7	Mounting rubber (6 off)
8	Catalytic converter
9	Silencer - Center
10	Silencer - Rear

3.0L TdV6 EXHAUST SYSTEM COMPONENT LOCATION - WITH DIESEL PARTICULATE FILTER (IF FITTED)



Item	Description
1	Bolt (5 off)
2	Gasket
3	Temperature sensor mounting boss
4	Flexible coupling
5	HO2S mounting boss
6	Catalytic converter
7	Clamp
8	Mounting rubber (6 off)
9	Clamp
10	Differential pressure sensor
11	Silencer - Center
12	Silencer - Rear
13	Temperature sensor mounting boss
14	Diesel Particulate Filter (DPF)
15	Temperature sensor mounting boss

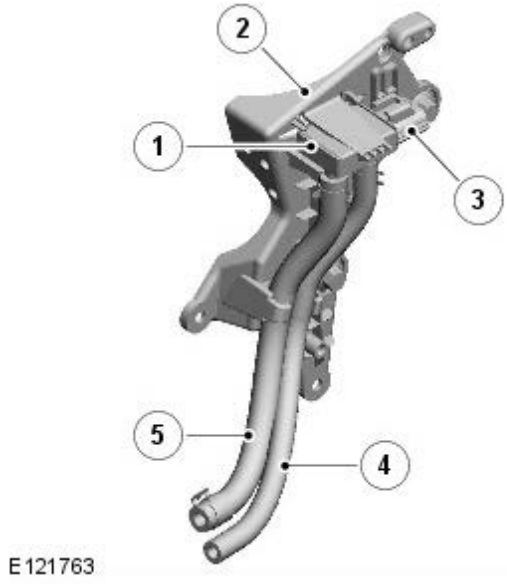
DIESEL PARTICULATE FILTER (DPF)



Item Description

1 Exhaust gas temperature sensor (2 off)
2 HO2S
3 Catalytic converter
4 Pre DPF temperature sensor
5 Differential pressure sensor
6 High pressure pipe
7 Low pressure pipe
8 Post DPF temperature sensor
9 DPF

DIFFERENTIAL PRESSURE SENSOR



Item Description

1 Differential pressure sensor
2 Bracket (attached to transfer box)
3 Electrical connector
4 Low pressure pipe

5 High pressure pipe

Published: 24-May-2013

Exhaust System - TDV6 3.0L Diesel - Diesel Particulate Filter - System Operation and Component Description

Description and Operation

System Operation

DIESEL PARTICULATE FILTER (DPF)

Two processes are used to regenerate the DPF; passive and active.

Passive Regeneration

Passive regeneration requires no special engine management intervention and occurs during normal engine operation. The passive regeneration involves a slow conversion of the particulate matter deposited in the DPF into carbon dioxide. This process occurs when the DPF temperature exceeds 250°C (482°F) and is a continuous process when the vehicle is being driven at higher engine loads and speeds.

During passive regeneration, only a portion of the particulate matter is converted into carbon dioxide. This is because the chemical reaction, which utilises nitrogen dioxide, is slower than the rate of engine production of particulate matter and is effective from 250°C (482°F).

Above 580°C the conversion efficiency of the particulates into carbon dioxide rapidly increases. These temperatures are generally only be achieved using the active regeneration process.

Active Regeneration

Active regeneration starts when the particulate loading of the DPF reaches a threshold as monitored or determined by the DPF control software. The threshold calculation is based on driving style, distance travelled and back pressure signals from the differential pressure sensor.

Active regeneration generally occurs every 250 miles (400 km) although this is dependant on how the vehicle is driven. For example, if the vehicle is driven at low loads in urban traffic regularly, active regeneration will occur more often. This is due to the rapid build-up of particulates in the DPF than if the vehicle is driven at high speeds when passive regeneration will have occurred.

The DPF software incorporates a mileage trigger which is used as back-up for active regeneration. If active regeneration has not been initiated by a back pressure signal from the differential pressure sensor, regeneration is requested based on distance travelled.

Active regeneration of the DPF is commenced when the temperature of the DPF is increased to the combustion temperature of the particles. The DPF temperature is raised by increasing the exhaust gas temperature. This is achieved by introducing post-injection of fuel after the pilot and main fuel injections have occurred.

It is determined by the DPF software monitoring the signals from the two DPF temperature sensors to establish the temperature of the DPF. Depending on the DPF temperature, the DPF software requests the ECM (engine control module) to perform either one or two post-injections of fuel:

- The first post-injection of fuel retards combustion inside the cylinder which increases the temperature of the exhaust gas.
- The second post-injection of fuel is injected late in the power stroke cycle. The fuel partly combusts in the cylinder, but some unburnt fuel also passes into the exhaust where it creates an exothermic event within the catalytic converter, further increasing the temperature of the DPF.

The active regeneration process takes up to 20 minutes to complete. The first phase increases the DPF temperature to 500°C (932°F). The second phase further increases the DPF temperature to 600°C (1112°F) which is the optimum temperature for particle combustion. This temperature is then maintained for 15-20 minutes to ensure complete oxidation of the particles within the DPF. The oxidation process converts the carbon particles to carbon dioxide.

The active regeneration temperature of the DPF is closely monitored by the DPF software to maintain a target temperature of 600°C (1112°F) at the DPF inlet. The temperature control ensures that the temperatures do not exceed the operational limits of the turbocharger and the catalytic converter. The turbocharger inlet temperature must not exceed 830°C (1526°F) and the catalytic converter brick temperature must not exceed 800°C (1472°F) and the exit temperature must remain below 875°C (1382°F).

During the active regeneration process the following ECM controlled events occur:

- The turbocharger is maintained in the fully open position. This minimizes heat transmission from the exhaust gas to the turbocharger and reduces the rate of exhaust gas flow allowing optimum heating of the DPF. If the driver demands an increase in engine torque, the turbocharger will respond by closing the vanes as necessary.
- The throttle is closed as this assists in increasing the exhaust gas temperature and reduces the rate of exhaust gas flow which has the effect of reducing the time for the DPF to reach the optimum temperature.
- The EGR (exhaust gas recirculation) valve is closed. The use of EGR decreases the exhaust gas temperature and therefore prevents the optimum DPF temperature being achieved.

If, due to vehicle usage and/or driving style, the active regeneration process cannot take place or is unable to regenerate the DPF, the dealer can force regenerate the DPF. This is achieved by either driving the vehicle until the engine is at its normal operating temperature and then driving for a further 20 minutes at speeds of not less than 30 mph (48 km/h).

DPF Control

The DPF requires constant monitoring to ensure that it is operating at its optimum efficiency and does not become blocked. The ECM contains DPF software which controls the monitoring and operation of the DPF system and also monitors other vehicle data to determine regeneration periods and service intervals.

The DPF software can be divided into three separate control software modules; a DPF supervisor module, a DPF fuel management module and a DPF air management module.

These three modules are controlled by a fourth software module known as the DPF co-ordinator module. The co-ordinator module manages the operation of the other modules when an active regeneration is requested.

DPF Fuel Management Module

The DPF fuel management module controls the following functions:

- Timing and quantity of the four split injections per stroke (pilot, main and two post injections).
- Injection pressure and the transition between the three different calibration levels of injection.

The above functions are dependant on the condition of the catalytic converter and the DPF.

The controlled injection determines the required injection level in addition to measuring the activity of the catalytic converter and the DPF. The fuel management calculates the quantity and timing for the four split injections, for each of the three calibration levels for injection pressure, and also manages the transition between the levels.

The two post injections are required to separate the functionality of increasing in-cylinder gas temperatures and the production of hydrocarbons. The first post injection is used to generate the higher in-cylinder gas temperature while simultaneously retaining the same engine torque output produced during normal (non-regeneration) engine operation. The second post injection is used to generate hydrocarbons by allowing unburnt fuel into the catalytic converter without producing increased engine torque.

DPF Air Management Module

The DPF air management module controls the following functions:

- EGR control
- Turbocharger boost pressure control
- Intake air temperature and pressure control.

During active regeneration, the EGR operation is disabled -except for overrun conditions - and the closed-loop activation of the turbocharger boost controller is calculated. The air management module controls the air in the intake manifold to a predetermined level of pressure and temperature. This control is required to achieve the correct in-cylinder conditions for stable and robust combustion of the post injected fuel.

The module controls the intake air temperature by actuating the EGR throttle and by adjustment of the turbocharger boost pressure control.

DPF Co-ordinator Module

The DPF co-ordinator module reacts to a regeneration request from the supervisor module by initiating and co-ordinating the following DPF regeneration requests:

- EGR cut-off - except for overrun condition
- Turbocharger boost pressure control
- Engine load increase
- Control of air pressure and temperature in the intake manifold
- Fuel injection control.

When the supervisor module issues a regeneration request, the co-ordinator module requests EGR cut-off and a regeneration specific turbocharger boost pressure control. It then waits for a feedback signal from the EGR system confirming that the EGR valve is closed.

When the EGR valve is closed, the co-ordinator module initiates requests to increase engine load by controlling the intake air temperature and pressure.

Once confirmation is received that intake conditions are controlled or a calibration time has expired, the co-ordinator module then changes to a state awaiting an accelerator pedal release manoeuvre from the driver. If this occurs or a calibration time has expired, the co-ordinator module generates a request to control fuel injections to increase exhaust gas temperature.

DIFFERENTIAL PRESSURE SENSOR

As the amount of particulates trapped by the DPF increases, the pressure at the inlet side of the DPF increases in comparison to the DPF outlet. The DPF software uses this comparison, in conjunction with other data, to calculate the accumulated amount of trapped particulates.

By measuring the pressure difference between the DPF inlet and outlet and the DPF temperature, the DPF software can determine if the DPF is becoming blocked and requires regeneration.

Component Description

DIESEL PARTICULATE FILTER (DPF)

The DPF system reduces diesel particulate emissions to negligible levels to meet current European stage 5 emission standards.

The particulate emissions are the black fumes emitted from the diesel engine under certain load conditions. The emissions are a complex mixture of solid and liquid components with the majority of the particulates being carbon microspheres on which hydrocarbons from the engine's fuel and lubricant condense.

The DPF system comprises the following components:

- Diesel Particulate Filter (DPF)
- DPF control software incorporated in the ECM
- Differential pressure sensor.

The DPF is located in the exhaust system, downstream of the catalytic converter. Its function is to trap particulate matter in the exhaust gases leaving the engine. A major feature of the DPF is its ability for regeneration. Regeneration is the burning of particulates trapped by the filter to prevent obstruction to the free flow of exhaust gasses. The regeneration process takes place at calculated intervals and is not noticeable by the driver of the vehicle.

Regeneration is most important, since an overfilled filter can damage the engine through excessive exhaust back pressure and can itself be damaged or destroyed. The material trapped in the filter is in the most part carbon particles with some absorbed hydrocarbons.

The DPF uses a filter technology based on a filter with a catalytic coating. The DPF is made from silicon carbide housed in a steel container and has excellent thermal shock resistance and thermal conductivity properties. The DPF is designed for the engine's operating requirements to maintain the optimum back pressure requirements.

The porous surface of the filter consists of thousands of small parallel channels positioned in the longitudinal direction of the exhaust system. Adjacent channels in the filter are alternately plugged at the end. This design forces the exhaust gasses to flow through the porous filter walls, which act as the filter medium. Particulate matter which are too big to pass through the porous surface are collected and stored in the channels.

The collected particulate matter, if not removed, can create an obstruction to exhaust gas flow. The stored particles are removed by a regeneration process which incinerates the particles.

Diesel Particulate Filter Temperature Sensors

The sensors measure the temperature of exhaust gas exiting the turbocharger and before it passes through the DPF and provides the information needed to calculate the DPF temperature.

The information is used, in conjunction with other data, to estimate the amount of accumulated particulates and to control the DPF temperature.

Instrument Cluster (IC) Indications

For drivers who make regular short journeys at low speeds, it may not be possible to efficiently regenerate the DPF. In this case, the DPF software will detect a blockage of the DPF from signals from the differential pressure sensor and will alert the driver as follows:

The driver will be alerted to this condition by a message 'EXHAUST FILTER NEARLY FULL'. See 'HANDBOOK'. As detailed in the Owners Handbook, the driver should drive the vehicle until the engine is at its normal operating temperature and then drive for a further 20 minutes at speeds of not less than 30 mph (48 km/h). Successful regeneration of the DPF is indicated to the driver by the 'EXHAUST FILTER NEARLY FULL' message no longer being displayed. If the DPF software detects that the DPF is still blocked, the message will continue to be displayed or an additional message 'EXHAUST FILTER FULL VISIT DEALER' will be displayed. The driver should take the vehicle to an authorized dealer to have the DPF force regenerated using an approved diagnostic system.

Diesel Particulate Filter Side Effects

The following section details some side effects caused by the active regeneration process.

Engine Oil Dilution

Engine oil dilution can occur due to small amounts of fuel entering the engine crankcase during the post-injection phases. This has made it necessary to introduce a calculation based on driving style to reduce oil service intervals if necessary. The driver is alerted to the oil service by a message in the instrument cluster.

The DPF software monitors the driving style and the frequency of the active regeneration and duration. Using this information a calculation can be made on the engine oil dilution. When the DPF software calculates the engine oil dilution has reached a predetermined threshold (fuel being 7% of engine oil volume) a service message is displayed in the IC.

Depending on driving style, some vehicles may require an oil service before the designated interval. If a service message is displayed, the vehicle will be required have a full service and the service interval counter will be reset.

Fuel consumption

During the active regeneration process of the DPF, there will be an increase in fuel consumption.

However, because active regeneration occurs infrequently, the overall effect on fuel consumption is approximately 2%. The additional fuel used during the active regeneration process is accounted for in the instantaneous and average fuel consumption displays in the instrument cluster.

DIFFERENTIAL PRESSURE SENSOR

The differential pressure sensor is used by the DPF software to monitor the condition of the DPF. Two pipe connections on the sensor are connected by pipes to the inlet and outlet ends of the DPF. The pipes allow the sensor

to measure the inlet and outlet pressures of the DPF.

Aftermarket DPF cleaning fluids

Recent years have seen the introduction of 'DPF cleaning fluids' to (non JLR approved) aftermarket sales. These products claim to reduce the temperature that the soot reaction takes place. It should be stressed that, during the vehicle development activity, every effort is made to generate DPF regeneration temperatures whilst maintaining safe levels for all other vehicle components. Unauthorized use of the aftermarket fluids produces a significant risk to soot burn rates and DPF peak temperatures real world driving conditions. These fluids are not authorised for JLR use.

Published: 21-Jun-2013

Exhaust System - TDV6 3.0L Diesel - Exhaust System

Diagnosis and Testing

Principle of Operation

For a detailed description of the exhaust system, refer to the relevant Description and Operation section of the workshop manual.

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Leaks • Metal fatigue • Pipes • Catalytic converter • Muffler(s) • Joints • Mountings • Clearance around components	• 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 cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for DTCs and refer to the DTC Index

Symptom Chart

Symptom	Possible Causes	Action
Noisy or leaking exhaust	• Exhaust system/components	Install new components as necessary. Refer to the relevant section of the workshop manual
Lack of power	• Air intake system fault • Restricted exhaust system • Low fuel pressure • Exhaust gas recirculation (EGR) valve(s) fault • Turbocharger fault	Check the air intake system. Check for a blocked catalytic converter or muffler, install new components as necessary. Check the fuel pressure. For EGR and turbocharger tests, refer to the relevant section of the workshop manual

DTC Index

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00.

Published: 17-Jul-2013

Exhaust System - TDV6 3.0L Diesel - Diesel Particulate Filter

Diagnosis and Testing

Principle of Operation

For a detailed description of the exhaust system, refer to the relevant Description and Operation section of the workshop manual.
REFER to: Diesel Particulate Filter (309-00 Exhaust System - TDV6 3.0L Diesel, Description and Operation) / Diesel Particulate Filter (309-00A Exhaust System - TDV6 3.0L Diesel, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Diesel particulate filter • Differential pressure sensor hoses • Differential pressure sensor metal pipes and unions • Differential pressure sensor mounting position integrity • Metal fatigue • Joints • Mountings • Clearance around components • Damaged diesel particulate filter	• Differential pressure sensor • Differential pressure sensor connector • Differential pressure sensor 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 cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for DTCs and refer to the DTC Index

Symptom Chart

Symptom	Possible Causes	Action
Amber warning message on instrument cluster - DPF FULL REFER TO HANDBOOK -	• Blocked regeneration • Customer driving routine does not allow the system to clean the particulate filter	If DTC is P2459-65 or AMBER DPF FULL REFER TO HANDBOOK message is displayed with no other reported messages. No repair is required, if the vehicle is driven on a highway AS DIRECTED IN THE HANDBOOK then the light will be extinguished and the system self healed, nothing more than this is required
Lack of power	• Air intake system fault • Restricted exhaust system • Low fuel pressure • Exhaust Gas Recirculation (EGR) valve(s) fault • Turbocharger fault • Diesel particulate filter fault	Check the air intake system. Check for a blocked catalytic converter or muffler, install new components as necessary. Check the fuel pressure. For EGR and turbocharger tests, refer to the relevant section of the workshop manual

DTC Index

NOTES:

 If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component

 Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer approved diagnostic system)

 Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests

 Inspect connectors for signs of water ingress, and pins for damage and/or corrosion

 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
P0030-11	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Circuit short to ground	• Harness fault - Universal Heated Exhaust Gas Oxygen sensor heater control circuit short to ground • Universal Heated Exhaust Gas Oxygen sensor internal fault	• Using the manufacturer approved diagnostic system check datalogger signals, Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 1 (0x03A1). Refer to the electrical circuit diagrams and check the Universal Heated Exhaust Gas Oxygen sensor heater control (heater ground) circuit for short to ground. This circuit runs from the Engine Control Module (ECM) through the transmission harness to the exhaust system. Check for external harness damage due to chafing or heat. Repair harness as required, clear DTC and retest system • Suspect sensor internal fault if DTC resets. Heater circuit resistance measured at the component connector at approximately 20ºC ambient temperature should be 2.4 - 4.0 Ohms. Refer to the new module/component installation note at the top of the DTC Index
P0030-12	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Circuit short to battery	• Harness fault - Universal Heated Exhaust Gas Oxygen sensor heater control circuit short to power • Universal Heated Exhaust Gas Oxygen sensor internal fault	• Using the manufacturer approved diagnostic system check datalogger signals, Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 1 (0x03A1). Refer to the electrical circuit diagrams and check the Universal Heated Exhaust Gas Oxygen sensor heater control (heater ground) circuit for short to power. This circuit runs from the Engine Control Module (ECM) through the transmission harness to the exhaust system. Check for external harness damage due to chafing or heat. Repair harness as required, clear DTC and retest system • Suspect sensor internal fault if DTC resets. Heater circuit resistance measured at the component connector at approximately 20ºC ambient temperature should be 2.4 - 4.0 Ohms. Refer to the new module/component installation note at the top of the DTC Index
P0030-13	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Circuit open	• Harness fault - Universal Heated Exhaust Gas Oxygen sensor heater control circuit open • Universal Heated Exhaust Gas Oxygen sensor internal fault	• Using the manufacturer approved diagnostic system check datalogger signals, Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 1 (0x03A1). Refer to the electrical circuit diagrams and check the Universal Heated Exhaust Gas Oxygen sensor heater control (heater ground) circuit for open circuit. This circuit runs from the Engine Control Module (ECM) through the transmission harness to the exhaust system. Check for external harness damage due to chafing or heat. Repair harness as required, clear DTC and retest system • Suspect sensor internal fault if DTC resets. Heater circuit resistance measured at the component connector at approximately 20ºC ambient temperature should be 2.4 - 4.0 Ohms. Refer to the new module/component installation note at the top of the DTC Index
P0030-4B	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Over temperature	• Harness fault - Heated Oxygen Sensor heater control circuit short to power • Heated Oxygen Sensor	• Using the manufacturer approved diagnostic system check datalogger signals, Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 1 (0x03A1). Refer to the electrical circuit diagrams and check the Universal Heated Exhaust Gas Oxygen sensor heater control (heater ground) circuit for short to power. This circuit runs from the Engine Control Module (ECM) through the transmission harness to the exhaust system. Check for external harness damage due to chafing or heat. Repair harness as required, clear DTC and retest system

		internal fault	• Suspect sensor internal fault if DTC resets. Heater circuit resistance measured at the component connector at approximately 20ºC ambient temperature should be 2.4 - 4.0 Ohms. Refer to the new module/component installation note at the top of the DTC Index
P0130-00	O2 Circuit (Bank 1, Sensor 1) - No sub type information	• Harness fault - Universal Heated Exhaust Gas Oxygen sensor circuits open circuit • Universal Heated Exhaust Gas Oxygen sensor internal component fault	• Refer to the electrical circuit diagrams and check the Universal Heated Exhaust Gas Oxygen circuits for open circuits on the Nernst Voltage and Pumping Current signal lines. Check harness for signs of damage due to chaffing or heat. Check the other Universal Heated Exhaust Gas Oxygen sensor circuits for short circuits and open circuits • If no fault found in wiring harness suspect Universal Heated Exhaust Gas Oxygen sensor. Refer to the new module/component installation note at the top of the DTC Index
P0130-11	O2 Circuit (Bank 1, Sensor 1) - Circuit short to ground	• The Engine Control Module (ECM) has detected a ground measurement for a period longer than expected or has detected a ground measurement when another value was expected • Harness fault - Universal Heated Exhaust Gas Oxygen sensor circuit short to ground • Universal Heated Exhaust Gas Oxygen sensor internal component fault	• Refer to the electrical circuit diagrams and check the Universal Heated Exhaust Gas Oxygen sensor circuits for short to ground. Repair wiring harness as required, clear DTC and retest system • If no fault found in wiring harness suspect Universal Heated Exhaust Gas Oxygen sensor. Refer to the new module/component installation note at the top of the DTC Index
P0130-12	O2 Circuit (Bank 1, Sensor 1) - Circuit short to battery	• Harness fault - Universal Heated Exhaust Gas Oxygen sensor circuit short to power • Universal Heated Exhaust Gas Oxygen sensor internal component fault	• Refer to the electrical circuit diagrams and check the Universal Heated Exhaust Gas Oxygen sensor circuits for short to power. Repair wiring harness as required, clear DTC and retest system • If no fault found in wiring harness suspect Universal Heated Exhaust Gas Oxygen sensor. Refer to the new module/component installation note at the top of the DTC Index
P0130-13	O2 Circuit (Bank 1, Sensor 1) - Circuit open	• Harness fault - Universal Heated Exhaust Gas Oxygen sensor circuit open circuit • Universal	• Refer to the electrical circuit diagrams and check the Universal Heated Exhaust Gas Oxygen sensor circuits for open circuit. Repair wiring harness as required, clear DTC and retest system • If no fault found in wiring harness suspect Universal Heated Exhaust Gas Oxygen sensor. Refer to the new module/component installation note at the top of the DTC Index

		Heated Exhaust Gas Oxygen sensor internal component fault	
P0130-1A	O2 Circuit (Bank 1, Sensor 1) - Circuit Resistance Below Threshold	• Harness fault - Universal Heated Exhaust Gas Oxygen sensor circuit fault • Universal Heated Exhaust Gas Oxygen sensor internal component fault	• This DTC is set when the Universal Heated Exhaust Gas Oxygen sensor internal trim resistance value is less than that expected by the Engine Control Module. Refer to the electrical circuit diagrams and check the Universal Heated Exhaust Gas Oxygen sensor circuits for short circuits. Repair wiring harness as required, clear DTC and retest system • If no fault found in wiring harness suspect Universal Heated Exhaust Gas Oxygen sensor internal fault. Refer to the new module/component installation note at the top of the DTC Index
P0130-1B	O2 Circuit (Bank 1, Sensor 1) - Circuit Resistance Above Threshold	• Harness fault - Universal Heated Exhaust Gas Oxygen sensor circuit fault • Universal Heated Exhaust Gas Oxygen sensor internal component fault	• This DTC is set when the oxygen sensor internal trim resistance value is greater than that expected by the Engine Control Module. Refer to the electrical circuit diagrams and check the Universal Heated Exhaust Gas Oxygen sensor circuits for short circuits, open circuits. Repair wiring harness as required, clear DTC and retest system • If no fault found in wiring harness suspect Universal Heated Exhaust Gas Oxygen sensor internal fault. refer to the new module/component installation note at the top of the DTC Index
P0130-26	O2 Circuit (Bank 1, Sensor 1) - Signal Rate Of Change Below Threshold	• Exhaust system leak • Fuel control system fault • Universal Heated Exhaust Gas Oxygen sensor to Engine Control Module (ECM) circuit short to ground, short to power, high resistance • Universal Heated Exhaust Gas Oxygen sensor failure	• Check for and rectify any exhaust leak between cylinder head and catalytic converter. Check Universal Heated Exhaust Gas Oxygen sensor is correctly installed in exhaust manifold • Check fuel control system for related DTCs and refer to the relevant DTC Index • Refer to the electrical circuit diagrams and check Universal Heated Exhaust Gas Oxygen sensor to Engine Control Module (ECM) circuit for short to ground, short to power, high resistance, open circuit • Check and install a new Universal Heated Exhaust Gas Oxygen sensor as required
P0133-00	O2 Circuit Slow Response (Bank 1, Sensor 1) - No sub type information	• Exhaust system leak • Fuel control system fault • Universal Heated Exhaust Gas Oxygen sensor to Engine Control Module (ECM) wiring shield high resistance • Universal Heated	• Check for and rectify any exhaust leak between cylinder head and catalytic converter. Check Universal Heated Exhaust Gas Oxygen sensor is correctly installed in exhaust manifold • Check fuel control system for related DTCs and refer to the relevant DTC Index • Refer to the electrical circuit diagrams and check Universal Heated Exhaust Gas Oxygen sensor to Engine Control Module (ECM) wiring shield for high resistance • Check and install a new Universal Heated Exhaust Gas Oxygen sensor as required

		Exhaust Gas Oxygen sensor failure	
P0135-16	O2 Heater Circuit (Bank 1, Sensor 1) - Circuit Voltage Below threshold	• Harness fault - Universal Heated Exhaust Gas Oxygen sensor circuit fault • Universal Heated Exhaust Gas Oxygen sensor internal component fault	• This DTC is set when the voltage on the Universal Heated Exhaust Gas Oxygen sensor heater circuit is less than that expected by the Engine Control Module. Refer to the electrical circuit diagrams and check the Universal Heated Exhaust Gas Oxygen sensor heater supply and heater ground circuits for short circuits, open circuits. Repair wiring harness as required, clear DTC and retest system • If no fault found in wiring harness suspect Universal Heated Exhaust Gas Oxygen sensor internal fault. refer to the new module/component installation note at the top of the DTC Index
P0435-00	Catalyst Temperature Sensor Circuit (Bank 2, Sensor Circuit 1) - No sub type information	• Catalyst temperature sensor bank 2, sensor 1 circuit short to ground • Catalyst temperature sensor bank 2, sensor 1 circuit short to power • Catalyst temperature sensor bank 2, sensor 1 circuit high resistance • Catalyst temperature sensor bank 2, sensor 1 circuit open circuit • Catalyst temperature sensor bank 2, sensor 1 circuit disconnected • Catalyst temperature sensor bank 2, sensor 1 failure	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 1 Voltage (0x03BF), Exhaust Gas Temperature Bank 2 Sensor 1 (0x03F7) • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for short to ground. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for short to power. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for high resistance. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for open circuit. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for disconnected. Repair wiring harness as required, clear DTC and retest system • Check and install a new catalyst temperature sensor - bank 2, sensor 1 as required. Refer to the new module/component installation note at the top of the DTC Index
P0436-00	Catalyst Temperature Sensor Circuit Range/Performance (Bank 2, Sensor Circuit 1) - No sub type information	• Catalyst temperature sensor bank 2, sensor 1 circuit short to ground • Catalyst temperature sensor bank 2, sensor 1 circuit short to power • Catalyst temperature sensor bank 2, sensor 1 circuit high resistance • Catalyst temperature sensor bank 2, sensor 1 circuit open circuit	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 1 Voltage (0x03BF), Exhaust Gas Temperature Bank 2 Sensor 1 (0x03F7) • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for short to ground. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for short to power. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for high resistance. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for open circuit. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for disconnected. Repair wiring harness as required, clear DTC and retest system

		Catalyst temperature sensor bank 2, sensor 1 circuit disconnected • Catalyst temperature sensor bank 2, sensor 1 failure	Check and install a new catalyst temperature sensor - bank 2, sensor 1 as required. Refer to the new module/component installation note at the top of the DTC Index
P0437-00	Catalyst Temperature Sensor Circuit Low (Bank 2, Sensor Circuit 1) - No sub type information	• Catalyst temperature sensor bank 2, sensor 1 circuit short to ground • Catalyst temperature sensor bank 2, sensor 1 circuit high resistance • Catalyst temperature sensor bank 2, sensor 1 circuit open circuit • Catalyst temperature sensor bank 2, sensor 1 circuit disconnected • Catalyst temperature sensor bank 2, sensor 1 failure	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 1 Voltage (0x03BF), Exhaust Gas Temperature Bank 2 Sensor 1 (0x03F7) • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for short to ground. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for high resistance. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for open circuit. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for disconnected. Repair wiring harness as required, clear DTC and retest system • Check and install a new catalyst temperature sensor - bank 2, sensor 1 as required. Refer to the new module/component installation note at the top of the DTC Index
P0438-00	Catalyst Temperature Sensor Circuit High (Bank 2, Sensor Circuit 1) - No sub type information	• Catalyst temperature sensor bank 2, sensor 1 circuit short to power • Catalyst temperature sensor bank 2, sensor 1 failure	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 1 Voltage (0x03BF), Exhaust Gas Temperature Bank 2 Sensor 1 (0x03F7). Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 1 circuit for short to power. Repair wiring harness as required, clear DTC and retest system • Check and install a new catalyst temperature sensor - bank 2, sensor 1 as required. Refer to the new module/component installation note at the top of the DTC Index.
P043A-00	Catalyst Temperature Sensor Circuit (Bank 2, Sensor Circuit 2) - No sub type information	• Catalyst temperature sensor bank 2, sensor 2 circuit short to ground • Catalyst temperature sensor bank 2, sensor 2 circuit short to power • Catalyst temperature sensor bank 2, sensor 2 circuit high resistance • Catalyst temperature sensor bank 2, sensor 2 circuit open circuit • Catalyst temperature	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 2 Sensor 2 (0x03F8), Exhaust Gas Temperature Sensor Bank 2 Sensor 2 Voltage (0x03E9) • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for short to ground. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for short to power. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for high resistance. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for open circuit. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for disconnected. Repair wiring harness as required, clear DTC and retest system • Check and install a new catalyst temperature sensor - bank 2, sensor 2 as required. Refer to the new

		sensor bank 2, sensor 2 circuit disconnected • Catalyst temperature sensor bank 2, sensor 2 failure	module/component installation note at the top of the DTC Index
P043B-00	Catalyst Temperature Sensor Circuit Range/Performance (Bank 2, Sensor Circuit 2) - No sub type information	• Catalyst temperature sensor bank 2, sensor 2 circuit short to ground • Catalyst temperature sensor bank 2, sensor 2 circuit short to power • Catalyst temperature sensor bank 2, sensor 2 circuit high resistance • Catalyst temperature sensor bank 2, sensor 2 circuit open circuit • Catalyst temperature sensor bank 2, sensor 2 circuit disconnected • Catalyst temperature sensor bank 2, sensor 2 failure	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 2 Sensor 2 (0x03F8), Exhaust Gas Temperature Sensor Bank 2 Sensor 2 Voltage (0x03E9) • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for short to ground. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for short to power. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for high resistance. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for open circuit. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for disconnected. Repair wiring harness as required, clear DTC and retest system • Check and install a new catalyst temperature sensor - bank 2, sensor 2 as required. Refer to the new module/component installation note at the top of the DTC Index
P043C-00	Catalyst Temperature Sensor Circuit Low (Bank 2, Sensor Circuit 2) - No sub type information	• Catalyst temperature sensor bank 2, sensor 2 circuit short to ground • Catalyst temperature sensor bank 2, sensor 2 circuit high resistance • Catalyst temperature sensor bank 2, sensor 2 circuit open circuit • Catalyst temperature sensor bank 2, sensor 2 circuit disconnected • Catalyst temperature sensor bank 2, sensor 2 failure	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 2 Sensor 2 (0x03F8), Exhaust Gas Temperature Sensor Bank 2 Sensor 2 Voltage (0x03E9) • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for short to ground. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for high resistance. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for open circuit. Repair wiring harness as required, clear DTC and retest system • Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for disconnected. Repair wiring harness as required, clear DTC and retest system • Check and install a new catalyst temperature sensor - bank 2, sensor 2 as required. Refer to the new module/component installation note at the top of the DTC Index
P043D-00	Catalyst Temperature Sensor Circuit High (Bank 2, Sensor	• Catalyst temperature sensor bank 2, sensor 2	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 2 Sensor 2 (0x03F8), Exhaust Gas Temperature Sensor Bank 2 Sensor 2 Voltage (0x03E9)

	Circuit 2) - No sub type information	circuit short to power • Catalyst temperature sensor bank 2, sensor 2 failure	Refer to the electrical circuit diagrams and check catalyst temperature sensor bank 2, sensor 2 circuit for short to power. Repair wiring harness as required, clear DTC and retest system • Check and install a new catalyst temperature sensor - bank 2, sensor 2 as required. Refer to the new module/component installation note at the top of the DTC Index
P0544-00	Exhaust Gas Temperature Sensor Circuit - Bank 1 Sensor 1 - No sub type information	• Exhaust gas temperature sensor, bank 1 sensor 1 circuit short to ground • Exhaust gas temperature sensor, bank 1 sensor 1 circuit short to power • Exhaust gas temperature sensor, bank 1 sensor 1 circuit high resistance • Exhaust gas temperature sensor, bank 1 sensor 1 circuit open circuit • Exhaust gas temperature sensor, bank 1 sensor 1 circuit disconnected • Exhaust gas temperature sensor, bank 1 sensor 1 failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor, bank 1 sensor 1 circuit for short to ground • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor, bank 1 sensor 1 circuit for short to power • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor, bank 1 sensor 1 circuit for high resistance • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor, bank 1 sensor 1 circuit for open circuit • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor, bank 1 sensor 1 circuit for disconnected. Repair wiring harness as required, clear DTC and retest system • Check and install a new exhaust gas temperature sensor, bank1 sensor 1 as required. Refer to the new module/component installation note at top of DTC Index
P0545-00	Exhaust Gas Temperature Sensor Circuit Low - Bank 1 Sensor 1 - No sub type information	• Exhaust gas temperature sensor, bank 1 sensor 1 circuit short to ground • Exhaust gas temperature sensor, bank 1 sensor 1 circuit high resistance • Exhaust gas temperature sensor, bank 1 sensor 1 circuit open circuit • Exhaust gas temperature sensor, bank 1 sensor 1 circuit disconnected • Exhaust gas temperature sensor, bank 1 sensor 1 failure	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor, bank 1 sensor 1 circuit for short to ground • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor, bank 1 sensor 1 circuit for high resistance • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor, bank 1 sensor 1 circuit for open circuit • Refer to the electrical circuit diagrams and check exhaust gas temperature sensor, bank 1 sensor 1 circuit for disconnected. Repair wiring harness as required, clear DTC and retest system • Check and install a new exhaust gas temperature sensor, bank1 sensor 1 as required. Refer to the new module/component installation note at top of DTC Index
P0546-00	Exhaust Gas Temperature Sensor Circuit High - Bank 1 Sensor 1 - No sub type	• Exhaust gas temperature sensor, bank 1 sensor 1 circuit short	• Refer to the electrical circuit diagrams and check exhaust gas temperature sensor, bank 1 sensor 1 circuit for short to power. Repair wiring harness as required, clear DTC and retest system • Check and install a new exhaust gas temperature sensor,

	information	to power • Exhaust gas temperature sensor, bank 1 sensor 1 failure	bank1 sensor 1 as required. Refer to the new module/component installation note at top of DTC Index
P2002-68	Diesel Particulate Filter Efficiency Below Threshold (Bank 1) - event information	• Diesel particulate filter regeneration disabled by other DTCs logged	• Using the manufacturer approved diagnostic system, check for related DTCs and refer to the relevant DTC Index. Carry out a diesel particulate filter regeneration
P2031-00	Exhaust Gas Temperature Sensor Circuit Bank 1 Sensor 2 - No sub type information	• Harness fault - Particulate filter inlet exhaust gas temperature sensor • Particulate filter inlet exhaust gas temperature sensor internal fault	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 2 Voltage (0x03C4), Exhaust Gas Temperature Bank 1 Sensor 2 (0x03F5). This DTC is set if the particulate filter inlet exhaust gas temperature sensor fails a plausibility check at cold start. Refer to the workshop manual and check the particulate filter inlet exhaust gas temperature sensor and wiring harness for obvious signs of mechanical damage due to chaffing or heat. The particulate filter inlet exhaust gas temperature sensor is a thermistor located in the inlet to the particulate filter housing with a signal and ground connection. Refer to the electrical circuit diagrams and check the signal circuit for open circuit, short circuit to power, short circuit to ground, high resistance. Check the ground circuit for open circuit, high resistance, short circuit to power. Repair the wiring harness as required • If there are no wiring faults, refer to the workshop manual and check the sensor resistance value. Replace the sensor if required, refer to the new module/component installation note at top of DTC Index
P2032-00	Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 2 - No sub type information	• Harness fault - Particulate filter inlet exhaust gas temperature sensor • Particulate filter inlet exhaust gas temperature sensor internal fault	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 2 Voltage (0x03C4), Exhaust Gas Temperature Bank 1 Sensor 2 (0x03F5). This DTC is set if the particulate filter inlet exhaust gas temperature sensor fails a diagnostic check due to the circuit voltage being less than the expected value. Refer to the workshop manual and check the particulate filter inlet exhaust gas temperature sensor and wiring harness for obvious signs of mechanical damage due to chaffing or heat. The particulate filter inlet exhaust gas temperature sensor is a thermistor located in the inlet to the particulate filter housing with a signal and ground connection. Refer to the electrical circuit diagrams and check the signal circuit for open circuit, short circuit to power, short circuit to ground, high resistance. Check the ground circuit for open circuit, high resistance, short circuit to power. Repair the wiring harness as required • If there are no wiring faults, refer to the workshop manual and check the sensor resistance value. Replace the sensor if required, refer to the new module/component installation note at top of DTC Index
P2033-00	Exhaust Gas Temperature Sensor Circuit High Bank 1 Sensor 2 - No sub type information	• Harness fault - Particulate filter inlet exhaust gas temperature sensor • Particulate filter inlet exhaust gas temperature sensor internal fault	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 2 Voltage (0x03C4), Exhaust Gas Temperature Bank 1 Sensor 2 (0x03F5). This DTC is set if the particulate filter inlet exhaust gas temperature sensor fails a diagnostic check due to the circuit voltage being greater than the expected value. Refer to the workshop manual and check the particulate filter inlet exhaust gas temperature sensor and wiring harness for obvious signs of mechanical damage due to chaffing or heat. The particulate filter inlet exhaust gas temperature sensor is a thermistor located in the inlet to the particulate filter housing with a signal and ground connection. Refer to the electrical circuit diagrams and check the signal circuit for open circuit, short circuit to power, short circuit to ground, high resistance. Check the ground circuit for open circuit, high resistance, short circuit to power. Repair the wiring harness as required • If there are no wiring faults, refer to the workshop manual and check the sensor resistance value. Replace the sensor if required, refer to the new module/component installation note at top of DTC Index
P2080-	Exhaust Gas	• Harness fault	• This DTC is set when there is a plausibility error on the

00	Temperature Sensor Circuit Range/Performance Bank 1 Sensor 1 - No sub type information	- Secondary turbo outlet temperature sensor • Secondary turbo outlet temperature sensor internal fault	signal from the secondary turbo outlet temperature sensor. Refer to the workshop manual and check the secondary turbo outlet temperature sensor and wiring harness for obvious signs of mechanical damage due to chaffing or heat. The secondary turbo outlet temperature sensor is a thermistor with a signal and ground connection. Refer to the electrical circuit diagrams and check the signal circuit for open circuit, short circuit to power, short circuit to ground, high resistance. Check the ground circuit for open circuit, high resistance, short circuit to power. Repair the wiring harness as required • If there are no wiring faults, refer to the workshop manual and check the sensor resistance value. Replace the sensor if required, refer to the new module/component installation note at top of DTC Index
P2084-00	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 2 - No sub type information	• Harness fault - close coupled catalyst outlet temperature sensor • Close coupled catalyst outlet temperature sensor internal fault	• This DTC is set when there is a plausibility error on the signal from the close coupled catalyst outlet temperature sensor. Refer to the workshop manual and check the close coupled catalyst outlet temperature sensor and wiring harness for obvious signs of mechanical damage due to chaffing or heat. The close coupled catalyst outlet temperature sensor is a thermistor with a signal and ground connection. Refer to the electrical circuit diagrams and check the signal circuit for open circuit, short circuit to power, short circuit to ground, high resistance. Check the ground circuit for open circuit, high resistance, short circuit to power. Repair the wiring harness as required • If there are no wiring faults, refer to the workshop manual and check the sensor resistance value. Replace the sensor if required, refer to the new module/component installation note at top of DTC Index
P2226-62	Barometric Pressure Sensor A Circuit - Signal compare failure	• The Engine Control Module (ECM) has been submersed in water or mud • The Engine Control Module (ECM) has been sealed in a non approved covering	• Check the Engine Control Module (ECM) is clean and dry. • Check the Engine Control Module (ECM) is not sealed by any non approved covering. • If the DTC does not clear install a new Engine Control Module (ECM) as required. Refer to the new module/component installation note at top of DTC Index.
P2245-00	O2 Sensor Reference Voltage Circuit Low - Bank 1, Sensor 1 - No sub type information	• Harness fault - oxygen sensor circuit • Oxygen sensor internal fault	• This DTC is set if the Engine Control Module (ECM) detects the bank 1, oxygen sensor 1 reference voltage (LPV_A) is lower than expected. Refer to the electrical circuit diagrams and check the oxygen sensor harness for signs of damage caused by chaffing or heat. Check the oxygen sensor circuits for open circuits, high resistance, short to ground. Repair wiring as required, clear the DTC and retest the system • If there are no wiring faults suspect the oxygen sensor. Refer to the new module/component installation note at the top of the DTC Index
P2246-00	O2 Sensor Reference Voltage Circuit High - Bank 1, Sensor 1 - No sub type information	• Harness fault - oxygen sensor circuit • Oxygen sensor internal fault	• This DTC is set if the Engine Control Module (ECM) detects the bank 1, oxygen sensor 1 reference voltage (LPV_A) is greater than expected. Refer to the electrical circuit diagrams and check the oxygen sensor harness for signs of damage caused by chaffing or heat. Check the oxygen sensor circuits for open circuits, high resistance, short to power. Repair wiring as required, clear the DTC and retest the system • If there are no wiring faults suspect the oxygen sensor. Refer to the new module/component installation note at the top of the DTC Index
P242A-00	Exhaust Gas Temperature Sensor Circuit Bank 1 Sensor 3 - No sub type information	• Harness fault - particulate filter outlet temperature sensor • Particulate filter outlet temperature sensor internal fault	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 3 (0x03F6), Exhaust Gas Temperature Bank 1 Sensor 3 Voltage (0x03F8). This DTC is set if the Particulate filter outlet temperature sensor fails a cold start diagnostic check by the Engine Control Module. Refer to the workshop manual and check the particulate filter and sensor for obvious signs of damage. Check the sensor harness for chaffing or heat damage. Refer to the electrical circuit diagrams and check the particulate filter outlet temperature

			sensor signal circuit for open circuit, short to ground, short to other circuits. Check the sensor ground circuit for open circuit, short to power, high resistance. Repair wiring as required • If there are no wiring faults suspect the particulate filter outlet temperature sensor. Refer to the new module/component installation note at the top of the DTC Index
P242B-00	Exhaust Gas Temperature Sensor Circuit Range/Performance Bank 1 Sensor 3 - No sub type information	• Harness fault - particulate filter outlet temperature sensor • Particulate filter outlet temperature sensor internal fault	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 3 (0x03F6), Exhaust Gas Temperature Bank 1 Sensor 3 Voltage (0x03F8). This DTC is set if the Particulate filter outlet temperature sensor fails a plausibility check by the Engine Control Module. Refer to the workshop manual and check the particulate filter and sensor for obvious signs of damage. Check the sensor harness for chaffing or heat damage. Refer to the electrical circuit diagrams and check the particulate filter outlet temperature sensor signal circuit for open circuit, short to ground, short to other circuits. Check the sensor ground circuit for open circuit, short to power, high resistance. Repair wiring as required • If there are no wiring faults suspect the particulate filter outlet temperature sensor. Refer to the new module/component installation note at the top of the DTC Index
P242C-00	Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 3 - No sub type information	• Harness fault - particulate filter outlet temperature sensor • Particulate filter outlet temperature sensor internal fault	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 3 (0x03F6), Exhaust Gas Temperature Bank 1 Sensor 3 Voltage (0x03F8). This DTC is set if the Particulate filter outlet temperature sensor signal voltage is less than the Engine Control Module (ECM) was expecting. Refer to the workshop manual and check the particulate filter and sensor for obvious signs of damage. Check the sensor harness for chaffing or heat damage. Refer to the electrical circuit diagrams and check the particulate filter outlet temperature sensor signal circuit for open circuit, short to ground, short to other circuits. Check the sensor ground circuit for open circuit, short to power, high resistance. Repair wiring as required • If there are no wiring faults suspect the particulate filter outlet temperature sensor. Refer to the new module/component installation note at the top of the DTC Index
P242D-00	Exhaust Gas Temperature Sensor Circuit High Bank 1 Sensor 3 - No sub type information	• Harness fault - particulate filter outlet temperature sensor • Particulate filter outlet temperature sensor internal fault	• Using the manufacturer approved diagnostic system check datalogger signals, Exhaust Gas Temperature Bank 1 Sensor 3 (0x03F6), Exhaust Gas Temperature Bank 1 Sensor 3 Voltage (0x03F8). This DTC is set if the Particulate filter outlet temperature sensor signal voltage is greater than the Engine Control Module (ECM) was expecting. Refer to the workshop manual and check the particulate filter and sensor for obvious signs of damage. Check the sensor harness for chaffing or heat damage. Refer to the electrical circuit diagrams and check the particulate filter outlet temperature sensor signal circuit for open circuit, short to ground, short to other circuits. Check the sensor ground circuit for open circuit, short to power, high resistance. Repair wiring as required • If there are no wiring faults suspect the particulate filter outlet temperature sensor. Refer to the new module/component installation note at the top of the DTC Index.
P242F-00	Diesel Particulate Filter Restriction - Ash Accumulation (Bank 1) - No sub type information	• Maximum ash load	NOTE: The setting value of this DTC is inhibited • Contact dealer technical support
P244A-00	Diesel Particulate Filter Differential Pressure Too Low (Bank1) - No sub type information	• Diagnostic fault check for minimum pressure differential characteristics	• Using the manufacturer approved diagnostic system, check for related DTCs and refer to the relevant DTC index • Clear DTC and retest
P244A-96	Diesel Particulate Filter Differential Pressure Too Low	• Destroyed particulate filter	• GO to Pinpoint Test A.

	(Bank1) - component internal failure		
P244B-68	Diesel Particulate Filter Differential Pressure Too High (Bank 1) - Event information	• Engine protection back pressure high • Sudden increases in differential pressure across the diesel particulate filter	NOTE: This DTC when logged on its own is advisory only and no further action should be taken • Using the manufacturer approved diagnostic system, check for related DTCs. If this DTC exists with any other diesel particulate filter differential pressure sensor DTCs, follow the advise given for that DTC
P2452-23	Diesel Particulate Filter Pressure Sensor A Circuit - Signal stuck low	• Differential pressure sensor circuit, short circuit to ground • Diesel particulate filter pressure sensor A circuit, hose line error	• Refer to the electrical circuit diagrams and check the differential pressure sensor circuit, for short circuit to ground • Using the manufacturer approved diagnostic system, check for related DTCs and refer to the relevant DTC Index
P2452-29	Diesel Particulate Filter Pressure Sensor A Circuit - Signal invalid	• Diagnostic fault check for frozen sensor	• Using the manufacturer approved diagnostic system, check for related DTCs and refer to the relevant DTC Index
P2452-95	Diesel Particulate Filter Pressure Sensor A Circuit - Incorrect assembly	• Diesel particulate filter pressure sensor hoses connected incorrectly • Diesel particulate filter pressure sensor hoses crushed, blocked, split	NOTE: If a new Diesel Particulate Filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the Engine Control Module must learn and store the new Diesel Particulate Filter pressure sensor offset value. The following conditions must be met to allow the Diesel Particulate Filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from Engine Control Module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500RPM for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the Engine Control Module to power down, learn and store Diesel Particulate Filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa • Using the manufacturer approved diagnostic system check datalogger signals, Particulate Filter Differential Pressure Sensor Voltage - Bank 1 (0x03DB). Refer to the workshop manual and check diesel particulate filter pressure sensor hoses are installed correctly • Check diesel particulate filter pressure sensor hoses for crushed, blockage, split
P2453-00	Diesel Particulate Filter Pressure Sensor A Circuit Range/Performance - No sub type information	• Harness fault - Particulate filter pressure sensor • Particulate filter pressure sensor internal fault	NOTE: If a new Diesel Particulate Filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the Engine Control Module must learn and store the new Diesel Particulate Filter pressure sensor offset value. The following conditions must be met to allow the Diesel Particulate Filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from Engine Control Module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500RPM for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the Engine Control Module to power down, learn and store Diesel Particulate Filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa • Using the manufacturer approved diagnostic system check

			datalogger signals, Particulate Filter Differential Pressure Sensor Voltage - Bank 1 (0x03DB). This DTC is set when the particulate pressure sensor fails a plausibility check. Refer to the workshop manual and check the particulate filter and sensor for obvious signs of damage. Check the sensor harness for chaffing or heat damage. Refer to the electrical circuit diagrams and check the particulate filter pressure sensor signal circuit for open circuit, short to ground, short to other circuits. Check the sensor ground circuit for open circuit, short to power, high resistance. Check the sensor power supply circuit for open circuit, short to ground, high resistance. Repair wiring as required • If there are no wiring faults suspect the particulate filter pressure sensor. Refer to the new module/component installation note at the top of the DTC Index
P2453-16	Diesel Particulate Filter Pressure Sensor A Circuit Range/performance - Circuit voltage below threshold	• Diagnostic fault check for Signal Range Check low in flow resistance	• Using the manufacturer approved diagnostic system, check for related DTCs and refer to the relevant DTC Index
P2453-17	Diesel Particulate Filter Pressure Sensor A Circuit Range/Performance - Circuit voltage above threshold	• Diagnostic fault check for Signal Range Check high in flow resistance	• Using the manufacturer approved diagnostic system, check for related DTCs and refer to the relevant DTC Index
P2454-00	Diesel Particulate Filter Pressure Sensor A Circuit Low - No sub type information	• Harness fault - Particulate filter pressure sensor • Particulate filter pressure sensor internal fault	NOTE: If a new Diesel Particulate Filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the Engine Control Module must learn and store the new Diesel Particulate Filter pressure sensor offset value. The following conditions must be met to allow the Diesel Particulate Filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from Engine Control Module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500RPM for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the Engine Control Module to power down, learn and store Diesel Particulate Filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa • Using the manufacturer approved diagnostic system check datalogger signals, Particulate Filter Differential Pressure Sensor Voltage - Bank 1 (0x03DB). This DTC is set when the particulate pressure sensor voltage is less than the threshold set in the Engine Control Module (ECM) diagnostic check. Refer to the workshop manual and check the particulate filter and sensor for obvious signs of damage. Check the sensor harness for chaffing or heat damage. Refer to the electrical circuit diagrams and check the particulate filter pressure sensor signal circuit for open circuit, short to ground, short to other circuits. Check the sensor ground circuit for open circuit, short to power, high resistance. Check the sensor power supply circuit for open circuit, short to ground, high resistance. Repair wiring as required • If there are no wiring faults suspect the particulate filter pressure sensor. Refer to the new module/component installation note at the top of the DTC Index
P2455-00	Diesel Particulate Filter Pressure Sensor A Circuit High - No sub type information	• Harness fault - Particulate filter pressure sensor • Particulate filter pressure sensor internal fault	NOTE: If a new Diesel Particulate Filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the Engine Control Module must learn and store the new Diesel Particulate Filter pressure sensor offset value. The following conditions must be met to allow the Diesel Particulate Filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from Engine Control Module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500RPM for 2 minutes, then a further 30 seconds at idle. Ensure

			the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the Engine Control Module to power down, learn and store Diesel Particulate Filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa • Using the manufacturer approved diagnostic system check datalogger signals, Particulate Filter Differential Pressure Sensor Voltage - Bank 1 (0x03DB). This DTC is set when the particulate pressure sensor voltage is greater than the threshold set in the Engine Control Module (ECM) diagnostic check. Refer to the workshop manual and check the particulate filter and sensor for obvious signs of damage. Check the sensor harness for chaffing or heat damage. Refer to the electrical circuit diagrams and check the particulate filter pressure sensor signal circuit for open circuit, short to ground, short to other circuits. Check the sensor ground circuit for open circuit, short to power, high resistance. Check the sensor power supply circuit for open circuit, short to ground, high resistance. Repair wiring as required • If there are no wiring faults suspect the particulate filter pressure sensor. Refer to the new module/component installation note at the top of the DTC Index
P2456-00	Diesel Particulate Filter Pressure Sensor A Circuit Intermittent/Erratic - No sub type information	• Diesel particulate filter pressure sensor hoses crushed, blocked, split • Diesel particulate filter differential pressure sensor failure	NOTE: If a new Diesel Particulate Filter pressure sensor or hose lines have been installed or incorrectly routed, or any pressure sensor circuit repairs carried out, the Engine Control Module must learn and store the new Diesel Particulate Filter pressure sensor offset value. The following conditions must be met to allow the Diesel Particulate Filter pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from Engine Control Module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500RPM for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the Engine Control Module to power down, learn and store Diesel Particulate Filter pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa • Check diesel particulate filter pressure sensor hoses for crushed, blocked, split • Check and replace diesel particulate filter differential pressure sensor as required. Refer to the new module/component installation note at the top of the DTC Index
P2458-66	Diesel Particulate Filter Regeneration Duration (Bank 1) - Signal has too many transitions / events	• Permanent regeneration	NOTE: This code is enabled for JLR engineering detailed diagnostics only. No further action should be taken • Using the manufacturer approved diagnostic system, check for related DTCs and refer to the relevant DTC Index
P2459-65	Diesel Particulate Filter Regeneration Frequency (Bank 1) - Signal has too few transitions / events	• Blocked regeneration • Customer driving routine does not allow the system to clean the particulate filter	NOTE: If DTC is P2459-65 or AMBER DPF FULL REFER TO HANDBOOK message is displayed with no other reported messages. No repair is required, if the vehicle is driven on a highway AS DIRECTED IN THE HANDBOOK then the light will be extinguished and the system self healed, nothing more than this is required • Refer to the diesel particulate filter regeneration procedure at the bottom of the DTC Index • Advise customer of driving routine required to regenerate diesel particulate filter as stated in the vehicle handbook
P2459-66	Diesel Particulate Filter Regeneration Frequency (Bank 1) - Signal has too many transitions / events	• Regeneration frequency	NOTE: This code is enabled for JLR engineering detailed diagnostics only. No further action should be taken • Using the manufacturer approved diagnostic system, check for related DTCs and refer to the relevant DTC Index
P2463-	Diesel Particulate	• Maximum	• GO to Pinpoint Test B.

00	Filter Restriction - Soot Accumulation (Bank 1) - No sub type information	soot mass	
P246C-00	Diesel Particulate Filter Restriction - Forced Limited Power - No sub type information	• Diagnostic fault check for maximum pressure differential characteristics	• Using the manufacturer approved diagnostic system, check for related DTCs and refer to the relevant DTC Index

Pinpoint Tests

PINPOINT TEST A : DTC P244A-96 IS STORED	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**
A1: CHECK FOR OTHER DTCS	
	1 Using the manufacturer approved diagnostic system, check if any of the following DTCs are stored • P2456-00 • P2226-62 • P2452-95 • P2453-00
	Are any of the additional DTCs stored? **Yes** Refer to the relevant DTC Index and carry out the relevant repair procedure. **Only after the repair,** using the manufacturer approved diagnostic system clear the DTC and retest **No** Proceed to next step
A2: EXHAUST PIPE AND JOINTS	
	1 Check all exhaust pipes and joints for leaks
	2 Check for external damage to the diesel particulate filter metalwork
	Are any of the exhaust pipes leaking, or is there external damage to the diesel particulate filter metalwork? **Yes** Repair leaking exhaust joints as required Check and install a new diesel particulate filter as requiredRefer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component **No** Proceed to next step
A3: DIESEL PARTICULATE FILTER PRESSURE SENSOR PIPES	
	1 Check differential pressure sensor pipes for cracks, mis-routing or hoses crossed
	Are any of the differential pressure sensor pipes cracked, mis-routed or hoses crossed? **Yes** Repair as required, clear DTC and retest **No** Proceed to next step
A4: HARNESS DIFFERENTIAL PRESSURE SENSOR	
	1 Check wiring harness to the differential pressure sensor, include any inline connectors
	Was the wiring harness to the differential pressure sensor damaged? **Yes** Repair wiring harness as required, clear DTC and retest **No** Proceed to next step
A5: CONNECTOR INTEGRITY DIFFERENTIAL PRESSURE SENSOR	
	1 Check differential pressure sensor connector for damage and terminal corrosion
	Was the differential pressure sensor connector damaged or terminal corrosion present? **Yes** Refer to the electrical circuit diagrams and check connections are secure and wiring integrity. Repair as required, clear DTC and retest **No** Proceed to next step
A6: FUNCTIONAL CHECK DIFFERENTIAL PRESSURE SENSOR	
	NOTES:  The Particulate Filter Differential Pressure Sensor measured voltage with the ignition on checks the sensor output with no variation/pressure in the exhaust system, checking the Particulate Filter Differential Pressure Sensor adaption is working. The measured voltages at engine idle and 4000 RPM will be considerably different depending on the diesel particulate filter soot loading. The idle value tells us that the Particulate Filter Differential Pressure Sensor is working if it goes up from the ignition

	on value. The 4000 RPM value tells us how much soot is in the diesel particulate filter. A diesel particulate filter which is recoverable measures less than 1.5volts / 300mbar at 4000 RPM  If a new differential pressure sensor or hose lines have been installed, incorrectly routed, or any differential pressure sensor circuit repairs carried out, the Engine Control Module must learn and store the new differential pressure sensor offset value. The following conditions must be met to allow the differential pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from Engine Control Module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500RPM for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the Engine Control Module to power down, learn and store differential pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa **1** Using the manufacturer approved diagnostic system check datalogger signal - Particulate Filter Differential Pressure Sensor Voltage - Bank 1 - (0x03DB) under the conditions described below. Allow the voltage to stabilize before recording the value for approximately 7 seconds • Ignition is ON and engine speed is 0 RPM • Engine idle speed • Engine speed is 4000 RPM
	Was datalogger signal - Particulate Filter Differential Pressure Sensor Voltage - Bank 1 - (0x03DB) - value approximately 0.75 Volts when ignition ON and engine speed is 0 RPM?Was datalogger signal - Particulate Filter Differential Pressure Sensor Voltage - Bank 1 - (0x03DB) - value less than 1 Volt when engine speed at idle?Was datalogger signal - Particulate Filter Differential Pressure Sensor Voltage - Bank 1 - (0x03DB) - value less than 1.5 Volt when engine speed at 4000 RPM? (1volt = 100mbar, 1.5 volts = 300mbar at 4000RPM) **Yes** Proceed to next step **No** Check and install a new differential pressure sensor as requiredRefer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/componentUsing the manufacturer approved diagnostic system clear the DTC and retest NOTE: If a new differential pressure sensor or hose lines have been installed, incorrectly routed, or any differential pressure sensor circuit repairs carried out, the Engine Control Module must learn and store the new differential pressure sensor offset value. The following conditions must be met to allow the differential pressure sensor offset value to be learnt and stored: Using the manufacturer approved diagnostic system, clear DTCs from Engine Control Module, then monitor the datalogger signal 'sump oil temperature - measured' ensuring a minimum of 50 degrees C is achieved. Start engine, run above 500RPM for 2 minutes, then a further 30 seconds at idle. Ensure the engine cooling fan is not running. Set vehicle in park and set ignition status to off. Wait 30 seconds for the Engine Control Module to power down, learn and store differential pressure sensor offset value. This process must be carried out six times, to allow a large negative offset value to adapt back to 0 Hpa
A7: ACCELERATION SMOKE TEST	
	 NOTE: Ensure the engine is at normal operating temperature **1** Increase the engine speed momentarily to 4000RPM and allow the engine to settle back to idle
	2 Carry out above step 3 times
	3 Carry out visual check for excessive black smoke leaving the tailpipe during each of the 3 tests
	Is excessive black smoke visible leaving the tailpipe during each of the 3 tests? **Yes** Note: Only install a new diesel particulate filter if black smoke is visible leaving the tailpipe Check and install a new diesel particulate filter as requiredRefer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/componentUsing the manufacturer approved diagnostic system clear the DTC and retest. Return vehicle to the customer **No** Check and install a new differential pressure sensor as requiredCarry out differential pressure sensor adaption process

PINPOINT TEST B : RED WARNING MESSAGE DPF FULL VISIT DEALER IS DISPLAYED AND DTC P2463-00 IS LOGGED	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**
B1: VIN INFORMATION	
	1 Record the full vehicle identification number for the vehicle under test, as this information may later be required by dealer technical support
	Has the vehicle identification number been recorded? **Yes** Proceed to the next step **No** Record the vehicle identification number and proceed to the next step

B2: VEHICLE MILEAGE	
	1 Record the full mileage for the vehicle under test, as this information may later be required by dealer technical support
	Has the mileage been recorded? **Yes** Proceed to the next step **No** Record the mileage and proceed to the next step
B3: VEHICLE SOFTWARE PART NUMBER	
	 NOTE: Known software issue on PD software level where Lambda sensor adaption is not complete and the assumed value of O2 in air is 0%, PE software level corrected to 21% This can lead to non recognition of good regenerations of the diesel particulate filter **1** Using the manufacturer approved diagnostic system, record the software part number for the Engine Control Module (ECM)
	Has the software part number been recorded? Is the software installed to the vehicle to the latest relevant level? **Yes** Proceed to the next step **No** Record the software part number and proceed to the next step
B4: RECORD ALL ENGINE CONTROL MODULE (ECM) DTCS	
	1 Using the manufacturer approved diagnostic system, check Engine Control Module (ECM), for related DTCs
	Are other DTCs logged? **Yes** Proceed to the next step **No** Proceed to step 7
B5: DTC P2459-65 IS LOGGED	
	1 Using the manufacturer approved diagnostic system, the logged mileage for DTCs can be seen by viewing the snapshot data
	Was DTC P2459-65 logged at a mileage up to 625 miles (1000KM) before the diagnostic trouble P2463-00 was logged? **Yes** Suspect the customer has ignored the AMBER DPF FULL REFER TO HANDBOOK message. The customer should be advised of this and the repair may become chargeable Proceed to step 7 **No** Proceed to the next step
B6: OTHER RELATED ENGINE CONTROL MODULE (ECM) DTCS	
	1 Related Engine Control Module (ECM) DTCs other than P2459-65 and P2463-00 are logged
	Are related Engine Control Module (ECM) DTCs other than P2459-65 and P2463-00 logged? **Yes** Refer to the relevant DTC Index. Repair as required. Using the manufacturer approved diagnostic system clear the DTCs and retest **No** Proceed to step 7
B7: DIESEL PARTICULATE FILTER REGENERATION CYCLE	
	 NOTE: Using the manufacturer approved diagnostic system begin to perform a service regeneration cycle, **DO NOT** drive the cleaning cycle. **Record the grams of soot only** **1** With the engine at running temperature check the pre catalyst oxygen sensor operation as follows:-
	2 Using the manufacturer approved diagnostic system check datalogger signals - Oxygen Sensor Voltage - (0xF424) • Idle vehicle and record, should be (0.9 ~ 1 volt) • Idle to 100% pedal, during acceleration record, should be 0 volts • Accelerate to 4500RPM (stationary) and close throttle, should read 1.2 ~ 1.3 volts
	Does the pre catalyst oxygen sensor meets this criteria? **Yes** Pre catalyst oxygen sensor is operating correctlyNote: **DO NOT** carry out the adaption process on the pre catalyst oxygen sensor, as this resets the adaption to 0Proceed to step 8 **No** Pre catalyst oxygen sensor adaption cycle is required Pre catalyst oxygen sensor adaption cycle is **NOT** possible while DTCs are loggedUsing the manufacturer approved diagnostic system, carry out FIT NEW PARTICULATE FILTER PROCESS only and clear the DTCsAfter completing FIT NEW PARTICULATE FILTER PROCESS continue with pre catalyst oxygen sensor adaption cycle as follows:-1. Idle vehicle for 10 minutes2. Set car in command shift 3rd gear3. Accelerate to 3800RPM (where achievable) and overrun / coastdown without braking until revs drop below 1500 RPM4. Repeat step 3 a further 3 times5. Check for any DTCs, if adaption failed a DTC will be evident and the sensor will require replacement6. Check oxygen sensor adaption is now complete by returning to B7 item 27. Using the manufacturer approved diagnostic system clear the DTC and retest. Return vehicle to the

	customer
B8: SOOT ESTIMATOR IS ACCURATE AND THE DIFFERENTIAL PRESSURE SENSOR READING IS WORKING CORRECTLY	
	1 Using the manufacturer approved diagnostic system check datalogger signal - Particulate Filter Differential Pressure Sensor Voltage - Bank 1 - (0x03DB) • Record value with ignition ON • Idle engine record value • Hold engine speed at 4000RPM and record value • Note: 1volt = 100mbar, 1.5 volts = 300mbar at 4000RPM
	Have the values been recorded for each of the conditions? **Yes** Proceed to step 9 **No** Record values for each of the conditions and proceed to step 9
B9: EXHAUST GAS TEMPERATURES	
	1 Using the manufacturer approved diagnostic system check datalogger signals • Exhaust Gas Temperature Bank 1 Sensor 2 - (0x03F5) • Exhaust Gas Temperature Bank 1 Sensor 3 - (0x03F6) • Exhaust Gas Temperature Bank 2 Sensor 1 - (0x03F7) • Exhaust Gas Temperature Bank 2 Sensor 2 - (0x03F8)
	2 Hold engine speed at 2000RPM for 5 minutes and record values (By doing this we are trying to establish if the system can recognize heat in the exhaust during regeneration)
	Are all of the exhaust gas temperature sensors showing reasonable values between 120°C and 400°C? **Yes** Proceed to step 10 **No** Check and install new exhaust gas temperature sensors as required. Refer to the new module/component installation note at the top of the DTC Index Using the manufacturer approved diagnostic system clear the DTCs and retest
B10: COMPARISON OF SOOT MASS IN DIESEL PARTICULATE FILTER AND PARTICULATE FILTER DIFFERENTIAL PRESSURE SENSOR VOLTAGE	
NOTE: Using the results from steps 7 and 8 establish if the Soot Mass estimator and the differential pressure sensor are aligned, in terms of their assessment of soot in the filter. If the soot mass is less than 54 grams the diesel particulate filter is recoverable.	
	1 Using the results from step 7 check soot mass is less than 54 grams
	2 Using the results from step 8 check particulate filter differential pressure sensor voltage at 4000RPM is less than 1.5 volts (300mbar)
	Is diesel particulate filter soot mass value less than 54 grams and particulate filter differential pressure sensor voltage at 4000RPM less than 1.5 volts (300mbar)? **Yes** If the diesel particulate filter soot mass value is greater than 50 grams and the differential pressure sensor voltage is between 0.5Volts and 1.1Volts then the diesel particulate filter is low on soot but has not been driven to allow pressure correction of the diesel particulate filter, if other issue from the tests performed are evident. Proceed to next step **No** If the diesel particulate filter soot mass value is greater than 50 grams and the differential pressure sensor voltage greater than 1.5 volts then the diesel particulate filter has a high soot contentIf no other issue from the tests performed are evident then the vehicle has a soot generated fault not detected by DTCs. Refer to the relevant section of the workshop manual and check for boost pressure leakage using the manufacturer approved leak check toolContact dealer technical support for further advice
B11: SOOT MASS REDUCTION	
	1 With the vehicle fully up to temperature and in Park maintain 2500RPM for 10 minutes
	2 Return to step 7, check diesel particulate filter soot mass value
	Has the diesel particulate filter soot mass reduced from the original recorded value? **Yes** Proceed to next step **No** Proceed to step 13
B12: DRIVE VEHICLE	
	CAUTION: At all times during this procedure you should observe all relevant speed limits, laws, and regulations **1** Drive the vehicle until the engine reaches normal operating temperature. The engine should **NOT** be left idling to achieve working temperature. Drive the vehicle for a further twenty minutes, keeping the vehicle at a constant speed between 75 km/h (45 mph) and 120 km/h (75 mph). Keeping a constant speed enables the diesel particulate filter to regenerate more efficiently. It is therefore recommended that cruise control is used to achieve this, if possible (Do NOT carry out diesel particulate filter service regeneration)
	Is the diesel particulate filter soot mass less than 20 grams? **Yes**

	Using the manufacturer approved diagnostic system clear the DTC and retest. Return vehicle to the customer **No** Contact dealer technical support with all of the recorded values from the above tests
B13: CARRY OUT FIT NEW PARTICULATE FILTER PROCESS	
	 WARNING: **DO NOT** carry out this process on any other occasion without first installing a new diesel particulate filter **1** Using the manufacturer approved diagnostic system, select SPECIAL APPLICATIONS ~ POWERTRAIN ~ carry out FIT NEW PARTICULATE FILTER PROCESS
	2 Carry out diesel particulate filter service regeneration. Record grams of soot following diesel particulate filter service regeneration
	Is the diesel particulate filter soot mass less than 20 grams? **Yes** Using the manufacturer approved diagnostic system clear the DTC and retest. Return vehicle to the customer **No** Contact dealer technical support with all of the recorded values from the above tests

Diesel particulate filter regeneration procedure

If DPF FULL SEE HANDBOOK appears in the message center, carry out the following procedure

CAUTIONS:

 The regeneration procedure produces high temperatures in the diesel particulate filter. Heat can be felt radiating from beneath the vehicle, which is normal and not a cause for concern. However, the vehicle should not be parked over combustible material, particularly during dry weather. The heat generated could be sufficient to start a fire when in close proximity to combustible material such as long dry grass, paper etc

 At all times during this procedure you should observe all relevant speed limits, laws, and regulations

NOTES:

 The ideal speed and conditions for regeneration are 100 km/h (62 mph) ~ 120 km/h (75 mph), in Drive. Keeping a constant speed enables the diesel particulate filter to regenerate more efficiently. It is therefore recommended that cruise control is used to achieve this, if possible

 When driving off-road during the regeneration process, greater accelerator pedal use may be required

1. Drive the vehicle until the engine reaches normal operating temperature. The engine should **NOT** be left idling to achieve working temperature
2. Drive the vehicle for a further twenty minutes, keeping the vehicle at a constant speed between 75 km/h (45 mph) and 120 km/h (75 mph)
3. If regeneration is successful the warning message will be extinguished, once the message is extinguished please keep driving for 10 minutes to ensure that the diesel particulate filter is completely clean
4. If the message remains repeat the process

DTC Index

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00.
REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 03-Jul-2013

Exhaust System - TDV6 3.0L Diesel - Exhaust System Repair

General Procedures

Check

NOTES:

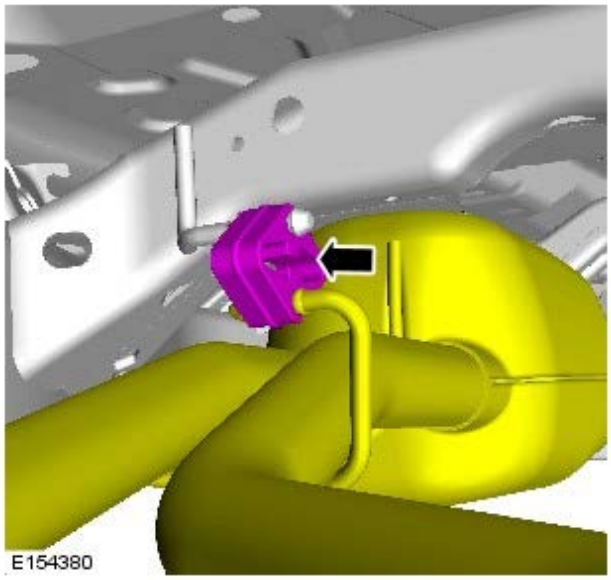
Some variation in the illustrations may occur, but the essential information is always correct.

Some components shown removed for clarity.

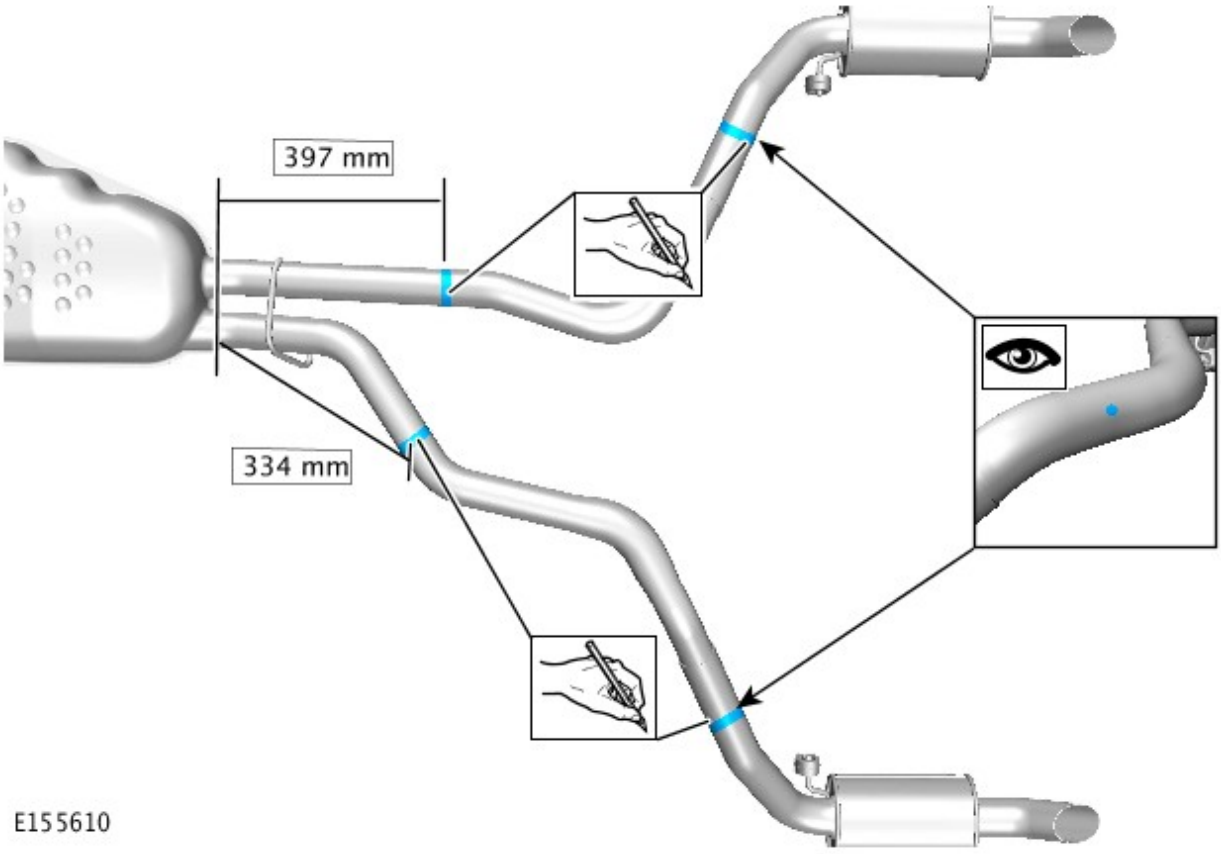
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

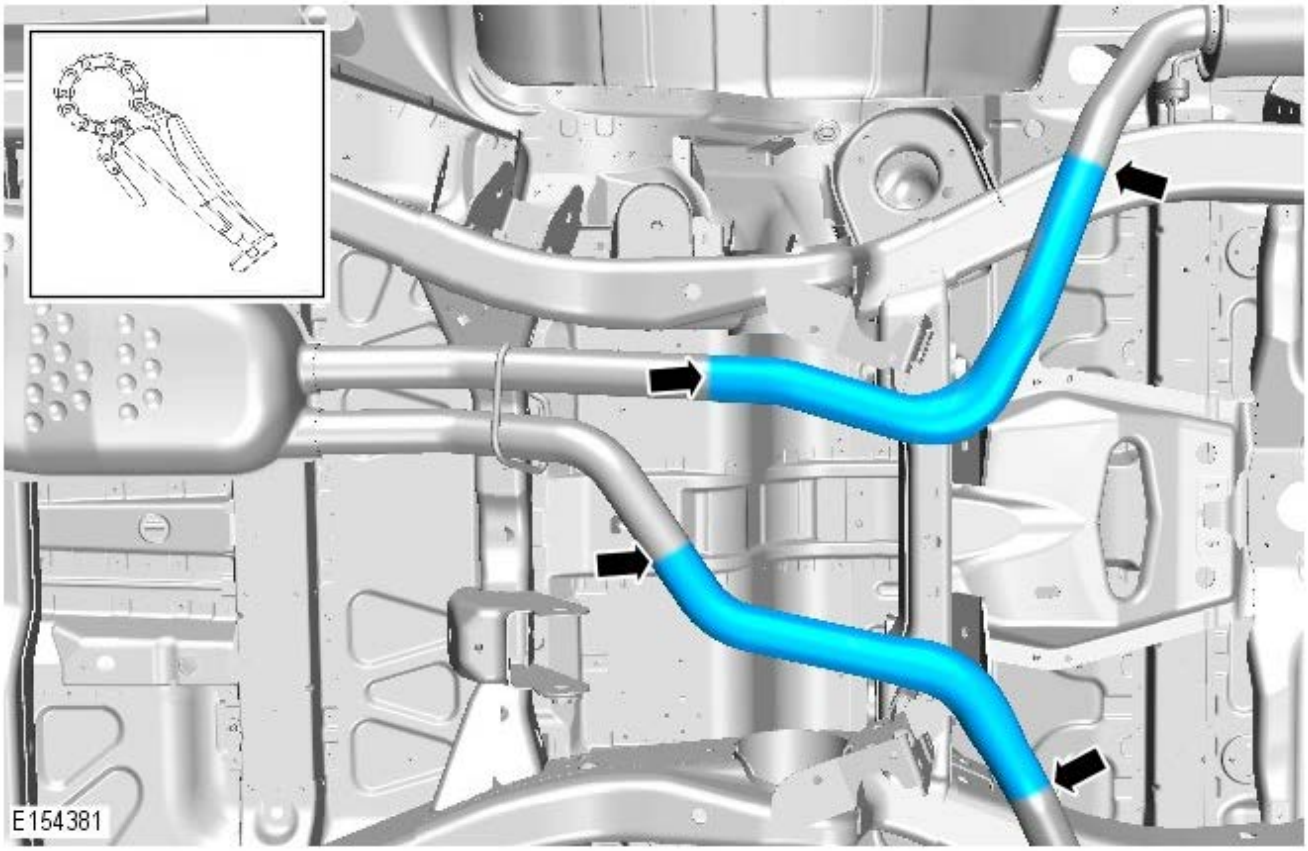
2.



3.



4.



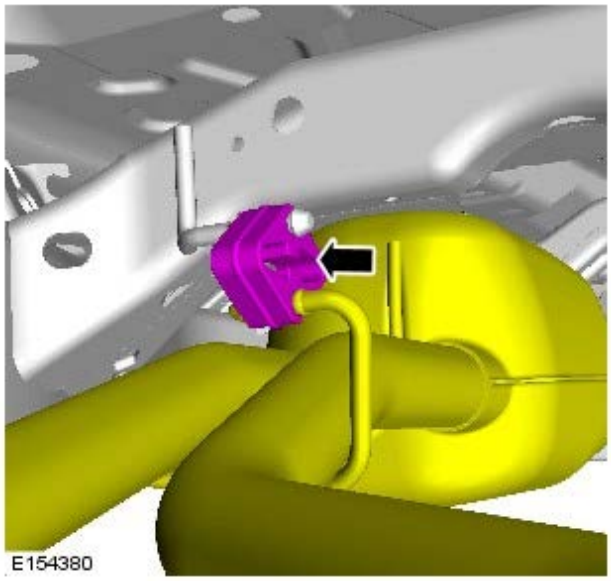
Adjustment

NOTES:

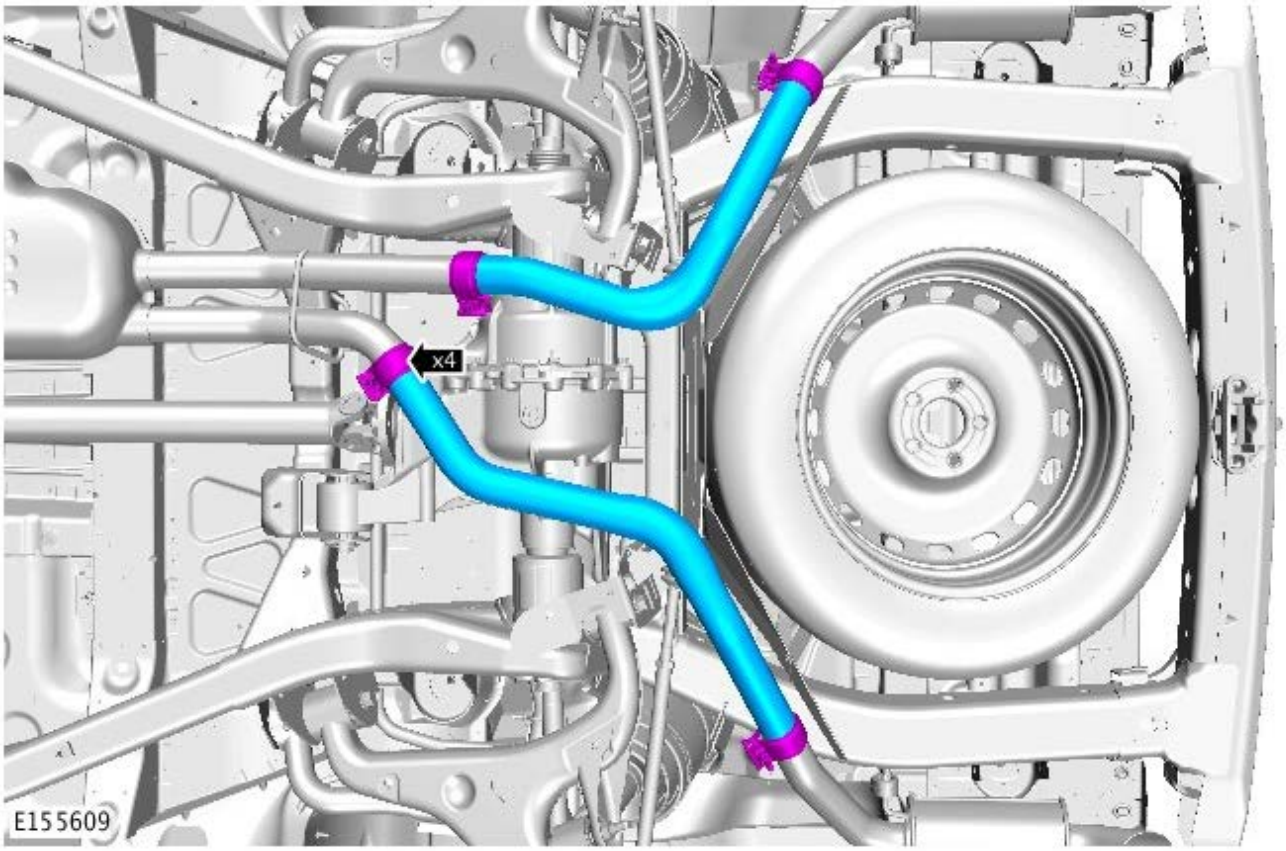
Some variation in the illustrations may occur, but the essential information is always correct.

Some components shown removed for clarity.

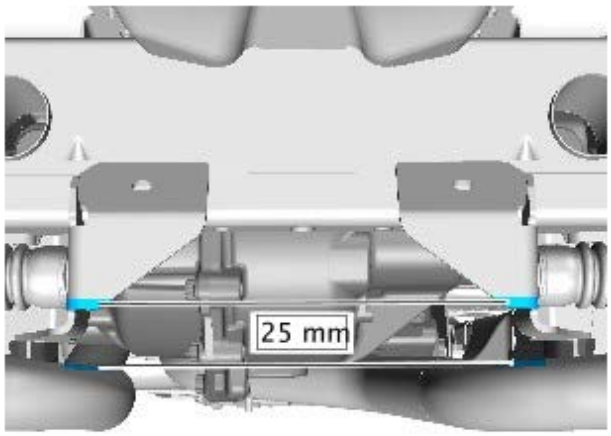
1.



2. *Torque:* 55 Nm



3. After the exhaust has been tightened, measure the clearance between exhaust and the chassis. If the measurement is not correct, loosen the exhaust retaining clamp and position the exhaust until the clearance is achieved.



E155612

Published: 15-Nov-2011

Exhaust System - TDV6 3.0L Diesel - Catalytic Converter

Removal and Installation

Special Tool(s)

	310-121 Wrench, H02S

Removal

NOTE: Removal steps in this procedure may contain installation details.

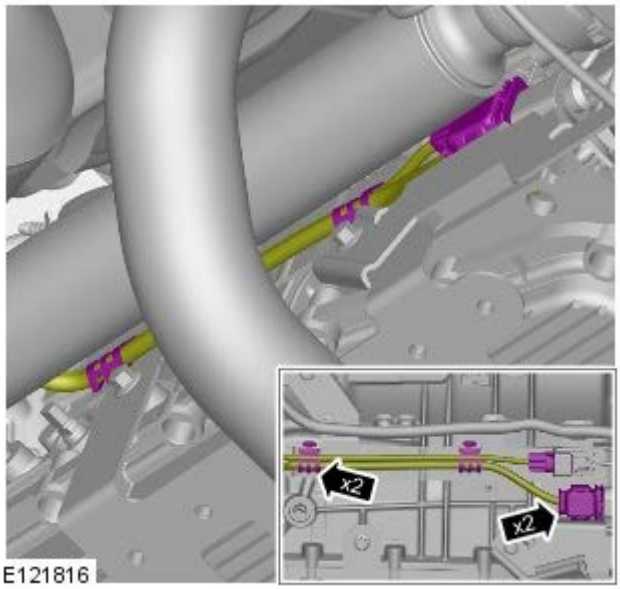
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

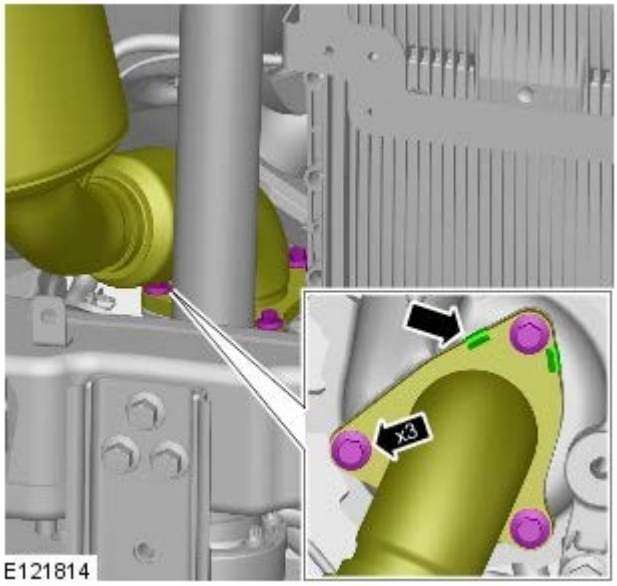
3. Refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

4.

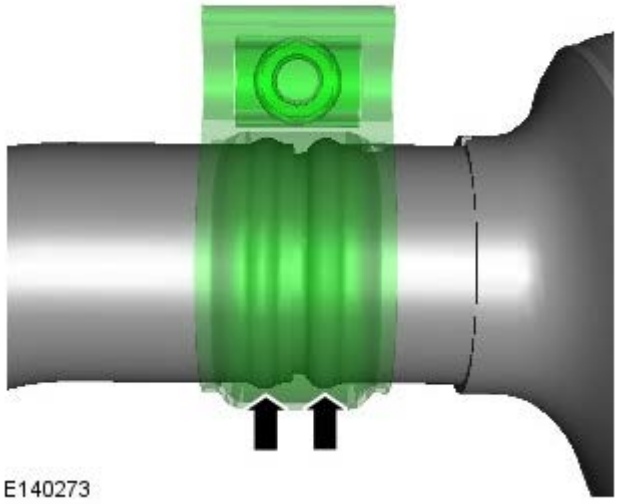


5. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

   Torque: 28 Nm



6. NOTE: Note the orientation of the component prior to removal.



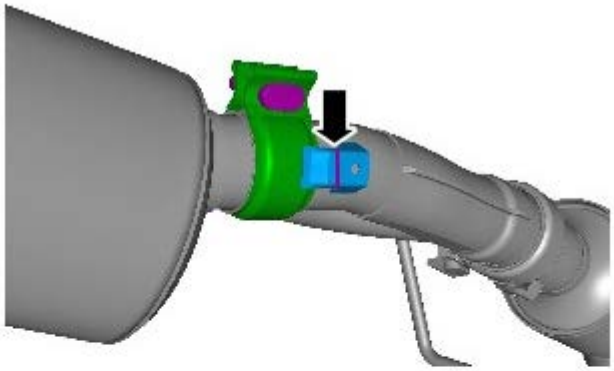
7. WARNING: Always wear hand, eye and ear safety standard protection when grinding.

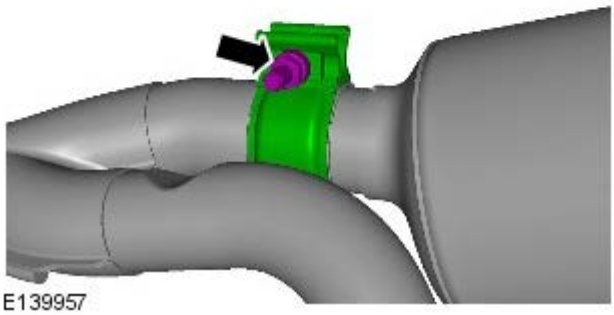
CAUTION: Discard the clamp.

NOTE: For vehicles with a welded exhaust clamp only.

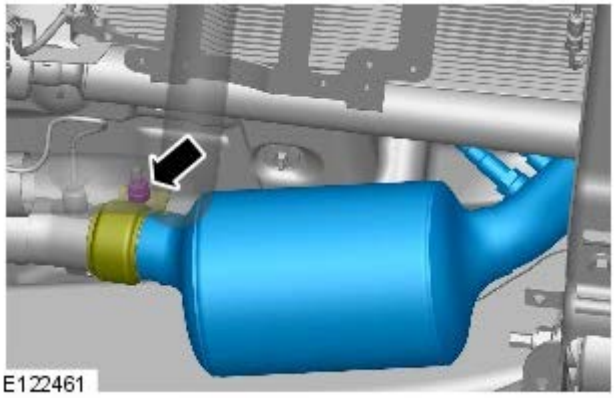
Using suitable cutting/grinding equipment remove the clamp weld at the point illustrated.

Torque: 55 Nm

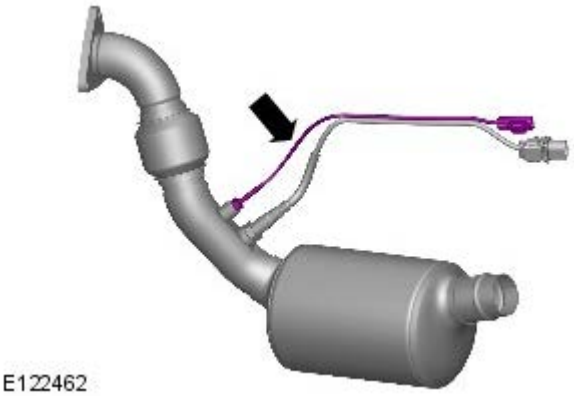




E139957



E122461



E122462

8. CAUTIONS:

   If weld is present on the clamp, grind off and install a new clamp.

   Discard the clamp.

   NOTE: Note the orientation of the component prior to removal.

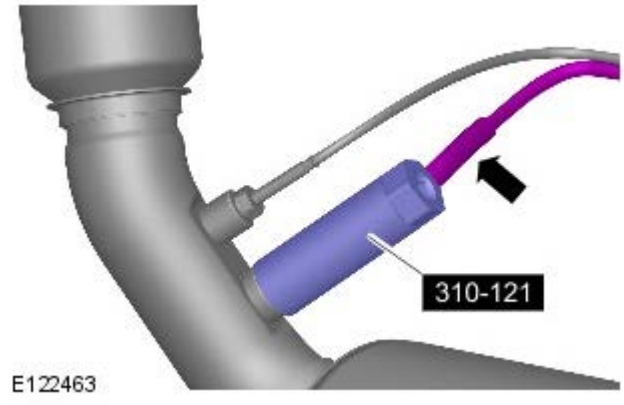
   Torque: 55 Nm

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

   Torque: 35 Nm

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

    Special Tool(s): 310-121
    Torque: 48 Nm



Installation

1. CAUTIONS:

   If accidentally dropped or knocked install a new sensor.

   Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

   NOTES:

   Install the retaining clamp.

   Make sure the anti-seize compound does not contact the heated oxygen sensor (HO2S) tip.

   If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

Published: 02-Feb-2012

Exhaust System - TDV6 3.0L Diesel - Diesel Particulate Filter (DPF)

Removal and Installation

General Equipment

Transmission jack

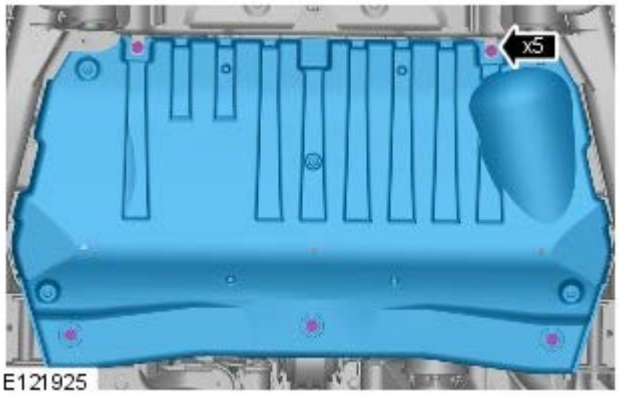
Removal

NOTE: Removal steps in this procedure may contain installation details.

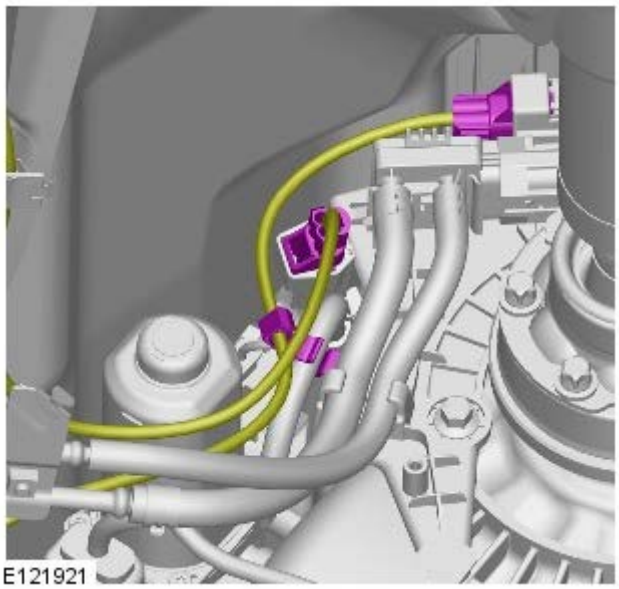
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

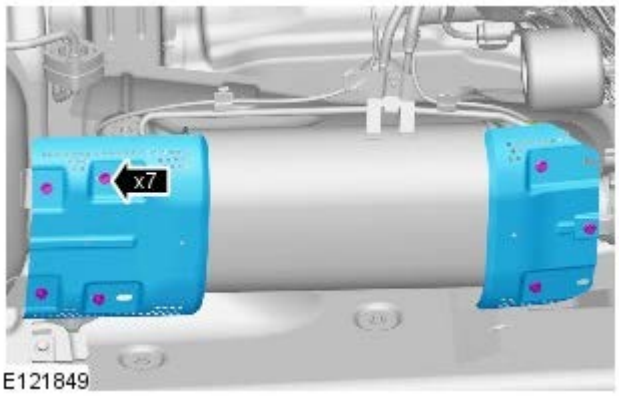
2. *Torque:* 10 Nm

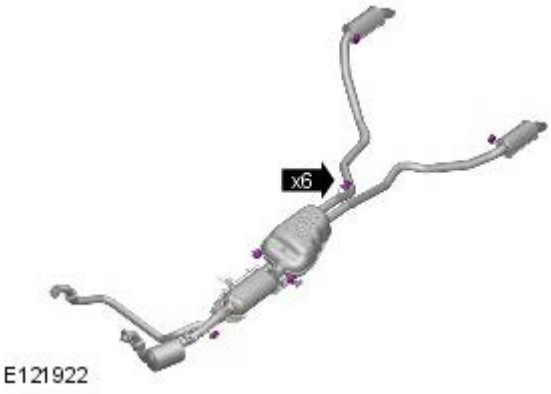


3.



4. *Torque:* 10 Nm

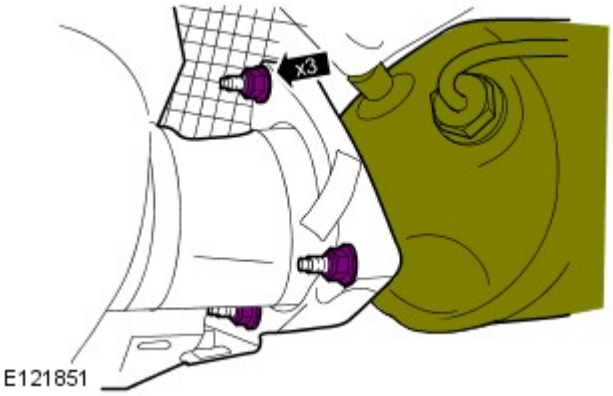




5. CAUTION: Make sure that the exhaust system is supported with a suitable transmission stand.

   Release the 6 exhaust hangers.

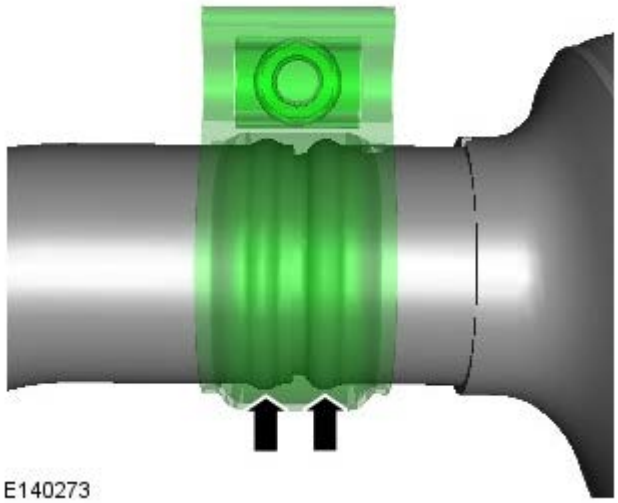
   General Equipment: Transmission jack



6. NOTE: Discard the gasket.

   Torque: 23 Nm

7. NOTE: Note the orientation of the component prior to removal.



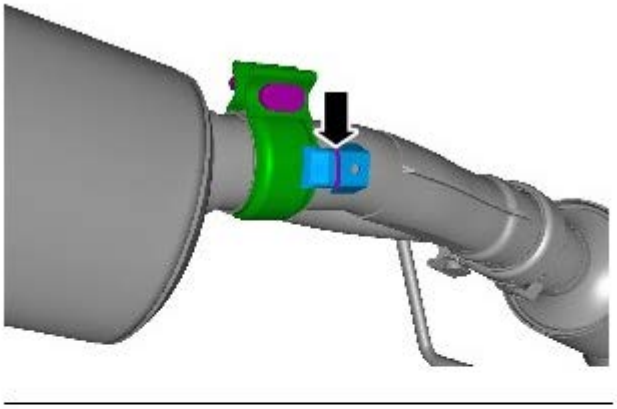
8. WARNING: Always wear hand, eye and ear safety standard protection when grinding.

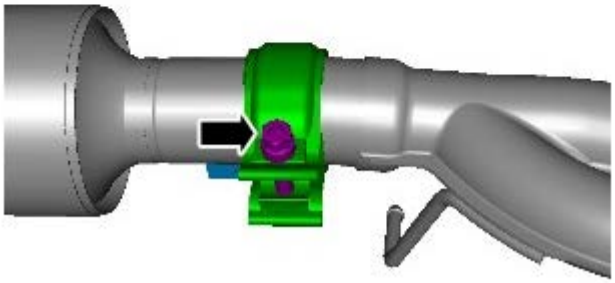
   CAUTION: Discard the clamp.

   NOTE: For vehicles with a welded exhaust clamp only.

   Using suitable cutting/grinding equipment remove the clamp weld at the point illustrated.

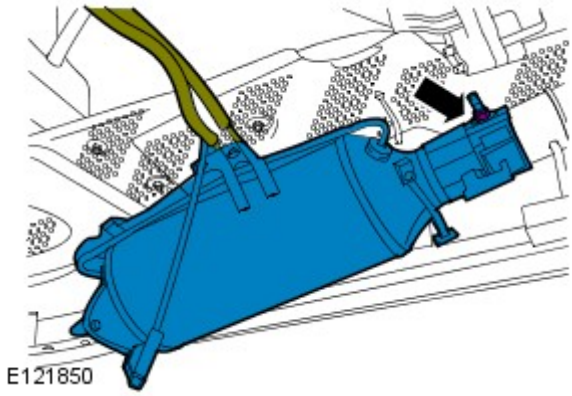
   Torque: 50 Nm





E140009

9. *Torque:* 50 Nm



E121850

Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

Published: 11-May-2011

Exhaust System - TDV6 3.0L Diesel - Exhaust System

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

All vehicles

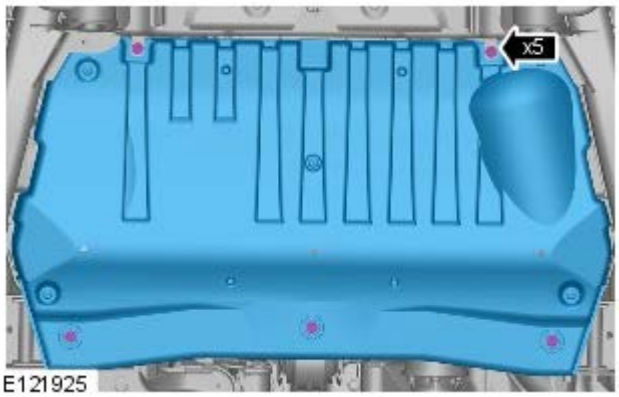
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

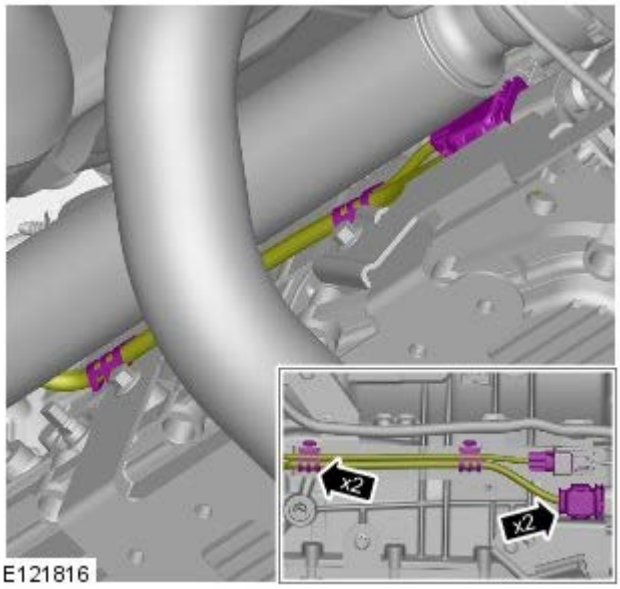
2. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

3. Refer to: Transmission Support Crossmember - TDV6 3.0L Diesel (502-02 Full Frame and Body Mounting, Removal and Installation).

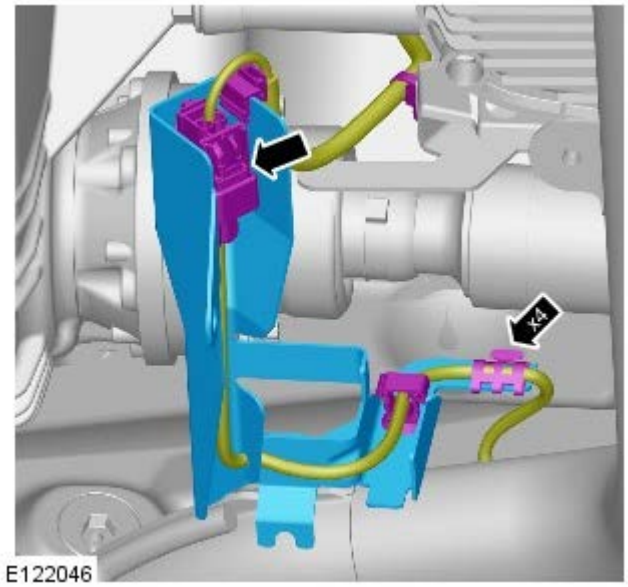
4. *Torque:* 10 Nm



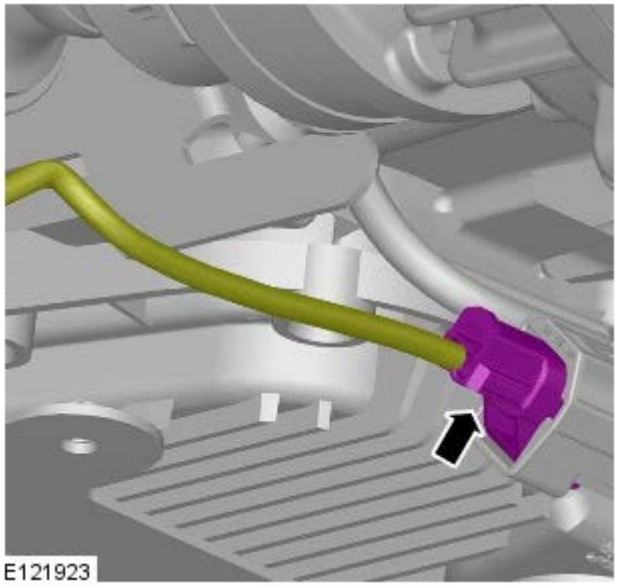
5.



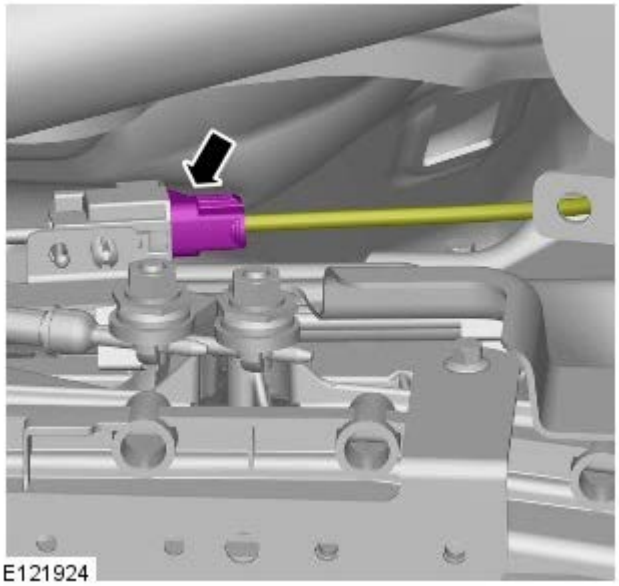
6.



7.

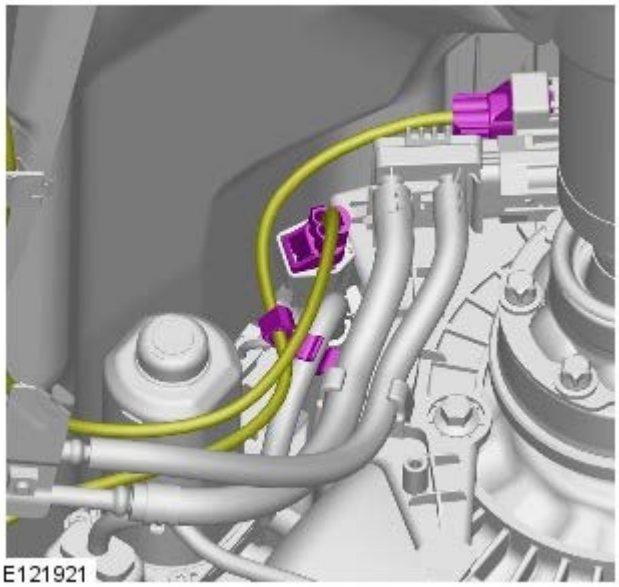


8.

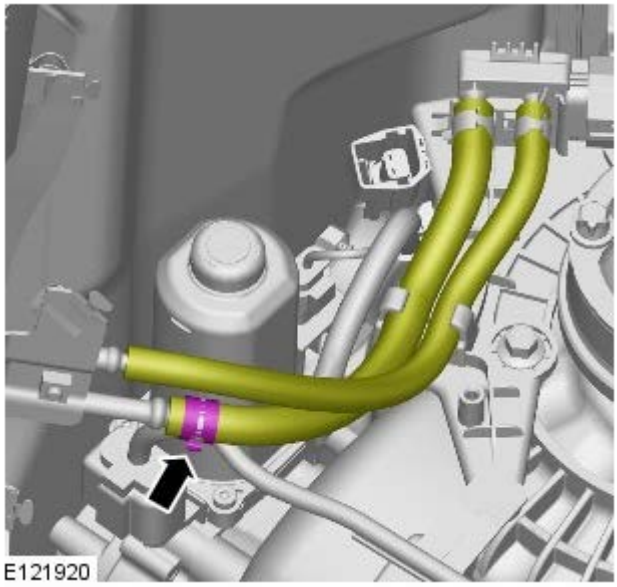


Vehicles with diesel particulate filter (DPF)

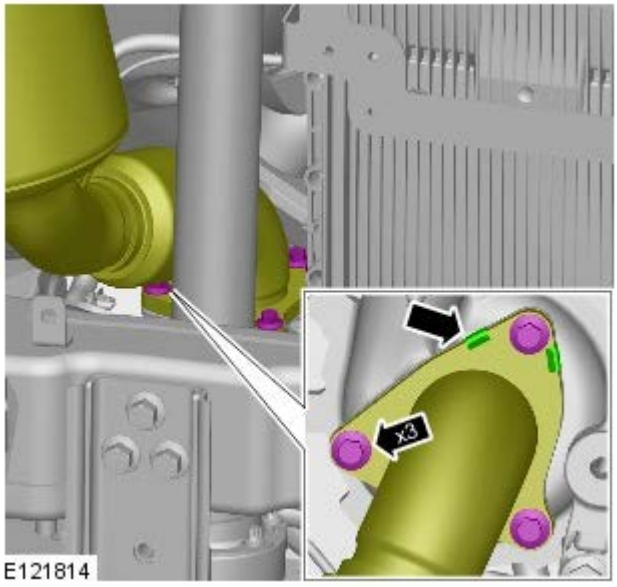
9.



10.



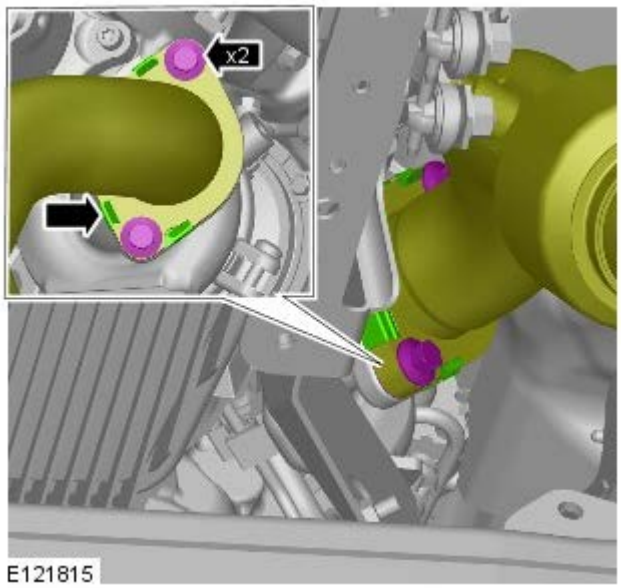
All vehicles



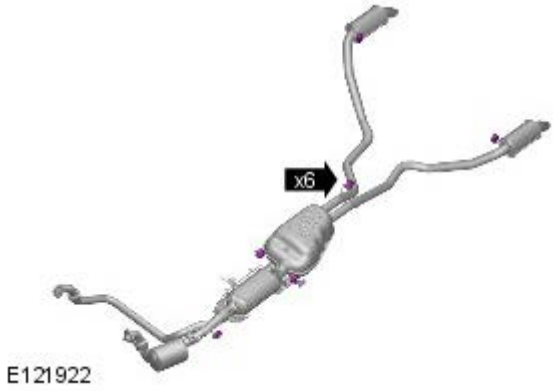
11. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

Torque: 28 Nm

12. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.



Torque: 28 Nm



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

    With assistance, remove the exhaust system.

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Exhaust System - TDV6 3.0L Diesel - Front Muffler

Removal and Installation

Special Tool(s)

	100-051 Cutter, Exhaust Pipe

General Equipment

Transmission jack

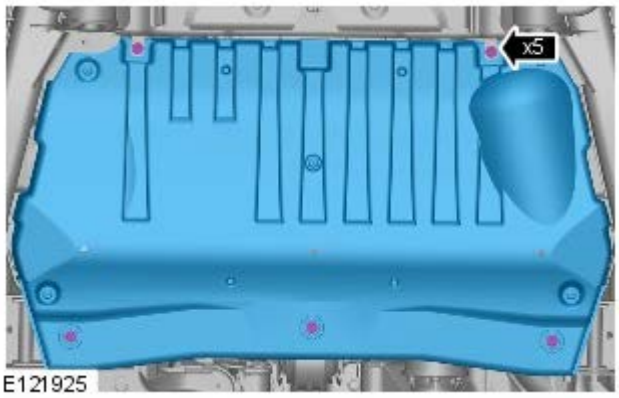
Removal

All vehicles

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

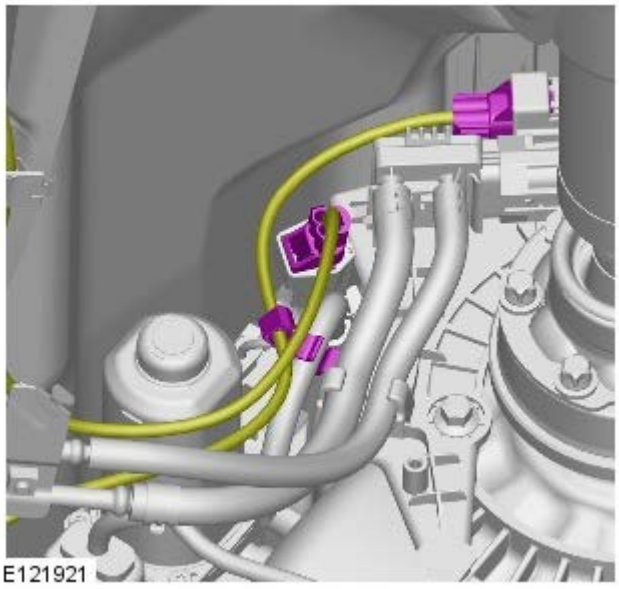
   Raise and support the vehicle.

2. Remove the 6 bolts.

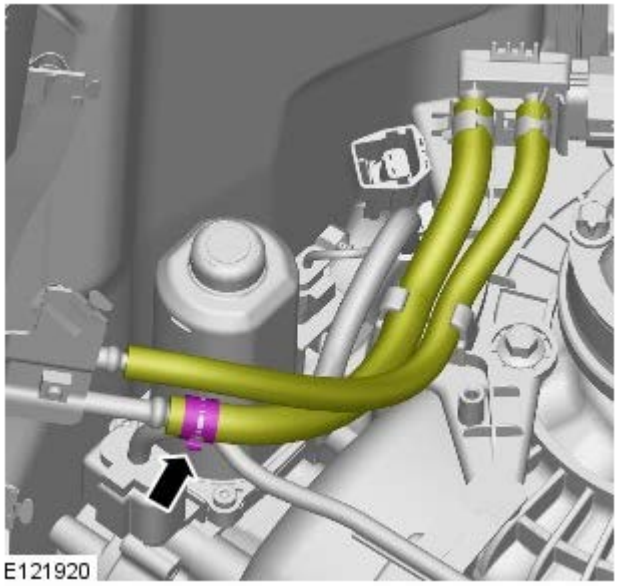


Vehicles with diesel particulate filter (DPF)

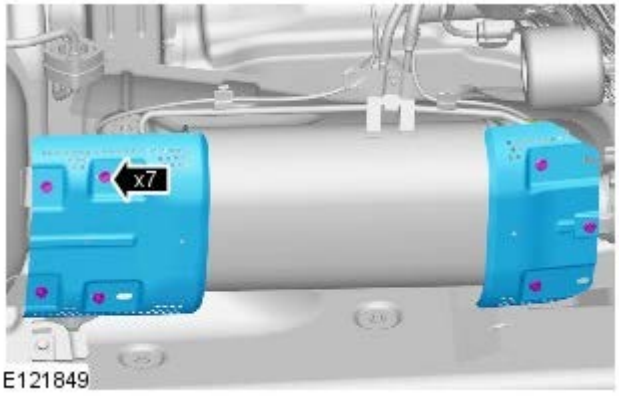
3.



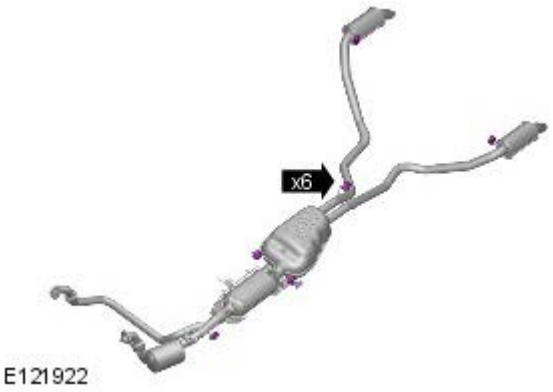
4.



5.



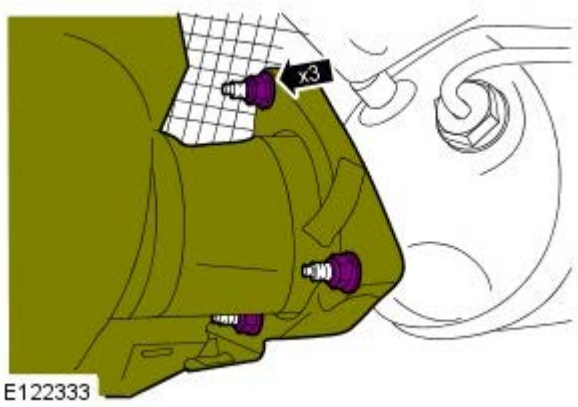
All vehicles



6. CAUTION: Make sure that the exhaust system is supported with a suitable transmission stand.

Release the 6 exhaust hangers.

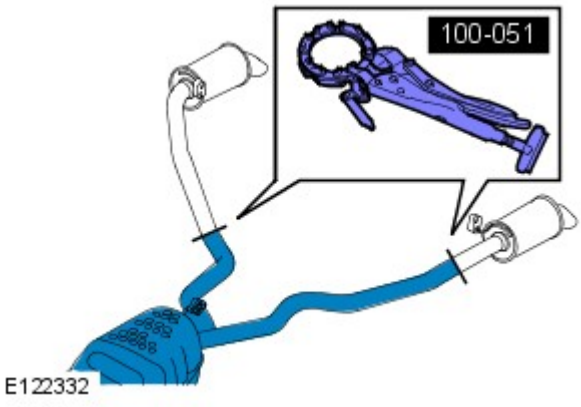
General Equipment: Transmission jack



7. NOTE: Discard the gasket.

With assistance, remove the muffler and tailpipe assembly.

8. Using the special tool, cut the exhaust pipe at the marked position.



Special Tool(s): 100-051

Installation

All vehicles

1. NOTE: Do not tighten the retaining clamp at this stage.

   Position the RH tail pipe to the muffler assembly.

2. NOTE: Do not tighten the retaining clamp at this stage.

   Position the LH tail pipe to the muffler assembly.

3. NOTE: Install a new gasket.

   With assistance, install the muffler assembly.

4. Tighten the nuts to 23 Nm (17 lb.ft).

5. Align both tail pipes and tighten the retaining clamps to 55 Nm (40 lb.ft).

Vehicles with diesel particulate filter (DPF)

6. Install the heat shields.

   Torque: 10 Nm

7. Install the DPF differential pressure sensor, high and low pressure pipes.

8. Connect the DPF differential pressure sensor electrical connectors.

All vehicles

9. Install the transmission undershield.

10. Install the bolts and tighten to 10 Nm (7 lb.ft).

Published: 11-May-2011

Exhaust System - TDV6 3.0L Diesel - Rear Muffler

Removal and Installation

Special Tool(s)

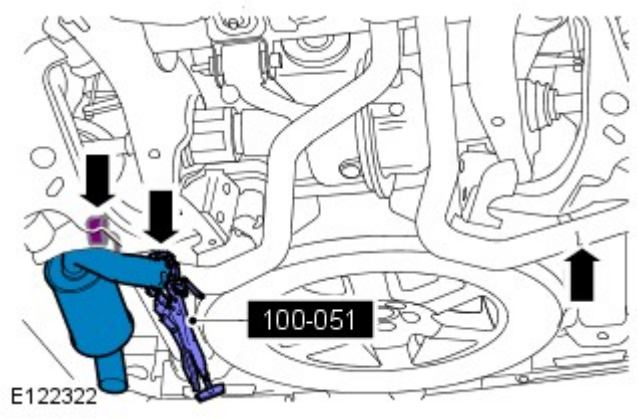
	100-051 Cutter, Exhaust Pipe

Removal

NOTE: Removal steps in this procedure may contain installation details.

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. NOTES:

   Right-hand shown, left-hand similar.

   Using the special tool, cut the exhaust pipe at the marked position.

   Remove the tail pipe.

   Special Tool(s): 100-051

Installation

1. NOTES:

   Do not tighten the retaining clamp at this stage.

   Clean the components.

   Install the retaining clamp.

   Install the tail pipe.

2. Align the tail pipe and tighten the retaining clamp to 55 Nm (40 lb.ft).

Published: 11-May-2011

Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol -

Torque Specifications

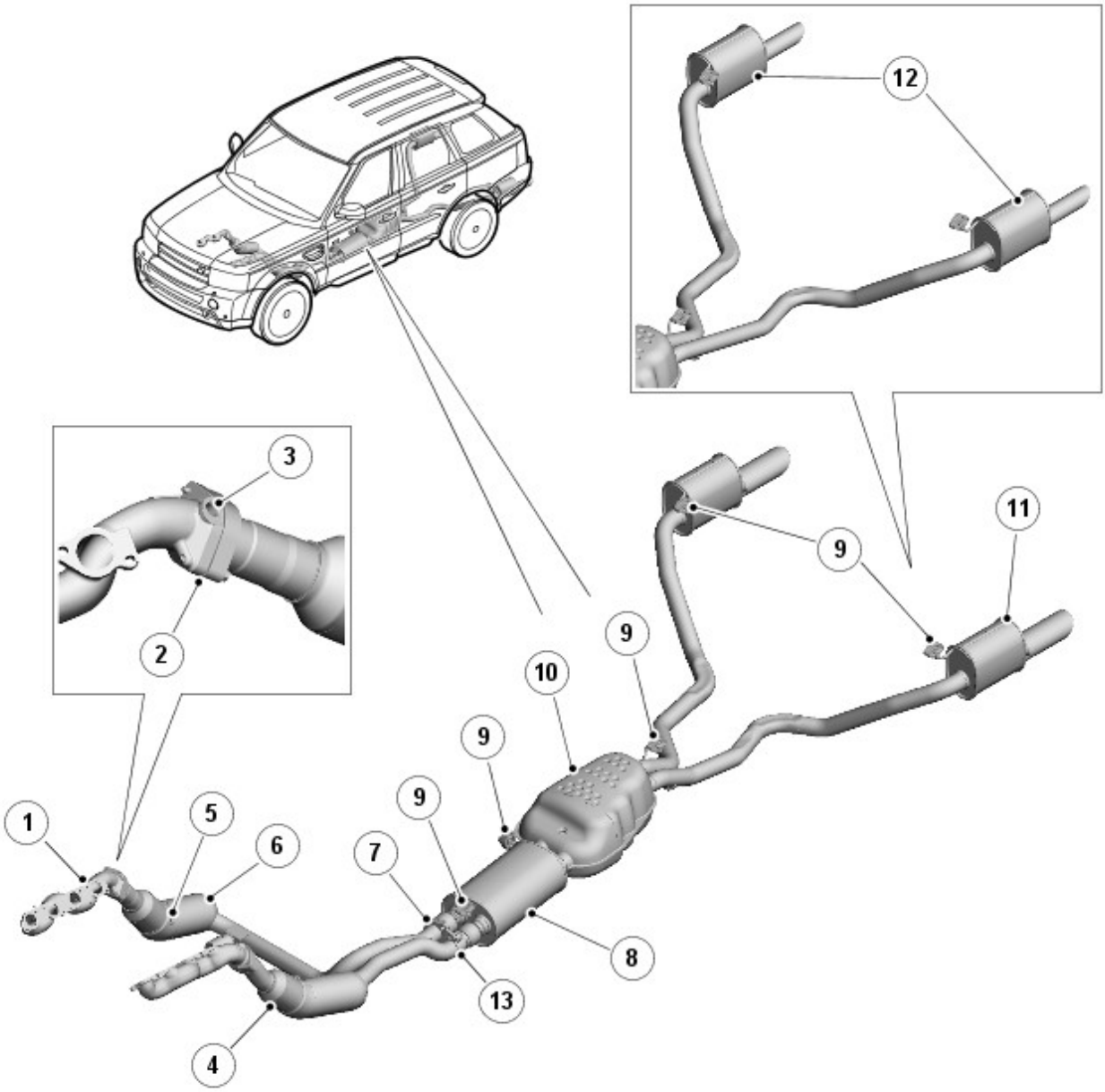
Description	Nm	lb-ft	lb-in
Heated oxygen sensor (HO2S)	48	35	-
Catalyst monitor sensor	48	35	-
Catalytic converter retaining clamp	55	40	-
Catalytic converter retaining bolts to exhaust manifold	25	16	-
Exhaust manifold retaining bolts	18	13	-

Published: 01-Nov-2012

Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Exhaust System

Description and Operation

5.0L V8 COMPONENT LOCATION - FROM 2010MY



E122815

Item	Part Number	Description
1	-	Exhaust manifold
2	-	Flange joint - manifold to front section
3	-	Pre-starter catalyst Heated Oxygen Sensor (HO2S) mounting boss
4	-	Pre-catalytic (starter) converter
5	-	Post starter catalyst HO2S mounting boss
6	-	Main catalytic converter
7	-	Flange joint - Right Hand (RH) front section to rear section
8	-	Silencer - Front
9	-	Mounting rubber (5 off)
10	-	Silencer - Center
11	-	Silencer - Rear (Supercharger vehicles)
12	-	Silencer - Rear (Naturally Aspirated vehicles)
13	-	Clamp joint - Left Hand (LH) front section to rear section

EXHAUST SYSTEM

The 5.0L V8 exhaust system is fabricated from stainless steel and is supplied as three separate assemblies; a Left Hand (LH) front section incorporating a catalytic converter, a Right Hand (RH) front section incorporating a catalytic converter and a rear section incorporating a front silencer, a centre silencer and two rear silencers.

The system is attached to the underside of the body with 5 mounting rubbers which are located on mild steel hanger bars that are welded to the system. The mounting rubbers locate on corresponding hangers which are welded to the underside of the vehicle body. The system is routed mainly on the inside of the LH chassis longitudinal before splitting near the rear differential to exit at each side of the rear of the vehicle.

The system has service repair items available. Indentations in the rear section, between the center and the rear silencers, show the cut points for the service replacement rear silencers or front section. When a service repair section is used, the joint is connected using a sleeve and two clamps to connect the pipes at the cut points.

Front Section

Both front sections have a loose flange with two holes which provide for the attachment with two bolts onto the LH and RH exhaust manifolds. The flange is sealed by a tapered seat in the flange and a machined cone on the manifold.

Each flange is located on a short, straight pipe, which in turn is welded to the body of the catalytic converter. The pipe has a threaded boss which is welded over a hole to provide location for the Heated Oxygen Sensor (HO2S) in a position between the pre-catalyst and the main catalyst.

On the LH front section, the converter outlet pipe is a 60 mm (2.36 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, which is welded to the converter body. The rear of the outlet pipe is inserted into the flared end of the rear section. A clamp is used to compress and secure the joint.

On the RH front section, the converter outlet pipe is a 60 mm (2.36 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, which is welded to the converter body. The rear of the pipe curves left, under the transmission and then curves again to run parallel to the LH pipe. The end of the pipe has a welded flange with two holes which locate on two studs on the rear section and is secured with nuts. A metal gasket is used to seal the joint between the front and rear section flanges.

Rear Section

The rear section has a short 55 mm (2.16 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, which is flared to an inside diameter of 61 mm (2.4 in) to locate the LH front section. The tube is welded to the front silencer assembly. A second short 55 mm (2.16 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, has a welded flange with captive studs to provide attachment for the flange on the RH front section. This tube is also welded to the front silencer assembly.

The front silencer comprises a double skin and two end plates which are rolled together to give a capacity of 10.45 litres (637 in^3). The silencer contains baffles and perforated tubes which reduce noise as the exhaust gases pass through the silencer. A hanger bar is welded to the front of the silencer and provides for the location of a mounting rubber.

The silencer has two short 55 mm (2.16 in) diameter outlet pipes, with a 1.5 mm (0.06 in) wall thickness, which connect to the centre silencer.

The centre silencer comprises two pressed stainless steel shells which are welded together to give a capacity of 25.2 litres (1538 in^3). The silencer contains baffles and perforated tubes which reduce noise as the exhaust gasses pass through the silencer. A hanger bar is welded to the front right hand side of the silencer and provides location for a mounting rubber.

The silencer has two 55 mm (2.16 in) diameter outlet pipes, with a 1.5 mm (0.06 in) wall thickness, which are curved to pass around the rear suspension components.

Each outlet pipe terminates in a welded joint with the tail silencers. The outlet pipes have a hanger bar which provides for the location of a mounting rubber.

A hanger bar is welded to the front face of each rear silencer and provides for the location of a mounting rubber. The silencer is a rectangular fabrication with a baffle tube which is surrounded with glass fibre to provide further noise suppression. Each silencer has a capacity of 4.35 litres (265 in^3).

On naturally aspirated models, the silencers each have an outlet pipe which is 65 mm (2.56 in) diameter, with a wall thickness of 1.2 mm (0.05 in). On supercharger models, the silencers each have an outlet pipe which is 70 mm (2.76 in) diameter with a wall thickness of 1.2 mm (0.05 in). A stainless steel finisher is fitted to the outlet pipes on supercharger models.

EXHAUST MANIFOLDS

The cast exhaust manifolds are unique for each cylinder bank. Spacers on the securing bolts allow the manifolds to expand and retract with changes of temperature while maintaining the clamping loads. Heat shields are integrated into the exhaust manifold gaskets. Each manifold has a threaded port near to its outlet which allows for the fitment of the pre-catalyst HO2S.

CATALYTIC CONVERTERS

The engine management system provides accurately metered quantities of fuel to the combustion chambers to ensure the most efficient use of fuel and to minimise the exhaust emissions. A threaded boss is located on each manifold and a and another threaded boss is located between the starter and the main catalyst to house the pre and post catalyst oxygen sensors. The engine management system monitors the sensors and uses the information to further improve the fuelling and exhaust emissions.

To further reduce the carbon monoxide and hydrocarbons content of the exhaust gases, two catalytic converters are

integrated into the front down pipe from each exhaust manifold. In the catalytic converter the exhaust gases are passed through honeycombed ceramic elements coated with a special surface treatment called 'washcoat'. The washcoat increases the surface area of the ceramic elements by a factor of approximately 7000. On top of the washcoat is a coating containing metals, which are the active constituent for converting harmful emissions into inert by-products. The metals add oxygen to the carbon monoxide and the hydrocarbons in the exhaust gases, to convert them into carbon dioxide and water respectively.

Two catalytic converters are used in each cylinder bank down pipe. A starter and main catalyst are located below the downpipe flange. The starter catalyst is monitored by two HO2S's. The main catalyst is not monitored.

Published: 20-Aug-2012

Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Exhaust System

Diagnosis and Testing

Principle of Operation

For a detailed description of the exhaust system, refer to the relevant Description and Operation section of the workshop manual. REFER to: Exhaust System (309-00B Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).

Inspection and Verification

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

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

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

Visual Inspection

Mechanical	Electrical
• Leaks • Metal fatigue • Pipes • Catalytic converter • Muffler(s) • Joints • Mountings • Clearance around components	• 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 cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Noisy or leaking exhaust	• Exhaust system/components	• Install new components as necessary. Refer to the relevant section of the workshop manual
Lack of power	• Air intake system fault • Restricted exhaust system • Low fuel pressure	• Check the air intake system • Check for a blocked catalytic converter or muffler, install new components as necessary • Check the fuel pressure

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00, Description and Operation).

Published: 03-Jul-2013

Exhaust System - V8 5.0L Petrol / V8 S/C 5.0L Petrol - Exhaust System Repair

General Procedures

Check

NOTES:

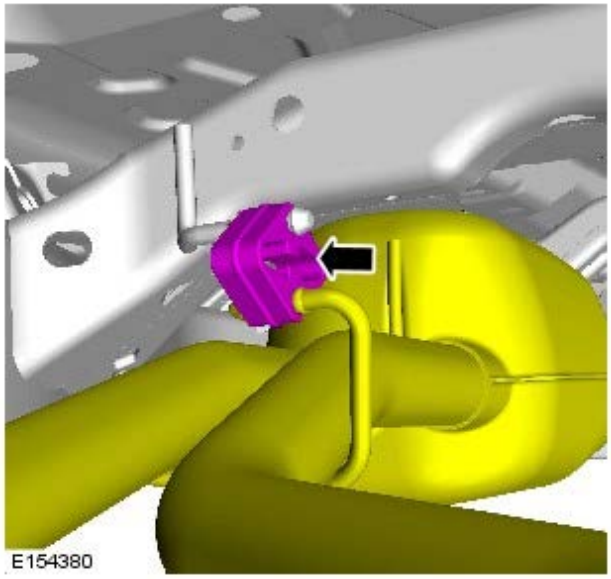
Some variation in the illustrations may occur, but the essential information is always correct.

Some components shown removed for clarity.

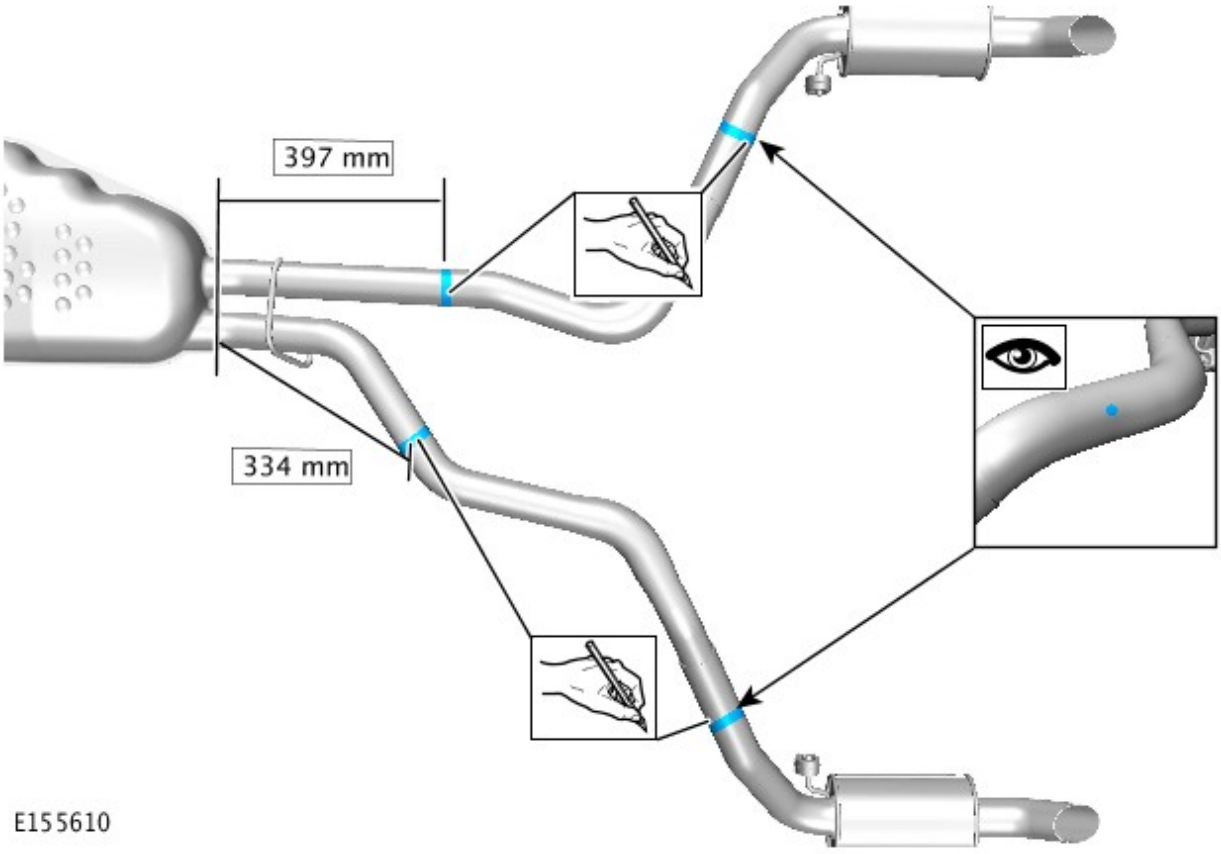
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

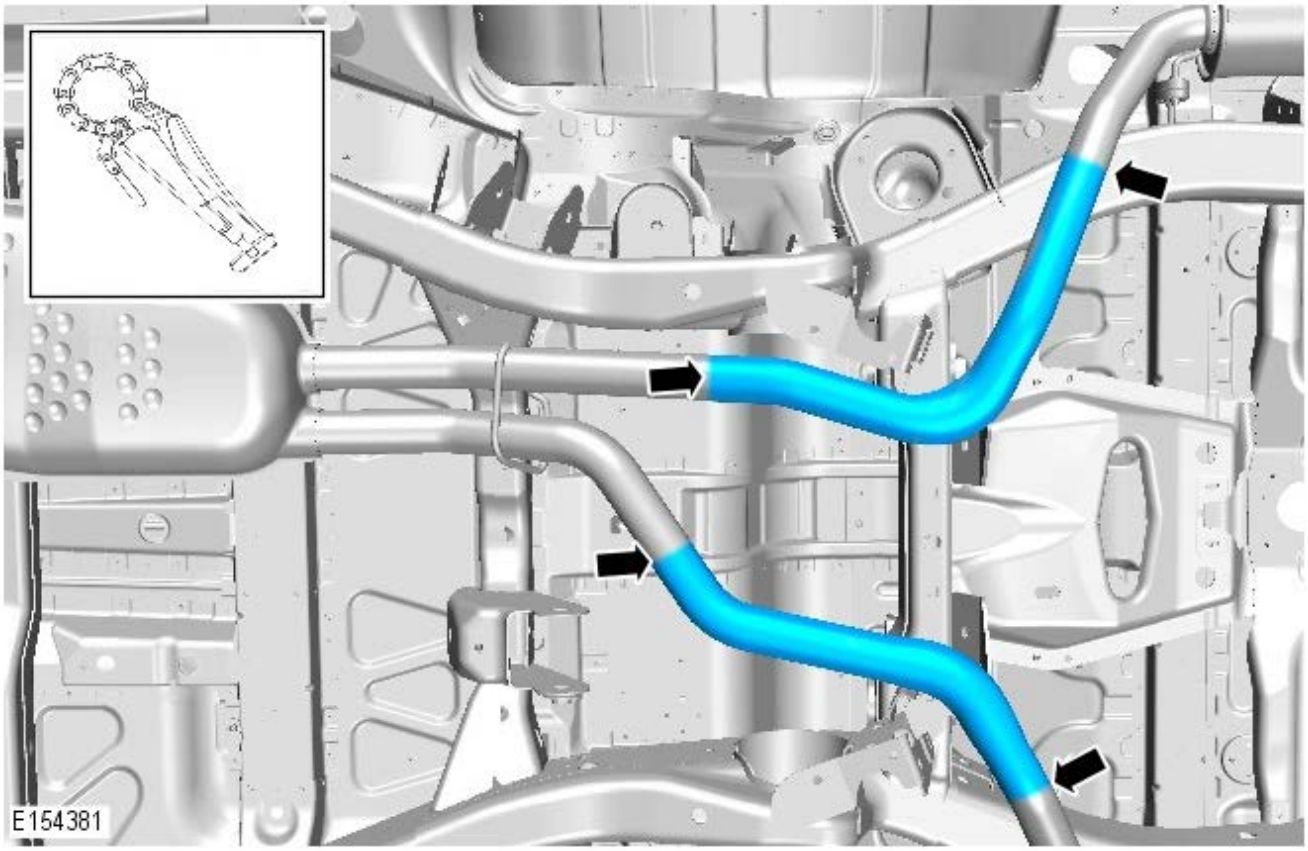
2.



3.



4.



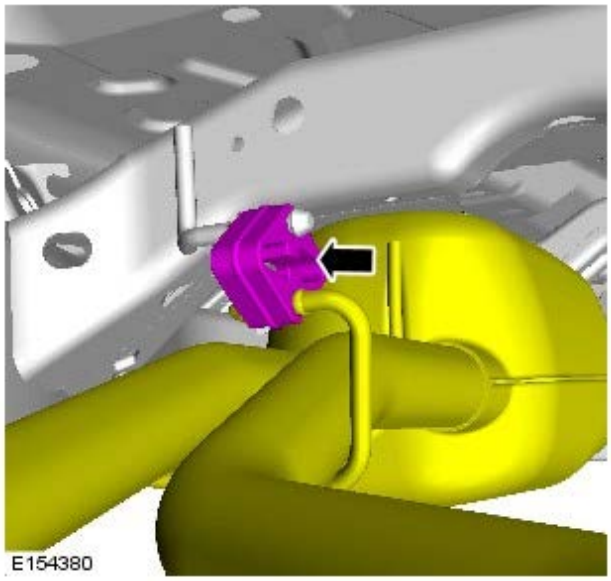
Adjustment

NOTES:

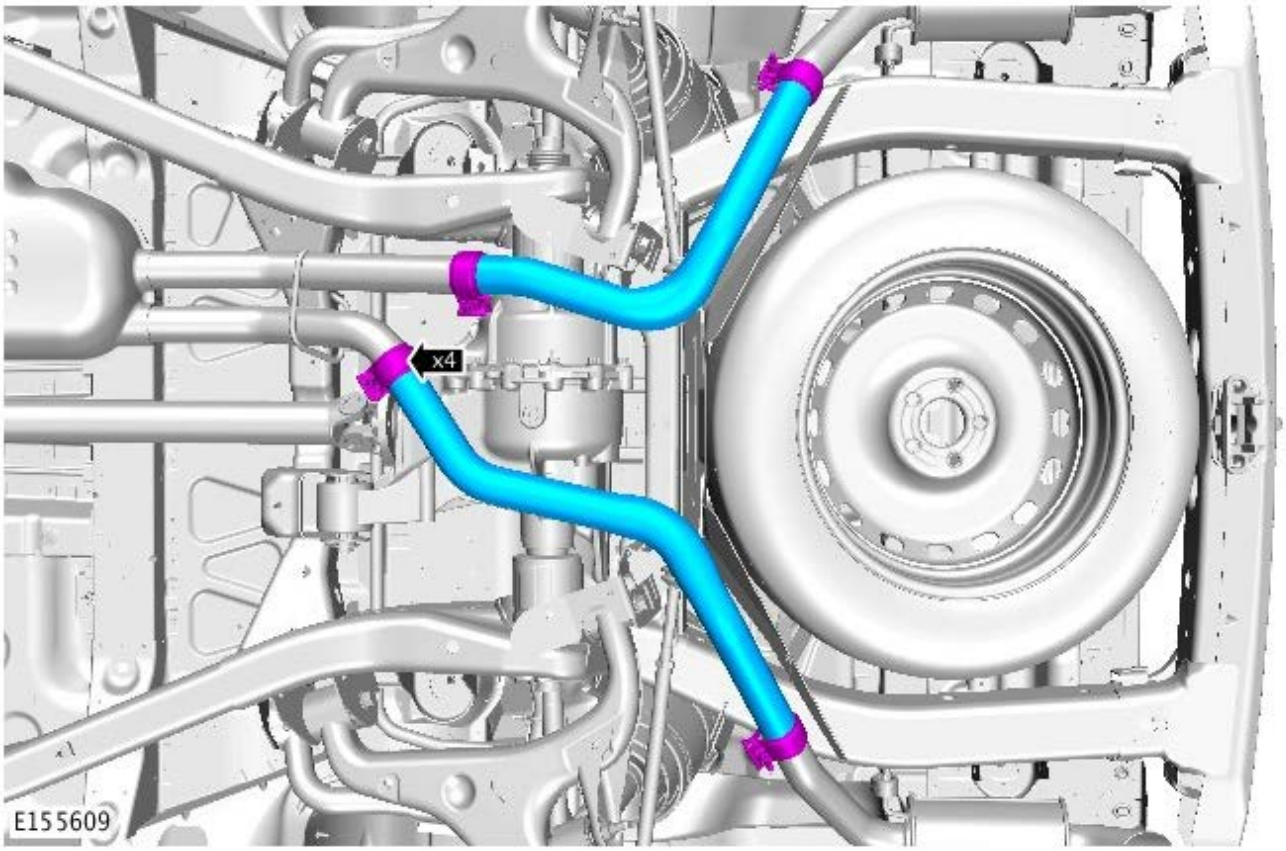
Some variation in the illustrations may occur, but the essential information is always correct.

Some components shown removed for clarity.

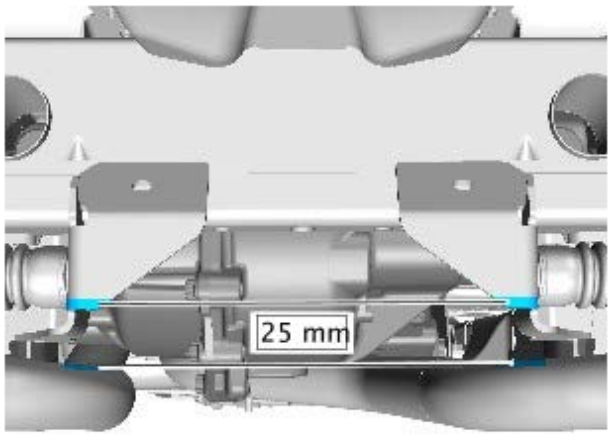
1.



2. *Torque:* 55 Nm



3. After the exhaust has been tightened, measure the clearance between exhaust and the chassis. If the measurement is not correct, loosen the exhaust retaining clamp and position the exhaust until the clearance is achieved.



E155612

Published: 11-May-2011

Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Catalytic Converter LH

Removal and Installation

Removal

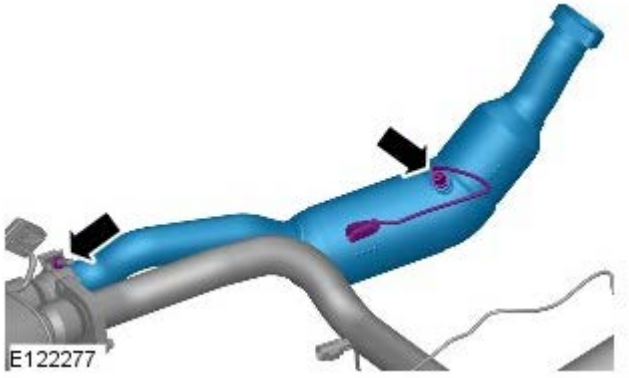
NOTE: Removal steps in this procedure may contain installation details.

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. Refer to: Exhaust System (309-00, Removal and Installation).

3. *Torque:* 48 Nm



Installation

1. CAUTIONS:

   Make sure the anti-seize compound does not contact the heated oxygen sensor (HO2S) tip.

   If accidentally dropped or knocked install a new sensor.

   Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

Published: 11-May-2011

Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Catalytic Converter RH

Removal and Installation

Removal

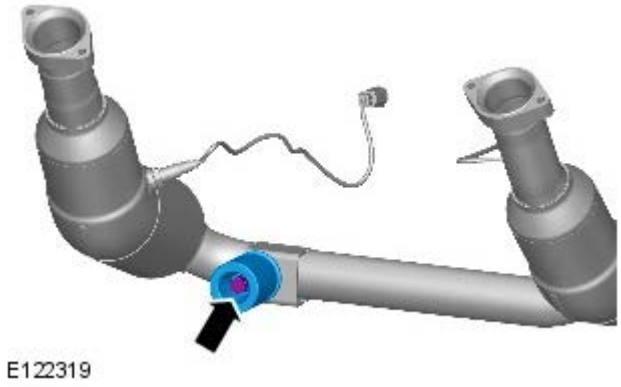
NOTE: Removal steps in this procedure may contain installation details.

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

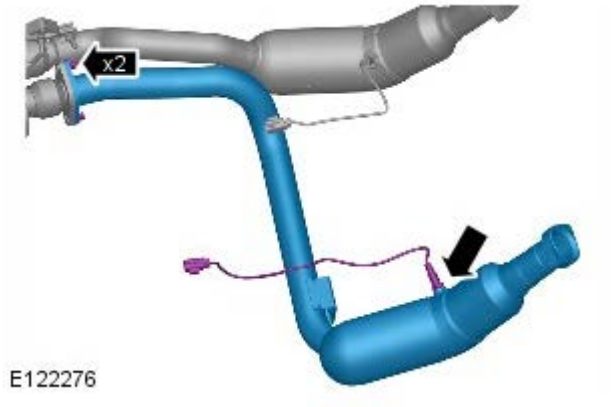
   Raise and support the vehicle.

2. Refer to: Exhaust System (309-00, Removal and Installation).

3. *Torque:* 22 Nm



4. *Torque:* 48 Nm



Installation

1. CAUTIONS:

   Make sure the anti-seize compound does not contact the heated oxygen sensor (HO2S) tip.

   If accidentally dropped or knocked install a new sensor.

   Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

   NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

Published: 11-May-2011

Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Exhaust System

Removal and Installation

General Equipment

Transmission jack

Removal

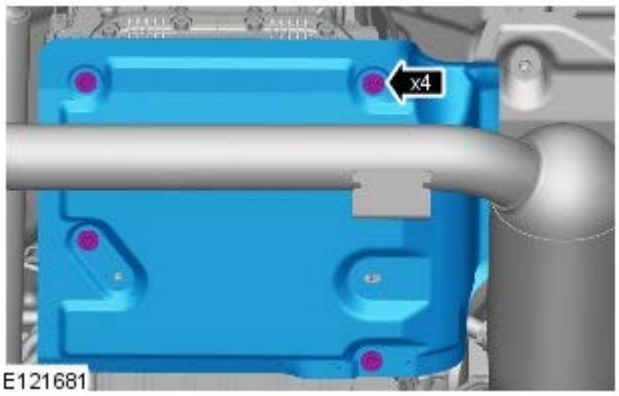
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

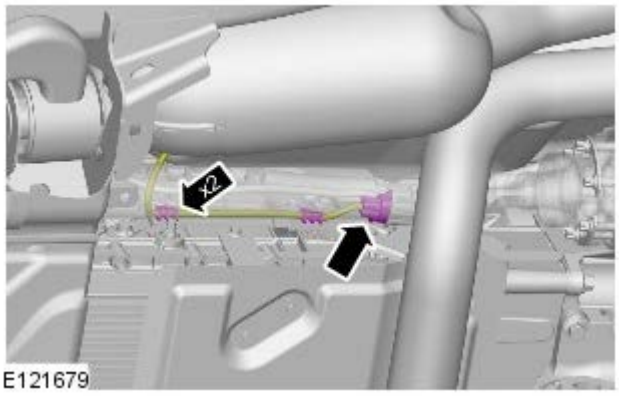
2. Refer to: Engine Undershield (501-02, Removal and Installation).

3. Refer to: Transmission Support Crossmember (502-02, Removal and Installation).

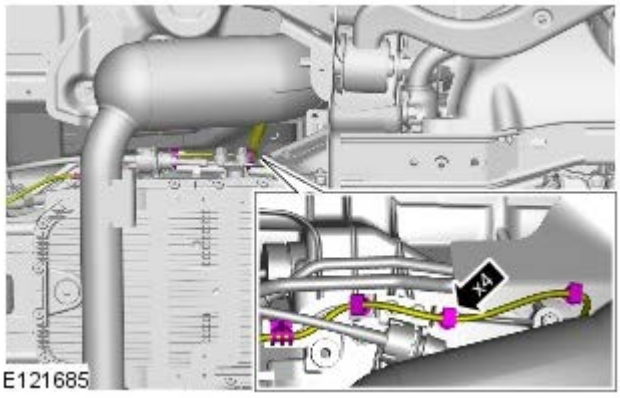
4. *Torque:* 10 Nm



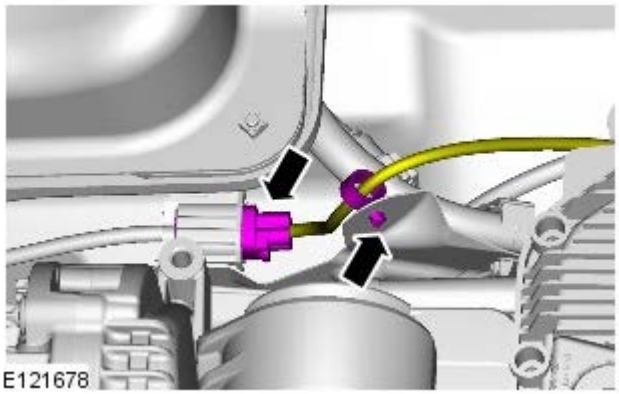
5.

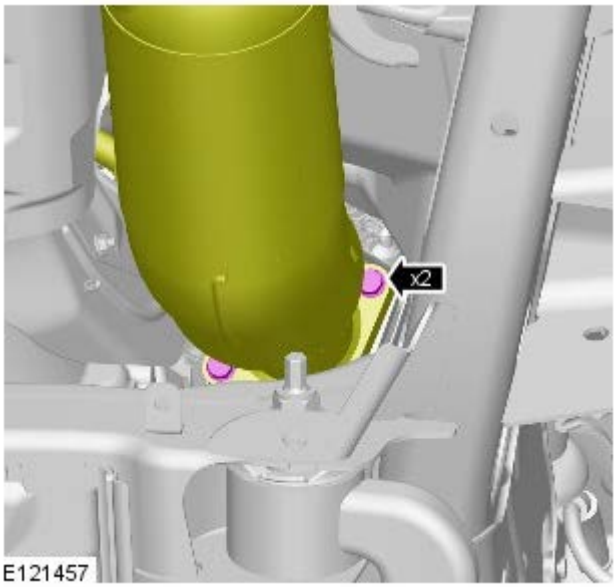


6.



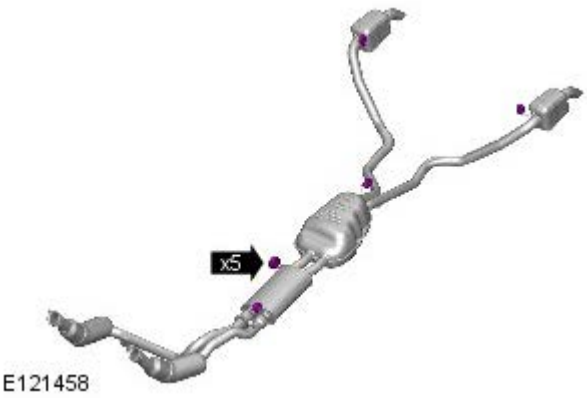
7.





8. NOTE: Right-hand shown, left-hand similar.

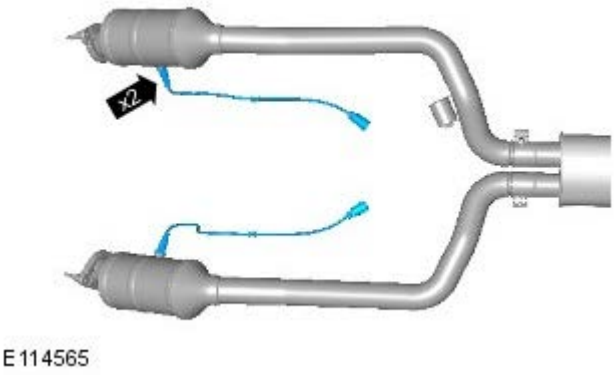
   Torque: 22 Nm



9. CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

   With assistance, remove the exhaust system.

   General Equipment: Transmission jack



10. NOTES:

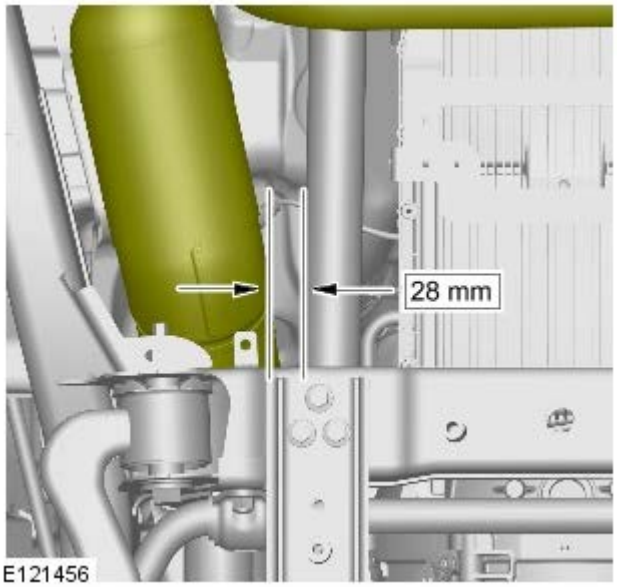
    Do not disassemble further if the component is removed for access only.

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

    Torque: 45 Nm

Installation

1. To install, reverse the removal procedure.



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

Published: 11-May-2011

Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Front Muffler

Removal and Installation

Special Tool(s)

	100-051 Cutter, Exhaust Pipe

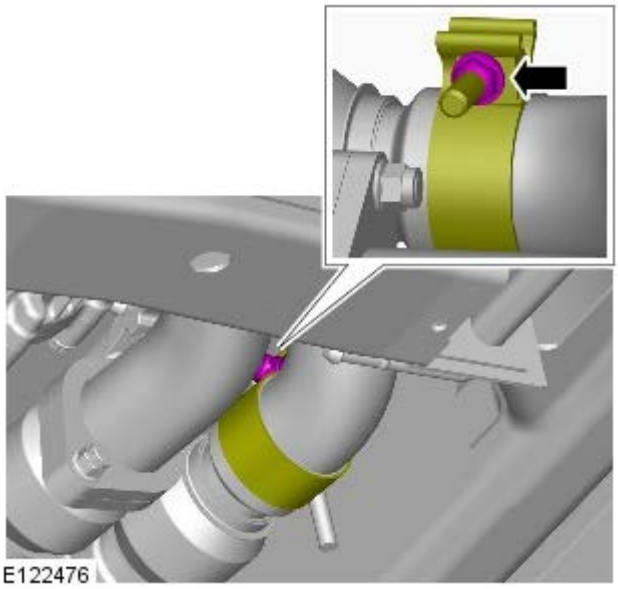
General Equipment

Transmission jack

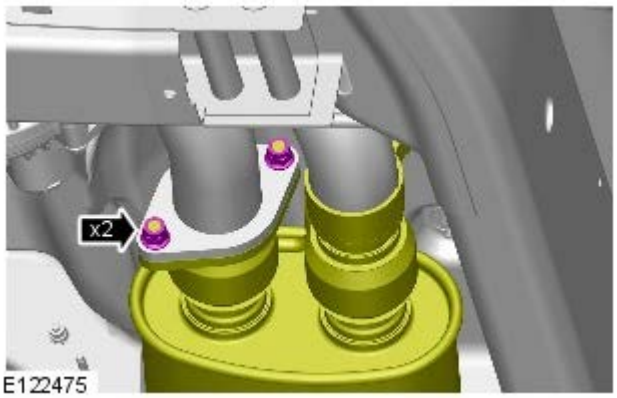
Removal

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

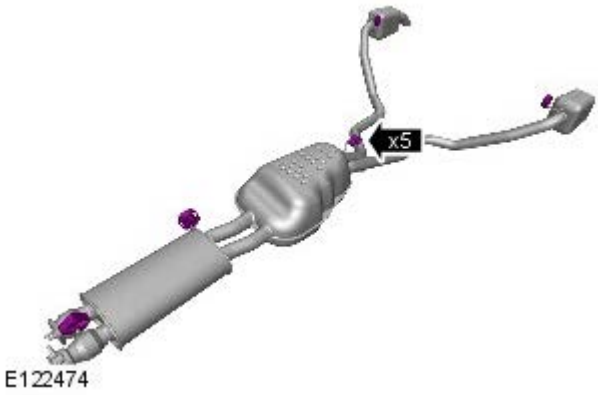
2. 

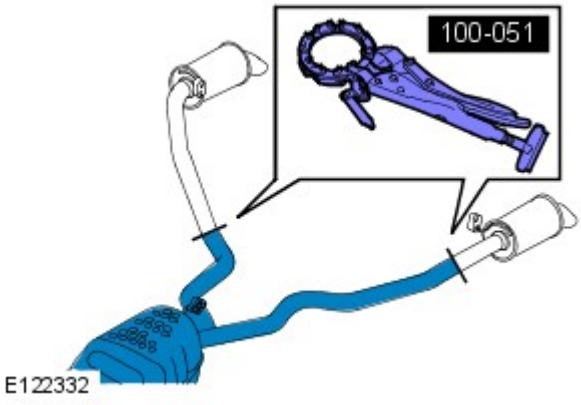
3. Discard the gasket.



4. With assistance, remove the muffler assembly.

   General Equipment: Transmission jack





5. Using the special tool, cut the exhaust pipe at the marked position.

   Special Tool(s): 100-051

Installation

1. NOTE: Do not tighten the retaining clamp at this stage.

   Position the RH tail pipe to the muffler assembly.

2. NOTE: Do not tighten the retaining clamp at this stage.

   Position the LH tail pipe to the muffler assembly.

3. NOTE: Install a new gasket.

   With assistance, install the muffler assembly.

4. Align both tail pipes and tighten the retaining clamps to 55 Nm (40 lb.ft).

5. Tighten the catalytic converter nuts and clamp to 48 Nm (35 lb.ft).

Published: 11-May-2011

Exhaust System - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Rear Muffler

Removal and Installation

Special Tool(s)

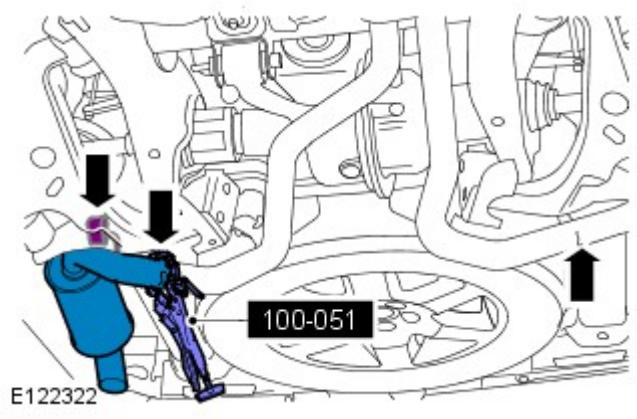
	100-051 Cutter, Exhaust Pipe

Removal

NOTE: Removal steps in this procedure may contain installation details.

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. NOTES:

   Right-hand shown, left-hand similar.

   Using the special tool, cut the exhaust pipe at the marked position.

   Remove the tail pipe.

   Special Tool(s): 100-051

Installation

1. NOTES:

   Do not tighten the retaining clamp at this stage.

   Clean the components.

   Install the retaining clamp.

   Install the tail pipe.

2. Align the tail pipe and tighten the retaining clamp to 55 Nm (40 lb.ft).

Published: 16-Aug-2012

Fuel System - General Information - Fuel System

Diagnosis and Testing

Fuel tank and lines

For further information, refer to the relevant section in the workshop manual - 310-01 Fuel Tank and Lines. REFER to:

Fuel Tank and Lines (310-01A Fuel Tank and Lines - TDV6 3.0L Diesel, Diagnosis and Testing),
Fuel Tank and Lines (310-01B Fuel Tank and Lines - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Diagnosis and Testing).

Published: 11-May-2011

Fuel System - General Information - Diesel Filter Water Drain-Off

General Procedures

WARNINGS:

Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

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.

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.

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

If taken internally, do not induce vomiting, seek immediate medical attention. Failure to follow these instructions may result in personal injury.

Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

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

CAUTIONS:

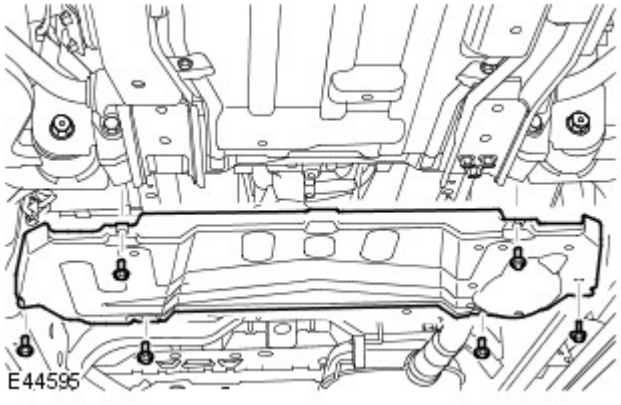
Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

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

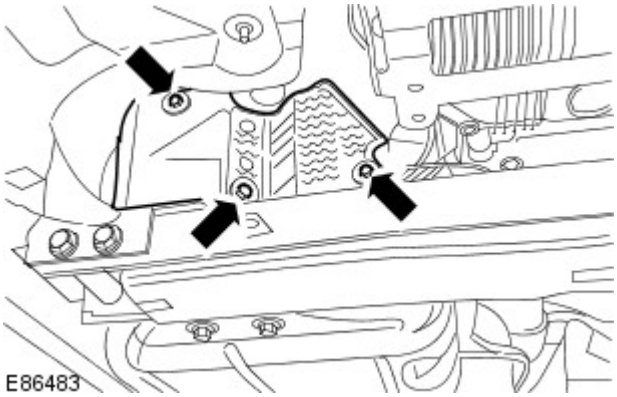
   Raise and support the vehicle.

2. Remove the transmission undershield.
   - Remove the 6 bolts.



3. WARNING: Observe due care when working near a hot exhaust system.

   Remove the fuel filter heat shield.
   - Remove the 3 bolts.





4. Drain the fuel filter element.
    - Attach a suitable drain tube to the water-in-fuel drain port.
    - Loosen the water-in-fuel drain port 2 complete turns and allow the fluid to drain into a container.
    - Turn the ignition to position 2 until 100ml of fluid is drained, then turn to position O.
    - Remove the drain tube.
5. Tighten the water-in-fuel drain port.
6. Install the fuel filter heat shield.
    - Tighten the bolts to 6 Nm (4 lb.ft).
7. Install the transmission undershield.
    - Tighten the bolts to 10 Nm (7 lb.ft).

Published: 17-Sep-2013

Fuel System - General Information - Fuel System Pressure Release V8 5.0L Petrol/V8 S/C 5.0L Petrol

General Procedures

Draining

1. WARNING:

   Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00 General Information, Description and Operation).

2. Remove the fuel pump fuse.

3. Remove the fuel filler cap.

4. Start the engine and allow it to idle until the engine stalls.

5. Crank the engine for approximately five seconds to make sure that the fuel rail pressure is released.

Filling

1. NOTE: Make sure all repairs have been carried out before proceeding to the following steps.

   Install the fuel pump fuse.

2. Install the fuel filler cap..

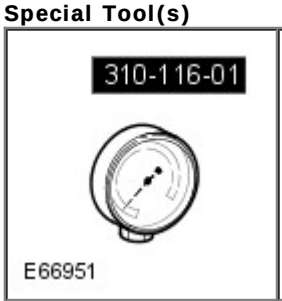
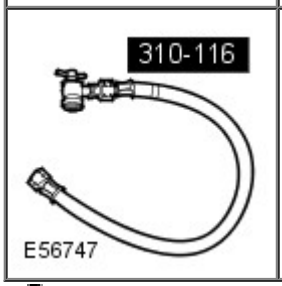
3. Read and clear stored DTC fault codes.

Published: 11-May-2011

Fuel System - General Information - Fuel System Pressure Check

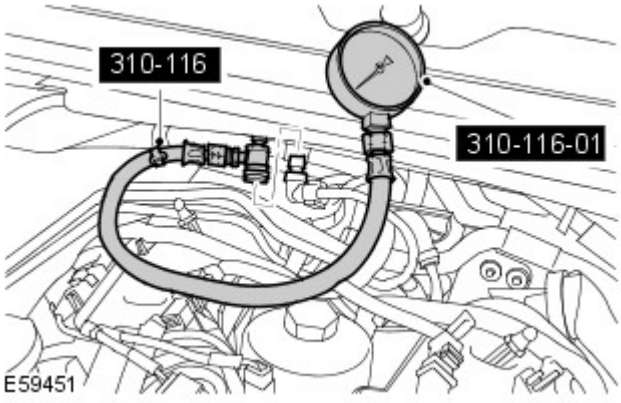
General Procedures

Special Tool(s)

	Gauge fuel pressure 310-116-01
	Adapter - fuel pressure check 310-116(LRT-19-006A)

NOTE: This procedure only checks the supply pressure to the high pressure pump.

1. Disconnect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the engine cover.
   For additional information, refer to: Engine Cover - 2.7L Diesel (501-05, Removal and Installation).
3. Remove the fuel rail Schraeder valve cap.
4. Install the special tool to the fuel rail Schraeder valve.



5. WARNINGS:

   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.

   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.

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

   Start and run the engine.

- Open the valve on the special tool.
- Note the fuel pressure readings.

6. For fuel pressure data, refer to specifications.
   For additional information, refer to: Specifications (303-01, Specifications).

7. Close the special tool valve.

8. Disconnect the special tool from the Schraeder valve.

9. Install the Schraeder valve cap.

10. Install the engine cover.
    For additional information, refer to: Engine Cover - 2.7L Diesel (501-05, Removal and Installation).

11. Connect the battery ground cable.
    For additional information, refer to: Specifications (414-00, Specifications).

Published: 11-May-2011

Fuel System - General Information - Fuel Tank Draining

General Procedures

WARNINGS:

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

 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.

 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.

 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. Open the fuel filler door and remove the cap.
2. Disconnect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).
3. Connect the fuel tank drain equipment ground cable to the vehicle.
4. Remove the fuel from the fuel tank, via the filler neck, using the fuel tank draining equipment. Follow the manufacturer's operating instructions.
5. To install, reverse the removal procedure.

Published: 11-May-2011

Fuel System - General Information - Low-Pressure Fuel System Bleeding TDV6 3.0L Diesel

General Procedures

Special Tool(s)

	Adaptor fuel rail pressure check 310-116 (LRT-19-006A)

WARNINGS:

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

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.

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.

After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

If taken internally, do not induce vomiting, seek immediate medical attention. Failure to follow these instructions may result in personal injury.

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

Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

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.

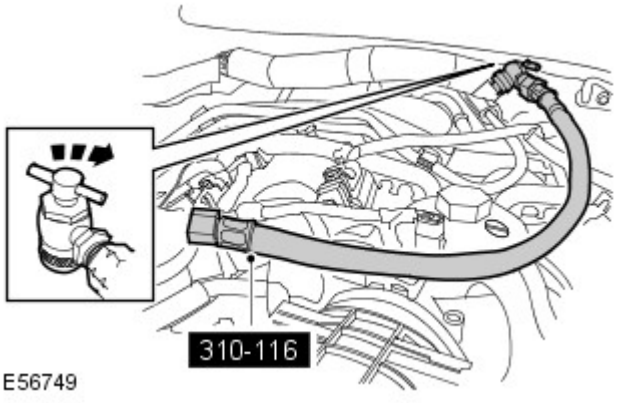
CAUTIONS:

Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

This procedure must be carried out before the engine is attempted to be started, following removal or replacement of any fuel system component involving fuel line intrusion. Failure to follow this instruction will result in damage to the fuel injection pump.

1. This procedure is necessary if any of the following fuel system components are removed, disconnected or replaced: Fuel tank, fuel lines, fuel filter element, fuel coolers, fuel injection pump or fuel rail pressure sensor.
2. Remove the engine cover. For additional information, refer to: Engine Cover - 3.0L V6 - TdV6 (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Install the special tool to the fuel rail Schraeder valve.
   - Remove the fuel rail Schraeder valve cap.
4. Position a container to collect spillage.

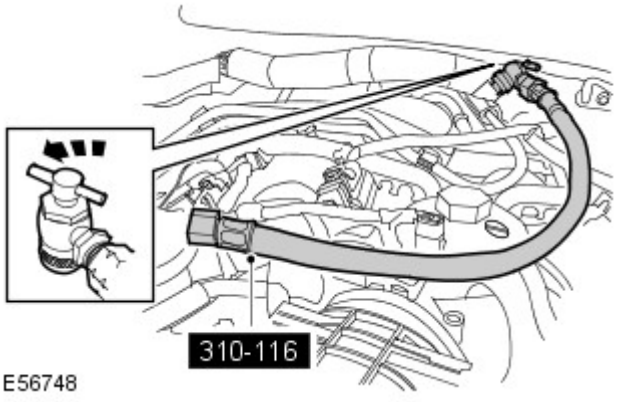
Open the valve on the special tool.



5. Turn the ignition switch to the ON position for 25 seconds. The fuel pump in the fuel tank will be audible.

6. Repeat the above procedure until clean, air free fuel is seen escaping from the special tool.
    - While the pump is still running, close the valve on the special tool to prevent air entering the fuel system.

7. Remove the special tool from the Schraeder valve.
    - Install the Schraeder valve protective cap.



8. Remove the container.

9. CAUTION: If a new fuel injection pump is fitted, the following step must be carried out to make sure the fuel injection pump is fully primed. Failure to follow this instruction may result in damage to the vehicle.

    Repeat Step 5 four times.

10. NOTE: The engine must be allowed to idle for two minutes to allow air in the fuel injection supply manifolds and fuel injectors to purge.

    Start the engine and allow to idle.

11. Install the engine cover. For additional information, refer to: Engine Cover - 3.0L V6 - TdV6 (501-05 Interior Trim and Ornamentation, Removal and Installation).

Published: 11-May-2011

Fuel Tank and Lines - TDV6 3.0L Diesel -

General Specifications

Item	Specification
Fuel system	Mechanical - returnless
Fuel tank	Multi layer plastic
High pressure fuel pump	Located at rear of engine between the cylinder heads, belt driven from the camshafts
Low pressure fuel pump	Located in the fuel tank
Fuel filter	Remotely mounted on the inside of the longitudinal member - fitted with a renewable element
Fuel tank sender units	Two - Front and Rear - front sender is attached to the frame of the fuel pick up tube and the rear sender is attached to the fuel pump swirl pot
High pressure fuel pump maximum operating pressure	1650 bar - 23931.2 lbf/in²
Low pressure fuel pump operating pressure	0.5 bar - 7.25 lbf/in²

Capacities

	Liters
Fuel tank capacity	86.3 (total)

Torque Specifications

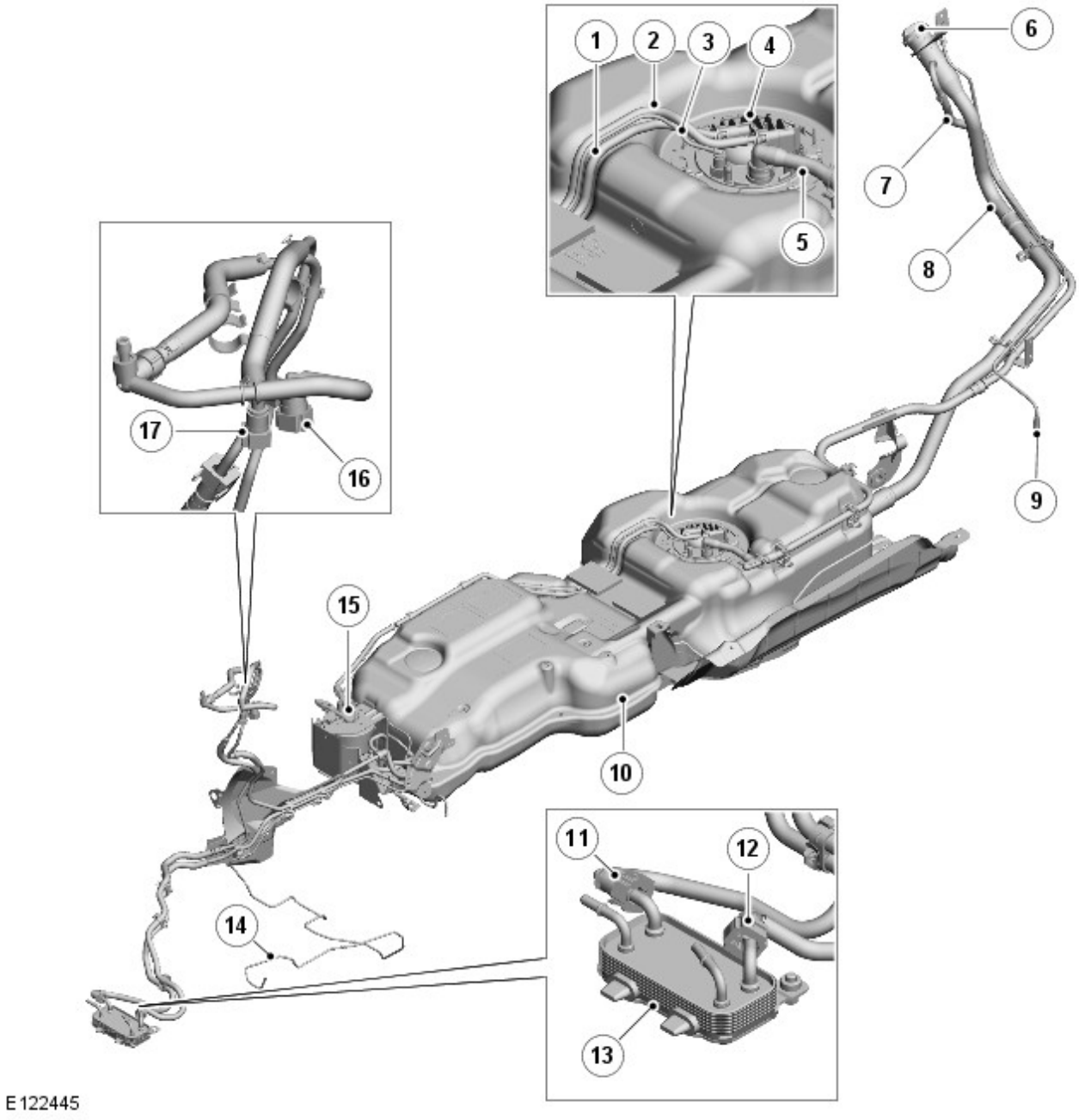
Description	Nm	lb-ft	lb-in
Fuel tank filler pipe retaining bolt	4	-	35
Fuel tank retaining bolts	45	33	-
Fuel tank heat shield retaining bolts	6	-	53
Fuel tank heat shield retaining nuts	3	-	27
Fuel filter heat shield retaining bolts	6	-	53
Transmission undershield retaining bolts	10	7	-
Fuel cooler retaining bolt	23	17	-

Published: 11-May-2011

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Tank and Lines

Description and Operation

3.0L V6 DIESEL FUEL TANK AND LINES COMPONENT LOCATION



Item	Part Number	Description
1	-	Pipe - Fuel pump to filter (fuel feed)
2	-	Pipe - Filter to pump module (fuel return)
3	-	Pipe - Fuel burning heater supply
4	-	Fuel pump module assembly
5	-	Fuel tank vent pipe
6	-	Filler cap and lanyard
7	-	Fuel tank vent pipe
8	-	Fuel filler pipe
9	-	Rear differential breather pipe (Ref only)
10	-	Cover
11	-	Pipe - Fuel cooler to filter (fuel return)
12	-	Pipe - HP pump to fuel cooler (fuel return)
13	-	Fuel cooler
14	-	Pipe - Fuel burning heater supply
15	-	Fuel filter

16	-	Pipe - HP pump to fuel cooler (fuel return)
17	-	Pipe - Filter to HP pump (fuel feed)

GENERAL

The major components of the 3.0L TdV6 fuel system comprises a fuel tank, a fuel pump module, a fuel filter, a fuel cooler, a fuel filler pipe and cap assembly and two fuel level sensors. The fuel system is a high pressure common rail system which uses an engine mounted and driven high pressure pump to deliver a uniform level of pressure to the common fuel rails which supply all 6 fuel injectors.

The fuel tank houses an internal fuel lift pump, located in the fuel pump module. The lift pump is employed to provide a low-pressure supply to the common rail high pressure fuel system.

Two fuel level sensors are installed in the front and rear 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 gauge.

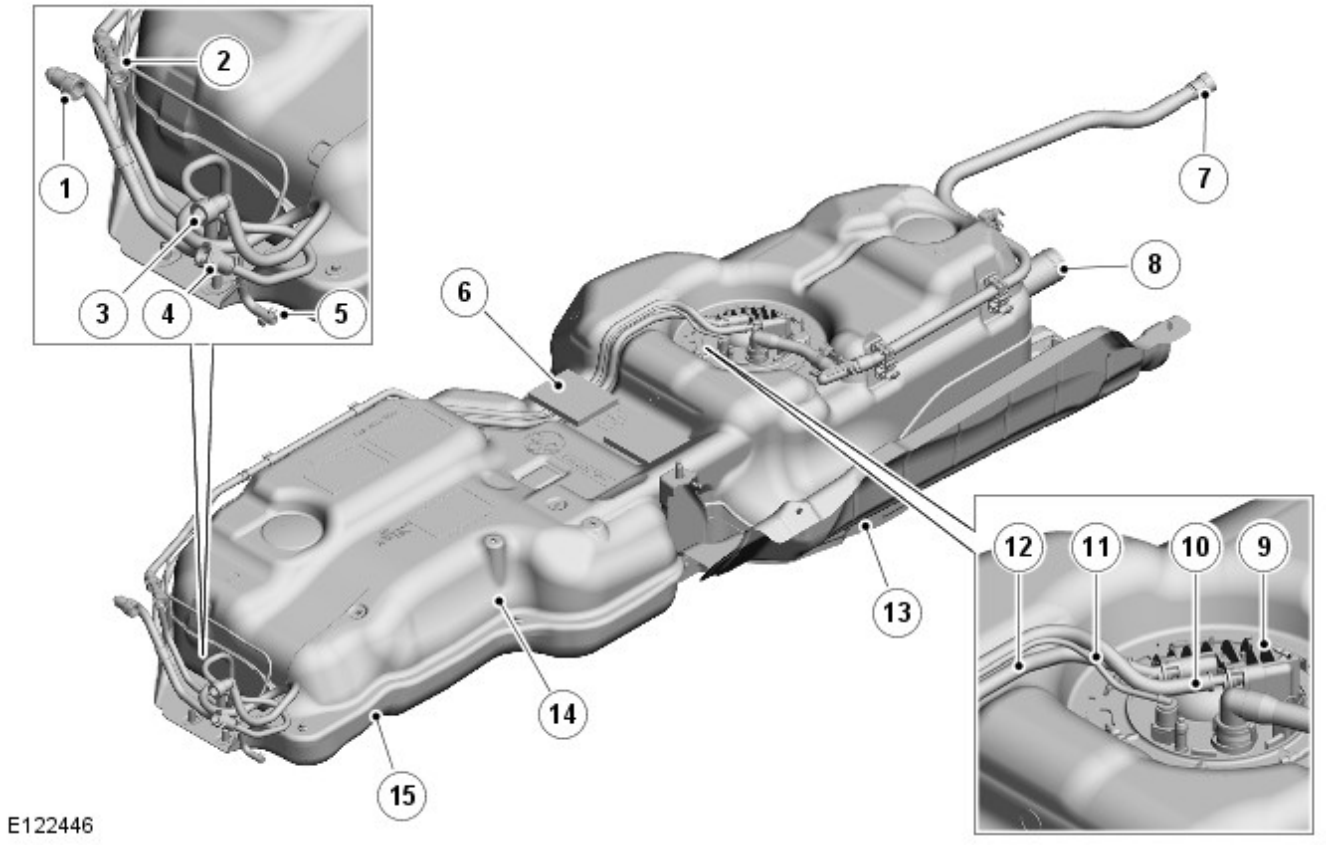
A fuel cooler is located in the low pressure side of the system in the fuel return line and is a fuel to water type cooler.

The fuel tank breather system consists of a fuel cut-off elbow. No Roll Over Valves (ROV's) are fitted.

The fuel filter is a disposable canister type and is located on a bracket at the front of the fuel tank.

DESCRIPTION

FUEL TANK ASSEMBLY



Item	Part Number	Description
1	-	Fuel return from filter to tank
2	-	Fuel supply from fuel pump to filter
3	-	Pipe - return from fuel cooler
4	-	Pipe - Fuel supply to HP pump
5	-	Pipe - Fuel burning heater supply
6	-	Pad (2 off)
7	-	Pipe - Fuel tank breather
8	-	Fuel tank filler inlet hose
9	-	Fuel pump module assembly
10	-	Pipe - Fuel return
11	-	Pipe - Fuel burning heater supply
12	-	Pipe - Fuel supply from pump
13	-	Heat shield
14	-	Cover

15	-	Cradle

The fuel tank is located on the right hand side of the vehicle, between the transmission and the right hand chassis longitudinal. The tank is located on a mounting cradle which secures the whole fuel tank assembly to the vehicle. The tank is blow moulded from HDPE (high density polyethylene) and has a useable capacity of 84.0 liters (18.4 gallons).

The cradle is attached to the chassis with six bolts. When the cradle is attached to the chassis, the tank is positively secured via foam pads which bear against the central chassis cross beam. A protective cover is fitted to the front right hand corner of the tank and provides additional protection.

The fuel tank is manufactured from moulded plastic which is a minimum of 3 mm thick. The tank is a sealed unit with the only internal access being via the pump module flange aperture on the top of the tank.

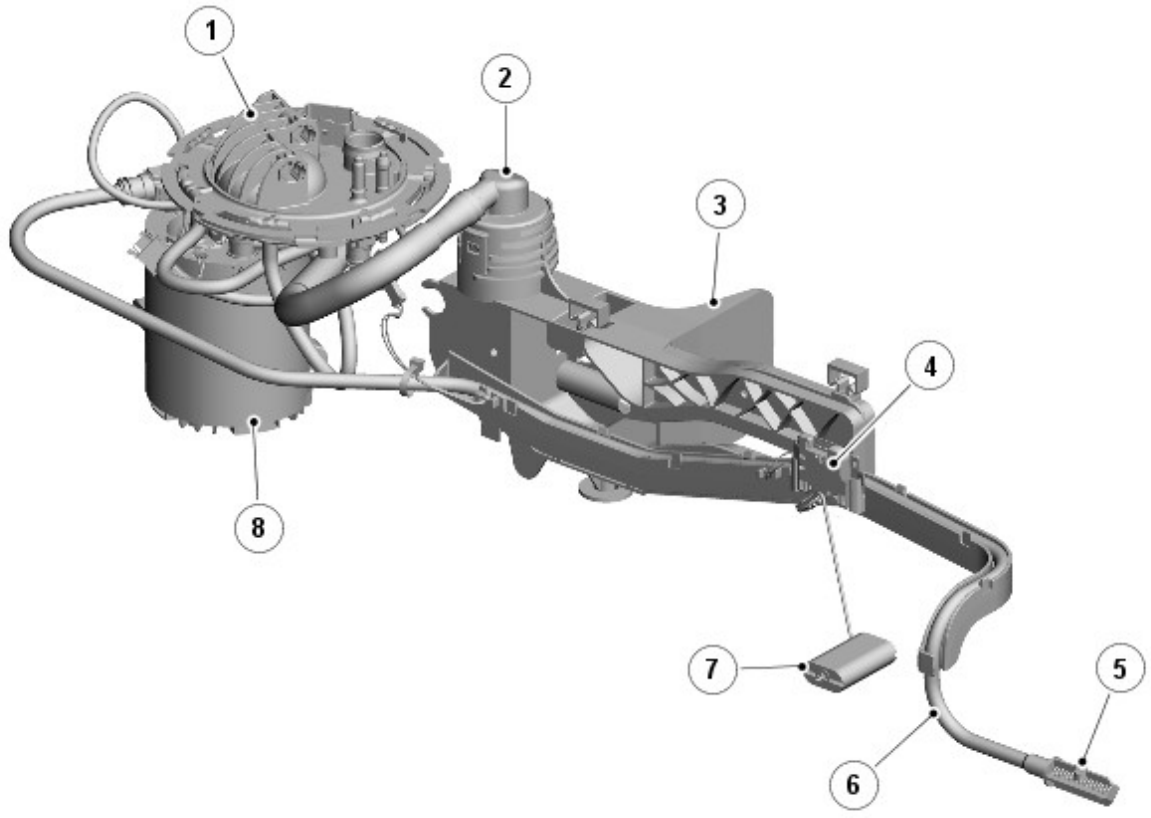
The flange is fitted with a locking ring and seal. The seal locates in a groove on the tank. The locking ring locates and clamps on the encapsulated ring that is moulded into the fuel tank. The flange has a tag which locates in the top of the tank to ensure correct orientation.

The flange has six pin internal and external connectors which provide for electrical connections for the level sensors and the fuel pump. Two quick release connectors provide for the connection of the fuel feed and return pipes and the vent pipes. The fuel return connection contains a non return valve which prevents fuel escaping from the connection in the event of a vehicle roll over and the pipe becoming detached. On vehicles with a fuel burning heater, a third connection provides the connection for the fuel feed supply to the fuel burning heater.

The fuel pump module is mounted on a bayonet lock ring which is welded inside the fuel tank. A carrier within the tank provides for the mounting of the fuel suction jet, front and rear fuel level sensors and the fuel cut-off elbow.

The fuel pump module contains a number of components. The module comprises the fuel pump, the rear jet pump, the pump inlet filter and the fuel pressure regulator. Only the pump module assembly, the fuel level sensors and the flange are available as serviceable components, the individual assembly components are not available separately.

Fuel Tank Internal Components



E122447

Item	Part Number	Description
1	-	Fuel pump module assembly
2	-	Fuel cut-off elbow
3	-	Carrier
4	-	Front fuel level sensor
5	-	Suction port filter
6	-	Suction port pipe
7	-	Level sensor float
8	-	Swirl pot

Fuel Pump Module

The low pressure fuel lift pump is located in the fuel pump module. The lift pump is employed to provide a low pressure supply at approximately 0.5 bar, to the common-rail high pressure fuel system and to allow the jet pump

assemblies to maintain a full swirl pot.

The lift pump operation is controlled by the Engine Control Module (ECM), via the fuel pump relay located in the Engine Junction Box (EJB). When the ignition is switched on, the fuel pump operates for 25 seconds to build up fuel pressure. As engine cranking commences the fuel pump stops running until the engine starts. This function is employed to decrease load on the battery.

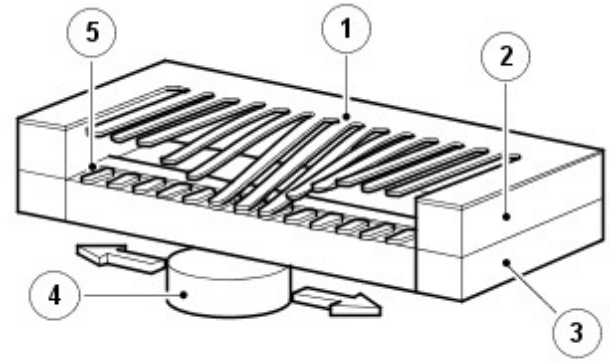
In cold conditions, 'waxing' of the fuel can occur. For this reason a coarse mesh filter is attached to the swirl pot inlet port at the bottom of the pump module.

A three way connection is located on the top of the module. Two outlets supply the jet pumps, the other outlet is the pressure feed through the pressure regulating valve to the fuel delivery line. The module incorporates a jet pump which draws fuel from the front of the tank and delivers it directly into the swirl pot.

Fuel Level Sensors

Two fuel level sensors are installed at either end of the tank. One is mounted at the rear of the internal carrier, the other is mounted near the front of the internal carrier within the tank. The sensors are a MAPPS (magnetic passive position sensor) which provide a variable resistance to ground for the output from the fuel gauge. The sensor is sealed from the fuel preventing contamination of the contacts, increasing reliability. The fuel level sensors are connected to an electrical connector 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.



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 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 gauge 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 low.

The fuel level sender signal is converted into a CAN (controller area network) message by the instrument cluster as a direct interpretation of the fuel tank contents in liters.

In the event that fuel is allowed to run too low, signals transmitted from the fuel level sensors initiate the fuel run-dry strategy. The driver will be notified before the tank is run critically low on fuel. Although this is a simulated run-dry procedure, it provides the symptoms of the vehicle running out of fuel and the driver will perceive it as such. The engine will stop when there is approximately 4 liters (0.87 gallons) of fuel remaining in the fuel tank.

Jet Pumps

The fuel system incorporates twin jet pumps which are integral with the fuel pump module. One jet pump collects fuel from the rear of the tank, and the other draws additional fuel from the front of the tank through a suction line that is mounted on the carrier. The jet pump operates on a venturi effect created by the fuel at pump output pressure passing through the jet pump.

The prime function of the jet pump is to collect fuel from the front of the tank and transfer it into the fuel pump module swirl pot at the rear of the tank. The jet pump feature ensures that fuel is drained from the front of the tank before fuel run-out at the rear of the tank.

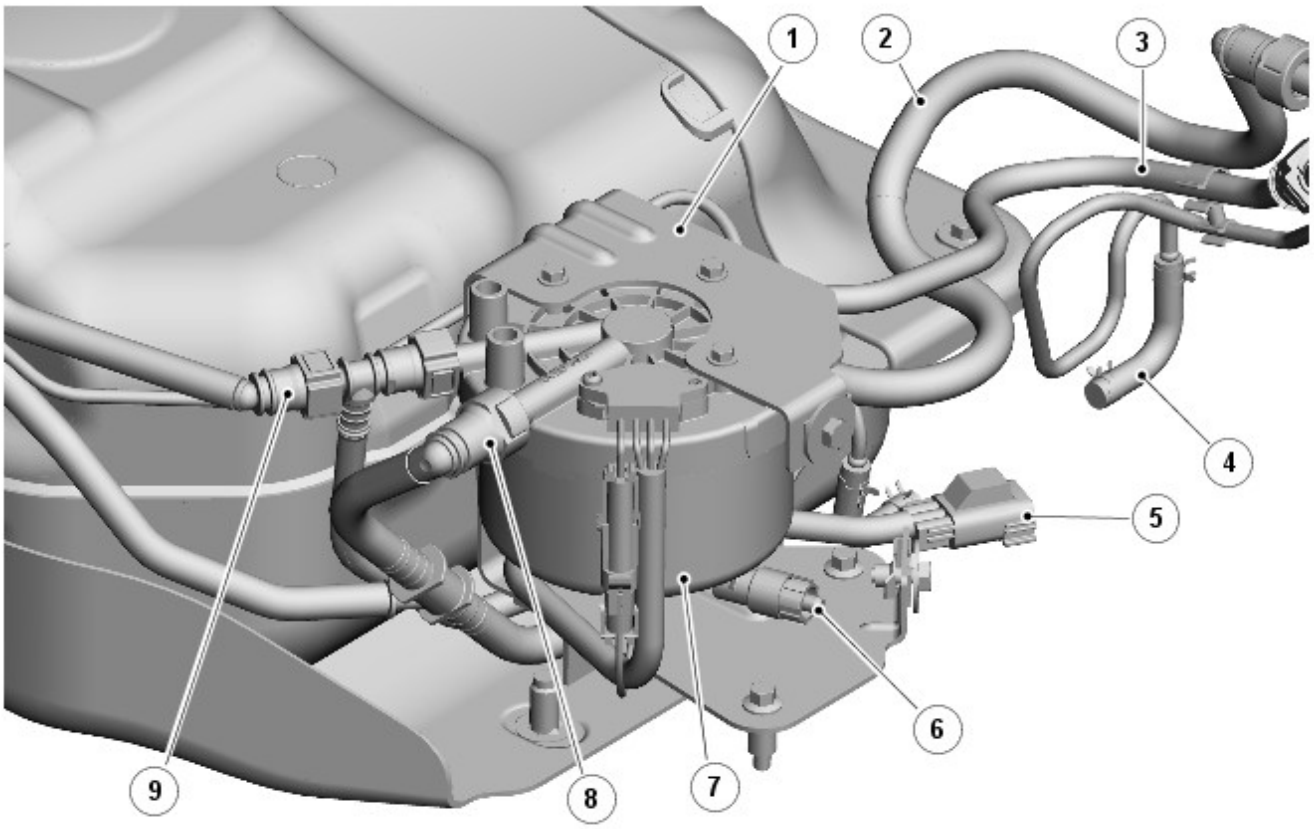
Fuel Cut-Off Elbow

The fuel cut-off elbow is located in the upper half of the tank on the carrier and is connected to the tank breather. The main purpose of the fuel cut-off elbow is to control the fill volume of the tank. During filling air, trapped inside

the tank and a small amount of vapor is passed via the fuel cut-off elbow to the tank breather. The air and vapor mix then vents to atmosphere through the breather. During filling, when the tank reaches its full level, the fuel cut-off elbow closes and prevents air/vapor passing through to the tank breather. The resulting back pressure causes refueling to stop automatically.

The fuel cut-off elbow is always open when the fuel tank is below full, providing an unrestricted air/vapor outlet to the tank breather.

FUEL FILTER



E122448

Item	Part Number	Description
1	-	Mounting bracket
2	-	Pipe - Fuel return from fuel cooler
3	-	Pipe - Fuel supply to high pressure fuel pump
4	-	Pipe - Fuel supply to Fuel Burning Heater (FBH)
5	-	Electrical connector
6	-	Water drain
7	-	Fuel filter
8	-	Fuel return to tank connection
9	-	Fuel supply from tank connection

The fuel filter assembly is located in front of the fuel tank and is mounted on a bracket which is attached to the top face of the transfer box chassis cross member. The fuel filter assembly comprises a bracket, filter housing and the filtration element. The filter housing is secured to the bracket with 3 bolts. The bracket is secured to the cross member with 2 bolts which are screwed into threaded holes in the cross member.

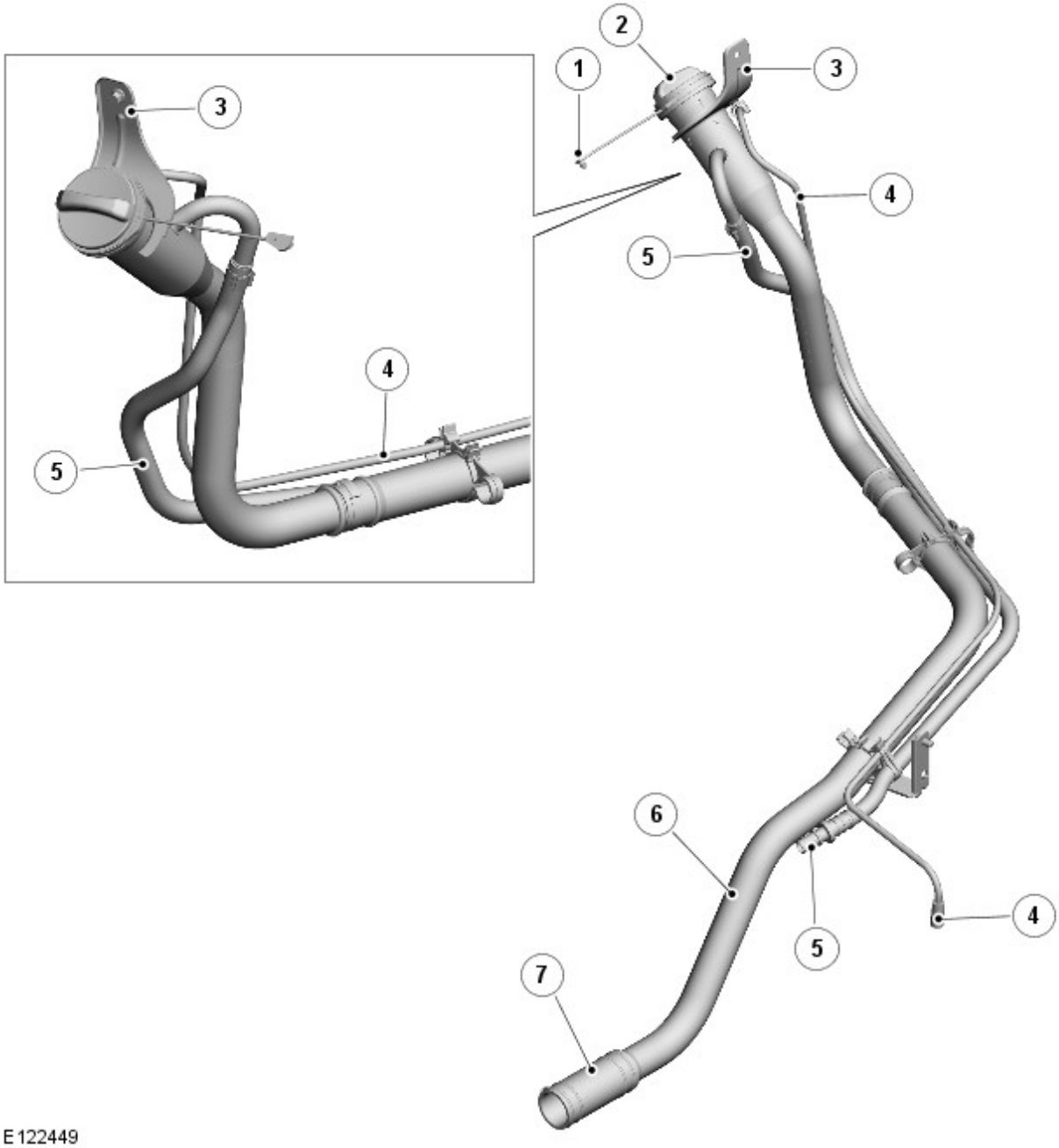
The filter housing has an inlet and outlet which allow for the attachment of hoses using quick release connectors. The filter element is located on the underside of the housing and can be removed by rotating one quarter turn to release from the housing.

The filter element has a capacity of 200 cm3 (12.2 in3). The filtration element can filter particulate matter larger than 15 microns. A water drain valve is located on the base of the filter. The filter can be purged of water by partially unscrewing the drain valve and allowing at least 84 cm3 (5.12 in3) of fuel to drain into a suitable container. The drain plug has a centre outlet which allows for the attachment of a drain hose.

The filter element also has a water sensor located in its base. The sensor is screwed into a threaded hole in the base of the element. When the filter is replaced at service, the sensor can be unscrewed from the element and installed in the new element. The sensor has an electrical connector located at the side of the element which can be disconnected to assist element removal.

The water sensor is connected to the Engine Control Module (ECM). When the water in the element reaches 64 cm3 (3.9 in3) the ECM issues a high speed Controller Area Network (CAN) bus message to the instrument cluster to display a 'WATER IN FUEL' message in the message center.

FUEL FILLER PIPE



E122449

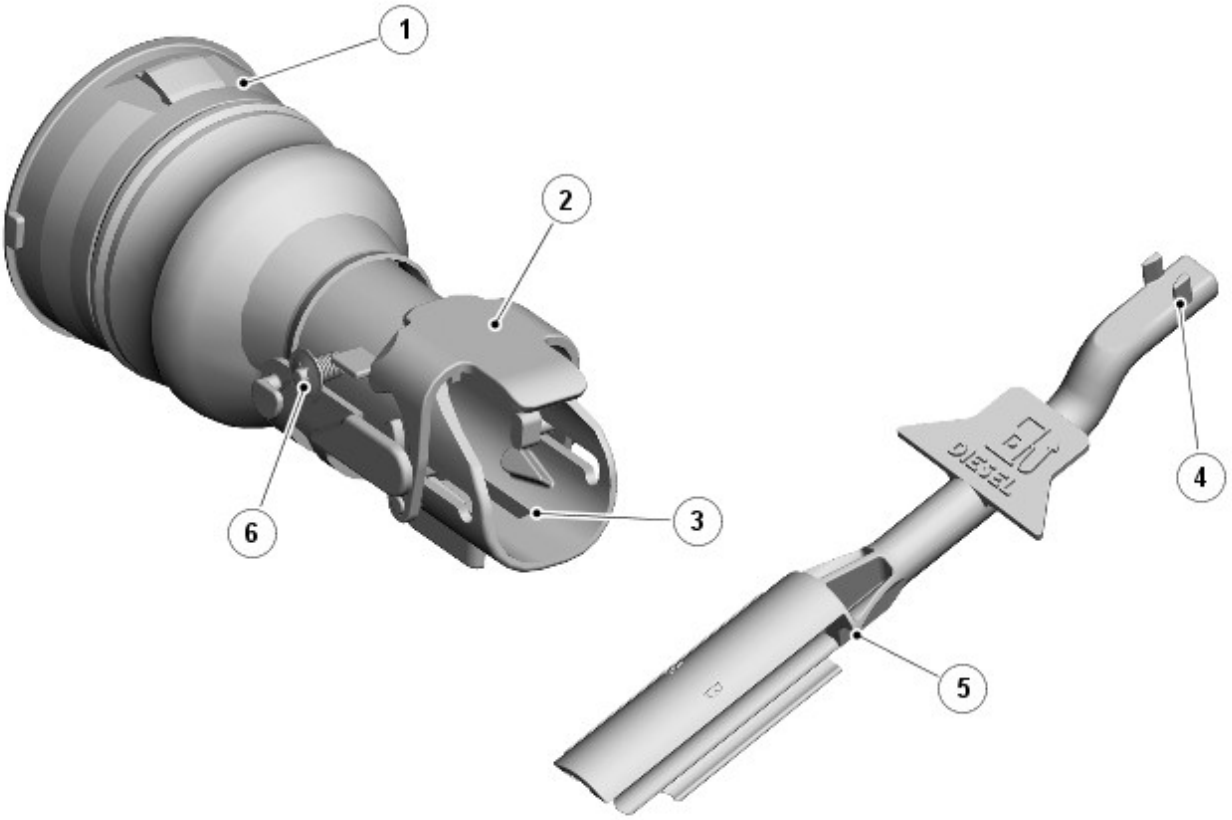
Item	Part Number	Description
1	-	Lanyard
2	-	Filler cap
3	-	Bracket
4	-	Pipe - Rear differential breather (Reference only)
5	-	Pipe - Fuel vapor vent
6	-	Fuel filler pipe
7	-	Hose - connection to fuel tank

The stainless steel filler neck has a wide bore neck specially designed to reduce diesel frothing while the fuel tank is being replenished. The filler pipe is connected at its lower end to the fuel tank by a hose which is secured to the pipe with a worm drive clamp. The opposite end of the hose is connected to the fuel tank inlet check valve and secured with another worm drive clamp.

A fuel vapor vent pipe is attached to the filler pipe and connects between the fuel level vent valve in the fuel tank and fuel filler pipe neck.

The filler head incorporates the Fuel Guard system to prevent accidental filling of the tank with petrol (gasoline).

Fuel Guard System



E117721

Item	Part Number	Description
1	-	Filler neck
2	-	Flap
3	-	Reset slots
4	-	Spigots
5	-	Reset tool
6	-	Spring

The fuel guard system comprises a mechanically operated flap which is triggered when the smaller diameter filler nozzle tube, used on petrol (gasoline) pumps, is inserted in the filler neck. The flap is actuated and blocks the sensor port on the fuel pump nozzle, causing it to automatically switch off. The flap is locked in this position by a latch mechanism.

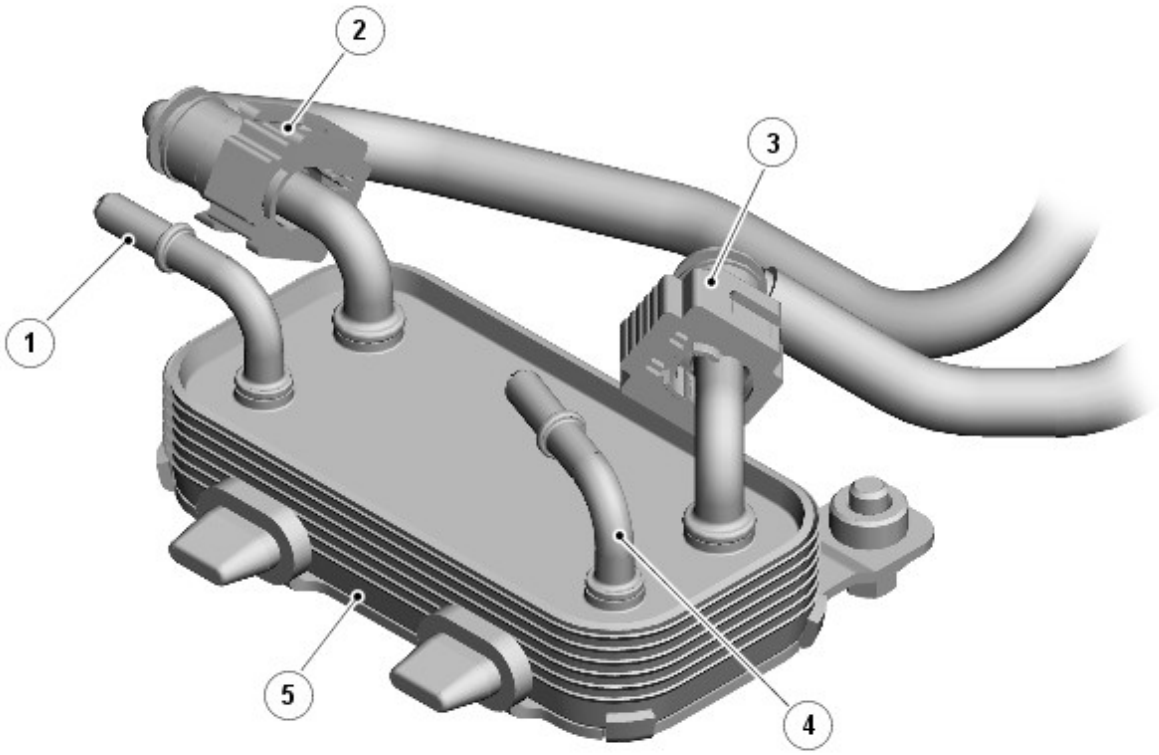
A reset tool is provided and stored in the luggage compartment. The tool is used to reset the fuel guard device if triggered and release the latch. Two spigots on the tool locate in slots in the filler neck which release a latch and the flap is opened by its own spring. The tool is located in the filler neck and once the two spigots on the tool are located in the slots it can be pulled outwards, releasing a latch and allowing the flap to be opened by its own spring pressure. The tool is stored on the battery mounting clamp.

The flap is colored yellow so that it is clearly visible when activated and has a 'Handbook' symbol on it.

A diesel fuel pump nozzle will not activate the fuel guard because the nozzle stops against two molded lugs. However, if an unleaded gasoline pump nozzle is inserted into the housing, its smaller diameter allows it to pass the two molded lugs. The nozzle strikes two pins on the inside of the filler housing which move forward. This movement rotates the shut-off flap which is then held in place when the nozzle is removed by the latch mechanism.

NOTE: Russian markets do not use the fuel guard system and are fitted with a conventional filler neck.

FUEL COOLER



E122450

Item	Part Number	Description
1	-	Coolant outlet
2	-	Pipe - cooler to fuel filter
3	-	Pipe - HP pump to cooler
4	-	Coolant inlet
5	-	Fuel cooler

The fuel cooler uses engine coolant, direct from the lower part of the radiator, to cool fuel returning to the tank from the HP injection pump.

The fuel cooler is located on the right hand side of the chassis, at the rear of the engine, near to transmission cooler. A bracket, which is attached to the right hand chassis rail, provides for the attachment of the cooler. The bracket has two slots which accept two plastic pegs which are attached to the cooler. A bolt is inserted through a hole in the bracket and screws into a captive nut on the cooler to positively secure the cooler to the bracket.

The cooler has four quick fit connector pipes which provide for the attachment of the fuel inlet hose from the HP injection pump, the fuel outlet hose to the fuel filter, the coolant inlet hose from the radiator and the coolant outlet hose to the coolant thermostat housing. The coolant pipes can be identified by their smaller diameter.

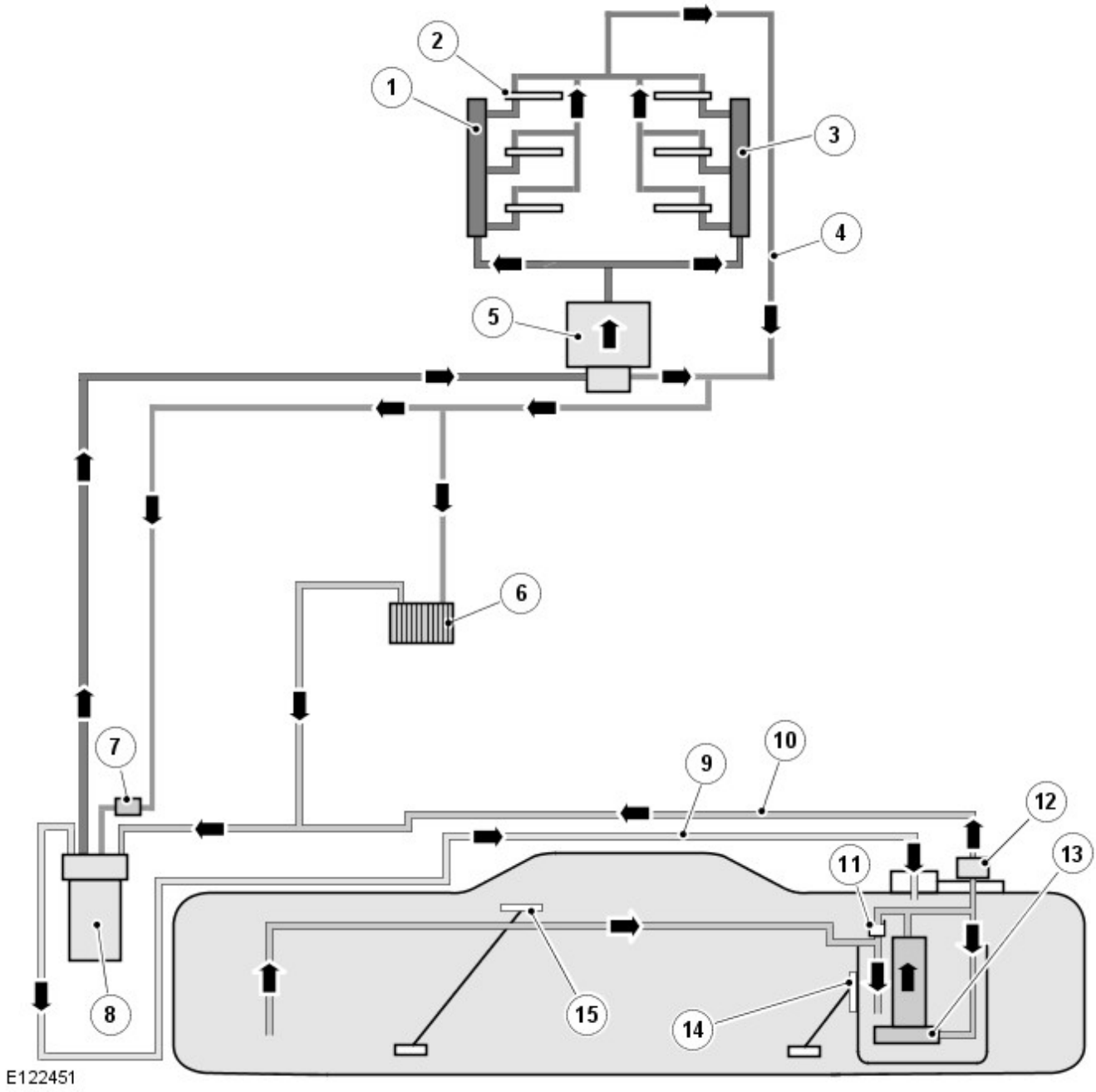
OPERATION

Diesel fuel is drawn from the tank by the internal electric lift pump. The fuel pressure regulator located in the fuel pump module assembly regulates the delivery pressure at approximately 0.5 bar to the transfer pump housed in the High Pressure (HP) pump. A Volume Control Valve (VCV) governs the amount of fuel supplied to the HP pump.

The transfer and high pressure pump are driven directly by the engine. Due to the storage volume of the common rail, the injection pressure will remain practically constant over the complete duration of the injection process.

The HP pump has a return pipe circuit which is separate from the injector return pipes.
For additional information, refer to: Fuel Charging and Controls (303-04C, Description and Operation).

Fuel Delivery Schematic Diagram



Item	Part Number	Description
1	-	Left Hand (LH) common rail
2	-	Fuel injector (6 off)
3	-	Right Hand (RH) common rail
4	-	Fuel rail and injector leak-off return line
5	-	High Pressure (HP) fuel pump
6	-	Fuel cooler
7	-	Thermostatic diverter valve
8	-	Fuel filter assembly
9	-	Fuel return/air bleed pipe
10	-	Low Pressure (LP) delivery pipe
11	-	Jet pump
12	-	Pressure regulator
13	-	Fuel pump module
14	-	Fuel level sensor - Rear
15	-	Fuel level sensor - Front

Published: 09-Apr-2013

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Tank and Lines

Diagnosis and Testing

Principle of Operation

For a detailed description of the fuel tank and lines system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Fuel Tank and Lines (310-01A Fuel Tank and Lines - TDV6 3.0L Diesel, Description and Operation).

Inspection and Verification

WARNINGS:

 Do **NOT** carry out any work on the fuel system with the engine running. The fuel pressure within the system can be as high as 2000 bar (29,008 lb/in²). Failure to follow this instruction may result in personal injury.

 Eye protection must be worn at all times when working on or near any fuel related components. Failure to follow this instruction may result in personal injury.

 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow this instruction may result in personal injury.

 After carrying out repairs, the fuel system must be checked visually for leaks. This should be done after the engine has been run, but with the engine switched **OFF**. Failure to follow this instruction may result in personal injury.

 If taken internally, **DO NOT** induce vomiting. Seek immediate medical attention. Failure to follow this instruction may result in personal injury.

 If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek medical attention. Failure to follow this instruction may result in personal injury.

 Wash hands thoroughly after handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention. Failure to follow this instruction may result in personal injury.

CAUTIONS:

 Before disconnecting any part of the system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into the fuel system. Failure to follow this instruction may result in damage to the vehicle.

 The fuel pipes between the injectors and the rail must be discarded after each use, and new pipes installed. Failure to follow this instruction may result in damage to the vehicle.

 It is essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in damage to the vehicle.

 Make sure that the workshop area in which the vehicle is being worked on is as clean and dust-free as possible. Areas in which work on clutches, brakes or where welding or machining are carried out are not suitable in view of the risk of contamination to the fuel system. Failure to follow this instruction may result in damage to the vehicle.

 Make sure that any protective clothing worn is clean and made from lint-free non-flocking material. Failure to follow this instruction may result in damage to the vehicle.

 Make sure that any protective gloves worn are new and are of the non-powdered latex type. Failure to follow this instruction may result in damage to the vehicle.

 Make sure that clean, non-plated tools are used. Clean tools using a new brush that will not lose it's bristles and fresh cleaning fluid prior to starting work on the vehicle. Failure to follow this instruction may result in damage to the vehicle.

 Use a steel-topped work bench and cover it with clean, lint-free, non-flocking material. Failure to follow this instruction may result in damage to the vehicle.

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

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

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

Visual Inspection

Mechanical	Electrical
• Low/contaminated fuel • Fuel supply/return line(s) • Fuel tank and filler pipe • Fuel leak(s) • Fuel filler cap • Fuel filter • Push connect fittings • Fuel pump	• Fuses • Links • Relays • Fuel pump module • Sensor(s) • Engine control module (ECM) • Central Junction Box (CJB) • Restraints Control Module (RCM) • Electric Park Brake Control Module (EPBCM)

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

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not start	• Crash mode detected • Low/contaminated fuel • Air leakage • Low-pressure fuel system fault • Fuel pump module (lift pump) fault • Blocked fuel filter • Crankshaft position (CKP) sensor	• Using the manufacturer approved diagnostic system, check the Restraints Control Module (RCM) for related DTCs and refer to the relevant DTC index • Check the fuel level and condition. Draw off approximately 1L (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Check the intake air system for leaks • Check the lift pump operation • Check the low-pressure fuel system for leaks/damage • Check the fuel filter • Refer to the electrical circuit diagrams and test the CKP sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance
Difficult to start	• Glow plug system fault (very cold conditions) • Low/contaminated fuel • Air leakage • Fuel pump module (lift pump) fault • Low-pressure fuel system fault • Blocked fuel filter • Exhaust Gas Recirculation (EGR) valve(s) fault	• Refer to the electrical circuit diagrams and test the glow plug circuits for short circuit to ground, short circuit to power, open circuit, high resistance • Check the fuel level and condition. Draw off approximately 1L (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Check the intake air system for leaks • Check the lift pump operation • Check the low-pressure fuel system for leaks/damage • Check the fuel filter • Check the EGR system
Rough idle	• Intake air system fault • Low/contaminated fuel • Low-pressure fuel system fault • Blocked fuel filter • Exhaust Gas Recirculation (EGR) valve(s) fault	• Check the intake air system for leaks • Check the fuel level and condition. Draw off approximately 1L (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Check the low-pressure fuel system for leaks/damage • Check the fuel filter • Check the EGR system
Lack of power when accelerating	• Intake air system fault	• Check the intake air system for leakage or restriction • Check for a blockage/restriction in the exhaust system, install

	Restricted exhaust system • Low fuel pressure • Exhaust Gas Recirculation (EGR) valve(s) fault • Turbocharger actuator fault	new components as necessary • Check the EGR system • Check turbocharger actuator
Engine stops/stalls	• Air leakage • Low/contaminated fuel • Low-pressure fuel system fault • Exhaust Gas Recirculation (EGR) valve fault	• Check the intake air system for leaks • Check the fuel level and condition. Draw off approximately 1L (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Check the fuel system for leaks/damage • Check the EGR system
Engine judders	• Low/contaminated fuel • Air ingress • Low-pressure fuel system fault	• Check the fuel level and condition. Draw off approximately 1L (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel • Check the intake air system for leaks • Check the low-pressure fuel system for leaks/damage
Excessive fuel consumption	• Low-pressure fuel system fault • Fuel temperature sensor leak • Exhaust Gas Recirculation (EGR) valve(s) fault	• Check the low-pressure fuel system for leaks/damage • Check the fuel temperature sensor, fuel pump, etc for leaks • Check the EGR system
Fuel gauge reading empty with fuel in the fuel tank	• Active fuel level sensor circuit open circuit • Passive fuel level sensor circuit open circuit • Instrument cluster internal failure	• Using the manufacturer approved diagnostic system, perform the guided diagnostic routine - Fuel Level Sensor Test

Fuel Gauge, Resistance, Voltage And Fuel Tank Level Comparison Chart

Use the chart to determine fuel tank fuel volume versus fuel gauge reading to determine the fuel level symptom and fault.

NOTE: The vehicle must be parked on a level surface to obtain an accurate fuel level gauge reading.

Volume, Resistance and Voltage Values

Gauge Reading	Fill Volume (L)	Fuel Level Sensor "pump/active/A"(0xD908) - Rear		Fuel Level Sensor "eject/passive/B" (0xD907) - Front	
		Resistance (Ω)	Voltage (V)	Resistance (Ω)	Voltage (V)
	0	51.30	0.37	51.60	0.38
	1	51.30	0.37	51.60	0.38
	2	51.30	0.37	51.60	0.38
	3	51.30	0.37	51.60	0.38
(4.9L unuseable fuel)	4	51.30	0.37	51.60	0.38
Empty	5	51.30	0.37	51.60	0.38
	6	67.30	0.47	51.60	0.38
	8	92.90	0.63	51.60	0.38
	10	111.10	0.74	51.60	0.38
	12	130.20	0.84	67.80	0.47
	14	139.70	0.89	76.40	0.53
	16	160.20	0.99	93.70	0.64
	18	171.00	1.04	111.40	0.74
	20	182.00	1.10	120.90	0.78
	22	193.40	1.15	131.20	0.85
	24	204.90	1.21	150.90	0.95
¼	25	216.50	1.25	151.20	0.96
	26	228.50	1.30	161.40	0.99
	28	241.20	1.36	172.20	1.05

	30	254.20	1.41	193.90	1.15
	32	267.50	1.46	205.90	1.21
	34	281.30	1.51	217.90	1.26
	35	281.50	1.52	229.70	1.31
	36	295.50	1.56	230.00	1.32
	38	310.30	1.62	242.50	1.37
	40	325.20	1.68	269.00	1.47
	42	341.30	1.73	282.70	1.52
	44	357.10	1.78	297.20	1.58
½	45	373.10	1.83	312.00	1.64
	46	373.50	1.84	312.30	1.64
	48	390.50	1.89	327.70	1.68
	50	407.50	1.94	358.50	1.78
	52	427.10	1.99	374.80	1.84
	54	463.90	2.09	391.80	1.89
	55	463.90	2.09	409.60	1.95
	56	484.30	2.14	409.80	1.95
	58	505.90	2.00	427.90	1.96
	60	528.40	2.25	447.30	2.05
	62	550.90	2.29	486.40	2.11
	64	573.40	2.35	507.60	2.20
¾	65	573.60	2.36	507.70	2.20
	66	597.70	2.40	529.40	2.26
	68	623.40	2.45	553.60	2.31
	70	650.50	2.50	577.40	2.38
	72	677.50	2.55	628.20	2.46
	74	706.80	2.62	654.50	2.52
	75	736.70	2.66	655.00	2.53
	76	737.00	2.67	682.30	2.58
	78	801.10	2.76	710.00	2.63
	80	835.80	2.81	772.50	2.72
	82	872.30	2.87	805.00	2.79
	84	950.60	2.98	875.40	2.88
	86	992.10	3.02	951.60	2.98
Full	87	992.20	3.02	995.70	3.03

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - TDV6 3.0L Diesel, DTC: Engine Control Module (PCM) (100-00, Description and Operation).

Published: 11-May-2011

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Cooler

Removal and Installation

Removal

WARNINGS:

Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install new blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

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.

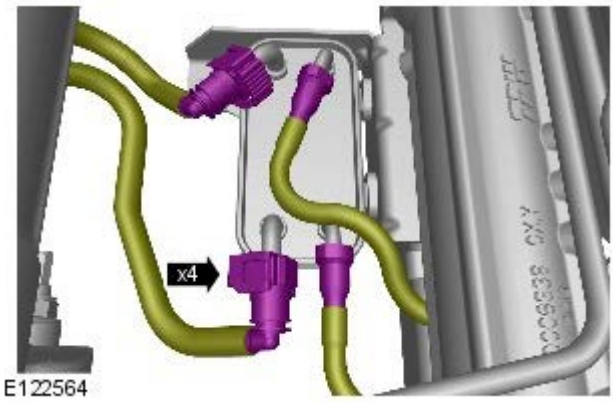
CAUTION: Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

NOTE: Removal steps in this procedure may contain installation details.

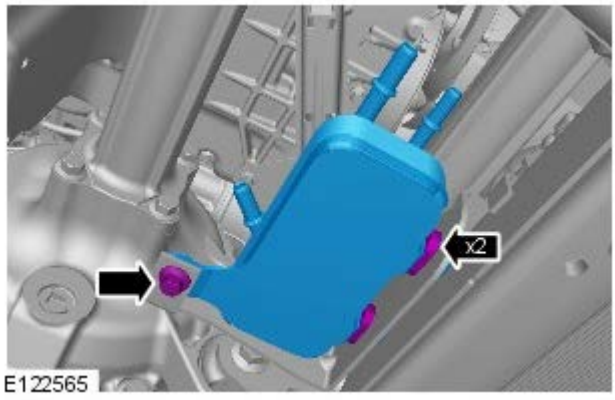
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Engine Undershield (501-02, Removal and Installation).



3. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.



4. CAUTION: Always plug any open connections to prevent contamination.

   Torque: 23 Nm

Installation

1. CAUTION: Remove and discard all blanking caps.

   To install, reverse the removal procedure.

2. Fill the cooling system, keeping coolant to the upper level mark

of the expansion tank.

Published: 11-May-2011

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Pump and Sender Unit

Removal and Installation

Special Tool(s)

	310-123 Locking Ring, Fuel Tank

General Equipment

Transmission jack

Removal

WARNINGS:

After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

After the fuel tank drain is complete always fit the sealing covers over the drain ports. Failure to do so will mean that fuel vapor can escape.

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.

CAUTION: Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

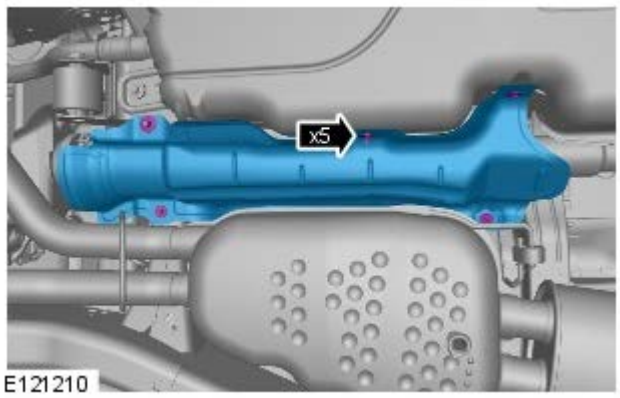
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

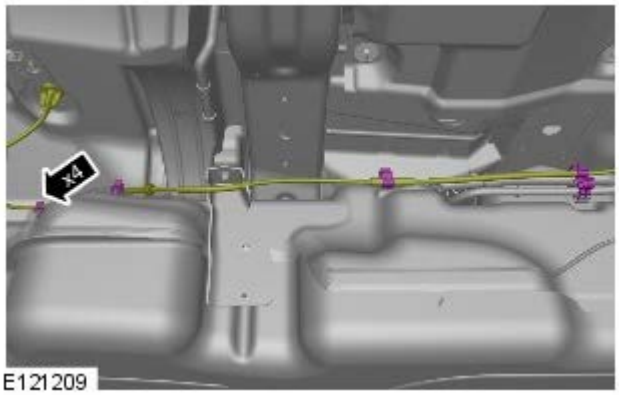
   Raise and support the vehicle.

3. Refer to: Fuel Tank Draining (310-00, General Procedures).

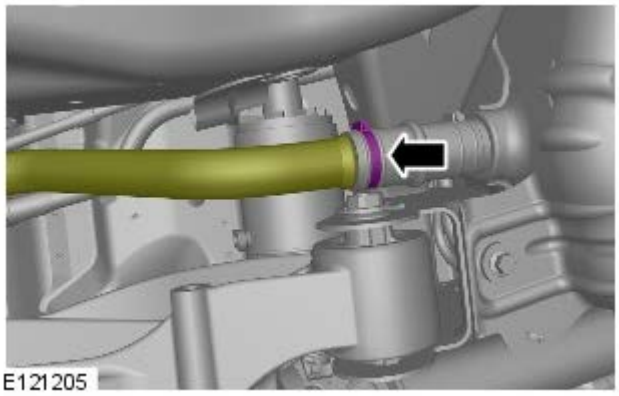
4. *Torque:*
   Bolts 6 Nm
   Nuts 3 Nm



5.

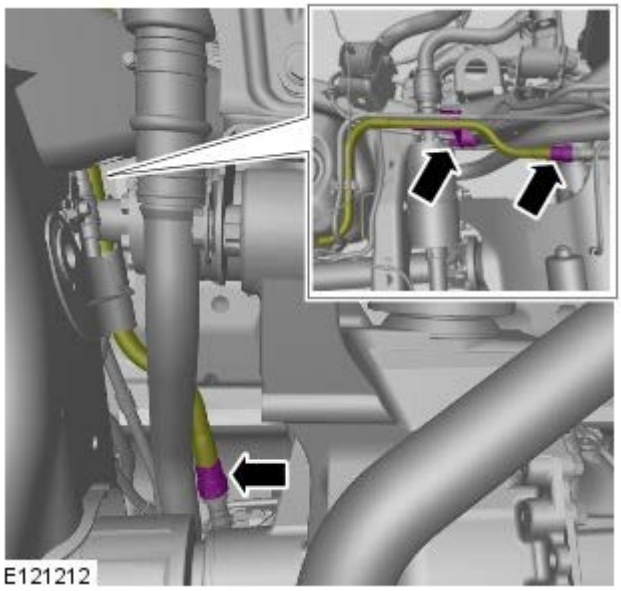


E121209

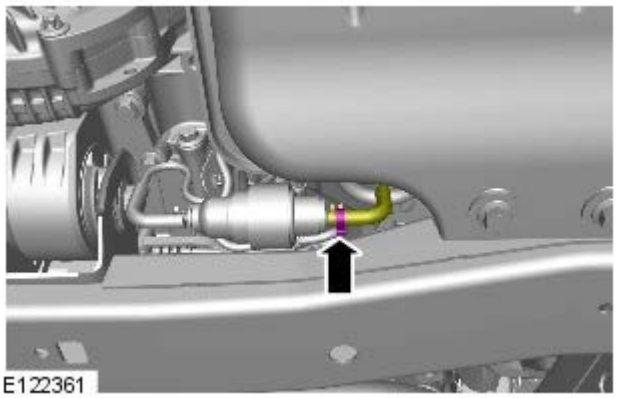

E121205

6. CAUTION: Discard the retaining clip.

   Remove the tamper proof cover.


E121212

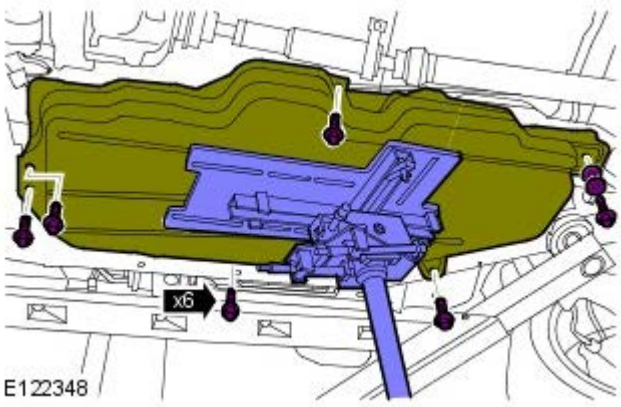
7. CAUTION: Make sure that all openings are sealed. Use new blanking caps.


E122361

8. WARNING: Be prepared to collect escaping fuel.

   CAUTION: Make sure that all openings are sealed. Use new blanking caps.

9. WARNING: Secure the component to the transmission jack.

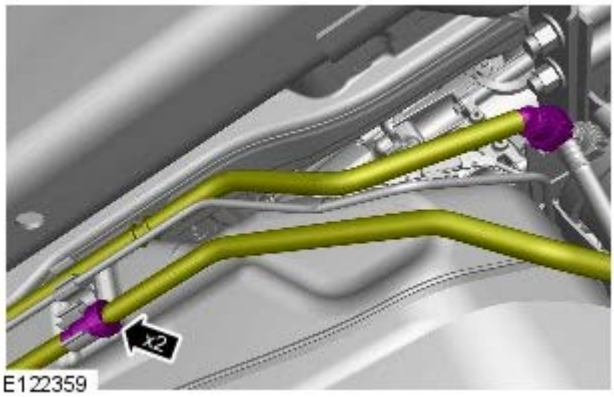


CAUTION: Do not lower the fuel tank more than 250 mm.

NOTE: Note the orientation of the two rear retaining bolts and washers.

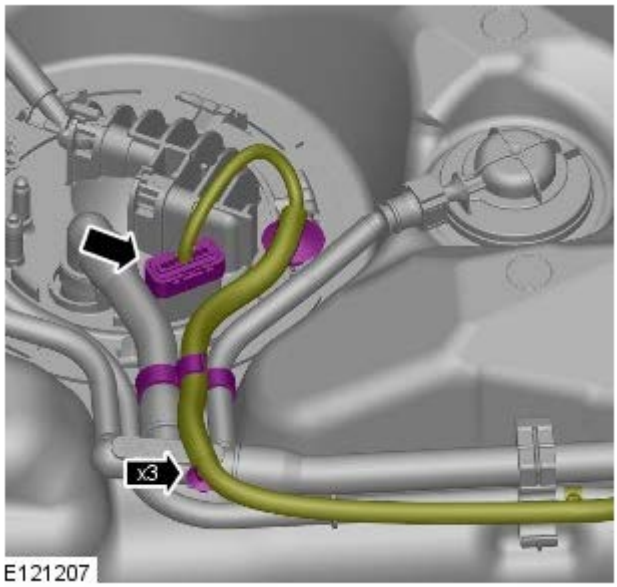
Using a suitable transmission jack, lower the fuel tank sufficiently only to access the top of the fuel tank.

General Equipment: Transmission jack
Torque: 45 Nm

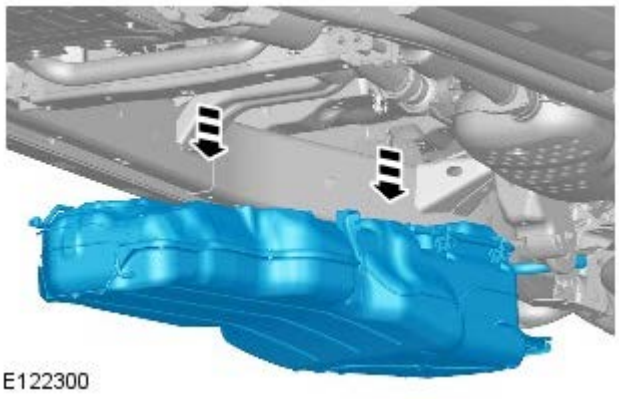


10. WARNING: Be prepared to collect escaping fuel.

CAUTION: Make sure that all openings are sealed. Use new blanking caps.

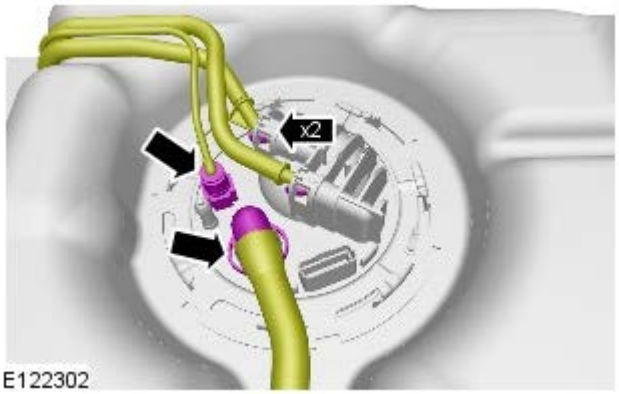


11. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

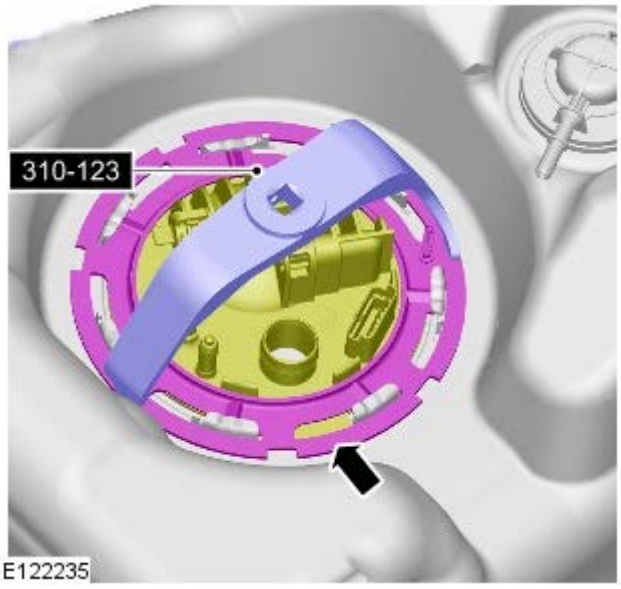


12. NOTE: Do not disassemble further if the component is removed for access only.

With assistance, remove the fuel tank.



13. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

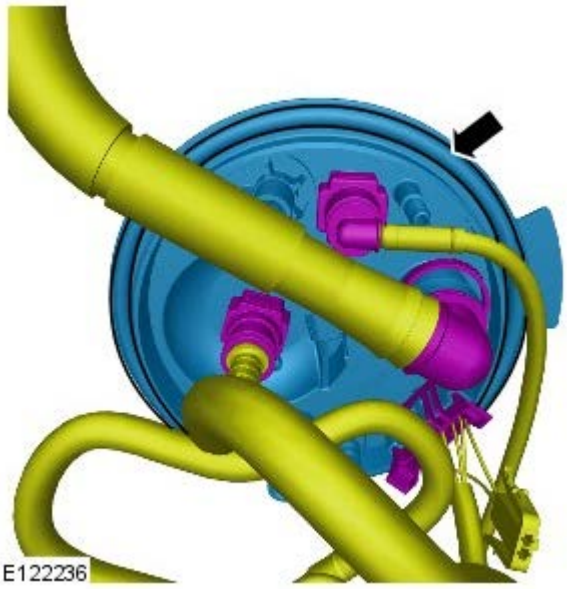


14. NOTES:

Note the position of the locating tang.

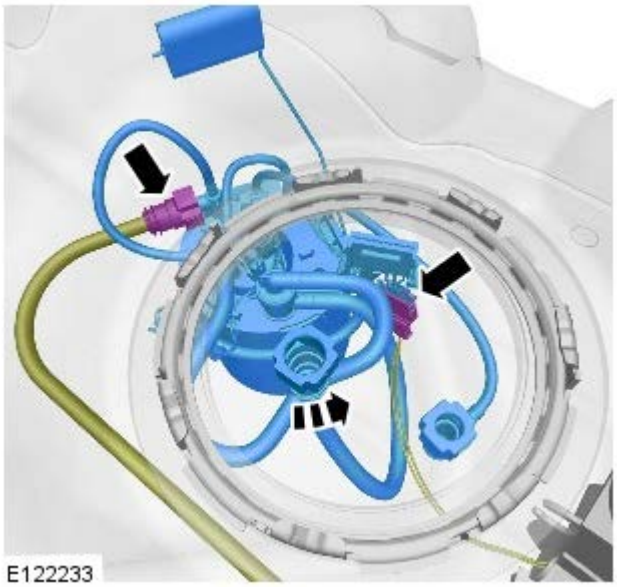
Some variation in the illustrations may occur, but the essential information is always correct.

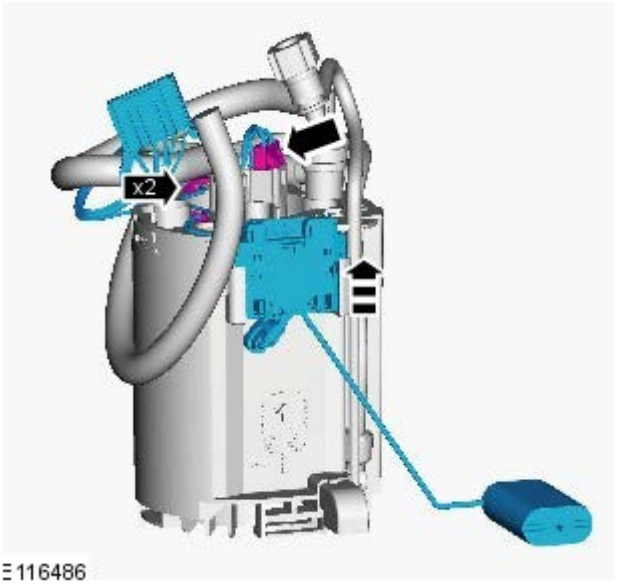
Special Tool(s): 310-123



15. NOTE: Remove and discard the O-ring seal.

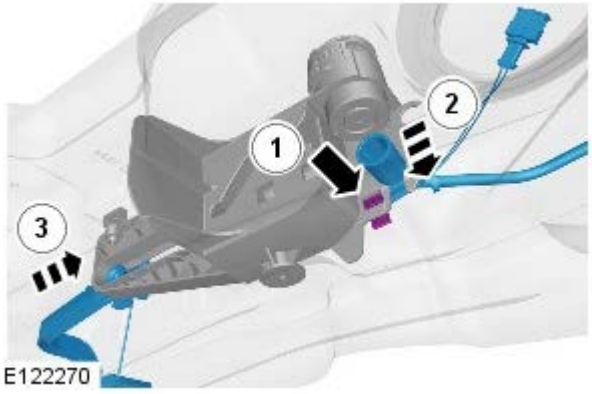
16. CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.





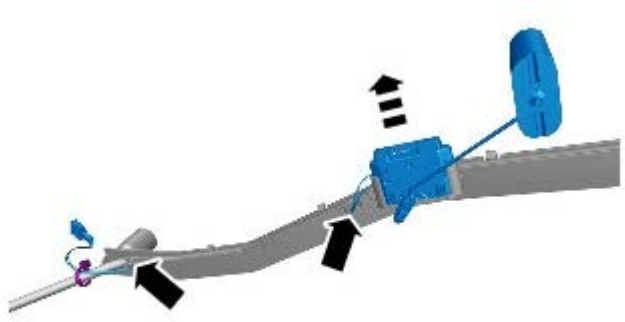
17. CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.

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



18. CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.

19.



E122269

Installation

1. NOTES:

   Remove and discard all blanking caps.

   Make sure the locating tang is installed in the position noted in the removal step.

   To install, reverse the removal procedure.

Published: 11-May-2011

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Tank

Removal and Installation

Special Tool(s)

 E80148	310-123 Locking Ring, Fuel Tank

Removal

WARNINGS:

After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

After the fuel tank drain is complete always fit the sealing covers over the drain ports. Failure to do so will mean that fuel vapor can escape.

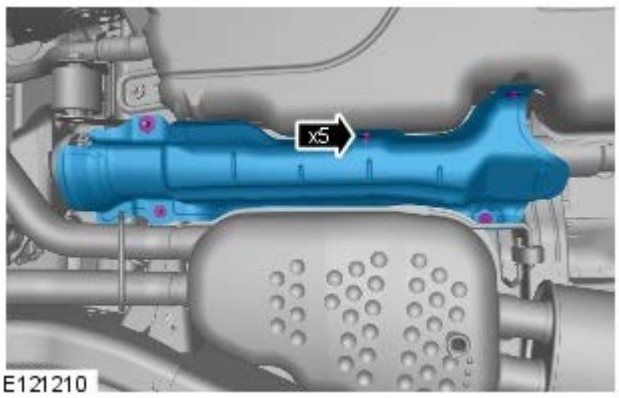
This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

CAUTION: Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

NOTE: Removal steps in this procedure may contain installation details.

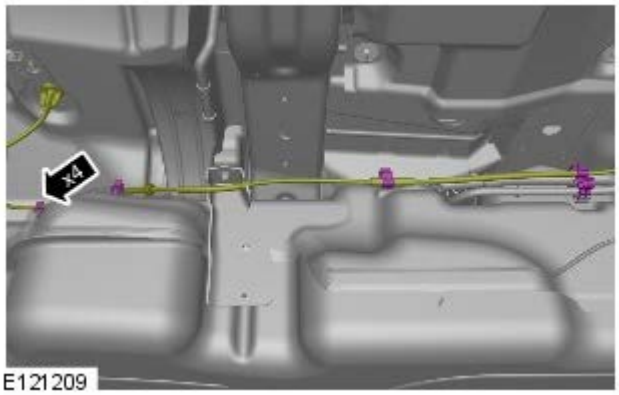
1. Refer to: Specifications (414-00, Specifications).
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.
3. Refer to: Fuel Tank Draining (310-00, General Procedures).
4. *Torque:*
   Bolts 6 Nm
   Nuts 3 Nm

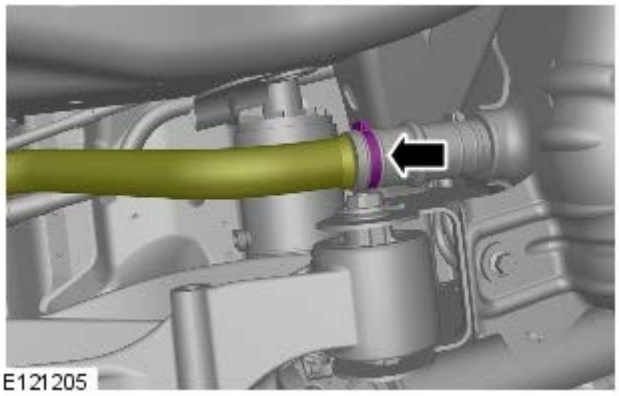


E121210

5.

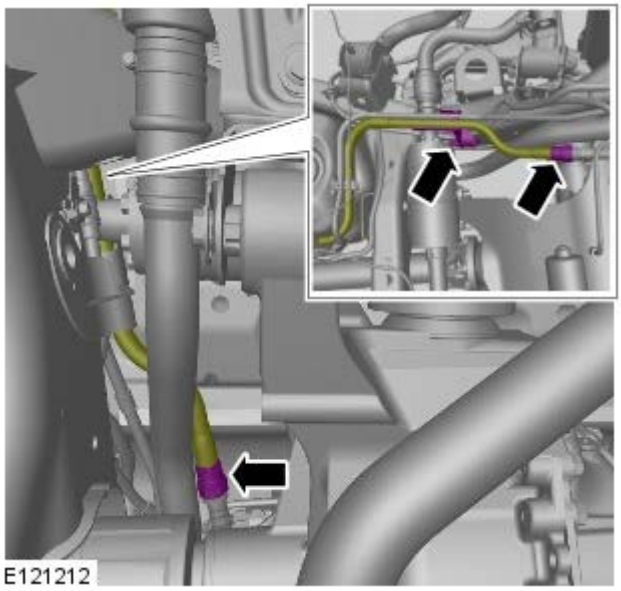


E121209

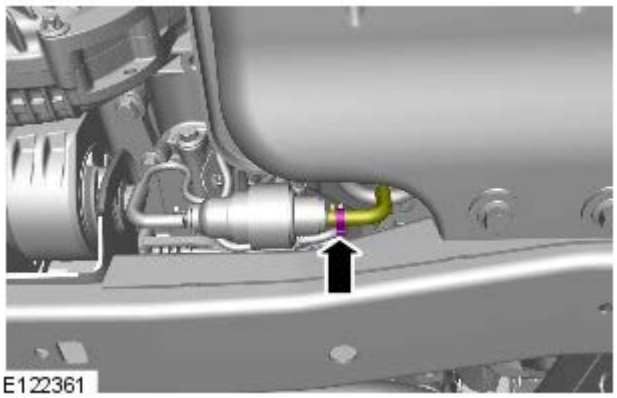

E121205

6. NOTE: Discard the retaining clip.

   Remove the tamper proof cover.


E121212

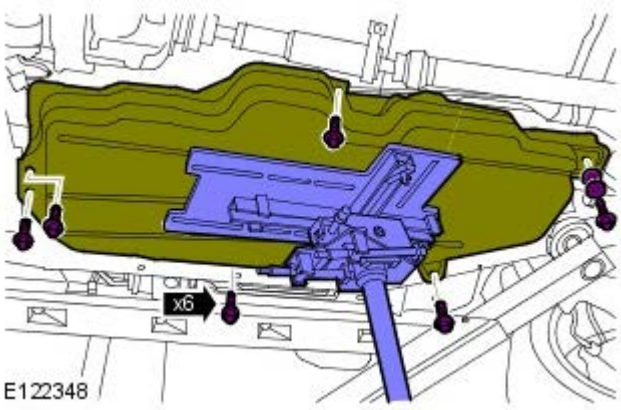
7. CAUTION: Make sure that all openings are sealed. Use new blanking caps.


E122361

8. WARNING: Be prepared to collect escaping fuel.

   CAUTION: Make sure that all openings are sealed. Use new blanking caps.

9. WARNING: Secure the component to the transmission jack.

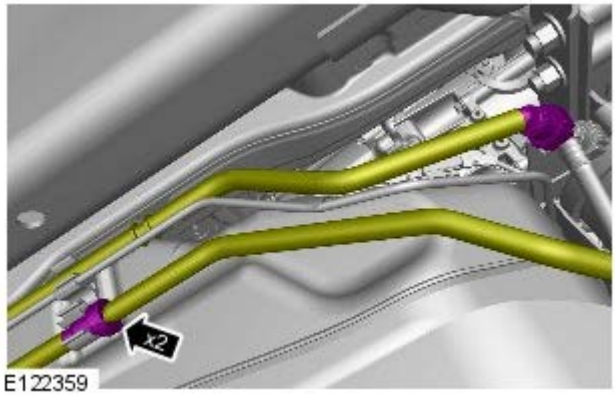


CAUTION: Do not lower the fuel tank more than 250 mm (9.75 in)

NOTE: Note the orientation of the two rear retaining bolts and washers.

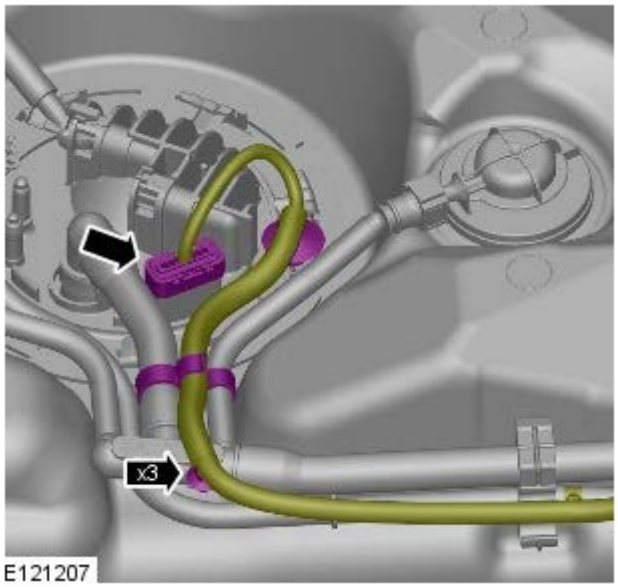
Using a transmission jack, lower the fuel tank sufficiently only to access the top of the fuel tank.

Torque: 45 Nm

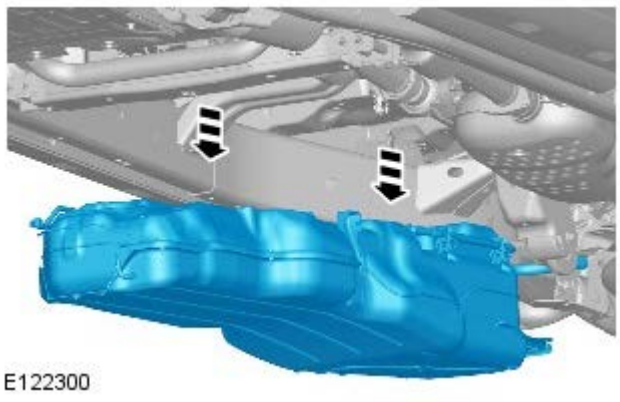


10. WARNING: Be prepared to collect escaping fuel.

CAUTION: Make sure that all openings are sealed. Use new blanking caps.



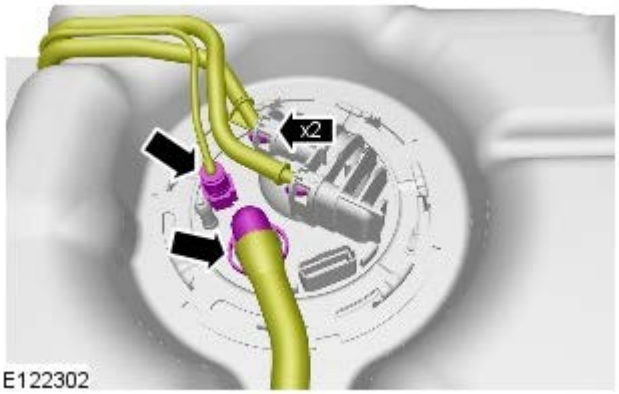
11. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



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

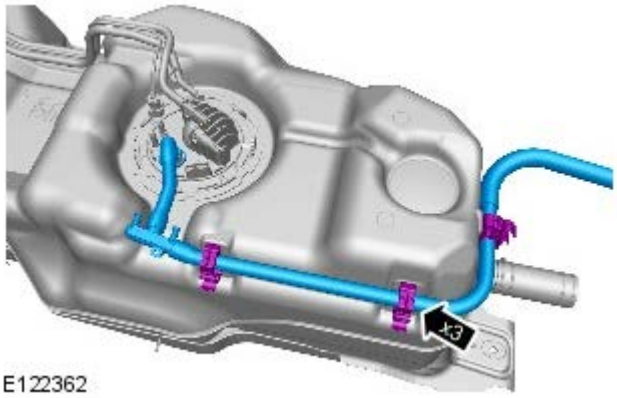
With assistance, remove the fuel tank.

13. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



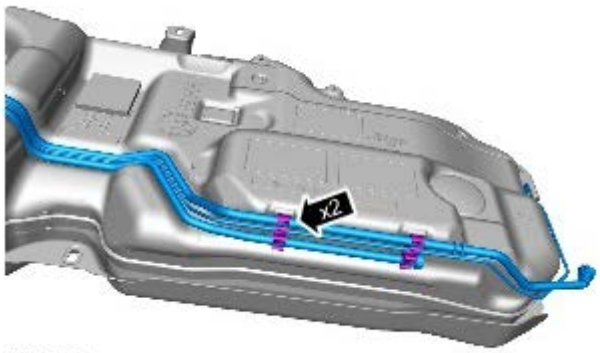
E122302

14.



E122362

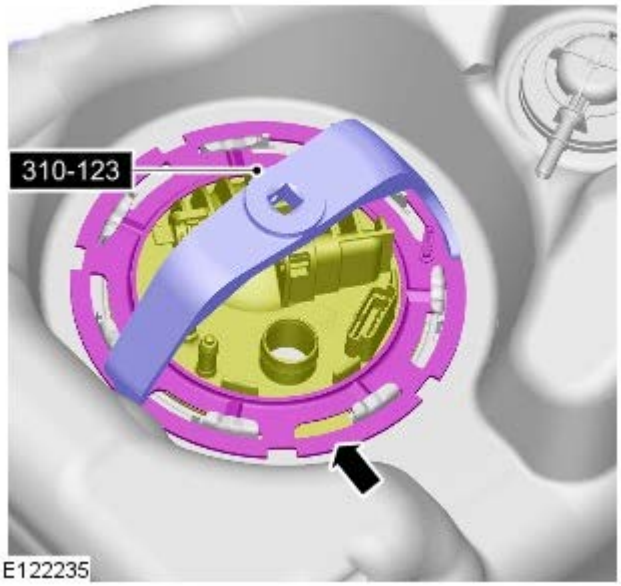
15.



E122360

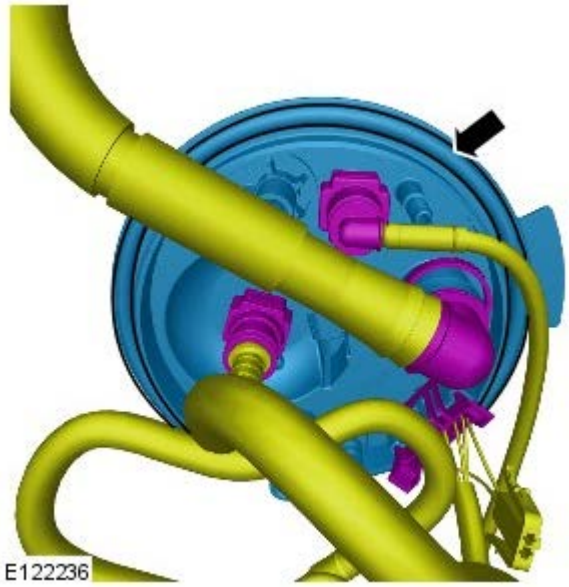
16. NOTE: Note the position of the locating tang.

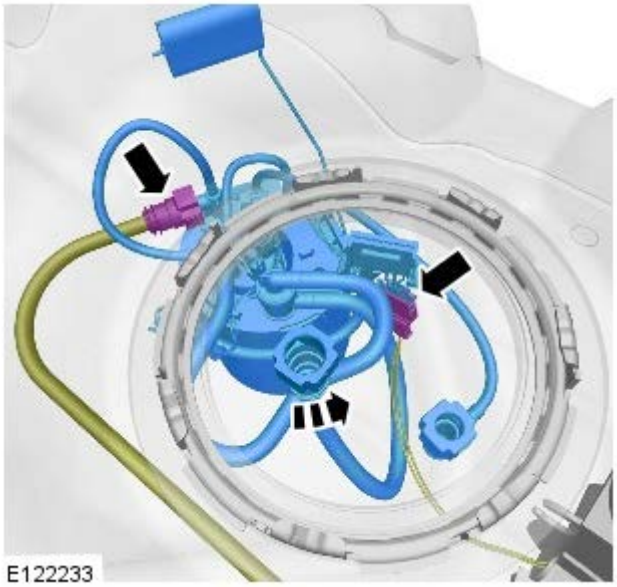
Special Tool(s): 310-123



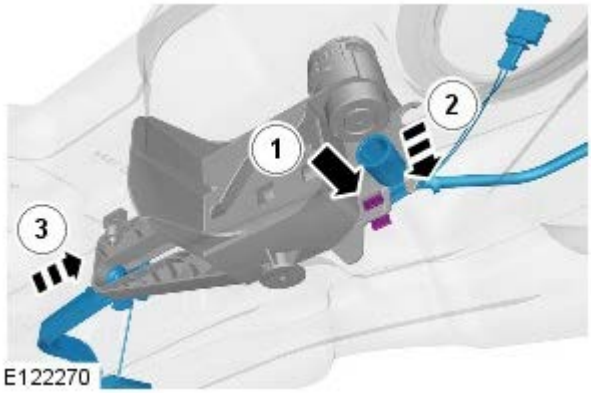
E122235

17. NOTE: Remove and discard the O-ring seal.



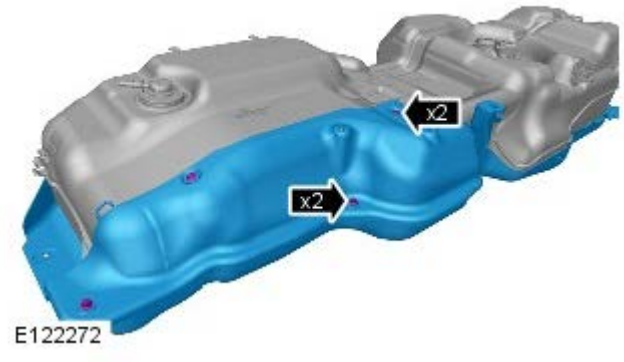


18. CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.



19. CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.

20.



Installation

1. NOTES:

   Remove and discard all blanking caps.

   Make sure the locating tang is installed in the position noted in the removal step.

   To install, reverse the removal procedure.

Published: 03-Dec-2012

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Tank Filler Pipe

Removal and Installation

Removal

WARNINGS:

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

After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow these instructions may result in personal injury.

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.

NOTE: Removal steps in this procedure may contain installation details.

1. Remove the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. Remove the spare wheel and tire.

3. WARNING: Make sure to support the vehicle with axle stands.

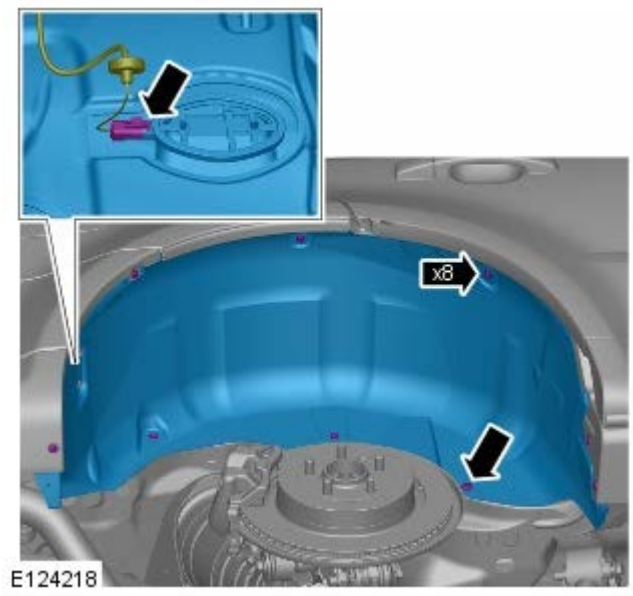
   Raise and support the vehicle.

4. Refer to: Fuel Tank Draining (310-00 Fuel System - General Information, General Procedures).

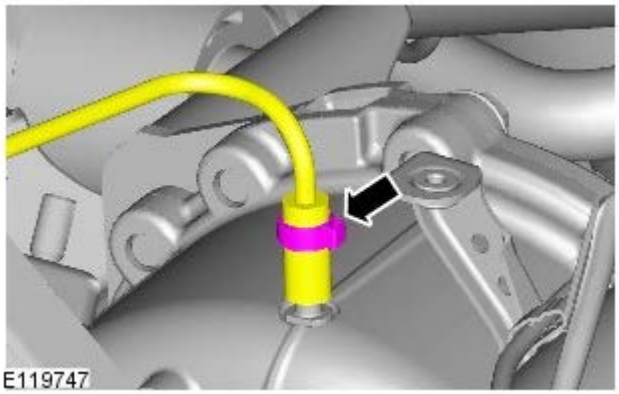
5. Refer to: Fuel Filler Door Assembly (501-03 Body Closures, Removal and Installation).

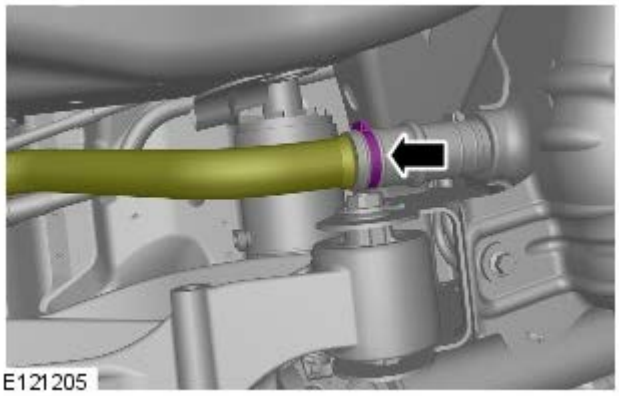
6. Remove the RH rear wheel and tire.

7.



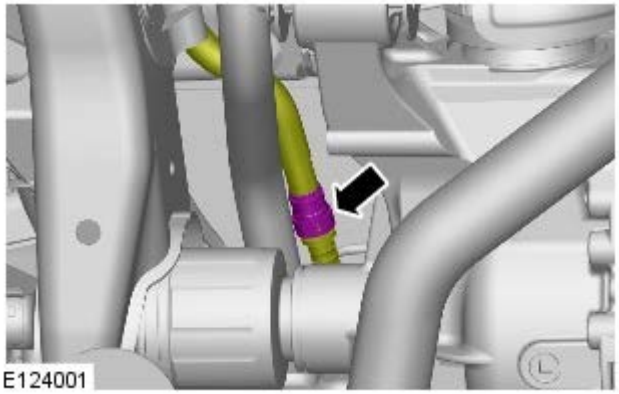
8.





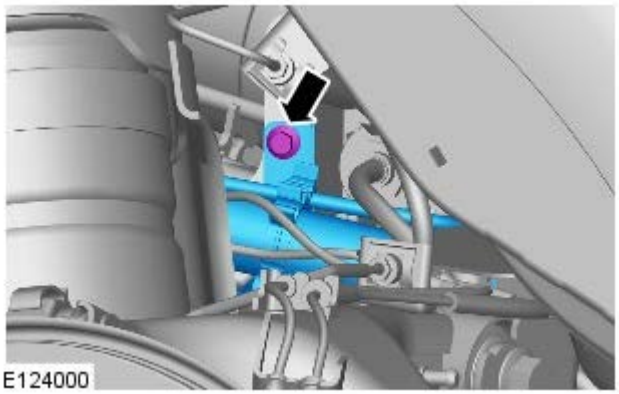
9. NOTE: Discard the retaining clip.

   Remove the tamper proof cover from the fuel tank filler pipe hose clip.

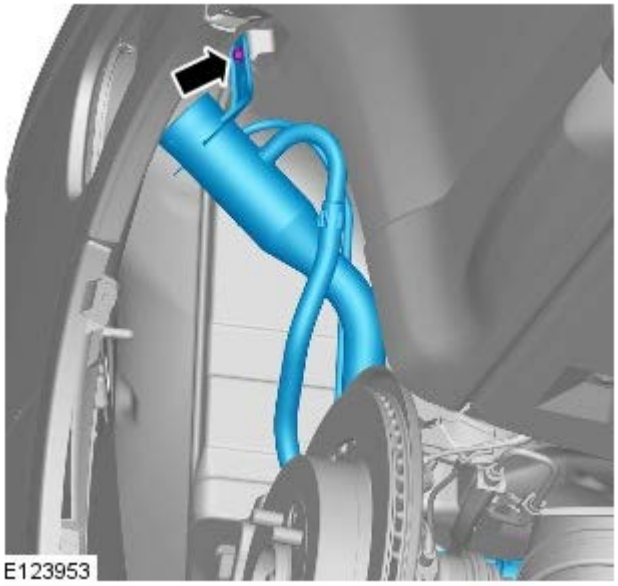


10. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

11. *Torque:* 4 Nm

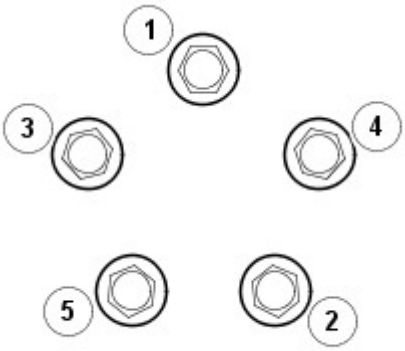


12. *Torque:* 4 Nm


E123953

Installation

1. To install, reverse the removal procedure.



E74593

2. NOTE: Tighten the wheel nuts in the sequence shown:

Torque:
Stage 1: 4 Nm
Stage 2: 70 Nm
Stage 3: 140 Nm

Published: 12-Oct-2011

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Filter Element

Removal and Installation

Removal

WARNINGS:

Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

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.

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.

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

If taken internally, do not induce vomiting, seek immediate medical attention. Failure to follow these instructions may result in personal injury.

Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

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

CAUTIONS:

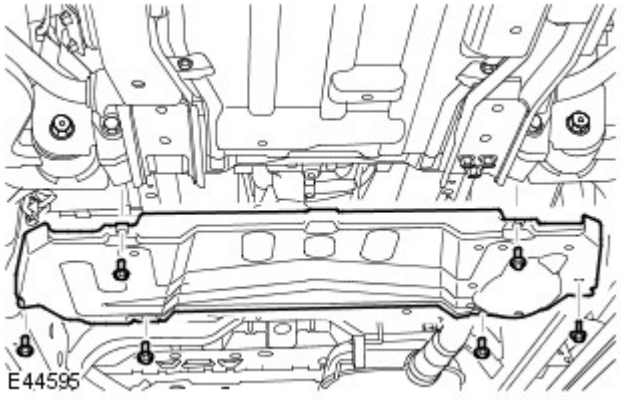
Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

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

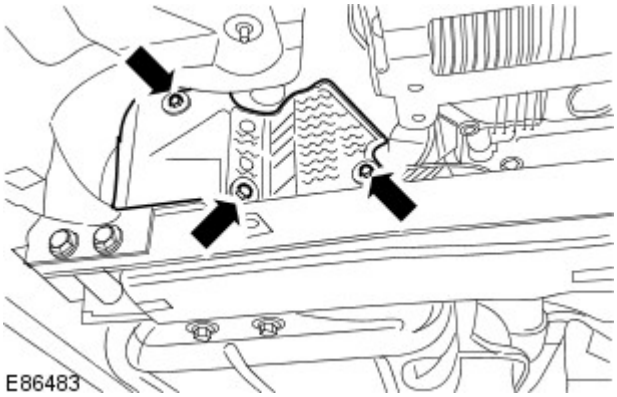
   Raise and support the vehicle.

2. Remove the transmission undershield.
   - Remove the 6 bolts.



3. WARNING: Observe due care when working near a hot exhaust system.

   Remove the fuel filter heat shield.

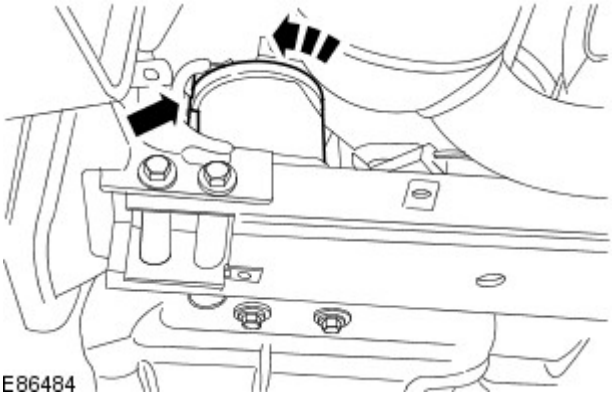


Remove the 3 bolts.



4. CAUTION: Make sure the water-in-fuel sensor remains in the aligned position.

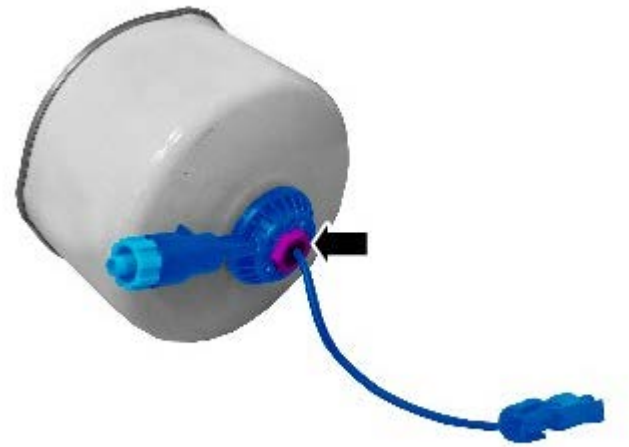
   Drain the fuel filter element.
   - Position a container to collect the fluid spillage.
   - Loosen the nut.
   - Attach a suitable drain tube to the water-in-fuel sensor drain port.
   - Remove the drain tube.
   - Tighten the nut.



5. CAUTION: Make sure that the area around the component is clean and free of foreign material.

   Remove the fuel filter element.
   - Disconnect the water-in-fuel sensor electrical connector.

6. Remove the water-in-fuel sensor.
   - Discard the fuel filter element.



7. Remove and discard the O ring seals.





E138941

Installation

1. Install new O ring seals.





E138940

2. CAUTION: Make sure that the mating faces are clean and free of foreign material.

NOTE: Make sure that the water-in-fuel sensor is aligned with the drain arrow.



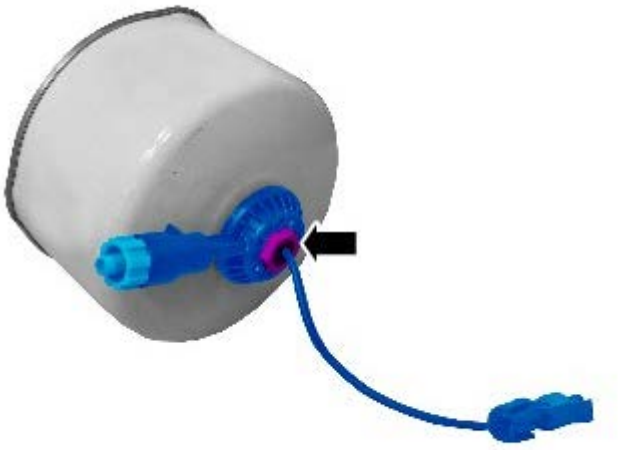
E138603

Install the water-in-fuel sensor.

- Remove and discard the water-in-fuel drain plug from the new fuel filter element.

3. CAUTION: Make sure the water-in-fuel sensor remains in the aligned position.

   Tighten the plastic nut to 1.6 Nm.



E138939

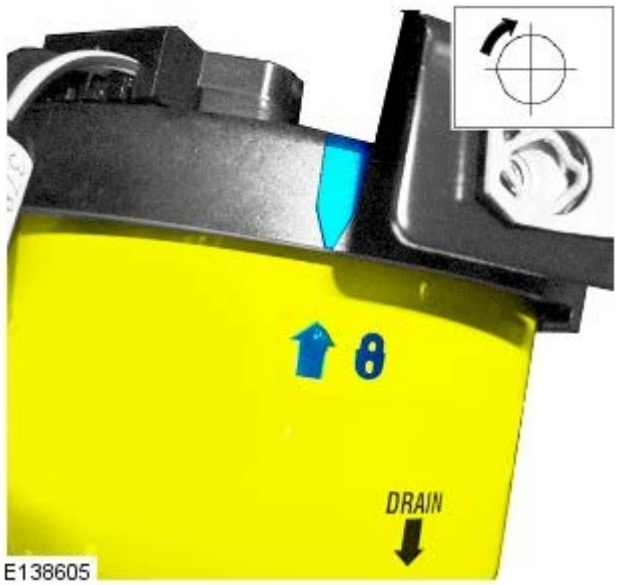
4. NOTE: Make sure that the fuel filter element is correctly aligned. Failure to follow this instruction may result in damage to the vehicle.

   Install the fuel filter element.

   1. Insert the fuel filter with the the lock symbol arrow aligned with the inlet pipe on the fuel filter housing.



E138604



E138605

5. NOTE: Make sure that the fuel filter element is correctly aligned. Failure to follow this instruction may result in damage to the vehicle.

   Rotate to tighten and seal the fuel filter element.
   1. When tightened correctly, the lock symbol arrow should be aligned with the arrow symbol on the fuel filter housing.
   - Connect the water-in-fuel sensor electrical connector.
   - Remove the container.

6. Install the fuel filter heat shield.
   - Tighten the bolts to 6 Nm.

7. Install the transmission undershield.
   - Tighten the bolts to 10 Nm.

8. Carry out the low-pressure fuel system bleeding.

Published: 11-May-2011

Fuel Tank and Lines - V8 5.0L Petrol/V8 S/C 5.0L Petrol -

Capacity

Item	Liters
Fuel tank capacity	86.3 (total)

General Specifications

Item	Specifications
Fuel system	Electronic - returnless
Fuel tank	Multi layer plastic
Fuel tank sender units	Two - Front and Rear - front sender unit is attached to the frame of the fuel pick up tube and the rear sender unit is attached to the fuel pump swirl pot
Fuel filter	Located in the fuel tank - if the fuel filter becomes blocked a new pump and sender unit must be installed
Fuel pump	Dual stage electric - submersible - located in fuel tank
System pressure	4.5 bar - 65.3 lbf/in2
Starting pressure	6.3 bar - 91.4 lbf/in2

Torque Specifications

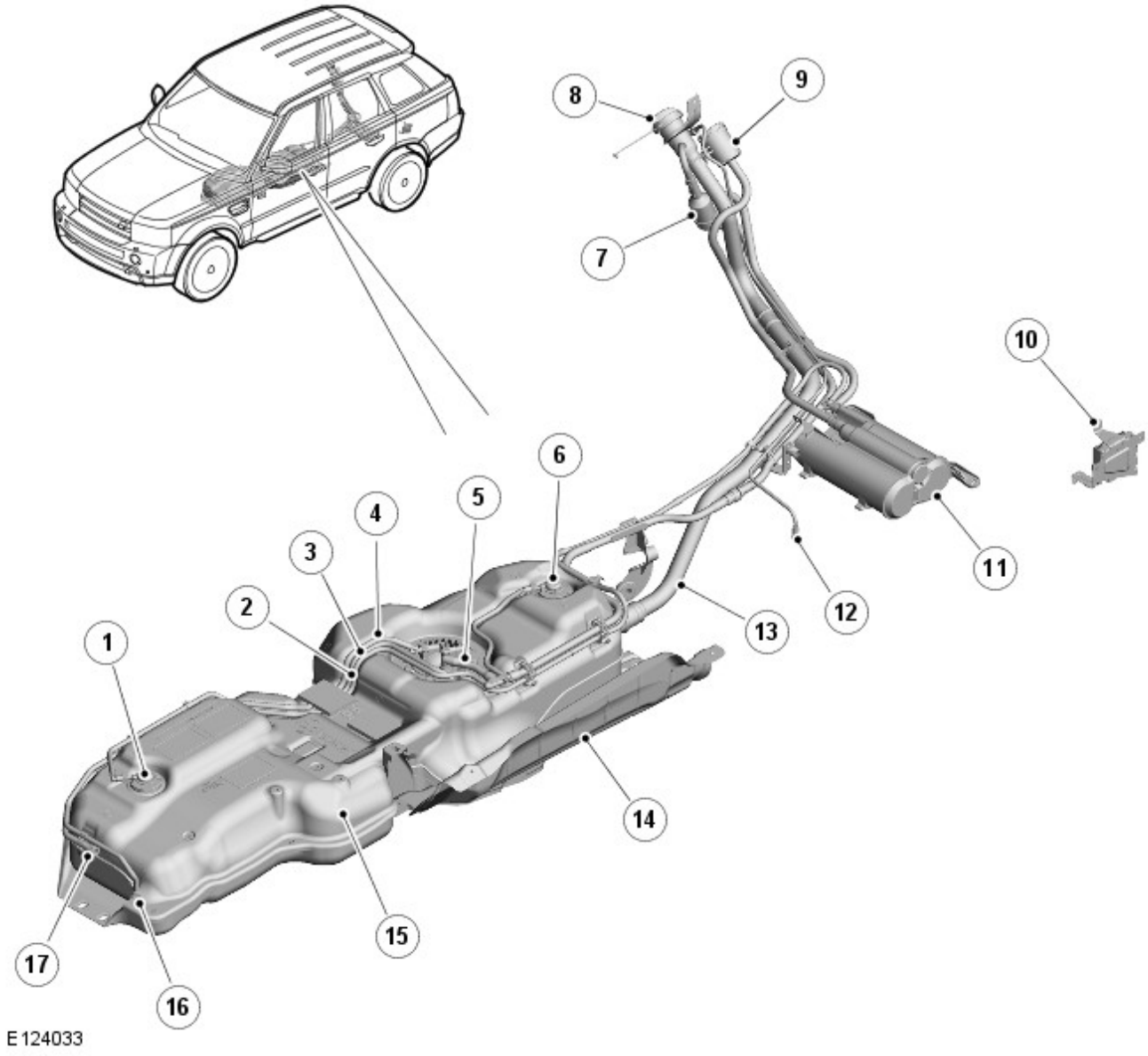
Item	Nm	lb-ft	lb-in
Fuel tank filler pipe retaining bolt	4	-	35
Fuel tank heat shield retaining bolts	6	-	53
Fuel tank heat shield retaining nuts	3	-	27
Fuel tank retaining bolts	45	33	-

Published: 30-Jan-2012

Fuel Tank and Lines - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Fuel Tank and Lines

Description and Operation

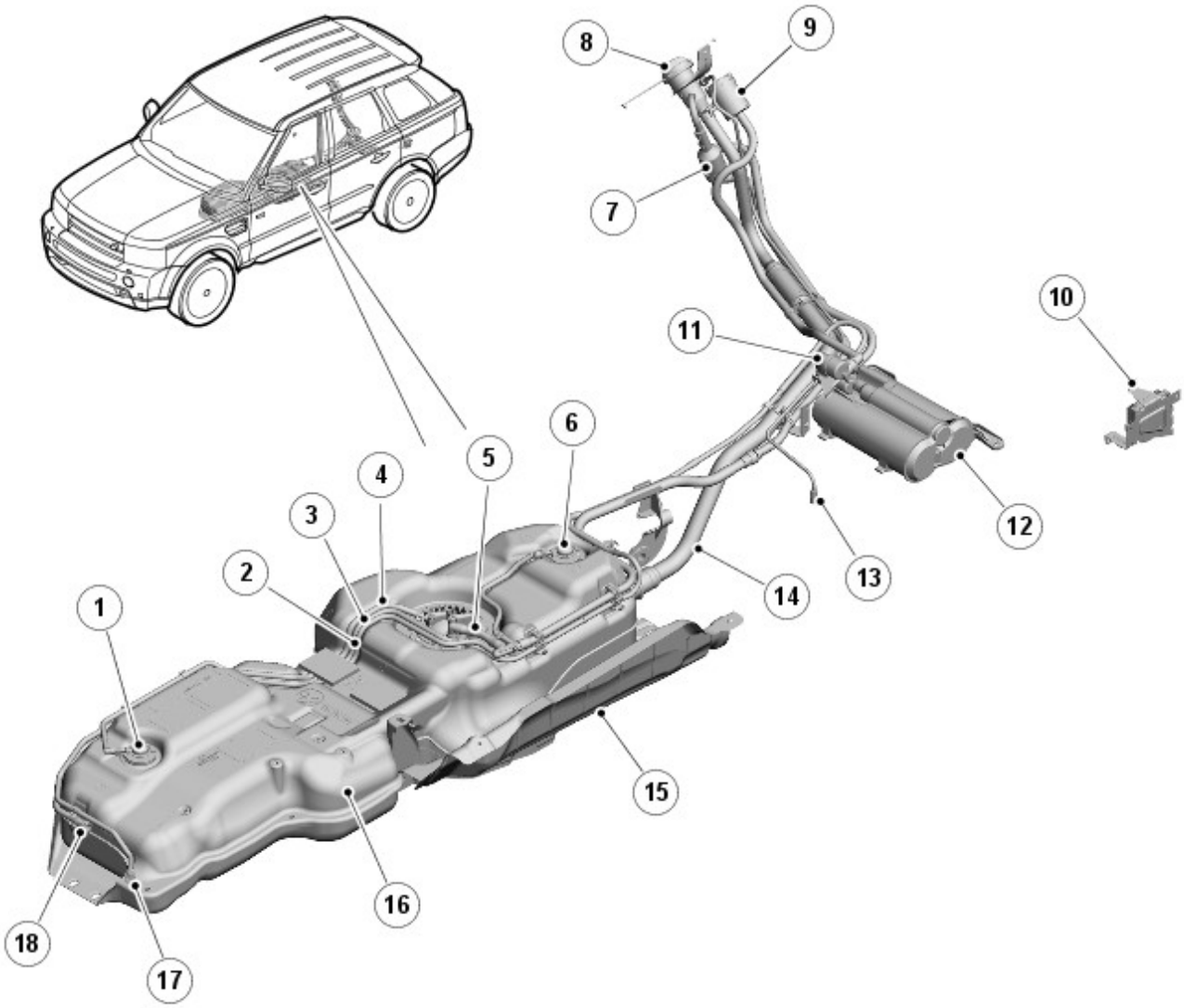
5.0L V8 FUEL TANK AND LINES COMPONENT LOCATION (All except NAS)



Item	Part Number	Description
1	-	Front Roll Over Valve (ROV)
2	-	Pipe - fuel vapor from charcoal canister to purge valve
3	-	Pipe - vent from front ROV
4	-	Pipe - fuel supply to engine mounted fuel pumps
5	-	Fuel delivery module
6	-	Rear ROV
7	-	Liquid Vapor Separator (LVS)
8	-	Fuel filler cap
9	-	Charcoal canister breather pipe
10	-	Fuel Pump Delivery Module (FPDM)
11	-	Charcoal canister
12	-	Pipe - rear differential breather (Reference only)
13	-	Filler pipe
14	-	Heat shield

15	-	Cover
16	-	Pipe - connection to purge valve
17	-	Pipe - fuel supply

5.0L V8 FUEL TANK AND LINES COMPONENT LOCATION (NAS Only)



E124034

Item	Part Number	Description
1	-	Front Roll Over Valve (ROV)
2	-	Pipe - fuel vapor from charcoal canister to purge valve
3	-	Pipe - vent from front ROV
4	-	Pipe - fuel supply to engine mounted fuel pumps
5	-	Fuel delivery module
6	-	Rear ROV
7	-	Liquid Vapor Separator (LVS)
8	-	Fuel filler cap
9	-	Charcoal canister breather pipe
10	-	Fuel Pump Delivery Module (FPDM)
11	-	Diagnostic Monitoring Tank Leakage (DMTL) pump
12	-	Charcoal canister
13	-	Pipe - rear differential breather (Reference only)
14	-	Filler pipe
15	-	Heat shield

16	-	Cover
17	-	Pipe - connection to purge valve
18	-	Pipe - fuel supply

GENERAL

The major components of the 5.0L V8 fuel system comprises a fuel tank, a fuel delivery module, a fuel filler assembly and two fuel level sensors.

The 5.0L V8 fuel system uses a return less fuel system which comprises a fuel pump mounted in the fuel tank to deliver fuel at a constant 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 driver module regulates the flow and pressure supplied by controlling the operation of the fuel pump using a Pulse Width Modulation (PWM) output.

The fuel rails and the injectors are described in Fuel Charging and Controls – 5.0L V8.
For additional information, refer to: Fuel Charging and Controls (303-04 Fuel Charging and Controls - TDV8 3.6L Diesel, Description and Operation) /
Turbocharger (303-04 Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel, Description and Operation).
Fuel system emission control is described in Engine Emission Control - 5.0L V8
For additional information, refer to: Electronic Engine Controls (303-14 Electronic Engine Controls - TDV8 3.6L Diesel, Description and Operation).
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FUEL TANK

The fuel tank is located on the right hand side of the vehicle, between the transmission and the right hand chassis longitudinal. The tank is located on a mounting cradle which secures the whole fuel tank assembly to the vehicle. The tank is blow moulded from High Density PolyEthylene (HDPE) and has a useable capacity of 88.0 liters (19.4 gallons).

The cradle is attached to the chassis with six bolts. When the cradle is attached to the chassis, the tank is positively secured via foam pads which bear against the central chassis cross beam. A protective cover is fitted to the front right hand corner of the tank and provides additional protection.

The fuel tank is manufactured from moulded plastic which is a minimum of 3 mm thick. 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 is fitted with a locking ring and seal. The seal locates in a groove on the tank. The locking ring locates and clamps on the encapsulated ring that is moulded into the fuel tank. The flange has a tag which locates in the top of the tank to ensure correct orientation.

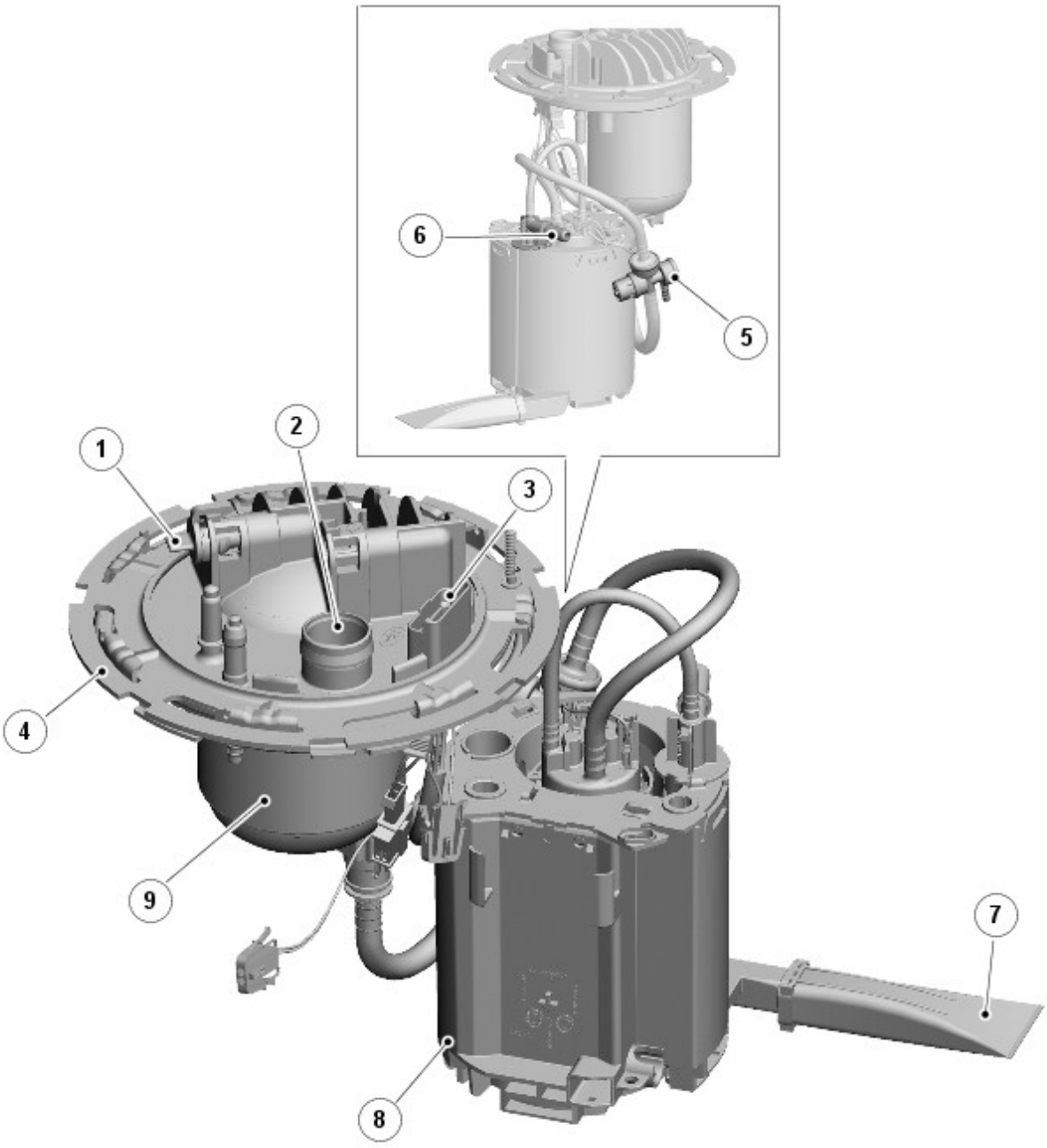
The flange has a six pin internal and external connectors which provide for electrical connections for the level sensors and the fuel pump. A quick release connector provides for the connection of the fuel supply pipe.

A carrier within the tank provides for the mounting of the fuel suction port, vent valve, the level sensors and a passive drain.

The fuel delivery module is mounted on a bayonet lock ring which is welded inside the fuel tank. The fuel delivery module comprises the fuel pump, a jet pump, the pump inlet filter and the fuel pressure relief valve. The rear fuel level sensor is also mounted on the side of the pump module body.

Only the pump module assembly and the fuel level sensors are available as serviceable components, the individual assembly components are not available separately.

FUEL DELIVERY MODULE



E124035

Item	Part Number	Description
1	-	Fuel supply outlet connection
2	-	Vent pipe connection
3	-	Electrical connector
4	-	Locking ring
5	-	Pressure relief valve
6	-	Suction pipe connection
7	-	Fuel pick-up filter
8	-	Fuel pump
9	-	Fuel filter

The fuel delivery module is a new design for 5.0L V8 2010MY vehicles. The module is located inside the fuel tank and comprises three main components; a fuel pump, a remote fuel pick-up and a top flange assembly.

Fuel Pump

The fuel pump is a variable-speed rotary-vane type, which operates in a fuel pump module located at the rear of the fuel tank. A venturi transfer pump is also located in the rear of the tank. The fuel pump module is secured in the fuel tank with a bayonet style locking ring that is welded into the tank structure. The fuel pump module has an integral top plate for the external pipe work and electrical connectors.

The fuel pump delivers fuel at a maximum pressure of 630 kPa (6.3 bar; 91.4 lbf/in.^{2}) to the filter bowl in the top flange.

The electric pump is located in a plastic swirl pot which collects fuel from the base of the fuel tank via a filter. The swirl pot acts as a fuel reserve, providing a constant supply of fuel to the fuel pump irrespective of fuel quantity or

vehicle attitude. When the vehicle is level the swirl pot contains approximately 400 cm3 (24.4 in3) of fuel when the engine is running. The jet pump ensures that fuel is constantly supplied to the swirl pot to provide a sufficient fuel supply for the pump. A one way valve is located in the base of the swirl pot. The valve allows fuel from the tank to enter the swirl pot, but prevents it from escaping.

The fuel pump is a serviceable component and access to the pump is by removal of the top flange.

Remote Fuel Pick-Up and Level Sensor Assembly

The fuel system incorporates twin jet pumps which are integral with the fuel pump module. One jet pump collects fuel from the rear of the tank, and the other draws additional fuel from the front of the tank through a suction line that is mounted on the carrier. The jet pump operates on a venturi effect created by the fuel at pump output pressure passing through the jet pump.

The prime function of the jet pump is to collect fuel from the front of the tank and transfer it into the fuel pump module swirl pot at the rear of the tank. The jet pump feature ensures that fuel is drained from the front of the tank before fuel run-out at the rear of the tank.

The fuel level sensors for the front and rear of the fuel tank are attached to the carrier frame. The fuel pick-up and the level sensors are serviceable components and access is by removal of the flange cover on the top rear of the fuel tank.

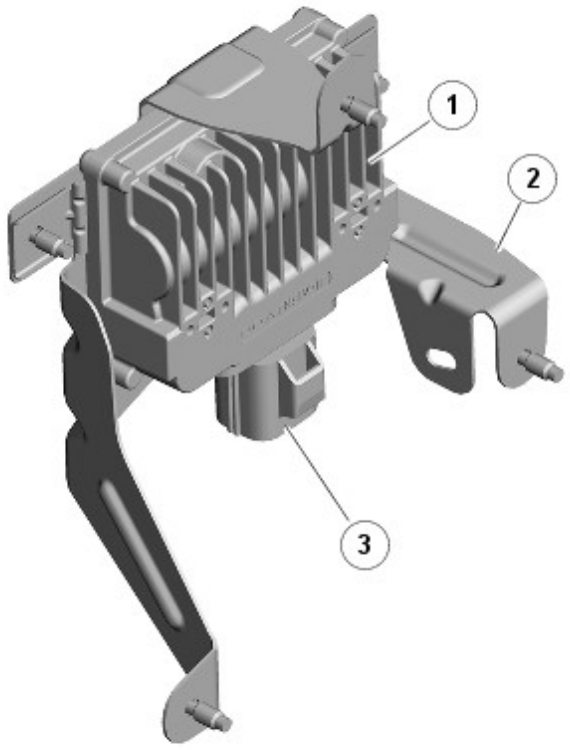
Top Flange Assembly

The top flange is located on the top of the fuel tank. The flange assembly is sealed in the tank with a with a sealing ring. A locking ring secures the flange assembly in the tank and requires a special tool for removal.

The outer surface of the flange has 1 outlet with a quick-fit connection. The connection is for the fuel supply pressure outlet to the engine mounted fuel pumps. An electrical connector is located adjacent to the pipe connections and provides the electrical interface to the fuel pump and the level sensors.

On the underside of the flange, inside the tank, is a moulded housing which contains the non-serviceable fuel filter. Fuel from the fuel pump enters the base of the housing and passes through the filter before exiting the tank to the engine mounted fuel pumps. An electrical connection on the base of the filter housing provides a ground for the filter.

FUEL PUMP DRIVER MODULE (FPDM)



E124036

Item	Part Number	Description
1	-	Fuel Pump Driver Module (FPDM)
2	-	Mounting bracket

The FPDM is located in the LH side of the luggage compartment, above the LH wheel arch, behind the trim panel. The FPDM is located on a bracket and secured with 2 bolts and nuts.

The fuel pump operation is regulated by the FPDM which is controlled by the Engine Control Module (ECM). The FPDM regulates the flow and pressure supplied by controlling the operation of the fuel pump using a PWM output.

The FPDM is powered by a supply from the fuel pump relay in the Engine Junction Box (EJB). The fuel pump relay is

energized on opening the driver's door or when power mode 9 engine crank is initiated using the stop/start button. The FPDM supplies power to the fuel pump, and adjusts the power to control the speed of the fuel pump and thus the pressure and flow in the fuel delivery line.

A Pulse Width Modulation (PWM) signal from the ECM tells the FPDM the required speed for the fuel pump. The on time of the PWM signal represents half the fuel pump speed, e.g. if the PWM signal has an on time of 50%, the FPDM drives the pump at 100%.

The FPDM will only energize the fuel pump if it receives a valid PWM signal, with an on time of between 4% and 50%. To switch the fuel pump off, the ECM transmits a PWM signal with an on time of 75%.

The output pressure from the fuel pump will change with changes of engine demand and fuel temperature. The ECM monitors the input from the Low Pressure (LP) fuel sensor and the fuel rail pressure sensor and adjusts the speed of the fuel pump as necessary to maintain a nominal output pressure of 450 kPa (4.5 bar; 65.3 lbf/in.^{2}), except during engine start-up. At engine start-up the target pressure for the fuel delivery line is 630 kPa (6.3 bar; 91.4 lbf/in.^{2}).

If the Supplemental Restraint System (SRS) outputs a crash signal on the high speed Controller Area Network (CAN) bus, the ECM de-energizes the fuel pump relay to prevent any further fuel being pumped to the engine.

If the ECM does not detect pressure in the fuel delivery line, it stops, or refuses to start the engine and stores the appropriate Diagnostic Trouble Code (DTC).

The ECM receives a monitoring signal from the FPDM. Any DTC's produced by the FPDM are stored by the ECM.

DTC's can be retrieved from the ECM using an approved Land Rover diagnostic system. The FPDM itself cannot be interrogated by the approved Land Rover diagnostic system.

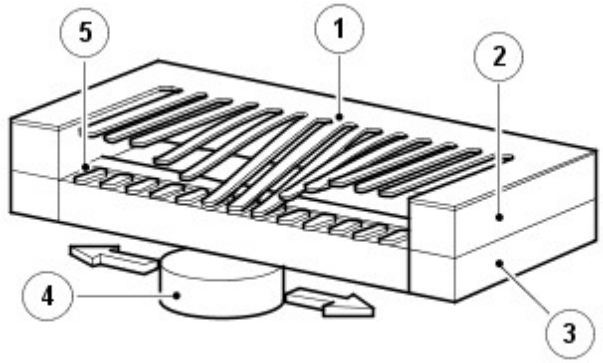
FUEL LEVEL SENSORS

Two fuel level sensors are used in the fuel tank to measure the amount of remaining fuel in the front and rear of the fuel tank. Both level sensors are attached to the internal carrier. The sensors are connected to the vehicle wiring harness via a connector on the outer face of the top flange assembly.

The sensors are a MAgnetic Passive Position Sensor (MAPPS) which provides a variable resistance to ground for the output from the fuel gauge. The sensor is sealed from the fuel preventing contamination of the contacts and 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

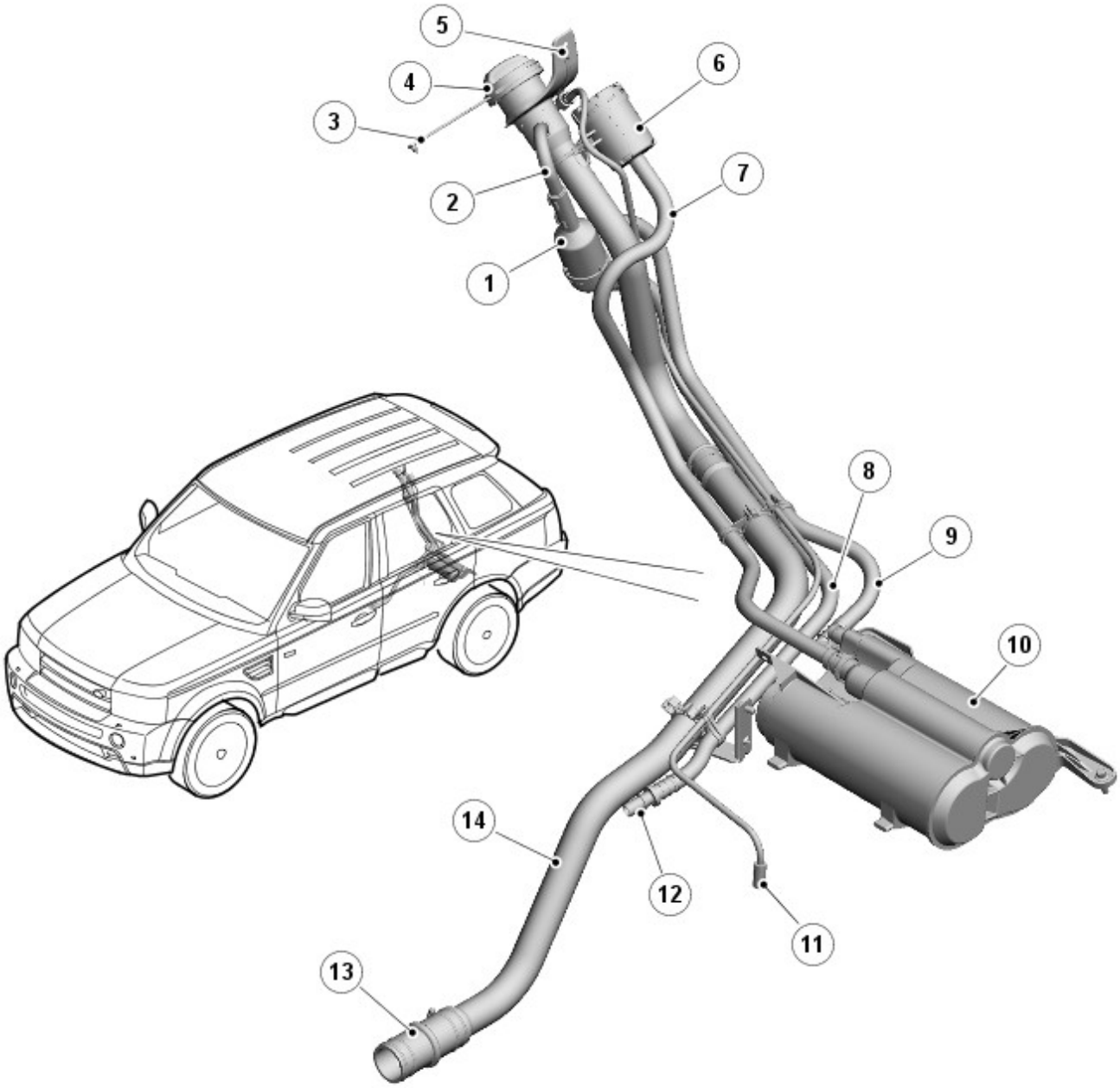
The film resistors are arranged in a linear arc with resistance ranging from 51.2 to 992.11 Ohms. The electrical output signal output is proportional to the amount of fuel in each side of the tank and the position of the float arms. The measured resistance is processed by the instrument cluster to implement an anti-slosh function. This monitors the signal and updates the fuel gauge pointer position at regular intervals, preventing constant pointer movement caused by fuel movement in the tank due to cornering or braking.

A warning indicator is incorporated in the instrument cluster and illuminates when the fuel level is at or below 1/8th of tank capacity.

The fuel level sender signals are converted into a CAN bus message by the instrument cluster as a direct interpretation of the fuel tank contents in liters. The ECM uses the CAN bus message to store additional On-Board Diagnostic (OBD) P Codes for misfire detection when the fuel level is below a predetermined capacity.

FUEL FILLER PIPE AND TANK BREATHER ASSEMBLY

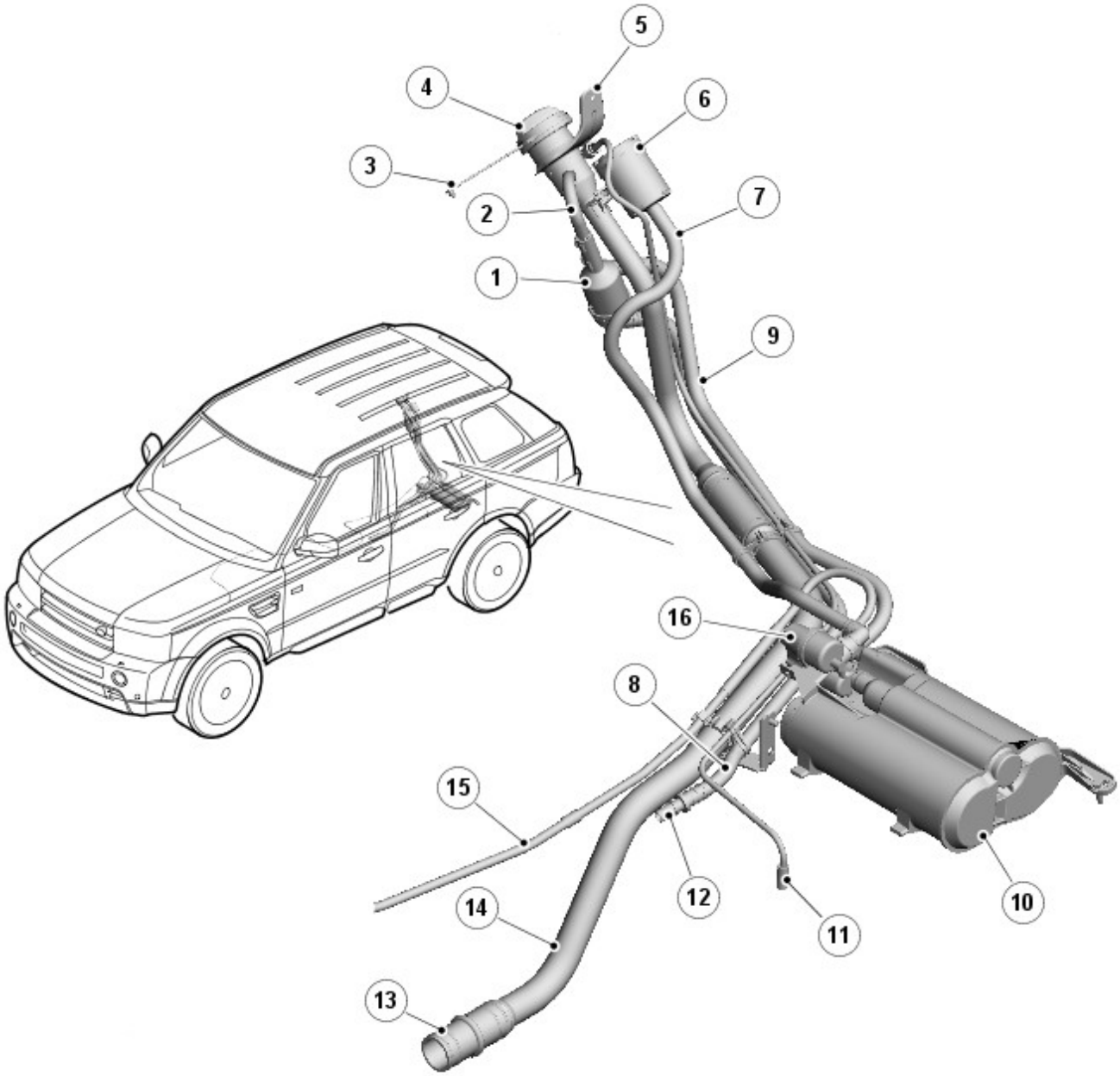
Fuel Filler Pipe Assembly (All Except NAS)



E124037

Item	Part Number	Description
1	-	Liquid Vapor Separator (LVS)
2	-	Pipe - fuel vapor vent
3	-	Filler cap lanyard
4	-	Filler cap
5	-	Bracket
6	-	Charcoal canister breather/dust filter
7	-	Pipe - breather
8	-	Pipe - fuel vapor vent
9	-	Pipe - fuel vapor to charcoal canister
10	-	Charcoal canister
11	-	Pipe - rear differential breather (Reference only)
12	-	Pipe - fuel vapor connection
13	-	Hose - fuel filler pipe to fuel tank spit back flap
14	-	Pipe - fuel filler

Fuel Filler Pipe Assembly (NAS Only)



E124038

Item	Part Number	Description
1	-	Liquid Vapor Separator (LVS)
2	-	Pipe - fuel vapor vent
3	-	Filler cap lanyard
4	-	Filler cap
5	-	Bracket
6	-	Charcoal canister breather/dust filter
7	-	Pipe - breather
8	-	Pipe - fuel vapor vent
9	-	Pipe - fuel vapor to charcoal canister
10	-	Charcoal canister
11	-	Pipe - rear differential breather (Reference only)
12	-	Pipe - fuel vapor connection
13	-	Hose - fuel filler pipe to fuel tank spit back flap
14	-	Pipe - fuel filler
15	-	Pipe - fuel vapor to purge valve
16	-	Diagnostic Tank Monitoring Leakage (DMTL)

The fuel filler head is positioned at the rear of the vehicle, above the right hand rear wheel. The filler head and cap is covered by a moulded 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 cap must be securely fitted to ensure that the tank venting system is sealed. The cap has a locking mechanism which gives an audible click when the cap is correctly tightened.

Failure to correctly secure the filler cap will result in vapor being lost from the system. On NAS Vehicles, if the cap is incorrectly secured when the engine management system operates the Diagnostic Monitoring Tank Leakage (DMTL) system, the loss of vapor will be detected as a leak and the MIL lamp will be illuminated.

The filler head is a stainless steel fabrication. A bracket provides for the attachment of the filler head to the vehicle body.

A connection on the rear of the filler head allows for the connection of the fuel tank breather pipe from the vapor separator on ROW vehicles and from the roll over valves on NAS vehicles.

The fuel filler pipe locates in the tank and incorporates a spitback flap in the tank end of the pipe. The flap is a spring loaded cover which acts as a 1-way valve, allowing the tank to be filled but preventing fuel leaving the tank into the filler pipe.

All vehicles have a charcoal canister breather pipe which is connected from the charcoal canister and is routed alongside the fuel filler pipe to the filler head. The filler head end of this pipe is connected differently depending on market as follows:

- On ROW vehicles the breather pipe is fitted with a mesh and allows fresh air to be drawn into the charcoal canister when fuel vapor is being purged from the system.
- On NAS vehicles the breather pipe is connected to the DMTL pump. Fresh air is drawn into the pipe via a DMTL filter integral with the pump when fuel vapor is being purged from the system. When the DMTL system is active, the breather pipe is closed by the pump, sealing the system and allowing the system to be pressure checked for leakage.

For information on the charcoal canister and purging system refer to the evaporative emissions section.
For additional information, refer to: Evaporative Emissions (303-13 Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).

A second pipe is routed alongside the charcoal canister breather pipe. On ROW vehicles, this pipe is the fuel tank breather pipe from the vapor separator and is connected into the fuel filler pipe near to the filler head. On NAS vehicles, this pipe is smaller in diameter and also serves as the fuel tank breather pipe. The pipe is not connected to the vapor separator but allows fuel vapor from the right hand roll over valve to vent into the connection with the fuel filler pipe near to the filler head.

A pipe is routed across the top of the tank in front of the vapor separator. This pipe connects the charcoal canister to the purge valve located in the engine compartment.

FUEL LOW PRESSURE (LP) SENSOR


E112870

The fuel LP sensor supplies a pressure signal to the Engine Control Module (ECM) to enable closed loop control of the fuel pump. The fuel LP sensor is installed in a manifold in the fuel supply line. The manifold is located in the rear of the front Right Hand (RH) wheelarch, behind the splash shield.

OPERATION

The fuel pump is a variable-speed rotary-vane type, which operates in a fuel delivery module located in the fuel tank. The fuel delivery module is secured in the fuel tank with a bayonet style locking ring that is welded into the tank structure. The fuel pump module has an integral top plate for the external pipe work and electrical connectors.

Fuel level is biased towards the rear of the fuel tank by drawing fuel from the front of the tank via the jet pump, which serves to deliver a constant supply of fuel to the swirl pot. High pressure fuel from the fuel pump is directed through the jet pump's orifice, creating a low pressure area to be formed in the cross over pipe. The fuel is drawn into this low pressure area in the cross over pipe and directed into the swirl pot delivery pipe.

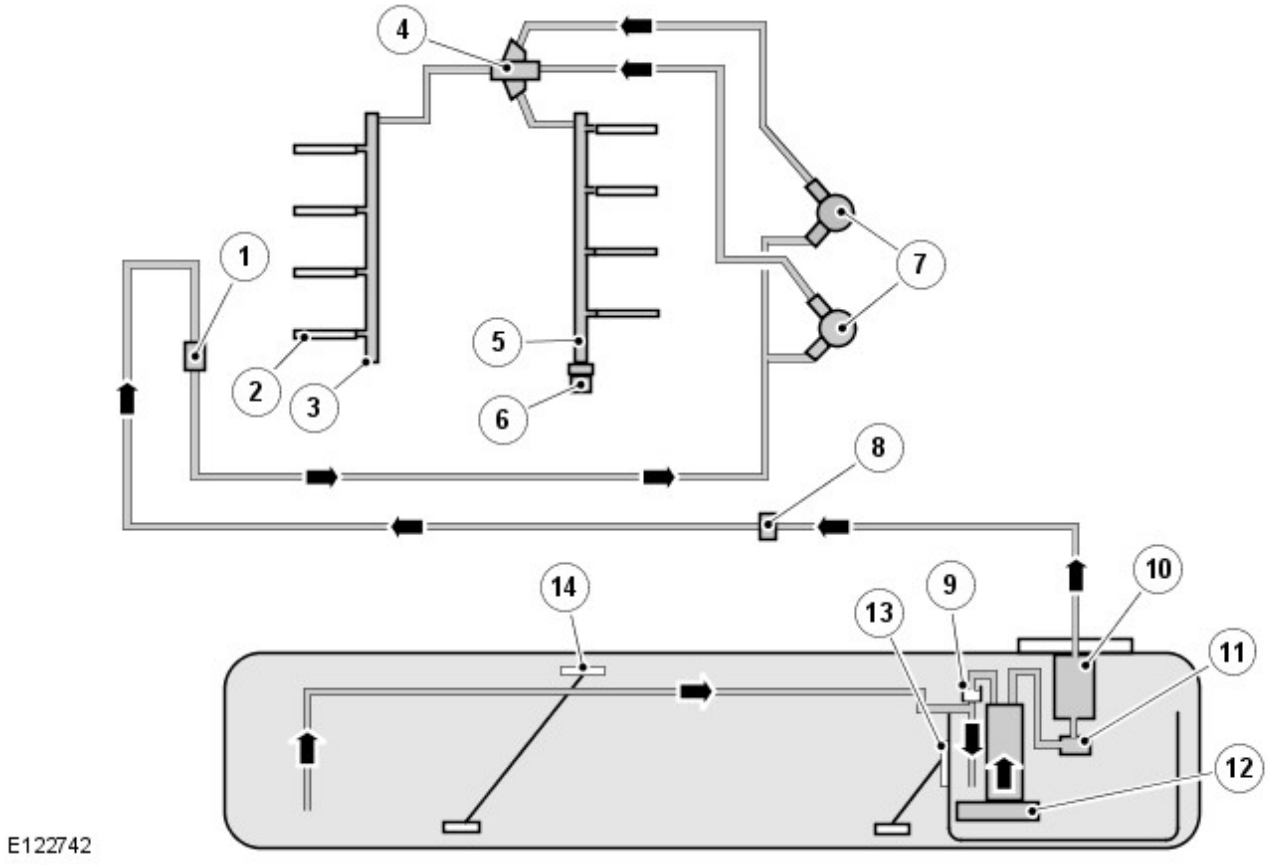
Fuel is pumped from the fuel pump to the to the two engine mounted HP fuel pumps via the integral filter and pressure relief valve.

The pressure relief valve assists engine starting by retaining a pre-set fuel pressure in the supply pipe and fuel rail. The pressure relief valve also limits fuel rail pressure due to temporary vapor increase in hot conditions and pressure caused by sudden load changes, for example, a fully open to closed throttle transition.

To meet emission requirements, the fuel tank and associated components are designed to minimize fuel vapor loss during refueling. This is achieved by preventing fuel vapor from the fuel tank venting directly to the atmosphere. Instead fuel vapor is directed into the charcoal canister where it is stored before being purged at intervals to the engine’s intake manifold.

North American Specification (NAS) vehicles feature additional connections and pipes at the rear of the filler head and also incorporates a Diagnostic Monitoring Tank Leakage (DMTL) pump for leak detection requirements.

Fuel System Schematic Diagram



Item	Part Number	Description
1	-	Fuel line connection
2	-	Fuel injector (8 off)
3	-	Left Hand (LH) fuel rail
4	-	High pressure (HP) fuel line connection
5	-	Right Hand (RH) fuel rail
6	-	Fuel rail pressure sensor
7	-	HP fuel pumps
8	-	Fuel Low Pressure (LP) sensor Jet pump
9	-	Jet pump
10	-	Fuel filter
11	-	Pressure relief valve
12	-	Fuel delivery module assembly
13	-	Fuel level sensor - Rear
14	-	Fuel level sensor - Front

Published: 09-Apr-2013

Fuel Tank and Lines - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Fuel Tank and Lines

Diagnosis and Testing

Principle of Operation

For a detailed description of the fuel tank and lines system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Fuel Tank and Lines (310-01A Fuel Tank and Lines - TDV6 3.0L Diesel, Description and Operation).

Inspection and Verification

WARNINGS:

Eye protection must be worn at all times when working on or near any fuel related components. Failure to follow this instruction may result in personal injury.

This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow this instruction may result in personal injury.

After carrying out repairs, the fuel system must be checked visually for leaks. This should be done after the engine has been run, but with the engine switched **OFF**. Failure to follow this instruction may result in personal injury.

If taken internally, **DO NOT** induce vomiting. Seek immediate medical attention. Failure to follow this instruction may result in personal injury.

If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek medical attention. Failure to follow this instruction may result in personal injury.

Wash hands thoroughly after handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention. Failure to follow this instruction may result in personal injury.

CAUTIONS:

Before disconnecting any part of the system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into the fuel system. Failure to follow this instruction may result in damage to the vehicle.

It is essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in damage to the vehicle.

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

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

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

Visual Inspection

Mechanical	Electrical
• Low/contaminated fuel • Fuel supply/return line(s) • Fuel tank and filler pipe • Fuel leak(s) • Fuel filler cap • Fuel filter • Push connect fittings • Fuel pump	• Fuses • Links • Relays • Fuel Pump Driver Module (FPDM) • Fuel pump module • Sensor(s) • Engine control module (ECM) • Central Junction Box (CJB) • Restraints Control Module (RCM) • Electric Park Brake Control Module (EPBCM)

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

Symptom Chart

Symptom	Possible Causes	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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
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	• Check for evaporative emissions, fuel system and ignition system related DTCs and refer to the relevant DTC Index
Difficult cold start	• Engine coolant level/anti-freeze content • Battery • Electronic engine controls • Fuel pump • Purge valve	• Check the engine coolant level and condition • Ensure the battery is in a fully charged and serviceable condition • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Difficult hot start	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system	• Check for injector leak, install new injector as required • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system	• Check for injector leak, install new injector as required • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Engine stalls soon after start	• Breather system disconnected/restricted • Engine Control Module (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 • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check for blockage in air filter and air intake system • Check for air leakage in air intake system
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 • Transmission malfunction	• Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index • Check for injector leak, install new injector as required • Check for air leakage in air intake system • Ensure accelerator pedal is free from restriction • Using the manufacturer approved diagnostic system, check the Transmission Control Module (TCM) for related DTCs and refer to the relevant DTC index
Engine backfires	• Fuel pump/lines • Air leakage • Electronic engine controls • Ignition system • Sticking Variable Camshaft Timing	• Check for fuel system failures • Check for air leakage in intake air system • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index

	(VCT) hub	
Engine surges	• Fuel pump/lines • Electronic engine controls • Throttle motor • Ignition system	• Check for fuel system failures • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Engine detonates/knocks	• Fuel pump/lines • Air leakage • Electronic engine controls • Sticking Variable Camshaft Timing (VCT) hub	• Check for fuel system failures • Check for air leakage in intake air system • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
No throttle response	• Electronic engine controls • Throttle motor	• Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM) for related DTCs and refer to the relevant DTC index
Poor throttle response	• Breather system disconnected/restricted • Electronic engine controls • Transmission malfunction • Traction control event • Air leakage	• Ensure the engine breather system is free from restriction and is correctly installed • Using the manufacturer approved diagnostic system, check the Engine Control Module (ECM), Transmission Control Module (TCM), and Anti-lock Brake System control module (ABS) for related DTCs and refer to the relevant DTC index • Check for air leakage in intake air system
Fuel gauge reading empty with fuel in the fuel tank	• Active fuel level sensor circuit open circuit • Passive fuel level sensor circuit open circuit • Instrument cluster internal failure	• Using the manufacturer approved diagnostic system, perform the guided diagnostic routine - Fuel Level Sensor Test

Fuel Gauge, Resistance, Voltage And Fuel Tank Level Comparison Chart

Use the chart to determine fuel tank fuel volume versus fuel gauge reading to determine the fuel level symptom and fault.

NOTE: The vehicle must be parked on a level surface to obtain an accurate fuel level gauge reading.

Volume, Resistance and Voltage Values

Gauge Reading	Fill Volume (L)	Fuel Level Sensor "pump/active/A"(0xD908) - Rear		Fuel Level Sensor "eject/passive/B" (0xD907) - Front	
		Resistance (Ω)	Voltage (V)	Resistance (Ω)	Voltage (V)
(0.9L unuseable fuel)	0	51.30	0.37	51.60	0.38
	1	51.30	0.37	51.60	0.38
	2	51.30	0.37	51.60	0.38
	3	51.30	0.37	51.60	0.38
	4	51.30	0.37	51.60	0.38
Empty	5	51.30	0.37	51.60	0.38
	6	67.30	0.47	51.60	0.38
	8	92.90	0.63	51.60	0.38
	10	111.10	0.74	51.60	0.38
	12	130.20	0.84	67.80	0.47
	14	139.70	0.89	76.40	0.53
	16	160.20	0.99	93.70	0.64
	18	171.00	1.04	111.40	0.74
	20	182.00	1.10	120.90	0.78
	22	193.40	1.15	131.20	0.85
	24	204.90	1.21	150.90	0.95
¼	25	216.50	1.25	151.20	0.96
	26	228.50	1.30	161.40	0.99
	28	241.20	1.36	172.20	1.05
	30	254.20	1.41	193.90	1.15
	32	267.50	1.46	205.90	1.21
	34	281.30	1.51	217.90	1.26
	35	281.50	1.52	229.70	1.31
	36	295.50	1.56	230.00	1.32
	38	310.30	1.62	242.50	1.37

	40	325.20	1.68	269.00	1.47
	42	341.30	1.73	282.70	1.52
	44	357.10	1.78	297.20	1.58
½	45	373.10	1.83	312.00	1.64
	46	373.50	1.84	312.30	1.64
	48	390.50	1.89	327.70	1.68
	50	407.50	1.94	358.50	1.78
	52	427.10	1.99	374.80	1.84
	54	463.90	2.09	391.80	1.89
	55	463.90	2.09	409.60	1.95
	56	484.30	2.14	409.80	1.95
	58	505.90	2.00	427.90	1.96
	60	528.40	2.25	447.30	2.05
	62	550.90	2.29	486.40	2.11
	64	573.40	2.35	507.60	2.20
¾	65	573.60	2.36	507.70	2.20
	66	597.70	2.40	529.40	2.26
	68	623.40	2.45	553.60	2.31
	70	650.50	2.50	577.40	2.38
	72	677.50	2.55	628.20	2.46
	74	706.80	2.62	654.50	2.52
	75	736.70	2.66	655.00	2.53
	76	737.00	2.67	682.30	2.58
	78	801.10	2.76	710.00	2.63
	80	835.80	2.81	772.50	2.72
	82	872.30	2.87	805.00	2.79
	84	950.60	2.98	875.40	2.88
	86	992.10	3.02	951.60	2.98
Full	87	992.20	3.02	995.70	3.03

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol/V8 S/C 5.0L Petrol, DTC: Engine Control Module (ECM) (100-00 General Information, Description and Operation).

Published: 11-May-2011

Fuel Tank and Lines - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Fuel Filter

Removal and Installation

Removal

WARNINGS:

After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

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.

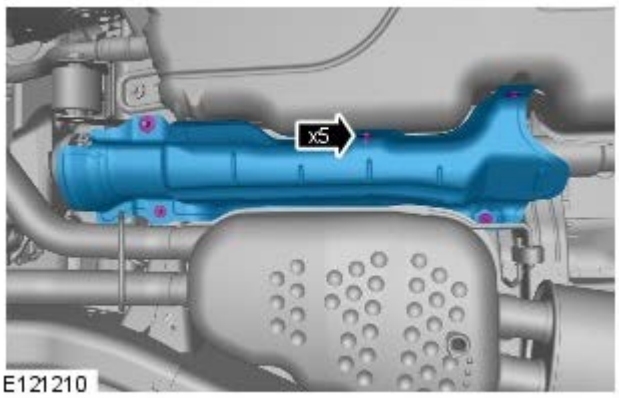
CAUTIONS:

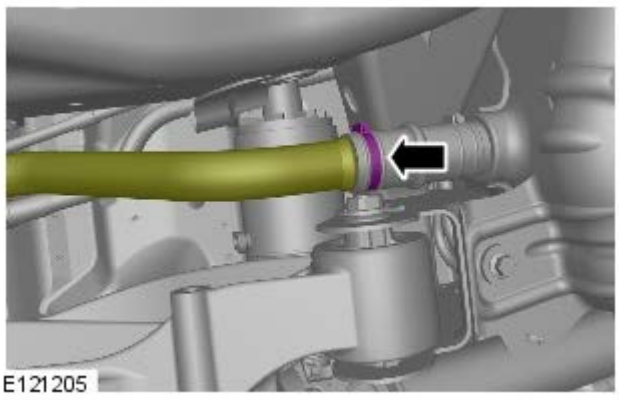
Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

NOTE: Removal steps in this procedure may contain installation details.

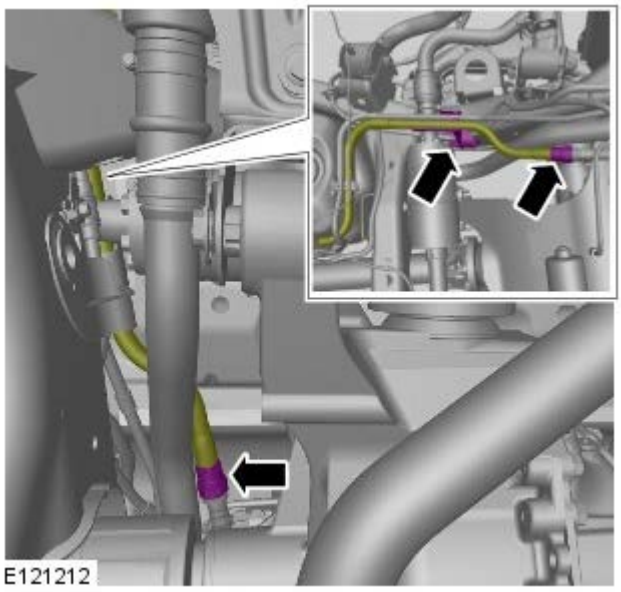
1. For additional information, refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00, Description and Operation).
2. For additional information, refer to: Fuel System Pressure Release - 5.0L (310-00, General Procedures).
3. Disconnect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).
4. For additional information, refer to: Fuel Tank Draining (310-00, General Procedures).
5.



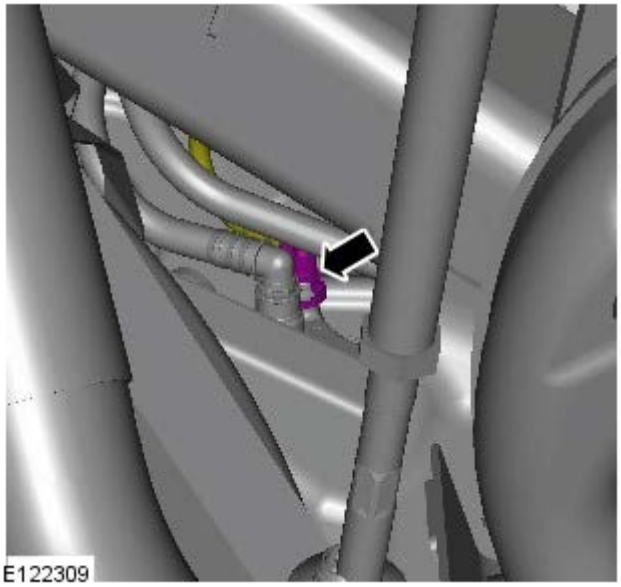


6. NOTE: Discard the retaining clip.

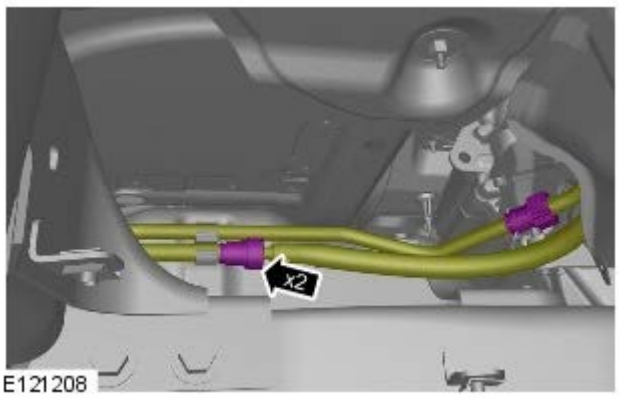
   Remove the tamper proof cover.



7. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



8. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



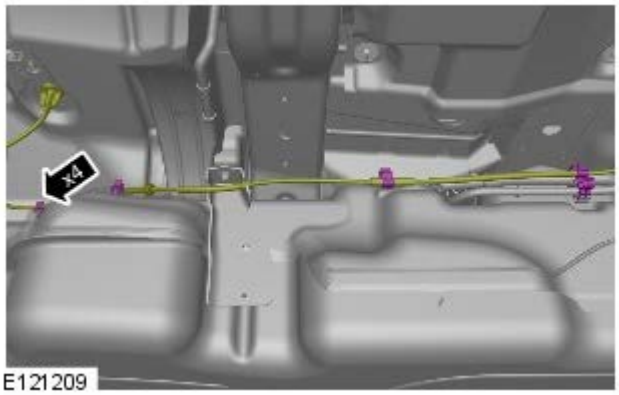
9. CAUTIONS:

   Be prepared to collect escaping fuel.

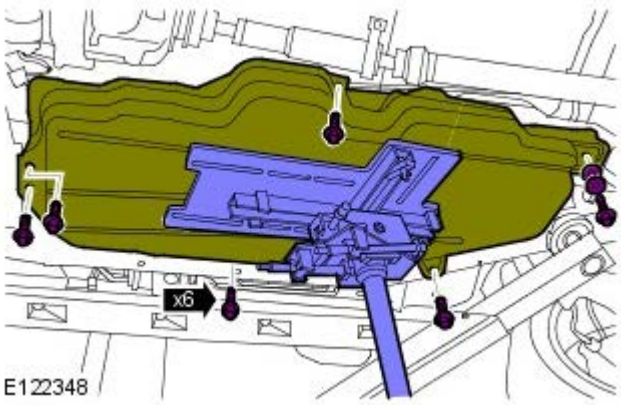
   Make sure that all openings are sealed. Use new blanking caps.

   NOTE: Transmission support heat shield shown removed for clarity.

10.



E121209



E122348

11. WARNING: Secure the component to the transmission jack.

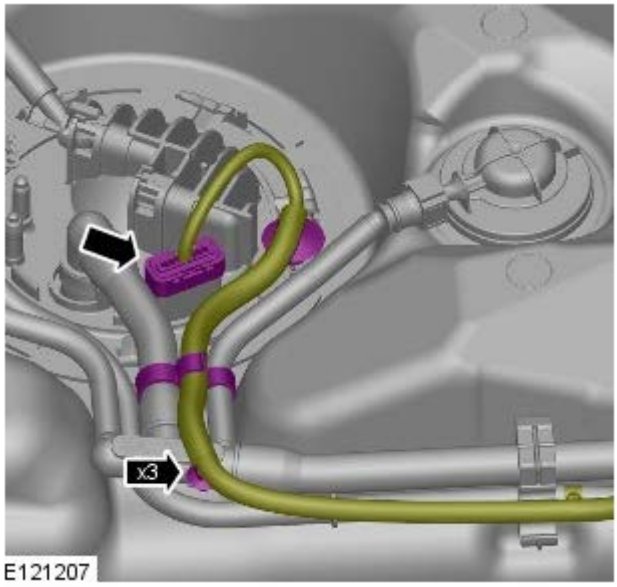
CAUTION: Do not lower the fuel tank more than 250 mm.

NOTE: Note the orientation of the two rear retaining bolts and washers.

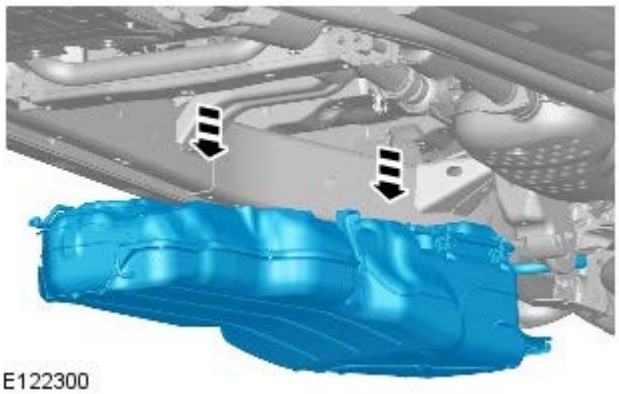
Using a suitable transmission jack, lower the fuel tank sufficiently only to access the top of the fuel tank.

- TORQUE: 45 Nm

12.



E121207

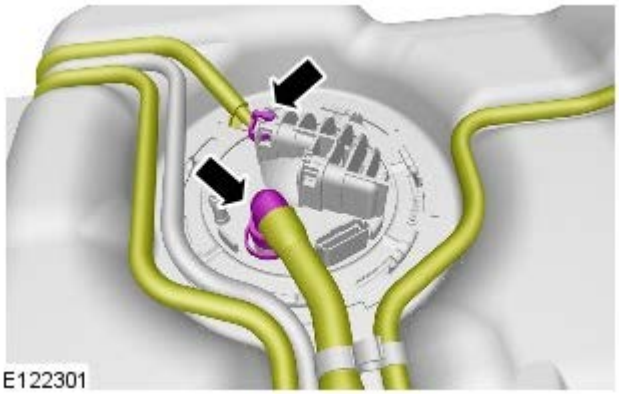

E122300

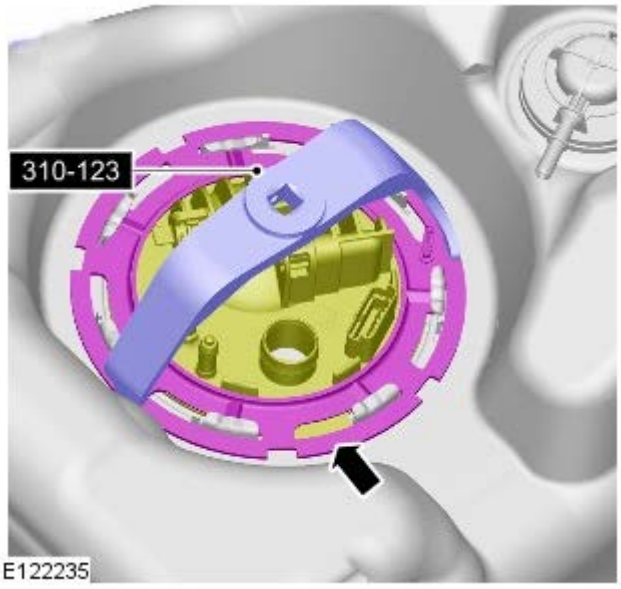
13. CAUTION: Position the breather hose and vent hose through the vehicle body during the fuel tank removal operation.

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

With assistance, remove the fuel tank.

14. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

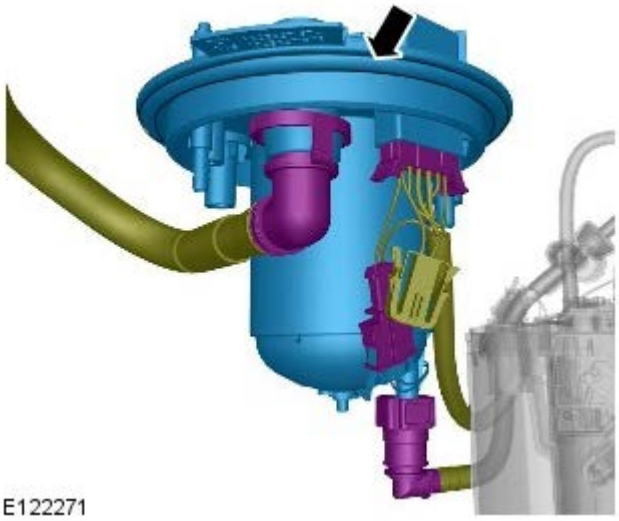




15. NOTE: Note the position of the locating tang.

16. CAUTION: Be prepared to collect escaping fuel.

NOTE: Remove and discard the O-ring seal.



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Fuel Tank and Lines - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Fuel Tank

Removal and Installation

Special Tool(s)

 E80148	310-123 Locking Ring, Fuel Tank

General Equipment

Transmission jack

Removal

WARNINGS:

After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

After the fuel tank drain is complete always fit the sealing covers over the drain ports. Failure to do so will mean that fuel vapor can escape.

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.

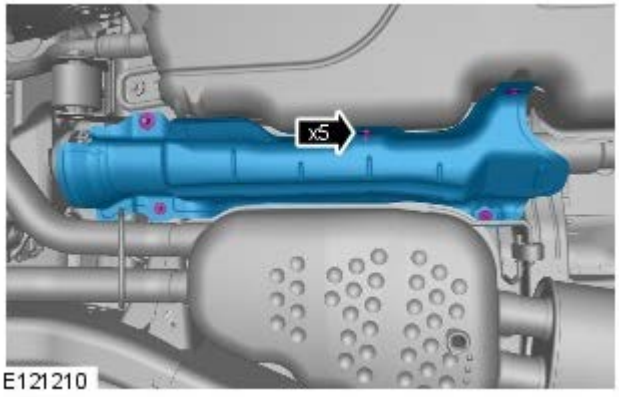
CAUTION: Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00, Description and Operation).
2. Disconnect the battery ground cable.

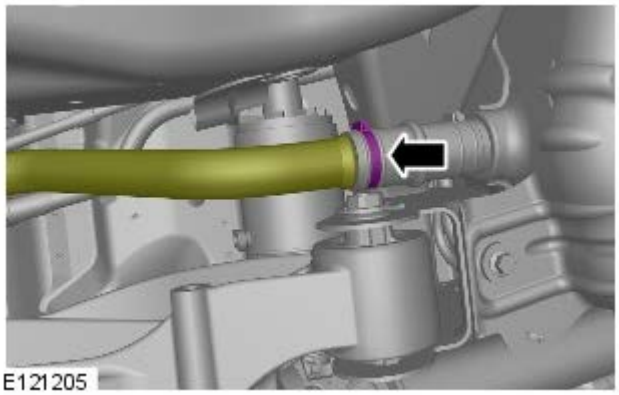
   Refer to: Specifications (414-01, Specifications).
3. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.
4. Refer to: Fuel Tank Draining (310-00, General Procedures).
5. *Torque:*
   Bolts 6 Nm
   Nuts 3 Nm

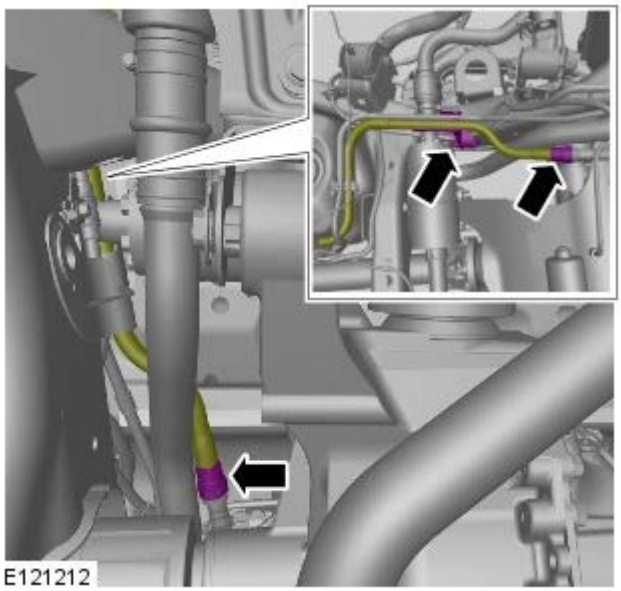


E121210

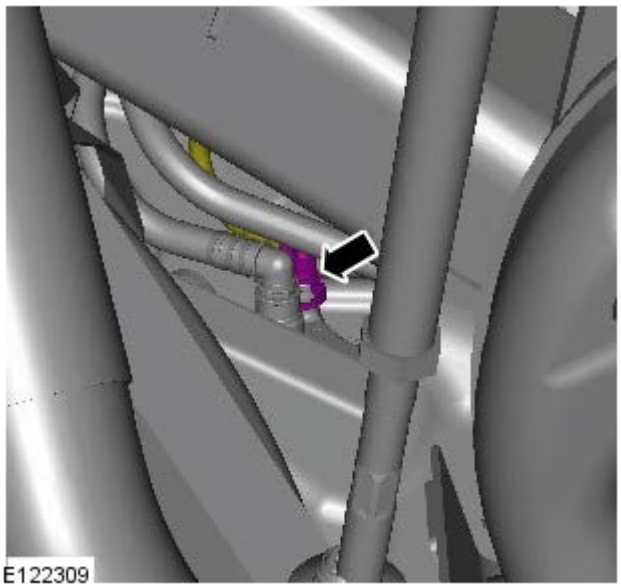
6. CAUTION: Discard the retaining clip.



Remove the tamper proof cover.



7. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



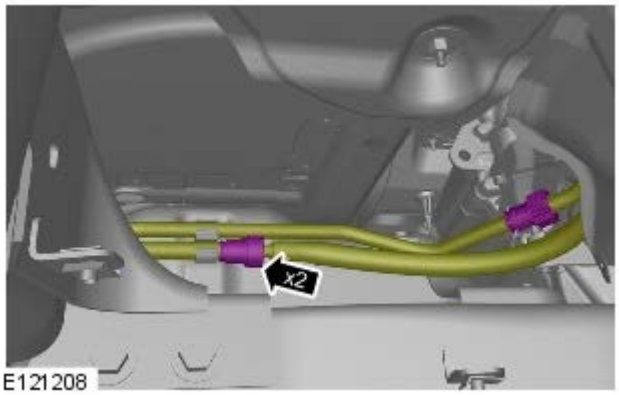
8. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

9. CAUTIONS:

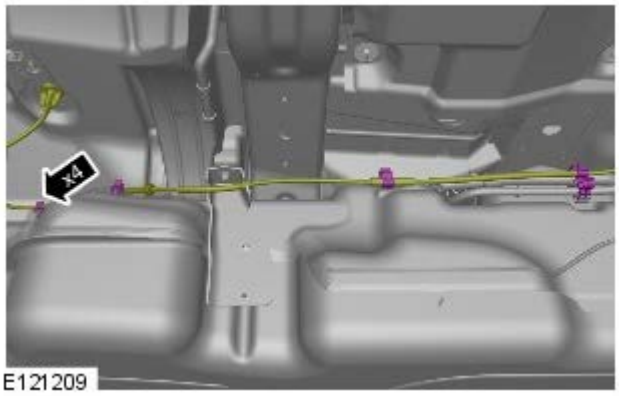
   Be prepared to collect escaping fluids.

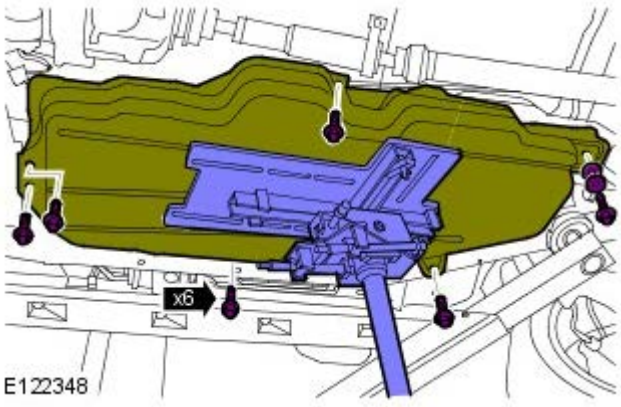
   Make sure that all openings are sealed. Use new blanking caps.

   NOTE: Transmission support heat shield shown removed for clarity.



10.





11. WARNING: Secure the component to the transmission jack.

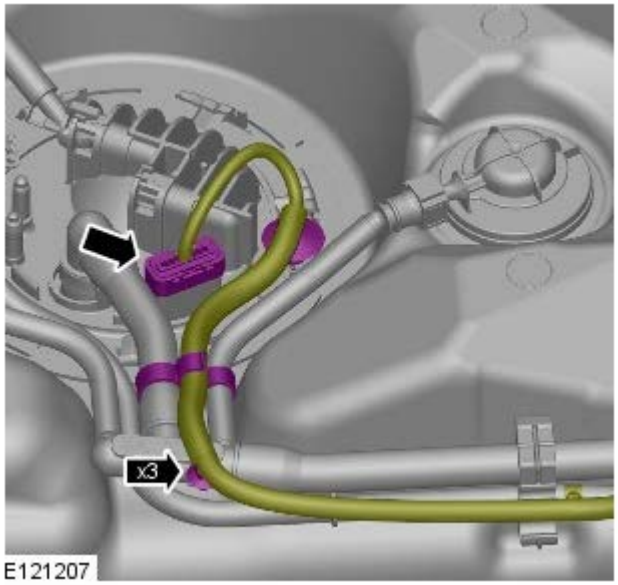
CAUTION: Do not lower the fuel tank more than 250 mm.

NOTE: Note the orientation of the two rear retaining bolts and washers.

Using a suitable transmission jack, lower the fuel tank sufficiently only to access the top of the fuel tank.

General Equipment: Transmission jack
Torque: 45 Nm

12.

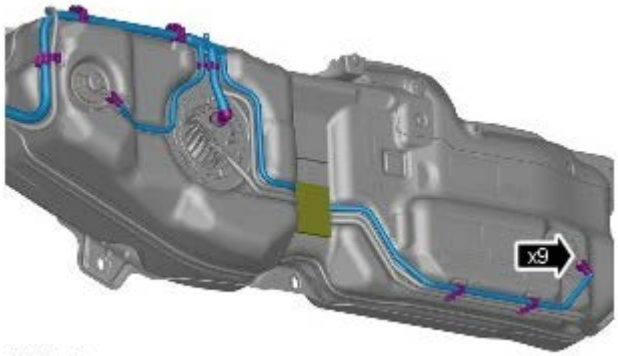


13. CAUTION: Postion the breather and vent hoses through the vehicle body during the fuel tank removal.

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

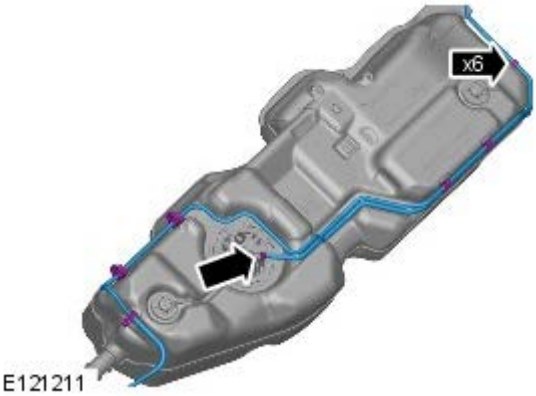
With assistance, remove the fuel tank.

14.



E121213

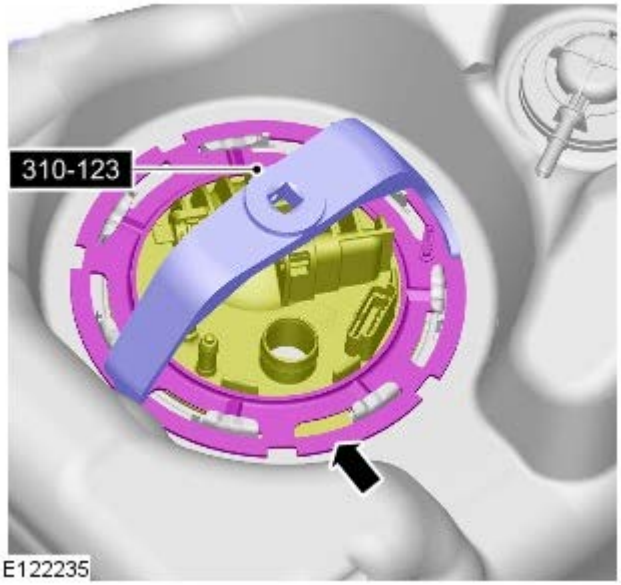
15.



E121211

16. NOTE: Note the position of the locating tang.

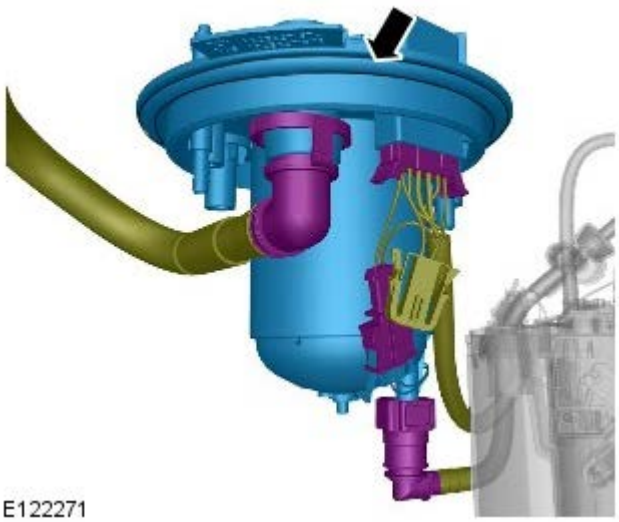
Special Tool(s): 310-123



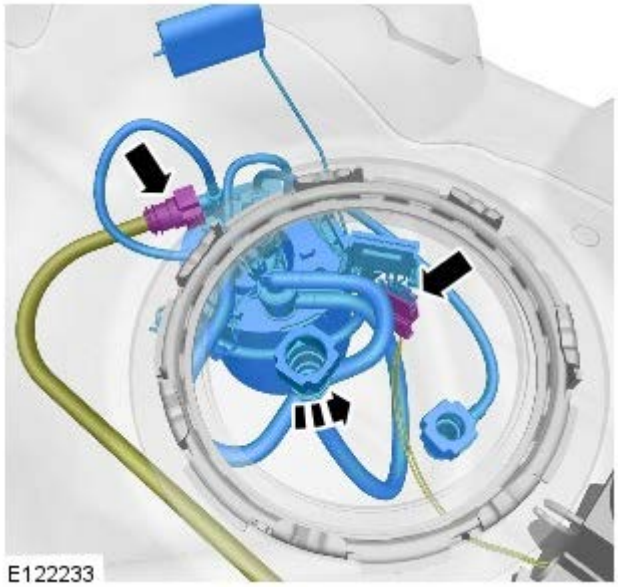
E122235

17. CAUTION: Be prepared to collect escaping fluids.

NOTE: Remove and discard the O-ring seal.



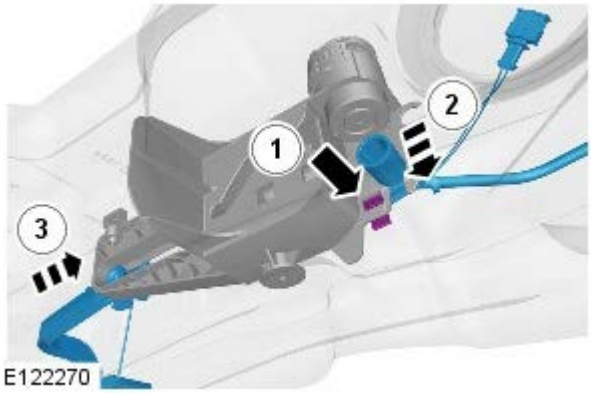
E122271



E122233

18. CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.

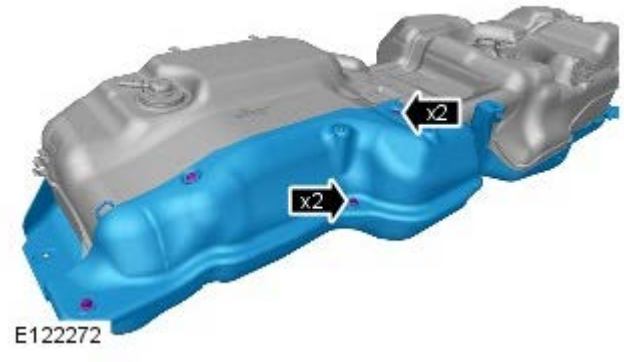
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



E122270

19. CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.

20.



Installation

1. NOTES:

   Remove and discard all blanking caps.

   Make sure the locating tang is installed in the position noted in the removal step.

   To install, reverse the removal procedure.

Published: 11-May-2011

Fuel Tank and Lines - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Fuel Tank Filler Pipe

Removal and Installation

Removal

WARNINGS:

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

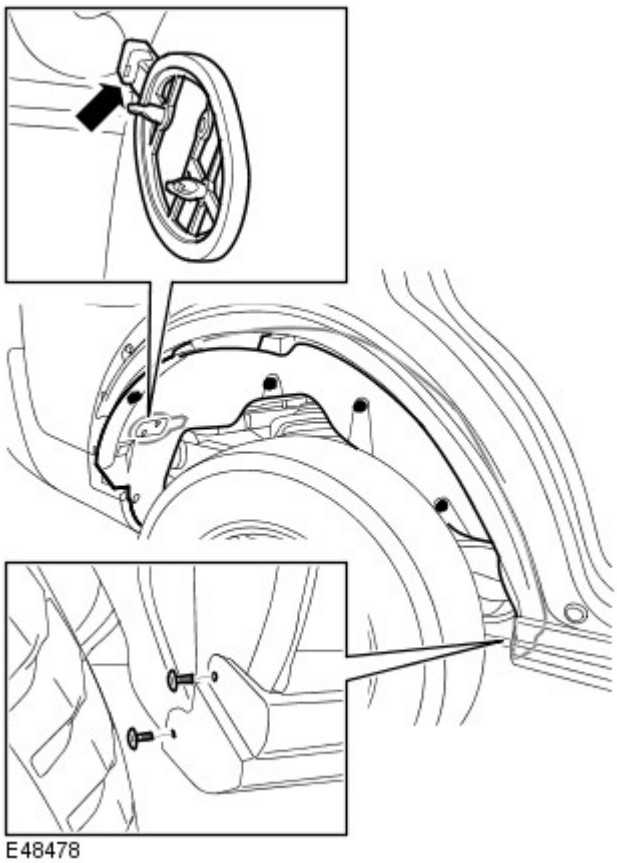
After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow these instructions may result in personal injury.

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.

NOTE: Removal steps in this procedure may contain installation details.

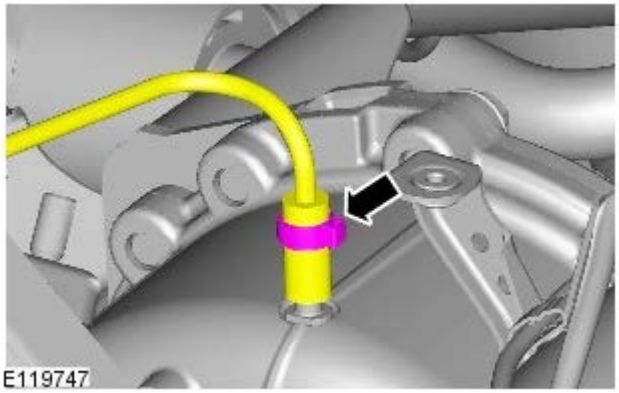
1. Remove the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).
2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.
3. For additional information, refer to: Fuel Tank Draining (310-00, General Procedures).
4. For additional information, refer to: Fuel Filler Door Assembly (501-03, Removal and Installation).
5. Remove the RH rear wheel and tire.
   - TORQUE: 140 Nm
6. Remove the fender splash shield.



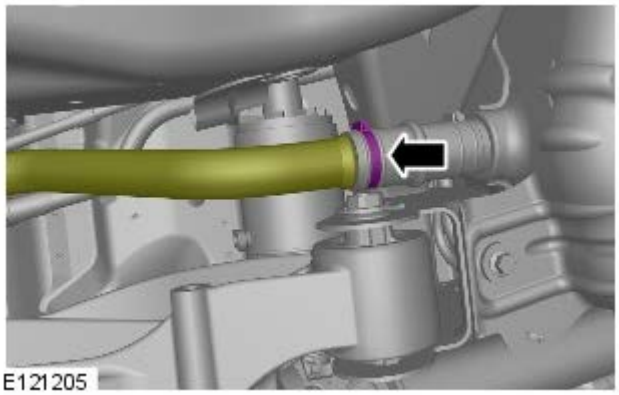
E48478

7.

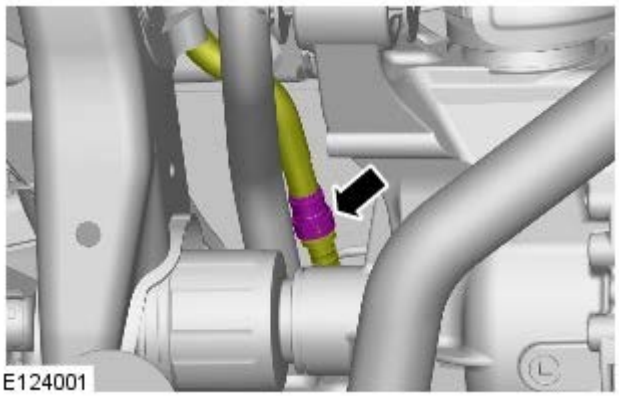


8. NOTE: Discard the retaining clip.

Remove the tamper proof cover from the fuel tank filler pipe hose clip.

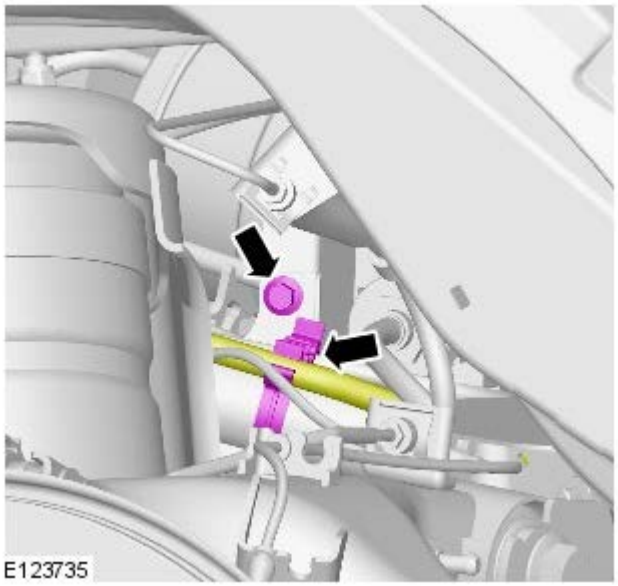


9. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

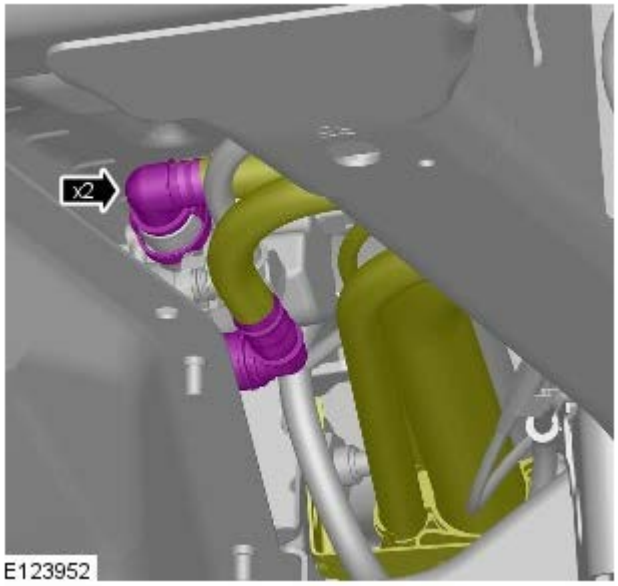


10.

- TORQUE: 4 Nm

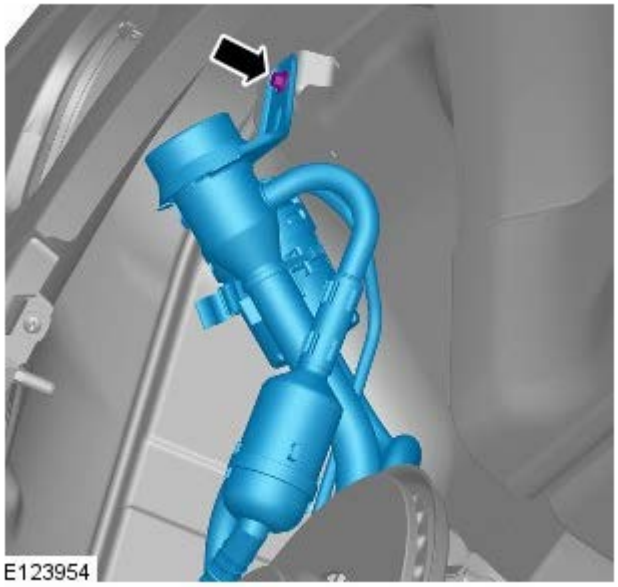


11. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



12.

- TORQUE: 4 Nm



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Fuel Tank and Lines - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Fuel Pump and Sender Unit

Removal and Installation

Special Tool(s)

 E80148	310-123 Locking Ring, Fuel Tank

General Equipment

Transmission jack

Removal

WARNINGS:

After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

After the fuel tank drain is complete always fit the sealing covers over the drain ports. Failure to do so will mean that fuel vapor can escape.

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.

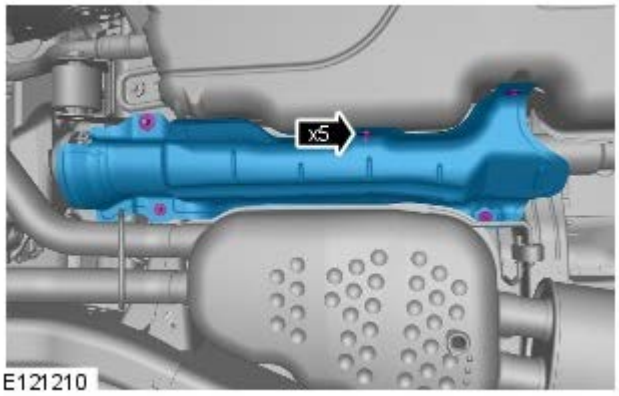
CAUTION: Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

NOTE: Removal steps in this procedure may contain installation details.

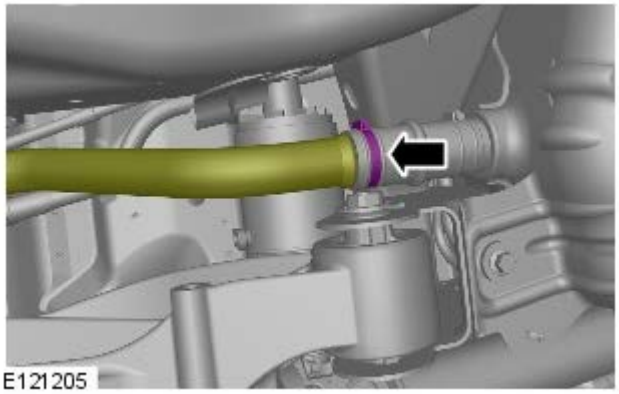
1. Refer to: Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions (100-00, Description and Operation).
2. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).
3. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.
4. Refer to: Fuel Tank Draining (310-00, General Procedures).
5. *Torque:*
   Bolts 6 Nm
   Nuts 3 Nm

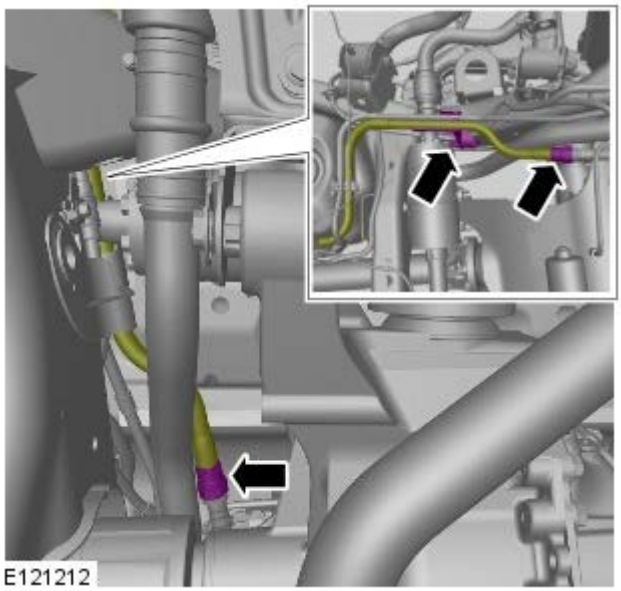


E121210

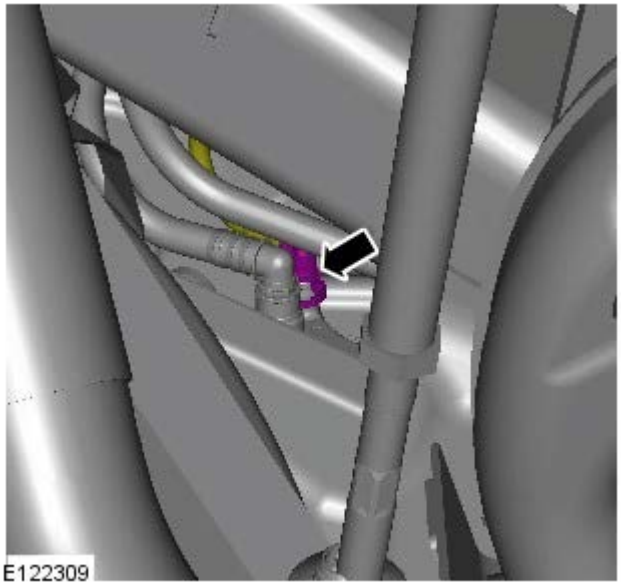


6. NOTE: Discard the retaining clip.

   Remove the tamper proof cover.



7. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



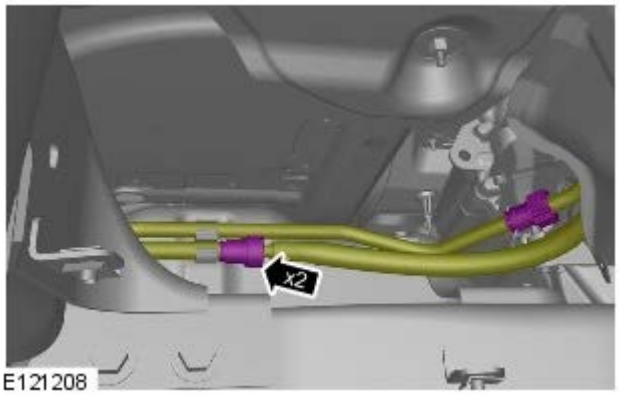
8. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

9. CAUTIONS:

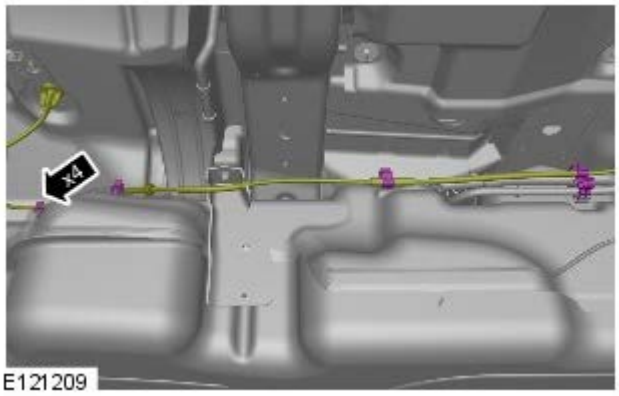
   Be prepared to collect escaping fluids.

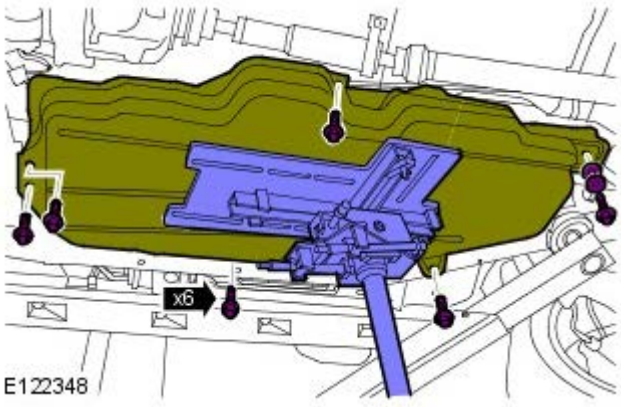
   Make sure that all openings are sealed. Use new blanking caps.

   NOTE: Transmission support heat shield shown removed for clarity.



10.





11. WARNING: Secure the component to the transmission jack.

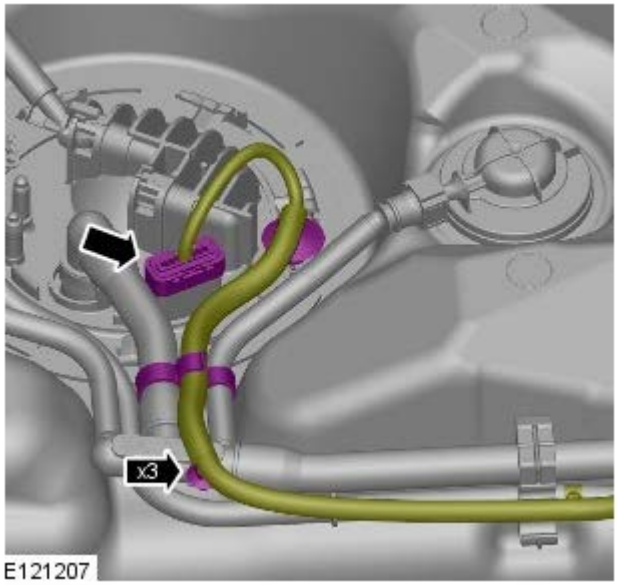
CAUTION: Do not lower the fuel tank more than 250 mm.

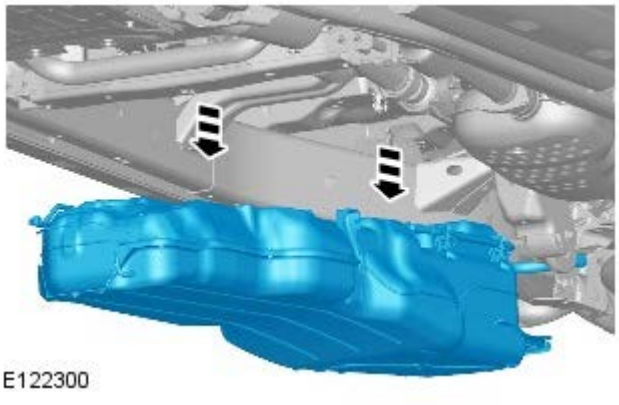
NOTE: Note the orientation of the two rear retaining bolts and washers.

Using a suitable transmission jack, lower the fuel tank sufficiently only to access the top of the fuel tank.

General Equipment: Transmission jack
Torque: 45 Nm

12.

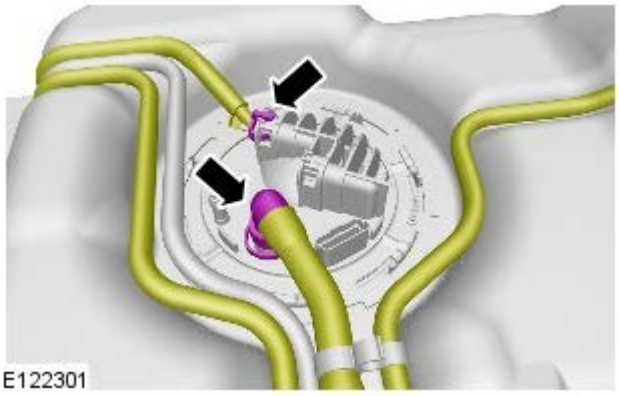



E122300

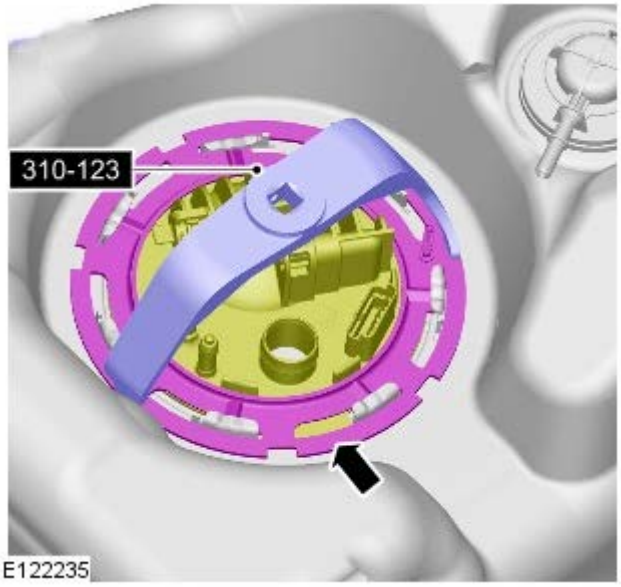
13. CAUTION: Position the breather hose and vent hose through the vehicle body during the fuel tank removal operation.

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

With assistance, remove the fuel tank.


E122301

14. CAUTION: Make sure that all openings are sealed. Use new blanking caps.



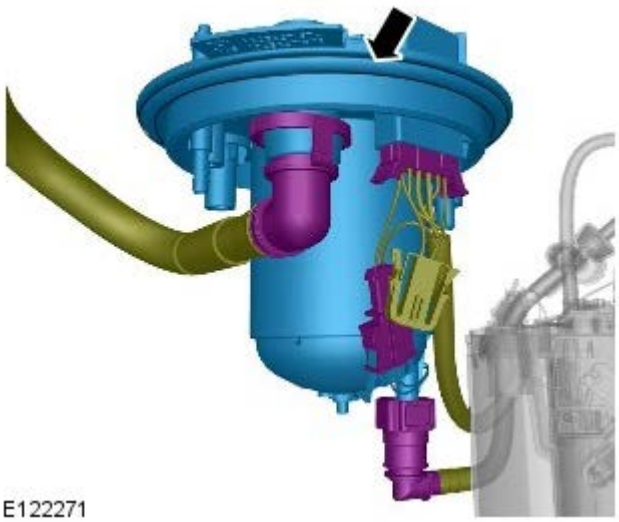
E122235

15. NOTE: Note the position of the locating tang.

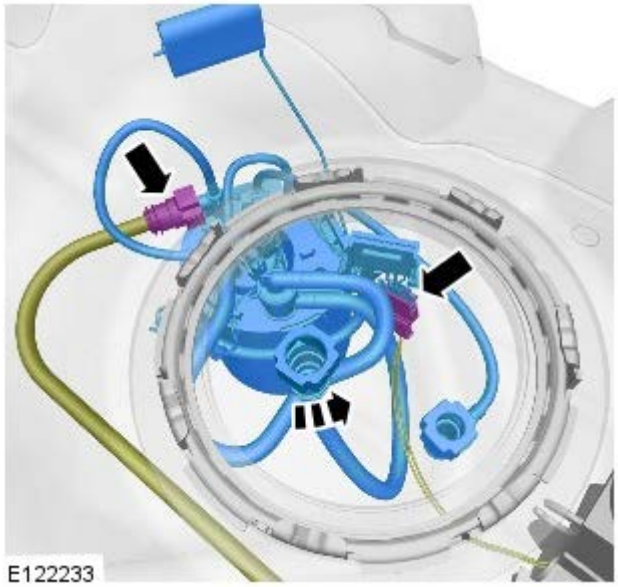
- *Special Tool(s):* 310-123

16. CAUTION: Be prepared to collect escaping fuel.

NOTE: Remove and discard the O-ring seal.



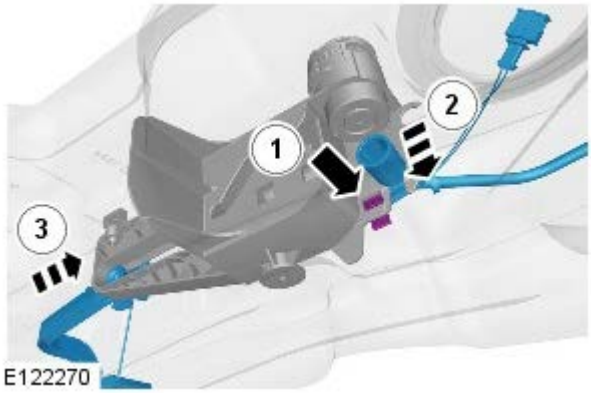
E122271



E122233

17. CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.

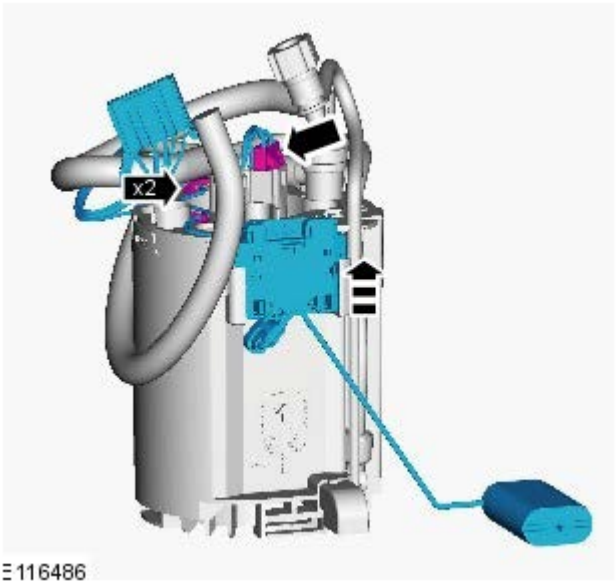
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



E122270

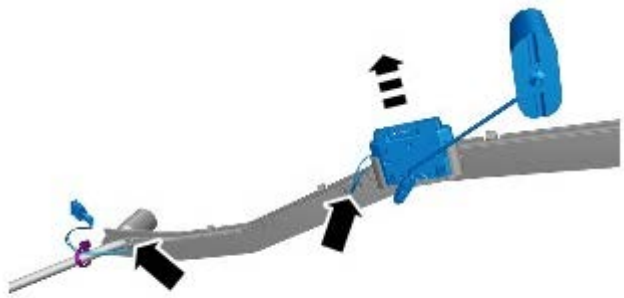
18. CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.

19. CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.



E116486

20.



E122269

Installation

1. NOTES:

   Remove and discard all blanking caps.

   Make sure the locating tang is installed in the position noted in the removal step.

   To install, reverse the removal procedure.

Published: 11-May-2011

Speed Control - TDV6 3.0L Diesel -

Item	Specification
Speed control sensor vertical alignment	90° ± 1.2°

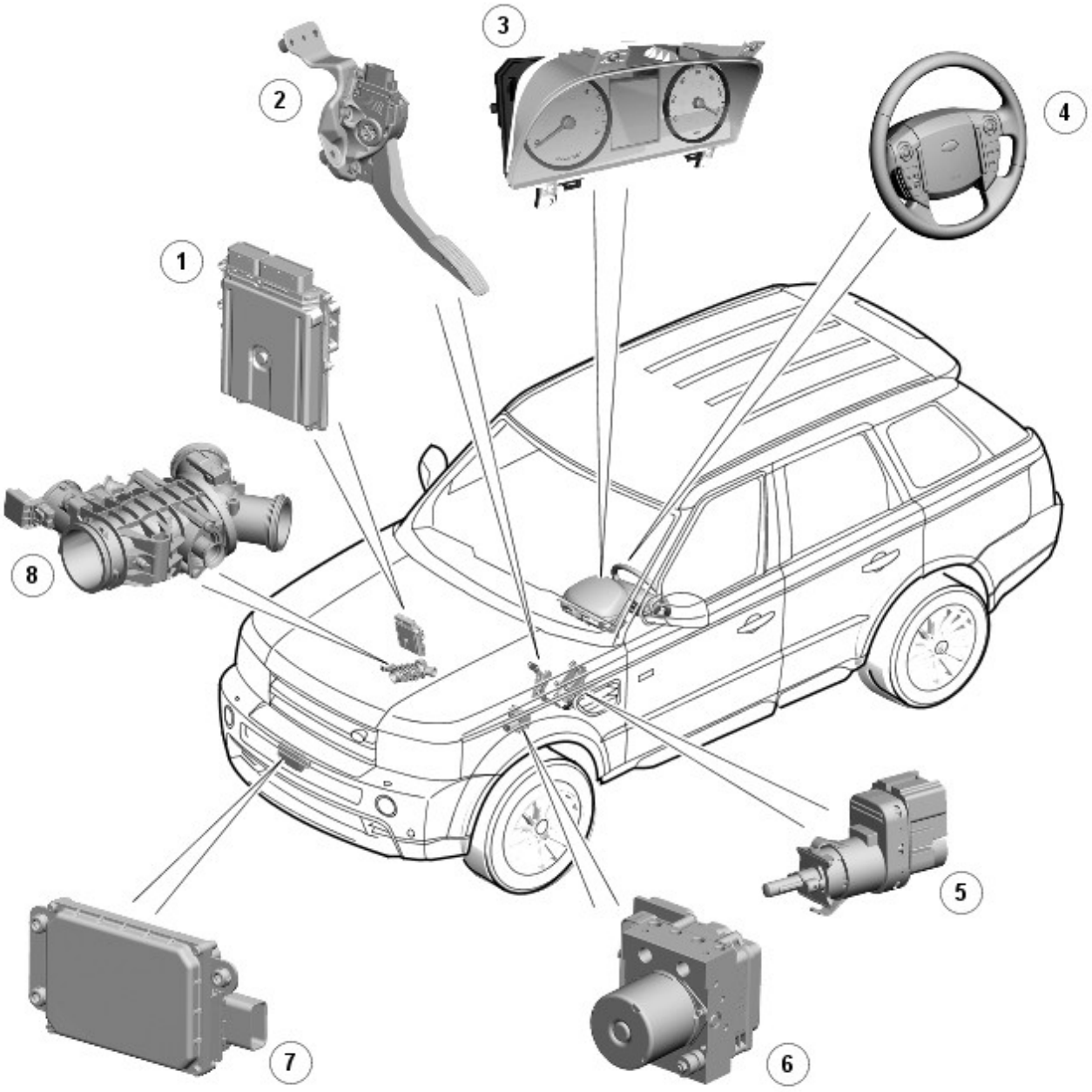
Description	Nm	lb-ft	lb-in
Speed control module bracket retaining bolt	9	-	80
Speed control sensor retaining bolts	5	-	44
Speed control sensor retaining nut	5	-	44

Published: 11-May-2011

Speed Control - TDV6 3.0L Diesel - Speed Control

Description and Operation

COMPONENT LOCATION - 3.0L TdV6



E131571

Item	Part Number	Description
1	-	Engine control module
2	-	Accelerator pedal position sensor
3	-	Instrument cluster
4	-	Speed control switches
5	-	Brake switch
6	-	Anti-lock brake system module
7	-	Adaptive speed control radar module
8	-	Electric throttle

GENERAL

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 (engine control module). 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 - switch
- A RESUME switch
- A CANCEL switch.

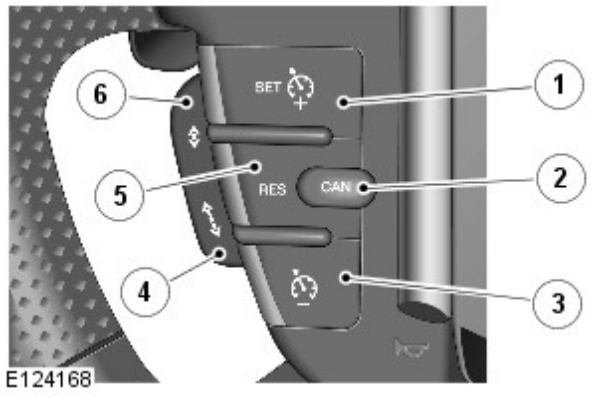
Both systems also use:

- The ECM
- The brake switch
- The APP (accelerator pedal position) sensor.

The adaptive system incorporates the following additional components:

- An adaptive speed control radar module
- Forward alert selection in the instrument cluster set-up menu
- The ABS (anti-lock brake system) module.

SPEED CONTROL SWITCHES



Item	Part Number	Description
1	-	Set or increase the speed
2	-	Cancel
3	-	Decrease the speed
4	-	Gap decrease (if fitted - Adaptive speed control only)
5	-	Resume set speed
6	-	Gap increase (if fitted - Adaptive speed control only)

The speed control switches are located on the LH (left-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 (local interconnect network) bus to the instrument cluster. The instrument cluster routes the control signals to the ECM on the high speed CAN (controller area network)Controller Area Network (CAN) bus.

Speed control is engaged by pressing the set/increase switch. Once engaged the speed can be varied by the speed adjustment switches. Each press of the speed adjustment switches will increase or decrease the set speed in steps of 1 mph (2 kph).

Where fitted, the gap adjustment switches allow the driver to adjust the length of the time gap between the vehicle and the vehicle in front.

STANDARD SPEED CONTROL

The standard speed control system is integrated with the within the ECM 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 standard speed control system also uses inputs from the Stop lamp switch, the APP sensor, the ECM and the ABS module.

The standard speed control is operated by the driver using only the steering wheel switches. When standard 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 standard 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 150 mph (240 kph)
- If the accelerator pedal is used to accelerate beyond the set speed for too long
- Engine speed too high (cancel limit set just below red line).

ADAPTIVE SPEED CONTROL

The adaptive speed control system uses the radar module 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 choose between four gap settings, 1, 1.4, 1.8 and 2.2 seconds.

The system will detect but not react to the following:

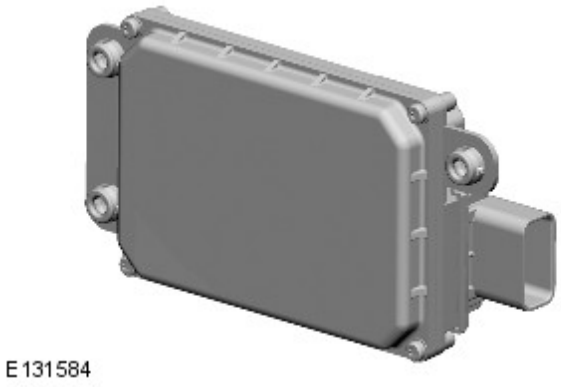
- Vehicles in the oncoming lane
- Stationary vehicles
- Pedestrians
- Vehicles not in the same lane.

Adaptive speed control is active when the vehicle is moving at a minimum speed of 20 mph (32 km/h) and a maximum speed of 112 mph (180 km/h). Adaptive speed control only functions when a set speed is entered in standard 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 20 mph (32 km/h) 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 the standard speed control variants.

Adaptive Speed Control Radar Module


E131584

The adaptive speed control radar module is located in a central position, behind the front bumper. The radar module is connected to the other vehicle systems via the high speed CAN bus. If the radar module is replaced in service it must be mechanically leveled vertically. Horizontal alignment is achieved by putting the radar module in service mode using approved Land Rover diagnostic equipment. The vehicle then needs to be driven for a short period while the radar module calibrates itself. Calibration is complete when the 'follow' icon in the instrument cluster stops flashing.

The radar module monitors reflections from stationary roadside objects such as street lighting poles, signposts and barriers, and the road surface itself. In areas with few of these features the radar module may incorrectly judge that the radar is blocked. In these cases, confirm that the radar horizontal alignment is correct, and that the vehicle has not had a front end protective cover or film applied.

OPERATION

Standard Speed Control

The standard 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:

- '+' and '-' (set/accelerate and decelerate) steering wheel switches
- Resume switch
- Cancel switch
- Clock spring
- Speed control warning lamp.

The standard speed control system also uses inputs from the brake pedal switch, the APP sensor, the ECM and the ABS module.

The standard speed control is operated by the driver using only the steering wheel switches. When speed control is

active, the ECM regulates the PWM (pulse width modulation) signals to the fuel injectors to adjust the fuel supply as required to maintain the set speed.

During standard speed control operation, the ECM controls vehicle speed by adjusting fuel injection duration and timing. When the accelerator pedal is pressed with speed control active, the ECM outputs a calculated throttle angle signal in place of the actual throttle angle signals produced by the APP sensor. The calculated throttle angle is derived from fuel demand.

The minimum set speed for standard 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
- Certain Terrain Modes are selected (i.e. Rock crawl)
- Low range gear selected
- The difference between actual speed and the set speed is too great
- When the vehicle speed reaches a maximum speed of 150 mph (240 kph)
- If the accelerator pedal is used to accelerate beyond the set speed for too long
- Stability control system intervention
- System error causes shut-off.

Adaptive Speed Control

The adaptive speed control system comprises the following components:

- Adaptive speed control radar module
- Steering wheel control switches
- ECM
- Throttle intake manifold - Electric throttle
- ABS module and pump
- Adaptive speed control warning indicator (in the instrument cluster).

The adaptive speed control system uses an electronic scanning radar in the radar module 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 20 mph (32 km/h) 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, electric throttle and throttle control are unchanged from those used for standard speed control variants.

The adaptive speed control system is based on the use of a front mounted radar sensor. The sensor transmits a radar beam forward of the vehicle and detects the returning signals reflected off other vehicles and objects ahead.

The radar beam is electronically scanned at a rate of 20 sweeps/second across a total arc of 20° 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). The radar provides a list of 64 targets.

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.

In 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, 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. A ‘cruise cancelled’ message will be displayed to the driver in the message center.

When the vehicle is in follow mode, the Follow Mode warning indicator is illuminated in the instrument cluster.



E124180

Item	Part Number	Description
1	-	Follow Mode active (amber)
2	-	Speed control active (green)
3	-	Forward Alert active (green)

The radar sensor detects three primary parameters of objects within the scanned arc. These are:

- Range
- Relative velocity
- Angle.

Range: The radar module detects the presence and ranges of different vehicles and objects within the scanned arc up to a distance of approximately 130 meters (426.5 feet). 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: The antenna consists of several receivers; if an object is offset from the vehicle center line, there will be a small time difference between the receive time on the near side compared to the far side. The radar can use this time difference to measure the angular position of the object. This enables the system to distinguish between vehicles in different lanes and between vehicles and roadside objects.

System Restrictions

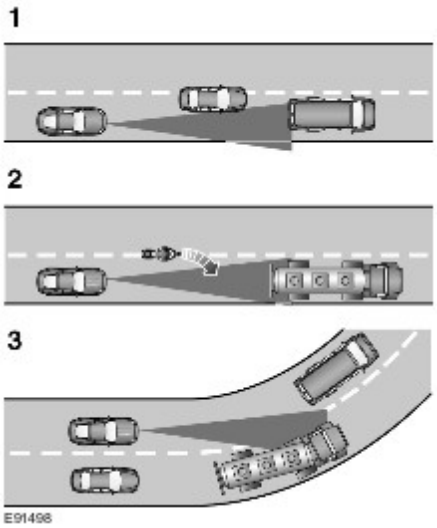
The adaptive speed control system is only intended to provide enhanced speed control as described above in certain restricted conditions. The following points should be noted:

- 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 to intervene and override the brakes. A ‘driver intervene’ message will be displayed in the message center accompanied with an audible chime.

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.

The following illustration shows circumstances where the adaptive speed control system may brake late or unexpectedly. The driver is required to intervene in these situations.



Item	Part Number	Description
1	-	Driving on a different line to the vehicle in front
2	-	Vehicles that merge into the same lane are only detected once they have moved fully into the lane.
3	-	On bends in the road there can be issues with detection of the vehicle in front when going into and coming out of a bend.

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.

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.

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, using the vehicle set-up menu in the instrument cluster. 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.

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.

Advanced Emergency Brake Assist

WARNING: Advanced Emergency Brake Assist is an additional safety system and is not intended to override driver responsibility for driving with care and attention.

On vehicles fitted with the Advanced Emergency Brake Assist system, brake response is improved during emergency braking when a moving vehicle is detected close ahead. The system activates if the risk of collision increases after the Forward Alert warning is issued.

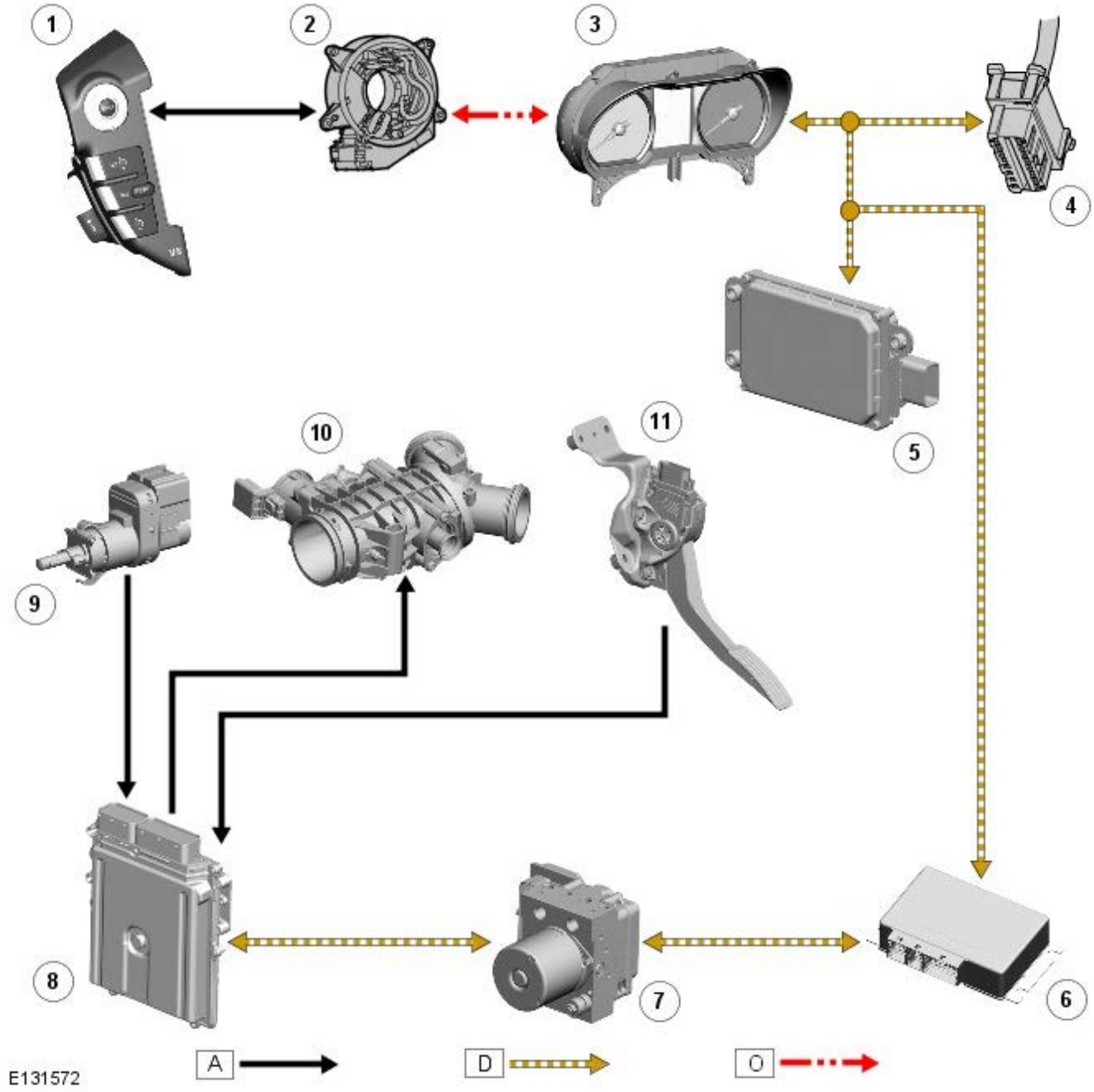
After a Forward Alert warning is displayed, the brakes are automatically applied gently in preparation for rapid braking. If the brake pedal is then pressed quickly then braking is fully implemented by the Emergency Brake Assist system, even if the pressure on the brake pedal is light.
For additional information, refer to: Anti-Lock Control - Traction Control (206-09 Anti-Lock Control - Traction Control, Description and Operation).

Advanced Emergency Brake Assist is available at speed above 5 mph (7 km/h) and will function even when Forward Alert and adaptive cruise control are switched off.

If a fault occurs in the system a message Forward Alert Unavailable is displayed in the message center. Advanced Emergency Brake Assist will not be available until the fault is rectified.

CONTROL DIAGRAM

NOTE: A = Hardwired; D = High speed CAN bus; O = LIN bus.



Item	Part Number	Description
1	-	Speed control switches
2	-	Clock spring
3	-	Instrument cluster
4	-	Diagnostic socket
5	-	Adaptive speed control radar module
6	-	Transfer box control module
7	-	ABS module
8	-	ECM
9	-	Brake switch
10	-	Electric throttle
11	-	APP sensor

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Speed Control - TDV6 3.0L Diesel - Speed Control

Diagnosis and Testing

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. REFER to: Speed Control (310-03A, Description and Operation).

Inspection and Verification

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

Visual Inspection

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.

Symptom Chart

Symptom	Possible Cause	Action
Speed control inhibited or disabled	• Default mode enabled • 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	• Check for Network related DTCs that could be caused by power failure to the module or sensor and refer to DTC Index. • Check for steering wheel speed control switch and circuit faults. • Check for engine throttle position sensor DTCs and refer to the relevant DTC Index. • Check for brake switch faults.
Unable to regulate/adjust vehicle speed	• Steering wheel switch malfunction	• Check for steering wheel speed control switch and circuit faults.
Unable to cancel speed control from steering wheel	• Steering wheel switch malfunction	• Check for steering wheel speed control switch and circuit faults.
Unable to cancel speed control from brake pedal	• Brake switch malfunction	• Check for brake switch faults.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Engine Control Module (PCM) 3.0L TdV6 (100-00, Description and Operation) /
Diagnostic Trouble Code (DTC) Index - DTC: Speed Control Module (CCM) (100-00, Description and Operation).

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Speed Control - TDV6 3.0L Diesel - Speed Control Sensor Adjustment

General Procedures

Special Tool(s)

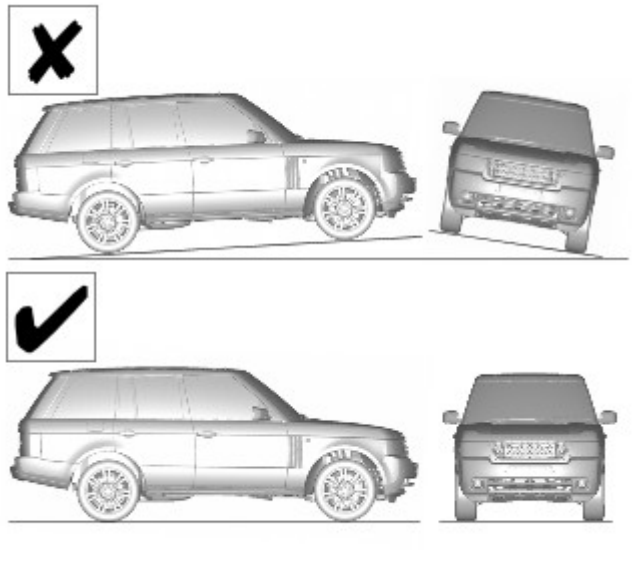
	310-148 Setting Tool, Speed Control

NOTES:

Removal steps in this procedure may contain installation details.

This procedure details how to adjust the speed control sensor vertically. There is no horizontal adjustment required.

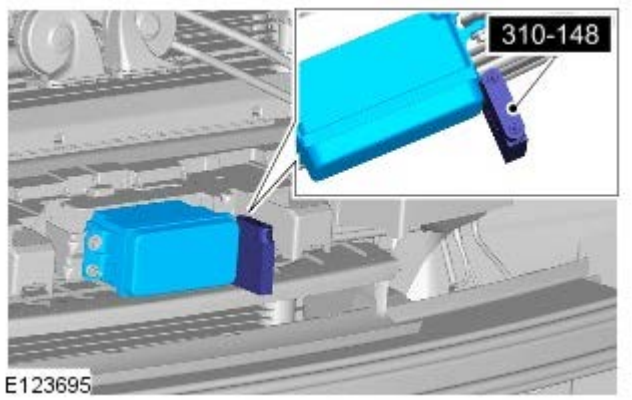
1. Refer to: Front Bumper Cover (501-19, Removal and Installation).



2. CAUTION: Drive the vehicle on to a flat, level surface.

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

   Set the air suspension ride height to the STANDARD setting.



3. NOTES:

   Using the special tool, check the speed sensor is level, (+/- 0.5 degree).

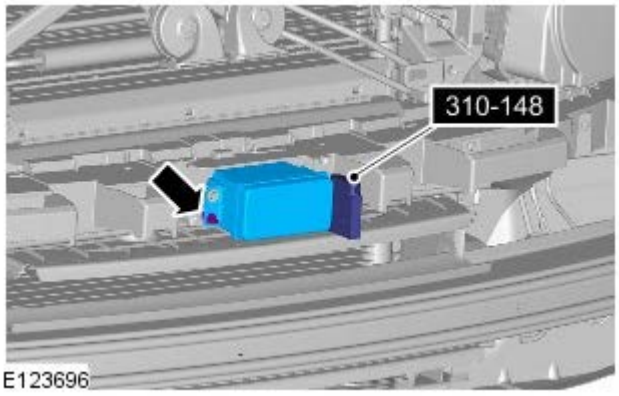
   Make sure that the special tool is installed to the front of the speed control sensor as it is shown in the illustration to check the level.

   Do not release the securing nut.

   Special Tool(s): 310-148

4. NOTE: The speed sensor has no mechanical horizontal adjustment.

   Special Tool(s): 310-148



5. Refer to: Front Bumper Cover (501-19, Removal and Installation).

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Speed Control - TDV6 3.0L Diesel - Speed Control Deactivator Switch

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Stoplamp Switch (417-01, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

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Speed Control - TDV6 3.0L Diesel - Speed Control Module

Removal and Installation

Removal

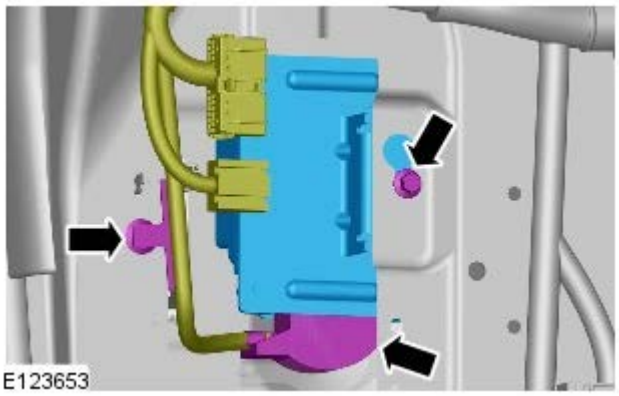
NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. Refer to: Dynamic Response Module (204-06, Removal and Installation).

3. *Torque:* 9 Nm



4.



E123652

Installation

1. To install, reverse the removal procedure.

2. Program a new control module using T4.

Published: 11-May-2011

Speed Control - TDV6 3.0L Diesel - Speed Control Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.

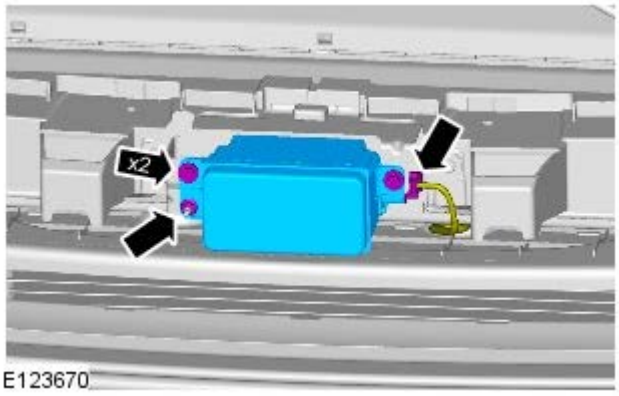
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Front Bumper Cover (501-19, Removal and Installation).

4. *Torque:* 5 Nm



Installation

1. To install, reverse the removal procedure.

2. Refer to: Speed Control Sensor Adjustment (310-03, General Procedures).

Published: 11-May-2011

Speed Control - TDV6 3.0L Diesel - Speed Control Switch

Removal and Installation

Removal

WARNINGS:

To avoid accidental deployment, the restraints control module backup power supply must be depleted. Wait at least one minute after disconnecting the battery ground cable(s) before commencing any repair or adjustment to the supplemental restraint system (SRS), or any component(s) adjacent to the SRS sensors. Failure to follow these instructions may result in personal injury.

Always wear safety glasses when working on an air bag equipped vehicle and when handling an air bag module. Failure to follow this instruction may result in personal injury.

To minimize the possibility of premature deployment, do not use radio key code savers when working on the supplemental restraint system. Failure to follow this instruction may result in personal injury.

To minimize the possibility of injury in the event of premature deployment, always carry a live air bag module with the bag and trim cover pointed away from the body. Failure to follow this instruction may result in personal injury.

To minimize the possibility of premature deployment, live air bag modules must only be placed on work benches which have been ground bonded and with the trim cover facing up. Failure to follow these instructions may result in personal injury.

Never probe the electrical connectors of air bag modules or any other supplemental restraint system component. Failure to follow this instruction may result in personal injury.

Painting over the driver air bag module trim cover or instrument panel could lead to deterioration of the trim cover and air bags. Do not for any reason attempt to paint discolored or damaged air bag module trim covers or instrument panel. Install a new component. Failure to follow this instruction may result in personal injury.

NOTE: Removal steps in this procedure may contain installation details.

1. Make the air bag supplemental restraint system (SRS) safe.

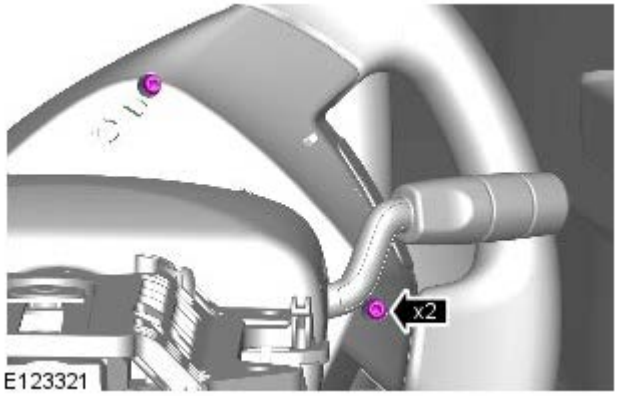
   Refer to: Standard Workshop Practices (100-00, Description and Operation).

2. Disconnect the battery ground cable.

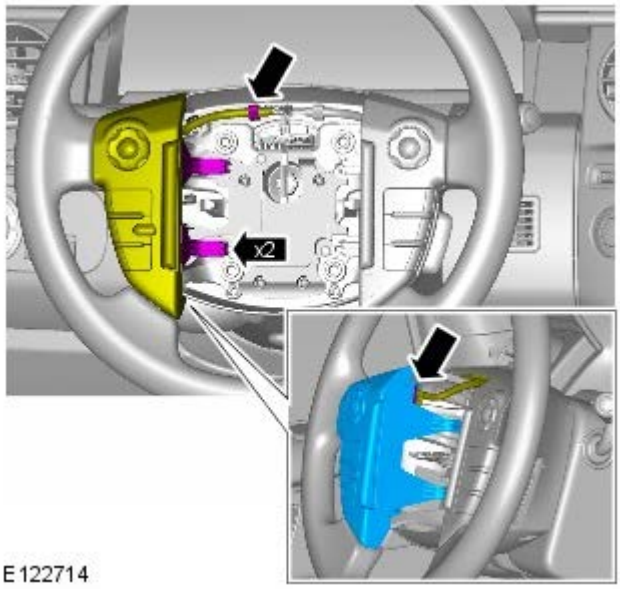
   Refer to: Specifications (414-00, Specifications).

3. Refer to: Driver Air Bag Module (501-20, Removal and Installation).

4. *Torque:* 1.5 Nm



5.



Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Speed Control - V8 5.0L Petrol/V8 S/C 5.0L Petrol -

Item	Specification
Speed control sensor vertical alignment	90° ± 1.2°

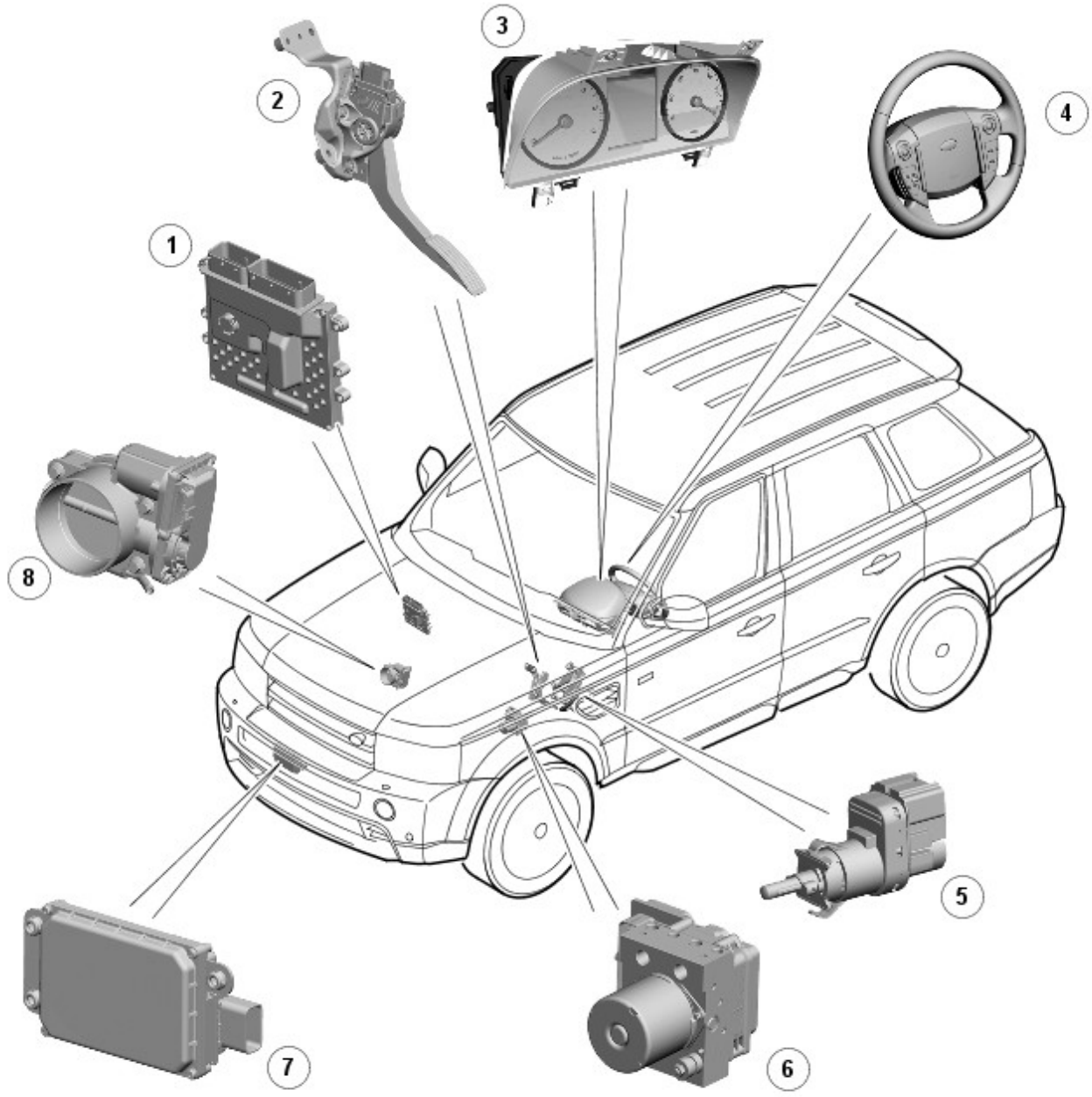
Description	Nm	lb-ft	lb-in
Speed control module bracket retaining bolt	9	-	80
Speed control sensor retaining bolts	5	-	44
Speed control sensor retaining nut	5	-	44

Published: 11-May-2011

Speed Control - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Speed Control

Description and Operation

COMPONENT LOCATION - 5.0L V8



E131573

Item	Part Number	Description
1	-	Engine control module
2	-	Accelerator pedal position sensor
3	-	Instrument cluster
4	-	Speed control switches
5	-	Brake switch
6	-	Anti-lock brake system module
7	-	Adaptive speed control radar module
8	-	Electric throttle

GENERAL

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 (engine control module). 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 - switch
- A RESUME switch
- A CANCEL switch.

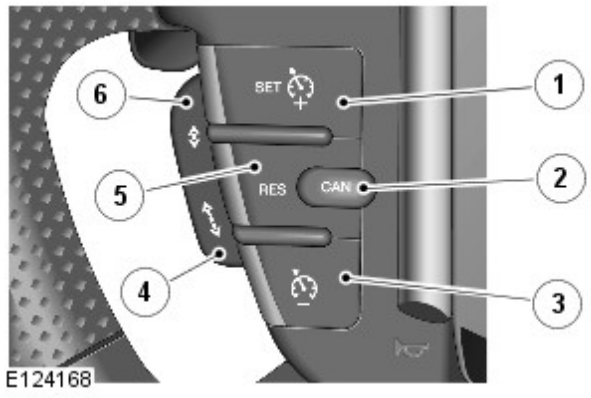
Both systems also use:

- The ECM
- The brake switch
- The APP (accelerator pedal position) sensor.

The adaptive system incorporates the following additional components:

- An adaptive speed control radar module
- Forward alert selection in the instrument cluster set-up menu
- The ABS (anti-lock brake system) module.

SPEED CONTROL SWITCHES



Item	Part Number	Description
1	-	Set or increase the speed
2	-	Cancel
3	-	Decrease the speed
4	-	Gap decrease (if fitted - Adaptive speed control only)
5	-	Resume set speed
6	-	Gap increase (if fitted - Adaptive speed control only)

The speed control switches are located on the LH (left-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 (local interconnect network) bus to the instrument cluster. The instrument cluster routes the control signals to the ECM on the high speed CAN (controller area network)Controller Area Network (CAN) bus.

Speed control is engaged by pressing the set/increase switch. Once engaged the speed can be varied by the speed adjustment switches. Each press of the speed adjustment switches will increase or decrease the set speed in steps of 1 mph (2 kph).

Where fitted, the gap adjustment switches allow the driver to adjust the length of the time gap between the vehicle and the vehicle in front.

STANDARD SPEED CONTROL

The standard speed control system is integrated with the within the ECM 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 standard speed control system also uses inputs from the Stop lamp switch, the APP sensor, the ECM and the ABS module.

The standard speed control is operated by the driver using only the steering wheel switches. When standard 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 standard 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 150 mph (240 kph)
- If the accelerator pedal is used to accelerate beyond the set speed for too long
- Engine speed too high (cancel limit set just below red line).

ADAPTIVE SPEED CONTROL

The adaptive speed control system uses the radar module 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 choose between four gap settings, 1, 1.4, 1.8 and 2.2 seconds.

The system will detect but not react to the following:

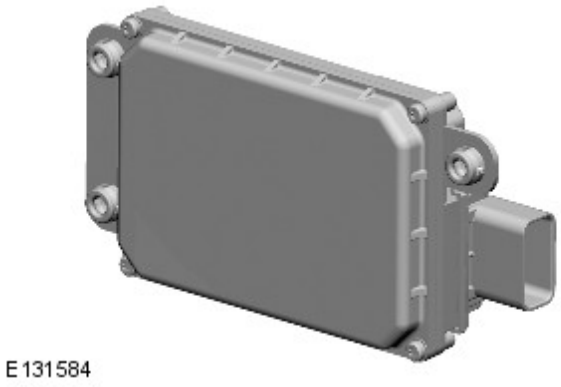
- Vehicles in the oncoming lane
- Stationary vehicles
- Pedestrians
- Vehicles not in the same lane.

Adaptive speed control is active when the vehicle is moving at a minimum speed of 20 mph (32 km/h) and a maximum speed of 112 mph (180 km/h). Adaptive speed control only functions when a set speed is entered in standard 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 20 mph (32 km/h) 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 the standard speed control variants.

Adaptive Speed Control Radar Module


E131584

The adaptive speed control radar module is located in a central position, behind the front bumper. The radar module is connected to the other vehicle systems via the high speed CAN bus. If the radar module is replaced in service it must be mechanically leveled vertically. Horizontal alignment is achieved by putting the radar module in service mode using approved Land Rover diagnostic equipment. The vehicle then needs to be driven for a short period while the radar module calibrates itself. Calibration is complete when the 'follow' icon in the instrument cluster stops flashing.

The radar module monitors reflections from stationary roadside objects such as street lighting poles, signposts and barriers, and the road surface itself. In areas with few of these features the radar module may incorrectly judge that the radar is blocked. In these cases, confirm that the radar horizontal alignment is correct, and that the vehicle has not had a front end protective cover or film applied.

OPERATION

Standard Speed Control

The standard 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:

- '+' and '-' (set/accelerate and decelerate) steering wheel switches
- Resume switch
- Cancel switch
- Clock spring
- Speed control warning lamp.

The standard speed control system also uses inputs from the brake pedal switch, the APP sensor, the ECM and the ABS module.

The standard speed control is operated by the driver using only the steering wheel switches. When speed control is

active, the ECM regulates the PWM (pulse width modulation) signals to the fuel injectors to adjust the fuel supply as required to maintain the set speed.

During standard speed control operation, the ECM controls vehicle speed by adjusting fuel injection duration and timing. When the accelerator pedal is pressed with speed control active, the ECM outputs a calculated throttle angle signal in place of the actual throttle angle signals produced by the APP sensor. The calculated throttle angle is derived from fuel demand.

The minimum set speed for standard 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
- Certain Terrain Modes are selected (i.e. Rock crawl)
- Low range gear selected
- The difference between actual speed and the set speed is too great
- When the vehicle speed reaches a maximum speed of 150 mph (240 kph)
- If the accelerator pedal is used to accelerate beyond the set speed for too long
- Stability control system intervention
- System error causes shut-off.

Adaptive Speed Control

The adaptive speed control system comprises the following components:

- Adaptive speed control radar module
- Steering wheel control switches
- ECM
- Throttle intake manifold - Electric throttle
- ABS module and pump
- Adaptive speed control warning indicator (in the instrument cluster).

The adaptive speed control system uses an electronic scanning radar in the radar module 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 20 mph (32 km/h) 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, electric throttle and throttle control are unchanged from those used for standard speed control variants.

The adaptive speed control system is based on the use of a front mounted radar sensor. The sensor transmits a radar beam forward of the vehicle and detects the returning signals reflected off other vehicles and objects ahead.

The radar beam is electronically scanned at a rate of 20 sweeps/second across a total arc of 20° 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). The radar provides a list of 64 targets.

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.

In 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, 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. A ‘cruise cancelled’ message will be displayed to the driver in the message center.

When the vehicle is in follow mode, the Follow Mode warning indicator is illuminated in the instrument cluster.



E124180

Item	Part Number	Description
1	-	Follow Mode active (amber)
2	-	Speed control active (green)
3	-	Forward Alert active (green)

The radar sensor detects three primary parameters of objects within the scanned arc. These are:

- Range
- Relative velocity
- Angle.

Range: The radar module detects the presence and ranges of different vehicles and objects within the scanned arc up to a distance of approximately 130 meters (426.5 feet). 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: The antenna consists of several receivers; if an object is offset from the vehicle center line, there will be a small time difference between the receive time on the near side compared to the far side. The radar can use this time difference to measure the angular position of the object. This enables the system to distinguish between vehicles in different lanes and between vehicles and roadside objects.

System Restrictions

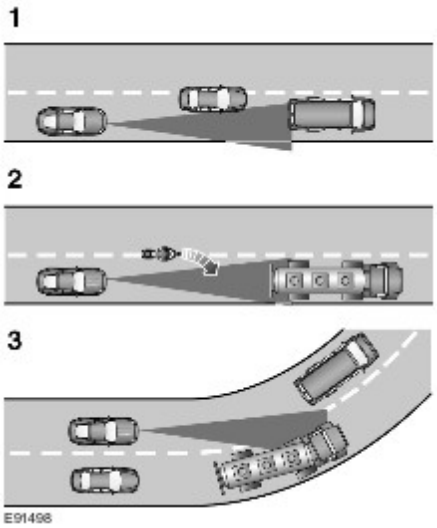
The adaptive speed control system is only intended to provide enhanced speed control as described above in certain restricted conditions. The following points should be noted:

- 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 to intervene and override the brakes. A ‘driver intervene’ message will be displayed in the message center accompanied with an audible chime.

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.

The following illustration shows circumstances where the adaptive speed control system may brake late or unexpectedly. The driver is required to intervene in these situations.



Item	Part Number	Description
1	-	Driving on a different line to the vehicle in front
2	-	Vehicles that merge into the same lane are only detected once they have moved fully into the lane.
3	-	On bends in the road there can be issues with detection of the vehicle in front when going into and coming out of a bend.

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.

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.

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, using the vehicle set-up menu in the instrument cluster. 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.

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.

Advanced Emergency Brake Assist

WARNING: Advanced Emergency Brake Assist is an additional safety system and is not intended to override driver responsibility for driving with care and attention.

On vehicles fitted with the Advanced Emergency Brake Assist system, brake response is improved during emergency braking when a moving vehicle is detected close ahead. The system activates if the risk of collision increases after the Forward Alert warning is issued.

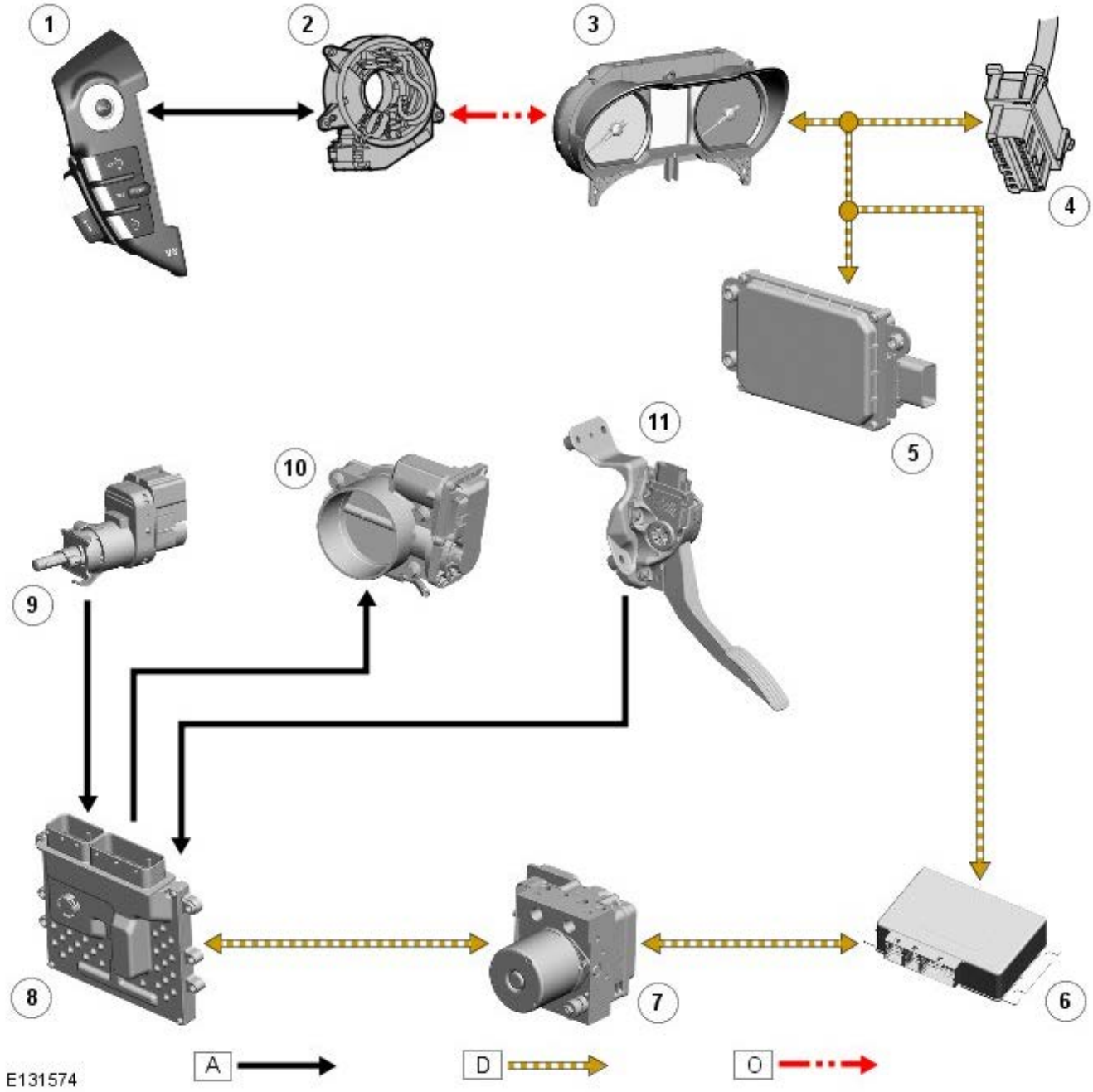
After a Forward Alert warning is displayed, the brakes are automatically applied gently in preparation for rapid braking. If the brake pedal is then pressed quickly then braking is fully implemented by the Emergency Brake Assist system, even if the pressure on the brake pedal is light.
For additional information, refer to: Anti-Lock Control - Traction Control (206-09 Anti-Lock Control - Traction Control, Description and Operation).

Advanced Emergency Brake Assist is available at speed above 5 mph (7 km/h) and will function even when Forward Alert and adaptive cruise control are switched off.

If a fault occurs in the system a message Forward Alert Unavailable is displayed in the message center. Advanced Emergency Brake Assist will not be available until the fault is rectified.

CONTROL DIAGRAM

NOTE: A = Hardwired; D = High speed CAN bus; O = LIN bus.



Item	Part Number	Description
1	-	Speed control switches
2	-	Clock spring
3	-	Instrument cluster
4	-	Diagnostic socket
5	-	Adaptive speed control radar module
6	-	Transfer box control module
7	-	ABS module
8	-	ECM
9	-	Brake switch
10	-	Electric throttle
11	-	APP sensor

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Speed Control - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Speed Control

Diagnosis and Testing

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. REFER to: Speed Control (310-03C, Description and Operation).

Inspection and Verification

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

Visual Inspection

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.

Symptom Chart

Symptom	Possible Cause	Action
Speed control inhibited or disabled	• Default mode enabled • 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	• Check for Network related DTCs that could be caused by power failure to the module or sensor and refer to DTC Index. • Check for steering wheel speed control switch and circuit faults. • Check for engine throttle position sensor DTCs and refer to the relevant DTC Index. • Check for brake switch faults.
Unable to regulate/adjust vehicle speed	• Steering wheel switch malfunction	• Check for steering wheel speed control switch and circuit faults.
Unable to cancel speed control from steering wheel	• Steering wheel switch malfunction	• Check for steering wheel speed control switch and circuit faults.
Unable to cancel speed control from brake pedal	• Brake switch malfunction	• Check for brake switch faults.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Engine Control Module (PCM) 5.0L V8 (100-00, Description and Operation) /
Diagnostic Trouble Code (DTC) Index - DTC: Speed Control Module (CCM) (100-00, Description and Operation).

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Speed Control - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Speed Control Sensor Adjustment

General Procedures

Special Tool(s)

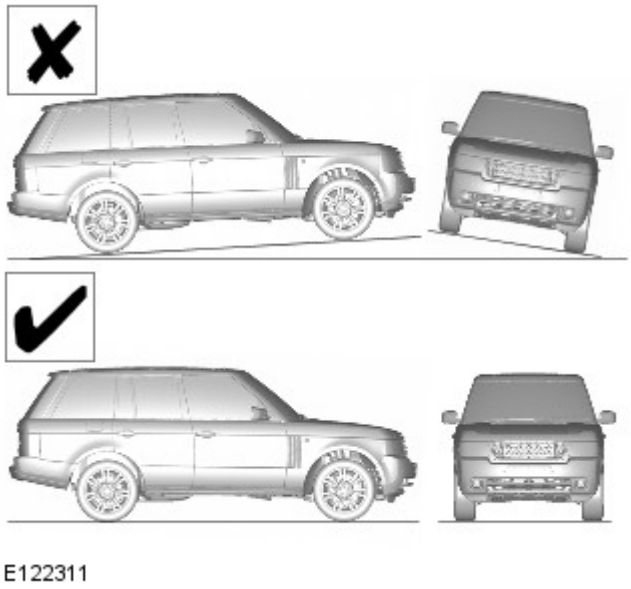
	310-148 Setting Tool, Speed Control

NOTES:

Removal steps in this procedure may contain installation details.

This procedure details how to adjust the speed control sensor vertically. There is no horizontal adjustment required.

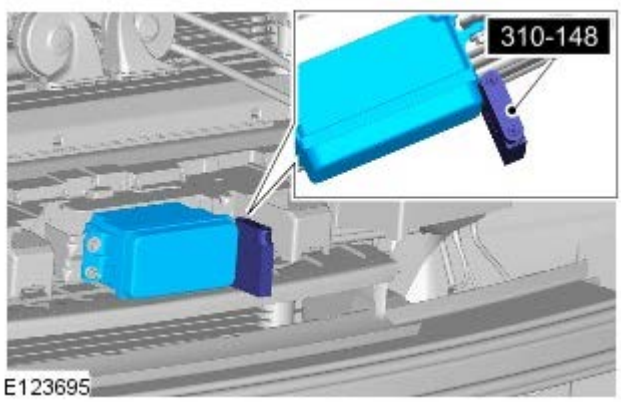
1. Refer to: Front Bumper Cover (501-19, Removal and Installation).



2. CAUTION: Drive the vehicle on to a flat, level surface.

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

   Set the air suspension ride height to the STANDARD setting.



3. NOTES:

   Using the special tool, check the speed sensor is level, (+/- 0.5 degree).

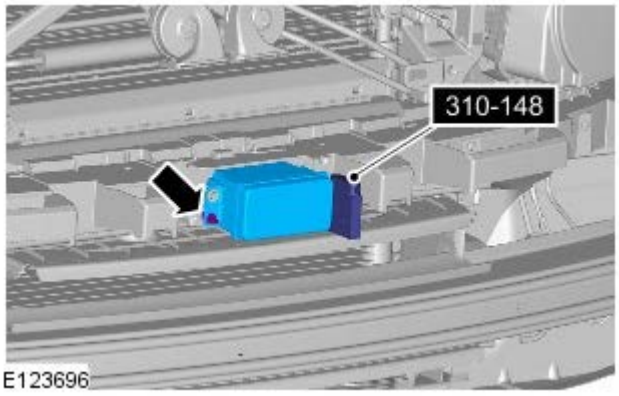
   Make sure that the special tool is installed to the front of the speed control sensor as it is shown in the illustration to check the level.

   Do not release the securing nut.

   Special Tool(s): 310-148

4. NOTE: The speed sensor has no mechanical horizontal adjustment.

   Special Tool(s): 310-148



5. Refer to: Front Bumper Cover (501-19, Removal and Installation).

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Speed Control - V8 5.0L Petrol / V8 S/C 5.0L Petrol - Speed Control Deactivator Switch

Removal and Installation

Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Stoplamp Switch (417-01, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

Published: 11-May-2011

Speed Control - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Speed Control Module

Removal and Installation

Removal

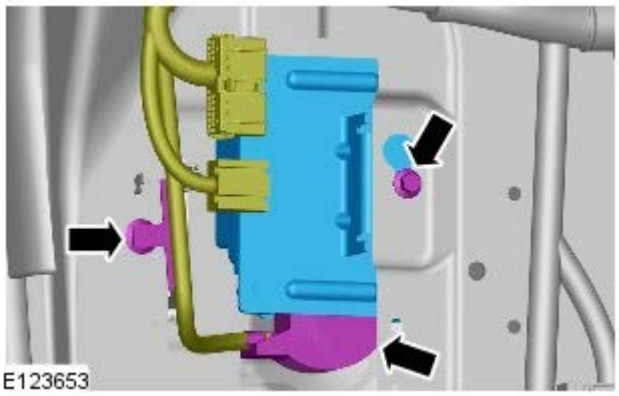
NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. Refer to: Dynamic Response Module (204-06, Removal and Installation).

3. *Torque:* 9 Nm



4.



E123652

Installation

1. To install, reverse the removal procedure.

2. Program a new control module using T4.

Published: 11-May-2011

Speed Control - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Speed Control Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.

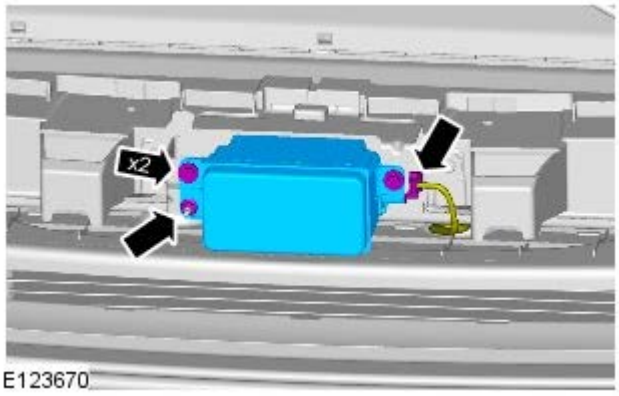
   Refer to: Specifications (414-00, Specifications).

2. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Front Bumper Cover (501-19, Removal and Installation).

4. *Torque:* 5 Nm



Installation

1. To install, reverse the removal procedure.

2. Refer to: Speed Control Sensor Adjustment (310-03, General Procedures).

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Speed Control - V8 5.0L Petrol/V8 S/C 5.0L Petrol - Speed Control Switch

Removal and Installation

Removal

WARNINGS:

To avoid accidental deployment, the restraints control module backup power supply must be depleted. Wait at least one minute after disconnecting the battery ground cable(s) before commencing any repair or adjustment to the supplemental restraint system (SRS), or any component(s) adjacent to the SRS sensors. Failure to follow these instructions may result in personal injury.

Always wear safety glasses when working on an air bag equipped vehicle and when handling an air bag module. Failure to follow this instruction may result in personal injury.

To minimize the possibility of premature deployment, do not use radio key code savers when working on the supplemental restraint system. Failure to follow this instruction may result in personal injury.

To minimize the possibility of injury in the event of premature deployment, always carry a live air bag module with the bag and trim cover pointed away from the body. Failure to follow this instruction may result in personal injury.

To minimize the possibility of premature deployment, live air bag modules must only be placed on work benches which have been ground bonded and with the trim cover facing up. Failure to follow these instructions may result in personal injury.

Never probe the electrical connectors of air bag modules or any other supplemental restraint system component. Failure to follow this instruction may result in personal injury.

Painting over the driver air bag module trim cover or instrument panel could lead to deterioration of the trim cover and air bags. Do not for any reason attempt to paint discolored or damaged air bag module trim covers or instrument panel. Install a new component. Failure to follow this instruction may result in personal injury.

NOTE: Removal steps in this procedure may contain installation details.

1. Make the air bag supplemental restraint system (SRS) safe.

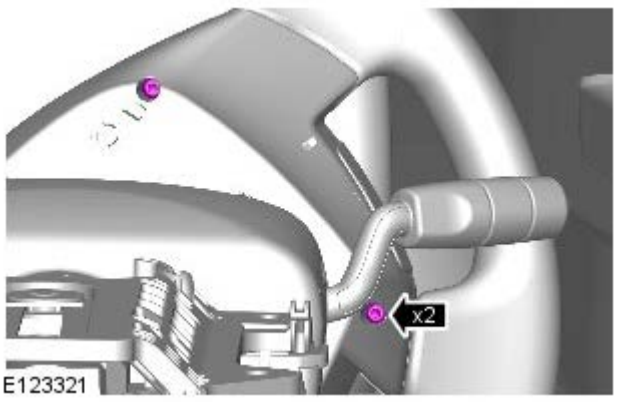
   Refer to: Standard Workshop Practices (100-00, Description and Operation).

2. Disconnect the battery ground cable.

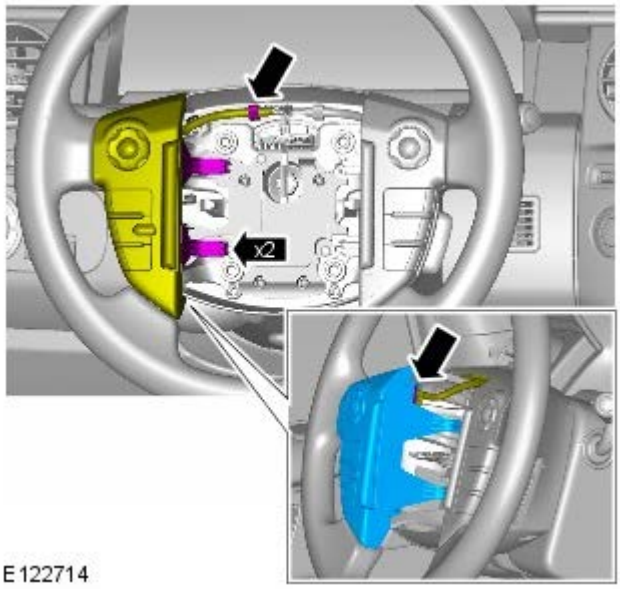
   Refer to: Specifications (414-00, Specifications).

3. Refer to: Driver Air Bag Module (501-20, Removal and Installation).

4. *Torque:* 1.5 Nm



5.



Installation

1. To install, reverse the removal procedure.